

# Large Systems

## *iCOM* Microprocessor

### Environmental Training and Service Manual

TM-10098: Rev. 02/06



# **iCOM**

# **Training & Service**

# **Manual**

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# Chapter 1

## Temperature and Humidity Control Programs

This section provides details on how your Liebert iCOM control responds to the user programmed inputs values and room conditions. Refer to this section when you need specific information control operation. This section includes details on four (4) user selectable temperature control programs and two (2) user selectable and humidity control programs.

### **Cooling and/ or Heating Required, in Percent (%)**

The temperature control programs for the iCOM microprocessor is based on a calculated percent (%) requirement for cooling and/ or heating. This percent (%) requirement is determined by the control type (algorithm) selected by the user.

The four (4) user selectable temperature control programs are:

- Intelligent
- Proportional (P)
- Proportional + Integral (PI)
- Proportional + Integral + Derivative (PID)

## Temperature Control Program Types

### **Intelligent Control – Factory Default Setting**

The Intelligent Control operates from a set of general rules that defines 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.

Basically, this is done in a three-function process that differs from earlier mathematically defined strict type data, hence, fuzzy logic. The on and off, true or

untrue type of statement is not used. The consideration now is how to set the input value into a membership set, qualify this membership with rules, then decide on the output consequence for action. It is not really that simple, but it is basically how it works. The process:

### **Membership**

- Measure value of input variables
- Map and transfer data into range of set domain
- Assign input membership into sets

### **Knowledge Base/Decision Making**

- Provide a data base of definitions for rules base
- Provide a rules base and define function and domain
- Simulate human decision making based on concepts and actions defined by implications and rules

### **Consequence**

- Convert defined range of knowledge to a corresponding output variable
- Define a non-intelligent action from a deduced intelligent action

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?
- 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.
- Recognizes conditions, which indicate a large load change and allows the control to temporarily respond more quickly than normal.
- Cause the control to anticipate the need for reheat during dehumidification and activates reheats when overcooling occurs.

### **Proportional (P) Control**

The proportional control is the 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 set point (TSP) plus  $\frac{1}{2}$  of the temperature proportional band (PB). The operator programmed inputs are the temperature set point (TSP) and temperature proportional band (PB) adjustments. The operator may also program a temperature dead band (DB) adjustment.

### **Proportional + Integral (PI) Control**

The PI control combines two (2) individual terms to determine the control output for a given set of conditions. Note that PI control is used only for temperature. If PI control is selected, the humidity control will be in percent relative humidity (%RH).

The proportional (P) term is determined by the difference between the current temperature and the control set point. This term is expressed in % cooling (heating desired for each degree above (below) the set point. 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 set point.

The integral (I) term is determined by two things: the difference between the return air temperature and control set point 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 set point. It is adjustable from 0% - 100% per degree/minute. The purpose of this term is to force the control to maintain the temperature around the set point by slowly but continuously adding (subtracting) a small amount of cooling (heating) to the total control output until the temperature is at the set point.

### **Proportional + Integral + Derivative (PID) Control**

The PID control combines three (3) 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, the humidity control will be in percent relative humidity (%RH).

The proportional (P) term is determined by the difference between the current temperature and the control set point. This term is expressed in % cooling (heating) desired for each degree above (below) the set point. 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 set point.

The integral (I) term is determined by two things: the difference between the return air temperature and control set point 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 set point. It is adjustable from 0% - 100% per degree/minute. The purpose of this term is to force the control to maintain the temperature around the set point by slowly but continuously adding (subtracting) a small amount of cooling (heating) to the total control output until the temperature is at the set point.

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/minute. 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 by selecting the "Setpoints" icon in either the USER or SERVICE Menu screen. If PID control is selected, the temperature proportional band value (and optional temperature dead band value) 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 returning 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 set point).
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: approximate room load (in % full load) time between peaks x peak amplitude x 4.

**Note: If 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: time between peaks x 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 set point, increase the integral setting.

# Temperature Control

## Operations and Charts

The temperature proportional control band value is divided into two parts: the temperature set point plus  $\frac{1}{2}$  of the temperature proportional band for cooling operation and the temperature set point minus  $\frac{1}{2}$  of the temperature proportional band for heating operation. A temperature dead band can also be programmed into the control to shift the cooling and/ or heating on/ off operations away from the temperature set point.

This programmed temperature dead band value is divided into two parts: the temperature set point plus  $\frac{1}{2}$  of the dead band – no cooling operation and the temperature set point minus  $\frac{1}{2}$  of the band – no heating operation.

The temperature set point range is adjustable from 41 - 104°F in increments of 1°F. The temperature proportional band range is adjustable from 2 - 54°F in increments of 1°F. The temperature dead band range is adjustable from 0 - 36°F in increments of 1°F.

### **Standard 2 Stage Compressorized Cooling**

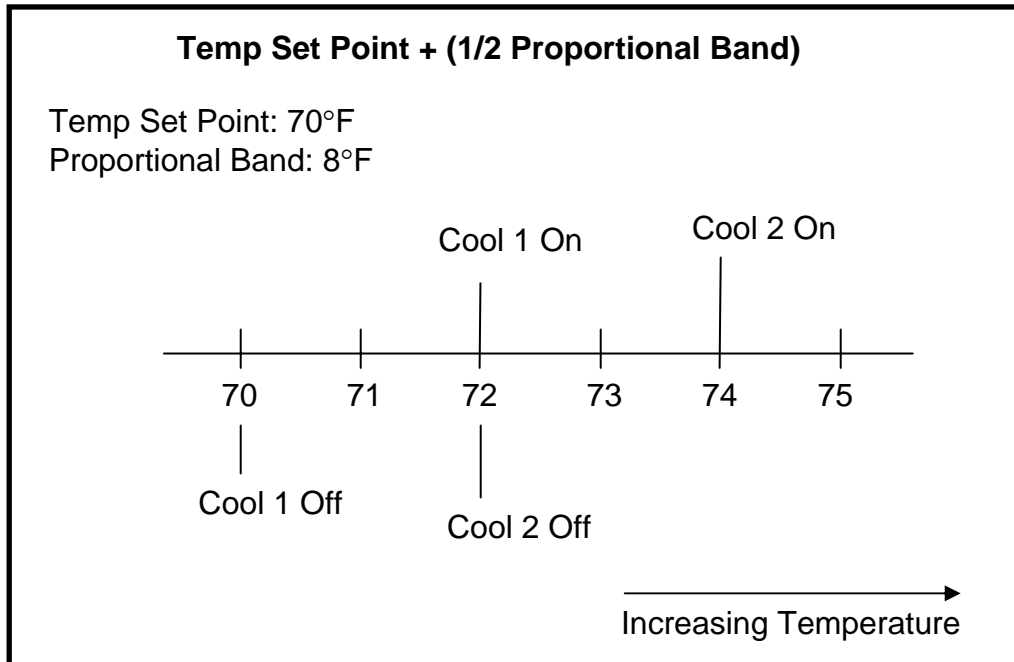
The basic temperature cooling control band is established at the temperature set point with the length equal to  $\frac{1}{2}$  of the programmed temperature proportional band divided by the number of cooling stages.

The Liebert DS units are supplied with two (2) compressors, each compressor is rated at  $\frac{1}{2}$  of the unit capacity. The two (2) compressors will be either the semi-hermetic or scroll type and will operate in an on/ off configuration to cool the space.

The temperature controller activates the first cooling stage (lead compressor) when the return air temperature increases to 50% of the cooling proportional band and the second cooling stage (lag compressor) at 100% of the cooling proportional band. The optional hot gas bypass solenoid valve, supplied with each compressor when ordered, is also energized on a call for cooling.

The temperature controller deactivates the second stage of cooling (lag compressor) when the return air temperature decreases to 50% of the cooling proportional control band value. The first cooling stage (lead compressor) is deactivated when the return air temperature decreases to the temperature set point value or 0% of the cooling proportional control band value.

## 2 Stage Compressorized Cooling – No Dead Band

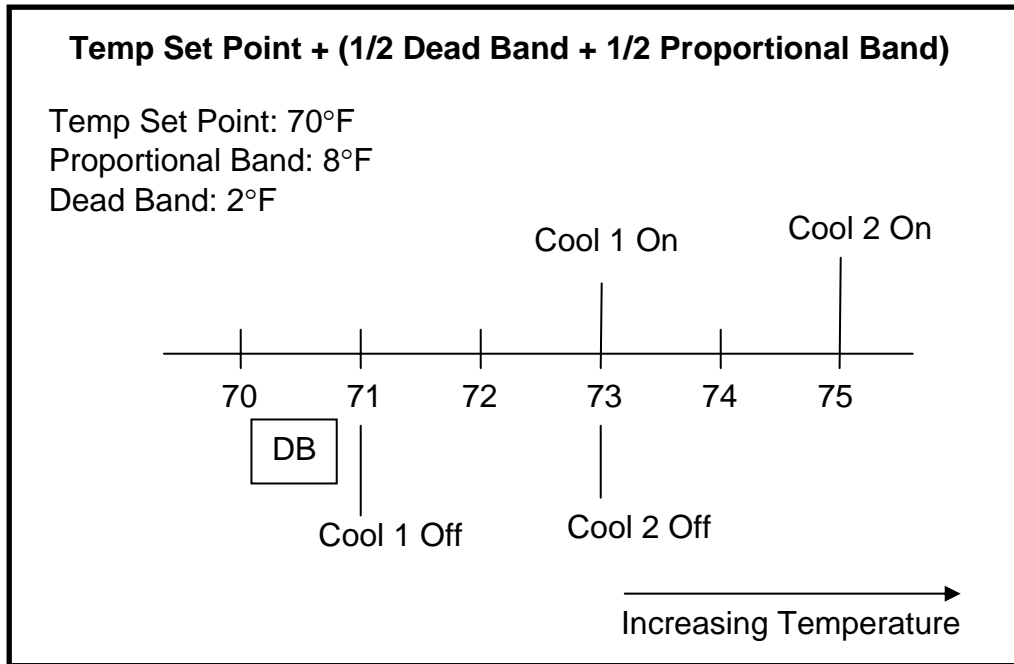


Note: in the above example that the control band begins at the 70°F temperature set point and has a length of 4°F, which is  $\frac{1}{2}$  of the programmed temperature proportional band value.

As the return air temperature increases Cooling 1 (lead compressor) is activated at 72°F or 50% of the cooling control band. If the return air temperature continues to increase Cooling 2 (lag compressor) will activate at 74°F or 100% of the cooling control band.

When the return air temperature starts to decrease, Cooling 2 (lag compressor) is deactivated at 72°F or 50% of the cooling control band and Cooling 1 (lead compressor) is deactivated at the temperature set point of 70°F or 0% of the cooling control band.

## 2 Stage Compressorized Cooling – With Dead Band



Note: in the above example that the control band begins at the 70°F temperature set point and has a length of 5°F, which is  $\frac{1}{2}$  of the programmed temperature dead band value plus  $\frac{1}{2}$  of the programmed temperature proportional band value.

As the return air temperature increases Cooling 1 (lead compressor) is activated at 73°F or  $\frac{1}{2}$  of the dead band value plus 50% of the cooling control band. If the return air temperature continues to increase Cooling 2 (lag compressor) will activate at 75°F or  $\frac{1}{2}$  of the dead band value plus 100% of the cooling control band.

When the return air temperature starts to decrease, Cooling 2 (lag compressor) is deactivated at 73°F or  $\frac{1}{2}$  of the dead band value plus 50% of the cooling control band and Cooling 1 (lead compressor) is deactivated at 71°F or  $\frac{1}{2}$  of the dead band value plus 0% of the cooling control band.

Remember the temperature dead band value is used by the control to shift the cooling on/ off operations away from the temperature set point.

### Optional 4 - Stage Cooling, Two (2) Compressors with Unloaders

The basic temperature cooling control band is established at the temperature set point with the length equal to  $\frac{1}{2}$  of the programmed temperature proportional band divided by the number of cooling stages.

The Liebert DS units are supplied with two (2) compressors, each compressor is rated at  $\frac{1}{2}$  of the unit capacity. Each compressor will be the semi-hermetic type

and will be supplied with an electrical cylinder unloader valve. The electrical solenoid valve used to unload or reduce the cooling capacity of the compressor. The compressors will operate in an on/ off - loaded/ unloaded configuration method to cool the space. The hot gas bypass solenoid valve option is not available on 4 stage systems.

The temperature controller activates the first cooling stage, lead compressor unloaded, when the return air temperature increases to 25% of the cooling proportional band. The second cooling stage, lag compressor unloaded, is activated when the return air temperature increases to 50% of the cooling proportional band.

The temperature controller activates the third cooling stage, the lead compressor loaded, when the return air temperature increases to 75% of the cooling proportional band. The fourth cooling stage, the lag compressor loaded, is activated when the return air temperature increases to 100% of the cooling proportional band.

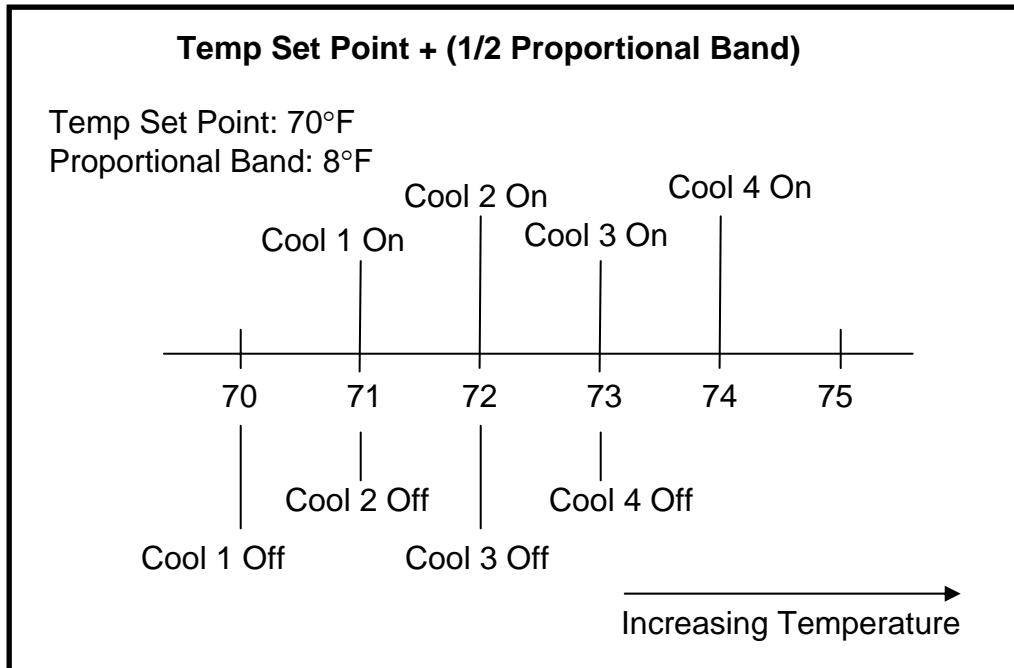
The temperature controller deactivates the fourth cooling stage, lag compressor loaded, when the return air temperature decreases to 75% of the cooling proportional control band value. The third cooling stage, lead compressor loaded, is deactivated when the return air temperature decreases to 50% of the cooling proportional control band value.

The temperature controller deactivates the second cooling stage, lag compressor unloaded, when the return air temperature decreases to 25% of the cooling proportional control band value. The first cooling stage, lead compressor unloaded, is deactivated when the return air temperature decreases to the temperature set point value or 0% of the cooling proportional control band value.

The table below shows the devices activated by each of the four cooling stages.

| <b><u>STAGE</u></b> | <b><u>COMPRESSORS, UNLOADER STATE</u></b>  |
|---------------------|--|
| 1                   | Compressor 1 On, Unloader On (Energized)<br>Compressor 2 Off, Unloader Off (De-Energized)    |
| 2                   | Compressor 1 On, Unloader On (Energized)<br>Compressor 2 Off, Unloader On (Energized)        |
| 3                   | Compressor 1 On, Unloader Off (De-Energized)<br>Compressor 2 On, Unloader On (Energized)     |
| 4                   | Compressor 1 On, Unloader Off (De-Energized)<br>Compressor 2 On, Unloader Off (De-Energized) |

## 4 Stage Compressorized Cooling – No Dead Band



Note: in the above example that the control band begins at the 70°F temperature set point and has a length of 4°F, which is  $\frac{1}{2}$  of the programmed temperature proportional band value.

As the return air temperature increases Cooling 1, the lead compressor unloaded, is activated at 71°F or 25% of the cooling control band. If the return air temperature continues to increase Cooling 2, the lag compressor unloaded is activated at 72°F or 50% of the cooling control band. If the return air temperature continues to increase Cooling 3, the lead compressor is loaded at 73°F or 75% of the cooling control band. If the return air temperature continues to increase Cooling 4, the lag compressor is loaded at 74°F or 100% of the cooling control band.

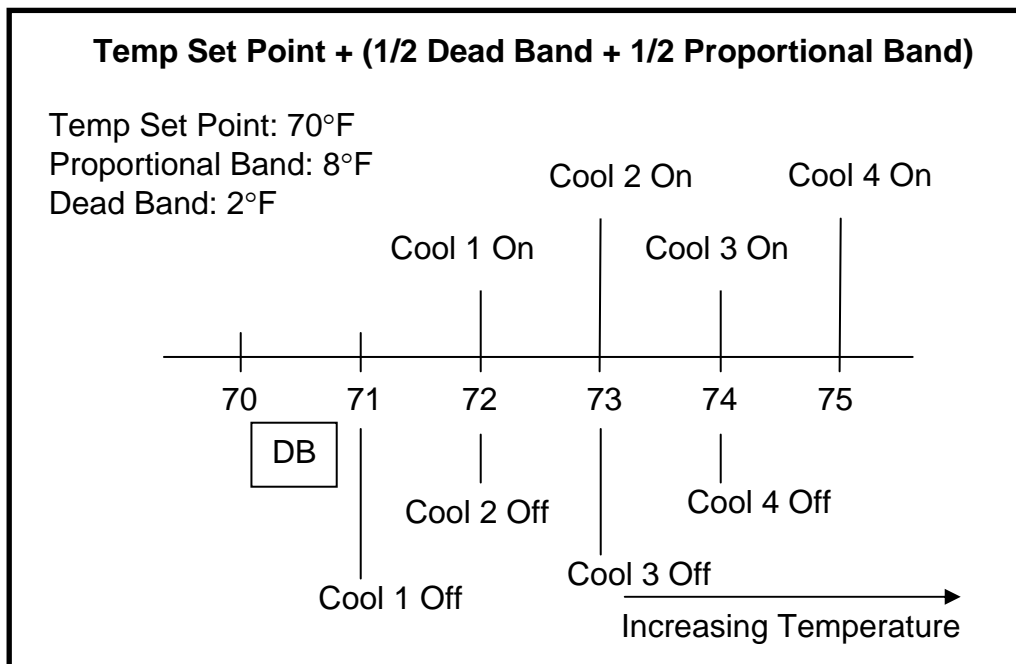
When the return air temperature starts to decrease, Cooling 4 is deactivated at 73°F or 75% of the cooling control band. If the return air temperature continues to decrease Cooling 3 is deactivate at 72°F or 50% of the cooling control band. If the return air temperature continues to decrease Cooling 2 is deactivate at 71°F or 25% of the cooling control band and Cooling 1 is deactivated at the temperature set point of 70°F or 0% of the cooling control band.



The example below is based on a temperature set point of 70°F with a control band length of 4°F, which is ½ of the programmed temperature proportional band value.

| <u>STAGE</u> | <u>TEMPERATURE</u> |
|--------------|--------------------|
| Cool 1 ON    | Set point plus 1°F |
| Cool 2 ON    | Set point plus 2°F |
| Cool 3 ON    | Set point plus 3°F |
| Cool 4 ON    | Set point plus 4°F |
| Cool 4 OFF   | Set point plus 3°F |
| Cool 3 OFF   | Set point plus 2°F |
| Cool 2 OFF   | Set point plus 1°F |
| Cool 1 OFF   | Set point          |

### 4 Stage Compressorized Cooling – With Dead Band



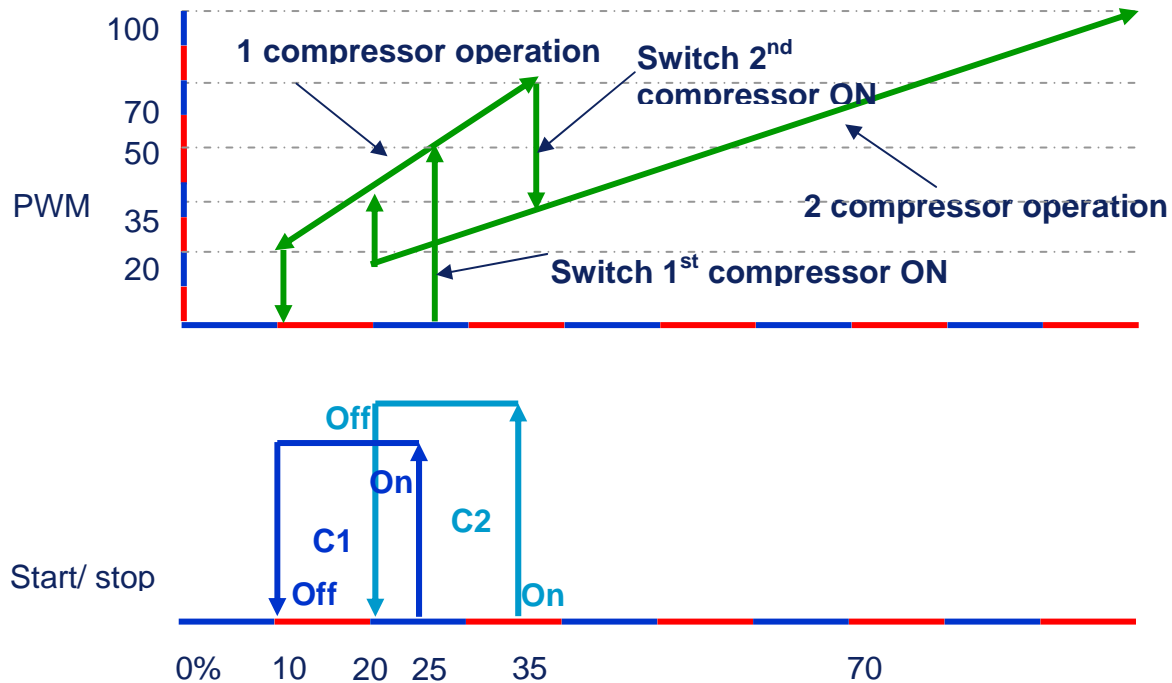
Note: in the above example that the control band begins at the 70°F temperature set point and has a length of 5°F, which is ½ of the programmed temperature dead band value plus ½ of the programmed temperature proportional band value.

As the return air temperature increases Cooling 1, lead compressor unloaded, is activated at 72°F or  $\frac{1}{2}$  of the dead band value plus 25% of the cooling control band. If the return air temperature continues to increase Cooling 2, lag compressor unloaded, will activate at 73°F or  $\frac{1}{2}$  of the dead band value plus 50% of the cooling control band. If the return air temperature continues to increase Cooling 3, lead compressor unloaded, is activated at 74°F or  $\frac{1}{2}$  of the dead band value plus 75% of the cooling control band. If the return air temperature continues to increase Cooling 4, lag compressor loaded, will activate at 75°F or  $\frac{1}{2}$  of the dead band value plus 100% of the cooling control band.

When the return air temperature starts to decrease, Cooling 4 is deactivated at 74°F or  $\frac{1}{2}$  of the dead band value plus 75% of the cooling control band. If the return air temperature continues to decrease Cooling 3 will be deactivate at 73°F or  $\frac{1}{2}$  of the dead band value plus 50% of the cooling control band. If the return air temperature continues to decrease Cooling 2 will be deactivate at 72°F or  $\frac{1}{2}$  of the dead band value plus 25% of the cooling control band and Cooling 1 is deactivated at 71°F or  $\frac{1}{2}$  the dead band value plus 0% of the cooling control band.

Remember the temperature dead band value is used by the control to shift the cooling on/ off operations away from the temperature set point.

## Optional Dual Compressor Digital Scroll Operation



In the chart above we are defining the Digital Compressor start and stop at the capacity need and how the compressors load and unload with the PWM from the controller and the unit setting for temperature control.

Note that the Digital Scroll will run continuously while the head is raised and lowered as the need for cooling is required from 10% to 100% and vice versa.

## Optional Glycool (Econ-O-Cycle) Cooling

When supplied with the Glycool option, the basic unit is supplied with an additional coil, piping, valve and a Glycol Fluid Sensor (AQ), which is mounted to the unit supply fluid line and serves as control interface in determining the system operation. Selection of the glycool or compressorized operation is controlled by microprocessor using this aquastat to sense the glycol temperature.

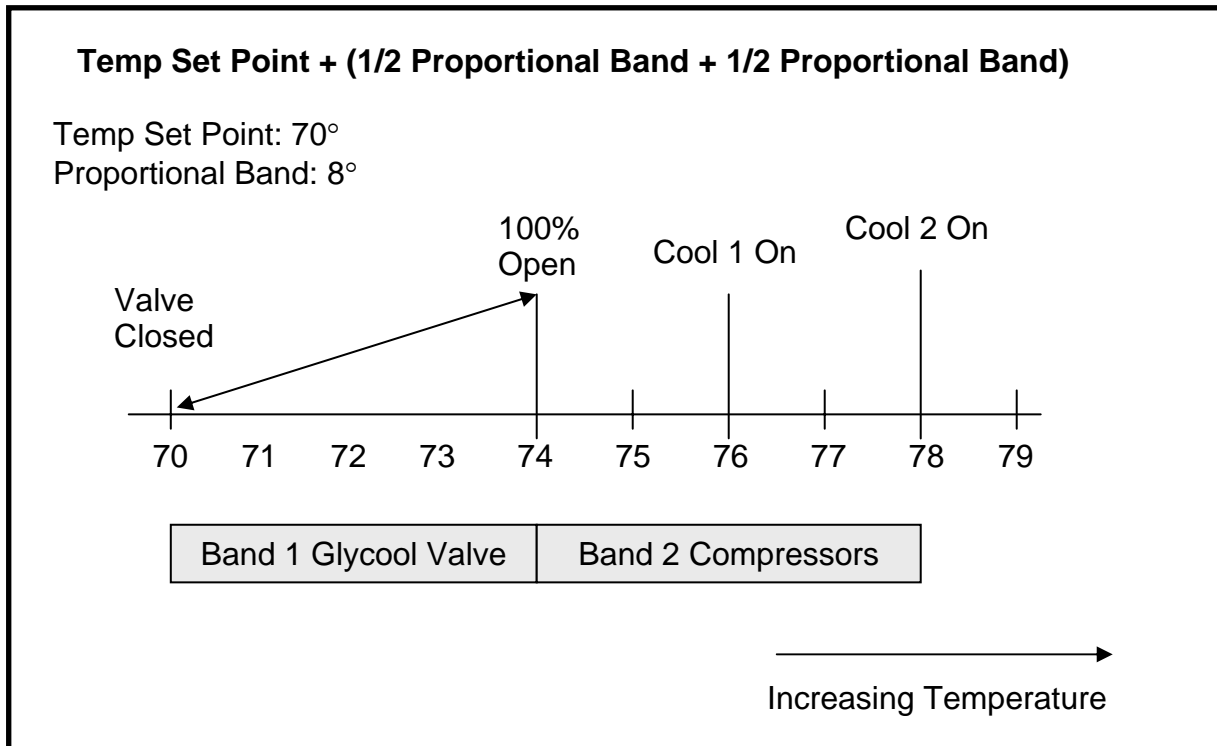
The Glycool (Econ-O-Cycle) Cooling program establishes two distinct control bands for cooling control operation. The first band controls the operation of the chilled glycol valve and the second controls the operation of the compressors, either 2-stage or 4-stage.

The microprocessor checks the return air temperature and the entering glycol fluid temperature to determine a cooling capacity. In order to reduce compressor cycling and to prevent chilled glycol valve hunting, Glycool (Econ-o-Cycle) cooling capacity does not become available until the entering chilled glycol fluid

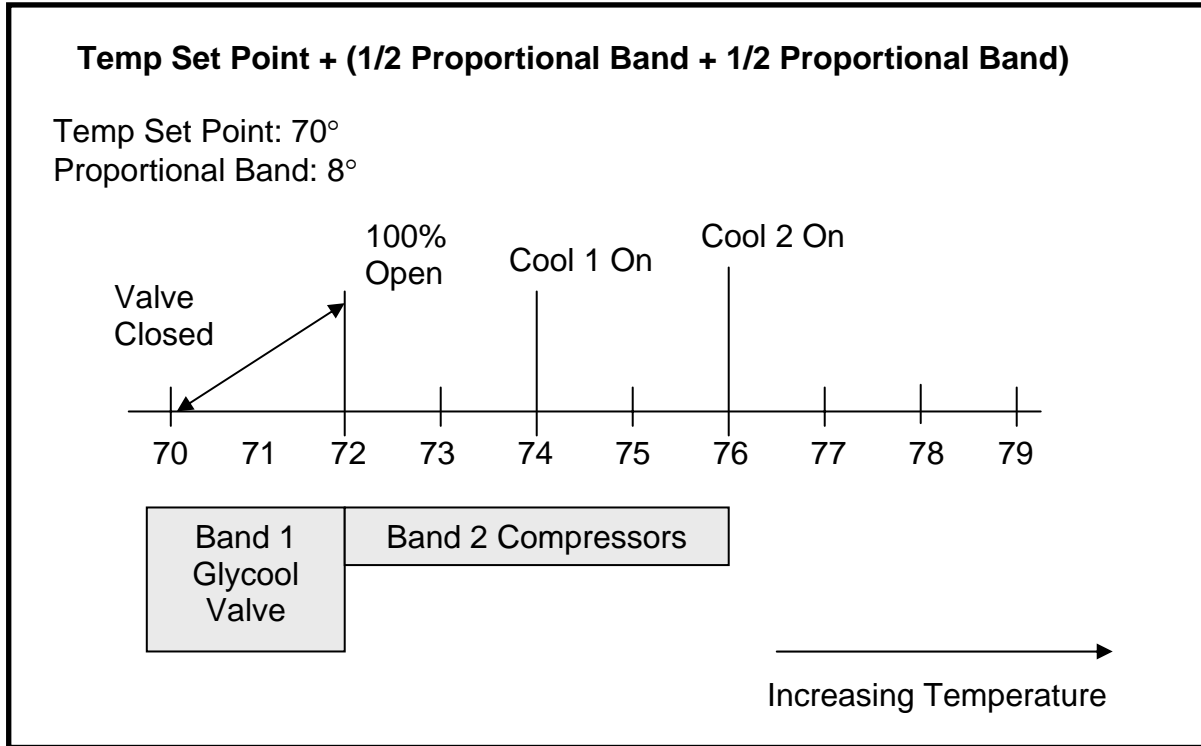
temperature is at least 8°F below the return air temperature, or 3°F lower than the return air temperature for two consecutive hours.

When the microprocessor decides that the return glycol fluid temperature is cold enough the first cooling band is the modulating valve control method, and the second band, added to the first band, is for the compressors as in the normal 2-Stage or 4-Stage control method. If the chilled glycol fluid temperature is not cold enough the valve control band is replaced by the compressor band. If the chilled glycol cooling capacity is reduced by a rise in the glycol fluid temperature, the control band shrinks proportionally. This allows the compressor band to move down as well. The following shows the Glycool operation at 100% capacity and the Glycool at 50% capacity.

### Glycool at 100% Capacity – No Dead Band



## Glycool at 50% Capacity – No Dead Band



### Dual Source Cooling

When supplied with the Dual Cooling option, the basic unit is supplied with an additional coil, piping, valve and a Glycol Fluid Sensor (AQ), which is mounted to the unit supply fluid line and serves as control interface in determining the system operation. Selection of the chilled water or compressorized operation is controlled by microprocessor using this aquastat to sense the water temperature.

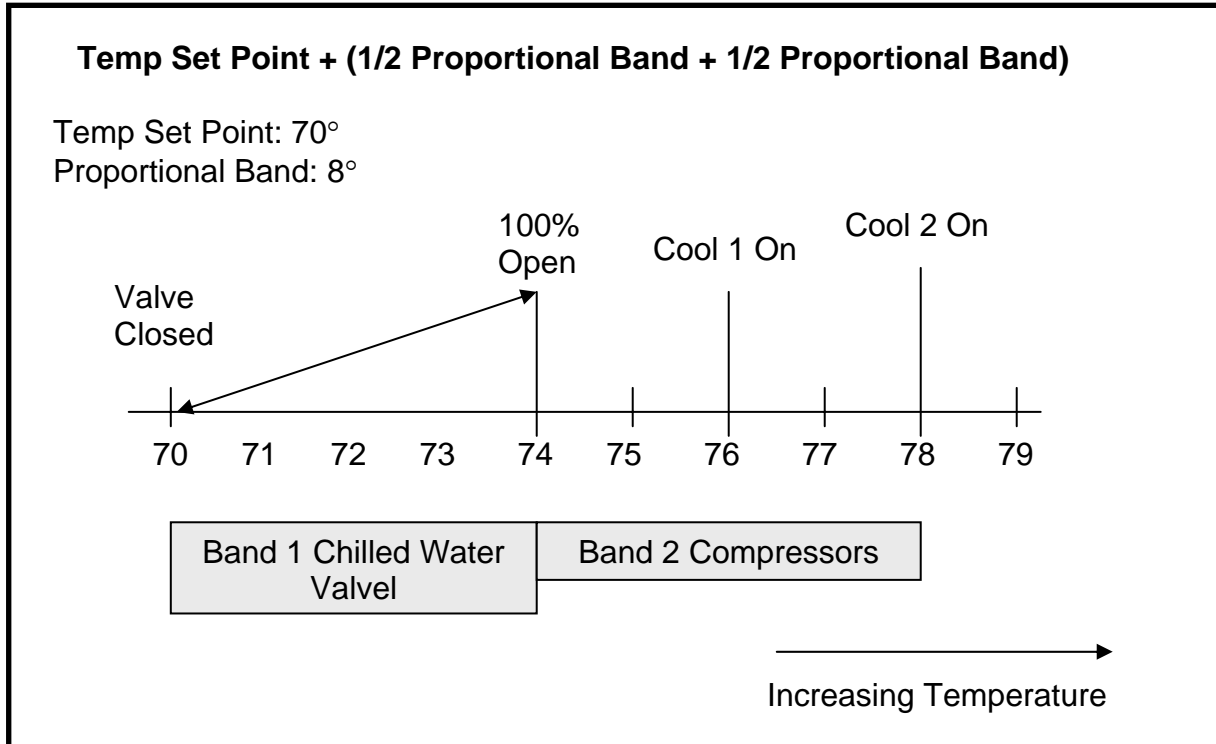
The Dual Source Cooling program establishes two distinct control bands for cooling control operation in the same method as Glycool. The first band controls the operation of the chilled water valve and the second controls the operation of the compressors, either 2-stage or 4-stage.

The microprocessor checks the return air temperature and the entering chilled water fluid temperature to determine a cooling capacity. The chilled water cooling capacity is considered to be 100% if the entering Chilled Water fluid temperature is 8°F lower than the return air temperature.

When the microprocessor decides that the return chilled water temperature is cold enough the first cooling band is the modulating valve control method, and the second band, added to the first band, is for the compressors as in the normal

2-Stage or 4-Stage control method. If the chilled water temperature is not cold enough the valve control band is replaced by the compressor band.

### Dual Cooling at 100% Capacity – No Dead Band



An addition program available with the Dual Cooling option is called Minimum Chilled Water Temperature. This program allows the end user to select the minimum chilled water temperature that permits simultaneous operation of the chilled water control and compressor control. When the supply chilled water temperature decreases to this programmed value ONLY the chilled water valve control is operational, the compressors are locked out.

### Staged Electric Reheat

The basic temperature heating control band is established at the temperature set point with the length equal to  $\frac{1}{2}$  of the programmed temperature proportional band divided by the number of reheat stages.

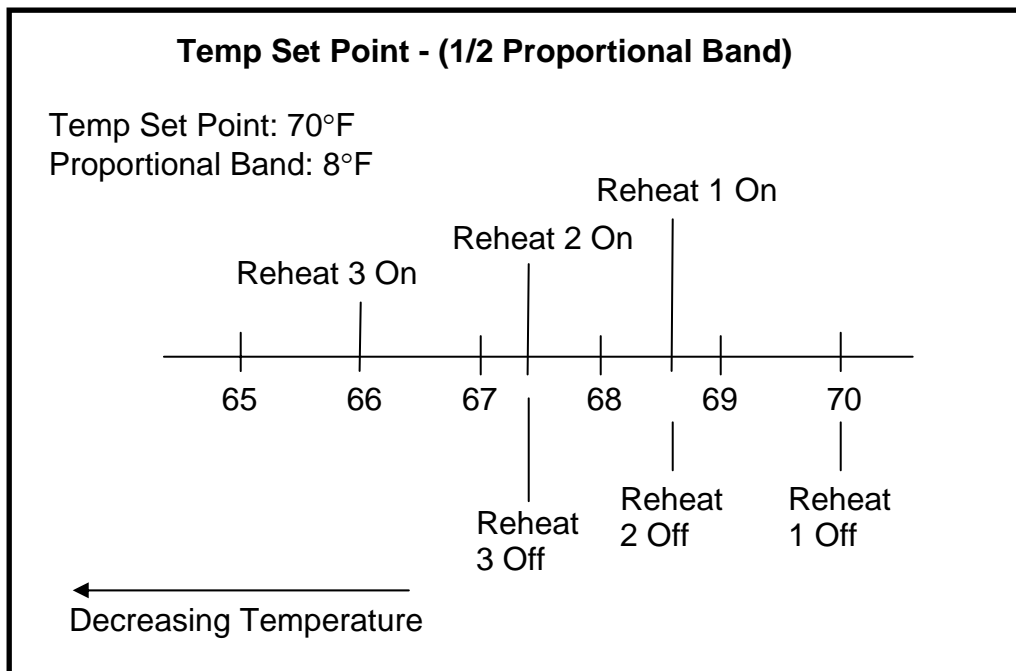
The Liebert DS units are supplied with three (3) reheat stages (elements), each stage is rated at  $\frac{1}{3}$  of the unit capacity. The three (3) stages will operate in an on/ off configuration to reheat the unit discharge air as it enters the space.

The temperature controller activates the first electric heating stage when the return air temperature decreases to 33% of the heating proportional band. The second electric heating stage activates when the return air temperature decreases to 66%

of the heating proportional band. The third electric heating stage activates when the return air temperature decreases to 100% of the heating proportional band.

The temperature controller deactivates the third heating stage when the return air temperature increases to 66% of the heating proportional control band value. The second heating is deactivated when the return air temperature increases to 33% of the heating proportional control band value. The first heating stage is deactivated when the return air temperature increases to the temperature set point value or 0% of the heating proportional control band value.

### 3 Stage Electric Reheat – No Dead Band

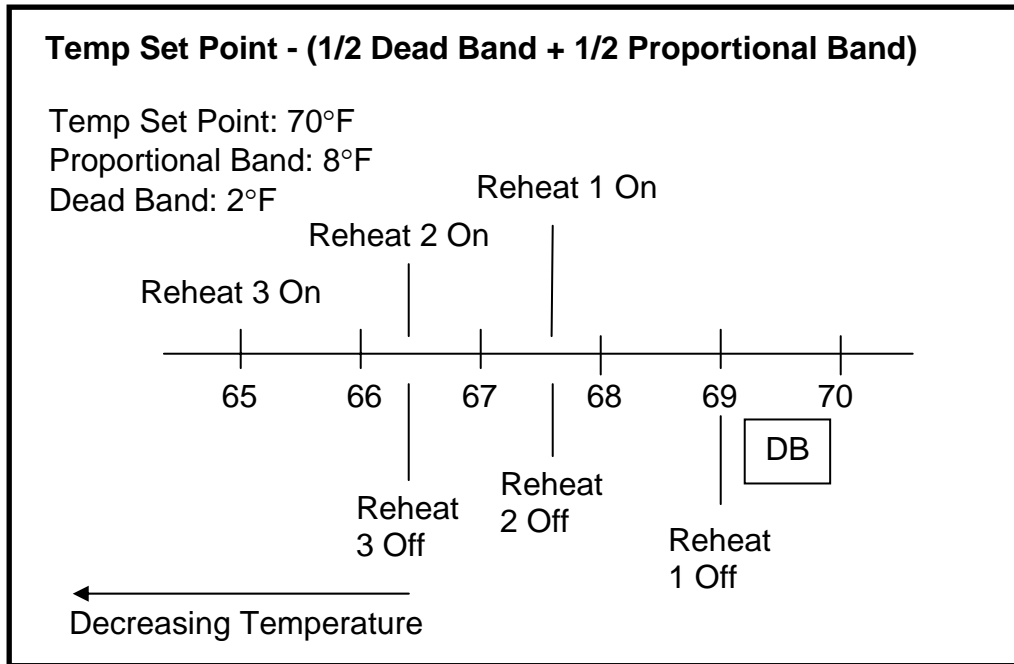


Note: in the above example that the control band begins at the 70°F temperature set point and has a length of 4°F, which is ½ of the programmed temperature proportional band value.

