FMS-1655
Programmer's Guide
Version: 12.13.16

TRIATEK FMS-1655
The Next Generation in Critical Airflow Controls

PROGRAMMER'S GUIDE

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GENERAL

Specifications

Electrical

Optional External Remote Sensor Distance .....up to 4,000 feet
Optional External Remote Sensor .....Wiring 18-22 AWG, shielded twisted pair
Power Supply .....24 Vac ±10%, 30Va
Accuracy of Measurement .....±0.5%FS
Pressure Range .....±0.2500 "WC
**NIST Traceable / Individual certification available as option*
Pressure/Flow .....up to 0.25 "WC
4 Analog Inputs .....4-20mAdc, 0-5Vdc or 0-10Vdc
4 Analog Outputs .....4-20mAdc, 0-5Vdc or 0-10Vdc
2 Thermistor Inputs .....NTC Type 2 or 3, 10kΩ @ 25°C
4 Digital Inputs .....0-5Vdc or 0-24Vdc, Active-High or Active-Low
4 Relay Outputs .....1A@24Vdc
Control Signal Wire Size .....18 AWG minimum
Power Supply .....Class 2, 24Vac ±10%, 30VA universal 120/240 to 24 Vac, 60/50 Hz, step-down isolation transformer provided

Communications

BACnet® MS/TP network .....Two-Wire Twisted Pair, RS-485 signaling
Metasys® N2 network .....Two-Wire Twisted Pair, RS-485 signaling
LonWorks® FTT-10A peer-to-peer network .....Two-Wire Twisted Pair, FTT-10A signaling
Recommended Cable Type ..... Belden 1325A

Specifications

Touch Screen User Interface

LCD Size	3.2" diagonal
LCD Type	Transmissive
Resolution	240 x 320 portrait
Viewing Area	50.60 mm x 66.80 mm
Color Depth	18-bit or 262K colors
Backlight Color	White
Luminous Intensity	min 2500 cd/m2

Mechanical

FMS-1655 Internal Sensor Flush Mount Housing (Brushed Stainless Steel) Housing	5.6"W x 8.5"H x 1.9"D
FMS-1655 Display Module Housing	3"W x 5"H x 0.75"D
Optional External Remote Sensor Housing	2"W x 3"H x 2.7"D
Stainless Steel Cover Plate for Flow Tube	2.7"W x 4.5"H x 0.2"D
Stainless Steel Cover Plate for Remote Sensor	2.7"W x 4.5"H x 0.2"D
FMS-1655 w/ Flow Tube Cover Plate	approx. 3.5 lb
FMS-1655 w/ Optional External Remote Sensor	approx. 4.0 lb
FMS-1655 Mounting Options	Surface, Flush
Flow Tube Cover Plate Mounting	Flush
Optional External Remote Pressure Sensor Mounting	Flush

Environmental

Operating Temperature	32° to 125° F Operating
Operating Humidity	10% - 95% RH, Non-condensing

Part Number Guide

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Case Style
S = surface
F = flush
T = thin

Internal Sensor [1]
0 = no internal sensor
1 = standard internal sensor
R = optional remote display [3]

 # Remote Sensors
0 = no remote sensors (demo)
1 = one standard remote sensor
A = optional no-flow internal sensor
B = custom remote sensor
N = no remote sensors

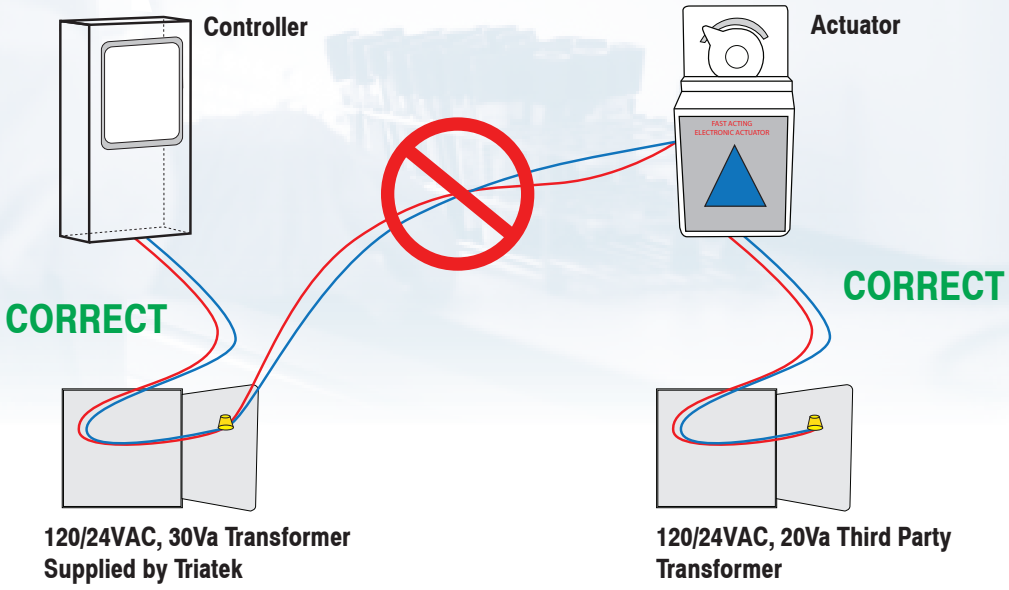
 # Optional Sensors [2]
Blank = no optional sensors
1 = one optional remote sensor
L = legacy standard remote sensor(s)

[1] Internal sensor option only available on flush-mount model FMS-1655-F-x-x
[2] This digit only applies to optional sensors specified in preceding digit or when ordering legacy 2-wire remote sensors
[3] Optional remote display does not include internal sensor

CAUTION

Failure to follow the wiring diagrams could result in damage to your equipment and could void your warranty. Wiring diagrams can also be found at www.triatek.com.

Under no circumstances should a single transformer be split between actuator and controller. Doing so will damage the actuator, the transformer, the controller or all units. A single 120/24V 30Va transformer is required for the controller and a separate 120/24V 20Va transformer is required for the actuator.



FMS-1655 Overview

The touch-screen user interface of the FMS-1655 room pressure controller is designed to facilitate the initial setup and configuration, diagnosis, and troubleshooting during the installation process. Each menu screen is limited to four options, thereby simplifying navigation through the menu system. Context-sensitive help (Figure 2) is available at most menu screens and is accessed simply by touching the menu title on that screen. To exit from any help screen, simply touch the display anywhere on the popup. Multi-page menu screens have navigation buttons at the bottom of each screen that allow the user to move forward or backward, and include a convenient exit button on the last screen (Figure 1) to quickly exit the menu system to return to the main display.

To preserve the security of the configuration settings, up to ten (10) multilevel passwords may be programmed to prevent unauthorized access to the system configuration settings. To further prevent unauthorized access, the FMS-1655 user menu system incorporates display timeout periods based on the screen currently displayed. Menu screens timeout after 90 seconds of inactivity, while popup screens automatically timeout after 60 seconds. This prevents unauthorized access to the menus should a unit be inadvertently left unattended at one of the user menus or configuration screens.

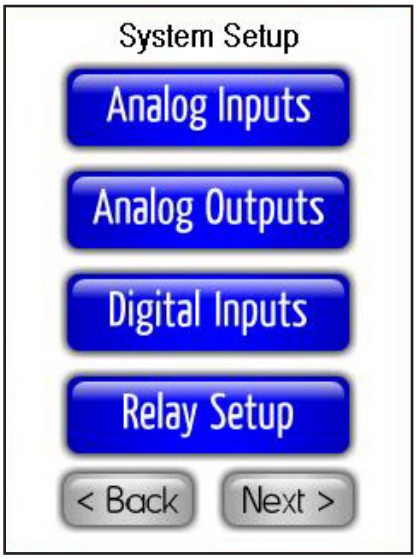


Figure 1. Navigation buttons appear at each menu screen which facilitates moving through the user menu system.

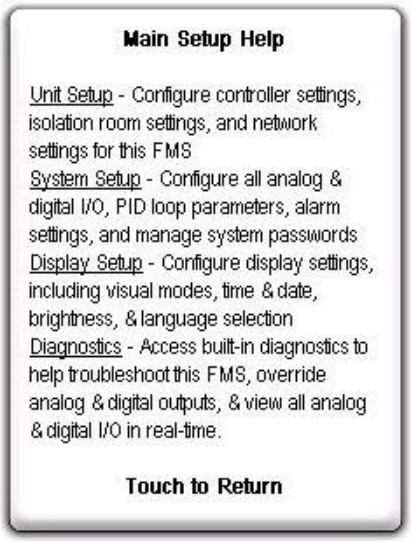


Figure 2. Context-sensitive help is available at most menu screens simply by touching the menu title at any screen.

MAIN SETUP MENU

Introduction

The Main Setup menu provides four options for 1) configuring the settings specific to the unit as a room pressure controller, 2) configuring the settings associated with the additional hardware resources, as well as managing the system security passwords, 3) configuring the display-specific settings, and 4) using the diagnostics and troubleshooting resources (Figure 3).

Figure 3. Main Setup menu provides access to configuration of all FMS-1655 settings.

If this FMS-1655 is being used primarily as a room pressure controller monitoring a single room, then the majority of the configuration settings will be available through the Unit Setup option on the Main Setup Menu. The options for configuring the additional hardware resources available on the FMS-1655 may be accessed through the System Setup options. These additional hardware resources include universal analog inputs 2 through 4, dedicated thermistor inputs 1 and 2, analog outputs 2 through 4, digital inputs 2 through 4, and relay outputs 2 through 4. Other additional resources available through the System Setup options include the secondary PID control loops associated with analog outputs 2 through 4, the comprehensive alarm facility, and the security password management facility.

The *Display Setup* option includes six menu items for configuring all of the display-specific settings integrated into the FMS-1655. These include configuring the patent-pending Safety Halo settings, the primary display mode, selecting the individual display options, setting the time and date, adjusting the brightness of the touch screen display, and defining the names associated with each analog input. The FMS-1655 can simultaneously display the differential pressure, room temperature, relative humidity, and air change rate for the monitored room in real-time. The sources for each of these displayed parameters may easily be specified using the *Display Options* on the *Display Setup* menus.

The Diagnostics options provide information specific to this particular FMS-1655 unit, assistance with the troubleshooting of the unit, and real-time confirmation of the signals connected to the backplane. The Overrides option on the Diagnostics menus allows the analog outputs and relay outputs to be manually overridden independently to assist with verifying the correct operation and/or allocation of the controller resources. There are two options that provide support for zero-calibrating the FMS-1655 once it has been installed, to ensure maximum accuracy of the displayed differential pressure readings. To further assist with troubleshooting the FMS-1655 during the installation phase, the Real-Time View option on the Diagnostics menus allows the user to view the real-time conditions of each of the resources attached to the FMS-1655 controller.

More information on each of the four options on the Main Setup Menu is available in subsequent sections of this guide. The next section covers the options available on the Unit Setup menu.

Configuring Controller Settings

(For overview, see FLOW DIAGRAMS - Page 66)

Configuring Controller Settings

The Unit Setup menu shown in Figure 4 provides support for:

1. Configuring the controller settings
2. Configuring the settings associated with the room being monitored and/or controlled
3. Configuring the network-specific settings of the controller module

Figure 4. Unit Setup menu provides options for configuring the controller settings, room settings and network settings.

The *Controller Setup* options provide access to facilities for configuring all of the settings associated with the FMS-1655 when primarily being used as a room pressure controller. This includes setting up the analog input and output, door switch, alarm relay, PID control loop, alarm setpoints, audible alert settings, and the engineering units for the differential pressure reading. If the FMS-1655 is being used with multiple differential pressure sensors, the *Controller Setup* options allow the primary sensor to be configured, while the *System Setup* options must be used to configure the secondary sensor(s).

If the FMS-1655 is being used primarily as a room pressure controller, the *Room Setup* option provides access to the settings associated with the spaces being monitored and/or controlled. Options available on the *Isolation Room Setup* menu include selecting the mode of isolation, the state of occupancy for the monitored space, defining the name associated with each space or room being monitored, and configuring the duration associated with the *Auto Clean* feature.

The *Network Setup* option provides support for configuring the settings associated with the networking capability of the FMS-1655. These options include selecting the baud rate for the network interface (if the current protocol is BACnet MS/TP), setting the network or MAC address for the unit, and setting several parameters specific to the BACnet® protocol such as the device ID offset and the Max_Master parameter. The available options on the *Network Setup* menu strictly depend on the protocol selected at the controller module via hardware configuration switch settings. More information on the two different sets of menu options is given in the *Configuring Network Settings* section later in this document.

The next section details the options available on the *Controller Setup* menus.

Configuring Controller Settings

The *Controller Setup* menus shown below in Figure 5 and Figure 6 provide access to facilities for configuring all of the settings associated with the FMS-1655 when it has been set up as a room pressure controller, including setting up the analog input and output, configuring the door switch input, setting up the alarm relay, configuring the PID loop settings, alarm setpoints, audible alert settings, and selecting the engineering units for the differential pressure reading.

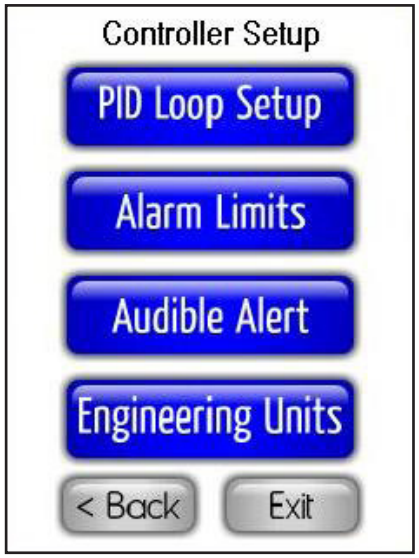


Figure 5. The Controller Setup menu (2 of 2) allows the capabilities of the primary room controller to be configured.

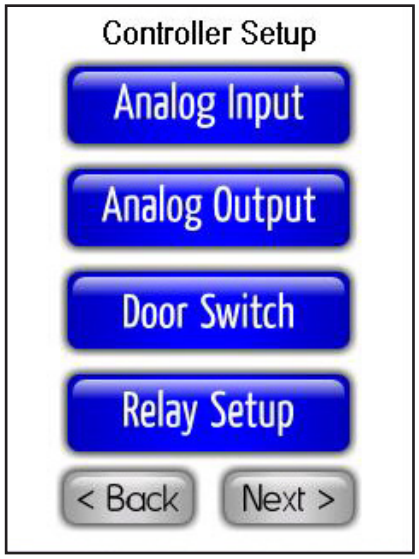


Figure 6. The Controller Setup menu (1 of 2) allows all of the hardware resources for the primary room controller to be configured.

Setting up the Main Sensor Input

For remote sensor models (FMS1655-x-0-x), the *Analog Input* option on the *Controller Setup* menus allows the primary differential pressure sensor input to be configured as required by the specific application. Selecting this option invokes the *Sensor Input Settings* configuration screen shown in Figure 8. At this configuration screen, the user may specify whether or not the linearization of the sensor input should be enabled, and whether or not to invert the analog input signal. The *Inverted Mode option* is very useful if the actual remote sensor connected to the FMS-1655 was installed backwards inadvertently, such that the reference and monitor ports of the pressure sensor are reversed. Selecting the *Inverted Mode* is equivalent to manually reversing the tubing at the remote sensor ports.

For internal sensor models (FMS1655-F-1-x), the *Analog Input* option on the Controller Setup menus allows the location of the touch screen display to be specified. This setting determines whether or not the differential pressure signal needs to be inverted prior to being displayed. If the display is mounted at the interior of the room being monitored, then *Monitored Space* should be selected on the *Display Location* configuration screen. Otherwise, assuming the display is mounted in the reference space just outside of the room being monitored, then *Referenced Space* should be selected.

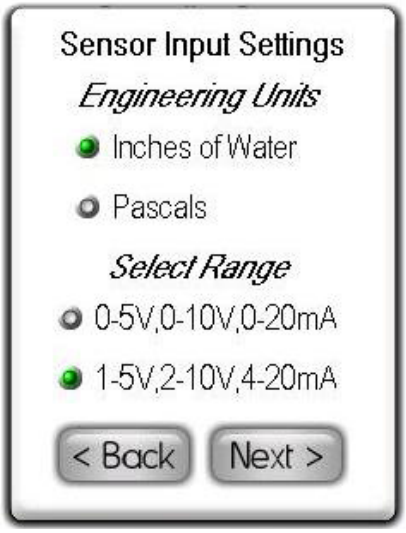


Figure 7. Engineering units and input signal range may be selected during configuration.

Configuring Controller Settings

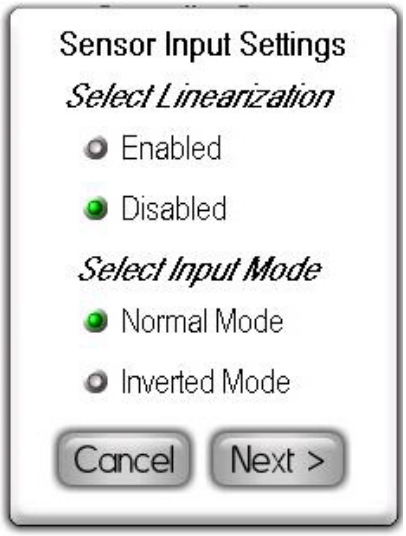


Figure 8. Sensor Input Settings popup screen allows the input signal to be inverted if the sensor was inadvertently installed backwards.

Clicking the *Next* button invokes the *Sensor Input Settings* configuration screen shown in Figure 7, where the engineering units may be selected, as well as the voltage or current range for the sensor input. For internal sensor models (FMS-1655-F-1-x), the sensor input defaults to the 0-5V range, and clicking the *Next* button invokes the Enter XX-ISO Setpoint configuration screen. For remote sensor models (FMS-1655-x-0-1), the sensor input defaults to the 4-20mA range.

Clicking the *Next* button invokes the AI-1 Sensor Range configuration screen as shown in Figure 9, where the pressure range associated with the remote sensor may be specified. The default pressure range for all standard FMS-1655 models is ±0.25 "WC, although existing remote sensor units may have pressure ranges that match one of the other choices on this setup screen. Once the pressure range has been specified, the user is prompted to enter the setpoint for the current isolation mode.

Setting up the Damper Control Output

The *Analog Output* option on the *Controller Setup* menus allows the primary control output to be configured as required by the specific application. Selecting this option invokes the *Analog Output Settings* configuration screen (Figure 10). Each of the four (4) analog outputs of the FMS-1655 may be configured for one of two operating modes: *Direct Analog Output* or *PID Analog Output*.

The direct analog output or proportional mode allows the output to track the mapped analog input directly or inversely. The PID mode employs the *proportional-integral-derivative* scheme for closed-loop control of the analog output. Independent of the mode for which the analog output is configured, the range of the output may or may not include an offset.

Selecting the *0-5V,0-10V,0-20mA* range allows the analog output to swing from zero to the maximum specified by the hardware dipswitch selection, while the *1-5V,2-10V,4-20mA* range includes an offset from zero.

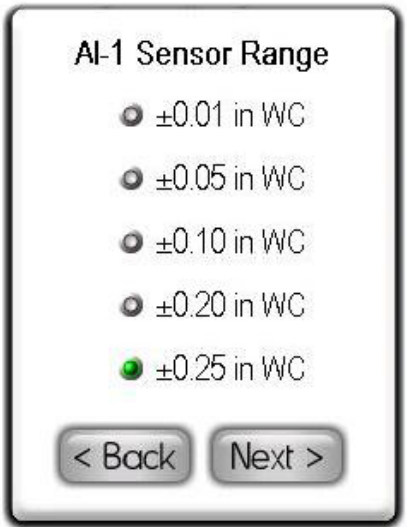


Figure 9. Multiple differential pressure ranges are supported by the FMS-1655.

Configuring Controller Settings

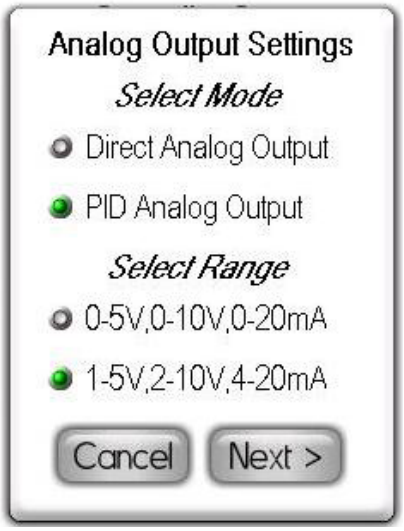


Figure 10. Proportional (direct) and PID analog output modes are supported.

Once the operating mode and output range have been specified, the next *Analog Output Setup* configuration screen prompts the user to specify the minimum and maximum limits for the analog output in percentage (Figure 11). The default minimum and maximum are zero and 100 percent, respectively. This allows the analog output to not exceed or go below a predetermined voltage or current output.

Clicking the *Next* button invokes the last *Analog Output Settings* configuration screen (Figure 12), where the user can specify the analog input to which this analog output should be mapped, and select the action mode for the analog output. The default setting uses AI-1 as the analog input channel for the analog output. The action mode determines the direction in which the output is driven based on the sensor input (AI-1). The default action mode is *Direct Acting* for positive isolation and *Reverse Acting* for negative isolation. Neutral isolation mode defaults to *Direct Acting* mode for the primary analog output.

Figure 11. Upper and lower limits for each analog output may be specified, independent of offset from zero.

Figure 12. Input channel used by the main analog output may be selected independently for each, as well as the action mode.

Configuring Controller Settings

Setting up the Door Switch

The FMS-1655 uses digital input 1 (DI-1) as the door switch input for the primary isolation room. This capability allows the FMS-1655 to monitor the door to the monitored room and use the status of the door to delay the sounding of alarms and/or hold the analog output fixed until the door returns to the closed position. The *Door Switch* option on the *Controller Setup* menus allows the door switch input to be configured as required by the specific application. Selecting this option invokes the *Door Switch Settings* configuration screen shown below (Figure 14).

The door switch input may be configured for one of two modes: *Normally-Open* or *Normally-Closed*. While any suitable switch may be used with the FMS-1655, the door switch provided by Triatek (part no. SWD200-2) supports both normally-open (N.O.) and normally-closed (N.C.) operating modes. After selecting N.O. or N.C. for the door switch, set the delay as required by the specific installation. The default value for the door delay is zero seconds, but can be as long as 180 seconds, or three minutes.

When the door to the monitored room opens, the door delay timer begins counting down, and inhibits the alarm buzzer and alarm relay from triggering until the timer expires. If the audible alert is configured with a delay, the door delay counts down first, and then the audible alert delay begins timing. Similarly, if the alarm relay has a delay associated with it, it begins counting down after the door delay expires.

Figure 13. Relays may be triggered by one of three methods, and may include an activation delay.

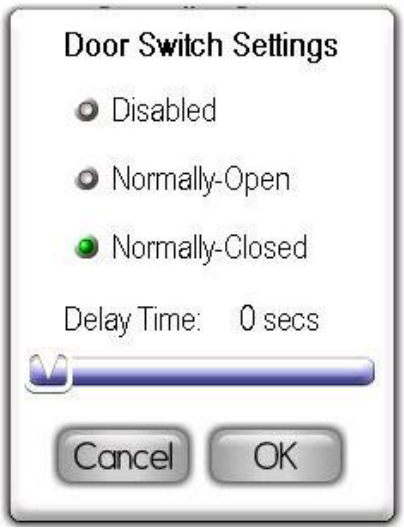


Figure 14. Door switch may be set for N.O. or N.C. contacts, or disabled at the configuration screen.

Setting up the Alarm Relay

The FMS-1655 uses relay output 1 (RL-1) as the alarm relay output for the primary isolation room. This capability is typically used to allow the FMS-1655 to trigger a remote alarm annunciator. The *Relay Setup* option on the *Controller Setup* menus allows the alarm relay output to be configured as required by the specific application. Selecting this option invokes the Relay 1 *Trigger Mode* configuration screen shown in Figure 13. The alarm relay output may be configured to be triggered in one of three modes: *Setpoints*, *Isolation Mode*, or *Occupancy Mode*. *Setpoints Mode* uses a pair of setpoints to determine when to activate or deactivate the alarm relay. *Isolation Mode* allows the alarm relay to be triggered based on the mode of isolation selected. *Occupancy Mode* uses the state of occupancy to determine when the alarm relay should be active or inactive.

