MULTI-PROBE ALARM SYSTEM
OPERATING INSTRUCTIONS

Firmware Version 3.0 or Greater

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Limited Warranty

Hampshire Controls Corporation warrants each manufactured item against defects in material and workmanship, when used as recommended, for a period of one year from original purchase. Products believed to have such defects must be returned to the factory by prepaid transportation.

Hampshire Controls' obligation under this warranty is limited to the repair or replacement, at its option, of those items which upon examination prove to be defective. Such repair or replacement will be made without charge.

This warranty will be void if repairs or alterations are made or attempted without factory authorization; or if the item has been subject to misuse, negligence or accident.

Hampshire Controls Corporation assumes no liability for consequential damages of any kind. The purchaser, by acceptance of the product, assumes all liability of the consequence of its use or misuse.
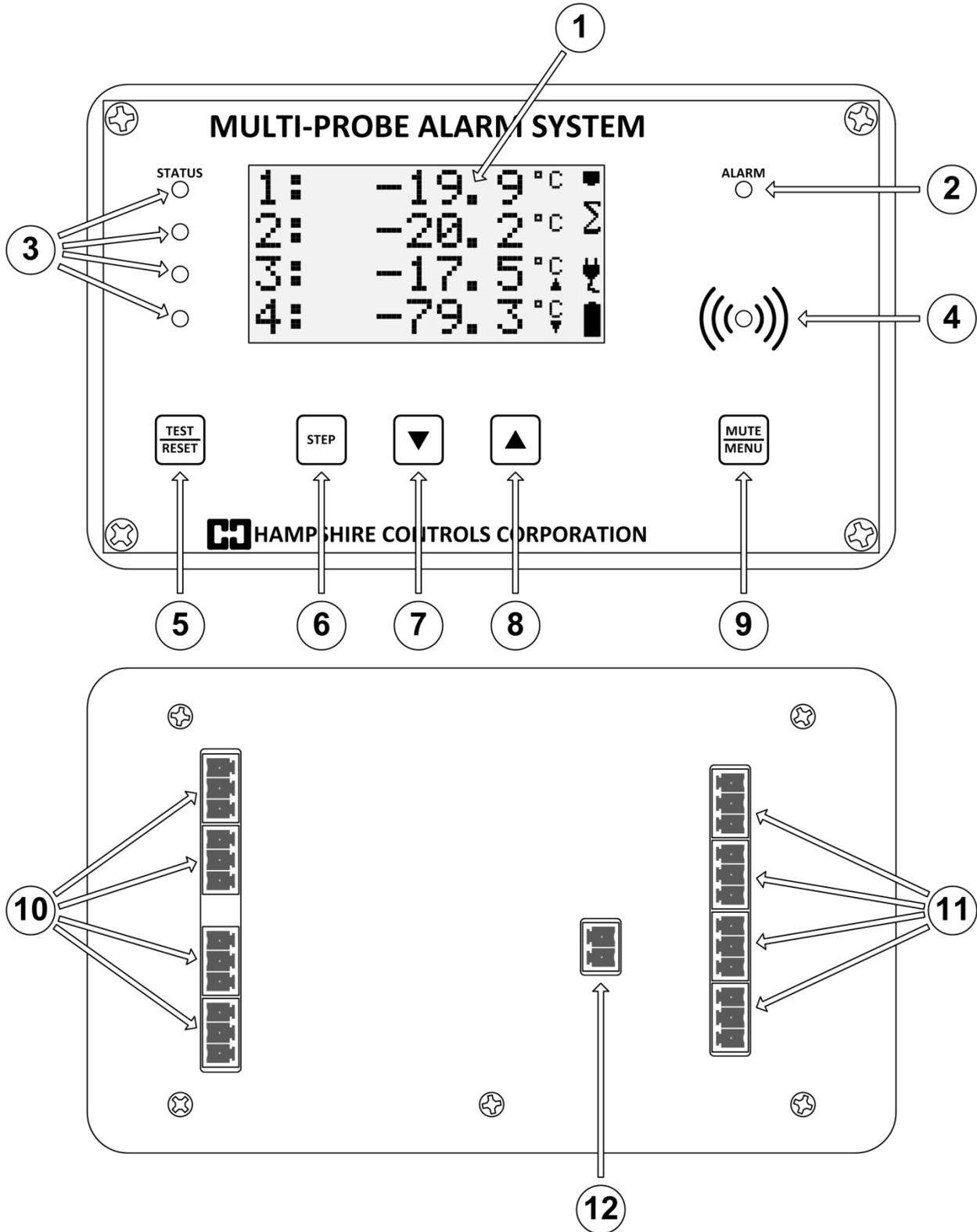
Hampshire Controls Corporation makes no other warranty, whether expressed or implied, in connection with the sale or use of its products.
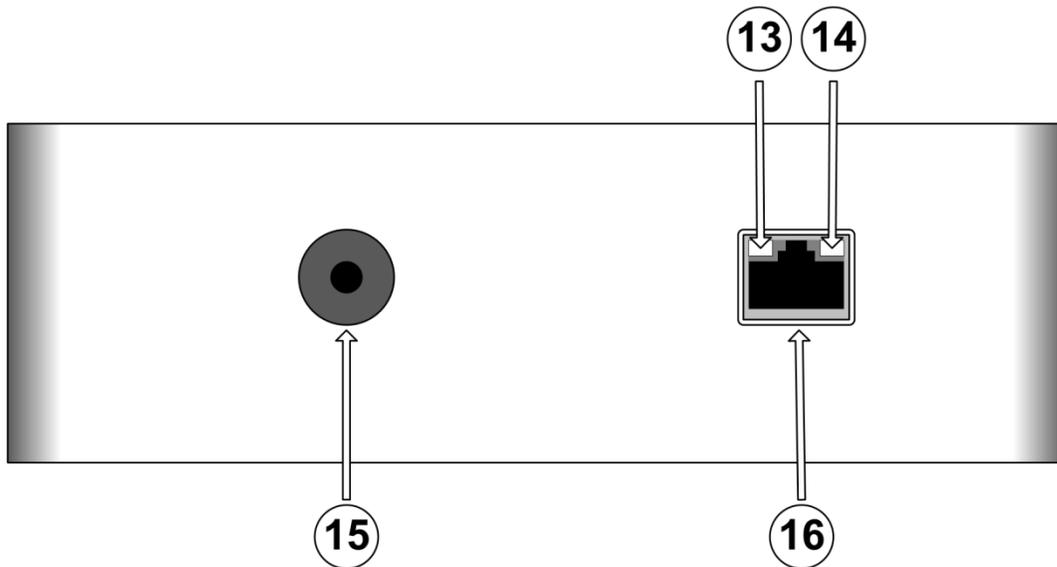
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Hampshire Controls Corporation

1 Multi-Probe Alarm System Components

The Multi-Probe Alarm System consists of the following:

FRONT
1. Backlit 128x64 pixel graphic LCD
2. High-brightness alarm status LED
3. Three-color (green/amber/red) channel status LEDs
4. Audible alarm indicator, 3600Hz piezo beeper
5. TEST/RESET button
6. STEP button (and network info display)
7. Decrement button (and min/max display)
8. Increment button (and alarm limit display)
9. MUTE/MENU button

BACK
10. Four 3-pin pluggable terminal blocks (usu. probe channels 1 to 4)
11. Four 3-pin pluggable terminal blocks (usu. probe channels 5 to 8)
12. One 2-pin pluggable terminal block (selectable NO or NC relay contact)

BOTTOM
13. Amber network activity LED (flashes when transmitting/receiving data)
14. Green network link LED (solid green when network connection is established)
15. Power cord entry (grommet)
16. RJ-45 Ethernet connector

2   Sensor Probes

The probes supplied with your system may vary depending on custom options. Commonly used probes are:

- Pt100 (100 ohm platinum) RTD
- Type-T thermocouple
- Type-K thermocouple
- HX-71 relative humidity transmitter (voltage output)
- Heated cryogenic Pt100 RTD (for LN2 level sensing)
- Switch (mechanical or magnetic reed)

The most common probe option is the Pt100 RTD, a highly accurate resistive temperature device. The sensor element is enclosed in a 4 inch long and 3/16 inch diameter stainless steel sheath. The standard lead length is 10 feet of FEP jacketed 3-conductor wire. Custom lead lengths may be specified when ordering. The probe sheath may be placed in water or other mild aqueous solutions from -100°C to 100°C.

