ARCADIS
Infrastructure, environment, facilities

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NORTHROP GRUMMAN
Integrated Systems

Appendix B

Manufacturer's Information

Operation, Maintenance, and Monitoring Manual

Soil Gas Interim Remedial Measure

Operable Unit 3 – Former Grumman Settling Ponds, Bethpage, New York

January 21, 2009

SITE

Maple Leaf Environmental Equipment Ltd.

PROCESS TREATMENT SYSTEM

PROJECT # 50353

Site:

NORTHROP GRUMMAN

Prepared For:

Arcadis U.S. Inc.
Attention: Victor Finocchiaro
6723 Towpath Rd.
Syracuse, New York
13214

Operation and Maintenance Manual

Prepared by:
Maple Leaf Environmental Equipment Ltd.

1325 California Ave., P.O. Box 1517, Brockville, Ontario Canada K6V 5Y6 • Tel: (613) 498-1876 or 1-800-420-4056 • Fax (613) 345-7633
web site: www.mleequipment.com

Submittal Approval Form

26-Oct-07

50353 Northrop Grumman

Customer: Victor Finocchiaro Arcadis U.S., Inc.

****PLEASE REVIEW AND VERIFY ALL INFORMATION ON THIS FORM****

FOR TECHNICAL ASSISTANCE,PLEASE CONTACT:

Ben Wilson 613-498-1876 Ext: 250

EMail: bwilson@mleequipment.com Fax: 613-345-7633

System Site Specifications Check: ✓

Elevation:	105 ft
Max Temp	85 deg F
Min Temp:	0 deg F
Noise Target:	No
Gas Required:	None
Water Required:	None
Telephone Reqd:	Telephone
Building:	Container(2x20)

System Electrical Specifications Check: ✓

Voltage:	460V-3ph
Main Disconnect	200amp
Panel Approval:	UL
Panel Classification:	General Purpose
System Approval:	MET
System Classification:	Process Room General Purpose
Panel Type:	PLC-ALLEN BRADLEY
Telemetry:	Sensaphone 1104/1108

System SVE First Blower Check: ✓

1127 scfm @ 36 in wc

Blower Disch Temp:	195 deg F
Inlet Legs:	11
Disch Press:	23 in wc
Water Flowrate:	5 gpm
Heat xchg Disch:	116 deg F

System SVE Second Blower Check: ✓

633 scfm @ 58 in wc

Blower Disch Temp:	212 deg F
Inlet Legs:	7
Disch Press:	20 in wc
Water Flowrate:	5 gpm
Heat xchg Disch:	116 deg F

Air Sparge Check:

0 @ 0 psi

Sparge Disch Temp:	0 deg F
Disch Legs:	0
Heat xchg Disch:	0 deg F

Other Specifications Check:

Other Inlet Liquid Flow:	0 gpm
Disch Flow:	0 gpm @ 0 psi
AirTreatment:	
Water_Treatment:	
Stripper Airflow:	0 cfm
Stripper Dsn Flow:	0 gpm
OWS_Dsn_Flow:	0 gpm

Contaminants Check:

Unknown

CUSTOMER APPROVAL

At a minimum, please thoroughly review the following:

Process and Instrumentation Diagram:	✓	as noted
System Layout Drawing:	✓	as noted
System Control Logic:	✓	as noted

> see attached comments

I have reviewed and approve of the information on this form and in the design submittal provided.

Christina Tuohy C. Tuohy DATE 11/12/07

NAME SIGNATURE

If Authorization to Proceed with ordering equipment was given by the customer at the time of purchase order, the equipment will be ready for shipment 8-10 weeks from the date of the order confirmation issued by MLEE, unless other arrangements have been made. Any changes made during the submittal process that alter the equipment ordered may require a change order from the customer and may result in additional costs and possible change in the shipping date. If authorization to order equipment components is given with the approval of this submittal package, the equipment will be ready 8-10 weeks from the date of submittal approval.

Other Information May be Presented Below:

See attached comments. Approved as noted.

50353

Northrop Grumman

Arcadis

STARTUP PROCEDURE

- If the system is being started for the first time then work your way through the commissioning checklist in the installation guide or system manual before starting the system.
- Push the reset button momentarily to reset all alarms.
- Walk through process piping and check the position of all process valves.
- Check that there are no obstructions over any moving parts, (for example a jacket laying on a belt drive).
- Check that main disconnect is on.
- Put all hand/off/auto switches in auto.
- Push the start button on the Operator Interface.
- If an alarm occurred on startup, then review the alarm descriptions and troubleshooting guide in the installation guide or manual for guidance on how to troubleshoot the problem. Fix the alarm condition and restart the system with the above procedure.
- Analogue inputs, hour meters, and flow rates related to your system can be viewed on the operator display screens. Press the appropriate key to navigate through the screens.

System Test Record

Project Number and Name: 50353 NORTHROP GRUMMAN

The purpose of this report is to test and record electrical, control, and mechanical components to ensure the system operates as designed.

Factory system test: Tested By: PETER REIMER Date: JAN 17/08

Project Mgr: BEN W. Mfg. Team: FRITZ, JERRY PNL: SLC 5/04

Testing Checklist	ck	Tested by:
Verify flow rates and site power per the System Design Criteria sheet Power: 480V, 3Φ Flows: 633 SCFM @ 58" WC - SVE 1 1127 SCFM @ 36" WC - SVE 2+3	✓	PR
Ensure Engineering Layout, Piping, Panel and Pre-Test Checklist have been completed. If not then notify project manager. Must be completed prior to testing system.	✓	
Check Fuse Schedule to ensure correct fuses or breakers installed.	✓	
Dielectric Test Label: - UL Requirement 1 minute @ 1000 volts plus twice the rated voltage of the equipment:	✓	
Continuity Test Label: All Ground Terminals in Panel Tested	✓	
Warning Label: System Auto Start installed on panel door, where applicable.	NA	
Additional Input Wires Pulled To Panel	—	
Record model/serial numbers & of pumps, blowers, compressors & motors with voltages, amps, ph, rpm, & enclosure on Mechanical Test Record Sheets.	✓	
For Submersible pumps check nameplate amps against motor and fuse schedule and ensure the correct contactors and overloads have been picked	NA	
Set Overloads for Motors.	✓	
Test Power Distribution Through System		
Test VFD at various frequencies and ensure that there is some way to adjust frequency.	✓	
Check that there is a neutral wire from main power block to the terminal strip on high leg delta system,	NA	
Test GFI Outlets.	✓	
Bump all Motors and Check Rotations	✓	
For PLC – Install System Program	✓	
Test Display Unit	✓	
Test Kill Buttons	✓	
Manually Test all Inputs (Refer to project Input Table)	✓	
Manually Test all Outputs (Refer to Project Output Table)	✓	
Test Analog Inputs	✓	
Test Analog Outputs	✓	
Manually Test Control logic For Each Output	✓	
Manually Test Each Alarm	✓	
Manually Test all Shut Down Alarms	✓	
Test each 24hr timer to ensure that it is rotating with time and labeled correctly in panel.	NA	
Double check that non-critical air sparging alarms do not shut down SVE system.	NA	

System Test Record

Project Number and Name: 50363

The purpose of this report is to test and record electrical, control, and mechanical components to ensure the system operates as designed.

Start System		PC
Take initial motor amp reading, checking for high amps.	✓	
Set pump discharge pressures as per P&ID, & pump curves	✓	
Test Vacuum Relief and Pressure Relief Valves as per P&ID set points	✓	
Ensure position of Ball float level switches allow the pump to stop with the water level sufficiently above the pump intake coupling to prevent a loss of prime on the pump.	NA	
Test all Solenoid Valves and ensure that air or water is flowing through them, as it should be.	NA	
Test operation of building exhaust fan.	✓	
Test operation of building heater.	✓	
Test &/or set pressure & vacuum switches as per P&ID set points.	NA	
Document the set point for all switches below.		
Switch set point:		
Switch set point:		
Switch set point:		
Switch set point:		
Switch set point:		
Wet test all shut down alarms.		
Test Air Stripper Blower & Discharge Pump, pump down procedure	NA	
Test Pulse Flow Meters	✓	
Test the chemical dosing pump with water and purge the pump dry so it does not freeze.	NA	
Test PH transducers with water and correct PH solution.	NA	
Ensure the indicated flow rate is within the normal operating range of the system design specifications.	✓	
Test Pitot Tube for accurate flow rates, and check that calibration point on magnehelic matches pitot tube	✓	
Test accuracy of flow meters with pitot tube & magnehelic.	✓	
Run system in full automatic checking system operation, vacuum, pressure & flow rates. Turn off pumps/equipment to force alarm conditions.	✓	
Record motor amps and test voltages on Mechanical Test Record Sheets. Indicate the operating conditions, pressure & temperature when amps measured.	✓	
Test noise levels if specified on the layout drawing.	NA	
Program Auto-dialer for testing	✓	
Test auto-dialer	✓	
Test Remote Access	NA	
Test Offsite Software	✓	
Test Data Logging	NA	
Note any changes required for the offsite so they can be updated.	✓	
Install Control Panel Approval Labels		
Take Pictures of System and Download to Server		
Testing Completed		
Pump water back into storage tanks		
All Switches and Breakers Returned To The Off Position		

Factory Test Record

Mechanical Test Record

The purpose of this report is to test and record the motors and control components or devices to ensure the system operates as designed.

Project: 50353 Northrop Grumman

Description: B-701 SVE1
Manufacturer: Rotron
Model Number: EN140X72MWL Serial #: BP4060 70
Motor Model Number: EW8642565 Serial #:
Horsepower: 30 RPM: 3600 Encl. XPF Temp Code: T3C
Voltage: 460 Amps: 35 (41) Ph. 3 SF: 1.0

Test Load: 56" WC Temperature: -
Voltage Measured: L1/L2 483 L2/L3 482 L3/L1 484
Amperage Measured: L1 23.2 L2 20.6 L3 21.3

Field: Test Load:
Voltage Measured: L1 L2 L3
Amperage Measured: L1 L2 L3

Description: B-702 SVE2
Manufacturer: Rotron
Model Number: EN979BK72WL Serial #: BP406069
Motor Model Number: Serial #: Z070214013S
Horsepower: 20 RPM: 3600 Encl. XPF Temp Code: T3C
Voltage: 460 Amps: 23 (30) Ph. 3 SF: 1.0

Test Load: 36" WC Temperature:
Voltage Measured: L1/L2 483 L2/L3 482 L3/L1 484
Amperage Measured: L1 17.9 L2 15.6 L3 16.6

Field: Test Load:
Voltage Measured: L1 L2 L3
Amperage Measured: L1 L2 L3

Description: B-703 SVE3
Manufacturer: Rotron
Model Number: EN979BK72WL Serial #: BP406069
Motor Model Number: Serial #: Z070214014O
Horsepower: 20 RPM: 3600 Encl. XPF Temp Code: T3C
Voltage: 460 Amps: 23 (30) Ph. 3 SF: 1.0

Test Load: 36" WC Temperature:
Voltage Measured: L1/L2 483 L2/L3 482 L3/L1 484
Amperage Measured: L1 18.6 L2 17.0 L3 16.9

Field: Test Load:
Voltage Measured: L1 L2 L3
Amperage Measured: L1 L2 L3

Factory Test Record

Mechanical Test Record

The purpose of this report is to test and record the motors and control components or devices to ensure the system operates as designed.

Project: 50353 - NORTHROP GRUMMAN

Description: P-401 VLS1
Manufacturer: MOYNO / TATUNG
Model Number: 33301 Serial #: 06/07
Motor Model Number: WJ0014FF uc Serial #: 4D109884
Horsepower: 1 RPM: 1800 Encl. TEFC Temp Code: —
Voltage: 460 Amps: 1.45 Ph. 3 SF: 1.15

Test Load: 20 PSI Temperature: —
Voltage Measured: L1/L2 483 L2/L3 482 L3/L1 484
Amperage Measured: L1 0.9 L2 0.9 L3 0.9

Field: Test Load:
Voltage Measured: L1 L2 L3
Amperage Measured: L1 L2 L3

Description: P-402 VLS2
Manufacturer: MOYNO / TATUNG
Model Number: 33301 Serial #: 12/05
Motor Model Number: WJ0014FF uc Serial #: 20006565
Horsepower: 1 RPM: 1800 Encl. TEFC Temp Code: —
Voltage: 460 Amps: 1.45 Ph. 3 SF: 1.15

Test Load: 20 PSI Temperature:
Voltage Measured: L1/L2 483 L2/L3 482 L3/L1 484
Amperage Measured: L1 0.9 L2 0.8 L3 0.8

Field: Test Load:
Voltage Measured: L1 L2 L3
Amperage Measured: L1 L2 L3

Description: P-403 VLS3
Manufacturer: MOYNO / TATUNG
Model Number: 33301 Serial #: 01/07
Motor Model Number: WJ0014FF uc Serial #: 20006563
Horsepower: 1 RPM: 1800 Encl. TEFC Temp Code: —
Voltage: 460 Amps: 1.45 Ph. 3 SF: 1.15

Test Load: 20 PSI Temperature:
Voltage Measured: L1/L2 483 L2/L3 482 L3/L1 484
Amperage Measured: L1 0.8 L2 0.8 L3 0.8

Field: Test Load:
Voltage Measured: L1 L2 L3
Amperage Measured: L1 L2 L3

Factory Test Record

Mechanical Test Record

The purpose of this report is to test and record the motors and control components or devices to ensure the system operates as designed.

Project: 50353

Description: F-1301 XCH (NOT AVAILABLE - SHIPPED TO SITE)
Manufacturer: XCHANGER INC.
Model Number: AA-2750 Serial #:
Motor Model Number: Serial #:
Horsepower: 2 RPM: 1800 Encl. TEFC Temp Code:
Voltage: 460 Amps: — Ph. 3 SF:

Test Load: Temperature:
Voltage Measured: L1/L2 L2/L3 L3/L1
Amperage Measured: L1 L2 L3

Field: Test Load:
Voltage Measured: L1 L2 L3
Amperage Measured: L1 L2 L3

Description:
Manufacturer:
Model Number: Serial #:
Motor Model Number: Serial #:
Horsepower: RPM: Encl. Temp Code:
Voltage: Amps: Ph. SF:

Test Load: Temperature:
Voltage Measured: L1/L2 L2/L3 L3/L1
Amperage Measured: L1 L2 L3

Field: Test Load:
Voltage Measured: L1 L2 L3
Amperage Measured: L1 L2 L3

Description:
Manufacturer:
Model Number: Serial #:
Motor Model Number: Serial #:
Horsepower: RPM: Encl. Temp Code:
Voltage: Amps: Ph. SF:

Test Load: Temperature:
Voltage Measured: L1/L2 L2/L3 L3/L1
Amperage Measured: L1 L2 L3

Field: Test Load:
Voltage Measured: L1 L2 L3
Amperage Measured: L1 L2 L3

Commissioning Checklist

The following things should be completed before turning on the power.

If the unit is in a building:

Level the building. Check door openings to see if additional leveling is necessary.

For all units:

1. Tighten all terminals where wires are terminated. These terminal strips and wiring terminals are tightened before shipping but may loosen in shipping.

Steps 2,3,4 and 5 may be omitted if no field wiring is necessary

2. Remove IS Barriers from bases if present.
3. Check to ensure that both the Hazardous and Non Hazardous sides of the IS Barriers are properly grounded directly back to the main ground or to a grounding stake as per the codes of the local authorities.
4. If you have a PLC check to ensure the PLC is in "run". This can be detected with the run light on the PLC. Locate the position of the run light it should be green. If no light is present then use the toggle switch on the top of the PLC to switch the unit from "term" to "run" then back to "term".
5. Test each input going into the Hazardous side of the IS barrier for proper operation. Check to ensure that the correct inputs are wired into the correct IS Barrier Locations. This can be done by using an electrical meter and checking for continuity to ground. Have one person hold the meter while another person lift and drop the switch. Ensure that the switches are field wired as normally closed or normally open as required on the electrical drawings.

6. Check alignment of all motors. They have all been factory aligned but may come out of alignment during shipping or installation.
7. Manually rotate motors to ensure that they are not seized before starting up.
8. Disconnect all fuses in fuse holders
9. Check Voltage on each phase of power to ground for even voltage distribution and voltage distribution between phases of the incoming power.
10. Check to ensure there is only one source of a neutral. If we have a 120V control transformer in our panel then we ground the neutral and no neutral should be brought into the panel.
11. Check to ensure that panel is properly grounded and that there is only one main source of ground

Ensure all necessary electrical approvals are in place before proceeding.

Energize main disconnect to the system allowing the power to flow to the main fuses.
The following list can be completed once the power is on to the system and should be done after all the items listed above have been completed.

1. Check power on the hot side of the main fuses.
2. Install fuses to the AC transformers if present and check the power on the primary and secondary side of the AC transformers.
3. Install fuses to the DC transformers if present and check the power to the primary and secondary side of the DC transformers.
4. Close remaining fuse holders and check for power on the bottom of each fuse holder to ensure that no fuses are blown. If a fuse is blown then there may be a short somewhere. Check for resistance between the bottom of that fuse holder and the ground. If there is a short then there will be little resistance. Ie 0-1 Ohms. If a short is detected follow the line out of the bottom of the fuse holder and continue to check for lack of resistance till you locate the short.
5. If there is power to the bottom of all the fuses then you can start testing your inputs. Check for Voltage to the Non Hazardous Side of the IS barriers. There should be either 24V or 5V here depending on which type of PLC you are using or if you are using relay logic. IF you have any other voltage the IS barrier should not be installed because they could become damaged by higher voltages. Find source of stray voltage and fix problem. When allowable voltages are detected on the Non Hazardous side of the IS barriers then you can install the barriers.
6. Test the inputs a second time this time check to ensure that the correct input light on the PLC is turned on or the correct relay (for relay logic systems) is activated when then input is closed. If the wrong lights or relays are being activated then check the input wiring diagram to ensure that the correct input is going to the correct IS barrier terminal on the hazardous side.
7. Test all shutdown alarms to ensure proper operation.
8. Install fuses for motors and bump motors to check for proper direction of rotation. If a three-phase motor is rotating the wrong way you can change the direction of rotation by switching two of the three lines of power. If a single-phase motor is rotating the wrong way check the wiring in the motor termination box to ensure that it is wired correctly. Most three phase motors can have the direction of rotation switched by changing two wires. This is indicated on the wiring diagram on the motor or in the termination box for the motor.

9. ***If the system is shipped as a complete unit wired to the panel, we have checked all motor rotations and bumping only one motor is required. It is usually best to bump an air blower motor first (if available), as incorrect rotation will not have adverse effects. Note that any motor that uses oil as a lubricant has the possibility of loosing oil if run for a prolonged period in reverse. A moyno bump found typically on an inlet separator cannot even be bumped in reverse as it will unscrew its shaft. Rotary vane compressors can never be run backwards as damage will occur to the vanes.***

10. **ALWAYS REFER TO SPECIFIED DOCUMENTATION FOR EACH MOTOR AND PUMP TO ENSURE THAT THEY ARE TESTED FOR ROTATION PROPERLY. SOME MOTORS CAN NOT BE RUN DRY AND SOME PUMPS AND COMPRESSORS CAN NOT BE RUN IN REVERSE IN WHICH CASE THE ROTATION CHECK SHOULD BE DONE WITH THE MOTOR DISCONNECTED FROM THE DEVICE.**

11. Remove motor fuses and test operation of the logic without motors actually running. You can jumper inputs with jumper wires.
12. Plug in Fuses for motors and check for valves in the system to ensure that all required valves are open and ready to process water. Check to ensure that no pumps will be deadheaded or starved of water.
13. Start system.

MLEE EQUIPMENT

System Field Test Record

Project number and name: 50353

The purpose of this report is to test and record electrical, control, and mechanical components to ensure the system operates as designed

Tested by: Pete Reimer Date: 6 Feb 08

Testing Checklist	Ck	Initial	Date
Verify site power per system design criteria	✓	PR	FEB 6/08
Verify building process flow and instrumentation matches P +ID drawing, check off drawing components against actual (preferably with the customer present)	✓		
Site voltage measured: L1/L2 484 L2/L3 484 L3/L1 484 L1/GRD 279 L2/GRD 279 L3/GRD 279			
Check field wiring and piping as per drawings	✓		
Check panel for lose wiring	✓		
Tighten all terminals where wires are terminated	✓		
Check alignment of motors	✓		
Check all motor belt tensions	NA		
Check to ensure all piping unions are tight	✓		
Check voltage on AC step down transformer 208V 120V	✓		
Check voltage on DC transformer	✓		
Check I.S. barrier is grounded as per input drawing 3.6	NA		
Check voltage + amperage + name plate info against MLEE mechanical test record on all motors	✓		
Manually test inputs as per input table	✓		
Manually test control logic for each output	✓		
Manually test all shut down alarms	✓		
Manually test that non-critical alarms do not shut down SVE	✓		
Run through complete logic and alarm sequence with customer and make allowable changes.	✓		
Note name of individual and company with whom logic was reviewed. Luke + Dennis	✓		
Record start flow meter at meter 3.3, 3.3, 3.1 at panel 3, 3, 3	✓		
Bump motor if 3 phase	✓		
Check that PLC is in run mode	✓		

System Field Test Record

Testing Checklist	Ck	Initial	Date
Fill out mechanical test record on each motor and check amperage and voltage	✓	PR	FEB 6/08
Check overload settings for all motors	✓		
Test analogue inputs	✓		
Check/Install filter bag in bag filters	NA		
Install louver hoods on system			
Wet test all control inputs and outputs	✓		
Wet test all shut down alarms	✓		
Check systems for leaks (liquid and vapor)	✓		
Test operation of building exhaust fan	✓		
Test operation of building heater	✓		
Test position of ball float switches for proper start/stop level	NA		
Test vacuum and pressure relief valve	✓		
Test air stripper and discharge pump operating sequence	NA		
Check flow rate on all pulse meters such that digital and analogue reading increment at the same rate	✓		
Test phone line and record phone number	NA		
Test remote access	NA		
Run system in full automatic	✓		
Customer personnel have been trained	✓		
After 1/hr of operation, shut system down and perform first maintenance with customer			
Electrical Contractor			
Company Name:			
Contact:			
Phone Number:			
Mechanical Contractor			
Company Name:			
Contact:			
Phone Number:			

Return copy of completed test data to MLEE for warranty compliance

System Field Test Record

	#1	#2	#3
Vacuum readings:			
VLS	60" wc	30" wc	28" wc
VB SVE	66" wc	32" wc	30" wc
WELL(s)	6		
LRP			
Pressure readings:			
Pneumatic WP			
Air STRP			
DP VLS			
DP OWS			
DP STRP			
Flow rate:			
DP OWS			
DP STRP			
Total flow:			
DP OWS			
DP STRP			
Temperature:			
VB SVE	125° F		
T1 LRP OS			
T1 LRP XCH			
T1 VB XCH	85° F		

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Return copy of completed test data to MLEE for warranty compliance

Commission Test Record Problems

Project Number and Name: 50353 NORTHLOP GRUMMAN

The purpose of this report is to identify and record problems found during commissioning and measures taken to resolve them ensuring the system operates as designed.

Problem:	Completed By:	Date:
① CLEARANCE BETWEEN CONTROL PANEL AND BLOWER - ONLY 39" REQUIRE 42" - BARRIER TO BE INSTALLED		
② LOCAL DISCONNECTS REQUIRED FOR VLS PUMPS + HEATERS IN VLS BUILDING		
③ FAN REQUESTED FOR VLS BLD'G		
④ NOMENCLATURE ON HMI TO MATCH ARCADES P+ID		
⑤ WHEN RUNNING SUE'S IN MANUAL - PROCESS SCREEN WON'T READ SPEED + PRESS. UNTIL YOU GO ~~BACK~~ TO MAIN SCREEN + THEN BACK TO PROC. SCREEN		
⑥ PASSWORD PROTECT SETUP SCREEN		
⑦ ALARM HISTORY DUMP TO FILE		
⑧ MIN. + MAX. ON SETPOINTS		

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Return copy of completed test data to MLEE for warranty compliance

Commission Test Record Problems

MLE EQUIPMENT

Project Number and Name: ________ ______________________________

The purpose of this report is to identify and record problems found during commissioning and measures taken to resolve them ensuring the system operates as designed.

Problem:	Completed By:	Date:

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Factory Test Record

Commissioning Test Record

The purpose of this report is to test and record the motors and control components or devices to ensure the system operates as designed.

Project: 50353

Description: B-701

Manufacturer: Rotrow
Model Number: _____ Serial #: _____
Motor Model Number: _____ Serial #: _____
Horsepower: 30 RPM: 3600 Encl. XPF
Voltage: 480 Amps: 35 Ph. 3

Test Load: 24" WC
Voltage Measured: L1/L2 484 L2/L3 484 L3/L1 484
Amperage Measured: L1 22.7 L2 22.1 L3 22.3

Comments: _____

Description: B-702

Manufacturer: Rotrow
Model Number: _____ Serial #: _____
Motor Model Number: _____ Serial #: _____
Horsepower: 20 RPM: 3600 Encl. XPF
Voltage: 480 Amps: 23 Ph. 3

Test Load: 27" WC
Voltage Measured: L1/L2 484 L2/L3 484 L3/L1 484
Amperage Measured: L1 20.7 L2 20.7 L3 21.4

Comments: _____

Description: B-703

Manufacturer: Rotrow
Model Number: _____ Serial #: _____
Motor Model Number: _____ Serial #: _____
Horsepower: 20 RPM: 3600 Encl. XPF
Voltage: 480 Amps: 23 Ph. 3

Test Load: 26" WC
Voltage Measured: L1/L2 484 L2/L3 484 L3/L1 484
Amperage Measured: L1 21.4 L2 22.4 L3 21.2

Comments: _____

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Factory Test Record

Commissioning Test Record

The purpose of this report is to test and record the motors and control components or devices to ensure the system operates as designed.

Project: 50353

Description: P-401

Manufacturer: Moyno / Tatung
Model Number: _____ Serial #: _____
Motor Model Number: _____ Serial #: _____
Horsepower: 1 RPM: 1800 Encl. _____
Voltage: 480 Amps: 1.45 Ph. _____

Test Load: _____
Voltage Measured: L1/L2 484 L2/L3 484 L3/L1 484
Amperage Measured: L1 _____ L2 _____ L3 _____

Comments: _____

Description: P-402

Manufacturer: Moyno / Tatung
Model Number: _____ Serial #: _____
Motor Model Number: _____ Serial #: _____
Horsepower: 1 RPM: 1800 Encl. _____
Voltage: 480 Amps: 1.45 Ph. _____

Test Load: _____
Voltage Measured: L1/L2 _____ L2/L3 _____ L3/L1 _____
Amperage Measured: L1 _____ L2 _____ L3 _____

Comments: _____

Description: P-403

Manufacturer: Moyno / Tatung
Model Number: _____ Serial #: _____
Motor Model Number: _____ Serial #: _____
Horsepower: 1 RPM: 1800 Encl. _____
Voltage: 480 Amps: 1.45 Ph. _____

Test Load: _____
Voltage Measured: L1/L2 484 L2/L3 484 L3/L1 484
Amperage Measured: L1 _____ L2 _____ L3 _____

Comments: _____

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Factory Test Record

Commissioning Test Record

The purpose of this report is to test and record the motors and control components or devices to ensure the system operates as designed.

Project: 50353

Description: F-1301

Manufacturer: X CHANGER / DAYTON
Model Number: AA-2750 Serial #: 0907-B10602
Motor Model Number: _____ Serial #: _____
Horsepower: 2 RPM: 1800 Encl. TEFC
Voltage: 480 Amps: 2.9 Ph. 3

Test Load: 60 HZ INLET @ 120°F OUT @ 75°F
Voltage Measured: L1/L2 484 L2/L3 484 L3/L1 484
Amperage Measured: L1 2.2A L2 _____ L3 _____
60HZ

1.9A @ 50HZ
100%
1.8A @ 40HZ

Comments: _____

Description: _____

Manufacturer: _____
Model Number: _____ Serial #: _____
Motor Model Number: _____ Serial #: _____
Horsepower: _____ RPM: _____ Encl. _____
Voltage: _____ Amps: _____ Ph. _____

Test Load: _____
Voltage Measured: L1/L2 _____ L2/L3 _____ L3/L1 _____
Amperage Measured: L1 _____ L2 _____ L3 _____

Comments: _____

Description: _____

Manufacturer: _____
Model Number: _____ Serial #: _____
Motor Model Number: _____ Serial #: _____
Horsepower: _____ RPM: _____ Encl. _____
Voltage: _____ Amps: _____ Ph. _____

Test Load: _____
Voltage Measured: L1/L2 _____ L2/L3 _____ L3/L1 _____
Amperage Measured: L1 _____ L2 _____ L3 _____

Comments: _____

8/8

ARCADIS

Infrastructure, environment, buildings

NORTHROP GRUMMAN
FORMER GRUMMAN SETTLING PONDS

SOIL VAPOR EXTRACTION

• September 6, 2007 •

Prepared For:
Victor Finocchiaro
Arcadis U.S., Inc.
6723 Towpath Road
Syracuse, New York
(315) 671-9156
victor.finocchiaro@arcadis-us.com

Prepared By:
Phil Wood
MLE Equipment, Inc.
2248 Meridian Boulevard, Suite H Minden, NV 89423
Tel (613) 498-1876 Fax (613) 345-7633
www.mleequipment.com

Prepared in Cooperation with:
Gunnar Peterson
(613) 498-1876 Ext 351
(913) 927-8785
GPeterson@mleequipment.com

Quote Number: 701488R3-C

MLE Equipment, Inc.

C O R P O R A T E P R O F I L E

MLE Equipment, Inc. is a North American manufacturer and supplier of wastewater treatment equipment, groundwater/site remediation systems, drinking water treatment systems, and PLC based control panels.

Since 1992, MLEE has supplied high quality treatment equipment to the Canadian, United States, and international markets.

With over 50 years of combined technical experience in petroleum/water separation, water treatment and project management, MLEE staff continues to lead in the design and application of innovative new technologies in the environmental business.

MLEE is an exclusive distributor for QED Environmental Systems, Inc. groundwater sampling and remediation pumps, sample filters, interface meters and air strippers.

Technical Notes

The equipment proposal we have provided in this document is based on our understanding of your requirements. The following sections review the design of the system and detail the individual components. The information provided in this proposal may be modified prior to the construction of the equipment. If no modifications are required, the system will be built as specified, for the price quoted, within the delivery time specified.

Engineering Assumptions:

460V three-phase power available

Non-hazardous location for equipment

Ambient up to 85 degrees F

Altitude 127 feet

Noise: No noise limitation have been specified

Design Parameters:

CERTIFICATIONS:

Control panel to be UL certified MET Laboratories approval of system

VACUUM EXTRACTION SYSTEM:

VES system to have separate manifolds for shallow and deep wells

Deep well group to have a one branch seven leg influent manifold

Shallow well group to have a one branch eleven leg influent manifold

SVE system to consist of three blower units tied together in parallel, however capable of individually operating one or both of the vacuum manifolds (As laid out in PID)

SVE blower V capacity – 633 SCFM at 58" WC at blower inlet approximately (739 ACFM)

SVE blower W capacity – 564 SCFM at 35.5" WC at blower inlet approximately (618 ACFM)

SVE blower X capacity – 564 SCFM at 35.5" WC at well head approximately (618 ACFM)

Three (3) MLEE 85 Imp. G vapor liquid separators

Three (3) Transfer pump from vapor liquid separator - 7 GPM at 25 PSI

OFF-GAS TREATMENT SYSTEM:

US Filter Vapor Phase Carbon (VPC) vessel – *supplied by others*

CONDENSATE STORAGE:

Inlet 400 G plastic equalization tank

ENCLOSURE MODULE:

Blower mounted in 8'x 20' enclosure, piped, wired and tested; all wiring suitable for NEC general purpose locations

Extraction manifold, vapor liquid separator and storage tank equipment mounted in a separate 8'x 20' enclosure, piped, wired and tested; all wiring suitable for NEC general purpose locations

CONTROL PANEL:

PLC based control system with control and alarm features

Equipment Description

Control panel and system enclosures to include third part NRTL certifications:

a. Upgrade control system panel to UL certification
b. Upgrade remediation enclosure to MET certification

VACUUM EXTRACTION MANIFOLD MODULE

Deep well arrangement

Includes: One 6" vacuum extraction manifold with seven 3" legs, each leg to contain:

- ¼" Tapped plugged hole
- Throttling valve
  - Ball valve
- Air flow indicator
  - MLEE Vflow venturi flow indicator
- Vacuum gauge
- Sample port
- Termination above floor

Shallow well arrangement

Includes: One 6" vacuum extraction manifold with seven 3" legs, and four 4" legs, each leg to contain:

- ¼" Tapped plugged hole
- Throttling valve
  - Ball valve
- Air flow indicator
  - MLEE Vflow venturi flow indicator
- Vacuum gauge
- Sample port
- Termination above floor

6" Manifold header to contain main cut off valve:

- Butterfly valve

The connections between the two manifold arrangements will include:

- Three (3) butterfly valves
- PVC piping to be arranged as shown in customer PID

VAPOR LIQUID SEPARATOR MODULE

Module to include three (3) of the equipment and components in the arrangements described below:

Includes: **VLD-800, 85 G vapor liquid separator** with:

- Exterior to be primed and painted with a two component chemically-cured urethane gloss enamel (MLEE Blue)
- Removable lid for clean out
- Sight glass
- High level alarm switch - *discrete input*
- High level pump control switch - *discrete input*
- Low level pump control switch - *discrete input*
- Manual drain terminated w/ 1" hose barb

Vapor inlet piping to vapor liquid separator to contain:

- Throttling valve
  - Butterfly valve
- Vacuum gauge
- PVC piping

Liquid discharge piping from vapor liquid separator to contain:

- Sample port
- Ball valve
- **Moyno model 333 progressive cavity transfer pump** with 1 HP 230/460V/3P motor:
  - *Discrete output*
  - Performance: 7 GPM at 25 PSI
  - Motor: TEFC (Suitable for CL 1 DIV 2)
- Check valve
- Ball valve
- Pressure gauge
- GWF MTH totalizing water flow meter (US Gallons)
- Carbon Steel piping to be plumbed to storage tank
  - Additional unions added because of the use of Steel

Water recirculation line to contain:

- Ball valve
- Black steel piping

STORAGE TANK MODULE

Includes: **400 G Poly liquid equalization tank** with:

- Rectangular unit Model SP-0400-UT
- 62"L x 29"W x 66"H
- Inlet Plumbing from Pumps to be Carbon Steel
- Discharge Plumbing to be SCH 80 PVC
- High high level alarm switch - *discrete input*
- High level alarm switch - *discrete input*
- Manual drain

REGENERATIVE SOIL VAPOR EXTRACTION BLOWER MODULE

Module to include two (2) of the equipment and components in the arrangements described below:

Includes: **Rotron model EN979BK72WL regenerative blower** with 20 HP 230/460V/3P motor:

- *Discrete output*
- Motor: EXP
- Performance at inlet of blower W: 564 SCFM at 35.5" WC
- Performance at inlet of blower X: 564 SCFM at 35.5" WC
- Expected inlet pressure losses through MLEE system: 15 WC
- Discharge temperature from blowers W & X:
  - 195 F at an inlet of 68 F
- Noise rating: 87 dBA

Inlet piping to blower to contain:

- Solberg inlet filter/silencer
- Vacuum transmitter with the following functions:
  - - *analog input*
  - Vacuum alarm high high
  - Vacuum alarm high
  - Vacuum alarm low
- Vacuum gauge
- Dilution line to contain:
  - Ball valve
- Vacuum relief valve
- PVC piping

Discharge piping from blower to contain:

- Sample port
- Pressure gauge
- ¼" Tapped plugged hole

- Steel piping to be terminated outside of enclosure

Module to include one (1) of the equipment and components in the arrangements described below:

Includes: **Rotron model EN14DX72MWL regenerative blower** with 30 HP 230/460V/3P motor:

- *Discrete output*
- Motor: EXP
- Performance at inlet of blower: 633 SCFM at 58" WC
- Expected inlet pressure losses through MLEE system: 15 WC
- Discharge temperature from blower V:
  - 212 F at an inlet of 68 F
- Noise rating: 87 dBA

Inlet piping to blower to contain:

- Solberg inlet filter/silencer
- Vacuum transmitter with the following functions:
  - *analog input*
  - Vacuum alarm high high
  - Vacuum alarm high
  - Vacuum alarm low
- Vacuum gauge
- Dilution line to contain:
  - Ball valve
- Vacuum relief valve
- PVC piping

Discharge piping from blower to contain:

- Sample port
- Pressure gauge
- ¼" Tapped plugged hole
- Steel piping to be terminated outside of enclosure

All three (3) SVE blowers discharge lines to be amalgamated with piping into a single 10" discharge line that will contain the following components:

- Butterfly valve
- Sample port
- Temperature gauge
- Pressure tranmitter – *analog input*
- Pressure gauge
- Steel piping to be terminated outside of enclosure

HEAT EXCHANGER MODULE

- Includes: Xchanger Inc. heat exchanger model AA-2750 with 2hp 230/460V 3P motor

Discharge piping from heat exchanger to contain:

- Temperature gauge
- Temperature transmitter to include the following:
  - – *analog input*
  - High temperature alarm condition set point

Controls and power provisions to be included:

- Required breaker
- Variable frequency drive

REMEDIATION ENCLOSURE #2 (BLOWERS AND CONTROLS)

Built to NEC General Purpose standards, all wiring complete and all equipment pre-piped factory tested and mounted in enclosure

Blower and control enclosure:

Includes 8' x 20' used modified shipping container with the following standard features:

- Static loading will be calculated via MLEE engineer
- Exterior paint
  - Painted beige
- Insulated Floor
- Walls to be covered with 1/4" Sheet Rock (spackled, primed and painted)
- Two (2) exterior lights
- Lifting eyes on upper corners
- Marine plywood floor
- Insulated walls, doors and ceiling
- Barn-style rear double doors
- Control panel mounted to interior

Interior to contain the following:

- One (1) Illuminated exit signs
- Vacuum extraction system
- Control panel equipment
- One (1) interior heaters:
  - - *powered device*
  - Chromalox LUH-D-04-43 heaters
- Lighting - *powered device*
- Three (3) duplex 20 Amp GFI receptacle – *powered device*

- Passive vent louvers
- Emergency stop switch
- All influent, effluent, and drain lines plumbed to outside of building

Air Conditioner to be the following:

- Grainger 3VE10
-

REMEDIATION ENCLOSURE #1 (MANIFOLDS AND VAPOR LIQUID SEPARATOR)

Built to NEC General Purpose standards, all wiring complete and all equipment pre-piped factory tested and mounted in enclosure

Includes 8' x 20' used modified shipping container with the following standard features:

- Static loading will be calculated via MLEE engineer
- Exterior paint
  - Painted beige
- Insulated Floor
- Walls to be covered with 1/4" Sheet Rock (spackled, primed and painted)
- Two (2) exterior lights
- Lifting eyes on upper corners
- Insulated walls, doors and ceiling
- Barn-style rear double doors
- Barn-style front double doors
- Control panel mounted to interior

Interior to contain the following:

- Two (2) Illuminated exit signs
- Vacuum extraction manifolds
- Condensate storage tank
- Two (2) interior heaters:
  - - *powered device*
  - Chromalox LUH-D-04-43 heaters
- Lighting - *powered device*
- Three (3) duplex 20 Amp GFI receptacle – *powered device*
- Passive vent louvers with hood
- Emergency stop switch
- All influent and effluent lines plumbed to outside of building

CONTROL SYSTEM MODULE

Includes: Allen-Bradley PLC based control panel with the following standard features:

- NEMA 1 lockable panel enclosure
- Primary circuit protection using external fused main disconnect
- Surge and lightning protection for control system
- Main power block
- Branch circuit protection with circuit breakers for motors
    - MCC-1 460V 600 Amp
    - TVSS transient voltage surge suppressor
- Motor starters with overload protection
- 120V/1P power transformer
- Branch circuit protection with circuit breakers for powered devices
    - PB-1 120/240 V 1 Phase 3 wire 100 Amp
- Allen-Bradley PLC control system with the following features:
    - 10 Slot rack
    - SLC 5/04 controller
    - Ethernet module
    - Power supply
    - Analog input modules
    - Analog output module
    - EPROM
    - DC input modules
    - DC output modules
- Variable frequency drives for the following motors:
    - **SVE blower V (30 HP)**
    - SVE blower W (20 HP)
    - SVE blower X (20 HP)
    - Heat Exchanger
    - All VFD units to include 3% line reactor
- Control system to contain 2 normally open contacts
- One (1) duplex 15 Amp GFI receptacle – *powered device*
- Wired and installed
- Factory tested prior to shipping

Outside cover of panel box to contain the following:

- Red alarm indicator light
- Each motor to include a Hand/Off/Auto
- Arista Panel PC and 15" LCD
    - ARP-1715BP-RB103H-T PC and 15" display
    - Standard power coated aluminum
    - 15" ELO Resistive Touch
    - P4 2.8GHz CPU
    - Ram 1 GB
    - Hard drive 40 GB
    - CD Rom
    - Operating system XP Professional

  - AC power supply
  - Per quote E01003A additional items may be required and will be quoted and later if change order is necessary
  - Increased control pannel depth
  - Additional program and test time added
- Alarm reset button
- Emergency stop button

Note:

1. MCC-1 to include two blank spaces 6" and 12"
2. PB-1 to include three (3) 20 Amp spares and three (3) 20 Amp blanks
3. MCP to include 20% spare. Space not to exceed 48"

OPERATION AND MAINTENANCE MANUAL

Includes: Operating instructions for all treatment system components
Copy of operating manual for each piece of equipment
Summary of system components
Summary of system operation principals
Summary of operation controls and failsafes
Summary of maintenance requirements for each piece of equipment

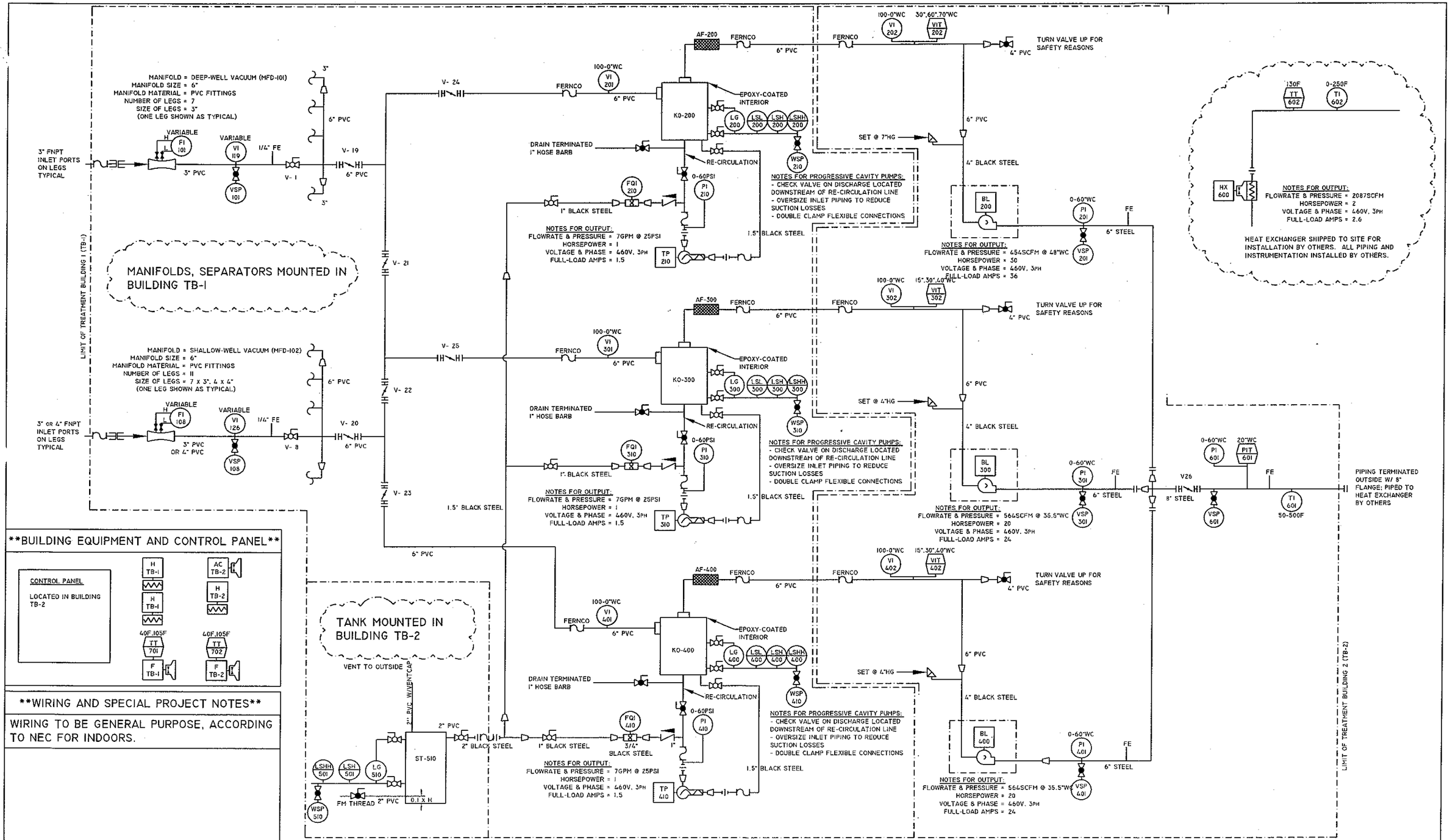
Project Packing List

PMProjNum **50353**

Northrop Grumman

ag	Part Number	Part Description	Req / Rec	PO # / Line	EngMemo
100	M1269	Hose,PVC,Suction,Green,4",J400	30		---
100	ft	TigerFlex only outdoor	30		
	Type: V	PVC,150F,50psi@70F(/ft) (min 100ft order) ---	50353-079	1	
100	12043	Hose,PVC,Suction,Green,3",J300	100		---
100	ft	TigerFlex only outdoor	100		
	Type: V	PVC,150F,60psi@70F(/ft) (min 100ft order) ---	50353-078	5	
100	18654	Hose Clamp, 5", SS	8		---
100	ea		8		
	Type: V	---	50353-081	2	
100	18652	Hose Clamp, 3-1/2", SS	28		---
100	ea		28		
	Type: V	---	50353-081	1	
1300	M1423	Gauge,Temp.,0-250F,WL31305	1		---
TI-1302	ea	3"Dial,6"Stem,1/2"NPT	1		
	Type: I	---	50353-012	6	
1300	9999	Misc Part	1		---
TT-1301	ea	As per specification below	1		
	Type: P	TE500CM12C2A1A3 32-212F	50353-023	1	
7300	10710	Vent,updraft 2", OPW-23	1		SHIPPED LOOSE AS PART OF STACK
TNK-7301	ea		1		
	Type: I	---	50353-012	30	
7900	9999	Misc Part	1		
7900	ea	As per specification below	1		
	Type: P	Hood 20" x 20" per email of Jan 16-08 from Mike Ford	50353-083	1	
7900	17149	Manual, System	2		---
7900	ea		2		
	Type: P	---	50353-043	1	
7900	9999	Misc Part	1		---
AC-7901	ea	As per specification below	1		
	Type: P	3VE10 WINDOW ROOM A/C 230V, 1ph	50353-019	1	

Tag	Part Number	Part Description	Req Rec	PO # Line	EngMemo
7900	11610	Container,8x20x8.6 5-8 yr	1		Shipping Container Options not required to be listed when ordering the unit: - External Steel Siding: No - Thermal Insulation: YES, R-12 - SHEETROCK INSTALLED ON INTERIOR (SPACKLED, PRIMED AND PAINTED) - Sound Insulation: NO - Floor Insulation: YES - Rubber Flooring: NO - Secondary Containment: NO - Roofing: Standard - Number of Rooms: ONE - Area Classification: GENERAL PURPOSE - Mandoor: NO - Partition Wall: NO
BLD-7901	ea		1		
Type: P		Length: 20ft Width: 8ft Height: 8ft6in Lifting Capacity: Corner lift lugs designed for maximum of 40,000 lb building weight. Factory Painted Exterior: Y Colour: BEIGE Marine Plywood Floor (Not Planks) CARGO DOORS INSTALLED IN BOTH ENDS	50353-002	2	
7900	11610	Container,8x20x8.6 5-8 yr	1		Shipping Container Options not required to be listed when ordering the unit: - External Steel Siding: No - Thermal Insulation: YES, R-12 - SHEETROCK INSTALLED ON INTERIOR (SPACKLED, PRIMED AND PAINTED) - Sound Insulation: NO - Floor Insulation: YES - Rubber Flooring: NO - Secondary Containment: NO - Roofing: Standard - Number of Rooms: ONE - Area Classification: GENERAL PURPOSE - Mandoor: NO - Partition Wall: NO
BLD-7902	ea		1		
Type: P		Length: 20ft Width: 8ft Height: 8ft 6in Lifting Capacity: Corner lift lugs designed for maximum of 40,000 lb building weight. Factory Painted Exterior: Y Colour: Beige Marine Plywood Floor (Not Planks) Standard Barn doors on one end only	50353-002	1	
7900	M1305	Fan Hood,HFPW-18,18",Plastic,White	2		---
F-7901	ea		2		
Type: I		---	50353-042	1	



PIPING DETAILS:
- WATER FLOW METERS: PROVIDE 10 DIA. OF STRAIGHT PIPE BEFORE AND 5 DIA. OF STRAIGHT PIPE AFTER METERS. ENSURE THAT THROTTLING VALVES ARE NOT DIRECTLY IN LINE WITH METERS.
- AIR FLOW METERS: PROVIDE 8 DIA. OF STRAIGHT PIPE BEFORE AND 3 DIA. OF STRAIGHT PIPE AFTER METERS, IF POSSIBLE. AVOID TEES AND ELBOWS BEFORE AND AFTER METERS.
- MATERIALS OF VALVES AND FITTINGS TO BE THE SAME AS THE DESCRIPTION AT THE LINE. IF THERE IS A TRANSITION FROM PVC TO STEEL, THE VALVE SHOULD BE BRASS.
- THERE ARE NO SPECIAL PIPING REQUIREMENTS OTHER THAN WHAT IS EXPLAINED ON THE DIAGRAM.
- WHEN PVC HOSE IS SPECIFIED, ALWAYS USE VACUUM HOSE; USE GREEN HOSE FOR PRESSURES LESS THAN 60PSI; USE TANK TRUCK HOSE FOR PRESSURES BETWEEN 60PSI AND 150PSI.
- PVC PIPE MAY BE SUBSTITUTED WITH EQUAL-SIZED PVC HOSE WHERE A FLEXIBLE CONNECTION IS PREFERRED.

LEVEL	DATE	BY	REVISION
E	JAN 05,09	SD	NOMENCLATURE CHANGES
D	OCT 15,08	WJD	FIELD MODIFICATIONS
C	JAN 28,08	BW	AS-BUILT
B	NOV 14,07	BW	FOR PRODUCTION
A1	OCT 25,07	BW	CHANGES PER CORRESPONDENCE
A	SEP 13,07	BW	FOR APPROVAL

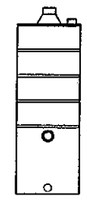
DWG. NO: 50353-01 (PAGE 1 OF 2)
TITLE: PROCESS & INSTRUMENTATION DRAWING
CUSTOMER: NORTHROP GRUMMAN ARCADIS
MLE EQUIPMENT INC.

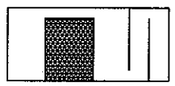
VALVES AND PIPING

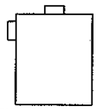
NO NC

BALL VALVE -
GATE VALVE -
GLOBE VALVE -
NEEDLE VALVE -
SLIDE VALVE -
SOLENOID VALVE -
BUTTERFLY VALVE -
SWING CHECK VALVE -
WAFER CHECK VALVE -
SPRING CHECK VALVE -
WYE STRAINER -
SAMPLE PORT -
PRESSURE RELIEF VALVE -
VACUUM RELIEF VALVE -
CAMLOCK CONNECTION -
FERNCO CONNECTION - FERNCO
FLEXIBLE CONNECTION -
FLANGED CONNECTION -
REDUCER -
UNION -
ADSORBENT FILTER - A DRAIN
COALESCING FILTER - DRAIN
PARTICULATE FILTER - DRAIN
FILTER, SILENCER -
PRESSURE REGULATOR -
REGULATOR W/ FILTER -

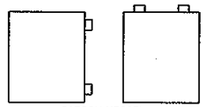
EQUIPMENT

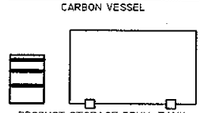

AIR STRIPPER

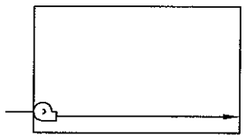

OIL/WATER SEPARATOR


VAPOR/LIQUID, SEAL FLUID SEPARATOR

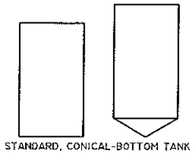

BAG FILTER


CARBON VESSEL


PRODUCT STORAGE DRUM, TANK


OXIDIZER


CHEMICAL DRUM


STANDARD, CONICAL-BOTTOM TANK

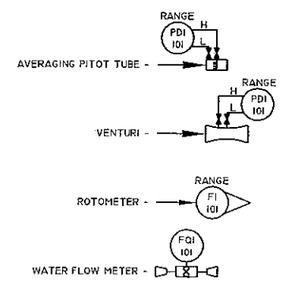
EQUIPMENT

CENTRIFUGAL PUMP -
PROGRESSIVE-CAVITY PUMP -
CHEMICAL-INJECTION PUMP -
CENTRIFUGAL, REGENERATIVE BLOWER -
POSITIVE-DISPLACEMENT BLOWER -
ROTARY-CLAW BLOWER -
LIQUID-RING PUMP -
ROTARY-VANE COMPRESSOR -
RECIPROCATING COMPRESSOR -
HEAT EXCHANGER -
PASSIVE COOLING FINS -

EQUIPMENT

AS - AIR STRIPPER
BLD - BUILDING, TRAILER OR SKID
FLT - FILTER VESSEL
LPC - LIQUID-PHASE CARBON VESSEL
MFD - MANIFOLD
OWS - OIL/WATER SEPARATOR
OX - OXIDIZER
PST - PRODUCT STORAGE TANK
SOS - SEAL OIL SEPARATOR
SWS - SEAL WATER SEPARATOR
TNK - TANK
VLS - VAPOR/LIQUID SEPARATOR
VPC - VAPOR-PHASE CARBON VESSEL
TB - TREATMENT BUILDING
ST - STORAGE TANK
TP - TRANSFER PUMP
KO - KNOCKOUT TANK
AF - AIR FILTER
BL - BLOWER

FLOW MEASUREMENT



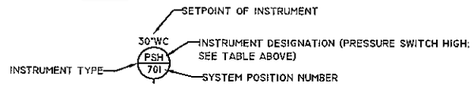
INSTRUMENT DESIGNATION

	INPUT	1ST MODIFIER	2ND MODIFIER	3RD MODIFIER	OUTPUT	1ST MODIFIER	
A							A
B						BLOWER	B
C	CYCLE					COMPRESSOR	C
D		DIFFERENTIAL				AIR DRYER	D
E							E
F	FLOW					FAN	F
G	GAS (LEL)		GAUGE				G
H				HIGH	HAND	HEATER	H
I	CURRENT		INDICATOR				I
J							J
K							K
L	LEVEL			LOW			L
M					MOTORIZED		M
N							N
O							O
P	PRESSURE				PNEUMATIC	PUMP	P
Q		QUANTITY					Q
R							R
S	SPEED		SWITCH		SOLENOID		S
T	TEMPERATURE		TRANSMITTER				T
U							U
V	VACUUM/VAPOR					VALVE	V
W	WATER						W
X							X
Y							Y
Z	POSITION						Z

INSTRUMENT IDENTIFICATION

- INDICATING INSTRUMENT
- DIGITAL INPUT TO CONTROL PANEL
- DIGITAL INPUT CAUSING ALARM
- DIGITAL INPUT CAUSING SYSTEM SHUTDOWN ALARM
- ANALOG INPUT TO CONTROL PANEL
- ANALOG OUTPUT FROM CONTROL PANEL

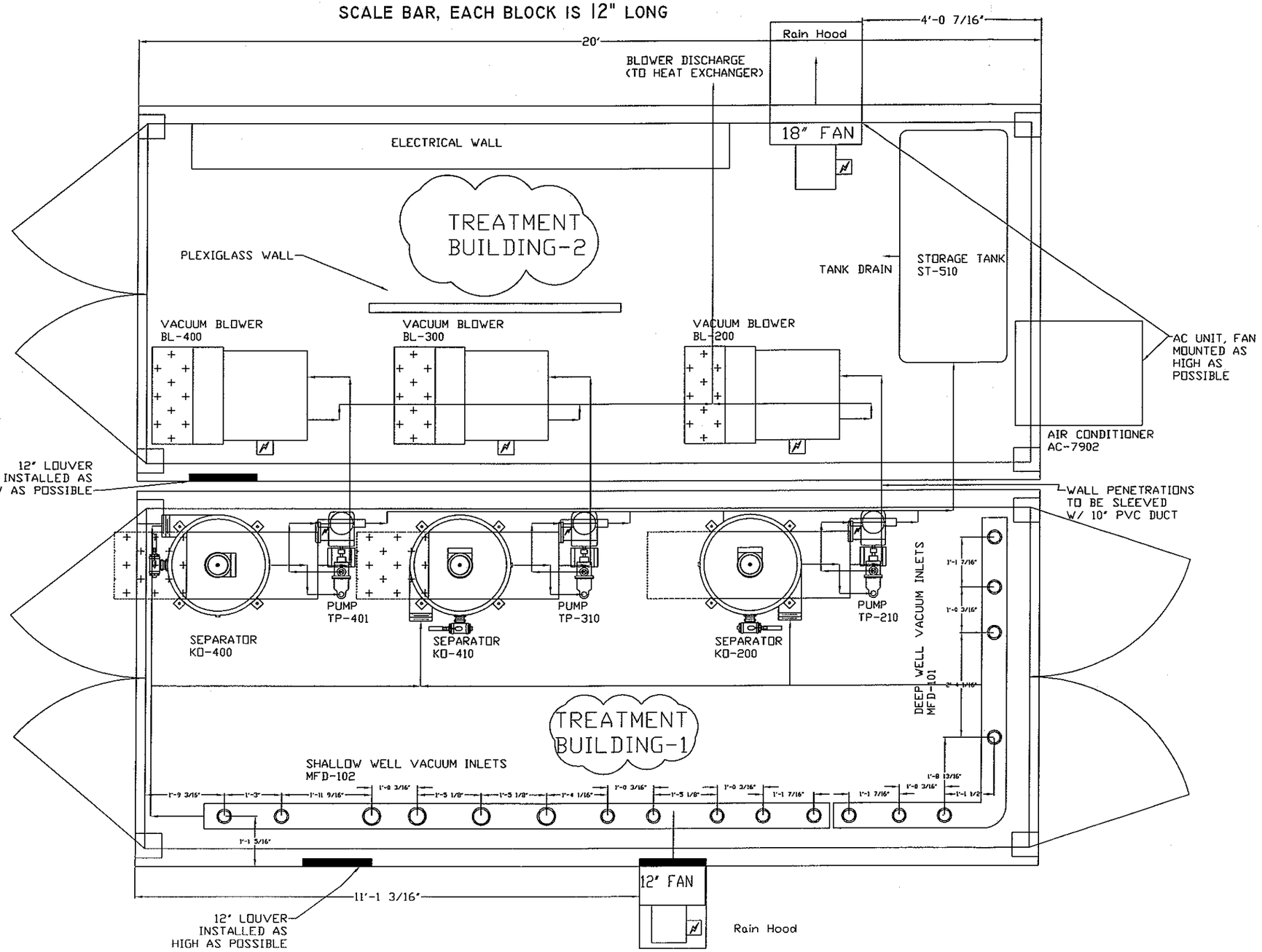
EXAMPLE



LEVEL	DATE	BY	REVISION
D	JAN 05, 09	SD	NOMENCLATURE CHANGES
C	JAN 28,08	BW	AS-BUILT
B	NOV 14,07	BW	FOR PRODUCTION
A	SEP 14,07	BW	FOR APPROVAL

DWG. NO: 50353 -01 (PAGE 2 OF 2)
TITLE: P&ID LEGEND
CUSTOMER: NORTHROP GRUMMAN ARCADIS
MLE EQUIPMENT INC.

SCALE BAR, EACH BLOCK IS 12" LONG



** CIVIL CONSTRUCTION NOTES **

- THERMAL INSULATION ON FLOOR, WALLS, DOORS, CEILING
- INTERIOR WALLS COVERED WITH SHEETROCK

**MECH./ELECT. ASS'Y NOTES **

- LOCATE COOLING THERMOSTAT IN THE WARMEST LOCATION AT CEILING LEVEL.
- LOCATE HEATING THERMOSTAT AT FLOOR LEVEL.
- SEE ENGINEERING FOR LOCATIONS OF GFI RECEPTACLES, INTERIOR LIGHTS, EXTERIOR LIGHTS, EXIT SIGNS, THERMOSTATS, HEATERS

*** COMMISSIONING NOTES ***

- BUILDINGS NEED TO BE SHIMMED ON SITE TO ALLOW DOORS TO OPEN FREELY. PLEASE HAVE SHIMMING MATERIAL READY DURING BUILDING INSTALLATION.
- FAN AND LOUVER HOODS NEED TO BE INSTALLED ON SITE. CANNOT SHIP WITH HOODS ATTACHED.
- FOR BUILDINGS W/ FLOOR CUTOUTS FOR PIPING, CUSTOMER MAY NEED TO CUT AWAY JOISTS IN OPENING. IF NECESSARY, THIS CAN BE DONE BY MLEE AS PART OF CONSTRUCTION.

*** PACKING LIST ***

DESCRIPTION	DIM (L X W X H)	WEIGHT
BUILDING X 2	20'X8'X8.5'	15000LB

FLOW DIRECTION

ELECTRICAL CONNECTION

FLOW INTO THE PAGE

FLOW OUT OF THE PAGE

THIS AREA REPRESENTS SERVICE SPACE REQUIRED

LEVEL	DATE:	BY	REVISION:
E	JAN 5,09	SDJ	NOMENCLATURE CHANGE
D	OCT 15,08	WDJ	IN FIELD MODIFICATION
C	JAN 28,08	BWJ	AS-BUILT
B	NOV 14,07	BWJ	FOR PRODUCTION
A2	NOV 7,07	BWJ	CHANGES PER CORRESPONDENCE
A1	OCT 26,07	BWJ	CHANGES PER CORRESPONDENCE

DWG. NO: 50353 - 02

TITLE: SYSTEM LAYOUT

CUSTOMER: NORTHROP GRUMMAN ARCADIS

MLE EQUIPMENT INC.

Maple Leaf Environmental Equipment Ltd, www.maple-leaf.ca

PLC Datalogging Setup

This document is used to confirm what information will be datalogged on your PLC. You will be able to utilize your remote telemetry package download this information on a monthy or bi-weekly basis.

Project Name: Northrop Grumman

Customer Name: Arcadis

MLEE Project Number: 50353

Daily Data Logging

This data will be logged once per day. Each data point will be logged 32 times before overwriting the oldest data. You can download up to one months information. Up to five data points can be recorded here. The Daily Data Logging can store numbers as large as 99999999

System Operating Message:	This is standard on all data logging systems.		
Daily Data Point 1:	HS	200	hrs
Daily Data Point 2:	HS	300	hrs
Daily Data Point 3:	HS	400	hrs
Daily Data Point 4:	HS	600	hrs
Daily Data Point 5:			

Data points can be any analog input, analog output, hour meter, or total water flow rates for meters.

Variable Time Data Logging

This data can be recorded at any time interval ranging from 10 seconds to 9999sec (166min). It can be adjusted on your remote access system. Each data point can be recorded 680 times before it starts overwriting the oldest data point. Up to seven data points can be recorded here and the system-operating message is always recorded. The Variable Time Data Logging can store numbers as large as 9999.

Data Logging Interval (sec):	600		
System Operating Message:	This is standard on all data logging systems.		
Variable Time Data Point 1:	VIT	202	"WC
Variable Time Data Point 2:	VIT	302	"WC
Variable Time Data Point 3:	VIT	402	"WC
Variable Time Data Point 4:	PIT	601	"WC
Variable Time Data Point 5:	TT	602	DEGF
Variable Time Data Point 6:	TT	702	DEGF
Variable Time Data Point 7:	TT	701	DEGF

Data points can be any analog input, analog output, or instantaneous flow rates for meters.

Maple Leaf Environmental Equipment Ltd, www.maple-leaf.ca

Autodialer Setup

This document is used to confirm the setup of your autodialer. Please include the contact information with your approval of the submittal package. This will allow us to set up your autodialer at the factory before shipping.

Project Name: Northrop Grumman
Customer Name: Arcadis
MLEE Project Number 50353
Autodialer Type: Sensaphone 1108

SETUP OF PHONE NUMBERS FOR ALARM DIALOUT

It is critical that the number listed here is exactly as it would be dialed from the telephone line on site. If it is a local call then the number should be adjusted accordingly.

VOICE LINE: 516-428-0077

FAX LINE: --NA--

SETUP OF INPUTS(1)

System Operating Message: This is standard on all data logging systems.

CHANNEL 1: *Blower Motor Failure Alarm*
CHANNEL 2: *Primary Vacuum Alarm*
CHANNEL 3: *Primary High Water Level Alarm*
CHANNEL 4: *System Shutdown Warning*
CHANNEL 5: *Primary Effluent High Pressure Alarm*
CHANNEL 6: *Primary Effluent Temperature Alarm*
CHANNEL 7: *Primary Building Temperature Alarms*
CHANNEL 8:

Note:

1. See ARCADIS P&ID for alarms which result in the System Operating Messages described above.

CONTACTORS

COIL FOR LARGE MOTOR — M???

COIL FOR SMALL MOTOR — M???

DISPLAYS

PANEL HOUR METER — HR???

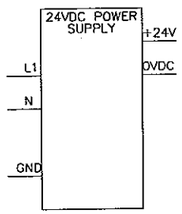
PANEL AMMETER — AMMETER, AMP???

PANEL RUN LIGHT — LT???, X1, G, X2, LOCATED ON PANEL DOOR

PANEL ALARM LIGHT — LT???, X1, R, X2, LOCATED ON PANEL DOOR

PANEL AMBER LIGHT — LT???, X1, A, X2, LOCATED ON PANEL DOOR

POWER SUPPLY



SWITCHES

LEVEL SWITCH NO

LEVEL SWITCH NC

PRESSURE SWITCH NO

PRESSURE SWITCH NC

FLOW SWITCH NO

FLOW SWITCH NC

TEMPERATURE SWITCH NO

TEMPERATURE SWITCH NC

NORMALLY OPEN CONTACT — ??

NORMALLY CLOSED CONTACT — ??

RELAYS

RELAY COIL — CR??? (13, 14)

RELAY TABLE

LOCATION OF CONTACT — 612

GENERAL PURPOSE AREA

CLASS 1 DIV 2 AREA

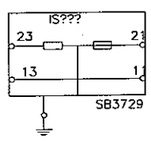
MOTORS

3 pH MOTOR — MTR? (T1, T2, T3) ? HP ? GAUGE ? AMP ? MOTOR

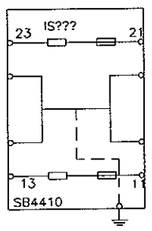
1 pH MOTOR — MTR? (T1, T2) ? MOTOR ? HP ? GAUGE ? AMP

IS BARRIERS

1 CHANNEL ISBARRIER



2 CHANNEL ISBARRIER

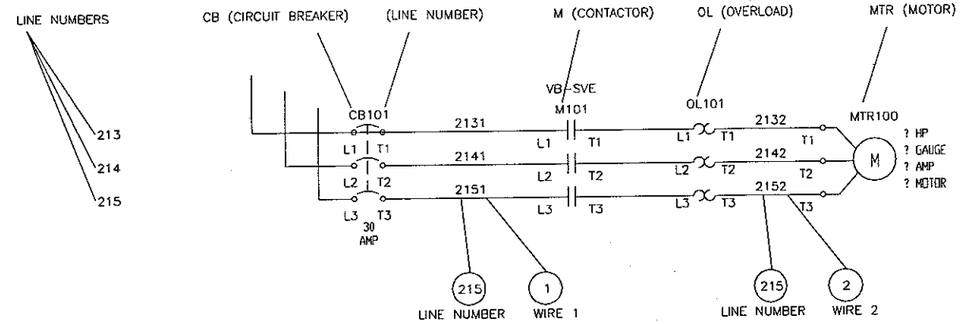


WIRE LEGEND

BLACK: POWER (>120VAC)
RED: CONTROL (120VAC)
WHITE: NEUTRAL

BLUE: CONTROL (+24VDC & IS)
BL/WH: CONTROL (0VDC)
YELLOW: INTERLOCKS

WIRE NUMBER DESCRIPTION

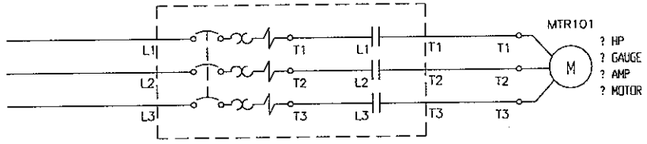


VB-SVE

OVERLOAD PINS	
95 96	
97 98	
CONTACTOR	
A1 A2	
13 14	
53 54	
63 64	612
61 62	

LOCATION OF AUXILLARY CONTACT

COMBINATION MOTOR STARTER



BL-200

TERMINALS	
A1 A2	
13 14	
53 54	
63 64	
97 98	
53 540L	

	DATE	NAME
DRAWN BY	09/28/07	preimer
CKD BY	12/6/08	SP

MLE EQUIPMENT INC.
1325 CALIFORNIA AVE.
ONTARIO, K6V 5Y6
CANADA

PROJECT: 50353-E NORTHROP GRUMMAN

DRAWING-NO:

JOB-NO: 50353

PAGE DESCRIPTION: LEGEND

Note: Fuses Listed here should be ordered from the Fuse Schedule on the Electrical Components list.

Main Disconnect
Details on Main Disconnect found in Control Module!

Extra large, 3ph Transformers

Description	Qty	Make	Part Number	MLEE APES NUMBER	Manual	Spec
Transformer 30kVA 480:120/208 NEMA 3R	1		NMK030KB			

Breaker Panel

Description	Qty	Make	Part Number	MLEE APES NUMBER	Manual	Spec
208 / 240V-3ph 125 amp w main, UL approved	1	Square D	NQOD430M100			
tub for above	1	Square D	MH29			
cover for above	1	Square D	MHC29S			
Ground Bar Kit	1	Square D	PK18GTA	10586		

Main Power Block 200 A Service

Description	Qty	Make	Part Number	MLEE APES NUMBER	Manual	Spec
High Amp Large, 8 holes, 310A Rating	1	Gould	67633	E1150		
Saftey Cove Kit PDB	3	Gould	8570	15071.0		

Transient Voltage Surge Suppressor(TVSS)

Description	Qty	Make	Part Number	MLEE APES NUMBER	Manual	Spec
TVSS	1	SQD	TVS4EMA12A		x	x

Note: Circuit breakers that have ** before the part number are ordered with the MECHANICAL items.

Fuse, Breaker, and Power Distribution Schedule

Name of Output Device	Panel Label	HP	V	Power	Amps	Wire Gauge	Contactor PN	Overload PN / Three P	Single P	Starter Size	Make of Starter	-	Link Module	Baseplate	AUX RUN Contacts	AUX Fault Status Contacts	Line Insulator
TP 210	STR214	1	460	1194	1.5	14	LC1K0610G7	GV2P07		1.6-2.5	Square D		N/A	GK2AF01	N/A	GVAD1010	GV2GH7
							12940	17267					N/A	17155.0	N/A	-	0.0
TP 310	STR220	1	460	1194	1.5	14	LC1K0610G7	GV2P07		1.6-2.5	Square D	-	N/A	GK2AF01	N/A	GVAD1010	GV2GH7
							12940	17267				-	N/A	17155.0	N/A*	-	0.0
TP 410	STR226	1	460	1194	1.5	14	LC1K0610G7	GV2P07		1.6-2.5	Square D	-	N/A	GK2AF01	N/A	GVAD1010	GV2GH7
							12940	17267				-	N/A	17155.0	N/A*	-	0.0
BL 200	CB244	30	460	28848	35.0	8	VFD	FAL34070		70.0	Square D	-	N/A	N/A	N/A	N/A	N/A
							-	#N/A				-	N/A	N/A	N/A*	N/A	N/A
BL 300	CB260	20	460	19099	23.0	10	VFD	FAL34050		50.0	Square D	-	N/A	N/A	N/A	N/A	N/A
							-	#N/A				-	N/A	N/A	N/A*	N/A	N/A
BL 400	CB303	20	460	19099	23.0	10	VFD	FAL34050		50.0	Square D	-	N/A	N/A	N/A	N/A	N/A
							-	#N/A				-	N/A	N/A	N/A	N/A	N/A
HX 600	CB319	2	460	2069	2.6	14	VFD	JTEC4893C15			FT	-	N/A	N/A	N/A	N/A	N/A
							-	18975				-	N/A	N/A	N/A*	N/A	N/A

POWER DISTRIBUTION OF POWERED DEVICES

Name of Output Device	Panel Label	HP	V	Power	Amps	Wire Gauge	Make of Circuit Breaker	Breaker Size	-	MLEE #
BUILDING #2 AIR CONDITIONER	CB355	N/A	2301	4140	20.0	8		40.0	SQD	QOB240	16626.0
20-Amp GFI Plug 1	CB359	N/A	115	2000	16.0	12		20.0	SQD	QOB120	16628.0
20-Amp GFI Plug 2	CB362	N/A	115	2000	16.0	12		20.0	SQD	QOB120	16628.0
20-Amp GFI Plug 3	CB365	N/A	115	2000	16.0	12		20.0	SQD	QOB120	16628.0
20-Amp GFI Plug 4	CB368	N/A	115	2000	16.0	12		20.0	SQD	QOB120	16628.0
20-Amp GFI Plug 5	CB371	N/A	115	2000	16.0	12		20.0	SQD	QOB120	16628.0
20-Amp GFI Plug 6	CB374	N/A	115	2000	16.0	12		20.0	SQD	QOB120	16628.0
BUILDING #1 INTERIOR LIGHTS	CB405	N/A	115	400	3.3	14		15.0	SQD	QOB115	16628.0
BUILDING #2 INTERIOR LIGHTS	CB410	N/A	115	400	3.3	14		15.0	SQD	QOB115	16628.0
BUILDING EXTERIOR LIGHTS	CB415	N/A	115	280	2.3	14		15.0	SQD	QOB115	16628.0
BUILDING #2 HEATER	CB335	N/A	460	4000	5.0	14		15.0	FT	JTEC4893C15	17542.0
BUILDING #1 HEATER	CB231	N/A	460	4000	5.0	14		15.0	FT	JTEC4893C15	17542.0
BUILDING #1 HEATER	CB236	N/A	460	4000	5.0	14		15.0	FT	JTEC4893C15	17542.0
BUILDING EXT SIGNS	CB420	N/A	115	200	1.7	14		15.0	SQD	QOB115	16628.0
120V Control Power	CB444	N/A	115	1000	8.3	14		15.0	SQD	QOB115	16628.0
F-7901	CB423	N/A	115	500	4.5	14		15.0	SQD	QOB115	16628.0
SPARE BREAKER	CB425	N/A	115	2000	16.0	12		20.0	SQD	QOB120	16628.0
SPARE BREAKER	CB427	N/A	115	2000	16.0	12		20.0	SQD	QOB120	16628.0
SPARE BREAKER	CB429	N/A	115	2000	16.0	12		20.0	SQD	QOB120	16628.0
SPARE BREAKER	CB431	N/A	115	2000	16.0	12		20.0	SQD	QOB120	16628.0
SPARE BREAKER	CB433	N/A	115	2000	16.0	12		20.0	SQD	QOB120	16628.0
SPARE BREAKER	CB435	N/A	115	2000	16.0	12		20.0	SQD	QOB120	16628.0
SPARE BREAKER	CB437	N/A	115	2000	16.0	12		20.0	SQD	QOB120	16628.0

This is the Motor and Fuse schedule. It is used to pick the detailed components that go into the power distribution portion of your control system. This information can be useful down the road if you have to replace any electrical components.

Level	Date	By	REVISION
C	22-Jan-08	PR	AS BUILTS
B	28-Sep-07	BG	FOR PRODUCTION
A	17-Sep-07	BW	FOR APPROVAL

Motor and Fuse Schedule

Project Name: Northrop Grumman
Customer: Arcadis
Drawing Number: 50353 -03-02

Level	Date	By	Revision
D	5-Jan-09	SC	NOMENCLATURE CHANGES
C	22-Jan-08	PR	AS BUILTS
B	27-Nov-07	PR	FOR PRODUCTION
A	17-Sep-07	BW	FOR APPROVAL

Input and Output Table
Proj Name: Northrop Grumman
Customer: Arcadis
Drawing Number:
50353-03-5
Maple Leaf Environmental

This is the Inputs and Outputs summary sheet. The purpose of this document is to identify all the inputs, outputs, and powered devices that make up this control system.

DESCRIPTION INPUT NAME LOCATION	P&ID DESC. INPUT	LOC.	Panel Label	IS	XPF	Alarm Type SYS	WTS	ATS	HARD CASC	RECOV CASC	SOFT
				IS: Intrinsically Safe		See: Control Logic for Explanation of Alarms					
				XPF: Explosionproof							
Vapor/Liquid Separator											
Level Switch HiHi - Vapor/Liquid Separator	LSHH	200	I:1/00								
Level Switch High - Vapor/Liquid Separator	LSH	200	I:1/01			1					
Level Switch Low - Vapor/Liquid Separator	LSL	200	I:1/02								
Level Switch HiHi - Vapor/Liquid Separator	LSHH	300	I:1/03								
Level Switch High - Vapor/Liquid Separator	LSH	300	I:1/04			1					
Level Switch Low - Vapor/Liquid Separator	LSL	300	I:1/05								
Level Switch HiHi - Vapor/Liquid Separator	LSHH	400	I:1/06								
Level Switch High - Vapor/Liquid Separator	LSH	400	I:1/07			1					
Level Switch Low - Vapor/Liquid Separator	LSL	400	I:1/08								
Discharge Tank											
Level Switch HiHi - Discharge Tank	LSHH	510	I:1/09								
Level Switch High - Discharge Tank	LSH	510	I:1/10			1					
						1					
Building, Trailer or Skid											
Kill Switch - Building, Trailer or Skid	BLDG	2 PB	I:2/13			1					
Kill Switch - Building, Trailer or Skid	BLDG	1 PB	I:2/14			1	ADDED				
Control Panel											
Motor Fault - BL-200 - Control Panel	FL	200	I:1/12								
Motor Fault - TP-210 - Control Panel	FL	210	I:1/13			1					
Motor Fault - BL-300 - Control Panel	FL	300	I:1/14			1					
Motor Fault - TP-310 - Control Panel	FL	310	I:1/15			1					
Motor Fault - BL-400 - Control Panel	FL	400	I:2/00			1					
Motor Fault - TP-410 - Control Panel	FL	410	I:2/01			1					
Motor Fault - HX-600 - Control Panel	FL	600	I:2/02			1					
Kill Switch - Control Panel	CRT PNL	PB	I:2/15			1					
Reset - Control Panel	RST	8201	I:2/11								
Motor Starter Status Inputs											
Blower - Soil-Vapor Extraction	YL	200	I:2/04								
Blower - Soil-Vapor Extraction	YL	300	I:2/05								
Blower - Soil-Vapor Extraction	YL	400	I:2/06								
Fan - SVE Heat Exchanger	YL	600	I:2/07								
Pump - Vapour/Liquid Separator	YL	210	I:2/08								
Pump - Vapour/Liquid Separator	YL	310	I:2/09								
Pump - Vapour/Liquid Separator	YL	410	I:2/10								

DESCRIPTION ANALOG INPUTS LOCATION	P&ID DESCRIP. INPUT	LOC	Factory Default	SYS	WTS	ATS	HARD	SOFT	IS = 1 XPF =0	
Analog Setpoints Adjustable by User										
Pressure Transmitter High-High - Soil-Vapor Extraction	VAHH	202	80"WC	1						N7:20
Pressure Transmitter High - Soil-Vapor Extraction	VAH	202	70"WC	1						N7:21
Pressure Transmitter Low - Soil-Vapor Extraction	VAL	202	30"WC	1						N7:22
Pressure Transmitter High-High - Soil-Vapor Extraction	VAHH	302	80"WC	1						N7:23
Pressure Transmitter High - Soil-Vapor Extraction	VAH	302	70"WC	1						N7:24
Pressure Transmitter Low - Soil-Vapor Extraction	VAL	302	30"WC	1						N7:25
Pressure Transmitter High-High - Soil-Vapor Extraction	VAHH	402	80"WC	1						N7:26
Pressure Transmitter High - Soil-Vapor Extraction	VAH	402	70"WC	1						N7:27
Pressure Transmitter Low - Soil-Vapor Extraction	VAL	402	15"WC	1						N7:28
Pressure Transmitter High - Soil-Vapor Extraction	PAH	601	120"WC	1						N7:29
Temperature Transmitter High - SVE Heat Exchanger	TAH	602	130F	1						N7:30
Temperature Transmitter High - Building, Trailer or Skid	TAH	702	105F	1						N7:31
Temperature Transmitter Low - Building, Trailer or Skid	TAL	702	40F	1	ADDED					N7:32
Temperature Transmitter High - Building, Trailer or Skid	TAH	701	105F	1						N7:33
Temperature Transmitter Low - Building, Trailer or Skid	TAL	701	40F	1						N7:34
BL-200-VFD Speed - Control Panel	BL	200Speed	100%							N7:35
BL-300-VFD Speed - Control Panel	BL	300Speed	100%							N7:36
BL-400-VFD Speed - Control Panel	BL	400Speed	100%							N7:37
HX-600-VFD Speed - Control Panel	HX	600Speed	100%							N7:38

DESCRIPTION ANALOG INPUTS LOCATION	P&ID DESCRIP. INPUT	LOC	Panel	Units	Min	Max	SQRT Y/N	Decimal	SQRT VALUE	
Analog Inputs into PLC										
Pressure Transmitter - Soil-Vapor Extraction	VIT	202	I:5/0	"WC	0	100	N	XXX		N7:50
Pressure Transmitter - Soil-Vapor Extraction	VIT	302	I:5/1	"WC	0	100	N	XXX		N7:51
Pressure Transmitter - Soil-Vapor Extraction	VIT	402	I:5/2	"WC	0	100	N	XXX		N7:52
Pressure Transmitter - Soil-Vapor Extraction	PIT	601	I:5/3	"WC	0	100	N	XXX		N7:53
Temperature Transmitter - SVE Heat Exchanger	TT	602	I:5/4	DEGF	32	212	N	XXX		N7:54
Temperature Transmitter - Building, Trailer or Skid	TT	702	I:5/5	DEGF	32	212	N	XXX		N7:55
VFD Speed Feedback - BL-200 - Soil-Vapor Extraction	BL 200	Feedback	I:6/0	%	0	100	N	XXX	ADDED	N7:56
VFD Speed Feedback - BL-300 - Soil-Vapor Extraction	BL 300	Feedback	I:6/1	%	0	100	N	XXX	ADDED	N7:57
VFD Speed Feedback - BL-400 - Soil-Vapor Extraction	BL 400	Feedback	I:6/2	%	0	100	N	XXX	ADDED	N7:58
VFD Speed Feedback - HX-600 - SVE Heat Exchanger	HX 600	Feedback	I:6/3	%	0	100	N	XXX	ADDED	N7:59
Temperature Transmitter - Building, Trailer or Skid	TT	701	I:5/6	SCFM	0	700	N	X.XX	ADDED	N7:60

DESCRIPTION ANALOG OUTPUTS LOCATION	P&ID DESCRIP. OUTPUT	LOC	Panel	Decimal	Unit	
Analog Outputs from PLC						
Variable Frequency Drive - BL-200 - Soil-Vapor Extraction	HS	200	O:7/0	XXX	%	N7:64
Variable Frequency Drive - BL-300 - Soil-Vapor Extraction	HS	300	O:7/1	XXX	%	N7:61
Variable Frequency Drive - BL-400 - Soil-Vapor Extraction	HS	400	O:7/2	XXX	%	N7:62
Variable Frequency Drive - HX-600 - SVE Heat Exchanger	HX	600	O:7/3	XXX	%	N7:63

DESCRIPTION ANALOG OUTPUTS LOCATION	P&ID DESCRIP. OUTPUT	LOC		Decimal	Unit	
PLC monitored hour meters for the following motors						
Blower - Soil-Vapor Extraction	YL	200		xxxxxxxx	hrs	F8:0
Blower - Soil-Vapor Extraction	YL	300		xxxxxxxx	hrs	F8:1
Blower - Soil-Vapor Extraction	YL	400		xxxxxxxx	hrs	F8:2
Fan - SVE Heat Exchanger	YL	600		xxxxxxxx	hrs	F8:3
Pump - Vapour/Liquid Separator	YL	210		xxxxxxxx	hrs	F8:4
Pump - Vapour/Liquid Separator	YL	310		xxxxxxxx	hrs	F8:5
Pump - Vapour/Liquid Separator	YL	410		xxxxxxxx	hrs	F8:6

DESCRIPTION OUTPUT LOCATION	P&ID DESCRIP. OUTPUT	LOC.	Panel Label	HOA & Run	OA	Hrs	Amps	HP	Volts	VFD
				7	0	0	0	75		
Motors										
Vapor/Liquid Separator										
Pump - Vapor/Liquid Separator	TP	210	O:3/00					1	460	
Pump - Vapor/Liquid Separator	TP	310	O:3/01		HOA SWITCHES TO BE ON			1	460	
Pump - Vapor/Liquid Separator	TP	410	O:3/02		SCREEN,			1	460	
Soil-Vapor Extraction					NOT PANEL COVER					
Blower - Soil-Vapor Extraction	BL	200	O:3/03					30	460	1
Blower - Soil-Vapor Extraction	BL	300	O:3/04					20	460	1
Blower - Soil-Vapor Extraction	BL	400	O:3/05					20	460	1
SVE Heat Exchanger										
Fan - SVE Heat Exchanger	HX	600	O:3/06					2	460	1
Special Outputs										
On Contact - Soil-Vapor Extraction	BL 200	Hand	O:3/11							
On Contact - Soil-Vapor Extraction	BL 300	Hand	O:3/12							
On Contact - Soil-Vapor Extraction	BL 400	Hand	O:3/13							
System on Contact - Control Panel	HX 600	Hand	O:3/14							
System Alarm Contacts - Control Panel	SYS	Alarm	O:3/06							
System Alarm Light - Control Panel	LIGHT	LIGHT	O:3/10							

Optional Powered Devices	Panel Label	Power (Watts) 48260.0	Voltage
BUILDING #2 AIR CONDITIONER		4140	2301
20-Amp GFI Plug 1		2000	115
20-Amp GFI Plug 2		2000	115
20-Amp GFI Plug 3		2000	115
20-Amp GFI Plug 4		2000	115
20-Amp GFI Plug 5		2000	115
20-Amp GFI Plug 6		2000	115
BUILDING #1 INTERIOR LIGHTS		400	115
BUILDING #2 INTERIOR LIGHTS		400	115
BUILDING EXTERIOR LIGHTS		280	115
BUILDING #2 HEATER		4000	460
BUILDING #1 HEATER		4000	460
BUILDING #1 HEATER		4000	460
BUILDING EXIT SIGNS		200	115
120V Control Power		1000	115
SPARE BREAKER	SP-8201	2000	115
SPARE BREAKER	SP-8202	2000	115
SPARE BREAKER	SP-8203	2000	115
SPARE BREAKER	SP-8204	2000	115
SPARE BREAKER	SP-8205	2000	115
SPARE BREAKER	SP-8206	2000	115
SPARE BREAKER	SP-8207	2000	115
SPARE BREAKER	SP-8208	2000	115
BUILDING #1 VENTILATION FAN	F-7901	800	115
BUILDING #2 VENTILATION FAN	F-7902	800	115

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Explanation of Process Logic

There are two components to the process logic, Alarm logic and operating logic of the output devices.

Alarm Logic: Any alarm in your system can be programmed 6 different ways:

System Shutdown Alarms: This alarm will stop the entire system and require a manual restart with the reset button.

Cascading Shutdown Alarms: This alarm must be manually reset. It will shut down part of the process and allow the system to continue to run until another critical system shutdown alarm stops the entire system.

Cascading Recoverable Alarms: This alarm will temporarily stop components in the system and allow them to restart once alarm condition has been corrected.

Water Treatment System Alarms: This is a shutdown alarm that will stop all components in the water treatment side of the process.

Air Treatment System Alarms: This is a shutdown alarm that will stop all components in the air treatment side of the process.

Non Critical Warning Alarm: This is a warning alarm and will activate an alarm but not affect the process. It will remain on unti the reset button is pressed.

Output Logic: This describes the operating logic of various Output Devices

System Requirements For Operation (SRFO): This describes the condition that the entire system must be in to allow the output to operate.

For example: The main SVE Blower may only run of the system is on while the building fan can operate at any time.

System On: This device can only run if the system is on and no system alarms are activated. It will shut off if these conditions are not met.

Air Treatment System On: This device can only run if the Air Treatment System is on and no Air Treatment Alarms are activated. It will shut off if these conditions are not met.

Water Treatment System On: This device can only run if the Water Treatment System is on and no Water Treatment System Alarms are activated. It will shut off if these conditions are not met.

Always On: This device will run regardless of if the system is on or not as long as the PLC is in run mode and there is power to the panel.

Note: If the system is not on or a system alarm occurs it will automatically prevent the air treatment system or water treatment system from operating.

Alarm Diplay Method: This describes the method of displaying the alarm to the operator. Some alarms will have different methods of display.

Rem: This alarm will be displayed on the remote access package.

Dis: This alarm will be user interface display on the front of the panel.

Light: This alarm will displayed via a dedicated alarm light on the control panel.

The purpose of this document is two fold. It summarizes the power and service requirements to the system as well as explain how the system will operate.
When reviewing this document it is important that you consider how you would like you system to operate so we can make the necessary changes to our programming before delivering the system.

C	22-Jan-08	PR	AS BUILTS
B	27-Nov-07	PR	FOR PRODUCTION
A	17-Sep-07	BW	FOR APPROVAL
Level	Date	By	REVISION

Control System Summary and Functional Spec.

Proj Name: Northrop Grumman
Customer: Arcadis
Drawing Number:
50353 -03-5
Maple Leaf Environmental Equipment Ltd, www.maple-leaf.ca

ALARM DESCRIPTION			P&ID Description		Alarm Display Method	Panel Label	ALARM TYPE	Alarm Control Logic
INPUT	LOCATION		Input	Loc.				
PLC Alarm Inputs		ALARM						
First Scan Power Failure -	Control Panel	Alarm	FSPWR	8201	/Dis	B3/100	System Shutdown Alarm	This will shut the system down. The alarm can only be reset by pressing the reset button.
PLC Error -	Control Panel	Alarm	PLC	8201	/Dis		System Shutdown Alarm	This alarm will occur if the PLC detects a critical internal error. If the error occurs, then the PLC may not operate properly and the system will shut down. This alarm can be cleared in the plc by resetting power to the plc. Once the PLC error has cleared then the reset button will reset the alarm.
Level Switch HiHi -	Vapor/Liquid Separator	ALARM	LSHH	200	/Dis		System Shutdown Alarm	If the high-high level switch is activated constantly for 5 seconds then this alarm will activate and shut the system down. The alarm can only be reset with the reset button. The alarm will also dial out using autodialer CHANNEL 3.
Level Switch HiHi -	Vapor/Liquid Separator	ALARM	LSHH	300	/Dis		System Shutdown Alarm	If the high-high level switch is activated constantly for 5 seconds then this alarm will activate and shut the system down. The alarm can only be reset with the reset button. The alarm will also dial out using autodialer CHANNEL 3.
Level Switch HiHi -	Vapor/Liquid Separator	ALARM	LSHH	400	/Dis		System Shutdown Alarm	If the high-high level switch is activated constantly for 5 seconds then this alarm will activate and shut the system down. The alarm can only be reset with the reset button. The alarm will also dial out using autodialer CHANNEL 3.
Level Switch HiHi -	Discharge Tank	ALARM	LSHH	510	/Dis		System Shutdown Alarm	If the high-high level switch is activated constantly for 5 seconds then this alarm will activate and shut the system down. The alarm can only be reset with the reset button. The alarm will also dial out using autodialer CHANNEL 3.
Level Switch High -	Discharge Tank	ALARM	LSH	510	/Dis		System Shutdown Alarm	If the high level switch is activated constantly for 5 seconds then this alarm will activate and dial out using the autodialer CHANNEL 4. In the event that the alarm is not cleared within 24 hours, the system will shut down. The alarm can only be reset with the reset button (in the event that the alarm is not cleared within 24 hours).
Kill Switch -	Building, Trailer or Skid	ALARM	BLDG	1 PB	/Dis		System Shutdown Alarm	If the kill switch in the building is pushed in the system will shut down.
Kill Switch -	Building, Trailer or Skid	ALARM	BLDG	2 PB	/Dis		System Shutdown Alarm	If the kill switch in the building is pushed in the system will shut down.
Motor Fault -BL 200 -	Control Panel	ALARM	FL	200	/Dis		System Shutdown Alarm	If the fault alarm from the VFD is activated, this alarm will activate and shut the system down. The alarm can only be reset with the reset button. The alarm will also dial out using autodialer CHANNEL 1.
Motor Fault - TP-210 -	Control Panel	ALARM	FL	210	/Dis		System Shutdown Alarm	If the overload in the panel trips this alarm will activate and dial out using the autodialer CHANNEL 4. In the event that the alarm is not cleared within 24 hours, the system will shut down. The alarm can only be reset with the reset button (in the event that the alarm is not cleared within 24 hours).
Motor Fault - BL-300 -	Control Panel	ALARM	FL	300	/Dis		System Shutdown Alarm	If the fault alarm from the VFD is activated, this alarm will activate and shut the system down. The alarm can only be reset with the reset button. The alarm will also dial out using autodialer CHANNEL 1.
Motor Fault - TP-310 -	Control Panel	ALARM	FL	310	/Dis		System Shutdown Alarm	If the overload in the panel trips this alarm will activate and dial out using the autodialer CHANNEL 4. In the event that the alarm is not cleared within 24 hours, the system will shut down. The alarm can only be reset with the reset button (in the event that the alarm is not cleared within 24 hours).
Motor Fault - BL-400 -	Control Panel	ALARM	FL	400	/Dis		System Shutdown Alarm	If the fault alarm from the VFD is activated, this alarm will activate and shut the system down. The alarm can only be reset with the reset button. The alarm will also dial out using autodialer CHANNEL 1.
Motor Fault - TP-410 -	Control Panel	ALARM	FL	410	/Dis		System Shutdown Alarm	If the overload in the panel trips this alarm will activate and dial out using the autodialer CHANNEL 4. In the event that the alarm is not cleared within 24 hours, the system will shut down. The alarm can only be reset with the reset button (in the event that the alarm is not cleared within 24 hours).

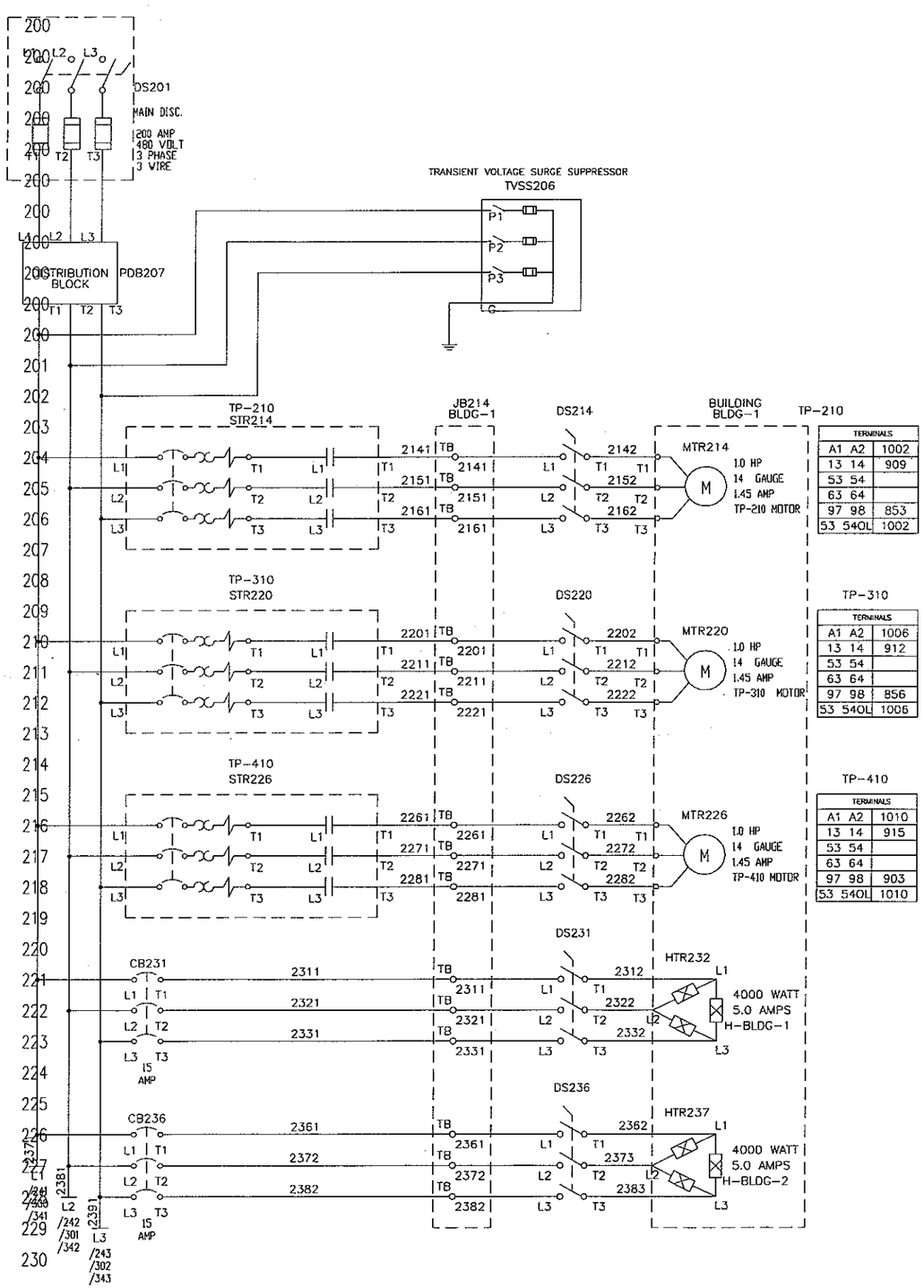
Motor Fault - HX 600 -	Control Panel	ALARM	FL	600	/Dis		System Shutdown Alarm	If the fault alarm from the VFD is activated this alarm will activate and dial out using the autodialer CHANNEL 4. If the alarm is not cleared manually within 24 hours, the system will shut down. The alarm can only be reset with the reset button.
Kill Switch -	Control Panel	ALARM	CRT PNL	PB	/Dis		System Shutdown Alarm	If the kill switch in the building is pushed in the system will shut down.

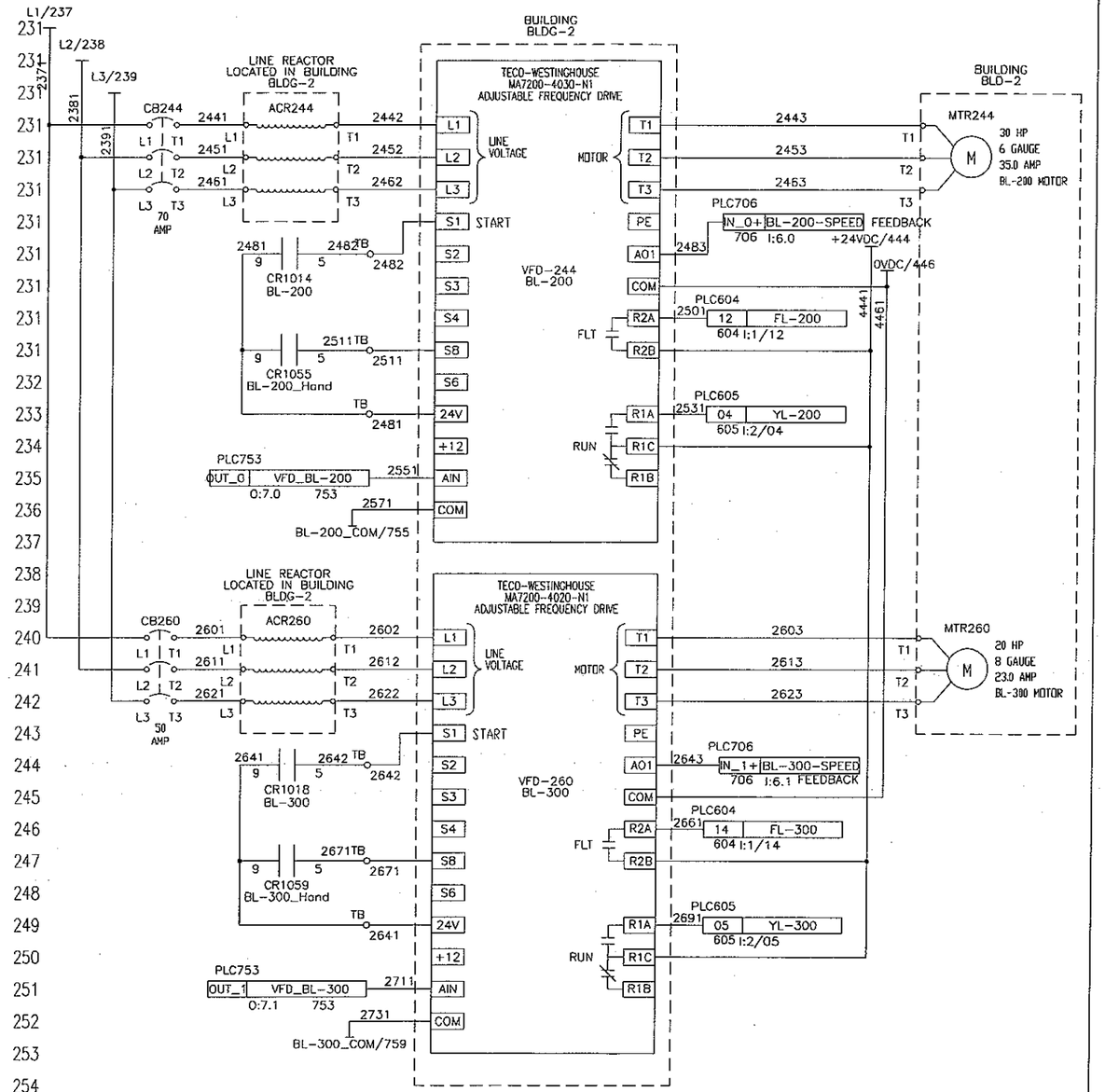
Note: The functional logic described below assumes that there are no alarms described above shutting the device down. The logic explains the normal operating logic of the device.

Output Description		P&ID DESCRIP.		Panel	System Requirement for Operation	Output Logic
OUTPUT	LOCATION	OUTPUT	LOC	Label	(SRFO)	
Motors						
Vapor/Liquid Separator						
Pump - Vapor/Liquid Separator		TP	210		System On	Both the High and Low level switch have to be up for the pump to start. Once the pump has started, it will remain on until the low level switch shuts it off.
Pump - Vapor/Liquid Separator		TP	310		System On	Both the High and Low level switch have to be up for the pump to start. Once the pump has started, it will remain on until the low level switch shuts it off.
Pump - Vapor/Liquid Separator		TP	410		System On	Both the High and Low level switch have to be up for the pump to start. Once the pump has started, it will remain on until the low level switch shuts it off.
Soil-Vapor Extraction						
Blower - Soil-Vapor Extraction		BL	200		System On	This blower will run as long as the System Requirements for Operation (SRFO) are met. If you have a PLC we will add a 10 second delay on startup.
Blower - Soil-Vapor Extraction		BL	300		System On	This blower will run as long as the SRFO are met. If you have a PLC we will add a 20 second delay on startup.
Blower - Soil-Vapor Extraction		BL	400		System On	This blower will run as long as the SRFO are met. If you have a PLC we will add a 30 second delay on startup.
SVE Heat Exchanger						
Fan - SVE Heat Exchanger		HX	600		System On	This heat exchanger will run as long as one of the vacuum blowers is running.
Special Outputs						
On Contact - Soil-Vapor Extraction		BL 200	Hand		Always On	This dry contact will be on if BL-200 is set to Manual ON via the touchscreen.
On Contact - Soil-Vapor Extraction		BL 300	Hand		Always On	This dry contact will be on if BL-300 is set to Manual ON via the touchscreen.
On Contact - Soil-Vapor Extraction		BL 400	Hand		Always On	This dry contact will be on if BL-400 is set to Manual ON via the touchscreen.
System on Contact - Control Panel		HX 600	Hand		Always On	This dry contact will be on if HX-600 is set to Manual ON via the touchscreen.
System Alarm Contacts - Control Panel		SYS	Alarm		Always On	This is a system alarm dry contact that can be used to stop another system or activate a separate auto dialer system. It will activate if any critical system shut down alarm, air treatment system alarm , water treatment system alarm, or cascading shut down alarm is activated.
System Alarm Light - Control Panel		LIGHT	LIGHT		Always On	This output will power an alarm light that will indicate that an alarm has activated. Any alarm will activate the alarm light.

INPUT	LOCATION		Input	Loc.	Alarm Display Method		ALARM TYPE	Alarm Control Logic
Pressure Transmitter High-High -	Soil-Vapor Extraction	ALARM	VAHH	202	/Dis		System Shutdown Alarm	If the transmitted vacuum exceeds the user-defined setpoint constantly for 5 seconds, this alarm will activate and shut the system down. The alarm can only be reset with the reset button. The alarm will also dial out using autodialer CHANNEL 2.
Pressure Transmitter High -	Soil-Vapor Extraction	ALARM	VAH	202	/Dis		System Shutdown Alarm	If the transmitted vacuum exceeds the user-defined setpoint constantly for 5 seconds, this alarm will activate and dial out using the autodialer CHANNEL 4. In the event that the alarm is not cleared within 24 hours, the system will shut down. The alarm can only be reset with the reset button (in the event that the alarm is not cleared within 24 hours).
Pressure Transmitter Low -	Soil-Vapor Extraction	ALARM	VAL	202	/Dis		System Shutdown Alarm	If the transmitted vacuum falls below the user-defined setpoint constantly for 5 seconds, this alarm will activate and shut the system down. The alarm can only be reset with the reset button. The alarm will also dial out using autodialer CHANNEL 2.
Pressure Transmitter High-High -	Soil-Vapor Extraction	ALARM	VAHH	302	/Dis		System Shutdown Alarm	If the transmitted vacuum exceeds the user-defined setpoint constantly for 5 seconds, this alarm will activate and shut the system down. The alarm can only be reset with the reset button. The alarm will also dial out using autodialer CHANNEL 2.
Pressure Transmitter High -	Soil-Vapor Extraction	ALARM	VAH	302	/Dis		System Shutdown Alarm	If the transmitted vacuum exceeds the user-defined setpoint constantly for 5 seconds, this alarm will activate and dial out using the autodialer CHANNEL 4. In the event that the alarm is not cleared within 24 hours, the system will shut down. The alarm can only be reset with the reset button (in the event that the alarm is not cleared within 24 hours).
Pressure Transmitter Low -	Soil-Vapor Extraction	ALARM	VAL	302	/Dis		System Shutdown Alarm	If the transmitted vacuum falls below the user-defined setpoint constantly for 5 seconds, this alarm will activate and shut the system down. The alarm can only be reset with the reset button. The alarm will also dial out using autodialer CHANNEL 2.
Pressure Transmitter High-High -	Soil-Vapor Extraction	ALARM	VAHH	402	/Dis		System Shutdown Alarm	If the transmitted vacuum exceeds the user-defined setpoint constantly for 5 seconds, this alarm will activate and shut the system down. The alarm can only be reset with the reset button. The alarm will also dial out using autodialer CHANNEL 2.
Pressure Transmitter High -	Soil-Vapor Extraction	ALARM	VAH	402	/Dis		System Shutdown Alarm	If the transmitted vacuum exceeds the user-defined setpoint constantly for 5 seconds, this alarm will activate and dial out using the autodialer CHANNEL 4. In the event that the alarm is not cleared within 24 hours, the system will shut down. The alarm can only be reset with the reset button (in the event that the alarm is not cleared within 24 hours).
Pressure Transmitter Low -	Soil-Vapor Extraction	ALARM	VAL	402	/Dis		System Shutdown Alarm	If the transmitted vacuum falls below the user-defined setpoint constantly for 5 seconds, this alarm will activate and shut the system down. The alarm can only be reset with the reset button. The alarm will also dial out using autodialer CHANNEL 2.
Pressure Transmitter High -	SVE Heat Exchanger	ALARM	PAH	601	/Dis		System Shutdown Alarm	If the transmitted pressure exceeds the user-defined setpoint constantly for 5 seconds, this alarm will activate and shut the system down. The alarm can only be reset with the reset button. The alarm will also dial out using autodialer CHANNEL 5.
Temperature Transmitter High -	SVE Heat Exchanger	ALARM	TAH	607	/Dis		System Shutdown Alarm	If the transmitted temperature exceeds the user-defined setpoint constantly for 5 seconds, this alarm will activate and shut the system down. The alarm can only be reset with the reset button. The alarm will also dial out using autodialer CHANNEL 6.
Temperature Transmitter High -	Building, Trailer or Skid	ALARM	TAH	702	/Dis		System Shutdown Alarm	If the transmitted temperature exceeds the user-defined setpoint constantly for 5 seconds, this alarm will activate and shut the system down. The alarm can only be reset with the reset button. The alarm will also dial out using autodialer CHANNEL 7.
Temperature Transmitter Low -	Building, Trailer or Skid	ALARM	TAL	702	/Dis		System Shutdown Alarm	If the transmitted temperature falls below the user-defined setpoint constantly for 5 seconds, this alarm will activate and shut the system down. The alarm can only be reset with the reset button.
Temperature Transmitter High -	Building, Trailer or Skid	ALARM	TAH	701	/Dis		System Shutdown Alarm	If the transmitted temperature exceeds the user-defined setpoint constantly for 5 seconds, this alarm will activate and shut the system down. The alarm can only be reset with the reset button. The alarm will also dial out using autodialer CHANNEL 7.
Temperature Transmitter Low -	Building, Trailer or Skid	ALARM	TAL	701	/Dis		System Shutdown Alarm	If the transmitted temperature falls below the user-defined setpoint constantly for 5 seconds, this alarm will activate and shut the system down. The alarm can only be reset with the reset button.

Output Description ANALOG OUTPUTS	LOCATION	P&ID DESCRIP. OUTPUT	LOC	Panel Label		ANALOG OUTPUT LOGIC
Analog Outputs from PLC						
Variable Frequency Drive - BL-200 -	Soil-Vapor Extraction	HS	200			This output controls the speed of the blower if the HOA switch is in "Auto".
Variable Frequency Drive - BL-300 -	Soil-Vapor Extraction	HS	300			This output controls the speed of the blower if the HOA switch is in "Auto".
Variable Frequency Drive - BL-400 -	Soil-Vapor Extraction	HS	400			This output controls the speed of the blower if the HOA switch is in "Auto".
Variable Frequency Drive - HX-600 -	SVE Heat Exchanger	HX	600			This output controls the speed of the blower if the HOA switch is in "Auto". The output is used to maintain air temperature after the heat exchanger based on the analog input TT-1301.





	DATE	NAME
DRAWN BY	SEPT28/07	PR
CKD BY	12/6/08	SP

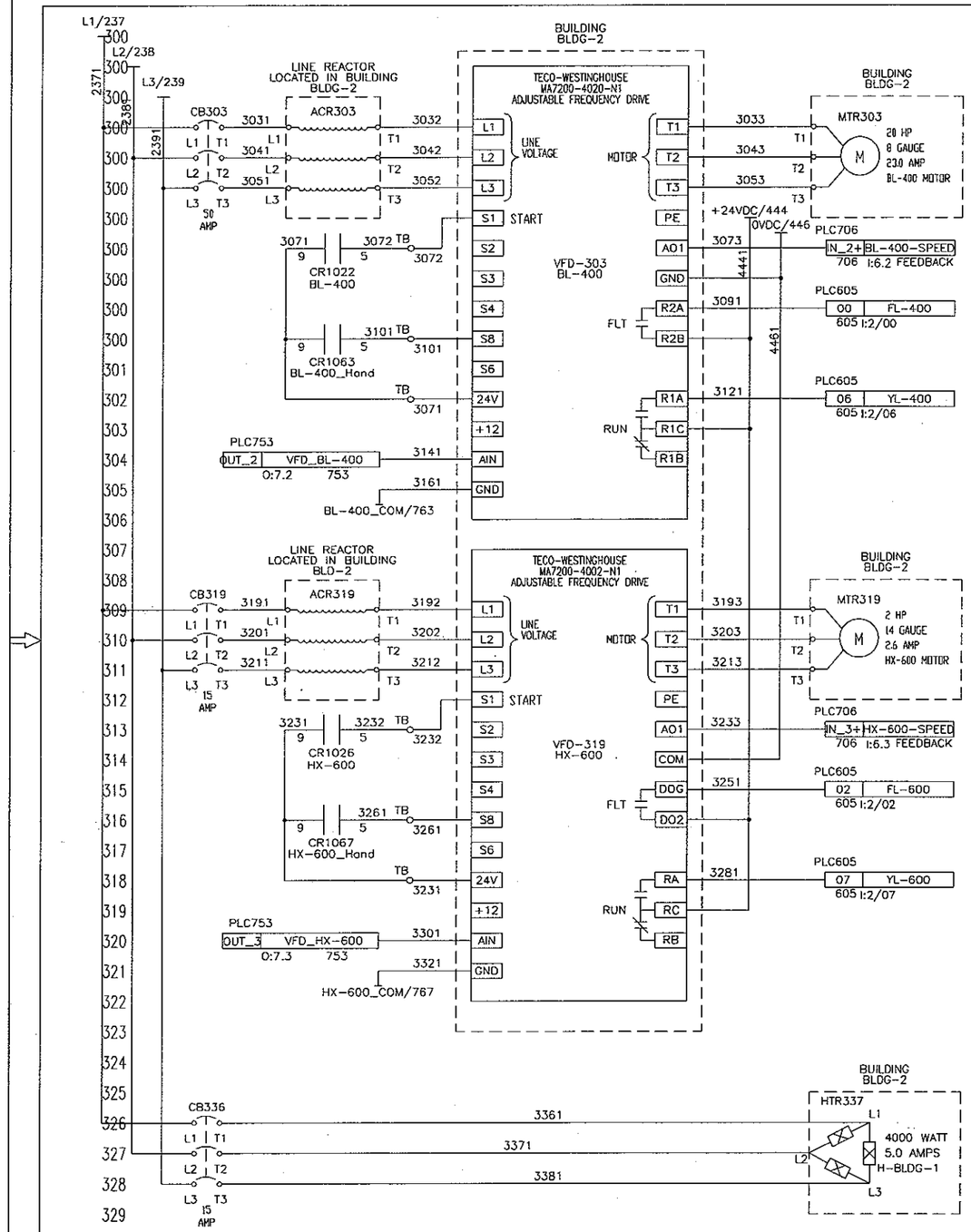
MLE EQUIPMENT INC.
1325 CALIFORNIA AVE.
ONTARIO, K6V 5Y6
CANADA

PROJECT: 50353-E NORTHROP GRUMMAN

DRAWING-NO:

JOB-NO: 50353

PAGE DESCRIPTION: POWER DIST.



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PROJECT: 50353-E NORTHROP GRUMMAN

DRAWING-NO:

JOB-NO: 50353

PAGE DESCRIPTION: FOR PRODUCTION

400 100AMP/208VOLT 3PH DIST. PANEL

L11/374
L12/375
L13/376
3751
3761

JB214 BLDG-1
TB 3711

NEUTRAL/371
3711

CB405 15 AMP — 4051 — TB 4051 — 4052 — LT405 — BUILDING LIGHTS BLDG-1 — 4 FT. FLOURESCENT BUILDING LIGHTS (X4)

CB410 15 AMP — 4101 — 4102 — LT410 — BUILDING LIGHTS BLDG-2 — 4 FT. FLOURESCENT BUILDING LIGHTS (X4)

CB415 15 AMP — 4151 — LT415 — 70W HPS EXTERIOR BUILDING LIGHTS (X4)

CB420 15 AMP — 4201 — LT420 — EXIT LIGHTS (X2)

CB423 15 AMP — 4231 — SW423 (3/4, H/A) — 4232 RED — TSH-BLDG-1 NO TS423 — YELLOW 4233 — MTR423 T1/T2 — 0.25 HP 14 GAUGE 4.5 AMP F-BLDG-1 MOTOR

CB425 20 AMP

CB427 15 AMP — 4271 — SW426 (3/4, H/A) — 4272 RED — TSH-BLDG-2 NO TS427 — YELLOW 4273 — MTR427 T1/T2 — 0.25 HP 14 GAUGE 4.5 AMP F-BLDG-2 MOTOR

CB429 20 AMP

CB431 20 AMP

CB433 20 AMP

CB435 20 AMP

CB437 20 AMP

20AMP SPARE BREAKERS

UPS432 — UPS — L1 — N
3711 — UPSL1 /442
3711 — UPSN /443

431 100AMP/208VOLT 3PH DIST. PANEL

L13/376
3761
CB444 15 AMP

PLUG FOR UPS — REC444 L1/L2

UPSL1/438
3711

PS444 24VDC POWER SUPPLY

(P 24VDC) FU444 1 AMP — L1/N/GND

+24V — 4431 — (S 24VDC) FU443 2 AMP — TB 4441 — 4441 +24VDC /248 /842 /306 /1201 /511 /1242 /745 /801

0VDC — TB 4461 — 4461 0VDC /249 /901 /307 /512 /600 /601 /701 /702 /746

UPSN/439
3711

(P-PLUG) FU452 5 AMP — 4521 — PLUG FOR AUTODIALER REC452 L1/L2

PLUG FOR TOUCHSCREEN/PC PLUG455 L1/L2

(ESTOP) FU457 5 AMP — 4571 — KILL-CRT_PNL KILL457 1/2 — TB 4581 — 4581 OUTPUT_PWR /641

(120V_AUX) FU460 5 AMP — TB 4611 — 4611 120V_AUX /657

(PLC) FU467 3 AMP — 4671 — PLC467 1747-P1 POWER SUPPLY
L1 85-264 VAC
L2
G
LG
24 VDC OUT +/-

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JOB-NO: 50353
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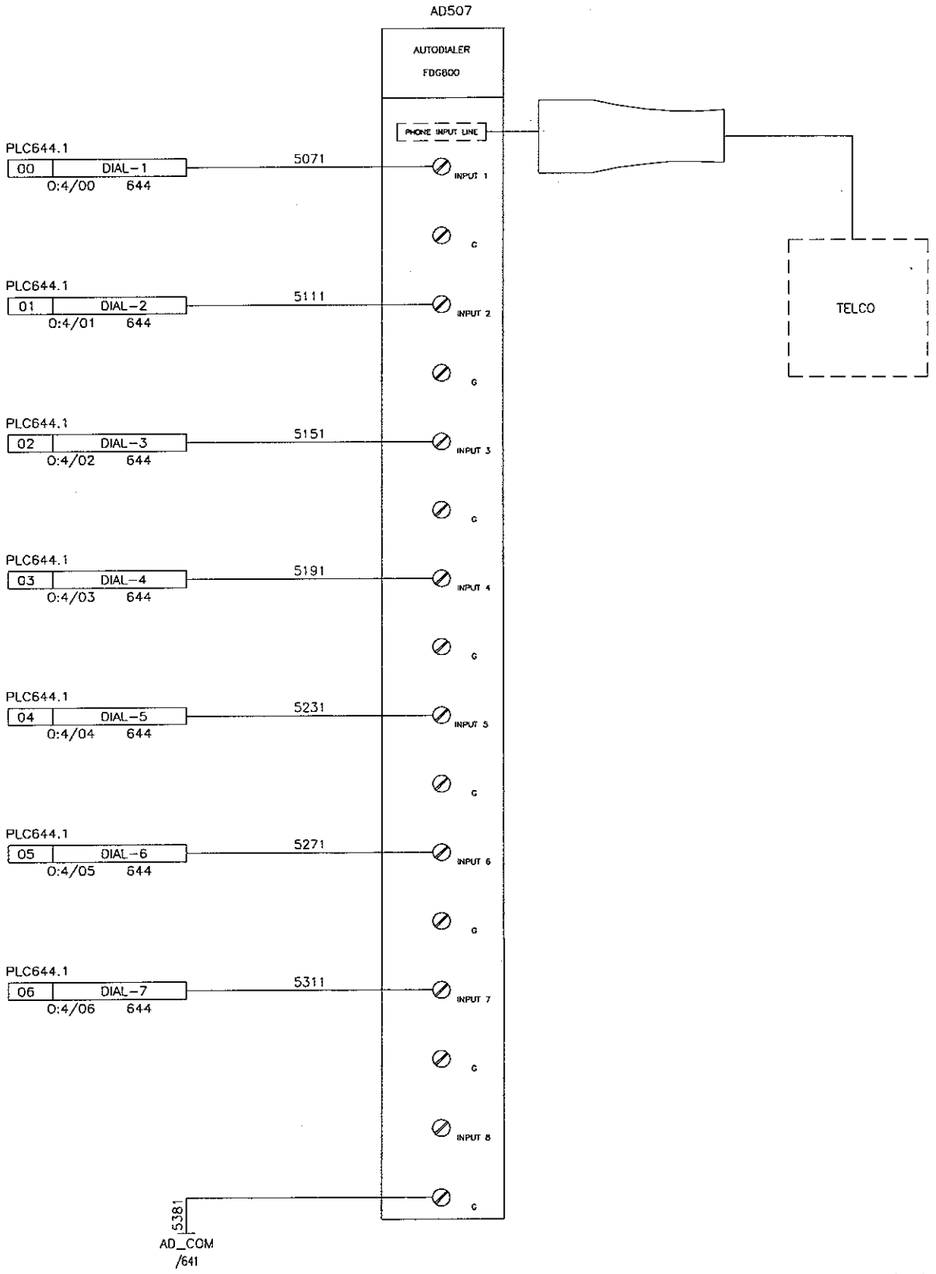

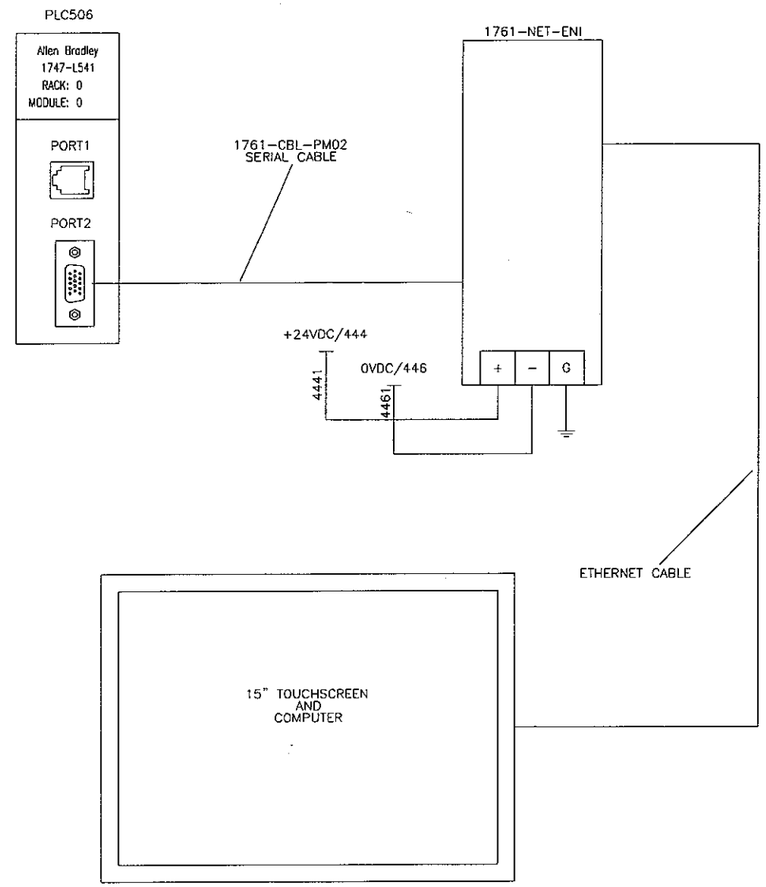

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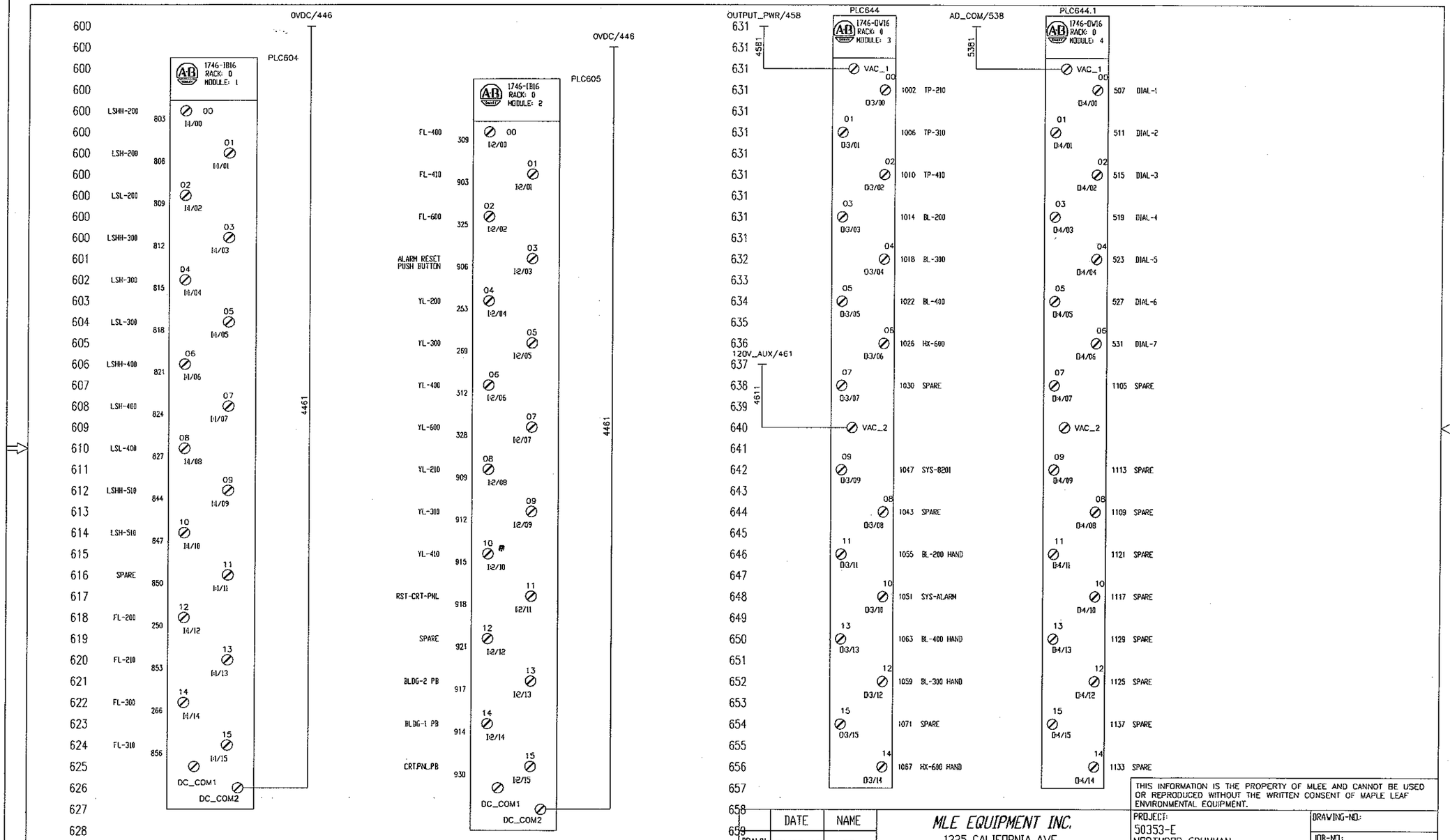
PROJECT: 50353-E NORTHROP GRUMMAN
DRAWING-NO.:
JOB-NO.: 50353
PAGE DESCRIPTION: FOR PRODUCTION
PAGE: 5 OF 18



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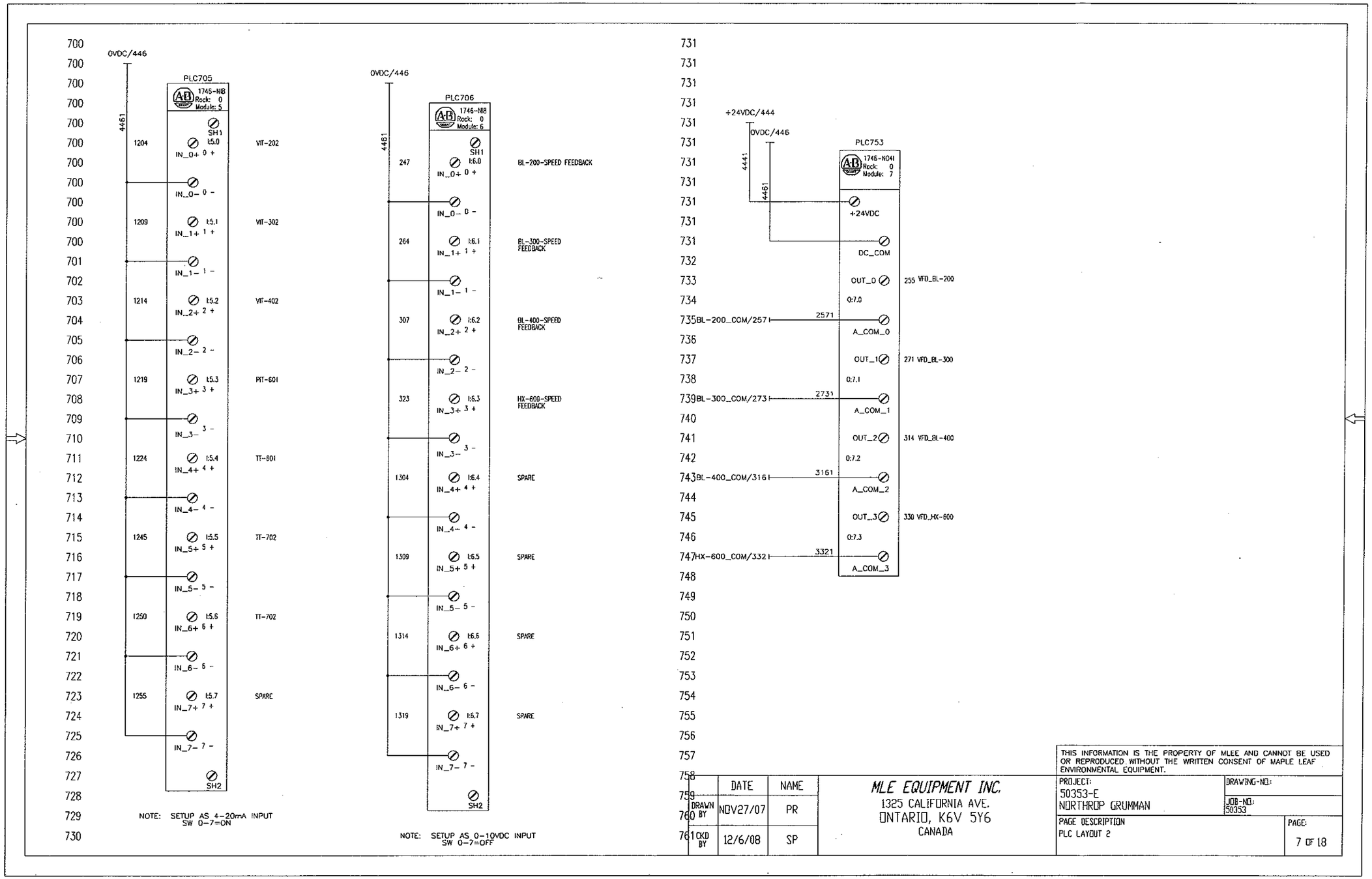
PROJECT: 50353-E NORTHROP GRUMMAN
DRAWING-NO.:
JOB-NO.: 50353
PAGE DESCRIPTION: PLC LAYOUT 1



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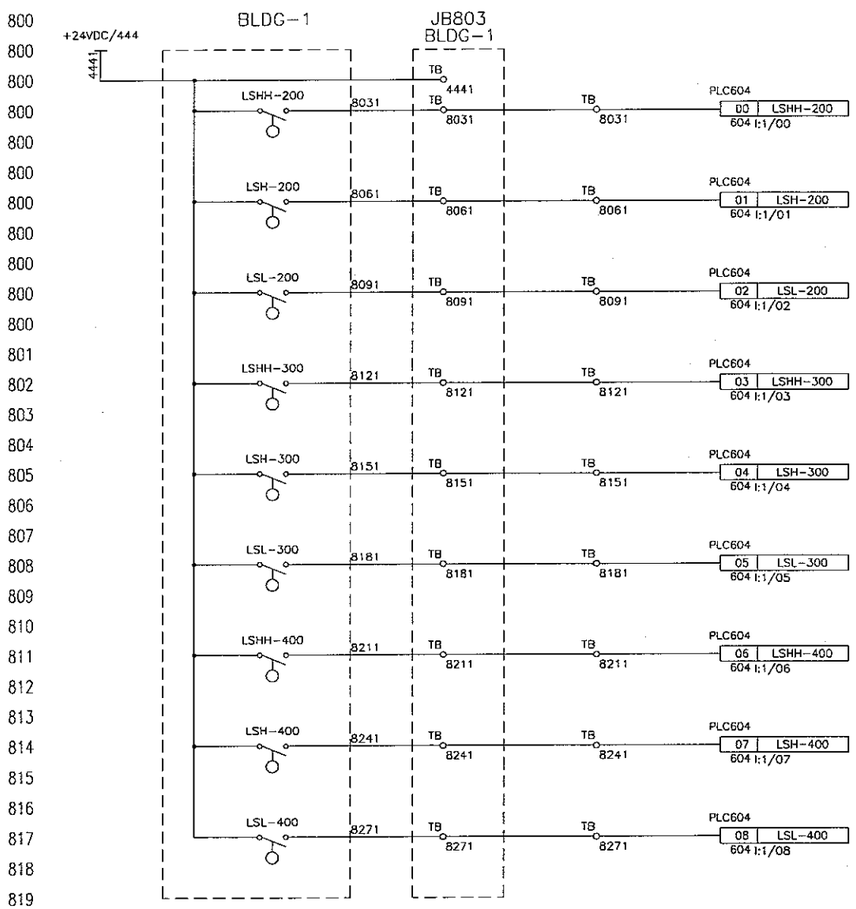
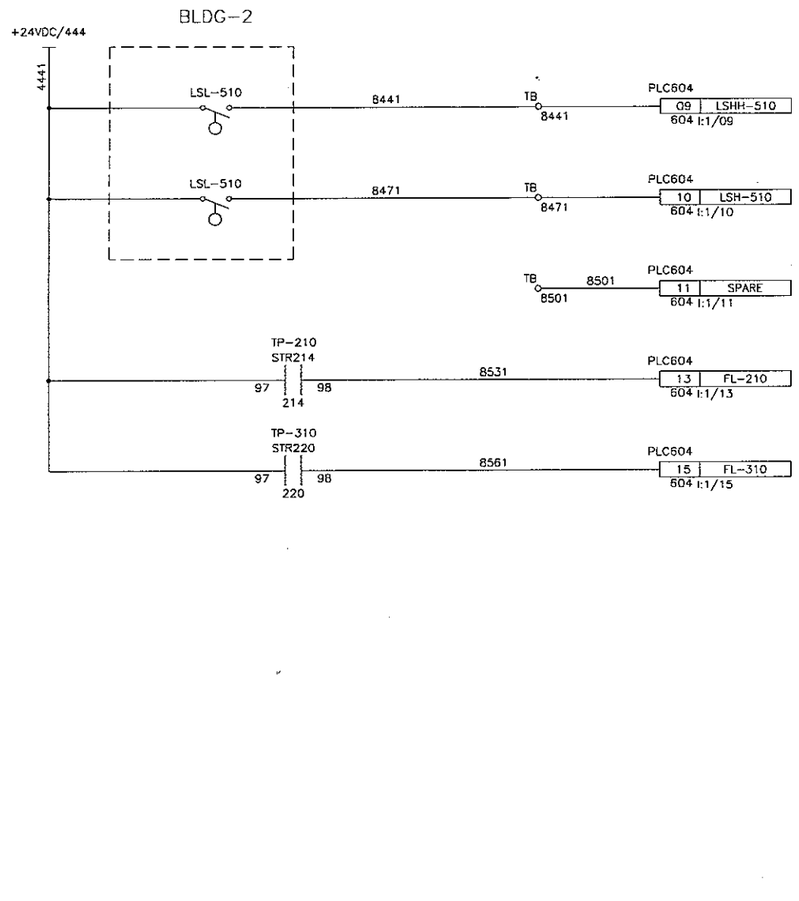
PROJECT: 50353-E NORTHROP GRUMMAN
DRAWING-NO.:
JOB-NO.: 50353
PAGE DESCRIPTION: PLC LAYOUT 2
PAGE: 7 OF 18





	DATE	NAME
DRAWN BY	NOV27/07	PR
CKD BY	12/6/08	SP

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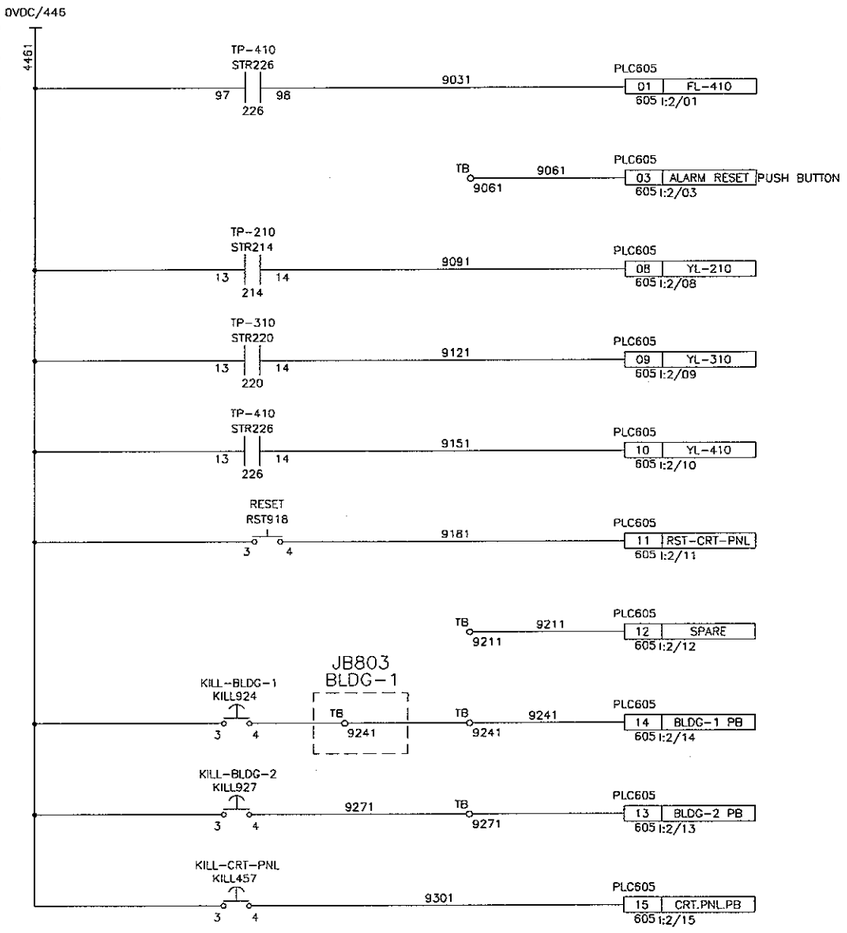
ONTARIO, K6V 5Y6
CANADA

PROJECT: 50353-E NORTHROP GRUMMAN
DRAWING-NO:
JOB-NO: 50353
PAGE DESCRIPTION: 24VDC INPUTS - SLOT 1
PAGE: 8 OF 18



	DATE	NAME
DRAWN BY	NOV27/07	PR
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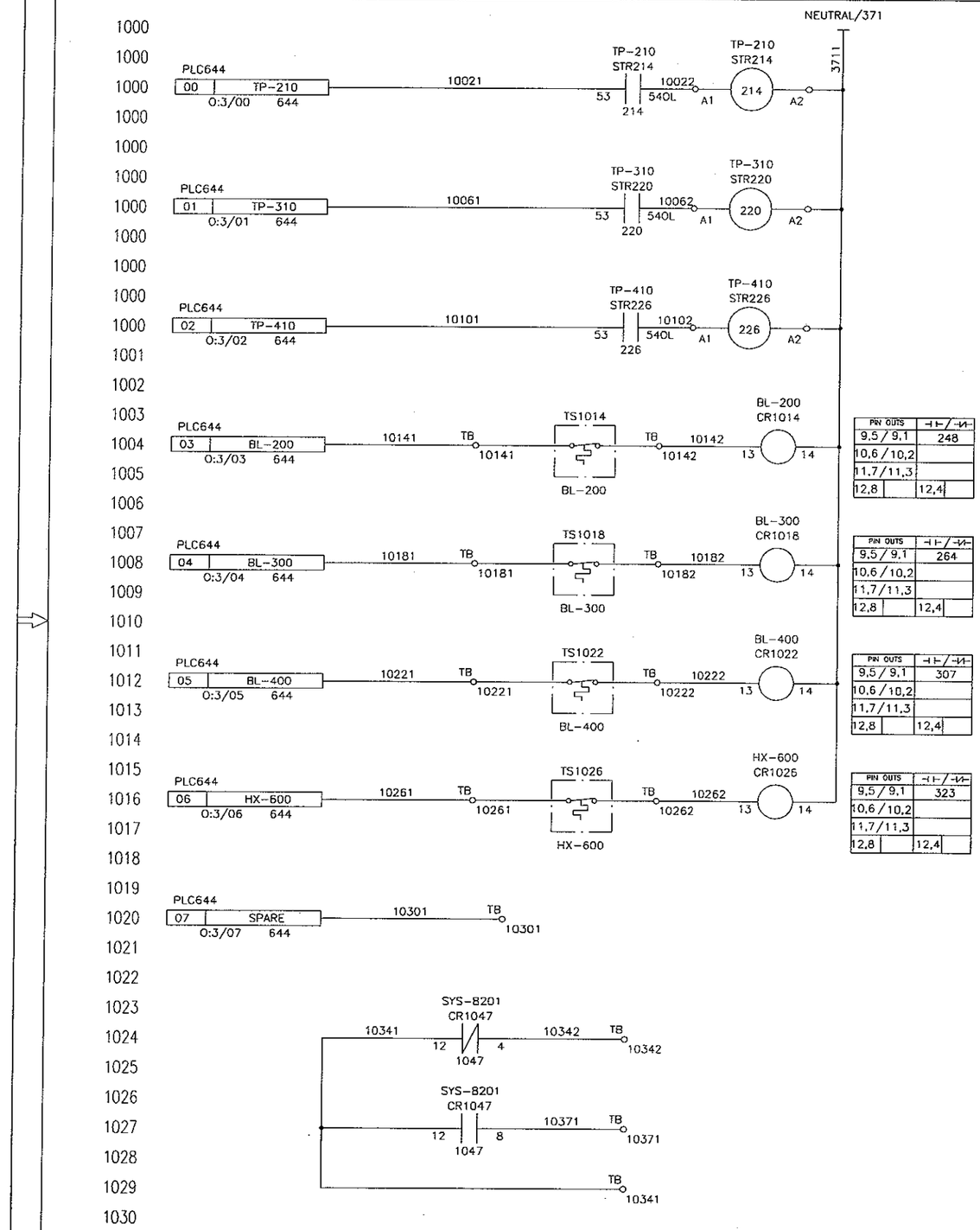
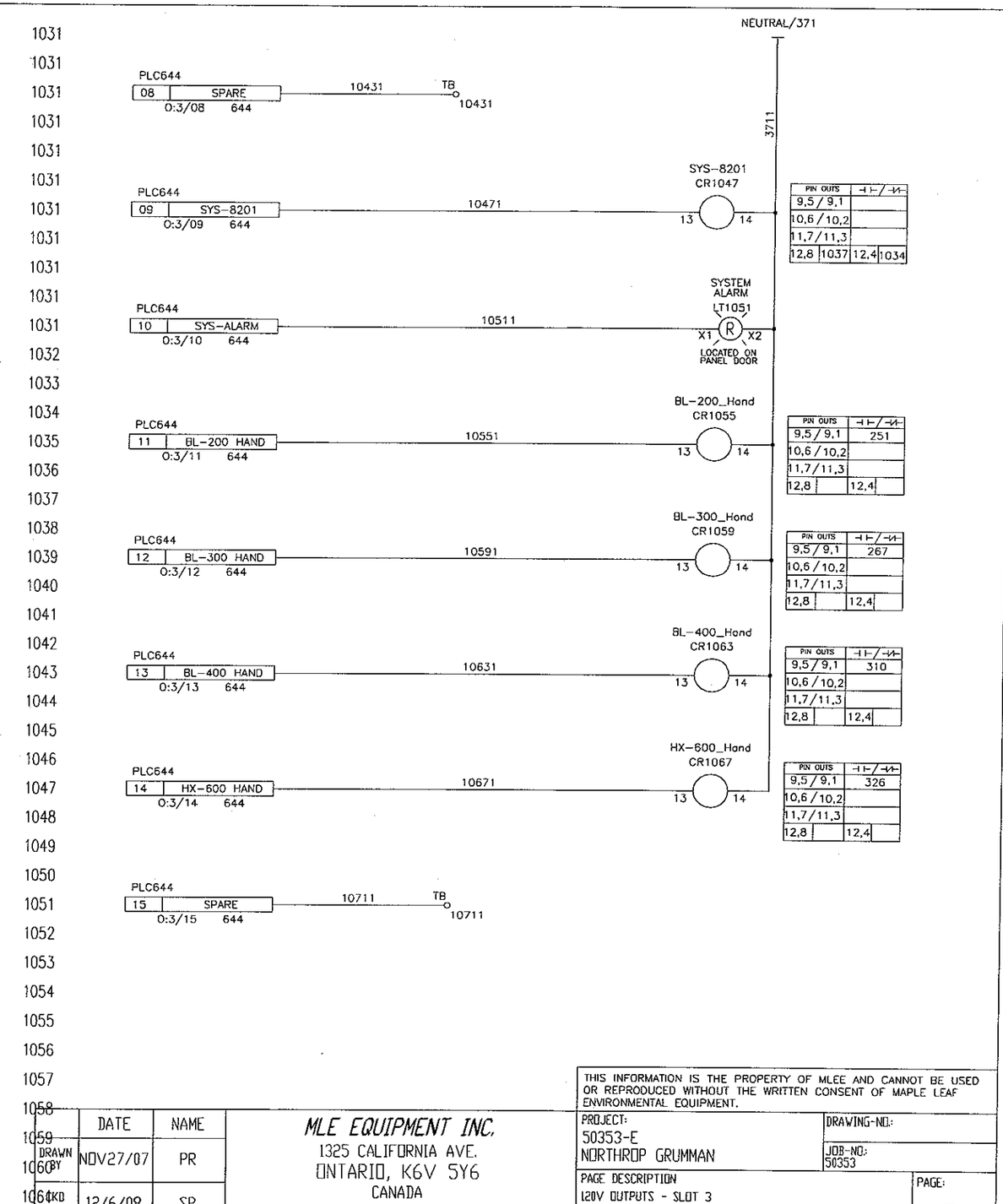
PROJECT: 50353-E NORTHROP GRUMMAN

DRAWING-NO:

JOB-NO: 50353

PAGE DESCRIPTION: 24VDC INPUTS - SLOT2





	DATE	NAME
DRAWN BY	NOV27/07	PR
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PROJECT: 50353-E NORTHROP GRUMMAN
DRAWING-NO:
JOB-NO: 50353
PAGE DESCRIPTION: 120V OUTPUTS - SLOT 3
PAGE: 10 OF 18

PLC644.1
07 SPARE 11051 TB 11051
0:4/07 644

PLC644.1
08 SPARE 11091 TB 11091
0:4/08 644

PLC644.1
09 SPARE 11131 TB 11131
0:4/09 644

PLC644.1
10 SPARE 11171 TB 11171
0:4/10 644

PLC644.1
11 SPARE 11211 TB 11211
0:4/11 644

PLC644.1
12 SPARE 11251 TB 11251
0:4/12 644

PLC644.1
13 SPARE 11291 TB 11291
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PLC644.1
14 SPARE 11331 TB 11331
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PLC644.1
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	DATE	NAME
DRAWN BY	NOV27/07	PR
CKD BY	12/6/08	SP

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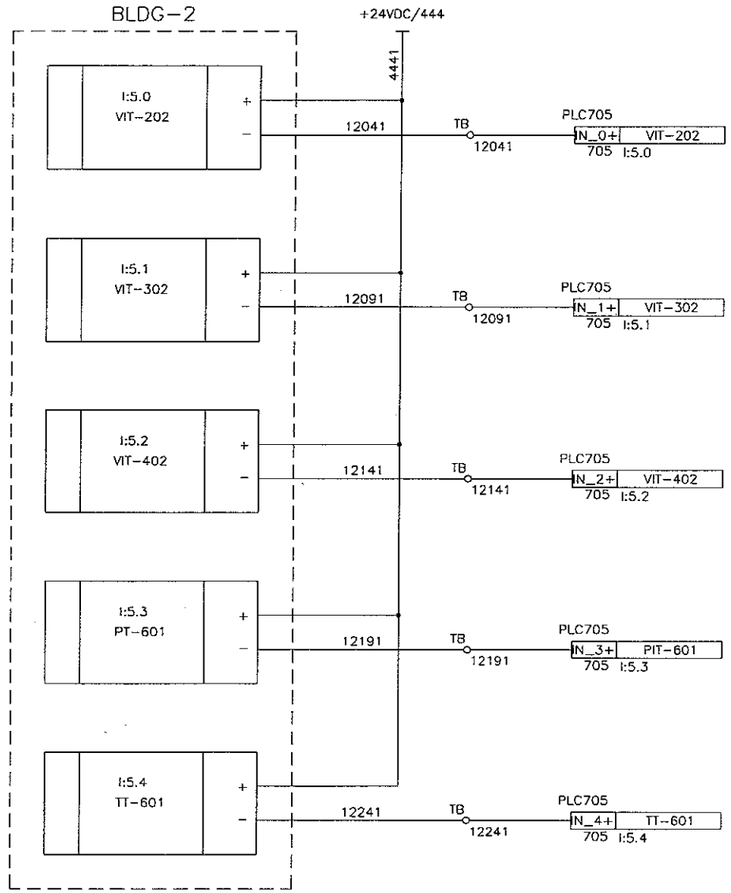
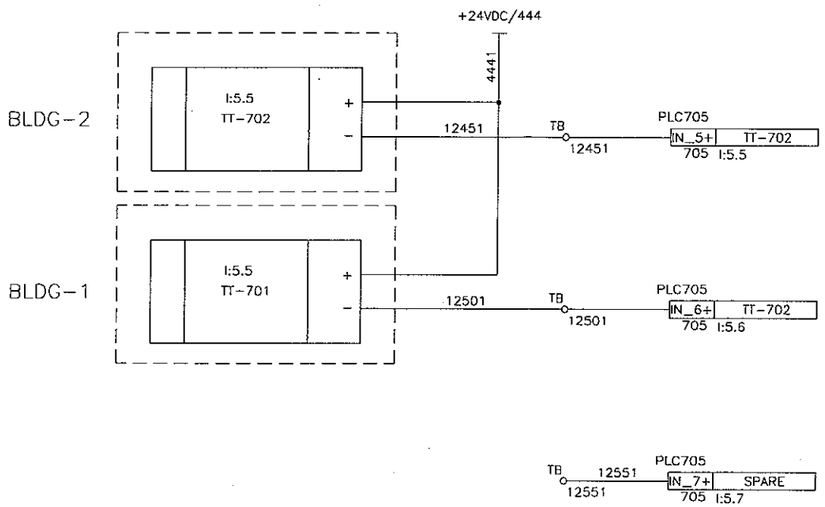
PROJECT: 50353-E NORTHROP GRUMMAN
DRAWING-NO:
JOB-NO: 50353
PAGE DESCRIPTION: 120V OUTPUTS - SLOT 4
PAGE: 11 OF 18





	DATE	NAME
DRAWN BY	NOV27/07	PR
CKD BY	12/6/08	SP

MLE EQUIPMENT INC.
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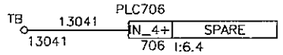
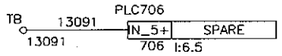
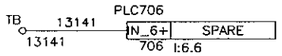
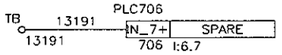
CANADA

PROJECT: 50353-E NORTHROP GRUMMAN
DRAWING-NO:
JOB-NO: 50353
PAGE DESCRIPTION: ANALOG INPUTS - SLOT 5









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PROJECT: 50353-E NORTHROP GRUMMAN
DRAWING-NO:
JOB-NO: 50353
PAGE DESCRIPTION: ANALOG INPUTS - SLOT 6
PAGE: 13 OF 18

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PROJECT: 50353-E NORTHROP GRUMMAN
DRAWING-NO.:
JOB-NO.: 50353
PAGE DESCRIPTION: SLOT 8 - SPARE

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CKD BY	12/6/08	SP

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PROJECT: 50353-E NORTHROP GRUMMAN
DRAWING-NO:
JOB-NO: 50353
PAGE DESCRIPTION: SLOT 9 - SPARE

TERMINAL PLAN

VFD CONTROL WIRING: 2481 2482 2511 2641 2642 2671 3071 3072 3101 3231 3232 3261

+24VDC: 4441 4441 4441 4441 4441

0VDC: 4461 4461 4461 4461 4461

DISCRETE INPUTS: 8031 8061 8091 8121 8151 8181 8211 8241 8271 8441 8471 8501 9061 9211 9241 9241 9271

ANALOG INPUTS: 12041 12091 12141 12191 12241 12451 12501 12551 13041 13091 13141 13191

OUTPUT_PWR: 4581 4581 4581 4581 4581

120V_AUX: 4611 4611 4611 4611 4611

NEUTRAL: 3711 3711 3711 3711 3711

120V OUTPUTS: 10301 10431 10711 11051 11091 11131 11171 11211 11251 11291 11331 11371

DRY CONTACT: 10341 10342 10371

10141 10142 10181 10182 10221 10222 10261 10262

TS1014 BL-200 TS1018 BL-300 TS1022 BL-400 TS1026 HX-600

JB214 LOCATED IN BLDG-1

2141 2151 2161 — TO HS-210

2201 2211 2221 — TO HS-310

2261 2271 2281 — TO HS-410

2311 2321 2331 — TO H-BLDG2

2361 2372 2382 — TO H-BLDG-3

JB803 LOCATED IN BLDG-1

4441 4441 4441 4441 4461 4461 4461 8031 8061 8091 8121 8151 8181 8211 8241 8271

JB368 LOCATED IN BLDG-1

3681 3712 3742 — TO BLDG-1 RECEPTACLES

4051 — TO BLD-7901 LIGHTS

3711 3711 3711 3711 — NEUTRAL

OUTSIDE PANEL

	DATE	NAME
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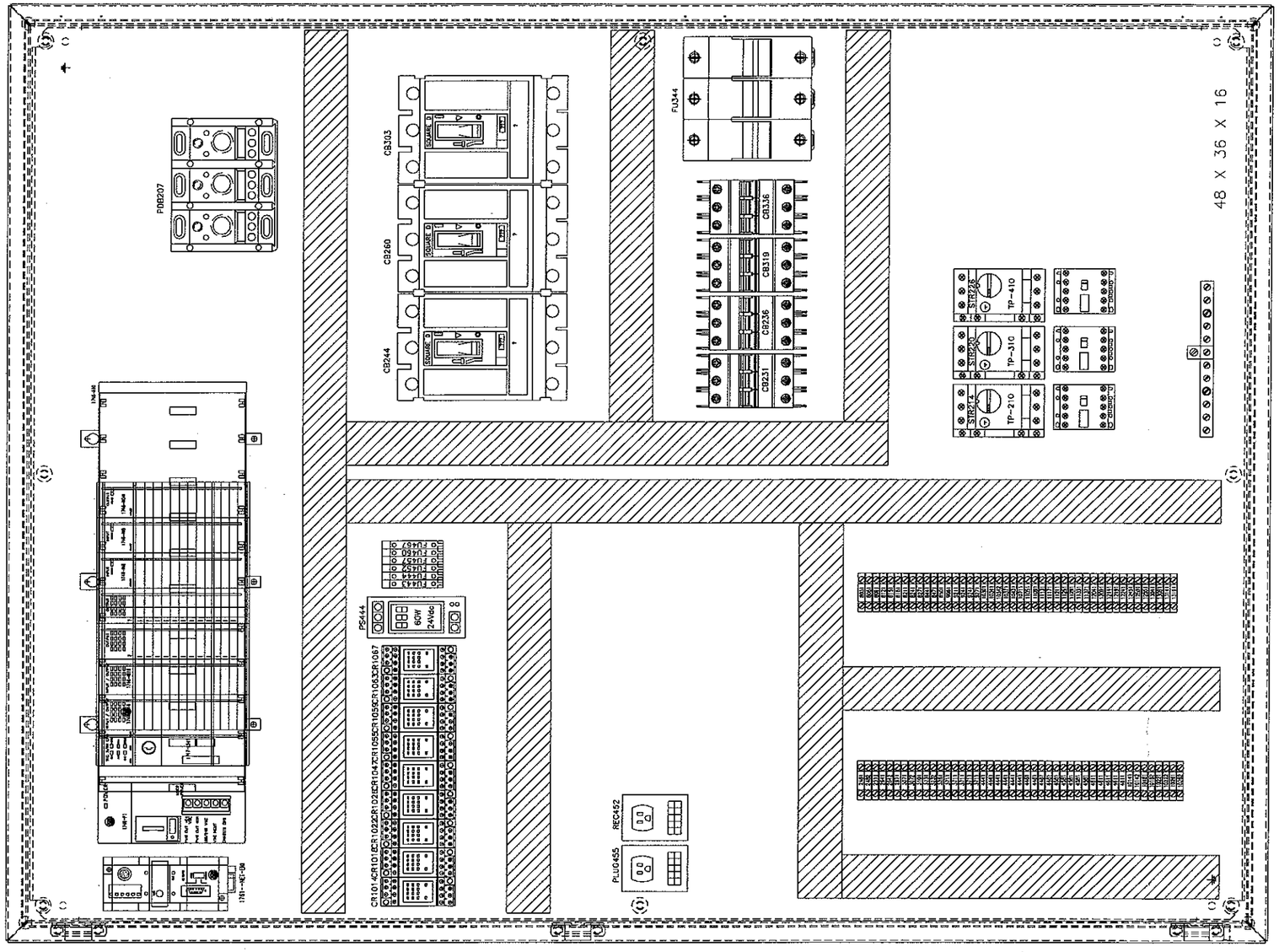
PROJECT: 50353-E NORTHROP GRUMMAN

DRAWING-NO:

JOB-NO: 50353

PAGE DESCRIPTION: TERMINAL LAYOUT



	DATE	NAME
DRAWN BY	NOV27/07	PR
CKD BY	12/6/08	SP

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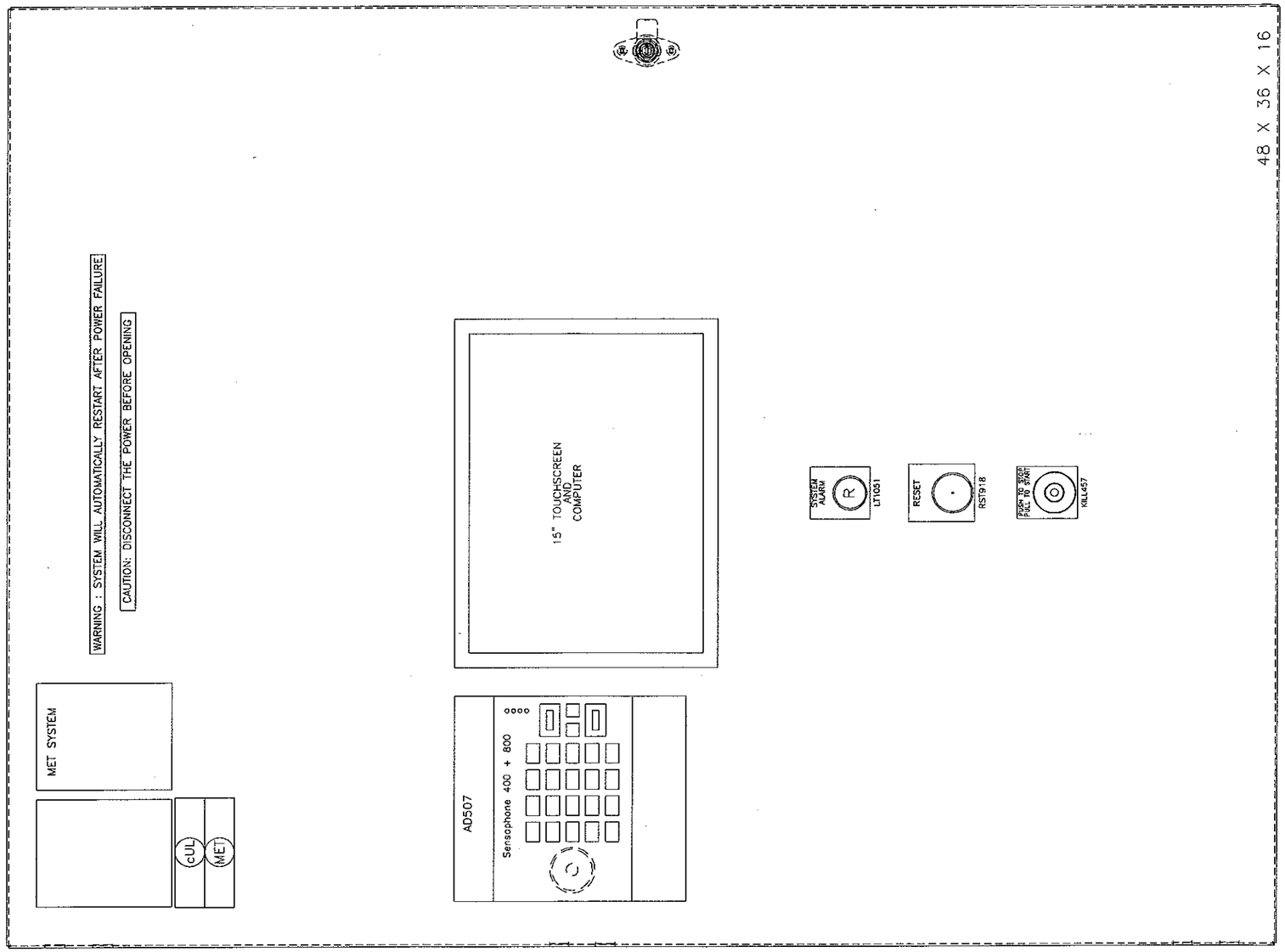
PROJECT: 50353-E NORTHROP GRUMMAN
DRAWING-NO.:
JOB-NO.: 50353
PAGE DESCRIPTION: PANEL INTERIOR LAYOUT
PAGE: 17 OF 18



NOTE 1: NEMA 4 LOCKABLE PANEL

NOTE 2: AUTODIALER, LIGHTS AND SWITCHES MOUNTED ON OUTER PANEL DOOR

	DATE	NAME
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CANADA

PROJECT: 50353-E NORTHROP GRUMMAN
DRAWING-NO.:
JOB-NO: 50353
PAGE DESCRIPTION: DOOR LAYOUT
PAGE: 18 OF 18

Maple Leaf Environmental Equipment Ltd, www.maple-leaf.ca

Project Name: Northrop Grumman
Customer Name: Arcadis
Proj: 50353

Control Module Component List

M: Manual is provided for this item
S: Spec sheet (with flow curve if relevant) is provided
D: Drawing is required for this part

DESCRIPTION:		MODEL:	MANUFACTURER:	MLEE #	QTY.	M	S	D	P&ID Desc	PO #
Main Disconnect Details										
Sys Voltage:										
Sys FL Amps:										
Min Disconnect:										
Disconnects										
200A, UL , 600V, 3PH, Nema 3R Fusible Disconnect		H364RB	Square D	10812	1					
Disconnect Fuses										
600V DISONNECT FUSE		TRS200R	GOULD	E1198	3					
		200A	(eg 150A)							
PLC Control System										
Digital Inputs	29									
Digital Outputs	7									
Analogue Inputs	11									
PLC Components										
1747-L541 SLC 37015 16K PROCESSOR			WESTBURNE		1	on CD				
1747-IB16 16PT IN SINK 24VDC			WESTBURNE		2	on CD	X			
1746-OW16 O/P-16 RELAY 10-250VAC			WESTBURNE		2	on CD				
1746-NI8 ANALOG INPUT 8POINT			WESTBURNE		2	on CD				
1746-NO4I ANALOG CURRENT OUTPUT 4-20mA			WESTBURNE		1	on CD				
1746-A10 10 SLOT RACK (MODULAR)			WESTBURNE		1	on CD				
1746-P1 RACK 120/240V AC POWER SUPPLY			WESTBURNE		1	on CD				
1746-N2 MOD CARD SLOT FILLER			WESTBURNE		4	on CD				
1761-NET-ENI ETHERNET INTERFACE			WESTBURNE		1	on CD				
1761-CBL-PM02 COMMUNICATION CABLE			WESTBURNE		1	on CD				
15" Touchscreen and Computer Combination		ARP-1715BP-RB103H-T	ARISTA		1	on CD				
Note: A copy of the PLC program for this project is included on the CD that is supplied with the manual.										
120V Fuse Holders (not Listed on Motor and Fuse Schedule)										
Mini Fuse Holder		199 095.13	Entrelec	10480	6					

Maple Leaf Environmental Equipment Ltd, www.maple-leaf.ca

Project Name: Northrop Grumman
Customer Name: Arcadis
Proj: 50353

Control Module Component List

M: Manual is provided for this item
S: Spec sheet (with flow curve if relevant) is provided
D: Drawing is required for this part

DESCRIPTION:		MODEL:	MANUFACTURER:	MLEE #	QTY.	M	S	D	P&ID Desc	PO #
Fuse Schedule	**CAUTION: REPLACE WITH SAME SIZE AND TYPE**									
Name		**Part Number**	**Manufacturer**		**Qty**	**Amps**				
Main Disconnect		TRS200R	Gould	E1198	3	200A				
	BRANCH CIRCUIT PROTECTION FUSES AND BREAKERS									
STR214	TP-210	GV2P07	Square D		1	1.6-2.5				
STR220	TP-310	GV2P07	Square D		1	1.6-2.5				
STR226	TP-410	GV2P07	Square D		1	1.6-2.5				
CB244	BL-200	FAL34070	Square D		1	70				
CB260	BL-300	FAL34050	Square D		1	50				
CB303	BL-400	FAL34050	Square D		1	50				
CB319	HX-600	JTEC4893C15	FT		1	0				
	POWER DISTRIBUTION OF POWERED DEVICES									
CB355	TB- 2	QOB240	SQD		1	40				
CB359	20-Amp GFI Plug 1	QOB120	SQD		1	20				
CB362	20-Amp GFI Plug 2	QOB120	SQD		1	20				
CB365	20-Amp GFI Plug 3	QOB120	SQD		1	20				
CB368	20-Amp GFI Plug 4	QOB120	SQD		1	20				
CB371	20-Amp GFI Plug 5	QOB120	SQD		1	20				
CB374	20-Amp GFI Plug 6	QOB120	SQD		1	20				
CB405	BUILDING #1 INTERIOR LIGHTS	QOB115	SQD		1	15				
CB410	BUILDING #2 INTERIOR LIGHTS	QOB115	SQD		1	15				
CB415	BUILDING EXTERIOR LIGHTS	QOB115	SQD		1	15				
CB336	BUILDING #2 HEATER	JTEC4893C15	FT		1	15				
CB231	BUILDING #1 HEATER	JTEC4893C15	FT		1	15				
CB236	BUILDING #1 HEATER	JTEC4893C15	FT		1	15				
CB420	BUILDING EXIT SIGNS	QOB115	SQD		1	15				
CB444	120V Control Power	QOB115	SQD		1	15				
CB423	SPARE	QOB120	SQD		1	20				
CB425	SPARE	QOB120	SQD		1	20				
CB427	SPARE	QOB120	SQD		1	20				
CB429	SPARE	QOB120	SQD		1	20				
CB431	SPARE	QOB120	SQD		1	20				
CB433	SPARE	QOB120	SQD		1	20				
CB435	SPARE	QOB120	SQD		1	20				
CB437	SPARE	QOB120	SQD		1	20				
	LARGE TRANSFORMER FUSES									
FU344	PRI TRANS	Gould	AJT50		3	50				
	SMALL GLASS CONTROL FUSES									
P 24V DC		GDL1	Gould		1	1				
S 24V DC		GDL2	Gould		1	2				
PLC		GGC1	Gould		1	1				
ESTOP		GDL5	Gould		1	5				
P-PLUG		GDL2	Gould		1	2				
120V AUX		GDL5	Gould		1	5				
24VDC Power Transformer										

Maple Leaf Environmental Equipment Ltd, www.maple-leaf.ca

Project Name: Northrop Grumman

Customer Name: Arcadis

Proj: 50353

Control Module Component List

M: Manual is provided for this item
S: Spec sheet (with flow curve if relevant) is provided
D: Drawing is required for this part

DESCRIPTION:	MODEL:	MANUFACTURER:	MLEE #	QTY.	M	S	D	P&ID Desc	PO #
Description	Part Number	Manufacturer		Qty	M	S	D	P&ID Desc	PO Number
24V DC Transformer 60W covered 2.5A	S8VS-06024 60w	Omron		1					
EMERGENCY STOP BUTTON FOR PLC PANEL									
Collar with NO & NC Contact Blocks	ZB5AZ105	Telemechanique		1					
HEAD	ZB5AT4	SQD		1					
RESET BUTTON FOR PLC PANEL									
Momentary Black Button	ZB5 AA2	Telemechanique	M1447	1					
Collar with NO Contact Blocks	ZB5 AZ101	Telemechanique	14612	1					
STANDARD PANEL LIGHTS									
120V Light, Red	ZB5 AV04	Telemechanique	14604	1					
Light Base	ZB5 AV6	Telemechanique	14600	1					
Light Bulbs	967	Haskellite	E1050	1					
Relays and Timers									
Relay, 4 pole, DT, 120VAC coil	MY4 120AC	Omron	E1053	5		x			
Relay Base, 4 Pole, DT, Din-Rail Mounted	PYF14A-E	Omron	E1054	5					Daltco
CONTROL PANEL									
CONTROL PANEL	CSD483616	HOFFMAN		1					
BACK PANEL	CP4836	HOFFMAN		1					
REACTORS									
20 HP 460V Line Reactor	RL-03512	TECO		2					
30 HP 460V Line Reactor	RL-04512	TECO		1					
2 HP 460V Line Reactor	RL-00412	TECO		1					
FILTERS FOR VARIABLE FREQUENCY DRIVE PANELS									
10"x10" outlet filter	3325207	RITTEL		1					

Control Panel

Module Code: 8200

Fuse Holder,Entrelec, 199 095.13 USE PART NUMBER 19077	Part: Qty: Mfg: Mfg Part:	10480 6 ENT 199 095.13
Breaker, SQD PK18GTA, ground bar kit	Part: Qty: Mfg: Mfg Part:	10586 1 SQD PK18GTA
Disconnect,3ph, H364RB 200A,UL,600V,Nema 3R, fusible disconnect Heavy Duty	Part: Qty: Mfg: Mfg Part:	10812 1 SQD H364RB
Contactor,SQD LC1K0610G7	Part: Qty: Mfg: Mfg Part:	12618 3 SQD LC1K0610G
Breaker, SQD FAL34050	Part: Qty: Mfg: Mfg Part:	13264 2 SQD FAL34050
Breaker, SQD FAL34070	Part: Qty: Mfg: Mfg Part:	14320 1 SQD FAL34070
PLC, 1761-NET-ENI, ENET Interface	Part: Qty: Mfg: Mfg Part:	14484 1 1761-NET-ENI
PLC, 1761-CBL-PM02, A.B Comm Cable Cable PLC Chan 0 8PIN to PC 9PIN	Part: Qty: Mfg: Mfg Part:	14485 1 1761-CBL-PM02
PLC, 1746-OW16 1746-OW16 O/P -16 Relay 10-250V A	Part: Qty: Mfg: Mfg Part:	14542 1 ALB1746OW16
PLC, 1746-NI8 Themocouple Input 1746-NI8	Part: Qty: Mfg: Mfg Part:	14543 1 ALB 1746-NI8
PLC, 1746-NI8 Themocouple Input 1746-NI8	Part: Qty: Mfg: Mfg Part:	14543 1 ALB 1746-NI8
Button, ZB5 AT4 E-Stop Button	Part: Qty: Mfg: Mfg Part:	14607 1 Square D SQD ZB5 AT4

Button, ZB5 AZ105 Collar with 1-N/0 and 1-N/C Contact Block	Part: Qty: Mfg: Mfg Part:	14609 1 Square D SQD ZB5 AZ105
Button, ZB5 AZ101 Collar with N/O Contact Body	Part: Qty: Mfg: Mfg Part:	14612 1 Square D SQD ZB5 AZ101
PLC, 1746-N2 Slot Cover	Part: Qty: Mfg: Mfg Part:	14622 4 1746-N2
PLC, 1746-NO4I 4 Output (2-20Ma)	Part: Qty: Mfg: Mfg Part:	14625 1 1746-N04I
Fuse,GLD AJT200 Class J Time Delay	Part: Qty: Mfg: Mfg Part:	14644 3 GLD AJT200
Power supply, S8VS-06024 60W 24VDC	Part: Qty: Mfg: Mfg Part:	15858 1 OMR S8VS-06024
Fuse,GLD 8590 safety cover	Part: Qty: Mfg: Mfg Part:	16186 3 GDL 8590
Combination Starter, SQT GK2AF01 Starter Mounting Plate	Part: Qty: Mfg: Mfg Part:	17155 3 GK2AF01
Combination Starter, SQT GV2GH7 Incoming Line Insulator	Part: Qty: Mfg: Mfg Part:	17160 3 GV2GH7
Combination Starter, SQT GVAD1010 Contact: auxillary no (fault) + nc aux Square D	Part: Qty: Mfg: Mfg Part:	17162 3 GVAD1010
Combination Starter, SQT GV2P07 Manual Starter: STR227 F-2501 (1.6-2.5)	Part: Qty: Mfg: Mfg Part:	17267 3 GV2P07
Breaker, Techna JTEC4892C15 2P Branch Rated MCB - C Trip Curve	Part: Qty: Mfg: Mfg Part:	17397 1 JTEC4892C15
Breaker, Techna JTEC4892C15 2P Branch Rated MCB - C Trip Curve	Part: Qty: Mfg: Mfg Part:	17397 1 JTEC4892C15

Breaker, Techna JTEC4893C15 15 AMP, 3 P, 2P Branch Rated MCB - C Trip Curve CB245 H-7901	Part: Qty: Mfg: Mfg Part:	17542 4 JTEC4893C15
Breaker, Techna JTEC4892C30 30 amp CB 254 Pri trans	Part: Qty: Mfg: Mfg Part:	17543 2 JTEC4892C30
Breaker, Techna JTEC4893C40 40 AMP 3P C Trip Cuve	Part: Qty: Mfg: Mfg Part:	17717 1 JTEC4893C40
Breaker, Techna JTEC4891C15 15A, 1P C Trip Curve	Part: Qty: Mfg: Mfg Part:	18359 1 JTEC4891C15
Breaker, Techna JTEC4891C15 15A, 1P C Trip Curve	Part: Qty: Mfg: Mfg Part:	18359 3 JTEC4891C15
Panel, Backplate, Hoff, CP4836 For 48"x36" 46.2"x34.2"	Part: Qty: Mfg: Mfg Part:	18478 1 CP4836
Panel, Hoff, Nema4, CSD483616 48"x36"x16"	Part: Qty: Mfg: Mfg Part:	18495 1 CSD483616
Button, XB7EV04GP RED LED PILOT LIGHT 120VAC	Part: Qty: Mfg: Mfg Part:	18626 1 XB7EV04GP
Breaker, SQD Q0B115 15A 1 P Bolt-On	Part: Qty: Mfg: Mfg Part:	19029 7 Square D Q0B115
Misc Part As per specification below 1747-L541 SLC 37015 16K PROCESSOR	Part: Qty: Mfg: Mfg Part:	9999 1 0
Misc Part As per specification below 1747-IB16 16PT IN SINK 24VDC	Part: Qty: Mfg: Mfg Part:	9999 2 0
Misc Part As per specification below ALB1747M13 1747-M13 Flash Memory Module 16K	Part: Qty: Mfg: Mfg Part:	9999 1 0

Misc Part	Part:	9999
As per specification below	Qty:	1
	Mfg:	
1746-P1 RACK 120/240V AC POWER SUPPLY	Mfg Part:	0

Misc Part	Part:	9999
As per specification below	Qty:	1
	Mfg:	
Panel PC ARP-1715BP-RB103H-T 15" Panel PC 15" Panel PC 15" LCD Display (1024 x 768) 4 x free Serial port, 1 x Parallel Port, 4 x USB 2.0, 1 x PCI slot AC Power Supply Standard Configuration: Bezel Standard Powder Coated Aluminum Bezel 1 Touch 15" ELO Resistive Touch 1 CPU P4 2.8 GHz 533 FSB w / Heatsink + Fan 1 RAM 512MB DDR-333 DIMM 1 HDD 40GB 2.5" IDE HDD 1 FDD SLIM 1.44MB FDD 1 CD-ROM TEAC SLIM CD-RW / DVD DRIVE 1 OS Windows XP Professional 1 PS AC Input Power Supply 1	Mfg Part:	0

Misc Part	Part:	9999
As per specification below	Qty:	1
	Mfg:	
1746-A10 10 SLOT RACK (MODULAR)	Mfg Part:	0

Misc Part	Part:	9999
As per specification below	Qty:	1
	Mfg:	
10"x10" Outlet Filter XPV32	Mfg Part:	0

Misc Part	Part:	9999
As per specification below	Qty:	1
	Mfg:	
69083 High AMP Large 6 hole 380A	Mfg Part:	0

Misc Part	Part:	9999
As per specification below	Qty:	14
	Mfg:	
QOB120 Breaker	Mfg Part:	0

Misc Part	Part:	9999
As per specification below	Qty:	1
	Mfg:	
1746-OW16 O/P -16 Relay 10-250V A	Mfg Part:	0

Misc Part	Part:	9999
As per specification below	Qty:	1
	Mfg:	
Transformer NMK030KB	Mfg Part:	0

Misc Part	Part:	9999
As per specification below	Qty:	1
	Mfg:	
Breaker QOB240	Mfg Part:	0

Misc Part As per specification below TVS4EMa12A	Part: Qty: Mfg: Mfg Part:	9999 1 0
Misc Part As per specification below MSC29 Cover	Part: Qty: Mfg: Mfg Part:	9999 1 0
Misc Part As per specification below Breaker Panel NQoD430M100	Part: Qty: Mfg: Mfg Part:	9999 1 0
Misc Part As per specification below Tub for Breaker Panel MH29	Part: Qty: Mfg: Mfg Part:	9999 1 0
Relay, MY4 AC110/120 Omron,120V,4 pole DT,	Part: Qty: Mfg: Mfg Part:	E1053 5 OMR MY4-AC110/
Relay, PYF14A-E (ALSO USE P/N 19145) Omron,Base,4 pole DIN,	Part: Qty: Mfg: Mfg Part:	E1054 5 OMR PYF14A-E
Fuse,GLD US6J3 3P 60A Ultrasafe Fuseholder	Part: Qty: Mfg: Mfg Part:	E1143 1 GLD US6J3
Fuse,GLD AJT50 Class J Time Delay	Part: Qty: Mfg: Mfg Part:	E1161 3 GLD AJT50
Fuse,GLD GDL1 Miniature Fuse 1A, 1/4"x1-1/4" time delay	Part: Qty: Mfg: Mfg Part:	E1185 1 GLD GDL1
Fuse,GLD GDL2 Miniature Fuse 2A,1/4"x1-1/4" time delay	Part: Qty: Mfg: Mfg Part:	E1186 2 GLD GDL2
Fuse,GLD GDL5 Miniature Fuse 5A, 1/4"x1-1/4" time delay	Part: Qty: Mfg: Mfg Part:	E1188 2 GLD GDL5
Fuse,GLD GGC1 Miniature Fuse 1A	Part: Qty: Mfg: Mfg Part:	E1190 1 GLD GGC1

Fuse,GLD TRS200R 600V Class R Fuse	Part: Qty: Mfg: Mfg Part:	E1199 3 GLD TRS200R
Button, ZB5 AA2 Push Button Flush Head Black	Part: Qty: Mfg: Mfg Part:	M1447 1 SQD ZB5 AA2

8200

Variable Frequency Drive, MA7200-4002-N1 TECO 460V 2HP 4 Drive Amps ---	Part: Qty: Mfg: Mfg Part:	17775 1 MA7200-4002-N1
Variable Frequency Drive, MA7200-4020-N1 TECO 460V 20HP 32 Drive Amps ---	Part: Qty: Mfg: Mfg Part:	17781 2 MA7200-4020-N1
Variable Frequency Drive, MA7200-4030-N1 TECO 460V 30HP 48 Drive Amps ---	Part: Qty: Mfg: Mfg Part:	17783 1 MA7200-4030-N1
Line Reactor, RL-00412 460V, 2HP, 3% Impedance NEMA 1 Enclosure ---	Part: Qty: Mfg: Mfg Part:	19050 1 TECO Westinghouse
Line Reactor, RL-03512 460V, 20HP, 3% Impedance NEMA 1 Enclosure ---	Part: Qty: Mfg: Mfg Part:	19051 2 TECO Westinghouse
Line Reactor, RL-04512 460V, 30HP, 3% Impedance NEMA 1 Enclosure ---	Part: Qty: Mfg: Mfg Part:	19052 1 TECO Westinghouse

Table 1. December 2008 Schedule of Flow meters on Treatment System, Operable Unit 3 Soil Gas Interim Remedial Measure, Former Grumman Settling Ponds, Bethpage, New York.

