



Eco-Smart

Installation Instructions



Now with
Smart Access!
Get your controller
online in 3 easy steps.
See page 16

Benefits of Smart Access

- It's easier than ever to set up every controller you service to provide alarm notifications via text or e-mail
- Smart Access auto connects, and can eliminate the need for costly IT support
- Easy setup of remote monitoring & system control
- Doesn't require port forwarding or a vpn
- Customized dashboard lets you remotely view all the controllers on one page

Introduction

The Eco-Smart is an electronically operated evaporator controller engineered to save energy in refrigeration systems through precise control of superheat, space temperature, fan cycling, reducing compressor runtime, and implementing demand defrosts. The Eco-Smart was designed to be used in single and

multiple evaporator installations, with a payback period of two years*, and a life expectancy that matches that of the system. Once the controller pays for itself, it continues to pay dividends for the life of the system.

*based on utility rate of \$.09/kWh

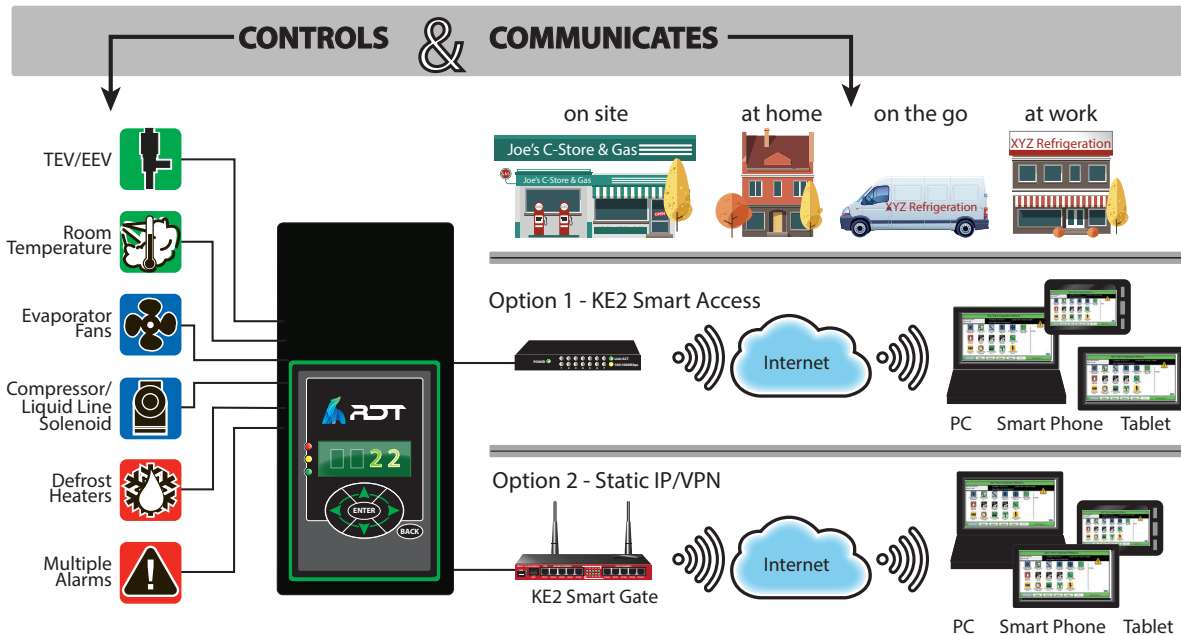


Table of Contents

| | |
|--|-------------------|
| Location | Page 3 |
| Installation & Wiring | Page 3 - 9 |
| Figure 1: Installation Locations | Page 3 |
| Figure 2: Return Air Sensor Placement | Page 3 |
| Figure 3: Proper Sensor Location | Page 4 |
| Figure 4: Sensor Positioned to Touch Circuit Tubes | Page 4 |
| Figure 5: Sensor Positioned Vertically. | Page 4 |
| Mounting the Controller | Page 11 |
| Figure 6: Evaporator Efficiency Diagram | Page 6 |
| Figure 7: Typical Piping Diagram - Hot Gas | Page 7 |
| Figure 8: Wiring Schematic - New Install. | Page 8 |
| Figure 9: Wiring Schematic - with Contactor Box | Page 9 |
| Dimensions | Page 10 |
| Figure 10: Dimensions | Page 10 |
| Controller Setup Page 11 | |
| Table 1: Introduction Mode | Page 11 |
| Adjusting Controller Parameters | Page 11-15 |
| Table 2: Navigation Through Controller Parameters. | Page 12 |
| Table 3: Controller Menus and Menu Parameters | Pgs. 13-15 |
| Manual Menu | Page 13 |
| Variables Menu | Page 13 |
| Alarm Status Menu | Page 13 |
| Setpoint Menu. | Page 14 & 15 |
| Table 4: Defrost Defaults | Page 16 |
| Communication Page 16 | |
| Table 5: Ethernet Specifications Summary. | Page 16 |
| Specifications | Page 16 |

Parts List

The following parts are included in the Eco-Smart kits:

- **Kit #20178 with 120/208-240 VAC controller**
 - **Kit #20844^① with 120/208-240 VAC controller**
 - **Kit #20631^② with 120/208-240 VAC controller**
 - **Kit #21096^③ with 120/208-240 VAC controller**
 - **Kit #20222^④ Beacon® I & II replacement controller**
- (3) **Temperature sensors** part #20199
 (1) **Air sensor mount**
 (5) **Self-tapping screws**
 (1) **Installation Instructions**
 (4) **90 degree quick disconnect**
 (1) **Liquid line solenoid fuse**
 (1) **KE2 Terminal Board**

- ① 20844 KE2 Ultimate Install kit includes KE2 Mounting Box pn 20687 and 40' colored temperature sensors
- ② 20631 kit does not include temperature sensors
- ③ 21096 KE2 Supermarket Retrofit kit also includes KE2 Mounting Box pn 20687, 10' Wire Harness pn 20736, Ethernet Adaptor pn 20938, & Door Switch 20543
- ④ 20222 Beacon® kit includes an extra temperature sensor, and pressure transducer with cable.

Accessories to Aid in Installation

The following parts are available separately:

- 10' Wire Harness** pn 20736,
- 25' Wire Harness** pn 20670
- 40' Wire Harness** pn 20737
- KE2 Evap Mounting Box** pn 20687

Further information on the Wire Harness and Mounting Box can be found in literature Q-1-21.

Location

The Eco-Smart was developed with ease of installation in mind. The controller is supplied in an enclosure, with encapsulated electronics to protect the circuitry from moisture damage. This extra level of protection allows the controller to be installed in the refrigerated space.

When installing the controller, it may either be mounted on an interior/exterior wall or on the evaporator. Many evaporators have sufficient space to install the controller on the face of the evaporator or on its housing. Locating the controller as close to the evaporator as possible reduces the amount of wiring when converting existing systems, as well as when it is applied on new applications.

Alternatively, users may find it beneficial to install the controller in a location providing easy access — on the wall or near the entrance. This enables the user to easily view the display, and eliminates the need to use a ladder or lift to modify the set-points or check alarms.

If viewing the temperature outside the walk-in or refrigerated room is desirable, the Eco-Smart may be used as a digital thermostat. The controller is then installed near the door of the

space for easy viewing of the room temperature and/or system status. See **Figure 1** for locations.

If installing the controller on the face of the evaporator, preexisting knockouts on the evaporator should be used for installing the high voltage wiring. If knockouts do not preexist, hole(s) may be carefully cut into an unobstructed area of the evaporator case. If modifying the face of the evaporator is not feasible or desired, the controller's conduit knockouts may be used with ½ inch conduit.

The bottom side of the controller includes a cutout with cable tie slots providing a strain relief for the low voltage and sensor wires. Additional knockouts are available on either side if conduit is preferred.

Installation & Wiring

The Eco-Smart is supplied with pluggable connectors for all connections. Pluggable connectors permit the controller to be placed in a safe location while the wiring is installed. They also simplify the wiring, allowing the wires to be fastened to the screw terminals in the open air. Once all wiring is completed using accepted wiring practices, it is plugged into the controller prior to final mounting.

Although there is one pressure transducer and four temperature sensor inputs, when used with mechanical valves (TEVs), Eco-Smart only requires the **(3) sensors supplied with the kit**. One sensor reads the return air temperature and the other two measure the coil temperature. **NOTE! Sensor location is critical to the proper operation of the controller.**

Return Air Temperature Sensor - The air temperature sensor is installed in the return air of the evaporator using the included sensor mount. Most applications allow the sensor mount to be installed using an existing screw. On evaporators where using an existing screw is not possible, the included self-tapping screw may be used to secure the sensor mount to the evaporator. **Note: Be careful to avoid damage to an evaporator tube or causing a leak in the drip pan.** When installing, it is important to prevent the air sensor from coming into contact with the mounting bracket, cable ties, or any other solid material. **Figure 2** shows an example of how to mount the sensor. The sensor must be a minimum of 8 inches from the coil surface.

