SERVICE INSTRUCTIONS WITH REPLACEMENT PARTS LIST

LV1000-200 CONTROLLER

Part of the Bard Free Cooling Unit System

NOTE: LV1000 Controller is required for operation when multiple FUSION-TEC® HR**AP wall-mount units are used.

Bard Manufacturing Company, Inc.
Bryan, Ohio 43506
www.bardhvac.com

Manual : 2100-673E
Supersedes: 2100-673D
Date: 6-27-18

CONTENTS

Using the LV1000 Interface.....5
LV1000 Controller Interface.....5
System Interface Structure/ Menu Password Levels.....5
Main Menu.....6
Status Screen.....6
Quick Menu.....6
Setpoints.....6
Info.....7
System Information.....7
System Demand.....7
Shelter Last 24 Hours.....7
Shelter Info.....7
Software Info.....7
Unit Information.....8
Unit Main Status Screen Mirror.....8
Unit A/C Circuit Information.....8
Unit Model/Serial Number.....8
Unit Last 24 Hours Operation.....9
Component Lifetime.....9
Data Log.....9
Changing to Celsius.....9
Calibrating Sensors.....9
Reset to Factory Defaults.....9
Clear Alarm Logs.....9
IP Configuration.....10
Modbus TCP Configuration.....11
Alarms.....12
Alarm Adjustment.....12
Acknowledging/Clearing Alarms.....12
Sensor Failure Alarms.....12
Temperature Alarms.....12
Low Temperature Alarm.....12
High Temperature Warning.....12
High Temperature Alarm.....13
Humidity Alarms.....13
Low Humidity Alarm.....13
High Humidity Alarm.....13
Smoke Alarm.....14
Hydrogen Alarm.....14
Generator Alarm.....15
Utility Power Loss Alarm.....16
Inverter Failure Alarm.....16
HVAC Fail Alarm.....16
HVAC Maintenance Alarm.....17
Anti-Theft Alarm.....17
Compressor Safety Timers.....18
Humidifier Output.....18
Control Operation.....19
Temperature Control.....19
Control Value Averaging.....19
Comfort Mode.....19
Emergency Vent.....19
Emergency Cool.....19
Cooling.....19
Unit Rotation.....19
Heating.....21
Humidity Control.....22
Humidification.....22
Dehumidification.....22
Fan Control.....23
Hour Counting.....23
LV1000 Modbus TCP Register List.....24
LV1000 Replacement Parts.....30

FIGURES AND TABLES

Figure 1 LV1000 Controller Display and Interface...5
Figure 2 Quick Menu Icon.....6
Figure 3 Enabling Comfort Mode.....7
Figure 4 System Demand.....7
Figure 5 Shelter Last 24 Hours.....7
Figure 6 Shelter Info.....7
Figure 7 Software Info.....8
Figure 8 Unit Main Status Screen Mirror.....8
Figure 9 Unit A/C Circuit Information.....8
Figure 10 Unit Model/Serial Number.....8
Figure 11 Unit Last 24 Hours Operation.....9
Figure 12 Component Lifetime.....9
Figure 13 Restoring Factory Default Settings.....9
Figure 14 Clearing LV1000 Alarm Logs.....10
Figure 15 IPv4 Configuration.....10
Figure 16 IPv6 Configuration Screen 1.....10
Figure 17 IPv6 Configuration Screen 2.....11
Figure 18 Modbus TCP Setup.....11
Figure 19 Clearing All Alarms.....12
Figure 20 Adjusting Temperature Alarm Setpoints..12
Figure 21 Adjusting Humidity Alarm Setpoints.....13
Figure 22 Changing Input Values.....14
Figure 23 Adjusting Units Running When Generator is Active.....15
Figure 24 Adjusting Economizers Running When Generator is Active.....16
Figure 25 Changing Output Values.....16
Figure 26 Changing HVAC Fail Outputs.....17
Figure 27 Changing HVAC Maintenance Outputs....17
Figure 28 Changing Compressor Safety Timer Values.....18
Figure 29 Adjusting Setpoints.....19
Figure 30 Adjusting Unit Rotation Parameters.....21
Figure 31 Adjusting Humidifiers Settings.....22
Figure 32 Adjusting Dehumidify Setpoints.....23
Figure 33 Adjusting Continuous Fan Setting.....23
Figure 34 Last 24 Hours Tracking.....23
Figure 35 LV100-200 Wiring Diagram.....29

Table 1 LV1000 Passwords (Defaults).....6
Table 2 LV1000 System Status Messages.....6
Table 3 Modbus Unit of Measure (UOM) Values...11
Table 4 Temperature and Humidity Sensors.....12
Table 5 Cooling Staging.....20
Table 6 Heating Staging.....22
Table 7 LV1000-200 Terminal Block Index.....28

Free Cooling Unit System

This Bard Free Cooling Unit system is composed of FUSION-TEC wall-mount air conditioners matched with an LV1000 first on/next on controller. The wall mount units are specifically engineered for telecom/motor control center rooms.

NOTE: *The LV1000 controller and FUSION-TEC wall-mount units are designed specifically to work together. The LV1000 controller cannot run other Bard models or other brands of systems. They are a complete system, and must be used together.*

NOTICE

It is important to check the software version during installation to ensure that the latest version has been installed. Current software versions, change log and installation instructions are available on the Bard website at http://www.bardhvac.com/software-download/

Controller

LV1000 controller and accessories included are shown below.

LV1000 Series

LV1000 Series
Programmable Logic
Controller

TEC-EYE™ Hand-Held
Diagnostic Tool
Bard P/N 8301-059

Remote Temperature/
Humidity Sensor*
(with 35' shielded cable)
Bard P/N 8403-079

Communication
EMI Filters
Bard P/N 8301-055

* One remote temperature/humidity sensor and 35' of 5-wire shielded cable are included with the LV1000 controller. Up to two additional remote temperature/humidity sensors can be purchased and installed. Temperature-only sensors (Bard P/N 8301-058) may be used instead of the additional temperature/humidity sensors, but will also need to be purchased separately. Temperature-only sensors require field-supplied 2-wire shielded cable.

The equipment covered in this manual is to be installed by trained, experienced service and installation technicians.

These instructions should be carefully read before beginning the installation. Note particularly any tags and/or labels attached to the equipment.

While these instructions are intended as a general recommended guide, they do not supersede any national and/or local codes in any way. Authorities having jurisdiction should be consulted before the installation is made. See **Additional Publications** for information on codes and standards.

Shipping Damage

Upon receipt of equipment, the cartons should be checked for external signs of shipping damage. If damage is found, the receiving party must contact the last carrier immediately, preferably in writing, requesting inspection by the carrier's agent.

Additional Publications

These publications can help when installing the air conditioner. They can usually be found at the local library or purchased directly from the publisher. Be sure to consult the current edition of each standard.

National Electrical Code.....ANSI/NFPA 70

Standard for the Installation of Air Conditioning and Ventilating Systems .....ANSI/NFPA 90A

Standard for Warm Air Heating and Air Conditioning Systems .....ANSI/NFPA 90B

Load Calculation for Residential Winter and Summer Air Conditioning ..... ACCA Manual J

Duct Design for Residential Winter and Summer Air Conditioning and Equipment Selection ..... ACCA Manual D

For more information, contact these publishers:

Air Conditioning Contractors of America (ACCA)
1712 New Hampshire Ave. N.W.
Washington, DC 20009
Telephone: (202) 483-9370 Fax: (202) 234-4721

American National Standards Institute (ANSI)
11 West Street, 13th Floor
New York, NY 10036
Telephone: (212) 642-4900 Fax: (212) 302-1286

American Society of Heating, Refrigeration and Air Conditioning Engineers, Inc. (ASHRAE)
1791 Tullie Circle, N.E.
Atlanta, GA 30329-2305
Telephone: (404) 636-8400 Fax: (404) 321-5478

National Fire Protection Association (NFPA)
Batterymarch Park
P. O. Box 9101
Quincy, MA 02269-9901
Telephone: (800) 344-3555 Fax: (617) 984-7057

ANSI Z535.5 Definitions:

DANGER: Indicate[s] a hazardous situation which, if not avoided, will result in death or serious injury. The signal word "DANGER" is to be limited to the most extreme situations. DANGER [signs] should not be used for property damage hazards unless personal injury risk appropriate to these levels is also involved.

WARNING: Indicate[s] a hazardous situation which, if not avoided, could result in death or serious injury. WARNING [signs] should not be used for property damage hazards unless personal injury risk appropriate to this level is also involved.

CAUTION: Indicate[s] a hazardous situation which, if not avoided, could result in minor or moderate injury. CAUTION [signs] without a safety alert symbol may be used to alert against unsafe practices that can result in property damage only.

NOTICE: [this header is] preferred to address practices not related to personal injury. The safety alert symbol shall not be used with this signal word. As an alternative to "NOTICE" the word "CAUTION" without the safety alert symbol may be used to indicate a message not related to personal injury.

FIGURE 1
LV1000 Controller Display and Interface (Status Screen Shown)

ALARM KEY
Allows viewing of active alarms
Silences audible alarms
Resets active alarms

MENU KEY
Allows entry to Main Menu

ESCAPE KEY
Returns to previous menu level
Cancels a changed entry

UP KEY
Steps to next screen in the display menu
Changes (increases) the value of a modifiable field

ENTER KEY
Accepts current value of a modifiable field
Advances cursor

DOWN KEY
Steps back to previous screen in the display menu
Changes (decreases) the value of a modifiable field

LV1000 Controller Interface

The microprocessor control used in these wall mount air conditioners allows for complete control and monitoring through the use of the LV1000 controller. These controllers utilize the latest in state-of-the-art technology including a large, easy-to-read backlit LCD graphic display.

The menu driven interface provides users the ability to scroll through two menu levels: Quick Menu and Main Menu. The menus permit the user to easily view, control and configure the unit.

The controller is completely programmed at the factory; therefore, most applications will require no field set-up. However, the default setpoints and their ranges are easily viewed and adjusted from the controller display. The program and operating parameters are permanently stored on FLASH-MEMORY in case of power failure. The controller is designed to manage temperature levels to a user-defined setpoint via control output signals to the wall-mount air conditioning system.

NOTE: *Screenshots shown in this manual reflect default settings (when applicable).*

System Interface Structure/Menu Password Levels

- Quick Menu
  - Setpoints (Comfort Mode)
  - Information
    - System Information
      - Unit 1 Information
      - Unit 2 Information (when configured)
      - Unit 3 Information (when configured)
      - Unit 4 Information (when configured)
  - Alarm Log
- Main Menu
  - System Configuration: A1-A10 User (2000)
  - Adv. System Config: B1-B4 Technician (1313)
  - I/O Configuration: C1-C18 Technician (1313)
  - On/Off: User (2000)
  - Alarm Log: User (2000)
  - Settings
    - Date/Time: Technician (1313)
    - Language: User (2000)
    - Network Configuration: Technician (1313)
    - Modbus TCP Config: Technician (1313)
    - Import/Export: User (2000)
    - Initialization: User (2000)
    - Change Passwords
  - Logout

In addition to the menu structure above, there are also Status and Alarm screens.

TABLE 1
LV1000 Passwords (Defaults)

User	2000
Technician	1313
Engineer	9254
Use UP or DOWN keys and ENTER key to enter password	

Main Menu

Press the MENU key from any screen to return to the Main Menu. Press the UP or DOWN keys to scroll through the available menus. When the desired menu is highlighted, press the ENTER key to access that menu. Press the ESCAPE key or MENU key to return to the Status screen from the Main Menu.