When using *Setpoints* trigger mode, the unit must be in either positive or negative isolation mode in order to enter the high and low relay setpoints. If the unit is in neutral isolation mode, then setpoint entry will not be available.

If *Setpoints Mode* is selected as the trigger mode for the alarm relay, the user is next prompted for the Input Channel to use for analyzing the relay setpoints. While relay output 1 uses Analog Input 1 by

Configuring Controller Settings

default, it may be remapped to any one of the four universal analog inputs (AI-2 through AI-4) or either of the two dedicated thermistor inputs (TI-1 and TI-2). After selecting the desired input channel, the user is next prompted for high and low relay setpoints for the current isolation mode.

The high setpoint determines the threshold at which the alarm relay gets activated if in direct acting mode, or gets deactivated if in reverse acting mode. The low setpoint determines the threshold at which the alarm relay gets deactivated if in direct acting mode, or gets activated if in reverse acting mode. After specifying the high and low setpoints, the user is prompted for the acting mode and delay associated with the alarm relay. In direct acting mode, the alarm relay will be activated when the sensor input exceeds the high setpoint, and will be deactivated when the sensor input falls below the low setpoint. In reverse acting mode, the alarm relay will be deactivated when the sensor input exceeds the high setpoint, and will be activated when the sensor input falls below the low setpoint. The alarm relay delay may be up to 180 seconds, or three minutes, in duration.

If *Isolation Mode* is selected as the trigger mode for the alarm relay, the user is next prompted to select whether the alarm relay should activated or deactivated for each mode of isolation. Next, the user is prompted for the acting mode and delay to be associated with the alarm relay. If the FMS-1655 has been configured for a door switch with a delay setting greater than zero, then the door switch delay will count down before the alarm relay delay will begin counting down. Otherwise, the alarm relay delay will begin counting down immediately after the trigger condition is achieved, and the alarm relay will activate or deactivate when the timer expires, depending on the acting mode selected for the alarm relay.

If *Occupancy Mode* is selected as the trigger mode for the alarm relay, the user is next prompted to select whether the alarm relay should activated or deactivated for the two states of occupancy. Next, the user is prompted for the acting mode and delay to be associated with the alarm relay. If the FMS-1655 has been configured for a door switch with a delay setting greater than zero, then the door switch delay will count down before the alarm relay delay will begin counting down. Otherwise, the alarm relay delay will begin counting down immediately after the trigger condition is achieved, and the alarm relay will activate or deactivate when the timer expires, depending on the acting mode selected for the alarm relay.

Adjusting the PID Loop Settings

When the FMS-1655 is configured to use analog output 1 for closed-loop control applications, the proportional, integral, and derivative constants that determine the performance and characteristics of the control scheme may be specified using the PID Loop Setup option on the *Controller Setup* menus. Selecting this option invokes the *PID Loop Settings* configuration screen as shown in Figure 16, where the user can fine-tune the PID constants to be used by the closed-loop control scheme for analog output 1. These three dimensionless constants may vary from zero to 100 using the three sliders on the configuration screen. See the *PID Tutorial* in the appendix at the end of this document for more information on fine-tuning the PID constants for a specific application.

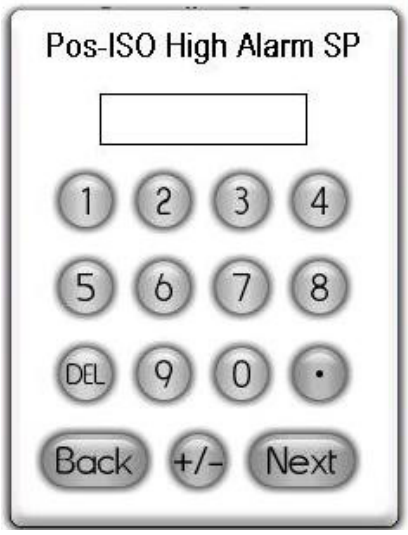


Figure 15. High alarm setpoint for positive isolation mode may be specified at this configuration popup screen.

Configuring Controller Settings

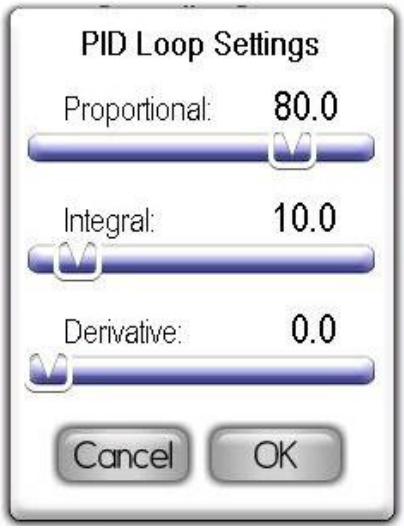


Figure 16. PID loop constants may be fine-tuned to optimize performance of the closed-loop control scheme.

Configuring the Alarm Parameters

The FMS-1655 allows the user to specify multiple alarm setpoints for each analog input. The *Alarm Limits* option on the *Controller Setup* menus allows the high and low alarm setpoints to be configured as required by the specific application. Selecting this option while the unit is in positive isolation mode invokes the *Pos ISO High Alarm SP* configuration screen shown in Figure 15. If the unit is in negative isolation mode, selecting the *Alarm Limits* option invokes the *Neg ISO High Alarm SP* configuration screen shown in Figure 18. If the unit is in neutral isolation mode, then the alarm setpoints cannot be configured, and the warning message shown in Figure 17 is displayed.

After entering the high alarm setpoint, the user is subsequently prompted for the high warning setpoint, low warning setpoint, and low alarm setpoint. These four setpoint values must be sequentially decreasing or increasing in magnitude to be valid, depending on the selected isolation mode.

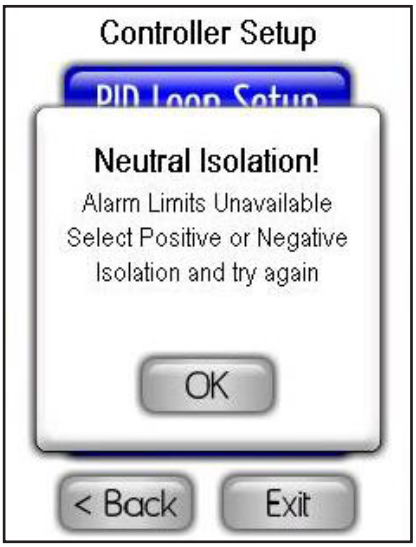


Figure 17. Positive or negative isolation mode must be currently active to enter alarm setpoints. Otherwise, this message is displayed.

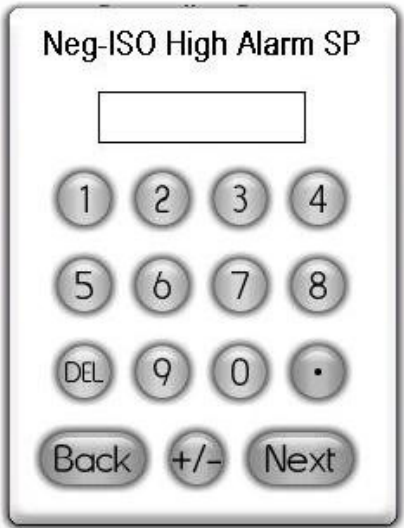


Figure 18. High alarm setpoint for negative isolation mode may be specified at this configuration popup screen.

Configuring Controller Settings

Setting up the Alarm Buzzer

The FMS-1655 alarm resources provide support for both visual and audible alerts. The *Audible Alert* option on the *Controller Setup* menus allows the alarm buzzer settings to be configured. Selecting this option invokes the *Alarm Buzzer Settings* configuration screen shown in Figure 19. At this configuration screen, each analog input may be individually enabled for audible alerts. Clicking the *Next* button invokes the next *Alarm Buzzer Settings* configuration screen shown in Figure 20.

The alarm buzzer may be selected for one of two modes of operation: *Audible Mode* or *Silent Mode*. If audible mode is selected, the user is prompted to enter the desired delay in seconds or minutes. If silent mode is selected, then the alarm buzzer will not sound whenever the unit enters alarm status. If audible mode is selected, clicking the *Next* button invokes the next *Alarm Buzzer Settings* configuration screen shown in Figure 21, which allows the user to specify an *Alarm Quiet Period*. This feature allows the audible alerts to be suppressed between the specified hours every day, thereby eliminating the potential for nuisance alarms.

In the example shown in Figure 21, the alarm buzzer will be muted between the hours of 9:00 pm and 5:00 am every day. Hospitals may take advantage of this feature to minimize nuisance alarms during non-visiting hours in patient rooms.

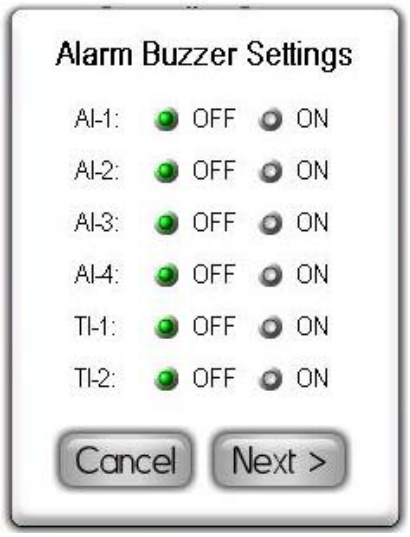


Figure 19. Each analog input may be independently enabled to trigger the alarm buzzer.

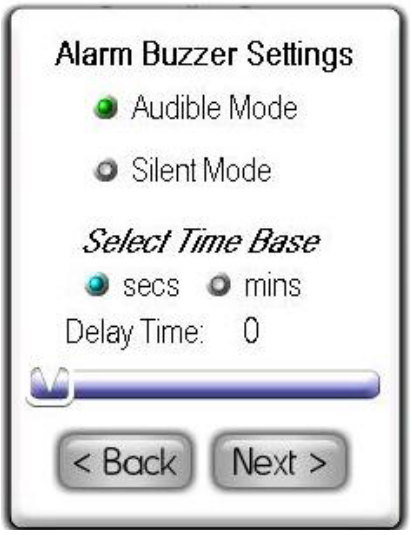


Figure 20. The alarm buzzer can be configured for audible or silent mode. In audible mode, a buzzer delay may be specified in seconds or minutes.

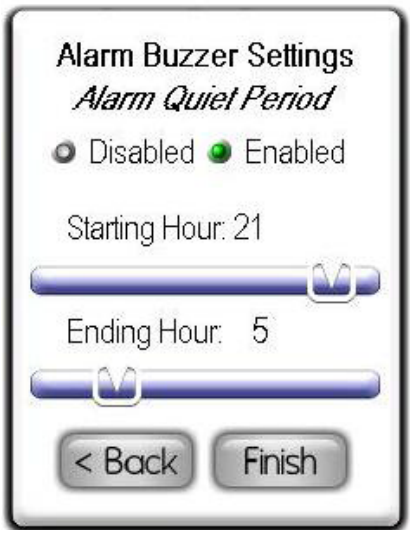


Figure 21. An Alarm Quiet Period may be specified, during which the alarm buzzer is muted between the starting hour and ending hour.

Configuring Controller Settings

Selecting Engineering Units

The FMS-1655 displays differential pressure readings in one of two units: *inches of water column (in WC)* or *Pascals (Pa)*. The *Engineering Units* option on the *Controller Setup* menus allows the units to be selected by the user. Selecting this option invokes the *Select Engineering Units* configuration screen shown in Figure 22. If the engineering units selection is changed, the corresponding alarm setpoints, PID loop setpoints, and alarm relay setpoints are all automatically converted to the newly selected units.

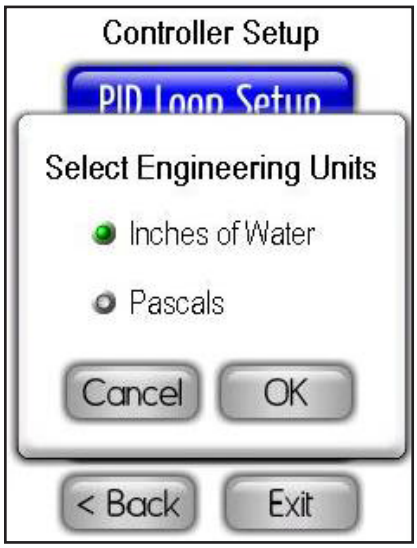


Figure 22. Engineering units for the differential pressure displayed on the main screen may be expressed in "WC or Pa.

The next section details the options available on the *Isolation Room Setup* menu.

Configuring Isolation Room Settings

The *Isolation Room Setup* menu shown in Figure 23 provides support for configuring the settings associated with the primary and secondary spaces being monitored. This includes selecting the mode of isolation, setting the state of occupancy, modifying the name associated with the monitored space, and configuring the duration associated with the *Auto Clean* feature.

In a typical application, the FMS-1655 may be configured to monitor/control the differential pressure in an isolation room as well as in an adjoining anteroom. In this case, the isolation room would be considered the primary monitored space, while the anteroom would be the secondary monitored space. The primary sensor input (AI-1) is used for the primary monitoring/control capability, while the secondary sensor input (AI-2) is used for the secondary monitoring/control capability.

The following sections discuss each of the options on the *Isolation Room Setup* menu.

Figure 23. Settings specific to the space being monitored and/or controlled may be configured at this menu. The time duration associated with the automated clean cycle may be configured from this menu.

Selecting the Mode(s) of Isolation

The *Isolation Mode* option on the *Isolation Room Setup* menu allows the primary isolation mode to be configured as required. If the FMS-1655 has been configured for *Single Sensor Mode*, then selecting this option invokes the *Set Isolation Mode* configuration screen shown in Figure 24. If the FMS-1655 has been configured for *Dual Sensor Mode*, then the room selection configuration screen shown in Figure 25 appears first, and then the *Set Isolation Mode* popup appears for the selected room.

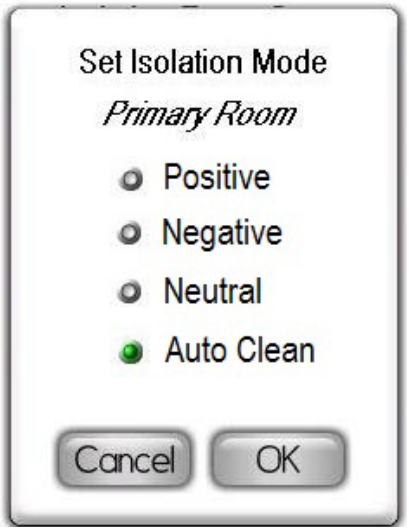


Figure 24. The FMS-1655 may be configured for *Positive*, *Negative*, or *Neutral* isolation mode, or for *Auto Clean* mode, which automates the turnover of a vacated isolation room.

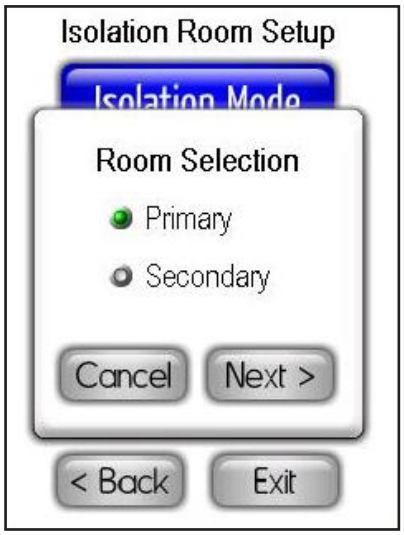


Figure 25. If Dual Sensor Mode is enabled, then this popup appears prior to selecting a new isolation mode, occupancy state, and editing the room name.

Configuring Isolation Room Settings

Setting the State(s) of Occupancy

The *Set Occupancy* option on the *Isolation Room Setup* menu allows the occupancy mode to be configured as required. If the FMS-1655 has been configured for *Single Sensor Mode*, then selecting this option invokes the *Room Occupancy* configuration screen. If the FMS-1655 has been configured for *Dual Sensor Mode*, then the room selection configuration screen (Figure 25) appears first, and then the *Room Occupancy* popup appears for the selected room.

Modifying the Room Name(s)

The *Edit Room Name* option on the *Isolation Room Setup* menu allows the name of the monitored space to be specified. This name is displayed on the main screen while in either single- or dual-sensor mode.

If the FMS-1655 has been configured for *Single Sensor Mode*, then selecting this option invokes the alphanumeric popup keyboard shown above (Figure 27). If the FMS-1655 has been configured for *Dual Sensor Mode*, then the room selection configuration screen shown above in Figure 25 appears first, and then the alphanumeric popup keyboard appears allowing the name to be edited for the selected room. With the uppercase characters displayed, clicking the orange button next to the *Save* button will switch to the lowercase character set. With the lowercase characters displayed, clicking the orange button again will switch to the numeric character set. With the numeric characters displayed, clicking the orange button returns to the uppercase character set. Click the *Save* button to store the new name to non-volatile memory.

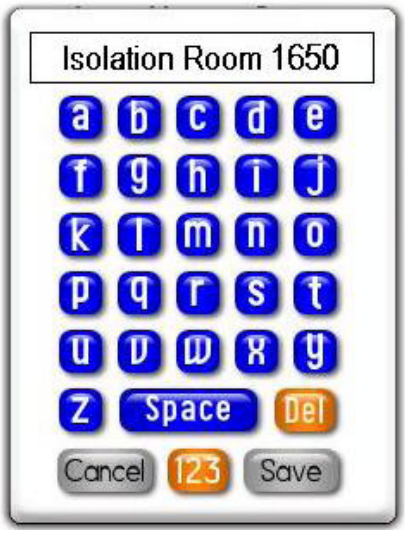


Figure 27. Alphanumeric popup keyboard allows text entries to be entered & modified conveniently.

Configuring the Auto Clean Cycle Duration

The Auto Clean Time option on the Isolation Room Setup menu allows the time duration associated with the automated clean cycle to be configured. The clean cycle duration may be adjusted using the slider from a minimum of 10 minutes up to a maximum of 4 hours, in increments of one minute. This duration may be readjusted at any time to increase or decrease the time associated with the automated cleaning cycle.

The next section details the options available on the *Network Setup* menu.

Configuring Network Settings

Configuring Network Settings

The *Network Setup* menu provides access to facilities for configuring the settings associated with the networking capabilities of the FMS-1655. This includes selecting the network address, specifying the baud rate, and configuring any protocol-specific settings.

The options available on the *Network Setup* menu depend on the protocol selected on the controller module.

- For those units configured for the BACnet® protocol, the *Network Setup* menu shown below in Figure 29 is displayed.
- For those units configured for the Metasys® N2 Open protocol, the *Network Setup* menu shown below in Figure 28 is displayed.

Figure 28. Network Setup menu options available for units configured for Metasys N2 protocol.

Figure 29. Network Setup menu options available for units configured for BACnet protocol.

Setting up BACnet® Parameters

On units configured for BACnet® protocol, *Protocol Options* on the *Network Setup* menu allows the *Device ID Offset* and *Max_Master* property to be configured as required. For units configured for Metasys® N2 Open protocol, this option is non-functional at this time. *In a future firmware release, this option may allow users to configure specific settings associated with the N2 Open protocol.*

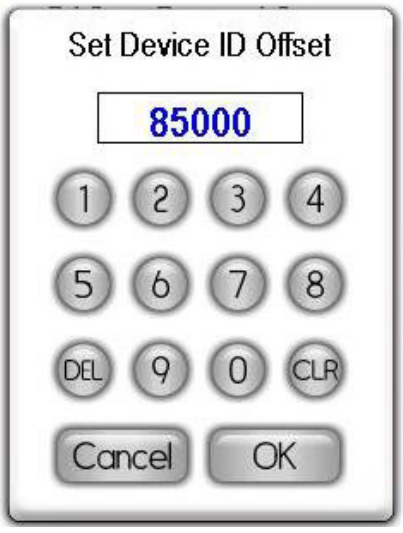


Figure 30. BACnet-specific settings may be configured at this menu.

Configuring Network Settings

Figure 31. Settings specific to BACnet may be configured through this menu.

Selecting the *Protocol Options* option on the *Network Setup* menu invokes the *BACnet® Protocol Setup* menu shown in Figure 31. The *DeviceID Offset* option allows the user to specify an device instance offset from zero to 4,9140,000 in increments of 1,000 (Figure 30).

The device instance number that uniquely identifies a BACnet® device within a network of devices is calculated as the sum of the *MAC address* and the *DeviceID offset* value. For example, if the DeviceID offset is set to the default value of 85,000 and the current MAC address is 123, then the device instance number which uniquely identifies this particular FMS-1655 on the network is 85,123.

The *Max_Master* option on the *BACnet® Protocol Setup* menu allows the user to specify a new value for the *Max_Master* parameter used by the BACnet® MS/TP protocol (Figure 32). This parameter specifies the highest allowable address for a master node on the same network. The default value for this parameter is 127. Setting this parameter to a value lower than the default reduces the number of addresses that are polled by each master node on the network, which effectively improves the overall networking efficiency. Use the slider to specify a new *Max_Master* value. The blue increment and decrement buttons may be used to change the displayed value one step at a time.

For example, if there are at most 25 master mode devices on a given network, and they are addressed between 1 and 30, then setting the Max_Master parameter to 30 limits the addresses which must be polled periodically by each master node on the network. Each master node polls for *new* master nodes periodically, which allows BACnet® devices to be auto-discovered. It is recommended that the Max_Master parameter be left at the default value so that future devices can be added to the network without having to reset the Max_Master parameter at each device.

Figure 32. The Max_Master property may be lowered to improve efficiency

The *Object List* and *Properties* options on the *BACnet® Protocol Setup* menu allow the user to display the list of BACnet® objects and their properties, respectively. *These menu options are currently disabled, but will be enabled in a future firmware release for the FMS-1655.*

Choosing the Baud Rate

The *Set Baud Rate* option on the *Network Setup* menu allows the baud rate to be configured as required by the network to which the FMS-1655 is connected. This menu option is only available while the unit has been configured for BACnet® protocol support. Selecting the *Set Baud Rate* option invokes the *Select Baud Rate* configuration screen shown in Figure 33.

Configuring Network Settings

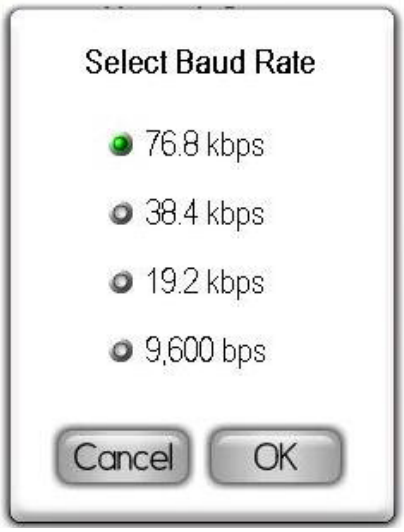


Figure 33. Baud rate may be selected from one of four standard BACnet rates.

Setting the Network or MAC Address

The *Set Address* option on the *Network Setup* menu allows the network or MAC address to be specified as required. For BACnet® MS/TP networks, the valid range of MAC addresses that support master mode is 1 to 127. For Metasys® N2 Open networks, the valid range of network addresses is 1 to 255.

Selecting the Set Address option on the *Network Setup* menu invokes the *Enter MAC Address* configuration screen if the unit has been configured for BACnet® protocol support. Otherwise, the *Enter Network Address* configuration screen is invoked, which prompts the user for a new Metasys® N2 node address. Use the slider to specify a new address. The blue increment and decrement buttons may be used to change the displayed address one step at a time.

The next section details the options available on the *System Setup* menus.

Configuring Secondary Analog Inputs

(For overview, see FLOW DIAGRAMS - Page 67)

Introduction

The *System Setup* menus provide support for configuring all of the hardware resources on the FMS-1655. The first page of the *System Setup* menu as shown in Figure 35 provides options for configuring the four universal analog inputs, two dedicated thermistor inputs, four universal analog outputs, and the four relay outputs.

The second page of the *System Setup* menu as shown in Figure 36 provides options for configuring the four (4) PID loop settings, all alarm settings, specifying the engineering units for each analog input, and managing the system security passwords. Several of the configuration options on the *System Setup* menus specific to the hardware resources are redundant with those on the *Controller Setup* menus.

Figure 35. System Setup menu (1 of 2) provides options for configuring the analog and digital inputs/ outputs.