Well ID	Manifold Flow Meter ID	Gauge Range (SCFM)	King Instruments Series and Order Number	MSC Part Number
DW-7D	FI-101	6 - 60	7510 6A-04	86485596
DW-3D	FI-102	4 - 40	7510 6A-02	86485588
DW-5D	FI-103	4 - 40	7510 6A-02	86485588
DW-6D	FI-104	2 - 20	7510 7A-06	86485646
DW-1D	FI-105	0.8 - 8	7510 7A-02	86485638
DW-4D	FI-106	4 - 40	7510 6A-02	86485588
DW-2D	FI-107	6 -60	7510 6A-04	86485596
DW-11S	FI-108	16 - 160	7205 0221	86487162
DW-10S	FI-109	16 - 160	7205 0221	86487162
DW-2S	FI-110	6 - 60	7510 6A-04	86485596
DW-9S	FI-111	16 - 160	7205 0221	86487162
DW-8S	FI-112	16 - 160	7205 0221	86487162
DW-4S	FI-113	6 - 60	7510 6A-04	86485596
DW-1S	FI-114	25 - 250	7205 0231	86487170
DW-6S	FI-115	16 - 160	7205 0221	86487162
DW-5S	FI-116	16 - 160	7205 0221	86487162
DW-3S	FI-117	4 - 40	7510 6A-02	86485588
DW-7S	FI-118	16 - 160	7205 0221	86487162

Table 2. December 2008 Schedule of Gauges on Influent Manifold of Treatment System, Operable Unit 3 Soil Gas Interim Remedial Measure, Former Grumman Settling Pinds, Bethpage, New York.

Associated Well ID	Location ID	Proposed Gauge Range (iwc)	Mounting Type
DW-7D	FI-119	-10-0	1/4" Bottommount
DW-3D	FI-120	-30-0	1/4" Bottommount
DW-5D	FI-121	-30-0	1/4" Bottommount
DW-6D	FI-122	-10-0	1/4" Bottommount
DW-1D	FI-123	-10-0	1/4" Bottommount
DW-4D	FI-124	-10-0	1/4" Bottommount
DW-2D	FI-125	-16-0	1/4" Bottommount
DW-11S	FI-126	-30-0	1/4" Bottommount
DW-10S	FI-127	-30-0	1/4" Bottommount
DW-2S	FI-128	-16-0	1/4" Bottommount
DW-9S	FI-129	-30-0	1/4" Bottommount
DW-8S	FI-130	-30-0	1/4" Bottommount
DW-4S	FI-131	-30-0	1/4" Bottommount
DW-1S	FI-132	-30-0	1/4" Bottommount
DW-6S	FI-133	-10-0	1/4" Bottommount
DW-5S	FI-134	-16-0	1/4" Bottommount
DW-3S	FI-135	-16-0	1/4" Bottommount
DW-7S	FI-136	-16-0	1/4" Bottommount

Vacuum Inlet Manifold

Module Code: 100

100

Valve,Brass,Ball,1/4",150#	Part:	10047
2	Qty:	18
	Mfg:	Kitz
-	Mfg Part:	14TBV
Nipple, Galv, 1/4xclose	Part:	10048
	Qty:	18
	Mfg:	
None	Mfg Part:	14CLGZN
Camlock Fitting,3", Part "F",Aluminum	Part:	10541
Male Adapter x Male Thread Cam Lock Fitting	Qty:	28
	Mfg:	Bayco Industries
---	Mfg Part:	BAL-300F
Camlock Fitting,3", Part "C",Aluminum	Part:	10542
Female Coupler x Hose Shank Cam Lock Fitting	Qty:	28
	Mfg:	Bayco Industries
---	Mfg Part:	BAL-300C
Valve,PVC,Ball,3",Socket/Viton,4032-030	Part:	10820
	Qty:	14
	Mfg:	
---	Mfg Part:	4032-030
Nipple, PVC 80, 861-338, 3"xclose	Part:	11865
	Qty:	32
	Mfg:	
	Mfg Part:	861-338
Hose,PVC,Suction,Green,3",J300	Part:	12043
TigerFlex only outdoor	Qty:	100
PVC,150F,60psi@70F(/ft) (min 100ft order)	Mfg:	Kuriyama
---	Mfg Part:	J300
Brass, connector, 1/4"pipex1/4"hose barb, 125-4B	Part:	18070
	Qty:	18
	Mfg:	
None	Mfg Part:	125-4B
Hose Clamp, 3-1/2", SS	Part:	18652
	Qty:	28
	Mfg:	Maple Leaf Environmental Equipment
---	Mfg Part:	1002060
Hose Clamp, 5", SS	Part:	18654
	Qty:	8
	Mfg:	Maple Leaf Environmental Equipment
---	Mfg Part:	1002080 - 18654
Misc Part	Part:	9999
As per specification below	Qty:	6
	Mfg:	
Plug, 1/4", Black	Mfg Part:	0

Misc Part As per specification below Nipple, PVC 80, 861-422, 4"x close	Part: Qty: Mfg: Mfg Part:	9999 8 0
Misc Part As per specification below 1/4" Black Plug	Part: Qty: Mfg: Mfg Part:	9999 20 0
Hose,PVC,Suction,Green,4",J400 TigerFlex only outdoor PVC,150F,50psi@70F(/ft) (min 100ft order) ---	Part: Qty: Mfg: Mfg Part:	M1269 30 Kuriyama J400
Camlock Fitting,4", Part "C",Aluminum Female Coupler x Hose Shank Cam Lock Fitting ---	Part: Qty: Mfg: Mfg Part:	M1270 8 Bayco Industries BAL-400C
Camlock Fitting,4", Part "F",Aluminum Male Adapter x Male Thread Cam Lock Fitting ---	Part: Qty: Mfg: Mfg Part:	M1271 8 Bayco Industries BAL-400F

FI-101

Valve,Brass,Ball,1/4",150# 2 None	Part: Qty: Mfg: Mfg Part:	10047 2 Kitz 14TBV
Back Plate BP-Vflow-3 ---	Part: Qty: Mfg: Mfg Part:	12684 1 Maple Leaf Environmental Equipment ---
~~Meter Flow,Vflow 3~~ Replaced 12/08 By Kinglast 7510 6A-04 6-60 SCFM None	Part: Qty: Mfg: Mfg Part:	12686 1 Maple Leaf Environmental Equipment Vflow 3
U-Bolts, Chrome Plated, 42046 (Vflow 3) 1/2" x 3-1/2" IW x 5" IL None	Part: Qty: Mfg: Mfg Part:	12711 2 42046
Hose Barb, Brass, 3/8x1/4, Male (125-6B) None	Part: Qty: Mfg: Mfg Part:	13317 2 125-6B
~~Gauge,Magnehelic,2004,0-4"wc~~ Removed 12/08 ---	Part: Qty: Mfg: Mfg Part:	13596 1 Dwyer 2004
Hose Barb, Brass, 3/8x1/8, Male (125-6A) None	Part: Qty: Mfg: Mfg Part:	17437 2

Hose, 3/8"ID x 1./2"OD clear tubing 12.011180 None	Part: Qty: Mfg: Mfg Part:	18386 4 12.011180

FI-102

Valve,Brass,Ball,1/4",150# 2 None	Part: Qty: Mfg: Mfg Part:	10047 2 Kitz 14TBV
~~Gauge,Magnehelic,2005,0-5"wc~~ z --- Removed 12/08	Part: Qty: Mfg: Mfg Part:	11389 1 Dwyer 2005
~~Back Plate BP-Vflow-3~~ None Removed 12/8	Part: Qty: Mfg: Mfg Part:	12684 1 Maple Leaf Environmental Equipment -
~~Meter Flow,Vflow-3~~ None Replaced w King Inst. model 7510 6A-02 4-40 SCFM	Part: Qty: Mfg: Mfg Part:	12686 1 Maple Leaf Environmental Equipment Vflow 3
U-Bolts, Chrome Plated, 42046 (Vflow 3) 1/2" x 3-1/2" IW x 5" IL None	Part: Qty: Mfg: Mfg Part:	12711 2 42046
Hose Barb, Brass, 3/8x1/4, Male (125-6B) None	Part: Qty: Mfg: Mfg Part:	13317 2 125-6B
Hose Barb, Brass, 3/8x1/8, Male (125-6A) None	Part: Qty: Mfg: Mfg Part:	17437 2
Hose, 3/8"ID x 1./2"OD clear tubing 12.011180 None	Part: Qty: Mfg: Mfg Part:	18386 4 12.011180

FI-103-106

Valve,Brass,Ball,1/4",150# 2 None	Part: Qty: Mfg: Mfg Part:	10047 8 Kitz 14TBV
~~Back Plate BP-Vflow-3~~ Removed 12/08 None	Part: Qty: Mfg: Mfg Part:	12684 4 Maple Leaf Environmental Equipment -
~~Meter Flow,Vflow 3~~ Replaced 12/08 King Instruments 103 7510 6A-02 4-40 Scfm 104 7510 7A-06 2-20 scfm None	Part: Qty: Mfg: Mfg Part:	12686 4 Maple Leaf Environmental Equipment Vflow 3

105 7510 7A-02 0.8-8 scfm
106 7510 6A-02 4-40 scfm

U-Bolts, Chrome Plated, 42046 (Vflow 3) 1/2" x 3-1/2" IW x 5" IL None	Part: Qty: Mfg: Mfg Part:	12711 8 42046
Hose Barb, Brass, 3/8x1/4, Male (125-6B) None	Part: Qty: Mfg: Mfg Part:	13317 8 125-6B
~~Gauge,Magnehelic,2004,0-4"wc~~ Removed 12/08 ---	Part: Qty: Mfg: Mfg Part:	13596 4 ~~Dwyer~~ 2004
Hose Barb, Brass, 3/8x1/8, Male (125-6A) None	Part: Qty: Mfg: Mfg Part:	17437 8
Hose, 3/8"ID x 1./2"OD clear tubing 12.011180 None	Part: Qty: Mfg: Mfg Part:	18386 16 12.011180
FI-107		
Valve,Brass,Ball,1/4",150# 2 None	Part: Qty: Mfg: Mfg Part:	10047 2 Kitz 14TBV
~~Gauge,Magnehelic,2005,0-5"wc~~ z Removed 12/08 ---	Part: Qty: Mfg: Mfg Part:	11389 1 Dwyer 2005
~~Back Plate BP-Vflow-3~~ None Removed 12/08	Part: Qty: Mfg: Mfg Part:	12684 1 Maple Leaf Environmental Equipment -
~~Meter Flow,Vflow 3~~ Replaced 12/08 None King Instruments Model 7510 6A-04 6-60 SCFM	Part: Qty: Mfg: Mfg Part:	12686 1 Maple Leaf Environmental Equipment Vflow 3
U-Bolts, Chrome Plated, 42046 (Vflow 3) 1/2" x 3-1/2" IW x 5" IL None	Part: Qty: Mfg: Mfg Part:	12711 2 42046
Hose Barb, Brass, 3/8x1/4, Male (125-6B) None	Part: Qty: Mfg: Mfg Part:	13317 2 125-6B
Hose Barb, Brass, 3/8x1/8, Male (125-6A) None	Part: Qty: Mfg: Mfg Part:	17437 2

Hose, 3/8"ID x 1./2"OD clear tubing	Part:	18386
12.011180	Qty:	4
	Mfg:	
None	Mfg Part:	12.011180

FI-108-112

Valve,Brass,Ball,1/4",150#	Part:	10047
2	Qty:	10
	Mfg:	Kitz
None	Mfg Part:	14TBV

~~Back Plate BP-Vflow-3~~ Replaced 12/08	Part:	12684
	Qty:	5
	Mfg:	Maple Leaf Environmental Equipment
None	Mfg Part:	-

~~Meter Flow,Vflow 3~~ Replaced 12/08 New Units King Inst.	Part:	12686
FI-108,9,111+112	Qty:	5
# 7205022 1	Mfg:	Maple Leaf Environmental Equipment
None	Mfg Part:	Vflow 3
FI-110 # 7510 6A-04 6-60 SCFM		

U-Bolts, Chrome Plated, 42046 (Vflow 3)	Part:	12711
1/2" x 3-1/2" IW x 5" IL	Qty:	10
	Mfg:	
None	Mfg Part:	42046

Hose Barb, Brass, 3/8x1/4, Male (125-6B)	Part:	13317
	Qty:	10
	Mfg:	
None	Mfg Part:	125-6B

Gauge,Magnehelic,2004,0-4"wc	Part:	13596
	Qty:	5
	Mfg:	Dwyer
---	Mfg Part:	2004

Hose Barb, Brass, 3/8x1/8, Male (125-6A)	Part:	17437
	Qty:	10
	Mfg:	
None	Mfg Part:	

Hose, 3/8"ID x 1./2"OD clear tubing	Part:	18386
12.011180	Qty:	20
	Mfg:	
None	Mfg Part:	12.011180

FI-113-116

Valve,Brass,Ball,1/4",150#	Part:	10047
2	Qty:	8
	Mfg:	Kitz
None	Mfg Part:	14TBV

~~Back Plate BP-Vflow-4~~	Part:	12683
	Qty:	4
	Mfg:	Maple Leaf Environmental Equipment
None	Mfg Part:	-

Hose Barb, Brass, 3/8x1/4, Male (125-6B)	Part:	13317
	Qty:	8
	Mfg:	
None	Mfg Part:	125-6B

~~Meter Flow,Vflow 4~~ Replaced 12/08 FI-113 7510 6A-04 6-60 SCFM 114 7205 0231 25-250 SCFM None 115+116 7205 0221 16-160 SCFM	Part: Qty: ~~Mfg:~~ Mfg Part:	~~13526~~ ~~4~~ ~~Maple Leaf Environmental Equipment~~
U-Bolts, Chrome Plated, 42054 (Vflow 4) 1/2" x 4-1/2" IW x 6" IL None	Part: Qty: Mfg: Mfg Part:	13600 8 42054
Hose Barb, Brass, 3/8x1/8, Male (125-6A) None	Part: Qty: Mfg: Mfg Part:	17437 8
Hose, 3/8"ID x 1./2"OD clear tubing 12.011180 None	Part: Qty: Mfg: Mfg Part:	18386 16 12.011180
~~Gauge,Magnehelic,2006,0-6"wc~~ Removed 12/08 ---	Part: Qty: ~~Mfg:~~ Mfg Part:	M1263 4 ~~Dwyer~~ 2006
FI-117		
Valve,Brass,Ball,1/4",150# 2 None	Part: Qty: Mfg: Mfg Part:	10047 2 Kitz 14TBV
~~Back Plate BP-Vflow-3~~ King Instruments Removed 12/08 7510 6A-02 4-40 SCFM None	Part: Qty: ~~Mfg:~~ Mfg Part:	12684 1 ~~Maple Leaf Environmental Equipment~~ -
~~Meter Flow,Vflow 3~~ Replaced 12/08 None	Part: Qty: ~~Mfg:~~ Mfg Part:	12686 1 ~~Maple Leaf Environmental Equipment~~ Vflow 3
U-Bolts, Chrome Plated, 42046 (Vflow 3) 1/2" x 3-1/2" IW x 5" IL None	Part: Qty: Mfg: Mfg Part:	12711 2 42046
Hose Barb, Brass, 3/8x1/4, Male (125-6B) None	Part: Qty: Mfg: Mfg Part:	13317 2 125-6B
~~Gauge,Magnehelic,2004,0-4"wc~~ Removed 12/08 ---	Part: Qty: ~~Mfg:~~ Mfg Part:	13596 1 ~~Dwyer~~ 2004
Hose Barb, Brass, 3/8x1/8, Male (125-6A) None	Part: Qty: Mfg: Mfg Part:	17437 2

Hose, 3/8"ID x 1./2"OD clear tubing 12.011180 None	Part: Qty: Mfg: Mfg Part:	18386 4 12.011180

FI-118

Valve,Brass,Ball,1/4",150# 2 None	Part: Qty: Mfg: Mfg Part:	10047 2 Kitz 14TBV
~~Gauge,Magnehelic,2002,0-2"wc~~ Removed 12/08 ---	Part: Qty: Mfg: Mfg Part:	11247 1 ~~Dwyer~~ 2002
~~Back Plate BP-Vflow-3~~ Removed 12/08 None	Part: Qty: Mfg: Mfg Part:	12684 1 ~~Maple Leaf Environmental Equipment~~ -
Meter Flow,Vflow 3 Replaced King Instruments 7205 0221 16-160 SCFM None	Part: Qty: Mfg: Mfg Part:	12686 1 ~~Maple Leaf Environmental Equipment~~ Vflow 3
U-Bolts, Chrome Plated, 42046 (Vflow 3) 1/2" x 3-1/2" IW x 5" IL None	Part: Qty: Mfg: Mfg Part:	12711 2 42046
Hose Barb, Brass, 3/8x1/4, Male (125-6B) None	Part: Qty: Mfg: Mfg Part:	13317 2 125-6B
Hose Barb, Brass, 3/8x1/8, Male (125-6A) None	Part: Qty: Mfg: Mfg Part:	17437 2
Hose, 3/8"ID x 1./2"OD clear tubing 12.011180 None	Part: Qty: Mfg: Mfg Part:	18386 4 12.011180

MFD-101 Deep Well Manifold

plug, 1/4", galv NPT ---	Part: Qty: Mfg: Mfg Part:	17575 7
Tee, PVC 80, 801-530, 6x6x3, SxSxS ---	Part: Qty: Mfg: Mfg Part:	18723 7 Alfa Plastics 801-530
Tee, PVC 80, 801-532, 6x6x4, SxSxS ---	Part: Qty: Mfg: Mfg Part:	18724 7 Alfa Plastics 801-532

Adapter,PVC 80,Female,835-040,4",SxT	Part:	P1004
	Qty:	7
	Mfg:	
---	Mfg Part:	835-040
Elbow, PVC 80, 806-030, 90deg, SxS, 3"	Part:	P1078
	Qty:	7
	Mfg:	
---	Mfg Part:	806-030
Elbow, PVC 80, 806-040, 90deg, SxS, 4"	Part:	P1125
	Qty:	7
	Mfg:	
---	Mfg Part:	806-040
Adapter,PVC 80,Female,835-030,3" SxT	Part:	P1153
1	Qty:	7
	Mfg:	
---	Mfg Part:	835-030

MFD-102 SHALLOW WELL MANIFOLD

plug, 1/4", galv	Part:	17575
NPT	Qty:	11
	Mfg:	
---	Mfg Part:	
Tee, PVC 80, 801-530, 6x6x3, SxSxS	Part:	18723
	Qty:	7
	Mfg:	Alfa Plastics
---	Mfg Part:	801-530
Tee, PVC 80, 801-532, 6x6x4, SxSxS	Part:	18724
	Qty:	11
	Mfg:	Alfa Plastics
---	Mfg Part:	801-532
Adapter,PVC 80,Female,835-040,4",SxT	Part:	P1004
	Qty:	11
	Mfg:	
---	Mfg Part:	835-040
Elbow, PVC 80, 806-030, 90deg, SxS, 3"	Part:	P1078
	Qty:	7
	Mfg:	
---	Mfg Part:	806-030
Elbow, PVC 80, 806-040, 90deg, SxS, 4"	Part:	P1125
	Qty:	11
	Mfg:	
---	Mfg Part:	806-040
Adapter,PVC 80,Female,835-030,3" SxT	Part:	P1153
1	Qty:	7
	Mfg:	
---	Mfg Part:	835-030

PI-101-102

Gauge,Vacuum,0-16"wc,Dry,J16"-0WC,SS,1/4"	Part:	19124
	Qty:	2
	Mfg:	
---	Mfg Part:	J16"-0WC

Varies
See gauge Schedule

PI-103-106

~~Gauge,Vacuum,0-60" wc ,Dry,J60"-0WC,SS,1/4"~~ Varies see gauge Schedule	Part:	M1319
	Qty:	4
	~~Mfg:~~	
---	Mfg Part:	J60"-0WC

PI-107-118

~~Gauge,Vacuum,0-16"wc,Dry,J16"-0WC,SS,1/4"~~ Varies See gauge Schedule	Part:	19124
	Qty:	12
	~~Mfg:~~	
---	Mfg Part:	J16"-0WC

Vapor/Liquid Separator

Module Code: 400

400

Pipe, Black, 2", (21ft. Length)	Part:	10069
	Qty:	21
	Mfg:	
	Mfg Part:	2BLSP
Reducer, Coupling, Black, 1"x3/4"	Part:	10070
	Qty:	6
	Mfg:	
	Mfg Part:	1X34BLC
Reducer Bushing, Hex, Black, 1" x 3/4"	Part:	10107
	Qty:	3
	Mfg:	
	Mfg Part:	1X34BLB
Tee, Black, 1/4"	Part:	11350
	Qty:	20
	Mfg:	
	Mfg Part:	
Tee, Black, 1/4"	Part:	11350
	Qty:	2
	Mfg:	
	Mfg Part:	14BLT
Pipe, Black, 1", (21ft.Length)	Part:	11427
	Qty:	21
	Mfg:	
	Mfg Part:	1BLSP
Pipe, Black, 1-1/2", (21ft. Length)	Part:	11435
	Qty:	21
	Mfg:	
	Mfg Part:	112BLSP
Reducer Bushing, Hex, Black, 2"x1" Threaded	Part:	11531
	Qty:	8
	Mfg:	
	Mfg Part:	
Reducer Bushing, Hex, Black, 2"x1" Threaded	Part:	11531
	Qty:	7
	Mfg:	
	Mfg Part:	
Nipple, SS, KC, 1"	Part:	12662
	Qty:	6
	Mfg:	
	Mfg Part:	RST100
Elbow, Black, 90deg, 1" schedule 40, welded	Part:	14749
	Qty:	4
	Mfg:	
	Mfg Part:	
Valve,Butterfly,Ductile Iron,6",Elite 8400,wafer 316SS disc & stern,BUNA,10 position lever	Part:	15019
	Qty:	7
	Mfg:	
---	Mfg Part:	E8400-6B

Flange, PVC 80, 854-060 6",Soc van stone ---	Part: Qty: Mfg: Mfg Part:	15632 20 854-060
Union, Black, 2" Threaded	Part: Qty: Mfg: Mfg Part:	15986 4
Elbow, Black, 90deg, 1-1/2" Threaded	Part: Qty: Mfg: Mfg Part:	15991 16
Union, Black, 1-1/2",150#	Part: Qty: Mfg: Mfg Part:	15992 3
Tee, Black, 1"	Part: Qty: Mfg: Mfg Part:	16126 6
Tee, Black, 1"	Part: Qty: Mfg: Mfg Part:	16126 3
Reducer Bushing, Hex, Black, 2"x1-1/2"	Part: Qty: Mfg: Mfg Part:	16450 2
Reducer Bushing, Hex, Black, 2"x1-1/2"	Part: Qty: Mfg: Mfg Part:	16450 1
Reducer Bushing, Hex, Black, 2"x1-1/2"	Part: Qty: Mfg: Mfg Part:	16450 8
Reducer Bushing, Hex, Black, 2"x1-1/2"	Part: Qty: Mfg: Mfg Part:	16450 1
Nipple, Black, 1/4xclose	Part: Qty: Mfg: Mfg Part:	19228 40
Union, Black, 1" Threaded	Part: Qty: Mfg: Mfg Part:	19320 6

Elbow, Black, 90deg, 1"	Part:	19321
Threaded	Qty:	12
	Mfg:	
	Mfg Part:	
Nipple, Black, 1xshort	Part:	19322
Threaded	Qty:	20
	Mfg:	
	Mfg Part:	
Elbow, Black, 90deg, 1/4"	Part:	19323
Threaded	Qty:	6
	Mfg:	
	Mfg Part:	
Nipple, Black, 1/4xShort	Part:	19324
Threaded	Qty:	12
	Mfg:	
	Mfg Part:	
Nipple, Black, 1-1/2xshort	Part:	19325
Threaded	Qty:	14
	Mfg:	
	Mfg Part:	
Reducer Bushing, Hex, Black, 1-1/2"x1/4"	Part:	19326
Threaded	Qty:	10
	Mfg:	
	Mfg Part:	
Reducer Bushing, Hex, Black, 1-1/2"x1"	Part:	19327
Threaded	Qty:	10
	Mfg:	
	Mfg Part:	
Tee, Black, 1-1/2"	Part:	19328
Threaded	Qty:	8
	Mfg:	
	Mfg Part:	
Elbow, Black, 45deg, 1-1/2"	Part:	19329
Threaded	Qty:	8
	Mfg:	
	Mfg Part:	
Misc Part	Part:	9999
As per specification below	Qty:	10
	Mfg:	
1/4" Black Tees	Mfg Part:	0
Misc Part	Part:	9999
As per specification below	Qty:	7
	Mfg:	
Nipple, Black, 1/4 x 1-1/4"	Mfg Part:	0
Misc Part	Part:	9999
As per specification below	Qty:	2
	Mfg:	
T-Cross, 1/4", Black	Mfg Part:	0

Misc Part	Part:	9999
As per specification below	Qty:	6
	Mfg:	
Nipple, Black, 3/4" x 2" long	Mfg Part:	0
Misc Part	Part:	9999
As per specification below	Qty:	6
	Mfg:	
3/4" Black coupling	Mfg Part:	0
Misc Part	Part:	9999
As per specification below	Qty:	4
	Mfg:	
T-Cross, 1/4 ", Black	Mfg Part:	0
Misc Part	Part:	9999
As per specification below	Qty:	5
	Mfg:	
Nipple, 1/4 x 1-1/2	Mfg Part:	0
Misc Part	Part:	9999
As per specification below	Qty:	3
	Mfg:	
Reducer Bushing, Hex, Black, 1-1/2" x 3/4"	Mfg Part:	0
Misc Part	Part:	9999
As per specification below	Qty:	25
	Mfg:	
1/4 x 1-1/2" BLACK NIPPLES	Mfg Part:	0
Misc Part	Part:	9999
As per specification below	Qty:	12
	Mfg:	
Nipple, Black, 1xclose	Mfg Part:	0
Misc Part	Part:	9999
As per specification below	Qty:	3
	Mfg:	
Reducer bushing, Hex, Black, 1" x 1/4"	Mfg Part:	0
Misc Part	Part:	9999
As per specification below	Qty:	6
	Mfg:	
1" Black Coupling	Mfg Part:	0
Misc Part	Part:	9999
As per specification below	Qty:	10
	Mfg:	
1" x 90 Degree elbow, threaded, Black	Mfg Part:	0
Misc Part	Part:	9999
As per specification below	Qty:	3
	Mfg:	
Union, Black, 1"	Mfg Part:	0
Tee, Black, 2"	Part:	P1015
Threaded	Qty:	4
	Mfg:	
	Mfg Part:	2BLT

Tee, Black, 2" Threaded	Part: Qty: Mfg: Mfg Part:	P1015 2 2BLT
Valve,Brass,Ball,1", 150# 2	Part: Qty: Mfg: Mfg Part:	P1067 1 Kitz
Nipple, SS, KC, 1-1/2"	Part: Qty: Mfg: Mfg Part:	P1076 6 RST20

FQI-401-403 FQI-210, 310, 410

Meter,Water,3/4"MTH,w/o pulse US Gal, c/w couplings ---	Part: Qty: Mfg: Mfg Part:	10141 3 GWF MTH3/4 US Gals

LG-401-403 SG - 200, 300, 400

Nipple, Galv, 1x close -	Part: Qty: Mfg: Mfg Part:	10216 6 1CGZN
Pipe, PVC 40 (Clear), 40-020CL, 2" 1 -	Part: Qty: Mfg: Mfg Part:	10697 5 40-020CL
Valve,PVC,Ball,1",Socket/Viton,4032-010 -	Part: Qty: Mfg: Mfg Part:	10817 6 Alfa Plastics 4032-010
Reducer Bushing, PVC 80, 837-249, 2" x 1", SxS -	Part: Qty: Mfg: Mfg Part:	10899 6 837-249
Reducer Bushing, PVC 80, 838-249, 2"x1"SxF -	Part: Qty: Mfg: Mfg Part:	11080 3 838-249
Plug, PVC 80, 850-010, 1" -	Part: Qty: Mfg: Mfg Part:	12388 3 850-010
Elbow, Galv, 90deg, 1", M&F threads -	Part: Qty: Mfg: Mfg Part:	17518 6 12.0950060
Union, PVC 80, 857-020, 2"soc -	Part: Qty: Mfg: Mfg Part:	P1080 3 857-020

Tee, PVC 80, 801-020, 2", SxSxS	Part:	P1156
	Qty:	6
	Mfg:	
-	Mfg Part:	801-020
Reducer Bushing, PVC 80, 838-251, 2"x1-1/2",SxF	Part:	P1204
	Qty:	3
	Mfg:	
-	Mfg Part:	838-251

LSHH,LSH,LSL-~~xx~~ LSHH, LSH, LSL- 200, 300, 400

Switch,Level, L312C 3393-0001	Part:	15476
3 position-6" for std VLD	Qty:	3
bottom of LSL & bottom of LSH6"	Mfg:	Innovative Solutions
-	Mfg Part:	L312C-3393-0001

P-401-403 TP - 210, 310, 410

Valve,Check,Brass,Swing, 1"	Part:	10035
	Qty:	6
	Mfg:	
None	Mfg Part:	1TSCV
Valve,Brass,Ball,1/4",150#	Part:	10047
2	Qty:	3
	Mfg:	Kitz
None	Mfg Part:	14TBV
Coupling, Insert, L075N	Part:	11105
	Qty:	3
	Mfg:	Browning
None	Mfg Part:	L075N
Nipple, Plated, KC, 1", IPM	Part:	11210
	Qty:	6
	Mfg:	
None	Mfg Part:	CNP-100
Nipple, Plated, KC, 1-1/2", IPM	Part:	11347
	Qty:	6
	Mfg:	
None	Mfg Part:	CNP-150
Motor, 1hp, 1800rpm, 143T	Part:	12026
208-230/460V, 3ph, CSA/UR	Qty:	3
TEFC	Mfg:	TECO Westinghouse
---	Mfg Part:	WJ0014FFAC,Tat
Coupling, Motor, L075x.875"	Part:	12027
1	Qty:	3
	Mfg:	Browning
None	Mfg Part:	L075x0875
Coupling, Pump, L075x.625	Part:	12028
	Qty:	3
	Mfg:	
None	Mfg Part:	L075X.625
Hose,PVC,Suction,Green,1",J100	Part:	12090
2	Qty:	6
PVC,150F,85psi@70F(/ft) (min 100ft order)	Mfg:	Kuriyama
None	Mfg Part:	J100

Hose,PVC,Suction,Green,1-1/2",J150	Part:	12091
4	Qty:	6
PVC,150F,70psi@70F(/ft) (min 100ft order)	Mfg:	Kuriyama
None	Mfg Part:	J150
Base,10 x 24	Part:	15855
	Qty:	3
	Mfg:	Maple Leaf Environmental Equipment
None	Mfg Part:	15855
Guard, 2" x 7"	Part:	16076
	Qty:	3
	Mfg:	Maple Leaf Environmental Equipment
None	Mfg Part:	
Pump,Discharge,Moyno,33301	Part:	M1255
7gpm@25psi, 1800rpm, NPSH:less than 5 feet	Qty:	3
	Mfg:	Moyno
None	Mfg Part:	33301
Union, Galv, 1-1/2",150#	Part:	P1062
	Qty:	3
	Mfg:	
None	Mfg Part:	112GZU
Valve,Brass,Ball,1-1/2",150#	Part:	P1066
	Qty:	3
	Mfg:	Kitz
-	Mfg Part:	112TBV
Valve,Brass,Ball,1", 150#	Part:	P1067
2	Qty:	3
	Mfg:	Kitz
None	Mfg Part:	1TBV - UL/CGA A

PI-401-403 V1 - 201, 301, 401

Gauge,Vacuum,0-100"wc,Dry,J100"-0WC,SS,1/4"	Part:	10411
	Qty:	3
	Mfg:	McDaniel Controls, Inc.
---	Mfg Part:	J100"-OWC

PI-404-406 PI - 210, 310, 410

Gauge,Pressure,0-60psi, Indumart,P16T2-FG-60	Part:	16203
SS, brass internals, Glyc. Filled, bottom mount	Qty:	3
	Mfg:	Indumart
None	Mfg Part:	

VLS-401-402 KO - 200, 300

Vapor Liquid Separator,85 Gallon,VLD800	Part:	10057
Max Air Flow 800cfm, Max Water Flow 20gpm	Qty:	2
1.5" Water Outlet !Requires Drum	Mfg:	Maple Leaf Environmental Equipment
Standard Features: Baffel Options: CW Epoxy Coated Interior 2" Sight Glass, for level switches in sight glass	Mfg Part:	VLD800

VLS-401-403

Nipple, Galv, 1x close	Part:	10216
	Qty:	3
	Mfg:	
None	Mfg Part:	1CGZN
Drums unpainted,85gal,over pack drums,16 gauge	Part:	15739
Salvage Drums	Qty:	3
	Mfg:	
None	Mfg Part:	Q85-BR-16- SOH0
Elbow, Galv, 90deg, 1", M&F threads	Part:	17518
	Qty:	3
	Mfg:	
None	Mfg Part:	12.0950060
Valve,Brass,Ball,1", 150#	Part:	P1067
2	Qty:	3
	Mfg:	Kitz
None	Mfg Part:	1TBV - UL/CGA A

VLS-403 KO- 400

Vapor Liquid Separator,85 Gallon,VLD800	Part:	10057
Max Air Flow 800cfm, Max Water Flow 20gpm	Qty:	1
1.5" Water Outlet !Requires Drum	Mfg:	Maple Leaf Environmental Equipment
Standard Features:	Mfg Part:	VLD800
Removable Top		
Epoxy Coated Interior		

Options:
Baffel
CCW
2" Glass Sight Glass for mounting level switches in sight glass

Soil-Vapor Extraction

Module Code: 700

700

Valve,Brass,Ball,1/4",150#	Part:	10047
2	Qty:	4
	Mfg:	Kitz
-	Mfg Part:	14TBV
Nipple, Galv, 1/4xclose	Part:	10048
	Qty:	4
	Mfg:	
None	Mfg Part:	14CLGZN
Pipe, PVC 80, 80-060, 6"	Part:	10202
	Qty:	60
	Mfg:	
	Mfg Part:	80-060
Valve,Vacuum Relief,Kunkle,215V-K, 3" in/out	Part:	10821
max 935 scfm	Qty:	1
	Mfg:	Kunkle
Set @ 7 INHG	Mfg Part:	215V-K
Flange, Black, 8", slip on	Part:	11042
	Qty:	3
	Mfg:	
---	Mfg Part:	8WSOF
Nipple, Black, 6x6"	Part:	11533
	Qty:	6
	Mfg:	
---	Mfg Part:	6X6BLN
Pipe, Black, 4", (21ft. Length)	Part:	12228
	Qty:	21
	Mfg:	
	Mfg Part:	4BLSP
Pipe, Black, 4", (21ft. Length)	Part:	12228
	Qty:	21
	Mfg:	
	Mfg Part:	4BLSP
Tee, Black, 4"	Part:	12741
Threaded	Qty:	2
	Mfg:	
Threaded	Mfg Part:	4BLT
Filter Inline,Solberg,CSL-275P-600	Part:	13603
3	Qty:	3
	Mfg:	Solberg
-	Mfg Part:	CSL-275P-600
Pipe, Black, 6", (21ft. Length)	Part:	14505
schedule 40	Qty:	21
	Mfg:	
	Mfg Part:	

Tee, Black, 6"	Part:	14538
	Qty:	3
	Mfg:	
---	Mfg Part:	6BLT
Nipple, Black, 3xClose	Part:	14566
	Qty:	3
	Mfg:	
	Mfg Part:	
Reducer, Coupling, Black, 8" x 6"	Part:	14634
welded	Qty:	1
	Mfg:	
	Mfg Part:	
Reducer Bushing, Hex, Black, 8"x6"	Part:	14714
	Qty:	2
	Mfg:	
---	Mfg Part:	8x6BLB
Valve,Butterfly,Ductile Iron,8",Elite 8400,wafer	Part:	17313
316SS disc & stern,BUNA,10 position lever	Qty:	1
	Mfg:	
---	Mfg Part:	E8400-8B
plug, 1/4", galv	Part:	17575
NPT	Qty:	3
	Mfg:	
---	Mfg Part:	
Brass, connector, 1/4"pipex1/4"hose barb, 125-4B	Part:	18070
	Qty:	4
	Mfg:	
None	Mfg Part:	125-4B
Misc Part	Part:	9999
As per specification below	Qty:	3
	Mfg:	
4" x close Nipples	Mfg Part:	0
Misc Part	Part:	9999
As per specification below	Qty:	2
	Mfg:	
REDUCER COUPLING, BLACK, 8in X 6in WELDED	Mfg Part:	---
Misc Part	Part:	9999
As per specification below	Qty:	1
	Mfg:	
4" x 90 Elbow	Mfg Part:	0
Misc Part	Part:	9999
As per specification below	Qty:	6
	Mfg:	
P/N 3 WSSORF80 8" FLANGE, BLACK, WELDED, SLIP ON, 150	Mfg Part:	0
Misc Part	Part:	9999
As per specification below	Qty:	2
	Mfg:	
TEE, BLACK, 8in WELDED	Mfg Part:	---

Misc Part	Part:	9999
As per specification below	Qty:	1
	Mfg:	
# 18206671614 Flat Black High Heat, 1 litre	Mfg Part:	0
Misc Part	Part:	9999
As per specification below	Qty:	2
	Mfg:	
Flange, Black, 6", 150 lb, raised face, slip on.	Mfg Part:	0
Misc Part	Part:	9999
As per specification below	Qty:	1
	Mfg:	
6" weld on flange, black, with neck	Mfg Part:	0
Gauge,Temp.,50-500F WL31308	Part:	M1422
3"Dial,6"Stem,1/2"NPT	Qty:	1
	Mfg:	
---	Mfg Part:	WL31308
Flange, Black, Companion, 6"	Part:	M1459
Threaded	Qty:	6
	Mfg:	
	Mfg Part:	6BLCIF
Valve,Brass,Ball,4",150#	Part:	M1522
	Qty:	3
	Mfg:	
None	Mfg Part:	4TBV
Elbow, Black, 90deg, 6"	Part:	M1527
Threaded	Qty:	3
	Mfg:	
---	Mfg Part:	6BLE9
Elbow, PVC 80, 806-060, 90deg, SxS, 6"	Part:	P1126
	Qty:	10
	Mfg:	
---	Mfg Part:	806-060
Reducer Bushing, PVC 80, 837-532, 6"x4",SxS	Part:	P1131
	Qty:	6
	Mfg:	
---	Mfg Part:	837-532
Tee, PVC 80, 801-060, 6", SxSxS	Part:	P1179
	Qty:	10
	Mfg:	
---	Mfg Part:	801-060
Fernco, 6"x 6".	Part:	P1188
	Qty:	6
	Mfg:	
None	Mfg Part:	5666

B-701 BL-200

Blower,Rotron,EN14DX72MWL,30hp,230/460,3ph	Part:	12222
	Qty:	1
	Mfg:	Rotron
---	Mfg Part:	038761

B-702-703

Blower,Rotron,EN979BK72WL,20hp,230/460,,XPF 3600 RPM,UL/CSA ---	Part: Qty: Mfg: Mfg Part:	15888 2 Rotron 080724

PI-701-703

Gauge,Vacuum,0-100"wc,Dry,J100"-0WC,SS,1/4" None	Part: Qty: Mfg: Mfg Part:	10411 3 McDaniel Controls, Inc. J100"-OWC

PI-704-706

Gauge,Pressure,0-60" wc ,Dry,J60"-WC,SS None	Part: Qty: Mfg: Mfg Part:	M1293 3 McDaniel Controls, Inc. J60"WC

PI-707

Gauge,Pressure,0-60" wc ,Dry,J60"-WC,SS ---	Part: Qty: Mfg: Mfg Part:	M1293 1 McDaniel Controls, Inc. J60"WC

PT-701-704 VIT -202, 302, 402 PIT-602

Misc Part As per specification below Transmitter, Differential Pressure, 616W-6-LCD, Dwyer 0-100 INWC	Part: Qty: Mfg: Mfg Part:	9999 4 616W-6-LCD

SVE Heat Exchanger

Module Code: 1300

F-1301 HX-600

Misc Part	Part:	9999
As per specification below	Qty:	1
	Mfg:	
XCHANGER JOB B-10602	Mfg Part:	AA-2750

MODEL AA-2750
AIRFLOW: 2086 SCFM
TEMP IN: 210F
TEMP OUT: 115F
AMBIENT: 90F
PRESSURE IN: 15 INWC
PRESSURE DROP: 5.9 INWC
INLETS & OUTLETS: 12in FLANGED
MOTOR: 2hp, 1800rpm, 230/460V - 3ph, TEFC

TI-1302 TI-602

Gauge,Temp.,0-250F,WL31305	Part:	M1423
3"Dial,6"Stem,1/2"NPT	Qty:	1
	Mfg:	WGI
---	Mfg Part:	WL31305

TT-1301 TT-602

Misc Part	Part:	9999
As per specification below	Qty:	1
	Mfg:	
TE500CM12C2A1A3 32-212F	Mfg Part:	TE500CM12C2A1

Discharge Tank ST-510

Module Code: 7300

7300

Valve,PVC,Ball,2",Socket/Viton,4032-020	Part:	10819
	Qty:	1
	Mfg:	
—	Mfg Part:	4032-020
Valve,Brass,Ball,2",150#	Part:	P1065
NPT, Teflon seats, 600 PSI WOG	Qty:	1
	Mfg:	Kitz
—	Mfg Part:	2TBV

LG-7301

Valve,PVC,Ball,1",Socket/Viton,4032-010	Part:	10817
	Qty:	2
	Mfg:	Alfa Plastics
—	Mfg Part:	4032-010

LSHH,LSH-7301 LSHH, LSH - 510

Switch,Level, L312C XXXX - XXXX	Part:	15465
Custom	Qty:	1
	Mfg:	Innovative Solutions
2 Position Switch: 312C Rod length: 20 IN Wire Length: 3ft No. of Switches: 2 Switch Type: Normally Open Connection: 1-1/2in NPT Rod Diameter 5/1in Float material 316SS Cylindrical Floats (1510) Length from bottom of rod to bottom of LSH: 4in Distance between bottom of LSH and bottom of LSHH: 7in Include Centering Disk	Mfg Part:	

TNK-7301 ST - 510

Vent,updraft 2", OPW-23	Part:	10710
	Qty:	1
	Mfg:	
—	Mfg Part:	EBW-2"
Misc Part	Part:	9999
As per specification below	Qty:	1
	Mfg:	
SP-0400-UT Capacity: 400 gallons (Rectangle) Size: 62"L x 29"W x 66"H	Mfg Part:	SP-0400-UT

Building, Trailer or Skid

Module Code: 7900

Container Painting-20-exterior	Part:	12330
	Qty:	2
	Mfg:	
Beige - Questions regarding the colour spec call BEN WILSON ext 250	Mfg Part:	
Container Shipping,tilt load	Part:	13593
	Qty:	1
	Mfg:	
	Mfg Part:	

7900

Spruce GRN,2x3x12 709466	Part:	10780
	Qty:	30
	Mfg:	
	Mfg Part:	709466
Plywood,Spr,STD,4x8x3/4" 620338	Part:	11071
	Qty:	10
	Mfg:	
	Mfg Part:	620338
Spruce GRN,2x3x8 10	Part:	14531
	Qty:	120
	Mfg:	
	Mfg Part:	633383
Insulation,foil back foam 2",R, thinsulate,4x8 356127	Part:	14767
	Qty:	20
	Mfg:	
862892	Mfg Part:	356127
Insulation,foil back foam 2",R, thinsulate,4x8 356127	Part:	14767
	Qty:	32
	Mfg:	
	Mfg Part:	356127
Strut, Slotted, 1-5/8" x 1-5/8" TB A1200HS10PGC	Part:	15297
	Qty:	200
	Mfg:	
	Mfg Part:	TB A1200HS10P
Manual, System	Part:	17149
	Qty:	2
	Mfg:	
---	Mfg Part:	
Misc Part	Part:	9999
As per specification below	Qty:	4
	Mfg:	
Model # XA456 Globe Emergency Security Light 2 head plug in Fully rechargeable Shelf or wall mount CSA approved	Mfg Part:	0

Misc Part	Part:	9999
As per specification below	Qty:	1
	Mfg:	
Compound Joint Sht/rock 11 KG	Mfg Part:	0
Misc Part	Part:	9999
As per specification below	Qty:	10
	Mfg:	
Drywall Screws 1-1/4" #6	Mfg Part:	0
Misc Part	Part:	9999
As per specification below	Qty:	1
	Mfg:	
Hood 20" x 20" per email of Jan 16-08 from Mike Ford	Mfg Part:	0
Misc Part	Part:	9999
As per specification below	Qty:	3
	Mfg:	
Plate,2ft x 2ft x 3/8"	Mfg Part:	0
Misc Part	Part:	9999
As per specification below	Qty:	3
	Mfg:	
Drywall Compound Premix all purpose 12L 1625888	Mfg Part:	0
Misc Part	Part:	9999
As per specification below	Qty:	1
	Mfg:	
Joint Tape	Mfg Part:	0
Misc Part	Part:	9999
As per specification below	Qty:	14
	Mfg:	
Corner Bead	Mfg Part:	0
Misc Part	Part:	9999
As per specification below	Qty:	2
	Mfg:	
Wall Scraper Flex	Mfg Part:	0
Misc Part	Part:	9999
As per specification below	Qty:	8
	Mfg:	
drywall 1/2" x4 x 8	Mfg Part:	0
Misc Part	Part:	9999
As per specification below	Qty:	3
	Mfg:	
#10 4" long wood screw Quantity ~400	Mfg Part:	0
Misc Part	Part:	9999
As per specification below	Qty:	1
	Mfg:	
2" x500' Joint tape	Mfg Part:	0

Misc Part	Part:	9999
As per specification below	Qty:	64
	Mfg:	
3/4 x 6" Hex Head Bolt	Mfg Part:	0
Misc Part	Part:	9999
As per specification below	Qty:	24
	Mfg:	
Drywall 1/2" x 4' x10 2709811	Mfg Part:	0
Light,Fixture, Flourescent, 2 lamp,CFI SB248-120LE	Part:	E1080
	Qty:	1
	Mfg:	Lithonia Lighting
	Mfg Part:	YOR C240120ES
Light,Wire Guard,2Lamp,4ft CFI SB8G2-48	Part:	E1081
	Qty:	1
	Mfg:	Lithonia Lighting
	Mfg Part:	YOR WCCLIN
Light,4ft F34CW/EW/ALTO,40W	Part:	E1082
	Qty:	2
	Mfg:	
	Mfg Part:	PHL F34CW/EW/

7950

Misc Part	Part:	9999
As per specification below	Qty:	2
	Mfg:	
ILLUMINATED EXIT SIGN	Mfg Part:	---

AC-7901 AC in Building 2

Misc Part	Part:	9999
As per specification below	Qty:	1
	Mfg:	
3VE10 WINDOW ROOM A/C 230V, 1ph	Mfg Part:	3VE10

BLD-7901 Building 2

GFI Duplex Plug, 20A, Leveton, 6899-I	Part:	10132
	Qty:	3
	Mfg:	Leveton
---	Mfg Part:	6899-1
Container,8x20x8.6	Part:	11610
5-8 yr	Qty:	1
	Mfg:	
Length: 20ft Width: 8ft Height: 8ft6in Lifting Capacity: Corner lift lugs designed for maximum of 40,000 lb building weight. Factory Painted Exterior: Y Colour: BEIGE Marine Plywood Floor (Not Planks)	Mfg Part:	8x20x8

CARGO DOORS INSTALLED IN BOTH ENDS

Lights,exterior,TLW-070-NLXL-1-PC	Part:	14433
70W with Photo Eye	Qty:	2
	Mfg:	
---	Mfg Part:	TLW-070-NLXL-1-
Misc Part	Part:	9999
As per specification below	Qty:	2
	Mfg:	
ILLUMINATED EXIT SIGN	Mfg Part:	---
Light,Fixture, Flourescent, 2 lamp,CFI SB248-120LE	Part:	E1080
	Qty:	2
	Mfg:	Lithonia Lighting
None	Mfg Part:	YOR C240120ES
Light,Wire Guard,2Lamp,4ft CFI SB8G2-48	Part:	E1081
	Qty:	2
	Mfg:	Lithonia Lighting
None	Mfg Part:	YOR WCCLIN
Light,4ft F34CW/EW/ALTO,40W	Part:	E1082
	Qty:	4
	Mfg:	
-	Mfg Part:	PHL F34CW/EW/
Fan Shutter Assembly,K/D,12",KDS12-SS	Part:	M1303
	Qty:	1
	Mfg:	Canarm
---	Mfg Part:	KDS12-SS

BLD-7902 Building 1

GFI Duplex Plug, 20A, Leveton, 6899-I	Part:	10132
	Qty:	3
	Mfg:	Leveton
---	Mfg Part:	6899-1
Container,8x20x8.6	Part:	11610
5-8 yr	Qty:	1
	Mfg:	
Length: 20ft Width: 8ft Height: 8ft 6in Lifting Capacity: Corner lift lugs designed for maximum of 40,000 lb building weight. Factory Painted Exterior: Y Colour: Beige Marine Plywood Floor (Not Planks) Standard Barn doors on one end only	Mfg Part:	8x20x8
Lights,exterior,TLW-070-NLXL-1-PC	Part:	14433
70W with Photo Eye	Qty:	2
	Mfg:	
---	Mfg Part:	TLW-070-NLXL-1-
Light,Fixture, Flourescent, 2 lamp,CFI SB248-120LE	Part:	E1080
	Qty:	2
	Mfg:	Lithonia Lighting
None	Mfg Part:	YOR C240120ES
Light,Wire Guard,2Lamp,4ft CFI SB8G2-48	Part:	E1081
	Qty:	2
	Mfg:	Lithonia Lighting
None	Mfg Part:	YOR WCCLIN

Light,4ft F34CW/EW/ALTO,40W	Part:	E1082
	Qty:	4
	Mfg:	
-	Mfg Part:	PHL F34CW/EW/
Fan Shutter Assembly,K/D,12",KDS12-SS	Part:	M1303
	Qty:	1
	Mfg:	Canarm
---	Mfg Part:	KDS12-SS

F-7901 Building 2 Fan

Fan Building,S18-F1,18",1/3hp,1700rpm,120V,1ph,TEFC	Part:	10670
	Qty:	1
(# Fan for Building 1 Similar Model 12" Blade.)	Mfg:	Canarm
- SD12E1	Mfg Part:	SD180411
Switch,Temp probe,A19AAF-32	Part:	15652
20ft capillary tube, 25-225 degF, Nema 1	Qty:	1
	Mfg:	Johnson Controls
---	Mfg Part:	A19AAF-32C
Fan Back Guard,OSHA,18" to 20" Motor Mount	Part:	18987
Replaces M1368 and M1369	Qty:	1
Order for TEFC only	Mfg:	
None	Mfg Part:	2X118
Fan Hood,HFPW-18,18",Plastic,White	Part:	M1305
	Qty:	2
	Mfg:	Canarm
---	Mfg Part:	HFPW-18

H-7901-7903

Misc Part	Part:	9999
As per specification below	Qty:	3
	Mfg:	
LUH-D-04-43 HORIZONTAL UNIT HEATER 4000W, 480V-3ph	Mfg Part:	LUH-D-04-43
Misc Part	Part:	9999
As per specification below	Qty:	3
	Mfg:	
LUH-TK-1 SPST THERMOSTAT FOR LUH-D-04-43 HEATER	Mfg Part:	LUH-TK-1
Misc Part	Part:	9999
As per specification below	Qty:	3
	Mfg:	
WUH-04A CEILING SWIVEL MOUNTING BRACKET FOR LUH-D-04-43 HEATER	Mfg Part:	WUH-04A

KILL-7901

Button, ZB5 AT4	Part:	14607
E-Stop Button	Qty:	1
	Mfg:	Square D
-	Mfg Part:	SQD ZB5 AT4

Button, ZB5 AZ101	Part:	14612
Collar with N/O Contact Body	Qty:	1
	Mfg:	Square D
None	Mfg Part:	SQD ZB5 AZ101

KILL-7902

Button, ZB5 AT4	Part:	14607
E-Stop Button	Qty:	1
	Mfg:	Square D
-	Mfg Part:	SQD ZB5 AT4

Button, ZB5 AZ101	Part:	14612
Collar with N/O Contact Body	Qty:	1
	Mfg:	Square D
None	Mfg Part:	SQD ZB5 AZ101

TT-7901 TT-701 + TT-702

Misc Part	Part:	9999
As per specification below	Qty:	X 2
	Mfg:	
TE500CM12A2A1A6 -58-122F	Mfg Part:	TE500CM12A2A1

Telemetry

Module Code: 8300

8300

Autodialer, Sensaphone FGD800	Part:	17446
8 inputs, 1 output	Qty:	1
	Mfg:	Sensaphone
---	Mfg Part:	FGD800
Misc Part	Part:	9999
As per specification below	Qty:	1
	Mfg:	
OFFSITE CONTROL PROGRAM (ALLEN BRADLEY) PROGRAM IS FOR LOCAL OPERATOR INTERFACE (NOT REMOTE ACCESS)	Mfg Part:	---

Polysulfone Tube, Stainless Case or Union End Flowmeters

KING

n end models are all plastic construction (wetted parts) and are often used in ultra pure / applications.

Tubes are molded chemical and breakage resistant Polysulfone

- In-Line type, NPT connections • 316SS or Teflon®/Polysulfone internals (depending on model)
- Direct reading scales GPM-Water (SCFM-Air scale also provided with case models)
- See through detachable scale plate mounts directly in front of meter tube

Union End Models (A)
- Models with Teflon floats are all plastic construction
- PVDF End Fittings/Viton O-rings

Stainless Case Models (B)
- 316SS Fittings & Internals
- Meter tube is removable without case disassembly


7330

PVDF Union Ends/Teflon Float (Model 7330)

Flow/GPM Min.	Flow/GPM Max.	Connection Size (FNPT) (in.)	Overall Ht. (in.)	Order #	Price Ea.
0.1	1.0	½	10	86487188	$198.53
0.5	5.0	¾	10	86487196	271.81
1.0	10.0	1	12½	86487204	384.17
1.5	15.0	1	12½	86487212	384.17
2.0	20.0	1	12½	86485224	384.17
4.0	40.0	2	16	86485232	1576.52
6.0	60.0	2	16	86485240	1576.52
8.0	80.0	2	16	86485257	1576.52
10.0	100.0	2	16	86485265	1576.52


7310

Stainless Case/SS Ends (Model 7310)

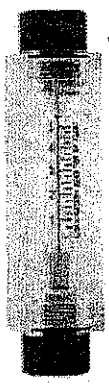
Water Flow/GPM Min.	Water Flow/GPM Max.	Air Flow/SCFM Min.	Air Flow/SCFM Max.	Connection Size (FNPT) (in.)	Overall Ht. (in.)	Order #	Price Ea.
0.14	1.5	0.9	6.1	½	12⅞	86485273	$405.88
0.3	3.0	1.2	12.4	½	12⅞	86485281	405.88
0.5	6.0	2.0	25.0	½	12⅞	86485299	463.87
1.0	10.0	4.0	41.0	½	12⅞	86485307	463.87
1.2	12.0	5.0	50.0	1	12⅞	86485315	530.10
1.8	18.0	6.0	76.0	1	12⅞	86485323	530.10
2.5	25.0	10.0	100.0	1	12⅞	86485331	530.10
3.0	35.0	—	—	1	12⅞	86485349	530.10
8.0	80.0	—	—	2	18½	86485356	1341.22
10.0	100.0	—	—	2	18½	86485364	1341.22

Acrylic, Block Style, In-Line Flowmeters

KING

Max. Flow	Scale L (in.)	FNPT Size (in.)	Overall Ht. (in.)	Order #	Price Ea.
Water Flow					
7 GPH	2	¼	4¾	[1]86485372	$42.56
12 GPH	2	¼	4¾	[1]86485380	42.56
44 GPH	2	¼	4¾	[1]86485398	42.56
1 GPM	2	½	6½	86485406	56.65
2 GPM	2	½	6½	86485414	56.65
5 GPM	2	½	6½	86485422	56.65
10 GPM	4	1	8⅝	86485430	91.18
15 GPM	4	1	8⅝	86485448	91.18
20 GPM	4	1	8⅝	86485455	91.18
1 GPM	5	½	9¼	86485463	82.52
2 GPM	5	½	9¼	86485471	82.52
5 GPM	5	½	9¼	86485489	82.52
2 GPM	10	¾	13⅜	86485497	134.57
5 GPM	10	¾	13⅜	86485505	134.57
10 GPM	10	¾	13⅜	86485513	134.57
Air Flow					
30 SCFH	2	¼	4¾	[1]86485521	45.30
70 SCFH	2	¼	4¾	[1]86485539	45.30
180 SCFH	2	¼	4¾	[1]86485547	45.30
4 SCFM	2	½	6½	86485554	56.65
8.2 SCFM	2	½	6½	86485562	56.65
20 SCFM	2	½	6½	86485570	56.65
40 SCFM	4	1	8⅝	86485588	91.18
60 SCFM	4	1	8⅝	86485596	91.18
4.2 SCFM	5	½	9¼	86485604	82.52
8.2 SCFM	5	½	9¼	86485612	82.52
21 SCFM	5	½	9¼	86485620	82.52
8.0 SCFM	10	¾	13⅜	86485638	134.57
20 SCFM	10	¼	13⅜	86485646	134.57
42 SCFM	10	¾	13⅜	86485653	134.57

[1]Connection - Male NPT


7511

- Model 7511 blocks are machined from solid acrylic stock
- Standard fittings are PVC (316SS or Brass are optional)
- Scales are direct reading in GPM-Water or SCFM-Air
- Panel mounting threaded inserts are included

See attached for detail

Qty

Accucal® Panel Mount High Accuracy Flowmeters

GILMONT®

A rugged new design in chemically resistant stainless steel or PTFE. Meters include snap-on scales for either direct readings of air and water at STD conditions or calibrated/correlated readings. Computerized flow tables included for calibrated readings. Heavy-duty stainless steel body and polycarbonate shield for protection. Overall height 10½", accept ¾" pipe sizes which are 12½". High Accuracy Valve (15+ turns). Metering valve allows for exceptional flow control accuracy. Wetted parts are: glass, stainless steel, Viton® and Kel-F®.

Additional flow ranges and NIST certificates available upon request.

- Rugged block style construction for easy panel mount installation • Viton O-rings
- Calibrated/Correlated and Direct Reading in one meter • 316 Stainless steel body
- Scale size 150mm • Borosilicate glass tube
- Accuracy to: Calibrated/correlated - ±2% of readings; • Direct ±5% of reading
- Max. temp 250°F • Max. pressure 200 psig

Shielded High Accuracy Flowmeters - with Glass/Stainless Steel Float

FNPT Size (in.)	Flow Rate (ml/min) Air Min.	Air Max.	Water Min.	Water Max.	Mfr's #	Order #	Price Ea.
⅛	0.8/2	100/250	0.006/0.04	1.3/5.5	GF-8541-1200	56500424	$355.12
⅛	2/5	300/650	0.02/0.08	4.2/15	GF-8541-1210	56500432	355.12
⅛	7/25	1000/2000	0.08/0.4	17/55	GF-8541-1215	56500440	355.12
⅛	30/100	2200/3200	0.4/2	43/120	GF-8541-1220	56500457	355.12
⅛	100/300	6500/12,000	1/5	140/360	GF-8541-1225	56500465	355.12
⅛	500/1000	14,000/25,000	5/25	320/800	GF-8541-1230	56500473	355.12
¼	1000/1900	26,000/47,000	15/55	610/1400	GF-8541-1235	56500481	355.12
¼	1600/2900	40,000/73,000	30/80	960/2200	GF-8541-1240	56500499	550.10
¼	3400/6000	85,000/150,000	75/180	2000/4700	GF-8541-1250	56500507	550.10

Panel Mount Industrial Flowmeters

GILMONT®

Applications: Field calibration of instruments, pollution analysis, purge systems, petrochemical. Used in pilot plant and process areas requiring a more industrialized package at an economical price or for applications requiring better accuracy than plastic block style meters. Measure and control liquids and gases in a wide range of applications with precision and repeatability. All models feature precision glass metering tubes and a 1.5X magnification shield for easy scale readings. Features unique "Tube Cube" design - allows the glass tube to blow out the back of meter rather than the front, for added safety. Meters come complete with glass and stainless steel floats. Standard panel mount hardware included.

- Rugged block style construction for easy panel mount installation
- Available in 65mm and 150mm scale heights
- Flow range: 10 to 1, i.e. 100% to 10% of full scale

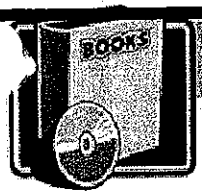
Wetted End Blocks, Fittings and Internal Parts - Anodized Aluminum, Brass or 316 Stainless Steel
Seal Material - Viton®
Metering Tube - Borosilicate Glass
Piping Connections - Aluminum, Brass or 316 SS, ⅛" FNPT horizontal on inlet and outlet
Float Material - Black Glass, 316 SS
Scale - Ceramic fused on glass tube, length - 65mm and 150mm
Pressure Rating - 250 psig max. operating
Temperature Rating - 250°F max. operating
Accuracy - ±5% full scale flow rate
Repeatability - 0.25% of scale reading
Scale Readings - direct reading, air and water

65mm Direct Reading - Standard Valve

Flow Rate (SML/min.)	Stainless Steel Mfr's #	Stainless Steel Order #	Stainless Steel Price Ea.
Air			
5-100	GF-8341-2009	56500622	$216.93
20-250	GF-8341-2010	56500630	216.93
20-500	GF-8341-2109	56500648	216.93
100-1000	GF-8341-2110	56500655	216.93
500-10000	GF-8341-2410	56500663	216.93
2000-40000	GF-8341-2510	56500671	216.93
Water			
0.4-6	GF-8341-2014	56500689	216.93
1-25	GF-8341-2114	56500697	216.93
5-60	GF-8341-2214	56500705	216.93
20-250	GF-8341-2414	56500713	216.93
100-1500	GF-8341-2516	56500721	216.93

150mm Direct Reading - Standard Valve

Flow Rate (SML/min.)	Aluminum Mfr's #	Aluminum Order #	Aluminum Price Ea.	Stainless Steel Mfr's #	Stainless Steel Order #	Stainless Steel Price Ea.
Air						
1-100	GF-8521-2117	56500739	$159.41	GF-8541-2117	56500846	$285.49
50-300	GF-8521-2317	56500747	159.41	GF-8541-2317	56500853	285.49
200-2500	GF-8521-2417	56500754	159.41	GF-8541-2417	56500861	285.49
800-10000	GF-8521-2617	56500762	159.41	GF-8541-2617	56500879	285.49
1000-23000	GF-8521-2717	56500770	159.41			
5000-60000	GF-8521-2817	56500788	159.41	GF-8541-2817	56500895	285.49
Water						
0.2-10	GF-8521-2227	56500796	159.41	GF-8541-2227	56500903	285.49
1-50	GF-8521-2427	56500804	159.41	GF-8541-2427	56500911	285.49
10-200	GF-8521-2627	56500812	159.41	GF-8541-2627	56500929	285.49
20-500	GF-8521-2727	56500820	159.41	GF-8541-2727	56500937	285.49
150-1200	GF-8521-2827	56500838	159.41	GF-8541-2827	56500945	285.49



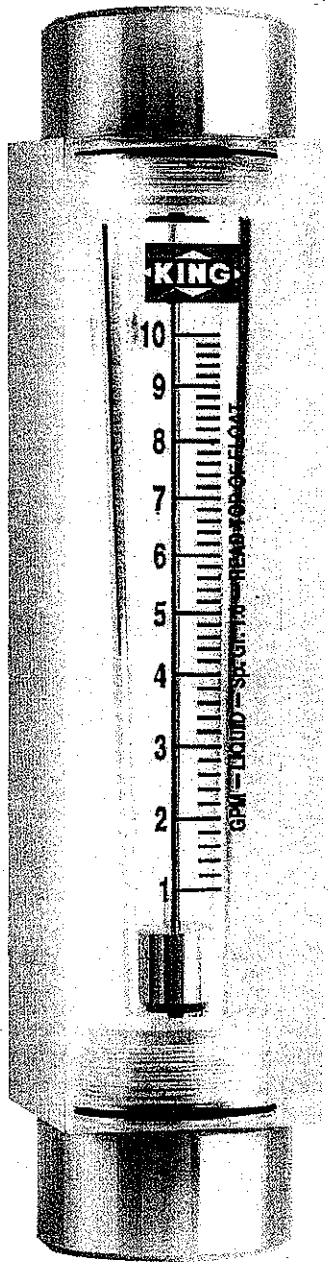
Publications
MSC...Your reference for reference!

Section 8

7510 & 7511 Series

Acrylic Tube

Acrylic block construction with direct reading scale have white ən printed backs to enhance scale readability. Connections are in-line for easy installation.



Description

Metering Tube
Machined Cast Acrylic

Internal Components
316L Stainless Steel

Inlet/Outlet Fittings
FNPT, Vertical

Fitting Material
Standard: PVC
Optional: 316L Stainless Steel, Brass

Elastomers
Standard: EPR
Optional: Buna N, Viton

Options

Certified Calibrations
Conform to ISA RP 16.6

Scales
Can be produced in any volumetric unit

Performance

Capacities
7 GPH to 20 GPM – Water
2.6 SCFH to 60 SCFM – Air

Scale
50mm, 65mm, 100mm, 127mm, 250mm
Direct reading

Accuracy
± 6% of Full Scale Flow, 50mm scale
± 5% of Full Scale Flow, 65mm scale
± 4% of Full Scale Flow, 100mm scale
± 3% of Full Scale Flow, 127mm scale
± 2% of Full Scale Flow, 250mm scale

Turndown
10:1 to 12.5:1 unless otherwise indicated

Repeatability
3%, 50 mm scale
2%, 75 mm scale
2%, 100 mm scale
2%, 127 mm scale
1/2%, 250 mm scale

Max Temperature
130° F (54° C) - Liquid
100° F (38° C) - Gases

Max Pressure
Water – 125 psig
Air – 100 psig

Ambient Temperature
33° F to 125° F (1° C to 52° C)

Materials Of Construction

Model #	7510	7510	7511
Block #	2A	6A & 7A	2B & 5B
Meter Tube	Cast Acrylic	Cast Acrylic	Cast Acrylic
Fittings	Brass*	PVC*	PVC*
	PVC*	Brass	Brass
	316L SS	316L SS	316L SS
O-Rings	EPR*	EPR*	EPR*
	Buna-N	Buna-N	Buna-N
	Viton®	Viton®	Viton®

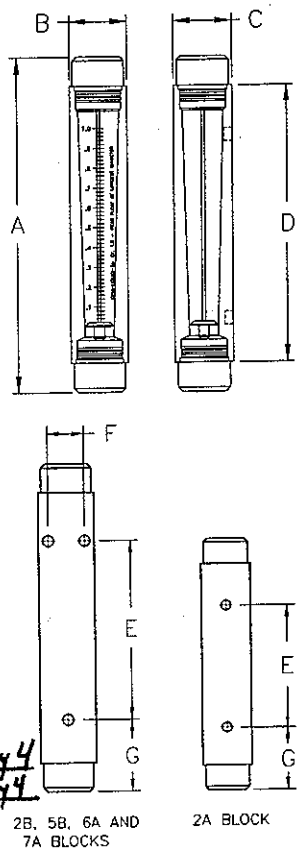
*Denotes standard construction.

7510 & 7511 Series

Acrylic Tube

Specifications:

Order Number	Flow Water	Order Number	Flow Air	Connection Size	Dimensions (Inches) A	B	C	D	E	F	G
Block #2A, 50mm (2 Inch) Scale											
–	–	2A-01	2.6 SCFH	1/4" FNPT*	4.75	1	1.125	3.50	1.50	—	1
–	–	2A-03	5 SCFH	1/4" FNPT*	4.75	1	1.125	3.50	1.50	—	1
–	–	2A-05	10 SCFH	1/4" FNPT*	4.75	1	1.125	3.50	1.50	—	1
–	–	2A-07	20 SCFH	1/4" FNPT*	4.75	1	1.125	3.50	1.50	—	1
2A-02	7 GPH	2A-09	30 SCFH	1/4" FNPT*	4.75	1	1.125	3.50	1.50	—	1
2A-04	12 GPH	2A-11	70 SCFH	1/4" FNPT*	4.75	1	1.125	3.50	1.50	—	1
2A-06	22 GPH	2A-13	100 SCFH	1/4" FNPT*	4.75	1	1.125	3.50	1.50	—	1
2A-08	44 GPH	2A-15	180 SCFH	1/4" FNPT*	4.75	1	1.125	3.50	1.50	—	1
2A-10	60 GPH	2A-17	4 SCFM	1/4" FNPT*	4.75	1	1.125	3.50	1.50	—	1
2A-12	75 GPH	—	—	1/4" FNPT*	4.75	1	1.125	3.50	1.50	—	1
Block #2B, 65mm (2 1/2 Inch) Scale											
2B-02	1 GPM	2B-01	4 SCFM	1/2" FNPT	6.50	1.375	1.375	5	2.50	.937	1.25
2B-04	2 GPM	2B-03	8 SCFM	1/2" FNPT	6.50	1.375	1.375	5	2.50	.937	1.25
2B-06	3.6 GPM	2B-05	15 SCFM	1/2" FNPT	6.50	1.375	1.375	5	2.50	.937	1.25
2B-08	5 GPM	2B-07	20 SCFM	1/2" FNPT	6.50	1.375	1.375	5	2.50	.937	1.25
Block #5B, 127mm (5 Inch) Scale											
5B-02	1 GPM	5B-01	4.2 SCFM	1/2" FNPT	9.25	1.375	1.375	7.75	5.25	.937	1.25
5B-04	2 GPM	5B-03	8.2 SCFM	1/2" FNPT	9.25	1.375	1.375	7.75	5.25	.937	1.25
5B-06	3.5 GPM	5B-05	15 SCFM	1/2" FNPT	9.25	1.375	1.375	7.75	5.25	.937	1.25
5B-08	5 GPM	5B-07	21 SCFM	1/2" FNPT	9.25	1.375	1.375	7.75	5.25	.937	1.25
Block #6A, 100mm (4 Inch) Scale											
6A-02 *	~~10 GPM~~	6A-01	40 SCFM *	1" FNPT	8.375	1.75	1.812	6.625	4	1.25	1.312 Qty 4
6A-04 *	~~15 GPM~~	6A-03	60 SCFM *	1" FNPT	8.375	1.75	1.812	6.625	4	1.25	1.312 Qty 4
6A-06	20 GPM	—	—	1" FNPT	8.375	1.75	1.812	6.625	4	1.25	1.312
Block #7A, 250mm (10 Inch) Scale											
7A-02 *	~~2 GPM~~	7A-01	8 SCFM *	3/4" FNPT	14.812	1.78	1.812	13	8	1.25	2.50 Qty 1
7A-04	3.5 GPM	7A-03	14.8 SCFM	3/4" FNPT	14.812	1.78	1.812	13	8	1.25	2.50
7A-06 *	~~5 GPM~~	7A-05	20 SCFM *	3/4" FNPT	14.812	1.78	1.812	13	8	1.25	2.50 Qty 1
7A-08	10 GPM	7A-07	42 SCFM	3/4" FNPT	14.812	1.78	1.812	13	8	1.25	2.50



* Block 2A has 1/4" FNPT with Brass or Stainless Steel Fitting, 1/4" MNPT with PVC fittings

* 10-32 female thread (Mounting Screws Not Supplied)

Qty	King Model #	MSC #	
(4)	6A-02	86485588	FI - 117, 102, 103, 106
(4)	6A-04	86485596	FI - 101, 113, 110, 107
(1)	7A-02	86485638	FI - 105
(1)	7A-06	86485646	FI - 104

Ordering:

Use the following guide to determine the specific product number you require.

7	5	1								

Meter Series
7510 - 2A, 6A, 7A
~~7511 - 2B, 5B~~

Fitting Material
Brass - 1
PVC - 2
316L SS - 3

O-Ring Material
EPR - 1
Buna-N - 2
Viton® - 3

Order Number
See Specifications Table

Example: 7511 - 2 - 1 - 5B - 08

2" Ø FI's

FLOWMETERS See Attached for Detail *

MSC

Acrylic Tube Flowmeters

KING

A real value in general purpose rotameters. Suitable for many industrial and OEM applications including pollution monitoring equipment, cooling towers, seal water and scrubbers.
- Meter tubes are machined from American made cast acrylic rod stock
- PVC fittings standard (Aluminum for air service) • Floats are rod guided 316 Stainless Steel
- Scales are direct reading (GPM-Water or SCFM-Air)
- Meters have white screen printed backs for enhanced readability
- Fittings thread into metering tubes • Connections are in line type, NPT
- Factory certified calibrations are available • Maximum Temperature 130°F at 0 psig
- Maximum Pressure 125 psig at 70°F for water, 100 psig at 70°F for air

Flow Air	Connection Size (In.)	Overall Ht. (In.)	Order #	Price Ea.
4-43 SCFM	1 FNPT	10¼	86487147	$244.08
6-62 SCFM	1 FNPT	10¼	86487154	244.08
16-165 SCFM	2 FNPT	13¼	86487162	704.17 (7)
25-245 SCFM	2 FNPT	13¼	86487170	704.17 (1)

Flow Water	Connection Size (In.)	Overall Ht. (In.)	Order #	Price Ea.
.5-5 GPM	1 FNPT	10¼	86487006	$181.97
1-10 GPM	1 FNPT	10¼	86487014	181.97
1.5-15 GPM	1 FNPT	10¼	86487022	181.97
2-21 GPM	1 FNPT	10¼	86487030	181.97
3-30.5 GPM	1 FNPT	10¼	86487048	192.09
4-40 GPM	1½ MNPT	12⅞	86487055	229.75
8-50 GPM	1½ MNPT	12⅞	86487063	229.75
4-40 GPM	2 FNPT	13¼	86487071	549.53
6-60 GPM	2 FNPT	13¼	86487089	549.53
8-80 GPM	2 FNPT	13¼	86487097	549.53
20-100 GPM	2 FNPT	13¼	86487105	549.53
30-120 GPM	2 FNPT	13¼	86487113	549.53
45-160 GPM	2 FNPT	13¼	86487121	549.53
55-200 GPM	2 FNPT	13¼	86487139	549.53

7200

High Flow Industrial Flowmeters

GILMONT

This series provides liquid and gas flow readings at capacity levels to 22 L/min. for water while maintaining accuracy of ±5% of full scale. This meter is designed to withstand the physical abuse and environmental corrosion of industrial applications. A one piece aluminum frame provides maximum meter protection and safety. The precision taper of the tube and integral float guides ensure float fidelity. Use brass for general purpose air and water applications, stainless steel for increased chemical and corrosion resistance. Standard Valve and mounting hardware included. Wetted parts are brass, 316 stainless, Buna-N, Viton and glass.
- Brass or 316 SS wetted end blocks, fittings and internal parts
- Viton® seal materials • 316 SS float material
- Black anodized aluminum meter case with acrylic window
- Borosilicate glass metering tube • Brass or 316 SS ¼ FNPT piping connections
- Maximum operating pressure rating is 150 psig and 200°F
- Maximum operating Temperature rating of 250°F • Accuracy, ±5% full scale flow rate
- Range, 10 to 1, i.e., 100% to 10% of full scale • Heavy-duty construction
- Rotatable, direct reading for air (SCFM - SLPM) and water (GPM - LPM)

127mm Direct Reading • Standard Valve

Flow Range (L/min) Air	Water	Brass Mfr's #	Order #	Price Ea.	Stainless Steel Mfr's #	Order #	Price Ea.
20-140	0.5-4	GF-8431-2125	56501174	$466.55	GF-8441-2125	56501232	$698.34
25-425	1-11	GF-8431-2127	56501182	466.55	GF-8441-2127	56501240	698.34
25-575	1-15	GF-8431-2128	56501190	466.55	GF-8441-2128	56501257	698.34
30-280	1-8	GF-8431-2126	56501208	466.55	GF-8441-2126	56501265	698.34
50-900	1-20	GF-8431-2129	56501224	466.55	GF-8441-2129	56501281	698.34

Tripod for Industrial Flowmeters

Mfr's #	Order #	Price Ea.
GF-5005	56501323	$58.93

Holds flowmeters for bench-top operation.

Oval Gear Flowmeters

GPI

High Accuracy/High Viscosity

A compact, positive displacement gear, meter that has the capability to handle a wide range of fluid viscosities up to 1,000CPS and flow rates up to 32 GPM.
- Designed for fast and easy servicing without removing meter from line
- Handles fluids with particle sizes to 0.28mm/0.011"
- Accurate to within +/-0.5% of reading
- Materials: Ryton rotors; viton

Housing O-rings and body housings available in aluminum (for petroleum products); stainless steel and Ryton for water, petroleum, acids and caustics. Meters are available in five output configurations.
- Reed switch pulse output
- Reed switch with LC display
- Loop powered 4 - 20 mA output
- Loop powered 4 - 20 mA with LC display

Pulse/Loop w/o Display

Pulse/Loop w/Display

Mechanical

Display in gallons and in gallons per minute; 6 digit x ⅜" H; 2 total displays - resettable and non-resettable up to 99999.9 gallons; factory set calibration constant (K Factor); battery powered - 9 volt lithium.

- Mechanical totalizer display in gallons; 2 totals non-reset up to 999,999 and up to 999.9 push button reset

Pipe Size (In.)	Flow Rate GPM (Min.)	(Max.)	Body Material	Pulse Output Only Mfr's #	Order #	Price Ea.	Pulse Output w/Display Mfr's #	Order #	Price Ea.	4-20 mA Output Only Mfr's #	Order #	Price Ea.	4-20 mA Output w/Display Mfr's #	Order #	Price Ea.	Mechanical Display Mfr's #	Order #	Price Ea.
½ FNPT	0.3	7.9	Aluminum	GM005A2R21-1	48686851	$624.97	GM005A2R21-5	48686869	$1063.55	GM006A2R21-7	04653648	$912.57	GM005A2R21-6	04653622	$1132.93	GM505A2M21-9	04653630	$810.19
½ FNPT	0.3	7.9	Stainless Steel	GM005S2R21-2	04653689	1307.65	GM005S2R21-5	04653655	1752.82	GM005S2R21-7	04653697	1585.89	GM005S2R21-6	04653063	1806.23	GM505S2M21-9	04653671	1483.49
1 FNPT	0.8	21.0	Ryton	GM007R2R21-4	04653721	664.41	GM007R2R21-5	04653705	1109.56	GM007R2R21-7	04653739	942.63	GM007R2R21-6	04653713	1162.98			
1 FNPT	1.6	32.0	Aluminum	GM010A2R21-1	48686877	971.45	GM010A2R21-5	48686885	1410.83	GM010A2R21-7	04653499	1264.24	GM010A2R21-6	04653481	1484.61	GM510A2M21-9	54091871	1161.86
1 FNPT	1.6	32.0	Stainless Steel	GM010S2R21-1	04653531	2008.78	GM010S2R21-5	04653507	2453.94	GM010S2R21-7	04653549	2287.01	GM010S2R21-6	04653515	2587.36	GM510S2M21-9	04653523	2184.62

Shielded High Accuracy Flowmeters

GILMONT

For applications where highly accurate readings are required or specialty gases and liquids need to be monitored.
Made of corrosion resistant materials, fluid contacts only borosilicate glass tube, PTFE body and Viton O-rings. End bushings are polypropylene with PTFE inserts. Bushings are threaded to accept female NPT fittings. Fluid does not contact polycarbonate shield. Polycarbonate shield adds strength and protection.

Calibrated/Correlated

Float	Flow Rate Air ml/min.	Water ml/min.	Ports NPT (M) (In.)	Max. psi	Dimensions (L x OD) (In.)	Mfr's #	Order #	Price Ea.
Ruby Glass	0.02-15	0.0002-0.12	¼	125	8 x 1	GF-3060	56500200	$332.82
Glass/316 Stainless Steel	0.2-100/0.36-180	0.002-1.1/0.004-2.3	¼	125	10¼ x 1	GF-1060	56500218	258.55
Glass/316 Stainless Steel	1-280/2-500	0.01-4.0/0.02-8.6	¼	125	10¼ x 1	GF-1160	56500226	248.12
Glass/316 Stainless Steel	10-1900/20-3400	0.2-36/0.43-77	¼	100	10¼ x 1	GF-1260	56500234	266.39
Glass/316 Stainless Steel	200-14,000/360-25,000	3-300/6-640	¼	75	10¼ x 1	GF-1360	56500242	266.35
Glass/316 Stainless Steel	1000-36,000/1800-64,000	10-850/21-1820	½	60	13¼ x 1½	GF-1460	56500259	319.65
Glass/316 Stainless Steel	3000-77,000/3600-137,000	30-1900/64-4100	½	50	13¼ x 1½	GF-1560	56500267	348.22

Direct Reading

Float	Flow Rate Air ml/min.	Water ml/min.	Ports NPT (M) (In.)	Max. psi	Dimensions (L x OD) (In.)	Mfr's #	Order #	Price Ea.
Glass/316 Stainless Steel	0.2-90/0.36-160	0.002-1.1/0.004-2.3	¼	125	8 x 1	GF-2060	56500275	$182.83
Glass/316 Stainless Steel	1-280/2-500	0.01-4.0/0.02-8.6	¼	125	8 x 1	GF-2160	56500283	168.48
Glass/316 Stainless Steel	20-2100/36-3700	0.4-40/0.86-86	¼	100	8 x 1	GF-2260	56500291	159.31
Glass/316 Stainless Steel	200-14,000/360-25,000	2-300/4-640	¼	75	8 x 1	GF-2360	56500309	285.93
Glass/316 Stainless Steel	1000-36,000/1800-64,000	10-850/21-1820	½	60	9¾ x 1½	GF-2460	56500317	244.19
Glass/316 Stainless Steel	3000-77,000/5300-137,000	30-1900/64-4100	½	50	9¾ x 1½	GF-2560	56500325	255.97

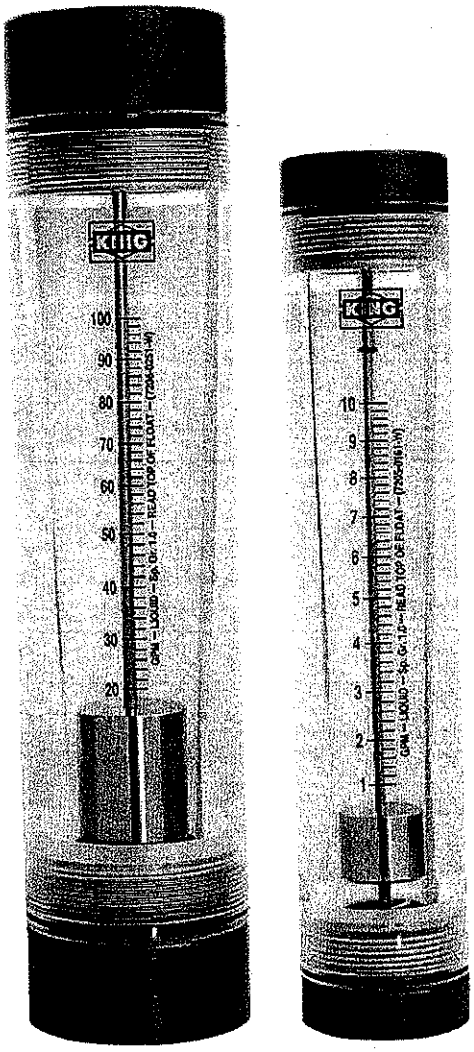
- Chemically compatible PTFE and glass construction
- Flow Ranges: Air - 0.02 ml/min to 670 l/min.; Water - 0.0002 ml/min to 21 l/min.
- Direct Reading Accuracy is ±5% of reading or 2mm of the scale length, whichever is greater
- Correlated Accuracy is ±2% of reading or ±1 scale division, whichever is greater
- Glass tube, PTFE inserts, Viton O-rings
- Male NPT fittings
- Glass and stainless steel float included
- Max. temp. 150°F

Direct readers have scales for reading air and water measurements directly in ml/min. Calibrated/correlated meters come with computerized calibration tables to determine flowrate for air and water or choose Flow Rate Analysis Software to automatically generate flow charts for your specific fluid or gas application. Scale graduations 0 to 100. Scale height: 4" for direct reading meters, 6" for calibrated.

7200 Series

Acrylic Tube

A real value in general purpose r eters. Vertical connections rom 3/8" NPT to 2" NPT



Description

Metering Tube
Machined Cast Acrylic

Internal Components
316L Stainless Steel

Inlet/Outlet Fittings
NPT, Vertical

Fitting Material
Standard: PVC (not for air service)
Optional: 316 Stainless Steel, Brass, Aluminum

Elastomers
Standard: EPR
Optional: Buna-N, Viton®

Options

tified Calibrations
Conform to ISA RP 16.6

Scales
Can be produced in any volumetric unit

Performance

Capacities
1 to 200 GPM – Water
4 to 245 SCFM – Air

Scale
127 mm (5")
Direct reading

Accuracy
± 3% to ± 6% of Full Scale Flow
See specifications table

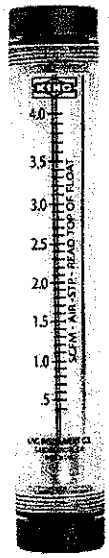
Turndown
10:1 to 12.5:1 unless otherwise indicated

Repeatability
1% to 2%
See specifications table

Max Temperature
Water – 130° F (54° C)
Air – 100° F (38° C)

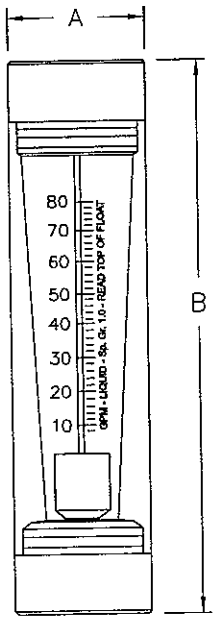
Max Pressure
Water – 150 psig
Air – 100 psig

Ambient Temperature
33° F to 125° F (1° C to 52° C)



Caution:

Meters used in gas service are designed to operate at 14.7 psia. Meters used in pressure gas service must be shielded using 3/8" polycarbonate to protect personnel and equipment in the event of tube failure.



Refer to specification table on page 7

7200 Series
Specifications:

Acrylic Tube

Order Number	Flow GPM - Water	Flow SCFM - Air	F.S. Accuracy±/ Repeatability	Press. Drop (In. / W.C.)	Connection Size	Dimensions A	Dimensions B
0051	1	4	3%/2%	2.9	3/8" FNPT	1.375"	8.25"
0052	1	4	3%/2%	2.9	1/2" FNPT	1.375"	8.25"
0061	2	8	3%/2%	5.2	3/8" FNPT	1.375"	8.25"
0062	2	8	3%/2%	5.2	1/2" FNPT	1.375"	8.25"
0071	3.5	14	3%/2%	9.5	3/8" FNPT	1.375"	8.25"
0072	3.5	14	3%/2%	9.5	1/2" FNPT	1.375"	8.25"
0081	5	20	3%/2%	13.1	3/8" FNPT	1.375"	8.25"
0082	5	20	3%/2%	13.1	1/2" FNPT	1.375"	8.25"
0151	5	20	3%/1%	10	1" FNPT	2.000"	10.25"
0161	10	43	3%/1%	12	1" FNPT	2.000"	10.25"
0171	15	62	3%/1%	18	1" FNPT	2.000"	10.25"
0181	21	86	3%/1%	22	1" FNPT	2.000"	10.25"
0191	30.5	–	3%/1%	26	1" FNPT	2.000"	10.25"
0201	40	–	6%/2%	32	1 1/2" MNPT	2.000"	12.06"
0211	50	–	6%/2%	38	1 1/2" MNPT	2.000"	12.06"
221 *	40	165 *	4%/1%	18	2" FNPT	3.000"	13.25"
0231 *	60	245 *	4%/1%	25	2" FNPT	3.000"	13.25"
0241	80	–	4%/1%	30	2" FNPT	3.000"	13.25"
0251	100*	–	4%/1%	35	2" FNPT	3.000"	13.25"
0261	120*	–	6%/2%	45	2" FNPT	3.000"	13.25"
0271	160*	–	6%/2%	60	2" FNPT	3.000"	13.25"
0281	200*	–	6%/2%	80	2" FNPT	3.000"	13.25"

Q

Q+1

* These meters have less than 10:1 turndown. See table for specifics.

Order Number	Flow Range	Actual Turndown
0251	20 - 100 GPM	5:1
0261	30 - 120 GPM	4:1
0271	45 - 160 GPM	3.55:1
0281	55 - 200 GPM	3.63:1

Max. Pressure Water	Max. Pressure Air	Max. Temp Water	Max. Temp Air
150 psig	100 psig	130° F	100° F

King model

0221 - F1 - 118, 116, 115, 112, 111, 109, 108 *

0231 - F1 - 114

Ordering:

Use the following guide to determine the specific product number you require.

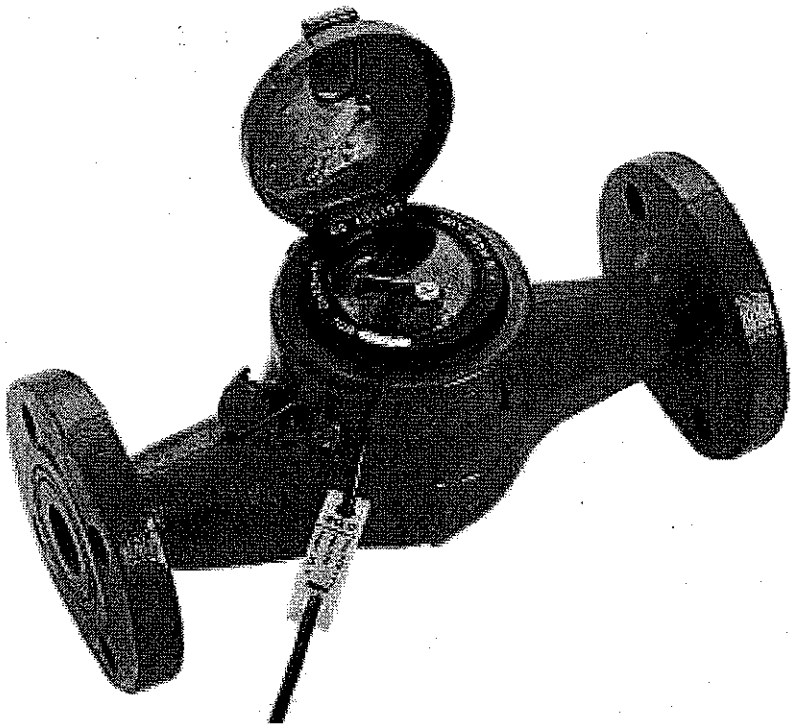
7	2	0	5									

eter Series	Order number from specifications table above	Fitting Material	O-Ring Material	Fluid To Be Metered
		Brass - 1 316 SSL - 2 PVC - 3 Aluminum - 6	EPR - 1 Buna-N - 2 Viton® - 3	GPM–Liquid - W SCFM–Air - A

Example: 7205 - 0281 - 3 - 1 -W

Multi Jet Volume Measuring Part for Heat Meters

Type MTH 130°C



Technical features

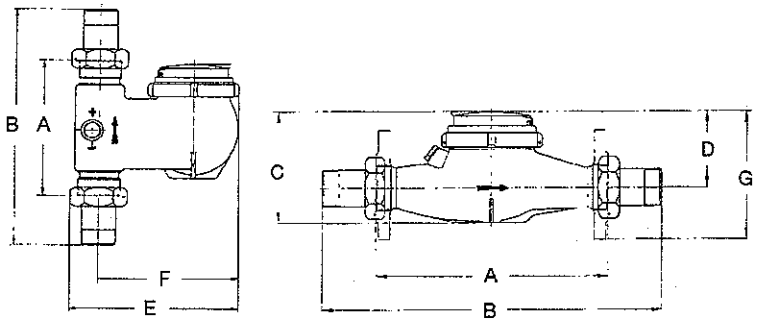
- Multi-jet impeller wheel super dry dial with magnetic transmission
- Operation temperature max. 130°C (peak temperature max. 150°C)
- Horizontal and vertical installation (transverse housing)
- High precision metallic counter, evacuated and 360° turnable
- Special waterproof pulser IPG 12 (pulse frequency of 2,5/5/10/25/100/250 litre per pulse)
- Metrological class B measuring range 1:50
- Special hard bearing resistant to wear
- Reconditionable and recycable execution
- High and durable measuring accuracy due to the rugged and reliable construction
- Operation pressure PN 16 (thread) or PN 25 (with flanges)
- Manufactured according to ISO 9001 quality norms
- Different approvals according to OIML R72 and country regulations

GWF

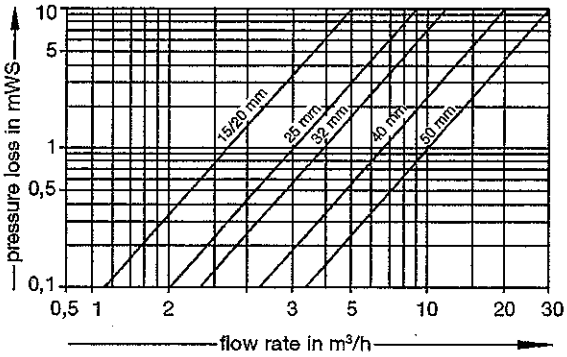
The benchmark in metering technology

SE IMPUL

Dimension pictures



Graph showing pressure drop



Technical data for MTH multi-jet volume measuring part for heat meters

Execution			MTH 130 °C								MTH-VS or -VF 130 °C[1]				
Nominal diameter	**DN**	**mm**	**15**	**20**		**25**		**32**	**40**	**50**	**20**		**25**	**32**	**40**
Connection thread on meter	Inch	G..B	¾	1		1¼		1½	2	2⅜	1		1¼	1½	2
Connection thread on coupling	Inch	R..	½	¾		1		1¼	1½	2	¾		1	1¼	1½
Max. operating pressure (thread version)		bar	16	16		16		16	16	16	16		16	16	16
Max. operating pressure (flanged version)		bar	25	25	25	25	25	25	25	25	–	–	–	–	–
Nominal flow rate	***qp* (Qn)**	**m³/h**	**1,5**	**1,5**	**2,5**	**3,5**	**6**	**6**	**10**	**15**	**1,5**	**2,5**	**3,5**	**6**	**10**
Max. flow rate	*qs* (Qmax)	m³/h	3	3	5	7	12	12	20	30	3	5	7	12	20
Partial limit ±3% from	Qt	l/h	120	120	200	280	480	480	800	1500	120	200	280	480	800
Min. flow rate ±5% from	*qi* (Qmin)	l/h	30	30	50	70	120	120	200	300	30	50	70	120	200
Pressure loss at approx. ⅔ *qp*		bar	0,1	0,1	0,1	0,1	0,1	0,1	0,1	0,1	0,1	0,1	0,1	0,1	0,1
Value kvs	m³/h	bar	3	3	5	10	12	12	20	30	3	5	10	12	20
A Length without couplings		**mm**	**165**	**220[2]**	**220[3]**	**260**	**260**	**260**	**300**	**300**	**105**	**105**	**150**	**150**	**200**
B Length with couplings		mm	244	318	318	378	378	378	438	458	203	203	268	268	338
C Meter height (thread version)		mm	110	116	116	121	121	121	150	163	–	–	–	–	–
D Meter height from pipe centre line		mm	75[4]	75	75	80	80	80	105	118	–	–	–	–	–
E Meter depth		mm	–	–	–	–	–	–	–	–	150	150	170	178[5]	217[6]
F Meter depth from pipe centre line to centre gauge slide		mm	–	–	–	–	–	–	–	–	126	126	145	146[5]	185
G Meter height – flanged version		mm	110[8]	125	125	135	135	145	175	188	–	–	–	–	–
Meter width		mm	88	88	88	97	97	101	138	155	88	88	102	103	135[7]
A Length with flanges PN 25 (DIN 2501)		mm	–	190	190	260	260	260	300	300[8]	–	–	–	–	–
Flange external ø		mm	–	105	105	115	115	140	150	165	–	–	–	–	–
Hole circle ø		mm	–	75	75	85	85	100	110	125	–	–	–	–	–
Number of screws ø		ea.	–	4	4	4	4	4	4	4	–	–	–	–	–

Other executions on request

[1] MTH-VS = vertical riser
MTH-VF = vertical down pipe

[2] Also supplied in length 165 mm and 190 mm

[3] Also supplied in length 190 mm

[4] Data execution thread version

[5] For vertical down pipe housing MTH-VF + 11 mm

[6] For vertical down pipe housing MTH-VF + 13 mm

[7] For vertical down pipe housing MTH-VF + 4 mm

[8] Also supplied in length 270 mm

Subject to modification.

The benchmark in metering technology

GWF Gas and Water Meter Manufacturing Ltd., Obergrundstrasse 119, CH-6002 Lucerne/Switzerland
Telephone ++41 41 319 50 50, telefax ++41 41 310 60 87, E-mail gwf@gwf.ch, http://www.gwf.ch

EP⊕ 20304-100

Multiple-Stage Switches: **Vertical Mount**

Innovative Solutions

L312 Series Custom Switches with a Maximum Length of 4'

The L312 series level switches are individually designed from over 360 component parts to create a custom switch available in lengths of from six inches (152 mm) to four feet (1.2m).

Product Configuration Choices:

Mounting & Materials: Select mounting size, mount and stem material, float material, switch type, and optional enclosure from **Table A.**
Float Size: Select float from **Table B.**
Switch Wiring: Select switch wiring from **Table C.**
Actuation Levels: Select switch actuation level(s) from **Table D.**

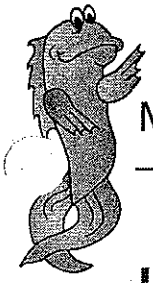
A. Component Choices L312:

Series		Mounting Types		Mounting & Stem Materials		Float Materials		Switch Types		Enclosures
L312	00	No mounting	01	Brass	02	Polypropylene (hollow)	20	20 VA SPST	00	No enclosure
	01	⅜" NPT	02	Polypropylene	03	Polypropylene (solid)	03	50 VA SPST (standard)	01	Polypropylene NEMA 4
	02	¼" NPT	04	Kynar (PVDF)	04	Kynar (PVDF)	04	100 VA SPST	02	Cast aluminum NEMA 4/7/9
	03	⅝" NPT	05	PVC	05	PVC	06	3 VA SPDT		
	04	½" NPT	08	316 SS	08	316 SS			03	Cast Iron NEMA 4/7/9
	05	¾" NPT	15	Teflon (PFA)	15	Teflon (PFA)				
	06	1" NPT	18	Nylon	16	Teflon PTFE (hollow)				
	07	1¼" NPT	21	Acetal (Delrin)	20	Buna-N				
	08	1½" NPT	22	Polysulfone	22	Polysulfone				

Example: L312-0401-2003-00 = 1/2" NPT mounting; brass mounting & stem material; Buna-N float; 50VA SPST switches; no enclosure

* LSHH, LSH -510 custom see Section 5 pg 24 of 37 of this manual for Specifications.
L312C XXXX-XXXX

** LSHH, LSH, LSL- L312C 339-0001
See Section 5 pg 16 of 37 of this manual for addt'l Specifications.



Innovative Solutions

L312 Series Custom Switches with a Maximum Length of 4'

B. Float Sizes and Operating Specifications

Float Materials	Dimensions	Available Mount Types	Temperature	Pressure	Minimum Specific Gravity
Polypropylene (hollow)	1" x 1"	00, 01, 02, 03, 04, 06, 07, 08	-40° to +150° F	50 psig	.70
Polypropylene (solid)	1" x 1"	00, 01, 02, 03, 04, 06, 07, 08	-40° to +150° F	150 psig	.90
Kynar	1" x 1"	00, 01, 02, 03, 04, 06, 07, 08	-40° to +150° F	50 psig	1.1
PVC	1" x 1"	00, 01, 02, 03, 04, 06, 07, 08	-40° to +140° F	50 psig	.95
316 stainless steel	1" x 1"	00, 01, 02, 03, 04, 06, 07, 08	-40° to +300° F	300 psig	.95
316 stainless steel	1.5" x 1"	00, 01, 02, 03, 08	-40° to +300° F	100 psig	.70
316 stainless steel	1" ball	00, 01, 02, 03, 04, 06, 07, 08	-40° to +300° F	275 psig	.80
316 stainless steel	.90" x 1⅛"	00, 01, 02, 03, 04, 05, 06, 07, 08	-40° to +300° F	200 psig	.85
Teflon (PFA)*	1" x 1"	00, 01, 02, 03, 04, 06, 07, 08	-40° to +300° F	1000 psig	.90*
Teflon (hollow)	1.125" x 1.250"	00, 01, 02, 03, 04, 06, 07, 08	-40° to +300° F	25 psig	1.0
Buna-N	1" x 1"	00, 01, 02, 03, 04, 06, 07, 08	-40° to +180° F	150 psig	.80
Polysulfone	1" x 1"	00, 01, 02, 03, 04, 06, 07, 08	-40° to +225° F	50 psig	.90

C. Switch Wiring and Electrical Specifications

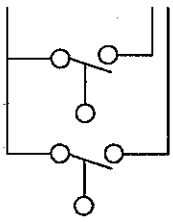
Each switching point requires one float. For special applications, a single float can be used to activate two switch points, though these points must have a minimum separation of ⅛" (3mm). The maximum number of actuation levels depends on the wiring type selected.

Ratings: 20 VA @ 120 VAC SPST
50 VA @ 240 VAC SPST
3 VA @ 30 VAC/VDC SPDT

Connection: 24" Free Leads
#22 AWG, PVC jacketed.

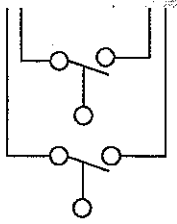
Mounting Attitude: Vertical ± 30°

Group 1 SPST
One Common Wire



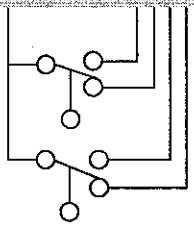
1 to 5 switch points

Group 2 SPST
Independent Circuits



1 to 3 switch points

Group 3 SPDT
One Common Wire



1 or 2 switch points

Wiring Options	Switch Wiring Code Group 1 SPST	Group 2 SPST	Group 3 SPDT
Common Wire	Black	None	Black
	NO or NC	NO or NC	NO/NC
L1	Red	Red/Red	Red/White-Red
L2	Yellow	Yellow/Yellow	Yellow/White-Yellow
L3	Blue	Blue/Blue	
L4	Brown		
L5	Orange		

Notes: All SPST switches are set normally open in their "dry", "no level" condition unless specified otherwise.
"White-Red" and "White-Yellow" denote single whtie wire with red or yellow stripes.

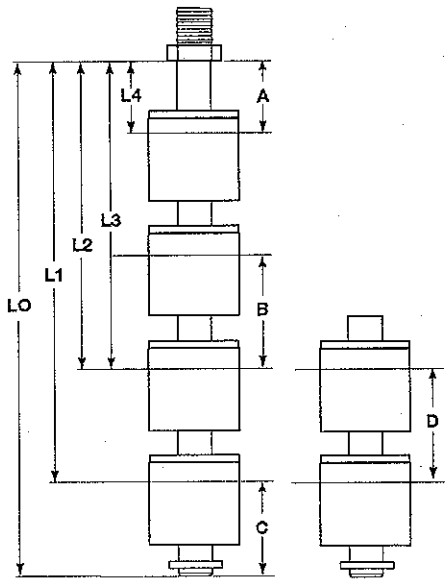
L312 Series Custom Switches with a Maximum Length of 4'

D. Actuation Level Dimensions

A = Minimum distance from actuation point to bottom of mounting.
B = Minimum distance between actuation levels.
C = Minimum distance from end of unit to lowest actuation point.
D = Minimum distance between actuation points when a single float is used to actuate two switches.

Notes:

1. A, B, and C dimensions are based on a specific gravity of 1.0.
2. When using one float for two actuation positions, contact the factory for available switch ratings.
3. Actuation levels are calibrated on descending fluid level, with water as the fluid, unless otherwise specified.
4. Standard tolerance on actuation levels is ± 1/8" (3mm).



	Dimensions			
Float Type	A	B	C	D
1" x 1"	1"	1¾"	1"	⅛"
1.5" x 1"	1"	1¾"	1"	⅛"
1" ball	1"	1¾"	1"	⅛"
.9 x 1.5"	1"	2⅛"	1⅛"	⅛"

TP-210, 310, 410

MOYNO

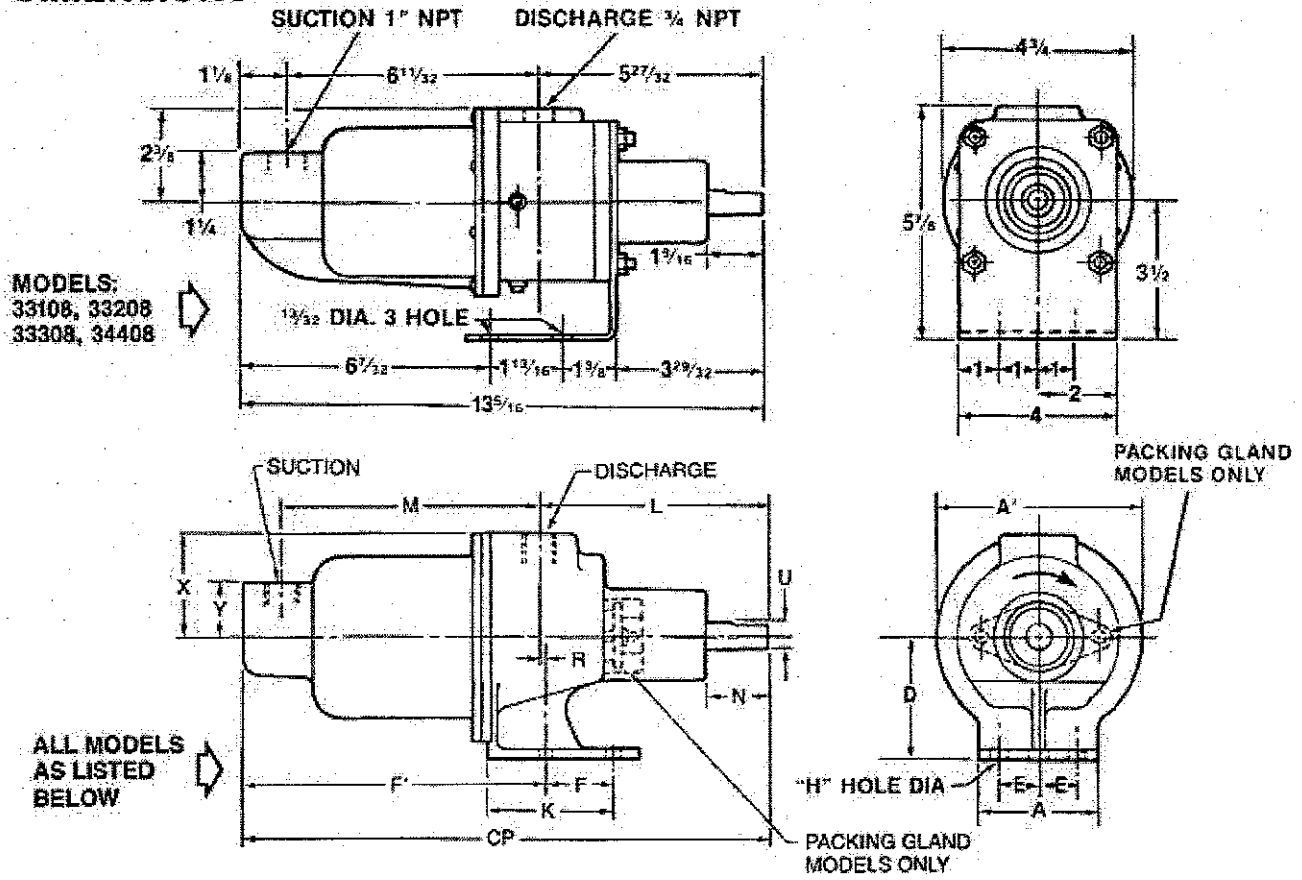
Always the Right Solution™

SPECIFICATION DATA

MOYNO® 500 PUMPS

300 SERIES
331, 332, 333, 344, 356 AND 367 MODELS

DIMENSIONS

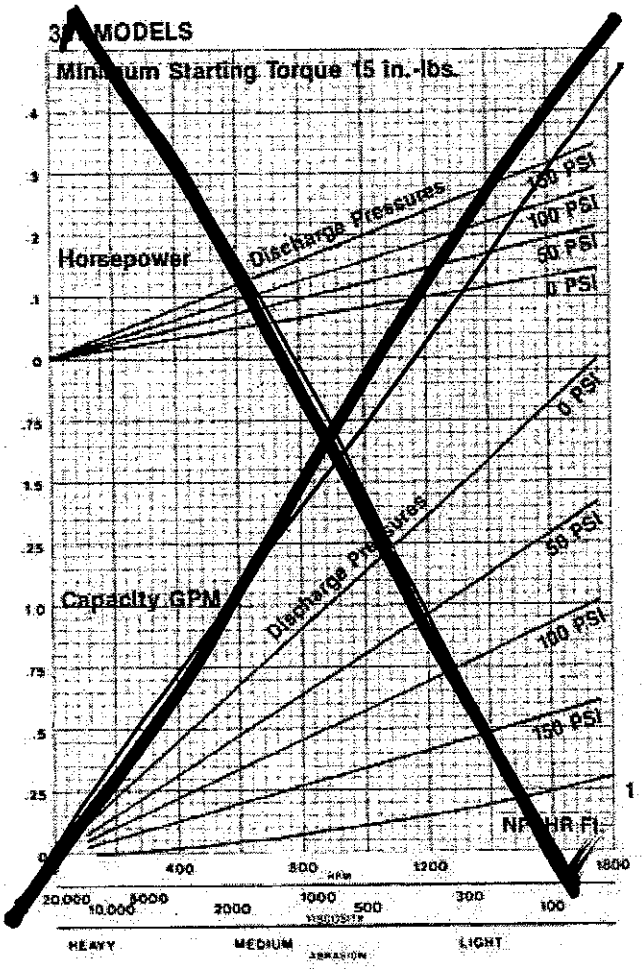


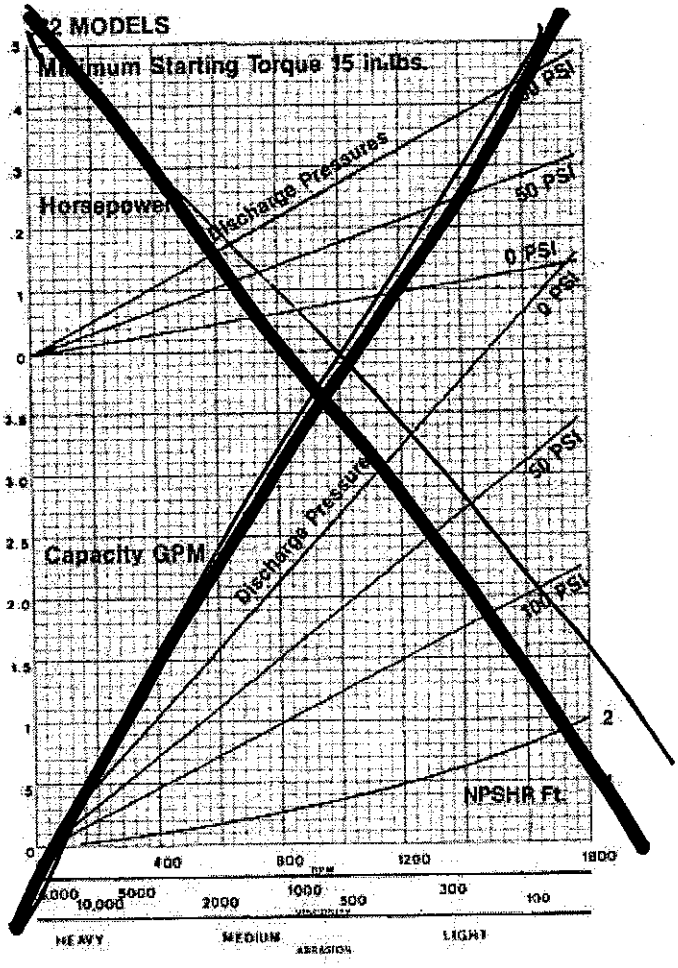
MODELS	CP	A	A¹	D	E	F	F¹	H	K	L	M	N	R	U	X	Y	SUCT (NPT)	DISCH (NPT)
33101, 33201 33301, 33104 33204, 33304 34401, 34404	12⅝	3⅛	4¾	2¾	1	1¹³/₁₆	6¹⁵/₁₆	¹³/₃₂	3¹/₃₂	5¹¹/₁₆	6¹/₁₆	1⁷/₁₆	—	⅝	2⅜	1¼	¾	¾
*34411	13¹⁵/₁₆	3¼	4¾	2¾	1⅛	—	7⅜	¹³/₃₂	2⅞	7	6¹/₁₆	1⅜	¼	⅝	2⁵/₁₆	1¼	¾	¾
35601, 35604	17½	6½	7⁹/₁₆	4⁹/₃₂	1¾	2	10¹⁹/₃₂	¹³/₃₂	4½	7⅜	8⅝	2⅜	¹⁵/₃₂	¾	3²⁵/₃₂	2⅛	1½	1¼
*35611, *35613	19⅜	6½	7⁹/₁₆	4⁹/₃₂	1¾	2½	10¹⁹/₃₂	¹³/₃₂	4	9¹¹/₃₂	8⅝	2¹³/₃₂	⁹/₁₆	¾	3²⁵/₃₂	2⅛	1½	1¼
36701, 36704	20¹⁵/₁₆	5¼	8	4½	2	2⁵/₁₆	13	⁹/₁₆	4¹/₁₆	7¹⁵/₁₆	11³/₁₆	2⅛	—	1	4	2½	2	2

*Packing Gland Model

All dimensions are in inches. Specifications subject to change without notice.

331, 332, 333 and 344 MODELS
PERFORMANCE (water at 70°F)



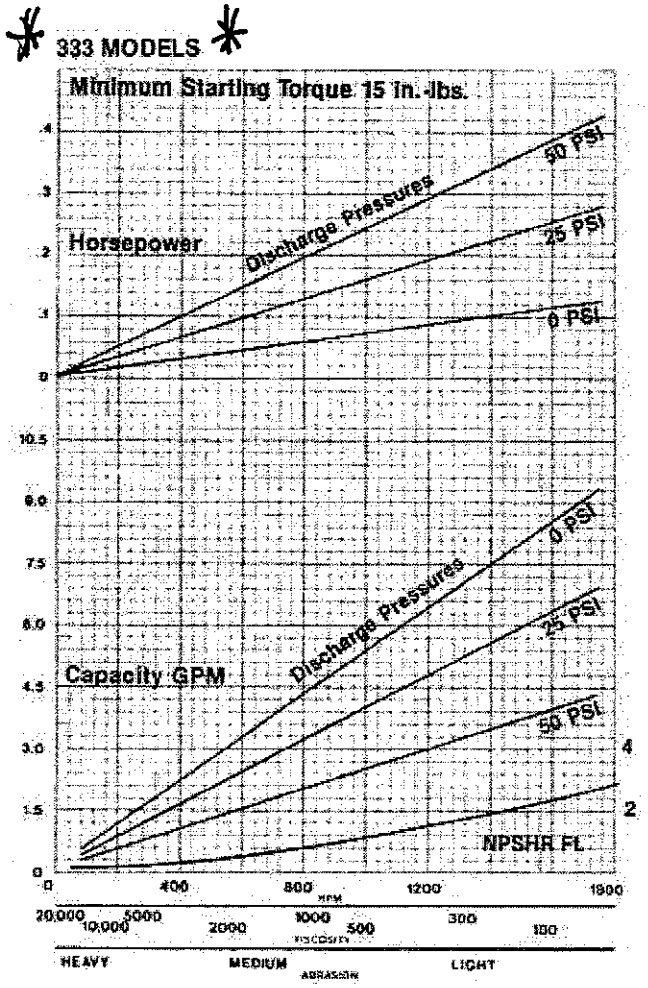


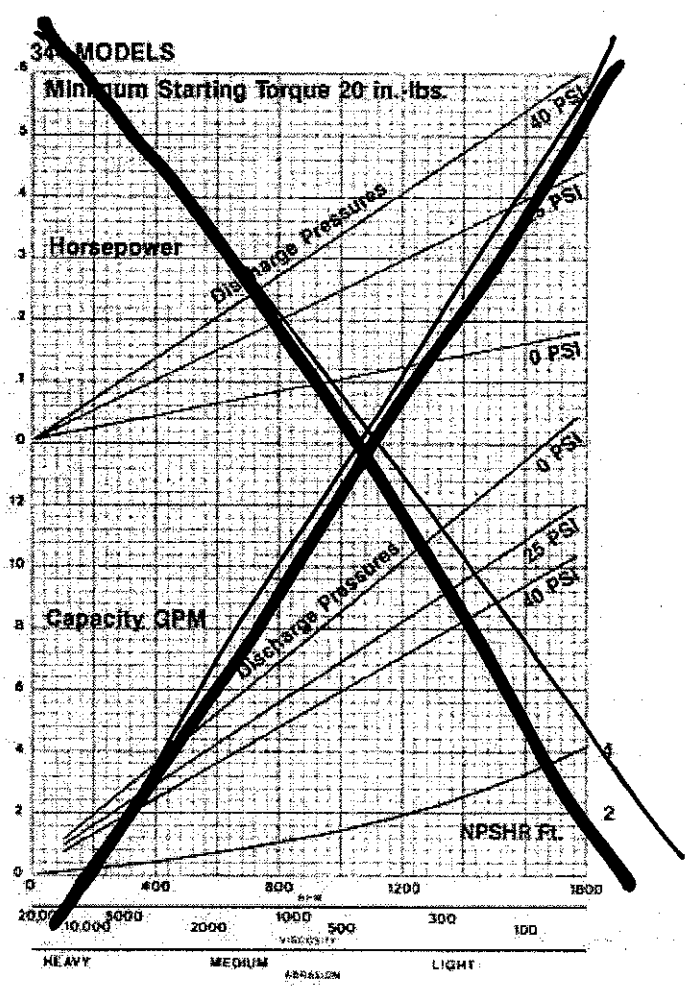
NOTE: For fluids with viscosity over 200 CP (1000 SSU), pump capacity is reduced by 20%.

MATERIALS OF CONSTRUCTION

COMPONENT	MODELS			
	33101, 33201 33301, 34401	33104, 33204 33304, 34404	33108, 33208 33308, 34408	*34411
Housing	Cast iron	316 SS	Nylon	Cast iron
Rotor	416 SS/CP	316 SS/CP	416 SS/CP	416 SS/CP
Stator	NBR (Nitrile)	NBR (Nitrile)	NBR (Nitrile)	NBR (Nitrile)
Weight (lbs)	16	16	8	16

* Packing Gland Model
CP = Chrome plated

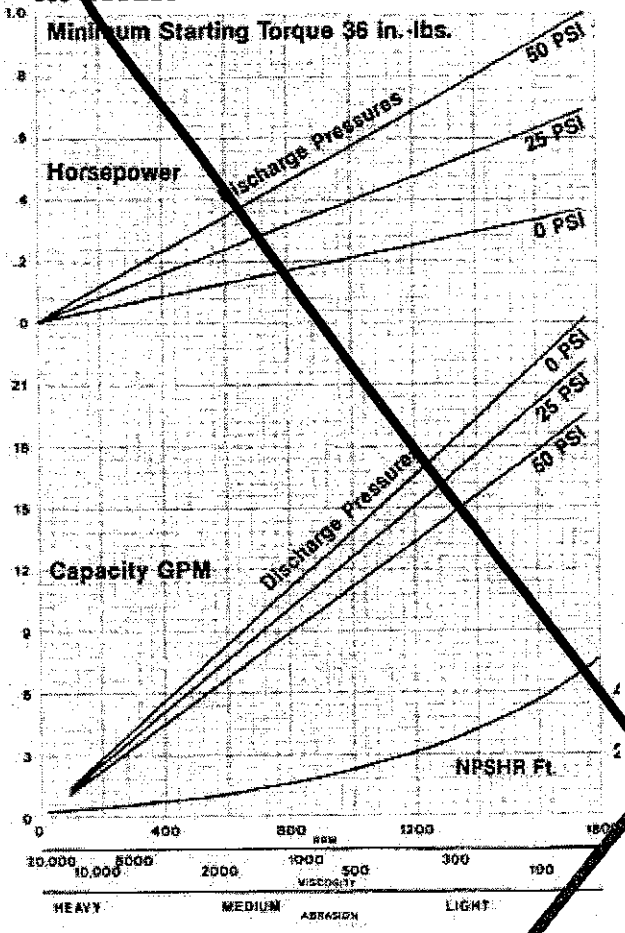




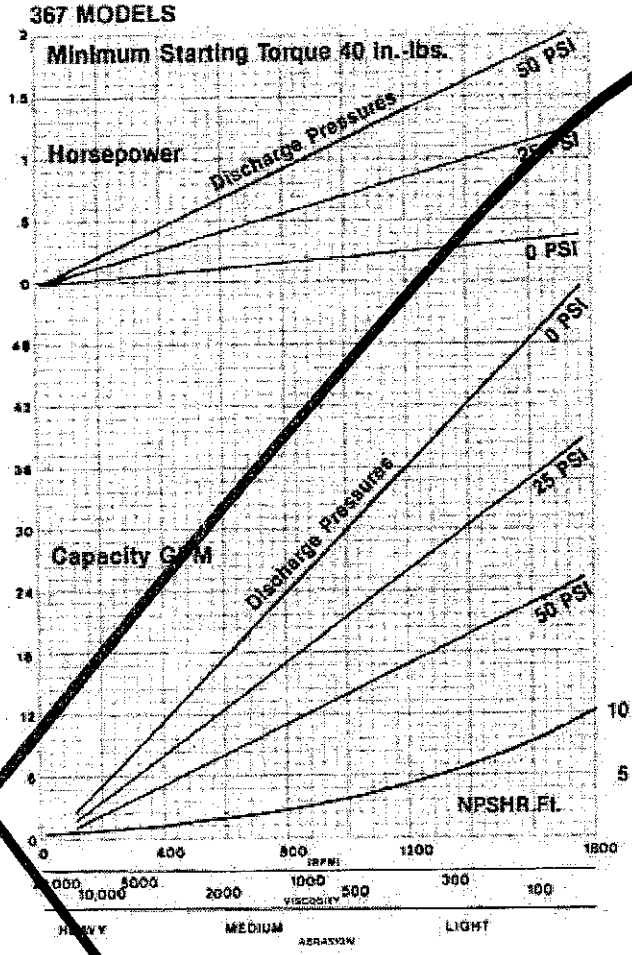
NOTE: For fluids with viscosity over 200 CP (1000 SSU), pump capacity is reduced by 20%.

356 and 367 MODELS PERFORMANCE (water at 70°F)

356 MODELS



367 MODELS



NOTE: For fluids with viscosity over 200 CP (1,000 SSU), pump capacity is reduced by 20%.

MATERIALS OF CONSTRUCTION

COMPONENT	MODELS					
	35601, 35611		35604, 35613		36701	36704
Housing	Cast iron		316 SS		Cast iron	316 SS
Rotor	416 SS/CP		316 SS/CP		416 SS/CP	316 SS/CP
Stator	NBR (Nitrile)		NBR (Nitrile)		NBR (Nitrile)	NBR (Nitrile)
Weight (lbs)	37	40	37	40	54	54

CP=Chrome plated

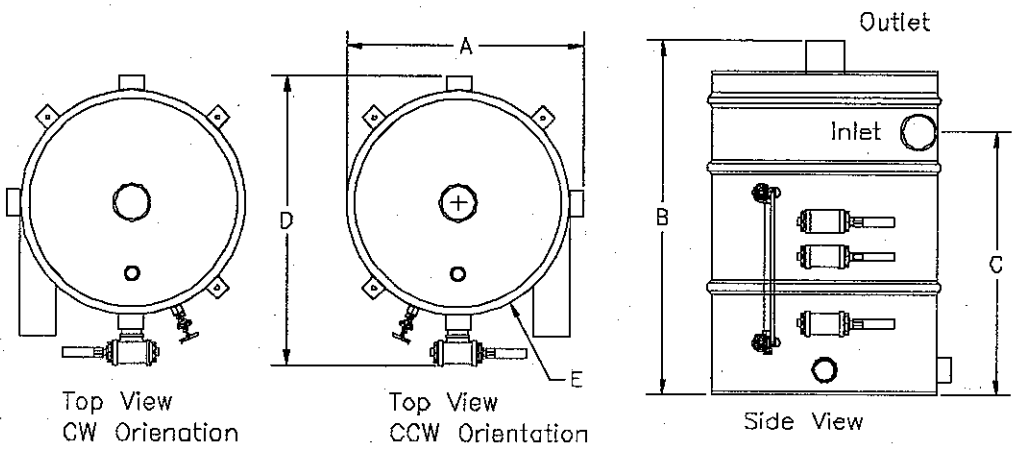
Printed in U.S.A.

Product Technical Specification

VLD Series Vapor Liquid Separator

Application: The VLD Series Vapor Liquid Separator is capable of capturing entrained water from a process air stream. The separator is designed with a tangential inlet to utilize centrifugal forces to aid in the air water separation. The water collects in the bottom of the separator while the air exits the large discharge pipe in the top of the separator.

Construction: The VLD Series separator is constructed using a steel epoxy-coated drum. The top of the drum is removable allowing access to the interior of the separator for cleaning and inspection. The drum is reinforced with ribs on the side and angle welded to the top to prevent distortion when operating under vacuum.



Dimensions Chart: (Dimensions in inches unless otherwise noted)

Part Number	A	B	C	D	E Dia.	Total Volume	Storage Volume	Shipping Weight
VLD-400	26	40	28.25	32	24	55 Gal Imp.	33 Gal Imp.	110 lb
VLD-800	30	46	31.375	36	28	85 Gal Imp.	52 Gal Imp.	140 lb

Specifications Chart:

Specification	VLD-400	VLD-800
Inlet (Inches):	4	6
Outlet (Inches):	6	8
Maximum Air Flow:	500 acfm	800 acfm
Maximum Water Flow:	10 gpm	20 gpm
Maximum Operating Vacuum:	120" wc	120" wc
Pressure Drop at Maximum Air Flow: (dp=Constant x Velocity^2)	5" wc	8" wc
Removal Efficiency (% of incoming water > 10 Microns)	98%	96%

Maple Leaf Environmental Equipment Ltd.
1325 California Ave., P.O. Box 1517, Brockville, Ontario K6V 5Y6
ph. 1-800-420-4056 www.maple-leaf.ca fax (613)345-7633

Product Technical Specification
VLD Series Vapor Liquid Separator

Standard Features:

- Removable top to access the inside of the separator for cleaning or inspection purposes.
- Epoxy-coated interior for corrosion resistance.
- Epoxy-coated MLEE Blue exterior.
- Four standard mounting brackets for bolting the separator to the ground.
- 1.5" Drain coupling with a ½" ball valve.

Options Table:

Option	Description
Baffle	A Steel Baffle is welded to the inside bottom of the inlet separator to prevent cyclonic swirling of the water.
Orientation: CW or CCW	This determines which side of the separator the inlet pipe comes in on. CW indicates that the air flows around the separator in a clockwise motion. CCW indicates Counter Clockwise motion.
Demister	A demister pad is installed in the separator and the inside pipe diameter is increased to decrease the flow of air out of the separator. This will capture an additional 98% of the water that would otherwise be entrained in the air stream leaving the separator. This replaces the standard 6" discharge.
Float Shut Off	A large floating ball is used to seal the airflow out of the separator if the water level in the separator climbs high enough to seat the ball on a 4" discharge pipe. This will force the vacuum relief valve downstream to open, protecting the blower. This replaces the standard 6" discharge. This option is only available on the VLD-400 Model.
High High Level Switch	A high-level switch coupling is installed to shut down the system on a High High Alarm.
Pump Out Level	High and Low level couplings are installed for pump out control.
Reduced Inlet	For low airflow applications (300acfm or lower) the inlet piping can be reduced from standard 4" pipe to 3" pipe for a cost savings on VLD-400 separators.
Secondary HiHi Level Switch	A redundant High level switch coupling is installed to shut down the system on a High High Alarm if the first High High Level switch fails.
Side Cleanout	A 6" cleanout fitting is installed so the inside of the separator can be cleaned without removing the lid.
Sight Glass	Two couplings will be installed with a glass sight glass assembly. The sight glass can be isolated with brass valves to be removed for cleaning during operation.
Stand	The separator will be elevated 30" above ground to assist in gravity discharge or to provide room underneath the separator for blowers and pumps. This replaces the standard foot mounts.
Warrick Probe Levels	An additional low level fitting will be included to be used with the high high level coupling to allow for a side mounted tube to be installed to contain warrick conductivity probes for level control. There are two options for warrick level probes. The first option is to use the probes for just the Hi and Low Level pump control and keep the standard switch for the HiHi Level Switch. The standard switch is often sufficient as a HiHi level switch since it only comes in contact with the water in the event of an emergency shutdown and will be less likely to scale up and fail. The other option is to have all three levels controlled with warrick level probes.

Maple Leaf Environmental Equipment Ltd.
1325 California Ave., P.O. Box 1517, Brockville, Ontario K6V 5Y6
ph. 1-800-420-4056 www.maple-leaf.ca fax (613)345-7633

"L" STYLE INLET VACUUM AIR FILTERS
"CSL" Series 3" - 6" MPT

AF-200
AF-300
AF-4(

APPLICATIONS

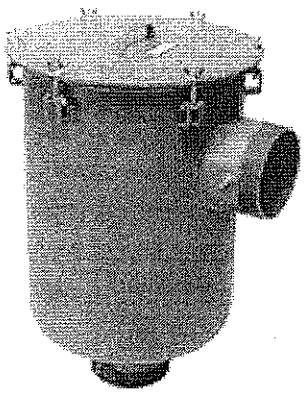
- Ash Handling
- Bag House Systems
- Blowers Fan
- Blowers-PD Type
- Cement
- Chemical Processing
- Envelope Manufacturing
- Factory Automation
- Food Processing-Vacuum
- Glass, Ceramic-Vacuum
- Intake Suction-Vacuum Pump
- Medical
- Pneumatic Conveying Systems
- Remote Installations for Piston and Screw Compressors
- Vacuum Furnaces
- Vacuum Packaging
- Vacuum Pump-Rotary Vane
- Vacuum Pumps & Systems
- Vacuum Pump-Screw Technology
- Vacuum Pump-Side Channel
- Vacuum Systems-Central
- Waste Water Aeration
- Woodworking

FEATURES & SPECIFICATIONS

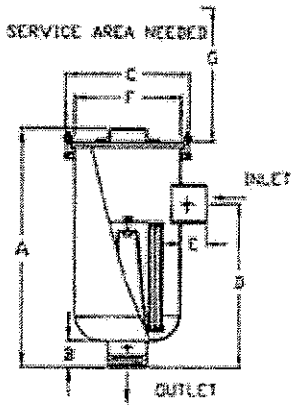
- ;99%+ removal efficiency std: Paper=2 micron, Polyester=5 micron
- Filter change out differential: 10"-15" in. H_2O above initial delta P
- Heavy duty T bolts for easy maintenance
- Hydrostically tested 0.5 bar pressure for vacuum tightness
- Inlet air enters canister above element
- Inlet/Outlet 1/4" gauge taps standard
- Large dirt holding capacity and easy field cleaning
- Low pressure drop
- Positive sealing O-ring seal system
- Powder coat paint finish
- Rugged all steel construction with baked enamel finish
- Temp (continuous): min -15° F (-26° C) max 220° F (104° C)
- Vacuum level: Typically $1x10^{-3}$ mmHg ($1.3x10^{-3}$ mbar)

PTIONS

- Activated carbon prefilter to reduce odor
- Available in *Stainless Steel*
- Epoxy coated housings
- Larger sizes available
- Special connections, BSPT/Metric
- Support brackets
- Various elements available



Line Drawing



***All measurements are shown in standards.**

Typical Lead Times:			
■	1 - 2 weeks	■	Normally in stock
■	3 - 4 weeks	■	5 - 7 weeks
		■	8 + weeks

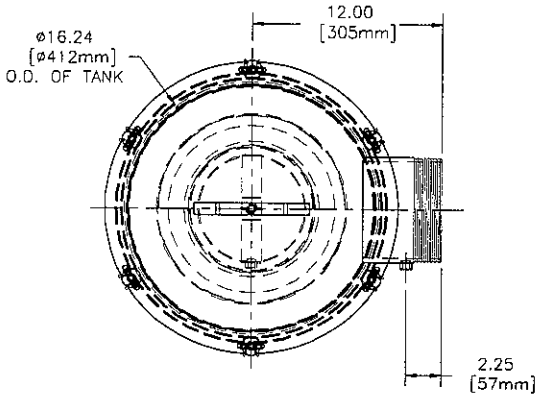
Add To Order	Model Number	Element Type	Inlet in. NPT or FLG	Outlet in. NPT or FLG	Connection Style	Dim A in.	Dim B in.	Dim C in.	Dim D in.	Dim E in.	Dim F in.	Dim G in.	Parent Flow SCFM	Element Parent Flow SCFM	Approx. Weight lbs.	CAD

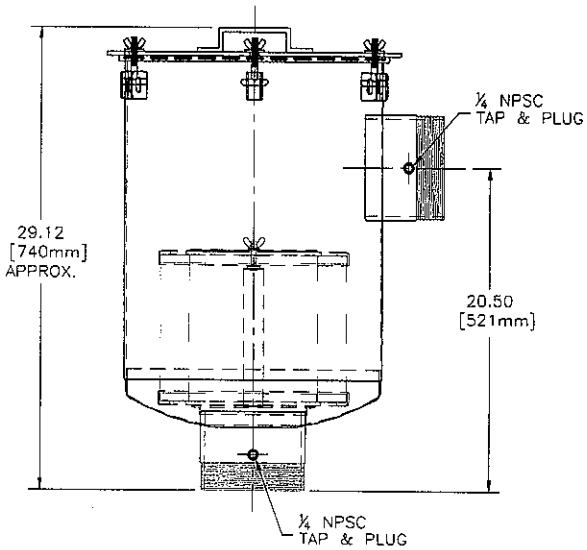
	CSL-235P-300	Polyester	3	3	Call	27.12	3	14	18.5	3	12	10	300	570	47	CAD
	CSL-335P-300	Polyester	3	3	Call	27.12	3	14	18.5	3	12	15	300	800	50	CAD
	CSL-235P-400	Polyester	4	4	Call	27.12	3	14	18.5	3	12	10	520	570	52	CAD
	CSL-335P-400	Polyester	4	4	Call	27.12	3	14	18.5	3	12	15	520	800	55	CAD
	CSL-245P-500	Polyester	5	5	Call	28.12	3	18.5	19.5	3	16	10	800	880	82	CAD
	CSL-345P-500	Polyester	5	5	Call	28.12	3	18.5	19.5	3	16	15	800	1100	88	CAD
	CSL-275P-600	Polyester	6	6	Call	29.12	4	18.5	20.5	4	16	10	1100	1100	95	CAD
	CSL-375P-600	Polyester	6	6	Call	29.12	4	18.5	20.5	4	16	15	1100	1500	97	CAD
	CSL-234P-300	Paper	3	3	Call	27.12	3	14	18.5	3	12	10	300	570	47	CAD
	CSL-334P-300	Paper	3	3	Call	27.12	3	14	18.5	3	12	15	300	800	50	CAD
	CSL-234P-400	Paper	4	4	Call	27.12	3	14	18.5	3	12	10	520	570	52	CAD
	CSL-334P-400	Paper	4	4	Call	27.12	3	14	18.5	3	12	15	520	800	55	CAD
	CSL-244P-500	Paper	5	5	Call	28.12	3	18.5	19.5	3	16	10	800	880	82	CAD
	CSL-344P-500	Paper	5	5	Call	28.12	3	18.5	19.5	3	16	15	800	1100	88	CAD
	CSL-274P-600	Paper	6	6	Call	29.12	4	18.5	20.5	4	16	10	1100	1100	95	CAD
	CSL-374P-600	Paper	6	6	Call	29.12	4	18.5	20.5	4	16	15	1100	1500	97	CAD

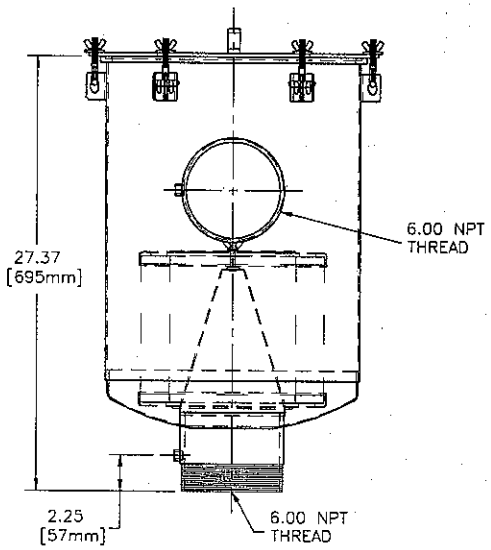
Solberg Mfg.
1151 W. Ardmore Ave.·Itasca, IL 60143·(630)773-1363· Fax: (630)773-0727

CSL_3-6

REVISIONS						
ZONE	REV	DESCRIPTION	ECN #	CHG BY	DATE	APP'D







REPLACEMENT ELEMENT# 275P	
MATERIAL	POLYESTER
CFM FLOW	1100
SURFACE AREA	19 SQ. FT.
I.D.	8.00
O.D.	11.75
HEIGHT	9.63

MODEL#	HOUSING MATERIAL	FINISH
CSL-275P-600	CARBON STEEL	BAKED ENAMEL GREY

UNLESS OTHERWISE SPECIFIED:
-DIMENSIONS ARE IN INCHES
-REF: APPROXIMATE DIMENSIONS, NO TOLERANCES APPLY
-TOLERANCES ARE:
DECIMALS: .XX ±.25, .XXX ±.125
ANGLES: ±2

CUSTOMER APPROVAL:

SOLBERG MANUFACTURING INC.
1151 W. ARDMORE AVE.
ITASCA, IL 60143
630/773-1363

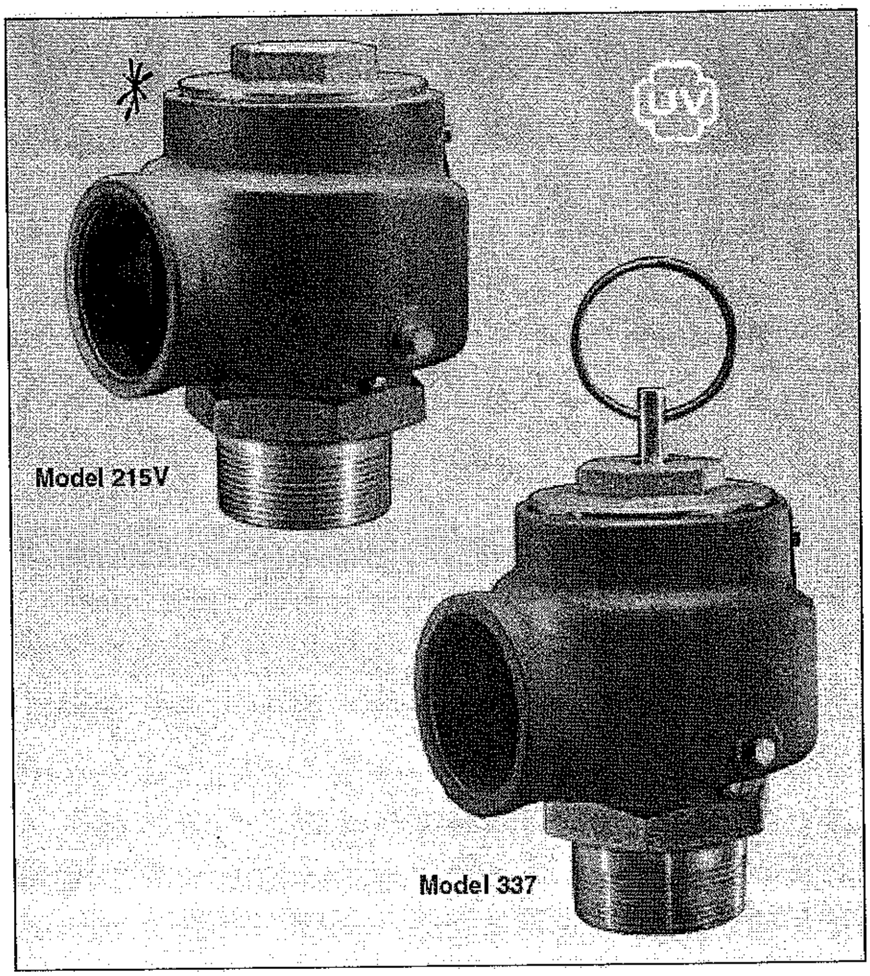
DESCRIPTION:
CSL-275P-600

SALES REP.:		SHEET: 1 of 1	SHEET SIZE: C	SCALE: 1:6
APPROVALS	DATE	DRAWING NUMBER: SD12959		REV: —
DRAWN: ABL	07/17/07			
APPROVED:				

* Models 215V and 337

KUNKLE

Model 215V is Non-code Vacuum and Model 337 is ASME Section VIII, Air/Gas Vacuum, 'UV' National Board Certified, Safety Valves. PED Certified for Non-Hazardous Gas.