Status Screen

The Status screen is the default start-up screen and also the return screen after 5 minutes of no activity. The screen can be accessed any time by pressing the ESCAPE key repeatedly. The LV1000 Status screen displays the current date and time, indoor room conditions and system status. See Table 2 for LV1000 system status messages.

The Quick Menu is available on the Status screen. Use UP or DOWN keys while on the Status screen to scroll between the three Quick Menu options (see Figure 2); press ENTER key when the desired icon is displayed.

FIGURE 2
Quick Menu Icons

Data Log System Information Setpoints

Quick Menu

Setpoints

The Setpoints quick menu allows for a technician in the shelter the ability to set up, enable or disable comfort mode.

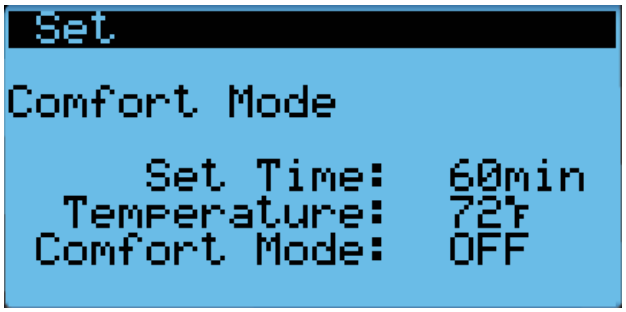
To enable comfort mode:

1. From the Status screen, press UP or DOWN key until Quick Menu displays Setpoints icon. Press ENTER key.
2. Press ENTER key to scroll to the Comfort Mode (see Figure 3).
3. Press UP or DOWN key to change value from **OFF** to **ON.**
4. Press ENTER key to save.
5. Press ESCAPE key until Main Menu screen is displayed.

TABLE 2
LV1000 System Status Messages

Message	Description
Waiting...	POC is on and has not started the application yet.
Freecooling	System is actively economizing.
Cooling	System is actively mechanical cooling.
Optomized Cool	System is mechanical cooling while actively economizing.
Heating	System is actively heating.
Passive Dehum	System is taking measures to decrease humidity without using extra energy.
Active Dehum	System is taking active measures to decrease humidity.
Power Loss	Unit(s) in system have suffered a power loss.
Inverter Mode	System is operating on inverter power.
Off by Alarm	System has major fault preventing operation.
Off by BMS	System has been turned off from BMS system.
Off by Keypad	System has been turned off by local user.
Unit in Test	Unit(s) in system are currently conducting a self test.
Override Active	There is an active override on the system.
Comfort Mode	System is operating in Comfort Mode.
Emergency Vent	Unit is in Emergency Ventilation. System has active hydrogen alarm.
Emergency Cool	System is in Emergency Cooling. Indoor temperatures have exceeded high temp alarm.
Emergency Off	System is in Emergency Off. System has an active smoke alarm.

FIGURE 3
Enabling Comfort Mode



Info

The Info quick menu displays system and unit status information for all devices attached to the system. The info display is broken up into two menu types (system information and unit information). The number of unit information menu items available will depend on the number of units the LV1000 is set up to command.

System Information

The System Information menu displays the following information: system demand, system last 24 hour run times, system last hour averages (indoor temperature, indoor humidity, outdoor temperature and outdoor humidity) and software version information.

System Demand

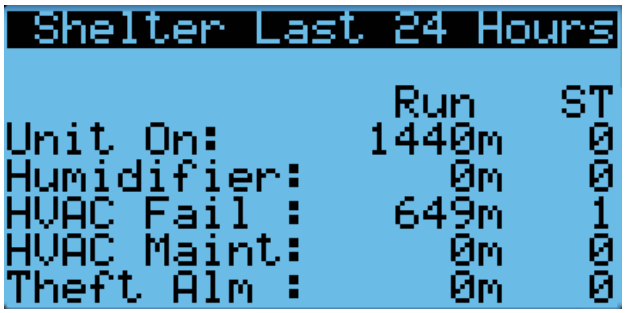
The System Demand screen displays the current demand that is required from the system to heat or cool the indoor space. Each function of the system has a separate demand that is displayed in the upper portion of the display (see Figure 4). The lower half of the display indicates each output stage that is to be called on for each unit. It will also display **No Device** if a specific unit is not connected. When functions like freecooling or heating are not available, this area will display **--** for that specific unit.

FIGURE 4
System Demand

Shelter Last 24 Hours

Last 24 hour operation information tracks the run times (**Run**) and start calls (**ST**) of different NOC output alarms in the last 24 hour period (see Figure 5).

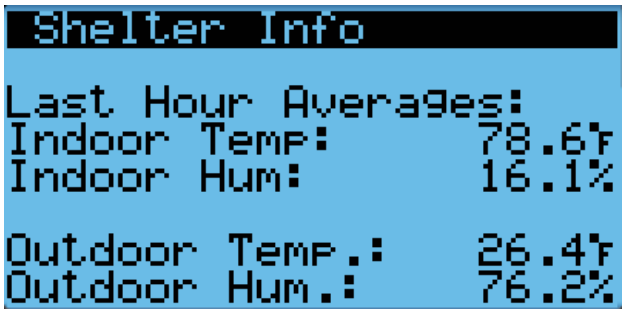
FIGURE 5
Shelter Last 24 Hours



Shelter Info

The Shelter Info screen displays the average temperature/humidity readings of the last hour (see Figure 6).

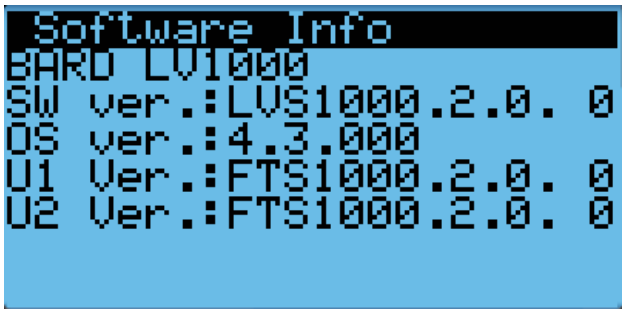
FIGURE 6
Shelter Info



Software Info

The Software Info screen (Figure 7 on page 8) displays the LVS1000 software version (**SW ver.**) and PLC operating system version (**OS ver.**) for the LV1000 and each wall-mount unit software version (**U1 ver.**, **U2 ver.**, **U3 ver.**, **U4 ver.**). This information can be used to determine whether a software update may be required based on information found in the software change log. This change log can be found at http://www.bardhvac.com/software-download/.

FIGURE 7
Software Info



NOTICE

It is important to check the software version during installation to ensure that the latest version has been installed. Current software versions, change log and installation instructions are available on the Bard website at http://www.bardhvac.com/software-download/

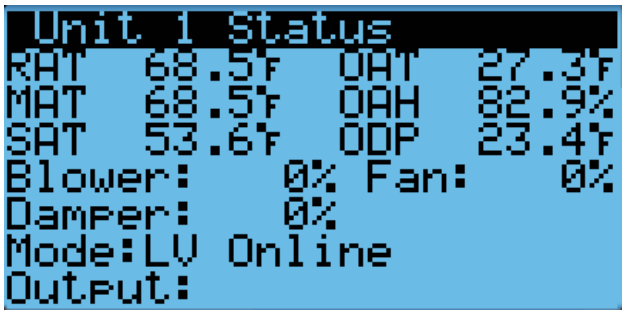
Unit Information

The LV1000 has the ability to provide individual wall unit information which it displays in individual unit information screens. The purpose of these screens is to eliminate the need to remove the panel from a wall unit in order to plug in the TEC-EYE™. Each unit information menu item displays the following information: unit main status screen mirror, unit A/C circuit information, unit model/serial number, unit last 24 hour run times and component lifetimes.

Unit Main Status Screen Mirror

The Unit Main Status screen (Figure 8) mirrors the main status screen of the wall unit. The main status screen also shows the return air temperature (RAT), mixed air temperature (MAT), outdoor air temperature (OAT), outdoor air humidity (OAH) and outdoor dew point (ODP) conditions. Blower speed, condenser fan speed, damper position and unit status are also displayed. In addition to what is displayed on the wall unit's main status screen, this screen also displays the actual wall unit output staging. Refer to the latest version of unit service manual 2100-670 for a list of wall-mount unit status messages.

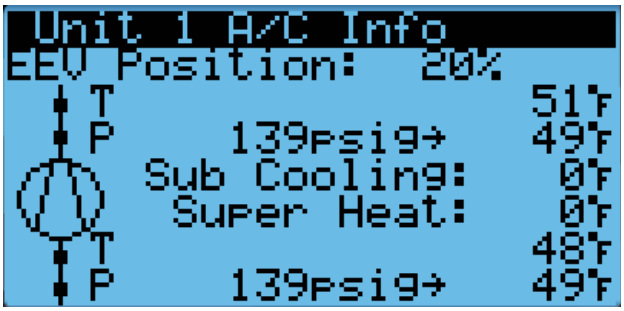
FIGURE 8
Unit Main Status Screen Mirror



Unit A/C Circuit Information

The A/C Circuit Information screen lists all available A/C sensor measurements and calculations on the unit specified (see Figure 9). The information and measurements provided are liquid line temperature, liquid line pressure, condensing saturated temperature, suction line temperature, suction line pressures, suction saturated temperature, super heat, sub-cooling and electronic expansion valve position.

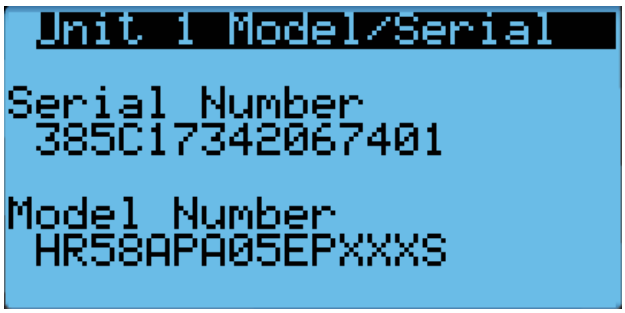
FIGURE 9
Unit A/C Circuit Information



Unit Model/Serial Number

The Unit Model/Serial Number screen allows for the user to verify model and serial number from the LV1000 (see Figure 10).

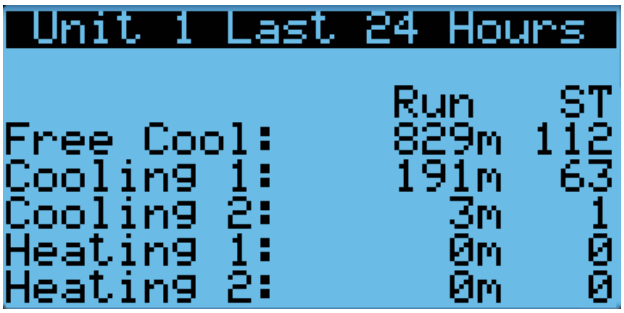
FIGURE 10
Unit Model/Serial Number



Unit Last 24 Hours Operation

The Unit Last 24 Hours Operation information tracks the runtimes (**Run**) and start calls (**ST**) of different unit operations in the last 24 hour period (see Figure 11).

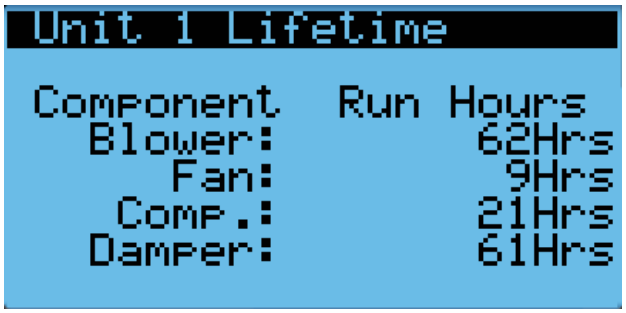
FIGURE 11
Unit Last 24 Hours Operation



Component Lifetime

The Component Lifetime screen tracks the cumulative running hours of specific components within the unit. (see Figure 12).