As the return air temperature decreases Reheat 1 is activated at 68.7°F or 33% of the heating control band. If the return air temperature continues to decrease Reheat 2 will activate at 67.4°F or 66% of the heating control band. If the return air temperature continues to decrease Reheat 3 will activate at 66°F or 100% of the heating control band.

When the return air temperature starts to increase, Reheat 3 is deactivated at 67.4°F or 66% of the heating control band, Reheat 2 is deactivated at 68.7°F or 33% of the heating control band and Reheat 1 is deactivated at the temperature set point of 70°F or 0% of the heating control band.

### 3 Stage Electric Reheat – With Dead Band



Note: in the above example that the control band begins at the 70°F temperature set point and has a length of 5°F, which is  $\frac{1}{2}$  of the programmed temperature dead band value plus  $\frac{1}{2}$  of the programmed temperature proportional band value.

As the return air temperature decreases Reheat 1 is activated at 67.7°F or  $\frac{1}{2}$  of the dead band value plus 33% of the heating control band. If the return air temperature continues to decrease Reheat 2 will activate at 66.4°F or  $\frac{1}{2}$  of the dead band value plus 66% of the heating control band. If the return air temperature continues to decrease Reheat 3 will activate at 65°F or  $\frac{1}{2}$  of the dead band value plus 100% of the heating control band.

When the return air temperature starts to increase, Reheat 3 is deactivated at 66.4°F or  $\frac{1}{2}$  of the dead band value plus 66% of the heating control band. Reheat 2 is deactivated at 67.7°F or  $\frac{1}{2}$  of the dead band value plus 33% of the heating control band. Reheat 1 is deactivated at 69°F or  $\frac{1}{2}$  of the dead band value plus 0% of the heating control band.

Remember the temperature dead band value is used by the control to shift the cooling on/ off operations away from the temperature set point.



# Humidity Control

## Humidification and/ or Dehumidification Required, in Percent (%)

The humidity control programs for the *iCOM* microprocessor is based on a calculated percent (%RH) requirement for humidification and/ or dehumidification. This percent (%RH) requirement is determined by the control type (algorithm) selected by the user.

The two (2) user selectable humidity control programs are:

- Absolute Humidity, grains of moisture in the air
- Relative Humidity (%RH)

## Humidity Control Program Types

### **Absolute (predictive) Humidity Control – Factory Default Setting**

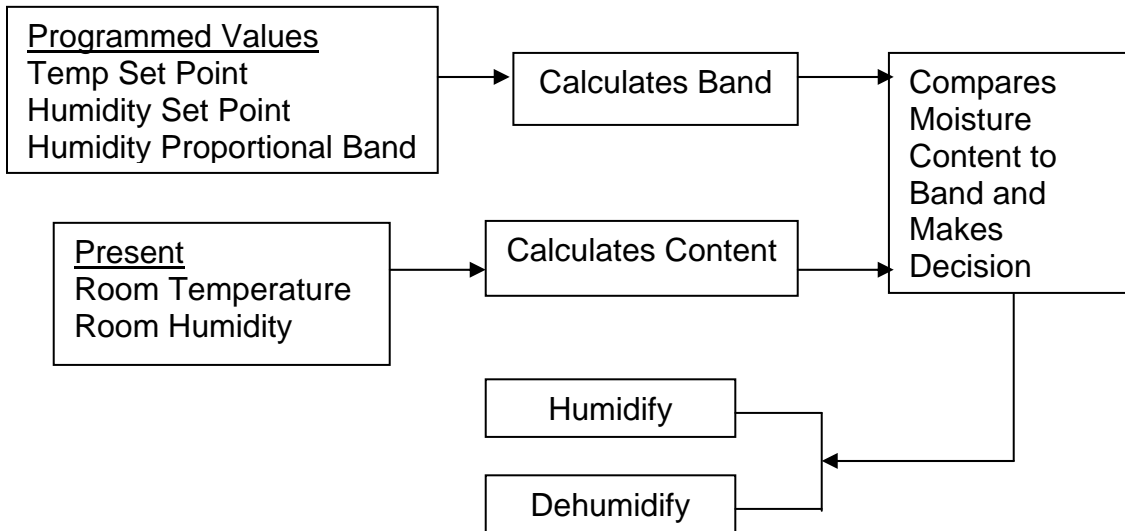
Absolute (predictive) humidity control is based on the moisture content in the return air. The *iCOM* microprocessor control automatically adjusts the humidity control as the return air temperature deviates from the programmed temperature set point. This calculation converts the return temperature and humidity values to a moisture content value defined as either grains per cubic foot or grains per pound. This recalculated content value is compared to the content control band that is determined by the:

- Programmed temperature set point
- Programmed humidity set point in %RH
- Programmed humidity proportional band in %RH

This automatic adjustment results in a predictive humidity control response. With absolute humidity control, the humidity control program is automatically adjusted approximately 2% RH for each degree difference between the return air temperature and the temperature set point. Note the following example:

| <u>Temperature Set Point</u> | <u>Humidity Set Point</u> | <u>Humidity Proportional Band = 6%</u> | <u>Content Level Grains per LB.</u> |
|------------------------------|---------------------------|--|-------------------------------------|
| 75°F                         | 50%                       | +3%                                    | 59.2                                |
| 75°F                         | 50%                       | -3%                                    | 52.5                                |

The Absolute (Predictive) Humidity Control Flowchart shows what the program is doing and why.



The program can be analyzed using the Moisture Content Charts supplied in a later chapter of this manual. It is important to remember that the display provides the humidity value in %RH, not moisture content. The moisture content (grains) values are used only in the internal control program calculation. The LCD display will indicate relative humidity percentage for both methods of control. If the absolute method of control is selected, the adjusted humidity reading will be shown.

**When utilizing the absolute (predictive) humidity control program feature, the humidity level is automatically adjusted ~ 2% RH for each degree difference between the return air temperature and the temperature set point.**

When absolute humidity control is used, over dehumidification is avoided in the space. When overcooling occurs, causing an increase in the relative humidity reading, the humidity control program “predicts” what the RH will be when the dehumidification cycle ends and the temperature returns to the programmed set point. This allows the dehumidification cycle to end at the proper time.

## **Relative Humidity Control**

Relative humidity control is based on the humidity content in the return air. The iCOM microprocessor control determines the unit humidification/ dehumidification operation by comparing the return air humidity value to the control band that is determined by the:

- Programmed humidity set point in %RH
- Programmed humidity proportional band in %RH

## **Operations and Charts**

The humidity proportional control band value is divided into two parts: the humidity set point plus  $\frac{1}{2}$  of the programmed humidity proportional band for dehumidification operation and the humidity set point minus  $\frac{1}{2}$  of the programmed humidity proportional band for humidification operation.

A humidity dead band can also be programmed into the control to shift the humidification and/ or dehumidification on/ off operations away from the humidity set point.

This programmed humidity dead band value is divided into two parts: the humidity set point plus  $\frac{1}{2}$  of the dead band – no dehumidification operation and the humidity set point minus  $\frac{1}{2}$  of the band – no humidification operation.

The humidity set point range is adjustable from 1 – 80% RH in increments of 1% RH. The humidity proportional band range is adjustable from 1 – 20% RH in increments of 1% RH. The humidity dead band range is adjustable from 0 – 50% RH in increments of 1% RH.

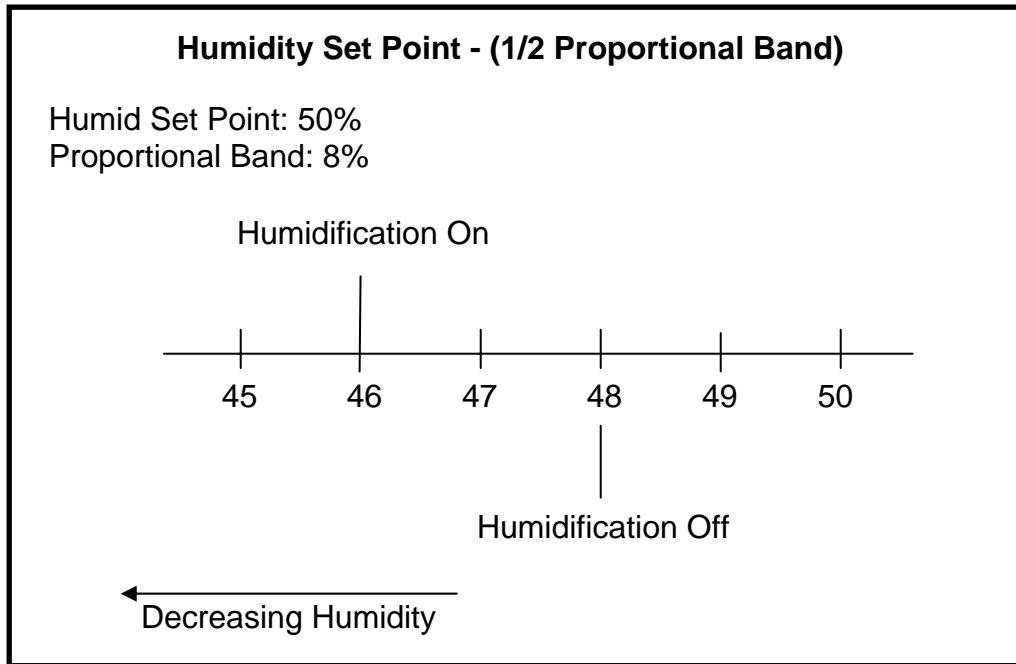
## **Humidifier Operation**

The Relative Humidity control program is used to illustrate the humidification operation in the following examples. The basic humidification control band is established at the humidity set point with the length equal to  $\frac{1}{2}$  of the programmed humidity proportional band value. The Liebert DS units are supplied with an infrared humidifier rated at the unit capacity.

The humidity controller activates the infrared humidifier when the return air humidity level decreases to 100% of the humidity proportional band. The humidifier makeup water solenoid valve also operates during humidification operation based on a timing sequence.

The humidity controller deactivates the infrared humidifier and makeup water solenoid valve when the return air humidity level increases to 50% of the humidity proportional control band value.

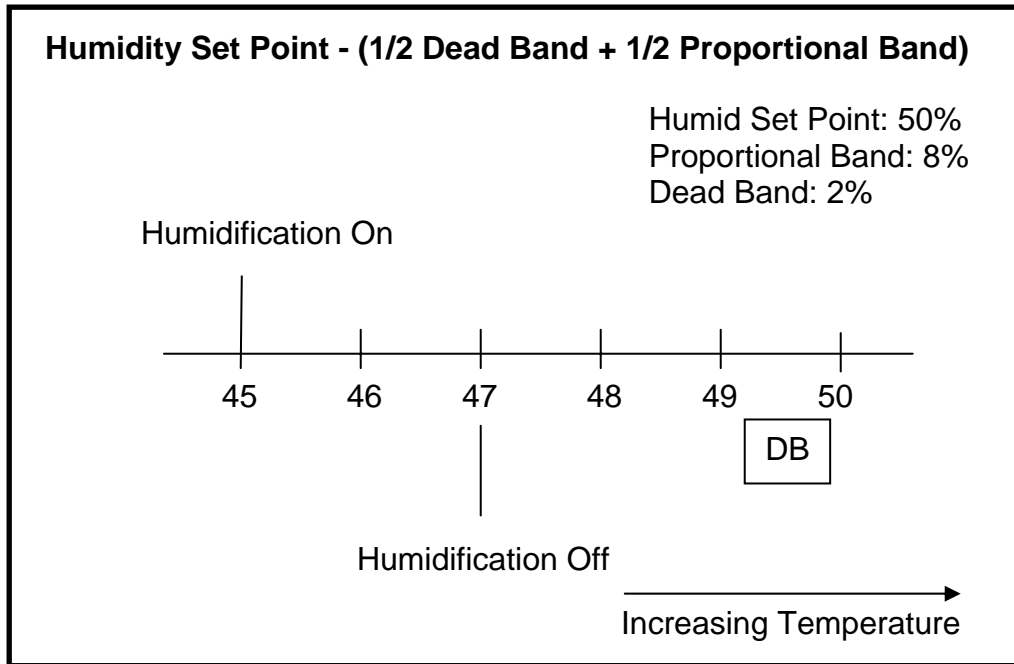
## Infrared Humidification – No Dead Band



Note: in the above example that the control band begins at the 50% humidity set point and has a length of 4%, which is  $\frac{1}{2}$  of the programmed humidity proportional band value.

As the return air humidity decreases the infrared humidifier is activated at 46%RH or 100% of the humidification control band. When the return air humidity starts to increase, the infrared humidifier is deactivated at 48%RH or 50% of the humidification control band.

## Infrared Humidification – With Dead Band



Note: in the above example that the control band begins at the 50% humidity set point and has a length of 5%, which is  $\frac{1}{2}$  of the programmed dead band value plus  $\frac{1}{2}$  of the programmed humidity proportional band value.

As the return air humidity decreases the infrared humidifier is activated at 45%RH or  $\frac{1}{2}$  of the dead band value plus 100% of the humidification control band. When the return air humidity starts to increase, the infrared humidifier is deactivated at 47%RH or  $\frac{1}{2}$  of the dead band value plus 50% of the humidification control band.

## Autoflush Control for Infrared Large (IFL) or Small (IFS) Pans

The Autoflush Water-Level Control software program is an integral part of the infrared humidifier system. The program automatically controls a water makeup valve to maintain the proper water level in the humidifier pan during operation. When a call for humidification exists, the program performs a series of checks.

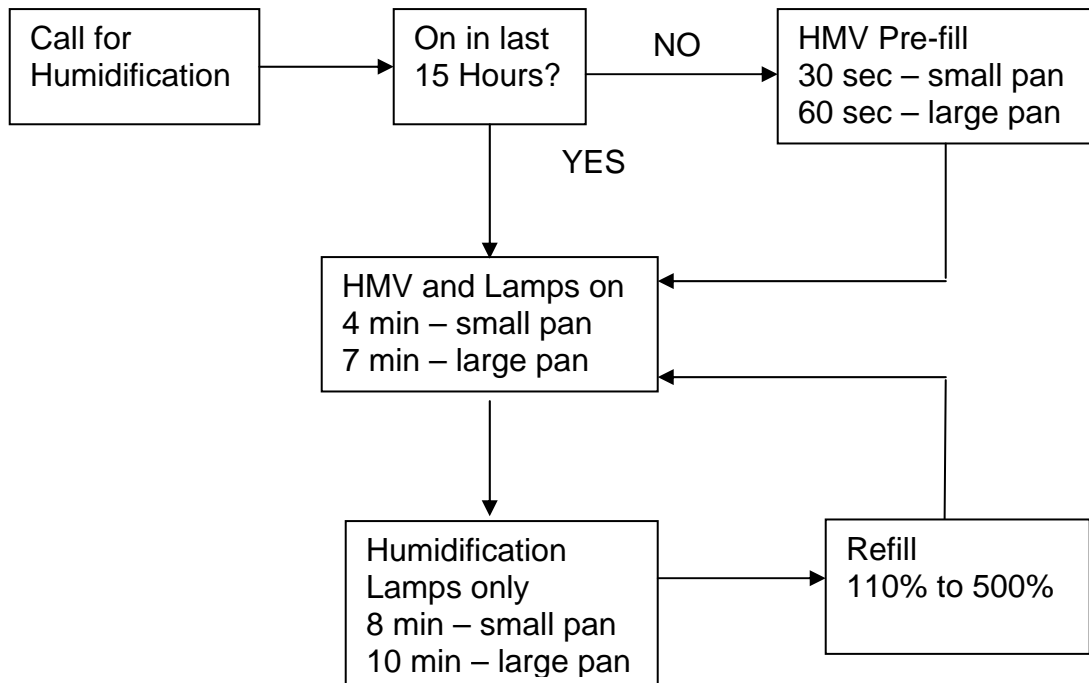
The first check to see how long the infrared humidifier has been off. If the off time is equal to or greater than the programmed value (factory default is 15 hours), it is assumed that the pan is dry and a program called pre-fill is initiated to add water to the pan. During the pre-fill operation the infrared lamps are inactive. The pre-fill time is programmable with an adjustable range of 1 to 120 seconds for either pan size. The factory default for a large (IFL) pan is 60 seconds and for a small (IFS) pan is 30 seconds.

If the off time is less than 15 hours (or user programmed value) the pre-fill program is bypassed and the infrared lamps and water valve are activated at the same time to fill the pan to the proper water level and initiate humidification.

During normal infrared humidification operation the water makeup valve is periodically closed (no pan fill) and opened (pan fill) based on a timing sequence to allow for the evaporation of water from the pan (see flow chart below).

With the humidifier water flush rate set at the factory default value of 150% the water makeup valve will open for 7 minutes of fill time with an off time of 45 seconds between fill cycles for a small pan. For a large pan water makeup valve will open for 10 minutes of fill time with an off time of 80 seconds between fill cycles. The user can modify the percentage from 110% to a maximum of 500% in 1% increments.

### Autoflush Control Flow Chart



**Notes:**

1. IFL: Infra-red Large and IFS: Infra-red Small
2. Last 15 Hours is programmable from 1-120hours.
3. Pre-fill time is programmable from 1-120 seconds on Large or Small pans
4. Normal Fill is programmable from 1-120 seconds
5. Refill is programmable in 1% increments

## **Dehumidification Operation**

The Relative Humidity control program is used to illustrate the dehumidification operation in the following examples. The basic dehumidification control band is established at the humidity set point with the length equal to  $\frac{1}{2}$  of the programmed humidity proportional band value.

The humidity controller activates dehumidification operation when the return air humidity level increases to 100% of the humidity proportional band. The humidity controller deactivates dehumidification operation when the return air humidity level decreases to 0% of the humidity proportional control band value.

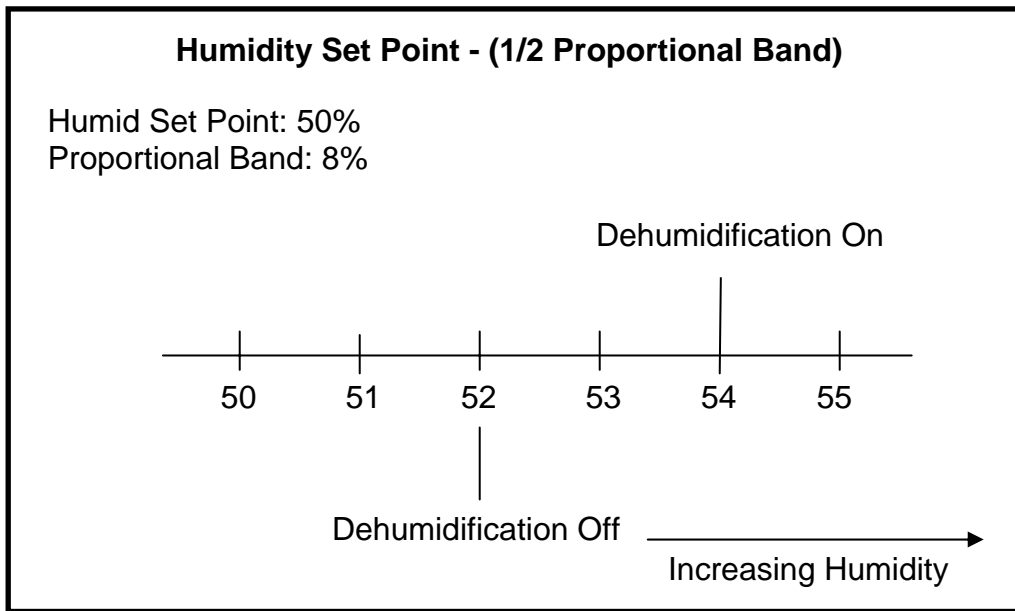
## **1-Stage Dehumidification, Compressorized Direct Expansion (DX) Systems**

The Liebert DS unit is supplied with two (2) compressors. Under normal operation, the lead compressor is used for sensible cooling and the lag compressor is used for either additional cooling or for dehumidification control. The optional hot gas bypass solenoid valve is de-energized during dehumidification.

If single compressor dehumidification is selected, the lag compressor is activated by the humidity controller when the return air humidity level increases to 100% of the humidity proportional band.

The humidity controller deactivates the lag compressor when the return air humidity level decreases to 50% of the humidity proportional control band value.

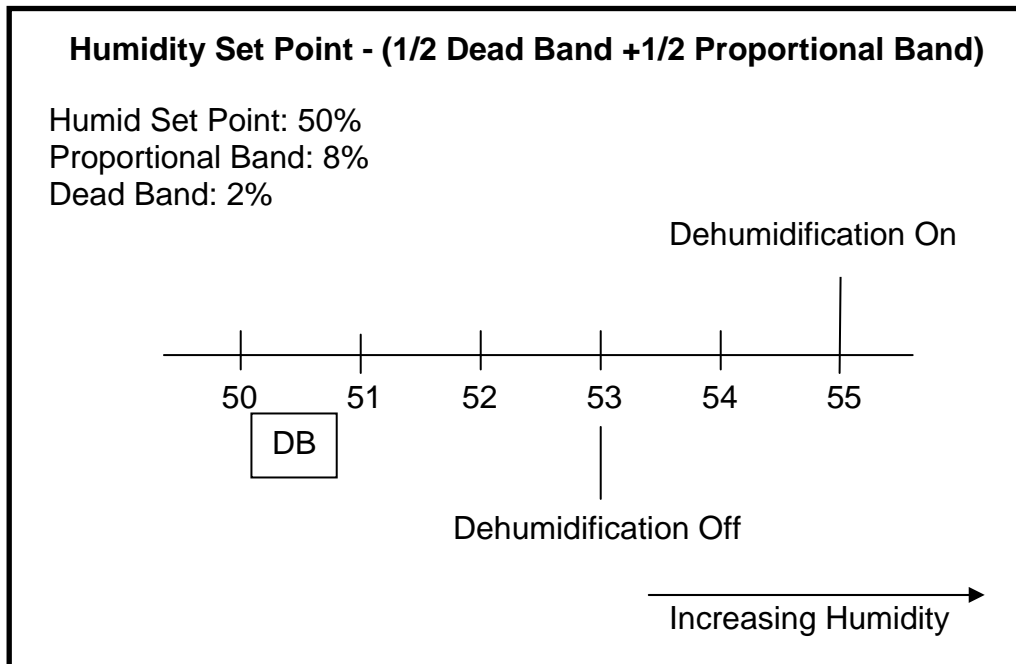
### **1 Stage Compressorized Dehumidification – No Dead Band**



Note: in the above example that the control band begins at the 50% humidity set point and has a length of 4%, which is  $\frac{1}{2}$  of the programmed humidity proportional band value.

As the return air humidity increases, dehumidification operation is activated at 54%RH or 100% of the dehumidification control band. When the return air humidity starts to decrease, dehumidification operation is deactivated at 52%RH or 50% of the humidity proportional control band.

## 1 Stage Compressorized Dehumidification – With Dead Band



Note: in the above example that the control band begins at the 50% humidity set point and has a length of 5%, which is  $\frac{1}{2}$  of the programmed dead band value plus  $\frac{1}{2}$  of the programmed proportional band value.

As the return air humidity increases, dehumidification operation is activated at 55% RH or  $\frac{1}{2}$  of the dead band value plus 100% of the dehumidification control band. When the return air humidity starts to decrease, dehumidification operation is deactivated at 53%RH or  $\frac{1}{2}$  of the dead band value plus 50% of the humidity proportional control band.

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

The basic dehumidification control band is established at the humidity set point with the length equal to  $\frac{1}{2}$  of the programmed humidity proportional band value. When 2 stage dehumidification is selected, the controller works as follows.

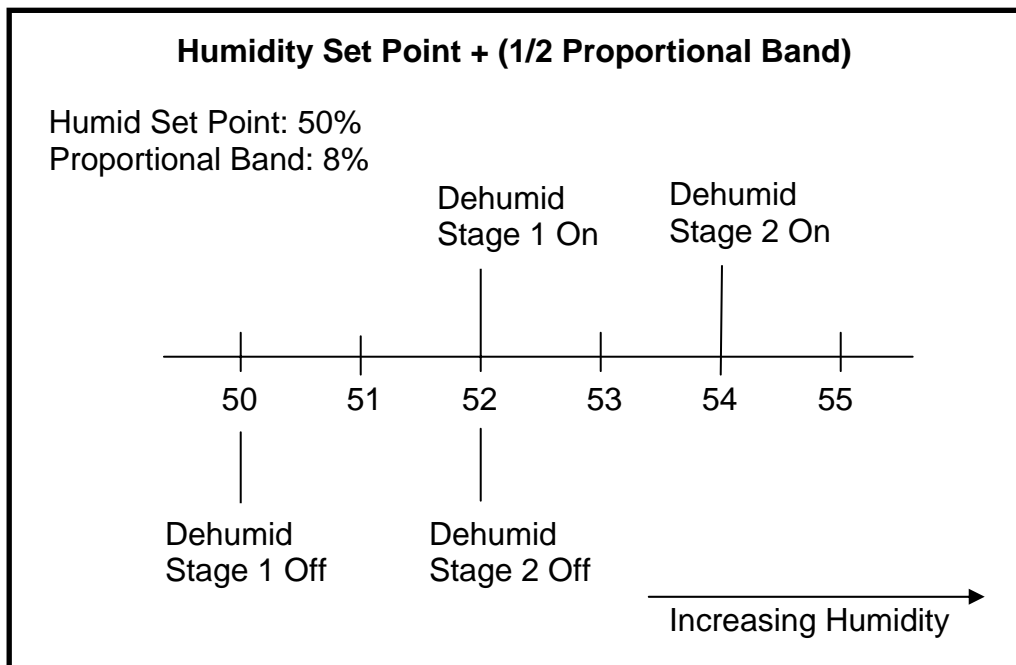


The humidity controller activates the first stage of dehumidification operation when the return air humidity level increases to 50% of the humidity proportional band. The second stage of dehumidification is activated when the return air humidity level increases to 100% of the humidity proportional band.

The humidity controller deactivates the second stage of dehumidification operation when the return air humidity level decreases to 50% of the humidity proportional control band value. The first stage of dehumidification is deactivated when the return air humidity level decreases to the humidity set point of 50% or 0% of the humidity proportional band.

If the compressors have unloading capability (4-stage cooling), then the compressors are activated in the fully loaded condition for each stage of dehumidification.

## 2 Stage Compressorized Dehumidification – No Dead Band

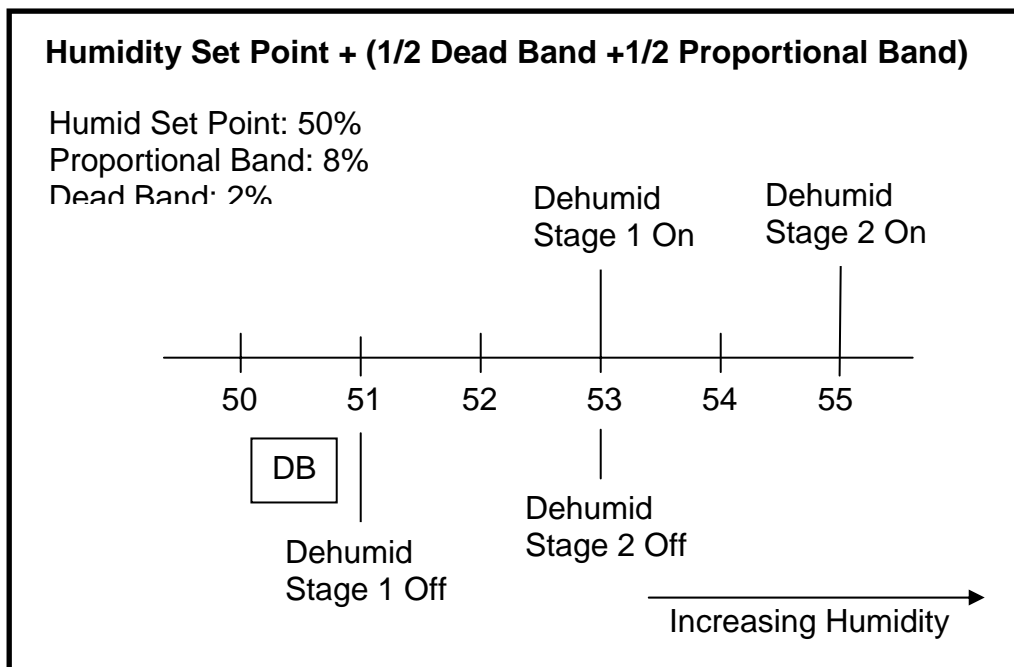


Note: in the above example that the control band begins at the 50% humidity set point and has a length of 4%, which is 1/2 of the programmed humidity proportional band value.

As the return air humidity level increases, first stage dehumidification operation is activated at 52%RH or 50% of the dehumidification control band. If the return air humidity level continues to increase the second dehumidification stage activates at 54%RH, which 100% of the dehumidification control band.

When the return air humidity level decreases to 52%RH or 50% of the dehumidification control band the second dehumidification stage is deactivated. When the return air humidity level decreases to the humidity set point of 50% or 0% of the humidity proportional band the first dehumidification stage is deactivated.

## 2 Stage Compressorized Dehumidification – With Dead Band



Note: in the above example that the control band begins at the 50% humidity set point and has a length of 5%, which is  $\frac{1}{2}$  of the programmed dead band value plus  $\frac{1}{2}$  of the programmed humidity proportional band value.

As the return air humidity level increases, first stage dehumidification operation is activated at 53%RH or  $\frac{1}{2}$  of the programmed dead band value plus 50% of the dehumidification control band. If the return air humidity level continues to increase the second dehumidification stage activates at 54%RH or  $\frac{1}{2}$  of the programmed dead value plus 100% of the programmed humidity proportional control band.

When the return air humidity level decreases to 53%RH or  $\frac{1}{2}$  of the programmed dead band value plus 50% of the programmed proportional control band the second dehumidification stage is deactivated. When the return humidity level decreases to 51%RH or  $\frac{1}{2}$  of the dead band value plus 0% of the programmed proportional control band the first stage dehumidification deactivated.

## Reheating during Dehumidification

The Parameter Electric Reheat Enabled defines how the reheats react when the return air temperature decreases below the temperature set point during the

dehumidification process. The end user can choose to select from the following selections:

| <b>Parameter</b> | <b>Operation</b>  |
|------------------|---|
| <b>No</b>        | No electric reheat allowed during compressorized dehumidification operation.  |
| <b>Normal</b>    | Electric reheat operates as normal. A decrease in return air temperature below set point will start reheats as described previously in his chapter. |
| <b>Delayed</b>   | No low limit reached / low limit reset: heaters disabled. Only one of two compressors operating in dehum or low limit 1 reached: heaters enabled    |

### **Normal or Delayed Reheat (2-Stage Dehumidification Only)**

When normal reheat (factory default) control is selected, the unit reheats are not disabled during dehumidification, even if both compressors are operating. As the return air temperature decreases below the temperature set point the reheats will stage on and off as described earlier in this chapter.

If delayed reheat is selected and both compressors are operating for dehumidification control, the reheats are disabled until only one compressor is required. If, during reheat disable, the return air temperature decreases far enough below the temperature set point to require 150% total available reheat capacity, then dehumidification is disabled and reheats are activated.

When the return temperature raises to the point where reheat is no longer required, then dehumidification operation is re-enabled. However, if the amount of time that both compressors were operating prior to being disabled by the low temperature condition was less than 10 minutes, then only one compressor is allowed to operate for subsequent dehumidification requirements. This prevents excessive system cycling, which can occur if the room heat load is small. Once the requirement for dehumidification is no longer present, then both compressors are enabled.

### **Caution:**

Dehumidification with normal reheat allows for operating both compressors and reheats simultaneously. It is very important that the electrical service to the unit be sized and wired for this option if selected. If not sized properly the electrical service could experience nuisance trips and or possible damage to building circuit breakers (or Fuses) and wiring.

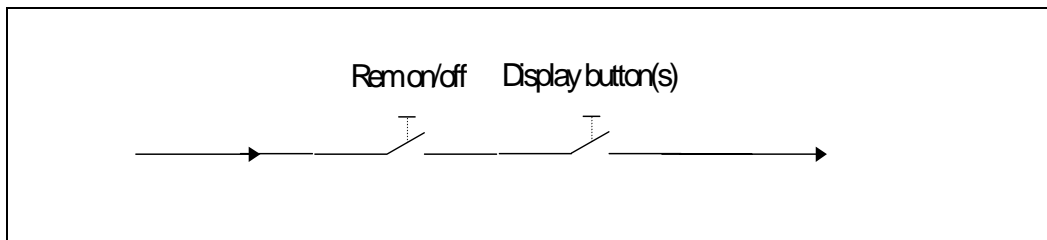
# Additional Programs

## Start

The unit fan is activated. The unit can be switched on/ off from 2 inputs:

1. Remote on/ off input (RSD – Remote Shutdown Device)
2. Display button

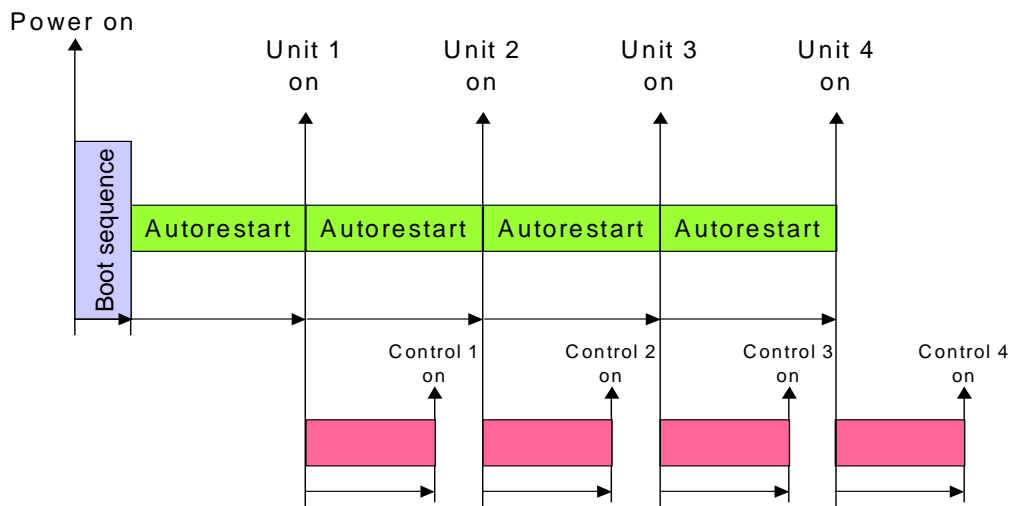
**Note:** Switches 1 and 2 are in series; the unit will start only if both switches are in the on position. If either switch is in the off position the unit will stop



## Auto restart

When there is a power outage the unit will provide an automatic restart on power restoration when programmed. The unit will start and the loads will sequence on with the Fan first, the first Cooling need and so forth until all loads are on as the room requirement demands.

The **Unit Auto Restart Sequence** (customer programmable) takes place. Each unit will restart by this program, however, with a network of units, the start loop will start the next unit at each individual time when elapsed beginning with unit number ID #1. The unit control start sequence will start at this point as well.



## **Fan Alarm / Fan settings**

The fan operation is controlled by two (2) digital devices: the **Loss of Airflow** differential pressure switch and the **Main fan Overload** motor protection. The time delay at the unit start is always 5 seconds shorter than the control delay.

## **High Pressure Cutout**

The control uses high head lockout functionality. If one compressor trips or is locked out on high head, the other compressor turns on when the space temperature increases 1°F. Pressing the alarm button on the display twice can reset high head Alarm. A lockout condition occurs on the third trip and must be reset by turning the main power switch to off then back on.

## **Suction Pressure Transducer**

The suction pressure transducer operation is only on air conditioning products (not chiller applications). Transducer measurements are made **at least once every 1** second. With all other operating times for all compressors, additional measurements, shall be taken based on **operation “at limit conditions” for 5 seconds** and shall not include readings taken during **Pumpdown or Winter Start Kit (WSK)** timeout.

## **Call for Cooling**

The following applies for both R22 and R407C systems and applies to all compressor types. The call for cooling opens the **Liquid Line Solenoid Valve (LLSV)**. Note: on units with Digital Scroll Compressors the unloader is energized 0.1 second before the compressor contactor is energized. On air-cooled units with **fan speed type condenser (FSC)** the low pressure start threshold is 35psiG (50psiA). On air-cooled units with **lee-temp control (LT) and all fluid cooled units** the low-pressure start threshold is 60psiG (75psiA).

## **All compressorized units use the following start sequence:**

Open LLSV, if WSK is set to 0, wait for suction pressure to reach setting, then start compressor and freeze protection timer.

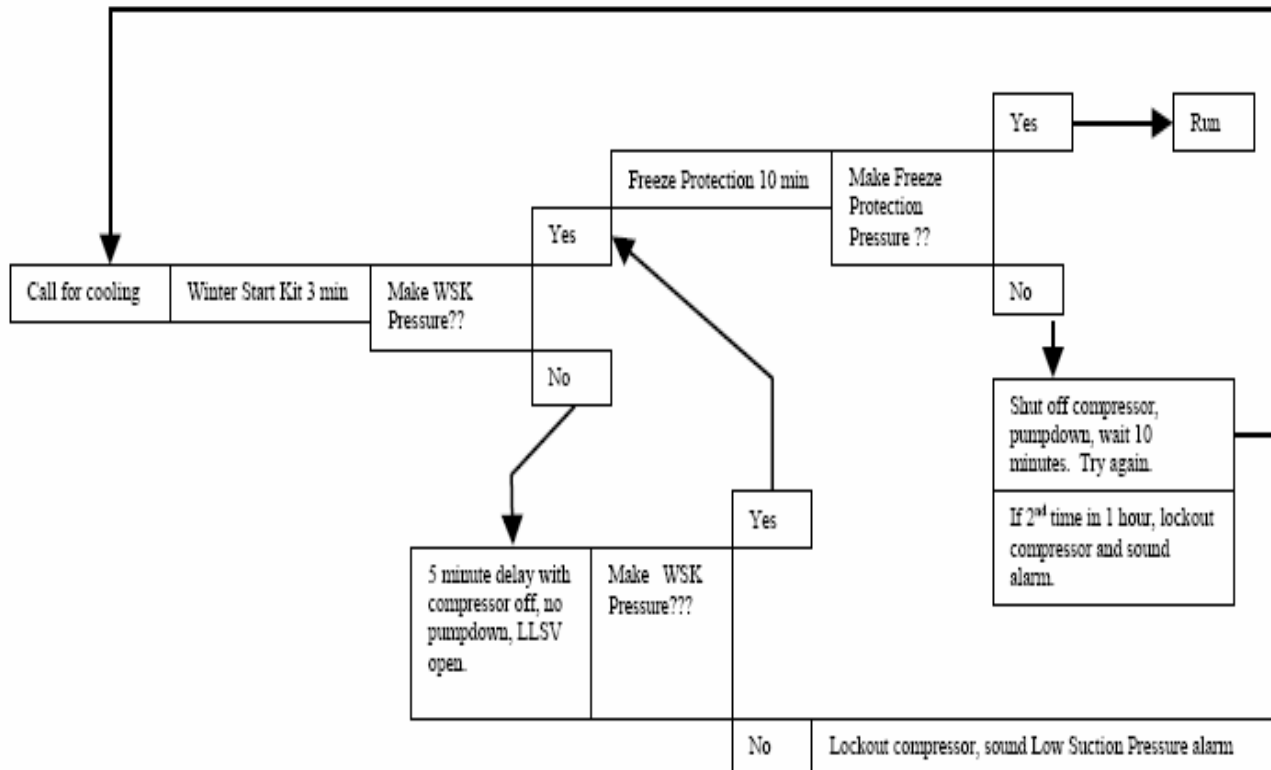
If WSK is set greater than 0, operate the compressor for the WSK override time and monitor suction transducer value.

If pressure is achieved the compressor is allowed to operate, and the freeze protection timer is started.

If pressure is not achieved, turn compressor off and leave LLSV open.

If pressure is achieved within next 30 seconds the compressor is allowed to operate, and the freeze protection timer is started.