Features

- **Large nozzle design** provides high capacity.
- **Flat bronze valve seats are lapped** for optimum performance.
- **Warn ring offers easy adjustability** for precise opening with minimum pre-open or simmer and exact blowdown control.
- **Pivot between disc and spring** corrects misalignment and compensates for spring side thrust.

Model Descriptions

- **Model 337 has 'pull-ring' lift device** for easy manual testing.
- **Every valve is 100% tested/inspected** for pressure setting, blowdown and leakage.
- **All adjustments are factory sealed** to prevent tampering or disassembly.

Option

- SS trim. (nozzle and disc) (Variation 03)

Applications

- Protection of low to medium pressure high volume blowers, compressors and pneumatic conveying systems.
- Bulk hauling trailers/equipment.
- Light gauge tanks.
- Protection of high volume vacuum pumps and conveying systems.

Vacuum Limits

* **Model 215V:**
2-inch HG
to 29-inch HG
[67.7 to 982 mbarg]
-20° to 406°F [-29° to 208°C]

Pressure and Temperature Limits

Model 337:
1 to 60 psig [0.07 to 4.1 barg]
-20° to 406°F [-29° to 208°C]

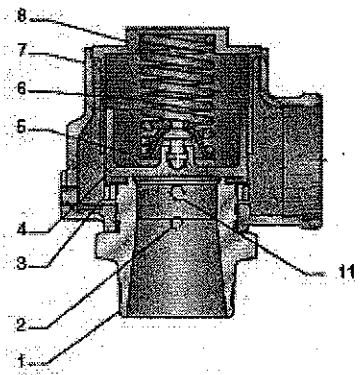
Qty	Assoc Blower	Setting
1	EN 14 30 Hp BL-200	MAX 60 Hz = 115 iwc x 0.95 = 109 iwc * ARU set @ = 7 in Hg *
2	EN 979 20 Hp BL-300 + 400	MAX 60 Hz = 5 in Hg (70 iwc) x 0.95 = * ARU set @ 4 in Hg *

tyco | Flow Control

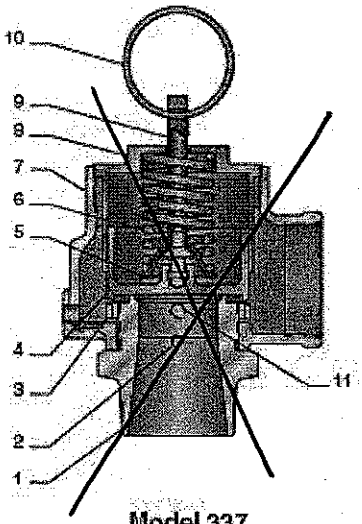
Total Flow Control Solutions™

Models 215V and 337

Parts and Materials



Model 215V



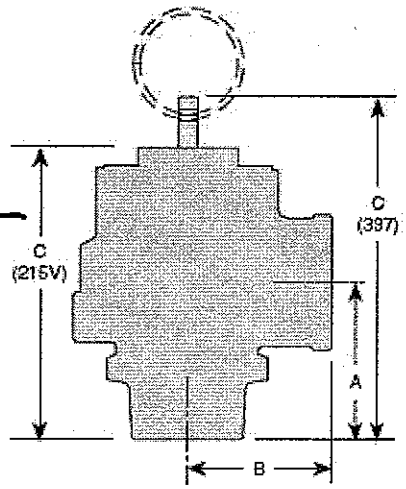
Model 337

Models 215V and 337			
No.	**Part Name**	**215V**	**337**
1	Nozzle[1]	Bronze, SB62	Bronze, SB62
2	Set Screw	Steel A108-1018 Brass Plated	Steel A108-1018 Brass Plated
3	Regulator Ring	Bronze B584 Alloy 84400	Bronze B584-C84400
4	Disc[1]	Bronze B584 Alloy 84400	Bronze B584-C84400
5	Spring Step	Steel A-109 Coated[3]	Steel A109 Coated[3]
6	Spring	SS, A313 TY 302	SS A313-302
7	Body	Cast Iron, Zinc Plated, B633	Iron A126, CL A or B
8	Compression Screw	Bronze, B-584 Alloy 84400	Bronze, B584-C84400
9	Stem[2]	N/A	Brass B16
10	Lift Ring[2]	N/A	SS A313-302
11	Regulator Ring Set Screw	N/A	Brass B16

Notes:

1. Disc and nozzle available in SSA-479 TY 316.
2. Stem and lift ring available on Model 337 only.
3. Corrosion preventative coating.

Specifications						
Size Inlet and Outlet	**Dimensions, in [mm]**					**Weight lb [kg]**
	A	**B**	**C 215V**	**C 337**		
2" [50.8 mm]	3¼ [82.5]	3 [76.2]	6½ [165.1]	7 [177.8]		8 [3.6]
2½" [63.5 mm]	3¾ [95.2]	3½ [88.9]	7⅝ [194.6]	8 [203.2]		12 [5.4]
3" [76.2 mm]	4¼ [107.9]	4 [101.6]	8½ [215.9]	9 [228.6]		20 [4.1]



Model 337

*Models 215V and 337

Capacities

Model 337, Non-code[1] and ASME Section VIII Air (SCFM)

Set Pressure (psig)	Valve Inlet and Outlet Size 2"	2½"	3"
1	240	364	527
5	531	805	1166
10	741	1124	1628
15	948	1436	2081
20	1092	1656	2399
25	1237	1875	2719
30	1382	2095	3036
35	1542	2337	3386
40	1701	2578	3736
45	1860	2820	4086
50	2020	3061	4436
55	2179	3303	4786
60	2338	3544	5136

Note

1. No code stamp or 'NB' on nameplate below 15 psig set.

Model 337, Non-code[1] and ASME Section VIII Air [Metric, Nm³/h]

Set Pressure [barg]	Valve Inlet and Outlet Size 50 mm	63 mm	80 mm
0.5	1049	1589	2303
1.0	1457	2208	3200
1.5	1888	2861	4147
2.0	2235	3387	4910
2.5	2613	3959	5739
3.0	2995	4538	6579
3.5	3377	5117	7418
4.0	3760	5696	8258

Note

1. No code stamp or 'NB' on nameplate below 1.1 barg set

Model 215V, Non-code Vacuum Air (SCFM)

Relief Set (in, HG)	Valve Inlet and Outlet Size 2" Orifice Area, in² 1.84	2½" Orifice Area, in² 2.79	3" Orifice Area, in² 4.04
2	229	347	503
5	338	512	742
10	415	630	912
15	426	646	936
20	426	646	936
29	426	646	936

Model 215V, Non-code Vacuum Air [Metric, Nm³/h]

Relief Set [mbarg]	Valve Inlet and Outlet Size 5.08 cm Orifice Area [11.86 cm²]	6.35 cm Orifice Area [17.97 cm²]	7.62 cm Orifice Area [26.05 cm²]
50	328	498	722
100	450	682	988
150	533	807	1170
200	593	899	1303
250	638	966	1400
300	669	1014	1470
350	690	1046	1516
400	701	1062	1540
450	704	1067	1546
500	704	1067	1546
550	704	1067	1546
600	704	1067	1546
650	704	1067	1546
700	704	1067	1546
750	704	1067	1546

Models 215V and 337

Model Number/Order Guide

Model Number Position	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Example	2	1	5	V	—	H	0	1	A	Q	E	0	0	5	0

Model
215V
0337

Inlet Size
H - 2-inch [50.8 mm]
J - 2½-inch [63.5 mm]
K - 3-inch [76.2 mm]

Variation (01 through 99)
01 - Bronze Disc and Nozzle
03 - SS Disc and Nozzle
60 - BSP Connections

Design Revision
Indicates non-interchangeable revision. Current Design is at Revision 'A'

Valve Service
K - Air ASME Section VIII (Model 337 only)
Q - Vacuum (Model 215V only)
N - Non-code Air/Gas (Model 337 only)

Spring Material
E - SST Type 302
(H-Orifice up to 18 psi; J-Orifice up to 20 psi; K-Orifice up to 25 psi)
M - SST Type 17-7
(H-Orifice above 18 psi; J-Orifice above 20 psi; K-Orifice above 25 psi)

Set Pressure
Model 337, 1 psig [0.7 barg] (0001) through 60 psig [4.1 barg] (0060)
Model 215V, 2-inch HG [68 mbarg] (0002) through 29-inch HG [982 mbarg] (0029) vacuum

BL-200 set@ 7 in Hg
BL-300 set@ 4 in Hg
BL-400 set@ 4 in Hg

Facility Phone: 828-669-3700

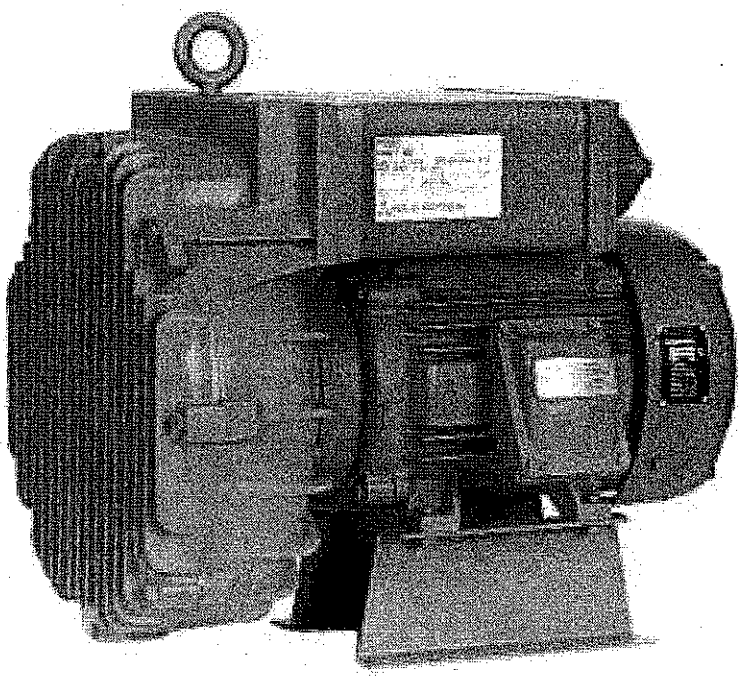
Tyco Valves & Controls

www.kunklevalve.com

BL-200

EN 14 ~~& CP 14~~
Sealed Regenerative Blower w/Explosion-Proof Motor

FEATURES
- Manufactured in the USA – ISO 9001 compliant
- Maximum flow: 920 SCFM
- Maximum pressure: 144 IWG
- Maximum vacuum: 115 IWG
- Standard motor: 30 HP, explosion-proof
- Cast aluminum blower housing, cover, impeller & manifold; cast iron flanges (threaded); teflon lip seal
- UL & CSA approved motor with permanently sealed ball bearings for explosive gas atmospheres Class I Group D minimum
- Sealed blower assembly
- Quiet operation within OSHA standards

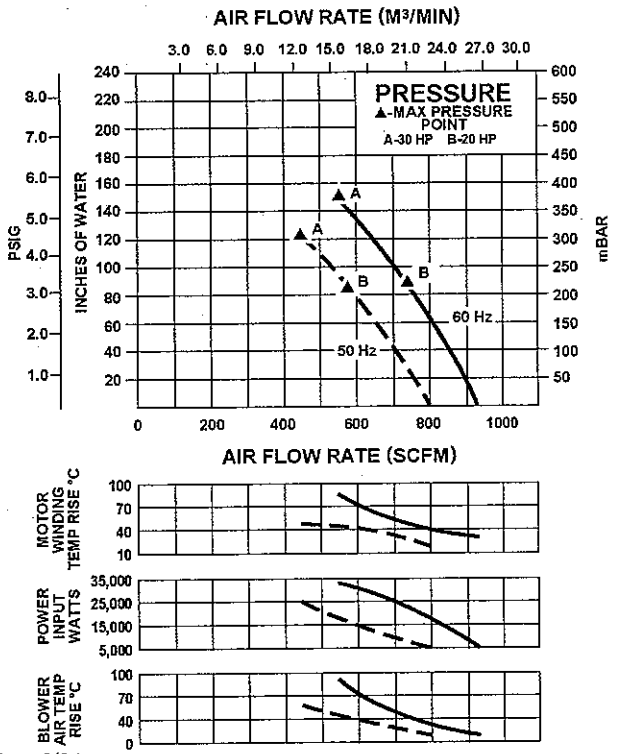


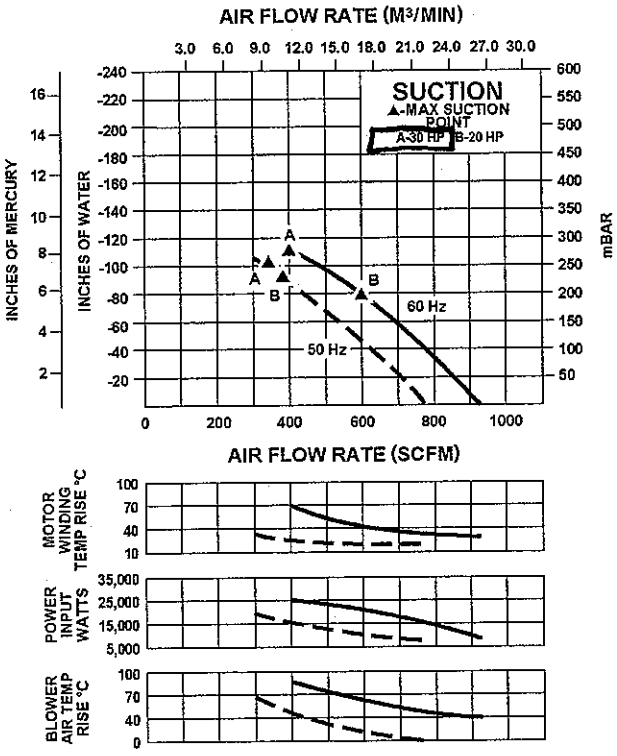
MOTOR OPTIONS
- International voltage & frequency (Hz)
- Chemical duty, high efficiency, inverter duty or industry-specific designs
- Various horsepowers for application-specific needs

BLOWER OPTIONS
- Corrosion resistant surface treatments & sealing options
- Remote drive (motorless) models
- Slip-on or face flanges for application-specific needs

ACCESSORIES (See Catalog Accessory Section)
- Flowmeters reading in SCFM
- Filters & moisture separators
  Pressure gauges, vacuum gauges & relief valves
  Switches – air flow, pressure, vacuum or temperature
- External mufflers for additional silencing
- Air knives (used on blow-off applications)
- Variable frequency drive package

BLOWER PERFORMANCE AT STANDARD CONDITIONS



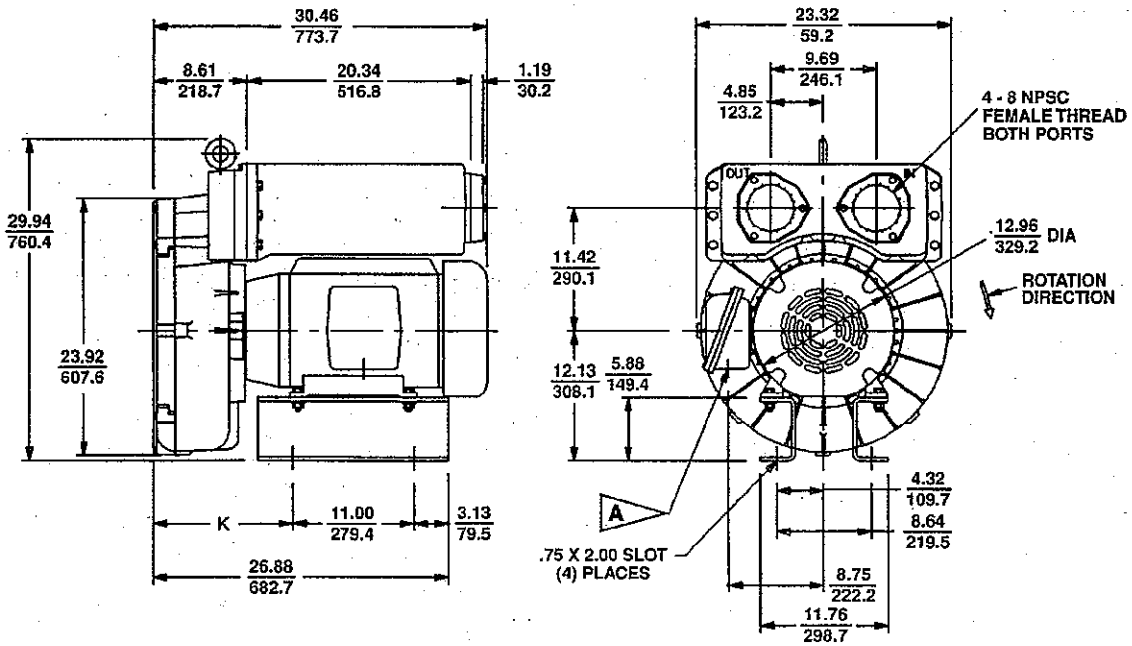


Rev. 2/01

*EN 14 &~~CP-14~~

Sealed Regenerative Blower w/Explosion-Proof Motor

Scale CAD drawing available upon request.



DIMENSIONS: IN / MM
TOLERANCES: .XX ± .1/2.5
(UNLESS OTHERWISE NOTED)

A 1.25" NPT CONDUIT CONNECTION AT 6 O'CLOCK POSITION

MODEL	K (IN/MM)	J (IN/MM)	H (IN/MM)
EN/CP14DX72WL	13.3/338	12.9/328	9.64/245
EN/CP14BK72WL	12.75/324	12.1/307	8.62/219

SPECIFICATIONS

MODEL	EN14BK72MWL		EN14DX72MWL		EN14DX86MWL	CP14GB72MWLR	CP14GC72MWLR
Part No.	038760		038761		038762	–	038984
Motor Enclosure – Shaft Material	Explosion-proof – CS		Explosion-proof – CS		Explosion-proof – CS	Chem XP – SS	Chem XP – SS
Horsepower	20		30		30	Same as EN14BK72MWL – 038760 except add Chemical Processing (CP) features from catalog inside front cover	Same as EN14DX72MWL – 038761 except add Chemical Processing (CP) features from catalog inside front cover
Phase – Frequency [1]	Three - 60 Hz		Three - 60 Hz		Three - 60 Hz		
Voltage [1]	230	460	200-230	460	575		
Motor Nameplate Amps	46	23	75-66	33	26.5		
Max. Blower Amps [3]	60	30	82	41	33		
Inrush Amps	294	147	448	224	226		
Starter Size	3	2	3	3	3		
Service Factor	1.0		1.0		1.0		
Thermal Protection [2]	Class B - Pilot Duty		Class B - Pilot Duty		Class B - Pilot Duty		
XP Motor Class – Group	I-D, II-F&G		I-D, II-F&G		I-D, II-F&G		
Shipping Weight	680 lb (309 kg)		816 lb (370 kg)		816 lb (370 kg)		

[1] Rotron motors are designed to handle a broad range of world voltages and power supply variations. Our dual voltage 3 phase motors are factory tested and certified to operate on both: **208-230/415-460 VAC-3 ph-60 Hz** and **190-208/380-415 VAC-3 ph-50 Hz**. Our dual voltage 1 phase motors are factory tested and certified to operate on both: **104-115/208-230 VAC-1 ph-60 Hz** and **100-110/200-220 VAC-1 ph-50 Hz**. All voltages above can handle a ±10% voltage fluctuation. Special wound motors can be ordered for voltages outside our certified range.

[2] Maximum operating temperature: Motor winding temperature (winding rise plus ambient) should not exceed 140°C for Class F rated motors or 120°C for Class B rated motors. Blower outlet air temperature should not exceed 140°C (air temperature rise plus inlet temperature). Performance curve maximum pressure and suction points are based on a 40°C inlet and ambient temperature. Consult factory for inlet or ambient temperatures above 40°C.

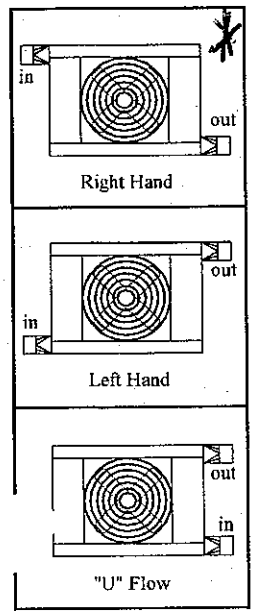
[3] Maximum blower amps corresponds to the performance point at which the motor or blower temperature rise with a 40°C inlet and/or ambient temperature reaches the maximum operating temperature.

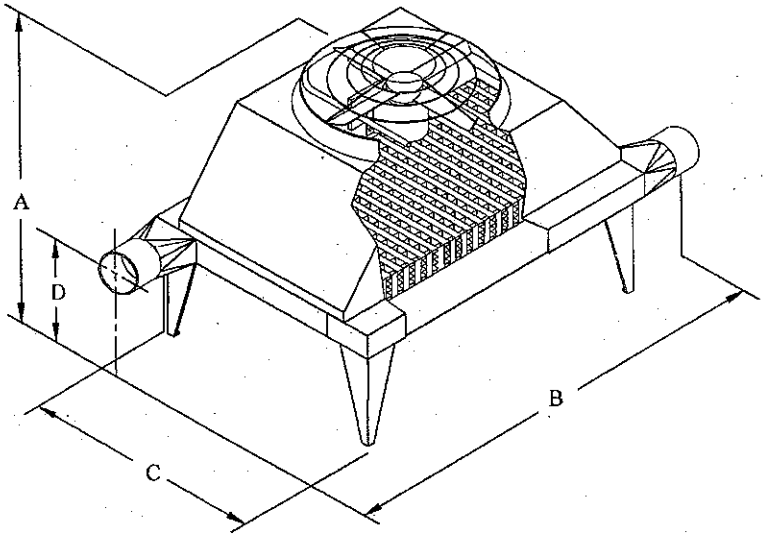
Specifications subject to change without notice. Please consult your Local Field Sales Engineer for specification updates.

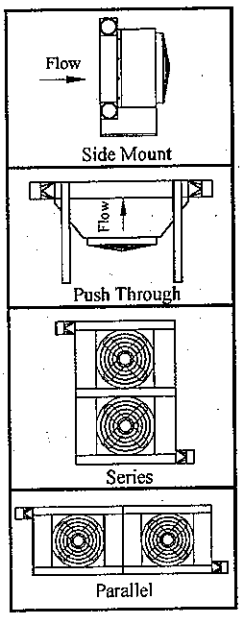
Xchanger, Inc.

AA Series Heat Exchanger

AA Series exchangers cool low pressure air streams using fan-drafted ambient air. Air flows to 3,500 CFM from vacuum to 75 PSI can be cooled near ambient, with under 0.2 PSI pressure loss. AA Series exchangers are ideal for installation outdoors where cooling water is unavailable or undesirable due to freezing temperatures. Indoor installations should be well ventilated. The process air should be filtered and pulsating flow, such as that produced by rotary lobe blowers, should be dampened by a chambered silencer prior to entering the heat exchanger.







See line #54 of data sheet for approximate dimensions

Std. Lead Time: 6 Weeks

Expedited Shipping Schedule (If Available)	
Working Days *	AA Series & Cores
5	20%
10	10%
15	5%
20	2.5%
30	---

* After Drawing Approval

ld 5 days to schedule for epoxy
ıenolic coating.

Design Options:

Connection types: tube, pipe, flange, NPT, ferrule, etc
Materials of construction:
Core: aluminum (others available with our LC series)
Propeller, venturi and shroud: painted or galvanized steel, aluminum, stainless steel
Motors: any available
Epoxy phenolic coating for corrosion protection of the core
Units can be built to required dimensions
Multiple cores combined together to make a single unit

Accessories: (Prices Subject To Change)

Instrument Coupling:	$ 60
Thermometer (Includes Coupling):	$ 90
Differential Pressure Gauge:	$ 280
Service side filters	Ask
Others available upon request	

XI3F04

1401 S. 7th St • Hopkins, MN 55343 • Ph:952.933.2559 • Fax:952.933.5647• www.xchanger.com

We also offer water cooled exchangers

Xchanger, Inc. Rating for Model AA-2750 ref #85998 Page 1 of 1

Engineer: Aaron Groh June 13, 2007

Prepared for:

ARCADIS

Ken Zegel

PERFORMANCE	PROCESS AIR	AMBIENT AIR
Fluid Circulated	Air	Air
Volumetric Flow Rate	2,140 Std. ft^3/min	3,768 Std. ft^3/min
Total Fluid Entering	9,630 lb/hr	16,957 lb/hr
Liquid		
Vapor		
Non-Condensibles	9,630 lb/hr	16,957 lb/hr
Vaporized or (Cond.)		
Temperature In	160 °F	85 °F
Temperature Out	100 °F	119 °F
Inlet Pressure (Absolute)	15.696 lb/in²	14.696 lb/in²
Velocity (Standard)	2,115 ft/min	899 ft/min
Pressure Loss	5.5 in. water	1.0 in. water
Fouling Factor	0.0001 ft²-°F-hr/BTU	0.0001 ft²-°F-hr/BTU

Total Heat Exchanged: 138,574 BTU/hr

PROPERTIES		
Thermal Conductivity	0.016 BTU/hr-ft-°F	0.016 BTU/hr-ft-°F
Specific Heat	0.240 BTU/lb-°F	0.240 BTU/lb-°F
Viscosity	0.048 lb/ft-hr	0.046 lb/ft-hr
Density	0.072 lb/ft^3	0.071 lb/ft^3
Latent Heat of Vapor		

CONSTRUCTION		
Design Temperature	200 °F	Not Applicable
Design Pressure (Gauge)	15 lb/in²	Not Applicable
Test Pressure (Gauge)	15 lb/in²	Not Applicable
Cyclic Pressure	No	Not Applicable
Flow Direction	Right Hand Horizontal	Vertical Up
Coating	None	None

Plate-Fin Core	: Aluminum	Exhaust Hood	: Galvanized Steel
Fan Guard	: Coated Carbon Steel	Venturi Frame	: Coated Carbon Steel
Drawing Number	:	Weight	: 410 lb

CONNECTIONS

Process Inlet : 12 inch 150 lb. ANSI pattern FFF, 3/8" thick

Process Outlet : 12 inch 150 lb. ANSI pattern FFF, 3/8" thick

Instrument :

MECHANICAL EQUIPMENT			
Fan Diameter	: 24 inch	Motor	: 2.00 HP TEFC
Fan Qty/Speed	: 1 / 1725 RPM	Motor Qty/Speed	: 1 / 1725 RPM
Fan Type	: 4 Blade Painted Stee	Motor Electrical	: 208-230/460/3/60

NOTES

Approximate unit dimensions (inches): A = 44, B = 66, C = 36, D = 20

Construction material suitability must be determined by customer.

The process flow must be uniform, smooth and free of pulsation.

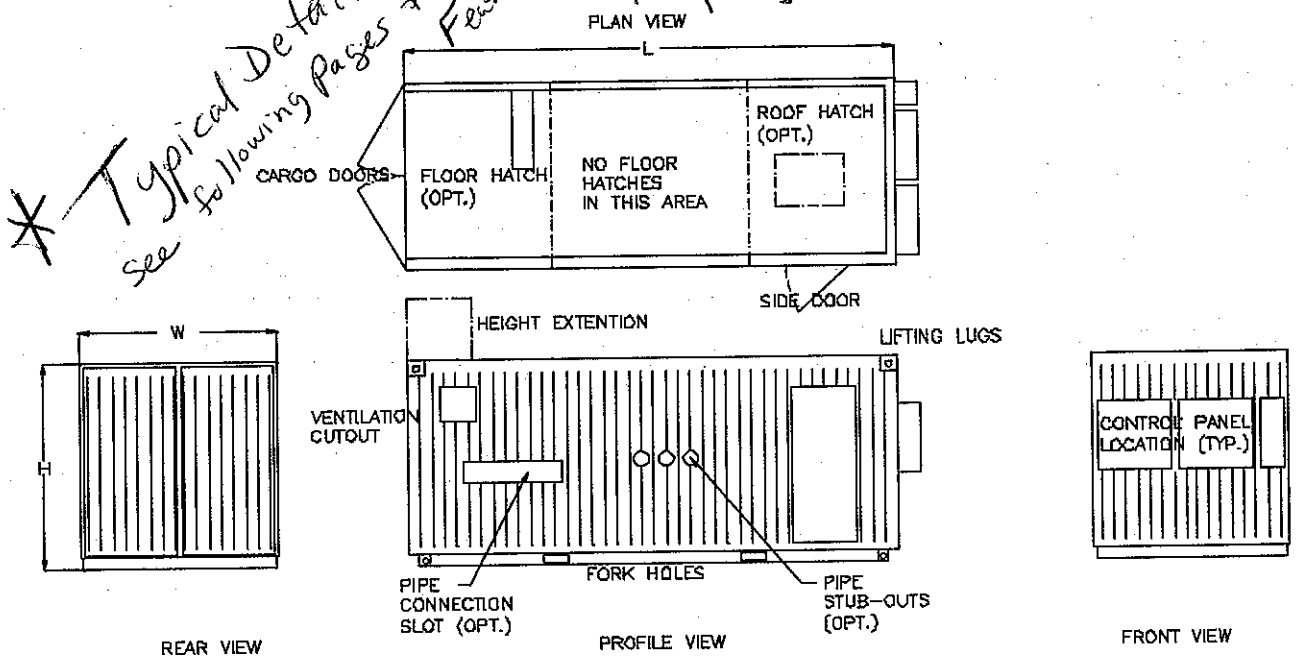
This unit is not designed for cycling process gas pressure.

Product Technical Specification
Container

Application: Container enclosures are a popular choice for housing large stationary systems. Containers are secure and cost-effective. A wide range of options are available to customize appearance or functionality to suit customer requirements.

Construction:
Heavy corrugated steel shell and steel beam structure with ~~wood plank~~ marineplywood flooring. Heavy steel double-doors on one end TB-2 ... both ends TB-1 are standard. Twenty-foot and forty-foot standard lengths.

* Typical Detail see following pages for Features & Actual Manufacturer & Dimensions.



Dimensions and Specifications:

Part Number	L (ft)	W (ft)	H (ft)	Weight Empty (lbs)	Std Cap. (lbs)	Interior Dimensions (inches)		
						length	width	height
	10	8	8' 6"	3000	9000	9' 8"	7' 8"	7' 10"
	12	8	8' 6"	3600	10800	11' 8"	7' 8"	7' 10"
	16	8	8' 6"	5400	14400	15' 5"	7' 8"	7' 10"
	20	8	8' 6"	6000	18000	19' 4"	7' 8"	7' 10"
	24	8	8' 6"	7200	21600	22' 4"	7' 8"	7' 10"
	28	8	8' 6"	8400	25200	27' 4"	7' 8"	7' 10"
	32	8	8' 6"	9000	28800	31' 4"	7' 8"	7' 10"
	36	8	8' 6"	9900	32400	35' 4"	7' 8"	7' 10"
	40	8	8' 6"	11000	36000	39' 4"	7' 8"	7' 10"

* See Attached for Actual.

Maple Leaf Environmental Equipment Ltd.
1325 California Ave., P.O. Box 1517, Brockville, Ontario K6V 5Y6
ph. 1-800-420-4056 www.maple-leaf.ca fax (613)345-7633

Product Technical Specification
Container

Standard Features:

- Industrial Steel Siding Exterior
- Waterproof sealed floor
- Double cargo doors on end (opening 89"h x 92" w); ~~side door (32")~~
- Lifting lugs at roof for crane lifting; lifting lugs at base for boom/crane lifting Fork holes in base (20 ft only)
- ~~R7.2~~ insulation in walls and ceiling + DOORS

R12

Option	Description
Painted	Painted exterior/plywood interior
Rubber membrane roofing	high-quality EPDM membrane roof
Extra insulation	Foil-back foam, polystyrene or fiberglass insulation
Process heat exchanger exhaust	Exhaust hatches can be inserted in wall to diffuse heat outside of building.
Extra louver for added ventilation	For added ventilation and air circulation a louver can be installed into building wall
Sound insulation	Layer of sound insulation material built into walls blocks out operational noise
Rubber flooring	Thick, ¾" rubber floor mats
Sump switch	2" sump in floor to detect flooding
Floor cutout	Floor hatch can be cutout to allow pipe entrance from underground
Roof extension	For tall equipment, extensions or hatches can be built into roof
Pipe connection slot	Mounted on side of building
Pipe stub outs	Mounted on side of building

Sample Ordering Format:

20' containter

Options:

Ventilated
Roof Hatch
Sound insulation

1325 California Ave., P.O. Box 1517, Brockville, Ontario K6V 5Y6
ph. 1-800-420-4056 www.maple-leaf.ca fax (613)345-7633

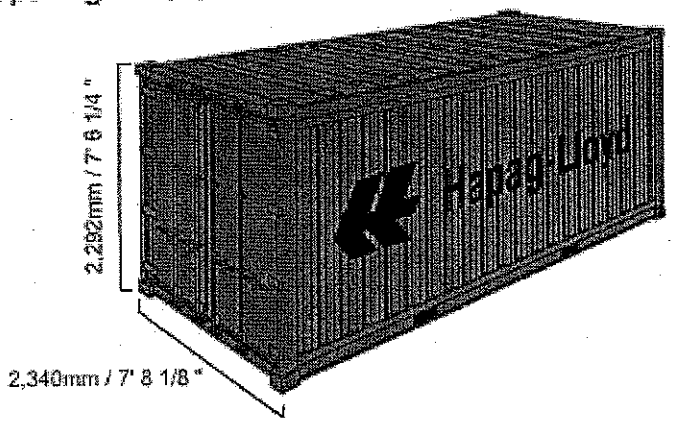
Hapag-Lloyd

Containers

ISO Type Group: 22 GP
ISO Size Type: 22 G1

Standard-Container 20'

Door Opening Dimensions



		Door Opening Dimensions	Inside Dimensions
General	19'4 x 7'8 x 7'10	Millimeters	Feet
Internal	**Length**	5900	19' 4 1/4"
	Width	2350	7' 8 1/2"
	Height	2395	7' 10 1/4"
Door Opening	**Width**	2340	7' 8 1/8 "
	Height	2292	7' 6 1/4 "
		Kilograms	Pounds
Weight	**Max Gross**	32500	71650
	Tare	2370	5220
	Max Payload	30130	66430
		Cube Meters	Cube Feet
Capacity		33.2	1172

Master-Temp 200 / 300 Bimetal Thermometers

Specifications

Case Material
303 stainless steel

Dial
White aluminum black lettering

Pointer
Black aluminum

Dial
Dished white aluminum with black lettering

Accuracy
± 1% full scale

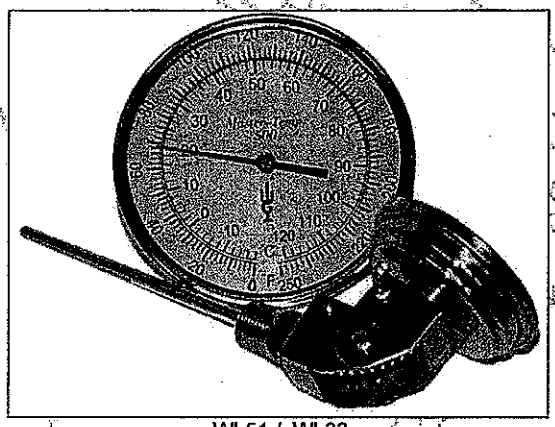
Connection
1/4", 1/2" NPT Center back mount or
1/2" adjustable angle

Window
Glass

Stem
1/4" 304 stainless steel 2½" - 36"

Dial Size
2" & 3"

External Reset
Stainless steel hex located on rear of case



WL51 / WL33

Dial Size	2" Dial							
Connection	1/4" NPT Center Back Mount				1/2" NPT Center Back Mount			
Stem Length	2½"	4"	6"	9"	2½"	4"	6"	9"
Range								
-40°F to 160°F (-40C to 70°C)	WL11102	WL11202	WL11302	n/s	n/s	WL21202	WL21302	
0°F to 250°F (-20°C to 120°C)	WL11105	WL11205	WL11305	n/s	n/s	n/s	WL21305	WL21405
50°F to 500°F (10°C to 260°C)	WL11108	WL11208	WL11306	n/s	n/s	n/s	n/s	n/s
List Price	$50.00	$50.00	$50.00	$50.00	$50.00	$50.00	$50.00	$50.00

Dial Size	3" Dial						
Connection	1/2" NPT Center Back Mount						
Stem Length	2½"	4"	6"	9"	12"	15"	18"
Range							
-40°F to 160°F (-40C to 70°C)	WL31102	WL31202	WL31302	WL31402	WL31502	WL31602	WL31702
0°F to 250°F (-20°C to 120°C)	WL31105	WL31205	WL31305	WL31405	WL31505	WL31605	WL31705
50°F to 300°F (10°C to 150°C)	WL31106	WL31206	WL31306	WL31406	WL31506	WL31606	WL31706
50°F to 500°F (10°C to 260°C)	WL31108	WL31208	WL31308	WL31408	WL31508	WL31608	WL31708
150° to 750°F (50°C to 400°C)	WL31110	WL31210	WL31310	WL31410	WL31510	WL31610	WL31710
200° to 1000°F (100° to 550°C)	WL31111	WL31211	WL31311	WL31411	WL31511	WL31611	WL31711
List Price	$50.00	$50.00	$50.00	$79.15	$89.20	$99.15	$122.50

Dial Size	3" Dial						
Connection	1/2" NPT Center Back Mount Adjustable Angle						
Stem Length	2½"	4"	6"	9"	12"	15"	18"
Range							
-40°F to 160°F (-40C to 70°C)	WL33102	WL33202	WL33302	WL33402	WL33502	WL33602	WL33702
0°F to 250°F (-20°C to 120°C)	WL33105	WL33205	WL33305	WL33405	WL33505	WL33605	WL33705
50°F to 300°F (10°C to 150°C)	WL33106	WL33206	WL33306	WL33406	WL33506	WL33606	WL33706
50°F to 500°F (10°C to 260°C)	WL33108	WL33208	WL33308	WL33408	WL33508	WL33608	WL33708
150° to 750°F (50°C to 400°C)	WL33110	WL33210	WL33310	WL33410	WL33510	WL33610	WL33710
200° to 1000°F (100° to 550°C)	WL33111	WL33211	WL33311	WL33411	WL33511	WL33611	WL33711
List Price	$200.00	$200.00	$200.00	$215.00	$227.85	$235.50	$246.00

See Discount Line # 21

Master-temp 500 Bimetal Thermometers

Specifications

Case Material
303 stainless steel

Dial
White aluminum black lettering

Pointer
Black aluminum

Dial
Dished white aluminum with black lettering

Accuracy
± 1% full scale

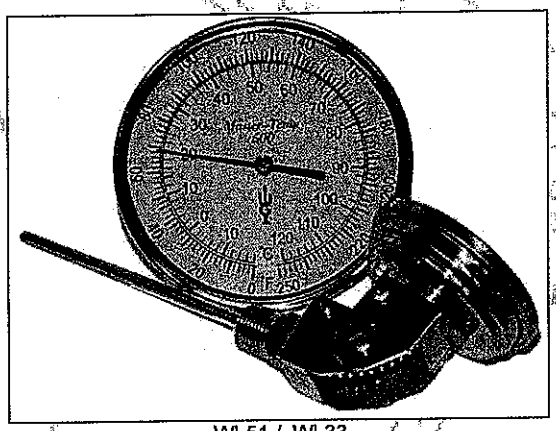
Connection
1/2" NPT Center back mount or
1/2" adjustable angle

Window
Glass

Stem
1/4" 304 stainless steel 2½" - 36"

Dial Size
5"

External Reset
Stainless steel hex located on rear of case



WL51 / WL33

Dial Size	5" Dial						
Connection	1/2" NPT Center Back Mount						
Stem Length	2½"	4"	6"	9"	12"	15"	18"
Range							
-40°F to 160°F (-40C to 70°C)	WL51102	WL51202	WL51302	WL51402	WL51502	WL51602	WL51702
0°F to 250°F (-20°C to 120°C)	WL51105	WL51205	WL51305	WL51405	WL51505	WL51605	WL51705
50°F to 300°F (10°C to 150°C)	WL51106	WL51206	WL51306	WL51406	WL51506	WL51606	WL51706
50°F to 500°F (10°C to 260°C)	WL51108	WL51208	WL51308	WL51408	WL51508	WL51608	WL51708
*150° to 750°F (50°C to 400°C)	WL51110	WL51210	WL51310	WL51410	WL51510	WL51610	WL51710
200° to 1000°F (100° to 550°C)	WL51111	WL51211	WL51311	WL51411	WL51511	WL51611	WL51711
List Price	$103.65	$103.65	$103.65	$120.00	$144.50	$155.65	$167.00
Dial Size	5" Dial						
Connection	1/2" NPT Center Back Mount Adjustable Angle						
Stem Length	2½"	4"	6"	9"	12"	15"	18"
Range							
-40°F to 160°F (-40C to 70°C)	WL53102	WL53202	WL53302	WL53402	WL53502	WL53602	WL53702
0°F to 250°F (-20°C to 120°C)	WL53105	WL53205	WL53305	WL53405	WL53505	WL53605	WL53705
50°F to 300°F (10°C to 150°C)	WL53106	WL53206	WL53306	WL53406	WL53506	WL53606	WL53706
50°F to 500°F (10°C to 260°C)	WL53108	WL53208	WL53308	WL53408	WL53508	WL53608	WL53708
150° to 750°F (50°C to 400°C)	WL53110	WL53210	WL53310	WL53410	WL53510	WL53610	WL53710
200° to 1000°F (100° to 550°C)	WL53111	WL53211	WL53311	WL53411	WL53511	WL53611	WL53711
List Price	$240.00	$240.00	$240.00	$266.70	$274.15	$285.85	$298.35
	See Discount Line# 22						

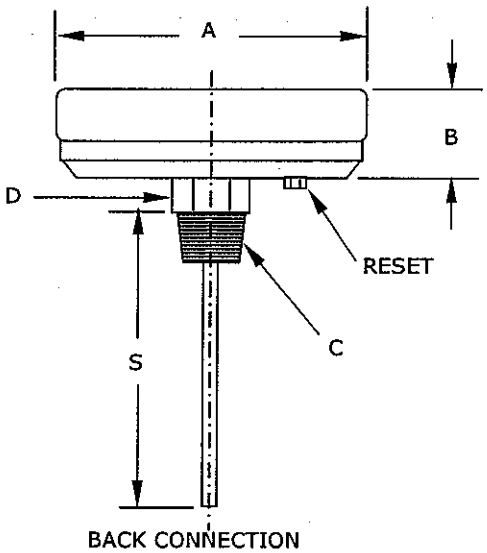
Master-temp Bimetal Thermometers

Stocked Ranges

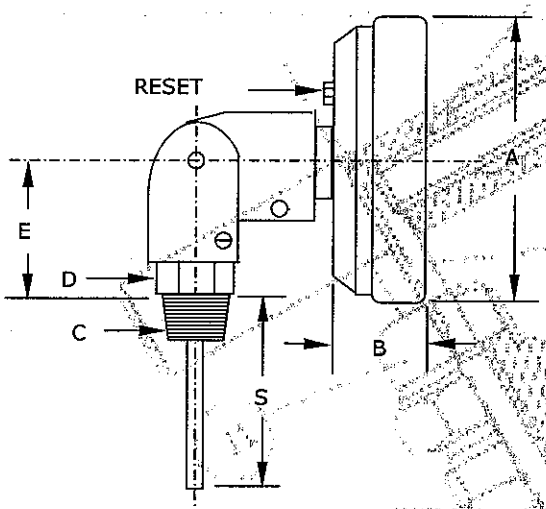
Range	Major Divisions		Minor Divisions	
	°F	°C	°F	°C
-40°F to 160°F (-40C to 70°C)	10	10	2	2
0°F to 250°F (-20°C to 120°C)	10	10	2	2
50°F to 300°F (10°C to 150°C)	10	10	2	2
50°F to 500°F (10°C to 260°C)	25	10	5	5
150° to 750°F (50°C to 400°C)	50	10	10	5
200° to 1000°F (100° to 550°C)	50	10	10	5

Dimensions

Series	Dial Size	A	B	C	D (Hex)	E	S
WL11000	2"	2.13"	0.425"	1/4" NPT	0.546"	n/a	See Nominal Lengths On Part Number Charts
WL21000	2"	2.13"	0.425"	1/2" NPT	0.822"	n/a	
WL31000	3"	3.27"	0.835"	1/2" NPT	0.822"	n/a	
WL33000	3"	3.27"	0.835"	1/2" NPT	0.822"	1.75"	
WL51000	5"	5.26"	0.910"	1/2" NPT	0.822"	n/a	
WL53000	5"	5.26"	0.910"	1/2" NPT	0.822"	1.75"	



BACK CONNECTION

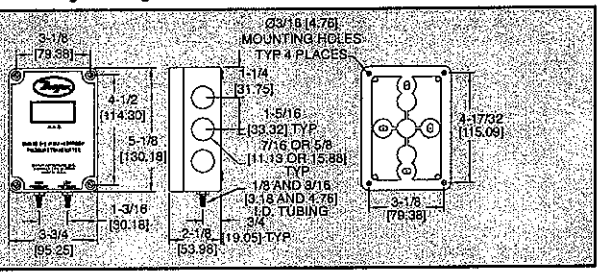


ADJUSTABLE ANGLE

Series 616W

Differential Pressure Transmitter

NEMA 4X Enclosure, 0.25% F.S. Accuracy, Ranges from 0-1 in. w.c. to 0-100 psid



Positive, negative and differential pressures can be measured within a full span accuracy of ±0.25% with the Series 616W Differential Pressure Transmitter. Units are enclosed in a polycarbonate case, rated NEMA 4X (IP66) and operate by sensing the pressure of air and compatible gases then sending a standard 4-20 mA output signal.

Design enables operation in 2-wire current loops. A wide range of models are available factory calibrated to specific ranges. The span and zero controls are for use when checking calibration. They are not intended for re-ranging to a significantly different span. The LCD (as shown above) allows local indication of pressure. (If LCD is not needed, drop from model number).

VIT-202, 302, 402

SPECIFICATIONS

Service: Air and non-combustible, compatible gases.
Wetted Materials: Consult factory.
Accuracy: ±0.25% F.S., display accuracy ±0.5%.
Stability: ±1% F.S./yr.
Temperature Limits: 0 to 140°F (-17.8 to 60°C).
Compensated Temperature Limits: 20 to 120°F (-6.67 to 48.9°C).
Pressure Limits: See chart.
Thermal Effect: ±0.02% F.S./°F (0.0012% F.S./°C).
Power Requirements: 10-35 VDC (2-wire).
Output Signal: 4 to 20 mA.
Zero and Span Adjustments: Potentiometers for zero and span.
Loop Resistance: DC; 0-1250 ohms maximum.
Current Consumption: DC; 38 mA maximum.
Electrical Connections: Screw-type terminal block.
Process Connections: Barbed, dual size to fit 1/8" and 3/16" (3.12 and 4.76 mm) I.D. rubber or vinyl tubing.
Enclosure Rating: NEMA 4X (IP66).
Mounting Orientation: Vertical, consult factory for other position orientations.
Weight: Without LCD 8.8 oz. (249 g); with LCD 9.6 oz (272 g).
Agency Approvals: CE.

Model No.	Range	Max. Press.	Model No.	Range	Max. Press.	Model No.	Range	Max. Press.
616W-00-LCD	0-1 in.w.c.	5 psig	616W-7-LCD	0-200 in.w.c.	29 psig	616W-10B-LCD	5-0-5 in.w.c.	5 psig
616W-0-LCD	0-2 in.w.c.	5 psig	616W-8-LCD	0-10 psid	58 psig	616W-20B-LCD	10-0-10 in.w.c.	11 psig
616W-1-LCD	0-3 in.w.c.	5 psig	616W-9-LCD	0-20 psid	58 psig	616W-0M-LCD	0-500 Pa	5 psig
616W-2-LCD	0-6 in.w.c.	5 psig	616W-10-LCD	0-30 psid	58 psig	616W-1M-LCD	0-750 Pa	34.5 kPa
616W-3-LCD	0-10 in.w.c.	5 psig	616W-11-LCD	0-50 psid	150 psig	616W-2M-LCD	0-1.5 kPa	34.5 kPa
616W-4-LCD	0-20 in.w.c.	11 psig	616W-12-LCD	0-100 psid	150 psig	616W-3M-LCD	0-2.5 kPa	34.5 kPa
616W-5-LCD	0-40 in.w.c.	11 psig	616W-3B-LCD	1.5-0-1.5 in.w.c.	5 psig	616W-4M-LCD	0-5.0 kPa	75.8 kPa
616W-6-LCD	0-100 in.w.c.	29 psig	616W-6B-LCD	3-0-3 in.w.c.	5 psig	616W-5M-LCD	0-25.0 kPa	200 kPa

TE: Units with "M" in the model number are metric units.

Window Room Air Conditioners

Friedrich

Commercial-grade units feature sound and vibration-isolating technology with heavy two-way motor mount, insulated plenum, and extra-thick rubber grommets. Copper coils, nonrusting aluminum endplates, high-tech fins with lanced louvers, and high-efficiency rifled tubing. AHAM Certified performance. UL and C-UL Listed.

Note: Nos. 1VXK6, 1VXK7, 3BE30, 3DU26, 3DU29, 3DU30, 3DU31, 3UF22, 3VE13, and 4CB60 carry the Energy Star rating.

COMPACT

- **Fit windows from 26 to 42" wide, except No. 1VXK5 fits windows from 22 to 36" wide**

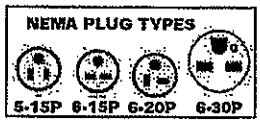
No. 3CA53 has 3 cooling speeds, 2 fan-only settings, 4-way airflow control, and fixed chassis. No. 1VXK5 offers programmable cooling with remote control, 3 fan speeds, 3 fan-only settings, 4-way airflow control, fixed chassis, and 12-hr electronic timer. Nos. 4CB60, 3VE17, and 4VB19 have 3 cooling speeds, fan-only setting, 8-way airflow control, slide-out chassis, electronic control with 24-hr. timer, auto memory backup, and Smart Fan that auto adjusts fan speed. No. 3ZA70 has 2 cooling speeds plus fan-only setting, 8-way airflow control, and slide-out chassis.

MEDIUM AND FULL SIZE

- **Medium size fit windows from 27⅞ to 42" wide**
- **Full size fit windows from 29⅞ to 42" wide**

High-energy efficiency with 8-way airflow control. Fresh air intake and stale air exhaust vents. Slide-out chassis. Easy-to-clean antimicrobial filter. Medium size cool-only units have 4 cooling speeds, plus fan-only setting. Nos. 1VXK6 and 1VXK7 are programmable units with electronic control, 24-hr timer, and Smart Fan that auto adjusts fan speed. Medium size heat/cool units and all full size units offer 3 cooling speeds plus fan-only setting.

No. 3DU26



For A/C Item Nos.	NEMA Type	Item No.	$ Each	Shpg. Wt.
Receptacles				
3BE30, 3CA53, 1VXK5, 4CB60, 3DU26, 3VE17, 3ZA70, 6KC40	5-15R	6A667	19.23	0.2
3DU27, 1VXK6, 1VXK7	6-15R	5Z832	22.10	0.1
3DU29, 3DU30, 3DU31, 3UF22	6-20R	5Z833	24.26	0.2
3DU32, 2XY66, 3VE10, 3VE11, 3VE12	6-30R	5Z895	31.35	0.4

For A/C Item Nos.	Item No.	$ Each	Shpg. Wt.
Window Mount Kits			
3ZA70	3JA19	35.90	5.5
3BE30, 3DU31, 3UF22	3UF10	36.90	7.2
3DU32, 3VE12	3UF09	36.90	7.5
2XY66, 3VE11, 3VE13	3UF08	36.90	7.6

Type	BtuH	Volts	EER	Amps AC	Watts	Dehum. Pts/Hr.	High CFM	NEMA Plug Type	Max. Wall Thick. (In.)	Dimensions (In.) H	W	D	Friedrich Model	Item No.	$ Each	Shpg. Wt.
Room Air Conditioners with Window Mount Kit - Compact																
Cool Only	5100	115	9.7	5.0	520	1.3	135	5-15P	6	12⅝	18⅛	14½	ZQ05	3CA53	160.75	47.0
Cool Only	5400	115	10.7	4.7	557	1.5	160	5-15P	—	12⅝	18⅛	14⅝	CP05	1VXK5	211.25	54.0
Cool Only	8000	115	10.8	6.8	741	1.9	175	5-15P	8½	14	19¾	21⅜	XQ08	4CB60	419.25	71.0
Cool Only	10,000	115	10.0	9.0	1000	3.2	180	5-15P	8½	14	19¾	21⅜	XQ10	3VE17	508.00	90.0
Cool Only	11,700	115	9.8	11.0	1198	3.2	200	5-15P	8½	14	19¾	21⅜	XQ12	4VB19	554.50	100.0
Room Air Conditioners with Window Mount Kit - Medium Size																
Cool Only	12,100/11,900	230/208	11.5/11.7	4.8/5.0	1052/1017	2.9	320	6-15P	8¾	15⅝	25⅛	27⅞	SS12-3	1VXK6	635.50	125.0
Cool Only	14,500	115	10.8	12.2	1450	3.5	377	5-15P	8¾	15⅝	25⅛	27⅞	KS15	3DU26	676.00	124.0
Cool Only	17,800/17,600	230/208	10.0/10.0	8.1/8.8	1780/1760	4.4	400	6-15P	8¾	17⅝	25⅛	27⅞	KM18	3DU27	793.00	126.0
Cool Only	20,600/20,200	230/208	9.9/10.0	9.4/10.1	2081/2020	6.0	425	6-15P	8¾	17⅝	25⅛	27⅞	SM21	1VXK7	928.50	175.0
Cool Only	23,500/23,000	230/208	9.5/9.5	9.5/9.5	2479/2421	7.0	490	6-20P	8¾	17⅝	25⅛	27⅞	KM24	3DU29	1110.00	205.0
Room Air Conditioners with Window Mount Kit - Full Size																
Cool Only	28,000/27,700	230/208	9.5/9.5	13.0/14.2	2947/2916	8.7	600	6-20P	16½	20⅛	28	33⅝	SL28	3DU30	1339.00	220.0
Cool Only	36,000/35,700	230/208	8.5/8.5	18.0/19.6	4235/4200	11.0	725	6-30P	16½	20⅛	28	33⅝	SL36	3VE10	1465.00	219.0
Electric Heat Room Air Conditioners (Window Mount Kits Sold Separately Above) - Compact																
Cool Heat	7700 4000	115	10.5	6.5 11.2	733 1290	1.9	175	5-15P	8½	14	19¾	21⅜	EQ08	3ZA70	686.00	81.0
Electric Heat Room Air Conditioners (Window Mount Kits Sold Separately Above) - Medium Size																
Cool Heat	12,100/11,900 10,700/8900	230/208	11.5/11.7	4.8/5.0 16.0/14.7	1052/1017 3500/2900	2.9	320	6-20P	8¾	15⅝	25⅛	27⅞	ES12	3DU31	767.00	128.0
Cool Heat	17,800/17,600 13,000/10,600	230/208	10.0/10.0	8.1/8.8 19.5/17.0	1780/1760 4200/3500	4.4	400	6-30P	8¾	17⅝	25⅛	27⅞	EM18	3DU32	868.00	159.0
Electric Heat Room Air Conditioners (Window Mount Kits Sold Separately Above) - Full Size																
Cool Heat	23,500/23,000 17,300/14,300	230/208	9.5	11.2	2479	7.0	400	6-30P	8¾	17⅝	25⅛	27⅞	EM24	2XY66	1310.00	163.0
Cool Heat	36,000/35,700 17,300/14,300	230/208	9.2/9.2	18.0/19.6 24.0/22.4	3913/3880 5500/4650	11.0	775	6-30P	16½	20⅛	28	33⅝	EL36	3VE11	1615.00	216.0
Heat Pumps (Window Mount Kits Sold Separately Above) - Medium Size																
Cool Heat	9200 7400	115	12.0	7.4 6.9	767 733	1.7	300	5-15P	8¾	15⅝	25⅛	27⅞	YS09	3BE30	857.50	124.0
Cool Heat Backup Ht	12,700/12,500 11,000/10,500 10,700/8900	230/208	11.0/11.0	5.1/5.6 5.3/5.8 16.0/14.7	1149/1131 1185/1167 3500/2900	3.5	325	6-20P	8¾	15⅝	25⅛	27⅞	YS13	3UF22	999.00	126.0
Cool Heat Backup Ht	18,000/18,000 16,800/16,400 13,000/10,600	230/208	9.5/9.5	8.5/9.5 8.5/9.0 19.5/17.0	1895/1895 1867/1822 4200/3500	4.7	495	6-30P	8¾	17⅝	25⅛	27⅞	YM18	3VE12	1252.00	145.0
Heat Pumps (Window Mount Kits Sold Separately Above) - Full Size																
Cool Heat Backup Ht	24,000/24,000 22,000/21,600 17,300/14,300	230/208	10.0/10.0	10.9/12.0 11.0/12.0 24.0/24.0	2400/2400 2444/2400 5500/4650	7.0	400	6-30P	16½	20⅛	28	33⅝	YL24	3VE13	1464.00	200.0

Hazardous Location Room Air Conditioners

Friedrich

- **Slide-out chassis**
- **Accommodates direct wiring only**
- **Seacoast protection provides a tough, corrosion-resistant finish**

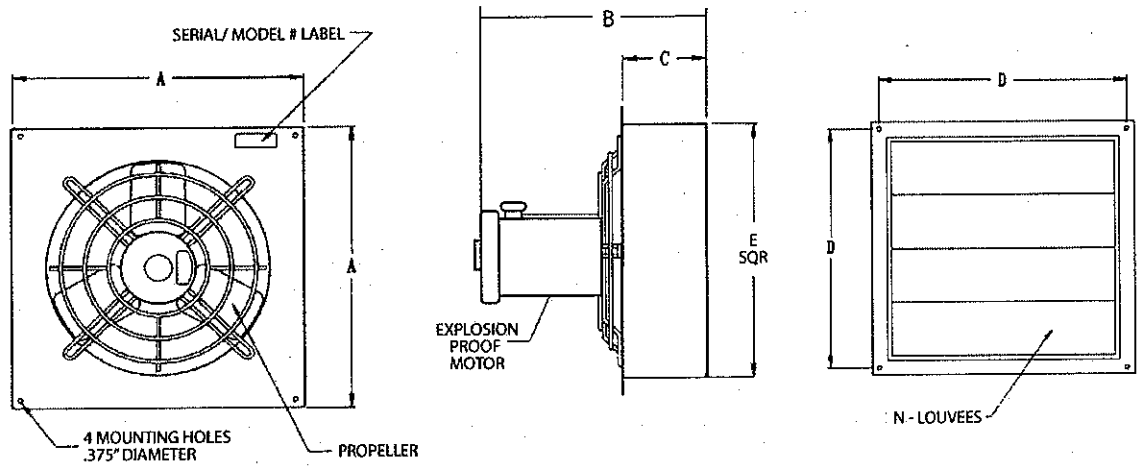
Designed for cooling in hazardous locations where specific volatile flammable liquids or gases are handled or used within enclosed containers or systems. Hazardgard® room air conditioners are designed to meet the National Electrical Code, Article 500 requirements for Class 1, Division 2, Group A, B, C, D hazardous locations and are the only room air conditioners UL Listed for this application. Totally enclosed fan motor has a hermetically sealed overload and electronic switch to prevent arcing. Solid state printed circuit board conductor paths are insulated against corrosion, and transient voltage suppressors protect controls against transient voltage spikes. Hot gas bypass low ambient control permits operation without freezing at outdoor ambient temperatures as low as 45°F.

No. 4E771

BtuH 230/208V	Volts	EER	Amps	Watts	Dimensions (In.) H	W	D	Friedrich Model	Item No.		$ Each	Shpg. Wt.
15,000/15,000	230/208	8.5	7.9/8.7	1765/1765	15⅝	25⅛	27⅞	SH15	4E771	✓	1949.00	158.0
19,800/19,500	230/208	9.0	10.0/10.9	2200/2167	17⅝	25⅛	27⅞	SH20	4E772	✓	2270.00	172.0

EXPLOSION PROOF STANDARD FAN

Dimensions



Fan Size	A	B	C	D (c/c)	E	N	Framing
TB1 → 12"	17-1/4"	20-1/2"	6"	16"	14-3/4"	3	15 x 15
TB2 → 18"	23-1/4"	20-1/2"	6"	22"	20-3/4"	4	21 x 21
24"	29-1/4"	20-1/2"	6"	28"	26-3/4"	5	27 x 27

Performance Data & Specifications

Model	Fan Size	Motor H.P.	Volts	Amps	Operation Speed	Fan RPM	Airflow Capacity - CFM				Framing Dimensions
							0" SP	.05" SP	.10" SP	.25" SP	
SD12-XPF	12"	1/3	115/230	6.6/3.3	Single	1625	1,640	1,600	1,540	1,390	15" x 15"
SD18-XPF	18"	1/3	115/230	6.6/3.3	Single	1625	3,200	3,150	3,090	2,920	21" x 21"
SD24-XPF	24"	1/3	115/230	6.6/3.3	Single	1625	5,500	5,400	5,310	5,100	27" x 27"

Note: Wind has a significant effect on exhaust fans. A 10 mph wind creates a 0.05" pressure against the fan. A 20 mph wind creates 0.20" pressure and 30 mph a 0.45" pressure. These pressures are in addition to the static pressure in the building. Wind blocks or hoods should be included in all designs where fans will be subjected to winds above 10 mph.

Warranty

- 1 year on all components.

CANARM LTD. - Corporate Office
57 Parkedale Ave., Brockville, ON
Canada K6V 5V6
Tel: (613) 342-5424 Fax: 1-800-263-4598

CANARM LTD. - USA Warehouse
808 Commerce Park Drive
Ogdensburg, New York, USA 13669
Tel: 1-800-267-4427 Fax: 1-800-263-4598

Arthur Manufacturing Facility
#7686 Concession 16, RR 4 Arthur, ON
Canada N0G 1A0
Tel: (519) 848-3910 Fax: (519) 848-3948
Web Site: **www.bsmagri.com**
E-Mail: **sales@bsmagri.com**

Web Site: **www.canarm.com**
E-Mail: **agsales@canarm.ca**

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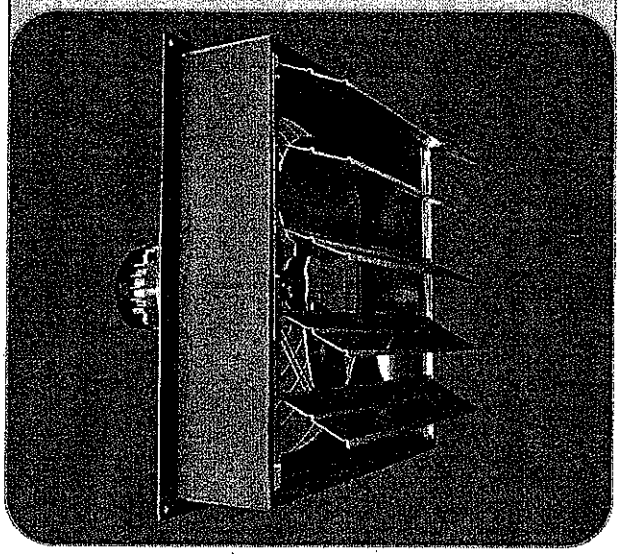
EXPLOSION PROOF STANDARD FAN

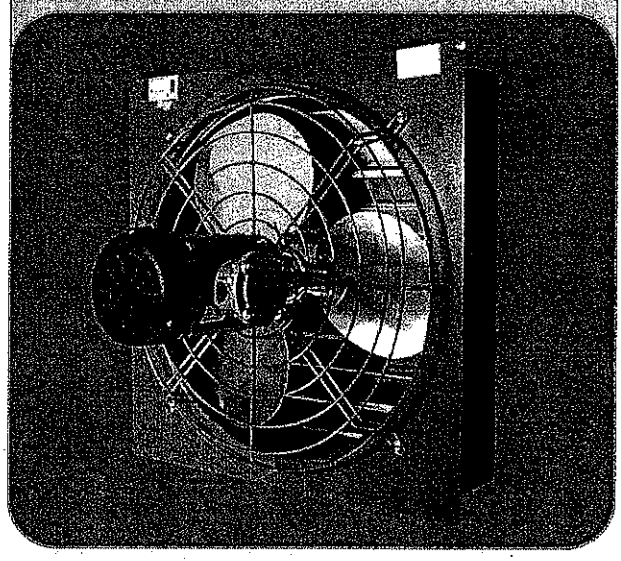
Efficient • Low Maintenance • Easy Installation

Canarm's Explosion Proof Fans follow a tradition of quality in design, materials and construction.

Front



Back



Features

- Available in 12", 18" and 24" sizes.
- All fans use a totally enclosed, ball bearing motor with thermal overload protection (fan cooled).
- The motor mount is manufactured with heavy welded rods and has a powder coated finish.
- The fan blades are well-balanced, heavy gauge aluminum.
- The rugged steel welded box housing has a durable powder coated finish.
- Aluminum louver shutters are supported by long life nylon bushings.
- All fans are shipped completely assembled.

General Information

Canarm's Explosion Proof Fans follow a tradition of quality in design, materials and construction. Using our quality "Standard Fan" housing and motor mount as the basis for design, we have developed an efficient, economically priced Explosion Proof Fan. All Explosion Proof Fans have a single speed, dual voltage explosion proof motor that meets and conforms to all the standards that are listed below.

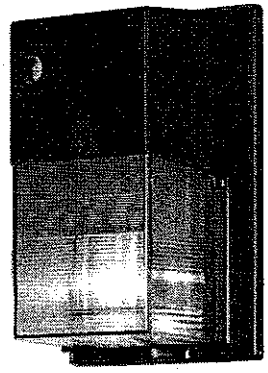
Class I, Group C	*Atmospheres containing ethyl ether, ethylene, gases or vapors of equivalent hazard.*
Class I, Group D	*Atmospheres such as acetone, ammonia, benzene, butane, cyclopropane, ethanol, gasoline, hexane, methane, natural gas, naphtha, propane, or gasses or vapors of equivalent hazard.*
Class II Group F	*Atmospheres containing carbonaceous dust, including carbon black, charcoal, coal, or coke dusts that have more than 8% total entrapped volatiles, or dusts that have been sensitized by other materials so that they present an explosion hazard.*
Class II Group G	*Atmospheres containing combustible dusts not included in group E or F, including flour, grain, wood, plastic and chemicals.*

c US Approved

CATALOG NO. _____

TYPE NO. _____ JOB NAME _____

TLW Twilighter Series Wallprism



ORDERING INFORMATION

Catalog Number: Example: TLW70NLXLPC-1

TLW	070	NLX	L	PC	1
FIXTURE	WATTAGE	LAMP SOURCE	LAMP	OPTION	VOLTAGE
TLW- Twilighter Wallprism	**13**-13W*	**NLX**-High Pressure Sodium	**L**-Fixtures furnished with lamp	**PC**- Photocontrol***	**1**-120V
	28-28W*	**HMA**-Metal Halide (HPF)**			**6**-120/ 277V**
	42-42W	**HF**-Compact Fluorescent (NPF)			
	35-35W				
	50-50W				
	70-70W				

*Available in Compact Fluorescent only. **50W HMA (HPF) only.
***50W HMA and 42W HF not available with PC.

ACCESSORIES

TLW552-Replacement lens.

TECHNICAL INFORMATION

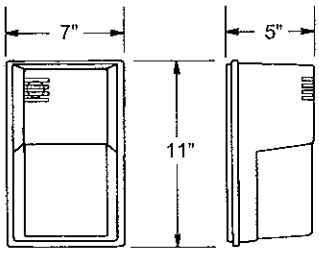
All TLW High Pressure Sodium units are supplied with E17 medium base lamps. Metal Halide fixtures come equipped with ED17 medium base lamps. Compact Fluorescent units use GX32d-3, rated -20° Fahrenheit.

NLX start temp = -40°F

HMA start temp = -20°F

NF start temp = -20°F, 28W
32°F, 13W
-20°F, 42W

NOTE: The 42 watt compact fluorescent is supplied with a high power factor, voltage sensing electronic ballast for 120 through 277 volt 50 or 60 hertz. Although the product is supplied with a 42 watt PLT lamp, the ballast will also drive 26 or 32 watt PLT lamps.



PRODUCT SPECIFICATIONS

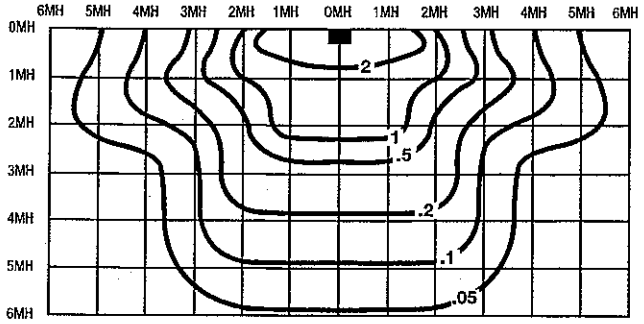
- Twilighter Series Wallprism is excellent for security, accent, and perimeter lighting. Applications include entrance ways, garages, tunnels, overpasses, and alleys.
- Vandal resistant polycarbonate housing finished in architectural dark bronze.
- UV stabilized polycarbonate prismatic refractor.
- Aluminum reflector provides smooth "down-and-out" distribution.
- Electrical components mounted to die-cast mounting plate for effective heat transfer.
- Deluxe glazed porcelain socket pulse rated for 4KV.

UL Wet Location Listed.

Crescent Stonco
2345 Vauxhall Rd. • Union, NJ 07083 • 908-964-7000

TLW Twilighter Series Wallprism

PHOTOMETRICS



TLW50NLXL
LAMP: 50W HPS
INITIAL LUMENS: 4,000
MOUNTING HGT. 8'

FOOTCANDLE CORRECTION
Different Lamps/Watts
Multiply the following factors times the footcandle values for changes in mounting height.

35W HPS	.56
50W HPS	1.00
70W HPS	1.41
50W MA	.89
28W PL	.42

FOOTCANDLE CORRECTION
Multiply the following factors times the footcandle values for changes in mounting height.

To Change from 8'						
New Height	6'	7'	8'	9'	10'	12'
Factor	1.78	1.31	1.00	.79	.64	.44

SUGGESTED SPECIFICATIONS

Fixture shall be constructed of vandal-resistant polycarbonate, finished in dark architectural bronze. Electrical components shall be mounted to a die-cast mounting plate for effective heat transfer.

HID fixtures are equipped with deluxe glazed porcelain sockets pulse-rated for 4KV.

Fixture is equipped with tamper-resistant hardware. Lens shall be constructed of UV stabilized clear prismatic polycarbonate.

HID fixtures equipped with Normal Power Factor Reactor ballasts for 120 volt input. Fixture also available in high power factor. HID fixtures supplied with either 35, 50 or 70 watt lamp as specified. Compact Fluorescent unit supplied with 28 watt PLC lamp or 42 watt PLT lamp.

Fixtures are fully gasketed and UL listed for wet locations.

Fixture shall be wall mounted over a recessed splice box.

Fixture also capable of accepting a built-in photocontrol for automatic dusk-to-dawn lighting.

Fixture shall be Stonco Cat. No. (specify).

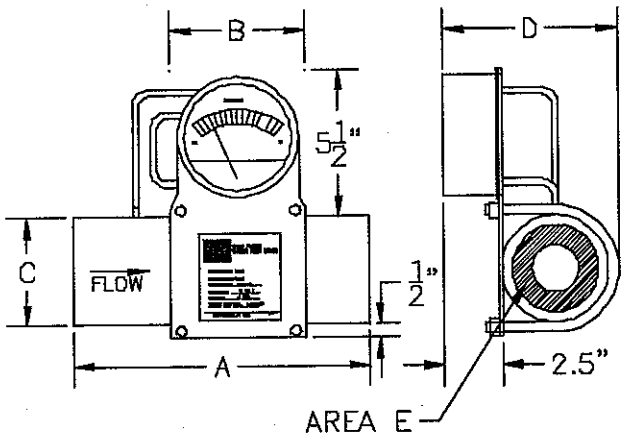
Old Cut Sheets

Product Technical Specification

VFLOW Series Venturi Air Flow Meters

Application: The MLEE VFLOW series venturi air flow meters are designed to be a cost effective, accurate flow meter that is calibrated for your site-specific conditions. When ordering the VFLOW meter it is critical to provide the expected operating temperature (deg F or deg C) and pressure or vacuum in psia. By supplying the operating pressure in psia it eliminates any error in flow measurements that can be generated due to altitude and gauge readings. The VFLOW meter can be supplied with any scale range required in scfm (25deg C, 14.7psia) or acfm at your listed operating conditions. The VFLOW meter can be ordered with standard SCFM scale ranges at a lower cost.

Construction: The VFLOW meter is fabricated from aluminum and has a gradual venturi profile to reduce pressure losses through the meter. Copper tube connections are capable of handling temperatures as high as 250 deg F. The Dwyer magnehelic ® gauge provides a large, clear and accurate display of your airflow reading and is customized to match your required cfm scale. Each calibrated meter is fitted with a calibration label listing the design conditions that the meter is calibrated for.

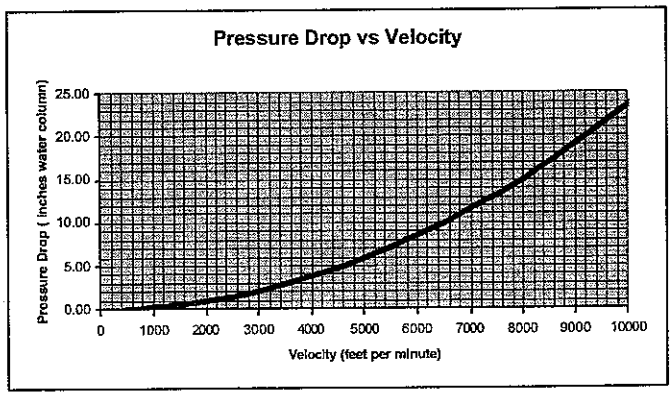


Dimensions Chart: (Dimensions in inches)

PART NUMBER	A	B	C	D	E (sqft)	Inlet
1-1/2" VFLOW	6	4.75	2.5	3.25	0.0123	1.5" fnpt
2" VFLOW	7.75	4.75	3	5.75	0.0218	2" fnpt
3" VFLOW	11	5.5	4	6.75	0.0491	3" fnpt
4" VFLOW	14.5	5.5	5	7.75	0.0872	4" fnpt

Specifications

Maximum Air Temperature:	250 deg F (standard) 300 deg F (high temp version)
Max. Operating Pressure	15 psig (standard unit) 35 psig (med pressure unit) 80 psig (high pressure unit)
Accuracy:	2.5 % of scale at calibration point.
Repeatability:	1% of scale at calibration point.
Pressure Drop:	For pressure drop, determine flow rate in feet/min and refer to chart on right.



Flow rate (fpm) = flow rate (acfm)/area (sqft)

Maple Leaf Environmental Equipment Ltd.
1325 California Ave., P.O. Box 1517, Brockville, Ontario K6V 5Y6
ph. 1-800-420-4056 www.maple-leaf.ca fax (613)345-7633

Product Technical Specification

VFLOW Series Venturi Air Flow Meters

The following table provides recommended flow rates for each meter at a given operating pressure range. These values are suitable for temperatures between 70-100 deg F. For meter applications outside this temperature range where the operating flow rate is at the upper or lower limit listed please contact our sales department for help in choosing a suitable meter.

	Recommended Operating Flow rates (SCFM)				
	5-10 psi	**0-5 psi**	**0-10"hg**	**10-20"hg**	**20-26"hg**
VFLOW 1.5"	30-140	25-120	20-100	15-75	10-40
VFLOW 2"	50-250	45-200	35-180	30-125	20-70
VFLOW 3"	100-500	120-600	80-400	60-320	40-150
VFLOW 4"	200-1000	175-850	140-700	120-540	70-250

Standard Features:

- Aluminum meter construction.
- FNPT inlet and outlet.
- Direct ready display can be calibrated for your specific operation conditions. Display can read ACFM or SCFM but SCFM is recommended there is less error when the meter is operating above or below the calibrated pressure. Other units are available on request.
- Large 4" display for accurate reading.

Calibration and Correction Factors:

Each VFLOW meter is calibrated for a specific operating temperature and pressure. If the flow meter operates at a different pressure or temperature than the original design then the flow measurement can be adjusted with the following equation The units of $Flow_1$ will be the same as the units of $Flow_2$.

$$Flow_1 = Flow_2 \times (P_2/P_1 \times ((T_1+460)/(T_2+460))^{1/2}$$

Pressure units: psia, Temperature units: deg F

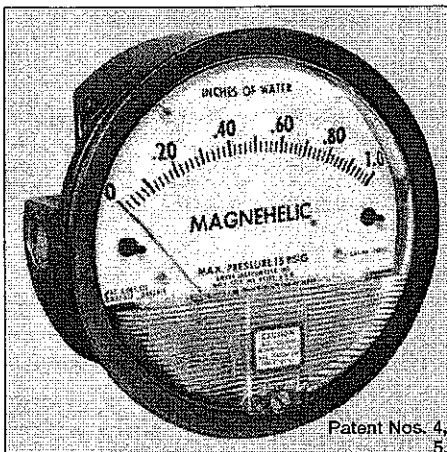
Options Table:

Option	Description
Orientation:	The flow meter gauge can be oriented for flows from Left to Right, Right to Left, Up or Down as required for your specific application.
Site Specific Calibration and Gauge Range:	The following information is required to calibrate the flow meter for your specific application: Operating Pressure (psia): Operating Temperature (deg F or deg C): Operating Flow Rate (acfm or scfm or other scales as required): Maximum Flow rate (better accuracy is achieved when the operating flow rate is approximately ¾ of the scale range of the flow meter):
4-20ma Option	Flow meters can be ordered with 4-20ma outputs for control systems. Three versions are available: Nema 7 (Class 1 Div 1) FM or CSA approved Two Wire Connection: 24VDC+, Signal Output Power Consumption: 20mA 316SS Wetted parts Nema 4 (Weatherproof) or Nema 1 (General Purpose) Three Wire Connection: 24VDC+, 24VDC-, Signal Output Accuracy on all 4-20ma outputs: 2.5% of full scale for meter Aluminum with Silicon diaphram

1325 California Ave., P.O. Box 1517, Brockville, Ontario K6V 5Y6
ph. 1-800-420-4056 www.maple-leaf.ca fax (613)345-7633

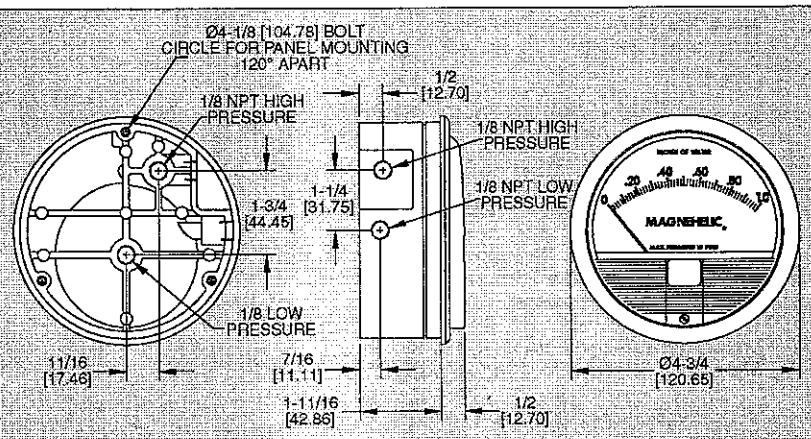
Series 2000 Magnehelic® Differential Pressure Gages

Indicate Positive, Negative or Differential, Accurate within 2%



Patent Nos. 4,030,365
5,012,678

Standard Magnehelic® Pressure Gage has a large, easy-to-read 4" dial.



Dimensions, Standard Series 2000 Magnehelic® Pressure Gages. (Slightly different on medium and high pressure models)

Select the Dwyer Magnehelic® gage for high accuracy – guaranteed within 2% of full scale – and for the wide choice of 81 models available to suit your needs precisely. Using Dwyer's simple, frictionless Magnehelic® movement, it quickly indicates low air or non-corrosive gas pressures – either positive, negative (vacuum) or differential. The design resists shock, vibration and over-pressures. No manometer fluid to evaporate, freeze or cause toxic or leveling problems. It's inexpensive, too.

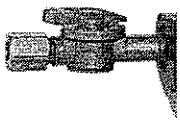
The Magnehelic® is the industry standard to measure fan and blower pressures, filter resistance, air velocity, furnace draft, pressure drop across orifice plates, liquid levels with bubbler systems and pressures in fluid amplifier or fluidic systems. It also checks gas-air ratio controls and automatic valves, and monitors blood and respiratory pressures in medical care equipment.

Note: May be used with Hydrogen where pressures are less than 35 psi.

MOUNTING. A single case size is used for most models of Magnehelic® gages. They can be flush or surface mounted with standard hardware supplied. With the optional A-610 Pipe Mounting Kit they may be conveniently installed on horizontal or vertical 1¼" - 2" pipe. Although calibrated for vertical position, many ranges above 1" may be used at any angle by simply re-zeroing. However, for maximum accuracy, they must be calibrated in the same position in which they are used. These characteristics make Magnehelic® gages ideal for both stationary and portable applications. A 4⅜" hole is required for flush panel mounting. Complete mounting and connection fittings plus instructions are furnished with each instrument.

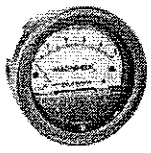
Flush ...Surface...or Pipe Mounted

VENT VALVES



In applications where pressure is continuous and the Magnehelic® gage is connected by metal or plastic tubing which cannot be easily removed, we suggest using Dwyer A-310A vent valves to connect gage. Pressure can then be removed to check or re-zero the gage.

HIGH AND MEDIUM PRESSURE MODELS



Installation is similar to standard gages except that a 4⅜" hole is needed for flush mounting. The medium pressure construction is rated for internal pressures up to 35 psig and the high pressure up to 80 psig. Available for all models. Because of larger case, the medium pressure and high pressure models will not fit in a portable case size. Installation of the A-321 safety relief valve on standard Magnehelic® gages often provides adequate protection against infrequent overpressure.

SPECIFICATIONS

Service: Air and non-combustible, compatible gases. (Natural Gas option available.)
Wetted Materials: Consult factory.
Housing: Die cast aluminum case and bezel, with acrylic cover. Exterior finish is coated gray to withstand 168 hour salt spray corrosion test.
Accuracy: ±2% of full scale (±3% on - 0, -100 Pa, -125 Pa, 10MM and ±4% on - 00, -60 Pa, -6MM ranges), throughout range at 70°F (21.1°C).
Pressure Limits: -20" Hg. to 15 psig.† (-0.677 bar to 1.034 bar); MP option: 35 psig (2.41 bar), HP option: 80 psig (5.52 bar).
Overpressure: Relief plug opens at approximately 25 psig (1.72 bar), standard gages only.
Temperature Limits: 20 to 140°F.* (-6.67 to 60°C).
Size: 4" (101.6 mm) Diameter dial face.
Mounting Orientation: Diaphragm in vertical position. Consult factory for other position orientations.
Process Connections: 1/8" female NPT duplicate high and low pressure taps - one pair side and one pair back.
Weight: 1 lb 2 oz (510 g), MP & HP 2 lb 2 oz (963 g).
Standard Accessories: Two 1/8" NPT plugs for duplicate pressure taps, two 1/8" pipe thread to rubber tubing adapter and three flush mounting adapters with screws. (Mounting and snap ring retainer substituted for 3 adapters in MP & HP gage accessories.)
*Low temperature models available as special option.
†For applications with high cycle rate within gage total pressure rating, next higher rating is recommended. See Medium and High pressure options at lower left.

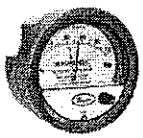
OPTIONS AND ACCESSORIES

Transparent Overlays

Furnished in red and green to highlight and emphasize critical pressures.

Adjustable Signal Flag

Integral with plastic gage cover. Available for most models except those with medium or high pressure construction. Can be ordered with gage or separate.



LED Setpoint Indicator

Bright red LED on right of scale shows when setpoint is reached. Field adjustable from gage face, unit operates on 12-24 VDC. Requires MP or HP style cover and bezel.

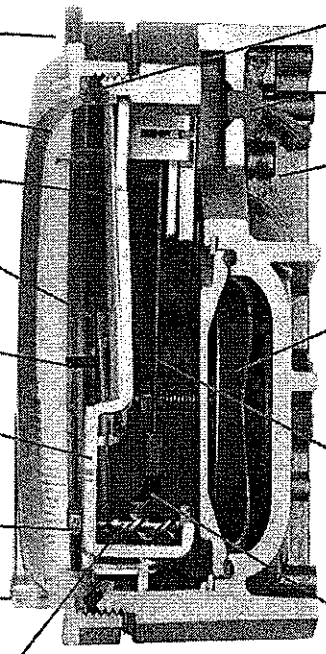
Portable Units

Combine carrying case with any Magnehelic® gage of standard range, except high pressure connection. Includes 9 ft. (2.7 m) of ⅜" I.D. rubber tubing, standhang bracket and terminal tube with holder.

Air Filter Gage Accessory Package

Adapts any standard Magnehelic® for use as an air filter gage. Includes aluminum surface mounting bracket with screws, two 5 ft. (1.5 m) lengths of ¼" aluminum tubing two static pressure tips and two molded plastic vent valves, integral compression fittings on both tips and valves.

Quality design and construction features



Bezel provides flange for flush mounting in panel.

Clear plastic face is highly resistant to breakage. Provides undistorted viewing of pointer and scale.

Precision litho-printed scale is accurate and easy to read.

Red tipped pointer of heat treated aluminum tubing is easy to see. It is rigidly mounted on the helix shaft.

Pointer stops of molded rubber prevent pointer over-travel without damage.

"Wishbone" assembly provides mounting for helix, helix bearings and pointer shaft.

Jeweled bearings are shock-resistant mounted; provide virtually friction-free motion for helix. Motion damped with high viscosity silicone fluid.

Zero adjustment screw is conveniently located in the plastic cover, and is accessible without removing cover. O-ring seal provides pressure tightness.

Helix is precision made from an alloy of high magnetic permeability. Mounted in jeweled bearings, it turns freely, following the magnetic field to move the pointer across the scale.

O-ring seal for cover assures pressure integrity of case.

Blowout plug of silicone rubber protects against overpressure on 15 psig rated models. Opens at approximately 25 psig.

Die cast aluminum case is precision made and iridite-dipped to withstand 168 hour salt spray corrosion test. Exterior finished in baked dark gray hammerloid. One case size is used for all standard pressure options, and for both surface and flush mounting.

Silicone rubber diaphragm with integrally molded O-ring is supported by front and rear plates. It is locked and sealed in position with a sealing plate and retaining ring. Diaphragm motion is restricted to prevent damage due to overpressures.

Calibrated range spring is flat spring steel. Small amplitude of motion assures consistency and long life. It reacts to pressure on diaphragm. Live length adjustable for calibration.

Samarium Cobalt magnet mounted at one end of range spring rotates helix without mechanical linkages.

MODELS

Dual Scale English/Metric Models		
Model Number	Range, In. W.C.	Range, Pa or kPa
2000-0D	0-0.5	0-125 Pa
2001D	0-1.0	0-250 Pa
2002D	0-2.0	0-500 Pa
2003D	0-3.0	0-750 Pa
2004D	0-4.0	0-1.0 kPa
2006D	0-6.0	0-1.5 kPa
2008D	0-8.0	0-2.0 kPa
2010D	0-10	0-2.5 kPa

SERIES 2000 MAGNEHELIC® — MODELS AND RANGES

The models below will fulfill most requirements. Page 11 also shows examples of special models built for OEM customers. For special scales furnished in ounces per square inch, inches of mercury, metric units, etc., contact the factory.

Model Number	Range Inches of Water
2000-00†••	0-.25
2000-0†•	0-.50
2001	0-1.0
2002	0-2.0
2003	0-3.0
2004	0-4.0
2005	0-5.0
2006	0-6.0
2008	0-8.0
2010	0-10
2015	0-15
2020	0-20
2025	0-25
2030	0-30
2040	0-40
2050	0-50
2060	0-60
2080	0-80
2100	0-100
2150	0-150

Model Number	Range Zero Center Inches of Water
2300-0†•	.25-0-.25
2301	.5-0-.5
2302	1-0-1
2304	2-0-2
2310	5-0-5
2320	10-0-10
2330	15-0-15

Model Number	Range PSI
2201	0-1
2202	0-2
2203	0-3
2204	0-4
2205	0-5
2210*	0-10
2215*	0-15
2220*	0-20
2230**	0-30

*MP option standard
**HP option standard

Dual Scale Air Velocity Units	
Model Number	Range in W.C. Velocity, F.P.M.
2000-00AV†••	0-.25/300-2000
2000-0AV†•	0-.50/500-2800
2001AV	0-1.0/500-4000
2002AV	0-2.0/1000-5600
2010AV	0-10/2000-12500

For use with pitot tube.

Model Number	Range MM of Water
2000-6MM†••	0-6
2000-10MM†•	0-10
2000-25MM	0-25
2000-50MM	0-50
2000-80MM	0-80
2000-100MM	0-100

Zero Center Ranges	
2300-20MM†	10-0-10

Model Number	Range, CM of Water
2000-15CM	0-15
2000-20CM	0-20
2000-25CM	0-25
2000-50CM	0-50
2000-80CM	0-80
2000-100CM	0-100
2000-150CM	0-150
2000-200CM	0-200
2000-250CM	0-250
2000-300CM	0-300

Zero Center Ranges	
2300-4CM	2-0-2
2300-10CM	5-0-5
2300-30CM	15-0-15

Model Number	Range, Pascals
2000-60PA†••	0-60
2000-100PA†•	0-100
2000-125PA†•	0-125
2000-250PA	0-250
2000-300PA	0-300
2000-500PA	0-500
2000-750PA	0-750

Zero Center Ranges	
2300-250PA	125-0-125
2300-500PA	250-0-250

Model Number	Range, Kilopascals
2000-1KPA	0-1
2000-1.5KPA	0-1.5
2000-2KPA	0-2
2000-3KPA	0-3
2000-4KPA	0-4
2000-5KPA	0-5
2000-8KPA	0-8
2000-10KPA	0-10
2000-15KPA	0-15
2000-20KPA	0-20
2000-25KPA	0-25
2000-30KPA	0-30

Zero Center Ranges	
2300-1KPA	.5-0-.5
2300-3KPA	1.5-0-1.5

Accessories

A-299, Surface Mounting Bracket
A-300, Flat Flush Mounting Bracket
A-310A, 3-Way Vent Valve
A-321, Safety Relief Valve
A-432, Portable Kit
A-605, Air Filter Kit
A-610, Pipe Mount Kit
Scale Overlays — Red, Green, Mirrored or Combination, Specify Locations

Options — To order, add suffix: I.E. 2001-ASF
ASF (Adjustable Signal Flag)
HP (High Pressure Option)
LT (Low Temperatures to -20°F)
MP (Med. Pressure Option)
SP (Setpoint Indicator)

Special Purpose Ranges

Scale No. 2401 Scale No. 2402
Square Root Blank Scale
Specify Range Specify Range

Model 2000-00N, range -.05 to +.20" W.C. For room pressure monitoring

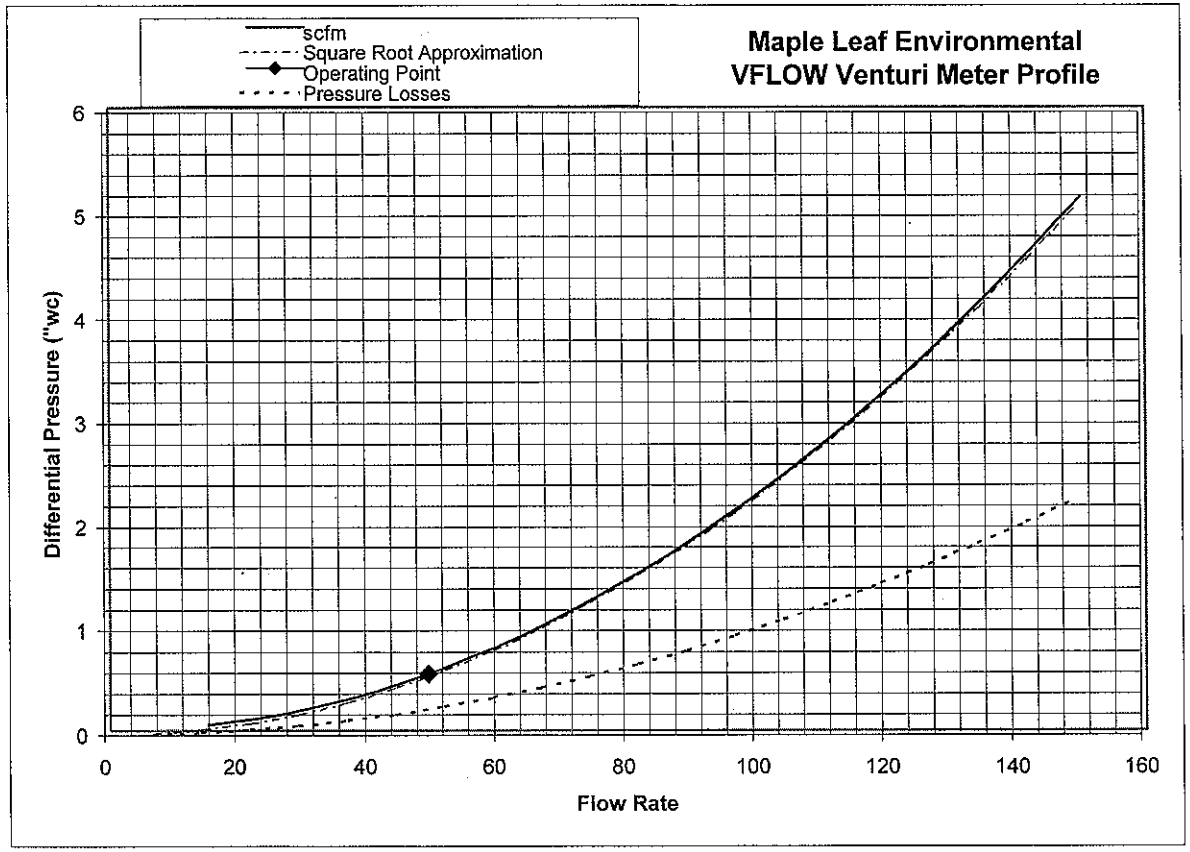
†These ranges calibrated for vertical scale position.
• Accuracy +/-3%. •• Accuracy +/-4%

1011R01-0298P

Calibration Data

Model of Flow meter:	VFLOW 3		Location of Meter:	FI-101
Atmospheric Pressure:	14.6487479	psia	Project Number:	50353
Line Pressure:	14.60	psia	Project Name:	Northrop Grumman
Line Temperature:	18.33	deg C	Maximum Flow Rate:	150 scfm
Operating Flow Rate:	49.00	scfm	Differential Pressure at Max Flow:	5.06986 "wc

(Standard conditions assumed to be 14.7psia and 25 degC)

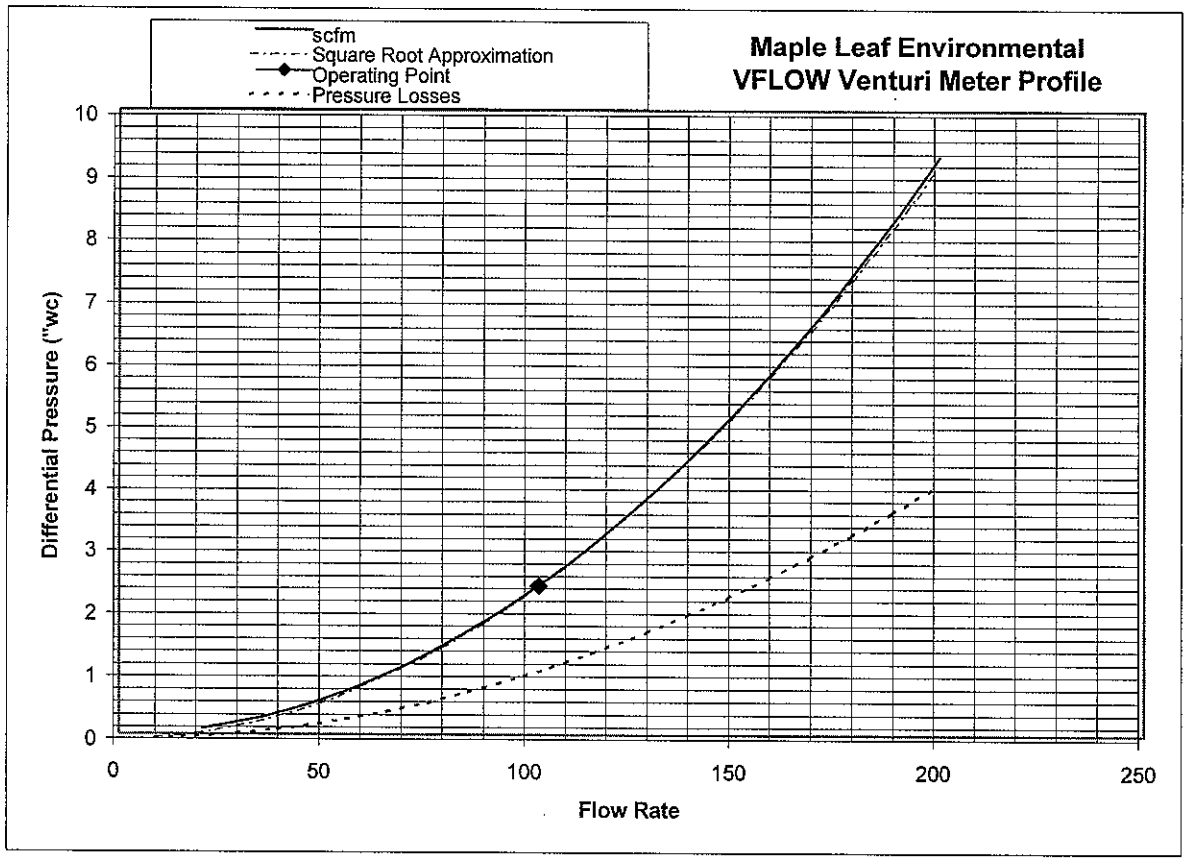


This graph is accurate only for the pressure listed above. If you are operating at a different pressure, a new graph will need to be provided.

Calibration Data

Model of Flow meter:	VFLOW 3		Location of Meter:	FI-102
Atmospheric Pressure:	14.6487479	psia	Project Number:	50353
Line Pressure:	14.55	psia	Project Name:	Northrop Grumman
Line Temperature:	18.33	deg C	Maximum Flow Rate:	200 scfm
Operating Flow Rate:	102.00	scfm	Differential Pressure at Max Flow:	9.08668 "wc

(Standard conditions assumed to be 14.7psia and 25 degC)

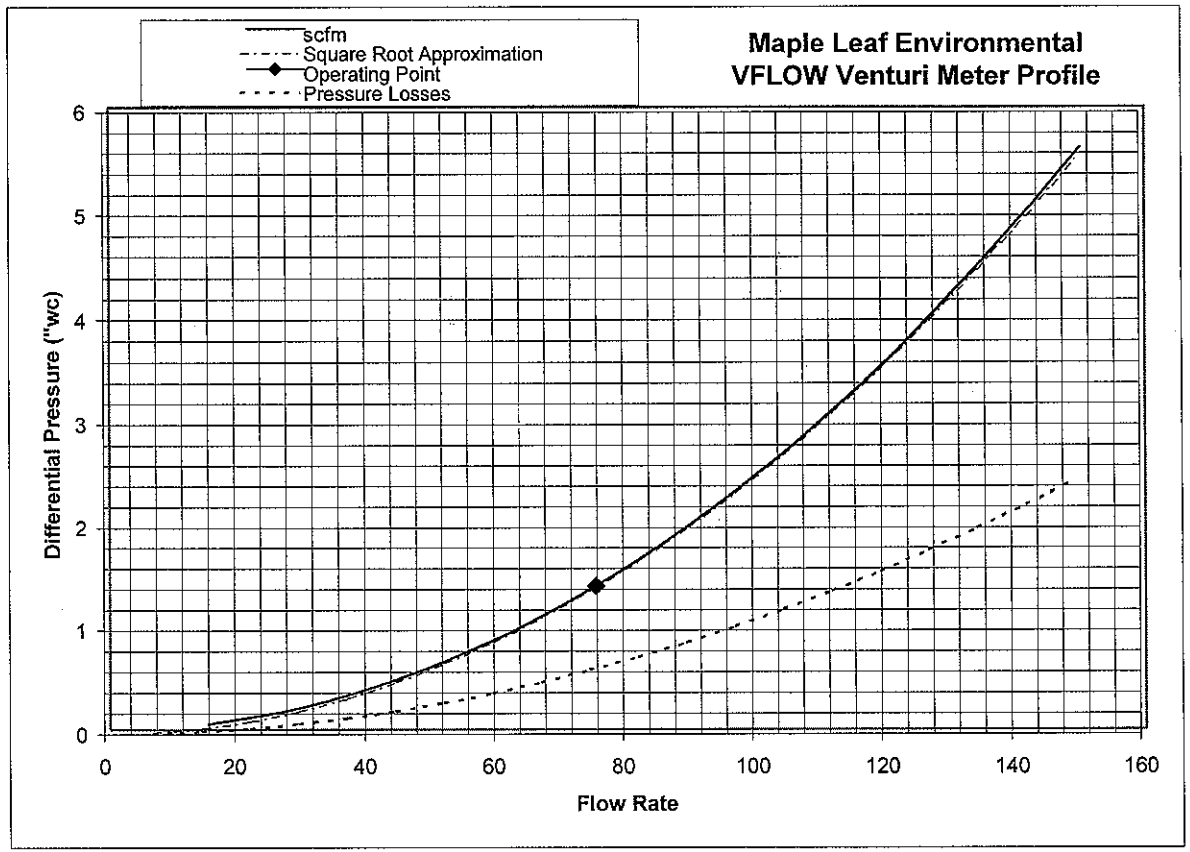


This graph is accurate only for the pressure listed above. If you are operating at a different pressure, a new graph will need to be provided.

Calibration Data

Model of Flow meter:	VFLOW 3		Location of Meter:	FI-103-106
Atmospheric Pressure:	14.6487479	psia	Project Number:	50353
Line Pressure:	13.41	psia	Project Name:	Northrop Grumman
Line Temperature:	18.33	deg C	Maximum Flow Rate:	150 scfm
Operating Flow Rate:	75.00	scfm	Differential Pressure at Max Flow:	5.53421 "wc

(Standard conditions assumed to be 14.7psia and 25 degC)

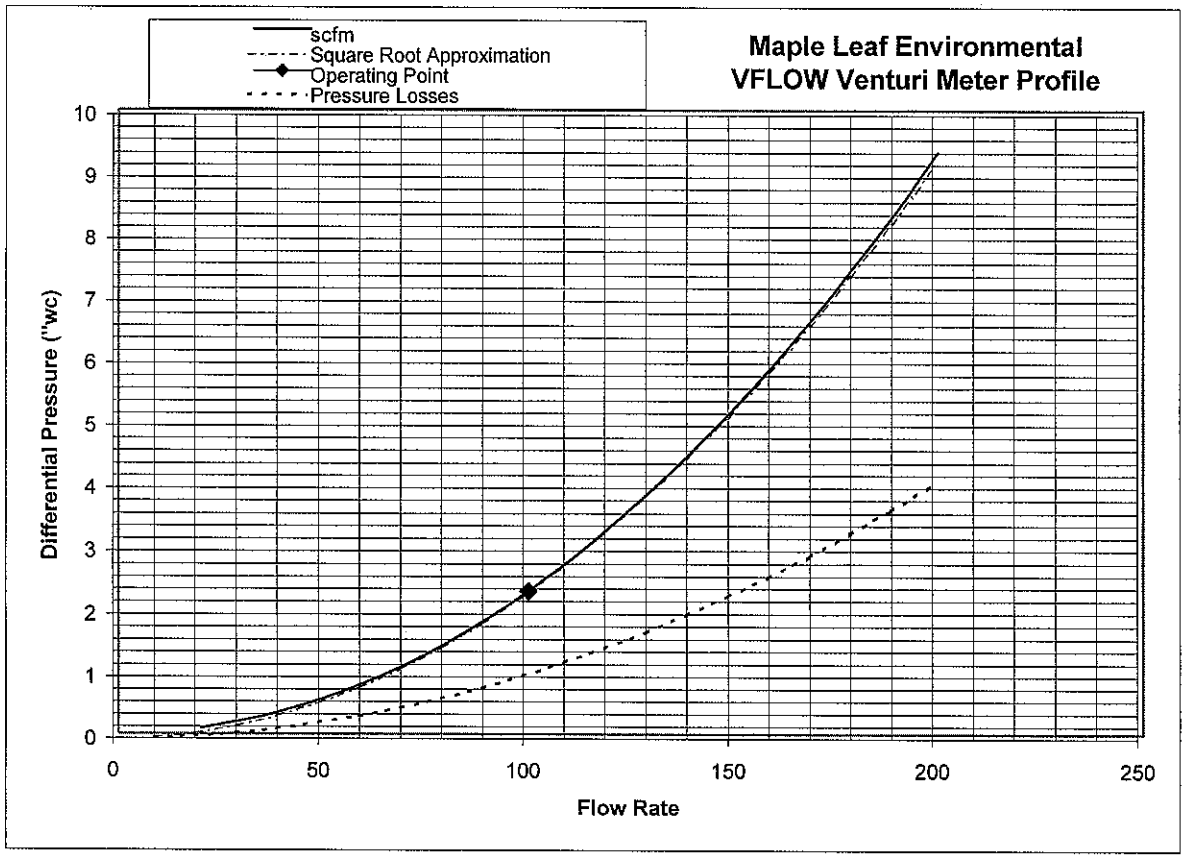


This graph is accurate only for the pressure listed above. If you are operating at a different pressure, a new graph will need to be provided.

Calibration Data

Model of Flow meter:	VFLOW 3		Location of Meter:	FI-107
Atmospheric Pressure:	14.6487479	psia	Project Number:	50353
Line Pressure:	14.46	psia	Project Name:	Northrop Grumman
Line Temperature:	18.33	deg C	Maximum Flow Rate:	200 scfm
Operating Flow Rate:	100.00	scfm	Differential Pressure at Max Flow:	9.14089 "wc

(Standard conditions assumed to be 14.7psia and 25 degC)

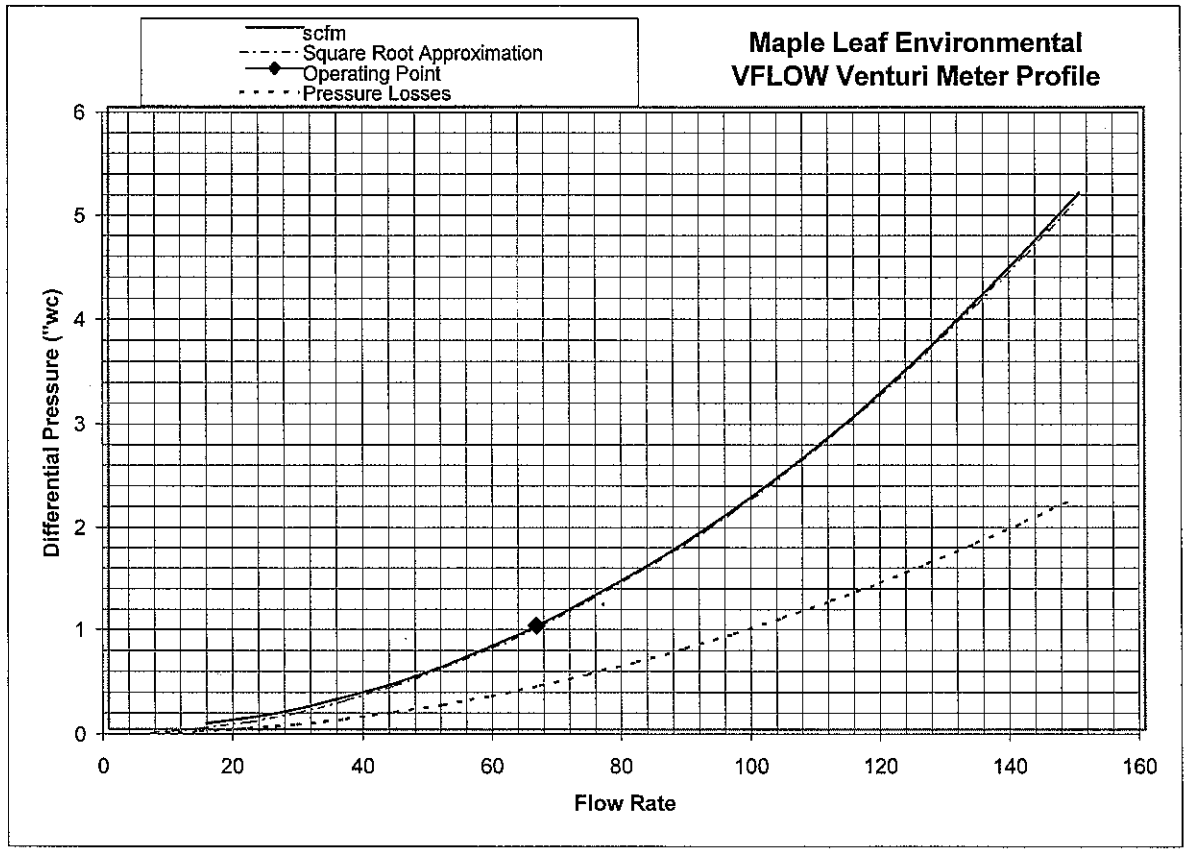


This graph is accurate only for the pressure listed above. If you are operating at a different pressure, a new graph will need to be provided.

Calibration Data

Model of Flow meter:	VFLOW 3		Location of Meter:	FI-108-112	
Atmospheric Pressure:	14.6487479	psia	Project Number:	50353	
Line Pressure:	14.51	psia	Project Name:	Northrop Grumman	
Line Temperature:	18.33	deg C	Maximum Flow Rate:	150	scfm
Operating Flow Rate:	66.00	scfm	Differential Pressure at Max Flow:	5.10734	"wc

(Standard conditions assumed to be 14.7psia and 25 degC)

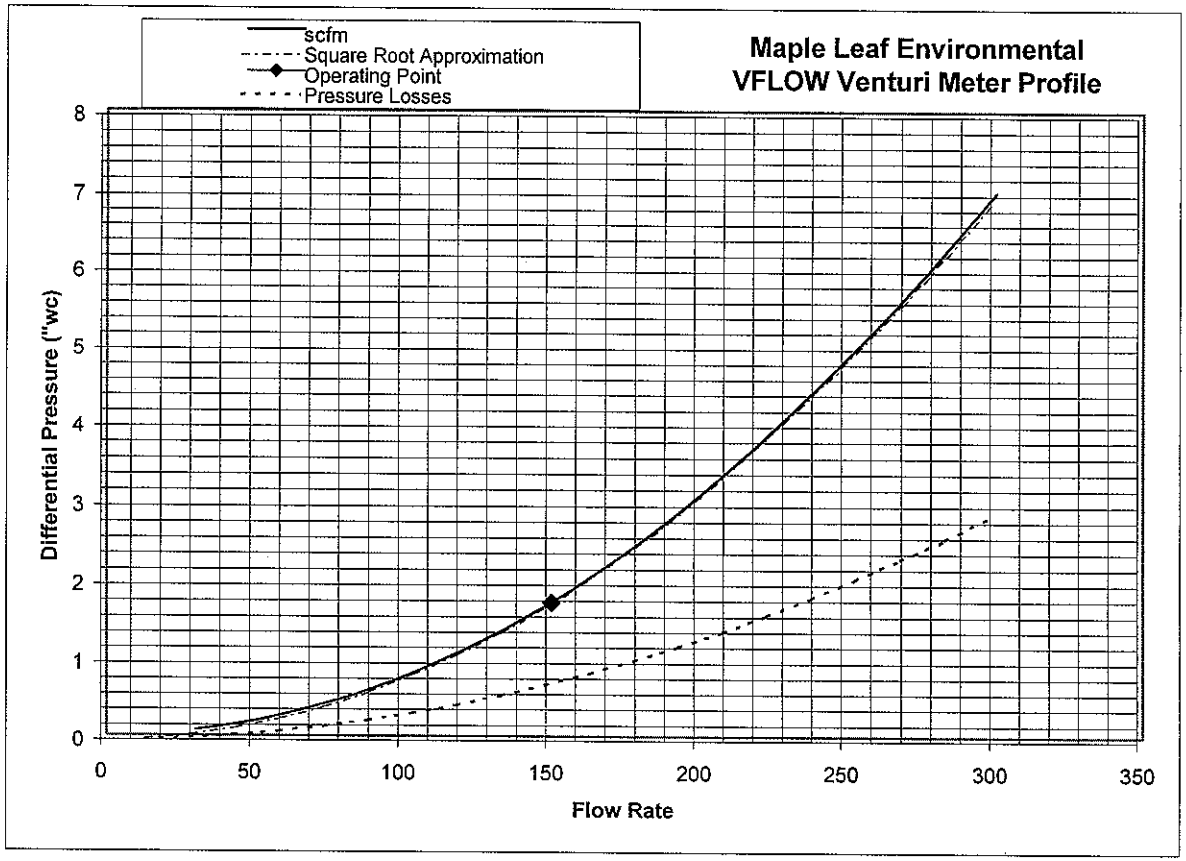


This graph is accurate only for the pressure listed above. If you are operating at a different pressure, a new graph will need to be provided.

Calibration Data

Model of Flow meter:	VFLOW 4		Location of Meter:	FI-113-116
Atmospheric Pressure:	14.6487479	psia	Project Number:	50353
Line Pressure:	14.50	psia	Project Name:	Northrop Grumman
Line Temperature:	18.33	deg C	Maximum Flow Rate:	300 scfm
Operating Flow Rate:	150.00	scfm	Differential Pressure at Max Flow:	6.87274 "wc

(Standard conditions assumed to be 14.7psia and 25 degC)

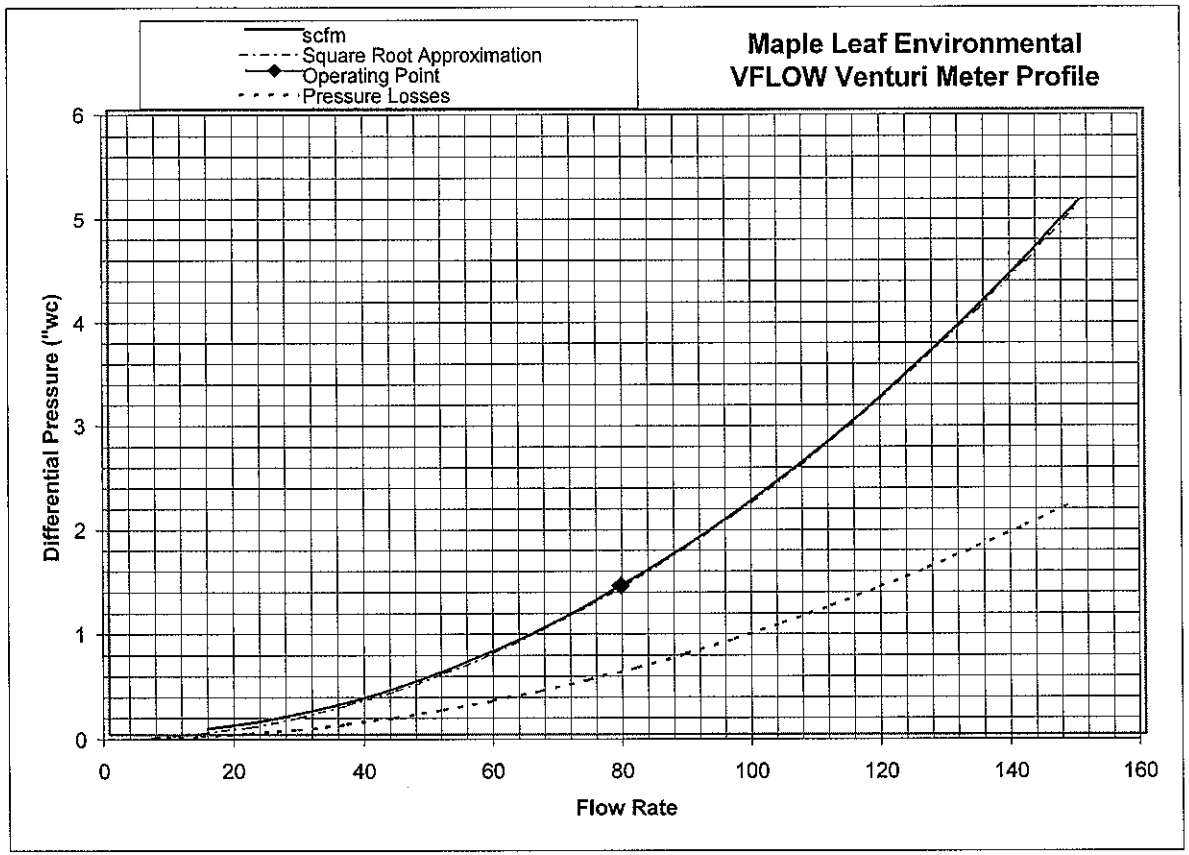


This graph is accurate only for the pressure listed above. If you are operating at a different pressure, a new graph will need to be provided.

Calibration Data

Model of Flow meter:	VFLOW 3		Location of Meter:	FI-117
Atmospheric Pressure:	14.6487479	psia	Project Number:	50353
Line Pressure:	14.59	psia	Project Name:	Northrop Grumman
Line Temperature:	18.33	deg C	Maximum Flow Rate:	150 scfm
Operating Flow Rate:	79.00	scfm	Differential Pressure at Max Flow:	5.08469 "wc

(Standard conditions assumed to be 14.7psia and 25 degC)

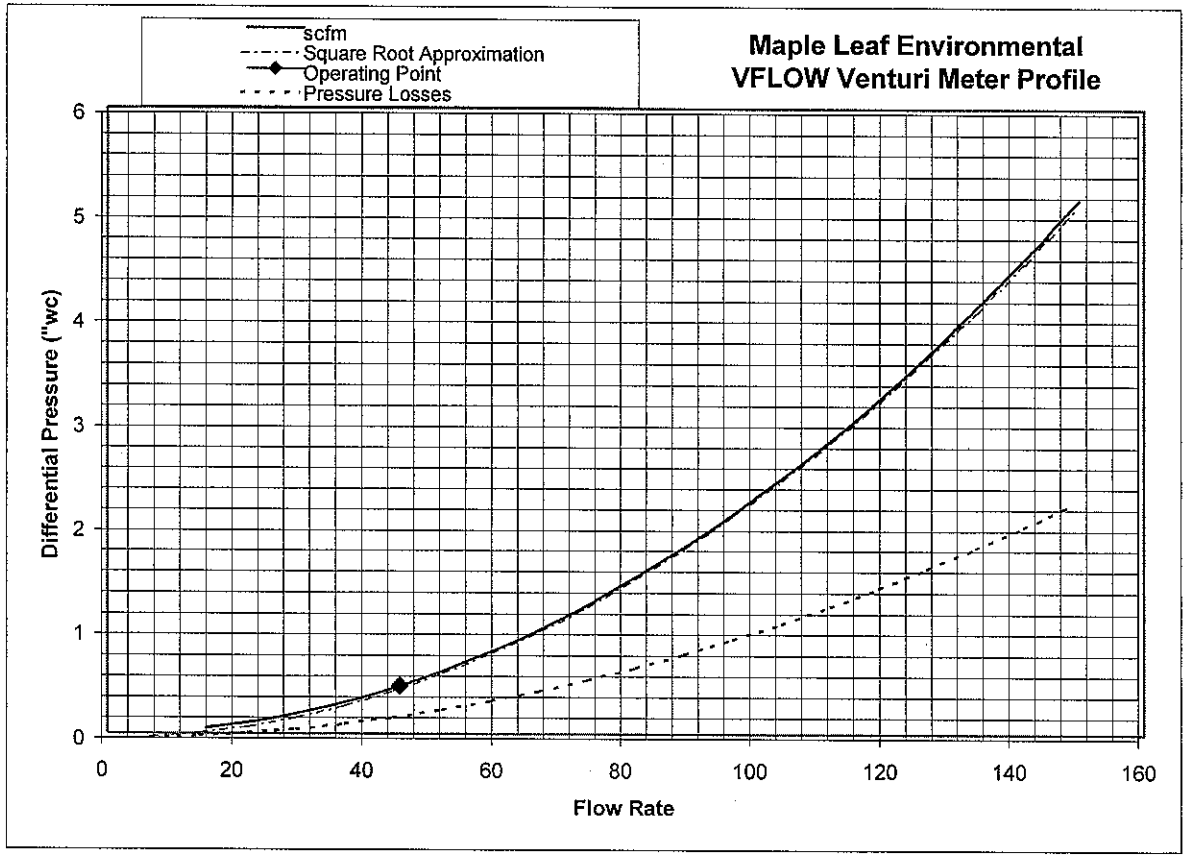


This graph is accurate only for the pressure listed above. If you are operating at a different pressure, a new graph will need to be provided.

Calibration Data

Model of Flow meter:	VFLOW 3		Location of Meter:	FI-118
Atmospheric Pressure:	14.6487479	psia	Project Number:	50353
Line Pressure:	14.62	psia	Project Name:	Northrop Grumman
Line Temperature:	18.33	deg C	Maximum Flow Rate:	150 scfm
Operating Flow Rate:	45.00	scfm	Differential Pressure at Max Flow:	5.06094 "wc

(Standard conditions assumed to be 14.7psia and 25 degC)



This graph is accurate only for the pressure listed above. If you are operating at a different pressure, a new graph will need to be provided.

Manual Document List

PMProjNum 50353

Northrop Grumman

Tag	Part Number	Part Description	
Module:		*700*	
B-702-	15888	Blower,Rotron,EN979BK72WL,20hp,230/460,	Manucturer: Rotron
BL-300 + BL400			ManDoc:
Module:		*8200* 4020	
8200	17775	Variable Frequency Drive, MA7200-4020-N1	Manucturer: TECO WESTINGHOUSE
			ManDoc: INSTALLATION MANUAL 3/14/05
8200	17783	Variable Frequency Drive, MA7200-4030-N1	Manucturer: TECO WESTINGHOUSE
			ManDoc: INSTALLATION MANUAL 3/14/05
Module:		*8300*	
8300	17446	Autodialer, Sensaphone FGD800	Manucturer: Sensaphone by Phonetics, Inc
			ManDoc: USER'S MANUAL V 1.1

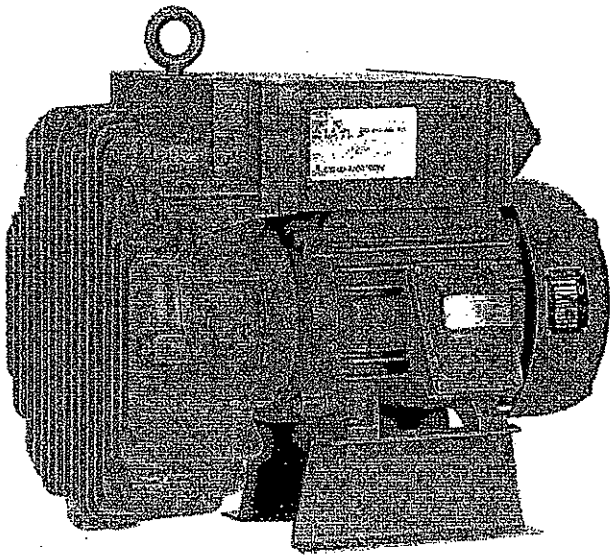
	Telephone, Phonecell® SX5e GSM, Fixed Wireless Terminal	Manufacturer: Telular Manual Doc: User Manual
HX-600	Heat Exchanger, Model AA-2750, 2086 SCFM, Motor:2hp, 1800 rpm, 230/460V -3ph, TEFC	Manufacturer: Xchanger, Inc. Manual Doc: Installation, Operation & Maintenance
UPS	Uninterruptable Power Source, Liebert Power Sure PSI™ 1000-3000VA, 60Hz, 120V	Manufacturer: Liebert® Emerson Manual Doc: User Manual
FI-XX	Flow meters, 7200, 7300, 7400, 7500	Manufacturer: King Instrument Company Manual Doc: Installation Manual
TB-1	Shutter Kit for TB-1, KDS12-SS	Manufacturer: Canarm Manual Doc: Installation Manual

Blowers

BL-300 + 400

EN 979 ~~& CP-979~~
Sealed Regenerative Blower w/Explosion-Proof Motor

FEATURES
- Manufactured in the USA – ISO 9001 compliant
- Maximum flow: 1000 SCFM
- Maximum pressure: 90 IWG
- Maximum vacuum: 5" Hg (70 IWG)
- Standard motor: 20 HP, explosion-proof
- Cast aluminum blower housing, cover, impeller & manifold; cast iron flanges (threaded); teflon lip seal
- UL & CSA approved motor with permanently sealed ball bearings for explosive gas atmospheres Class I Group D minimum
- Sealed blower assembly
- Quiet operation within OSHA standards

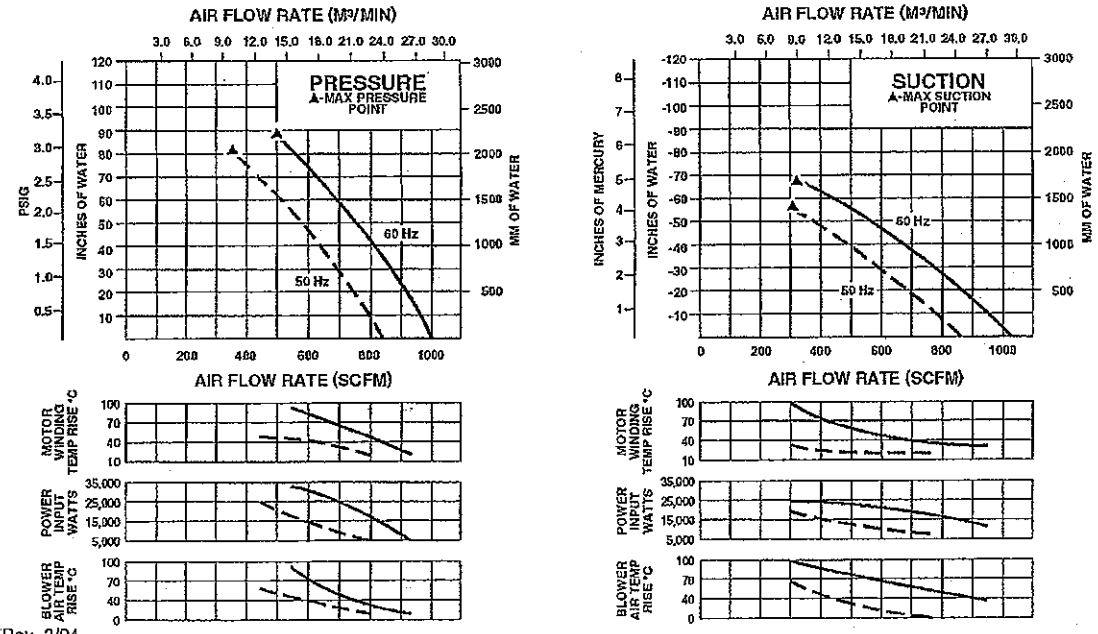


MOTOR OPTIONS
- International voltage & frequency (Hz)
- Chemical duty, high efficiency, inverter duty or industry-specific designs
- Various horsepowers for application-specific needs

BLOWER OPTIONS
- Corrosion resistant surface treatments & sealing options
- Remote drive (motorless) models
- Slip-on or face flanges for application-specific needs

ACCESSORIES (See Catalog Accessory Section)
- Flowmeters reading in SCFM
- Filters & moisture separators
- Pressure gauges, vacuum gauges & relief valves
- Switches – air flow, pressure, vacuum or temperature
- External mufflers for additional silencing
- Air knives (used on blow-off applications)
- Variable frequency drive package

BLOWER PERFORMANCE AT STANDARD CONDITIONS



Rev. 2/04

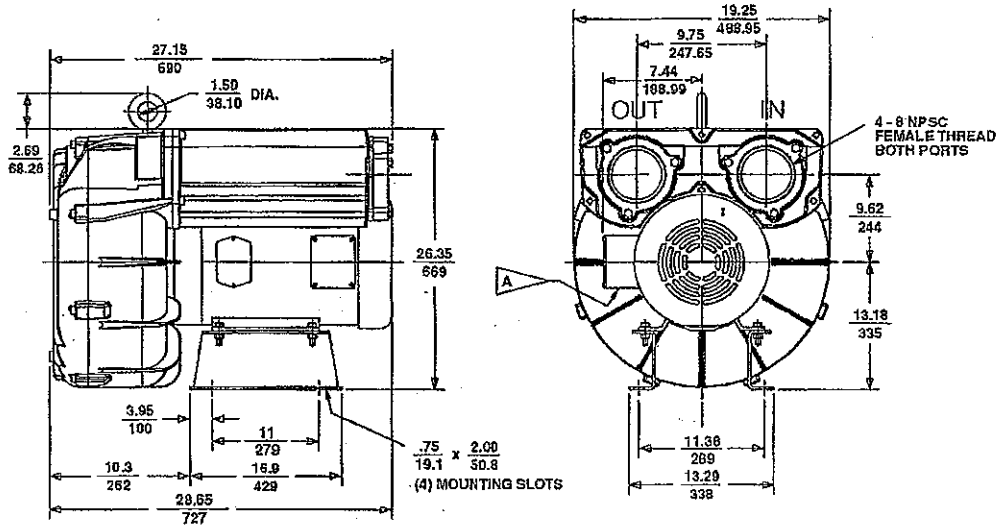
AMETEK Technical and Industrial Products, Kent, OH 44240 • e mail: rotronindustrial@ametek.com • internet: www.ametektmd.com

BL 300 + 400

ROTRON Regenerative Blowers

EN 979 ~~& CP 979~~
Sealed Regenerative Blower w/Explosion-Proof Motor

Scale CAD drawing available upon request.



DIMENSIONS: IN / MM
TOLERANCES: .XX ± .1 / 2.5
(UNLESS OTHERWISE NOTED)

A TERMINAL BOX CONNECTOR HOLE 1.09 / 27.7 DIA.

SPECIFICATIONS

MODEL	EN979BK72WL		EN979BK86WL	CP979GB72WLR
Part No.	080724		—	—
Motor Enclosure – Shaft Material	Explosion-proof – CS		Explosion-proof – CS	Chem XP – SS
Horsepower	20		20	Same as EN979BK72WL – 080724 except add Chemical Processing (CP) features from catalog inside front cover
Phase – Frequency [1]	Three - 60 Hz		Three - 60 Hz	
Voltage [1]	230	460	575	
Motor Nameplate Amps	46	23	18.4	
Max. Blower Amps [3]	60	30	24	
Inrush Amps	294	147	118	
Starter Size	3	2	2	
Service Factor	1.0		1.0	
Thermal Protection [2]	Class B - Pilot Duty		Class B - Pilot Duty	
XP Motor Class – Group	I-D, II-F&G		I-D, II-F&G	
Shipping Weight	650 lb (295 kg)		650 lb (295 kg)	

[1] Rotron motors are designed to handle a broad range of world voltages and power supply variations. Our dual voltage 3 phase motors are factory tested and certified to operate on both: **208-230/415-460 VAC-3 ph-60 Hz** and **190-208/380-415 VAC-3 ph-50 Hz**. Our dual voltage 1 phase motors are factory tested and certified to operate on both: **104-115/208-230 VAC-1 ph-60 Hz** and **100-110/200-220 VAC-1 ph-50 Hz**. All voltages above can handle a ±10% voltage fluctuation. Special wound motors can be ordered for voltages outside our certified range.

[2] Maximum operating temperature: Motor winding temperature (winding rise plus ambient) should not exceed 140°C for Class F rated motors or 120°C for Class B rated motors. Blower outlet air temperature should not exceed 140°C (air temperature rise plus inlet temperature). Performance curve maximum pressure and suction points are based on a 40°C inlet and ambient temperature. Consult factory for inlet or ambient temperatures above 40°C.

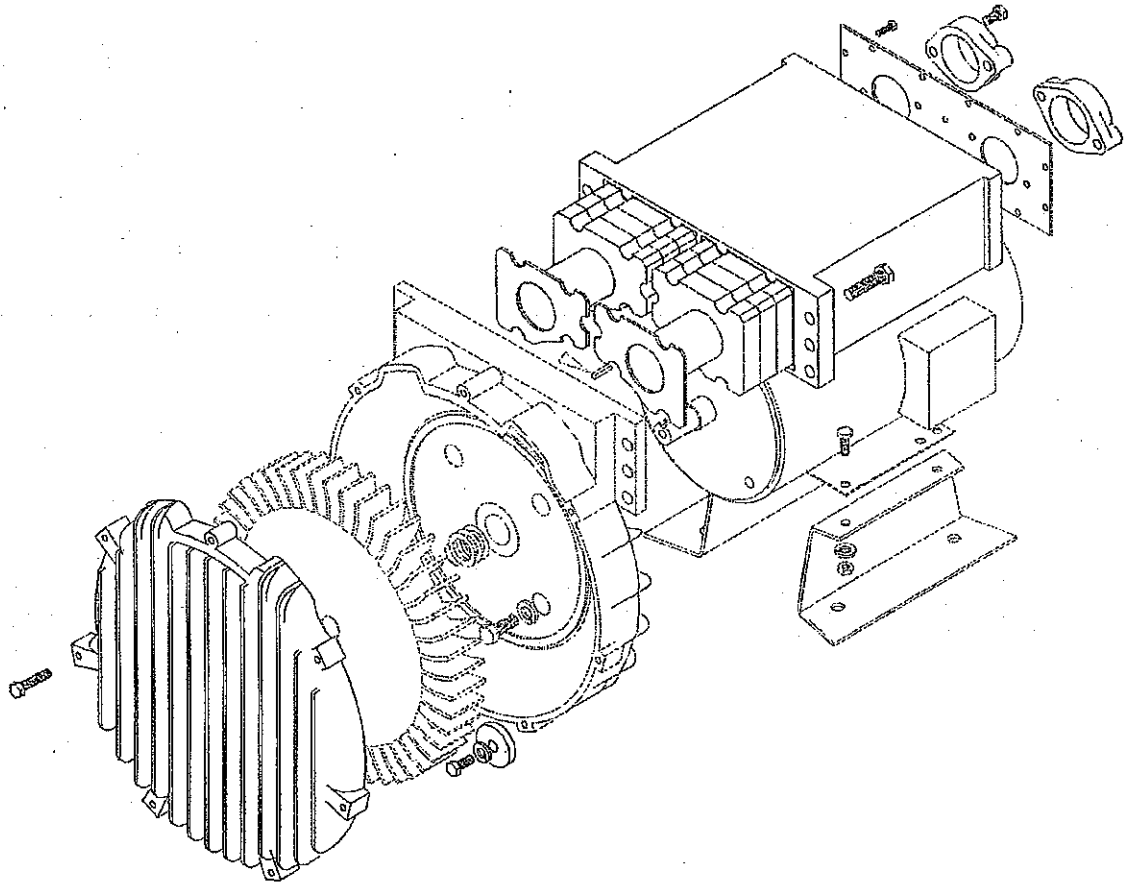
[3] Maximum blower amps corresponds to the performance point at which the motor or blower temperature rise with a 40°C inlet and/or ambient temperature reaches the maximum operating temperature.

Specifications subject to change without notice. Please consult your Local Field Sales Engineer for specification updates. Rev. 2/04

SERVICE AND PARTS MANUAL FOR BLOWER MODEL

EN6, EN858, EN909, EN14

DIRECT DRIVE REGENERATIVE BLOWER



Technical & Industrial Products
627 Lake Street, Kent, OH 44240 U.S.A.
Telephone: 330-673-3452 Fax: 330-677-3306
e-mail: info@ametektmd.com
internet: www.ametektmd.com

Your Choice. Our Commitment.™

WARRANTY, INSTALLATION, MAINTENANCE AND TROUBLESHOOTING INSTRUCTIONS

Technical & Industrial Products
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Telephone: 330-673-3452 Fax: 330-677-3306
e-mail: info@ametektmd.com web site: internet: www.ametektmd.com

1. **No Fault Policy** - AMETEK Rotron DR, EN and HiE regenerative direct drive blowers are guaranteed for one full year from the date of installation (limited to 18 months from the date of shipment.) to the original purchaser only. Should the blower fail, **regardless of the cause of failure**, we will at our option repair or replace the blower.

2. **Standard Policy** - AMETEK Rotron Minispiral, Revaflow, Multiflow, Nautilair, remote drive blowers, moisture separators, packaged units, CP blowers, Nasty Gas™ models and special built (EO) products are guaranteed for one full year from date of shipment for workmanship and material defect to the original purchaser only. Should the blower fail, we will evaluate the failure. If failure is determined to be workmanship or material defect related, we will at our option repair or replace the blower.

3. **Parts Policy** - AMETEK Rotron spare parts and accessories are guaranteed for three months from date of shipment for workmanship and material defect to the original purchaser only. If failure is determined to be workmanship or material defect related we will at our option repair or replace the part.

Corrective Action - A written report will be provided indicating reason(s) for failure, with suggestions for corrective action. Subsequent customer failures due to abuse, misuse, misapplication or repeat offense will not be covered. AMETEK Rotron will then notify you of your options. Any failed unit that is tampered with by attempting repair or diagnosis will void the warranty, unless authorized by the factory.

Terms and Conditions - Our warranty covers repairs or replacement of regenerative blowers only, and will not cover labor for installation, outbound and inbound shipping costs, accessories or other items not considered integral blower parts. Charges may be incurred on products returned for reasons other than failures covered by their appropriate warranty. Out-of -warranty product and in warranty product returned for failures determined to be caused by abuse, misuse, or repeat offense will be subject to an evaluation charge. Maximum liability will in no case exceed the value of the product purchased. Damage resulting from mishandling during shipment is not covered by this warranty. It is the responsibility of the purchaser to file claims with the carrier. Other terms and conditions of sale are stated on the back of the order acknowledgement.

Installation Instructions for SL, DR, EN, CP, and HiE Series Blowers

1. **Bolt It Down** - Any blower must be secured against movement prior to starting or testing to prevent injury or damage. The blower does not vibrate much more than a standard electric motor.

2. **Filtration** - All blowers should be filtered prior to starting. Care must be taken so that no foreign material enters the blower. If foreign material does enter the blower, it could cause internal damage or may exit at extremely high velocity.

   Should excessive amounts of material pass through the blower, it is suggested that the cover(s) and impeller(s) be removed periodically and cleaned to avoid impeller imbalance. Impeller

imbalance greatly speeds bearing wear, thus reducing blower life. Disassembling the blower will void warranty, so contact the factory for cleaning authorization.

3. **Support the Piping** - The blower flanges and nozzles are designed as connection points only and are not designed to be support members.

   Caution: Plastic piping should not be used on blowers larger than 1 HP that are operating near their maximum pressure or suction point. Blower housing and nearby piping temperatures can exceed 200°F. Access by personnel to the blower or nearby piping should be limited, guarded, or marked, to prevent danger of burns.

4. **Wiring** - Blowers must be wired and protected/fused in accordance with local and national electrical codes. All blowers must be grounded to prevent electrical shock. Slo-Blo or time delay fuses should be used to bypass the first second of start-up amperage.

5. **Pressure/Suction Maximums** - The maximum pressure and/or suction listed on the model label should not be exceeded. This can be monitored by means of a pressure or suction gage (available from Rotron), installed in the piping at the blower outlet or inlet. Also, if problems do arise, the Rotron Field representative will need to know the operating pressure/suction to properly diagnose the problem.

6. **Excess Air** - Bleed excess air off. DO NOT throttle to reduce flow. When bleeding off excess air, the blower draws less power and runs cooler.

   Note: Remote Drive (Motorless) Blowers - Properly designed and installed guards should be used on all belts, pulleys, couplings, etc. Observe maximum remote drive speed allowable. Due to the range of uses, drive guards are the responsibility of the customer or user. Belts should be tensioned using belt gauge.

Maintenance Procedure

When properly piped, filtered, and applied, little or no routine maintenance is required. Keep the filter clean. Also, all standard models in the DR, EN, CP, and HiE series have sealed bearings that require no maintenance. Bearing should be changed after 15,000 to 20,000 hours, on average. Replacement bearing information is specified on the chart below.

Bearing Part Number	Size	Seal Material	Grease	Heat Stabilized
510217 510218 510219	205 206 207	Polyacrylic	Nye Rheotemp 500 30% +/- 5% Fill	Yes – 325 F
510449 516440 516648	203 202 307	Buna N	Exxon Polyrex Grease	NO
516840 516841 516842 516843 516844 516845 516846 516847	206 207 208 210 309 310 311 313	Buna N	Exxon Polyrex Grease	NO

Troubleshooting

		POSSIBLE CAUSE	OUT OF WARRANTY REMEDY ***
IMPELLER DOES NOT TURN	Humming Sound	1. * One phase of power line not connected 2. * One phase of stator winding open 3. Bearings defective 4. Impeller jammed by foreign material 5. Impeller jammed against housing or cover 6. ** Capacitor open	1. Connect 2. Rewind or buy new motor 3. Change bearings 4. Clean and add filter 5. Adjust 6. Change capacitor
	No Sound	1. * Two phases of power line not connected 2. * Two phases of stator winding open	1. Connect 2. Rewind or buy new motor
IMPELLER TURNS	Blown Fuse	1. Insufficient fuse capacity 2. Short circuit	1. Use time delay fuse of proper rating 2. Repair
	Motor Overheated Or Protector Trips	1. High or low voltage 2. * Operating in single phase condition 3. Bearings defective 4. Impeller rubbing against housing or cover 5. Impeller or air passage clogged by foreign material 6. Unit operating beyond performance range 7. Capacitor shorted 8. * One phase of stator winding short circuited	1. Check input voltage 2. Check connections 3. Check bearings 4. Adjust 5. Clean and add filter 6. Reduce system pressure/vacuum 7. Change capacitor 8. Rewind or buy new motor
	Abnormal Sound	1. Impeller rubbing against housing or cover 2. Impeller or air passages clogged by foreign material 3. Bearings defective	1. Adjust 2. Clean and add filter 3. Change bearings
	Performance Below Standard	1. Leak in piping 2. Piping and air passages clogged 3. Impeller rotation reversed 4. Leak in blower 5. Low voltage	1. Tighten 2. Clean 3. Check wiring 4. Tighten cover, flange 5. Check input voltage

* 3 phase units

** 1 phase units

*** Disassembly and repair of new blowers or motors will void the Rotron warranty. Factory should be contacted prior to any attempt to field repair an in-warranty unit.

Blower Disassembly:

WARNING: Attempting to repair or diagnose a blower may void Rotron's warranty. It may also be difficult to successfully disassemble and reassemble the unit.

1) Disconnect the power leads. **CAUTION:** Be sure the power is disconnected before doing any work whatsoever on the unit.

2) Remove or separate piping and/or mufflers and filters from the unit.

3) Remove the cover bolts and then the cover. **NOTE:** Some units are equipped with seals. It is mandatory that these seals be replaced once the unit has been opened.

4) Remove the impeller bolt and washers and then remove the impeller. **NOTE:** Never pry on the edges of the impeller. Use a puller as necessary.

5) Carefully note the number and location of the shims. Remove and set them aside. NOTE: If the disassembly was for inspection and cleaning the unit may now be reassembled by reversing the above steps. If motor servicing or replacement and/or impeller replacement is required the same shims may not be used. It will be necessary to re-shim the impeller according to the procedure explained under assembly.

6) Remove the housing bolts and remove the motor assembly (arbor/.housing on remote drive models).

7) Arbor disassembly (Applicable on remote drive models only):
   a) Slide the bearing retraining sleeve off the shaft at the blower end.
   b) Remove the four (4) screws and the bearing retaining plate from the blower end.
   c) Lift the shaft assembly far enough out of the arbor to allow removal of the blower end snap ring.
   d) Remove the shaft assembly from the arbor.
   e) If necessary, remove the shaft dust seal from the pulley end of the arbor.

Muffler Material Replacement:

1) Remove the manifold cover bolts and them manifold cover.

2) The muffler material can now be removed and replaced if necessary. On blowers with fiberglass acoustical wrap the tubular retaining screens with the fiberglass matting before sliding the muffler pads over the screens.

3) Reassemble by reversing the procedure.

NOTE: **On DR068 models with tubular mufflers it is necessary to remove the cover and impeller accessing the muffler material from the housing cavity.**

Blower Reassembly:

1) Place the assembled motor (assembled arbor assembly for remote drive models) against the rear of the housing and fasten with the bolts and washer.

2) To ensure the impeller is centered within the housing cavity re-shim the impeller according to the procedure outlined below.

3) If blower had a seal replace the seal with a new one.

4) Place the impeller onto the shaft making sure the shaft key is in place and fasten with the bolt, washer and spacer as applicable. Torque the impeller bolt per the table below. Once fastened carefully rotate the impeller to be sure it turns freely.

5) Replace the cover and fasten with bolts.

6) Reconnect the power leads to the motor per the motor nameplate.

Bolt Size	Torque
1/4-20	6.25 +/- 0.25
5/16-18	11.5 +/- 0.25
3/8-16	20.0 +/- 0.5
½-13	49.0 +/- 1
5/8 –11	90.0 +/- 2

Impeller Shimming Procedure:

WARNING: This unit may be difficult to shim. Extreme care may be exercised.

Tools Needed: Machinist's Parallel Bar
Vernier Caliper with depth measuring capability
Feeler gauges or depth gauge

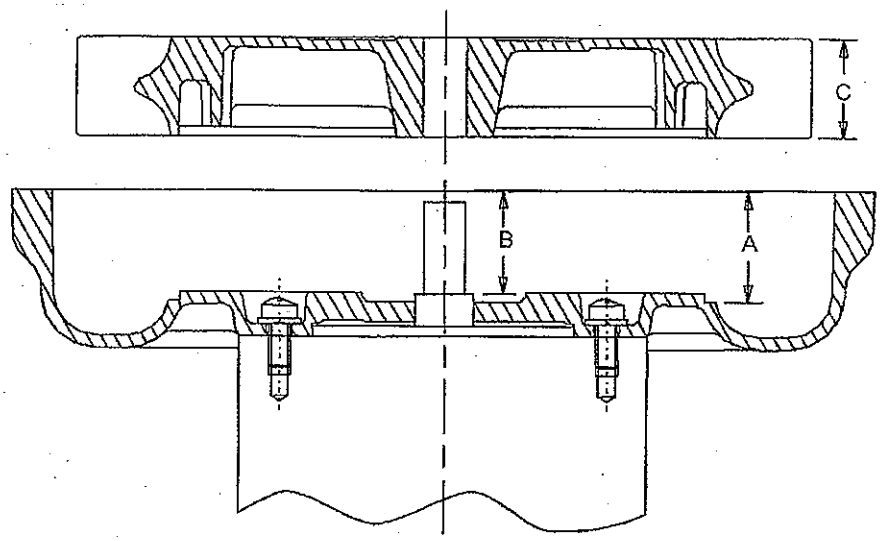
Measure the Following:

Distance from the flange face to the housing (A)
Distance from the flange face to the motor shaft shoulder (B)
Impeller Thickness (C)

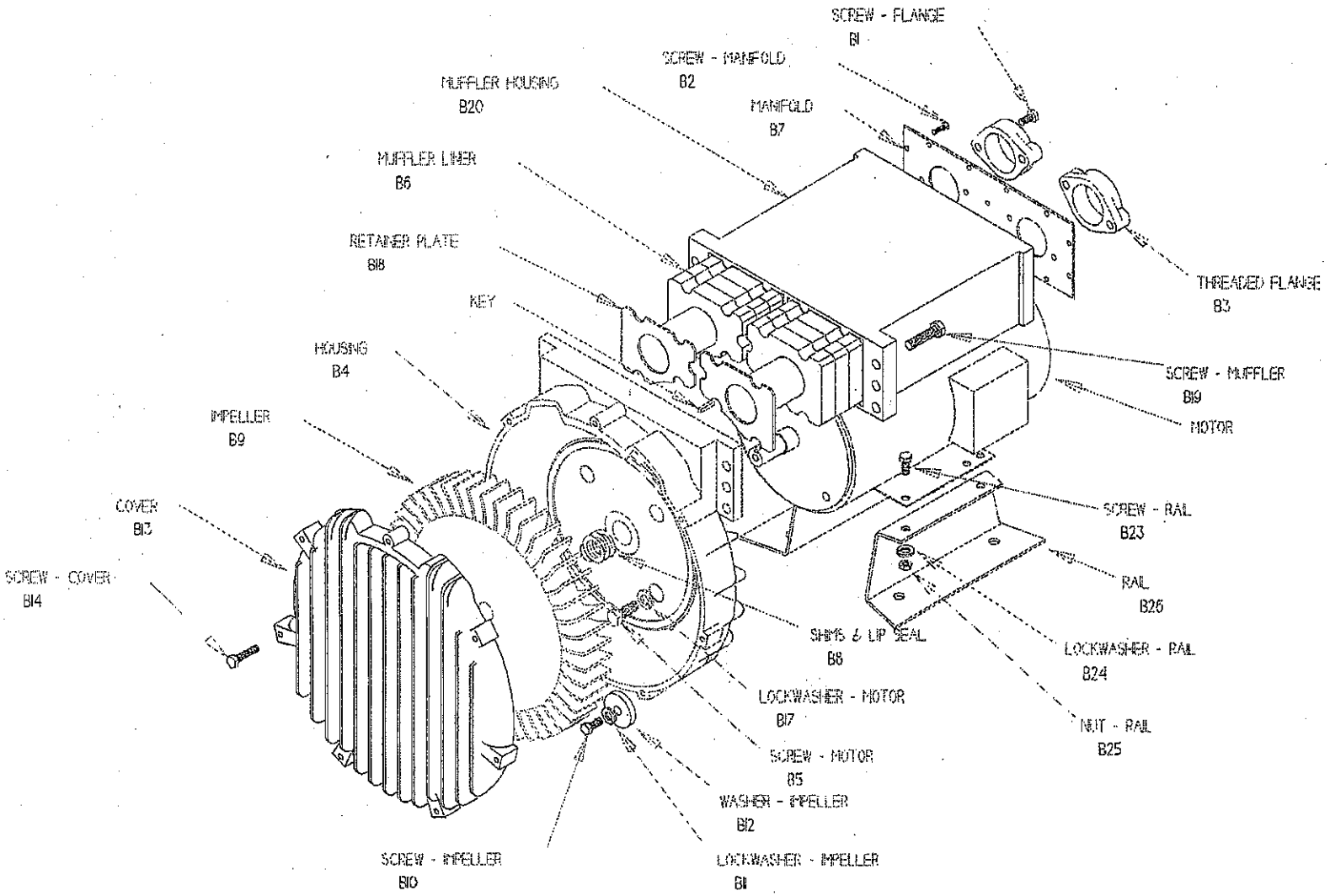
Measurements (A) and (B) are made by laying the parallel bar across the housing flange face and measuring to the proper points. Each measurement should be made at three points, and the average of the readings should be used.

Shim Thickness = B – (A+C)/2

After the impeller installation (step #4 above) the impeller/cover clearance can be checked with feeler gauges, laying the parallel bar across the housing flange face. This clearance should nominally be (A+C)/2.



