Liebert®
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Deluxe System 3 AM/AG Controls

Model Number Designations

FH	245.000	A	—	A	AM
FH = Downflow UH = Upflow FE = Downflow with Econ-o-coil UE = Upflow with Econ-o-coil	Nominal capacity in thousand BTU/H	A = Air Cooled W = Water Cooled G = Glycol Cooled C = Chilled Water	— = 2 Step DX or Std. CW U = 4 Step DX V = VSD CW (Variable Speed Drive)	A = 460/3/60 B = 575/3/60 C = 208/3/60 D = 230/3/60 F = 380/3/50 G = 415/3/50 H = 230/3/50 J = 200/3/50 U = 400/3/50	00 = Standard Microprocessor SM = Standard Microprocessor AM = Advanced Microprocessor AG=Advanced Graphics Microprocessor

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SECTION 3A — OPERATION WITH ADVANCED MICROPROCESSOR CONTROLS

SECTION 3A OPERATION WITH ADVANCED MICROPROCESSOR CONTROLS

The Advanced Microprocessor (AM) Control for your Liebert Deluxe unit features an easy to use menu driven LCD display. The menus, control features, and circuit board details are described in this section. For more control details refer to Section 4, and for more alarm information refer to Section 5.

3A.1 BASICS

Control keys include ON/OFF, Menu/ESCape, Enter, Increase (UP) arrow, and Decrease (DOWN) arrow. Refer to Figure 3A-1. These keys are used to move through the menus as prompted on the LCD display (refer to Figure 3A-2).

To turn the unit ON, press the ON/OFF key after power is applied. To turn the unit OFF, press the ON/OFF key before power is disconnected.

Active alarms are displayed on the LCD screen. Alarms are also annunciated by an audible beeper. To silence an alarm, press the ENTER key as prompted on the display. The unit stores the 10 most recent alarms for review.

Setpoints, DIP switch settings, and other selections were made on your unit before testing at the factory. Setpoints were chosen based on typical operating experience. Other selections were made based on options included with your unit. Make adjustments to the factory default selections ONLY if they do not meet your specifications. When entering setpoints, time delays, etc., the allowable ranges are displayed and may require a password, if enabled.

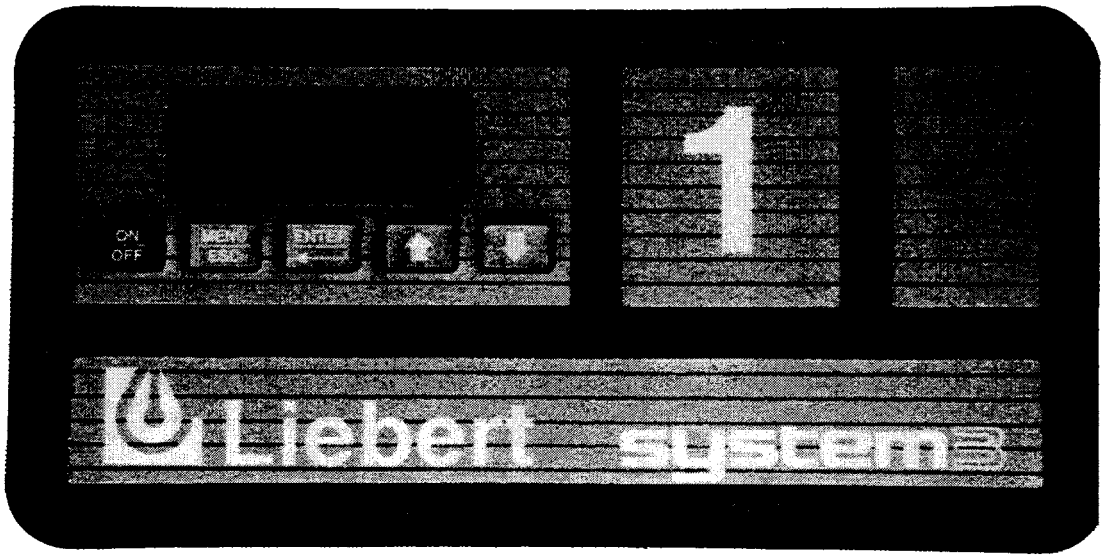

Figure 3A-1. Advanced Microprocessor Control Panel

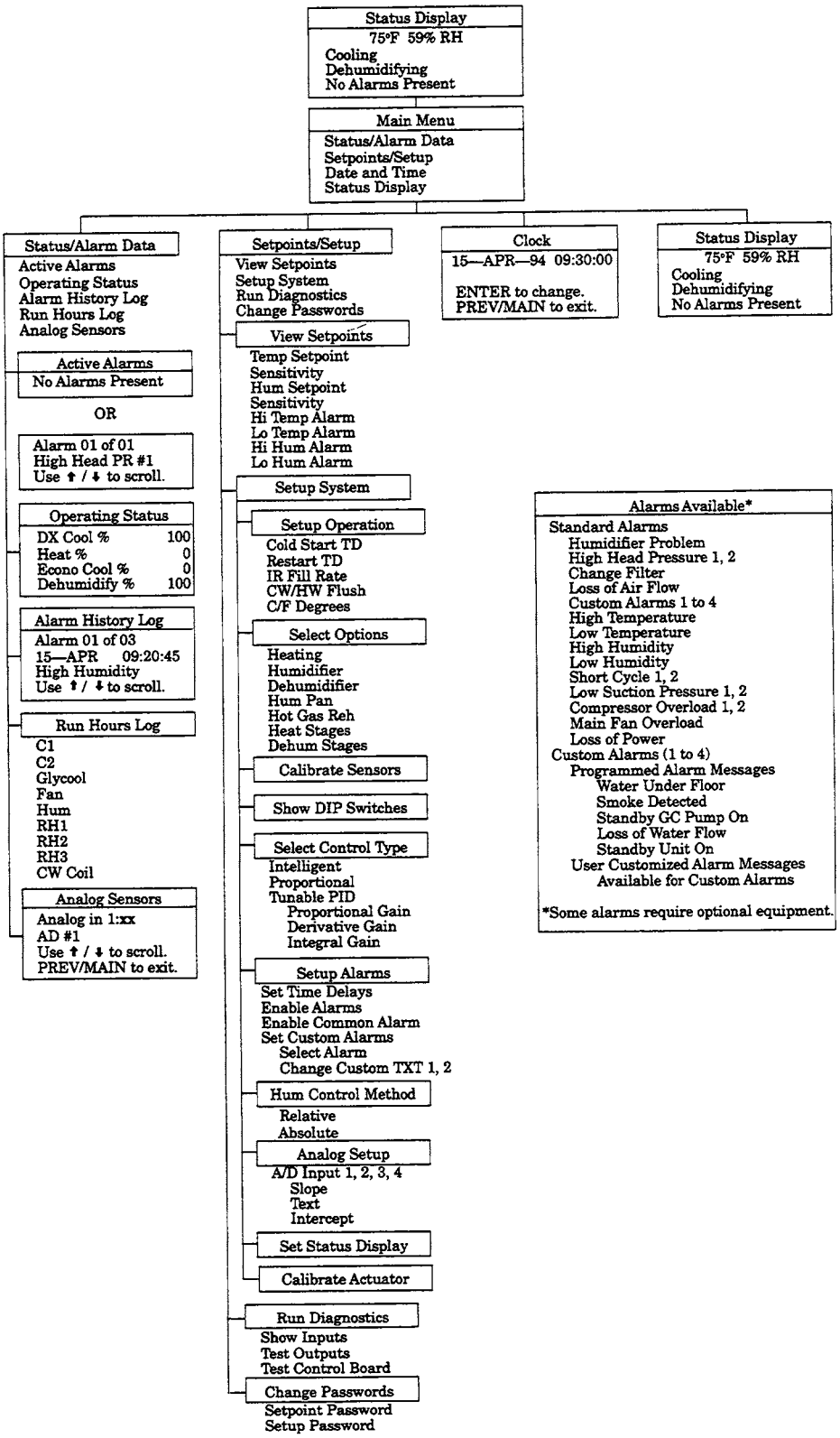

Figure 3A-2. Advanced Microprocessor Control Menu

3A.2 STATUS DISPLAY

The display normally shown includes the present room temperature, humidity, active status functions (cooling, heating, dehumidifying, humidifying), and active alarms. If no keys are pressed for five minutes, the system automatically returns to the Status Display. The Status Display may also be selected from the Main Menu.

3A.3 MAIN MENU <MENU/ESC>

Press the MENU/ESC key to display the Main Menu. The Menu selections include:

- STATUS/ALARM DATA
- SETPOINTS/SETUP
- DATE AND TIME
- STATUS DISPLAY

3A.4 STATUS/ALARM DATA

Selecting STATUS/ALARM DATA from the Main Menu will display the following selections:

- ACTIVE ALARMS
- OPERATING STATUS
- ALARM HISTORY LOG
- RUN HOURS LOG
- ANALOG SENSORS

3A.4.1 Active Alarms

This screen displays any active alarm. The alarms are numbered, #1 being the most recent. If there are no active alarms, then "NO ALARMS PRESENT" will be displayed.

3A.4.2 Operating Status

The Operating Status is intended to provide the user with displayed information concerning what the control is calling for the system to do.

NOTE
There may be some time elapse before a specific component matches the displayed number.

For example: The display indicates the chilled water valve is 68% open. On a new call for cooling, it takes several seconds for the valve to travel from full closed to 68% open. So when the display reads

68%, it may take a few seconds for the valve to actually open 68%. Also, if the display indicates a compressor is operating but the compressor has not turned on yet, it may be off because of the short cycle control (see Load Control/Short Cycle Control in Section 4).

3A.4.3 Alarm History Log

A history of the ten (10) most recent alarms is kept in non-volatile memory complete with the date and time of its occurrence. The first alarm in the history is the most recent and the tenth is the oldest. If the alarm history is full (10 alarms) and a new alarm occurs, the oldest is lost and the newest is saved in alarm history location 1. The rest are moved down the list by 1. Alarm history on new units may show the results of factory testing.

3A.4.4 Run Hours Log

The total operating hours of all major components in the unit can be monitored from the display and are retained in non-volatile memory. Run times are available for the following:

- (C1) compressor 1
- (C2) compressor 2
- Glycool Coil (or Dual Cool Coil)
- Fan
- (HUM) humidifier
- (RH1) reheat 1 (or Hot Water Reheat)
- (RH2) reheat 2
- (RH3) reheat 3
- (CW) chilled Water Coil

The component run hours for each individual component can be reset by selecting the run hours display screen for the desired component, then pressing ENTER within five (5) minutes of applying power to the control. The user will then be prompted to press ENTER to clear the selected component's run hours.

NOTE
Run hours for a component should ONLY BE RESET when the component has been replaced.

3A.4.5 Analog Sensors

The four (4) analog sensor inputs can be monitored from the display. The inputs are filtered, then displayed along with the text label assigned during setup. See "ANALOG SETUP" under SETUP SYSTEM.

3A.5 SETPOINTS/SETUP

Selecting Setpoints/Setup from the Main Menu will display the following selections:

- VIEW SETPOINTS
- SETUP SYSTEM
- RUN DIAGNOSTICS
- CHANGE PASSWORDS

NOTE
Setpoints and system setup parameters are kept in non-volatile memory.

3A.5.1 View Setpoints

Control and alarm setpoints can be reviewed and/or changed through the display. The following table lists the default setpoints and their allowable ranges.

Setpoint	Default	Range
Temperature Setpoint	72°F	40 to 85°F (5 to 29°C)
Temperature Sensitivity	2.0°F	1 to 9.9°F (0.6 to 5.6°C)
Humidity Setpoint	50%	20 to 80% RH
Humidity Sensitivity	5%	1 to 30% RH
High Temperature Alarm	80°F	35 to 90°F (2 to 32°C)
Low Temperature Alarm	65°F	35 to 90°F (2 to 32°C)
High Humidity Alarm	60%	15 to 85% RH
Low Humidity Alarm	40%	15 to 85% RH

3A.5.2 Setup System

The Setup System menu includes the following selections:

- SETUP OPERATION
- SELECT OPTIONS
- CALIBRATE SENSORS
- SHOW DIP SWITCHES
- SELECT CONTROL TYPE
- SETUP ALARMS
- HUM CONTROL METHOD
- ANALOG SETUP
- SET STATUS DISPLAY
- CALIBRATE ACTUATOR

Setup Operation

The Setup Operation menu permits the review and/or adjustment of the unit configuration. This may include:

Cold Start: This feature, also referred to as Positive Start or Winter Start Kit, allows for the low pressure switch to be ignored for the programmed time during a cold start of the compressors. Entering a "0" for this time will bypass this feature. A "1", will bypass the low pressure switch for one minute, a "2" for two minutes, etc. The programmed value can be from 0 to 3 minutes. This delay is factory set to 0 for water cooled, glycol cooled, and glycool units. Typically, only air cooled units need a "Winter Start" time.

