UNITED COOLAIR

Marvel HPC and HPC$_{SE}$

HVAC – Head Pressure Controller for PBK Condensers

Installation and Operating Guide

Effective April 2022

Interactive PDF

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United CoolAir utilizes two different controllers pictured on the cover. Be sure to double check which controller is installed in your unit.

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GENERAL INFORMATION for HPC

The Marvel HPC Head Pressure Controller is a basic microprocessor controller setup for improved compressor system operation. The Marvel HPC maintains compressor discharge pressure by modulating the EC Fans of a Kelvion Remote Air Cooled Condenser to increase/decrease the amount of airflow across the remote air cooled condenser's condenser coils. This controller should not need any adjustments of set points for proper system operation. However, if required, settings are completely adjustable and are located within the password protected Set Point menu. Please contact the factory before making adjustments to these set point values.

Electrical Installation

The Marvel HPC controller is installed internal to the Kelvion Control box section. The fans have been pre-wired to two modulating outputs of the Marvel HPC. Each pressure transducer is installed and pre-wired back to the Marvel HPC. A set of interlock wires need to be installed from the United CoolAir Evaporator Section main control box to the Kelvion Remote Air Cooled Condenser's main control box. Field installers must install either an 18 AWG 300 volt rated 2-conductor cable or 2-conductors 18 AWG MTW/ THHN or equivalent through conduit routed between the United CoolAir Evaporator main control box and the Kelvion Remote Air Cooled Condenser main control box.

Connect the conductors as follows:

Evaporator Section	Condenser Section
TB1 – SC	TB1 – SC
TB1 – GND	TB1 – GND

Basics of Operation

The pre-installed pressure transducers read the refrigerant head/discharge pressure of each separate compressor circuit. The Marvel HPC monitors the pressure of each refrigerant circuit determining the Control Pressure Demand based on the compressor with the highest refrigerant pressure.

Pressure Transducers

Pressure transducers are pre-installed and wired back to the Marvel HPC controller. Each unit compressor should have a corresponding number of pressure transducers. For instance if there are three compressors, there will be three pressure transducers.

Pressure Transducer Troubleshooting

When a pressure transducer reads below 0 psig, there will be no pressure reading on the Marvel HPC controller's display panel. When the pressure transducer is connected correctly with a good reading above 0 psig, the reading for the corresponding compressor will appear on the display. If the Pressure reading is greater than 700 psig, the Marvel HPC will initiate a sensor alarm on the Marvel HPC.

Marvel HPC Display and Keypad Buttons

Below is the main display with buttons.

Alarm Key ⚠

Use the Alarm Key to access any active alarms. This button will illuminate red when an alarm is active.

Program Key ⊙

Use the Program Key to access the Main Menu.

Esc Key ↩

Use the Esc Key to escape from sub-menus.

Up Key ↑

Use the up arrow key to view the next screens in a loop, cycle through menu options and increment changeable values.

Enter Key ↵

Use the Enter Key to enter sub-menus, move the cursor to the next changeable field, and save changed parameters.

Down Key ↓

Use the down arrow key to view the next screens in a loop, cycle through menu options and decrement changeable values.

Marvel HPC Controller Setup

This selection process is performed by the Factory during the functional run test process. Production sets up the total fans based on fan quantity installed in the Kelvion Remote Condenser. The screen for Fan Quantity appears immediately following the initial software upload to the controller. This information allows the controller to use a Primary Fan only or Primary and Secondary set of fans for maintaining proper Low Ambient Control during much colder low ambient outdoor air conditions.

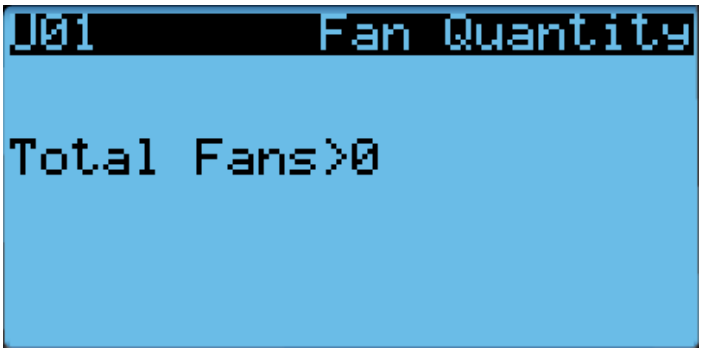
Primary and Secondary Fan Differences

Primary Fan

The primary fan will always operate when a compressor is on and will not shut down unless all compressors are off. Every remote condenser shall have a primary fan even when there are no secondary fans.

Secondary Fans

The secondary fans will start as the control pressure rises above the Start HPC Set point of 270 psig. The secondary fans will stop if there is a compressor on and the control pressure falls below the Stop HPC Set point of 240 psig or if all compressors are off.



Head Pressure Control Operation

When a compressor starts, the primary fan will start and maintain minimum fan speed of 10% as long as the Control Pressure is less than the Liquid Pressure Set Point of 295 psig. If the remote condenser has greater than 1 fan, secondary fans are enabled. The secondary fans start as the Control Pressure rises above 270 psig and maintains minimum speed once on and the Control Pressure is less than 295 psig and greater than 240 psig. Should the Control Pressure fall below 240 psig with a compressor is on, the secondary fans will stage off until the Control Pressure rises above the 270 Start HPC Set Point again.

As the Control Pressure rises above 295 psig, both primary and secondary fans will ramp up and down in unison (based on proportional and integral logic) to maintain a Discharge Pressure Set Point of 295 psig.

When all compressors are off, primary and secondary fans stop.

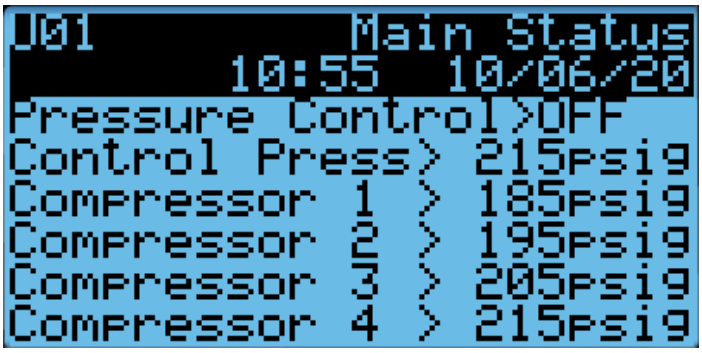
Main Status

Main Status is the menu with all of the main operational data/readings.

Pressure Control is the read point that provided information whether the ECM Fans are ON or OFF providing pressure control.