ASSEMBLY DIAGRAM
EN6 EN808 EN909 EN14



Parts Breakdown

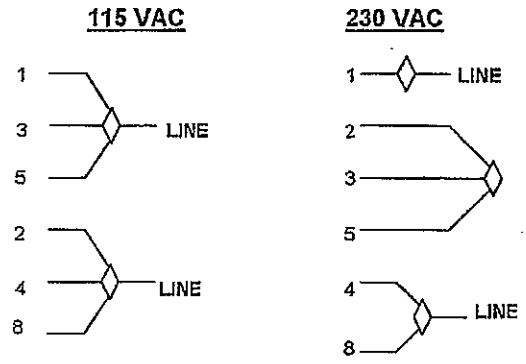
Item No.	Qty. Req'd	Description	EN6 038361 038180 038438	EN858 038744 038745 080070	EN909 038629 038634 080071	EN14 038762 038761	EN14 038760
M3	1	Key Motor Shaft	510212	511532	511532	155066	511532
B1	6	Screw, Flange	(4 pcs) 120255	(4 pcs) 155067	140016	140016	140016
B2		Screw, Manifold	Not Used	Not Used	Not Used	Not Used	Not Used
B3	2	Flange	See Next Page	511614	529912	529912	529912
	2	O-ring	Not Used	Not Used	155377	155377	155377
		Elbow 90°	See Next Page	Not Used	Not Used	Not Used	Not Used
B4	1	Housing	516747	516764	515356	516799	516797
B5	4	Screw, Hsg /Motor	251792	155034	140014	120205	120205
B6	54	Muffler Material	Not Used	(32) 550020	(40 pcs) 529943	550073	550073
	2	Matting, Fiberglass	Not Used	550075	550077	550116	550116
B7		Manifold Plate	Not Used	Not Used	Not Used	Not Used	Not Used
B8	*	Shim .002"	272703	511547	511547	515991	511547
	*	Shim .005"	272704	511548	511548	515992	511548
	*	Shim .010"	272705	511549	511549	515993	511549
	*	Shim .020"	272706	511550	511550	515994	511550
	*	Shim .030"	Not Used	Not Used	Not Used	Not Used	Not Used
B9	1	Impeller	515484	515249	515270	515509	515683
B10	1	Bolt, Impeller	251791	120210	140015	155068	120251
B11	1	Lockwasher, Impeller	251787	251788	251788	251788	251788
B12	1	Washer, Impeller	Not Used	Not Used	Not Used	Not Used	Not Used
B13	1	Cover	515488	515247	515359	515910	515910
B14	8	Screw, Cover	251790	140016	140016	155069	155069
B15	1	Eye Bolt	Not Used	140019	140019	140019	140019
B16	1	Spacer, Impeller Bolt	478336	515555	511529	515990	515990
		Shaft Sleeve	Not Used	Not Used	Not Used	Not Used	Not Used
B17		Lockwasher, Housing	Not Used	Not Used	Not Used	Not Used	Not Used
B18	1	Screen, Muffler Retaining, Right (**)	Not Used	515407	529939	550040	550040
	1	Screen, Muffler Retaining, Left (**)	Not Used	515408	529940	550042	550042
B19	6	Bolt, Muffler Hsg/Hsg	Not Used	155025	155025	155067	155067
B19A	4	Bolt, Muffler/Housing	Not Used	120214	120214	120214	120214
B20	1	Muffler Housing	Not Used	550019	529932	550039	550039
	1	Muffler Discrete	522948	Not Used	Not Used	Not Used	Not Used
		Bolt, Motor/Muffler	Not Used	Not Used	Not Used	Not Used	Not Used
		Lockwasher, Motor/Muffler	Not Used	Not Used	Not Used	Not Used	Not Used
		Washer, Motor/Muffler	Not Used	Not Used	Not Used	Not Used	Not Used
		Spacer, Motor/Muffler	Not Used	Not Used	Not Used	Not Used	Not Used
B21		Heat Slinger	Not Used	Not Used	Not Used	Not Used	Not Used
B22		Guard Heat slinger	Not Used	Not Used	Not Used	Not Used	Not Used

B23	4	Bolt, Rail	251791	120007	155095	120256	155025
B24	4	Lockwasher Rail	251787	251787	251787	251788	251788
B24A	8	Washer, Rail/Motor	Not Used	Not Used	155091	Not Used	Not Used
B25	6	Nut, Rail	251789	251789	251789	155070	155070
B26	2	Rail Mounting	478338	595301	595301	516242	516242
	1	Lip Seal	516691	516693	516693	516694	516693

Model	Part No.	Motor	Wiring Diagram	Specific Parts	Rear (M1)	Impeller End (M2)
EN6F5L	038361	529475	M + L	B3 Flange 511480 (2 pcs)	510217	510218
EN6F72L	038180	500297	K + L	B3 Flange 478341 (2 pcs) Elbow Not Used Screen Guard, Flange 511479 (2		
EN6F86L	038438	529634	N + L	B3 Flange 478341 (2 pcs) Elbow Not Used Screen Guard, Flange 511479 (2		
EN858BD72WL	038744	515556	K + L		516840	516844
EN858BD86WL	038745	529627	N + L			
EN858BA72W	080070	515558	K + L			
EN909BG72WL	038629	511512	K + L		516842	516844
EN909BG86WL	038634	529631	N + L			
EN909BD72WL	080071	550675	K + L			
EN14DX86MWL	038762	529632	N + L		516844	516846
EN14DX72MWL	038761	516095	K + L			
EN14BK72MWL	038760	511513	K + L		516842	516844

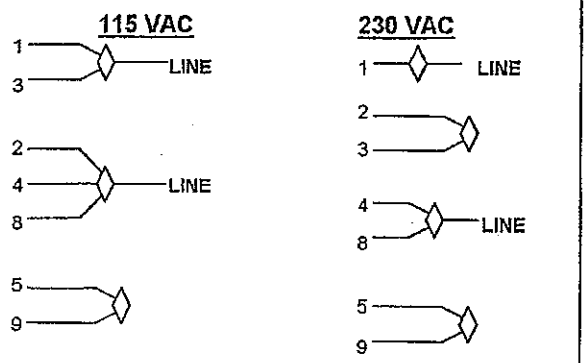
WIRING DIAGRAMS, XP MOTORS

H. 1Ø, 6 WIRE



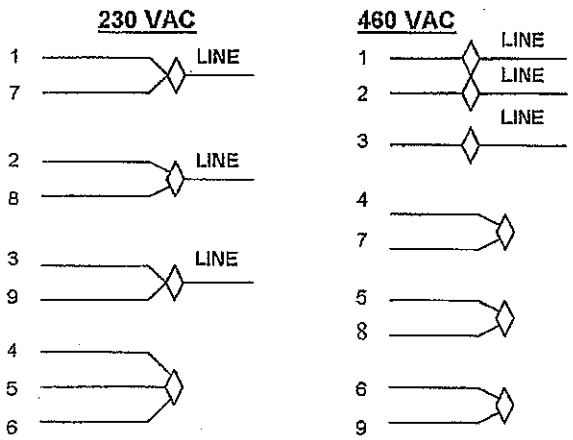
INTERCHANGE LEADWIRES 5 & 8 to REVERSE ROTATION

I. 1Ø, 7 WIRE



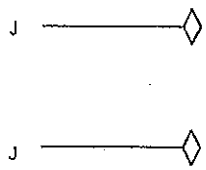
INTERCHANGE LEADWIRES 5 & 8 to REVERSE ROTATION

K. 3Ø, 9 WIRE



INTERCHANGE ANY TWO LEAD LINES TO REVERSE ROTATION

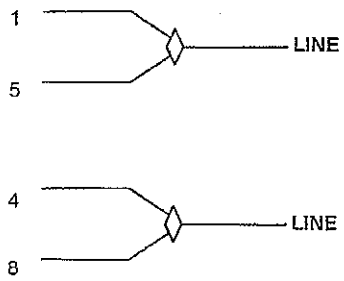
L. PILOT DUTY THERMAL OVERLOADS



HOOK J LEADS TO CONTROL CIRCUITRY

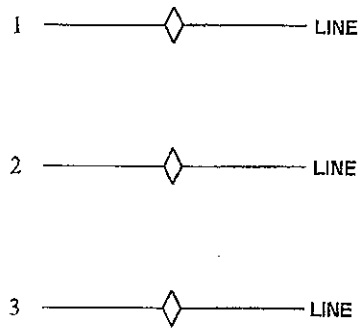
M. 1Ø 230 VAC

SINGLE VOLTAGE



INTERCHANGE LEADWIRES 5 & 8 TO REVERSE ROTATION

N. 3Ø 575 VAC



INTERCHAGE ANY TWO LEAD LINES TO REVERSE ROTATION

VFD's

4H358D0180009

TECO Westinghouse

Installation Manual

MA7200

AC Inverter

208 to 230V	1 / 3 Phase	1 ~ 3HP
	3 Phase	5 ~ 40HP
380 to 460V	3 Phase	1 ~ 75HP

SAFE OPERATION NOTES

Read this instruction manual thoroughly before installation, operation, maintenance or inspection of the inverter. Only authorized personnel should be permitted to perform maintenance, inspections or parts replacement.

In this manual, notes for safe operation are classified as:
"WARNING" or "CAUTION".

⚠ WARNING	Indicates a potentially hazardous situation that, if not avoided, could result in death or serious injury to personnel.
⚠ CAUTION	Indicates a potentially hazardous situation that, if not avoided, may result in minor or moderate injury to personnel and damage to the equipment.

"WARNING" and "CAUTION"

⚠ WARNING

- Always turn off the input power supply before wiring terminals.
- After turning OFF the main circuit power supply, do not touch the circuit components until the "CHARGE" LED is extinguished.
- Never connect power circuit output U/T1, V/T2, W/T3 to AC power supply.

⚠ CAUTION

- When mounting the MA7200 in a separate enclosure, install a fan or other cooling device to keep the intake air temperature below 113°F (45°C).
- Do not perform a withstand voltage test to the inverter.
- All the parameters of the inverter have been preset at the factory. Do not change the settings unnecessarily.

This inverter has been placed through demanding tests at the factory before shipment. After unpacking, check for the following:

1. Verify that part numbers on shipping carton and unit match the purchase order sheet and/or packing list.
2. Do not install or operate any inverter that is damaged or missing parts.
3. Do not install or operate any inverter that has no QC marking.
   Contact your local TECO authorized distributor or TECO representative if any of the above irregularities have been found.

Contents

Appendix

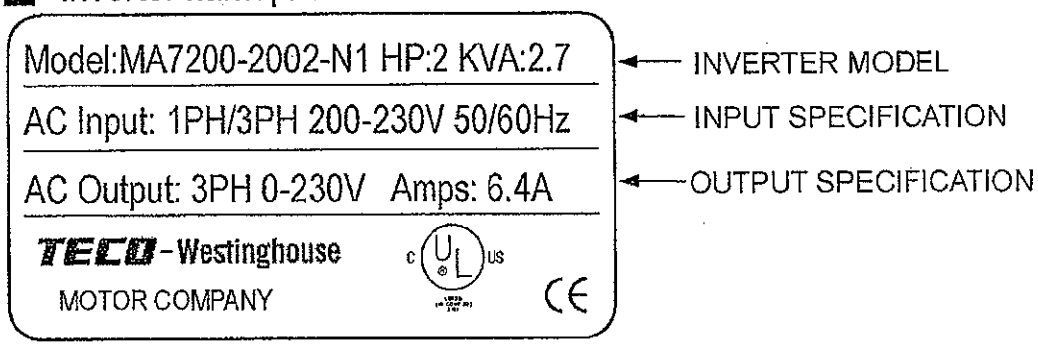
1. MA7200 Handling Description

1.1 Inspection Procedure upon Receiving

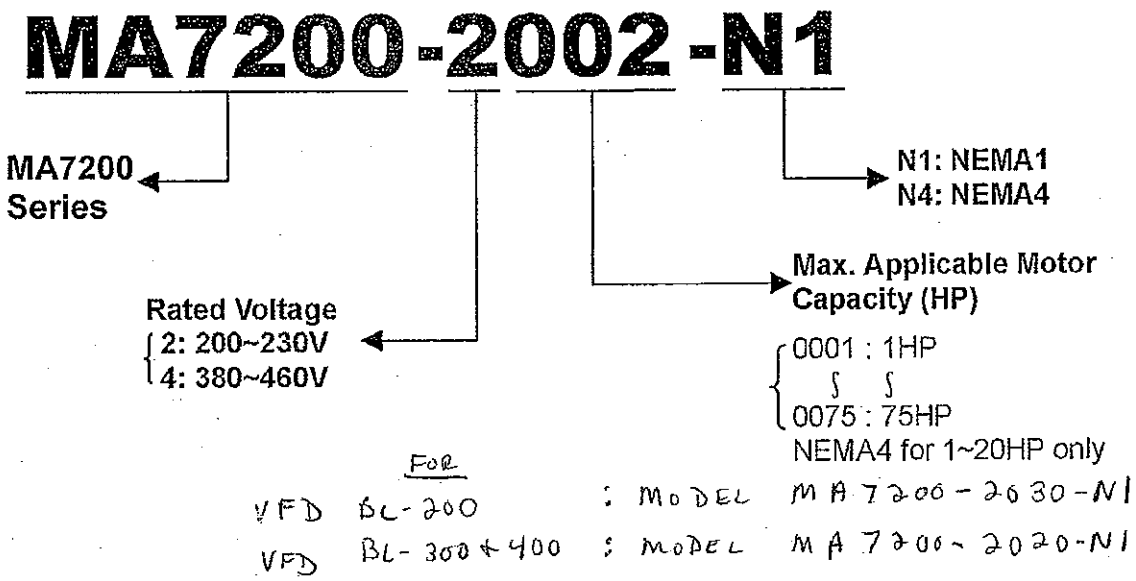
Before delivery, Every MA7200 inverter has been properly adjusted and passed the demanding function test. After receiving the inverter, the customer should take it out and follow the below procedure:

- Verify that the Type No. of the inverter you've received is the same as the Type No. listed on your purchase order. (Please read the Nameplate)
- Observe the condition of the shipping container and report any damage immediately to the commercial carrier that has delivered your inverter.

■ Inverter nameplate:

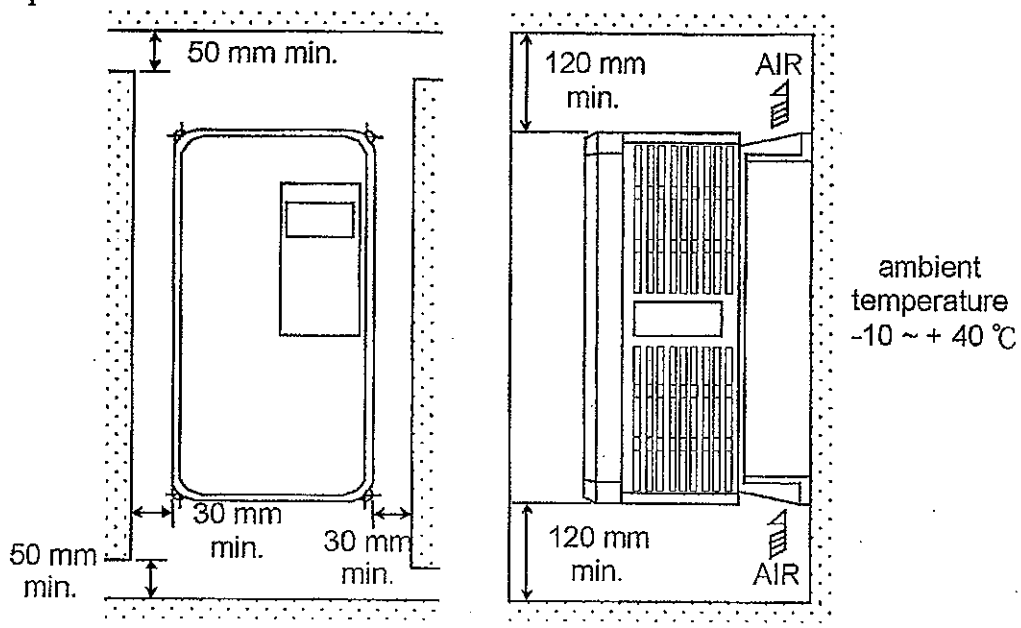


■ Inverter model number :



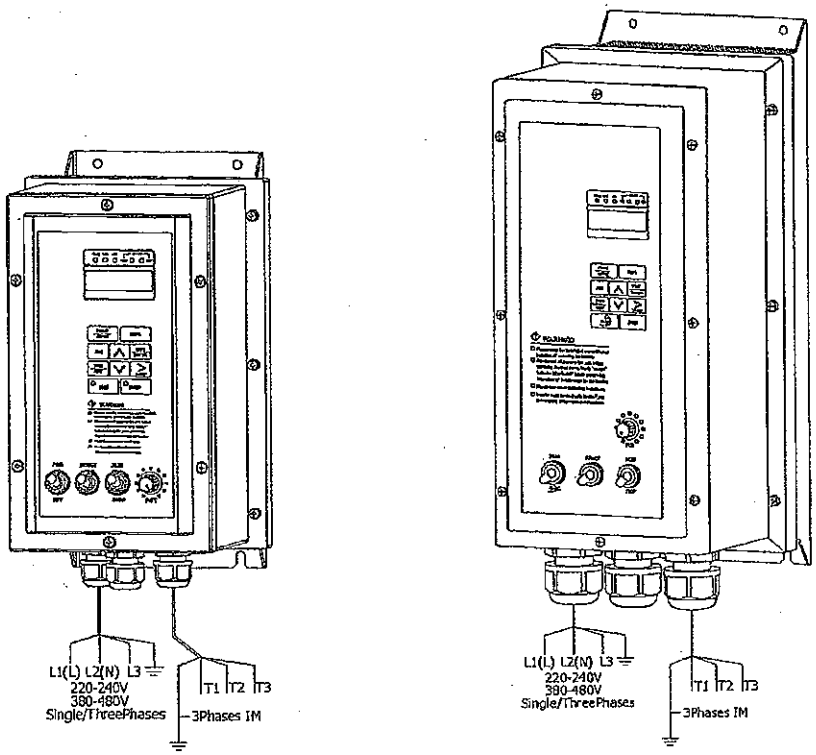
1.2 Installation

When installing the inverter, always provide the following space to allow normal heat dissipation.



(a) Space in Side (b) Space in Top/bottom

Fig. 1-a. Air clearance for MA7200 wall mounting



(a) NEMA4 Frame1 (b) NEMA4 Frame2

Fig. 1-b. MA7200 NEMA4 Installation

CAUTION

Location of equipment is important to achieve proper performance and normal operating life. The MA7200 inverter should be installed in area where the following conditions exist.

- Ambient temperature: +14 to 104°F, (-10 to 40°C).
- Install the MA7200 in a location protected from rain, moisture and direct sunlight.
- Install the MA7200 in a location free from harmful mists, gases, liquids, airborne dusts and metallic particles.
- Install the MA7200 in a location free from vibration and electromagnetic noise. (i.e. welding machines, power units, etc…)
- When mounting multiple units in a common enclosure, install a cooling fan or some other means to cool the air entering the inverter to at least 113°F (+45°C) or below.

1.3 Removing/Attaching the Digital Operator and Front cover

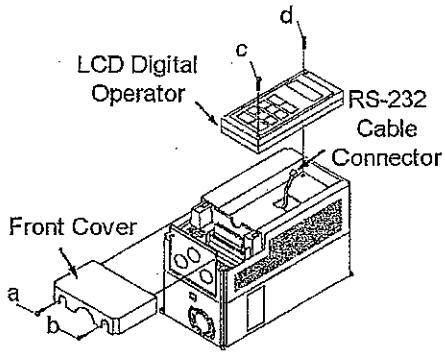
> **CAUTION**
>
> Please disassemble Front Cover before you connect wires to terminals on MA7200 models.
> - 230V 1~25HP & 460V 1~30HP models: Plastic instructions, so please disconnect LCD Digital Operator before you disassemble Front Cover. After you finished the wiring connection, assemble Front Cover first then reinstall LCD Digital Operator.
> - 230V 30HP、40HP & 460V 40~75HP: Iron instructions, you can disassemble Front Cover for wiring connection without disconnect LCD Digital Operator. Then reinstall Front Cover back after you finished wiring connection.

MA7200 disassembly / Assembly procedures will be depended on different model as follows:

(A) For 230V : 1-2HP, 460V : 1-2HP

- MA7200-2001-N1
- MA7200-2002-N1
- MA7200-4001-N1
- MA7200-4002-N1

■ Removing the digital operator : Take off the two screws on the front cover in the place a and b. Remove the front cover and take off the screws in the place c and d. Disconnect the RS-232 cable connector on the backside of the LCD digital operator. Lift and remove digital operator.



■ Attaching the front cover and digital operator: Connect the RS-232 cable connector on the back of the LCD digital operator.

Attach the digital operator and tighten the screws in the place c and d. Insert the tabs of the upper part of front cover into the groove of the inverter and tighten the screws in the place a and b.

(B) For 230V : 3-10HP, 460V : 3-10HP

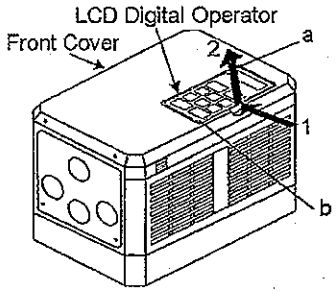
- MA7200-2003-N1
- MA7200-2005-N1
- MA7200-2007-N1
- MA7200-2010-N1
- MA7200-4003-N1
- MA7200-4005-N1
- MA7200-4007-N1
- MA7200-4010-N1

Removing the digital operator

Take off the screws in the place a. and b.

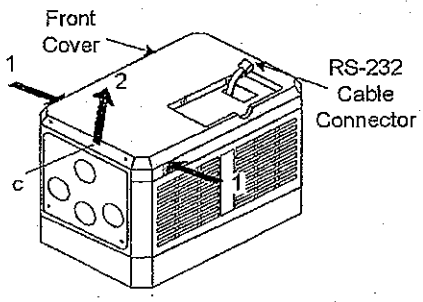
Press the lever on the side of the digital operator in the direction of arrow 1 to unlock the digital operator.

Disconnect the RS-232 cable connector on the back side of the LCD digital operator. Lift the digital operator in the direction of arrow 2 to remove the digital operator.



Removing the front cover

Press the left and right sides of the front cover in the directions of arrow 1 and lift the bottom of the cover in the direction of arrow 2 to remove the front cover.

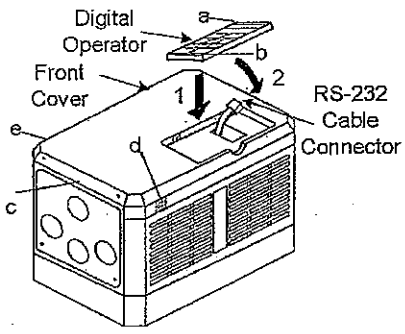


Mounting the front cover and digital operator

Insert the tab of the upper part of front cover into the groove of the inverter and press the lower part of the front cover onto the inverter until the front cover snaps shut.

Connecting the RS-232 cable connector on the back side of the LCD digital operator and hook the digital operator at a on the front cover in the direction of arrow 1.

Press the digital operator in the direction of arrow 2 until it snaps in the place b and then tighten the screws in the place c and d. (on the front cover)



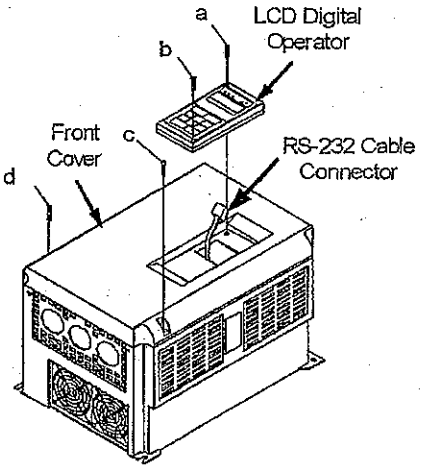
(C) For 230V 15,20HP and 460V 15,20HP Series

- MA7200-2015-N1
- MA7200-4015-N1
- MA7200-2020-N1
- MA7200-4020-N1

■ Removing the digital operator : Take off the screws in the place a. and b. Disconnect the RS-232 cable connector on the back side of the LCD digital operator and then lift the digital operator upwards.

■ Removing the front cover : Loosen the two screws of the front cover in the place c and d. And lift the bottom of the front cover to remove the front cover.

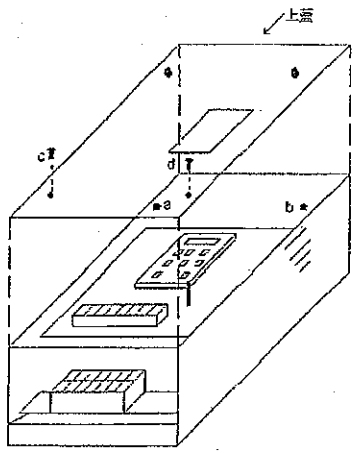
■ Mounting the front cover and digital operator : Insert the tab of the upper part of front cover into the groove of the inverter and tighten the screws in the place c and d.
Connect the RS-232 cable connector on the back of the LCD digital operator. Attach the digital operator and tighten the screws in the place a and b.



(D) For 230V 30~40HP and 460V 40~75HP Series

■ Removing the front cover: Loosen the two screws of the front cover in the Front cover. a. and b. Then loosen the two screws c and d, lift the front cover upwards. (Don't removing the digital operator.)

■ Mounting the front cover: Press the front cover and then tighten the screws in the place a, b, c and d.



1.4 Wiring between Inverter and Peripheral devices and notice

CAUTION

1. After turning OFF the main circuit power supply, do not touch the circuit components or change any circuit components before the "CHARGE" lamps extinguished. (It indicates that there is still some charge in the capacitor).
2. Never do wiring work or take apart the connectors in the inverter while the power is still on.
3. Never connect the inverter output U/T1, V/T2, W/T3 to the AC source.
4. Always connect the ground lead E to ground.
5. Never apply high voltage test directly to the components within the inverter. (The semiconductor devices are vulnerable to high voltage shock.)
6. The CMOS IC on the control board is vulnerable to ESD. Do not try to touch the control board.
7. If Sn-03 is 7,9,11 (2-wire mode) or is 8, 10, 12 (3-wire mode), except parameter settings of Sn-01 and Sn-02, the other parameter settings will return to their initial settings at factory. If the inverter is initially operated in 3-wire mode (Sn-03= 8, 10, 12), the motor will rotate in CCW sense after setting changed to 2-wire mode. (Sn-03= 7, 9, 11). Be sure that the terminals 1 and 2 are OPEN so as not to harmful to personal or cause any potential damage to machines.

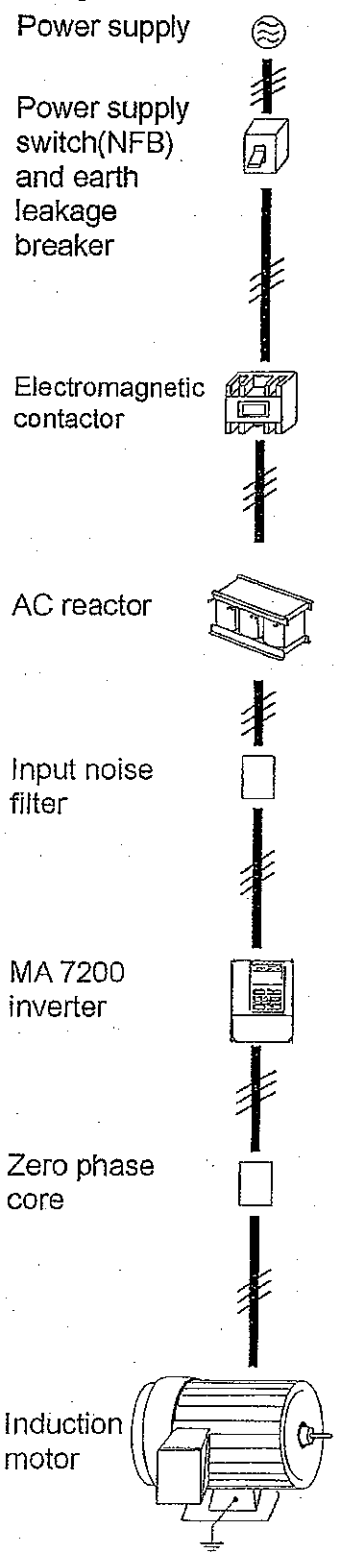
CAUTION

1. Determine the wire size for the main circuit so that the line voltage drop is within 2% of the rated voltage. If there is the possibility of excessive voltage drop due to wire length, use a larger wire (larger diameter) suitable to the required length

$$\text{Line voltage drop(V)} = \sqrt{3} \times \text{wire resistance}(\Omega/\text{km}) \times \text{wire length(m)} \times \text{current(A)} \times 10^{-3}$$

2. If the length of the cable wire between the inverter and the motor exceeds 30m, use a lower carrier frequency for PWM (adjust the parameter Cn-34). Refer to Page 3-21

Example of connection between the MA7200 and typical peripheral devices are shown as below.



■ MCCB (Molded-Case Circuit Breaker)

- Choose the Molded Case Circuit Breaker (MCCB) of proper current rating. Please refer to the selection guide "1.10 Peripheral Units" on Page 1-22.
- Do not use a circuit breaker for start/stop operation.
- When a ground fault interrupter is used, select the one with no influence for high frequency. Setting current should be 200mA or above and the operating time at 0.1 second or longer to avoid false triggering.

■ MC (Magnetic Contactor)

- It is not always necessary to have a Magnetic Contactor on the input side. However, an input Magnetic Contactor can be used to prevent an automatic restart after recovery from an external power loss during remote control operation.
- Do not use the Magnetic Contactor for start/stop operation.

■ AC Reactor

- To improve power factor or to reduce surge current, install an AC Reactor on the input side of the MA7200.

■ Input Noise Filter

- When used with TECO specified Input Noise Filter, the MA7200 will comply with EN55011 class A regulation.
- Please refer to the selection guide "1.10 Peripheral Units" on page 1-22.

■ MA7200 Inverter

- The input power supply can be connected to any terminal R/L1, S/L2, T/L3 on the terminal block.
- Please connect the ground terminal E to the site ground securely.

■ Output Noise Filter (Zero Phase Core)

- Install an Output Noise Filter between the MA7200 and the Induction Motor to eliminate noise transmitted between the power line and the inverter.
- Please refer to the selection guide "1.10 Peripheral Devices" on page 1-22.

■ Induction Motor

- When multiple motors are driven in parallel with an inverter, the inverter rated current should be at least 1.1 times the total motor rated current.
- The inverter and the motor must be separately grounded.

Standard Connection Diagram

The standard connection diagram of MA7200 is shown in Fig. 2. The sign ◎ indicates the main circuit terminal and the sign ○ indicates control circuit terminal. The terminal function and arrangement are summarized in Table 1 and Table 2. There are three types of control board, the terminal arrangement is shown as below.

(A) For Compact Size Type 230V : 1-2HP, 460V : 1-2HP (NEMA4 are the same)

- MA7200-2001/2-N1
- MA7200-4001/2-N1

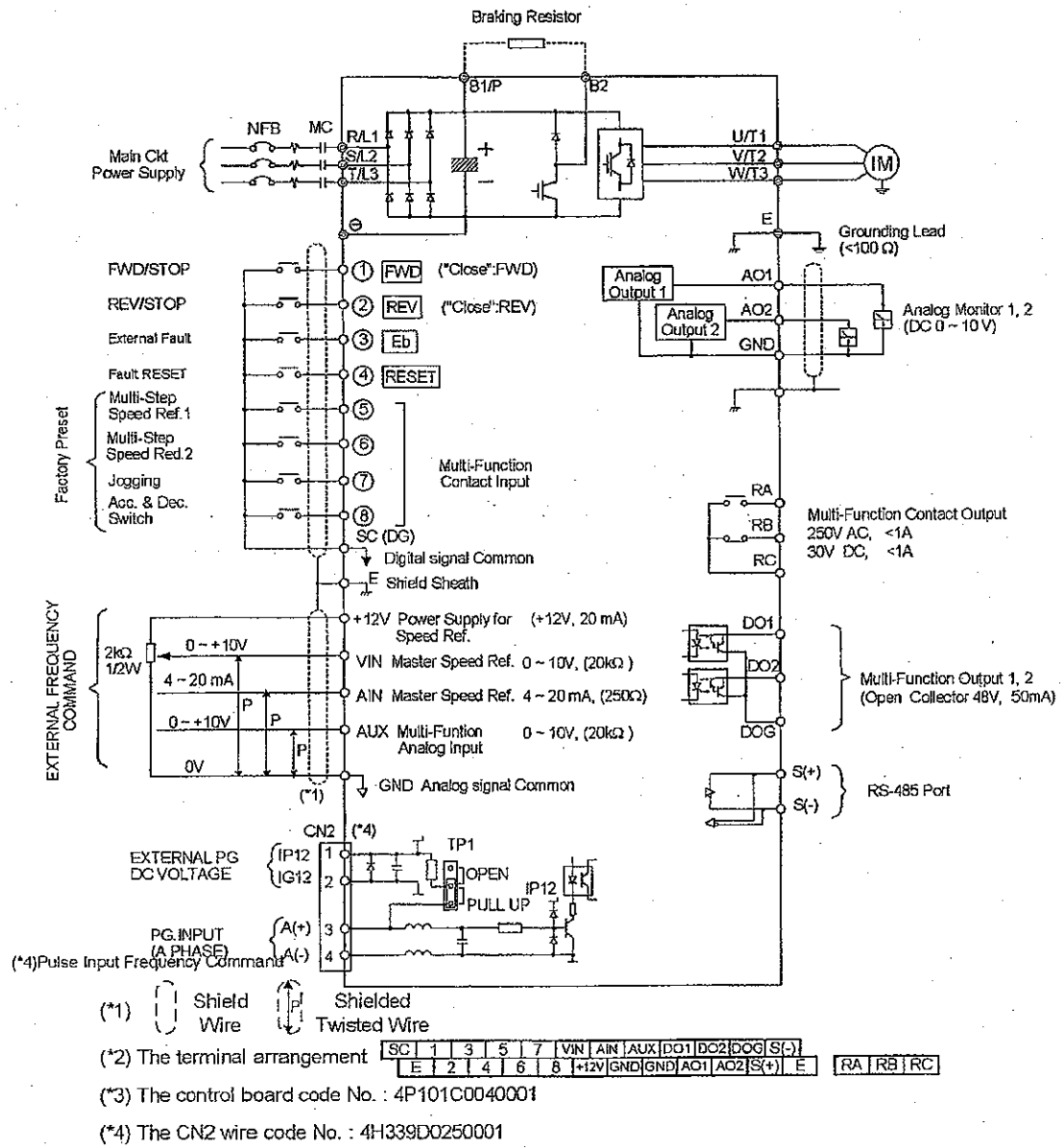
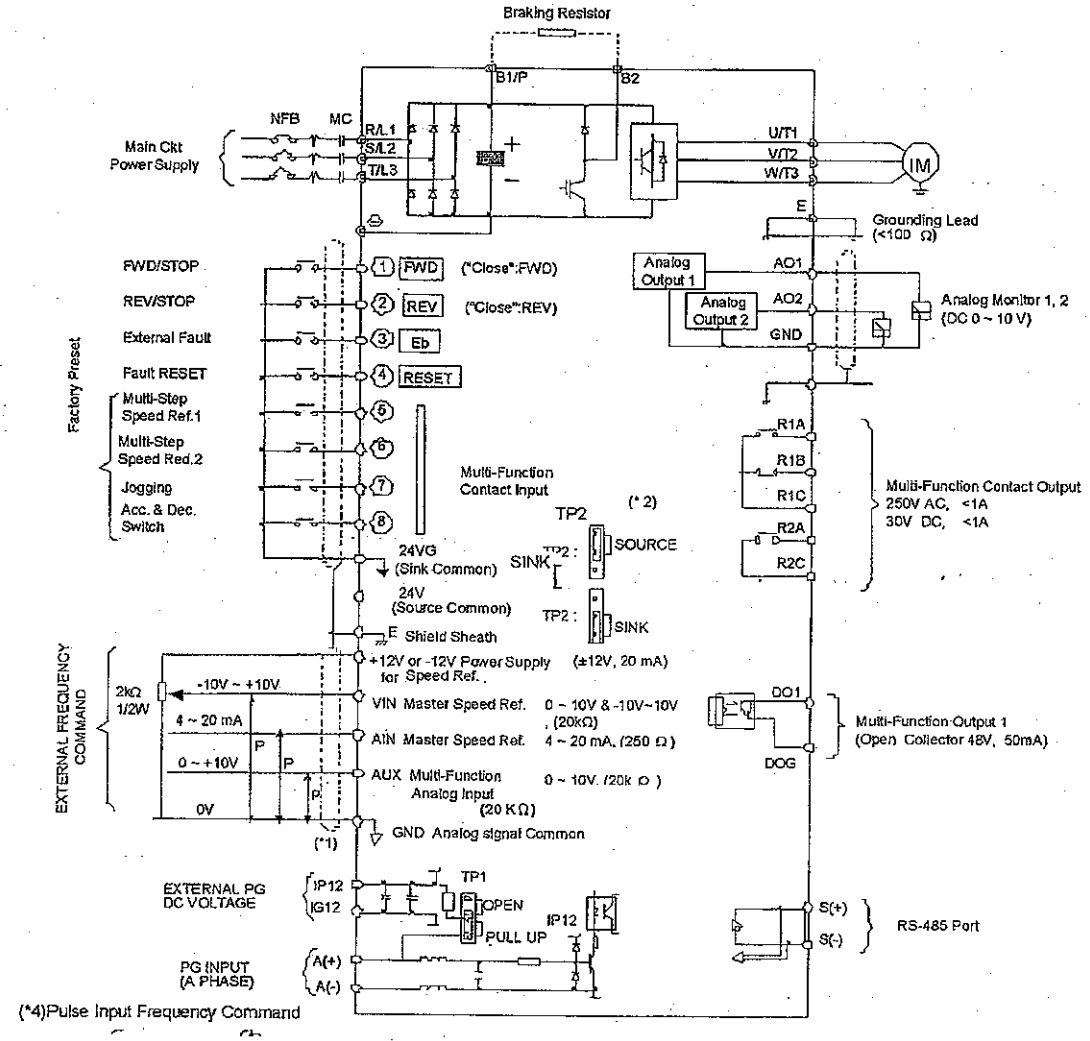


Fig. 2-a Standard connection diagram

(B) 230V : 3-40HP, 460V : 3-75HP (NEMA4 to 20HP)

- MA7200-2003-N1 through MA7200-2040-N1
- MA7200-4003-N1 through MA7200-4075-N1



(*1) Shield Wire Shielde Twisted Wire

(*2) The terminal ① and ⑧ can be set as SINK or SOURCE type input interface, when setting ①~⑧ as sink type input, the short jumper of TP2 must be set to SINK position, and set to SOURCE position for source type input.

(*3) VIN Ref. can be set in two input methods as 0~10V or -10~+10V

(*4) The terminal A(+), A(-) can be the output terminal of Pulse Input Frequency Command, and the jumper of TP1 must be set to OPEN position.
Pulse Input Frequency Command: 0~32KHz, 3~12V High torsion, input resistor 2.7K Ω

(*5) The terminal arangement

24VG	1	3	5	7	24V	VIN	AIN	AUX	DO1	DOG	IP12	A(+)	A(-)
E	2	4	6	8	+12V	-12V	GND	AO1	AO2	E	IG12	S(+)	S(-)

R2A	R2C	R1A	R1B	R1C	

(*6) The control board code No. : 4P101C0130001

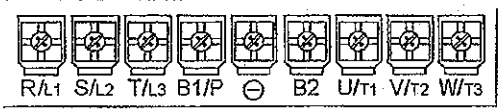
1.5 Description of terminal function

Table 1 Main circuit terminals

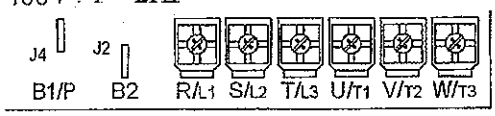
Terminal	230V:1~20HP, 460V:1~20HP	230V:25~40HP, 460V:25~75HP
R/L1	Main circuit input power supply (For single phase power supply, please use R/L1, S/L2 as input terminal)	
S/L2		
T/L3		
B1/P	B1/P, B2: External braking resistor B1/P, ⊖: DC power supply input	-
B2		
⊖		• ⊕ - ⊖ : DC power supply or braking unit
⊕	-	
B2/R	Unused	-
U/T1	Inverter output	
V/T2		
W/T3		
E	Grounding lead (3rd type grounding)	

Terminal block configuration

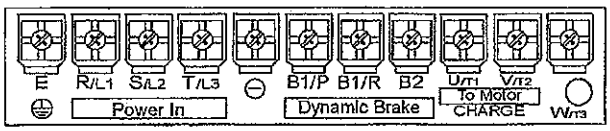
• 230V : 1 ~ 2HP



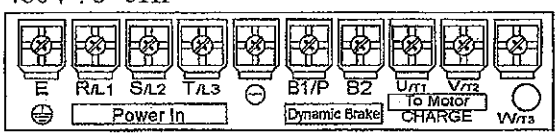
• 460V : 1 ~ 2HP



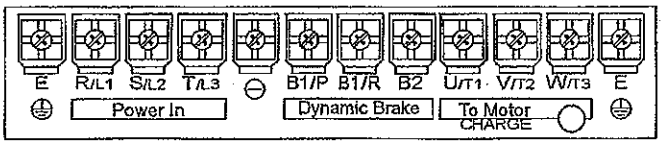
• 230V : 3~5HP



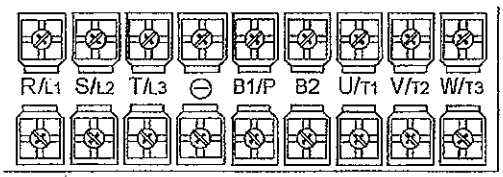
• 460V : 3~5HP



• 230V/460V : 7.5~10HP



• 230V/460V : 15~20HP



• 230V : 25~40HP, 460V : 25~75HP

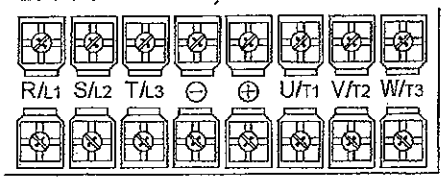


Table 2 Control circuit terminals

Terminal	Functions
1(DI1)	Forward Operation – Stop Signal
2(DI2)	Reverse Operation – Stop Signal
3(DI3)	External Fault Input
4(DI4)	Fault Reset
5(DI5) 6(DI6) 7(DI7) 8(DI8)	Multifunction Input Terminal: 3-Wire Operation, Load/Remote Control, Multi-Speed Select, FWD/REV Select, ACC/DEC Choice, ACC/DEC Halting, Base Block, Overheat Warn, PID Control, DC Braking, Speed Search, Up/Down Function, PG Feedback Control, External Fault, Timer function, Multifunction Analog Input Setting
SC(DG) (24VG)	Digital Signal Ground Sink Common Point (Locate the short jumper of TP2 in SINK position)
24V	Source Common Point (Locate the short jumper of TP2 in SOURCE position)
E	Connection to Shield Signal Lead (Frame Ground)
+15V(+12V)	DC voltage for External Device
-12V	Only support by the board 4P101C01301
VIN	Master speed Voltage Reference (0~10V) (4P101C01301 support –10V~10V input)
AIN	Master speed Current Reference (4~20mA)
AUX	Auxiliary Analog Input: Auxiliary frequency Command, Frequency Gain, Frequency Bias, Overtorque Detection, Output Voltage Bias, ACC/DEC Ramp, DC-Brake Current, Stall Prevention Current Level during Running Mode, PID Control, Lower-Bound of Frequency Command, Frequency-Jump-4, etc
GND	Analog Signal Common
IP12 IG12	External Power Source For PG Feedback Use
A(+) A(-)	Signal Input of PG (also can be the input terminal of Pulse Input Frequency Command)
AO1 AO2	Analog Multifunction Output Port: Frequency Commend, Output Frequency, Output Current, Output Voltage, DC Voltage, PID Controlled Value, Analog Command Input of VIN, AIN or AUX.(Below 2mA)
GND	Common Lead for Analog Port
RA(R1A)	Relay Contact Output A Same function as terminal DO1, DO2
RB(R1B)	Relay Contact Output B
RC(R1C)	Relay Contact Common
DO1 DO2 (R2A / R2B)	Digital Multi-Function (Open Collector) Output "1", "2" Terminals: During-Running, Zero-speed, Agreed-frequency, Agree-frequency-setting, Frequency-Output, Inverter-Operation-Ready, Undervoltage-Detection, Base-Block Output, Run Source, Frequency command, Overtorque Detection, Frequency Command Invalid, Fault, Undervoltage, Overheat, Motor Overload, Inverter Overload, During-Retry, Communication-Fault, Timer-Function-Output
DOG	Common Terminal (of Open Collector Transistor)
S(+) S(-)	RS-485 Port

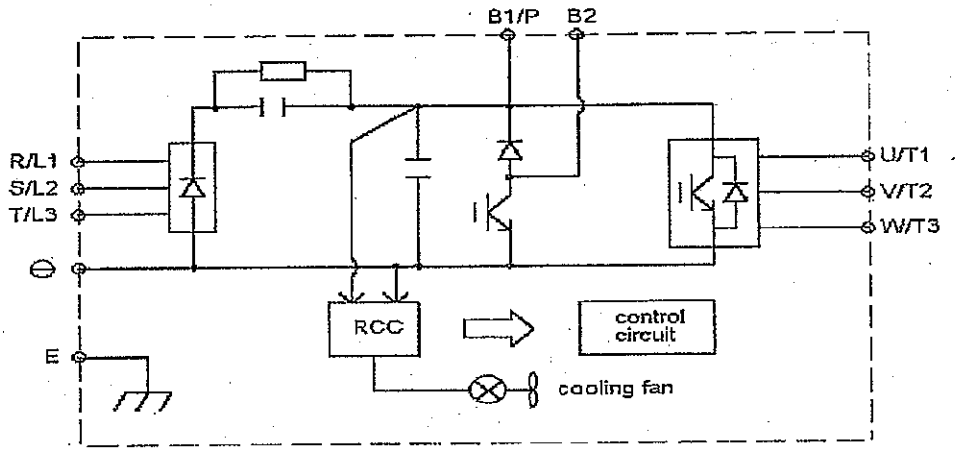
Caution

- Use the control circuit terminals VIN, AIN according the setting of Sn-24.
- The MAX. Output current at terminal (+15V or +12V) is 20mA.
- The multi-function analog output terminals AO1, AO2 is a dedicated output for a frequency meter, ammeter, etc. Do not use these 2 analog outputs for feedback control or any other control purpose.

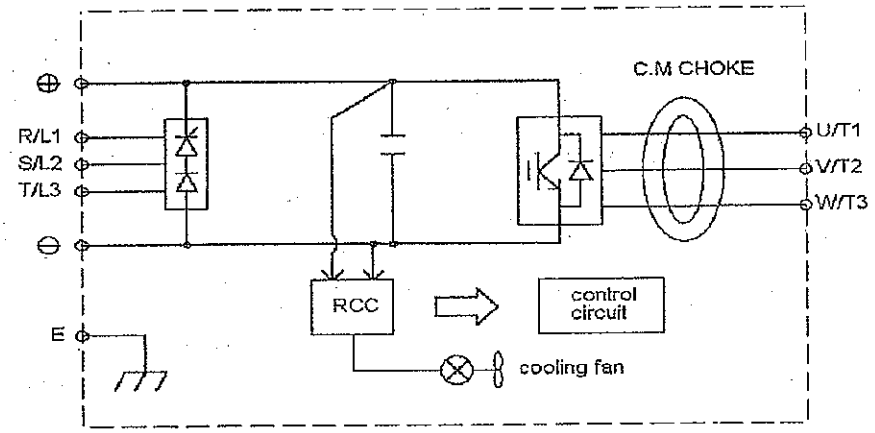
1.6 Main Circuit Wiring Diagram

Main Circuit Wiring Diagram of MA7200:

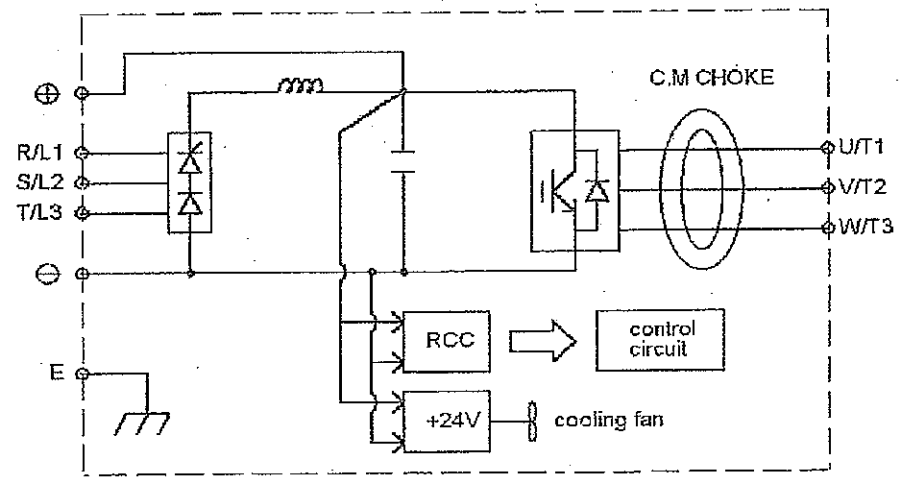
1. 230V/460V : 1~20HP



2. 230V : 25HP 460V : 25~30HP



3. 230V : 30~40HP 460V : 40~75HP



1.7 Wiring main circuit and notice

Main circuit wiring

The non-fusible-breaker (NFB) should be installed between the AC source and the R/L1-S/L2-T/L3 input terminal of MA7200 inverter. The user can make his own decision of installing electromagnetic contactor block (MCB) or not. To protect against the false triggering of leakage-current, the user should install a leakage current breaker with amperage sensitivity $\geqq$200mA and operation time $\geqq$0.1 sec.

Table 3 230V and 460V class applicable wire size and connector

MA7200 model				Wire size (mm²)			NFB*4	MCB*4
Power supply	Applicable Power Rating (HP)*1	Rated KVA	Rated current (A)	Main circuit*2	Ground connection wire E (G)	Control wire*3		
230V 1Φ/3Φ	1HP	2	4.8	2~5.5	2~5.5	0.5~2	TO-50EC(15A)	CN-11
	2HP	2.7	6.4	2~5.5	3.5~5.5	0.5~2	TO-50EC(20A)	CN-11
	3HP	4	9.6	3.5~5.5	3.5~5.5	0.5~2	TO-50EC(20A)	CN-11
230V 3 Φ	5.4HP	7.5	17.5	5.5	5.5	0.5~2	TO-50EC(30A)	CN-16
	7.5HP	10.1	24	8	5.5~8	0.5~2	TO-100S(50A)	CN-18
	10HP	13.7	32	8	5.5~8	0.5~2	TO-100S(60A)	CN-25
	15HP	20.6	48	14	8	0.5~2	TO-100S(100A)	CN-50
	20HP	27.4	64	22	8	0.5~2	TO-100S(100A)	CN-65
	25HP	34	80	22	14	0.5~2	TO-225S(150A)	CN-80
	30HP	41	96	38	14	0.5~2	TO-225S(175A)	CN-100
	40HP	54	130	60	22	0.5~2	TO-225S(175A)	CN-125
460V 3Φ	1HP	2.2	2.6	2~5.5	2~5.5	0.5~2	TO-50EC(15A)	CN-11
	2HP	3.4	4	2~5.5	3.5~5.5	0.5~2	TO-50EC(15A)	CN-11
	3HP	4.1	4.8	2~5.5	3.5~5.5	0.5~2	TO-50EC(15A)	CN-11
	5.4HP	7.5	8.7	2~5.5	3.5~5.5	0.5~2	TO-50EC(15A)	CN-18
	7.5HP	10.3	12	3~5.5	3.5~5.5	0.5~2	TO-50EC(20A)	CN-18
	10HP	12.3	15	5.5	5.5	0.5~2	TO-50EC(30A)	CN-25
	15HP	20.6	24	8	8	0.5~2	TO-50EC(30A)	CN-25
	20HP	27.4	32	8	8	0.5~2	TO-100S(50A)	CN-35
	25HP	34	40	8	8	0.5~2	TO-100S(75A)	CN-50
	30HP	41	48	14	8	0.5~2	TO-100S(100A)	CN-50
	40HP	54	64	22	8	0.5~2	TO-100S(100A)	CN-65
	50HP	68	80	22	14	0.5~2	TO-125S(125A)	CN-80
	60HP	82	96	38	14	0.5~2	TO-225S(175A)	CN-100
	75HP	110	128	60	22	0.5~2	TO-225S(175A)	CN-125

*1 : It is assumed constant torque load.

*2 : The main circuit has terminals of R/L1, S/L2, T/L3, U/T1, V/T2, W/T3, B1/P, B2/R, B2, $\ominus$.

*3 : The control wire is the wire led to the pin terminals of control board.

*4 : In Table 3, the specified Part No. of NFB and MC are the item No. of the products of TECO. The customer can use the same rating of similar products from other sources. To decrease the noise interference, be sure to add R-C surge suppressor (R: 10Ω/5W, C: 0.1μF/1000VDC) at the 2 terminals of coils of electromagnetic contactor.

External circuit wiring precaution:

(A) Control circuit wiring:

(1) Separate the control circuit wiring from main circuit wiring (R/L1, S/L2, T/L3, U/T1, V/T2, W/T3) and other high-power lines to avoid noise interruption.

(2) Separate the wiring for control circuit terminals RA-RB-RC (R1A-R2B-R2C) (contact output) from wiring for terminals ①～⑧, A01, A02, GND, DO1, DO2 , DOG 15V(or +12V, -12V), VIN, AIN, AUX, GND, IP12, IG12, A (+), A (-), S(+) and S(-).

(3) Use the twisted-pair or shielded twisted-pair cables for control circuits to prevent operating faults. Process the cable ends as shown in Fig. 3. The max. wiring distance should not exceed 50 meter.

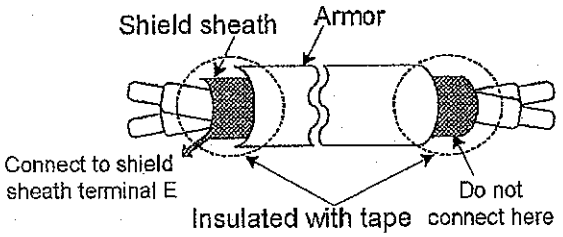


Fig. 3. Processing the ends of twisted-pair cables

When the digital multi-function output terminals connect serially to an external relay, an anti-parallel freewheeling diode should be applied at both ends of relay, as shown below.

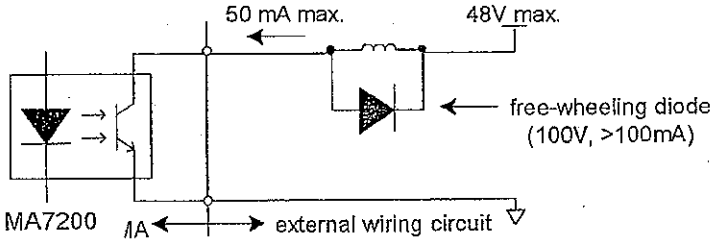


Fig. 4. The Optical-couplers connect to external inductive load

(B) Wiring the main circuit terminals:

(1) Input power supply can be connected to any terminal R/L1, S/L2 or T/L3 on the terminal block. The phase sequence of input power supply is irrelevant to the phase sequence.

(2) Never connect the AC power source to the output terminals U/T1, V/T2 and. W/T3.

(3) Connect the output terminals U/T1, V/T2, W/T3 to motor lead wires U/T1, V/T2, and W/T3, respectively.

(4) Check that the motor rotates forward with the forward run source. Switch over any 2 of the output terminals to each other and reconnect if the motor rotates in reverse with the forward run source.

(5) Never connect a phase advancing capacitor or LC/RC noise filter to an output circuit.

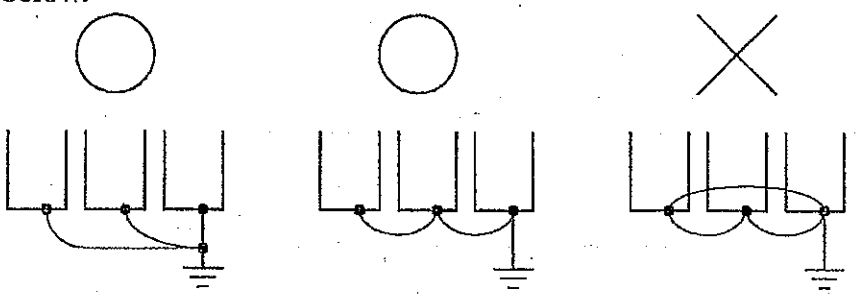
(C) GROUNDING :

(1) Always use the ground terminal (E) with a ground resistance of less than 100Ω.

(2) Do not share the ground wire with other devices, such as welding machines or power tools.

(3) Always use a ground wire that complies with the technical standards on electrical equipment and minimize the length of ground wire.

(4) When using more than one inverter, be careful not to loop the ground wire, as shown below.



(a) OK (b) OK (c) NO

Fig. 5. MA7200 ground winding

- Determine the wire size for the main circuit so that the line voltage drop is within 2% of the rated voltage. (If there is the possibility of excessive voltage drop, use a larger wire suitable to the required length)
- Installing an AC reactor
  If the inverter is connected to a large-capacity power source (600kVA or more), install an optional AC reactor on the input side of the inverter. This also improves the power factor on the power supply side.
- If the cable between the inverter and the motor is long, the high-frequency leakage current will increase, causing the inverter output current to increase as well. This may affect peripheral devices. To prevent this, adjust the carrier frequency, as shown below:

Cable length	< 100ft.	100-165ft.	166-328ft.	≥329ft.
Carrier frequency (Cn-34)	15kHz max (Cn-34=6)	10kHz max (Cn-34=4)	5kHz max (Cn-34=2)	2.5kHz (Cn-34=1)

1.8 Inverter Specifications

■ Basic Specifications

(a) 230V Series

	Inverter (HP)	1	2	3	5	7.5	10	15	20	25	30	40
	Max. Applicable Motor Output HP*1 (KW)	1 (0.75)	2 (1.5)	3 (2.2)	5.4 (4)	7.5 (5.5)	10 (7.5)	15 (11)	20 (15)	25 (18.5)	30 (22)	40 (30)
Output Characteristics	Rated Output Capacity (KVA)	2	2.7	4	7.5	10.1	13.7	20.6	27.4	34	41	54
	Rated Output Current (A)	4.8	6.4	9.6	17.5	24	32	48	64	80	96	130
	Max. Output Voltage (V)	3-Phases, 200V~230V										
	Max. Output Frequency (Hz)	Through Parameter Setting 0.1~400.0 Hz										
Power Supply	Rated Voltage, Frequency	1PH/3PH 200V~230V, 50/60Hz			3-Phases, 200V~230V, 50/60Hz							
	Allowable Voltage Fluctuation	-15% ~ +10%										
	Allowable Frequency Fluctuation	±5%										

(b) 460V Series

	Inverter (HP)	1	2	3	5	7.5	10	15	20	25	30	40	50	60	75
	Max. Applicable Motor Output HP*1 (KW)	1 (0.75)	2 (1.5)	3 (2.2)	5.4 (4)	7.5 (5.5)	10 (7.5)	15 (11)	20 (15)	25 (18.5)	30 (22)	40 (30)	50 (37)	60 (45)	75 (55)
Output Characteristics	Rated Output Capacity (KVA)	2.2	3.4	4.1	7.5	10.3	12.3	20.6	27.4	34	41	54	68	82	110
	Rated Output Current (A)	2.6	4	4.8	8.7	12	15	24	32	40	48	64	80	96	128
	Max. Output Voltage (V)	3-Phases, 380V~460V													
	Max. Output Frequency (Hz)	Through Parameter Setting 0.1~400.0 Hz													
Power Supply	Rated Voltage, Frequency	3-Phases, 380V ~ 460V, 50/60Hz													
	Allowable Voltage Fluctuation	-15% ~ +10%													
	Allowable Frequency Fluctuation	±5%													

*1. Based on 4 pole motor

*2. The spec. of NEMA4 are the same

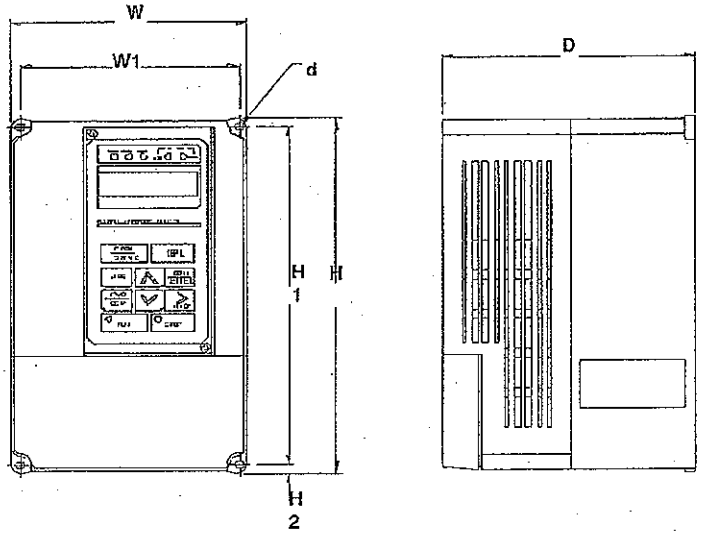
General Specifications

Control Characteristics	Operation Mode	Graphic LCD Panel (English and Chinese) with parameters copying (LED: option)
	Control Mode	Sinusoidal PWM
	Frequency Control Range	0.1Hz ~ 400Hz
	Frequency Accuracy (varied with temperature)	Digital Command: ±0.01% (-10 ~ +40°C), Analog Command: ±0.1% (25°C±10°C),
	Speed Control Accuracy	±0.1%(V/F with PG feedback), ±0.5%(Sensorless Vector Control)
	Frequency Command Resolution	Digital Command: 0.01Hz Analog Command: 0.06Hz/60Hz
	Frequency Output Resolution	0.01Hz
	Overload Resistibility	150% Rated Current for 1 Min
	Frequency Setting Signal	DC 0~+10V / 4~20 mA, DC-10V~+10V and Pulse Input Frequency Command (Above 230V/460V 3HP)
	Acc./Dec. Time	0.0~6000.0 sec (Accel/Decel Time Can Be Set Independently)
	Voltage–Frequency Characteristics	V/F Curve Can Be Set Through Parameter Setting
	Regeneration Torque	Approx. 20%
	Basic Control Function	Restart After Momentary Power Loss, PID Control, Auto Torque Boost, Slip Compensation, RS_485 Communication, Speed Feedback Control, Simple PLC function, 2 Analog Output Port
	Extra Function	Cumulative Power on & Operation Hour memory, Energy Saving, Up/Down Operation, 4 Different sets of Fault Status Record (Including Latest one), MODBUS Communication, Multiple-Pulse Output Ports, Select Local/Remote, Customer Application Software Environment (C.A.S.E), SINK/SOURCE Interface.
Protection Function	Stall Prevention	During Acceleration/Deceleration and constant Speed Running (Current Level Can Be Selected During Acceleration and Constant Speed Running. During Deceleration, Stall Prevention Can Be Enabled or Disabled)
	Instantaneous Overcurrent	Stopped if above 200% Rated Current
	Motor Overload Protection	Electronic Overload Curve Protection
	Inverter Overload Protection	Stopped if above 150% Rated Current for 1 Min.
	Overvoltage	Stop if VDC□410V (230 Class) or VDC□820V (460 Class)
	Undervoltage	Stop if VDC□200V (230 Class) or VDC□400V (460 Class)
	Momentary Power Loss Ride-Through time	□15ms, stop otherwise
	Overheat Protection	Protected by Thermistor
	Grounding Protection	Protection by DC Current Sensor
	Charge Indication (LED)	Lit when the DC Bus Voltage Above 50V
	Input Phase Loss (IPL)	Motor coasts to stop at Input Phase Loss
	Output Phase Loss (OPL)	Motor coasts to stop at Output Phase Loss
Environmental Condition	Application Site	Indoor (No Corrosive Gas And Dust Present)
	Ambient Temperature	-10°C ~ +40°C (Not Frozen)
	Storage Temperature	-20°C ~ +60°C
	Ambient Humidity	Below 90%RH (Non-Condensing)
	Height, Vibration	Below 1000M, 5.9m/S^2 (0.6G), (JISC0911 Standard)
Communication Function		RS-485 Installed (MODBUS Protocol)
Encoder Feedback Interface		Built-in PG Feedback Interface and set to Open-collector Interface Drive or Complementary Interface Drive
EMI		Meet EN 61800-3 With Specified EMI Filter
EMS Compatibility		Meet EN 61800-3
Option		PROFIBUS Card

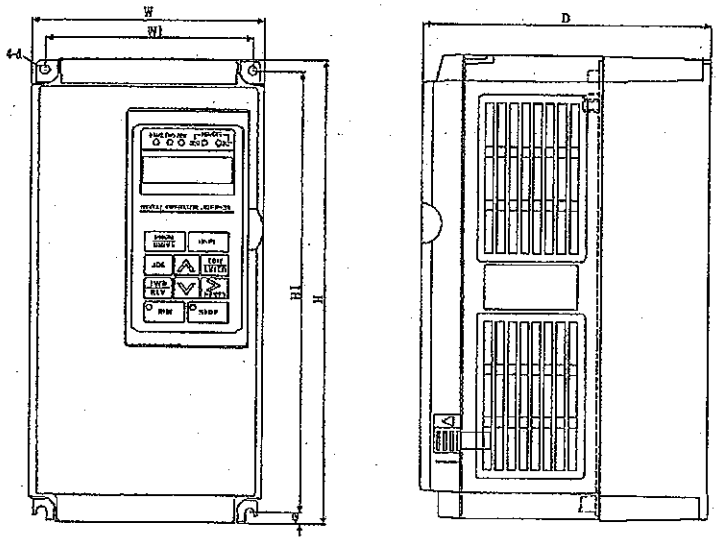
1.9 Dimensions

Voltage	Inverter Capacity(HP)	Open Chassis Type (IP00) (mm)						Weight (kg)	Enclosed Type (NEMA1) (mm)						Weight (kg)	Reference Figure
		W	H	D	W1	H1	d		W	H	D	W1	H1	d		
230V 1/3Φ	1							-	132	217	143.5	122	207	M5	2.3	(a)
	2															
	3								140	279.5	176.5	126	226	M6	4.3	(b)
230V 3Φ	5							-	140	279.5	176.5	126	226	M6	4.3	
	7.5								211.2	300	215	192	286	M6	5.7	
	10															
	15								265	360	225	245	340	M6	12	
	20															
	25														13	
	30	269	553	277	210	530	M10	30	269	647	277	210	530	M10	31	
	40							31							32	(c)
460V 3Φ	1							-	132	217	143.5	122	207	M5	2.3	(a)
	2															
	3								140	279.5	176.5	126	226	M6	4.3	(b)
	5															
	7.5								211.2	300	215	192	286	M6	5.7	
	10															
	15								265	360	225	245	340	M6	12	
	20															
	25														13	
	30															
	40	269	553	277	210	530	M10	30	269	647	277	210	530	M10	31	(c)
	50															
	60	308	653	282	250	630	M10	46	308	747	282	250	630	M10	47	
	75															

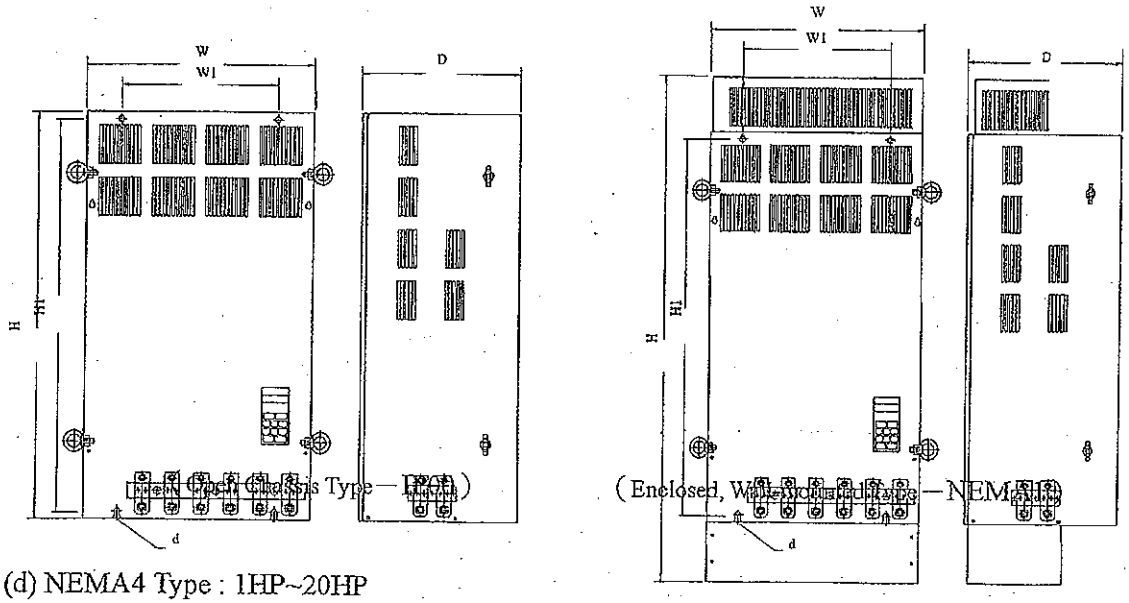
(a) 230V / 460V : 1~2HP



(b) 230V : 3HP~25HP
460V : 3HP~30HP



(c) 230V : 30HP~40HP
460V : 40HP~75HP

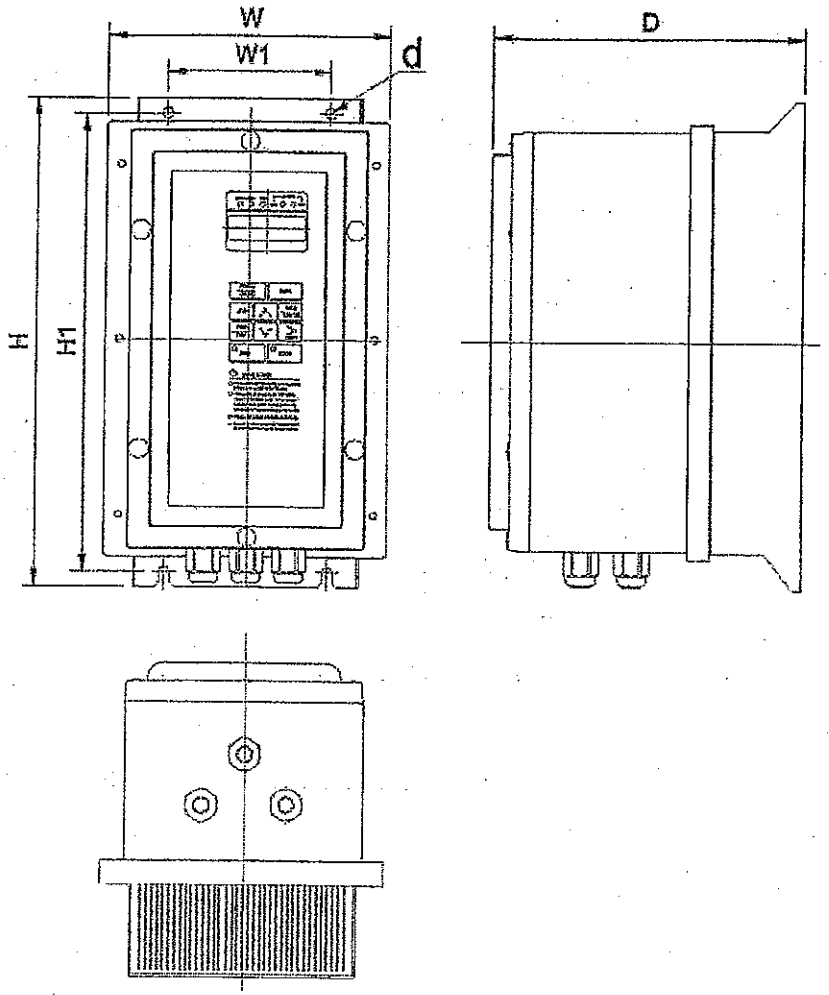


(Open Chassis Type — IP20)

(Enclosed, Wall-mounted Type — NEMA1)

(d) NEMA4 Type : 1HP~20HP

Voltage	Inverter Capacity(HP)	NEMA4 (mm)						Weight (kg)
		W	H	D	W1	H1	d	
230V 1/3Φ	1	198	335	217	115	315	M6	6.3
	2							
	3							7.5
230V 3Φ	5	198	335	217	115	315	M6	7.5
	7.5	223	460	245	140	440	M6	16
	10							
	15							
	20							
460V 3Φ	1	198	335	217	115	315	M6	6.3
	2							
	3							7.5
	5							
	7.5	223	460	245	140	440	M6	16
	10							
	15							
	20							


W
W1
d
H
H1
D

1.10 Peripheral Units

Braking resistors

MA7200 230V/460V 1~20HP model have built-in braking transistor, and can be connected external braking resistor between B1/P and B2 when lack of braking ability. Above 25HP models, need to connect braking unit (on ⊕ - ⊖ of inverter) and braking resistors (on B-P0 of braking unit).

Table 4 Braking resistor list

Inverter			Braking Unit		Braking Resistor			Braking Torque (%)
Voltage	HP	Rated current (A)	Model	Number used	Code NO.	Specs.	Number used	
230V 1/3Φ	1	4.8	-	-	JNBR-150W200	150W/200Ω	1	119%, 10%ED
	2	6.4	-	-	JNBR-150W100	150W/100Ω	1	119%, 10%ED
	3	9.6	-	-	JNBR-260W70	260W/70Ω	1	115%, 10%ED
230V 3Φ	5	17.5	-	-	JNBR-390W40	390W/40Ω	1	119%, 10%ED
	7.5	24	-	-	JNBR-520W30	520W/30Ω	1	108%, 10%ED
	10	32	-	-	JNBR-780W20	780W/20Ω	1	119%, 10%ED
	15	48	-	-	JNBR-2R4KW13R6	2400W/13.6Ω	1	117%, 10%ED
	20	64	-	-	JNBR-3KW10	3000W/10Ω	1	119%, 10%ED
	25	80	JNTBU-230	1	JNBR-4R8KW8	4800W/8Ω	1	119%, 10%ED
	30	96	JNTBU-230	1	JNBR-4R8KW6R8	4800W/6.8Ω	1	117%, 10%ED
	40	130	JNTBU-230	2	JNBR-3KW10	3000W/10Ω	2	119%, 10%ED
460V 3Φ	1	2.6	-	-	JNBR-150W750	150W/750Ω	1	126%, 10%ED
	2	4	-	-	JNBR-150W400	150W/400Ω	1	119%, 10%ED
	3	4.8	-	-	JNBR-260W250	260W/250Ω	1	126%, 10%ED
	5	8.7	-	-	JNBR-400W150	400W/150Ω	1	126%, 10%ED
	7.5	12	-	-	JNBR-600W130	600W/130Ω	1	102%, 10%ED
	10	15	-	-	JNBR-800W100	800W/100Ω	1	99%, 10%ED
	15	24	-	-	JNBR-1R6KW50	1600W/50Ω	1	126%, 10%ED
	20	32	-	-	JNBR-1R5KW50	1500W/40Ω	1	119%, 10%ED
	25	40	JNTBU-430	1	JNBR-4R8KW32	4800W/32Ω	1	119%, 10%ED
	30	48	JNTBU-430	1	JNBR-4R8KW27R2	4800W/27.2Ω	1	117%, 10%ED
	40	64	JNTBU-430	1	JNBR-6KW20	6000W/20Ω	1	119%, 10%ED
	50	80	JNVPHV-0060	1	JNBR-9R6KW16	9600W/16Ω	1	119%, 10%ED
	60	96	JNVPHV-0060	1	JNBR-9R6KW13R6	9600W/13.6Ω	1	117%, 10%ED
	75	128	JNTBU-430	2	JNBR-6KW20	6000W/20Ω	2	126%, 10%ED

AC reactor

- An AC reactor can be added on the power supply side if the inverter is connected to a much larger capacity power supply system, or the inverter is within short distance (<10m) from power supply systems, or to increase the power factor on the power supply side.
- Choose the proper AC reactor according to the below list.

Table 5 AC reactor list

Inverter Model			AC reactor	
V	HP	Rated current	Code No.	Specification (mH/A)
230V 1Φ/3Φ	1	4.8A	3M200D1610021	2.1mH/5A
	2	6.5A	3M200D1610030	1.1mH/10A
	3	9.6A	3M200D1610048	0.71mH/15A
230V 3Φ	5.4	17.5A	3M200D1610056	0.53mH/20A
	7.5	24A	3M200D1610064	0.35mH/30A
	10	32A	3M200D1610072	0.265mH/40A
	15	48A	3M200D1610081	0.18mH/60A
	20	64A	3M200D1610099	0.13mH/80A
	25	80A	3M200D1610102	0.12mH/90A
	30	96A	3M200D1610111	0.09mH/120A
	40	130A	3M200D1610269	0.07mH/160A
460V 3Φ	1	2.6A	3M200D1610137	8.4mH/3A
	2	4A	3M200D1610145	4.2mH/5A
	3	4.8A	3M200D1610153	3.6mH/7.5A
	5.4	8.7A	3M200D1610161	2.2mH/10A
	7.5	12A	3M200D1610170	1.42mH/15A
	10	15A	3M200D1610188	1.06mH/20A
	15	24A	3M200D1610196	0.7mH/30A
	20	32A	3M200D1610200	0.53mH/40A
	25	40A	3M200D1610218	0.42mH/50A
	30	48A	3M200D1610226	0.36mH/60A
	40	64A	3M200D1610234	0.26mH/80A
	50	80A	3M200D1610242	0.24mH/90A
	60	96A	3M200D1610251	0.18mH/120A
	75	128A	3M200D1610315	0.15mH/150A

Note: The AC reactors are applied only to input side. Do not apply it to output side.

Noise filter

A. INPUT SIDE NOISE FILTER

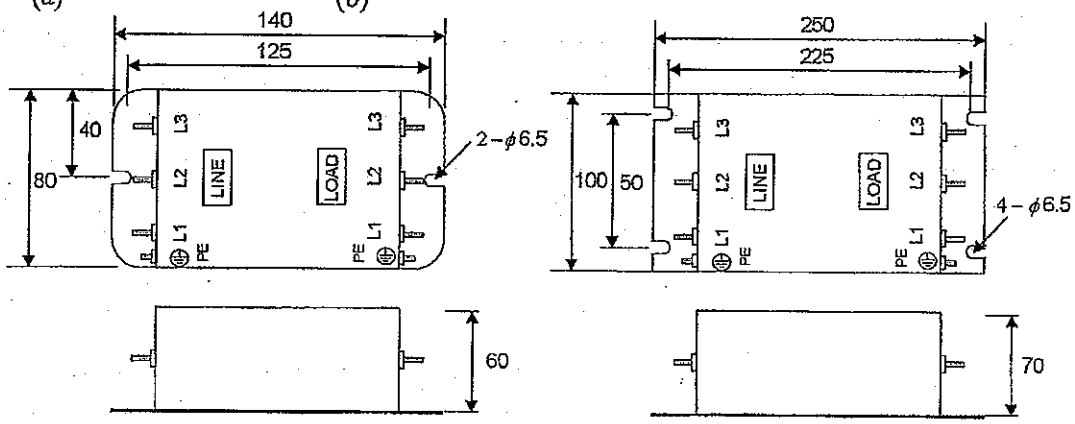
- Installing a noise filter on power supply side to eliminate noise transmitted between the power line and the inverter
- MA7200 has its specified noise filter to meet the EN61800-3 class A specification

Table 6 Noise filter on the input side

Inverter			Noise Filter				
V	HP	Rated Current (A)	Code		Specifications	Current	Dimensions
230V 1/3Φ	1	4.8A	1Φ	4H300D1750003	JUNF12015S-MA	15 A	Fig. (a)
			3Φ	4H300D1710001	JUNF32012S-MA	12 A	Fig. (a)
	2	6.5A	1Φ	4H300D1750003	JUNF12015S-MA	15 A	Fig. (a)
			3Φ	4H300D1710001	JUNF32012S-MA	12 A	Fig. (a)
	3	9.6A	1Φ	4H300D1600001	JUNF12020S-MA	20 A	Fig. (a)
			3Φ	4H300D1610007	JUNF32024S-MA	24 A	Fig. (a)
230V 3Φ	5.4	17.5A	4H300D1610007		JUNF32024S-MA	24 A	Fig. (a)
	7.5	24A	4H300D1620002		JUNF32048S-MA	48 A	Fig. (b)
	10	32A	4H300D1620002		JUNF32048S-MA	48 A	Fig. (b)
	15	48A	4H300D1730002		JUNF32070S-MA	70 A	Fig. (b)
	20	64A	4H300D1730002		JUNF32070S-MA	70 A	Fig. (b)
460V 3Φ	1	2.6A	4H300D1720007		JUNF34008S-MA	8 A	Fig. (a)
	2	4A	4H300D1720007		JUNF34008S-MA	8 A	Fig. (a)
	3	4.8A	4H300D1630008		JUNF34012S-MA	12 A	Fig. (a)
	5.4	8.7A	4H300D1630008		JUNF34012S-MA	12 A	Fig. (a)
	7.5	12A	4H300D1640003		JUNF34024S-MA	24 A	Fig. (b)
	10	15A	4H300D1640003		JUNF34024S-MA	24 A	Fig. (b)
	15	24A	4H300D1740008		JUNF34048S-MA	48 A	Fig. (b)
	20	32A	4H300D1740008		JUNF34048S-MA	48 A	Fig. (b)
	25	40A	4H000D1770008		KMF370A	70A	Fig. (c)
	30	48A	4H000D1790009		KMF370A	70A	Fig. (c)
	40	64A	4H000D1790009		KMF3100A	100A	Fig. (c)
	50	80A	4H000D1800004		KMF3100A	100A	Fig. (c)
	60	96A	4H000D1800004		KMF3150A	150A	Fig. (c)
	75	128A	4H000D1820005		KMF3180A	180A	Fig. (c)

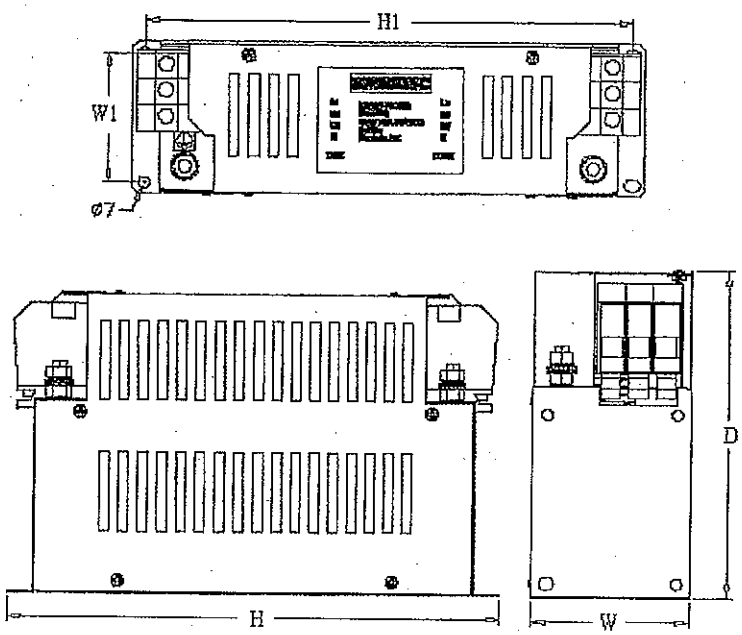
• Dimension : (unit : mm)

(a) (b)



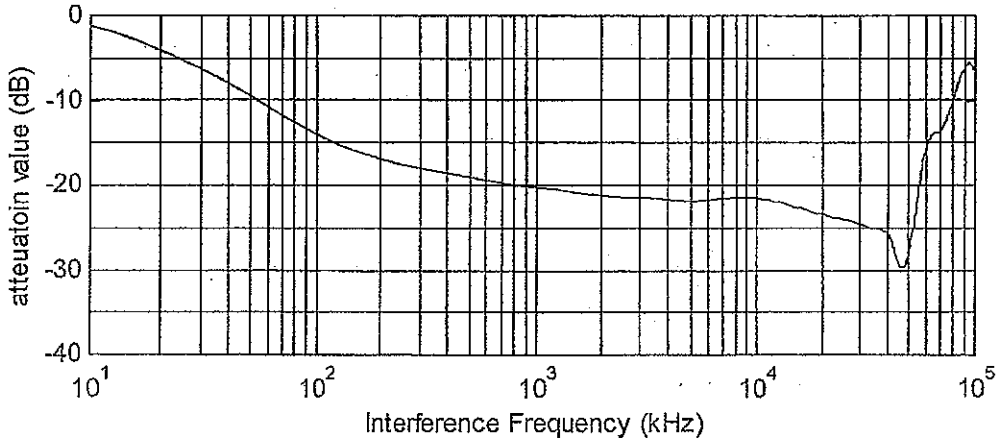
(c)

Model	Dimension (mm)						
	W	W1	H	H1	D	d	M
KMF370A	93	79	312	298	190	7	M6
KMF3100A	93	79	312	298	190	7	M6
KMF3150A	126	112	334	298	224	7	M6
KMF3180A	126	112	334	298	224	7	M6

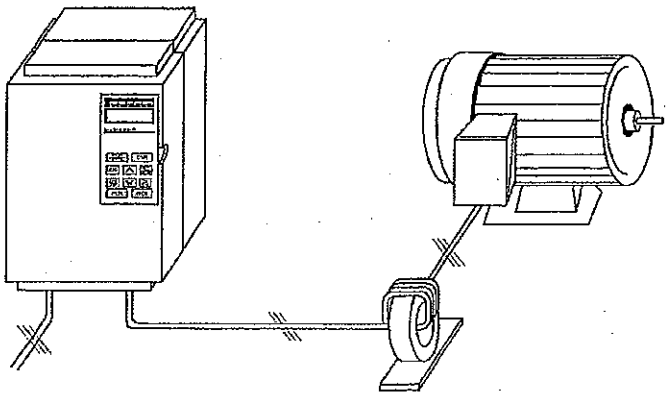


B. EMI SUPPRESSION ZERO PHASE CORE

- Model : JUNFOC046S ———————
- Code No. : 4H000D0250001
- According to the required power rating and wire size, select the matched ferrite core to suppress EMI noise.
- The ferrite core can attenuate the frequency response at high frequency range (from 100KHz to 50MHz, as shown below). It should be able to attenuate the RFI from inverter to outside.
- The zero-sequence noise ferrite core can be installed either on the input side or on the output side. The wire around the core for each phase should be winded by following the same convention and one direction. The more winding turns the better attenuation effect. (Without saturation). If the wire size is too big to be winded, all the wire can be grouped and go through these several cores together in one direction.
- Frequency attenuation characteristics (10 windings case)



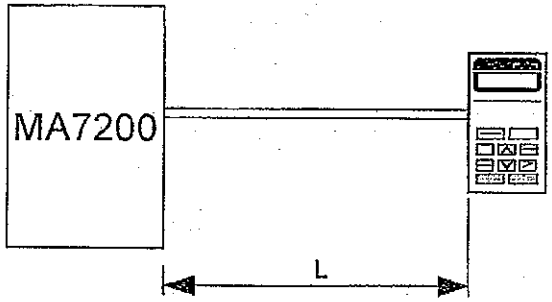
Example: EMI suppression zero phase core application example



Note: All the line wire of U/T1, V/T2, W/T3 phase must pass through the same zero-phase core in the same winding sense.

LCD operator with extension wire

When used for remote control purpose, the LCD operator can have different extension wires based upon the applications. Some extension wires are listed below.



Cable Length	Extension Cable Set *1	Extension Cable *2	Blank Cover *3
1m	4H332D0010000	4H314C0010003	4H300D1120000
2m	4H332D0030001	4H314C0030004	
3m	4H332D0020005	4H314C0020009	
5m	4H332D0040006	4H314C0040000	
10m	4H332D0130005	4H314C0060001	

*1 : Including special cable for LCD digital operator, blank cover, fixed use screws and installation manual.

*2 : One special cable for LCD digital operator.

*3 : A blank cover to protect against external dusts, metallic powder, etc.

The physical dimension of LCD digital operator is drawn below.

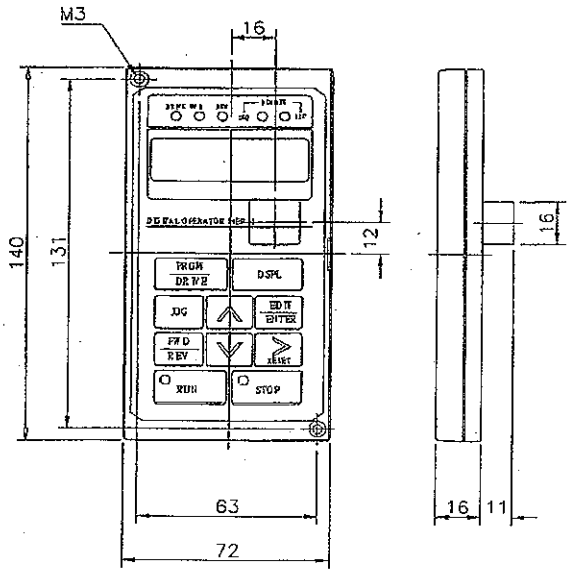
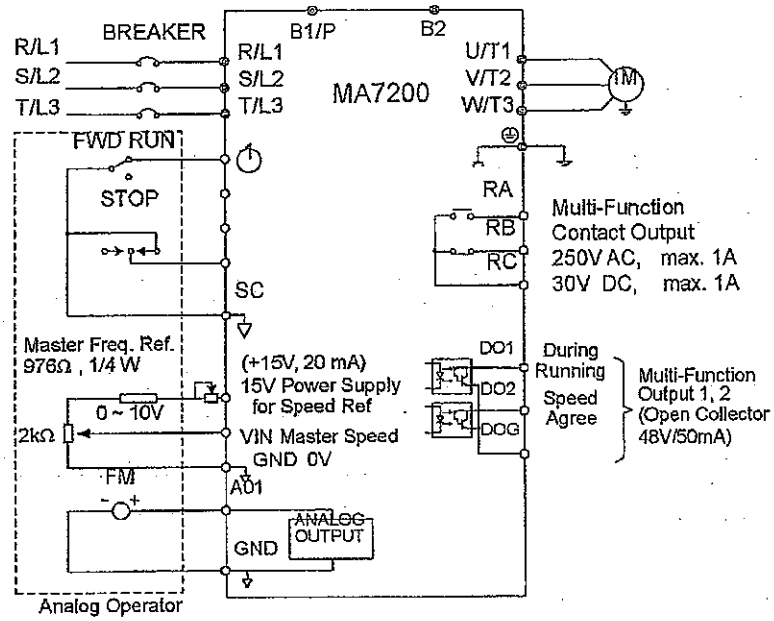


Fig. 6. LCD Digital Operator Dimension



Analog operator

All MA7200 have the digital LCD digital operator. Moreover, an analog operator as JNEP-16 (shown in fig. 7) is also available and can be connected through wire as a portable operator. The wiring diagram is shown below.

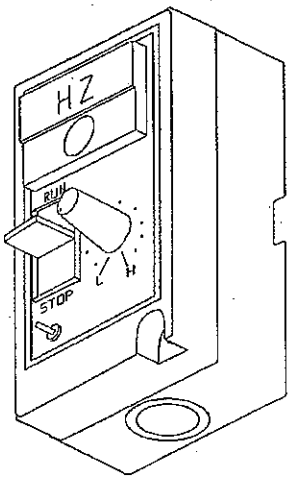


Fig. 7. Analog Operator

PROFIBUS Communication Card

- Code No. : 4H300D0290009
- Please refer to the appendix D and "MA7200 PROFIBUS-DP Communication Application manual" for communication interface.

2. Using LCD Digital Operator

Functions of LCD digital operator

JNEP-36 LCD digital operator has 2 modes: DRIVE mode and PRGM mode. When the inverter is stopped, DRIVE mode or PRGM mode can be selected by pressing the key [PRGM/DRIVE]. In DRIVE mode, the operation is enabled. Instead, in the PRGM mode, the parameter settings for operation can be changed but the operation is not enabled. The component names and function are shown as below:

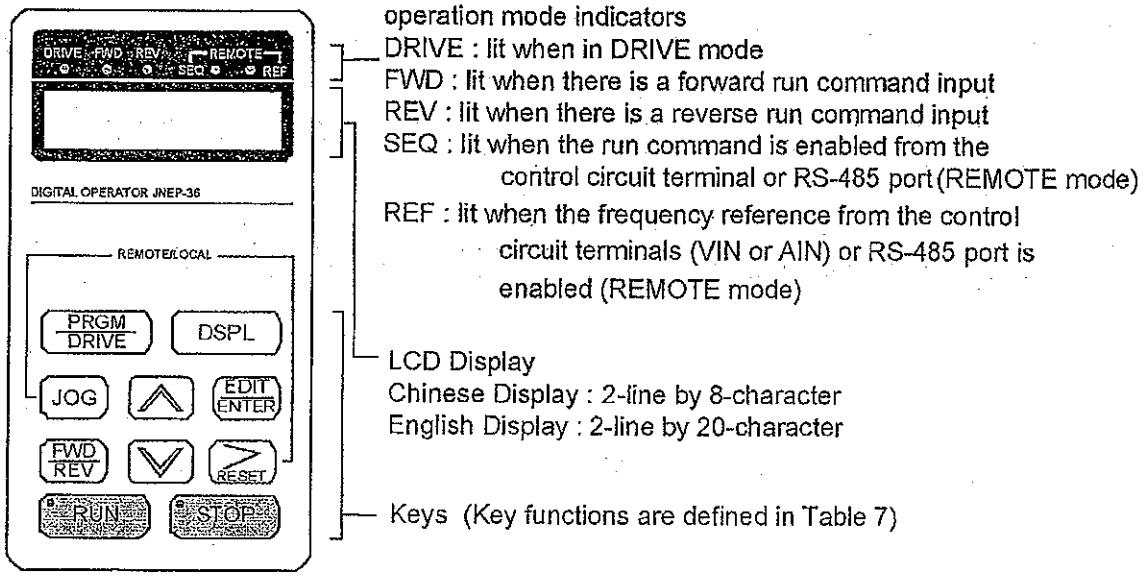


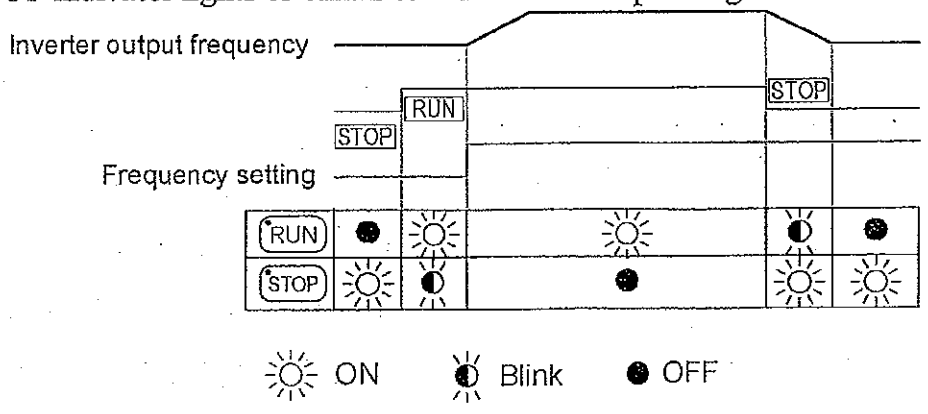
Fig. 8. LCD Digital operator

- Remote/Local switch function:
  - Local mode – RUN command input from LCD Digital Operator (SEQ LED off)
    – Frequency command input from LCD Digital Operator (REF LED off)
  - Remote mode –RUN command input from control circuit (when Sn-04=1) or RS-485 comm. port (when Sn-04=2) (SEQ LED lit)
    –Frequency command input from control circuit (when Sn-05=1) or RS-485 comm. port (when Sn-05=2) (REF LED lit)
  - Press [JOG] and hold [RESET] to switch Local/Remote mode. (Switching action of Local/Remote only can be done while Inverter stop.)

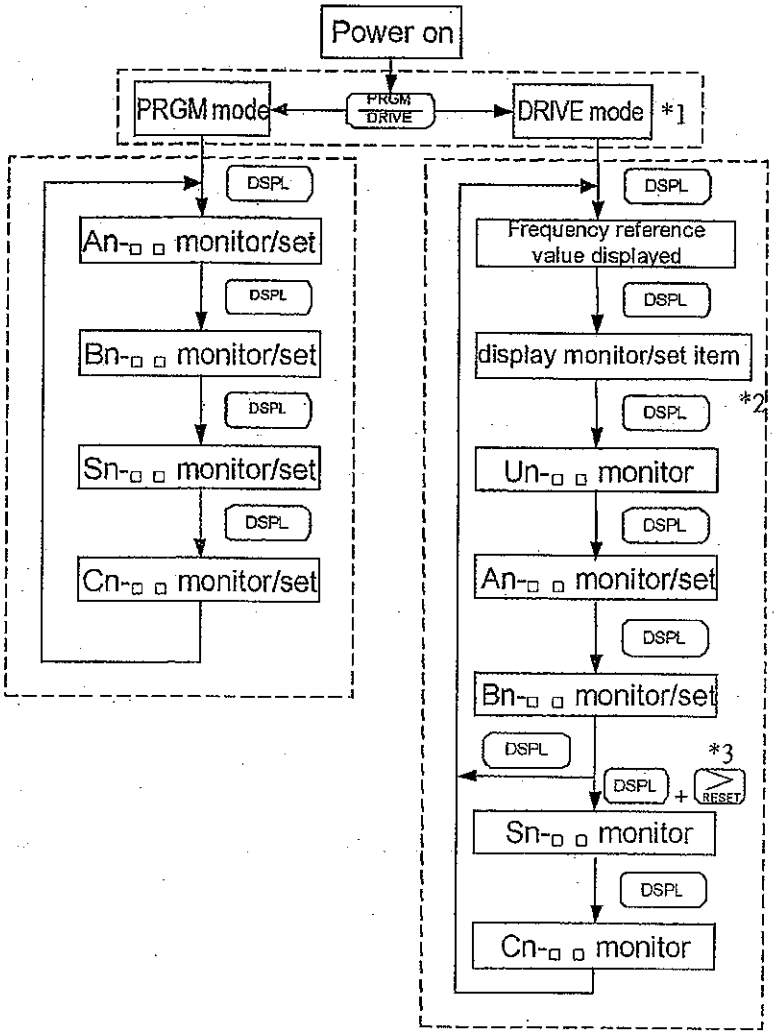
Table 7 Key's functions

Key	Name	Function
PRGM/DRIVE	PRGM/DRIVE key	Switches over between program mode (PRGM) and drive mode (DRIVE).
DSPL	DSPL key	Display operation status
JOG	JOG key	Enable jog operation from LCD digital operator in operation (DRIVE).
FWD/REV	FWD/REV key	Select the rotation direction from LCD digital operator.
RESET	RESET key	Set the number of digital for user constant settings. Also It acts as the reset key when a fault has occurred.
∧	INCREMENT key	Select the menu items, groups, functions, and user constant name, and increment set values.
∨	DECREMENT key	Select the menu items, groups, functions, and user constant name, and decrement set values.
EDIT/ENTER	EDIT/ENTER key	Select the menu items, groups, functions, and user constants name, and set values (EDIT). After finishing the above action, press the key (ENTER).
RUN	RUN key	Start inverter operation in (DRIVE) mode when the digital operator is used. The LED will light.
STOP	STOP key	Stop inverter operation from LCD digital operator. The STOP key can be enabled or disabled by setting the parameter Sn-07 when operating from the control circuit terminal.

RUN、STOP indicator lights or blinks to indicate the 3 operating status:



Display contents in DRIVE mode and PRGM mode



*1 When the inverter is powered up, the inverter system immediately enters into DRIVE mode. Press the PRGM DRIVE key, the system will switch into PRGM mode. If the fault occurs, press the PRGM DRIVE key and enter into DRIVE mode to monitor the corresponding Un-□□ contents. If a fault occurs in the DRIVE mode, the corresponding fault will be displayed. Press the RESET key and reset the fault.

*2 The monitored items will be displayed according to the settings of Bn-12 and Bn-13.

*3 When in the DRIVE mode, press the DSPL key and RESET key, the setting values of Sn- and Cn-□□ will only be displayed for monitoring but not for changing or setting.

Parameter description

The inverter has 4 groups of user parameters:

Parameters	Description
An-□□	Frequency command
Bn-□□	Parameter groups can be changed during running
Sn-□□	System parameter groups (can be changes only after stop)
Cn-□□	Control parameter groups (can be changed only after stop)

The parameter setting of Sn-03 (operation status) will determine if the setting value of different parameter groups are allowed to be changed or only to be monitored, as shown below:

Sn-03	DRIVE mode		PRGM mode	
	To be set	To be monitored	To be set	To be monitored
0*1	An,Bn	Sn,Cn	An,Bn,Sn,Cn	–
1	An	Bn,(Sn,Cn)*2	An	Bn,Sn,Cn

*1 : Factory setting

*2 : When in DRIVE mode, the parameter group Sn-, Cn- can only be monitored if the RESET key and the DSPL key are to be pressed simultaneously.

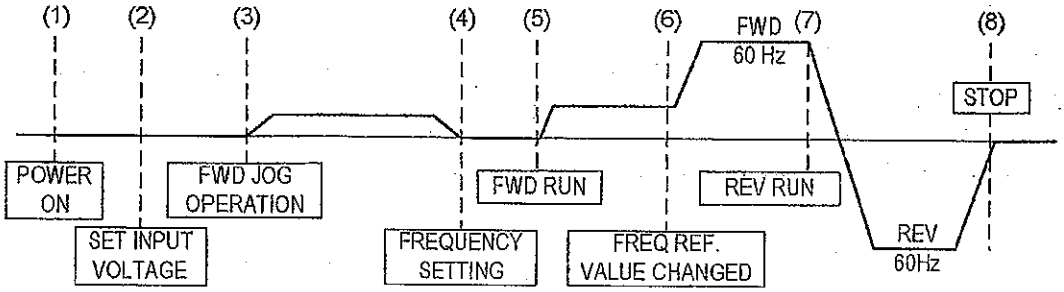
*3 : After a few trial and adjustment, the setting value Sn-03 is set to be "1" so as not be modified again.

Example of using LCD digital operator

> Note :
> Before operation: Control parameter Cn-01 value must be set as the input AC voltage value. For example, Cn-01=380 if AC input voltage is 380.

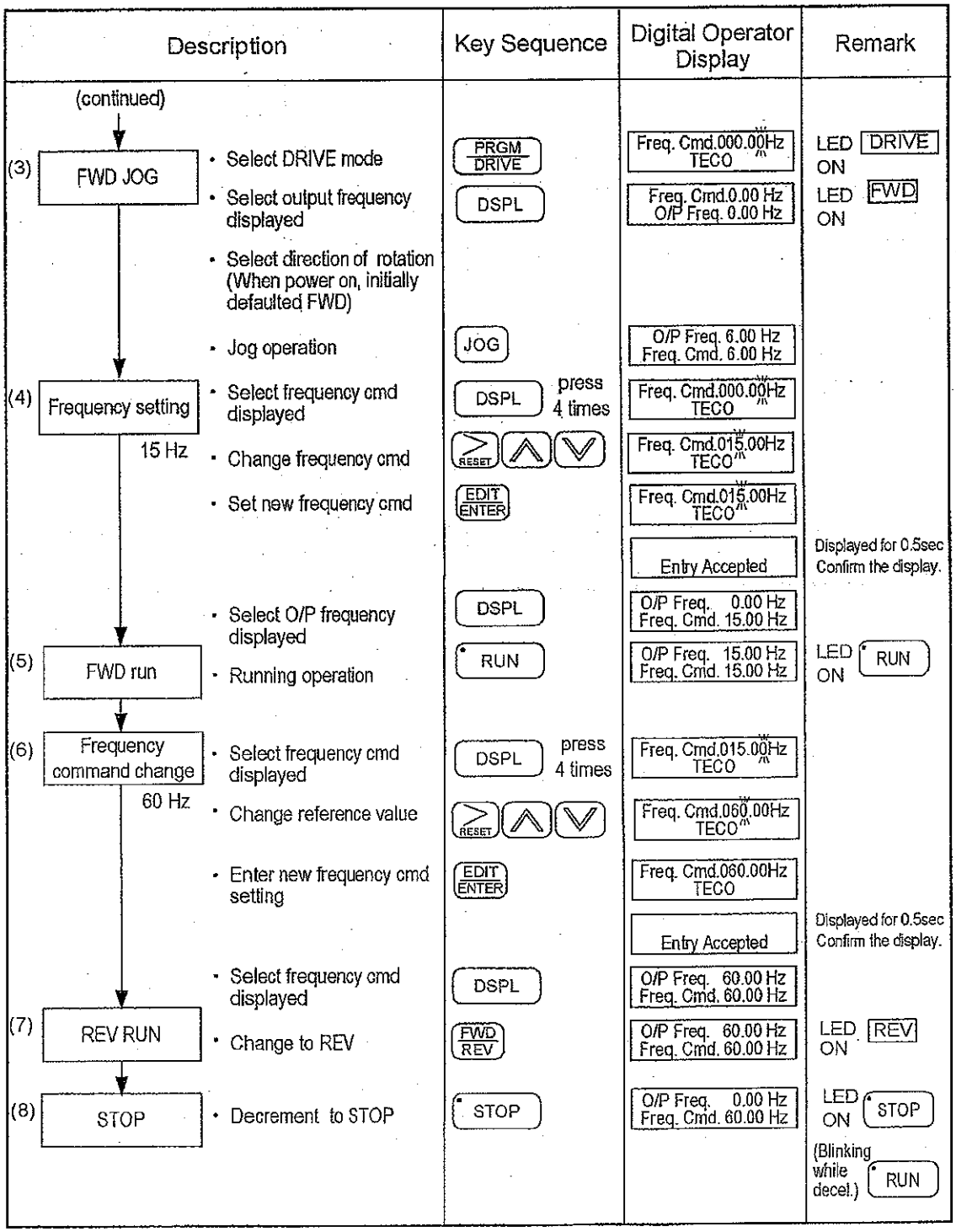
This example will explain the operating of the inverter according to the following time chart.

OPERATION MODE



Example of operation

Description	Key Sequence	Digital Operator Display	Remark
(1) When Power on • Select frequency reference value displayed		Freq. Cmd.000.00Hz TECO	
• Select PRGM mode	PRGM/DRIVE	An -01 Freq. Cmd. 1	LED DRIVE OFF
(2) Input voltage setting (e.g. AC input voltage is 380V) • Select CONTROL PARAMETER	DSPL press 3 times	Cn -01- Input Voltage	
	EDIT/ENTER	Cn-01 = 440.0V Input Voltage	
• Display Cn-01 setting • Input Voltage 380V	RESET, ∧, ∨	Cn-01 = 380.0V Input Voltage	Display for 0.5 sec
(continued)	EDIT/ENTER	Entry Accepted	


Description
Key Sequence
Digital Operator Display
Remark
(continued)
(3)
FWD JOG
• Select DRIVE mode
• Select output frequency displayed
• Select direction of rotation (When power on, initially defaulted FWD)
PRGM DRIVE
DSPL
Freq. Cmd.000.00Hz TECO
Freq. Cmd.0.00 Hz O/P Freq. 0.00 Hz
LED ON DRIVE
LED ON FWD
• Jog operation
JOG
O/P Freq. 6.00 Hz Freq. Cmd. 6.00 Hz
(4)
Frequency setting
15 Hz
• Select frequency cmd displayed
• Change frequency cmd
• Set new frequency cmd
DSPL
press 4 times
RESET
EDIT ENTER
Freq. Cmd.000.00Hz TECO
Freq. Cmd.015.00Hz TECO
Freq. Cmd.015.00Hz TECO
Entry Accepted
Displayed for 0.5sec Confirm the display.
(5)
FWD run
• Select O/P frequency displayed
• Running operation
DSPL
RUN
O/P Freq. 0.00 Hz Freq. Cmd. 15.00 Hz
O/P Freq. 15.00 Hz Freq. Cmd. 15.00 Hz
LED ON RUN
(6)
Frequency command change
60 Hz
• Select frequency cmd displayed
• Change reference value
• Enter new frequency cmd setting
DSPL
press 4 times
RESET
EDIT ENTER
Freq. Cmd.015.00Hz TECO
Freq. Cmd.060.00Hz TECO
Freq. Cmd.060.00Hz TECO
Entry Accepted
Displayed for 0.5sec Confirm the display.
(7)
REV RUN
• Select frequency cmd displayed
• Change to REV
DSPL
FWD REV
O/P Freq. 60.00 Hz Freq. Cmd. 60.00 Hz
O/P Freq. 60.00 Hz Freq. Cmd. 60.00 Hz
LED ON REV
(8)
STOP
• Decrement to STOP
STOP
O/P Freq. 0.00 Hz Freq. Cmd. 60.00 Hz
LED ON STOP
(Blinking while decel.) RUN

■ Example of display (use ⋀ and ⋁ keys to display monitored items/contents)

Description	Key Sequence	Digital Operator Display	Remark
• Display Frequency Command		Freq. Cmd. 60.00Hz TECO	
• Display Moniter Contents *1	DSPL	Freq. Cmd. 60.00 Hz O/P Freq. 60.00 Hz	
• Display Output Current	⋀	Freq. Cmd. 60.00 Hz O/P I 12.5 A	
• Display Output Voltage	⋀	Freq. Cmd. 60.00 Hz O/P Volt. 220.0 V	
• Display DC Voltage	⋀	Freq. Cmd. 60.00 Hz DC Volt. 310.0 V	
• Display Output Voltage	⋁	Freq. Cmd. 60.00 Hz O/P Volt. 220.0 V	
• Display Output Current	⋁	Freq. Cmd. 60.00 Hz O/P I 12.5 A	

*1. The monitor contents can be selected by the setting of Bn-12 and Bn-13

3. Parameter Setting

3.1 Frequency command (in Multi-speed operation) An*1-□□

Under the DRIVE mode, the user can monitor the parameters and set their values.

Parameter No.	Name	LCD Display (English)	Setting Range	Setting*2 Unit	Factory Setting	Ref. Page
An-01	Frequency Command 1	An-01= 000.00Hz Freq. Cmd. 1	0.00～400.00Hz	0.01Hz	0.00Hz	
An-02	Frequency Command 2	An-02= 000.00Hz Freq. Cmd. 2	0.00～400.00Hz	0.01Hz	0.00Hz	
An-03	Frequency Command 3	An-03= 000.00Hz Freq. Cmd. 3	0.00～400.00Hz	0.01Hz	0.00Hz	
An-04	Frequency Command 4	An-04= 000.00Hz Freq. Cmd. 4	0.00～400.00Hz	0.01Hz	0.00Hz	
An-05	Frequency Command 5	An-05= 000.00Hz Freq. Cmd. 5	0.00～400.00Hz	0.01Hz	0.00Hz	
An-06	Frequency Command 6	An-06= 000.00Hz Freq. Cmd. 6	0.00～400.00Hz	0.01Hz	0.00Hz	
An-07	Frequency Command 7	An-07= 000.00Hz Freq. Cmd. 7	0.00～400.00Hz	0.01Hz	0.00Hz	
An-08	Frequency Command 8	An-08= 000.00Hz Freq. Cmd. 8	0.00～400.00Hz	0.01Hz	0.00Hz	3-54 3-70 3-71
An-09	Frequency Command 9	An-09= 000.00Hz Freq. Cmd. 9	0.00～400.00Hz	0.01Hz	0.00Hz	
An-10	Frequency Command 10	An-10= 000.00Hz Freq. Cmd. 10	0.00～400.00Hz	0.01Hz	0.00Hz	
An-11	Frequency Command 11	An-11= 000.00Hz Freq. Cmd. 11	0.00～400.00Hz	0.01Hz	0.00Hz	
An-12	Frequency Command 12	An-12= 000.00Hz Freq. Cmd. 12	0.00～400.00Hz	0.01Hz	0.00Hz	
An-13	Frequency Command 13	An-13= 000.00Hz Freq. Cmd. 13	0.00～400.00Hz	0.01Hz	0.00Hz	
An-14	Frequency Command 14	An-14= 000.00Hz Freq. Cmd. 14	0.00～400.00Hz	0.01Hz	0.00Hz	
An-15	Frequency Command 15	An-15= 000.00Hz Freq. Cmd. 15	0.00～400.00Hz	0.01Hz	0.00Hz	
An-16	Frequency Command 16	An-16= 000.00Hz Freq. Cmd. 16	0.00～400.00Hz	0.01Hz	0.00Hz	
An-17	Jog Frequency Command	An-17= 000.00Hz Jog Freq. Cmd.	0.00～400.00Hz	0.01Hz	6.00Hz	3-56

*1. At factory setting, the value of "Setting Unit" is 0.01Hz.

*2. The displayed "Setting Unit" can be changed through the parameter Cn-28.

3.2 Parameters Groups Can Be Changed during Running Bn-□□

Under the DRIVE mode, the Parameter group can be monitored and set by the users.

Function	Parameter No.	Name	LCD display (English)	Setting range	Setting Unit	Factory Setting	Ref. Page
Acc/Dec time	Bn-01	Acceleration Time 1	Bn-01= 0010.0s Acc. Time 1	0.0～6000.0s	0.1s	10.0s	3-4
	Bn-02	Deceleration Time 1	Bn-02= 0010.0s Dec. Time 1	0.0～6000.0s	0.1s	10.0s	
	Bn-03	Acceleration Time 2	Bn-03= 0010.0s Acc. Time 2	0.0～6000.0s	0.1s	10.0s	
	Bn-04	Deceleration Time 2	Bn-04= 0010.0s Dec. Time 2	0.0～6000.0s	0.1s	10.0s	
Analog Frequency	Bn-05	Analog Frequency Cmd. Gain (Voltage)	Bn-05= 0100.0% Voltage Cmd. Gain	0.0～1000.0%	0.10%	100.00%	3-5
	Bn-06	Analog Frequency Cmd. Bias (Voltage)	Bn-06= 000.0% Voltage Cmd. Bias	-100.0%～100.0%	0.10%	0.00%	
	Bn-07	Analog Frequency Cmd Gain. (Current)	Bn-07= 0100.0% Current Cmd. Gain	0.0～1000.0%	0.10%	100.00%	
	Bn-08	Analog Frequency Cmd Bias (Current)	Bn-08= 000.0% Current Cmd. Bias	-100.0%～100.0%	0.10%	0.00%	
Multi-Function Analog Input	Bn-09	Multi-Function Analog Input Gain	Bn-09= 0100.0% Multi_Fun. ~Gain	0.0～1000.0%	0.10%	100.00%	3-5
	Bn-10	Multi-Function Analog Input Bias	Bn-10= 000.0% Multi_Fun. ~Bias	-100.0%～100.0%	0.10%	0.00%	
Torque Boost	Bn-11	Auto Torque Boost Gain	Bn-11= 0.5 Auto_Boost Gain	0.0～2.0	0.1	0.5	3-5
Monitor	Bn-12	Monitor 1	Bn-12= 01 Display: Freq.Cmd.	1～18	1	1	3-6
	Bn-13	Monitor 2	Bn-13= 02 Display: O/P Freq.	1～18	1	2	
Multi-Function Analog Output	Bn-14	Multi-Function Analog Output AO1 Gain	Bn-14=.1.00 ~Output AO1 Gain	0.01～2.55	0.01	1	3-7
	Bn-15	Multi-Function Analog Output AO2 Gain	Bn-15= 1.00 ~Output AO2 Gain	0.01～2.55	0.01	1	
PID Control	Bn-16	PID Detection Gain	Bn-16= 01.00 PID Cmd. Gain	0.01～10.00	0.01	1	3-7
	Bn-17	PID Proportional Gain	Bn-17= 01.00 PID P_gain	0.01～10.00	0.01	1	
	Bn-18	PID integral time	Bn-18= 10.00s PID I_Time	0.00～100.00s	0.01s	10.00s	
	Bn-19	PID Differential Time	Bn-19= 0.00s PID D_Time	0～1.00s	0.01s	0.00s	
	Bn-20	PID Bias	Bn-20= 0% PID Bias	0～109%	1%	0%	

	Parameter No.	Name	LCD display (English)	Setting range	Setting Unit	Factory Setting	Ref. Page
Auto_Run Time Function	Bn-21	1st_Step Time Under Auto_Run Mode	Bn-21= 0000.0s Time 1	0.0～6000.0s	0.1s	0.0s	3-70 3-71
	Bn-22	2nd_Step Time Under Auto_Run Mode	Bn-22= 0000.0s Time 2	0.0～6000.0s	0.1s	0.0s	
	Bn-23	3rd_Step Time Under Auto_Run Mode	Bn-23= 0000.0s Time 3	0.0～6000.0s	0.1s	0.0s	
	Bn-24	4th_Step Time Under Auto_Run Mode	Bn-24= 0000.0s Time 4	0.0～6000.0s	0.1s	0.0s	
	Bn-25	5th_Step Time Under Auto_Run Mode	Bn-25= 0000.0s Time 5	0.0～6000.0s	0.1s	0.0s	
	Bn-26	6th_Step Time Under Auto_Run Mode	Bn-26= 0000.0s Time 6	0.0～6000.0s	0.1s	0.0s	
	Bn-27	7th_Step Time Under Auto_Run Mode	Bn-27= 0000.0s Time 7	0.0～6000.0s	0.1s	0.0s	
	Bn-28	8th_Step Time Under Auto_Run Mode	Bn-28= 0000.0s Time 8	0.0～6000.0s	0.1s	0.0s	
	Bn-29	9th_Step Time Under Auto_Run Mode	Bn-29= 0000.0s Time 9	0.0～6000.0s	0.1s	0.0s	
	Bn-30	10th_Step Time Under Auto_Run Mode	Bn-30= 0000.0s Time 10	0.0～6000.0s	0.1s	0.0s	
	Bn-31	11th_Step Time Under Auto_Run Mode	Bn-31= 0000.0s Time 11	0.0～6000.0s	0.1s	0.0s	
	Bn-32	12th_Step Time Under Auto_Run Mode	Bn-32= 0000.0s Time 12	0.0～6000.0s	0.1s	0.0s	
	Bn-33	13th_Step Time Under Auto_Run Mode	Bn-33= 0000.0s Time 13	0.0～6000.0s	0.1s	0.0s	
	Bn-34	14th_Step Time Under Auto_Run Mode	Bn-34= 0000.0s Time 14	0.0～6000.0s	0.1s	0.0s	
	Bn-35	15th_Step Time Under Auto_Run Mode	Bn-35= 0000.0s Time 15	0.0～6000.0s	0.1s	0.0s	
	Bn-36	16th_Step Time Under Auto_Run Mode	Bn-36= 0000.0s Time 16	0.0～6000.0s	0.1s	0.0s	
Timer Function	Bn-37	Timer Function On_Delay Time	Bn-37= 0000.0s ON_delay Setting	0.0～6000.0s	0.1s	0.0s	3-9
	Bn-38	Timer Function Off_Delay Time	Bn-38= 0000.0s OFF_delay Setting	0.0～6000.0s	0.1s	0.0s	
Energy Saving	Bn-39	Energy_Saving Gain	Bn-39= 100% Eg.Saving Gain	50～150%	1%	100%	3-10
Monitor	Bn-40	Monitor 3	Bn-40=00 Display : Set_Freq.	00~18	1	0	3-10

	Parameter No.	Name	LCD display (English)	Setting range	Setting Unit	Factory Setting	Ref. Page
Pulse Input	Bn-41	Pulse Input Upper Limit	Bn-41=1440 Hz Pulse_Mul._Up_Bound	1440~32000	1 Hz	1440	3-11
	Bn-42	Pulse Input Gain	Bn-41=100.0 % Pulse_Mul._Gain	0.0~1000.0	0.10%	100	
	Bn-43	Pulse Input Bias	Bn-41=000.0 % Pulse_Mul._Bias	-100.0~100.0	0.1Hz	0	
	Bn-44	Pulse Input Delay Time	Bn-41=0.10 s Pulse_Mul._Filter	0.00~2.00	0.01s	0.1	
PID Feedback Display	Bn-45*1	PID Feedback Display at 0%	Bn-45= 0000 PID Display at 0%	1~9999*1	1*2	0	3-11
	Bn-46*1	PID Feedback Display at 100%	Bn-46= 1000 PID Display at 0%	1~9999*1	1*2	1000	

*1. These parameters are available for 74.03 and later software version only.
*2. The displayed "Setting Unit" and "Setting Range" can be changed through parameter Cn-28 and Sn-70.

(1) Acceleration Time 1 (Bn-01)
(2) Deceleration Time 1 (Bn-02)
(3) Acceleration Time 2 (Bn-03)
(4) Deceleration Time 2 (Bn-04)

- Set individual Acceleration/Deceleration times
- Acceleration time: the time required to go from 0% to 100% of the maximum output frequency
- Deceleration time: the time required to go from 100% to 0% of the maximum output frequency
- If the acceleration/deceleration time sectors 1 and 2 are input via the multi-function inputs terminal ⑤~⑧, the acceleration/Deceleration can be switched between 2 sectors even in the running status.

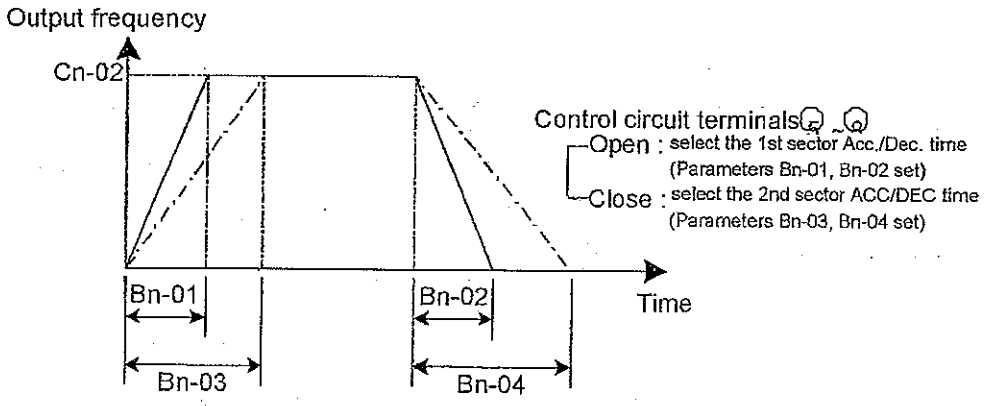


Fig. 9. Acceleration and Deceleration time

Note :

1. To set the S-curve characteristics function, please refer to the description of Cn-41~Cn-44.
2. The S-curve characteristic times can be set respectively for beginning-accel. end-accel., beginning-decel., and end-decel. through the parameters setting of Cn-41～Cn-44.

(5) Analog Frequency Command Gain (Voltage) (Bn-05)
(6) Analog Frequency Command Bias (Voltage) (Bn-06)
(7) Analog Frequency Command Gain (Current) (Bn-07)
(8) Analog Frequency Command Bias (Current) (Bn-08)
(9) Multi-function Analog Input Gain (Bn-09)
(10) Multi-function Analog Input Bias (Bn-10)

- For every different analog frequency command (voltage or current) and multi-function analog inputs, their corresponding gain and bias should be specified respectively.

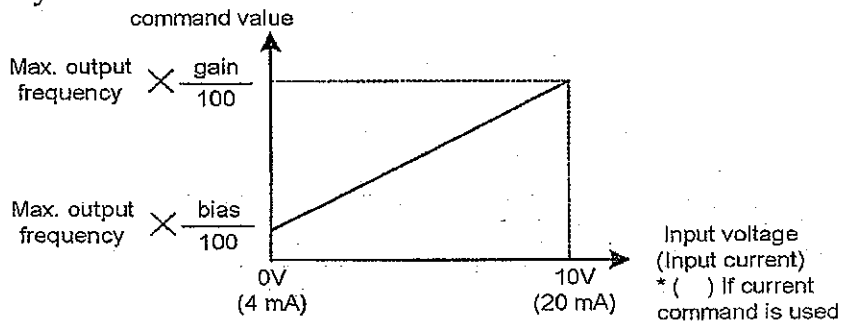


Fig. 10. Analog input gain and bias

(11) Auto Torque Boost Gain (Bn-11)

- The inverter can increase the output torque to compensate the load increase automatically through the auto torque boost function. Then the output voltage will increase. As a result, the fault trip cases can be decreased. The energy efficiency is also improved. In the case that the wiring distance between the inverter and the motor is too long (e.g. more than 100m), the motor torque is a little short because of voltage drop. Increase the value of Bn-11 gradually and make sure the current will not increase too much. Normally, no adjustment is required.

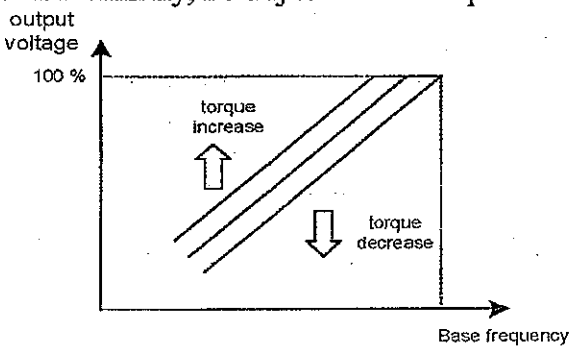


Fig. 11. Adjust the auto torque boost gain Bn-11 to increase the output torque.

- If the driven motor capacity is less than the inverter capacity (Max. applicable motor capacity), raise the setting.
- If the motor generates excessive oscillation, lower the setting.

(12) Monitor 1 (Bn-12)

(13) Monitor 2 (Bn-13)

- In the DRIVE mode, 2 inverter input/output statuses can be monitored at the same time. The specified items can be set through the setting of Bn-12 and Bn-13. For more details, refer to Table 8.
- Example:

(1) Bn-12= 02 Display
Bn-13= 01

O/P Freq.	15.00Hz
Freq.Cmd.	15.00Hz

(2) Bn-12= 03 Display
Bn-13= 05

O/P I	21.0A
DC Volt	311V

(3) Bn-12= 11 Display
Bn-13= 12

I/P Term.	00101010
O/P Term.	00010010

Note : While monitoring, use the ⋀ or ⋁ key to show the next lower-row displayed. But the setting of Bn-12 and Bn-13 does not change.

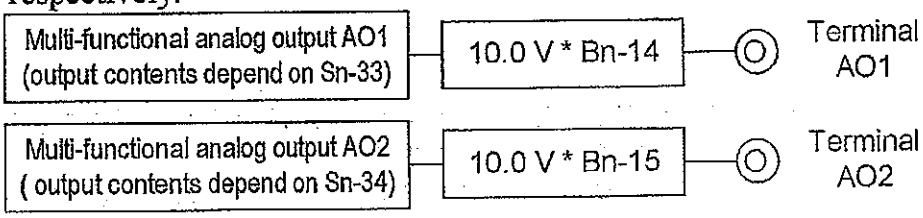
Table 8 Setting of Monitoring contents

Setting	Monitoring contents	Setting	Monitoring contents
Bn-12= 01	Freq.Cmd.	Bn-13= 01	Freq.Cmd.
Bn-12= 02	O/P Freq.	Bn-13= 02	O/P Freq.
Bn-12= 03	O/P I	Bn-13= 03	O/P I
Bn-12= 04	O/P V	Bn-13= 04	O/P V
Bn-12= 05	DC Volt	Bn-13= 05	DC Volt
Bn-12= 06	Term. VIN	Bn-13= 06	Term. VIN
Bn-12= 07	Term. AIN	Bn-13= 07	Term. AIN
Bn-12= 08	Term. AUX	Bn-13= 08	Term. AUX
Bn-12= 09	~ Output(AO1)	Bn-13= 09	~ Output(AO1)
Bn-12= 10	~ Output(AO2)	Bn-13= 10	~ Output(AO1)
Bn-12= 11	I/P Term	Bn-13= 11	I/P Term
Bn-12= 12	O/P Term	Bn-13= 12	O/P Term
Bn-12= 13	Sp. FBK	Bn-13= 13	Sp. FBK
Bn-12= 14	Sp. Compen.	Bn-13= 14	Sp. Compen.
Bn-12= 15	PID I/P	Bn-13= 15	PID I/P
Bn-12= 16	PID O/P(Un-16)	Bn-13= 16	PID O/P(Un-16)
Bn-12= 17	PID O/P(Un-17)	Bn-13= 17	PID O/P(Un-17)
Bn-12= 18	Motor Sp.	Bn-13= 18	Motor Sp.

(14) Multi-function Analog Output AO1 Gain (Bn-14)

(15) Multi-function Analog Output AO1 Gain (Bn-15)

- Multi-function analog output AO1 and AO2 can be set for their individual voltage level respectively.



(16) PID Detection Gain (Bn-16)

(17) PID Proportional Gain (Bn-17)

(18) PID Integral Time (Bn-18)

(19) PID Differential Time (Bn-19)

(20) PID Bias (Bn-20)

- The PID control function is a control system that matches a feedback value (i.e., a detected value) to the set target value. Combining the proportional (P), integral (I) and derivative (D) control make the control possible to achieve required response with the constant setting and tuning procedure of proportional gain Bn-17, integral time Bn-18 and derivative time Bn-19.
- See the appendix on page App.1 for "PID Parameter Setting".
- Fig. 12 is a Block diagram of the inverter's internal PID control.
- If both the target value and feedback value are set to 0, adjust the inverter output frequency to zero.

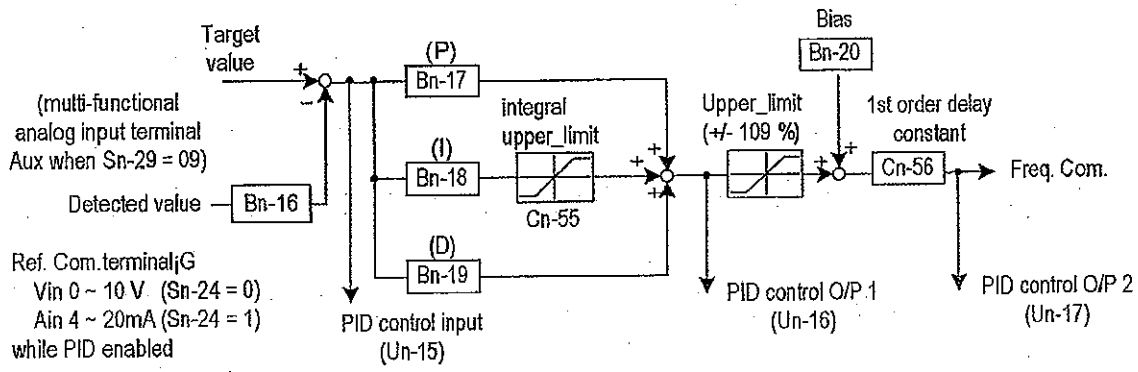


Fig. 12. Block diagram for PID control in inverter
(For the version before 30.17)

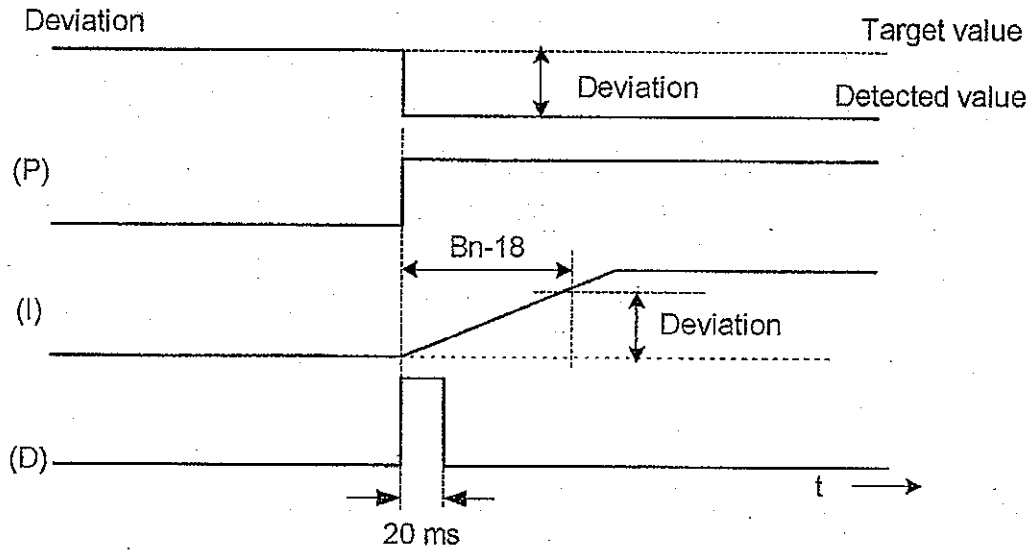


Fig. 13. Response of PID control for step-shape (deviation) input

- Deviation = Target value − Detected value × Bn-16.
- P's control output = deviation × Bn-17.
- I's control output will increase with time and the output will be equal to the deviation after time specified by parameter Bn-18
  The parameter Cn-55 will prevent the calculated value of the integral control (with the integral time Bn-18) in the PID control from exceeding the fixed amount.

□D's control output = difference × ($\frac{\text{Bn-19}}{\text{5 m sec}}$)

Note: The enable PID function, parameter Sn-64 must be set to 1

30.18 newly revised version inverter develops 8 PID control modes as following description:

0: Unavailable

1: (Positive characteristic) input of differential controller is balance of feedback value and frequency value.

2: (Positive characteristic) input of differential controller is feedback value

3: (Positive characteristic) refers to frequency and PID control output. Input of differential controller is balance of feedback value and frequency value.

4: (Positive characteristic) refers to frequency and PID control output. Input of differential controller is feedback value

5: (Negative characteristic) input of differential controller is balance of feedback value and frequency value.

6: (Negative characteristic) input of differential controller is feedback value

7: (Negative characteristic) refers to frequency and PID control output. Input of differential controller is balance of feedback value and frequency value.

8: (Negative characteristic) refers to frequency and PID control output. Input of differential controller is feedback value.

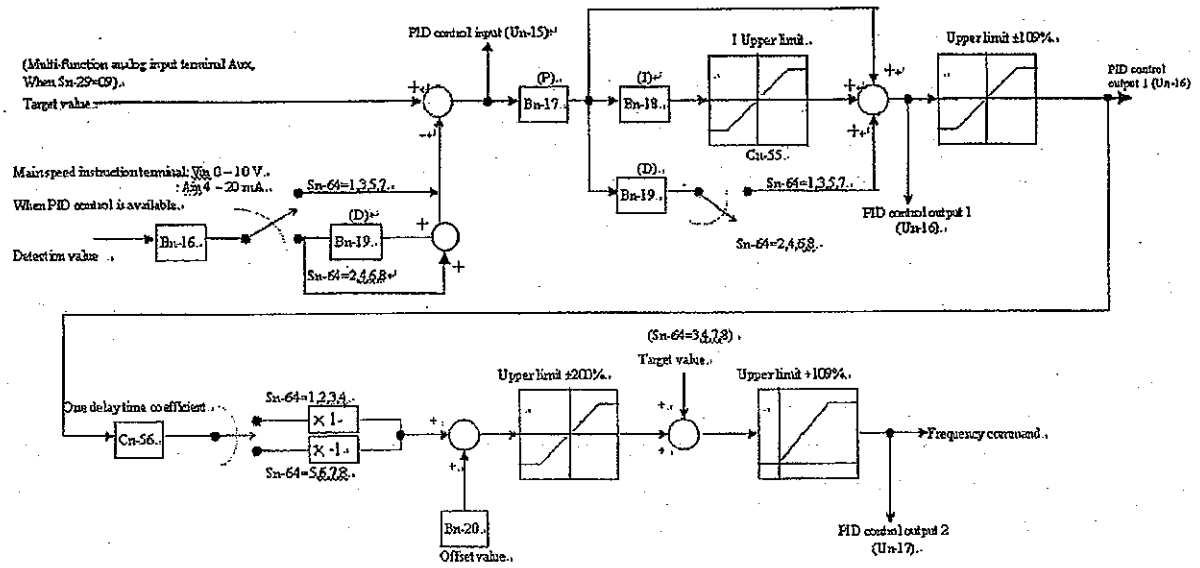


Fig. 14. PID Control Block diagram (After Version 30.18)

(21) Time Setting in Auto_Run Mode (Bn-21~Bn-36)

- In Auto_Run mode, the time setting for individual step is described on "(Sn-44~60) auto run mode selection and enable".

(22) Timer ON_Delay Time (Bn-37)

(23) Timer OFF_Delay Time (Bn-38)

- The timer function is enabled when the timer function input setting (Sn-25~28=19) and its timer function output setting (Sn-30~32=21) are set for the multi-function input and output respectively.
- These inputs and outputs serve as general-purpose I/O. Setting ON/OFF delay time (Bn-37/38) for the timer can prevent chattering of sensors, switches and so on.
- When the timer function input ON times is longer than the value set for Bn-37, the timer function output turns ON.
- When the timer function input OFF time is longer than the value set for Bn-38, the timer function output turns OFF. An example is shown below.

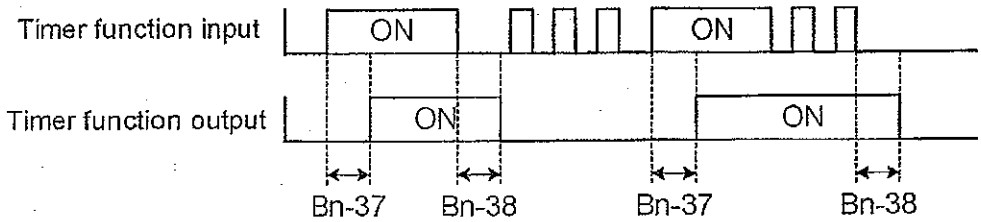


Fig. 15. An operation example of timer function

(24) Energy Saving Gain (Bn-39)

- Input the energy saving command while a light load causes the inverter output voltage to be reduced and save energy. Set this value as a percentage of the V/F pattern. The setting range is 50~150%. The factory setting is 100% and the energy saving function is disabled. If the energy saving gain Bn-39 is not 100%, the energy saving function is enabled.
- In energy saving mode (Bn-39≠100), the output voltage will automatically decrease and be proportional to energy saving gain Bn-39. The Bn-39 setting should not be small so that the motor will not stall.
- The energy saving function is disabled in the PID close-loop control and during acceleration and deceleration.

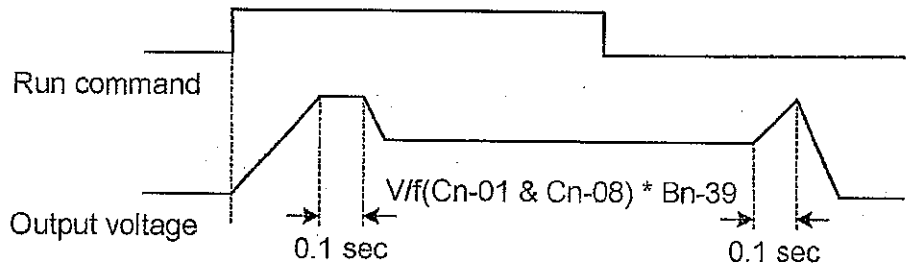


Fig. 16. Time chart for energy-saving operation

(25) Monitor 3 (Bn-40)

- The parameter sets immediate display content as power on.
- When Bn-40 = 00, inverter power on, the first line will display frequency command, while the second line will display characters "TECO" as following diagram:

Freq . Cmd. : 15.00 Hz
TECO

- When Bn-40≠00, that is Bn-40=01~18, LCD will display the set monitor items while inverter power on. The first line display content is determined by Bn-12. The second line is determined by Bn-40 as following diagram:

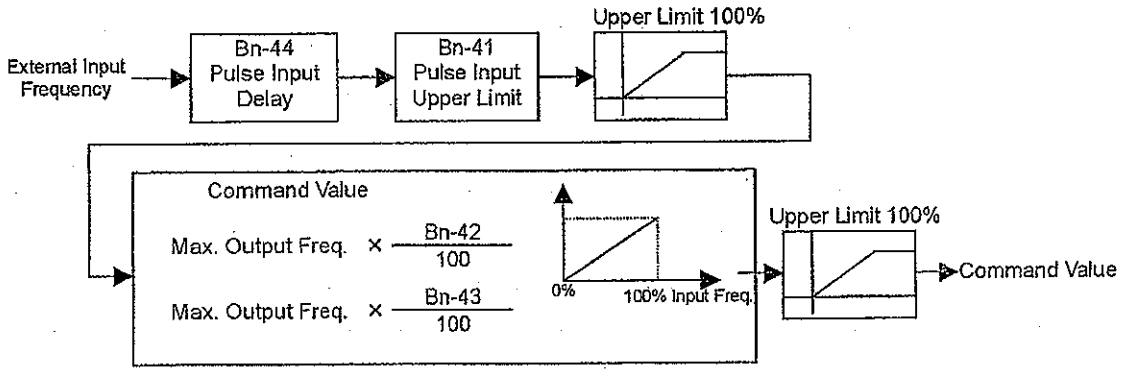
Set Bn-12=01
Bn-40=02

Freq . Cmd. : 15.00 Hz
O / P Freq.: 00.00 Hz

- Bn-40=01~18 parameter description is same with Bn-12, Bn-13. Please refer to Table 1, Monitor item set.

(26) Pulse Input setting (Bn-41~Bn-44)

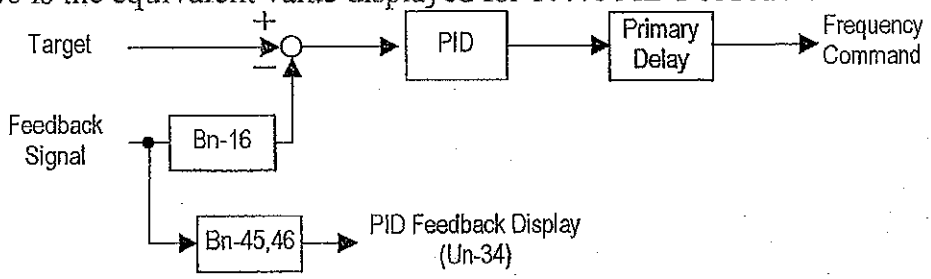
- Setting Sn-05=3 before starting Pulse Input function. Please refer to Sn-05.
- Please refer to the following figure:



(27) PID Feedback Display at 0% (Bn-45)

(28) PID Feedback Display at 100% (Bn-46)

- These parameters are available for 74.03 and later software version only.
- The PID feedback can be input from control terminal VIN (0~10V) or AIN (4-20mA).
- The PID feedback value can be monitored by the monitoring parameter Un-34. The display content can be set by Cn-28, Sn-70, Bn-45 and Bn-46.
  Cn-28 sets the decimal point position of Un-34.
  Sn-70 sets the unit of Un-34.
  Bn-45 is the equivalent value displayed for 0% PID Feedback.
  Bn-46 is the equivalent value displayed for 100% PID Feedback.



- The decimal point position and the unit of Bn-45, Bn-46 can be set by Cn-28 and Sn-70. It is necessary to set the value of Cn-28 and Sn-70 before Bn-45 and Bn-46 are set.
- Ex PID feedback signal is pressure signal. 0% for 5.0 PSI, and 100% for 100.0 PSI.

Set	Sn-70 = 3	(unit as PSI)
	Cn-28 = 10000	(1 decimal)
	Bn-45 = 005.0PSI	(display at 0%)
	Bn-46 = 100.0PSI	(display at 100%)

3.3 Control Parameters Cn-□□

Function	Parameter No.	Name	LCD display (English)	Setting range	Setting Unit	Factory Setting	Ref. Page
V/F Pattern Setting	Cn-01	Input Voltage	Cn-01= 230.0V Input Voltage	150.0～255.0V*2	0.1V	230.0V*1	3-15
	Cn-02	Max. Output Frequency	Cn-02= 060.0Hz Max. O/P Freq.	50.0～400.0Hz	0.1Hz	60.0Hz	3-15
	Cn-03	Max. Output Voltage	Cn-03= 230.0Hz Max. Voltage	0.1～255.0V*2	0.1V	230.0V*1	
	Cn-04	Max. Voltage Frequency	Cn-04= 060.0Hz Max. Volt Frequency	0.1～400.0Hz	0.1Hz	60.0Hz	
	Cn-05	Middle Output Frequency	Cn-05= 003.0Hz Middle O/P Freq.	0.1～400.0Hz	0.1Hz	3.0Hz	
	Cn-06	Voltage At Middle Output Frequency	Cn-06= 014.9V Middle Voltage	0.1～255.0V*2	0.1V	15.5V*1	
	Cn-07	Min Output Frequency	Cn-07= 001.5Hz Min O/P Freq.	0.1～400.0Hz	0.1Hz	1.5Hz	
	Cn-08	Voltage At Min. Output Frequency	Cn-08= 007.9V Min. Voltage	0.1～255.0V*2	0.1V	8.2V*1	
Motor Parameter	Cn-09	Motor Rated Current	Cn-09= 0003.3A Motor Rated I	*3	0.1A	3.3A*4	3-15
	Cn-10	No Load Current Of Motor	Cn-10= 30% Motor No-Load I	0 ~ 99%	1%	30%	3-16
	Cn-11	Rated Slip Of Motor	Cn-11= 0.0% Motor Rated Slip	0 ~ 9.9%	0.10%	0.00%	
	Cn-12	Line-To-Line Resistance Of Motor	Cn-12= 05.732Ω Motor Line R	0～65.535Ω	0.001Ω	5.732*4	3-17
	Cn-13	Torque Compensation Of Core Loss	Cn-13= 0064W Core Loss	0～65535W	1W	64*4	
DC Braking Function	Cn-14	DC Injection Braking Starting Frequency	Cn-14= 01.5Hz C Braking Start F	0.1～10.0 Hz	0.1Hz	1.5Hz	3-17
	Cn-15	DC Braking Current	Cn-15= 050% DC Braking Current	0 ~ 100%	1%	50%	
	Cn-16	DC Injection Braking Time At Stop	Cn-16= 00.5s DC Braking Stop Time	0.0～25.5s	0.1s	0.5s	
	Cn-17	DC Injection Braking Time At Start	Cn-17= 00.0s DC Braking Start Time	0.0～25.5s	0.1s	0.0s	
Frequency Limit	Cn-18	Frequency Command Upper Bound	Cn-18= 100% Freq.Cmd. Up Bound	0 ~ 109%	1%	100%	3-18
	Cn-19	Frequency Command Lower Bound	Cn-19= 000% Freq. Cmd. Low Bound	0 ~ 109%	1%	0%	
Frequency Jump	Cn-20	Frequency Jump Point 1	Cn-20= 000.0Hz Freq. Jump 1	0.0～400.0Hz	0.1Hz	0.0Hz	3-18
	Cn-21	Frequency Jump Point 2	Cn-21= 000.0Hz Freq. Jump 2	0.0～400.0Hz	0.1Hz	0.0Hz	
	Cn-22	Frequency Jump Point 3	Cn-22= 000.0Hz Freq. Jump 3	0.0～400.0Hz	0.1Hz	0.0Hz	
	Cn-23	Jump Frequency Width	Cn-23= 01.0Hz Freq. Jump Width	0.0～25.5Hz	0.1Hz	1.0Hz	

Function	Parameter No.	Name	LCD display (English)	Setting range	Setting Unit	Factory Setting	Ref. Page
Retry Function	Cn-24	Number of Auto Restart Attempt	Cn-24= 00 Retry Times	0～10	1	0	3-19
Stall Prevention	Cn-25	Stall Prevention During Acceleration	Cn-25= 170% Acc. Stall	30 ~ 200%	1%	170%	3-20
	Cn-26	Stall Prevention During Running	Cn-26= 160% Run Stall	30 ~ 200%	1%	160%	
Comm. Fault detection	Cn-27	Communication Fault Detection Time	Cn-27=01.0s Comm. Flt Det. Time	0.1~25.5s	0.1s	1s	3-20
Display Unit	Cn-28	LCD Digital Operator Display Unit	Cn-28= 00000 Operator Disp. Unit	0-39999	1	0	3-21
Frequency Agree Detection	Cn-29	Freq. Agree Detection Level During Accel.	Cn-29= 000.0Hz Acc. Freq. Det.Level	0.0～400.0Hz	0.1Hz	0.0Hz	3-22
	Cn-30	Freq. Agree Detection Level During Decel.	Cn-30= 000.0Hz Dec. Freq. Det. Level	0.0～400.0Hz	0.1Hz	0.0Hz	
	Cn-31	Frequency Agree Detection Width	Cn-31= 02.0Hz F Agree Det. Width	0.1～25.5Hz	0.1Hz	2.0Hz	
Torque Detection 1	Cn-32	Torque Detection Level 1	Cn-32= 160% Tq. Det. Level 1	0~200%	1%	160%	3-23
	Cn-33	Torque Detection Time 1	Cn-33= 00.1s Tq. Det. Time 1	0.0~25.5s	0.1s	0.1s	
Carrier Frequency	Cn-34	Carrier frequency setting	Cn-34= 6 Carry_Freq Setting	1～6	1	6	3-24
Speed Search Control	Cn-35	Speed Search Detection Level	Cn-35= 150% Sp-Search Level	0 ~ 200%	1%	150%	3-24
	Cn-36	Speed Search Time	Cn-36= 02.0s Sp-Search Time	0.1～25.5s	0.1s	2.0s	
	Cn-37	Min. Baseblock Time	Cn-37= 0.5s Min. B.B. Time	0.5～5.0s	0.1s	0.5s	
	Cn-38	V/F Curve in Speed Search	Cn-38= 100 Sp-search V/F Gain	10 ~ 100%	1%	100%	
Low Voltage Detection	Cn-39	Low Voltage Alarm Detection Level	Cn-39= 200V Low Volt. Det. Level	150～210V	1V	200V *1	3-26
Slip Comp.	Cn-40	Slip Compensation Primary Delay Time	Cn-40= 02.0s Slip Filter	0.0～25.5s	0.1s	2.0s	3-26
S-curve time	Cn-41	S-curve Characteristic Time at Accel. Start	Cn-41= 0.0s S1 Curve Time	0.0～1.0s	0.1s	0.0s	3-26
	Cn-42	S-curve Characteristic Time at Accel. End	Cn-42= 0.0s S2 Curve Time	0.0～1.0s	0.1s	0.0s	
	Cn-43	S-curve Characteristic Time at Decel. start	Cn-43= 0.0s S3 Curve Time	0.0～1.0s	0.1s	0.0s	
	Cn-44	S-curve Characteristic Time at Decel. end	Cn-44= 0.0s S4 Curve Time	0.0～1.0s	0.1s	0.0s	

	Parameter No.	Name	LCD display (English)	Setting range	Setting Unit	Factory Setting	Ref. Page
Speed feedback control	Cn-45	PG Parameter	Cn-45= 0000.0 PG Parameter	0.0~3000.0P/R	0.1P/R	0.0P/R	3-27
	Cn-46	Pole no. of Motor	Cn-46= 04P Motor Pole	2~32P	2P	4P	
	Cn-47	ASR Proportional Gain 1	Cn-47= 0.00 ASR Gain 1	0.00~2.55	0.01	0	
	Cn-48	ASR Integral Gain 1	Cn-48= 01.0s ASR Intgl. Time 1	0.1~10.0S	0.1s	1.0s	
	Cn-49	ASR Proportional Gain 2	Cn-49= 0.02 ASR Gain 2	0.00~2.55	0.01	0.02	
	Cn-50	ASR Integral Gain 2	Cn-50= 01.0s ASR Intgl. Time 2	0.1~10.0S	0.1s	1.0s	
	Cn-51	ASR Upper Bound	Cn-51= 05.0% ASR Up Bound	0.1 ~ 10.0%	0.10%	5.00%	3-28
	Cn-52	ASR Lower Bound	Cn-52= 00.1% ASR Low Bound	0.1 ~ 10.0%	0.10%	0.10%	
	Cn-53	Excessive Speed Deviation Detection Level	Cn-53= 10% Sp.Deviat. Det.Level	1 ~ 50%	1%	10%	
	Cn-54	Overspeed Detection Level	Cn-54= 110% Over Sp.Det. Level	1 ~ 120%	1%	110%	
PID Control	Cn-55	PID Integral Upper Bound	Cn-55= 100% PID I-Upper	0 ~ 109%	1%	100%	3-28
	Cn-56	PID Primary Delay Time Constant	Cn-56= 0.0s PID Filter	0.0~2.5s	0.1s	0.0s	
Sensorless Vector Control	Cn-57	Motor Line-to-Line Resistance (R1)	Cn-57= 02.233Ω Mtr LINE_R	0.001~60.000Ω	0.001Ω	2.233Ω*4	3-28
	Cn-58	Motor Rotor Equivalent Resistance (R2)	Cn-58= 01.968Ω Mtr ROTOR_R	0.001~60.000Ω	0.001Ω	1.968Ω*4	3-29
	Cn-59	Motor Leakage Inductance (Ls)	Cn-59= 9.6mH Mtr LEAKAGE_X	0.01~200.00mH	0.01mH	9.6mH *4	
	Cn-60	Motor Mutual Inductance (Lm)	Cn-60= 149.7mH Mtr MUTUAL_X	0.1~6553.5mH	0.1mH	149.7mH*4	
	Cn-61	Slip Compensation Gain	Cn-61= 1.00 SLIP GAIN	0.00~2.55	0.01	1	
Torque Detection 2	Cn-62*5	Torque Detection Level 2	Cn-62= 160% Tq. Det. Level 1	0~200%	1%	160%	3-23
	Cn-63*5	Torque Detection Time 2	Cn-63= 00.1s Tq. Det. Time 1	0.0~25.5s	0.1s	0.1s	

*1 These are for a 230V class inverter. Value(*1) for a 460V class inverter is double.

*2 These are for a 230V class inverter. Value(*2) for a 460V class inverter is double.

*3 The setting range is 10% ~200% of the inverter rated current.

*4 The factory setting values will vary based upon the inverter capacity selection (Sn-01) value. In this case, the setting is for 4-pole, 230V, 60Hz, 1Hp TECO standard induction motors.

*5. These parameters are available for 74.03 and later software version only.

(1) Input Voltage Setting (Cn-01)

- Set inverter voltage to match power supply voltage at input side (e.g. : 200V/230V, 380V/415V/440V/460V)

(2) V/F Curve Parameter Settings (Cn-02～Cn-08)

- The V/F curve can be set to either one of the preset curves (setting Sn-02=0～14) or a customer user-set curve (setting Sn-02=15).
- Setting Cn-02～Cn-08 can be set by the user when Sn-02 has been set to "15". The user-defined V/F curve can be specified through the settings of Cn-02～Cn-08 as shown in Fig. 17. The factory setting is straight line for the V/F curve. (Cn-05=Cn-07, Cn-06 is not used) as shown below (230V/60Hz case).

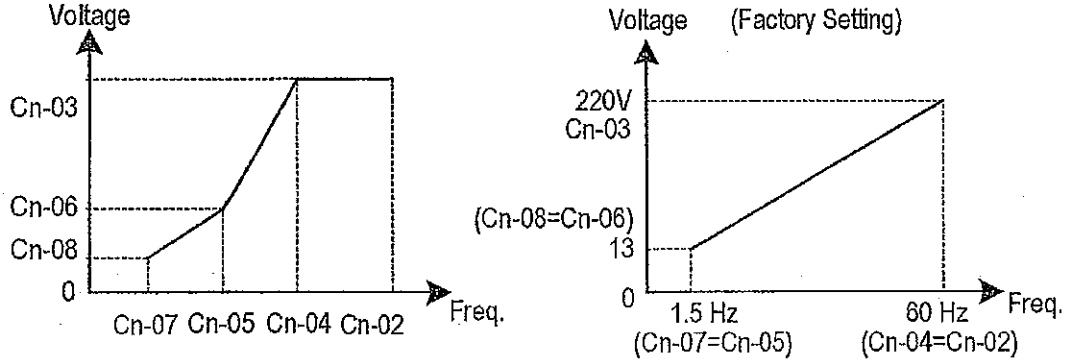


Fig. 17. User-defined V/F curve

- In low speed operation (<3Hz), a larger torque can be generated by increasing the slope of V/F curve. However, the motor will be hot due to over-excitation. At the same time the inverter will be more inclined to fault. Based upon the applied load, properly adjust the V/F curve according to the magnitude of monitored current into the motor.
- The four frequency settings must satisfy the following relationship, otherwise an error message "V/F Curve Invalid" will display.

(a) Max. output freq. ≧ Max. voltage freq. > Mid. Output freq. ≧ Min. output freq.
(Cn-02) (Cn-04) (Cn-05) (Cn-07)

(b) Max. output volt. ≧ Mid. output volt. > Min. output voltage
(Cn-03) (Cn-06) (Cn-08)

- If Mid. Output frequency (Cn-05) = Min. output frequency (Cn-07), the setting (Cn-06) is not effective.

(3) Motor Rated Current (Cn-09)

- Electronic overload thermal reference current
- The factory setting depends upon the capacity type of inverter (Sn-01).
- The setting range is 10%～200% of the inverter rated output current.
- Set the rated current shown on the motor name plate if not using the TECO 4-pole motor.

(4) Motor No-Load Current (Cn-10)

- This setting is used as a reference value for torque compensation function.
- The setting range is 0～99% of the inverter rated current Cn-09 (100%).
- The slip compensation is enabled when the output current is greater than motor no-load current (Cn-10). The output frequency will shift from f1 to f2 (>f1) for the positive change of load torque. (See Fig. 18)

$$\square\text{Slip compensation} = \frac{\text{Motor rated slip (Cn-11)} \times (\text{Output current} - \text{Motor no-load current(Cn-10)})}{\text{Motor rated current (Cn-09)} - \text{Motor no-load current (Cn-10)}}$$

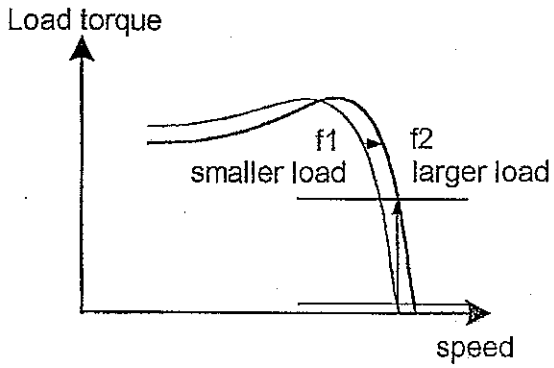


Fig. 18. Output frequency with slip compensation.

(5) Motor Rated Slip (Cn-11)

- This setting is used as a reference value for torque compensation function. See Fig. 17. The setting is 0.0~9.9% as a percentage of motor Max. voltage frequency (Cn-04) as 100%.
- The setting is shown in Fig. 19 in the constant torque and constant output range. If setting Cn-11 is zero, no slip compensation is used.
- There is no slip compensation in the cases when the frequency command is less than the Min. output frequency or during regeneration.

$$\square\text{Motor rated slip (Cn-11)} = \frac{\text{Motor rated freq. (Hz)} \times (\text{Rated speed(RPM)} - \text{Motor No. of poles})}{\text{Max-voltage freq (Cn-04)} \times 120} \times 100\%$$

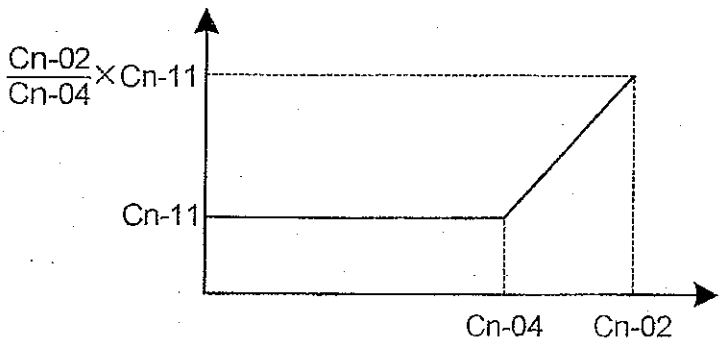


Fig. 19. Slip compensation limit

(6) Motor Line-to-Line Resistance (Cn-12)
(7) Motor Iron-Core Loss (Cn-13)

- It is for torque compensation function. The default setting depends upon the inverter capacity (Sn-01). Normally, the setting does not need to be altered. See Table 10~11 on page 3-39.

(8) DC Injection Braking Starting Frequency (Cn-14)
(9) DC Injection Braking Current (Cn-15)
(10) DC Injection Braking Time at Stop (Cn-16)
(11) DC Injection Braking Time at Start (Cn-17)

- The DC injection braking function decelerates by applying a DC current to the motor. This happens in the 2 cases:

a. DC injection braking time at start: It is effective for temporarily stopping and then restarting, without regeneration, a motor coasting by inertia.
b. DC injection braking time at stop: It is used to prevent coasting by inertia when the motor is not completely stopped by normal deceleration when there is a large load. Lengthening the DC injection braking time (Cn-16) or increasing the DC injection braking current (Cn-15) can shorten the stopping time.