The *Analog Inputs* option on the *System Setup* menus allows the additional universal analog inputs on the FMS-1655 to be individually configured based on the mode selected for each. Each of the secondary universal analog inputs (AI-2 through AI-4) may be configured for *differential pressure, volumetric flow, relative humidity,* or *temperature setpoint adjust*. When using one of the dedicated thermistor inputs for temperature control applications, any one of the secondary analog inputs may be configured for use with a thermostat slider to serve as a temperature setpoint offset adjustment.

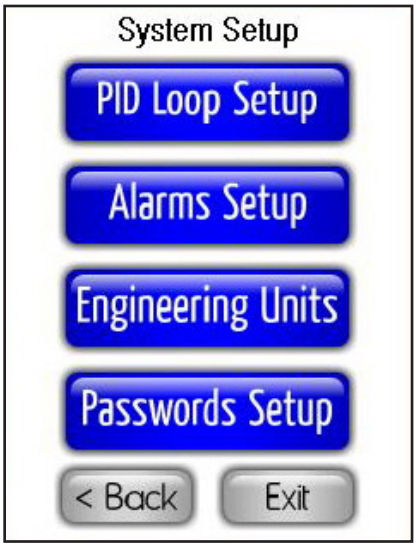


Figure 36. System Setup menu (2 of 2) provides options for configuring engineering units, alarm settings, and managing the system passwords.

The *Analog Inputs* option on the *System Setup* menus also allows the two (2) thermistor inputs to be configured as required by the specific installation, including target setpoints for each should they be utilized as the input channel for one of the PID control outputs, e.g., for temperature control applications.

The *Analog Outputs* option on the *System Setup* menus allows the additional universal analog outputs on the FMS-1655 to be individually configured. Each of the secondary analog outputs may be configured for *proportional (direct) analog output mode* or *PID analog output mode*. As with the primary analog output (AO-1), each of the secondary analog outputs may be independently mapped to any of the available analog inputs. This includes any one of the four (4) universal analog inputs or either of the two (2) dedicated thermistor inputs. Each analog output may also be configured for either *direct acting* or *reverse acting* mode as required by the specific application.

The *Digital Inputs* option on the *System Setup* menus allows the additional digital inputs on the FMS-1655 to be individually configured. Each of the secondary digital inputs may be configured for one of four input types: *door switch, occupancy switch, override switch*, or *auxiliary input*. Currently, only the door switch input type is available as an option for the secondary digital inputs. *The other digital input types will be supported in a future firmware release for the FMS-1655*.

Configuring Secondary Analog Inputs

The *Relay Setup* option on the *System Setup* menus allows the additional relay outputs on the FMS-1655 to be individually configured. As with the primary relay output, each of the secondary relay outputs may be configured for one of three trigger modes: *Setpoints*, *Isolation Mode*, or *Occupancy Mode*.

- *Setpoints Mode* uses a pair of setpoints to determine when to activate or deactivate the alarm relay.
- Isolation Mode allows the alarm relay to be triggered based on the mode of isolation selected.
- *Occupancy Mode* uses the state of occupancy to determine when the alarm relay should be active or inactive.

The *PID Loop Setup* option on the System Setup menus allows the additional PID control loops to be individually configured based on the requirements of the specific application. Each of the secondary PID control loops is directly associated with the corresponding secondary analog output. As with the primary PID loop settings, the three constants (proportional, integral, derivative) may be independently tuned for the desired response at each analog output.

The *Alarms Setup* option on the *System Setup* menus allows all of the settings associated with the alarm functionality of the FMS-1655 to be configured independently. This includes all of the individual alarm enables, alarm setpoints, and alarm buzzer enables. The flexibility of the alarm capabilities incorporated in the FMS-1655 is unmatched in the industry, and can be tailored to meet most any specification requirements.

The *Engineering Units* option on the *System Setup* menus allows the user to select between Imperial and Metric units for each analog input resource, including the two thermistor inputs. The default selection is Imperial units for all analog inputs.

The *Passwords Setup* option on the *System Setup* menus allows the user to manage the system security password facility that has been incorporated into the FMS-1655. Up to ten (10) unique multiple access level passwords may be stored in the unit to prevent unauthorized access to the system menus and configuration settings.

The next section details the options available on the *Analog Inputs Setup* menus.

Configuring Secondary Analog Inputs

Selecting one of the secondary analog inputs from the Analog Inputs Setup menu invokes the Select Input Type configuration screen as shown in Figure 37. If Analog Input 1 is selected, the same options accessed through the Controller Setup menus are traversed (Figure 7 through Figure 9).

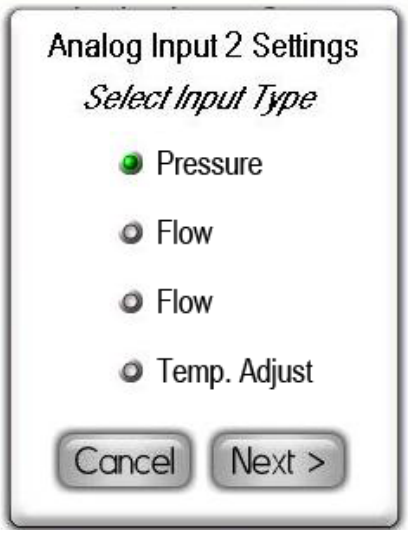


Figure 37. Secondary analog inputs may be configured for pressure, flow, humidity, or temperature.

Setting Up Analog Inputs for Pressure

To configure one of the secondary analog inputs for differential pressure, select *Pressure* from the *Select Input Type* configuration screen (Figure 37) and click the *Next* button.

The *Pressure Sensor Input* configuration screen appears where the user may specify the type of pressure sensor being used. There are two types of Triatek pressure sensors, and an option for using a non-Triatek pressure sensor. The two Triatek types are *Remote Digital 4-20mA*, using a standard 4-20 mA current output to represent the full pressure range, and *Remote Legacy Current*, using a non-standard 7.8-19.55 mA current output. The legacy sensor option provides the FMS-1655 complete backward-compatibility with Triatek's legacy remote pressure sensors. Specify the pressure sensor type and click *Next* to advance to the *Analog Input Settings* configuration screen, where the user may specify if the linearization of the analog input should be enabled, and whether or not the analog input signal should

Configuring Secondary Analog Inputs

be inverted. The *Inverted Mode* option is useful for situations where the remote sensor was installed backwards with the reference port facing the monitored space instead of the reference space. Clicking the *Next* button invokes the next *Analog Input Settings* configuration screen where the displayed engineering units may be specified, as well as the voltage or current range for the analog input signal.

For all Triatek remote sensor units, the default pressure range is ±0.25 "WC and the input range should be set to *4-20mA*. Clicking the *Next* button invokes the *AI-x Sensor Range* configuration screen (Figure 9) where the pressure range associated with the remote sensor should be specified. Once the pressure range is specified, the user is prompted to enter a setpoint for the currently active isolation mode as well as the deadband setting to be used for all modes. The default deadband setting is zero.

Setting up Analog Inputs for Flow

The FMS-1655 can be configured to calculate and display the real-time *Air Change Rate* using one of three types of air flow input methods or sensors. To configure one of the secondary analog inputs for air flow measurement, select *Flow* from the *Select Input Type* configuration screen as shown in Figure 38 and click the *Next* button. The *Flow Sensor Input* configuration screen shown in Figure 39 appears, allowing the user to select which type of sensor will be used for measuring air flow.

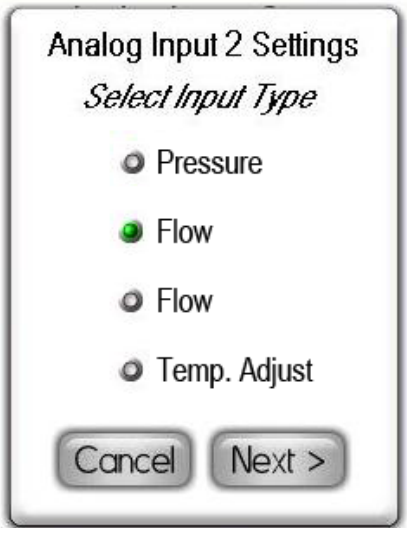


Figure 38. To calculate & display air change rate, input should be configured for flow.

After selecting the type of sensor that is being used to measure air flow, clicking the *Next* button invokes two configuration screens (Figure 40) which allow the user to specify the minimum and maximum flows supported by the sensor. These values should be entered in the engineering units which correspond to the type of sensor. For example, the units would be either inches of water column ("WC) or Pascals (Pa) for DP transmitters.

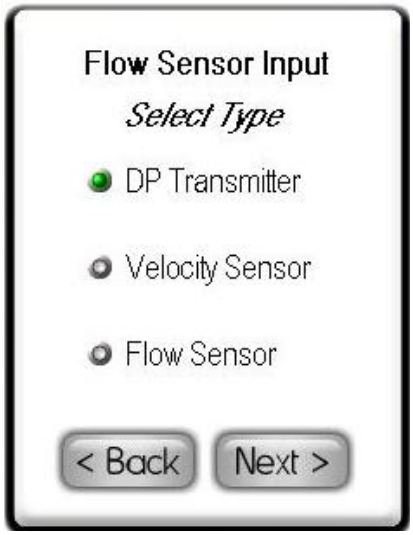


Figure 39. FMS-1655 supports three types of sensors for Air Flow measurement.

After specifying the maximum and minimum for the flow input, the user is prompted to specify the *cross-sectional duct area* in square inches as shown in Figure 43 if the type of flow sensor is either a DP transmitter or a velocity transmitter. This duct area is required to convert a differential pressure or a velocity to a real-time volumetric flow, which may then used to calculate the air change rate (if enabled). For round ducts, the cross-sectional area can be determined by multiplying the square of the radius by pi (3.1416). As an example, the cross-sectional area of a round 12" duct, which has a radius of 6", is calculated as follows:

$$Area_{round\ duct} = \pi * r^2 = 3.1416 * (6")^2 = 113.09\ in^2$$

For rectangular ducts, the cross-sectional area can be determined by multiplying the length and width. As an example, the cross-sectional area of a duct that measures 24" by 12" is calculated as follows:

$$Area_{rectangular\ duct} = L * W = 24" * 12" = 288\ in^2$$

Configuring Secondary Analog Inputs

After specifying the duct cross-sectional area, click the *Next* button to specify a K-factor for the specific sensor being used to input flow. The default value for this K-factor is 1.0, but may be provided by the manufacturer of the sensor to serve as a correction factor for the actual output of that particular sensor unit. If no K-factor is available, this value should be left at the default of 1.0.

Clicking the *Next* button invokes the *Analog Input x Settings* configuration screen as shown in Figure 41, where the user may specify whether or not air changes should be calculated and displayed on the main screen, as well as the range of the input signal (voltage or current) for the air flow sensor. If the air changes have been selected for display, the user is prompted to enter the *room volume* in cubic feet at the *Enter Room Volume* configuration screen shown in Figure 42. The room volume is required to calculate the real-time air change rate based on the flow input signal. To calculate the volume of a rectangular room in cubic feet, multiply the length of the room by the width and the height. For irregular shaped rooms, the volume will have to be determined by breaking the room up into multiple smaller rectangular areas and summing the individual volumes to calculate the total room volume in cubic feet. Otherwise, an approximation may be specified for the room volume. This volume may also be *fine-tuned* to increase the accuracy of the displayed air change rate according to the actual volumetric flow offset of the room.

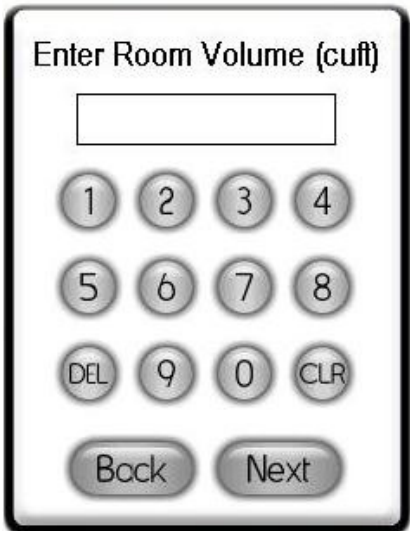


Figure 42. The room volume in cubic feet should be entered here to allow the air change rate to be calculated.

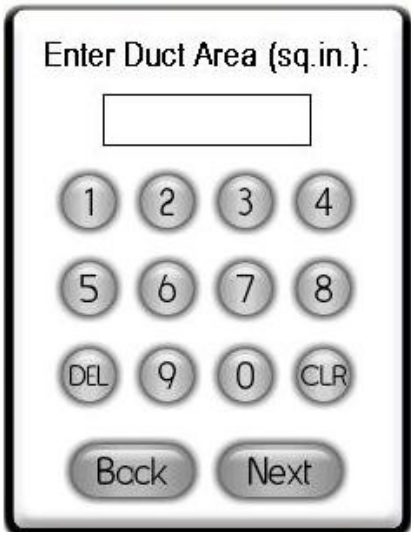


Figure 43. To allow velocity or velocity pressure measurements to be converted to flow, the duct area is required in square inches.

Clicking the *Next* button at the *Enter Room Volume* configuration screen advances to the next three screens prompting the user for the air change rate setpoints for each mode of isolation (positive, negative, neutral). The controller uses these setpoints to modulate the associated analog output to maintain the desired air change rate in the three different modes of isolation. AI-2 must be used to monitor the supply air flow if it is desired to have separate air change rate setpoints based on the current mode of isolation. Using AI-3 or AI-4 for the supply air flow only one air change rate setpoint is available.

Setting up Analog Inputs for Humidity

The FMS-1655 can be configured to measure and display humidity in real-time using readily available sensors from BAPI® and other manufacturers. To configure one of the secondary analog inputs for ***humidity*** measurement, select *Humidity* from the *Select Input Type* configuration screen (Figure 44) and click the *Next* button. The *Analog Input x Settings* configuration screen shown in Figure 45 appears, allowing the user to select the engineering units and voltage or current input range for the connected sensor.

Click the *Next* button at the *Enter Room Volume* configuration screen to advance to the three screens prompting the user for air change rate setpoints for each mode of isolation (*positive*, *negative*, *neutral*). The controller uses setpoints to modulate the associated analog output to maintain the desired air change rate in the three modes of isolation.

Configuring Secondary Analog Inputs

If the humidity input is being utilized for a humidity control scheme, then clicking the *Next* button at the popup shown in Figure 45 invokes the setpoint entry configuration screen shown in Figure 46 where the user may enter a target humidity setpoint. The humidity input must also be mapped to one of the analog outputs that has been configured for PID control mode.

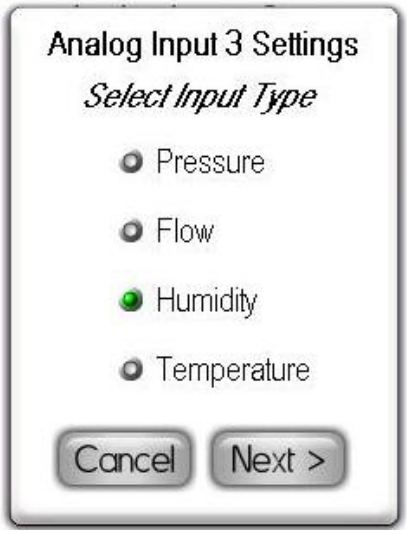


Figure 44. The FMS-1655 supports humidity monitoring and control.

Figure 45. Default engineering units selection for humidity measurement is %RH.

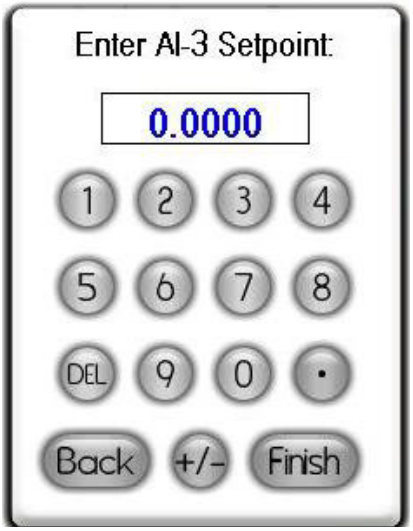


Figure 46. If humidity control is required, the target setpoint may be entered here.

Setting up Analog Inputs for Temperature Setpoint Adjust

Many thermostat devices, such as those available from BAPI®, include a slider or rotary potentiometer-based input that may be configured for use with the FMS-1655 as a temperature setpoint offset adjustment. To configure one of the secondary analog inputs as a **temperature setpoint offset**, select the *Temp. Adjust* option from the *Select Input Type* configuration screen and click *Next*. The user is prompted to specify the *Temperature SP Delta*, which determines the total range of the offset. For example, to specify a setpoint offset of ±10ºF, a delta of 20 should be entered. The value entered is assumed to be in the same units as the engineering units setting for the thermistor inputs (Fahrenheit or Celsius).

Configuring Secondary Analog Inputs

Setting up Thermistor Inputs

The FMS-1655 includes two (2) dedicated thermistor inputs for measuring and monitoring resistive temperature sensors, or thermistors. These inputs may be configured for use with negative temperature coefficient (NTC) Type 2 or Type 3 thermistors from BAPI® or other manufacturers.

BAPI® manufactures several combination temperature and humidity sensor products which are ideal for use with the FMS-1655 for complete room monitoring and control applications. Triatek recommends BAPI® part no. BA/10K-2-H200-R, which is a combination temperature and humidity sensor includes a NTC Type 2 thermistor for temperature sensing and a ±2% humidity transmitter with a 0 to 10V output.

Selecting *Thermistor Input 1* or *Thermistor Input 2* on the second page of the *Analog Inputs Setup* menu invokes the *Thermistor x Settings* configuration screen as shown in Figure 50. From this configuration popup, the user may specify which type of NTC thermistor device is connected and the engineering units for displaying the monitored temperature on the main screen. If the thermistor input is being utilized as part of a temperature control scheme, then clicking the *Next* button at the *Thermistor x Settings* popup invokes the setpoint entry configuration screen shown in Figure 49 where the user may enter a target temperature setpoint. The thermistor input must also be mapped to one of the analog outputs that has been configured for PID control mode.

The monitored temperature may be displayed on the main screen by setting the temperature display source to use the corresponding thermistor input. This may be configured from *Display Options* on the *Display Setup* menu, discussed in more detail in a later section of this document.

The next section discusses the options available on the *Analog Outputs Setup* menu and the configuration of the secondary analog outputs on the FMS-1655.

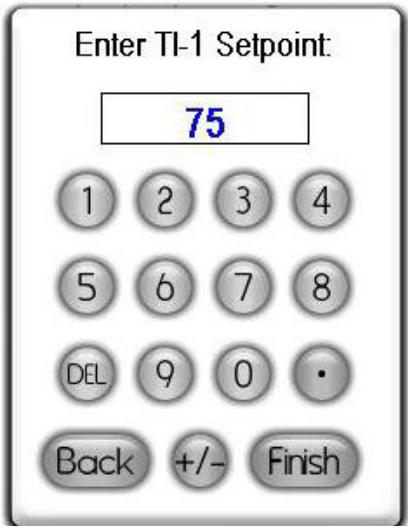


Figure 49. A temperature setpoint may be entered here for temperature control applications using one of the PID analog outputs.

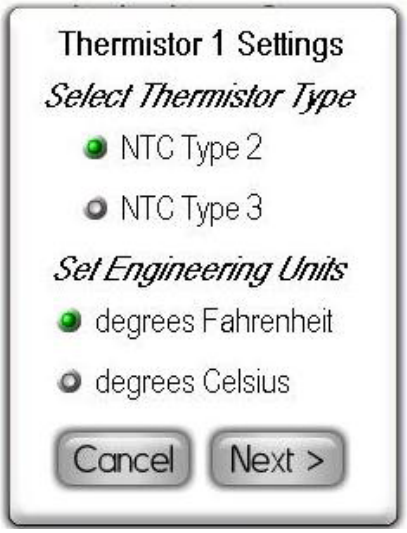


Figure 50. The FMS-1655 supports the use of NTC Type 2 and 3 thermistors for temperature control and/or monitoring applications.

Notes

Configuring Secondary Analog Outputs

Selecting one of the secondary analog outputs from the *Analog Outputs Setup* menu invokes the *Select AO-x Settings* configuration popup as shown in Figure 52. The user may select the operating mode for this analog output resource (*direct* or *PID*), as well as the signal range for this control output. The selection between voltage and current mode for the analog output is accomplished using the hardware configuration dipswitch on the controller module. See the ***FMS-1655 Wiring and Installation Guide*** for complete details on configuring the analog output hardware resources.

Figure 51. For a temperature control application that measures temperature using thermistor input 2 and analog output 2 in PID control mode, the settings would be configured as shown above.

Once the operating mode and output range have been specified, click the *Next* button to invoke the *Set Upper Limit* and *Set Lower Limit* configuration screen. The user may specify both an upper and lower limit above and below which the analog output will not exceed, respectively. This feature is useful for applications requiring a minimum output at the control signal for an air flow damper, for example.

Click the *Next* button to invoke the final *Select AO-x Settings* popup where the user may remap the analog output to one of the other analog inputs and change the action mode for the control output.

For example, if analog output 2 is being used in a temperature control application which receives the temperature signal via thermistor input 2, TI-2 should be selected in the *Select Input Channel* section of the configuration popup as shown in Figure 51.

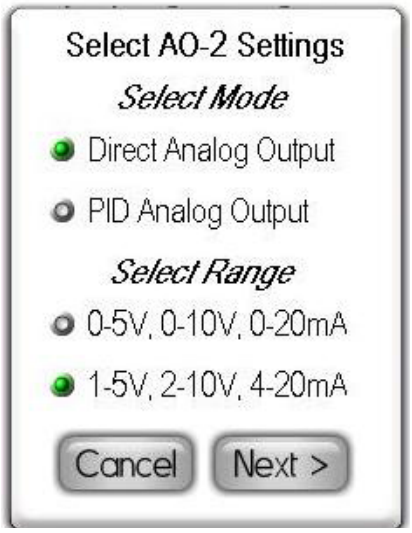


Figure 52. Each of the three secondary analog outputs may be independently configured for direct or PID analog output mode, depending on the application requirements.

Remapping the Secondary Analog Outputs

While the analog outputs may each be remapped at the final configuration popup, they may also be remapped using the *Analog I/O Mapping* option on the *Analog Inputs Setup* menus. Selecting this option invokes the *Analog I/O Mapping* configuration popup as shown in Figure 53. Each analog output may be mapped to one of the analog input resources, including the two dedicated thermistor inputs. Selecting a different analog input channel for any given analog output cancels the existing mapping for that output. However, multiple analog outputs may each be mapped to the same analog input, which may each have their own specific setpoints associated for their particular application.

For example, two analog outputs may use the primary differential pressure input on AI-1 to satisfy two different control objectives. AO-1 may control the exhaust valve to maintain a target differential pressure whenever the pressure is within a specific range. Simultaneously, AO-2 may control the supply valve to maintain a specific volumetric offset between the supply and the exhaust.

The next section discusses the options available on the *Digital Inputs Setup* menu and the configuration of the secondary digital inputs on the FMS-1655.

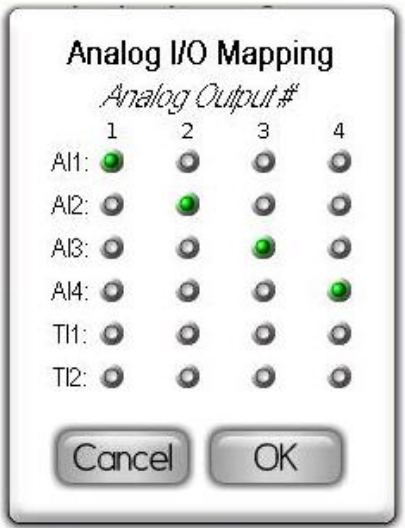


Figure 53. Analog I/O resources may be remapped at any time by selecting which analog input channel is used by each analog output.

Configuring Secondary Digital Inputs

Selecting one of the secondary digital inputs from the *Digital Inputs Setup* menu invokes the *Select Input Type* configuration popup as shown in Figure 54. The user may select the operating mode and polarity for this digital input resource. The selection between active-high and active-low mode for the digital inputs is a global hardware configuration setting and is accomplished using the configuration slide switch (S5) on the controller module. ***See the FMS-1655 Wiring and Installation Guide*** for complete details on configuring the digital input hardware resources.