Figure 1 - Eco-Smart Installation Locations

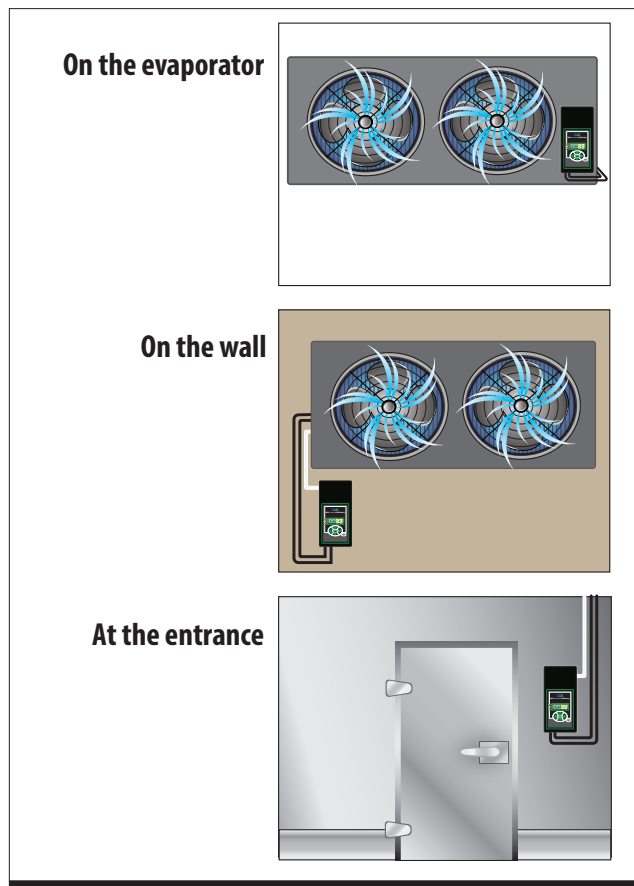
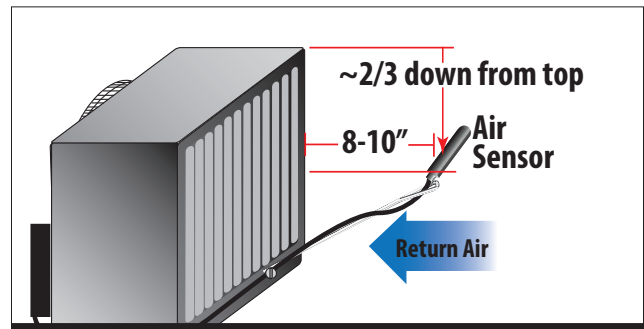


Figure 2 - Return Air Sensor Placement





After the sensor is installed, route the wire back to the controller. When routing sensor wire, it is important to avoid interference from high voltage lines. If sensor wire is run parallel to the high voltage, there is a potential for inductance to affect the sensor reading. This is of particular concern with long wire runs. When extending sensors, use the 18 gage, shielded twisted pair. Sensor wires can be run beyond 100 feet when using 18 gage twisted shielded pair. After the wire has been successfully routed, it may be connected to the pluggable terminal on the controller.

Coil Temperature Sensor - As a critical input to the controller, it is essential the sensor is located at the **coldest point on the evaporator coil** for optimal operation. The coil sensor is an integral part of the control algorithm used to determine coil efficiency, to initialize defrosts, and to terminate defrosts.

Determine the coil sensor location

To determine the most appropriate sensor location, when arriving on site, put the system into defrost. The location where frost is last to disappear is where the coil sensor should be placed. Monitor both the air entering side, as well as the air exiting side, of the evaporator coil. Don't be surprised if the last place for frost to disappear is on the air exiting side. It is usually near the right or left end of the coil.

Steps to Ensure Proper Coil Sensor Location

For more robust installations, RDT recommends using two coil sensors, located as described above. Typically the coldest spot is on the side of the suction header/expansion valve side of the evaporator. Select two places that are the last to defrost, preferably at each end of the evaporator.

More often than not on coils, the location of the sensor is a short distance from the end, approximately 1 to 1-1/2" away from the right and left edges of the active coil surface. The ice tends to grow from these edges towards the center. Therefore, the sensor location is best situated approximately 1 to 1-1/2" from the outer edges and typically near the bottom 1/3rd of the evaporator. The sensor needs to be as far away from the defrost heat sources as possible. See **Figure 3**. Locating the sensor too close to the elements will cause false defrost termination temperatures. It is important to note, the most active portion of the sensor is the first 1/2" of the 1-1/2" long stainless steel probe.

Option 1 - Sensor touching two circuit tubes

Figure 4A shows the sensor touching two circuit tubes. When inserting the sensor into the coil, the tip should touch one of the circuit tubes. It should not be located adjacent to the electric heating elements. It should be about half the distance between the heaters if possible. In **Figure 4B** the probe is inserted into the fins approximately 1/16" deeper than the stainless shielding. Pinch the fins gently together, securing the sensor in place. This provides thermal ballast to ensure a complete defrost.

Option 2 - Sensor inserted parallel to the evaporator fins

As the defrost termination sensor, it is important to ensure the sensor does not terminate defrost before all frost has been removed from the coil. In some installations, inserting the sensor into the coil may position it too close to the defrost heat source. An alternate method of positioning places the sensor vertically between the coil fins. **Figure 5** shows the proper way to secure the coil sensor.

Figure 3 - Proper Sensor Location

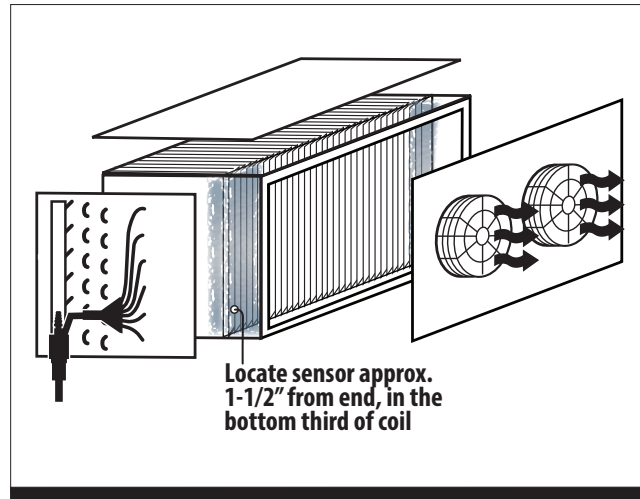


Figure 4 - Option 1: Sensor Positioned to Touch Two Circuit Tubes

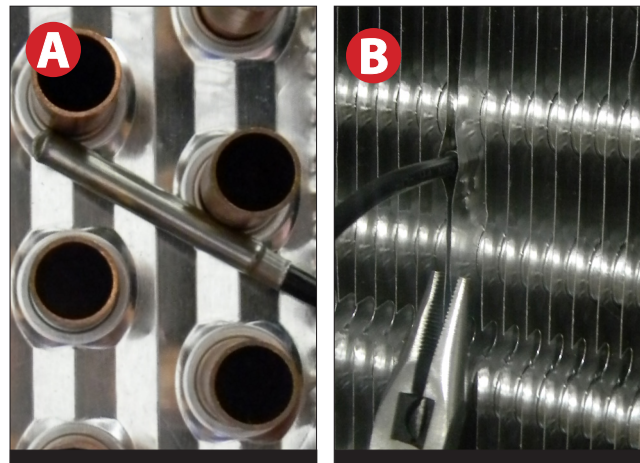


Figure 5 - Option 2: Sensor Positioned Parallel to Evaporator Fins



Important: Verify all heating elements are working properly.

Due to the many factors influencing the evaporator performance, it is impossible for RDT to provide the proper location of every installation. However, the coil sensor is an integral part of the control algorithm used to determine coil efficiency to initiate, as well as, terminate defrosts. The coldest point in the coil can be identified from existing system knowledge or by monitoring the normal operation.

Controller Power - The high voltage wiring is protected by a metal shield fastened to the back side of the controller. The shield should be removed to gain access to the wiring connections, making note of the location of the fasteners. The screws in the upper corners are coarse thread screws, while the screw in the middle is a 4-40 machine screw.

The controller accepts either 120V or 208/240V incoming power. The controller includes metal oxide varistors (MOVs), providing protection from voltage spikes. MOVs use the same technology commonly applied to protect consumer electronics (surge protectors). They function by filtering out voltages high enough to damage the board. When the voltage exceeds the allowed amount, the MOVs short to ground, protecting the circuitry. For additional protection, the board has a replaceable 1/2 or 500mA fuse in line. The grey plug is accessible without removing the metal shield in the fuse holder. Depress slightly and turn 1/4 turn counterclockwise to remove. Replace by depressing slightly and turning 1/4 turn clockwise. Do not overtighten.

The board uses a pluggable screw terminal connector for incoming power. The terminal is in the top right corner of the controller, when the terminals are facing the user. See **Figure 6**.

Fan and Defrost Relays - There are 2 larger relays on the controller with spade connectors. These are used for the evaporator fans and defrost heaters. Due to the spacing of the enclosure the spades require a 90 degree terminal. RDT has included (4) spade connectors to assist in wiring the relays.

Evaporator Fan Relay - The fan relay is rated 10A inductive at 240V. One leg of the incoming power (L1) for the fans connects to the COM terminal of the fan relay, the upper of the two larger relays. The remaining leg, (L2) connects to one lead of the fan. The remaining fan lead should be connected to the NO (Normally Open) terminal on the fan relay. See **Figure 8**.