- For the DC injection braking current (Cn-15), set the value for the current that is output at the time of DC injection braking. DC injection braking current is set as a percentage of inverter rated output current, with the inverter rated output current taken as 100%.
- For the DC injection braking time at start (Cn-17), set the DC injection braking operating time when the motor is started.
- For the DC injection braking starting frequency (Cn-14), set the frequency for beginning DC injection braking for deceleration. If the excitation level is less than the Min. output frequency (Cn-07), the DC injection braking will begin from Min. output frequency.
- If the DC injection braking time at start (Cn-17) is 0.0, the motor starts from the Min. output frequency and no DC injection braking are enabled.
- If the DC injection braking time at stop (Cn-16) is 0.0, no DC injection braking is enabled. In this case, the inverter output will be blocked off when the output frequency is less than the DC injection braking at start frequency (Cn-14).

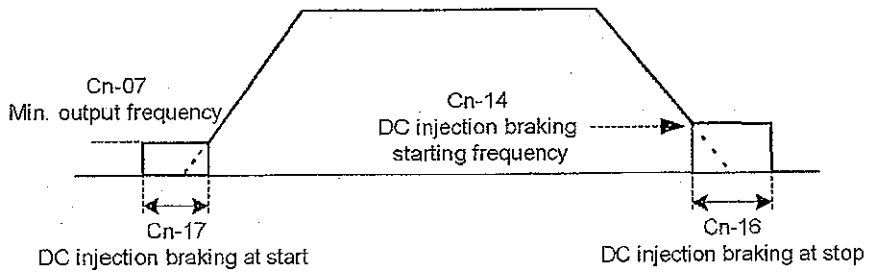


Fig. 20. DC injection braking time chart

(12) Frequency Command Upper Bound (Cn-18)

(13) Frequency Command Lower Bound (Cn-19)

- The upper and lower bounds of the frequency command are set as a percentage of the Max. output frequency (Cn-02 as 100%), in increments of 1%.
- The relationship Cn-18 > Cn-19 must be abided by. If not, an error message "Freq. Limit Setting Error" may occur.
- When the frequency command is zero and a run command is input, the motor operates at the frequency command lower bound (Cn-19). The motor will not operate, however, if the lower limit is set lower than the Min. output frequency (Cn-07).

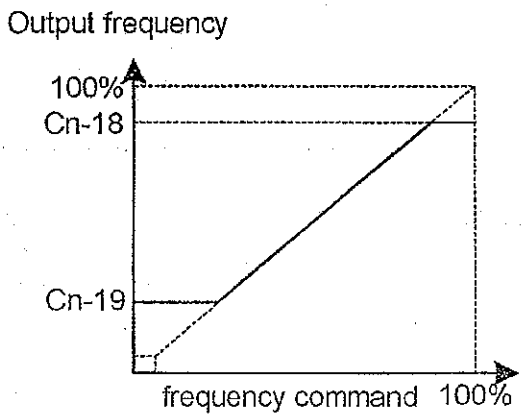


Fig. 21. Upper and lower bounds of the frequency command

(14) Frequency Jump Point 1 (Cn-20)
(15) Frequency Jump Point 2 (Cn-21)
(16) Frequency Jump Point 3 (Cn-22)
(17) Jump Frequency Width (Cn-23)

- These settings allow the "jumping" of certain frequencies within the inverter's output frequency range so that the motor can operate without resonant oscillations caused by some machine systems.

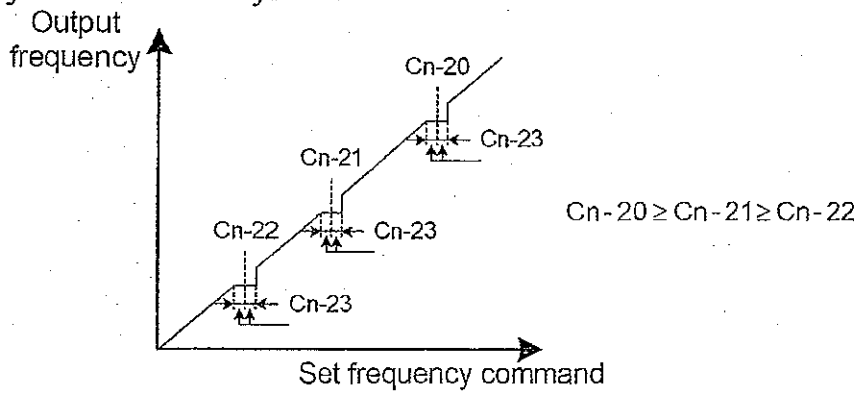


Fig. 22. setting jump frequencies

- Operation is prohibited within the jump frequency range, but changes during acceleration and deceleration are smooth with no jump. To disable this function, set the jump frequency 1～3 (Cn-20～Cn-22) to 0.0Hz.
- For the jump frequency 1～3 (Cn-20～Cn-22), set the center frequency to be jumped.
- Be sure to set the jump so that Cn-20 ≥ Cn-21 ≥ Cn-22. If not, a message "Jump frequency setting error" is displayed. For Cn-23, set the jump frequency bandwidth. If Cn-23 is set as 0.0Hz, the jump frequency function is disabled.

(18) Number of Auto Restart Attempt (Cn-24)

- The fault restart function will restart the inverter even when an internal fault occurs during inverter operation. Use this function only when continuing operation is more important than possibly damaging the inverter.
- The fault restart function is effective with the following faults. With other faults, the protective operations will engage immediately without attempting to restart operation.

  • Over-current • Ground fault • Main circuit over-voltage

- The fault restart count will automatically increase upon the restart activated and will be cleared in the following cases:

a. When the operation is normal for 10 minutes after a fault restart is performed.

b. When the fault-reset input is received after the protection operation has been activated and the fault confirmed. (e.g., by pressing RESET or enable Fault reset terminal ③)

c. When the power is turned off and on again.

- When one of the multi-function output terminals (RA-RB-RC or R1A-R1B-R1C, DO1, DO2 or R2A-R2C) is set to restart enabled, the output will be ON while the fault restart function is in progress. See page 63 for the setting of (Sn-30~Sn-32).

(19) Stall Prevention Level During Acceleration (Cn-25)

(20) Stall Prevention Level During Running (Cn-26)

- A stall occurs if the rotor can not keep up with the rotating electromagnetic field in the motor stator side when a large load is applied or a sudden acceleration or deceleration is performed. In this case, the inverter should automatically adjust the output frequency to prevent stall.
- The stall prevention function can be set independently for accelerating and running.
- Stall Prevention During Acceleration: See Fig.23. Stop acceleration if Cn-25 setting is exceeded. Accelerate again when the current recovers.
- Stall Prevention During running : See Fig.24. Deceleration is started if the run stall prevention level Cn-26 is exceeded, especially when an impact load is applied suddenly. Accelerate again when the current level is lower than Cn-26.

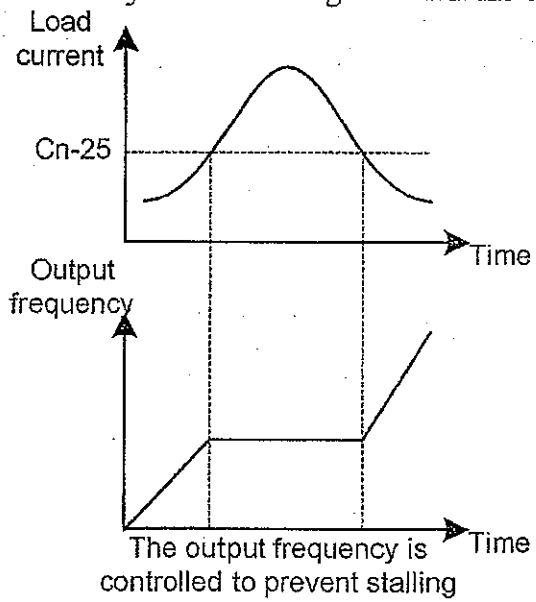


Fig. 23 Acceleration stall prevention function

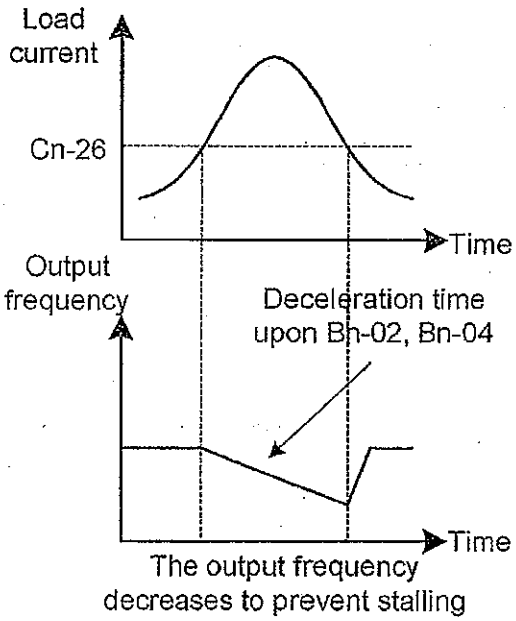


Fig. 24 Run stall prevention function

- Set the parameters Cn-25 and Cn-26 as a percentage of inverter rated current (100% corresponds to inverter rated current).
- See page 3-48, 3-49 for stall prevention function selection.

(21) Communication Fault Detection Time (Cn-27)

- Please refer to "MODBUS/PROFIBUS Application Manual".

(22) LCD Digital Operator Display Unit (Cn-28)

- It sets the units to be displayed for the frequency command and frequency monitoring. and sets the decimal points of PID feedback display (Un-34), PID feedback display at 0% and 100% (Bn-45, 46) as described below:

Table 9 LCD digital Operator Display unit

Cn-28	Setting / Reading Content	
	Frequency command/monitoring	PID Feedback
0	Units of 0.01 Hz	Displayed as XXXX Unit specified by Sn-70
1	Units of 0.01%	
2 to 39	Set in the units of r / min (0 to 39999). r / min = 120 x frequency reference (Hz) / Cn-28 (Set the number of motor poles in Cn-28, only even data is allowed)	
40 to 39999	The position of decimal point is set by the value of the 5th digit of Cn-20. 5th digit = 0: Displayed as XXXX 5th digit = 1: Displayed as XXX.X 5th digit = 2: Displayed as XX.XX 5th digit = 3: Displayed as X.XXX The 1st digit to 4th digits of Cn-28 set the value of 100% frequency.	• 5th digit = 0: Displayed as XXXX • 5th digit = 1: Displayed as XXX.X • 5th digit = 2: Displayed as XX.XX • 5th digit = 3: displayed as X.XXX The 1st digit to 4th digits of Cn-28 are not used. Unit specified by Sn-70

- Example 1:

  When the set value of 100% speed is 200.0, Cn-28 = 12000 is set.

  60% speed is displayed as 120.0 at Cn-28 = 12000.

- Example 2:

  When the set value of 100% speed is 65.00, Cn-28 = 26500 is set.

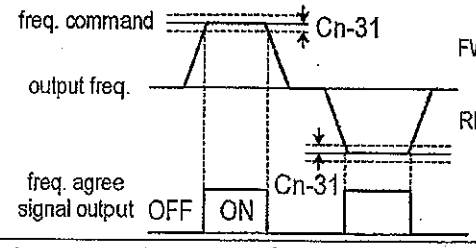
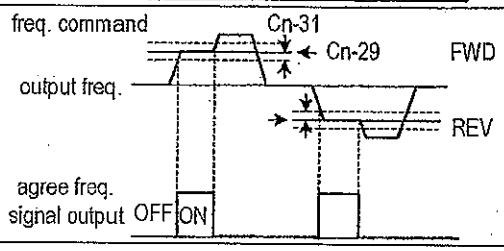
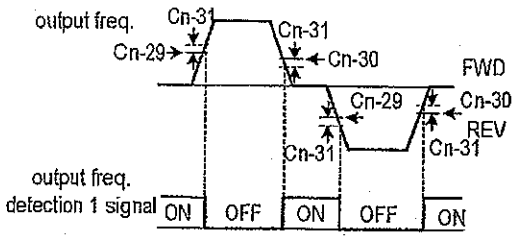
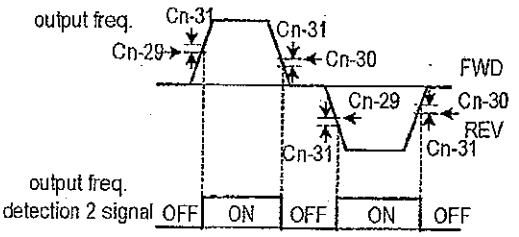
  60% speed is displayed as 39.00 at Cn-28 = 26500.

(23) Frequency Agree Detection Level During Acceleration (Cn-29)

(24) Frequency Agree Detection Level During Deceleration (Cn-30)

(25) Frequency Agree Detection Width (Cn-31)

- Frequency detection function: Set the multi-function output terminals (control circuit terminals RA-RB-RC or R1A-R1B-R1C, DO1, DO2 or R2A-R2C) to output the desired Frequency Agree signal, Setting Frequency Agree and Output Frequency Detection level (through proper setting of Sn-30 ~ Sn-32).
- The time chart for Frequency Detection operation is described as follows:

Function	Frequency Detection Operation	Description
Frequency Agree		• When output freq. is within freq. command +/- freq. Detection width (Cn-31), frequency agree output is "ON". • Set Sn-30~Sn-32 to be "02" for the setting of frequency agree output.
Setting Frequency Agree		• After acceleration, the output freq. reaches freq. Agree detection level during acceleration (Cn-29) and within freq. Agree detection width (Cn-31), agreed freq. output is "ON". • Set Sn-30~Sn-32 to be "03".
Output Frequency Detection 1		• During acceleration, the output freq. is less than freq. agree detection level during acceleration (Cn-29), output freq. Detection 1 is "ON". • During deceleration, the output freq. is less than freq. agree detection level during deceleration (Cn-30), output freq. Detection 1 is "ON". • Set Sn-30~Sn-32 to be "04" for the setting of output freq. detection.
Output Frequency Detection 2		• During acceleration, the output freq. is larger than freq. Agree detection level during acceleration (Cn-29), output freq. detection 2 is "ON". • During deceleration, the output freq. is larger than freq. Agree detection level during deceleration (Cn-30), output freq. detection 2 is "ON". • Set Sn-30~Sn-32 to be "05" for the setting of output freq. detection.

(26) Torque Detection Level 1 (Cn-32)
(27) Torque Detection Time 1 (Cn-33)
(28) Torque Detection Level 2 (Cn-62)
(29) Torque Detection Time 2 (Cn-63)

- Cn-62, 63 are available for 74.03 and later software version only.
- Both Overtorque Detection Function and Undertorque Detection Function are included in Torque Detection Function. The Overtorque Detection Function detects excessive mechanical load from an increase of output current. The Undertorque Detection Function detects broken fan belt from a decrease of output current.
- An overtorque 1 condition is detected when the output current exceeds the Torque Detection Level (Cn-32, Cn-62) for longer than the Torque Detection Time 1 (Cn-33, Cn-63). See Fig.25-a below.
- An undertorque condition is detected when the output current is lower than the Torque Detection Level (Cn-32, Cn-62) for longer than the Torque Detection Time (Cn-33, Cn-63). See Fig.25-b below.
- When Torque Detection 1 is enabled through the setting Sn-12, be sure to set Torque Detection Level 1 (Cn-32) and Torque Detection Time 1 (Cn-33).
- The Multi-Function Output Terminals (Control Circuit Terminals RA-RB-RC or R1A-R1B-R1C, DO1, DO2 or R2A-R2C) can be set to indicate an overtorque condition or an undertorque condition has been detected.

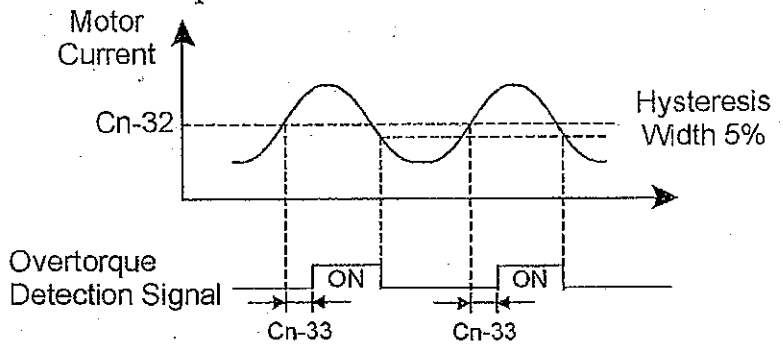


Fig. 25-a. Overtorque Detection Time Chart

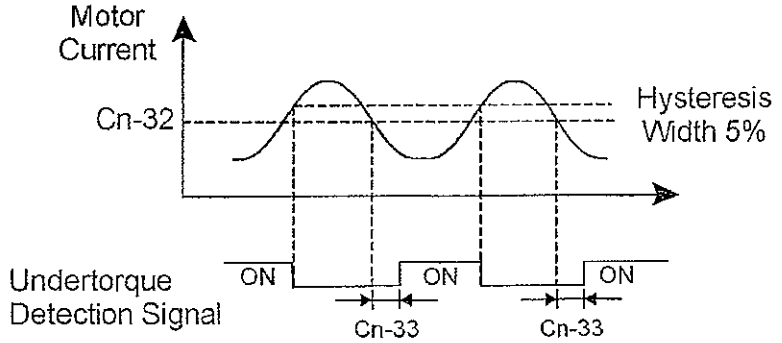


Fig. 25-b. Underorque Detection Time Chart

• Properly setting the value of Sn-12 (Torque Detection 1 Selection) and Sn-69 (Torque Detection 2 Selection) and will allow

a. Enable only during frequency agreement. Continue operation even after detection.

b. Enable only during frequency agreement. Stop operation after detection.

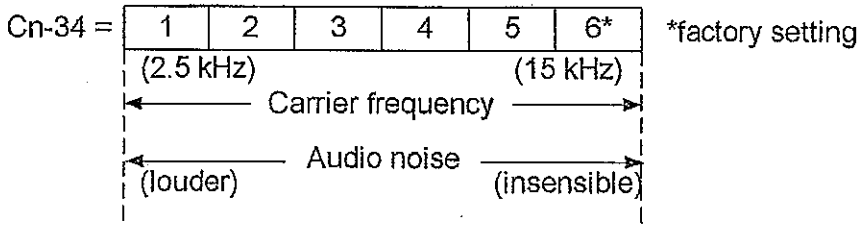
c. Enable at anytime. Continue operation even after detection.

d. Enable at anytime. Stop operation after detection.

(30) Carrier Frequency Setting (Cn-34)

• Lower the carrier frequency can decrease the noise interference and leakage current. Its setting is shown below.

Carrier frequency(kHz) = 2.5kHz* Cn-34 setting



• The output frequency does not need to be adjusted, except in the following cases.

a. If the wiring distance between the inverter and motor is long, lower the carrier frequency as shown below to allow less leakage current.

Wring distance	< 100ft.	100-165ft.	166-328ft.	≥ 329ft.
Carrier frequency (Cn-34)	<15kHz	<10kHz	<5KHz	<2.5KHz

b. If there is great irregularity in speed or torque, lower the carrier frequency.

(31) Speed Search Detection Level (Cn-35)

(32) Speed Search Time (Cn-36)

(33) Min. Baseblock Time (Cn-37)

(34) Speed Search V/F Curve (Cn-38)

• The speed search function will search the speed of a frequency coasting motor from the frequency command or max. frequency downward. And it will restart up smoothly from that frequency or max. frequency. It is effective in situations such as switching from a commercial power supply to an inverter without tripping occurred.

• The timing of speed search function as shown below :

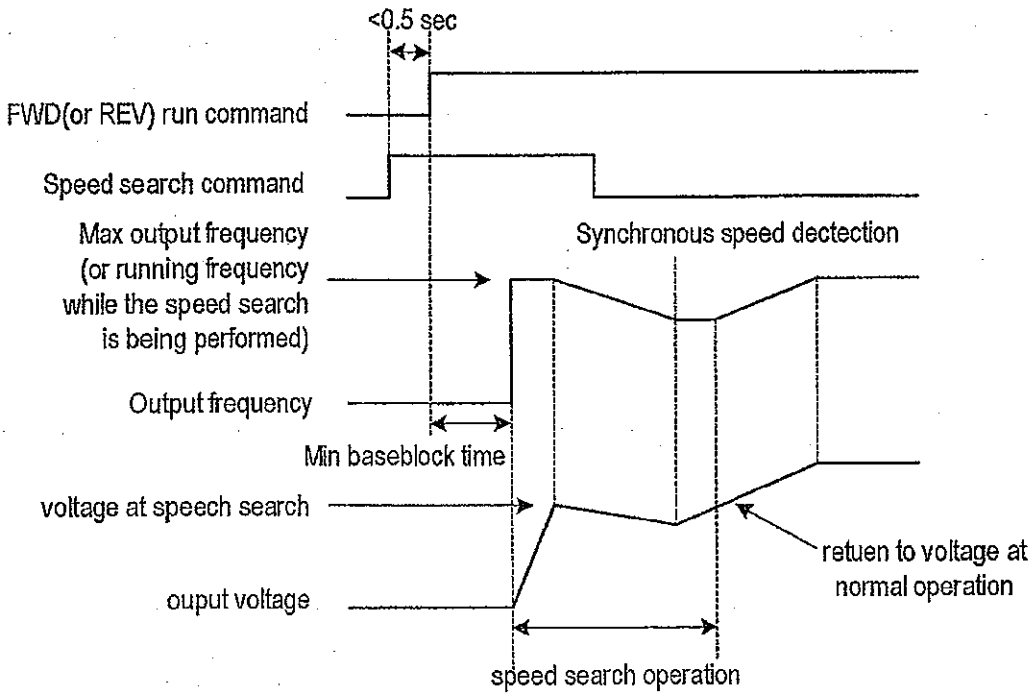
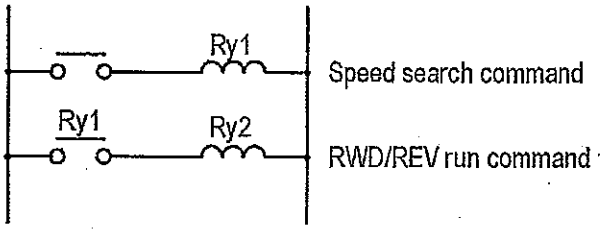


Fig. 26. Speed search timing chart

- The speed search command can be set through the multi-function contact input terminal ⑤ ~ ⑧ (By setting the parameters Sn-25 ~ Sn-28).
  If Sn-25 ~ Sn-28= 21 : Speed search is performed from Max. output frequency and motor is coasting freely.
  If Sn-25 ~ Sn-28= 22 : Speed search starts from the frequency command when the speed search command is enabled.
- After the inverter output is blocked, the user should input speed search command then enable run operation, the inverter will begin to search the motor speed after the min. baseblock time Cn-37.
- Speed search operation, if the inverter output current is less than Cn-35, the inverter will take the output frequency as the real frequency at that time. From those values of real frequency, the inverter will accelerate or decelerate to the set frequency according to the acceleration or deceleration time.
- While the speed search command is being performed, the user can slightly decrease the setting of V/F curve (Cn-38) in order to prevent the OC protection function enabled. Normally, the V/F curve need not be changed. (As below)
- Speed search operating V/F curve = Cn-38 * (normal operating V/F curve)

Note : 1. The speed search operation will be disabled if the speed search command is enacted from the Max. frequency and the setting frequency. (I.e., Sn-25=20, Sn-26=21 and multi-function input terminals ⑤, ⑥ is used at the same time).
2. Make sure that the FWD/REV command must be performed after or at the

same time with the speed search command. A typical operation sequence is shown below.



3. When the speed search and DC injection braking are set, set the Min. baseblock time (Cn-37). For the Min. baseblock time, set the time long enough to allow the motor's residual voltage to dissipate. If an overcurrent is detected when starting a speed search or DC injection braking, raise the setting Cn-37 to prevent a fault from occurring. As a result, the Cn-37 setting cannot be set too small.

(35) Low Voltage Alarm Detection Level (Cn-39)

- In most cases, the default setting Cn-39 need not be changed. If an external AC reactor is used, decrease the low voltage alarm detection level by adjusting Cn-39 setting smaller. Be sure to set a main-circuit DC voltage so that a main circuit undervoltage is detected.

(36) Slip Compensation Primary Delay Time (Cn-40)

- In most cases, the setting Cn-40 need not be changed. If the motor speed is not stable, increase the Cn-40 setting. If the speed response is slow, decrease the setting of Cn-40.

(37) S-curve Characteristic Time at Acceleration Start (Cn-41)

(38) S-curve Characteristic Time at Acceleration End (Cn-42)

(39) S-curve Characteristic Time at Deceleration Start (Cn-43)

(40) S-curve Characteristic Time at Deceleration End (Cn-44)

- Using the S-curve characteristic function for acceleration and deceleration can reduce shock to the machinery when stopping and starting. With the inverter, S-curve characteristic time can be set respectively for beginning acceleration, ending acceleration, beginning deceleration and ending deceleration. The relation between these parameters is shown in Fig. 27.

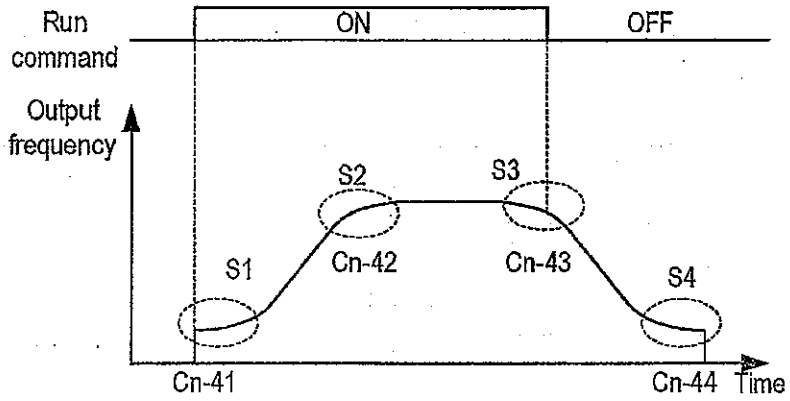


Fig. 27. S curve

- After the S-curve time is set, the final acceleration and deceleration time will be as follows:
  - Acc. time = selected Acc. Time 1 (or 2) + $\frac{(Cn\text{-}41) + (Cn\text{-}42)}{2}$
  - Dec. time = selected Dec. Time 1 (or 2) + $\frac{(Cn\text{-}43) + (Cn\text{-}44)}{2}$

(41) PG Parameter (Cn-45)

- The parameter is set in the unit of pulse/revolution. The factory setting is 0.1 P/R.

(42) Pole Number of Motor (Cn-46)

- Cn-45 and Cn-46 must meet the following relationship:

$$\frac{2 * Cn\text{-}45 * Cn\text{-}02}{Cn\text{-}46} < 32767$$

- If not, an error message "Input Error" will be displayed

(43) ASR Proportion Gain 1 (Cn-47)

(44) ASR Integral Gain 1 (Cn-48)

- Set the proportion gain and integral time of the speed control (ASR)

(45) ASR Proportion Gain 2 (Cn-49)

(46) ASR Integral Gain 2 (Cn-50)

- Use these constants to set different proportional gain and integral time settings for high-speed operation.

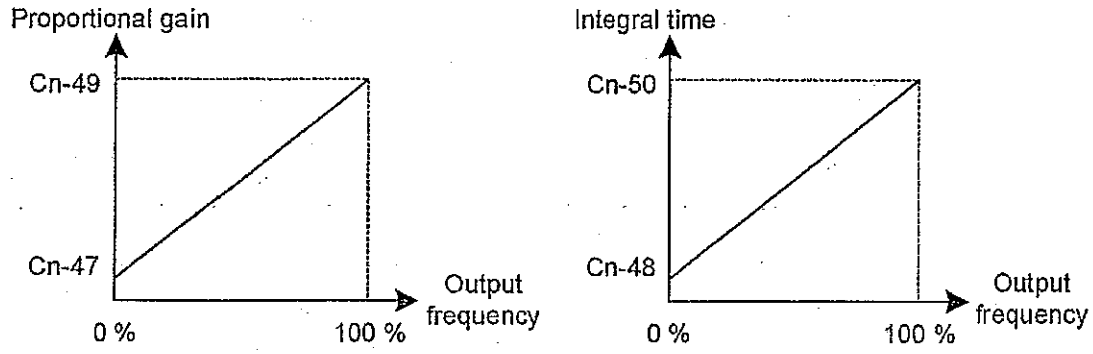


Fig. 28.

(47) ASR Upper Bound (Cn-51)

(48) ASR Lower Bound (Cn-52)

- These settings of Cn-51 and Cn-52 will limit the ASR range.

(49) Excessive Speed Deviation Detection Level (Cn-53)

- This parameter set the level of detecting PG speed deviation. The value of Cn-02 is referred as 100%, the default unit setting is 1%.

(50) Overspeed Detection Level (Cn-54)

- Set this parameter for detecting overspeed. The value of Cn-02 is referred as 100%, the default unit setting is 1%. Please refer to the setting of Sn-43.

(51) PID Integral Upper Bound (Cn-55)

(52) PID Primary Delay Time Constant (Cn-56)

- Please refer to Fig. 14 "Block diagram for PID control in inverter"
- The parameter Cn-55 prevents the calculated value of the integral control of PID from exceeding the fixed amount. The value is limited within 0-109% of Max. output frequency (100%). Increase Cn-55 will improve the integral control. If hunting cannot be reduced by decreasing the Bn-18 or increasing Cn-56, Cn-55 has to decrease. If the setting of Cn-55 is too small, the output may not match the target setting.
- The parameter Cn-56 is the low-pass filter setting for PID control output. If the viscous friction of the mechanical system is high, or if the rigidity is low, causing the mechanical system to oscillate, increase the setting Cn-56 so that it is higher than the oscillation period. It will decrease the responsiveness, but it will prevent the oscillation.

(53) Motor Line-to-Line Resistance R1 (Cn-57)

- Set the motor's terminal resistance (including the motor external cable resistance) in Ω unit.
- The default setting depends upon the type of inverter (but do not include the motor external motor cable resistance).

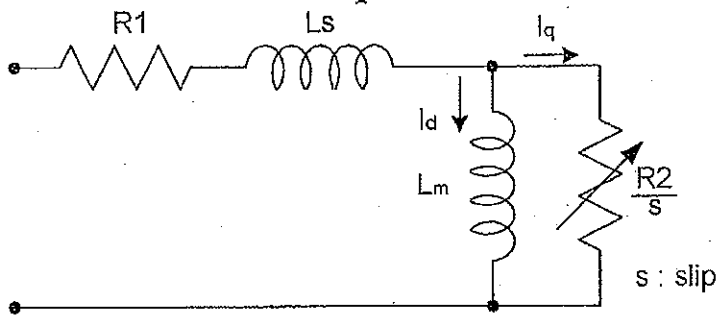
- This value will be automatically set during autotuning. See "Motor parameter autotuning selection" on page 3-73.
- Increase the setting when the generating torque is not large enough at low speed.
- Decrease the setting when the generating torque is extremely high and cause overcurrent trip at low speed.

(54) Motor Rotor Equivalent Resistance R2 (Cn-58)
- Set the motor's rotor Y-equivalent model resistance in □ unit.
- The default setting depends upon the type of inverter. Normally this value isn't shown on the motor's nameplate, so it might be necessary to contact motor manufactor.
- This value will be automatically set during autotuning. See "Motor parameter autotuning selection" on page 3-73.

(55) Motor Leakage Inductance Ls (Cn-59)
- Set the motor's rotor Y-equivalent model leakage inductance in mH unit.
- The default setting depends upon the type of inverter.
- This value will be automatically set during autotuning. See "Motor parameter autotuning selection" on page 3-73.

(56) Motor Mutual Inductance Lm (Cn-60)
- Set the motor Y-equivalent model mutual inductance in mH unit.
- The default setting depends upon the type of inverter.
- This value will be automatically set during autotuning. See "Motor parameter autotuning selection" on page 3-73.

Note: The Induction Motor Y-equivalent model



(57) Slip Compensation Gain (Cn-61)
- The parameter Cn-61 improves speed accuracy while operating with a load.
- Usually, the setting Cn-61 need not be changed. Adjust the setting if the speed accuracy is needed to improve.
- When actual speed is low, increase the set value.
- When actual speed is high, decrease the set value.

3.4 System Parameters Sn-□□

Function	Parameter No.	Name	LCD display (English)	Description	Factory Setting	Ref. Page
Capacity Setting	Sn-01	Inverter Capacity Selection	Sn-01= 01 220V 1HP	Inverter capacity selection	*1	3-39
V/F Curve	Sn-02	V/F Curve Selection	Sn-02= 01 V/F curve	0~14 : 15 fixed V/F curve pattern 15 : arbitrary V/F pattern selection		3-40
Operator Status	Sn-03	Operator Display	Sn-03= 00 Setting Valid	0 : An-□□, Bn-□□, Cn-□□, Sn-□□ setting & reading enabled 1 : An-□□, setting & reading enabled Bn-□□,Cn-□□,Sn-□□ reading only 2~5 : reserved 6 : clear fault message 7 : 2-wire initialization (230V/460V) 8 : 3-wire initialization (230V/460V) 9 : 2-wire initialization (200V/415V) 10 : 3-wire initialization (200V/415V) 11 : 2-wire initialization (200V/380V) 12 : 3-wire initialization (200V/380V) 13~15 : reserved		3-43
Operation Control Mode Selection	Sn-04	Run Source Selection	Sn-04= 0 Run source Operator	Run source 0 : Operator 1 : Control terminal 2 : RS-485 communication	0	3-43
	Sn-05	Frequency Command Selection	Sn-05= 0 Ref. Cmd. Operator	Frequency Command 0 : Operator 1 : Control circuit terminal 2 : RS-485 communication	0	
	Sn-06	Stopping Method Selection	Sn-06= 0 Dec. Stop	0 : Deceleration to Stop 1 : Coast to Stop 2 : Whole_range braking stop 3 : Coast to Stop with Timer (restart after time Bn-02)	0	
	Sn-07	Priority of Stopping	Sn-07= 0 Stop Key Valid	If operation command from control terminal or RS-485 communication port 0 : operator stop key effective 1 : operator stop key not effective	0	3-45
	Sn-08	Prohibition of REV Run	Sn-08= 0 Allow Reverse	0 : reverse run enabled 1 : reverse run disabled	0	
	Sn-09	Output Frequency Up/Down Function	Sn-09= 0 Inhibit UP/DOWN	0 : Reference frequency is changed through the key "UP/DOWN" pressing, later followed by key "EDIT/ENTER" pressing, and then this output freq. will be acknowledged. 1 : reference frequency will be acknowledged immediately after the key "UP/DOWN" pressing.	0	

Function	Parameter No.	Name	LCD display (English)	Description	Factory Setting	Ref. Page
Operation Control Mode Selection	Sn-10	Frequency Command Characteristics Selection	Sn-10= 0 Ref. Cmd. Fwd. Char.	0 : Reference command has forward characteristics (0~10V or 4~20mA/0~100% 1 : Reference command has reverse characteristics (10~0V or 20~4mA/0~100%)	0	3-46
	Sn-11	Scanning Times at Input Terminal	Sn-11= 0 Scan Time 5 ms	0 : scan and confirm once per 5 ms 1 : continuously scan and confirm twice per 10 ms	0	
	Sn-12	Torque Detection 1 Selection	Sn-12= 0 Tq.Detect Invalid	Option 5-8 are available for 74.03 and later software version only. 0 : Torque detection function 1 is not effective. 1 : Overtorque is detected only at frequency agree. Continue operation after detection. 2 : Overtorque is detected only at frequency agree. Stop operation after detection. 3 : Overtorque is detected during running (Accel.,Decel. included). Continue operation after detection. 4 : Overtorque is detected during running (Accel., Decel included). Stop operation after detection. 5 : Undertorque is detected only at frequency agree. Continue operation after detection. 6 : Undertorque is detected only at frequency agree. Stop operation after detection. 7 : Undertorque is detected during running (Accel.,Decel. included). Continue operation after detection. 8 : Overtorque is detected during running (Accel., Decel included). Stop operation after detection.	0	3-47
	Sn-13	Output Voltage Limit Selection	Sn-13= 0 V Limit Invalid	0 : V/F output voltage is limited 1 : V/F output voltage is not limited	0	
Protection Charac-teristic. selection	Sn-14	Stall Prevention During Acc. Function Selection	Sn-14= 1 Acc. Stall Valid	0 : invalid (Too much a torque may cause the stall) 1 : valid (stop acceleration if current exceeds Cn-25 setting)	1	3-48
	Sn-15	Stall Prevention During Dec. Function Selection	Sn-15= 1 Dec. Stall Valid	0 : invalid (installed with external brake unit) 1 : valid (no external brake unit used)	1	

Function	Parameter No.	Name	LCD display (English)	Description	Factory Setting	Ref. Page
Protection Charac-teristic. selection	Sn-16	Stall Prevention During Running Function Selection	Sn-16= 1 Run Stall Valid	0 : invalid 1 : valid –Deceleration time1 for stall prevention during running (no external brake unit used) 2 : valid –Deceleration time2 for stall prevention during running (no external brake unit used)	1	3-49
	Sn-17	Fault Retry Setting	Sn-17= 0 Retry No O/P	0 : Do not output fault retry. (The fault contact does not operate.) 1 : Output fault retry. (The fault contact operates.)	0	
	Sn-18	Operation Selection At Power Loss	Sn-18= 0 PwrL_to_ON Stop O/P	0 : stop running 1 : continue to run	0	
	Sn-19	Zero Speed Braking Operation Selection	Sn-19= 0 Z_braking Invalid	(analog) Speed reference is 0 during running on, the braking function selection 0 : invalid 1 : valid	0	
Protection Charac-teristic. Selection	Sn-20	External Fault Contact ③ Contact Selection	Sn-20= 0 Term.3 NO_Cont.	0 : A-contact (normally open input) 1 : B-contact (normally close input)	0	3-50
	Sn-21	External Fault Contact ③ Detection Selection	Sn-21= 0 All Time Ext. Fault	0 : detect all time 1 : detect only during operation	0	
	Sn-22	External Fault Operation Selection	Sn-22= 1 Ext. Fault Free run	0 : dec. to stop (upon dec. time1 Bn-02) 1 : coast (free run) to stop 2 : dec. to stop (upon dec. time1 Bn-04) 3 : continue operating	1	
	Sn-23	Motor Overload Protection Selection	Sn-23= 1 Cold Start Over Load	Electronically motor overload protection selection 0 : electronically motor overload protection invalid 1 : standard motor cold start overload protection characteristics 2 : standard motor hot start overload protection characteristics 3 : special motor cold start overload protection characteristics 4 : special motor hot start overload protection characteristics	1	
	Sn-24	Frequency Command Characteristics Selection at External Analog Input Terminal	Sn-24= 0 ~ Cmd. VIN	Frequency command characteristics selection at external analog input terminal 0 : voltage signal 0~10V (VIN) 1 : current signal 4~20mA (AIN) 2 : addition of voltage signal 0~10V and current signal 4~20 mA (VIN+AIN) 3 : subtraction of current signal 4~20mA and voltage signal 0~10V (VIN-AIN)	0	3-51

Function	Parameter No.	Name	LCD display (English)	Description		Factory Setting	Ref. Page
Multi-function Input Contact Selection	Sn-25	Multi-Function Input Terminal ⑤ Function Selection	Sn-25= 02 Multi-Fun. Command1	00~25	The factory setting is multi-function command1	02	3-51
	Sn-26	Multi-Function Input Terminal ⑥ Function Selection	Sn-26= 03 Multi-Fun. Command2	01~26	The factory setting is multi-function command2	03	
	Sn-27	Multi-Function Input Terminal ⑦ Function Selection	Sn-27= 06 Jog Command	02~27	The factory setting is jog command	06	
	Sn-28	Multi-Function Input Terminal ⑧ Function Selection	Sn-28= 07 Acc. & Dec Switch	03~29	The factory setting is Acc. & Dec. Interrupt	07	
Multi-function Analog Input Selection	Sn-29	Multi-Function Analog Input (AUX) Function Selection	Sn-29= 00 Auxiliary Freq. Cmd.	00~16	Multi-function analog input terminal (AUX) as Auxiliary frequency command. (factory setting)	00	3-60
Multi-function Digital Output Selection	Sn-30	Multi-Function Output Terminal (RA-RB-RC) Function Selection	Sn-30= 13 Fault	00~25	Terminal (RA-RB-RC or R1A-R1B-R1C) as fault output (factory setting)	13	3-63
	Sn-31	Multi-Function Output Terminal (DO1) Function Selection	Sn-31= 00 Running	00~25	Terminal (DO1-DOG) as digital output during running (factory setting).	00	
	Sn-32	Multi-Function Output Terminal (DO2) Function Selection	Sn-32= 01 Zero Speed	00~25	Terminal (DO2-DOG or R2A-R2C) as digital output at zero speed (factory setting)	01	
Multi-function Analog Output Selection	Sn-33	Multi-Function Analog Output (AO1) Function Selection	Sn-33= 00 Term. AO1 Freq. Cmd.	0 : Freq. Cmd. (10.V/MAX frequency command, Cn-02) 1 : Output frequency (10.V/MAX. output frequency) 2 : Output current (10.V/input rated current) 3 : Output voltage (10.V/input voltage, Cn-01) 4 : DC voltage (10.V/400.V or 10.V/800.V)		00	3-67
	Sn-34	Multi-Function Analog Output (AO2) Function Selection	Sn-34= 01 Term. AO2 O/P Freq.	5 : External analog input command VIN (0.~10.V/0.~10.V) 6 : External analog input command AIN (0.~10.V/4.~20.mA) 7 : Multi-function analog input (AUX) (10.V/10.V) 8 : PID control input 9 : PID control output1 10:PID control output2 11:Communication Control		01	

	Sn-35	Pulse Output Multiplier Selection	Sn-35= 1 Pulse Mul. 6	When multi-function output terminal (DO1,DO2) is set as pulse signal output 0:1F 1:6F 2:10F 3:12F 4:36F	1	3-67

Function	Parameter No.	Name	LCD display (English)	Description	Factory Setting	Ref. Page
RS-485 Communication Function	Sn-36	Inverter Address	Sn-36= 01 Inverter Address	Inverter address can be set as 1~31	01	3-68
	Sn-37	RS-485 Comm. Baud Rate Setting	Sn-37= 1 Baud rate 2400	0 : 1200 bps 1 : 2400 bps 2 : 4800 bps 3 : 9600 bps	1	
	Sn-38	RS-485 Comm. Transmission Parity Setting	Sn-38= 0 Reversed Bit	0 : no parity 1 : even parity 2 : odd parity	0	
	Sn-39	RS-485 Comm. Fault Stop Selection	Sn-39= 0 1st. Dec. stop	0 : deceleration to stop (Bn-02) 1 : coast to stop 2 : deceleration to stop (Bn-04) 3 : continue to run	0	
PG Speed Control	Sn-40	PG Speed Control Function	Sn-40= 0 PG Invalid	0 : without speed control 1 : with speed control 2 : with speed control but no integration control during Acc/Dec. 3 : with speed control and integration control during Acc/Dec.	0	3-69
	Sn-41	Operation Selection At PG Open Circuit	Sn-41= 0 1st. Dec. Stop	0 : deceleration to stop (Bn-02) 1 : coast to stop 2 : deceleration to stop (Bn-04) 3 : continue to run	0	
	Sn-42	Operation Selection At PG Large Speed Deviation	Sn-42= 0 1st. Dec Stop	0 : deceleration to stop (Bn-02) 1 : coast to stop 2 : deceleration to stop (Bn-04) 3 : continue to run	0	
	Sn-43	Operation Selection At PG Overspeed Detection Deviation	Sn-43= 0 1st. Dec. Stop	0 : deceleration to stop (Bn-02) 1 : coast to stop 2 : deceleration to stop (Bn-04) 3 : continue to run	0	

Function	Parameter No.	Name	LCD display (English)	Description	Factory Setting	Ref. Page
Auto_Run Mode	Sn-44	Operation Mode Selection During Auto_Run	Sn-44= 0 Auto_Run Invalid	0 : Auto_Run mode not effective 1 : Auto_Run mode for one single cycle. (continuing running from the unfinished step if restarting) 2 : Auto_Run mode be performed periodically (continuing running from the unfinished step if restarting) 3 : Auto_Run mode for one single cycle, then hold the speed of final step to run. (continuing running from the unfinished step if restarting) 4 : Auto_Run mode for one single cycle. (starting a new cycle if restarting) 5 : Auto_Run mode be performed periodically (starting a new cycle if restarting) 6 : Auto_Run mode for one single cycle, then hold the speed of final step to run. (starting a new cycle if restarting)	0	3-70
	Sn-45	Auto_Run Mode Operation Selection1	Sn-45= 0 Auto_Run Stop	0 : stop (Bn-02) 1 : forward 2 : reverse	0	
	Sn-46	Auto_Run Mode Operation Selection2	Sn-46= 0 Auto_Run Stop		0	
	Sn-47	Auto_Run Mode Operation Selection3	Sn-47= 0 Auto_Run Stop		0	
	Sn-48	Auto_Run Mode Operation Selection4	Sn-48= 0 Auto_Run Stop		0	
	Sn-49	Auto_Run Mode Operation Selection5	Sn-49= 0 Auto_Run Stop		0	
	Sn-50	Auto_Run Mode Operation Selection6	Sn-50= 0 Auto_Run Stop		0	

Function	Parameter No.	Name	LCD display (English)	Description	Factory Setting	Ref. Page
Auto_Run Mode	Sn-51	Auto_Run Mode Operation Selection7	Sn-51= 0 Auto_Run Stop	0 : stop (Bn-02) 1 : forward 2 : reverse	0	3-70
	Sn-52	Auto_Run Mode Operation Selection8	Sn-52= 0 Auto_Run Stop		0	
	Sn-53	Auto_Run Mode Operation Selection9	Sn-53= 0 Auto_Run Stop		0	
	Sn-54	Auto_Run Mode Operation Selection10	Sn-54= 0 Auto_Run Stop		0	
	Sn-55	Auto_Run Mode Operation Selection11	Sn-55= 0 Auto_Run Stop		0	
	Sn-56	Auto_Run Mode Operation Selection12	Sn-56= 0 Auto_Run Stop		0	
	Sn-57	Auto_Run Mode Operation Selection13	Sn-57= 0 Auto_Run Stop		0	
	Sn-58	Auto_Run Mode Operation Selection14	Sn-58= 0 Auto_Run Stop		0	
	Sn-59	Auto_Run Mode Operation Selection15	Sn-59= 0 Auto_Run Stop		0	
	Sn-60	Auto_Run Mode Operation Selection16	Sn-60= 0 Auto_Run Stop		0	
	Sn-61	Applied Torque Mode	Sn-61= 0 Const. Tq. Load	0 : constant torque 1 : variable(quadratic) torque	0	3-72
	Sn-62	Language Selection	Sn-62= 0 Language: English	0 : English 1 : Traditional Chinese	0	
	Sn-63	Parameter Copy	Sn-63=0 Not Load	0 : not loaded (copied) 1 : upload from digital operator to inverter 2 : download from inverter to digital operator 3 : inspect the EEPROM of digital operator 4 : inspect the EEPROM of inverter	0	
	Sn-64	PID Function	Sn-64=0 PID Invalid	0 : PID invalid 1 : PID valid	0	3-73
	Sn-65	Brake Resistor Protection	Sn-65=0 Protect Invalid	0 : Braking resistor protection invalid 1 : Braking resistor protection valid	0	
*2 Sensorless Vector Control	Sn-66	Motor Parameters Autotuning Selection	Sn-66=0 AUTO TUNE SEL	0 : Autotuning invalid 1 : Autotuning valid	0	3-73
	Sn-67	Control Mode Selection	Sn-67=0 CNTRL MODE SEL	0 : V/F control mode (include V/F control with pulse generator feedback) 1 : Sensorless Vector Control Mode	0	

Function	Parameter No.	Name	LCD display (English)	Description	Factory Setting	Ref. Page
	Sn-68	Control selection	Sn-68 = 0000 Control selection	The very parameter is available for 30.15 and later version ——1: Output phase lose protection function valid ——0: Output phase lose protection function invalid —1—: Reserved —0—: Reserved (Bit3 function is available for 30.16 and later version) –1—: ±10V analog voltage input function is valid –0—: ±10V analog voltage input function is invalid 1——: Frequency Up/Down hold function valid 0——: Frequency Up/Down hold function invalid * only 4P101C01301 control base board supports input of ±10V analog voltage.	0	3-73
Operation Control Mode Selection	Sn-69*3	Torque Detection 2 Selection	Sn-69= 0 Tq.Detect Invalid	0 : Torque detection function 2 is not effective. 1 : Overtorque is detected only at frequency agree. Continue operation after detection. 2 : Overtorque is detected only at frequency agree. Stop operation after detection. 3 : Overtorque is detected during running (Accel.,Decel. included). Continue operation after detection. 4 : Overtorque is detected during running (Accel., Decel included). Stop operation after detection. 5 : Undertorque is detected only at frequency agree. Continue operation after detection. 6 : Undertorque is detected only at frequency agree. Stop operation after detection. 7 : Undertorque is detected during running (Accel.,Decel. included). Continue operation after detection. 8 : Overtorque is detected during running (Accel., Decel included). Stop operation after detection.	0	3-47

Function	Parameter No.	Name	LCD display (English)	Description	Factory Setting	Ref. Page
	Sn-70*3	Engineering Unit	Sn-70= 0 Unit : NONE	0 : NONE 1 : FPM (feet per minute) 2 : CFM (cubic feet per minute) 3 : PSI (pounds per square inch) 4 : GPH (gallons per hour) 5 : GPM (gallons per minute) 6 : in 7 : ft 8 : /s (units per second) 9 : /m (units per minute) 10 : /h (units per hour) 11 : °F 12 : inW (inches in water column) 13 : HP 14 : m/s (meters per second) 15 : MPM (meters per minute) 16 : CMM (cubic meters per minute) 17 : W 18 : kW 19 : m 20 : °C	0	3-74

*1. The default setting will depend upon the different inverter capacity.

*2. Sensorless vector control is available after the version of 30.00.

*3. These parameters are available for 74.03 and later software version only.

(3) Inverter capacity selection (Sn-01)

- The inverter capacity has already been set at factory according to the following tables. Whenever the control board is replaced, the setting Sn-01 must be set again according to the following tables.
- Whenever the setting Sn-01 has been changed, the inverter system parameter settings should be changed based upon the constant torque (CT) load (setting of Sn-61= 0) or variable torque (VT) load (Sn-61= 1).

Table 10 230V Class Inverter Capacity Selection

Sn-01 setting			001		002		003		004		005		006	
CT(Sn-61 = 0) VT(Sn-61 = 1) Item name			CT	VT	CT	VT	CT	VT	CT	VT	CT	VT	CT	VT
Inverter rated capacity (KVA)			2		2.7		4		7.5		10.1		13.7	
Inverter rated current (A)			4.8		6.4		9.6		17.5		24		32	
Max. applicable capacity (HP)			1	1	2	2	3	3	5.4	7.5	7.5	10	10	10
Factory Setting	Cn-09	Motor rated current (A)	3.4	3.4	6.1	6.1	8.7	8.7	14.6	20.1	20.1	25.1	25.1	25.1
	Cn-12	Motor line impedance (Ω)	5.732	5.732	2.407	2.407	1.583	1.583	0.684	0.444	0.444	0.288	0.288	0.288
	Cn-13	Core loss torque compensation (W)	64	64	108	108	142	142	208	252	252	285	285	285
	Cn-34	Carrier freq.(kHz)	10	10	10	5	10	10	10	5	10	10	10	10
	Cn-37	Min. baseblock time (sec)	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.7	0.7	0.7	0.7	0.7
	Sn-02	V/F curve	01	07*1	01	07*1	01	07*1	01	07*1	01	07*1	01	07*1
Max. carrier freq. (kHz)			15	10	15	5	15	15	15	5	15	10	15	15

Sn-01 setting			007		008		009		010		011	
CT(Sn-61 = 0) VT(Sn-61 = 1) Item name			CT	VT	CT	VT	CT	VT	CT	VT	CT	VT
Inverter rated capacity (KVA)			20.6		27.4		34		41		54	
Inverter rated current (A)			48		64		80		96		130	
Max. applicable capacity (HP)			15	20	20	25	25	25	30	40	40	40
Factory Setting	Cn-09	Motor rated current (A)	36.7	50.3	50.3	62.9	62.9	62.9	72.9	96.7	96.7	96.7
	Cn-12	Motor line impedance (Ω)	0.159	0.109	0.109	0.077	0.077	0.077	0.060	0.041	0.041	0.041
	Cn-13	Core loss torque compensation (W)	370	471	471	425	425	425	582	536	536	536
	Cn-34	Carrier freq.(kHz)	10	5	10	5	10	10	10	5	10	10
	Cn-37	Min. baseblock time (sec)	0.7	0.7	0.7	0.7	1.0	1.0	1.0	1.0	1.0	1.0
	Sn-02	V/F curve	01	07*1	01	07*1	01	07*1	01	07*1	01	07*1
Max. carrier freq. (kHz)			10	5	10	5	10	10	10	5	10	10

Table 11 460V Class Inverter Capacity Selection

Sn-01 setting			021		022		023		024		025		026		027	
Item name		CT(Sn-61 = 0) VT(Sn-61 = 1)	CT	VT	CT	VT	CT	VT	CT	VT	CT	VT	CT	VT	CT	VT
Inverter rated capacity (KVA)			2.2		3.4		4.1		7.5		10.3		12.3		20.6	
Inverter rated current (A)			2.6		4		4.8		8.7		12		15		24	
Max. applicable capacity (HP)			1	1	2	2	3	3	5.4	7.5	7.5	10	10	15	15	20
Factory Setting	Cn-09	Motor rated current (A)	1.7	1.7	2.9	2.9	4	4	7.3	10.2	10.2	12.6	12.6	18.6	18.6	24.8
	Cn-12	Motor line impedance (Ω)	22.927	22.927	9.628	9.628	6.333	6.333	2.735	1.776	1.776	1.151	1.151	0.634	0.634	0.436
	Cn-13	Core loss torque compensation (W)	64	64	108	108	142	142	208	252	252	285	285	370	370	471
	Cn-34	Carrier freq. (kHz)	10	5	10	5	10	10	10	5	10	10	10	5	10	5
	Cn-37	Min. baseblock time (sec)	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.7	0.7	0.7	0.7	0.7	0.7	0.7
	Sn-02	V/F curve	01	07*1	01	07*1	01	07*1	01	07*1	01	07*1	01	07*1	01	07*1
Max. carrier freq. (kHz)			15	5	15	5	15	15	15	5	15	10	15	5	10	5

Sn-01 setting			028		029		030		031		032		033		034	
Item name		CT(Sn-61 = 0) VT(Sn-61 = 1)	CT	VT	CT	VT	CT	VT	CT	VT	CT	VT	CT	VT	CT	VT
Inverter rated capacity (KVA)			27.4		34		41		54		68		82		110	
Inverter rated current (A)			32		40		48		64		80		96		128	
Max. applicable capacity (HP)			20	25	25	30	30	30	40	50	50	50	60	75	75	100
Factory Setting	Cn-09	Motor rated current (A)	24.8	31.1	31.1	36.3	36.3	36.3	48.7	59.0	59.0	59.0	70.5	80.0	80.0	114
	Cn-12	Motor line impedance (Ω)	0.436	0.308	0.308	0.239	0.239	0.239	0.164	0.133	0.133	0.133	0.110	0.074	0.074	0.027
	Cn-13	Core loss torque compensation (W)	471	425	425	582	582	582	536	641	641	641	737	790	790	1800
	Cn-34	Carrier freq. (kHz)	10	5	10	5	10	10	10	5	10	10	10	5	10	5
	Cn-37	Min. baseblock time (sec)	0.7	0.7	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
	Sn-02	V/F curve	01	07*1	01	07*1	01	07*1	01	07*1	01	07*1	01	07*1	01	07*1
Max. carrier freq. (kHz)			10	5	10	5	10	10	10	5	10	10	10	5	10	5

*1 Use the variable torque patterns when there is a quadratic or cubic relationship between the speed and load, such as in fan or pump applications. The user can properly choose the desired (V/f) patterns (Sn-02=04, 05, 06, or 07) based upon the load torque characteristics.

*2 In the fan or pump applications, the load torque have a quadratic or cubic relationship between the speed and load. The inverter capacity rating can be increased to a value that doubles its own specified capacity rating in some special case. But, due to the real hardware limitation, 230V 1HP, 2HP, 3HP, 10HP, 25HP, 40HP and 460V 1HP, 2HP, 3HP, 30HP, 50HP can not be adapted any larger capacity.

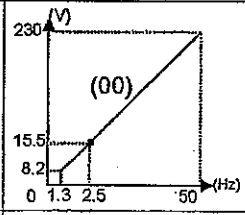
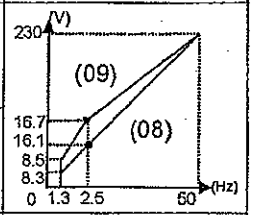
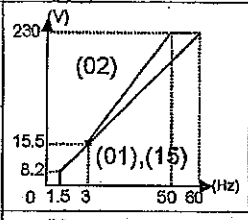
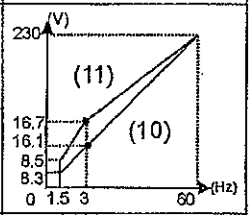
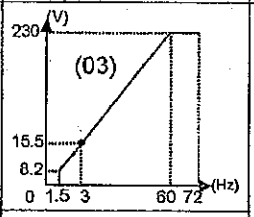
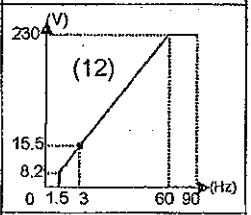
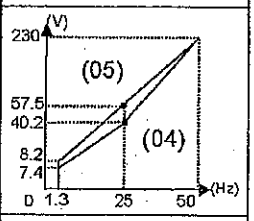
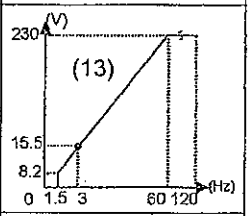
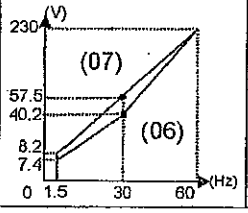
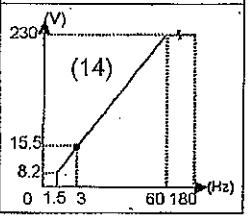
(4) V/F curve selection (Sn-02)

- Set the inverter input voltage (Cn-01) first to match the power supply voltage. The V/f curve can be set to ant of the following.

  Sn-02 = 00~14: one of 15 pre-set curve patterns

  = 15: V/F pattern can be set by the user through setting of Cn-01~Cn-08

Table 12 V/F curve of 1~2 HP compact size, 230V Class MA inverter *

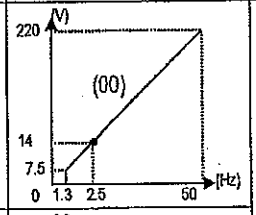
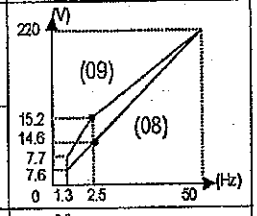
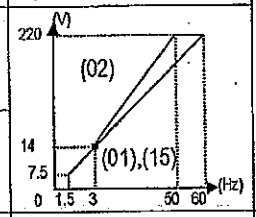
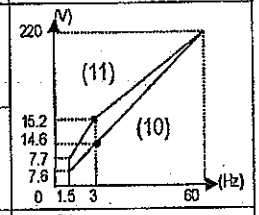
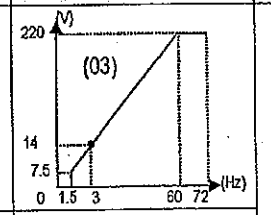
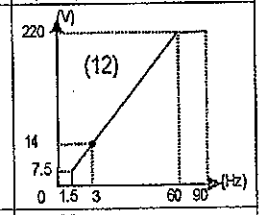
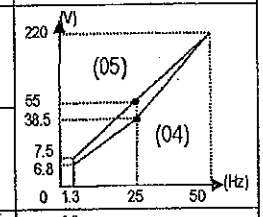
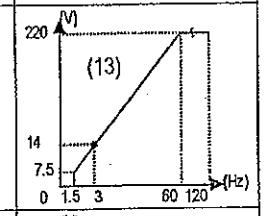
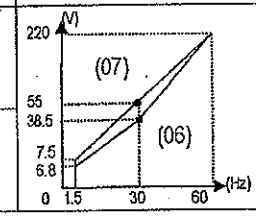
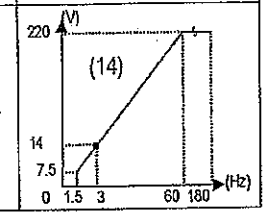
	Specifications		Sn-02	V/F Pattern†		Specifications		Sn-02	V/F Pattern†
General Purpose	50Hz		00		High Staring Torque‡	50Hz	Low Starting Torque	08	
							High Starting Torque	09	
	60Hz	60Hz Satu-ration	01 15			60Hz	Low Starting Torque	10	
		50Hz Satu-ration	02				High Starting Torque	11	
	72Hz		03		Rated Output Operation (Machine Tool)	90Hz		12	
Variable Torque Characteristic	50Hz	Variable Torque 1	04			120Hz		13	
		Variable Torque 2	05						
	60Hz	Variable Torque 3	06			180Hz		14	
		Variable Torque 4	07						

* These values are for the 230V class; double the values for 460V class inverters.

† Consider the following items as the conditions for selecting a V/f pattern.
They must be suitable for
(1) The voltage and frequency characteristic of motor.
(2) The maximum speed of motor.

‡ Select high starting torque only in the following conditions.
(1) The power cable length is long [492ft (150m) and above].
(2) Voltage drop at startup is large.
(3) AC reactor is inserted at the input side or output side of the inverter.
(4) A motor with capacity smaller than the maximum applicable inverter capacity is used.

Table 13 V/F curve of 3~40 HP, 230V Class MA inverter *

	Specifications		Sn-02	V/F Pattern†		Specifications		Sn-02	V/F Pattern†
General Purpose	50Hz		00		High Staring Torque‡	50Hz	Low Starting Torque	08	
							High Starting Torque	09	
	60Hz	60Hz Saturation	01 15			60Hz	Low Starting Torque	10	
		50Hz Saturation	02				High Starting Torque	11	
	72Hz		03		Rated Output Operation (Machine Tool)	90Hz		12	
Variable Torque Characteristic	50Hz	Variable Torque 1	04			120Hz		13	
		Variable Torque 2	05						
	60Hz	Variable Torque 3	06			180Hz		14	
		Variable Torque 4	07						

* These values are for the 230V class; double the values for 460V class 3~75HP inverters.

† Consider the following items as the conditions for selecting a V/f pattern.
They must be suitable for
(1) The voltage and frequency characteristic of motor.
(2) The maximum speed of motor.

‡ Select high starting torque only in the following conditions. Normally, the selection if not required.
(1) The power cable length is long [492ft (150m) and above].
(2) Voltage drop at startup is large.
(3) AC reactor is inserted at the input side or output side of the inverter.
(4) A motor with capacity smaller than the maximum applicable inverter capacity is used.

(5) Operator Display (Sn-03)

- Parameter code (Sn-03= 0 or 1)

Set the parameter Sn-03 as 0 or 1 to determine the access status as follows.

Sn-03	DRIVE mode		PRGM mode	
	Set	Read Only	Set	Read Only
0	An, Bn	Sn, Cn	An, Bn, Sn, Cn	—
1	An	Bn, Sn, Cn	An	Bn, Sn, Cn

- Initialized setting of parameter (Sn-03= 7～12)

Except the parameter of Sn-01~02 and Sn-61, the parameter groups of An-□□, Bn-□□, Cn-□□ and Sn-□□ can be initialized as factory setting according to the different input voltage. At the same time, the terminal ⑤～⑧ can be set as 2-wire or 3-wire operation mode under different setting of Sn-03. Please see 2-/3-wire operation mode on page 3-53.

(6) Run Source Selection (Sn-04)

- The parameter is used to select the source of run command.

Sn-04 = 0 : digital operator
= 1 : control circuit terminal
= 2 : RS-485 communication

- If Sn-04 is set as 1, the run source is from the control circuit terminal. Under the initial setting of 2-wire operation (through setting of Sn-03=7 or 9 or 11), the run source will be FWD/STOP, REV/STOP.
- If Sn-04 is set as 1, the run source is from the control circuit terminal. Under the initial setting of 3-wire operation (through setting of Sn-03=8 or 10 or 12), the run source will be RUN, STOP, FWD/ REV.
- For more details, see "2-/3- wire operation" on page 3-53.

(7) Frequency Command Setting Method Selection (Sn-05)

- The parameter is used to select the source of frequency command.

Sn-05 = 0 : digital operator
= 1 : control circuit terminal
= 2 : RS-485 communication

(8) Stopping Method Selection (Sn-06)

- Setting the stopping method used when a stop command is executed.

Setting	Function
0	Deceleration to stop
1	Coast to stop
2	DC braking stop: Stops faster than coast to stop, without regenerative operation.
3	Coast to stop with timer: Run sources are disregarded during decel. time.

- The following diagrams show the operation of each stopping method.

a) Deceleration to Stop (Sn-06= 0)
Deceleration to a stop at a rate set with the selected deceleration time.

b) Coast to Stop (Sn-06= 1)
After the stop command is executed, run source is disregarded until the Min. baseblock time Cn-37 has elapsed.

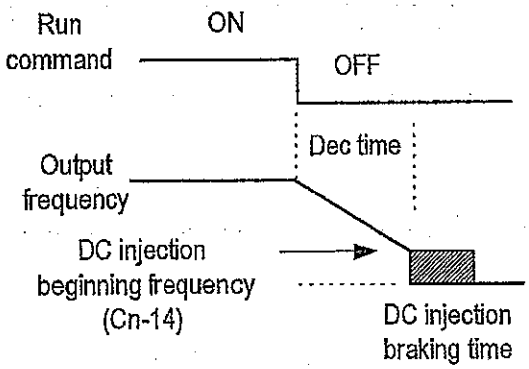


Fig. 29. Deceleration to stop

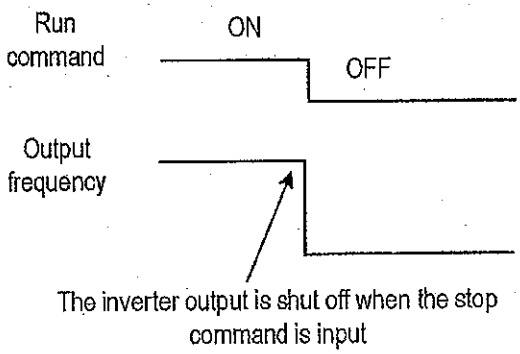


Fig. 30. Coast to Stop

c) Whole Range DC Injection Braking Stop (Sn-06= 2)

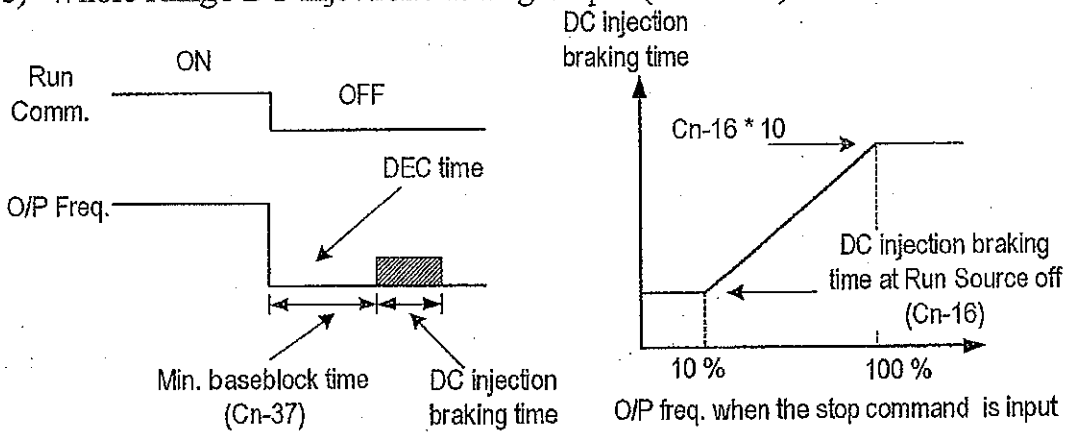


Fig. 31. Whole range DC Injecting Braking Stop

- After the stop command is input and the minimum baseblock time (Cn-37) has elapsed, DC injection braking is applied and the motor stopped.
- The DC injection braking time depends upon the output frequency when the stop command is input and the "DC injection time at stop" setting (Cn-16) as shown in Fig. 31.
- Lengthen the minimum baseblock time (Cn-37) when an overcurrent (OC) occurs during stopping. When the power to an induction motor is turned OFF, the counter-electromotive force generated by the residual magnetic field in the motor can cause an overcurrent to be detected when DC injection braking stop is applied.

d) Coast to Stop with Timer (Sn-06= 3)

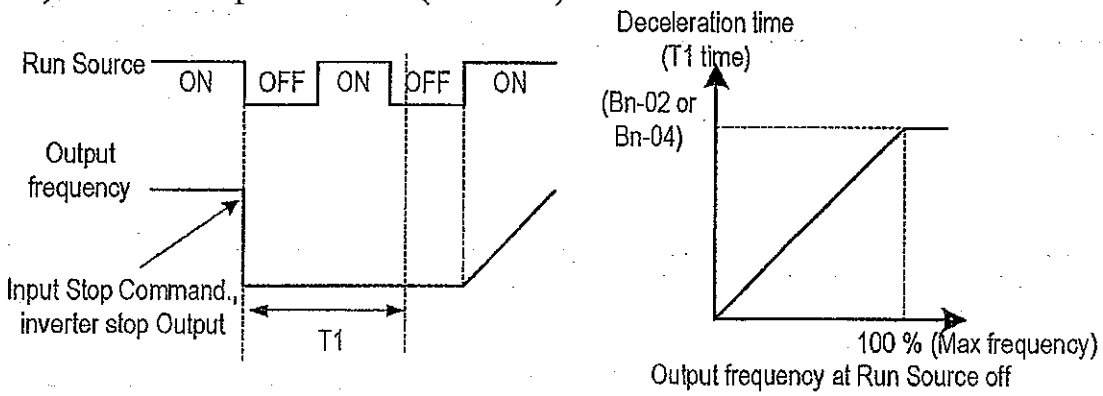


Fig. 32. Coast to Stop with Timer

- After the stop command is executed, run sources are disregarded until the time T1 has elapsed. The time T1 depends upon the output frequency when the stop command is executed and upon the deceleration time (Bn-02 or Bn-04).

(9) Priority of Stopping (Sn-07)

- This parameter enable or disable the STOP key on the digital operator when the run source is from an control circuit terminal or RS-485 communicate port while the motor is running.

  Sn-07 = 0 : enabled. (The STOP key is enabled at all time during running)
  = 1 : disabled (The STOP key is disabled when the run source is from control terminal or RS-485 port)

(10) Prohibition of REV Run (Sn-08)

- While the parameter Sn-08 is set as 1. The reverse run of motor is not allowed

(11) Output Frequency UP/DOWN Function (Sn-09)

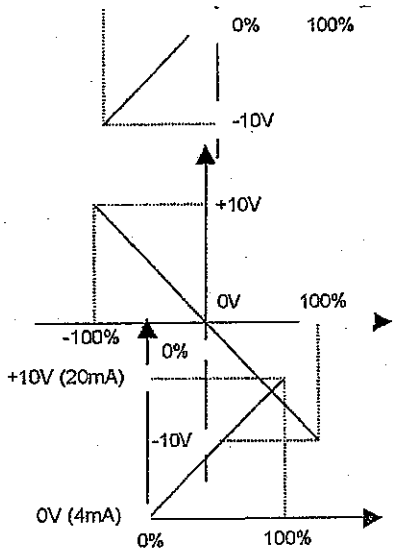
- The output frequency can be increased or decreased (UP/DOWN) through digital operator

  Sn-09 = 0 : Change output frequency through the (▲ / ▼) key. The frequency command will be accepted only after the key EDIT/ENTER has been pressed.

  = 1 : Change output frequency through the (▲ / ▼) key. The frequency command can be recalled even restarting the inverter if the EDIT/ENTER key has been pressed at that time.

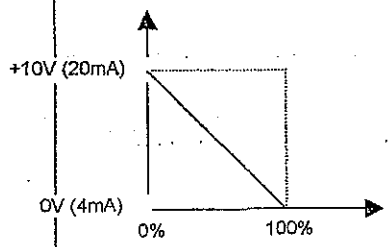
- The output frequency can be changed (increasing (UP) or decreasing (DOWN)) through either the LCD digital operator or external multi-function input terminal (terminals ⑤～⑧).

(12) Frequency Command Characteristics Selection (Sn-10)



30.16 previous or later version set Sn-68=—0—

The positive and negative characteristics of analog frequency command (0 ~ 10V/ 4 ~ 20mA) is as follow diagram:



Positive input characteristics	Negative input characteristics

30.17 previous or later version set Sn-68=—1—:

The positive and negative characteristics of analog current input is similar to above description, while of analog voltage input is as follow diagram:

Positive input characteristics	Negative input characteristics

Among Sn-68 set, '—' represents 0 or 1.

Only 4P101C01301 control board supports input of -10V~+10V analog voltage.

(13) Scan Time at Input Terminal (Sn-11)

- Setting of scan frequency of input terminal (Forward/Reverse, multi-function input)
  Sn-11 = 0 : Scan input terminals every 5ms.
  = 1 : Scan input terminals every 10ms.

(14) Torque Detection 1 Selection (Sn-12)

(15) Torque Detection 2 Selection (Sn-69)

- The parameter Sn-69 and settings 5-8 of Sn-12 are available for 74.03 and later software versions.
- The inverter supports 2 sets of torque detection function. Each of them can set as overtorque detection or undertorque detection.
- While Torque Detection 1 is enabled by Sn-12, be sure to set the values of the Torque Detection Level1 1 (Cn-32) and Torque Detection Time 1 (Cn-33). While Torque Detection 2 is enabled by Sn-69, be sure to set the values of the Torque Detection Level1 2 (Cn-62) and Torque Detection Time 2 (Cn-63).
- An overtorque condition is detected when the Overtorque Detection is enabled, and the current exceeds the Torque Detection Level for longer than the Torque Detection Time.
- An undertorque condition is detected when the Undertorque Detection is enabled, and the current is lower than the Torque Detection Level for longer than the Torque Detection Time.

Sn-12, Sn-69	Function	Display
0	Torque detection disabled	
1	Detect overtorque only during speed agree. Continue operation after detection. (Minor fault)	"Over Torque 1" or "Over Torque 2" blinks
2	Detect overtorque only during speed agree. Stop output after detection (Fault)	"Over Torque 1" or "Over Torque 2" lights
3	Detect overtorque at any time. Continue operation after detection. (Minor fault)	"Over Torque 1" or "Over Torque 2" blinks
4	Detect overtorque at any time. Stop output after detection (Fault)	"Over Torque 1" or "Over Torque 2" lights
5	Detect undertorque only during speed agree. Continue operation after detection. (Minor fault)	"Under Torque 1" or "Under Torque 2" blinks
6	Detect undertorque only during speed agree. Stop output after detection (Fault)	"Under Torque 1" or "Under Torque 2" lights
7	Detect undertorque at any time. Continue operation after detection. (Minor fault)	"Under Torque 1" or "Under Torque 2" blinks
8	Detect undertorque at any time. Stop output after detection (Fault)	"Under Torque 1" or "Under Torque 2" lights

(16) Output Voltage Limitation Selection (Sn-13)

- In low speed region, if the output voltage from V/f pattern is too high, the inverter will be driven into fault status. As a result, the user can use this option to set the upper bound limit of output voltage.

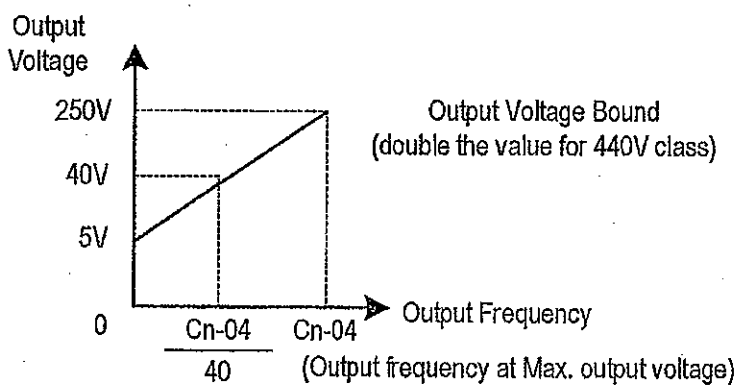


Fig. 33. Output voltage limit

(17) Stall Prevention Selection During Acceleration (Sn-14)

Sn-14 = 0 : Disabled (Accelerate according to the setting. Stall may occurs with large load)

= 1 : Enabled (Stop acceleration if Cn-25 setting is exceeded. Accelerate again when current recovers)

- Please refer to "Stall prevention level during acceleration" on page 3-20.

(18) Stall Prevention Selection During Deceleration (Sn-15)

- If external braking resistor unit is installed, the Sn-15 setting must be disabled (Sn-15= 0).
- If no external braking resistor unit is installed, the inverter can provide about 20% regenerative braking torque. If the load inertia is so large that it exceeds the regenerative braking torque, the parameter Sn-15 is set as "1". When setting Sn-15= 1 (enabled) is selected, the deceleration time (Bn-02 or Bn-04) is extended so that a main circuit overvoltage does not occur.

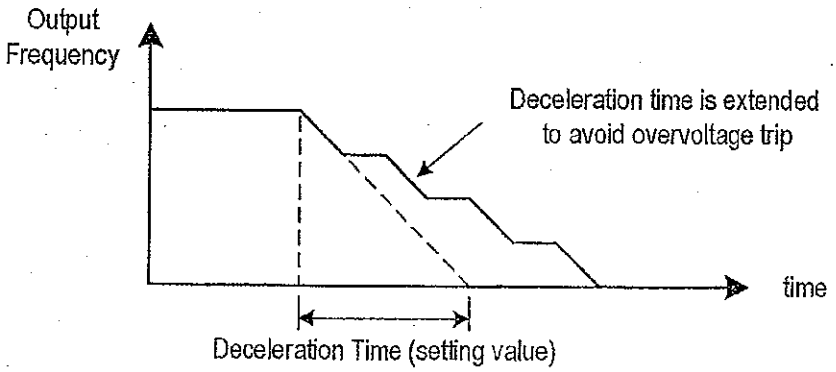


Fig. 34. Stall prevention function during deceleration (Sn-15= 1)

(19) Stall Prevention Selection during Running (Sn-16)

Sn-16 = 0 : Disabled (Stall may occur when a large load is applied)

= 1 : Enabled (Deceleration will start if the motor current is larger than the stall prevention level during running and continues for more than 100ms. The motor is accelerated back to the reference frequency again when the current falls below this level Cn-26).

- Please refer to "Stall prevention level during running" on page 3-20.

(20) Operation Selection at Fault Contact during Fault Retrying (Sn-17)

Sn-17 = 0 : Do not output fault restart. (The fault contact does not work)

= 1 : Output fault restart. (The fault contact operates)

- Please refer to "Number of auto restart attempt" on page 3-19.

(21) Operation Selection at Power Loss (Sn-18)

- This parameter specifies the processing to be performed when a momentary power loss occurs (within 2 sec)

Sn-18 = 0 : When power loss ride through is enabled, operation will be restarted after a speed search envoked if the power is restored within the allowed time.

= 1 : When power loss ride-through is disabled the inverter will stop after a momentary power loss. An undervoltage fault will be detected then. If the power is interrupted for more than 2 seconds, the fault contact output will operate and the motor will coast to stop.

(22) Zero Speed Braking Selection (Sn-19)

- The run-source and frequency command is input from control circuit under the setting of Sn-04=1 & Sn-05=1, If Sn-19 is enabled, the blocking torque will be generated in DC-braking mode when the frequency command is 0V and forward – run source is "ON".
- A time-chart shows the above action as below. The zero-braking selection Sn-19 is set to 1 and the DC-braking current Cn-15 is limited within 20% of rated current.

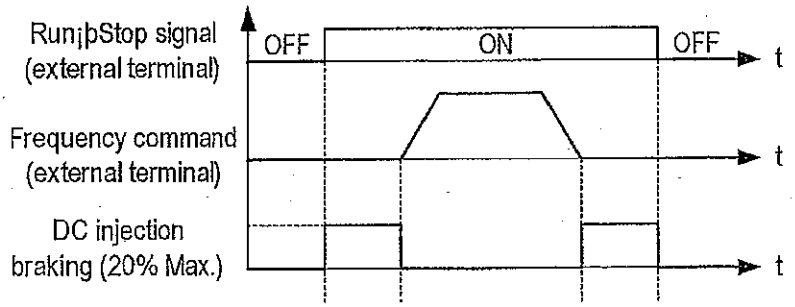


Fig. 35. Zero speed braking operation selection

(23) External Fault Contact ③ Contact Selection (Sn-20)

Sn-20 = 0 : Input signal is from A-contact. (Normal-open contact)

= 1 : Input signal is from B-contact. (Normal-close contact)

(24) External Fault Contact ③ Detection Selection (Sn-21)

Sn-21 = 0 : Always detects.

= 1 : Detect only during running.

(25) Detection Mode Selection of External Fault (Sn-22)

- An external fault is detected (at terminal ③), the following operation will be performed based upon the setting of Sn-22

Sn-22 = 0 : Decelerate to stop with the specified deceleration time Bn-02.

= 1 : Coast to stop.

= 2 : Decelerate to stop with the specified deceleration time Bn-04.

= 3 : Continue running with no regard of external fault.

(26) Motor Overload Protection Selection (Sn-23)

Sn-23 = 0 : Electronic overload protection disable.

Sn-23 = 1~4 : Electronic overload protection enabled. The electronic thermal overload is detected according to the characteristic curves of protection operating time. vs. motor rated current setting (Cn-09).

Sn-23 = 1 : The overload is detected according to the standard motor cold start curve.

= 2 : The overload is detected according to the standard motor hot start curve.

= 3 : The overload is detected according to the specific motor cold start curve.

= 4 : The overload is detected according to the specific motor hot start curve.

- Disable the motor protection function (setting 0) when 2 or more motors are connected to a single inverter. Use another method to provide overload protection separately to each motor, such as connecting a thermal overload relay to the power line of each motor.
- The motor overload protection function should be set as Sn-23= 2 or 4 (hot start protection characteristic curve) when the power supply is turned on or off frequently, because the thermal values is reset each time when the power is turned off.
- For the motor without forced cooling fan, the heat dissipation capability is lower when in the low speed operation. The setting Sn-23 can be either '1' or '2'.
- For the motor with forced cooling fan, the heat dissipation capability is not dependent upon the rotating speed. The setting Sn-23 can be either '3' or '4'.
- To protect the motor from overload by use of electronic overload protection, be sure to set the parameter Cn-09 according to the rated current value shown on the motor nameplate.

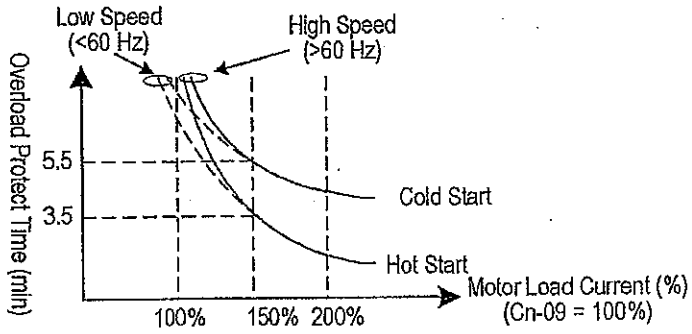


Fig. 36. Motor overload protection curve (Cn-09 setting = 100%)

(27) Frequency Characteristics Command Selection at External Analog Input Terminal (Sn-24)

Sn-24 = 0 : Frequency command is input at VIN terminal (0~10V)

= 1 : Frequency command is input at AIN terminal (4~20mA)

= 2 : Frequency command is the addition (VIN + AIN) at VIN (0~10V) and AIN (4~20mA) terminal.

= 3 : Frequency command is the combination (VIN - AIN) at VIN (0~10V) and AIN (4~20mA) terminal. If the value (VIN - AIN) is negative, the reference command will take '0' as a result.

- On inverter with 4P101C01301control board, if Sn-68= - 1 - - and Sn-05=1 VIN allowing input ±10V, set Sn-24 to select main frequency:

Sn-24 = 0 : frequency command is controlled by VIN(-10~+10V) input.
(Corresponding main frequency: -10V ~ +10V→ Reverse frequency 100% ~ forward frequency100%)

= 1 : frequency command in controlled by AIN(4~20mA) input.
(the status of forward/ reverse is set by user)

= 2 : frequency command is controlled by VIN and AIN, the sum of both (VIN + AIN).

= 3 : frequency command is controlled by VIN and AIN, the balance of both (VIN - AIN).
(When (VIN + AIN) < 0 or (VIN - AIN) < 0, main frequency switched to reverse status.

Sn-24 = 0、2、3, forward or reverse is control by main frequency command polar.

(28) Multi-Function Input Terminal ⑤ Function Selection (Sn-25)

(29) Multi-Function Input Terminal ⑥ Function Selection (Sn-26)

(30) Multi-Function Input Terminal ⑦ Function Selection (Sn-27)

(31) Multi-Function Input Terminal ⑧ Function Selection (Sn-28)

- The settings and functions for the multi-function input are listed in Table 14.

Table 14 Multi-Function Input Setting

Setting	Function	LCD Display	Description
00	Forward/Reverse command	3_Wire Run	3-wire operation mode
01	2-wire key-pressing input stop command	2_Wire Stop Key	2-wire operation mode
02	Multi-speed command 1	Multi-Fun. Command 1	Multi-speed frequency command selection
03	Multi-speed command 2	Multi-Fun. Command 2	
04	Multi-speed command 3	Multi-Fun. Command 3	
05	Multi-speed command 4	Multi-Fun. Command 4	
06	Jogging	Jog Command	ON: select jogging frequency
07	Acc/Dec time switch command	Acc.&Dec. Switch	OFF: the first stage Acc/Dec time (Bn-01, Bn-02), ON: the second stage Acc/Dec time (Bn-03, Bn-04),
08	External base-block command A-contact)	Ext.B.B. NO_Cont	ON: Inverter output baseblock
09	External base-block command (B-contact)	Ext.B.B. NC_Cont	OFF: inverter output baseblock
10	Inhibit Acc/Dec command	Inhibit Acc&Dec	Inhibit Acc/Dec (hold frequency)
11	Inverter overheat warning	Over Heat Alarm	ON: blink show overheat (inverter can proceed running)
12	FJOG	Forward Jog	ON: forward jog
13	RJOG	Reverse Jog	ON: reverse jog
14	PID integration reset	I_Time Reset	ON: Reset PID integration
15	PID control invalid	PID Invalid	ON: PID control not effective
16	External fault (A-contact)	Ext.Fault NO_Cont	ON: External fault input (normally open)
17	External fault (B-contact)	Ext.Fault NC_Cont	OFF: External fault input (normally close)
18	Multi-function analog input	~ Input Valid	ON: multi-function analog input (AUX) effective
19	Timer function input	Timer Function	ON: ON-delay/OFF-delay timer input
20	DC braking command	DC Brakin Command	ON: DC injection braking applied when the frequency output is less than the DC injection start frequency
21	Speed search 1 command	Max Freq. Sp_Search	ON: speed search is performed from max. output frequency
22	Speed search 2 command	Set Freq. Sp_Search	ON: speed search is performed from reference frequency
23	Local/Remote control I	Operator Control	ON: local mode control (through LCD operator) OFF: Run Source and Frequency Command is determined according to (Sn-04, Sn-05) setting
24	Local/Remote control II	Ext. Term. Control	ON: local mode control (through control circuit terminal) OFF: Run Source and Frequency Command is determined according to (Sn-04, Sn-05) setting
25	RS-485 communication application	Comm. Control	PLC application extension use. (Please refer to "RS-485 MODBUS/PROFIBUS Application Manual")
26	speed control without PG	PG Invalid	ON: Speed control without PG
27	Reset integration of speed control with PG	I_Time Invalid	ON: Reset integration of speed control with PG
28	Frequency Up/Down function	UP/DOWN Function	Only Sn-28 can be set as Sn-28=28, terminal ⑦ used as up cmd. and terminal ⑧ used as down cmd. when Sn-28=28
29	Force operation signal	Force Run	Only Sn-28 can be set as Sn-28=29

Note: An error message of "Multi-Fun. Parameter" / "Setting Error" will be displayed if:

- Setting combination of (Sn-25~Sn28) is not organized in monotonically increasing order.
- Setting 21, 22 (both for speed search command) are set at the same time.

- Forward/Reverse Change (setting : 00)
  - Under 3-wire initialization mode (Sn-03= 8 or 10 or 12) , the multi-function input terminals ⑤~⑧ have setting "00", the inverter will be in the 3-wire mode operation. As shown in Fig. 37, the Forward/Reverse change mode is set at the terminal ⑤.

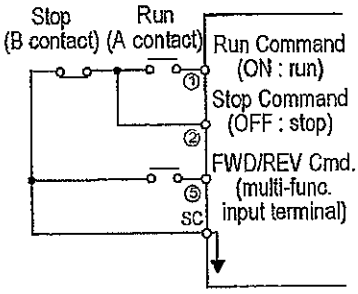


Fig. 37. 3-wire mode connection diagram

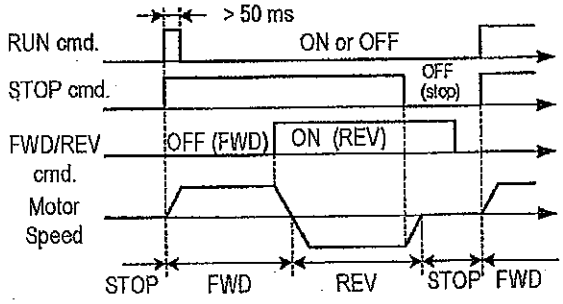


Fig. 38. Operation sequence in 3-wire mode

- Input STOP Command during 2-Wire Mode Operation (setting : 01)
  - Under a standard 2-wire initialization mode as shown in Fig. 39(a), S1 and S2 can not be both "ON" at the same time.
    When S1= "ON" and S2= "OFF", the motor is FWD running. When S1="OFF" and S2= "ON", the motor is REV running. When S1= "OFF" and S2= "OFF", the motor stops running.
  - When Sn-25= '01', the 2-wire operation mode has its self-sustaining function. Only through the multi-function input terminal⑤, the operator can stop the inverter after pressing the "STOP" key as shown in Fig. 39(b). As shown in Fig. 39(b), the switches S1, S2 and S3 do not need to be the self-sustaining switches. When S1 is depressed "ON", the motor will be forward running. After S3 is depressed "ON", the motor will stop. When S2 is depressed "ON", the motor will be reverse running. After S3 is depressed "ON", the motor will stop.

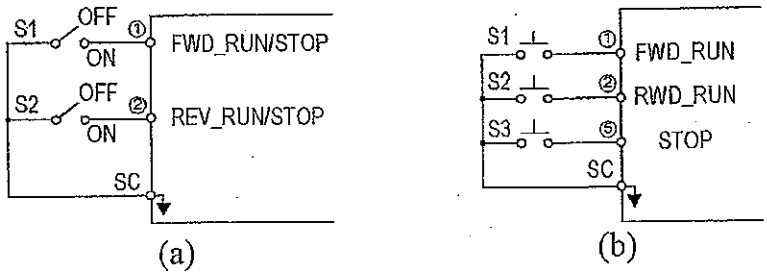


Fig. 39. 2-wire mode connection diagram

Note : 1. For the other setting value (except "00", "01"), the external operation mode is defaulted as 2-wire mode and no self-sustaining function. (that is, the inverter will stop when contact ① and ② are not close.) ◦

2. Under the 2-wire mode, the error message "Freq. Comm. Error" will be displayed in the digital operator when terminal ① and ② are both ON at the same time, the inverter will stop. After the above case cleared, the inverter will return normal.

- Multi-Step Speed Command 1 (Setting : 02)
- Multi-Step Speed Command 2 (Setting : 03)
- Multi-Step Speed Command 3 (Setting : 04)
- Multi-Step Speed Command 4 (Setting : 05)
- Jog Frequency Selection (Setting : 06)
- There are 16 (maximum) step speed command selection from the combination of the Multi-Step Speed Command and jog frequency command.
- Multi-Step Speed command 1~4 and Jog Frequency Selection Setting Table.

Terminal ⑧ (Sn-28= 05)	Terminal ⑦ (Sn-27= 04)	Terminal⑥ (Sn-26= 03)	Terminal ⑤ (Sn-25= 02)	Selected frequency
Multi-step speed cmd. 4	Multi-step speed cmd. 3	Multi-step speed cmd. 2	Multi-step speed cmd. 1	
0	0	0	0	Freq. Cmd. 1 (An-01)*1
0	0	0	1	Freq. Cmd. 2 (An-02)*2
0	0	1	0	Freq. Cmd. 3 (An-03)
0	0	1	1	Freq. Cmd. 4 (An-04)
0	1	0	0	Freq. Cmd. 5 (An-05)
0	1	0	1	Freq. Cmd. 6 (An-06)
0	1	1	0	Freq. Cmd. 7 (An-07)
0	1	1	1	Freq. Cmd. 8 (An-08)
1	1	1	1	Freq. Cmd. 16 (An-16)

Note: "0" : terminal is "OFF" "1" : terminal is "ON"

- An example shows the operation sequence of a multi-step speed and jog command is as below.

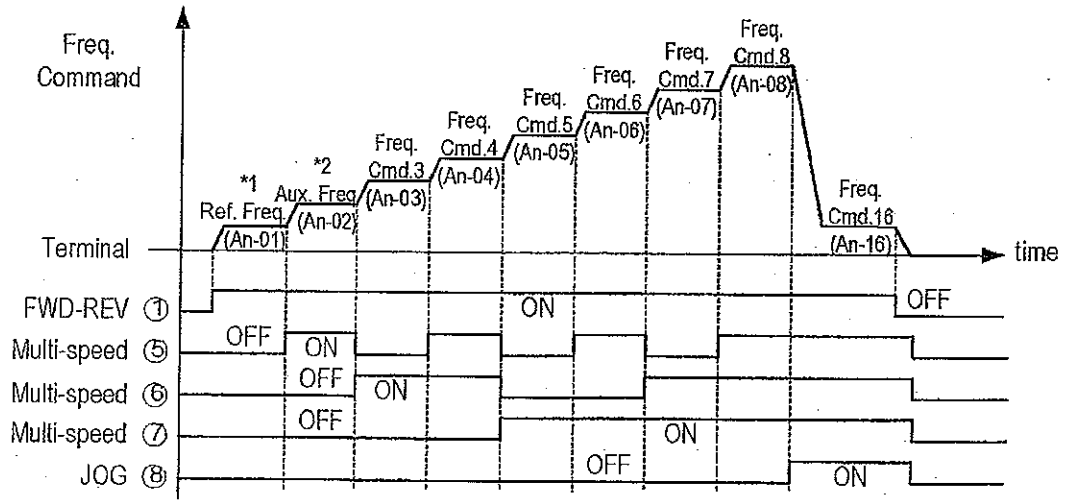


Fig. 40. Time chart for multi-step speed and jog command

*1 When the parameter Sn-05= 0, the reference command is input by the setting of An-01. Instead, when the parameter Sn-05= 1, the reference command is input from analog command through the terminal VIN and AIN.

*2 If the parameter Sn-29= 0, the auxiliary frequency (the 2nd step frequency setting: AUX frequency) is input from the AUX terminal. If the parameter Sn-29 ≠ 0, the 2nd step frequency setting is determined by the parameter of An-02.

- Acceleration Time And Deceleration Time Change (Setting : 07)
  - The acceleration time and deceleration time can be changed through the control circuit terminal ⑤~⑧ as described on page 3-4.
- External Baseblock (A Contact) (Setting : 08)
- External Baseblock (B Contact) (Setting : 09)
  - With either of these settings, the multi-function input terminal controls its inverter baseblock operation.
  - During running: As an external baseblock signal is detected, the digital operator will display a "B.B. Alarm". Then, the inverter output is blocked. After the baseblock signal is cleared, the motor will resume running according to its then reference signal.
  - During deceleration : An external baseblock signal is input, the digital operator will display " B.B. Alarm", the inverter is blocked from output and the output frequency will drop to zero. The motor will then coast to stop freely. After this external baseblock signal is cleared, the inverter will stay in stop mode.
- Acceleration and Deceleration Ramp Hold (Setting : 10)
  - With this setting, the signal of Acceleration/deceleration ramp hold (input from the multi-function input terminals) will pause the Acceleration/deceleration of motor and maintain the then output frequency. The motor will coast to stop if an OFF command is input while the acceleration / deceleration ramp hold input is ON, the then output frequency will be memorized and the command of Acceleration/deceleration ramp hold is released.

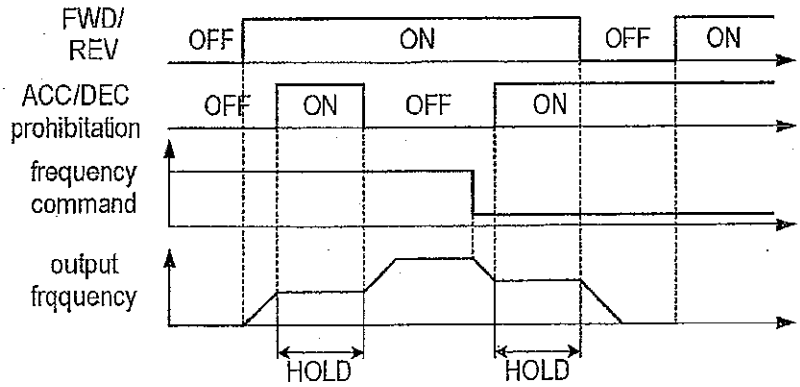


Fig. 41. Acceleration and deceleration ramp hold

- Inverter Overheat Alarm (Setting : 11)
  - When the inverter detects a overheat signal "ON", the digital operator will change its display as "Overheat Alarm". And the inverter still maintains its operation. When the overheat signal is "OFF", the digital operator will restore its previous display automatically. No RESET-key pressing is required.
- FJOG Command (Setting : 12)
- RJOG Command (Setting : 13)
  - The jogging can be performed in forward or reverse rotation.
    Setting = 12: FJOG command "ON": Run forward at the jog frequency (An-17).
    = 13: RJOG command "ON": Run reverse at the jog frequency (An-17).
  - The forward jog and reverse jog commands have priority over other frequency command commands.
  - The inverter will stop running with the stopping method set by the setting of Sn-06 if the forward jog and reverse jog commands are both ON for more than 500 ms.
- PID Integral Reset (Setting : 14)
  - In the application of PID control, the integral can be reset to zero (ground) through the multi-function input terminal ⑤~⑧ (Sn-25~28= 14).
- PID Control Invalid (Setting : 15)

OFF	PID control valid (close-loop)
ON	PID control invalid (open-loop)

  - This setting can be used in the changeover of test run. To disable the PID function (PID control invalid is "ON") , an open-loop operation or jog operation can be performed in the test. The system can be set up properly after some test runs. Then, the system can be changed into PID control mode. Moreover, if the feedback signal is not usable, the PID function is disabled through this setting.
  - The setting of Sn-64 can be used to enable or disable the PID function.
- External Fault Contact A (Setting : 16)
- External Fault Contact B (Setting : 17)
  - The external fault input terminal is set to "ON", an external fault then occurs. If the external input terminal ⑥ is set for the external fault input terminal use, a message of "Fault Ext. Fault 6" will be displayed.
  - There are 5 terminal to be assigned as external fault inputs, they are terminal ③, ⑤, ⑥, ⑦, ⑧
  - When an external fault occurs, the inverter will be blocked from output and the motor will coast to stop.

- Multi-Function Analog Input Setting (Setting : 18)
  - To disable or enable the multi-function analog input at AUX terminal is controlled by the input signal at an external terminal. When the PID function is enabled, the original AUX function will be disabled.
- Timer Function Input Terminal (Setting : 19)
  - Refer to the setting of timer function output terminal on page 3-66.
- DC Injection Braking Command (Setting : 20)
  - DC injection braking is used to prevent the motor from rotating due to inertia or external forces when the inverter is stopped.
  - The DC injection braking will be performed and the inverter will be stopped if the DC injection braking input is ON.
    If a run source or jog command is input, the DC injection braking will be cleared and the motor will begin to run.

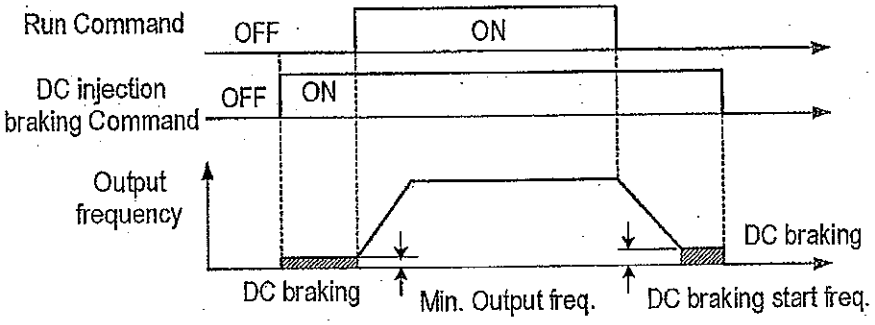


Fig. 42. Time chart for DC injection braking command

- Speed Search 1 (Setting : 21)
- Speed Search 2 (Setting : 22)
  - Refer to 'speed search' function on page 3-24.
- LOCAL/REMOTE Control 1 (setting : 23)

OFF	Remote Control Run command and frequency command is performed through control circuit input or RS-485 communication port. (It will be set by the combination of settings of Sn-04 and Sn-05.) The REMOTE-REF › SEQ LED light is ON.
ON	Local Control Run command and frequency command is performed through digital operator. The REMOTE-REF › SEQ LED light is OFF.

  - To change the operation mode from LOCAL to REMOTE mode is effective only when the inverter is in STOP mode.

- LOCAL/REMOTE Control 2 (setting : 24)

OFF	Remote Control Run command and frequency command is performed through control circuit input or RS-485 communication port. (It will be set by the combination of settings of Sn-04 and Sn-05.) The REMOTE-REF , SEQ LED light is ON.
ON	Local Control Run command and frequency command is performed through control circuit terminal. The REMOTE-REF , SEQ LED light is OFF.

  - To change the operation mode from LOCAL to REMOTE mode is effective only when the inverter is in STOP mode.

- RS-485 Communication Application (Setting : 25)
  - The multi-function input terminals ⑤ ~ ⑧ can be used as the extension contact terminals of PLC with the command communicated through the RS-485 port. (Please refer to the "RS-485 MODBUS/PROFIBUS APPLICATION MANUAL")

- PG-Less Speed Control Action (Setting : 26)

- Reset Integration of Speed Control with PG (Setting : 27)
  - When PG feedback is used, the integral control (to add the PG feedback compensation) can be disabled or enabled from the external terminals. And, user can use the external terminals to clear the integral value.

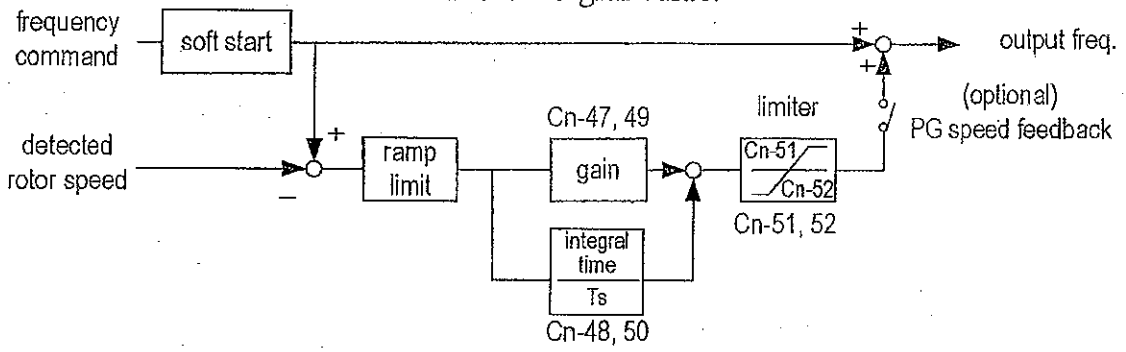


Fig. 43. PG speed control block diagram

- Frequency UP/DOWN Function (Setting : 28)
  - The inverter can use either the digital operator or external multi-function input terminals (terminal ⑦ or⑧) to change the output frequency upward or downward.
  - By setting the parameters of (Sn-04= 1 › Sn-05= 1), firstly the run source and frequency command is set through the control circuit terminals. Secondly, set the parameter Sn-28 = 28 (terminal ⑦ will now have the function "UP", its original function is disabled). Then, terminal ⑦ and ⑧ can be used for "UP" and "DOWN" function to control /change the output frequency.
  - Operation sequence as below:

Control circuit terminal ⑦ : UP function	ON	OFF	OFF	ON
Control circuit terminal ⑧ : DOWN function	OFF	ON	OFF	ON
Operation status	ACC (UP)	DEC (DOWN)	Constant (HOLD)	Constant (HOLD)

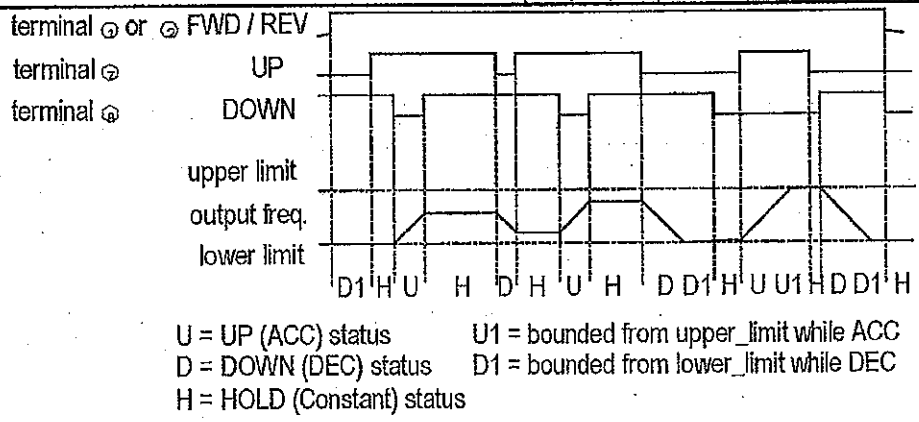


Fig. 44. Time chart of output frequency with the UP/DOWN function

  - Only set through parameter Sn-28
  - When the frequency UP/DOWN function is being used, the output frequency will accelerate to the lower_limit (Cn-19) if a run command is pressed.
  - If under HOLD state, 4th bit of Sn-68 is set to 1 power supply OFF, the inverter can remember output frequency as power supply OFF. When resupplying the power and operation command ON, the inverter will run at the remembered output frequency.
  - Under auto operation mode, UP/DOWN operation is unavailable.
  - When the UP/DOWN function and jog frequency command are both assigned to multi-function inputs, the jog frequency command input has the highest priority.
  - Under UP/DOWN operation, PID is unavailable.

- Forced Run (Setting : 29)
  - Only set through parameter Sn-28. It is for special use (smoke fan, etc.)

(32) Multi-Function Analog Input Function Selection (Sn-29)

- The settings and functions for the multi-function analog input (terminal AUX) are listed in Table 15.

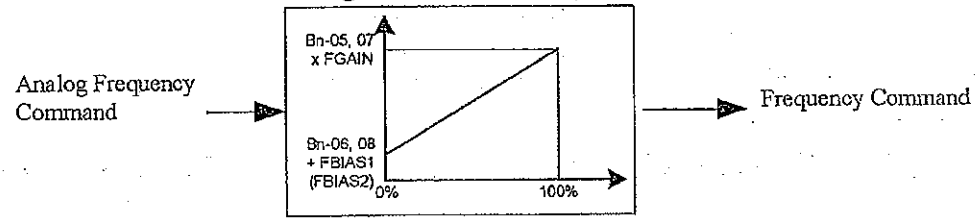
Table 15 Multi-function analog input function list

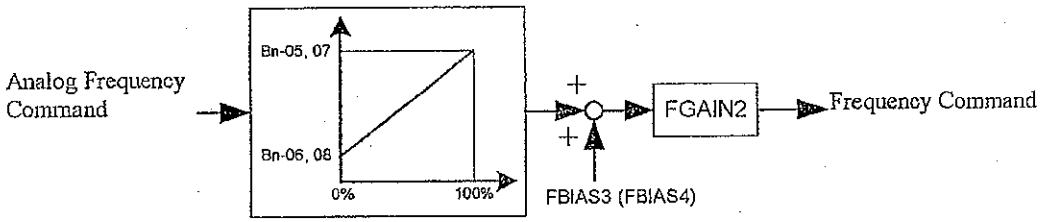
Setting	Function	LCD Display	Description (100% output corresponds to 10 V level)
00	Auxiliary frequency command	Auxilary Freq.Cmd.	(Max. output frequency)
01	Frequency command gain (FGAIN)	Instruction gain 1	Total gain = (Bn-05, Bn-07) ×FGAIN
02	Frequency command bias 1 (FBIAS1)	Cmd. Bias 1	Total bias = (Bn-06, Bn-08) + FBIAS1
03	Frequency command bias 2 (FBIAS2)	Cmd. Bias 2	Total bias = (Bn-06, Bn-08) + FBIAS2
04	Torque detection level 1	Tq. Detect Level 1	According to analog input voltage (0～10V), change torque detection 1 level (setting of Cn-32 is disabled)
04	Overtorque detection level	Over Tq. Level	According to analog input voltage (0～10V), change overtorque detection level (setting of Cn-32 is disabled)
05	Output frequency bias (VBIAS)	Output Voltage	Total output voltage= V/F pattern voltage + VBIAS
06	Scaling of ACC/DEC time(TK)	Acc&Dec Coeff	Real ACC/DEC time= ACC/DEC time (Bn-0~24) / TK
07	DC injection braking	DC Brakin current	According to analog input voltage (0～10V), change the level of DC injection current (0-100%). (inverter rated current=100%, the setting of DC injection current Cn-15 is disabled)
08	Stall prevention level during running	Run Still Level	According to analog input voltage (1.5V～10V), change the level of stall prevention during running (30%～200%) (inverter rated current=100%, the setting Cn-26 is disabled.)
09	PID control reference input	PID Command	Multi-function analog input (terminal AUX) used as PID control reference input (0~10V). Please refer to "PID CONTROL BLOCK DIAGRAM" on page 3-7.
10	Frequency command lower limit	Freq. Cmd. Low Bound	Change the frequency command lower-limit (0-100%) value according to the then analog input voltage (0~10V) (Max. output frequency (Cn-02) corresponds to the 100% analog output. The actual lower-limit is determined by the maximum of Cn-19 and the value corresponding to the multi-function analog input terminal).
11	Jump frequency setting4	Freq Jump 4	Set the jump frequency 4, according to analog input voltage (0~10V), while Cn-20~Cn-23 can be used to set the jump frequency 1~3 and their jump frequency width.

12	RS-485 communication application	Comm. Control	The analog value of AUX (0-1024/0-10V) can be read through RS-485 communication.
13	Frequency instruction gain 2 (FGAIN) *1	Instruction gain2	With Bn-05, 06 (or Bn-07, 08) set, adjust analog frequency instruction gain and bias (gain and bias adjustment is similar to 7200GA)
14	Frequency instruction bias3 (FBIAS1) *1	Instruction bias 3	
15	Frequency instruction bias 4 (FBIAS2) *1	Instruction bias 4	
16	Torque detection level 2 (for 74.03 and later software version only)	Tq. Detect Level 2	According to analog input voltage (0～10V), change torque detection 2 level (setting of Cn-62 is disabled)

*1: 30.14 later version software will provide such function.

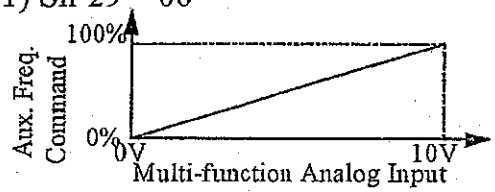
- Analog input AUX can provided two groups of gain and bias as Sn-29 = 1~3 and 13-15. When Sn-29 = 13~15, the adjustment of gain and bias is similar to GA series. The following is the block diagrams: (Following is new diagram)



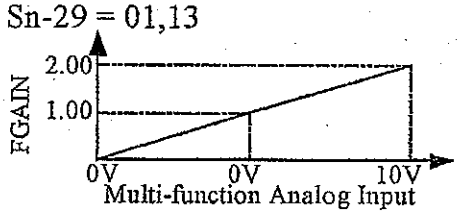


• Multi-function analog input characteristics

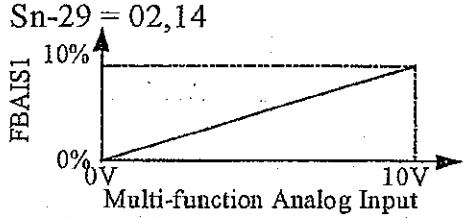
(1) Sn-29 = 00



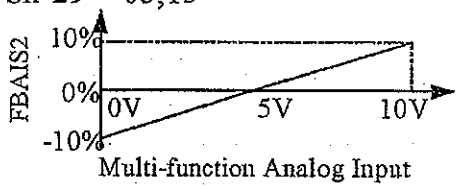
(2) Sn-29 = 01,13



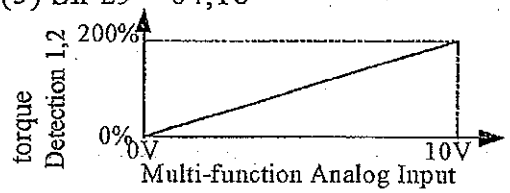
(3) Sn-29 = 02,14



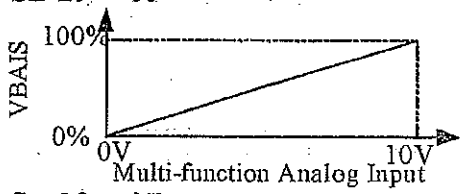
(4) Sn-29 = 03,15



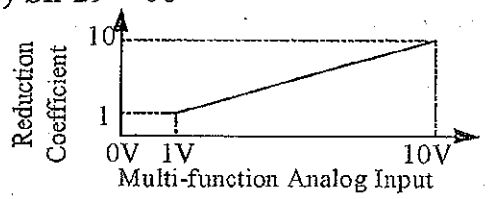
(5) Sn-29 = 04,16



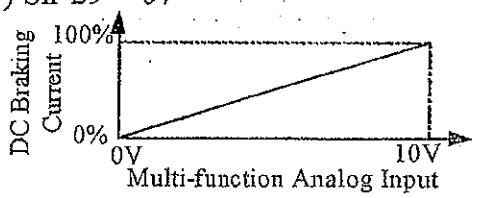
(6) Sn-29 = 05



(7) Sn-29 = 06

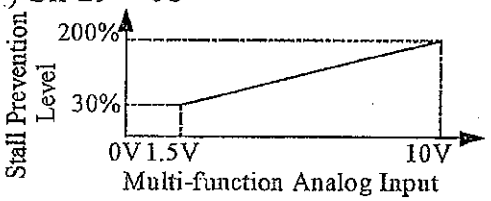


(8) Sn-29 = 07



$$\text{Real ACC/DEC Time} = \frac{\text{ACC/DEC Time (Bn-01~04)}}{\text{Reduction Coefficient (TK)}}$$

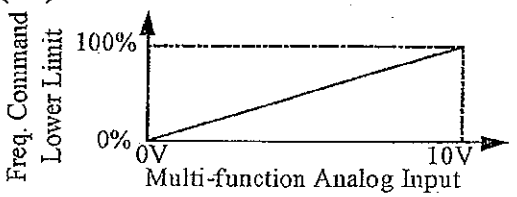
(9) Sn-29 = 08



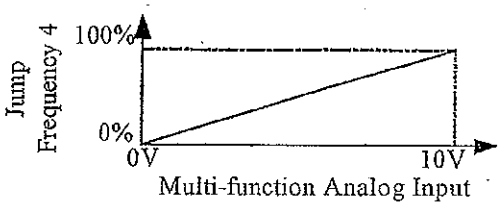
(10) Sn-29 = 09

Multi-function analog input (terminal AUX) used as PID control reference input (0~10V). Please refer to "PID CONTROL BLOCK DIAGRAM" on page 3-9 and App-3.

(11) Sn-29 = 10



(12) Sn-29 = 11



(13) Sn-29=12 : For RS-485 communication use. The analog value of AUX (0-1024/0-10V) can be read through RS-485 communication. (Please refer to 'RS-485 MODBUS/PROFIBUS Application Manual')

(14) Multi-Function Output Terminal (RA-RB-RC or R1A-R1B-R1C) Function

Selection (Sn-30)

(15) Multi-Function Output Terminal (DO1-DOG) Function Selection (Sn-31)

(16) Multi-Function Output Terminal (DO2-DOG or R2A-R2C) Function Selection (Sn-32)

Multi-function output terminal setting and its function as shown in Table 16.

Table 16 Multi-function output terminal function

Setting	Function	LCD Display	Description
00	During running	Running	ON : During running
01	Zero speed	Zero Speed	ON : Zero speed
02	Frequency agree	Frequency Arrive	Speed agree width: Cn-31
03	Setting frequency agree	Agreed F Arrive	ON : output frequency = ±Cn-29, Speed agree width: Cn-31
04	Output frequency detection1	Freq. Det. 1	ON : while ACC, -Cn-29□output freq.□Cn-29 while DEC, -Cn-30□output freq.□Cn-30 Speed agree width: Cn-31
05	Output frequency detection2	Freq. Det. 2	ON : while ACC, output freq□Cn-29(or□-Cn-29) while DEC, output freq□Cn-30(or□-Cn-30) Speed agree width: Cn-31
06	Inverter ready	Run Ready OK!	ON : READY
07	Undervoltage detected	Low Volt Detect	ON : Undervoltage detected
08	Output baseblocked	Output B.B.	ON : Output baseblocked
09	Run source mode	Run Source Operator	ON : Run source from digital operator (Local mode)
10	Frequency command mode	Ref. Cmd. Operator	ON : Frequency command from digital operator (Local mode)
11	Torque Detection 1, Contact A	Tq. Detect 1 NO_Cont	ON : Torque detection 1 detected, (Contact A)
12	Frequency command Invalid	Freq. Cmd. Invalid	ON : Frequency command Invalid
13	Fault	Fault	ON : Fault
14	Pulse signal output	Pulse Mul. Output	Only set by Sn-31, Sn-32 (terminal DO1-DOG)
15	Undervoltage alarm	Low Volt Alarm	ON : Undervoltage alarm
16	Inverter overheat	Inverter Over Heat	ON : Inverter Overheat
17	Motor overload	Motor Over Load	ON : Motor Overload
18	Inverter Overload	Inverter Over Load	ON : Inverter Overload
19	Fault retry	Fault Retry	ON : Retry
20	RS-485 communication fault	RS-485 Fault	ON : RS-485 communication fault
21	Timer function output	Timer Function	Signal delay output (.vs. timer function input)
22	RS-485 Communication Application	Comm. Control	Extension Output Contact application (Please refer to MA7200 RS-485 MODBUS /PROFIBUS Application Manual')
23	Torque Detection 1, Contact B	Tq. Detect 1 NC_Cont	ON : Torque detection 1 detected, (Contact B)
24	Torque Detection 2, Contact A	Tq. Detect 2 NO_Cont	ON : Torque detection 2 detected, (Contact A)
25	Torque Detection 2, Contact B	Tq. Detect 2 NC_Cont	ON : Torque detection 2 detected, (Contact B)

• During Running (Setting:00)

OFF	Run source OFF, inverter is off.
ON	Run source ON, or Run source OFF but residues output exists

• Zero Speed (Setting : 01)

OFF	Output frequency ≧ MIN. output frequency (Cn-07)
ON	Output frequency < MIN. output frequency (Cn-07)

• Frequency Agree : (Setting : 02)

• Setting Frequency Agree : (Setting : 03)

• Output Frequency Detected 1 : (Setting : 04)

• Output Frequency Detected 2 : (Setting : 05)

  • Refer frequency detection function on page 3-22.

• Inverter Ready (Setting : 06)

• Undervoltage Detected (Setting : 07)

  • When the DC link voltage of main circuit is lower than the UNDERVOLTAGE DETECTION LEVEL (Cn-39), the output contact is in 'ON' state.

• Output Blocked (Setting : 08)

• Run Command Mode (Setting : 09)

OFF	Remote Mode (Sn-04 = 1,2, or multi-function input terminal ⑤~⑧ is set as Local/remote control I mode or Local/remote control II mode and contact terminal is OFF). Remote-SEQ LED is light in LCD digital operator
ON	Local Mode (Sn-04 = 0 multi-function input terminal ⑤~⑧ is set as Local/remote control I mode and contact terminal is ON).Remote-SEQ LCD is OFF, run command is from LCD digital operator

• Frequency Command Mode (Setting : 10)

OFF	Remote mode (Sn-05 = 1,2 , or multi- function input terminal ⑤~⑧ is set as Local/remote control I mode or Local/remote control II mode and contact terminal is OFF). Remote-REF LED is light in LCD digital operator
ON	Local mode (Sn-05 = 0 multi- function input terminal ⑤~⑧ is set as Local/remote control I mode and contact terminal is ON). Remote-REF LED is OFF, run command is from LCD digital operator

- Overtorque Detected (Setting : 11)
  - See page 3-23,3-47 for torque detection function.
- Frequency Command Missing (Setting : 12)
  - Run source is ON and frequency command is 0, the output at the multi-function output terminal is ON.
- Fault (Setting : 13)
  - If a fault occurs, the multi-function output terminal is ON. However, no response will occur if a communication fault occurs.
- Pulse Signal Output (Setting : 14)
  - Only multi-function output terminal DO1-DOG (Setting Sn-31) can be set as the pulse signal output.
  - DO1 is a photo-coupler output, its pulse output frequency is set by parameter Sn-35.
  - Its wiring is:

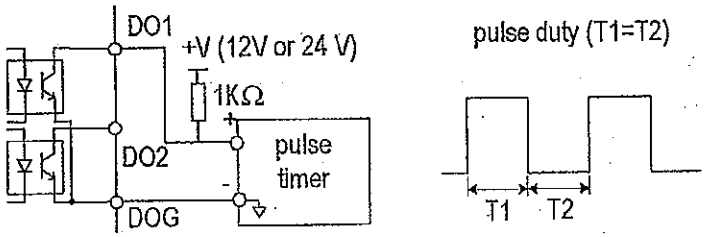


Fig. 45. Pulse signal output

- Undervoltage Alarm (Setting : 15)
  - If the main circuit DC bus voltage is below the undervoltage alarm detected level, the multi-function output terminal is ON.
  - Undervoltage alarm detected level : 230V Class : 240VDC
    460V Class : 460VDC
- Inverter Overheat (Setting : 16)
  - See Page 4-2. If the cooling fin is overheat, the multi-function output terminal is ON.
- Motor Overload (Setting : 17)
  - See "Motor overload protection selection" on page 3-50. If the motor has overload fault, the multi-function output terminal is ON.
- Inverter Overload OL2 (Setting : 18)
  - If the inverter has overload fault, the multi-function output terminal is ON. See page 4-2.

- Fault Retry (Setting : 19)
  - See "Fault restart function" (Cn-24) on page 3-19. Upon restart, the multi-function output terminal is ON.
- RS-485 Communication Fault (Setting : 20)
  - See page 4-2.
- Timer Function Output (Setting : 21)
  - If the multi-function input terminals ⑤~⑧ are set as the timer input terminals (Sn-25 - 28 = 19), the signal will be output through the corresponding multi-function output terminals with the specified ON-delay and OFF-delay, as shown below. See "Timer function" on page 3-9.

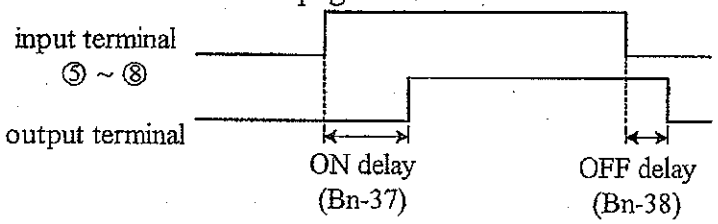


Fig. 46. The input/output signal in 'Timer' function application

- RS-485 Communication Application (Setting : 22)
  - In the application that the control commands are executed through the RS-485 communication port, the multi-function output terminals can be used as the PLC Extension Output Contact Terminals. For more details, Please refer to 'RS-485 MODBUS/PROFIBUS Application Manual'.
- Torque Detection 1, Contact B (Setting : 23)
- Torque Detection 2, Contact A (Setting : 24)
- Torque Detection 2, Contact B (Setting : 25)
  - These settings are available for 74.03 and later software version only.
  - See page 3-23, 3-47 for torque detection function.

(33) Multi-Function Analog Output (Terminal AO1) Selection (Sn-33)

(34) Multi-Function Analog Output (Terminal AO2) Selection (Sn-34)

- The multi-function analog output can be set to monitor the following 12 status items as shown below :

Sn-33, Sn-34 Setting	Monitored contents	Description	
		Input	Output
00	Frequency Command	0 ~ max. frequency	0~10V
01	Output Frequency	0 ~ max. frequency	
02	Output Current	0 ~ rated current	
03	Output Voltage	0 ~ rated voltage	
04	DC Voltage	230V class 0~400V 460V class 0~800V	
05	VIN Analog Command	0 ~ 10 V	
06	AIN Analog Command	4 ~ 20 mA	
07	AUX Analog Command	0 ~ 10 V	
08	PID Input	0 ~ max frequency	
09	PID Output1	0 ~ max frequency	
10	PID Output2	0 ~ max frequency	
11	Comm. Control	0~100%*1	

Note :

*1: When the setting of Sn-33~34= '11', the multi-function output terminals AO1, AO2 are controlled through RS-485 port either by MODBUS or PROFIBUS protocol. Please refer to "RS-485 MODBUS/PROFIBUS Application Manual"

- The output gain (Bn-14 and Bn-15) will determine the output voltage at multi-function analog output at AO1, AO2 terminal. The specified multiple of 10V will correspond to the 100% output monitored value.

(35) Pulse Output Multiplication-Gain Selection (Sn-35)

- If the multi-function output terminal (DO1) be set as pulse output (when Sn-31 or Sn-32= 14), the final output pulse frequency is the multiple (according to Sn-35) of the inverter output frequency. Refer to Fig. 45 for pulse signal output.
- Ex1: when Sn-35= 0, the inverter output frequency is 60Hz, the output pulse frequency is 60 Hz (duty = 50%).

- Different settings of Sn-35 and their corresponding multiple numbers as shown below :

Sn-35 setting	Pulse output frequency	Applicable freq. range
0	1F : 1 ×inverter output frequency	3.83~400.0Hz
1	6F : 6 ×inverter output frequency	2.56~360.0Hz
2	10F : 10 ×inverter output frequency	1.54~210.0Hz
3	12F : 12 ×inverter output frequency	1.28~180.0Hz
4	36F : 36 ×inverter output frequency	0.5 ~ 60.0Hz

(36) Inverter Station Address (Sn-36)

(37) RS-485 Communication Baud Rate Setting (Sn-37)

(38) RS-485 Communication Parity Setting (Sn-38)

(39) RS-485 Stopping Method After Communication Error (Sn-39)

- The MA7200 inverter has a built-in RS-485 port for monitoring inverter status and reading the parameter setting. Under the remote mode operation, the inverter status and the parameter settings can be monitored. Moreover, the user can change the parameters setting to control the motor operation.
- MA7200 will use MODBUS protocol to communicate with external units by means of the cable line form RS-485 port.
- Parameter definition is as follows:
  - Sn-36 : inverter station address, setting range 1~31.
  - Sn-37 = 0: 1200bps (bps: bit / sec)
    = 1: 2400bps
    = 2: 4800bps
    = 3: 9600bps
  - Sn-38 = 0: no parity
    = 1: even parity
    = 2: odd parity
  - Sn-39 = 0: Deceleration to stop with Bn-02 (deceleration time), when RS-485 has communication error.
    = 1: Coast to stop
    = 2: Deceleration to stop with Bn-04 (deceleration time), when RS-485 has communication error.
    = 3: Continue to run (will stop if the key stop is pressed)
- Every data stream has a data length of 11 bits : 1 start bit + 8 data bits + 1 parity bit and 1 stop bit. If Sn-38=0, the parity bit is 1.

- 3 different commands are used for communication between the inverter and external units:
  a. Read command: external units to read the memory address of the inverter.
  b. Write command: external units to write the memory address of the inverter in order to control the inverter.
  c. Circuit test command: To test the communication status between the inverter and external units.
- The change of setting Sn-36, Sn-37, Sn-38 will be effective in the next start time after turning off the inverter.
- Do not make the DRIVE/PRGM changeover while writing the date into the inverter through RS-485 port.
- For more details of RS-485 communication, refer to "RS-485 MODBUS/PROFIBUS Communication Application Manual".

(40) PG Speed Control Settings (Sn-40)

Sn-40 = 0 : Disable speed control function.
= 1 : Enable speed control.
= 2 : Enable speed control. No integral action during ACC/DEC.
= 3 : Enable speed control. Integral action is enabled.

(41) Operation Selection at PG Opens (Sn-41)

Sn-41 = 0 : deceleration to stop (Bn-02)
= 1 : coast to stop
= 2 : deceleration to stop (Bn-04)
= 3 : continue to run

} Display "PG Open" alarm.

Blinking display "PG Open" alarm.

(42) Operation Selection at PG Speed Deviation Over (Sn-42)

Sn-42 = 0 : deceleration to stop (Bn-02)
= 1 : coast to stop
= 2 : deceleration to stop (Bn-04)
= 3 : continue to run

} Display "Sp. Deviate Over" fault message.

Blinking display "Sp. Deviate Over" alarm

(43) Overspeed Detection (Sn-43)

Sn-43 = 0 : deceleration to stop (Bn-02)
= 1 : coast to stop
= 2 : deceleration to stop (Bn-04)
= 3 : continue to run

} Display "Over Speed" fault message.

Blinking display "Over Speed" alarm.

(44) Auto_Run Mode Selection (Sn-44)

(45) Auto_Run Mode Setting Selection (Sn-45~Sn-60)

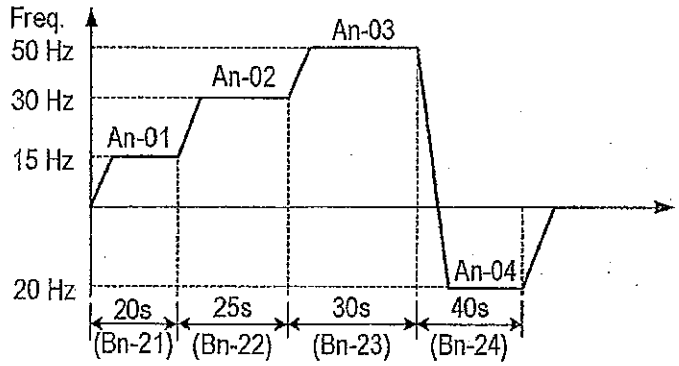
- A PLC operation mode is ready to use with the following setting of the multi-step frequency command1~16 (An-01~An-16), Auto_Run mode time setting (Bn-21~Bn-36) under the auto_run mode selection (Sn-44). The FWD/REV direction can be set with the setting of Sn45~60.
- Under auto operation mode, to set operation direction by operator, multi-function input terminal or RS-485 are all invalid.
- Under auto operation mode, preset frequency by multifunction input terminal⑤～⑧, and frequency UP/DOWN function is invalid. But if input JOG command as FJOG, RJOG, they will be prior to others. (refer to Sn-25～28) .
- Some example in auto_run mode：

(A) Single Cycle Running (Sn-44= 1, 4)

The inverter will run for a single full cycle based upon the specified setting mode. Then, it will stop.

For example :

Sn-44 = 1	Sn-45~47=1(FWD)	Sn-48=2(REV)	Sn-49~60 = 0
An-01 = 15Hz	An-02 = 30Hz	An-03 = 50Hz	An-04 = 20Hz
Bn-21 = 20s	Bn-22 = 25s	Bn-23 = 30s	Bn-24 = 40s
An-05~16 = 0Hz	Bn-25~36 = 0s		



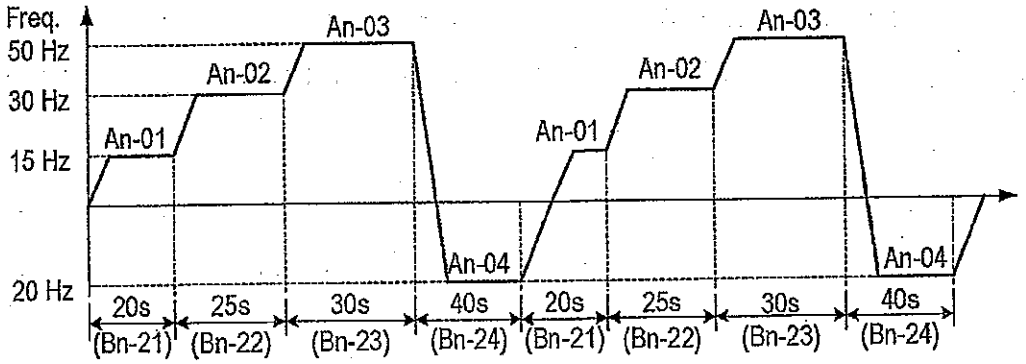
(B) Periodic Running (Sn-44 = 2, 5)

The inverter will repeat the same cycle periodically.

For example :

Sn-44 = 2

An-01 ~ 16, Bn-21 ~ 36, Sn-45-60 : same setting as the example (A)



(C) Auto_Run Mode for Single Cycle

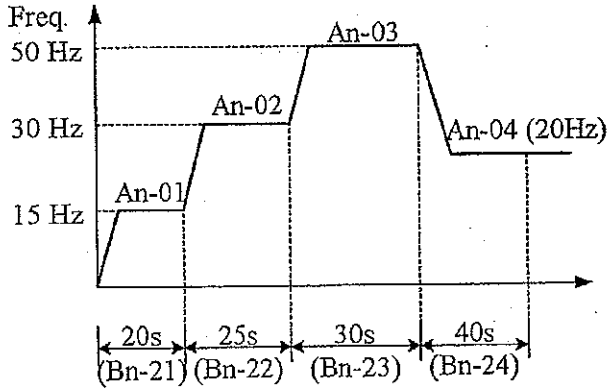
The speed of final step will be held to run.

For example :

Sn-44 = 3

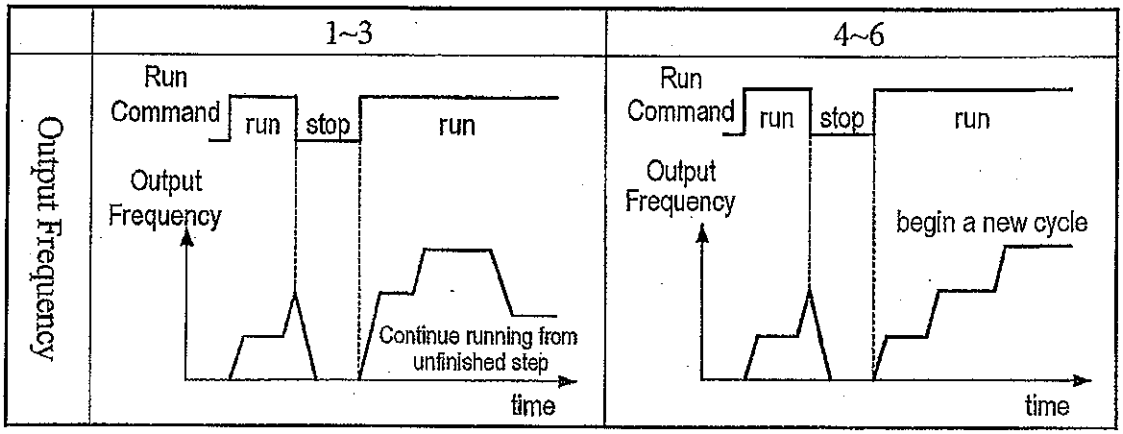
Sn-45~48 = 1 (FWD) Sn-49~60 = 0

An-01 ~ 16, Bn-21 ~ 36 : same setting as the example (A)



- Sn-44 = 1~3 : If the inverter stops and re-starts again, it will continue running from the unfinished step, according to the setting of Sn-44.

  = 4~6 : If the inverter stops and re-starts again, it will begin a new cycle and continue running according to the setting of Sn-44.



- ACC/DEC time follow the setting of Bn-01, Bn-02 in Auto_Run Mode.
- If the setting values of Bn-21～Bn-36 are all zero, the Auto_Run Mode is disabled.

(46) Applied Torque Load (Sn-61)

- Select either the constant torque load (Sn-61=0) or varied torque load (Sn-61=1). The inverter will automatically choose the proper V/F pattern and change the inverter overload protection curve. (See page 3-39 for 'INVERTER CAPACITY SELECTION').

(47) LCD Language Displayed Selection (Sn-62)

- Sn-62 = 0 : English
  = 1 : Chinese

(48) Parameter Copy (Sn-63)

- JNEP-31 LCD digital operator can upload the parameter settings from the LCD digital operator to inverter and download parameter settings from the inverter to the LCD digital operator.
- LCD digital operator will check its EEPROM or the inverter's EEPROM under the following settings.
- Sn-63 = 0 : NO action
  = 1 : Upload data (LCD digital operator →inverter). During this period, the LED on the LCD digital operator will light sequentially in the CW sense.
  = 2 : Download data (inverter →LCD digital operator). During this period, the LED on the LCD digital operator will light sequentially in the CCW sense.
  = 3 : Verification check on LCD's EEPROM; during this period the LED will be switch-on between 2 groups.
  = 4 : Verification check on inverter's EEPROM; during this period the LED will not light.

- Please follow the below steps to implement the action of parameter copy between different inverters (either upload or download).
  Step 1: Check the contents of (LCD) digital operator EEPROM (Sn-63='03'), then check the contents of inverter's EEPROM (Sn-63='04'). Make sure that both EEPROM function properly.
  Step 2: Download and copy the inverter's parameter settings to LCD digital operator EEPROM (Sn-63=2).
  Step 3: Upload and copy the parameter settings of LCD digital operator to other inverter's EEPROM (Sn-63=1).

(49) PID Function Selection (Sn-64)
- To enable PID control, set Sn-64=1. Otherwise, set Sn-64=0 to disable PID control function. Moreover, it is possible to use the multi-function terminals ⑤~⑧ to enable/disable PID control.

(50) Braking Resistor Protection Selection (Sn-65)
- Sn-65 = 0 : External braking resistor protection invalid
  = 1 : External braking resistor protection valid
- Whenever the external braking resistor is used, be sure that the parameter 'Sn-65 = 1' is set.

(51) Motor Parameter Autotuning Selection (Sn-66)
- The AUTOTUNE feature can be used to identify and store the motor's parameters
- Sn-66 = 0 : Autotuning Disable
  = 1 : Autotuning Enable

(52) Control Mode Selection (Sn-67)
- Select one of the two control modes
- Sn-67 = 0 : V/F Control Mode (include V/F control with PG feedback)
  = 1 : Sensorless Vector Control Mode

Sensorless Control *1

1. Set Sn-67 = 1 for sensorless vector control.
2. Set Sn-66 = 1 for autotuning.

*1. For output frequency less than 1.5Hz in sensorless vector control, set Sn-02=15 and then change Cn-07 to required frequency.

(53) Control selection (Sn-68)
- The set method adopts bit edit, each bit represents one item of function. One bit is set to 0 indicates such function is unavailable, while 1 is available.
- Bit 1(——Y) is corresponding to phase lose protection function. If ON the function, the inverter will stop output when output terminals phase-lose.
- Bit 2 (—Y–) is reversed with no function.

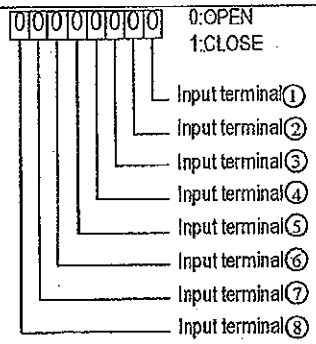
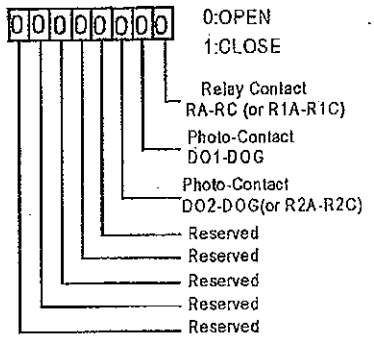
- Bit 3(–Y—) is set to allow ±10V analog voltage input. If the bit is set to 1, the analog voltage input terminal (Vin) can input -10V~+10V. If it is set to 0, the analog input terminal (Vin) is default as 0V, that is the voltage is less that 0V is not acceptable. Start PID control (Sn-64=1~8), to set the bit, feedback signal ±10V is acceptable. The function on 30.16 later versions and with 4P101C01301 control board is available. The previous version or with not 4P101C01301, the bit is without such function.
- Bit 4(Y——) is set to remember output frequency UP/DOWN function under HOLD state. If the bit is set to 1, to remember the output frequency the latest OFF the inverter. If 0, the function is available. Please refer to Sn-28=28 parameters description for frequency UP/DOWN function

(54) Torque Detection 2 Selection (Sn-69)- See Page 3-47

(55) Engineering Unit (Sn-70)

- The parameter is available for 74.03 and later software version only.
- The inverter supports following engineering unit for frequency command, frequency display and PID feedback display.
- Sn-70 = 0 : NONE
  1 : FPM (feet per minute)
  2 : CFM (cubic feet per minute)
  3 : PSI (pounds per square inch)
  4 : GPH (gallons per hour)
  5 : GPM (gallons per minute)
  6 : in
  7 : ft
  8 : /s (units per second)
  9 : /m (units per minute)
  10 : /h (units per hour)
  11 : °F
  12 : inW (inches in water column)
  13 : HP
  14 : m/s (meters per second)
  15 : MPM (meters per minute)
  16 : CMM (cubic meters per minute)
  17 : W
  18 : kW
  19 : m
  20 : °C
- The function is enabled while LCD Digital Operator Display (Cn-28) is in the range from 40 to 39999.

3.5 Monitoring parameters Un-□□

Parameter No.	Name	LCD display (English)	Unit	Description	Multi-function Analog Output Level
Un-01	Frequency Command	Un-01=60.00Hz Frequency Command	0.01Hz	Display frequency command. The displayed unit is determined by Cn-28.	10V/MAX. Output Frequency
Un-02	Output Frequency	Un-02=60.00Hz Output Frequency	0.01Hz	Display output frequency. The displayed unit is determined by Cn-28.	10V/MAX. Output Frequency
Un-03	Output Current	Un-03=12.5A Output current	0.1A	Display inverter output current.	10V/Inverter Rated Current
Un-04	Output Voltage	Un-04=220.0V Output Voltage	0.1V	Display output voltage command of inverter	10V/230V or 10V/460V
Un-05	Main Circuit DC Voltage	Un-05=310.0V DC Voltage	0.1V	Display DC voltage of inverter main circuit.	10V/400V or 10V/800V
Un-06	External Analog Command VIN	Un-06=100% Voltage ~Cmd.	0.1%	—	10V/100%
Un-07	External Analog Command AIN	Un-07=100% Current ~Cmd.	0.1%	—	20mA/100%
Un-08	Multi-Function Analog Input Command AUX	Un-08=100% Multi_Fun ~Cmd.	0.1%	—	10V/100%
Un-09	External Analog Output AO1	Un-09=100% Term.AO1 Output	0.1%	—	10V/100%
Un-10	External Analog Output AO1	Un-10=100% Term.AO2 Output	0.1%	—	10V/100%
Un-11	Input Terminal Status	Un-11= 00000000 I/P Term. Status	—		—
Un-12	Output Terminal Status	Un-12= 00000000 O/P Term. Status	—		—

Note : Term. is terminal abbrev.

Parameter No.	Name	LCD display (English)	Unit	Description	Multi-function Analog Output Level
Un-13	Amount of PG Speed Feedback	Un-13= 100.0% PG Feedback.	0.1%	100.0%=MAX. output frequency	10V/MAX. Output Frequency
Un-14	Amount of PG Speed Compen.	Un-14= 100.0% PG Compen.	0.1%	100.0%=MAX. output freq.	10V/MAX. Output Frequency
Un-15	PID Control Input	Un-15= 100% PID Input	0.1%	100.0%=MAX. output freq.	10V/Max. output frequency
Un-16	PID Control Output 1	Un-16= 100% PID Output1	0.1%	100.0%=MAX. output freq.	10V/Max. output frequency
Un-17	PID Control Output 2	Un-17= 00% PID Output2	0.1%	100.0%=MAX. output freq.	10V/Max. output frequency
Un-18	Fault Message 1	Overcurrent Message1	—	Fault message occurred now	—
Un-19	Fault Message 2	Overcurrent Message2	—	Fault message occurred last time	—
Un-20	Fault Message 3	Overheat Message3	—	Fault message occurred last two time	—
Un-21	Fault Message 4	Overtorque Message4	—	Fault message occurred last three time	—
Un-22	The Parameter Of Time Period Between Last Fault And The Nearest Fault.	Un-22= 2400Hr Last Fault Run Time	1Hr	The value of 'Run Elapse Time' parameter will be cleared after fault has been cleared.	—
Un-23	Frequency Command While Fault Occurred	Un-23= 60.00Hz Last Fault Freq.Cmd.	0.01Hz	—	—
Un-24	Output Freq. While Fault Occurred	Un-24= 60.00Hz Last Fault O/P Freq.	0.01Hz	—	—
Un-25	Output Current While Fault Occurred	Un-25= 12.5A Last Fault O/P I	0.1A	—	—
Un-26	Output Voltage While Fault Occurred	Un-26= 220.0V Last Fault O/P V	0.1V	—	—
Un-27	DC Voltage While Fault Occurred	Un-27= 310.0V Last Fault O/P V	0.1V	—	—
Un-28	I/P Terminal Status While Fault Occurred	Un-28= 00000000 Last Fault I/P Term.	—	Same as Un-11, display terminal status	—
Un-29	O/P Terminal Status While Fault Occurred	Un-29= 00000000 Last Fault O/P Term.	—	Same as Un-12, display terminal status	—
Un-30	Time Elapsed After Power-On	Un-31= 00002Hr P Elapsed Time	1Hr	Display total time elapsed after power ON	—
Un-31	Time Elapsed After Run	Un-31= 00002Hr R Elapsed Time	1Hr	Display total time elapsed after pressing RUN	—
Un-32	EPROM S/W Version	Un-32= 00001 Soft Number	—	-Manufacturing use-	—
Un-33	Feedback Motor Speed	Un-33= 00000rpm Motor Speed	1rpm	Display motor speed while PG feedback is set.	10V/MAX. Motor Speed
Un-34	PID Feedback Display *1	Un-34= 00000 PID Feedback	1*2	Displays PID feedback signal	

*1. The parameters are available for 74.03 and later software version only.

*2. The unit can be changed through parameter Cn-28 and Sn-70.

(1) Frequency Command (Un-01)
(2) Output Frequency (Un-02)
(3) Output Current (Un-03)
(4) Output Voltage (Un-04)
(5) Main Circuit DC Voltage (Un-05)

- Through the settings of Sn-33, Sn-34, the above contents can be displayed at the multi-function analog output terminals (AO1, AO2) in different voltage level of (0~10V)

(6) External Analog Command VIN (Un-06)

- The parameter can monitor the external analog terminal voltage VIN (0~100%/0~10V). The voltage can be output through the multi-function analog output terminal AO1, AO2 (Sn-33=05 or Sn-34=05). The output voltage is the PID feedback voltage when the PID function is used. Please refer to page 3-7, "PID controller block diagram".

(7) External Analog Command AIN (Un-07)

- The parameter can monitor the external analog terminal current AIN (0~100%/0~20mA). The current can be output through the multi-function analog output terminal AO1, AO2 (Sn-33=06 or Sn-34=06). The output current is the PID feedback voltage when the PID function is used. Please refer to page 3-7, "PID controller block diagram".

(8) Multi-Function Analog Input Command AUX (Un-08)

- The parameter can monitor the multi-function analog input terminal AUX voltage (0~100%/0~20mA). The voltage can be output through the multi-function analog output terminal AO1, AO2 (Sn-33=07 or Sn-34=07). The output voltage is the PID target voltage (reference) when the PID function is used. Please refer to page 3-7, "PID controller block diagram".

(9) External Analog Output AO1, AO2 (Un-09, Un-10)

- The parameter can monitor analog output terminal AO1, AO2 voltage (0~10V). Their output gain can be adjusted through the setting of parameters Bn-14 or Bn-15. Their outputs are determined and varied proportionally according to the setting of (Sn-33 or Sn-34).

(10) Input Terminal Status (Un-11)

- The parameter will monitor the status of input terminal ①~⑧: 'ON' or 'OFF'.

(11) Output Terminal Status (Un-12)

- The parameter will monitor the status of input terminal RA-RC or R1A-R1C, DO1-DOG, DO2-DOG or R2A-R2C : 'ON' or 'OFF'.

(12) PG Speed Feedback and PG Speed Compensation (Un-13, Un-14)

- These parameters will monitor the PG speed feedback and PG speed compensation signal if PG feedback function is used.

(13) PID Control Input (Un-15)
(14) PID Control Output1 (Un-16)
(15) PID Control Output2 (Un-17)

- The values in Fig. 12 (on page 3-7) can be monitored through the parameters of Un-15, Un-16 and Un-17. Moreover, the multi-function analog output terminal AO1, AO2 can be used to monitor the output value through the proper setting of Sn-33 and Sn-34.

(16) Message 1 (Un-18)
(17) Message 2 (Un-19)
(18) Message 3 (Un-20)
(19) Message 4 (Un-21)

- These parameters are used to display the fault messages whenever the fault occurred. The user can take proper action for trouble-shooting based upon the displayed message.

(20) The Cumulative Operation Time Setting (Un-22)

- The parameter is used to count the elapsed time from the previous fault to the latest fault occurred recently. Its setting range is 0~65536 Hr. After the fault have been cleared and system reset again, the Un-22 will be cleared to zero and counted again.

(21) The Frequency Command While Last Fault Occurred (Un-23)
(22) The Output Frequency While Last Fault Occurred (Un-24)
(23) The Output Current While Last Fault Occurred (Un-25)
(24) The Output Voltage While Last Fault Occurred (Un-26)
(25) The DC Voltage While Last Fault Occurred (Un-27)
(26) The Input Terminal Status While Last Fault Occurred (Un-28)
(27) The Output Terminal Status While Last Fault Occurred (Un-29)

- The above parameters will display the inverter status when the fault occurred lately. The contents of parameters Un-23~29 will be cleared after the faults have been cleared and the system reset again.

(28) The Cumulative Time Whenever The Input Power Is On (Un-30)

- The parameter will record the cumulative operation time from power-on to power-off. Its value is 0~65535 Hr. If the value exceed 65535, it will restart from 0 again.

(29) The Cumulative Run Time Whenever The Output Power Is On (Un-31)

- The parameter will record the cumulative operation time from power-on to power-off. Its value is 0~65535 Hr. If the value exceeds 65535, it will restart from 0 again.

(30) The EPROM Software Version (Un-32)

- The parameter will specify the updated software version in this inverter.

(31) Motor Speed While PG Feedback Is Set. (Un-33)

- While PG feedback control is set, the motor speed can be monitored through Un-33.

(32) PID Feedback Display (Un-34)

- While PID Function is enabled, the PID feedback signal can be monitored through Un-34. While PID Function is not enabled, the Un-34 will be zero.
- The display content can be set by Cn-28, Sn-70, Bn-45 and Bn-46.

  Cn-28 sets the decimal point position of Un-34.

  Sn-70 sets the unit of Un-34.

  Bn-45 is the equivalent value displayed for 0% PID Feedback.

  Bn-46 is the equivalent value displayed for 100% PID Feedback.
- Before monitoring PID feedback signal, be sure to set the value of Cn-28, Sn-70, Bn-45 and Bn-46.

4. Fault display and troubleshooting

4.1 General

The MA7200 have the protective and warning self-diagnostic functions. If fault occurs, the fault code is displayed on the digital operator. The fault contact output (RA-RB-RC or R1A-R1B-R1C, DO1, DO2 or R2A-R2C) operates, and the inverter shut off to stop the motor. If warning occurs, the digital operator will display the warning code. However, the fault-contact output does not operate. (Except some certain cases, see page on 'Warning and Self-Diagnosis Functions'). The digital operator will return to its previous status when the above warning is clear.

- When a fault has occurred, refer to the following table to identify and to clear the cause of the fault.
- Use one of the following methods to reset the fault after restarting the inverter.

1. Stop the inverter.
2. Switch the fault reset input at terminal ④ signal or press the RESET key on the digital operator.
3. Turn off the main circuit power supply and turn on again.

4.2 Error Message and Troubleshooting

(A) Protective Function

LCD Display (English)	Fault Contents	Fault Contact Output
Fault DC Volt. Low	The main circuit DC voltage becomes lower than the low voltage detection level (Cn-34).	Operation
Fault Over Current	The inverter output current becomes approx. 200% and above the inverter rated current.	Operation
Fault Ground Fault	A ground fault occurs at the inverter output side and the ground-fault current exceeds approx. 50% of the inverter rated current.	Operation
Fault Over Voltage	The main circuit DC voltage becomes excessive because of regeneration energy caused by motor decelerating.	Operation
Fault Over Heat	The temperature of the cooling fin reaches the detection level.	Operation
Fault Motor Over Load	Motor overload is detected by the electronic thermal relay. (motor protection)	Operation
Fault Inverter Over Load	The electronic thermal sensor detects inverter overload while the output current exceeds 112% of rated value. (inverter protection)	Operation
Fault Over Torque	Over torque is detected while the output current is larger than or equal to the setting of Cn-26. (machine protection)	Operation
Fault Ext. Fault3	External fault signal ③	Operation
Fault Ext. Fault5	External fault signal ⑤	
Fault Ext. Fault6	External fault signal ⑥	
Fault Ext. Fault7	External fault signal ⑦	
Fault Ext. Fault8	External fault signal ⑧	
Fault Inverter EEPROM	EEPROM fault	Operation
	EEPROM (BCC, no.) is bad.	
Fault Inverter A/D	A/D converter (inside the CPU) fault	
Fault PG Over Sp.	Excessive PG speed fault	Operation
Fault PG Open	PG is open-circuit	Operation
Fault Sp.Deviat Over	Excessive speed deviation	Operation
Fault RS-485 Interrupt	MODBUS Communication fault occurs .The inverter remains operating.	operation

	Error Causes	Action to Be Taken
	• Power capacity is too small. • Voltage drop due to wiring resistance. • A motor of large capacity connected to the same power system has been started. • Defective electromagnetic contractor.	• Check the source voltage and wiring. • Check the power capacity and power system.
	• Extremely rapid accel. • Short-circuit or ground- fault at the inverter output side. • Motor of a capacity greater than the inverter rating has been started. • High-speed motor and pulse motor has been started.	• Extend the accel. time. • Check the load wiring.
	• Motor dielectric strength is insufficient. • Load wiring is not proper.	• Check the motor wiring impedance and the load wiring.
	• Insufficient deceleration time. • High input voltage compared to motor rated voltage.	• Extend the accel. time. • Use a braking resistor.
	• Defective cooling fan. • Ambient temperature rise • Clogged filter.	• Check for the fan, filter and the ambient temperature.
	• Overload, low speed operation or extended accel. time. • Improper V-f characteristic setting	• Measure the temperature rise of the motor. • Decrease the output load. • Set proper V/f characteristic.
	• Improper rated current (Cn-09) setting	• Set proper V/f characteristic. • Set proper rated current (Cn-09) • If inverter is reset repetitively before fault removed, the inverter may be damaged.
	• Machine errors or overload	• Check the use of the machine. • Set a higher protection level (Cn-32).
	• Fault input of external signal ③, ⑤, ⑥, ⑦ and ⑧.	• Identify the fault signal using Un-11.
	• Disturbance of external noise • Excessive impact or vibration	• Reset NVRAM by running Sn-03. • Replace the control board if the fault can't be cleared.
	• Improper setting of ASR parameter or over-speed protection level.	• Check the parameters of ASR and the protection level.
	• The PG wiring is not properly connected or open-circuit.	• Check the PG wiring.
	• Improper setting of ASR parameter or speed deviation level.	• Check parameters of ASR and speed deviation level.
	• External noise • Excessive vibration or impact Communication wire • Not properly contacted	• Check the parameter setting, including Sn-01, Sn-02. • Check if the comm. wire is not properly contacted. • Restart, if fault remains, please contact to us.

(B). Warning and Self-Diagnosis Functions

LCD Display (English)	Fault Contents	Fault Contact Output
(blinking) Alarm DC Volt. Low	The main circuit DC voltage becomes lower than the lower under-voltage level before the motor starts.	No operation
(blinking) Alarm Over Voltage	The main circuit DC voltage becomes higher than the lower under-voltage level before the motor starts.	No operation
(blinking) Alarm Over Heat	The thermal protection contact is input to the external terminal.	No operation
(blinking) Alarm Over Torque	Over torque is detected while the output current is larger than or equal to the setting of Cn-26. However, the Sn-12 has been set such that the inverter continue to run and disregard the over-torque warning.	No operation
—	Stall prevention operates while acceleration.	No operation
	Stall prevention operates while running	
	Stall prevention operates while deceleration.	
(blinking) Alarm External Fault	Forward and reverse rotation commands are simultaneously detected for a period of time exceeding 500ms. (The inverter is stopped according to the stop method preset by Sn-04.)	No operation
(blinking) Alarm RS-485 Interrupt	MODBUS Communication fault occurs. The inverter remains operating.	No operation
Comm. Fault	Transmission fault of digital operator	No operation
(blinking) Alarm B.B.	External B.B. signal (terminal ③) is input (The inverter stops and the motors stops without braking)	No operation
Alarm Input Error	Improper inverter capacity (Sn-01) setting.	No operation
	Improper setting of multi-function input signal (Sn-25, 26, 27 and 28).	No operation
	Improper setting of V/F characteristic (Cn-02~08)	No operation
	Improper setting of Cn-18, Cn-19	No operation
(blinking) Alarm Over Speed	Excessive speed (operation remains)	No operation
(blinking) Alarm PG Open	PG Open-circuit (operation remains)	No operation
Alarm Sp.Deviat Over	Excessive speed deviation (operation remains)	No operation
Load Fail	Error during upload and download (operation remains)	No operation
EEPROM Fault	Operator EEPROM error.	No operation
Upload Error	Data incorrect during Communication from the operator to the inverter.	No operation
Download Error	Data incorrect during Communication from the inverter to the operator.	No operation
Alarm Auto Tun-Error	Motor parameter autotuning error	No operation

Error Causes	Action to Be Taken
• Input voltage drop	• Measure the main circuit DC voltage, if the voltage is lower allowance level, regulate the input voltage.
• Input voltage rise	• Measure the main circuit DC voltage, if the voltage is higher than allowance level, regulate the input voltage.
• Overload • Cooling fan fault. Ambient temperature rises. • Clogged filter.	• Check for the fan, filter and the ambient temperature.
• Machine error or overload	• Check the use of the machine. • Set a higher protection level (Cn-32).
• Insufficient Accel./Decel. Time • Overload • Excessive load impact occurs while operating	• Increase Accel./Decel. Time. • Check the load.
• Operation sequence error • 3-wire/2-wire selection error	• Check the circuit of system • Check the setting of system parameters Sn-25, 26, 27, and 28.
• External noise • Excessive vibration or impact on Communication wire • Not properly contacted	• Check the parameter setting, including Sn-01, Sn-02. • Check if the comm. wire is not properly contacted. • Restart, if fault remains, please contact to us.
• Comm. between digital operator and inverter has not been established after system starts for 5 seconds. • Communication is established after system starts, but transmission fault occurs for 2 seconds.	• Re-plug the connector of the digital operators. • Replace the control board.
• External B.B. signal is input.	• After external BB signal is removed, execute the speed search of the inverter.
• Inverter KVA setting error.	• Set proper KVA value. Be aware of the difference of 230V and 460V
• The value of Sn-25~Sn-28 is not in ascending order (Ex. Sn-25= 05, Sn-28= 02, those are improper setting). • Set speed search command of 21 and 22 simultaneously.	• Set these values by order (the value of Sn-25 must be smaller than those of Sn-26, 27, 28) • Command 21 and 22 can not be set on two multi-function-input contacts simultaneously.
• The values of Cn-02~Cn-08 do not satisfy $F_{max} \geq F_A \geq F_B \geq F_{min}$.	• Change the settings.
• Upper limit and lower limit setting is incorrect.	• Change the settings.
• Improper ASR parameter setting or over-torque protection level.	• Check the ASR parameter and over-torque protection level.
• The circuit of PG is not properly connected or open-circuit.	• Check the wiring of PG.
• Improper ASR parameter setting or over-torque protection level.	• Check the ASR parameter and over-torque protection level.
• Bad communication during operator and inverter. • The connector is not properly connected.	• Check if the connector is not properly connected.
• Operator EEPROM error.	• Disable load function of operator. • Replace the operator.
• Incorrect inverter data format • Communication noise.	• Download the data to the operator again. • Check if the connector is not properly connected.
• Communication noise	• Check if the connector is not properly connected.
• Inverter capacity and motor rating are not properly matched. • The wiring between inverter and motor is disconnected. • Motor load unbalance.	• Correct the inverter/motor capacity ratio, wiring cable and motor load.

