

# MCT4 4.3 User Manual

## MCT4 - 1/4 DIN Controller

A 1/4 DIN multi-loop controller that operates like your favorite smartphone or tablet

EASY TO USE  
TOUCH SCREEN  
INTERFACE



Combines multiple control and monitor components into a single, low cost solution

## Safety Information in this Manual

Notes, cautions and warnings appear throughout this book to draw your attention to important operational and safety information.

A “**NOTE**” marks a short message to alert you to an important detail.

A “**CAUTION**” appears with information that is important for protecting your equipment and insuring performance.

A “**WARNING**” appears with information that is important for protecting you, others and equipment from damage. Pay very close attention to all warnings that apply to your application.



This symbol (an exclamation point in a triangle) precedes a general CAUTION or WARNING statement.



This symbol (a lightning bolt in a lightning bolt in a triangle) precedes an electric shock hazard CAUTION or WARNING safety statement.

## Technical Assistance

If you encounter a problem with your MCT4 controller, review all of your configuration information to verify that your selections are consistent with your application: inputs; outputs; alarms; limits; etc. If the problem persists after checking the above, you can get technical assistance by dialing +1 (866) 342-5332 or by faxing your request to +1 (866) 332-8014, Monday thru Friday, 8:00 a.m. to 5:00 p.m. Eastern Standard Time. You can also email your request to [support@futuredesigncontrols.com](mailto:support@futuredesigncontrols.com).

An applications engineer will discuss your application with you.

### **Please have the following information available:**

- Complete Model #'s and/or Serial #'s for Component(s) in Question
- Complete Software Version #'s
- All Configuration Information
- All User Manuals

**Warranty and return information is on the back cover of this manual.**

## Comments

Your comments or suggestions on this manual are welcome. Please send them to:  
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## 1 What is the MCT4?

The MCT4 system combines all of the features of a loop controller, high-limit control, video/chart recorder and data logging system into a single/intuitive display device. Email (supporting SSL/TLS), SMS (text messaging), FTP, FileWeb, DataWeb (file transfer protocols for automated data backup and web database interface) and remote viewing/control (via Web server/VNC server) are standard with the MCT4 and can be accessed via LAN/WAN using a PC, tablet or smart phone device.

Future Design Controls' MCT4 provides a 4.3" color touch screen interface with standard "Smart Device" user interface features for multi-loop OEM control applications. All loop configuration and runtime user access is configurable at the device with no PC software required. OEM's have the ability to configure runtime features (screen availability, menus, language, etc...) to easily customize the system for their requirements. These configurations can be imported/exported to any other MCT4 device for setup (from scratch) within minutes.

Individual, high performance board level PID loop controls (one for each loop up to a maximum of three) offer up to four control outputs each, powerful profiling capabilities with up to three events and full auto tune functionality with high resolution universal process inputs.

### 1.1 Features

Each of the MCT4 loop control boards provide a single digital input that can be programmed as an automatic program control input, input alarm or input status (visual loop status indication).

Each of the loop control boards also provide up to four control outputs which can be used as PID control outputs for heat/cool, direct outputs for controlling external equipment related to the application through software switches called events or be programmed to act as system alarm outputs. When single or dual loop control is used, the HLM high-limit control board can be installed, providing a single interface for all loop control and limit functions from one display.

The MCT4 can be operated in single set point or automatic program control mode. Program entry is made easy through the use of slide list selections and menu items on a single screen. Programs can be copied to the external USB memory stick and then imported to another MCT4 controller which eliminates the need to enter duplicate programs on multiple systems.

Data file analysis tools make looking at historical data a simple task. Any control variable saved to the data file can be plotted on the historical data chart for any time frame within the data file's total time range.

The built in Ethernet functionality includes a Web Server to provides access to all MCT4 data (view only), a VNC interface for remote control and monitoring and an NTS clock, all available via a local Intranet connection (wired or wireless), or the World Wide Web using standard software like Microsoft's Internet Explorer.

The MCT4 provides a rich set of tools for control interaction and process monitoring. The interface provides various loop, chart, alarm, automated program status as well as historical data, alarm log and audit trail views. The menu driven interface eliminates screen "clutter" by providing an easy to use "Smart Device" interface for interaction between the user and MCT4.

The MCT4 can store over a year's worth of data on its SD memory card. Data logging can be enabled manually or automatically during program operation. Data backup is provided via a USB memory stick for plug and play transfer of files to any PC and through the included FTP back-up utility.

The MCT4 protects system access with a four-level security system (user rights based), including audit trail capability that documents all user activity and ensures data integrity by digitally signing all data files and audit trails to meet regulatory requirements.



**The MCT4 controller includes the following features:**

### ACCESSIBILITY

- Touch screen, “Smart Device” user interface (UI) with 30,000-hour LED display
- Built in configuration software; no external software or PC required
- Email, SMS, FTP, FileWeb, DataWeb, VNC and Web functionality standard
- Remote View/Control using PC, Tablet or Smartphone.
- National time server connectivity with daylight savings.

### COMMAND BAR ICONS NAVIGATION, HELP & HOME

The Master Command Bar located on the top of the display provides easy & intuitive 1-touch access from anywhere in the system to Navigation, Help and configured Home view.

Home brings the user back to the system “Home” view. The Home icon can be configured for the following standard views:

- Loop view: includes PV & SP digital display, PV min/max, PID % Output, Auto-Manual, event, profile access and more.
- Overview: all loops, profile and event status
- Chart view: (trend up to the last 24 hours from system RAM) supporting 4 trends with up to 6 values per trend
- Alarm view or Alarm File

Help offers content sensitive text for every view / page in one of 11 supported languages chosen by the user.

Navigation provides access to the configured menu system, traditional drop down or icon.

### SECURITY AND AUDIT TRAIL

- Supports up to 30 users over four user groups with access to 40+ functions restricted by user group.
- Supports password aging and verification.
- Operator Audit Trail provides history for all user activity that includes date, time, user name and action; i.e. Loop SP change from 55.2 to 103.5.

### PROFILE RAMP/SOAK

- Loop 1 and/or 2; loop 3 always static
- Start: via touch screen or Event input
- Profile Name: 16-character naming convention
- Global Profile Configuration:
  - Start from PV or static SP
  - Guaranteed Soak & Ramp band
  - Power Fail / Recovery: Continue from last SP value, PV or static mode.
- Profile Segments: (maximum of 64)
- Guaranteed Soak & Ramp per step
- Events: up to 3 or 6 events per step (1 or 2 loop).
- Jump-To Step: configurable per step
- Profile End Alarm
- Configurable Profile End Logic:
  - Current (Static) Control SP: Set Point & Event status prior to Profile Start is loaded at end of the Profile.
  - Final SP of Profile with all Events off

### ALARMS

- Up to 19 alarms, 10 soft configurable to PCM & HLM, up to 3 alarm outputs per PCM and HLM up to 2 alarm outputs.
- Loop\* Alarm Types: Process High & Low, Deviation High & Low, Deviation Band, Event Input and End of Profile.
- \* PCM configured as Monitor Input (no PID control) configurable only with Process alarms.

#### Alarm Mode:

Normal or Hold (on start-up Hold mode will not activate if in alarm condition and arm once out of alarm condition).

Silent Alarm, activation does not indicate alarm or write to alarm log file.

Alarm outputs configurable as latching or non-latching.

### DATA ACQUISITION

- Data log PV, SP and PID percent output.
- File name: Free form 16 character appended by time/date or the profile name if started with a profile.
- File Start/Stop: user on-demand, on system boot or profile ramp-soak start/end.
- Data Log interval: configurable 1 second to 31 minutes.
- File Interval: configurable to set time in days (1 to 31) to end and start a new file. This allows syncing files to match product cycles as well as keeping file size manageable.
- ID#1 and ID#2 fields allow user to enter specific information such as a batch and/or lot information that is associated with the data file.
- Operator Comments/Events: Unlimited operator comments/events linked to each file
- File Type: Data Log files are saved in .csv format.
- Digital Signatures: Automatic system as well as user entered signatures.
- Historical Data Viewer: View data log files on the display. Chart is auto-scaled on an X & Y axis for time and units.
- Meets the requirements for:
  - CFR21 Part 11
  - AMS2750E

### EVENT INPUTS

- PCM / HLM each have 1 event input configurable for one of the following functions.
  - PCM: Profile Run, Hold, Run/Hold, Abort, Step Advance, Failure Transfer (Outputs), Alarm Input (indication only) and Loop Status Input
  - HLM: Remote Reset

## 2 Installation

All MCT4 components are pre-loaded with all operating software and firmware before leaving the factory so it is ready to install when you receive it. Before beginning installation, completely read through this section as well as the following section (3. Power and Wiring) to gain an understanding of the entire installation process. Consider the installation carefully. Plan the power, signal and control wiring before installing the MCT4. Also consider the cabinet space, hardware dimensions, environmental conditions and use good wiring practices to minimize problems that may occur due to electrical interference.

**WARNING:**

- To avoid potential electric shock and other hazards, all mounting and wiring for the MCT4 must conform to the National Electric Code (NEC) and other locally applicable codes.
- Special expertise is required to install, wire, configure and operate the MCT4 controller. Personnel without such expertise should not install, wire or operate the MCT4.

**CAUTION:**

- Prevent metal fragments and pieces of wire from dropping inside the housing of the MCT4. If necessary, place a cover over the unit during installation and wiring. Ingress of such fragments and chips may cause a fire hazard, damage or malfunction of the device.
- When handling the MCT4 PCM and HLM series control boards, use proper ESD (electro-static discharge) handling procedures to prevent damage to board components.
- Locate the MCT4 away from AC power/motor wiring and sources of direct heat output such as transformers, heaters or large capacity resistors.

### 2.1 Enclosure Guidelines

The MCT4 must be installed correctly for reliable operation. The MCT4 controller is designed for installation within a suitable enclosure. Do not install the MCT4 outside of an enclosure. Care must be taken when locating components to ensure that AC power wiring, contactors, starters, relays and other sources of electrical interference are properly located to minimize their impact on the MCT4.

Particular note should be taken to the position of variable speed drives and switching power supplies. Their input and load cables should be screened and properly grounded to a central equipment grounding point to prevent radiated emissions from affecting MCT4 operation.

#### 2.1.1 Locating the MCT4

It is recommended that the unit be mounted within the front panel of a steel enclosure, through an appropriately sized opening. Proper enclosure depth is required to ensure that there is adequate spacing between the rear of the unit and the front of any high voltage devices mounted in the enclosure when the enclosure door is closed. It is required that a minimum separation of 4" be maintained for proper wiring clearance, so plan a depth to accommodate at least 9" (230mm) behind the front of the panel.

Proper clearance must also be maintained above, below and on both sides of the MCT4 to allow for heat dissipation and to facilitate mounting. A minimum of 2" is recommended.

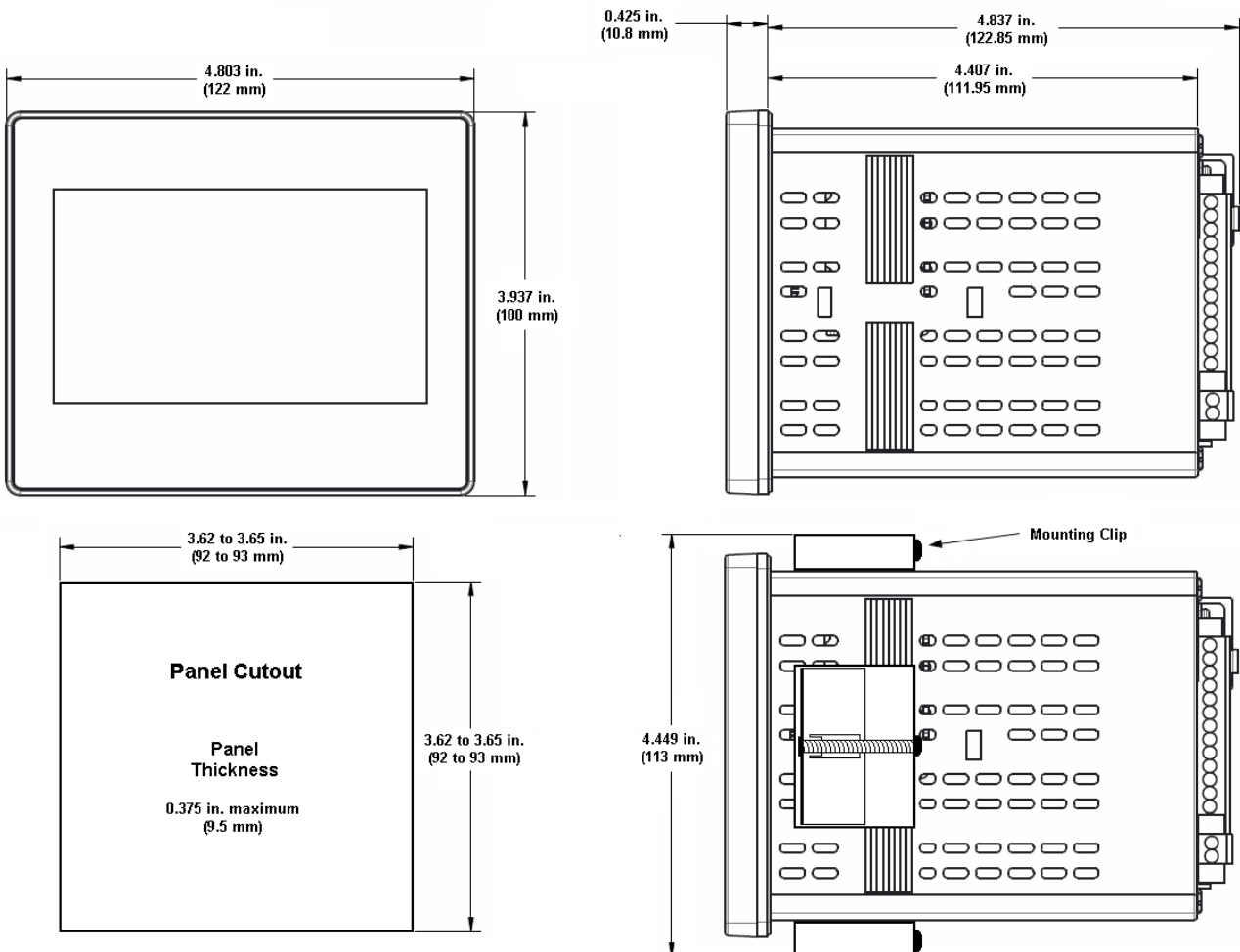
## 2.2 Environmental Considerations

Do not subject the MCT4 to operating temperatures below 0°C (32°F) or above 50°C (122°F). Minimum and maximum relative humidity levels are limited between 10% and 90% (non-condensing). The MCT4 touch is to be used indoors only. The unit should not be installed where fast temperature variations may occur as this can cause condensation of water vapor on the device.

The MCT4 should not be exposed to excessive dust, dirt, salt, direct sunlight or shock and vibration. Do not operate the MCT4 controller in an area where chemicals or flammable gases are present. Permitted storage temperature extremes for the MCT4 control system are limited to -10°C (14°F) and 60°C (140°F).

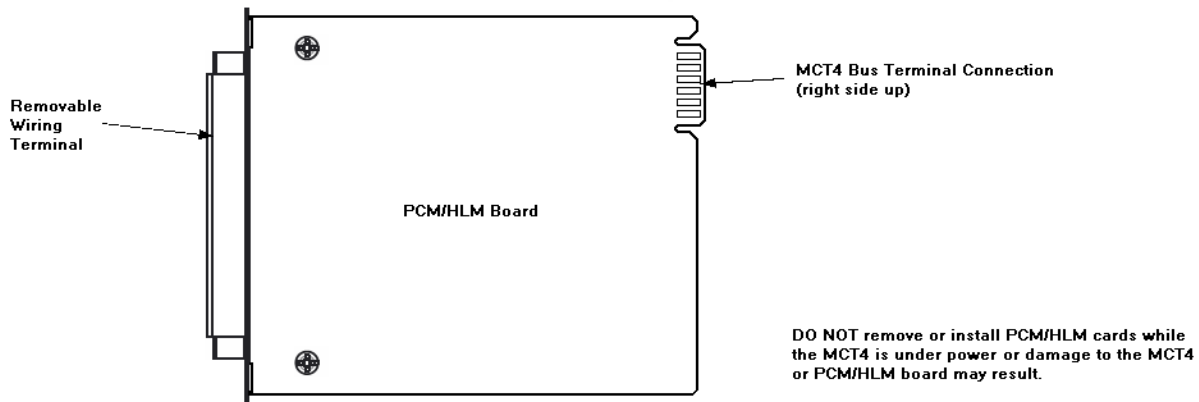
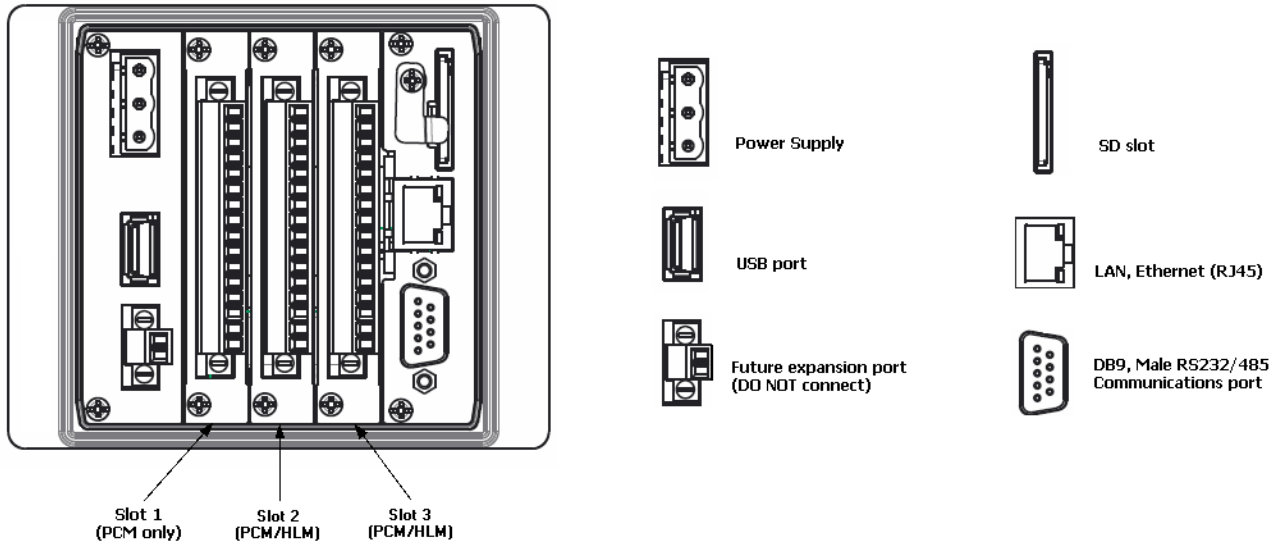
## 2.3 Mounting Dimensions

The MCT4 is supplied with four mounting clips. All four clips must be installed and properly tightened to insure the IP66 protective rating. Failure to install all mounting clips may also affect touch screen operation. Be sure to tighten each mounting clip evenly so as not to flex the case of the unit. DO NOT over tighten the mounting clips. The clips should be tightened just enough to compress the gasket so that the bezel is parallel with the mounting surface.



**2.3.1 MCT4 Process Loop/Limit Controls**

One PCM control board is required for each process control loop. Each PCM must be installed in sequential order beginning with slot 1 up through slot 3. Only one HLM limit board can be installed in the MCT4. The HLM must be installed after all of the PCM cards in the next open slot. For a single loop MCT4, a PCM will be installed in slot 1 and the HLM in slot 2. For a dual loop MCT4, PCM cards will be installed in slots 1 and 2 while the HLM will be installed in slot 3.



**NOTE:** The MCT4 will not operate properly without the SD card installed into the SD card slot on the back of the unit. The SD card is preloaded with all software required for 'Auto-Boot' operation. The slot on the back of the interface is 'keyed' so the card can only be installed in one direction. The card is pre-installed for your convenience. If the card is removed, take care when inserting the SD card and DO NOT force it into the slot. The card MUST be installed prior to application of power.

### 3 Wiring

This section describes the methods and precautions for wiring the MCT4.



**WARNING:**

- Turn off power before starting installation, removal, wiring, maintenance and inspection of the MCT4 controller. Failure to turn off power may cause electric shock, create a fire hazard or cause damage to the MCT4.
- Emergency stop and interlocking circuits **MUST** be configured outside of the MCT4. If such circuits are made through the MCT4, failure of the MCT4 may cause uncontrollable operation, damage to equipment or accidents.



**CAUTION:**

- This section presents recommended installation practices and procedures. Since no two applications are identical, these recommendations should be considered as guidelines. The system designer should be aware that devices in control systems could fail and thereby create an unsafe condition.
- Electrical interference in an operator interface can lead to equipment start-up, which could result in property damage and/or physical injury to the equipment operator.

If the application requires an operator or attendant, you should be aware that this potential safety hazard exists and take appropriate precautions. Consult NEMA ICS 3-304 for more information regarding safety for the installation of solid-state programmable control devices.

#### 3.1 Power Requirements

The MCT4 can be ordered to operate from either 11-26VAC/VDC or 90-250VAC (47-63Hz) supply. Power draw for both power options is 36VA, 15W maximum. Do not power the MCT4 controller and highly inductive loads or input circuitry to other equipment with the same power source used for the MCT4.

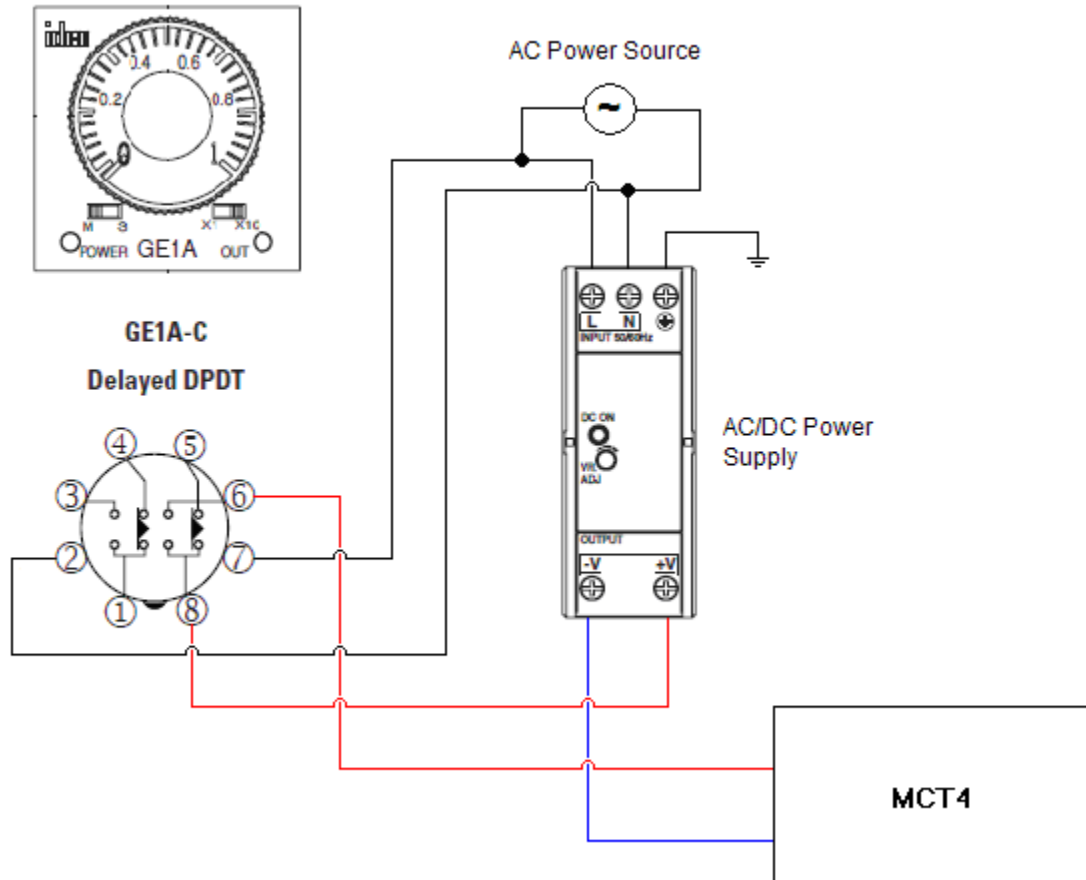
For 11-26VAC/VDC models of the MCT4, it is recommended that a time delay-on relay be installed in the power supply wiring to the MCT4. This will prevent rapid on-off cycling of the MCT4 during brown-out or momentary power interruptions. Rapid power cycling to the MCT4 can cause damage to the electronics and/or loss of data. The 90-250VAC model of the MCT4 does not require this power-on delay relay. The internal power supply protects the circuitry from rapid power cycles.

##### 3.1.1 Installing the Power-On Delay Relay

Due to the rate at which AC/DC power supplies reach their nominal supply voltage after application of power, the relay contact of the timer should be installed between the output of the power supply and the power input of the MCT4. This allows the power supply output voltage to reach its nominal value prior to connecting the MCT4 to its output terminals.

In order to properly sense the loss of power, the time delay relay coil should be wired to the AC power source for the DC power supply. This will insure that the MCT4 is turned off/on at the proper times and prevent malfunction that can be caused by rising or falling voltage at the power supply output during power interruption.

**NOTE:** *It is recommended that the time delay-on relay be set for a minimum period of 3 seconds.*

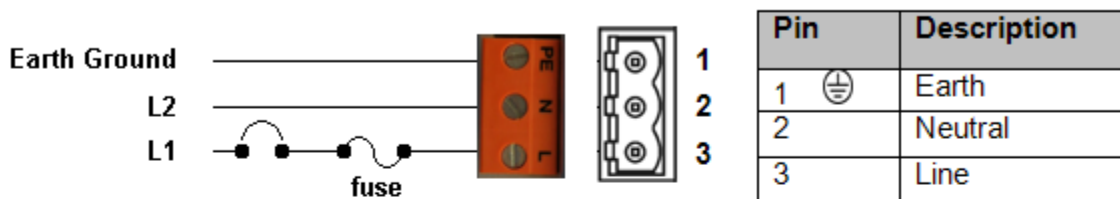


### 3.2 Connecting to the MCT4

Power connections should be made using 14 AWG copper conductors rated for at least 90°C (maximum wire size = 12 AWG). To make a connection, strip about ¼” of insulation off the end of the wire, turn the connector screw counterclockwise until the gap is wide open, insert the wire all the way in, and turn the screw clockwise until it’s tight (maximum torque rating = 0.51 N-m).

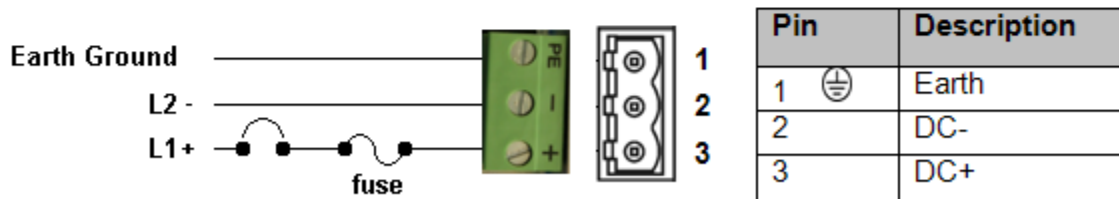
**NOTE:** Upon application of power, if the MCT4 does not come on within 2 seconds, remove power. Check wiring to insure proper connections and try to power up again. An Internal fuse will prevent damage for over voltage conditions; however, it isn’t guaranteed.

#### AC Power, 90-250 V AC, 47~63Hz



**Note:** Orange color terminal supplied for AC

#### DC Power, 11-26 V AC/DC



**Note:** Green color terminal supplied for DC

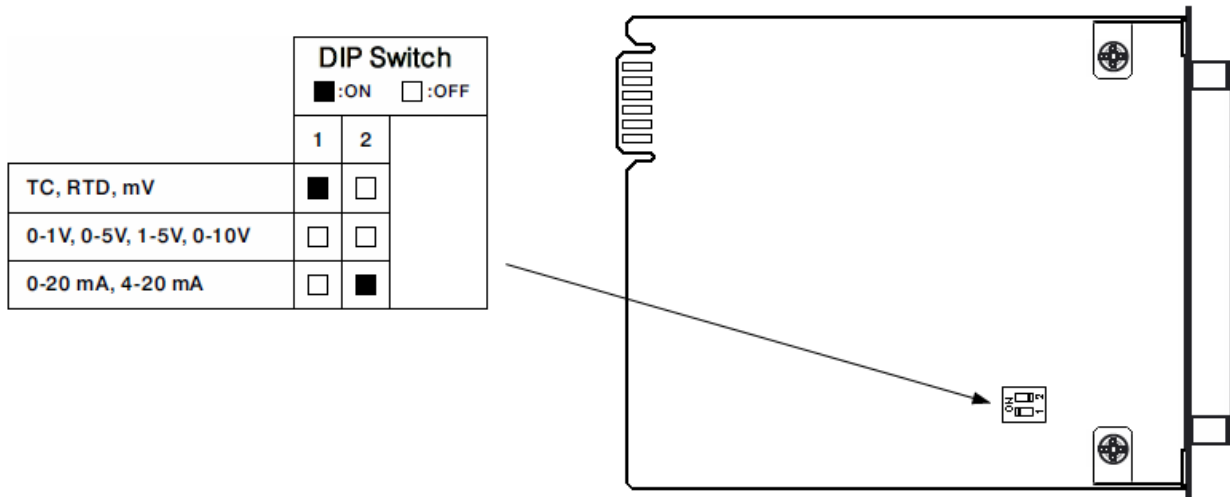
### 3.2.1 Process Control Module (PCM) Connections

The MCT4 can have a maximum of three PCM boards installed. The PCM boards must be installed beginning with slot 1 up to slot 3 for the maximum. DO NOT remove or install PCM boards while the MCT4 is under power or damage to the PCM or MCT4 may result.

*PCM screw terminals are rated for up to 14 AWG wire and a maximum torque of 0.19 N-m.*

#### 3.2.1.1 Sensor Input

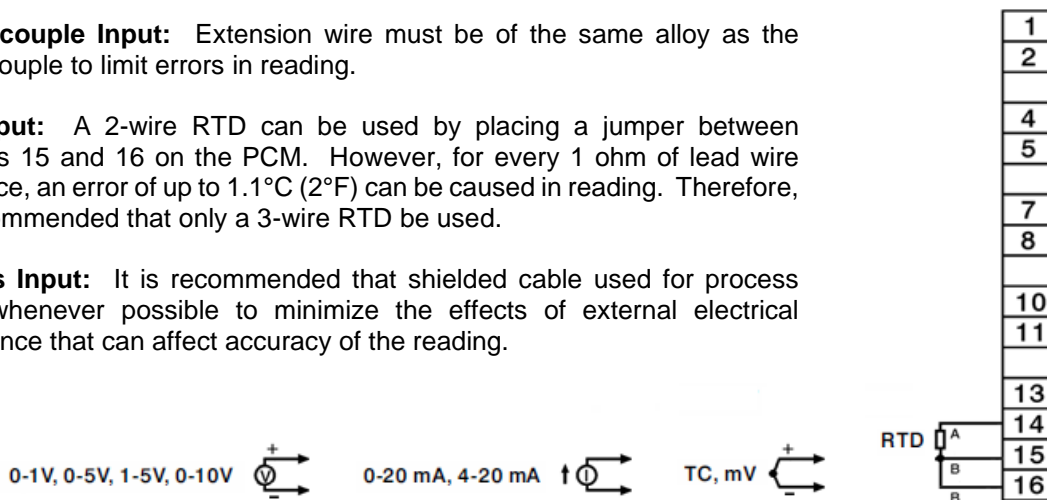
The PCM provides a universal input via DIP switch and software selections to choose from the available input types. During installation, the DIP switch setting should be verified to ensure that it matches the type of sensor used. The DIP switch is located on the component side of the PCM board.



**Thermocouple Input:** Extension wire must be of the same alloy as the thermocouple to limit errors in reading.

**RTD Input:** A 2-wire RTD can be used by placing a jumper between terminals 15 and 16 on the PCM. However, for every 1 ohm of lead wire resistance, an error of up to 1.1°C (2°F) can be caused in reading. Therefore, it is recommended that only a 3-wire RTD be used.

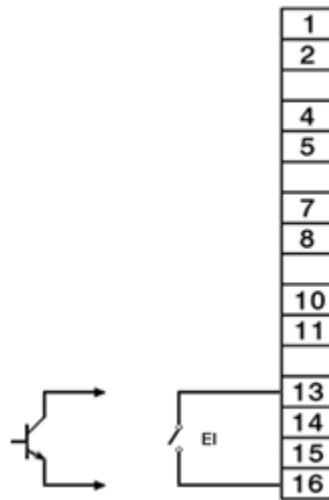
**Process Input:** It is recommended that shielded cable used for process inputs whenever possible to minimize the effects of external electrical interference that can affect accuracy of the reading.





3.2.1.2 Event Input

The Event input accepts a digital type signal via a dry contact (switch/relay) closure. The input can also be activated via an open collector/TTL source.

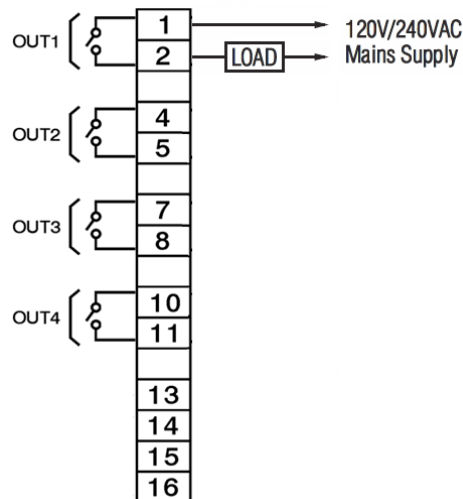


3.2.1.3 Control Outputs

Each PCM can provide up to four outputs. The output type (if present) is based upon the PCM ordering code. Verify that the required output is supplied on the PCM prior to connecting it to the load.

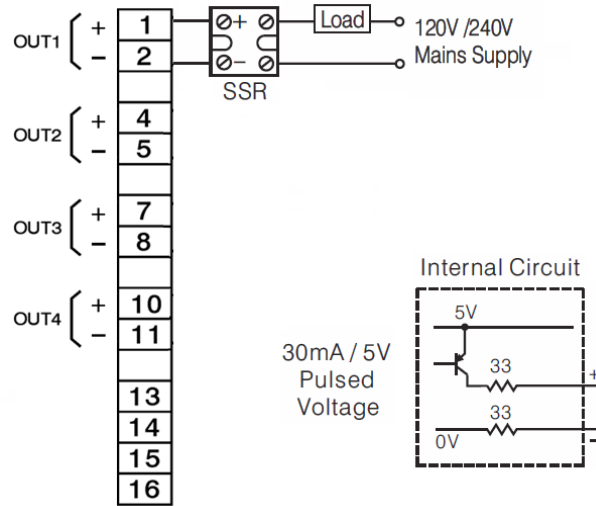
**Relay Outputs**

Contacts rated 240VAC (30VDC), maximum 2A resistive.  
Maximum 1A inductive load  $\cos\Phi = 0.4$  (L/R = 7ms).  
Minimum 100,000 operations at 20 times/minute (resistive load).



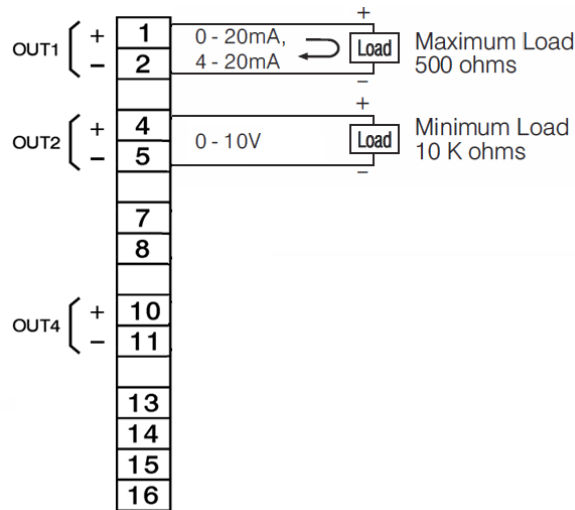
**Pulsed Voltage Outputs**

Source Voltage: 5V at 30mA, current limiting resistance 66 ohms  
 14Vat 40mA, current limited at 70mA (recommended for driving 3 phase SSR)



**Isolated Linear Outputs**

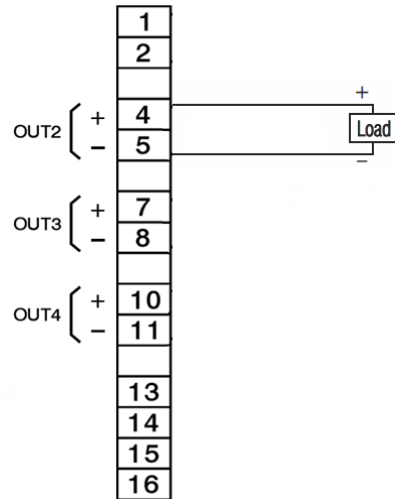
Output 1 and 2 are capable of providing linear outputs for control operation, i.e., heat/cool.  
 Output 3 does not provide a linear output option.  
 Output 4 is capable of providing a linear output for process value (PV) or set point (SP) retransmission.



**Transmitter Power Supply**

Output 1 does not provide a power supply option. It is for control operation only.

Outputs 2, 3 and 4 each provide options for a 5VDC/80mA, 12VDC/40mA or 20VDC/25mA power supply.



### 3.2.2 High Limit Module (HLM) Connections

The MCT4 can have a maximum of one HLM board installed. The HLM must be installed after all PCM boards in the next open slot. If only one PCM is installed, the HLM would be installed in slot 2. If a PCM is installed in both slots 1 and 2, the HLM would be installed in slot 3. At least one PCM must be installed in the MCT4 for proper operation.

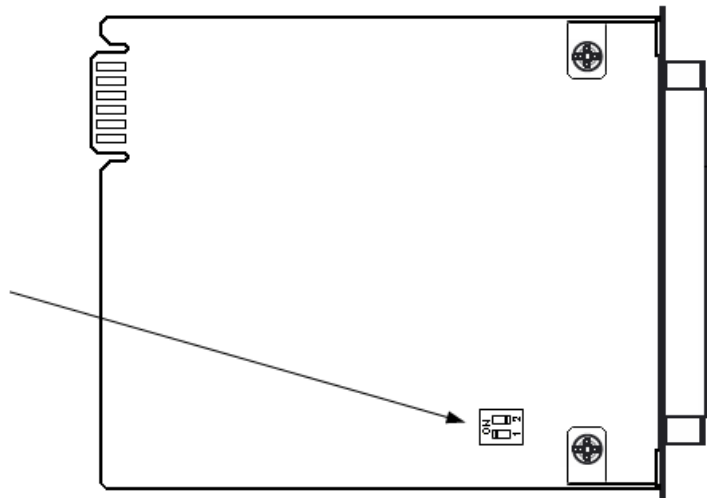
**HLM screw terminals are rated for up to 14 AWG wire and a maximum torque of 0.19 N-m.**

#### 3.2.2.1 Sensor Input

The HLM provides input type selection via DIP switch and software selections. During installation, the DIP switch setting should be verified to ensure that it matches the type of sensor used. The DIP switch is located on the component side of the HLM board.

	DIP Switch	
	1	2
TC, RTD, mV	<input checked="" type="checkbox"/>	<input type="checkbox"/>
0-1V, 0-5V, 1-5V, 0-10V *	<input type="checkbox"/>	<input checked="" type="checkbox"/>
0-20 mA, 4-20 mA	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>

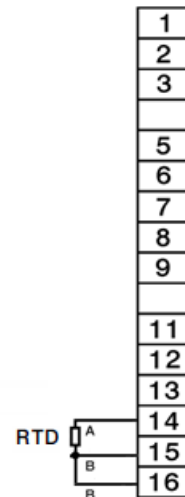
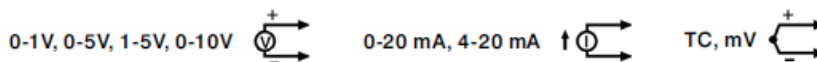
**\*0-1V and 0-5V/1-5V input types are special order. HLM units ordered with either input type cannot be programmed for any other type.**



**Thermocouple Input:** Extension wire must be of the same alloy as the thermocouple to limit errors in reading.

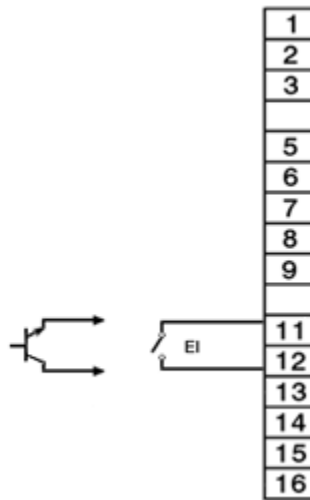
**RTD Input:** A 2-wire RTD can be used by placing a jumper between terminals 15 and 16 on the PCM. However, for every 1 ohm of lead wire resistance, an error of up to 1.1°C (2°F) can be caused in reading. Therefore, it is recommended that only a 3-wire RTD be used.

**Process Input:** Linear voltage and current inputs are *NOT* FM approved. It is recommended that shielded cable used for process inputs whenever possible to minimize the effects of external electrical interference that can affect accuracy of the reading.



3.2.2.2 Event Input

The Event input accepts a digital type signal via a dry contact (switch/relay) closure. The input can also be activated via an open collector/TTL source.

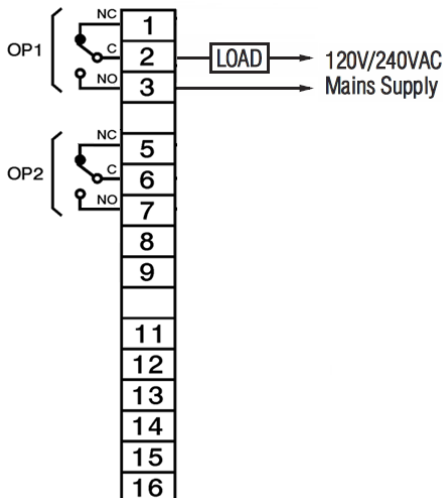


3.2.2.3 Control Outputs

The HLM provides one limit output as well as an optional programmable output. The output type is based upon the HLM ordering code. Verify that the required output is supplied on the HLM prior to connecting it to the load.

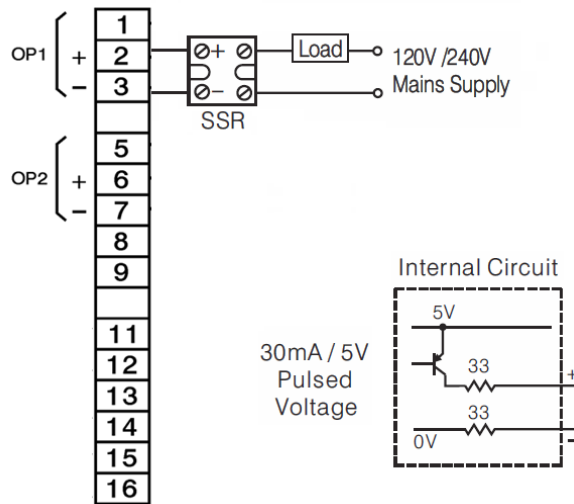
**Relay Outputs**

Contacts rated 240VAC (30VDC), maximum 2A resistive.  
Maximum 1A inductive load  $\cos\Phi = 0.4$  (L/R = 7ms).



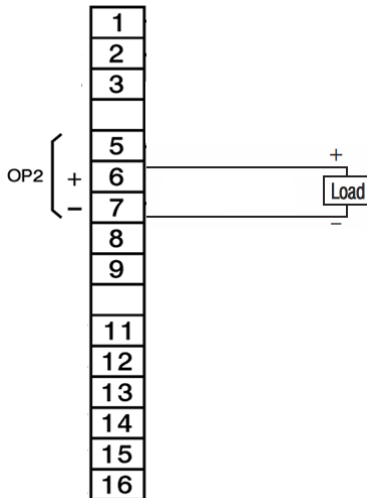
**Pulsed Voltage Outputs**

Source Voltage: 5V at 30mA, current limiting resistance 66 ohms  
 14Vat 40mA, current limited at 70mA (recommended for driving 3 phase SSR)



**Transmitter Power Supply**

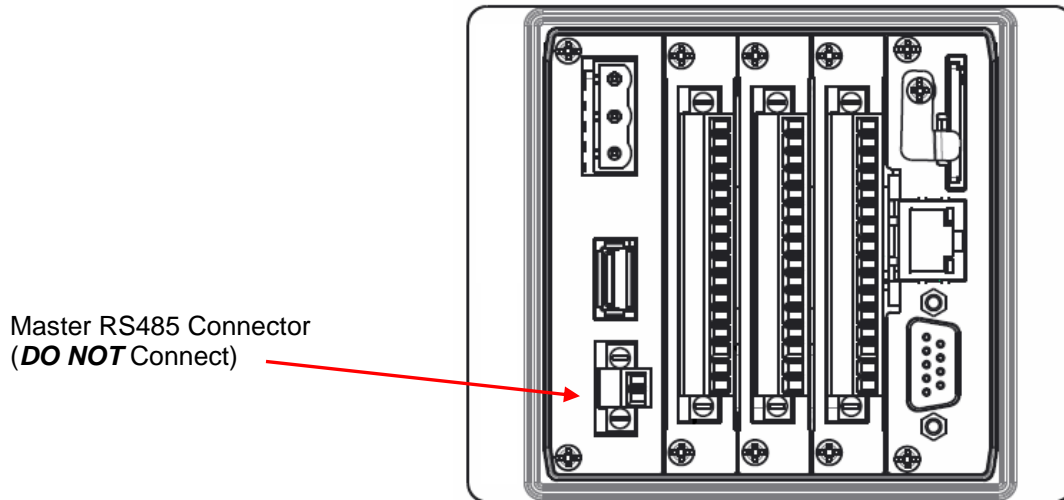
Output 1 is for high/low limit operation only. Output 2 provides options for a 5VDC/80mA, 12VDC/40mA or 20VDC/25mA power supply.