Restart: This feature allows for the unit to restart automatically after a loss of power. The programmed value is in 0.1 minute (6 seconds) intervals. A programmed value of zero (0) would require the user to manually press the ON/OFF key to start the unit, i.e. no auto restart. The purpose of this feature is to prevent several units from starting at the same time after a loss of power. (It is suggested multiple unit installations be programmed with different auto restart times.)

IR Fill Rate (infrared humidifiers only): An autoflush system automatically controls a water makeup valve to maintain proper level in the infrared humidifier water pan during humidifier operation. If humidification is needed and 30 hours have elapsed since the last time the humidifier was on, the humidifier is held off until the valve completes an initial fill of the humidifier pan. This

pre-fill is about 35 seconds for a small pan and 60 seconds for a large pan. The valve continues to fill and flush the pan for about 4 and 1/2 minutes for a small pan or 7 and 1/2 minutes for large pan. Pan size is selected based on unit specifications and is preset at the factory.

During humidifier operation, with the flush rate set at the default of 150%, the valve is opened periodically to add water to the pan (about 45 seconds every 7 minutes of humidifier operation for a small pan, or 80 seconds every 10 minutes of operation for a large pan). This adds enough water to the pan to cause about a third of the total water used to be flushed out the overflow standpipe located in the humidifier pan. This action helps to remove solids from the pan. The flush rate is adjustable from 110% to 500%. If the water quality is poor, it may be desirable to increase the water flushing action above the normal 150% rate. Also, if the supply water pressure is low, the flush rate adjustment can be increased so that sufficient water level is maintained during humidification.

Chilled Water/Hot Water/Econ-O-Coil Flush: This feature will flush the respective coil for three (3) minutes after the programmed number of hours of non-use. For example, if the flush time is programmed with 24 hours on a hot water reheat type system, and heating is not required for a 24 hour period, the hot water valve will be open for 3 minutes to allow the coil to be flushed. The programmed value can be from 0 (no flush) to 99 (99 hours of non-use).

C/F Degrees: The control can be selected to show readings and setpoints in either degrees Fahrenheit (F) or Celsius (C).

The following table lists the Setup functions, their factory default values, and the allowable ranges of which they can be programmed:

Function	Default	Range
Cold Start Time Delay[1]	3	0 to 3 min (0 = no delay)
Restart Time Delay	0.1	0 to 9.9 min (0 = manual restart)
Infrared Fill Rate	150	110 to 500%
Chilled/Hot Water Coil Flush	24	0 to 99 hrs (also Econ-O-Coil)
C/F Degrees	F	C or F

[1] Factory set to 0 for water cooled, glycol, and glycool units.

Select Options

The following table is a list of options which should match the options installed with your unit and should not need to change during normal operation.

Option	Selection
Heating	YES or NO
Humidifier	YES or NO
Dehumidifier	YES or NO
Humidifier Pan	SMALL or LARGE
Hot Gas Reheat	YES or NO
Heat Stages[1]	2 or 3
Dehumidification Stages	1 or 2

[1] If heat stage is set to 2 on a chilled water unit, the reheat 3 output is energized on a call for dehumidification.

Calibrate Sensors

The temperature and humidity sensors can be calibrated by selecting this menu item. "SENSOR" shows the actual sensor reading or raw reading. "CALIBRATED" shows the sensor reading after the calibration offset has been added. The temperature sensor can be calibrated +/- 5 degrees Fahrenheit and the humidity sensor can be calibrated +/- 10%RH. When calibrating the humidity sensor, the value shown will always be %RH, even though absolute humidity control may be selected. If absolute humidity control is selected, the Normal Status Display **will** display the **adjusted** reading and may not agree with the relative humidity reading displayed while in calibration.

Show DIP Switches

The DIP switch settings can be reviewed from the display panel. Changing the DIP switches requires opening the upper panel for access to the DIP switches on the microprocessor control board.

NOTE
Power MUST be cycled off, then on from the unit disconnect switch for the control system to update the DIP switch settings.

Number	OFF	ON
1	**Dx** Compressor **Cool**	**Chilled Water**
2	**Electric/Hot Gas Reheat**	**Hot Water Reheat**
3	**2 Step Dx**	**4 Step Dx**
4	**No Glycool**	**Glycool**
5	**No Dual Cooling**	**Dual Cooling**
6	Not Used	Not Used
7	**Delayed Reheat**	**Dehumidification with Normal Reheat**

These selections should match options installed on your unit and should not need to change during normal operation. Switches 1 through 6 are self explanatory. Switch 7 is described in more detail below. Dip switch 8, not shown above, enables the password feature when set to ON and disables the password feature if set to OFF.

Dehumidification with Normal or Delayed Reheat: Dehumidification with normal reheat allows for operating **BOTH** compressors and three stages of electric reheats simultaneously. It is very important that electrical service to the unit be sized and wired for this option if selected.

CAUTION
The result of electrical service to the unit not being sized properly for this option could be nuisance trips of the building circuit breakers (or fuses) or, in extreme cases, damage to building wiring.

With delayed reheat selected, the reheats are prevented from turning on when dehumidifying with both compressors until the point at which 100% heating is called for. At this time, the compressors are turned off until the reheats bring the temperature back up to the point at which the reheats are turned off.

Select Control Type

- Intelligent
- Proportional
- Tunable PID

The type of system control method used by the microprocessor can be selected from the front panel. The default setting is **Intelligent**, which approximates the actions that a human operator would take to maintain precise, stable control. The control logic uses Artificial Intelligence techniques including "fuzzy logic" and "expert systems" methods to maintain precise, stable control and increase reliability by reducing component cycles. **Proportional** is a standard control

method that uses one gain factor (temperature sensitivity adjustment). **Tunable PID** (Proportional, Integral, and Derivative) uses three gain factors selected by the operator. PID allows precision tuning, but requires an experienced operator and seasonal adjustments. Note that if PID is selected, it is used for temperature control while humidity will continue to use Proportional control. For chilled water units with the optional Variable Speed Drive, intelligent control is required for proper operation. Refer to Section 4 for more detail on types of control.

Setup Alarms

Selecting SETUP ALARMS will step to the following menu:

- SET TIME DELAYS
- ENABLE ALARMS
- ENABLE COMMON ALARM
- SET CUSTOM ALARMS

Each individual alarm can be programmed with a time delay from 0 to 255 seconds. Each individual alarm can be ENABLED or DISABLED and each individual alarm can be programmed to energize or not to energize the Common Alarm Relay.

Set Time Delays: By programming a time delay for an alarm, the system will delay the specified amount of time before recognizing the alarm. The alarm condition must be present for the amount of time programmed for that alarm before it will be annunciated. If the alarm condition goes away before the time delay has timed out, the alarm will not be recognized and the time delay timer will be reset. For software alarms such as Loss of Power, Short Cycle, and Low Suction Pressure, a time delay will only delay the annunciation of that alarm. The condition of the alarm is not applicable because the condition has already occurred. For these alarms the time delay should be left at the factory default of 0. The following table shows the default time delays for each alarm.

Enable Alarms: Each individual alarm can be selected to be ENABLED (annunciated audibly, visually, and communicated to a Site Products System) or DISABLED (ignored).

Alarm	Default Time Delay (seconds)
Humidifier Problem	2
High Head Pressure 1	2
High Head Pressure 2	2
Change Filter	2
Loss of Air Flow	3
Custom Alarm #1	0
Custom Alarm #2	0
Custom Alarm #3	0
Custom Alarm #4	6
High Temperature	30
Low Temperature	30
High Humidity	30
Low Humidity	30
Low Suction Pressure 1, 2	0
Short Cycle 1, 2	0
Compressor #1 Overload	2
Compressor #2 Overload	2
Main Fan Overload	5
Loss of Power	0

Enable Common Alarm: Each individual alarm can be selected to energize or to not energize the common alarm relay. If the energize common alarm function is set to YES, the relay is energized immediately as the alarm is annunciated and de-energized when the alarm condition goes away (only after the alarm has been recognized). If the function is set to NO, the alarm has no effect on the common alarm relay regardless of whether the alarm is ENABLED or DISABLED.

Set Custom Alarms: The custom alarm messages can be from a list of standard alarm messages or you can write your own message.

NOTE
Only one (1) or two (2) of the alarm messages can be your own message.

They can be in any location(s) 1 through 4. The text for custom alarms can be changed at any time by selecting "SET CUSTOM ALARMS". To change the text for a custom alarm, select "SELECT ALARM". Then, select which alarm you would like to change, 1 through 4. Using the UP/DOWN arrows will step through the list of five standard alarm messages (see list below) and the two custom alarms.

NOTE
The two custom alarm message will be shown with what was previously programmed in them and can be changed.

Press ENTER to make your selection. To modify the two custom alarm messages, go back one screen and select "CHANGE CUSTOM TXT 1" (or 2). Text can be up to 20 characters in length and can be any of the following characters (or a blank space): ABCDEFGHIJKLMNOPQRSTUVWXYZ#%*-0123456789.

Standard Custom Alarm Messages

- WATER UNDER FLOOR
- SMOKE DETECTED
- STANDBY GC PUMP ON
- LOSS OF WATER FLOW
- STANDBY UNIT ON

For more information concerning alarms, see Section 5.

Hum(idity) Control Method

The user may select between relative (direct) and absolute (predictive) humidity control. If relative is selected, the RH control is taken directly from the RH sensor. If absolute is selected, the RH control is automatically adjusted as the return air temperature deviates from the desired temperature setpoint. This results in a predictive humidity control. The display will indicate %RH for both methods of control, but the **adjusted humidity reading will be displayed** if absolute is selected. With predictive humidity control, the humidity control is automatically adjusted approximately 2% RH for each degree difference between the return air temperature and the temperature setpoint.

With relative humidity control, unnecessary dehumidification can result when overcooling occurs during a dehumidification cycle. This is because a higher than normal RH reading is caused by overcooling the room (about 2% RH for each degree of overcooling). This extends the dehumidification cycle. Later, when the dehumidification ends and the temperature rises to the setpoint, the RH reading falls. The final RH reading will then be lower than actually desired. If the overcooling was significant enough, the RH could be low enough to activate the humidifier.

If absolute humidity control is selected, over- dehumidification is avoided. When overcooling occurs, causing an increase in the RH reading, the humidity control program "predicts" what the RH will be when the dehumidification cycle ends and temperature returns to the setpoint. This allows the dehumidification cycle to end at the proper time. The predictive humidity control can reduce energy

consumption by minimizing compressor and reheat operation, and eliminating unnecessary humidifier operation.

Analog Setup

For installation of analog sensors, see ANALOG INPUTS in Section 4.
After selecting a compatible sensor and properly wiring it to the terminals, setting up the control to monitor the sensor is as follows:

Slope: The slope is a multiplier used to scale the input signal. The slope can be positive (rising) or negative (falling) and can range from 0 (resulting in a horizontal line) to (+/-) 999. The slope for a 0-5 volt input is per 1 volt input, for 0-10 volt input is per 2 volt input, and for 4-20 mA is per 4 mA input. For example, assuming an intercept of 0, for a 0-10 volt sensor input with a slope of 50, an input of 1 volt would be displayed as 25: (1x(50/2)); 2 volts would be 50: (2x(50/2)); 3 volts would be 75: (3x(50/2)); etc.

Intercept: The intercept is an offset from point 0 corresponding to 0 volts or 0 mA input. The intercept can be positive or negative and can be a point from 0 to (+/-) 999. Adding an intercept of 100 to the slope example above, 1 volt would be 125: 100 + (1x(50/2)); 2 volts would be 150: 100 + (2x(50/2)); 3 volts would be 175: 100 + (3x(50/2)); etc.

NOTE
For a 4-20 mA input sensor, if the desired reading at 4 mA input is 0, then an intercept of -1 x slope would be required. For example, assuming a slope of 50, the formula would be ((-1 x 50) + 4 x (50/4)) = 0. The intercept is -50.

Text: You may enter a custom label for each analog input. The text label can be 20 characters in length including any of the following: ABCDEFGHIJKLMNOPQRSTUVWXYZ#%*-0123456789, or space.

Set Status Display

The Status Display can be set to display the return air temperature and humidity SENSOR READINGS or the temperature and humidity control SETPOINTS through this selection. When SETPOINTS is selected, the status display indicates so by displaying "SETPTS". If SENSOR READINGS is selected, the Status Display will show the return air sensor readings.

