# Installation, Operation and Maintenance Manual

## MatrixMonitor™ V2

This is the installation, maintenance and operation manual for the ClimateCraft® MatrixMonitor™ airflow monitoring system for fan arrays.

# Contents

# Introduction

The ClimateCraft® MatrixMonitor™ is a digital instrument that monitors the operation of ClimateCraft® FanMatrix™ fan arrays. A fan array will have two or more fans operating in parallel to provide airflow in an air handling system. MatrixMonitor™ solves the problems of monitoring the airflow of multiple fans by combining the individual fan airflow readings into a combined reading for the array. MatrixMonitor™ provides additional added value features to aid in the operation and maintenance of your fan array. These features include fan failure detection, surge detection, vibration monitoring and lubrication monitoring.

# MatrixMonitor™ Components

## Control Unit

The control unit contains the embedded control system, the 12VDC power supply and the keypad display unit. These parts are enclosed in a polycarbonate NEMA 4X enclosure with a clear hinged cover that allows visual inspection of the keypad display unit while closed. The keypad display unit is mounted on a swing out dead front panel. Opening the dead front panel allows access to the embedded control system and power supply. The parts in the control unit are described separately below.


**Control Unit**

## Embedded Control System

The embedded control system used in the MatrixMonitor™ uses a Rabbit® RCM3000 control module made by Digi International. The control module is mounted on a custom motherboard that provides all of the input and output connections. It is mounted on the back side of the swing out dead front panel directly behind the keypad display unit. Swinging the panel out exposes the motherboard and the control module that is mounted on it. The interface connections to the fan and pressure transducers and the field connections to the building management system (BMS) are made on the mother board with the pull off terminal strips provided. This design provides easy access to the wiring connections and internal components of the control unit.

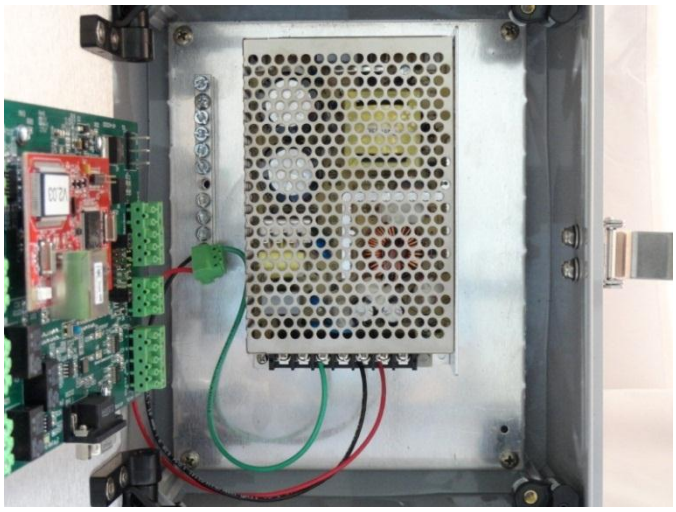

**Embedded Control Module**

The control unit supplies power to the fan sensors and the array pressure rise sensor and communicates digitally with those devices over an EIA/TIA 485 2 wire multi-point communication line. It can monitor one or two fan arrays with as many as 49 fans in each array.

A second EIA/TIA 485 (RS485) 2 wire multi-point communication line is provided for communication to the building automation system (BMS) using the Modbus RTU protocol.

The control unit firmware is written to flash memory on the Rabbit RCM3000 module. It is self-contained, universal and upgradeable on site. MatrixMonitor™ can be used on any ClimateCraft® FanMatrix™ fan array using standard firmware. The unit is configured for a specific unit by selecting data from set up menus accessed by the key pad display. There is only one active version of the firmware at any given time and there are only a few parts necessary to make the system work. This makes it easy to keep the system up and running with minimum number of spare parts. If your site has multiple air handlers, all equipped with a MatrixMonitor™ all the parts will be interchangeable regardless of how varied the air handling units are in capacity and configuration.

## Power Supply



The power supply for the MatrixMonitor™ system is a 100 watt Mean Well Direct model RS-100-12. It is a switching power supply that provides 12 volts DC to the embedded control system, the fan sensor boards and the array pressure rise transducers. It accepts input voltage from 88 VAC to 264VAC at 47 Hz to 63 Hz. The power supply is mounted to the backplane of the control enclosure. The AC supply power connections are made directly to the appropriate terminals on the power supply.

**WARNING**

The wiring connections to the MatrixMonitor™ should only be made when the power is disconnected. Failure to disconnect power before servicing can cause severe personal injury or death.

## Key Pad Display

The key pad display unit has a backlit 122 x 32 pixel LCD graphic display, 7 signal LEDS (1 red, 4 green, 2 yellow), and a 7 switch key pad. The unit plugs into the backside of the motherboard through the onboard connectors.

The signal LEDS on the front of the key pad display unit are programmed to provide specific information. The red LED is turned on if there is a fan failure. The 4 green LED's are used indicate flow level. They are scaled to the same maximum level as the airflow analog output signal. The closer the actual array airflow is to the maximum scale flow the more green LED's are lit. The first (left) yellow LED is turned on if one


**Key Pad Display**

or more fans go into surge. The second yellow LED (right) is turned on if the MatrixMonitor™ determines that there is a problem in reading any of the transducers. If a transducer has gone bad or a signal has reached the maximum making it impossible to calculate the actual flow or pressure this LED will be lit. It will also light when the grease monitor trips or the fan vibration limits are exceeded.

The keys along with text prompts from the graphic display are used to configure the control to the application through menu driven setup screens and display real time fan array performance information screens.

## Piezometric Pressure Port

**Connection to Throat Tap**

The piezometric pressure port is a pressure tap that is usually inserted into the throat of the fan inlet cone at its smallest diameter. The tap connection fitting is on the high pressure side of the cone. The tap is piped from the downstream side of the cone through the back plate of the fan so that connection can be made to the pressure transducer located on the inlet side of the fan air seal wall. If the design flow through the fan is higher than the rating of the pressure transducer on the fan sensor board (FSB) an alternate low pressure tap placed higher on the cone will be used. Only one port will be connected to the pressure transducer on the FSB. The taps are mounted on the inlet cone with the port end exposed to the flow side of the inlet cone. They are press fit into the cone and the connection side is on the high pressure side of the inlet cone. The fan sensors are mounted on the inlet side of the fan back plate so the pressure tubing that connects to the pressure tap is routed to the inlet side of the back plate through a bulkhead connector. The connection is made to the low pressure side (negative side) of the pressure transducer on the FSB. The high pressure side of the pressure transducer is left open to sense the fan inlet pressure. The section titled “Throat and Cone Tap Flow Range” below gives the basic information about when the throat tap or the cone tap should be used.


**Location of Pressure Taps**

## Fan Sensor

The fan sensor is a custom assembly that contains the special MEMS pressure transducer, a temperature transducer, a tri-axial accelerometer, and a high performance 32 bit RISC microcontroller to read and process the transducer data and communicate with the host. The fan sensor board (FSB) has the pressure transducer mounted on the top side and the components and connection points on the bottom side. It is designed to mount on a standard 2 x 4 outdoor utility electrical box. The pressure transducer

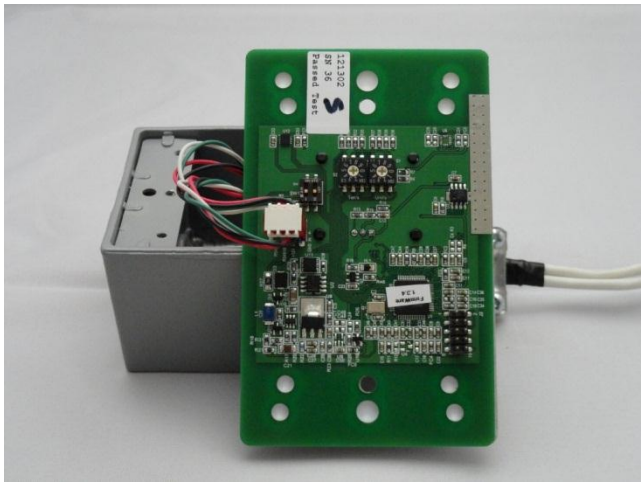
ports are accessible for connecting to the piezometric port. The FSB acts as the box cover. When it is removed the switches and connections are accessible.

The fan sensors are mounted on the entering air side of the fan back panel. There is one fan sensor for every fan in the array. The low pressure port (-) of the pressure transducer is connected to the piezometric port of the fan it monitors with UV resistant 1/8" ID vinyl tubing. The high pressure port (+) is open to sense the air pressure at the inlet of the fan.

The fan sensor is mounted on the fan back plate so that the accelerometer can sense the fan vibration. The FSB microcontroller continuously reads the tri-axial accelerometer data and performs a real time FFT on the data stream to convert the information from the time domain to the frequency domain where it can be analyzed. Each fan sensor has a temperature transducer and the host computer in the control unit calculates the average of all of the sensors in the array to determine the entering air density for the airflow calculation. Only the system with the worst vibration needs to be monitored, substantially reducing the data collection effort.


**Fan Sensor**

Each fan sensor board (FSB) is connected to the control unit through a common dual twisted pair plenum rated cable (Belden 1325A or equal). One twisted pair is used to supply 12VDC power to the FSB units. The other twisted pair is used for digital communications between the FSB units and the control unit. The units are connected in a "daisy chain". One cable connection is made at the CPU which goes to the first FSB on the chain. From there the cable goes to the next FSB unit. This connection sequence continues until all if the FSB units are connected. There is no need to maintain a particular order of connection between specific FSB units because the control unit can address each unit individually.



The connection from the cable to the FSB unit is made with a 4 position feed through insulation displacement connector. The cable wires run unbroken from the control unit to the last FSB unit on the chain. This insures the reliability of the connections. Each twisted pair is foil wrapped and there is a tinned copper bleed wire running through the cable in continuous contact with the foil shields on each twisted pair. At each FSB connection box the cable jacket and the foils shields are removed to give access to the conductors. The bleed wire is never cut. It is connected to ground in the control unit and runs continuously to the end of the cable where it is left unattached. Each 4 pin conductor has

a strain relief cover attached to keep incidental wire movement from pulling on the connection pins which insures a good electrical connection between the cable conductors and the connector.

There is a dual DIP switch mounted on the component side of the FSB assembly. This switch is to activate the line termination resistors.

| NOTICE |
| --- |
| The dual Dip switches should be in the off position on all of the FSB units except for the last unit on the cable. |

The last FSB unit on the cable should have the switches turned on to tie in the line termination resistors. It is possible (but not necessary) to have two cables run out from the control unit. A unit with two arrays might be wired where one cable goes to a first array and the second cable goes to the second array. This architecture is important when large numbers of fans are used because it increases the ability to deliver power to the FSB units. When two cables are used the line termination switches must be switched on for the FSB units on the end of each line. In this case the FSB line termination jumpers on the mother board in the control unit must be removed.

There are two rotary switches mounted on the component side of the FSB units. These switches provide the FSB unit with an ID which it uses to communicate with the control unit. These switches must be set in a specific sequence for the MatrixMonitor™ to function properly. For array 1, the fan sensor switches must be set between “01” and “49”. The FSB unit on fan 1 will be set to “01”. The FSB unit on Fan 2 will be set to “02”. This sequence will be followed or up to 49 fan in fan array 1. Switch setting “00” is reserved for the array pressure rise sensor (see below). Each fan must have a fan sensor. The numbering starts with “01” and there can be no gaps in the numbers after that until there are no more fans.

If the MatrixMonitor™ control unit is tied to a second fan array, as might be the case if the AHU has a supply fan array and a return fan array, the numbers start with “51”. ID numbers “51” to “99” are reserved for fan array 2. ID 50 is reserved for the pressure rise sensor of the second fan array. To get the switch setting for the FSB units in fan array 2 simply add 50 to the fan number. Otherwise the sequencing and restrictions are exactly the same as for fan array 1.

## Fan Array Pressure Rise Sensor

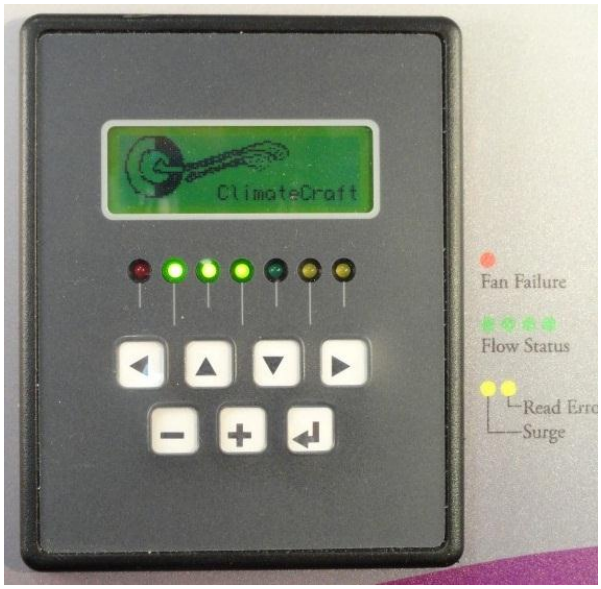

The same FSB assembly used for the fan sensor is also used for the fan array pressure rise sensor. The pressure rise sensor is mounted to the fan air seal wall on the air inlet side. The high pressure port (+) of the pressure transducer is connected to the downstream side of the fan air seal wall with flexible tubing to a bulkhead connector. The low pressure port is left open to reference the air pressure entering the fan array.

Each array connected to the MatrixMonitor™ control unit must have a pressure sensor. The switch setting for the pressure rise sensor on array 1 is “00”. If there is a second array connected to the control unit, it will use switch setting “50”.

The pressure rise sensor FSB units are connected to the connection cable in exactly the same manner as the fan sensor FSB units. They do not need to be located on the cable in any particular order.

## User Interface

MatrixMonitor™ uses a hierarchical menu structure to allow the user to access the considerable amount of information available about the performance of the fan array and to configure the unit to any conceivable ClimateCraft® fan array.




When the unit powers up a sign on message appears. The sign on message will display the ClimateCraft® logo and the message string "ClimateCraft MatrixMonitor V2.nn" will scroll horizontally across the screen from left to right. The last letters in the scrolling message are the version level of the software that is installed on your equipment. MatrixMonitor is fully functional while this screen is up and will perform all of its monitoring and communication functions. Communications with the building management system (BMS) are active.

The keys have graphic symbols on them that are designated in the software with the following meaning:

| | | | |
|---|---|---|---|
| < = Left | > = Right | - = minus 1 | + = plus 1 |
| ^ = Up | ˅ = Down | ↵ = enter | |

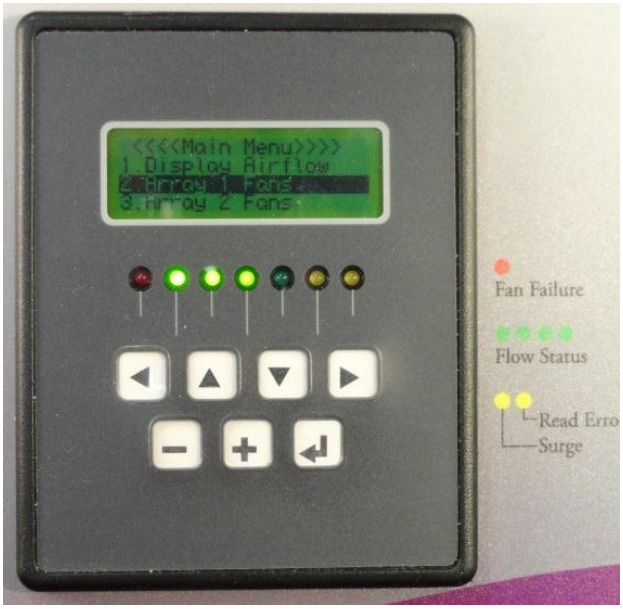
These keys along with prompts given on the graphic display allow you to navigate the menu structure of the MatrixMonitor™ in order to set up the system and display the performance information for the fan arrays it monitors.

**There are seven signal LED lamps on the front of the keypad display unit that provide valuable information about the fan array. See the section above titled "Key Pad Display" for a detailed description about the function of the signal LEDs.**

Press the ↵ (enter) key when the sign on message is active and you will get the main menu screen.

The main menu is the highest menu in the structure and is your starting point for navigating through the display and set up screens. The main menu of the MatrixMonitor™ is as follows:

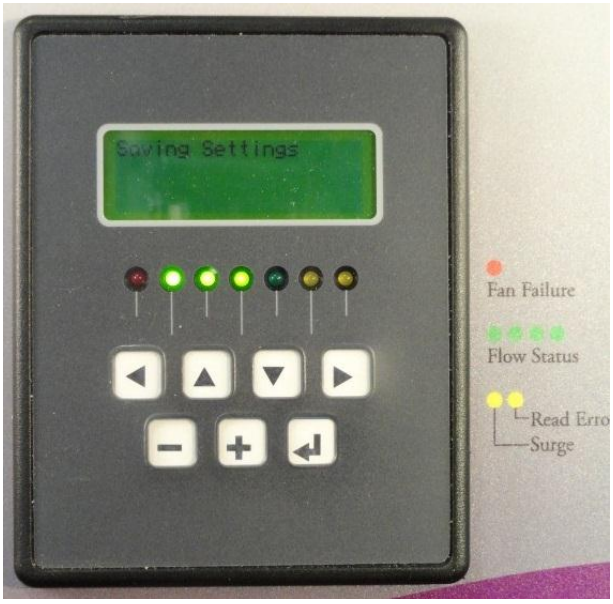
| **Menu Lines Displayed** | **Screen Type *(Screen Function)*** |
|---|---|
| <<< Main Menu >>> | |
| 1. Display Airflow | Display *(Airflow, Pressure Rise, Temperature, Fan Speed)* |
| 2. Array 1 Fans | Display *(Airflow & Piezometric Pressure by fan for array 1)* |
| 3. Array 2 Fans | Display *(Airflow & Piezometric Pressure by fan for array 2)* |
| 4. Array 1 Options | Setup submenu *(Fan set up data for array 1)* |
| 5. Array 2 Options | Setup submenu *(Fan set up data for array 2)* |
| 6. Control Setup | Setup Submenu *(Control set up data)* |
| 7. Clock Settings | Setup Submenu *(Set time and Date)* |
| 8. Display Time and Date | Display *(Current Time and Date)* |
| 9. Comm Status | Display *(Communication performance overall & each FSB)* |
| 10. Array 1 Vibration | Display *(Peak vibration levels per fan for array 1)* |
| 11. Array 2 Vibration | Display *(Peak vibration levels per fan for array 2)* |
| 12. Mother Board Data | Display *(Board temp, barometric press, FSB current & volts)* |
| 13. Grease Life Data | Display *(Airflow, Pressure Rise, Temperature, Fan Speed)* |
| 14. About | Display *(Sign on message with firmware version number)* |




Only 4 lines of data will fit on the graphic display so 11 of the 15 lines of data are not visible. Use the ^ and ˅ keys to scroll through the main menu and expose all of the menu items. As you scroll through the menu, the display will invert the pixels for an individual menu line as you scroll. In this text we will refer to that line as the "highlighted" line. There are four types of screens used by MatrixMonitor™, the Main Menu, Display Screens, Submenu screens, and Setup screens. When you are in the main menu or on any sub-menu, pressing the ↵ (enter) key will close the menu you are in and open the display, setup, or submenu screen that was highlighted.

Display screens are used to display useful information about the performance for the fan arrays) attached to the MatrixMonitor™. The lay out and data presented vary by screen type and function. Pressing the ↵ key when on any display screen, will close the current display screen and return to the main menu. On the display screens that provide data for individual fans (such as "Array 1 Options" screen) the ^ and ˅ keys are used to scroll between fans. When multiple pieces of information is available for ach fan (such as "Array 1 Vibration") the > and < keys are used to scroll between data items. Each screen will give specific instructions on the navigation keys used in that display function. The instructions are on the bottom 1 or 2 lines of the display.

Submenu screens are used for set up functions to simplify the collection of data. They allow branching to setup screens for entering individual data items required to properly set up the MatrixMonitor™ for the array(s) used with it. The submenu screens function in the same way as the main menu screen. In order to exit a submenu screen and return to the main menu the last menu item in each submenu screen is "**Return to Main**". Scroll down until this is highlighted and press the ↵ (enter) key to return to the main menu. At the time you exit any submenu screen and return to the main menu, the set up data collected will be saved to flash memory set up files. You will be able to see this because the display will momentarily show the message "**Saving Settings**" on the first line. These files are read when the MatrixMonitor powers up so the system knows the configuration of the fan array(s).




Setup screens are used to input the data required to configure the MatrixMonitor™ for the attached fan arrays and control environment. They are used to set the time and date of the real time clock, to set the vibration alarm limits and reset the grease life monitor. The setup screens are accessed through the main menu or a submenu and are used to select a single configuration or sequential data points. The + and – keys are used to scroll through data selections or enter numbers. The ↵ (enter) key is used to select that data choice and return to the main or submenu. When the ↵ key is pressed the data selected by the setup screen becomes live data and is immediately used in any ongoing calculations, alarm checks, or data collection processes.

## NOTICE

When the main menu, any display screen or submenu is active, the MatrixMonitor™ functions normally and reads data from the sensors, computes the airflow and other performance information, sets the analog and relay outputs and maintains communications with the BMS. When any of the set up screens is active, these functions are suspended until the setup procedure is completed.

On the setup and display screens, there will be information prompts to aid you in navigating through the screens to get the information you are looking for and to tell you how to change the set up information. These prompts will be on the third or fourth line of the display and will interactively change depending on the key strokes you make.