Each of the secondary digital inputs may be configured for one of four types: *door switch, occupancy switch, override switch,* or *auxiliary input*. The latter two options are unavailable at this time and may not be selected. These options may be implemented in a future firmware release for the FMS-1655. If *door switch* is selected as the input type for one of the secondary digital inputs, that input may be used to suspend the PID control loop processing for the corresponding analog output. For example, DI-2 configured as a door switch input will allow the PID loop processing for AO-2 to be suspended whenever the door monitored by DI-2 is open. Once *Door Switch* has been selected at the *Select Input Type* configuration screen, clicking the *Next* button invokes *Door Switch Settings* configuration screen (Figure 14). The door switch input may be configured for one of two modes: *Normally-Open* or *Normally-Closed*. While any suitable switch may be used with the FMS-1655, the door switch provided by Triatek (part no. SWD200-2) supports both Normally-Open (N.O.) and Normally-Closed (N.C.) operating modes.

After selecting N.O. or N.C. as the operating mode for the door switch, set the delay as required by the specific installation. The default value for the door delay is zero seconds, but may be as much 240 seconds, or 4 minutes. When the door to the monitored room opens, the associated PID control loop is suspended, preventing the controlled valve from being modulated unnecessarily while the door is open. Once the door closes, the door delay timer begins counting down, and releases the PID control loop once it expires and resumes modulating the controlled valve to maintain the differential pressure target setpoint.

Configuring one of the secondary digital inputs for *Occupancy Switch* mode allows an external signal, either from an occupancy switch or sensor, or a relay output, to switch the mode of isolation between neutral and either positive or negative. Clicking *Next* after selecting *Occupancy Switch* as the input type invokes the *Occupied Mode* configuration screen, which allows the user to specify which mode of isolation should be active when the room is occupied. When the digital input configured as an occupancy switch returns to the inactive state, the isolation mode automatically switches back to neutral mode.

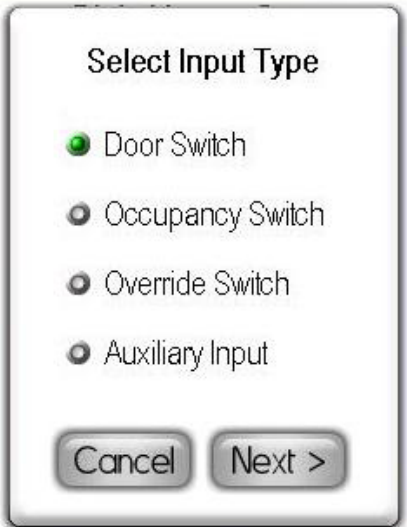


Figure 54. Secondary digital inputs may be used for a variety of applications.

Configuring Secondary Relay Outputs

(For overview, see FLOW DIAGRAMS - Page 68)

Selecting one of the secondary relay outputs from the Relay Setup menu invokes the *Relay x Trigger Mode* configuration popup as shown in Figure 56. The user may select one of three trigger modes for this digital output resource: *Setpoints*, *Isolation Mode*, or *Occupancy Mode*. Currently, the only available option for triggering the relay outputs on the FMS-1655 is *Setpoints Mode.* The other two trigger modes will be made available in a future firmware release.

Once *Setpoints Mode* is selected as the trigger mode for the relay output, the user is prompted to select one of the four universal analog inputs or one of the two dedicated thermistor inputs as the input channel. While the default setting for the relay outputs is a one-to-one mapping, this selection allows the relay output to be remapped to any one of the analog input resources. For example, if one of the secondary relay outputs is to be used to control a strip heater in a temperature control application, then that relay should be remapped to the thermistor input that monitors the room temperature.

After selecting the input channel, clicking *Next* advances to the *Relay x High Setpoint* entry screen, where the user may specify the threshold above which the relay gets activated, or deactivated if in reverse acting mode. After entering the high setpoint, clicking *Next* advances to the *Relay x Low Setpoint* entry screen, where the user is prompted for the threshold below which the relay gets deactivated, or activated if in reverse acting mode.

After specifying the high and low setpoints, the user is prompted for the acting mode and delay associated with the relay output (Figure 55). In direct acting mode, the relay output will be activated when the sensor input exceeds the high setpoint, and will be deactivated when the sensor input falls below the low setpoint.

In reverse acting mode, the relay output will be deactivated when the sensor input exceeds the high setpoint, and will be activated when the sensor input falls below the low setpoint. The relay output delay may be up to 180 seconds, or three minutes, in duration. If *Isolation Mode* is selected as the trigger mode for the relay output, the user is next prompted to select whether the relay output should activated or deactivated for each mode of isolation. Next, the user is prompted for the acting mode and delay to be associated with the relay output.

If *Occupancy Mode* is selected as the trigger mode for the relay output, the user is next prompted to select whether the relay output should activated or deactivated for the two states of occupancy. Next, the user is prompted for the acting mode and delay to be associated with the relay output.

Figure 55. The action mode and delay time for secondary relays may be configured at this popup screen.

Figure 56. Secondary relay outputs may be triggered in one of three modes, with the default being Setpoints mode.

The next section discusses the options available on the *PID Loop Setup* menu and the configuration of the secondary PID loops on the FMS-1655.

Notes

Configuring Secondary PID Loops

When the FMS-1655 is configured to use any of the secondary analog outputs in PID mode, the constants that determine the performance and characteristics of the closed-loop control scheme may be specified using the corresponding option on the *PID Loop Setup* menu. Selecting one of the secondary PID loops from the *PID Loop* Setup menu invokes the *PID Loop x Settings* configuration popup as shown in Figure 57, where the user can specify the proportional, integral, and derivative constants to be used by the closed-loop control scheme for the corresponding analog output.

The three dimensionless PID constants may vary from zero to 100 using the three sliders on the configuration screen. The proportional constant is limited to 0.5 as a minimum to prevent the inadvertent disabling of the analog output. The blue increment and decrement buttons may be used to step each constant in increments of 0.5.

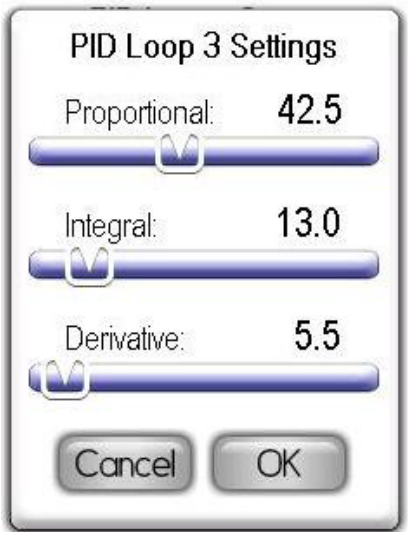


Figure 57. PID constants may be fine-tuned here to affect the performance of analog output 3 while it is configured for PID mode.

The next section discusses the options available on the *Alarms Setup* menu and the configuration of the alarm resources on the FMS-1655.

Configuring Universal Alarm Settings

Introduction

The FMS-1655 incorporates an extremely flexible alarm facility that can meet most any application requirements. The alarm system includes both visual and audible alarms that may be independently enabled for each monitored analog input in the system. There are two distinct audible alarms to indicate higher and lower priority alarm conditions by sound alone. An *Alarm Quiet Period* feature has been integrated in the FMS-1655 which allows the audible alarms to be suppressed while still allowing visual and networking alarms to continue.

All of the configuration settings associated with the FMS-1655 alarm facility may be access at the *Alarms Setup* option on the second page of the *System Setup* menus. Selecting this option invokes the *Alarms Setup* menu as shown in Figure 58. Options on this menu allow individual alarms to be enabled for each of the universal analog inputs as well as the two thermistor inputs. Up to four (4) distinct alarm setpoints may be configured for each analog input.

Enabling Individual Visual Alarms

Selecting the *Enable Alarms* option from the *Alarms Setup* menu invokes the *Alarm Enable Settings* configuration popup shown in Figure 59. Each of the universal analog inputs and the two dedicated thermistor inputs may be individually enabled for visual alarming at this configuration screen.

Figure 58. The FMS-1655 has an extensive alarm facility that can accommodate most any application requirements.

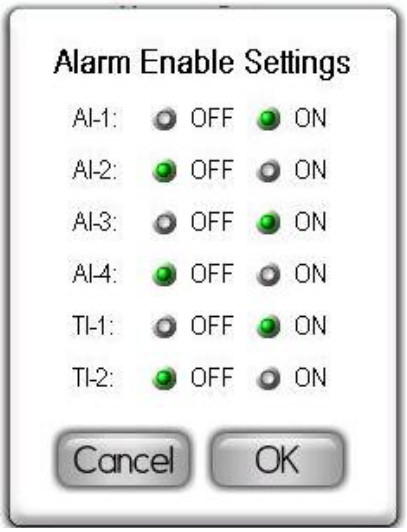


Figure 59. Alarm support for each analog input may be enabled independently.

An analog input or thermistor input that has been enabled for alarming at the *Alarm Enable Settings* configuration screen will report their alarm statuses visually and independent of their audible alarm enable settings. There are three alarm status conditions, each represented by a distinct background color on the display.

- *Normal status* indicates that the monitored input is within its normal operating range and is indicated by a green background as shown in Figure 61.
- *Warning status* indicates that the monitored input has drifted outside of its normal operating range, but has not yet exceeded the alarm setpoints. This status condition is indicated by a yellow background as shown in Figure 60, and does not sound the audible alarm regardless of the enable settings.
- *Alarm status* indicates that the monitored input has exceeded the alarm setpoints and is indicated by a red background as shown in Figure 62.

If the primary monitored room is currently in neutral isolation mode, then the visual alarming will be temporarily disabled for the differential pressure input only, and will be indicated by a blue background as shown in Figure 63. While the FMS-1655 is in neutral isolation mode, the audible alarms as well as the alarm relay will be disabled and will not be activated. The current differential pressure reading, however,

Configuring Universal Alarm Settings

will continue to be shown on the main display. If the temperature and humidity are being displayed on the main screen and they have been enabled for alarming, their status will be indicated on the main screen using the same philosophy as the primary differential pressure input.

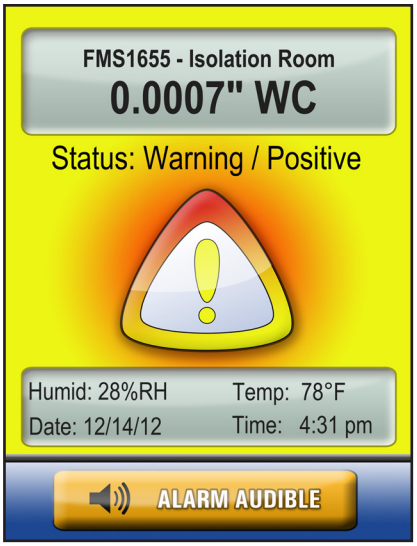


Figure 60. Warning status is indicated by a yellow background on the main display.

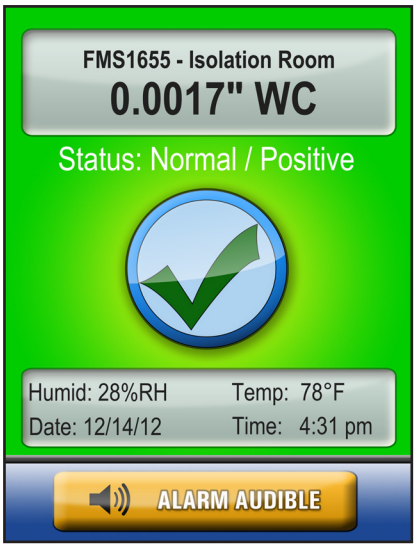


Figure 61. Normal status is indicated by a green background on the main display.

Should the temperature enter the warning zone based on its alarm setpoints, the background on the "temperature line" of the display will turn yellow to indicate the warning status (Figure 65). Similarly, if the humidity exceeds the alarm setpoint and enters alarm status, the background on the "humidity line" of the display will turn red to indicate the alarm status as shown in Figure 64.

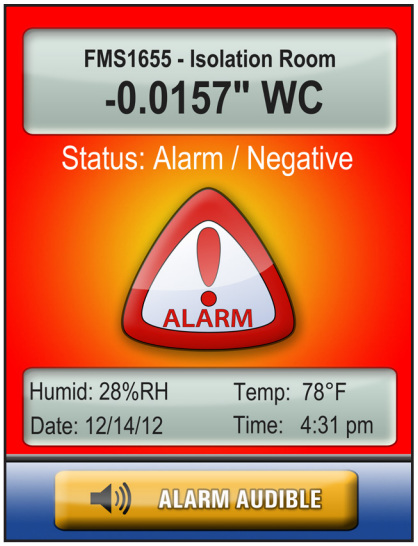


Figure 62. Alarm status is indicated by a red background on the main display.

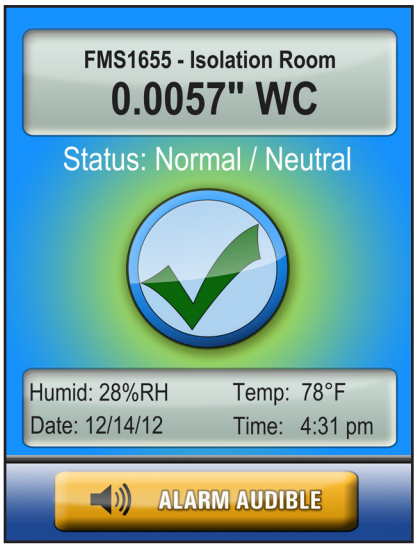


Figure 63. Neutral isolation mode is indicated by a blue background on the main display.

Configuring Universal Alarm Settings

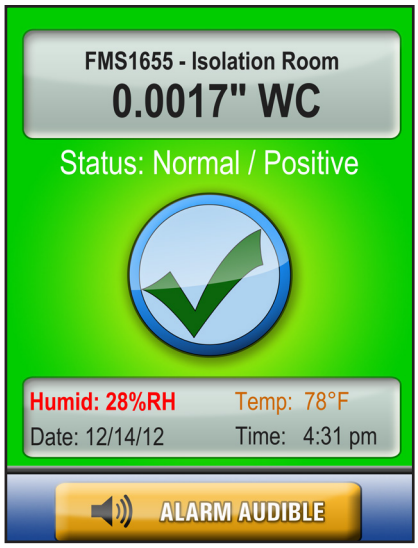


Figure 64. Humidity alarm and temperature warning while in normal mode is represented by red and orange displays, respectively.

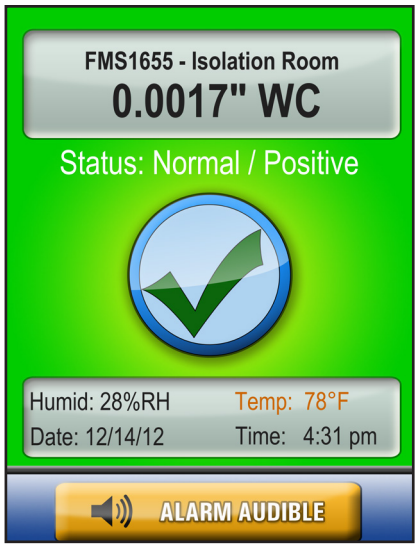


Figure 65. Temperature warning while in normal mode is represented by orange temperature display.

Enabling Individual Audible Alarms

Selecting the *Audible Alert* option from the *Alarms Setup* menu invokes the *Alarm Buzzer Settings* configuration popup shown in Figure 67. Each of the universal analog inputs and the two dedicated thermistor inputs may be individually enabled for audible alarming at this configuration screen.

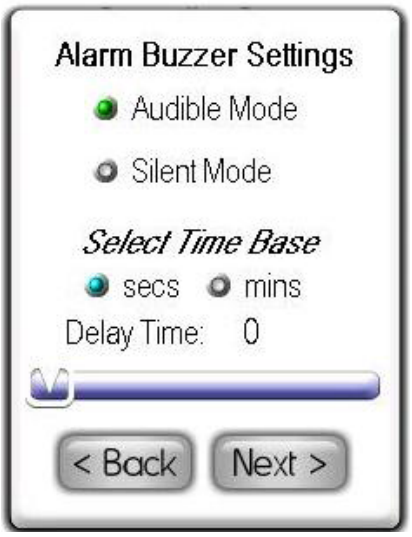


Figure 66. Audible alarm may be set to silent mode, and may include a delay time before being activated.

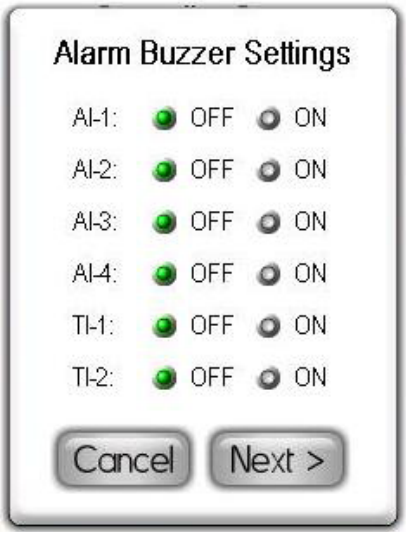


Figure 67. Audible alarms may be enabled individually for each analog input and thermistor input.

Configuring Universal Alarm Settings

After selecting the individual analog and thermistor inputs which should activate the audible alert when in alarm mode, click the *Next* button to invoke the *Alarm Buzzer Settings* configuration popup as shown in Figure 66.

The alarm buzzer may be selected for one of two modes of operation: *Audible Mode* or *Silent Mode*. If audible mode is selected, the user is prompted to enter the desired delay in seconds or minutes. If silent mode is selected, then the alarm buzzer will not sound whenever the enabled analog inputs enter alarm status. If audible mode is enabled, clicking the *Next* button invokes the *Alarm Buzzer Settings* configuration screen shown in Figure 21 in a previous section, where the user may specify an *Alarm Quiet Period* during which the audible alarm buzzer will be suppressed.

The next section discusses the options available on the *Engineering Units* menu and the configuration of the displayed units for each analog input resource on the FMS-1655.

Configuring Engineering Units for Secondary Inputs

(For overview, see FLOW DIAGRAMS - Page 69)

Each of the analog input resources available on the FMS-1655 may be displayed using one of two engineering units settings: *Imperial* and *Metric*. The default engineering units setting is Imperial.

To change the units settings for a particular analog input, select the *Engineering Units* option from the *System Setup* menu. The four universal analog inputs and two thermistor inputs are shown as options on the *Engineering Units Setup* menus. Selecting one of these options invokes the *AI-x Engineering Units* popup where the user may select either the Imperial units or the metric units.

The choice of engineering units available will be entirely dependent on how the specific analog input was configured. For analog inputs configured for differential pressure measurements, the available options for engineering units include inches of water column and pascals as shown in Figure 69. For an analog input that has been configured for measuring air flow using a velocity sensor, the available engineering units are feet per minute and meters per second as shown in Figure 68.

Figure 68. Analog inputs configured for air flow with a velocity sensor may display reading in either ft/min or m/sec.

Figure 69. Analog inputs configured for measuring pressure may display the reading in "WC or Pa.

The two thermistor inputs are dedicated for measuring temperature and may be displayed in degrees Fahrenheit or degrees Celsius. The next section discusses the options available on the *Passwords Setup* menu and the management of the security passwords for the FMS-1655.

Managing System Passwords

The FMS-1655 room pressure controller incorporates a system security password facility to prevent unauthorized access to the system menus and configuration settings. The password facility has a capacity of ten (10) unique, multiple access level passwords. The *Password Setup* option on the *System Setup* menus allows the user to manage the system passwords including adding, editing, and deleting entries from the system (Figure 71). The following sections discuss the use of the four options on the *Password Setup* menu.

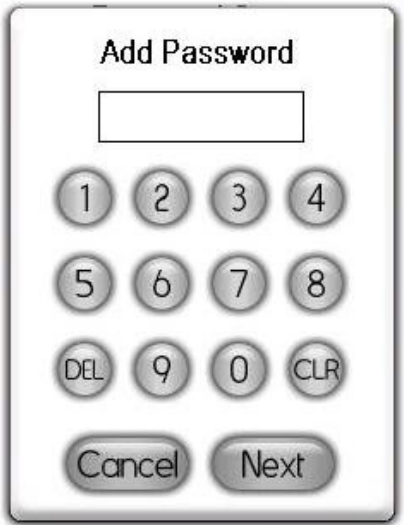


Figure 70. Password entries can contain between 4 and 8 digits.

Adding a New Password

The first password is automatically saved with an access level of *Unrestricted*, to eliminate any issues with trying to add new passwords when a *Restricted Access* password has been saved to the system.

To add a new password entry, select the *Add Password* option from the *Password Setup* menu. At the password entry screen shown in Figure 70, enter at least four (4) and up to eight (8) digits to define a new entry. Assuming the entry is unique, clicking the *Next* button advances to the *Set Menu Access Level* configuration popup as shown in Figure 72. If the entry is invalid or not unique, the warning buzzer will sound and the password entry screen will reset to accept a new entry.

Figure 71. Passwords may be added, edited, or deleted from the Password Setup menu.

After a successful password entry has been entered, select one of four menu access levels for the new entry.

- Unrestricted Access grants the password owner full access to the user menu system with no restrictions. This access level should be used for any passwords established for building management personnel, managers, or any other individuals who would need full unrestricted access to the user menus.
- Standard Access level restricts the user from accessing a very limited number of administrative menu options.
- Basic Access offers a more restricted access to the user menu system, but allows minimal access to options that affect the configuration settings.
- Restricted Access limits the access level of the user to a few view-only menu options, and restricts access to any options that may affect configuration settings in the unit.

Click *OK* to save the new password entry and return to the Password Setup menu.

Managing System Passwords

Editing an Existing Password

To edit the user level for an existing password entry, the password being modified must be used to enter the user menu system. Select the *Edit Password* option from the *Password Setup* menu, and select a different access level at the *Set Menu Access Level* configuration popup shown in Figure 72. Click *OK* to save the new settings to non-volatile memory and return to the *Password Setup* menu.

Figure 72. Select one of four access levels based on who will use the password being entered.

Deleting an Existing Password

To delete an existing password entry, the password being deleted must be used to enter the user menu system. Select the *Delete Password* option from the Password Setup menu, and click *OK* to confirm that you want to delete the existing password.

Purging All Passwords

To purge all existing password entries from the system, an unrestricted password must be used to enter the user menu system. Select the *Purge All Passwords* option from the *Password Setup* menu, and click *OK* to confirm that you want to purge all existing passwords from the system.

The next section discusses the options available on the *Display Setup* menu and the management of the display options for the FMS-1655.

Selecting the Display Options

(For overview, see FLOW DIAGRAMS - Page 76)

The Display Modes option on the Display Setup menus allows the main display to be configured based on the number of sensors being monitored. Selecting this option invokes the Select Display Mode configuration screen which provides five different options: Single Sensor Mode, Dual Sensor Mode, Triple Sensor Mode, Quad Sensor Mode, and Custom Display Mode. Each of these modes is discussed in more detail in the following sections.

The second page of the *Display Setup* menus includes options for selecting an alternate language for the user interface, adjusting the display backlighting brightness, and configuring the screensaver option. The primary display settings can be found under the *Display Modes* and *Display Options* menu options.

Each of these *Display Setup* menu options is discussed in more detail in the following sections.

Selecting the Display Mode

When configured for dual sensor mode, there is an alternative view that may be selected which allows both differential pressure readings to be displayed simultaneously at the main screen. To enable this option, select *Simultaneous View* at the *Dual View Mode* configuration screen that appears when dual sensor mode is selected. This results in the main screen being divided exactly in half, with the upper half displaying the primary differential pressure reading (AI-1) and the lower half displaying the secondary differential pressure (AI-2). This is useful for applications monitoring both an isolation room and its anteroom, with the display mounted in the corridor outside of the anteroom. The pressure reading along with the alarm status of both spaces is continuously displayed at the main screen.

Using Single Sensor Mode

For applications that utilize the FMS-1655 as a room pressure monitor or controller for a single space, the *Single Sensor Mode* is the best choice for the display mode setting. All FMS-1655 units are preconfigured at the factory for this default display mode, unless otherwise specified on the sales order.