Defrost Heater Relay - The heater relay is rated 20A resistive at 240V. One leg of the incoming power (L1) for the heaters connects to the COM terminal of the heater relay, the lower of the two larger relays. The remaining leg, (L2) connects to one lead of the heater. The remaining heater lead connects to the NO (Normally Open) terminal on the heater relay.

Compressor/Liquid Line Solenoid Relay - The compressor relay is rated at 3A inductive at 240V. This relay uses the 3-position pluggable screw terminal to make the connection to the board. The relay is not intended to control the compressor directly. It is designed to be used to control the liquid line solenoid or as

a pilot to the compressor contactor. One leg of the incoming power supply (L1) should be connected to COM terminal of the compressor relay, the upper of the two smaller relays. The remaining leg, (L2), should be connected to one lead on the solenoid/compressor contactor. The remaining lead, should be connected to the normally open (NO) position on the terminal.

Auxiliary Relay - The auxiliary relay is rated at 3A inductive at 240V. This relay uses the 3-position pluggable screw terminal to make the connection to the board. The relay may be connected to a variety of devices. One leg of the incoming power supply (L1) should be connected to COM terminal of the auxiliary relay, the lower of the two smaller relays. The remaining leg, (L2), should be attached to one lead on the connected device. The remaining alarm lead, should be connected to the normally open (NO) position on the terminal.

After all high voltage wiring is completed, the metal shield must be replaced and screws tightened.

Additional Inputs

T1 Suction Temperature Sensor (Auxiliary) - The suction temperature sensor is required when applying the controller with an electronic expansion valve. The sensor's proximity to the evaporator outlet differs slightly for electronically controlled valves from the placement of a TEV bulb. Due to the more refined control from an electronically controlled valve, the sensor must be placed as close to the outlet of the coil as feasible. Although the distance from the outlet is different, the nature of the refrigerant's flow through the tube remains unchanged, thus the orientation of the sensor remains at the 4 or 8 o'clock position. The sensor should be secured to the suction line using the included wire ties designed for low ambient operation. In addition to being configured as a suction sensor, the T1 input may also be configured like the auxiliary sensor.

Pressure Transducer - In addition to the suction temperature sensor, a pressure transducer is required for superheat measurement when applying RDT's Hybrid Stepper Valve (HSV) or Refrigeration Stepper Valve (RSV). Mount the pressure tap on the top of a horizontal section of tube, near the suction sensor, approx. 3 inches downstream of the temperature sensor.

T4 Auxiliary Temperature Sensor - The auxiliary temperature sensor provides flexibility and may be used for any purpose desired by the user. The placement of the sensor is dependent on the requirements of the user's intended application. The Auxiliary Temperature sensor must be supplied by RDT.

Digital Inputs - The controller includes (3) digital inputs. See **Table 3** for configuration options.

Mounting the Controller

Once the wiring has been run to the controller location, the controller can be connected. When installing the Eco-Smart, the (4) screws supplied in the kit may be preinstalled in the mounting surface. The controller has keyholes in each mounting tab allowing the controller to install over the screws.