## Set Up Procedure

MatrixMonitor™ must be configured for the fan array(s) and building management system it is used with. Each fan array has a unique collection of fans and options. This information must be input into the control in order for it to properly function and supply correct information. When MatrixMonitor™ is factory installed the configuration is done at ClimateCraft® before the unit is shipped. The only thing that might be required to do on the job site would be to set the local time and to set the scaling factors for the analog output signals if they are used by the building management system (BMS).

If it is necessary to replace the Rabbit RCM3000 control module it will be necessary to configure the system after the module is replaced. The setup data is stored in the flash memory of the control module and will be lost when the replacement is made. When the firmware is installed default setup data for a basic one array and one fan unit is stored in the setup data file in flash memory.

This section will step you through the set up process. Make sure to read the "User Interface" section above before you attempt to do the set up. It will explain the conventions used and menu structure employed. It is not necessary to execute the complete set up procedure if all of the set up data does not need to be modified. If you need to change a specific data item you can use the menu structure to go directly to the specific setup screen you need, update the information, and return without changing anything else. For practical purposes, this section is written as though you were doing a complete set up on a new system.


If you need to check what configuration data is being used by the MatrixMonitor™ you can step through the set up screens to see the data entered. The set up screens will always display the information currently used.

There is a substantial amount of information required to complete this setup. All of this information is available in the submittal information shipped with the unit. If you do not have the submittal call ClimateCraft® customer service for a copy or make a request providing unit tagging and serial number via our website at www.climatecraft.com.

| NOTICE |
| --- |
| Remember! When the set up screens are active in the user interface the main functions of the MatrixMonitor™ are suspended. Do not leave a set up screen active and spend as little time as possible in them! |

## Set the Array Data

The array data setup is accomplished through by using the "**Array 1 Options**" and "**Array 2 Options**" submenus. If the unit has just one array only "**Array 1 Options**" need to be set. All of the setup information for array 1 must be entered for the MatrixMonitor™ to function properly.

The default setting for Array 2 is 0 fans. This tells the MatrixMonitor™ that it needs to look at only one fan array and some of the display screens and setup screens are altered to simplify the layout for displaying information for just one array instead of two. If there is only one array attached to the control unit of the MatrixMonitor™ you will not need to enter any data for array 2. If there is a second array all of the setup information for array 2 must be entered for the MatrixMonitor™ to function properly.

### Set Up Array 1

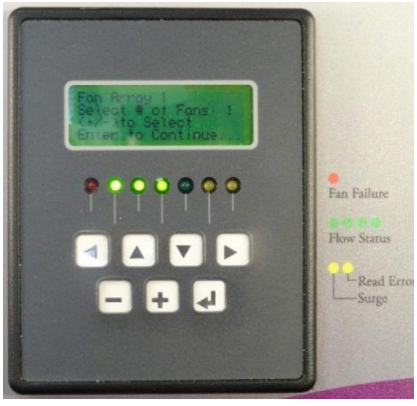
From the main menu, use the ^ and ˅ keys to scroll and highlight menu option "**4. Array 1 Options**". Press the ↵ (enter) key and the "**Array 1 Options**" submenu will appear.

| **Menu Lines Displayed** | ..... **Screen Type *(Screen Function)*** |
|---|---|
| << Array 1 Options >> | |
| 1. Number of Fans | ..... Setup *(sets the number fans in the array)* |
| 2. Fan Model | ..... Setup *(selects the fan model used in the array)* |
| 3. Wheel Width | ..... Setup *(selects the wheel width of the fans)* |
| 4. Array Name | ..... Setup *(assigns a name for the array)* |
| 5. Sensor Position | ..... Setup *(selects the piezometric tap location-throat or cone)* |
| 6. Dampers | ..... Setup *(assigns backdraft dampers to the array)* |
| 7. Set Fan Status | ..... Setup *(sets the operational status of each fan in the array)* |
| 8. Return to Main | |

You can navigate from this submenu screen to enter all of the setup information for array 1.

### Set the Number of Fans

The number of fans on Array 1 can be set from 1 to 49 fans. MatrixMonitor will poll the FSB communication line for FSB's with addresses starting with 1 and ending with the number of fans set. If the number entered here is larger than the number of fans MatrixMonitor™ will assume that communication has been lost to the fans FSB and flag an error. If the number entered is smaller than the number of fans installed in the array MatrixMonitor™ will not poll all of the FSBs and the airflow calculation will be incorrect. This setting needs to be the total number of fans in the array even if some of the fans are not operating (see "**Set the Fan Status**"). You can count the fans to get this information. It is also available in the submittal documents for the air handling unit on the fan performance data sheet. If there is more than one array in the air handling unit make sure you identify the correct performance data sheet.



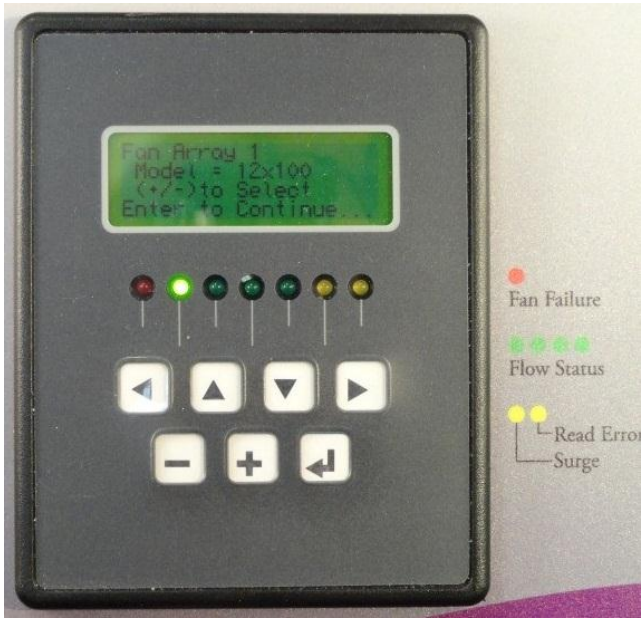
From the "**Array 1 Options**" submenu highlight "**2. Number of Fans**". Press the ↵ (enter) key and the fan quantity setup screen will appear. The first line on the screen will display the array name if it has been set. The default name setting for array 1 is "**Fan Array 1**" (see "Select the Array Name"). The second line on the screen will read "**Select Number of Fans: 1**". The number at the end will reflect the current setting. The default setting for the number of fans is 1. If the controller has been previously set up some other number may appear.

The bottom two lines are the navigation aids. Use the + and - keys to select the correct number of fans. When you press the keys the displayed number at the end of line two will change reflecting the current selection. The number will scroll between 1 and 49 and wrap around these values. A + keystroke when the display shows 49 will result in a display of 1. Similarly, a – keystroke when the display shows 1 will result in a display of 49. Holding either + or - key down for over 1 second will result in a fast scroll mode.

When the displayed number on line 2 is correct press the ↵ key to confirm the selection and return to the submenu. The change in the number of fans will take effect as soon as control is passed to the submenu screen.

## Select the Fan Model

This selects the FanMatrix™ fan model that is used in the array. This enables the control to use the appropriate flow constants and fan data stored in the software so that the MatrixMonitor™ can calculate the correct airflow, surge curve and backflow from the piezometric port pressure readings.




This information is available in the submittal documents for the air handling units. It will be on the fan performance data sheet. Make sure you identify the correct fan array if there is more than one in the unit.

From the "**Array 1 Options**" submenu highlight "**2. Fan Model**". Press the ↵ (enter) key and the fan model setup screen will appear. The first line on the screen will display the array name if it has been set. The default name setting for array 1 is "**Fan Array 1**" (see "Select the Array Name"). The second line on the screen will read "**Model = 12 x 100**". The data after the = sign is an abbreviated form of the fan model number. The number before the x is the nominal fan wheel diameter. The number after the x is the wheel width expressed as a percentage of the width of a full width wheel. The default value for fan model is "**12 x 100**" and this is what will appear here the first time a fan model is set. If the controller has been previously set up some other model number might appear but the structure will be the same. This screen will not affect the wheel width portion of the model number. That information is adjusted in the next menu selection (**3. Wheel Width**)

The bottom two lines are the navigation aids. Use the + and - keys to select the nominal fan diameter. When you press the keys, the number displayed after the = and before the x will change reflecting the current selection of nominal fan wheel diameter. The number will scroll to display all of the nominal fan diameters currently available on ClimateCraft® fan arrays. It will wrap around these values.

When the model displayed on line 2 is correct, press the ↵ (enter) key to confirm the selection and return to the submenu. The change in the model will take effect as soon as control is passed to the submenu screen.

### Select the Wheel Width

This selects the wheel width of the fans installed in the fan array. This data is used to select the correct surge curve for the MatrixMonitor™ functional check. The control unit continuously checks the airflow measured on each fan. It compares the airflow of each fan to the others and uses the array pressure rise information to determine if a fan is operating in surge. If a fan is found to be in surge, the control will issue a surge warning. MatrixMonitor™ uses stored values for surge curves to help determine if a fan is in surge. It needs to know the wheel width in order to select the proper surge curve. FanMatrix™ fan arrays are often selected with partial width wheels to achieve high static pressure at relatively low flow rates where full width wheels might be in surge.


**NOTICE**

If the wheel width input is not set properly, MatrixMonitor might improperly identify fans operating is surge.

This information is available in the submittal documents for the air handling units. It will be on the fan performance data sheet. Make sure you identify the correct fan array if there is more than one in the unit.

From the "**Array 1 Options**" submenu, scroll down to highlight "**3. Wheel Width**". Press the ↵ (enter) key and the wheel width setup screen will appear. The first line on the screen will display the array name if it has been set. The default name setting for array 1 is "**Fan Array 1**" (see "Select the Array Name"). The second line on the screen will read "**Wheel Width = 100**". The number after the = sign is the current selection for wheel width. The default value is 100. This may display some other value if the control unit has been previously set. The number represents the width of the wheel as a percentage of a full width wheel. 100 would be a full width wheel and 50 would represent a wheel width that is 50% of the full width wheel.

The bottom two lines are the navigation aids. Use the + and - keys to select the wheel width. When you press the keys the number displayed after the = will change reflecting the current selection of nominal fan wheel width. The number will scroll between 50 and 100 in increments of 5 and will wrap around these values.

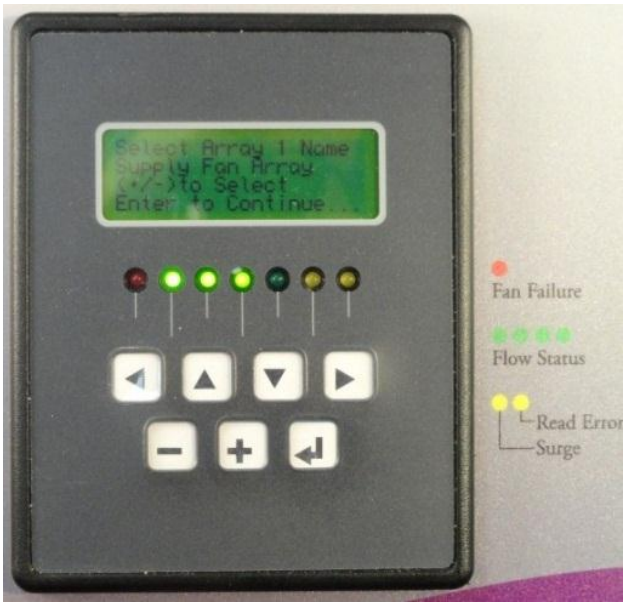
When the width displayed on line 2 is correct, press the ↵ (enter) key to confirm the selection and return to the submenu. The change in wheel width will take effect as soon as control is passed to the submenu screen.

### Set the Array Name

The array name feature is used by MatrixMonitor™ to make it easier to navigate through the screens when more than 1 fan array is monitored by the control. "Fan Array 1" or "Fan Array 2" associate no meaning to the function of the individual fan arrays installed in a unit and make it difficult to follow some of the display and set up screens. Instead of "Fan Array 1" the array name that appears on the display and setup screens can be selected from the following group:

"Supply Fan Array"
"Return Fan Array"
"Exhaust Fan Array"
"Outside Fan Array"
"Fan Array 1"

Setting this value is optional. It is not necessary for the control to function properly. It is recommended if more than one array is monitored by the same control. It makes the data screens clear and easy to use.




From the "Array 1 Options" submenu, scroll down to highlight "4. Array Name". Press the ↵ key and the array name setup screen will appear. The first line on the screen will display "Select Array 1 Name". The second line will read the array name selected from one of the labels above. The default value is "Fan Array 1". (The default value is "Fan Array 2" for array 2). This will be displayed if the control has not been previously set up.

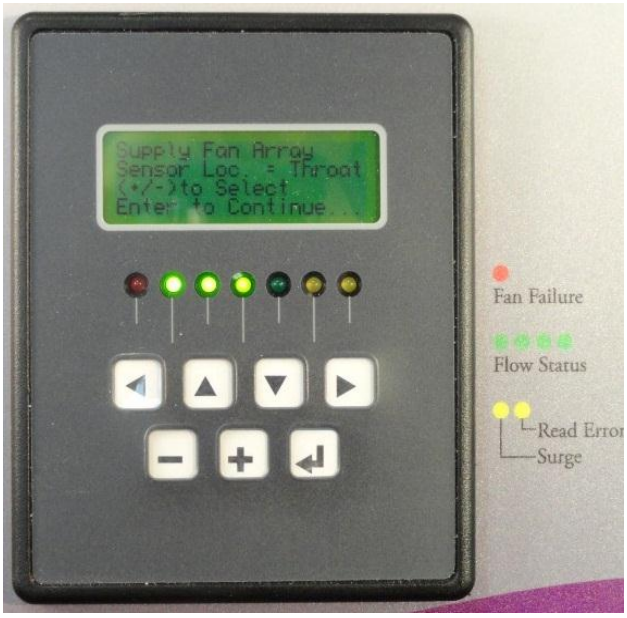
The bottom two lines are the navigation aids. Use the + and - keys to select the array name. When you press the keys, the description displayed on line 2 will change reflecting the current selection of the array name. Array 2 has the same selection set of names available to use. Since it is undesirable to have two fan arrays with the same name on the same air handling unit, the name selections between array 1 and array 2 are interlocked. If a name, other than the default, is selected for array 1 that name is not available for selection for array 2. The

reverse is also true. If a name has been selected for array 2 that name will not be available for selection for array 1. If a name is not available it will not show up as you scroll through the name selections.

When the array name displayed on line 2 is correct press the ↵ (enter) key to confirm the selection and return to the submenu. The change in array name will take effect as soon as control is passed to the submenu screen. If you enter or re-enter any of the Array 1 Options set up screens the first line of the screen will now display the array name you just selected.

### Set the Sensor Position

This selects the position of the piezometric flow tap. The MEMS pressure transducer used on the FSB assemblies to monitor the piezometric pressure depression has a range of 0 to 14 inches WC. The velocity increases and the static pressure decreases as it flows through the cone until the minimum diameter is reached. There is a well-defined mathematical relationship between the geometry of the inlet cone, the pressure depression at any point along the cone and the air flowing through the cone. By placing a static pressure probe at some point in the inlet cone and measuring the pressure depression between that probe and the fan inlet, the airflow can be calculated.




In most cases 0 to 14 inches WC is sufficient for fan operating conditions used FanMatrix™ fans. ClimateCraft® fans have the pressure tap installed at the minimum diameter, or throat, of the inlet cone so that the maximum pressure signal is available. If a fan is expected to have abnormally high flow, the piezometric pressure depression may be higher than 14 inches WC and outside of the range of the sensor. In those cases, the tap is installed in the cone at a location before the minimum diameter allowing the FSB pressure transducer to stay in range.

| NOTICE |
| --- |
| In order to correctly calculate the airflow for the fans the MatrixMonitor™ control unit must know which tap is being used. |

You can inspect the fans to determine which connection is made or you can get this information from the air handler submittal. The information is on the MatrixMonitor™ wiring diagram in the data block on the bottom of the sheet. A sample of the wiring diagram is in the appendix of this manual. There may be more than one fan array in the air handler so make sure you identify the correct wiring diagram for this array. The section titled “Throat and Cone Tap Flow Range” below gives the basic information about when the throat tap or the cone tap should be used.

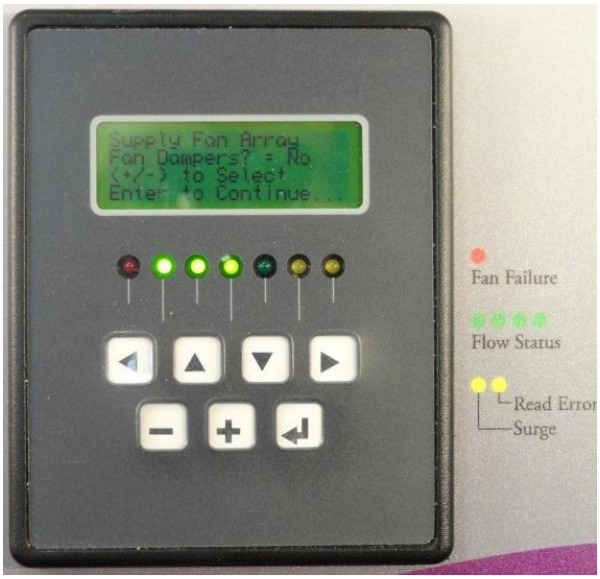
From the "**Array 1 Options**" submenu, scroll down to highlight "**5. Sensor Position**". Press the ↵ (enter) key and the sensor position setup screen will appear. The first line on the screen will display the array name. It should have been set in a previous step. The second line on the screen will read "**Sensor Loc = Throat**". The description after the = sign is the current selection for the sensor location. The default value is "**Throat**". It can be switched between "**Throat**" and "**Cone**"

The bottom two lines are the navigation aids. Use the + and - keys to select the sensor location. When you press the keys the description displayed after the = will change reflecting the current selection of the sensor location.

When the location displayed on line 2 is correct press the ↵ key to confirm the selection and return to the submenu. The change in sensor location will take effect as soon as control is passed to the submenu screen.

## Set the Optional Dampers

This sets a flag if back flow prevention dampers are installed. The dampers can be a control damper or gravity operated back draft damper. The flag is either Yes or No for the entire array. This flag is used when a fan failure is detected. If a back draft damper is not installed air back flows through a fan that is off or has failed. The amount of air that back flows is calculated and then subtracted from the sum of the flows from the operating fans which gives a true calculation of the airflow delivered by the array. If back draft dampers are provided, the flow, in the fans that have failed or are turned off, is set to zero and there is no air back flowing through them.




From the "**Array 1 Options**" submenu, scroll down to highlight "**6. Dampers**". Press the ↵ (enter) key and the damper setup screen will appear. The first line on the screen will display the array name. It should have been set in a previous step. The second line on the screen will read "**Fan Dampers? = No**". The description after the = sign is the current selection. The default value is "No". It can be switched between "**No**" and "**Yes**"

The bottom two lines are the navigation aids. Use the + and - keys to select "**Yes**" or "**No**". When you press the keys the description displayed after the = will change reflecting the current selection of the backdraft damper flag.

When the backdraft damper flag displayed on line 2 is correct press the ↵ key to confirm the selection and return to the submenu. The change in sensor location will take effect as soon as control is passed to the submenu screen.

### Set the Fan Status

The fan status flag is used by MatrixMonitor™ to correctly calculate the array airflow in the event that it detects a fan is not operating and to properly set the fan failure alarm. The control unit monitors the piezometric port pressure of each fan. When a fan fans not operating, the port pressure is considerably lower than the other fans in the array which tells the control unit that the fan is not running.

The internal data stored for each fan model allow the control unit to calculate the amount of air flowing backwards through the fan when it is not operating. Matrix monitor knows a back flow prevention damper is installed when the damper flag is set (see "Set the Optional Dampers" above).

The fan status flag is used by the MatrixMonitor™ software to control how it reacts when it determines a fan is not operating.

If the fan status flag is set to "**On**", the control assumes that the fan has failed and sets the fan failure alarm. A fan failure alarm will turn on the fan failure relay, light the red LED lamp on the keypad and respond to a BMS inquiry that a fan failure has occurred. The calculated backflow will subtracted from the flow totaled from the rest of the fans if back flow prevention dampers are not installed. If dampers are installed, the flow for this fan is set to 0.

If the fan status flag is set to "**Off**" the control assumes that the fan is off for a reason and does not set a fan failure alarm. The calculated backflow will subtracted from the flow totaled from the rest of the fans if back flow prevention dampers are not installed. If dampers are installed, the flow for this fan is set to 0.

If the fan status is set to "**Blanked Off**" the control assumes that the fan is off and a blank off plate has been installed on the inlet to prevent backflow. The fan failure alarm is not set and the flow for the fan is set to 0.


The default status for all fans is "**On**". The "**Off**" status is for the user to inhibit the fan failure alarm. This is useful after the failure has been acknowledged to clear the alarm. It is also useful if a fan has been shut down for capacity or maintenance purposes. The "**Blanked Off**" status is for the same purpose but allows the control to calculate array airflow correctly when the fan has a blank off plate installed.

From the "**Array 1 Options**" submenu, scroll down to highlight "**7. Set Fan Status**". Press the ↵ (enter) key and the fan status setup screen will appear. The first line on the screen will display the array name. (It should have been set in a previous step) The second line on the screen will read "**Fan 1: On**". The number before the colon (:) is the selected fan. This can be scrolled through all of the fans in the

array so that the status of each fan can be set individually. The description after the colon (:) is the current selection. The default value is "**On**". It can be switched between "**On**", "**Off**" and "**Blanked Off**"

The bottom two lines are the navigation aids.