The probes will be pre-wired to terminal-block plugs which mate with the pluggable terminal-block sockets on the back of the MPS. Each connection will be marked with identifying information about the probe or relay connection and any other pertinent electrical information.

Please take care when making connections, as the terminal-block sockets are all physically identical but may be VERY different electrically. For instance, with an MPS-2HT (humidity and temperature) the MPS supplies 15VDC to the humidity transmitter. If you were to plug the Pt100 RTD probe into the socket for the humidity transmitter you may permanently damage the RTD element or the MPS electronics due to Electrical Over-Stress (EOS).

NOTE: Avoid submerging the probe in solvents or harsh chemicals. Use protective thermowells when monitoring such materials.

NOTE: The warranty does NOT cover damage to probes or electronics that is caused by exceeding temperature limitations, or damage to probes caused by using them in solvents or other unsuitable environments.

2.1   Probe Installation

The probe may be used in air, water, or simulated product (usu. glycol or glass beads).

If installing the sensor in a cabinet or enclosure (particularly freezers), make sure to use good techniques to prevent room moisture from getting into the cabinet. Whenever possible, install the probe through an existing access port provided by the cabinet manufacturer, then reseal the port. Alternatively, the probe can be run under, over, or through the door-sealing gasket. Often a door gasket will have a joint at one or more corners. Open that joint slightly by carefully making a slit with a razor blade. Insert the probe wire and then reseal the joint with flexible silicone sealing compound. Inside the cabinet, run the probe wire so that it will not become snagged during loading, unloading or cleaning procedures.

2.2 Probe Location

Install the sensor probe in a location where it will respond to the average temperature of the space being monitored and not to local conditions caused by door openings, ventilation fans, etc.

The object of the probe location is to provide some safety for the area being monitored without generating "false" or nuisance alarms. For example, locating the sensor probe on the bottom of a chest freezer will result in the alarm being sounded later than if it was located near the top.

However, locating the sensor too close to the top of the chest freezer could result in the alarm being sounded due to routine lid opening. Choose a probe location that offers the safety desired for the enclosure contents.

3 Power

3.1 Power-up

Connect all supplied probes to the correct connectors on the back of the MPS and then plug the power supply into an available receptacle. During power-up, the MPS will show a "splash" screen with the firmware revision for about 10 seconds, prior to showing the current probe readings.

3.2 Power-down

The MPS contains a lithium polymer (LiPo) battery connected through an auto-latching disconnect circuit. During shipping, this circuit prevents the battery from supplying power to the MPS. When you plug in the MPS power supply for the first the time, the circuit will activate, preventing the device from turning off when power is disconnected.

In order to completely power-down the MPS you must follow this procedure:

- Press-and-hold the TEST/RESET button until the MPS is in the reset state (backlight and all LEDs are off)
- With the TEST/RESET button held, unplug the power supply
- Continue to hold the TEST/RESET button for 5 seconds
- Release the TEST/RESET button

If the MPS turns back on (running on battery) you will need to repeat the procedure by first plugging in the power supply. Then, be sure to **HOLD DOWN the TEST/RESET button during the entire procedure**. You may also increase the time you keep the button held down after unplugging the power supply. This allows any capacitors in the power supply to completely drain their charge. If they are not fully drained there may be enough power remaining to enable the battery latch circuit when you release the TEST/RESET button.

The backup battery may also be permanently disabled by setting the `Battery` option in the `Edit SETUP` menu to `OFF`, or by modifying the same option by accessing the MPS via a web browser and selecting *System Options*.

4 Sensor Readings Display

4.1 Current Readings

During normal operation the display will shows the current sensor readings of up to 8 probes. On an MPS with 5 or more probes, the display will automatically alternate between displaying probes 1-4 and 5-8. Units of measurement are shown for each sensor reading, as well as an up or down arrow indicating a positive or negative change from the prior reading.

If a probe is disconnected (or open circuit), shorted, or has some other problem *ERROR* will be displayed in place of the normal reading.

Binary-type inputs (i.e. door switch or level detector) will display either OK or Alarm, depending on the current state of the input.

Example sensor reading displays are shown below.
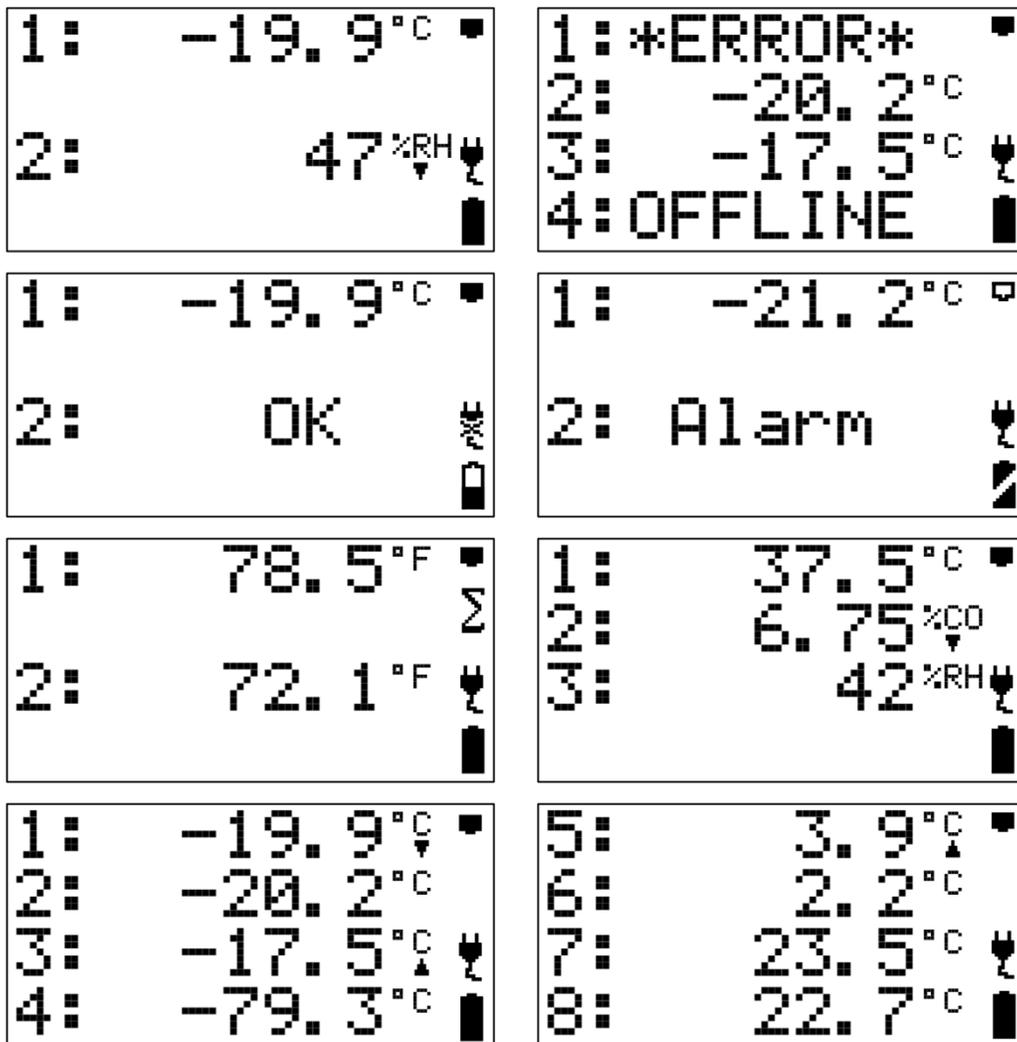
4.2 Status Icons

On the right side of the LCD is a vertical row of status icons. The bottommost icon indicates the state of the internal backup battery. Above the battery icon is an indicator for line-power. Next is an indicator for math or logic alarms (blank if no alarms are active). Finally, in the top location, is an indicator for network status. Additionally, two icons may display near the sensor reading or sensor ✳ERROR✳ message. A list of the possible icons is shown below.