FIGURE 12
Component Lifetime



Data Log

The data log displays the record number, time of alarm event, date of alarm event, description of alarm event and whether the entry is the beginning or end of event. The data log will have as many screens as events occurred, up to 64 entries.

Changing to Celsius

1. Press MENU key to go to the Main Menu screen.
2. Use UP or DOWN keys and ENTER key to enter USER password 2000.
3. Press UP or DOWN keys to scroll to **Sys Config**; press ENTER key.
4. Press UP or DOWN keys to scroll to **Unit Setup (A1)**.
5. Press ENTER key to scroll to **UOM**.
6. Press UP and DOWN keys to change value to **SI**.

Calibrating Sensors

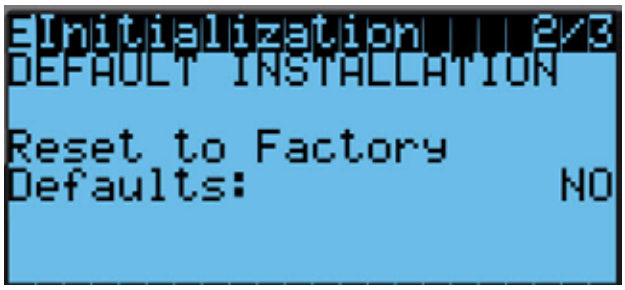
1. Press MENU key to go to the Main Menu screen.
2. Use UP or DOWN keys and ENTER key to enter TECHNICIAN password 1313.
3. Press UP or DOWN keys to scroll to **I/O Config**; press ENTER key.
4. Press UP or DOWN keys to scroll to sensor to be adjusted.
5. Press ENTER key to scroll to **Offset**.
6. Press UP or DOWN keys to add or subtract to the sensor offset value.
7. Press ENTER key to save.

Reset to Factory Defaults

To reset the LV controller to factory default settings:

1. Press MENU key to go to the Main Menu screen.
2. Use UP or DOWN keys and ENTER key to enter ENGINEER password 9254.
3. Press UP or DOWN keys to scroll to **Settings**; press ENTER key.
4. Press UP or DOWN keys to scroll to **Initialization**; press ENTER key.
5. Press UP or DOWN keys to scroll to the **Default Installation** screen; press ENTER key.
6. Press ENTER key to scroll to **Reset to Factory Defaults** (see Figure 13).
7. Press UP or DOWN key to value to **YES**; press ENTER key.
8. System will restart with default values.

FIGURE 13
Restoring Factory Default Settings



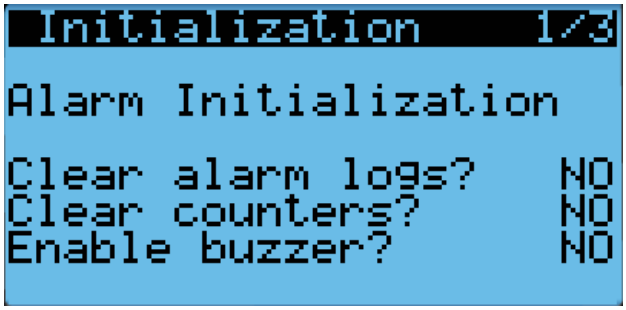
Clear Alarm Logs

To clear the LV controller alarm logs:

1. Press MENU key to go to the Main Menu screen.
2. Use UP or DOWN keys and ENTER key to enter USER password 2000.
3. Press UP or DOWN keys to scroll to **Settings**; press ENTER key.
4. Press UP or DOWN keys to scroll to **Initialization**; press ENTER key.

5. Press ENTER key to scroll to **Clear Alarm Logs?** (see Figure 14).
6. Press UP or DOWN key to value to **YES**; press ENTER key.
7. Press ESCAPE key several times to return to Main Menu screen.

FIGURE 14
Clearing LV1000 Alarm Logs

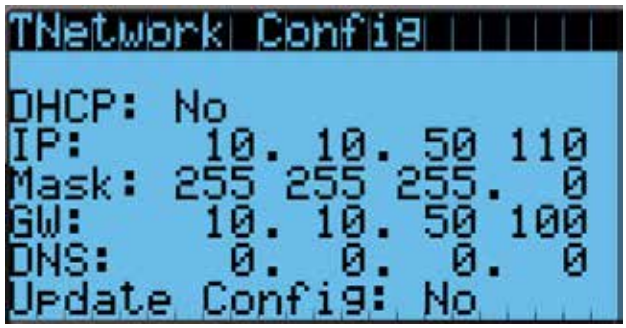


IP Configuration

To set an LV IPv4 address:

1. Press MENU key to go to the Main Menu screen.
2. Use UP or DOWN keys and ENTER key to enter TECHNICIAN password 1313.
3. Press UP or DOWN keys to scroll to **Settings**; press ENTER key.
4. Press UP or DOWN keys to scroll to **Network Config**; press ENTER key.
5. Press ENTER key to scroll to desired value to be changed (see Figure 15).
6. Press UP or DOWN keys to change selected value.
7. Press ENTER key to save and scroll to next value.
8. When finished, press ENTER key until cursor is on the **Update Configure** value; press ENTER key to update **Network Configuration**.
9. Press ESCAPE key several times to return to Main Menu screen.

FIGURE 15
IPv4 Configuration

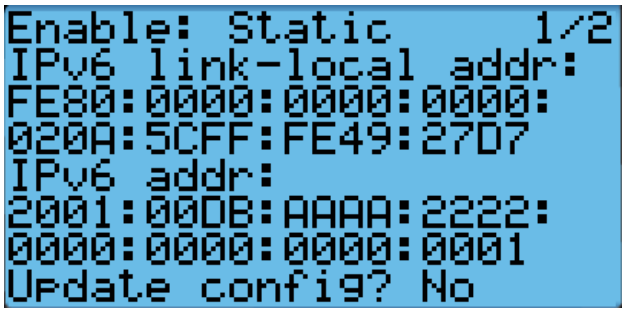


The LV1000 is capable of IPv6 communication over Ethernet and is set up differently than the IPv4 address.

To set an LV IPv6 address:

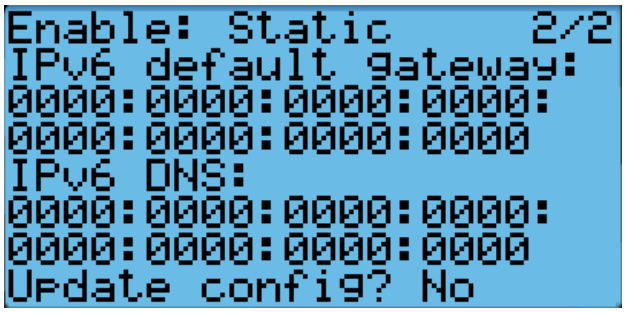
1. Press and hold the ALARM and ENTER key for 3 seconds.
2. Press UP or DOWN keys to scroll to **Settings**; press ENTER key.
3. Press UP or DOWN keys to scroll to **TCP/IPv6 Settings**; press ENTER key.
4. Press ENTER key to scroll to desired value to be changed (see Figure 16).
5. Press UP or DOWN keys to change selected value.
6. Press ENTER key to save and scroll to next value.
7. When finished, press ENTER key until cursor is on the **Update Configure** value; press ENTER key to update **Network Configuration**.

FIGURE 16
IPv6 Configuration Screen 1



8. To update additional IPv6 settings such as Gateway and DNS addresses, press ENTER key until cursor is on the page value; press ENTER key.
9. Press ENTER key to scroll to desired value to be changed (see Figure 15).
10. Press UP or DOWN keys to change selected value.
11. Press ENTER key to save and scroll to next value.
12. When finished, press ENTER key until cursor is on the **Update Configure** value; press ENTER key to update **Network Configuration**.
13. Press ESCAPE key several times to return to Main Menu screen.

FIGURE 17
IPv6 Configuration Screen 2



Modbus TCP Configuration

LV1000 version 1.1.0 and higher include Modbus RTU over TCP included on the Ethernet connection. This is a Modbus Slave device and requires a Modbus Master device to properly communicate. Modbus Register list can be found on page 24 of this manual.

To make changes to the Modbus setup:

1. Press MENU key to go to the Main Menu screen.
2. Use UP or DOWN keys and ENTER key to enter TECHNICIAN password 1313.
3. Press UP or DOWN keys to scroll to **Settings**; press ENTER key.
4. Press UP or DOWN keys to scroll to **ModbusTCP Config**; press ENTER key.
5. Press ENTER key to scroll to **Address** (see Figure 18).
6. Press UP or DOWN keys change the Modbus address.
7. Press ENTER key to scroll to **Port**.
8. Press UP or DOWN keys change the Port number if needed. (Default is port 502.)
9. Press ENTER key to scroll to **UOM**.
10. Press UP or DOWN keys change the Unit of Measure for Modbus values (see Table 3).

FIGURE 18
Modbus TCP Setup

TABLE 3
Modbus Unit of Measure (UOM) Values

UOM Type	Temperature UOM	Pressure UOM
SI	°C	KPA
USA (Default)	°F	PSI
UK	°F	BAR
CAN	°C	PSI
LON	°C	KPA

ALARMS

NOTE: *Screenshots shown in this manual reflect default settings (when applicable).*

Alarm Adjustment

Acknowledging/Clearing Alarms

When there are active alarm conditions on the system, a red LED indicator will backlight the ALARM function key. As an option, an alarm condition may also be enunciated by an audible alarm signal. Active alarms on the system can be viewed by pressing the ALARM key. This calls up the alarm display screen(s) that provide a text message detailing the active alarm condition(s).

After an alarm condition is corrected, the alarm can be cleared by pressing the ALARM key for 3 seconds if that specific alarm is not self-clearing. To reset all alarms on the system, from the alarm display screen, press UP or DOWN key until the screen appears that states **Press ALARM for 3s to reset all alarms** and press the ALARM key for 3 seconds (see Figure 19). If alarms do not clear, the alarm condition is still present. If the alarms clear, the screen should display **NO ALARMS**.

FIGURE 19
Clearing All Alarms

Sensor Failure Alarms

The controller is capable of determining if a sensor has failed. If the temperature or humidity measurement is outside the ranges shown in Table 4, the controller will consider the sensor as failed.

The sensor failure alarms are self clearing.

TABLE 4
Temperature and Humidity Sensors

Sensor	Range
Indoor Temperature 1	-41°F to 303°F
Indoor Temperature 2	-41°F to 303°F
Indoor Temperature 3	-41°F to 303°F
Indoor Humidity 1	0-100%
Indoor Humidity 2	0-100%
Indoor Humidity 3	0-100%

Temperature Alarms (Low Temp, High Temp Warn, High Temp Alarm)

Low Temperature Alarm

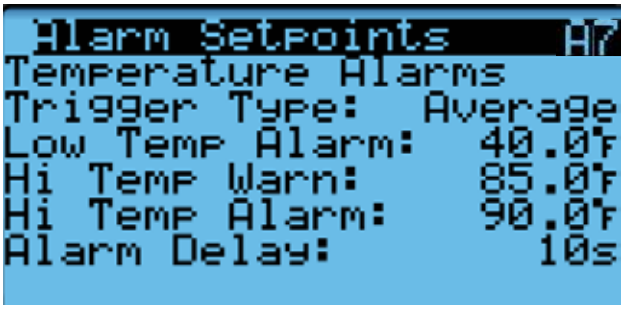
The LV will indicate an indoor low temperature alarm when any of the connected sensors that are enabled read a value below the low temperature limit of 40°F (factory default). By default, this alarm uses the average of sensors if more than one space sensor is used.