## The Startup and Freeze Protection Program



The sequence for the call for cooling with the program features is as follows:

The need for cooling is defined by the control setting for the temperature setpoint, proportional band, and deadband (if used). At this point the Winter Start Kit (WSK) time delay is the wait period for the compressor to run without the indication of the low-pressure condition (also known as LP bypass). The WSK time delay is programmable with a range of 0 - 5 minutes. If the LP switch setting is achieved in this time then full cooling is in process with the Freeze Protection (FP) now watching the LP for an additional 10 minutes (fixed). If the LP remains closed the cooling process continues.

If the WSK is not made in the set time period the cooling process stops and waits an additional 5 minutes with the compressor off (no pumpdown). The liquid line solenoid valve will remain open during this time period. If the LP switch is made the control will now advance and wait for the freeze protection time delay as stated as above. If the LP switch does not prove in the WSK time delay period plus the 5 minute wait period, the compressor is locked off and the Low Suction Pressure Alarm will activate. A power off/ on reset is required to reset the cooling function.

If the WSK is made and the control is in the 10 minute Freeze Protection (FP) wait time period and this function does not prove the LP the control will go into additional 10 minute wait (fixed), with the compressor off (no pumpdown) and the liquid line solenoid valve to remain open. If the freeze protection does not make

during the second time frame the cooling process locks off and will require a power off sequence.

## Next Maintenance Calculation

### Foreword

The next maintenance calculation will help run the Liebert Environmental unit in an optimum way, to ensure minimum components stress resulting in increased reliability.

### Calculation of next Maintenance Parameters

The following components are included in the calculation individually:

- Fan(s)
- Compressor 1
- Compressor 2
- Electric Heaters
- Humidifier

For **each individual component** the next maintenance will be calculated from following parameters:

1. Standard service interval (1, 2, 4 or 6 times a year, to be programmed).
2. Working hours (counted).
3. Number of starts (counted).
4. Average running time (calculated).
5. Optimum number of starts per hour (to be programmed).
6. Maximum number of starts per hour (to be programmed).
7. Maximum bonus to enlarge time to next maintenance (to be programmed).
8. Maximum penalty to reduce time to next maintenance (to be programmed).

### The Maintenance Calculation is done as follows:

Basic: maintenance frequency (1). The control counts the working hours of the component, as well as the number of starts.

The working hours and the number of starts are compared with the programmed optimum / maximum starts per hour. This results in "Wellness Factor".

This factor, in accordance to the service interval, will add a "Bonus" to increase the time before the next maintenance, or will add a "Penalty" to decrease the time before the next maintenance. In simple words: If a component starts very often, the time to next maintenance will be decreased, if it starts rarely, the time to next maintenance will be increased.

The control always takes the component with the most on/ off (cycling) as the reference component, which asking for the nearest maintenance (example: if the fan runs continuously, but the compressor switches on/off all the time, the next maintenance will be calculated from the compressor).

Alarms or warnings (like clogged filter, high or low pressure, fans alarm etc.) will decrease the time to next maintenance immediately to 0. If the alarm was reset, the original situation will be displayed again, but the alarm will be counted in the diagnostics window.

The display's main window provides information about the next maintenance: a bar graph (graphical display screen) will fill in, as the next maintenance gets closer (the width of the graph equals to the standard maintenance Interval (1, 2, 4 or 6 times a year). The date of the next maintenance is also displayed.

## **Parameters for next Maintenance Calculation:**

### **General Maintenance Settings:**

**Maintenance Frequency:** can be set at 1, 2, 4 or 6 times a year. "NO" means the maintenance calculation program is disabled.

**Maximum Bonus:** this value increases the time to next maintenance with the set value, if all components run in optimum way (number of starts, average running time).

**Maximum Penalty:** this value decreases the time to next maintenance with the set value, if some components run in non-optimum way (number of starts, average running time).

**Last Maintenance:** this date can be will be set by the calculations and the service-engineer and others to view.

**Service-Engineer:** name can be added and edited.

**Reset:** puts all counters of all components (fans, compressors, ect.) to 0, and starts new maintenance calculation (always reset after maintenance is completed).

### **Fans / Heaters / Humidifier Settings / Compressor 1 /2 Settings**

**Number of starts and Working hours:** counted from the last maintenance. Total working hours can be read in the standard working hours window (customer window).

**Average Working Hours:** calculated by the number of starts and working hours of each component.



**Starts per Day Optimum:** the number of individual component starts that is considered as good or optimum. To be set by Service Engineer.

**Starts per Day Worst:** the number of individual component starts that is considered as “hunting” or worst case. To be set by Service Engineer.

**Number of Alarms:** counts the number of alarms occurring between service intervals.

**Actual Bonus:** calculated from “number of starts” and “average working time” values. The result can be positive (for a bonus) or negative (for a penalty). This value influences the time remaining to the next maintenance.

## Shared Parameters an understanding

If we have multiple units in the same room (zone) they will need to communicate with each other to avoid opposite operational functions. This will prevent the cooling and heating functions from operating at the same time on different units. This condition called “fighting “ often exists in the room due to imbalanced loads and the crossing of airflow conditions. This is also considered when using the Lead/ Lag and Cascade functions.

When a system is setup the parameters are shared by all units. The unit selected as the Lead Unit (#1 unit) is used to program the system, if program parameters are not set in this unit they will be ignored. This is true for all of the active units in the system. However, if a unit in the system is not active it will be ignored until it is active and the parameters will be shared within 2 minutes of activation.

### **Shared Temperature and Humidity parameters example:**

Two units share the master Temperature Control (1/2) Proportional Band Setting such as 10°F, and then each unit will use the master band divided by 2 (units) or 5°F proportional bands. To avoid the cooling hunting process or compressor cycling too quickly, the primary temperature proportional band needs to be set wide enough to compensate for the number of units in the system setup. Note that shared parameters are not used on single unit applications.

Heating, humidification, and dehumidification will follow the same example with each function starting in each unit one after the other or in sequence.

In Chilled Water units all valves operate are in parallel but this operation may be overridden by the setting and use of the Supply Limit sensor. This parameter is controlled by the individual unit. Here we may see uneven valve positioning (operation) in some of the units.

Freecooling and Dual cooling will operate in the same manner as chilled water with the supervision of the Supply Limit, again showing different valve positions on the units

If in a Freecooling or Dual Cooling unit if the limit of the coil operation is detected (no free cooling or no CW available) the valve will close off and unit will become DX operation in the system.

## **Networking and Functions**

**Unit 2 Unit (U2U) Communications by networking will allow the following functions to be placed into operation when the requirements exist. The user must install the correct hardware and properly program the units for the functionality.**

In the iCOM Network the owner may perform the following functions:

The **Teamwork Mode** functions, which allow multiple stages of Cooling/ Heating and/ or Humidification/ Dehumidification. The ability to prevent the units fighting is included in this feature.

The **Lead/ Lag** function, which allows one or more units to be set as “Running and Standby” for activation in case of an alarm. This also has the ability to be programmed in a rotation for assurance of functional standbys.

The **Cascade** function, which allows additional units to be staged on based on the temperature or humidity requirement.

### **Understanding the iCOM Network setup process:**

To setup a system network with the iCOM control requires a complete understanding of the control processes and parameter programming to insure the proper functional operation without incident. To insure the setup is correct and that the operation will function as selected you need to map both the room layout and the unit setup. First, read and record all programmed settings in all of the single units. Second, document the network parameter settings that are needed and identify the numerical order of the units to be networked. The order of the setup process is very important.

## **The Basics for Cooling Unit Placement:**

Installation instructions are found in the product manuals for the Cooling units. Networking setup should include these additional factors for planning.

- Locations of heat loads in conditioned space.
- Air distribution for cooling.
- Number of operating units versus standby.

## **The Basics for Hardware:**

### **Multi-unit networking requires the following hardware:**

Minimum Network Switch Requirements:

- IEEE 802.3, IEEE 802.3u
- 10/100 Mbps speed
- Multiple RJ-45 ports – one shared RJ45 uplink

CAT 5 patch cables (straight through) in the proper lengths not to exceed 150 ft. maximum length each. One for each board and display added into the iCOM network. Cable management will apply.

### **The Basic for Programming:**

An IP address number will be used to identify each receiver/ sender of information. (See Computer and Network Terms in Training and Service Manual)

The iCOM Network is a Class C Private Network and will use the 192.168.254.xxx series of static IP address. This has nothing to do with the local building or owner network. The iCOM Network may only be attached to these networks through a WEB Card or 485 Card using the Liebert Intellislot.

A series of basic rules must be followed to connect and program the units for this private iCOM Network. See the following rules.

1. Small Displays are CAN connections only, programming of single unit parameters is required.
2. Small Displays CANNOT look at or program other iCOM Network functions.
3. Small Displays may be networked with a CAT 5 crossover cable (2 units).
4. All Large Displays and Control Boards will use a CAT 5 or greater straight through (patch) cables to connect to the switch.
5. One large Display (Wall Mount) with a separate power adapter may be used with multiple units (Control Boards and Small Displays) through the network switch.

6. Each set of unit control boards must be set up individually, then connected to the network switch and checked before the next board can be setup

6a. Large Displays and Control Boards must each be programmed with a different IP Address.

Example: Display: 192.168.254.001

Example: Control Board: 192.168.254.010

6b. Each Display and Control Board in the iCOM network must have the same Gateway IP address.

Example: Gateway IP: 192.168.254.75

6c. Each Display and Control Board in the iCOM network must have the same Netmask IP address.

Example: Netmask IP = 255.255.255.000

6d. The Unit to Unit (U2U) address must be programmed in the necessary order for setup.

Example: Unit Display: 33 – 64 and Unit Control Board: 1 - 32

## Setting Parameters

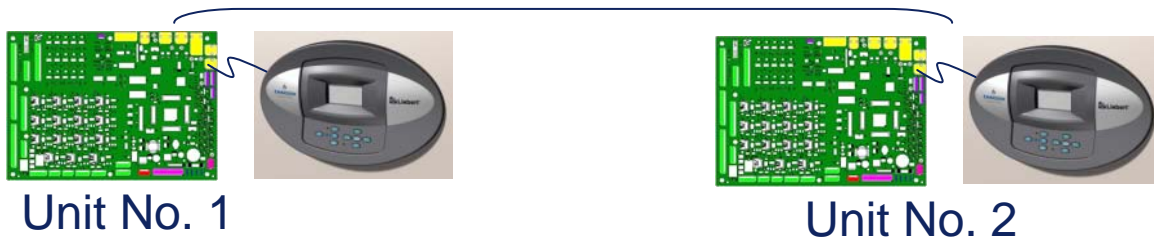
**Example: 2 Units with Small Display's**

**All Network parameters are viewed and programmed using the Service Menu function and by selecting the Network Setup Icon**

The following example references menu lines on the Network Setup screen:

- Line S802: Number units connected: xx (2)
- Line S803: Teamwork: xx (No, 1, 2)
- Line S804: Control Board IP Address: 192.168.254. xxx (010, 011)
- Line S805: Control Board Netmask IP the same for all units
- Line S806: Control Board Gateway IP the same for all units
- Line S808: U2U address Control Board #: xx (1-2)
- Line S810: U2U group #: xx (1)

**U2U: CAT5 (Crossover-cable)**

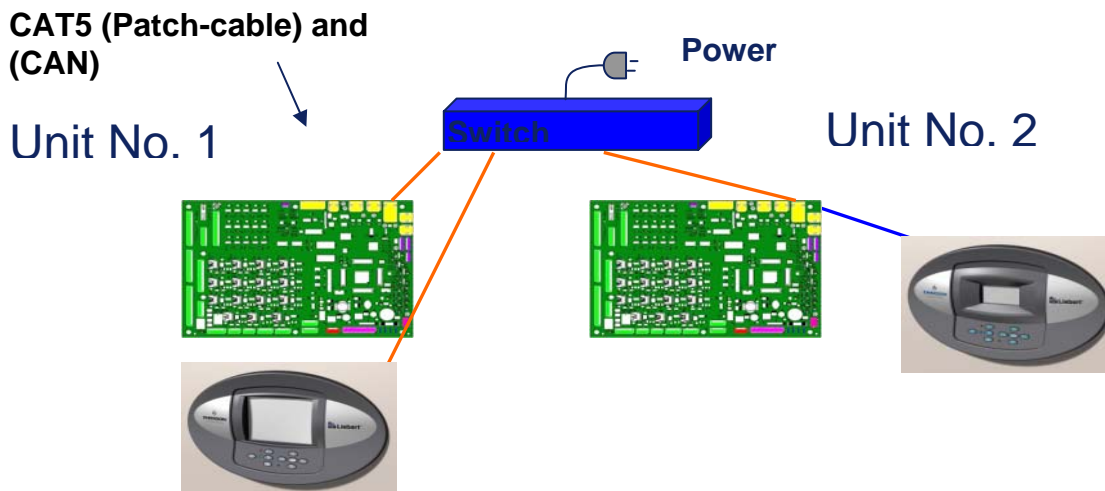


## Example: 2 Units, One Large Display and One Small Display

**All Network parameters are viewed and programmed using the Service Menu function and by selecting the Network Setup Icon**

The following example references menu lines on the Network Setup screen:

- Line S802: Number units connected: xx (2)
- Line S803: Teamwork: xx (No, 1, 2)
- Line S804: Large Display Board IP Address: 192.168.254. xxx (001 - 049)
- Line S804: Control Board IP Address: 192.168.254. xxx (050 - 099)
- Line S805: Large Display Board Netmask IP: 255.255.255.000
- Line S805: Control Board Netmask IP: 255.255.255.000
- Line S806: Large Display Board Gateway IP: 192.168.254.255
- Line S806: Control Board Gateway IP: 192.168.254.255
- Line S808: U2U address Display #: xx (33 - 64)
- Line S808: U2U address Control Board #: xx (1 - 32)
- Line S810: U2U group #: xx (1 - 99)

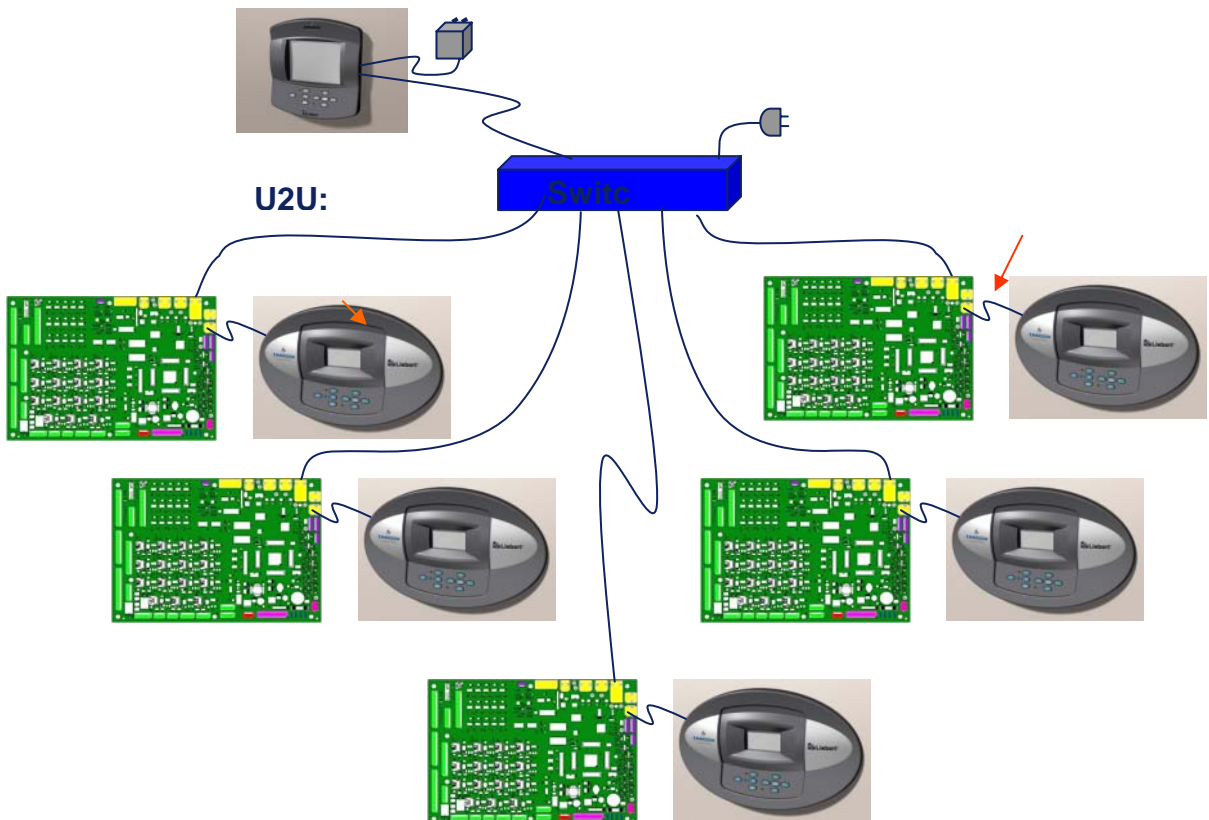


## Example: Large Wall Display and Five Units with Small Displays

**All Network parameters are viewed and programmed using the Service Menu function and by selecting the Network Setup Icon**

The following example references menu lines on the Network Setup screen:

- Line S802: Number units connected: xx (01 - 32)
- Line S803: Teamwork: xx (No, 1, 2)
- Line S804: Large Display Board IP Address: 192.168.254. xxx (001 - 049)
- Line S804: Control Board IP Address: 192.168.254. xxx (050 - 099)
- Line S804: Wall Mount (LBB) IP Address: 192.168.254. xxx (100 - 149)
- Line S806: Large Display Board Gateway IP: 192.168.254.255
- Line S806: Control Board Gateway IP: 192.168.254.255
- Line S808: U2U address Display #: xx (33 - 64)
- Line S808: U2U address Control Board #: xx (01 - 32)
- Line S810: U2U group #: xx (01 - 99)

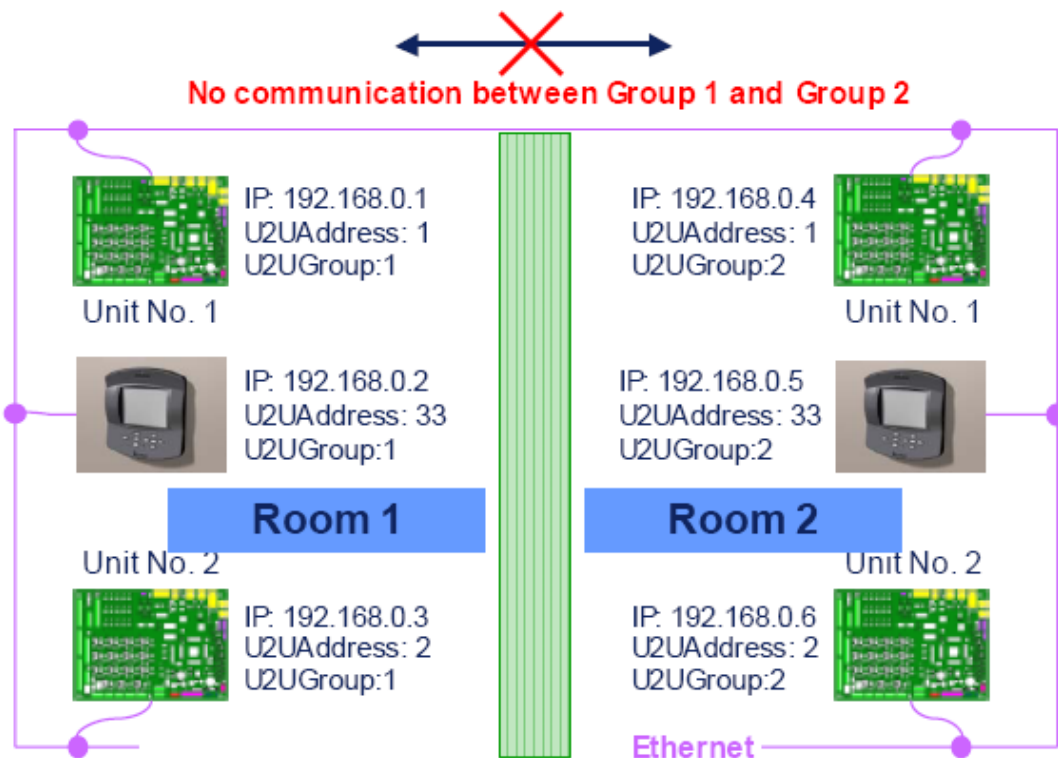


## Example: 4 Units in 2 Groups with 2 Large Displays

**All Network parameters are viewed and programmed using the Service Menu function and by selecting the Network Setup Icon**

The following example references menu lines on the Network Setup screen:

- Line S802: Number units connected: xx (01 - 32)
- Line S803: Teamwork: xx (No, 1, 2)
- Line S804: Large Display Board IP Address: 192.168.254. xxx (001 - 008)
- Line S804: Control Board IP Address: 192.168.254. xxx (010 - 080)
- Line S806: Large Display Board Gateway IP: 192.168.254.xxx (000 – 254)
- Line S806: Control Board Gateway IP: 192.168.254.xxx (000 – 254)
- Line S808: U2U address Display #: xx (33 - 64)
- Line S808: U2U address Control Board #: xx (01 - 32)
- Line S810: U2U group #: xx (01 - 99)



Using GROUP addresses to differentiate between units inside the same LAN



# Teamwork

## Teamwork Modes

Teamwork is the ability to group unit functionality, while connected in a network, to provide the ability to work together as a team and address control functions in three different teamwork modes:

### “No” Teamwork

In this mode all units are working independently for control and functionality. No values or sensors are shared. While in this mode units may be setup to provide the Lead/ Lag function and rotation, however, units may not be setup in the Cascade functionality.

### Teamwork Mode 1

In this mode unit parameters (system settings) are shared if the system value is set in any of the units, all units will follow with same settings. (See Glossary of Unit and System parameters section).

The return air temperature and humidity sensed by each unit in the network will be averaged and used for control by the lead unit.

The Lead Unit designation #1 and will provide the calculations for the system requirements and will provide the calculated divisions of the proportional band to each of the units to start the required operations. The width of the proportional band in multiple unit configurations is shown as normal, but internally the lead unit (unit #1) sends the requests to the other units and multiplies this width by the number of available units in the program.

To be an available unit for operations in this mode:

- a) The unit cannot be in a standby (lead/lag) configuration: all units must be on
- b) The units in the cascade function are not off or set with alarms functions to be switch off.

This mode of control will drive all Chilled Water or FreeCooling actuators in parallel for all units operating in the teamwork mode. The individual unit will control its own Dual Cooling switchover functions, the low temperature functions and low discharge air functions.

Teamwork Mode 1 will rotate the lead unit by 1 unit every 24 hours.

## **Teamwork Mode 2**

In teamwork mode 2 all system parameters are shared equally as in teamwork mode 1. The lead unit will define the temperature and humidity averages for the operational needs if there is a request for cooling, heating, dehumidification or humidification.

If there is a temperature control request because of a need for either cooling or heating (determined by highest or lowest temperature of all the units), teamwork mode 2 activates all of the connected units. Each unit will operate in the cooling or heating mode using their individual temperature control settings. If in the cooling mode the heating function is disabled in all units. If in the heating mode the cooling function is disabled in all units.

If there is a humidity control request because of a need for either humidification or dehumidification (determined by highest or lowest humidity of all the units), teamwork mode 2 activates all of the connected units. Each unit will operate in the humidification or dehumidification mode using their individual humidity control settings. If in the humidification mode the dehumidification function is disabled in all units. If in the dehumidification mode the humidification function is disabled in all units.

Teamwork Mode 2 does not allow unit rotation (lead/ lag), unbalanced unit working hours are to be expected.

## **Unit Lead/ Lag or Running/ Standby Function**

This program will allow the user to select the multi-unit function of Lead and Lag, or as sometimes stated Running and Standby, by selecting the number of running and standby units to provide the redundancy needed in the space.

### **Typical Lead/ Lag (Running/ Standby) Function**

The lead/ lag operational sequence has a lead (running) unit operating and an alarm becomes active (selected by alarm programming). The active alarm in the lead unit will cause the first lag (standby) unit to active and maintain the space conditions. If multiple units are selected as lag (standby) the units will continue to rotate on active alarms as long as a lag unit is available. If there are no lag (standby) units left in the sequence the first failed will restart (if not in a critical alarm state i.e. fan overload, etc).

**Note:** The unit with the active alarm will operate in the fan only mode for 3 minutes before going into a standby mode to stabilize conditions, then it will turn off.

The Lead/ Lag function may be used in either the No Teamwork Mode, in Teamwork 1 Mode and in Teamwork 2 Mode. One or more units can be defined as lag (standby), the normal status of the lag (standby) unit(s) is off.

The lag or standby function can be performed as a daily rotation (setting the time), weekly rotation (setting the day of the week and time) or as a monthly rotation. The units will rotate based on the programmed number of units:

Example A: if the rotation is set in the "Rotate by 1" parameter, the standby units will rotate from 1 to 2 or 2 to 3 or 3 to 4 or 4 to 1 in a basic 4 unit configuration.

Example B: if the rotation is set in the "Rotate by 2" parameter, the standby units will rotate from 1 - 2 to 3 - 4 or 3 - 4 to 1 - 2 in a basic 4 unit configuration.

### **Standby & Cascade**

This program function will activate the lag (standby) unit(s) when an active alarm in a running unit is detected. This program parameter will also provide for unit staging. With an increase or decrease in either the temperature and/ or humidity conditions is sensed in the operating units the additional standby unit(s) will be activated to aid in the control of the space requirements.

The Cascade function operates in Teamwork Mode 1 only. The Cascaded units are not part of the system temperature and humidity average.

Settings are:

|   |         |
|---|---------|
| Cascade Active                          | Yes/ No |
| Cascade Cool/ Heat and Humid./ Dehumid. | Yes/ No |
| Cascade for Cooling and Heating         | Temp    |
| Cascade for Cooling only                | Cool    |

# Notes:

# Chapter 2

## Programming Functions

The standard iCOM control is supplied with a front panel mounted small display screen display which features a 128 x 64 dot matrix graphics. The display provides both descriptive text readouts and two (2) menu icons. The optional large screen display features a 320 x 240 dot matrix graphic display that shows user and service icons as well as descriptive text and graphics. The information provided visually on either of these displays is: room temperature and humidity, temperature and humidity set points, alarm status and settings, event histories and the current time. All programming functions will be done through the supplied display.

**Small Graphic Display  
with Panel Mount Bezel**



**Optional Large Graphic  
Display with Panel  
Mount Bezel**

## iCOM Display Components and Functions

The large display is shown for reference. The keypad and LEDs are identical on all displays.

Liquid Crystal display

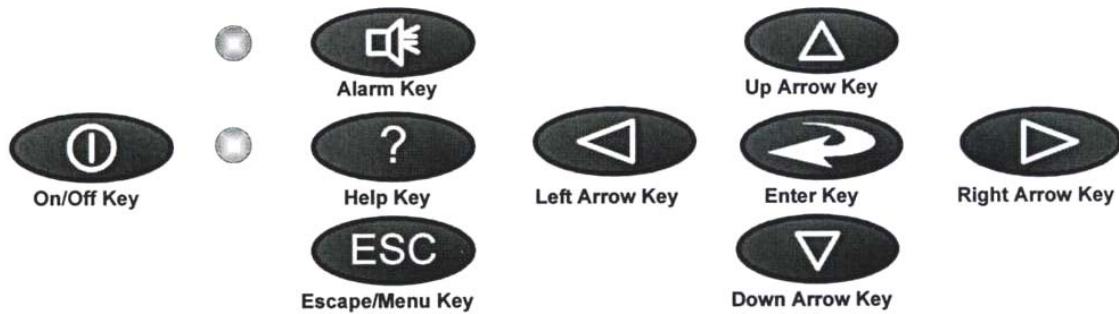


LED Status Indicators

Top LED is red or flashing red - alarm,  
Bottom LED is amber (power on) or green (unit on)












Keypad

### iCOM Keyboard Layout:

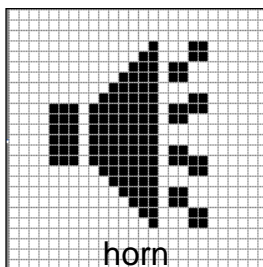
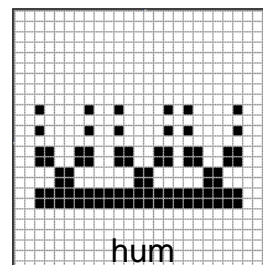
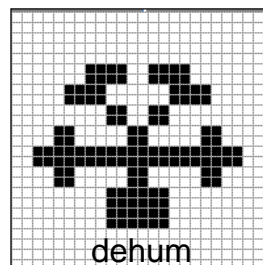
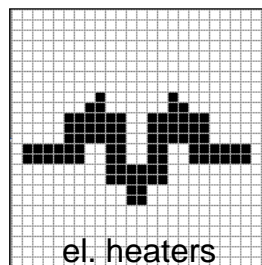
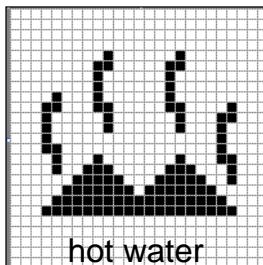
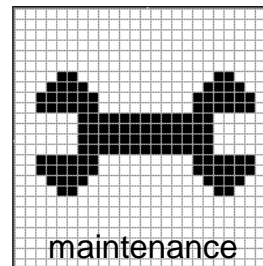
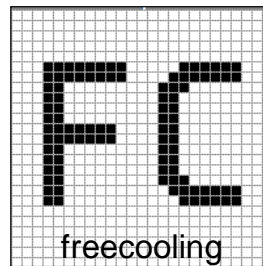
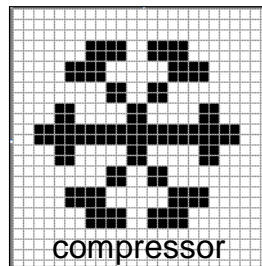
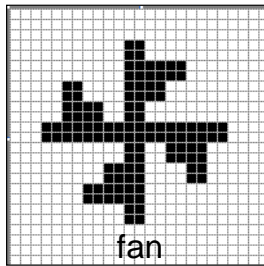


The iCOM control screen displays text and icons for monitoring and programming your Liebert unit and/ or network of units. The number of icons and the amount of text shown depends upon the display type supplied on your unit. From the default menu, the user menu may be accessed by pressing the enter key. When the user selects an icon the various submenus, set points, status, thresholds and service information is displayed. The following defines the various keyboard icons and functions.

## **iCOM Keyboard Layout:**

| <b>Icon</b>   | <b>Key Name</b>              | <b>Function</b>   |
|---|------------------------------|---|
|    | On/ Off Key                  | Controls the operation state of the unit.   |
|    | Alarm Key                    | Silences the audible alarm.   |
|    | Help Key                     | Accesses the integrated help menus.   |
|    | ESCape Key                   | Returns to the previous display.  |
|    | Enter Key                    | Confirms all selections, icons and text.  |
|    | Increase Key<br>(Up Arrow)   | Moves upward through the menu or increases the value of the selected parameter.                                       |
|   | Decrease Key<br>(Down Arrow) | Moves downward through the menu or decreases the value of the selected parameter.                                     |
|  | Left Arrow Key               | Navigates through text and selections of the display.   |
|  | Right Arrow<br>Key           | Navigates through text and selections of the display.   |
|  | Upper LED                    | Blinking Red: Active, unacknowledged alarm exists.<br><br>Solid Red: Active, acknowledged alarm exists.               |
|  | Lower LED                    | Amber: Power available to the unit, unit NOT operating.<br><br>Green: Power available to the unit, unit is operating. |

## iCOM Display Symbols/ Icons



The iCOM programming functions are separated into three (3) basic menus:

- User Menu
- Service Menu
- Advanced Menu

When the desired icon has been selected, press the enter key. If the selected menu item has submenus, they are now revealed. If there are no submenus, the function or setting or command level text is displayed. User and Service menu settings are readable without a password, changing the programmed values requires a password. When a password is required to perform a programming function, the iCOM displays a password prompt. Advanced menu setting requires a password to read and program.

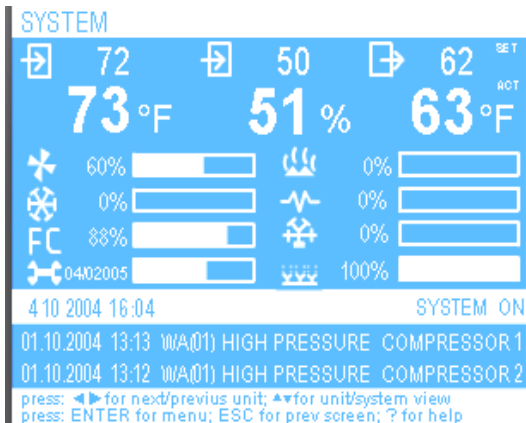


# Programming Functions

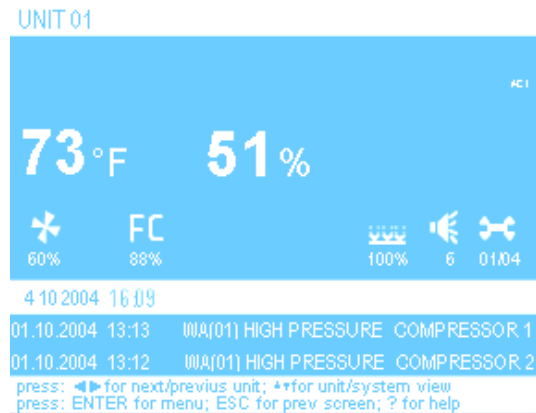
## Status Display

The unit display will show the unit operational mode(s), return air temperature/humidity readings and if active present alarm conditions. The end user can select from two (2) display types, graphical or simple.

System View Screen Graphic



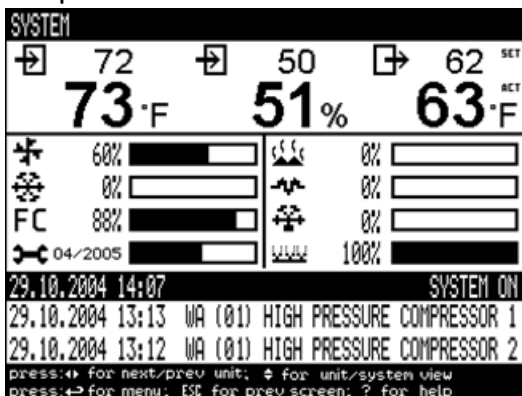
Unit View Screen Simple



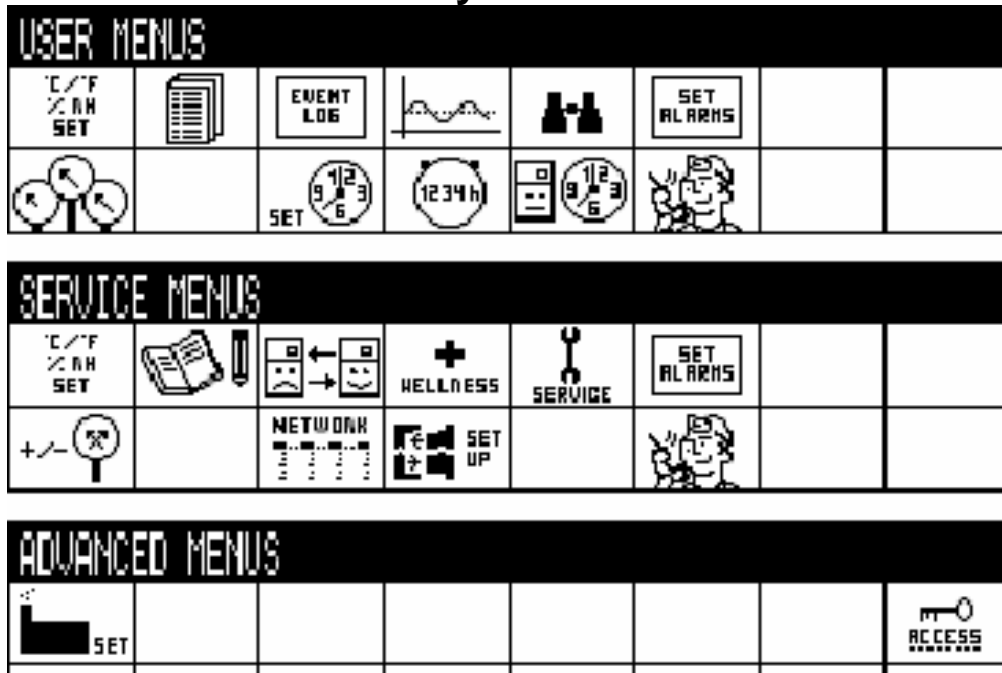
The **Large and Small Display's** have the ability to present information in two formats; the **Graphic** format will show the set points and/or the actual values of the return air temperature and humidity readings. The operational functions of the components are displayed with an icon and a bar graph to indicate to amount of the required function. The bottom of the screen will indicate date, time, on/off status and events. The message area below will provide additional information and provide some basic navigation help. The **Simple** format will reduce the amount of graphics displayed and offers a not so busy display of the same information. The displays will provide the **System** and **Unit** views

The end user can also select from dark background with white text or light background with dark text.

Graphic Screen with reversed Contrast




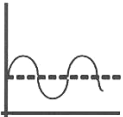
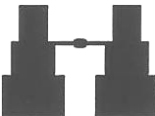



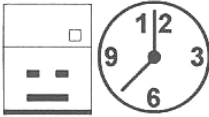

## Menu Screens ICON Symbols



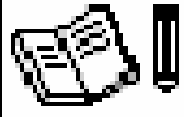
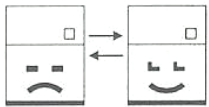





## Menu Parameters Names

|    | Level 1: User                                   | Level 2: Service                                | Level 3: Advanced                 |
|----|---|---|-----------------------------------|
|    | Readable w/o password<br>PW required to program | Readable w/o password<br>PW required to program | PW required to read<br>or program |
| 1  | Setpoints                                       | Setpoints                                       | Factory Settings                  |
| 2  | Spare Parts List                                | Unit Diary                                      |                                   |
| 3  | Events Log/ Status Report                       | Standby Settings/ Lead-Lag                      |                                   |
| 4  | Graphics  | Maintenance/ Wellness Settings                  |                                   |
| 5  | View Network                                    | Diagnostics/ Service Mode                       |                                   |
| 6  | Set Alarms                                      | Set Alarms                                      |                                   |
| 7  |   |   |                                   |
| 8  |   |   | Change Passwords                  |
| 9  | Various Sensors                                 | Sensor Calibration/ Sewtup                      |                                   |
| 10 |   |   |                                   |
| 11 | Display Setup                                   | System/ Network Setup                           |                                   |
| 12 | Total Run Hours                                 | Options Setup                                   |                                   |



## User Menu Icons and Descriptions:

| Icon  | Name                | Descriptions  | Available Display |
|---|---------------------|---|-------------------|
| °C/ °F<br>% RH<br>SET   | Set Points          | To view and change temperature and humidity set points                                | Small and Large   |
|    | Spare Parts List    | Displays the spare parts list of the unit   | Large             |
| EVENT LOG   | Event Log           | Contains a log of the last 400 events   | Small and Large   |
|    | Graphic Data Record | Displays the temperature and humidity graphs  | Small and Large   |
|    | View Network        | Shows the status of all connected units   | Large             |
| SET ALARMS  | Set Alarms          | Allows the enabling, disabling and setting of the alarm parameters                    | Small and Large   |
|  | Sensor Data         | Shows readings for the standard and optional sensors                                  | Small and Large   |
|  | Display Setup       | Change the settings for display, language, time and simple or graphic display         | Small and Large   |
|  | Total Run Hours     | Records the run time of all components and allows for setting the limits on run time  | Small and Large   |
|  | Sleep Mode          | Allows for setback programming for non-peak operation                                 | Small and Large   |
|  | Service Contacts    | Contains key contact information for local service, including names and phone numbers | Large             |

## Service Menu Icons and Descriptions:

| Icon   | Name                           | Descriptions  | Available Display |
|--|--------------------------------|---|-------------------|
| °C/ °F<br>% RH<br>SET  | Set Points                     | To view and change temperature and humidity set points  | Small and Large   |
|               | Unit Diary                     | Is a notepad containing notes from the service person or customer   | Large             |
|               | Standby Settings               | Programs lead/ lag setup when multiple units are connected together   | Small and Large   |
| +<br>WELLNESS  | Maintenance/ Wellness Settings | Allows programming of the maintenance interval reminder, maintenance messages, number of unit starts and stops, time since last maintenance | Small and Large   |
| <br>SERVICE  | Diagnostic/ Service Mode       | Allows for troubleshooting, manual mode and viewing of the analog and digital inputs  | Small and Large   |
| SET<br>ALARMS  | Set Alarms                     | Allows the enabling, disabling and setting of the alarm parameters  | Small and Large   |
|             | Sensor Calibration/ Setup      | Allows for the calibration of the various sensors   | Small and Large   |
| NETWORK<br> | System/ Network Setup          | Allows for setup and unit-2-unit communication for multiple units   | Large             |
|             | Options Setup                  | Allows for the setup of component operation   | Small and Large   |
|             | Service Contacts               | Contains key contact information for local service, including names and phone numbers   | Small and Large   |

## Advanced Menu Icons and Descriptions:

| Icon  | Name             | Descriptions   | Available Display |
|---|------------------|--|-------------------|
|  | Factory Settings | Factory configuration files. <b>Do Not Change Settings Consult the Factory First</b> | Small and Large   |
|   |                  |  |                   |
|  | Change Passwords | Allows the user to change the various passwords                                      | Small and Large   |

## Menu Parameters

All of the various parameters and program ranges are shown in tables located in this chapter. The following sections highlight the various parameters and programs in the iCOM control.