Battery charging (animation) ▯→▯→▮→▮→▮
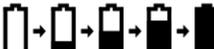
Battery discharging (animation) ▮→▮→▮→▯→▯
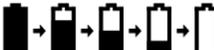
Battery charged ▮

Battery disconnected ◪

Battery trouble ▯

Line power connected ⚡

Line power disconnected ⚡

Math or logic alarm active Σ

Network disconnected ▭

Network connected ▰

Network trouble ▨

Sensor battery low BAT

Sensor communication fault COM

4.3 Network and Device Information

Tap the STEP button to view the firmware version, number of times the MPS has been reset, MAC address, and current network configuration.

```
MPS-8E V3.0
BOOT COUNT: 56
MAC: 00C0033160FC2
DHCP enabled
IP: 10.20.30.100
NM: 255.255.252.0
GW: 10.20.30.1
NS: 10.20.30.2
```

4.4 Max/Min Readings and Alarm Limits

To view the maximum and minimum readings (since last power-up or reset) tap the DOWN ARROW button. To view the high and low alarm limits tap the UP ARROW button. To reset the Max/Min readings hold down the DOWN ARROW button until you hear a beep.

```
1   -15.7   5   -16.3        1   -10.0   5   -10.0
    -27.3       -26.5            -40.0       -40.0
2   -12.8   6   -14.2        2   -10.0   6   -10.0
    -25.4       -28.9            -40.0       -40.0
3    -5.7   7    -6.8        3   -10.0   7   -10.0
    -22.6       -21.3            -40.0       -40.0
4   -75.2   8   -62.4        4   -65.0   8   -65.0
    -82.9       -85.7            -90.0       -90.0
```

5 MPS Configuration

5.1 Setup Menu

Device configuration options, such as networking parameters, are contained in the Edit SETUP menu, which can only accessed by resetting the MPS. To access this menu press-and-hold the TEST/RESET button until the MPS fully shuts down, about 10 seconds. Continue to hold down the TEST/RESET button and also hold down the MUTE/MENU button. Continue to hold down the MUTE/MENU button and release the TEST/RESET button. Wait for all status LEDs to turn GREEN. Finally, release the MUTE/MENU button.

Use the STEP button to go to the next parameter or the TEST/RESET button to go to the previous parameter. To change the currently displayed parameter use the UP and DOWN arrow buttons.

When you are finished, press MUTE/MENU to save your changes, or hold down TEST/RESET for 10 seconds to reset the device without making any changes.

```
Edit SETUP
# Channels
        8
Use ▲ and ▼ to edit
RESET last, STEP next
```

Refer to the Configuration Parameter Descriptions section for information about each setup parameter.

5.2 Setting Alarm Limits

To configure the system's alarm parameters press the MUTE/MENU button while the display is showing the probe readings. The display will show the first parameter 1 Low.

Use the STEP button to go to the next parameter or the TEST/RESET button to go to the previous parameter.

```
Edit LIMITS
1 Low
     -40.0
Use ▲ and ▼ to edit
RESET last, STEP next
```

To change the currently displayed parameter use the UP and DOWN arrow buttons. The value is given in the units configured for the probe being edited (i.e. °F, °C, or %RH).

While in the `Edit LIMITS` menu, the STEP button will advance through `Low` and `High` limits for each probe.

Continue to the `Edit DELAYS` menu by pressing the MUTE/MENU button once, or return to the sensor readings by pressing the MUTE/MENU button twice.

5.3 Setting Alarm Delays

To configure alarm delays and other system timings press the MUTE/MENU button twice while the system is showing the probe readings, or once if you are already in the `Edit LIMITS` menu.

Use the STEP button to go to the next parameter or the TEST/RESET button to go to the previous parameter.

```
Edit DELAYS
1AlarmDelay
        30
Use ▲ and ▼ to edit
RESET last, STEP next
```

To change the currently displayed parameter use the UP and DOWN arrow buttons. All delays are given in minutes.

While in the `Edit DELAYS` menu, the STEP button will advance through an `AlarmDelay` for each enabled probe, then a `Relay Delay` and finally a `Mute Period`.

Return to the probe readings by pressing the MUTE/MENU button once.

5.4 Calibration Menu

Gaining access to the `CALIBRATE` menu is much like accessing the `Edit SETUP` menu. To access this menu press-and-hold the TEST/RESET button until the MPS fully shuts down, about 10 seconds. Continue to hold down the TEST/RESET button and also hold down the UP ARROW button. Continue to hold down the UP ARROW button and release the TEST/RESET button. Wait for all status LEDs to turn GREEN. Finally, release the UP ARROW button.

```
CALIBRATE
Begin
Tap STEP to confirm
or RESET to cancel
```

Press STEP to confirm entry into the `CALIBRATE` menu, or press TEST/RESET to reboot the device.

Within this menu you can press STEP to advance through each channel and calibrate it at two preset points for offset and slope correction.

For each individual channel, you will need to first press the DOWN ARROW. The MPS calibration program assumes you have the probe acclimated to the **Cal Point A** reference value to perform an offset correction. Next, you would press the UP ARROW when the probe has been acclimated to the **Cal Point B** reference value. At this point, the MPS calibration program will calculate the gain required to correct the slope.

The **Cal Point A** and **Cal Point B** values can be specified in the web browser on the MPS *Channel Configuration & Calibration* page. Refer to *Web Browser Access* for details.

For any active channel pressing the MUTE/MENU button will reset its calibration to the default offset of 0 and gain of 1.

When you are finished, press TEST/RESET and confirm saving the new calibration values, or hold TEST/RESET for 10 seconds to reboot the device without saving.

5.5 Factory Memory Reset Menu

Gaining access to the `MemoryRESET` menu is much like accessing the `Edit SETUP` menu. To access this menu press-and-hold the TEST/RESET button until the MPS fully shuts down, about 10 seconds. Continue to hold down the TEST/RESET button and also hold down the DOWN ARROW button. Continue to hold down the DOWN ARROW button and release the TEST/RESET button. Wait

```
MemoryRESET
Enter menu?

Tap MENU to continue
or RESET to exit
```

for all status LEDs to turn GREEN. Finally, release the DOWN ARROW button.

There are 4 memory reset options `Limit+Delay`, `Setup`, `Calibration`, and `Lim/Set/Cal` (all parameters). Follow the on-screen instructions to select the parameters to reset. When a reset is confirmed the MPS will reboot and the selected parameters will return to their original factory preset values.

5.6 Configuration Parameter Descriptions

`Edit LIMITS` Menu

`1 Low,2 Low,…,8 Low`

Low alarm limit for probes 1 to 8. The maximum number of probes shown will depend on the system configuration and the value defined by the `# Channels` parameter. The low limit parameter is defined in the same units as shown in the sensor readings for each probe.

`1 High,2 High,…,8 High`

High alarm limit for probes 1 to 8. The maximum number of probes shown will depend on the system configuration and the value defined by the `# Channels` parameter. The high limit parameter is defined in the same units as shown in the sensor readings for each probe.

Edit DELAYS Menu

1AlarmDelay,2AlarmDelay,…,8AlarmDelay

Alarm delay (in minutes) for each probe. The maximum number of probes shown will depend on the system configuration and the value defined by the # Channels parameter. This value defines the delay between the time the probe reading exceeds an alarm limit and the time the alarm is activated. The range is 0 to 30 minutes, with a default of 0 minutes.

Relay Delay

Relay delay (in minutes) for the single relay. This value defines the delay between the time the alarm is activated and the time the relay changes state. Therefore, the time from the probe reading exceeding a limit to the time the relay changes state is equal to the sum of the AlarmDelay and the Relay Delay for each probe. The range is 0 to 120 minutes with a default of 0 minutes.

Mute Period

This parameter configures the alarm mute time (in minutes). When the MUTE/MENU button is pressed during an alarm condition, the beeper will be silenced (periodic chirp only) until either the alarm condition goes away, or the mute time elapses. The range is 0 to 120, with a default of 15.

Edit SETUP Menu

Channels [FACTORY CONFIGURED]

This parameter configures the number of probes actually present on the device. Probes must be populated in order, starting from channel 1. If a probe is missing from an active channel, that channel will be in a persistent alarm state. The range is 1 to 8, with a default value defined by the model ordered (MPS-**2**, MPS-**3**, MPS-**4**, or MPS-**8**).

Tmpr Unit

Unit of measurement for all temperature probes.

°C = Degree Celsius (default).
°F = Degree Fahrenheit.

AngleDisply

This parameter configures the method for displaying angular measurements.

DEG = Degrees (0-360) (default).
NESW = Compass points (4 cardinal points, 4 ordinal points, and 8 half-wind points).

Relay

This parameter configures the relay operation. The state defined here will be the state of the relay when no alarm condition is present.

`N. C.` = Normally closed (default).
`N. O.` = Normally open.

Battery

This parameter configures the internal backup battery connection.

`ON` = Normal backup battery function (default).
`OFF` = Permanently disconnect the backup battery.