Figure 6 - Back View of Controller - General Layout

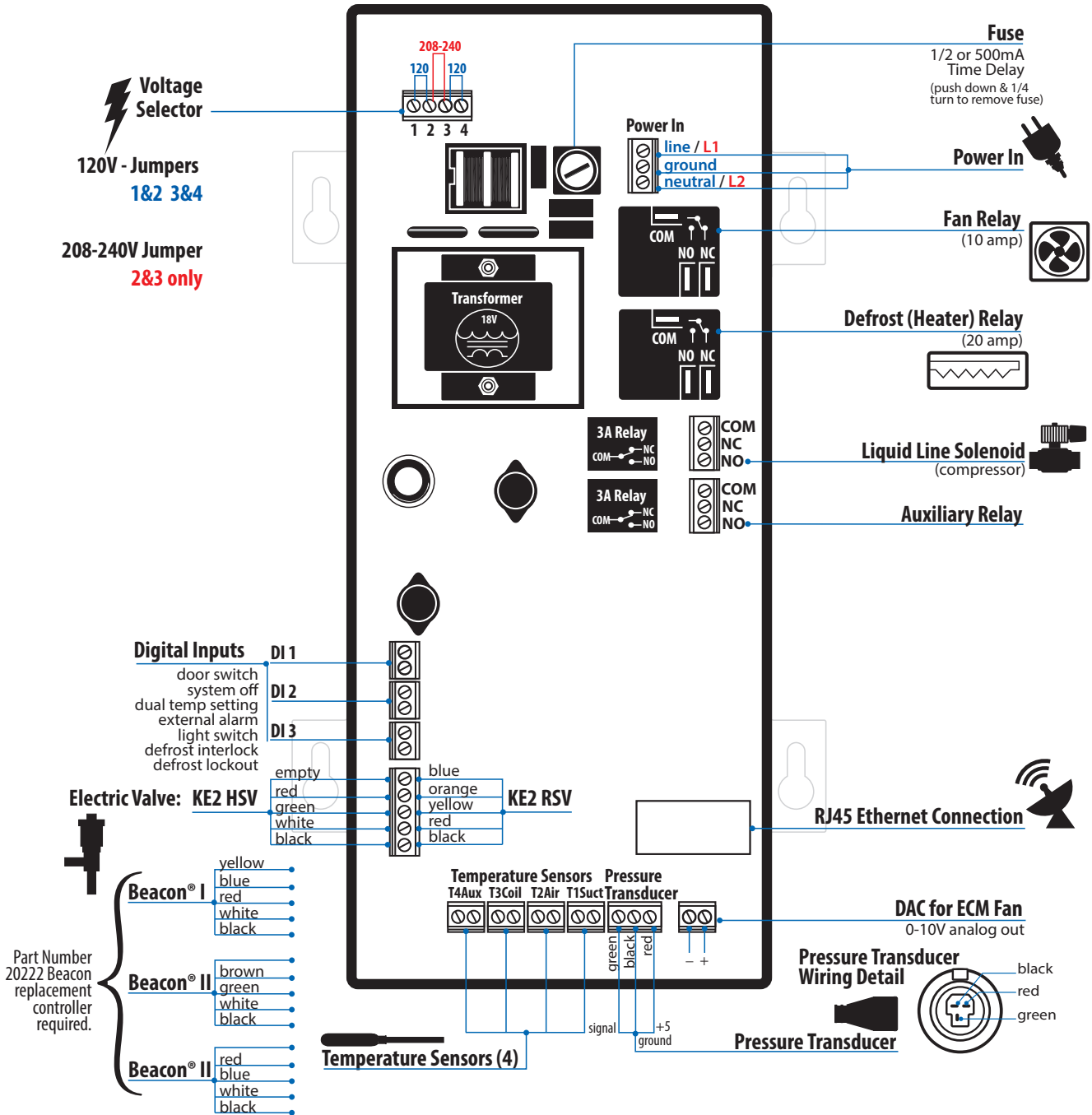


Figure 7- Typical Piping Diagram - Hot Gas

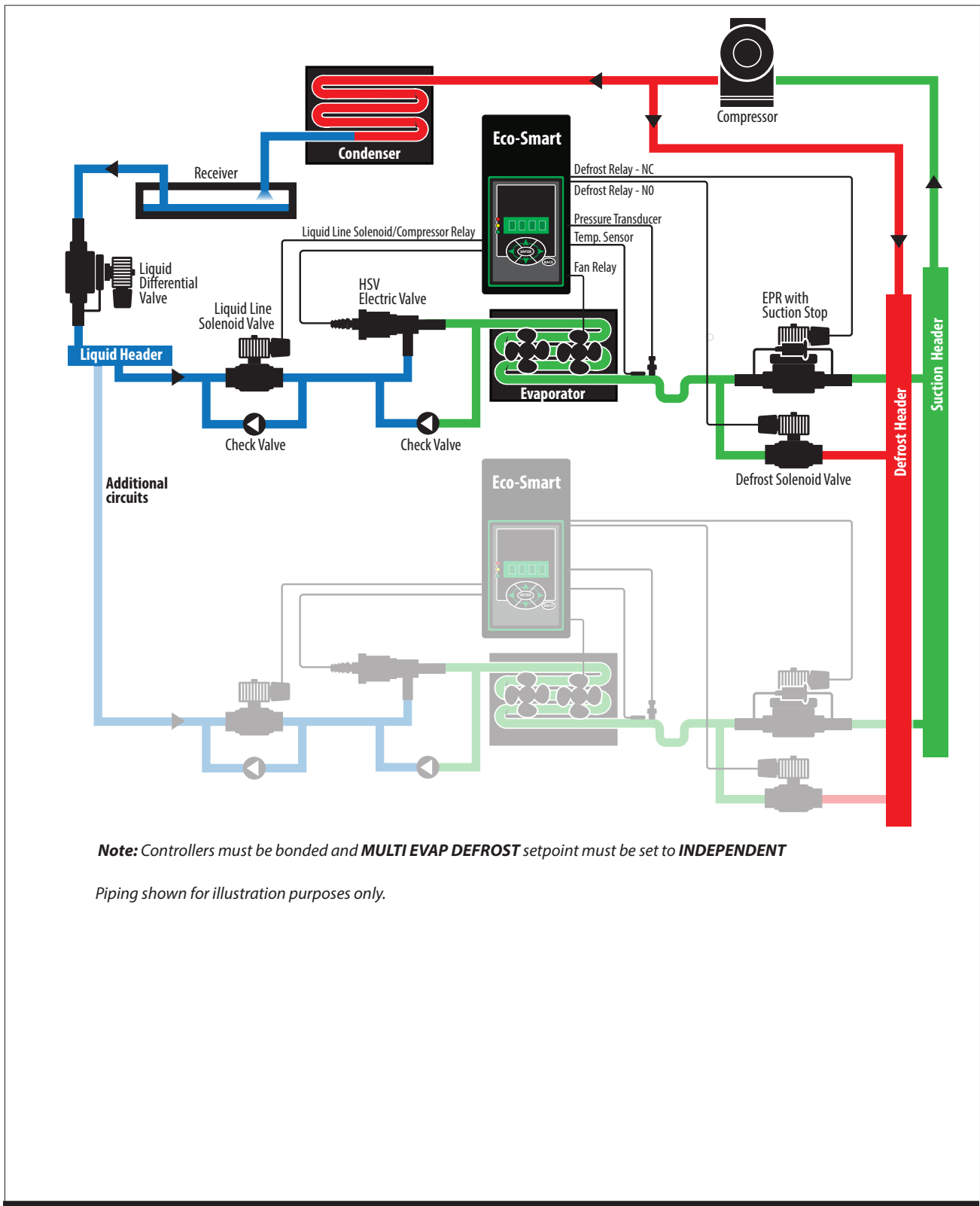


Figure 8 - Wiring Schematic - Controller New Install

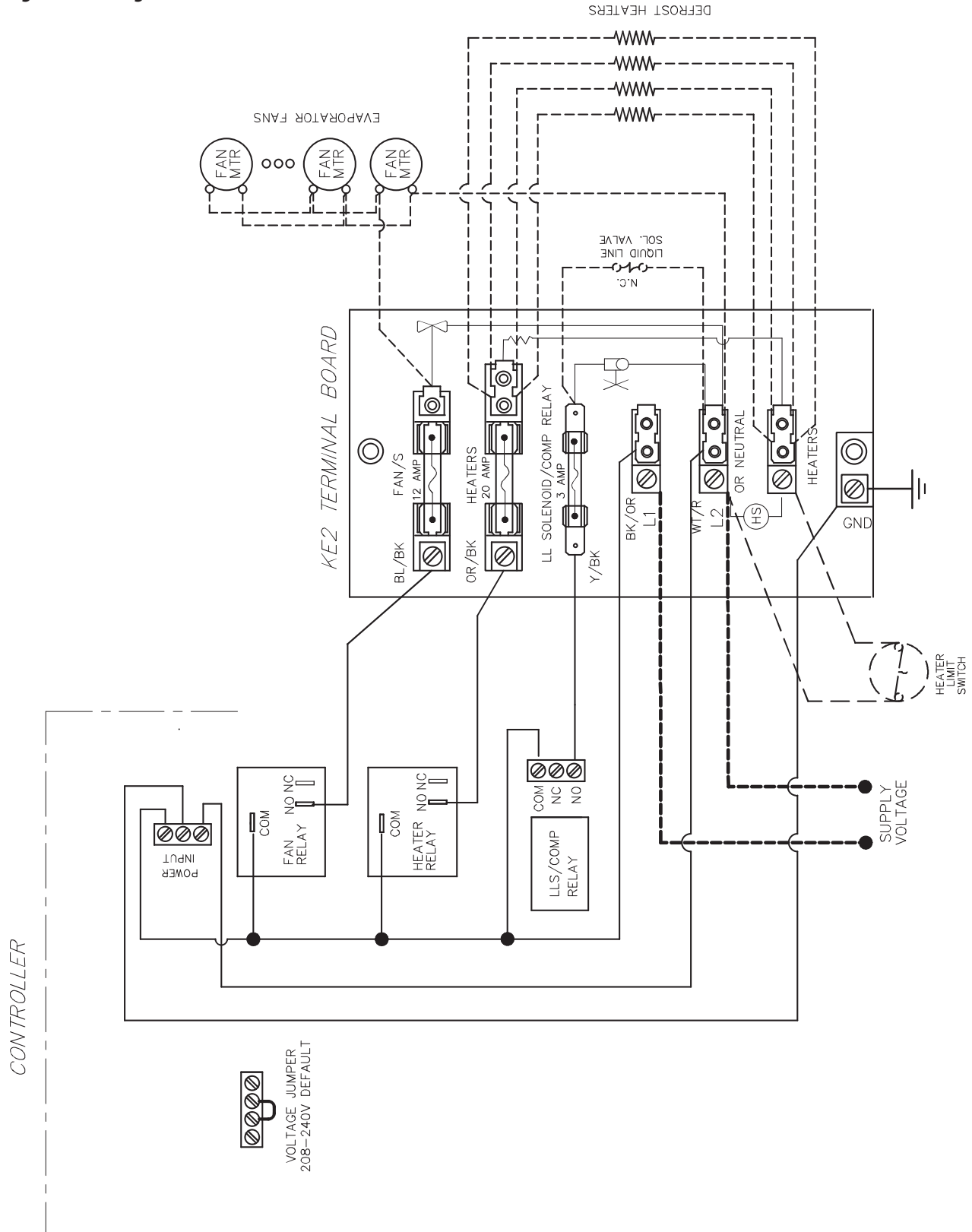


Figure 9 - Wiring Schematic - Controller with Contactor Box

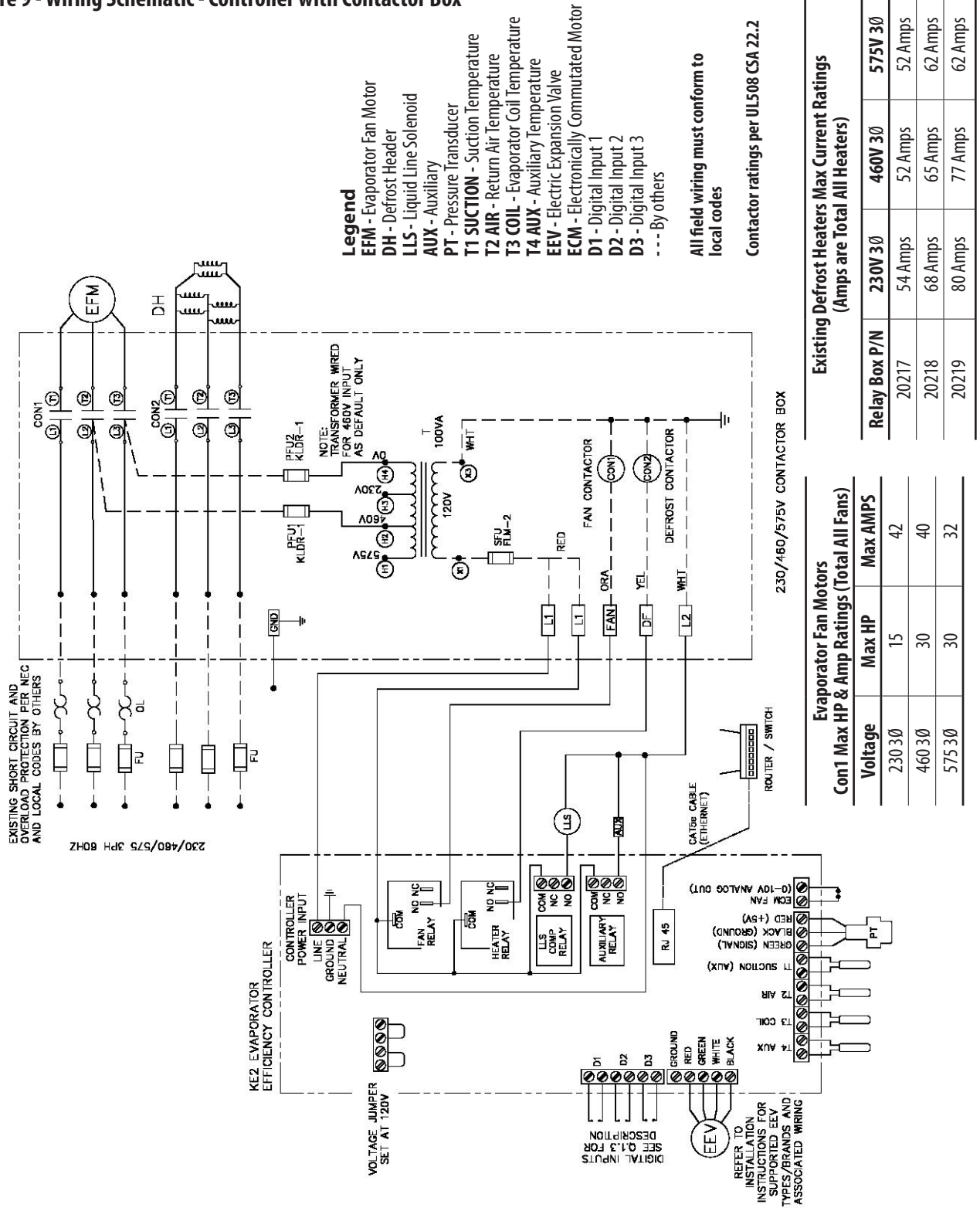
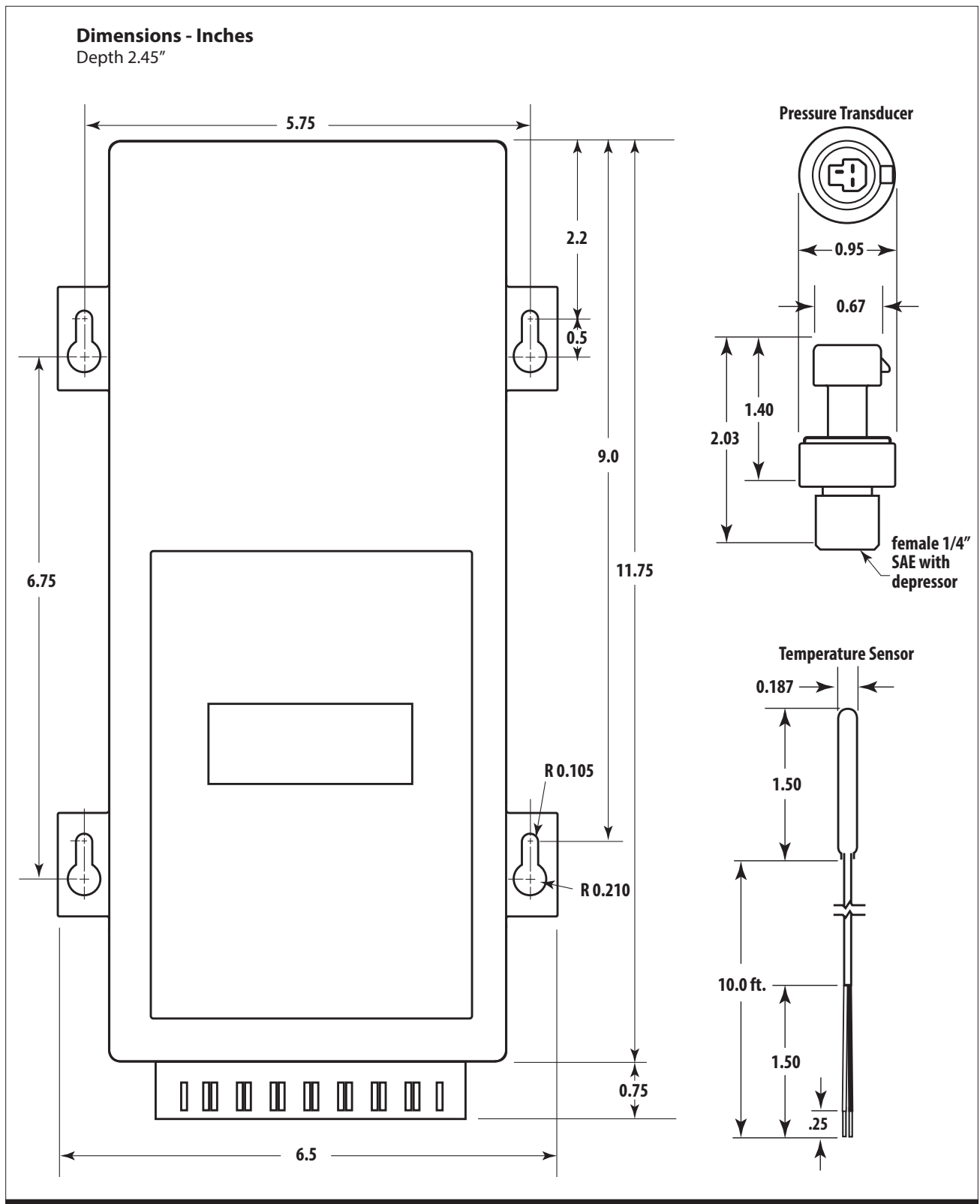


Figure 9 - Wiring Schematic - Controller with KEZ Contactor Box

Figure 10 - Eco-Smart - Dimensions (front view)



User Interface

The Eco-Smart's onboard user interface uses a familiar 6-button arrangement to simplify navigation through the controller's menus. The menu has been grouped by category to provide an easy to program structure. By grouping the menu by each functional area, the user is not required to scroll through unrelated parameters to access the desired functionality.

The **left** and **right arrows** move between the menus. When pressed while in a menu, the left and right arrows will move to the main screen or the adjacent menu.

The **up** and **down arrows** move the user through the available options for each group. All users are allowed access to the variable alarms. All other information is password protected to prevent unauthorized access to the controller's functionality.

The **ENTER** button is used to save an input option when it has been changed. **The enter button must be held for 3 seconds to prevent accidental changes.** Changes may be discarded by waiting, to allow the controller to timeout and return to default screen, or hitting the **BACK** button.

The **BACK** button is used to return to the previous screen. Pressing the **BACK** button three times at any time will return the user to the default view. **See Table 2 (following page).**

Controller Setup

Upon initially applying power to the controller, the controller will initialize, then automatically enter the **Introduction Mode**. The Introduction Mode consists of as little as 4 setpoints that must be configured for Eco-Smart to begin controlling the system. See **Table 2**.

The first setpoint the user is asked to enter is the desired **ROOM TEMP**. This is followed by the **DEFROST TYPE**. The controller is designed to work with electric, hot gas, and off time defrosts. The last setpoint is the **VALVE TYPE**. The controller is defaulted to be used with a mechanical valve, but may be used with a variety of EEVs, including a customer defined valve. To easily view your controller online enable **SMART ACCESS**. These are the only setpoints required to begin controlling the system, when applied on a single evaporator, with a mechanical valve.

If using a standard/predefined EEV, the user will also be prompted to specify the **REFRIGERANT**. The Eco-Smart may also be applied to user defined EEVs. When this option is selected, the user will be prompted to select **MOTOR TYPE, MOTOR STEP RATE, and MAX VALVE STEPS**. Once these have been set, the Eco-Smart will begin controlling EEV and the system.