Calibrate Actuator

For systems that use a valve actuator for chilled water or glycool, the actuator timing may be calibrated. The display will show the present amount of time that is used by the control for valve actuator full travel time. If this is not correct, an automatic calibration sequence can be initiated by pressing the ENTER key. The actuator will first be driven shut for a period equal to the full travel time. This insures the valve is completely shut before beginning the calibration. As the

valve is then re-opened, a feedback signal from the actuator indicates to the control when the actuator has reached the half open position. The time required to receive this signal is then used by the control to calculate a new actuator full travel time. This new value is displayed and the valve is driven shut again to complete the calibration sequence.

The actuator may also be manually calibrated by pressing the ENTER key, again, after the automatic sequence is initiated. In this case, the valve will first be driven shut as before. When the valve reaches the half open position, **the operator must press** the ENTER key to indicate "half open" to the control.

3A.5.3 Run Diagnostics

By selecting Run Diagnostics, maintenance personnel can check system inputs, outputs, and complete a test of the microcontroller circuit board, all from the front panel. Review of the system inputs and the microcontroller test can be done without interrupting normal operation. To test the system outputs, the normal system control is temporarily suspended. **DO NOT** leave the unit in the diagnostics mode any longer than is necessary for troubleshooting. The control system will return to normal operation in 5 minutes, automatically, if no key is pressed.

Show Inputs

With the unit on and the fan running, the input state for the following devices may be displayed:

- Air Sail Switch: normally off unless Loss of Air Alarm is active
- Custom Alarm #1: normally off unless this alarm is active
- Custom Alarm #2: normally off unless this alarm is active
- Custom Alarm #3: normally off unless this alarm is active
- Custom Alarm #4: normally off unless this alarm is active
- Humidifier Problem: normally on unless this alarm is active
- Filter Clog: normally off unless Change Filters Alarm is active
- Main Fan Overload: normally on unless Main Fan Overload Alarm is active

- High Head Comp 2: normally off unless High Head Pressure Alarm Compressor 2 is active
- Comp 2 Overload: normally on unless Compressor 2 Overload Alarm is active

- Shutdown Device: normally on unless unit is off through the Fire Stat or Remote Shutdown Device

- Low Press Switch 2: normally on if compressor circuit 2 is in operation

- Low Press Switch 1: normally on if compressor circuit 1 is in operation

- Comp 1 Overload: normally on unless Compressor 1 Overload Alarm is active

- High Head Comp 1: normally off unless High Head Pressure alarm Compressor 1 is active

Test Outputs

When this feature is selected, the unit is effectively turned off. When stepping from one load to the next, the previous load, if on, is turned off automatically. The loads can also be toggled on/off by selecting "ENTER". Once turned on, the output will remain on for 5 minutes unless toggled off or the Test Outputs function is exited by selecting "MENU/ESC". (COMP1 and COMP2 are limited to 15 seconds on to prevent damage.) The outputs are as follows:

- Main Fan: main fan contactor

- Comp 1: compressor 1 contactor

- LLSV1: liquid line solenoid valve 1

- HGBP/CUV1: hot gas bypass or compressor 1 unloader valve (on certain units)

- Comp 2: compressor 2 contactor

- LLSV2: liquid line solenoid valve 2

- HGBP/CUV2: hot gas bypass or compressor 2 unloader valve (on certain units)

- CWV/CGV: chilled water or Glycool valve

- R5 Relay: Relay 5 (heat rejection)

- Reheat 1: Reheat 1 contactor (also energizes fan for safety)

- Reheat 2: Reheat 2 contactor (also energizes fan for safety)
- RH 3/ Dehum Damper: Reheat 3/ dehum damper contactor (also energizes fan for safety)
- HWR/Steam: hot water or steam valve
- Humidifier: humidifier contactor (also energizes humidifier makeup valve and fan for safety)
- HMV: humidifier makeup valve
- Comm alarm: common alarm relay

CAUTION
Do not test a compressor output for more than a few seconds. Compressor damage could result!!!

Test Control Board

By selecting this function, the microcontroller will perform a self test lasting approximately 30 seconds.

3A.5.4 Change Passwords

The display prompts you to enter a three digit password when making changes. The system includes two (2) passwords, one for setpoints and one for setup. The system allows the passwords to be changed by first entering the present password, factory set as "123" for setpoints and "321" for setup. The password function provides system security, so only personnel authorized to make changes should know the passwords. If unauthorized changes are being made, the passwords may be compromised and new ones should be selected. The password function can be disabled by setting DIP switch 8 to OFF.

3A.6 DATE AND TIME

The current date and time is available through the display. This feature allows the date and time to be read or changed and is accessed by selecting "DATE AND TIME" from the Main Menu. The "DATE AND TIME" is only used by the control for recording the Alarm History.

NOTE
The clock uses the 24 hour system (For Example: 17:00 would be 5:00 PM). The date and time are battery backed up.

3A.7 STATUS DISPLAY

The Status Display selected from the Main Menu is the same Status Display that is normally on the screen. While the Main Menu is displayed, you can press the MENU/ESC key again to back up the Status Display.

NOTE
The system automatically returns to the Status Display in five minutes if no control keys are pressed.

3A.8 CONTROL CIRCUIT BOARD

The control circuit board is located inside the unit behind the LCD display and control key panel. Open and raise the upper panel for access to the board. Use the two pull-out brackets to keep the panel up.

The control board includes an adjustment for LCD display contrast, non-volatile memory, DIP switches (which should not require customer changes), and control output LEDs.

3A.8.1 LCD Display Contrast

The level of contrast due to viewing angle of the LCD display can be adjusted using a small thumb wheel at the upper left of the control board just under the cable going to the display. The control is labeled RA1.

NOTE
The LED backlighting on the text (4x20) display is always lit.

3A.8.2 Non-volatile Memory

All critical information is stored in non-volatile memory. Setpoints, setup parameters, and component run hours are kept inside the microcontroller in EEPROM. Information retained for the alarm history is kept in battery-backed RAM. The battery, located in the upper left hand corner of the control board, is field replaceable. Use only a direct replacement battery.

3A.8.3 DIP Switches

Equipment options are selected and enabled using DIP switches 1 to 7. These are located at the upper left of the control board and are labeled SW1. Switch 1 is at the top. These switches are factory set and should not require any user changes. The setting and function of the switches can be read from the LCD display and are also described in more detail in the Controls section, Section 4.

3A.8.4 Control Outputs

Active control outputs are indicated with LEDs on the lower section of the control board. Each LED is lit if the control output is active (on). The LEDs assist in troubleshooting the system.

Control Output LEDs

R5	—	Heat Rejection
LLSV1	—	Liquid Line Solenoid Valve 1
HGBP1	—	Hot Gas By-Pass 1 or Compressor Unloader Valve 1
C1	—	Compressor 1
C2	—	Compressor 2
RH1	—	Reheat Stage 1 or Hot Gas Reheat Solenoid
RH2	—	Reheat Stage 2
RH3	—	Reheat Stage 3
HUM	—	Humidifier
HGBP2	—	Hot Gas By-Pass 2 or Compressor Unloader Valve 2
FAN	—	Main Fan
HMV	—	Humidifier Make-up Valve
LLSV2	—	Liquid Line Solenoid Valve 2

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SECTION 3B — OPERATION WITH ADVANCED MICROPROCESSOR WITH GRAPHICS CONTROLS

SECTION 3B OPERATION WITH ADVANCED MICROPROCESSOR WITH GRAPHICS CONTROLS

The Advanced Microprocessor with Graphics (AG) Control for your Liebert Deluxe unit features an easy to use menu driven LCD Graphics Display. The menus, control features, and circuit board details are described in this section. For more details on the control refer to Section 4, and Section 5 for more details on the alarms.

3B.1 BASICS

Control keys include ON/OFF, Menu/ESCape, Enter, Increase (up) arrow, and Decrease (down) arrow. Refer to Figure 3B-1. These keys are used to move through the menus as prompted on the LCD display (refer to Figure 3B-2).

To turn the unit ON, press the ON/OFF key after power is applied. To turn the unit OFF, press the ON/OFF key before power is disconnected.

Active alarms are indicated on the LCD screen by a ringing bell. Alarms are also annunciated by an audible beeper. To silence an alarm, press the ENTER key as prompted on the display. The unit stores the 60 most recent alarms for review.

Setpoints, DIP switch settings, and other selections were made on your unit before testing at the factory and are kept in non-volatile memory. Setpoints were chosen based on typical operating experience. Other selections were made based on options included with your unit. Make adjustments to the factory default selections ONLY if they do not meet your specifications. When entering setpoints, time delays, etc., the allowable ranges are displayed and may require a password, if enabled.

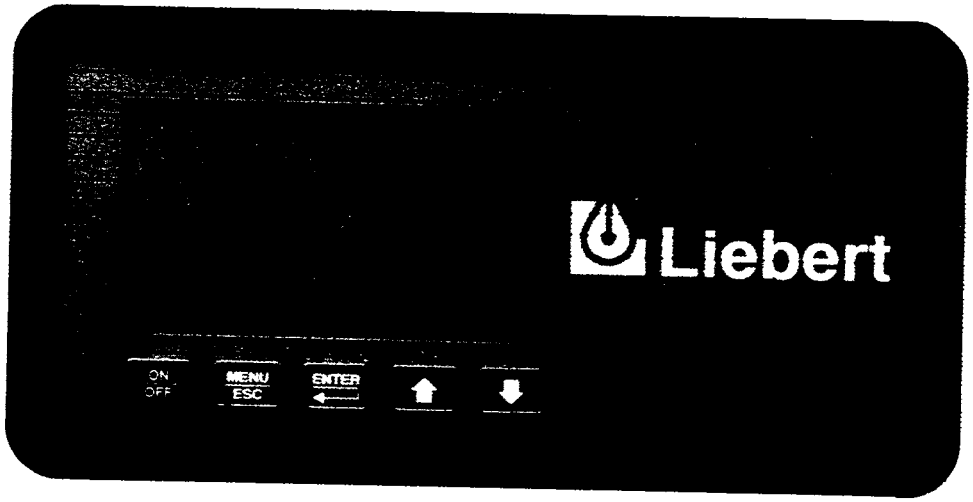

Figure 3B-1. Advanced Microprocessor with Graphics Control Panel

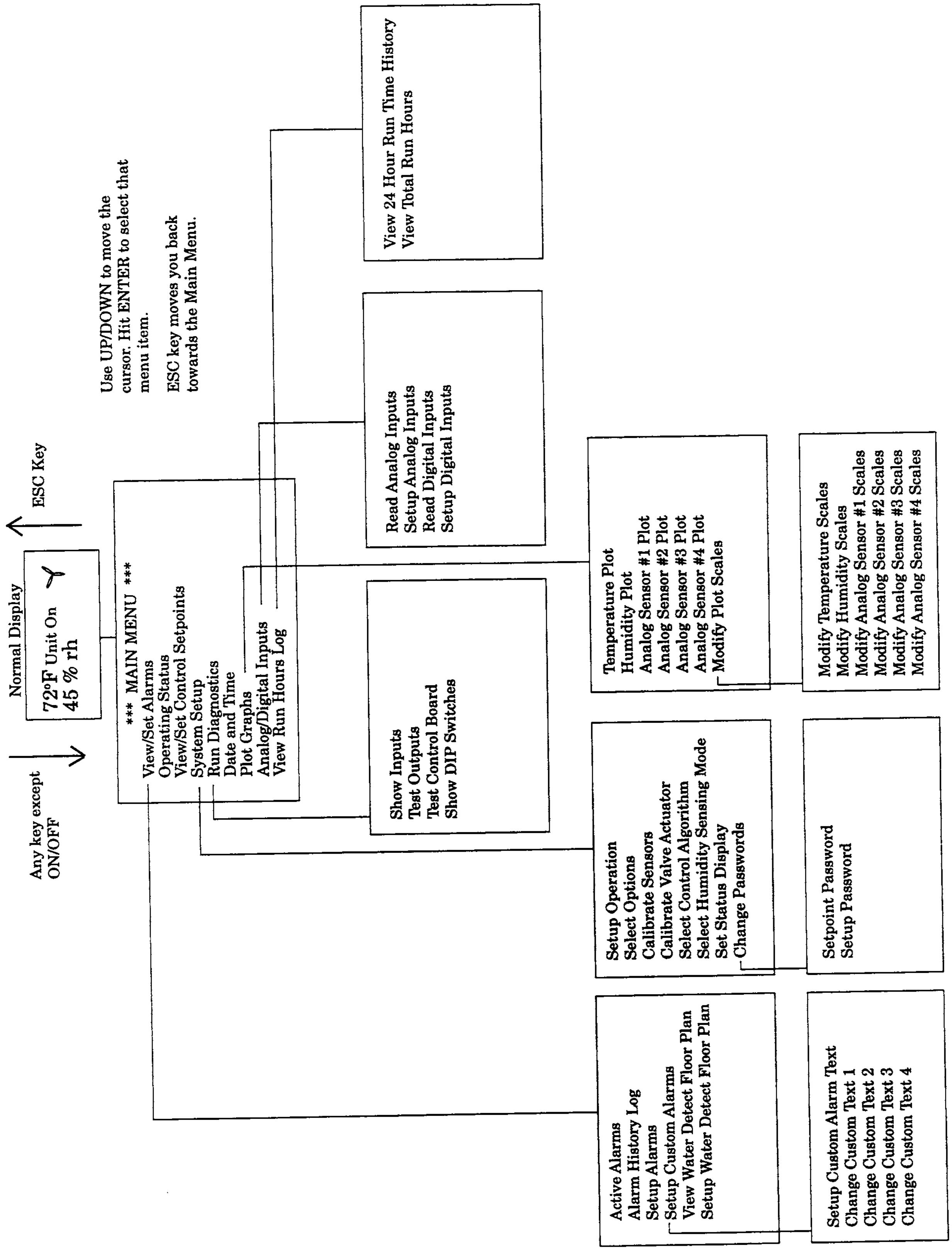

Figure 3B-2. Advanced Microprocessor with Graphics Control Menu

3B.2 STATUS DISPLAY

The normal status screen is divided into two sections, a right half and a left half. The left half displays the return air temperature and humidity readings in large characters.