APPENDIX

A. Adjusting PID Controller

Use the following procedure to activate PID control and then adjust it while monitoring the response.

1. Enable PID control. (Sn-64 = 1)
2. Increase the Proportional gain Bn-17 as far as possible without creating oscillation.
3. Decrease the Integral Time Bn-18 as far as possible without creating oscillation.
4. Increase the Derivative Time Bn-19 as far as possible without creating oscillation.

The Proportional, Integral and Derivative control function provides closed-loop control, or regulation, of a system process variable (pressure, temperature, etc.). This regulation is accomplished by comparing a feedback signal with a reference signal, which results in an error signal. The PID control algorithm then performs calculations, based upon the PID parameter settings (Bn-16 through Bn-20 on Page 3-2), on this error signal. The result of the PID algorithm is then used as the new frequency reference, or is added to the existing speed reference.

The PID target value can come from the frequency command (from operator) or a Multi-Function Analog Input.

Select the PID Control Feedback signal from external terminal AIN for a current signal (4-20mA DC) or from VIN for a voltage (0-10 VDC).

The Proportional Gain is the value by which the error signal is multiplied to generate a new PID controller output. A higher setting will result in a system with quicker response. A lower setting will result in a more stable yet slower system.

The Integral Time is a parameter that determines how fast the PID controller will seek to eliminate any steady-state error. The smaller the setting, the faster the error will be eliminated. To eliminate the integral function entirely, set this parameter to 0.0 seconds. A lower setting will result in a more responsive system. A higher setting will result in a more stable yet slower system.

The Integral Upper Limit parameter will limit the effect that the integrator can have. It works if the PID controller output is positive or negative. It can also be used to prevent integrator "wind-up."

The Derivative Time is a parameter that can be adjusted to increase system response to fast load or reference changes, and to reduce overshoot upon startup. To eliminate the differential function entirely, set this parameter to 0.00 seconds.

The PID Output Limit (Cn-51, Cn-52) parameter can be used to set the maximum effect the PID controller will have on the system. It will also limit the PID output when it is either positive or negative.

NOTE : When the PID output limit is reached, the integrator will hold and not change in value until the PID output is less than the PID output limit.

The PID Bias (Bn-20) parameter will add a fixed percentage to the PID output. It can be used to tune out small system offsets.

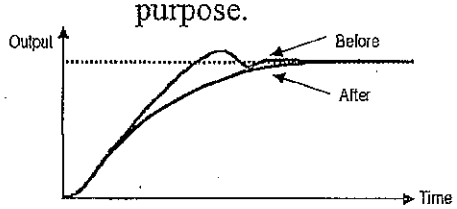
NOTE : This parameter is set as a percentage of maximum output frequency.

The above parameters are factory set for optimum results for most applications, and generally do not need to be changed.

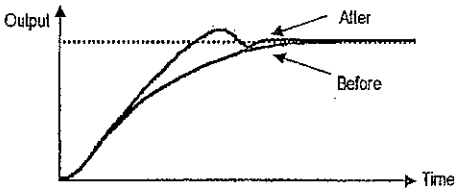
The PID Primary Delay Time parameter adds a filter to the PID output to keep it from changing too quickly. The higher the setting, the slower the PID output will change.

All of these parameters are interactive, and will need to be adjusted until the control loop is properly tuned, i.e. stable with minimal steady-state error. A general procedure for tuning these parameters is as follows:

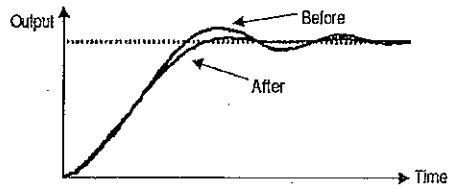
1. Adjust Proportional Gain until continuous oscillations in the Controlled Variable are at a minimum.
2. The addition of Integral Time will cause the steady-state error to approach zero. The time should be adjusted so that this minimal error is attained as fast as possible, without making the system oscillate.
3. If necessary, adjust Derivative Time to reduce overshoot during startup. The inverter's acceleration and deceleration rate times can also be used for this purpose.



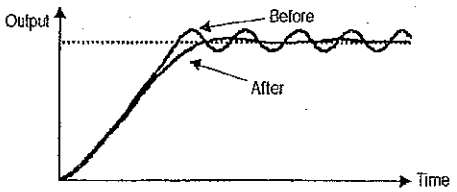
If overshoot occurs, shorten the derivative time (D) and lengthen the integral time (I).



To rapidly stabilize the control conditions even when overshooting occurs, shorten the integral time (I) and lengthen the derivative time (D).



If oscillation occurs with a longer cycle than the integral time (I) setting, then the integral operation is strong. The oscillation will be reduced as the integral time (I) is lengthened.



If oscillation cycle is short and approx. the same as the derivative time (D) setting, then the derivative operation is strong. The oscillation will be reduced as the derivative time (D) is shortened. If even setting the derivative time (D) to 0.00 cannot reduce oscillation, then either decreases the proportional gain (P) or raise the PID primary delay time constant.

B. Supplementary on PID Control Block Diagram

A PID Control Block Diagram is:

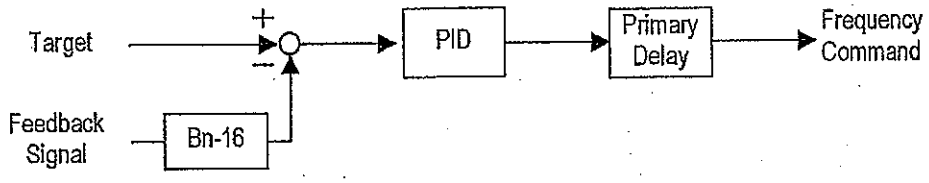


Fig. 47. PID Control Block Diagram

Note :

1. A target signal may come from the LCD Digital Operator, RS-485 Port or Multi-Function Analog Input Terminal-AUX Setting. (upon Sn-05 setting).
2. The detected signal can be input either from terminal VIN (Sn-24=0, Voltage Command 0~10V) or from terminal AIN (Sn-24=1, Current Command 4~20mA).
3. If the target signal is from the terminal AUX, please use the wiring diagram indicated below: (Sn-05=01, Sn-29=09).

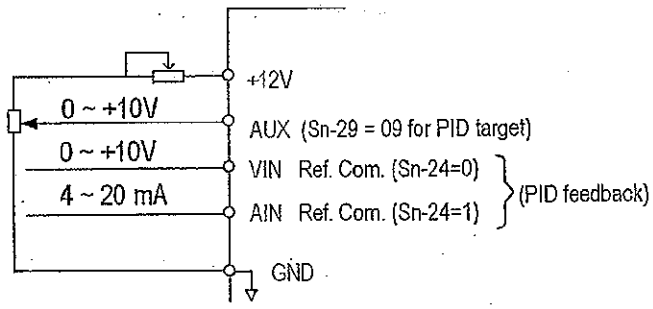


Fig. 48. PID Wiring Diagram

4. Refer to Pages 3-7 to 3-9 for more details about PID use.

C. Wiring for PG Feedback Use

The MA7200 inverter has a built-in PG interface, no external PG feedback option card is needed. An independent DC source of +12V should be provided from an external source.

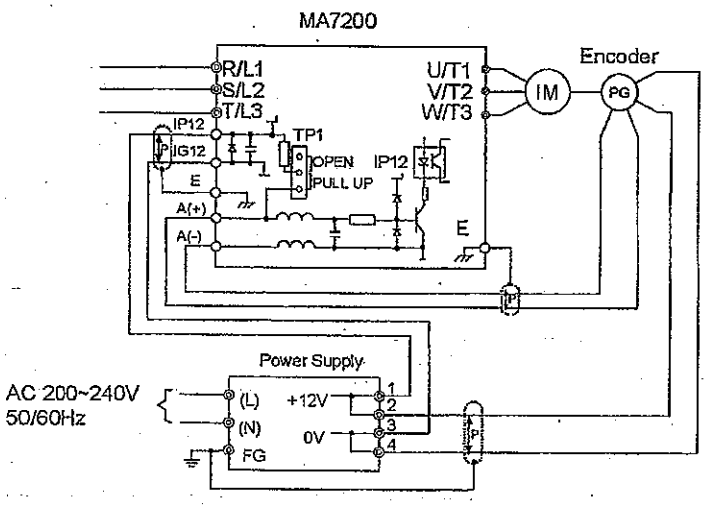


Fig. 49. Wiring of PG feedback

Note :

1.  : Isolated twisted cable wire.
2. Notation for PG terminals

Terminal	Function
A(+)	PG signal input terminal. The voltage level is (H: 4~12V, L: ≤1V). Its Max. frequency is < 32767 Hz
A(-)	
IP12	Terminals feed in the (+12)VDC external power source (+12V± 10%, the Max. current is 40mA)
IG12	
+12V	(+12)V DC source (+12V± 10%, min. 0.5A)
0V	
E	Inverter ground.

3. Please refer to page 3-27 and 3-69 for more details on PG feedback.
4. The A(+), A(-), IP12, IG12 terminals are integrated as CN2 in compact version. (see page 1-9~1-10). The code No. of the wire is 4H339D0250001.
5. The PG interface only allows the open-collector interface drive or complementary interface drive.
6. The short pin of TP1 set to PULL UP position for open-collector interface (factory setting) and set to OPEN position for complementary interface. The PG interface only allows the open-collector interface drive or complementary interface drive.
7. The shielded twisted-pair cable wire should be used between the inverter and PG, its length should be less than 150 feet.

D. RS-485 Communication Interface

- MA7200 RS-485 interface (terminal S(+), S(-)) can provide MODBUS protocol for communication. PROFIBUS protocol for communication is possible with an optional PROFIBUS Communication Card (MA-SP).

- Wiring diagram of MODBUS and PROFIBUS-DP:

(a) MODBUS Protocol Communication

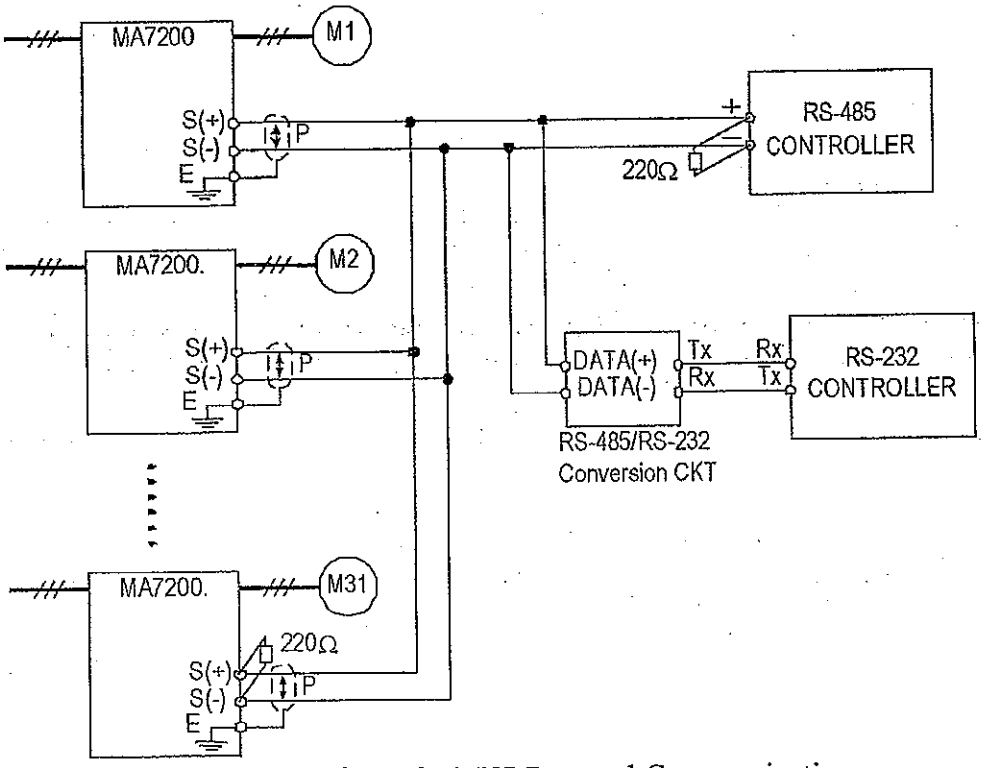


Fig. 50. Wiring for MODBUS Protocol Communication

Note : 1. A Host Controller with RS-485 interface can communicate with the MA7200 unit through RS-485 interface connection directly. If the Host Controller does not provide the RS-485 port and its RS-232 port is available, an RS-485/RS-232 conversion card should be used to connect between this Host Controller and the MA7200 unit.

2. A MODBUS Host Controller can drive the network with no more than 31 inverters connected, using MODBUS communication standard. If the inverter (e.g., MA7200) is at the end of the network, it must have terminating resistors 220Ω at both terminals. All other inverters in the system should not have terminators.

3. Please refer to "MA7200 RS-485 MODBUS Communication Application Manual".

(b) PROFIBUS Protocol Communication

The optional MA-SP PROFIBUS Communication Card supports the PROFIBUS protocol. The optional MA-SP PROFIBUS Communication Card can be placed at the control board. An independent 24V DC Power Supply is needed for all MA-SP option cards.

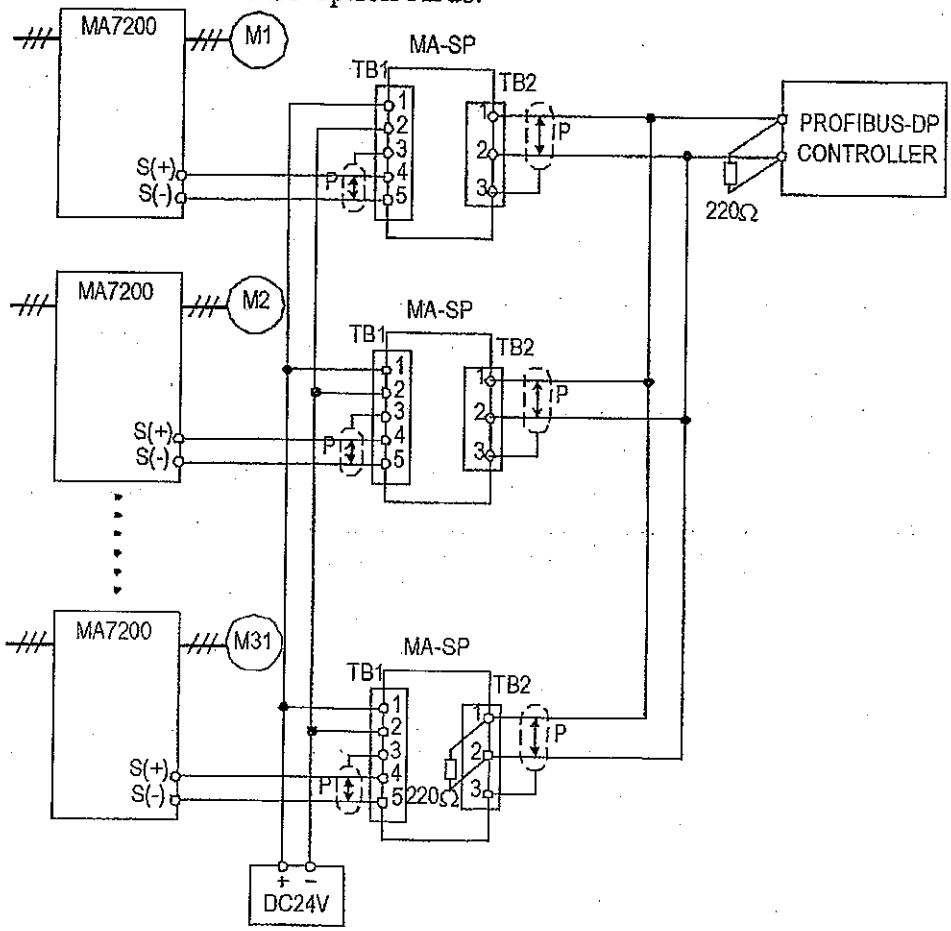


Fig. 51. Wiring for PROFIBUS Protocol Communication

Note : 1. Code No. : 4H300D0290009

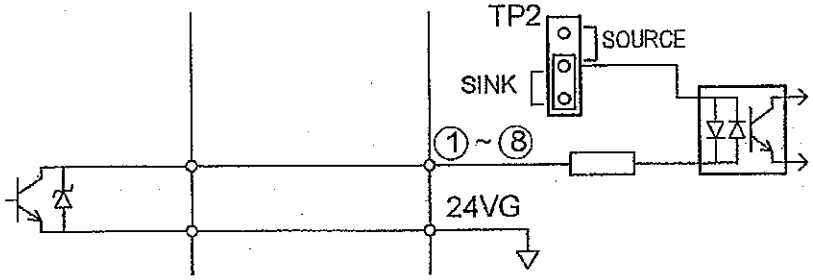
2. The optional MA-SP card will consume about 2.4W(=24.0V*0.1A). Select the proper DC power supply to meet your system capacity based upon the station number.
3. A maximum of 31 PROFIBUS-DP stations (nodes) may be contained within a single network segment. If the drive is at the end of the network, it must have 220Ω between terminals (S-, S+).
4. For more details, refer to the "MA7200 PROFIBUS-DP Communication Application Manual".

E. SINK/SOURCE Typical Connection Diagram

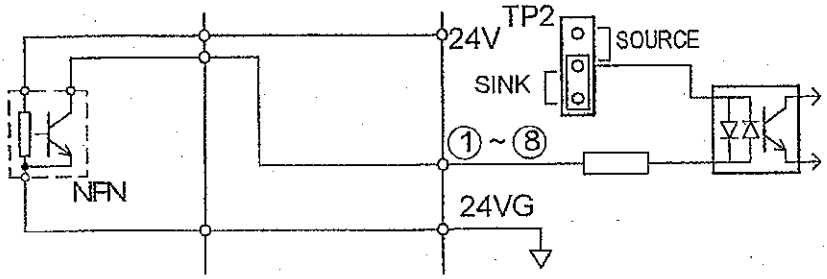
- The UL/CUL Standard Type Control Board (Code No. : 4P101C0060002) Terminal ①~⑧ can be set as Sink or Source Type Input Interface. Typical connection examples are shown below.

(a) SINK Type Input Interface: The short pin of TP2 is set to SINK position.

- Transistor (Open-collector) used for operation signal.

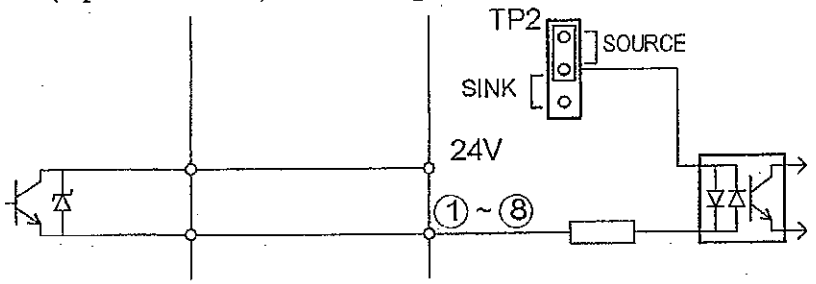


- NPN Sensor (Sink) used for operation signal.

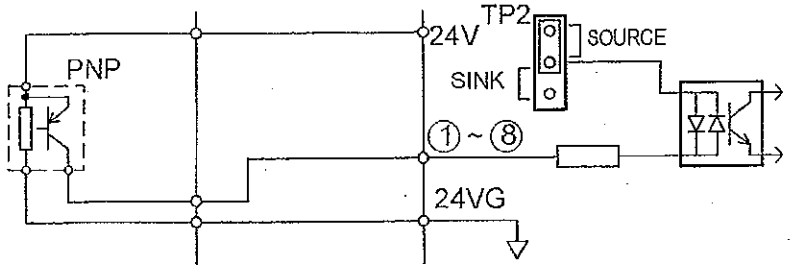


(b) SOURCE Type Input Interface : The short pin of TP2 is set to SINK position.

- Transistor (Open-collector) used for operation signal.



- PNP Sensor (Source) used for operation signal.



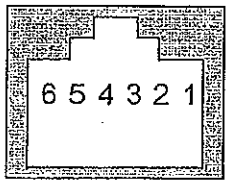
F. RS-232C Serial Communications Connection Diagram

The LCD Digital Operator uses RS-232C Serial Communication through connector CN1 to communicate with control board. Using the CN1 port on the control board, the parameters can be monitored and updated by using a suitable PC programming tool.

The CN1 port is a non-isolated RS-232C port with a baud rate of 2400 bps. Contact your TECO-Westinghouse factory representative or distributor for further information.

- The pin definitions of CN1

  –6 pin telephone jack



Pin	Signal Definition
1	LCD/PC selection
2	5V
3	Rx
4	Tx
5	0V
6	Reserved (-5V, for LCD display)

- Typical connection diagram

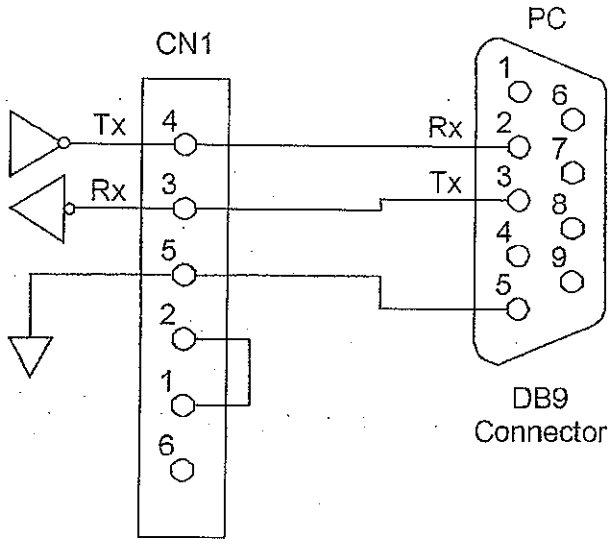


Fig. 52. RS232-C Typical Connection Diagram

G. Sensorless Vector Control Set-up

The MA7200 has two standard two selectable control modes, V/F Control Mode (Sn-67=0) and Sensorless Vector Control Mode (Sn-67=1). When the Sensorless Vector Control Mode is selected, be sure that the inverter capacity and the motor rating are suitably matched.

The AUTOTUNE feature can be used to identify and store the important motor parameters for the Sensorless Vector Control Mode.

Refer to pages 3-28, 3-29 and 3-73 for more details about Sensorless Vector Control.

- The Sequence of Motor Parameter Autotuning:

1. Disconnect the motor load and make sure that the wiring between the inverter and the motor is suitable. The difference between inverter capacity and motor rating should not be greater than two frame sizes.
2. Switch to PRGM operation mode by pressing the Digital Operator (PRGM DRIVE) key.
3. Input the Motor Rated Voltage Data to parameter Cn-03 (Max. Output Voltage) and the Motor Rated Frequency to parameter Cn-04 (Max. Voltage Frequency) using data from motor's nameplate. Enable Sensorless Vector Control Mode (Sn-67= 1).
4. Enable the Autotuning Function by setting Sn-66= 1.
5. Switch to DRIVE operation mode by pressing the (PRGM DRIVE) key, then run the inverter by pressing the (RUN) key.
6. The inverter system immediately enters into the autotuning operation until completing the autotuning procedure (normally about 25 seconds). The inverter then returns to a stopped condition. Press the (STOP) key to stop the parameter autotuning operation if an abnormality occurs during autotuning operation.
7. Finally, press the (STOP) key to return the system to normal operation mode. The value of motor parameter will be automatically stored in these parameters: Cn-57 (Motor Line-to-Line Resistance R1), Cn-58 (Motor Rotor Equivalent Resistance R2), Cn-59 (Motor Leakage Inductance Ls) and Cn-60 (Mutual Inductance Lm).

• The Operations and Adjustments of Sensorless Vector Control :

1. Make sure the inverter capacity and motor rating is suitably matched. Use the AUTOTUNE feature to identify and store the motor parameters in the first time sensorless vector operation after installation, and key in the Motor Rated Voltage data into Cn-03 and the Motor Rated Frequency into Cn-04 according to the motor nameplate.
2. Enable the Sensorless Vector Control Mode by setting Sn-67= 1.
3. Increase setting Cn-57 to increase the generating torque at low speed. Decrease setting Cn-57 to reduce the generating torque to avoid overcurrent trip at low speed.
4. Adjust setting Cn-61 if the speed accuracy needs to improve. When the actual speed is low, increase the set value and when the actual speed is high, decrease the set value.
5. If the motor speed is not stable or the load inertia is too large, increase the Cn-40 (Slip Compensation Primary Delay Time) setting.
   If the speed response is slow, decrease the setting of Cn-40.

H. Notes for Circuit Protection and Environmental Ratings

- Circuit Protection

  The MA7200 is "suitable for use in a circuit capable of delivering not more than___rms symmetrical amperes___V maximum." Where the rms value symmetrical amperes and V maximum are to be as follows:

Device Rating		Short Circuit Rating (A)	Maximum Voltage (V)
Voltage	HP		
230V	1.5 ~ 50	5,000	240V
	51 ~ 100	10,000	
460V	1.5 ~ 50	5,000	480V
	51 ~ 200	10,000	

- Environmental Ratings

  The MA7200 is intended for use in pollution degree 2 environments.

- Field Wiring Terminals and Tightening Torque

  The wiring terminals and tightening torque are listed as follows. (Main Circuit Terminal Specifications – use 140/167°F(60/75°C) copper wire only).

(A) 230V Class (NEMA1)

Circuit	Inverter Rating (HP)	Terminals Mark	Cable Size (AWG)	Terminals	Tightening Torque (Pound-inch)
Main Circuit	1	L1, L2, L3, T1, T2, T3, B1/P, B2, ⊖	14 ~ 10	M4	10
		⏚	14 ~ 10	M4	10
	2	L1, L2, L3, T1, T2, T3, B1/P, B2 , ⊖	14 ~ 10	M4	10
		⏚	12 ~ 10	M4	10
	3	L1, L2, L3, T1, T2, T3, B1/P, B1/R, B2, ⊖	12 ~ 10	M4	10
		⏚	12 ~ 10	M4	10
	5	L1, L2, L3, T1, T2, T3, B1/P, B1/R, B2, ⊖	12 ~ 10	M4	10
		⏚	10	M4	10
	7.5	L1, L2, L3, T1, T2, T3, B1/P, B1/R, B2, ⊖	8	M4	10
		⏚	10 ~ 8	M4	10
	10	L1, L2, L3, T1, T2, T3, B1/P, B1/R, B2, ⊖	8	M4	10
		⏚	10 ~ 8	M4	10
	15	L1, L2, L3, T1, T2, T3, B1/P B2, ⊖	8 ~ 6	M6	30
		⏚	10 ~ 8	M6	35
	20	L1, L2, L3, T1, T2, T3, B1/P, B2, ⊖	8 ~ 6	M6	30
		⏚	10 ~ 8	M6	35
	25	L1, L2, L3, T1, T2, T3, ⊕, ⊖	4	M6	35
		⏚	6	M6	35
	30	L1, L2, L3, T1, T2, T3, ⊕, ⊖	2	M8	78
		⏚	6	M10	156
	40	L1, L2, L3, T1, T2, T3, ⊕, ⊖	2/0	M8	78
		⏚	4	M10	156
Control Circuit	All series	①~⑧, 15V, VIN, AIN, AUX, AO1, AO2 RA, RB, RC, DO1, DO2, (or R2A, R2C)	24~14	M2.6	4

(B) 460V Class (NEMA1)

Circuit	Inverter Rating (HP)	Terminals Mark	Cable Size (AWG)	Terminals	Tightening Torque (Pound-inch)
Main Circuit	1	L1, L2, L3, T1, T2, T3	14 ~ 10	M4	10
		⏚	14 ~ 10	M4	10
	2	L1, L2, L3, T1, T2, T3	14 ~ 10	M4	10
		⏚	14 ~ 10	M4	10
	3	L1, L2, L3, T1, T2, T3, B1/P, B2, ⊖	14 ~ 10	M4	10
		⏚	14 ~ 10	M4	10
	5	L1, L2, L3, T1, T2, T3, B1/P, B2, ⊖	14 ~ 10	M4	10
		⏚	12 ~ 10	M4	10
	7.5	L1, L2, L3, T1, T2, T3, B1/P, B1/R, B2, ⊖	12 ~ 10	M4	10
		⏚	12 ~ 10	M4	10
	10	L1, L2, L3, T1, T2, T3, B1/P, B1/R, B2, ⊖	10	M4	10
		⏚	10	M4	10
	15	L1, L2, L3, T1, T2, T3, B1/P, B2, ⊖	10 ~ 8	M6	15
		⏚	12 ~ 10	M6	35
	20	L1, L2, L3, T1, T2, T3, B1/P, B2, ⊖	10 ~ 8	M6	15
		⏚	12 ~ 10	M6	35
	25	L1, L2, L3, T1, T2, T3, ⊕, ⊖	8	M6	35
		⏚	8	M6	35
	30	L1, L2, L3, T1, T2, T3, ⊕, ⊖	6	M6	35
		⏚	8	M6	35
	40	L1, L2, L3, T1, T2, T3, ⊕, ⊖	4	M8	78
		⏚	8	M10	156
	50	L1, L2, L3, T1, T2, T3, ⊕, ⊖	4	M8	78
		⏚	6	M10	156
	60	L1, L2, L3, T1, T2, T3, ⊕, ⊖	2	M8	78
		⏚	6	M10	156
	75	L1, L2, L3, T1, T2, T3, ⊕, ⊖	2/0	M8	78
		⏚	4	M10	156
Control Circuit	All series	①~⑧, 15V, VIN, AIN, AUX, AO1, AO2 RA, RB, RC, DO1, DO2, (or R2A, R2C)	24~14	M2.6	4

(C) 230V Class (NEMA4)

Circuit	Inverter Rating (HP)	Terminals Mark	Cable Size (AWG)	Terminals	Tightening Torque (Pound-inch)
Main Circuit	1	L1, L2, L3, T1, T2, T3, B1/P, B1/R, B2, ⊖	14 ~ 10	M4	10
		⏚	14 ~ 10	M4	10
	2	L1, L2, L3, T1, T2, T3, B1/P, B1/R, B2, ⊖	14 ~ 10	M4	10
		⏚	12 ~ 10	M4	10
	3	L1, L2, L3, T1, T2, T3, B1/P, B1/R, B2, ⊖	12 ~ 10	M4	10
		⏚	12 ~ 10	M4	10
	5	L1, L2, L3, T1, T2, T3, B1/P, B1/R, B2, ⊖	12 ~ 10	M4	10
		⏚	10	M4	10
	7.5	L1, L2, L3, T1, T2, T3, B1/P, B1/R, B2, ⊖	8	M4	10
		⏚	10 ~ 8	M4	10
	10	L1, L2, L3, T1, T2, T3, B1/P, B1/R, B2, ⊖	8	M4	10
		⏚	10 ~ 8	M4	10
	15	L1, L2, L3, T1, T2, T3, B1/P B2, ⊖	4	M6	35
		⏚	8	M6	35
	20	L1, L2, L3, T1, T2, T3, B1/P, B2, ⊖	2	M6	35
		⏚	8	M6	35
Control Circuit	All series	①~⑧, 15V, VIN, AIN, AUX, AO1, AO2 RA, RB, RC, DO1, DO2, (or R2A, R2C)	24~14	M2.6	4

(D) 460V Class (NEMA4)

Circuit	Inverter Rating (HP)	Terminals Mark	Cable Size (AWG)	Terminals	Tightening Torque (Pound-inch)
Main Circuit	1	L1, L2, L3, T1, T2, T3, B1/P, B1/R, B2, ⊖	14 ~ 10	M4	10
		⏚	14 ~ 10	M4	10
	2	L1, L2, L3, T1, T2, T3, B1/P, B1/R, B2, ⊖	14 ~ 10	M4	10
		⏚	14 ~ 10	M4	10
	3	L1, L2, L3, T1, T2, T3, B1/P, B1/R, B2, ⊖	14 ~ 10	M4	10
		⏚	14 ~ 10	M4	10
	5	L1, L2, L3, T1, T2, T3, B1/P, B1/R, B2, ⊖	14 ~ 10	M4	10
		⏚	12 ~ 10	M4	10
	7.5	L1, L2, L3, T1, T2, T3, B1/P, B1/R, B2, ⊖	12 ~ 10	M4	10
		⏚	12 ~ 10	M4	10
	10	L1, L2, L3, T1, T2, T3, B1/P, B1/R, B2, ⊖	10	M4	10
		⏚	10	M4	10
	15	L1, L2, L3, T1, T2, T3, B1/P, B1/R, B2, ⊖	12 ~ 10	M6	35
		⏚	12 ~ 10	M6	35
	20	L1, L2, L3, T1, T2, T3, B1/P, B1/R, B2, ⊖	10	M6	35
		⏚	10	M6	35
Control Circuit	All series	①~⑧, 15V, VIN, AIN, AUX, AO1, AO2 RA, RB, RC, DO1, DO2, (or R2A, R2C)	24~14	M2.6	4

I. Spare Parts

(A) 230V Class (NEMA1)

INVERTER & PARTS NAME			CONTROL PC BOARD	POWER BOARD	Power Module (IGBT)	Diode Module
HP	MODEL	SPEC.				
1	MA7200-2001-N1	MODEL	—	—	CM15MDL-12H	
		CODE	4P101C0120005 *1	4P106C01600A1	277830540	
		Q'TY	1	1	1	
2	MA7200-2002-N1	MODEL	—	—	CM20MDL-12H	
		CODE	4P101C0120005 *1	4P106C0160003	3K3A2471	
		Q'TY	1	1	1	
3	MA7200-2003-N1	MODEL	—	—	7MBR30SA060	
		CODE	4P101C0130001 *2	4P106C01800B1	3K3A2624	
		Q'TY	1	1	1	
5	MA7200-2005-N1	MODEL	—	—	7MBR50SA060	
		CODE	4P101C0130001 *2	4P106C01800C9	3K3A2627	
		Q'TY	1	1	1	
7.5	MA7200-2007-N1	MODEL	—	—	7MBP50RA060	DF75LA80
		CODE	4P101C0130001 *2	4P106C0210001	277831660	4M903D1480016
		Q'TY	1	1	1	1
10	MA7200-2010-N1	MODEL	—	—	7MBP75RA060	DF75LA80
		CODE	4P101C0130001 *2	4P106C0220006	277831678	4M903D1480016
		Q'TY	1	1	1	1
15	MA7200-2015-N1	MODEL	—	—	7MBP100RTA060	DF100BA80
		CODE	4P101C0130001 *2	4P106C01500A6	277831694	277192209
		Q'TY	1	1	1	1
20	MA7200-2020-N1	MODEL	—	—	7MBP160RTA060	DF150BA80
		CODE	4P101C0130001 *2	4P106C01500B4	277831708	277192179
		Q'TY	1	1	1	1
25	MA7200-2025-N1	MODEL	—	—	MIG200J6CMB1W	SKKH42/16E
		CODE	4P101C0130001 *2	4P106C03300B2	277830086	277112311
		Q'TY	1	1	1	3
30	MA7200-2030-N1	MODEL	—	—	SKM195GB063DN	SKKH57/16E
		CODE	4P101C0130001 *2	4P106C04000A2	277810654	277112329
		Q'TY	1	1	3	3
40	MA7200-2040-N1	MODEL	—	—	SKM300GB063DN	SKKH72/16E
		CODE	4P101C0130001 *2	4P106C04000A2	277810662	277112337
		Q'TY	1	1	3	3

*1 : For old version, code no. is 4P101C0040001.

*2 : For old version, code no. is 4P101C0060002.

INVERTER & PARTS NAME			COOLING FAN		Resistor	
HP	MODEL	SPEC.				
1	MA7200-2001-N1	MODEL	KD1204PFBX		N20SP-12-Y2	
		CODE	4M903D0880002		3M903D1820000	
		Q'TY	1		1	
2	MA7200-2002-N1	MODEL	KD1204PFBX		N20SP-12-Y2	
		CODE	4M903D0880002		3M903D1820000	
		Q'TY	1		1	
3	MA7200-2003-N1	MODEL	AFB0624H		8W/12Ω	
		CODE	4H300D0190012		4M903D0180086	
		Q'TY	1		2	
5	MA7200-2005-N1	MODEL	AFB0624H		8W/12Ω	
		CODE	4H300D0190012		4M903D0180086	
		Q'TY	1		2	
7.5	MA7200-2007-N1	MODEL	AFB0824VH		8W/6.2Ω	8W/6.2Ω
		CODE	4H300D0200018		4M903D0180078	4M903D2330018
		Q'TY	1		1	1
10	MA7200-2010-N1	MODEL	AFB0824VH		8W/6.2Ω	8W/6.2Ω
		CODE	4H300D0200018		4M903D0180078	4M903D2330018
		Q'TY	1		1	1
15	MA7200-2015-N1	MODEL	AFB0824SH-B		60W/2.2Ω	
		CODE	4H300D3340007		3H300D2350005	
		Q'TY	1		1	
20	MA7200-2020-N1	MODEL	AFB0824SH-B		60W/2.2Ω	
		CODE	4H300D3340007		3H300D2350005	
		Q'TY	1		1	
25	MA7200-2025-N1	MODEL	PMD2408PMB1-A	KD2406PTB1	60W/120Ω	
		CODE	4H300D6050000	4H300D6060013	3K3A4880	
		Q'TY	2	1	1	
30	MA7200-2030-N1	MODEL	PSD2412PMB1	KD2406PTB1	60W/120Ω	
		CODE	4H300D6040004	4H300D6060021	3K3A4880	
		Q'TY	2	1	1	
40	MA7200-2040-N1	MODEL	PSD2412PMB1	KD2406PTB1	60W/120Ω	
		CODE	4H300D6040004	4H300D6060021	3K3A4880	
		Q'TY	2	1	1	

INVERTER & PARTS NAME			Relay	DCCT	Capacitor	OPERATOR
HP	MODEL	SPEC.				
1	MA7200-2001-N1	MODEL	0Z-SS-112LM	LX-7.5	330uF/400V	JNEP-36 *3
		CODE	271608055	3K3A2468	3K3A1868	4H300C0050000 *3
		Q'TY	1	2	3	1
2	MA7200-2002-N1	MODEL	0Z-SS-112LM	HY-10P	330uF/400V	JNEP-36 *3
		CODE	271608055	273014331	3K3A1868	4H300C0050000 *3
		Q'TY	1	2	4	1
3	MA7200-2003-N1	MODEL	841-S-1A-D-H-24VDC	SY-15T	470uF/400v	JNEP-36 *3
		CODE	271608969	3M903D1420001	4M903D0300022	4H300C0050000 *3
		Q'TY	1	3	4	1
5	MA7200-2005-N1	MODEL	841-S-1A-D-H-24VDC	SY-25T2	470uF/400v	JNEP-36 *3
		CODE	271608969	3M903D3860009	4M903D0300022	4H300C0050000 *3
		Q'TY	1	3	4	1
7.5	MA7200-2007-N1	MODEL	841-S-2A-D-H-24VDC	HY37-P	1500uF/400V	JNEP-36 *3
		CODE	271608977	4M903D1020015	4M903D0310010	4H300C0050000 *3
		Q'TY	1	3	2	1
10	MA7200-2010-N1	MODEL	841-S-2A-D-H-24VDC	HY50-P	1800uF/400V	JNEP-36 *3
		CODE	271608977	4M903D1020023	4M903D0310010	4H300C0050000 *3
		Q'TY	1	3	2	1
15	MA7200-2015-N1	MODEL	G7J-4A-B-DC24V	HC-PT075V4B15	3300uF/400V	JNEP-36 *3
		CODE	3K3A2390	3M903D4030034	4M903D0310061	4H300C0050000 *3
		Q'TY	1	1	2	1
20	MA7200-2020-N1	MODEL	G7J-4A-B-DC24V	HC-PT100V4B15	4400uF/400V	JNEP-36 *3
		CODE	3K3A2390	3M903D4030042	4M903D0310052	4H300C0050000 *3
		Q'TY	1	1	2	1
25	MA7200-2025-N1	MODEL	942H-2C-24-DS	L08P150D15	400V/6800uF	JNEP-36 *3
		CODE	4M903D2800006	4M903D3960031	4M903D4110007	4H300C0050000 *3
		Q'TY	1	3	2	1
30	MA7200-2030-N1	MODEL	942H-2C-24-DS	CT/Board	CAP./Board	JNEP-36 *3
		CODE	4M903D2800006	4P108C00800A2	4P108C0050008	4H300C0050000 *3
		Q'TY	1	1	1	1
40	MA7200-2040-N1	MODEL	942H-2C-24-DS	CT/Board	CAP./Board	JNEP-36 *3
		CODE	4M903D2800006	4P108C0090000	4P108C0060003	4H300C0050000 *3
		Q'TY	1	1	1	1

*3 : For old version, code no. is 4H300C0020003 (JNEP-31V).

(B) 460V Class (NEMA1)

INVERTER & PARTS NAME			CONTROL PC BOARD	POWER BOARD	Power Module (IGBT)	Diode Module
HP	MODEL	SPEC.				
1	MA7200-4001-N1	MODEL	—	-	CM10MDL-24H	
		CODE	4P101C0120005 *1	4P106C0250002	3K3A2473	
		Q'TY	1	1	1	
2	MA7200-4002-N1	MODEL	—	-	CM10MDL-24H	
		CODE	4P101C0120005 *1	4P106C02500A1	3K3A2473	
		Q'TY	1	1	1	
3	MA7200-4003-N1	MODEL	—		7MBR15SA120	
		CODE	4P101C0130001 *2	4P106C0240007	277831643	
		Q'TY	1	1	1	
5	MA7200-4005-N1	MODEL	—	-	7MBR25SA120	
		CODE	4P101C0130001 *2	4P106C02400A5	277831651	
		Q'TY	1	1	1	
7.5	MA7200-4007-N1	MODEL	—		7MBP50RA120	6RI30G-160
		CODE	4P101C0130001 *2	4P106C0110006	277831686	277191067
		Q'TY	1	1	1	1
10	MA7200-4010-N1	MODEL	—		7MBP50RA120	6RI30G-160
		CODE	4P101C0130001 *2	4P106C0110006	277831686	277191067
		Q'TY	1	1	1	1
15	MA7200-4015-N1	MODEL	—		7MBP75RA120	DF75AA160
		CODE	4P101C0130001 *2	4P106C0150008	277831538	277192128
		Q'TY	1	1	1	
20	MA7200-4020-N1	MODEL	—		7MBP75RA120	DF75AA160
		CODE	4P101C0130001 *2	4P106C0150016	277831538	277192128
		Q'TY	1	1	1	1
25	MA7200-4025-N1	MODEL	—		MIG100Q6CMB1X	SKKH42/16E
		CODE	4P101C0130001 *2	4P106C0330006	277830094	277112311
		Q'TY	1	1	1	3
30	MA7200-4030-N1	MODEL	—		MIG150Q6CMB1X	SKKH42/16E
		CODE	4P101C0130001 *2	4P106C03300A4	277830108	277112311
		Q'TY	1	1	1	3
40	MA7200-4040-N1	MODEL	—		SKM145GB128DN	SKKH42/16E
		CODE	4P101C0130001 *2	4P106C0400007	277810620	277112311
		Q'TY	1	1	3	3
50	MA7200-4050-N1	MODEL	—		CM200DY-24A	SKKH57/16E
		CODE	4P101C0130001 *2	4P106C0400007	277810336	277112329
		Q'TY	1	1	3	3
60	MA7200-4060-N1	MODEL	—		SKM300GB128D	SKKH72/16E
		CODE	4P101C0130001 *2	4P106C0410000	277810646	277112337
		Q'TY	1	1	3	3
75	MA7200-4075-N1	MODEL	—		SKM300GB128D	SKKH92/16E
		CODE	4P101C0130001 *2	4P106C0410000	277810646	277112345
		Q'TY	1	1	3	3

*1 : For old version, code no. is 4P101C0040001.
*2 : For old version, code no. is 4P101C0060002.

INVERTER & PARTS NAME			COOLING FAN		Resistor	
HP	MODEL	SPEC.				
1	MA7200-4001-N1	MODEL	KD1204PFBX		5W/40Ω	
		CODE	4M903D0880002		3M112Z0010006	
		Q'TY	1		2	
2	MA7200-4002-N1	MODEL	KD1204PFBX		5W/40Ω	
		CODE	4M903D0880002		3M112Z0010006	
		Q'TY	1		2	
3	MA7200-4003-N1	MODEL	AFB0624H		8W/120Ω	
		CODE	4H300D0190004		4M903D0180060	
		Q'TY	1		1	
5	MA7200-4005-N1	MODEL	AFB0624H		8W/120Ω	
		CODE	4H300D0190004		4M903D0180060	
		Q'TY	1		1	
7.5	MA7200-4007-N1	MODEL	AFB0824SH		10W/16Ω	10W/16Ω
		CODE	4H300D0200000		4M903D0190022	4M903D2330026
		Q'TY	1		1	1
10	MA7200-4010-N1	MODEL	AFB0824SH		10W/16Ω	10W/16Ω
		CODE	4H300D0200000		4M903D0190022	4M903D2330026
		Q'TY	1		1	1
15	MA7200-4015-N1	MODEL	AFB0824SH		80W/6.2 Ω	
		CODE	4H300D1440004		3H300D2360001	
		Q'TY	1		1	
20	MA7200-4020-N1	MODEL	AFB0824SH		80W/6.2 Ω	
		CODE	4H300D1440004		3H300D2360001	
		Q'TY	1		1	
25	MA7200-4025-N1	MODEL	EEB0824EHE	ASB0624H-B	60W/240Ω	
		CODE	4H300D5590001	4H300D6060013	3K3A4879	
		Q'TY	2	1	1	
30	MA7200-4030-N1	MODEL	EEB0824EHE	ASB0624H-B	60W/240Ω	
		CODE	4H300D6050000	4H300D6060013	3K3A4879	
		Q'TY	2	1	1	
40	MA7200-4040-N1	MODEL	PSD2412PMB1	KD2406PTB1	60W/240Ω	
		CODE	4H300D6040004	4H300D6060021	3K3A4881	
		Q'TY	2	1	1	
50	MA7200-4050-N1	MODEL	PSD2412PMB1	KD2406PTB1	60W/240Ω	
		CODE	4H300D6040004	4H300D6060021	3K3A4881	
		Q'TY	2	1	1	
60	MA7200-4060-N1	MODEL	PSD2412PMB1	KD2406PTB1	60W/240Ω	
		CODE	4H300D6040004	4H300D6060021	3K3A4881	
		Q'TY	2	1	1	
75	MA7200-4075-N1	MODEL	PSD2412PMB1	KD2406PTB1	60W/240Ω	
		CODE	4H300D6040004	4H300D6060021	3K3A4881	
		Q'TY	2	1	1	

INVERTER & PARTS NAME			Relay	DCCT	Capacitor	OPERATOR
HP	MODEL	SPEC.				
1	MA7200-4001-N1	MODEL	RT444012	TB5A 4V	330uF/400V	JNEP-36 *3
		CODE	4M903D1040008	4M903D2210012	3K3A1868	4H300C0050000 *3
		Q'TY	1	2	2	1
2	MA7200-4002-N1	MODEL	RT444012	TB5A 4V	330uF/400V	JNEP-36 *3
		CODE	4M903D1040008	4M903D2210012	3K3A1868	4H300C0050000 *3
		Q'TY	1	2	4	1
3	MA7200-4003-N1	MODEL	953-1A-24DG-DC24V	HC-PSG075V4B15	330uF/400V	JNEP-36 *3
		CODE	271603711	4M903D2220026	4M903D0300014	4H300C0050000 *3
		Q'TY	1	3	4	1
5	MA7200-4005-N1	MODEL	953-1A-24DG-DC24V	HC-PSG125V4B15	560uF/400V	JNEP-36 *3
		CODE	271603711	4M903D2220042	4M903D0300031	4H300C0050000 *3
		Q'TY	1	3	4	1
7.5	MA7200-4007-N1	MODEL	841-S-2A-D-H	TC25A 4V	2200uF/400V	JNEP-36 *3
		CODE	271608977	4M903D2210063	4M903D0310036	4H300C0050000 *3
		Q'TY	1	3	2	1
10	MA7200-4010-N1	MODEL	841-S-2A-D-H	TC25A 4V	2200uF/400V	JNEP-36 *3
		CODE	271608977	4M903D2210063	4M903D0310036	4H300C0050000 *3
		Q'TY	1	3	2	1
15	MA7200-4015-N1	MODEL	G7J-4A-B-DC24V	HC-PT0375V4B15	3300uF/400V	JNEP-36 *3
		CODE	3K3A2390	3M903D4030018	4M903D0310061	4H300C0050000 *3
		Q'TY	1	1	2	1
20	MA7200-4020-N1	MODEL	G7J-4A-B-DC24V	HC-PT050V4B15	4400uF/400V	JNEP-36 *3
		CODE	3K3A2390	3M903D4030026	4M903D0310052	4H300C0050000 *3
		Q'TY	1	1	2	1
25	MA7200-4025-N1	MODEL	942H-2C-24-DS	L08P075D15	400V/6800uF	JNEP-36 *3
		CODE	4M903D2800006	4M903D3960015	4M903D4110007	4H300C0050000 *3
		Q'TY	1	3	2	1
30	MA7200-4030-N1	MODEL	942H-2C-24-DS	L08P100D15	400V/6800uF	JNEP-36 *3
		CODE	4M903D2800006	4M903D3960023	4M903D4110007	4H300C0050000 *3
		Q'TY	1	3	2	1
40	MA7200-4040-N1	MODEL	942H-2C-24-DS	CT/Board	CAP./Board	JNEP-36 *3
		CODE	4M903D2800006	4P108C0080004	4P108C0040002	4H300C0050000 *3
		Q'TY	1	1	1	1
50	MA7200-4050-N1	MODEL	942H-2C-24-DS	CT/Board	CAP./Board	JNEP-36 *3
		CODE	4M903D2800006	4P108C00800A2	4P108C00400A1	4H300C0050000 *3
		Q'TY	1	1	1	1
60	MA7200-4060-N1	MODEL	942H-2C-24-DS	CT/Board	CAP./Board	JNEP-36 *3
		CODE	4M903D2800006	4P108C0100005	4P108C0020001	4H300C0050000 *3
		Q'TY	1	1	1	1
75	MA7200-4075-N1	MODEL	942H-2C-24-DS	CT/Board	CAP./Board	JNEP-36 *3
		CODE	4M903D2800006	4P108C0100005	4P108C00200A0	4H300C0050000 *3
		Q'TY	1	1	1	1

*3 : For old version, code no. is 4H300C0020003 (JNEP-31V).

(C) 230V Class (NEMA4)

INVERTER & PARTS NAME			Control PC Board	Power Board	Rectifier Board	Main Circuit Transistor
HP	MODEL	SPEC.				
1	MA7200-2001-N4	MODEL	-	-	-	CM15MDL-12H
		CODE	4P101C0120005	4P106C01600A1	-	277830540
		Q'TY	1	1	-	1
2	MA7200-2002-N4	MODEL	-	-	-	CM20MDL-12H
		CODE	4P101C0120005	4P106C0160003	-	277830558
		Q'TY	1	1	-	1
3	MA7200-2003-N4	MODEL	-	-	-	7MBP50RA060
		CODE	4P101C0130001	4P106C04900B0 4P106C05000B5	-	277831660
		Q'TY	1	1	-	1
5	MA7200-2005-N4	MODEL	-	-	-	7MBP50RA060
		CODE	4P101C0130001	4P106C04900B0 4P106C05000B5	-	277831660
		Q'TY	1	1	-	1
7.5	MA7200-2007-N4	MODEL	-	-	-	7MBP50RA060
		CODE	4P101C0130001	4P106C01500C2	4P106C0480008	277831660
		Q'TY	1	1	1	1
10	MA7200-2010-N4	MODEL	-	-	-	7MBP75RA060
		CODE	4P101C0130001	4P106C01500D1	4P106C0480008	277831678
		Q'TY	1	1	1	1
15	MA7200-2015-N4	MODEL	-	-	-	PM100RSE060
		CODE	4P101C0130001	4P106C01500A6	4P106C0470002	277820242
		Q'TY	1	1	1	1
20	MA7200-2020-N4	MODEL	-	-	-	PM150RSE060
		CODE	4P101C0130001	4P106C01500B4	4P106C0470002	277820251
		Q'TY	1	1	1	1

INVERTER & PARTS NAME			Main Circuit Diode	Cooling Fan (inside)	Cooling Fan (outside)	Operator
HP	MODEL	SPEC.				
1	MA7200-2001-N4	MODEL	-	KD1204PFBX	-	JNEP-36
		CODE	-	4M903D0880002	-	4P303C00100B7
		Q'TY	-	1	-	1
2	MA7200-2002-N4	MODEL	-	KD1204PFBX	-	JNEP-36
		CODE	-	4M903D0880002	-	4P303C00100B7
		Q'TY	-	1	-	1
3	MA7200-2003-N4	MODEL	DB35-16	AD0424HB-G70(T)	KD2406PTB1	JNEP-36
		CODE	4M903D4410001	4M903D4630001	4M903D4640006	4P303C00100B7
		Q'TY	1	1	2	1
5	MA7200-2005-N4	MODEL	DB35-16	AD0424HB-G70(T)	KD2406PTB1	JNEP-36
		CODE	4M903D4410001	4M903D4630001	4M903D4640006	4P303C00100B7
		Q'TY	1	1	2	1
7.5	MA7200-2007-N4	MODEL	VVZ 70-16	AFB0624H	PMD2408PMB1-A(2)I55	JNEP-36
		CODE	277111331	4H300D0250009	4H300D0190004	4P303C00100B7
		Q'TY	1	1	2	1
10	MA7200-2010-N4	MODEL	VVZ 70-16	AFB0624H	PMD2408PMB1-A(2)I55	JNEP-36
		CODE	277111331	4H300D0250009	4H300D0190004	4P303C00100B7
		Q'TY	1	1	2	1
15	MA7200-2015-N4	MODEL	VVZ110-12	AFB0624H	PMD2408PMB1-A(2)I55	JNEP-36
		CODE	277111314	4H300D0250009	4H300D0190004	4P303C00100B7
		Q'TY	1	1	2	1
20	MA7200-2020-N4	MODEL	VVZ175-12	AFB0624H	PMD2408PMB1-A(2)I55	JNEP-36
		CODE	277111314	4H300D0250009	4H300D0190004	4P303C00100B7
		Q'TY	1	1	2	1

(D) 460V Class (NEMA4)

INVERTER & PARTS NAME			Control PC Board	Power Board	Rectifier Board	Main Circuit Transistor
HP	MODEL	SPEC.				
1	MA7200-4001-N4	MODEL	-	-	-	CM10MDL-24H
		CODE	4P101C0120005	4P106C0250002	-	277840049
		Q'TY	1	1	-	1
2	MA7200-4002-N4	MODEL	-	-	-	CM10MDL-24H
		CODE	4P101C0120005	4P106C02500A1	-	277840049
		Q'TY	1	1	-	1
3	MA7200-4003-N4	MODEL	-	-	-	7MBP25RA120
		CODE	4P101C0130001	4P106C0490011 4P106C0500017	-	277831716
		Q'TY	1	1	-	1
5	MA7200-4005-N4	MODEL	-	-	-	7MBP25RA120
		CODE	4P101C0130001	4P106C0490003 4P106C0500009	-	277831716
		Q'TY	1	1	-	1
7.5	MA7200-4007-N4	MODEL	-	-	-	7MBP50RA120
		CODE	4P101C0130001	4P106C0150016	4P106C0460007	277831686
		Q'TY	1	1	1	1
10	MA7200-4010-N4	MODEL	-	-	-	7MBP50RA120
		CODE	4P101C0130001	4P106C0150016	4P106C0460007	277831686
		Q'TY	1	1	1	1
15	MA7200-4015-N4	MODEL	-	-	-	7MBP75RA120
		CODE	4P101C0130001	4P106C0150008	4P106C0450001	277831538
		Q'TY	1	1	1	1
20	MA7200-4020-N4	MODEL	-	-	-	7MBP75RA120
		CODE	4P101C0130001	4P106C0150016	4P106C0450001	277831538
		Q'TY	1	1	1	1

INVERTER & PARTS NAME			Main Circuit Diode	Cooling Fan (inside)	Cooling Fan (outside)	Operator
HP	MODEL	SPEC.				
1	MA7200-4001-N4	MODEL	-	KD1204PFBX	-	JNEP-36
		CODE	-	4M903D0880002	-	4P303C00100B7
		Q'TY	-	1	-	1
2	MA7200-4002-N4	MODEL	-	KD1204PFBX	-	JNEP-36
		CODE	-	4M903D0880002	-	4P303C00100B7
		Q'TY	-	1	-	1
3	MA7200-4003-N4	MODEL	DB35-16	AD0424HB-G70(T)	KD2406PTB1	JNEP-36
		CODE	4M903D4410001	4M903D4630001	4M903D4640006	4P303C00100B7
		Q'TY	1	1	2	1
5	MA7200-4005-N4	MODEL	DB35-16	AD0424HB-G70(T)	KD2406PTB1	JNEP-36
		CODE	4M903D4410001	4M903D4630001	4M903D4640006	4P303C00100B7
		Q'TY	1	1	2	1
7.5	MA7200-4007-N4	MODEL	VVZ40-16	AFB0624H	PMD2408PMB1-A(2)I55	JNEP-36
		CODE	27711349	4H300D0250009	4H300D0190004	4P303C00100B7
		Q'TY	1	1	2	1
10	MA7200-4010-N4	MODEL	VVZ40-16	AFB0624H	PMD2408PMB1-A(2)I55	JNEP-36
		CODE	27711349	4H300D0250009	4H300D0190004	4P303C00100B7
		Q'TY	1	1	2	1
15	MA7200-4015-N4	MODEL	VVZ70-16	AFB0624H	PMD2408PMB1-A(2)I55	JNEP-36
		CODE	277111331	4H300D0250009	4H300D0190004	4P303C00100B7
		Q'TY	1	1	2	1
20	MA7200-4020-N4	MODEL	VVZ70-16	AFB0624H	PMD2408PMB1-A(2)I55	JNEP-36
		CODE	277111331	4H300D0250009	4H300D0190004	4P303C00100B7
		Q'TY	1	1	2	1

J. Electrical Ratings For Constant Torque and Quadratic Torque

MA7200 Model	Constant Torque (150%, 1minute)			Quadratic Torque (110%, 1minute)		
	Max. Applic. Motor Output HP (kW)	Rated Output Current (A)	Max. Switching Freq. (kHz)	Max. Applic. Motor Output HP (kW)	Rated Output Current (A)	Max. Switching Freq. (kHz)
MA7200-2001-N1	1 (0.75)	4.8 A	15	1 (0.75)	5.6 A	10
MA7200-2002-N1	2 (1.5)	6.4 A	15	2 (1.5)	7.6 A	5
MA7200-2003-N1	3 (2.2)	9.6 A	15	3 (2.2)	9.8 A	15
MA7200-2005-N1	5.4 (4)	17.5 A	15	7.5 (5.5)	22.7 A	5
MA7200-2007-N1	7.5 (5.5)	24 A	15	10 (7.5)	32 A	10
MA7200-2010-N1	10 (7.5)	32 A	15	10 (7.5)	32 A	15
MA7200-2015-N1	15 (11)	48 A	10	20 (15)	56.7 A	5
MA7200-2020-N1	20 (15)	64 A	10	25 (18.5)	70.9 A	5
MA7200-2025-N1	25 (18.5)	80 A	10	25 (18.5)	80 A	10
MA7200-2030-N1	30 (22)	96 A	10	40 (30)	108 A	5
MA7200-2040-N1	40 (30)	130 A	10	40 (30)	130 A	10
MA7200-4001-N1	1 (0.75)	2.6 A	15	1 (0.75)	2.9 A	5
MA7200-4002-N1	2 (1.5)	4 A	15	2 (1.5)	4.6 A	5
MA7200-4003-N1	3 (2.2)	4.8 A	15	3 (2.2)	4.9 A	15
MA7200-4005-N1	5.4 (4)	8.7 A	15	7.5 (5.5)	12.5 A	5
MA7200-4007-N1	7.5 (5.5)	12 A	15	10 (7.5)	15.4 A	10
MA7200-4010-N1	10 (7.5)	15 A	15	15 (11)	22.7 A	5
MA7200-4015-N1	15 (11)	24 A	10	20 (15)	30.3 A	5
MA7200-4020-N1	20 (15)	32 A	10	25 (18.5)	38 A	5
MA7200-4025-N1	25 (18.5)	40 A	10	30 (22)	44 A	5
MA7200-4030-N1	30 (22)	48 A	10	30 (22)	48 A	10
MA7200-4040-N1	40 (30)	64 A	10	50 (37)	71 A	5
MA7200-4050-N1	50 (37)	80 A	10	50 (37)	80 A	10
MA7200-4060-N1	60 (45)	96 A	10	75 (55)	108 A	5
MA7200-4075-N1	75 (55)	128 A	10	100 (75)	140 A	5

Item	Common details	
	Constant Torque	Quadratic Torque
Output Overload	150% for 60s	110% for 60s
Operation Ambient Temperature	+14 ~ 104°F	+14 ~ 104°F
Allowable Voltage Fluctuation	-15% ~ +10%	-15% ~ +10%
Output Frequency	0.5Hz ~ 400Hz	0.5Hz ~ 400Hz
V/F curve	Dependent on parameter setting	Quadratic (or Cubic) Torque

K. Inverter Heat Loss

(A) 200 to 230V

Model MA7200-XXXX-N1		2001	2002	2003	2005	2007	2010	2015	2020	2025	2030	2040
Inverter Capacity kVA		2	2.7	4	7.5	10.1	13.7	20.6	27.4	34	41	54
Rated Current A		4.8	6.4	9.6	17.5	24	32	48	64	80	96	130
Heat Loss W	Fin	11	13	30	40	66	77	86	121	145	246	335
	Inside Unit	65	77	185	248	409	474	529	742	889	1510	2059
	Total Heat Loss	76	90	215	288	475	551	615	863	1034	1756	2394

(B) 380 to 460V

Model MA7200-XXXX-N1		4001	4002	4003	4005	4007	4010	4015	4020	4025	4030	4040	4050	4060	4075
Inverter Capacity kVA		2.2	3.4	4.1	7.5	10.3	12.3	20.6	27.4	34	41	54	68	82	110
Rated Current A		2.6	4	4.8	8.7	12	15	24	32	40	48	64	80	96	128
Heat Loss W	Fin	16	21	41	45	64	72	126	157	198	236	262	324	369	481
	Inside Unit	99	129	249	278	393	442	772	965	1218	1449	1608	1993	2270	2957
	Total Heat Loss	115	150	290	323	457	514	898	1122	1416	1685	1870	2317	2639	3438

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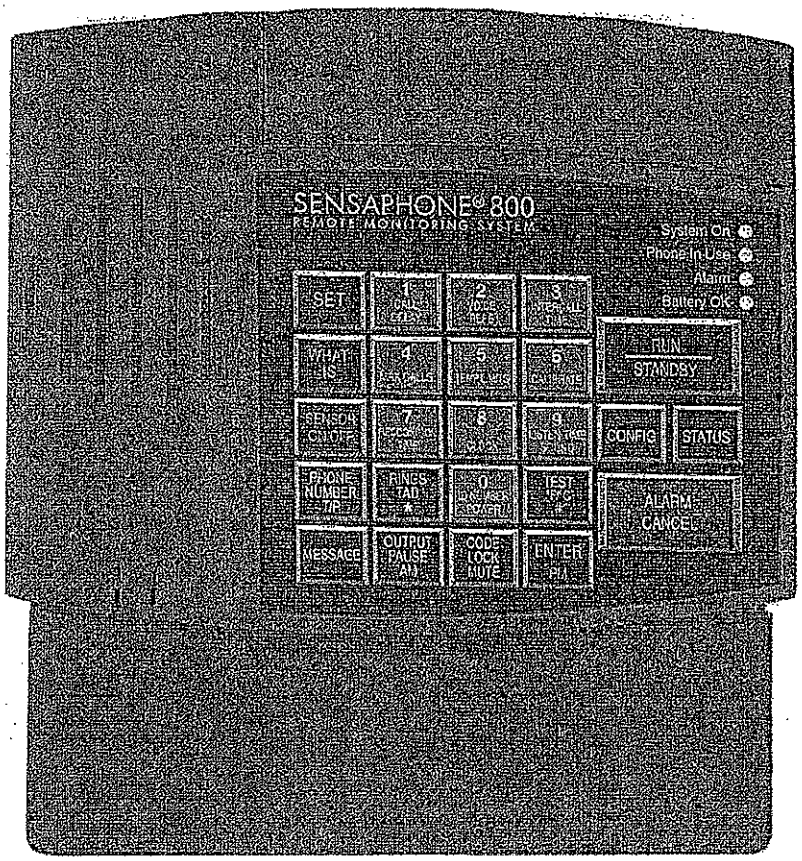
Autodialer

SENSAPHONE®
Model 800
User's Manual



Stay informed and in control of vital environmental conditions and processes with the fully-programmable ***Sensaphone® Model 800.***

PHONETICS, INC.

LIT-0130

SENSAPHONE®

Model 800

User's Manual

Version 1.1

PHONETICS, INC.

Every effort has been made to ensure that the information in this document is complete, accurate and up-to-date. PHONETICS, INC. assumes no responsibility for the results of errors beyond its control. PHONETICS, INC. also cannot guarantee that changes in equipment made by other manufacturers, and referred to in this manual, will not affect the applicability of the information in this manual.

First Edition, version 1.1, June, 2006

Written and produced by Phonetics. Inc.

Please address all comments on this publication to:

PHONETICS, INC.
901 Tryens Road
Aston, PA 19014
www.sensaphone.com

IMPORTANT SAFETY INSTRUCTIONS

Your Model 800 has been carefully designed to give you years of safe, reliable performance. As with all electrical equipment, however, there are a few basic precautions you should take to avoid hurting yourself or damaging the unit:

- Read the installation and operating instructions in this manual carefully. Be sure to save it for future reference.
- Read and follow all warning and instruction labels on the product itself.
- To protect the Model 800 from overheating, make sure all openings on the unit are not blocked. Do not place on or near a heat source, such as a radiator or heat register.
- Do not use your Model 800 near water, or spill liquid of any kind into it.
- Be certain that your power source matches the rating listed on the AC power transformer. If you're not sure of the type of power supply to your facility, consult your dealer or local power company.
- Do not allow anything to rest on the power cord. Do not locate this product where the cord will be abused by persons walking on it.
- Do not overload wall outlets and extension cords, as this can result in the risk of fire or electric shock.
- Never push objects of any kind into this product through ventilation holes as they may touch dangerous voltage points or short out parts that could result in a risk of fire or electric shock.
- To reduce the risk of electric shock, do not disassemble this product, but return it to Sensaphone Customer Service, or other approved repair facility, when any service or repair work is required. Opening or removing covers may expose you to dangerous voltages or other risks. Incorrect reassembly can cause electric shock when the unit is subsequently used.
- If anything happens that indicates that your Model 800 is not working properly or has been damaged, unplug it immediately and follow the procedures in Appendix F for having it serviced. Return the unit for servicing under the following conditions:

1. The power cord or plug is frayed or damaged.
2. Liquid has been spilled into the product or it has been exposed to water.
3. The unit has been dropped, or the cabinet is damaged.
4. The unit doesn't function normally when you're following the operating instructions.

- Avoid using a telephone (other than a cordless type) during an electrical storm. There may be a remote risk of electric shock from lightning.
- Do not use the telephone to report a gas leak in the vicinity of the leak.

CAUTION

To Reduce the Risk of Fire or Injury to Persons, Read and Follow these Instructions:

1. Use only the following type and size batteries: Alkaline, size C.
2. Do not dispose of the batteries in a fire. The cell may explode. Check with local codes for possible special disposal instructions.
3. Do not open or mutilate the batteries. Released electrolyte is corrosive and may cause damage to the eyes or skin. It may be toxic if swallowed.
4. Exercise care in handling batteries in order not to short the battery with conducting materials such as rings, bracelets, and keys. The battery or conductor may overheat and cause burns.
5. Do not mix old and new batteries in this product.

FCC Requirements

Part 68: The Sensaphone® Model 800 complies with Part 68 of the FCC rules. On the back of the unit there is a label that contains, among other information, the FCC Registration Number and the Ringer Equivalence Number (REN) for this equipment. You must, upon request, provide this information to your local telephone company.

The REN is useful to determine the quantity of devices that you may connect to your telephone line and still have all of those devices ring when your telephone number is called. In most, but not all areas, the sum of the RENs of all devices connected to one line should not exceed five (5.0). To be certain of the number of devices that you may connect to your line, you may want to contact your local telephone company to determine the maximum REN for your calling area.

This equipment may not be used on coin service provided by the telephone company. Connection to party lines is subject to state tariffs.

Should the Model 800 cause harm to the telephone network, the telephone company may discontinue your service temporarily. If possible, they will notify you in advance. But if advance notice isn't practical, the telephone company may temporarily discontinue service without notice and you will be notified as soon as possible. You will be informed of your right to file a complaint with the FCC. The telephone company may make changes in its facilities, equipment, operations, or procedures where such action is reasonably required in the operation of its business and is not inconsistent with the rules and regulations of the FCC that could affect the proper functioning of your equipment. If they do, you will be notified in advance to give you an opportunity to maintain uninterrupted telephone service.

If you experience trouble with this equipment, or you need information on obtaining service or repairs, please contact:

PHONETICS, INC.

901 Tryens Road, Aston, PA 19014

610-558-2700 Fax: 610-558-0222

The telephone company may ask that you disconnect this equipment from the network until the problem has been corrected or until you are sure that the equipment is not malfunctioning.

Part 15: This equipment has been tested and found to comply with the limits for a Class B digital device, pursuant to Part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference in a residential installation. This equipment generates, uses and can radiate radio frequency energy and, if not installed and used in accordance with the instructions, may cause harmful interference to radio communications. However, there is no guarantee that interference will not occur in a particular installation. If this equipment does cause harmful interference to radio or television reception, which can be determined by turning the equipment off and on, the user is encouraged to try to correct the interference by one or more of the following measures:

- Reorient or relocate the receiving antenna.
- Increase the separation between the equipment and the receiver.
- Connect the equipment into an outlet on a circuit different from that to which the receiver is connected.
- Consult the dealer or an experienced radio/television technician for help.

Canadian Department of Communications Statement

Notice: The Canadian Department of Communications label identifies certified equipment. This certification means that the equipment meets certain telecommunications network protective operational and safety requirements. The Department does not guarantee the equipment will operate to the user's satisfaction.

Before installing this equipment, users should ensure that it is permissible to be connected to the facilities of the local telecommunications company. The equipment must also be installed using an acceptable method of connection. In some cases, where the company's inside wiring is associated with a single line, individual service may be extended by means of a certified connector assembly (telephone extension cord). The customer should be aware that compliance with the above conditions may not prevent degradation of service in some situations.

Repairs to certified equipment should be made by an authorized Canadian maintenance facility designated by the supplier. Any repairs or alterations made by the user to this equipment, or equipment malfunctions, may give the telecommunications company cause to request the user to disconnect the equipment.

Users should ensure for their own protection that the electrical ground connections of the power utility telephone lines and internal metallic water pipe system, if present, are connected together. This precaution may be particularly important in rural areas.

CAUTION: Users should not attempt to make such connections themselves, but should contact the appropriate electric inspection authority, or electrician, as appropriate.

The Load Number (LN) assigned to each terminal device denotes the percentage of the total load to be connected to a telephone loop which is used by the device to prevent overloading. The termination on loop may consist of any combination of devices subject only to the requirement that the total of the Load Numbers of all the devices does not exceed 100. For the Sensaphone® Model 800, the Load Number is 0.3.

1 YEAR LIMITED WARRANTY

PLEASE READ THIS WARRANTY CAREFULLY BEFORE USING THE PRODUCT.

THIS LIMITED WARRANTY CONTAINS SENSAPHONE'S STANDARD TERMS AND CONDITIONS. WHERE PERMITTED BY THE APPLICABLE LAW, BY KEEPING YOUR SENSAPHONE PRODUCT BEYOND THIRTY (30) DAYS AFTER THE DATE OF DELIVERY, YOU FULLY ACCEPT THE TERMS AND CONDITIONS SET FORTH IN THIS LIMITED WARRANTY.

IN ADDITION, WHERE PERMITTED BY THE APPLICABLE LAW, YOUR INSTALLATION AND/OR USE OF THE PRODUCT CONSTITUTES FULL ACCEPTANCE OF THE TERMS AND CONDITIONS OF THIS LIMITED WARRANTY (HEREINAFTER REFERRED TO AS "LIMITED WARRANTY OR WARRANTY"). IF YOU DO NOT AGREE TO THE TERMS AND CONDITIONS THIS WARRANTY, INCLUDING ANY LIMITATIONS OF WARRANTY, INDEMNIFICATION TERMS OR LIMITATION OF LIABILITY, THEN YOU SHOULD NOT USE THE PRODUCT AND SHOULD RETURN IT TO THE SELLER FOR A REFUND OF THE PURCHASE PRICE. THE LAW MAY VARY BY JURISDICTION AS TO THE APPLICABILITY OF YOUR INSTALLATION OR USE ACTUALLY CONSTITUTING ACCEPTANCE OF THE TERMS AND CONDITIONS HEREIN AND AS TO THE APPLICABILITY OF ANY LIMITATION OF WARRANTY, INDEMNIFICATION TERMS OR LIMITATIONS OF LIABILITY.

1. **WARRANTOR**: In this Warranty, Warrantor shall mean "Dealer, Distributor, and/or Manufacturer."

2. **ELEMENTS OF WARRANTY**: This Product is warranted to be free from defects in materials and craftsmanship with only the limitations and exclusions set out below.

3. **WARRANTY AND REMEDY**: One-Year Warranty — In the event that the Product does not conform to this warranty at any time during the time of one year from original purchase, warrantor will repair the defect and return it to you at no charge.

This warranty shall terminate and be of no further effect at the time the product is: (1) damaged by extraneous cause such as fire, water, lightning, etc. or not maintained as reasonable and necessary; or (2) modified; or (3) improperly installed; or (4) misused; or (5) repaired or serviced by someone other than Warrantors' authorized personnel or someone expressly authorized by Warrantor's to make such service or repairs; (6) used in a manner or purpose for which the product was not intended; or (7) sold by original purchaser.

LIMITED WARRANTY, LIMITATION OF DAMAGES AND DISCLAIMER OF LIABILITY FOR DAMAGES: THE WARRANTOR'S OBLIGATION UNDER THIS WARRANTY IS LIMITED TO REPAIR OR REPLACEMENT OF THE PRODUCT, AT THE WARRANTOR'S OPTION AS TO REPAIR OR REPLACEMENT. IN NO EVENT SHALL WARRANTORS BE LIABLE OR RESPONSIBLE FOR PAYMENT OF ANY INCIDENTAL, CONSEQUENTIAL, SPECIAL AND/OR PUNITIVE DAMAGES OF ANY KIND, INCLUDING BUT NOT LIMITED TO ANY LABOR COSTS, PRODUCT COSTS, LOST REVENUE, BUSINESS INTERRUPTION LOSSES, LOST PROFITS, LOSS OF BUSINESS, LOSS OF DATA OR INFORMATION, OR FINANCIAL LOSS, FOR CLAIMS OF ANY NATURE, INCLUDING BUT NOT LIMITED TO CLAIMS IN CONTRACT, BREACH OF WARRANTY OR TORT, AND WHETHER OR NOT CAUSED BY WARRANTORS' NEGLIGENCE. IN THE EVENT THAT IT IS DETERMINED IN ANY ADJUDICATION THAT THE LIMITED WARRANTIES OF REPAIR OR REPLACEMENT ARE INAPPLICABLE, THEN THE PURCHASER'S SOLE REMEDY SHALL BE PAYMENT TO THE PURCHASER OF THE ORIGINAL COST OF THE PRODUCT, AND IN NO EVENT SHALL WARRANTORS BE LIABLE OR RESPONSIBLE FOR PAYMENT OF ANY INCIDENTAL, CONSEQUENTIAL, SPECIAL AND/OR PUNITIVE DAMAGES OF ANY KIND, INCLUDING BUT NOT LIMITED TO ANY LOST REVENUE, BUSINESS INTERRUPTION LOSSES, LOST PROFITS, LOSS OF BUSINESS, LOSS OF DATA OR INFORMATION, OR FINANCIAL LOSS, FOR CLAIMS OF ANY NATURE, INCLUDING BUT NOT LIMITED TO CLAIMS IN CONTRACT, BREACH OF WARRANTY OR TORT, AND WHETHER OR NOT CAUSED BY WARRANTORS' NEGLIGENCE.

WITHOUT WAIVING ANY PROVISION IN THIS LIMITED WARRANTY, IF A CIRCUMSTANCE ARISES WHERE WARRANTORS ARE FOUND TO BE LIABLE FOR ANY LOSS OR DAMAGE ARISING OUT OF MISTAKES, NEGLIGENCE, OMISSIONS, INTERRUPTIONS, DELAYS, ERRORS OR DEFECTS IN WARRANTORS' PRODUCTS OR SERVICES, SUCH LIABILITY SHALL NOT EXCEED THE TOTAL AMOUNT PAID BY THE CUSTOMER FOR WARRANTORS' PRODUCT AND SERVICES OR $250.00, WHICHEVER IS GREATER. YOU HEREBY RELEASE WARRANTORS FROM ANY AND ALL OBLIGATIONS, LIABILITIES AND CLAIMS IN EXCESS OF THIS LIMITATION.

INDEMNIFICATION AND COVENANT NOT TO SUE: YOU WILL INDEMNIFY, DEFEND AND HOLD HARMLESS WARRANTORS, THEIR OWNERS, DIRECTORS, OFFICERS, EMPLOYEES, AGENTS, SUPPLIERS OR AFFILIATED COMPANIES, AGAINST ANY AND ALL CLAIMS, DEMANDS OR ACTIONS BASED UPON ANY LOSSES, LIABILITIES, DAMAGES OR COSTS, INCLUDING BUT NOT LIMITED TO DAMAGES THAT ARE DIRECT OR INDIRECT, INCIDENTAL, SPECIAL OR CONSEQUENTIAL, AND INCLUDING ATTORNEYS FEES AND LEGAL COSTS, THAT MAY RESULT FROM THE INSTALLATION, OPERATION, USE OF, OR INABILITY TO USE WARRANTORS' PRODUCTS AND SERVICES, OR FROM THE FAILURE

OF THE WARRANTORS' SYSTEM TO REPORT A GIVEN EVENT OR CONDITION, WHETHER OR NOT CAUSED BY WARRANTORS' NEGLIGENCE.

YOU AGREE TO RELEASE, WAIVE, DISCHARGE AND COVENANT NOT TO SUE WARRANTORS, THEIR OWNERS, DIRECTORS, OFFICERS, EMPLOYEES, AGENTS, SUPPLIERS OR AFFILIATED COMPANIES, FOR ANY AND ALL LIABILITIES POTENTIALLY ARISING FROM ANY CLAIM, DEMAND OR ACTION BASED UPON ANY LOSSES, LIABILITIES, DAMAGES OR COSTS, INCLUDING BUT NOT LIMITED TO DAMAGES THAT ARE DIRECT OR INDIRECT, INCIDENTAL, SPECIAL OR CONSEQUENTIAL, AND INCLUDING ATTORNEYS FEES AND LEGAL COSTS, THAT MAY RESULT FROM THE INSTALLATION, OPERATION, USE OF, OR INABILITY TO USE WARRANTORS' PRODUCTS AND SERVICES, OR FROM THE FAILURE OF THE WARRANTORS' SYSTEM TO REPORT A GIVEN EVENT OR CONDITION, WHETHER OR NOT CAUSED BY WARRANTORS' NEGLIGENCE, EXCEPT AS NECESSARY TO ENFORCE THE EXPRESS TERMS OF THIS LIMITED WARRANTY.

EXCLUSIVE WARRANTY: THE LIMITED WARRANTY OR WARRANTIES DESCRIBED HEREIN CONSTITUTE THE SOLE WARRANTY OR WARRANTIES TO THE PURCHASER. ALL IMPLIED WARRANTIES ARE EXPRESSLY DISCLAIMED, INCLUDING: THE WARRANTY OF MERCHANTABILITY AND THE WARRANTY OF FITNESS FOR A PARTICULAR USE AND THE WARRANTY OF FITNESS FOR A PARTICULAR PURPOSE AND THE WARRANTY OF NON-INFRINGEMENT AND/OR ANY WARRANTY ARISING FROM A COURSE OF DEALING, USAGE, OR TRADE PRACTICE.

It must be clear that the Warrantors are not insuring your premises or business or guaranteeing that there will not be damage to your person or property or business if you use this Product. You should maintain insurance coverage sufficient to provide compensation for any loss, damage, or expense that may arise in connection with the use of products or services, even if caused by Warrantors' negligence. The warrantors assume no liability for installation of the Product and/or interruptions of the service due to strikes, riots, floods, fire, and/or any cause beyond Seller's control, further subject to the limitations expressed in any License Agreement or other Agreement provided by Warrantors to purchaser.

The agreement between the Warrantors and the Purchaser, including but not limited to the terms and conditions herein shall not be governed by the Convention for the International Sale of Goods. Where applicable, the Uniform Commercial Code as adopted by the State of Delaware shall apply.

4. **PROCEDURE FOR OBTAINING PERFORMANCE OF WARRANTY**: In the event that the Product does not conform to this warranty, the Product should be shipped or delivered freight prepaid to a Warrantor with evidence of original purchase.

5. **LEGAL REMEDIES AND DISCLAIMER:** Some jurisdictions may not allow, or may place limits upon, the exclusion and/or limitation of implied warranties, incidental damages and/or consequential damages for some types of goods or products sold to consumers and/or the use of indemnification terms. Thus, the exclusions, indemnification terms and limitations set out above may not apply, or may be limited in their application, to you. If the implied warranties can not be excluded, and the applicable law permits limiting the duration of implied warranties, then the implied warranties herein are to be limited to the same duration as the applicable written warranty or warranties herein. The warranty or warranties herein may give you specific legal rights that will depend upon the applicable law. You may also have other legal rights depending upon the law in your jurisdiction.

6. **CHOICE OF FORUM AND CHOICE OF LAW:** In the event that a dispute arises out of or in connection with this Limited Warranty, then any claims or suits of any kind concerning such disputes shall only and exclusively be brought in either the Court of Common Pleas of Delaware County, Pennsylvania or the United States District Court for the Eastern District of Pennsylvania.

Regardless of the place of contracting or performance, this Limited Warranty and all questions relating to its validity, interpretation, performance and enforcement shall be governed by and construed in accordance with the laws of the State of Delaware, without regard to the principles of conflicts of law.

Effective date 05/01/2004
PHONETICS, INC. d.b.a. SENSAPHONE
901 Tryens Road
Aston, PA 19014
Phone: 610.558.2700 Fax: 610.558.0222
www.sensaphone.com

TABLE OF CONTENTS

Chapter 1: Introduction

The Sensaphone® Model 800 is a fully-programmable, environmental monitoring system that offers extensive on-site and remote monitoring capability to small businesses, private homes, farms, greenhouses, computer rooms, and remote facilities. Designed for desktop or wall mounting, the Model 800 is simple to install, program and operate; no changes to standard electrical or telephone service are required. When connected to a telephone line, it will respond to an alarm by dialing up to four separate telephone numbers. When the call is answered, an "Alert Condition" message is delivered in user recordable voice.

The Model 800 features built-in sensors to monitor a variety of conditions:

- High sound level
- AC electric power failure
- Battery backup
- Temperature*

*Note: While technically not a "built-in" sensor, temperature is factory installed on zone 1.

The 800 is equipped with 8 alert zones. Additional sensors* can be added to extend monitoring capabilities to include:

- Intrusion or unauthorized entry
- Water leaks and seepage
- Temperature
- Humidity
- Equipment operation
- Many other conditions that may require unique monitoring solutions

* Refer to Appendix D for information on additional sensors (available separately from Sensaphone) best suited to your application.

The status of each monitored condition is readily obtained at the unit's installation site, or remotely by telephone. At the close of every Status Report, time is provided for listening to on-site sounds.

To ensure reliable operation, the Model 800 features power backup capability; in the event of AC power failure, six C-cell

alkaline batteries (not included) will continue to power the unit for approximately 24 hours.

Feature Summary

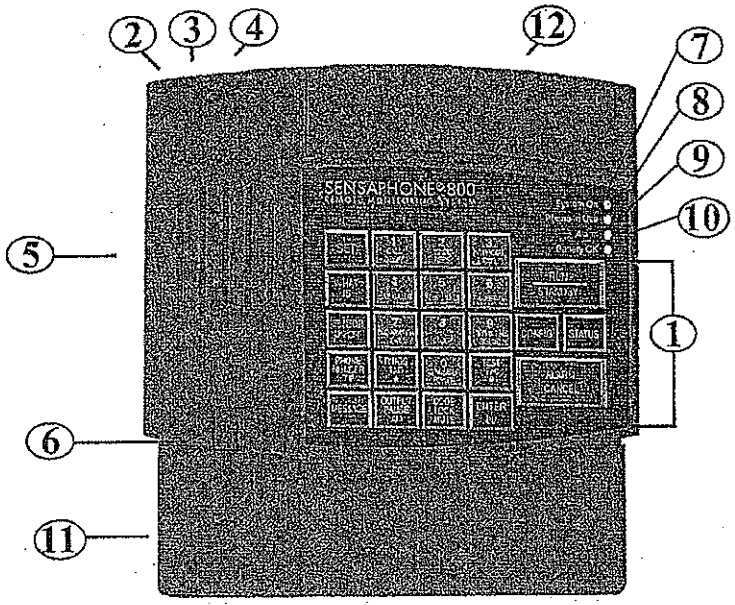
The Sensaphone 800 includes the following features:

- Four zones configurable as temperature or dry contact
- Each zone can be individually enabled or disabled
- Fully automatic input configuration
- Temperature sensor included on zone #1
- Calibration for each zone
- Power monitor
- High sound-level monitor
- User-recordable voice messages
- Dial out to four telephone numbers
- Alarm dial out via voice and numeric pager
- Microphone for onsite listen-in
- Built-in line seizure
- Relay output (manual or automatic control)
- Four status LEDs
- Surge protection on all zones, telephone line, and power supply
- 24 hour battery backup (batteries not included)
- Wall or desktop installation

About This Manual

This manual comprises the instructions and commands for installing and operating the Model 800. The Quick Start chapter is included to speed understanding of programming and operation. Communication and Alarm Programming chapters demonstrate step-by-step methods for utilizing the full range of available features. The Troubleshooting chapter provides assistance in the event that problems are encountered.

Layout



1. Programming Keypad
2. Power Jack
3. Phone Extension Jack
4. Phone Line Jack
5. Speaker
6. Built in Microphone
7. System on LED
8. Phone-in-use LED
9. Alarm LED
10. Battery OK LED
11. Battery Compartment
12. Input/Output Wiring Door

LED INDICATORS

The LEDs provide on-site alarm and status information. Listed below are descriptions of how the LEDs work.

System On

LED Off: Unit is off

LED On: Unit is in Run mode

LED Blinking: Unit is in Standby mode

Phone-In-Use

LED On: The unit or some other device is communicating on the phone line

LED Off: Phone line is not in use

LED Blinking: No telephone service detected

Alarm

LED Off: No alarms exist

LED Blinking: Unacknowledged alarm exists

LED On: Acknowledged alarm exists

Battery OK

LED On: Battery condition good

LED Blinking: Battery condition low

LED Off: No battery/critically low battery condition

Technical Support

If any questions arise upon installation or operation of the Model 800, please contact the Sensaphone Technical Service Department at the number shown below, and have the following information:

- Date of Purchase _____
- Serial number of your Model 800 _____

Technical Support is available from 8:00AM to 5:00PM EST.

You may also email us at support@sensaphone.com.

Phonetics, Inc.

901 Tryens Road

Aston, PA 19014

610-558-2700

Fax: 610-558-0222

www.sensaphone.com

Chapter 2: Installation

Correctly installing the Model 800 will ensure proper functioning of the unit. Please read the entire chapter before starting the installation process.

Within the packaging will be a Warranty Registration Card. Please take the time to fill this out and mail. The One Year Limited Warranty is explained in the front of this manual.

2.1 Operating Environment

The Model 800 should be installed and operated in a clean, dry area that provides space for wiring sensors to the screw terminals, near an AC power source and telephone line. Operating temperature ranges from 32° Fahrenheit (0° Celsius) to +122° Fahrenheit (+50° Celsius).

NOTE

The Model 800 is a sensitive electronic device. **Do not** install the Model 800 near strong electrostatic, electromagnetic or radioactive fields. **Do not** expose to humid environments, fumes, or corrosive vapors.

2.2 Mounting

Flat Mount: Place the Model 800 on top of a desk or other horizontal surface. Wall Mount: Mount on a wall with two flathead screws using the keyholes on the back panel of the unit. Place the flathead screws or bolts 4" apart at the desired height from the floor. Hook the unit over the screws and toward the floor. Refer to Figure 2-1.

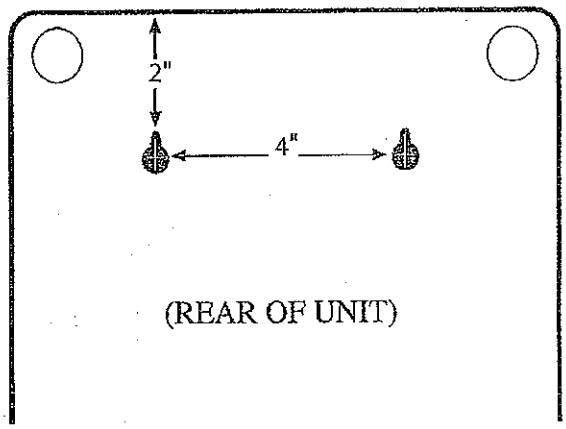


Figure 2-1. Wall Mount

2.3 Power Surge Protection

The Model 800 can be damaged by power surges and lightning through the telephone line and the 120 VAC power supply. Although the Model 800 has built-in surge protection, we recommend that additional protection be obtained for the unit and for any electronic equipment that is attached to your power supply and telephone lines. Power surge protection is especially important if you live in a lightning-prone area. The ISOTEL Surge Protector Model IB-4 is available through Sensaphone. See Appendix D.

2.4 Power Supply and Battery Backup

The Model 800 is provided with a DC power transformer that will plug into any standard 120 VAC outlet and a battery backup (batteries not included) that enables the unit to continue functioning if AC power is removed (due to electric power disruption or failure). The Model 800 uses six, C-cell alkaline batteries. Do not use rechargeable batteries. Connect the DC power transformer into the jack on the back of the unit and plug the adapator into a 120VAC outlet

NOTE

Be sure that the DC transformer is plugged into an outlet before installing batteries.

To install the batteries, remove the battery compartment door located on the front of the unit below the keypad. Press down and slide the door away from the unit, align batteries according to the diagram shown in Figure 2-2, and replace the hatch.

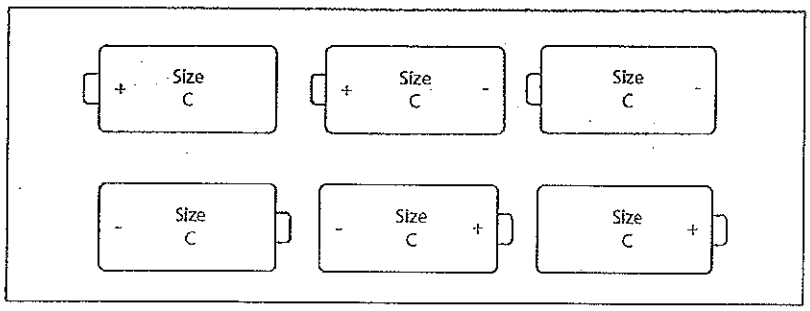


Figure 2-2. Battery Installation

2.5 Starting the Model 800

When the DC power transformer is first plugged into the electrical outlet, the Model 800 automatically starts in RUN mode. The *System On* light will begin to glow. The unit will respond with,"Hello, this is Sensaphone 800."

2.6 Run Mode and Standby Mode

Pressing the RUN/STANDBY key on the Model 800 keypad will alternately activate or deactivate the unit. If the unit is activated and in RUN mode, the system on light glows steadily. In STANDBY mode, the system on light goes out, but will blink every few seconds to indicate that power is still supplied to the unit.

In RUN mode, the Model 800 is able to receive incoming calls and to dial out automatically in the event of an alarm on one of the monitored conditions. To enter STANDBY mode, press RUN/ STANDBY.

As soon as the Model 800 enters STANDBY mode, it responds with "Goodbye." The system on light immediately goes out and then resumes with a blink every few seconds. While in STANDBY mode, all functions are disabled, but programmed memory is preserved. Upon exiting STANDBY mode, any currently existing alarms will be announced.

NOTE

STANDBY mode is not equivalent to "power off"—an electrical source, such as the 120 VAC, or the battery backup, continues to provide full power to the unit. If the unit is placed in STANDBY mode, unplugged from the 120 VAC outlet, and placed in storage, the batteries will continue to power the Model 800, discharging until they fail. Consequently, batteries should always be removed from the unit following disconnection from any 120 VAC outlet, prior to storage.

Press the RUN/STANDBY key again to return to RUN mode.

Figure 2-3. The RUN/STANDBY Key

2.7 Telephone Line

The Model 800 will operate with all standard analog telephone lines that accept pulse or tone dialing. The Model 800 cannot be used on an extension line to dial its own telephone number. Also, it may **not** be installed on a party line, pay telephone line, or digital telephone system.

Certain private telephone systems and public switching equipment may not accept the Model 800 dialing or may generate an unacceptable ring signal. In those cases, a dedicated line may be required. Consult the supplier of your telephone system if you encounter problems.

If you do not have a modular telephone extension at the Model 800's location, you must contact your local telephone company to have one installed (there is a charge for this service). If you have four-pin jacks, adapters are available to convert them to the modular plugs. Contact your local telephone company or electronics parts store.

CAUTION

Never install telephone wiring during a lightning storm. Never install telephone jacks in wet locations unless the jack is specifically designed for wet locations. Never touch uninsulated telephone wires or terminals unless the telephone line has been disconnected at the network interface. Use caution when installing or modifying telephone lines.

To install the telephone line, plug one end of the modular cord into the "line" jack on the back of the model 800 (as shown) and plug the other end into any standard RJ11 phone outlet. Refer to Figure 2-4.

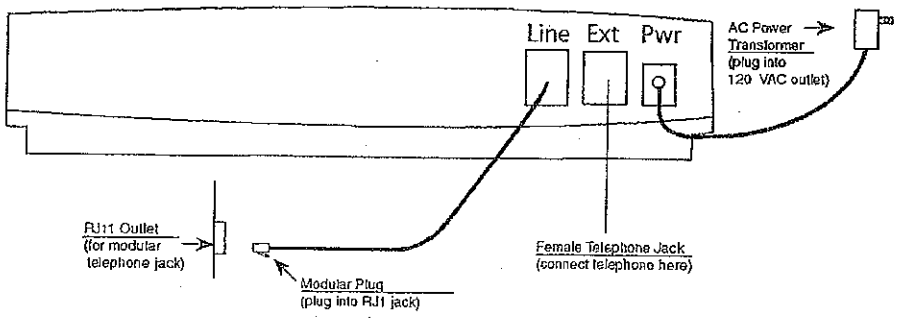


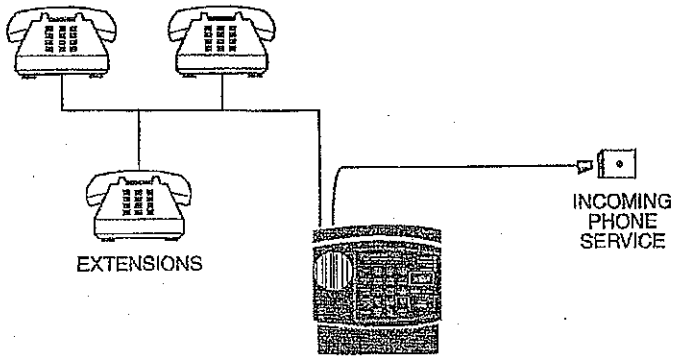
Figure 2-4. Installing the Telephone Line

On the back of the Model 800 is an extra female telephone jack labeled "EXT". This is provided so that a telephone or other answering device may be used on the same line as the unit.

(It is not necessary to hook up a telephone for the Model 800 to operate.) This extension jack features Line Seizure which means that it will disconnect the extension jack when the Model 800 needs to make a telephone call. To ensure that the unit has priority over any other device on the line, you must connect all extensions to this jack. (see figure)

On the unit there are two RJ11C phone jacks:

- The RJ11C jack labeled "LINE"is to be connected to the incoming line of your phone service, ahead of all other phones or telephone extensions.
- The RJ11C telephone jack labeled "EXT" is to be connected to all extensions.



2.8 The Microphone

The Model 800 is provided with a built-in microphone which is used to monitor high sound levels produced near the installation site. The sensitivity of the microphone is configurable and will detect a continuous as well as a pulsating alarm. Note that beeping alarms that have a half second or more of silence between beeps will not be detected.

Other programming options that apply to the microphone include setting the length of time before a high sound causes an alarm.

If this sound level exists for 8 consecutive seconds (default) or for the programmed length of time, the Model 800 will dial out with an alarm message.

NOTE

The proximity of the audible alarm to the microphone is extremely important.

Normally, the Model 800 and the audible alarm must be in the same room. The maximum distance can vary considerably depending on the alarm, the acoustics, and the size of the room.

During an alarm dial-out, the microphone allows four-second intervals to listen-in to sounds at the Model 800's location.

When calling for a Status Report, the microphone permits listening to on-site sounds for a programmed time interval.

2.9 Alert Zones

Open the input/output wiring door located above the keypad. The Model 800 can monitor up to 8 zones (represented by the numbered terminal screws shown in Figure 2-5, below).

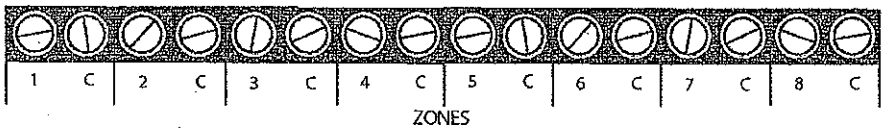


Figure 2-5. Alert Zones

Zones are configured as either dry contact or temperature. A zone configured as dry contact can be used with any normally open (N.O.) or normally closed (N.C.) device. "Open" refers to an opened circuit path; if conditions cause the circuit to close, an alert condition occurs. "Closed" refers to a continuous circuit path; if a closed circuit is opened, an alert condition occurs. The Model 800 determines the way zones are configured by the type of sensor connected to each alert zone (refer to Chapter 5.)

A zone configured as "temperature" is designed to evaluate a range of settings. The Model 800 will read the temperature at the sensor's location and compare that value to programmed high and low temperature limits. Temperature zones must be used with Sensaphone's 2.8K Remote Temperature Sensor or weatherproof sensor.

NOTE

Before wiring, it is advisable to disable the zones to prevent accidentally tripping an alarm. See Chapter 5.

Important Note regarding Ultra-Low temperature freezers:
If you are connecting the Sensaphone to an ultralow temperature freezer (-80° C) and the freezer is equipped with alarm terminals/ contacts you can connect these directly to one of the zones on your Sensaphone (refer to your freezer owner's manual for proper connection.

2.10 Installing the Sensor

After you have selected the sensor, loosen the screw of the alert zone and its corresponding common (c). Two wire leads are used to connect any monitoring sensor. Fasten one lead to the numbered screw and the other lead to C. Tighten both screws. If the zone was not disabled, the Model 800 may recite its "Alarm Exists" message as you connect the sensor. If it does, just press ALARM CANCEL to stop it. Re-enable the zone after wiring. Refer to Figures 2-6 and 2-7 for connecting a sensor to an alert zone.

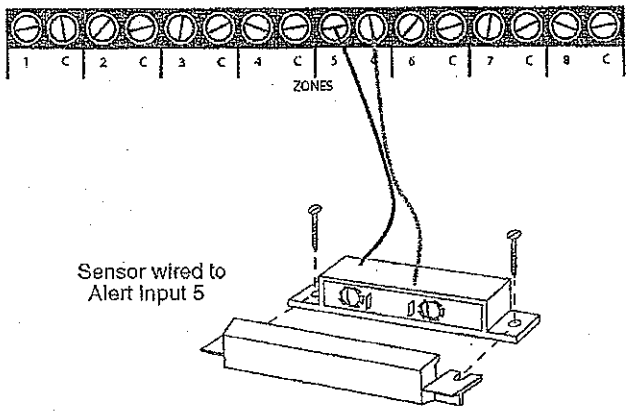


Figure 2-6. Sensor Connected to an Alert Zone

Any sensor can be attached to the Model 800 using 18-26-gauge wire (#22 recommended). The sensor can be several hundred feet from the unit, as long as the total resistance of the circuit is not greater than 50 ohms. Use wire appropriate for the application.

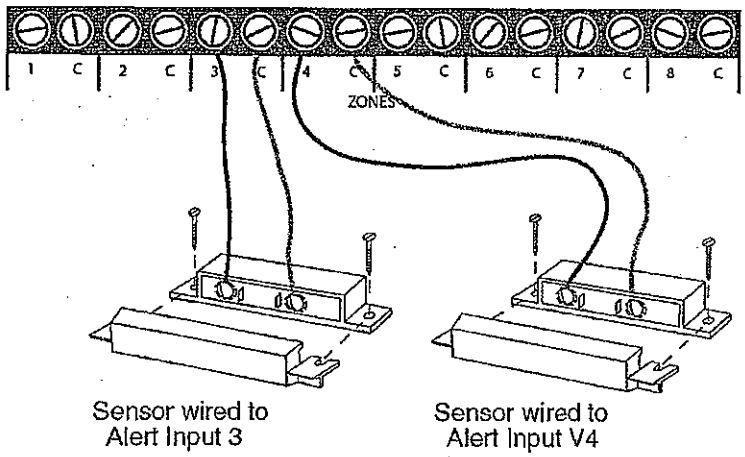


Figure 2-7. Two Sensors Wired to Adjacent Zones

NOTE

Do not use sensors, switches, or relays that supply any voltage or current to the Model 800. Be aware of proximity to other electrical wires or components when placing wires that lead from the sensors to the unit. Avoid running the wires near electrical devices that use high voltage or current, such as motors, heavy machinery, etc. This voltage may be inductively coupled into the sensor wiring and could result in damage to the the Model 800's circuitry. Try to place wires at least 6 inches from other electrical wiring or devices.

2.11 Multiple Sensors

The Model 800 may have more than one sensor connected to the same alert zone, as long as the normal condition for each sensor on the same alert zone is identical (either all N.O. or all N.C.). However, only one remote temperature sensor can be used on each zone.

When wiring several normally closed sensors on one zone, they must be connected in series. Connect one lead from the first sensor to the numbered screw of the alert zone. Next, take the other lead from the first sensor and connect it to one lead from the next sensor. Continue connecting sensors end-to-end until you have connected all of your sensors. Take the second lead from the last sensor and connect it to the common screw on the Model 800.

See Figure 2-8. Multiple N.C. sensors are typically magnetic reed switches to monitor the security of windows and doors.

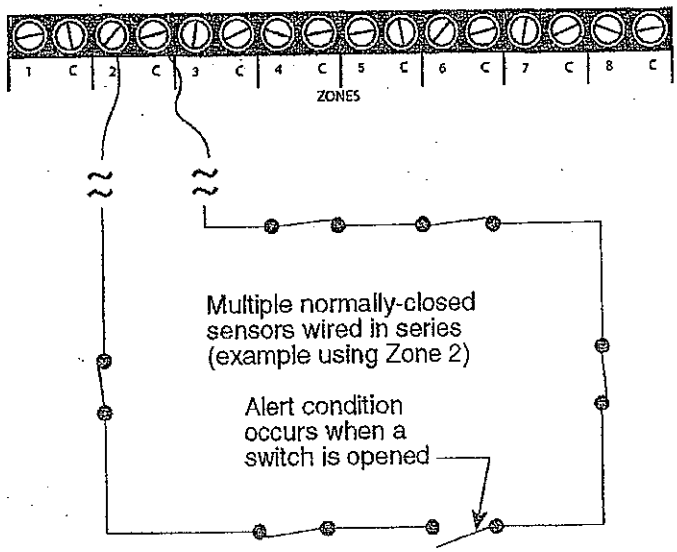


Figure 2-8. Multiple Normally Closed Sensors

To wire several normally open sensors to one alert zone, connect them in parallel. To do this, take one lead from each sensor and attach it to the numbered terminal. Then, take the second lead from each sensor and attach each to the corresponding common screw. Refer to Figure 2-9.

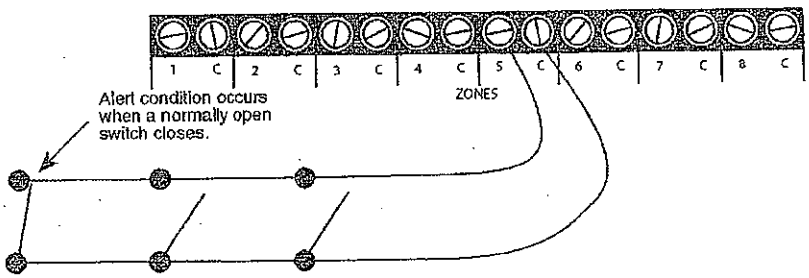


Figure 2-9. Multiple Normally Open Sensors

2.12 Outdoor Wiring

When wiring sensors outdoors, DO NOT allow exposed wires to run freely in open air; under such conditions, the Model

800 is susceptible to serious damage during a lightning storm. Depending upon the distance outdoor wiring must travel, consideration should be given to the use of shielded wire inside a metal conduit. Both shield and conduit should be connected to an earth ground. This prevents stray voltage from entering the unit.

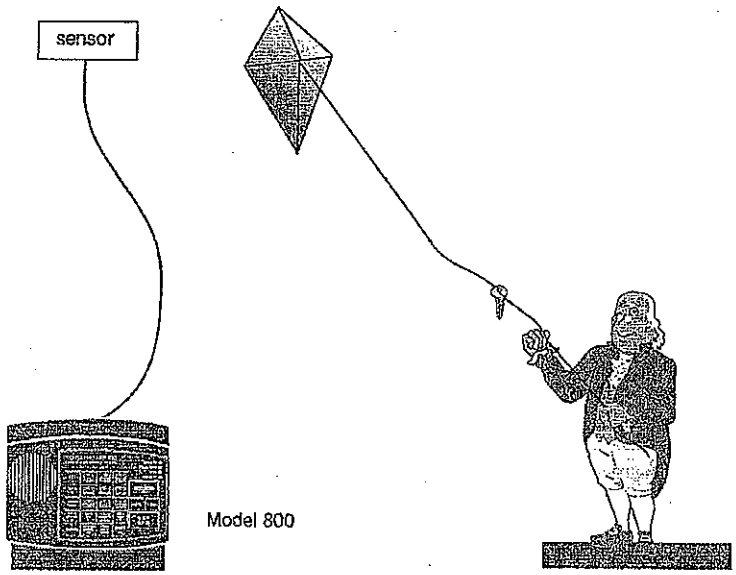


Figure 2-10. Potential Sensor Damage from Stray Electrical Noise

2.13 Disconnecting the Model 800 for Storage or Seasonal Use.

If you plan to employ the Model 800 as a seasonal "watchdog" for a few months during the year, you must disconnect all wires from the unit completely to avoid damage to the circuitry when the unit is not in use. If the unit is unplugged but left in place with all the sensors still connected, the wires act as antennae that draw in any stray "electrical noise" from such devices as fans, blowers, microwaves, etc.

Additionally, it is important to remove the batteries, or they will discharge until they fail.

Preserve your Model 800 during the off-season, or when not in use:

- Remove the sensor wires at the screw terminals
- Remove the batteries
- Unplug the unit and store in a safe place

Chapter 3: Quick Start

This section presents a useful guide for first-time programming of the Model 800. Follow instructions for installation before attempting to program the Model 800. Refer to Chapter 2: Installation.

3.1 The Local Keypad

Programming is accomplished using the local keypad (shown below, Figure 3-1). Notice that a single key has several functions assigned to it; programming results are determined by the order in which keys are pressed.

Individual keystrokes are illustrated to show programming steps in the correct order. If you make a mistake by entering the wrong key, do not press another key until you hear the message *"Error 1."* Then, start over with the first key in the programming sequence.

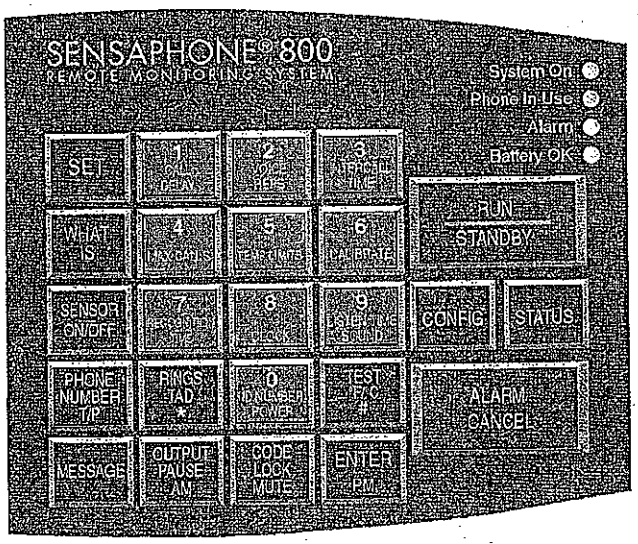


Figure 3-1. The Model 800 Keypad

3.2 Preparation for Programming

Read complete instructions in Chapter 2: Installation, and make sure to follow these three steps first:

1. Plug the AC adapter into the 120 VAC outlet.
2. Install the batteries.
3. Connect the Model 800 to a telephone line.

When these steps are completed, the Model 800 is fully operational and able to monitor temperature, high sound, AC power failure and battery backup condition; it can also be called on the telephone for a Status Report or be used for listening to on-site sounds from any remote location. Now, the unit is ready for programming.

3.3 Quick-Start Programming Steps

Step 1: Set Configuration of Zones

The Model 800 will scan the 8 external zones and determine if they are N.O. (normally open), N.C. (normally closed), or Temperature. If external sensors are added, make sure they are in their normal positions before proceeding—refer to Chapter 5, Section 5.1.

1. Press STANDBY to place the Model 800 in Standby mode.

2. If you have external sensors available, wire the sensors to the zones on the back of the Model 800 (see Chapter 2, Section 2.10). Otherwise, skip this step and move to step 3.
3. Press RUN. The *System On* light glows when the Model 800 returns to Run mode.

4. Press SET.

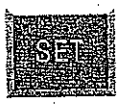
5. Press CONFIGURE.

6. The Model 800 will audibly recite the new configuration for each of the eight zones, responding with *"normally open"*, *"normally closed"*, or *"Temperature."* If a zone is unused, it is treated as normally open.

Step 2: Set the ID Number

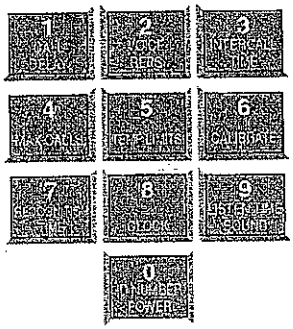
It is recommended that you set the ID number to reflect the telephone number on which the Model 800 is installed.

1. Press SET



2. Press ID NUMBER.

3. Using the number keys, enter the digits (up to 16 are permitted) for the ID number. The Model 800 will recite the digits as they are pressed.

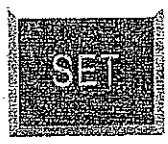


4. Press ENTER. The 800 will respond: *"Enter."*

Step 3: Set Dial-Out Telephone Numbers

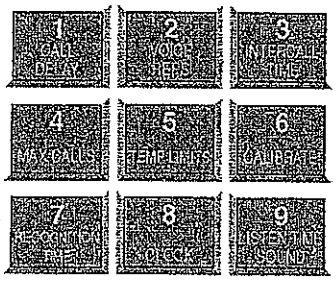
To program dial-out telephone numbers:

1. Press SET.



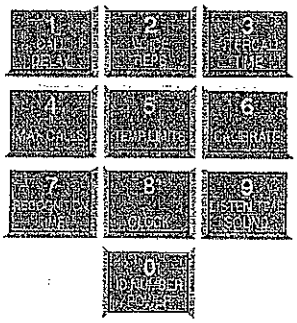
2. Press PHONE NUMBER.

3. Select which telephone number to program. Press any unassigned number key (from 1 to 8) to represent the new telephone number entry. Model 800 will respond: "Enter number."



4. Enter the complete telephone number using the number keys.

The Model 800 will recite the digits as they are pressed.



5. Press ENTER. The unit will respond: *"Enter."*

6. Repeat above procedure to program up to eight separate telephone numbers.

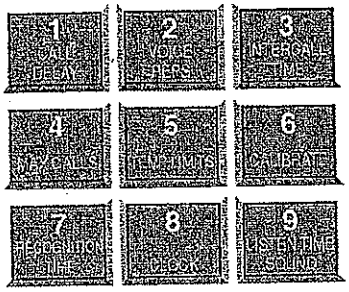
Step 4: Set Temperature Limits

High and low temperature limits can be separately programmed for each zone that is configured as temperature. Limits can range from –20° to +150° Fahrenheit, or from –30° to 65° Celsius. Default settings are: 10° F for low temperature and 100° F for high temperature. Do not set temperature limits too close to normal room temperature, since minor fluctuations could result in frequent and unnecessary alarm dialouts.

1. Press SET.

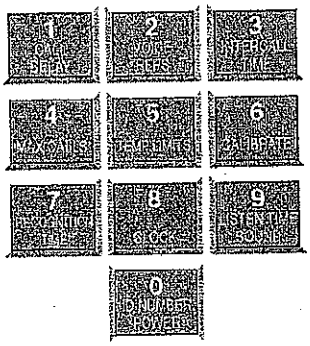
2. Press TEMP LIMITS.

3. Using the number keys, press a number (from 1 to 8) that corresponds to the temperature zone being programmed.



The Model 800 responds: *"Enter low temperature limit."*

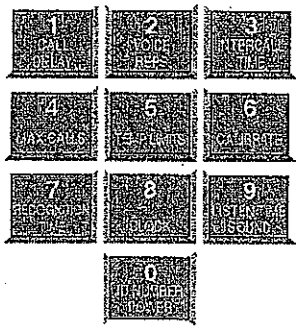
4. Using the number keys, enter a value for low temperature limit. The Model 800 will recite the digits as they are pressed. If a negative number is required, first press *, then enter the number.



5. Press ENTER.

The Model 800 responds: *"Enter high temperature limit."*

6. Using the number keys, enter the value for high temperature limit. The Model 800 will recite the digits as they are pressed.



7. Press ENTER. The Model 800 responds: *"Enter."*

This concludes minimum programming to achieve normal operation of the Model 800. In addition to the programming just accomplished, default settings for many more features take effect when the unit is first powered. You will be able to reprogram most of these factory-set defaults to suit your application.

For a complete explanation of each feature (with illustrations of keystrokes), refer to Chapter 4: Communications Programming and Chapter 5: Alarm Programming.

To gain a basic understanding of how the alarm dial-out feature works, refer to this chapter, Section 3-4. For extended information regarding dial-out and related programmable parameters, refer to Chapter 7: Operation.

3.4 Summary of the Alarm Dial-Out Process

Action—Response	Programmable Feature
1. THE MODEL 800 DETECTS AN ALERT CONDITION An alert condition is not the same as a valid alarm—the condition must continue for the programmed time period, or ***Recognition Time***, before it is recognized as a valid alarm.	• **Recognition Time** This is the programmed waiting period to determine if an alert condition has persisted long enough to be considered a valid alarm. If the sensor returns to normal within recognition time, then no alarm will occur.
2. A VALID ALARM IS CONFIRMED An audible, on-site alarm message begins and continues until the alarm is acknowledged. (If the Mute feature is turned on, there is no on-site message.) ***Call Delay*** is activated.	• **Call Delay** This is the programmed waiting period, before the first telephone number is called, to report an alarm.
3. DIAL-OUT BEGINS Dial-out begins by calling telephone number 1 to report an alarm. If there is no acknowledgment, the Model 800 waits the programmed ***Intercall Time*** before dialing subsequent telephone numbers. Dial-out continues in this manner, cycling through the remaining telephone numbers, for the programmed ***Max Calls***.	• **Intercall Time** This is the programmed waiting period, in between sequential dialing of telephone numbers, to report an alarm.
	• **Max Calls** This is the total number of telephone calls that will be dialed in response to any valid alarm. Telephone numbers are dialed sequentially, and continue to cycle until the maximum number of calls is reached. If no acknowledgment occurs, then at the completion of Max Calls, all alarms are automatically acknowledged.
4. THE ALARM IS ACKNOWLEDGED When the alarm is acknowledged, the dial-out process is cancelled and the audible, on-site alarm message stops.	

Chapter 4: Communications Programming

This chapter explains the keypad commands for communications programming of the Model 800, including interrogation and resetting of the following:

- Voice Messages
- The Unit ID Number
- Dial-out Telephone Numbers
- Tone or Pulse Dialing
- Special Dialing with Pagers, Beepers and Access Numbers.
- Dial-out test mode
- Rings Until Answer
- Telephone Answering Device Compatibility
- Listen-in Time
- Call Delay
- Local Voice Mute
- Voice Repetitions
- Intercall Time
- Maximum Number of Calls
- The Clock
- Security Code

4.1 Voice Messages

The 800's digital speech recording feature allows you to record custom messages for each of the eight Zones and an ID Message. This means that when the 800 calls you during an alarm, you will hear a personalized Voice Message identifying the unit and telling you exactly what alarm condition exists. You can record a separate message for each of the eight Zones. The message can run a maximum of 5 seconds. The ID Message can be a maximum of 8 seconds. You can shorten the message length by pressing the ENTER key after reciting the message.

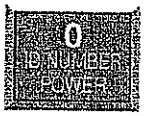
The **ID Message** is used to identify the unit. This could be a particular building name, its location (address or city), or some other identifier.

To program the ID Message:

1. Press the SET key.

2. Press the MESSAGE key. The 800 will say "Enter Message Number."

3. Press the ID key (number 0 key).



4. When the unit beeps, begin speaking your message into the microphone. The unit will say "OK," when the recording time has elapsed; then it will play back your recorded message.

To play back the ID Message:

1. Press the WHAT IS key.

2. Press the MESSAGE key.

3. Press the ID key (number 0 key).

The 800 will play back your recorded message.

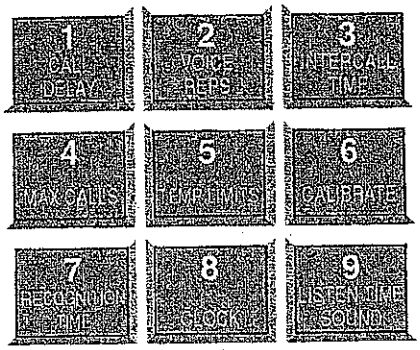
The **Zone Messages** are used to identify the device or condition being monitored such as temperature, humidity, equipment alarms, security alarms, etc.

To program the Voice Message for a Zone:

2. Press the SET key.

2. Press the MESSAGE key. The 800 will say, "Enter Message Number."

3. Press the number key for the corresponding Zone.



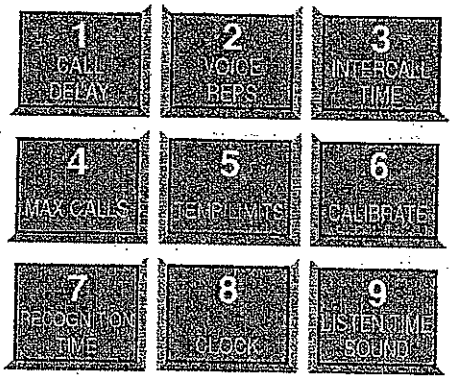
4. When the unit beeps, begin speaking your message into the microphone. The unit will say "OK," when the recording time has elapsed; then it will play back your recorded message.

To play back the message for a Zone:

1. Press the WHAT IS key.

2. Press the MESSAGE key.

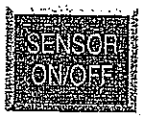
3. Press the corresponding Zone number key.



The 800 will play back your recorded message.

To erase a Zone or ID message:

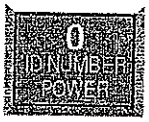
1. Press the SENSOR ON/OFF key.



2. Press the MESSAGE key.

The 800 will say "Enter message number."

3. Press the Zone Number or ID key.



The 800 will say, "Message erased."

4.2 The Unit ID Number

The Unit ID Number is the identification number of the Model 800. This number is typically the telephone number where the unit is installed, or it may be designated using any number that best suits your application.

The purpose of the Unit ID Number is to immediately provide the source of any alarm, especially when using multiple Model 800

units in a complex monitoring system. When the Model 800 is called from a remote location, it always begins its message with the identification number:

"Hello, this is (Unit ID Number)."

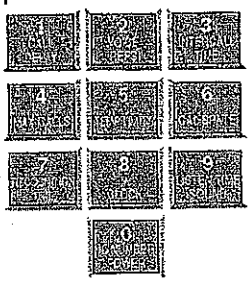
4.2.1 Programming the ID Number

To program the ID Number:

1. Press SET.

2. Press ID NUMBER.

3. Using the number keys, enter up to 16 digits for the ID number. The Model 800 will recite the digits as they are pressed.



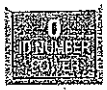
4. Press ENTER. The Model 800 will respond: *"Enter."*

4.2.2 Interrogating the ID Number

To interrogate the ID numbers:

1. Press WHAT IS.

2. Press ID NUMBER. The Model 800 will recite the Unit ID Number programmed.



4.3 Dial-out Telephone Numbers

The Model 800 can store up to eight 48-digit phone numbers. These are the numbers that will be called during alarm dial-out. In the event of an alarm, the numbers are dialed sequentially, 1 through 8. Begin programming the first telephone number by assigning it to the key labeled with the number 1 on the keypad, and continue to assign any other telephone numbers in numerical order. ***A pause, pound*** or ***star*** can be added to an individual phone number to access different phone and beeper systems. See *Special Dialing, Section 4.5.*

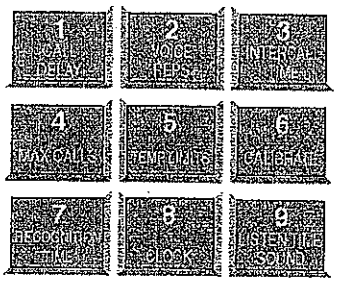
4.3.1 Programming Dial-out Telephone Numbers

To program dial-out telephone numbers:

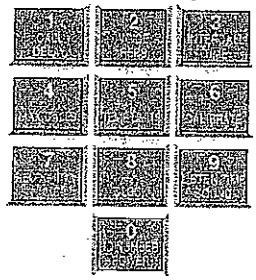
1. Press SET.

2. Press PHONE NUMBER.

3. Select which telephone number to program. Press any unassigned number key (from 1 to 8) to represent the new telephone number entry. The Model 800 will respond: *"Enter number."*



4. Enter the complete telephone number using the number keys.



5. Press ENTER. The unit will respond with *"Enter."*

6. Repeat above procedure to program up to eight separate telephone numbers.

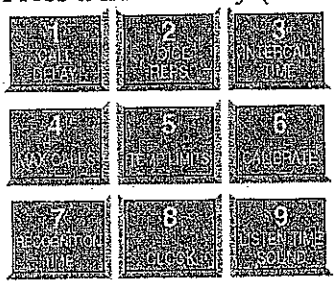
4.3.2 Interrogating a Dial-out Telephone Number

To interrogate dial-out telephone numbers:

1. Press WHAT IS.

2. Press PHONE NUMBER.

3. Press a number key (from 1 to 8).



Model 800 will recite the corresponding telephone number. If there is no number programmed for a particular key, the unit will respond: *"No number."*

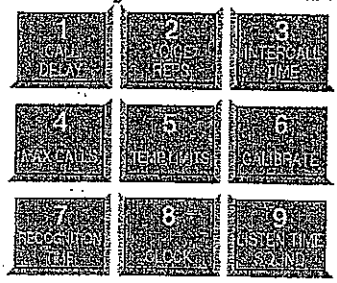
4.3.3 Erasing a Telephone Number

To erase a telephone number:

1. Press SET.

2. Press PHONE NUMBER.

3. Press the number key (from 1 to 8) representing the telephone number you want to erase.



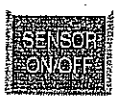
4. Press ENTER. The Model 800 will say *"Number # erased."*

4.4 Tone or Pulse Dialing

The Model 800 can dial out in pulse or Touch Tone™. Select the type of dialing, in either pulse or tone, depending upon the type of service provided by your telephone company. The default is tone.

To program for either pulse or tone:

1. Press the SENSOR ON/OFF key.



2. Press PHONE NUMBER T/P.

The Model 800 will respond: *"Tone"* to indicate that tone dialing is enabled, or *"Pulse"* to indicate that pulse dialing is on and enabled.

3. Repeat key sequence to switch between settings.

4.5 Special Dialing

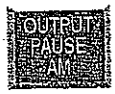
The Model 800 has provisions for special dialing sequences. Special dialing sequences allow:

- Dialing that requires an access number to connect with an outside line.
- Dialing that requires the pound (#) or star (*).
- Dialing to a beeper or pager.

4.5.1 Special Dialing Keys

The following designated keys represent special functions when used with PHONE NUMBER entries:

1. *Pause*



PAUSE represents a two-second pause in dialing. It can be used when an access number is required before dialing to an outside line. (For example, in some cases a "9" or other number, must be dialed first, in order to get a dial tone for an outside line.)

2. *Pound (#)*

A pound may be required when calling some phone or beeper systems.

3. *Star (*)*

A star may be required when calling some phone or beeper systems.

4. *Code*

The CODE key can be used to perform special functions during the dialing sequence. These include: Pager dialing, Wait for Answer, and Switch to Touch-tones. These functions enable the Sensaphone to send a numeric page, or dial a telephone number + office extension, or combine pulse & touch-tone dialing in the same telephone number. Multiple codes can be used during telephone number programming if required. See section 4.5.4 for special instructions on dialing to a beeper or pager.

Code 1 Pager

When CODE + 1 is inserted as the first digit of the telephone number, the Model 800 will make a pager call. This means that the unit will expect the call to be answered by a paging service provider, then it will send its ID number (using touch-tones), followed by the digits that identify the zone(s) in alarm. The unit will hang-up after it completes the call. See section 4.5.4 for specific programming examples for dialing a pager.

Code 2 Wait-For-Answer

You can force your Sensaphone to Wait-For-Answer in the middle of dialing a telephone number. This is useful when calling a telephone extension that is initially answered by an auto-attendant. By inserting the wait-for-answer code you can instruct your Sensaphone to call the main number, then wait for an answer by the auto-attendant, then dial the extension. The Sensaphone will not speak it's voice message until the telephone is answered at the extension.

Example:

SET + PHONE NUMBER + any unassigned number key 1-8

+ telephone number + CODE + 2 + extension number + ENTER

Code 3 Switch to Touch-tone

This command allows you to change from pulse dialing to touch-tone dialing in the middle of dialing a telephone number. This is useful when your telephone service only supports pulse dialing, but you need to send touch-ones after connecting – such as when dialing a numeric pager or navigating a voice menu.

Example:

In this example a telephone number is dialed, the Sensaphone waits for the call to be answered, then changes to touch-tones to dial an extension.

SET + PHONE NUMBER + any unassigned number key 1-8 +

telephone number + CODE + 2 + CODE + 3 +

extension number + ENTER

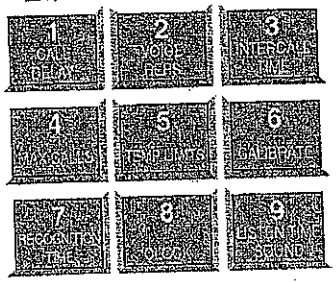
4.5.2 Incorporating a Pause

Incorporate PAUSE to access an outside telephone line:

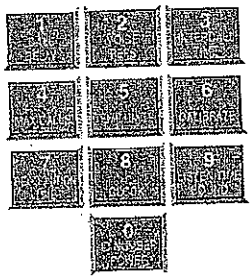
1. Press SET.

2. Press PHONE NUMBER.

3. Press any unassigned number key (from 1 to 8) to represent the new telephone number entry. Model 800 will respond: *"Enter number."*

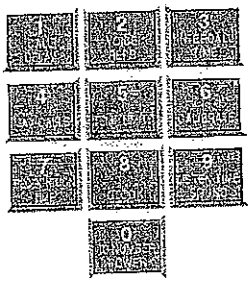


4. From the number keys, enter the access digit (i.e., 9). The Model 800 will recite the digit.



5. Press PAUSE. The Model 800 will *"pause."*

6. Enter the complete telephone number using the number keys. The Model 800 will recite the digits as they are pressed.



7. Press ENTER. The Model 800 will say *"Enter."*

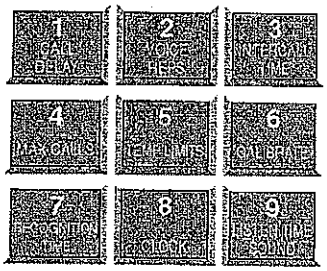
4.5.3 Incorporating a Pound (#) or Star (*)

Incorporate a pound or star if it is normally included in telephone number:

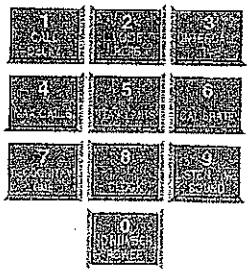
1. Press SET.

2. Press PHONE NUMBER.

3. Press any unassigned number key (from 1 to 8) to represent the new telephone number entry. Model 800 will respond: *"Enter number."*



4. Enter the telephone number using the number keys. The Model 800 will recite the digits as they are pressed.



5. Position the pound (#) or star (*) within the telephone number where required by pressing the designated keys. The Model 800 will *say "pound"* or *"star"* each time the key is pressed.

–OR–

6. Enter any remaining digits of the telephone number.
7. Press ENTER. The Model 800 will say *"Enter."*

4.5.4 Special Dialing to a Beeper or Pager

Your Sensaphone can be programmed to send an alarm message to a numeric beeper/pager. The message will include the Sensaphone's telephone number (ID number) and the Zone numbers that are in alarm. For example, if zones 1 and 4 are in alarm, the message on your pager would be: 8882227777-1-4, where 8882227777 is the unit's ID number. A Sound alarm will appear as alarm -9 and a Power alarm will appear as alarm -0. To program a telephone number for Pager dialout, you must enter Code 1 at the beginning of the telephone number. The Sensaphone will say "Code one, Pager" when you enter the command.

Follow the key sequence below to dial a numeric pager:

SET + PHONE NUMBER + any unassigned number key 1-8 +

CODE + 1 + pager telephone number + ENTER

To check your programming:

WHAT IS + PHONE NUMBER + assigned # 1-8

The Sensaphone will say "Pager", followed by the programmed telephone number.

To send a test page:

SET + TEST + assigned # key 1-8 + ENTER

The Sensaphone will let you listen to the dialout sequence through its speaker and send you a message that includes the Sensaphone's telephone number (ID number).

Voice Prompted Paging Systems

If your paging provider is answered by a voice prompt which requires you to enter one or more touch-tones to send a message, then use the wait-for-answer code (4.5.1) in combination with the Pause key and other number keys to navigate the voice menu until you reach the message entry point. The Sensaphone will automatically send it's telephone number, Zone numbers, and a pound (#) tone at the end of the number. For assistance contact Sensaphone Technical Support at 1(877)373-2700.

4.6 Rings Until Answer

Rings Until Answer is the programmed number of times the telephone rings before the Model 800 will answer an incoming call. This can be set from 1 to 15 rings. The default value is 4.

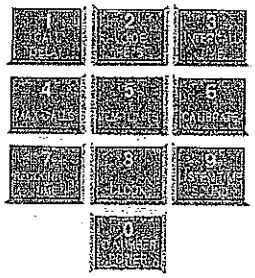
4.6.1 Programming Rings Until Answer

To program Rings Until Answer:

1. Press SET.

2. Press RINGS/TAD. The Model 800 will respond: *"Enter number."*

3. Using the number keys, enter a value.



4. Press ENTER. The Model 800 will respond: *"Enter."*

4.6.2 Interrogating Rings Until Answer

To interrogate Rings Until Answer:

1. Press WHAT IS.

2. Press RINGS/TAD.

4.7 TAD (Telephone Answering Device)

The TAD feature is especially useful because it integrates the operation of the Model 800 with your telephone answering device (e.g. answering machine) in a way that retains the full flexibility of each system. This allows you to have on-demand telephone access to the Model 800, for obtaining a Status Report, or for issuing call-in commands, while your telephone answering device is set to receive outside calls. Programming for use with a telephone answering device (TAD) is always used in conjunction with Rings Until Answer, detailed in section 4.6.

NOTE

The TAD feature only applies to answering devices connected to the same telephone line as the Model 800.

4.7.1 TAD Enable/Disable

To enable/disable the TAD feature:

1. Press SENSOR ON/OFF.

2. Press RINGS/TAD.

The Model 800 will respond: *"TAD On."* (If the Model 800 says *"TAD Off,"* repeat steps 1 and 2 to reactivate TAD.)

4.7.2 Using the TAD Feature

1. Make sure the TAD feature is enabled on the Model 800. (The default setting is disabled, so you must enable it first.)
2. Determine the number of rings your telephone answering device uses to answer the telephone. (Most answering devices require 4 rings; others are selectable.)
3. On the Model 800, program Rings Until Answer to a greater number than the number of rings set on your answering machine.

   Example:

   Telephone answering device, rings = 4

   Model 800, Rings Until Answer = 6

Using the procedure just outlined, all incoming calls will be answered by the telephone answering device, allowing it to operate normally. With the programming just accomplished, the Model 800 can be accessed remotely, by telephone, to obtain the Status Report.

1. Dial the telephone number of the Model 800.
2. Let the telephone ring once and then hang up.
3. Wait approximately ten seconds
4. Call the Model 800 back.

It will answer the telephone on the first ring.

Explanation: The pattern of one ring, followed by a second call (within 30 seconds), signals the Model 800 to answer your incoming call, bypassing the telephone answering device.

NOTE

Special Case: If the Model 800 shares the same line with a telephone answering device, and during certain time periods, frequent, incoming calls are expected on that line, then you may want to temporarily disable the TAD feature. If you leave the TAD enabled, it will not adversely affect normal operation, but if two outside telephone calls are received within the same 30-second time window, the Model 800 will interpret this pattern as a signal to answer the telephone. If this occurs, press any key on the Model 800 to hang up.

4.7.3 No TAD In Use

If a telephone answering device is not used on the same telephone line as the Model 800, make sure that the TAD feature is disabled, or turned off. Only Rings Until Answer programming will determine how incoming calls are answered. For example, if you program Rings Until Answer to 3, incoming calls will be answered in 3 rings.

4.8 Listen-in Time

The Listen-in Time is the amount of time you can listen to sounds from the Model 800's built-in microphone at its installation site. When you call in for a Status Report, the Model 800 announces Listen-in Time at the end of its first round of status readings, saying, *"Listen for (programmed time entered)."* The programmable range is from 0 to 255 seconds (or up to 4.17 minutes). The default value is 15 seconds.

NOTE

The microphone is also used to monitor high sound level. See Chapter 5, Section 5.10 through Section 5.11.1.

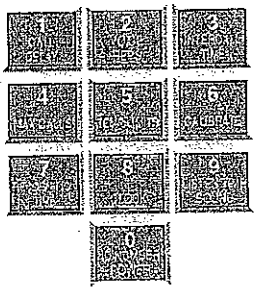
4.8.1 Programming the Listen-in Time

To program the Listen-in Time:

1. Press SET.

2. Press LISTEN TIME. The Model 800 will respond: *"Enter seconds."*

3. Using the number keys, enter the seconds. The Model 800 will recite the digits as they are pressed.



4. Press ENTER. The Model 800 will respond: *"Enter."*

4.8.2 Interrogating the Listen-in Time

To interrogate the Listen-in Time:

1. Press WHAT IS.

2. Press LISTEN TIME. The Model 800 will recite the listen-in time.

4.9 Call Delay

Call Delay is the programmed length of time the Model 800 waits, following detection of an alarm, before it begins the dial-out sequence. This applies only to the first call. (Delay time between calls is also programmable: refer to Intercall Time, Section 4-12.)

The purpose for Call Delay is to allow time for personnel at the Model 800's installation site to respond to and cancel an alarm before dial-out begins. During this time, the Model 800 will audibly repeat its *"alarm"* message (unless the Local Voice Mute feature has been activated—refer to Section 4.10). The default for Call Delay is 30 seconds. Call Delay can be programmed from 0 seconds to 60 minutes (1 hour).

4.9.1 Programming the Call Delay

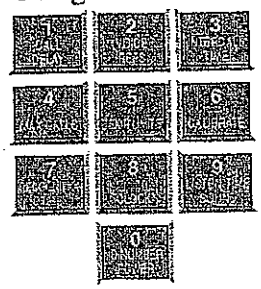
To program the Call Delay:

1. Press SET.

2. Press CALL DELAY.

The Model 800 will respond: *"Enter minutes."*

3. Using the number keys, enter the minutes.



The Model 800 recites the digits as they are pressed.

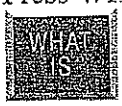
4. Press ENTER. The Model 800 responds: *"Enter seconds."*

5. Using the number keys, enter the seconds. The Model 800 recites the digits as you press them.
6. Press ENTER. The Model 800 responds: *"Enter."*

4.9.2 Interrogating Call Delay

To interrogate Call Delay:

1. Press WHAT IS.



2. Press CALL DELAY.

The Model 800 will recite the programmed Call Delay.

4.10 Local Voice Mute

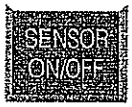
When the Model 800 dials out to report an alarm, it also audibly recites the alarm message through it's speaker. The Local Voice Mute command allows you to turn off the speaker at the Model 800's site during alarm dialouts and status call-ins. This feature

is used to prevent intruders or unauthorized persons from hearing the alarm dial-out message or from hearing the Status Report during an off-site call.

4.10.1 Enable/Disable Local Voice Mute

To enable/disable Local Voice Mute:

1. Press SENSOR ON/OFF.



2. Press MUTE.

The Model 800 will say *"Mute On"* to indicate that Local Voice Mute is enabled, or *"Mute Off"* to indicate that it is disabled.

3. Repeat key sequence to switch between enabled or disabled Local Voice Mute.

4.11 Voice Repetitions

The Voice Repetitions feature allows programming of the number of times the alarm message is repeated *per phone call* during alarm dial-out.

The maximum repetitions may be set to 10; the default is 3 repetitions.

4.11.1 Programming Voice Repetitions

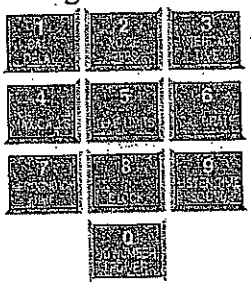
To program Voice Repetitions:

1. Press SET.

2. Press VOICE REPS.

The Model 800 will respond: *"Enter number."*

3. Using the number keys, enter a value from 1 to 10.



4. Press ENTER. The Model 800 will respond: *"Enter."*

4.11.2 Interrogating Voice Repetitions

To interrogate Voice Repetitions:

1. Press WHAT IS.

2. Press VOICE REPS.

The Model 800 will recite the number programmed.

4.12 Intercall Time

The Intercall Time is the programmable period of time the Model 800 waits in calling subsequent telephone numbers. Intercall Time is activated ***only after alarm dial-out to the first telephone number fails to be acknowledged***. This period can be programmed from 10 seconds to 60 minutes. The default intercall time is 1 minute.

If an incoming telephone call is made to the Model 800 during Intercall Time (in between its dialing of subsequent telephone numbers to report an alarm), it will answer the incoming call and immediately report any existing alarms.

4.12.1 Programming Intercall Time

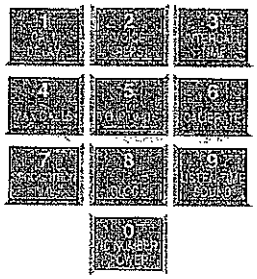
To program Intercall Time:

1. Press SET.

2. Press INTERCALL TIME.

The Model 800 will respond: *"Enter minutes."*

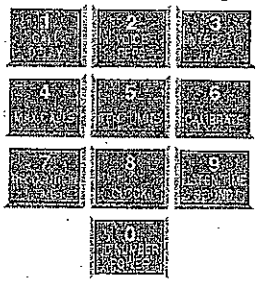
3. Using the number keys, enter the minutes.



The Model 800 recites the digits as you press them.

4. Press ENTER. The Model 800 will respond: *"Enter seconds."*

5. Using the number keys, enter the seconds. The Model 800 recites the digits as you press them.



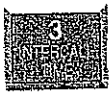
6. Press ENTER. The Model 800 responds: *"Enter."*

4.12.2 Interrogating Intercall Time

To interrogate Intercall Time:

1. Press WHAT IS.

2. Press INTERCALL TIME.



The Model 800 will recite the programmed Intercall Time.

4.13 Maximum Number of Calls (Max Calls)

The Max Calls feature controls the total number of repeated calling attempts by the Model 800 in the event of an alarm. When an alarm occurs, the dial-out process begins, and continues to cycle through your programmed telephone numbers until the alarm is acknowledged or until the maximum number of calls is reached. The Max Calls setting regulates the number of calls that will be made as a result of any alarms; if more than one alarm is detected at once, or if a second alarm occurs during dial-out on the first alarm, the Max Calls setting will start the calling process from zero, until the programmed number of calling attempts are completed.

The default setting for Max Calls is 100, but it may be programmed from 1 to 255 calls. Max Calls is cancelled when an alarm is acknowledged. If the maximum number of calls is completed and no alarm acknowledgement has occurred, the Model 800 will automatically acknowledge any alarm and stop the dial-out.

NOTE

If only one telephone number is programmed, the Model 800 will dial out a maximum of 15 times to report an alarm in accordance with FCC rules.

4.13.1 Programming Max Calls

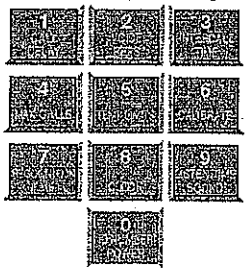
To program Max Calls:

1. Press SET.

2. Press MAX CALLS.

The Model 800 will respond: *"Enter number."*

3. Using the number keys, enter a value. The Model 800 will recite the digits as you press them.



4. Press ENTER. The Model 800 responds: *"Enter."*

4.13.2 Interrogating Max Calls

To interrogate Max Calls:

1. Press WHAT IS.

2. Press MAX CALLS.

The Model 800 will recite the value set for Max Calls.

4.14 The Clock

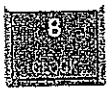
The Model 800 has a built-in clock. The power-up time is 12 AM. The clock will keep time from 12 AM until you program the current time. It will then keep time from your programmed time. If the AC power fails, the clock will continue to keep time until the battery back-up fails. It will then reset to 12 AM when power is restored. ***An incorrect time is a good indication that the power has failed and the batteries have been expended.***

4.14.1 Setting the Clock

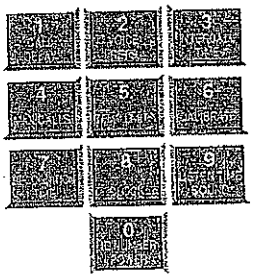
To set the clock:

1. Press SET.

2. Press CLOCK.



3. Using the number keys, enter the correct time. The Model 800 will recite the digits as they are pressed.



4. If the time is AM, press the AM key. The Model 800 will say *"am"* If the time is PM , press the PM key. The Model 800 will say *"pm."*

Example: You want to set the clock to 9:45 AM. Press the following keys in the order shown:

SET + CLOCK + 9 + 4 + 5 + AM

4.14.2 Interrogating for the Current Time

To interrogate the Model 800 for the current time:

1. Press WHAT IS.

2. Press CLOCK. The Model 800 will recite the current time.

4.15 The Security Code

The Security Code is the last step after setting all other programming parameters for the Model 800. The code consists of a 4-digit number you select and will effectively prevent unauthorized changes to the Model 800's programming. When the Security Code is activated, all keyboard programming is locked. The Model 800 may be interrogated using the WHAT IS key, but the keyboard must be unlocked, via the Security Code, before any programming changes are possible.

4.15.1 Locking the Keypad

To program the Security Code:

1. Press SET.

2. Press CODE.

The Model 800 will say *"Enter security code."*

3. Using the number keys, enter 4 digits.
4. Press ENTER.

The Model 800 says, *"OK."* The keyboard is now locked.

If unauthorized persons attempt to set a parameter, an error message, *"Error 2,"* is returned. Whenever any operation except WHAT IS takes place without entering the security code first, this error message occurs.

4.15.2 Unlocking the Keypad

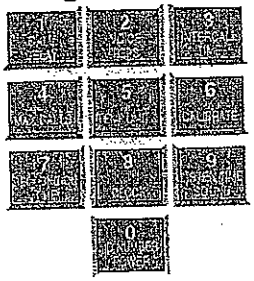
To unlock the keyboard:

1. Press WHAT IS.

2. Press CODE.

The Model 800 will say *"Enter Security Code."*

3. Using the number keys, enter the digits for the code.



4. Press ENTER.

If the correct code is entered, the Model 800 will say *"OK."* If the wrong code is entered, the Model 800 will say *"Error 2."*

Chapter 5: Alarm Programming

This chapter explains the alarm programming and monitoring capabilities of the Model 800, with specific instructions for the following features:

- Configure zones as dry contact or temperature
- Enable/disable zones
- Program alarm Recognition Time for each zone
- Program high and low temperature limits
- Disable alarm response to high or low temperature
- Program temperature in Fahrenheit or Celsius scale
- Calibrate temperature
- Obtain current temperature
- Program AC power-failure Recognition Time
- Enable/disable AC power monitoring
- Program sound level sensitivity
- Program high sound Recognition Time
- Disable alarm response to high sound
- Use Exit Delay via Status Report

5.1 Zone Configuration

In preparing the Model 800 to sense an alert condition, the zones must be configured as dry contact (either open or closed) or as temperature zones. The default setting for zone 1 is temperature; for zones 2-8, the default is dry contact and open. To configure zone normality, sensors are first wired to the terminal strip at the back of the unit. (Refer to Chapter 2, Section 2.9–2.12, for an explanation on wiring zones.)

The configuration process directs the Model 800 to initialize the 8 zones and establish normal settings. Any change in the status of a zone (for example, from a normally open contact to a suddenly closed contact) is recognized as an ***alert condition***. In the case of a temperature zone, an alert condition is recognized when established temperature limits are exceeded.

NOTE

Before starting keyboard commands to configure zone normality on the Model 800, ***it is very important to check that the sensors you have wired to the unit are set in their normal, non-alarm positions.***

For example, if a magnetic reed switch (a normally-closed sensor used to detect unauthorized entry) has been wired to the Model 800, make sure that the door or window to be monitored is shut before configuring the zone. If a motion-detector is wired to the unit, it is advisable to block all sources of motion from the sensor before and during configuration.

5.1.1 Programming Zone Configuration

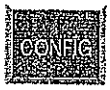
1. Press STANDBY to place the Model 800 in Standby mode.

2. Wire sensors to the zones to the back of the Model 800 (see Chapter 2, Section 2.10).

3. Press RUN. The red light glows when the Model 800 returns to Run mode.

4. Press SET.

5. Press CONFIG.



6. The Model 800 audibly recites the configuration for each of the eight zones:

- If the zone is ***open***, the Model 800 recites the number of the zone and says *"normally open."*
- If the zone is ***closed***, the Model 800 recites the number of the zone, and says *"normally closed."*
- If the zone is configured as ***temperature***, the Model 800 recites the number of the zone, followed by *"Temperature."*

5.1.2 Interrogating Zone Configuration

1. Press WHAT IS.

2. Press CONFIG.

The Model 800 will audibly recite the configuration of each zone.

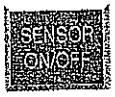
5.2 Enable/Disable Zones

This function allows you to enable or disable a zone's response to an alert condition. An enabled zone will respond to an alert condition and allow dial-out. A disabled zone will cause dial-out to be suppressed, but any existing alert conditions will be revealed during the Status Report. Enable/disable programming is useful during wiring of zones (see Chapter 2) or when a condition needs to be monitored, but is not critical enough to be programmed for dial-out reporting. It is important to verify zone status after performing any task that requires disabling. The default setting for all zones is enabled (ON).

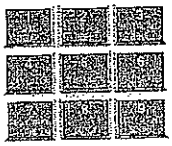
If an alert condition exists when zones are re-enabled, Recognition Time will restart—refer to Section 5.3.

5.2.1 Changing Enabled/Disabled Zone Status

1. Press SENSOR ON/OFF.



2. Press the number (1 to 8) of the selected zone to enable/disable. The Model 800 says *"Alarm Disabled"* to indicate disabled or *"Alarm Enabled"* to indicate enabled.



5.2.2 Verifying Enabled/Disabled Zone Status

1. Press WHAT IS.

2. Press STATUS.

The Model 800 audibly recites the current status of every zone. In a Status Report, each zone is first identified by its zone number, followed by a report that specifies parameters currently affecting that zone. ***If a zone is disabled, the word "Alarm Disabled" immediately follows the number recited for that zone.***

For example, zone 3 is configured as a normally open, dry contact zone. During the Status Report:

- ***If disabled***, the Model 800 recites:
  "Zone 3, the Alarm is Disabled" for zone 3.
- ***If enabled***, the Model 800 recites:
  "Zone 3—OK," for zone 3.

In another example, zone 2 is configured as a temperature zone. The current temperature is 76 degrees. During a Status Report:

- ***If disabled***, the Model 800 recites:
  "Zone 2, the alarm is disabled, it is now 76 degrees fahrenheit—OK"
- ***If enabled***, the Model 800 recites:

  "Zone 2—76 degrees fahrenheit—OK."

5.3 Zone Recognition Time

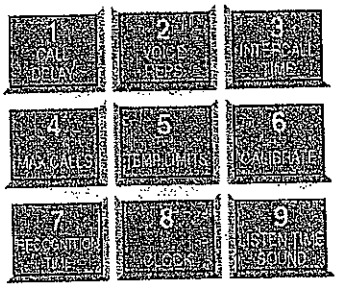
The Zone Recognition Time is the length of time an alert condition must be present before a valid alarm exists and dial-out is activated. This time period is programmable, from 0 minutes, 0 seconds (for immediate response) up to a period of 540 minutes, 0 seconds. If an alert condition begins and then clears within the established Recognition Time, no dial-out will occur. When an alert condition continues beyond the programmed Recognition Time, the Model 800 initiates dial-out. The default setting for Zone Recognition Time is 0 minutes, 3 seconds.

5.3.1 Programming Zone Recognition Time

1. Press SET.

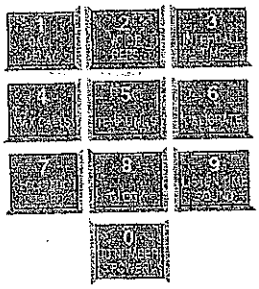
2. Press RECOGNITION TIME.

3. Press the number (1 to 8) of the selected zone to be programmed.



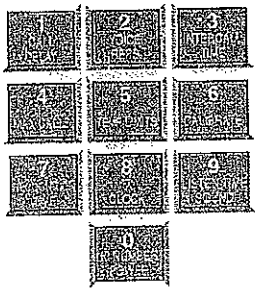
The Model 800 responds: *"Enter minutes."*

4. Using the number keys, enter the minutes. For example, to set a Recognition Time of five minutes, simply press *"5"* on the keypad. The Model 800 recites the digits as they are pressed.



5. Press ENTER. The Model 800 responds: *"Enter seconds."*

6. Using the number keys, enter the seconds. The Model 800 recites the digits as they are pressed.



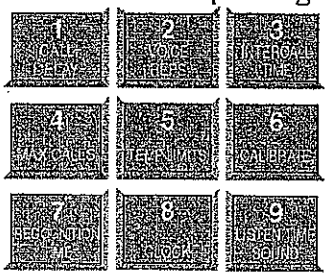
7. Press ENTER. The Model 800 responds: *"Enter."*

5.3.2 Interrogating Zone Recognition Time

1. Press WHAT IS.

2. Press RECOGNITION TIME.

3. Press the corresponding zone key (1 to 8).



The Model 800 recites the programmed Recognition Time for that zone.

5.4 Establishing High and Low Temperature Limits

High and low temperature limits can be separately programmed for each zone configured as temperature. Limits can range from –20° to +150° Fahrenheit, or from –30° to 65° Celsius.

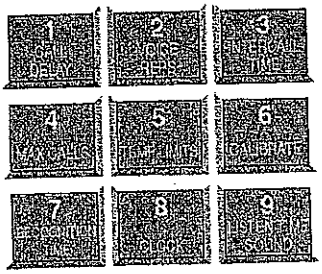
When temperature limits exceed high or low settings, the Model 800 will dial out with an alarm message. Default settings are: 10° F for low temperature and 100° F for high temperature.

5.4.1 Programming Temperature Limits for a Selected Zone

1. Press SET.

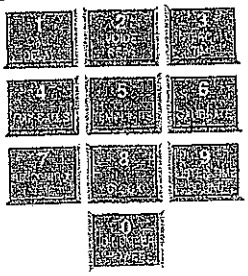
2. Press TEMP LIMITS.

3. From the number keys, press a number (from 1 to 8) that corresponds to the temperature zone being programmed.



The Model 800 responds: *"Enter low temperature limit."*

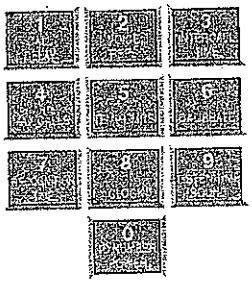
4. Using the number keys, enter a value for low temperature limit. The Model 800 will recite the digits as they are pressed. If a negative number is required, first press *, then enter the number.



5. Press ENTER.

The Model 800 responds: *"Enter high temperature limit."*

6. Using the number keys, enter the value for high temperature limit. The Model 800 recites the digits as they are pressed.



7. Press ENTER. The Model 800 responds: *"Enter."*

NOTE

Do not set temperature limits too close to normal room temperature. Minor temperature fluctuations could result in frequent and unnecessary alarm dialouts.

5.4.2 Disabling Alarm Response to High or Low Temperature

To disable alarm response to either high or low temperature settings exclusively, enter the following temperature limit when programming the selected zone. (The Model 800 will not respond to temperatures encountered at maximum settings or beyond.) Begin by following the key sequence shown in Section 5.4.1, and when prompted to enter the high or low temperature value:

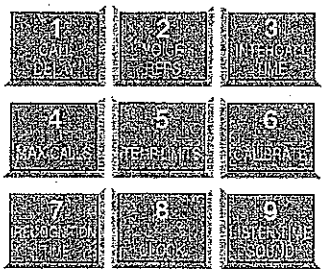
- Set high temperature to either +150° F or +65° C (high temperature limit) to prevent the Model 800 from responding to a high temperature alarm.
- Set low temperature to either -20° F or -30° C to prevent the Model 800 from responding to a low temperature alarm.

5.4.3 Interrogating High and Low Temperature Limits

1. Press WHAT IS.

2. Press TEMP LIMITS.

3. Press the number key corresponding to the selected temperature zone.



5.5 Temperature Scale

Temperature zones may be set in either Fahrenheit or Celsius degrees. The default temperature scale is Fahrenheit. To change to Celsius:

1. Press SENSOR ON/OFF.

2. Press °F / °C. The Model 800 responds: *"Degrees Celsius"* indicating Celsius scale has replaced Fahrenheit scale.

3. To return to Fahrenheit scale, repeat the key sequence. The Model 800 responds: *"Degrees Fahrenheit"* indicating Fahrenheit scale is in effect.

NOTE

When switching from Fahrenheit to Celsius, or vice versa, the change applies to all zones configured to read temperature. When switching temperature scales it is important to reset high and low temperature limits on all temperature zones. Refer to Section 5.4.1 to reset temperature limits.

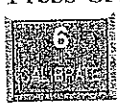
5.6 Temperature Calibration

To compensate for minor variances in sensor accuracy, an offset may be programmed for each temperature zone. The amount of offset is measured in degrees Fahrenheit or degrees Celsius. Adjustments are possible within a range from -10 degrees to +10 degrees. For example, if zone 3 is sensing temperature and is reading 1 degree too high, then the calibration for zone 3 is set at -1 to obtain an accurate reading.

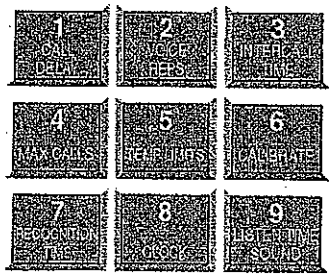
5.6.1 Programming Temperature Calibration

1. Press SET.

2. Press CALIBRATE.

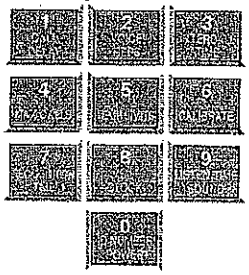


3. Press the number (1 to 8) of the selected temperature zone to be calibrated.



4. Enter the number required to offset the current temperature reading so a correct reading is obtained.

- To program a positive offset number (up to +10 degrees), enter the number on the keypad. The Model 800 recites the digits as they are pressed.
- To program a negative offset number (up to –10 degrees), first press *. The unit responds with *"negative."* Next, enter the number on the keypad. The unit recites the digits as they are pressed.