Adjusting Controller Parameters

The controller is able to access an abundance of information from the 4-digit alphanumeric display. However, the controller requires a password, adding a degree of protection from unwanted modifications. The controller will prompt the user for a password **PASSWORD** when the user attempts to access setpoints they do not have permission to change.

Table 1 shows the menu structure of the controller. The default display of the controller always displays the actual room temperature. Pressing the **ENTER** button will display room temp **ROOM TEMP**. Pressing the **up** and **down** arrows moves the display through the **VARIABLES** menu. See Controller Navigation on page 16. By default, the controller only allows access to the room temperature. The **VARIABLES** menu consists of the current sensor readings and the relays' state. The **User Password (1111)** only provides access to the ROOM TEMP setpoint.

For the protection of the system, access to the **SETPOINT** and **MANUAL** control requires an **Installer Password (2222)**. Pressing the right or left arrow will move from the Variables menu to the next menu, shown in the Controller Navigation on page 16 a complete list of parameters is shown in **Table 3**.

Pressing the **BACK** key at any time will return the user to next level up the menu. A second press will either return to the **Main Menu** or to the room temperature reading.

Table 2 - Introduction Mode

| Mechanical Valve TEV - 4 steps | Defined EEV 5 steps | Custom EEV 8 steps |
|--------------------------------|---------------------|-------------------------------|
| Room Temp | Room Temp | Room Temp |
| Defrost Type | Defrost Type | Defrost Type |
| Valve Type | Valve Type | Valve Type |
| KE2 Smart Access | Refrigerant | Refrigerant |
| | KE2 Smart Access | Motor Type (Unipolar/Bipolar) |
| | | Motor Step Rate |
| | | Max Valve Steps |
| | | KE2 Smart Access |

Web Login

When accessing the controller using the webpage, the Username and Password are required.

The defaults are set as:

User: ke2admin **Password:** ke2admin

IMPORTANT: the Password should be changed from the default for security purposes.



KE2 Therm Evaporator Efficiency

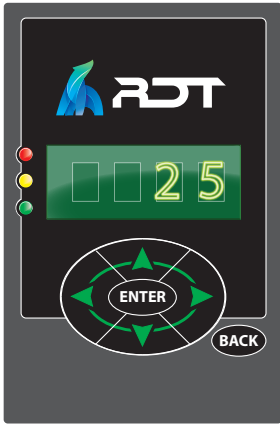
KE2 Therm Solutions (888) 337 3358 IP Address: 10.1.0.15 Location: (Set Location) MAC Address: 00 04 A3 14 E6 F8

User Name: ke2admin

Password: *****

Home Page Settings Network Setpoints Graphs Submit

Table 2 - Navigation Through the Controller Menu and Menu Parameters



Indicator lights

- **Red light** - critical alarm (system off)
- **Yellow light** - non-critical alarm (system running)
- **Green light** - compressor on
- **Green flashing** - compressor waiting on timer to start/stop

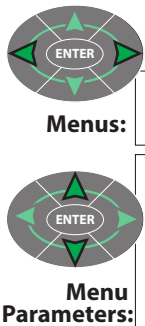
To move through controller menus: ← **Left and Right Arrows** Use to move between **Menus**
↑ **Up Arrow and Down Arrow**
↓ Scroll through **Menu Parameters**

To return to Main Menu: **BACK** Press BACK to return to the previous view.