NOTE
The display can also be set to display the temperature and humidity setpoints. See SET STATUS DISPLAY under SYSTEM SETUP.

The right half of the screen is divided into four quadrants (top to bottom). In the four quadrants, six different graphic symbols may be displayed depending on the unit status. At the top there will be a moving hammer striking a bell that appears when an alarm is present. The word "Alarm" also appears next to the hammer and bell. The second quadrant down displays a rotating fan as long as the unit is turned on and the fan is running. The words "Unit on" appear next to the fan symbol. The third quadrant may display one of two symbols relating to heating or cooling. If the control is calling for cooling, a growing snowflake is shown next to the word "Cooling." If the control is calling for heating, three moving heat rays are displayed next to the word "Heating." In the bottom quadrant, there may be one of two symbols relating to humidification and dehumidification. If the control is calling for humidification, a growing water drop is shown next to the word "Humidification." If the control is calling for dehumidification, a shrinking water drop is shown next to the word "Dehumidification".

3B.3 MAIN MENU <MENU/ESC>

Press the MENU/ESC key to display the Main Menu. The Menu selections include:

- VIEW/SET ALARMS
- OPERATING STATUS
- VIEW/SET CONTROL SETPOINTS
- SYSTEM SETUP
- RUN DIAGNOSTICS
- DATE AND TIME
- PLOT GRAPHS
- ANALOG/DIGITAL INPUTS
- VIEW RUN HOURS LOG

Pressing the MENU/ESC key while the Main Menu is displayed will return the screen to the Status Display.

3B.4 VIEW/SET ALARMS

Selecting VIEW/SET ALARMS will step to the following menu:

- ACTIVE ALARMS
- ALARM HISTORY LOG
- SETUP ALARMS
- SETUP CUSTOM ALARMS
- VIEW WATER DETECT FLOOR PLAN
- SETUP WATER DETECT FLOOR PLAN

3B.4.1 Active Alarms

This screen displays any active alarm. The alarms are numbered, #1 being the most recent. The type of alarm (Urgent or Warning) is also displayed. If there are no active alarms, then "NO ALARMS PRESENT" will be displayed.

3B.4.2 Alarm History Log

A history of the sixty (60) most recent alarms is kept in non-volatile memory complete with the type of alarm, the alarm name, and the date and time of its occurrence. The first alarm in the history is the most recent and the largest (up to 60) is the oldest. If the Alarm History is full (60 alarms) and a new alarm occurs, the oldest is lost and the newest is saved in alarm history location 1. The rest are moved down the list by 1. Alarm history on new units may show the results of factory testing.

3B.4.3 Setup Alarms

The list of alarms may be reviewed using the UP/DOWN keys. Any alarm may be selected to have it's parameters modified by pressing the ENTER key. All alarms have a time delay and alarm type parameter. The high/low temperature and humidity alarms also have a programmable Trip Point. The Trip Point is the point at which the alarm is activated. By programming a time delay for an alarm, the system will delay the specified amount of time before recognizing the alarm. The alarm condition must be present for the amount of time programmed for that alarm before it will be annunciated. If the alarm condition goes away before the time delay has timed out, the alarm will not be recognized. For software alarms such as Loss of Power, Short Cycle, and Low Suction Pressure, a time delay will only delay the annunciation of that alarm. The condition of the alarm is not applicable because the condition has already occurred. For these alarms the time delay should be left at the factory default of 0.

The following table shows the default time delays for each alarm.

Alarm	Default Time Delay (seconds)
Humidifier Problem	2
High Head Pressure 1	2
High Head Pressure 2	2
Change Filter	2
Loss of Air Flow	3
Custom Alarm #1	0
Custom Alarm #2	0
Custom Alarm #3	0
Custom Alarm #4	6
High Temperature	30
Low Temperature	30
High Humidity	30
Low Humidity	30
Short Cycle 1, 2	0
Low Suction Pressure 1, 2	0
Compressor #1 Overload	2
Compressor #2 Overload	2
Main Fan Overload	5
Loss of Power	0

Each individual alarm can be either DISABLED, WARNING, or URGENT. The four custom alarms may also be selected to be a Status Only input. If the alarm is DISABLED, it is ignored. If the alarm is WARNING or URGENT, it will be annunciated audibly, visually, and communicated to a Site Products System if appropriate. When the alarm is selected to be a WARNING, the alarm will NOT activate the common alarm relay. When the alarm is selected to be URGENT, the alarm is first annunciated as a WARNING, and then annunciated again, after the programmed time delay. When the alarm becomes URGENT, the control will activate the common alarm relay. The common alarm relay is de-energized after the alarm has been recognized and when the alarm no longer exists. When the alarm type has been selected to be URGENT, the allowable range for the time delay from warning to urgent is 0 minutes to 999 hours. When any of the four custom alarm inputs have been selected as Status Only, they become digital inputs for monitoring only and are no longer treated as alarms.

3B.4.4 Setup Custom Alarms

Selecting SETUP CUSTOM ALARMS will step to the following menu:

- SETUP CUSTOM ALARM TEXT
- CHANGE CUSTOM TEXT 1
- CHANGE CUSTOM TEXT 2
- CHANGE CUSTOM TEXT 3
- CHANGE CUSTOM TEXT 4

The custom alarm messages can be selected from a list of standard messages or you can write your own messages. The message selected for any custom alarm can be changed at any time by selecting SETUP CUSTOM ALARM TEXT. A list of 5 standard messages (see list below) and 4 custom messages are available to choose from. To modify the custom messages press CHANGE CUSTOM TEXT 1 (2, 3 or 4). Each message can be up to 20 characters in length and can be any of the following characters (or a blank space): ABCDEFGHIJKLMNOPQRSTUVWXYZ#%*-0123456789.

Standard Custom Alarm Messages

- WATER UNDER FLOOR
- SMOKE DETECTED
- STANDBY GC PUMP ON
- LOSS OF WATER FLOW
- STANDBY UNIT ON

For more information concerning alarms, see Section 5.

3B.4.5 View Water Detect Floor Plan (for optional LTM1000/LT750)

When water is detected the alarm will sound and the WATER UNDER FLOOR alarm message will be displayed. To see where the water is in the room, select VIEW/SET ALARMS from the main menu, then VIEW WATER DETECT FLOOR PLAN. A tile will be highlighted and blinking to indicate the position of the detected water.

3B.4.6 Setup Water Detect Floor Plan

The selected (i.e. cursor) floor tile will be highlighted and blinking. The UP and DOWN arrow keys are used to position the cursor tile. The UP key will move the cursor tile up and then it wraps around to

the bottom of the next column to the right. The DOWN arrow key moves the cursor down, then to the top of the next column to the left. The cursor will also wrap around from the right top tile to the left bottom tile and back.

There are three different types of tiles to be defined, the environmental unit, the LT750 and sensor cable tiles. To setup the cable layout, first move the cursor to the location of the environmental unit and press the ENTER key. A rectangular box will be drawn at that location. Then move the cursor to the location of the LT750 and press the ENTER key. A solid circle will be drawn on the display. No tile can have two definitions, so if the LT750 is physically directly under the unit it has to be defined at least one tile away.

The sensor cable does not, and should not be defined one tile at a time. The only sensor cable tiles that need to be defined are the tiles where the cable is going to change direction, and the last tile. The display will automatically define any tiles between two consecutively defined sensor tiles to be sensor tiles.

The ENTER key is also used to undo tile definitions. If a tile is defined in the wrong place, position the cursor on that tile and press the ENTER key. It will undefine the tile under the cursor and move the cursor back to the last defined tile. The entire layout can be erased by successively pressing the ENTER key. When the last tile is defined, press the ESCape key to leave the setup screen.

For more information and detailed installation instructions, see Section 4.

3B.5 OPERATING STATUS

The Operating Status is intended to provide the user with displayed information concerning what the control is calling for the system to do.

NOTE
There may be some time elapse before a specific component matches the displayed number.

For example: The display indicates the chilled water valve is 68% open. On a new call for cooling, it takes several seconds for the valve to travel from full closed to 68% open. So when the display reads 68%, it may take a few seconds for the valve to actually open 68%. Also, if the display indicates a compressor is operating but the compressor has not turned on yet, it may be off because of the short cycle control (see Load Control/Short Cycle Control, under Section 4).

3B.6 VIEW/SET CONTROL SETPOINTS

Control setpoints can be reviewed and/or changed through the display. The following table lists the default setpoints and their allowable ranges.

Setpoint	Default	Range
Temperature Setpoint	72°F	40 to 85°F (5 to 29°C)
Temperature Sensitivity	2.0°F	1 to 9.9°F (0.6 to 5.6°C)
Humidity Setpoint	50%	20 to 80% RH
Humidity Sensitivity	5%	1 to 30% RH
High Temperature Alarm	80°F	35 to 90°F (2 to 32°C)
Low Temperature Alarm	65°F	35 to 90°F (2 to 32°C)
High Humidity Alarm	60%	15 to 85%RH
Low Humidity Alarm	40%	15 to 85%RH

3B.7 SYSTEM SETUP

Selecting SYSTEM SETUP will step to the following menu:

- SETUP OPERATION
- SELECT OPTIONS
- CALIBRATE SENSORS
- CALIBRATE VALVE ACTUATOR
- SELECT CONTROL ALGORITHM
- SELECT HUMIDITY SENSING MODE
- SET STATUS DISPLAY
- CHANGE PASSWORDS

3B.7.1 Setup Operation

The Setup Operation menu permits the review and/or adjustment of the unit configuration. This may include:

Cold Start Delay

This feature, also referred to as Positive Start or Winter Start Kit, allows for the low pressure switch to be ignored for the programmed time during a cold start of the compressors. Entering a "0" for this time will bypass this feature. A "1", will bypass the low pressure switch for one minute, a "2" for two minutes, etc. The programmed value can be from 0 to 3 minutes. This delay is factory set to 0 for water cooled, glycol cooled, and glycool units. Typically, only air cooled units need a "Winter Start" time.

Auto Restart Delay

This feature allows for the unit to restart automatically after a loss of power. The programmed value is .1 minute (6 seconds) intervals. A programmed value of zero (0) would require the user to manually press the ON/OFF switch to start the unit, i.e. no auto restart. The purpose of this feature is to prevent several units from starting at the same time after a loss of power. (It is suggested multiple unit installations be programmed with different auto restart times.)

IR Flush Overfill (infrared humidifiers only)

An autoflush system automatically controls a water makeup valve to maintain proper level in the infrared humidifier water pan during humidifier operation. If humidification is needed and 30 hours have elapsed since the last time the humidifier was on, then the humidifier is held off until the valve completes an initial fill of the humidifier pan. This pre-fill is about 35 seconds for a small pan and 60 seconds for a large pan. The valve continues to fill and flush the pan for about 4 and 1/2 minutes for a small pan or 7 and 1/2 minutes for large pan. Pan size is selected based on unit specifications and is preset at the factory.

During humidifier operation, with the flush rate set at the default of 150%, the valve is opened periodically to add water to the pan (about 45 seconds every 7 minutes of humidifier operation for a small pan, or 80 seconds every 10 minutes of operation for a large pan). This adds enough water to the pan to cause about a third of the total water used to be flushed out the overflow standpipe located in the humidifier pan. This action helps to remove solids from the pan. The flush rate is adjustable from 110% to 500%. If the water quality is poor, it may be desirable to increase the water flushing action above the normal 150% rate. Also, if the supply water pressure is low, the flush rate adjustment can be increased so that sufficient water level is maintained during humidification.