### 3.2.3 Communication Connections

The MCT4 provides an RS232/485 serial interface, 10/100 base-T Ethernet port and USB port. The serial port and Ethernet port provide user communication options for remote monitoring and control of the MCT4. See section 11 Communications for more information regarding their use. The USB port provides data file options for copy/backup of internal files (see section 8.4 USB File Transfer) as well as simple import/export configuration utilities (see section 10.7 Configuration).

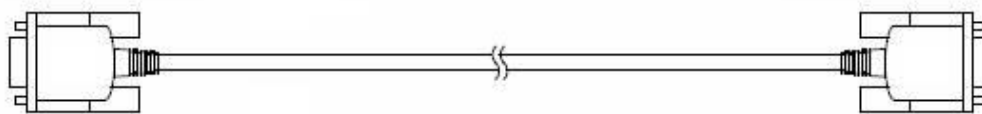
The MCT4 also provides a “Master” RS485 communication connection. DO NOT wire to this connection as malfunction of the MCT4 may occur. This is for custom OEM applications only. Contact your OEM if you have questions regarding its use.



#### 3.2.3.1 RS232/485 User Serial Communications

The MCT4 is equipped with a DB9 male serial port that provides both RS232 and RS45 communication options. Only one hardware interface can be used at a time. In order to connect the MCT4 to a PC running software such as Future Design Control’s Envision software a cable must be fashioned according to the following diagrams.

#### RS232



D-sub 9-pin Female Connector Pinouts

Description	Pin
Shield	Cover
RXD Receive Data	2
TXD Transmit Data	3
SG Signal Ground	5

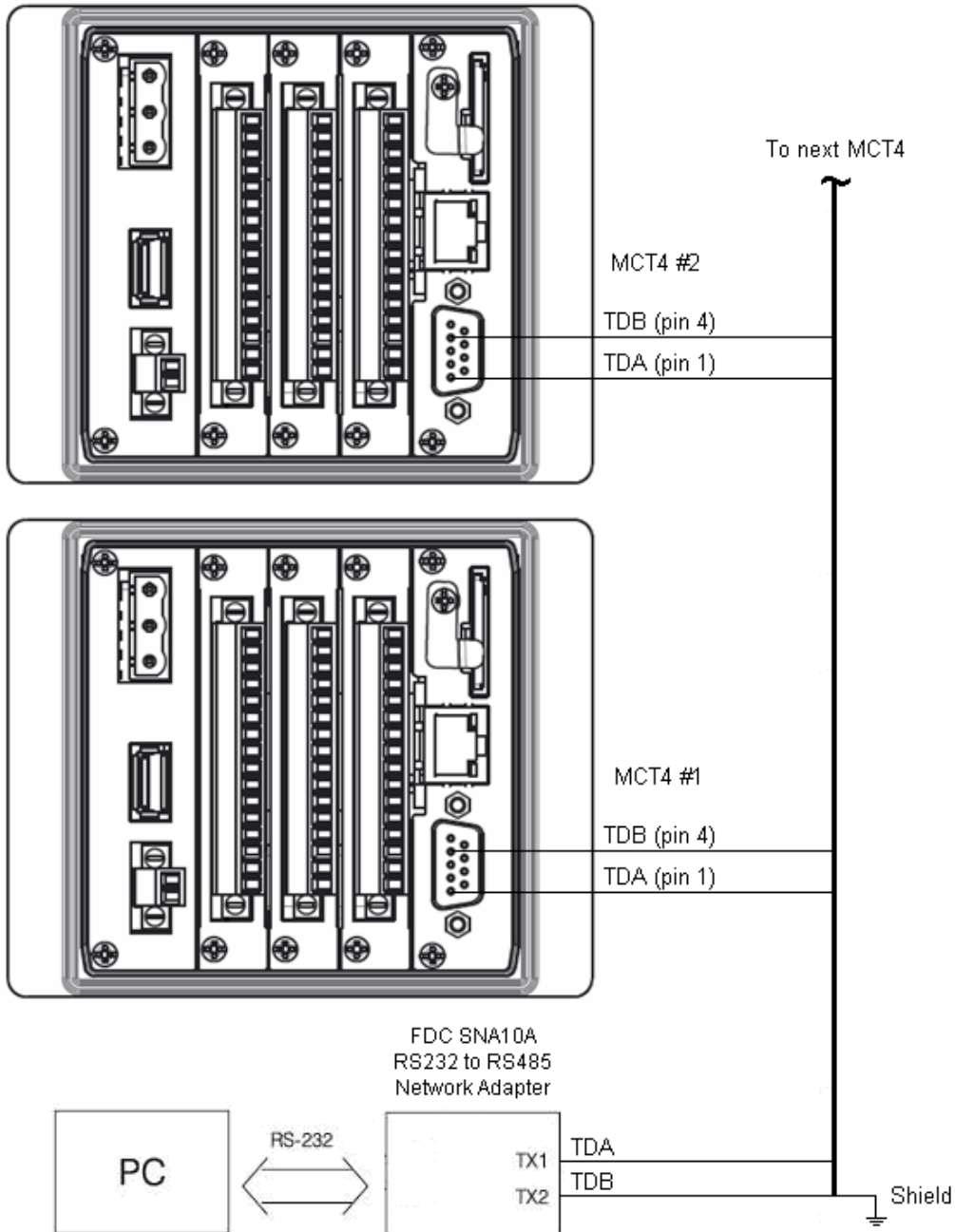
D-sub 9-pin Female Connector Pinouts

Pin	Description
Cover	Shield
2	RXD Receive Data
3	TXD Transmit Data
5	SG Signal Ground

**NOTE:** DO NOT use a standard null-modem cable to connect the MCT4 to a PC. Most computers do not provide a standard serial port and a USB to serial converter must be used. Incompatibilities may exist between the MCT4 and certain USB to serial adapters which may cause the MCT4 to malfunction when connected using a standard null-modem cable.

**RS485**

If more than one MCT4 controller is to be placed on the communication link with a PC or the distance between the PC and the MCT4 exceed the recommended maximum of 30 feet for RS232, an RS485 converter is required at the PC in order to utilize the RS485 connection.



**NOTE:** The connection requires a single twisted-pair cable that is daisy-chained from one MCT4 to the next. When using shielded twisted-pair cable, be sure to ground only one end of the cable, preferably at the RS232 to RS485 network adapter. Allowing any other portion of the cable shield to come in contact with ground, or grounding both ends, will cause ground loop currents to flow in that section of the cable which can cause communication errors.



## 4 Configuring the MCT4

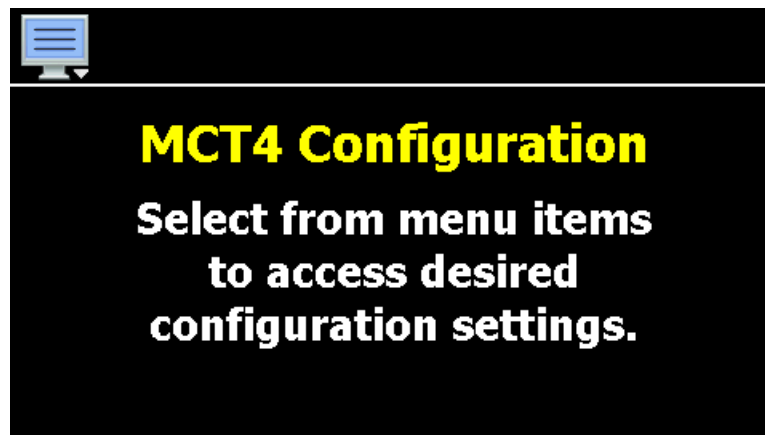
The MCT4 Configurator is a powerful tool that is built in to the system. It is a program that allows the OEM or user to set up control system options for the MCT4 runtime application. This allows for on-the-spot setup of the MCT4 without the need for external hardware and software. The user or OEM must first run the Configurator prior to putting the MCT4 into service in order to properly setup the system for its intended use. The MCT4 Configurator provides the following functionality:

- Set the control type, i.e., single loop, dual loop, cascade, etc.
- Enable/disable the limit option
- Configure the availability of soft alarms
- Provide control loop/limit configuration settings for input type, output function, set point range, etc.
- Select the type of user communications for the Modbus slave interface
- 'Splash Screen' name editing for custom OEM or user requirements
- Enable/disable options for runtime menu and screen availability
- Text editing for all system event and alarm names

The Configurator program does not run at the same time as the main runtime software. It can be run by exiting the runtime software via the Offline Setup\Exit Application screen. When the "Exit application (configuration mode startup)" option is selected, on the next power-up, the Configurator application will automatically start.

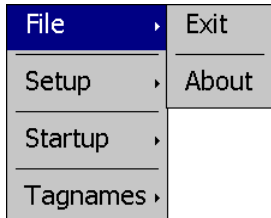
### To access the Configurator:

1. From the runtime application, press the "Home" icon to make sure you are on the main view.
2. Press the "Menu" icon (monitor) and select Device and then Settings.
3. From Settings, press the "Menu" icon (monitor) and select Offline and then Offline. Press "Yes" at the prompt to go offline.
4. From Offline, press the "Menu" icon (monitor) and select System and then Exit.
5. On the Exit Application screen, press the "Exit Application (configuration mode startup)" button. Press "Yes" at the prompt to exit the application.
6. Once the runtime application quits and the desktop is shown (black screen with the words "System Startup Please Wait..."), cycle power to the MCT4. Once the MCT4 finishes its boot sequence, the Configurator application will be automatically started.



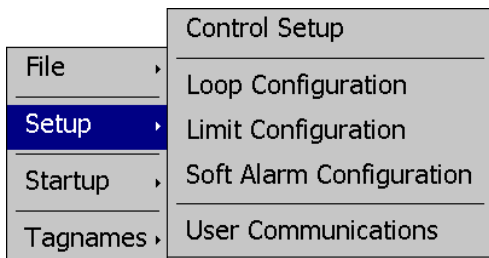
From the Configurator, the user or OEM can then setup all process loop controls and limit control (if installed) as well as choose from a long list of standard features to provide in the runtime application. During setup, the output control functions of each device can be changed, so any equipment being controlled by the outputs should be placed in an “off” state, so that any modifications to output functions will not cause an unsafe condition or damage to equipment.

The Configurator menu is accessed by pressing the “Monitor” icon at the top left of the screen.

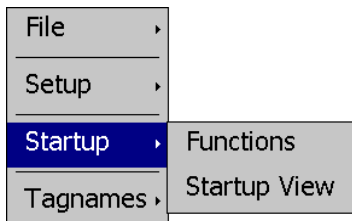


The **File** menu provides selections of “Exit” and “About”. The exit function for the Configurator saves all settings and closes the Configurator application.

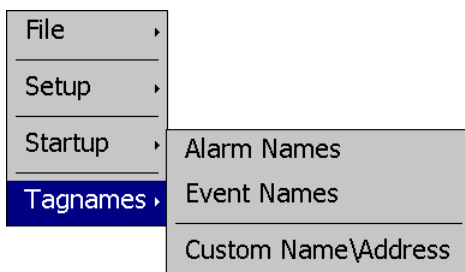
The about selection displays version information for the Configurator application and configured control devices.




The **Setup** menu provides access to the control setup options. These options include the controller type (single loop, dual loop, cascade, etc.), the process loop and limit settings, soft alarm settings and user communications.



The **Startup** menu provides access to enable and disable MCT4 runtime screens/menus and set the desired startup view selection.



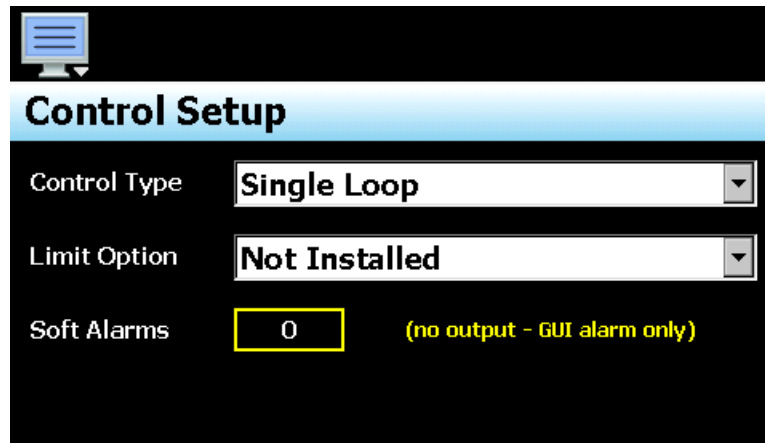
The **Tagnames** menu provides access to the text editing functions of the Configurator which allow the event and alarm names to be changed to match their use in the system. The menu also provides access to edit the splash screen information that is shown when the runtime application starts.

**IMPORTANT:**  Once all configuration settings are made, you must select “Exit” from the File menu to exit the Configurator prior to cycling power to the MCT4. All configuration files are written upon exiting the Configurator. Do not cycle power prior to exiting the Configurator or settings will be lost and the MCT4 will not operate properly once the runtime application starts.

Upon exiting the Configurator application and cycling power to the MCT4, the runtime application will be automatically started on the next boot sequence.

## 4.1 Control Setup

The Control Setup screen is accessed from the Setup menu. It allows the user or OEM to set the control type and enable/disable limit and soft alarm options.



The **Control Type** drop down menu is used to define the mode of operation for the MCT4. The number of PCM process loop boards required is set automatically and is dependent upon the control type selected. The selections include:

- |                                    |   |
|------------------------------------|---|
| <i>Single Loop</i>                 | When single loop is selected, the MCT4 will be configured as a single loop controller. A PCM process loop control must be attached and set to a communications address of 1 for proper operation.   |
| <i>Cascade</i>                     | When cascade is selected, the MCT4 will be configured for cascade control. In this mode, two PCM process loop controls must be installed in slots 1 and 2 for proper operation. See section 4.1.1 Cascade Settings for more information on cascade operation.   |
| <i>Dual Loop</i>                   | When dual loop is selected, the MCT4 will be configured as a dual loop controller. Two PCM process loop controls must be attached and set for communications addresses of 1 and 2 for proper operation.   |
| <i>Dual Loop + Cascade</i>         | When dual loop + cascade is selected the MCT4 will be configured as a three loop controller; however, loops two and three will be configured for cascade control. In this mode, three PCM process loop controls must be attached and set for communications addresses of 1, 2 and 3 for proper operation. See section 4.1.1 Cascade Settings for more information on cascade operation. |
| <i>Triple (Loop 3 static only)</i> | When triple is selected, the MCT4 will be configured as a three loop controller. As the selection indicates, loop 3 operates in static mode only, i.e., it does not operate under program control. In this mode, three PCM process loop controls must be attached and set for communications addresses of 1, 2 and 3 for proper operation.  |

The **Limit Option** is used to enable (Installed) or disable (Not Installed) the use of an HLM limit control board. This option is only available for control type selections that use one or two process loop controls. It cannot be enabled when three process loop controls are used. When enabled for the control type of single loop, the HLM must be installed in slot 2 of the MCT4. When enabled for the control type of cascade or dual loop, the HLM must be installed in slot 3.

The **Soft Alarms** field is used to enter the number of soft alarms that will be provided on the system. A soft alarm is an alarm without a control output. It is a software-based alarm that can be used to alert an operator that a process has exceeded desired operating conditions. The MCT4 is capable of providing up to 10 soft alarms. When at least one soft alarm is entered, the Soft Alarm Configuration menu item is enabled and the mode of operation for the soft alarm(s) can be specified. See section 4.4 Soft Alarm Configuration for more information.

**4.1.1 Cascade Settings**

Cascade operation is a concept in which one control loop (a.k.a. primary, outer or master) is used to drive a second control loop (a.k.a. secondary, inner or slave). The primary loop is typically slower to respond to changes in the process (i.e., has thermal mass) while the secondary loop directly affects the process at a rate much faster than the primary loop. The MCT4 provides two control type selections for cascade operation which include:

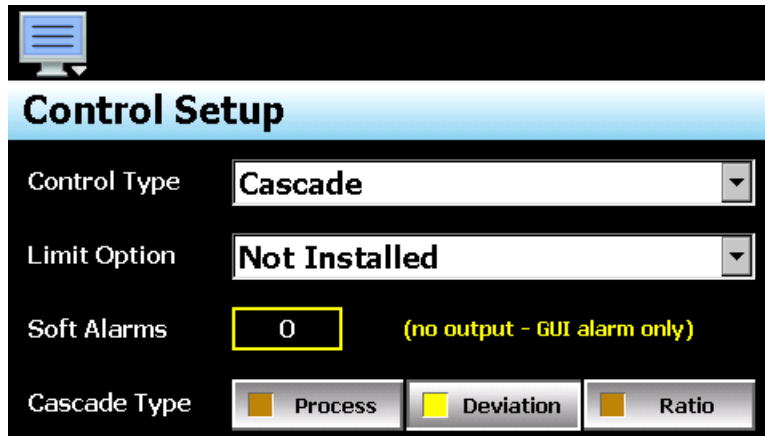
*Cascade* When selected loop 1 is set as the primary loop. Its set point can be set manually by the operator in static mode as well as automatically via a ramp/soak program.

Loop 2 is set as the secondary loop for cascade operation. It will appear as a normal loop in the runtime application; however, its set point is directly set by loop 1 and it cannot be set by the operator. Its set point will also not appear under ramp/soak program entry.

*Dual Loop + Cascade* When selected loop 1 is a standard control loop with standard operator set point control and ramp/soak program ability. Loop 2 is set as the primary loop for cascade operation. Its set point can be set manually by the operator in static mode as well as automatically via a ramp/soak program operation like loop 1.

Loop 3 is set as the secondary loop for cascade operation. It will appear as a normal loop in the runtime application; however, its set point is directly set by loop 2 and it cannot be set by the operator. Its set point will also not appear under ramp/soak program entry.

When a cascade control type is selected, additional **Cascade Type** selection buttons will be provided on the Control Setup screen. The buttons are used to choose the mode of cascade operation.



**Process** This mode provides lower and upper set point entry fields (on the Cascade screen in the runtime application) which are used as lower and upper range of the secondary loop. The output of the primary loop is used to calculate a linear set point between the lower and upper values in order to generate the set point for the secondary loop.

For example, if the primary loop is configured for heat only or cool only, it will have an output of 0 to 100%. If the lower and upper limits entered in the runtime on the Cascade screen are 0 and 50, an output of 0 to 100% on the primary loop will generate a set point of 0 to 50 on the secondary loop. So, an output of 50% would be a set point of 25 on the secondary loop.

If the primary loop is configured for heat/cool operation, it will have an output of -100 to 100% where -100% is full cooling and 100% is full heating. If the lower and upper limits entered in the runtime on the Cascade screen are 0 and 50, an output of -100 to 100% on the primary loop will generate a set point of 0 to 50 on the secondary loop. So, an output of 0% (no heating or cooling) would be a set point of 25 on the secondary loop.

**Deviation** This mode provides lower and upper set point entry fields (on the Cascade screen in the runtime application) which are used generate a set point for the secondary loop that is offset from the primary loop set point. The lower and upper range of the secondary loop is calculated by adding and/or subtracting these values as offsets from the primary loop set point. As the primary loop set point changes, the window defined by the lower and upper points automatically changes with it.

For example, if the primary loop is configured for heat/cool operation, it will have an output of -100 to 100% where -100% is full cooling and 100% is full heating. The cooling output of 0 to -100% will apply an offset of 0 to the lower set point and the heating output of 0 to 100% will apply an offset of 0 to the upper set point. With an output of 0% on the primary loop and a set point of 25, the secondary loop set point would also be 25.

However, with a lower set point of -10, the secondary loop set point would go from 25 to 15 as the primary loop cooling output goes from 0 to -100%. Likewise, if the upper set point is 10, the secondary loop set point would go from 25 to 35 as the primary loop set point goes from 0 to 100%.

**Ratio** This mode provides a single set point entry field (on the Cascade screen in the runtime application) which is used to generate a set point for the secondary loop according to the primary loop process value. Typically used in flow control applications, the ratio set point is a multiplication factor. The value entered is multiplied to the primary loop process value and the result is used as the secondary loop set point.

For example, if the ratio set point is 0.2, with a primary loop process value of 0, the secondary loop set point will also be 0. As the process value of the primary loop increases, the secondary loop set point will also increase proportionally to the primary loop process value. So, with a primary loop process value of 10, the secondary loop set point would be 2 (10 multiplied by 0.2).

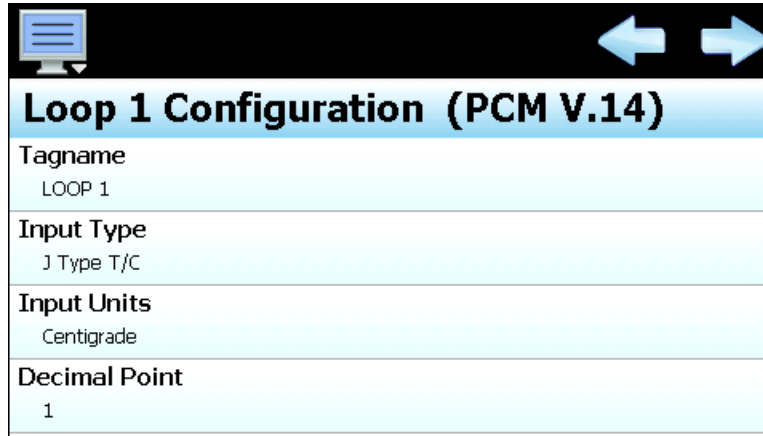
**IMPORTANT:** *When using one of the cascade control types, the control outputs of the secondary loop must be wired to the controlled process. The primary loop is not used to directly control the process. It is used to generate the set point for the secondary loop.*



*When a cascade control type is selected, the Cascade Settings menu option under the Startup\Functions Configurator menu must be enabled in order to provide access to the lower/upper or ratio set points in the runtime application.*

## 4.2 Loop Configuration

The Loop Configuration screen is accessed from the Setup menu. The screen provides access to all loop control board settings. When the selected control type requires more than one loop control, the left/right scroll buttons will be provided at the top right of the screen. These buttons can be used to scroll through all available loop controls in order to view/edit settings for each.



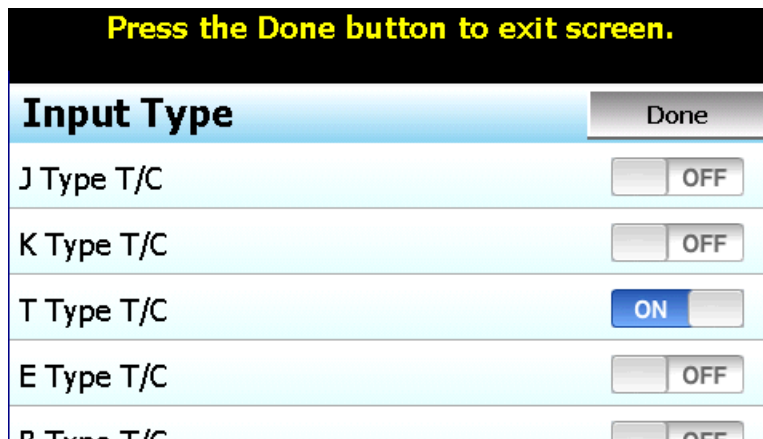
The model and version of the PCM installed will be shown in the scroll list header. To view all of the available settings, simply swipe up or down on the screen to scroll through the list items. To edit a value, tap the row for the desired item. If the entry is a simple numeric value, the number entry pad will be shown. If the item has multiple selections to choose from, a list of individual selections for the item will be shown. For a comprehensive list of all loop control board settings, their ranges and factory default values see appendix section A.5.1 PCM Parameter Description.

### 4.2.1 Tagname

The Tagname entry allows the user or OEM to assign a specific name for each control loop, up to 11 characters in length. This name will be used throughout the MCT4 runtime application and can be used to provide a more detailed description as to the function the loop provides. Default tag names are Loop1, Loop2 and Loop3.

### 4.2.2 Input Type

The Input Type entry is used to select the type of sensor that will be connected to the loop control. The input type can be a temperature input (thermocouple or RTD) or a linear input type (VDC or mA).

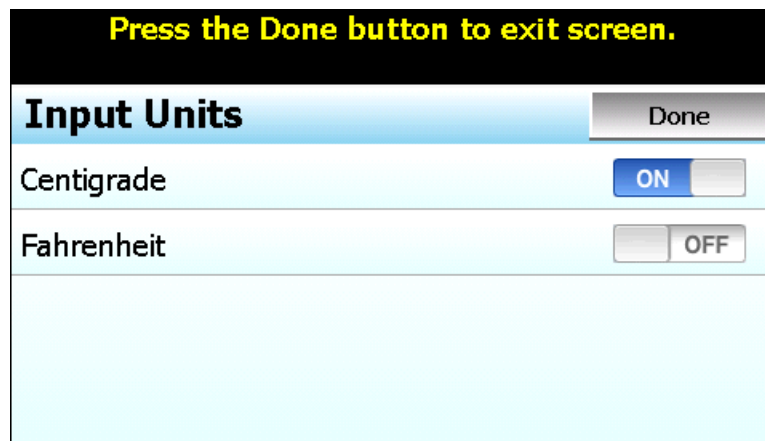


The input type selections are mutually exclusive, i.e., selecting one input will turn all other selections off. Once the desired input type has been selected, press the “Done” button to set the input type for the loop control board and return to the main Loop Configuration screen.

**NOTE:** *The PCM is equipped with DIP switches on the component side of the board. The DIP switches must be set properly according to the input type selection made. See section 3.2.1.1 Sensor Input for details on sensor wiring and DIP switch settings according to selected sensor type.*

#### 4.2.3 Input Units

The Input Units entry is used to select the temperature units for temperature input types (thermocouple or RTD). If the selected input type for the loop is a linear input (VDC or mA), the Input Units entry will display the text entry keypad allowing the user or OEM to enter specific engineering units up to 4 characters.



The input unit selections for temperature are mutually exclusive, i.e., selecting one will turn off the other. Once the desired temperature units have been selected, press the “Done” button to set the input units for the loop control board and return to the main Loop Configuration screen.

#### 4.2.4 Decimal Point

The Decimal Point entry allows the input precision to be adjusted between 0 and 1 decimal digits for temperature input types, between 0 and 2 for a 0-60mV input and from 0 to 3 for VDC and mA input types.

**IMPORTANT:** *Once the loop control board has been configured with a specific decimal point, changing the decimal point will require the loop control board to be reconfigured in order to maintain previous control settings. Automatic programs, alarm set points, set point limits, input low/high scale, etc., DO NOT automatically scale. An entry of 100.0 becomes 1000 when changing the decimal point to zero (not 100) and must be re-entered to set the proper value.*



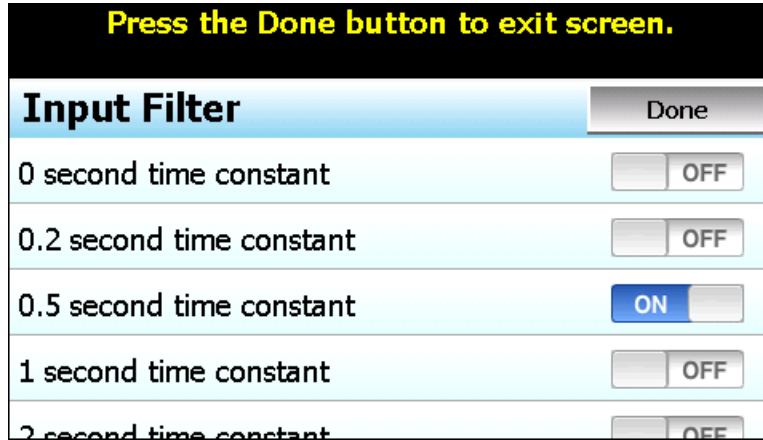
#### 4.2.5 Input Low/High Scale

The Input Low Scale and Input High Scale entries are used to set the input range for linear input types (VDC or mA). The entries are not available for temperature input types since they utilize a fixed range based on the sensor type. The input low scale value can be set from -32768 up to the high scale value minus 50. The high scale value can be set from the low scale value plus 50 up to 32767.

**NOTE:** *The minimum and maximum scale values are limited by the decimal point selection. For a decimal of 0, the values are -32768 and 32767 respectively. For one decimal point, the values are -3276.8 and 3276.7. For two decimal digits, the values are -327.68 and 327.67 and for three decimal digits the values are -32.768 and 37.767.*

**4.2.6 Input Filter**

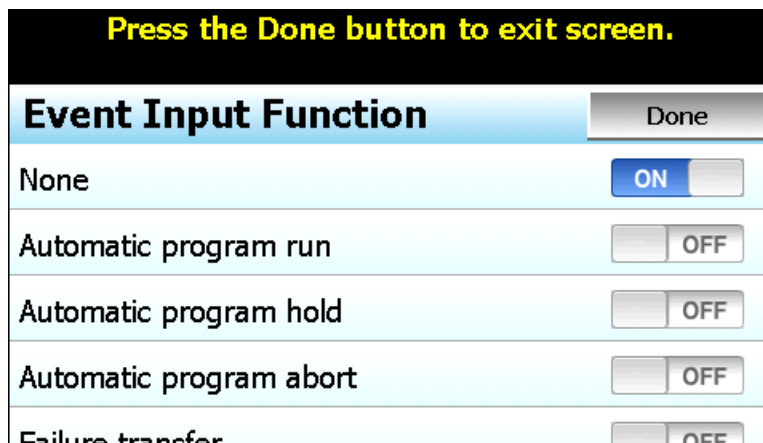
The Input Filter entry is used to select the time constant used for filtering the process input.



The time constant selections are mutually exclusive, i.e., selecting one will turn off the others. Once the desired filter constant has been selected, press the “Done” button to set the input filter for the loop control board and return to the main Loop Configuration screen.

**4.2.7 Event Input Function**

The Event Input Function is used to select the desired mode of operation for the digital input of the loop control board. The event input selections are mutually exclusive, i.e., selecting one will turn off the others. Once the desired function has been selected, press the “Done” button to set the event input function for the loop control board and return to the main Loop Configuration screen.



**IMPORTANT:** *If the MCT4 control type is set for Dual Loop, Dual Loop + Cascade or Triple loop operation, loop control boards 1 and 2 must be set to the same Automatic program function (if used) and both inputs must be wired to the same control switch. If an automatic program function is activated on only one of the loop control boards, program operation of one loop will continue while the other will be affected by the input function selected.*



The **Automatic program run** function is a single-shot action that will start the currently loaded program when the event input is activated.



The **Automatic program hold** function will put the currently running program into hold when the event input is activated. The program will resume operation and return to the run mode when the input is deactivated.

The **Automatic program abort** function is a single-shot action that will abort the currently running program. Note that the abort function does not work if the program is in hold. The program must be running in order for the abort function to work.

The **Failure transfer** function puts the loop control outputs into failure transfer mode when the input is activated. The output will then go to the percent output value set for failure transfer. The loop control outputs will return to normal PID control when the input is deactivated.

**NOTE:** *If an automatic ramp/soak program is in operation and one or both programmed control loops are placed in failure transfer via the event input, the program will be stopped. When the event input is then turned off and failure transfer is disabled, the loops will operate in static mode at the set point and event output status prior to the time which the program was started.*

The **Automatic program advance next step** function is a single-shot action that will advance the currently running program by one step each time the event input is activated.

The **Automatic program run/hold** function is a combination of the automatic program run and program hold functions. Upon first activation of the input, the currently loaded program will be started if not already running. Deactivating the input will then cause the program to go into hold. The input must then be reactivated in order for the program to resume operation.

The **Loop status input** function provides a visual indication on the Loop View screen in the runtime application. When the input is activated, the border around the loop is highlighted blue. When the input is deactivated, the border around the loop returns to the default dark gray color. This can be used as a means for alerting the user of an operating condition, such as the equipment the loop is controlling is in operation.

The **Alarm input** function allows the event input to be used for alarm indication. When the input is activated, the Event Input Alarm Message (see section 4.2.8) is displayed on the alarm screen in the runtime application and the audible alarm sounds.

**NOTE:** *The automatic program functions are not available on loop 3. Only loops 1 and 2 operate under ramp/soak program control.*

#### **4.2.8 Event Input Alarm Message**

When the event input function is set to alarm input, the Event Input Alarm Message entry allows the user or OEM to assign the alarm message that will be shown on the alarm screen in the runtime application when the input is activated. The alarm message can be up to 25 characters long.

#### **4.2.9 Low/High Limit Setpoint**

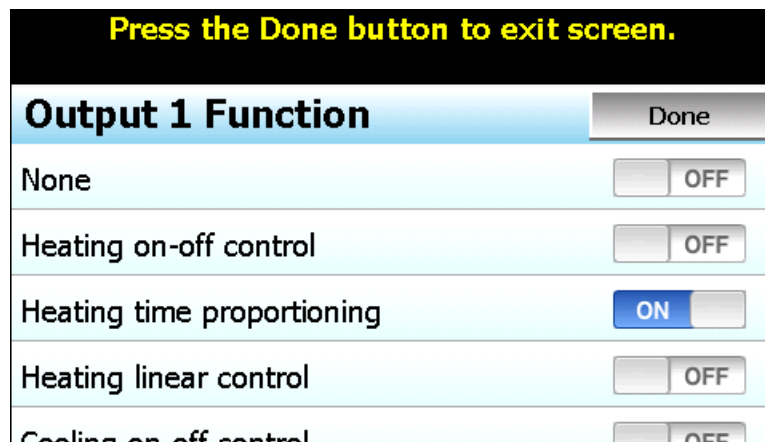
The low and high limit set points are used to set the minimum and maximum allowed set points that can be entered for the loop control. These are typically set by the OEM to limit the control range to within the safe operating range of the equipment.

**NOTE:** *The runtime application provides additional user low and high set point limits (see section 9.3 Setpoint Limits). These can be adjusted to further limit the allowable set point range within the band set by the OEM low and high limit set points. By default, the user set point limits are zero. The user set points must also be adjusted in the runtime application in order to allow proper set point entry.*

#### 4.2.10 Output 1 Function

The Output 1 Function is used to set the mode of operation for the primary control output of the loop control board. The output can be set for heating or cooling on/off control, time proportioning or linear control. The output selections are mutually exclusive, i.e., selecting one will turn off the others. Once the desired function has been selected, press the “Done” button to set the output function for the loop control board and return to the main Loop Configuration screen.

**NOTE:** *The output function must be set to match the type of output ordered on the loop control board. Relay and SSRD output types are used for on/off and time proportioning control. The isolated VDC and mA output types are used for linear control.*



The **Heating on-off control** function will turn on the output when the process value is below set point. When the process value rises above the set point plus the on-off control hysteresis, the output will turn off.

The **Heating time proportioning** function uses the PID settings to cycle the output on and off according to the percentage of heating required using the cycle time configured for output 1. For example, if the percentage of output is 50% and the cycle time is 18 seconds, the output will repeat on/off cycles of 9 seconds each. If the output was only 25%, the output would be on for 4.5 seconds and off for 13.5 seconds of the 18 second cycle time.

The **Heating linear control** function uses the PID settings to vary the VDC or mA output from the minimum to the maximum range of the output as a direct percentage of the heating output.

The **Cooling on-off control** function will turn on the output when the process value is above set point. When the process value falls below the set point minus the on-off control hysteresis, the output will turn off.

The **Cooling time proportioning** function uses the PID settings to cycle the output on and off according to the percentage of cooling required using the cycle time configured for output 1. For example, if the percentage of output is 50% and the cycle time is 6 seconds, the output will repeat on/off cycles of 3 seconds each. If the output was only 25%, the output would be on for 0.75 seconds and off for 5.25 seconds of the 6 second cycle time.

The **Cooling linear control** function uses the PID settings to vary the VDC or mA output from the minimum to the maximum range of the output as a direct percentage of the cooling output.

**NOTE:** *Linear heating and cooling outputs are either 0-20mA or 0-10VDC. If a non-zero based or less than the maximum value output is required i.e. 4-20mA or 1-5VDC, the output low/high limit values must be set accordingly; refer to section 4.2.14 Output 1 Low/High Limit Values.*

#### **4.2.11 Output 1 Failure Transfer**

The output 1 failure transfer setting is used to set the value the output should go to if there is an input failure, i.e., sensor break. The output can be set for bumpless (-1) operation or a fixed percentage of output (from 0 to 100%) if proportioning or linear control is selected for the output function. When failure transfer is set to bumpless, the output will remain at its previous percentage of output until the input condition is corrected. Note that this should not be used for extended periods of time as a runaway condition could occur if separate limit devices are not installed to insure safe limits of operation by turning off the system should a limit be exceeded.

If the output function is set for on-off control, the failure transfer can be set to have the output turn on (1) or turn off (0) when a sensor break occurs.

#### **4.2.12 Output 1 ON-OFF Control Hysteresis**

The output 1 on-off control hysteresis can be set when the output 1 function is set for heating or cooling on-off control. It is used to eliminate rapid cycling of the control output by applying a safe-sided dead band to the control output. When the control set point is exceeded, the output will turn on. The output will not turn off until the process rises above (for heating) or falls below (for cooling) the set point by the hysteresis value.

The hysteresis can be set from a minimum of 0.1 to a maximum of 50.0 for units of degrees Centigrade and to a maximum of 90.0 for units of degrees Fahrenheit and when a linear input type is used.

#### **4.2.13 Output 1 Cycle Time**

The output 1 cycle time can be set when the output 1 function is set for heating or cooling time proportioning control. The cycle time can be adjusted from 0.1 to 90.0 seconds. For cycle times less than 18 seconds, it is recommended that the loop control board be ordered with the SSRD drive output for output 1 to extend the life of the control output.

#### **4.2.14 Output 1 Low/High Limit Values**

The output low and high limit values can be set when the output 1 function is set for heating or cooling time proportioning or linear control. They are used to set the minimum and maximum percentage of the output range for the installed output type.

For example, the standard range of the mA output is 0-20mA. In order to use the output as a 4-20mA output, the low limit value would need to be set to 20% (20% of 20ma = 4ma). For the voltage output, the default range is 0-10VDC. In order to achieve a 1-5VDC output, the low limit would have to be set to 10% (10% of 10VDC is 1VDC). The high limit would then have to be set to 50% in order cut the output span in half to get a maximum output of 5VDC.

It is recommended that the output low limit be set for 0% when time proportioning is selected as the output function. Otherwise, the output would continue to cycle on and off even if the control output required by the PID value is 0%. In the case of time proportioning outputs, the cycle time is used as the range of the output. If the cycle time were set to 18 seconds, a low limit setting of 10% would equate to a 1.8 second minimum on time. Thus, even with the PID value calling for 0% output, the output would still cycle 1.8 seconds on and 16.2 seconds off.

#### **4.2.15 Output 2 Function**

The Output 2 Function is used to set the mode of operation for the secondary control output of the loop control board.

**NOTE:** The output function must be set to match the type of output ordered on the loop control board. Relay and SSRD output types are used for proportioning control, alarm or event outputs. The isolated VDC and mA output types are used for linear control.

Press the Done button to exit screen.	
<b>Output 2 Function</b>	Done
None	<input type="checkbox"/> OFF
Cooling time proportioning	<input checked="" type="checkbox"/> ON
Cooling linear control	<input type="checkbox"/> OFF
Alarm output	<input type="checkbox"/> OFF
Reverse alarm output	<input type="checkbox"/> OFF

The output can be set for cooling time proportioning or linear control, an alarm or an event. The output selections are mutually exclusive, i.e., selecting one will turn off the others. Once the desired function has been selected, press the “Done” button to set the output function for the loop control board and return to the main Loop Configuration screen.

The **Cooling time proportioning** function uses the PID settings to cycle the output on and off according to the percentage of cooling required using the cycle time configured for output 1. For example, if the percentage of output is 50% and the cycle time is 6 seconds, the output will repeat on/off cycles of 3 seconds each. If the output was only 25%, the output would be on for 0.75 seconds and off for 5.25 seconds of the 6 second cycle time.

The **Cooling linear control** function uses the PID settings to vary the VDC or mA output from the minimum to the maximum range of the output as a direct percentage of the cooling output.

**NOTE:** The linear cooling output is either 0-20mA or 0-10VDC. If a non-zero based or less than the maximum value output is required i.e. 4-20mA or 1-5VDC, the output low/high limit values must be set accordingly; refer to section 4.2.17 Output 2 Low/High Limit Values.

The **Alarm output** function activates the Alarm 1 configuration settings for assigning the type of alarm logic to apply to output 2. When the alarm condition is active, the output will turn on.

The **Reverse alarm output** function activates the Alarm 1 configuration settings for assigning the type of alarm logic to apply to output 2. The output will be normally “on” when this function is selected. When the alarm condition is active, the output will turn off.

The **Event output** function allows the output to be turned on and off via an automatic program or manually through the MCT4 runtime application to act as a “soft” switch to turn system components on and off.

The **DC power supply output** function must be selected when the output type ordered for the loop control board output 2 is a transmitter power supply.

#### 4.2.16 Output 2 Failure Transfer

The output 2 failure transfer setting is used to set the value the output should go to if there is an input failure, i.e., sensor break. The output can be set for bumpless (-1) operation or a fixed percentage of output (from 0 to 100%) if proportioning or linear control is selected for the output function.

When failure transfer is set to bumpless, the output will remain at its previous percentage of output until the input condition is corrected. Note that this should not be used for extended periods of time as a runaway condition could occur if separate limit devices are not installed to insure safe limits of operation by turning off the system should a limit be exceeded.

If the output function is set as an alarm, the failure transfer can be set to have the output turn on (1) or turn off (0) when a sensor break occurs.

**NOTE:** *The failure transfer setting is not applicable when the output 2 function is set for event or DC power supply and does not affect output operation.*

#### **4.2.17 Output 2 Cycle Time**

The output 2 cycle time can be set when the output 2 function is set for cooling time proportioning control. The cycle time can be adjusted from 0.1 to 90.0 seconds. For cycle times less than 18 seconds, it is recommended that the loop control board be ordered with the SSRD drive output for output 2 to extend the life of the control output.

#### **4.2.18 Output 2 Low/High Limit Values**

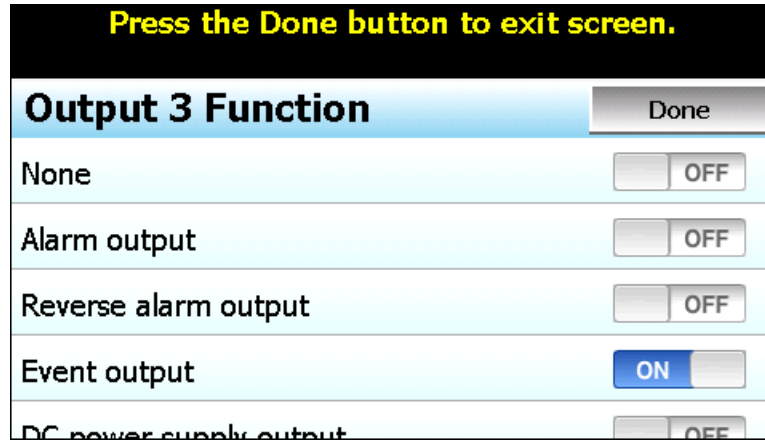
The output low and high limit values can be set when the output 2 function is set for cooling time proportioning or linear control. They are used to set the minimum and maximum percentage of the output range for the installed output type.

For example, the standard range of the mA output is 0-20mA. In order to use the output as a 4-20mA output, the low limit value would need to be set to 20% (20% of 20ma = 4ma). For the voltage output, the default range is 0-10VDC. In order to achieve a 1-5VDC output, the low limit would have to be set to 10% (10% of 10VDC is 1VDC). The high limit would then have to be set to 50% in order cut the output span in half to get a maximum output of 5VDC.

It is recommended that the output low limit be set for 0% when time proportioning is selected as the output function. Otherwise, the output would continue to cycle on and off even if the control output required by the PID value is 0%. In the case of time proportioning outputs, the cycle time is used as the range of the output. If the cycle time were set to 18 seconds, a low limit setting of 10% would equate to a 1.8 second minimum on time. Thus, even with the PID value calling for 0% output, the output would still cycle 1.8 seconds on and 16.2 seconds off.