### User Menu Parameters

The User menu displays the various unit operating values and status icons. The factory default password to access the user menu items for programming is "149". The User Menu selections include the following choices in the order shown:

- Set Point Parameters
- Spare Part List
- Event Log
- Graphics Log Parameters
- View Network Parameters
- Set Alarm Parameters
- Sensor Parameters
- Active Alarms
- Display Setup Parameters
- Total Run Hours
- Sleep Mode Timer Parameters
- Service Contacts Information

**User Menu: Set Point Parameters U100 series**

| Menu Line | Parameter               | Default  | Range               |
|-----------|-------------------------|----------|---------------------|
| U101      | Password                | -        | -                   |
| U102      | Temperature Setpoint    | 73°F     | 41 - 104°F          |
| U103      | Humidity Setpoint       | 50%      | 1 – 80%             |
| U104      | Humidity Control Type   | Yes      | Yes or No           |
| U105      | Supply Limit            | Disabled | Disabled or Enabled |
| U106      | Supply Limit Temp Value | 41°F     | 41 - 77°F           |
| U107      |                         |          |                     |
| U108      |                         |          |                     |
| U109      |                         |          |                     |
| U110      |                         |          |                     |
| U111      |                         |          |                     |

**User Menu: Spare Parts List, Large Display Only**

| Parameter             |
|-----------------------|
| Unit spare parts list |

**User Menu: Event Log**

| Parameter  |
|--|
| Stores the last 400 events (messages, warnings and alarms a that have occurred |

**User Menu: Graphics Parameters**

| <b>Parameter</b>                | <b>Default</b> | <b>Range</b>  |
|---------------------------------|----------------|---|
| System Temperature Time Scale   | 24 Hours       | 8, 32 min or 1, 12, 24 hours<br>or 2, 4, 8, 16 days |
| System Temperature Graph Height | 9°F            | ±36°F   |
| System Humidity Time Scale      | 24 Hours       | 8, 32 min or 1, 12, 24 hours<br>or 2, 4, 8, 16 days |
| System Humidity Graph Height    | 10%            | ±20%  |
| Unit Temperature Time Scale     | 24 Hours       | 8, 32 min or 1, 12, 24 hours<br>or 2, 4, 8, 16 days |
| Unit Temperature Graph Height   | 9°F            | ±36°F   |
| Unit Humidity Time Scale        | 24 Hours       | 8, 32 min or 1, 12, 24 hours<br>or 2, 4, 8, 16 days |
| Unit humidity Graph Height      | 10%            | ±20%  |

**User Menu: View Network Parameters**

| <b>Parameter</b>  |
|---|
| User to select and view status of all units connected together (only Large Display) |

**User Menu: Set Alarm Parameters U200 series**

| Menu Line | Parameter                 | Default  | Range               |
|-----------|---------------------------|----------|---------------------|
| U201      | Password                  | -        | -                   |
| U202      | Return Sensor Alarms      | Enabled  | Enabled or Disabled |
| U203      | High Return Temperature   | 80°F     | 33 - 210°F          |
| U204      | Low Return Temperature    | 60°F     | 33 - 210°F          |
| U205      | High Return Humidity      | 60%      | 1 – 99%             |
| U206      | Low Return Humidity       | 40%      | 1 – 99%             |
| U207      | Sensor A Alarms           | Disabled | Disabled or Enabled |
| U208      | High Temperature Sensor A | 90°F     | 33 - 210°F          |
| U209      | Low Temperature Sensor A  | 55°F     | 33 - 210°F          |
| U210      | High Humidity Sensor A    | 70%      | 1 - 99%             |
| U211      | Low Humidity Sensor A     | 30%      | 1 - 99%             |

**User Menu: Sensor Data U300 series: Page 1 of 2**

| Menu Line | Parameter                     | Range          |
|-----------|-------------------------------|----------------|
| U301      | Actual Temperature Setpoint   | 41 – 104°F     |
| U302      | Actual Humidity Setpoint      | 20 – 80%       |
| U303      | Optional Sensor A Temperature | 32 - 122°F     |
| U304      | Optional Sensor A Humidity    | 20 – 80%       |
| U305      | Optional Sensor B Temperature | 32 - 122°F     |
| U306      | Optional Sensor B Humidity    | 20 – 80%       |
| U307      | Optional Sensor C Temperature | 32 - 122°F     |
| U308      | Optional Sensor C Humidity    | 20 – 80%       |
| U309      | Freecooling Fluid Temperature | 4 - 113°F      |
| U310      | DigiScroll 1 Temperature      | 84 - 313°F     |
| U311      | DigiScroll 2 Temperature      | 84 - 313°F     |
| U312      | Freecooling Status            | Off, Start, On |



**User Menu: Sensor Data U300 series: Page 1 of 2**

| Menu Line | Parameter              | Time/ Value |
|-----------|------------------------|-------------|
| U313      | Daily High Temperature |             |
| U314      | Daily Low Temperature  |             |
| U315      | Daily High Humidity    |             |
| U316      | Daily Low Humidity     |             |

**User Menu: Active Alarms Parameters**

| Parameter   |
|---|
| User to view all active alarms of all units connected together (only Large Display) |

**User Menu: Display Setup Parameters U400 series**

| Menu Line | Parameter                  | Default      | Range                                  |
|-----------|----------------------------|--------------|--|
| U401      | Language                   | English      | English . . .                          |
| U402      | Date (Month/Day/Year)      | MM/ DD/ YYYY | MM/ DD/ YYYY                           |
| U403      | Time (Hrs:Min:Sec)         | -            | HH/ MM/ SS                             |
| U404      | Temperature Indication     | °F           | °F/ °C                                 |
| U405      | Display Contrast           | 80%          | 0 – 100%                               |
| U406      | Buzzer Frequency           | On at 80%    | On, Off, 0 – 100%                      |
| U407      | Backlite Off After x Hours | 5 minute     | 5 min – 12 hours                       |
| U408      | Screen                     | Simple       | Simple or Graphical                    |
| U409      | Display Shows              | Set + Act    | Set + Act, Set, Act                    |
| U410      | Display Colors             | Normal       | Normal or Inverted                     |
| U411      | Date Format                | dd.mm.yyyy   | yyyy-mm-dd<br>dd.mm.yyyy<br>mm/dd/yyyy |

**User Menu: Total Run Hours Parameters U500 series**

| Menu Line | Parameter                | Range (Hours) |
|-----------|--------------------------|---------------|
| U501      | -                        | Actual        |
| U502      | Fan motor(s)             | 0 - 32000     |
| U503      | Compressor 1             | 0 - 32000     |
| U504      | Compressor 2             | 0 - 32000     |
| U505      | Chilled Water/ Free Cool | 0 - 32000     |
| U506      | Hot Gas / Hot Water      | 0 - 32000     |
| U507      | Electrical Heater 1      | 0 - 32000     |
| U508      | Electrical Heater 2      | 0 - 32000     |
| U509      | Electrical Heater 3      | 0 - 32000     |
| U510      | Humidifier               | 0 - 32000     |
| U511      | Dehumidification         | 0 - 32000     |

**User Menu: Sleep Mode Parameters U600 series**

| Menu Line | Parameter                         | Default       | Range             |
|-----------|-----------------------------------|---------------|-------------------|
| U601      | Password                          | -             | -                 |
| U602      | Sleep On                          | -             | -                 |
| U603      | Mon, Tue, Wed, Thu, Fri, Sat, Sun | No            | No or Yes         |
| U604      | Sleep Every Day (1)               | -             | -                 |
| U605      | From / To                         | 00:00 / 00:00 | Time (hh:mm)      |
| U606      | Sleep Every Day (2)               | -             | -                 |
| U607      | From / To                         | 00:00 / 00:00 | Time (hh:mm)      |
| U608      |                                   |               |                   |
| U609      | Timer Mode                        | No            | No, Yes, Auto     |
| U610      | Timer Mode Type                   | System Off    | Sys off, Deadband |
| U611      | Dead Band                         | 4°F           | 4 - 27°F          |

**User Menu: Service Contacts U700 series**

| <b>Menu Line</b> | <b>Parameter</b> | <b>Range</b> |
|------------------|------------------|--------------|
| U701             |                  |              |
| U702             |                  |              |
| U703             | Address Line 1   | Text String  |
| U704             | Address Line 2   | Text String  |
| U705             | Address Line 3   | Text String  |
| U706             | Address Line 4   | Text String  |

## Service Menu Parameters

The Service menu display allows the user to customize the various unit settings for site specific operation. The factory default password to access the service menu items for programming is “501”. The Service Menu selections include the following choices in the order shown:

- Set Point Parameters
- Unit Diary
- Standby Settings Parameters
- Maintenance / Wellness Setting Parameters
- Diagnostic / Service Mode Parameters
- Set Alarm Parameters
- Sensor Calibration / Setup Parameters
- System / Network Setup Parameters
- Operations Setup Parameters
- Service Contacts Parameters

### Service Menu: Set Point Parameters S100 series: Page 1 of 2

| Menu Line | Parameter                     | Default  | Range               |
|-----------|-------------------------------|----------|---------------------|
| S101      | Password                      | -        | -                   |
| S102      | Temperature Setpoint          | 73°F     | 41 - 104°F          |
| S103      | Humidity Setpoint             | 50%      | 1 – 80%             |
| S104      | Humidity Control Type         | Yes      | Yes or No           |
| S105      | Supply Limit                  | Disabled | Disabled or Enabled |
| S106      | Supply Limit Temp Value       | 41°F     | 41 - 77°F           |
| S107      | Autoset Enable                | Yes      | Yes or No           |
| S108      | Temperature Proportional Band | 7°F      | 2 - 54°F            |
| S109      | Temperature Integration Time  | 0        | 0 – 5 minutes       |
| S110      | Temperature Deadband          | 0        | 0 - 36°F            |
| S111      | Short Cycle Control           | Yes      | Yes or No           |

**Service Menu: Set Point Parameters S100 series: Page 2 of 2**

| <b>Menu Line</b> | <b>Parameter</b>               | <b>Default</b> | <b>Range</b>            |
|------------------|--------------------------------|----------------|-------------------------|
| S112             | Password                       | -              | -                       |
| S113             | Humidity Proportional Band     | 10%            | 1 – 20%                 |
| S114             | Humidity Integration Time      | 0              | 0 – 5 minutes           |
| S115             | Humidity Deadband              | 0              | 0 – 50%                 |
| S116             | DT Between Room / FC Type      | Disable        | Disable, Contact, Value |
| S117             | DT Between Room Air / FC Fluid | 8°F            | 0 - 36°F                |
| S118             | Minimum CW Temp                | Disable        | Enable / Disable        |
| S119             | Minimum CW Temp Value          | 45°F           | 32 - 68°F               |
| S120             |                                |                |                         |
| S121             |                                |                |                         |
| S122             |                                |                |                         |

**Service Menu: Unit Diary Log**

| <b>Parameter</b>  |
|---|
| Displays changes to the unit as performed and entered by the service person or customer |

**Service Menu: Standby Setting / Lead-lag Parameters S500 series**

| Menu Line | Parameter                     | Default | Range                                  |
|-----------|-------------------------------|---------|--|
| S501      | Password                      | -       | -                                      |
| S502      | Number of Standby Units       | 0       | 0 – 15                                 |
| S503      | Rotation Frequency            | No      | No, Daily, Every M, T, W, Th, F, S, Su |
| S504      | Rotate at (hour)              | 0       | 0 – 23                                 |
| S505      | Rotate at (minute)            | 0       | 0 – 59                                 |
| S506      | Rotate by                     | 1       | 1 – 8                                  |
| S507      | Perform one rotation          | -       | No or Yes                              |
| S508      | Cascade units                 | No      | No, Yes, Cool, Temp                    |
| S509      | Start All Standby Units by HT | No      | No or Yes                              |
| S510      |                               |         |  |
| S511      |                               |         |  |

**Service Menu: General Settings Maintenance / Wellness Parameters S000 series: Page 1 of 8**

| Menu Line | Parameter                      | Default | Range           |
|-----------|--------------------------------|---------|-----------------|
| S001      | Password                       | -       | -               |
| S002      | Maintenance Frequency Per Year | 1       | 0 – 12 per year |
| S003      | Max Bonus                      | 0       | 0 – 12          |
| S004      | Max Penalty                    | 0       | 0 – 12          |
| S005      | Last Maintenance               | -       | Date            |
| S006      | Service Engineer               | -       | Name            |
| S007      | Confirm PM                     | -       | No or Yes       |
| S008      | Calculated Next Maintenance    | -       | Date            |

**Service Menu: Fan Settings Maintenance / Wellness Parameters: Page 2 of 8**

| <b>Menu Line</b> | <b>Parameter</b>       | <b>Default</b> | <b>Range</b>    |
|------------------|------------------------|----------------|-----------------|
| S012             | Password               | -              | -               |
| S013             | Number of Starts       | -              | 0 – 32000       |
| S014             | Run Hours              | -              | 0 – 32000       |
| S015             | Average Working Time   | -              | 0 – 999 minutes |
| S016             | Starts per Day Optimum | 1              | 1 – 240         |
| S017             | Starts per Day Worst   | 24             | 1 – 240         |
| S018             | Number of Alarms       | -              | 0 – 32000       |
| S019             | Actual Bonus           | -              | 0 - 12          |

**Service Menu: Compressor 1 Settings Maintenance / Wellness Parameters:  
Page 3 of 8**

| <b>Menu Line</b> | <b>Parameter</b>       | <b>Default</b> | <b>Range</b>    |
|------------------|------------------------|----------------|-----------------|
| S023             | Password               | -              | -               |
| S024             | Number of Starts       | -              | 0 – 32000       |
| S025             | Run Hours              | -              | 0 – 32000       |
| S026             | Average Working Time   | -              | 0 – 999 minutes |
| S027             | Starts per Day Optimum | 12             | 1 – 240         |
| S028             | Starts per Day Worst   | 240            | 1 – 240         |
| S029             | Number of HP Alarms    | -              | 0 – 32000       |
| S030             | Number of LP Alarms    | -              | 0 – 32000       |
| S031             | Number of OL Alarms    | -              | 0 – 32000       |
| S032             | Number of DS HT Alarms | -              | 0 - 32000       |
| S033             | Actual Bonus           | -              | 0 - 12          |

**Service Menu: Compressor 2 Settings Maintenance / Wellness Parameters:  
Page 4 of 8**

| Menu Line | Parameter              | Default | Range           |
|-----------|------------------------|---------|-----------------|
| S034      | Password               | -       | -               |
| S035      | Number of Starts       | -       | 0 – 32000       |
| S036      | Run Hours              | -       | 0 – 32000       |
| S037      | Average Working Time   | -       | 0 – 999 minutes |
| S038      | Starts per Day Optimum | 12      | 1 – 240         |
| S039      | Starts per Day Worst   | 240     | 1 – 240         |
| S040      | Number of HP Alarms    | -       | 0 – 32000       |
| S041      | Number of LP Alarms    | -       | 0 – 32000       |
| S042      | Number of OL Alarms    | -       | 0 – 32000       |
| S043      | Number of DS HT Alarms | -       | 0 - 32000       |
| S044      | Actual Bonus           | -       | 0 - 12          |

**Service Menu: Electric Heater 1 Settings Maintenance / Wellness  
Parameters: Page 5 of 8**

| Menu Line | Parameter              | Default | Range           |
|-----------|------------------------|---------|-----------------|
| S045      | Password               | -       | -               |
| S046      | Number of Starts       | -       | 0 – 32000       |
| S047      | Run Hours              | -       | 0 – 32000       |
| S048      | Average Run Time       | -       | 0 – 999 minutes |
| S049      | Starts per Day Optimum | 24      | 1 – 240         |
| S050      | Starts per Day Worst   | 240     | 1 – 240         |
| S051      | Number of Alarms       | -       | 0 – 32000       |
| S052      | Actual Bonus           | -       | 0 - 12          |



**Service Menu: Electric Heater 2 Settings Maintenance / Wellness  
Parameters: Page 6 of 8**

| <b>Menu Line</b> | <b>Parameter</b>       | <b>Default</b> | <b>Range</b>    |
|------------------|------------------------|----------------|-----------------|
| S056             | Password               | -              | -               |
| S057             | Number of Starts       | -              | 0 – 32000       |
| S058             | Run Hours              | -              | 0 – 32000       |
| S059             | Average Run Time       | -              | 0 – 999 minutes |
| S060             | Starts per Day Optimum | 24             | 1 – 240         |
| S061             | Starts per Day Worst   | 240            | 1 – 240         |
| S062             | Number of Alarms       | -              | 0 – 32000       |
| S063             | Actual Bonus           | -              | 0 - 12          |

**Service Menu: Electric Heater 3 Settings Maintenance / Wellness  
Parameters: Page 7 of 8**

| <b>Menu Line</b> | <b>Parameter</b>       | <b>Default</b> | <b>Range</b>    |
|------------------|------------------------|----------------|-----------------|
| S067             | Password               | -              | -               |
| S068             | Number of Starts       | -              | 0 – 32000       |
| S069             | Run Hours              | -              | 0 – 32000       |
| S070             | Average Run Time       | -              | 0 – 999 minutes |
| S071             | Starts per Day Optimum | 24             | 1 – 240         |
| S072             | Starts per Day Worst   | 240            | 1 – 240         |
| S073             | Number of Alarms       | -              | 0 – 32000       |
| S074             | Actual Bonus           | -              | 0 - 12          |

**Service Menu: Humidifier Settings Maintenance / Wellness Parameters:  
Page 8 of 8**

| Menu Line | Parameter              | Default | Range           |
|-----------|------------------------|---------|-----------------|
| S078      | Password               | -       | -               |
| S079      | Number of Starts       | -       | 0 – 32000       |
| S080      | Run Hours              | -       | 0 – 32000       |
| S081      | Average Run Time       | -       | 0 – 999 minutes |
| S082      | Starts per Day Optimum | 24      | 1 – 240         |
| S083      | Starts per Day Worst   | 240     | 1 – 240         |
| S084      | Number of Alarms       | -       | 0 – 32000       |
| S085      | Actual Bonus           | -       | 0 - 12          |

**Service Menu: Diagnostics / Service Mode S300 series: Page 1 of 5**

| Menu Line | Parameter               | Range     |
|-----------|-------------------------|-----------|
| S301      | Password                | -         |
| S302      | Manual Mode             | Yes or No |
| S303      | Motor(s)                | Off or On |
| S304      | Compressor 1            | Off or On |
| S305      | Compressor 1 Capacity   | Off or On |
| S306      | Compressor 1 Cycle Ramp | 0-100%    |
| S307      | Compressor 1 LLSV       | Off or On |
| S308      | Compressor 2            |           |
| S309      | Compressor 2 Capacity   | Off or On |
| S310      | Compressor 2 Cycle Ramp | 0 – 100%  |
| S311      | Compressor 2 LLSV       |           |

**Service Menu: Diagnostics / Service Mode: Page 2 of 5**

| <b>Menu Line</b> | <b>Parameter</b>           | <b>Range</b> |
|------------------|----------------------------|--------------|
| S312             | Password                   | -            |
| S313             | HP 1 Alarm Counter         | 0            |
| S314             | HP 2 Alarm Counter         | 0            |
| S315             | HT 1 Alarm Counter         | 0            |
| S316             | HT 2 Alarm Counter         | 0            |
| S317             |                            |              |
| S318             |                            |              |
| S319             |                            |              |
| S320             | Electric Heat 1(or HG/ HW) | Off or On    |
| S321             | Heat 2 (or E.Heat 1)       | Off or On    |
| S322             | Heat 3 (or E.Heat 2)       | Off or On    |

**Service Menu: Diagnostics / Service Mode: Page 3 of 5**

| <b>Menu Line</b> | <b>Parameter</b>  | <b>Range</b> |
|------------------|-------------------|--------------|
| S323             | Password          | -            |
| S324             | Humidifier Fill   | Off or On    |
| S325             | Humidifier        | Off or On    |
| S326             | Alarm Relay       | Off or On    |
| S327             | FC Relay          | Off or On    |
| S328             | 3P Actuator Open  | Off or On    |
| S329             | 3P Actuator Close | Off or On    |
| S330             | Analog Out 1      | 0 – 100%     |
| S331             | Analog Out 2      | 0 – 100%     |
| S332             | Analog Out 3      | 0 – 100%     |
| S333             | Analog Out 4      | 0 – 100%     |

**Service Menu: Diagnostics / Service Mode: Page 4 of 5**

| <b>Menu Line</b> | <b>Parameter</b>        | <b>Range</b> |
|------------------|-------------------------|--------------|
| S334             | Password                | -            |
| S335             | Status Remote Shutdown  | Off or On    |
| S336             | Status Airflow Loss     | OK or Active |
| S337             | Status Motor Overload   | OK or Active |
| S338             | Status Filter           | OK or Active |
| S339             | Status Customer Input 1 | OK or Active |
| S340             | Status Customer Input 2 | OK or Active |
| S341             | Status Customer Input 3 | OK or Active |
| S342             | Status Customer Input 4 | OK or Active |

**Service Menu: Diagnostics / Service Mode: Page 5 of 5**

| <b>Menu Line</b> | <b>Parameter</b>          | <b>Range</b> |
|------------------|---------------------------|--------------|
| S345             | Password                  | -            |
| S346             | Status HP1                | OK or Active |
| S347             | Status LP1                | OK or Active |
| S348             | Status C1 OL              | OK or Active |
| S349             | Status HP2                | OK or Active |
| S350             | Status LP2                | OK or Active |
| S351             | Status C2 OL              | OK or Active |
| S352             | Status Humidifier Problem | OK or Active |
| S353             | Status DT2                | Off or On    |
| S354             | Status Min CW             | Off or On    |
| S355             |                           |              |

**Service Menu: Set Alarm Parameters S200 series: Page 1 of 6**

| Menu Line | Parameter                 | Default  | Range               |
|-----------|---------------------------|----------|---------------------|
| S201      | Password                  | -        | -                   |
| S202      | Return Sensor Alarms      | Enabled  | Disabled or Enabled |
| S203      | High Return Temperature   | 80°F     | 34 - 210°F          |
| S204      | Low Return Temperature    | 65°F     | 34 - 210°F          |
| S205      | High Return Humidity      | 60%      | 1 – 99%             |
| S206      | Low Return Humidity       | 40%      | 1 – 99%             |
| S207      | Sensor A Alarms           | Disabled | Disabled or Enabled |
| S208      | High Temperature Sensor A | 90°F     | 34 - 210°F          |
| S209      | Low Temperature Sensor A  | 55°F     | 34 - 210°F          |
| S210      | High Humidity Sensor A    | 70%      | 1 – 99%             |
| S211      | Low Humidity Sensor A     | 30%      | 1 – 99%             |

**Service Menu: Set Alarm Parameters: Page 2 of 6**

| Menu Line | Parameter                     | Default     | Range          |
|-----------|-------------------------------|-------------|----------------|
| S212      | Password                      | -           | -              |
| S213      | Customer Input 1              | Water alarm | See note       |
| S214      | Customer Input 1 Active When  | Closed      | Open or Closed |
| S215      | Customer Input 2              | Water alarm | See note       |
| S216      | Customer Input 2 Active When  | Closed      | Open or Closed |
| S217      | Customer Input 3              | Water alarm | See note       |
| S218      | Customer Input 3 Active When  | Closed      | Open or Closed |
| S219      | Customer Input 4              | Water alarm | See note       |
| S220      | Customer Input 4 Active When  | Closed      | Open or Closed |
| S221      | Warning Activates Alarm Relay | Yes         | Yes or No      |
| S222      | Reset Disabled Alarms         | No          | Yes or No      |

**Note:** Customer Inputs 1, 2, 3 and 4 messages may be selected from Smoke Detected, Water Alarm, Condensate Pump Alarm, Flow Alarm, Standby Pump, Standby Unit.

**Service Menu: Set Alarm Parameters: Page 3 of 6**

| Menu Line | Parameter             |        |        |         |
|-----------|-----------------------|--------|--------|---------|
| S223      | Password              |        |        |         |
| S224      |                       | DELAY  | EN-DIS | TYPE    |
| S225      | Main Fan Overload     | 10 Sec | En     | Alarm   |
| S226      | Loss of Airflow       | 10 Sec | En     | Alarm   |
| S227      | Clogged Filters       | 60 Sec | En     | Warning |
| S228      | High Room Temperature | 10 Sec | En     | Warning |
| S229      | Low Room Temperature  | 10 Sec | En     | Warning |
| S230      | High Room Humidity    | 10 Sec | En     | Warning |
| S231      | Low Room Humidity     | 10 Sec | En     | Warning |
| S232      | High Temp Sensor A    | 10 Sec | En     | Warning |
| S233      | Low Temp Sensor A     | 10 Sec | En     | Warning |
| S234      | High Humid Sensor A   | 10 Sec | En     | Warning |
| S235      | Low Humid Sensor A    | 10 Sec | En     | Warning |

**Service Menu: Set Alarm Parameters: Page 4 of 6**

| Menu Line | Parameter             |        |        |       |
|-----------|-----------------------|--------|--------|-------|
| S236      | Password              |        |        |       |
| S237      |                       | DELAY  | EN-DIS | TYPE  |
| S238      | Comp 1 Overload       | 10 Sec | En     | Alarm |
| S239      | Comp 2 Overload       | 10 Sec | En     | Alarm |
| S240      | Comp 1 High Pressure  | -      | En     | Alarm |
| S241      | Comp 1 High Pressure  | -      | En     | Alarm |
| S242      | Comp 1 Low Pressure   | -      | En     | Alarm |
| S243      | Comp 2 Low Pressure   | -      | En     | Alarm |
| S244      | Comp 1 Pumpdown Fail  | -      | En     | Alarm |
| S245      | Comp 2 Pumpdown Fail  | -      | En     | Alarm |
| S246      | Dig Scroll1 High Temp | -      | En     | Alarm |
| S247      | Dig Scroll2 High Temp |        |        | Alarm |

**Service Menu: Set Alarm Parameters: Page 5 of 6**

| Menu Line | Parameter               |        |            |
|-----------|-------------------------|--------|------------|
| S249      | Password                |        |            |
| S250      | DELAY                   | EN-DIS | TYPE       |
| S251      | Working Hours Exceeded  | -      | En Warning |
| S252      | Smoke Detected          | 5 Sec  | En Alarm   |
| S253      | Water Under Floor       | 5 Sec  | En Alarm   |
| S254      | Cond Pump-High Water    | 5 Sec  | En Alarm   |
| S255      | Loss of Flow            | 5 Sec  | En Alarm   |
| S256      | Standby Glycol Pump On  | 5 Sec  | En Alarm   |
| S257      | Standby Unit On         | 5 Sec  | En Alarm   |
| S258      | Humidifier Problem      | 5 Sec  | En Alarm   |
| S259      | No Connection w/ Unit 1 | -      | En Alarm   |
| S260      | Unit X Disconnected     | -      | En Alarm   |

**Service Menu: Set Alarm Parameters: Page 6 of 6**

| Menu Line | Parameter              |        |            |
|-----------|------------------------|--------|------------|
| S262      | Password               |        |            |
| S263      | DELAY                  | EN-DIS | TYPE       |
| S264      | Customer Input 1       | 5 Sec  | En Alarm   |
| S265      | Customer Input 2       | 5 Sec  | En Alarm   |
| S266      | Customer Input 3       | 5 Sec  | En Alarm   |
| S267      | Customer Input 4       | 5 Sec  | En Alarm   |
| S268      | Call Service           | 5 Sec  | En Message |
| S269      | High Temperature       | 5 Sec  | En Message |
| S270      | Loss of Air Blower 1   | 5 Sec  | En Alarm   |
| S271      | Reheat Lockout         | 5 Sec  | En Message |
| S272      | Humidifier Lockout     | 5 Sec  | En Message |
| S273      | Humid + Reheat Lockout | 5 Sec  | En Message |
| S274      | Compressor(s) Lockout  | 5 Sec  | En Message |

**Service Menu: Sensor Calibration/ Setup Parameters S600 series:  
Page 1 of 3**

| Menu Line | Parameter                       | Range      |
|-----------|---------------------------------|------------|
| S601      | Password                        | -          |
| S602      | Return temperature              | ±17°F      |
| S603      | Calibrated return temperature   | 32 - 122°F |
| S604      | Return humidity                 | ±9.9%      |
| S605      | Calibrated return humidity      | 20 – 80%   |
| S606      | Digital Scroll 1 NTC            | ±17°F      |
| S607      | Calibrated digital scroll 1 NTC | 84 – 313°F |
| S608      | Digital Scroll 2 NTC            | ±17°F      |
| S609      | Calibrated digital scroll 2 NTC | 84 - 313°F |

**Service Menu: Sensor Calibration/ Setup Parameters: Page 2 of 3**

| Menu Line | Parameter                       | Range      |
|-----------|---------------------------------|------------|
| S612      | Password                        | -          |
| S613      | Temperature sensor A            | ±17°F      |
| S614      | Calibrated temperature sensor A | 32 - 122°F |
| S615      | Humidity sensor A               | ±9.9%      |
| S616      | Calibrated humidity sensor A    | 20 – 80%   |
| S617      | Temperature sensor B            | ±17°F      |
| S618      | Calibrated temperature sensor B | 32 - 122°F |
| S619      | Humidity sensor B               | ±9.9%      |
| S620      | Calibrated humidity sensor B    | 20 – 80%   |



**Service Menu: Sensor Calibration/ Setup Parameters: Page 3 of 3**

| Menu Line | Parameter                       | Default | Range      |
|-----------|---------------------------------|---------|------------|
| S623      | Password                        |         | -          |
| S624      | Glycol sensor PTC or NTC        | NTC     | NTC or PTC |
| S625      | Glycol sensor                   | -       | ±17°F      |
| S626      | Calibrated glycol sensor        | -       | 4 – 113°F  |
| S627      | Supply sensor PTC or NTC        | NTC     | NTC or PTC |
| S628      | Supply sensor                   | -       | ±17°F      |
| S629      | Calibrated supply sensor        | -       | 32 - 122°F |
| S630      | Temperature sensor C            | -       | ±17°F      |
| S631      | Calibrated temperature sensor C | -       | 32 - 122°F |
| S632      | Humidity sensor C               | -       | ±9.9%      |
| S633      | Calibrated humidity sensor C    | -       | 20 – 80%   |

**Service Menu: System / Network Setup Parameters Series S800:  
Page 1 of 2, System View**

| Menu Line | Function                  | Default | Range          |
|-----------|---------------------------|---------|----------------|
| S801      | Password                  | -       | -              |
| S802      | Number of connected units | -       | 1 – 16         |
| S803      | Teamwork mode             | No      | No, 1, 2       |
| S804      |                           |         |                |
| S805      | U2U group                 | -       | 1 - 99         |
| S806      |                           |         |                |
| S807      |                           |         |                |
| S808      |                           |         |                |
| S809      | Configuration Safe Status | No      | No, Save, Load |
| S810      | Network Safe Status       | -       | No, Save, Load |
| S811      | SW version:               | -       |                |

**Service Menu: System / Network Setup Parameters Series S800:**  
**Page 2 of 2, System View**

| Menu Line | Function                     | Default | Range             |
|-----------|------------------------------|---------|-------------------|
| S812      | Password                     | -       | -                 |
| S813      | IP Address                   | -       | IP Address        |
| S814      | Netmask                      | -       | Netmask Range     |
| S815      | Gateway                      | -       | Gateway Range     |
| S816      | MAC                          | -       | MAC Range         |
| S817      | U2U Protocol                 | -       | -                 |
| S818      | U2U Address                  | -       | 33 - 64           |
| S819      |                              | -       | -                 |
| S820      |                              | -       |                   |
| S821      | Bootloader Variables Status  | -       | Changed, Updating |
| S822      | Bootloader Variables Control | -       | No, Save + Reboot |

**Service Menu: System / Network Setup Parameters Series S800:**  
**Page 1 of 2, Unit View**

| Menu Line | Function                  | Default | Range          |
|-----------|---------------------------|---------|----------------|
| S823      | Password                  | -       |                |
| S824      | Monitoring Address        | 3       |                |
| S825      |                           |         |                |
| S826      | U2U Group                 |         | 1 – 99         |
| S827      | Unit Name                 | Unit    | 6 Digits       |
| S828      |                           |         |                |
| S829      |                           |         |                |
| S830      |                           |         |                |
| S831      | Configuration Safe Status | No      | No, Save, Load |
| S832      | Network Safe Status       | No      | No, Save, Load |
| S833      | SW version:               | -       |                |

**Service Menu: System / Network Setup Parameters Series S800:**

Page 2 of 2, Unit View

| Menu Line | Function                     | Default | Range             |
|-----------|------------------------------|---------|-------------------|
| S834      | Password                     | -       |                   |
| S835      | Monitoring Protocol          | -       | -                 |
| S836      | IP Address                   | -       | IP Range          |
| S837      | Netmask                      | -       | Netmask Range     |
| S838      | Gateway                      | -       | Gateway Range     |
| S839      | MAC                          | -       | MAC Range         |
| S840      | U2U Protocol                 | -       | 33 - 64           |
| S841      | U2U Address                  | -       | -                 |
| S842      |                              | -       |                   |
| S843      | Bootloader Variables Status  | -       | Changed, Updating |
| S844      | Bootloader Variables Control | -       | No, Save + Reboot |

**Service Menu: Option Setup Parameters S400 series: Page 1 of 2**

| Menu Line | Function                 | Default     | Range                |
|-----------|--------------------------|-------------|----------------------|
| S401      | Password                 | -           | -                    |
| S402      | Compressor Sequence      | Auto        | 1, 2, Auto           |
| S403      | Low Pressure Delay (WSK) | 3           | 0 – 5 Minutes        |
| S404      | Actual LP1 Pressure      | -           | 14.5 – 87.0 psiA     |
| S405      | Actual LP2 Pressure      | -           | 14.5 – 87.0 psiA     |
| S406      | Electric Stages          | -           | 0, 1, 2, 3           |
| S407      | Hot Water Heat On / Off  | No          | No or Yes            |
| S408      | Hot Gas Heat             | No          | No, Comp. 1, Comp. 2 |
| S409      | Total Heat Stages        | No          | 0, 1, 2, 3l          |
| S410      | 3P Actuator Runtime      | 165 Seconds | 50 – 400 seconds     |
| S411      | 3P Actuator Direction    | Direct      | Direct or Reverse    |

**Service Menu: Option Setup Parameters S400 series:: Page 2 of 2**

| Menu Line | Function                  | Default   | Range               |
|-----------|---------------------------|-----------|---------------------|
| S412      | Password                  | -         | -                   |
| S413      | Humidification Enabled    | Yes       | Yes or No           |
| S414      | Infrared Flush Rate       | 150%      | 110 – 500%          |
| S415      | Dehumidification Enabled  | Yes       | No or Yes           |
| S416      | Electric Reheat Operation | No        | No, Normal, Delayed |
| S417      | Single Unit Auto Restart  | 5 Seconds | 0 – 999 seconds     |
| S418      | On – Off Enabled          | Yes       | Yes or No           |
| S419      |                           |           |                     |
| S420      | CW Flush                  | No        | No, 1 – 99 Hours    |
| S421      | Freecooling Flush         | No        | No, 1 – 99 Hours    |
| S422      | Hot Water Flush           | No        | No, 1 – 99 Hours    |

**Service Menu: Service Contacts Parameters S700 series:**

| Menu Line | Function       | Default | Range               |
|-----------|----------------|---------|---------------------|
| S701      | Password       | -       | -                   |
| S702      | Country        | USA     | None, United States |
| S703      | Address line 1 | -       | Text-string         |
| S704      | Address line 2 | -       | Text-string         |
| S705      | Address line 3 | -       | Text-string         |
| S706      | Address line 4 | -       | Text-string         |

## Advanced Menu Parameters

The Advanced menu displays allows the service technician to set the unit configuration code and to customize the various unit settings for site-specific operation. The factory default password to access the advanced menu items for programming is “221”. The Advance Menu selections include the following choices in the order shown:

- Factory Settings
- Access Levels

### Advanced Menu: Factory Settings Parameters A001 series: Page 1 of 6

| Menu Code | Parameter              | Range                              |
|-----------|------------------------|------------------------------------|
| A001      | Password               | -                                  |
| A002      | Unit field code (R)    | (01 – 06)                          |
| A003      | Set code (W)           | (01 – 06)                          |
| A004      | Unit field code (R)    | (07 – 12)                          |
| A005      | Set code (W)           | (07 – 12)                          |
| A006      | Unit field code (R)    | (13 – 18)                          |
| A007      | Set code (W)           | (13 – 18)                          |
| A008      | Unit Code Control      | No<br>Load+Execute<br>Save+Execute |
| A009      | Unit Code Status       | No<br>Load+Execute<br>Save+Execute |
| A010      | Exception List Control | No, Load                           |
| A011      | Exception List Status  | No<br>Load+Execute<br>Save+Execute |

**Advanced Menu: Factory Settings Parameters A100 series: Page 2 of 6**

| Menu Code | Function                    | Default   | Range                                     |
|-----------|-----------------------------|-----------|---|
| A101      | Password                    | -         | -   |
| A102      | Refrigerant Type            | R22       | R22, R407C                                |
| A103      | Main Fan Overload           | Shut down | Shut down, Disable                        |
| A104      | Loss of Airflow             | Shut down | Shut down, Disable                        |
| A105      | Number of Compressors       | 2         | 0, 1, 2                                   |
| A106      | Compressor Delay Time       | 0         | 0 - 120 Sec                               |
| A107      | Compressor Minimum On Time  | 3 Min     | 0 - 5 Min                                 |
| A108      | Compressor Minimum Off Time | 3 Min     | 0 - 5 Min                                 |
| A109      | Pump Down                   | Yes       | No, Yes                                   |
| A110      | Capacity Control Type       | Unloader  | No, Unloader, HGBP, Digital, Digital + TH |

**Advanced Menu: Factory Settings Parameters A100 series: Page 3 of 6**

| Menu Code | Parameter                      | Default      | Range           |
|-----------|--------------------------------|--------------|-----------------|
| A112      | Password                       | -            | -               |
| A113      | Digi Scroll Cycle              | 15           | No, 10 - 30 Sec |
| A114      | High Temperature Digi Scroll   | 268°F        | 33 - 392°F      |
| A115      | Digi Scroll Switchback         | 250°F        | 33 - 392°F      |
| A116      | Low Pressure Device Type       | Analog       | Analog, Switch  |
| A117      | Low Pressure Threshold Phase 1 | * See Note 1 | 0.0 - 145 psiA  |
| A118      | Low Pressure Threshold Phase 2 | * See Note 2 | 0.0 - 145 psiA  |

**Advanced Menu: Factory Settings Parameters: Page 4 of 6**

| Menu Code | Parameter                   | Default   | Range                         |
|-----------|-----------------------------|-----------|-------------------------------|
| A123      | Password                    | -         | -                             |
| A124      | LP1 Sensor                  | 10%       | 0 - 100%                      |
| A125      | LP1 Signal                  | 150 psiA  | -87.0 to +725 psiA            |
| A126      | Actual LP1 Signal           | -         | 0 - 100%                      |
| A127      | LP2 Sensor                  | 10%       | 0 - 100%                      |
| A128      | LP2 Signal                  | 150 psiA  | -87.0 to +725 psiA            |
| A129      | Actual LP2 Signal           | -         | 0 - 100%                      |
| A130      | Pumpdown Cutout             | 35 psiA   | 0.0 - 145 psiA                |
| A131      | Pumpdown Recycle            | 80 psiA   | 0.0 - 145 psiA                |
| A132      | Heat Rejection Control Type | Fan Speed | Fan Speed / Lee-Temp / Glycol |

**Advanced Menu: Factory Settings Parameters A100 series: Page 5 of 6**

| Menu Code | Parameter                   | Default | Range         |
|-----------|-----------------------------|---------|---------------|
| A134      | Password                    | -       | -             |
| A135      |                             |         |               |
| A136      | CW flush Duration           | 0       | No, 1 - 3 min |
| A137      | Freecooling                 | No      | No, Yes       |
| A138      |                             |         |               |
| A139      | Freecooling Flush Duration  | 0       | No, 1 - 3 min |
| A140      | Freecooling Flush Starts R5 | Yes     | No, Yes       |
| A141      | CO + FC simultaneously      | Yes     | No, Yes       |
| A142      |                             |         |               |
| A143      | Hot water flush duration    | 0       | No, 1 - 3 min |

## Advanced Menu: Factory Settings Parameters: Page 6 of 6

| Menu Code | Parameter                 | Default          | Range                  |
|-----------|---------------------------|------------------|------------------------|
| A145      | Password                  | -                | -                      |
| A146      | Humidifier Model          | No               | No, external, IFS, IFL |
| A147      | Humidity in Last xx Hours | 15hr             | 1 - 120 hours          |
| A148      | Prefill Time              | IFS 30<br>IFL 60 | 1 - 120 seconds        |
| A149      | Fill Time                 | IFS 30<br>IFL 50 | 1 - 120 seconds        |
| A150      | Humidifier On Time        | IFS 8<br>IFL 10  | 1 - 60 minutes         |
| A151      | Dehum with Compressor     | 2                | 1, 2, both             |
| A152      | Analog Output 1           | Not used         | * See note 3           |
| A153      | Analog Output 2           | Not used         | *See note 3            |
| A154      | Analog Output 3           | Not used         | * See note 3           |
| A155      | Analog Output 4           | Not used         | * See note 3           |

**Note 1:** LP threshold Phase 1 (A117):

If **condenser ctrl (A132)** = fan speed then setting is 50 psiA ; otherwise 75 psiA.  
If the condenser control setting changes, the setting for A117 will be updated automatically. If any of the sources (Refrigerant, Freecooling, Hotwater) changes, the setting for A118 will be updated automatically.