Single Sensor Mode supports the display of the differential pressure of the monitored room, the room temperature (if a temperature sensor was ordered), the relative humidity of the room (if a humidity sensor was ordered), and the air change rate associated with the monitored room (if a flow sensor was ordered). Other information displayed on the main screen in *Single Sensor Mode* includes the room name, the current mode of isolation, the occupancy status, and the time and date.

Figure 73 shows the main display screen for a FMS-1655 configured for *Single Sensor Mode* with no active alarms. There are several "hot spots" on the main display screen that allow quick and convenient access. The Display Setup menus provide support for configuring all of the display settings on the FMS-1655. The first page of the Display Setup menus includes options for configuring the patent-pending Safety Halo™ feature, configuring the display modes, configuring the display options and sources for each parameter on the main display, and setting the system time and date. The second page of the Display Setup menus includes options for adjusting the display brightness, and editing the names associated with each analog input.

Figure 73. Single Sensor Mode displays all of the above information, if enabled. The alarm status is indicated by background screen color.

DISPLAY SETUP

Selecting the Display Options

To change the current mode of isolation for the room being monitored and/or controlled, just touch the screen at the current isolation mode to bring up the *Set Isolation Mode* configuration screen (Figure 24). If at least one security password has been stored in the system, then clicking on the current isolation mode will invoke the password entry popup before allowing the user to change the mode of isolation. This prevents the isolation mode from being inadvertently changed by unauthorized personnel.
Changing the current displayed units for the room differential pressure reading is as simple as clicking on the existing units (*in WC* or *Pa*), which brings up a popup that provides convenient access to the *Engineering Units* menu option on the *Controller Settings* menus without having to go through the user menu system. The time and date that are displayed at the bottom of the main screen may be set simply by touching them individually and entering the new settings.

Using Dual Sensor Mode

For applications that utilize the FMS-1655 as a room pressure monitor or controller for a two adjacent spaces, the *Dual Sensor Mode* is the optimum choice for the display mode setting. All dual sensor FMS-1655 units are preconfigured at the factory for this default display mode, unless otherwise specified on the sales order.

This mode is typically used in applications where an isolation room or patient room is separated from the main corridor or hallway by an anteroom. *Dual Sensor Mode* allows each monitored space to have independent isolation modes and separately controlled target setpoints.

For example, an isolation room that is being controlled by a dual-sensor FMS-1655 may be configured for positive isolation with respect to the adjacent anteroom, while the anteroom may be configured for negative isolation with respect to the corridor or main hallway.

Dual Sensor Mode supports the display of the differential pressure of the monitored room, the room temperature (if a temperature sensor was ordered), the relative humidity of the room (if a humidity sensor was ordered), and the air change rate associated with the monitored room (if a flow sensor was ordered). Other information displayed on the main screen in *Dual Sensor Mode* include the room name, the current mode of isolation, the occupancy status, and the time and date.

Figure 76 shows the main display screen for a FMS-1655 configured for *Dual Sensor Mode* with no active alarms. The same “hot spots” available when configured for *Single Sensor Mode* are active for *Dual Sensor Mode* as well.

There is an additional “hot spot” available when the FMS-1655 is configured for *Dual Sensor Mode*. To display the current differential pressure reading for the secondary space, simply touch the pressure reading on the main display to bring up the secondary screen, which displays the differential pressure, temperature, and relative humidity of the secondary room (if equipped with the appropriate sensors). Other information displayed on the secondary screen in *Dual Sensor Mode* includes the name and current isolation mode of the secondary space, as well as the current time and date.

The next section discusses the *Display Options* configuration screens in more detail.

Selecting the Display Options

The *Display Options* option on the *Display Setup* menu allows the user to customize the main display of the FMS-1655 and select the sources for each of the displayed parameters. Selecting this option invokes the *Set Display Options* configuration popup as shown in Figure 79.

If this FMS-1655 is not monitoring temperature or humidity, then *Temperature* and *Humidity* may be disabled by deselecting these options on the *Set Display Options* configuration popup. Similarly, if the air flow is not being monitored for the purpose of calculating the air change rate for the monitored room, then *Air Changes* may be disabled by deselecting it. The other parameters are always available, but may be disabled from the display if so desired.

Once the desired parameters to be displayed are selected as shown in Figure 75, clicking the *Next* button invokes the *Select Source* for *Temperature Display* configuration popup as shown in Figure 76. Here, the user may specify the source input for the temperature display. The default source for the temperature display is *Thermistor Input 1*. If so desired, the temperature may be retrieved from the network and displayed on the main screen by selecting *Network Variable* on the configuration popup. The temperature network variable is available as an analog value object at AV-44. Writing to this variable over the network effectively updates the displayed temperature when its source is set to *Network Variable*.

Figure 75. This configuration popup allows the main display to be customized based on the parameters being monitored.

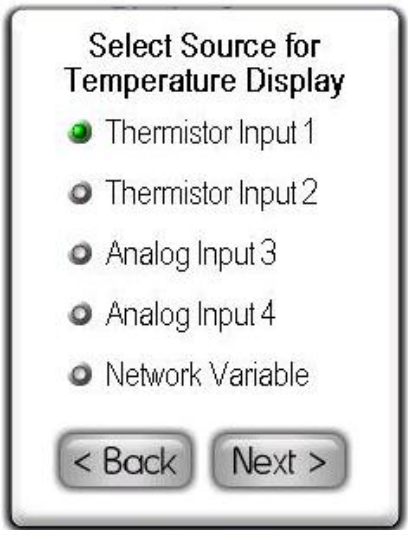


Figure 76. The temperature value displayed on the main screen may originate from one of five (5) sources.

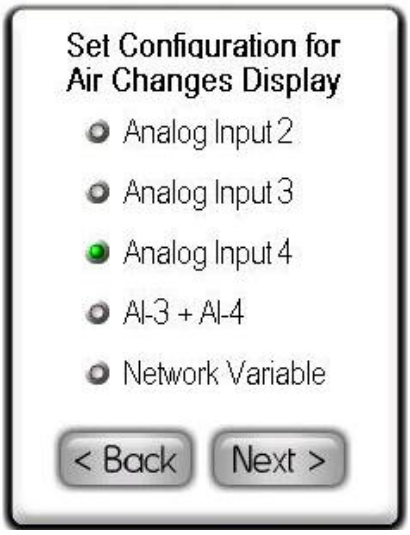


Figure 77. The calculated air change rate displayed on the main screen may originate from one of five (5) sources.

Clicking the Next button at the temperature source popup invokes the *Select Source* for *Humidity Display* configuration popup as shown in Figure 78. At this configuration screen, the user may specify the source input for the humidity display. The default source for the humidity display is Analog Input 3. If so desired, the humidity reading may be retrieved from the network and displayed on the main screen by selecting Network Variable on the configuration popup shown in Figure 78. The humidity network variable is available as an analog value object at AV-43. Writing to this variable over the network effectively

Selecting the Display Options

updates the displayed humidity when its source is set to *Network Variable*. Clicking the Next button at the humidity source popup invokes the Select *Source* for *Air Changes Display* configuration popup as shown in Figure 77. The air change rate is displayed on the main screen in the lower LCD window as an alternating field with the current date as shown below in Figure 79a. The display toggles between the current date and the real-time air change rate every three seconds.

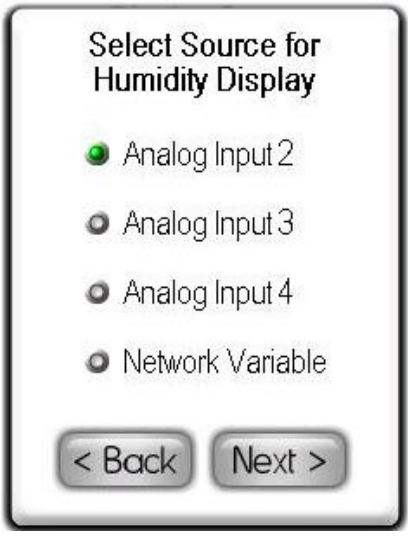


Figure 78. The humidity value displayed on the main screen may originate from one of four (4) sources.

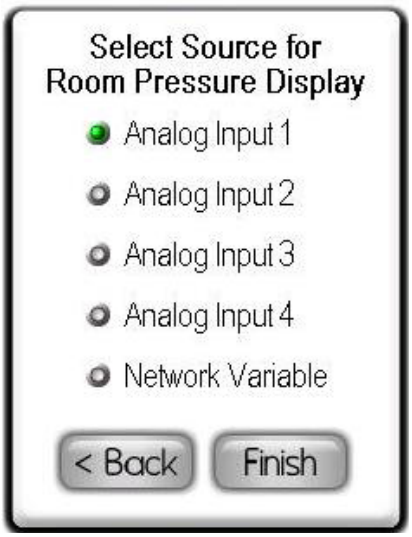


Figure 79. Default source for differential pressure reading is AI-1.

This popup includes an option for summing the input signals at two analog inputs for the purpose of displaying a total air change rate on the main display. If the application requires the air flow measurements from two separate flow sensors to be summed to calculate total air changes, the flow sensors must be connected to analog inputs 3 and 4.

Clicking *Next* at the air changes source popup invokes the *Select Source* for *Room Pressure Display* configuration popup as shown in Figure 79. This allows the user to specify which input should be used for displaying the differential pressure reading on the main screen.

For example, if the FMS-1655 includes multiple pressure sensors connected to the universal analog inputs, this configuration popup allows the sensor that should be displayed on the main screen to be selected. If the pressure is measured separate from the resources attached to the FMS-1655, then that pressure value may be written to the *differential pressure network variable* over the network.

The FMS-1655 incorporates four (4) writable network points that support the displaying of sensor readings from other devices on the same network. The four network writable points include *differential pressure, temperature, humidity,* and *air changes*. To display any one of these readings from a remote source, the *Network Variable* option must be selected on the source selection configuration screen for that particular reading.

For more information on the network variables, see the objects lists at the end of the ***FMS-1655 Wiring and Installation Guide***.

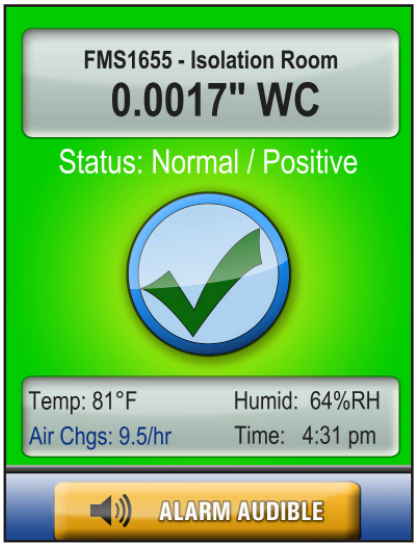


Figure 79A: If Air Changes have been selected as a displayed option, then the calculated real-time air change rate will be displayed in the lower LCD window in place of the date field. This display will alternate between the date and the air change rate every three seconds.

Setting System Date & Time

The FMS-1655 integrates a battery-backed real-time clock that will maintain the system time and date in the event of a power loss. If the controller is connected to a building automation system with a time master, then the time and date will be synchronized with the time server associated with the master.

The FMS-1655 supports the *Time Synchronization* service requests on a BACnet® MS/TP network. The time and date settings may be configured using the *Set Time & Date* option on the *Display Setup* menus. Selecting this option invokes the time entry popup as shown in Figure 80, where the user may specify the current time in 12-hour format. The colon between the hours and minutes automatically appears during the time entry process.

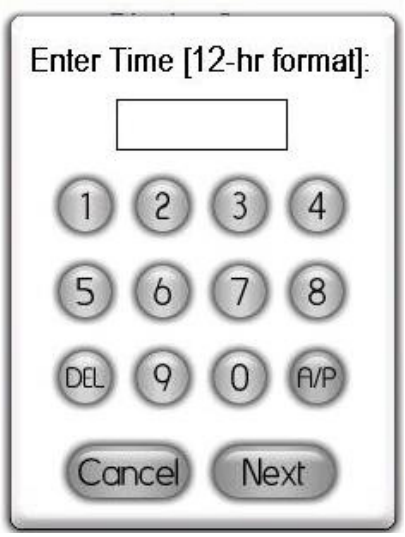


Figure 80. The system time may be set using 12-hour format (HH:MM A/P)

After entering the digits for the current time, click the *A/P* button to specify whether the time is *AM* or *PM*, and then click the *Next* button to advance to the date entry popup shown in Figure 87. The date entry should be in the U.S. format as shown. Note that the year should be entered as a two-digit entry. Clicking the *Finish* button saves the new time and date settings to the controller's real-time clock.

For convenience, the date and time may also be entered directly from the main display screen by touching the date and time, respectively. Clicking each invokes the appropriate entry popup as shown in Figure 80 and Figure 81 without entering the user menu system.

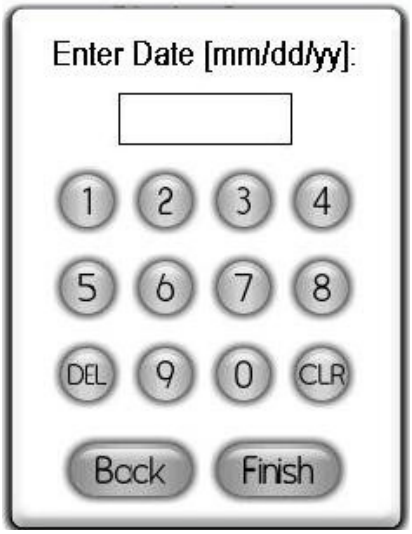


Figure 81. The system date may be entered using US format (MM/DD/YY)

Selecting the *Set Brightness* option on the *Display Setup* menus invokes the *Set Backlight Level* popup slider as shown in Figure 82. To increase the brightness of the display, move the slider to the left. Moving the slider to the right reduces the brightness down to a minimum level that remains visible. Clicking the *OK* button saves the new brightness setting to non-volatile memory, which allows the display to return to this brightness level even if a power loss is experienced.

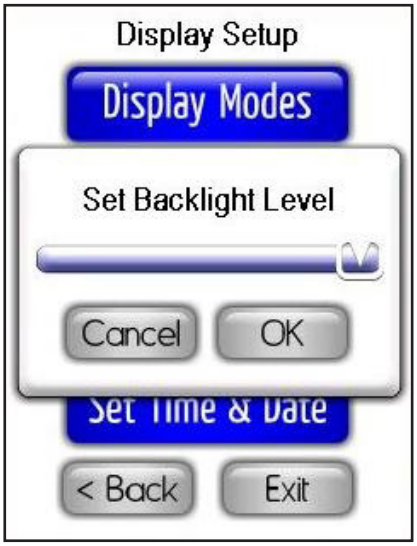


Figure 82. The display brightness may be adjusted using this slider.

DISPLAY SETUP

Configuring Safety Halo™

The Safety Halo™ option on the Display Setup menus allows the configuration of the settings for the Safety Halo™ status bezel, including the Nightly Auto-Dim feature. This feature allows the Safety Halo™ indicator to automatically reduce its brightness to the specified percentage at the specified Starting Hour, and return to normal brightness at the specified Ending Hour.

Modifying Input Names

The analog and thermistor inputs on the FMS-1655 may be labeled with custom names that can more accurately describe the location or type of each input. Each of the default names associated with the analog and thermistor inputs may be edited by selecting the *Edit Input Names* option on the *Display Setup* menus, which invokes the *Input Names Setup* menu. Selecting one of the analog inputs or thermistor inputs on the I*nput Names Setup* menu invokes the alphanumeric popup keyboard as shown in Figure 27, where the existing name may be edited and customized for the specific application of that particular input on the FMS-1655.

Uppercase, lowercase, and numeric characters are available on the popup keyboard by repeatedly clicking the orange shift button between the *Cancel* and *Save* buttons. Clicking the orange *abc* button of the uppercase keyboard switches to the lowercase character set as shown in Figure 82, while clicking on the orange *123* button of the lowercase keyboard switches to the numeric character set as shown in Figure 83. To switch back to the uppercase character set from the numeric keyboard, click the orange *ABC* button.

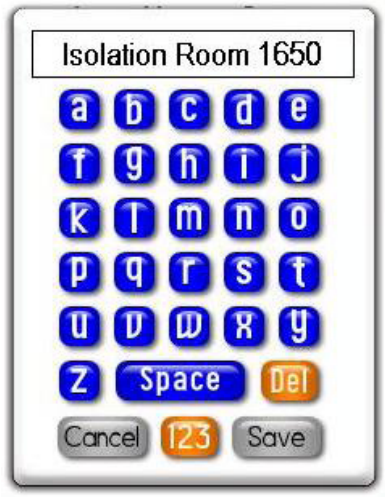


Figure 82. This keyboard allows names associated with analog and thermistor inputs to include lowercase letters. Clicking the orange 123 button above invokes the numeric keypad shown at right.

Figure 83. This keyboard allows numeric digits and other characters to be included in custom names for the inputs. Clicking the orange ABC button above invokes the uppercase keyboard.

Getting System Information

(For overview, see FLOW DIAGRAMS - Page 71)

The *Diagnostics* menus incorporate several options that provide information specific to this particular FMS-1655 unit, as well as options for assisting in the troubleshooting of the unit during the installation or commissioning process. The *Overrides* option on the *Diagnostics* menu allows the user to manually override analog outputs and relay outputs independently to assist with verifying the correct operation and/or allocation of the controller resources.

To further assist with troubleshooting the FMS-1655 during the installation and commissioning phase, the Real-Time View option on the *Diagnostics* menu allows the user to view the real-time conditions of each of the resources included on the FMS-1655 controller. This includes the analog input values and their actual voltages, the analog outputs in percentage, the analog input and output pairs along with the corresponding setpoint, the digital inputs, the digital outputs, the alarm statuses, and the network variables. Should there be a need to reset the FMS-1655 without removing power from the unit, the *Reset Controller* option on the *Diagnostics* menus performs a soft reboot of both the controller and display modules.

The *About This FMS* option on the *Diagnostics* menus provides information specific to the specific unit, including firmware version numbers, electronic serial numbers, protocol selection, and network address (Figure 85). If you have any general questions regarding the FMS-1655 or need technical assistance during installation, this screen lists the phone number to Triatek's *Tech Support* line. You will need the information included on the About screen to identify the specific details pertaining to your unit.

At the bottom of the first About This FMS screen, clicking on the Next button advances to the first of six screens which display the configuration settings for AI-1 through TI-2, respectively. Information displayed on each of screen include the type of sensor connected to that input, the target setpoint and deadband settings, and the four alarm/warning setpoints. Repeatedly clicking the Next button advances to the next information screen, and then cycles back to the first screen.

Figure 84. The Diagnostics menu (1 of 2) includes options that assist with the initial setup and commissioning of the FMS-1655.

Figure 85. The About popup screen reveals pertinent information such as firmware versions, serial numbers, and network address.

Using Override Capabilities

The *Overrides* option on the *Diagnostics* menus provide a very useful feature that allows the user to manually control the analog outputs and relay outputs independently to assist with verifying the correct operation and/or allocation of the controller resources. Selecting the *Overrides* option on the *Diagnostics* menus invokes the *Overrides* menu as shown in Figure 86.

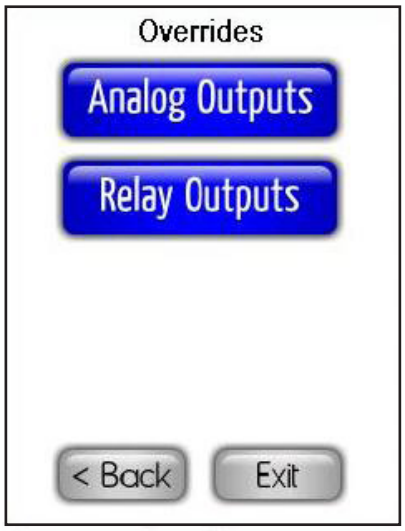


Figure 86. The Overrides option on the Diagnostics menu allows both analog outputs and relay outputs to be overridden independently.

Figure 87. Relay outputs may be overridden independently and temporarily.

During the installation process, oftentimes it becomes necessary to set an analog output that is being used to control an air flow damper to a specific percentage while manually adjusting the damper. The ability to manually override individual analog outputs is an extremely useful feature that accomplishes this goal. Likewise, it may be necessary to trigger one of the relay outputs to test the operation of the device to which it is connected. One of the typical uses for the relay outputs on the FMS-1655 is to trigger remote annunciators to alert users of an alarm condition at the controller. Being able to manually override individual relay outputs allows this to easily perform this verification test.

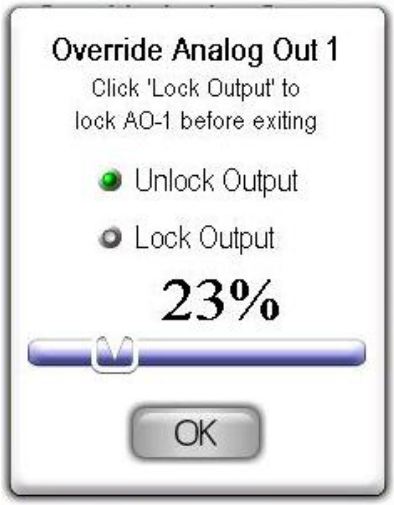


Figure 88. Analog outputs may be fixed at the overridden level indefinitely.

Selecting the *Analog Outputs* option on the *Overrides* menu allows the user to choose one of the four analog outputs to override temporarily. Selecting an analog output for override mode invokes the *Override Analog Output x* configuration screen as shown below in Figure 88. The slider may be used to manually set the output to a specific percentage. To lock the analog output temporarily at the overridden level, the *Lock Output* option should be selected before clicking *OK* to exit the override configuration screen. Any analog output that is overridden and locked will remain fixed at the overridden level until the output is subsequently unlocked. At the *Override Analog Outputs* menu screen, any analog output that is currently locked at a specific overridden level will be indicated by a yellow button instead of the standard blue menu button.

Selecting the *Relay Outputs* option on the *Overrides* menu allows the user to override each relay output independently while the *Override Relay Outputs* configuration screen is displayed as shown in Figure 96.

Zero Calibrating the FMS-1655

Unlike the analog output override feature, the relay outputs remain in the override state only while the *Override Relay Outputs* configuration screen is displayed. All relay outputs return to their previous commanded states once the override mode is cancelled.

The FMS-1655 incorporates an extremely useful feature that allows the unit's zero reading to be calibrated after being installed. The *Zero Calibration* and *Reset Zero Offset* options on the *Diagnostics* menus provide the capability to reset the zero pressure reading for the specific installation. Once the FMS-1655 has been completely installed, including any peripheral remote sensor modules, this feature may be used to recalibrate the unit's zero reading so that it reads accurately with the door to the monitored room left open.

With the door to the monitored room open, the differential pressure measured by the FMS-1655 should approach zero. However, due to imperfections in the sealing of the remote sensor enclosure and pressure accumulation in the wall dividing the monitored room and the adjacent corridor, the pressure reading may not reach zero. It is common for the differential pressure reading to be up to 0.0010 "WC with the monitored room's door left open to allow pressure to equalize.

By selecting the *Zero Calibration* option on the *Diagnostics* menu, this offset from zero may be completely eliminated so that the display reads a true zero with the door open. Selecting this option invokes the *Zero Calibration* input selection configuration screen as shown in Figure 90, where the input to be zero calibrated should be selected.

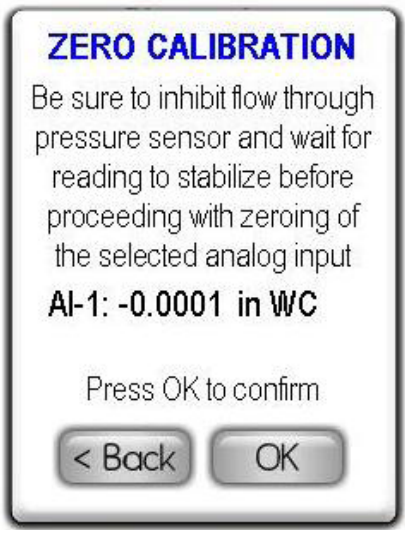


Figure 89. Sensor input must be capped prior to zero calibrating unit in the field.

Clicking the *Next* button after selecting the input to zero calibrate, the message shown in Figure 98 is displayed indicating that air flow through the sensor should be inhibited before proceeding with the zero calibration procedure.

Leave the door to the monitored space open until the differential pressure reading on the configuration screen stabilizes for at least 10 seconds. Once stabilized, click the *Next* button to perform the zero calibration procedure to reset the zero reading. A popup window appears indicating the status of the zero calibration process while displaying the real-time differential pressure reading, which should approach zero within a few seconds.