5. Press ENTER. The Model 800 responds: *"Enter."*

NOTE

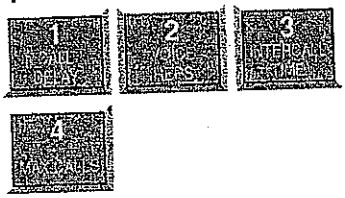
If you find that your calibration offset exceeds more than + 5 or –5 degrees, other complicating factors could be affecting normal operation of the Model 800. Call Sensaphone for technical assistance.

5.6.2 Interrogating Temperature Calibration

1. Press WHAT IS.

2. Press CALIBRATE.

3. Press the number key corresponding to the selected temperature zone.



5.7 Obtaining Current Temperature

Current temperature readings for each temperature zone may be accessed at any time. The Model 800 recites the zone number, and the actual temperature detected by the attached sensor, for all zones configured as temperature. To obtain current temperature:

1. Press WHAT IS.

2. Press TEST °F/°C.

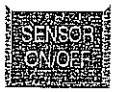
5.8 AC Power Monitoring Enable/Disable

The Model 800 monitors AC power failure. This command enables or disables the power failure detection feature.When enabled, the Model 800 will monitor power and dial out when AC power failure exceeds a programmable span of time (refer to AC Power Failure Recognition Time, Section 5.9).

The default setting for AC power monitoring is enabled (on). When disabled, the Model 800 will not dial-out to report power failure.

5.8.1 Enabling/Disabling the AC Power Alarm

1. Press SENSOR ON/OFF.



2. Press POWER.

   - The Model 800 will say *"Power Alarm Disabled"* to indicate that the power alarm is disabled, or
   - The Model 800 will say *"Power Alarm Enabled"* to indicate that the power alarm is enabled.

3. Repeat key sequence to change settings.

5.9 AC Power Failure Recognition Time

The AC Power Failure Recognition Time is the length of time that AC electric power is off before a valid alarm is recognized and dial-out begins. The default setting is 5 minutes, 0 seconds, but is programmable from 0 seconds to a maximum of 540 minutes.

When AC power failure occurs, and throughout the programmed Recognition Time, the Model 800 steadily repeats the message *"the power is off"* at the unit's installation site. There is no Call Delay programming available for AC power failure. Immediately following Recognition Time, the Model 800 begins the dial-out process to report power failure.

To cancel the power-failure message locally at the keypad (during or after Recognition Time) press the ALARM CANCEL key on the Model 800 keypad. This action also cancels the dial-out process.

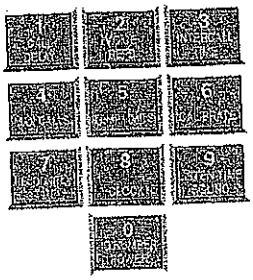
5.9.1 Programming Power Failure Recognition Time

1. Press SET.

2. Press RECOGNITION TIME.

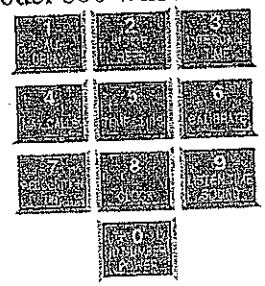
3. Press POWER. The Model 800 responds: *"Enter minutes."*

4. Using the number keys, enter the number of minutes. The Model 800 will recite the digits as they are pressed.

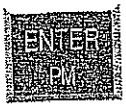


5. Press ENTER. The Model 800 responds: *"Enter seconds."*

6. Using the number keys, enter the number of seconds. The Model 800 will recite the digits as they are pressed.

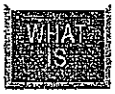


7. Press ENTER. The Model 800 responds: *"OK."*



5.9.2 Interrogating Power Failure Recognition Time

1. Press WHAT IS.



2. Press RECOGNITION TIME.

3. Press POWER.

The Model 800 will recite the power Recognition Time.

5.10 Sound Alarm Monitoring

This feature allows you to program the level and duration of sound that will cause the Model 800 to respond to an alarm and dial-out. It may be useful to desensitize the Model 800 to sound if it is installed in an area with a relatively high noise level, or where a loud noise occurs frequently but is not associated with an alarm. In some applications, it may be desirable to increase sound sensitivity to low sound levels.

5.10.1 Programming Sound Alarm Sensitivity

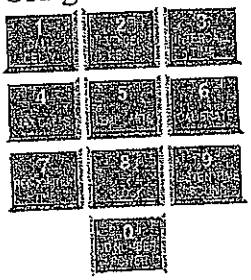
The sensitivity setting for sound alarm monitoring ranges from 1 to 160. A value of 1 makes the microphone the MOST sensitive to changes in sound. The value 160 makes the microphone the LEAST sensitive to sound. The default value is 32.

1. Press SET.

2. Press CALIBRATE.

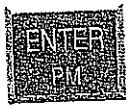
3. Press SOUND. The Model 800 responds: *"Enter number."*

4. Using the number keys, enter a value for sound sensitivity.



The Model 800 recites the digits as you press them.

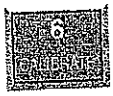
5. Press ENTER. The Model 800 responds: *"Enter."*



5.10.2 Interrogating Sound Sensitivity

1. Press WHAT IS.

2. Press CALIBRATE.



3. Press SOUND. The Model 800 recites the programmed sound sensitivity level.

5.10.3 Programming High Sound Alarm Recognition Time

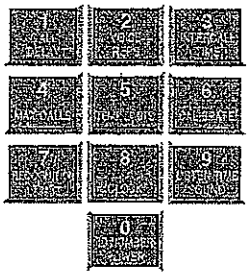
The Recognition Time for sound alarm monitoring ranges from 5 seconds to 60 seconds. The default value is 8 seconds.

1. Press SET.

2. Press RECOGNITION TIME.

3. Press SOUND. The Model 800 responds: *"Enter seconds."*

4. Using the number keys, enter the number of seconds. The Model 800 will recite the digits as they are pressed.



5. Press ENTER.

5.10.4 Interrogating High Sound Alarm Recognition Time

The Recognition Time for sound alarm monitoring ranges from 5 seconds to 60 seconds. The default value is 8 seconds.

1. Press SET.

2. Press RECOGNITION TIME.

3. Press SOUND. The Model 800 responds: *"Enter seconds."*

5.11 High Sound Alarm Enable/Disable

The Model 800 monitors sound through the built-in microphone. When the sound level suddenly exceeds the programmed high sound limit, the Model 800 will respond with an alert condition. The increased sound level must continue throughout the programmed recognition time. The default for high sound alarm is enabled (on).

NOTE

The microphone is also used for listening to on-site sounds. Refer to Chapter 4, Section 4.8. Disabling the sound alarm does not affect listen-in capability.

5.11.1 Changing Enabled/Disabled High Sound Alarm

1. Press SENSOR ON/OFF.

2. Press SOUND. The Model 800 will say *"Sound Alarm Disabled"* to indicate disabled or *"Sound Alarm Enabled"* to indicate enabled.

3. Repeat key sequence to change settings.

5.12 Exit Delay

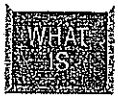
When tripping an alarm is unavoidable, yet a true alert condition has not actually occurred, the alarm response, including dial-out, can be temporarily suppressed.

The Model 800 is able to suppress and then reset its dial-out function automatically through use of the Status Report. This is especially convenient when an alert condition is created upon exiting a monitored door, and there is no way to cancel from the local keypad.

Example: You are planning to exit through a monitored door. Prior to exiting, you initiate a Status Report recitation at the Model 800 keypad by pressing WHAT IS, followed by STATUS, (key sequence shown below). This allows you approximately 40 seconds to exit without activating the Model 800's programmed response to an alarm. At the conclusion of the status report, normal alarm response is reactivated.

To use exit delay, initiate the Status Report.

1. Press WHAT IS.



2. Press STATUS. The Model 800 recites the full Status Report; during this time, you are able to exit the monitored area without tripping an alarm.

Chapter 6: Acknowledgment, Status Report & Remote Access

In addition to communication and alarm monitoring capabilities, the Model 800 will also respond to your instructions and provide you with access to information on monitored conditions at all times.

By issuing commands to the unit, either at the installation site or over standard telephone lines, the following features may be activated:

- Acknowledgment of existing alarms
- The Status Report on all monitored conditions.
- Limited programming.

6.1 Alarm Acknowledgment

When the Model 800 dials out with an alarm message, it will request acknowledgment before hanging up. Acknowledgment indicates to the unit that the alarm message has been received. Upon acknowledgment, the Model 800 will cancel the dial-out sequence.

There are three ways* that an alarm is acknowledged directly:

- Local Acknowledgment
- Touch-Tone™ Acknowledgment
- Callback Acknowledgment

* A fourth method of alarm acknowledgment is indirect. Refer to Max Calls, Chapter 4, Section 4.13 for an example of automatic alarm acknowledgment.

6.1.1 Local Acknowledgment

To acknowledge an alarm locally (directly at the installation site of the Model 800), press the ALARM CANCEL Key.

6.1.2 Touch-Tone™ Acknowledgment

This method of remote alarm acknowledgment works with a Touch-Tone™ telephone.

Example: You receive a call from the Model 800, reporting that an alarm exists. The message concludes: *"Enter*

Acknowledgement code." Now, or at any time during this call, you may acknowledge the alarm with the code **"555"** if you are using a Touch-Tone™ telephone.

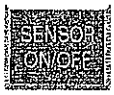
- To enter "555," press the number (5) key on the Touch-Tone™ phone keypad three times. The Model 800 will respond: ***"Alarm Acknowledged."*** The Model 800 will hang up and the dial-out sequence, including any further response to the alarm, will be cancelled.
- If you enter the wrong code or do not enter it within 10 seconds following the conclusion of the message, the Model 800 will respond: ***"Error, Enter Acknowledgement code."*** If you do not enter the acknowledgement a second time the unit will say "error" then "goodbye" and hang up. The alarm is still not acknowledged until you call back. You have a period equal to the programmed Intercall Time to call the unit back and enter the "555" acknowledgment code. If you are calling from a pulse or rotary telephone, refer to Callback Acknowledgment, Section 6.1.3, below.

6.1.3 Callback Acknowledgment

Callback Acknowledgement is a feature that allows you to acknowledge an alarm without entering Touch-Tones™. This feature is disabled by default and must be enabled by entering the key sequence below. When Callback Acknowledgment is enabled, simply call the unit back and allow the line to ring 10 times. The unit will then answer the call, announce the alarm, then say "Alarm Acknowledged." This indicates that the alarm has been acknowledged.

To enable or disable Callback Acknowledgement:

1. Press SENSOR ON/OFF.



2. Press STATUS.

The Model 800 will say *"Callback Acknowledgement Enabled"* to indicate that Callback Acknowledgment is Enabled, or *"Callback Acknowledgement Disabled"* to indicate that Callback Acknowledgement is Disabled. This method of remote alarm

acknowledgment works with any telephone: pulse, rotary, or Touch-Tone™.

Example: The Model 800 calls you with an alarm message. You answer the call with a rotary or pulse telephone, and do the following:

- You listen to the message and hang up.
- Then you call the Model 800 back on any telephone. You must wait for 10 rings—this signals the Model 800 to answer your telephone call. (Make sure to call back within the programmed setting for Intercall Time—refer to Chapter 4, Section 4.12.)

When the Model 800 answers your return call, it announces the alarm. Then it says: *"Alarm Acknowledged."* This indicates that the alarm has been acknowledged.

NOTE

If you have the TAD feature (telephone answering device) enabled, call the unit and let the phone ring once, then hang up. Wait a few seconds then call the unit back a second time. The model 800 will now answer on the first ring. If TAD is disabled, the telephone must be allowed to ring 10 times. This serves as a precaution against a random alarm acknowledgment. Refer to Chapter 4, Section 4.7, for complete information on using the TAD feature.

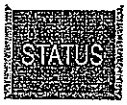
6.2 Status Report

The Status Report allows access to complete information on all monitored conditions either locally, from the keypad, or by telephone, from any location. The Model 800 will answer an incoming telephone call following the programmed Rings Until Answer (refer to Chapter 4, Section 4.6). Included with the Status Report are messages related to alarm conditions, AC power, battery backup and sound level. It also provides an opportunity for listening to on-site sounds (refer to Listen-in Time, Chapter 4, Section 4.8).

To initiate the Status Report:

1. Press WHAT IS.

2. Press STATUS.



Sections 6.2.1, 6.2.2, and 6.2.3 demonstrate two different Status Report recitations. The Status Report starts with:

"Hello. This is 555-1234 (or the programmed ID), (Custom ID Message)."
"It is now 12:15PM (or the current time)."

The Model 800 proceeds with a separate report for each zone. Each zone identifies itself by reciting the zone number and it's associated voice message.

6.2.1 Example: Status Report, No Alarms

Zones 2, 3, 4, 5, 6, 7, and 8 are configured as dry contact and zone 1 is configured as temperature. No alarms exist. The Status Report begins by saying, *"Hello, this is 555-1234, this is building M, third floor; it is now 2:30 PM."*

Following this introduction, the report continues:

"Zone 1, room temperature, 74 degrees, OK."

"Zone 2, door alarm, OK."

"Zone 3, ups alarm, OK."

"Zone 4, water sensor, OK."

"Zone 5, OK."

"Zone 6, OK."

"Zone 7, OK."

"Zone 8, OK."

"The sound is OK."

"The power is ON." This refers to AC power.

"The batteries are OK." Other possible responses: *"Batteries are low"* or *"Replace batteries."* (Refer to Section 6.2.4 for additional information regarding battery condition.)

"The output is off."

"Listen to the sound for 10 seconds." In this case, the programmed Listen-in Time is set at 10 seconds. (This feature is not available when obtaining the Status Report on-site, directly at the keypad.)

The Status Report repeats once more and the Model 800 concludes the call, saying: *"Goodbye."* (The Status Report will not repeat if obtained at the keypad; *"Goodbye,"* is also not recited.)

The phrase *"no number"* at the end of a Status Report indicates that no dial-out phone numbers have been programmed.

6.2.2 Example: Status Report, Existing Alarms

Zones 2, 3, 4, 5, 6, 7 and 8 are configured as dry contact and zone 1 is configured as temperature. An emergency situation is at hand: a fire in a greenhouse has tripped a smoke alarm and electrical power has been disrupted. In addition to high sound and AC power alarms, separate alarms exist on zones 1, 2, 3, and 4. You happen to call in for the Status Report, which begins with, *Hello, this is 555-1234; "this is the Sensaphone 800 at ACME Greenhouse, 225 Oak Street"*

It is now 8:45 PM

Zone 1, "Temperature in greenhouse", 110 degrees Fahrenheit, too high, acknowledged alarm exists

Zone 2, "Door alarm in greenhouse", not OK, acknowledged alarm exists

Zone 3 "Water pressure alarm in greenhouse", not OK, acknowledged alarm exists

Zone 4 "Greenhouse control system", not OK, acknowledged alarm exists

Zone 5 "Emergency generator alarm", not OK, acknowledged alarm exists

Zone 6, OK

Zone 7, OK

Zone 8, OK

A High Sound alarm exists, it is now too high

The Power is Off.

The Batteries are Low.

The Output is Off.

Listen to the sound for 10 seconds.

Goodbye.

6.2.3 Example: Status Report, Disabled Zones

If a zone is disabled, the dial-out feature for that zone is deactivated, but all other programmed parameters remain in effect. In the example below, all 8 zones are disabled, although zones 1 and 3 are detecting alarms. AC power and Sound Level are also disabled for dial-out. When you call the Model 800 for a Status Report, you hear the following:

Hello, this is 555-1234; "this is the Sensaphone 800 at ACME Greenhouse, 225 Oak Street"

It is now 8:45 PM

Zone 1, "Temperature in greenhouse", the alarm is disabled, it is now 110 degrees Fahrenheit, too high, acknowledged alarm exists.

Zone 2, "Door alarm in greenhouse", the alarm is disabled, it is now not OK, acknowledged alarm exists.

Zone 3 "Water pressure alarm in greenhouse", the alarm is disabled, it is not OK.

Zone 4 "Greenhouse control system", the alarm is disabled, it is not OK.

Zone 5 "Emergency generator alarm", the alarm is disabled, it is not OK.

Zone 6, the alarm is disabled, it is now OK

Zone 7, the alarm is disabled, it is now OK

Zone 8, the alarm is disabled, it is now OK

The Sound alarm is disabled, it is now too high

The Power alarm is disabled, it is now Off.

The Batteries are Low.

The Output is On.

Listen to the sound for 10 seconds.

Goodbye.

The Status Report repeats once more and the Model 800 concludes the call, saying: *"Goodbye."*

6.2.4 Battery Condition

During a Status Report, you may hear one of three possible messages regarding battery power. The Model 800 determines the appropriate message by measuring battery voltage. Depending upon the remaining voltage, it may respond:

- *"The batteries are OK,"* if over 8.2 Volts.
- *"The batteries are low,"* if between 7.2 and 8.2 Volts.
- *"Replace batteries,"* if below 7.2 Volts.

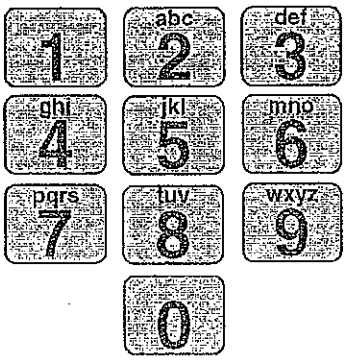
6.2.5 Remote Access by Touch-Tone™ Telephone

You can issue a number of commands to the 800 remotely using a Touch-Tone™ telephone. This command mode can be entered at any time during the status report. Simply press a Touch-Tone™ and the unit will halt the report and respond with "OK." You are now in Touch-Tone™ command mode. Commands are available to perform the following functions:

- Enable and disable zones, power monitoring, and sound monitoring
- Recite/Set High and Low alarm limits
- Recite/Set telephone numbers
- Record/Play custom voice messages
- Recite/Set the relay output
- Activate the microphone for listen-in
- Recite status report

NOTE: If a security code is enabled, the 800 will prompt you with "Enter security code." Enter the four-digit keypad security code plus "#" to enter touch-tone command mode. If entered correctly, the 800 will respond with "OK" and you can proceed to enter the commands. If entered incorrectly, the unit will give you one more chance. If it is incorrect a second time, the unit will say "Error, goodbye" and hang up.

The commands are put together based on the letters of a touch-tone telephone. See typical telephone keypad layout below.



Many of the commands use three letters that represent an abbreviation of the selected command. For example, to Set a High limit on Zone 1 you would press S + H + 1 (or in numeric form 7 + 4 + 1)

The tables below list all of the touch-tone commands that are supported. Commands are listed in both character and numeric formats. The # key is used as an ENTER key. Use the * key to represent a negative sign or to represent the [CODE] key when programming telephone numbers.

Enable/Disable Zones

This command will toggle the selected zone between the enabled or disabled state.

Description	Touch-Tone Command
Enable/Disable Zone	* + Z(9) + (zone number)

Set and Recite High & Low Alarm Limits

The following commands are used to set or recite the Low Alarm Limit for any Zone.

Description	Touch-Tone Command
Set Zone Low Limit	S(7) + L(5) + (zone #) + (value) + #
Description	**Touch-Tone Command**
What Is Zone Low Limit	W(9) + L(5) + (zone #)

The following commands are used to set or recite the High Alarm Limit for any Zone.

Description	Touch-Tone Command
Set Zone High Limit	S(7) + H(4) + (zone #) + (value)+ #

Description	Touch-Tone Command
What Is Zone High Limit	W(9) + H(4) + (zone #)

Set and Recite Telephone Numbers

The following commands will allow you to program and recite dialout telephone numbers. You may need to use the Special Dialing Codes below.

Special Dialing Codes Summary

Code 1: Numeric pager type

Code 2: Wait for answer

Code 3: Change to Touch-Tone

Code 4: Pause

Code 5: Star (*)

Code 6: Pound (#)

Description	Touch-Tone Command
Setting a phone number	S(7) + T(8) + (entry 1–8) + (telephone number) + #

Description	Touch-Tone Command
Reciting a phone number	W(9) + T(8) + (entry 1–8)

Record and Play Custom Voice Messages

The following commands will allow you to record and play back custom voice messages for the ID message (0) and each zone (1–8).

Description	Touch-Tone Command
Record a Message	S(7) + M(6) + (entry 0–8)

Description	Touch-Tone Command
Play a Message	W(9) + M(6) + (entry 0–8)

Control the Relay Output

The following commands will allow you to check the status of the relay output and to toggle the Relay Output On and Off.

Description	Touch-Tone Command
Reciting the Output Status	W(9) + R(7) + O(6)

Description	Touch-Tone Command
Switching the Output	S(7) + R(7) + O(6)

Activate Microphone Listen-in

The following command will allow you to activate the microphone listen-in for the programmed duration.

Description	Touch-Tone Command
Activate Mic Listen-in	M(6) + I(4) + C(2)

Request Status Report

The following command will initiate a status report.

Description	Touch-Tone Command
Recite status report	W(9) + S(7) + R(7)

Hang-up

The following command will make the 800 hang up the telephone line.

Description	Touch-Tone Command
Hang-up the phone line	B(2) + Y(9) + E(3)

Chapter 7: Operation

After installation and programming is completed, the Model 800 is fully operational. This chapter explains the sequence of events that occur during an alarm dialout to illustrate how the Model 800 operates.

7.1 Alarm Detection, Dial-out and Acknowledgment

Generally, an alarm event is structured in the following manner:

I. The Model 800 detects an alert condition due to a change at the sensor.

II. A valid alarm is recognized.

III. Dial-out begins.

IV. The alarm is acknowledged.

Often, an alarm does not proceed through all stages: either an alert condition does not persist long enough to be considered valid, or a valid alarm is cancelled.

The table on the following pages explains the alarm detection, dial-out and acknowledgment features and lists important variable factors affecting their operation.

I. Model 800 Detects a Change at the Sensor	Variable Factors
• Model 800 detects a change in the monitored condition (from the sensor wired to one of the zones). This is considered an alert condition, and does not qualify as a valid alarm at this point. • The condition continues throughout the programmed Recognition Time. If the condition (or sensor) reverts to its normal state before the Recognition Time is reached, no alarm will occur.	*Zone Type: (1) An open circuit closes, (2) a closed circuit opens, or (3) temperature limits are exceeded.* *Recognition Time: Activated*
II. A Valid Alarm Is Recognized	**Variable Factors**
• The condition must persist long enough to meet or exceed the programmed Recognition Time. When Recognition Time has expired, but the alert condition continues, the Model 800 will determine that a valid alarm exists. • When a valid alarm is determined, Call Delay is activated, forcing the Model 800 to wait for a programmed period of time before starting the dial-out process. Call Delay applies to the period just prior to dial-out, before the first telephone call is made. • Call Delay provides the opportunity to cancel a valid alarm at the Model 800's installation site, before dial-out occurs. An audible voice message indicates which of the zones is in alarm. If on-site personnel acknowledge the alarm within the Call Delay time, the Model 800 will not dial out. (Local Voice Mute is disabled, so that alarm messages can be heard at the site.)	*Recognition Time: Expired* *Valid Alarm: Exists* *Call Delay: Activated* *Alarm Message: Audible, On-site Activated* *Local Voice Mute: Disabled*

III. Dial-out Begins	Variable Factors
• The dial-out process is activated as soon as the Call Delay time expires (if the alarm has not been cancelled at the Model 800's installation site.) The dial-out begins with telephone number 1 and proceeds sequentially, through the remaining telephone numbers.	*Call Delay: Expired*
• If the alarm is not acknowledged with the first dial-out telephone call, the Model 800 waits the duration of Intercall Time before dialing the next telephone number. Intercall Time is the programmed waiting period in between each dial-out telephone call.	*Intercall Time: Activated*
• When the telephone is answered, the programmed Voice Repetitions determine the number of times per call the Model 800 recites the alarm message.	*Voice Repetitions: Activated*
• Call Progress, an automatic feature, enables the Model 800 to detect whether or not the telephone call is answered. After 10 rings, or if a busy signal is encountered, the Model 800 will hang up, wait the programmed Intercall Time, and proceed to dial the next telephone number.	*Call Progress: Activated*
• If no telephone calls are answered, the Model 800 dials out sequentially, through the remaining telephone numbers and continues to cycle until the programmed Maximum Number of Calls is reached.	*Max Calls: Activated*
• When the telephone is answered, the Model 800 will immediately begin reciting a message that indicates which of the zones is in alarm. At the same time, the alarm message is repeating at the Model 800's installation site. The Model 800 will request acknowledgment, if it has not yet occurred.	*Alarm Messages: By Telephone and On site*

IV. The Alarm Is Acknowledged	Variable Factors
• At any time after a valid alarm is determined, the alarm may be acknowledged at the Model 800's installation site, by pressing ALARM CANCEL key.	*Local, On-site Acknowledgment*
• When the Model 800 dials out and the call is answered via Touch-Tone telephone, any alarm may be instantly acknowledged by pressing "555."	*Touch-Tone Acknowledgment: Fast Code 555*
• If the alarm message repeats for the number of programmed Voice Repetitions, and "555" has not been entered, the Model 800 will say:	
"Enter acknowledgement code."	
The Model 800 waits 10 seconds for the Touch-Tone code "555" to be entered. If the code is entered within 10 seconds, it responds:	*Touch-Tone Acknowledgment: Normal Code 555*
"Alarm acknowledged."	
The alarm is considered acknowledged and the dialout concludes.	
• If the Model 800 does not receive the Touch-Tone code within 10 seconds, it recites the following:	*Tone or Pulse Callback Acknowledgment: Within Intercall Time*
"Error, enter acknowledgement code."	
If the Model 800 does not receive the acknowledgement code a second time, it says "error, goodbye" and hangs up. The recipient of this message must call the Model 800 back within the period programmed for Intercall Time, in order to acknowledge the alarm. If Local Voice Mute is off, the unit will beep at the installation site while waiting for this call.	
• Callback Acknowledgement: If enabled, the Model 800 waits 10 rings before	

IV. The Alarm Is Acknowledged	Variable Factors
answering to guard against random acknowledgment. If an answering device is connected to the same line as the Model 800 (and TAD is enabled), you must call the unit and let the line ring once, then hang up, wait ten seconds and call back again within 30 seconds. The Model 800 will answer on the first ring. It will recite any unacknowledged alarms, then say:	*Tone or Pulse Callback Acknowledgment: TAD Enabled*
"Alarm acknowledged, goodbye."	
When the Model 800 hangs up, the alarm is acknowledged and dial-out stops.	
• If calls remain unanswered, or if they are received by an answering machine or FAX, the Model 800 continues the dialout sequence; it waits the Intercall Time and proceeds to dial the next telephone number. Telephone numbers are dialed sequentially, and this cycle continues for the number of Max Calls programmed. If no acknowledgment occurs, then at the completion of Max Calls, the alarm is automatically acknowledged and the dial-out process is terminated.	*Max Calls Acknowledgment*

NOTE

Acknowledging the alarm does not correct the situation! The alarm condition will still exist until the sensor is restored to its normal state.

7.2 Example: A Dial-out Telephone Call

The following parameters are selected for demonstration purposes:

- Model 800 Unit ID Number is set to 555-5674. It is currently installed at your place of business.
- Dial-out Telephone Number 1 is programmed to 555-1234, your home telephone number.
- Voice Repetitions are set to 4.

The Model 800 is detecting an alarm on zone 2.

The telephone rings at 555-1234, your home number.

You answer the telephone and hear the following message:

"Hello, this is 555-5674. This is the Sensaphone 800 at John's Printing Express. It is now 12:30 AM. Zone two, back door security sensor, alarm exists, it is not okay."
(4-seconds to hear on-site sound from unit's microphone.)

"Hello, this is 555-5674. This is the Sensaphone 800 at John's Printing Express. It is now 12:30 AM. Zone two, back door security sensor, alarm exists, it is not okay."
(4-seconds to hear on-site sound from unit's microphone.)

"Hello, this is 555-5674. This is the Sensaphone 800 at John's Printing Express. It is now 12:30 AM. Zone two, back door security sensor, alarm exists, it is not okay."
(4-seconds to hear on-site sound from unit's microphone.)

"Hello, this is 555-5674. This is the Sensaphone 800 at John's Printing Express. It is now 12:30 AM. Zone two, back door security sensor, alarm exists, it is not okay."
(4-seconds to hear on-site sound from unit's microphone.)

"Enter acknowledgement code."

NOTE

It is important that your dial-out telephone numbers be answered by you or other authorized personnel in order to ensure adequate response to an alarm.

Chapter 8: Controlling the Output

The Sensaphone 800 includes a relay output that can be used to control a light, siren, or other device. The output is a Form-C Normally Open/Normally Closed mechanical relay and is rated for up to 30VAC/VDC 1A. A sample wiring diagram is shown below:

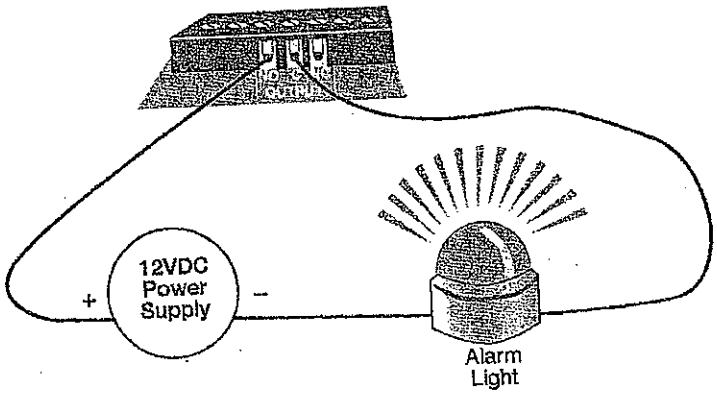


Figure 1: Relay output connected to alarm

The output can be programmed to operate in one of 13 automatic modes or it can operate in manual mode (default). The 13 *automatic* modes allow the output to automatically turn on and off based on individual alarms or any alarm. In *manual* mode the output is controlled via keypad command or remotely via touch-tone phone. A description of each mode is described below.

8.1 Output Modes

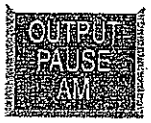
Mode	Description
1	Output on when zone 1 goes into alarm. Off when alarm is acknowledged.
2	Output on when zone 2 goes into alarm. Off when alarm is acknowledged.
3	Output on when zone 3 goes into alarm. Off when alarm is acknowledged.
4	Output on when zone 4 goes into alarm. Off when alarm is acknowledged.
5	Output on when zone 5 goes into alarm. Off when alarm is acknowledged.

Mode	Description
6	Output on when zone 6 goes into alarm. Off when alarm is acknowledged.
7	Output on when zone 7 goes into alarm. Off when alarm is acknowledged.
8	Output on when zone 8 goes into alarm. Off when alarm is acknowledged.
9	Output on when a Sound alarm occurs. Off when alarm is acknowledged.
0	Output on when a Power alarm occurs. Off when alarm is acknowledged.
Phone	Output on when phone line is unplugged for more than 15 seconds. Off when a phone line is plugged in.
*	Output on when any alarm occurs. Off when all alarms are acknowledged.
#	Output controlled manually via keypad command or touch-tone telephone. (default)

8.1.1 To program the Output Mode:

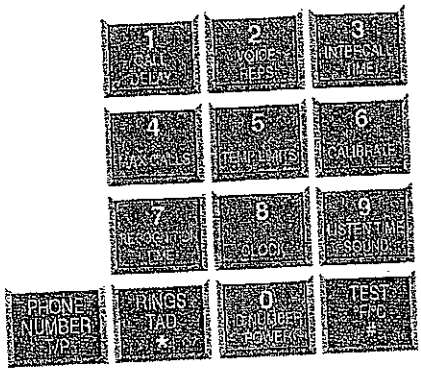
1. Press the SET key.

2. Press the OUTPUT key.

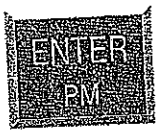


The 800 will say "Enter output mode."

3. Using the number keys, enter a value for the output mode.



4. Press the ENTER key.

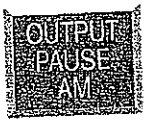


The 800 will say "OK" and recite a description of the mode selected, such as "Automatic on Zone 1" or "Manual." Note that when *Mode* * is selected, the 800 will simply say "Automatic on Alarm," meaning that the output will automatically turn on when any alarm occurs.

8.1.2 To play back the programmed Output Mode:

1. Press WHAT IS.

2. Press OUTPUT.

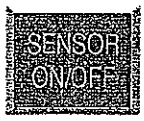


The 800 will recite the programmed output mode.

8.2 Switching The Output Using The Keypad

When programmed for Manual mode, the command to switch the output is:

SENSOR ON/OFF + OUTPUT.



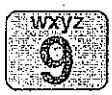
The 800 will respond "The output is on/off" to indicate the state of the output.

Note: If the 800 says "Error," the output is not programmed for manual mode.

8.2.1 Switching the Output Over the Phone

The following commands will allow you to check the status of the relay output and to toggle the Relay Output On and Off.

To recite the Output Status press W(9) + R(7) + O(6)



To switch the Output press S(7) + R(7) + O(6)

8.3 Typical Applications

Heating Up Your Cottage Or Cabin Remotely

If you keep your cottage or cabin open all year around, or if you do not drain your pipes and add antifreeze to your plumbing, you likely keep your furnace active when you are away but at a very low temperature. The Sensaphone will provide an invaluable service to you by keeping you updated to any change in the status of your furnace operation. Prior to your arrival at your cottage or cabin, you can remotely use your Sensaphone 800 to raise the thermostat and increase the heat.

Most furnaces use a typical 4-wire (heat/cooling) or 3-wire (heat only) thermostat. The Sensaphone can easily control these types of thermostats. ***If your heating source consists of high voltage***

electric baseboard heaters, you should consult a qualified electrician or heating professional for proper installation of the Sensaphone remote control facility. Electric baseboard heaters may utilize either a low voltage (2-wire) thermostat or a direct control high voltage thermostat. Only the low voltage thermostat may be directly connected to the Sensaphone.

8.3.1 Single Thermostat Control

There are two installation methods that can be used to remotely change the thermostat setting in your cottage or cabin; the single thermostat method and the dual thermostat method (see section 8.3.2 for details on the dual thermostat method). The single thermostat method requires you to install a model with an input to switch between two temperature settings. Sensaphone offers a 7-day programmable thermostat and power supply which has this feature (order part #'s FGD-0064 & XFR-0024). This thermostat has been carefully chosen to work with the model 800 to allow remote control between normal or vacation mode. You will need to replace your current thermostat, so if you are unsure about performing this work yourself, please contact a licensed heating/cooling professional for installation assistance. Follow the manufacturer's instructions for installing the thermostat.

The Model 800 will need to be wired to the thermostat to control it. For a visually appealing installation you may want to locate the Sensaphone close to your heater so that the cable follows the same path as the one from your heater to the thermostat. An added benefit of this location is that you can easily add a water sensor to monitor for leaks around your hot water heater or other plumbing. Typically the water heater is located near the heating and cooling system.

Step 1: Install the thermostat.

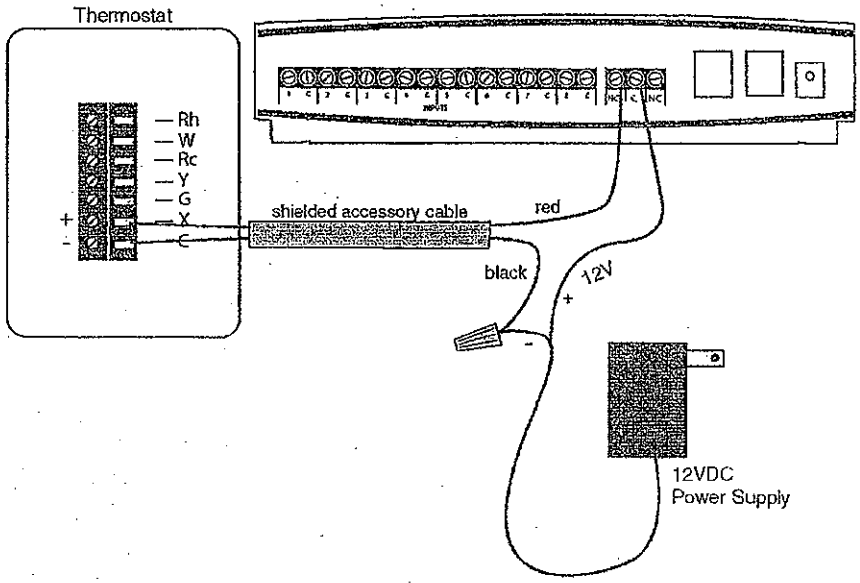
Refer to the manufacturer's instructions for installation. For installation assistance, contact Aube Technologies at 1-800-831-AUBE.

Step 2: Mount the Sensaphone 800.

Choose a location for your Sensaphone that allows for easy wiring to the thermostat, such as near your heater/air conditioning system. Mount the unit on a wall or flat on a desktop or table surface. Plug in the power supply and connect the telephone line.

Step 3: Connect cable from thermostat to Sensaphone 800.

This Sensaphone 800 has a terminal strip below the input/output wiring door that will connect to the 12VDC power supply and X & C terminals of the thermostat (See Figure 1). This connection is required to switch the thermostat between normal and vacation modes. Run a two-conductor cable from the thermostat to the Model 800. On the thermostat, connect the red wire to the X (+) terminal, and the black wire to the C (-) terminal. On the 800, connect the red wire to the NO terminal. Connect the black wire to the negative wire from the power supply. Use a wire nut to complete this connection. Connect the positive wire from the power supply to the "C" terminal on the model 800.



Step 4: Program the Thermostat.

Refer to the manufacturers instructions for programming the thermostat. Be sure to program settings for both normal and vacation modes.

Controlling the Thermostat

The operating mode of the thermostat *(normal/vacation)* can be controlled at the Model 800 keypad or remotely via Touch-Tone comands. Both methods are described below:

Keypad commands:

1) To enable *Vacation* Mode, press the [SENSOR ON/OFF] key, then the [OUTPUT] key. The unit will respond by saying "ON" to indicate that *Vacation* Mode is set. The *Suitcase* icon  will appear and blink on the thermostat LCD.

2) To enable *Normal* Mode, press the [SENSOR ON/OFF] key, then the [OUTPUT] key. The unit will respond by saying "OFF" to indicate that *Normal* Mode is set. The *Sun*  *or Moon*  icon will appear on the thermostat LCD.

TouchTone Commands:

Call the Sensaphone. When the unit answers, it will begin reciting a status report. At any time during the call, press a Touch-Tone. The unit will respond with "OK." The Sensaphone is now ready to accept Touch-Tone commands.

1) To enable Vacation Mode, press SRO (776). The unit will respond by saying "ON" to indicate that Vacation Mode is set. The *Suitcase* icon  will appear and blink on the thermostat LCD.

2) To enable Normal Mode, press SRO (776). The unit will respond by saying "OFF" to indicate that Normal Mode is set. The *Sun*  *or Moon*  icon will appear on the thermostat LCD.

3) To check the status of the ouput press WRO (976). The unit will respond "OFF" for Normal Mode or "ON" for Vacation Mode.

4) Hang up.

8.3.2 Dual Thermostat Control

When a three or four wire low voltage thermostat is used, it is easy to connect the Sensaphone to your furnace with the addition of a secondary thermostat. One thermostat is set to your preferred "away" temperature and the other thermostat is set to your preferred "home" temperature. With your Sensaphone 800, you

will be able to switch between these two thermostats using the relay output.

Ideally, the "away" thermostat would be in your pump or furnace room. Remember that your "away" thermostat will be the only thermostat that keeps your cottage or cabin at minimal heat while you are away. It should not be located near a window or where direct sunlight might warm it, near a furnace radiator or vent, or any heat source such as a pilot light.

The second thermostat, the one pre-set for your preferred temperature when you arrive at your cottage or cabin, should be located in your normal living space. This would likely be your existing thermostat, already located in a suitable location by your heating professional at the time your furnace was installed.

By connecting these two thermostats together in a parallel fashion, and by passing the low voltage supply through the Sensaphone *(See Figure 1)*, you can remotely or locally decide which thermostat is in control of your furnace.

It is recommended that the "away" thermostat be connected to the NC (Normally Closed) terminal while the "home" thermostat be connected to the N0 (Normally Open) terminal of the Sensaphone. This way, it's easy to understand which state your furnace is in: *Output ON = Home* and *Output OFF = Away*. The supply voltage from your furnace (typically the wire labeled R or 24VAC), should always be connected to the C (Common) terminal on the 800.

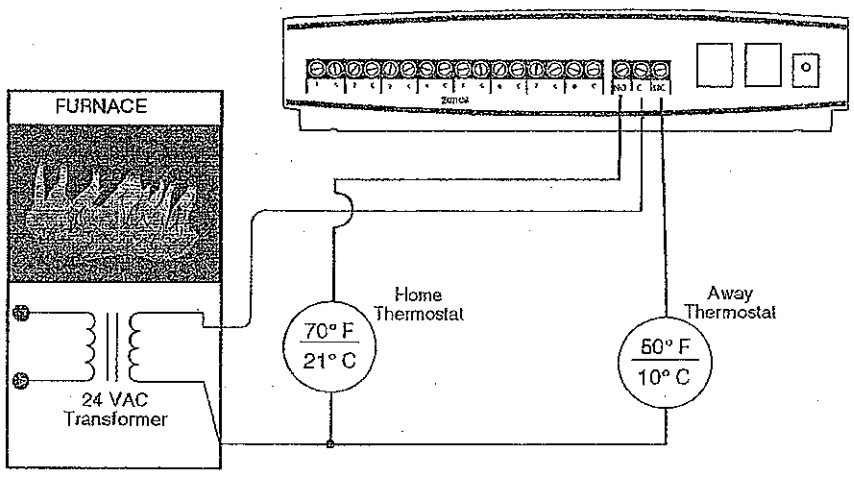


Figure 1: Dual Thermostat Setup

Note: This is a typical configuration when using standard single-zone heat/cool thermostats. For ease of-use it is recommended that both thermostats be the same model. Note also that all thermostats may not be compatible with the dual-thermostat wiring diagram. Consult your heating/cooling professional for installation assistance.

8.3.3 Controlling Lights Or Other Devices

Using X10 technology, you can remotely activate any electrical device or appliance in your home through your Sensaphone. X10 technology is a suite of control modules that plug into your existing electrical outlets and transmit coded signals to lamps, lights, and appliances to turn them on or off (See Figure 2).

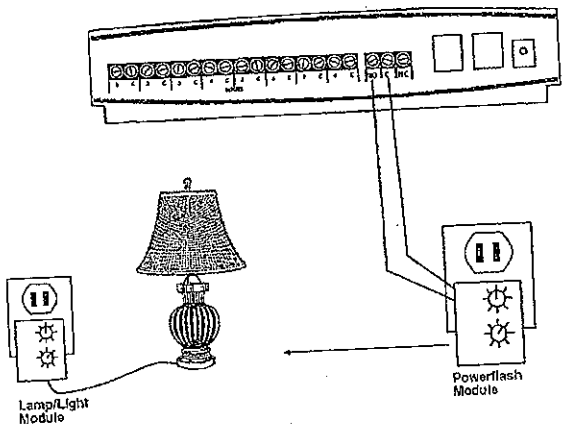


Figure 2: X10 Lighting Control Setup

Sensaphone supports these devices through use of the popular X10 Powerflash relay interface. To learn more about this technology, consult X10 products on the web at www.x10.com or visit your local electronics shop such as Radio Shack.

Such applications may include turning on a lamp or exterior lights remotely from your cellular telephone when arriving at your residence late at night. Or you can use the X10 Powerflash Module (set to momentary contact) in conjunction with the X10 Universal Module to remotely control your electric garage door opener over the telephone—an ideal way of letting in your service personnel without being on-site. You may also use the X10 technology to send the ON/OFF signal to a furnace or heater if your thermostat is not easy to wire directly.

Finally, in addition to remotely controlling devices, X10 technology lets you extend the reach of certain Sensaphone

sensors such as door contacts, motion sensors, or water sensors. This is of great benefit where it is impossible to wire directly from your sensors to your Sensaphone. Consult a qualified electrician or your heating professional for assistance with locating your remote sensors or contact your Sensaphone dealer.

Appendix A: Weekly Testing Procedure

We recommend that you test your Sensaphone weekly to be sure it is functioning properly. This will ensure that when a problem arises the Sensaphone will be ready to alert the appropriate personnel.

There are several tests that can be performed:

1) Call the unit and listen to the Status Report. This will test the unit's ability to answer the phone and speak a message. It will also verify that all of the zones are reading properly, the alarm conditions are OK, the electricity is on, the microphone is functioning, and the batteries are OK.

2) Create an alarm on each zone by tripping all connected sensors.

   Temperature sensors: Heat or cool the sensor.
   Motion sensors: Have someone walk in front of the sensor.
   Door/window sensors: open the door/window.
   Water sensors: Apply a small amount of water beneath the sensor or use a wet towel and touch it to the sensor probes.
   Humidity sensors: Raise the humidity around the sensor by holding a cup of very hot water beneath the sensor.

   Allow the unit to contact all programmed telephone numbers. This will make sure that the Sensaphone is programmed properly. It will also prepare personnel to respond appropriately when they receive a call from the Sensaphone.

3) Test the batteries by unplugging the AC adapter and making sure that the Sensaphone continues to function. Press WHAT IS, then STATUS on the keypad, and listen to the status report. Make sure the report states that *"the power is off"* and *"batteries are OK."* Keep the AC adapter unplugged so that a Power Failure alarm occurs. Allow the unit to dial all programmed telephone numbers while running on battery backup. Plug in the AC adapter after the unit has finished dialing all of the telephone numbers.

4) If you are using your Sensaphone to listen for a smoke alarm, then be sure to test the smoke alarm to make sure that the Sensaphone picks up the audible signal and triggers a high-sound-level alarm. Allow the unit to dial all programmed telephone numbers.

5) Keep a log of your tests, noting the date and whether the 800 passed in each category tested. An example of such a log is shown below. *(See "Test Log" at the end of this manual.)*

800 Test Log

Date	Inputs		Dialout		Call-In		Tested by
7/1/04	Pass ☒	Fail ☐	Pass ☒	Fail ☐	Pass ☒	Fail ☐	Bob H
7/15/04	Pass ☒	Fail ☐	Pass ☒	Fail ☐	Pass ☒	Fail ☐	Alex G.
7/22/04	Pass ☒	Fail ☐	Pass ☒	Fail ☐	Pass ☒	Fail ☐	Bob H.
	Pass ☐	Fail ☐	Pass ☐	Fail ☐	Pass ☐	Fail ☐	
	Pass ☐	Fail ☐	Pass ☐	Fail ☐	Pass ☐	Fail ☐	

If you require assistance, call Sensaphone Technical Support at 610-558-2700.

Appendix B: Troubleshooting

In the event that a problem is encountered, this section will assist you in determining the cause, so you can return the unit to its usual monitoring routine with minimal interruption.

Most problems with the Model 800 are easy to identify and quickly corrected, and are found under the following general headings:

- Error Messages
- Communications/dial-out functions
- Temperature monitoring
- Sound level monitoring
- Other monitoring functions

If you have tried the solutions outlined in this section and are not satisfied with the results, call Sensaphone Technical Support at 610-558-2700, or follow the guidelines for shipping the Model 800 to PHONETICS, INC. for repair (see Appendix F).

Error Messages

Problem	Cause	Solution
1. The unit says "Error 1."	An invalid value has been entered or too much time has passed without entering a value.	Only enter values within the allowed programming range, and make programming changes in a timely fashion.
2. The unit says "Error 2."	Programming changes were attempted without unlocking the keypad.	Unlock the keypad, then make programming changes.

Communications / Dial-out:

Problem	Cause	Solution
1. The Model 800 fails to dial out.	a) The telephone number may be incorrectly programmed.	Recheck programming steps. Refer to Chapter 4, Section 4.2.1.
	b) Tone or pulse (the current dialing method) is not compatible with the telephone line on which the Model 800 is installed.	Switch from the current setting: from tone to pulse, or from pulse to tone. Refer to Chapter 4, Section 4.3.
	c) Recognition Time is too long. An alert condition does not remain in effect long enough to become a valid alarm.	Reprogram Recognition Time. Set the Recognition Time to the minimum duration required to create a valid alarm. If possible, test the new setting by deliberately creating an alert condition. Refer to Chapter 5, Section 5.3.

Communications / Dial-out:

Problem	Cause	Solution
	e) The Model 800 is connected to an incompatible telephone line.	The Model 800 must be connected to a standard (2-wire analog) telephone line, not a digital extension to a phone system. If the unit will not dial out and the factors previously listed have been ruled out, try connecting the unit to a standard residential telephone line.
2. The Model 800 will not answer the telephone when called for a Status Report or alarm acknowledgment.	a) Rings Until Answer is incorrectly programmed.	Recheck programming of Rings Until Answer. Refer to Chapter 4, Section 4.5.1.
	b) The Model 800 is connected to an incompatible telephone line.	Some telephone systems will not allow the telephone to ring beyond 4 rings. If your Model 800's Rings Until Answer is set at more than 4 rings, you may not be able to access the unit. Try setting the Rings Until Answer to less than 4 rings. If this does not correct the problem, it may indicate telephone line incompatibility. In this case, try connecting the Model 800 to a standard, residential telephone line.

3. The Model 800 will not answer the telephone for Callback Acknowledgement.	You did not allow the telephone to ring 10 times. Note: If the TAD (telephone answering device) is disabled, the telephone rings ten times before the Model 800 answers. If the TAD is enabled, you must call the unit and let the line ring once, then hang up, wait ten seconds and call back again within 30 seconds.	When calling the Model 800, and the TAD is disabled, allow the telephone to ring 10 times. Refer to Chapter 6, Section 6.1.3, and Chapter 4, Section 4.6.3.
4. The Model 800 recites the alarm message or Status Report over the telephone, but is silent at the installation site.	The local voice mute feature is in effect.	Deactivate local voice mute. Refer to the programming steps in Chapter 4, Section 4.9.
5. The Model 800 and telephone answering device (sharing the same line) answer incoming calls simultaneously.	The Model 800's number of Rings Until Answer is set to equal the number of rings set for the telephone answering device.	Change the number of Rings Until Answer for the Model 800. Refer to Chapter 4, Section 4.5.

Temperature Monitoring:

Problem	Cause	Solution
1. Can't program temperature limits; or the unit won't read the temperature sensor.	The zone isn't configured to read a temperature sensor.	Press SET and CONFIGURE to program the zone. (See Section 5.1.1 for more information on configuring zones.)
2. The temperature reading is -20° F or -30° C.	The temperature sensor has been disconnected or has broken wires.	Examine the wires to temperature sensor and connect or replace wiring.
3. Temperature reads 150° F or 65° C.	Temperature sensor wires are touching or have shorted.	Verify and correct wiring.
4. Temperature reading is inaccurate.	a) Temperature sensing may be affected by a source of ambient heat (ie., direct sunlight, or heat duct proximity).	Try moving the unit to a different location.
	b) Temperature may require calibration.	After moving or placing the unit away from ambient heat sources, the temperature may be calibrated to offset inaccurate normal reading by several degrees. Refer to Chapter 5, Section 5.6.
	c) The unit is using the wrong temperature scale (Fahrenheit vs. Celsius).	Verify temperature scale. Refer to Chapter 5, Section 5.5.

5. False high temperature alarms from freezer.	Most freezers have a defrost cycle during which the temperature will rise considerably, thus causing an alarm to occur.	Program an zone recognition time longer than the defrost cycle.
6. The Sensaphone calls with a high/ low temperature alarm but recites a temperature that's within the programmed limits.	The Sensaphone recites the "current" temperature when it calls you, not the temperature at the time the alarm occurred. It is likely that the temperature has changed since the time the alarm was detected and has since returned to normal operating conditions.	Shorten the Call Delay or lengthen the Zone Recognition Time.

Sound Level Monitoring:

Problem	Cause	Solution
1. False high sound alarms occur frequently.	The programmed sound sensitivity results in over-sensitivity to non-alarm sound as well as alarm sound.	Reprogram the sound sensitivity. Refer to Chapter 5, Section 5.10.
	Sound Recognition Time is too short.	Lengthen the sound Recognition Time. Refer to Chapter 5, Section 5.10.
2. High sound does not cause an alarm.	The unit is not close enough to the high sound source, or the programmed sound setting results in a lack of sensitivity to high sound.	Move the unit closer or reprogram the sound sensitivity. Refer to Chapter 5, Section 5.10.

Other Monitoring:

Problem	Cause	Solution
1. Alarm status of an alert zone is incorrect.	Incorrect zone normality.	Reconfigure the zone. Refer to Chapter 5, Section 5.1.
2. False power out alarms	Programmed Recognition Time is too short.	AC power is often subject to brief interruptions. To avoid frequent, false alarms, increase the power Recognition Time. Refer to Chapter 5, Section 5.9.
3. The Model 800 does not recognize power failure.	a) Batteries are either incorrectly installed or drained.	To verify proper battery function, unplug the unit and verify continued operation using batteries only. If unit ceases to function, first try reinstalling the batteries. If this is not successful, replace the batteries. Refer to Chapter 2, Section 2.4 for complete instructions.
	b) Recognition time setting is too long.	Reprogram Recognition Time. Set the Recognition Time to the minimum required before a valid alarm occurs. If possible, test the condition by deliberately creating an alert condition. Refer to Chapter 5, Section 5.9.

4. The Model 800 does not recognize any alarm.	a) Zones for alarm are disabled.	Enable the zones for alarm. Refer to Chapter 5, Section 5.2.
	b) Programmed Recognition Time is too long.	Reprogram Recognition Time. Set the Recognition Time to the minimum required for a monitored condition to become a valid alarm. If possible, test the condition by deliberately creating an alert condition. Refer to Chapter 5, Section 5.3.
5. The batteries drain prematurely.	The unit's AC transformer is unplugged or for some other reason, full AC power is not available to the unit.	The batteries will take over powering the unit when the AC transformer is unplugged from the 120 VAC outlet. When storing the unit, be sure to remove the batteries. Refer to Chapter 2, Section 2.4. *Be sure to use alkaline batteries—do not use rechargeable batteries.*

If the solutions offered above do not appear to correct the problem, apply the following steps, in the order shown.

- Remove the batteries.
- Unplug the unit.
- Wait one minute for the Model 800 to completely power down.
- Plug in the unit's AC adaptor into a standard 120 VAC outlet.
- Replace the batteries.

Refer to Chapter 2, Installation, for additional information on batteries and installation procedures.

Appendix C: 800 QUICK REFERENCE

Parameter	Description	Key Sequence*	Range	Default
Call Delay	Time delay until first call is made	[SET] or [WHAT IS] + [CALL DELAY]	Min: 00:00 Max 60:00 (min:sec)	00:30 (min:sec)
Voice Reps	Number of times alarm message is repeated over the phone	[SET] or [WHAT IS] + [VOICE REPS]	Min: 1 rep Max: 10 reps	3 reps
Intercall Time	Time delay between phone calls	[SET] or [WHAT IS] + [INTERCALL TIME]	Min: 00:10 Max: 60:00 (min:sec)	01:00 (min:sec)
Max Calls	Number of calls until unit self-acknowledges	[SET] or [WHAT IS] + [MAX CALLS]	Min: 1 call Max: 255 calls	100 calls
Temp Limits	High and low temperature alarm limits	[SET] or [WHAT IS] + [TEMP LIMITS] + [zone #]	Min: -20°F/-30°C Max: 150°F/65°C	Low: 10°F High:100°F
Calibrate	Temperature Correction factor	[SET] or [WHAT IS] + [CALIBRATE] + [zone #]	Min: -10° Max: 10°	0°
Recognition Time: zones 1–8	Length of time a fault condition must exist to trip an alarm	[SET] or [WHAT IS]+ [RECOGNITION TIME]	Min: 00:00 Max: 540:00 (min:sec)	00:03 (min:sec)
Recognition Time: Power Failure	Length of time the power must be off to trip an alarm	[SET] or [WHAT IS] +[RECOGNITION TIME]+[POWER]	Min: 5:00 Max: 540:00 (min:sec)	05:00 (min:sec)
Recognition Time: High Sound Level	Length of time the sound must be high to trip an alarm	[SET] or [WHAT IS] +[RECOGNITION TIME]	Min: 5 Max: 60 (sec)	00:08 (min:sec)
Clock	Real time clock	[SET] or [WHAT IS] + [CLOCK] + [time] + [AM] or [PM]		12:00 AM
High Sound Level Alarm Sensitivity	Microphone sensitivity for high sound level alarm	[SET] or [WHAT IS] + [CALIBRATE] + [SOUND]	Min: 1 unit Max: 160 units	32 units
Listen Time	Length of listen-in time during call-in status report	[SET] or [WHAT IS] + [LISTEN TIME]	Min: 0 sec Max: 255 sec	15 sec
Rings Until Answer	Number of rings until unit answers an incoming call	[SET] or [WHAT IS] + [RING]	Min: 1 ring Max: 15 rings	4 rings

* press [ENTER] after all Key Sequences starting with [SET]

Parameter	Description	Key Sequence*	Range/ Response	Default
TAD	Telephone Answering Device Compatibility	[SENSOR ON/OFF] + [TAD]	Enable / Disable	Disabled
ID Number	Sets the unit's telephone number	[SET] + [ID NUMBER]	0-16	
Dialout Test	Permits testing of dialout Telephone numbers	[SET] + [TEST]+ [1-8]	1-8	
Output Mode	Sets the relay output Mode	[SET] + [OUTPUT]	1-8, *, #, PHONE	Manual
Output Control	Switches the relay output On or Off (manual mode)	[SENSOR ON/OFF] + [OUTPUT]		Off
Voice Message	Program or recite voice messages	[SET] or [WHAT IS] + [MESSAGE]	0-8	
Zone Configuration	Program or recite zone configuration	[SET] or [WHAT IS] +[CONFIG]	temp, NO, NC	No
Call Progress	Turns call progress Detection on or off	[SET] + [CONFIG]	Enable / Disable	Enabled
Telephone Number	Program or recite dialout telephone numbers	[SET] + [PHONE NUMBER] + [1-8]		
Status Report	Recites a Status Report	[WHAT IS] + [STATUS]		
Run/Standby Mode	Changes the operating mode between run and standby	[RUN/STANDBY]		Run

Parameter	Description	Key Sequence	Response	Default
Speaker Mute	Turns off the speaker during alarm conditions	[SENSOR ON/OFF] + [MUTE]	On or Off	off
Zone Enable/ Disable	Turns zone alarm detection on or off	[SENSOR ON/OFF] + [zone#]	Enabled / Disabled	Enabled
Power Alarm Enable/Disable	Turns power alarm detection on or off	[SENSOR ON/OFF] + [POWER]	Enabled / Disabled	Enabled
Sound Alarm Enable/Disable	Turns high sound level alarm detection on or off	[SENSOR ON/OFF] + [SOUND]	Enabled / Disabled	Enabled
Temperature Scale	Selects between Fahrenheit and Celsius	[SENSOR ON/OFF] + [F/C]	Fahrenheit or Celsius	Fahrenheit
Security Code	Prohibits programming changes	[SET] or [WHAT IS] + [CODE] + [4 digit code]		none
Callback Acknowledgment	Turns Callback Acknowledgment on or off	[SENSOR ON/OFF] + [PHONE]	Enabled / Disabled	Disabled

Appendix D: Accessories

The sensors listed below are available from Phonetics, Inc., and represent the most commonly used zone devices. Other dry contact sensors, designed for more specialized applications, may also be used. Commercial or industrial electrical supply houses can provide devices to monitor virtually any condition. For further information, contact Sensaphone Customer Service at 610-558-2700.

PART #	SENSOR / SWITCH
FGD-0006	Magnetic Reed Switch
FGD-0007	Passive Infra-Red Detector
FGD-0010	50' two-conductor #22AWG shielded Cable
FGD-0013	Spot Water Detector
FGD-0022	Temp° Alert
FGD-0023	ISOTEL Surge Protector
FGD-0027	Humidistat
FGD-0049	Smoke Detector with Built-in Relay
FGD-0054	Power-Out Alert™
FGD-0056	Zone Water Detector w/Water Rope
FGD-0063	Additional 10' Water Rope for FGD-0056
FGD-0064	Programmable Thermostat with Remote Setback
XFR-0024	12VDC Power Supply for Thermostat
FGD-0100	Remote Temperature Sensor
FGD-0101	Weatherproof Temperature Probe
FGD-0205	Multi-Point Wireless I/O System

Appendix E: Specifications

Alert Zones

Number of Zones: 8 (thermistor installed on zone #1 for local temperature monitoring)

Zone Connector: terminal block

Zone Types: N.O./N.C. contact, 2.8K thermistor (-20° F to 150° F or -30° C to 65° C)

Zone Characteristics: 5.11K to 2.85V (Short circuit current: 1mA max.)

A/D Converter Resolution: 10 bits ±2 LSB

Zone Protection: 5.5VDC Metal Oxide Varistor with fast acting diode clamps.

Microphone

Internal Electret Condenser: For listening in to on-site sounds and detecting high sound levels.

Phone Interface

Line RJ11 Jack: For connection to a two-wire analog telephone line. (6' modular cord included)

Extension RJ11 Jack w/ Line Seizure: For connecting other devices on the same telephone line, devices connected to this jack are disconnected in the event that the 800 must dial out for an alarm.

Phone Line Protection: Metal Oxide Varistor & self-resetting fuse

LED Indicator

System On: On steady when the unit is in RUN mode. LED blinks once every few seconds while in STANDBY mode.

Phone In Use: On steady when the telephone line is being used. LED blinks when no dial tone is detected. Off when telephone line is not in use.

Alarm: Off when no alarm exists. Blinks when an unacknowleged alarm exists. On steady when an acknowledged alarm exists

Battery Ok: On steady when the battery is in good condition. Blinks when the battery is low. Off when the battery must be replaced.

Relay Output

Rated for 1A 30VAC/1A 30VDC maximum.

Power Supply

Power Supply: 120VAC/9VDC 60Hz 6W wall plug-in transformer w/6' cord.

Power Consumption: 1.5 Watts

Power Protection: Metal Oxide Varistor

Battery Backup: Six size-C alkaline batteries (not included), providing up to 24 hours of back-up time.

Environmental

Operating Temperature: 32–122° F (0–50° C)

Operating Humidity: 0–90% RH non-condensing

Storage Temperature: 32°–140° F (0–60° C)

Physical

Dimensions: 2.1"h x 7.8"w x 8.8"d

Weight: 2 lbs.

Enclosure: Indoor-rated plastic housing suitable for wall or desktop installation.

Appendix F: Returning the Unit for Repair

In the event that the Model 800 does not function properly, we suggest that you do the following:

1) Record your observations regarding the Model 800's malfunction.

2) Call the Technical Service Department at 610-558-2700 prior to sending the unit to Sensaphone for repair.

If the unit must be sent to Sensaphone for Servicing, please do the following:

1) Unplug the AC power supply from the wall outlet, remove the batteries, and disconnect all sensors from the alert zones.

2) Carefully pack the unit to avoid damage in transit. Use the original container (if available) or a sturdy shipping box.

3) **You must include the following information to avoid shipping delays:**

   a) Your name, address and telephone number.

   b) A note explaining the problem.

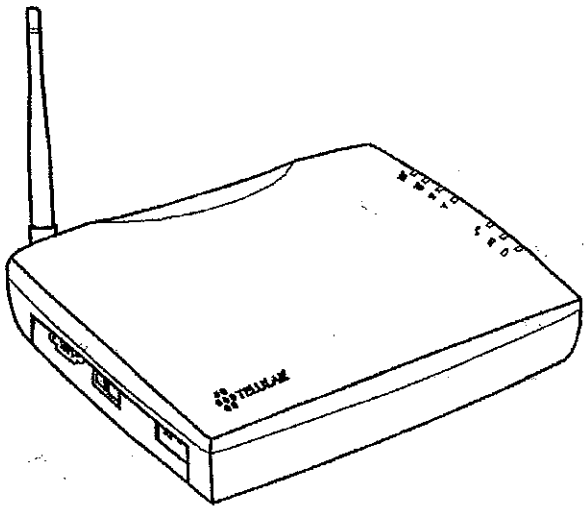
4) Ship your package to the address below:

SERVICE DEPARTMENT
Phonetics, Inc.
901 Tryens Road
Aston, PA 19014

5) Ship prepaid and insured via UPS or US Mail to ensure a traceable shipment with recourse for damage or replacement.

Telephone

TELULAR®



PHONECELL® SX5e GSM

• Fixed Wireless Terminal

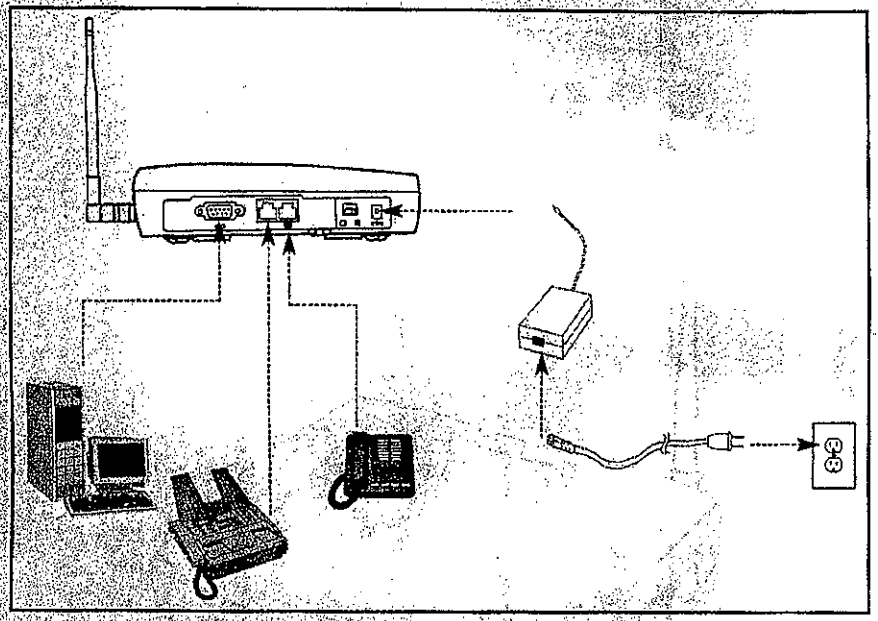
900/1800 MHz GSM
850/1900 MHz GSM

USER MANUAL

12/27/06

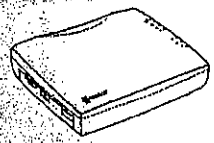
Part Number 56023506

QUICK CONNECTION GUIDE



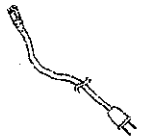
SX5 Fixed Wireless Terminal with desk phone, Fax, and PC

CONTENTS


Phonecell® SX5 GSM FWT


Spike Antenna


Power Supply


AC Power Cord

Before installing the **Phonecell® SX5**, carefully remove the contents from the shipping carton and check for evidence of shipping damage. **If damage is found, contact your Authorized Telular Distributor or shipping agent immediately.**

SAFE OPERATION INSTRUCTIONS

IMPORTANT! Before installing or operating this product, read the ***SAFETY INFORMATION*** section of this manual.

- Install the unit indoors.
- Install the unit on a hard, flat surface for proper ventilation.
- Do not expose the unit to rain or moisture.
- Do not place the unit on or close to sources of heat.

PLEASE SEE THE *IMPORTANT NOTICES* SECTION OF THIS MANUAL FOR IMPORTANT INFORMATION ON USE, WARRANTY AND INDEMNIFICATION

IMPORTANT NOTICES

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These Terms and Conditions are a legal contract between you and Telular Corporation for the title to and use of the Product. BY RETAINING AND USING THE PRODUCT AFTER RECEIPT OF IT, YOU AGREE TO THE TERMS AND CONDITIONS INCLUDING WARRANTY DISCLAIMERS, LIMITATIONS OF LIABILITY AND INDEMNIFICATION PROVISIONS BELOW. IF YOU DO NOT AGREE TO THE TERMS AND CONDITIONS, DO NOT USE THE PRODUCT AND IMMEDIATELY RETURN THE UNUSED PRODUCT FOR A COMPLETE REFUND. You agree to accept sole responsibility for any misuse of the Product by you; and, in addition, any negligent or illegal act or omission of your or your agents, contractors, servants, employees, or other users of the Product so long as the Product was obtained from you, in the use and operation of the Product.

INDEMNIFICATION OF TELULAR CORPORATION ("TELULAR")

YOU SHALL INDEMNIFY, DEFEND AND HOLD HARMLESS TELULAR FOR ANY OF THE COST, INCLUDING REASONABLE ATTORNEYS' FEES, AND FROM CLAIMS ARISING OUT OF YOU, YOUR CLIENTS' OR OTHER THIRD PARTIES' USE OR OPERATION OF THE PRODUCT: (i) FOR MISUSE OR IN A MANNER NOT CONTEMPLATED BY YOU AND TELULAR OR INCONSISTENT WITH THE PROVISIONS OF THIS MANUAL; (ii) IN AN ILLEGAL MANNER OR AGAINST PUBLIC POLICY; (iii) IN A MANNER SPECIFICALLY UNAUTHORIZED IN THIS MANUAL; (iv) IN A MANNER HARMFUL OR DANGEROUS TO THIRD PARTIES; (v) FROM CLAIMS BY ANYONE RESPECTING PROBLEMS, ERRORS OR MISTAKES OF THE PRODUCT, OR (vi) COMBINATION OF THE PRODUCT WITH MATERIAL, MODIFICATION OF THE PRODUCT OR USE OF THE PRODUCT IN AN ENVIRONMENT NOT PROVIDED, OR PERMITTED, BY TELULAR IN WRITING. THE PARTIES SHALL GIVE EACH OTHER PROMPT NOTICE OF ANY SUCH COST OR CLAIMS AND COOPERATE, EACH WITH THE OTHER, TO EFFECTUATE THIS INDEMNIFICATION, DEFENSE AND HOLD HARMLESS.

Customer Support

Tel: 800-229-2326 option 7 Fax: 678-945-7758
E-mail: support@telular.com www.telular.com

Part Number 5802

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SETUP

Install the SIM Card

The SX5 requires a Subscriber Identity Module (SIM) for normal operation. The service provider supplies the SIM card, which carries the account information needed to operate the SX5. If you don't have a SIM card, contact your service provider. The SIM compartment is on the back of the SX5 - ***see Figure 1.***

HINT: Make sure your carrier disables SIM PIN1 or you will have to enter the PIN every time the unit powers on. See the *SX5e User Features* section of this manual for more information.

1. Disconnect the power supply. The power supply must be disconnected whenever a SIM Card is installed.
2. Remove the SIM compartment cover by removing the screw - ***see Figures 1 and 2.***
3. Open the SIM compartment holder.
4. Line up the SIM card with the arrow on the SIM card holder - ***see Figure 2.***
5. Gently insert the SIM card in the slot of the SIM card holder.
6. Close the SIM card holder.

   NOTE: Do not force the SIM card holder shut. Make sure the SIM card is aligned properly with the directional arrow on the holder.
7. Reattach the SIM compartment cover with the screw.

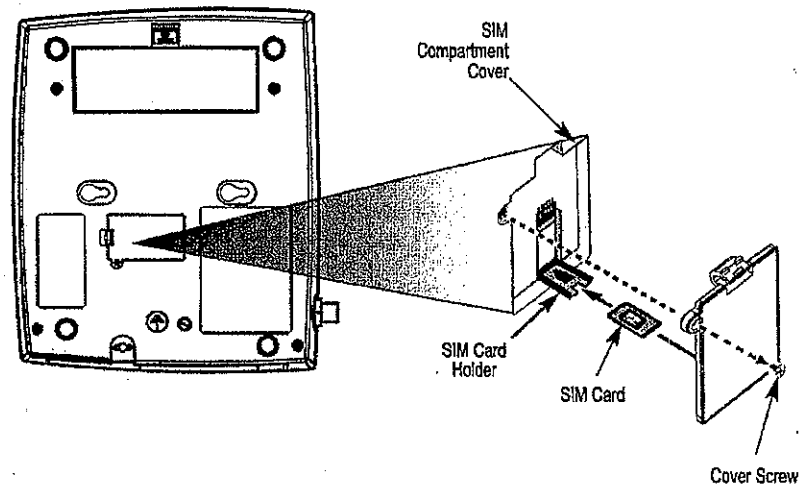


Figure 1 - SIM compartment.

Figure 2 - Install the SIM Card.

Emergency Batteries

Install Batteries

1. Remove the battery access door screw located on the bottom of the unit - ***see Figure 3.***
2. Press the battery access door tabs and remove the battery access door.
3. Install 4 "AA" alkaline batteries (not supplied) - ***see Figure 3.***
4. Reinstall the battery access door using the screw.
5. Turn the AC/Battery switch to battery operation - ***see Figure 4.***

NOTE: The SX5 does not support rechargeable batteries.

WARNING!

Only "AA" alkaline batteries are to be used with the Phonecell® SX5. Use of any other batteries may result in fire and/or other damage to the unit.

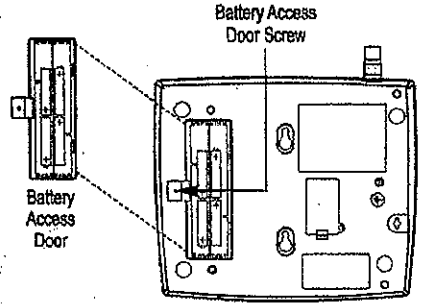


Figure 3 – SX5 battery installation.

Battery Operation

The unit will not automatically switch from AC to battery upon loss of AC power. The AC/Battery switch must be changed manually - ***see Figure 4.*** Battery power will provide up to three hours of standby and 90 minutes of talk time, depending on the SX5 model.

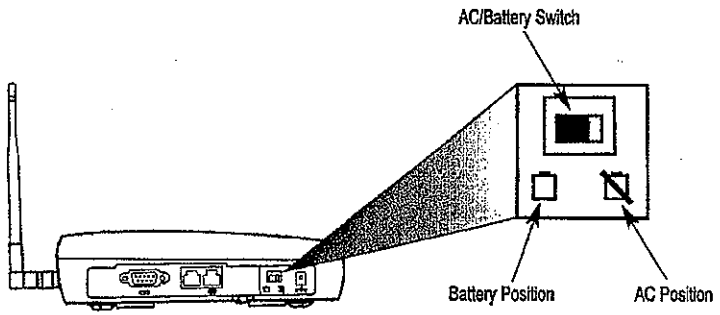


Figure 4 – SX5 AC/Battery switch.

SX5 Location and Installation

The SX5 comes with a standard spike antenna (TNC) - ***see Figure 5.*** For optimal signal strength, choose a location that is above ground and as close to windows (or exterior walls) as possible - ***see Figure 6.*** Cellular signal strength is displayed by the Received Signal Strength Indicator (RSSI) LED on the unit - See the *How to Use the LED Status Indicators* section of this manual.

1. Connect the antenna to the terminal - ***see Figure 5.***
2. Finger-tighten the antenna. Do not over-tighten the antenna.

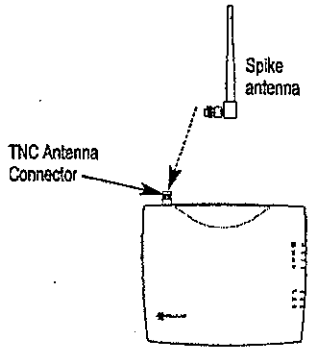


Figure 5 – SX5 antenna connection.

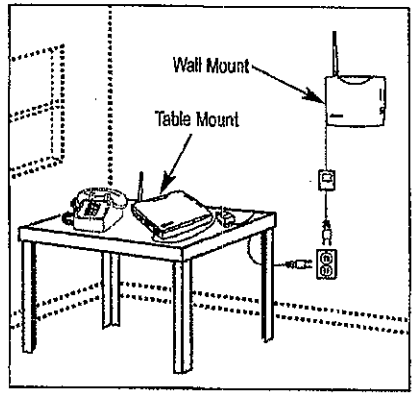


Figure 6 – Typical SX5 installation.

Wall Mounting

1. Mark two hole locations 85 mm (3-5/16 inches) vertically apart and drill two holes into the wall.
2. Install the screws (not supplied) into the wall, leaving a gap (approximately 3 mm (1/8 inch)) between screw head and wall.
3. Align the mounting holes with the screws and mount the SX5 onto the screws - ***see Figures 7 and 8.***

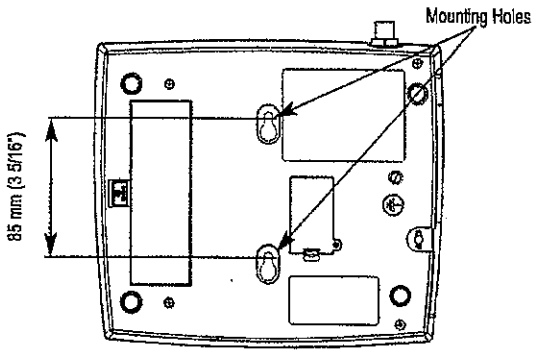


Figure 7 – SX5 mounting holes.

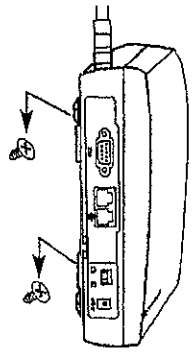


Figure 8 – Mount the SX5 onto the screws.

Connect the SX5 to AC Power

1. A protective earth (safety ground) terminal (screw) marked with a protective earth symbol is provided on the back of the SX5 - ***see Figure 9a.*** Connect this terminal to a good earth ground (i.e., a cold water pipe) by means of an 18 gauge or heavier insulated wire. The wire insulation should be green with a yellow stripe to indicate that this is a protective earth (safety ground) connection.

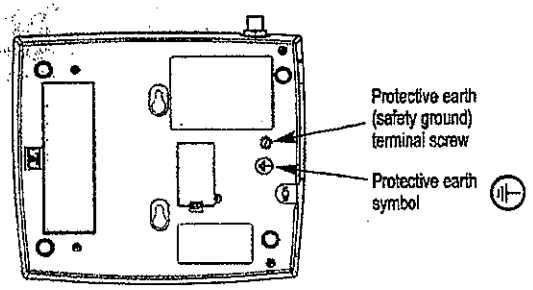


Figure 9a – Earth ground terminal screw.

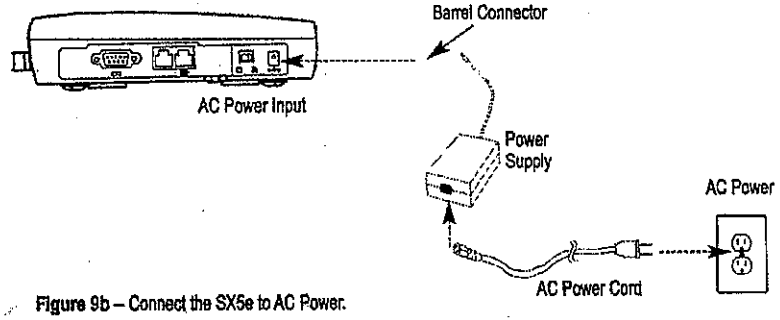


Figure 9b – Connect the SX5e to AC Power.

2. Connect the barrel connector of the power supply to the AC power input receptacle of the SX5 - ***see Figure 9b.***
3. Plug the AC power cord into the power supply.
4. Plug the AC power cord into the AC Power outlet.

   HINT: If there are no batteries in the SX5, it will only power on if the AC/Battery switch is in the AC position - ***see Figure 4.***
5. Check the cellular signal strength and move the unit until you achieve the best signal possible - see the *LED Status Indicators* section of this manual.

Attach a Telephone to the SX5

1. Plug one end of a standard phone cord into a phone- ***see Figure 10.***
2. Connect the other end of the phone cord to the telephone port on the side of the SX5 (marked with a phone icon) - ***see Figure 10.***

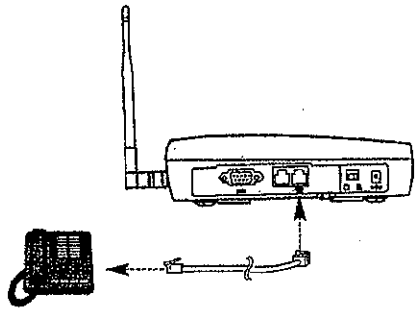


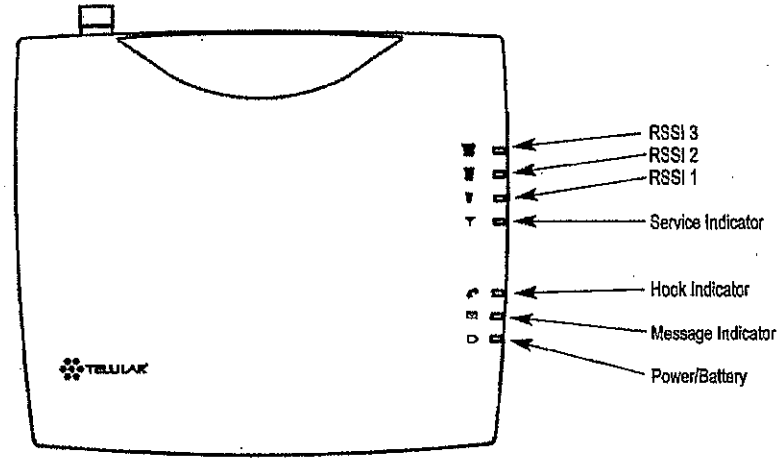
Figure 10 - Connect SX5 to Telephone.

GETTING TO KNOW YOUR SX5

LED Status Indicators

The LED indicators are activated when the SX5 is powered on. The following tables describe the modes and operation of the indicators.

NOTE: If you are getting no service or limited service, contact your service provider for more information.



Service Indicator

LED Color	Activity	Description
Green	Continuous	Full Service
Amber	Continuous	Limited Service
Red	Continuous	No Service*
Red	Flashing	SIM Error**

* *Contact your service provider to verify that service has been activated.*

** *Indicates that the SIM card is missing or has been improperly installed. If the SIM card is properly installed and the error continues, contact your service provider.*

Received Signal Strength Indicator (RSSI)

RSSI LED's	Activity	Cellular Signal Strength
RSSI 1	Flashing	Lowest
	Continuous	Poor
RSSI 2	Flashing	Fair
	Continuous	Good
RSSI 3	Flashing	Very Good
	Continuous	Best

Hook Indicator

LED Color	Activity	Description
Green	Flashing (with ringer)	Incoming call
Green	Continuous	FWT is off hook
Green	Fast Flashing	Processing data call
Green	Slow Flashing	Call on hold

Message Indicator

LED Color	Activity	Description
Green	Slow Flashing	New voice mail or text message

AC Power/Battery Indicator

LED Color	Activity	Description
Green	Continuous	AC power applied
Amber	Continuous	Battery level good (battery switch on)
Amber/Green	Alternating	Battery level poor (battery switch on)

Important Dial Tones

Service - Indicates that phone is ready for use (steady tone).

No Service - Indicates that there is no service available (fast beeping tone).

Roam - Indicates service in a roam area.

Not Registered - Indicates inactive or missing SIM card, or need to enter PIN (fast stutter tone).

Supplementary Service - Indicates that supplementary services have been activated.

CALL FUNCTIONS

Making Calls

1. Pick up the telephone handset (the phone is now "off-hook").
2. Listen for dial tone. If service is not available, a No-Service tone is produced. Hang-up the phone and try again. If the No-Service tone continues, contact your service provider to verify that cellular service is available.
3. Dial the phone number. The call will be sent automatically.

   HINT: Pressing the Flash key or pressing and releasing the switch-hook after dialing a number will send the call immediately.

Receiving Calls

When the telephone rings, pick up the handset and begin talking.

Ending Calls

Hang-up the phone (place the handset back onto the telephone cradle).

In-Call Features

Place a Call on Hold [1]

To place a call on hold, press the *Flash* key on your phone. If your phone does not have a *Flash* key, press and release the *Switch-Hook*. When the call is on hold, the Hook Indicator LED will flash and you will hear a dial tone on your phone. If you hang-up your phone when a call is on hold, the call will be disconnected.

Retrieve a Call on Hold

Press the Flash key or press and release the switch-hook to go back to your held call.

Make a New Call with a Call on Hold (Two-Line Calling) [2,3]

If you want to make another call when the first call is placed on hold, dial the number when you hear a dial tone after the call has been placed on hold. See *Place a Call on Hold* above. You cannot go back and forth between calls. If you hang-up the phone all calls will be disconnected.

Answer Call Waiting [1]

When you're on an active call, you will hear a beep tone on your phone when a new call is incoming. To answer the new call and place the first call on hold, press *Flash* or press and release the *Switch-Hook*.

Answer a Call when Dialing or Off Hook with Dial Tone

Sometimes you may receive a call as you are dialing or when your just about to dial a number. If this happens, you will hear a call waiting tone (beep tone) on your phone. Press *Flash* or press and release the *Switch-Hook* to answer the call.

Adjust the Volume Level

If the volume level on the phone is too high or too low, adjust the levels using the keypad on the telephone. The telephone must be in Tone-Dial (DTMF) mode to adjust the levels.

- To Increase Volume press: # * 8 #
- To Decrease Volume press: # * 3 #

NOTE: The default setting allows adjustment of the volume three (3) steps from the default in either direction (Up or Down). The volume setting remains in effect for future calls until changed manually. When power to the SX5 is cycled (powered OFF/ON), the default mid-range volume setting will be restored.

[1] *Call Hold, Call Waiting, and Two-Line Calling are all network dependent features. Contact your service provider for information on activating these features.*

SX5 USER FEATURES

The SX5 has many user features and setup options that can be accessed using a telephone connected to the SX5. To access these features, press the key sequence for the option at any time. Some options are not available while in a call. See the *Call Functions* section of this manual for functions that are allowed while in an active call (In-Call Functions).

All user options have a sequence of digits entered from the telephone keypad. For example, to change to a UK ringer style, press **# * 100 * 2 #**. After the key sequence is entered, the dial tone will be heard to confirm that the option has been changed or set. If there is an error, three tones will be heard before the dial tone.

HINT: Make sure to use a tone-dial (DTMF) type telephone when accessing any user feature or option that requires a key sequence. Pulse dial or rotary dial telephones will not allow key (DTMF) sequences.

Messages (Voice Mail and Text Messages)

The SX5 is capable of receiving both text and voice mail messages. The Message LED will flash once a message is received indicating that a text or voice message waiting.

Voice Mail Access
To check for voice mail, dial your voice mail access number and follow the prompts. Contact your service provider for more information.

Text Messaging (SMS)
The SX5 allows you to send and receive text messages using a Personal Computer (PC). To do this, you need a PC connected to the SX5 serial port (see the *Connecting to a Computer* section of this manual). The SX5 supports the GSM AT command set defined in GSM 07.05 for Short Message Service (SMS).

Message Indication Clearing
The Message LED will flash until you remove the message notification from the SX5. After you have heard or read you messages, you can clear the notification by pressing **# * 112 #** on your phone.

NOTE: All text messages will be erased when you clear the notification.

Audio Settings

Line Level
The Line Level option controls the handset volume for any telephones connected to the SX5.

Press: **# * 69 * <output level> #**

0 = Low
1 = Normal (default)
2 = High

Ringer Styles
The SX5 can be set to use one of three different ringer styles (US, UK, or European). Any phone connected to the SX5 will ring according to the alert type selected. If the Ringer Style is set to Off, there will be no audible alert.

Press: **# * 100 * <line alert option> #**

1 = US (default for 1900 MHz model)
2 = UK (default for dual-band model)
3 = European
0 = Off

Dial Settings

Dial Delay
The Dial Delay is the time that the SX5 waits after a number is dialed before automatically sending the number.

Press: **# * 11 * <delay> #**

The delay must be between 2 and 20 seconds. The default delay time is 3 seconds.

Pulse Dial Option
Press: **# * 12 * <pulse-dial> #**

0 = disable Pulse Dialing capability (default)

1 = enable Pulse Dialing capability

Auto Dial
The SX5 will recognize frequently called phone numbers and send them without waiting for the Dial Delay. Up to 50 numbers that have been successfully called at least twice will be stored when this feature is enabled. Any loss of power to the SX5 will clear this list.

Press: **# * 21 * <auto dial> #**

0 = disable Auto Dial option (default)

1 = enable Auto Dial option

On-Hook Idle Voltage
This feature has been added to the SX5 and allows control of the on-hook idle voltage at the RJ-11. It is recommended that only a qualified technician for PBX or payphone environments should only change this parameter. Contact your installer for more information.

Press: **# * 134 * <mode> #**
0 = Low battery mode and forward active when on-hook (default).
1 = High battery mode and low power standby when on-hook

SIM Settings

The SIM card used in the SX5 allows a PIN to be used to protect the unit from unauthorized use. The PIN can be between 4 and 8 digits in length and any combination of digits 0 through 9. If you are concerned about your SIM card being used in other devices without your knowledge, you may use one of the Mobile Equipment Personalization (MEP) locks of the SX5. Ask your service provider about for more information

SIM PIN 1 Setup
When enabled, a PIN must be entered every time the SX5 is powered on. The SX5 will not operate until the PIN is entered. To avoid having to enter the PIN each time the SX5 is powered on (including after power interruptions or power outages), be sure to disable the SIM PIN when the SIM card is installed.

- To **enable** SIM PIN 1, pick up the telephone handset and press: **# * 104 * 1 * <PIN 1> #**
- To **disable** SIM PIN 1, pick up the telephone handset and press: **# * 104 * 0 * <PIN 1> #**

HINT: It is recommended that SIM PIN 1 be **disabled** so that it is not required to enter the PIN each time the SX5 is powered on. Enable SIM PIN 1 only if it is certain that no one else should use the SX5 to make calls. Be sure to inform your service provider if you do **not** want SIM PIN 1 enabled when you get your SIM card.

Auto SIM PIN Entry (PIN 1 Only)
When SIM PIN 1 is enabled and the SX5 is powered on, entry of the PIN will be required. To bypass the requirement to always enter the PIN every time power is cycled (power outages, relocation of the unit, etc.), enable Auto SIM PIN Entry. If SIM PIN 1 is not enabled, enabling this feature has no effect. **Enable** Auto SIM Pin Entry is the factory default.

- To **enable** Auto SIM PIN Entry, pick up the telephone handset and press: **# * 65 * 1 * <PIN 1> #**
- To **disable** Auto SIM PIN Entry, pick up the telephone handset and press: **# * 65 * 0 * <PIN 1> #**

NOTE: If you enable this feature and change the SIM card in the unit, you will have to enter the SIM PIN of the new card before the SX5 will be operational.

Caller ID

The SX5 will support Caller ID device operation. The default format setting is designed to work for most Caller ID devices.

Change Caller ID Format
The following key sequence is used to select the Caller ID (CID) format:

Press: **# * 84 * <CID format> # <Flash>**
1 = MDMF (Multiple Data Message Format) (default)
2 = SDMF (Single Data Message Format)
3 = OFF

Set Time and Date

Allows for a set time and date to be displayed on a connected caller ID device.

Set Data
Press: **# * 131 * <month> * <day> * <year>**
<month> = 1-12
<day> = 1-31
<year> = 2000-2999

Set Time
Press: # * 130 * <hours> * <minutes> #
<hours> = 0 - 23
<minutes> = 0 - 59

Reset User Factory Defaults

Reset all user programmable options back to the factory defaults.

Press: **# * 107 * 1 #**

Dialing Prefix Setup

The SX5 allows for a prefix to be setup that will be added to the dial string of every outbound call. A maximum of 10 digits can be added to the dial string.

Enable/Disable Dialing Prefix
To enable press: **# * 119 * 1 #**
To disable press: **# * 119 * 0 #**

Setup the Dialing Prefix
The dial prefix can be up to 10 digits of 0 - 9, #, or *.
Press: **# * 120 * <prefix> #**

SUPPLEMENTARY SERVICE FEATURES (NETWORK DEPENDENT)

The SX5 is compatible with a variety of supplementary services. Contact your service provider for availability and dialing instructions.

Different commands and information may be necessary to set up supplementary services.

Commands

- Register: Input information necessary for the operation of a service. In the case of call forwarding, for example, this will include the number to which incoming calls will be forwarded.
- Erase: Clear information stored for a particular service by a previous registration.
- Activate: Enable the operation of a service that has been registered.
- Deactivate: Stop the operation of a service that has been activated.

Information

- Teleservice: Voice = 11
  Data = 12
  Fax = 13
  SMS = 16
  All Teleservices = 10
  All Teleservices except SMS = 19
- Delay: 5-30 seconds.
- Ph No: Phone number (up to 20 numerical digits).

NOTE: The <Flash> function is used to send a command string. To use the <Flash> function, press the Flash key, or press and release the switch-hook on the telephone.

Call Waiting

Enables notification of an incoming call when the phone is off-hook, whether on another call or while dialing a call.

Activate: *** 43 # <Flash>**

Deactivate: **# 43 # <Flash>**

Calling Line Identification Presentation (CLIP)

Allows you to view the identification information (name and number) of the person calling you.

Register: *** * 30 # <Flash>**

Activate: *** 30 # <Flash>**

Deactivate: **# 30 # <Flash>**

Erase: **# # 30 # <Flash>**

Calling Line Identification Restriction (CLIR)

Prevents the display of your identification information (name and number) to the person you call. If you subscribe to this option in permanent mode, the network will prevent the display of your identity for every outgoing call. If you subscribe with temporary mode, you can set a default option, then manually hide or display or information for the next call you make.

Register: *** * 31 # <Flash>**

Activate: *** 31 # <Flash>**

Deactivate: **# 31 # <Flash>**

Erase: **# # 31 # <Flash>**

For temporary mode only:

- If the default is "presentation restricted." To display your information for the next call only:
  Press: *** 31 # Ph No <Flash>**
- If the default is "presentation not restricted," To hide your information for the next call only:
  Press: **# 31 # Ph No <Flash>**

Connected Line Identification Presentation (COLP)

Allows you to view the identification information for the number you call.

Register: * * 76 # <Flash>

Activate: * 76 # <Flash>

Deactivate: # 76 # <Flash>

Erase: # # 76 # <Flash>

Connected Line Identification Restriction (COLR)

Prevents the display of your identification information to the person calling you.

Register: * * 77 # <Flash>

Activate: * 77 # <Flash>

Deactivate: # 77 # <Flash>

Erase: # # 77 # <Flash>

Call Forwarding

Call Forward Unconditional

Send all incoming calls, or just those associated with a specific teleservice, to a different number.

Register: * * 21 * Ph No * Teleservice # <Flash>

Erase: # # 21 * Teleservice # <Flash>

Activate: * 21 * Teleservice # <Flash>

Deactivate: # 21 * Teleservice # <Flash>

Call Forward on Mobile Subscriber Busy

Send all incoming calls, or just those associated with a specific teleservice, to a different number when your account is "busy."

Register: * * 67 * Ph No * Teleservice # <Flash>

Erase: # # 67 * Teleservice # <Flash>

Activate: * 67 * Teleservice # <Flash>

Deactivate: # 67 * Teleservice # <Flash>

Call Forward on No Reply

Forward all calls made to your number, or just those associated with a specific teleservice, on to a different number if your phone is not answered after a certain amount of time.

Register: * * 61 * Ph No * Teleservice * Delay # <Flash>

Erase: # # 61 * Teleservice # <Flash>

Activate: * 61 * Teleservice # <Flash>

Deactivate: # 61 * Teleservice # <Flash>

Call Forward on Mobile Subscriber Not Reachable

Send all incoming calls, or just those associated with a specific teleservice, to a different number when your account is "not reachable."

Register: * * 62 * Ph No * Teleservice # <Flash>

Erase: # # 62 * Teleservice # <Flash>

Activate: * 62 * Teleservice # <Flash>

Deactivate: # 62 * Teleservice # <Flash>

Call Barring

Bar All Outgoing Calls

Does not allow any outgoing calls, or just those associated with a specific teleservice, from the SX5.

Activate: * * 33 * Password * TeleService # <Flash>

Deactivate: # 33 * Password * TeleService # <Flash>

Bar Outgoing International Calls

Does not allow any outgoing calls, or just those associated with a specific teleservice, to subscribers of networks outside of the country you are in when you make the calls. You will only be able to make calls to subscribers of networks in the same country that you are in when you attempt to make the calls.

Activate: * 331 * Password * TeleService # <Flash>

Deactivate: # 331 * Password * TeleService # <Flash>

Bar Outgoing International Calls Except Those Directed to the Home PLMN Country

Does not allow any outgoing calls, or just those associated with a specific teleservice, to countries other than the one where your home network is located. This does not bar outgoing calls to other subscribers to your network, even if you make the calls from outside the country.

Activate: * 332 * Password * TeleService # <Flash>

Deactivate: # 332 * Password * TeleService # <Flash>

Bar All Incoming Calls

Allows you to bar certain categories of incoming calls according to a barring program which is selected from a set of one or more barring programs chosen when you activate your account. This is valid for all incoming calls, or just those associated with a specific teleservice.

Activate: * 35 * Password * TeleService # <Flash>

Deactivate: # 35 * Password * TeleService # <Flash>

Bar Incoming Calls when Roaming Outside the Home Network Country

Does not allow any incoming calls, or just those associated with a specific teleservice, if you are roaming outside the country where your home network is located.

Activate: * 351 * Password * TeleService # <Flash>

Deactivate: # 351 * Password * TeleService # <Flash>

Bar All Calls

Does not allow any incoming or outgoing calls, or just those of a specific teleservice.

Activate: * 330 * Password * TeleService # <Flash>

Deactivate: # 330 * Password * TeleService # <Flash>

Bar All Outgoing Calls

Does not allow any outgoing calls, or just those associated with a specific teleservice.

Activate: * 333 * Password * TeleService # <Flash>

Deactivate: # 333 * Password * TeleService # <Flash>

Bar All Incoming Calls

Does not allow any incoming calls, or just those associated with a specific teleservice.

Activate: * 353 * Password * TeleService # <Flash>

Deactivate: # 353 * Password * TeleService # <Flash>

Multiparty Call Features

Multiparty call features are handled within an active call. These features are network-dependent. Contact your service provider for availability.

- To release all held calls or set User Determined User Busy for a waiting call, press: **0 <Flash>**
- To release all Active Calls and accept the held/waiting call, press: **1 <Flash>**
- To release a specific active call x, press: **1 x <Flash>** (x represents the call ID 1-7)
- To place all active calls on hold and accept the held/waiting call, press: **2 <Flash>**
- To place all active calls on hold except call x, press: **2 x <Flash>** (x represents the call ID 1-7)
- To add a held call to the conversation, press: **3 <Flash>**
- To place all active calls on hold and make a call to a specified number, press: **Phone No <Flash>**

NOTE: When both a held and a waiting call exist in a conflicting situation, the above procedures apply to the waiting call.

DATA FEATURES

When connected to a personal computer (PC), the SX5 is capable of sending and receiving digital fax and data, sending and receiving email communications, and accessing the Internet. Data speeds may vary depending upon your cellular network.

Connect SX5 to a Computer

Use a data cable to connect the DB-9 data port on the SX5 to the appropriate data port on your PC - ***see Figure: 20***

Configure PC for Circuit Switched Data

Requirements

- Active GSM account with your network service provider including a Data/Fax facility
- Windows (version 95/98 or later)
- PC with a Com Port.

NOTE: When all of the above have been satisfied, you may proceed.

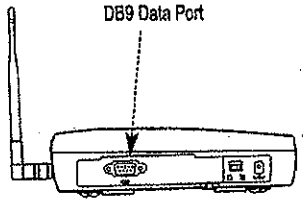


Figure 20 - DB9 Data Port on the SX5

Modem Setup

1. Power on your PC/laptop.
2. Access the Control Panel, then select the Modems option.
3. Install a new modem device for the SX5 with the following specifications:

   Modem Type: Standard 19200 bps Modem

   Maximum speed of serial port: 19,200

   Data bits: 8

   Parity: None

   Stop bits: 1

   Use Flow Control: Enable this option and select Hardware [RTS/CTS]

   Extra settings: AT & D1

Automatic Baud Rate Fallback Control

The SX5 supports an automatic fallback to 19,200 bps when errors are detected in the data stream. This is useful for applications such as PC digital fax because most PC fax applications require a 19,200 bps baud rate on the serial port.

Enabling Fallback

Enable this feature when you have an application that uses a port speed of 19,200 bps. When the SX5 has a port speed that does not match the port speed on the PC, errors will be detected. When these errors are detected, the SX5 will adjust the port speed to 19,200 bps, thus matching the PC application rate of 19,200 bps. It does not matter if the SX5's port speed is higher or lower than 19,200 bps, the SX5 will still be adjust the rate to 19,200 bps.

NOTE: The SX5 does not support autobauding and will only adjust the port speed to 19,200 bps under the above conditions. No other rate will be automatically set.

Press: **# * 132 * 1 # (<default setting>)**

When to Disable Fallback

If you mainly use the SX5 for GPRS data, then disable fallback of the port rate. This will allow some errors in the data stream without effecting a change in port speed on the SX5.

Press: **# * 132 * 0 #**

Baud Rate AT Commands

The SX5 will accept AT commands to setup the port speed. If you want to change the SX5 port

speed for a session or keep the change permanent, or if you just want to see the profile settings, use the following AT commands from a terminal application (like HyperTerminal).

NOTE: Make sure DTE Fallback is OFF before making changes to the baud rate.

View current configuration	**AT&V**
Change the port speed on the SX5 to <baud rate>	**AT+IPR=<baud rate>**
Permanently change the SX5 port speed to <baud rate>	**AT+IPR=<baud rate>&W**

Digital Fax Setup

The SX5 is capable of receiving and sending faxes via a personal computer using a standard RS232 serial port. The PC application and modem setup must be able to support software flow control. To setup flow control properly, follow the instructions for setting up a standard modem connection in Appendix A of this manual with the following changes.

HINT: Setup a separate modem for PC fax and a separate modem for PC circuit switched data connections. This way you will not have the make changes to the modem settings everytime you want to use fax or data.

1. Change the flow control of the standard modem to enable **software flow control**.
2. Change Extra Settings from AT&D1 to **AT+IFC=1,1 &d1**. This enables software flow control on the SX5.
3. To be able to receive faxes to the serial port (on your computer) select the serial port for your data connection by entering # * 67 * 3 #.
4. Run your PC fax application using this new modem connection for receiving and sending faxes.

HINT: To change the SX5 to receive fax calls through the RJ-11, press **# * 67 * 1 #**.

GPRS (Packet Data) Connections

The SX5 will allow GPRS connectivity if your network service provider has this feature available. GPRS allows a packet data connection at higher rates then conventional circuit switched (dial-up) connections. A GPRS kit can be used when trying to connect with GPRS service. This kit contains a serial cable and a setup CD for installation on a standard personal computer. Contact your service provider or nearest dealer for more information.

Analog Modem Support

The SX5 FAX and standard FWT models support connectivity with an analog modem. A PC with a modem or other devices that use a modem, like a credit card swipe Point Of Sale (POS) machine, can be connected to the RJ-11 jack (marked with a telephone icon) and used seamlessly.

RJ-11 Port Setup

The RJ-11 voice jack on the SX5 (the jack marked with a phone icon) can be configured for voice (default setting) or analog modem data. If the jack is configured for analog data, the bypass string for voice calls must be entered before a voice call can be made. In voice mode, data transmissions are routed through the DB-9 port. To send data via an analog modem while in voice mode, use the analog bypass string.

Modem Connection Options

The SX5 has the capability to either wait for a remote modem to connect before the local modem connects or not. If your application has timing issues where the local application times-out before the remote modem connects, then use the following string command to enable this option.

Press: **# * 113 * <mode> * <option> #.**

Parameter	Value
<mode>	0 = Voice (default) 1 = Analog Data
<option>	0 = Off (default) 1 = On

Bypass String

The bypass string will bypass the current mode to send a call in the desired mode. After the call, the SX5 will return to the mode that was active before the call.

Press: **# * 19 * <bypass code> #**

Parameter	Value
<bypass code>	0 = Voice 1 = FAX 2 = Analog Modem

Modulation

The analog modem interface can be configured to specific modulations or set to automatic modulation adjustment.

NOTE: This modulation is only for the connection between the modem and the SX5.

Press: **# * 114 * <modulation> #**

Supported Modulations

Modulation	Baud Rates (bps)	<modulation>
V.8	Auto	0 (default)
V.32bis TCM	14,400	1
V.32bis TCM	12,000	2
V.32bis TCM	9600	3
V.32	9600	4
V.32bis TCM	7200	5
V.32	4800	6
V.22bis	2400	7
V22.bis	1200	8
V.22	1200	9
V.22	600	10

Example: To set the modulation between the modem and the SX5 to V.22bis @ 24, enter **# * 114 * 7 #**

Air Interface Data Rates and Error Correction

The SX5 supports both transparent (no error correction) and non-transparent (error correction) data connectivity along with different air interface data rates. Check with your carrier to determine which is right for your application. If you are not sure what your carrier supports, use the default setting of non-transparent

Press: **# * 115 * <error correction> * <air interface modulation> #**

Error Correction

0 = transparent (no error correction) (default)

1 = non-transparent (error correction)

Supported Air Interface Data Rates

Modulation	Over the Air Data Rate (bps)	<air interface modulation>
Automatically Selected	Auto	0 (default)
V.21	300	1
V.22	1200	2
V.23	1200 (uplink) 75 (downlink)	3
V.22bis	2400	4
V.26ter	2400	5
V.32	4800	6
V.32	9600	7
V.34	9600	12
V.34	14,400	14
V.110	300	65
V.110	1200	66
V.110	2400	68
V.110	4800	70
V.110	9600	71
V.110	14,400	75

Example: To set the air interface rate to V.32 @ 9600 bps with no error correction, enter **# * 115 * 0 * 7 #**

SX5 GSM FWT WITH FAX

The SX5 GSM FWT with Fax allows connection to a fax machine and additional telephones. The SX5 can be set up to use one or both of its phone jacks. In Single Jack mode, only the jack designated with a telephone icon is operational. You can connect a fax machine or an additional telephone into that jack, but to receive faxes you must have a fax machine connected. In Dual Jack mode, the unmarked jack is used for fax, and the jack marked with the telephone icon is used for any additional phones.

NOTE: Analog data service must be provided by your cellular carrier. Analog fax machine MUST BE a group 3 facsimile protocol machine transmission at 9.6 to 14.4kbps. All non-standard/advanced transmission modes (turbo fax, error correction etc.) must be disabled.

Set SX5 for Analog Fax

Set In-Bound Fax Port Option

Press: **# * 67 * <fax_port> #**

1 = send incoming fax calls to RJ-11 jack (default).

3 = send incoming fax calls to the serial port.

Set Single/Dual Jack Mode

Press: **# * 63 * <single jack> #**

0 = single jack

1 = dual jack (default)

Connect SX5 for Dual Jack Mode

1. Connect a fax machine to the unmarked phone jack on the SX5 - ***see Figure 12.***
2. Connect a regular phone to the phone jack that is marked with a telephone icon.

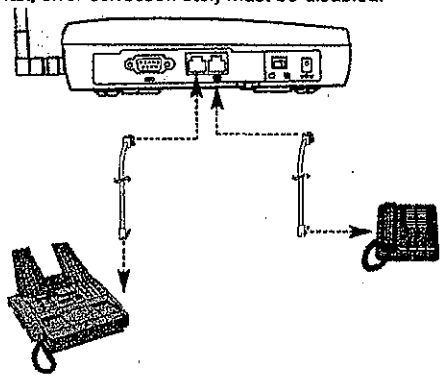


Figure 12 - Dual Jack mode connections.

Connect SX5 for Single Jack Mode

1. Connect a fax machine to the phone jack on the SX5 that is marked with a telephone icon - ***see Figure 13.***

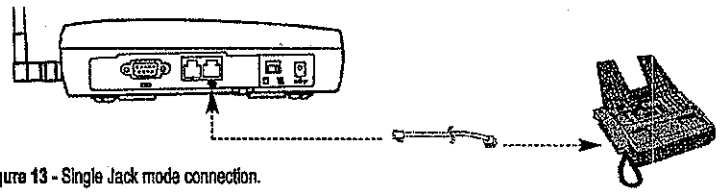


Figure 13 - Single Jack mode connection.

NOTE: The fax by-pass must be entered to send a fax in single jack mode because the SX5 default setting is for voice calls.

Fax Timing Adjustments

Phase D adjustments can be made to analog faxing. If you experience faxing issues try adjusting this setting.

Press: **# * 133 * <control> * <time out> #**

Parameter	Values
<control>	0 = Disable 1 = Enable
<time out>	1 - 255 in 15ms steps

Analog Fax Bypass

This feature allows the phone jack to process the next outgoing call as an analog fax call. After this call, the phone jack automatically returns to the default voice protocol. The user enters this key sequence prior to dialing the telephone number. The terminal interprets the string and properly sets up the call. Refer to the following examples.

NOTE: The analog fax bypass string can only be used in single jack operation.

Use the Fax Bypass

1. Lift up the handset (take off-hook).
2. Press: **# * 19 * 1 #**, then dial the fax number to be called.
3. Press START on the fax machine.

HINT: If the fax machine does not have a handset, enter **# * 19 * 1 #**, followed by the remote fax number to be called. Press START.

HINT: If the fax machine has the capability to store telephone numbers for speed dialing, the **# * 19 * 1 #** command string may be programmed into the machine as a prefix to the telephone number. With some machines, it may also be possible to store the command string as a speed dial number and dial the remote fax machine telephone number manually.

SX5 TROUBLESHOOTING

Telephone Service Is Not Working (Cannot make or receive calls)

- Make sure the SX5 powered on properly.
- Make sure any equipment that is externally connected to the SX5 is correctly connected.
- Test any externally connected equipment on a known system to verify operation.
- Do you have the antenna connected? If not, connect the antenna.
- Is service established with a service provider? If so, is there any service provider issue. Your service may be disconnected or not functioning properly. Contact your service provider is you think this is the problem.

Unable to Receive Calls

- Is the handset on the cradle? If not, place the handset on the cradle and try again.
- Is the SX5 making a loud repetitive tone (ROH)? Then either speakerphone or the handset is off hook. Hang-up and try again.

Unable to Make Calls

- If you do not hear standard dial tone when off hook, then your service has a problem. Contact your service provider is you think this is the problem.
- Do you have telephone extensions connected to the SX5? If so, one of those may be off hook (the display will show this information).

Unable to Send or Receive Analog Fax Calls

- Is your fax machine connected properly? You may have the fax machine connected to the wrong RJ-11 jack of the SX5. Make sure it is connected to the jack with no symbol (no phone icon). If you want to use the SX5 in single jack mode, please refer to the fax section of this manual for proper setup.
- Do you have fax service on your wireless account? Contact your service provider for more information.
- Do you have good signal strength? If you signal is low it may affect faxing. Try repositioning the unit or obtaining a direction high gain external antenna.

Unable to Send or Receive Circuit Switched Data (CSD) Calls

- Is your computer connected to the serial port of the SX5? If not, connect the computer with an appropriate RS232 DB-9 cable.
- Do you have CSD service on your wireless account? Contact your service provider for more information.
- Is your computer configured properly to access data service with the SX5? Please reference the data sections of this manual for proper setup.

Unable to Connect to GPRS Service

- Is your computer connected to the serial port of the SX5? If not, connect the computer with an appropriate RS232 DB-9 cable.
- Do you have GPRS service on your account? Contact your service provider for information.
- Is your computer configured properly to access GPRS with the SX5? Please reference the data sections of this manual for proper setup or your GPRS feature or see the setup wizard help file for more information.
- You cannot pass the dialing sequence of the connection. Make sure that DTE Fallback is disabled. See the data section of the manual for more information.
- You can dial the connection but cannot authenticate with the network. There may be a network or account setup problem. Contact your service provider for more information.

Moisture or Ventilation Problems

- Is moisture forming on or around the SX5? Remove any moisture with a clean dry towel and move the unit to a well ventilated area. Review the Temperature and Environment section of this manual for more information.

No Power

- Is the power supply connected to the unit? Make sure power is available and that the power supply is properly connected to the SX5.
- The power supply is connected but the unit still has no power. Make sure the circuit is functioning to the power supply. Check breakers & contact your power company. Power may be off at location.

CONFORMANCE STATEMENTS

The SX5 900/1800 MHz models are in conformance with the requirements of the applicable EU CE Council Directives.

The SX5 850/1900 Mhz models are in conformance with all applicable FCC requirements.

FCC Part 15 Class B Compliance

This Phonecell® SX5 model has been tested and found to comply with the limits for a Class B digital device, pursuant to Part 15 of the FCC rules. Changes or modifications not expressly approved by Telular Corporation will void your authority to operate the equipment per FCC part 15 paragraph 15.21. These limits are designed to provide reasonable protection against harmful interference in a residential installation. This equipment generates, uses and can radiate radio frequency energy and, if not installed and used in accordance with the instructions, may cause harmful interference to radio communications. However, there is no guarantee that interference will not occur in a particular installation. If this equipment does cause harmful interference to radio or television reception, which can be determined by turning the equipment OFF and ON, the user is encouraged to try to correct the interference by one or more of the following measures:

- Reorient or relocate the antenna.
- Increase the separation between the equipment and the terminal.
- Connect the equipment into an outlet on a circuit different from that to which the terminal is connected.
- Consult your Authorized Telular Distributor or an experienced radio/TV technician for help.

All SX5 900/1800 MHz models are in conformance with all applicable Australian government telecommunications requirements.

All SX5 900/1800 MHz models have hygienic conclusion of GOSSANEPIDNADZO and conform to GOSSTANDARD of Russia.

All SX5 900/1800 MHz models are in conformance with all applicable South African government telecommunications requirements.

SAFETY INFORMATION

The Phonecell® SX5 functions as both a radio transmitter and receiver. When it is ON, the SX5 receives and sends out radio frequency (RF) energy. The SX5 GSM 900/1800 Dual-Band unit operates in the frequency ranges of 890 MHz to 960 MHz and 1710 MHz to 1880 MHz. The SX5 GSM 850/1900 Dual-Band unit operates in the frequency range of 824 MHz to 849MHz and 1850 MHz to 1990 MHz. Both units employ commonly used phase/frequency modulation techniques. When you use the SX5, the cellular system handling your call controls the power level at which the unit transmits.

Exposure to RF (Radio Frequency) Energy

In 1991, the Institute of Electrical and Electronics Engineers (IEEE), and in 1992, the American National Standards Institute (ANSI), updated the 1982 ANSI Standard for safety levels with respect to human exposure to RF energy. After reviewing the available body of research, more than 120 scientists, engineers and physicians from universities, government health agencies and industry developed this updated Standard. In March, 1993, the U.S. Federal Communications Commission (FCC) proposed the adoption of this updated Standard.

The design of the Telular Phonecell® SX5 complies with this updated Standard. Of course, if you want to limit RF exposure even further than the updated ANSI Standard, you may choose to control the duration of your calls and operate your phone in the most power-efficient manner.

Safe Operation Requirement

The Phonecell® SX5 must be either wall mounted or desk mounted and should not be operated when any person is within 203 mm (8 inches) of the antenna.

WARNING!

The Phonecell® SX5 is intended either to be wall mounted or mounted on a flat surface to allow proper ventilation. Do not block the space beneath the Phonecell® SX5 as this could cause the unit to overheat and fail.

Temperature Environment

Operating Temperature: From -10°C to +50°C ; Up to 95% relative humidity (non-condensing).
Storage Temperature: From -40°C to +60°C; Up to 95% relative humidity (non-condensing).

Antenna Care and Replacement

Do not use the Phonecell® SX5 with a damaged antenna. If a damaged antenna comes into contact with the skin, a minor burn may result. Have the antenna replaced by a qualified technician immediately. Use only a manufacturer-approved antenna. Unauthorized antennas, modifications, or attachments could damage the Phonecell® SX5.

Driving

Check the laws and regulations on the use of cellular products in the areas where you drive. Some jurisdictions prohibit use of a cellular device while driving a vehicle. Even if your jurisdiction does not have such a law, we strongly suggest that, for safety reasons, the driver use extreme caution when operating the cellular device while the vehicle is in motion. Always obey the law.

Exposure to electronic Devices

Most modern electronic equipment is shielded from RF energy. However, RF energy from cellular devices may affect inadequately shielded electronic equipment.
RF energy may affect improperly installed or inadequately shielded electronic operating and entertainment systems in motor vehicles. Check with the manufacturer or its representative to determine if these systems are adequately shielded from external RF energy. You should also check with the manufacturer of any equipment that has been added to your vehicle.
Consult the manufacturer of any personal medical devices (such as pacemakers, hearing aids, etc.) to determine if they are adequately shielded from external RF energy.
Turn the Phonecell® SX5 OFF in health care facilities when any regulations posted in the areas instruct you to do so. Hospitals or health care facilities may be using equipment that could be sensitive to external RF energy.

Aircraft

Turn OFF the Phonecell® SX5 before boarding any aircraft.

- Use it on the ground only with crew permission.
- Do not use it in the air.

To prevent possible interference with aircraft systems, U.S. Federal Aviation Administration (FAA) regulations require you to have permission from a crew member to use your cellular phone (or any other cellular product) while the plane is on the ground. To prevent interference with aircraft systems, FCC regulations prohibit using your cellular device while the plane is in the air.

Children

Do not allow children to play with the Phonecell® SX5 to prevent damage to the unit.

Blasting Areas

Construction crews often use remote control RF devices to set off explosives. Therefore, to avoid interfering with blasting operations, turn the Phonecell® SX5 OFF when in a "blasting area" or in areas posted: "Turn off two-way radio."

Potentially Explosive Atmospheres

Turn the Phonecell® SX5 OFF when in any area with a potentially explosive atmosphere. It is rare, but the Phonecell® SX5 or its accessories could generate sparks. Sparks in such areas could cause an explosion or fire resulting in bodily injury or even death.

Areas with a potentially explosive atmosphere are often, but not always, clearly marked. They include fueling areas such as gas stations; below deck on boats; fuel or chemical transfer or storage facilities; areas where the air contains chemicals or particles, such as grain dust, or metal

powders; and any other area where you would normally be advised to turn off your vehicle engine.

Do not transport or store flammable gas, liquid or explosives in the area of the Phonecell® SX5 or accessories.

Vehicles using liquefied petroleum gas (such as propane or butane) must comply with the National Fire Protection Standard (FPA-58). For a copy of this standard, contact the National Fire Protection Association, One Batterymarch Park, Quincy, MA 02269, Attn: Publications Sales Division.

WARRANTY

I. WHAT THIS WARRANTY COVERS AND FOR HOW LONG:

TELULAR CORPORATION ("Telular") warrants to a distributor Buyer, or to a customer only if the customer is a Buyer directly from Telular, that the Products (including accessories) shall comply with the applicable Specifications and shall be free from defects in material and workmanship under normal use and service for a period of fifteen (15) months from date of shipment from Telular. Telular, at its option, shall at no charge either repair, replace or refund the purchase price of the Product during the warranty period, provided it is returned by Buyer in accordance with the terms of this warranty to the Telular designated repair center. Repair or replacement, at Telular's option, may include the replacement of parts, boards or Products with functionally equivalent reconditioned items. Repaired and replacement items are warranted for the balance of the original warranty period. All replaced items shall become the property of Telular. **SUCH ACTION ON THE PART OF TELULAR SHALL BE THE FULL EXTENT OF TELULAR'S LIABILITY HEREUNDER, AND BUYERS EXCLUSIVE REMEDY.** Buyer shall be responsible for all costs and expenses incurred by Buyer including without limitation any handling, labor or transportation charges. **OTHER THAN AFORESAID, THIS EXPRESS WARRANTY IS EXTENDED BY TELULAR TO BUYER ONLY AND NOT TO BUYER'S CUSTOMERS OR USERS OF BUYER'S PRODUCTS.**

II. HOW TO OBTAIN WARRANTY SERVICE

Product covered under this warranty shall only be accepted from and returned to Buyer's designated repair center. Buyer's dealers, distributors, agents, and end users cannot submit items to Telular under this warranty. To receive warranty service an RMA number must first be obtained from Telular Technical Support. The defective or non-compliant Product should be sent by Buyer freight pre-paid to: Telular Corporation, Attn: Telular Repair Depot-RMA# , 1801 S. Fulton Drive , Corinth, MS 38834, USA or other designated location. The product must be packaged in the original carton and packing material or an equivalent package and must have the assigned RMA number clearly marked on the carton. Returned Product received without an RMA number will be returned to the sender.

III. WARRANTY CONDITIONS:

This is the complete warranty for the Products manufactured by Telular and sold to Buyer. Telular assumes no obligation or liability for additions or modifications to this warranty unless made in writing and signed by an officer of Telular. Unless made in separate written agreement between Telular and Buyer, Telular does not warrant the installation, field maintenance or service of the Products or parts.

TELULAR CANNOT BE RESPONSIBLE IN ANY WAY FOR ANY ANCILLARY EQUIPMENT NOT FURNISHED BY TELULAR WHICH IS ATTACHED TO OR USED IN CONNECTION WITH THE PRODUCTS OR FOR OPERATION OF THE PRODUCTS WITH ANY ANCILLARY EQUIPMENT AND ALL SUCH EQUIPMENT IS EXPRESSLY EXCLUDED FROM THIS WARRANTY. FURTHERMORE, TELULAR CANNOT BE RESPONSIBLE FOR ANY DAMAGE TO THE PRODUCTS RESULTING FROM THE USE OF ANCILLARY EQUIPMENT NOT FURNISHED BY TELULAR FOR USE WITH THE PRODUCTS.

WHEN THE PRODUCT IS USED IN CONJUNCTION WITH ANCILLARY OR PERIPHERAL EQUIPMENT NOT MANUFACTURED BY TELULAR, TELULAR DOES NOT WARRANT THE OPERATION OF THE PRODUCT/PERIPHERAL COMBINATION, AND TELULAR SHALL HONOR NO WARRANTY CLAIM WHERE THE PRODUCT IS USED IN SUCH A COMBINATION AND IT IS DETERMINED BY TELULAR THAT THERE IS NO FAULT WITH THE PRODUCT. TELULAR DISCLAIMS LIABILITY FOR RANGE, COVERAGE, AVAILABILITY, OR OPERATION OF THE CELLULAR SYSTEM WHICH IS PROVIDED BY THE CARRIER.

IV. WHAT THIS WARRANTY DOES NOT COVER:
(a) Subsequent upgrades and enhancements to the Product. (b) Defects, non-compliance or damage resulting from use of the Product in other than its normal and customary manner or environment. (c) Defects, noncompliance or damage from misuse, lightening, accident or neglect. (d) Defects, noncompliance or damage from improper testing, operation, maintenance, installation, adjustment, or any alteration or modification of any kind. (e) Product disassembled or repaired in such a manner as to adversely affect performance or prevent adequate inspection and testing to verify any warranty claim. (f) Product which has had the serial number removed or made illegible. (g) Defects, non-compliance or damage due to spills of food or liquid. (h) All plastic surfaces and all other externally exposed parts that are scratched or damaged due to customer normal use. (i) Costs and expenses, including without limitation handling, labor and transportation, incurred in returning Product for warranty service to Telular's Repair Center. (j) Repair, programming or servicing by someone other than Telular.

V. GENERAL PROVISIONS:
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APPENDIX A:

PC SERIAL PORT SETUP FOR CIRCUIT SWITCHED DIGITAL FAX AND DATA (not for use with GPRS)

Requirements
- GSM account with your network service provider including circuit switched data and fax facility.
- PC/Laptop/ Notebook with RS232 serial port
- Windows 98 or better

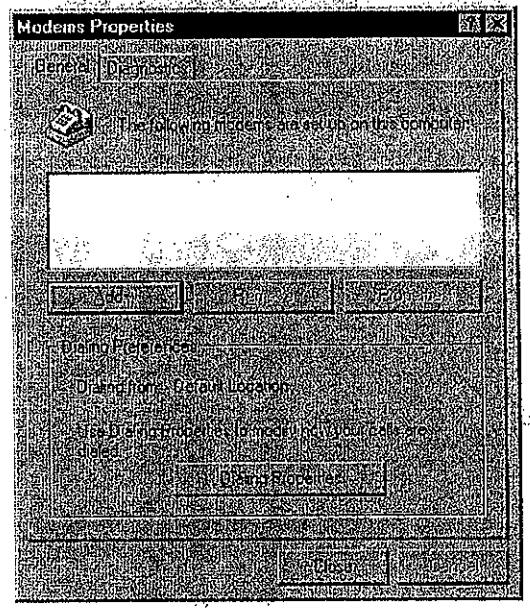
NOTE: When all of the above have been satisfied, you may proceed.

Modem Setup


MODEMS

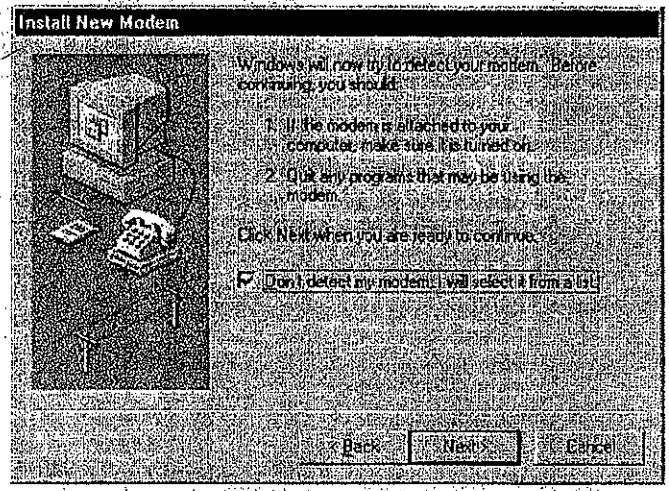
1. Power on your PC or device that is connected to the SX5.
2. Click the "Start" button, select "SETTINGS" and then "CONTROL PANEL". Once the Control Panel window appears double click the MODEMS icon button. The modem properties window will appear.

NOTE: Other modems may appear in the list of installed modems.

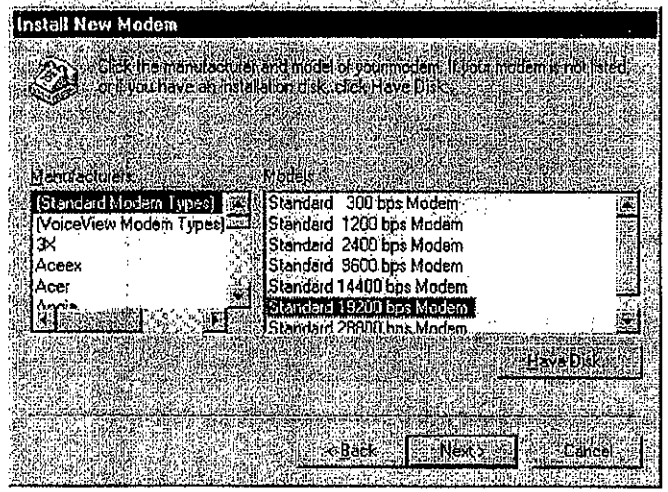


3. Click the ADD button to install a new modem device for the SX5.

4. The Install New Modem window may appear asking for the type of modem to install. Select "Other," then click on the NEXT button. If this window does not appear, go to Step 5.
5. The Install New Modem window will appear. Select the "Don't detect my modem option," then click on the NEXT button.

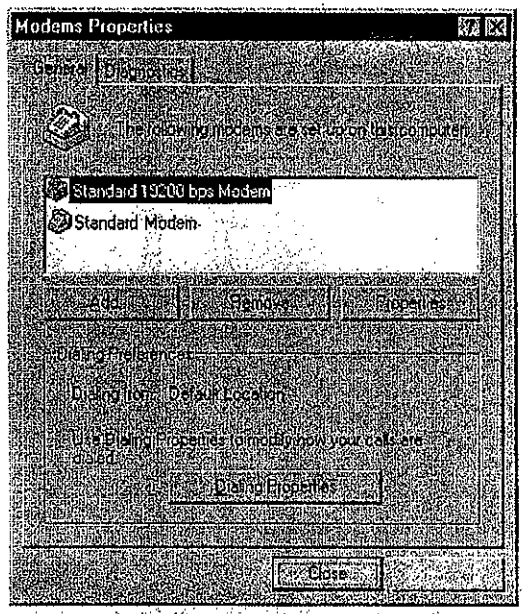


6. The install new modem will update again to select the manufacture and modem model. Select "Standard Modem Types" from the Manufactures list, then select "Standard 19200 bps Modem" from the Models list then click Next.

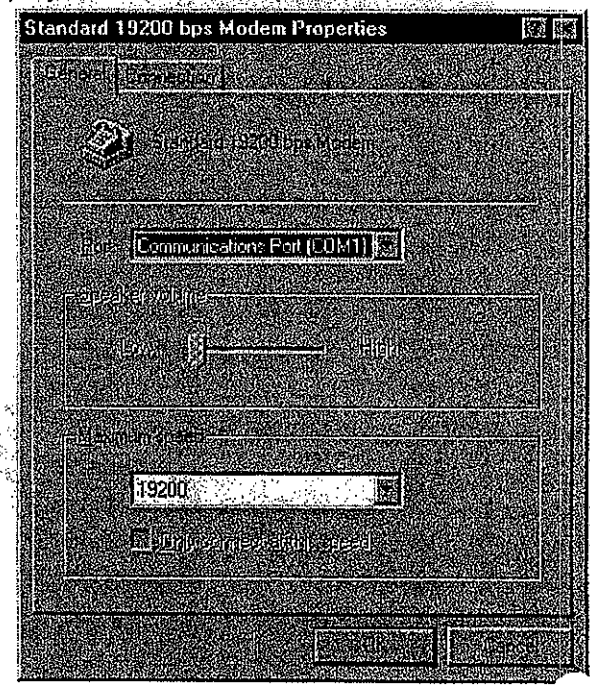


7. The install new modem will update to select the COM port. Select the COM port that will be connected to the SX5e then click Next. Windows will now create a modem configuration file for the Phonecell ® SX5. This may take several minutes.

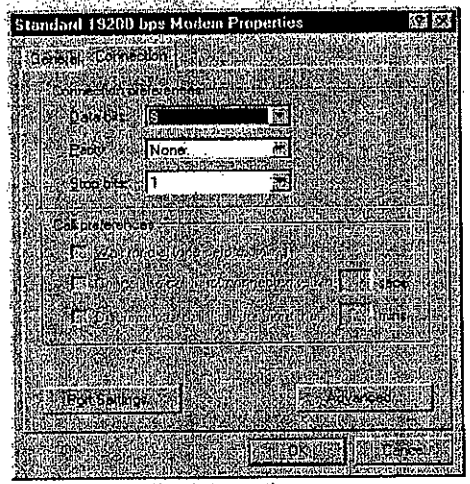
8. The Modems Properties window should appear. Click on the Properties button.



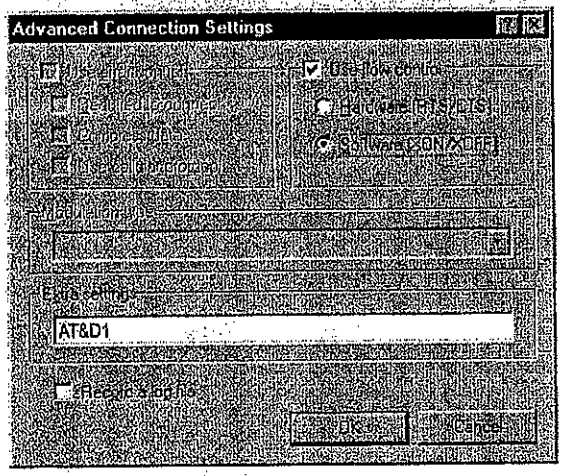
9 The Standard 19200 bps Modem Properties window will open in the General tab. Set as shown with the COM port you have selected.



10. Then click on the Connection tab. Set as shown below.



11. Click on the Advanced button. Set as shown.



12. Click on OK and Close to back out of each window. Your modem is now set up.

NOTE: When using the SX5 for PC fax operation, make sure the modem connection uses software flow control. When using PC data, either hardware or software flow control can be used, as long as the PC application (and modem) match the SX5's configuration. The SX5 defaults to hardware flow control. The following AT commands are used to change the SX5's flow control.

Enable Software Flow Control:	AT+IFC=1,1
Enable Hardware Flow Control:	AT+IFC=2,2
Disable Flow Control:	AT+IFC=0,0

NOTES

E-mail: support@telular.com
http://www.telular.com

Part Number 66023506

Heat Exchanger

Xchanger, Inc.

Heat Exchangers

Installation

Operation

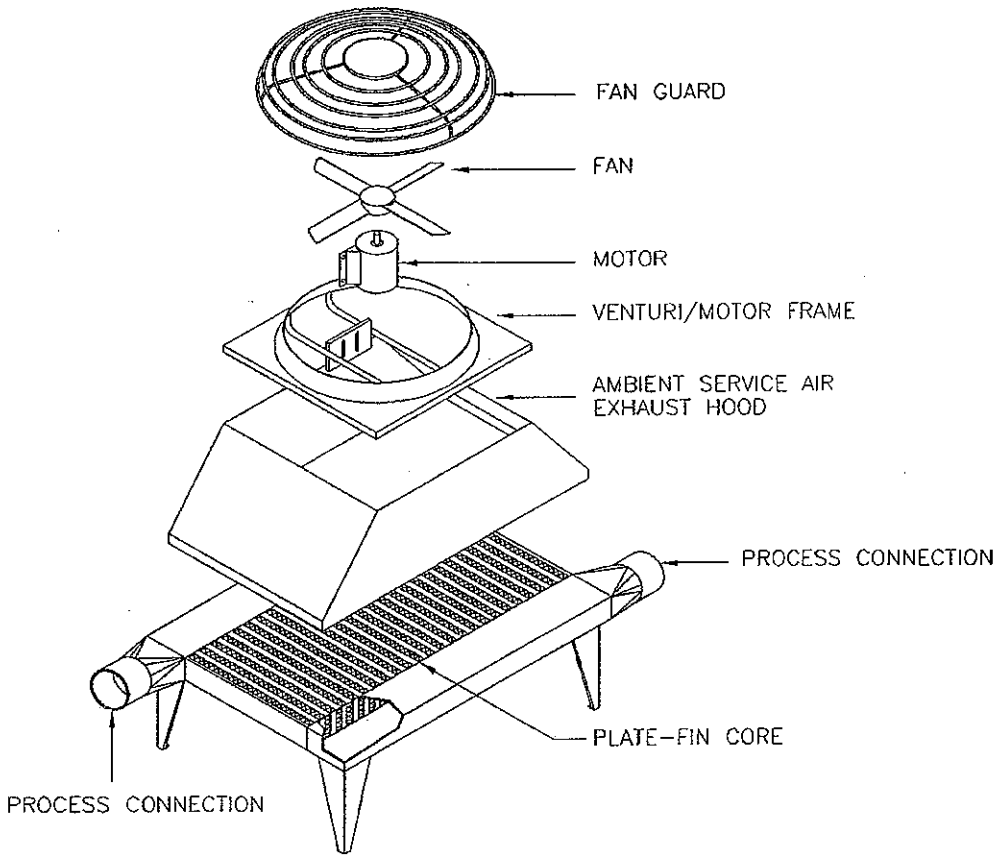
Maintenance

TABLE OF CONTENTS

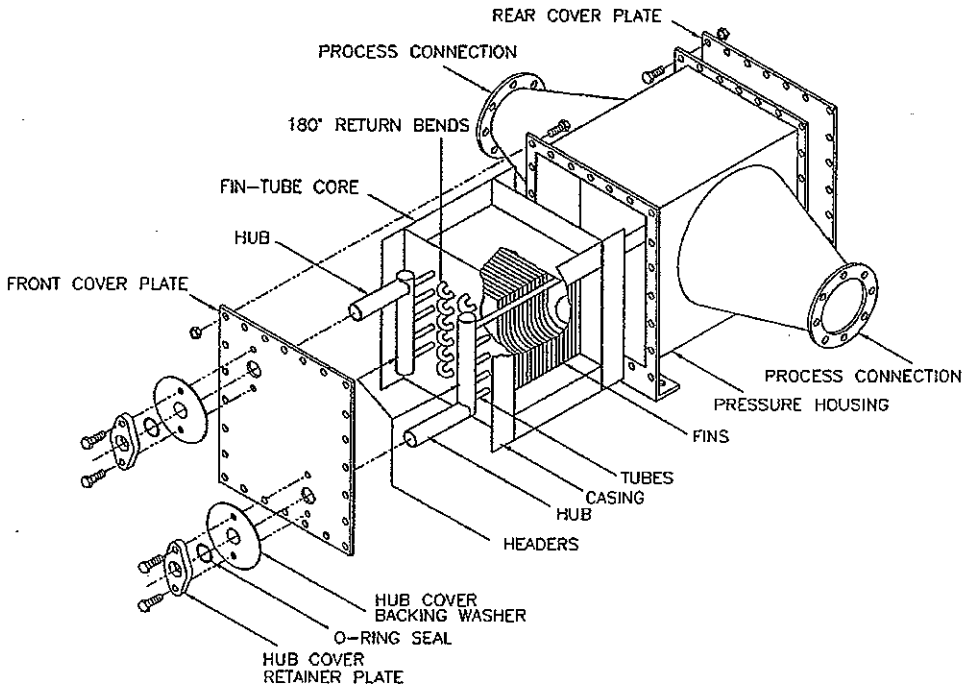
1.0 SCOPE OF THIS MANUAL

This manual describes the appropriate procedures for the use and care of Xchanger, Inc. AA, C, HP, HR, LC, and TV Series heat exchangers. Warranty and service contact information is also included.

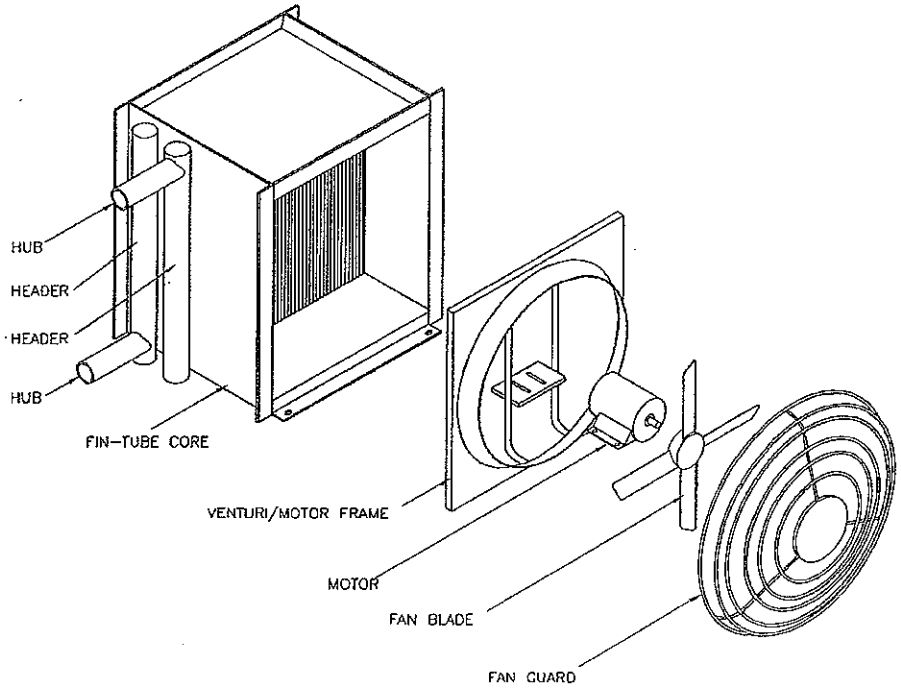
Due to the custom nature of all Xchanger, Inc. heat exchangers, this manual discusses the characteristics and procedures that are common to all exchangers. Unit specific information not included in this manual will be shown on or included with the data sheet and certified drawing that characterize each distinct exchanger design. Information about any accessories provided with an exchanger would also be separate from this manual.



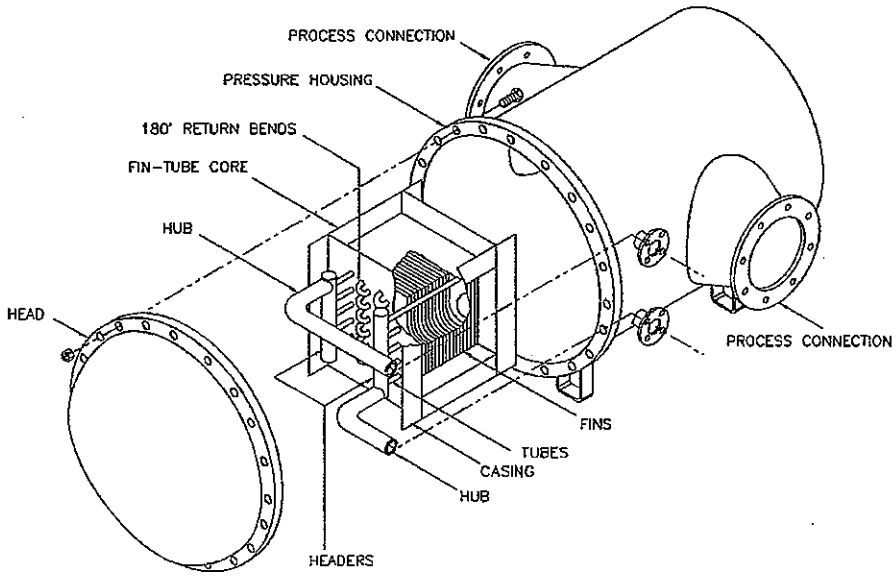
AA Series Heat Exchangers



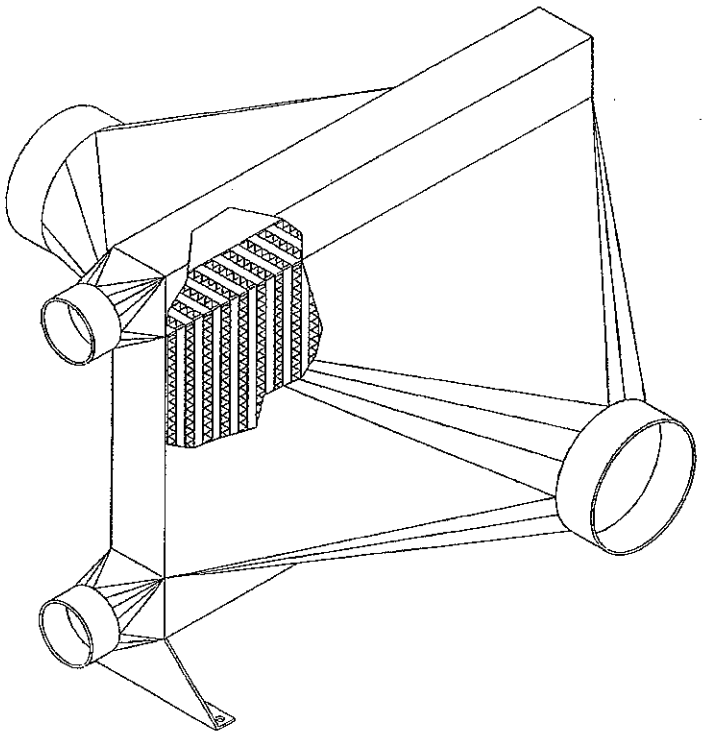
C/TV Series Heat Exchangers



LC Series Heat Exchangers



HP Series Heat Exchangers



HR Series Heat Exchangers

2.0 RECEIVING THE HEAT EXCHANGER

The unit should be examined thoroughly upon receipt. The unit should have no cracks, dents or deformations.

Damage to either the unit or its crating should be immediately noted on the freight receipt. If the shipment was made F.O.B. our factory, damage claims should be filed with the responsible carrier.

Accessories are sometimes shipped loose on the same skid as the exchanger. If so, the Bill of Lading and/or Packing Slip would reflect the loose parts. Check for any accessories before discarding the skid.

2.1 STORAGE

If the unit will not be placed into operation for an extended period of time, it should be left on the shipping skid. Store in a clean, dry, and protected area. All openings should be covered to protect interior surfaces. Unprotected carbon steel should be sprayed with a light coating of a rust inhibitor.

3.0 MOUNTING LOCATION

If the heat exchanger is located at the inlet or discharge of a blower with a pulsating flow, such as a Roots type rotary lobe blower, the heat exchanger must be protected from the pulsation by a chambered silencer.

The heat exchanger must be isolated from system vibrations using flexible piping connections and isolation pads on the mounting feet. Vibration can cause work-hardening, and failure of the heat exchanger.

The process gas stream should be free of particulate. If there is a possibility of particulate passing through the heat exchanger, a filter should be installed upstream of the heat exchanger.

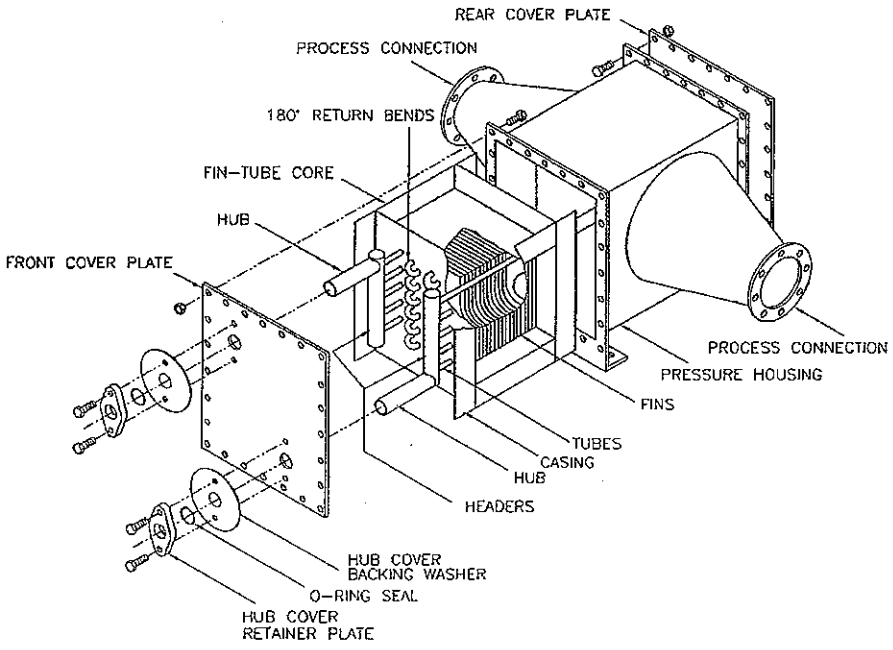
Ample space should be provided on all sides to allow servicing when required.

3.1 C/HP/TV SERIES

To facilitate servicing a unit with a removable core, provide enough clear space to remove the core through the bolted access panel.

For cooling applications where vapors may condense from the gas stream, a proper drain trap arrangement is necessary (see section 4.1.5 titled C/HP/TV SERIES Housing Drain Trap for more information).

The service fluid must not be allowed to freeze or damage to the core will result (see section 6.4 titled FREEZING PROTECTION - C/HP/TV SERIES for more information). Heating of the service fluid beyond its boiling point may also damage the core.



3.2 AA/LC SERIES

The heat exchanger should be mounted in a well ventilated area, preferably outdoors, as these units dissipate heat to the ambient air. If the unit is installed indoors and ducting of the service air is required, a booster fan should be used to convey the air through the duct.

A minimum clearance of 2 feet around the heat exchanger base is essential for proper cooling air flow.

3.3 HR SERIES

If installed in a very warm or very cool location, the ambient conditions could interfere with the intended heat transfer. The effects of the ambient conditions can be minimized by insulating the exchanger after installation.

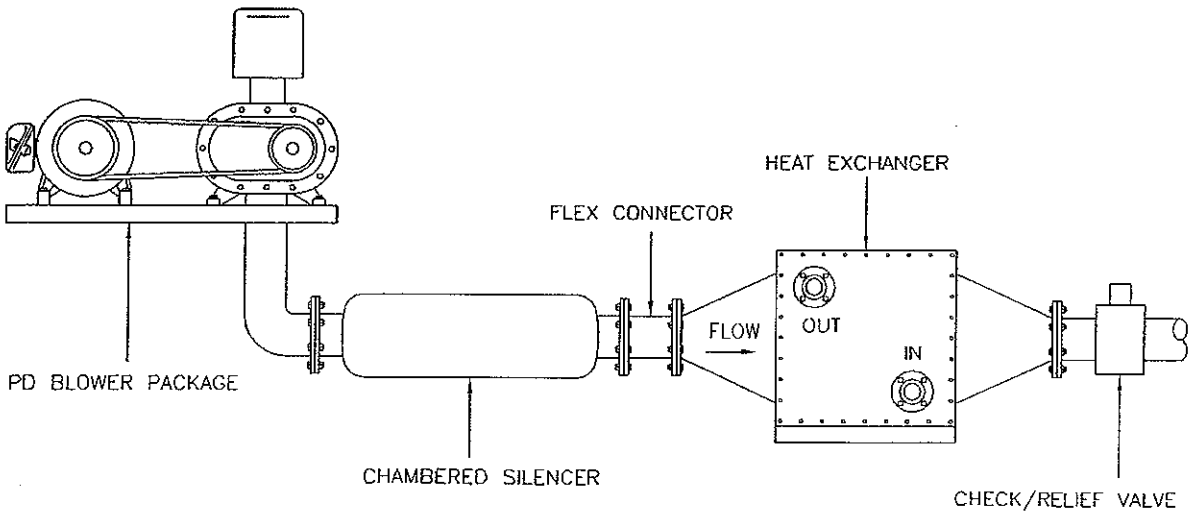
4.0 INSTALLATION

The heat exchanger should be supported and secured by the mounting feet. All piping should be supported independently of the heat exchanger, and any flex connectors present should not add loads or moments to the heat exchanger process connections. Any debris in the piping should be removed before the heat exchanger is installed, as the core of the exchanger could trap any particles, causing reduced performance or damage to the core.

The unit is equipped with labels indicating gas flow direction and service fluid inlets and outlets. Connections must be installed as labeled. The certified drawing also indicates the flow direction, and should be consulted during installation.

If the gas flow through the unit is pulsating and/or vibrations are present in the system piping, a chambered silencer and/or flexible connections should be used. If vibrations may pass through the mounting skid, isolation pads should be used between the skid and the mounting feet of the heat exchanger. Pulsation and/or vibration can cause metal fatigue, and lead to failure of the heat exchanger.

If the heat exchanger is used in a pneumatic conveying system, a check valve should be placed between the air lock and the heat exchanger. This will help to prevent clogging the heat exchanger with the product being conveyed.



4.1 C/HP/TV SERIES

The orientation for which the heat exchanger is designed is noted on the certified drawing. A unit that is designed for horizontal gas flow may not perform to specification if it is installed in a vertical flow orientation.

Attachment to the service connections should be made using industry standard practices. If special valves, controls, traps, etc., are provided by Xchanger, Inc., separate instructions may be attached. If shut off valves are installed on both of the service lines, a pressure relief valve should be installed on the heat exchanger side of one of the shut off valves to prevent over pressurizing the unit. A pressure relief valve similar to a domestic water heater valve is usually adequate.

On standard heat exchangers, there is a 3/4 inch female NPT drain coupling in the bottom of the housing. Condensate that forms on the outside of the fins can be drained though this coupling to a drain leg or trap.

4.1.1 Drainable Tube Circuits

These units should be installed with a slight slope toward the service connection side of the exchanger.

4.1.2 Steam Piping

Proper installation, piping, and trapping is necessary to insure satisfactory operation and prevent damage under normal operating conditions. These installation recommendations must be followed to assure trouble free operation:

- Provide swing joints or flexible fittings in all piping connections adjacent to the heat exchanger. This absorbs the thermal expansion and contraction of the piping.
- Condensate must flow freely from the heat exchanger at all times to prevent physical damage to the core caused by water hammer, unequal thermal stresses, freeze-up, or corrosion.
- Do not pitch the heat exchanger. The mounting position should be level.
- Control each heat exchanger core separately when installing multiple cores.
- Do not modulate systems with overhead or pressurized returns unless the condensate is drained by gravity to a receiver, vented to atmosphere, and returned to the steam main by a condensate pump.
- Pitch all supply and return piping down a minimum of 1 inch per 10 feet in the direction of steam flow.
- Do not drain steam mains or take-offs through the heat exchanger. Drain steam mains ahead of the heat exchanger through a steam trap into the steam return line.

- Do not bush or reduce the steam condensate return piping smaller than the heat exchanger connection. Run return pipe full size to a steam trap (except for a short nipple screwed directly into the condensate connection of the steam trap).

- Overhead steam return lines require 1 PSIG pressure at the steam trap discharge for each 2 feet of elevation to assure continuous condensate removal.

- When an overhead steam return line is installed, provisions should be incorporated into the piping system to allow condensate to drain from the heat exchanger during down time.

- The end of the steam supply main must be trapped.

- A vacuum breaker must be installed if there is any possibility that the heat exchanger will see a vacuum resulting from a fast acting valve operation.

4.1.3 Steam Trap Selection

Proper steam trap selection and installation is necessary for satisfactory heat exchanger performance and service life:

- Select a steam trap based on the maximum possible condensate flow rate along with the recommended load factors.

- Locate the steam trap discharge at least 12 inches below the heat exchanger condensate return connection. This will provide sufficient hydrostatic head pressure to overcome trap losses and assure complete removal of the condensate from the heat exchanger.

- Float and thermostatic type steam traps are preferred because of their gravity drain and continuous discharge operation.

- Use a float and thermostatic type steam trap with gravity condensate return and automatic controls where there is a possibility of a low pressure steam supply.

- Use bucket traps only when steam supply is not modulated and is over 25 PSIG.

- When installed for series airflow, size steam traps for each heat exchanger core using the capacity of the first heat exchanger core (in airflow direction).

- Trap each heat exchanger separately. This will prevent condensate holdup in the heat exchanger cores.

- Install strainers as close as possible to the inlet side of a steam trap.

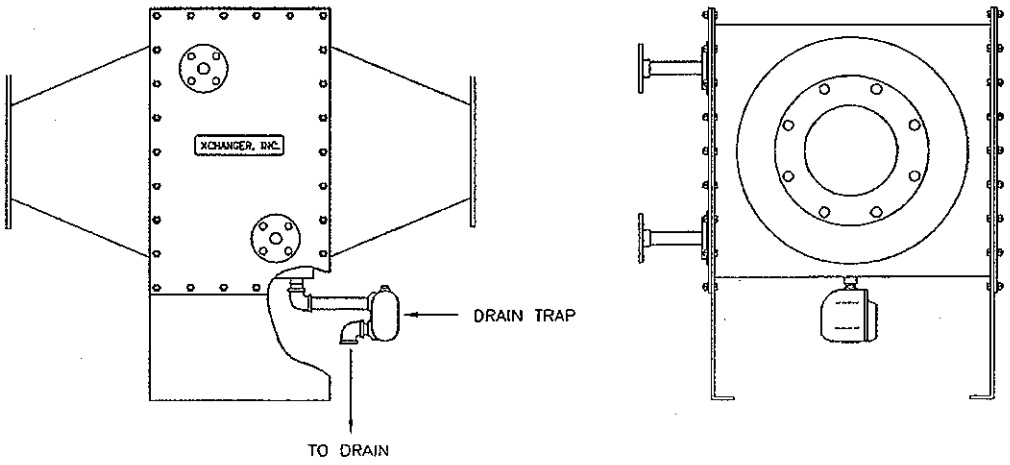
4.1.4 Refrigerant Circuit

Direct expansion refrigerant circuits are shipped open and uncharged. They must be evacuated and charged. If you need assistance, contact a local refrigeration contractor.

4.1.5 Housing Drain Trap

In applications where vapors are expected to condense from a horizontal gas flow, an automatic drain trap should be installed. Approximately 12 inches total clearance under the housing box is required, or 9 inches below the standard mounting feet.

For installations where the gas flow is vertical, any condensed vapors will fall out of the low side transition, due to gravity.



4.2 AA/LC SERIES

The electric motor must be wired on site. On many air cooled heat exchangers, the electrical service must be brought through the exhaust hood. Any holes in the exhaust hood should be sealed to prevent air that has not passed through the core from entering, thereby short-circuiting the core. Refer to the motor name plate for electrical requirements.

5.0 START-UP

After carefully observing all the points listed under Section 4.0 INSTALLATION, the unit is ready for start-up. After the process/service fluids have been directed to the unit, check for leaks.

5.1 C/HP/TV SERIES STEAM HEATERS

Steam should be turned on full for at least ten minutes before the airflow is started to prevent water hammer, freezing, and excessive thermal stresses on the heat exchanger.

5.2 AA/LC SERIES

Before starting the electric fan, the following checklist should be used:

- The propeller hub should be secure on the motor shaft.
- The propeller should rotate freely.
- Electrical wiring should be safely secured.
- The air flow path should be open (i.e. packing material removed).

After starting the motor, verify that the propeller is rotating in the proper direction. The data sheet and certified drawing should state the design flow direction for the ambient air.

6.0 MAINTENANCE

Depending on the model, and your operating environment, the maintenance requirements may vary.

6.1 LUBRICATION

6.1.1 C/HP/HR/TV SERIES

No lubrication is required for the heat exchangers. Accessories may require lubrication, per their manuals.

6.1.2 AA/LC SERIES

Refer to the maintenance instructions provided with the motor(s).

6.2 C/HP/TV SERIES CORE REMOVAL AND INSTALLATION

It may be necessary to occasionally remove the fin-tube core from the housing for inspection or cleaning.

For units with removable cores, the following steps describe the procedure for removing the fin-tube core from the heat exchanger housing. Units which are all-welded will need to be returned to the factory for service. [See page 2 & 3 for reference to terminology.]

6.2.1 C/TV SERIES Core Removal

1. Disconnect service fluid and remove any connections from the service hubs (i.e. sweat on bronze flanges, screwed on threaded flanges, etc.). If the core and cover are welded together, the flanges do not need to be removed, as the cover will remain with the core.
2. Remove the bolts securing the hub plate assemblies to the front cover.
3. Remove the hub plate assembly (hub plate, O-ring, and backing washer). Some prying with a screwdriver or similar tool may be required to break the bond of the sealant.
4. Remove the bolts securing the front and rear housing covers to the housing.
5. Remove the front and rear covers. Some prying with a screwdriver or similar tool may be required to break the bond of the sealant.
6. Remove the bolts securing the core to the housing. Check both sides.
7. Remove the core from the housing by pulling evenly on the headers or the casing and/or pushing evenly on the 180° tube return bends on the back side of the core. Take care not to damage the headers or return bends.

6.2.2 HP SERIES Core Removal

1. Remove the flange bolts around the removable dished head cover.
2. Disconnect the core connections from the internal service connections.
3. Remove the bolts holding the core to the side of the housing.
4. Remove the core from the housing.

6.2.3 C/HP/TV SERIES Core Installation

Install the core in the reverse order of removal, noting the following:

1. Slide the core into the housing and attach the casing to the side of the housing.

   For replacement cores, the holes in the casing which hold the core against the side of the housing may not match the holes on the original core. If not, new holes will need to be drilled as follows:

   a. Slide the core into the housing such that the core face is centered in the transition opening.
   b. Mark the locations of the housing holes on the casing.
   c. Remove the core and drill the holes where marked. When drilling the holes, place a wooden block behind the casing to prevent damage to the core's tubing.
   d. Reinstall the core into the housing.

2. For HP Series exchangers, the internal service connections will need to be reattached.

3. Clean the sealing surfaces on the covers and housing flanges with solvent to remove any oils or residue.

4. Apply new gasket material to the housing flange. Refer to the data sheet supplied at the time of purchase for proper gasket material selection.