**Note 2:** LP threshold Phase 1 (A118):

R22 (A102) + **NO** FC (A137) + **NO** Hotwater (S408) = 63 psiA  
R22 (A102) + **YES** FC (A137) + **NO** Hotwater (S408) = 68 psiA  
R22 (A102) + **NO** FC (A137) + **YES** Hotwater (S408) = 75 psiA  
R22 (A102) + **YES** FC (A137) + **YES** Hotwater (S408) = 75 psiA  
R407c (A102) + **NO** FC (A137) + **NO** Hotwater (S408) = 70 psiA  
R407c (A102) + **YES** FC (A137) + **NO** Hotwater (S408) = 75 psiA  
R407c (A102) + **NO** FC (A137) + **YES** Hotwater (S408) = 83 psiA  
R407c (A102) + **YES** FC (A137) + **YES** Hotwater (S408) = 83 psiA

**Note 3:** The following components may be controlled with the Analog Outputs and labeled as: Hot Water Reheat, 3P Valve, Fan Speed, Cooling, Cooling 1, Cooling 2, Heating and Not Used.



**Advanced Menu: Factory Access Parameters A200 series:**

| <b>Menu Code</b> | <b>Parameter</b>            | <b>Default</b> | <b>Range</b> |
|------------------|-----------------------------|----------------|--------------|
| A201             | Password Level 1 (User)     | 149            | 4 digits     |
| A202             | Password Level 2 (Service)  | 501            | 4 digits     |
| A203             | Password Level 3 (Advanced) | 221            | 4 digits     |

## Events Notifications Parameters

| ID      | Type    | Description (Large Display) | Description (Small Display) |
|---------|---------|-----------------------------|-----------------------------|
| 000     | Alarm   | GENERAL ALARM               | GENERAL ALARM               |
| 001     | Alarm   | COMP. 1 HIGH PRESSURE       | COMP. 1 HIGH PRESSURE       |
| 002     | Alarm   | COMP. 1 LOW PRESSURE        | COMP. 1 LOW PRESSURE        |
| 003     | Warning | HIGH CHILLED WATER          | HIGH CHILLED WATER          |
| 004     | Warning | LOW CHILLED WATER FLOW      | LOW WATER FLOW              |
| 005     | Warning | EL. HEAT. OVERHEATED        | EL. HEAT. OVERHEATED        |
| 006     | Alarm   | MAIN FAN OVERLOAD           | MAIN FAN OVERLOAD           |
| 007     | Alarm   | LOSS OF AIRFLOW             | LOSS OF AIRFLOW             |
| 008     | Warning | CLOGGED FILTERS             | CLOGGED FILTERS             |
| 009-017 | Future  | Future                      | Future                      |
| 018     | Warning | HIGH ROOM TEMPERATURE       | HIGH ROOM TEMPERATURE       |
| 019     | Warning | LOW ROOM TEMPERATURE        | LOW ROOM TEMPERATURE        |
| 020     | Warning | HIGH ROOM HUMIDITY          | HIGH ROOM HUMIDITY          |
| 021     | Warning | LOW ROOM HUMIDITY           | LOW ROOM HUMIDITY           |
| 022     | Warning | HIGH ROOM TEMPERATURE       | HIGH ROOM TEMPERATURE       |
| 023     | Warning | LOW ROOM TEMPERATURE        | LOW ROOM TEMPERATURE        |
| 024     | Warning | HIGH ROOM HUMIDITY          | HIGH ROOM HUMIDITY          |
| 025     | Warning | LOW ROOM HUMIDITY           | LOW ROOM HUMIDITY           |
| 026     | Warning | UNIT HOURS EXCEEDED         | UNIT HOURS EXCEEDED         |
| 027     | Warning | C1 HOURS EXCEEDED           | C1 HOURS EXCEEDED           |
| 028     | Warning | HUMIDIFIER HOURS EXCEEDED   | HUM. HOURS EXCEEDED         |
| 029     | Warning | SUPPLY SENSOR FAILURE       | SUPPLY SENSOR FAILURE       |
| 030     | Future  | Future                      | Future                      |
| 031     | Alarm   | ROOM SENSOR FAILURE         | ROOM SENSOR FAILURE         |
| 032     | Warning | SENSOR "A" FAILURE          | SENSOR "A" FAILURE          |
| 033     | Future  | Future                      | Future                      |
| 034     | Warning | NETWORK FAILURE             | NETWORK FAILURE             |
| 035     | Future  | Future                      | Future                      |
| 036     | Message | UNIT ON                     | UNIT ON                     |

## Events Notifications Parameters (continued)

| ID      | Type    | Description (Large Display) | Description (Small Display) |
|---------|---------|-----------------------------|-----------------------------|
| 037     | Message | UNIT OFF                    | UNIT OFF                    |
| 038     | Message | SLEEP MODE                  | SLEEP MODE                  |
| 039     | Message | STANDBY MODE                | STANDBY MODE                |
| 040     | Message | POWER ON UNIT LOGIN         | POWER ON UNIT LOGIN         |
| 041     | Message | POWER OFF                   | POWER OFF                   |
| 042     | Warning | Unit 1 disconnected         | Unit 1 disconnected         |
| 043     | Warning | Unit 2 disconnected         | Unit 2 disconnected         |
| 044     | Warning | Unit 3 disconnected         | Unit 3 disconnected         |
| 045     | Warning | Unit 4 disconnected         | Unit 4 disconnected         |
| 046     | Warning | Unit 5 disconnected         | Unit 5 disconnected         |
| 047     | Warning | Unit 6 disconnected         | Unit 6 disconnected         |
| 048     | Warning | Unit 7 disconnected         | Unit 7 disconnected         |
| 049     | Warning | Unit 8 disconnected         | Unit 8 disconnected         |
| 050     | Warning | Unit 9 disconnected         | Unit 9 disconnected         |
| 051     | Warning | Unit 10 disconnected        | Unit 10 disconnected        |
| 052     | Warning | Unit 11 disconnected        | Unit 11 disconnected        |
| 053     | Warning | Unit 12 disconnected        | Unit 12 disconnected        |
| 054     | Warning | Unit 13 disconnected        | Unit 13 disconnected        |
| 055     | Warning | Unit 14 disconnected        | Unit 14 disconnected        |
| 056     | Warning | Unit 15 disconnected        | Unit 15 disconnected        |
| 057     | Warning | Unit 16 disconnected        | Unit 16 disconnected        |
| 058     | Alarm   | COMP. 2 HIGH PRESSURE       | COMP. 2 HIGH PRESSURE       |
| 059     | Alarm   | COMP. 2 LOW PRESSURE        | COMP. 2 LOW PRESSURE        |
| 060     | Warning | C2 HOURS EXCEEDED           | C2 HOURS EXCEEDED           |
| 061     | Future  | Future                      | Future                      |
| 062     | Warning | GLYCOL TEMP. SENSOR         | GLYCOL TEMP. SENSOR         |
| 063     | Future  | Future                      | Future                      |
| 064     | Warning | ON-OFF KEY DISABLED         | ON-OFF KEY DISABLED         |
| 065-069 | Future  | Future                      | Future                      |

## Events Notifications Parameters (continued)

| ID      | Type    | Description (Large Display) | Description (Small Display) |
|---------|---------|-----------------------------|-----------------------------|
| 070     | Warning | NO CONNECTION TO UNIT 1     | NO CONN. TO UNIT 1          |
| 071     | Alarm   | C1 MOTOR PROTECTION         | C1 MOTOR PROTECTION         |
| 072     | Alarm   | C2 MOTOR PROTECTION         | C2 MOTOR PROTECTION         |
| 073-078 | Future  | Future                      | Future                      |
| 079     | Message | UNIT DISABLED               | UNIT DISABLED               |
| 080     | Message | UNIT SHUT DOWN              | UNIT SHUT DOWN              |
| 081-084 | Future  | Future                      | Future                      |
| 085     | Message | UNIT SYNCHRONISATION        | UNIT SYNCHRONISATION        |
| 086     | Warning | HUMIDIFIER PROBLEM          | HUMIDIFIER PROBLEM          |
| 087     | Future  | Future                      | Future                      |
| 088     | Message | DEHUM HOURS EXCEEDED        | DEHUM HOURS EXCEEDED        |
| 089     | Warning | FC. HOURS EXCEEDED          | FC. HOURS EXCEEDED          |
| 090     | Future  | Future                      | Future                      |
| 091     | Alarm   | PUMP DOWN FAILURE C1        | PUMP DOWN FAILURE C1        |
| 092-095 | Future  | Future                      | Future                      |
| 096     | Alarm   | PUMP DOWN FAILURE C2        | PUMP DOWN FAILURE C2        |
| 097     | Alarm   | DIGISCROLL 1 HIGH TEMP.     | D.SCROLL 1 HIGH TEMP.       |
| 098     | Alarm   | DIGISCROLL 2 HIGH TEMP.     | D.SCROLL 2 HIGH TEMP.       |
| 099 102 | Future  | Future                      | Future                      |
| 103     | Message | SHORT CYCLING               | SHORT CYCLING               |
| 104     | Alarm   | SMOKE DETECTED              | SMOKE DETECTED              |
| 105     | Alarm   | WATER UNDER FLOOR           | WATER UNDER FLOOR           |
| 106     | Alarm   | COND. PUMP-HIGH WATER       | COND. PUMP-HIGH WATER       |
| 107     | Alarm   | LOSS OF FLOW                | LOSS OF FLOW                |
| 108     | Alarm   | STANDBY GLYCOL PUMP ON      | STBY GLYCOL PUMP ON         |
| 109     | Alarm   | STANDBY UNIT ON             | STANDBY UNIT ON             |
| 110     | Warning | HW/HG HOURS EXCEEDED        | HW/HG WORKING HOURS         |

## Events Notifications Parameters (continued)

| ID  | Type    | Description (Large Display) | Description (Small Display) |
|-----|---------|-----------------------------|-----------------------------|
| 111 | Warning | EL.HEAT 1 HOURS EXCEEDED    | EL.HEAT 1 HOURS EXC.        |
| 112 | Warning | EL.HEAT 2 HOURS EXCEEDED    | EL.HEAT 2 HOURS EXC.        |
| 113 | Warning | EL.HEAT 3 HOURS EXCEEDED    | EL.HEAT 3 HOURS EXC.        |

## Event ID number, Description and Function

| ID  | Description          | Event explanation  | Default Type | Shut down single unit    | Rotate stand by | restart if duty unit fails also |
|-----|----------------------|--|--------------|--------------------------|-----------------|---------------------------------|
| 000 | GENERAL ALARM        | Warning or Alarm was acknowledged or reset   | Reset        | -                        | -               | -                               |
| 001 | COMP 1 HIGH PRESSURE | Compressor 1 stopped because of high pressure  | Alarm        | no                       | yes             | yes (broken co will remain off) |
| 002 | COMP 1 LOW PRESSURE  | Compressor 1 stopped because of low pressure   | Alarm        | no                       | yes             | yes (broken co will remain off) |
| 003 | HIGH CW TEMP         | chilled water temperature too high (input from thermostat)   | Warning      | no                       | no              | -                               |
| 004 | LOSS OF CW FLOW      | chilled water flow too low (input from flow switch)  | Warning      | no                       | no              | -                               |
| 005 | EL HEAT HIGH TEMP    | electric heaters stopped because of too high temperature on the safety thermostat  | Warning      | no                       | no              | -                               |
| 006 | MAIN FAN OVERLOAD    | fan motor protection has stopped the fan due to overload.<br>this event can be set to switch off the unit or to disable hum and electric heat. | Alarm        | yes, if set to shut down | yes             | yes, only if set to "disable"   |

|     |                     |  |         |                          |     |                               |
|-----|---------------------|--|---------|--------------------------|-----|-------------------------------|
| 007 | LOSS OF AIRFLOW     | not enough airflow through the unit. this event can be set to switch off the unit or to disable hum and electric heat. | Alarm   | yes, if set to shut down | yes | yes, only if set to "disable" |
| 008 | CLOGGED FILTERS     | air filters are dirty  | Warning | no                       | no  | -                             |
| 018 | HIGH ROOM TEMP      | actual return air temperature (value from std. sensor) is higher than the threshold                                    | Warning | no                       | no  | -                             |
| 019 | LOW ROOM TEMP       | actual return air temperature (value from std. sensor) is lower than the threshold                                     | Warning | no                       | no  | -                             |
| 020 | HIGH ROOM HUM       | actual return air humidity (value from std. sensor) is higher than the threshold                                       | Warning | no                       | no  | -                             |
| 021 | LOW ROOM HUM        | actual return air humidity (value from std. sensor) is lower than the threshold  | Warning | no                       | no  | -                             |
| 022 | HIGH TEMP SENSOR A  | actual temperature (value from optional sensor A) is higher than the threshold   | Warning | no                       | no  | -                             |
| 023 | LOW TEMP SENSOR A   | actual temperature (value from optional sensor A) is lower than the threshold  | Warning | no                       | no  | -                             |
| 024 | HIGH HUM SENSOR A   | actual humidity (value from optional sensor A) is higher than the threshold  | Warning | no                       | no  | -                             |
| 025 | LOW HUM SENSOR A    | actual humidity (value from optional sensor A) is lower than the threshold   | Warning | no                       | no  | -                             |
| 026 | UNIT HRS EXCEEDED   | actual working hours of the fan are higher than the threshold set.   | Warning | no                       | no  | -                             |
| 027 | COMP 1 HRS EXCEEDED | actual working hours of compressor 1 are higher than the threshold set.  | Warning | no                       | no  | -                             |

|     |                       |   |         |     |     |    |
|-----|-----------------------|---|---------|-----|-----|----|
| 028 | HUM HRS EXCEEDED      | actual working hours of the fan are higher than the threshold set.  | Warning | no  | no  | -  |
| 029 | SUPPLY SENSOR FAILURE | sensor faulty or not present, but needed from control (supply limit control enabled).                                       | Warning | no  | no  | -  |
| 031 | ROOM SENSOR FAILURE   | no valid data from the std. sensor  | Alarm   | yes | yes | no |
| 032 | SENSOR A FAILURE      | no valid data from sensor A   | Warning | no  | no  | -  |
| 034 | NETWORK FAILURE       | the unit showing this event has no connection to the unit #1.   | Warning | no  | no  | -  |
| 036 | UNIT ON               | fan motor in operation  | Message | -   | -   | -  |
| 037 | UNIT OFF              | unit shut down  | Message | -   | -   | -  |
| 038 | SLEEP MODE            | unit is in sleep mode: according to the settings it is switched off or working with a selectable deadband.                  | Message | -   | -   | -  |
| 039 | STANDBY MODE          | unit is in standby (fan off), waiting for a call to start from the system (if a unit fails or there is a bus interruption). | Message | -   | -   | -  |
| 040 | POWER ON              | control is powered again after a power off.   | Message | -   | -   | -  |
| 041 | POWER OFF             | no power to the control: this message will appear at the next power on.   | Message | -   | -   | -  |
| 042 | Unit 1 disconnected   | this event is created from a coldfire display only: the display doesn't find unit #1  | Warning | no  | no  | -  |
| 043 | Unit 2 disconnected   | "   | Warning | no  | no  | -  |
| 044 | Unit 3 disconnected   | "   | Warning | no  | no  | -  |
| 045 | Unit 4 disconnected   | "   | Warning | no  | no  | -  |
| 046 | Unit 5 disconnected   | "   | Warning | no  | no  | -  |
| 047 | Unit 6 disconnected   | "   | Warning | no  | no  | -  |

|     |                       |  |         |    |     |                                 |
|-----|-----------------------|--|---------|----|-----|---------------------------------|
| 048 | Unit 7 disconnected   | "  | Warning | no | no  | -                               |
| 049 | Unit 8 disconnected   | "  | Warning | no | no  | -                               |
| 050 | Unit 9 disconnected   | "  | Warning | no | no  | -                               |
| 051 | Unit 10 disconnected  | "  | Warning | no | no  | -                               |
| 052 | Unit 11 disconnected  | "  | Warning | no | no  | -                               |
| 053 | Unit 12 disconnected  | "  | Warning | no | no  | -                               |
| 054 | Unit 13 disconnected  | "  | Warning | no | no  | -                               |
| 055 | Unit 14 disconnected  | "  | Warning | no | no  | -                               |
| 056 | Unit 15 disconnected  | "  | Warning | no | no  | -                               |
| 057 | Unit 16 disconnected  | "  | Warning | no | no  | -                               |
| 058 | COMP 2 HIGH PRESSURE  | Compressor 2 stopped because of high pressure  | Alarm   | no | yes | yes (broken co will remain off) |
| 059 | COMP 2 LOW PRESSURE   | Compressor 2 stopped because of low pressure   | Alarm   | no | yes | yes (broken co will remain off) |
| 060 | COMP 2 HRS EXCEEDED   | actual working hours of compressor 2 are higher than the threshold set.              | Warning | no | no  | -                               |
| 062 | FREECOOL TEMP SENSOR  | sensor faulty or not present, but needed from control (freecooling control enabled). | Warning | no | no  | -                               |
| 064 | ON-OFF KEY DISABLED   | the display on-off button was set disabled but somebody pressed it.                  | Warning | no | no  | -                               |
| 070 | NO CONNECTION w/Unit1 | the unit showing this event has no connection to the unit #1.                        | Warning | no | no  | -                               |
| 071 | COMP 1 OVERLOAD       | Compressor 1 stopped because of overload   | Alarm   | no | yes | yes (broken co will remain off) |



|     |                       |   |         |    |     |                                 |
|-----|-----------------------|---|---------|----|-----|---------------------------------|
| 072 | COMP 2 OVERLOAD       | Compressor 2 stopped because of overload  | Alarm   | no | yes | yes (broken co will remain off) |
| 079 | UNIT DISABLED         | this message appears after a critical alarm (airflow, main fan overload) and indicates that the unit is operating w/o humidifier or electrical heaters. | Message |    | -   | -                               |
| 080 | UNIT SHUT DOWN        | this message appears after a critical alarm (airflow, main fan overload) and indicates that the unit is shut down due to the alarm.                     | Message |    | -   | -                               |
| 085 | UNIT SYNCHRONISATION  | a unit came back into the network.  | Message | -  | -   | -                               |
| 086 | HUMIDIFIER PROBLEM    | humidifier overtemperature or high water level  | Alarm   | no | yes |                                 |
| 088 | DEHUM HRS EXCEEDED    | actual working hours of dehumidification are higher than the threshold set.   | Warning | no | no  |                                 |
| 089 | FC HRS EXCEEDED       | actual working hours of freecooling are higher than the threshold set.  | Warning | no | no  | -                               |
| 091 | COMP 1 PUMPDOWN FAIL  | Pump down of circuit 1 was not completed (pressure value not reached).  | Alarm   | no | yes | yes (broken co will remain off) |
| 096 | COMP 2 PUMPDOWN FAIL  | Pump down of circuit 2 was not completed (pressure value not reached).  | Alarm   | no | yes | yes (broken co will remain off) |
| 097 | DIG SCROLL1 HIGH TEMP | Digital Scroll compressor #1 shut off because of high temperature (sensor is inside the compressor).  | Alarm   | no | yes | yes (broken co will remain off) |

|     |                          |  |         |    |     |                                    |
|-----|--------------------------|--|---------|----|-----|------------------------------------|
| 098 | DIG SCROLL2<br>HIGH TEMP | Digital Scroll compressor #1 shut off because of high temperature (sensor is inside the compressor). | Alarm   | no | yes | yes<br>(broken co will remain off) |
| 103 | SHORT CYCLE              | compressors are requested from control to start too often - control is unstable.                     | Message | -  | no  | -                                  |
| 104 | SMOKE<br>DETECTED        | customer input is active.  | Alarm   | no | yes | yes (if not disabled externally)   |
| 105 | WATER<br>UNDER<br>FLOOR  | customer input is active.  | Alarm   | no | yes | yes (if not disabled externally)   |
| 106 | COND PUMP-<br>HIGH WATER | customer input is active.  | Alarm   | no | yes | yes (if not disabled externally)   |
| 107 | LOSS OF<br>FLOW          | customer input is active.  | Alarm   | no | yes | yes (if not disabled externally)   |
| 108 | STBY GLYCOL<br>PUMP ON   | customer input is active.  | Alarm   | no | yes | yes (if not disabled externally)   |
| 109 | STANDBY<br>UNIT ON       | customer input is active.  | Alarm   | no | yes | yes (if not disabled externally)   |
| 110 | HW/HG HRS<br>EXCEEDED    | actual working hours of hot water heat / hot gas reheat are higher than the threshold set.           | Warning | no | no  | -                                  |
| 111 | EL HEAT1 HRS<br>EXCEEDED | actual working hours of electrical heater stage 1 are higher than the threshold set.                 | Warning | no | no  | -                                  |
| 112 | EL HEAT2 HRS<br>EXCEEDED | actual working hours of electrical heater stage 2 are higher than the threshold set.                 | Warning | no | no  | -                                  |
| 113 | EL HEAT3 HRS<br>EXCEEDED | actual working hours of electrical heater stage 3 are higher than the threshold set.                 | Warning | no | no  | -                                  |

|     |                       |  |       |     |     |    |
|-----|-----------------------|--|-------|-----|-----|----|
| 114 | UNIT CODE MISSING     | this alarm appears if a totally new board was started the very first time in its life. the unit code must be set in order to let the board know in which type of unit it is mounted, which component it shall drive and how to map the inputs and outputs. | Alarm | yes | yes | no |
| 115 | UNIT CODE 01 MISMATCH | this digit of the unit code has been set to a value out of range (no code logic available for this number)   | Alarm | yes | yes | no |
| 116 | UNIT CODE 02 MISMATCH | "  | Alarm | yes | yes | no |
| 117 | UNIT CODE 03 MISMATCH | "  | Alarm | yes | yes | no |
| 118 | UNIT CODE 04 MISMATCH | "  | Alarm | yes | yes | no |
| 119 | UNIT CODE 05 MISMATCH | "  | Alarm | yes | yes | no |
| 120 | UNIT CODE 06 MISMATCH | "  | Alarm | yes | yes | no |
| 121 | UNIT CODE 07 MISMATCH | "  | Alarm | yes | yes | no |
| 122 | UNIT CODE 08 MISMATCH | "  | Alarm | yes | yes | no |
| 123 | UNIT CODE 09 MISMATCH | "  | Alarm | yes | yes | no |
| 124 | UNIT CODE 10 MISMATCH | "  | Alarm | yes | yes | no |
| 125 | UNIT CODE 11 MISMATCH | "  | Alarm | yes | yes | no |
| 126 | UNIT CODE 12 MISMATCH | "  | Alarm | yes | yes | no |
| 127 | UNIT CODE 13 MISMATCH | "  | Alarm | yes | yes | no |
| 128 | UNIT CODE 14 MISMATCH | "  | Alarm | yes | yes | no |
| 129 | UNIT CODE 15          | "  | Alarm | yes | yes | no |

|     |                          |   |       |     |     |    |
|-----|--------------------------|---|-------|-----|-----|----|
|     | MISMATCH                 |   |       |     |     |    |
| 130 | UNIT CODE 16<br>MISMATCH | " | Alarm | yes | yes | no |
| 131 | UNIT CODE 17<br>MISMATCH | " | Alarm | yes | yes | no |
| 132 | UNIT CODE 18<br>MISMATCH | " | Alarm | yes | yes | no |

# Chapter 3

## iCOM

### Control Board Connections

#### Introduction

This section describes the basic connection points on the Liebert Deluxe System 3 units. Each sub-section describes the standard electrical connections supplied with the iCOM controls. The detail is as follows:

Display Assembly: Large and Small

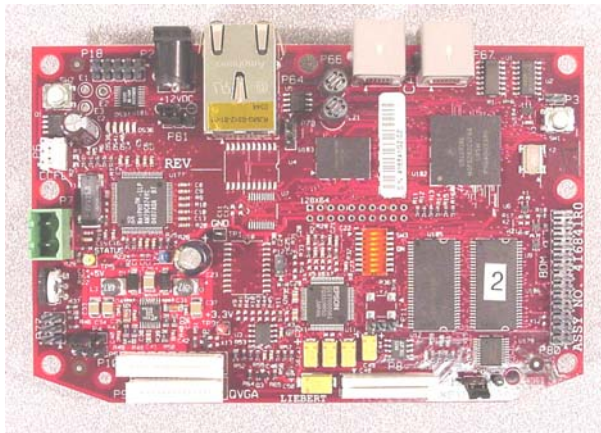
Plug and Terminal Block Connections

Fuse Board: All Units

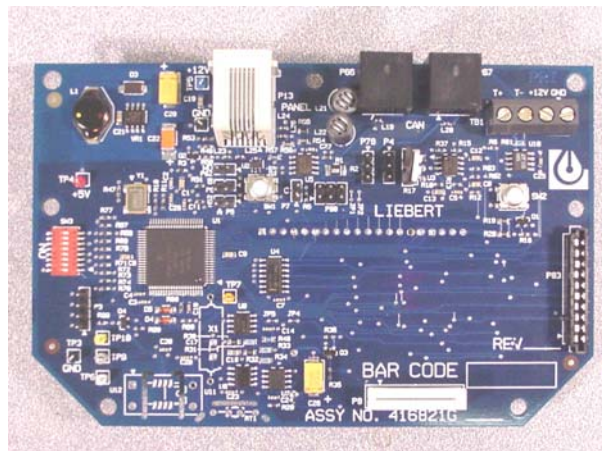
## LCD Display Board

The Advanced and Advanced with Graphics LCD display board is mounted to the system unit accent panel. The LCD display board connection to the system control board is identified as ribbon connector P26.

### Large Display

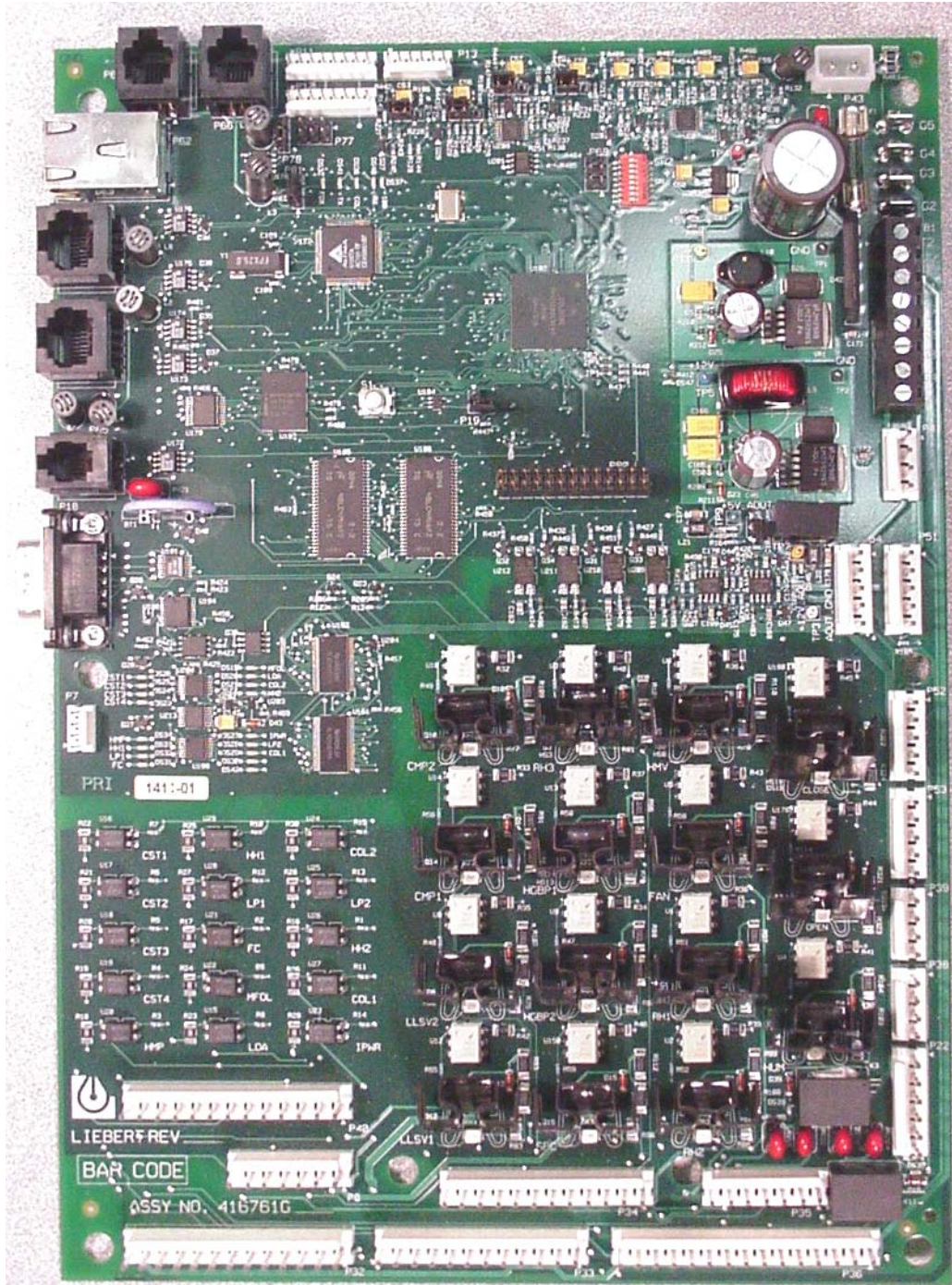


### Small Display



## Control Board DIP Switches and Plug Connectors

This section deals with the 20 plug connections and the terminal block located on the unit control board. The tables in this section show all of the pin connections and the reference points for signal flow through these connections.



Unit Mounted Control Board

**iCOM Control Board DIP Switch #2 Settings**

| <b><u>Connector</u></b> | <b><u>Input/ Output Type</u></b>   | <b><u>Setting</u></b>   |
|-------------------------|--|---|
| P7-1 (+)/ P7-2 (-)      | NTC Thermistor<br>PTC Thermistor   | * Software (ASW1 = 1)<br>Software (ASW1 = 0)                              |
| P11-1 (+)/ P11-2 (-)    | Analog Voltage: 0 to +10V<br>Analog Voltage: 0 to +5V<br>Analog Current: 4 to 20mA | * Sw2-1: Off/ Sw2-2: Off<br>Sw2-1: On/ Sw2-2: Off<br>Sw2-1: On/ Sw2-2: On |
| P11-3 (+)/ P11-4 (-)    | +5V Output   | None  |
| P11-5 (+)/ P11-6 (-)    | Analog Voltage: 0 to +10V<br>Analog Voltage: 0 to +5V<br>Analog Current: 4 to 20mA | * Sw2-3: Off/ Sw2-4: Off<br>Sw2-3: On/ Sw2-4: Off<br>Sw2-3: On/ Sw2-4: On |
| P11-7 (+)/ P11-8 (-)    | +5V Output   | None  |
| P12-1 (+)/ P12-2 (-)    | Analog Voltage: 0 to +10V<br>Analog Voltage: 0 to +5V<br>Analog Current: 4 to 20mA | * Sw2-5: Off/ Sw2-6: Off<br>Sw2-5: On/ Sw2-6: Off<br>Sw2-5: On/ Sw2-6: On |
| P12-3 (+)/ P12-4 (-)    | +5V Output   | None  |
| P12-5 (+)/ P12-6 (-)    | Analog Voltage: 0 to +10V<br>Analog Voltage: 0 to +5V<br>Analog Current: 4 to 20mA | * Sw2-7: Off/ Sw2-8: Off<br>Sw2-7: On/ Sw2-8: Off<br>Sw2-7: On/ Sw2-8: On |
| P12-7 (+)/ P12-8 (-)    | +5V Output   | None  |
| P13-1 (+)/ P13-2 (-)    | NTC Thermistor<br>PTC Thermistor   | * Software (ASW2 = 1)<br>Software (ASW2 = 0)                              |
| P13-3 (+)/ P13-4 (-)    | NTC Thermistor<br>NTC Scroll Thermister  | Sw2-9: On<br>* Sw2-9: Off   |
| P13-5 (+)/ P13-6 (-)    | NTC Thermistor<br>NTC Scroll Thermister  | Sw2-10: On<br>* Sw2-10: Off   |

\* **Default Setting**



### **iCOM Control Board Jumper Settings**

| <b><u>Jumper</u></b> | <b><u>Type</u></b> | <b><u>Setting</u></b>                                 |
|----------------------|--------------------|---|
| P19                  | Watchdog           | * On: Shunt on Pins 1 & 2<br>Off: No Shunt            |
| P78                  | CAN Bus Terminator | On: Shunt on Pins 2 & 3<br>* Off: Shunt on Pins 1 & 2 |
| P83                  | Bootloader         | Enabled: Shunt on Pins 1 & 2<br>* Disabled: No Shunt  |

\* **Default Setting**

### **Large Display DIP Switch #3 Settings**

| <b><u>Position</u></b> | <b><u>Type</u></b> | <b><u>Setting</u></b> |
|------------------------|--------------------|-----------------------|
| 1                      | CAN Address        | Off                   |
| 2                      | CAN Address        | Off                   |
| 3                      | CAN Address        | Off                   |
| 4                      | CAN Address        | Off                   |
| 5                      | CAN Address        | Off                   |
| 6                      | CAN Address        | Off                   |
| 7                      | CAN Baud           | Off                   |
| 8                      | CAN Baud           | Off                   |

### Large Display Jumper Settings

| <u>Jumper</u> | <u>Type</u>                 | <u>Setting</u>        |
|---------------|-----------------------------|-----------------------|
| P3            | Watchdog                    | * Shunt on Pins 1 & 2 |
| P4            | Manual Contrast<br>(Rev. 1) | * Shunt on Pins 2 & 3 |
| P8            | open                        | * open                |
| P13           | open                        | * open                |
| P78           | CAN Termination             | * Shunt on Pins 2 & 3 |
| P82           | Watchdog<br>(Rev. 2 Only)   | * Shunt on Pins 1 & 2 |
| P83           | Bootloader                  | * Shunt on Pins 2 & 3 |

\* Default Setting

### Small Display DIP Switch #3 Settings

| <u>Position</u> | <u>Type</u> | <u>Setting</u> |
|-----------------|-------------|----------------|
| 1               | CAN Address | Off            |
| 2               | CAN Address | Off            |
| 3               | CAN Address | Off            |
| 4               | CAN Address | Off            |
| 5               | CAN Address | On             |
| 6               | CAN Address | On             |
| 7               | CAN Baud    | Off            |
| 8               | CAN Baud    | Off            |

**Small Display Jumper Settings**

| <u>Jumper</u> | <u>Type</u>                      | <u>Setting</u>        |
|---------------|----------------------------------|-----------------------|
| P4            | Manual Contrast<br>(Rev. 2 only) | * Shunt on Pins 2 & 3 |
| P78           | CAN Termination                  | * Shunt on Pins 2 & 3 |
| P80           | BDM Header                       | * open                |
| P82           | Watchdog<br>(Rev. 2 Only)        | * Shunt on Pins 1 & 2 |

**\* Default Setting**

Temperature/ Humidity Board DIP Switch #1 Settings

| <u>Position</u> | <u>Type</u> | <u>Setting</u>                      | <u>Notes</u>                             |
|-----------------|-------------|-------------------------------------|--|
| 1               | CAN Address | Off                                 | On (if Sensor A)                         |
| 2               | CAN Address | Off                                 | On (if Sensor B)                         |
| 3               | CAN Address | Off                                 | On (if Sensor C)                         |
| 4               | CAN Address | Off                                 | open                                     |
| 5               | CAN Address | On (Normal &<br>Constant Operation) | Off (Analog Mode)                        |
| 6               | CAN Address | Off (Normal Operation)              | On (Analog Mode &<br>Constant Operation) |
| 7               | CAN Baud    | Off                                 | open                                     |
| 8               | CAN Baud    | Off                                 | open                                     |

**Temperature/ Humidity Board Jumper Settings**

| <u>Jumper</u> | <u>Type</u>     | <u>Setting</u>        |
|---------------|-----------------|-----------------------|
| P2            | BDM Header      | * open                |
| P3            | CAN Termination | * Shunt on Pins 2 & 3 |
| P4            | Programming     | * open                |

**\* Default Setting**

## **DS Systems:**

### **P3: Not Used**

### **P4: 24 VAC Power**

- |                       |                       |
|-----------------------|-----------------------|
| P4-1: Fuse 1 (24 VAC) | P4-3: Fuse 3 (24 VAC) |
| P4-2: Fuse 2 (24 VAC) | P4-4: Fuse 4 (24 VAC) |

### **P7: Fluid Sensor**

- P7-1: Aquastat Sensor
- P7-2: Aquastat Sensor

### **P8: 24 VAC Alarm Inputs**

- |                            |                          |
|----------------------------|--------------------------|
| P8-1: 24 VAC (RAD1/ TS 50) | P8-5: 24 VAC (HWA)       |
| P8-2: 24 VAC (RAD2/ TS 51) | P8-6: 24 VAC Out (TS 24) |
| P8-3: 24 VAC (RAD3/ TS 55) | P8-7: 24 VAC Out (HWA)   |
| P8-4: 24 VAC (RAD4/ TS 56) | P8-8: no connection      |

### **P11: Low Pressure Switch Circuits**

- P11-1: DCV Signal to LPT1
- P11-2: Cold Start Bypass 1 Signal
- P11-3: LPT1 Input to MP
- P11-4:
- P11-5: DCV Signal to LPT2
- P11-6: Cold Start Bypass 1 Signal
- P11-7: LPT2 Input to MP
- P11-8:

### **P12: Analog Sensor Inputs**

- |                            |                            |
|----------------------------|----------------------------|
| P12-1: T+ Analog 1 (TS 41) | P12-5: T+ Analog 3 (TS 45) |
| P12-2: T- Analog 1 (TS 42) | P12-6: T- Analog 3 (TS 46) |
| P12-3: T+ Analog 2 (TS 43) | P12-7: T+ Analog 4 (TS 47) |
| P12-4: T- Analog 2 (TS 44) | P12-8: T- Analog 4 (TS 48) |

### **P13: DCV Thermistor Signals**

- P13-1: DCV Signal to Digital Scroll Thermistor 1
- P13-2: DCV Signal from Digital Scroll Thermistor 1
- P13-3: DCV Signal to Digital Scroll Thermistor 2
- P13-4: DCV Signal from Digital Scroll Thermistor 2
- P13-5: DCV Signal to Customer Thermistor
- P13-6: DCV Signal from Customer Thermistor