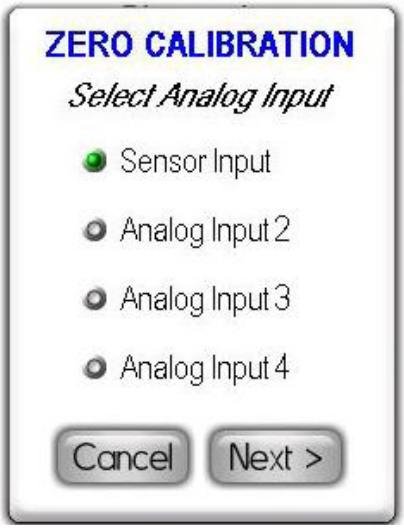


Figure 90. Convenient zero calibration feature supports easy field calibration procedure.

If the zero calibration process does not result in the differential pressure reading being zeroed, it may be necessary to reset any existing offset using the *Reset Zero Offset* option on the *Diagnostics* menus. This option should be selected before repeating the zero calibration procedure. Selecting this option invokes the *Select Analog Input* configuration screen as shown in Figure 101, where the analog input to be calibrated should be specified. Once the appropriate analog input has been selected, clicking the *Next* button performs the reset operation and displays the results screen shown in Figure 90.

Zero Calibrating the FMS-1655

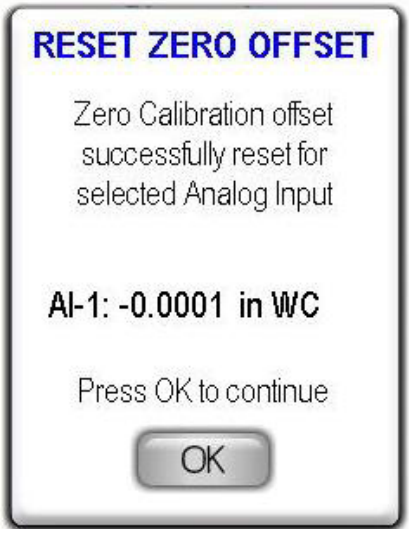


Figure 91. Results from the Reset Zero Offset procedure are displayed on this popup.

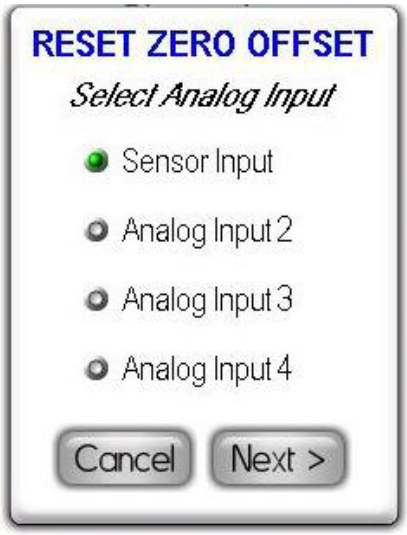


Figure 92. The Reset Zero Offset option should be executed prior to performing the Zero Calibration process.

Using the Real-Time View Option

The FMS-1655 incorporates a convenient feature that allows the installer or commissioning technician to view the real-time conditions of all of the hardware resources as well as several system variables. This includes the universal analog inputs, dedicated thermistor inputs, universal analog outputs, digital inputs, relay outputs, alarm status for each analog input and thermistor input, and the four network variables for pressure, temperature, humidity, and air changes.

Selecting the *Real-Time View* option from the *Diagnostics* menus invokes the menu shown in Figure 94. From this menu, the user may select to view the real-time conditions of any of the listed resources. For example, selecting the *Analog Inputs* option from the *Real-Time View* menu invokes the real-time view configuration screen shown in Figure 93. To skip to the next set of resources to view, click the *Next* button. To cancel the real-time view display at any time, click the *Exit* button to return to the *Real-Time View* menu.

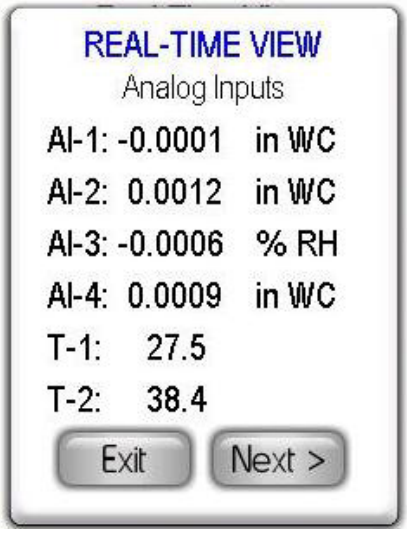


Figure 93. While viewing real-time conditions of the selected resources, clicking Next advances to the next set of resources for viewing.

While displaying the real-time views of the four universal analog inputs and two dedicated thermistor inputs, clicking the *Next* button advances to the real-time view of the voltage levels for the four analog inputs (AI-1 through AI-4). All voltages are scaled to 5 volts, so if one of the inputs has been configured for accepting a 0-10 Vdc signal and its current voltage level is 7 Vdc, the real-time view voltage will be displayed as 3.5 Vdc. Clicking *Next* at the analog input voltages screen advances to the real-time view of the four universal analog outputs expressed as percentages. While displaying the real-time views of the four universal analog output percentages, clicking the *Next* button advances to the real-time view of the voltage or current levels for the four analog outputs. The voltages are expressed as both 0-5 Vdc and 0-10Vdc values, while the currents are displayed as 0-20 mA values.

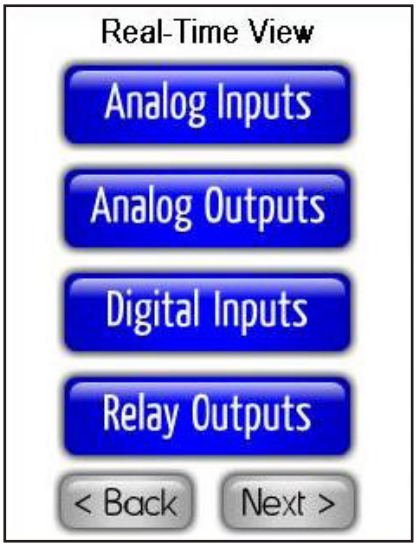


Figure 94. Real-Time View menu offers the ability to monitor real-time conditions of the hardware resources on the FMS-1655.

Clicking *Next* while displaying the analog output voltages/currents advances to the first of two real-time view screens for the analog input/output pairs as currently configured. The first *Analog I/O Pairs* screen simultaneously displays the real-time view of AO-1 and AO-2, along with their associated analog inputs and their corresponding target setpoints. This view is extremely useful for analyzing the performance of the PID control loops during the installation/ commissioning process. The commissioning technician may observe simultaneously the monitored parameter (AI), the target setpoint (SP), and the resulting control output (AO). While at this screen, clicking on either AO-1 or AO-2 invokes the associated PID loop configuration screen, where the individual constants may be quickly adjusted, and then immediately return to the *Analog I/O Pairs* screen to see the effect of the change in PID loop settings. Clicking *Next* at the first *Analog I/O Pairs* screen advances to the second screen, which displays the real-time view of AO-3 and AO-4, along with their associated analog inputs and their corresponding target setpoints. If the unit has been configured for *Volumetric Offset Control* mode, then AO-4 will be displayed along with the real-time volumetric offset and the associated offset setpoint.

Using the Real-Time View Option

Clicking *Next* at the second *Analog I/O Pairs* screen advances to the *Digital Inputs* screen, which displays the real-time status of the four digital inputs. The next real-time views screen in the sequence displays the status of the four relay outputs. Clicking *Next* at the real-time view of the *Relay Outputs* advances to the *Alarm Status's* real-time view, which shows the current alarm status of the four universal analog input and the two dedicated thermistor inputs. For any analog or thermistor input that is disabled, the status will show as *Disabled*. Otherwise, the status will be either *Normal*, *Warning*, or *Alarm*. The last of the real-time view screens displays the current values for the four network variables for pressure, temperature, humidity, and air changes. Clicking *Next* at the last real-time view screen cycles back to the first screen - *Analog Inputs*.

Testing/Resetting/Restoring the FMS-1655

Saving User Configuration Settings

Once all of the configuration settings have been specified and verified for proper operation of the FMS-1655 unit, they may be stored to non-volatile flash memory for later retrieval in the event one of the settings gets inadvertently changed by unauthorized personnel. Selecting the Save Settings option on the Diagnostics menu presents the user with a warning message indicating that the stored user settings will be overwritten with the current configuration settings. This option is password protected, and requires the entry of a valid security password in order to proceed with the save operation.

Restoring Configuration Settings

Selecting the Restore Settings option on the Diagnostics menu allows the user to select either factory default settings or previously saved user settings. Upon selection, this option presents the user with a warning message indicating that the current configuration settings will be overwritten with the factory defaults or user settings. This option is password protected, and requires the entry of a valid security password in order to proceed with the restore operation.

Running the Self Test

The *Run Self-Test* option on the *Diagnostics* menus allows the user to invoke the automated self-test which displays the three alarm status background screens and sounds the audible alarm buzzer. Performing this self-test takes about five seconds to complete and confirms that the alarm status screens and audible alarm are both functioning properly. Click the *OK* button on the alarm configuration screen to cancel the selt-test and return to the *Diagnostics* menus.

Resetting the Controller

The *Reset Controller* option on the *Diagnostics* menus allows the user to perform a soft reboot of the controller and display modules and completely reinitialize them. This option may be useful whenever problems are encountered during the installation process when changes have been made to the communications parameters, i.e., new baud rate selection. Selecting this option invokes the warning message popup as shown in Figure 104, informing the user that the controller will be reset when the *OK* button is clicked to confirm the request.

Restoring Factory Default Settings

The *Factory Restore* option on the second page of *Diagnostics* menus allows the user to restore all of the factory default settings for the resources in the FMS-1655. This option is password-protected, and requires the user to enter a valid security password to perform the restore. A warning message alerts the user that all existing configuration data will be completely erased and replaced by the factory default settings for each resource. Upon confirmation, a status message will appear indicating that the factory default settings are being restored, and shortly thereafter, the system will reboot.

TYPICAL APPLICATIONS FOR THE FMS-1655

Wiring & Configuring External Devices

Since the FMS-1655 integrates a full-featured controller with multiple analog and digital I/O resources and an intuitive touch screen user interface that can satisfy most application requirements, it is a very effective solution for serving as a comprehensive room controller.

This section details the complete installation and configuration process for using the FMS-1655 as a room pressure controller monitoring the differential pressure in two separate spaces, ambient temperature, relative humidity, and air change rate. This application utilizes all four (4) universal analog inputs, one thermistor input, two analog outputs, one digital input, and one relay output.

In addition to the FMS-1655 room pressure controller with internal and remote sensors, the following components will be used to satisfy the application requirements:

- Combination Temperature & Humidity Sensor, *BAPI® part no. BA/10K-2-H200-R*
- Differential Pressure Transmitter, *Ashcroft® part no. CX-4-MB2-10-1IWL*
- Door Switch, *Triatek part no. SWD200-2*
- Remote Alarm Annunciator Panel

The hardware configuration dipswitch settings on the XMS1650 CPU controller board should be set as follows:

- S1: positions 1, 3, 4, 5, 6, 8 *OFF*; positions 2 and 7 *ON*
- S3: position 5 *OFF*; positions 1, 2, 3, 4, 6, 7, 8 *ON*
- S4: positions 1 through 4 *ON*

While the FMS-1655 is capable of serving as a stand-alone room pressure controller, there are several added benefits that may be achieved from connecting it to a network with other controllers. For example, instead of using a remote alarm annunciator panel to alert personnel of an alarm condition at the monitored room, Triatek's Central Monitoring Station (CMS-1650) may be used to remotely monitor up to four (4) individual FMS-1655 room pressure controllers. For more information on this product, please refer to the datasheet for the ***CMS-1650 Central Monitoring Station***.

Wiring

For this application of the FMS-1655, the wiring requirements are relatively straightforward. The specific model number used as the main room controller is Triatek's stainless flush-mount room pressure controller, part code FMS-1655-F-1-1. This specific model is mounted in a flush-mount enclosure, includes an internal sensor and one remote sensor. Both sensors can accommodate differential pressures in the ±0.25" WC range and have an accuracy of ±0.5% FS.

The wiring diagram shown below in Figure 104 details the connections from the sensors to the FMS-1655 backplane. Note that both the BAPI® humidity sensor and Ashcroft® differential pressure transmitter receive power from the FMS-1655 auxiliary power supply.

The step-by-step procedure for configuring the hardware resources of the FMS-1655 room pressure controller for the application shown in Figure 104 will be discussed in the next section.

Configuring Hardware Resources

The configuration of the FMS-1655 room pressure controller for the application as shown below in Figure 104 involves setting up the remote differential pressure sensor, temperature sensor, humidity sensor, flow sensor (DP transmitter), and configuring the display accordingly. While the internal differential pressure sensor has been configured and calibrated at the factory and needs no adjustments, the following procedure includes a confirmation of the internal sensor configuration.

Confirm Internal Pressure Sensor Settings

Enter the user menus and navigate to the first page of the *Controller Setup* menus to begin confirming the configuration settings of the internal pressure sensor. The internal pressure sensor integrated within the flush mount room controller (FMS-1655-F-1-1) should be configured as follows:

- Analog Input: *AI-1*
- Linearization: *Disabled*
- Input Mode: *Normal Mode*
- Engineering Units: *Inches of Water*
- Input Range: *0-5V*

Wiring & Configuring External Devices

After confirming the above settings, enter a neutral isolation mode setpoint of 0.0000 "WC at the *Enter No-ISO Setpoint* configuration screen. To enter setpoints for positive and negative isolation modes, change the mode of isolation as required and repeat the above procedure. This completes the procedure for confirming the settings for the internal differential pressure sensor.

Configure Remote Pressure Sensor

The analog input resource for the remote differential pressure sensor included with the flush mount room controller (FMS-1655-F-1-1) should be configured using the *Analog Inputs* option on the first page of the *System Setup* menus. Enter the user menus and navigate to the *Analog Input 2* option on the *Analog Inputs Setup* menus and select it to begin configuring the input for the remote pressure sensor as follows:

- Analog Input: *AI-2*
- Linearization: *Disabled*
- Input Mode: *Normal Mode*
- Engineering Units: *Inches of Water*
- Input Range: *4-20mA*
- Pressure Range: *±0.2500 "WC*

After confirming the above settings, enter a neutral isolation mode setpoint of 0.0000 "WC at the *Enter No-ISO Setpoint* configuration screen. To enter setpoints for positive and negative isolation modes, change the mode of isolation as required and repeat the above procedure. This completes the configuration procedure for the remote differential pressure sensor.

Configure Humidity Sensor

The analog input resource for the input for the relative humidity sensor of the combination sensor from BAPI (p/n BA/10K-2-H200-R) should be configured using the *Analog Inputs* option on the first page of the *System Setup* menus. Enter the user menus and navigate to the *Analog Input 3* option on the *Analog Inputs Setup* menus and select it to begin configuring the input for the relative humidity sensor as follows:

- Analog Input: *AI-3*
- Linearization: *Disabled*
- Input Mode: *Normal Mode*
- Engineering Units: *Percentage RH*
- Input Range: *0-10V*

After confirming the above settings, accept the default setpoint of zero at the *Enter AI-3 Setpoint* configuration screen. If this controller were targeting a humidity control application, then this setpoint would be configured as required by the specific application. This completes the procedure for configuring the settings for the relative humidity sensor.

Configure Flow Sensor

The analog input resource for the flow input from the DP transmitter (Ashcroft part no. CX-4-MB2-10-1IWL) should be configured using the *Analog Inputs* option on the first page of the *System Setup* menus. Enter the user menus and navigate to the Analog Input 4 option on the *Analog Inputs Setup* menus and select it to begin configuring the input as follows:

- Analog Input: *AI-4*
- Flow Range Maximum: *1.00 "WC*
- Flow Range Minimum: *0.00 "WC*
- Display Air Changes: *Yes*
- Input Range: *0-10V*
- Duct Area: *120 in^2*
- Room Volume: *7500 ft^3*

This completes the procedure for configuring the settings for the flow input.

TYPICAL APPLICATIONS FOR THE FMS-1655

Wiring & Configuring External Devices

Configure Temperature Sensor

The analog input resource for the input for the temperature sensor of the combination sensor from BAPI (p/n BA/10K-2-H200-R) should be configured using the *Analog Inputs* option on the first page of the *System Setup* menus. Enter the user menus and navigate to the *Thermistor Input 1* option on the second page of the *Analog Inputs Setup* menus, and select it to begin configuring the input as follows:

- Thermistor Input: *TI-1*
- Thermistor Type: *NTC Type 2*
- Engineering Units: *degrees Fahrenheit*

After confirming the above settings, accept the default setpoint at the *Enter TI-1 Setpoint* configuration screen. If this controller were targeting a temperature control application, then this setpoint would be configured as required by the specific application. This completes the procedure for configuring the settings for the temperature sensor, as well as the configuration of the all required hardware resources.

The remainder of the configuration of the FMS-1655 room pressure controller for the application shown in Figure 95 will be discussed in the next section.

Configuring Analog Outputs

This section describes the configuration of the analog output for the FMS-1655 room pressure controller targeting the application shown above in Figure 95. Since this room controller is monitoring and controlling the differential pressure in two individual rooms, the analog outputs AO-1 and AO-2 will be utilized for controlling the exhaust dampers in the two spaces. The primary space, the isolation room, will be maintained at a positive differential pressure of 0.0100 "WC while in positive isolation mode.

The secondary space, the anteroom adjacent to the isolation room, will be maintained at a negative differential pressure of -0.0100 "WC while in negative isolation mode. Analog output AO-1 will control the damper in the isolation room, while AO-2 will control the damper in the anteroom. Both analog outputs will operate in closed-loop or PID control mode, and will output a 2 to 10 Vdc signal to the damper being controlled.

Configure Primary Exhaust Damper Control

The analog output resource for the primary exhaust damper control should be configured using the *Analog Output* option on the first page of the *Controller Setup* menus. Enter the user menus and navigate to the *Analog Output* option on the *Controller Setup* menus and select it to begin configuring the output as follows:

- Analog Output: *AO-1*
- Operating Mode: *PID Analog Output*
- Output Range: *2-10V*
- Maximum Limit: *100 percent*
- Minimum Limit: *0 percent*
- Input Channel: *AI-1*
- Action Mode: *Direct*

Configure Secondary Exhaust Damper Control

The analog output resource for the secondary exhaust damper control should be configured using the *Analog Output* option on the first page of the *Controller Setup* menus. Enter the user menus and navigate to the *Analog Output* option on the *Controller Setup* menus and select it to begin configuring the output as follows:

- Analog Output: *AO-2*
- Operating Mode: *PID Analog Output*
- Output Range: *2-10V*
- Maximum Limit: *100 percent*
- Minimum Limit: *0 percent*
- Input Channel: *AI-2*
- Action Mode: *Reverse*

This completes the procedure for configuring the settings for the analog outputs used to control the primary and secondary exhaust dampers.

Wiring & Configuring External Devices

Configuring Door Switch Input

This section describes the configuration of the digital input for the FMS-1655 room pressure controller targeting the application shown in Figure 95. This room controller monitors the door separating the isolation room and the adjacent anteroom, which consists of a normally-open magnetic switch connected to the primary digital input (DI-1).

The digital input resource for the primary door switch should be configured using the *Door Switch* option on the first page of the *Controller Setup* menus. Enter the user menus and navigate to the *Door Switch* option on the *Controller Setup* menus and select it to begin configuring the output as follows:

- Operating Mode: *Normally-Open*
- Delay Time: *0 seconds*

Configuring Alarm Relay

This section describes the configuration of the digital (relay) output for the FMS-1655 room pressure controller- targeting the application shown in Figure 95. This room controller triggers a remote annunciator panel which consists of an audible buzzer and an LED indicator. The primary relay output (RL-1) is used to trigger the remote annunciator, and should be configured using the *Relay Setup* option on the first page of the *Controller Setup* menus.

Enter the user menus and navigate to the *Relay Setup* option on the *Controller Setup* menus and select it to begin configuring the output as follows:

- Trigger Mode: *Setpoints*
- High Setpoint: *0.0125 "WC*
- Low Setpoint: *0.0010 "WC*
- Action Mode: *Direct*
- Delay Time: *30 seconds*

This section describes the configuration of the display settings for the FMS-1655 room pressure controller targeting the application shown in Figure 104. Since this room controller is monitoring and controlling the differential pressure in two individual rooms, the display mode should be selected to support a dual sensor room controller. Enter the user menus and navigate to the *Display Modes* configuration screen on the first page of the *Display Setup* menus. Select the *Dual Sensor Mode* option and click *OK* to save the setting to non-volatile memory.

To specify the sources for the temperature, humidity, and air change rate to be displayed on the main screen, the *Display Options* menu option should be selected. Enter the user menus and navigate to the *Display Options* configuration screen on the first page of the *Display Setup* menus. At the *Set Display Options* configuration screen, be sure to select all six (6) of the display options and click the *Next* button to begin specifying the sources for the individual sensors.
Configure the sources as follows:

- Temperature Display Source: *Thermistor Input 1*
- Humidity Display Source: *Analog Input 3*
- Air Changes Display Source: *Analog Input 4*
- Room Pressure Display Source: *Analog Input 1*

Click *Finish* to save the setting to non-volatile memory. This completes the procedure for configuring the display settings for the targeted application shown in Figure 95.

TYPICAL APPLICATIONS FOR FMS-1655

Complete Room Controller Example

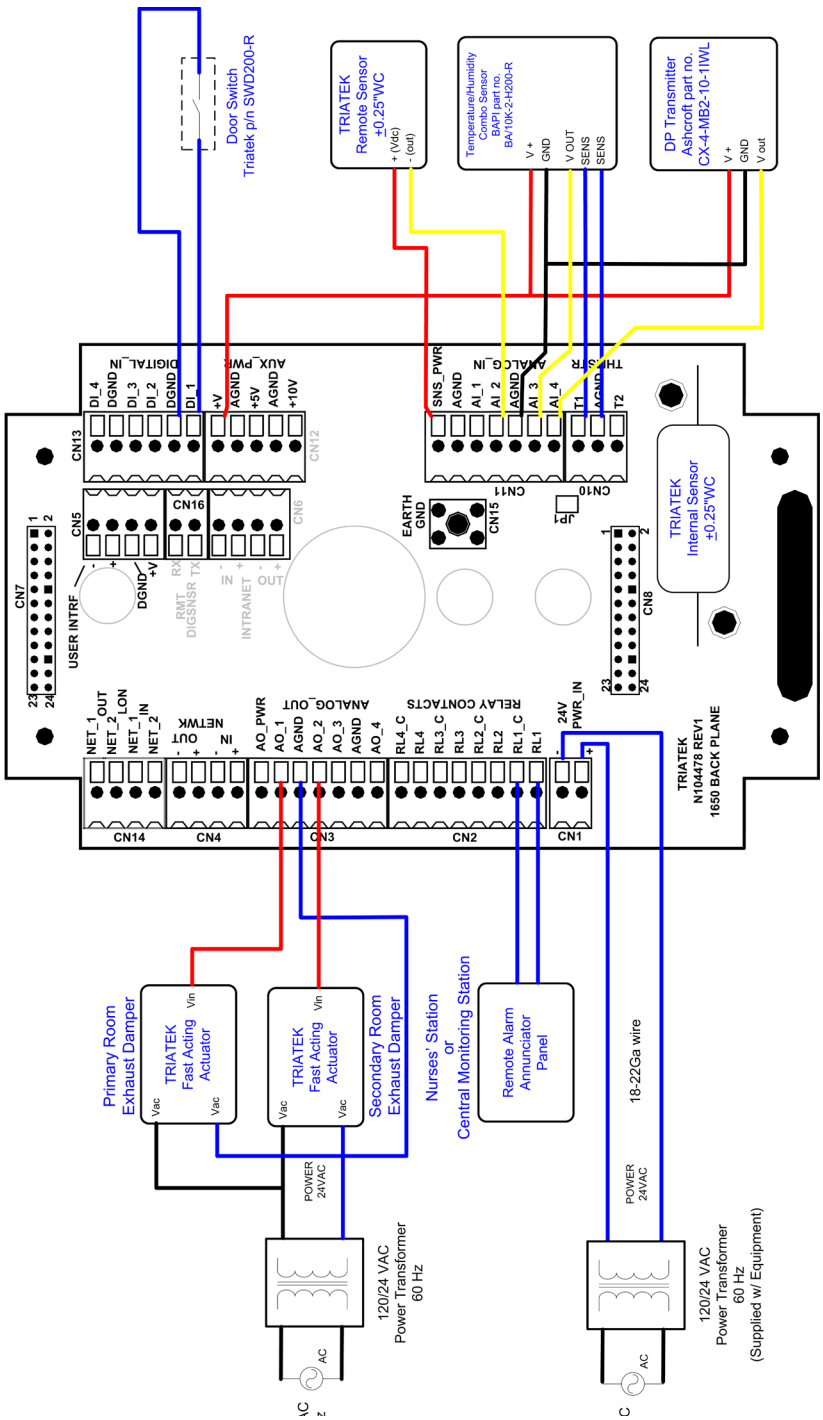


Figure 95. Wiring details for a typical FMS-1655 application monitoring differential pressure, temperature, humidity, and air changes.