#### **4.2.19 Output 3 Function**

The Output 3 Function selection is used to configure the loop control board output as an alarm or an event. The output selections are mutually exclusive, i.e., selecting one will turn off the others. Once the desired function has been selected, press the “Done” button to set the output function and return to the main Loop Configuration screen.



The **Alarm output** function activates the Alarm 2 configuration settings for assigning the type of alarm logic to apply to output 3. When the alarm condition is active, the output will turn on.

The **Reverse alarm output** function activates the Alarm 2 configuration settings for assigning the type of alarm logic to apply to output 3. The output will be normally “on” when this function is selected. When the alarm condition is active, the output will turn off.

The **Event output** function allows the output to be turned on and off via an automatic program or manually through the MCT4 runtime application to act as a “soft” switch to turn system components on and off.

The **DC power supply output** function must be selected when the output type ordered for the loop control board output 3 is a transmitter power supply.

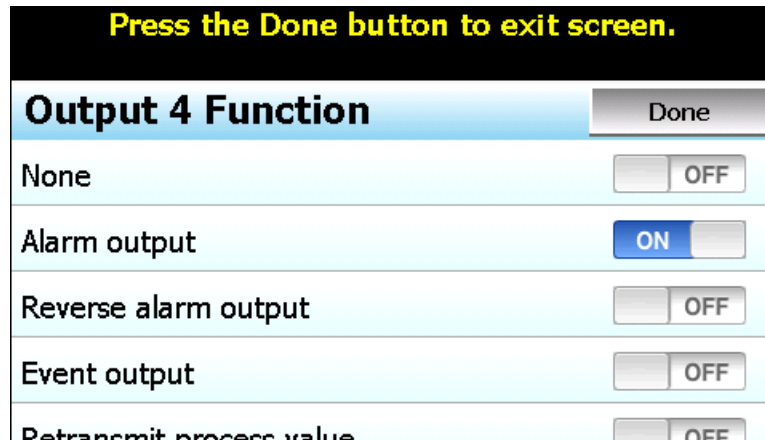
#### 4.2.20 Output 3 Failure Transfer

The output 3 failure transfer setting is used to set whether the output should be on (1) or off (0) when there is an input failure, i.e., sensor break. The setting applies to alarm output functions only.

#### 4.2.21 Output 4 Function

The Output 4 Function selection is used to configure the loop control board output as an alarm, event or retransmit output. The output selections are mutually exclusive, i.e., selecting one will turn off the others. Once the desired function has been selected, press the “Done” button to set the output function and return to the main Loop Configuration screen.

**NOTE:** *The output function must be set to match the type of output ordered on the loop control board. Relay and SSRD output types are used for alarm or event outputs. The retransmission VDC and mA output types are used for process value or set point retransmit.*



The **Alarm output** function activates the Alarm 3 configuration settings for assigning the type of alarm logic to apply to output 4. When the alarm condition is active, the output will turn on.

The **Reverse alarm output** function activates the Alarm 3 configuration settings for assigning the type of alarm logic to apply to output 4. The output will be normally “on” when this function is selected. When the alarm condition is active, the output will turn off.

The **Event output** function allows the output to be turned on and off via an automatic program or manually through the MCT4 runtime application to act as a “soft” switch to turn system components on and off.

The **Retransmit process value** and **Retransmit setpoint value** functions allow the loop control board output to retransmit the current input value or control set point to remote devices such as a chart recorder.

The **DC power supply output** function must be selected when the output type ordered for the loop control board output 4 is a transmitter power supply.

#### 4.2.22 Output 4 Failure Transfer

The output 4 failure transfer setting is used to set whether the output should be on (1) or off (0) when there is an input failure, i.e., sensor break. The setting applies to alarm output functions only.

#### 4.2.23 Output 4 Low/High Limit Values

The output low and high limit values can be set when the output 4 function is set for retransmit process or setpoint value. They are used to set the minimum and maximum percentage of the output range for the installed output type.

For example, the standard range of the mA output is 0-20mA. In order to use the output as a 4-20mA output, the low limit value would need to be set to 20% (20% of 20ma = 4ma). For the voltage output, the default range is 0-10VDC. In order to achieve a 1-5VDC output, the low limit would have to be set to 10% (10% of 10VDC is 1VDC). The high limit would then have to be set to 50% in order cut the output span in half to get a maximum output of 5VDC.

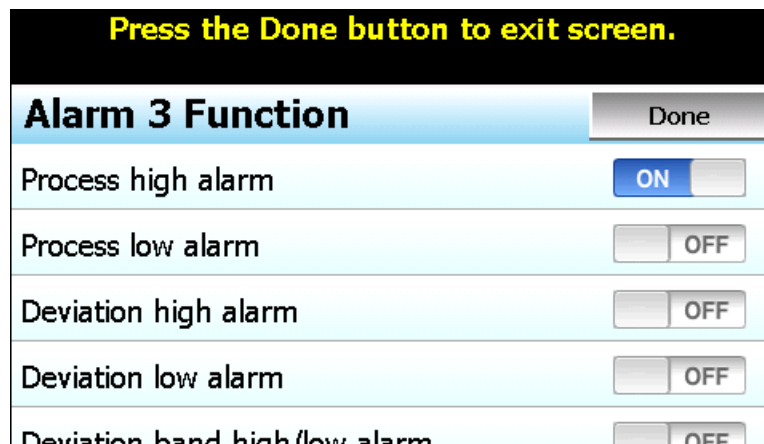
#### 4.2.24 Output 4 Retransmit Low/High Scale

The output retransmit low and high scale can be set when the output 4 function is set for retransmit process or setpoint value. They are used to set the retransmit range of the output. The low scale value corresponds to the output low limit value and the high scale value corresponds with the output high limit value.

For example, if the output function is set for “Retransmit process value”, setting the low scale to -100 and the high scale to 100, would produce a linear output between the output low limit and output high limit as the process value varies between -100 and 100. If the output low and high limit values scaled the output to a 4-20mA signal, as the process value varied between -100 and 100, the output would vary linearly between 4ma and 20mA.

#### 4.2.25 Alarm (1-3) Function

The Alarm 1, 2 and 3 Functions are used to select the alarm type for outputs 2, 3 and 4 respectively if the output function is configured as alarm or reverse alarm. The alarm selections are mutually exclusive, i.e., selecting one will turn off the others. Once the desired alarm type has been selected, press the “Done” button to set the alarm function for the loop control board output and return to the main Loop Configuration screen.



**NOTE:** For the following alarm descriptions, *PV* = process value, *SV* = the control set point value, *ASP* is the alarm set point and *AHY* is the alarm hysteresis.

A **Process high alarm** is independent of set point. When the process value is higher than the alarm set point ( $PV > ASP$ ), a process high alarm occurs. When the process value is lower than the alarm set point minus the alarm hysteresis ( $PV < ASP - AHY$ ), the alarm is off.

A **Process low alarm** is independent of set point. When the process value is lower than the alarm set point ( $PV < ASP$ ), a process low alarm occurs. When the process value is above the alarm set point plus the alarm hysteresis ( $PV > ASP + AHY$ ), the alarm is off.

A **Deviation high alarm** is dependent upon the control set point and alerts the operator when the process value deviates too high over the set point value. For deviation high alarms, the alarm set point is entered as a positive value. When the process is higher than the control set point plus the alarm set point ( $PV > SV + ASP$ ), a deviation high alarm occurs. When the process value falls below the control set point plus alarm set point minus the alarm hysteresis ( $PV < SV + ASP - AHY$ ), the alarm is off.

A **Deviation low alarm** is dependent upon the control set point and alerts the operator when the process deviates too far below the set point value. For deviation low alarms, the alarm set point is entered as a negative value. When the process is lower than the control set point plus the alarm set point ( $PV < SV + ASP$ ), a deviation low alarm occurs. When the process value rises above the control set point plus alarm set point plus the alarm hysteresis ( $PV < SV + ASP + AHY$ ), the alarm is off.

A **Deviation band high/low alarm** sets two trigger levels relative to the control set point value. For deviation band alarms, the alarm set point is entered as a positive value. The two alarm trigger levels are then defined as  $SV + ASP$  and  $SV - ASP$  for the high and low alarm values. When the process value is greater than the high alarm value ( $PV > SV + ASP$ ) or less than the low alarm value ( $PV < SV - ASP$ ), a deviation band alarm occurs.



When the process value is within the high and low trigger levels by the value of the alarm hysteresis ( $PV < SV+ASP-AHY$  and  $PV > SV-ASP+AHY$ ), the deviation band alarm is off.

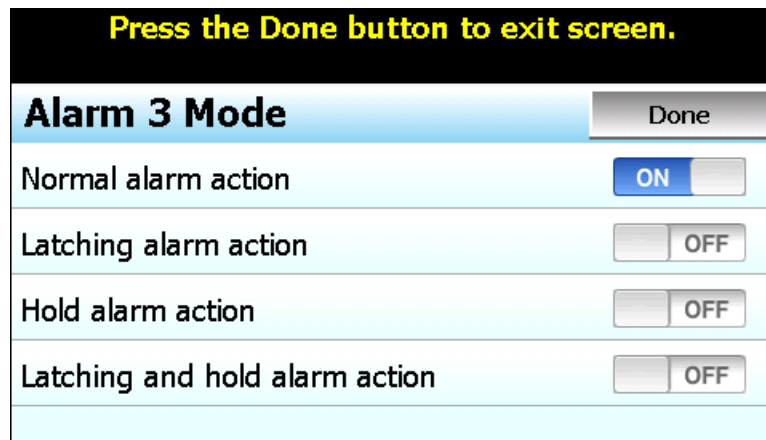
The **End of automated program alarm** is not associated with the process value or set point. The alarm is turned on upon completion of an automatic ramp/soak program. The alarm will turn off when another program is started, when power is cycled to the loop control board or when the “Reset” button is pressed on the Alarm screen of the runtime application.

The **Hold mode alarm** is not associated with the process value or set point. The alarm is turned on when the running program is in hold. The alarm will turn off when the program is placed back into run or the program is stopped. Note that this “alarm” is not indicated on the MCT4 interface.

The **Static mode alarm** is not associated with the process value or set point. The alarm is turned on when the loop control is in the single set point (static) mode of operation. The alarm will turn off when the loop control is running a ramp/soak program. Note that this “alarm” is not indicated on the MCT4 interface.

#### 4.2.26 Alarm (1-3) Mode

The Alarm 1, 2 and 3 Modes are used to select the mode of operation for outputs 2, 3 and 4 respectively if the output function is configured as an alarm or reverse alarm. The mode selections are mutually exclusive, i.e., selecting one will turn off the others. Once the desired alarm mode has been selected, press the “Done” button to set the alarm operation for the loop control board output and return to the main Loop Configuration screen.



**Normal alarm action** has the alarm output off in the non-alarm condition and on in the alarm condition. The output state is inverted for a reverse alarm output.

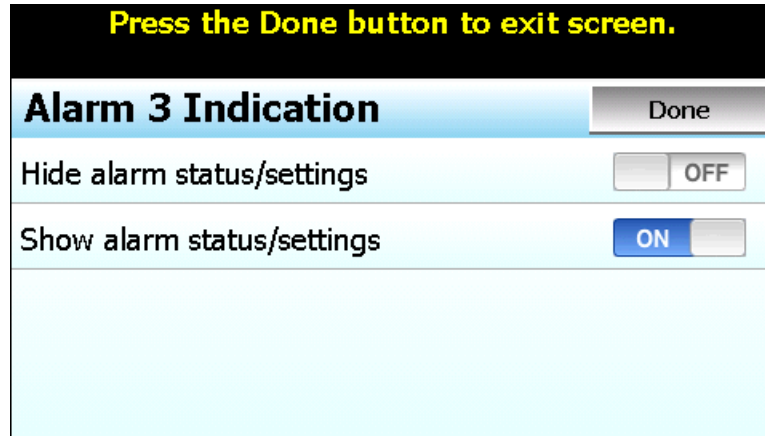
**Latching alarm action** will keep the alarm output on even if the alarm condition has cleared until the alarm is reset by the user. The output state is inverted for a reverse alarm output.

**Hold alarm action** prevents the alarm from activating on power up even when an alarm condition is present. The alarm will be blocked until the alarm condition clears. Once cleared, the alarm will then operate normally and activate when an alarm condition occurs.

The **Latching and hold alarm action** combines both the latching and hold alarm actions listed above.

#### 4.2.27 Alarm (1-3) Indication

The Alarm 1, 2 and 3 Indication settings are used to select whether the alarm will be shown in the MCT4 runtime application or be hidden from the user. This allows the OEM to configure an alarm to perform a specific control function while preventing the user from adjusting the set point or seeing the activation state of the alarm.



When the alarm indication is set for **Hide alarm status/settings**, the alarm will be removed from the MCT4 runtime application. The user will not be able to edit the alarm message or adjust the alarm set point. When the alarm activates, there will be no indication or message on the alarm screen and the audible alarm will not sound. The alarm operates as a “silent” alarm with no indication to the user.

When the alarm indication is set for **Show alarm status/settings**, the user will be able to access and change the alarm set point and alarm message under the device settings. When the alarm occurs, the alarm message will be displayed on the Alarm screen and the audible alarm will sound.

The indication selections are mutually exclusive, i.e., selecting one will turn off the other. Once the desired alarm indication has been selected, press the “Done” button to set the alarm operation and return to the main Loop Configuration screen.

**NOTE:** *If the alarm is hidden but its mode is set for latching, the user will not have any indication that the alarm requires manual reset. When an alarm is hidden, it is recommended that the normal or hold mode be used so that the alarm output automatically resets when the alarm condition is no longer present.*

#### 4.2.28 Alarm (1-3) Setpoint

The alarm set points can be set when the alarm function is set for a process or deviation type of alarm. If the alarm indication is set to “show” the alarm status and settings, the set point will also be available in the MCT4 runtime application. If the alarm indication is set for “hide” alarm status and settings, the alarm set point will not be available in the MCT4 runtime application and can only be changed in the Configurator.

#### 4.2.29 Alarm (1-3) Hysteresis

The alarm hysteresis can be set when the alarm function is set for a process or deviation type of alarm. It is used to eliminate rapid on/off cycling of the alarm output by applying a safe-sided dead band to the alarm. When the alarm set point is exceeded, the alarm will activate. The alarm will not deactivate until the process rises above (for low alarm) or falls below (for high alarm) the alarm set point by the hysteresis value. The hysteresis can be set from a minimum of 0.1 to a maximum of 50.0 for units of degrees Centigrade and to a maximum of 90.0 for units of degrees Fahrenheit and linear input types.

#### 4.2.30 Alarm (1-3) Delay

The alarm delay is used to delay the activation of the alarm for a specified period of time. The delay is entered in minutes and seconds and can be set with a minimum of zero (00.00) to a maximum of 99 minutes and 59 seconds (99.59).

For non-latching alarms (normal or hold mode), the programmed time delay is activated (timing begins) when the alarm setpoint is exceeded. The alarm delay will stop timing (and reset) if the PV = (Alarm SP – HY) (hysteresis). If the time delay times out and alarm setpoint is still exceeded, the output associated with the alarm will actuate.

For latching alarms (latching or latching and hold mode), the programmed time delay is activated (timing begins) when the alarm setpoint is exceeded. When time delay starts the internal alarm circuit is latched (not output but internal time circuit). After the delay expires, the output associated with the alarm will actuate. The alarm delay does not stop timing when PV = (Alarm SP-HY). This means programming an alarm delay when using the latching type of alarm acts as a “delay on” contact since the latching circuit is set immediately when the alarm setpoint is exceeded, but the output is not actuated until the delay times out.

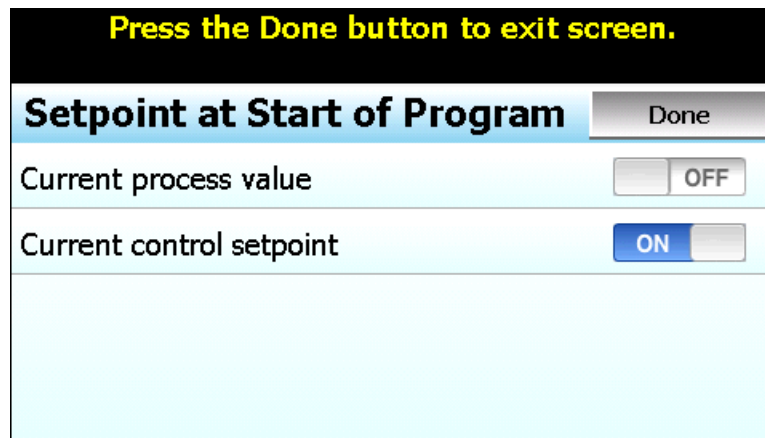
**NOTE:** *The alarm delay is available on PCM loop control boards starting with V.17 firmware. Loop control boards prior to this version must have their firmware updated in order to use the alarm delay feature.*

#### 4.2.31 Setpoint at Start of Automatic Program

The Setpoint at Start of Automatic Program entry is used to select the set point that will be used by the loop control at the start of a ramp/soak program. The start set point selections are mutually exclusive, i.e., selecting one will turn off the other. Once the desired starting set point has been selected, press the “Done” button to return to the main Loop Configuration screen.

**NOTE:** *If the MCT4 control type is set for Dual Loop, Dual Loop + Cascade or Triple loop operation, it is recommended that both loop 1 and loop 2 be set to the same selection so that both loop controls start an automatic ramp/soak program in the same manner to avoid operator confusion.*

*The PCM loop control board provides a selection for using the start set point value of a program. This selection is not supported by the MCT4 and cannot be configured or entered for an automatic program in the MCT4 runtime application. Only the current PV or control SP selections are supported.*

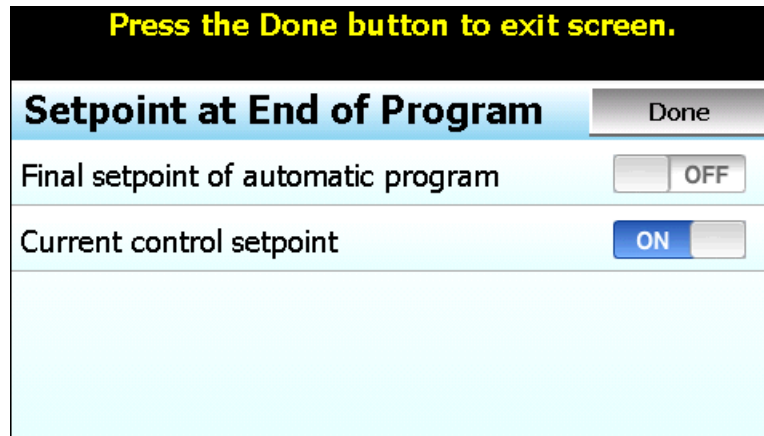


The **Current process value** selection will cause the loop control to immediately assume the current process value as the set point when the program is started. If the program is started on a ramp step, the program will begin ramping the set point from the current process value to the target set point of the step. If the program is started on a soak step, the program will hold the set point at the process value for the duration of the soak step.

The **Current control setpoint** selection will cause the loop control to use the current static set point when the program is started. If the program is started on a ramp step, the program will begin ramping from the static set point to the target set point of the step. If the program is started on a soak step, the program will hold the static set point for the duration of the soak step.

#### 4.2.32 Setpoint at End of Automatic Program

The Setpoint at End of Automatic Program entry is used to select the set point that will be used by the loop control at the end of a program. The end set point selections are mutually exclusive, i.e., selecting one will turn off the other. Once the desired end set point has been selected, press the “Done” button to return to the main Loop Configuration screen.



The **Final setpoint of automatic program** selection will use the final set point value programmed on the end step of the program as the control set point when the program reaches the end step. All events will be turned off and the program will remain in this condition until stopped by the user. Once the program is stopped by the user, the control set point and manual events will return to the previous static set point and event activation that were used prior to the program being started.

The **Current control setpoint** selection will return the control set point and event status to the previous static set point and event selections that were used prior to program operation once the program reaches the end step.

**IMPORTANT:** *If the MCT4 control type is set for Dual Loop, Dual Loop + Cascade or Triple loop operation, both loop 1 and loop 2 must be set to the same selection so that both loop controls end the program in the same manner or a program run error will occur. When the final set point is used, the program remains in operation on the end step with the final set point value while the program ends and the unit returns to static set point operation. If one loop ends while the other remains running in the end step, the automatic program run error will occur.*

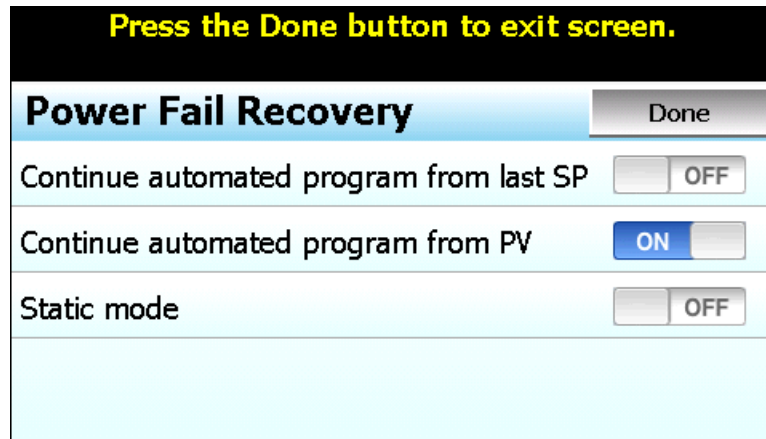
#### 4.2.33 Power Fail Recovery

The Power Fail Recovery entry is used to select the desired mode of operation of the loop control when power is restored if an automatic ramp/soak program was running at the time power was lost. The recovery selections are mutually exclusive, i.e., selecting one will turn off the others. Once the desired recovery mode has been selected, press the “Done” button to set the power recovery mode for the loop control board and return to the main Loop Configuration screen.

For additional information regarding the manner in which program recovery is achieved, see the Appendix section A.3 Power Recovery Detail.

**IMPORTANT:** *If the MCT4 control type is set for Dual Loop, Dual Loop + Cascade or Triple loop operation, both loop 1 and loop 2 must be set to the same recovery setting. If the recovery modes are set differently, program operation of one loop may continue while the other is terminated which will cause a program run error alarm to occur as well as result in incorrect operation of the program.*

*This selection can also be made via the runtime application on the “Recovery” screen in offline settings. The selection made in the runtime application is common to all programmed loop, i.e., when a selection is made each control loop is set to the current selection.*



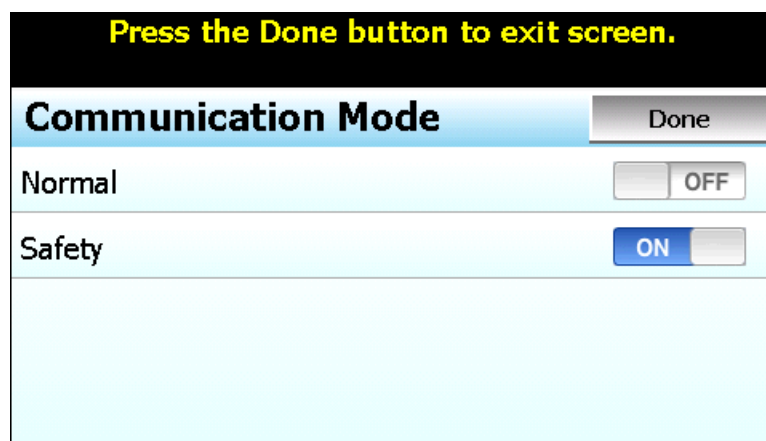
The **Continue automated program from last SP** selection will resume the program from where it left off with the last set point set by the program at the time of power failure.

The **Continue automated program from PV** selection will resume the program using the current process value at the time power is restored as the set point.

The **Static mode** selection will terminate the automated program and return the loop control to the single set point mode of operation using the previous set point value prior to starting the automatic program. In addition, any outputs configured as events will also be returned to their previous on/off prior to starting the program.

#### 4.2.34 Communication Mode

The Communication Mode selection is used to specify how the loop control responds to a loss of communications with the MCT4 base unit. The communication mode selections are mutually exclusive, i.e., selecting one will turn off the other. Once the desired mode has been selected, press the “Done” button to set the communication mode for the loop control board and return to the main Loop Configuration screen.



With the **Normal** mode selection, the loop control will continue operation according to the last command given. When power is first applied to the MCT4, the loop control outputs will activate immediately according to the last commands given prior to power loss.

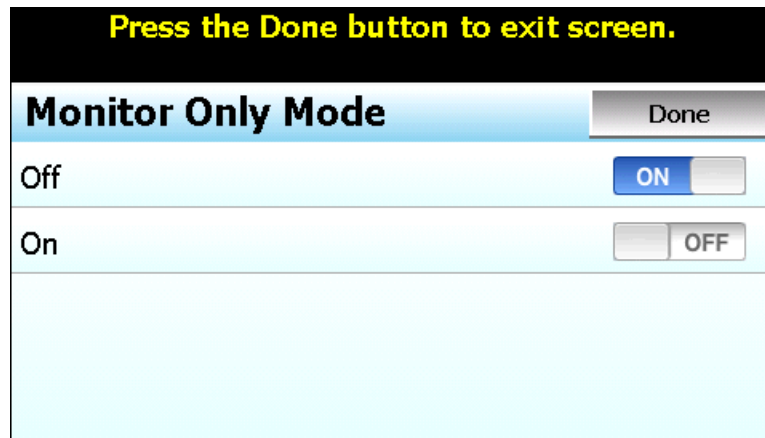
With the **Safety** mode selection, all loop control outputs will be set to their minimum output state (according to the value set in the output low limit setting) with event/alarm outputs turning off if there is a loss in communications with the MCT4 base unit that exceeds 60 seconds. Since the MCT4 base unit touch screen interface provides the means for control and monitoring of loop operation, this insures that any devices connected to the loop control outputs will be shut down/turned off until corrections can be made to restore normal operation.

It also prevents the loop control outputs from activating when power is first applied to the MCT4 until proper communication is established with the base unit. This prevents any devices connected to the loop control outputs from being activated until the runtime application has started which provides the user with access to the system through the touch screen interface.

**NOTE:** *The failure transfer setting will override the Safety communications mode in the event that there is also a control input failure. For example, if the output 1 low limit value is set to 10% and communications is lost with the MCT4 base unit, output 1 will operate at a fixed output value 10%. If the loop control input then fails and the failure transfer value is set to 20%, output 1 will then operate at a fixed 20% output. The loop output will return to normal (PID) control operation once communications are re-established with the MCT4 base unit and the control input is restored.*

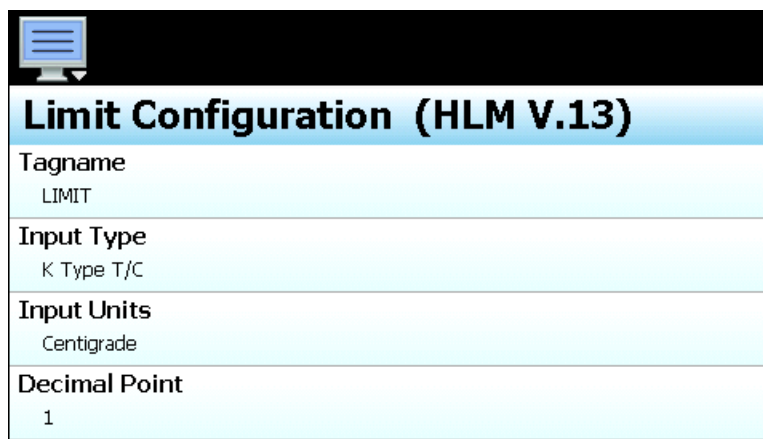
**4.2.35 Monitor Only Mode**

The Monitor Only Mode selection can be used to turn a control loop into a “monitor only” device, i.e., hide the loop set point and percentage of output in the MCT4 runtime and only display the input value. This provides an easy method for adding another input to the system for monitoring the value of a process, while also providing additional outputs that could be used as manual events (not in a program), sensor power supply, etc.



### 4.3 Limit Configuration

The Limit Configuration screen is accessed from the Setup menu. The screen provides access to all limit control settings.



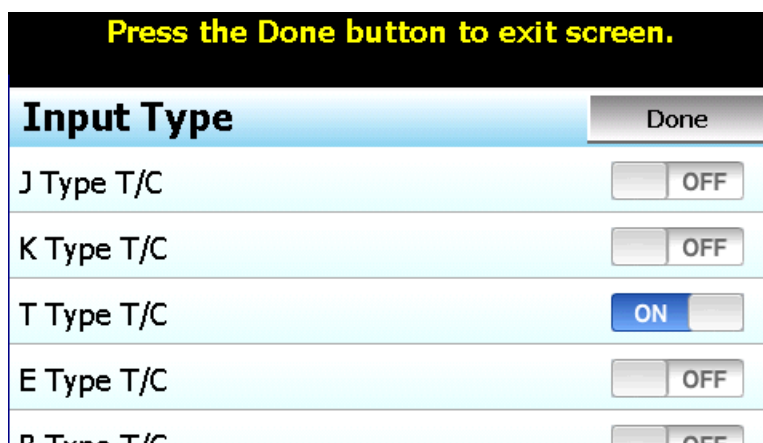
The model and version of the limit control attached will be shown in the scroll list header. To view all of the available settings, simply swipe up or down on the screen to scroll through the list items. To edit a value, tap the row for the desired item. If the entry is a simple numeric value, the number entry pad will be shown. If the item has multiple selections to choose from, a list of individual selections for the item will be shown. For a comprehensive list of all limit board settings, their ranges and factory default values see appendix section A.5.2 HLM Parameter Description.

#### 4.3.1 Tagname

The Tagname entry allows the user or OEM to assign a specific name for each control loop, up to 11 characters in length. This name will be used throughout the MCT4 runtime application. The default tag name is LIMIT.

#### 4.3.2 Input Type

The Input Type entry is used to select the type of sensor that will be connected to the limit control. The input type can be a temperature input (thermocouple or RTD) or a linear input type (VDC or mA).



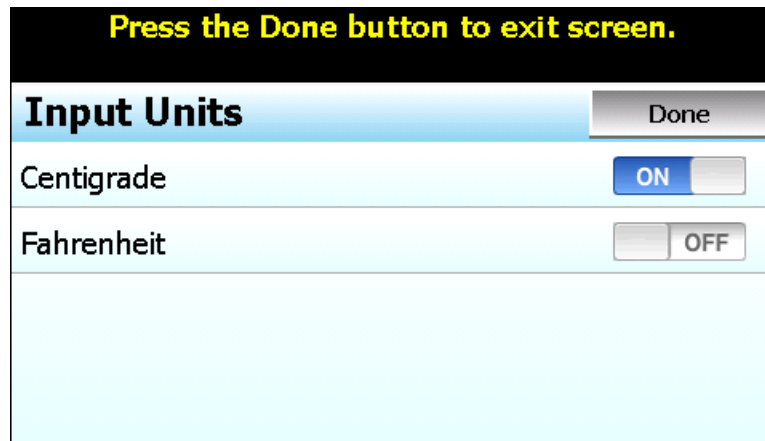
The input type selections are mutually exclusive, i.e., selecting one input will turn all other selections off. Once the desired input type has been selected, press the “Done” button to set the input type for the limit control and return to the main Limit Configuration screen.

**NOTE:** The HLM limit control is equipped with DIP switches on the component side of the board. The DIP switches must be set properly according to the input type selection made. See section 3.2.1.1 Sensor Input for details on sensor wiring and DIP switch settings according to selected sensor type.

Input type selections of 0-1V, 0-5V and 1-5V require special order HLM boards. Only the 0-10V input selection is compatible with standard HLM units. If a 0-1V, 0-5 or 1-5V input is required, it must be ordered accordingly. Linear inputs, current and voltage, are not FM approved.

### 4.3.3 Input Units

The Input Units entry is used to select the temperature units for temperature input types (thermocouple or RTD). If the selected input type for the limit is a linear input (VDC or mA), the Input Units entry will display the text entry keypad allowing the user or OEM to enter specific engineering units up to 4 characters.



The input unit selections for temperature are mutually exclusive, i.e., selecting one will turn off the other. Once the desired temperature units have been selected, press the “Done” button to set the input units for the limit control and return to the main Limit Configuration screen.

### 4.3.4 Decimal Point

The Decimal Point entry allows the input precision to be adjusted between 0 and 1 decimal digits for temperature input types and between 0 and 3 for a 0-60mV input and VDC and mA input types.

**IMPORTANT:** Once the limit control has been configured with a specific decimal point, changing the decimal point will require the limit control to be reconfigured in order to maintain previous control settings. Alarm set points, input low/high scale, etc., DO NOT automatically scale. An entry of 100.0 becomes 1000 when changing the decimal point to zero (not 100) and must be re-entered to set the proper value.



### 4.3.5 Input Low/High Scale

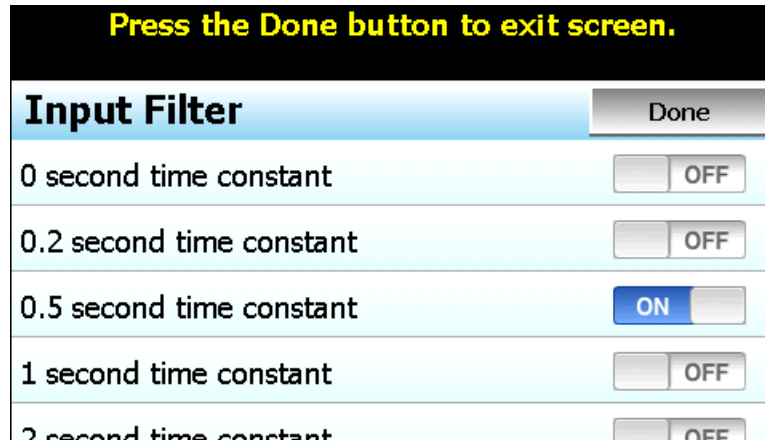
The Input Low Scale and Input High Scale entries are used to set the input range for linear input types (VDC or mA). The entries are not available for temperature input types since they utilize a fixed range based on the sensor type. The input low scale value can be set from -19999 up to the high scale value. The high scale value can be set from the low scale value up to 45536.

**NOTE:** The minimum and maximum scale values are limited by the decimal point selection. For a decimal of 0, the values are -19999 and 45536 respectively. For one decimal point, the values are -1999.9 and 4553.6. For two decimal digits, the values are -199.99 and 455.36 and for three decimal digits the values are -19.999 and 45.536.



#### 4.3.6 Input Filter

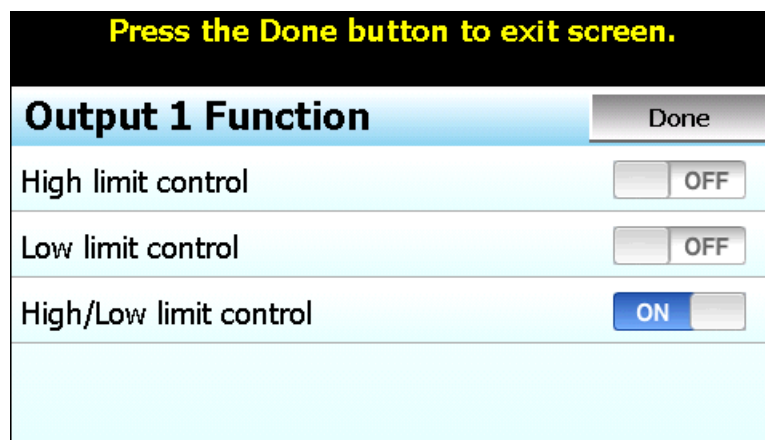
The Input Filter entry is used to select the time constant used for filtering the process input.



The time constant selections are mutually exclusive, i.e., selecting one will turn off the others. Once the desired filter constant has been selected, press the “Done” button to set the input filter for the limit control and return to the main Limit Configuration screen.

#### 4.3.7 Output 1 Function

The Output 1 Function is used to set the mode of operation of the limit control output. The output can be set for high limit control, low limit control or high/low limit control. The output selections are mutually exclusive, i.e., selecting one will turn off the others. Once the desired function has been selected, press the “Done” button to set the limit output function and return to the main Limit Configuration screen.



The **High limit control** function will turn off the output when the process value exceeds the high limit set point. Once the process value is below the high limit set point and the alarm is reset, the output will turn on.

The **Low limit control** function will turn off the output when the process value exceeds the low limit set point. Once the process value is above the low limit set point and the alarm is reset, the output will turn on.

The **High/Low limit control** function will turn off the output when the process value exceeds the high or low limit set point. Once the process value is within the high and low set point and the alarm is reset, the output will turn on.

**NOTE:** *If a sensor break occurs, the PV value is driven to a value above the maximum of the selected input type. Therefore, the limit will not go into alarm if configured for “Low limit control”. If this circumstance creates a safety issue, it is recommended that the output be configured as a “High/Low limit control”.*

#### **4.3.8 Output 1 Hysteresis**

The output 1 hysteresis is used to create a safe-sided dead band around the high/low limit set point to prevent the alarm from being reset and then immediately reactivating if the process is hovering around the alarm set point. In order to reset the high or low limit alarm, the process value must fall below the high limit set point or rise above the low limit set point by the hysteresis value.

#### **4.3.9 Lower/Upper Limit of High Setpoint**

The lower and upper limits of high set point are used to set the minimum and maximum allowed value that can be entered for the high limit alarm set point. These entry fields are active when the output 1 function of the limit control is set to high limit control or high/low limit control. These values are typically set by the OEM to ensure that the user can not adjust the high limit set point beyond the maximum safe operating limits of the process.

#### **4.3.10 Lower/Upper Limit of Low Setpoint**

The lower and upper limits of low set point are used to set the minimum and maximum allowed value that can be entered for the low limit alarm set point. These entry fields are active when the output 1 function of the limit control is set to low limit control or high/low limit control. These values are typically set by the OEM to ensure that the user can not adjust the low limit set point beyond the maximum safe operating limits of the process.

#### **4.3.11 High/Low Limit Setpoint**

The high and low limit set points are the alarm points at which output 1 of the limit control will open when the process value exceeds the entry. The high set point entry is available when the output 1 function of the limit control is set to high limit control or high/low limit control and the low set point entry is available when the output 1 function of the limit control is set to low limit control or high/low limit control. The set points are also available on the Alarm screen in the MCT4 runtime application.

#### **4.3.12 Output 2 Function**

The Output 2 Function is used to set the mode of operation for the secondary control output of the limit control. The output selections are mutually exclusive, i.e., selecting one will turn off the others. Once the desired function has been selected, press the “Done” button to set the output function for the limit control and return to the main Limit Configuration screen.

**NOTE:** *The output function must be set to match the type of output ordered on the limit control.*

**Press the Done button to exit screen.**

<b>Output 2 Function</b>	Done
None	<input type="checkbox"/> OFF
DC power supply output	<input type="checkbox"/> OFF
Alarm output	<input checked="" type="checkbox"/> ON
Limit annunciator	<input type="checkbox"/> OFF

The **DC power supply output** function must be selected when the output type ordered for the limit control is a transmitter power supply.

The **Alarm output** function activates the alarm configuration settings for assigning the type of alarm logic to apply to output 2. When the alarm condition is active, the output will turn on.

The **Limit annunciator** function uses output 2 as a means for activating an external audible alarm. When the limit output deactivates due to the process value exceeding the high or low limit set point, output 2 will also activate. The output will remain activate until the reset button is pressed on the Alarm screen in the runtime application or the remote reset is activated.

#### 4.3.13 Alarm Function

The Alarm Function is used to select the alarm type for output 2 if the output function is configured as an alarm output. The alarm selections are mutually exclusive, i.e., selecting one will turn off the other. Once the desired alarm type has been selected, press the “Done” button to set the alarm function for the limit control output and return to the main Limit Configuration screen.

**Press the Done button to exit screen.**

<b>Alarm Function</b>	Done
Process value high alarm	<input checked="" type="checkbox"/> ON
Process value low alarm	<input type="checkbox"/> OFF

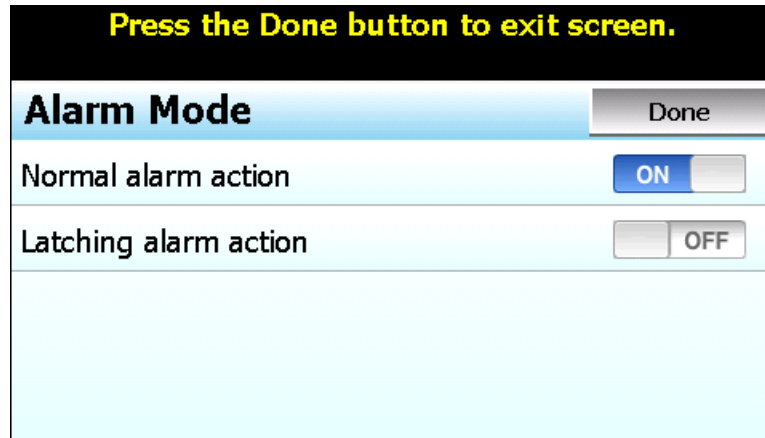
**NOTE:** For the following alarm descriptions, PV = process value, ASP is the alarm set point and AHY is the alarm hysteresis.

When **Process value high alarm** is selected and the process value is higher than the alarm set point ( $PV > ASP$ ), a process high alarm occurs. When the process value is lower than the alarm set point minus the alarm hysteresis ( $PV < ASP - AHY$ ), the alarm is off.

When **Process value low alarm** is selected and the process value is lower than the alarm set point ( $PV < ASP$ ), a process low alarm occurs. When the process value is above the alarm set point plus the alarm hysteresis ( $PV > ASP + AHY$ ), the alarm is off.

#### 4.3.14 Alarm Mode

The Alarm Mode is used to select the mode of operation for output 2 if the output function is configured as an alarm output. The mode selections are mutually exclusive, i.e., selecting one will turn off the other. Once the desired alarm mode has been selected, press the “Done” button to set the alarm operation for the limit control output and return to the main Limit Configuration screen.



**Normal alarm action** has the alarm output off in the non-alarm condition and on in the alarm condition.

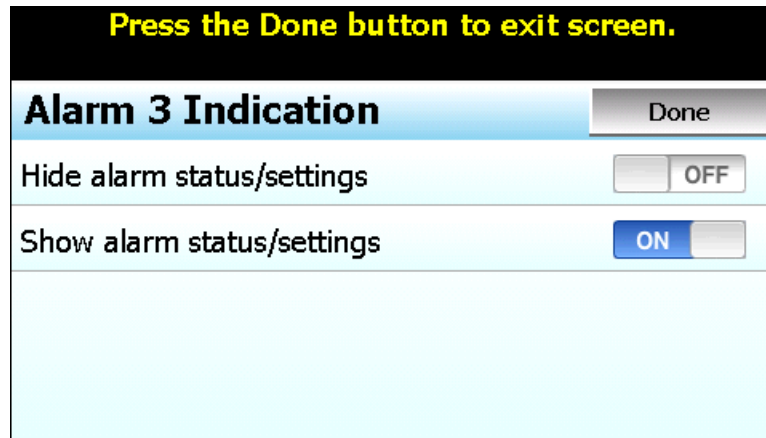
**Latching alarm action** will keep the alarm output on even if the alarm condition has cleared until the alarm is reset by the user.

#### 4.3.15 Alarm Indication

The Alarm Indication entry is used to select whether the alarm will be shown in the MCT4 runtime application or be hidden from the user. This allows the OEM to configure the alarm to perform a specific control function while preventing the user from adjusting the set point or seeing the activation state of the alarm.

The indication selections are mutually exclusive, i.e., selecting one will turn off the other. Once the desired alarm indication has been selected, press the “Done” button to set the alarm operation and return to the main Limit Configuration screen.

**NOTE:** *If the alarm is hidden but its mode is set for latching, the user will not have any indication that the alarm requires manual reset. When an alarm is hidden, it is recommended that the normal or hold mode be used so that the alarm output automatically resets when the alarm condition is no longer present.*



When the alarm indication is set for **Hide alarm status/settings**, the alarm will be removed from the MCT4 runtime application. The user will not be able to edit the alarm message or adjust the alarm set point. When the alarm activates, there will be no indication or message on the alarm screen and the audible alarm will not sound. The alarm operates as a “silent” alarm with no indication to the user.

When the alarm indication is set for **Show alarm status/settings**, the user will be able to access and change the alarm set point and alarm message under the device settings. When the alarm occurs, the alarm message will be displayed on the Alarm screen and the audible alarm will sound.

#### 4.3.16 Alarm Setpoint

The alarm set point can be set when output 2 is configured as an alarm output. If the alarm indication is set to “show” the alarm status and settings, the set point will also be available in the MCT4 runtime application. If the alarm indication is set for “hide” alarm status and settings, the alarm set point will not be available in the MCT4 runtime application and can only be changed in the Configurator.