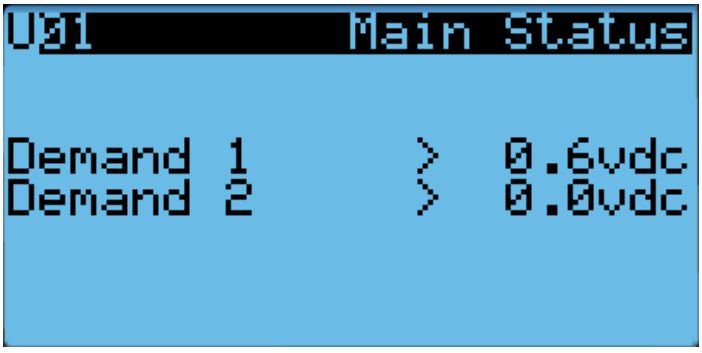
Control Pressure is the status of the maximum pressure of all compressors. The control pressure is the value that will be used for head pressure control. It is the value input to the set point function block in order to maintain the discharge refrigerant pressure as close to the refrigerant head pressure set point as possible. Compressor x is the operating pressure of the compressor. This Head Pressure Controller has capability to control refrigerant pressure for up to a maximum of four compressors. The number of compressor pressures displayed is based on the total number of compressors installed in the unit. The readings for compressor pressure are based on self-enabling inputs. A refrigerant pressure transducer is installed for each compressor. As the sensor reads refrigerant pressure greater than 0 bar/0 psig, the input becomes enabled.

Alarm Value (not shown) is hard coded at 700 psig. Should the refrigerant pressure on any compressor circuit rise above 700 psig for greater than 15 seconds, an alarm will be displayed on the Marvel HPC controller. Each compressor still has an independent High Pressure Switch installed that monitors for refrigerant pressure greater than 650 psig. This means that the compressor will most likely turn off based on high refrigerant pressure long before the 700 psig Alarm point.



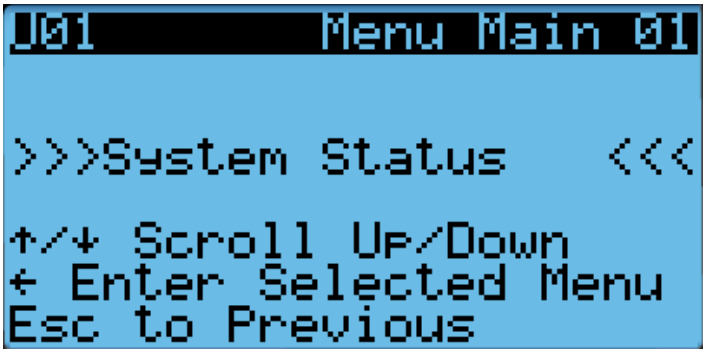
Demand 1 will always be present for both Low Ambient disabled and Low Ambient enabled selections.

Demand 2 will only be present for units with Low Ambient enabled.

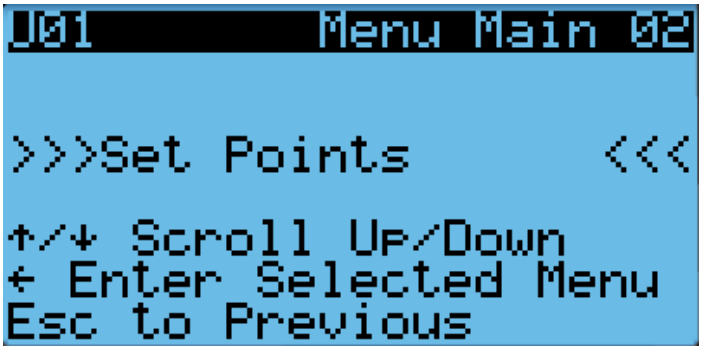


Main Menu Selections

When in the Main Menu, pressing the Enter button will redirect from the Main Menu back to the Main System Status.



Set Points will direct the setup into the Set Points Menu.



System Settings is the Set points menu. Set Point is the main set point control value that is trying to be maintained. The fans will increase and decrease speed trying to maintain this set point.

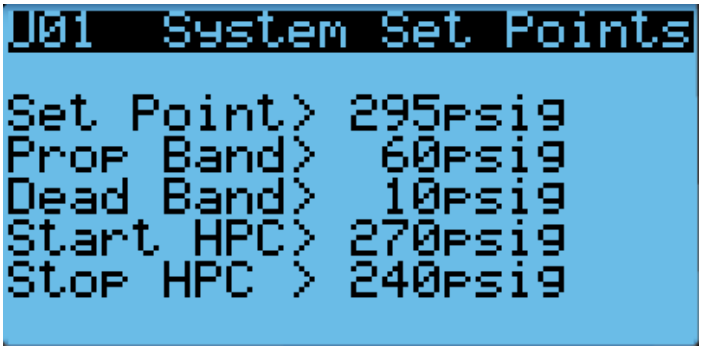
Prop Band is the Proportional Band set point. The Proportional Band is added to the main Set Point. If the Control Pressure is greater than or equal to the Set Point plus the Proportional Band, the demand for head pressure control is 100% in a direct proportional controlled system. The controller is set up based on Proportional and Integral type control scheme.

This means the Proportional Band is still used similarly but the output of to the fans is based on a rate of change from set point over time. This means the output value to the fans could be 100% event though the control pressure is less than the Set Point plus the Proportional Band but greater than the Set Point.

The Dead Band divides by 2 over the set point. The default Dead Band is 10.0psig. This means that there will be no increase or decrease in output within 5.0 psig above or 5.0 psig below the set point value.

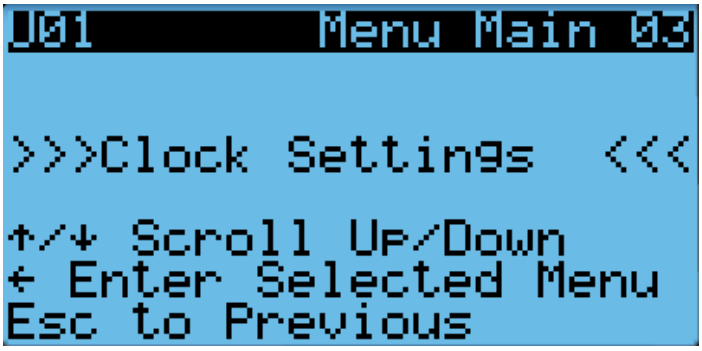
The Start HPC set point is the value that the Pressure Control Starts the ECM Fans as long as a compressor is on. As long as a Compressor is on and the Control Pressure is greater and the Start HPC, the Pressure Control is on.