PID Tutorial

PID is an acronym that stands for *P*roportional-*I*ntegral-*D*erivative, and is a generic closed-loop control mechanism that is commonly used in many industrial control systems. It is by far the most commonly used feedback controller in use today. A controller which implements PID mode continuously calculates the difference (or *error* signal) between a measured *process variable (PV)* and a desired *setpoint (SP)*. The PID controller attempts to minimize this error by adjusting the process control inputs, also referred to as the *manipulated variable (MV)*. A block diagram of a PID controller is shown in Figure 106.

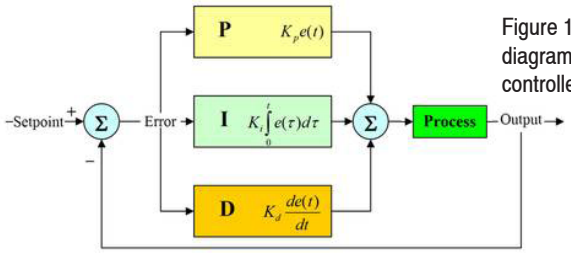


Figure 106. Block diagram of a PID controller.

The PID controller algorithm consists of three parameters: *proportional*, *integral*, and *derivative*. In terms of time, the proportional term depends on the present error, the integral term depends on the accumulation of past errors, and the derivative term is a prediction of future errors. The weighted sum of these three terms is used to adjust the process via a control variable such as the position of a control valve of the power applied to a heating element. In the case of applications for the FMS-1655 as a room pressure controller, the process variable is the differential pressure and the control variable is typically the position of an exhaust damper.

By tuning the PID parameters or constants in the algorithm, the controller can provide control action designed for specific process requirements. The response of the controller can be described in terms of the responsiveness of the controller to an error, the degree to which the controller overshoots the setpoint, and the degree of system oscillation. Some applications may require using only one or two terms to provide the appropriate system control. This is achieved by setting the constant(s) of the undesired control output(s) to zero. The variations include PI, PD, P, or I controllers in the absence of the respective control actions. PI controllers are relatively common, since the derivative term is sensitive to measurement noise, whereas the absence of an integral value may prevent the system from reaching its target value due to the control action.

A typical example of a closed-loop control scheme is when the hot and cold valves of a faucet are adjusted to maintain the water from the faucet at a desired temperature. This involves the mixing of the two process streams, the hot and cold water. Touching the water allows the temperature to be sensed or "measured." Based on this feedback of sensing the water temperature, a control action may be performed to adjust the hot and cold water valves until the process temperature stabilizes at the desired value.

Sensing the water temperature is analogous to taking a measurement of the process variable (PV), while the desired temperature is referred to as the setpoint (SP). The input to the process (water valve position) is referred to as the manipulated variable (MV). The difference between the "measured" temperature and the setpoint is the error (e) and quantifies whether the water is too hot or too cold, and by how much. After measuring the temperature (PV), and then calculating the error, the controller decides when to change the tap position (MV) and by how much. When the controller first turns the valve on, it may turn the hot valve only slightly if warm water is desired, or it may open the valve all the way if very hot water is desired. This is an example of a simple **proportional** control. In the event that hot water does not arrive quickly, the controller may try to speed-up the process by opening up the hot water valve more as time goes by. This is an example of an **integral** control.

PID Controller Theory

The PID closed-loop control scheme is named after its three correcting terms, whose sum constitutes the manipulated variable (MV):

$$MV(t) = P_{out} + I_{out} + D_{out}$$

where P_{out}, I_{out}, and D_{out} are the contributions to the output from the PID controller from each of the three terms, as defined in the subsequent sections below.

Proportional Term

The proportional term (sometimes referred to as gain) makes a change to the output that is proportional to the current error value. The proportional response can be adjusted by multiplying the error by a constant K_p called the proportional gain. The proportional term of the output is given by:

K_p: proportional constant (tuning parameter)
SP: setpoint or desired value

PID Tutorial

PV: process variable or measured value
e: error = SP – PV
t: time or instantaneous time (the present)

A high proportional gain results in a large change in the output for a given change in the error. If the proportional gain is too high, the system may become unstable. In contrast, a small gain results in a small output response to a large input error, and a less responsive (i.e, slower) controller. If the proportional gain is too low, the control action may be too small when responding to system disturbances. For most closed-loop control schemes, the proportional gain should contribute the bulk of the output change.

Integral Term

The integral term (sometimes referred to as *reset*) is proportional to both the magnitude of the error and the duration of the error. Summing the instantaneous error over time (integrating the error) gives the accumulated offset that should have been corrected previously. The accumulated error is then multiplied by the integral gain and added to the controller output. The magnitude of the contribution of the integral term to the overall control action is determined by the integral gain, K_i.

The integral term is given by: $$I_{\text{out}} = K_i \int_0^t e(\tau)\, d\tau$$

where:
K_i: integral constant (tuning parameter)
SP: setpoint or desired value
PV: process variable or measured value
e: error = *SP – PV*
t: time or instantaneous time (the present)
τ: dummy integration variable

The integral term, when added to the proportional term calculated above, accelerates the movement of the process towards setpoint and eliminates the residual steady-state error that occurs with a proportional-only control scheme. However, since the integral term is responding to accumulated errors from the past, it can cause the present value to overshoot the setpoint value (cross over the setpoint and then create a deviation in the other direction).

Derivative Term

The rate of change of the process error is calculated by determining the slope of the error over time (i.e., its first derivative with respect to time) and multiplying this rate of change by the derivative gain K_d. The magnitude of the contribution of the derivative term (sometimes called *rate*) to the overall control action is termed the derivative gain, K_d.

The derivative term is given by: $$D_{\text{out}} = K_d \frac{d}{dt} e(t)$$

where:
K_d: derivative constant (tuning parameter)
SP: setpoint or desired value
PV: process variable or measured value
e: error = SP – PV
t: time or instantaneous time (the present)

The derivative term slows the rate of change of the controller output and this effect is most noticeable close to the controller setpoint. Hence, derivative control is used to *reduce the magnitude of the overshoot* produced by the integral component and improve the combined controller-process stability. However, the differentiation of a signal amplifies noise and thus this term in the controller is highly sensitive to noise in the error term, and can cause a process to become unstable if the noise and the derivative gain are sufficiently large.

The proportional, integral, and derivative terms are summed to calculate the output of the PID controller. Defining *u(t)* as the controller output, the final form of the PID algorithm is:

$$\mathrm{u(t)} = \mathrm{MV(t)} = K_p e(t) + K_i \int_0^t e(\tau)\, d\tau + K_d \frac{d}{dt} e(t)$$

where the tuning parameters are:

Proportional gain, K_p
Larger values typically mean faster response since the larger the error, the larger the proportional term compensation. An excessively large proportional gain will lead to process instability and oscillation.

Integral gain, K_i
Larger values imply steady-state errors are eliminated more quickly. The trade-off is larger overshoot: any negative error integrated during transient response must be integrated away by positive error before reaching steady-state.

Derivative gain, K_d
Larger values decrease overshoot, but slow down transient response and may lead to instability due to signal noise amplification in the differentiation of the error.

Configuring Main Controller Module Settings

Analog Input Configuration Dipswitch (S1)			
1.	AI-1 Mode Selection:	OFF = voltage input	ON = current input
2.	AI-2 Mode Selection:	OFF = voltage input	ON = current input
3.	AI-3 Mode Selection:	OFF = voltage input	ON = current input
4.	AI-4 Mode Selection:	OFF = voltage input	ON = current input
5.	AI-1 Voltage Range Selection:	OFF = 0-5Vdc	ON = 0-10Vdc
6.	AI-2 Voltage Range Selection:	OFF = 0-5Vdc	ON = 0-10Vdc
7.	AI-3 Voltage Range Selection:	OFF = 0-5Vdc	ON = 0-10Vdc
8.	AI-4 Voltage Range Selection:	OFF = 0-5Vdc	ON = 0-10Vdc

NOTES: To configure FMS-1655 for an internal sensor, set dipswitch position 1 to OFF and dipswitch position 5 to OFF. To configure FMS-1655 for a remote sensor, set dipswitch position 1 to ON and dipswitch position 5 to OFF. For other inputs, see Table 1.

Analog Output Configuration Dipswitch (S3)			
1.	AO-1 Mode Selection:	OFF = current output	ON = voltage output
2.	AO-2 Mode Selection:	OFF = current output	ON = voltage output
3.	AO-3 Mode Selection:	OFF = current output	ON = voltage output
4.	AO-4 Mode Selection:	OFF = current output	ON = voltage output

Network Configuration Dipswitch (S3)			
5.	RS485 Network Termination:	OFF = disabled	ON = enabled
6.	RS485 Display Termination:	OFF = disabled	ON = enabled
7.	Protocol Select: see Table 2 below		
8.	Protocol Select: see Table 2 below		

MODULE SETTINGS

Configurations & Settings

Table 1. Analog Input Configuration Settings (S1)								
Mode	S1 - 1	S1 - 2	S1 - 3	S1 - 4	S1 - 5	S1 - 6	S1 - 7	S1 - 8
AI-1 5Vdc	OFF				OFF			
AI-1 20mA	ON				OFF			
AI-1 10Vdc	OFF				ON			
Not Valid	ON				ON			
AI-2 5Vdc		OFF				OFF		
AI-2 20mA		ON				OFF		
AI-2 10Vdc		OFF				ON		
Not Valid		ON				ON		
AI-3 5Vdc			OFF				OFF	
AI-3 20mA			ON				OFF	
AI-3 10Vdc			OFF				ON	
Not Valid			ON				ON	
AI-4 5Vdc				OFF				OFF
AI-4 20mA				ON				OFF
AI-4 10Vdc				OFF				ON
Not Valid				ON				ON

Table 2. Protocol Selection Settings (S3)		
Protocol Selection	S3-7	S3-8
Reserved	OFF	OFF
Metasys® N2	ON	OFF
LonWorks®	OFF	ON
BACnet® MS/TP (default)	ON	ON

Controller Configuration Dipswitch (S4)		
1. AO-1 Voltage Range Selection:	OFF = 0-10Vdc	ON = 0 - 5Vdc
2. AO-2 Voltage Range Selection:	OFF = 0-10Vdc	ON = 0 - 5Vdc
3. AO-3 Voltage Range Selection:	OFF = 0-10Vdc	ON = 0 - 5 Vdc
4. AO-4 Voltage Range Selection:	OFF = 0-10Vdc	ON = 0 - 5 Vdc

Controller Configuration Slideswitch (S2)	Controller Configuration Slideswitch (S5):
LEFT = Analog Outputs powered by remote source	LEFT = Digital Inputs pulled-high (triggered by active low input - default)
RIGHT = Analog Outputs powered locally by FMS-1655 (default)	RIGHT = Digital Inputs pulled-low (triggered by active high input, up to 24Vdc)

BACnet® Objects

The following table itemizes the list of points available for integration in a building management system (BMS). This table contains the objects for open BACnet integration.

Object		Read
Analog Inputs		
AI - 1	Analog Input 1 (default: Isolation Pressure)	Read-Only
AI - 2	Analog Input 2	Read-Only
AI - 3	Analog Input 3	Read-Only
AI - 4	Analog Input 4	Read-Only
AI - 5	Thermistor Input 1	Read-Only
AI - 6	Thermistor Input 2	Read-Only
Analog Outputs		
AO - 1	Analog Output 1 (default: Damper Position)	Read-Only
AO - 2	Analog Output 2 (default: Anteroom Damper Control)	Read-Only
AO - 3	Analog Output 3 (spare control output)	Read-Only
AO - 4	Analog Output 4 (spare control output)	Read-Only
Binary Inputs		
BI - 1	Digital Input 1 (default: Door Switch)	Read-Only
BI - 2	Digital Input 2 (default: Anteroom Door Switch)	Read-Only
BI - 3	Digital Input 3 (spare digital input)	Read-Only
BI - 4	Digital Input 4 (spare digital input)	Read-Only
Binary Outputs		
BO - 1	Relay Output 1 (default: Primary Alarm Relay Output)	Read-Only
BO - 2	Relay Output 2 (default: Spare Relay Output)	Read-Only
BO - 3	Relay Output 3 (spare relay output)	Read-Only
BO - 4	Relay Output 4 (spare relay output)	Read-Only
Analog Values		
AV - 1	AI-1 Setpoint (Room Pressure)	Read/Write
AV - 2	AI-2 Setpoint	Read/Write
AV - 3	AI-3 Setpoint	Read/Write
AV - 4	AI-4 Setpoint	Read/Write

Analog Values (continued)		
AV - 5	TI-1 Setpoint	Read/Write
AV - 6	TI-2 Setpoint	Read/Write
AV - 7	Air Change Rate based on Flow Input at AI-1	Read/Write
AV - 8	Air Change Rate based on Flow Input at AI-2	Read/Write
AV - 9	Air Change Rate based on Flow Input at AI-3	Read/Write
AV - 10	Air Change Rate based on Flow Input at AI-4	Read/Write
AV - 11	Alarm Relay 1 High Setpoint	Read/Write
AV - 12	Alarm Relay 1 Low Setpoint	Read/Write
AV - 13	Alarm Relay 2 High Setpoint	Read/Write
AV - 14	Alarm Relay 2 Low Setpoint	Read/Write
AV - 15	Alarm Relay 3 High Setpoint	Read/Write
AV - 16	Alarm Relay 3 Low Setpoint	Read/Write
AV - 17	Alarm Relay 4 High Setpoint	Read/Write
AV - 18	Alarm Relay 4 Low Setpoint	Read/Write
AV - 19	AI-1 Low Alarm Setpoint (low pressure alarm)	Read/Write
AV - 20	AI-1 Low Warning Setpoint (low pressure warning)	Read/Write
AV - 21	AI-1 High Warning Setpoint (high pressure warning)	Read/Write
AV - 22	AI-1 High Alarm Setpoint (high pressure alarm)	Read/Write
AV - 23	AI-2 Low Alarm Setpoint	Read/Write
AV - 24	AI-2 Low Warning Setpoint	Read/Write
AV - 25	AI-2 High Warning Setpoint	Read/Write
AV - 26	AI-2 High Alarm Setpoint	Read/Write
AV - 27	AI-3 Low Alarm Setpoint	Read/Write
AV - 28	AI-3 Low Warning Setpoint	Read/Write
AV - 29	AI-3 High Warning Setpoint	Read/Write
AV - 30	AI-3 High Alarm Setpoint	Read/Write
AV - 31	AI-4 Low Alarm Setpoint	Read/Write

BACnet OBJECTS

BACnet® Objects

Object		Read
Analog Values (continued)		
AV - 32	AI-4 Low Warning Setpoint	Read/Write
AV - 33	AI-4 High Warning Setpoint	Read/Write
AV - 34	AI-4 High Alarm Setpoint	Read/Write
AV - 35	TI-1 Low Alarm Setpoint	Read/Write
AV - 36	TI-1 Low Warning Setpoint	Read/Write
AV - 37	TI-1 High Warning Setpoint	Read/Write
AV - 38	TI-1 High Alarm Setpoint	Read/Write
AV - 39	TI-2 Low Alarm Setpoint	Read/Write
AV - 40	TI-2 Low Warning Setpoint	Read/Write
AV - 41	TI-2 High Warning Setpoint	Read/Write
AV - 42	TI-2 High Alarm Setpoint	Read/Write
AV - 43	Writable Network Variable – Humidity	Read/Write
AV - 44	Writable Network Variable – Temperature	Read/Write
AV - 45	Writable Network Variable – Air Changes	Read/Write
AV - 46	Writable Network Variable – Differential Pressure	Read/Write
AV - 47	Device ID Offset (range: 0 – 4,194,000)	Read/Write
AV - 48	Duct Air Flow based on AI-1 flow input	Read-Only
AV - 49	Duct Air Flow based on AI-2 flow input	Read-Only
AV - 50	Duct Air Flow based on AI-3 flow input (Supply Flow)	Read-Only
AV - 51	Duct Air Flow based on AI-4 flow input (Exhaust Flow)	Read-Only
AV - 52	Volumetric Offset (Supply Flow – Exhaust Flow)	Read-Only
AV - 53	Volumetric Offset Setpoint	Read-Write
AV - 54	AO-1 Override Level	Read-Write
AV - 55	AO-2 Override Level	Read-Write
AV - 56	AO-3 Override Level	Read-Write
AV - 57	AO-4 Override Level	Read-Write
AV - 58	AI-1 Deadband Setting	Read/Write
AV - 59	AI-2 Deadband Setting	Read/Write

Analog Values (continued)		
AV - 60	AI-3 Deadband Setting	Read/Write
AV - 61	AI-4 Deadband Setting	Read/Write
AV - 62	TI-1 Deadband Setting	Read/Write
AV - 63	TI-2 Deadband Setting	Read/Write
Multistate Objects		
MSO - 1	Primary solation Mode: 1=positive, 2=negative, 3=neutral	Read/Write
MSO - 2	Secondary Isolation Mode: 1=positive, 2=negative, 3=neutral	Read/Write
MSO - 3	Primary Alarm Status: 1=normal, 2=warning, 3=alarm	Read-Only
MSO - 4	Secondary Alarm Status: 1=normal, 2=warning, 3=alarm	Read-Only
MSO - 5	AI-3 Alarm Status: 1=normal, 2=warning, 3=alarm	Read-Only
MSO - 6	AI-4 Alarm Status: 1=normal, 2=warning, 3=alarm	Read-Only
MSO - 7	TI-1 Alarm Status: 1=normal, 2=warning, 3=alarm	Read-Only
MSO - 8	TI-2 Alarm Status: 1=normal, 2=warning, 3=alarm	Read-Only
MSO - 9	Offset Control Status	Read-Only

Metasys® N2 Objects

The following table itemizes the list of points available for integration in a building management system (BMS). This table contains the objects for open N2 integration.

Object	Functional Description	Read or Write
Analog Inputs		
AI - 1	Analog Input 1 (default: Primary Pressure)	Read-Only
AI - 17	Analog Input 2	Read-Only
AI - 18	Analog Input 3	Read-Only
AI - 19	Analog Input 4	Read-Only
AI - 20	Thermistor Input 1	Read-Only
AI - 21	Thermistor Input 2	Read-Only
Analog Outputs		
AO - 1	Analog Output 1 (default: Primary Damper Control)	Read-Only
AO - 11	Analog Output 2 (default: Supply/Exhaust Damper	Read-Only
AO - 12	Analog Output 3 (spare control output)	Read-Only
AO - 13	Analog Output 4 (spare control output)	Read-Only
Binary Inputs		
BI - 3	Digital Input 1 (default: Primary Room Switch)	Read-Only
BI - 4	Digital Input 2 (default: Secondary Room Door Switch)	Read-Only
BI - 5	Digital Input 3 (spare digital input)	Read-Only
BI - 6	Digital Input 4 (spare digital input)	Read-Only
Binary Outputs		
BO - 1	Relay Output 1 (default: Primary Alarm Relay Output)	Read-Only
BO - 2	Relay Output 2 (spare relay output)	Read-Only
BO - 3	Relay Output 3 (spare relay output)	Read-Only
BO - 4	Relay Output 4 (spare relay output)	Read-Only
Internal Float Values		
ADF - 1	PID Control Loop 1 Setpoint (Primary Pressure)	Read/Write
ADF - 2	Primary Room Alarm Relay High Setpoint	Read/Write
ADF - 3	Primary Room Alarm Relay Low Setpoint	Read/Write
ADF - 4	Secondary Room Alarm Relay High Setpoint	Read/Write

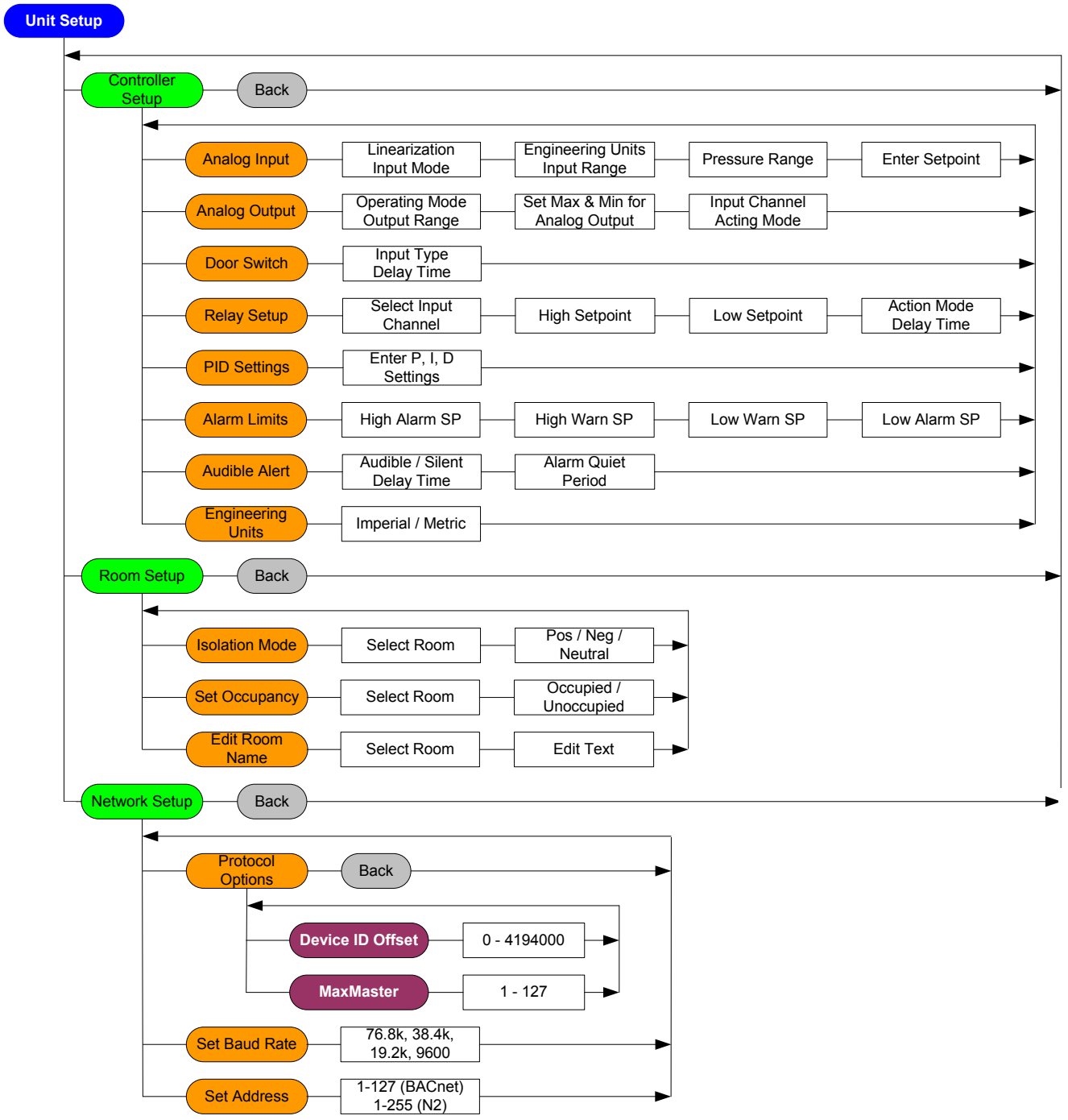
Internal Float Values (continued)		
ADF - 5	Secondary Room Alarm Relay Low Setpoint	Read/Write
ADF - 8	Primary Room Low Alarm Setpoint	Read/Write
ADF - 9	Primary Room Low Warning Setpoint	Read/Write
ADF - 10	Primary Room High Warning Setpoint	Read/Write
ADF - 11	Primary Room High Alarm Setpoint	Read/Write
ADF - 13	PID Control Loop 2 Setpoint	Read/Write
ADF - 14	PID Control Loop 3 Setpoint	Read/Write
ADF - 15	PID Control Loop 4 Setpoint	Read/Write
ADF - 16	Air Change Rate based on Flow Input at AI-1	Read-Only
ADF - 17	Air Change Rate based on Flow Input at AI-2	Read-Only
ADF - 18	Air Change Rate based on Flow Input at AI-3	Read-Only
ADF - 19	Air Change Rate based on Flow Input at AI-4	Read-Only
ADF - 20	Alarm Relay 3 High Setpoint	Read/Write
ADF - 21	Alarm Relay 3 Low Setpoint	Read/Write
ADF - 22	Alarm Relay 4 High Setpoint	Read/Write
ADF - 23	Alarm Relay 4 Low Setpoint	Read/Write
ADF - 24	AI-2 Low Alarm Setpoint	Read/Write
ADF - 25	AI-2 Low Warning Setpoint	Read/Write
ADF - 26	AI-2 High Warning Setpoint	Read/Write
ADF - 27	AI-2 High Alarm Setpoint	Read/Write
ADF - 28	AI-3 Low Alarm Setpoint	Read/Write
ADF - 29	AI-3 Low Warning Setpoint	Read/Write
ADF - 30	AI-3 High Warning Setpoint	Read/Write
ADF - 31	AI-3 High Alarm Setpoint	Read/Write
ADF - 32	AI-4 Low Alarm Setpoint	Read/Write
ADF - 33	AI-4 Low Warning Setpoint	Read/Write
ADF - 34	AI-4 High Warning Setpoint	Read/Write