To select the fan that needs its fan status flag changed, us the ^ and ˅ keys to scroll to the right fan. The number before the colon (:) will change when the keys are pressed changing the fan selection.

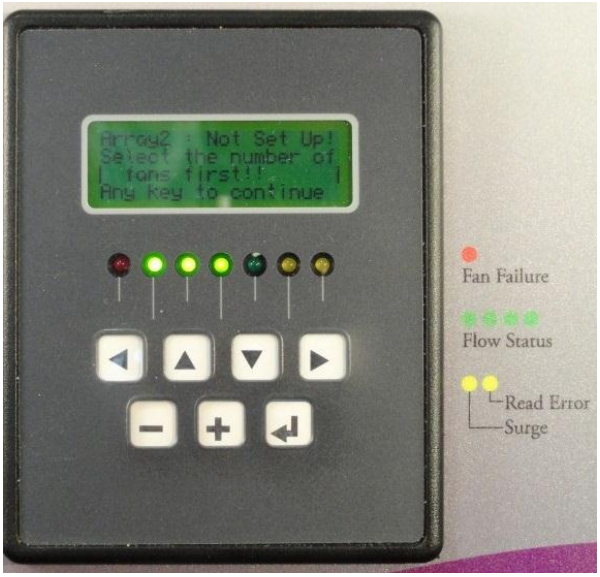
Use the + and - keys to select "**On**", "**Off**" or "**Blanked Off**". When you press the + or - keys the description displayed after the colon (:) will change reflecting the current selection of the fan status flag for the selected fan.

If the status of more than one fan needs to be changed, repeat this procedure until the status of all fans is correct.

When you have finished adjusting the fan status flags press the ↵ (enter) key to confirm the changes and return to the submenu. The fan status flag changes will take effect as soon as control is passed to the submenu screen.

### *Return to Main Menu*

From the "**Array 1 Options**" submenu, scroll down to highlight "**8. Return to Main**". Press the ↵ (enter) key to return to the main menu. Before the systems transfers control to the main menu it saves the array set up option data to a setup data file in the flash memory of the Rabbit RCM3000 control module. A momentary screen displaying the message "**Saving Settings**" will appear to confirm this.




## Set Up Array 2

The set up procedure for Array 2 is almost identical to the procedure for Array 1 so the instructions will not be duplicated here. Instead we will describe the minor differences between the set of Array 1 and Array 2.

The difference between Array 1 and Array 2 is that the number of fans in Array 2 can be set to 0 and this setting affects the way the control behaves. One is the minimum number of fans in Array 1. Zero is the default value for the number of fans in Array 2. When the number of fans in Array 2 is set to 0, the control unit inhibits the display of any data for Array 2 and will not allow any option data to be set. If you attempt to enter any Array 2 set up screens when the number of fans is set to 0 you will get the following message:

```
Array2  :  Not Set Up!
Select the Number of
    Fans First!!
Any Key to Continue
```

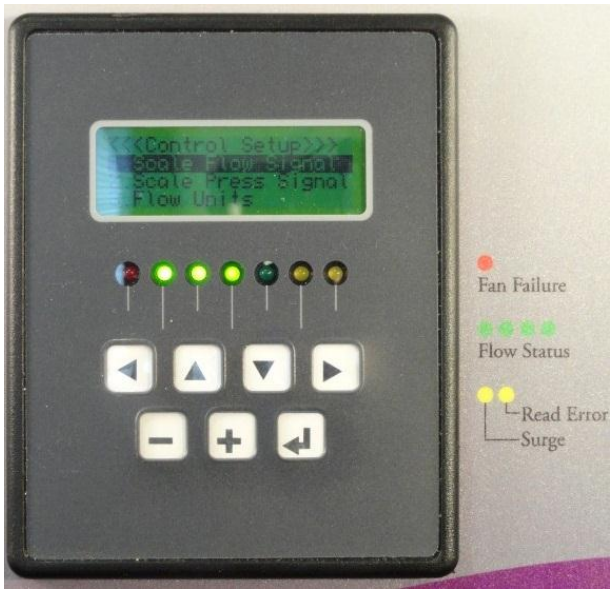
You will get a similar message any display screens that are to display data about Array 2 fans. The "**Display Airflow**" screen is also different when the number of fans for Array 2 is not 0. (See "Display Information" below)

In order to set up the data for Array 2 you will have to set the number of fans first before you can do anything else. If the fan option data has been set for Array 2 and you change the number of fans to 0 the system will reset all of the Array 2 option data back to the default values. Before it does so you will get the following message as you exit the "**Number of Fans**" set up screen:

```
ARRAY 2 WILL DELETE!
PRESS ENTER TO ABORT
ANY OTHER KEY WILL
 DELETE ARRAY 2!
```

If you press the ↵ (enter) key the Array 2 fan number setting will not be modified and no setting data will be reset. If you press any other key the number of fans in Array 2 will be set to 0 and all of the Array 2 option data will be reset to the default values. The reverse function of the ↵ (enter) key is to insure that the set up data is not accidentally erased.

## Set the Control Data




Setting up the control information is accomplished through the "**Control Setup**" submenu. This set of data entry screens manages the four 0 to 10 VDC output signals, selects the units that the airflow is displayed in, sets up the EIA/TIA 485 multipoint communication line for communication to the building management system, sets the alarm limits for the vibration monitor, and initiates the grease life monitor.

See the section "Interface to Building Management System" for detailed information on the digital communication capability between MatrixMonitor™ and the site building management system. See the section "Vibration Monitoring" for an explanation of the vibration monitoring system. See the section "Lubrication Monitoring" for instructions for the use of the grease life system.

From the main menu, scroll and highlight "**6.Control Setup**". Press the ↵ (enter) key and the control setup menu will be displayed.

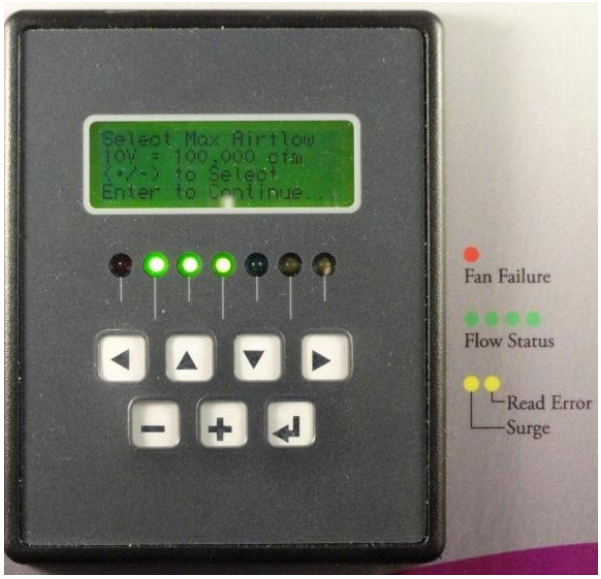
| **Menu Lines Displayed** | ..... **Screen Type *(Screen Function)*** |
|---|---|
| **<<<Control Setup>>>** | |
| **1. Scale Flow Signal** | ..... Setup *(scales the 0-10VDC array flow output signals)* |
| **2. Scale Pressure Signal** | ..... Setup *(scales the 0-10VDC array press rise output signals)* |
| **3. Flow Units** | ..... Setup *(selects the flow units cfm or scfm)* |

4. BMS Protocol ..... Setup *(selects the BMS communication protocol)*
5. BMS Baud Rate ..... Setup *(selects the baud rate for the BMS RS485 comm line)*
6. BMS Parity ..... Setup *(selects the parity for the BMS RS485 comm line)*
7. BMS Device ID ..... Setup *(selects the device ID number for the BMS comm line)*
8. Vibration Limits ..... Setup *(selects the high vibration alarm limits)*
9. Reset Grease Life ..... Setup *(Reset the grease life back to 100%)*
10. Return to Main

In order to select one of the menu options use the ^ and ˅ keys to highlight the menu option desired and then press the ↵ (enter) key to display the setup screen.

## Scale the Flow Signal

This setting tells the control how to scale the 0 to 10 VDC airflow output signal. It can be adjusted between 10,000 and 300,000 in increments of 10,000 cfm. The airflow output signal will be set to 0 VDC when there is no flow and it will increase to 10 VDC linearly as the calculated array airflow increases to the value of this setting. The default setting is 10,000 cfm. This setting applies to both Fan Array 1 and Fan Array 2.




This setting also affects the operation of the green LEDs on the front of the keypad display unit. The green LEDs function as a flow meter for fan array 1. The number of LEDs turned on is controlled by the airflow measured for Array 1 and this setting. The measured airflow of Array 1 is divided by this setting and that result is multiplied by 4 to determine the number of green LED lamps to turn on.

From the "**Control Set Up**" submenu scroll down to highlight "**1. Scale Flow Signal**". Press the ↵ (enter) key to display the flow signal set up screen. The first line will read "**Select Max Airflow**". The second line will read "**10V = 10,000 cfm**". The number after the = sign is the maximum airflow scale setting. The last two lines are navigation aids.

Use the + and - keys to raise and lower the airflow scale setting to the required value and press the ↵ (enter) key to confirm the selection and return to the sub menu.

## Scale the Pressure Signal

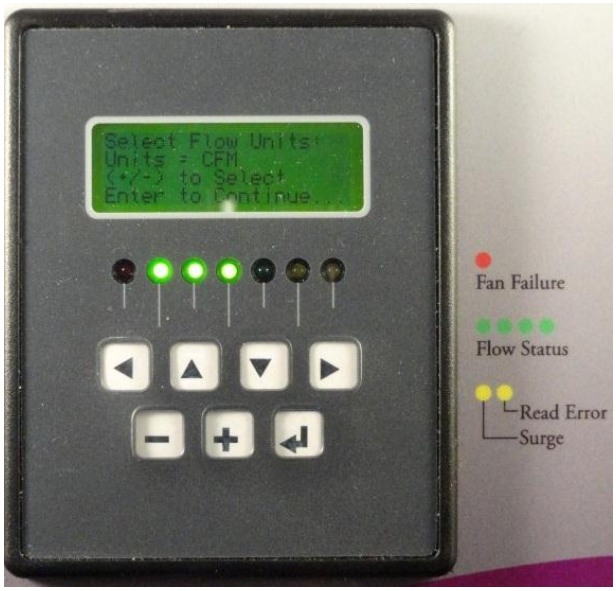
This setting tells the control how to scale the 0 to 10 VDC array pressure rise output signal. This can be set from 0 to 25 inch WC in increments of 1 inch WC. The array pressure rise signal will be set to 0 VDC when the array pressure rise is measured to be 0. It will increase linearly to 10 VDC as the measured pressure increases to the value of this setting. The default setting is 10 inch WC. This setting applies to both Fan Array 1 and Fan Array 2.

From the "**Control Set Up**" submenu scroll down to highlight "**2. Scale Pressure Signal**". Press the ↵ (enter) key to display the pressure signal set up screen. The first line will read "**Select Max Pressure**". The second line will read "**10V = 10 in WC**". The number after the = sign is the maximum pressure scale setting. The last two lines are navigation aids.

Use the + and - keys to raise and lower the pressure scale setting to the required value and press the ↵ (enter) key to confirm the selection and return to the sub menu.

### Select the Flow Units

This setting selects the unit of measure that the flow from both Arrays is reported in. It can be set to "cfm" or "scfm". When the setting is "cfm" the control reports flow in actual cubic feet per minute (ACFM) which is a volumetric flow rate. When the setting is "scfm", the control reports flow in units of standard cubic feet of air per minute (SCFM) which is an equivalent mass flow rate. It is determined by calculating the mass flow rate of the air in lbm/min and dividing it by the standard density of air (0.075 lbm/ft$^3$). When the density of the air entering the fan is equal to the standard air density, the value reported for ACFM will be exactly equal to the value reported for SCFM.




From the "**Control Set Up**" submenu scroll down to highlight "**3. Flow Units**". Press the ↵ (enter) key to display the flow unit set up screen. The first line will read "**Select Flow Units**". The second line will read "**Units = cfm**". The text after the = sign is the units used to report flow. The last two lines are navigation aids.

Use the + and - keys to select "**cfm**" or "**scfm**" and press the ↵ (enter) key to confirm the selection and return to the sub menu.

### Enable Modbus Communication with BMS

Digital communication with the Building Management System (BMS) can be enabled or disabled through the BMS protocol set up screen. When the BMS protocol is set to "None" communication with the BMS is turned off at the MatrixMonitor™ control unit. When the BMS Protocol is set to "Modbus RTU" the control unit will actively respond to requests from a "Master" device using the Modbus RTU protocol over the EIA/TIA 485 multi-port 2 wire communication line. See the subsection labeled "Modbus® Communications" under "Interface to Building Management System" for a complete discussion about the digital communication interface provided with MatrixMonitor™.

From the "**Control Set Up**" submenu scroll down to highlight "**4. BMS Protocol**". Press the ↵ (enter) key to display the flow unit set up screen. The first line will read "**Select BMS Comm:**". The second line

will read "**Type = None**". The text after the = sign is the BMS protocol used. The last two lines are navigation aids.

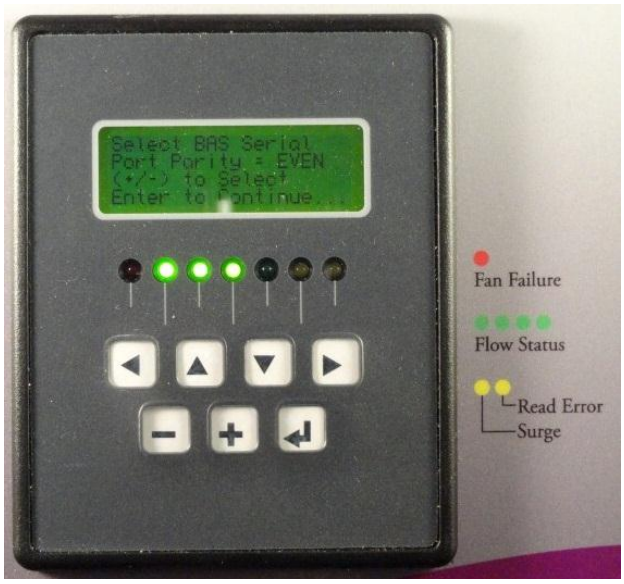
Use the + and - keys to select "**None**" or "**Modbus RTU**" and press the ↵ (enter) key to confirm the selection and return to the sub menu.

### Set the Baud Rate for the RS485 communication line

The baud rate setting controls the speed at which the BAS master communicates with the MatrixMonitor™ slave devices. The baud rate is user selectable to allow the control to adapt to different networks. The Modbus RTU protocol requires that the control be able to support baud rates of 9,600 and 19,200. In addition to those required MatrixMonitor™ supports baud rates of 38,400 and 57,600. 19,200 is the default baud rate. See the subsection labeled "Modbus® Communications" under "Interface to Building Management System" for a complete discussion about the digital communication interface provided with MatrixMonitor™.

From the "**Control Set Up**" submenu scroll down to highlight "**5. BMS Baud rate**". Press the ↵ (enter) key to display the baud rate set up screen. The first line will read "**Select BAS Serial**". The second line will read "**Baud rate = 19,200**". The text after the = sign is the baud rate used. The last two lines are navigation aids.

Use the + and - keys to select "**9,600**", "**19,200**", "**38,400**", or"**57,600**" and press the ↵ (enter) key to confirm the selection and return to the sub menu.




### Set Parity for the RS485 communication line

Data transferred over a serial communication line must be formatted so that the transmitter and receiver can understand the data transferred. A typical communication unit will include a start bit and 7 or 8 data bits. It may include a parity bit for error checking and 1 or 2 stop bits. The Modbus communication unit requires 1 start bit, 8 data bits, 1 parity bit, and 1 stop bit. The parity bit can be odd or even or can also be omitted. If the parity bit is omitted the Modbus protocol requires that 2 stop bits be used so that the communication unit always contains 11 bits. This selects the communication parity. The selections are "Even", "Odd", or "None". "Even" parity is the default value.

See the subsection labeled "Modbus® Communications" under "Interface to Building Management System" for a complete discussion about the digital communication interface provided with MatrixMonitor™.

From the "Control Set Up" submenu scroll down to highlight "6. BMS Parity". Press the ↵ (enter) key to display the BMS parity set up screen. The first line will read "Select BAS Serial:". The second line will read "Parity = EVEN". The text after the = sign is the parity used. The last two lines are navigation aids.

Use the + and - keys to select "EVEN", "ODD", or "NONE" and press the ↵ (enter) key to confirm the selection and return to the sub menu.

## Set the device ID for BMS communication

The Modbus protocol consists of a single master control communicating with multiple slave devices. For integration into a building management system the BMS assumes the role of the master with the MatrixMonitor™ in the role of a slave device. The communication protocol requires that each slave device on the network have a unique ID number that identifies it on the multipoint network. This ID or address must be a number between 1 and 247. This sets the Modbus ID number for the MatrixMonitor™.

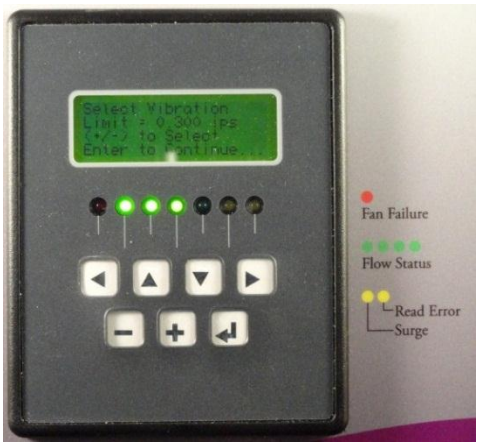
From the "Control Set Up" submenu scroll down to highlight "7. BMS Device ID". Press the ↵ (enter) key to display the device ID set up screen. The first line will read "Select BAS Slave". The second line will read "Address = 75". The text after the = sign is the BMS protocol used. The last two lines are navigation aids.

Use the + and - keys to select the Modbus slave address for this unit. The number can be adjusted from 1 to 247. The software will wrap around the limits. A "+" key press when the Address = 247 will result in an address of 1. A "– " key press when the address = 1 will result in an address of 247. When the desired address is selected press the ↵ (enter) key to confirm the selection and return to the sub menu.

## Set the Vibration Alarm Limits

See the section "Vibration Monitoring" below for a complete description of the vibration monitoring system built into MatrixMonitor™.

This section shows how to set the alarm limits for the vibration monitor. The vibration is measured at the backplane of each fan in the array. MatrixMonitor™ polls the fan sensors on a periodic basis for the top 10 measured vibration levels on each fan. If any of the fan vibration levels exceeds the alarm limit setting, an alarm is triggered.




From the "Control Set Up" submenu scroll down to highlight "8. Vibration Limits". Press the ↵ (enter) key to display the device ID set up screen. The first line will read "Select Vibration". The second line will read "Limit = 200 ips". The text after the = sign is the vibration alarm limit. The last two lines are navigation aids.

Use the + and - keys to select the alarm limit for the fans in the arrays

monitored by this unit. The number can be adjusted from 0.100 ips to 0.300 ips in increments of 0.010 ips. The software will wrap around the limits. A "+" key press when the limit = 0.300 ips will result in a limit of 0.100 ips. A "– "key press when the limit = 0.300 ips will result in a limit of 0.100 ips. When the desired vibration alarm limit is selected press the↵ (enter) key to confirm the selection and return to the sub menu.

### Grease Life Timer

See the section "Lubrication Monitoring" below for a complete discussion of the lubrication monitoring system. This section shows how to initiate and reset the grease life timer.

| NOTICE |
| --- |
| The grease life timer uses the real time clock. It is important to set the clock before you initiate the grease life timer. |

Make sure the time and date settings are correct. The time and date display can be accessed from the main menu (see "Display Time/Date" below.) If the clock needs to be set, see the section titled "Set the real time clock". The grease life timer keeps track of the lubrications of one or two fan arrays connected to the MatrixMonitor™. Also, the fan array parameters must be entered before the grease life timer is started. See the section titled "Set the Array Data" above. The same control setup screen ("**10. Reset Grease Life**") is used to both start and reset the grease life timer.

### Starting the Grease Life Timer

When the MatrixMonitor is shipped, the grease life timer is not set and it is not operating. Starting one array systems is slightly different than systems with two arrays. To get it started follow this procedure:

**One array systems:**

( if you have a two array system skip this section and go to the section for "Two array systems" directly below)

From the "**Control Set Up**" menu scroll down to highlight "**10. Reset Grease Life**". Press↵ (enter) to display the start screen. If the grease life timer has not been started the screen will look like the following:

```
Supply  :  Life 100
Monitor Not Enabled
+ Starts Monitor
Enter to Continue
```

The label on the first line before the colon is the array name label and it will correspond to the name set up for array 1. The second line indicates that the grease life timer is not running. If you do not want to start the grease life timer you can press enter and you will return to the "**Control set Up**" sub menu. If the screen does not look like the above the grease life timer has already been started and you are in the grease timer reset mode. Skip to "Resetting the Grease Life Timer" below if this is the case.

If you press the "+" key, the grease life timer for array 1 will start and the following screen will appear confirming this:

```
Supply :
Has been reset or
  enabled. Press any
key to continue. . .
```

When you press any key you will get:

```
Supply  :  Life 100
Last Grease: 10/28/12
+ Resets Grease Life
Enter to Continue
```

Press the ↵ (enter) key to return to the "**Control set Up**" sub menu and the grease life timer for array 1 will be operational.