The Stop HPC set point is the value that the Pressure Control Stops the ECM Fans and Pressure Control is off. ECM Fans can stop below the Stop Point even if a compressor is on to help increase head pressure within the system. The ECM Fans would then restart once the head pressure rises above the Start HPC set point. If the application type Low Ambient is enabled. Then the primary fan will not stop when there is a compressor on even if the Control Pressure falls below the Stop HPC.

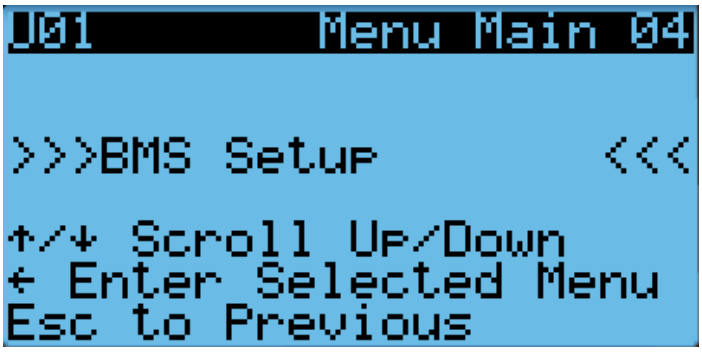


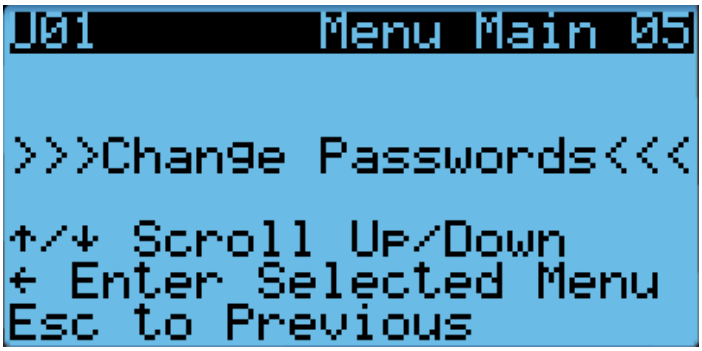
Clock Settings set up the present time and date for the internal time clock.

Change Password set up a basic password to protect the Set Points menu.

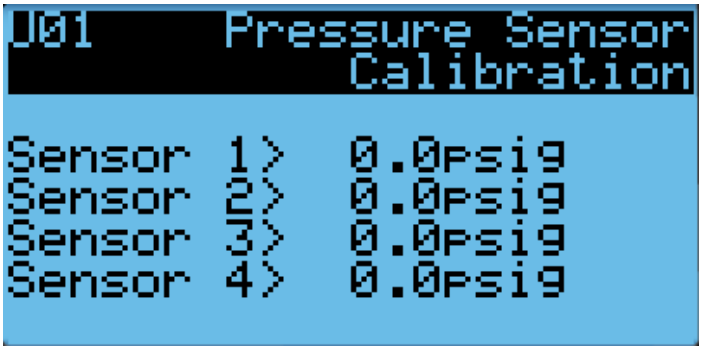


BMS Setup is used to set the Modbus Address and connection information for interlocking with a Marvel Premium Controller.

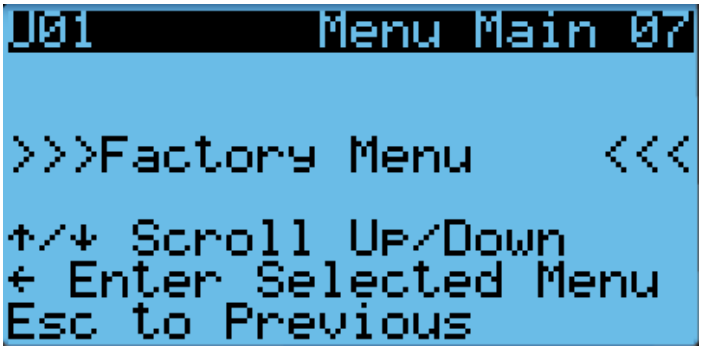


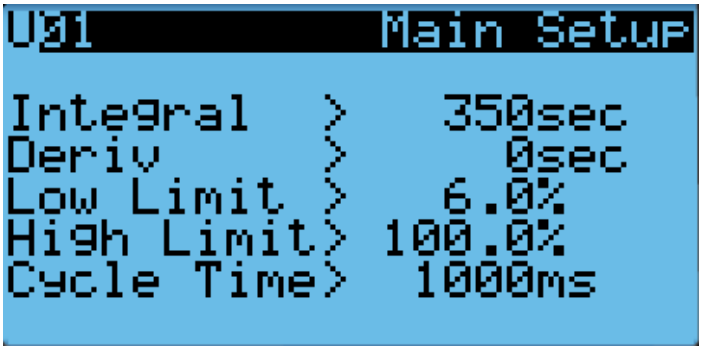


Technician Menu is password protected. Under the Technician Menu, the pressure sensor calibration can be adjusted between -99.9 and 99.9 psig total offset. Typically if a sensor is out of tolerance by more than 10.0%, it should be replaced. To adjust the calibration press the enter button to move the cursor to the desired field for adjustment. Pressure up or down to adjust as required and press enter to save the change.



Factory Menu is password protected. Under the Factory Menu, the Settings for PI Control are located under Factory Menu. Contact the factory if required for setting adjustments.

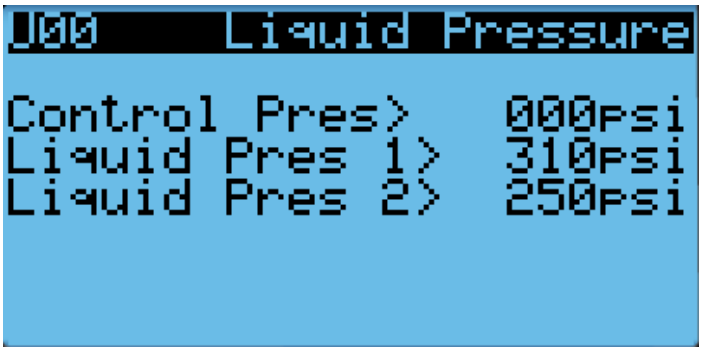


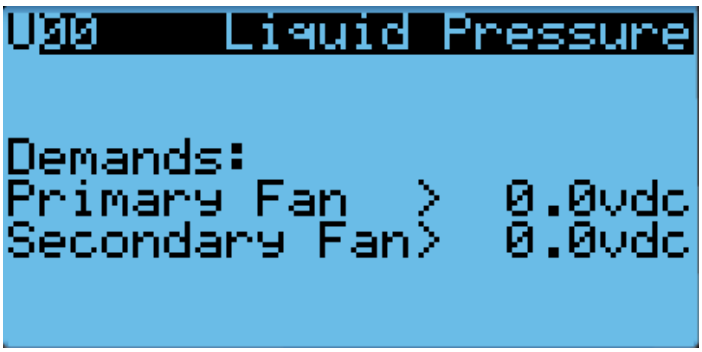


Units with Marvel Premium Controller (option)