Metasys® N2 Objects

Object		Read
Internal Float Values (continued)		
ADF - 35	AI-4 High Alarm Setpoint	Read/Write
ADF - 36	TI-1 Low Alarm Setpoint	Read/Write
ADF - 37	TI-1 Low Warning Setpoint	Read/Write
ADF - 38	TI-1 High Warning Setpoint	Read/Write
ADF - 39	TI-1 High Alarm Setpoint	Read/Write
ADF - 40	TI-2 Low Alarm Setpoint	Read/Write
ADF - 41	TI-2 Low Warning Setpoint	Read/Write
ADF - 42	TI-2 High Warning Setpoint	Read/Write
ADF - 43	TI-2 High Alarm Setpoint	Read/Write
ADF - 44	Humidity Network Variable (writable)	Read/Write
ADF - 45	Temperature Network Variable (writable)	Read/Write
ADF - 46	Air Changes Network Variable (writable)	Read/Write
ADF - 47	Differential Pressure Network Variable (writable)	Read/Write
ADF - 48	Air Flow based on Flow Input at AI-1	Read-Only
ADF - 49	Air Flow based on Flow Input at AI-2	Read-Only
ADF - 50	Air Flow based on Flow Input at AI-3 (Supply Flow)	Read-Only
ADF - 51	Air Flow based on Flow Input at AI-4 (Exhaust Flow)	Read-Only
ADF - 52	Volumetric Offset (Supply Flow – Exhaust Flow)	Read-Only
ADF - 53	Volumetric Offset Setpoint	Read-Write
ADF - 54	AO-1 Override Level	Read-Write
ADF - 55	AO-2 Override Level	Read-Write
ADF - 56	AO-3 Override Level	Read-Write
ADF - 57	AO-4 Override Level	Read-Write
Internal Integer Values		
ADI - 1	AI-1 Isolation Mode: 1=positive, 2=negative, 3=neutral	Read/Write
ADI - 2	AI-1 Alarm Status: 1=normal, 2=warning, 3=alarm	Read-Only
ADI - 7	AI-2 Isolation Mode: 1=positive, 2=negative, 3=neutral	Read/Write
ADI - 8	AI-2 Alarm Status: 1=normal, 2=warning, 3=alarm	Read-Only

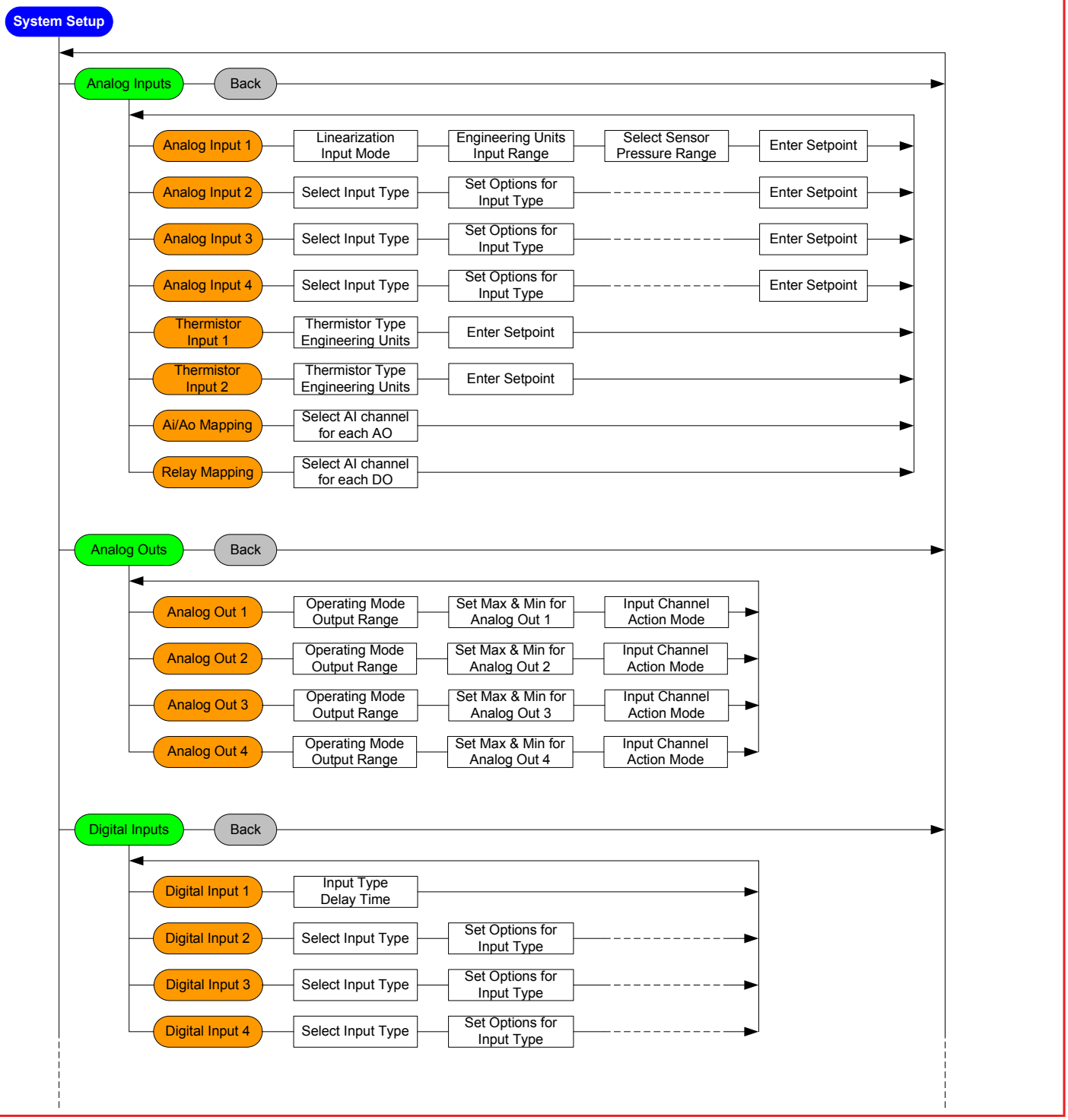
Internal Float Values (continued)		
AI-3 Alarm	Read-Only	Read/Write
AI-4 Alarm	Read-Only	Read/Write
TI-1 Alarm	Read-Only	Read/Write
TI-2 Alarm	Read-Only	Read/Write

Unit Setup Menu Tree (See Corresponding Pages 6 - 19)

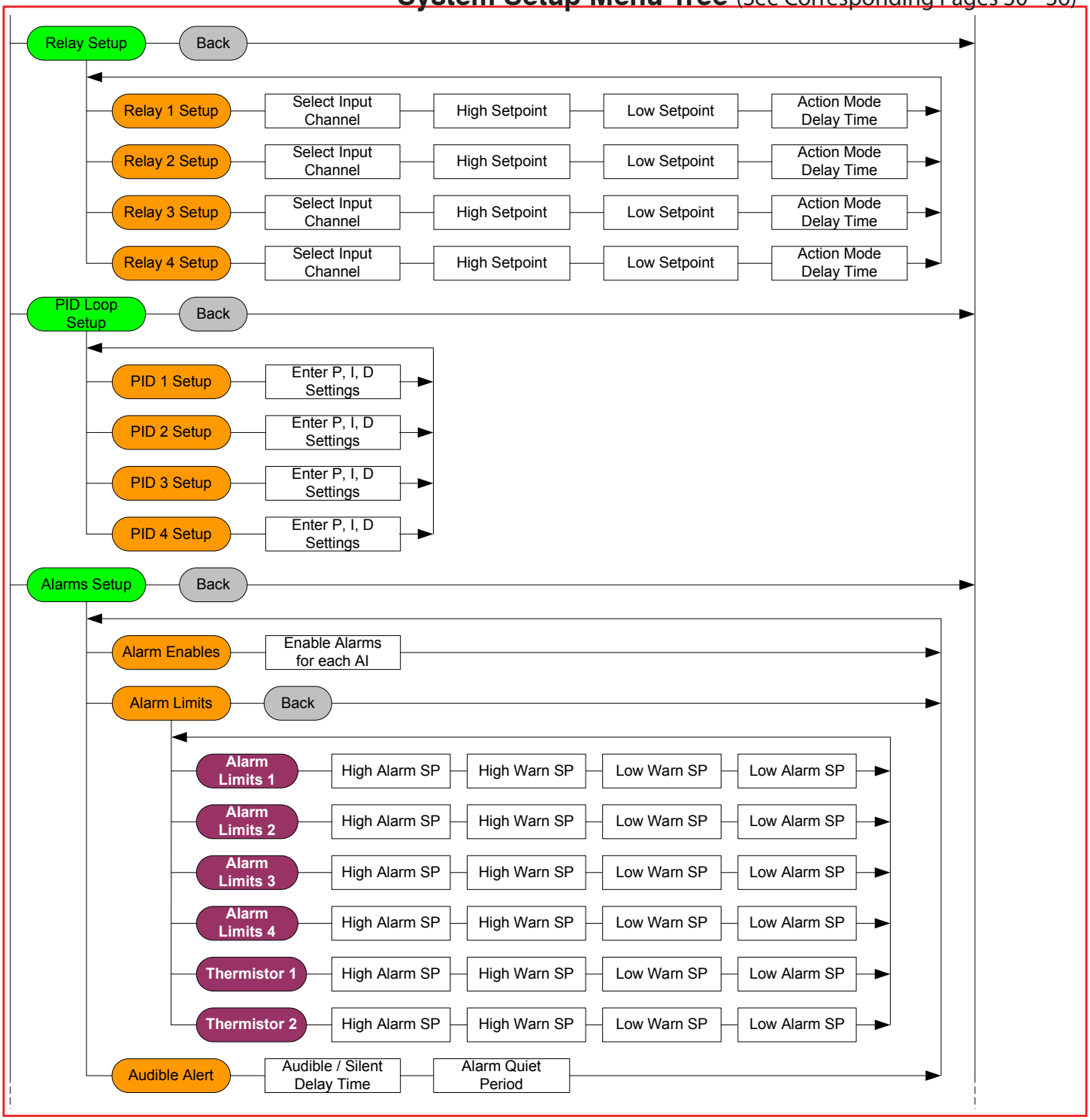


FLOW DIAGRAMS

System Setup Menu Tree (See Corresponding Pages 20 - 29)

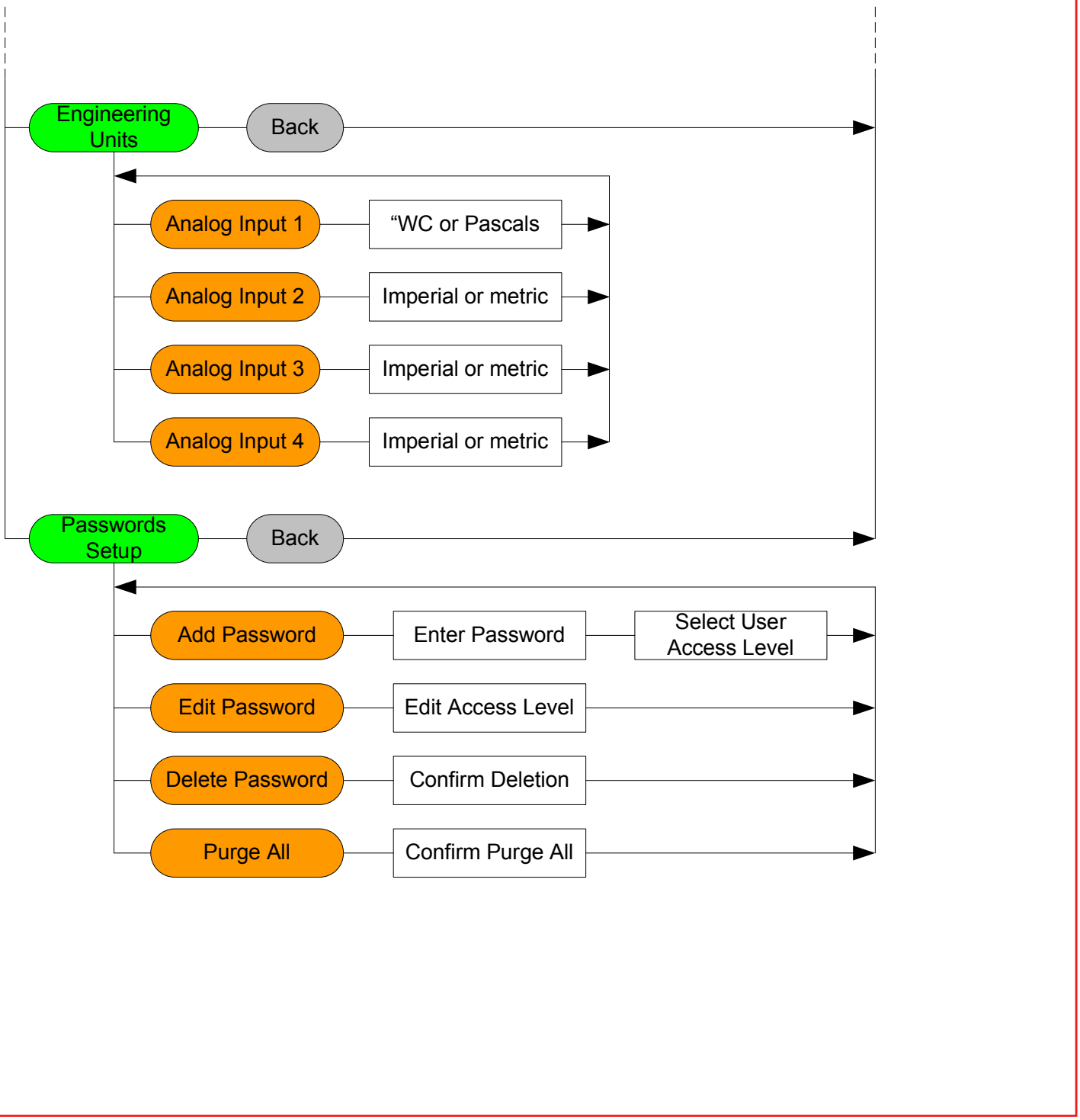


System Setup Menu Tree (See Corresponding Pages 30 - 36)

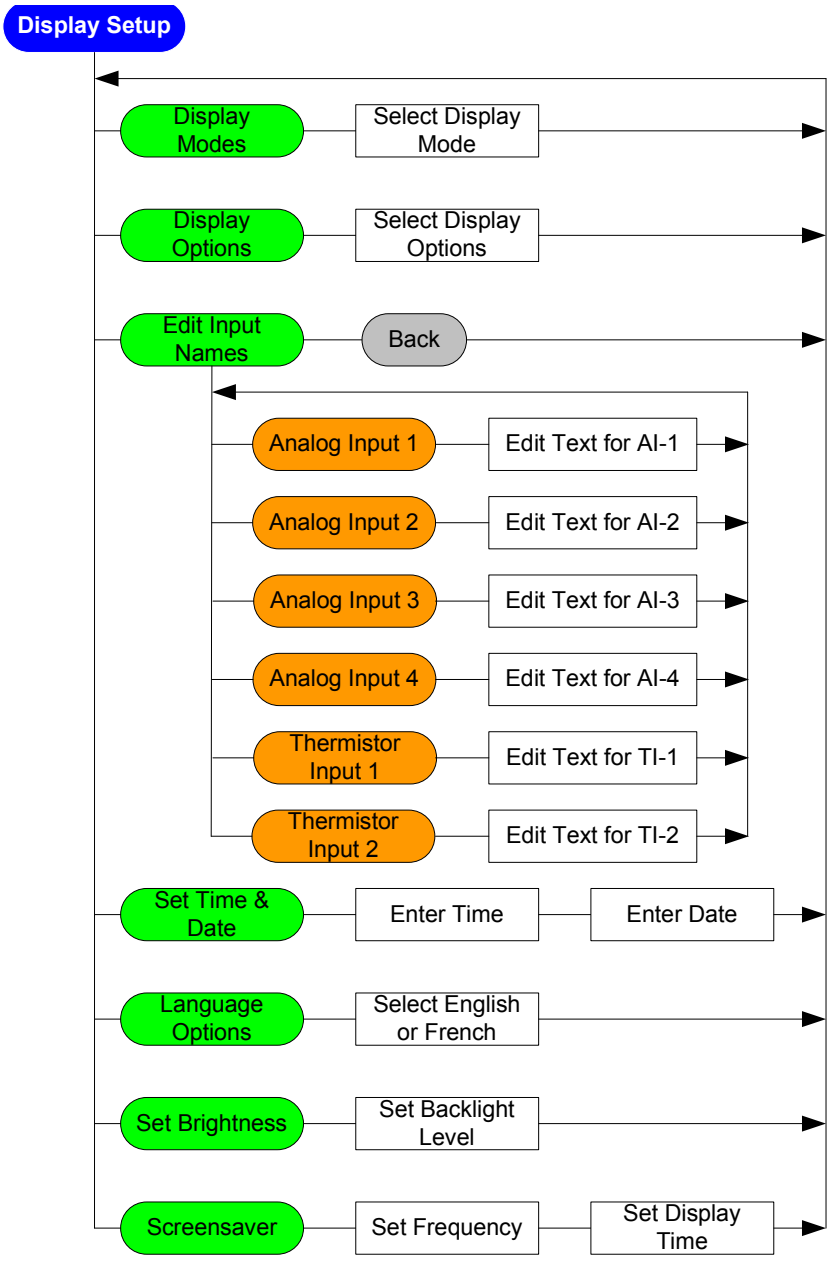


FLOW DIAGRAMS

System Setup Menu Tree (See Corresponding Pages 37 - 39)

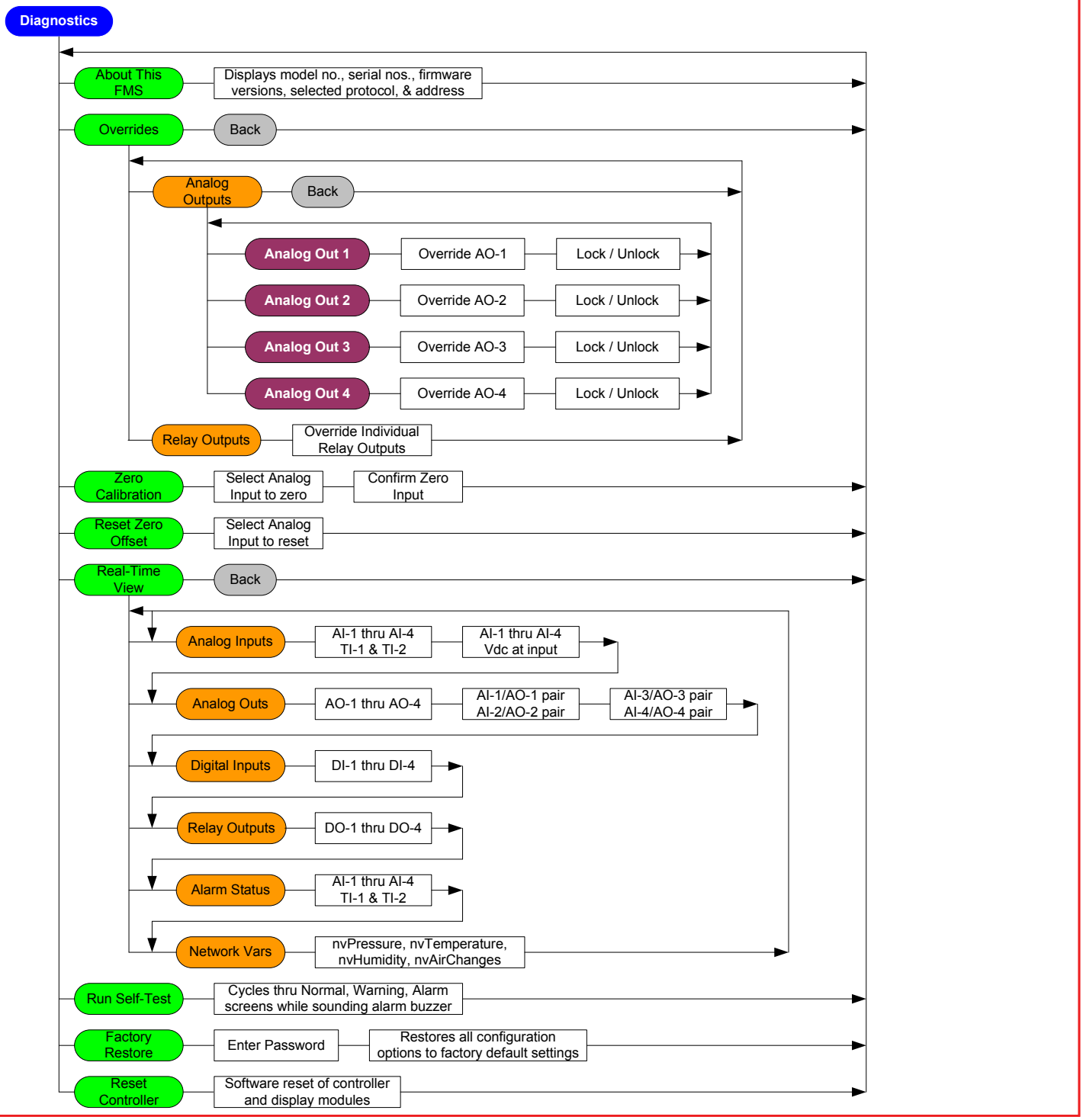


Display Setup Menu Tree (See Corresponding Pages 40 - 44)



FLOW DIAGRAMS

Diagnostics Menu Tree (See Corresponding Pages 46 - 52)



NOTES

Notes

Triatek, located in Norcross, Georgia, has an extensive network of manufacturer's representatives located throughout North America to service you. Our helpful, experienced sales team can provide solutions for your Laboratory Controls, Medical Controls, HVAC Controls, and Industrial Instrumentation needs. Call **770-242-1922** or visit our website at **www.triatek.com** for more information or to find an agent near you.

Triatek has been a pioneer in controllers since its origins in the 1980s. Today, Triatek has the most complete line of controllers and monitors in the industry, the latest of which use full-color touchscreens. Additionally, Triatek is unique in that the company both engineers and sells venturi valves and controllers or monitors. Thus, Triatek is the one company to turn to for a complete air pressure solution.

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