**Two array systems:**

(If you have a one array system do not use this section. Go to the section for "One array systems" directly above)

From the "**Control Set Up**" menu scroll down to highlight "**10. Reset Grease Life**". Press ↵ (enter) to display the start screen. If the grease life timer has not been started the screen will look like the following:

```
Supply  :  Life 100
Monitor Not Enabled
+ Starts Monitor
Enter to Continue
```

The label on the first line before the colon is the array name label and it will correspond to the name set up for array 1. The second line indicates that the grease life timer is not running. If you do not want to start the grease life timer you can press enter and you will return to the "**Control set Up**" sub menu. If the screen does not look like the above the grease life timer for array 1 has already been started and you are in the grease timer reset mode. Skip to "Resetting the Grease Life Timer" below if this is the case.

If you press the "+" key, the grease life timer for array 1 will start and the following screen will appear to confirm this:

```
Supply :
Has been reset or
  enabled. Press any
key to continue. . .
```

When you press any key you will get the following screen:

```
Supply  :  Life 100
Last Grease: 10/28/12
+ Resets Grease Life
Enter to Continue
```

Press the↵ (enter) key and the grease life system for array one will be operational and you can now start the grease life timer for array two. If the grease life timer for array two has not been started the screen will look like this:

```
Return  :  Life 100
Monitor Not Enabled
+ Starts Monitor
Enter to Continue
```

The label on the first line before the colon is the array name label and it will correspond to the name set up for array 2. The second line indicates that the grease life timer is not running. If you do not want to start the grease life timer you can press enter and you will return to the "**Control set Up**" sub menu. If the screen does not look like the above the grease life timer for array 2 has already been started and you are in the grease timer reset mode. Skip to "Resetting the Grease Life Timer" below if this is the case.

If you press the "+" key, the grease life timer for array 2 will start and the following screen will appear confirming this:

```
Return :
Has been reset or
  enabled. Press any
key to continue. . .
```

When you press any key you will get the following screen:

```
Return  :  Life 100
Last Grease: 10/28/12
+ Resets Grease Life
Enter to Continue
```

Press the↵ (enter) key to return to the "**Control set Up**" sub menu and the grease life timer for both arrays will be operational.

### *Resetting the Grease Life Timer*

When it is time to grease the fan motors MatrixMonitor™ signals an alarm, the warning relay (K3) will switch and the yellow "Read Error" LED (furthest to the right) on the Keypad Display unit will light. The information/status line under the array airflow line of the "**Display Airflow**" screen will signal "**Grease Bearings Soon**" and the "**Grease Life Data**" display shows 0 life and 0 hours to the next grease. This signals that a bearing lubrication is required.

When you have finished the greasing service the timer must be reset so it can keep track of the operational status and predict the next service requirement.

Resetting one array systems is slightly different than 2 array systems. To reset the grease life timers follow this procedure:

**One array systems:**
( if you have a two array system skip this section and go to the section for "Two array systems" directly below)

From the "**Control Set Up**" menu scroll down to highlight "**10. Reset Grease Life**". Press ↵ (enter) to display the reset screen. If the grease life timer has been started the screen will look like the following:

```
Supply  :  Life   3
Last Grease: 12/15/11
+ Resets Grease Life
Enter to Continue
```

The label on the first line before the colon is the array name label and it will correspond to the name set up for array 1. The second line displays the last reset date. If the screen does not look like the above the grease life timer has not been started and you are in the grease timer startup mode. Jump to "Starting the Grease Life Timer" above if this is the case.

If you press the "+" key, the grease life timer for array 1 will reset and the following screen will appear confirming this:

```
Supply :
Has been reset or
  enabled. Press any
key to continue. . .
```

When you press any key you will get the following screen:

```
Supply  :  Life 100
Last Grease: 10/28/12
+ Resets Grease Life
Enter to Continue
```

The date on the second line will be todays date. If it is not, the real time clock is not set properly. That must be done before you can use the grease life timer. Leave the reset screen by pressing the ↵ (return) key and returning to the "Control set Up" sub menu. Follow the instructions in the section "Set the real time clock" and start over.

Press the ↵ (enter) key to return to the "**Control set Up**" sub menu and the grease life timer for array 1 will be reset.

**Two array systems:**

(If you have a one array system skip this section and go to the section for "One array systems" directly above)

On a typical system with two fan arrays measured by one MatrixMonitor™ both arrays seldom required service at the same time. The maintenance staff will adopt one of two policies to deal with this situation.

The first and most common strategy is to grease all of the fans in the unit when any of the fan arrays requires it. This reduces the requirement to schedule down time to perform the scheduled maintenance.

The other strategy is to only grease the fan arrays when required. This strategy minimizes the amount of work that must be done to keep the equipment running properly at the expense of more service interruptions.

If you have adopted the first strategy for your site it will be necessary to reset the timers for both arrays at the same time. If you have adopted the latter strategy you will have to reset the grease life timer for the array you just serviced without resetting the other. The "**10. Reset Grease Life**" screen allows you to reset the grease life timer on either or both timers when you have two arrays. To reset the timers for a two array system use the following procedure.

From the "**Control Set Up**" menu scroll down to highlight "**10. Reset Grease Life**". Press ↵ (enter) to display the reset screen. If the grease life timer for array 1 has been started the screen will look like the following:

```
Supply  :  Life    3
Last Grease: 12/15/11
+ Resets Grease Life
Enter to Continue
```

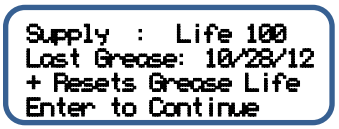
The label on the first line before the colon is the array name label and it will correspond to the name set up for array 1. The second line displays the last reset date. If the screen does not look like the above the grease life timer has not been started for array 1 and you are in the grease timer startup mode. Jump to "Starting the Grease Life Timer" above if this is the case.

If you intend to reset the timer for fan array 1 press the "+" key, the grease life timer for array 1 will reset and the following screen will appear to confirm this:

```
Supply :
Has been reset or
  enabled. Press any
key to continue. . .
```

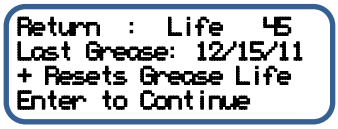
If you did not want to reset the timer for array 1 then pressing the ↵ (enter) key will skip the screen above and the next screen and go directly to the Array 2 reset screen.

Assuming you reset the grease life timer for array 1 and are looking at the screen directly above, pressing any key you will get the following screen:



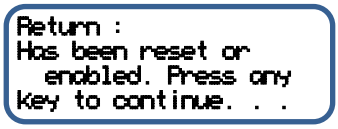

The date on the second line will be todays date. If it is not, the real time clock is not set properly. That must be done before you can use the grease life timer. Leave the reset screen by pressing the ↵ (enter) key twice and returning to the "**Control set Up**" sub menu. Follow the instructions in the section "Set the real time clock" and start over.

Press the ↵ (enter) key and the reset screen for fan array 2 will display.



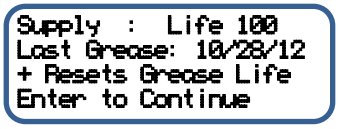

The label on the first line before the colon is the array name label and it will correspond to the name set up for array 2. The second line displays the last reset date for array 2. If the screen does not look like the above the grease life timer has not been started for array 2 and you are in the grease timer startup mode. Jump to "Starting the Grease Life Timer" above if this is the case.

If you intend to reset the timer for fan array 2 press the "+" key, the grease life timer for array 1 will reset and the following screen will appear to confirm this:




If you did not want to reset the timer for array 2 then pressing the ↵ (enter) key will skip the screen above and return to the "**Control Set Up**" sub menu.

Assuming you reset the grease life timer for array 2 and are looking at the screen directly above, pressing any key you will get the following screen:




The date on the second line will be todays date. If it is not, the real time clock is not set properly. That must be done before you can use the grease life timer. Leave the reset screen by pressing the ↵ (return) key and return to the "**Control set Up**" sub menu. Follow the instructions in the section "Set the real time clock" and start over. If the date is correct you have successfully reset the grease life timer for array 2. Press the ↵ (enter) key to return to the "**Control set Up**" sub menu.

Press the↵ (enter) key to return to the "**Control Set Up**" sub menu and the grease life timer for array 1 will be reset.

### *Return to Main Menu*

From the "**Control Setup**" submenu, scroll down to highlight "**10. Return to Main**". Press the↵ (enter) key to return to the main menu. Before the systems transfers control to the main menu it saves the array set up option data to a setup data file in the flash memory of the Rabbit RCM3000 control module. A momentary screen displaying the message "**Saving Settings**" will appear to confirm this.

## Set the real time clock

Setting the real time clock is accomplished from the submenu that is accessed from the main menu screen. The real time clock has a battery backup and never needs to be reset. The clock does not automatically adjust for daylight savings time so you may want to do so to keep the time current with the actual time on the site. The clock is needed for the lubrication monitoring system and it is not necessary for the clock to be adjusted for daylight savings time changes for this to function properly.

From the "**Main Menu**" scroll down and highlight "**7. Clock Settings**". The following submenu will display:

**Menu Lines Displayed** ..... **Screen Type *(Screen Function)***

```
<<<Clock Settings>>>
1. Time and Date
2. Return to Main
```

In order to select one of the menu options use the ^ and ˅ keys to highlight the menu option desired and then press the enter key.

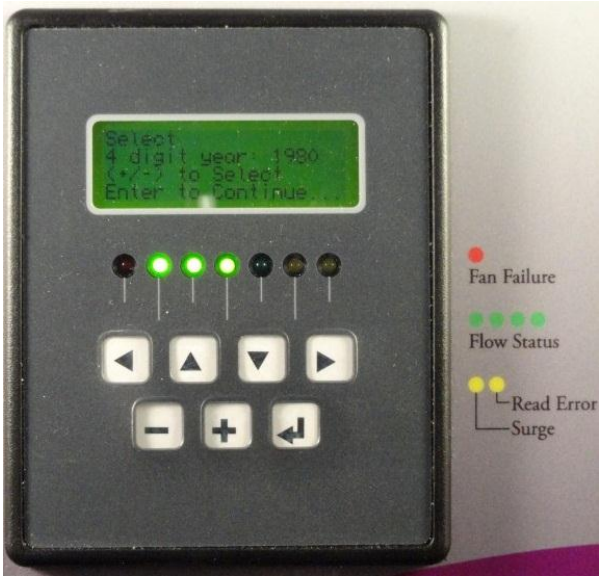
### Time and Date

From the "**Clock Settings**" submenu scroll down and highlight "**1. Time and date**" and press↵ (enter) key to set the real time clock.

The following lines will appear on the graphic display:

```
Select
4 digit year :  1980
(+/-) to Select
Enter to Continue
```

The clock starts counting from January 1, 1980. The number after the colon in the second line is the year. If the clock has never been set or the battery has been replaced the year will be 1980. To change



this to the actual year press the + key until the current year is displayed on the second line. It will increment by 1 year for every key press and auto scroll if the key is held for more than 1 second. If you overshoot the year you can use the – key to back up. When you have the correct year on the display press the↵ (enter) key. The following lines will appear on the graphic display:

```
Enter Month :  01

(+/-) to Select
Enter to Continue
```

The number after the colon is the month. To change this to the actual month press the + key until the current year is displayed on the second line. It will increment by 1 month for every key press and auto scroll if the key is held for more than 1 second. If you overshoot the year you can use the – key to back up. When you have the correct month on the display press the↵ (enter) key. The following lines will appear on the graphic display:

```
Enter
Day of month :  01
(+/-) to Select
Enter to Continue
```

The number after the colon is day of the month. To change this to the actual day press the + key until the current day is displayed on the second line. It will increment by 1 day for every key press and auto scroll if the key is held for more than 1 second. If you overshoot the day you can use the – key to back up. When you have the correct day on the display press the↵ (enter) key. The following lines will appear on the graphic display:

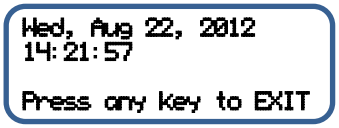

```
Enter
Hour (24 hr) : 01
(+/-) to Select
Enter to Continue
```

The number after colon is the hour. It is displayed in a 24 hour format sometimes called “military time”. AM time is the same in this format. Add 12 hours to PM times to get the “military time”. To change this to the actual hour press the + key until the current hour is displayed on the second line. It will increment by 1 hour for every key press and auto scroll if the key is held for more than 1 second. If you overshoot the hour you can use the – key to back up. When you have the correct hour on the display press the↵ (enter) key. The following lines will appear on the graphic display:

```
Enter minute : 05

(+/-) to Select
Enter to Continue
```

The number after the colon is the minute. To change this to the actual minute press the + key until the current minute is displayed on the first line. It will increment by 1 minute for every key press and auto scroll if the key is held for more than 1 second. If you overshoot the minute you can use the – key to back up. When you have the correct year on the display press the ↵ (enter) key. The following lines will appear on the graphic display:




This shows the currently active date on the first line and the time on the second. The time is shown in 24 hour format Hour : Minute : Second. It is an active display and will continue to update the time and date every second. Any key pad press will return control to the "**Clock Settings**" sub menu.

### *Return to Main Menu*

From the "**Clock Settings**" submenu, scroll down to highlight "**2. Return to Main**". Press the ↵ (enter) key to return to the main menu.

## Display Information

This section will step you through the information available on the display screens. Make sure to read the "User Interface" section above before you use the menu system to access the display information. It will explain the conventions used and menu structure employed. There is a great deal of information available that can be viewed through the display screens of MatrixMonitor™. All of these screens are accessed through a selection from the "**Main Menu**". All of the screens are real time and as data changes data on the screen changes. **When you are in the data screens all the normal processing of the MatrixMonitor™ continues and all communication to the host operates normally.**

### Display Airflow

The Information displayed is the current total array airflow, array pressure rise, average array temperature and current fan speed. The physical screen layout is different if two arrays are set up.


From the "**Main Menu**" scroll down and highlight "**1. Display Airflow**". This will airflow display screen. If the MatrixMonitor™ is set up for one array the following screen will appear:

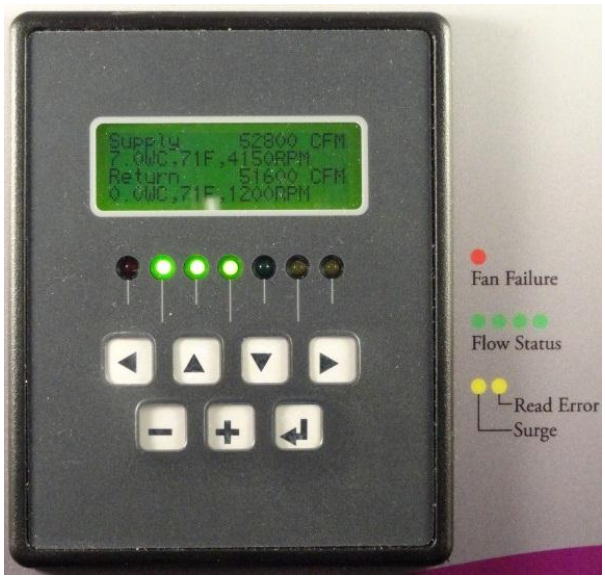

The first line is the airflow for the entire fan array. It is in double size characters for easy viewing at a distance. The airflow can be displayed in units of CFM or SCFM as indicated by the tag following the

numbers. This is an option selectable under the "**Control Setup**" submenu. The second line is a status information line. It will display the fan array pressure rise in units of inches Water Column, the air temperature entering the fan array in $^{o}$F, and the calculated speed of the fans in RPM.

If the yellow "Read Error" LED (furthest to right) on the Keypad display unit is lit there may be a status message on the second line. If the FSB board used for the array pressure rise is not communicating with the control unit, the second line will display "**Bad Pressure Sensor**!". Refer to the "Trouble Shooting Guide" later in this manual for instructions when this message appears. The message "**Grease Bearings Soon**" will display on the second line when the lubrication monitoring system has determined it is time to grease the bearings. See "Lubrication Monitoring" section for information on the operation of the lubrication monitoring system.

When there are two arrays monitored by the MatrixMonitor™ the display will look slightly different to accommodate information about both arrays.

```
Supply 115000 CFM
5.1WC, 58.3F,2333RPM
Return  75300 CFM
2.3WC, 78.9F,1557RPM
```




The large font is not used for the airflow display. The airflow for array 1 is shown on line 1. The array name selected for array 1 is displayed just before the airflow. This array name is selected in the control setup procedure. See "Set the Array Name" section in the setup procedure covered earlier in this manual for information on how to select array names. The second line is the status information line and it gives the same information and behaves the same way as previously discussed.

The second and third lines give the same information for fan array 2 as is shown on lines 1 and 2 for array 1.

Because of limited space there is no navigation line provided as is customary with MatrixMonitor display screens. Pressing any key will return you to the main menu.

### Display Individual Fan Details

These display screens provide individual status data for each fan in the fan array. The information displayed are the airflow for each fan and the corresponding piezometric pressure port measurement for that fan. Detailed error and warning messages specific to each fan are also displayed to aid in trouble shooting the fan array and control. The information is available for two arrays and each has a separate menu item in the main menu. Menu items "**2. Array 1 Fans**" and "**3. Array 2 Fans**" will display the fan details for each array respectively. Menu item 3 will show up on the "Main Menu" even though the second array is not used. If you select "**3. Array 2 Fans**" from the main menu when the second array is not set up you will get the following message screen:

```
Array2 : Not Set Up!
Go back to Main Menu
  for Array2 Options
Any key to continue
```

Pressing any key will return you to the main menu if you see this screen. This section will describe information available and the navigation details for menu option "**2. Array 1 Fans**". The procedure and details will be exactly the same for fan array 2 if it is set up on the MatrixMonitor™.

From the "**Main Menu** "scroll down and highlight "**2. Array 1 Fans**" and press the ↵ (enter) key. The following screen will appear:

```
Supply : Fan 1
13,300 CFM  9.9inWC
Up/Dn to Scroll fans
Enter to Continue…
```


The first line is the header line. The label before the colon is the array name selected for fan array 1 in the set up process. The label after the colon indicates which fan in the array that the data displayed on line two corresponds to. It will scroll between Fan 1 to the last fan in the array. This could be as large as Fan 49. The second line is the fan information line. It will normally display the fan airflow and the piezometric pressure depression measurement that produced the calculated flow. This information is specific to the fan indicated by line 1.

To display information about other fans in the array press the ^ or ˅ keys and the display will scroll through the fans in the array. Each key press will update the fan number and the flow and pressure data on line two. The scrolling function will wrap around the number of fans in the array showing only valid fan numbers.

If a problem is detected with the fan operation or the data readings a warning message will be displayed in place of the flow and pressure readings. The message will be specific to the array and fan number indicated on line 1. The following error or warning messages could appear on line 2:

| **Message on Line 2** | ..... | **Explanation of Message** |
|---|---|---|
| 4,300 CFM Fan Surge | ..... | The fan is in surge. The airflow for this fan is likely to be substantially less than other fans in this array that are not in surge. The yellow "Surge" LED on the Keypad display unit will be lit.<br>See the "Trouble Shooting Guide". |

| | | |
|---|---|---|
| 13,300 CFM Max Flow | ..... | The piezometric pressure port reading reported from the FSB for this fan is greater than 14 inches WC. This is the full scale reading for the pressure transducer and the actual flow of the selected fan is greater than the displayed flow. The yellow "Read Error" LED on the keypad display will be lit. See the "Trouble Shooting Guide". |
| Bad Air Flow Sensor | ..... | The FSB for the selected fan is not communicating with the control unit or it has reported a bad pressure transducer. The yellow "Read Error" LED on the keypad display will be lit. See the "Trouble Shooting Guide". |
| Bad Air Flow Reading | ..... | The piezometric port reading for the selected fan is inconsistent with the array pressure rise and the readings from the rest of fan is in the array. The yellow "Read Error" LED on the keypad is lit. See the "Trouble Shooting Guide". |
| 3200 CFM Backflow | ..... | The control unit thinks the selected fan has failed and has air flowing backwards though it. The flow indicated is calculated from the fan air pressure rise measurement and backflow curves stored in the system for the fan selected for this array. The displayed airflow has been subtracted from the sum of the rest of the operating fans in the array to arrive at the total airflow displayed under "Main Menu" option "1. Display Airflow". The red "Fan Failure" LED on the keypad display unit is lit. See the "Trouble Shooting Guide". |
| Fan Has No Flow | ..... | The control unit thinks the selected fan has failed. The fan has backflow prevention dampers installed. No backflow is calculated for this fan. The red "Fan Failure" LED on the keypad display unit is lit. See the "Trouble Shooting Guide". |
| High Vibration | ..... | The fan vibration readings read from the FSB for the selected exceed the vibration alarm limits. More detail about the fan vibration levels is available in vibration display screens. The yellow "Read Error" LED on the keypad display unit is lit. |

If the fan status for the selected fan has been set to “Off” or Blanked Off” in the “Set the Fan Status” setup procedure one of the following messages will appear on the second line in place of the fan flow information. This message will only apply to the fan selected and displayed on the first line.

| **Message on Line 2** | **Explanation of Message** |
|---|---|
| Fan Is Switched Off | The fan status has been selected as off and the readings are normal. There is no flow reported for this fan because it is off. This is the normal status line for a fan that has the “Off” status. |
| Fan is Blanked Off | The fan status has been selected as “Blanked Off”. The control thinks the fan is shut off and there is a blank off plate installed. There is no flow reported because this fan is off. This is the normal status line for a fan with the status “Blanked Off”. |
| Off-Bad Sensor | The fan status has been selected as “off”. The control thinks the fan is shut off and cannot read the FSB for the selected fan. The yellow “Read Error” LED on the keypad display unit is lit. See the “Trouble Shooting Guide”. |
| Off-Bad Reading | The fan status has been selected as “off. The control thinks the fan is shut off and the piezometric pressure reading for the selected fan is inconsistent with this status. The yellow “Read Error” LED on the keypad display unit is lit. See the “Trouble Shooting Guide”. |
| Blankoff-Bad Sensor | The fan status has been selected as “Blanked Off”. The control thinks the fan is shut off and there is blank off plate installed. The control unit cannot read the FSB for the selected fan. The yellow “Read Error” LED on the keypad display unit is lit. See the “Trouble Shooting Guide”. |
| Blankoff-Bad Reading | The fan status has been selected as “Blanked Off”. The control thinks the fan is shut off and there is a blank off plate installed. The piezometric pressure reading for the selected fan is inconsistent with this status. The yellow “Read Error” LED on the keypad display unit is lit. See the “Trouble Shooting Guide”. |

When you are done scrolling through the fan status screen press the ↵ (enter) key to return to the main menu.