The low temperature alarm is self clearing.

To adjust the low temperature alarm setpoint:

1. Press MENU key to go to the Main Menu screen.
2. Use UP or DOWN keys and ENTER key to enter USER password 2000.
3. Press UP or DOWN keys to scroll to **Sys Config**; press ENTER key.
4. Press UP or DOWN keys to scroll to **Alarm Setpoints (A7)**.
5. Press ENTER key to scroll to **Low Temp** (see Figure 20).
6. Press UP or DOWN keys to adjust setpoint.

FIGURE 20
Adjusting Temperature Alarm Setpoints



High Temperature Warning

The LV will indicate a high temperature warning alarm when any of the connected sensors that are enabled read a value above the high temperature limit of 85°F (factory default). By default, this alarm uses the average of sensors if more than one space sensor is enabled.

The high temperature warning alarm is self clearing.

To adjust the high temperature warning setpoint:

1. Press MENU key to go to the Main Menu screen.
2. Use UP or DOWN keys and ENTER key to enter USER password 2000.
3. Press UP or DOWN keys to scroll to **Sys Config**; press ENTER key.

4. Press UP or DOWN keys to scroll to **Alarm Setpoints (A7)**.
5. Press ENTER key to scroll to **High Temp Warn** (see Figure 20).
6. Press UP or DOWN keys to adjust setpoint.

High Temperature Alarm

The LV will indicate a high temperature alarm when any of the connected sensors that are enabled read a value above the high temperature limit of 90°F (factory default). By default, this alarm uses the average of sensors if more than one space sensor is enabled. In addition to the alarm being generated, this event will put the system into Emergency Cool mode. See **Emergency Cool** on page 19 for more information.

To adjust the high temperature alarm setpoint:

1. Press MENU key to go to the Main Menu screen.
2. Use UP or DOWN keys and ENTER key to enter USER password 2000.
3. Press UP or DOWN keys to scroll to **Sys Config**; press ENTER key.
4. Press UP or DOWN keys to scroll to **Alarm Setpoints (A7)**.
5. Press ENTER key to scroll to **High Temp Alarm** (see Figure 20).
6. Press UP or DOWN keys to adjust setpoint.

The trigger type for the low temperature, high temperature warning and high temperature alarms can be changed to reference either the displayed average or the lowest value (for low temperature alarm) and the highest value (for high temperature alarms). This only applies to multiple sensor installations. If only one sensor is used, this does not affect operation.

The default setting is **Average**.

To adjust the temperature alarms trigger type:

1. Press MENU key to go to the Main Menu screen.
2. Use UP or DOWN keys and ENTER key to enter USER password 2000.
3. Press UP or DOWN keys to scroll to **Sys Config**; press ENTER key.
4. Press UP or DOWN keys to scroll to **Alarm Setpoints (A7)**.
5. Press ENTER key to scroll to **Trigger Type** (see Figure 20).
6. Press UP or DOWN keys to change from **Average** to **Hi/Low**.

A delay of 10 seconds (factory default) is applied to each alarm. This can be adjusted by:

1. Press MENU key to go to the Main Menu screen.
2. Use UP or DOWN keys and ENTER key to enter USER password 2000.
3. Press UP or DOWN keys to scroll to **Sys Config**; press ENTER key.
4. Press UP or DOWN keys to scroll to **Alarm Setpoints (A7)**.
5. Press ENTER key to scroll to **Alarm Delay** (see Figure 20).
6. Press UP or DOWN keys to adjust the delay.

Humidity Alarms (Low Hum, High Hum)

Low Humidity Alarm

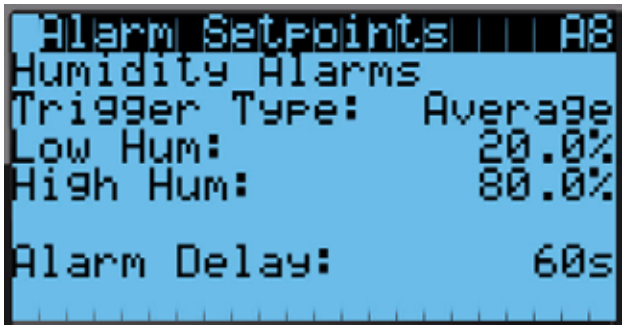
The LV will indicate an indoor low humidity alarm when any of the connected sensors that are enabled read a value below the low humidity limit of 10% RH (factory default). By default, this alarm uses the average of sensors if more than one space sensor is enabled.

The low humidity alarm is self clearing.

To adjust the low humidity alarm setpoint:

1. Press MENU key to go to the Main Menu screen.
2. Use UP or DOWN keys and ENTER key to enter USER password 2000.
3. Press UP or DOWN keys to scroll to **Sys Config**; press ENTER key.
4. Press UP or DOWN keys to scroll to **Alarm Setpoints (A8)**.
5. Press ENTER key to scroll to **Low Hum** (see Figure 21).
6. Press UP or DOWN keys to adjust setpoint.

FIGURE 21
Adjusting Humidity Alarm Setpoints



High Humidity Alarm

The LV will indicate a high humidity alarm when any of the connected sensors that are enabled read a value above the high humidity limit of 80% RH (factory default). By default, this alarm uses the average of sensors if more than one space sensor is enabled.

The high humidity alarm is self clearing.

To adjust the high humidity alarm setpoint:

1. Press MENU key to go to the Main Menu screen.

2. Use UP or DOWN keys and ENTER key to enter USER password 2000.
3. Press UP or DOWN keys to scroll to **Sys Config**; press ENTER key.
4. Press UP or DOWN keys to scroll to **Alarm Setpoints (A8)**.
5. Press ENTER key to scroll to **High Hum** (see Figure 21).
6. Press UP or DOWN keys to adjust setpoint.

The trigger type for the low humidity and high humidity alarms can be changed to reference either the displayed average or the lowest value (for low humidity alarm) and the highest value (for high humidity alarm). This only applies to multiple sensor installations. If only one sensor is used, this does not affect operation.

The default setting is **Average**.

To adjust the temperature alarms trigger type:

1. Press MENU key to go to the Main Menu screen.
2. Use UP or DOWN keys and ENTER key to enter USER password 2000.
3. Press UP or DOWN keys to scroll to **Sys Config**; press ENTER key.
4. Press UP or DOWN keys to scroll to **Alarm Setpoints (A8)**.
5. Press ENTER key to scroll to **Trigger Type** (see Figure 21).
6. Press UP or DOWN keys to change from **Average** to **Hi/Low**.

A delay is available to be applied to each humidity alarm (default is 60 seconds). This can be adjusted by:

1. Press MENU key to go to the Main Menu screen.
2. Use UP or DOWN keys and ENTER key to enter USER password 2000.
3. Press UP or DOWN keys to scroll to **Sys Config**; press ENTER key.
4. Press UP or DOWN keys to scroll to **Alarm Setpoints (A8)**.
5. Press ENTER key to scroll to **Alarm Delay** (see Figure 21).
6. Press UP or DOWN keys to adjust the delay.

Smoke Alarm

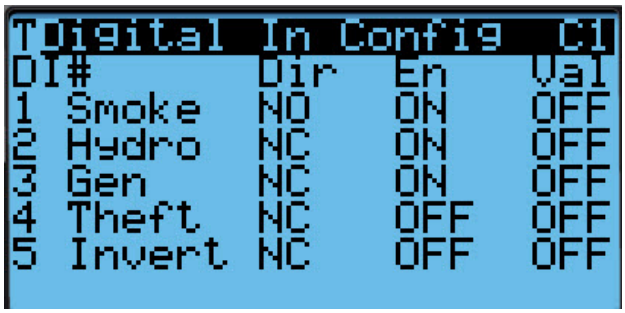
The LV will indicate a smoke alarm when the smoke detector input is activated in the shelter. This input is enabled by default. To utilize this input, connect the detector alarm relay to the smoke detector input and smoke detector common. The alarm will be communicated to all of the wall-mount units. The LV1000 will disable all operations and all connected wall-mount units will be disabled so that no operations occur while a smoke alarm is present. See smoke alarm installation instructions for specific wiring information. This alarm will automatically clear when the smoke detector no longer indicates smoke is present. This alarm will latch on once activated; it requires a user to manually reset it.

NOTE: *The variable provided in the Direction column of the Digital In Config (C1) screen (as shown in Figure 22) displays either NO (Normally Open) or NC (Normally Closed). This column lists the type of signaling contact connected to the LV1000. If connected to an NO contact on the smoke detector, the input circuit will be closed if there is a smoke event. Therefore, in this case the LV1000 must be set to look for NO.*

To change the smoke inputs:

1. Press MENU key to go to the Main Menu screen.
2. Use UP or DOWN keys and ENTER key to enter TECHNICIAN password 1313.
3. Press UP or DOWN keys to scroll to **IO Config**; press ENTER key.
4. Press UP or DOWN keys to scroll to **Digital In Config (C1)**.
5. Press ENTER key to scroll to the variable in the table that intersects **Smoke** and **Dir** (see Figure 22).
6. Press UP or DOWN key to change direction.
7. Press ENTER key to save the value and move cursor to variable in the table that intersects **Smoke** and **En**.
8. Press UP or DOWN keys to change the value from **ON** to **OFF**.

FIGURE 22
Changing Input Values



Hydrogen Alarm

The LV will indicate a hydrogen alarm when the hydrogen detector indicates high levels of hydrogen inside the shelter. This input is enabled by default but comes with a factory-installed jumper. To utilize this input, remove the jumper and connect the sensor in place of the jumper. In addition to the alarm being generated, this event will put the system into

emergency vent mode. See **Emergency Vent** on page 19 for more information. This alarm will automatically clear when the hydrogen detector no longer indicates hydrogen is present.

NOTE: *The variable provided in the Direction column of the Digital In Config (C1) screen (as shown in Figure 22) displays either NO (Normally Open) or NC (Normally Closed). This column lists the type of signaling contact connected the LV1000. If connected to an NC contact on the hydrogen detector, the input circuit will be open if there is a hydrogen event. Therefore, in this case the LV1000 must be set to look for NC.*

To change the hydrogen inputs:

1. Press MENU key to go to the Main Menu screen.
2. Use UP or DOWN keys and ENTER key to enter TECHNICIAN password 1313.
3. Press UP or DOWN keys to scroll to **IO Config**; press ENTER key.
4. Press UP or DOWN keys to scroll to **Digital In Config (C1)**.
5. Press ENTER key to scroll to the variable in the table that intersects **Hydro** and **Dir** (see Figure 22).
6. Press UP or DOWN key to change direction.
7. Press ENTER key to save the value and move cursor to variable in the table that intersects **Hydro** and **En**.
8. Press UP or DOWN keys to change the value from **ON** to **OFF**.

Generator Alarm

The LV will indicate a generator run alarm when the generator run input indicates that the generator is running. This input is enabled by default but comes with a factory-installed jumper. To utilize this input, remove the jumper and connect the generator in place of the jumper.