Backlight

This parameter configures the LCD backlight operation.

`-1` = The backlight is always OFF.
`0` = The backlight is always ON (default).
`1` to `60` = The backlight will shut off after this delay time (in seconds).

NOTE: When using the backlight timer, if the backlight is off, the first press of any button will turn on the backlight without performing the normal button operation. The following button press will perform normally.

AlarmBeeper

This parameter configures the operation of the audible alarm beeper.

`ON` = Normal alarm beeper function (default).
`OFF` = Permanently disables the alarm beeper.

Use DHCP

This parameter configures the use of DHCP to assign the network configuration.

`YES` = Network configuration is assigned by DHCP (default).
`NO` = Network configuration uses statically assigned values.

IP Address

This parameter configures the statically assigned IPv4 address.

Netmask

This parameter configures the statically assigned IPv4 network mask.

Gateway

This parameter configures the statically assigned IPv4 gateway address.

DNS

This parameter configures the statically assigned IPv4 name server address.

`Target`

> This parameter configures the IPv4 destination address when using Hampshire Controls' *ALERT Monitoring System* (AMS).

`Unit ID`

> This is a 6-character alpha-numeric value that may be used as a unique identifier if you have more than one MPS on site. It is included in alert email messages and as the ID passed to the AMS. The default value is `MPS1`.

`NetPassword`

> This parameter specifies the password for the "admin" account when logging into the MPS via a web browser (Default: "adminpass!").

6 Alarms

6.1 Power Loss

When the MPS loses line-power it will continue to operate on the internal LiPo battery. However, the following changes in operation will occur:

- Display and backlight will turn off to save power (press any button to enable)
- Display will show `PowerFail` down the right edge (when display is enabled)
- Status LEDs will turn off (press any button to enable)
- Alarm LED will flash until power is restored
- Alarm beeper will sound (press any button to mute)
- Relay will change to alarm state

No action is required when power is restored; the MPS will resume normal function.

6.2 Sensor Limits

If the probe readings are within the alarm limits (less than the high limit and greater than the low limit), the STATUS LED will blink green.

When the temperature reading meets or exceeds one of the temperature limits the STATUS LED will blink red.

After the probe's alarm delay time is exceeded, the unit will blink the ALARM LED and the buzzer will beep.

The user can MUTE the buzzer by tapping the MUTE/MENU button. The unit will reduce the audible signal from a long beep, to a shorter, and less frequent, chirp. It will remain muted until the `Mute Period` time expires or a different probe goes into alarm.

Once the Alarm state has been signaled, the unit will wait the `Relay Delay` time before changing the state of the relay contacts.

6.3   Alarm Relay Testing

An alarm condition can be simulated by tapping the TEST/RESET button. When the button is pressed, you will be presented with a confirmation screen. When you press STEP to confirm the test, the relay will change to the alarm state and remain in alarm for 30 seconds. When the time expires, the relay will toggle back to the non-alarm state. Pressing TEST/RESET at any time during the test will return the relay to normal operation.
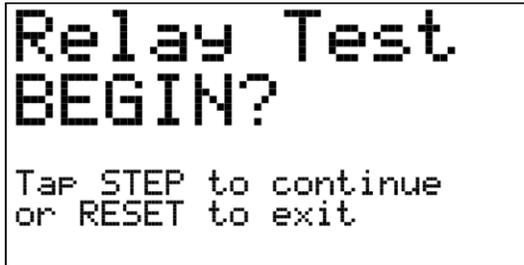
7   Web Browser Access

Version 3.0 firmware provides many enhanced features when accessing the MPS through a web browser. Simply type "http://" followed by the IP address of the MPS into your browser's address bar (press the STEP button on the MPS to view the current IP address). You will be presented with the main page (shown here).

Direct data access links are provided at the bottom of the page in JSON and XML formats. Should you desire to implement your own data-logging system, these links would provide an efficient way of polling the current configurations and sensor readings in an easy to interpret format. See Appendix A for an example.

The main page and the direct data link files are the only data available from the MPS without providing authentication credentials. When clicking any of the other links you will need to provide a username and password. The usernames and passwords are all configurable on the System Options page. For initial configuration, the administrative account has a default username of "admin" and default password of "adminpass!".

7.1 System Options

The System Options link provides access to the same parameters as the `Edit SETUP` menu of the MPS, and more. This would be the place to start when configuring your MPS. The sections below will explain the additional features.

7.1.1 Relay Latch

When enabled, the relay latch feature will keep the relay in the alarm state until the alarm is acknowledged by pressing the MUTE/MENU button on the MPS. When disabled, the relay will return to the non-alarm state as soon as the alarm condition clears.

7.1.2 Relay Control

By default, all alarm conditions will control the relay state. The relay control parameter allows you to select specific channels to control the relay. This feature would be useful if you would like to use the relay as a control signal, rather than an alarm signal.

7.1.3 Menu Lockout

When enabled, the menu lockout feature prevents the MUTE/MENU button on the MPS from accessing the `Edit LIMITS` and `Edit DELAYS` menus. It also prevents access to the `CALIBRATION` and `Edit SETUP` menus when the MPS is reset.

The `MemoryRESET` menu is still available as this would be the only way to recover if you forget the administrator password. See section 5.5 for details.

7.1.4 Channel IDs

The channel IDs allow you to specify short (8 character) names or descriptions for each channel. These IDs are included in the alert emails sent from the MPS.

7.1.5 Usernames/Passwords

These parameters allow you to customize the names and passwords for three sets of credentials which are used to controlled access to the MPS web pages.

"Admin" can review and change all settings.

"User" can view most settings, but may only change alarm limits and delays.

"Guest" may only view data, and has no access to system settings.

7.2 Email Options

The MPS has the capability of sending emails to a distribution list of up to 10 addresses.   This feature was present in prior firmware releases, but there have been a few changes.

When email alerts are enabled, the MPS will send email to the distribution list for the following events:

- Alarm
- Alarm continuation
- Mute button pressed
- Mute period expired
- Recovery from alarm condition
- Loss of line-power
- Recovery from loss of line-power

The SMTP client in the MPS now has the ability to use "STARTTLS" (TLS) which allows a more secure form of authentication with the SMTP server. With this added feature, it is now possible

HAMPSHIRE CONTROLS CORPORATION

Multi-Probe System Email Options

Email Account & Server Info:

Email Alerts	On
From Address	alerts@company.com
Auth Username	alerts@company.com
Auth Password	•••••••••••••••••• ☐ Show
SMTP Server	smtp.company.com
SMTP Port	587
TLS	On

Alert Email Contact List:

Contact 1	bob@company.com
Contact 2	alice@company.com
Contact 3	
Contact 4	
Contact 5	
Contact 6	
Contact 7	
Contact 8	
Contact 9	
Contact 10	

Send Test Email

Reload Submit

Main Menu

to use widely available services (such as Gmail) to send alert messages. In the case of Gmail, you will need to go to the Gmail account settings and either turn on "allow less-safe apps", or use an "application specific password", to enable the ability to send alert email messages from smtp.gmail.com.

Due to the improved external data logging options of the version 3.0 firmware, the capability of sending daily reports (logs) has been removed. Logging and reporting can be accomplished via Hampshire Controls AMS, SNMP, or via your own implementation through the use of the XML and JSON data access links.

7.3 Network Configuration

The Network Configuration page contains parameters for configuring the IPv4 network settings, data communication options for AMS and/or SNMP, and NTP. A method for setting the time manually is also provided if you do not want to use NTP.

7.3.1 IP Communications

The IP communications section currently provides options for Hampshire Controls AMS, MSA ProtoNode (OEM application only), and SNMP.

If you are using the AMS or an MSA ProtoNode, select the appropriate option from the drop-down menu. Next, configure the Destination as the IP address of either the AMS computer or the MSA ProtoNode.

If you would like to integrate the MPS into your SNMP monitoring solution, enable SNMP and enter the desired name for the SNMPv1 read-only community string. A MIB file is not currently available. Please see Appendix B for the list of available OIDs.

7.3.2 Network Time Protocol & Clock

To use NTP for automatic time adjustment, enable NTP and enter a host name for a specific time server or a time server pool. If you are not using NTP, you may manually set the time using the provided form inputs. A CR1220 lithium battery (not included) may be installed in the battery clip inside the MPS to keep the real-time-clock (RTC) running during *complete* power loss (line-power & LiPo backup battery); however, it is normally not required.