### Display Time/Date

This displays the current time and date on the graphic display screen. Use this to check that the real time clock is set so the lubrication system will function properly.

From the "**Main Menu**", scroll down to menu option "**8. Display Time and Date**" and press the ↵ (enter) key to display the time and data screen.


The first line is todays date. The second line is the time in Hour: Minute: Second format. The hour is in the 24 hour format (Military Time).

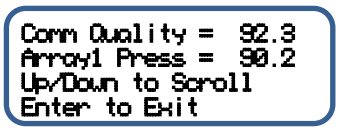
Press any key to return to the main menu.

### Communication Status

The communication status screen is provided as a diagnostic tool to check the quality of the communication status between the control unit and the Fan Sensor Boards (FSBs). The FSBs communicate digitally to the embedded microcontroller in the central control unit over a 2 wire EIA/TIA 485 multi drop communication line. Up to 101 devices can be on this network. The control unit acts as a "master" and polls all of the downstream devices for the information it needs to function. The control unit keeps track of its communication requests and valid responses. Using this data it calculates the communication quality index for each downstream device and combines these into an overall quality index. The index is simply the number of valid responses divided by the number of requests. This information is displayed as a percentage in the communication status screen. This is a useful diagnostic tool. By looking at the quality index you can tell if a particular FSB is having communication problems and if there are widespread communication issues on the network.

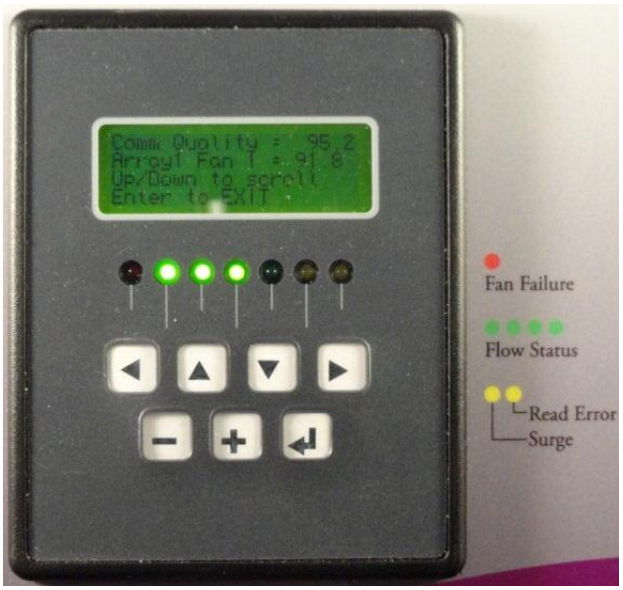
This function does not report on the communication quality between the MatrixMonitor™ and the building management system (BMS). That information must come from the BMS.

From the "**Main Menu**", scroll down to menu option "**9. Comm Status**" and press the ↵ (enter) key to display the time and data screen. The following screen will appear:




The first line shows the overall communication quality. It is calculated for all of the FSB devices on the communication line including the devices for the second fan array if it is installed. The value of the communication quality should be over 85%. If it is lower than that there may be a problem with an individual FSB or there may be a general problem with the communication line in general.

The second line shows the communication quality for a specific sensor. In the example above the communication quality for the array 1 pressure rise sensor is displayed. The bottom two lines are navigation aids.




The ^ and ˅ keys allow you to scroll through all of the FSB devices installed on the network. If you press the ^ key the next screen in the sequence will display as follows:

```
Comm Quality =  95.2
Array1 Fan 1 =  91.8
Up/Down to Scroll
Enter to Exit
```

The second line now shows the FSB communication quality for fan 1 in array 1. Continuing to scroll up will cycle through the rest of the fans installed in array 1. If there is a second array, the quality index for the array 2 pressure rise sensor will then be displayed followed by the fans installed in array 2. See the "Trouble Shooting Guide" for information in resolving poor communication quality issues.

If the control unit loses communication with one of FSB's on the network, the text on line 2 will change to "**Array1 Fan1:Bad Sns** " or "**Array1 Press:Bad Sns** ".

Press the↵ (enter) key to return to the main menu.

### Vibration Data

This screen displays the vibration data received from the FSB sensors mounted on the fan backplanes. There are two options on the "**Main Menu**", "**10. Array 1 Vibration**" and "**11. Array 2 Vibration**". The menu structure cannot be changed during the unit configuration and set up so both of these options are available on the main menu even though a second fan array may not be present on your equipment. The explanation of the display screen for array 1 is presented here. The function for array 2 will be exactly the same if it is present and set up.

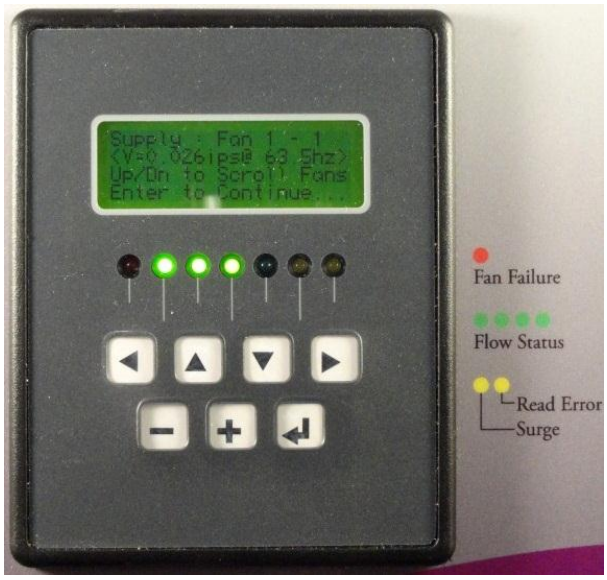
From the "**Main Menu**" scroll down and highlight "**10. Array 1 Vibration**". Press the↵ (enter) key. The following screen will appear:

```
Supply  : Fan  1 - 1
<V=0.053ips@19.1hz>
Up/Dn to Scroll Fans
Enter to continue...
```

The text before the colon on the first line is the array name assigned to the array. The first number after the word "Fan" is the fan number in the array. The number after the dash is the index of the vibration

data displayed on line 2. The 10 highest vibration levels are determined for each fan and can be displayed on line 2. The vibration levels are indexed from highest to lowest so the vibration for index 1 is the highest vibration level in units of inches/second currently measured for that fan.

The second line displays the actual vibration measurement in units of inches/second and the corresponding frequency of that vibration in hertz. To see other vibration readings for the same fan press the > or < keys. They will scroll the vibration data on line 2 between the highest and lowest vibration level for that fan. Pressing the key > will move the vibration index up and pressing the key < will move the index down. The < character at the beginning and the > character at the end of line 2 are there to remind you of the vibration index scrolling feature. Unless there is a problem with the fan operation there will probably only be vibration data for 2 or 3 of the index values. Most of the index values will be 0.




To scroll between fans in the array use the ^ and ˅ keys.

If a fan is switched off or an alarm condition exists the second line will show the warning message for the selected fan. These warning messages will be the same as those shown in the "Display Individual Fan Details" section above. They will not be repeated here for the sake of brevity.

If you selected menu option "**11. Array 2 Vibration**" and your system does not have a second array you will get the following message screen:

```
Array2 : Not Set UP!
Go back to Main Menu
   for Array 2 Options
Any key to continue
```

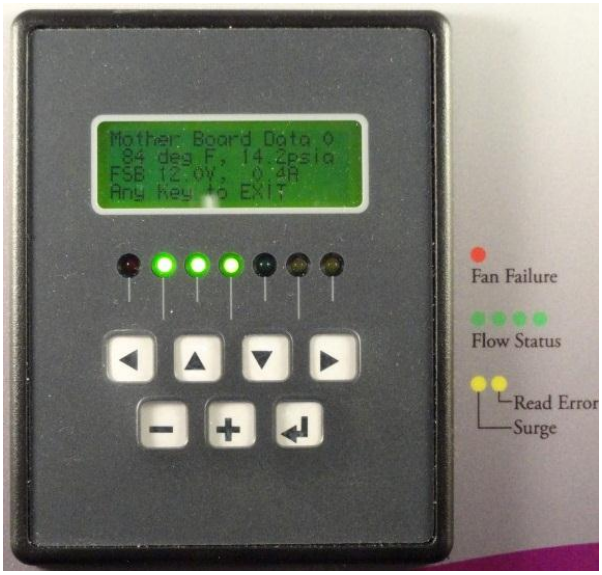
If your system has a second array you will see the first screen above with the array name for array 1 on the first line.

For a comprehensive explanation of the vibration monitoring system refer to the "Vibration Monitoring" section later in this manual.

Press the↵ (enter) key to return to the main menu.

## Motherboard Data

This screen displays the environmental conditions of the control unit. The information displayed is the temperature of the control enclosure, the barometric pressure, and the DC voltage and current supplied to the FSB communication network.




From the "**Main Menu**", scroll down to highlight menu selection "**12. Mother Board data**" and press the ↵ (enter) key. The following will display on the screen:

```
Mother Board Data
110 deg F, 14.7psia
FSB 12.1V,  3.2A
Any Key to Exit
```

The second line of the display shows the temperature of the motherboard inside of the control unit and the atmospheric pressure. This value of atmospheric pressure is used to calculate the density of the air entering the array which is used to calculate the actual fan airflow from the piezometric pressure depression measurement. The second line displays information about the power supplied to the FSB sensor network. The voltage and the current supplied to the FSB network is measured on the motherboard and displayed here.

It is normal for the control unit temperature to be $10^{o}$ to $20^{o}$ F warmer than the ambient temperature. The FSB voltage should be above 11.9V and lower than 12.4V. The FSB current should be less than 3.5 amps.

Pressing any key will return control to the main menu.

## Lubrication Status

This screen displays the state of the grease life timer, predicts the hours left until the next required lubrication, and displays the date of the last lubrication. For a complete description of the lubrication monitoring system built into MatrixMonitor™ see the "Lubrication Monitoring" section below in this document.

From the "Main Menu" scroll down and highlight menu selection "**13. Grease Life Data**" and press the ↵ (enter) key. If there is only one fan array installed and the grease timer has been started the following screen will display:

```
Supply  :  78 Life
Last Grease-11/22/11
Hours To Next 1553
Any Key to EXIT
```

The text before the colon in the first line is the name assigned to array 1. The number after the colon is the percent of life left before the next required bearing grease maintenance. The second line displays

the last date the grease timer was set. The third line predicts the number of consecutive hours until the next required lubrication. If the grease timer has not been started you will see the following screen:

```
Grease Life Monitor
  is not enabled. Go
  to Control Set UP
Any Key to EXIT
```

If you get this message go to the control set up submenu and follow the instructions in section titled "Starting the Grease life Timer" above.

If there are two fan arrays installed and both grease timers have been started this screen will display instead of the one above:

```
Supply  :  78 Life
Hours To Next 1553
Return  :  78 Life
Hours To Next 2345
```

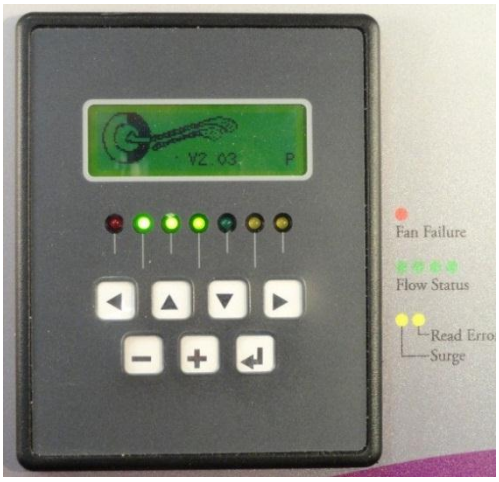
The text before the colon in the first line is the name assigned to array 1. The number after the colon is the percent of life left before the next required bearing grease maintenance for array 1. The second line in the display is a prediction of the consecutive hours of grease life left before the next required lubrication on array 1.

Similarly:

The text before the colon in the third line is the name assigned to array 2. The number after the colon is the percent of life left before the next required bearing grease maintenance for array 2. The fourth line in the display is a prediction of the consecutive hours of grease life left before the next required lubrication on array 2.

The display will be modified slightly by the appropriate message if the grease timer on either fan array has not been started.

The last grease date is not supplied when there are two fan arrays installed in the system.




To exit and return to the main menu press any key.

## Software Version

This displays the ClimateCraft® logo and the software version number.

From the "**Main Menu**" scroll down and highlight menu option "**14. About**". This will bring up a screen that displays the ClimateCraft logo graphic and a scrolling message that reads: "**ClimateCraft MatrixMonitor V2.03**". The last digits are the version of software loaded into your MatrixMonitor™.

Pressing the ↵ (enter) key returns to the main menu.

## Vibration Monitoring

The fan sensors used with MatrixMonitor™ have a tri-axial accelerometer on the printed circuit board that contains the pressure transducer. The accelerometer reads the acceleration of all three axis 3000 times a second with 10 bit accuracy. The fan sensor assemblies (FSBs) are mounted on the backplane of every fan where they can sense vibration in the fan assembly. The 32 bit RISC microcontroller on the board continuously reads the data from the accelerometer. The acceleration data from all three axes is converted into a single acceleration vector by summing as follows:

$$a_T = \sqrt{(a_x{}^2 + a_y{}^2 + a_z{}^2)}$$

After conversion to a single vector, a real time Fast Fourier Transform is performed on the data to convert it from the time domain to frequency domain. Converting the acceleration to a single vector simplifies the FFT conversion and allows the microcontroller to process the data in real time without any loss of acceleration amplitude. The microcontroller then converts the acceleration data to velocity data and sorts it in descending order where it can be transmitted to the MatrixMonitor™ control unit for analysis. The control unit can display the top 5 vibration levels for each fan on the network. It can compare those vibration levels against selectable limits and issue a vibration alarm when those limits are exceeded.

The vibration sensor is mounted on the backplane, not on the motor bearings. The directional data is lost because of the acceleration vectors are summed and the velocity amplitudes do not correlate directly to directional bearing velocity data. Despite these limitations, the data from this system can provide valuable information about the operating condition of the fan motors.

**CAUTION**

This system is intended to supplement, not replace motor bearing vibration analysis in a preventative maintenance system.

This information can be used to enhance a comprehensive bearing monitoring system using portable vibration equipment. It can identify the fans with the highest vibration levels which can then be singled out for more detailed bearing vibration trending. The alarm limits can be used to signal changes in normal vibration levels. These tools allow the maintenance staff to concentrate on those fans that need the most attention. This overcomes the extra work required because of the multitude of fans in fan array systems and makes comprehensive preventative maintenance practical. **When properly used, the vibration monitor can maximize the life of your fan motors and keep your FanMatrix™ operating for many years.**

## Lubrication Monitoring

MatrixMonitor™ is equipped with a lubrication monitoring system to control the motor bearing lubrication cycle and reduce the cost associated with this maintenance. The running speed of each fan array is continuously calculated. The fan speed is calculated from the airflow and pressure rise data measured for the array knowing the performance of the fans installed in the array. That calculated speed is checked by comparing it to the vibration measurements for the fans. Every 5 minutes a calculation is made by the grease life timer to determine the percent of grease life used. This calculation uses a proprietary formula based on the average fan motor speed in that period. A running total of the grease life left is kept by the grease life timer. The value is set to 100% when the timer is reset and every 5 minutes, the calculated percent grease life used is subtracted from the running total. When the value of grease life left is used is equal to 0% the control unit will issue a lubrication warning to tell the maintenance staff the fan motor bearings need to be greased. When the lubrication has been done the grease life timer must be reset through the Keypad Display Unit.

The system will predict the hours left until the next required motor bearing lubrication using the life used calculation. In order to predict the number of hours until the next lubrication the system uses the real time clock to calculate the elapsed number of hours since the last lubrication. Using this and the percentage of grease life used the number of hours until the next lubrication can be calculated. The hours left until the next required lubrication are calculated by the following:

$$Hours\ Left = \left(\frac{hours\ elapsed\ since\ reset}{100 - percent\ grease\ life\ left}\right) * (percent\ grease\ life\ left)$$

This calculation results in total elapsed hours until the next required lubrication. It is not a running hour calculation. The accuracy of this equation gets better the longer the system runs. A typical lubrication cycle can be several thousand hours of operation. The unit may run continuously or it may be shut off at night or on weekends. The running speed of the array will vary throughout the day as the building load and outside ambient conditions vary. All of these factors influence the grease life used. The longer the monitor tracks, the more accurate the prediction of the next grease requirement will be. The “hours left” calculation will bounce around quite a bit until about half of the grease life is used and will be fairly stable after that as long as the unit operation cycle is consistent. The equation above gives unusable predictions during the first ten days of operation after a reset. The “hours left” value is set to 2400 during this period. After 10 days the prediction is made with the equation above. The result from the equation will improve as more time has elapsed since the reset. The value should be monitored and the maintenance scheduled at either 20% of life left or 100 hours

left of the grease life for planning purposes. This prediction of the "hours left" until the next grease requirement is very useful to help schedule this necessary maintenance.

This data is available from the display screens or through the Modbus interface. See the "Lubrication Status" section under "Display Information" above for instructions on accessing this data through the Keypad Display Unit. Data is available for one or two fan arrays depending on the system configuration. MatrixMonitor™ tracks the lubrication requirements for the arrays separately. One array will typically run at a faster speed than the other and require lubrication more often. For example, the supply fan array usually runs much faster than the return fan array in a typical unit because it normally delivers greater pressure. The array with the faster speed will require lubrication far more often than the slower one. If you choose to lubricate both arrays at the same then the lubrication frequency is set by the faster array. When you do so both lubrication timers must be reset when the lubrication maintenance is performed.

**NOTICE**

The lubrication warning given by MatrixMonitor™ does not automatically reset. It must be manually reset through the Keypad Display Unit interface or through the BMS communication system. See the "Grease Life Timer" section under "Set Up Procedure" above for details on how to do this. You must reset the monitor even if it has not issued a lubrication warning to keep the timing accurate after lubrication.

The grease life timer should be reset immediately after the unit is lubricated so that MatrixMonitor™ can start calculating the next lubrication requirement. The only way the system knows that the bearings have been greased is by performing the reset action.

When the grease life timer calculates that the grease life is used up and lubrication is required for one of the arrays it is monitoring it issues a lubrication alarm. The lubrication alarm will do several things to alert the maintenance staff. The rightmost yellow "Read Error" LED on the Keypad Display Unit will light and the "Warning" relay (K3) will switch signaling the BMS of a potential problem. The main airflow display screen will signal the warning "Grease Bearings Soon" in the status line below the airflow display of the array that requires maintenance. The "Grease Life Data" screen available from the main menu will indicate that there is 0 grease life remaining and there are 0 hours left until the next grease requirement.

The BMS can detect the grease requirement by reading Modbus registers 40006 (Array1 hours left to bearing grease) and 40013 (Array2 hours left to bearing grease). They will be set to 0 hours when the grease timer issues a grease warning. The status of relay 3 can also be monitored through Modbus register 40024 which will be set to 01h when the grease warning switches the warning relay. See the "Interface to Building Management System" section below for more information on communication between MatrixMonitor™ and the BMS. The BMS cannot reset the grease life timer. That must be done at the control unit through the Keypad Display Unit.

| NOTICE |
| --- |
| The grease life timer does not start automatically when MatrixMonitor™ is set up and running. It must be activated by the user. This is a function that is not activated by ClimateCraft when it does the set up for units configured by the factory. The timer should be activated when the unit is first started in order to properly track the bearing life usage. |

Often the air handling unit is started and run prior to handing it over to the building owner. This is done during building construction to ventilate and dry out the building and to load and debug the mechanical systems. ClimateCraft® recommends that a bearing lubrication be performed at the time the building is handed over to the owner and the grease life timer started for each array on the system at that time. If not done at that time, the maintenance staff should perform the first bearing grease according to the schedule set up in the ClimateCraft IOM manual and set the grease life timer after it does that first bearing grease maintenance. In that way the grease life timer can be synchronized with the actual maintenance performed without extra work.