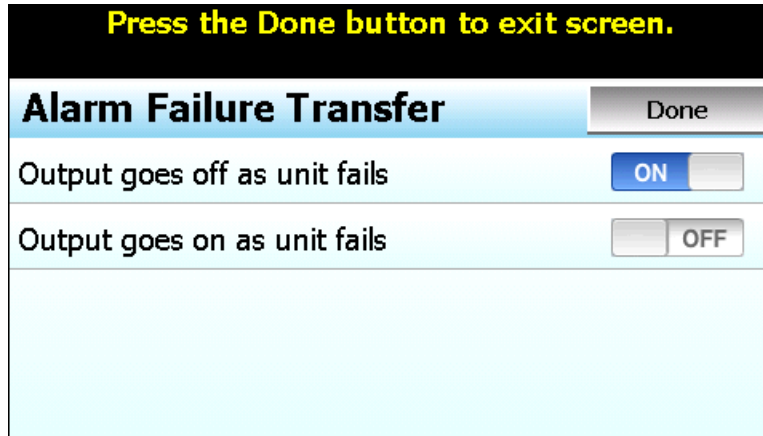
#### 4.3.17 Alarm Hysteresis

The alarm hysteresis can be set when output 2 is configured as an alarm output. It is used to eliminate rapid on/off cycling of the alarm output by applying a safe-sided dead band to the alarm. When the alarm set point is exceeded, the alarm will activate. The alarm will not deactivate until the process rises above (for low alarm) or falls below (for high alarm) the alarm set point by the hysteresis value.

The hysteresis can be set from a minimum of 0.1 to a maximum of 10.0 for units of degrees Centigrade and to a maximum of 18.0 for units of degrees Fahrenheit and linear input types.

#### 4.3.18 Alarm Failure Transfer

The Alarm Failure Transfer is used to set the state of output 2 if there is an input failure, i.e., sensor break. The selections are mutually exclusive, i.e., selecting one will turn off the other. Once the desired alarm failure transfer selection has been made, press the “Done” button to return to the main Limit Configuration screen.

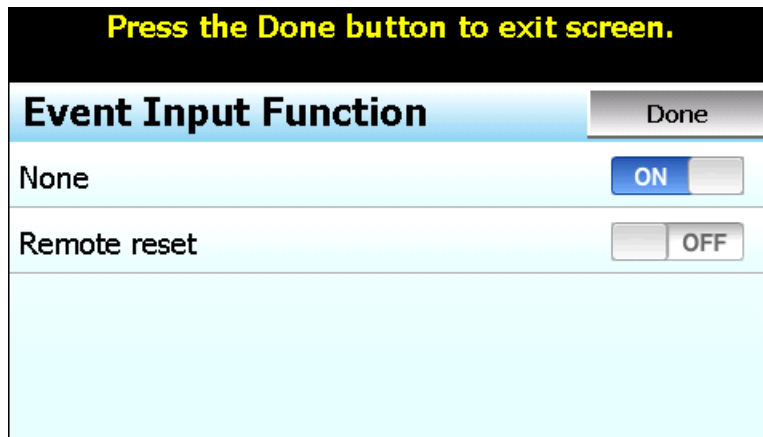


The **Output goes off as unit fails** selection will force the output off during failure regardless of the alarm activation status.

The **Output goes on as unit fails** selection will force the output on during failure regardless of the alarm activation status.

#### 4.3.19 Event Input Function

The Event Input Function is used to select the desired mode of operation for the digital input of the limit control board. The event input selections are mutually exclusive, i.e., selecting one will turn off the others. Once the desired function has been selected, press the “Done” button to set the event input function for the limit control and return to the main Limit Configuration screen.



When **Remote reset** is selected for the event input function, the event input will perform an alarm reset each time the input terminals go from open to closed.

#### 4.3.20 Display Format

The Display Format entry is used to select the normal display mode for the limit control in a non-limit condition. The display format selections are mutually exclusive, i.e., selecting one will turn off the others. Once the desired display format has been chosen, press the “Done” button to return to the main Limit Configuration screen.

**Press the Done button to exit screen.**

<b>Display Format</b>	<input type="button" value="Done"/>
Display SAFE	<input checked="" type="checkbox"/> ON <input type="checkbox"/>
Display high limit set point	<input type="checkbox"/> OFF <input type="checkbox"/>
Display low limit set point	<input type="checkbox"/> OFF <input type="checkbox"/>

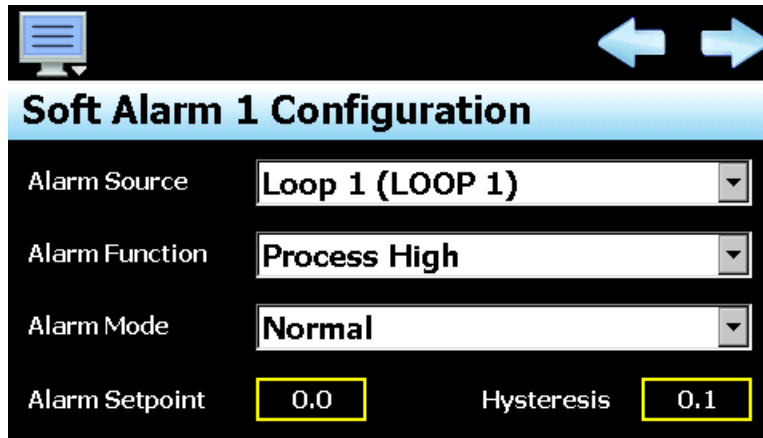
When **Display SAFE** is selected, the Loop View and All View screens in the runtime application will display the word "SAFE" when the limit alarm is not active. When a limit alarm is activated, the word "SAFE" will be replaced with either the high limit set point (if the high limit alarm is tripped) or the low limit set point (if the low limit alarm is tripped).

When **Display high limit set point** is selected, the Loop View and All View screens in the runtime application will display the high limit set point regardless of the limit alarm condition.

When **Display low limit set point** is selected, the Loop View and All View screens in the runtime application will display the low limit set point regardless of the limit alarm condition.

#### 4.4 Soft Alarm Configuration

The Soft Alarm Configuration screen is accessed from the Setup menu. The screen allows the user or OEM to program each soft alarm up to the total number entered on the Control Setup screen. When more than when soft alarm is programmed, the left/right scroll buttons will be provided at the top right of the screen in order to view/edit settings for each alarm.



The **Alarm Source** drop down menu selection lists all loops and monitor (if installed) to be chosen for the process value to be monitored by the alarm.

The **Alarm Function** drop down menu selection is used to choose the type of alarm. Alarm choices include process high, process low, deviation high, deviation low, deviation band and end of program. The deviation alarms can only be chosen for control loops. For the limit control and loops programmed for monitor only, there is no set point to associate with the alarm. For the end of program alarm, the alarm source is defaulted to loop 1, the alarm mode to normal and the alarm setpoint and hysteresis are disabled.

**NOTE:** For the following alarm descriptions, PV = process value, SV = the control set point value, ASP is the alarm set point and AHY is the alarm hysteresis.

**Process High** The alarm is independent of set point. When the process value is higher than the alarm set point ( $PV > ASP$ ), a process high alarm occurs. When the process value is lower than the alarm set point minus the alarm hysteresis ( $PV < ASP - AHY$ ), the alarm is off.

**Process Low** The alarm is independent of set point. When the process value is lower than the alarm set point ( $PV < ASP$ ), a process low alarm occurs. When the process value is above the alarm set point plus the alarm hysteresis ( $PV > ASP + AHY$ ), the alarm is off.

**Deviation High** The alarm is dependent upon the control set point and alerts the operator when the process value deviates too high over the set point value. For deviation high alarms, the alarm set point is entered as a positive value. When the process is higher than the control set point plus the alarm set point ( $PV > SV + ASP$ ), a deviation high alarm occurs. When the process value falls below the control set point plus alarm set point minus the alarm hysteresis ( $PV < SV + ASP - AHY$ ), the alarm is off.

**Deviation Low** The alarm is dependent upon the control set point and alerts the operator when the process deviates too far below the set point value. For deviation low alarms, the alarm set point is entered as a negative value. When the process is lower than the control set point plus the alarm set point ( $PV < SV + ASP$ ), a deviation low alarm occurs. When the process value rises above the control set point plus alarm set point plus the alarm hysteresis ( $PV < SV + ASP + AHY$ ), the alarm is off.



<i>Deviation Band</i>	The alarm sets two trigger levels relative to the control set point value. For deviation band alarms, the alarm set point is entered as a positive value. The two alarm trigger levels are then defined as SV+ASP and SV-ASP for the high and low alarm values. When the process value is greater than the high alarm value ( $PV > SV+ASP$ ) or less than the low alarm value ( $PV < SV-ASP$ ), a deviation band alarm occurs. When the process value is within the high and low trigger levels by the value of the alarm hysteresis ( $PV < SV+ASP-AHY$ and $PV > SV-ASP+AHY$ ), the deviation band alarm is off.
<i>End of Program</i>	The alarm is not associated with the process value or set point. The alarm is turned on upon completion of an automatic ramp/soak program. Once the alarm has occurred it must be manually cleared from the Alarm screen of the runtime application.

The **Alarm Mode** drop down menu selection is used to choose the mode of operation for the alarm. The selections include normal and hold.

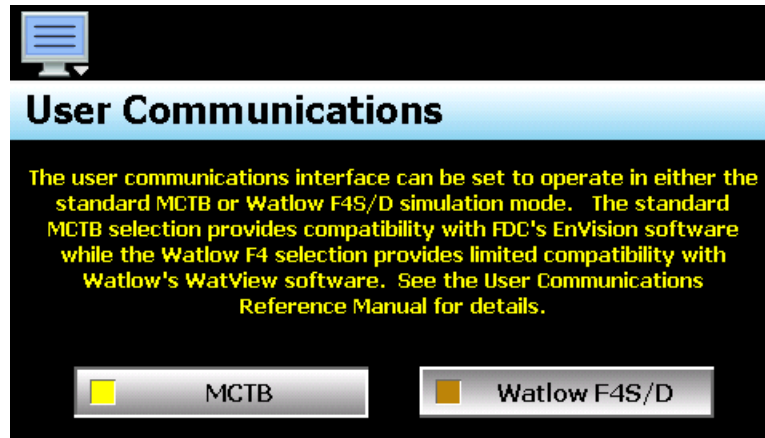
<i>Normal</i>	The alarm will be activated when the alarm set point has been exceeded. The alarm can be cleared from the Alarm screen in the runtime application once the alarm condition is no longer met.
<i>Hold</i>	Prevents the alarm from activating on power up even when an alarm condition is present. The alarm will be blocked until the alarm condition clears. Once cleared, the alarm will then operate normally and activate when an alarm condition occurs.

The **Alarm Setpoint** can be set when the alarm function is set for a process or deviation type of alarm. The alarm set point will also be available in the MCT4 runtime application.

The **Alarm Hysteresis** can be set when the alarm function is set for a process or deviation type of alarm. It is used to eliminate rapid on/off cycling of the alarm output by applying a safe-sided dead band to the alarm. When the alarm set point is exceeded, the alarm will activate. The alarm will not deactivate until the process rises above (for low alarm) or falls below (for high alarm) the alarm set point by the hysteresis value.

## 4.5 User Communications

The Modbus slave interface of the MCT4 can be set to operate in one of two modes. The default setting is to provide the standard MCT4 user interface for use with FDC's EnVision software. This selection assigns values to the Modbus slave register table in the proper positions to allow communications between EnVision and the MCT4.



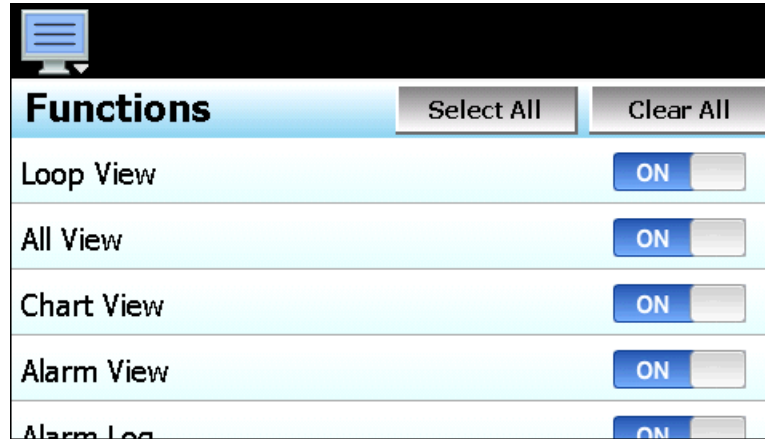
The second selection configures the Modbus slave interface to simulate the communications interface for a “Watlow F4S/D” controller. This selection assigns MCT4 control values to the corresponding register addresses of a Watlow F4S/D controller allowing limited compatibility with Watlow’s WatView software. This provides current users of the F4 controller and WatView software a control option for the replacement for aging F4 controllers while keeping the common software interface without the need for training on the use of different software.

**IMPORTANT:** *The Watlow F4S/D interface is limited to basic set point adjustment, event output control, profile operation and single profile download using WatView’s profile editor. Attempting unsupported functions may cause errors in the operation of WatView software and require it to be restarted.*

*See Appendix section A.1.3 MCT4 Simulated F4S/D Interface Option for details on the use of the Modbus slave interface including communications settings, register addresses and their associated values as well as the functionality of the selected interface type.*

## 4.6 Functions

The MCT4 functions are accessed from the Startup menu and allow the user or OEM to select which screens/menu items will be enabled (shown) in the MCT4 runtime application. These functions can be used to customize the system to meet specific requirements.



When functions are disabled at the Configurator level from the functions list, it will be disabled in the runtime software by removing the menu item or disabling the field so the operator cannot select the function or edit any corresponding settings related to the function. The following list provides the available MCT4 functions, where to find the menu item(s) applicable to the function and a description of what it applies to.

**IMPORTANT:** *Disabling MCT4 functions that are not required for the application results in a system that is clean and easy to use for the operator; however, be careful when disabling certain items. Without access to them, there may be no way to determine if the system is operating as required.*

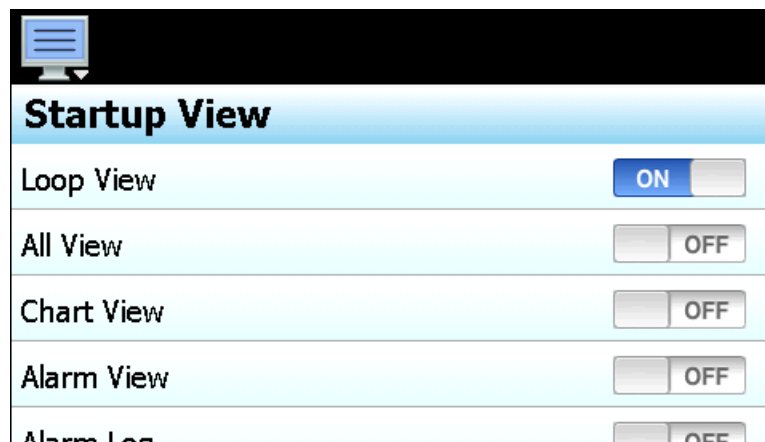
MCT4 Function	Runtime Menu Location	Description
Loop View	View\Loop	View loop PV, %Out, set loop set point and set fixed percentage of output  <b>NOTE:</b> Without access to the loop view screen, the user will be unable to set a fixed percentage of output for the loop. If access to All View is also removed, user will be unable to turn manual event outputs on and off.
All View	View\Overview	view loop PV, %Out, set loop set point  <b>NOTE:</b> If access to the Loop View is also removed, the user will be unable to monitor or adjust loop operation.
Chart View	View\Chart	view and set up real time trends for loops and monitors
Alarm View	View\Alarm Notifications	view and reset current alarms  current alarm status  <b>NOTE:</b> With the function disabled, the user will only be able to access the alarm screen to reset an alarm when the alarm occurs by pressing the flashing alarm icon.  If the alarm is latching and does not reset, the user will be unable to return to the screen to try and clear the alarm unless another alarm occurs to again display the flashing alarm icon.

MCT4 Function	Runtime Menu Location	Description
Alarm Log	View\Alarm File	view and email alarm history files
Security Settings	Security Notifications	view/set security rights, view audit trails, user log on view security and audit status  <b>NOTE:</b> If security is enabled, but system security is then disabled through this item, the user will be unable to log on. Default security (operator level) access will be used. This allows audit trails to be active while hiding all user security features.  With security menu disabled, audit trail files are accessible via Log/USB File Utilities or temporarily re-enable security menu to gain access to the audit files.
Automatic Program Control/Recovery	Program Device\Settings\Offline\Set\Recovery Notifications	view, create, edit and run automatic ramp/soak programs  set power recovery mode  view program status  <b>NOTE:</b> When disabled, all program items and menus will be removed from the runtime application. The user will be unable to access or start programs via the interface.
Data Logging	Data\Data Notifications	enable/disable data logging, select points for logging, access to historical viewer, FTP and USB File utilities  view data log status, length and interval  <b>NOTE:</b> If data logging is set to log on program operation or when the MCT4 starts and this menu is then disabled, data logging will be disabled. This menu item must remain visible in order for the built-in data logging of the MCT4 to function.  The USB File utilities will not be accessible to copy or delete data, alarm, audit or program files.
Data Log Viewer	Data\Chart	access to view historical data log files
Annotations	Data\View\Annotation	access to add and view operator annotations to data files
Digital Signatures	Data\View\Signature	access to view and add digital signature to data log file
File Utilities	Data\Utilities\USB	access to copy/delete alarm, audit, program and data log files  <b>Note:</b> Alarm, audit and data files may be transferred via FTP if unit is so configured.
FTP/WAN Settings	Data\Utilities\FTP\WAN	access to view/configure FTP file transfer settings  <b>NOTE:</b> Once the FTP is configured for Auto Backup in the runtime application, this menu item can be disabled and hidden from the operator so that OEM configuration is preserved and cannot be accessed or altered. The Auto Backup to the FTP Server would occur as configured.
Loop Manual Mode	View\Loop	access to placing the loop in manual and setting a fixed percentage of output
Loop PID Tuning	Device\Settings\View\Tuning	access loop tuning screen  <b>NOTE:</b> With loop PID tuning disabled, the user will also lose the ability to place the loop in auto tune.
Loop Cascade Settings	Device\Settings\Set\Cascade	access cascade settings screen

MCT4 Function	Runtime Menu Location	Description
Alarm Settings	Device\Settings\Set\Alarm	access alarm settings  <b>NOTE:</b> Alarms can be fully programmed in the Configurator and hidden in the runtime by disabling this function. The alarms will operate as programmed in the background removing all access by the operator.
Email/SMTP Settings	Device\Settings\Email\Email	access to view/configure email settings
Communication Settings	Device\Settings\Set\Comms Notifications	access to web server, Modbus and VNC settings view web server and VNC status
Edit Event Names	Device\Settings\Set \Event	access to view/edit system event names  <b>NOTE:</b> Event names can be assigned in the runtime and then this item disabled to prevent changes to event names.
Temperature Units	Device\Settings\Offline\Set\Units	access to set temperature units
Input Calibration	Device\Settings\Offline\Calibrate\Inputs	access to input calibration for all loops and limit control if installed
Import/Export Setup	Device\Settings\Offline\System\ Configuration	access import/export utility to back up current Orion-M configuration or restore configuration from back-up file
Setpoint Limits	Device\Settings\Set\Limit	access loop set point high and low entry limits
Language	Device\Settings\Offline\Set\Language	access to set the MCT4 display language selection for menus and online help
Exit Application	Device\Settings\Offline\System\Exit	access to the exit application screen
Loop view Manual Operation	View\Loop – Manual Operation button	access for turning manual events on and off
Loop View Program Operation	View\Loop – Program Operation button	access to program selection and run/hold control

## 4.7 Startup View

The Startup View screen is accessed from the Startup menu and allows the user or OEM to define which of the main view screens the runtime application will display when it first starts and when the “Home” icon is pressed.

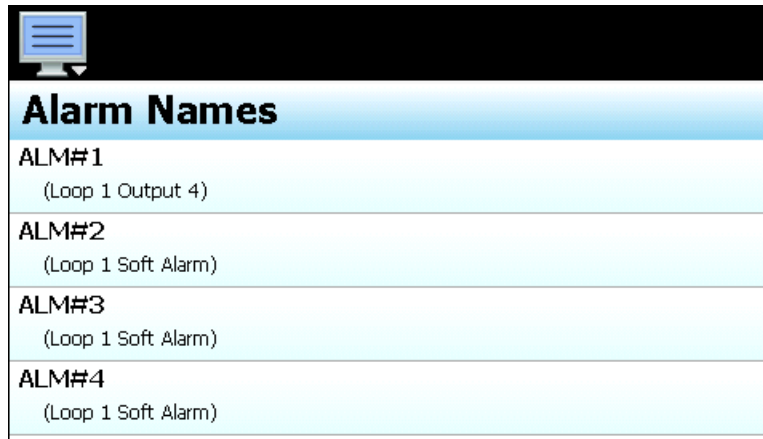


The available selections are Loop View, All View, Chart View, Alarm View and Alarm Log.

**NOTE:** If the selected screen to view on startup is disabled in the MCT4 functions list, the screen will only be available when the “Home” icon is pressed.

### 4.8 Alarm Names

The Alarm Names screen is accessed from the Tagnames menu and allows the user or OEM to edit the name (alarm message) of all configured alarms. In order to access the screen, there must be at least one loop control output configured as an alarm, one soft alarm programmed or the limit control installed.



The alarms will be listed in sequential order starting with any outputs programmed as an alarm on loop 1 through loop 3 and/or the limit, and then soft alarms. The default alarm names are ALM#1, 2, 3, etc. To assist in identifying which device/output the alarm is assigned to, the list includes the alarm source. The alarm names will be displayed in the runtime application as the alarm description on the Alarm screen. To change the name of an alarm, select the alarm from the list and enter the desired text up to 25 characters.

### 4.9 Event Names

The Event Names screen accessed from the Tagnames menu and allows the user or OEM to edit the names of all configured event outputs. In order to access the screen, there must be at least one loop control output configured as an event.



The events will be listed in sequential order starting with any outputs programmed as an event on loop 1 through loop 3. The default event names are EV1, 2, 3, etc. To assist in identifying which device/output the event is assigned to, the list includes the event source. The event names will be displayed in the runtime application

on the Manual Operation slide out, All View and program Entry screens. To change the name of an event, select the event from the list and enter the desired text up to 9 characters.

### 4.10 Custom Name\Address

The Custom Name\Address screen is accessed from the Tagnames menu and is typically used by the OEM to configure the main splash screen when the MCT4 runtime application starts. It allows the company name and contact information to be entered and shown each time the MCT4 controller is powered up. It also allows the name of the controller to be changed in order to adapt it to a specific product or market.

**Custom Name\Address**

Company: FUTURE DESIGN CONTROLS

Address: BRIDGEVIEW, IL

Phone: 888-751-5444

Prod Name: MCTB

Enter startup screen and about information.

To edit the company, address, phone number or controller (product) name, press the field and enter the desired text. Each field can be entered with a maximum of 24 characters that will be displayed on the splash screen when the MCT4 starts.

## 5 Basic Operation

This section is designed to help guide the user through the MCT4 touch screen interface and menu structure in order to navigate through the various operation, monitor and setup screens and gain an understanding of how to use them. Subsequent sections of this manual are tailored to the special features and functions of MCT4. Consult those sections of the manual for further information and specifics on how to set up and operate them.

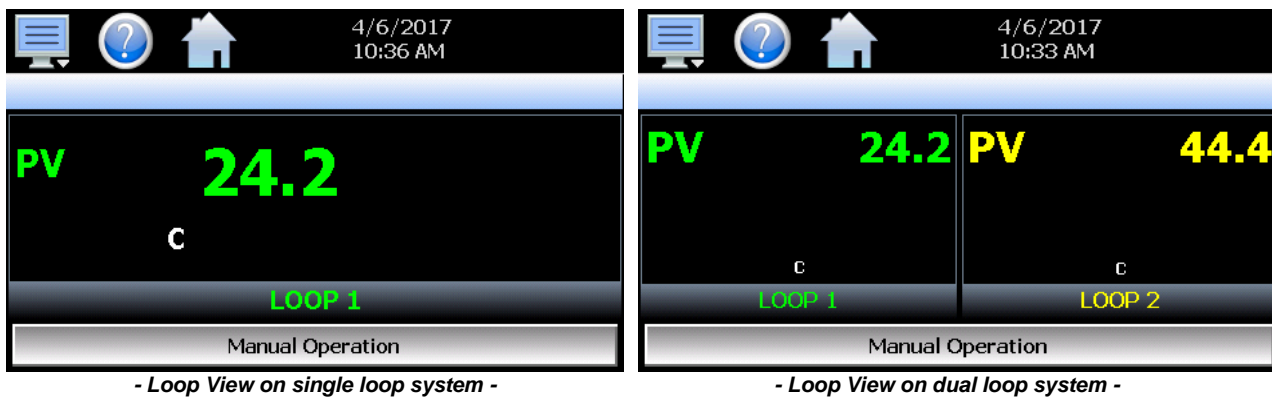
### 5.1 OEM Configuration Options

The availability of certain menu items, screens and the functionality of MCT4 are determined by the configuration of the loop control(s). This manual covers all available options, some of which may not be available on your system.

***If there are questions or concerns about the operation and available options on your MCT4 controller, contact your OEM for further information. Only your OEM can address equipment related issues.***

#### 5.1.1 Loop Control Monitor Only Mode

The loop control monitor only selection in the Configurator provides an OEM with a low-cost video recorder option to use in place of a standard circle/strip/paperless recorder. When the loop monitor only function is enabled in the Configurator for a loop, the MCT4 automatically configures itself to remove all set point fields, automatic ramp/soak program control options, loop tuning and set point limit access so that only the loop process value (PV) is available for the monitor only loop.



Unlike your basic chart recorder; however, the loop controls are still functional. They can be used to control a process if there is the need for fixed, single set point control. A loop can be programmed with a fixed set point by the OEM, and it will then control the process in the background without the need for any user access.

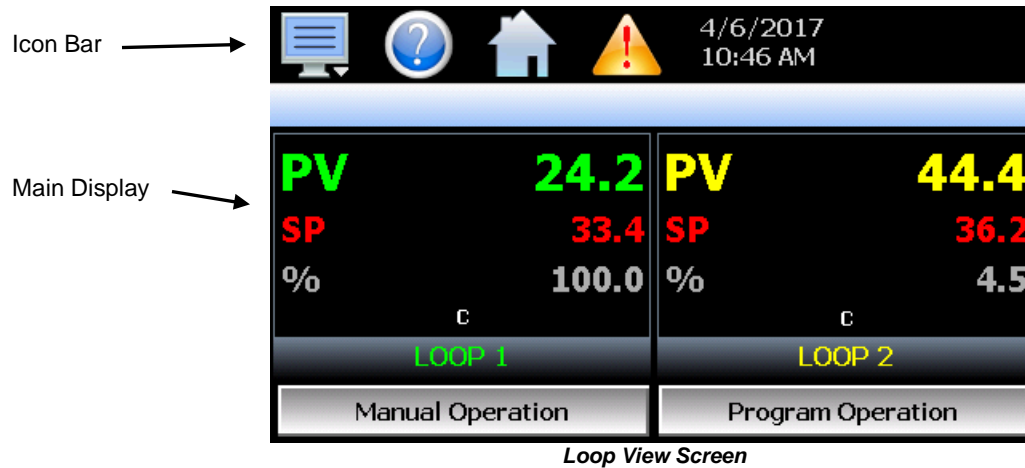
The OEM can also provide events for the user to turn equipment on or off, and alarms can be configured to alert the user to process changes.

If one control loop is required while another point is for recording only, enabling the monitor only mode on loop 2 in the Configurator will remove the set point fields, profiling operation for loop, loop tuning and set point limit access for loop 2 only. Loop 1 will maintain all control functions including the automatic ramp/soak program operation, while loop 2 will be shown as a monitor only point for recording purposes.



## 5.2 Touch Screen Interface

The MCT4 display is split into two sections; the icon bar and main display area.



The menu icon will open the main menu for navigating to the different control and monitoring screens. Menu items will dynamically appear providing available options based on the system area the user is in, i.e., security, data logging, setup, etc.



The information (help) icon will display text-based help associated with the current screen. Help is available in 10 languages based on the user selection in the offline setup of section of MCT4.



The home icon will return the user to the main view from anywhere in the MCT4 application. The main view is set by the OEM in the MCT4 configuration and can be the single or dual loop, chart, alarm, alarm history, event or digital IO view.



The alarm icon will appear and flash when a new system alarm occurs. Pressing the alarm icon will take the user directly to the alarm monitor screen in order to view and /or reset the active alarm condition.



The left and right navigation arrows will appear on screens that provide additional information that the user can scroll to such as the loop view screens, charts or program entry screen in order to cycle through each step of a ramp/soak program.

**NOTE:**

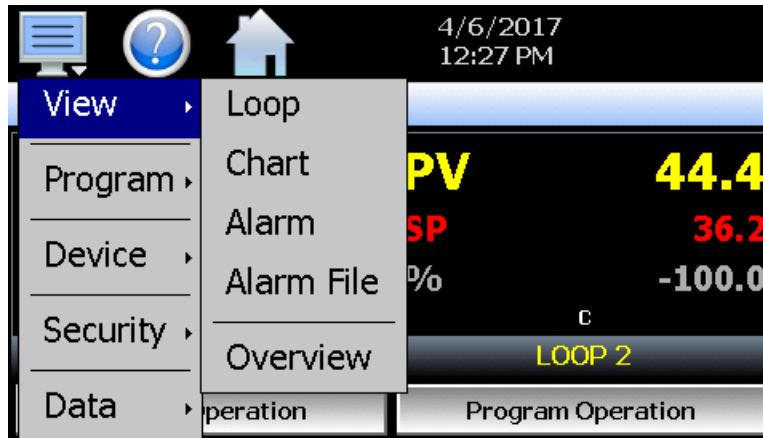
*A single press of the left or right arrows will scroll program steps to the next step or screens to the next available screen option (i.e. chart number). Pressing and holding the arrow keys will continue the item scrolling until the last step of the program is reached or the button is released.*

**IMPORTANT:**

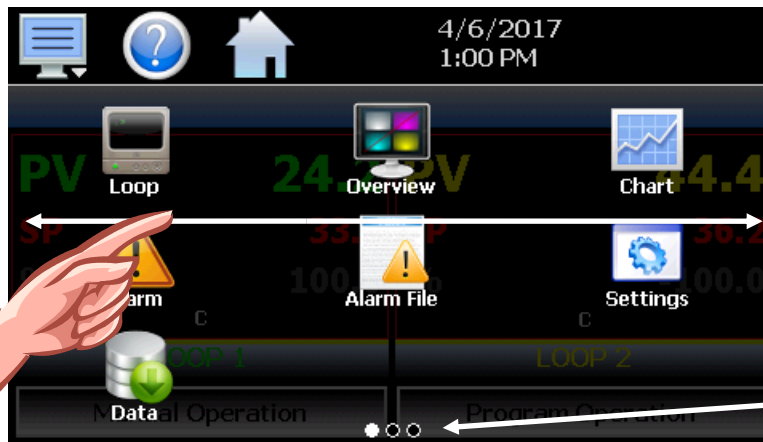
*Do not use any sharp or metal objects on the touch screen as they may damage the surface. Also, be sure that hands and fingers are free from oils or chemicals which may mar the surface of the touch screen.*

### 5.3 Menu Navigation

The MCT4 provides the user with the ability to select text-based menu navigation, much like the typical file menu system of a PC, as well as an icon-based navigation system like that of a “smart” device. The user can switch back and forth between the two from the Setup menu.



*Text Based Navigation*



Touch and drag finger across screen to switch between menu pages.

Active Page Indicator (1 of 3)

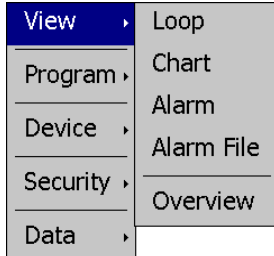
*Icon Based/Slide Page Navigation*

The available menu items are dependent upon the OEM configuration of MCT4. Not all of the menu items shown may be available on your system. The following information is provided as an overview of the full navigational menus for the MCT4.

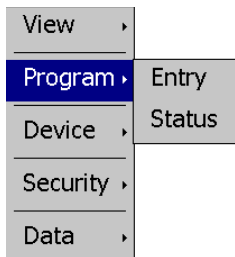
**5.3.1 Home Menu**

The home menu is the top level, default menu provided when MCT4 first powers on. Pressing the menu (monitor) icon will display the main menu offering the selections shown below.

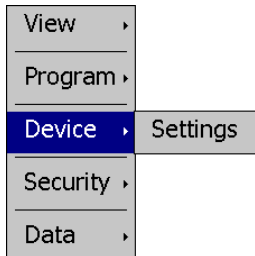
**5.3.1.1 Text Based Home Menu**



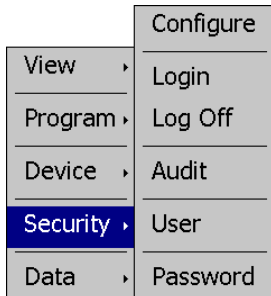
The **View** menu provides navigation to all standard view screens. These include the Loop view, real time Chart, Alarm monitor, Alarm File and Overview control screens.



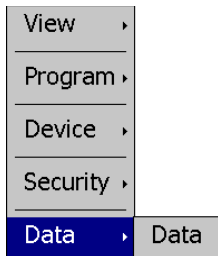
The **Program** menu provides access to the automatic ramp/soak program actions, Entry and Status views.



The **Device** menu provides access to the MCT4 controller settings. These include, loop set point entry limits, alarm set points, communication settings, email setup as well as access to offline settings for date/time, etc.

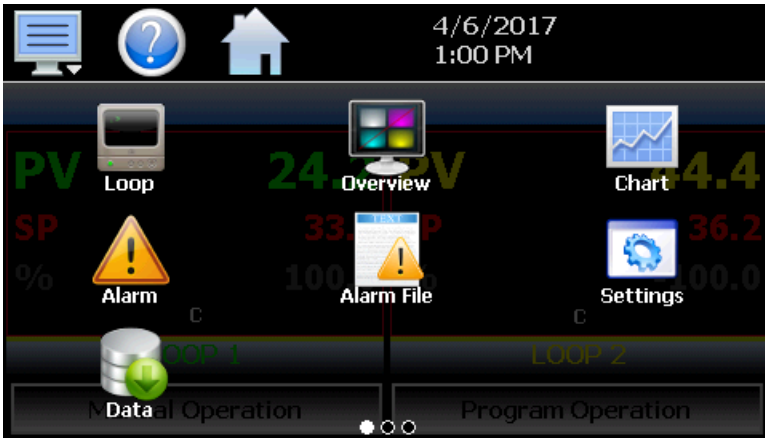


The **Security** menu provides access for user login, security settings and audit trail viewing if the security system is enabled.



The **Data** menu provides access to data log functions, file utilities, FTP\WAN back-up settings as well as the historical data viewer.

5.3.1.2 Icon/Slide Page Based Home Menu

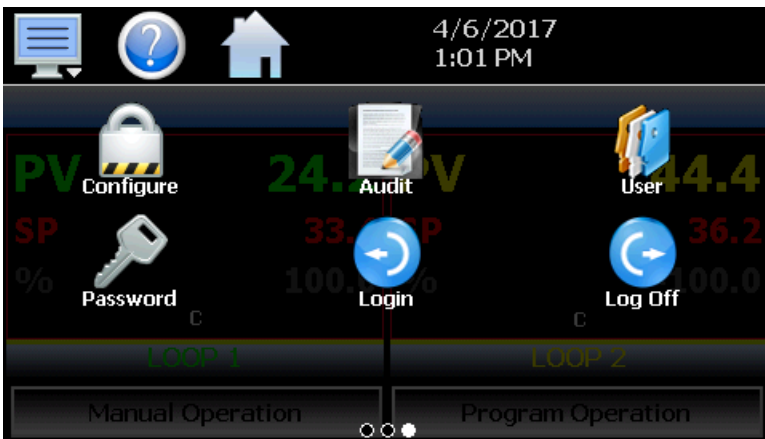


Slide page 1 provides navigation to all standard view screens. These include the Loop and Overview, Chart, Alarm monitor, and Alarm File.

It also provides quick access to the MCT4 Settings and Data file functions which include file utilities, FTP\WAN back-up settings as well as the historical data viewer.



Slide page 2 provides access to program Entry and Status views.

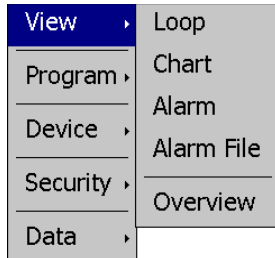


Slide page 3 provides access to Configure security settings, Audit trail viewing, current User information, user Password editing and user Login and Log Off functions.

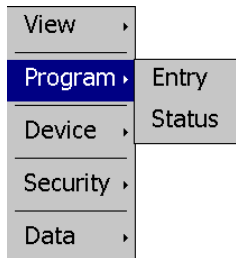
### 5.3.2 Automatic Ramp/Soak Program Menu

The automatic ramp/soak program menu is identical to the “Home” screen menus for ease of operation. See section 6 on Automatic Ramp/Soak Program Operation for detailed information on how to create and run programs.

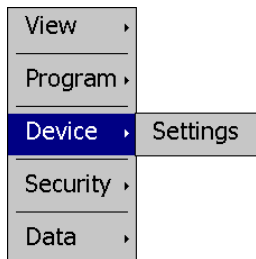
#### 5.3.2.1 *Text Based Program Menu*



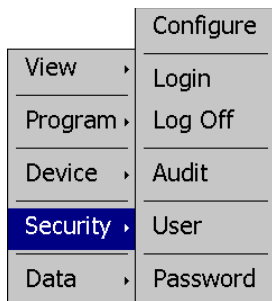
The **View** menu provides navigation to all standard view screens. These include the Loop view, real time Chart, Alarm monitor, Alarm File and Overview control screens.



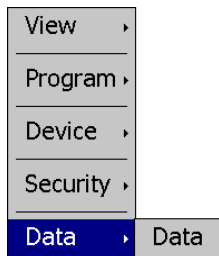
The **Program** menu provides access to the automatic ramp/soak program actions, Entry and Status views.



The **Device** menu provides access to the MCT4 controller settings. These include, loop set point entry limits, alarm set points, communication settings, email setup as well as access to offline settings for date/time, etc.

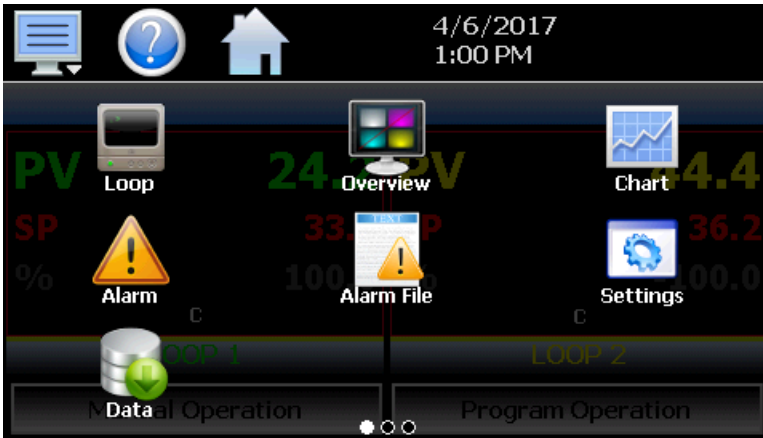


The **Security** menu provides access for user login, security settings and audit trail viewing if the security system is enabled.



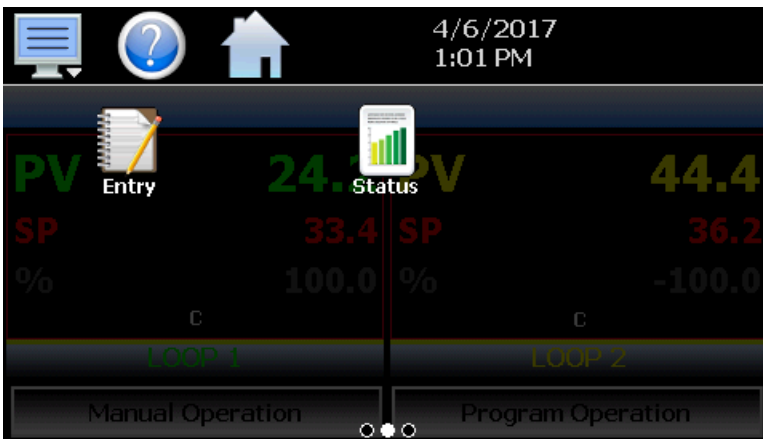
The **Data** menu provides access to data log functions, file utilities, FTP/WAN back-up settings as well as the historical data viewer.

5.3.2.2 Icon/Slide Page Based Program Menu

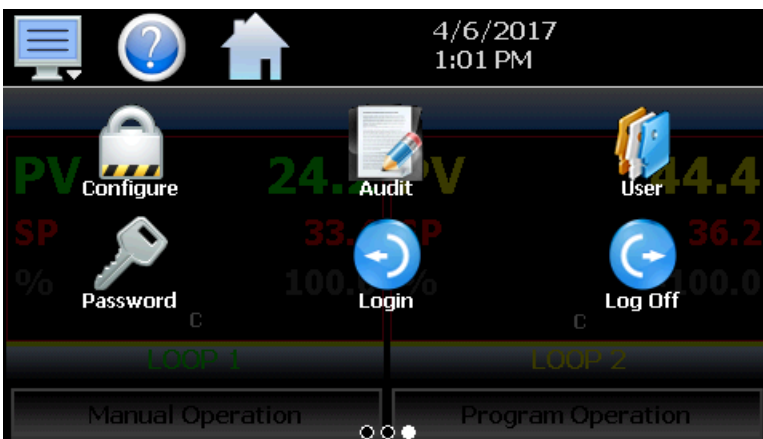


Slide page 1 provides navigation to all standard view screens. These include the Loop and Overview, Chart, Alarm monitor, and Alarm File.

It also provides quick access to the MCT4 Settings and Data file functions which include file utilities, FTP\WAN back-up settings as well as the historical data viewer.



Slide page 2 provides access to program Entry and Status views.

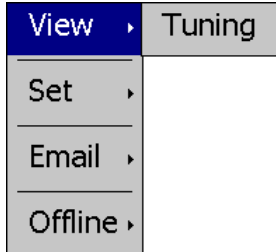


Slide page 3 provides access to Configure security settings, Audit trail viewing, current User information, user Password editing and user Login and Log Off functions.

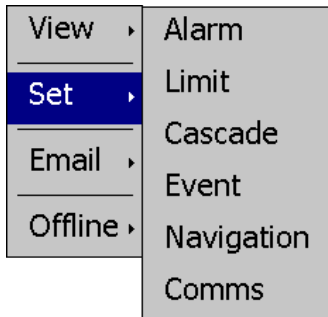
### 5.3.3 Device Settings Menu

The device settings menu is provided when the user selects “Settings” from the main “Device” menu. See section 9 on Device Settings for detailed information on these settings and their use.

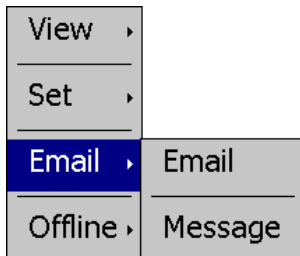
#### 5.3.3.1 Text Based System Setup Menu



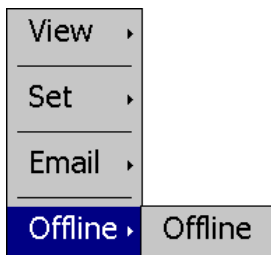
The **View** menu provides navigation to the manual loop Tuning screen.



The **Set** menu provides access to settings Alarm set points, control loop set point Limits, Cascade control settings, Event tagnames, Navigation type selection and Communications options.

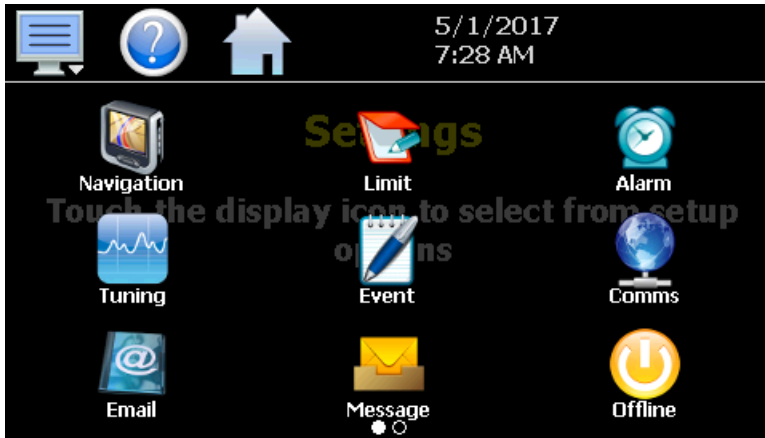


The **Email** menu provides settings for the email server to send SMS text messages and/or emails on alarm and allows the user to compose and send a Message to any user configured in the system.