7.4 Channel Configuration & Calibration

The Channel Configuration & Calibration page is the most complex and powerful feature of the MPS version 3.0 firmware. It provides methods for calibrating standard temperature probes, adjusting ranges for current or voltage input sensors, setting the display unit, applying exponential averaging to data readings, and scaling display values.

HAMPSHIRE CONTROLS CORPORATION

Multi-Probe System
Channel Configuration & Calibration

Channel	Raw Value	Cal Value	Unit	Type	Decimal Digits	Cal Point A	Cal Point B	Cal Offset	Cal Gain	User Offset	Range Min	Range Max	Alpha	Calibrate
1	75.161323	75.4	°F	TMPR	1	32.0	104.0	0	1.002901	0.00	-148.0	212.0	0.2500	A B
2	74.598823	74.6	°F	TMPR	1	32.0	104.0	0	1.000564	0.00	-148.0	212.0	0.2500	A B
3	70.6912	70.7	°F	TMPR	1	32.0	104.0	0	1.000042	0.00	-148.0	212.0	0.2500	A B
4	93.671089	94.8	°F	TMPR	1	32.0	104.0	0	1.015229	0.00	-148.0	212.0	0.2500	A B
5	0.776726	776.7	mV	ADCv	1	0.0	1.0	0	1	0.00	0.0	1000.0	0.1000	A B
6	0.776728	776.7	mV	ADCv	1	0.0	1.0	0	1	0.00	0.0	1000.0	0.1000	A B
7	0.776729	776.7	mV	ADCv	1	0.0	1.0	0	1	0.00	0.0	1000.0	0.1000	A B
8	0.776728	279.6	°	ADCv	1	0.0	1.0	0	1	0.00	0.0	360.0	1.0000	A B

Calibrate All: Point A Point B

WARNING! These parameters have been factory preset for your application. Making improper changes can invalidate the device calibration, and in certain cases cause the device to stop functioning. **READ THE INSTRUCTION MANUAL** before changing any values on this page!

Reload Submit
Main Menu

A brief description for each column in the table is supplied below. Functions using the data in these columns will be described in depth in the following sections.

1. **Channel**: The probe channel number will match the probe connector labels on the back of the MPS.
2. **Raw Value**: This is the raw data reading from the converter in the MPS; it will be either a temperature value (°C or °F) for temperature probes, or a voltage between 0 to 1.25 volts for current or voltage inputs (such as a humidity transmitter).
3. **Cal Value**: This will show the adjusted value after the calibration factors have been applied.
4. **Unit**: This is a three character string representing the units of measurement for the channel.
5. **Type**: The hardware type associated with the channel. This is factory set and will be either TMPR, ADCs, ADCv, ADCc, or ADCh.
6. **Decimal Digits**: The number of decimal digits to display.
7. **Cal Point A**: The expected reading for the offset calibration.
8. **Cal Point B**: The expected reading for the slope calibration.
9. **Cal Offset**: The calibration offset applied to correct the raw reading at **Cal Point A**.
10. **Cal Gain**: The calibration multiplier applied to correct the slope at **Cal Point B**.
11. **User Offset**: An offset applied to correct for a minor difference at a desired point (applied after the Cal Offset and Cal Gain adjustments).

12. **Range Min**: The low range value for a voltage or current input. Does not apply to "TMPR" types.
13. **Range Max**: The high range value for a voltage or current input. Does not apply to "TMPR" types.
14. **Alpha**: The "alpha" value for exponential averaging.
15. **Calibrate**: Buttons to initiate calibration at points A and B for each channel.

7.4.1 Units of Measurement

The Unit column defines the three character string that will be displayed on the MPS LCD to the right of each probe reading. This column is user editable and intended to allow for the specification of units for current and voltage inputs.

Caution should be taken in making changes to the Unit value for "TMPR" type probes. It is best NOT to change this value for "TMPR" channels. Instead, go to the *System Options* page and adjust the *Temperature Units* parameter to notify the MPS to make the appropriate conversion calculations between °C and °F (or vice-versa) for the probe readings as well as the alarm limits and the calibration parameters.

You may individually change the unit between °C and °F for a single channel, but YOU MUST make all the necessary changes to the stored parameters, or the resulting readings **will not be valid**.

7.4.2 Decimal Digits

For each channel you may specify the number of decimal digits to display (0 to 3). Displaying more digits does not increase the accuracy of readings, and showing too many digits could cause "jumpy" readings depending on probe type and accuracy.

Additionally, the display can only show 7 total characters per reading per channel. So, you must be cautious not to create a situation where a normal reading would extend beyond this count. For example, if you are measuring the temperature of liquid nitrogen (in °C), you would not show 3 decimal digits because the value "-195.789" is 8 characters long and would not display properly. In this case 0, 1, or 2 digits would be appropriate, yielding "-196", "-195.8", or "-195.79".

7.4.3 TMPR Channel Calibration

The calibration of "TMPR" type probes requires two known-good reference temperatures (typically some form of stable-temperature water bath). During factory calibration two of four possible references are used: liquid nitrogen (-195.8°C, -320.4°F), distilled ice-water slush (0°C, 32°F), heated water bath (40°C, 104°F), and boiling water bath (near 100°C, 212°F). The bath temperature selection depends on the intended usage range of the probe. The actual temperature of each bath is verified by a NIST-traceable reference thermometer.

Any of the reference options above or any two known-good reference points a minimum of 20°C apart may be used for field calibrations. The reference values must be entered in the same units as specified by the channel's unit of measurement.

Calibration procedure:

1. Enter the lower of the two temperatures in **Cal Point A** and the higher into **Cal Point B** for each of the probe channels to be calibrated. Enter a **Cal Offset** of "0", a **Cal Gain** of

2. "1", and a **User Offset** of "0" for the same channels. Click Submit to save this information.

2. Place each of the probes in the lower temperature calibration solution (**Cal Point A**) and allow the readings to stabilize for a MINIMUM of 5 minutes. The **Cal Value** will be a rounded version of the **Raw Value** and both should be very close to reading the expected **Cal Point A** value.

3. If you are calibrating ALL probes, and they are ALL type "TMPR", you may click the **Point A** button beneath the table, otherwise you MUST click the individual **A** buttons for each channel (one-at-a-time). To proceed with the calibration click "Ok" to confirm.

4. If the readings are stable during the 60 second duration of data acquisition, the **Cal Offset** values for the specified channel(s) will contain a calculated offset. If the values look reasonable (close to 0), click Submit to save.

5. After submission, the **Cal Value** column will differ from the **Raw Value** column by the calculated **Cal Offset**, and the readings should be equal to the **Cal Point A** (within expected system tolerance).

6. Move the probes into the higher temperature solution (**Cal Point B**) and allow the readings to stabilize for a MINIMUM of 5 minutes. The **Cal Value** will still be offset from the **Raw Value** by the **Cal Offset**, and both should be very close to reading the expected **Cal Point B** value.

7. If you are calibrating ALL probes (and they are ALL type "TMPR") you may click the **Point B** button beneath the table, otherwise you MUST click the individual **B** buttons for each channel (one-at-a-time). To proceed with the calibration, click "Ok" to confirm.

8. If the readings are stable during the 60 second duration of data acquisition, the **Cal Gain** values for the specified channel(s) should contain a calculated gain value. If the values look reasonable (close to 1), Submit the form.

9. After submission, the calibration is complete and the **Cal Value** column will differ from the **Raw Value** column by the calculated **Cal Offset** and **Cal Gain** factors and the readings should be equal to the **Cal Point B** (within expected system tolerance).

7.4.4 ADCv and ADCc Channel Calibration

For channel types "ADCv" (voltage) and "ADCc" (current) a different calibration method must be used. In these cases the input range must be scaled to a range of 0 to 1, which is then applied to the **Range Min** and **Range Max** values to calculate the output (display) value.

You will need the appropriate equipment to supply a calibrated voltage or current to the input channels of the MPS in order to perform a calibration on these channel types. Additionally, for these channel types, the current or voltage transmitter device should be calibrated separately.

Calibration procedure:

1. Enter "0" into **Cal Point A** and "1" into **Cal Point B** for each of the probe channels to be calibrated. Enter a **Cal Offset** of "0", a **Cal Gain** of "1", and a **User Offset** of "0" for the same channels. Set the **Unit**, **Range Min,** and **Range Max** values to the proper output values for your voltage or current transmitter device. Submit the form to store this information.