**The lubrication monitor built into MatrixMonitor™ is an effective tool to minimize the cost of FanMatrix™ maintenance and keep your ClimateCraft® air handlers operating trouble free for years.**

## Throat and Cone Tap Flow Range


The special MEMS differential pressure transducer used by MatrixMonitor™ has a range of 0 to 14 inch WC. It is extremely accurate over its entire operating range. Under certain high flow design conditions the piezometric pressure port depression measured at the throat tap of any of the FanMatrix™ fans may exceed the range of this sensor. When this is the case the low pressure port of the pressure transducer must be connected to the cone tap instead of the throat tap. The wiring diagram supplied with the unit submittal indicates which tap is to be used. There is a table at the bottom of the diagram that has unit specific information about the fan array the MatrixMonitor™ will be used with. A sample wiring diagram is provided in the appendix of this document for reference.

The maximum airflow in the table below is the flow at which the pressure depression at the throat or cone tap equals 13 inches WC. ClimateCraft® uses this table to select our recommended piezometric tap location. When the individual fan airflow will exceed the maximum airflow for the throat tap in the table, ClimateCraft will locate the tap in the cone. If the fan array is designed to give N-1 redundancy, the maximum design airflow will occur when one fan is off line.

| Fan Size | Maximum Design Airflow (cfm) | |
|---|---|---|
| | Throat Tap | Cone Tap |
| MTX12 | 4,500 | 8800 |
| MTX15 | 4,500 | 8,800 |
| MTX16 | 5,500 | 10,700 |
| MTX18 | 6,700 | 12,700 |
| MTX20 | 8,100 | 15,200 |
| MTX22 | 10,300 | 18,800 |
| MTX24 | 12,000 | 23,000 |
| MTX27 | 14,500 | 27,500 |

## Interface to Building Management System

MatrixMonitor™ can interface with the building management system (BMS) in two ways. There are hard wired analog signals and a digital communication interface using the Modbus protocol over a 2 wire, multipoint, EIA/TIA 485 communication port.

The physical connections are made on the motherboard with pull off terminal strips. The connections can be exposed by opening the clear cover of the NEMA 4 enclosure, removing the two fasteners opposite the hinged side and opening the swing out panel. The terminals are designed for solid or stranded wire from 14 to 26 AWG wire size. Strip the wire 3/16” back from the wire end to make the specified contact with the terminal block. The pull off strips makes wiring to the BMS I/O connections on the motherboard easy to accomplish.

**WARNING**

The wiring connections to the MatrixMonitor™ should only be made when the power is disconnected. Failure to disconnect power before servicing can cause severe personal injury or death.

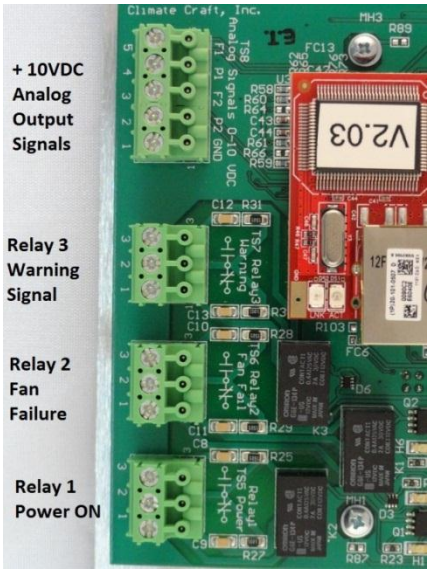
### Hard Wired Connections

The basic communication method for MatrixMonitor™ is through hard wired analog and relay output signals.

There are four analog output signals. The signals are 0 to 10 VDC and each can drive a 20mA load at 10 volts. The four output signals report array 1 airflow, array 1 pressure rise, array 2 airflow, and array 2

pressure rise. The physical connections to the analog output signals are on the motherboard through TS8. There are 5 positions on TS8, one for each signal and one for a common ground.

There are three SPDT output relays on MatrixMonitor™. These relays signal operation, alarms, and warnings. Three connections are available to the contacts on each relay. Each relay is connected to a separate three position terminal strip. Terminal 1 is for the NO (normally open) contact, terminal 2 is for common, and terminal 1 is for the NC (normally closed) contact.




Relay 1 is connected to TS5. It switches when MatrixMonitor™ powers up. It is used to signal the BMS that the control is turned on and available. As long as the control has power and is operating this relay will be switched on.

Relay 2 is connected to TS6. It switches when MatrixMonitor™ detects a fan failure. The red LED on the key pad display unit will light when this relay is switched on.

Relay 3 is connected to TS7. It switches when MatrixMonitor™ determines an alarm condition. Alarm conditions would include a fan in surge, an inoperative fan sensor, excessive vibration, lubrication alert, or several other conditions. The yellow LEDs on the key pad display will light when this relay is switched on.

The sample wiring diagram in the appendix of this document shows the physical connections available between the MatrixMonitor™ and the building management system.

## Modbus® Communications

The Modbus® protocol was introduces by Modicon, Inc. for use in control environments featuring Modicon programmable controllers. Due to its ease of use and implementation, this common PLC language was adopted as a standard for integration of a wide variety of Master controllers and slave devices. Because so many industrial and commercial control devices support this protocol most Building Management Systems have provisions to communicate with Modbus® devices.

Modbus is a serial, asynchronous protocol. Transmissions are half-duplex, with a single master controlling one or more slaves. MatrixMonitor™ is configured as a slave to communicate with a BS system acting as the master on the Modbus® network. **The physical connection layer used by MatrixMonitor® is EIA/TIA 485 commonly referred to as RS485.**

| CAUTION |
| --- |
| The Modbus® specification allows for two different and distinct transmission message modes, ASCII and RTU. **MatrixMonitor only supports RTU.** |

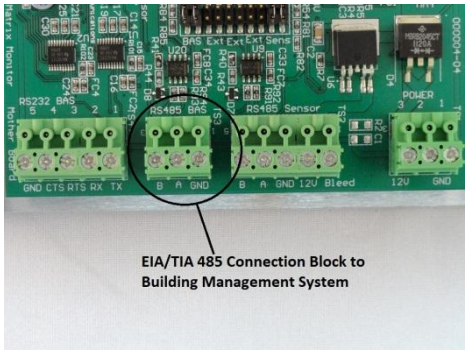
For more information about the Modbus® protocol visit http:/www.modbus.org/.

### *Electrical Connections*

**WARNING**

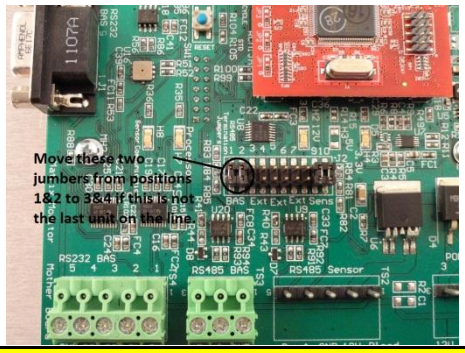
The wiring connections to the MatrixMonitor™ should only be made when the power is disconnected. Failure to disconnect power before servicing can cause severe personal injury or death.

Terminals 1, 2, and 3 are available on TS3 and are available for connection to the EIA/TIA 485 2 wire multipoint connection to the BMS. The terminal strip is labeled "RS485 BAS" and its terminals are labeled "GND", "A", and "B" on the silk screen of the PC board. TS3 can be pulled off of the board to ease wiring in awkward positions.




The cable and connections to MatrixMonitor must conform to the EIA/TIA 485 standards for 2 wire multipoint connections. ClimateCraft recommends Belden 9842 dual, shielded, twisted wire cable for the connection. One pair should be used to connect the digital communication lines (A and B) while both wires of the other pair are used to connect the ground connection back to the Reference or Signal Ground terminal on the Building Management System (BMS) controller. Line A is sometimes referred to as the negative (-) and line B is likewise referred to as the positive (+) line.

The connections will run from device to device. "A" must be connected to "A" and "B" must be connected to "B". Similarly the reference ground must run from device to device. The terminal strips can accommodate two wires in each for this purpose. Strip the conductors ¼" back from the wire end and twist them together before inserting into the terminal connection. The bleed line in the cable should be connected to the earth ground connection in the BMS controller and run unbroken through the cable to the last device on the communication line. The bleed line should remain unconnected at the last device and it should not be connected to the earth ground in the MatrixMonitor™ controller. Connect all of the controls on the communication line in a daisy chained bus without dropout lines.




**CAUTION**

If the MatrixMonitor™ is not the last device on the line, the two jumpers that tie in the line termination resisters must be removed. The jumpers are in positions 1 and 2 of J10, the 2 x 10 header directly behind TS3. These jumpers should be moved to positions 3 and 4.

### *Communications with the Building Management System*

In order to communicate with the BMS, Modbus® must be enabled and the communication line transmission parameters must be set up. These are all set up key pad display user interface. The set up procedures are accessed for the "Control Setup" submenus. See the section titled "Set the Control Data" found earlier in this manual for instructions.

The Modbus address must be established and entered. The address can be any number between 1 and 247. The default address set up in the control is 75.

The transmission parameters must be established and enter. The transmission baud rate must be selected. MatrixMonitor™ supports baud rates of 9600, 19200, 38400, and 57600. 19200 is the default rate. Odd, even, and no parity checking can be enabled. Even parity is the default setting. One start bit and eight data bits are used as required by the Modbus® standard. One stop bit is used unless no parity checking is specified. In that case two stop bits are used to conform to the standard.

MatrixMonitor™ only responds to a subset of Modbus® commands. The only commands enabled are 3(03h), read holding registers, and 6(06h) write holding register. The read holding registers function does not support reading multiple registers. If the read holding resisters command (03h) is issued with a request for more than 1 register to read, an exception error will be returned. MatrixMonitor will ignore broadcast commands with address 0.

MatrixMonitor™ supports the zero-based addressing of the Modbus® specification and conforms to the 4xxxx mapping convention for the holding registers. Holding register addresses start with 40001 and are below 49999. Holding register 40001 is addressed as 0000 in a Modbus® message. All holding registers can be read with the Modbus® read holding registers command (03h) from the master. Only selected registers can be written to by the master using the write holding register command (06h). **A complete list of holding registers available to the BMS is in the appendix of this document.** In general all of the data available on the data display screens is available through a Modbus® read registers (03h) command. Almost all of the data that can be entered through the set up screens on the keypad display unit and be written with the write register command (06h). The exception to this is the communication set up data. These parameters must be entered before communication can begin and are not available for change with Modbus® commands.

The Modbus message is formatted in the following sequence:

1. Slave Address – 1 byte ; 1 to 247
2. Function Code – 1 byte ; 03h or 06h
3. Data – Variable depending on function and data
4. CRC Error Check – 2 Bytes

This format is the same for commands from the master and responses from the salves. The Modbus protocol uses a Cyclic Redundancy Check to verify data validity on all transmissions. The sender calculates the two bytes of the CRC using the specified procedure on the data in the first three items of the Modbus® message. The two bytes from the CRC calculation are appended to the message which is then transmitted to the receiver. The receiver performs the same calculations on the message it received and compares the result to the last two bytes of the message. If the bytes match the transmission string is valid and the receiver will respond appropriately to the message. If not the transmission failed and the receiver will take appropriate action. Since messages go both ways between master and slave, either can be a transmitter or receiver. The data in Modbus holding registers is 16 bits long and it is transmitted in two 8 bit bytes. The upper byte is always transmitted first and the lower byte second in a Modbus® message.

### Reading Data from MatrixMonitor™

Modbus® function code 03h is supported by MatrixMonitor™ to read the data in the holding registers. This function is normally used to read multiple registers in sequential order. Matrix monitor does not support multiple register reads for this function code and will only return data for one register. If more than one register is requested, MatrixMonitor® will respond with an exception. For this example the BMS master wants to read the average speed of fan array 2 from a MatrixMonitor™ with the Modbus address of 35. The speed data for array 2 is in register 40012 and has a value of 2025 rpm.

This is the message from Master BMS to Slave MatrixMonitor™:

| Message Item | Decimal Value | Byte Order | Modbus Message | |
|---|---|---|---|---|
| | | | Byte No. | Data |
| Slave Address | 35 | | 1 | 23h |
| Function Code | 3 | | 2 | 03h |
| Register Address | 11 | High | 3 | 00h |
| | | Low | 4 | 0Bh |
| Registers to read Must be = 1 | 1 | High | 5 | 00h |
| | | Low | 6 | 01h |
| CRC | NA | High | 7 | F3h |
| | | Low | 8 | 4Ah |

Eight bytes of data are sent to the MatrixMonitor™ to make this read register request. The MatrixMonitor™ will respond to the read register request with the following message:

| Message Item | Decimal Value | Byte Order | Modbus Message | |
|---|---|---|---|---|
| | | | Byte No. | Data |
| Slave Address | 35 | | 1 | 23h |
| Function Code | 3 | | 2 | 03h |
| Data Quantity | 2 | | 3 | 02h |
| RPM Data from register 40012 | 2025 | High | 4 | 07h |
| | | Low | 5 | E9h |
| CRC | NA | High | 6 | 83h |
| | | Low | 7 | FDh |

The MatrixMonitor™ will respond to a read registers request with the above message string that has 7 bytes of data.

### Writing Data to Matrix Monitor™

Modbus® function code 06h is supported by MatrixMonitor™ to write data in the holding registers. Not all registers in MatrixMonitor™ can be written to. If the BMS master tries to write a register that can only be read from, MatrixMonitor™ will respond with an exception message. The Modbus® register list indicates which registers are "Read Only" and which and be written to ("R/W"). For this example assume that you want to change the name of array 1. Assume that it is currently the default value which is "Array 1" and you want to change it to "Supply". The name of Array 1 is stored in register 40007 which would make its address 6. From the register list you can see that the code for "Supply" is 01h.

This is the message from Master BMS to Slave MatrixMonitor™:

| Message Item | Decimal Value | Byte Order | Modbus Message | |
|---|---|---|---|---|
| | | | Byte No. | Data |
| Slave Address | 35 | | 1 | 23h |
| Function Code | 6 | | 2 | 06h |
| Register Address | 6 | High | 3 | 00h |
| | | Low | 4 | 06h |
| Data to write | 1 | High | 5 | 00h |
| | | Low | 6 | 01h |
| CRC | NA | High | 7 | 83h |
| | | Low | 8 | FDh |

Eight bytes of data are sent to the MatrixMonitor™ to make this read register request. The MatrixMonitor™ will respond to the read register request with the following message:

| Message Item | Decimal Value | Byte Order | Modbus Message | |
|---|---|---|---|---|
| | | | Byte No. | Data |
| Slave Address | 35 | | 1 | 23h |
| Function Code | 6 | | 2 | 06h |
| Register Address | 6 | High | 3 | 00h |
| | | Low | 4 | 06h |
| Register Value | 1 | High | 5 | 00h |
| | | Low | 6 | 01h |
| CRC | NA | High | 7 | 83h |
| | | Low | 8 | FDh |

The MatrixMonitor™ will respond to a write single register request with the above message string that has 8 bytes of data and is an echo of the original request. If the write was not successful an exception message is returned.

## Trouble Shooting Guide

| Problem | Possible Cause | Corrective Action |
|---|---|---|
| When power is available to the control unit the keypad display will always be active, there are red, yellow and green LEDs on the mother board that are lit. Power to the FSB units is supplied from the motherboard and there is a red LED on each unit that will be active when power is present.<br><br>If all of these indications are absent there is a problem with the power to the mother board. | Loss of power supplied to MatrixMonitor™ DC power supply. | Check AC input power to Power supply with voltmeter. Restore power to power supply if necessary. |
| | Bad Power Supply. | Check for 12VDC output from power supply at the V+ and V- terminals on the power supply. Replace the power supply if there is AC power supplied and the output voltage is not +12VDC. |
| | Bad Connections between the power supply and TS1. | Check connections between power supply and mother board. |
| Flashing red LED on an FSB Unit.<br><br>The FSB units have a red LED that is visible from the front of the unit when it is installed on its electrical box. When there is power to the mother board the LED should be on and not flashing. The LED flashes on and off when it cannot communicate with the control unit. | Bad connection | Remove the FSB from the electrical box it is mounted on. Pull the connector and remove the dust cover to check the wire connections. |
| | Wrong Switch setting | Remove the FSB from the electrical box and check the setting of the rotary switches. |
| | Incorrect Set up information | Check the setting for the number of fans in the fan array. The number of fans installed should agree with the setting. |
| The red LED on the front of the FSB will not light up and there is power on the network because the LEDs work on other FSBs. | BAD Connection | Remove the FSB from the electrical box it is mounted on. Pull the connector and remove the dust cover to check the wire connections. |
| | Bad FSB | Replace the FSB |
| There is a flashing green light on the mother board. | The green light labeled processor flashes on and off to indicate the microcontroller is working. | This is normal and it is not a problem. |

| Problem | Possible Cause | Corrective Action |
|---|---|---|
| The red LED on the Keypad Display Unit is lit. MatrixMonitor checks for fan failures by checking the fan pressure sensors. If a fan has a very low pressure in comparison to other fans in an array it will signal a fan failure and the red LED will light.<br><br>If a fan is in surge and the airflow in the array is low enough there can be a false indication of fan failure. If this is the case the yellow LED that indicates fan surge will often be lit as well. | Fan Failure: Identify the fan or fans that the MatrixMonitor™ indicates has failed by checking the Fan Status display screens under main menu options 2 or 3. The status line will read “Fan Has No Flow” or “xxxx CFM Backflow” | Check the indicated fan motors for failure. Repair or replace the motors as required. |
| | Fan Surge: Identify the fan or fans that the MatrixMonitor™ indicates has failed by checking the Fan Status display screens under main menu options 2 or 3. Watch the status screen for the failed fan for several minutes. If the status message changes from “Fan Has No Flow” to “xxxxx CFM Fan Surge” the fan has not failed but it is experiencing surge. | Fan surge happens when the airflow delivery is low and the pressure requirement remains high. Check the cabinet for physical signs of fan surge such as excessive vibration, noise and duct rumble.<br><br>Lowering the supply duct static pressure set point will help. Shutting one or more fans off and installing blank off plates will usually solve the problem.<br><br>Contact ClimateCraft® for help in resolving persistent surge issues. |
| There are one or more green LEDs lit on the keypad display unit. | The four green LEDs light up in response to array airflow. The higher the flow, the more LEDs are lit. | This is normal and it is not a problem. |
| The yellow LED, second from the right, on the keypad display unit is lit. This is the surge warning LED. | Fan Surge: Identify the fan or fans that the MatrixMonitor™ indicates has failed by checking the Fan Status display screens under main menu options 2 or 3. Watch the status screen for the failed fan for several minutes. If the status message changes from “Fan Has No Flow” to “xxxxx CFM Fan Surge” the fan has not failed but it is experiencing surge. | Fan surge happens when the airflow delivery is low and the pressure requirement remains high. Check the cabinet for physical signs of fan surge such as excessive vibration, noise and duct rumble.<br><br>Lowering the supply duct static pressure set point will help.<br><br>Shutting one or more fans off and installing blank off plates will usually solve the problem.<br><br>Contact ClimateCraft® for help in resolving persistent surge issues. |

| Problem | Possible Cause | Corrective Action |
|---|---|---|
| The yellow Read Error LED (furthest to the right) on the keypad display is lit and the information line on the Display Airflow screen says “Grease Bearings Soon” | The grease timer for the array has timed out and it is time to grease the motor bearings for that array | Perform the grease maintenance in accordance with your safety standards and reset the grease timer for the array. |
| The yellow Read Error LED (furthest to the right) on the keypad display is lit and the information line on the Display Airflow screen says “Bad Pressure Sensor” | MatrixMonitor™ has determined that the pressure rise sensor on the array is not functioning properly. | Replace the FSB used for the array pressure rise sensor. |

The yellow read error LED on the keypad display is the rightmost LED on the display. It is used to signal a number of warning messages. The two warnings listed above are displayed on the “Display Airflow Screen”. Many of the warnings that cause this signal to light are specific to a single fan. Those warnings that are specific to a signal fan can be found by scrolling through the fans in the fan status display screens available through menu options “2. Array 1 Fans” and “2. Array 2 Fans”. The second line of these screens is the status line and normally provides the individual fan airflow and piezometric pressure depression readings. If a condition on an individual fan triggered a “Read Error” warning, go to those menu options and scroll through all of the fans to determine the source of the warning. The following table assumes that the yellow “Read Error” LED has been triggered and lists the probable causes and corrective action by the warning message found on the status line for a fan. The status line warning message only applies to the fan selected. There may be more than one fan that would trigger the warning so make sure you scroll through all fans.

| Warning Message | Possible Cause | Corrective Action |
|---|---|---|
| xxxx CFM Max Flow | The fan airflow caused a piezometric pressure reading higher than 14” WC. | Check the pressure reading with a digital manometer to verify the high pressure reading. If it is high, move the FSB pressure connection to the cone tap. |
| | Bad Pressure transducer on the FSB. | Replace the FSB. |
| Bad Air Flow Sensor | The control unit cannot communicate with the FSB or the pressure returned by the FSB is inappropriate. | Check the IDC connector connections. Check the tubing connection from the FSB to the piezometric tap. Repair if possible.<br>or<br>Replace the FSB. |

| Warning Message | Possible Cause | Corrective Action |
|---|---|---|
| Bad Airflow Reading | The pressure returned by the FSB to the control unit is inappropriate. | Check the tubing connection from the FSB to the piezometric tap.<br>Repair if possible.<br>or<br>Replace the FSB. |
| High Vibration | The vibration readings from the FSB exceed the limits set up by the user. | Determine and correct the reason for the high vibration. |
| Off-Bad Sensor | The fan status is set to off and the control unit cannot communicate with the FSB. | Check the IDC connector connections. Check the tubing connection from the FSB to the piezometric tap.<br>Repair if possible.<br>or<br>Replace the FSB. |
| Off Bad Reading | The fan status is set to off but the pressure reading returned to the control unit by the FSB is too high. | Check the tubing connection from the FSB to the piezometric tap.<br>Repair if possible.<br>or<br>Replace the FSB. |

# Repair and Replacement

## Remove the Swing out Graphic Panel

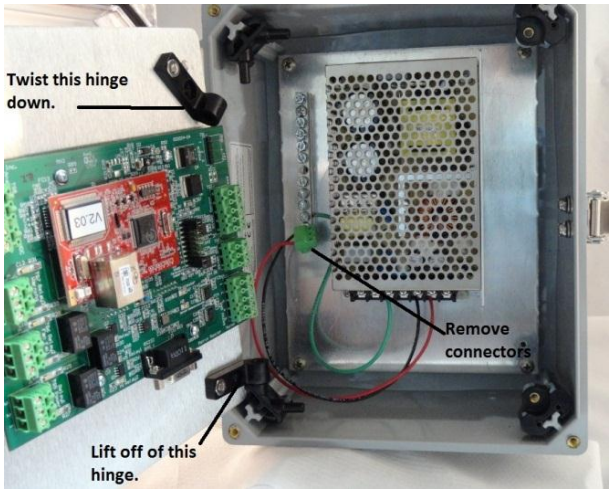
The mother board which houses the embedded RCM3000 processor board and the keypad display panel are mounted on the swing out graphic panel. These parts can be accessed by loosening the two captive screws on the right side of the panel (opposite the hinges) and swinging the panel open. Because of the tiny nature of the fasteners used to hold those parts together it is very difficult to remove and reinstall the fasteners when the swing out panel is inside of the NEMA 4 control enclosure and mounted on the side of an air handling unit. It is best to remove the swing out graphic panel from the control enclosure and work on the attached parts on a table or bench.