If the United CoolAir provided system (evaporator and condenser units) was provided with a Marvel Premium controller as well, the Marvel Premium can be field interlocked with the Marvel HPC via the Modbus communications connection. The benefit of interlocking these controllers is to see the data from the Marvel HPC on the Marvel Premium without having to go directly to the Remote Condenser and open the control box to look at the Marvel HPC. Follow the electrical diagram for Modbus connections. There is a set of terminal blocks in each section Evaporator Control Box and Remote Condenser Control Box for controls interlock. A minimum 3 conductor 18 AWG shielded cable should be installed to complete this interlock.

The following screen or equivalent will appear on the Display for the Marvel Premium controller once the interlock is complete and the Marvel HPC is online with the Marvel Premium.





NOTE: The Modbus Connection is not required to make the units work but the start command interlock is required. This Modbus connection has been tested and locked. It requires no field adjustment other than pulling a 3 conductor communication cable to interlock the controllers. Please refer to the electrical diagram provided with your equipment for reference of both the Start Command interlock and the Optional Modbus connection interlock. The maximum interlock distance for the Modbus Communications Cable is 200 feet.

Modbus Connections (Optional for data transfer between controllers)

Evaporator Section	**Condenser Section**
TB-MB – RxTx-	TB-1 – RxTx-
TB-MB – RxTx+	TB-1 – RxTx+
TB-MB – GND	TB-1 – GND