2. Apply the appropriate stimulus to the MPS input channel for the MINIMUM value of the input range (0 volts for voltage input, 4mA for current input).

3. Press the **A** button for the channel and press "OK" to confirm.

4. Submit the form. After submission the **Cal Value** should be reading **Range Min** (within expected system tolerance).
5. Apply the appropriate stimulus to the MPS input channel for the MAXIMUM value of the input range (typically 1 or 5 volts for voltage input, 20mA for current input).
6. Press the **B** button for the channel and press "OK" to confirm.
7. Submit the form. After submission the **Cal Value** should be reading **Range Max** (within expected system tolerance).
8. Repeat steps 1 through 7 for each channel.
9. Remove the calibration equipment and connect the voltage or current transmitter(s) to the appropriate MPS input channel(s).

7.4.5 ADCh Channel Calibration

Channels of type "ADCh" are for heated cryogenic RTD probes used for liquid nitrogen level sensing. For these probes a two-point calibration is not necessary. Instead, the calibration values may be left at their defaults and the trip point (high/low alarm limits) should be adjusted to the values appropriate for detecting liquid nitrogen liquid and vapor. Liquid nitrogen is required to achieve the desired result. This calibration is performed at the factory.

7.4.6 ADCs Channel Calibration

Channels of type "ADCs" are for switch inputs, which are factory configured and require no recalibration.

7.4.7 Exponential Averaging

The **Alpha (α)** value in the Channel Configuration & Calibration table sets the exponential averaging level for each channel to slow the displayed rate of change or to dampen the noise in the readings. **Alpha (α)** must be set to a value between 0.0 and 1.0. An **Alpha (α)** value of 1.0 applies no exponential averaging. Lower **Alpha (α)** values slow the response of the display and dampen noise more as described here.

Exponential averaging is represented by the following equation in which **Alpha (α)** represents the degree of exponential averaging:

$$avg_n = avg_{n-1}(1 - \alpha) + reading_n(\alpha) = avg_{n-1} + \alpha(reading_n - avg_{n-1})$$

Alpha (α) is related to the time constant (τ), the time it takes for the average reading to reach ~63% of the step input value, as represented here:

$$\tau = \frac{-\Delta T}{\ln(1 - \alpha)}$$

Where ΔT is the sampling period. The MPS takes readings 30 times per minute, so in this case ΔT is 2 seconds (0.0333 minutes). Solving the equation for α yields:

$$\alpha = 1 - e^{-\frac{\Delta T}{\tau}}$$

Therefore, if you want the displayed reading for a channel to approach 63% of the actual value within the time constant (τ), you will set the **Alpha (α)** value for that channel to the value in the following table:

α	τ
0.1813	10 sec
0.0952	20 sec
0.0328	1 min
0.01105	3 min

The chart below shows the effect that each of the **Alpha (α)** values listed in the table would have on a step change (0.0 to 1.0) in sensor reading.
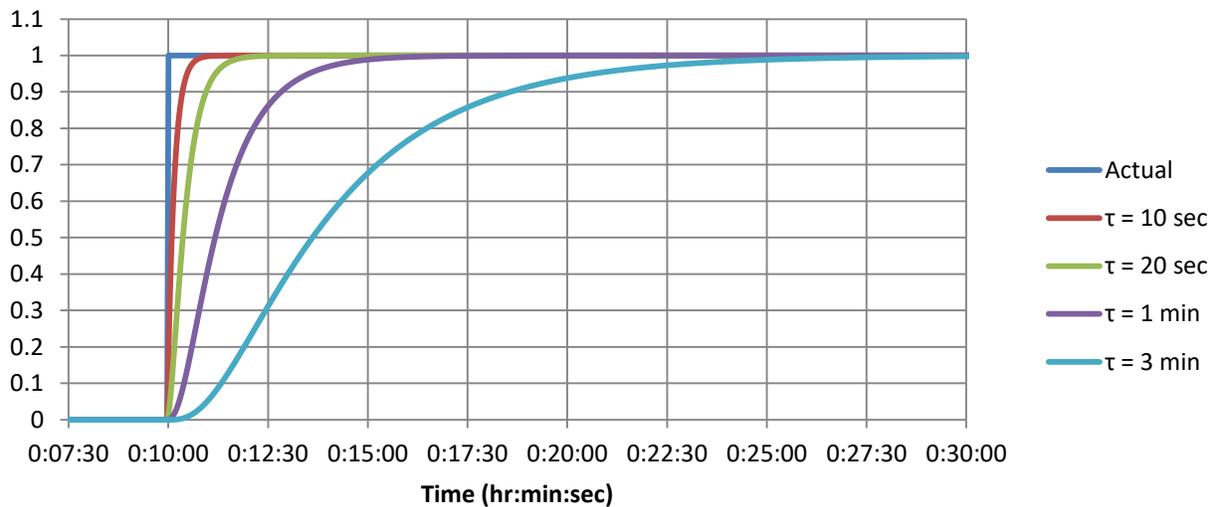
7.4.8 Equations

The following equation is used to convert the **Raw Value** to the **Cal Value** for TMPR channels:

$$CalValue = CalGain(RawValue - CalPointA + CalOffset) + CalPointA + UserOffset$$

After setting *CalPointA* and *CalOffset* to zero, the equation becomes the slope-intercept form of a line:

$$y = m(x) + b$$

Where m represents **Cal Gain**, x represents **Raw Value**, b represents **User Offset**, and y is the calculated **Cal Value**. Therefore a linear conversion can be applied any raw input.

ADC channels start with a similar equation to the one above:

$$TmpValue = CalGain(RawValue - CalPointA + CalOffset) + CalPointA$$

TmpValue is expected to be calibrated to a value between 0.0 and 1.0, which is then entered into:

$$CalValue = RangeMin + TmpValue(RangeMax - RangeMin) + UserOffset$$

Resulting in a **Cal Value** between **Range Min** (*TmpValue*=0.0) and **Range Max** (*TmpValue*=1.0), assuming the **User Offset** is 0.

Other mathematical manipulations and conversions may be performed on the **Raw Value** using the relationships described above.

One simple example of a Raw Value conversion would be performing a unit conversion from a 4-20mA pressure transducer with output value is listed in MPa to a display value in psi. Simply enter "psi" for the **Unit** and enter the appropriate psi equivalents for the MPa range end points in **Range Min** and **Range Max**.

A more complex example would be to estimate the gauge pressure of a cylinder of saturated CO_2. The CO_2 saturation pressure vs. temperature is a curve; however, we could linearize a small region of this curve around room temperature, and apply this information to the equations above to convert the measured cylinder temperature into an estimated gauge pressure reading. If we use the least-squares method to fit the gauge saturation pressure to temperature in °F over the range of 55°F to 75°F we get the following slope-intercept equation:

$$y = 10.517019(x) + 102.623356$$

Where x is the **Raw Value** of the cylinder temperature (°F) and y is the **Cal Value** which estimates the cylinder gauge pressure in psi.

Therefore, with **Cal Point A** set to 0, **Cal Offset** set to 0, **Cal Gain** set to 10.517019, and **User Offset** set to 102.623356, the MPS channel will convert a cylinder temperature measurement into an estimated gauge pressure reading.

7.5 Math and Logic Alerts

This page allows you to create up to four additional alarm conditions based on math or logic operations between two channels. These alarm conditions may be used in replacement of, or in addition to, the individual channel alarm limits.

Each of the four entries has a short ID that will be used when sending email alerts, an enable checkbox, A and B channel selections, the math or logic operation selection, two range entries, and an alarm delay.

7.5.1 Plus Operation

The plus operation requires the selection of two channels and the configuration of alarm range A only. During each sampling cycle, the two channel readings will be added (regardless of differing units of measurement) and the sum will be compared with range A. The alert will be triggered if the sum is "Inside" or "Outside" the range, depending on the selection.

7.5.2 Minus Operation

The minus operation requires the selection of two channels and the configuration of alarm range A only. During each sampling cycle, channel B will be subtracted from channel A (regardless of differing units of measurement) and the difference will be compared with range A. The alert will be triggered if the sum is "Inside" or "Outside" the range, depending on the selection.

7.5.3 And Operation

The logical "and" operation requires the selection of two channels and the configuration of both range A and B. During each sample cycle channel A will be compared with range A and channel B will be compared with range B. The alert will be triggered if, and only if, both channels are within their respective alarm ranges.