**WARNING**

The wiring connections to the MatrixMonitor™ should only be made when the power is disconnected. Failure to disconnect power before servicing can cause severe personal injury or death.

<u>To remove the swing out graphic panel:</u>

1. Disconnect the AC power that supplies the MatrixMonitor™ .
2. Open the clear cover of the ABS NEMA 4 control enclosure.
3. **Loosen the two captive screws on the right side of the panel (opposite the hinges) being careful not the pull off the rubber O-rings that keep them captive to the panel. Leave the captive screws on the panel.**
4. Swing the panel out to expose the mother board and pull off any of the terminal strips on the mother board that have wiring connections on them. It is not necessary to remove the individual wires because all of the connections to the mother board are made on two part pull out terminal strips. Carefully note the location of each strip so they can be correctly reinstalled.
5. There are two hinges on the left side of the graphic panel that are fastened to the panel with two machine screws at each hinge. Remove one



screw from each hinge. The screw to be removed is the inside screw closest to the hinge. There is a lock washer between the machine screw head and the panel. There is a machine nut held in place by a hexagonal cavity on the back of the plastic hinge body. Carefully tap on the hinges to remove these nuts as they will easily fall out once the screw is removed. Store the machine screws, lock washers and nuts for later reinstallation of the panel.

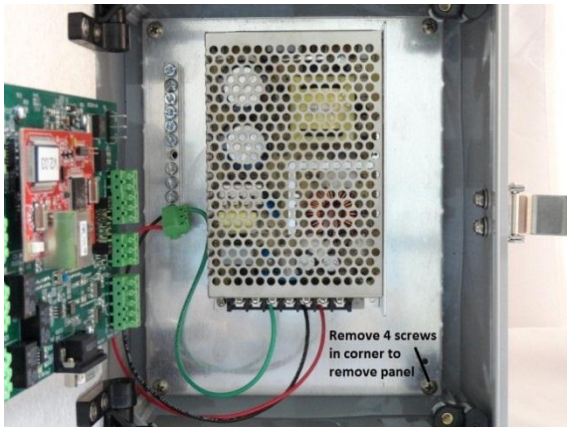
6. Loosen the remaining screws on the hinges by 1 turn but do not remove them.
7. With the swing out panel opened twist the top hinge part up far enough so that it will clear the pin of the stationary hinge part attached to the NEMA 4 box.
8. Once the top hinge is clear it will be easy to lift the panel up and off the bottom stationary hinge part.

<u>To reinstall the swing out graphic panel:</u>

1. With only the outside screw per hinge loosely holding the moving hinge part to the panel, mount the bottom hinge onto its pin.
2. Work the top hinge onto its pin by twisting it down onto the pin.
3. When both hinges are reattached install the other screws, lock washers and nuts into their place on the hinges. Leave the hinge screws slightly loose so that the panel can be aligned into the housing.
4. With the hinge screws loose, fasten the captive screws on the right side of the panel. After they are fastened tight you can tighten all four of the hinge screws. The panel will then be aligned properly to the housing.
5. Loosen the captive screws to open the swing out panel and reinstall the terminal strips on the mother board taking care to put them back in their original positions.
6. Close the swing panel and tighten the captive screws.
7. Close the cover and restore power to the MatrixMonitor™.

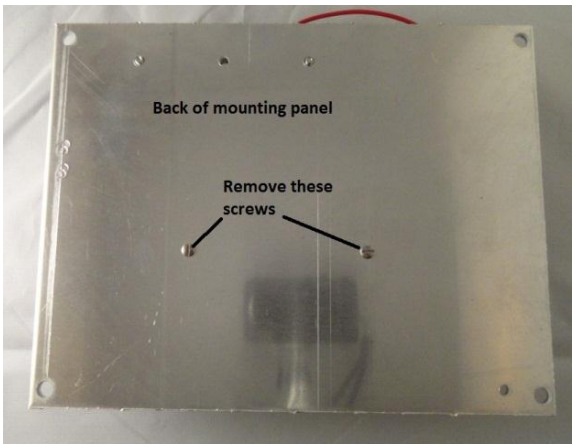
## Power Supply

In order to replace the power supply the backplane with the power supply on it will have to be removed in order to access the screws holding the power supply to the backplane.




1. Disconnect power to the control unit.
2. Open the clear cover on the NEMA 4 enclosure.
3. Disconnect the power wiring from the 115V power source including the ground connection carefully noting the position of the conductors so that they can be reconnected later.
4. Disconnect the 12VDC wiring that runs from the power supply to the motherboard carefully noting the position of the conductors.

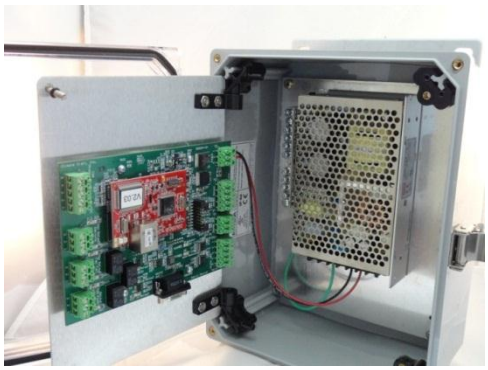
5. Remove all of the connections to the grounding strip.
6. Remove the 4 screws holding the backplane to the ABS NEMA 4 enclosure and carefully pull out the backplane with the power supply on it.
7. Remove the screws on the back of the panel holding the power supply to the backplane.
8. Dispose of the old power supply observing all local and state laws and regulations concerning the disposal of electronic equipment.
9. Install the new power supply on the backplane using the same hardware.




10. Reinstall the backplane in the control enclosure and reconnect the wiring by reversing the order of instructions 1 to 7 above.

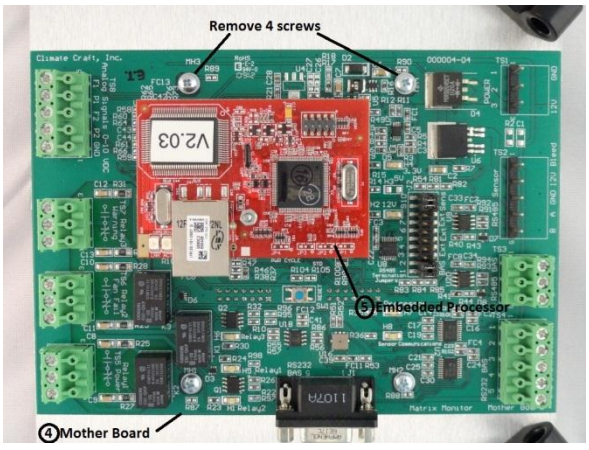
## Mother Board

The mother board is installed on the swing out graphic panel. The mother board can be removed and reinstalled in place but it is extremely difficult to replace the four tiny #4 machine screws that hold the mother board to the swing out graphic panel while it is in place on an air handling unit. ClimateCraft® recommends you first remove the graphic panel from the NEMA 4 enclosure per the instructions listed above. Reinstall the panel using the same instructions.



To remove the mother board from the swing out graphic panel:

1. Place the graphic panel on your work surface with the keypad display down and the mother board facing up.
2. Locate the four #4 screws that hold the board down to the standoffs on the graphic panel. They are identified on the motherboard silk screen as MH1, MH2, MH3, and MH4.
3. There are captive spacers under the board and between the board and the standoffs. Care must be taken not to lose these spacers. Loosen one of the screws by three turns and then move to the next and loosen it by three turns. Do this for the rest of the screws and repeat this rotation until the screws are free from the standoffs. This procedure will keep the captive spacer on the screws. Leave the screws in place and remove the mother board by pulling it off of the pin connector headers that connect the mother board to the keypad display unit still attached to the graphic panel.



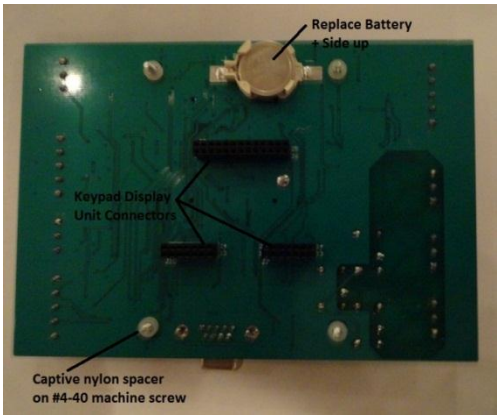
4. If you are replacing the mother board you will have to remove the embedded processor and install it on the new mother board before you install it. See the section below that details that replacement. The replacement mother board will have a full complement of removable terminal strips shipped with it. When you removed the graphic panel with the boards on it from the control unit you pulled off the removable terminal strips that were wired into the system and they are not on the motherboard you are about to replace. It would be a good time to remove and discard those same terminal strips on the new motherboard so there is no confusion when you reconnect the system. The new board should come with a new set of fasteners. If it has not you will have to transfer the fasteners from the old mother board to the new one. Each mounting hole should contain a #4-40 mounting screw, a lock washer, and a nylon captive screw washer.

To reinstall the mother board:

1. Place the mother board on the graphic panel by carefully aligning the three pin connector headers on the keypad display unit with the corresponding receptacle connectors on the back of the mother board. Make sure you line up all of the pins before you firmly press the connectors together.
2. Line up and screw in the four captive #4-40 machine screws into the standoffs on the graphic panel.

## Clock Battery

The clock battery is located on the back of the motherboard. **The battery is a model CR2025; 3V coin type battery commonly used in watches and automotive remote entry controls.** It is sandwiched between the mother board and the swing out graphic panel. In order to replace the clock battery the mother board will have to be removed from the panel. Remove the swing out graphic panel from the NEMA 4 control enclosure by following the instructions for that procedure above. Remove the mother board from the graphic panel by following the instructions for mother board replacement.




When the mother board has been removed from the graphic panel the battery and can be removed by prying out of the battery holder with your fingers. Insert the new battery into the holder carefully observing the polarity. The positive side of the battery should face out away from the board.

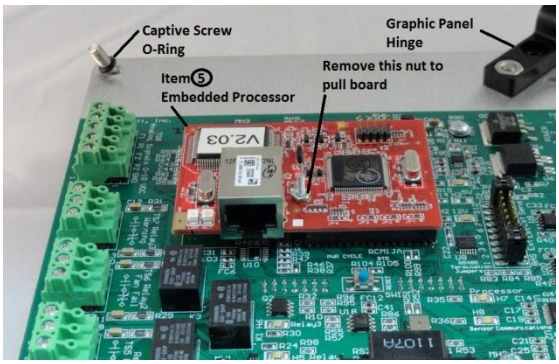
When the battery has been replaced you can reinstall the parts removed by following the procedure given for the motherboard and swing out graphic panel.

## Embedded Processor Board

The embedded processor board is installed on the mother board and held in place with a tiny #2-56 nut and lock washer. It is accessible from the back of the swing out graphic panel when it is opened up and possible to remove with the mother board in place. It is extremely difficult to deal with the tiny fasteners and it is difficult to line up the pin connectors on the processor board into the matching receptacles. ClimateCraft recommends removing the swing out graphic panel first per the instructions listed above before attempting to replace the embedded processor board.

To remove the processor board:

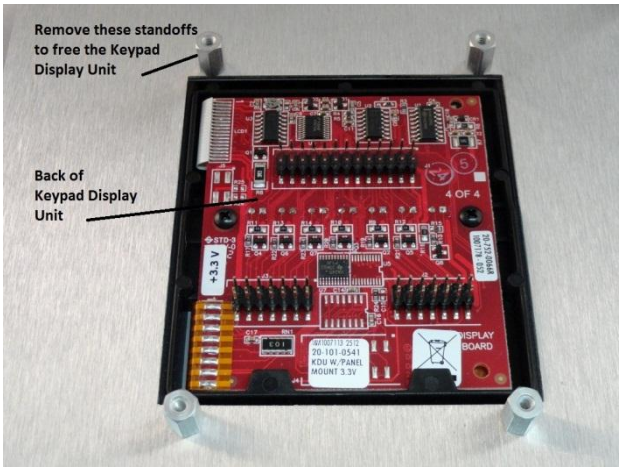
1. Lay the swing out graphic panel down on your work surface with the keypad display unit down and the motherboard facing up.
2. The embedded processor board is connected to the mother board through two dual row pin headers and matching receptacles on the mother board. It is secured with a #2-56 machine screw captured on the motherboard with a threaded spacer that forms a stud projecting from the mother board. The processor board has a hole that slips over that stud and is held in place by a nut and star washer.




3. Remove the #2-56 nut and star washer. Store them for later use.
4. Carefully pull the processor board away from the receptacles on the mother board to remove it. Take care not to remove or lose the small nylon spacer on the threaded post between the standoff and the board.

To replace the processor board:

1. Make sure the nylon washer is on the threaded mounting post on top of the threaded spacer.
2. Slip the processor board over the mounting post. Carefully line the two dual row pin connectors on the processor board with the mating receptacles on the board. Check the alignment from two directions before pushing the board into the pin header receptacles. If the pins are not lined up properly they could easily bend and break under the force it takes for proper insertion.
3. Replace the star washer on the threaded post and install and tighten the machine nut.




## Keypad Display Unit

The mother board will have to be removed first in order to gain access to the keypad display unit. For the reasons given above ClimateCraft® recommends

removal of the swing out graphic panel before you attempt to remove the motherboard and replace the keypad display unit. Remove the mother board using the procedure outlined above.

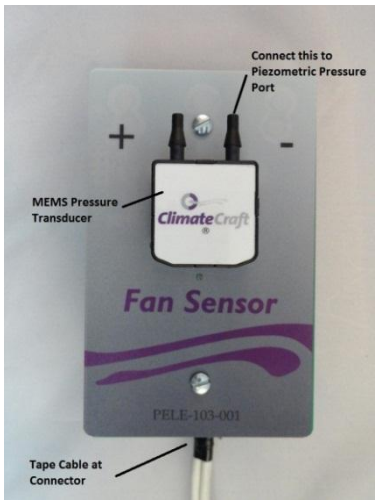
To remove the keypad display unit after the mother board has been removed:

1. Lay the graphic panel on the bench with the keypad display unit facing down.
2. Remove the 4 threaded standoffs that hold the keypad display unit to the graphic panel. Take care not to lose the standoffs.
3. Turn the graphic panel over and remove the keypad display unit.

To reinstall the new unit simply reverse the process described above.

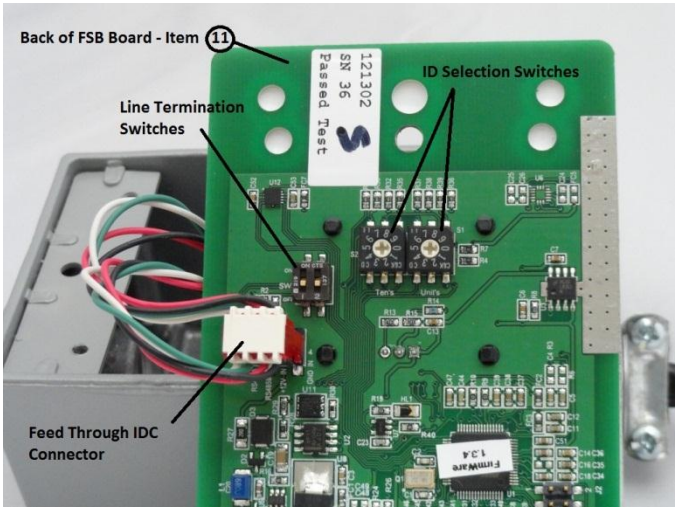
## Fan Sensor

The fan sensor is mounted on the back plate of the fans. A plastic hose is connected to the low pressure port of the pressure transducer mounted on the front of the FSB. The other end of that hose is connected to a bulkhead connector on the fan back plate which in turn runs to the piezometric pressure tap on the fan inlet cone. The high pressure port of the pressure transducer is open to sense the static pressure at the inlet of the fan. A die cast electrical box is mounted to the back plate and the Fan Sensor Board (FSB) mounts directly on the box and acts as the box cover.




To replace an FSB used as a fan sensor :

1. Remove the hose connected to the low pressure port (-) of the FSB.
2. Remove the two screws on the front of the FSB that secure the board to the electrical box. Save the screws for reinstallation later.
3. Pull the FSB off of the box and remove the 4 pin cable connector attached to the back of the FSB. Note the fan number, the positions of the rotary switches and the position of the line termination switches.
4. Dispose of the FSB in accordance with state and local laws and regulations dealing with electronic equipment.
5. Plug the 4 pin connector into the polarized 4 pin header on the back of the replacement FSB. Take care to position it correctly and securely. The connector is polarized and tabbed to assure proper



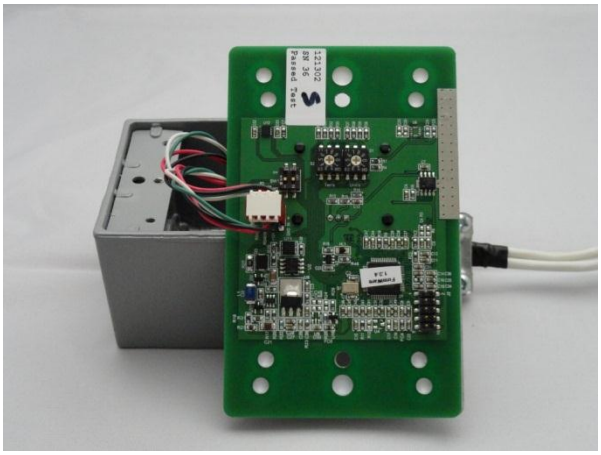
installation on the board.

6. Set the rotary switches and the line termination switches to the same positions as the old FSB unit.
7. Reposition the FSB back on the box and fasten with the screws previously removed.
8. Reconnect the plastic hose to the low pressure port (-) of the pressure transducer on the FSB.

## Array Pressure Rise Sensor

The array pressure rise sensor is mounted on the air seal wall in the fan inlet section of the air handler. A plastic hose is connected to the high pressure port of the pressure transducer mounted on the front of the FSB. The other end of that hose is connected to a bulkhead connector on the fan air seal wall which in turn runs to a static pressure tap that senses the discharge (high pressure) side of the fan array. The low pressure side of the pressure transducer is open to sense the static pressure on the inlet side of the fan array. A die cast electrical box is mounted to the fan air seal wall and the Fan Sensor Board (FSB) mounts directly on the box and acts as the box cover.

To replace an FSB used as an array pressure rise sensor:



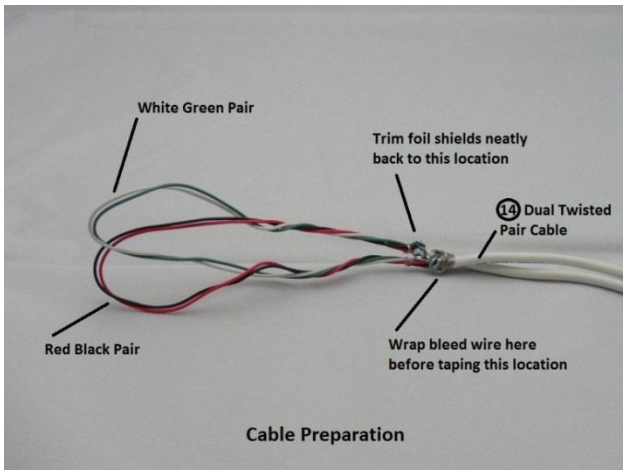
1. Remove the plastic hose connected to the high pressure port (+) of the FSB.
2. Remove the two screws on the front of the FSB that secure the board to the electrical box. Save the screws for reinstallation later.
3. Pull the FSB off of the box and remove the 4 pin cable connector attached to the back of the FSB.
4. Dispose of the FSB in accordance with state and local laws and regulations dealing with electronic equipment.
5. Plug the 4 pin connector into the polarized 4 pin header on the back of the replacement FSB. Take care to position it correctly and securely. The connector is polarized and tabbed to assure proper installation on the board.
6. Reposition the FSB back on the box and fasten with the screws previously removed.
7. Reconnect the plastic hose to the low pressure port (+) of the pressure transducer on the FSB.