TROUBLESHOOTING

PROBLEM	RESOLUTION
Total pressure readings on Display is less than the total installed Compressors	**1.** Check the Electrical terminations on UI1, UI2, UI3, UI4 as well as the Terminal White wires are the Output of the Sensor to the UIx input. **2.** Check for +5vdc to GND for dedicated 5 vdc. **3.** Make sure the Black wires of each cable connect to +5 vdc. **4.** Make sure the Green wires of the cable connect to the GND terminal.
Fans are off but the Main Status shows Demand output to the fans is greater than 0.0 vdc.	**1.** Check wires from the GND side of the ECM Fans to the GND Terminal. **2.** Check the wires from TB-1 – Y1 to the 0-10vdc input of ECM Fan. (Primary Fan) **3.** Check the wires from TB-1 – Y2 to the 0-10vdc input of ECM Fan. (Secondary Fan(s) for Low Ambient controlled units only)
Fans do not start on Remote Condenser	**1.** TB-1 – SC and GND for continuity dry contact closure from the Evaporator Section Compressor Contactor Auxiliary Contacts.
No Text on the Marvel HPC display	**1.** Check for 24 VAC on J1 G and G0.
Units with Marvel Premium that have no readings.	**1.** Check the Field Bus Communications cable Connect to the TB-MB terminal block for proper connections.

~~~~ End of HPC Section ~~~~

GENERAL INFORMATION for HPC$_{SE}$

The Marvel HPC$_{SE}$ Head Pressure Controller is a basic microprocessor controller setup for improved compressor system operation. The Marvel HPC$_{SE}$ maintains compressor discharge pressure by modulating the EC Fans of a Kelvion Remote Air Cooled Condenser to increase/decrease the amount of airflow across the remote air cooled condenser's condenser coils. This controller should not need any adjustments of set points for proper system operation. However, if required, settings are completely adjustable and are located within the password protected Set Point menu. Please contact the factory before making adjustments to these set point values.

Electrical Installation

The Marvel HPC$_{SE}$ controller is installed internal to the Kelvion Control box section. The fans have been pre-wired to two modulating outputs of the Marvel HPC$_{SE}$. Each pressure transducer is installed and pre-wired back to the Marvel HPC$_{SE}$. A set of interlock wires need to be field installed from the United CoolAir Evaporator Section main control box to the Kelvion Remote Air Cooled Condenser's main control box. Field installers must install either an 18 AWG 300 volt rated 2-conductor cable or 2-conductors 18 AWG MTW/THHN or equivalent through conduit routed between the United CoolAir Evaporator main control box and the Kelvion Remote Air Cooled Condenser main control box.

Connect the conductors as follows:

Evaporator Section	Condenser Section
TB1 – SC	TB1 – 205
TB1 – GND	TB1 – 204

Basics of Operation

The preinstalled pressure transducers read the refrigerant head/discharge pressure of each separate compressor circuit. The Marvel HPC$_{SE}$ monitors the pressure of each refrigerant circuit determining the Control Pressure Demand based on the compressor with the highest refrigerant pressure.

Pressure Transducers

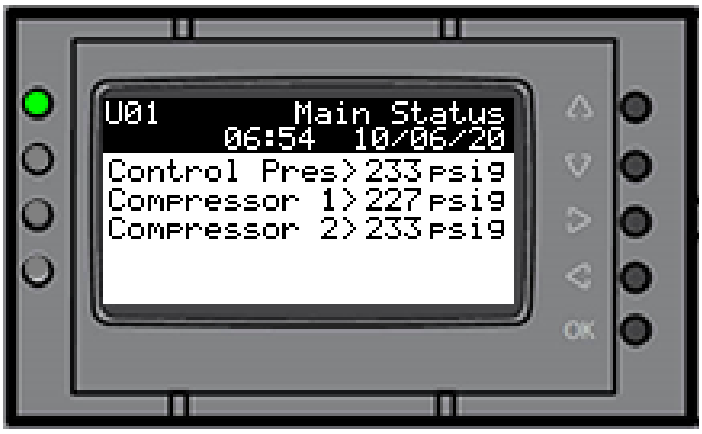
Pressure transducers are pre-installed and wired back to the Marvel HPC$_{SE}$ controller. Each unit compressor should have a corresponding number of pressure transducers. For instance if there are three compressors, there will be three pressure transducers.

Pressure Transducer Troubleshooting

When a pressure transducer reads below 0 psig, there will be no pressure reading on the Marvel HPC$_{SE}$ controller's display panel. When the pressure transducer is connected correctly with a good reading above 0 psig, the reading for the corresponding compressor will appear on the display. If the Pressure reading is greater than 700 psig, the Marvel HPC$_{SE}$ will initiate a sensor alarm on the Marvel HPC$_{SE}$.

Marvel HPC$_{SE}$ Display and Keypad Buttons

Below is the main display with buttons.



OK Button

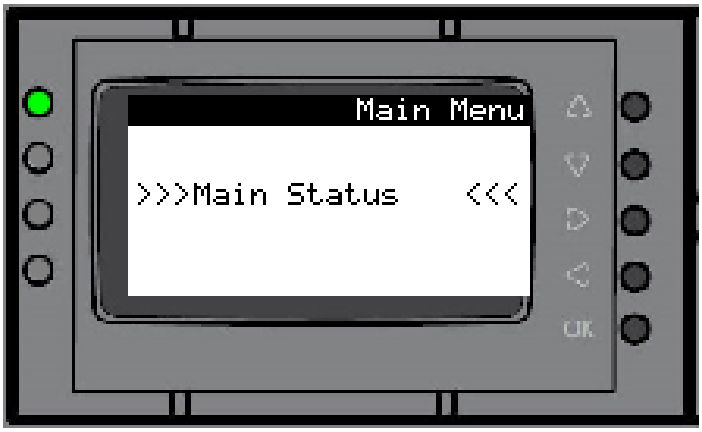