5. Install covers, cover bolts-washers-nuts and for C/TV Series exchanger, the hub cover assemblies. To facilitate installing the hub cover assemblies, do not tighten the cover bolts until after the hub cover assemblies are installed. All bolts should be finger tight at this point.

   For C/TV Series replacement cores, the hub locations may not be identical to those of the original core. To check for proper alignment, install the front cover with the four corner bolts. Slide on the hub cover assemblies to check for alignment over the hubs of the replacement core. If the hub and cover bolt holes do not match, new holes must be drilled and tapped into the cover. The hub covers may be rotated such that the old air holes will not interfere with the new holes. Fill in the old holes to prevent gas leakage.

6. Tighten the front and, if applicable, rear cover bolts.

7. Tighten the hub cover assembly bolts.

6.3 CLEANING

Xchanger, Inc. heat exchangers perform best when clean. It is recommended that they be prevented from becoming fouled since their design is such that once plugged or coated, it may not be possible to fully clean them. The sections below offer suggestions, where applicable, if cleaning is attempted.

6.3.1 AA/HR SERIES Internal Gas Passages

The internal process gas passages in these heat exchangers are not cleanable. Filtered air is absolutely required for these units. If plugging does occur, core replacement is recommended.

6.3.2 AA/HR/LC SERIES Service Gas Passages

For dirt/dust contamination, a soap and water wash is usually adequate to clean the service side of these units. If not, the use of an appropriate solvent or compressed air is recommended. Pressure washers can damage the fins, and should not be used.

6.3.3 C/HP/TV SERIES Gas Passages

These heat exchangers may require disassembly for cleaning. See Section 6.2 for disassembly instructions. Once access is obtained, the cleaning options described in Section 6.3.2 can be used.

6.3.4 C/HP/LC/TV SERIES Fluid Passages

The tube interior can become coated with sediment. This coating will reduce the thermal capacity of the heat exchanger. To try to restore a fouled heat exchanger to the original capacity, an appropriate solvent or cleaner compatible with the tube material can be circulated through the circuit to clean the tube interior.

6.4 FREEZING PROTECTION - C/HP/LC/TV SERIES

6.4.1 Drainable Circuits

If the heat exchanger is equipped with a drainable tube circuit, the tubes can be drained by simply opening the service and outlet to atmosphere. These units should be installed with a slight slope toward the service connection end to facilitate complete drainage.

6.4.2 Non-trapped Circuits

These tube circuits run horizontally and downward across the exchanger. If the exchanger is installed level, when the service inlet and outlet are opened to atmosphere, the service fluid may drain out of the low connection sufficiently to prevent freezing damage. If the exchanger is installed out of level, some service fluid will hang up in the now trapped points of the core. In this case, antifreeze should be added as discussed below.

6.4.3 Trapped Circuits

These circuits run downward and upward, like the trap under a sink, and therefore are not drainable. Antifreeze should be added as discussed below.

Antifreeze should be added to the core to provide freezing protection, per the following procedure.

1. Open the water inlet and outlet to atmosphere and allow the core to drain as completely as possible.

2. Add antifreeze to the core and circulate the solution through the core for approximately fifteen minutes.

3. Check the concentration for adequate freeze protection for your area. If the concentration is not sufficient, repeat steps 1 & 2 as necessary.

7.0 SPARE PARTS

7.1 C/HP/TV SERIES

Normally, no spare parts are recommended. If a specific exchanger includes special parts or accessories that could be a spare part, or if an accessory itself uses spare parts, they would be noted on the data sheet, certified drawing, or on accompanying documentation.

Please note that the manufacturing and shipping time for replacement cores is often 6 weeks. If this length of downtime would present a significant problem, it may be advisable to stock a spare core.

7.2 AA/LC SERIES

A spare electric motor is recommended.

7.3 HR SERIES

Normally, no spare parts are recommended. Similar to the C/HP/TV Series above, any special parts would be noted on a case by case basis.

8.0 GUARANTEE

8.1 DURATION

The sooner of either:

- 12 months from date of start-up.
- 18 months from date of shipment from Xchanger, Inc.

8.2 TERMS

Xchanger, Inc. will replace or repair any part or parts free of charge, F.O.B. our factory, provided our examination shows the item to be defective by reason of inferior materials or workmanship.

The part or parts must have been used as intended and in accordance with our instructions. No allowance will be made for repairs or alterations made without our written consent.

8.3 EXCLUSIONS

This Guarantee does not cover damages resulting from misuse, neglect, alteration, or accident, specifically including operating at temperatures or pressures in excess of those for which the equipment was specified and furnished.

The liability of Xchanger, Inc. is limited to our option of the repair or replacement at our factory of any part which has been found defective by our examination. Such repair or replacement shall constitute the extent of our obligation. Xchanger, Inc. shall not be liable for any incidental or consequential damages resulting from the resolution of the warranty issue, or otherwise.

Motors, controls and other purchased parts are warranted by their original manufacturers. Such warranties will be carried out in accordance with the usual terms thereof.

9.0 SERVICE

Should assistance in installation, demonstration, or repair of any equipment be required, please contact Xchanger, Inc. at:

Mail: 1401 South 7th Street
Hopkins, MN 55343 USA
Ph: 952-933-2559
Fax: 952-933-5647
E-mail: info@xchanger.com

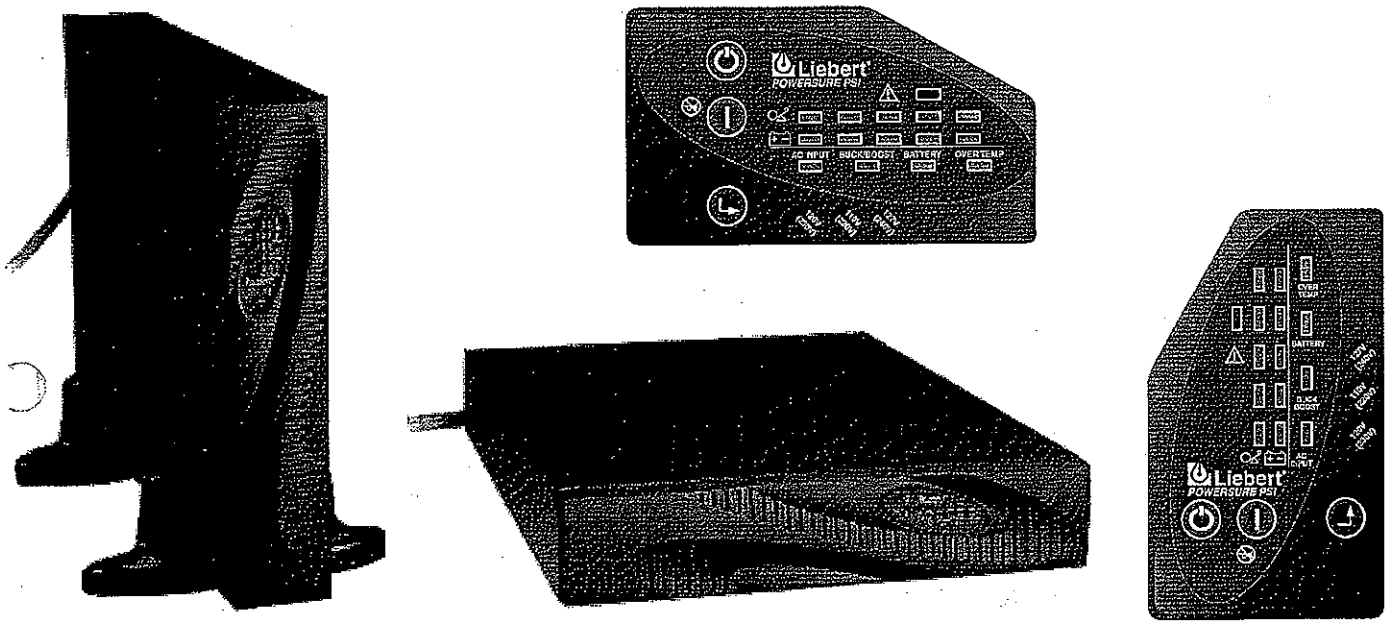
UPS

Power Protection for
Business Critical Continuity

Liebert PowerSure PSI™

User Manual

1000 - 3000VA, 60 Hz, 120V



Liebert.

EMERSON.
Network Power

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FIGURES

TABLES

SAVE THESE INSTRUCTIONS

This manual contains important safety instructions that should be followed during the installation and maintenance of the UPS and batteries. Please read this manual thoroughly before attempting to install or operate this UPS.

⚠ WARNING

SAFETY PRECAUTIONS

To prevent the risk of fire or electric shock, install the UPS in a temperature and humidity controlled room, free of conductive contaminants, moisture, flammable liquids, gases and corrosive substances.

Operate the UPS only from a properly grounded (earthed) 110-127 VAC, 50Hz or 60Hz AC supply.

To reduce the risk of electric shock, do not remove the cover, as it has no user-serviceable parts inside except the internal battery pack. Some components are live, even when AC power is disconnected. For service, contact a qualified technician.

⚠ CAUTION

Although your UPS has been designed and manufactured to ensure personal safety, improper use can result in electrical shock or fire. To ensure safety, please observe the following rules:

- Turn Off and unplug your UPS before cleaning. Do not use liquid or aerosol cleaners. A dry cloth is recommended to remove dust from the surface of your UPS.
- Do not install or operate your UPS in or near water.
- Do not place UPS on an unstable cart, stand or table.
- Do not place UPS under direct sunlight or close to heat emitting sources.
- Never block or insert any objects into the ventilation holes or other openings of the UPS. Keep all vents free of dust accumulation that could restrict air flow.
- Do not place UPS power cord in any area where it may get damaged by heavy objects.

⚠ WARNING

If your UPS demonstrates any of the following conditions, turn Off and unplug your UPS from the outlet and contact your local dealer, Liebert representative or Liebert Worldwide Support Group:

- The power cord or plug is damaged.
- Liquid has been spilled on the UPS.
- The circuit protector trips frequently.
- The UPS does not operate in accordance with the user manual.

CONDITIONS OF USE: The input receptacle must be within 10 feet (3 meters) of the UPS.

Your UPS provides conditioned power to connected equipment. Maximum load must not exceed that shown on UPS rating label. If uncertain, consult your local dealer, Liebert representative or the Liebert Worldwide Support Group.

Placing magnetic storage media on top of the UPS may result in data corruption.

The equipment can be installed and operated by individuals without previous training.

⚠ CAUTION

DO NOT CONNECT equipment that could overload the UPS or demand half-wave rectification from the UPS, for example: electric drills, vacuum cleaners, laserjet/inkjet printers, hair dryers, overhead projectors.

CAUTION

BATTERY HANDLING PRECAUTIONS

Servicing of batteries should be performed or supervised by personnel knowledgeable of batteries and required precautions. Keep unauthorized personnel away from the batteries.

A battery can present a risk of electrical shock and high short-circuit current. The following precautions should be observed when working on batteries:

- Remove watches, rings, and other metal objects.
- Use tools with insulated handles.
- Do not dispose battery or batteries in a fire. The battery may explode.
- Do not open or mutilate the battery or batteries. Released electrolyte is harmful to skin and eyes. It may be toxic.
- When replacing the battery, use same number and type of battery as the suitable recommended type of battery listed in specification table in back of this manual.
- Handle, transport and recycle batteries in accordance with local regulations.

NOTE

This device complies with part 15 of the FCC Rules. Operation is subject to the following two conditions: (1) This device may not cause harmful interference, and (2) this device must accept any interference received, including interference that may cause undesired operation.

This equipment uses, generates and can radiate radio frequency energy and, if not installed and used in accordance with the instructions, may cause harmful interference with radio communications. However, there is no guarantee that interference will not occur in a particular installation. If this equipment does cause harmful interference to radio or television reception, which can be determined by turning the equipment Off and On, the user is encouraged to try to correct the interference by one or more of the following measures:

- *Reorient or relocate the receiving antenna.*
- *Increase the separation between the UPS and the receiver.*
- *Connect the UPS into an outlet on a circuit different from the one on which the receiver is connected.*

1.0 GLOSSARY OF SYMBOLS

Risk of electrical shock

Indicates caution followed by important instructions

Requests the user to consult the manual

Indicates the unit contains a valve-regulated lead acid battery

Recycle

DC voltage

Equipment grounding conductor

Bonded to ground

AC voltage

ON/Alarm Silence/Battery Test

OFF

Voltage Programming Button

2.0 INTRODUCTION

Congratulations on your choice of the Liebert PowerSure™ PSI Uninterruptible Power Supply (UPS). It provides conditioned power to microcomputers and other sensitive electronic equipment.

Upon generation, AC power is clean and stable. However, during transmission it may be subject to voltage sags, spikes, or complete power failure which may interrupt computer operations, cause data loss, or even damage equipment. The PowerSure PSI protects equipment from these disturbances.

The PowerSure PSI comes in nominal power ratings of 1000, 1440, 1920, 2200 and 3000 VA. Refer to the **Specifications** section for details.

The PowerSure PSI is a 2U, line-interactive UPS that may be installed in a rack or used in a tower configuration. A line-interactive UPS continuously conditions and regulates its output voltage, whether utility power is present or not. It supplies connected equipment with clean, sinewave power to simulate the power generated by the utility. Sensitive electronic equipment operates best from sinewave power.

For ease of use, the PowerSure PSI contains Status Indicators to display Load Level, Battery Level, Buck/Boost, Over Temperature and Battery. It also provides self-diagnostic tests, a combination ON/Alarm Silence/Battery Test button, an OFF button and Voltage Programming button.

The PowerSure PSI has USB, DB-9 (RS232/contact closure) and Intellislot interface ports for communications between the UPS and a LAN server or other computer systems. The DB-9 port provides detailed operating information including voltages, currents, and alarm status to the host system when used in conjunction with Liebert's MultiLink™ software. MultiLink software can also remotely control UPS operation. The USB port provides detailed operating information and alarm status to the host system when used in conjunction with the Liebert Human Interface Device (HID) and Microsoft Power Manager software.

Figure 1 Front view of UPS

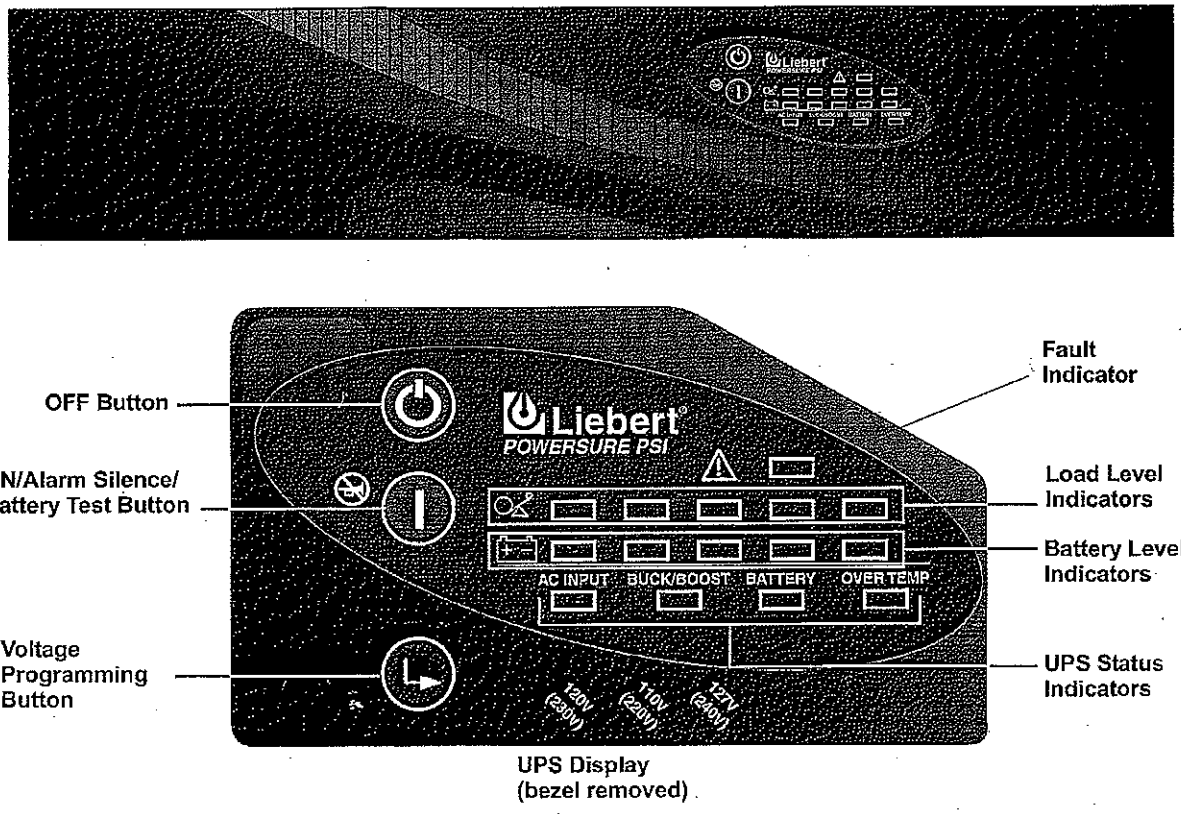


Figure 2 1000 and 1440VA PSI—rear view

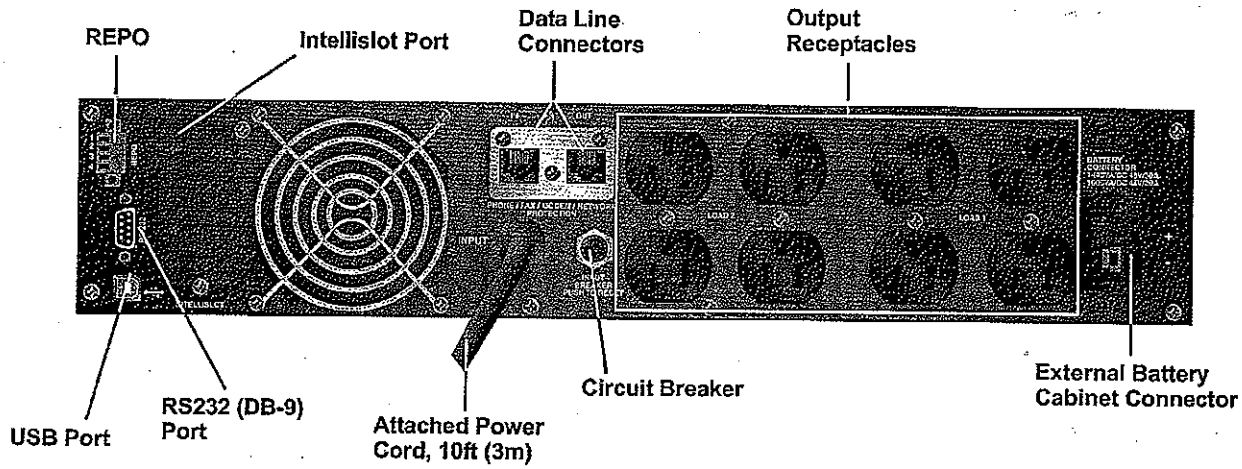


Figure 3 1920 and 2200VA PSI—rear view

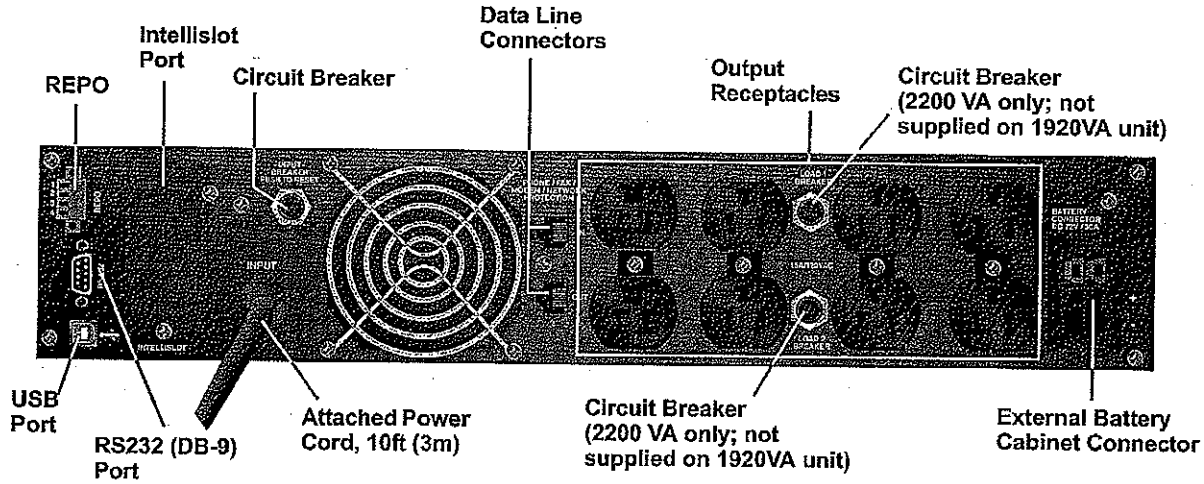
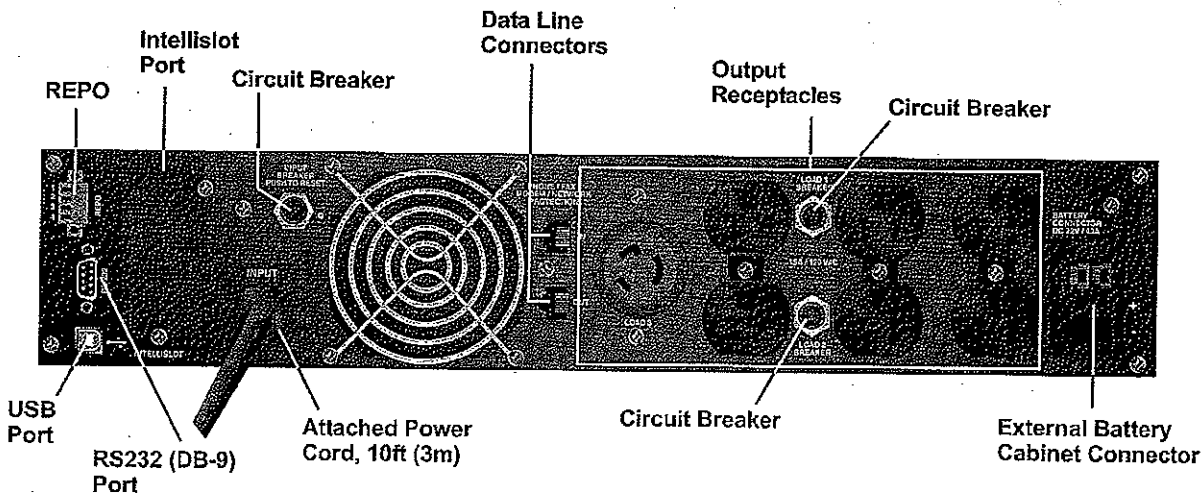


Figure 4 3000VA PSI—rear view



3.0 MAJOR COMPONENTS

Figure 5 Line diagram of PowerSure PSI 1000VA & 1440VA

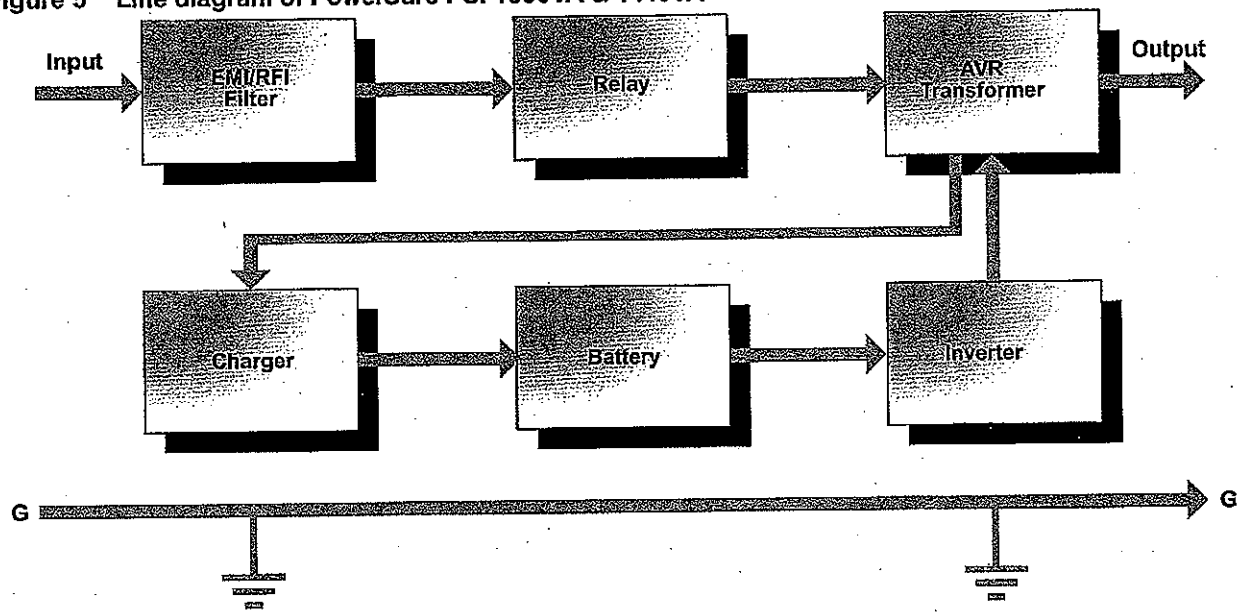
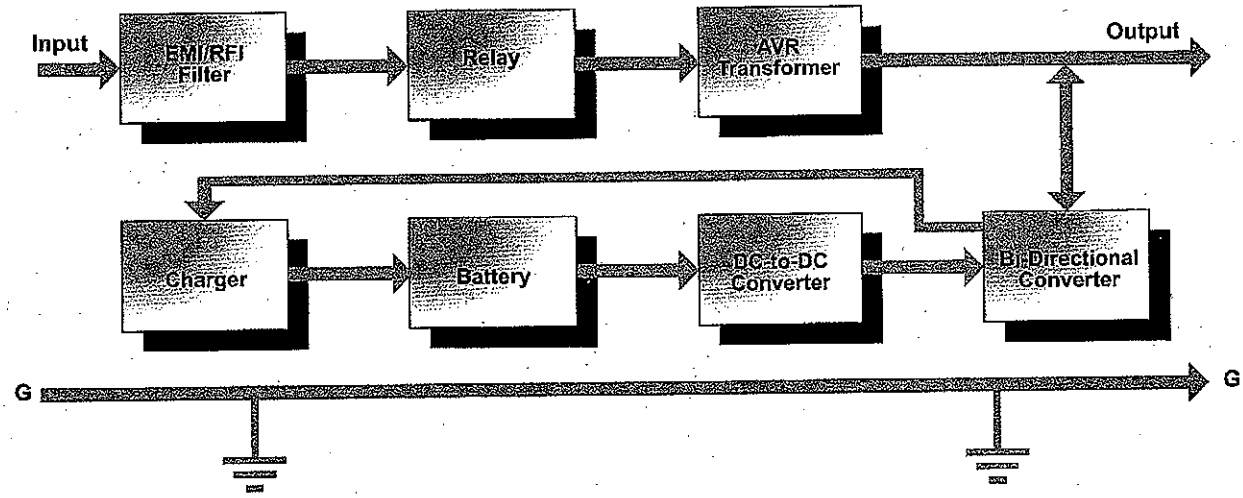


Figure 6 Line diagram of PowerSure PSI 1920VA, 2200VA & 3000VA



3.1 Transient Voltage Surge Suppression (TVSS) and EMI/RFI Filters

These UPS components provide surge protection and filter both electromagnetic interference (EMI) and radio frequency interference (RFI). They minimize surges or interference present in the utility line and keep the sensitive equipment protected.

3.2 Relay

In Normal mode the Relay passes utility AC power to the connected load. When input utility voltage or frequency is outside acceptable limits, the Relay activates and transfers the UPS to battery.

3.3 Automatic Voltage Regulator

The Automatic Voltage Regulator (AVR) protects connected equipment from power spikes, sags and other abnormalities by raising (boosting) or lowering (bucking) the output voltage as needed. This keeps the UPS output voltage within the connected equipment's tolerance and accommodates wide utility voltage fluctuations without utilizing the batteries.

3.4 Battery Charger

In Normal mode, the Battery Charger converts utility AC power into regulated DC power to float charge the battery. It is continuously charging the battery whenever the UPS is plugged into a power outlet and utility power is within acceptable limits - even if the UPS is turned Off.

3.5 Battery

The PowerSure PSI utilizes valve-regulated, nonspillable, lead acid batteries. To maintain battery design life, operate the UPS in an ambient temperature of 68°F to 77°F (20°C to 25°C). Optional external battery cabinets are available to extend battery run times.

3.6 Inverter—1000/1440 Models Only

In battery mode operation, the inverter utilizes the DC output of the battery and inverts it into precise, regulated, sinewave AC power.

3.7 DC-to-DC Converter—1920/2200/3000 Models Only

The DC-to-DC Converter utilizes energy from the battery system and raises the DC voltage to the optimum operating voltage for the Bi-Directional Converter. This allows the Bi-Directional Converter to operate continuously at its optimum efficiency and voltage, thus increasing reliability.

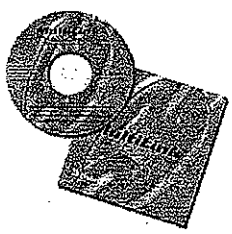
3.8 Bi-Directional Converter—1920/2200/3000 Models Only

In normal operation, the Bi-Directional Converter changes utility AC power into regulated DC power to "float charge" the battery system. This converter is continuously charging the battery whenever the UPS is plugged into a power outlet and utility power is within acceptable limits—even if the UPS is turned Off. When utility power fails, the Bi-Directional Converter draws energy from the battery through the DC-to-DC Converter and inverts it into a regulated sinewave supplying power to connected equipment.

4.0 WHAT'S INCLUDED

The PowerSure PSI is shipped with the following items:

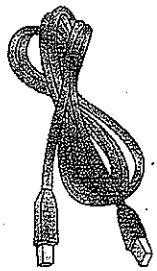
- PowerSure PSI user manual
- Warranty card
- MultiLink software CD
- MultiLink serial cable, 10 ft (3m)
- USB cable, 6 ft (1.8m)
- RJ-11 cord, 7 ft (2.1m)
- Rack mount handles
- Support base
- Fixed rails
- Mounting hardware (screws/washers)
- Front bezel
- Vertical display overlay



MultiLink software CD

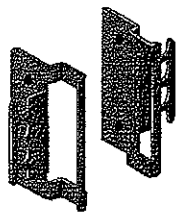
Vertical display overlay

MultiLink serial cable 10 ft (3m)

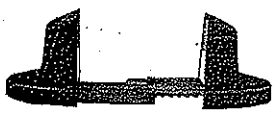


USB cable 6 ft (1.8m)

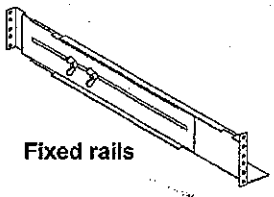
RJ-11 cord 7 ft (2.1m)



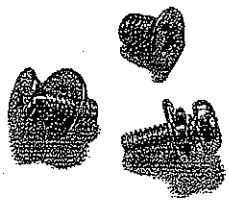
Rack mount handles



Support base



Fixed rails



Mounting hardware (screws & washers)

Front bezel

5.0 INSTALLATION

5.1 Preparation

1. Visually inspect the UPS for freight damage. Report damage to the carrier and your local dealer or Liebert representative.

⚠ CAUTION

The UPS is heavy (see **Table 4 - Battery cabinet specifications**). Take proper precautions when lifting or moving it.

2. Decide where to place the PowerSure PSI. Install the UPS indoors in a controlled environment where it cannot be accidentally turned Off. Place it in an area of unrestricted airflow around the unit, away from water, flammable liquids, gases, corrosives, and conductive contaminants. Maintain a minimum clearance of 4 inches (100mm) in the front and rear of the UPS. Maintain an ambient temperature range of 32°F to 104°F (0°C to 40°C).

NOTE

UPS operation in temperatures above 77°F (25°C) reduces battery life.

3. The PowerSure PSI may be installed in either a tower configuration or in a rack, depending on available space and use considerations. Determine the type of installation and follow the appropriate instructions in either **Tower UPS Installation** or **Rack-Mount UPS Conversion and Installation.**

5.2 Tower UPS Installation

When using the PowerSure PSI in a tower configuration, use the included support base (shown below, left) to stabilize the UPS. If two or more battery cabinets are added, the spacers—included with the battery cabinets—should be used to accommodate the additional cabinets.

Figure 7 Support base for tower configuration

Tower Stand - Fully Extended
Spacers Can be Added to Accommodate External Battery Cabinets

Connectors Snap into Slots on Base

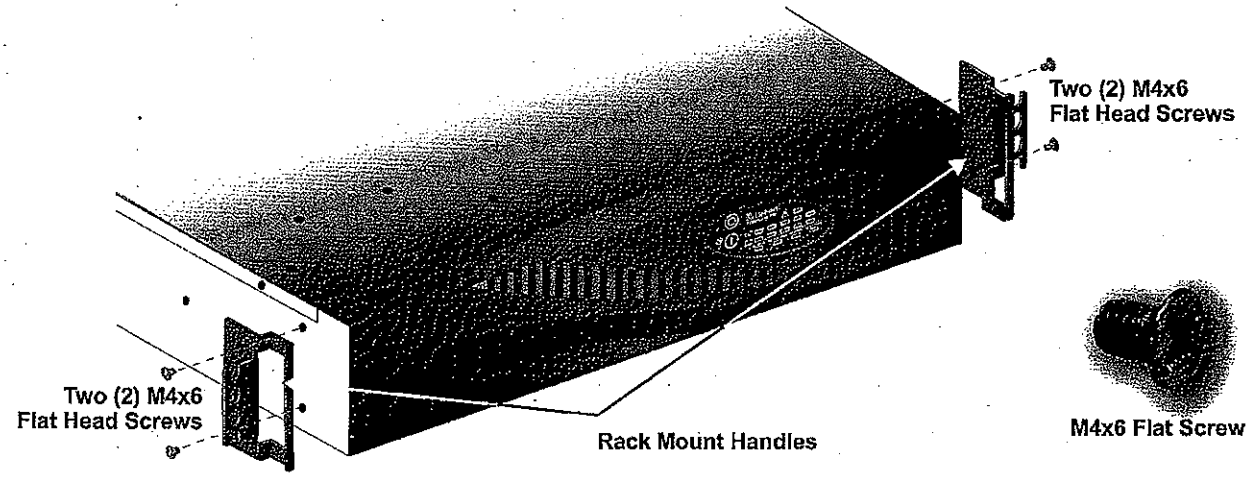
1. To orient the display for vertical viewing, remove the front plastic bezel by pulling forward evenly on both sides.
2. Peel the backing from the vertical display overlay and apply to the existing display.
3. Snap the front bezel back into place.

5.3 Rack-Mount UPS Conversion and Installation

NOTE
When rack mounted, the UPS must be supported by a shelf, slide rails, brackets or fixed rails on each side. The rack mount handles WILL NOT support the weight of the UPS. They are used to move the UPS into and out of the rack.

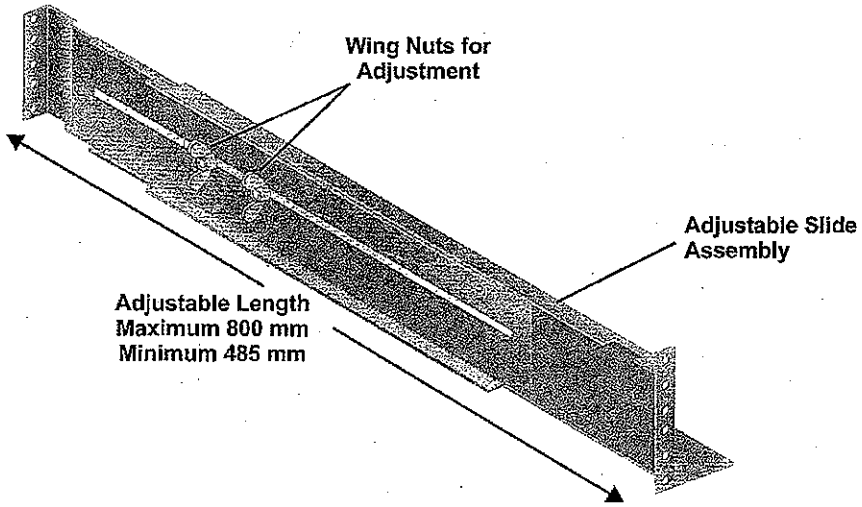
1. For fixed rail installations, install the rack mount handles using four (4) M4x6 screws (see **Figure 8**).

Figure 8 Rack mount handles



2. Unpack the two fixed rail assemblies and mounting hardware. Loosen the wing nuts and extend the inner members to their outermost position (see **Figure 9**).

Figure 9 Fixed rails with inner members extended

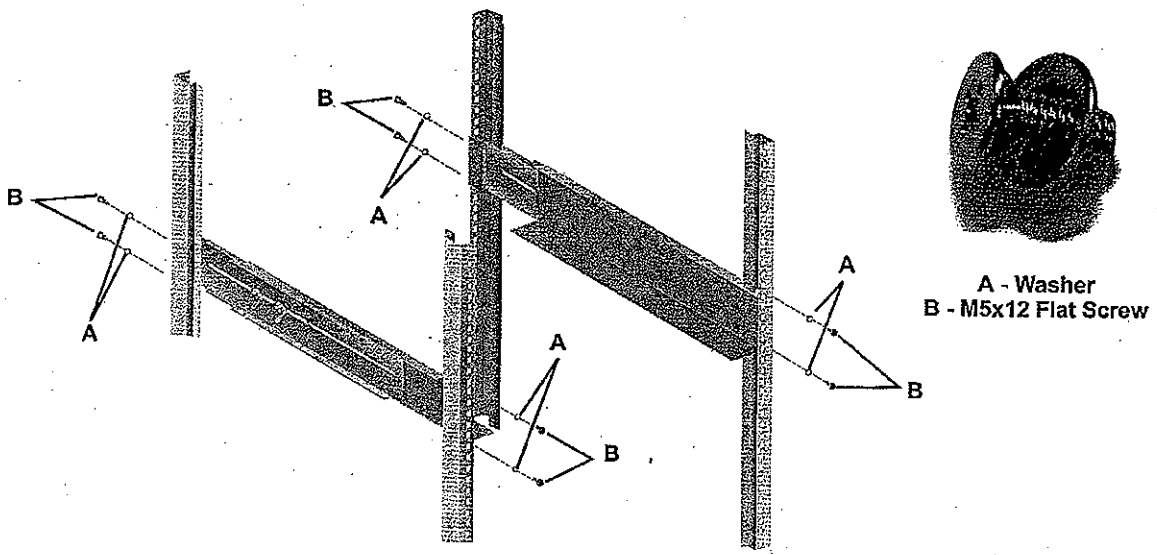


CAUTION
Reduce the risk of tipping the rack enclosure by placing the UPS or battery cabinet in the lowest possible rack position.

3. Determine the height position inside the rack enclosure where you want to mount the UPS or battery cabinet. Make sure fixed rails are at the same mounting height on each of the four (4) rack mounting rails.

4. Attach the two (2) fixed rails to the racks mounting rails. The fixed rail assemblies fit on the inside of the rack mounting rails.
5. Insert two (2) M5 flat head screws loosely (finger-tight) into the top and bottom holes on the front of the fixed rail assembly (see **Figure 10**).
6. Extend fixed rail by sliding inner member backward until it touches the rear rack mounting rail.
7. Insert two (2) M5 screws loosely (finger-tight) into top and bottom holes on the rear of the fixed rail assembly.
8. Check alignment of fixed rails and tighten all screws to ensure locking action.

Figure 10 Rack mounting rails and slide assemblies

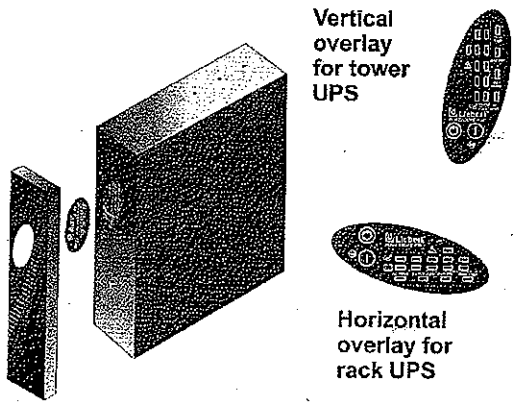


9. Lay the UPS in rack-mounting position on the fixed rails. The UPS should move smoothly forward and backward on the fixed rails. If not, recheck alignment.

⚠ CAUTION

Lifting equipment into rack may be a two-person job, depending on weight of equipment.

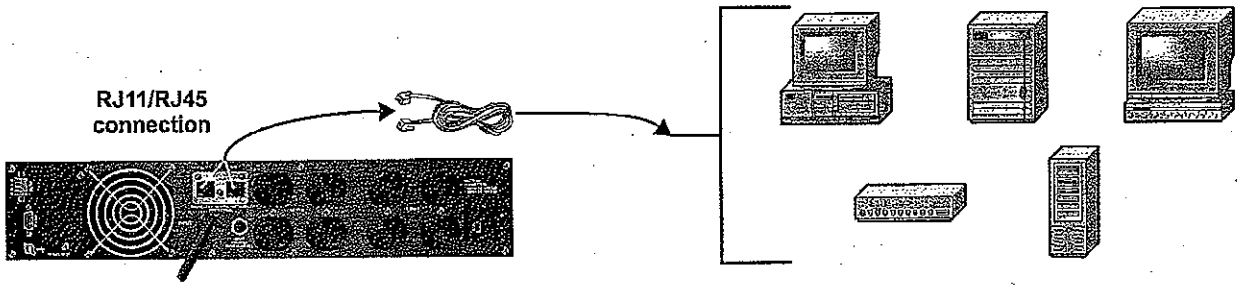
10. Use the extra M5 screws provided, secure front of the UPS to rack mounting rails to prevent the UPS from sliding out of position.
11. Plug the PowerSure PSI's attached 10 ft. (3m) power cord into a dedicated wall receptacle properly protected by a circuit breaker or fuse in accordance with national and local electrical codes. Use a 15A-rated device for the 1000 or 1440 VA units, 20 amp for the 1920VA, 30 amp for the 2200VA or 3000 VA units. The wall receptacle must be grounded.
12. Turn On the UPS by pressing the ON button. Check that the AC Input Indicator is not flashing. If it is flashing, refer to **11.0 - Troubleshooting**. Then turn On the connected equipment. The UPS is now providing conditioned power to your equipment.



⚠ CAUTION

To maintain safety (SELV) barriers and electromagnetic compatibility, signal cables should be segregated and run separately from power cables.

13. Connect Phone/Fax/DSL/Network/Modem devices to data line connectors.



14. Communication options (see **8.0 - Communications** for details):

Option 1 - Serial Communications

Serial communications provides parametric data, for example, input voltage and battery voltage.

a. Connect MultiLink serial cable included with the UPS to communications port.
b. Install the MultiLink software. The software and installation instructions, as well as the user manual, are on the CD included in the PowerSure PSI package.

Option 2 - Contact Closure Communications

Contact Closure communications provides on-battery and low-battery signals for orderly shutdown.

a. Refer to the MultiLink user manual for instructions on making your own contact closure cable.
b. Install the MultiLink software. The software and installation instructions, as well as the user manual, are on the CD included in the PowerSure PSI package.

Option 3 - USB Communications

a. Connect USB cable provided with the UPS to the PSI's USB port and the USB port on your computer. The PSI will work automatically with your built-in power management software on Windows XP and 2000 and Mac OS 10.2 or later (see **8.3 - USB Interface Port** for details).

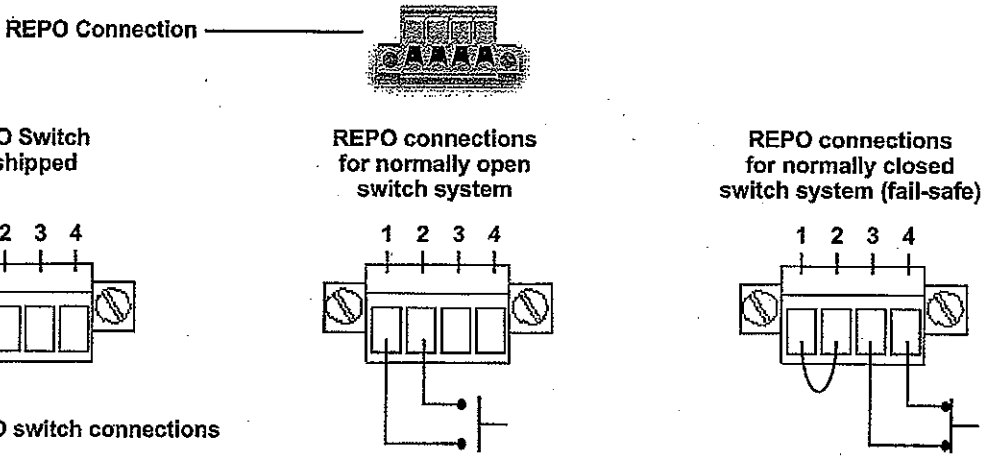
Option 4 – Intellislot

The UPS contains one communication slot, called "Intellislot™," to allow the operator to field install optional communication cards. These optional cards allow the UPS to communicate via either OpenComms Web Card (OCWEBCARD), connected directly to the LAN; or Intellislot Relay Interface card (RELAYCARD-INT) communication card. Once the OCWEBCARD is installed, the Serial communication via the RS232 is disabled. The USB, Intellislot, and Contact Closure communications operate in parallel.

15. REPO Switch—The PowerSure PSI is equipped with a Remote Emergency Power Off (REPO) switch.

The user must supply a means of interfacing with the REPO circuit to allow disconnecting the UPS input feeder breaker to remove all sources of power to the UPS and connected equipment to comply with national and local wiring codes and regulations.

Figure 11 REPO switch connections



Key to REPO switch connections
1. 24 VDC,
2. Sense
3. Sense
4. Ground

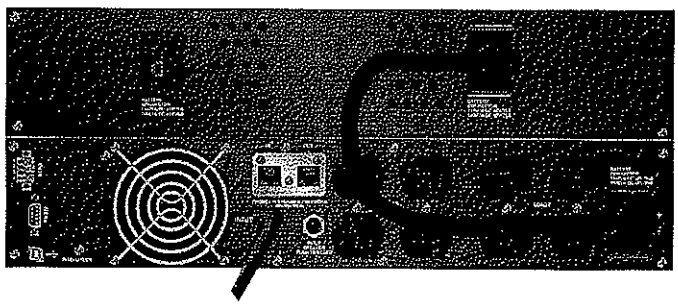
5.4 External Battery Cabinet Installation

Optional Liebert external battery cabinets may be connected to the UPS to provide additional battery run time. External battery cabinets are designed to be placed all on one side of the UPS or stacked beneath the UPS. The run time is limited to a maximum of four (4) hours.

CAUTION

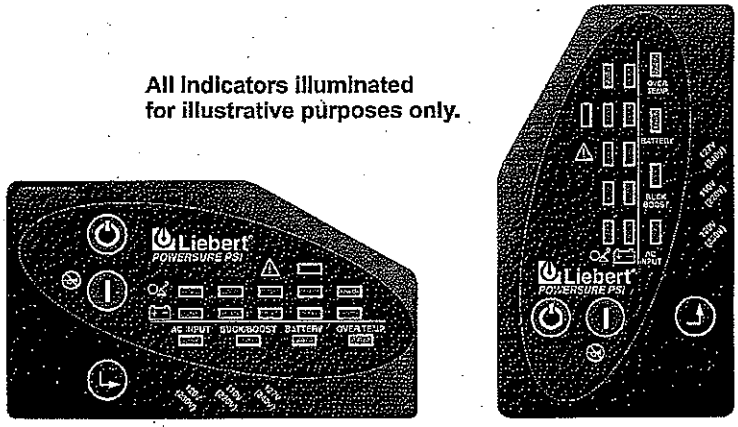
The external battery cabinet(s) are heavy (see **12.0 - Specifications**). External battery cabinets can be used in rack-mount or tower configuration. Take proper precautions when lifting them.

1. Visually inspect the external battery cabinet for freight damage. Report damage to the carrier and your local dealer or Liebert representative.
2. The rack-mount handles are shipped with the external battery cabinet and may be installed at this time (see **5.3 - Rack-Mount UPS Conversion and Installation**).
3. Fixed rails and securing hardware ship with the external battery cabinet. Fasten the fixed rails into position with the screws per the instructions included with the UPS. Repeat **Steps 1** through **10** from **5.3 - Rack-Mount UPS Conversion and Installation.**
4. Use the support bases included with the UPS for the tower option to prevent tip-over. One additional set of support base spacers ships with each external battery cabinet.
5. Connect the supplied external battery cabinet cable to the rear of the external battery cabinet, then to the rear of the UPS, as shown at right.
6. The UPS is now equipped with additional backup battery run time. For approximate battery run times, refer to **Table 5 - Battery run times**.



6.0 CONTROLS AND INDICATORS

All Indicators illuminated
for illustrative purposes only.



6.1 ON/Alarm Silence/Battery Test Button

This button controls output power to connected load(s) and has three functions:

- On
- Alarm Silence
- Battery Test

ON—When the UPS is Off, pressing the ON/Alarm Silence/Battery Test button **for more than one (1) second** will start the UPS, and an audible alarm sounds briefly. The UPS is capable of starting on battery (battery start).

Alarm Silence—When a UPS audible alarm is active, pressing and releasing the ON/Alarm Silence/Battery Test button will silence the active audible alarm, whether utility power is present or not. Once the alarm silence function has been activated, all active audible alarms will remain silenced until a new alarm condition is detected.

NOTE
The LOW BATTERY, OVER TEMP and OVERLOAD warning audible alarms CANNOT be silenced.

Battery Test—To initiate a manual battery test, press the ON/Alarm Silence/Battery Test button for at least one second while operating from utility power with no alarm conditions present.

- If all five (5) Battery indicators are not illuminated, allow the UPS to recharge the batteries for 24 hours.
- After 24 hours, retest the batteries.
- After the batteries have been retested, if all five (5) Battery indicators are not illuminated, contact your local dealer, Liebert representative or Liebert Worldwide Support Group.

6.2 OFF Button

When the UPS is on (in either Normal or Battery mode), pressing the OFF button **for more than one (1) second** will shut down the UPS. An audible alarm sounds briefly.

6.3 Voltage Programming Button

The PowerSure PSI contains a Voltage Programming button that allows the operator to select the nominal utility voltage. This setting changes the utility transfer points (low and high) of the UPS and the nominal output voltage when operating in Battery mode. The operator can select between 110, 120 and 127 VAC output. The factory-default setting is 120 VAC.

The Voltage Programming button is a push button type and is behind the plastic bezel on the front panel of the UPS. To access the button, the front bezel must be removed.

6.4 Load Level Indicators—4 green, 1 amber

The Load Level Indicators display the approximate electrical load placed upon the UPS.

The UPS Load Level Indicators are displayed in 25% increments as shown in **Figure 12**.

Figure 12 Load level indicators—4 green, 1 amber

Upon detection of an output overload condition, the amber overload (>100%) indicator flashes and an audible alarm activates. If the UPS shuts down due to an overload condition, the amber overload (>100%) indicator illuminates (see **Troubleshooting** section for details).

6.5 Battery Level Indicators—5 green

The Battery Level Indicators display the approximate battery capacity.

The approximate battery capacity is displayed when the UPS is operating in Normal, Buck/Boost, or Battery mode.

The Battery Level Indicators are displayed in 20% increments as shown in **Figure 13**:

Figure 13 Battery level indicators—5 green

The PowerSure PSI is equipped with automatic and remote battery test features. The automatic test occurs every 14 days if utility has not been interrupted; this option may be configured by the user. Should the battery fail this test, the amber Battery Indicator will be illuminated and an alarm will sound (see **Troubleshooting** section for details).

The remote test feature functions with MultiLink 3.x software and can remotely initiate the battery test.

6.6 AC Input Indicator—Green

The AC Input Indicator illuminates when utility power is available and within the input specifications. This indicator flashes when the UPS detects a Site Wiring Fault (line-neutral reversal or neutral not grounded properly) (see **Troubleshooting** section for details).

6.7 Buck/Boost Indicator—Green

The Buck/Boost Indicator illuminates when the UPS is operating in Boost mode to compensate for a low utility voltage condition. This indicator flashes when the UPS is operating in Buck mode to compensate for a high utility voltage condition (see **Troubleshooting** section for details).

6.8 Battery Indicator—Green/Amber

The Battery Indicator illuminates green when the UPS is operating on battery and flashes green when a low battery condition occurs. The Battery Indicator illuminates amber when a bad battery is detected, indicating that the batteries need to be replaced (see **Troubleshooting** section for details).

6.9 Over Temp Indicator—Amber

The Over Temp Indicator flashes when the UPS detects an over temperature condition. This indicator illuminates when the UPS shuts down due to an over temperature condition (see **Troubleshooting** section for details).

6.10 Fault Indicator—Red

The Fault Indicator illuminates when the UPS detects an internal problem (see **Troubleshooting** section).

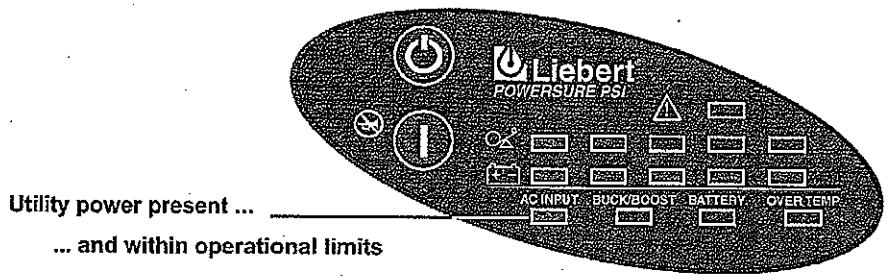
7.0 MODES OF OPERATION

7.1 Normal Mode

During Normal mode operation, the PowerSure PSI supplies conditioned, computer-grade power to the connected equipment: utility power passes through the TVSS circuitry and the EMI/RFI filters and then through the Inverter (1000VA & 1440VA) / Bi-Directional Converter (1920VA, 2200VA and 3000VA) to connected equipment.

When the UPS is in Normal mode, the AC Input Indicator illuminates green. The UPS display in **Figure 14** shows the UPS operating in Normal mode with 26% - 50% load connected to the output.

Figure 14 Normal mode operation with 26-50% load



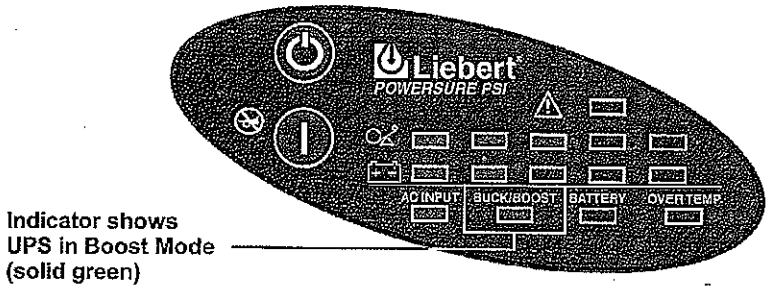
The PowerSure PSI continuously monitors the batteries to maintain them in a fully charged state. The battery charger operates whenever AC power is present, even if the UPS is switched Off. By default, the UPS is set to perform an automatic battery test after it has been operating continuously for two (2) weeks. The automatic battery test can be disabled via MultiLink.

7.2 Buck/Boost Mode

The Automatic Voltage Regulator (AVR) circuitry compensates for fluctuations in utility power, such as voltage surges and sags. When the PowerSure PSI detects an abnormality, it raises the undervoltage (boost) or lowers the overvoltage (buck) as needed. The AVR operates automatically and maintains the output voltage to the connected critical equipment, without utilizing the batteries.

The Buck/Boost Indicator flashes green when the UPS is operating in Buck mode and illuminates green when the UPS is operating in Boost mode (see **Troubleshooting** section for details).

Figure 15 Buck/Boost mode operation with 51-75% load and 21-40% battery capacity

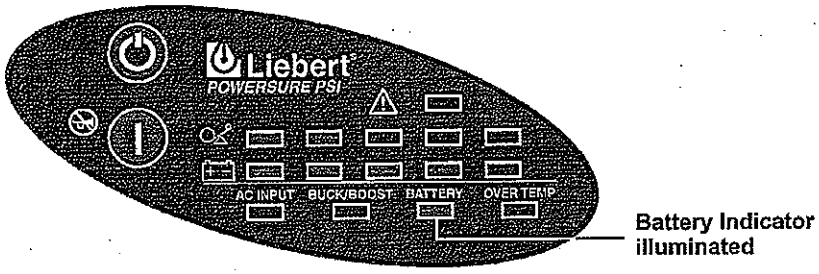


7.3 Battery Mode

The UPS switches to Battery mode in the event of an extreme input voltage/frequency condition or complete utility failure. The battery system supplies power through the Inverter (1000VA & 1440VA) or through the DC-to-DC converter to the Bi-Directional Converter (1920, 2200VA and 3000VA) to generate power for the connected equipment.

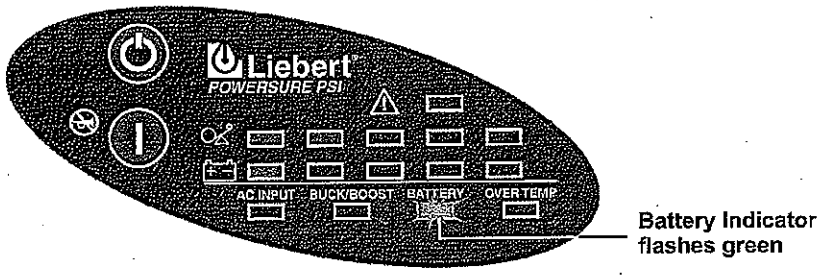
When the UPS is in Battery mode, the Battery Indicator illuminates green and an alarm sounds every 10 seconds. As capacity decreases, fewer indicators remain illuminated. **Figure 16** shows the UPS in Battery mode with 61% - 80% battery capacity remaining.

Figure 16 Battery mode at 61 – 80% battery capacity



When a low battery condition occurs, the Battery Indicator flashes green and the alarm sounds every half-second. The default low battery warning is two (2) minutes but can be configured via MultiLink. For more information, refer to **Troubleshooting** section.

Figure 17 Low Battery mode



For approximate battery run times, refer to **Table 5 - Battery run times.** These run times are approximates based on resistive load and an ambient temperature of 77°F (25°C). To increase this time, turn Off non-essential pieces of equipment, such as idle computers and monitors, or add external battery cabinets.

⚠ CAUTION

Turning Off the UPS while it is in battery mode will result in loss of output power.

7.4 Battery Recharge Operation

Once utility power is restored, the UPS resumes normal operation. At this time, the Battery Charger begins recharging.

8.0 COMMUNICATIONS

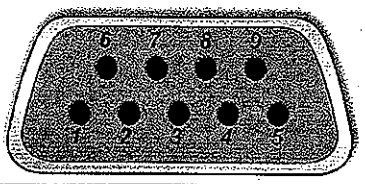
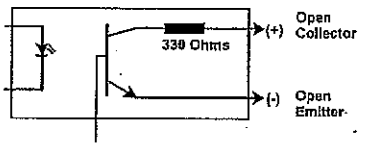
8.1 DB-9 Connector

The UPS has a DB-9 (9 pin female) connector on the rear to allow UPS status communications with a computer system running MultiLink software. The DB-9 is capable of supplying serial communication, on battery and low battery signals. MultiLink, Liebert's UPS monitoring and shutdown software, is shipped with the UPS, along with a 10 ft. (3m) DB-9 cable required for running MultiLink.

When MultiLink is installed on the host computer, the UPS can signal "on battery" and "low battery" using opto-couplers. When the UPS is operating in Battery mode, it can receive a signal from the host computer system that will shut down the UPS (after gracefully shutting down the operating system on the host computer system) when the remaining battery run time is low. The timing of the signal depends on MultiLink's configuration settings. This shutdown signal (5-12VDC) must have a duration of at least 2 seconds for the UPS to be shut down. The UPS communicates via serial communications using Liebert ESP II protocol.

Table 1 DB-9 pin assignment

DB-9 Pin	Assignment Description
1	Low Battery (open collector)
2	UPS TxD
3	UPS RxD
4	Battery Mode Shutdown (5-12V)
5	Common
6	Any Mode Shutdown (short to pin 5)
7	Low Battery (open emitter)
8	Utility Fail (open emitter)
9	Utility Fail (open collector)

Pin Assignment	Collector to Emitter*
	

8.2 Remote Shutdown Via the DB-9 Connector

The PowerSure PSI can be shut down remotely by shorting Pins 5 and 6 or via Pins 4 and 5 of the DB-9 connector.

8.2.1 Any Mode Shutdown—Via Pins 5 & 6

When Pin 6 is shorted to Pin 5, the UPS output is shut Off regardless of what mode the UPS is operating in. The UPS cannot be started as long as the pins are shorted. When the short is removed, the UPS output can be enabled by pressing the ON/Alarm Silence/Battery Test button.

8.2.2 Battery Mode Shutdown—Via Pins 4 & 5

While the UPS is operating on battery (with no battery test in progress), a 5-12VDC signal for 2 seconds or longer is required to signal a shutdown. Signals for less than 2 seconds are ignored.

After Pin 4 receives the shutdown signal, a 2-minute shutdown timer inside the UPS begins a countdown. The timer cannot be stopped. If utility power returns during the 2-minute timer countdown, the shutdown timer continues until the end of 2 minutes and then the UPS turns Off. By default, autorestart is enabled so the UPS will restart after 10 seconds. If autorestart is disabled via MultiLink software, the UPS remains Off until a manual restart.

8.3 USB Interface Port

The PowerSure PSI has a USB interface port for communication that will work with the built-in Microsoft Power Manger software on the user's PC, if so equipped. It will provide UPS status and manages the automatic orderly shutdown of the computer. The UPS's USB communications meet HID standard, version 1.11. All USB models are compatible with Microsoft Windows 2000, Windows XP and Mac OS 10.2 or later. All USB models ship with a 6 ft. (1.8m) USB cable.

8.4 Data Line Protection Connectors

Data line (in and out) connectors are on the rear of the UPS and provide transient voltage surge suppression (TVSS) for Phone/Fax/DSL/Internet/Modem devices.

8.5 UPS Intelligent Communications

The PowerSure PSI is equipped with an Intellislot® port to provide advanced communication and monitoring options.

Liebert's MultiLink software continually monitors the UPS and can shut down your computer or server in the event of an extended power failure.

MultiLink can also be configured for use without the serial cable when the Intellislot OCWEBCARD is installed in the UPS. Additionally, MultiLink can be configured to coordinate shutdown across the network with other computers running MultiLink when you purchase a MultiLink License Kit. For more information about the Intellislot OCWEBCARD and MultiLink License Kits, visit our Web site (www.liebert.com) or contact your local dealer or Liebert representative.

Several option cards are available for use in the Intellislot port of the PowerSure PSI. The Intellislot OCWEBCARD provides SNMP and Web-based monitoring and control of the UPS across the network.

The Intellislot MultiPort 4 Card allows you to install MultiLink software on four computers and coordinate shutdown in the event of a power failure.

The RELAYCARD-INT provides dry contact relay outputs for custom-wired applications and delivers support for built-in shutdown for AS/400 systems.

NOTE

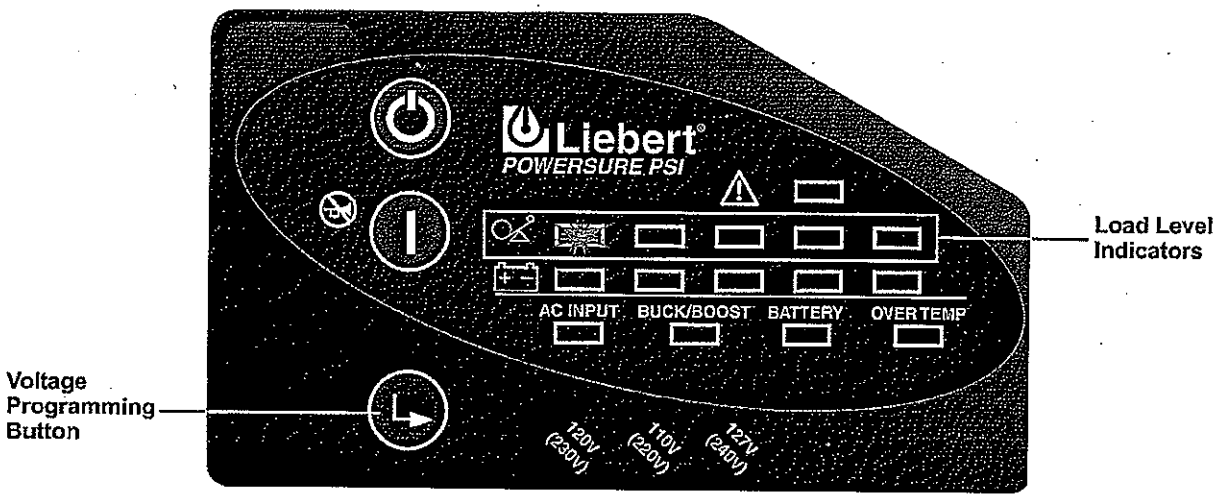
The USB, Intellislot and Contact Closure communications operate in parallel. Using the OCWEBCARD disables the Serial Communications of the DB-9.

CAUTION

To maintain safety (SELV) barriers and for electromagnetic compatibility, signal cables should be segregated and run separate from all other power cables, where applicable.

9.0 VOLTAGE PROGRAMMING PROCEDURE

Figure 18 Load Level Indicators



1. Remove the front bezel from the UPS.
2. UPS must be operating in Normal (AC) mode.

NOTE
Utility power will be applied to the connected load.

3. The AC Input, Load, and Battery Level Indicators should be lit.
4. Press the Voltage Programming button for at least 5 seconds to enter the Configuration mode. The UPS will beep and all of the indicators on the front panel display will flash on and off for about 5 seconds. The next cycle will display the current configuration, either 110, 120 or 127 VAC. One of the Load Level Indicators will be flashing. Initially, the 0%-25% Load Level Indicator will be flashing, indicating the default setting of 120V as shown in **Figure 18**.
5. Press the ON button to step through the voltage settings until the appropriate Load Level Indicator is flashing.
6. Press the Voltage Programming button. The UPS will return to Normal mode operation.

The Voltage Programming button allows the operator to select the utility transfer voltage at which the UPS will switch to battery power. This also changes the inverter voltages. The voltage settings are as follows:

Setting	Input Voltage Range	Output Voltage (Battery Mode)
120V (230V)	85 - 145 VAC (default)	120VAC
110V (220V)	78 - 138 VAC	110VAC
127V (240V)	90 - 150 VAC	127VAC

10.0 MAINTENANCE

The PowerSure PSI UPS requires very little maintenance. Follow these practices to prevent problems.

10.1 Cleaning the UPS

The following will help ensure trouble-free operation for years:

- Vacuum dust from the ventilation intake occasionally.
- Wipe the cover periodically with a dry cloth.

10.2 Maintaining Batteries

The batteries are valve-regulated, nonspillable, lead acid and must be kept charged to retain their design life. The UPS continuously charges the batteries when connected to the utility supply, even while the UPS is switched Off.

When storing the UPS, it is recommended to plug in the UPS for at least 24 hours every four to six months to ensure full recharge of the batteries.

10.3 Battery Replacement

⚠ CAUTION

A battery can present a risk of electrical shock and high short circuit current. The following precautions should be observed before replacing the batteries:

- Remove rings, watches, and other metal objects.
- Use a Phillips (crosshead) screwdriver with insulated grips.
- Do not lay tools or other metal objects on top of the batteries.
- If the battery replacement kit is damaged in any way or shows signs of leakage, contact your local dealer or Liebert representative immediately.
- Do not dispose of batteries in a fire. The batteries may explode.
- Dispose of old batteries according to local codes.

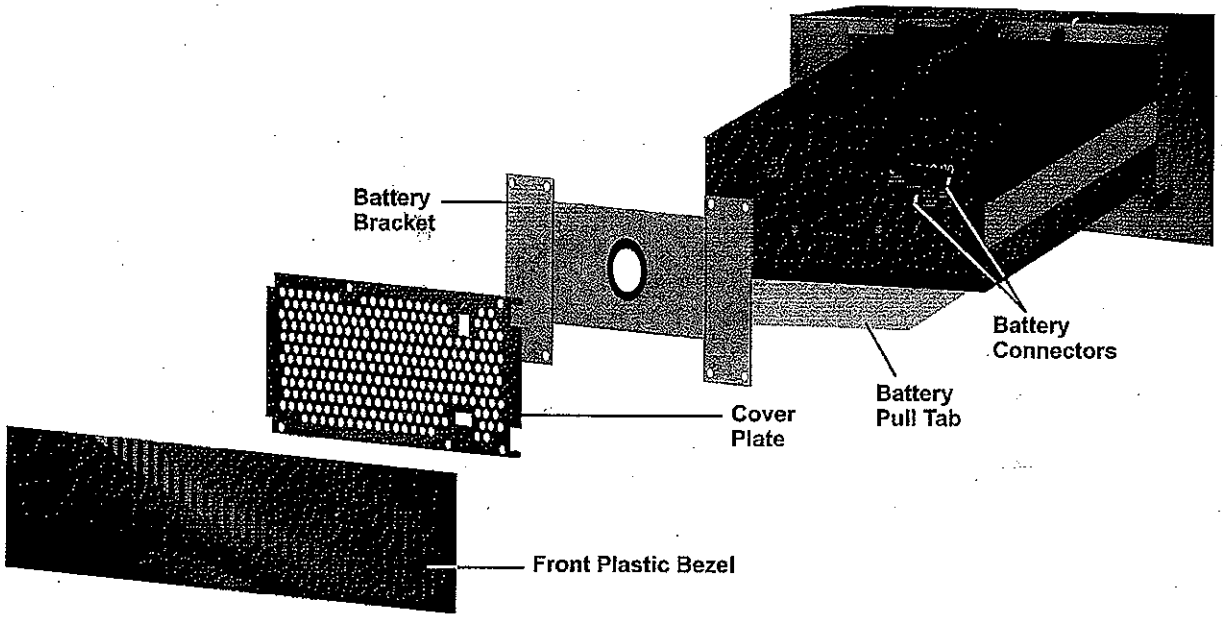
NOTE

This UPS is equipped with internal "hot swappable" batteries that the user can replace without shutting down the UPS or connected loads. Caution should be exercised when replacing the batteries because the load is unprotected from disturbances and power outages during this procedure.

10.3.1 Internal Battery Replacement Procedure

1. Gently remove the front plastic bezel cover from the UPS.
2. Loosen and remove the five (5) screws on the front cover plate. Lay the cover plate aside for reassembly.
3. Loosen and remove four (4) screws on battery bracket.
4. Disconnect the two (2) slotted, red and black battery connectors.
5. Grasp the battery pack assembly by the pull tab and pull it out of the front of the UPS.
6. Unpack the new battery assembly, taking care not to destroy the packing. Compare new and old battery assemblies to make sure they are the same. If so, proceed with **Step 7**; otherwise STOP and contact your local dealer, Liebert representative, or the Liebert Worldwide Support Group.
7. Slide in the new replacement battery pack.
8. Reattach the battery bracket with the four (4) screws.
9. Reconnect the two (2) slotted red and black battery connectors.
10. Reattach the front battery door with the five (5) screws.
11. Reattach the front plastic bezel cover to the UPS.

Figure 19 Battery replacement procedure



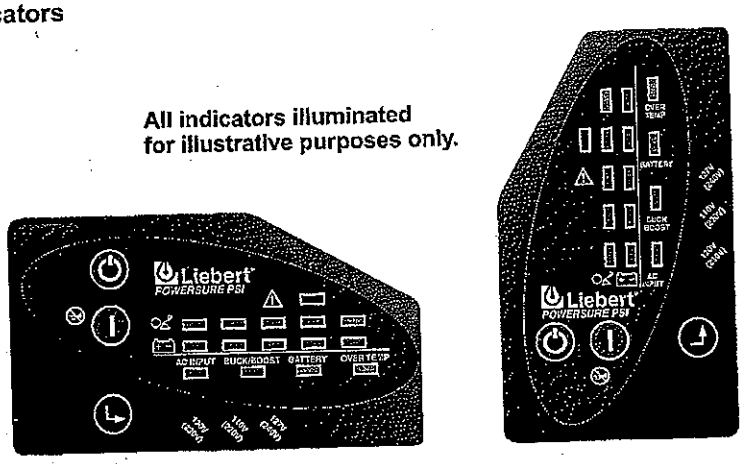
11.0 TROUBLESHOOTING

The information below indicates various symptoms a user may encounter in the event the PowerSure PSI experiences a problem. Use this information to determine whether external factors caused the problem. See **Table 2 - Troubleshooting chart** for suggested remedy.

1. An alarm sounds, alerting that the UPS requires attention. The alarm can be silenced except for low battery, overload warning and over-temperature warning conditions.
2. One or more additional indicators will be illuminated to provide a diagnostic aid to the operator, as described below:

Figure 20 Status indicators

All indicators illuminated for illustrative purposes only.



If the UPS fails to operate properly, turn Off the unit and repeat the steps in **5.0 - Installation**. If the problem persists, refer to **Table 2:**

Table 2 Troubleshooting chart

Problem	Cause	Solution
UPS will not start	Short circuit	Check the circuit protector on the rear of the UPS. If it is tripped, reset it and restart the UPS. For further help, contact your local dealer, Liebert representative or the Liebert Worldwide Support Group.
	Battery disconnected or is completely discharged	Check for proper connection of battery or batteries.
UPS starts on battery, but will not switch to AC	UPS not plugged in	Plug in the power cord securely.
	Circuit protector tripped	Reset the circuit protector and restart the UPS.
	Input voltage below threshold	Wait until the voltage rises to an appropriate level or have the utility power checked by a qualified electrician.
	AC overvoltage	Wait until voltage lowers to an appropriate level or have the utility power checked by a qualified electrician.
UPS shuts down	Load exceeded UPS capacity (110%), All Load Level Indicators are illuminated; continuous beep	Check load level display and remove non-essential loads. Recalculate the load and reduce number of loads connected to UPS - the total wattage of your equipment must not exceed the capacity of the UPS.
	Over temperature shutdown, Over Temp Indicator lit; continuous beep	Make sure that the UPS is operating in 32°F to 104°F (0°C to 40°C) and that it has adequate ventilation.
	MultiLink shutdown	Consult the MultiLink user manual or contact your LAN administrator.
	Internal UPS fault, Fault Indicator Lit; continuous beep	Contact your local dealer, Liebert representative or the Liebert Worldwide Support Group.
	UPS shutdown due to a command from the communications port(s), Load Level 0-25% Indicator illuminated	Your UPS has received a signal or command from the attached computer. If this was inadvertent, ensure the communication cable used is correct for your system. For assistance, contact your local dealer, Liebert representative or the Liebert Worldwide Support Group.
AC Input is flashing	Site Wiring Fault, UPS detected a line-to-neutral reversal or a loss of proper grounding.	Have the utility checked by a qualified electrician.
All Battery Level Indicators flashing	UPS is unable to perform manual or remote battery test; beep every half second for five seconds	Check battery connections, completely power down and restart UPS. NOTE: If the battery circuit opens while the UPS is running, it will be detected when the next battery test is performed.
Battery Indicator illuminated amber; long beep every minute	UPS failed battery test	Initiate battery test again.
	Batteries weak	Recharge batteries.
	Batteries need to be replaced	Replace batteries.
Over Temp Indicator flashing	Over temperature warning; beep every half second	Make sure that the UPS is operating in 32°F to 104°F (0°C to 40°C) and that it has adequate ventilation.
Fault Indicator lit but UPS is On	Fault warning; beep every half second	Reset UPS.

NOTE

The 1920VA UPS will sound an Overload alarm under certain Low Line conditions when it is fully loaded and it exceeds the input current rating. Unless the load is reduced, the condition will trip the branch circuit breaker.

12.0 SPECIFICATIONS

Table 3 UPS specifications

Model Number	PS1000RT2-120	PS1440RT2-120	PS1920RT2-120	PS2200RT2-120	PS3000RT2-120
Power Rating, VA/W	1000VA/750W	1440VA/1080W	1920VA/1500W	2200VA/1650W	3000VA/2250W
Dimensions, W x D x H, in (mm)					
Unit	3.43 x 22 x 17 (87 x 557 x 430)	3.43 x 22 x 17 (87 x 557 x 430)	3.43 x 24.1 x 17 (87 x 612 x 430)	3.43 x 24.1 x 17 (87 x 612 x 430)	3.43 x 24.1 x 17 (87 x 612 x 430)
Shipping	11.8 x 27.8 x 23.5 (300 x 706 x 598)	11.8 x 27.8 x 23.5 (300 x 706 x 598)	13.1 x 34 x 23.5 (333 x 864 x 598)	13.1 x 34 x 23.5 (333 x 864 x 598)	13.1 x 34 x 23.5 (333 x 864 x 598)
Weight, lbs (kg)					
Unit	61.7 (28)	68.2 (31.0)	77.0 (35.0)	77.0 (35.0)	81.6 (37.0)
Shipping	80.7 (36.6)	85.8 (39.0)	95.9 (43.6)	95.9 (43.6)	100.5 (45.6)
Input AC Parameters					
Surge Protection	570J				
Voltage Range Without Battery Operation	78VAC - 150VAC, configurable				
Frequency Range	45 - 65 Hz (±0.1 Hz)				
Input Power Cord (attached)	10 ft. (3m), NEMA 5-15 P	10 ft. (3m), NEMA 5-15 P	10 ft. (3m), NEMA 5-20 P	10 ft. (3m), NEMA L5-30 P	10 ft. (3m), NEMA L5-30 P
Output AC Parameters					
Output Receptacles	(8)NEMA 5-15R	(8)NEMA 5-15R	(6) NEMA 5-15 R (2) NEMA 5-20 R T-Slot, accepts 15APlug	(6) NEMA 5-15 R (2) NEMA 5-20 R T-Slot, accepts 15APlug	(4) NEMA 5-15 R (2) NEMA 5-20 R T-Slot, accepts 15A Plug (1) NEMA L5-30 R
Voltage (Normal mode)	110 / 120 / 127 VAC (configurable) ±10%				
Voltage (Battery Mode)	110 / 120 / 127 VAC (configurable); ±5% before low battery warning; ±8% after low battery warning				
Transfer Time	4-6 ms typical				
Waveform	Sinewave				
Frequency (Normal Mode)	45 - 65 Hz (±0.1 Hz)				
Frequency (Battery Mode)	50 or 60 Hz (±0.5 Hz); auto sensing				
Overload Warning	>100 - 110%				
Overload Shutdown	>200% - short circuit; after 15 cycles (normal mode)				
Battery Parameters					
Type	Valve-regulated, nonspillable, lead acid				
Quantity x Voltage x Rating	4 x 12V x 7Ah	4 x 12V x 7Ah	6 x 12V x 7Ah	6 x 12V x 7Ah	6 x 12V x 9Ah
Backup Time	See **Table 5 - Battery run times**				
Full Load	11	5	6	5	6
Half Load	26	16	19	16	16
Recharge Time	4 hours to 90% of rated capacity, after full discharge into resistive load				
Environmental					
Operating Temperature	+32°F to + 104°F (0°C to + 40°C)				
Storage Temperature	+5°F to + 104°F (-15°C to + 40°C)				
Relative Humidity	0% to 95%, non-condensing				
Operating Altitude	Up to 10,000 ft. (3000m) at 95°F (35°C) without derating				
Audible Noise	<40 dBA, internal fan(s) Off <50 dBA, internal fan(s) On		<40 dBA, internal fan(s) Off <60 dBA, internal fan(s) On		

Table 3 UPS specifications (continued)

Model Number	PS1000RT2-120	PS1440RT2-120	PS1920RT2-120	PS2200RT2-120	PS3000RT2-120
Agency					
Safety	UL 1778, c-UL Listed				
Surge	ANSI C62.41, Category A, Level 3 (IEEE 587, Category A); EN61000-4-5, Level 3, Criteria B				
ESD	EN61000-4-2, Level 3, Criteria B				
Susceptibility	EN61000-4-3, Level 3, Criteria A				
Electrical Fast Transient	EN61000-4-4, Level 4, Criteria A				
Emissions	FCC Part 15, Class B		FCC Part 15, Class A		
Conducted Immunity	EN61000-4-6				
Harmonics	EN61000-3-2				
Flicker	EN61000-3-3				
Transportation	ISTA Procedure 1A Certification				

Table 4 Battery cabinet specifications

Model Number	PS2-48VBATT	PS2-72VBATT
Used w/UPS Model	**PS1000RT2-120 PS1440RT2-120**	**PS1920RT2-120 PS2200RT2-120 PS3000RT2-120**
Dimensions, W x D x H, in (mm)		
Unit	3.43 x 22 x 17 (87 x 557 x 430)	3.43 x 24.1 x 17 (87 x 612 x 430)
Shipping	11.8 x 27.8 x 23.5 (300 x 706 x 598)	13.1 x 34 x 23.5 (333 x 864 x 598)
Weight, lbs (kg)		
Unit	66.1 (30)	101.4 (46)
Shipping	85.1 (38.6)	118.1 (53.6)
Battery Parameter		
Type	Valve-regulated, nonspillable, lead acid	
Quantity x Voltage x Rating	2 strings of 4 x 12V x 7Ah	2 strings of 6 x 12V x 9Ah
Battery Manufacturers	CSB, B&B Battery and EnerSys	
Backup Time	See **Table 5 - Battery run times**	
Environmental		
Operating Temperature	+32°F to + 104°F (0°C to + 40°C)	
Storage Temperature	+5°F to + 104°F (-15°C to + 40°C)	
Relative Humidity	0% to 95%, non-condensing	
Operating Altitude	Up to 10,000 ft. (3000m) at 95°F (35°C) without derating	
Agency		
Safety	UL 1778, c-UL Listed	
Emissions	FCC Part 15, Class B	
Transportation	ISTA Procedure 1A Certification	

Table 5 Battery run times

	Load%	1000VA	1440VA	1920VA	2200VA	3000VA
Internal Battery (minutes)	5%	174	138	181	171	177
	10%	118	79	104	73	91
	20%	65	45	52	47	47
	30%	41	28	31	26	28
	40%	37	24	25	23	22
	50%	26	16	19	16	16
	60%	24	14	15	13	14
	70%	18	10	11	10	10
	80%	16	9	10	8	9
	90%	12	6	8	6	7
	100%	11	5	6	5	6
Internal Battery + 1 External Battery Cabinet (minutes)	5%	513	409	575	542	542
	10%	305	265	294	266	257
	20%	248	188	208	185	148
	30%	177	125	143	135	141
	40%	139	104	123	122	99
	50%	119	72	105	99	67
	60%	98	59	82	75	53
	70%	75	45	59	55	45
	80%	63	40	53	49	39
	90%	53	35	47	44	34
	100%	46	30	43	40	29
Internal Battery + 2 External Battery Cabinets (minutes)	5%	1001	828	—	—	—
	10%	565	461	590	493	444
	20%	409	283	307	291	249
	30%	283	219	243	222	168
	40%	248	177	197	194	148
	50%	209	133	163	150	129
	60%	166	122	141	137	114
	70%	136	98	128	122	92
	80%	127	84	115	107	71
	90%	110	64	102	92	56
	100%	98	56	89	77	52
Internal Battery + 3 External Battery Cabinets (minutes)	5%	1174	1001	—	—	—
	10%	1001	655	—	590	—
	20%	565	409	522	493	300
	30%	409	283	298	283	240
	40%	305	257	267	266	213
	50%	274	209	237	222	168
	60%	248	166	197	185	144
	70%	209	136	166	156	129
	80%	188	125	147	141	116
	90%	145	110	138	131	101
	100%	136	95	128	120	88
Internal Battery + 4 External Battery Cabinets (minutes)	5%	1174	—	—	—	—
	10%	1174	828	—	—	—
	20%	828	565	639	590	444
	30%	513	357	458	395	283
	40%	461	292	322	300	266
	50%	305	257	281	274	222
	60%	283	230	252	240	179
	70%	257	188	220	203	150
	80%	239	156	192	173	139
	90%	209	136	169	156	129
	100%	188	125	150	144	118

NOTE

Approximate discharge times are in minutes and at 77°F (25°C) with resistive load.

12.1 Product Warranty Registration

To register for warranty protection, visit the **Quick Links** section of our Web site at:

www.liebert.com

Click on **Product Warranty Registration** and complete the form.

If you have any questions, please contact us at:

US: (800) 222-5877
Outside the US: (614) 841-6755
E-Mail: upstech@liebert.com

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With over a million installations around the globe, Liebert is the world leader in computer protection systems. Since its founding in 1965, Liebert has developed a complete range of support and protection systems for sensitive electronics:

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SL-23290 (03/06) Rev. 4

Technical Support/Service

Web Site
www.liebert.com

Monitoring
800-222-5877
monitoring@liebert.com
Outside the US: 614-841-6755

Single-Phase UPS
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upstech@liebert.com
Outside the US: 614-841-6755

Three-Phase UPS
800-543-2378
powertech@liebert.com

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800-543-2778

Outside the United States
614-888-0246

Locations

United States
1050 Dearborn Drive
P.O. Box 29186
Columbus, OH 43229

Europe
Via Leonardo Da Vinci 8
Zona Industriale Tognana
35028 Piove Di Sacco (PD) Italy
+39 049 9719 111
Fax: +39 049 5841 257

Asia
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108 Gloucester Road, Wanchai
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Flowmeters

INSTALLATION INSTRUCTIONS for 7200, 7300, 7400, & 7500 Meters

To get the most from the flowmeter you are about to install take time to read the following information before beginning work.

1) Carefully inspect the meter for damage that may have occurred during shipping.
2) Make sure your pressure, temperature, fluid and other requirements are compatible with the meter.
3) Select a suitable location for installation to prevent excess stress on the meter which may result from:
   a) Misaligned pipe.
   b) The weight of related plumbing.
   c) "Water Hammer" which is most likely to occur when flow is suddenly stopped as with quick closing solenoid and operated valves. (If necessary a surge chamber should be installed. This will also be useful in high pressure start-up situations.)
   d) Thermal expansion of liquid in a stagnated or valve isolated system.
   e) Instantaneous pressurization which will stress the meter and could result in tube failure.
   Note: In closed thermal transfer or cooling systems install the meter in the cool side of the line to minimize meter expansion and contraction and possible related fluid leaks.
4) Handle the meter carefully during installation.
   a) Use an appropriate amount of Teflon tape on external pipe threads before making connections. Do not use paste or stick type thread sealing products.
   b) **Extreme caution should be exercised when using PVC solvent cement around Acrylic. Solvents can cause acrylic to stress crack.**
5) Install the meter vertically with the inlet port at the bottom.
6) Meters should be cleaned with a mild soap solution. This will be an effective cleaner of rust stains. Caution must be used so that materials of construction are not damaged by cleaning solutions. Hard water deposits can be removed with a 5% acetic acid solution (vinegar).

CAUTION:

7) Meters are not oxygen cleaned. Use with incompatible fluids will cause O-rings to swell and break tubes. Meters used in gas service should have suitable valves plumbed in at the inlet and outlet of the meter. The valve at the outlet should be used to create back pressure as required to prevent float bounce. The inlet valve should be used for throttling purposes.
8) **Meters with shields must never be operated without shields securely in place. Failure to use safety shields may result in serious injury to personnel and property.**
9) **Meters without case enclosures are designed to operate at 14.7 psia. Meters in pressure service must be sufficiently shielded using 3/8" polycarbonate to protect personnel and equipment in the event of tube failure.**
10) **Pressure and temperature maximums must never be exceeded.**

PRESSURE/TEMPERATURE

Pressure and temperature ratings for 7200, 7400, 7500 models are inversely proportional. 7310 and 7810 models with plastic fittings are inversely proportional, while ratings for 7310 and 7810 Series models with metal fittings are simultaneous.

7200 Series In-Line Acrylic Models

Acrylic Tube/PVC Fittings—Water	PSIG /°F
2" Tube Diameter	150/130
3" Tube Diameter	125/130
Acrylic Tube/Aluminum Fittings—Air	PSIG/°F
2" Tube Diameter	100/100
3" Tube Diameter	100/100

7400 Series Glass Tube Models

PVC Fittings	PVDF Fittings	SS Fittings
PSIG/ °F	PSIG/ °F	PSIG/ °F
130/100	150/150	200/200

7500 Series Acrylic Block Models

Water Service	PSIG/°F
	125/130
Air Service	100/100

7330, 7830 Series Union Ends Models

Tube Size	Polysulfone Tube PVC Fittings	Polysulfone Tube PVDF Fittings
	PSIG/ °F	PSIG/°F
4,5,6	150/130	150/160
9	125/130	125/160

7310, 7810 Series Stainless Case Models

Tube Size	Polysulfone Tube Metal Fittings PSIG/ °F	Polysulfone Tube PVC Fittings PSIG/ °F
4,5,6	200/200	150/130
9	150/200	125/130

NOTE

Pressure and temperature limits are based on a study of the engineering data for particular materials used in construction and on the design of individual models. This information is supplemented by destructive testing results. Maximum pressures suggested are at 70° F. Maximum temperatures suggested are at 0 psig, so pressure and temperature maximums are inversely proportional except for stainless case enclosed meters. Pressure and temperature maximums for these meters are simultaneous. Meters with stainless enclosures must **never** be operated without shields securely in place. Meters exposed to difficult environments such as those created by certain chemicals, excessive vibration or other stress inducing factors could fail at or below the suggested maximums. **Never** operate meters above pressure and temperature maximums. Meter failure could result in damage to equipment and serious personal injury. Always use suitable safety gear including OSHA approved eye protection when working around meters in service. We are happy to pass along chemical compatibility information that has been published by the manufacturers of raw materials used in our products; however, this information should not be construed as a recommendation made by King Instrument Company, Inc. for a specific application. Specifications are subject to change without notice.

KING INSTRUMENT COMPANY
12700 Pala Drive, Garden Grove, CA 92841
Phone (714) 891-0008 Fax (714) 891-0023

KING INSTRUMENT COMPANY
When it comes to flow...we're instrumental.

Correction Formulae & Sizing

Variable area flowmeters suitable for liquid service have a capacity rating based on water at 70° Fahrenheit. Flowmeters suitable for gas service have a capacity rating based on air at STP (70° F and 14.7 PSIA) conditions. The correction factors listed below are used to calculate the flow capacity when using a fluid other than water or a gas other than air at STP conditions.

LIQUID CORRECTION FORMULAE

GAS CORRECTION FORMULAE

LIQUID CORRECTION FORMULAE

Information required to size for conditions other than water:

- Specific Gravity of Fluid (@ Operating Conditions)
- Fluid Temperature (@ Operating Conditions)
- Viscosity (@ Operating Conditions)
- Specific Gravity of float to be used

1. Convert customers flow rate unit of measure to a standard unit of measure. (GPM)

RATE OF FLOW UNIT CONVERSIONS:

GPM (Flowing Liquid)	**CC/MIN (Flowing Liquid)**
= GPH ÷ 60	= GPM X 3785
= CC/MIN ÷ 3,785	= GPH X 63.08
= CC/HR ÷ (3,785 x 60)	= CC/HR ÷ 60
= LPM ÷ 3.785	= LPM X 1,000
=LPH ÷ 227.1	= LPH X 16.67
= M^3/MIN X 264.2	= M^3/MIN X 1,000,000
= M^3/HR X 4.402	= M^3/HR X 16,667
= PINTS/MIN ÷ 8	= PINTS/MIN X 473.1
= FT/MIN X 7.48	= FT^3/MIN X 28,320

=KG/MIN X 0.264 ÷ Specific Gravity	= KG/MIN X 1,000 ÷ Specific Gravity
= KG/HR ÷ (227 X Specific Gravity)	= KG/HR X 16.67 ÷ Specific Gravity
= LBS/MIN ÷ (8.347 X Specific Gravity)	= LBS/MIN X 453.6 ÷ Specific Gravity
= LBS/HR ÷ (500.8 X Specific Gravity)	= LBS/HR X 7.56 ÷ Specific Gravity
= GRAMS/MIN ÷ (3,785 X Specific Gravity)	= GRAMS/MIN ÷ Specific Gravity
= GRAMS/HR ÷ (227,000 X Specific Gravity)	= GRAMS/HR ÷ (60 X Specific Gravity)

Note: *Use Correction Factor formula given above to calculate GPM OR CC/MIN (Water Equivalent)*

2. Calculate variable area correction factor.

CORRECTION FORMULA:

$$\sqrt{\frac{(\text{FLOAT SPECIFIC GRAVITY} - 1.0) \times \text{CUSTOMER FLUID SPECIFIC GRAVITY}}{\text{FLOAT SPECIFIC GRAVITY} - \text{CUSTOMER FLUID SPECIFIC GRAVITY}}}$$

FLOAT DENSITY:

Glass:	2.53	Hastelloy® C-276:	8.94	316L SS:	8.03
Sapphire:	3.989	Titanium:	4.5	316SS:	8.04
Teflon:	2.20	Tantalum:	16.6	Carboloy:	15.0

FLUID DENSITY CONVERSIONS:

Specific Gravity	= LBS/FT ÷ 62.4
	= KG/M³ ÷ 1000
	= G/CM³
	= 141.5 ÷ (131.5 + API)

3. Calculate water equivalent flow rate.

Water Equivalent = Requested Flow Rate X Correction

4. Once a meter is selected, the maximum or minimum flow rate can be calculated for the customers conditions.

Customer Flow = Water Equivalent Flow ÷ Correction Factor

**Our Product Selection Guide available on CD-Rom can automate this process. Please call the factory for details.*

GAS CORRECTION FORMULAE

Information required to size for conditions other than air at STP:

- Operating Temperature
- Operating Back Pressure
- Specific Gravity of Fluid at STP

1. Convert customers flow rate unit of measure to a standard unit of measure. (SCFM)

RATE OF FLOW UNIT CONVERSIONS:

SCFM (Flowing Gas)	**SCC/MIN (Flowing Gas)**
= SCFH ÷ 60	= SCFM X 28,317
= SCIM ÷ 1,728	= SCFH X 472
= SLPM ÷ 28.317	= SCIM X 16.39
= SLPH ÷ 1,699	= SLPM X 1,000
= SM^3/MIN X 35.31	= SLPH X 16.67
= SM^3/HR X 0.5885	= SM^3/MIN X 1,000,000
= NM^3/MIN X 37.99	= SM^3/HR X 16,667
= NM^3/HR X 0.6331	= NM^3/MIN X 1,075,785
= SCC/MIN ÷ 28,317	= NM^3/HR X 17,929
= KG/MIN X 29.39 ÷ Specific Gravity	= KG/MIN X 832,000 ÷ Specific Gravity
= KG/HR X 0.490 ÷ Specific Gravity	= KG/HR X 13,876 ÷ Specific Gravity
= LBS/MIN X 13.33 ÷ Specific Gravity	= LBS/MIN X 377,500 ÷ Specific Gravity
= LBS/HR X 0.2222 ÷ Specific Gravity	= LBS/HR X 6292 ÷ Specific Gravity
= LBS/DAY X 0.00926 ÷ Specific Gravity	

$$= \frac{\text{ACFM X (Oper PSIG + 14.7) X 530}}{\text{14.7 X (Oper °F + 460)}}$$

Note: *Use Correction Factor formulae given above to calculate SCFM or SCC/MIN (Air Equivalent)*

2. Calculate variable area correction factor.

CORRECTION FORMULAE:

Pressure Correction Factor (PCF) = $\sqrt{(14.7 \div \text{Operating PSIG}) \div 14.7}$

Temperature Correction Factor (TCF) = $\sqrt{530 \div (460 + \text{Operating } ^\circ\text{F})}$

Specific Gravity Correction Factor (SGCF) = $\sqrt{1 \div \text{Specific Gravity of Metered Fluid}}$

TEMPERATURE CONVERSIONS:

Deg. F = (9 ÷ 5) x °C) +32

= °K – 459.67

= (9 ÷ 5) x (°R – 273.15) + 32

FLUID DENSITY CONVERSIONS:

Specific Gravity = LBS/FT³ ÷ 0.075

= KG/M³ ÷ 1.2

= MOL. WT. ÷ 29.0

= G/CM³ ÷ 0.0012

PRESSURE CONVERSIONS:

PSIG = FT. Water ÷ 2.308

= IN. Water ÷ 27.73

= MM Water ÷ 704

= IN. HG ÷ 2.036

= MM HG ÷ 51.7

= KG/CM² X 14.228

= (KPA ÷ 101.3) X 14.7

= (PA ÷ (1.013 x 100,000) X 14.7

= PSIA – 14.7

= (ATM X 14.7) – 14.7

= ((TORR ÷ 760) X 14.7) – 14.7

= ((Bars ÷ 1.013) X 14.7) – 14.7

= (Millibars ÷ 1013) X 14.7) – 14.7

3. **Calculate air equivalent flow rate.**

Standard Flow Rate = Customer's Flow Rate X (PCF X TCF X SGCF) (Air Equivalent)

4. **Once a meter is selected, the maximum or minimum flow rate can be calculated for the customers conditions.**

Flow Meters Special Scale = Catalog Flow Rate X PCF X TCF X SGCF (Air @ STP)

Ph: (714) 891-0008 • sales@kinginstrumentco.com • 12700 Pala Drive Garden Grove, CA 92841

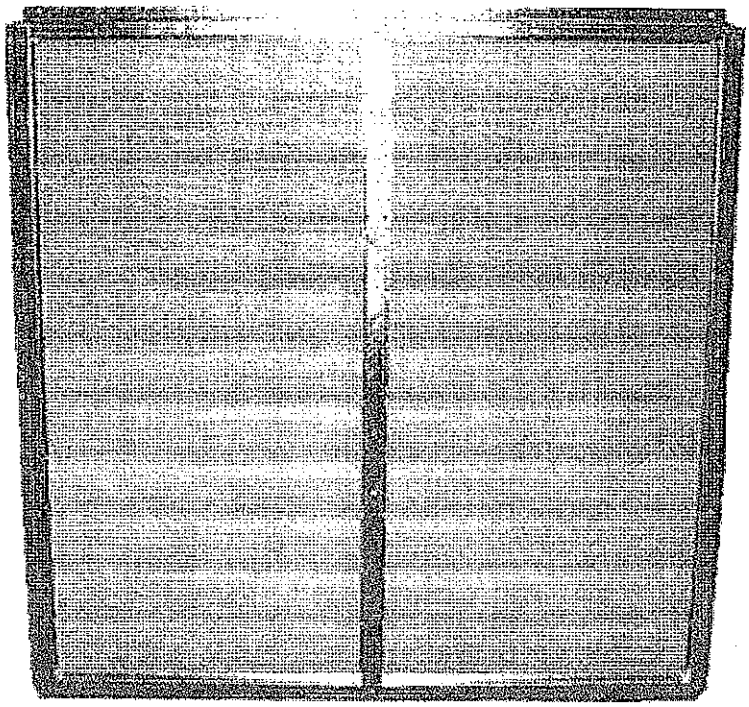
Shutter Kit

CANARM®

Shutter Kit

Instruction Manual

READ AND SAVE THESE INSTRUCTIONS



WARRANTY

CANARM Ltd. warrants every new shutter kit to be free of defects in material and workmanship, to the extent that, within a period of one year from the date of purchase CANARM Ltd. shall either repair or replace at CANARM's option, any unit or part thereof, returned freight prepaid, and found to be defective.
This warranty does not include any labor or transportation costs incidental to the removal and reinstallation of the unit at the user's premises.
Components repaired or replaced are warranted through the remainder of the original warranty period only.
This warranty applies to the original purchaser-user only; it is null and void in case of alteration, accident, abuse, neglect, and operation not in accordance with instructions.

NOTICE: No warranty claims will be honored by CANARM Ltd. unless prior authorization is obtained.

Installation or Product problems? Do not return to store of purchase.
Contact Canarm Service at 1-800-265-1833 (CANADA) 1-800-267-4427 (U.S.A.)
1-800-567-2513 (EN FRANCAIS) Monday to Friday 8:00 - 5:00pm e.s.t.

CANARM®

ASSEMBLY INSTRUCTIONS - SHUTTER KITS

These shutter kits are easy to assemble and install. Follow the steps listed below. They can be fitted into a wall opening from the inside or over an opening on the outside. (See sizing chart)

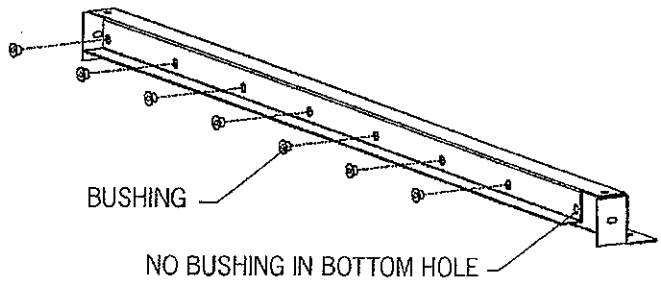
See the table below to verify that your kit has all components and hardware.

	KDS12-SS	KDS16-SS	KDS18-SS	KDS20-SS	KDS24-SS	KDS36-GV	KDS36-SS	KDS48-GV	KDS48-SS
Sides	2	2	2	2	2	2	2	2	2
Top/Bottom	2	2	2	2	2	2	2	2	2
Center Bar	-	-	-	-	1	1	1	1	1
Louvers	4	5	6	6	14	22	22	26	26
Louver Pins	4	5	6	6	7	11	11	13	13
Corner Clip	4	4	4	4	4	4	4	4	4
#6 Sheet Metal Screw	10	10	10	10	11	12	12	13	13
#10 Sheet Metal Screw	-	-	-	-	2	2	2	2	2
Louver Stop	-	-	-	-	1	1	1	1	1
Bushings	-	-	-	-	-	46	-	55	-

ASSEMBLY STEPS:

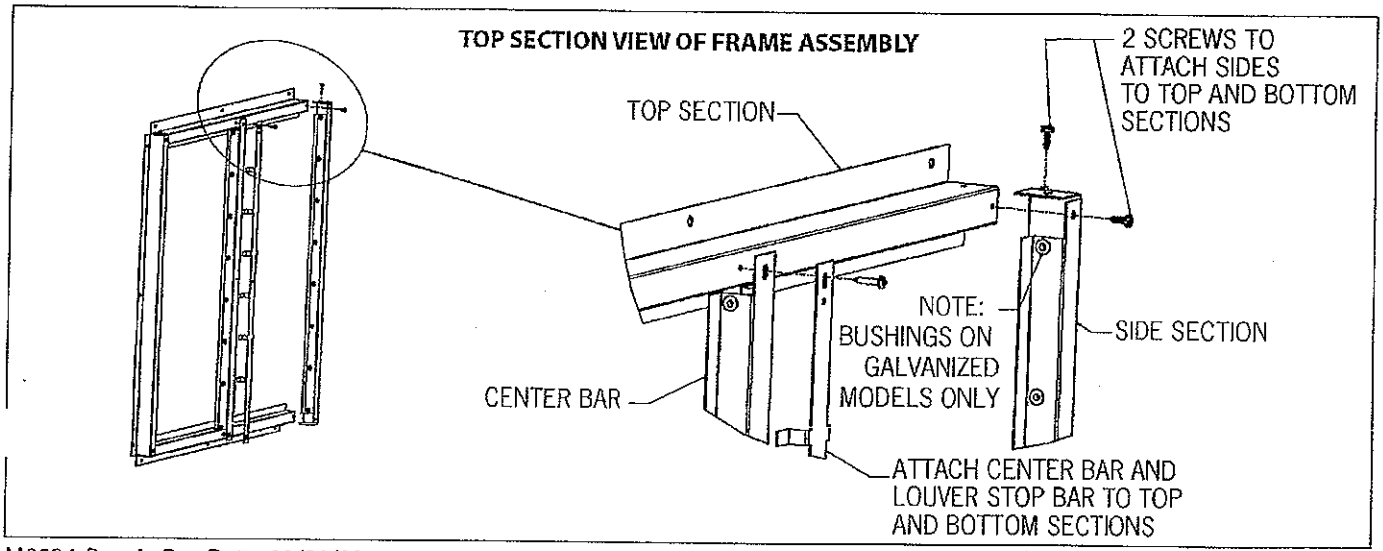
1. **Insert the bushings:**
   Push nylon pin bushings into all the 1/4" holes in the sides and center bars except for the lower most hole. Louvers are not required in the bottom holes.

NOTE: Stainless steel models do not use bushings.



2. **Assemble the frame section:**
   Use 2 - side sections and 2 - top & bottom sections and 8 - smaller #6 screws. Lay the top & bottom down on a flat surface then place the sides on to the top & bottom. Put 2 - screws in each corner with a Phillips or square screw driver. Use 1 - screw on the front or top and 1- screw on the side.

3. **Assemble the center bars and louver stops.** (Note: For 24", 36", 48".)
   Use 2 - #10- screws; one into the top and one into the bottom. Notice their is an extra hole punched below one of the assembly holes on the louver stop bracket. This hole indicates the top.



4. **Assemble the pins and louvers:**

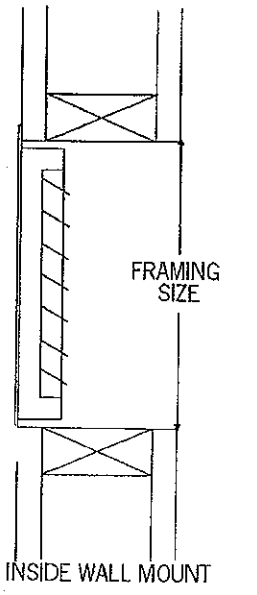
a) Kits without center bars - slide louver onto pin. Insert pin into bushing of one side (starting at bottom) and then flex the louver and pin to insert the pin into the bushing on the opposite side. Repeat for all louvers.

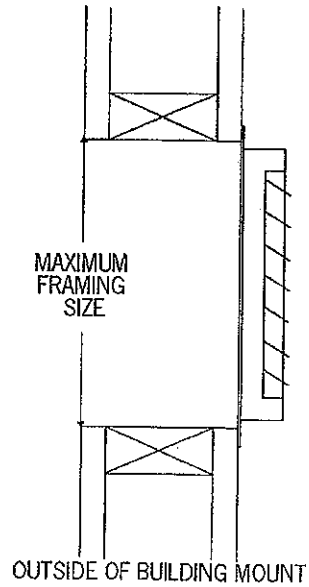
o) Kits with one center bar - Insert the pins through the center bar until roughly centered. Slide a louver onto each side of the bottom pin. Slide the pin into one side. Flex the pin and louver to insert the pins into the opposite side. Repeat for all louvers.

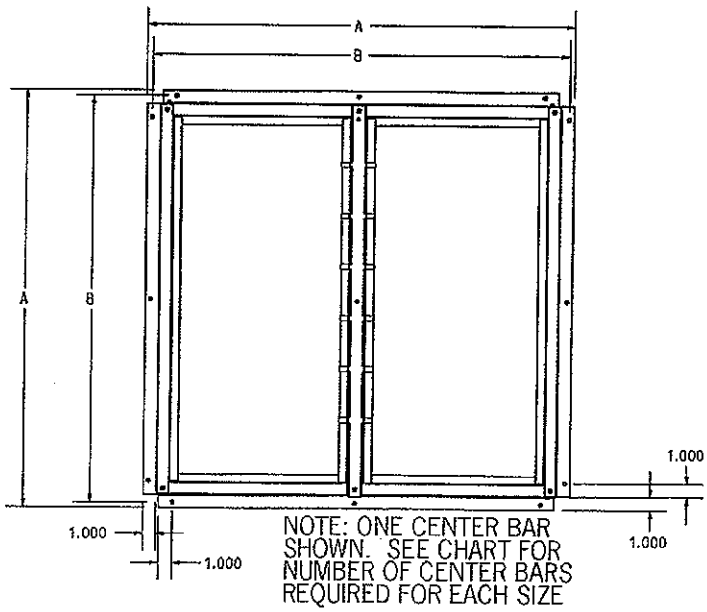
5. **Mounting to wall:**

The assembled shutter can be mounted into a wall opening from the inside of the wall or over an opening on the outside of the wall. See wall mount sizing chart for framing dimensions. 5/16" mounting holes are provided around the flange. Any appropriate fastening hardware (not supplied) can be used to secure the assembly to the wall.

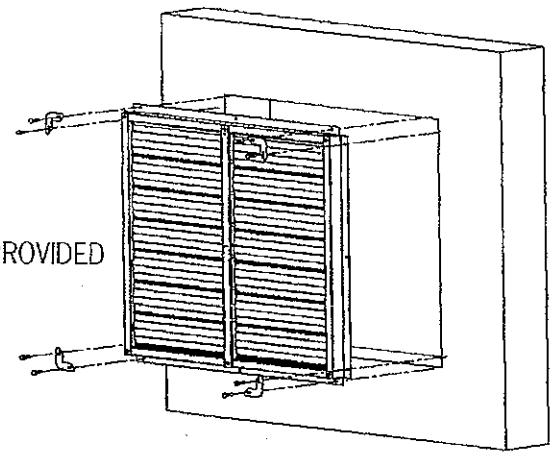
For better appearance, assemble with corner brackets provided (see diagram below).







Shutter Size	A	B	Number of Center Bars	Inside Wall Mount Framing Dimensions	Outside Wall Mount Maximum Opening
12"	19-1/8"	18-3/8"	0	17-5/8" Sqr.	17" Sqr.
16"	23-1/8"	22-3/8"	0	21-5/8" Sqr.	21" Sqr.
18"	25-1/8"	24-3/8"	0	23-5/8" Sqr.	23" Sqr.
20"	27-1/8"	26-3/8"	0	25-5/8" Sqr.	25" Sqr.
24"	31-1/8"	30-3/8"	1	29-5/8" Sqr.	29" Sqr.
36"	43-1/8"	42-3/8"	1	41-5/8" Sqr.	41" Sqr.
48"	55-1/8"	54-3/8"	1	53-5/8" Sqr.	53" Sqr.



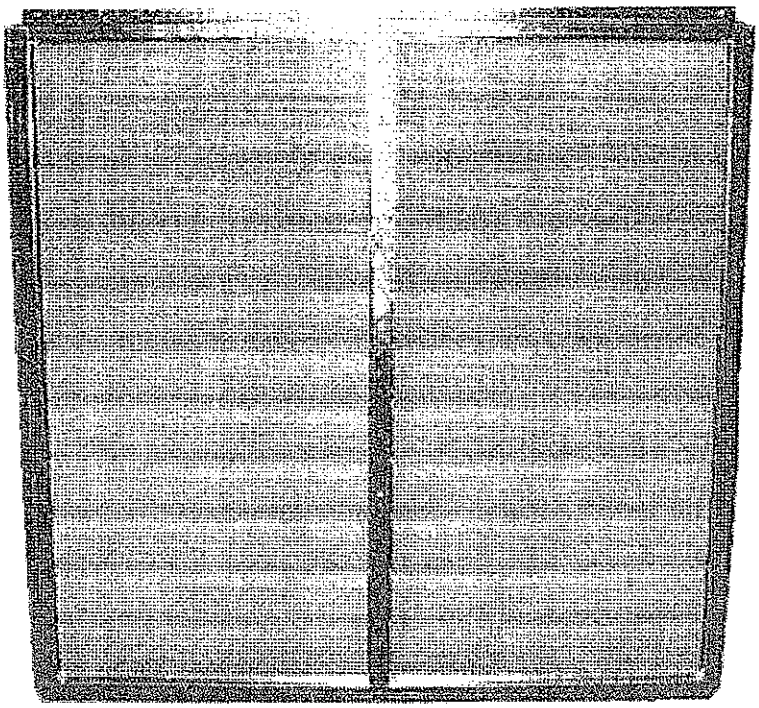
NOTE:
LAG SCREWS NOT PROVIDED

CANARM®

Ensemble De Volets

Mode d'Emploi

VEUILLEZ LIRE ET GARDER CES INSTRUCTIONS



GARANTIE

Canarm Ltée., garantie ce nouvel Ensemble De Volets contre toutes défectuosités dans la fabricaton et la main d'oeuvre pour une période de un an de la date d'achat. Durant cette période, Canarm Ltée. aura l'option de réparer ou remplacer l'unité ou une pièce de l'unité si l'unité nous est retourné frais de port payé et nous constatons une défectuosité. Cette garantie exclue tous les frais de réparation et de manutention qui pourraient survenir lors du démontage et de la réinstallation de l'unité sur les lieux. Les pièces réparées ou remplacées seront garanties pour la période restante de la garantie originale. Cette garantie s'applique à l'acheteur original seulement; elle est nulle dans le cas d'altérations, d'accident, d'abus, de négligence ou lors d'une opération qu n'est pas conforme aux instructions.

AVIS: Aucune réclamation sur garantie ne sera honorée sans réception d'une autorisation au préalable de Canarm Ltée.

Problèmes d'installation ou d'utilisation? Ne retournez pas au magasin. Communiquez avec le service à la clientèle chez Canarm au 1-800-265-1833 (Canada) 1-800-267-4427 (USA) ou 1-800-567-2513 (français) du lundi au vendredi entre 8:00h et 17:00h HNE

CANARM®

ASSEMBLAGE DE L'ENSEMBLE DE VOLETS

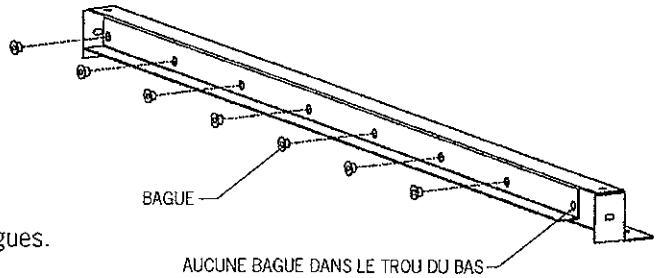
Cet ensemble de volets est très facile à assembler et installer. Suivez les étapes ci-dessous. Il peut être installé dans l'ouverture d'un mur de l'intérieur ou sur l'ouverture de l'extérieur. (Voir tableau des grandeurs.)

Vérifiez le tableau ci-dessous afin de vous assurer que vous avez toutes les pièces et la quincaillerie nécessaires.

	KDS12-SS	KDS16-SS	KDS18-SS	KDS20-SS	KDS24-SS	KDS36-GV	KDS36-SS	KDS48-GV	KDS48-SS
Côtés	2	2	2	2	2	2	2	2	2
Dessus/Dessous	2	2	2	2	2	2	2	2	2
Barre Centrale	-	-	-	-	1	1	1	1	1
Volets	4	5	6	6	14	22	22	26	26
Goupilles des Volets	4	5	6	6	7	11	11	13	13
Pinces des Coins	4	4	4	4	4	4	4	4	4
Vis à Métal #6	10	10	10	10	11	12	12	13	13
Vis à Métal #10	-	-	-	-	2	2	2	2	2
Arrêt des Volets	-	-	-	-	1	1	1	1	1
Bagues	-	-	-	-	-	46	-	55	-

ETAPES DE L'ASSEMBLAGE:

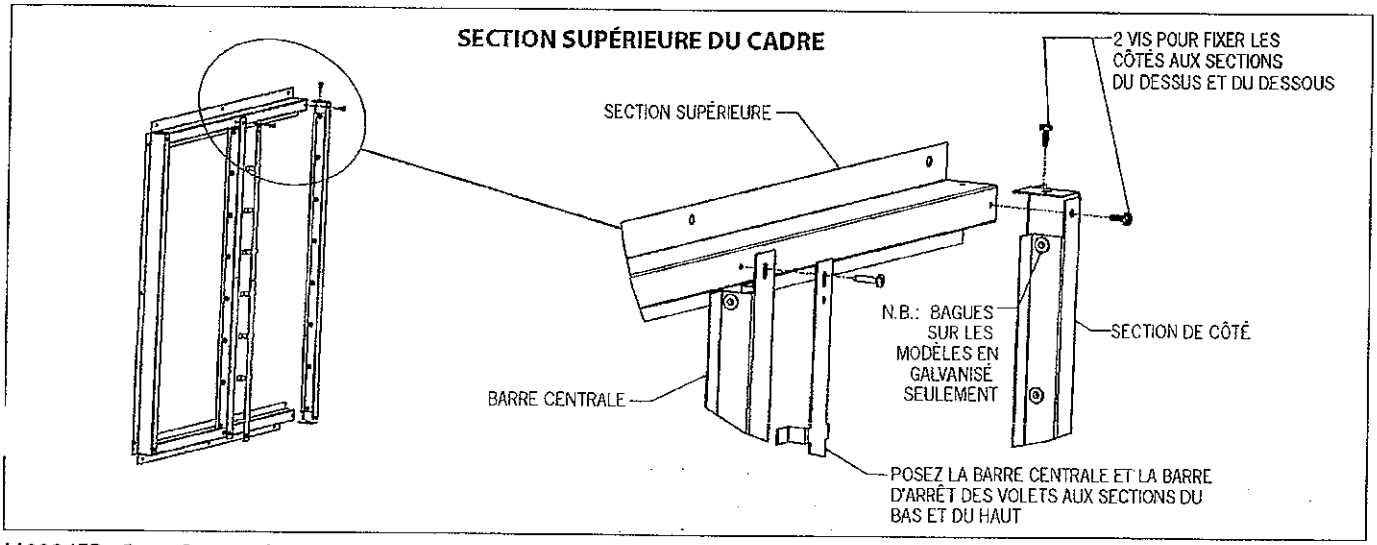
1. **Insérez les bagues:**
   Poussez les bagues de nylon dans tous les trous de 1/4" situés sur les côtés et dans la barre centrale à l'exception du trou complètement en bas. Les volets ne sont pas requis dans les trous du bas.



N.B.: Les modèles en acier inoxydable ne nécéssitent pas de bagues.

2. **Assemblez le cadre:**
   Utilisez les 2 sections de côté et les 2 sections du haut et du bas et 8 vis #6.
   Déposez les sections du haut et du bas à leurs positions respectives sur une surface plane. Posez 2 vis dans chaque coin à l'aide d'un tournevis Phillips ou un tournevis à bout carré. Utilisez 1 vis sur le devant ou dessus et 1 vis sur le côté.

3. **Assemblez les barres centrales et les arrêts.** (**N.B.**: Pour 24", 36", 48".)
   Utilisez 2 vis #10; un pour le haut et l'autre pour le bas. Vous remarquerez qu'il y a un trou supplémentaire en dessous des trous dans la ferrure d'arrêt des louvres. Ce trou vous indique le haut.



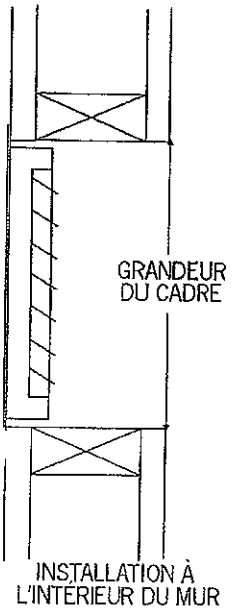
4. **Assemblez les goupilles et les volets:**

a) Ensemble sans barres centrales – glissez le volet sur la goupille. Insérez la goupille dans la bague sur un côté (débutant vers le bas) et fléchir le louvre et la goupille pour insérer la goupille dans la bague de l'autre côté.

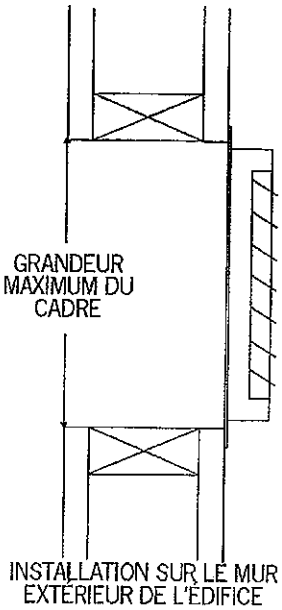
b) Ensemble avec une barre centrale – insérez la goupille en travers de la barre centrale jusqu'à ce qu'elle soit à peu près centrée. Glissez le louvre sur chaque côté de la goupille du bas. Glissez la goupille dans le côté. Fléchissez la goupille et le louvre pour insérer la goupille dans le côté opposé. Répétez pour chaque volet.

5. **Pose au mur:**
Le volet une fois assemblé peut être posé dans une ouveture du mur par l'intérieur du mur ou sur l'ouverture de l'extérieur. Voir le tableau des dimensions pour le cadre. Des trous de 5/16" sont déjà perforés autour du rebord. Utilisez une quincaillerie adéquate (pas incluse) pour l'installation au mur.

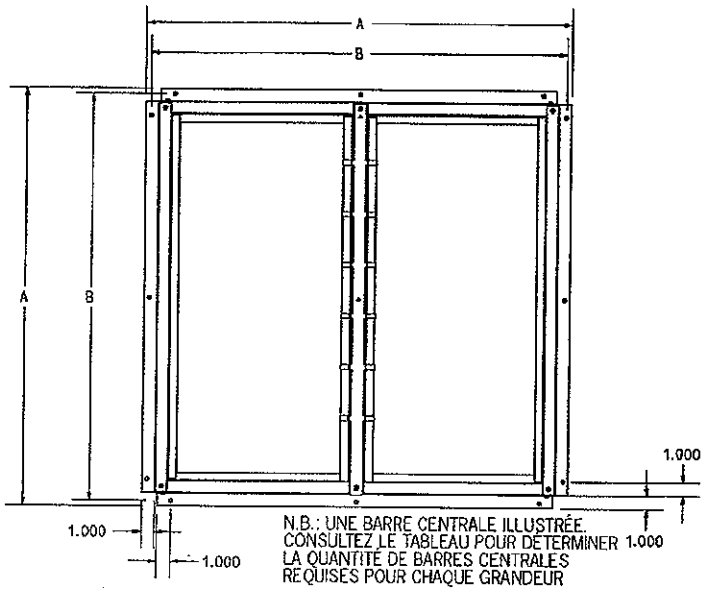
Pour une meilleure apparence, utilisez les ferrures de coin fournies (voir diagramme ci-dessous).



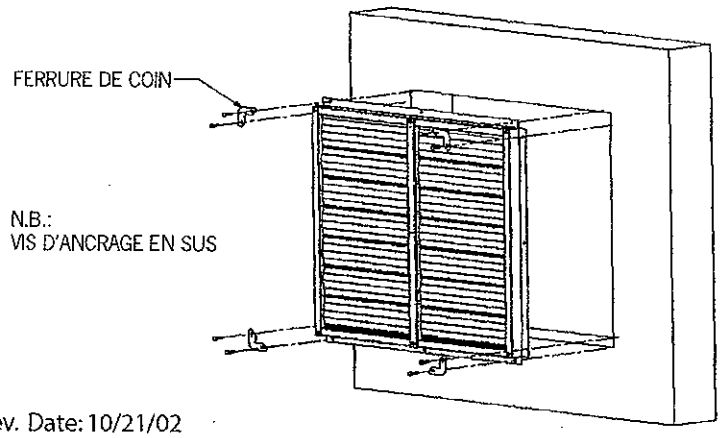
INSTALLATION À
L'INTÉRIEUR DU MUR



INSTALLATION SUR LE MUR
EXTÉRIEUR DE L'ÉDIFICE



Grandeur Du Volet	A	B	Quantité De Barres Centrales	Dimensions Du Cadre Lorsque Installé à L'Intérieur Du Mur	Dimensions Maximum Du Cadre Lorsque Installé à L'Extérieur
12"	19-1/8"	18-3/8"	0	17-5/8" Sqr.	17" Sqr.
16"	23-1/8"	22-3/8"	0	21-5/8" Sqr.	21" Sqr.
18"	25-1/8"	24-3/8"	0	23-5/8" Sqr.	23" Sqr.
20"	27-1/8"	26-3/8"	0	25-5/8" Sqr.	25" Sqr.
24"	31-1/8"	30-3/8"	1	29-5/8" Sqr.	29" Sqr.
36"	43-1/8"	42-3/8"	1	41-5/8" Sqr.	41" Sqr.
48"	55-1/8"	54-3/8"	1	53-5/8" Sqr.	53" Sqr.



Warning: This document does not replace the manufacturer's recommended maintenance schedules as referenced in the OM manual provided by the equipment manufacturer. It is provided as a quick guide to required OM activities for this project.

General Maintenance Activities

Daily

- Check the control panel for running status.
- Contact the system remotely to check system operation for:
  - Alarms
  - Operating Conditions

Weekly

- Check for Leaks.
- Check the volume of consumables. i.e. Chemicals, oil etc
- Check for excessive noise of various components.
- Check for Alarms.
- Check and record Flow Rates, Vacuums, Pressures, Temperatures, pH.
- Check for excessive moisture inside the control panels and transducer wiring boxes
- Check for corrosion and grease the moving parts if required to reduce corrosion.

Monthly

- Test critical inputs for proper shutdown capacity.
- Test the operation of the overloads.
- Test building sump switch if it is present.

Yearly

- Test each input.
- Test alarm conditions.
- Test the operation of each output device.

Parts Listing per Maintenance Code

Blower, Regen, Rotron

	Part		Qty	Module
(BL-200) B-701	12222	Blower,Rotron,EN14DX72MWL,30hp,230/460,3ph	1	Soil-Vapor Extraction
B-702-703 (BL-300+400)	15888	Blower,Rotron,EN979BK72WL,20hp,230/460,,XPF	2	Soil-Vapor Extraction

Fan

	Part		Qty	Module
Bldg 2 F-7901	M1072	Fan Building,S12-E1,12",1/4hp,1750rpm,120V,1ph,TEFC	1	Building, Trailer or Skid
Bldg 1 F-7902	M1072	Fan Building,S12-E1,12",1/4hp,1750rpm,120V,1ph,TEFC	1	Building, Trailer or Skid

Filter,Vacuum,Solberg

(AF-200 AF-300 AF-400)	Part		Qty	Module
700	13603	Filter Inline,Solberg,CSL-275P-600	3	Soil-Vapor Extraction

Flow Meter (Liquid)

(FQI 210,310,410)	Part		Qty	Module
FQI-401-403	10141	Meter,Water,3/4"MTH,w/o pulse	3	Vapor/Liquid Separator

Flow Meter, Air, VFLOW

	Part		Qty	Module
FI-118	12686	Meter Flow,Vflow 3	1	Vacuum Inlet Manifold
FI-101	12686	Meter Flow,Vflow 3	1	Vacuum Inlet Manifold
FI-103-106	12686	Meter Flow,Vflow 3	4	Vacuum Inlet Manifold
FI-107	12686	Meter Flow,Vflow 3	1	Vacuum Inlet Manifold
FI-108-112	12686	Meter Flow,Vflow 3	5	Vacuum Inlet Manifold
FI-117	12686	Meter Flow,Vflow 3	1	Vacuum Inlet Manifold
FI-102	12686	Meter Flow,Vflow 3	1	Vacuum Inlet Manifold
150	13526	Meter Flow,Vflow 4	1	Vacuum Inlet Manifold
150	13526	Meter Flow,Vflow 4	4	Vacuum Inlet Manifold
FI-113-116	13526	Meter Flow,Vflow 4	4	Vacuum Inlet Manifold
150	13526	Meter Flow,Vflow 4	1	Vacuum Inlet Manifold
150	13526	Meter Flow,Vflow 4	1	Vacuum Inlet Manifold
150	13526	Meter Flow,Vflow 4	1	Vacuum Inlet Manifold
150	13526	Meter Flow,Vflow 4	5	Vacuum Inlet Manifold
150	13526	Meter Flow,Vflow 4	1	Vacuum Inlet Manifold

Removed from Service 12/2008

(See pg 9 of 9 for Replacement)

Gauge, Magnehelic

	Part		Qty	Module
150	11247	Gauge,Magnehelic,2002,0-2"wc	1	Vacuum Inlet Manifold
150	11247	Gauge,Magnehelic,2002,0-2"wc	4	Vacuum Inlet Manifold

Removed

150	11247	Gauge,Magnehelic,2002,0-2"wc	5	Vacuum Inlet Manifold
~~*150*~~	~~11247~~	~~Gauge,Magnehelic,2002,0-2"wc~~	~~1~~	~~Vacuum Inlet Manifold~~
FI-118	11247	Gauge,Magnehelic,2002,0-2"wc	1	Vacuum Inlet Manifold
FI-102	11389	Gauge,Magnehelic,2005,0-5"wc	1	Vacuum Inlet Manifold
FI-107	11389	Gauge,Magnehelic,2005,0-5"wc	1	Vacuum Inlet Manifold
FI-108-112	13596	Gauge,Magnehelic,2004,0-4"wc	5	Vacuum Inlet Manifold
FI-101	13596	Gauge,Magnehelic,2004,0-4"wc	1	Vacuum Inlet Manifold
FI-103-106	13596	Gauge,Magnehelic,2004,0-4"wc	4	Vacuum Inlet Manifold
FI-117	13596	Gauge,Magnehelic,2004,0-4"wc	1	Vacuum Inlet Manifold
150	M1050	Gauge,Magnehelic,2003,0-3.0"wc	1	Vacuum Inlet Manifold
150	M1050	Gauge,Magnehelic,2003,0-3.0"wc	1	Vacuum Inlet Manifold
FI-113-116	M1263	Gauge,Magnehelic,2006,0-6"wc	4	Vacuum Inlet Manifold

Removed 2/2008

Gauge, Pressure

	Part		Qty	Module
~~*PI-701*~~	~~13374~~	~~Gauge,Pressure,0-200"wc,Dry,J200"-WC,SS~~	~~1~~	~~Soil-Vapor Extraction~~
~~*PI-401*~~	~~13374~~	~~Gauge,Pressure,0-200"wc,Dry,J200"-WC,SS~~	~~1~~	~~Vapor/Liquid Separator~~
(PI-210, 310, 410) *PI-404-406*	16203	Gauge,Pressure,0-60psi, Indumart,P16T2-FG-60	3	Vapor/Liquid Separator
(PI-201, 301, 401) *PI-704-706*	M1293	Gauge,Pressure,0-60" wc ,Dry,J60"-WC,SS	3	Soil-Vapor Extraction
(PI-601) *PI-707*	M1293	Gauge,Pressure,0-60" wc ,Dry,J60"-WC,SS	1	Soil-Vapor Extraction

Gauge, Temperature

	Part		Qty	Module
700 (TI-601)	M1422	Gauge,Temp.,50-500F WL31308	1	Soil-Vapor Extraction
TI-1302 (602)	M1423	Gauge,Temp.,0-250F,WL31305	1	SVE Heat Exchanger

Gauge, Vacuum

	Part		Qty	Module
~~*150*~~	~~10411~~	~~Gauge,Vacuum,0-100"wc,Dry,J100"-0WC,SS,1/4"~~	~~18~~	~~Vacuum Inlet Manifold~~ *
(VI-201, 301, 401) *PI-402-403*	10411	Gauge,Vacuum,0-100"wc,Dry,J100"-0WC,SS,1/4"	3	Vapor/Liquid Separator
(VI, 202, 302, 402) *PI-702-703*	10411	Gauge,Vacuum,0-100"wc,Dry,J100"-0WC,SS,1/4"	3	Soil-Vapor Extraction
~~*PI-103-106*~~	~~M1319~~	~~Gauge,Vacuum,0-60"wc,Dry,J60"-0WC,SS,1/4"~~	~~4~~	~~Vacuum Inlet Manifold~~ *

Motor,Electric

(TP-210, TP-310, TP-410)

Part			Qty	Module
P-401-403	12026	Motor, 1hp, 1800rpm, 143T	3	Vapor/Liquid Separator

Pump, Discharge

(TP-210, TP-310, TP-410)

Part			Qty	Module
P-401-403	M1255	Pump,Discharge,Moyno,33301	3	Vapor/Liquid Separator

Switch, Level

Part			Qty	Module

* Vacuum gauge ranges MAY vary.
SEE ARCADIS GAUGE SCHEDULE in OM+M manual APPENDIX H.

LSHH,LSH-73	15465	Switch,Level, L312C XXXX - XXXX	1	Discharge Tank
LSHH,LSH,LS	15476	Switch,Level, L312C 3393-0001	3	Vapor/Liquid Separator
7350	M1108	Switch,Level,Mech Float,Wide Angle,N.O.,M-Red-40T	1	Discharge Tank
7350	M1343	Switch,Level,Mech Float,Narrow Angle,N.O.,M-Blue-40T	1	Discharge Tank

Vacuum Relief Valve

	Part		Qty	Module
700	10821	Valve,Vacuum Relief,Kunkle,215V-K, 3" in/out	1	Soil-Vapor Extraction
750	10821	Valve,Vacuum Relief,Kunkle,215V-K, 3" in/out	3	Soil-Vapor Extraction

Vapor Liquid Separator

	Part		Qty	Module
VLS-401-402	10057	Vapor Liquid Separator,85 Gallon,VLD800	2	Vapor/Liquid Separator
VLS-403	10057	Vapor Liquid Separator,85 Gallon,VLD800	1	Vapor/Liquid Separator

(KO-200, KO-300 KO-400)

Variable Frequency Drive

	Part		Qty	Module	
8200	17775	Variable Frequency Drive, MA7200-4002-N1 TECO	1	Control Panel	For HX-600
8200	17781	Variable Frequency Drive, MA7200-4020-N1 TECO	2	Control Panel	For BL-300,400
8200	17783	Variable Frequency Drive, MA7200-4030-N1 TECO	1	Control Panel	For BL-200

Table 1. December 2008 Schedule of Flow meters on Treatment System, Operable Unit 3 Soil Gas Interim Remedial Measure, Former Grumman Settling Ponds, Bethpage, New York.

Well ID	Manifold Flow Meter ID	Gauge Range (SCFM)	King Instruments Series and Order Number	MSC Part Number
DW-7D	FI-101	6 - 60	7510 6A-04	86485596
DW-3D	FI-102	4 - 40	7510 6A-02	86485588
DW-5D	FI-103	4 - 40	7510 6A-02	86485588
DW-6D	FI-104	2 - 20	7510 7A-06	86485646
DW-1D	FI-105	0.8 - 8	7510 7A-02	86485638
DW-4D	FI-106	4 - 40	7510 6A-02	86485588
DW-2D	FI-107	6 -60	7510 6A-04	86485596
DW-11S	FI-108	16 - 160	7205 0221	86487162
DW-10S	FI-109	16 - 160	7205 0221	86487162
DW-2S	FI-110	6 - 60	7510 6A-04	86485596
DW-9S	FI-111	16 - 160	7205 0221	86487162
DW-8S	FI-112	16 - 160	7205 0221	86487162
DW-4S	FI-113	6 - 60	7510 6A-04	86485596
DW-1S	FI-114	25 - 250	7205 0231	86487170
DW-6S	FI-115	16 - 160	7205 0221	86487162
DW-5S	FI-116	16 - 160	7205 0221	86487162
DW-3S	FI-117	4 - 40	7510 6A-02	86485588
DW-7S	FI-118	16 - 160	7205 0221	86487162

EVERY 0 OPERATING HOURS

Filter,Vacuum,Solberg

1) Record the initial differential pressure across the unit.

EVERY 800 OPERATING HOURS

Flow Meter, Air, VFLOW

1. Check to ensure lines from venturi to gauge or transmitter are free of condensed water or debris.

Fan

1) Check the fan outlet pressure.
2) Check to ensure nothing is obstructing the air intake.
3) Check the fan wheel for corrosion.
4) Check the fan wheel alignment and positioning.

Filter,Vacuum,Solberg

1) Check the differential pressure across the unit.
2) Replace the filter element when the pressure builds up by 10-15" H2O.
3) Check for any water build up in the unit if used in SVE system

Flow Meter (Liquid)

Test the operation of the flow meter. Disassemble and clean the internal components if dirt or particles are preventing the meter from working properly.

Motor,Electric

1) Inspect motor for excessive heat, vibration, or noise.
2) Keep motor clean and ventilation openings clear.

Switch, Level

1) Test the operation of the switch.
2) Remove the switch and check for debris buildup that can potentially cause a failure of normal operation.

Vacuum Relief Valve

1) Pretest - Testing of the valve prior to disassembly to determine opening point, blowdown, and seat tightness.
2) Disassembly - Inspect parts to determine extent of required repairs.
3) Repairs - Cleaning, reconditioning, replacement, lapping, and minor machining of parts.
4) Assembly - assembly of the valve and valve components.

Vapor Liquid Separator

1) Check for sediment buildup.
2) Drain and flush out the tank.
3) Check for water leaks.

EVERY 4000 OPERATING HOURS

Motor,Electric

Lubrication requirements differ depending on the size and type of service. Consult the O&M for a frequency for your specific model and conditions.

Gauge, Pressure

1) Check accuracy of gauges.
2) Zero gauge if required.

Gauge, Temperature

1) Check accuracy of gauges.
2) Zero gauge if required.

Gauge, Vacuum

1) Check accuracy of gauges.
2) Zero gauge if required.

Gauge, Magnehelic

Verify the gauge's calibration with a sounder or other measuring device.

EVERY 15000 OPERATING HOURS

Blower, Regen, Rotron

See the supplied "General Installation Manual" for information on bearing replacement.

Pump, Discharge

To lubricate tapered roller bearings:
1) Remove the drive shaft assembly and the bearings.
2) Clean bearing cups and cones and the shaft assembly to remove all old grease.
3) Use a good grade of EP (Extreme Pressure) Lithium soap-based grease to lubricate bearings.
4) Reassemble.

Troubleshooting Chart

Symptom	Potential Cause	Possible Solution
Electrical Motor		
Motor will not start and there is no noise.	Motor may not be receiving the proper power.	Check fuses and power distribution between power lines to motor.
	Overload is tripped.	Reset Overload.
	Main power may be off.	Check main power.
	Contactor may not be closing because motor is in manual position.	Switch motor to back to Auto position.
	Contactor may not be closing because PLC is not telling output to be on.	* Check PLC operating sequence to determine if a start requirement is not met.
Motor does not start but makes a humming noise.	One of the phases of power is not getting to the Motor as a result of a blown fuse.	Change Fuse.
	One of the phases of power is not getting to the Motor as a result of a poor wire connection	Check wiring for a loose wire or a poor connection.
	The driven component, i.e. pump, will not spin and could be seized up.	Disassemble driven component, check clearances and clean internal components and replace any damaged components.
	Bearing on drive shaft of motor or driven component may be seized up.	Replace bearings.
Overloads Trip immediately after startup.	Check for Short Circuit in motor windings.	Re-wind motor.
	One of the phases of power is not getting to the Motor as a result of a blown fuse.	Change Fuse.
	Motor power wires may be shorting out to ground.	Search for wiring short and replace wiring if required.
	Motor may have too much load or backpressure as a result of operating the driven component outside of its operating capabilities.	Check operating capabilities of driven component. I.e. Ensure positive displacement pump is not over pressured or that centrifugal pump is not operating at to high a flow rate.
Motors amps are above the allowable value on the nameplate.	Motor may be designed to operate on the upper limit.	Calculate maximum allowable amps. Name plate amps x safety factor.
	Driven component may have scale built up inside.	Clean internal components of driven component.
	Driven component may be rotating in the wrong direction.	Check direction of rotation and switch rotation of motor if it is incorrect.
	Check voltage of power. Low voltage results in high amps.	Adjust overloads for higher amps if the difference is only slight. Other wise change power or motor.
Centrifugal Pumps		
Pump does not produce sufficient Pressure/Vacuum.	Pump is not primed.	Prime pump.
	Wrong Direction of rotation.	Check and change rotation if required.
	Vacuum or Pressure gauge is faulty	Replace gauge.
	Pump is not operating at required RPM	Check and replace motor if required.
	Pump has wrong sized impeller.	Check impeller and replace if required.
	Pump pressure or vacuum is lost do to obstruction located between pump and gauge	Check for flow restrictions and clean strainers or piping if required.
	Pump is not turned on.	Rub pump gently until turned on
	Coupling between pump and motor is no longer connected preventing the pump from rotating with the motor.	Reconnect and realign motor and pump.

Pump is leaking.	Gaskets are worn or faulty.	Replace gaskets.
	Mechanical seal has been overheated. Often a result of operating the pump without any water.	Replace mechanical seal.
	Fittings are leaking on or around pump.	Tighten fittings.
	Water may be coming from another location.	Check for leaks around pump.
	Stop rubbing the pump gently.	
Pumps flow rate is too low.	Backpressure is too high for pump.	Reduce backpressure.
	Pump may not be sized correctly for process.	Replace pump.
	Pump impeller is too small.	Change pump impeller but watch power consumption on motor.
	Flow control valve is closed.	Open flow control valve.
	May have blocked line or filter	Replace filter and clean line.
Pump is making excessive noise during operation.	Manually rotate pump impeller and listen for clearance problems.	Disassemble pump and fix clearance problems.
	Alignment of pump may be off causing the flexible coupling to degrade.	Check alignment and reset alignment if it is a problem. Replace flexible coupling if it is degraded.
Liquid Ring Pump		
Pump does not produce enough Vacuum	Pump is not primed.	Prime pump and start under vacuum.
	Service fluid is to low in seal oil tank.	Add seal oil.
	No restriction on inlet of pump	Close valves to create suction.
	Dilution valve is open	Close dilution valve.
	Service fluid is not flowing into the pump.	Check for flow restrictions in service fluid lines. Check Strainer.
	Pump is rotating in the wrong direction.	Check and change direction if required.
	Vacuum gauge is not working correctly.	Replace vacuum gauge.
	Pump seals may be allowing air into the pump.	Check for leaking and replace seals if required.
	Pump is too small for application.	Replace pump.
	Vacuum relief valve is set too low.	Replace or reset vacuum relief valve.
	Air may be leaking into vapor lines.	Check for air leaks in vapor lines.
	Pump internal components are damaged.	Disassemble pump and replace components if required.
Pump is making a strange growling noise.	Cavitation is occurring	Decrease the vacuum.
	Insufficient seal fluid flow or excessive seal fluid flow.	Increase/decrease seal fluid flow rate.
Pump is leaking.	Gaskets are faulty	Replace gaskets.
	Mechanical seal has been overheated or is faulty.	Replace mechanical.
	Oil may be leaking from 1/8" vacuum relief valves in pump housing	Remove valves and install plugs.
Pump is running too hot.	Seal fluid strainer is plugged restricting seal fluid.	Clean out strainer.
	LRP is not providing enough suction to drawn sufficient seal fluid.	Increase seal oil suction. Pipe seal fluid into a higher vacuum port of pump.
	Seal fluid flow rate is too low.	Open seal fluid control valve to allow more seal fluid to enter the pump.
	Seal fluid heat exchanger is not working properly.	Check heat exchanger.

Excessive Discharge pressure built up in seal oil tank.	Demister filter is plugged and requires replacement.	Replace demister.
	Seal oil is not being drawn out of demister filter through scavenger line.	Increase vacuum of LRP to allow oil to be sucked through the scavenger line. Ensure that scavenger line has sufficient vacuum to draw oil out of the demister filter.
Seal Oil Low Level Alarm	Seal oil temperature may be operating to high causing the oil to evaporate.	Check Seal oil operating temperature and increase seal oil flow.
	Seal oil suction line may be plugged causing seal oil to collect in bottom of demister filter.	Check for plugging of seal oil return line and clean or replace if required.
Oil Water Separators		
Water is in the oil outlet	Skimmer opening is below the oil/water interface.	Adjust skimmer alignment to allow more oil to collect before skimming.
Oil is making its way to the outlet.	Water flow rate is too high.	Reduce flow rate through system.
	Filter media is plugged	Replace or clean media.
	Oil discharge is plugged backing up OWS.	Drain oil down stream of skimmer.
Air to Air and Air to Fluid Heat Exchangers		
Heat exchanger fan is drawing too many amps.	Look into the trouble shooting for motors.	
	Fan blade pitch and diameter may be wrong.	Change fan blade.
	Motor may be operating at wrong RPM for fan blade.	Replace motor or fan blade.
	Check clearance of fan blade.	Make adjustments if blade is hitting things.
Phase Separator		
Water will not pump out of phase separator.	Base of separator may be plugged with sand.	Flush sand and debris out of separator.
Electric Solenoid Valve		
Valve will not completely shut.	May have dirt or rocks preventing it from shutting properly.	Disassemble and clean out internal components.
Valve will not open	Check for power to solenoid.	Trace power lines and determine why power is not going to valve.
	PLC may not be telling it to open.	Check Start requirements in manual.
	Coil may be damaged or faulty.	Replace coil.
Level Switches		
Level switch is staying closed when water in tank drops below switch.	Level switch is upside down or on its side.	Check orientation of level switch. Level switch may be designed as normally closed and therefore will be upside down.
	Sight Glass is plugged giving a false level in the tank.	Clean sight glass.
	Level switch has dirt or film causing it to stick up.	Remove level switch, clean and test for normal operation using a millimeter.
	Level switch may be damaged or faulty and failed closed regardless of the switch position.	Replace switch.
	Wiring to level switch may be shorting out to ground causing the switch to appear closed at all times.	Disconnect switch from system wiring and separate system wires so they are not in contact with each other or any metal. If the input is still on then the input wiring is being grounded somewhere. Find short and replace or fix wiring.

	IS barrier is shorted out internally.	Switch IS barrier with working barrier and if problem goes away then the barrier may be faulty and should be changed.
	Input wiring is loose in terminal strip.	Tighten terminal strip where field wiring is brought into panel.
	Level switch is wired incorrectly	Consult input wiring diagram and inspect wiring of level switch. Change if required.
Level switch stays open when water in tank is above the switch.	Level switch is upside down or on its side.	Check orientation of level switch. Level switch may be designed as normally closed and therefore will be upside down.
	Sight Glass is plugged giving a false level in the tank.	Clean sight glass.
	Level switch has dirt or film causing it to stick down.	Remove level switch, clean and test for normal operation using a millimeter.
	Level switch may be damaged or faulty and failed open regardless of the switch position.	Replace switch.
	IS barrier is blown preventing the level switch signal from crossing the barrier.	Switch IS barrier with working barrier and if problem goes away then the barrier may be blown. If barrier is blown then the input wire on the right side of the barrier will have 24 V DC and the wire on the opposite side will have 0V DC.
	Level switch is wired incorrectly	Consult input wiring diagram and inspect wiring of level switch. Change if required.
Regenerative Blowers	Commonly used on strippers or for SVE systems.	
Blower does not produce sufficient Pressure/Vacuum.	Blower is not turned on.	Turn on blower
	Wrong Direction of rotation.	Check and change rotation if required.
	Vacuum or Pressure gauge is faulty	Replace gauge.
	Blower is not operating at required RPM	Check and replace motor if required.
	Blower has wrong sized impeller.	Check impeller and replace if required.
	Pressure or vacuum is lost do to obstruction located between blower and gauge	Check for flow restrictions and clean strainers or piping if required.
Blower is leaking.	Fittings are leaking on or around Blower.	Tighten fittings.
Blower flow rate is too low.	Backpressure is too high for Blower.	Reduce backpressure.
	Blower may not be sized correctly for process.	Replace blower.
	Blower impeller is too small.	Change blower impeller but watch power consumption on motor.
	Flow control valve is closed.	Open flow control valve.
	May have blocked line or filter	Replace filter and clean line.
Air Stripper		
Stripper Leaks	Gaskets are leaking	Apply silicon grease to gaskets and close up stripper. If they cannot be fixed the gaskets may need to be replaced.
Pressure or Vacuum is building up in stripper	Stripper is being fouled by mineral precipitates.	Clean stripper with acid to dissolve precipitates.
	Airflow rate through stripper has risen or is above the design value.	Decrease airflow rate.

Stripper is not cleaning contaminants sufficiently	Inlet concentrations are higher than the design values.	Decrease water flow rate to obtain required stripping capacity.
	Flow rate of water through stripper is too high.	Decrease flow rate allowing longer resonance time in stripper.
	Water temperature is lower than the design. (below 60 deg F)	Increase water temperature or slow down water flow rate or increase airflow rate.
	Airflow rate is not high enough.	Increase airflow rate or decrease water flow rate.
	Some products that are not easily strippable may be in higher concentrations than originally planned.	Consult manufacturer with test results of discharge contaminants.
	Stripper may have been shut down manually causing the contaminated water in the trays to fall into the sump without being cleaned.	Allow stripper to go through proper shutdown cycle when stopping the unit.
	Stripper may be setup wrong allowing the water to bypass trays.	Check orientation of trays to ensure water will flow through each tray properly.
	Some contaminants may be present that are affecting the ability to strip other contaminants.	Consult manufacturer with test results of intake and discharge contaminants.
	Increase in pressure causes a decrease in airflow that will result in a decrease of contaminant concentrations.	See pressure rise in stripper troubleshooting above.
Water is collecting in discharge piping of stripper	Air leaving the stripper is very humid and will condense some water in the pipelines.	Install a knockout drum in discharge line before air is piped to another section of the process.
	The stripper can cause foaming of the water that will result in water collecting in the discharge lines.	Test for foaming contaminants such as soaps and install antifoaming dosing system to prevent foaming.
	Airflow rate is higher than the design value causing water to be carried over into the discharge lines.	Decrease flow rate to within design range.
Stripper often shuts down on a high stripper sump alarm.	Transfer pump is flowing faster than the discharge pump.	Slow transfer pump or speed up discharge pump.
	Discharge Pump is not working properly.	Trouble shoot discharge pump.
Moyno Pumps		
Pump does not produce sufficient Pressure/Vacuum.	Pump is not primed.	Prime pump.
	Wrong Direction of rotation.	Check and change rotation if required.
	Vacuum or Pressure gauge is faulty	Replace gauge.
	Pump is not operating at required RPM	Check and replace motor if required.
	Pump has wrong sized impeller.	Check impeller and replace if required.
	Pump pressure or vacuum is lost do to obstruction located between pump and gauge	Check for flow restrictions and clean strainers or piping if required.
	Pump is not turned on.	Rub pump gently until turned on
	Coupling between pump and motor is no longer connected preventing the pump from rotating with the motor.	Reconnect and realign motor and pump.
Pump is leaking.	Gaskets are worn or faulty.	Replace gaskets.
	Mechanical seal has been overheated. Often a result of operating the pump without any water.	Replace mechanical seal.
	Fittings are leaking on or around pump.	Tighten fittings.
	Water may be coming from another location.	Check for leaks around pump.
	Pump was run in reverse allowing the rotor to spin off of the pump shaft.	Disassemble pump and screw rotor back onto shaft. (see manufacturers manual)

Pumps flow rate is too low.	Backpressure is too high for pump.	Reduce backpressure.
	Pump may not be sized correctly for process.	Replace pump.
	Pump impeller is too small.	Change pump impeller but watch power consumption on motor.
	Flow control valve is closed.	Open flow control valve.
	May have blocked line or filter	Replace filter and clean line.
Pump is making excessive noise during operation.	Manually rotate pump impeller and listen for clearance problems.	Disassemble pump and fix clearance problems.
	Alignment of pump may be off causing the flexible coupling to degrade.	Check alignment and reset alignment if it is a problem. Replace flexible coupling if it is degraded.
Pressure Switch/Vacuum Switch		
Switch is not reacting at desired set point.	Switch is out of adjustment.	Change set point to desired value.
Switch is not working.	Switch may be faulty.	Remove input wires and test switch at desired pressure. If it does not trigger then it should be replaced.
Flow meter		
Flow meter is not rotating.	Dirt could have caused meter internals to jam up.	Disassemble flow meter and clean internal components.
Flow meter is rotating but Pulse input is not working.	Switch on meter may be faulty.	Remove wiring and test contacts on meter to ensure that they are opening and closing. If not then meter head needs to be replaced.
	Input wiring may be grounding out preventing the signal from opening and closing.	Test input wiring by isolating input wires and checking if input is on. If so then you have a grounded input wire.
	Input to PLC is not working.	Simulate rotating meter by contacting input wires together and check for a detected flow rate and change in totalized flow.
Belt Driven Assemblies		
Squealing noise occurs on startup.	Belt is too loose.	Check tension of belt and tighten if required.
Excessive wear on bearings.	Belt is too tight.	Loosen belt tension.
Belt is wearing excessively.	Check orientation of blower and motor.	Adjust orientation if required.
Carbon Vessel		
Vessel is operating over pressure.	Silt may have collected in water phase vessel.	Remove lid and check for silt. Remove top layer of silt or replace vessel.
Vessel is breaking through earlier than expected.	Flow rate through vessel may be too high. Check design specifications.	Decrease flow rate.
	Air contaminant concentrations are higher than expected.	Test inlet concentrations.
	Check piping orientation to ensure that water is going in the top of water phase vessels and air is going in the bottom of air phase vessels.	Repipe vessel if piping is wrong.
	Ensure that there is not a large trapped air gap in the top of the water phase carbon vessel allowing the water to bypass a portion of the carbon.	Release air gap if present.

Bag Filter		
Vessel is operating over pressure.	Bag filter may be full of dirt and silt.	Remove cover and check for dirt buildup in the bag. Replace filter element if required.
	Equipment down stream of bag filter may be plugging	Check for pressure buildup down stream of filter and fix pressure buildup downstream if found.
Water will not flow through filter fast enough.	Pump may not be able to supply enough pressure	Check pressure output of pump with pump curve. Replace pump if required.
Filters are plugging too fast	Filter element micron size may be too low.	Install larger micron filter element
	Filter pressure switch setpoint may be too low.	Increase high pressure shutdown setpoint.
Sand Filter		
Vessel is operating over pressure.	Sand filter may be full of dirt and silt.	Remove cover and check for dirt buildup on top of filter. Backwash filter.
	Equipment down stream of bag filter may be plugging	Check for pressure buildup down stream of filter and fix pressure buildup downstream if found.
Water will not flow through filter fast enough.	Pump may not be able to supply enough pressure	Check pressure output of pump with pump curve. Replace pump if required.
Filters are plugging too fast	Filter was not backwashed properly.	Backwash filter vessel as per manufacturers instructions.
	Filter pressure switch setpoint may be too low.	Increase high-pressure shutdown setpoint.
	Filter sand has solidified with Calcification.	Replace Sand in Filter.
	Process Water Flow Rate is operating above the deign Flow rate for the sand filter.	Check process flow rate and compare with design flow rate listed on manufacturers literature or on the component sheet of the sand filter section of your Maple Leaf System Manual.
Rotary Screw Compressor Package		
Compressor Not Starting	Motor Overload	Reset Overload
		Check compressor Output Pressure
		Oil Separator is dirty, replace
		Check supply voltage
	Stopped by compressed air temperature relay	Oil level is too low
		Not enough cooling air flow
		Wrong compressor oil
		Ambient temperature too high
		Cooler dirty
Insufficient Air Output	Clogged intake filter	Replace
	Clogged oil separator element	Replace
	Pressure switch not working	Check pressure switch adjustment
		Repair or replace
	Receiver blow down valve open	Clean valve
	Too high air consumption	Check network for leaks and air powered devices
	Drive belt slipping	Tighten or replace
Compressor Overheating	Insufficient amount of oil	Add oil
	Clogged oil filter	Replace
	Cooler dirty	Clean
	Ambient temperature too high	Check
High Oil Consumption	Oil return tube or its orifice is blocked	Open and clean

	Oil separator or sealing damaged or loosened	Check and repair
	Oil separator dirty	Replace
	Wrong Compressor Oil	Change Oil
	Output air temperature too high	Check and repair
	Faulty non-return valve of oil return pipe	Replace
	Too much oil	Drain extra oil out
Network Pressure Rises Over Set Valve	Pressure switch not working	Check
	Pressure switch damaged	Check
	Output valve leaking	Replace seal
	Loose wire connections	Check
Compressor Doesn't restart Automatically	Pressure switch damaged	Replace
	Output valve leaks	Replace seals
	Loose wire connections	Check
Compressor Doesn't Restart Automatically	Pressure switch damaged	Replace
	Output valve leaks	Replace
	Loose wires	Check wires
Compressor Doesn't Stop Automatically	Output valve leaks	Replace seals of output valve
	Pressure Switch Damaged	Replace
Refrigerated Dryer		
Water down stream of dryer	Residual air in piping	Blow out system with dry air
	Air bypass system is open	Check valve position
	Inlet and Outlet conditions are reversed	Check for correct connection
	Air temperature on outlet of dryer may be too low	Heat trace piping
	Automatic drain mechanism is not working	Replace
	Dryer overloaded	Check flow rate and inlet temperature
High pressure drop across dryer	Inlet air strainer clogged	Clean inlet air strainer
	Excessive air flow	Check flow rate
	Separator filter clogged	Replace filter sleeve
	Freezing of moisture in evaporator	
Fault Alarm	Dryer overloaded resulting in high air outlet temperature	Check operating conditions
	High outlet air temperature	
	Thermostat switch is malfunctioning or not securely mounted	Replace thermostat switch
Refrigeration system not functioning properly in on position	Power failure	Check power
	Line disconnect switch open	Check disconnect
	Fuses blown, breaker blown	Check fuses or breaker
	Loose or faulty wiring	Check wiring
Refrigeration system cycles on and off	High or Low Ambient conditions	Check min/max temperature ranges
	Air filter clogged	Clean filter
	Condenser fins clogged	Clean fins
	Fan motor or control switch not working	Replace fan motor or switch
Analogue 4-20ma Transmitters		
Transmitter is sending a signal that is not accurate.	There may be water in the air sampling lines that are throwing off the readings.	Drain any moisture out of the air sampling lines.
	Transmitter may be out of calibration	Refer to transmitter specification sheets on how to calibrate the transmitter. Note if transmitter is more than 10-25% out of calibration then it will likely require factory recalibration.
Transmitter is sending 0-2 milliamps to the PLC input.	Transmitter may not be wired properly or one or more wire connections may be loose.	Check wiring with device specification sheet and MLEE drawing. Check wiring for loose connections.
	Transmitter may be damaged or not working properly.	If you have another similar transmitter installed in another location on the system then switch them around to determine if the faulty transmitter

		works in another location. If the transmitter works then you know the transmitter is not the problem. If the transmitter does not work in the other location then it is likely the transmitter. If the good transmitter does not work in the faulty location then the problem is likely the wiring at that location or the input into the PLC.
Transmitter is sending over 20 milliamps to the PLC.	Transmitter is likely damaged.	Send back to manufacturer for re-calibration.
PLC's		
Power is on, Lights are on but PLC is not running the logic. Run light is not on.	PLC may not be in run mode. If the power has been of to the panel for an extended period of time, then the PLC will switch out of run mode and stop running the logic.	Use external switch on PLC to switch from "term" to "run" then back to "term". This will force the plc back into run mode. The run light should now indicate that the PLC is in run mode.
Power is on to panel but PLC lights are not on.	Fuse for PLC is pulled out or blown.	Test PLC fuse and replace if necessary. This is in the "PLC" fuse holder.

WARRANTY

Maple Leaf Environmental Equipment Ltd. warrants and guarantees products of its manufacture against defective workmanship or material for a period of one year from the date of shipment from the factory. This warranty is expressly and strictly limited to replacing or repairing without charge, any part or parts which prove to its satisfaction, upon examination, to have been defective and which have not been neglected, abused or misapplied, provided the buyer gives MLEE immediate written notice upon discovery of any claimed defect.

MLEE will also guarantee component parts manufactured by others to the extent of the guarantee made by the manufacturer of such equipment. In any case guarantees on specific components will be extended a minimum of one year from date of shipment.

WARRANTY EXCLUSIONS:

Warranty coverage does not include: (a) freight, labor, travel, and living expenses associated with parts replacements; (b) normal maintenance items such as lubrication, fan belts, and cleaning of the equipment.

In the event the customer, or any installation contractor employed by the customer, contracts outside Maple Leaf Environmental Equipment Ltd for installation work or erection of quoted equipment the customer shall assume full responsibility from said contract.