To toggle between description and value: **ENTER** Press ENTER to go from parameter to value.

To change settings: **ENTER** Press and hold ENTER for 3 seconds, when display begins blinking changes can be made

To save setting changes: **ENTER** Press and hold ENTER for 3 seconds to save change



| Non-adjustable Variables (view only) | Alarms (view only) | Setpoints | Enter Password | Manual |
|--|--|---|--|--------|
| <ul style="list-style-type: none"> ROOM TEMP COIL TEMP SYSTEM MODE SUPERHEAT SUCTION PRESSURE T1 SUCTION TEMP¹ SATURATION TEMP VALVE % OPEN⁴ T4 AUX TEMP¹ COMPRESSOR RELAY DEFROST RELAY FAN RELAY AUX RELAY DIG 1 STATUS DIG 2 STATUS DIG 3 STATUS IP OCTET 1 IP OCTET 2 IP OCTET 3 IP OCTET 4 SUBNET MASK OCTET 1 SUBNET MASK OCTET 2 SUBNET MASK OCTET 3 SUBNET MASK OCTET 4 FIRMWARE VERSION | <ul style="list-style-type: none"> NO ALARM PRESSURE SENSOR SUCTION TEMP SENSOR AIR TEMP SENSOR COIL TEMP SENSOR AUX TEMP SENSOR HIGH SUPERHEAT LOW SUPERHEAT HIGH AIR TEMP LOW AIR TEMP EXCESS DEFROST DEFR TERM ON TIME DOOR SWITCH COMMUNICATION ERROR EXT ALARM EMAIL FAILURE FTP SNTF | <ul style="list-style-type: none"> ROOM TEMP² DEFROST TYPE² VALVE TYPE² <i>MOTOR TYPE</i>³ <i>MOTOR STEP RATE</i>³ <i>MAX VALVE STEPS</i>³ <i>SUPERHEAT</i>⁴ <i>MAX OPERATING PRES</i>⁴ <i>REFRIGERANT</i> AUX TEMP 4 MODE AUX TEMP 1 MODE⁵ AUX RELAY MODE FAN SPEED MIN COMP RUN TIME MIN COMP OFF TIME REFRIG FAN MODE DEFROST MODE DEFROSTS / DAY 1ST DEFROST DELAY DEFROST FAN STATE DEFROST TERM TEMP DEFROST PARAMETER/MAX DEFROST TIME DRAIN TIME COMP RUN TIME⁷ ELEC DEFROST MODE FAN DELAY TEMP MAX FAN DELAY TIME PUMP DOWN TIME MULTI AIR TEMP CTRL MULTI EVAP COOL⁵ MULTI EVAP DEFROST⁶ MULTI EVAP SENSOR⁶ HIGH TEMP ALARM OFFSET HIGH TEMP ALARM DELAY LOW TEMP ALARM OFFSET LOW TEMP ALARM DELAY DOOR ALARM DELAY DIG IN 1 MODE DIG IN 1 STATE DIG IN 2 MODE DIG IN 2 STATE DIG IN 3 MODE DIG IN 3 STATE 2ND ROOM TEMP SUCT PRES OFFSET SUCT TEMP OFFSET AIR TEMP OFFSET COIL TEMP OFFSET AUX TEMP OFFSET TEMP UNITS AIR TEMP DIFF EXTREME TEMP DIFF PROPORTIONAL INTEGRAL DERIVATIVE | <ul style="list-style-type: none"> MANUAL CONTROL MANUAL VALVE⁴ CLEAR ALARMS MANUAL COMPRESSOR RELAY MANUAL DEFROST RELAY MANUAL FAN RELAY MANUAL AUX RELAY FACTORY RESET WEB PASSWORD RESET KE2 SMART ACCESS DHCP DOD INIT CLEAR MD | |

- 1 T1 and T4 are parameters that can be set to various functions. The default for T1 is Suction Temp, the T4 is Coil Temp.
- 2 The Setpoint parameters shown in **BOLD** (Valve Type, Room Temp Setpoint and Defrost Mode) need to be set by the user prior to start up. The other Setpoint Parameters can also be adjusted, however the factory setpoints are generally correct for most applications.
- 3 The Setpoint parameters shown in *ITALIC* are only displayed when a Custom EEV is used.
- 4 Displayed when an EEV is used.
- 5 Only available if mechanical valve is selected. When using an electric valve the default, suction temperature, is required.
- 6 The Setpoint parameters shown in **BOLD ITALIC** are used for bonded controllers only.
- 7 Only displayed when Run Time Defrost is selected.

- Variables for DIG IN STATUS**
- DISABLED
 - 2ND (ROOM) TEMP
 - DOOR SWITCH
 - EXT ALARM
 - SYSTEM OFF
 - DEFROST LOCKOUT
 - DEFROST INTERLOCK

Table 3 - Controller Menus and Menu Parameters

Manual Menu

| Parameter Name | Description | Range | Default |
|-------------------------|---|---|---------|
| MANUAL CONTROL | Force the controller into the next operating mode | REFRIGERATE/OFF, DEFROST, DRAIN TIME, FAN DELAY | |
| MANUAL VALVE | Manually open or close the EEV in percentage increments | 1% increment | |
| CLEAR ALARMS | Clear all active alarms | | |
| MANUAL COMPRESSOR RELAY | Manually energize or de-energize liquid line solenoid /compressor relay | AUTO (ON/OFF), MANUAL OFF, MANUAL ON | AUTO |
| MANUAL DEFROST RELAY | Manually energize or de-energize defrost relay | AUTO (ON/OFF), MANUAL OFF, MANUAL ON | AUTO |
| MANUAL FAN RELAY | Manually energize or de-energize evaporator fan relay | AUTO (ON/OFF), MANUAL OFF, MANUAL ON | AUTO |
| MANUAL AUX RELAY | Manually energize or de-energize auxiliary relay | AUTO (ON/OFF), MANUAL OFF, MANUAL ON | AUTO |
| FACTORY RESET | Reset the controller to the factory default setpoints | RESET | |
| WEB PASSWORD RESET | Reset the web password to the factory default | RESET | |
| KE2 Smart Access | Turn KE2 Smart Access on or off | DISABLE, ENABLE | DISABLE |
| DHCP | Turn DHCP mode on or off | DISABLE, ENABLE | DISABLE |
| DOD INIT | Re-initialize KE2 defrost algorithm | RESET | |
| CLEAR MD | NO LONGER USED | HOLD TO CLEAR MD | |

Variables Menu - Non Adjustable (view only)

| Parameter Name | Description |
|---------------------|---|
| ROOM TEMP | Walk-in freezer or cooler room temperature as measured by the controller |
| COIL TEMP | Coil temperature as measured by the controller |
| SYSTEM MODE | Current operating status |
| SUPERHEAT | Superheat as calculated by the controller (requires suction pressure transducer and T1 set as suction temperature sensor) |
| SUCTION PRESSURE | Suction pressure as measured by the controller (only available if suction pressure transducer installed) |
| T1 SUCTION TEMP | Suction temperature as measured by the controller |
| SATURATION TEMP | Saturation temperature as calculated by the controller (requires pressure transducer and T1 sensor) |
| VALVE % OPEN | Percentage the EEV is open (only available if EEV is selected) |
| T4 AUX TEMP | Auxiliary Temperature (Taux) sensor reading as measured by the controller (Not available if T4 set to DISABLED) |
| COMPRESSOR RELAY | Current state of liquid line solenoid/compressor relay |
| DEFROST RELAY | Current state of the defrost relay |
| FAN RELAY | Current state of the evaporator fan relay |
| AUX RELAY | Current state of the auxiliary relay |
| DIG 1 STATUS | Current status of the Digital Input #1 |
| DIG 2 STATUS | Current status of the Digital Input #2 |
| DIG 3 STATUS | Current status of the Digital Input #3 |
| IP OCTET 1 | The first three digits of the IP address |
| IP OCTET 2 | The second three digits of the IP address |
| IP OCTET 3 | The third three digits of the IP address |
| IP OCTET 4 | The fourth three digits of the IP address |
| SUBNET MASK OCTET 1 | The first three digits of the subnet mask |
| SUBNET MASK OCTET 2 | The second three digits of the subnet mask |
| SUBNET MASK OCTET 3 | The third three digits of the subnet mask |
| SUBNET MASK OCTET 4 | The fourth three digits of the subnet mask |
| FIRMWARE VERSION | Current version of the firmware on the controller |