Is the button that moves the blinking cursor from field to field and initiates a save of value change on the presently selected field. Press this button one time to move the cursor to the next field for value change. Use the Up or Down buttons to change the setting/set point and press the OK button again to save the changed value. The OK Button is also used to enter any of the menus structure (Main Status, Set Points, Clock Settings, Tech Menu, and Factory Menu).

Left Arrow Button

Is used like a back/escape function. Escape back to previous page. Press and hold the Left Arrow Button for one second to go back to the previous screen. It is also used to view liquid pressure sensor alarms. To get to the alarms menu, make sure one of the main status screen appears (status screen page 1 shown above). Then press and hold the Left Arrow button for one second and the Alarms Menu will appear.

Right Arrow Button

Is used to navigate to the built in menu system. Press and hold the Right Arrow Button for one second and the Menu Main Status will appear. This is the main status area from the previous display screen. Pressing the up or down button for one second will allow the next menu screen to appear. Press and hold the Left Arrow Button from here will navigate back to the Main Status or simply pressing the OK Button while on the screen will enter the selected menu.



Down Button

The down button is used to scroll downward through the main status and main menu sections as well as decrease a set point value.

Up Button

The up button is used to scroll upward through the main status and main menu sections as well as increase a set point value.

Marvel HPC$_{SE}$ Controller Setup

This selection process is performed by the Factory during the functional run test process. Production sets up the total fans based on fan quantity installed in the Kelvion Remote Condenser. The screen for Fan Quantity appears immediately following the initial software upload to the controller. This information allows the controller to use a Primary Fan only or Primary and Secondary set of fans for maintaining proper Low Ambient Control during much colder low ambient outdoor air conditions.

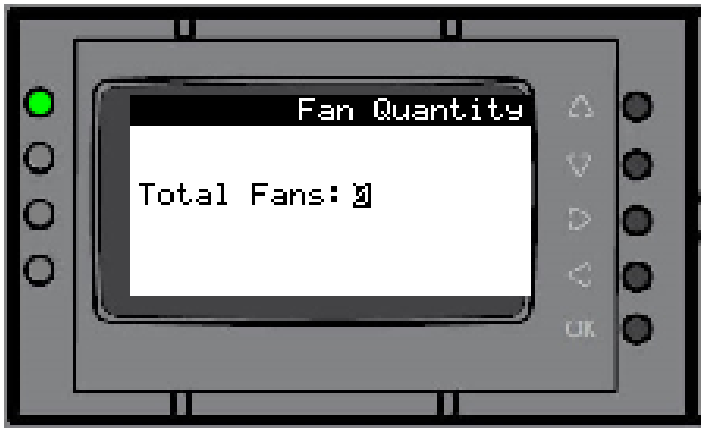
Primary and Secondary Fan Differences

Primary Fan

The primary fan will always operate when a compressor is on and will not shut down unless all compressors are off. Every remote condenser shall have a primary fan even when there are no secondary fans.

Secondary Fans

The secondary fans will start as the control pressure rises above the Start HPC$_{SE}$ Set point of 270 psig. The secondary fans will stop if there is a compressor on and the control pressure falls below the Stop HPC$_{SE}$ Set point of 240 psig or if all compressors are off.



Head Pressure Control Operation

When a compressor starts, the primary fan will start and maintain minimum fan speed of 10% as long as the Control Pressure is less than the Liquid Pressure Set Point of 295 psig. If the remote condenser has greater than 1 fan, secondary fans are enabled. The secondary fans start as the Control Pressure rises above 270 psig and maintains minimum speed once on and the Control Pressure is less than 295 psig and greater than 240 psig. Should the Control Pressure fall below 240 psig with a compressor is on, the secondary fans will stage off until the Control Pressure rises above the 270 Start HPC$_{SE}$ Set Point again.

As the Control Pressure rises above 295 psig, both primary and secondary fans will ramp up and down in unison (based on proportional and integral logic) to maintain a Discharge Pressure Set Point of 295 psig.

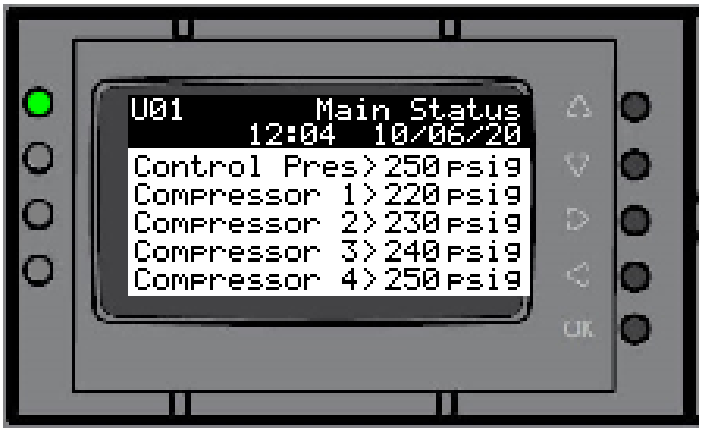
When all compressors are off, primary and secondary fans stop.

Main Status

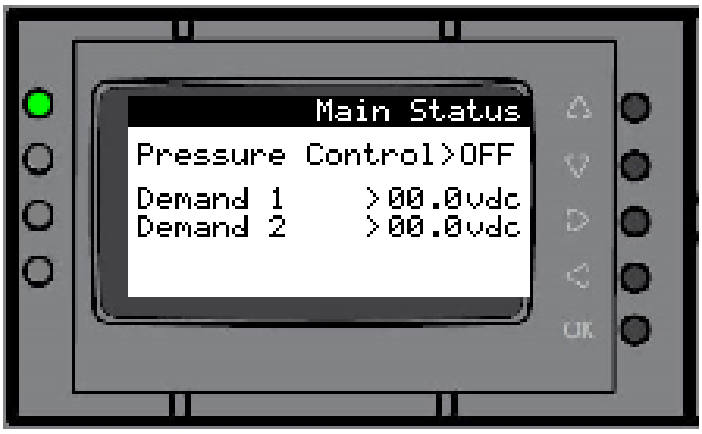
Main Status is the menu with all of the main operational data/readings.