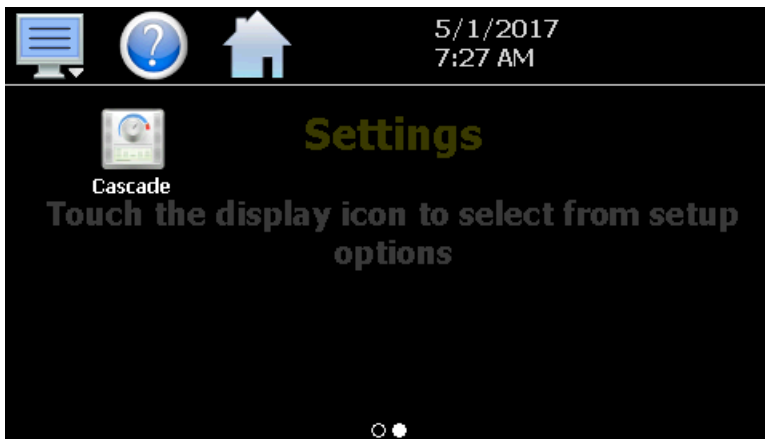
The **Offline** menu provides access to the MCT4 offline setup which provides the user with the ability to adjust the date/time, calibrate the touch screen, configure profile power recovery options, etc.

5.3.3.2 Icon/Slide Page Based Device Settings Menu



Slide page 1 provides access to Navigation type, control loop set point Limits, Alarm set points, loop Tuning, Event tagname entry and Email server settings and Messaging.

It also includes access to the communications settings for the web page, VNC server and Modbus user communications.



Slide page 2 provides access to Cascade control settings.

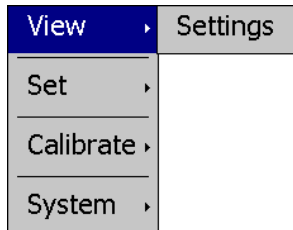


### 5.3.4 Offline Menu

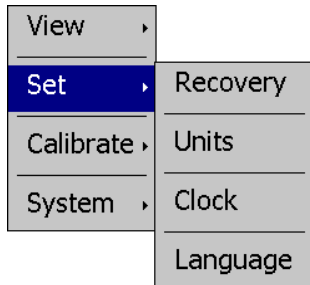
The offline menu is provided when the user selects “Offline” from the device settings “Offline” menu. See section 10 on Offline Settings for information on these settings and their use.

**NOTE:** *Offline settings can only be accessed when an automatic ramp/soak program is not running and data logging is turned off.*

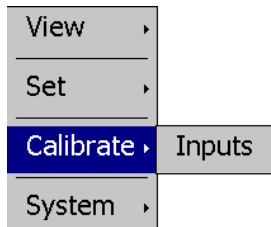
#### 5.3.4.1 Text Based Offline Setup Menu



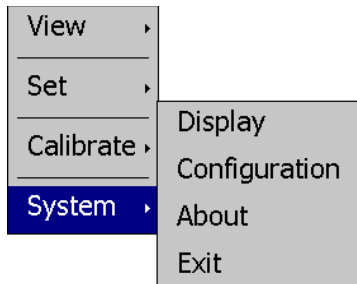
The **View** menu provides navigation back to the MCT4 device settings menu.



The **Set** menu provides access to the profile power Recovery options, temperature Units selection, NTS Clock, and Language settings.

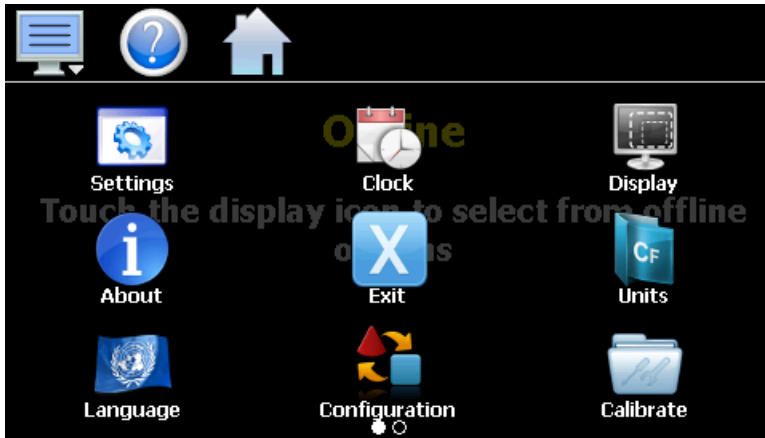


The **Calibrate** menu provides access to the user input calibration for the control loop/limit inputs.

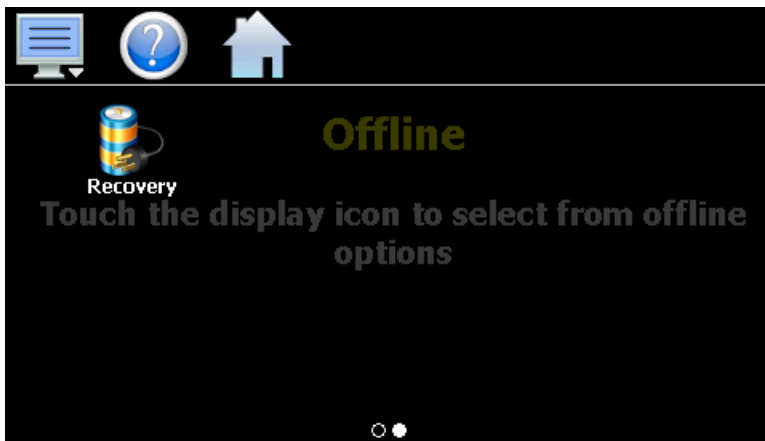


The **System** menu provides access to the MCT4 Display settings, import/export Configuration utility, About screen and Exit application screen.

5.3.4.2 Icon/Slide Page Based Offline Menu



Slide page 1 provides navigation back to the device Settings menu, Clock, Display settings, About MCT4 and Exit application screens, temperature Units selection, Language, import/export Configuration utility and input Offset calibration.

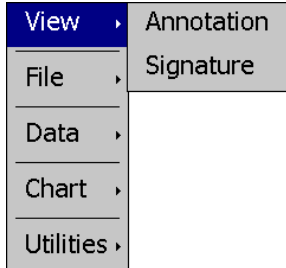


Slide page 2 provides access to the automated program power Recovery options.

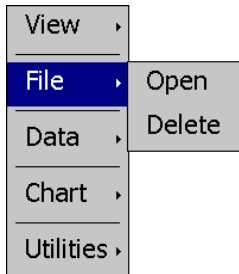
**5.3.5 Data Menu**

The data log menu is provided when the user selects “Data” from the main “Data” menu. See section 8 on Data Logging for information on these settings and their use.

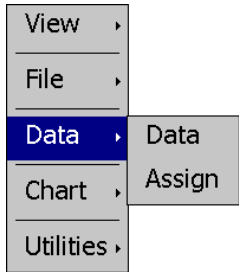
**5.3.5.1 Text Based Data Logging Menu**



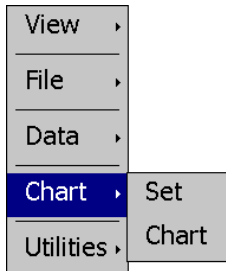
The **View** menu provides access to the data file Annotation and digital Signature screens.



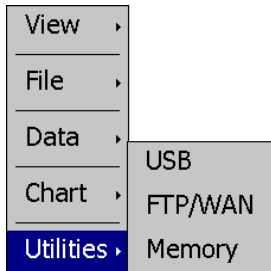
The **File** menu provides functions for opening and deleting historical data log files.



The **Data** menu provides access to the main Data screen for starting and stopping data logging and to the log point Assignment screen where the user can select which items are to be logged to the history file.

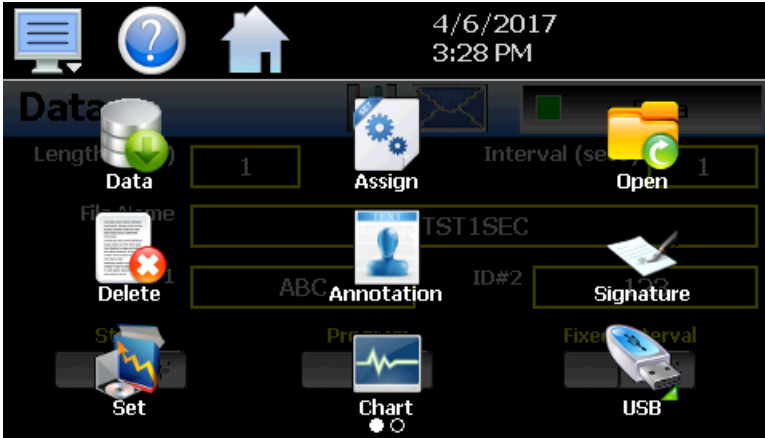


The **Chart** menu provides functions for viewing historical data files in graphical format.



The **Utilities** menu provides access to the MCT4 file management utilities including USB file transfer and FTP/WAN back-up.

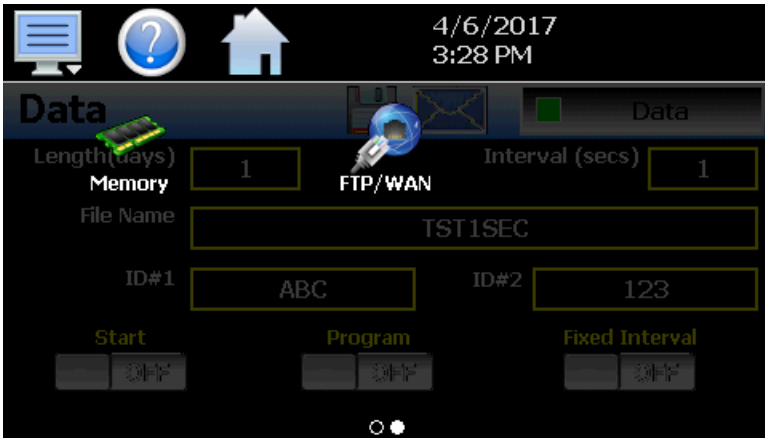
5.3.5.2 Icon/Slide Page Based Log Menu



Slide page 1 provides access to the main Data log screen and to the log point Assignment screen where the user can select which items are to be logged.

Historical data file functions are provided for Opening and Deleting historical files and viewing/setting data file Annotations and digital Signatures.

The plot Set and Chart icons provide access to the historical data viewer options.



Slide page 2 provides access to the FTP/WAN back-up settings and the memory check utility for viewing available system/storage memory space.

## 5.4 Notifications

The notification window is a feature that can be accessed by pressing the date/time field in the icon bar. This window provides a snapshot of current MCT4 activity. The notification window can be closed by pressing the date/time field again, or is automatically closed if the Menu, Home or a navigation arrow icon is pressed.



A user can view all notifications by touching the screen and dragging their finger up or down on the list to scroll through all items like other lists in MCT4. The notifications include the following:

- Loop PV and SP for each loop configured.
- Automatic program status including name of running profile.
- Active alarm status including the most recent alarm.
- Data logging status including active file name and the length and logging rate set.
- Security status including the current user.
- Audit trail active/inactive status.
- Web server active/inactive status.
- VNC server active/inactive status.
- MCT4 IP address.
- Available SD storage memory remaining.

The appearance of the items is based on the configuration of the MCT4. If data logging or security functions are disabled in the Configurator for example, their status items will be removed from the list as well.

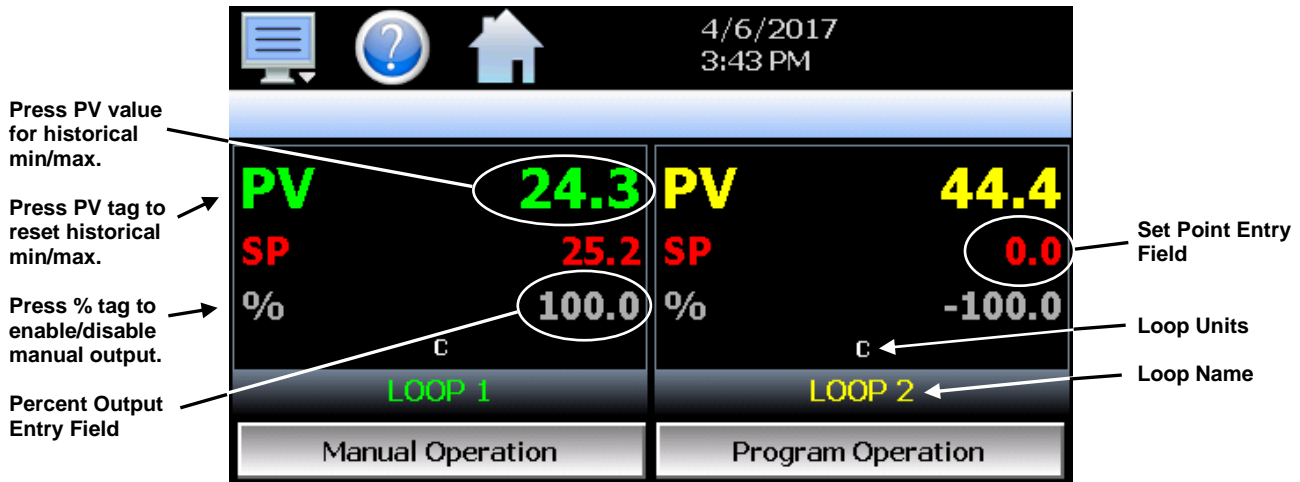
**NOTE:** *The notification items do not update while the list is shown. The information shown in the list is a snapshot of the data at the time the window was shown. Therefore, the PV or SP shown for a loop may not be the actual values for the loop if the notification window is left open for extended periods of time. The notification window is not available in the offline setup.*

## 5.5 Control Loops (Single Set point Operation)

The Loop view screen provide direct viewing options for the control and monitoring of the MCT4 control loops and limit control (if configured). The Loop screen allows the user to adjust the current loop set point (SP) and view the process variables (PV) and percentages of output (%) for each loop.

### 5.5.1 Loop View

The Loop screen is accessed from the home “View” menu. It automatically configures itself to display from one to three loops or up to two loops and limit control based on the configuration of the MCT4.



The **set point entry field** is the area where the screen can be touched in order to bring up the keypad entry window. Using the numeric entry keypad, a new set point can be entered. Once entered, the new set point will be shown in the set point entry field. Adjustment of the set point is locked out if an automated ramp/soak program is running.

**IMPORTANT:** *When operating in single set point mode, the set point is saved in the loop control board's memory once every 6 minutes. If the set point is changed and power is removed prior to the 6-minute time period, when power is re-applied, the loop set point will return to the previous value.*

*Insure that power remains on the unit for 6 minutes after a set point change in order to have it power-up with the desired set point the next time power is applied.*

The **percent output entry field** is the area where the screen can be touched in order to bring up the keypad entry window. Using the numeric keypad, a new fixed percentage of output can be set for the loop. In order to be able to enter a fixed output percentage, the loop must first be placed in manual output mode. This is done by pressing the “%” tag on the screen. This feature can be removed by turning off the “Loop Manual Mode” function in the Configurator.

The **loop name and loop units**, shown at the bottom of each loop (or limit), will display the tagname and units as entered in the Configurator.

#### 5.5.1.1 Historical Minimum and Maximum

The MCT4 monitors and stores the minimum and maximum process value reached during operation for each loop in the system as well as the limit if configured. The current historical values can be viewed by pressing the process value display field for the desired loop or limit.



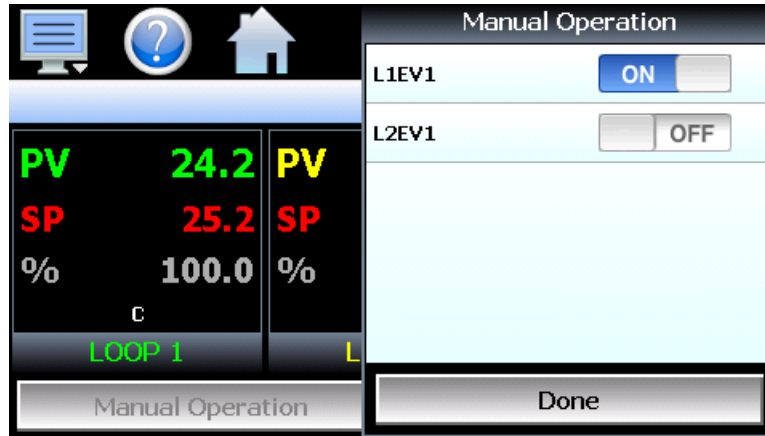
Pressing the “OK” button will close the dialog window and return to the Loop view screen. The historical values are reset each time the runtime application is started and can also be manually cleared by pressing the “PV” tag on the Loop view screen.



Pressing the “Yes” button in the dialog window will reset historical minimum and maximum values and default them both to the current process value. Pressing “No” will simply close the dialog.

**5.5.1.2** Manual Operation

The Manual Operation button displays a “slide out” window providing access to all events programmed for the system. To turn each event and its corresponding output on or off, simply press the button associated with the event. Slide the list up or down as necessary to view additional events if more are programmed than can be displayed in the window at one time.

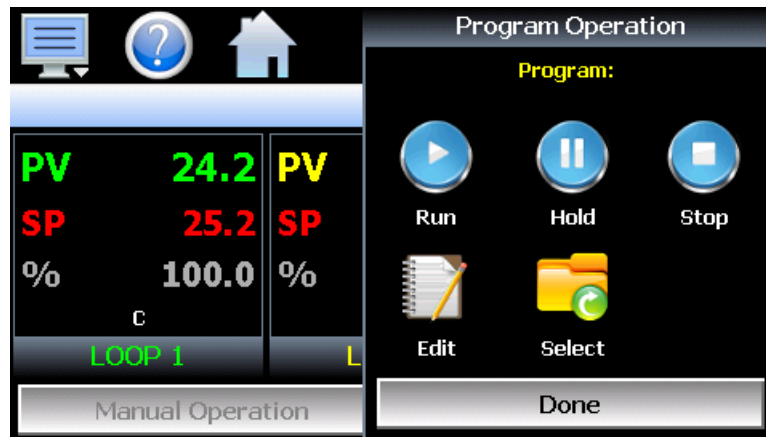


**NOTE:** The MCT4 loop controls can provide up to 3 event outputs each (for a total of 9 events). Depending upon the configuration of MCT4, some outputs may perform specific control or alarm functions. The use of each output, and what it controls, is determined by the system designer. If there are questions or concerns about the configuration and operation of your MCT4 controller, contact your OEM for further information. Only your OEM can address equipment related issues.

The names of events are also determined by the system designer. The screen shot above is an example. Consult section 9.3 on Event Names on how to change the names of events.

5.5.1.3 Program Operation

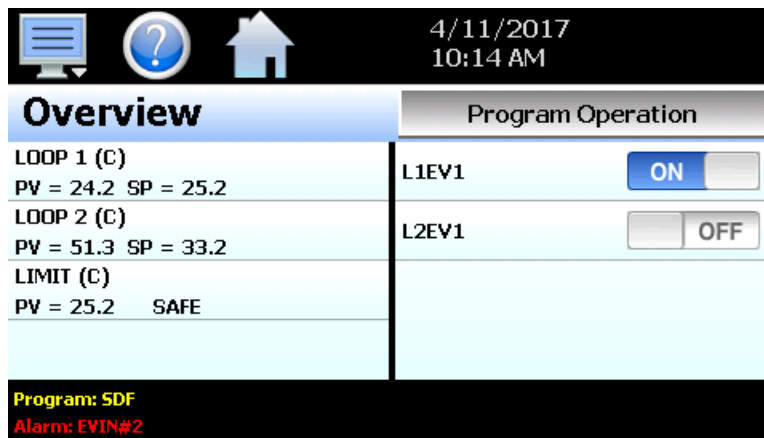
The Program Operation button displays a “slide out” window with all automated program operations included. Press the desired icon for quick access to any program operation. The “Select” icon can be used to select any program stored for quick run operations.



5.5.2 **Overview Screen**

The Overview screen displays all loops, the limit and events on a single screen for quick access to all system parameters. Press any loop to access the “slide out” keypad for set point entry. Press an event button to turn the output on and off. The Program Operation button displays the “slide out” window to access all automated program operations. Fields located at the bottom of the Overview screen will display the current program loaded as well as a scrolling alarm field which will cycle through any and all alarms that are active in the system.



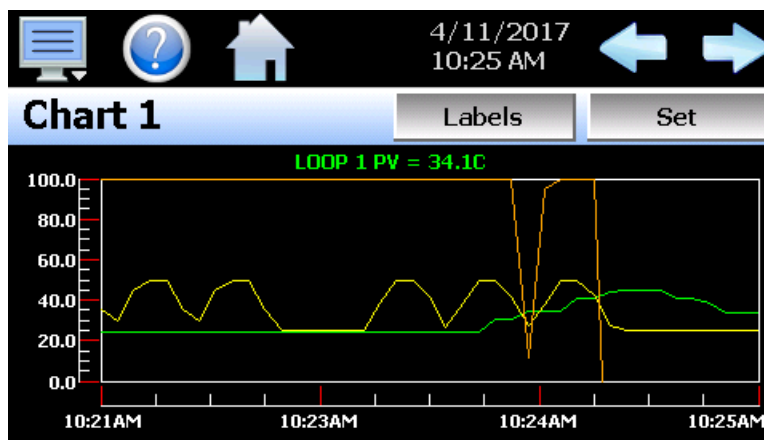


## 5.6 Process Monitoring

The Loop and Overview screens provide the current process values of the MCT4. In order to view the process inputs over time, the MCT4 provides real-time charts. Four user configurable charts are provided with up to six plot points per chart.

### 5.6.1 Charts

The Chart screen is accessed from the home “View” menu. The real-time charts can be configured to display the process variable (PV), set point (SP) and percentage of output (%) of each control loop over a selectable period of time. The vertical axis determines the range of displayed data while the horizontal axis determines the history period. The maximum time period that can be shown in a chart is 24 hours. The MCT4 comes standard with 4 configurable charts. Each chart includes up to 6 trend lines configurable by the user.



The rate at which the chart plots a new point is based on the time period to be shown. Each buffer can hold a total of 720 readings for each of the selected channels to plot. The update rate can be calculated by the formula: time period (in minutes) \* 60 / 720. Note that for time periods less than 72 minutes, the update rate will be held to a minimum of 6 seconds. Thus, the update rate will vary from a minimum of 6 seconds (for time periods of 72 minutes or less) up to a maximum of 120 seconds for 1440 minutes (24 hours).

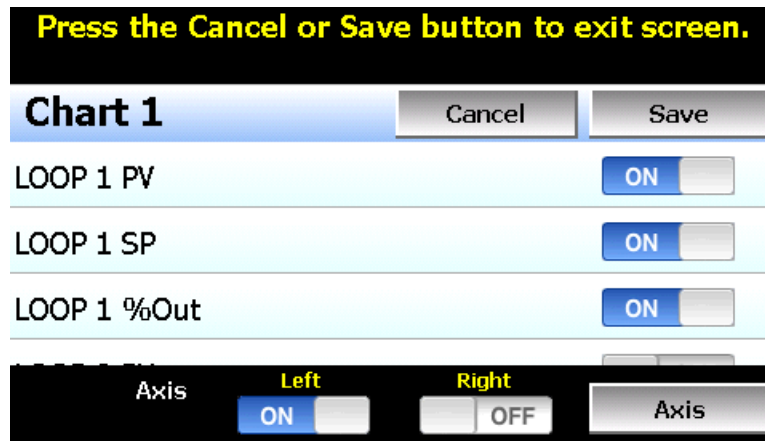
The **Labels** button allows the user to cycle through each of the configured plot channels to determine what each colored plot represents as well as view the current value without having to return to the Single or Dual view screens. The left and right scroll buttons at the upper right of the screen allow the user to cycle through each of the four available charts.

The charts also allow you to “zoom in” on a particular area to have a more detailed look at current data. By using your finger to select an area on the screen, the chart will zoom in on that area. To select a portion of the plot, touch and hold the screen with your finger. Drag your finger across the graph and a box will be drawn around the selected area. Removing your finger from the screen will cause the chart to redraw with only the selected plot area. To return to the normal view, touch the ‘X’ or ‘Y’ axis and select zoom out to return to the previous zoom setting or zoom normal to return to the full display.

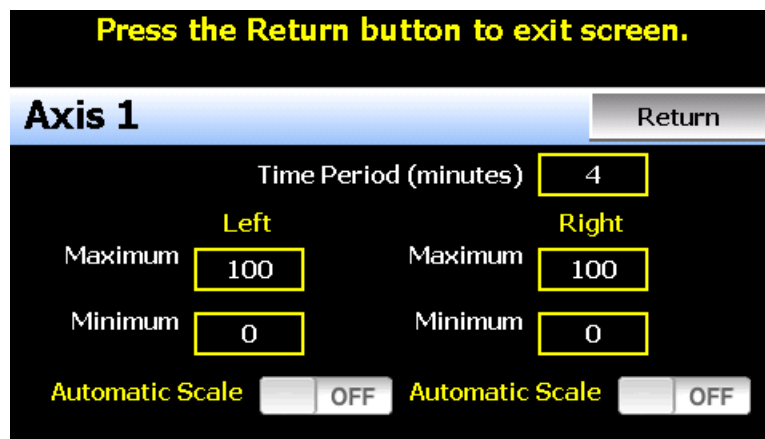
**NOTE:** When a chart is zoomed in, it will not update with new information. The chart must be in normal view mode in order to update at each time interval. The chart will return to normal automatically when selecting a different screen to view.

5.6.1.1 Chart Setup

To configure a chart, press the “Set” button in the upper right corner of the display. The setup screen will be shown. To assign channels to the chart, simply touch the on/off button for the desired items in the list to select them. Select the left or right vertical axis for each item by selecting the item in the list and press the button for the desired “Left” or “Right” axis. The left axis is the default axis selection. If none of the channels are assigned to the right axis, the axis will not be shown on the chart.



Once the channel selections have been made, press the “Axis” button to adjust the time period and vertical axis ranges of the graph.



**Time Period**

Adjusts the displayed time period for the graph. The allowable range is from 4 to 1440 minutes (24 hours).

<b>Maximum</b>	The maximum value sets the maximum range of the vertical axis with a minimum value of -32,760 and a maximum of 32,760.
<b>Minimum</b>	The minimum value sets the minimum range of the vertical axis with a minimum value of -32,760 and a maximum of 32,760.
<b>Automatic Scale</b>	When on, the vertical axis will automatically adjust its zero and span as needed to display the selected plot channels.

Once all settings have been made, press the “Return” button to return to the channel selection screen. Press the “Save” button to store the current channel and axis entries or the “Cancel” button to exit chart setup without altering the current chart settings. If channel selections or the time period for the chart has changed, all current chart data will be cleared when the new entries are saved. The chart will then begin plotting new data according to the new settings.

## 5.7 System Alarms

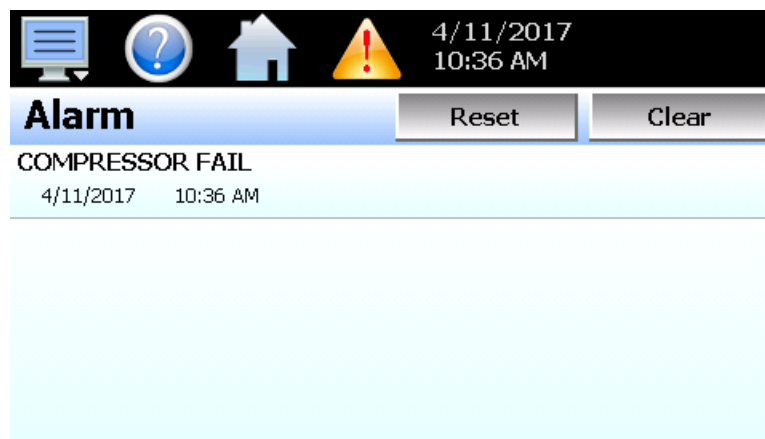
When an alarm condition occurs, the alarm icon flashes in the MCT4 icon bar to provide a visual indication of an alarm condition. An audible alarm will also sound if the alarm requires immediate operator attention such as a loop communications failure or a process alarm set point has been exceeded. For more information on adjusting the audible alarm volume, see Section 10.12.3, Alarm Volume.

**NOTE:** *The MCT4 loop controls can provide up to 3 alarm outputs each (for a total of 9 alarms). Depending upon the configuration of the MCT4, some outputs may perform specific control or event functions. The use of each output, and what it controls, is determined by the system designer. If there are questions or concerns about the configuration and operation of your MCT4 controller, contact your OEM for further information. Only your OEM can address equipment related issues.*

*For information on alarm operation, see Section 9.4, Alarm Settings.*

### 5.7.1 Alarm Monitor

The Alarm screen is accessed from the home “View” menu. It can also be displayed by pressing the alarm icon whenever a new alarm occurs. It displays all current and/or previously acknowledged alarms according to time and date of occurrence. Once the alarm is reset, the alarm icon will be hidden; however, the alarm condition may still be present.



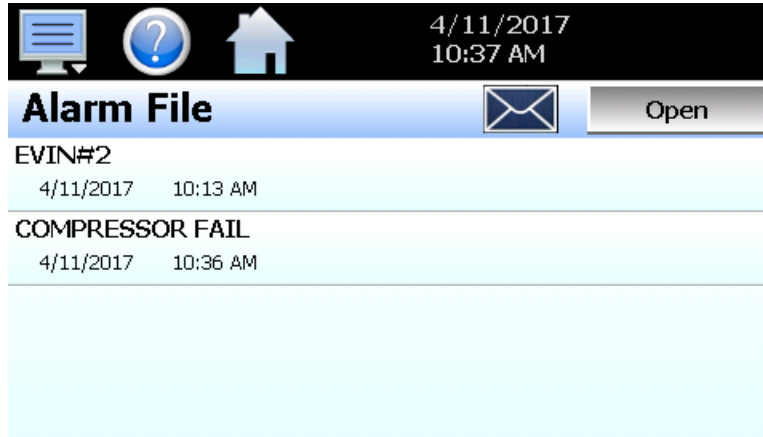
The alarm will be removed from the list when cleared by the operator by pressing the “Clear” button. Only alarms that are not currently active in the system can be cleared from the alarm list.


**IMPORTANT:** *If a loop control is in manual mode or in automatic tune and the reset button is preset, the alarm reset will terminate automatic tune or manual mode and place the loop back into normal operation.*

*Upon alarm reset, if the process no longer exceeds the alarm set point, but the loop control alarm output has not yet reset due to the alarm hysteresis, the alarm reset will ignore the alarm hysteresis and the alarm output will immediately go to the non-alarm output state.*

**5.7.2 Alarm File**

The Alarm File screen is accessed from the home “View” menu. It displays all alarms for any given day. The MCT4 can store daily alarm files for a period of a year or longer (time based on storage usage for data history). Each time an alarm occurs on the MCT4, the alarm is written to a file. Alarm file names are listed as MMDDYYYY (where MM = month, DD = day, YYYY = year. The “Open” file button will display a dialog box where the user can select any alarm file to view.

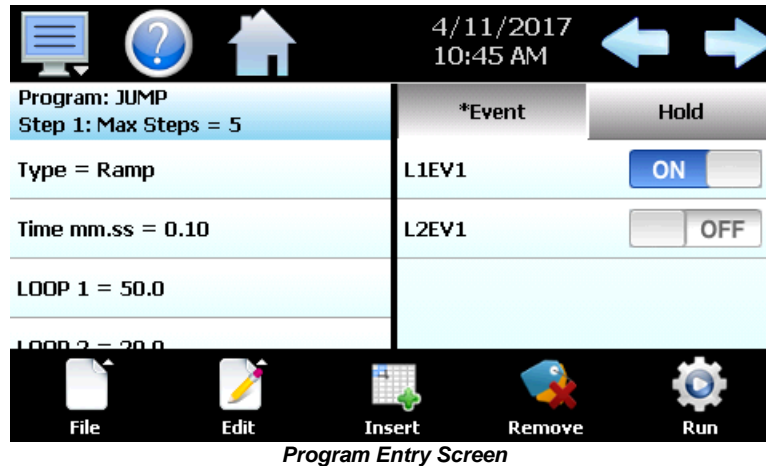


The send email icon  allows the user to send a copy of the currently opened alarm file to any user configured in MCT4. When the email icon is pressed, an “Add Recipients” window will be displayed where the user can select recipients for the file from any of the email addresses configured under the MCT4 email settings. For information on how to add email recipients to MCT4, see the section 8.9, Email.

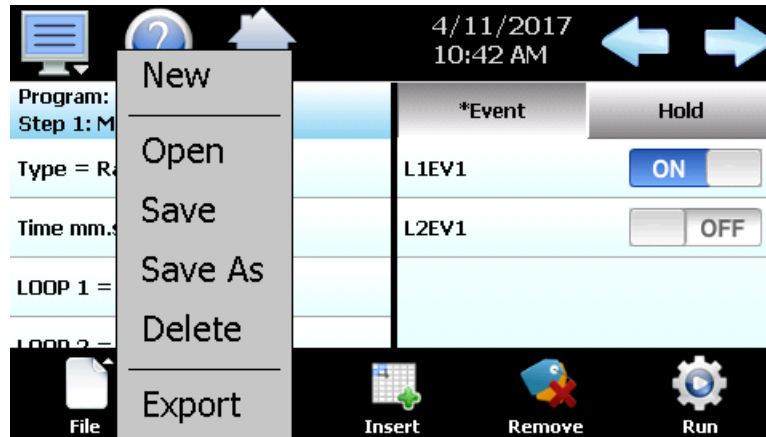
**NOTE:** *If no alarms occurred on a given day, an alarm file will not be created for that day. The alarm list will display up to 650 alarm files. If more than 650 alarm files are present, the alarm files cannot be shown in the list and the files will have to be exported from the MCT4 in order to view them. This can be done either via USB file utilities (see section 8.4) or FTP (see section 8.5).*

## 6 Automatic Ramp/Soak Program Operation

A ramp/soak program is a set of instructions (set points and events) programmed as a timed sequence of steps. When a program is run, the MCT4 executes each step of the program automatically, in sequence, based on the time duration and settings for each step. The MCT4 can store hundreds of programs (depending on storage usage for data history) with up to 64 steps in each. All program step entry is located on a single screen so even the most complex program is easy to create and edit.

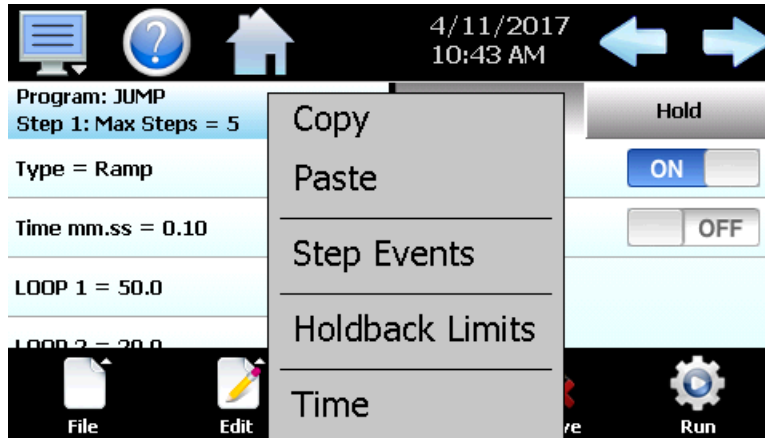


The pop-up “File” icon menu provides the following functions:



- New* Clears all current program entries.
- Open* Provides file open dialog to select a program from memory.
- Save* Saves the current program being edited.
- Save As* Saves the program being edited under a new name.
- Delete* Deletes the current program from internal memory.
- Export* Export the current program to USB memory device.

The pop-up “Edit” icon menu provides the following functions:



- Copy*                      Copies current step data including events.
- Paste*                     Pastes previously copied step data to the current step.
- Step Events*             Copies and pastes current step events to all following steps.
- Holdback Limits*       Sets holdback limit values for each loop (set once only per program).
- Time*                      Sets time for program in hh:mm or mm:ss (set once only per program).

### 6.1 Entering a Ramp/Soak Program

Ramp/Soak programs are created and edited from the program Entry screen. The program Entry screen can also be accessed directly from the “Program” menu or “Program Operation” button on Loop and Overview screens. To create an automatic ramp/soak program:

- 1.) From the File pop-up menu, select “New” to create a new program.
- 2.) Enter or delete steps by pressing the “Insert” or “Remove” icons. Steps can be added or deleted “on the fly” as required. Inserting steps anywhere within the program will not affect steps already programmed.
- 3.) For each step, press any row in the loop list view to set the step type, time or loop set point. Entry is dynamic and the interface will display a pop-up menu or slide out numeric keypad to match the type of entry pressed in the list. Slide the list up or down to view more data like any standard smart device. Press any button in the “Event” list to turn the event output on or off for the program step. If holdback for any loop step is required (and programmed in holdback screen), press the “Hold” button and select the loop the step holdback.
- 4.) From the File menu, select “Save” to save the program.

**NOTE:** *Programs can be saved with names of up to 16 characters long. However, the MCT4 only uses the first 14 characters of the program name for display updates and record keeping. When naming programs, try to keep the name limited to 14 characters in order to have the full program name shown, or use the first 14 characters as a means of more clearly identifying the program when more than 14 characters are used.*

### 6.1.1 Setting Step Type

Programs are entered as a sequence of steps which define the set point and length of time that a loop should take to reach the set point (ramp) or remain at a set point (soak). The ramp and soak units can both be set for hours/minutes or minutes/seconds or one can be set for hours/minutes while the other is set for minutes/seconds. To begin editing a program step, first select the type of step by pressing the first row in the list and make the desired selection from the step type pop-up menu.

**NOTE:** As the step type selection is changed, the list will update to include only the items specific to the selected step type. This simplifies step entry by only requesting user entry for the items necessary for proper step operation.



The **Ramp** selection allows the user to program each loop to ramp to a set point in a specific period of time. Simply select ramp from the pop-up menu and then enter the loop set point(s) and time.

The **Soak** selection allows the user to program each loop to maintain its set point for a specific period of time. Simply select soak from the pop-up menu and then enter the time desired to maintain the set point.

The **Jump** selection allows the user to jump to a previous step in the program and set the number of times the program should execute the jump before continuing to the following step of the program.

The **End** selection allows the user to program the last step of the program. The end step type includes final set points (if configured) and a cycle count entry to allow the user to enter the number of cycles the program should repeat itself if desired.

### 6.1.2 Setting Step Set Points and Time

Set point entry is only provided when entering a ramp step. If “soak” is selected for the step type, the loop(s) will remain at the previous set point for the amount of time entered for the step. The set point entered for each control loop is used as the target set point for the step, i.e., the set point the loop control will arrive at by the end of the step. Each set point will change independently of the other in order to arrive at the target set point when the time left in the step reaches zero.

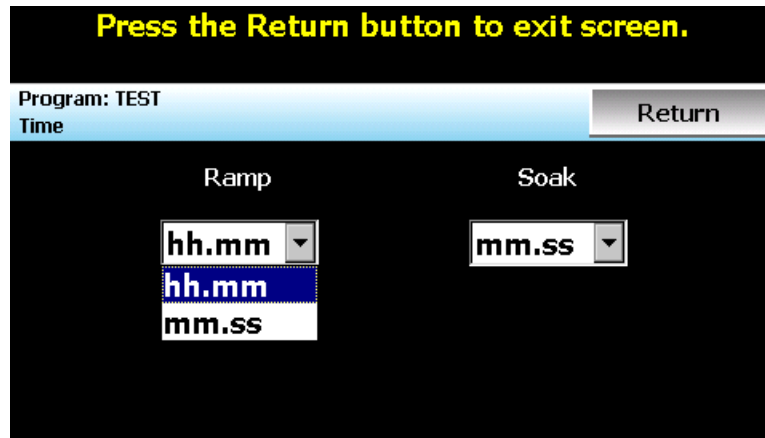
To enter the set point for a loop, touch the set point field for the loop and enter the desired set point. To enter the step time, touch the time field to enter in the desired time duration. Time is entered as HH.MM or MM.SS depending upon the selection made on the Time setup screen under the Edit icon pop-up menu. Thus, to enter a time of 1 hour for example, you would enter a value of 1.00 for one hour and zero minutes. To enter a step time of 30 minutes, the time entry would be made as 0.30 for 30 minutes. If the time selection was in minutes and seconds, an entry of 1 minute and 30 seconds would be made as 1.30.



**NOTE:** A step time of zero can be entered for a step to implement an immediate set point change when programmed for ramp. If holdback is enabled on a step, a minimum step time of 10 seconds 0.10 (mm:ss) or 1 minute 0.01 (hh:mm) is required to ensure that the holdback condition can recognize the process change in order for holdback to operate.

6.1.2.1 Ramp/Soak Time Units Selection

The Time selection screen is accessed by selecting the “Time” menu item from the Edit pop-up menu.



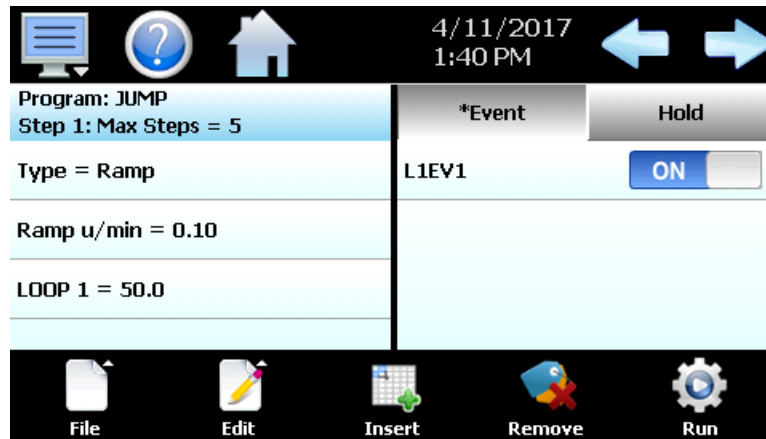
For dual loop and three loop systems, the ramp and soak time selections both provide the option of hours and minutes (hh.mm) and minutes and seconds (mm.ss). The selections apply to all steps of the program. The time units can be changed at any time during program entry; however, the time entry of each step is not scaled to the new unit selection when the change is made.

If program steps were entered in the previous selection of “mm.ss” for example, a time of one minute and thirty seconds (1.30) will become a time entry of one hour and thirty minutes (1.30). If the time units selection is changed, all steps must be reviewed in order to make sure the actual time length for each step is set to the desired length.

6.1.3 **Setting Step Set Point and Ramp Rate (single loop only)**

For single loop systems, the time units for ramp steps on the Time setup screen under the Edit icon pop-up menu can be set for units/hour or units/minute. If the ramp units are set for units/hour or units/minute, ramp steps are entered as a rate of change in process units/time period. If a set point is entered for the step that matches the set point of the previous step, the step will be skipped since the loop is already at set point.

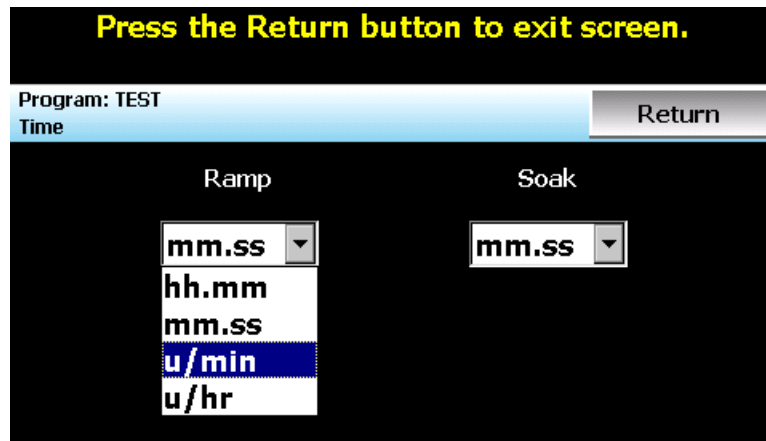




**NOTE:** A ramp rate entry is only available for single loop MCT4 systems because the length of time for the step to complete is based upon the change in set point and the rate at which the set point is to ramp. Ramp units of time are still available for selection on single loop systems if time entry is preferred over rate.

6.1.3.1 Ramp Rate/Soak Time Units Selection

The Time selection screen is accessed by selecting the “Time” menu item from the Edit pop-up menu.