Only displayed when certain configurations are selected

Variables Menu Options for DIG IN 1,2,3 STATUS

| DIG IN Setting | Status Displayed on Controller |
|-----------------------------------|--|
| DIG IN STATUS = DISABLED | DISABLED |
| DIG IN STATUS = 2ND (ROOM) TEMP | inactive = 2ND ROOM TEMP OFF; active = 2ND ROOM TEMP ON |
| DIG IN STATUS = DOOR SWITCH | inactive = DOOR CLOSED; active = DOOR OPEN |
| DIG IN STATUS = EXT ALARM | inactive = NO ALARM; active = EXT ALARM (x) |
| DIG IN STATUS = SYSTEM OFF | inactive = SYSTEM ON; active = SYSTEM OFF |
| DIG IN STATUS = LIGHT SWITCH | inactive = LIGHTS OFF; active = LIGHTS ON |
| DIG IN STATUS = DEFROST LOCKOUT | inactive = DEFROST RELAY AUTO; active = DEFROST LOCKED OUT |
| DIG IN STATUS = DEFROST INTERLOCK | inactive = DEFROST RELAY AUTO; active = DEFROST RELAY OFF |

Alarms Status Menu - Non Adjustable (view only)

| Parameter Name | Description |
|--------------------------|--|
| NO ALARM | No alarms active, everything is running correctly |
| PRESSURE SENSOR | Suction pressure sensor is shorted, open or pressure out of range |
| T1 SUCTION SENSOR | Suction temperature sensor is shorted or open |
| T2 AIR SENSOR | Return air temperature sensor is shorted or open |
| T3 COIL SENSOR | Coil temperature sensor is shorted or open |
| T4 AUX SENSOR | Auxiliary temperature sensor is shorted or open |
| HIGH SUPERHEAT | Superheat above upper limit |
| LOW SUPERHEAT | Superheat below lower limit |
| HIGH AIR TEMP | Room temperature is above ROOM TEMP + AIR TEMP DIFF + HIGH TEMP ALARM OFFSET for longer than HIGH TEMP ALARM DELAY |
| LOW AIR TEMP | Room temperature is below ROOM TEMP - LOW TEMP ALARM OFFSET for longer than LOW TEMP ALARM DELAY |
| EXCESS DEFROST | Three consecutive defrosts with less than a one hour interval between each defrost |
| DEFR TERM ON TIME | Defrost terminated on time instead of temperature for two consecutive cycles |
| DOOR SWITCH | If door is open and room temperature is 5 degrees above ROOM TEMP + AIR TEMP DIFF for DOOR ALARM DELAY time |
| COMMUNICATION ERROR | ONLY FOR BONDED CONTROLLERS: No communication between controllers for one minute or more |
| EXT ALARM | If DIG IN (1, 2 and/or 3) MODE = EXT ALARM : The digital input is in an active state |
| EMAIL FAILURE | Email alert was not confirmed by email server provided after seven consecutive attempts |
| FTP COMMUNICATION ALARM | ONLY FOR SITEVIEW MANAGER: No communication to the ftp server defined in Settings/Logging Options |
| SNTP COMMUNICATION ALARM | ONLY FOR SITEVIEW MANAGER: No communication to the SNTP server defined in Settings/Siteview Options |



Setpoints Menu

| | Parameter Name | Description |
|---------------------------------|---|--|
| | ROOM TEMP | Walk-in freezer or cooler room temperature to be maintained |
| | DEFROST TYPE | Method of defrost used on the evaporator coil: Electric, Air, Hot Gas with Liquid Line Solenoid/Compressor relay off, Hot Gas with Liquid Line Solenoid/compressor relay on |
| | VALVE TYPE | Type of valve used on the system: mechanical, pre-configured electric, custom EEV configuration |
| Custom EEV only | MOTOR TYPE | If VALVE TYPE = CUSTOM: The motor type used in the valve |
| | MOTOR STEP RATE | If VALVE TYPE = CUSTOM: The motor speed setting in number of steps per second |
| | MAX VALVE STEPS | If VALVE TYPE = CUSTOM: The total number of steps required to move the valve from closed to fully open |
| | SUPERHEAT | The superheat value that the controller will maintain, (not applicable if VALVE TYPE = MECHANICAL) |
| | MAX OPERATING PRES | The maximum allowable suction pressure, (not applicable if VALVE TYPE = MECHANICAL) |
| | REFRIGERANT | The type of refrigerant used in the refrigeration system |
| | AUX TEMP 4 MODE | Configuration mode of the auxiliary temperature sensor |
| | AUX TEMP 1 MODE | Configuration mode of the auxiliary temperature sensor (Not available if EEV is selected) |
| | AUX RELAY MODE | Configuration mode of the auxiliary relay. |
| | FAN SPEED | Provides 0-10V DC signal to control variable speed |
| | MIN COMP RUN TIME | Minimum amount of time the liquid line solenoid/compressor relay must remain on after it is energized |
| | MIN COMP OFF TIME | Minimum amount of time the liquid line solenoid/compressor relay must remain off before it can be energized again. |
| | REFRIG FAN MODE | Fan operation while in refrigeration mode |
| | DEFROST MODE | The method the controller uses to determine when to initiate a defrost. |
| | DEFROSTS / DAY | If DEFROST MODE = SCHEDULED: The number of evenly spaced defrosts per day the controller will initiate. |
| | 1ST DEFROST DELAY | If DEFROST MODE = SCHEDULED: The amount of time from controller power up until the first defrost is initiated. |
| | | DEFROST FAN STATE |
| | DEFROST TERM TEMP | The temperature the coil sensor(s) must exceed in order to terminate defrost. The defrost relay is de-energized at this point. |
| | DEFROST PARAMETER | if DEFROST MODE = DEMAND: Coefficient to KE2 Defrost algorithm |
| | MAX DEFROST TIME | If DEFROST MODE = SCHEDULE or RUNTIME: The maximum amount of time the defrost relay will be energized. (Not available if DEFROST MODE = DEMAND) |
| | DRAIN TIME | Time to be in drain mode (drip time) |
| | COMP RUN TIME | If DEFROST MODE = RUN TIME: The amount of time liquid line solenoid/compressor relay is energized before the next defrost is initiated. |
| | ELEC DEFROST MODE | If DEFROST TYPE = ELEC: Whether to leave the defrost relay energized during the defrost cycle or to utilize advanced defrost algorithm. |
| | FAN DELAY TEMP | After defrost, the coil sensor reading must fall below this temperature set point in order for the controller to resume normal fan operation. |
| | MAX FAN DELAY TIME | Maximum amount of time after defrost to resume normal fan operation. |
| | PUMP DOWN TIME | Minimum amount of time between de-energizing the liquid line solenoid/compressor relay and energizing the defrost relay. |
| Bonded Control- lers Only | MULTI AIR TEMP CTRL | Select control method to use with multiple room temperature sensors |
| | MULTI EVAP COOL | Select type of multi evaporator control - options are synchronous or independent |
| | MULTI EVAP DEFROST | Select whether to have all bonded controllers initiate defrost mode at the same time or independently. |
| | MULTI EVAP SENSOR | Select whether or not to share room temperature, coil temperature and suction pressure sensor data with bonded controllers. |
| | HIGH TEMP ALARM OFFSET | The number of degrees above ROOM TEMP for a HIGH TEMP ALARM condition. |
| | HIGH TEMP ALARM DELAY | Minutes the room temperature must remain above ROOM TEMP + HIGH TEMP ALARM OFFSET before issuing a HIGH TEMP ALARM |
| | LOW TEMP ALARM OFFSET | The number of degrees below ROOM TEMP for a LOW TEMP ALARM condition. |
| | LOW TEMP ALARM DELAY | Minutes the room temperature must remain below ROOM TEMP - LOW TEMP ALARM OFFSET before issuing a LOW TEMP ALARM |
| | DOOR ALARM DELAY | If DIG IN (1, 2 and/or 3) MODE = DOOR SWITCH: The amount of time, in minutes, before an alarm condition is initiated if door is open and room temperature is 5 degrees above ROOM TEMP + AIR TEMP DIFF |
| | DIG IN 1 MODE | Sets the function of the digital input |
| | DIG IN 1 STATE | Sets whether the switch activates when opened or closed |
| | DIG IN 2 MODE | Sets the function of the digital input |
| | DIG IN 2 STATE | Sets whether the switch activates when opened or closed |
| | DIG IN 3 MODE | Sets the function of the digital input |
| | DIG IN 3 STATE | Sets whether the switch activates when opened or closed |
| | 2ND ROOM TEMP | If DIG IN (1, 2 and/or 3) MODE = 2ND ROOM TEMP: This value becomes the ROOM TEMP setpoint when the digital input is active |
| | SUCT PRES OFFSET | An offset added or subtracted from the suction line pressure transducer reading, if needed |
| | SUCT TEMP OFFSET | An offset added or subtracted from the suction temperature sensor reading, if needed |
| | AIR TEMP OFFSET | An offset added or subtracted from the room temperature sensor reading, if needed |
| | COIL TEMP OFFSET | An offset added or subtracted from the coil temperature sensor reading, if needed |
| | AUX TEMP OFFSET | An offset added or subtracted from the auxiliary temperature sensor reading, if needed |
| TEMP UNITS | Units for temperature's display in °F or °C | |
| AIR TEMP DIFF | The number of degrees above ROOM TEMP before the controller will go into REFRIGERATION mode | |
| EXTREME TEMP DIFF | ADVANCED TOPIC: Call KE2 Therm for assistance | |
| PROPORTIONAL | A coefficient to the valve control algorithm that increases valve responsiveness | |
| INTEGRAL | A coefficient to the valve control algorithm that increases valve responsiveness | |
| DERIVATIVE | Should not be adjusted unless instructed by KE2 Therm technical support | |