## Replace or Install a Wiring Connector for an FSB

The FSBs are connected to the control unit with a 22 gauge dual twisted pair shielded plenum rated cable. The actual connection to the FSB from the cable is made with a feed trough style insulation displacement style 4 pin receptacles (ClimateCraft® P/N PELE-115-001). The insulation displacement technology allows the cable to run unbroken from the control unit to the last FSB on the network. This reduces communication problems caused by loose or poor connections. This is an important consideration when up to

100 FSB devices can be attached to the network. Finding the bad connection would be a nightmare. Because of the feed through technology a bad connection will only affect one FSB making that kind of problem easy to find and diagnose.

1. Locate the connection box and run the cable in and out of the box leaving 12 inches of cable looped inside of the box.
2. Remove the cable loop from the box marking the position of the box wire clamp connector location on the cable.
3. Strip away 17 inches of the cable jacket taking care not to nick the insulation of the individual connectors inside of the cable. With the jacket removed you will find two foil wrapped wire sets and a tinned copper bleed line.

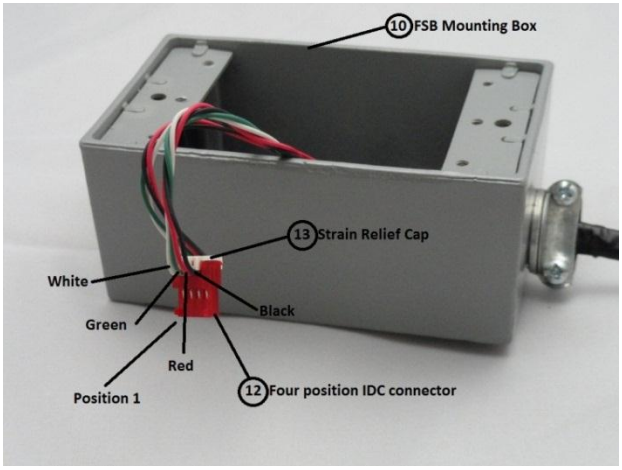


Cable Preparation

4. Trim away the foil shields on both wire pair exposing the insulated wires. There will be a white green pair and a red black pair.
5. Do not cut the bleed line or any of the wires. Loop the wire together with the cut away cable jacked ends positioned adjacent to each other. Wrap the uncut bleed line around the cable jacket ends and tape the assembly to secure the cable together and contain the bleed line.
6. Insert the insulated wire loop through the box wire clamp connector and tighten the clamp around the taped section. The four color coded insulated wires will be looped inside of the electrical box.
7. Punch the wires into the IDC connector positioned at the middle of the loop to allow for maximum flexibility of the connector inside of the box. Use a punch down tool specifically designed for the connector used. ClimateCraft® recommends a model D814 by Fluke using the number 66 punch down tip. The conductors must be punched into the connector in the following locations:

   Pin 1 : RS485A (-) : White Insulated Conductor
   Pin 2 : RS485B (+) : Green Insulated Conductor
   Pin 3 : + 12VDC : Red Insulated Conductor
   Pin 4 : Ground : Black Insulated Conductor

   The pin numbers are molded into the connector and can be seen on the tab side. When viewed from the locating tab side of the connector with the wire end up, pin 1 is furthest to the left.




8. Install the strain relief dust cover (ClimateCraft® P/N PELE-115-002) over the wires on the top of the IDC connector.

## Replacement parts list

| Item | Part Number | Description of Part | Location of Part |
|---|---|---|---|
| 1 | PELE-103-003 | NEMA 4 ABS control enclosure | Control unit |
| 2 | PELE-114-001 | 12VDC power supply | Control unit |
| 3 | PELE-080-001 | Grounding Strip | Control Unit |
| 4 | PELE-111-001 | Motherboard | Control Unit |
| 5 | PELE-113-001 | Rabbit RCM3000 embedded Processor | Control Unit |
| 6 | PELE-113-002 | Rabbit Keypad Display Unit | Control Unit |
| 7 | M100-310-001 | Backplane mounting panel | Control Unit |
| 8 | PLBL-029-001 | Swing out graphic panel | Control Unit |
| 9 | PELE-103-002 | Swing out panel hinge kit (includes hardware) | Control unit |
| 10 | PELE-014-001 | FSB mounting box | FSB units |
| 11 | M100-318-001 | Fan Sensor Board (FSB) | FSB units |
| 12 | PELE-115-001 | 4 position IDC connector | FSB units |
| 13 | PELE-115-002 | Strain Relief Cap for 4 position IDC connector | FSB units |
| 14 | PELE-112-001 | 22 gauge dual twisted pair plenum rated cable | Connecting Cable |
| 15 | PPLS-003-001 | UV resistant tubing for connections to pressure ports | FSB unit |

# System Specifications

**Environmental**

- Temperature: - 20°F to 145°F non condensing
- Barometric Pressure: 300 to 1100 mBar
- NEMA 4/4X high impact polycarbonate enclosure with hinged clear cover and SS latch

**Electrical**

- 100 watt power supply
- Input voltage: 88VAC to 264VAC
- Input frequency: 47 Hz to 63 Hz

**System Accuracy**

- Airflow: ±5% of reading from design flow to 15% design flow at 0° to 100° F
- Array Pressure Rise: ±1% of reading from 1" WC to 14" WC
- Array temperature: ±3° F
- Barometric Pressure: ±4 mBar
- Fan Speed: ±50 rpm

**Capacity**

- Number of Arrays: 2
- Maximum Fans per Array: 49
- Maximum Airflow per Array: 300,000 cfm
- Maximum Array Pressure Rise: 14" WC

**Analog Outputs**

- Quantity: 4
- Type: 0 to 10vdc proportional scaled outputs
- Max load per output: 20mA

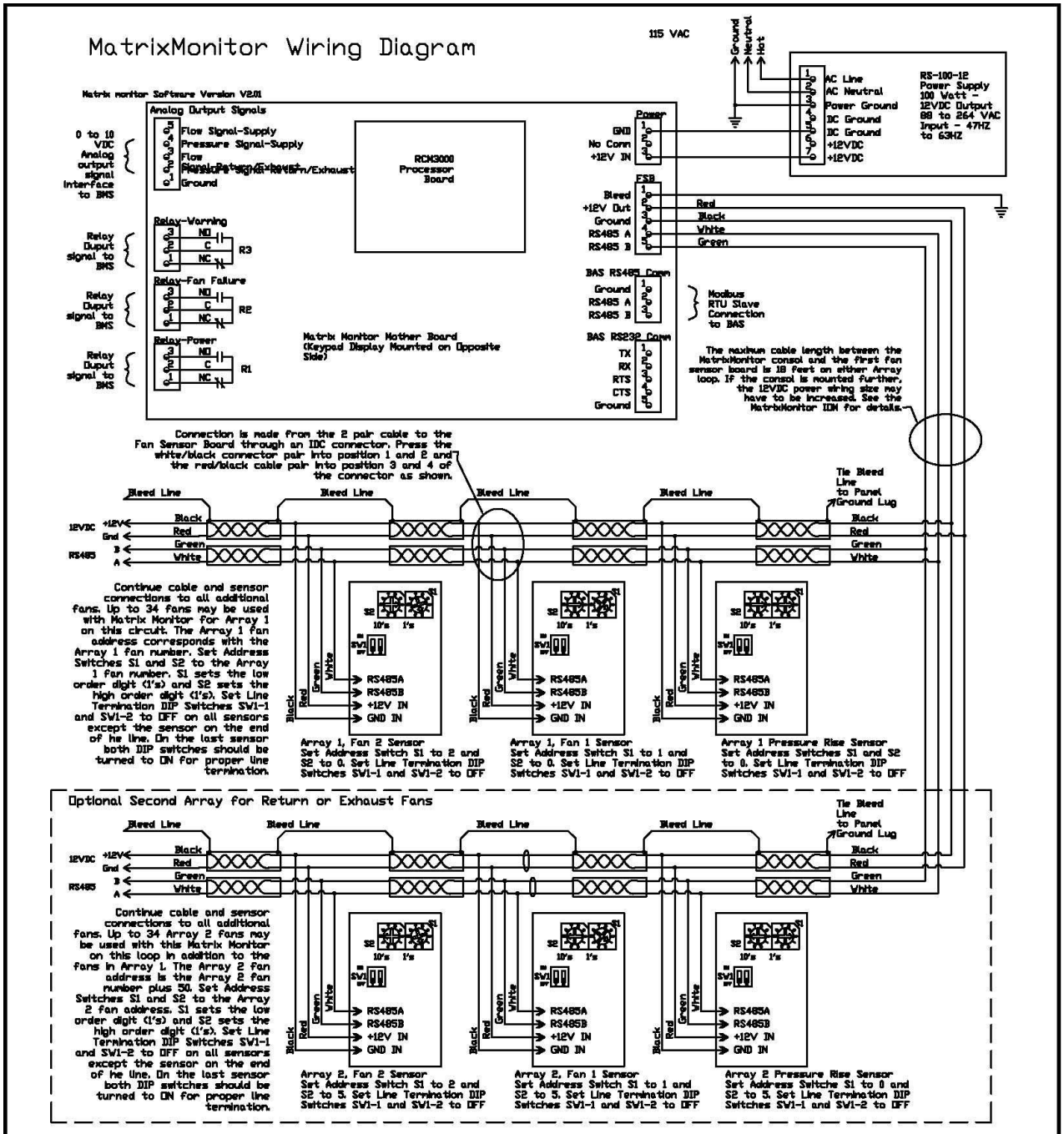
**Relay Outputs**

- Quantity: 3 SPDT
- Contact Ratings: 2A @ 30VDC ; 0.5A @ 125VAC

**Building Management System Communications**

- Protocol: Modbus RTU Slave
- Type: EIA/TIA 485 (RS485), 2 wire, multipoint communication line
- Baud Rate: 9,600; 19,200; 38,400; 57,600 user selectable – Default is 19,200
- Data bits: 8
- Parity: Even, Odd, or None; User selectable; Default is Even
- Stop bits: 1 (2 when no parity is selected)
- Modbus Address: 1 to 247; Default is 75

## Sample Wiring Diagram




| Array | Name | Qty Fans | Fan Model | Piezo Tap Position | Array Design Airflow (cfm) | Max Measured Fan Airflow (cfm) | Max Measured Array Airflow (cfm) |
|---|---|---|---|---|---|---|---|
| 1 | Supply | 4 | MTX16-100 | Cone | 24,000 | 6,000 | 24,000 |
| | | | | | | | |

| | | | | |
|---|---|---|---|---|
| ClimateCraft<br>518 North Indiana<br>OKLAHOMA CITY, OK 73106<br>PHONE (405) 415-9230 - FAX (405) 415-9231 | JOB<br>SAMPLE WIRING DIAGRAM | SN<br>23998 | BY<br>KLE | REV<br>B |
| | TAG<br>AHU1 | SHEET #<br> | DATE<br>08/28/2012 | MODEL NO.<br>CAH78X114 |

# Modbus® Register List

Software Version 2.04 Released to Production Rev 7 12/2/2012

| Abs. Address | Modbus® Register | Operation | Data Description | Units/Notes |
|---|---|---|---|---|
| 0 | 40001 | Read Only | Array 1 Airflow | cfm/100 or scfm/100 see Register 40015 |
| 1 | 40002 | Read Only | Array 1 Pressure Rise | inch WC x 10 sensor addr = 00 |
| 2 | 40003 | Read Only | Array 1 Average Temperature | deg F x 10 |
| 3 | 40004 | Read Only | Array 1 Density | lbm/cf x 1000 |
| 4 | 40005 | Read Only | Array 1 Average Speed | rpm x 1 |
| 5 | 40006 | Read Only | Array 1 Hours left to Bearing Grease | hours x 1 |
| 6 | 40007 | R/W | Array 1 Name<br>[Low Byte] 00h = Array 1<br>01h = Supply<br>02h = Return<br>03h = Exhaust<br>04h = Outside<br>[high Byte] Set to 0H | |
| 7 | 40008 | Read Only | Array 2 Airflow | cfm/100 or scfm/100 see Register 40015 |
| 8 | 40009 | Read Only | Array 2 Pressure Rise | inch WC x 10 sensor addr = 50 |
| 9 | 40010 | Read Only | Array 2 Average Temperature | deg F x 10 |
| 10 | 40011 | Read Only | Array 2 Density | lbm/cf x 1000 |
| 11 | 40012 | Read Only | Array 2 Average Speed | rpm x 1 |
| 12 | 40013 | Read Only | Array 2 hours left to Bearing Grease | hours x 1 |
| 13 | 40014 | R/W | Array 2 Name<br>[Low Byte] 00h = Array 2<br>01h = Supply<br>02h = Return<br>03h = Exhaust<br>04h = Outside<br>[high Byte] Set to 0h | |
| 14 | 40015 | R/W | Airflow Units<br>[Low Byte] 00h = CFM<br>01h = SCFM<br>[high Byte] set to 0h | CFM, SCFM |
| 15 | 40016 | Read Only | Barometric Pressure | psia x 100 |
| 16 | 40017 | Read Only | Monitor Board Temperature | deg F x 10 |
| 17 | 40018 | Read Only | Array 1 Airflow Voltage Signal | volts x 10 |
| 18 | 40019 | Read Only | Array 1 Pressure Voltage Signal | volts x 10 |
| 19 | 40020 | Read Only | Array 2 Airflow Voltage Signal | volts x 10 |
| 20 | 40021 | Read Only | Array 2 Pressure Voltage Signal | volts x 10 |
| 21 | 40022 | Read Only | Relay 1 Status - Power | on/off 1 = ON, 0 = OFF |
| 22 | 40023 | Read Only | Relay 2 Status - Fan Failure | on/off 1 = ON, 0 = OFF |
| 23 | 40024 | Read Only | Relay 3 Status - Warning | on/off 1 = ON, 0 = OFF |

| Abs. Address | Modbus® Register | Operation | Data Description | Units/Notes |
|---|---|---|---|---|
| 24 | 40025 | R/W | Number of fans in Array 1 | 1 to 49 |
| 25 | 40026 | R/W | Array 1 Fan Model | -----Register Value with: ------ |

| Model No. | Throat Port Connected | Cone Port Connected |
|---|---|---|
| MTX12 | 0 | 1000 |
| MTX15 | 1 | 1001 |
| MTX16 | 2 | 1002 |
| MTX18 | 3 | 1003 |
| MTX20 | 4 | 1004 |
| MTX22 | 5 | 1005 |
| MTX24 | 6 | 1006 |
| MTX27 | 7 | 1007 |
| MTX19 | 20 | 1020 |
| MTX23 | 21 | 1021 |
| MTX25 | 22 | 1022 |

| | | | | |
|---|---|---|---|---|
| 26 | 40027 | R/W | Number of fans in Array 2 | 1 to 49 |
| 27 | 40028 | R/W | Array 2 Fan Model | -----Register Value with: ------ |

| Model No. | Throat Port Connected | Cone Port Connected |
|---|---|---|
| MTX12 | 0 | 1000 |
| MTX15 | 1 | 1001 |
| MTX16 | 2 | 1002 |
| MTX18 | 3 | 1003 |
| MTX20 | 4 | 1004 |
| MTX22 | 5 | 1005 |
| MTX24 | 6 | 1006 |
| MTX27 | 7 | 1007 |
| MTX19 | 20 | 1020 |
| MTX23 | 21 | 1021 |
| MTX25 | 22 | 1022 |

| | | | | | |
|---|---|---|---|---|---|
| 28 | 40029 | R/W | Airflow Signal Limit | Min = 1 CFM x 10,000<br>Max = 30 | The airflow at which the analog airflow output voltage (registers 40018 and 40020) correspond to the maximum output voltage of 10.0 VDC in 10,000 cfm increments. |

| Abs. Address | Modbus® Register | Operation | Data Description | | Units/Notes |
|---|---|---|---|---|---|
| 29 | 40030 | R/W | Pressure Signal Limit | Min = 1 In WC<br>Max = 20 In WC | The pressure at which the analog pressure output voltage (registers 40019 and 40020) correspond to the maximum output voltage of 10.0 VDC. Can be any number between 1 and 20. Any values written to this register will be checked and conformed to this range. |
| 30 | 40031 | R/W | Array 1 Backdraft Damper Status<br>[Low Byte] 00h = No Dampers Installed<br>01h = Backdraft Dampers are Installed<br>[High Byte] Set to 00h | | |
| 31 | 40032 | R/W | Array 2 Backdraft Damper Status<br>[Low Byte] 00h = No Dampers Installed<br>01h = Backdraft Dampers are Installed<br>[High Byte] Set to 00h | | |
| 32 | 40033 | R/W | Array 1 Wheel Width<br>[Low Byte] 50 to 100 with increments of 5<br>[High Byte] Set to 00h | | % full width wheel |
| 33 | 40034 | R/W | Array 2 Wheel Width<br>[Low Byte] 50 to 100 with increments of 5<br>[High Byte] Set to 00h | | % full width wheel |
| 34-50 | 40035 to 40051 | | Not Used at this time | | |
| 51 | 40052 | Read Only | Array 1 Fan 1 Airflow | | Sensor Address = 01 |
| 52 | 40053 | Read Only | Array 1 Fan 2 Aiflow | | Sensor Address = 02 |
| | . | Read Only | . | | . |
| | . | Read Only | . | | . |
| | . | Read Only | . | | . |
| 99 | 40100 | Read Only | Array 1 Fan 49 Airflow | | Sensor Address = 49 |
| 100 | 40101 | Read Only | Array 2 Fan 1 Airflow | | Sensor Address = 51 |
| 101 | 40102 | Read Only | Array 2 Fan 2 Airflow | | Sensor Address = 52 |
| | . | Read Only | . | | . |
| | . | Read Only | . | | . |
| | . | Read Only | . | | . |
| 148 | 40149 | Read Only | Array 2 Fan 49 Airflow | | Sensor Address = 99 |

Note: The units for registers 40052 through 40149 are in cfm/100 or scfm/100 depending on the setting of register 40015.

| Abs. Address | Modbus® Register | Operation | Data Description | | Units/Notes |
|---|---|---|---|---|---|
| 149 | 40150 | R/W | Array 1 Fan 1 Status | Status Codes | |
| 150 | 40151 | R/W | Array 1 Fan 2 Status | [Low Byte] | Bit 0: 1=Fan Failed |
| | . | R/W | . | | Bit 1: 1= Fan In Surge |
| | . | R/W | . | | Bit 2: 1=Vibration Warning |
| | . | R/W | . | | Bit 3: 1=Fan is Backflowing |
| | . | R/W | . | | Bit 4: 1=Sensor Board not responding |
| | . | R/W | . | | Bit 5: Not Used |
| 197 | 40198 | R/W | Array 1 Fan 49 Status | | Bit 6: Not Used |
| | | | | | Bit 7: Not Used |
| 198 | 40199 | R/W | Array 2 Fan 1 Status | [High Byte] | Bit 0:0= Fan Enabled 1=Fan Disabled |
| 199 | 40200 | R/W | Array 2 Fan 2 Status | | Bit 1: 1=Blank Off Plate Installed |
| | . | R/W | . | | Bit 2: Not Used |
| | . | R/W | . | | Bit 3: Not Used |
| | . | R/W | . | | Bit 4: Not Used |
| | . | R/W | . | | Bit 5: Not Used |
| | . | R/W | . | | Bit 6: Not Used |
| 246 | 40247 | R/W | Array 2 Fan 49 Status | | Bit 7: Not Used |
| | | | Note: Any write operations to the fan status registers will only affect the high byte. Data in the low byte will be ignored. | | |

Communication Data:

| Default Communication Settings | | User Selectable Options |
|---|---|---|
| Baud Rate: | 19,200 | {9,600, 19,200, 38,400 and 57,600 Baud rates are selectable} |
| Data Bits: | 8 | 8 Data Bits are required by Modbus® RTU |
| Parity: | Even | {Odd and No Parity are selectable} |
| Stop Bits: | 1 | {2 stop bits are used if No Parity is selected as required by Modbus® RTU} |
| Factory Default Address: | 75 | {User selectable from 1 to 247} |

Notes:
1. Only Modbus® RTU is supported
2. All Modbus® registers are HOLDING registers
3. Only one register can be read or written to at a time
4. If a Modbus® command is sent to read or write multiple registers, an error will be returned
5. For information about the Modbus® protocol, visit www.modbus.org

Supported Commands

03(03h) Read Holding Register (only reads 1 register per command)
06(06h) Write Single Register

The Physical Layer for MatrixMonitor™ Modbus® communication to the Building Management System (BMS) is via EIA/TIA-485 (RS-485) two wire multipoint system. The MatrixMonitor™ is configured as a "slave" and will respond to messages sent by a "master" over this line.

## Notes:

## Notes:

## ClimateCraft® Service

For sales, parts and service support on this or any other ClimateCraft® product please contact customer service at (405) 415-9230.

http://www.climatecraft.com/



ClimateCraft's fan array products allow for fans to be turned off for safety, repair, and maintenance purposes. ClimateCraft's fan array products are not designed to turn individual fans on and off for the purpose of improving fan array efficiency, and ClimateCraft® does not endorse turning individual fans on and off for the purpose of improving fan array efficiency. Any statement to the contrary is not supported by ClimateCraft®.

Errata:

Rev 3 – First publication 12/3/2012

Rev 4 - Corrected punch down tool tip model number on page 65 4/11/2012