**P22: Glycool Valve (Std. Pressure Actuator)**

|        |                        |        |                 |
|--------|------------------------|--------|-----------------|
| P22-1: | 24 VAC Out (Close Q18) | P22-4: | DCV Signal      |
| P22-2: | DCV Signal             | P22-5: | E2 (24 VAC Gnd) |
| P22-3: | 24 VAC Out (Open Q17)  | P22-6: | +5 VDC          |

**P32: Compressor Devices**

|        |                           |         |                    |
|--------|---------------------------|---------|--------------------|
| P32-1: | 24 VAC Out (LLSV1)        | P32-8:  | 24 VAC             |
| P32-2: | E1 (LLSV1)                | P32-9:  | 24 VAC (HP1 Alarm) |
| P32-3: | 24 VAC Out (LLSV2)        | P32-10: | 24 VAC Out (C1)    |
| P32-4: | 24 VAC Out (OL/ KL1/ HP1) | P32-11: | E1 (C1)            |
| P32-5: | 24 VAC Out (OL/ KL2/ HP2) | P32-12: | 24 VAC Out (C2)    |
| P32-6: | 24 VAC (HP1)              | P32-13: | E2 (C2)            |
| P32-7: | 24 VAC (HP2)              |         |                    |

**P33: Compressor Devices**

|        |                         |         |                        |
|--------|-------------------------|---------|------------------------|
| P33-1: | 24 VAC Out (CUV1/ DSV1) | P33-7:  | 24 VAC (OL/ KL2 Alarm) |
| P33-2: | E1 (CUV1/ DSV1)         | P33-8:  | 24 VAC                 |
| P33-3: | E2 (LLSV2)              | P33-9:  | 24 VAC (HP2 Alarm)     |
| P33-4: | 24 VAC Out (CUV2/ DSV2) | P33-10: |                        |
| P33-5: | E2 (CUV2/ DSV2)         | P33-11: |                        |
| P33-6: | 24 VAC (OL/ KL1 Alarm)  | P33-12: |                        |

**P34: Reheat Devices**

|        |                            |         |                          |
|--------|----------------------------|---------|--------------------------|
| P34-1: | 24 VAC Out (RS1/ RS2/ RS3) | P34-7:  | no connection            |
| P34-2: | E3 (RS1/ RS2/ RS3)         | P34-8:  | 24 VAC Out (RH3)         |
| P34-3: | E3 (GCD/ BR)               | P34-9:  | no connection            |
| P34-4: | 24 VAC Out (RH1/ HGRS)     | P34-10: | E3 (RH1/ HGRS/ RH2/ RH3) |
| P34-5: | no connection              | P34-11: | no connection            |
| P34-6: | 24 VAC Out (RH2)           | P34-12: | 24 VAC Out (GCD/ BR)     |

**P35: Infrared Humidifier Devices**

|        |                   |        |                  |
|--------|-------------------|--------|------------------|
| P35-1: | 24 VAC Out (H)    | P35-4: | E4 (H MV)        |
| P35-2: | E3 (H)            | P35-5: | E3 (HS3)         |
| P35-3: | 24 VAC Out (H MV) | P35-6: | 24 VAC Out (HS3) |

**P36: Basic Unit Connections**

|        |                            |         |                     |
|--------|----------------------------|---------|---------------------|
| P36-1: | 24 VAC Out (Filter Clog)   | P36-9:  | no connection       |
| P36-2: | 24 VAC (Filter Clog Alarm) | P36-10: | E2                  |
| P36-3: | 24 VAC Out (MF)            | P36-11: | No connection       |
| P36-4: | 24 VAC Out (AS Switch)     | P36-12: | No connection       |
| P36-5: | 24 VAC (AS Alarm)          | P36-13: | K3 (Common: TB75)   |
| P36-6: | 24 VAC (MF Ovl d Alarm)    | P36-14: | K3 (N.O.: TB76/ R3) |
| P36-7: | 24 VAC                     | P36-15: | K3 (N.C.)           |
| P36-8: | E4 (MF)                    |         |                     |

**P38: Smoke Detector**

P38-1: 24 VAC Out (SDC)      P38-3: 24 VAC (RAD1)  
P38-2: E4 (SDC)              P38-4: no connection

**P39: Firestat & Remote Shutdown**

P39-1: 24 VAC Out (HTS)              P39-3: 24 VAC Out (RDS1)  
P39-2: 24 VAC Return (HTS)          P39-4: 24 VAC Return (RSD1)

**P40: Basic Unit Connections**

P40-1: no connections                  P40-8: E4 (Opt. CPAR)  
P40-2: no connections                  P40-9: no connection  
P40-3: no connections                  P40-10: E4  
P40-4: 24 VAC Out (Opt. CPAR)      P40-11: no connection  
P40-5: no connections                  P40-12: 24 VAC Out (MF Ovld)  
P40-6: no connections                  P40-13: 24 VAC  
P40-7: no connections

**P43: T6 Transformer**

P43-1: 24 VAC Gnd  
P43-2: 24 VAC

**P51: Hot Water Reheat**

P51-1: 24 VAC Out              P51-3: H.W. Mod (0 – 2.5 VDC)  
P51-2: -5 VDC Gnd              P51-4: 24 VAC Gnd (E1)

**P52: Glycool Valve (Opt. Pressure Modulating)**

P52-1: 24 VAC Out                  P52-4: 24 VAC Gnd (E1)  
P52-2: -5 VDC Gnd                  P52-5: no connection  
P52-3: Mod Valve (0 – 2.5 VDC)

**P53:**

P53-1: 24 VAC  
P53-2: no connection  
P53-3: no connection  
P53-4: E3  
P53-5: no connection

**P54:**

P54-1: 24 VAC  
P54-2: no connection  
P54-3: no connection  
P54-4: E3  
P54-5: no connection

**P67: Temperature/ Humidity Sensors**

P67-1: P16-3:  
P67-6: P16-4:

**P65: Site Monitoring Signals – No Intelleslot Supplied**

P65-1: +5 VDC to TS 78  
P65-2: -5 VDC to TS 77

**P65: Optional Intelleslot Power Supply**

P65-1: P65-3:  
P65-2: P65-4:

**P64: Unit Large Display (Digital Signals)**

**P66: Unit Small Display (Digital Signals)**

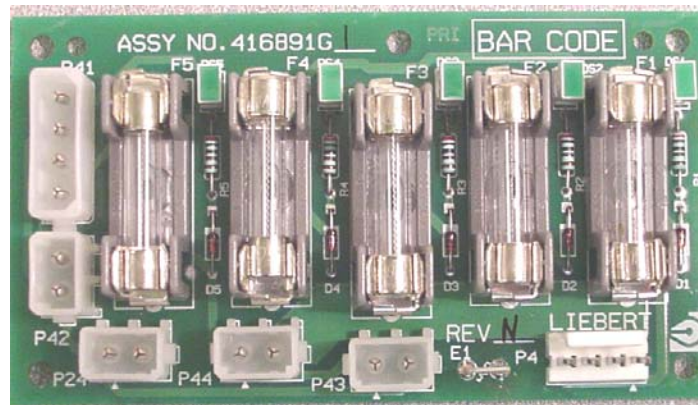
**TB1: 24 VAC**

|                    |                |
|--------------------|----------------|
| TB1-1: 24 VAC (T2) | TB1-5: E1 (G2) |
| TB1-2: 24 VAC (T3) | TB1-6: E2 (G3) |
| TB1-3: 24 VAC (T4) | TB1-7: E3 (G4) |
| TB1-4: 24 VAC (T5) | TB1-8: E4 (G5) |

**E1/ E2/ E3/ E4: Transformer Grounds**

## Fuse Board Layout: All Units

This section deals with the seven (7) plug connectors on the fuse board. The fuse board is supplied on all systems with iCOM and is located in the low voltage section of the unit. The tables in this section show all of the connections and reference points for signal flow through these connectors.



**Fuse Board**

### **P4: 24 VAC Power**

|              |              |
|--------------|--------------|
| P4-1: Fuse 1 | P4-3: Fuse 3 |
| P4-2: Fuse 2 | P4-4: Fuse 4 |

### **P24: T1 Transformer**

|                        |
|------------------------|
| P24-1: 24 VAC Gnd (T1) |
| P24-2: 24 VAC (T1)     |

### **P41: 24 VAC Power**

|                        |                                     |
|------------------------|-------------------------------------|
| P41-1: 24 VAC Gnd (T1) | P41-3: 24 VAC Gnd (not unit ground) |
| P41-2: 24 VAC (T1)     | P41-4: 24 VAC                       |

### **P42: Intelleslot**

|                                     |
|-------------------------------------|
| P42-1: 24 VAC Gnd (not unit ground) |
| P42-2: 24 VAC                       |

### **P43: T6 Transformer**

|                                     |
|-------------------------------------|
| P43-1: 24 VAC Gnd (not unit ground) |
| P43-2: 24 VAC                       |

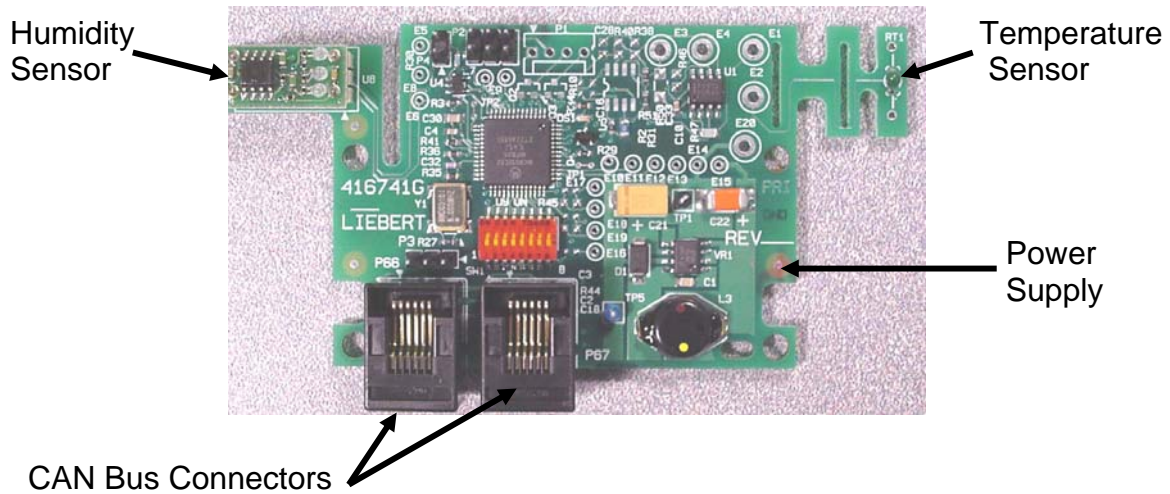
### **P44: Jumper**

### **E1: Transformer Secondary Ground (unit ground)**



## Temperature/ Humidity Board: All Units

This section deals with the single plug connection located on the system temperature and humidity board. The temperature/ humidity board is supplied on all systems with iCOM controls. The cable is plugged into Plug P67 on the unit microprocessor board and transmits information using “CAN” – Controlled Area Network communication. Troubleshooting is accomplished by observing an LED located on the board. If the LED is glowing the board is good. The temperature and humidity board is typically located in the unit return.



**Temperature/ Humidity Board**

### P67: Return Air Temperature/ Humidity Board

- P67-1: CAN communication
- P67-6: CAN communication



**Temperature/ Humidity Assembly Housing**

# NOTES

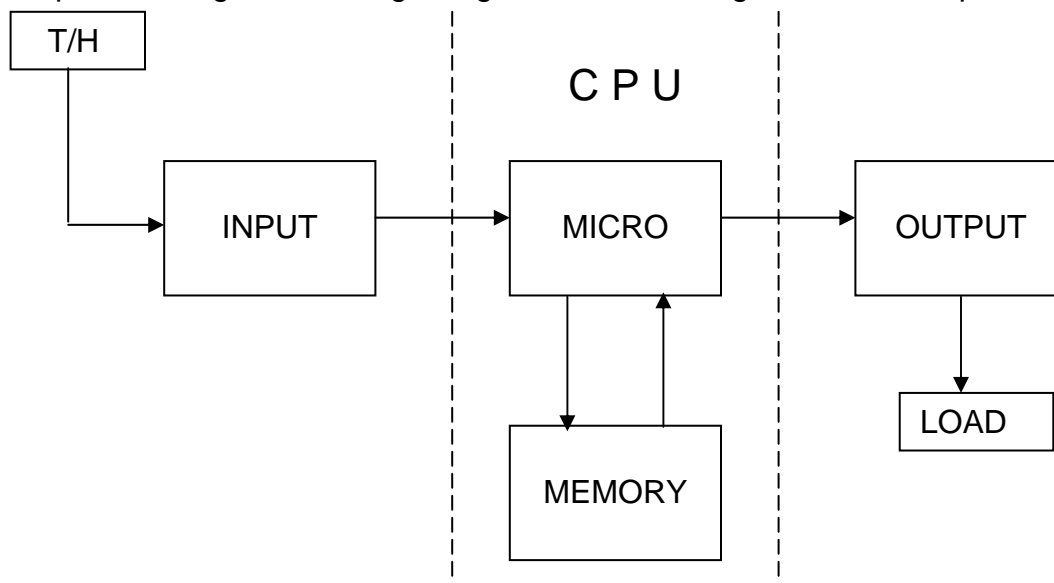
# Chapter 4

## General Troubleshooting Data

- \* Basic Operation of the Opto and Triac
- \* Troubleshooting the Opto-Isolator and Triac
- \* Control Input Check (Sensors)
- \* Frequency Conversion Chart (Temperature)
- \* Frequency Conversion Chart (Humidity)
- \* Troubleshooting Signals and Checklist
- \* Moisture Content Charts

This section covers only very basic electronics. The major components, such as triacs and opto-isolators are briefly described and related to the Liebert units you have come to study. It is our hope that this brief introduction to electronics stimulates your interest and encourages you to go further in the field.

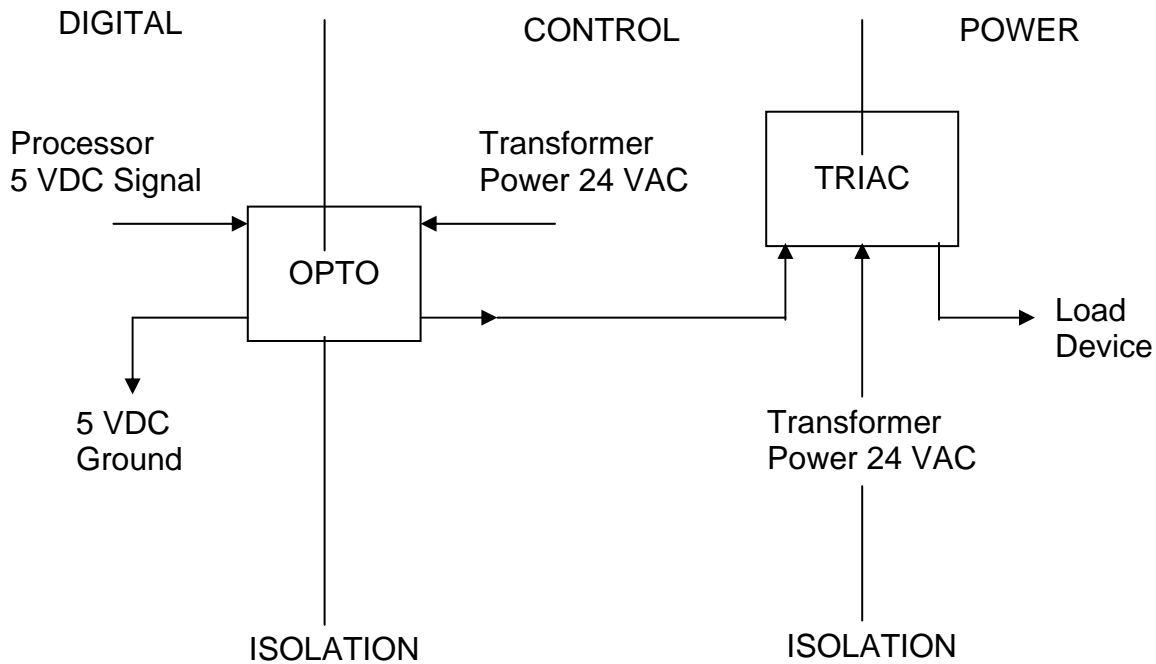
The path of a signal from beginning to the end - using the four block process.



The temperature sensor senses a rise in temperature. The rise is transmitted to the **C**entral **P**rocessing **U**nit (CPU). The CPU looks into its memory for information and instructions on what to do with the rise in temperature. The CPU then makes the decision to call for cooling.

## Isolation

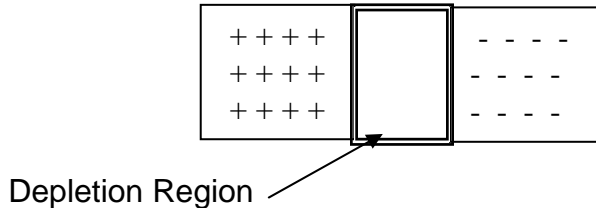
We use the opto-isolator and the triac to isolate areas of control and voltage. There are three areas of control and two voltage levels. Digital control comes from the microprocessor at 5 VDC and the other voltage level is 24 VAC. One voltage is used to turn on the triac and the other is used to operate the load device.



### Areas of Control

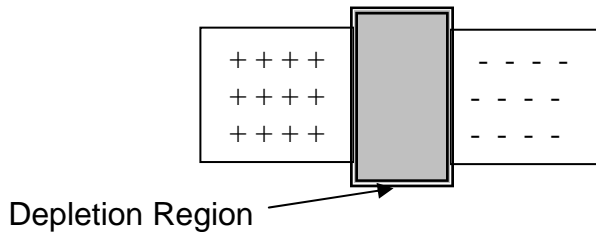
## BASIC OPERATION OF THE TRIAC

To better understand the operation of the triac, we need to look at the movement of electrons in a special type of material used in electronics. Here we have a semiconductor material with what is called a depletion region. The depletion region restricts the flow of electrons to a point.



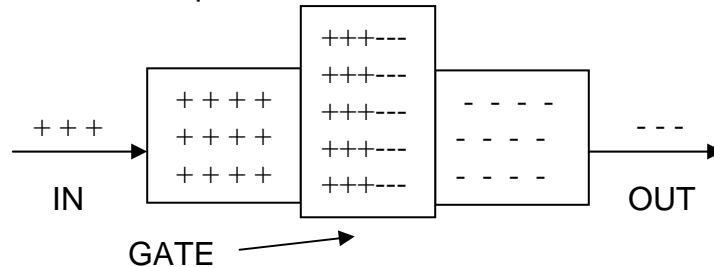
### Semiconductor

By forcing more electrons in to the depletion region, we can cause an overflow of these electrons resulting in electron flow that in turn produces current. When we have current flow, the device is on.



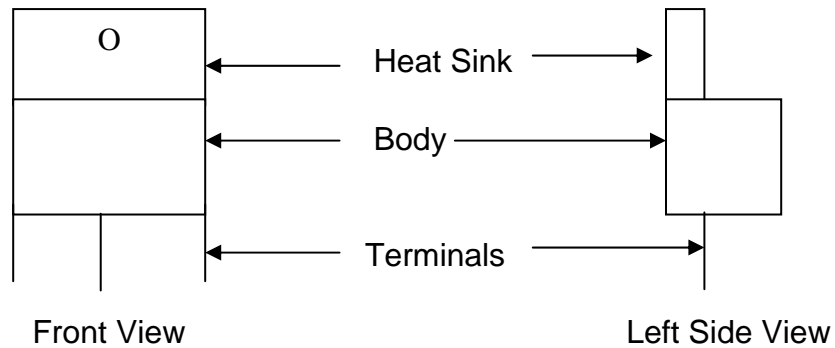
### Semiconductor Showing No Movement of Electrons

If we add a third terminal to this simple device and call it the Gate, we have a basic triac. By sending electrons to the gate, which is connected to the depletion region, we create an overflow condition. You can see how this device can be turned on or off by this process. Now to put this in perspective with AC voltage circuits, this ON and OFF condition takes place every half cycle. When the AC voltage is removed from the gate, conduction stops.



### Semiconductor Showing Movement of Electrons

The triacs that Liebert uses are standard in the industry and are rated at a 2-amp capacity. You can check these devices for proper operation while they are connected in the circuit. If the load is removed from the device, you can get a false reading from the meter. This is because the voltage potential is present and is detected by the meter. When the load is applied to the device, the potential is not detected by the meter. To test a triac for proper operation, energize the circuit and connect the load.

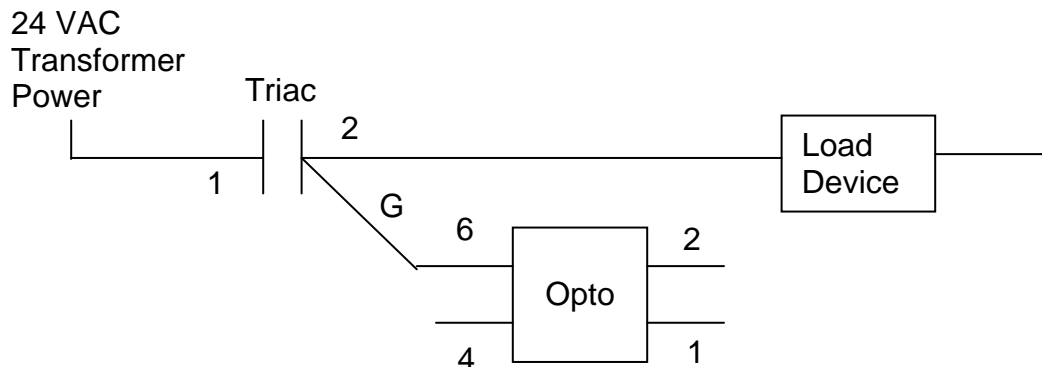


**Front and Left Side Views of the Triac**

As you view the triac from the front, the terminals are numbered as follows:

| <u>Terminal</u> | <u>Connection</u>                    |
|-----------------|--------------------------------------|
| Left            | #2 Connects to the Load              |
| Middle          | #1 Connects to the Transformer power |
| Right           | G(ate) Connects to the Opto-Isolator |

Below is a simple schematic drawing for the triac using Liebert symbols.



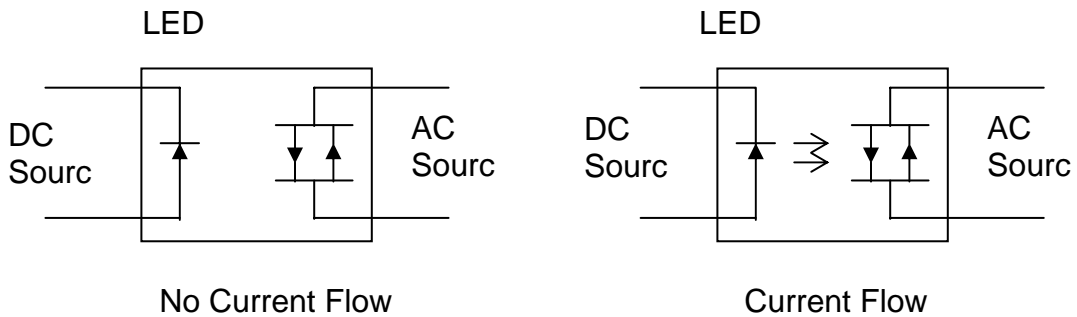
**Schematic Drawing for the Triac**

## Basic Operation of the Opto-Isolator

The purpose of the opto-isolator is to provide isolation of two voltage sources. This allows a DC voltage source to activate an AC voltage load device or allows an AC voltage source to provide a DC signal.

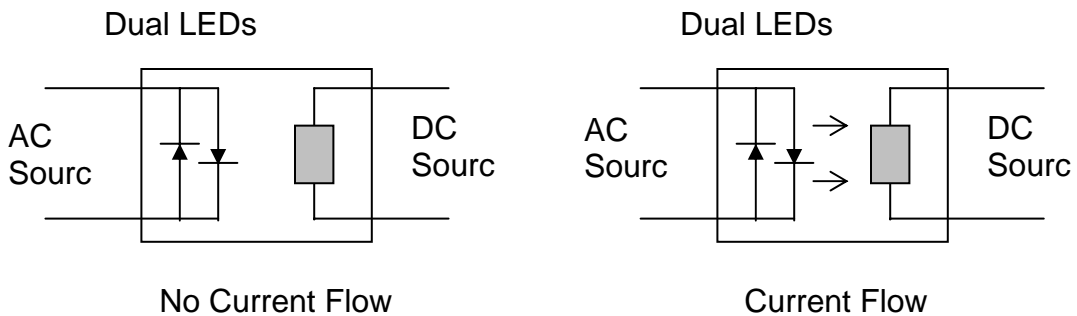
We are working with two types of circuits, an input and an output. Therefore, we require two types of opto-isolators (referred to as optos).

The output opto uses a DC voltage source to activate a **Light Emitting Diode (LED)** internal to the IC chip. This causes a triac, also internal to the IC chip, to switch ON allowing current to flow to the AC load device.



### Output Opto-Isolator

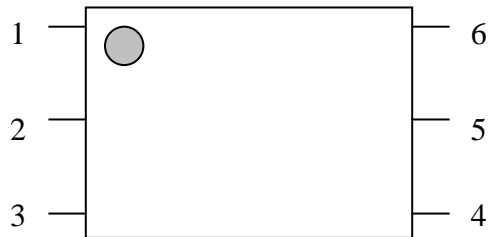
The input opto uses an AC voltage source to activate dual LEDs and turn on a transistor to pass the DC voltage and allow current to flow.



### Input Opto-Isolator

## Troubleshooting the Output Opto-Isolator

The opto-isolator IC chips used in these circuits are the H11J (output) devices. The drawing shows the pin location for component checks on the output opto. The indented circle in the upper left hand corner of this chip indicates the location of Pin 1. Note that the number sequence is in a "U" format: downward 1, 2 and 3 on the left and upward 4, 5 and 6 on the right.



**Output Opto-Isolator Pin Location**

### OUTPUT VOLTAGE CHECK

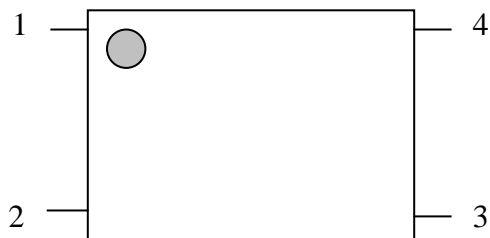
|       |  |
|-------|--|
| Pin 1 | Receives the DC source voltage (3.3 VDC range)                   |
| Pin 2 | Completes the DC source to the digital ground                    |
| Pin 3 | No voltage signal at this point                                  |
| Pin 4 | Receives the AC source voltage signal from the input transformer |
| Pin 5 | No voltage signal at this point                                  |
| Pin 6 | Completes the AC voltage path to the gate of the triac (24VAC)   |

**Note that all AC source checks are referenced to the associated transformer neutral and/or the safety ground, and that the DC source reference is to V- or digital ground.**



## Troubleshooting the Input Opto-Isolator

The opto-isolator IC chips used in these circuits are the H11AA (input) devices. The pin location for component checks on the input opto. The indented circle in the upper left hand corner of this chip indicates the location of Pin 1. Note that the number sequence is in a "U" format: down 1 and 2 on the left and up 3 and 4 on the right.



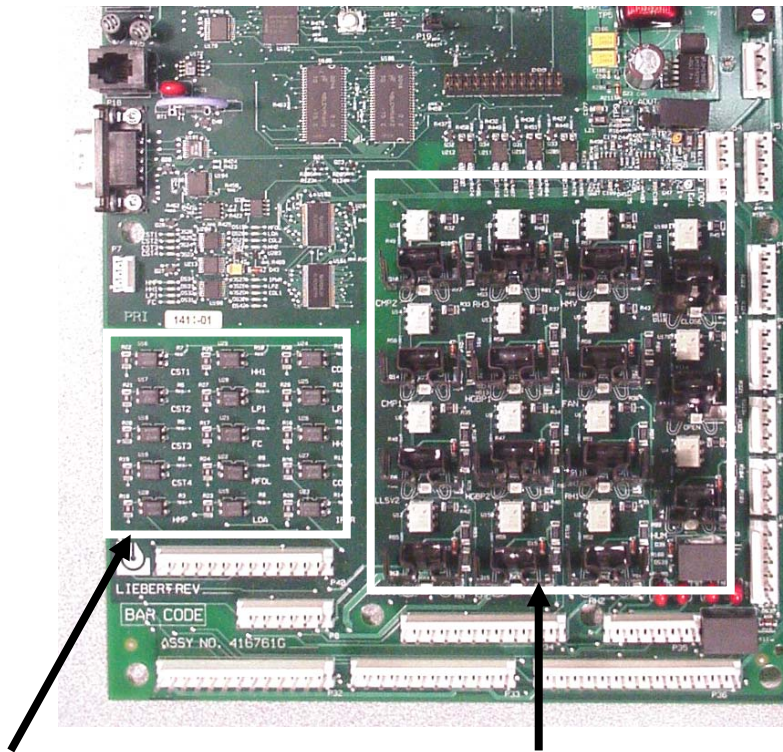
**Input Opto-Isolator Pin Location**

### INPUT VOLTAGE CHECK

|       |  |
|-------|--|
| Pin 1 | Receives the AC source voltage (This voltage is 24 VAC prior to the Opto and is about 1.2 VAC at the opto).                            |
| Pin 2 | Completes the AC source to the neutral and or safety ground.   |
| Pin 3 | Completes the DC source to the digital ground.   |
| Pin 4 | Receives the DC voltage source from the microprocessor (This voltage level is 3.3 VDC when not activated and is 0 VDC when activated.) |

**Note that all AC source checks are referenced to the associated transformer neutral and/or the safety ground, and that the DC source reference is to -V or digital ground.**

## Microprocessor Control Board: Typical Location of the Opto-Isolators and Triacs



Input Opto-Isolators

Output Opto-Isolators and Triacs

### Microprocessor Control Board

#### Alarm Input Opto-Isolator Legend:

| Opto | Purpose            | Opto | Purpose               |
|------|--------------------|------|-----------------------|
| U15  | Air Safety Switch  | U23  | Power On              |
| U16  | Custom Alarm 1     | U24  | Compressor 2 Overload |
| U17  | Custom Alarm 2     | U25  | Low Pressure Switch 2 |
| U18  | High Water Alarm   | U26  | High Head Pressure 2  |
| U19  | Custom Alarm 3     | U27  | Compressor 1 Overload |
| U20  | Humidifier Problem | U28  | Low Pressure Switch 1 |
| U21  | Filter Clog switch | U29  | High Head Pressure 1  |
| U22  | Main Fan Overload  |      |                       |

**Note: Use Pin 5 on the input opto-isolator with reference to the V- terminal for voltage check. The voltage level is 5 VDC.**

### **Control Output Opto-Isolator Legend:**

| <b>Opto</b> | <b>Purpose</b>         | <b>Opto</b> | <b>Purpose</b>          |
|-------------|------------------------|-------------|-------------------------|
| U1          | Reheat 1               | U10         | Compressor 2            |
| U2          | Reheat 2               | U11         | Econ-O-Cycle Relay (R5) |
| U3          | Reheat 3               | U12         | Liquid Line Solenoid 1  |
| U4          | Humidifier             | U13         | Hot Gas Bypass 2        |
| U5          | Main Fan               | U14         | Compressor 1            |
| U8          | Liquid Line Solenoid 2 | U17         | CW Actuator             |
| U9          | Hot Gas Bypass 2       | U18         | CW Actuator Close       |

**Note: Use Pin 4 on the output opto-isolator with reference to the correct transformer neutral/ ground. The voltage level is 24 VAC.**

### **Control Output Triac Legend:**

| <b>Opto</b> | <b>Purpose</b>         | <b>Opto</b> | <b>Purpose</b>          |
|-------------|------------------------|-------------|-------------------------|
| Q1          | Reheat 1               | Q10         | Compressor 2            |
| Q2          | Reheat 2               | Q11         | Econ-O-Cycle Relay (R5) |
| Q3          | Reheat 3               | Q12         | Liquid Line Solenoid 1  |
| Q4          | Humidifier             | Q13         | Hot Gas Bypass 2        |
| Q5          | Main Fan               | Q14         | Compressor 1            |
| Q8          | Liquid Line Solenoid 2 | Q17         | CW Actuator             |
| Q9          | Hot Gas Bypass 2       | Q18         | CW Actuator Close       |

## **iCOM Diagnostics / Service Mode Program**

The iCOM controller has a valuable tool built into software under the **SERVICE MENU**. This program allows the user to evacuate and charge the refrigerant circuit at installation, turn on/off all loads (outputs) for testing, and allows user to check all inputs.

The procedure is as follows:

- 1- From the main screen select the **SERVICE MENU** parameters.
- 2- In the **SERVICE MENU** screen select the **SERVICE** icon.
- 3- Enter password and scroll to **MANUAL MODE**, select YES with the up key.
- 4- Now scroll to Fan On and select ON with the up key. The fan must be on to operate loads in this mode. You must turn off the fan and service mode when completed.

The Compressor 1 and 2 selections are for the **ON/OFF** and **RUN, EVACUATE, and CHARGE** modes.

When user scrolls to the Compressor 1 or 2 positions in the parameters list he must press enter to select the first item. Enter again will move the cursor to the ON/OFF selection first (far right item) then using the up arrow key the compressor may be turn on and down key will turn off. Now with the cursor on the ON/OFF position, now use the right arrow key to select the RUN, EVACUATE, CHARGE function and the up or down arrow key to make changes. The RUN selection is the normal operating position.

Parameters list is found on pages in Chapter 2

## **Basic Troubleshooting Steps:**

Example: Unit load is not energizing.

### **Programming:**

1. Read and record all program parameter values.
2. Read and record all DIP (control) switch positions on all boards. Check all jumpers on each board, check for the CAN healthy light on the boards and check programming per the read and record sheet in appropriate manuals to verify selected options.
3. Turn Unit off with ON/OFF button and reboot system power (disconnect switch off - on) to reconfigure system. If programming error is detected, recheck unit for proper operation.

If problem is not resolved in programming section, begin the signal flow check.

**Signal Flow Check:** Assumption is the unit is calling for a mechanical operation but the load is not activated. Using the appropriate control training and service manual, identify the output opto-isolator to be checked, locate the opto-isolator on the PCB and perform the following.

### **DC Voltage check:**

1. Using a digital voltmeter check for the correct VDC signal at the output opto-isolator. Pin 1 referenced to -VDC will show low VDC (approximately 1.2 VDC) if the microprocessor control side of the device is functioning. A high VDC (approximately 3.3 VDC) indicates a microprocessor control problem. A meter reading of 0 VDC indicates a loss of microprocessor voltage, check VDC at the power supply referenced +VDC to -VDC should be approximately 3.3 VDC.
2. This check involves the microprocessor. To bypass the microprocessor completely, jumper from Pin 2 on the output opto-isolator to -VDC. As soon as the jumper is applied the load device should activate. If the load device activates the problem is in the microprocessor itself or the programming. If the load device does not activate continue the signal flow check.

### **AC Voltage check:**

1. Place the digital VOM meter on AC voltage scale and verify that 24 VAC is being applied to the output opto-isolator by placing the VOM between Pin 4 and the proper transformer ground connection. To verify that the switch leg of the output opto-isolator is working properly place the VOM between Pin 6 and the proper transformer ground connection. A high VAC (approximately 24 VAC) display indicates a closed switch leg; a low VAC indicates an open switch leg.

2. If the programming is correct and the output opto-isolator is functioning properly but the load device is not activated the next step is to check the triac and hard wiring to the load device. Verify that 24 VAC is being applied to Pin 1 of the triac, place the VOM leads between Pin 1 and the proper transformer ground connection. If 24 VAC is not present at Pin 1 of the triac backtrack the circuit to the proper secondary hot of the control transformer.

**If 24 VAC is present perform the following:**

Select the appropriate diagnostics function from the control menu; use the training and service manual for reference. During the TEST OUTPUTS function the green LED on the microprocessor should light. If the LED lights check the hardware from the plug to the load device. If the LED does not light run the TEST CONTROL BOARD diagnostics function. If board failure is displayed contact your local sales office.

**Note:** Triacs are current limiting devices; therefore the load device must be connected to obtain valid voltage readings when doing VOM checks and circuit troubleshooting. Repair or replace any missing or defective components in the circuit.

**Mechanical Problems:** If the failure of the load device to activate is determined to be mechanical in nature consult the appropriate Liebert system operation and maintenance, reference the individual component manufacturers literature or contact your local Liebert representative.

## Moisture Content Charts

The following charts show moisture content of various levels of relative humidity for given temperatures. Follow the procedures below to use the charts:

**STEP 1:** Locate the chart for the temperature with which you are working.

**STEP 2:** Locate the line with the relative humidity with which you are working.

**STEP 3:** Read the moisture content of the relative humidity in either grains per cubic foot or grains per pound of air.

For example, you have a room temperature of 70°F and 50% relative humidity.