Control Pressure is the status of the maximum pressure of all compressors. The control pressure is the value that will be used for head pressure control. It is the value input to the set point function block in order to maintain the discharge refrigerant pressure as close to the refrigerant head pressure set point as possible. Compressor x is the operating pressure of the compressor. This Head Pressure Controller has capability to control refrigerant pressure for up to a maximum of four compressors. The number of compressor pressures displayed is based on the total number of compressors installed in the unit. The readings for compressor pressure are based on self-enabling inputs. A refrigerant pressure transducer is installed for each compressor. As the sensor reads refrigerant pressure greater than 0 bar/0 psig, the input becomes enabled.

Alarm Value (not shown) is hard coded at 700 psig. Should the refrigerant pressure on any compressor circuit rise above 700 psig for greater than 15 seconds, an alarm will be displayed on the Marvel HPC$_{SE}$ controller. Each compressor still has an independent High Pressure Switch installed that monitors for refrigerant pressure greater than 650 psig. This means that the compressor will most likely turn off based on high refrigerant pressure long before the 700 psig Alarm point.

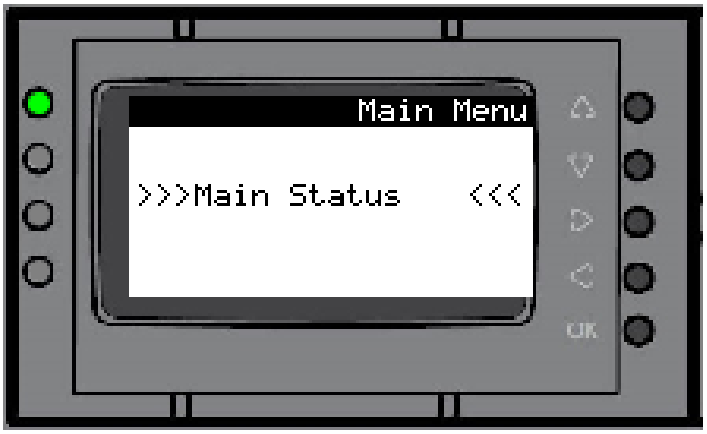


Pressure Control is the read point that provides information whether the ECM Fans are ON or OFF providing pressure control. **Demand 1** will always be present for both Low Ambient disabled and Low Ambient enabled selections. **Demand 2** will only be present for units with Low Ambient enabled.

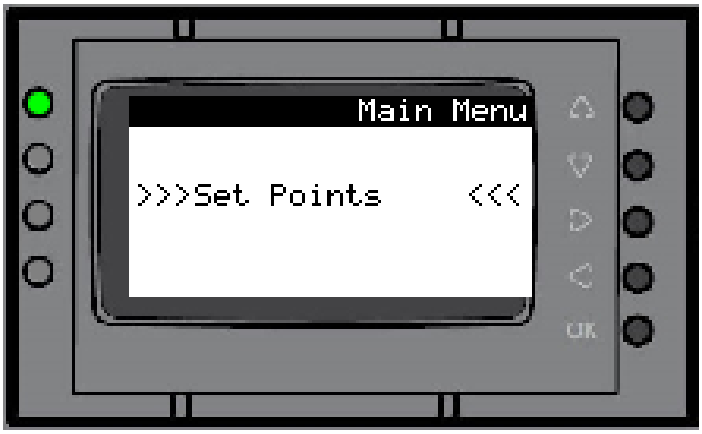


Main Menu Selections

When in the Main Menu, pressing the Enter button will redirect from the Main Menu back to the Main System Status.



Set Points will direct the setup into the Set Points Menu.



System Settings is the Set points menu. Set Point is the main set point control value that is trying to be maintained. The fans will increase and decrease speed trying to maintain this set point.

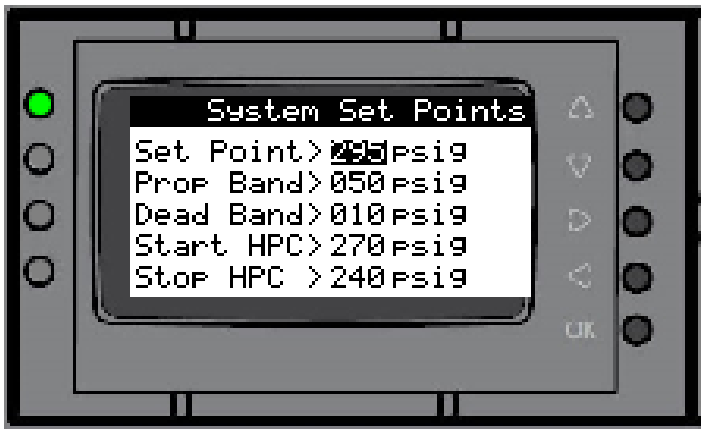
Prop Band is the Proportional Band set point. The Proportional Band is added to the main Set Point. If the Control Pressure is greater than or equal to the Set Point plus the Proportional Band, the demand for head pressure control is 100% in a direct proportional controlled system. The controller is set up based on Proportional and Integral type control scheme.

This means the Proportional Band is still used similarly but the output of to the fans is based on a rate of change from set point over time. This means the output value to the fans could be 100% event though the control pressure is less than the Set Point plus the Proportional Band but greater than the Set Point.

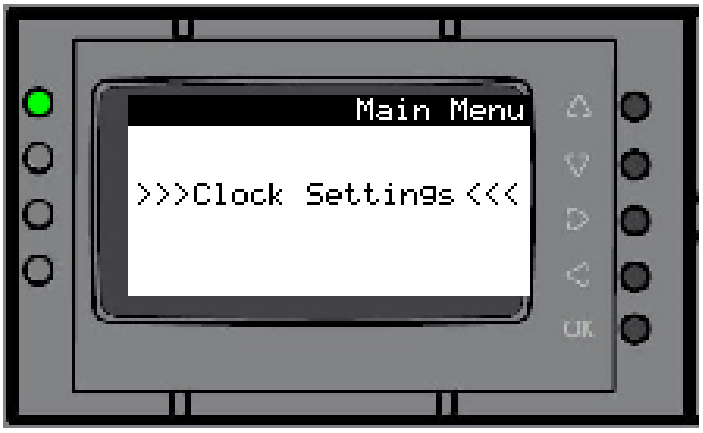
The Dead Band divides by 2 over the set point. The default Dead Band is 10.0psig. This means that there will be no increase or decrease in output within 5.0 psig above or 5.0 psig below the set point value.

The Start HPC_{SE} set point is the value that the Pressure Control Starts the ECM Fans as long as a compressor is on. As long as a Compressor is on and the Control Pressure is greater and the Start HPC_{SE}, the Pressure Control is on.

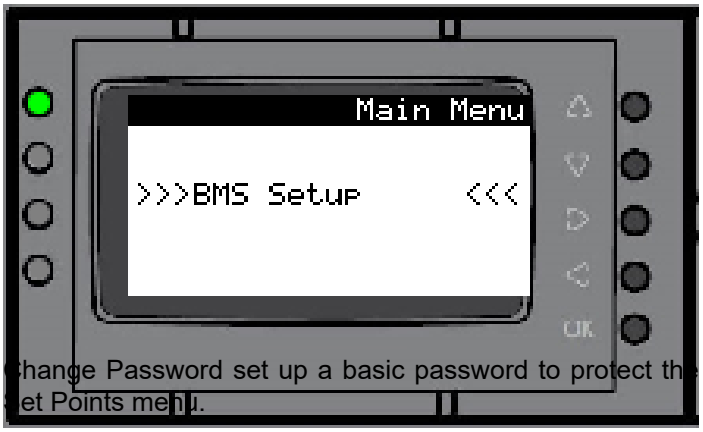
The Stop HPC set point is the value that the Pressure Control Stops the ECM Fans and Pressure Control is off. ECM Fans can stop below the Stop Point even if a compressor is on to help increase head pressure within the system. The ECM Fans would then restart once the head pressure rises above the Start HPC_{SE} set point. If the application type Low Ambient is enabled. Then the primary fan will not stop when there is a compressor on even if the Control Pressure falls below the Stop HPC_{SE}.



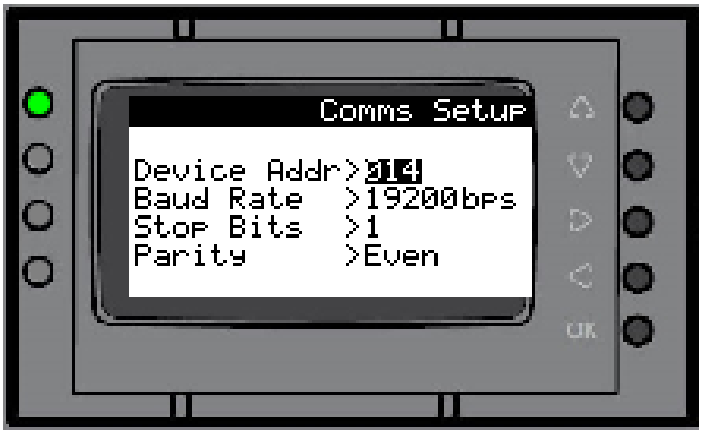
Clock Settings set up the present time and date for the internal time clock.



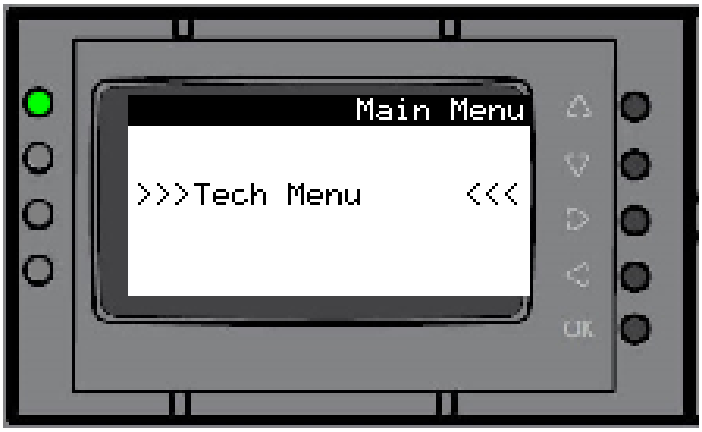
BMS Setup is used to set the Modbus Address and connection information for interlocking with a Marvel Premium Controller.



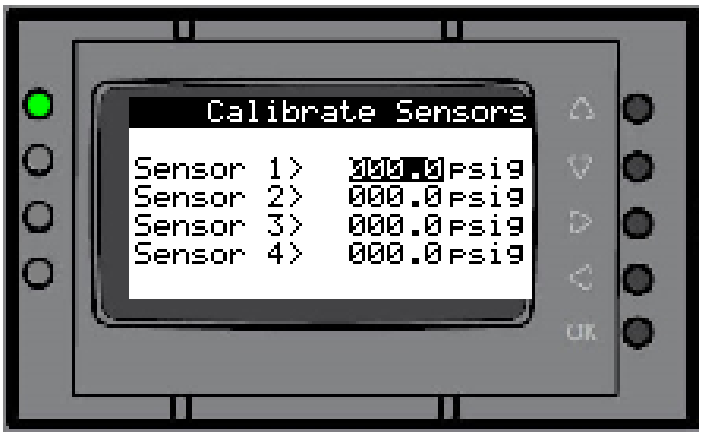
Change Password set up a basic password to protect the Set Points menu.



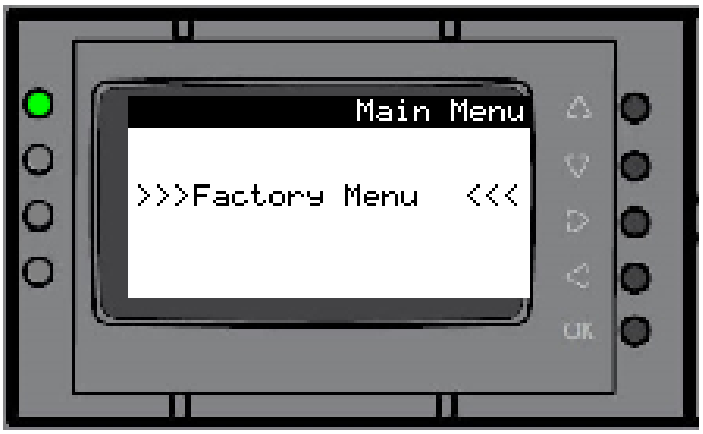