Chilled Water/Hot Water/Econ-O-Coil Flush

This feature will flush the respective coil for three (3) minutes after the programmed number of hours of non-use. For example, if the flush time is programmed with 24 hours on a hot water reheat type system, and heating is not required for a 24 hour period, the hot water valve will be opened for 3 minutes to allow the coil to be flushed. The programmed value can be from 0 (no flush) to 99 (99 hours of non-use).

Display in Degrees

The control can be set to display readings and setpoints in either degrees Fahrenheit (F) or Celsius (C).

Default Settings and Ranges

The following table lists the Setup functions, their factory default values, and the allowable ranges of which they can be programmed.

Function	Default	Range
Cold Start Time Delay[1]	3	0 to 3 min (0 = no delay)
Restart Time Delay	0.1	0 to 9.9 min (0 = manual restart)
Infrared Fill Rate	150	110 to 500%
Chilled/Hot Water Coil Flush	24	0 to 99 Hrs (also Econ-o-coil)
C/F Degrees	F	F or C

[1] factory set to 0 for water cooled, glycol, and glycool units

3B.7.2 Select Options

The following table is a list of options which should match the options installed with your unit and should not need to change

Option	Selection
Reheat	YES or No
Humidify	YES or NO
Dehumidify	YES or NO
Humidifier Pan Size	SMALL or LARGE
Hot Gas Reheat	YES or NO
Stages of Reheat	2 or 3
Dehumidification Stages	1 or 2

[1] If heat stages is set to 2 on a chilled water unit, the reheat 3 output is energized on a call for dehumidification.

during normal operation.

3B.7.3 Calibrate Sensors

The temperature and humidity sensors can be calibrated by selecting this menu item. "SENSOR" shows the actual sensor reading or raw reading. "CALIBRATED" shows the sensor reading after the calibration offset has been added. The temperature sensor can be calibrated +/- 5 degrees Fahrenheit and the humidity sensor can be calibrated +/- 10%RH. When calibrating the humidity sensor, the value shown will always be %RH, even though absolute humidity control may be selected. If absolute humidity control is selected, the Normal Status Display **will** display the **adjusted** reading and may not agree with the relative humidity reading displayed while in calibration.

3B.7.4 Calibrate Valve Actuator

For systems that use a valve actuator for chilled water or glycool, the actuator timing may be calibrated. The display will show the present amount of time that is used by the control for valve actuator full travel time. If this is not correct, an automatic calibration sequence can be initiated by pressing the ENTER key. The actuator will first be driven shut for a period equal to the full travel time. This insures that the valve is completely shut before beginning the calibration. As the valve is then re-opened, a feedback signal from the actuator indicates to the control when the actuator has reached the half open position. The time required to receive this signal is then used by the control to calculate a new actuator full travel time. This new value is displayed and the valve is driven shut again to complete the calibration sequence.

The actuator may also be manually calibrated by pressing the ENTER key, again, after the automatic sequence is initiated. In this case, the valve will first be driven shut as before. When the valve reaches the half open position, THE OPERATOR MUST PRESS the ENTER key to indicate "half open" to the control.

3B.7.5 Select Control Algorithm

The type of system control method used by the microprocessor can be selected from the front panel. The default setting is Intelligent, which approximates the actions that a human operator would take to maintain precise, stable control. The control logic uses Artificial Intelligence techniques including "fuzzy logic" and "expert systems" methods to maintain precise, stable control and increase reliability by reducing component cycles. Proportional is a standard control method that uses one gain factor (temperature sensitivity adjustment). Tunable PID (Proportional, Integral, and Derivative) uses three gain factors selected by the operator. PID allows precision tuning, but requires an experienced operator and seasonal adjustments. Note that if PID is selected, it is used for temperature control while humidity will continue to use proportional control. For chilled water units with the optional Variable Speed Drive, Intelligent is required for proper operation. Refer to Section 4 for more details on types of control.

3B.7.6 Select Humidity Sensing Mode

The user may select between relative (direct) and absolute (predictive) humidity control. If relative is selected, the RH control is taken directly from the RH sensor. If absolute is selected, the RH control is automatically adjusted as the return air temperature deviates from the desired temperature setpoint. This results in a predictive humidity control. The display will indicate %RH for both methods of control, but the **adjusted humidity reading will be displayed** if absolute is selected. With predictive humidity control, the humidity control is automatically adjusted approximately 2% RH

for each degree difference between the return air temperature and the temperature setpoint.
With relative humidity control, unnecessary dehumidification can result when overcooling occurs during a dehumidification cycle. This is because a higher than normal RH reading is caused by overcooling the room (about 2% RH for each degree of overcooling). This extends the dehumidification cycle. Later, when the dehumidification ends and the temperature rises to the setpoint, the RH reading falls. The final RH reading will then be lower than actually desired. If the overcooling was significant enough, the RH could be low enough to activate the humidifier.

If absolute humidity control is selected, over-dehumidification is avoided. When overcooling occurs, causing an increase in the RH reading, the humidity control program "predicts" what the RH will be when the dehumidification cycle ends and temperature returns to the setpoint. This allows the dehumidification cycle to end at the proper time. The predictive humidity control can reduce energy consumption by minimizing compressor and reheat operation, and eliminating unnecessary humidifier operation.

3B.7.7 Set Status Display

The Status Display can be set to display the return air temperature and humidity SENSOR READINGS or the temperature and humidity control SETPOINTS through this selection. When setpoints are selected, the status display indicates so by also displaying "SETPOINTS". If SENSOR READINGS is selected, the Status Display will show the return air sensor readings.

3B.7.8 Change Passwords

Selecting CHANGE PASSWORDS will prompt the user to select one of the following:

- SETPOINT PASSWORD
- SETUP PASSWORD

The display prompts you to enter a three digit password when making changes. The system includes two (2) passwords, one for setpoints and one for system setup. The system allows the passwords to be changed by first entering the present password, factory set as "123" for setpoints and "321" for setup. The password function provides system security, so only personnel authorized to make changes should know the passwords. If unauthorized changes are being made, the passwords may be compromised and new ones should be selected. The password function can be disabled by setting DIP switch 8 to OFF.

3B.8 RUN DIAGNOSTICS

By selecting Run Diagnostics, maintenance personnel can check system inputs, outputs, and complete a test of the microcontroller circuit board, all from the front panel. Review of the system inputs and the microcontroller test can be done without interrupting normal operation.

3B.8.1 Show Inputs

With the unit on and the fan running, the input state for the following devices may be displayed:

- Air Sail Switch: normally off unless Loss of Air Alarm is active
- Custom Alarm #1: normally off unless this alarm is active
- Custom Alarm #2: normally off unless this alarm is active
- Custom Alarm #3: normally off unless this alarm is active
- Custom Alarm #4: normally off unless this alarm is active
- Humidifier Problem: normally on unless this alarm is active
- Filter Clog Switch: normally off unless Change Filters Alarm is active
- Main Fan Overload: normally on unless Main Fan Overload Alarm is active
- High Head Compressor 2: normally off unless High Head Pressure Alarm Compressor 2 is active
- Compressor 2 Overload: normally on unless Compressor 2 Overload Alarm is active
- Shutdown Device: normally on unless unit is off through the Fire Stat or Remote Shutdown Device
- Low Pressure Switch 2: normally on if compressor circuit 2 is in operation
- Low Pressure Switch 1: normally on if compressor circuit 1 is in operation
- Compressor 1 Overload: normally on unless Compressor 1 Overload Alarm is active
- High Head Compressor 1: normally off unless High Head Pressure alarm Compressor 1 is active

3B.8.2 Test Outputs

When this feature is selected, the unit is effectively turned off. When stepping from one load to the next the previous load, if on, is turned off automatically. The loads can also be toggled on/off by selecting "ENTER". Once turned on, the output will remain on for 5 minutes unless toggled off or the test outputs function is exited by selecting "MENU/ESC" (Compressor 1 and Compressor 2 are limited to 15 seconds on to prevent damage.) DO NOT leave the unit in the test outputs mode any longer than is necessary for troubleshooting. The outputs are as follows:

- Main Fan: main fan contactor
- Compressor 1: compressor 1 contactor
- LLSV1: liquid line solenoid valve 1
- HGBP/CUV1: hot gas bypass or compressor 1 unloader valve (on certain units)
- Compressor 2: compressor 2 contactor
- LLSV2: liquid line solenoid valve 2
- HGBP/CUV2: hot gas bypass or compressor 2 unloader valve (on certain units)
- CWV/CGV: chilled water or Glycool valve
- R5 Relay: Relay 5 (heat rejection)
- Reheat 1: Reheat 1 contactor (also energizes fan for safety)
- Reheat 2: Reheat 2 contactor (also energizes fan for safety)
- Reheat 3: Reheat 3 contactor (also energizes fan for safety)
- HWR/Steam: hot water or steam valve
- Humidifier: humidifier contactor (also energizes humidifier makeup valve and fan for safety)
- HMV: humidifier makeup valve
- Common alarm: common alarm relay

CAUTION
Do not test a compressor output for more than a few seconds. Compressor damage could result!!!

3B.8.3 Test Control Board

By selecting this function, the microcontroller will perform a self test lasting approximately 10 seconds.

3B.8.4 DIP Switches

The DIP switch settings can be reviewed from the display panel. Changing the DIP switches requires opening the upper panel for access to the DIP switches on the microprocessor control board.

NOTE
Power MUST be cycled off, then on from the unit disconnect switch for the control system to update the DIP switch settings.

These selections should match options installed on your unit and should not need to change during normal operation. Switches 1 through 6 are self explanatory. Switch 7 is described in more detail below. DIP switch 8, not shown above, enables the password feature when set to ON and disables the password feature if set to OFF.

Number	OFF	ON
1	Compressor Cooling	Chilled Water
2	Electric/Hot Gas Reheat	Hot Water Reheat
3	2 Step	4 Step
4	No Glycool	Glycool
5	No Dual Cooling	Dual Cooling
6	Not Used	Not Used
7	Delayed Reheat	Dehum with Normal

Dehumidification with Normal or Delayed Reheat

Dehumidification with normal reheat allows for operating **BOTH** compressors and three stages of electric reheats simultaneously. It is very important that electrical service to the unit be sized and wired for this option if selected.

CAUTION
The result of electrical service to the unit not being sized properly for this option could be nuisance trips of the building circuit breakers (or fuses) or, in extreme cases, damage to building wiring.

With delayed reheat selected, the reheats are prevented from turning on when dehumidifying with both compressors until the point at which 100% heating is called for. At this time, the compressors are turned off until the reheats bring the temperature back up to the point at which the reheats are turned off.

3B.9 DATE AND TIME

The current date and time is available through the display. This feature allows the date and time to be read or changed and is accessed by selecting "DATE AND TIME" from the Main Menu. The "DATE AND TIME" is used by the control for recording the Alarm History and plotting graphs.

NOTE
The clock uses the 24 hour system (For Example: 17:00 would be 5:00 PM).

The date and time are battery backed up.

3B.10 PLOT GRAPHS

Selecting PLOT GRAPHS will step to the following menu:

- TEMPERATURE PLOT
- HUMIDITY PLOT
- ANALOG SENSOR #1 PLOT
- ANALOG SENSOR #2 PLOT
- ANALOG SENSOR #3 PLOT
- ANALOG SENSOR #4 PLOT
- MODIFY PLOT SCALES

Six different data types are recorded for graphing: temperature, humidity, and four user defined analog inputs. Each data type can be viewed over three different time scales and two different resolutions. The three time scales are 90 minutes, 8 hours, and 24 hours. The two resolutions are minimum and maximum. With minimum resolution selected, the full scale of the sensor is displayed. In other words, the largest and smallest possible sensor readings are shown. Maximum resolution shows a range which covers two fifths of the full scale sensor range.

3B.10.1 Modify Plot Scales

The MODIFY PLOT SCALES menu item adjusts the layout of the graph. This setup screen selects the time scale and resolution. It also adjusts the center of the graph for a maximum resolution graph.

The time scale and resolution can also be changed while the graph is displayed. The DOWN arrow key changes the time scale from 90 minutes, to 8 hours, to 24 hours. The UP arrow key toggles the display between maximum and minimum resolution.

3B.11 ANALOG/DIGITAL INPUTS

Selecting ANALOG/DIGITAL INPUTS steps to the following menu:

- READ ANALOG INPUTS
- SETUP ANALOG INPUTS
- READ DIGITAL INPUTS
- SETUP DIGITAL INPUTS

3B.11.1 Read Analog Inputs

The four (4) analog sensor inputs can be monitored from the display. The inputs are filtered, then displayed along with the text label assigned during setup.