NOTE: *The variable provided in the Direction column of the Digital In Config (C1) screen (as shown in Figure 22) displays either NO (Normally Open) or NC (Normally Closed). This column lists the type of signaling contact connected the LV1000. If connected to an NC contact on the generator, the input circuit will be open when the generator is running. Therefore, in this case the LV1000 must be set to look for NC.*

To change the generator inputs:

1. Press MENU key to go to the Main Menu screen.
2. Use UP or DOWN keys and ENTER key to enter TECHNICIAN password 1313.
3. Press UP or DOWN keys to scroll to **IO Config**; press ENTER key.
4. Press UP or DOWN keys to scroll to **Digital In Config (C1)**.
5. Press ENTER key to scroll to the variable in the table that intersects **Gen** and **Dir** (see Figure 22).
6. Press UP or DOWN key to change direction.
7. Press ENTER key to save the value and move cursor to variable in the table that intersects **Gen** and **En**.
8. Press UP or DOWN keys to change the value from **ON** to **OFF**.

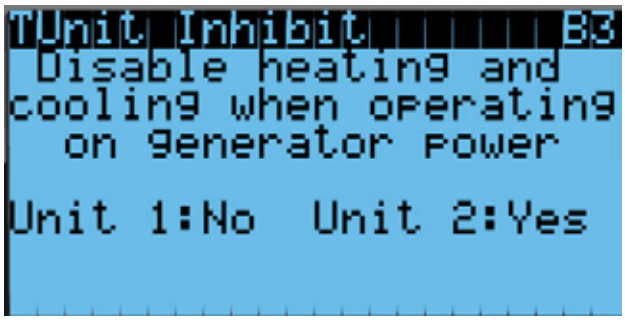
While the generator is running, the system will only allow selected units to run. This selection is customizable by the end user. This limitation is in place to match the unit power requirements to the shelter generator capacity.

The default for this setting is 1 unit is permitted to run if 1, 2, or 3 is selected for the number of units installed on the shelter. If the shelter is configured for 4 units, the default will be 2 units. If a different strategy is required, the end user can select which units by address are allowed to run when the generator run input is active.

To change which units run when the generator run input is active:

1. Press MENU key to go to the Main Menu screen.
2. Use UP or DOWN keys and ENTER key to enter TECHNICIAN password 1313.
3. Press UP or DOWN keys to scroll to **Adv System Config**; press ENTER key.
4. Press UP or DOWN keys to scroll to **Unit Inhibit (B3)**.
5. Press ENTER key to scroll to **Unit 1** (see Figure 23).
6. Press UP or DOWN key to change **Enabled on Gen** to **Disabled on Gen**.
7. Press ENTER key to save the value and move cursor to **Unit 2**.
8. Press UP or DOWN keys and ENTER key to change units to **Disabled on Gen** as needed.

FIGURE 23
Adjusting Units Running When Generator is Active



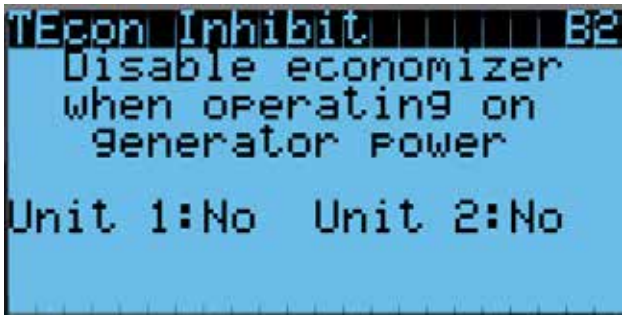
The system will also disable economizer operation of all wall-mount units when the generator is running. This setting can be changed per wall-mount unit by the end user to allow the economizer to operate if the exhaust of the generator is far enough away from the wall-mount unit's fresh air intake.

To change which units can use the economizer when the generator run input is active:

1. Press MENU key to go to the Main Menu screen.
2. Use UP or DOWN keys and ENTER key to enter TECHNICIAN password 1313.
3. Press UP or DOWN keys to scroll to **Adv System Config**; press ENTER key.
4. Press UP or DOWN keys to scroll to **Econ Inhibit (B2)**.
5. Press ENTER key to scroll to **Unit 1** (see Figure 24).
6. Press UP or DOWN key to change **Enabled on Gen** to **Disabled on Gen**.
7. Press ENTER key to save the value and move cursor to **Unit 2**.
8. Press UP or DOWN keys and ENTER key to change units to **Disabled on Gen** as needed.

This alarm will clear and operation will return to normal when the generator run input no longer indicates the generator is running.

FIGURE 24
Adjusting Economizers Running When Generator is Active



Utility Power Loss Alarm

The LV will indicate a utility power loss alarm if equipped with inverter-ready wall-mount units. When utility power is not present, the wall-mount unit controller will detect a power loss and communicate the event to the LV. The LV will then indicate a utility power loss alarm. When the power loss alarm is no longer present, the alarm will automatically clear.

Inverter Failure Alarm

The LV has the ability to monitor the VIC Series inverter (sold separately) for a failure. Once wired from the inverter fault relay in the VIC inverter to terminals 16 and 17 in the LV1000-200, the LV will alarm on inverter failure.

NOTE: *The variable provided in the Direction column of the Digital In Config (C1) screen (as shown in Figure 22) displays either NO (Normally Open) or NC (Normally Closed). This column lists the type of signaling contact connected the LV1000. If connected to an NC contact on the inverter, the input circuit will be open when the inverter reports a fault. Therefore, in this case the LV1000 must be set to look for NC.*

HVAC Fail Alarm

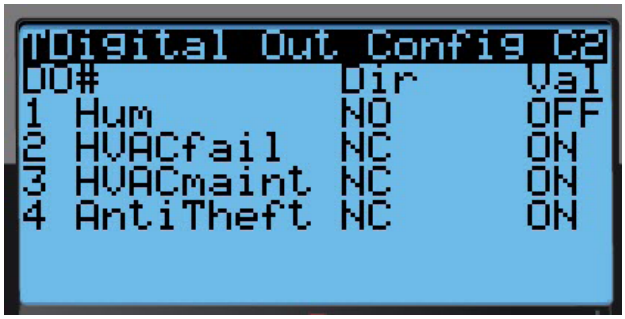
The LV monitors all connected wall-mount unit alarms. If any of the units communicate specific alarms, the LV will actuate an HVAC fail alarm relay output. The following wall-mount unit events have the possibility of actuating an HVAC failure: High pressure (always), low pressure (always), blower failure (always), high temperature warning (user selectable), high temperature alarm (user selectable) and low temperature alarm (user selectable). Each event will be displayed individually on the LV. However, any of these alarms (when enabled) will actuate the alarm relay for HVAC failure. This output is connected to the NOC for remote notification. When all of these events are no longer present, the alarm relay output will close, signaling there are no HVAC failure alarms.

The LV is will actuate a relay output when this alarm occurs. The output is set up to open when an alarm occurs by default. The direction of this alarm output can be changed if required.

To change the direction of the HVAC fail alarm output:

1. Press MENU key to go to the Main Menu screen.
2. Use UP or DOWN keys and ENTER key to enter TECHNICIAN password 1313.
3. Press UP or DOWN keys to scroll to **IO Config**; press ENTER key.
4. Press UP or DOWN keys to scroll to **Digital Out Config (C2)**.
5. Press ENTER key to scroll to the variable in the table that intersects **HVACfail** and **Dir** (see Figure 25).
6. Press UP or DOWN key to change direction.

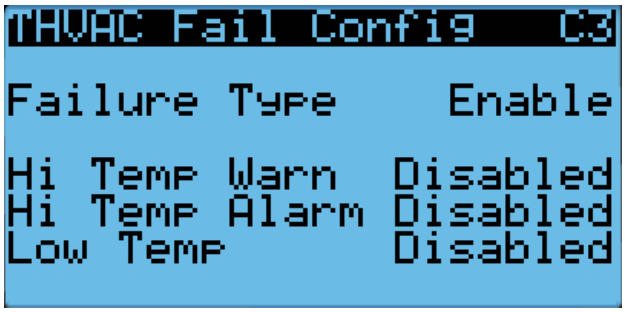
FIGURE 25
Changing Output Values



To change the alarms that actuate an HVAC fail alarm:

1. Press MENU key to go to the Main Menu screen.
2. Use UP or DOWN keys and ENTER key to enter TECHNICIAN password 1313.
3. Press UP or DOWN keys to scroll to **IO Config**; press ENTER key.
4. Press UP or DOWN keys to scroll to **HVAC Fail Config (C3)**.
5. Press ENTER key to scroll to the failure type enable (see Figure 26).
6. Press UP or DOWN key to change value.
7. Press ENTER key to save.

FIGURE 26
Changing HVAC Fail Outputs



HVAC Maintenance Alarm

The LV monitors all connected wall-mount unit alarms, and if any of the units communicate specific alarms, the LV will actuate an HVAC maintenance alarm relay output. The following alarms/events have the possibility of actuating an HVAC failure: Dirty filter alarm (always), dirty condenser coil alarm (always), lead +1/lag unit running (user selectable), economizer fail (user selectable), communications failure (user selectable). For all cases except lead +1, each of the alarms will be displayed individually on the LV. However, any of these alarms (when enabled) will actuate the alarm relay for HVAC maintenance, which is connected to the NOC for remote notification. When all of these events are no longer present, the alarm relay output will close signaling there are no HVAC maintenance alarms.

The LV is will actuate a relay output when this alarm occurs. The output is set up to open when an alarm occurs by default. The direction of this alarm output can be changed if required.

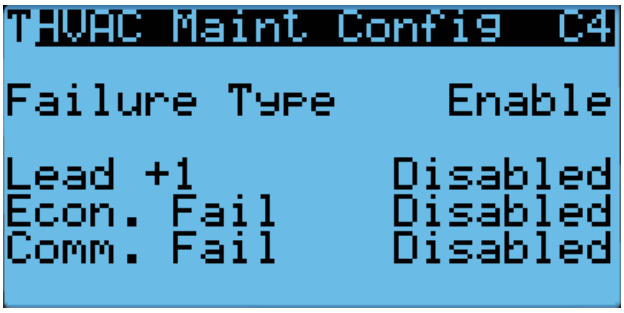
To change the direction of the maintenance alarm output:

1. Press MENU key to go to the Main Menu screen.
2. Use UP or DOWN keys and ENTER key to enter TECHNICIAN password 1313.
3. Press UP or DOWN keys to scroll to **IO Config**; press ENTER key.
4. Press UP or DOWN keys to scroll to **Digital Out Config (C2)**.
5. Press ENTER key to scroll to the variable in the table that intersects **HVACmaint** and **Dir** (see Figure 25).
6. Press UP or DOWN key to change direction.

To change the alarms that actuate an HVAC maintenance alarm:

1. Press MENU key to go to the Main Menu screen.
2. Use UP or DOWN keys and ENTER key to enter TECHNICIAN password 1313.
3. Press UP or DOWN keys to scroll to **IO Config**; press ENTER key.
4. Press UP or DOWN keys to scroll to **HVAC Maint Config (C4)**.
5. Press ENTER key to scroll to the maintenance type enable (see Figure 27).
6. Press UP or DOWN key to change value.
7. Press ENTER key to save.

FIGURE 27
Changing HVAC Maintenance Outputs



Anti-Theft Alarm

The LV will indicate a theft alarm when the Bard Guard anti-theft controller (sold separately) indicates an alarm to the anti-theft input on the LV. This alarm will open an alarm relay output to the NOC for remote notification. When the input no longer indicates a theft, the alarm will automatically clear and the alarm relay will return to its normal state.