7.5.4 Or/Xor Operation

The logical "or/xor" operation requires the selection of two channels and the configuration of both range A and B. During each sample cycle channel A will be compared with range A and channel B will be compared with range B. The alert will be triggered if either A or B is in its alarm range, not both (xor). For "or" functionality, do not use this feature, simply configure the normal alarm limits for each channel.

7.6 Alarm Limits & Delays

This page duplicates the operations of the MPS `Edit LIMITS` and `Edit Delays` menus. Additionally, the minimum and maximum values are shown, and the capability of resetting the min/max values and muting alarms has been added.

HAMPSHIRE CONTROLS CORPORATION

Multi-Probe System
Alarm Limits & Delays

Probe	ID	Reading		Min	Max	Low Limit	High Limit	Alarm Delay	
1	Eng Rm 1	75.4	°F	56.0	81.0	50.0	94.0	3	min.
2	Eng Rm 2	76.3	°F	55.5	81.4	50.0	94.0	3	min.
3	HVAC Ret	69.3	°F	53.7	74.0	50.0	94.0	3	min.
4	HVAC Sup	137.5	°F	53.6	137.7	50.0	150.0	3	min.
5	Vin 1	777.0	mV	775.8	777.2	0.0	1250.0	3	min.
6	Vin 2	777.0	mV	775.8	777.2	0.0	1250.0	3	min.
7	Vin 3	777.0	mV	775.8	777.2	0.0	1250.0	3	min.
8	Wind Dir	279.7	°	279.3	279.8	0.0	360.0	3	min.

Relay Delay: 0   minutes   **Mute Period:** 5   minutes

[Reload] [Submit]

[Reset Min/Max] [Alarm Mute]

[Main Menu]

7.7 Data Visualization

The Data Visualization page draws simple gauge-like graphics for each sensor, providing an at-a-glance determination of each channel's status. Additionally, the page contains a simple round-robin data logging feature for short-term monitoring with strip-chart graphics for visualization. The data logging feature runs entirely within the web browser and allows saving of the recorded data to a CSV file.
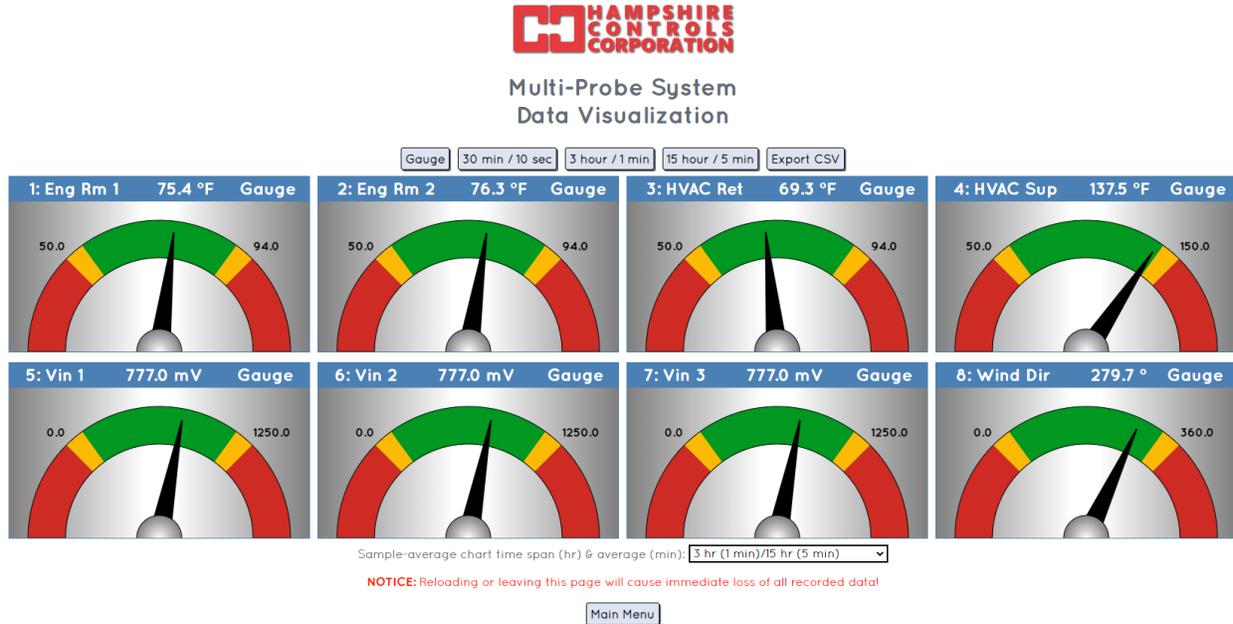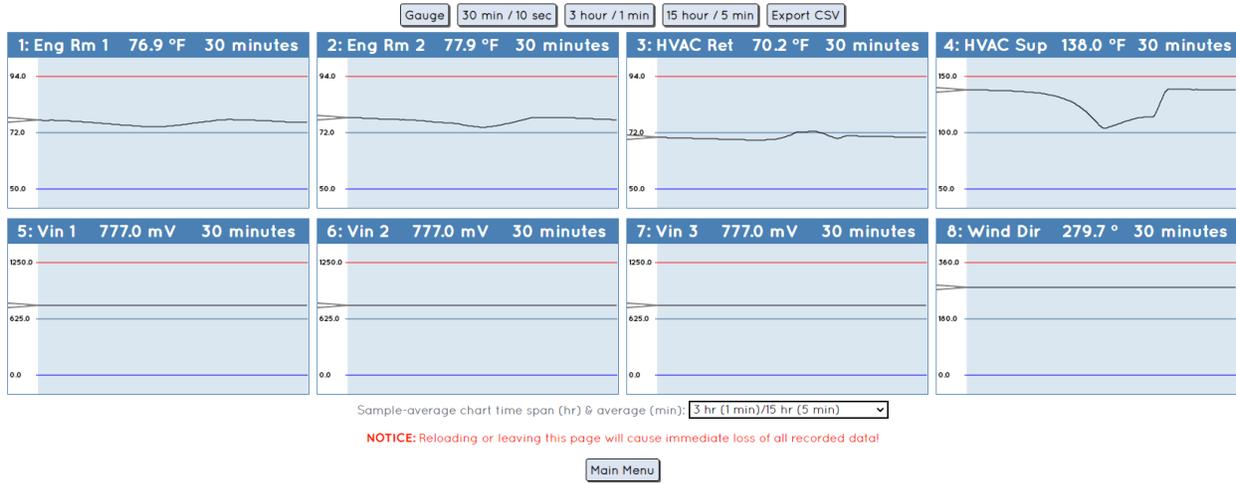

The gauge graphics show the channel ID, current reading, and the low & high alarm limits for each channel. The yellow bands are "warning" indicators that are 5% of scale above the low limit and below the high limit. The data is refreshed automatically every 10 seconds.

The data log contains three round-robin data storage blocks. The first block stores the most recent 180 readings with a 10 second sample period, thus it contains 30 minutes of data. The second and third block each contain 180 samples of time-averaged data. The averaging times are selected from the drop-down beneath the gauge graphics. The second and third blocks also contain additional samples for the minimum and maximum values during each time-averaged period. Once a data block reaches its 180 sample capacity, the next incoming sample will push the oldest value out.

You may select any of the visualization options (above the graphics), as well as the Export CSV option, at any time without impacting the data logging. The data logging will also continue to run in the background if you open another browser window or tab. However, if you leave the page or change the data logging time option, ALL DATA LOGGED BY THE WEB BROWSER WILL BE LOST! For a permanent data logging solution, refer to Hampshire Controls *ALERT Monitoring System* (AMS).

The strip-chart graphics show the channel ID, current reading, and high & low alarm limits for each channel. The full time period represented by the chart is shown in the upper right. The "needle" of the chart is on the left and the "paper" of the chart scrolls to the right. For the "30 minute" chart, the sampled data is shown as a black trace on the chart. For other time periods the average values are shown as the black trace, the minimum values are shown as a light-blue trace, and the maximum values are shown as a light-red trace. If the readings do not vary widely, the three traces (average, min, and max) may overlap.

Hampshire Controls Corporation

Appendix A

Sample JSON and XML data.