3B.11.2 Setup Analog Inputs

For installation of analog sensors, see ANALOG INPUTS, Section 4. After selecting a compatible sensor and properly wiring it to the terminals, setting up the control to monitor the sensor is as follows:

Slope

The slope is a multiplier used to scale the input signal. The slope can be positive (rising) or negative (falling) and can range from 0 (resulting in a horizontal line) to (+/-) 999. The slope for a 0-5 volt input is per 1 volt input, for 0-10 volt input is per 2 volt input, and for 4-20 mA is per 4 mA input. For example, assuming an intercept of 0, for a 0-10 volt sensor input with a slope of 50, an input of 1 volt would be displayed as 25: (1x(50/2)), 2 volts would be 50: (2x(50/2)), 3 volts would be 75: (3x(50/2)), etc.

Intercept

The intercept is an offset from point 0 corresponding to 0 volts or 0 mA input. The intercept can be positive or negative and can be a point from 0 to (+/-) 999. Adding an intercept of 100 to the slope example above, 1 volt would be 125: 100 + (1x(50/2)); 2 volts would be 150: 100 + (2x(50/2)); 3 volts would be 175: 100 + (3x(50/2)); etc.

NOTE
For a 4-20 mA input sensor, if the desired reading at 4 mA input is 0, then an intercept of -1 x slope would be required. For example, assuming a slope of 50, the formula would be ((-1 x 50) + 4 x (50/4)) = 0. The intercept is -50.

Text

You may enter a custom label for each analog input. The text label can be 20 characters in length including any of the following: ABCDEFGHIJKLMNOPQRSTUVWXYZ#%*-0123456789, or space.

3B.11.3 Read Digital Inputs

The four custom alarm inputs can be defined to be digital inputs. Digital inputs are used to sense customer devices for status display purposes only and will not activate the audible alarm.

3B.11.4 Setup Digital Inputs

A digital input is enabled by defining one of the four custom alarms to be STATUS ONLY type in the alarm setup screen. The digital input is given a name by specifying it to be one of the optional alarms or a custom text alarm. See SETUP ALARMS and SETUP CUSTOM ALARMS.

3B.12 VIEW RUN HOURS LOG

Selecting VIEW RUN HOURS LOG will step to the following menu:

- VIEW 24 HOUR RUN TIME HISTORY
- VIEW TOTAL RUN HOURS

3B.12.1 View 24 Hour Run Time History

The history of each load for every hour during the past 24 hours is displayed in the run hour history. The percentage of each hour that the load was on is displayed from 0 to 100% in increments of 5% or 3 minutes. Loads with a variable output are displayed as a percentage of their capacity for an hour. For example, a variable load that is 50% on for 1/2 of the hour will be displayed as 25% on for that hour.

3B.12.2 View Total Run Hours

The total operating hours of all major components in the unit can be monitored from the display and are retained in non-volatile memory. Run times are available for the following:

- Compressor 1
- Compressor 2
- Glycool Coil (or Dual Cool Coil)
- Fan
- Humidifier

- Reheat 1 (or Hot Water Reheat)
- Reheat 2
- Reheat 3
- Chilled Water Coil
- Heat Rejection

The component run hours for each individual component can be reset by selecting the run hours display screen for the desired component, then pressing ENTER within five (5) minutes of applying power to the control. The user will then be prompted to press ENTER to clear the selected component's run hours.

NOTE
Run hours for a component should ONLY BE RESET when the component has been replaced.

3B.13. CONTROL CIRCUIT BOARD

The control circuit board is located inside the unit behind the LCD display and control key panel. Open and raise the upper panel for access to the board. Use the two pull-out brackets to keep the panel up.

The control board includes an adjustment for LCD display contrast, non-volatile memory, DIP switches (which should not require customer changes) and control output LEDs.

3B.13.1 LCD Display Contrast

The level of contrast due to the viewing angle of the LCD display can be adjusted using a small thumb wheel at the upper left of the control board just under the cable going to the display. The control is labeled RA1.

NOTE: The LCD backlighting will turn on when any key is pressed and will go off 5 minutes after the last key is pressed.

3B.13.2 Non-volatile Memory

All critical information is stored in non-volatile memory. Setpoints, setup parameters, and component run hours are kept inside the microcontroller in EEPROM. Information retained for data logging, 24 hour component run hour graphs, alarm history, and the water detection floor plan is kept in battery-backed RAM. The battery, located in the upper left hand corner of the control board, is field replaceable. Use only a direct replacement battery.

3B.13.3 D I P Switches

Equipment options are selected and enabled using DIP switches 1 to 7. These are located at the upper left of the control board and are labeled SW1. Switch 1 is at the top. These switches are factory set and should not require any user changes. The setting and function of the switches can be read from the LCD display and are also described in more detail in the Controls section.

3B.13.4 Control Outputs

Active control outputs are indicated with LEDs on the lower section of the control board. Each LED is lit if the control output is active (on). Use these LEDs to assist in troubleshooting the system.

Control Output LEDs

R5	—	Heat Rejection
LLSV1	—	Liquid Line Solenoid Valve 1
HGBP1	—	Hot Gas By-Pass 1 or Compressor Unloader Valve 1
C1	—	Compressor 1
C2	—	Compressor 2
RH1	—	Reheat Stage 1 or Hot Gas Reheat Solenoid
RH2	—	Reheat Stage 2
RH3	—	Reheat Stage 3
HUM	—	Humidifier
HGBP2	—	Hot Gas By-Pass 2 or Compressor Unloader Valve 2
FAN	—	Main Fan
HMV	—	Humidifier Make-up Valve
LLSV2	—	Liquid Line Solenoid Valve 2

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SECTION 4 — SYSTEM PERFORMANCE WITH ADVANCED MICROPROCESSOR CONTROLS

SECTION 4 SYSTEM PERFORMANCE WITH ADVANCED MICROPROCESSOR CONTROLS

This section provides details on how your Deluxe unit responds to user inputs and room conditions. Refer to this section when you need specific information. This section includes details on control types: proportional, PID, and intelligent.

4.1 TEMPERATURE CONTROL

4.1.1 Cooling/Heating Required, in Percent (%)

The temperature control program for the advanced microprocessor is based on a calculated % requirement for cooling/ heating. This % requirement is determined by the control type (algorithm) selected by the user.

4.1.2 Response to Control Types

Proportional Control

If proportional control is selected, the % requirement is determined by the difference between the return air temperature and the temperature setpoint. As the return air temperature rises above the temperature setpoint, the % cooling required increases proportionally (from 0 to 100%) over a temperature band equal to the temperature sensitivity plus 1 degree F. The % heating requirement is determined the same way as the temperature decreases below the setpoint. With this type of control the temperature at which the room is controlled increases as the room cooling load increases. At full cooling load the room would be controlled at a temperature equal to the setpoint plus the sensitivity (see Control Types).

PID Control

If PID control is selected, the return air temperature is controlled at or near the temperature setpoint independent of the room load. The % cooling/heating requirement is calculated by adding together three individual terms - proportional, integral, and derivative.

The proportional term is figured in a manner similar to the previously described proportional control. The integral term (sometimes called "reset action") is figured by measuring how much and for how long the temperature has been above or below the setpoint. If the temperature is above the setpoint, the % cooling requirement is slowly but continuously increased until the total is sufficient to bring the temperature back to the setpoint. The derivative term provides an anticipation control for rapid changes in temperature. If the temperature is rising, the % cooling is increased temporarily until the temperature begins to stabilize. The % heating requirement is increased if temperature is falling.

The proportional, integral, and derivative terms are all adjustable through the control selection menu and should be set or "tuned" to the characteristics of the room being controlled (see Control Types).

Intelligent Control

If intelligent control is selected, the return air temperature is controlled at or near the temperature setpoint. The % cooling/heating required is calculated based on a set of logical "rules" that are programmed into the control. These "rules" basically simulate the actions that an expert human operator would take if manually controlling the system (see Control Types).

4.1.3 Cooling Operation

2-Step Cooling, Compressorized Direct Expansion (DX) Systems

The first stage of cooling activates when the temperature control calculates a requirement for cooling of 50%. The first stage of cooling is deactivated when the cooling requirement drops below 25%. The second stage of cooling is activated when the requirement for cooling rises to 100% and deactivated when the requirement falls below 75%.

4-Step Cooling, Compressorized Direct Expansion (DX) Systems

The four stages of cooling are activated when the requirement for cooling is 25%, 50%, 75%, and 100% respectively. Each stage of cooling is deactivated when the requirement for cooling falls 12% below the respective activation points. The four stages of cooling are accomplished in the following manner:

1 stage: One compressor, unloaded

2 stages: Both compressors, unloaded

3 stages: One compressor, loaded and one compressor, unloaded

4 stages: Both compressors, loaded

Glycool Cooling

When Glycool cooling is available, the temperature control will calculate a total cooling requirement of 200% rather than 100%. Assuming that full Glycool capacity is available, the Glycool valve opens proportionally as the requirement for cooling rises from 0 to 100%. If more than 100% cooling is required, then the compressors are activated at 150% and 200% respectively (125%, 150%, 175%, and 200% for a 4 step system). If full Glycool capacity is not available, then the Glycool valve will be opened proportionally over a cooling requirement band equal to the available Glycool capacity. The compressors would be activated at a cooling requirement of 50% and 100% above the available Glycool capacity.

For example, if the Glycool capacity is 60% then the Glycool valve would be full open at 60% cooling requirement, and the compressors would activate at 110% and 160% cooling requirement. In order to reduce compressor cycling and prevent hunting, glycool capacity first becomes available when the entering glycol temperature is at least 8 degrees F (22% capacity) below the return air temperature or 3 degrees F below the return air temperature for 2 hours. Glycool capacity is 100% when the glycol temperature is 25 degrees F below the return air temperature. The system will continue to Econo-cool as necessary as long as the entering glycol temperature remains at least 3 degrees F (0% capacity) below the return air temperature. If Glycool is not available, the temperature control will operate the compressors in the same manner as a 2-step or 4-step system without Glycool.

Dual Cooling Source

If dual cooling is available, the sensible cooling system operates in the same manner as a Glycool system, except that it is assumed that 100% chilled water capacity is available any time the chilled water temperature is 3° F below the return air temperature.

Chilled Water Cooling

The chilled water control valve is adjusted proportionally as the temperature control varies the requirement for cooling from 0% to 100%.

4.1.4 Heating Operation

Electric Heat

The 3 heat stages are activated when the temperature control calculates a requirement of 33%, 66%, and 100% respectively. Each stage is deactivated when the heat requirement is 16% less than the activation point.

Hot Water/Steam Heat

The valve begins to open when the requirement for heating is 33% and is proportionally adjusted until the valve is full open at 100% heat requirement.

4.2 HUMIDITY CONTROL

4.2.1 Dehumidification/Humidification Required, in Percent (%)

The humidity control program for the Advanced Microprocessor is based on a calculated % requirement for dehumidification/ humidification. This % requirement is determined by the particular type of control algorithm selected by the user.

4.2.2 Response to Control Types

Proportional Control

If proportional control is selected, the % requirement is determined only by the difference between the return air humidity and the humidity setpoint. As the return air humidity rises above the humidity

setpoint, the % dehumidification required increases proportionally from 0 to 100% over a humidity band equal to the humidity sensitivity setting. The converse is true for % humidification requirement.

PID Control

If PID control is selected, humidity is controlled in the proportional mode with the sensitivity band being determined by the humidity sensitivity setpoint.

Intelligent Control

If intelligent control is selected, the return air humidity is controlled at or near the humidity setpoint. The % dehumidification/humidification required is calculated based on a set of logical "rules" that simulate the actions of an expert human operator (see intelligent control section).

4.2.3 Dehumidification Operation

1-Stage Dehumidification, Compressorized Direct Expansion (DX) Systems

If single compressor dehumidification is selected, a compressor is activated when the humidity control calculates a requirement of 100%. The compressor is deactivated when the requirement falls below 50%.

2-Stage Dehumidification, Compressorized Direct Expansion (DX) Systems

The first stage of dehumidification activates when the humidity control calculates a requirement for dehumidification of 50%. The first stage of dehumidification is deactivated when the dehumidification requirement drops below 25%. The second stage of dehumidification is activated when the requirement for dehumidification rises to 100% and deactivated when the requirement falls below 75%. If the compressors have unloading capability (4-step cooling), then the compressors are activated in the fully loaded condition for each stage of dehumidification.

Normal or Delayed Reheat (for 2 stage dehumidification only)

If the return air temperature falls enough to require more than the total available reheat capacity, then one (1) stage of dehumidification is disabled and the reheats are activated. If the return air temperature falls enough to require twice the total reheat capacity (200%), both stages of dehumidification are disabled. One stage of dehumidification will be re-enabled at 66% call for heating. Both stages of dehumidification are re-enabled at 33% call.

If delayed reheat is selected and both compressors are activated for dehumidification, the reheats are disabled until only one compressor is required.

If normal reheat control is selected, then the reheats are not disabled during dehumidification, even if both compressors are

operating. Refer to Section 3A.5.2/3B.8.4 regarding wiring required for this option.