NOTE: *The variable provided in the Direction column of the Digital In Config (C1) screen (as shown in Figure 22) displays either NO (Normally Open) or NC (Normally Closed). This column lists the type of signaling contact connected the LV1000. If connected to an NC contact on the Bard Guard Anti-Theft Alarm, the input circuit will be open when the Bard Guard reports a theft event. Therefore, in this case the LV1000 must be set to look for NC.*

To change the anti-theft alarm inputs:

1. Press MENU key to go to the Main Menu screen.
2. Use UP or DOWN keys and ENTER key to enter TECHNICIAN password 1313.
3. Press UP or DOWN keys to scroll to **IO Config**; press ENTER key.
4. Press UP or DOWN keys to scroll to **Digital In Config (C1)**.
5. Press ENTER key to scroll to the variable in the table that intersects **Theft** and **Dir** (see Figure 22).
6. Press UP or DOWN key to change direction.
7. Press ENTER key to save the value and move cursor to variable in the table that intersects **Theft** and **En**.
8. Press UP or DOWN key to change the value from **OFF** to **ON**.

The LV is will actuate a relay output when this alarm occurs. The output is set up to open when an alarm occurs by default. The direction of this alarm output can be changed if required.

To change the direction of the anti-theft output:

1. Press MENU key to go to the Main Menu screen.
2. Use UP or DOWN keys and ENTER key to enter TECHNICIAN password 1313.
3. Press UP or DOWN keys to scroll to **IO Config**; press ENTER key.
4. Press UP or DOWN keys to scroll to **Digital Out Config (C2)**.
5. Press ENTER key to scroll to the variable in the table that intersects **AntiTheft** and **Dir** (see Figure 25).
6. Press UP or DOWN key to change direction.

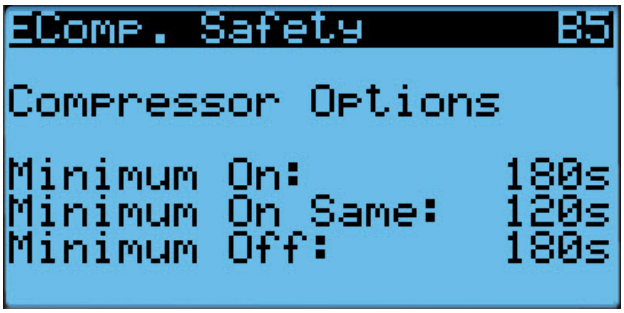
Compressor Safety Timers

The LV1000 has the ability to adjust compressor safety timers to all unit's communication with the LV1000. These timers include Minimum On Time (minimum compressor run time), Minimum On Same (minimum time between two starts) and Minimum Off Time (minimum time off between compressor operation).

To change the compressor safety timer values:

1. Press MENU key to go to the Main Menu screen.
2. Use UP or DOWN keys and ENTER key to enter ENGINEER password 9254.
3. Press UP or DOWN keys to scroll to **Adv Sys Config**; press ENTER key.
4. Press UP or DOWN keys to scroll to **Comp Safety (B5)**.
5. Press ENTER key to scroll to the desired timer value (see Figure 28).
6. Press UP or DOWN key to change value.
7. Press ENTER key to save.

FIGURE 28
Changing Compressor Safety Timer Values



Humidifier Output

The LV has the option to control a humidifier (sold separately) through a relay output. The output will close when a humidity call from the LV is active and open when the call is no longer present. The output can be configured to operate in reverse where the contacts will open when a humidity call is present and close when the call is no longer present.

To change the direction of the humidifier output:

1. Press MENU key to go to the Main Menu screen.
2. Use UP or DOWN keys and ENTER key to enter TECHNICIAN password 1313.
3. Press UP or DOWN keys to scroll to **IO Config**; press ENTER key.
4. Press UP or DOWN keys to scroll to **Digital Out Config (C2)**.
5. Press ENTER key to scroll to the variable in the table that intersects **Hum** and **Dir** (see Figure 25).
6. Press UP or DOWN key to change direction.

NOTE: *Screenshots shown in this manual reflect default settings (when applicable).*

Temperature Control

Control Value Averaging

The system requires one temperature and humidity sensor (included with LV) to operate. It allows a **total** of three temperature sensors and three humidity sensors to be connected to the LV for better representation of what is happening in the shelter. When more than one sensor is used, the value is averaged and then used for temperature control operations and humidity control operations.

Comfort Mode

The LV has a feature that allows a temporary override of the temperature control settings. When "comfort mode" is activated, the system will control to 72°F. The system will stay in this mode for 60 minutes and is intended to provide a more comfortable space for a technician during a service call or scheduled maintenance.

Emergency Vent

When the hydrogen input indicates an alarm, the system will enter emergency vent mode. The LV will communicate to each wall-mount unit that emergency vent mode is active. The wall-mount units will then override the damper position to 100% open and, after a short delay to allow the damper to open, turn the blower on. Emergency vent mode will stay active until the hydrogen detector is no longer in an alarm state.

Emergency Cool

When the high temperature alarm is activated, the system will enter emergency cool mode. The LV will communicate to each wall-mount unit that emergency cool mode is active. At that point, the units will override any restrictions to the economizer disable and operate the economizers normally, as long as the outdoor temperature is cooler than the indoor temperature. Emergency cool mode will stay active until the high temperature warning is no longer in an alarm state.

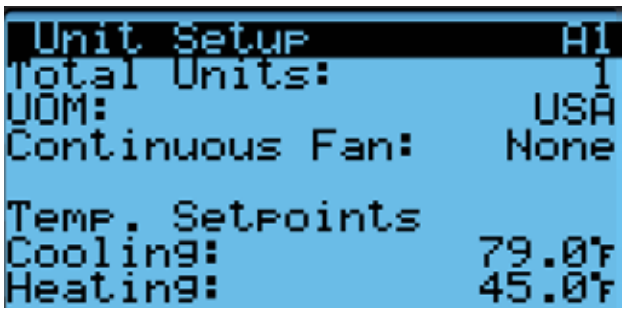
Cooling

When the wall-mount units are connected to the LV, the economizer and compressor are commanded off and on by the LV. This allows the supervisory controller to consider the most effective and efficient order to bring cooling functions on using all of the available equipment installed on the shelter. At the same time, the LV will be able to match the load requirements of the shelter.

To adjust the cooling setpoint:

1. Press MENU key to go to the Main Menu screen.
2. Press UP or DOWN keys and ENTER key to enter USER password 2000.
3. Press UP or DOWN keys to scroll to **Sys Config**; press ENTER key.
4. Press UP or DOWN keys to scroll to **Unit Setup (A1)**; press ENTER key.
5. Press ENTER key to scroll to **Cooling** (see Figure 29).
6. Press UP or DOWN keys to adjust value.
7. Press ENTER key to save.
8. Press the ESCAPE key several times to return to Main Menu screen.

FIGURE 29
Adjusting Setpoints



The LV monitors the space temperature and compares the value to the space cooling setpoint. The system will compare how far above or below the space temperature is when compared to the cooling setpoint. The LV will also consider how long the shelter temperature has been above or below the setpoint. Using these two considerations, the controller will generate a cooling demand. The cooling demand is a value between 0 and 100%. 0% represents no cooling demand and 100% representing full cooling demand.

The system will consider all of the available cooling stages and distribute the number of stages across the cooling demand range. As the demand rises, the system will stage on equipment every 2 minutes. As the demand lowers, the system will stage off equipment every 2 minutes.

The system will stage the equipment on in the order shown in Table 5 on page 20.

Unit Rotation

The system is also capable of rotating the order in which the units are brought on. This is done to distribute the equipment run time to each unit. This prevents one unit from providing all of the cooling for the shelter and shorting the lifespan of the wall-mount unit.

The system is set to switch the unit rotation order every 7 days from the factory. This timeframe is adjustable. In addition to the time-based auto rotation, the system

TABLE 5
Cooling Staging

1 Unit		
Order	**Freecooling Available**	**Freecooling Not Available**
1	Unit 1 Freecooling	Unit 1 Compressor Stage 1
2	Unit 1 Compressor Stage 1	Unit 1 Compressor Stage 2
3	Unit 1 Compressor Stage 2	--

2 Units		
Order	**Freecooling Available**	**Freecooling Not Available**
1	Unit 1 Freecooling	Unit 1 Compressor Stage 1
2	Unit 2 Freecooling	Unit 1 Compressor Stage 2
3	Unit 1 Compressor Stage 1	Unit 2 Compressor Stage 1
4	Unit 1 Compressor Stage 2	Unit 2 Compressor Stage 2
5	Unit 2 Compressor Stage 1	--
6	Unit 2 Compressor Stage 2	

3 Units		
Order	**Freecooling Available**	**Freecooling Not Available**
1	Unit 1 Freecooling	Unit 1 Compressor Stage 1
2	Unit 2 Freecooling	Unit 1 Compressor Stage 2
3	Unit 3 Freecooling	Unit 2 Compressor Stage 1
4	Unit 1 Compressor Stage 1	Unit 2 Compressor Stage 2
5	Unit 1 Compressor Stage 2	Unit 3 Compressor Stage 1
6	Unit 2 Compressor Stage 1	Unit 3 Compressor Stage 2
7	Unit 2 Compressor Stage 2	--
8	Unit 3 Compressor Stage 1	
9	Unit 3 Compressor Stage 2	

4 Units		
Order	**Freecooling Available**	**Freecooling Not Available**
1	Unit 1 Freecooling	Unit 1 Compressor Stage 1
2	Unit 2 Freecooling	Unit 1 Compressor Stage 2
3	Unit 3 Freecooling	Unit 2 Compressor Stage 1
4	Unit 4 Freecooling	Unit 2 Compressor Stage 2
5	Unit 1 Compressor Stage 1	Unit 3 Compressor Stage 1
6	Unit 1 Compressor Stage 2	Unit 3 Compressor Stage 2
7	Unit 2 Compressor Stage 1	Unit 4 Compressor Stage 1
8	Unit 2 Compressor Stage 2	Unit 4 Compressor Stage 2
9	Unit 3 Compressor Stage 1	--
10	Unit 3 Compressor Stage 2	
11	Unit 4 Compressor Stage 1	
12	Unit 4 Compressor Stage 2	

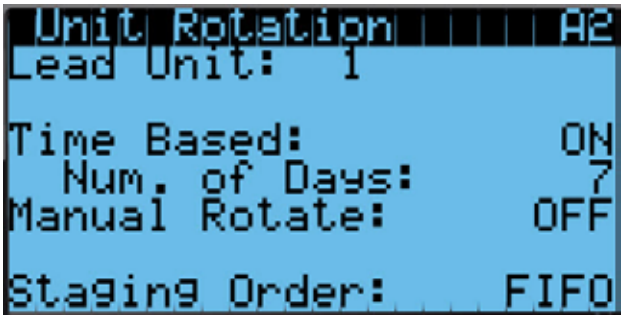
can be manually rotated on site for troubleshooting purposes.

The system has two different modes for staging unit operation: FIFO (First In/First Out) or FILO (First In/Last Out). With FIFO staging, the first unit on will be the first unit to turn off as demand decreases. In FILO staging, the first unit to turn on will be the last unit to turn off.

To view the lead unit and make adjustments to the unit rotation and staging:

1. Press MENU key to go to the Main Menu screen.
2. Press UP or DOWN keys and ENTER key to enter USER password 2000.
3. Press UP or DOWN keys to scroll to **Sys Config**; press ENTER key.
4. Press UP or DOWN keys to scroll to **Unit Rotation (A2)**; press ENTER key.
5. Press ENTER key to scroll to **Time Based** (see Figure 30).
6. Press UP or DOWN key to change the value from **ON** to **OFF**.
7. Press ENTER key to save the value and scroll to **Num. of Days**.
8. Press UP or DOWN keys to change the value.
9. Press ENTER key to save the value and scroll to **Manual Rotate**.
10. Press UP or DOWN key to change the value from **OFF** to **ON**.
11. Press ENTER key to save the value and scroll to **Staging Order**.
12. Press UP or DOWN keys to change the value from **FIFO** to **FILO**.
13. Press ENTER key to save.
14. Press the ESCAPE key several times to return to Main Menu screen.