| Range | Default | Current |
|---|--|---------|
| -50°F to 90°F | -10°F | |
| ELEC, AIR, HOT GAS COMP ON, HOT GAS COMP OFF | ELEC | |
| MECHANICAL, KE2 RSV, KE2 HSV, SER/SEI 1 TO 20, SER B TO L, SEI 30, SEI 50, SEH, ETS12 TO 50, ETS100, ETS250/400, CAREL, CUSTOM; | MECHANICAL | |
| BIPOLAR, UNIPOLAR | BIPOLAR | |
| 30 to 400 steps/second | 200 steps | |
| 200 to 6400 steps | 1600 steps | |
| 5°F to 30°F | 8°F | |
| 10-500 psig if R-744 selected, 10-300psig if R-410A selected, 10-150 psig all other refrigerants | 150 psig | |
| 404A, R507, 407A, 407C, 422A, 422D, 134A, R22, R717, 438A, 408A, 409A, 407F, 410A, R744 | 404A | |
| DISABLED, MONITOR, T4 ROOM TEMP, T4 COIL TEMP | DISABLED | |
| T1 SUCTION TEMP, MONITOR, T1 ROOM TEMP, 2ND COIL TEMP | T1 SUCTION | |
| ALARM RELAY, 2ND COMP RELAY, 2ND FAN RELAY, 2ND DEFR RELAY, 2 SPEED FAN CTL, LIGHT RELAY, PERM DEFROST RELAY | ALARM RELAY | |
| -100% to 100% | 0.000 (Off) | |
| 0 to 15 minutes | 2 minutes | |
| 0 to 15 minutes | 5 minutes | |
| ON WITH COMPRESSOR, PERMANENT, MANAGED, CONTROL FOR TITLE 24 | ON WITH COMPRESSOR | |
| DEMAND, SCHEDULED, RUN TIME | DEMAND | |
| 0 to 8 | 5 | |
| 0 to 240 minutes | 120 minutes | |
| ON/OFF | OFF if DEFROST TYPE = ELEC, HOT GAS COMP ON, HOT GAS COMP OFF ON if DEFROST TYPE = AIR | |
| 35°F to 90°F | 50°F if DEFROST TYPE = ELEC, HOT GAS COMP ON, HOT GAS COMP OFF 40°F if DEFROST TYPE = AIR | |
| 0 to 90 | 30 if DEFROST TYPE = ELEC 10 if DEFROST TYPE = HOT GAS COMP ON, HOT GAS COMP OFF 40 if DEFROST TYPE = AIR | |
| 0 to 90 minutes | 45 minutes if DEFROST TYPE = ELEC 10 minutes if DEFROST TYPE = HOT GAS COMP ON, HOT GAS COMP OFF 40 minutes if DEFROST TYPE = AIR | |
| 0 to 15 minutes | 2 minutes | |
| 0 to 24 hours | 6 hours | |
| PULSE, PERMANENT | PULSE | |
| -40°F to 35°F | 20°F | |
| 0 to 20 minutes | 2 minutes | |
| 0 to 90 minutes | 0 minutes if DEFROST TYPE = ELEC or AIR, 2 minutes if DEFROST TYPE = HOT GAS ON/OFF | |
| AVERAGE, WARMEST | WARMEST | |
| SYNC, INDEPENDENT | SYNC | |
| SYNC, INDEPENDENT | SYNC | |
| SHARED, NOT SHARED | SHARED | |
| 0°F to 99.9°F | 10°F | |
| 0 to 120 minutes | 60 minutes | |
| 0°F to 20°F | 4°F | |
| 0 to 30 minutes | 10 minutes | |
| 0 to 180 minutes | 30 minutes | |
| DISABLED, 2ND ROOM TEMP, DOOR SWITCH, EXT ALARM, SYSTEM OFF | DOOR SWITCH | |
| OPEN, CLOSED | CLOSED | |
| DISABLED, 2ND ROOM TEMP, DOOR SWITCH, EXT ALARM, SYSTEM OFF, DEFR INTERLOCK, DEFR LOCKOUT | DISABLED | |
| OPEN, CLOSED | CLOSED | |
| DISABLED, 2ND ROOM TEMP, DOOR SWITCH, EXT ALARM, SYSTEM OFF, LIGHT SWITCH | SYSTEM OFF | |
| OPEN, CLOSED | CLOSED | |
| -50°F to 90°F | -50°F | |
| -5.0 to 5.0 psig | 0.0 psig | |
| -5.0°F to 5.0°F | 0.0°F | |
| -5.0°F to 5.0°F | 0.0°F | |
| -5.0°F to 5.0°F | 0.0°F | |
| -5.0°F to 5.0°F | 0.0°F | |
| FAHRENHEIT/CELSIUS | FAHRENHEIT | |
| 0.1°F to 5°F | 1°F | |
| | | |
| 0 to 255 | 3 | |
| 0 to 255 | 5 | |
| 0 to 255 | 3 | |

Standard Communication

The Eco-Smart uses standard TCP/IP communication. The controller is equipped with an RJ-45 female connector to connect to Ethernet cable. To communicate with the controller, use a web browser to see the controller's MasterView webpage. The information is stored on the controller, so special software is not required.

A standard Ethernet cable is connected to the controller, and the other to the Ethernet port on the PC or Smart Gate. Networking the controllers is required for installations where multiple evaporators are piped to a single condenser. This prevents damage to the system by synchronizing the defrost cycles. When networked, the controllers share information, such as air temperature, allowing a controller in alarm mode to continue providing refrigeration until the system is serviced.

For more information on networking multiple controllers, visit KE2 Therm's website at:

<http://ke2therm.com/productliteratureevapmisclit.html>
and see bulletin Q.5.10 Advanced Configuration.

Communication using Smart Access

While accessing the Eco-Smart through the Internet using port forwarding or a VPN continues to be free, RDT recognizes that some customers prefer the simplicity and convenience of Smart Access to benefit from the controller's communication capability.

With version 4.0 firmware, the Eco-Smart comes with Smart Access capability. Smart Access makes it is easier than ever to monitor and adjust your Eco-Smarts remotely. For a nominal monthly fee, Smart Access provides quick, easy, real time access to your refrigeration system 24/7. No port forwarding. No VPN.

All the Eco-Smart needs is a physical connection to the network router with a cat 5 cable. Once enabled, Smart Access automatically connects to your personal web portal, hosted by KE2 Therm, and provides a "customized" dashboard of all the controllers you setup with Smart Access.

For more information on communications using Smart Access, visit KE2 Therm's website at:

<http://ke2therm.com/productliteratureevap4.html>
and see bulletin A.1.76 KE2 Evap v4.0 with KE2 Smart Access (overview) and Q.1.34 KE2 Smart Access Setup and Customizing.

Table 4 - Defrost Defaults

| Setpoint | Electric | Air | Hot Gas |
|--|----------|-----------|-----------|
| Defrost Fan State: | Off | On | Off |
| Defrost Termination Temperature Setpoint: | 50 | 40 | 50 |
| Defrost Parameter | 30 | 40 | 15 |
| Electric Defrost Mode: | Pulse | Permanent | Permanent |

Table 5 - Ethernet Specification Summary

| Specifications | Ethernet - Unshielded Twisted Pair (UTP) |
|-----------------------------|--|
| Topology | star |
| Network Friendly | YES |
| Maximum Cable Length | 330 feet (copper) |
| Maximum Data Rate | 1,000 mbs |
| Native Internet | YES |
| Supported Devices | thousands |
| Response Time | milliseconds |

For additional information on Ethernet Cable, consult IEEE 802.

Table 6 - Specifications

| Controller | |
|---|--|
| Input Voltage: | 120V or 208 - 240V |
| Ambient Temp: | -40° to 140°F |
| Operating Temp: | -40° to 140°F |
| Display: | 4-digit alphanumeric LED |
| IP Rating: | IP65 |
| Inputs: | (4) temperature sensors (KE2 SKU 20200) (1) pressure transducer (KE2 SKU 20204) |
| Valve Types: | unipolar and bipolar stepper motors (12V) |
| Relays: | 20A resistive (defrost) 10A inductive (evaporator fan) (2) 3A inductive rated cycles |
| Digital Input 1: | door contact, use 2nd air temp setpoint, disabled, system off, external alarm notification |
| Digital Input 2: | door contact, use 2nd air temp setpoint, disabled, system off, external alarm notification, defrost lockout, defrost interlock |
| Digital Input 3: | door contact, use 2nd air temp setpoint, disabled, system off, external alarm notification, lights |
| Communication: | Standard TCP/IP |
| Pressure Transducer - pn 20201 (10 ft lead) or pn 20204 (40 ft lead) | |
| Pressure Range: | 0 to 150 psia |
| Proof Pressure: | 450 psi |
| Burst Pressure: | 1500 psi |
| Operating Temp: | -40° to 275°F |
| Temperature Sensor | |
| Sensor Specs: | -60° to 150°F moisture resistant package |