Dual Cooling Source Dehumidification

When dual cooling is available, the humidity control will calculate a total dehumidification requirement of 200% rather than 100%. The cooling valve opens proportionally as the requirement for dehumidification rises from 0 to 100%. If more than 100% dehumidification is required, then the compressors are activated at 150% and 200% respectively. Dual cooling is available if the entering chilled water temperature is 14° F (50% capacity) below the return air temperature. If dual cooling is not available, the humidity control will operate the compressors in the same manner as a 2-stage dehumidification system.

Chilled Water Dehumidification

The chilled water control valve is adjusted proportionally as the humidity control varies the requirement for dehumidification from 0 to 100%.

4.2.4 Humidification Operation

System Activation

The humidifier (infrared or steam) is activated when the humidity control calculates a requirement of 100% humidification, and deactivated when the requirement falls below 50%.

4.2.5 Control Types

Proportional Control

This a standard control method that maintains the room at a temperature proportional to the load. The temperature maintained increases as the room load increases. At full load the room would be controlled at a temperature equal to the temperature setpoint plus the temperature sensitivity. If proportional control is selected, the gain is factory set and cannot be adjusted by the user. Operator inputs are the usual setpoint and sensitivity adjustments.

PID Control

The PID control combines three individual terms to determine the control output for a given set of conditions. Note that PID control is used only for temperature. If PID control is selected, humidity will continue to use proportional control.

The proportional (P term) is determined by the difference between the current temperature and the control setpoint. This term is expressed in % cooling (heating) desired for each degree above (below) the setpoint. It is adjustable from 0% to 100% per degree. The purpose of this term is to adjust the control output for any deviation between the current temperature and the control setpoint.

The integral (I term) is determined by two things: the difference between the temperature and control setpoint and the amount of time this difference has existed. This term is expressed in % cooling

(heating) desired for each minute and degree above (below) the setpoint. It is adjustable form 0% to 100% per degree-minute. The purpose of this term is to force the control to maintain the temperature around the setpoint by slowly but continuously adding (subtracting) a small amount of cooling (heating) to the total control output until the temperature is at the setpoint.

The derivative (D term) is determined by the rate of change of temperature. This term is expressed in % cooling (heating) desired for each degree per minute rise (fall) in temperature. It is adjustable from 0% to 100% per degree/min. The purpose of this term is to adjust the control output for quickly changing temperatures, thus providing an anticipation control.

All three terms are adjusted through the "select control type" menu. If PID control is selected, the temperature sensitivity setting is not used by the control.

For optimum performance, a PID control must be adjusted or tuned according to the characteristics of the particular space and load to be controlled. Improper tuning can cause the control to exhibit poor response and/or hunting. The characteristics of the space and load may change seasonally, so occasional retuning is required for optimum performance.

A suggested tuning procedure is as follows:

1. Initially adjust the integral and derivative settings to 0%/ degree-min and 0% /degree/min.
2. Starting with 20% /degree, adjust the proportional setting in small increments (10% steps) until the control sustains a constant hunting action (the temperature swings are approximately the same amplitude from one peak to the next).
3. Note the time in minutes between peaks of adjacent temperature swings and the amplitude of the temperature swing (degrees above the setpoint).
4. Adjust the proportional control setting to about 1/2 the value obtained in step 2.
5. Adjust the integral setting to a value calculated by the following equation:

$$\frac{\text{approximate room load (in \% full load)}}{\text{time between peaks} \cdot \text{peak amplitude} \cdot 4}$$

NOTE
If this calculation results in a value of less than 1%, then set the integral to 1%.

6. Adjust the derivative to a value calculated by the following equation:

$$\text{time between peaks} \cdot 5\%$$

The above tuning procedure is only an approximation for an initial set of adjustments and are based on the "average" room characteristics. Your particular settings may need to be further adjusted for optimum PID control performance. Some suggestions for additional tuning are as follows:

- If cooling output overshoot is occurring on load changes, decrease the proportional setting or the derivative setting.
- If system hunting occurs with constant room load, decrease the integral setting.
- If the control responds too slowly, resulting in large temperature excursions on a load change, increase the proportional setting or the derivative setting.
- If a constant temperature deviation exists between the temperature and setpoint, increase the integral setting.

Intelligent Control

The intelligent control operates from a set of general rules that define how the control output should be adjusted for different system conditions. The rules are designed to duplicate the actions that an experienced human operator would take if manually controlling the system.

Just as an operator might take several things into consideration before making a temperature control decision, the intelligent control can be programmed to do likewise. For example, not only is the current temperature used in making temperature control decisions, but also conditions such as:

- how fast is the temperature changing?
- what direction is the temperature changing?
- what is the cooling output now?
- what was the cooling output in the past?
- how long ago was the cooling output changed?
- and other factors.

Any number of rules can be used in an intelligent control to define the controls operation under various operating conditions. Hence, several advantages are gained from this type of control over a more standard control approach that uses a fixed mathematical equation to define the operation of the control for all conditions (such as a proportional or PID control). You can expect intelligent control to be more efficient and precise for most applications, but system performance based on room conditions is not as predictable as standard approaches that use a fixed equation.

The Liebert intelligent control includes rules that significantly enhance the performance of the system, both from a standpoint of precision control and system reliability.

Rules are included that:

- Cause the control to ignore very small or temporary temperature/humidity deviations. This eliminates unnecessary control adjustments that contribute to control instability.
- Help limit the frequency of control adjustments thus extending the life of system components that are susceptible to mechanical wear or cycling.
- Recognize undesired modes of control operation such as hunting, and make adjustments to the control response to eliminate them.
- Estimate the present load on the system and then tend to force the control output to the appropriate state.
- Recognize conditions which indicate a large load change and allow the control to temporarily respond more quickly than normal.
- Cause the control to anticipate the need for reheat during dehumidification and activates reheats before overcooling occurs.

4.3 LOAD CONTROL FEATURES

4.3.1 Short Cycle Control

The control system monitors both compressors and prevents each from turning on within a 3 minute period of being turned off. If this (on, off, on) occurs too often, ten (10) times in a one hour period, a Short Cycle alarm could occur.

4.3.2 Sequential Load Activation Control

The control allows only one load output to be energized at a time on a restoration of power or microcontroller reset. Each additional load output will be activated at one second intervals until desired operating conditions have been met.

4.3.3 Compressor Sequencing Control

The lead compressor is the first one to be turned on when compressor operation is required. The lag compressor is turned on second if both compressors are required. The control monitors the operating time of both compressors and will automatically switch lead/lag compressor operation to maintain less than eight hours difference between the running times of the two compressors.

When the operating hours on the lead compressor become eight hours greater than on the lag compressor, the lead/lag operation is automatically switched. If the lead compressor is operating by itself at that time, it will be turned off, the lead/lag operation will be changed, and the new lead compressor will be turned on.

NOTE
If the hot gas reheat option has been selected, compressor 2 is always the lead compressor.

4.4 ADDITIONAL FEATURES

4.4.1 Connecting the Analog Sensors

The sensor inputs are factory set to accept a 4 - 20 mA signal. However, the inputs can be changed by removing the appropriate resistor(s) on the control circuit board. See the table below and Figures 4-1 and 4-2.

The user supplied analog sensors MUST have their own power supply. To reduce the effects of interference from any noise source, the sensor input wiring should be shielded twisted pair and the shield tied to earth ground at one end.

Analog input terminals for field connections are factory wired to the microprocessor board if specified when ordered. Eight terminals are located in the field wiring compartment of the unit. Wire sensors to the terminals as follows:

Terminal	Signal
41	Input #1 (+)
42	Input #1 (-)
43	Input #2 (+)
44	Input #2 (-)
45	Input #3 (+)
46	Input #3 (-)
47	Input #4 (+)
48	Input #4 (-)

Consult your Liebert supplier for a field installation kit to add these connections after unit delivery, if required.

	INPUT #1		INPUT #2		INPUT #3		INPUT #4	
	R66	R64	R70	R68	R190	R188	R197	R195
4-20 mA	IN	IN	IN	IN	IN	IN	IN	IN
0-5 VDC	OUT	IN	OUT	IN	OUT	IN	OUT	IN
0-10 VDC	OUT	OUT	OUT	OUT	OUT	OUT	OUT	OUT

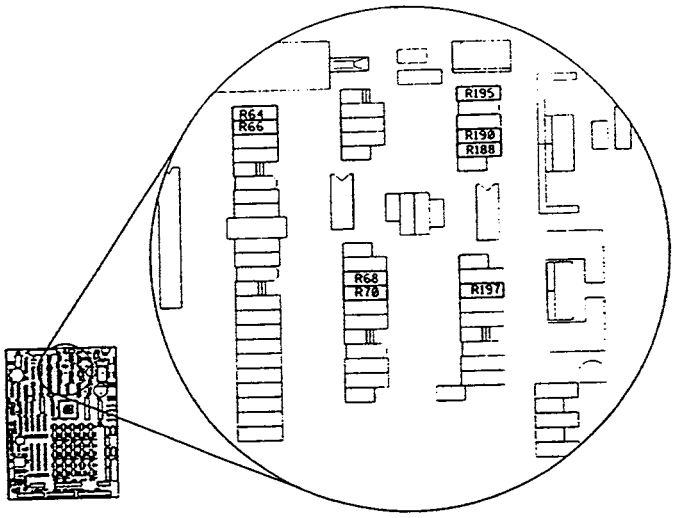

Figure 4-1 Analog Input Resistors

4.4.2 Water Detection Display

The water detection display is designed to graphically display the location of water under a raised floor when connected to an LT750 water detection system. The graphical floor plan screen shows a 30 x 16 grid. Each square represents one standard floor tile (approximately 2 ft. x 2 ft.).

Installation

LT750 DIP Switch Settings

Install the LT750 following the instructions in the LT750 Users Manual. The following additional switch selections should be made when connecting to an Advanced Microprocessor control:

DIP SW3-4 Off-(water alarm relay energizes for alarm)

DIP SW3-5 Off-(cable fault relay energizes for alarm)

Switch 1 - Off -(LT750 sources power for 4-20 mA loop)

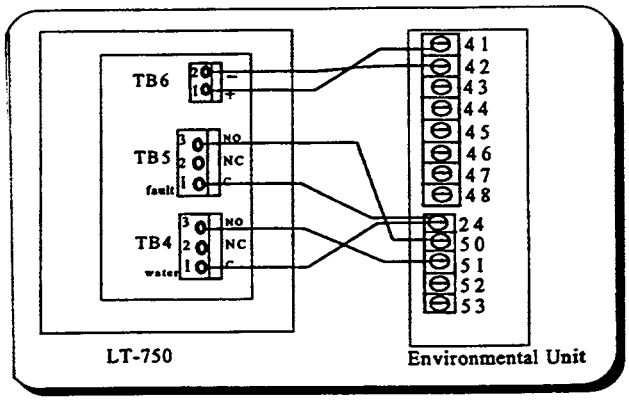

Figure 4-2 Connecting the LT750

Physical Connections

The above example shows the 4-20 mA output of LT750 connected to Analog Input #1 (41 and 42) on the external inputs terminal strip. This strip is provided on units ordered with analog inputs. (If this strip is not installed, there is a field installation kit available from your Liebert representative.)

The 4-20 mA output of the LT750 must be connected to the first analog input, as shown. TB4 is the *water detected* relay output. It can be connected to any one of the four *special alarm* inputs. TB5 is the *cable fault* relay output. It can also be connected to any one of the four *special alarm* inputs.

Setup

(The following description assumes the wiring connections as shown above.) First, verify that special alarms 1 and 2 are ENABLED to either WARNING or URGENT type. Do this by selecting VIEW/SET ALARMS from the Main Menu. Then, select SETUP ALARMS. Follow the instructions on the display to select the required type for CUSTOM ALARM #1 and CUSTOM ALARM #2 if not already set.

Next, select the alarm message for CUSTOM ALARM #1 and #2. From the Main Menu, select VIEW/SET ALARMS. Then, select SETUP CUSTOM ALARMS. Then, select SETUP CUSTOM ALARM TEXT. Define CUSTOM ALARM #1 to be CUSTOM 1. (CUSTOM 1 is the default message that will be displayed if a message has never been programmed.) Next, select the text for custom alarm #2 to be WATER UNDER FLOOR. Now, change the message CUSTOM 1 to LT750 CABLE FAULT. This is done by selecting the CHANGE CUSTOM TEXT 1 menu item in the SETUP CUSTOM ALARMS menu. Follow the instructions on the screen to change the message.

The slope and intercept values of Analog Input #1 are used to calculate the location of water. These values should initially be set to zero. The default values are zero, but it may be a good idea to verify those values. They can be viewed by selecting ANALOG/DIGITAL INPUTS from the Main Menu, then SETUP ANALOG INPUTS.