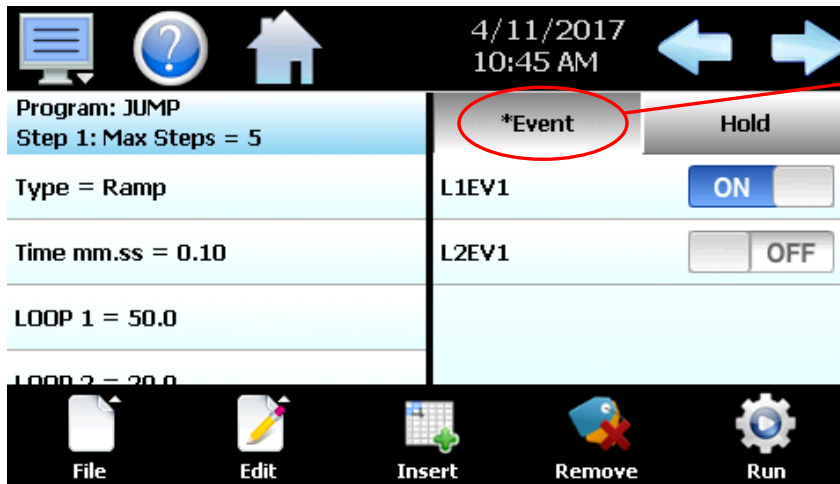


For single loop systems, the ramp and soak time selections both provide the option of hours and minutes (hh.mm) and minutes and seconds (mm.ss). In addition, the ramp time selections include units/minute (u/min) and units/hour (u/hr). The selections apply to all steps of the program. The time units can be changed at any time during program entry; however, the time entry of each step is not scaled to the new unit selection when the change is made.

If a ramp step was entered in the previous selection of “u/hr” for example, a ramp rate entry of 10 degrees per hour will become 10 degrees per minute if the ramp selection is changes to “u/min”. When time units selections are changed, all steps must be reviewed in order to make sure the actual ramp rate or time length for each step is set to the desired length.

6.1.4 **Setting Step Events**

For each step of the program, the user can select which events are to be on during the step. To edit step events, press the “Event” button on the program Entry screen. This will display the Event list for the program step.



When at least one event is turned on in a step, an asterisk (\*) will appear before the word "Event" on the list selection button.

This indicates that at least one event is turned on without having to press the "Event" button, or if the events that are turned on are not currently shown in the list due to the scroll position of the list.

The desired event state for the step can then be set by pressing the on/off button for each event to toggle them on and off. Sliding the list up or down will display additional events if more events are program than can be shown in the list at one time.

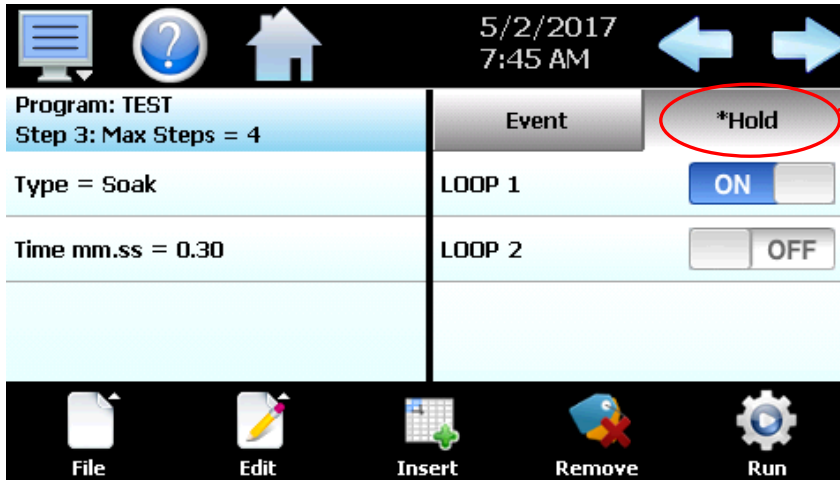
Events cannot be set for the End step. During program operation, when the End step is reached, the event outputs will return to their previous static setting (prior to starting program operation). If the loop controls are configured for "Final SetPoint" at end of program operation, the program will remain in the end step state and all event outputs will turn off until the user halts program operation. Upon stopping the program, the event outputs will then return to their static settings.

**NOTE:** *The step events must be set individually for each step. Even though a ramp/soak program may be in operation, if the events are not set, the associated loop control output will not turn on. To make setting step events quick and easy, the MCT4 provides the "Step Events" function from the "Edit" menu. When selected, all event selections of the current step will be copied to all following steps.*

*This requires the user to only enter event selections for one step (step 1 for example), and if all following steps use the same event selections, selecting "Step Events" from the "Edit" icon pop-up menu will then copy the selections to all other steps of the program. This feature can be used on any step of the program, so if event selections then change on step 5, the function can be used again and all steps after step 5 will then have event selections of step 5 copied to them leaving steps 1-4 with the previous selections.*

### 6.1.5 Setting Hold Events

The hold events are used to turn on the holdback option for each loop control. To edit hold events, press the "Hold" button on the program Entry screen. This will display the Hold list for the program step.



When at least one event is turned on in a step, an asterisk (\*) will appear before the word "Hold" on the list selection button.

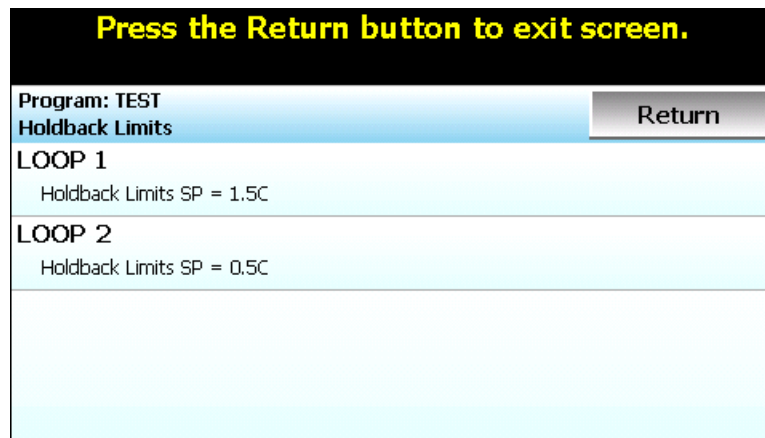
This indicates that holdback is enabled on at least one loop without having to press the "Hold" button.

Pressing the on/off button for each event will toggle holdback on and off for the loop. When the hold event is enabled, the program will automatically enter a hold condition during the step if the loop's process value deviates from its set point by more than the holdback limit setting for the loop.

**NOTE:** For proper holdback operation, a minimum step time of 10 seconds 0.10 (mm:ss) or 1 minute 0.01 (hh:mm) is required to ensure that the holdback condition can recognize the process change in order for holdback to operate. If the step time is less than 10 seconds, the holdback condition may not be triggered.

#### 6.1.5.1 HoldBack Limits

The holdback limit settings are used to set the control tolerance for each loop during steps that have hold back enabled. When the loop process variable deviates from its set point by more than the band value (above or below set point), the program timer will stop until the process variable re-enters the hold back band. The Holdback Limits are accessed from the Edit pop-up menu. The entries apply to every step in the program and only need to be entered once for the program.

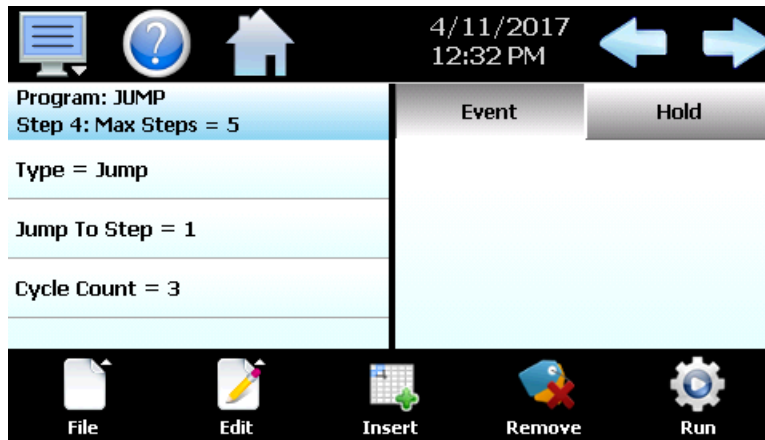


The MCT4 uses "band" type holdback operations. This means the MCT4 will be in hold mode when the loop process value is above or below the loop set point by the entered holdback limit value during step operation. Holdback steps must have a minimum value of .10 (mm:ss) or .01 (hh:mm) for holdback to engage during the step. A time value of 0 in a holdback step will cause the automated program to continue to the next step and skip the holdback step.

### 6.1.6 Setting Jump Steps

This feature allows the program to jump back to a previous step in order to repeat certain sections of a program. When a jump step is entered, the program will jump to the specified “jump step” rather than continuing on to the next step in the program. After all of the programmed jump cycles have been completed, the program will then continue to the following step without making any further jumps.

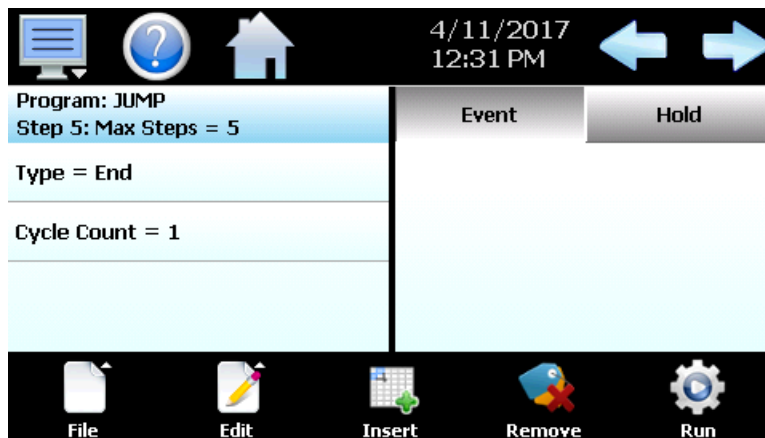
**NOTE:** The MCT4 has the ability to do nested looping, i.e., allowing multiple jump steps to be programmed throughout a program in which one jump cycle is repeated within another jump cycle. The program Status screen will display the current cycle count; however, this is for the outer most jump step. If nested jump loops are programmed, the cycle count of the inner jump loops is not displayed.



To program a jump step, select jump for the step type and enter the step number that you want the program to jump back to along with the total number of times the jump is to be made (by pressing each row in the list). A cycle count of one indicates that no jump will be made since one cycle is completed upon reaching the jump step.

### 6.1.7 Setting the End Step

All programs require that the last step is entered as an “End” step type regardless of the length (2 to 64 steps) of the program. The end step type provides a cycle count entry which makes it easy for the operator to repeat an entire program without having to enter a jump step. The end step cycle count can be set from 1 to 9999 cycles. An entry of 10,000 can also be made which signifies infinite looping, i.e., the program will keep repeating itself until manually stopped by the user. Press each row in the list to make the desired entry.



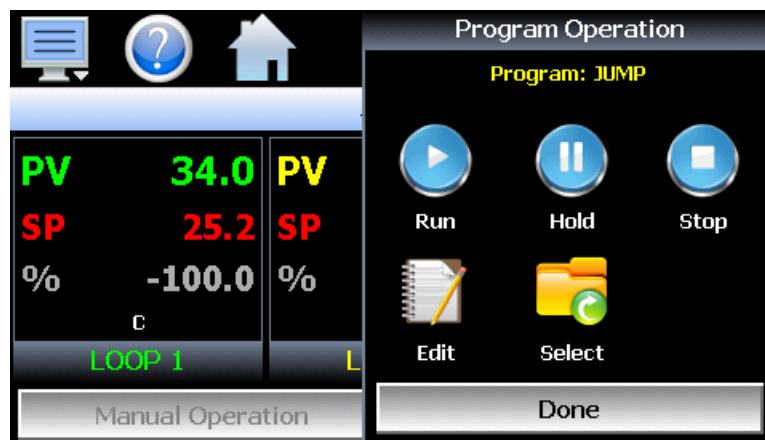
If the MCT4 is configured for automatic program final set point entry, the loop set point for each loop also will be displayed in the list. When the program ends, the set point entered on the end step will be used as the loop set point. The loop control will then remain at that set point until the user halts the program. Once the program is stopped, the loop control will then return to the previous static set point (prior to the start of the program).

The MCT4 configuration also provides the option for having the loop controls return to the static mode of operation when the program is completed. When configured to use the last control set point, the loop controls will automatically return to the previous static set point (prior to the start of the program) when the program ends. If there are questions or concerns about the configuration and operation of your MCT4 controller, contact your OEM for further information. Only your OEM can address equipment related issues.

**NOTE:** *When configured for automatic program final set point entry, MCT4 will remain in the end step until the user manually stops the program. If any loop control outputs are configured as events, they will remain in the off state and cannot be turned back on until the program is stopped.*

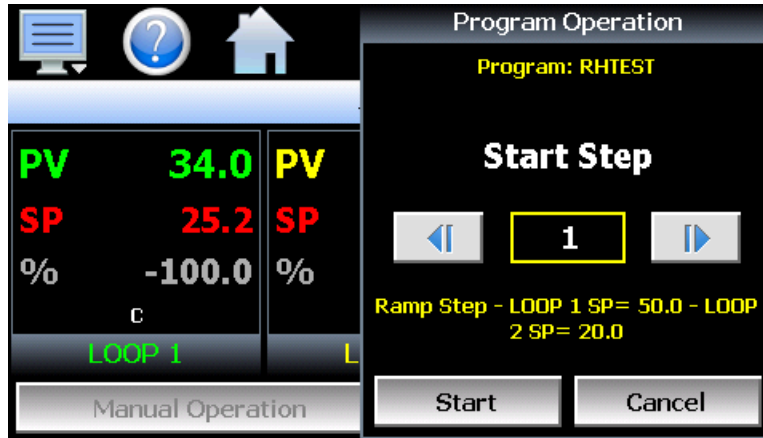
## 6.2 Starting an Automatic Ramp/Soak Program

All automated program operating functions are accessed via the Program Operation screen. This screen can be accessed by pressing the “Program Operation” button on the Loop view or Overview screens or by pressing the “Run” button on the program Entry screen.



The program operation allows an operator to run, hold, stop, edit and select automatic programs. The Program operation window will display the program loaded in the MCT4 which is ready for operation by pressing the Run, Hold or Stop buttons. If a program is already loaded, the user can start the program without entering a start step. This offers a quick start/stop of programs for repetitive test operations. In this case, the program will always start from step 1.

If entering a Start Step is required (to start the program on a specific step), press the “Select” button and choose the program from the list, then press the run button. This will display the **Start Step** entry.



The **start step** can be adjusted up and down by pressing the right/left arrow buttons or by pressing the step number field and directly entering the desired start step via the numeric keypad. Once the desired start step number is entered, press the “Start” button. The program will then be transferred to the loop control(s) and started once the transfer is complete.

To stop a program, select “Stop” from the Program Operation window. When a program is stopped, the loop set points and events will revert back to the single set point (static mode) values that were entered prior to the program being started. The Edit button will navigate directly to the program Entry screen so a program can be created, edited and stored.

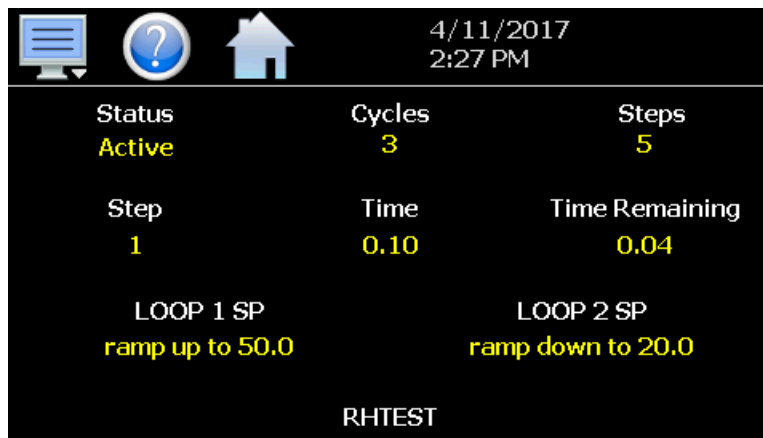
**6.2.1 Hold/Resume Ramp/Soak Program Operation**

At any time during the operation of a program, it can be manually placed into hold. This stops the program timer; however, the MCT4 continues operation under the current step settings at the time the program was put into hold. To pause a program, select “Hold” from the Program menu. To resume the program from the point in which it was paused, select “Start” from the Program menu.

**NOTE:** *The program will automatically be placed in hold if holdback is enabled for the step and the process value of the selected loop deviates from set point by more than the holdback band. When the program is in holdback, it cannot be resumed by pressing the Run button. The program will automatically resume once the process value of the selected “hold loop(s)” is within the holdback band from set point.*

**6.3 Monitoring Automated Ramp/Soak Program Operation**

The program Status view provides all information regarding the operation of the current program.



The **Status** field indicates the current operating mode of the program, i.e., On, In Hold and Off.

The **Cycles** field indicates the number of cycles left to be completed for the current jump loop.

The **Steps** field indicates the total number of steps in the current program.

The **Step** field indicates the step number currently being executed.

The **Time** field indicates the total length of time programmed for the current step.

**Time Remaining** is the time remaining in the current step.

The set point for each loop indicates the programmed set point for the loop that will be achieved by the end of the step. The fields will indicate the current ramp or soak status for the loop based on the set point of the step. If the target set point of the step is greater than the loop set point, “ramp up to” will be displayed. If the set point is lower than the current loop set point, “ramping down to” will be displayed. If the step is a soak step or the target set point is the same as the current loop set point, “soak at” will be displayed.

The name of the running program, or current program loaded to the MCT4 loop controls, will be shown at the bottom center of the screen. If no program has been loaded, the field will be empty.

**IMPORTANT:** *If the set point does not match the set point programmed for the step, check the lower and upper set point limits for the loop (see Section 9.3 Setpoint Limits). The lower and upper limits define the allowed operating range. If a step set point exceeds a limit, it will be coerced to the lower or upper limit that it exceeds. This is done automatically without altering the original program.*

## 6.4 Common Questions About Ramp/Soak Program Operation

### 1. How do I start or run a ramp/soak program?

To select and start a program, use the Program Operation window which can be accessed from the Loop, Overview or program Entry screens. All start, stop, hold, edit and program select operations are available from this window.

### 2. How do I know which program is running?

When a program is running, the name is displayed on program Status view screen as well as the Loop and Overview screens. It is also shown on the Program Operation window. The MCT4 will indicate that the program is running when it is in operation. If a program is not running, the MCT4 will display the name of the currently loaded program, i.e., present in memory and ready to be run.

### 3 Why is the program not running to the set point entered for the step?

Automatic ramp/soak program operation is limited by the lower and upper set point limits (see section 9.3 Setpoint Limits). If a program step has a set point that exceeds the lower or upper limit, the set point will be automatically coerced to the limit it exceeds. This prevents damage to equipment or product by insuring that the system only operates to the range entered by the user. If a program step has a set point of 100 for example, but the upper limit is 90, when the program is run the set point will be coerced to the maximum allowed upper limit of 90 during operation of the step.

The original program remains unaltered, so if the user then changes the lower and upper limits to match the range of set points within the program, the program will then operate to the programmed set points. This insures that the operating range of the system cannot be exceeded even if a user accidentally copies a program from another system with a greater operating range.

#### **4 Why is Holdback not working?**

In order for holdback to function, it must compare the loop process value to the loop set point. When entering a step with a hold event on for a loop, the step time must be long enough in order for the MCT4 to compare the loop process value to the set point to determine if it is within the holdback limit and then issue the command to the loop control to hold the program. This process can take several seconds. If the step time is less than 10 seconds, the program can proceed to the following step prior to the MCT4 issuing the hold command. To insure proper holdback operation, make sure the step time is minimum of 10 seconds (for minute/second time entry) or 1 minute (for hour/minute time entry).



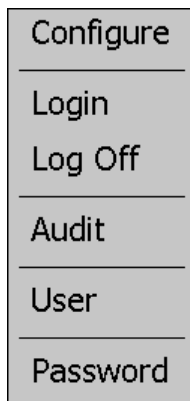
## 7 Security

The MCT4 security model provides an administrator with the tools to add up to 30 users to the system. Each user must have a unique ID, full name and password. Four user levels are provided which include system, user, supervisor and administrator levels. Specific access rights can be assigned to each user level and password aging can be implemented. Verification is provided (if enabled) for any parameters that will change a control parameter, which could upset the process (i.e. loop set point, start/stop automated ramp/soak programs, etc.).

Verification requires that the logged in user must log in again before the process value (at the controller) will actually be changed. This feature is provided for extra security. The following example will make re-authentication clearer:

*A supervisor logs on the system. The supervisor then steps away from the system to take a phone call but does not log out before leaving. If another user tries to change the control set point on any loop, the system will require another login (by an authorized user for that level) before the control set point is actually changed. This provides an extra level of protection to make the system more “tamper proof”.*

The Security menu is accessed from the home menu and provides access to the security section of the MCT4.



The Security menu provides the following functions:

Configure	Provides access to security setup to add users, set rights and options.
Login	Log on a user if security is enabled.
Log Off	Log off a user if security is enabled.
Audit	Allows the user to view any of the saved audit trail files.
User	Shows the current user logged into the system.
Password	Allows the current user to change their password.

## 7.1 Adding Users

The “New” user tab provides the ability to add up to 30 users to the system. Select the type of user from the drop-down list (System, User, Supervisor or Administrator). Press each field to add the user ID, full name and password (no spaces allowed, 5 characters minimum and 16 characters maximum). Press the “Create” button to add the user to the system. If the passwords do not match or the user ID is already used, the MCT4 will alert the user and not accept the entry.

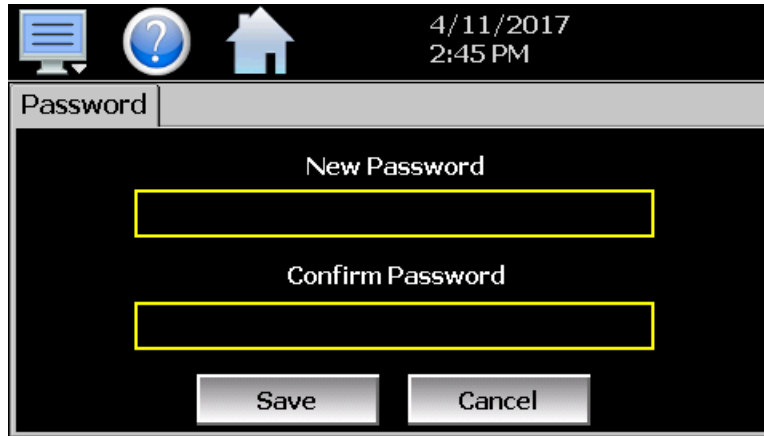
## 7.2 Viewing Users

The “Users” tab provides the administrator with the ability to view information on each user entered into the system. Password information is not available. The user can be deleted from this tab and a new password for each user can also be entered from this area.

To delete a user, select the user from the list and press the “Delete” button. Likewise, to change the password for a user, select the user from the list and press the “Password” button.

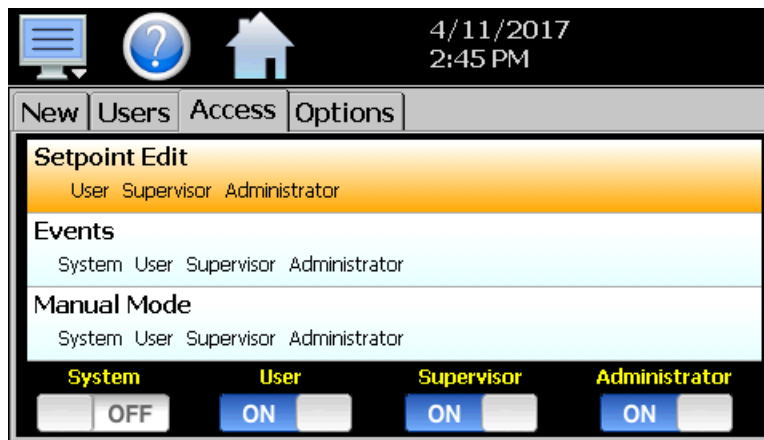
### 7.2.1 New Password Entry

To change a password, select the desired user by touching the User ID in the list box and press the ‘New Password’ button. Enter the new password and confirm the password. Press the “Accept” button to change the password (no spaces allowed, 5 characters minimum and 16 characters maximum).



### 7.3 Setting User Access

The “Access” tab provides the administrator the ability to assign rights to each user level (System, User, Supervisor and Administrator). To enable or disable specific program functions (user rights) for each user level, select the user right from the list and press the corresponding on/off button for the user level you want to change access rights for. If the button is set to on, user access will be enabled for the user group.



User access for “Security” cannot be disabled for the administrator group. This is a safety feature to make sure that any administrator with the proper user ID and password can access security. If the administrator loses his/her ID or password, there is no “back door” to the system and it will have to be reset and reprogrammed in order to return to normal operation.

#### 7.3.1 Security System User Access

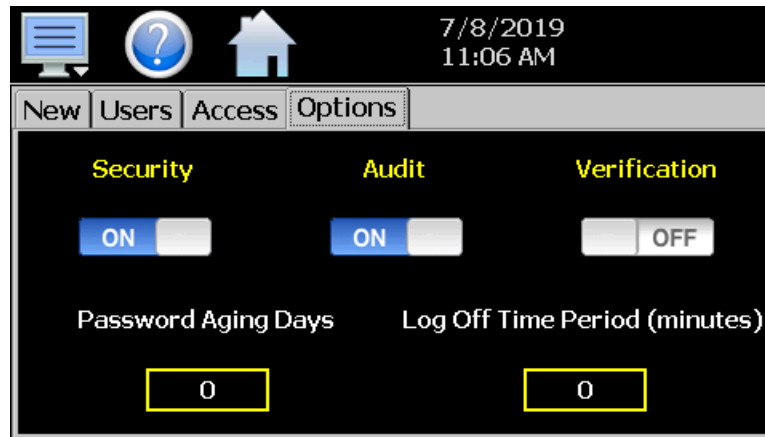
Shown below is a list of the available user rights, where to find the menu item(s) applicable to the user right and a description of what it applies to. Note that the OEM configuration allows many menu items to be disabled; in which case the menu for a specific user right may not be shown.

User Right	Menu Location	Description
Setpoint Edit	View/Loop, Overview	applies to loop controls when not running an automatic ramp/soak program (does not apply to loop alarms)
Events	View/Events	applies to enable or disable manual events
Manual Mode	View/Single	enable or disable loop control Manual mode button
Automatic Tune	View/Single	enable or disable loop control Automatic Tune button

User Right	Menu Location	Description
Program Operate	Program/Run, Hold, Stop actions	applies to all program control menu selections; does not affect digital Inputs configured for same action
Recovery	Device/Settings/Offline/Set/Recovery	logic when running an automated ramp/soak program when power lost & recovery:
Reset Alarms	View/Alarm	alarm Reset button
Clear Alarms	View/Alarm; Clear button	prevents alarm list view from being cleared
Chart Settings	View/Chart	configure plot channels, scale & time for charts
Data	Data/Data	applies to all data logging actions & settings
Annotation	Data/View/Annotation	access to add operator messages to active log file
Signature	Data/View/Signature	access to add digital signature to active historical data file
Open	see description	alarm, automatic program, audit & data files
Save	see description	program "save" and "save as"; note files may be copied from system with USB file transfer utilities
Delete	see description	data files & automatic programs; note files may be deleted with File Utilities
Program Edit	Program/Entry	no data entry or access to Events or Step SP/Time fields; can't insert/delete/copy/paste step.
USB	Data/Utilities/USB	allows USB memory stick to copy/delete data, alarm, program & audit trail files & to import programs
FTP/WAN	Data/Utilities/FTP/WAN	configure FTP client settings
Communications	Device/Settings/Set/Comms	configure web page, Modbus address & VNC settings
Tuning	Device/Settings/View/Tuning	manual adjustment of loop tuning parameters
Setpoint Limits	Device/Settings/Set/Limit	applies to loop controls (does not apply to loop/monitor alarms)
Adjust Alarms	Device/Settings/Set/Alarm	applies to all loop and monitor point alarms
Event Names	Device/Settings/Set/Event	configure event tagnames (seen in manual Events & program step Events)
Email Settings	Device/Settings/Email/Email Settings	configure email settings and addresses
Email Message	Device/Settings/Email/Message	access to compose & send email message
Offline	Device/Settings/Offline	access to Off-Line menu system: Units, set Clock, Calibrate Touch, Language, Exit To Application, input Offset, Configuration
Calibrate Touch	Device/Settings/Offline/System/Display	access to the touch screen calibration utility
Backlight	Device/Settings/Offline/System/Display	access to edit backlight settings for brightness and off delay time
Alarm Volume	Device/Settings/Offline/System/Display	allows edit of MCT4 alarm beeper volume
Units	Device/Settings//Offline/Set/Units	loop/monitor point temperature units configuration - C\F
Clock	Device/Settings/Offline/Set/Clock	Set Date/Time, Time Zone, DST and NTS connection
NTP	Device/Settings/Offline/Set/Clock	enable & choose National Time Server location
Daylight Savings	Device/Settings/Offline/Set/Clock	enable Daylight Savings Time (DST)
Language	Device/Settings/Offline/Set/Language	Select help language
Security	View/Security/Configure	applies to Security Setup
Configuration	Device/Settings/Offline/System/Configuration	access to import/export setup files of MCT4
Default Configuration	Device/Settings/Offline/System/Configuration; Reset Default Configuration button	function to clear system configuration and reset all to blank (default) state for reconfiguring
Exit (run mode)	Device/Settings /Offline/System/Exit; "Exit application. (automatic mode startup)." button	prevents MCT4 application from being stopped
Exit to Configurator	Device/Settings /Offline/System/Exit; "Exit Application. (configuration mode startup)." button	prevents MCT4 application from being stopped and access to the MCT4 configurator application
Cascade	Device/Settings //Cascade	Set cascade settings when cascade control enabled.
Calibrate Inputs	Device/Settings /Offline/Calibrate	Provides user offset calibration or full calibration of all MCT4 inputs.

## 7.4 Setting Security Options

The security “Options” tab provides the administrator the ability to set the global security options.



**Security** is the global setting that turns the MCT4 security system on or off. The security system must be enabled for the audit trail to be enabled.

**Audit** is a global setting that turns the audit trail on or off. When the audit trail is turned on, all user actions are written to a daily log.

When enabled, **Verification** requires that the logged in user must log in again before the entry value will actually be changed.

The **Password Aging Days** field is a global for all users. Password aging starts from the day the user is entered into the system. The value can be set from 0 to 365 days. A value of zero disables password aging.

**NOTE:** *When using password aging and the password expires for a user, the user will be required to change their password before access to the system is permitted. A user can change their password at any time (even if aging is not used) by selecting “Password” from the main security menu.*

The **Log Off Time Period (minutes)** field is a global for all users. The log off time begins once a user logs into the system. If the user does not perform any actions within the specified time, the system will automatically log the user out. User actions are defined as any action that requires a process change, i.e., changing a SP, changing an alarm description, etc. Any field protected by security settings of the MCT4 are user action fields. The log off time can be set from 0 to 1440 minutes (24 hours). A value of zero disables the auto log off feature.

**NOTE:** *If a user begins an action such as changing a set point, but does not complete the task and leaves the numeric keypad shown, the system will log the user out if the log off time elapses. However, since the keypad is still shown, the set point change can still be completed as the task had already begun. In this case, if a user then enters a new set point, the audit trail will record the change under the user that was previously logged in, but since the user was automatically logged out while the keypad was shown, the user will be required to log in to access the set point again.*

## 7.5 Audit Trail


The audit trail viewer is accessed by selecting “Audit” from the Security menu. It displays all user actions that affected the system for any given day. The MCT4 can store daily audit files for a period of a year or longer (time based on storage usage for data history).

Each time a user takes an action that affect the operation of the system (changing a set point, start/stop data logging, changes an alarm set point, etc.), the action is written to a file. Audit trail file names are listed as MMDDYYYY (where MM = month, DD = day, YYYY = year. The “Open” file button will display a dialog box where the user can select any audit file to view.

**NOTE:** *If no actions occurred on a given day, an audit file will not be created for that day.*



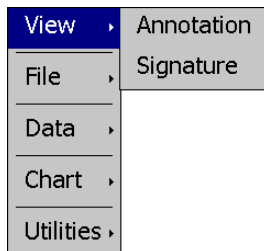
Each action recorded to the file includes the date/time it occurred as well as the user (if logged in) that made the change. If no user is logged in, the user will be listed as “Device Manager”, which is the default user account for the MCT4 system.

The send email icon  allows the user to send a copy of the currently opened audit trail file to any user configured in the MCT4. When the email icon is pressed, an “Add Recipients” window will be displayed where the user can select recipients for the file from any of the email addresses configured under the MCT4 email settings. For information on how to add email recipients to the MCT4, see the section 9.9, Email.

## 8 Data Logging

The MCT4 data logging features are accessed via the home ‘Data’ menu item. The system data logging provides the ability to select individual points for logging, view data log files and start/stop logging operations. The logging ability of MCT4 provides an easy-to-use, convenient method to obtain electronic data without the need for additional data acquisition equipment.

The Data Log menu provides navigation to the following functions:



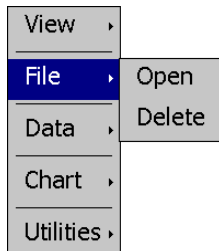
### View menu

Annotation:

Allows the user to insert a notification into the currently running log file or view all annotations associated with the currently loaded historical data file.

Signature:

Allows the user to digitally sign a file to prevent data tampering and view all digital signatures associated with the currently loaded historical data file.



### File menu

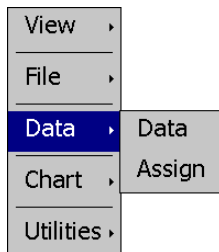
Open:

Opens a history file for review.

Delete:

Allows the user to delete the currently loaded history file.

**NOTE:** The “Delete” log file function does not affect data from a file that is running, only the current data log file loaded for review.



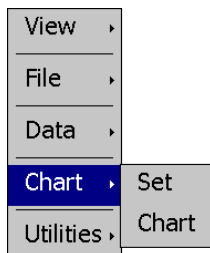
### Data menu

Data:

Displays main data log screen with status of logger.

Assign:

Allows the user to select what variables are to be logged.



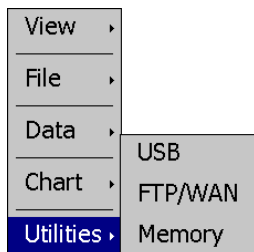
### Chart menu

Set:

Selection of data file points and time period for history review.

Chart:

Plots historical data after time and points are selected.



### Utilities menu

USB:

Allows the user to access file utility functions.

FTP/WAN:

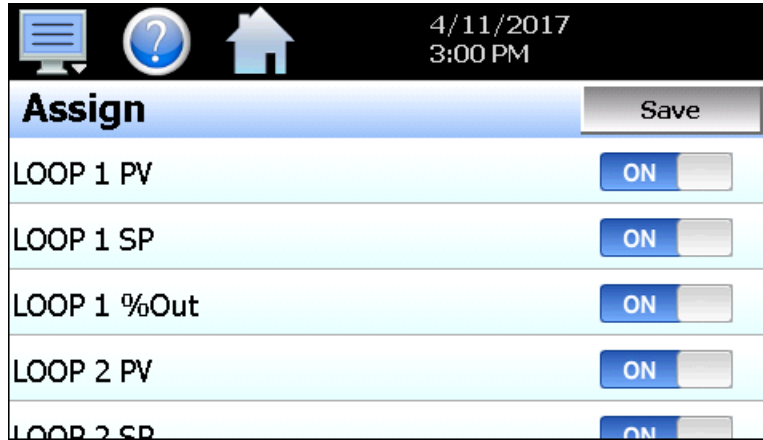
Provides access to the automatic file back-up settings.

Memory:

Displays memory capacity remaining on MCT4.

### 8.1 Selecting Points for Logging

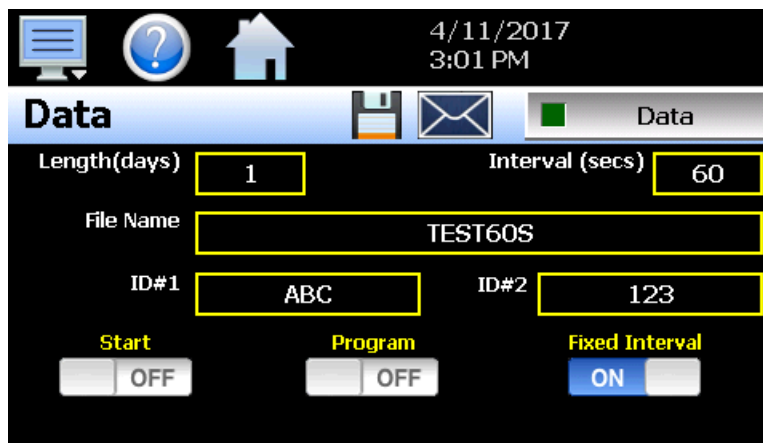
In order for the data logging function of the MCT4 to operate, the user must first select what variables are to be logged to the data file. To choose which points are to be logged, select “Assign” from the Data menu.



Press the on/off button for each item to toggle it on/off. When on, the variable will be logged to the data file. When selections are completed, press the “Save” button to save the point selection to memory. New selections will not take effect until the Save button is pressed.

### 8.2 Starting/Stopping Data Logging

The MCT4 logs data to its SD card. Current data for each variable is written to the log at a fixed interval based on the settings entered in the “Length” and “Interval” fields. File names are automatically generated using MMDDYYYY-HHMMSS format (where MM = month, DD= day, YYYY = year, HH = hour, MM = minutes, SS = seconds). To use a specific file name, touch the “File Name” field and enter the desired name (up to 16 characters). When a file name is entered, the file will be saved as FileName\_MMDDYYYY-HHMMSS.



The data logger also provides two entry fields, **ID#1** and **ID#2**, which allow the user to enter in information specific to the file such as a batch and/or lot number to identify product that may be associated with the new data file. These entries will be saved with the data log file for later identification.

The ID#1 and ID#2 fields are also used to identify the MCT4 when DataWeb is active (see section 8.5 FTP/FileWeb/DataWeb Interface). When the DataWeb feature is in use, the ID#1 and/or ID#2 entries are used to identify a specific MCT4 from many units that may be sending data to the same database. The ID#1 and ID#2 fields also allow the user to search for only the data specific to a single unit in the remote database. The entries in these fields should be unique to each MCT4 connected to the server.



If more than one MCT4 utilizes the same entries, the data from all units with the same ID's will be combined under the one ID in the database. This will render the data unusable as there will be no way to split the data between the different units and know which data points are from each unit. If this does occur; however, the MCT4 will still have a local copy of the data stored to the local data log file(s). This provides a backup copy of the data just in case the ID numbers of more than one unit are identical.

The **Length (days)** field sets the length of a data file in number of days. It can be set for 1 to 31 days. Once the selected number of days has elapsed, a new data file will be created and logging will continue in the new file.

The **Interval (secs)** field is used to set the rate at which points are written to the log file which equates to the sample rate in seconds. When the "Fixed Interval" option is turned on, the logging interval will be automatically set to record at minute intervals based on the number of days set for the file. If the file is set for 1 day in length, the logging rate will be at 1-minute intervals. If the file is set for 7 days, then the logging rate will be every 7 minutes. This keeps the data file size manageable and able to be viewed by the MCT4 data viewer.

The log interval can be manually set to any rate between 1 and 1860 seconds in any combination with the number of days before a new file is started. To do this, turn off the "Fixed Interval" option and enter in the desired logging rate in seconds.

**NOTE:** *Logging at shorter intervals allows the MCT4 to capture fast changing processes, but the data files can become extremely large. Files that exceed the capability of the MCT4 data viewer (>520KB in size) will have to be extracted from the MCT4 using a USB memory stick or FTP file transfer in order to be viewed remotely on a PC.*

*Files larger than the 520KB limit will not be automatically, digitally signed by the MCT4. If the files are to be digitally signed, this must be done manually by extracting the files and using the FDC data viewer program running on a remote PC.*

To manually start data logging, press the "Data" button. Any time logging is enabled, the indicator on the Data button will be illuminated. To stop data logging, press the Data button again. Data logging can also be started automatically by turning on the "Start" or "Program" option.

The **Start** option automatically turns data logging on whenever the MCT4 is first powered on. This action simulates that of a standard chart recorder.

The **Program** option is a convenient method for gathering information that pertains only to the operation of an automatic ramp/soak program. When selected, the MCT4 will turn the data logger on at the beginning of a program and off once the program is completed. This eliminates the need to scan through extensive data records to find the specific information you are looking for from a particular time period.

**NOTE:** *The MCT4 will automatically use the program name as the filename for the log file (up to 14 characters). This provides a simple identifier for log files that pertain only to automatic program operation. Any entry made in the File Name field will be ignored.*

The **Email** icon next to the data log on/off button allows the user to select the currently open data file and email the file to any user that has been setup to receive emails from the MCT4.

The **Disk** icon next to the **Email** icon allows the user to save the currently opened data file to a USB memory device connected to the MCT4.

### 8.2.1 Calculating Log File Size

The MCT4 saves the log file in a text-based format (.csv), so the amount of memory consumed for each reading is dependent upon the number of digits required to accurately display the value (1 byte per character). This optimizes memory usage but also makes calculating an exact file size difficult. To obtain a worst-case approximation of the resultant file size, use the following formula:

$$\text{File Size (Bytes)} = (64 + \text{LD}) * \text{number of readings in the file}$$

Where:

$$\text{LD (loop data)} = 7 * \text{number of points selected for logging}$$

#### Example

MCT4 with three loops of controller data (PV, SP, %Out selected) for each loop (total of nine points). Logging set at one second interval running for a duration of one day.

$$\text{LD: } 7 * 9 = 63$$

$$\text{number of readings in file: } 60 \text{ secs/min} * 60 \text{ mins/hr} * 24 \text{ hrs/day} = 86400$$

$$\text{File Size (Bytes)} = (64 + 63) * 86400 = 10,972,800$$

An MCT4 logging nine points of data at a one second interval will consume a maximum of 11MB of memory per day. With an SD memory card size of 8GB, the MCT4 can log data for approximately two years before the SD memory card is full.

$$8\text{GB} = 8,000\text{MB (total memory card space)} / 11\text{MB (per day)} = 727 \text{ days (1.9 years)}$$

**NOTE:** Available memory space on the SD card is also affected by the number of ramp/soak programs, alarm files and audit trail files that are stored. The quantity and size of these files will reduce the memory space available for logging. Regular file maintenance is recommended in order to ensure adequate space remains available for the logging of data.

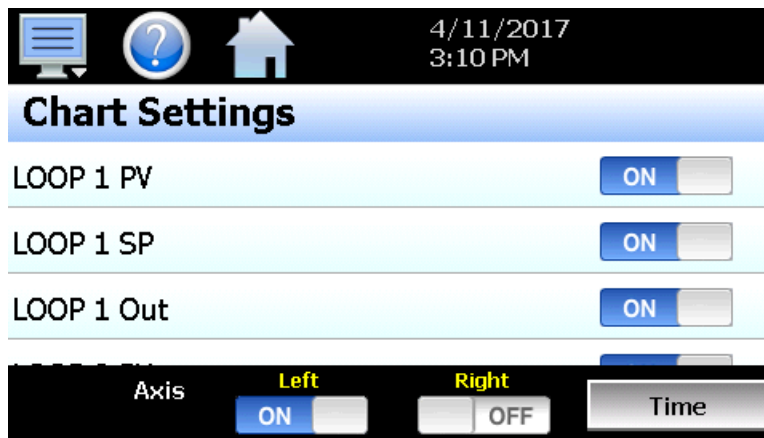
## 8.3 Reviewing Historical Data

Historical files can be opened and viewed using the historical viewer. In order to view a historical data file, it must first be opened by selecting "Open" from the File menu. Once the file has been opened, the MCT4 can automatically plot the first eight channels of the historical data file or the user can choose to cancel the plot and select which channels should be plotted as well as adjust the specific time period to plot.

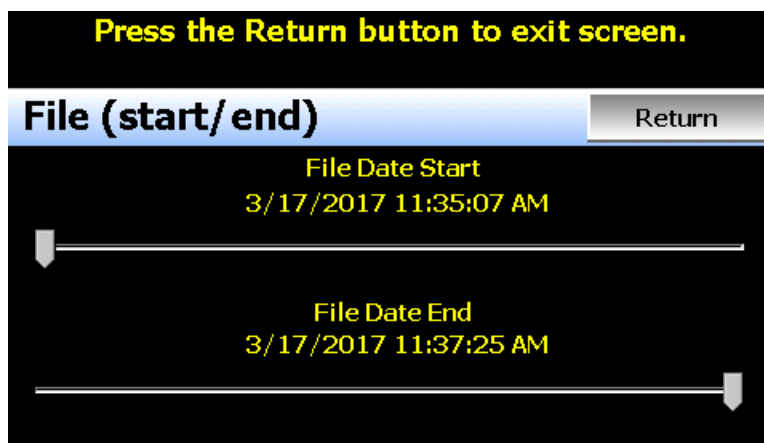
**NOTE:** The open historical data file list will display up to 650 files. If more than 650 log files are present, the files cannot be shown in the list and the files will have to be exported from the MCT4 in order to view them. This can be done either via USB file utilities (see section 8.4) or FTP (see section 8.5).

### 8.3.1 History Plot Setup

The history plot setup allows the user to select any time frame (zoom in/out) from the historical data file as well as select up to six channels of data to plot. To edit the settings for the historical plot, select "Set" from the Chart menu.