FIGURE 30
Adjusting Unit Rotation Parameters



Heating

When the wall-mount units are connected to the LV, the heat strips are commanded off and on by the LV. This allows the supervisory controller to match the required load of the shelter using all of the available equipment installed on the shelter.

To adjust the heating setpoint:

1. Press MENU key to go to the Main Menu screen.
2. Press UP or DOWN keys and ENTER key to enter USER password 2000.
3. Press UP or DOWN keys to scroll to **Sys Config**; press ENTER key.
4. Press UP or DOWN keys to scroll to **Unit Setup (A1)**; press ENTER key.
5. Press ENTER key to scroll to **Heating** (see Figure 29 on page 19).
6. Press UP or DOWN keys to adjust value.
7. Press ENTER key to save.
8. Press the ESCAPE key several times to return to Main Menu screen.

The LV monitors the space temperature and compares the value to the space heating setpoint. The system will compare how far above or below the space temperature is when compared to the heating setpoint. The LV will also consider how long the shelter temperature has been above or below the setpoint. Using these two considerations, the controller will generate a heating demand. The heating demand is a value between 0 and 100%. 0% represents no heating demand and 100% representing full heating demand.

The system will consider all of the available heating stages and distribute the number of stages across the heating demand range. As the demand rises, the system will stage on equipment every 2 minutes. As the demand lowers, the system will stage off equipment every 2 minutes.

The system will stage the equipment on in the order shown in Table 6 on page 22.

The system is also capable of rotating the order in which the units are brought on. This is done to distribute the equipment run time to each unit. This prevents one unit from providing all of the heating for the shelter and shortening the lifespan of the wall-mount unit.

See ***Unit Rotation*** on page 19 for information on unit rotation and staging.

TABLE 6
Heating Staging

1 Unit	
Order	**Heat Method**
1	Unit 1 Heat Strip

2 Units	
Order	**Heat Method**
1	Unit 1 Heat Strip
2	Unit 2 Heat Strip

3 Units	
Order	**Heat Method**
1	Unit 1 Heat Strip
2	Unit 2 Heat Strip
3	Unit 3 Heat Strip

4 Units	
Order	**Freecooling Available**
1	Unit 1 Heat Strip
2	Unit 2 Heat Strip
3	Unit 3 Heat Strip
4	Unit 4 Heat Strip

Humidity Control

The LV will monitor the indoor humidity of the space and compare the value to the indoor humidity lower and upper setpoints.

Humidification

When the humidity is below the lower setpoint of 20% RH and a humidifier output is configured, the shelter will begin to humidify using the relay output to control a third party humidifier.

To change the number of humidifiers, type and setpoint:

1. Press MENU key to go to the Main Menu screen.
2. Press UP or DOWN keys and ENTER key to enter USER password 2000.
3. Press UP or DOWN keys to scroll to **Sys Config**; press ENTER key.
4. Press UP or DOWN keys to scroll to **Unit Setup (A3)**; press ENTER key.
5. Press ENTER key to scroll to **Humidifiers** (see Figure 31).
6. Press UP or DOWN keys to adjust value.
7. Press ENTER key to scroll to **Humidifier Type**.
8. Press UP or DOWN keys to adjust value.
9. Press ENTER key to scroll to **Humidifier Setpoint Humidity**.
10. Press UP or DOWN keys to adjust value.
11. Press the ESCAPE key several times to return to Main Menu screen.

FIGURE 31
Adjusting Humidifiers Settings

Dehumidification

The system will take several actions to limit the indoor humidity level. At 70% RH, the economizer will be disabled to prevent outdoor air from being used to cool the shelter which may have a high moisture content. This mode will remain active until the shelter humidity level is below 60% RH. The system will switch from high sensible to standard mode when the indoor humidity is above 75% RH which will slow the blower down to remove more moisture. This mode will remain active until the shelter humidity level is below 65%. If the shelter reaches 80% RH, the system will switch the units into dehumidification mode. This mode will cool the shelter down to the heating setpoint and the compressor will turn off. Then the heat strip will activate and heat it back up to the cooling setpoint, then turn off. This will continue until the indoor humidity level is below 70% RH.

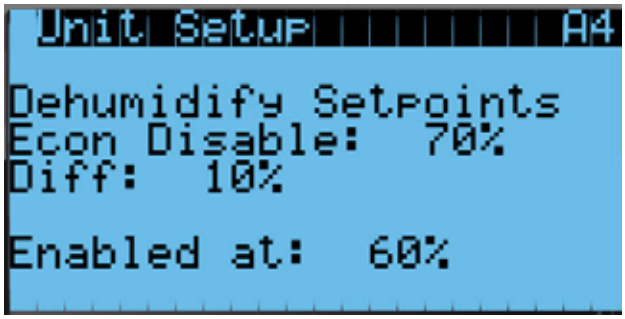
The economizer disable setpoint and differential (difference between disable setpoint and enable setpoint) are adjustable. The differential is limited to a minimum 10%.

To adjust the dehumidify economizer disable setpoint and differential:

1. Press MENU key to go to the Main Menu screen.
2. Press UP or DOWN keys and ENTER key to enter USER password 2000.
3. Press UP or DOWN keys to scroll to **Sys Config**; press ENTER key.
4. Press UP or DOWN keys to scroll to **Unit Setup (A4)**; press ENTER key.

5. Press ENTER key to scroll to **Econ Disable** (see Figure 32).
6. Press UP or DOWN keys to adjust value.
7. Press ENTER key to scroll to **Diff**.
8. Press UP or DOWN keys to adjust value.
9. Press ENTER key to save.
10. Press the ESCAPE key several times to return to Main Menu screen.

FIGURE 32
Adjusting Dehumidify Setpoints



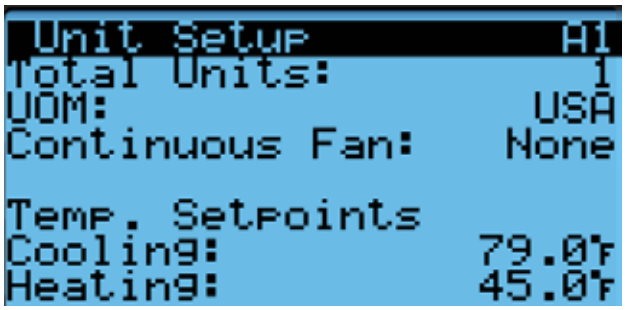
Fan Control

The LV has the option to change the continuous blower setting of the units connected to it. The options are All, Lead and None. If the option is set to All, then all of the units connected will run the blower continuously. If the option is set to Lead, only the unit in the lead position will run the blower continuously. If the option is set to None, then none of the units will run the blower continuously. When continuous blower doesn't apply to a unit, it will cycle the blower based on heating or cooling calls.

To adjust the continuous fan setting:

1. Press MENU key to go to the Main Menu screen.
2. Press UP or DOWN keys and ENTER key to enter USER password 2000.
3. Press UP or DOWN keys to scroll to **Sys Config**; press ENTER key.
4. Press UP or DOWN keys to scroll to **Unit Setup (A1)**; press ENTER key.
5. Press ENTER key to scroll to **Continuous Fan** (see Figure 33).
6. Press UP or DOWN keys to adjust value.
7. Press ENTER key to save.
8. Press the ESCAPE key several times to return to Main Menu screen.

FIGURE 33
Adjusting Continuous Fan Setting



Hour Counting

The LV will keep track of each unit's heating and cooling method run times for last 24 hours (see Figure 34). In addition to how long an item was on, it will also track how many times a method started. These screens are located in the Quick Menu Info screens.

FIGURE 34
Last 24 Hours Tracking

LV1000 MODBUS TCP REGISTER LIST

Version 1.1
For use with the following devices: LVS1000.1.1.0, LVS1000.1.1.1, LVS1000.2.0.0

Input Registers (Read Only)

The following input registers reflect system inputs, operation variables and alarm setpoints for read-only purposes. (Units are represented as a whole number but include a single decimal place, i.e., a value of 600 through Modbus equals a value of 60.0 in the LV1000 system.)

Input Registers (Read Only System Values and Setpoints)	
Index	Description
0	Indoor Temperature Sensor 1
1	Indoor Temperature Sensor 2 (if used)
2	Indoor Temperature Sensor 3 (if used)
3	Indoor Temperature Average
4	Indoor Humidity Sensor 1
5	Indoor Humidity Sensor 2 (if used)
6	Indoor Humidity Sensor 3 (if used)
7	Indoor Humidity Average
10	Cooling Setpoint
11	Heating Setpoint
12	High Temperature Warning Setpoint
13	High Temperature Alarm Setpoint
14	Low Temperature Setpoint
16	Number of Units in System
17	Lead Unit in Rotation
18	Lag Unit 1 in Rotation
19	Lag Unit 2 in Rotation
20	Lag Unit 3 in Rotation

Holding Registers (Read/Write)

The following holding registers reflect system setpoints that can be changed via Modbus TCP. (Units are represented as a whole number but include a single decimal place, i.e., a value of 600 through Modbus equals a value of 60.0 in the LV1000 system.)

Holding Registers (Writable Setpoints)	
Index	Description
0	Cooling Setpoint
1	Heating Setpoint
2	Low Temperature Setpoint
3	High Temperature Warning Setpoint
4	High Temperature Alarm Setpoint
5	Low Humidity Alarm Setpoint
6	High Humidity Alarm Setpoint
7	Free Cooling Outdoor Temperature Setpoint
8	Free Cooling Outdoor Humidity Setpoint
9	Free Cooling Outdoor Dew Point Setpoint
10	Modbus TCP Unit of Measure 0 = No Conversion 1 = SI 2 = US Customary 3 = Imperial 4 = Canadian Customary 5 = LON Units
11	1 = Unit Manual Rotation (Resets back to 0 after rotation)

Discrete Inputs (Read Only)

The following discrete inputs reflect system alarms, major unit alarms and unit staging operations.

Discrete Inputs (Read Only Alarms and System Operation)	
Index	Description
0	= 1 when smoke alarm is active
1	= 1 when hydrogen alarm is active
2	= 1 when generator is running
3	= 1 when anti-theft (Bard Guard) is alarming
5	= 1 when indoor temp falls below Low Temp Alarm setpoint
6	= 1 when indoor temp rises above High Temperature Warning setpoint
7	= 1 when indoor temp rises above High Temperature Alarm setpoint
8	= 1 when HVAC Fail is detected on any unit
9	= 1 when HVAC Fail is condition is active on Unit 1
10	= 1 when HVAC Fail is condition is active on Unit 2
11	= 1 when HVAC Fail is condition is active on Unit 3
12	= 1 when HVAC Fail is condition is active on Unit 4
13	= 1 when any unit requires maintenance
14	= 1 when Unit 1 is detected by the LV1000
15	= 1 when Unit 2 is detected by the LV1000
16	= 1 when Unit 3 is detected by the LV1000
17	= 1 when Unit 4 is detected by the LV1000
20	= 1 when Unit 1 has a call for Free Cooling (if available)
22	= 1 when Unit 1 has a call for Cooling Stage 1
23	= 1 when Unit 1 has a call for Cooling Stage 2
26	= 1 when Unit 1 has a call for Free Heating Stage 1 (if available)
27	= 1 when Unit 1 has a call for Free Heating Stage 2 (if available)
28	= 1 when Unit 1 has a call for Free Heating Stage 3 (if available)
31	= 1 when Unit 2 has a call for Free Cooling (if available)
33	= 1 when Unit 2 has a call for Cooling Stage 1
34	= 1 when Unit 2 has a call for Cooling Stage 2
37	= 1 when Unit 2 has a call for Free Heating Stage 1 (if available)
38	= 1 when Unit 2 has a call for Free Heating Stage 2 (if available)
39	= 1 when Unit 2 has a call for Free Heating Stage 3 (if available)
42	= 1 when Unit 3 has a call for Free Cooling (if available)
44	= 1 when Unit 3 has a call for Cooling Stage 1
45	= 1 when Unit 3 has a call for Cooling Stage 2

Discrete Inputs (Read Only) cont.