See Section 3B.3.1, SETUP WATER DETECT FLOOR PLAN for more information.

Calibration

Calibration should not be required for most installations. The accuracy of this display is approximately 1%.

The display is calibrated by the slope and intercept values of Analog Input #1. The position of the water is calculated from the analog output of the LT750 using the formula:

position = analog reading/full scale reading
X (measured length + slope) + intercept

position is the distance from the LT750 to the position of the detected water.

measured length is the length of the cable which is calculated automatically when the layout is defined. The units for these values are in floor tiles.

The intercept value read from Analog Input #1 is added to the measured position of a water indication to determine which tile to highlight. For example, if water is displayed under the seventh tile but determined to be under the fifth tile, set the offset value to -2 tiles. Use the intercept value to correct errors close to the start of the cable.

Accuracy errors farther out on the cable should be corrected using Analog Input #1's slope value. This value effectively adjusts the measured length of the cable. Increasing the effective length of cable will increase the distance of the water and move the highlighted tile farther along the cable, and vice versa. Unlike the intercept, which adjusts by the same amount for all locations on the cable, the slope increases its effect for larger distances.

The best procedure to calibrate the cable would be to first simulate water close to the LT750, about 5 tiles out. Adjust the intercept to get the correct reading. Next, simulate water 5 tiles from the end. Adjust the slope to get the correct reading.

4.5 COMMUNICATIONS

The control system uses a two-wire, RS-422 channel to communicate with Liebert Site Products. This communication uses a proprietary protocol. A converter board (ECA2) is available to allow communications with a dumb terminal or computer using an RS-232 channel. More details are provided in the Site Products and ECA2 user manuals.

The communications channel provides monitoring and control.

Monitor functions:

1. TEMPERATURE/HUMIDITY: Present readings
2. STATUS: Cooling/Heating and Humidifying/Dehumidify operating status in percent
3. PRESENT ALARMS: Alarms presently active
4. ALARM HISTORY: 10 most recent alarms (60 most recent alarms for AG)
5. RUN TIME LOG: Operating hours on major components
6. DAILY LOG: High & Low Temperature & Humidity

View/Change Functions:

1. SETPOINTS:
   - Temperature Setpoint
   - Temperature Sensitivity
   - Humidity Setpoint
   - Humidity Sensitivity
   - High Temperature Alarm
   - Low Temperature Alarm
   - High Humidity Alarm
   - Low Humidity Alarm
   - Cold Start Delay
   - Humidifier Flush Rate
   - Chilled Water Flush Rate
2. CONTROL TYPE: proportional, PID, intelligent
3. PID PARAMETERS: Proportional, Derivative, and Integral Gains
4. ON/OFF STATUS
5. TIME: View only
6. SILENCE ALARM

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SECTION 5 — ALARM DESCRIPTIONS

SECTION 5 ALARM DESCRIPTIONS

The Advanced Microprocessor (AM) and the Advanced Microprocessor with Graphics (AG) Control systems will audibly and visually annunciate all ENABLED alarms, including the four (4) custom alarms (the Standard Microprocessor (SM) Control has one (1) local alarm). With the AM & AG Controls, the customer alarms can be from the optional alarm list and/or can have their own fully custom text. Two (2) alarms may be selected as custom for AM and four (4) can be custom for AG. The custom alarm inputs are 24 Volts AC which is available from the Liebert unit. Alarms are wired from terminal 24 through a normally open contact to locations 50, 51, 55, and 56, respectively, for alarms 1 thru 4.

The AM and AG alarms can be delayed from 0 to 255 seconds (see Alarm Time Delays). The AM alarms can be ENABLED or DISABLED (see Alarm Enable/Disable). Also, the AM alarms can be programmed to energize the Common Alarm Relay or to "alarm only" and not energize the Common Alarm Relay (see Setup Alarms).

The AG alarms can be selected as WARNING, URGENT, or DISABLED. If selected to be a WARNING, they are annunciated after the Time Delay, but do not energize the Common Alarm Relay. If selected as URGENT, they are annunciated after the Time Delay as a WARNING alarm and then re-annunciated after a user programmable period from 0 minutes to 999 hours as an URGENT alarm. When annunciated as an URGENT alarm, the Common Alarm Relay is activated. The custom alarm inputs of the AG can be designated to be "Status Only". As Status Only the custom alarm input is referenced as a digital input and is no longer treated as an alarm. It is for monitoring only and can be reviewed by selecting "ANALOG/DIGITAL INPUTS."

When a new alarm occurs, it is displayed on the screen and the audible alarm is activated. If communicating with a Liebert Site Product, the alarm is also transmitted. The display will also show a message to "PRESS ENTER KEY TO SILENCE" the alarm. After the alarm is silenced, the display will return to the Normal Status Display. For the AG, the bell and hammer are shown at the top of the Normal Status Display. For the AM, the bottom line will display the number of Active Alarms. For the SM, the alarm is displayed by a lighted LED next to the alarm text. The active alarms can be reviewed on the Advanced Microprocessor Controls by selecting "ACTIVE ALARMS."

The alarms can also be silenced through communications with a Liebert Site Products unit. Most alarms will reset automatically when the alarm condition is no longer present and only, after it has been acknowledged by being "Silenced." The exceptions are: (1) The three software alarms: Loss of Power, Low Suction Pressure, and Short Cycle which reset automatically ninety minutes after being "Silenced" or acknowledged. (2) Some alarms such as overloads and high pressure switches may require a manual reset depending on your model.

A history of the ten (10) for AM and sixty (60) for AG alarms, is retained in non-volatile memory (see Alarm History).

The following list provides a definition of each available alarm. Troubleshooting suggestions are included. Refer to Section 7 - Troubleshooting for more details. If you need assistance with your environmental control system, contact your Liebert supplier.

5.1 STANDARD ALARMS

5.1.1 Change Filter

Periodically, the return air filters in the environmental units must be changed. The Change Filter alarm notifies the user that filter replace- ment is necessary. A differential air pressure switch closes when the pressure drop across the filters becomes excessive. The switch is adjustable using the procedure on the switch label.

5.1.2 Compressor Overload

The control break compressor safety stats located internal to the Carlyle compressors are tripped when an overload condition occurs. When a Copeland compressor is used, an optional tri-block overload device can be used for each compressor. Compressor overload may be manual or automatic reset, depending on your model. Overload is located at the electric connection box on the compressor. Note that compressor #1 is the top compressor and compressor #2 is the bottom one.

5.1.3 Custom Alarms (only with advanced controls)

Custom alarm messages are programmed at the LCD display. The alarms may be specified by the customer at the time of order. Additional devices and wiring may be required at the factory or by others. The message displayed may be included in this alphabetical list of alarms, or it may be customized text (for up to 2 alarms). If customized text is used, customer maintenance personnel should be informed of the alarm function and corrective action required.

5.1.4 High Head Pressure

Compressor head pressure is monitored with a pressure-sensing switch. One SPDT pressure switch is used for each compressor in the unit. If head pressure exceeds 360 PSIG, the switch turns off the compressor contactor and sends an input signal to the control. When the condition is acknowledged, the alarm is silenced. However, the pressure switch in the compressor compartment of the unit must be manually reset to clear the alarm. Note that compressor #1 is the top compressor and compressor #2 is the bottom one.

On air cooled systems, check for power shut off to the condenser, condenser fans not working, defective head pressure control valves, closed service valves, dirty condenser coils, and crimped lines. Also, make sure that when the compressor contactor is energized the side switch on the contactor closes to energize the control circuit on the air cooled condenser.

On water/glycol/Glycool systems, check water regulating valves. Verify water/glycol flow (are pumps operating and service valves open?). Is water tower or drycooler operating? Is the coolant temperature entering the condenser at or below design conditions? Is relay R5 operating during cooling to turn on the drycooler?

5.1.5 High Humidity

The return air humidity has increased to the High Humidity Alarm setpoint. Is the unit setup for dehumidification (check DIP switch)? Check for proper setpoints. Does the room have a vapor barrier to seal it from outdoor humidity? Are doors or windows open to outside air? Run diagnostics to make sure the cooling system is working properly (the cooling system dehumidifies).

5.1.6 High Humidity and Low Humidity (simultaneously)

If these two alarms are displayed at the same time, the humidity input signal is lost. Dashes will be displayed for the humidity reading. The control system will deactivate humidification and dehumidification. Check for a disconnected cable or a failed sensor.

5.1.7 High Temperature

The return air temperature has increased to the High Temperature Alarm setpoint. Check for proper setpoints. Is the room load more than the unit can handle (is the unit capacity too small)? Run diagnostics to make sure all cooling components are operating (compressors and/or valves).

5.1.8 High Temperature and Low Temperature (simultaneously)

If these two alarms are displayed at the same time, the temperature input signal is lost (or the humidity is out of sensor range: 15 to 85% RH). Dashes will be displayed for the temperature reading. The control system will initiate 100% cooling. Check for a disconnected cable or a failed sensor.

5.1.9 Humidifier Problem

Infrared Humidifiers

This alarm is activated by the high water float switch in the humidifier pan assembly. The high water float switch is normally closed and opens upon alarm condition. Check for drain clog, clean drain. Check for float switch stuck high, replace switch. Check for proper operation of the humidifier water makeup valve.

Steam Generating (canister) Humidifiers

This alarm is activated by a signal from the humidifier control indicating that the canister needs to be replaced.

5.1.10 Loss of Air Flow

A differential air pressure switch is used to indicate loss of air flow in Deluxe units.

Check for blockage of unit air outlet or inlet. Check blower motor fuses and overload reset. Check for broken belts. Make sure blower wheels are tight to shaft. Run diagnostics to see if the fan contactor is working properly.

5.1.11 Loss of Power

Unit has lost power, or the disconnect switch was turned off before the unit ON switch was pressed (to turn the unit Off). This local alarm will occur when power is restored to the unit. A Liebert remote monitoring unit (optional) will immediately indicate loss of power.

5.1.12 Low Humidity

The return air humidity has decreased to the Low Humidity Alarm setpoint. Is the unit setup for humidification (check DIP switch)? Check for proper setpoints. Does the room have a vapor barrier to seal it from outdoor humidity? Are doors or windows open to outside air? Run diagnostics to make sure the humidifier system is working properly.

5.1.13 Low Suction Pressure

Pressure has dropped below a factory preset point while the compressor is in cooling operation. A pressure switch monitors the suction pressure at the compressor inlet. When pressure drops below a factory preset point after the positive start kit time delay, the alarm is turned on.

Look for conditions that would cause loss of refrigerant. Check for piping problems such as leaks or crimped lines. Check for inoperative components such as liquid line solenoid valve, low pressure switch, expansion valve, and head pressure control valve. Check for closed service valves in the liquid line or at the condenser or receiver.

5.1.14 Low Temperature

The return air temperature has decreased to the Low Temperature Alarm setpoint. Check for proper setpoints. Run diagnostics to make sure all heating components are operating (contactors and reheats). Are reheats drawing the proper current (see nameplate for Amp rating)?

5.1.15 Main Fan Overload

An optional tri-block overload is required for this alarm, and may or may not replace internal motor overload, depending on your model. The overload device is located next to the main fan contactor in the line voltage section. The alarm is activated when the overload is tripped.

5.1.16 Short Cycle

On compressorized systems, one of the compressors has exceeded 10 cooling starts in a one hour period, or the compressor has cycled 5 times in 10 minutes on the low pressure switch during non-cooling. This can be caused by low refrigerant level (but not low enough to activate Low Suction Pressure alarm) or room cooling load is small compared to capacity of the unit.

Check for leaks, crimped lines, and defective components. If room load is low, increase sensitivity to reduce cycling (proportional control). On Glycool units, dirty filters can cause the coil freeze stats to cycle the compressor. Units using tunable PID control may require a seasonal adjustment.

5.2 OPTIONAL/CUSTOM ALARMS

5.2.1 Loss of Water Flow

No water flow is detected in the chilled water or condenser water supply line. An optional flow switch is required for this alarm. Check for service valves closed, pumps not working, etc.

5.2.2 Smoke Detected

Smoke is detected in the return air by an optional Liebert Smoke Detector. Check for source of smoke or fire, and follow appropriate emergency procedures.

5.2.3 Standby GC Pump On

The primary pump has failed, and the standby pump is activated (glycol cooled and Glycool units only).

Check for problems with the primary pump (fuses blown, motor burn out, service valve shut, stuck check valve, impeller damage, etc.).

5.2.4 Standby Unit On

The primary environmental control system has had an alarm condition, and the standby system is activated.

5.2.5 Water Under Floor

Water is detected by an optional Liebert Water Detection System. Check under the raised floor for water or other leaks.

NOTE
The alarms are specified by the customer at the time of order. All alarms will report to a Liebert remote monitoring unit. Additional devices and wiring may be required at the factory for some of the alarms.

Deluxe System/3

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