**STEP 1:** Locate the chart for 70°F.

**STEP 2:** Locate the line with relative humidity 50%.

**STEP 3:** Read the moisture content value of 50% relative humidity (4.0275 grains per cubic foot of air **OR** 55.86143 grains per pound of air).

| <b>Moisture Content at Temperature = 80°F (26.7°C)</b> |                         |                       |
|--|-------------------------|-----------------------|
| <b>RH</b>  | <b>Grains Per Cu Ft</b> | <b>Grains Per Lb.</b> |
| 35   | 3.864                   | 53.59368              |
| 36   | 3.9744                  | 55.12493              |
| 37   | 4.0848                  | 56.65618              |
| 38   | 4.1952                  | 58.18743              |
| 39   | 4.3056                  | 59.71868              |
| 40   | 4.416                   | 61.24992              |
| 41   | 4.5264                  | 62.78116              |
| 42   | 4.6368                  | 64.31241              |
| 43   | 4.7472                  | 65.84367              |
| 44   | 4.8576                  | 67.37492              |
| 45   | 4.968                   | 68.90616              |
| 46   | 5.0784                  | 70.43741              |
| 47   | 5.1888                  | 71.96865              |
| 48   | 5.2992                  | 73.4999               |
| 49   | 5.4096                  | 75.03115              |
| 50   | 5.52                    | 76.5624               |
| 51   | 5.6304                  | 78.09365              |
| 52   | 5.7408                  | 79.6249               |
| 53   | 5.8512                  | 81.15615              |
| 54   | 5.9616                  | 82.68739              |
| 55   | 6.072                   | 84.21864              |
| 56   | 6.1824                  | 85.74989              |
| 57   | 6.2928                  | 87.28112              |
| 58   | 6.4032                  | 88.81239              |
| 59   | 6.5136                  | 90.34362              |
| 60   | 6.624                   | 91.87488              |
| 61   | 6.7344                  | 93.40612              |
| 62   | 6.8448                  | 94.93738              |
| 63   | 6.9552                  | 96.46862              |
| 64   | 7.0656                  | 97.99987              |
| 65   | 7.176                   | 99.53111              |



| <b>Moisture Content at Temperature = 79°F (26.1°C)</b> |                         |                       |
|--|-------------------------|-----------------------|
| <b>RH</b>  | <b>Grains Per Cu Ft</b> | <b>Grains Per Lb.</b> |
| 35   | 3.7485                  | 51.9917               |
| 36   | 3.8556                  | 53.47717              |
| 37   | 3.9627                  | 54.96265              |
| 38   | 4.0698                  | 56.44813              |
| 39   | 4.1769                  | 57.9336               |
| 40   | 4.284                   | 59.41908              |
| 41   | 4.3911                  | 60.90456              |
| 42   | 4.4982                  | 62.39004              |
| 43   | 4.6053                  | 63.87551              |
| 44   | 4.7124                  | 65.36099              |
| 45   | 4.8195                  | 66.84647              |
| 46   | 4.9266                  | 68.33194              |
| 47   | 5.0337                  | 69.81742              |
| 48   | 5.1408                  | 71.3029               |
| 49   | 5.2479                  | 72.78838              |
| 50   | 5.355                   | 74.27385              |
| 51   | 5.4621                  | 75.75933              |
| 52   | 5.5692                  | 77.2448               |
| 53   | 5.6763                  | 78.73028              |
| 54   | 5.7834                  | 80.21575              |
| 55   | 5.8905                  | 81.70123              |
| 56   | 5.9976                  | 83.18671              |
| 57   | 6.1047                  | 84.67218              |
| 58   | 6.2118                  | 86.15767              |
| 59   | 6.3189                  | 87.64314              |
| 60   | 6.426                   | 89.12862              |
| 61   | 6.5331                  | 90.6141               |
| 62   | 6.6402                  | 92.09958              |
| 63   | 6.7473                  | 93.58504              |
| 64   | 6.8544                  | 95.07052              |
| 65   | 6.9615                  | 96.55601              |

| <b>Moisture Content at Temperature = 78°F (25.6°C)</b> |                         |                       |
|--|-------------------------|-----------------------|
| <b>RH</b>  | <b>Grains Per Cu Ft</b> | <b>Grains Per Lb.</b> |
| 35   | 3.633                   | 50.38971              |
| 36   | 3.7368                  | 51.82942              |
| 37   | 3.8406                  | 53.26913              |
| 38   | 3.9444                  | 54.70883              |
| 39   | 4.0482                  | 56.14854              |
| 40   | 4.152                   | 57.58824              |
| 41   | 4.2558                  | 59.02795              |
| 42   | 4.3596                  | 60.46765              |
| 43   | 4.4634                  | 61.90736              |
| 44   | 4.5672                  | 63.34707              |
| 45   | 4.671                   | 64.78677              |
| 46   | 4.774801                | 66.22648              |
| 47   | 4.8786                  | 67.66618              |
| 48   | 4.9824                  | 69.10589              |
| 49   | 5.0862                  | 70.5456               |
| 50   | 5.19                    | 71.9853               |
| 51   | 5.2938                  | 73.425                |
| 52   | 5.3976                  | 74.86471              |
| 53   | 5.5014                  | 76.30441              |
| 54   | 5.605201                | 77.74413              |
| 55   | 5.709                   | 79.18383              |
| 56   | 5.812801                | 80.62335              |
| 57   | 5.9166                  | 82.06325              |
| 58   | 6.0204                  | 83.50295              |
| 59   | 6.1242                  | 84.94265              |
| 60   | 6.228                   | 86.38236              |
| 61   | 6.3318                  | 87.82207              |
| 62   | 6.4356                  | 89.26176              |
| 63   | 6.5394                  | 90.70148              |
| 64   | 6.6432                  | 92.14118              |
| 65   | 6.747                   | 93.58089              |

| <b>Moisture Content at Temperature = 77°F (25.0°C)</b> |                         |                       |
|--|-------------------------|-----------------------|
| <b>RH</b>  | <b>Grains Per Cu Ft</b> | <b>Grains Per Lb.</b> |
| 35   | 3.521                   | 48.83628              |
| 36   | 3.6216                  | 50.2316               |
| 37   | 3.7222                  | 51.62691              |
| 38   | 3.8228                  | 53.02224              |
| 39   | 3.9234                  | 54.41756              |
| 40   | 4.024                   | 55.81288              |
| 41   | 4.124601                | 57.20821              |
| 42   | 4.2252                  | 58.60353              |
| 43   | 4.3258                  | 59.99885              |
| 44   | 4.4264                  | 61.39417              |
| 45   | 4.527                   | 62.78949              |
| 46   | 4.6276                  | 64.18481              |
| 47   | 4.7282                  | 65.58013              |
| 48   | 4.8288                  | 66.97546              |
| 49   | 4.9294                  | 68.37078              |
| 50   | 5.03                    | 69.7661               |
| 51   | 5.1306                  | 71.16143              |
| 52   | 5.2312                  | 72.55674              |
| 53   | 5.3318                  | 73.95206              |
| 54   | 5.4324                  | 75.34738              |
| 55   | 5.533001                | 76.74271              |
| 56   | 5.6336                  | 78.13803              |
| 57   | 5.734201                | 79.53336              |
| 58   | 5.8348                  | 80.92868              |
| 59   | 5.935401                | 82.32401              |
| 60   | 6.036001                | 83.71933              |
| 61   | 6.136601                | 85.11465              |
| 62   | 6.237201                | 86.50996              |
| 63   | 6.3378                  | 87.90529              |
| 64   | 6.438401                | 89.30061              |
| 65   | 6.539                   | 90.69593              |

| <b>Moisture Content at Temperature = 76°F (24.4°C)</b> |                         |                       |
|--|-------------------------|-----------------------|
| <b>RH</b>  | <b>Grains Per Cu Ft</b> | <b>Grains Per Lb.</b> |
| 35   | 3.41215                 | 47.32652              |
| 36   | 3.50964                 | 48.67871              |
| 37   | 3.60713                 | 50.03089              |
| 38   | 3.70462                 | 51.38307              |
| 39   | 3.80211                 | 52.73527              |
| 40   | 3.8996                  | 54.08745              |
| 41   | 3.99709                 | 55.43964              |
| 42   | 4.09458                 | 56.79182              |
| 43   | 4.19207                 | 58.14401              |
| 44   | 4.28956                 | 59.4962               |
| 45   | 4.38705                 | 60.84838              |
| 46   | 4.48454                 | 62.20057              |
| 47   | 4.58203                 | 63.55276              |
| 48   | 4.67952                 | 64.90494              |
| 49   | 4.77701                 | 66.25713              |
| 50   | 4.8745                  | 67.60931              |
| 51   | 4.97199                 | 68.9615               |
| 52   | 5.06948                 | 70.31368              |
| 53   | 5.16697                 | 71.66587              |
| 54   | 5.26446                 | 73.01805              |
| 55   | 5.36195                 | 74.37024              |
| 56   | 5.45944                 | 75.72243              |
| 57   | 5.55693                 | 77.07461              |
| 58   | 5.65442                 | 78.4268               |
| 59   | 5.75191                 | 79.77898              |
| 60   | 5.8494                  | 81.13118              |
| 61   | 5.94689                 | 82.48336              |
| 62   | 6.04438                 | 83.83555              |
| 63   | 6.14187                 | 85.18773              |
| 64   | 6.23936                 | 86.53992              |
| 65   | 6.336849                | 87.8921               |

| <b>Moisture Content at Temperature = 75°F (23.9°C)</b> |                         |                       |
|--|-------------------------|-----------------------|
| <b>RH</b>  | <b>Grains Per Cu Ft</b> | <b>Grains Per Lb.</b> |
| 35   | 3.3068                  | 45.86532              |
| 36   | 3.40128                 | 47.17575              |
| 37   | 3.49576                 | 48.48619              |
| 38   | 3.59024                 | 49.79663              |
| 39   | 3.68472                 | 51.10707              |
| 40   | 3.7792                  | 52.4175               |
| 41   | 3.87368                 | 53.72794              |
| 42   | 3.96816                 | 55.03838              |
| 43   | 4.06264                 | 56.34882              |
| 44   | 4.15712                 | 57.65926              |
| 45   | 4.251601                | 58.9697               |
| 46   | 4.34608                 | 60.28013              |
| 47   | 4.44056                 | 61.59057              |
| 48   | 4.53504                 | 62.901                |
| 49   | 4.62952                 | 64.21145              |
| 50   | 4.724                   | 65.52188              |
| 51   | 4.81848                 | 66.83231              |
| 52   | 4.91296                 | 68.14276              |
| 53   | 5.00744                 | 69.45319              |
| 54   | 5.10192                 | 70.76363              |
| 55   | 5.1964                  | 72.07407              |
| 56   | 5.29088                 | 73.38451              |
| 57   | 5.38536                 | 74.69495              |
| 58   | 5.479841                | 76.00539              |
| 59   | 5.57432                 | 77.31581              |
| 60   | 5.6688                  | 78.62625              |
| 61   | 5.76328                 | 79.9367               |
| 62   | 5.85776                 | 81.24713              |
| 63   | 5.95224                 | 82.55757              |
| 64   | 6.04672                 | 83.86801              |
| 65   | 6.1412                  | 85.17844              |

| <b>Moisture Content at Temperature = 74°F (23.3°C)</b> |                         |                       |
|--|-------------------------|-----------------------|
| <b>RH</b>  | <b>Grains Per Cu Ft</b> | <b>Grains Per Lb.</b> |
| 35   | 3.20355                 | 44.43324              |
| 36   | 3.29508                 | 45.70276              |
| 37   | 3.38661                 | 46.97228              |
| 38   | 3.47814                 | 48.2418               |
| 39   | 3.56967                 | 49.51132              |
| 40   | 3.6612                  | 50.78085              |
| 41   | 3.75273                 | 52.05037              |
| 42   | 3.84426                 | 53.31989              |
| 43   | 3.93579                 | 54.58941              |
| 44   | 4.02732                 | 55.85893              |
| 45   | 4.11885                 | 57.12845              |
| 46   | 4.21038                 | 58.39797              |
| 47   | 4.30191                 | 59.66749              |
| 48   | 4.39344                 | 60.93701              |
| 49   | 4.48497                 | 62.20654              |
| 50   | 4.5765                  | 63.47605              |
| 51   | 4.66803                 | 64.74558              |
| 52   | 4.75956                 | 66.0151               |
| 53   | 4.85109                 | 67.28461              |
| 54   | 4.94262                 | 68.55414              |
| 55   | 5.03415                 | 69.82366              |
| 56   | 5.12568                 | 71.09318              |
| 57   | 5.21721                 | 72.3627               |
| 58   | 5.30874                 | 73.63223              |
| 59   | 5.40027                 | 74.90173              |
| 60   | 5.4918                  | 76.17126              |
| 61   | 5.58333                 | 77.44079              |
| 62   | 5.67486                 | 78.7103               |
| 63   | 5.76639                 | 79.97983              |
| 64   | 5.85792                 | 81.24935              |
| 65   | 5.94945                 | 82.51887              |

| <b>Moisture Content at Temperature = 73°F (22.8°C)</b> |                         |                       |
|--|-------------------------|-----------------------|
| <b>RH</b>  | <b>Grains Per Cu Ft</b> | <b>Grains Per Lb.</b> |
| 35   | 3.10345                 | 43.04485              |
| 36   | 3.19212                 | 44.2747               |
| 37   | 3.28079                 | 45.50456              |
| 38   | 3.36946                 | 46.73441              |
| 39   | 3.45813                 | 47.96426              |
| 40   | 3.5468                  | 49.19412              |
| 41   | 3.63547                 | 50.42397              |
| 42   | 3.72414                 | 51.65382              |
| 43   | 3.81281                 | 52.88367              |
| 44   | 3.90148                 | 54.11352              |
| 45   | 3.99015                 | 55.34338              |
| 46   | 4.07882                 | 56.57323              |
| 47   | 4.16749                 | 57.80309              |
| 48   | 4.25616                 | 59.03294              |
| 49   | 4.34483                 | 60.26279              |
| 50   | 4.4335                  | 61.49264              |
| 51   | 4.52217                 | 62.72249              |
| 52   | 4.61084                 | 63.95235              |
| 53   | 4.69951                 | 65.1822               |
| 54   | 4.78818                 | 66.41206              |
| 55   | 4.87685                 | 67.64191              |
| 56   | 4.96552                 | 68.87176              |
| 57   | 5.05419                 | 70.10161              |
| 58   | 5.14286                 | 71.33146              |
| 59   | 5.23153                 | 72.56132              |
| 60   | 5.3202                  | 73.79117              |
| 61   | 5.40887                 | 75.02102              |
| 62   | 5.49754                 | 76.25087              |
| 63   | 5.58621                 | 77.48073              |
| 64   | 5.67488                 | 78.71058              |
| 65   | 5.76355                 | 79.94044              |

| <b>Moisture Content at Temperature = 72°F (22.2°C)</b> |                         |                       |
|--|-------------------------|-----------------------|
| <b>RH</b>  | <b>Grains Per Cu Ft</b> | <b>Grains Per Lb.</b> |
| 35   | 2.9988                  | 41.59336              |
| 36   | 3.08448                 | 42.78174              |
| 37   | 3.17016                 | 43.97012              |
| 38   | 3.25584                 | 45.1585               |
| 39   | 3.34152                 | 46.34688              |
| 40   | 3.4272                  | 47.53527              |
| 41   | 3.51288                 | 48.72365              |
| 42   | 3.59856                 | 49.91203              |
| 43   | 3.68424                 | 51.10041              |
| 44   | 3.76992                 | 52.28879              |
| 45   | 3.8556                  | 53.47717              |
| 46   | 3.94128                 | 54.66555              |
| 47   | 4.02696                 | 55.85393              |
| 48   | 4.11264                 | 57.04232              |
| 49   | 4.19832                 | 58.2307               |
| 50   | 4.284                   | 59.41908              |
| 51   | 4.36968                 | 60.60746              |
| 52   | 4.45536                 | 61.79584              |
| 53   | 4.54104                 | 62.98422              |
| 54   | 4.62672                 | 64.17261              |
| 55   | 4.7124                  | 65.36099              |
| 56   | 4.79808                 | 66.54937              |
| 57   | 4.88376                 | 67.73775              |
| 58   | 4.96944                 | 68.92613              |
| 59   | 5.05512                 | 70.11452              |
| 60   | 5.1408                  | 71.30289              |
| 61   | 5.22648                 | 72.49128              |
| 62   | 5.31216                 | 73.67966              |
| 63   | 5.39784                 | 74.86805              |
| 64   | 5.48352                 | 76.05642              |
| 65   | 5.5692                  | 77.2448               |



| <b>Moisture Content at Temperature = 71°F (21.7°C)</b> |                         |                       |
|--|-------------------------|-----------------------|
| <b>RH</b>  | <b>Grains Per Cu Ft</b> | <b>Grains Per Lb.</b> |
| 35   | 2.91165                 | 40.38459              |
| 36   | 2.99484                 | 41.53843              |
| 37   | 3.07803                 | 42.69228              |
| 38   | 3.16122                 | 43.84613              |
| 39   | 3.24441                 | 44.99997              |
| 40   | 3.3276                  | 46.15381              |
| 41   | 3.41079                 | 47.30766              |
| 42   | 3.49398                 | 48.46151              |
| 43   | 3.57717                 | 49.61535              |
| 44   | 3.66036                 | 50.7692               |
| 45   | 3.74355                 | 51.92304              |
| 46   | 3.82674                 | 53.07688              |
| 47   | 3.90993                 | 54.23073              |
| 48   | 3.99312                 | 55.38458              |
| 49   | 4.07631                 | 56.53842              |
| 50   | 4.1595                  | 57.69227              |
| 51   | 4.24269                 | 58.84611              |
| 52   | 4.32588                 | 59.99996              |
| 53   | 4.40907                 | 61.1538               |
| 54   | 4.49226                 | 62.30765              |
| 55   | 4.57545                 | 63.46149              |
| 56   | 4.65864                 | 64.61533              |
| 57   | 4.74183                 | 65.76918              |
| 58   | 4.825021                | 66.92304              |
| 59   | 4.908211                | 68.07688              |
| 60   | 4.9914                  | 69.23072              |
| 61   | 5.07459                 | 70.38457              |
| 62   | 5.15778                 | 71.53841              |
| 63   | 5.240971                | 72.69226              |
| 64   | 5.32416                 | 73.8461               |
| 65   | 5.40735                 | 74.99994              |

| <b>Moisture Content at Temperature = 70°F (21.1°C)</b> |                         |                       |
|--|-------------------------|-----------------------|
| <b>RH</b>  | <b>Grains Per Cu Ft</b> | <b>Grains Per Lb.</b> |
| 35   | 2.81925                 | 39.103                |
| 36   | 2.8998                  | 40.22023              |
| 37   | 2.98035                 | 41.33746              |
| 38   | 3.0609                  | 42.45469              |
| 39   | 3.14145                 | 43.57192              |
| 40   | 3.222                   | 44.68914              |
| 41   | 3.30255                 | 45.80637              |
| 42   | 3.3831                  | 46.9236               |
| 43   | 3.46365                 | 48.04083              |
| 44   | 3.5442                  | 49.15806              |
| 45   | 3.62475                 | 50.27529              |
| 46   | 3.7053                  | 51.39252              |
| 47   | 3.78585                 | 52.50975              |
| 48   | 3.8664                  | 53.62697              |
| 49   | 3.94695                 | 54.7442               |
| 50   | 4.0275                  | 55.86143              |
| 51   | 4.10805                 | 56.97866              |
| 52   | 4.1886                  | 58.09588              |
| 53   | 4.269151                | 59.21311              |
| 54   | 4.349701                | 60.33035              |
| 55   | 4.43025                 | 61.44757              |
| 56   | 4.510801                | 62.5648               |
| 57   | 4.59135                 | 63.68203              |
| 58   | 4.6719                  | 64.79925              |
| 59   | 4.75245                 | 65.91648              |
| 60   | 4.833                   | 67.03371              |
| 61   | 4.91355                 | 68.15094              |
| 62   | 4.994101                | 69.26818              |
| 63   | 5.074651                | 70.3854               |
| 64   | 5.1552                  | 71.50263              |
| 65   | 5.23575                 | 72.61986              |

| <b>Moisture Content at Temperature = 69°F (20.6°C)</b> |                         |                       |
|--|-------------------------|-----------------------|
| <b>RH</b>  | <b>Grains Per Cu Ft</b> | <b>Grains Per Lb.</b> |
| 35   | 2.7293                  | 37.85539              |
| 36   | 2.80728                 | 38.93697              |
| 37   | 2.88526                 | 40.01856              |
| 38   | 2.96324                 | 41.10014              |
| 39   | 3.04122                 | 42.18173              |
| 40   | 3.1192                  | 43.2633               |
| 41   | 3.19718                 | 44.34489              |
| 42   | 3.27516                 | 45.42647              |
| 43   | 3.35314                 | 46.50805              |
| 44   | 3.43112                 | 47.58964              |
| 45   | 3.5091                  | 48.67122              |
| 46   | 3.58708                 | 49.7528               |
| 47   | 3.66506                 | 50.83438              |
| 48   | 3.74304                 | 51.91596              |
| 49   | 3.82102                 | 52.99755              |
| 50   | 3.899                   | 54.07913              |
| 51   | 3.97698                 | 55.16072              |
| 52   | 4.05496                 | 56.2423               |
| 53   | 4.13294                 | 57.32389              |
| 54   | 4.21092                 | 58.40546              |
| 55   | 4.2889                  | 59.48704              |
| 56   | 4.36688                 | 60.56863              |
| 57   | 4.44486                 | 61.65021              |
| 58   | 4.52284                 | 62.73179              |
| 59   | 4.60082                 | 63.81338              |
| 60   | 4.6788                  | 64.89496              |
| 61   | 4.75678                 | 65.97653              |
| 62   | 4.83476                 | 67.05811              |
| 63   | 4.91274                 | 68.1397               |
| 64   | 4.99072                 | 69.22128              |
| 65   | 5.0687                  | 70.30286              |

| <b>Moisture Content at Temperature = 68°F (20.0°C)</b> |                         |                       |
|--|-------------------------|-----------------------|
| <b>RH</b>  | <b>Grains Per Cu Ft</b> | <b>Grains Per Lb.</b> |
| 35   | 2.64985                 | 36.75342              |
| 36   | 2.72556                 | 37.80352              |
| 37   | 2.80127                 | 38.85362              |
| 38   | 2.87698                 | 39.90371              |
| 39   | 2.95269                 | 40.95381              |
| 40   | 3.0284                  | 42.00391              |
| 41   | 3.10411                 | 43.05401              |
| 42   | 3.17982                 | 44.10411              |
| 43   | 3.25553                 | 45.1542               |
| 44   | 3.33124                 | 46.2043               |
| 45   | 3.40695                 | 47.2544               |
| 46   | 3.48266                 | 48.30449              |
| 47   | 3.55837                 | 49.35459              |
| 48   | 3.63408                 | 50.40469              |
| 49   | 3.70979                 | 51.45479              |
| 50   | 3.7855                  | 52.50489              |
| 51   | 3.86121                 | 53.55499              |
| 52   | 3.93692                 | 54.60509              |
| 53   | 4.01263                 | 55.65518              |
| 54   | 4.08834                 | 56.70528              |
| 55   | 4.16405                 | 57.75538              |
| 56   | 4.23976                 | 58.80547              |
| 57   | 4.31547                 | 59.85557              |
| 58   | 4.39118                 | 60.90567              |
| 59   | 4.46689                 | 61.95576              |
| 60   | 4.5426                  | 63.00587              |
| 61   | 4.61831                 | 64.05596              |
| 62   | 4.694021                | 65.10606              |
| 63   | 4.76973                 | 66.15616              |
| 64   | 4.84544                 | 67.20625              |
| 65   | 4.92115                 | 68.25635              |

| <b>Moisture Content at Temperature = 67°F (19.4°C)</b> |                         |                       |
|--|-------------------------|-----------------------|
| <b>RH</b>  | <b>Grains Per Cu Ft</b> | <b>Grains Per Lb.</b> |
| 35   | 2.5578                  | 35.47669              |
| 36   | 2.63088                 | 36.49031              |
| 37   | 2.70396                 | 37.50393              |
| 38   | 2.77704                 | 38.51755              |
| 39   | 2.85012                 | 39.53116              |
| 40   | 2.9232                  | 40.54479              |
| 41   | 2.99628                 | 41.5584               |
| 42   | 3.06936                 | 42.57202              |
| 43   | 3.14244                 | 43.58565              |
| 44   | 3.21552                 | 44.59926              |
| 45   | 3.2886                  | 45.61288              |
| 46   | 3.36168                 | 46.62651              |
| 47   | 3.43476                 | 47.64012              |
| 48   | 3.50784                 | 48.65374              |
| 49   | 3.58092                 | 49.66736              |
| 50   | 3.654                   | 50.68098              |
| 51   | 3.72708                 | 51.6946               |
| 52   | 3.80016                 | 52.70822              |
| 53   | 3.87324                 | 53.72184              |
| 54   | 3.94632                 | 54.73546              |
| 55   | 4.0194                  | 55.74908              |
| 56   | 4.09248                 | 56.7627               |
| 57   | 4.16556                 | 57.77632              |
| 58   | 4.238641                | 58.78994              |
| 59   | 4.31172                 | 59.80356              |
| 60   | 4.3848                  | 60.81718              |
| 61   | 4.45788                 | 61.8308               |
| 62   | 4.53096                 | 62.84442              |
| 63   | 4.60404                 | 63.85804              |
| 64   | 4.67712                 | 64.87166              |
| 65   | 4.750201                | 65.88528              |

| <b>Moisture Content at Temperature = 66°F (18.9°C)</b> |                         |                       |
|--|-------------------------|-----------------------|
| <b>RH</b>  | <b>Grains Per Cu Ft</b> | <b>Grains Per Lb.</b> |
| 35   | 2.4759                  | 34.34073              |
| 36   | 2.54664                 | 35.3219               |
| 37   | 2.61738                 | 36.30306              |
| 38   | 2.68812                 | 37.28422              |
| 39   | 2.75886                 | 38.26539              |
| 40   | 2.8296                  | 39.24655              |
| 41   | 2.90034                 | 40.22772              |
| 42   | 2.97108                 | 41.20888              |
| 43   | 3.04182                 | 42.19005              |
| 44   | 3.11256                 | 43.17121              |
| 45   | 3.1833                  | 44.15237              |
| 46   | 3.25404                 | 45.13354              |
| 47   | 3.32478                 | 46.1147               |
| 48   | 3.39552                 | 47.09587              |
| 49   | 3.46626                 | 48.07703              |
| 50   | 3.537                   | 49.05819              |
| 51   | 3.60774                 | 50.03935              |
| 52   | 3.67848                 | 51.02052              |
| 53   | 3.74922                 | 52.00168              |
| 54   | 3.81996                 | 52.98285              |
| 55   | 3.8907                  | 53.96401              |
| 56   | 3.96144                 | 54.94517              |
| 57   | 4.03218                 | 55.92634              |
| 58   | 4.10292                 | 56.9075               |
| 59   | 4.17366                 | 57.88866              |
| 60   | 4.2444                  | 58.86983              |
| 61   | 4.31514                 | 59.85099              |
| 62   | 4.38588                 | 60.83216              |
| 63   | 4.45662                 | 61.81332              |
| 64   | 4.52736                 | 62.79449              |
| 65   | 4.5981                  | 63.77564              |

| <b>Moisture Content at Temperature = 65°F (18.3°C)</b> |                         |                       |
|--|-------------------------|-----------------------|
| <b>RH</b>  | <b>Grains Per Cu Ft</b> | <b>Grains Per Lb.</b> |
| 35   | 2.39575                 | 33.22905              |
| 36   | 2.4642                  | 34.17846              |
| 37   | 2.53265                 | 35.12785              |
| 38   | 2.6011                  | 36.07726              |
| 39   | 2.66955                 | 37.02666              |
| 40   | 2.738                   | 37.97606              |
| 41   | 2.80645                 | 38.92546              |
| 42   | 2.8749                  | 39.87486              |
| 43   | 2.94335                 | 40.82426              |
| 44   | 3.0118                  | 41.77366              |
| 45   | 3.08025                 | 42.72307              |
| 46   | 3.1487                  | 43.67247              |
| 47   | 3.21715                 | 44.62187              |
| 48   | 3.2856                  | 45.57127              |
| 49   | 3.35405                 | 46.52067              |
| 50   | 3.4225                  | 47.47008              |
| 51   | 3.49095                 | 48.41947              |
| 52   | 3.5594                  | 49.36888              |
| 53   | 3.62785                 | 50.31828              |
| 54   | 3.6963                  | 51.26768              |
| 55   | 3.76475                 | 52.21708              |
| 56   | 3.8332                  | 53.16648              |
| 57   | 3.90165                 | 54.11589              |
| 58   | 3.9701                  | 55.06528              |
| 59   | 4.03855                 | 56.01469              |
| 60   | 4.107                   | 56.96409              |
| 61   | 4.17545                 | 57.91349              |
| 62   | 4.2439                  | 58.86289              |
| 63   | 4.31235                 | 59.81229              |
| 64   | 4.3808                  | 60.76169              |
| 65   | 4.44925                 | 61.7111               |

## Suction Transducer Information (Codes A124-A128)

| %  | psig  | psia  | volts | barg  | bara  | %   | psig  | psia  | volts | barg  | bara  |
|----|-------|-------|-------|-------|-------|-----|-------|-------|-------|-------|-------|
| 0  | -33.5 | -18.8 | 0     | -2.31 | -1.29 | 51  | 62.2  | 76.9  | 2.55  | 4.29  | 5.30  |
| 1  | -31.6 | -16.9 | 0.05  | -2.18 | -1.16 | 52  | 64.1  | 78.8  | 2.6   | 4.42  | 5.43  |
| 2  | -29.7 | -15.0 | 0.1   | -2.05 | -1.03 | 53  | 65.9  | 80.6  | 2.65  | 4.55  | 5.56  |
| 3  | -27.8 | -13.1 | 0.15  | -1.92 | -0.90 | 54  | 67.8  | 82.5  | 2.7   | 4.67  | 5.69  |
| 4  | -26.0 | -11.3 | 0.2   | -1.79 | -0.78 | 55  | 69.7  | 84.4  | 2.75  | 4.80  | 5.82  |
| 5  | -24.1 | -9.4  | 0.25  | -1.66 | -0.65 | 56  | 71.6  | 86.3  | 2.8   | 4.93  | 5.95  |
| 6  | -22.2 | -7.5  | 0.3   | -1.53 | -0.52 | 57  | 73.4  | 88.1  | 2.85  | 5.06  | 6.08  |
| 7  | -20.3 | -5.6  | 0.35  | -1.40 | -0.39 | 58  | 75.3  | 90.0  | 2.9   | 5.19  | 6.21  |
| 8  | -18.5 | -3.8  | 0.4   | -1.27 | -0.26 | 59  | 77.2  | 91.9  | 2.95  | 5.32  | 6.33  |
| 9  | -16.6 | -1.9  | 0.45  | -1.14 | -0.13 | 60  | 79.1  | 93.8  | 3     | 5.45  | 6.46  |
| 10 | -14.7 | 0.0   | 0.5   | -1.01 | 0.00  | 61  | 80.9  | 95.6  | 3.05  | 5.58  | 6.59  |
| 11 | -12.8 | 1.9   | 0.55  | -0.88 | 0.13  | 62  | 82.8  | 97.5  | 3.1   | 5.71  | 6.72  |
| 12 | -11.0 | 3.8   | 0.6   | -0.75 | 0.26  | 63  | 84.7  | 99.4  | 3.15  | 5.84  | 6.85  |
| 13 | -9.1  | 5.6   | 0.65  | -0.63 | 0.39  | 64  | 86.6  | 101.3 | 3.2   | 5.97  | 6.98  |
| 14 | -7.2  | 7.5   | 0.7   | -0.50 | 0.52  | 65  | 88.4  | 103.1 | 3.25  | 6.10  | 7.11  |
| 15 | -5.3  | 9.4   | 0.75  | -0.37 | 0.65  | 66  | 90.3  | 105.0 | 3.3   | 6.23  | 7.24  |
| 16 | -3.5  | 11.3  | 0.8   | -0.24 | 0.78  | 67  | 92.2  | 106.9 | 3.35  | 6.36  | 7.37  |
| 17 | -1.6  | 13.1  | 0.85  | -0.11 | 0.90  | 68  | 94.1  | 108.8 | 3.4   | 6.48  | 7.50  |
| 18 | 0.3   | 15.0  | 0.9   | 0.02  | 1.03  | 69  | 95.9  | 110.6 | 3.45  | 6.61  | 7.63  |
| 19 | 2.2   | 16.9  | 0.95  | 0.15  | 1.16  | 70  | 97.8  | 112.5 | 3.5   | 6.74  | 7.76  |
| 20 | 4.1   | 18.8  | 1     | 0.28  | 1.29  | 71  | 99.7  | 114.4 | 3.55  | 6.87  | 7.89  |
| 21 | 5.9   | 20.6  | 1.05  | 0.41  | 1.42  | 72  | 101.6 | 116.3 | 3.6   | 7.00  | 8.02  |
| 22 | 7.8   | 22.5  | 1.1   | 0.54  | 1.55  | 73  | 103.4 | 118.1 | 3.65  | 7.13  | 8.14  |
| 23 | 9.7   | 24.4  | 1.15  | 0.67  | 1.68  | 74  | 105.3 | 120.0 | 3.7   | 7.26  | 8.27  |
| 24 | 11.6  | 26.3  | 1.2   | 0.80  | 1.81  | 75  | 107.2 | 121.9 | 3.75  | 7.39  | 8.40  |
| 25 | 13.4  | 28.1  | 1.25  | 0.93  | 1.94  | 76  | 109.1 | 123.8 | 3.8   | 7.52  | 8.53  |
| 26 | 15.3  | 30.0  | 1.3   | 1.05  | 2.07  | 77  | 110.9 | 125.6 | 3.85  | 7.65  | 8.66  |
| 27 | 17.2  | 31.9  | 1.35  | 1.18  | 2.20  | 78  | 112.8 | 127.5 | 3.9   | 7.78  | 8.79  |
| 28 | 19.1  | 33.8  | 1.4   | 1.31  | 2.33  | 79  | 114.7 | 129.4 | 3.95  | 7.91  | 8.92  |
| 29 | 20.9  | 35.6  | 1.45  | 1.44  | 2.46  | 80  | 116.6 | 131.3 | 4     | 8.04  | 9.05  |
| 30 | 22.8  | 37.5  | 1.5   | 1.57  | 2.59  | 81  | 118.4 | 133.1 | 4.05  | 8.16  | 9.18  |
| 31 | 24.7  | 39.4  | 1.55  | 1.70  | 2.71  | 82  | 120.3 | 135.0 | 4.1   | 8.29  | 9.31  |
| 32 | 26.6  | 41.3  | 1.6   | 1.83  | 2.84  | 83  | 122.2 | 136.9 | 4.15  | 8.42  | 9.44  |
| 33 | 28.4  | 43.1  | 1.65  | 1.96  | 2.97  | 84  | 124.1 | 138.8 | 4.2   | 8.55  | 9.57  |
| 34 | 30.3  | 45.0  | 1.7   | 2.09  | 3.10  | 85  | 125.9 | 140.6 | 4.25  | 8.68  | 9.70  |
| 35 | 32.2  | 46.9  | 1.75  | 2.22  | 3.23  | 86  | 127.8 | 142.5 | 4.3   | 8.81  | 9.82  |
| 36 | 34.1  | 48.8  | 1.8   | 2.35  | 3.36  | 87  | 129.7 | 144.4 | 4.35  | 8.94  | 9.95  |
| 37 | 35.9  | 50.6  | 1.85  | 2.48  | 3.49  | 88  | 131.6 | 146.3 | 4.4   | 9.07  | 10.08 |
| 38 | 37.8  | 52.5  | 1.9   | 2.61  | 3.62  | 89  | 133.4 | 148.1 | 4.45  | 9.20  | 10.21 |
| 39 | 39.7  | 54.4  | 1.95  | 2.74  | 3.75  | 90  | 135.3 | 150.0 | 4.5   | 9.33  | 10.34 |
| 40 | 41.6  | 56.3  | 2     | 2.86  | 3.88  | 91  | 137.2 | 151.9 | 4.55  | 9.46  | 10.47 |
| 41 | 43.4  | 58.1  | 2.05  | 2.99  | 4.01  | 92  | 139.1 | 153.8 | 4.6   | 9.59  | 10.60 |
| 42 | 45.3  | 60.0  | 2.1   | 3.12  | 4.14  | 93  | 140.9 | 155.6 | 4.65  | 9.72  | 10.73 |
| 43 | 47.2  | 61.9  | 2.15  | 3.25  | 4.27  | 94  | 142.8 | 157.5 | 4.7   | 9.85  | 10.86 |
| 44 | 49.1  | 63.8  | 2.2   | 3.38  | 4.40  | 95  | 144.7 | 159.4 | 4.75  | 9.97  | 10.99 |
| 45 | 50.9  | 65.6  | 2.25  | 3.51  | 4.52  | 96  | 146.6 | 161.3 | 4.8   | 10.10 | 11.12 |
| 46 | 52.8  | 67.5  | 2.3   | 3.64  | 4.65  | 97  | 148.4 | 163.1 | 4.85  | 10.23 | 11.25 |
| 47 | 54.7  | 69.4  | 2.35  | 3.77  | 4.78  | 98  | 150.3 | 165.0 | 4.9   | 10.36 | 11.38 |
| 48 | 56.6  | 71.3  | 2.4   | 3.90  | 4.91  | 99  | 152.2 | 166.9 | 4.95  | 10.49 | 11.51 |
| 49 | 58.4  | 73.1  | 2.45  | 4.03  | 5.04  | 100 | 154.1 | 168.8 | 5     | 10.62 | 11.63 |
| 50 | 60.3  | 75.0  | 2.5   | 4.16  | 5.17  |     |       |       |       |       |       |



## **Digital Scroll High Temperature Sensor Chart NTC (Code S606 and S608)**

| <b>Deg C</b> | <b>Deg F</b> | <b>Resistance<br/>(kOhms)</b> |
|--------------|--------------|-------------------------------|
| -40          | -40          | 2889.60                       |
| -35          | -31          | 2087.22                       |
| -30          | -22          | 1522.20                       |
| -25          | -13          | 1121.44                       |
| -20          | -4           | 834.72                        |
| -15          | 5            | 627.28                        |
| -10          | 14           | 475.74                        |
| -5           | 23           | 363.99                        |
| 0            | 32           | 280.82                        |
| 5            | 41           | 218.41                        |
| 10           | 50           | 171.17                        |
| 15           | 59           | 135.14                        |
| 20           | 68           | 107.44                        |
| 25           | 77           | 86.00                         |
| 30           | 86           | 69.28                         |
| 35           | 95           | 56.16                         |
| 40           | 104          | 45.81                         |
| 45           | 113          | 37.58                         |
| 50           | 122          | 30.99                         |
| 55           | 131          | 25.68                         |
| 60           | 140          | 21.40                         |
| 65           | 149          | 17.91                         |
| 70           | 158          | 15.07                         |
| 75           | 167          | 12.73                         |
| 80           | 176          | 10.79                         |
| 85           | 185          | 9.20                          |
| 90           | 194          | 7.87                          |
| 95           | 203          | 6.77                          |
| 100          | 212          | 5.85                          |
| 105          | 221          | 5.09                          |
| 110          | 230          | 4.45                          |
| 115          | 239          | 3.87                          |
| 120          | 248          | 3.35                          |
| 125          | 257          | 2.92                          |
| 130          | 266          | 2.58                          |
| 135          | 275          | 2.28                          |
| 140          | 284          | 2.02                          |
| 145          | 293          | 1.80                          |
| 150          | 302          | 1.59                          |
| 155          | 311          | 1.39                          |
| 160          | 320          | 1.25                          |
| 165          | 329          | 1.12                          |
| 170          | 338          | 1.01                          |
| 175          | 347          | 0.92                          |
| 180          | 356          | 0.83                          |

## Unit Code Description

The iCOM controller uses a system parameters auto configuration methodology. The unit will have a code on a serial tag displayed on the front of the electric panel. This code when entered during the factory QA process will define unit configuration and auto set various parameters for functionality. The sheets in the back of this manual will allow the service technician to understand and be able to enter this unit code manually if necessary through the control panel and the **FACTORY SETTINGS** parameter. The parameter codes are listed in Chapter as A001 to A011. The **UNIT CODE** ID numbers must be entered in groups of six at a time. When all ID numbers of the **UNIT CODE** are entered user must select A008 to “Send and Execute Unit Code” then verify parameter code A011 for a “**VALID**” status. If **UNIT CODE** is missing or lost the unit will not start until the correct code is entered and saved.

The **UNIT CODE** sheets will show a **VALUE** field on the left of the first page and followed by 18 columns of unit configuration definitions.

**THIS UNIT CODE IS NOT TO BE CHANGED UNLESS INSTRUCTED BY A  
FACTORY SERVICE TECHNICIAN.**

## **Troubleshooting Checklist**

1. Check the obvious before beginning troubleshooting.
  - A. Be sure that a remote control switch has not been shut off.
  - B. Be sure that the communication cable is properly connected.
  - C. Be sure that power is reaching all modules associated with the system.
2. Power down the entire unit during the process of removing or replacing any component or cable.
  - A. Serious damage to components may result if this step is not taken.
  - B. After removal or replacement actions, power may be restored to the unit.
3. Wear a personal ground strap when handling printed circuit boards or associated connecting cables. Static electricity, besides being annoying, can damage delicate electronic components.
4. Protect exposed components from accidental contact by personnel or dropped hardware or tools.
5. When checking voltage, use the correct reference (ground) points. The chassis is not always the correct ground point, especially within the electronic housing.
6. Reassemble modules correctly.
  - A. Observe assembled appearance prior to disassembly.
  - B. Replace all hardware (especially insulating or nylon hardware) in the same places and in the same relationship as the original.
7. When advised to check and replace cables, do the following:
  - A. Inspect for damaged insulation, broken conductors, and/or loose connectors.
  - B. Check continuity with an ohm meter (Flex cable while checking.).
  - C. Make certain that connectors mate firmly with proper receptacles.
8. When changing set points to cause a call for heating or cooling, set the points at least 10°-15° above (for heating) or below (for cooling) the present room temperature.
9. Bring the room temperature level to within the working range of the equipment (35°-90°F) before attempting troubleshooting.
10. Bring the room humidity level to within the working range of the equipment (35%-65%) before attempting troubleshooting.