Any point from the data file can be selected along with the vertical axis to be used for each channel to be plotted. Select channels from the list by turning them on or off and use the “Left” and “Right” axis buttons to assign the selected item to the left or right axis for the plot range. To adjust the period of time to plot from the data file, press the “Time” button.

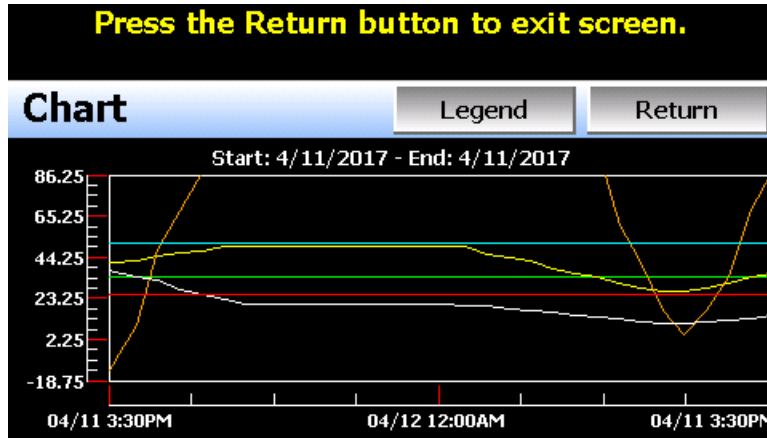


The start and end dates for the currently loaded file will be shown with time in hours, minutes and seconds. The “File Date Start” and “File Date End” sliders are used to select a time span for historical viewing. Once the desired start and end times have been set, press the “Return” button to return to the Chart Settings screen.

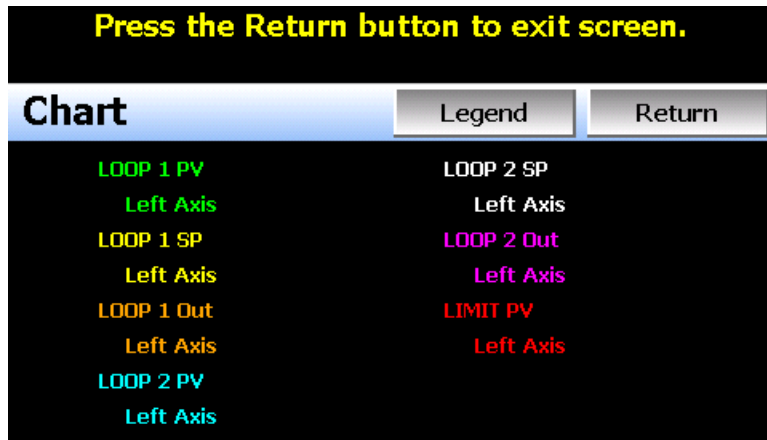
### 8.3.2 Plotting Historical Data

The history Chart plots the data from the currently opened history file according to the selections made under chart setup. If a file has not been opened or data points have not been assigned to a plot, the MCT4 will alert the user to correct the problem. The ‘X’ and ‘Y’ axis scales are set to auto scale based on current values for each plot channel so no user action is required.

The historical graph provides the same zoom feature as the real-time charts so the user can zoom in on a particular area of the historical plot by dragging their finger across the screen to draw a rectangle around the desired plot area.



Pressing the “Legend” button will provide the user with channel information by displaying the names of the selected plot channels, which axis they are associated with and the color used to display the plot channel. Pressing the button again will toggle the display back to the historical chart.



**NOTE:** When pressing the Legend button to toggle between the historical chart and the legend screen, it may take several seconds for the chart to become visible depending on the size of the data file and number of channels selected to plot.

When finished viewing the historical chart, you must press the “Return” button to exit the historical data viewer and return to the main data log screen.

## 8.4 USB File Transfer

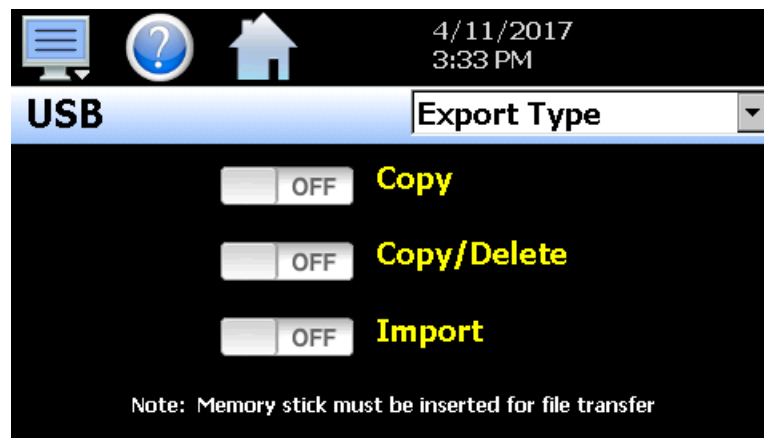
The “Utilities” section of the MCT4 interface provides all the functionality required for retrieving files and maintaining the internal SD memory card. The internal SD card should not be removed from the MCT4 interface. Any change to SD directory structure (moving or deleting files with a PC) may cause the MCT4 interface to stop operating and a new SD card will need to be ordered. Never move or delete the directories unless using the provided MCT4 file utilities functions.

**NOTE:** *The data log files, programs, alarm log and audit trail directories are saved to the internal SD card (not the USB memory stick device) plugged into the MCT4 interface. Never unplug the SD card when MCT4 is powered up or loss of data may result.*

The USB file transfer screen allows the user to copy or erase files from the internal SD card. Complete file directories for all MCT4 file types can be copied to the USB memory stick and erased from the internal SD card. The current status for file functions is displayed for the operator during copy/delete operations. The MCT4 also allows automatic programs to be imported from the USB memory stick. Programs must be exported from another MCT4 device to the memory stick first, before this function can be used. The MCT4 will look for “Program” directories on the memory stick for import and alert the user if none exist.

**NOTE:** *All file transfer functions can be used while data logging is running. If the operator needs to back up or delete files from the system, a large number of files could take considerable time to backup and delete from memory. The file transfer screen will be locked during file transfer so plan the timing appropriately when access to other screen functions is not required.*

*When data logging is running, the current data log file will not be copied or deleted while using the file transfer functions. This protects the current file and makes sure that the data file is complete before being copied and cannot be deleted from memory while it is still in operation.*



To **Copy** files, insert the USB memory stick into the USB port. Select the file type you wish to copy from the “Export Type” drop down menu. Available file selections are Program, Alarm, Audit and Data files. Once the selection is made, press the “Copy” button. All related files will be copied to the USB memory stick with progress status displayed to user.

To **Copy/Delete** files from internal memory, insert the USB memory stick into the USB port. Select the file type you wish to copy and erase from the MCT4 internal memory by selecting it from the “Export Type” drop down menu. Available file selections are Program files, Alarm files, Audit trail files and Data files. Once the selection is made, press the “Copy/Delete” button. All related files will be copied to the USB memory stick and then deleted from the MCT4 with progress status displayed to user.

The **Import** file function allows automatic ramp/soak program files to be copied from the USB memory device to the MCT4. A dialog box will appear listing the available program directories on the USB memory stick. Program directory names exported from the MCT4 are in the format 'Programs\_mm-dd-yyyy-hh-mm-ss'.

**NOTE:** *The USB memory stick must be inserted into the USB port for any of the file utility operations to function. It is recommended to only use memory sticks certified by Future Design Controls for use with the MCT4. Future Design Controls has tested and validated these memory devices for proper operation and performance.*

*Due to manufacturing variations in the USB memory sticks, it may take a few seconds up to 30 seconds for the MCT4 to recognize the device when it is plugged in. Allow sufficient time for the device to be recognized before attempting any file utility operations or the MCT4 will indicate a file transfer/memory stick error.*

When files are being copied to the USB storage device, a directory for each file type will be created to store the copied files. The directory structure is as follows:

Program files directory:	Programs_mm-dd-yyyy-hh-mm-ss
Alarm files directory:	Alarm Files_mm-dd-yyyy-hh-mm-ss
Audit files directory:	Audit Files_mm-dd-yyyy-hh-mm-ss
Data files directory	Data Files_mm-dd-yyyy-hh-mm-ss

The purpose for using the date and time as part of the directory name, is to make sure the user can track the date and time of the file transfer. If a user transfers a file type more than once in a single day, the files will be grouped logically by time.

When accessing the data files saved to the USB memory stick, the data files will be in ".csv" format. These files can be opened directly with Microsoft Excel or any program that opens a comma separated file format. You can copy or empty the "Data Files" directory by simply plugging the USB device into a PC's USB port. The device then becomes like any removable disk attached to the computer and can be manipulated once plugged into the PC.

The FDC Data Viewer program is a free Windows accessory program that allows users to view, plot and print data files and is available from Future Design Controls or any manufacturer that markets the MCT4 product. It is required when using the digital signature feature of MCT4.

**IMPORTANT:** *Once files are deleted from the MCT4 storage devices, they are gone and cannot be retrieved. DO NOT edit, move or delete any other files from the internal SD memory card unless using the MCT4 file utilities. The MCT4 will not operate properly if the file/directory structure is altered.*

#### **8.4.1 Recommend File Maintenance**

A quick note about file storage; data and setup files (programs, data files, alarm log and audit trail files) need some maintenance every now and then. After a period of time, storage devices fill up and files require backup or file deletion when no longer needed. The Microsoft WinCE platform allows for a maximum of 999 files per directory when all the files begin with the same 8 characters. Alarm and audit files are recorded by date (one per day) with the format of MMDDYYYY (where MM = month, DD = day, YYYY = year) so there is essentially no limit to the number of files other than available storage area.

Data log files however, could reach the maximum based on the number of files created per day and if the logging on Program is enabled or a file name is specified by the user. If data logging is manually started or activated on system Startup and only 1 file is created per day, there will be no effective file limit since the first 8 characters of the file name are the date, like that of alarm and audit files.

If a file name is specified or logging on Program operation is enabled, each file will begin with the same prefix. Thus, multiple files can begin with the same 8 characters this limiting the maximum number of files that can be stored. At a frequency of 3 per day, 7 days a week for example, the maximum 999 files would be reached within one year. It is recommended that a quarterly maintenance schedule be adopted to copy and delete all data files from the MCT4 through either the USB file transfer or FTP backup utilities to prevent the maximum file number from being reached.

If the maximum number of files is reached, the MCT4 will display the alarm message “Data file error. SD card full or missing.” and data logging will be disabled. Note that there is still sufficient memory space on the SD card; however, due to the maximum number of files being reached, no more files can be placed in the data log folder. Regular backup and removal of files from the MCT4 will prevent this from occurring.

It is also highly recommended to backup and delete alarm and audit files as well. While it is possible to store years of files, the time it will take to copy the files once the time has come, could take hours due to the large number of files. The MCT4 file browser is also limited to a total of 650 files. If the number of alarm files or audit files exceeds the 650 file limit, you will be unable to open and view alarm or audit files on the MCT4. They will have to be exported via USB or FTP in order to be viewed.

More frequent backups will also require less time to perform. The speed at which files can be transferred is more dependent on the number of files than the size of the files. A fewer number of large files takes less time than a large number of small files.

## 8.5 FTP/FileWeb/DataWeb Interface

The FTP/WAN screen allows the user to configure automatic back-up of all data files contained in the MCT4 memory to a user designated FTP or secure FileWeb site (https://). When enabled, the MCT4 will automatically back up all data log files, alarm files and audit trail files at 2:00AM each day. With the optional delete files selection, the MCT4 will then automatically delete the files from its internal memory after back up. This will maintain MCT4 memory automatically, so that continuous data logging can be performed without filling up the available memory space.

The MCT4 also offers a DataWeb LAN/WAN/Cloud interface. This allows the MCT4 to transfer data directly into a server’s data base rather than using file-based data solutions. The DataWeb interface provides the transfer of secure (https://), real time data which can be shared and viewed across networks for real time manufacturing data systems interface.

**NOTE:** *Setting up an FTP site on your network may require authorization and/or assistance from your network administrator. Contact your network administrator for proper settings and authorization from your network server (if required) to allow the MCT4 to connect to the designated FTP site.*

The screenshot displays the 'FTP/WAN' configuration interface on a black background. At the top right, the date and time are shown as '4/11/2017 3:34 PM'. Below this is a blue header bar with the title 'FTP/WAN' and two buttons: 'Start' and 'Save'. The main configuration area contains several fields and controls:

- Type:** A dropdown menu set to 'FTP'.
- IP Add:** A text field containing '192.168.1.15'.
- User:** An empty text field.
- PSWRD:** An empty text field.
- Server:** A text field containing 'FTP Data Files'.
- Port:** A text field containing '21'.
- Automatic Transfer (2:00AM):** A toggle switch currently set to 'OFF'.
- Delete internal files when done:** A toggle switch currently set to 'OFF'.

The **Type** drop down is used to select the FTP/WAN interface. Choices are FTP, FileWeb and DataWeb.

The **IP Add** field is used to enter the IP address of the FTP/FileWeb/DataWeb site that MCT4 is to interface with.

The **User** field allows you to enter a user name for site access. When the MCT4 connects to the FTP/FileWeb/DataWeb site, the user name will be used to identify the connection. If a security login is required (FileWeb/DataWeb always require security credentials), the proper user name will have to be entered in this field. If security is not used (FTP only), this field can be left blank (blank for anonymous login using FTP only).

The **PSWRD** (password) field is used in conjunction with the user name field and is for entering a password so the MCT4 can access the site. If security is not used (FTP only), this field can be left blank (blank for anonymous login using FTP only).

The **Server** field is used to enter the directory information where the files are to be backed during FTP/FileWeb operation. This field is not used during DataWeb interface selection. When the connection occurs, the MCT4 will place the historical data files in the “Sever” field directory structure when using FTP/FileWeb interfaces. The MCT4 will automatically create an “Alarms” directory and an “Audit” directory within the specified server directory for backup of the alarm files and audit trail files. The “Sever” field for FTP and FileWeb must match the directory structure setup at the server.

For example, if FTP is used and the “root” path at the server is “Files”, in order for the MCT4 files to be transferred to this directory, the “Sever” field must contain the text “Files”. If there is a directory inside of the server root “Files” directory named “unit1775” and the files are to be transferred to this directory, the “Server” field must contain the text “Files/unit1775”. The FTP operation will error and the transfer will not be completed if the “Server” field is not entered properly or does not match the FTP server configuration.

**NOTE:** For FileWeb operation, the Server field is optional and can be left blank. It can be used to enter additional directory information (if desired) on where the files are to be stored. By default, the MCT4 is hard coded to store files on the specified server in the “\Files\user name\” directory. If an entry is made in the Server field, the resulting path would be “\Files\user name\server\”.

When the **Automatic Transfer (2:00AM)** option is turned on, the MCT4 will perform an automatic backup of all historical data files, alarm files and audit trail files contained in its internal memory to the designated FTP/FileWeb site. Note that if data logging is currently active, the active file will not be copied. When the **DataWeb** interface is used, real time data is transferred to a database rather than transferring actual files so this option is not used and is disabled.

When the **Delete internal files when done** option is turned on, the MCT4 will delete all data log files, alarm files and audit trail files within its memory after completing the backup to the FTP site. Note that if data logging is currently active, the active file will not be deleted. When the DataWeb interface is used, real time data is transferred to a database rather than transferring actual files so this option is not used and is disabled.

Once all settings have been made, press the “Save” button to save the settings so that on the next power-up, the entries will be maintained. The “Start” button can be used at any time to perform a manual data backup using FTP or FileWeb interfaces. If the files already exist on the FTP/FileWeb site, they will be overwritten on each subsequent backup. If the FTP/FileWeb site is down, or the MCT4 is not connected to the network, a local alarm message on the Alarm screen will indicate a transmission failure.

**NOTE:** Typically, FTP/FileWeb Server connections use case sensitive alpha-numeric characters for the User name, Password and Server directory. Contact your network administrator for proper settings.



### 8.5.1 More About FTP, FileWeb and DataWeb Interfaces

FTP servers (File Transfer Protocol) have been around for many years and can be installed on local or network machines. The FTP server allows a client (MCT4) to transfer files to the FTP server once installed. This allows for manual and automatic backup of data from the MCT4.

MCT4 Field Setup	FTP Server Setup
Type = FTP	FTP server setup for passive operation (see Appendix section A.2 FTP, FileWeb, DataWeb Requirements/Installation for additional information).
IP Add = xxx.xxx.xxx.xxx	Actual IP address of FTP server
User = userName	Actual user name for login if authentication used.
Password = userPassword	Actual password for login if authentication used.
Server = myFTP	FTP server setup with a root directory named "myFTP". The FTP server directory path must exist and match the MCT4 setup for proper operation. If there is an additional directory within the "myFTP" root directory, its name would be appended to the path. (i.e. myFTP/Files if a "Files" directory inside the myFTP server root directory is the target for transfer).
Port = 21	Port used at MCT4 and open at FTP server.

**NOTE:** Make sure proper permissions are set at the FTP server for access/creation of directories and read/write access. Also check root directory structure at Server to identify the actual root that was created for the files since there can be additional layers created by the server and displayed in the path.

The FileWeb interface allows the MCT4 to transfer its files to a web site for download which can then be viewed using a standard web browser. This interface provides the user the ability to setup a web site to store files for local or global access without installing an FTP server. The MCT4 supports https:// (secure) transfer of files.

MCT4 Field Setup	FileWeb Server Setup
Type = FileWeb	FileWeb server setup (see Appendix section A.2 FTP, FileWeb, DataWeb Requirements/Installation for additional information).
IP Add = https://fdctuil.com/FDDataService.svc	Actual named address of FileWeb server/service.
User = userName	Actual user name for login at FileWeb server (required).
Password = userPassword	Actual password for login at FileWeb server (required).
Server = <i>optional path</i>	The FileWeb server/service must be configured with a root "files\" directory in order to use the MCT4 FileWeb feature. The MCT4 is hard coded to transfer files to the "files" directory in the root of the server. If the Server field also contains an entry (i.e. optionalPath), the resulting path would be "files\optionalPath". If the directory does not exist, it will be created at the server by the MCT4 based on the permissions settings at the server.
Port = not used	

**NOTE:** Make sure proper permissions are set at the FileWeb server for access/creation of directories and read/write access. Also check root directory structure at Server to identify the actual root that was created for the files since there can be additional layers created by the server and displayed in the path.

The DataWeb interface allows the MCT4 to transfer data to a web data base service using MySQL and Microsoft IIS as a web platform. The MCT4 can interface directly to a local or Web data base (Cloud) thereby allowing access to any system globally without any special “client” applications required to view the data. This allows the MCT4 to share data with local or global manufacturing systems by storing data directly to a manufacturing database. The MCT4 supports https:// (secure) transfer of data.

MCT4 Field Setup	DataWeb Server Setup
Type = DataWeb	FileWeb server setup (see Appendix section A.2 FTP, FileWeb, DataWeb Requirements/Installation for additional information).
IP Add = https://fdctuil.com/FDDataService.svc	Actual named address of DataWeb server/service.
User = userName	Actual user name for login at FileWeb server (required). This is the directory where the database structure will reside on the server. The MCT4 will use this directory path for sending data to the database.
Password = userPassword	Actual password for login at DataWeb server (required).
Server = not used	The directory where the database exists uses the userName as the default location for data storage.
Port = not used	
Data logging screen entries:  ID#1 = unit specific identifier ID#2 = unit specific identifier  (see section 8.2 Starting/Stopping Logging)	Used as the unit identifiers by the remote database in order to store the data sent from the MCT4. At least one field must contain an entry and should be unique to any other MCT4's that connect to the same server database.

**NOTE:** An IT professional with experience is required for DataWeb server setup. Future Design Controls does not support server-side programming or setup but can offer 3<sup>rd</sup> party resources to assist with or handle complete server-side projects.

The DataWeb interface does not transfer complete files for backup like the FTP and FileWeb interfaces. The DataWeb interface transfers records in real time based on the log setup interval at the MCT4. When logging is started at the MCT4, data will begin transfer to the server-side site. Data will be transferred to the server at the beginning of logging (one record) with additional records transferred based on the rate that the MCT4 data log interval is set for.

If the data log interval rate is set for 60 seconds, the MCT4 will populate the database with a single set of records (PV, SP, %Out determined by data log/server setup) once every 60 seconds. If the data log interval rate is set for 120 seconds, the MCT4 will populate the database with a single set of records (PV, SP, %Out determined by data log/server setup) once every 120 seconds. Data log intervals can be set as fast as a 1 second since buffering is used at the MCT4 for faster data log rates, but in this case the database would receive a total of 60 records once per minute (one record per second). Buffering for rates faster than 1 minute is used to reduce access/overhead at the server side while still maintaining 1 second date/time stamps for database record keeping.

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**8.5.2 FileWeb/DataWeb Server Components and Requirements.**

While the actual server-side development is more involved than this manual will cover, component overview and installation is covered in section A.2 of the Appendix.

**Web Development Support:**

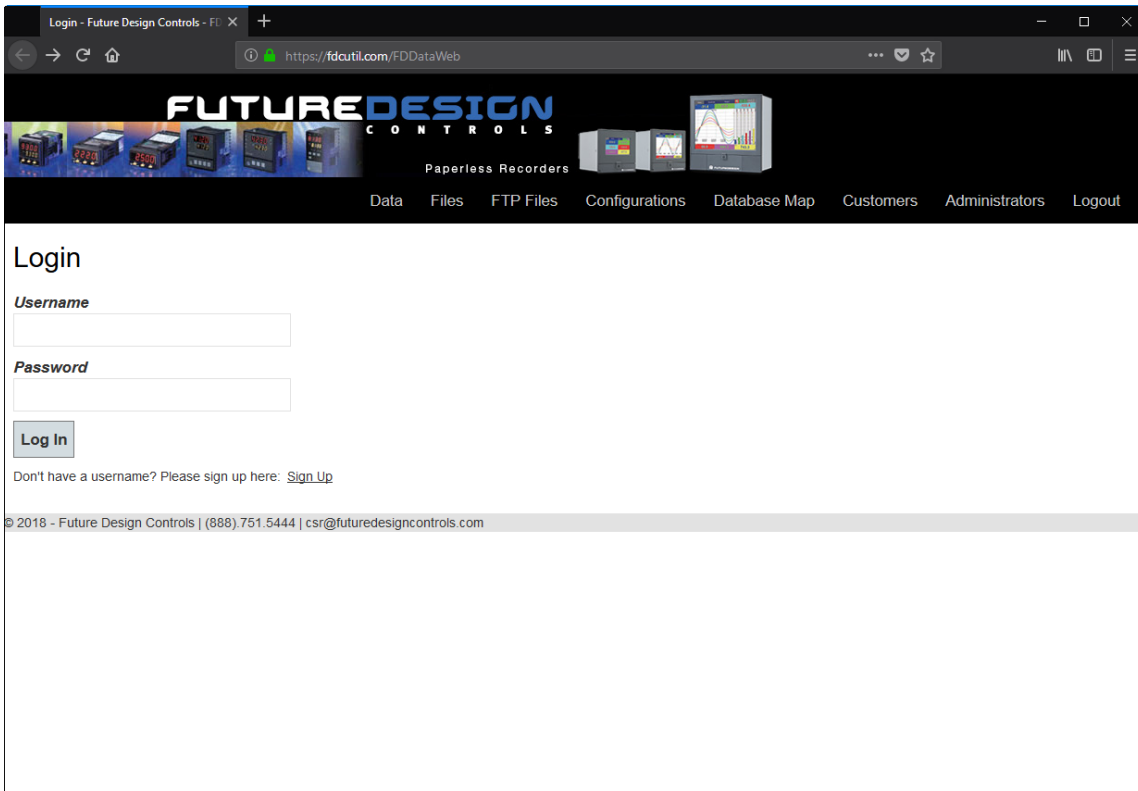
Future Design Controls does not support or develop custom server-side web solutions. We can offer 3rd party resources to assist customers in these development requirements.

### 8.6 FDCUtil.com Web site for FTP, FileWeb and DataWeb Testing

The FDCUtil web site is a Future Design Controls http/https site that allows customers to create a free account and test the FTP, FileWeb and DataWeb interfaces offered on the MCT4. The site automatically deletes files every hour since this is a test site only and cannot be used for permanent web storage of files or data. The site allows customers to fully test and verify that data is being transferred properly from the MCT4 device to the FDCutil site, thereby providing everything needed to test the MCT4 and the Internet connection without requiring additional software or development. This allows the customer to test the interface and pick which type of data transfer is the best for operations.

#### Access the Web Site and Create an Account:

To create a free account, go to the following link: <https://fdcutil.com/FDDataWeb/>



Click on the “Sign Up” link. Enter your name, company name, email address and password. Note that your email address will not be used for solicitation purposes. It is used to send an account verification email. The email sent requires no confirming information; it only verifies that a real user got the email before activating the account. Although FdcUtil.com is a no-charge site, important user data is encrypted for additional protection.

Sign Up - Future Design Controls

https://fdcutil.com/FDDataWeb/Login/Register

**FUTUREDESIGN**  
CONTROLS

Paperless Recorders

Data Files FTP Files Configurations Database Map Customers Administrators Logout

### Sign Up

**Name**

**Company Name**

**Email Address**

**Username**

**Password**

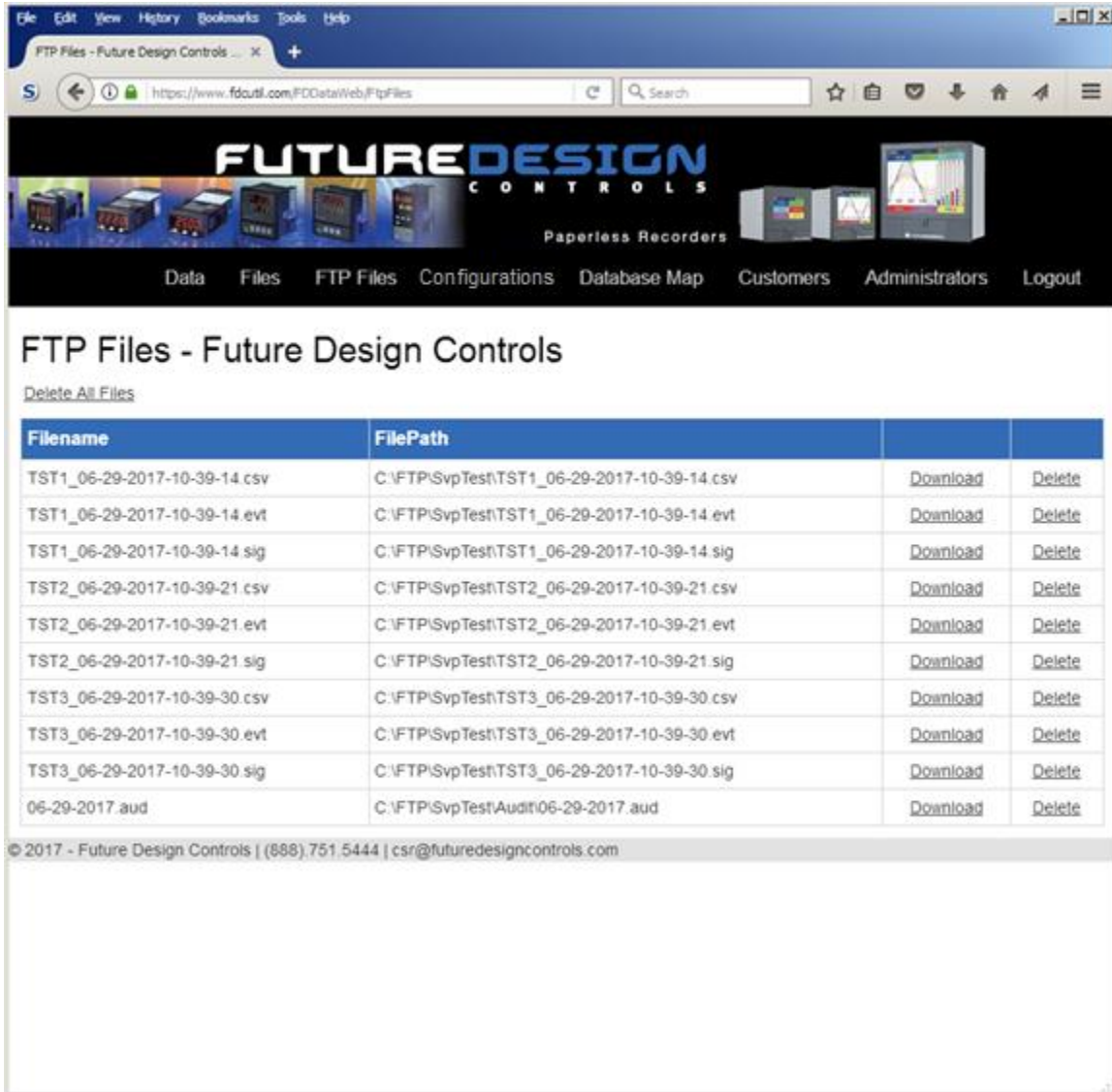
**Confirm Password**

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Once you have created and verified your account, you can log in to the website. Once logged in, the main FDCUtil website will be displayed with tabs for Data (DataWeb), Files (FileWeb), FTP Files (FTP) and Configurations. These tabs can be clicked on and will display data after transfer from the MCT device. Every hour, the data will be deleted from each section (except for Configurations) or the data can be manually deleted using the “Delete” link on each page.

**FTP Files Page:**

The FTP files page, accessible from the “FTP Files” menu item, lists the files in the customer’s FTP data directory. These are only the files in the customer’s directory, not all uploads. The user can delete the files from this page.



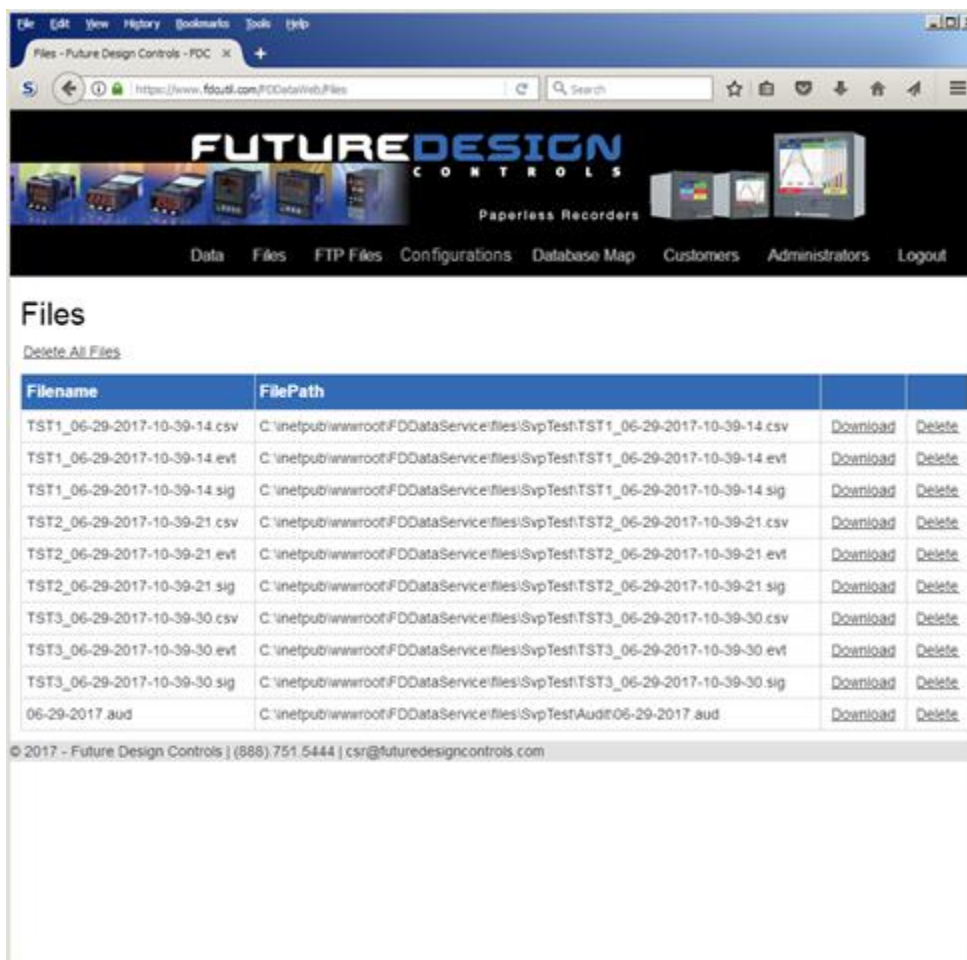
**FTP sample setup using FDCutil.com:**

To setup the MCT for use with the FDCutil.com FTP server, contact Future Design Controls technical support for FTP access. The FTP section of FDCutil.com is used for tech support (pass/fail) testing only when validation is required at a customer site (customer site not working for some reason). This is due to the user-based security in the FileWeb/DataWeb interfaces not included in the FTP services.

After FTP access is given by FDC technical support, press the “Save” button to complete the setup on the MCT FTP/WAN screen. Press the “Start” button to begin a manual transfer of files from the MCT to the FDCutil.com site. Login to the FDCutil.com site to view the FTP files by pressing on the FTP files link on the page (or press FTP link if already logged into FDCutil.com).

### Data Files Page (FileWeb):

The data files page, accessible from the “Files” menu item, lists the files in the customer’s data directory. These are only the files in the customer’s directory, not all uploads. The user can delete the files from this page.



### FileWeb sample setup using FDCutil.com:

To setup the MCT4 for use with the FDCutil.com FileWeb server, go to the FTP/WAN screen on the MCT4 and enter the following data into the screen fields. Make sure to replace the “custName” and “custPassword” text below with the actual user name/password entered during the FDCutil.com signup process.

Type = FileWeb  
 IP Add = https://fdcutil.com/FDDataService.svc  
 User = custName  
 Password = custPassword  
 Server = optional  
 Port = not used

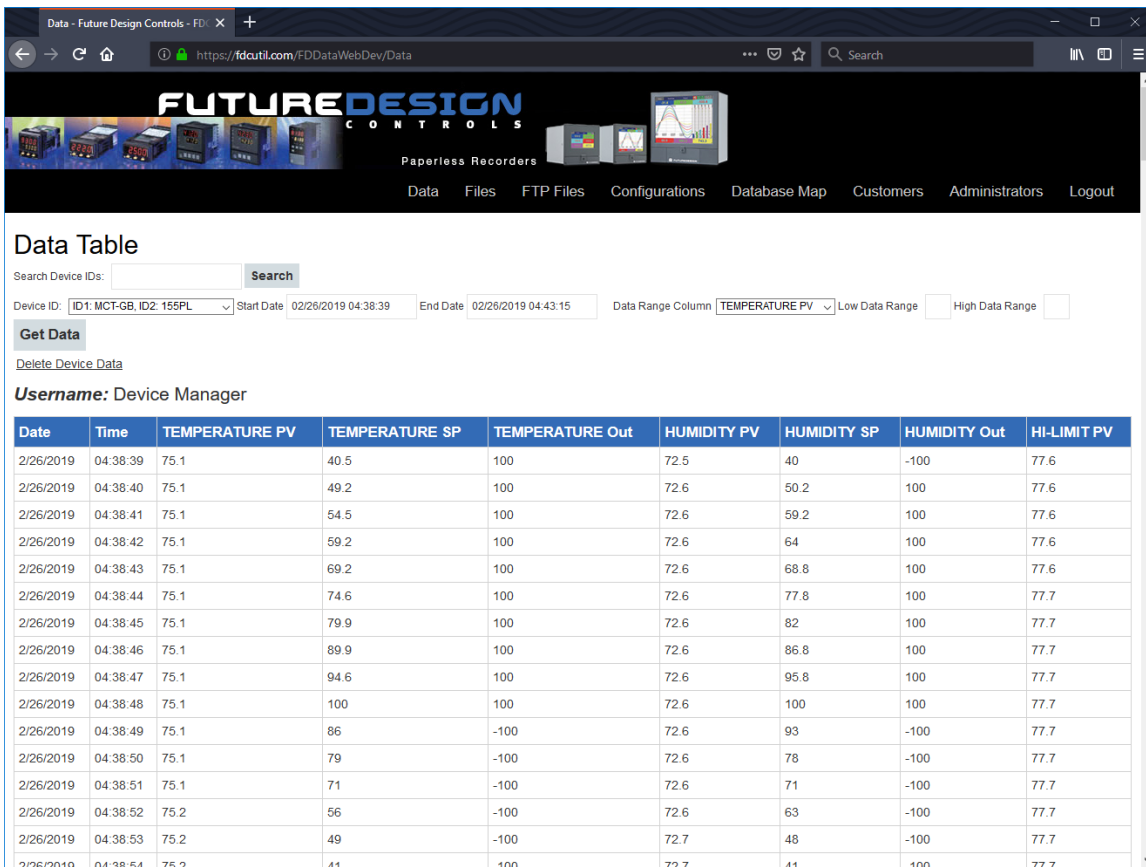
Press the “Save” button to complete the setup on the MCT4 FTP/WAN screen. Press the “Start” button to begin a manual transfer of files from the MCT4 to the FDCutil.com site. Login to the FDCutil.com site to view the FTP files by pressing on the Files link on the page (or press Files link if already logged into FDCutil.com)

**Database Data Page (DataWeb):**

Once logged in, the customer will be shown the Data page. If data has been uploaded to the database, the "Device ID" drop-down menu will contain the list of units (according to the ID#1 and/or ID#2 entries as made on the Data logging screen).



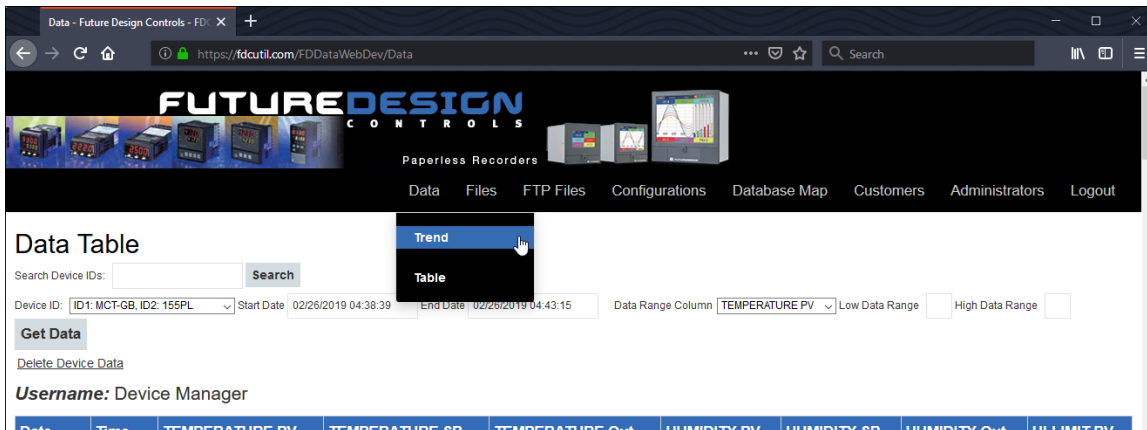
To view the data, select the desired unit from the list and click the "Get Data" button below the Device ID menu. The data available between the Start Date and End Date will be displayed.



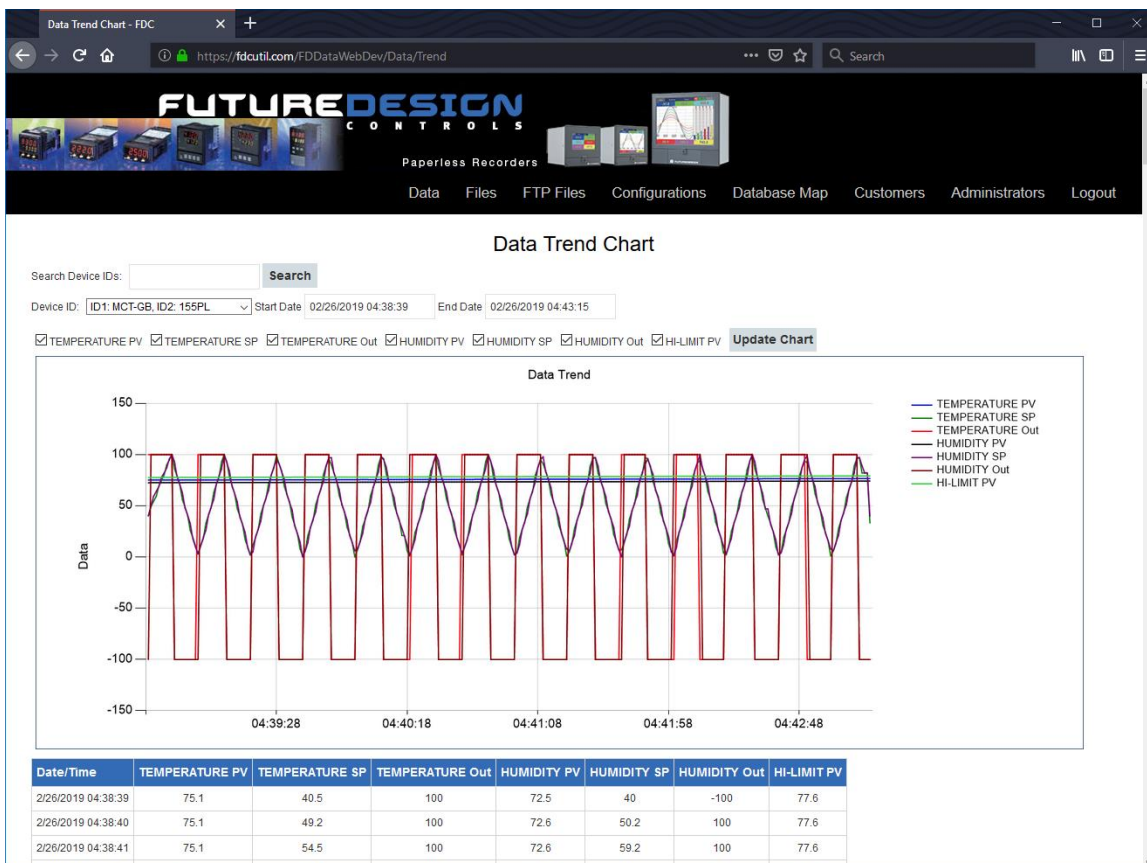
The start and end dates can be altered by simply clicking on the fields to display only data from a specific time frame. When the specified time period is entered, press the Get Data button to refresh the data table. The Data Range Column selection and Low/High Data Range fields can also be used to search for data points that fit within the specified range.



The available data can also be viewed in graph format. Hover the mouse over the Data tab and selections for Trend and Table will be provided.



Once Trend is selected, choose the desired unit from the Device ID menu. Place a check next to each available point you want to plot and click the Update Chart button. A trend plot according to the chosen plot points and time range will be displayed along with the corresponding data table below.



**NOTE:** Once you access the Data Table or Data Trend Chart page, the default start and end times are based on the available data at the server. If an MCT4 is actively sending data, you must manually set the end time to a future date so that each time you refresh the page via the Get Data or Update Chart buttons, the page is updated with the latest data sent from the MCT4.

### DataWeb sample setup using FDCutil.com:

To setup the MCT4 for use with the FDCutil.com DataWeb server, go to the FTP/WAN screen on the MCT4 and enter the following data into the screen fields. Make sure to replace the “custName” and “custPassword” text below with the actual user name/password entered during the FDCutil.com signup process.

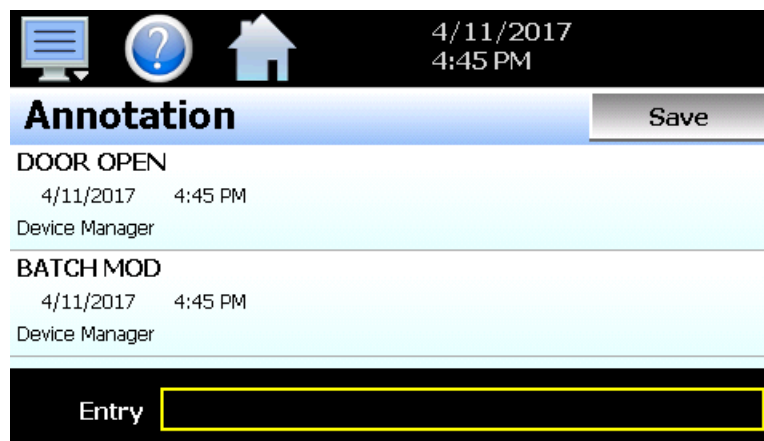
Type = DataWeb  
 IP Add = https://fdcutil.com/FDDataService.svc  
 User = custName  
 Password = custPassword  
 Server = empty (no characters)  
 Port = not used  
 ID#1 = unique identifier of your choice  
 ID#2 = unique identifier of your choice

Press the “Save” button to complete the setup on the MCT4 FTP/WAN screen. Next, navigate to the Data logging screen. Make entries in the ID#1 and/or ID#2 fields. These entries should be unique to the MCT4 and not duplicates of any other MCT4 you may have connected to the site. Once logging is started at the MCT4, data will begin transfer to the “Data” section of the server-side site. Data will be transferred to the server at the beginning of logging (one record) with additional records transferred based on the rate that the MCT4 data log interval is set for.