Note: The degree symbol ""°"" is changed to "$" in the unit strings

JSON Data: http://[MPS IP]/chdat.json

```
{"mps":{
"id":"MPS1",
"numCh":8,
"chData":[74.750,74.340,68.770,107.600,776.900,776.900,776.900,279.700]
}}
```

JSON Configuration: http://[MPS IP]/chcfg.json

```
{"mps":{
"id":"MPS1",
"numCh":8,
"chLoLim":[50.000,50.000,50.000,50.000,0.000,0.000,0.000,0.000],
"chHiLim":[94.000,94.000,94.000,150.000,1250.000,1250.000,1250.000,360.000],
"chUnit":["$F","$F","$F","$F","mV","mV","mV","$"]
}}
```

XML Data: http://[MPS IP]/chdat.xml

```
<mpsInfo id="MPS1">
  <numCh>8</numCh>
  <chData>
    <ch id="1">
      <data>74.700</data>
    </ch>
    <ch id="2">
      <data>74.270</data>
    </ch>
    <ch id="3">
      <data>68.780</data>
    </ch>
    <ch id="4">
      <data>107.420</data>
    </ch>
    <ch id="5">
      <data>776.900</data>
    </ch>
    <ch id="6">
      <data>776.900</data>
    </ch>
    <ch id="7">
      <data>776.900</data>
    </ch>
    <ch id="8">
      <data>279.700</data>
    </ch>
  </chData>
</mpsInfo>
```

XML Configuration: http://[MPS IP]/chcfg.xml

```
<mpsInfo id="MPS1">
  <numCh>8</numCh>
  <chData
    <ch id="1">
       <loLim>50.000</loLim>
       <hiLim>94.000</hiLim>
       <unit>$F</unit>
    </ch>
    <ch id="2">
       <loLim>50.000</loLim>
       <hiLim>94.000</hiLim>
       <unit>$F</unit>
    </ch>
    <ch id="3">
       <loLim>50.000</loLim>
       <hiLim>94.000</hiLim>
       <unit>$F</unit>
    </ch>
    <ch id="4">
       <loLim>50.000</loLim>
       <hiLim>150.000</hiLim>
       <unit>$F</unit>
    </ch>
    <ch id="5">
       <loLim>0.000</loLim>
       <hiLim>1250.000</hiLim>
       <unit>mV</unit>
    </ch>
    <ch id="6">
       <loLim>0.000</loLim>
       <hiLim>1250.000</hiLim>
       <unit>mV</unit>
    </ch>
    <ch id="7">
       <loLim>0.000</loLim>
       <hiLim>1250.000</hiLim>
       <unit>mV</unit>
    </ch>
    <ch id="8">
       <loLim>0.000</loLim>
       <hiLim>360.000</hiLim>
       <unit>$</unit>
    </ch>
  </chData>
</mpsInfo>
```

Appendix B

SNMP OID table

OID	Type	Description	Example
1.3.6.1.4.1.12807.3.1.1.1.1	String	MPS ID	MPS1
1.3.6.1.4.1.12807.3.1.1.2.1 to 8	String	Channel IDs	RoomTemp
1.3.6.1.4.1.12807.3.1.1.3.1 to 8	Integer	Current readings (x1000)	71700
1.3.6.1.4.1.12807.3.1.1.4.1 to 8	Integer	Low alarm limits (x1000)	50000
1.3.6.1.4.1.12807.3.1.1.5.1 to 8	Integer	High alarm limits (x1000)	95000
1.3.6.1.4.1.12807.3.1.1.6.1 to 8	String	Units for channels 1 to 8.	degF

SNMP v1 does not have floating point values, so all values are multiplied by 1000 to allow for up to 3 decimal digits. Most SNMP polling & logging software should be capable of applying the appropriate divide by 1000 conversion on the received values. Also to note, in the SNMP unit strings, the degree symbol '°' is replaced with "deg".

An example of the full output from an MPS using the Linux snmpwalk command is shown here:

```
$ snmpwalk -v1 -c MPS8SensorData! 192.168.0.145 1
iso.3.6.1.4.1.12807.3.1.1.1.1 = STRING: "MPS1"
iso.3.6.1.4.1.12807.3.1.1.2.1 = STRING: "Eng Rm 1"
iso.3.6.1.4.1.12807.3.1.1.2.2 = STRING: "Eng Rm 2"
iso.3.6.1.4.1.12807.3.1.1.2.3 = STRING: "HVAC Ret"
iso.3.6.1.4.1.12807.3.1.1.2.4 = STRING: "HVAC Sup"
iso.3.6.1.4.1.12807.3.1.1.2.5 = STRING: "Vin 1"
iso.3.6.1.4.1.12807.3.1.1.2.6 = STRING: "Vin 2"
iso.3.6.1.4.1.12807.3.1.1.2.7 = STRING: "Vin 3"
iso.3.6.1.4.1.12807.3.1.1.2.8 = STRING: "Wind Dir"
iso.3.6.1.4.1.12807.3.1.1.3.1 = INTEGER: 72300
iso.3.6.1.4.1.12807.3.1.1.3.2 = INTEGER: 71900
iso.3.6.1.4.1.12807.3.1.1.3.3 = INTEGER: 65200
iso.3.6.1.4.1.12807.3.1.1.3.4 = INTEGER: 82700
iso.3.6.1.4.1.12807.3.1.1.3.5 = INTEGER: 754200
iso.3.6.1.4.1.12807.3.1.1.3.6 = INTEGER: 754900
iso.3.6.1.4.1.12807.3.1.1.3.7 = INTEGER: 755800
iso.3.6.1.4.1.12807.3.1.1.3.8 = INTEGER: 279700
iso.3.6.1.4.1.12807.3.1.1.4.1 = INTEGER: 50000
iso.3.6.1.4.1.12807.3.1.1.4.2 = INTEGER: 50000
iso.3.6.1.4.1.12807.3.1.1.4.3 = INTEGER: 50000
iso.3.6.1.4.1.12807.3.1.1.4.4 = INTEGER: 50000
iso.3.6.1.4.1.12807.3.1.1.4.5 = INTEGER: 0
iso.3.6.1.4.1.12807.3.1.1.4.6 = INTEGER: 0
iso.3.6.1.4.1.12807.3.1.1.4.7 = INTEGER: 0
iso.3.6.1.4.1.12807.3.1.1.4.8 = INTEGER: 0
iso.3.6.1.4.1.12807.3.1.1.5.1 = INTEGER: 94000
iso.3.6.1.4.1.12807.3.1.1.5.2 = INTEGER: 94000
iso.3.6.1.4.1.12807.3.1.1.5.3 = INTEGER: 94000
iso.3.6.1.4.1.12807.3.1.1.5.4 = INTEGER: 150000
iso.3.6.1.4.1.12807.3.1.1.5.5 = INTEGER: 1250000
iso.3.6.1.4.1.12807.3.1.1.5.6 = INTEGER: 1250000
iso.3.6.1.4.1.12807.3.1.1.5.7 = INTEGER: 1250000
iso.3.6.1.4.1.12807.3.1.1.5.8 = INTEGER: 360000
iso.3.6.1.4.1.12807.3.1.1.6.1 = STRING: "degF"
iso.3.6.1.4.1.12807.3.1.1.6.2 = STRING: "degF"
iso.3.6.1.4.1.12807.3.1.1.6.3 = STRING: "degF"
iso.3.6.1.4.1.12807.3.1.1.6.4 = STRING: "degF"
iso.3.6.1.4.1.12807.3.1.1.6.5 = STRING: "mV"
iso.3.6.1.4.1.12807.3.1.1.6.6 = STRING: "mV"
iso.3.6.1.4.1.12807.3.1.1.6.7 = STRING: "mV"
iso.3.6.1.4.1.12807.3.1.1.6.8 = STRING: "deg"
```

List of Acronyms

ADC	Analog to Digital Converter (sometimes abbreviated as A/D)
AMS	ALERT Monitoring System (Hampshire Controls PC-based logging system)
DHCP	Dynamic Host Configuration Protocol
FEP	Fluorinated Ethylene Propylene
IPv4	Internet Protocol version 4
JSON	JavaScript Object Notation
LCD	Liquid Crystal Display
LED	Light Emitting Diode
LiPo	Lithium Polymer (battery chemistry)
MAC	Media Access Control
MIB	Management Information Base
MPS	Multi-Probe System
NC	Normally Closed
NO	Normally Open
NTP	Network Time Protocol
OEM	Original Equipment Manufacturer
OID	Object Identifier
PTFE	Polytetrafluoroethylene (aka. Teflon™)
SMTP	Simple Mail Transfer Protocol
SNMP	Simple Network Management Protocol
RTC	Real Time Clock
RTD	Resistance Temperature Detector
TLS	Transport Layer Security
XML	Extensible Markup Language