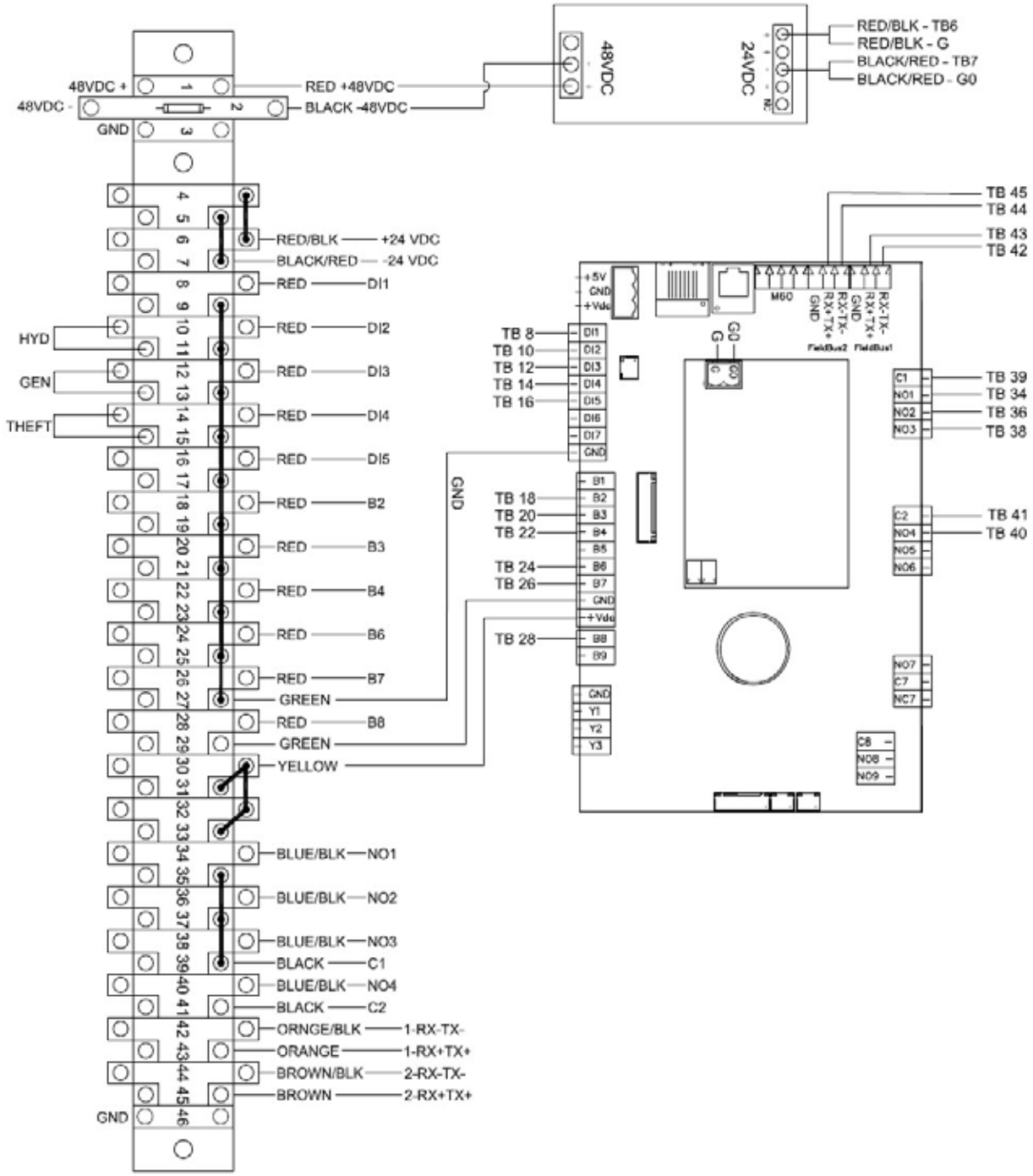
Discrete Inputs (Read Only Alarms and System Operation)	
Index	Description
48	= 1 when Unit 3 has a call for Free Heating Stage 1 (if available)
49	= 1 when Unit 3 has a call for Free Heating Stage 2 (if available)
50	= 1 when Unit 3 has a call for Free Heating Stage 3 (if available)
53	= 1 when Unit 4 has a call for Free Cooling (if available)
55	= 1 when Unit 4 has a call for Cooling Stage 1
56	= 1 when Unit 4 has a call for Cooling Stage 2
59	= 1 when Unit 4 has a call for Free Heating Stage 1 (if available)
60	= 1 when Unit 4 has a call for Free Heating Stage 2 (if available)
61	= 1 when Unit 4 has a call for Free Heating Stage 3 (if available)
100	= 1 when Unit 1 Low Pressure Alarm is active
101	= 1 when Unit 1 High Pressure Cut-Out is active
102	= 1 when Unit 1 economizer damper failed to close
103	= 1 when Unit 1 economizer damper failed to open
104	= 1 when Unit 1 blower failure
200	= 1 when Unit 2 Low Pressure Alarm is active
201	= 1 when Unit 2 High Pressure Cut-Out is active
202	= 1 when Unit 2 economizer damper failed to close
203	= 1 when Unit 2 economizer damper failed to open
204	= 1 when Unit 2 blower failure
300	= 1 when Unit 3 Low Pressure Alarm is active
301	= 1 when Unit 3 High Pressure Cut-Out is active
302	= 1 when Unit 3 economizer damper failed to close
303	= 1 when Unit 3 economizer damper failed to open
304	= 1 when Unit 3 blower failure
400	= 1 when Unit 4 Low Pressure Alarm is active
401	= 1 when Unit 4 High Pressure Cut-Out is active
402	= 1 when Unit 4 economizer damper failed to close
403	= 1 when Unit 4 economizer damper failed to open
404	= 1 when Unit 4 blower failure

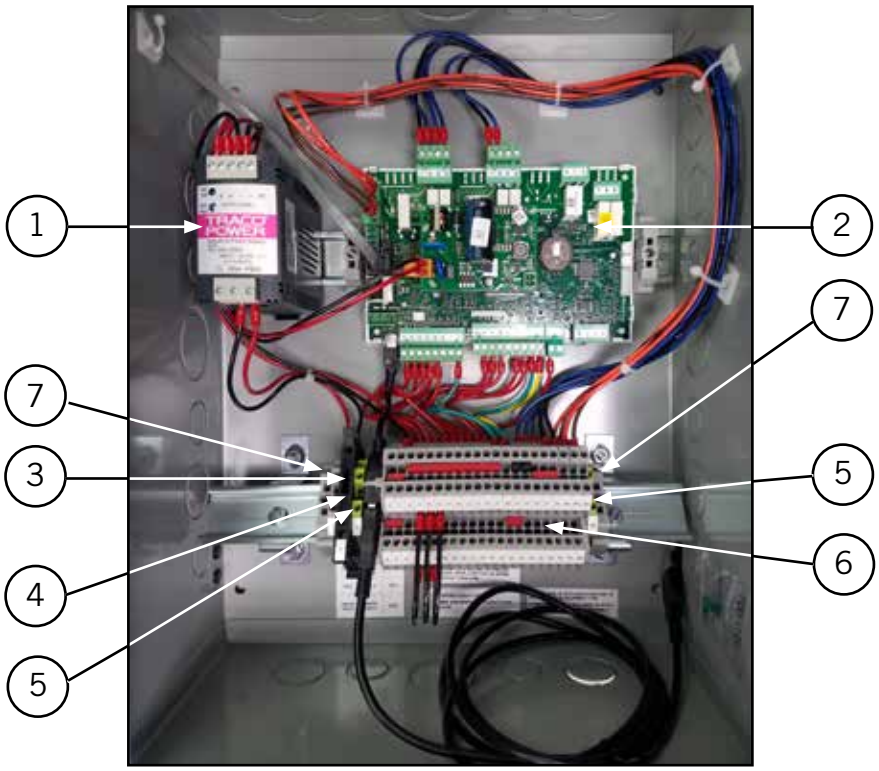
TABLE 7
LV1000-200 Terminal Block Index

TB#	Wire Mark	Description
1	48+	48VDC +Input
2	48–	48VDC – Input
3	GND	Ground
4	24+	24VDC +
5	24–	24VDC –
6	24+	24VDC +
7	24–	24VDC –
8	DI1	Smoke Detector Input
9	GND	Smoke Detector Common
10	DI2	Hydrogen Detector Input
11	GND	Hydrogen Detector Common
12	DI3	Generator Run Input
13	GND	Generator Run Common
14	DI4	Anti Theft Input
15	GND	Anti Theft Common
16	DI5	Inverter Fault Input
17	GND	Inverter Fault Common
18	B2	Humidity Sensor 1
19	GND	Ground
20	B3	Humidity Sensor 2
21	GND	Ground
22	B4	Humidity Sensor 3
23	GND	Ground

TB#	Wire Mark	Description
24	B6	Remote Temperature Sensor 1
25	GND	Ground
26	B7	Remote Temperature Sensor 2
27	GND	Ground
28	B8	Remote Temperature Sensor 3
29	GND	Ground
30	VDC+	Humidity Sensor 1 +24VDC (B2)
31	VDC+	Humidity Sensor 2 +24VDC (B3)
32	VDC+	Humidity Sensor 3 +24VDC (B4)
33	VDC+	Spare Power +24VDC
34	NO1	Humidifier Output Relay
35	C1	Common
36	NO2	HVAC Fail
37	C1	Common
38	NO3	HVAC Maintenance
39	C1	Common
40	NO4	HVAC Anti Theft
41	C2	Common
42	FB1R–	RS485 RX– / TX– (Fieldbus 1)
43	FB1R+	RS485 RX+ / TX+ (Fieldbus 1)
44	FB2R–	RS485 RX– / TX– (Wall Units)
45	FB2R+	RS485 RX+ / TX+ (Wall Units)
46	-	Ground

FIGURE 35
LV1000-200 Wiring Diagram





Dwg. No.	Part Number	Description	LV1000
1	8301-082	17 – 75VDC to 24VDC Converter 2.5 Amps	1
2	8301-085-001*	UPC3-LV1000	1
3	8614-059	1.0 Amp Fuse	1
4	8607-039	Fused Terminal Block	1
5	8607-052	Grounded Terminal Block	2
6	8607-058	Terminal Block Double Level	21
7	8611-144	End Clamp (for din rail)	4
NS	8301-053	Panel Mounting Display Flush, pGDEvolution 132x64, Black Buttons with Cable	1
NS	3020-010	35' 2 Conductor 18 Gauge Cable	1
NS	8301-055	EMI Ferrite Filter	2
NS	8301-058	Remote Temperature Sensor ①	1
NS	8403-079	Remote Temperature/Humidity Sensor	1
NS	8301-059	TEC-EYE (Service Tool), 5' Telephone Cable	1
NS	3000-1587	5' Telephone Cable	1

* Replacement part will have a letter attached to the end of the part number to designate software version (Example: 8301-085-001**A**). A software upgrade of all PLCs onsite (units and controllers) should accompany any PLC replacement. Latest revisions of software, change log and instructions are available on the Bard website at http://www.bardhvac.com/software-download/

① Optional

NS – Not Shown