Technician Menu is password protected. Under the Technician Menu, the pressure sensor calibration can be adjusted between -99.9 and 99.9 psig total offset. Typically if a sensor is out of tolerance by more than 10.0%, it should be replaced. To adjust the calibration press the enter button to move the cursor to the desired field for adjustment. Pressure up or down to adjust as required and press enter to save the change.

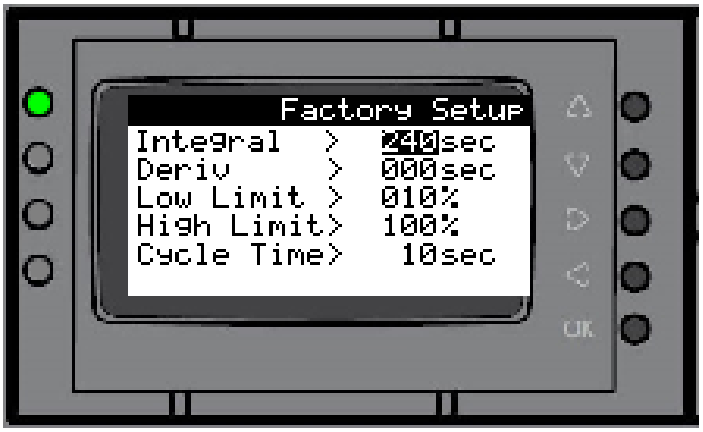


Enter a password of 9995 to enter and calibrate the pressure sensors under the technician's menu.



Factory Menu is password protected. Under the Factory Menu, the Settings for PI Control are located under Factory Menu. Contact the factory if required for setting adjustments.

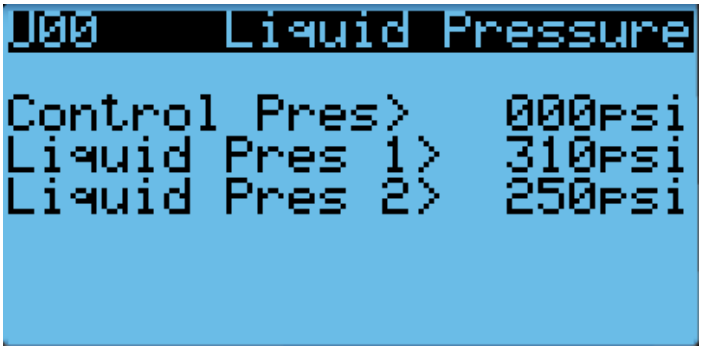


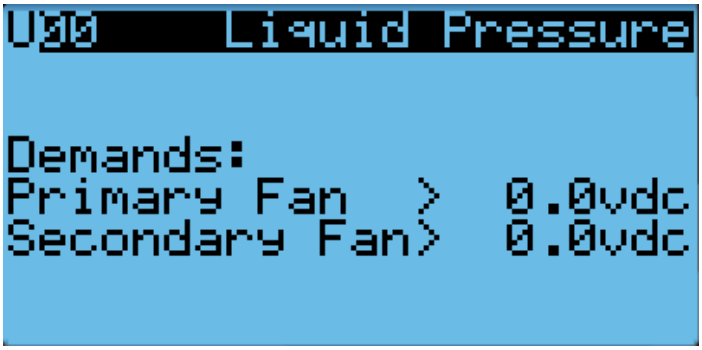


Units with Marvel Premium Controllers

If the United CoolAir provided system (evaporator and condenser units) was provided with a Marvel Premium controller as well, the Marvel Premium can be field interlocked with the Marvel HPC$_{SE}$ via the Modbus communications connection. The benefit of interlocking these controllers is to see the data from the Marvel HPC$_{SE}$ on the Marvel Premium without having to go directly to the Remote Condenser and open the control box to look at the Marvel HPC$_{SE}$. Follow the electrical diagram for Modbus connections. There is a set of terminal blocks in each section Evaporator Control Box and Remote Condenser Control Box for controls interlock. A minimum 3 conductor 18 AWG shielded cable should be installed to complete this interlock.

The following screen or equivalent will appear on the Display for the Marvel Premium controller once the interlock is complete and the Marvel HPC$_{SE}$ is online with the Marvel Premium.





NOTE: The Modbus Connection is not required to make the units work but the start command interlock is required. This Modbus connection has been tested and locked. It requires no field adjustment other than pulling a 3 conductor communication cable to interlock the controllers. Please refer to the electrical diagram provided with your equipment for reference of both the Start Command interlock and the Optional Modbus connection interlock. The maximum interlock distance for the Modbus Communications Cable is 200 feet.

Modbus Connections (Optional for data transfer between controllers)

Evaporator Section	**Condenser Section**
TB-MB – RxTx-	TB-1 – RxTx-
TB-MB – RxTx+	TB-1 – RxTx+
TB-MB – GND	TB-1 – GND

TROUBLESHOOTING

PROBLEM	RESOLUTION
Total pressure readings on Display is less than the total installed Compressors	**1.** Check the Electrical terminations on AI1, AI2, AI3, AI4 as well as the White wires are the Output of the Sensor to the AIx input. **2.** Check for +5vdc to GND for dedicated 5 vdc. **3.** Make sure the Black wires of each cable connect to +5 vdc. **4.** Make sure the Green wires of the cable connect to the GND terminal.
Fans are off but the Main Status shows Demand output to the fans is greater than 0.0 vdc.	**1.** Check wires from the GND side of the ECM Fans to the GND Terminal. **2.** Check the wires from TB-1 – 210 to the 0-10vdc input of ECM Fan. (Primary Fan) **3.** Check the wires from TB-1 – 209 to the 0-10vdc input of ECM Fan. (Secondary Fan(s) for Low Ambient controlled units only)
Fans do not start on Remote Condenser	**1.** TB-1 – 205 and 204 for continuity dry contact closure from the Evaporator Section Compressor Contactor Auxiliary Contacts.
No Text on the Marvel HPC$_{SE}$ display	**1.** Check for 24 VAC on J1 G and G0.
Units with Marvel Premium that have no readings.	**1.** Check the Field Bus Communications cable Connect to the TB-MB terminal block for proper connections.

Authorized Distributor:

LIMITED WARRANTY

United CoolAir Units are backed by a 1 year limited warranty on parts and a 5 year limited warranty on the compressor (labor not included). Maintenance items such as filters and belts are excluded under this limited warranty.

FACTORY TESTED

All units are functionally run tested before shipment to ensure a trouble-free start-up and unit commissioning. Industry proven components are used throughout to enhance system reliability and peace of mind.

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