# Glossary of Unit and System Parameters

## User Menu

| <b>Code</b> | <b>Setpoints</b>                | <b>Type</b> |
|-------------|---------------------------------|-------------|
| U102        | Temperature setpoint            | Unit        |
| U103        | Humidity setpoint               | Unit        |
| U104        | Predictive Humidity control     | Unit        |
| U105        | Supply Limit                    | Unit        |
| U106        | Supply Limit Value              | Unit        |
|             | <b>Graphics</b>                 | <b>Type</b> |
|             | System temperature time scale   | System      |
|             | System temperature graph height | System      |
|             | System humidity time scale      | System      |
|             | System humidity graph height    | System      |
|             | Unit temperature time scale     | Unit        |
|             | Unit temperature graph height   | Unit        |
|             | Unit humidity time scale        | Unit        |
|             | Unit humidity graph height      | Unit        |
| <b>Code</b> | <b>Set Alarms</b>               | <b>Type</b> |
| U202        | Std. Sensor Alarms              | Unit        |
| U203        | High temperature                | Unit        |
| U204        | Low temperature                 | Unit        |
| U205        | High humidity                   | Unit        |
| U206        | Low humidity                    | Unit        |
| U207        | Sensor A Alarms                 | Unit        |
| U208        | High temperature sensor A       | Unit        |
| U209        | Low temperature sensor A        | Unit        |
| U210        | High humidity sensor A          | Unit        |
| U211        | Low humidity sensor A           | Unit        |
| <b>Code</b> | <b>Various Sensors</b>          | <b>Type</b> |
| U301        | Actual temperature setpoint     | Unit        |
| U302        | Actual humidity setpoint        | Unit        |
| U303        | Optional sensor A temperature   | Unit        |
| U304        | Optional sensor A humidity      | Unit        |
| U305        | Optional sensor B temperature   | Unit        |
| U306        | Optional sensor B humidity      | Unit        |
| U307        | Optional sensor C temperature   | Unit        |
| U308        | Optional sensor C humidity      | Unit        |
| U309        | Glycol temperature              | Unit        |
| U310        | DigiScroll 1 temperature        | Unit        |
| U311        | DigiScroll 2 temperature        | Unit        |
| U312        | Freecooling status              | Unit        |

| <b>Code</b> | <b>Display Setup</b>        | <b>Type</b> |
|-------------|-----------------------------|-------------|
| U401        | Language                    | Display     |
| U402        | Date                        | Unit        |
| U403        | Time                        | Unit        |
| U404        | Temperature Indication      | Unit        |
| U405        | Display contrast            | Display     |
| U406        | Buzzer Frequency            | Display     |
| U407        | Backlight off after x hours | Display     |
| U408        | Screen:                     | Display     |
| U409        | Display shows:              | Display     |
| U410        | Display View                | Display     |
| <b>Code</b> | <b>Total Run Hours</b>      | <b>Type</b> |
| U502        | Fan Motor                   | Unit        |
| U502        | Fan Motor Limit             | Unit        |
| U503        | Compressor 1                | Unit        |
| U503        | Compressor 1 Limit          | Unit        |
| U504        | Compressor 2                | Unit        |
| U504        | Compressor 2 Limit          | Unit        |
| U505        | Freecooling                 | Unit        |
| U505        | Freecooling Limit           | Unit        |
| U506        | Hotgas / Hotwater           | Unit        |
| U506        | Hotgas / Hotwater Limit     | Unit        |
| U507        | Electrical Heater 1         | Unit        |
| U507        | Electrical Heater 1 Limit   | Unit        |
| U508        | Electrical Heater 2         | Unit        |
| U508        | Electrical Heater 2 Limit   | Unit        |
| U509        | Electrical Heater 3         | Unit        |
| U509        | Electrical Heater 3 Limit   | Unit        |
| U510        | Humidifier                  | Unit        |
| U510        | Humidifier Limit            | Unit        |
| U511        | Dehumidification            | Unit        |
| U511        | Dehumidification Limit      | Unit        |
| <b>Code</b> | <b>Timer</b>                | <b>Type</b> |
| U603        | Monday                      | Unit        |
| U603        | Tuesday                     | Unit        |
| U603        | Wednesday                   | Unit        |
| U603        | Thursday                    | Unit        |
| U603        | Friday                      | Unit        |
| U603        | Saturday                    | Unit        |
| U603        | Sunday                      | Unit        |
| U605        | From / to                   | Unit        |
| U607        | From / to                   | Unit        |
| U609        | Timer mode                  | Unit        |
| U610        | Timer Mode Type             | Unit        |
| U611        | Deadband                    | Unit        |

| <b>Code</b> | <b>Service contacts</b> | <b>Type</b> |
|-------------|-------------------------|-------------|
| U703        | Address line 1          | System      |
| U704        | Address line 2          | System      |
| U705        | Address line 3          | System      |
| U706        | Address line 4          | System      |
|             |                         |             |
|             |                         |             |

## Service Menu

| <b>Code</b> | <b>Setpoints</b>                   | <b>Type</b> |
|-------------|------------------------------------|-------------|
| S102        | Temperature setpoint               | Unit        |
| S103        | Humidity setpoint                  | Unit        |
| S104        | Predictive Humidity control        | Unit        |
| S105        | Supply Limit                       | Unit        |
| S106        | Supply Limit Value                 | Unit        |
| S107        | Autoset enable                     | Unit        |
| S108        | Temperature proportional band      | Unit        |
| S109        | Temperature integration time       | Unit        |
| S110        | Temperature deadband               | Unit        |
| S113        | Humidity proportional band         | Unit        |
| S114        | Humidity integration time          | Unit        |
| S115        | Humidity deadband                  | Unit        |
| S116        | DT between Room / Glycol Type      | Unit        |
| S117        | DT between Room / Glycol Value     | Unit        |
| S118        | Min.Chilled Water Temp. Enable     | Unit        |
| S119        | Min.Chilled Water Temp. Value      | Unit        |
| <b>Code</b> | <b>Standby settings / Lead-lag</b> | <b>Type</b> |
| S502        | Number of standby units            | System      |
| S503        | Rotation Frequency                 | System      |
| S504        | Rotate at (hour)                   | System      |
| S505        | Rotate at (minute)                 | System      |
| S506        | Rotate by                          | System      |
| S507        | Perform one rotation               | System      |
| S508        | Cascade units                      | System      |
| <b>Code</b> | <b>Wellness / General Settings</b> | <b>Type</b> |
| S002        | Maintenance frequency              | System      |
| S003        | Max bonus                          | System      |
| S004        | Max penalty                        | System      |
| S005        | Last maintenance                   | System      |
| S006        | Service engineer                   | System      |
| S007        | Reset                              | System      |
| S008        | Calculated next maintenance        | System      |

|      | <b>Fan Settings</b>          | <b>Type</b> |
|------|------------------------------|-------------|
| S013 | Number of starts             | Unit        |
| S014 | Working hours                | Unit        |
| S015 | Average working time         | Unit        |
| S016 | Starts per day optimum       | Unit        |
| S017 | Starts per day worst         | Unit        |
| S018 | Number of alarms             | Unit        |
| S019 | Actual bonus                 | Unit        |
|      | <b>Compr. 1 Settings</b>     | <b>Type</b> |
| S024 | Number of starts             | Unit        |
| S025 | Working hours                | Unit        |
| S026 | Average working time         | Unit        |
| S027 | Starts per day optimum       | Unit        |
| S028 | Starts per day worst         | Unit        |
| S029 | Number of HP alarms          | Unit        |
| S030 | Number of LP alarms          | Unit        |
| S031 | Number of TH alarms          | Unit        |
| S032 | Number of HT alarms          | Unit        |
| S033 | Actual bonus                 | Unit        |
|      | <b>Compr. 2 Settings</b>     | <b>Type</b> |
| S035 | Number of starts             | Unit        |
| S036 | Working hours                | Unit        |
| S037 | Average working time         | Unit        |
| S038 | Starts per day optimum       | Unit        |
| S039 | Starts per day worst         | Unit        |
| S040 | Number of HP alarms          | Unit        |
| S041 | Number of LP alarms          | Unit        |
| S042 | Number of TH alarms          | Unit        |
| S043 | Number of HT alarms          | Unit        |
| S044 | Actual bonus                 | Unit        |
|      | <b>EI. Heater 1 Settings</b> | <b>Type</b> |
| S046 | Number of starts             | Unit        |
| S047 | Working hours                | Unit        |
| S048 | Average working time         | Unit        |
| S049 | Starts per day optimum       | Unit        |
| S050 | Starts per day worst         | Unit        |
| S051 | Number of alarms             | Unit        |
| S052 | Actual bonus                 | Unit        |
|      | <b>EI. Heater 2 Settings</b> | <b>Type</b> |
| S057 | Number of starts             | Unit        |
| S058 | Working hours                | Unit        |
| S059 | Average working time         | Unit        |
| S060 | Starts per day optimum       | Unit        |
| S061 | Starts per day worst         | Unit        |
| S062 | Number of alarms             | Unit        |

|             |                              |             |
|-------------|------------------------------|-------------|
| S063        | Actual bonus                 | Unit        |
|             | <b>EI. Heater 3 Settings</b> | <b>Type</b> |
| S068        | Number of starts             | Unit        |
| S069        | Working hours                | Unit        |
| S070        | Average working time         | Unit        |
| S071        | Starts per day optimum       | Unit        |
| S072        | Starts per day worst         | Unit        |
| S073        | Number of alarms             | Unit        |
| S074        | Actual bonus                 | Unit        |
|             | <b>Humidifier Settings</b>   | <b>Type</b> |
| S079        | Number of starts             | Unit        |
| S080        | Working hours                | Unit        |
| S081        | Average working time         | Unit        |
| S082        | Starts per day optimum       | Unit        |
| S083        | Starts per day worst         | Unit        |
| S084        | Number of alarms             | Unit        |
| S085        | Actual bonus                 | Unit        |
| <b>Code</b> | <b>Diagnostics / Service</b> | <b>Type</b> |
| S302        | Manual Mode                  | Unit        |
| S303        | Unit Fan                     | Unit        |
| S304        | Compressor 1                 | Unit        |
| S304        | Compressor 1 (Mode)          | Unit        |
| S305        | Compressor 1 capacity        | Unit        |
| S306        | Compressor 1 cycle ramp      | Unit        |
| S307        | Compressor 2                 | Unit        |
| S307        | Compressor 2 (Mode)          | Unit        |
| S308        | Compressor 2 capacity        | Unit        |
| S309        | Compressor 2 cycle ramp      | Unit        |
| S313        | Heat 1                       | Unit        |
| S314        | Heat 2                       | Unit        |
| S315        | Heat 3                       | Unit        |
| S324        | Hum Fill                     | Unit        |
| S325        | Hum                          | Unit        |
| S326        | Alarm Relay                  | Unit        |
| S327        | R5                           | Unit        |
| S328        | 3P actuator open             | Unit        |
| S329        | 3P actuator close            | Unit        |
| S330        | Analog out 1                 | Unit        |
| S331        | Analog out 2                 | Unit        |
| S332        | Analog out 3                 | Unit        |
| S333        | Analog out 4                 | Unit        |
| S335        | Status Remote                | Unit        |
| S336        | Status Air Sail              | Unit        |
| S337        | Status Fan Overload          | Unit        |



|             |                                 |             |
|-------------|---------------------------------|-------------|
| S338        | Status Filter                   | Unit        |
| S339        | Status Customer Input 1         | Unit        |
| S340        | Status Customer Input 2         | Unit        |
| S341        | Status Customer Input 3         | Unit        |
| S342        | Status Customer Input 4         | Unit        |
| S343        | HP 1 alarm counter per 12 hours | Unit        |
| S344        | HP 2 alarm counter per 12 hours | Unit        |
| S346        | Status HP 1                     | Unit        |
| S347        | Status LP 1                     | Unit        |
| S348        | Status TH 1                     | Unit        |
| S349        | Status HP 2                     | Unit        |
| S350        | Status LP 2                     | Unit        |
| S351        | Status TH 2                     | Unit        |
| S352        | Status Humidifier Problem       | Unit        |
| S353        | Status DT 2                     | Unit        |
| S354        | Status Min CW                   | Unit        |
| <b>Code</b> | <b>Set Alarms</b>               | <b>Type</b> |
| S202        | Std. Sensor Alarms              | Unit        |
| S203        | High temperature                | Unit        |
| S204        | Low temperature                 | Unit        |
| S205        | High humidity                   | Unit        |
| S206        | Low humidity                    | Unit        |
| S207        | Sensor A Alarms                 | Unit        |
| S208        | High temperature sensor A       | Unit        |
| S209        | Low temperature sensor A        | Unit        |
| S210        | High humidity sensor A          | Unit        |
| S211        | Low humidity sensor A           | Unit        |
| S213        | Customer Input 1                | Unit        |
| S214        | Customer Input 1 active when    | Unit        |
| S215        | Customer Input 2                | Unit        |
| S216        | Customer Input 2 active when    | Unit        |
| S217        | Customer Input 3                | Unit        |
| S218        | Customer Input 3 active when    | Unit        |
| S219        | Customer Input 4                | Unit        |
| S220        | Customer Input 4 active when    | Unit        |
| <b>Code</b> | <b>Sensor Calibration</b>       | <b>Type</b> |
| S602        | Return temperature              | Unit        |
| S603        | Calibrated Return temperature   | Unit        |
| S604        | Return humidity                 | Unit        |
| S605        | Calibrated return humidity      | Unit        |
| S606        | DigiScroll 1 NTC                | Unit        |
| S607        | Calibrated DigiScroll 1 NTC     | Unit        |
| S608        | DigiScroll 2 NTC                | Unit        |
| S609        | Calibrated DigiScroll 2 NTC     | Unit        |
| S613        | Temperature Sensor A            | Unit        |

|             |                               |             |
|-------------|-------------------------------|-------------|
| S614        | Calibrated Temp. Sensor A     | Unit        |
| S615        | Humidity Sensor A             | Unit        |
| S616        | Calibrated Humidity Sensor A  | Unit        |
| S617        | Temperature Sensor B          | Unit        |
| S618        | Calibrated Temp. Sensor B     | Unit        |
| S619        | Humidity Sensor B             | Unit        |
| S620        | Calibrated Humidity Sensor B  | Unit        |
| S624        | Glycol Sensor PTC or NTC      | Unit        |
| S625        | Glycol Sensor                 | Unit        |
| S626        | Calibrated Glycol Sensor      | Unit        |
| S627        | Supply Sensor PTC or NTC      | Unit        |
| S628        | Supply Sensor                 | Unit        |
| S629        | Calibrated Supply Sensor      | Unit        |
| S630        | Temperature Sensor C          | Unit        |
| S631        | Calibrated Temp. Sensor C     | Unit        |
| S632        | Humidity Sensor C             | Unit        |
| S633        | Calibrated Humidity Sensor C  | Unit        |
| <b>Code</b> | <b>System / Network Setup</b> | <b>Type</b> |
| S802        | Number of connected units     | System      |
| S803        | Teamwork Mode                 | System      |
| S804        | IP Address                    | System      |
| S805        | Netmask                       | System      |
| S806        | Gateway                       | System      |
| S807        | MAC                           | System      |
| S808        | U2U Address                   | System      |
| S809        | U2U Protocol                  | System      |
| S810        | U2U Group                     | System      |
| S811        | SW Version                    | System      |
| S813        | Monitoring Address            | Unit        |
| S814        | Monitoring Protocol           | Unit        |
| S815        | IP Address                    | Unit        |
| S816        | Netmask                       | Unit        |
| S817        | Gateway                       | Unit        |
| S818        | MAC                           | Unit        |
| S819        | U2U Address                   | Unit        |
| S820        | U2U Protocol                  | Unit        |
| S821        | U2U Group                     | Unit        |
| S822        | SW Version                    | Unit        |
| <b>Code</b> | <b>Options Setup</b>          | <b>Type</b> |
| S402        | Compressor sequence           | Unit        |
| S403        | Low pressure alarm delay      | Unit        |
| S404        | Actual LP1 pressure           | Unit        |
| S405        | Actual LP2 pressure           | Unit        |
| S406        | Number of all heat stages     | Unit        |

|             |                           |             |
|-------------|---------------------------|-------------|
| S407        | Electrical                | Unit        |
| S408        | Hot water On/Off          | Unit        |
| S409        | Hot gas                   | Unit        |
| S410        | 3P actuator runtime       | Unit        |
| S411        | 3P actuator direction     | Unit        |
| S413        | Humidification enabled    | Unit        |
| S414        | Infrared Flush Rate       |             |
| S415        | Dehum enabled             | Unit        |
| S416        | Electric reheat operation | Unit        |
| <b>Code</b> | <b>Service contacts</b>   | <b>Type</b> |
| S702        | Country                   | System      |
| S703        | Address line 1            | System      |
| S704        | Address line 2            | System      |
| S705        | Address line 3            | System      |
| S706        | Address line 4            | System      |

## Advanced Menu

| <b>Code</b> | <b>Factory Settings</b>      | <b>Type</b> |
|-------------|------------------------------|-------------|
| A002        | Unit Code Field: (01-06)     | Unit        |
| A003        | Set Code: (01-06)            | Unit        |
| A004        | Unit Code Field: (7-12)      | Unit        |
| A005        | Set Code: (7-12)             | Unit        |
| A006        | Unit Code Field: (13-18)     | Unit        |
| A007        | Set Code: (13-18)            | Unit        |
| A008        | Send and Execute Unit Code   | Unit        |
| A009        | Load and Execute XML Code    | Unit        |
| A010        | Check XML Unit Code          | Unit        |
| A011        | Status Unit Code             | Unit        |
| A102        | Refrigerant Type             | Unit        |
| A103        | Main Fan Overload            | Unit        |
|             | Loss of Airflow              | Unit        |
| A104        |                              |             |
| A105        | Number of compressors        | Unit        |
| A106        | Compressor delay time        | Unit        |
| A107        | Compressor min on time       | System      |
| A108        | Compressor min off time      | System      |
| A109        | Pump down                    | Unit        |
| A110        | Capacity Ctrl.               | Unit        |
| A113        | Digi Scroll Cycle            | Unit        |
| A114        | High temperature Digi Scroll | Unit        |
| A115        | Digi Scroll switchback       | Unit        |
| A116        | Low pressure device          | Unit        |

|             |                                |             |
|-------------|--------------------------------|-------------|
| A117        | Low pressure threshold Phase 1 | Unit        |
| A118        | Low pressure threshold Phase 2 | Unit        |
| A124        | LP1 sensor 0% =                | Unit        |
| A124        | LP1 sensor 0% =                | Unit        |
| A125        | LP1 sensor 100% =              | Unit        |
| A125        | LP1 sensor 100% =              | Unit        |
| A126        | Actual LP1 signal              | Unit        |
| A127        | LP2 sensor 0% =                | Unit        |
| A127        | LP2 sensor 0% =                | Unit        |
| A128        | LP2 sensor 100% =              | Unit        |
| A128        | LP2 sensor 100% =              | Unit        |
| A129        | Actual LP2 signal              | Unit        |
| A130        | Pump down cutout               | Unit        |
| A131        | Pump down recycle              | Unit        |
| A132        | Condenser Control              | Unit        |
| A135        | CW flush                       | Unit        |
| A136        | CW flush duration              | Unit        |
| A137        | Freecooling                    | Unit        |
| A138        | Freecooling flush              | Unit        |
| A139        | Freecooling flush duration     | Unit        |
| A140        | Freecooling flush starts R5    | Unit        |
| A141        | CO + FC simultaneously         | Unit        |
| A142        | Hot water flush                | Unit        |
| A143        | Hot water flush duration       | Unit        |
| A146        | Humidifier Model               | Unit        |
| A147        | Humidity in Last xx Hours      | Unit        |
| A148        | Prefill Time                   | Unit        |
| A149        | Fill Time                      | Unit        |
| A150        | Humidifier On Time             | Unit        |
| A151        | Dehum with compressor          | Unit        |
| A152        | Analog output 1                | Unit        |
| A153        | Analog output 2                | Unit        |
| A154        | Analog output 3                | Unit        |
| A155        | Analog output 4                | Unit        |
| <b>Code</b> | <b>Access</b>                  | <b>Type</b> |
| A201        | Password Level 1 (User)        | System      |
| A202        | Password Level 2 (Service)     | System      |
| A203        | Password Level 3 (Advanced)    | System      |

## Glossary of Terms

**Address:** A pattern of characters that identifies a unique storage location

**Algorithm:** A set of procedures to obtain a given result

**Ambient:** Condition on immediately surrounding atmosphere or area: usually refers to temperature or pressure

**Analog:** Refers to circuitry; also called linear circuitry; circuitry that varies certain properties or electricity continuously and smoothly over a range

**Anti-Static Material:** A slightly conductive material that allows the net charge to be drained off through a path; an electrostatic protective material having a surface resistivity greater than  $10^4$  but not greater than  $10^9$  Ohms per square inch (does not generate static electricity)

**Binary Number System or Binary Code:** A method of writing numbers by using two digits, 0 and 1

**Bit:** The smallest possible piece of information; a specification of one of two possible conditions. (Bits are written as 1 for yes and 0 for no.)

**Bus:** Large trace or foil extending around the edge of a PCB to provide conduction for several sources

**Byte:** A set of adjacent binary digits operated upon as a unit (usually 8 bits)

**Charge:** The product of capacitance times voltage

**CMOS:** Complimentary Metal Oxide Substrate semiconductor

**Computer:** At least one CPU together with input, output, control switch buttons and memory units

**Conductive Material:** Material that conducts electrical charge (Because it conducts charge, there is no potential difference across or storage of a static charge.); electrostatic protective material having a maximum surface resistivity of 10 Ohms per square unit, or a maximum volume resistivity of 10 Ohms/cm.

**Control Buttons:** Push buttons on the display bezels to operate the increase/decrease, advance, or silence functions

**Control Switches:** Sometimes called dip switches and used for additional programming features on all levels

**CPU:** **C**entral **P**rocessing **U**nit; the part of a computer system that contains the main storage, arithmetic unit and special register groups (It performs arithmetic operations, controls instruction processing and provides timing signals.)

**Data:** Another name for information

**Data Bus:** One method of input/output for a system where data is moved by way of a group of wires forming a common bus

**Decrease Button:** Control button used to decrease values

**Digital:** Information in discrete or quantified form, not continuous

**DIP:** **D**ual **I**nterface **P**ackage; a type of Integrated Circuit (IC)

**DIP Switch:** Type of electronic switch having multiple, manually selectable settings

**Earth ground:** The portion of an electrical circuit that is at zero potential with respect to the earth

**Electrostatic Field:** The field around an electrostatically charged object

**Electrostatic Voltage:** Voltage generated by the sliding, rubbing or separating action between materials

**EPROM:** **E**rasable and **P**rogrammable **R**ead-**O**nly **M**emory; an integrated circuit memory chip whose stored data can be read at random (Data can be erased and new data can be stored.)

**ESDS:** **E**lectro**S**tatic **D**ischarge **S**ensitive; sensitive to electrostatic voltage of 4000 volts or less as determined by the human test circuit

**Fill Period:** The period during which the humidifier pan is filled from a partially filled state to the level required for optimum humidification

**Firmware:** Software stored in EPROM or PROM

**Hard Ground:** A direct connection to earthground (also refer to soft ground)

**Hardware:** The PCB, cable, switches and associated devices

**Hysteresis:** Differential

**IC:** **I**ntegrated **C**ircuit; an assembly that consists of all the necessary parts of an electronic circuit

**Impedance:** Opposition that a circuit offers to the flow of current through it, measured in Ohms

**Input:** An incoming information signal

**Isolation:** Separation of one device or environment from the effects of an adjacent or connected device or environment

**Lead Compressor:** Compressor coming on first as a result of a call for Cooling 1

**Lag Compressor:** Compressor coming on second as a result of a call for Cooling 2

**LED: Light Emitting Diode;** a semiconductor that emits light when electric current is passed through it by way of two terminals

**Manual Override:** A means of bypassing triac switches at all levels for manual operation of system components for test or emergency

**Memory:** In a digital system, the part of the system where information is stored

**Microprocessor:** An Integrated Circuit (IC, or set of a few ICs) that can be programmed with stored instructions to perform a wide variety of functions (A microprocessor consists of at least a controller, some registers and some sort of Arithmetic Logic Unit (ALU).

**N-Type Semiconductor:** Semiconductor crystal doped to have an excess of free electrons with a predominately negative current carrying capacity (also referred to as a P-Type Semiconductor).

**Off Time:** The time since humidification was last on

**Output:** An outgoing information signal

**P-N-Junction:** Interface boundary between two semiconductor regions with differing electrical properties (Current only flows across the junction in the forward direction if circuit voltage exceeds a certain threshold. Current cannot flow across the junction in the reverse direction.)

**P-Type Semiconductor:** Semiconductor crystal doped for an excess of holes to enable heavier positive current-carrying capacity (also referred to as an N-Type Semiconductor).

**PCB: Printed Circuit Board;** made of insulating material with conducting paths secured to one or both sides

**Prefill:** The period of time between when the water begins to fill the pan and the humidifier lamps turn on

**Program:** A set of instructions to achieve a certain result

**PROM:** **P**rogrammable **R**ead-**O**nly **M**emory; an **I**ntegrated **C**ircuit (IC) memory chip whose stored data can be read at random (The IC can be used only one time.)

**RAM:** **R**andom-**A**ccess **M**emory where work can be written (stored) or read (recovered) in any order

**Remote:** Component(s) or control(s) located at a distance away from the main components or controls

**Reset:** To return a control to its original position

**ROM:** **R**ead-**O**nly **M**emory: the location reserved for data permanently stored by the manufacturer

**Soft Ground:** A connection to ground through an impedance sufficiently high to limit current flow to safe levels for personnel (Impedance needed for a soft ground is dependent upon the voltage levels that can be contacted by personnel near the ground.)

**Software:** A set of computer programs, procedures and possible associated documentation concerned with the operation of a data processing system

**Static-Dissipative Material:** Electrostatic protective material having surface resistiveness greater than  $10^4$  but not greater than  $10^9$  Ohms per square inch

**Static-Shielding Material:** Material that does not allow spark energy or electrostatic fields to pass through or penetrate it

**Surface Resistivity:** An inverse measure of the conductivity of a material and equal to the ratio of the potential gradient to the current per unit width of the surface where the potential gradient is measured in the direction of current flow in the material (Surface resistivity is numerically equal to the surface resistance between two electrodes forming opposite sides of a square. The size of the square is immaterial. Its value is measured in Ohms per square inch.)

**Transformer:** Electromagnetic device for changing the voltage of an AC circuit by induction and/or isolating an AC circuit from its distribution

**Triboelectric Effect:** The generation of static electricity on an object by contact, separation or friction



## Computer and Network Terms

**Agent:** A program that performs some information gathering or processing task in the background. Typically, an agent is given a very small and well-defined task. Although the theory behind agents has been around for some time, agents have become more prominent with the recent growth of the Internet. Many companies now sell software that enables you to configure an agent to search the Internet for certain types of information.

In computer science, there is a school of thought that believes that the human mind essentially consists of thousands or millions of agents all working in parallel. To produce real artificial intelligence, this school holds, we should build computer systems that also contain many agents and systems for arbitrating among the agents' competing results.

**BOOTP:** Short for Bootstrap Protocol, an Internet protocol that enables a diskless workstation to discover its own IP address, the IP address of a BOOTP server on the network, and a file to be loaded into memory to boot the machine. This enables the workstation to boot without requiring a hard or floppy disk drive. The protocol is defined by RFC 951.

**Cookie:** A message given to a Web browser by a Web server. The browser stores the message in a text file called cookie.txt. The message is then sent back to the server each time the browser requests a page from the server. The main purpose of cookies is to identify users and possibly prepare customized Web pages for them. When you enter a Web site using cookies, you may be asked to fill out a form providing such information as your name and interests. This information is packaged into a cookie and sent to your Web browser who stores it for later use. The next time you go to the same Web site, your browser will send the cookie to the Web server. The server can use this information to present you with custom Web pages. So, for example, instead of seeing just a generic welcome page you might see a welcome page with your name on it.

**DHCP:** Short for Dynamic Host Configuration Protocol, a protocol for assigning dynamic IP addresses to devices on a network. With dynamic addressing, a device can have a different IP address every time it connects to the network. In some systems, the device's IP address can even change while it is still connected. DHCP also supports a mix of static and dynamic IP addresses.

Dynamic addressing simplifies network administration because the software keeps track of IP addresses rather than requiring an administrator to manage the task. This means that a new computer can be added to a network without the hassle of manually assigning it a unique IP address. Many ISPs use dynamic IP addressing for dial-up users. DHCP client support is built into Windows 95 and NT workstation. NT 4 server includes both client and server support.

**Ethernet:** A local-area network (LAN) architecture developed by Xerox Corporation in cooperation with DEC and Intel in 1976. Ethernet uses a bus or star topology and supports data transfer rates of 10 Mbps. The Ethernet specification served as the basis for the IEEE 802.3 standard, which specifies the physical and lower software layers. Ethernet uses the CSMA/CD access method to handle simultaneous demands. It is one of the most widely implemented LAN standards.

A newer version of Ethernet, called 100Base-T (or Fast Ethernet), supports data transfer rates of 100 Mbps. And the newest version, Gigabit Ethernet supports data rates of 1 gigabit (1,000 megabits) per second.

**Internet:** A global network connecting millions of computers. More than 100 countries are linked into exchanges of data, news and opinions. Unlike online services, which are centrally controlled, the Internet is decentralized by design. Each Internet computer, called a host, is independent. Its operators can choose which Internet services to use and which local services to make available to the global Internet community. Remarkably, this anarchy by design works exceedingly well. There are a variety of ways to access the Internet. Most online services, such as America Online, offer access to some Internet services. It is also possible to gain access through a commercial Internet Service Provider (ISP).

**IP address:** An identifier for a computer or device on a TCP/IP network. Networks using the TCP/IP protocol route messages based on the IP address of the destination. The format of an IP address is a 32-bit numeric address written as four numbers separated by periods. Each number can be zero to 255. For example, 1.160.10.240 could be an IP address. Within an isolated network, you can assign IP addresses at random as long as each one is unique. However, connecting a private network to the Internet requires using registered IP addresses (called Internet addresses) to avoid duplicates.

The four numbers in an IP address are used in different ways to identify a particular network and a host on that network. The InterNIC Registration Service assigns Internet addresses from the following three classes.

- Class A - supports 16 million hosts on each of 127 networks
- Class B - supports 65,000 hosts on each of 16,000 networks
- Class C - supports 254 hosts on each of 2 million networks

The number of unassigned Internet addresses is running out, so a new classless scheme called CIDR is gradually replacing the system based on classes A, B, and C and is tied to adoption of IPv6.

**Network:** A group of two or more computer systems linked together. There are many types of computer networks, including:

- local-area networks (LANs): The computers are geographically close together (that is, in the same building).

- wide-area networks (WANs): The computers are farther apart and are connected by telephone lines or radio waves.
- campus-area networks (CANs): The computers are within a limited geographic area, such as a campus or military base.
- metropolitan-area networks (MANs): A data network designed for a town or city.
- home-area networks (HANs): A network contained within a user's home that connects a person's digital devices.

In addition to these types, the following characteristics are also used to categorize different types of networks:

- topology: The geometric arrangement of a computer system. Common topologies include a bus, star, and ring. See the Network topology diagrams in the Quick Reference section.
- protocol: The protocol defines a common set of rules and signals that computers on the network use to communicate. One of the most popular protocols for LANs is called Ethernet. Another popular LAN protocol for PCs is the IBM token-ring network.
- architecture: Networks can be broadly classified as using either a peer-to-peer or client/server architecture.

Computers on a network are sometimes called nodes. Computers and devices that allocate resources for a network are called servers.

**Network cross-over cable:** A specially designed cable in which the receive and transmit lines (input and output) are crossed. Used to connect two computers together or hubs. Also called a null modem cable using either RS-232 port connectors or RJ-45 connectors.

**Network interface card:** Often abbreviated as NIC, an expansion board you insert into a computer so the computer can be connected to a network. Most NICs are designed for a particular type of network, protocol, and media, although some can serve multiple networks.

**Null-modem cable:** A specially designed cable that allows you to connect two computers directly to each other via their communications ports (RS-232 ports). Null modems are particularly useful with portable computers because they enable the portable computer to exchange data with a larger system.

**Protocol:** An agreed-upon format for transmitting data between two devices. The protocol determines the following:

- the type of error checking to be used
- data compression method, if any
- how the sending device will indicate that it has finished sending a message
- how the receiving device will indicate that it has received a message

There are a variety of standard protocols from which programmers can choose. Each has particular advantages and disadvantages; for example, some are simpler than others, some are more reliable, and some are faster. From a user's point of view, the only interesting aspect about protocols is that your computer or device must support the right ones if you want to communicate with other computers. The protocol can be implemented either in hardware or in software.

**RJ-45:** Short for Registered Jack-45, an eight-wire connector used commonly to connect computers onto a local-area networks (LAN), especially Ethernets. RJ-45 connectors look similar to the ubiquitous RJ-11 connectors used for connecting telephone equipment, but they are somewhat wider.

**SNMP:** Short for Simple Network Management Protocol, a set of protocols for managing complex networks. The first versions of SNMP were developed in the early 80s. SNMP works by sending messages, called protocol data units (PDUs), to different parts of a network. SNMP-compliant devices, called agents, store data about themselves in Management Information Bases (MIBs) and return this data to the SNMP requesters.

SNMP 1 reports only whether a device is functioning properly. The industry has attempted to define a new set of protocols called SNMP 2 that would provide additional information, but the standardization efforts have not been successful. Instead, network managers have turned to a related technology called RMON that provides more detailed information about network usage.

**TCP/IP:** Abbreviation for Transmission Control Protocol/Internet Protocol, the suite of communications protocols used to connect hosts on the Internet. TCP/IP uses several protocols, the two main ones being TCP and IP. TCP/IP is built into the UNIX operating system and is used by the Internet, making it the de facto standard for transmitting data over networks. Even network operating systems that have their own protocols, such as NetWare, also support TCP/IP.

**10BaseT:** One of several adaptations of the Ethernet (IEEE 802.3) standard for Local Area Networks (LANs). The 10Base-T standard (also called Twisted Pair Ethernet) uses a twisted-pair cable with maximum lengths of 100 meters. The cable is thinner and more flexible than the coaxial cable used for the 10Base-2 or 10Base-5 standards. Cables in the 10Base-T system connect with RJ-45 connectors. A star topology is common with 12 or more computers connected directly to a hub or concentrator. The 10Base-T system operates at 10 Mbps and uses baseband transmission methods.

**Understanding IP Addressing:** Every computer that communicates over the Internet is assigned an IP address that uniquely identifies the device and distinguishes it from other computers on the Internet. An IP address consists of 32 bits, often shown as 4 octets of numbers from 0-255 represented in decimal form instead of binary form. For example, the IP address 168.212.226.204 in binary form is: 10101000.11010100.11100010.11001100.

But it is easier for us to remember decimals than it is to remember binary numbers, so we use decimals to represent the IP addresses when describing them. However, the binary number is important because that will determine which class of network the IP address belongs to. An IP address consists of two parts, one identifying the network and one identifying the node, or host. The Class of the address determines which part belongs to the network address and which part belongs to the node address. All nodes on a given network share the same network prefix but must have a unique host number.

**Class A Network:** Binary address start with 0, therefore the decimal number can be anywhere from 1 to 126. The first 8 bits (the first octet) identify the network and the remaining 24 bits indicate the host within the network. An example of a Class A IP address is 102.168.212.226, where "102" identifies the network and "168.212.226" identifies the host on that network.

**Class B Network:** Binary addresses start with 10, therefore the decimal number can be anywhere from 128 to 191 (the number 127 is reserved for loopback and is used for internal testing on the local machine). The first 16 bits (the first two octets) identify the network and the remaining 16 bits indicate the host within the network. An example of a Class B IP address is 168.212.226.204 where "168.212" identifies the network and "226.204" identifies the host on that network.

**Class C Network:** Binary addresses start with 110, therefore the decimal number can be anywhere from 192 to 223. The first 24 bits (the first three octets) identify the network and the remaining 8 bits indicate the host within the network. An example of a Class C IP address is 200.168.212.226 where "200.168.212" identifies the network and "226" identifies the host on that network.

**Class D Network:** Binary addresses start with 1110, therefore the decimal number can be anywhere from 224 to 239. Class D networks are used to support multicasting.

**Class E Network:** Binary addresses start with 1111, therefore the decimal number can be anywhere from 240 to 255. Class E networks are used for experimentation. They have never been documented or utilized in a standard way.

## Network Information

Commonly known as: Network wire, Ethernet cable, Cat5 cable, the information following will explain the connectivity for Liebert Environmental units.

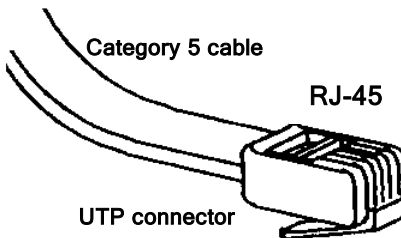
Fundamentally, this section will explain the terms of networking so that you can apply the information to building your own network. The parts and components are discussed in generic fashion since equipment manufacturers and price range of the equipment varies and changes on an almost daily basis. However, the terms themselves stay relatively consistent, so purchasing or discussing your needs with networking personnel remains the same.

*What is networking?...*

In it's simplest form, a network can be created when 2 units are connected through communication wires. This simple connection requires a special "crossover" cable which "crosses" the receive and transmit lines (hence, the name of the cable) and is readily available at your local computer store. However, for most applications, the simpler and more generic installation requires network cables and a hub or switch as explained below.

### NETWORK CABLING

Twisted Pair Ethernet (10baseT), sometime also called "UTP" from "Unshielded Twisted Pair", is based on using a cable and connectors similar to phone-wiring. The cable is connected via an RJ-45 connectors to the network connection installed in the Air Unit. The wire itself is generally called Category 5 wire.



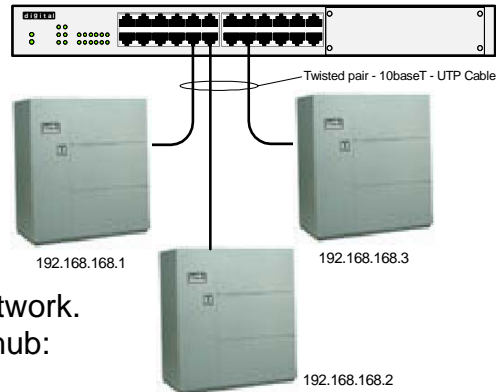
### HUBS AND SWITCHES



The opposite end of the network cable connects each Air Unit to the "hub" or "switch": these devices amplify and distribute the signal to other connected units. Switches and hubs range in prices from \$20 to thousands depending on the application. Most businesses have standardized on their networking equipment, so there is one probably already installed. Hubs are like mechanical devices where the connections themselves are automatically switched, allowing you to "bus" 2 or more devices easily. In a hub, only 1 device can communicate at a time.

Switches perform the same mechanical function, but they also include software inside that allows communication to operate at faster speeds and allow for multiple unit communication. Switches are the latest technology, but you are safe to use either device.

Hubs are available in different configuration, with 4, 8, 12, 15 or 24 RJ-45 connections. You can plug in the RJ45-connector into a hub while the network is running on the other connected systems, allowing you to move / add systems without having to shutdown the network. As network grow, you may need a second hub:



### **UNIT IDENTIFICATION OR ADDRESSING**

The units are separated and identified through their TCP/IP address. TCP/IP refers to the protocol or language being used to communicate between the Environmental Units. The addresses are arranged in 32-bit numbers. To make it easier to memorize such IP-addresses, they are usually expressed as 4 8-bit numbers (example: 192.168.10.1), where each of the 4 numbers is within the range of '0' to '255' (there are restriction on using '0' and '255', avoid using them.)

**When setting up a small private network, you are free to use ANY IP-address, however, when you are connected to a company network, you need to ask the Network-administrator to assign you an IP-address. And if you are connected to the Internet, your ISP (Internet Service Provider) will assign an IP-address to you.**

Even if a network is NOT connected to the Internet, it has become custom to use on private networks a range of IP-addresses, which are reserved for private networks (that makes it later possible to connect your private network to the Internet without having to re-configure everything). The reserved IP-address is: **192.168.x.y**, where x=same number on all systems and y=different/unique number on all systems.

See the example above under HUBS AND SWITCHES for an example of this configuration.

## How To Use The Schematics

As you look at the outside edge of the electrical schematic (drawing), you will see the numbers 8 through 1 (reading left to right) across the top and bottom and the letters D through A (reading from top to bottom) along both the left and right edges of the schematic. These numbers and letters are called locators, just like on a map. By intersecting the number and letter into the drawing, you can locate the section of the schematic you need to reference.

The next area of interest is the line numbers along both sides of the schematic. By using these line numbers and a straight edge, you can pinpoint a particular item in the located section. Also, useful is the Nomenclature section along the right side of the schematic. The nomenclature sections refers identifies the device by abbreviation and name and indicates on which line the device is found.

If you look deep into the schematic, you can see that the transformer section is laid out in a ladder progression making it easy to follow-out each circuit. You may wish to highlight each circuit with a marker making it easy to follow.

The number indicators in the area to the right of the ladder circuit section are also important. These are the contact locators for each relay or contactor shown on the drawing. The number represents the line location of the contact(s) for the adjacent shown relay or contactor. There are two types of line number indicators. One is highlighted with a bar across the top of the number, this indicates a normally closed contact. The other number shown without the bar indicates a normally open contact. Remember that the drawing is shown in the non-powered (de-energized) state.

These drawings are the latest revisions at publication of this manual and are what Liebert calls Universal drawings. Liebert has included numerous options on each one of these drawing to help in troubleshooting the system. These drawings may or may not be on your particular unit.

It is important to become familiar with legend, nomenclature and notes on each drawing.



# Electrical Schematics

- 182769 Liebert DS iCOM Global Control 8 - 12 Ton
- 182770 Liebert DS iCOM Global Control 15 – 30 Ton, 380 – 575V
- 182771 Liebert DS iCOM Global Control 15 – 30 Ton, 200 – 230V
- 182772 Liebert DS iCOM Global Control 8 - 12 Ton, SCR Reheat
- 182952 Connection Drawing Liebert DS

# Notes

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