If the data log interval rate is set for 60 seconds, the MCT4 will populate the database with a single set of records (PV, SP, %Out determined by data log/server setup) once every 60 seconds. If the data log interval rate is set for 120 seconds, the MCT4 will populate the database with a single set of records (PV, SP, %Out determined by data log/server setup) once every 120 seconds. Data log intervals can be set as fast as 1 second since buffering is used at the MCT4 for faster data log rates, but in this case the database would receive a total of 60 records in 1 minute (one record per second). Buffering for rates faster than 1 minute is used to reduce access/overhead at the server side while still maintaining 1 second date/time stamps for database record keeping.

## 8.7 Annotation

The Annotation screen allows the user to add messages to the running data file and view any messages currently associated with a loaded historical data file.

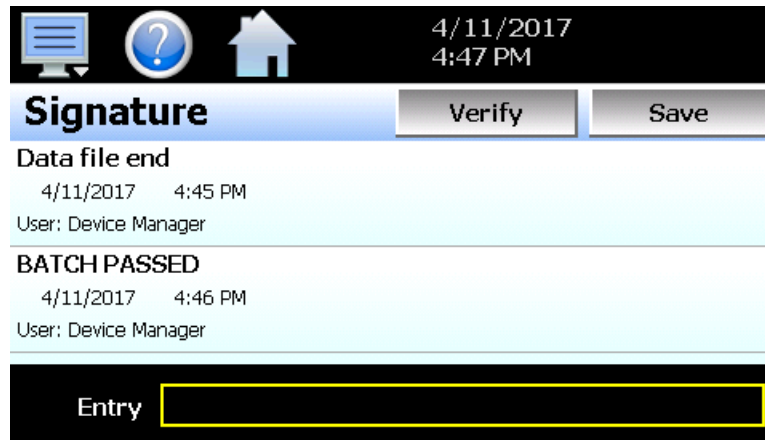


When a historical data file is loaded, the Annotation screen will display any messages that were written to the file. The date, time, user name and description of the data file annotation is shown. Note that the currently running data log file can be opened as a historical data file, and the current annotations for the running file will be shown.

To add an annotation to the running log file, touch the “Entry” field at the bottom of the screen and enter the message (up to 16 characters maximum). Press the “Add” button and the message will be added to the current log file. If the running log file was opened as the historical log file, the annotation will be shown immediately on the screen as it is added. If logging is not currently running, the entry field will be disabled.

## 8.8 AddView Digital Signatures

The Signature screen allows the user to add digital signatures to historical data log files and view any digital signatures currently associated with the loaded historical log file.



When a historical data file is loaded, the Signature screen will display any signatures currently associated with the file. To verify a digital signature and insure that the data file has not been altered, touch the signature in the list box and press the “Verify” button. The MCT4 will compare the signature to the log file to see if any alterations to the data have been made. The MCT4 will then indicate if the signature is valid or not.

If the signature is valid, the historical data file is intact and has not been altered. If the signature is invalid, the data has been altered at some time after the signature was assigned to the file. For data integrity, the MCT4 automatically signs a data file when logging is stopped; however, this only occurs if the “Auto Interval” is selected on the Log screen. If a different logging interval is used, the MCT4 will not automatically sign the file and it must be signed by a user.

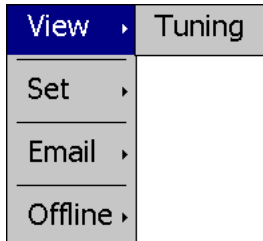
To add a digital signature to the historical log file, touch the “Entry” field at the bottom of the screen and enter in the comment line for the signature (up to 16 characters maximum). Press the “Add” button and the signature will be added to the log file. The signature includes the date and time of the signature, the user name and comment line. If a user is not logged into the system, the default user name “Device Manager” will be entered as the user.

**NOTE:** *The Signature screen is not available if security is disabled. The MCT4 security module must be enabled in order to digitally sign data log files. See Section 7, Security.*

## 9 Device Settings

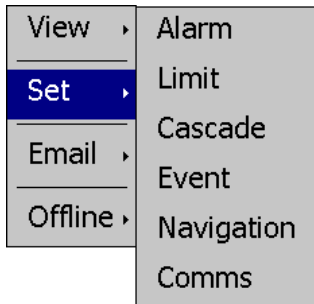
This section covers the use of extended controller features that enhance the functionality of the system. To gain access to the MCT4 setup options, select “Settings” from the home Device menu.

The Device Settings menu provides navigation to the following functions:



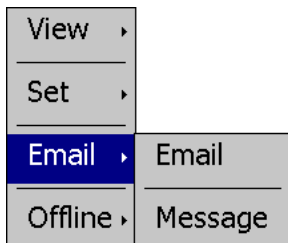
**View menu**

Tuning: Provides access to manual loop tuning.



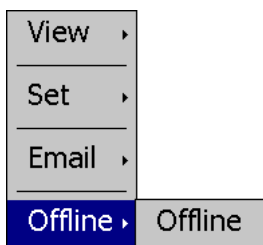
**Setup menu**

Alarm: Provides access to the alarm set points/message entry.  
 Limit: Sets minimum/maximum set points allowed for each loop.  
 Cascade: Provides access to the cascade control set points.  
 Event: Allows the user to edit names used to describe events.  
 Navigation: Allows the user to choose text based or icon based/slide page navigation menus.  
 Comms: Allows user to set MCT4 communication settings.



**Email menu**

Email: Provides access to the MCT4 email system manager.  
 Message: Allows the user to send an email message to users entered in the system.

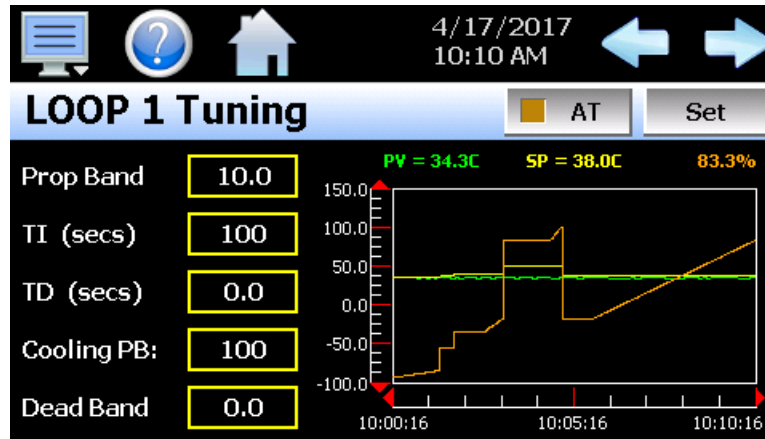


**Offline menu**

Offline: Provides access to offline system settings.

## 9.1 Tuning

The loop Tuning screen allows for manual and automatic tuning of the MCT4 control loops. Tuning parameters should only be manually adjusted by skilled users familiar with proportional control. Improper settings can result in control loop instability and equipment damage. The loop automatic tune function is the recommended method of loop tuning. If the control response achieved after performing an auto tune does not provide the desired control response, then minor adjustment of the tuning parameters may be done manually to obtain the desired response.



The available tuning parameters are dependent upon the loop configuration. If programmed for heat or cool only control, then the available parameters will be PB (proportional band), TI (integral time period) and TD (derivative time period). If the loop is configured for heat/cool operation then two additional parameters for Cooling PB (cooling proportional band) and Dead Band (heat/cool dead band) will be provided.

The tune screen also provides a live real time chart for monitoring the control response of the control loop while adjusting tuning parameters. The chart is fixed at a 10-minute time period and updates once per second.

Pressing the **Set** button allows the user to adjust the loop set point without having to leave the tuning screen in order to observe the control response.

Pressing the **AT** button allows the user to activate/deactivate the loop auto tuning feature. When auto tune is active, the indicator on the button will be illuminated. In addition, the process value of the loop on the Loop view screen will flash while auto tune is active. This allows the user to activate auto tune and then return to the main Loop view screen to observe system operation while being informed of the loop auto tune status.

### 9.1.1 Heat or Cool only P (or PD) Control

When a loop is programmed for heat or cool only control, it is possible to set the integral time to zero in order to eliminate reset action. A "PB Offset" field will then be shown for entering a manual reset value to correct for the control offset that will occur once the loop has stabilized. The offset entry is measured in percent with a range of 0-100%.

Once the process has stabilized, if the process value is lower than the set point by 5° for example, and 20.0 is used for the proportional band, that is equal to an offset of 25%. Thus, the PB offset would be increased by 25% to compensate for the set point offset in the process. Note that automatic tune is disabled for P or PD control. In order to perform an auto tune, the integral time would have to be set to a value greater than zero. P or PD control is not precise for processes with changing load conditions and will require frequent adjustments of the offset. The PID control mode should be used because it automatically does this.

**9.1.2 Heat/Cool (Bimodal) Control**

When a loop is programmed for heat/cool operation, the values of the Cooling PB and Dead Band affect the way the heat and cool outputs work together to control the process.

The **Cooling PB** is measured in % of the proportional band with a range 50-300. Set cooling PB to 100% to begin and examine the cooling effect. If cooling action should be enhanced then decrease the cooling band. If cooling action is too strong then increase the cooling band. The value of the cooling proportional band is related to the heating proportional band and its value remains unchanged throughout any auto tuning procedures.

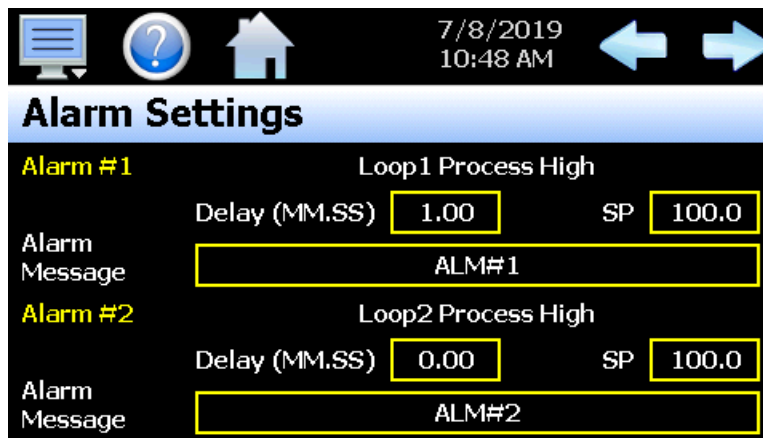
**NOTE:** *The adjustment of the Cooling PB is also related to the cooling media used. When air is used as the cooling media, it is recommended that the Cooling PB be set to 100%. For oil, a typical setting to use for the Cooling PB is 125%. If water is used as the cooling media then adjust the Cooling PB to 250%.*

The adjustment of **Dead Band** is more dependent upon system requirements. If more positive values of dead band (greater dead band) are used, an unwanted cooling action can be avoided but an excessive overshoot may occur. If more negative values of dead band (greater overlap) are used, an excessive overshoot can be minimized but an unwanted cooling action may occur.

Dead band is adjustable in the range of -36.0% to 36.0 % of the heating proportional band. A negative dead band value provides an overlap between heating and cooling action in which both outputs can be active at the same time. A positive dead band value provides a dead band area in which neither output is active around set point.

**9.2 Alarms**

The alarm screen allows the user to edit the alarm set points and alarm messages that will be displayed on the alarm screen should the alarm be activated.



The alarm numbers, **Alarm #**, identify the alarms currently shown on the screen along with the alarm description which contains the loop name that the alarm is assigned to as well as the alarm type. The left and right scroll buttons at the upper right of the screen will be shown if more than two alarms are available so that the user can access each alarm by pressing left or right to go to the previous or next alarm.

The alarm **Delay (MM.SS)** and **SP** (set point) fields allow the user to enter the alarm delay (in minutes and seconds) and the set point at which the alarm is to activate. The alarm type and alarm hysteresis are defined by the OEM in the MCT4 configuration and cannot be changed. Only the alarm delay and set point can be changed by the user.

**NOTE:** The End of Program alarm type does not have a set point; however, a delay can be set in order to delay the activation of the alarm for a specified time after the program ends.

Alarm delays are only on PCM models beginning with V.17 firmware. If the PCM does not support alarm delays, the alarm delay field will not be shown.

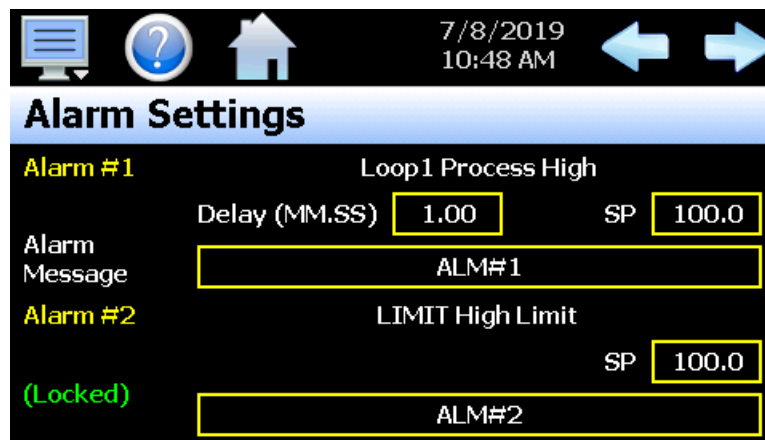
The **Alarm Message** is the text notification that appears on the Alarm screen when the alarm activates. This message can be edited (up to 25 characters maximum) so that the alarm message more accurately describes what the alarm means.

**NOTE:** The MCT4 supports a total of 9 hardware + 10 software alarms for a total of 19 alarms. The MCT4 loop control boards can provide up to 3 alarm outputs each for a total of 9 alarms (when three PCM's used or two PCM's and HLM limit control). Software alarms activate no hardware electrical outputs when energized and are for display only including audible alarm and email operation.

Depending upon the configuration of the MCT4, some PCM board outputs may perform specific control or event functions. The use of each output, and what it controls, is determined by the system designer. If there are questions or concerns about the configuration and operation of your MCT4 controller, contact your OEM for further information. Only your OEM can address equipment related issues.

### 9.2.1 Limit Alarms

If the limit option is installed, the high and low limit alarm set points and alarm (output 2) set point will be provided depending upon the configuration of the limit control. All limit alarm set points are locked in addition to system security settings if configured. In order to change a limit-alarm set point, the field must first be unlocked.

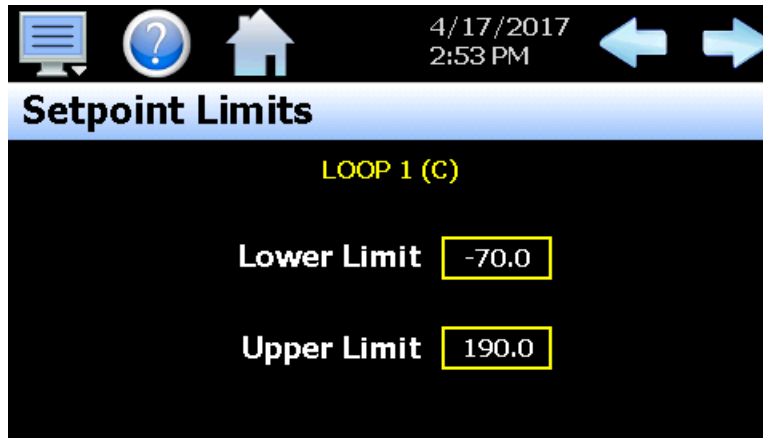


When the alarm is locked, the “Alarm Message” description will be replaced with “(Locked)”. Pressing alarm set point entry field will display a dialog indicating that the field is locked. In order to unlock a limit-alarm set point, press and hold the alarm set point field. After approximately 4 seconds, the “(Locked)” descriptor will be replaced with the standard “Alarm Message” text. When this occurs, stop pressing on the screen and the numeric keypad will be shown. A new alarm set point can then be entered.

After a period of 1 minute (if no further edits are made to limit alarm set points) or upon leaving the Alarm screen, the limit set points will automatically be relocked. The process will then have to be repeated to make another change.

### 9.3 Setpoint Limits

The set point Limit screen allows for the adjustment of the minimum and maximum operating set points allowed to be entered for the control loops. These limits can be used to prevent operators from entering a value that exceeds the survivability limits of equipment or product being manufactured, reducing the risk of property damage.



Enter the desired set point limits by touching the “Lower Limit” and “Upper Limit” entry fields and enter the desired values using the numeric keypad.

**IMPORTANT:** *The operation of automatic ramp/soak programs is limited by the lower and upper limits. If a program was created or imported from another MCT4 system with set points that exceed the current lower and/or upper limits, when the program is run, the program step set points will be coerced to the lower or upper limit that it exceeds. This protects the equipment or product being manufactured from being subjected to values that exceed current set point limits.*

*The minimum and maximum values for the lower and upper limits are defined by the OEM limits set in the MCT4 configuration. The MCT4 prevents the user from entering set point limits outside of these configuration values. Consult your OEM or equipment installer regarding the maximum set point limits permitted for your system.*

### 9.4 Cascade

The Cascade settings screen allows for the adjustment of the cascade low and high or ratio set point. It is available on systems programmed for the Cascade or Dual Loop + Cascade control type in the Configurator.

**NOTE:** *The implementation of cascade control and its mode of operation is application specific and determined by the system designer. The MCT4 provides process, deviation and ratio control modes. The cascade control mode is defined by the OEM in the MCT4 configuration. If there are questions or concerns about the configuration and operation of your MCT4 controller, contact your OEM for further information. Only your OEM can address equipment related issues.*

#### 9.4.1 Process Cascade Mode

This mode uses the low and high set points as the upper and lower range for the secondary loop set point. The percentage of output of the primary loop is converted to calculate a linear set point between these two values. The Process Low and Process High values are limited to the minimum and maximum values for the lower and upper set point limits of the secondary loop as defined by the OEM in the MCT4 configuration.

The process mode has the benefit of maximum change rates by allowing the secondary loop set point to go to absolute limits. This allows the process to achieve set point as quickly as possible but does so at the cost of



stability. If the process has a large lag time, the control may oscillate uncontrollably once the process reaches set point because of the large overshoot. In most cases, deviation is the recommended selection.



#### 9.4.2 Deviation Cascade Mode

This mode uses the low and high set points as the upper and lower range to generate a set point offset for the secondary loop set point relative to the primary loop set point. The secondary loop set point is calculated by adding these values as offsets from the primary loop set point. As the primary loop set point changes so does the window defined by the set points.

The deviation mode has the benefit of limiting the maximum and minimum overshoot that the secondary loop can exhibit relative to the desired primary loop set point. This allows the system to be fine-tuned to the minimum amount of overshoot required to obtain the desired set point.



#### 9.4.3 Ratio Cascade Mode

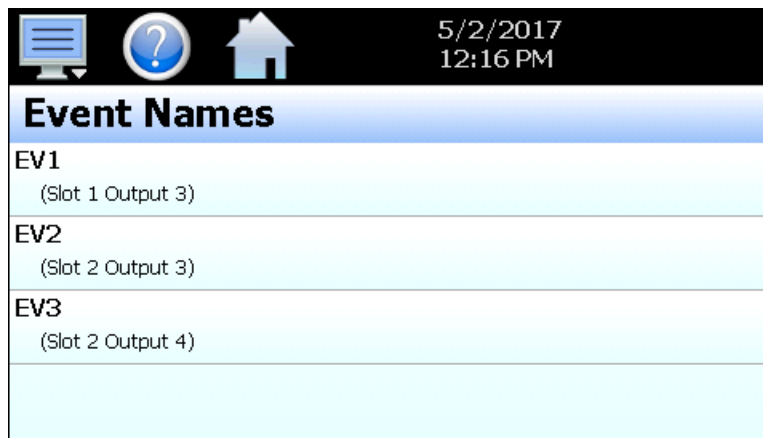
This mode provides a single set point which is used to calculate the secondary loop set point according to the primary loop process value. This is typically used in blending applications where the flow rate of the primary fluid is monitored and controlled via the primary loop, and the secondary loop is to add a fractional amount of another substance to the mix.

As the primary flow changes, the secondary loop set point will adjust according to the ratio multiplier in order to maintain the proper mixture.



## 9.5 Event Names

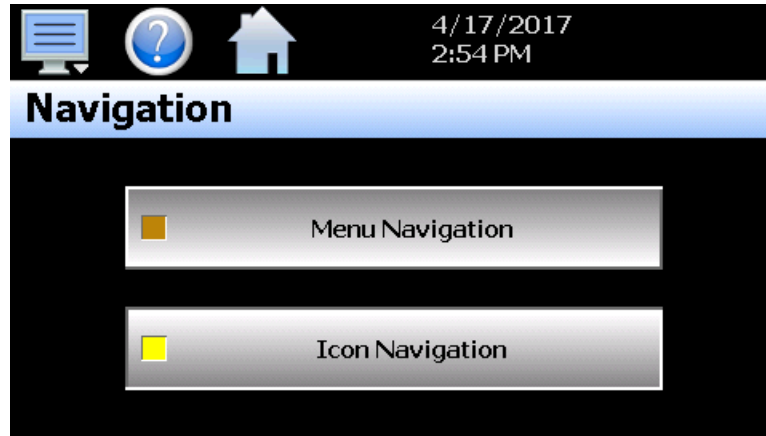
The Event names screen allows the user to change the names of the system events in order to describe what function they perform. The event names are limited to nine alphanumeric characters.



To change the name of the event, select the event by touching its current tag name in the list. Press the "Edit" button and enter the new tag name using the alpha-numeric keypad and press "Done" when finished. The new name will then appear in the event name list box and will be used throughout all MCT4 screens wherever the event is shown.

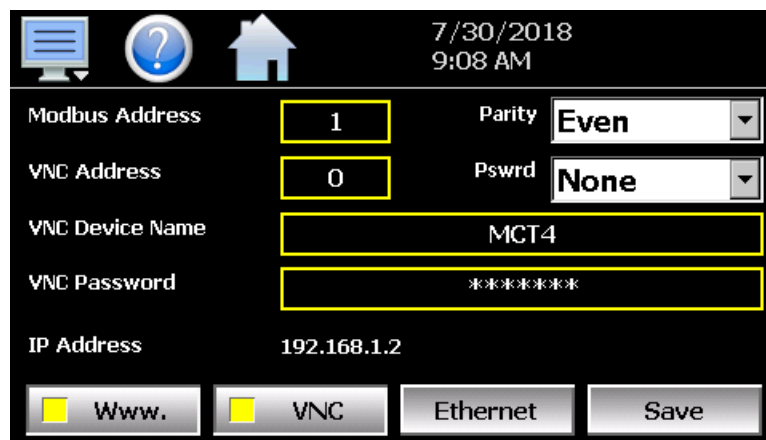
## 9.6 Navigation

The MCT4 provides both text-based PC style menus and icon based/slide page navigation menus similar to today's "smart" devices. The user can select either type at any time from the Navigation screen. Press the button for the desired menu type to make the selection. The choices are mutually exclusive, so when one selection is made, the other will be de-selected. The button indicator for the active selection will illuminate to show the current selection.



### 9.7 Communication Settings

The “Comms” screen provides settings for the Modbus serial and TCP interfaces as well as the web server and VNC interfaces. It also provides the MCT4 IP address, which is required for using the Modbus TCP, VNC and web server interfaces. For more information regarding the use of the MCT4 data communications interfaces, see Section 11, Communications.



The **Modbus Address and Parity** settings are used to configure the serial interface for user communications. Valid addresses are 1 to 247. The parity setting is only available for the standard MCT4 interface and allows the serial port to be set for Even, Odd or no parity (None). If the MCT4 is configured to provide the simulated Watlow F4S/D communications interface, the parity selection will not be provided.

The Modbus Address is also used to specify the unit ID for Modbus TCP communications. Modbus TCP communications is provided over the Ethernet interface on port 502.

The **VNC Address and Password** set access rights to the MCT4 VNC server. Valid addresses are from 0 to 255. The VNC password selection defines the connection mode for the server. The selections are “None” and “VncAuth” which requires users to enter the password when connecting to the MCT4 over the VNC interface.

**IMPORTANT:** *When multiple MCT4 controllers are connected to a single router (DHCP server), it is imperative that each MCT4 have a different VNC address. If multiple MCT4 controllers have the same VNC address, network errors may result causing the VNC server to shut down or cause the MCT4 to “lock-up” and become non-responsive requiring the unit to be power cycled in order to return to normal operation.*

The **VNC Device Name** field is used to enter a name (up to 35 characters) that can better identify the MCT4 to users logged into the VNC interface. The name entered here will be used on the VNC header window on a PC, so that if multiple VNC clients are open to different systems, each one can be identified.

The **VNC Password** field is used to enter the password (up to 20 characters) that a user must enter for the VNC interface to connect to MCT4 if the VNC password is enabled.

The **IP Address** field is a static field that provides the IP address of the MCT4 which is required for connecting over the VNC, web and Modbus TCP server interfaces. See the following section 9.7.1 Ethernet Settings for more information on how to adjust the device IP and other LAN information.

The **Www.** (web server) pushbutton is used to enable or disable the web server interface.

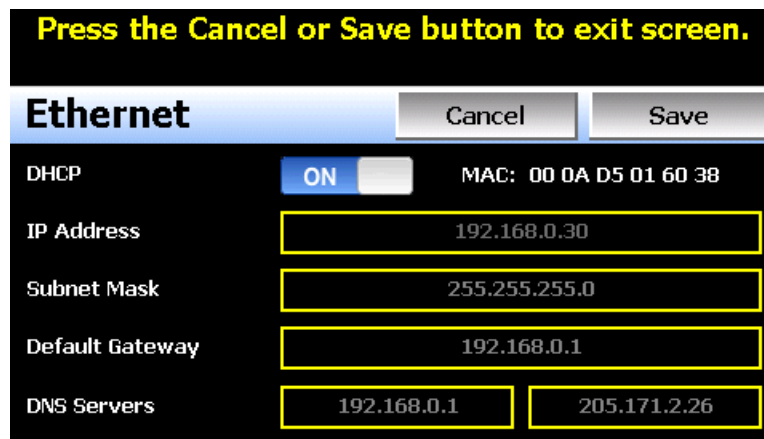
The **VNC** server pushbutton is used to enable or disable the VNC server interface.

The **Ethernet** button is used to access the Ethernet settings screen.

**NOTE:** Any changes made to the above settings must be saved in order for them to take effect. When changes are completed, press the “Save” button. In order for any changes to the VNC server to take effect, power must also be cycled to the MCT4. The new VNC settings will only take effect when MCT4 first boots up. Serial communication and web server settings take effect immediately upon save.

### 9.7.1 Ethernet Settings

The “Ethernet” screen provides settings for the network interface of the MCT4. It is accessed by pressing the Ethernet button on the Communications screen.



The **MAC** address field displays the media access control address (physical address) of the MCT4. This is a unique identifier for the network hardware of the MCT4 and cannot be changed. It is for informational purposes and may be required by your network administrator when connecting the MCT4 to your network.

The **DHCP** button is used to turn automatic addressing on and off. By default, the MCT4 is shipped with the DHCP setting on. This means the MCT4 will be assigned an IP address by the network router. When on, the entry fields will be disabled, but will display current connection information used by the MCT4. In order to enter a static address, press the button to turn it off.

To set the static network address, enter a valid **IP Address**, **Subnet Mask** and **Default Gateway**. The **DNS Servers** are not required, but typically the IP address of the network router is entered to provide one. Consult your network administrator for the proper values. The IP address must not be a duplicate of any other address on the network or the interface will not operate correctly. The entry fields except IPV4 addressing format only. The MCT4 does not except IPV6 addressing.

**NOTE:** When DHCP is on and the MCT4 is disconnected from the network, the entry fields on the Ethernet screen will continue to display connection information based on its last valid connection for diagnostic purposes. The IP address on the main Communications screen (or shown in the notifications list) always displays the current address used by the MCT4. If the IP address on the Communications screen displays the loop-back address of “127.0.0.1” then no connection is present.

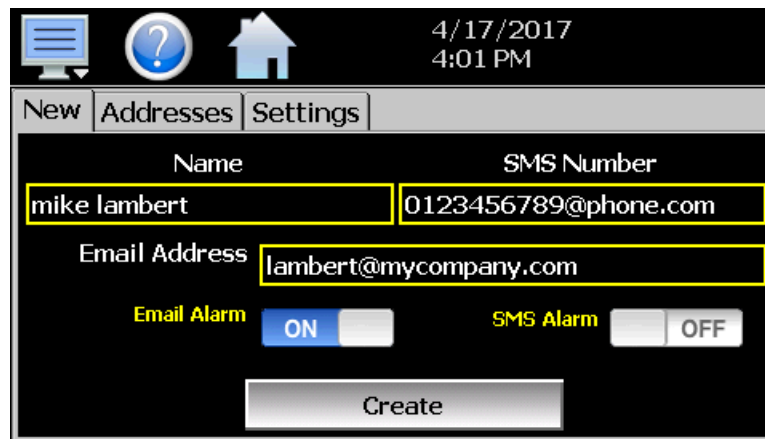
When DHCP is off, the IP address on the Communications screen will always display the user entered static IP address regardless of connection status. It does not indicate whether a valid network connection is present or not.

## 9.8 Email

The MCT4 email server has the ability to send alarm messages to email and SMS addresses. Up to 30 addresses can be programmed into the system. Each one can be configured to receive emails, SMS text messages or both. When an alarm occurs, MCT4 will send an alert to the specified address for each user in the list. The email settings are accessed by selecting “Email” from the setup “Email” menu.

### 9.8.1 Email Address Entry

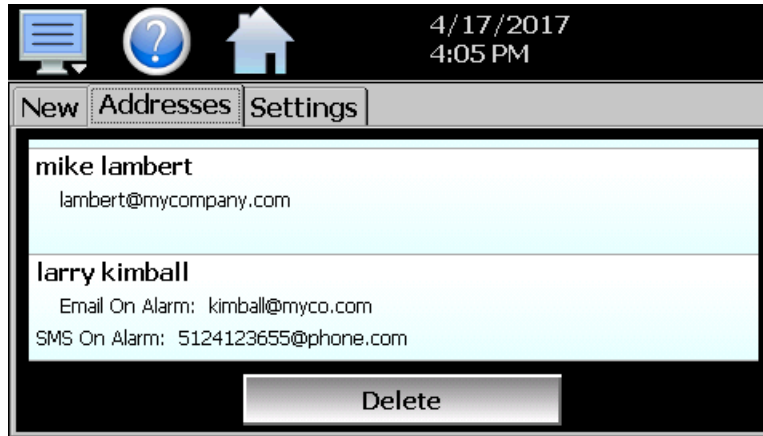
Select the “New” tab to add new email addresses to the system. For each entry, enter the recipient’s Name, Email Address and/or SMS Number (up to 50 characters each). Turn on the Email Alarm and/or SMS Alarm options to specify which addresses the alarm messages are to be sent to. Press the “Create” button to add the user to the list.



**NOTE:** The SMS address is specific to the service provider. Each service provider has their own unique address; however, the phone number is always the “name” for the address entry. There are internet sites with this information that cover most of the providers, or when in doubt, contact your service provider for the proper address format.

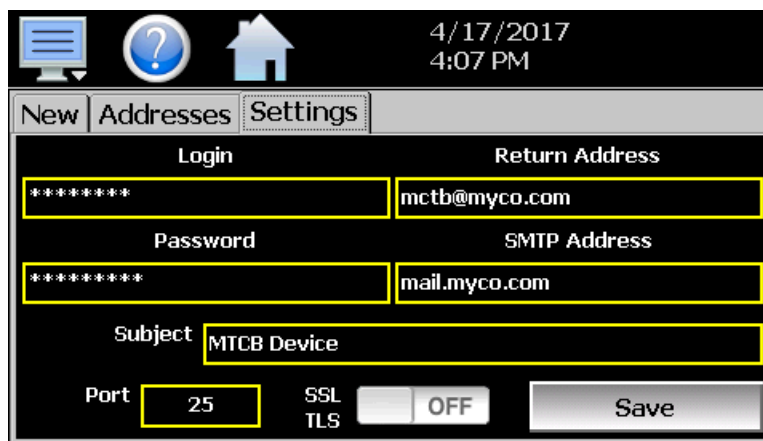
### 9.8.2 Email Addresses

Selecting the “Addresses” tab allows the user to view the list of email addresses entered in the MCT4. Each entry will be shown with the notification method and address associated with it (email/SMS). To delete a user, touch the name of the user in the list box and press the “Delete” button. This will permanently remove the user from the list.



### 9.8.3 Email Settings

The “Settings” tab provides access to the email server configuration, which is how the MCT4 is able to connect and send email messages over its Ethernet connection. Each field may have up to 50 characters.



The **Login** field is used to enter the login name required by the MCT4 to log in to your company’s mail server. You can use your login if one is not set up specifically for the MCT4 on your network. Contact your network administrator for assistance.

The **Return Address** is the address given for the MCT4 on your company’s mail server. The MCT4 does not accept email messages; however, this field is required for proper email delivery for security/anti-spam purposes. If using your personal login name, you can also use your personal email address if one is not set up specifically for the MCT4 on your network. Contact your network administrator for assistance.

The **Password** field is used for entering a password, if required by your network server, to send email. Contact your system administrator for assistance.

This **SMTP Address** field is for entering the address of the email server used for sending emails. This must be a valid mail server for which the above settings allow MCT4 access. Contact your system administrator for assistance.

This **Subject** field is used to enter a subject line for emails and/or SMS text messages. It can be used to provide an identifier to the recipients of the alarm message to know which chamber it is coming from.

**NOTE:** *It is recommended to put some form of entry in this field. It can be left blank; however, many firewalls and spam filters will filter out messages without subject lines. That may prevent recipients from receiving the email. It can also be useful for identifying a particular unit on the factory floor.*

The **Port** field is used to set the port number that will be used on the device for email operations. For non-secure connections (no SSL/TLS) port 25 is the default. If SSL/TLS is used, port 587 is usually the standard port selected.

The **SSL/TLS** button is used to enable or disable **Secure Socket Layer (SSL)** and **Transport Security Layer (TLS)** functionality. These protocols are used to provide an authenticated connection between servers and clients as well as encrypt information between the two. This provides a more secure environment for email information with many public email services only allowing SSL/TLS connectivity.

Once all settings have been made, be sure to press the “Save” button to begin using the new values and store them, so that on the next power up, the settings will be retained. The body of the email/SMS text message will contain the description of the alarm condition as it would appear on the alarm screen. If the mail server is down, or the MCT4 is not connected to the network, the message will not be sent and a local alarm message on the Alarm screen will indicate a transmission failure.

#### 9.8.4 Email Message

MCT4 provides the user with the ability to send short email messages to users configured in the MCT4 email server. To send a message, select “Message” from the device settings, Email menu.



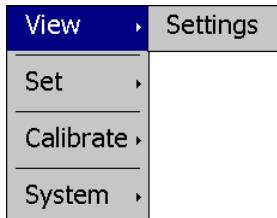
Press the “Compose” button to create a brief message using the keypad (up to 100 characters). When you are finished entering the message, press the “Done” button. The completed message will then be shown in the message window. Press the “Send” button to select the email recipients you wish to receive the message and send the message.

## 10 Offline

The Offline settings do not include the OEM setup of the MCT4. Refer to the documentation provided by your OEM regarding the MCT4 configuration. In order to enter offline setup, automated ramp/soak program operation and data logging must be manually stopped.

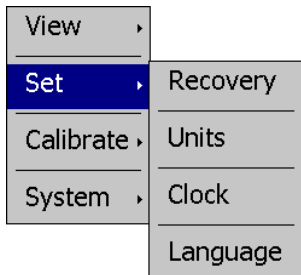
**NOTE:** Upon entering offline setup, all loop control outputs, event outputs and alarm outputs will be set to their corresponding OFF state. Power supply and retransmission outputs will continue to operate normally. Upon returning to the online mode, the outputs will be returned to normal operation. Limit outputs are not affected.

The offline menu provides navigation to the following functions:



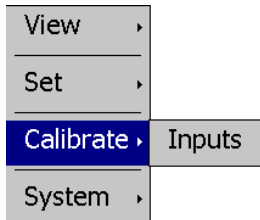
**View menu**

Settings: Navigation back to the device settings menu.



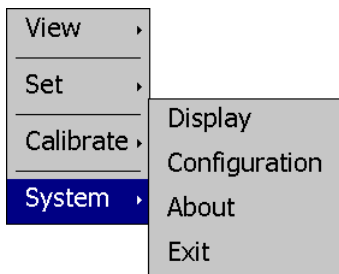
**Set menu**

Recovery: Settings for profile power recovery action.  
 Units: Setting for temperature units.  
 Clock: Settings for system date and time  
 Language: Settings for menu and help language text.



**Calibrate menu**

Offset: Settings for loop input offset calibration.



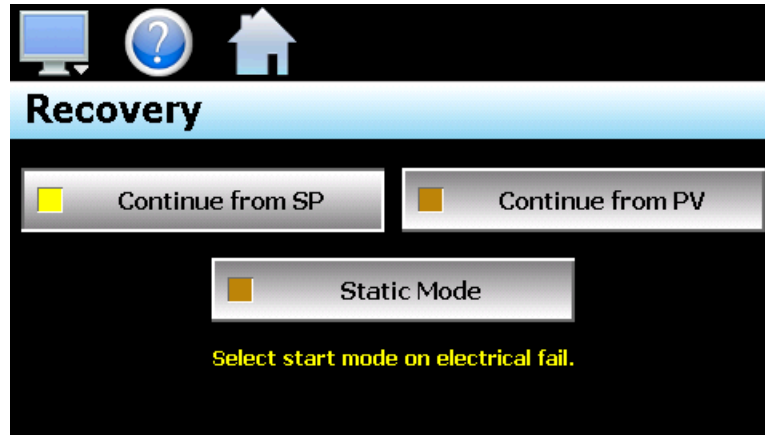
**System menu**

Display: Access to display calibration and backlight settings.  
 Configuration: Access to MCT4 import/export utility.  
 About: View current firmware/software version numbers.  
 Exit: Exit MCT4 application and access to the MCT4 configurator.



## 10.1 Power Recovery

The Power Recovery setting allows the user to select how the system should restart in the event of a power failure while an automatic ramp/soak program was running. When power is restored, the MCT4 will perform the selected recovery action. To set the power recovery action, push the recovery mode button for the desired setting to select it as the power-up state. The selections are mutually exclusive to one another, i.e., only one can be selected at a time. As a new selection is made, the previous setting will be automatically turned off.



Select **Continue from SP** to have the MCT4 resume the program from where it left off on loss of power. The set point ramp will continue from the set point value at the time of power interruption.

Select **Continue from PV** to have the MCT4 resume the program from where it left off on loss of power. The set point ramp will continue from the current process value of the loop and not the last set point value.

Select **Static Mode** to have the MCT4 default to single set point operation on power-up. The program will be stopped and the loops will control to the last static set point entry.

**NOTE:** *When a program is NOT running and a power down/up sequence occurs, the MCT4 will return with the same set points and system events active as when the power was lost.*

**See Appendix section A.3 Profile Recovery Detail for a more detailed explanation and examples of program recovery operation.**

### 10.1.1 Recovery Interval

During program operation, the current program progress is stored in memory on each step change and at 6-minute intervals during step operation. During static set point operation, the current control set point is also stored in memory every 6 minutes.

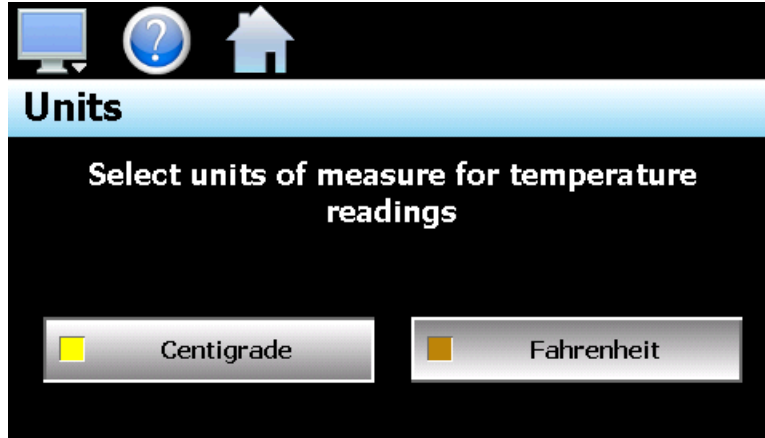
For program operation, this results in a possible recovery error of up to 6 minutes. For example, a program is running and enters step 2 which is a ramp step from 0 to 100 degrees in 10 minutes. If power is lost at 5 minutes into the step and “Continue from SP” is the selected recovery mode, when power is restored the program will begin operation from the beginning of step 2 with a set point of 0. It will not resume operation from 50 degrees at 5 minutes into the step.

If the power is lost at 8 minutes into the step (2 minutes remaining), the program will continue from the last save point which was 6 minutes into the step (4 minutes remaining) with a set point of 60 degrees. For soak steps the set point remains a constant and time remaining is the only variable. So as with the ramp step, the time remaining in the step will continue from the last save point.

When in static set point operation, if the set point is changed and power is immediately cycled, the loop control will resume operation when power is restored from the previous set point, not the one just entered. The save interval is from power up, so when a new set point is entered, it could be saved within seconds or take up to 6 minutes for it to be saved. In order to ensure that the system powers up with the desired set point, maintain power to the MCT4 after a set point change for at least 6 minutes before removing power.

### 10.2 Degrees C/F Units Selection

The MCT4 can display temperatures in either degrees Centigrade or Fahrenheit. To change the temperature display units, select "Units" from the offline Set menu.



Press the button for the desired temperature units to make the selection. The choices are mutually exclusive so when one selection is made, the other will be de-selected.

**NOTE:** When changing display units, ramp/soak program set points will not be converted between units. Separate programs are required for each temperature range. Operating the MCT4 with programs that have been written using alternate units could cause property damage or personal injury.

### 10.3 Clock Settings

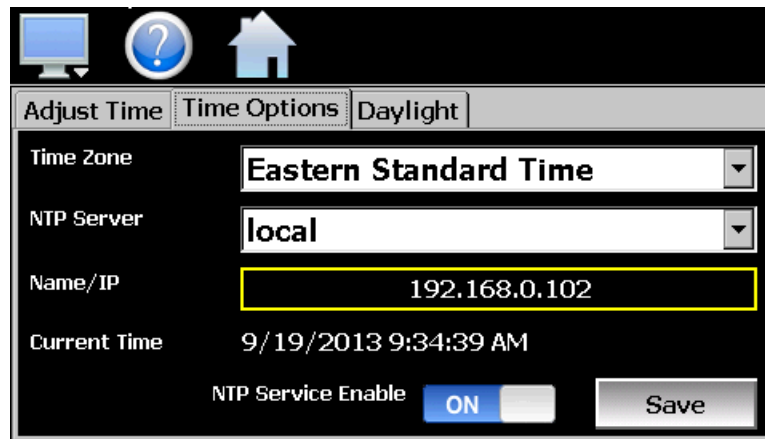
The system date and time is adjusted from the "Adjust Time" tab under the Set/Clock menu. The current date and time will be displayed in the thumb wheels as shown below.



To make adjustments, scroll each time wheel to adjust the month, day, year, hour, minutes, seconds and AM/PM selection. Once all adjustments have been made, press the “Save” button to set the system clock to the date and time entered.

### 10.3.1 Time Options

Select the “Time Options” tab to configure the time zone and national time server clock settings. If the MCT4 is connected to the internet, these settings can be used to have the MCT4 automatically synchronize its time with one of the nationally provided time servers.



To enable the national time server, select your time zone and which time server you wish to use from the drop-down menu selections. Turn on the “NTP Service Enable” option and press the “Save” button. The MCT4 will then synchronize its time with the selected national time server at 2:00AM each day.

If the MCT4 is not connected to the internet, a local alarm message will be shown on the alarm screen; “*NTP Failure. Check cable and server*” to indicate that the time server could not be located.

#### 10.3.1.1 Local Time Server Settings

If an active internet connection is not available, or company policy prohibits internet access, the MCT4 can be configured to use a local time server instead of one of the national time servers. To configure the use of a local time server, select “local” from the NTP server list. When selected, the “Name/IP” entry field will be shown. The computer name or IP address of the computer running the local timer server on the LAN can then be entered. The MCT4 will then contact the local computer in order to synchronize time.

**NOTE:** *The steps required to configure and provide NTP service from a computer on the LAN is outside the scope of this manual. Contact your network administrator for assistance.*

### 10.3.2 Daylight Savings

Select the “Daylight” tab to configure daylight saving time options. The daylight savings time options allow the user to set the start date and end date for daylight savings time.

**NOTE:** *If the NTS time server setting is enabled, and the selected time zone uses daylight savings time, daylight savings must be properly configured and enabled or the clock will not show the correct time.*



If your locale utilizes daylight savings time, set the start and stop dates for daylight savings and turn on the “Daylight Savings Enable” option. Press the “Save” button to store the settings. MCT4 will then automatically update its clock for daylight savings time.

### 10.4 Language

The Language screen is used to select the language for all of the online help, menus and most static display fields. Note that the keypad will remain in English, so all user text entry will still be in the English language.



Available language selections include:

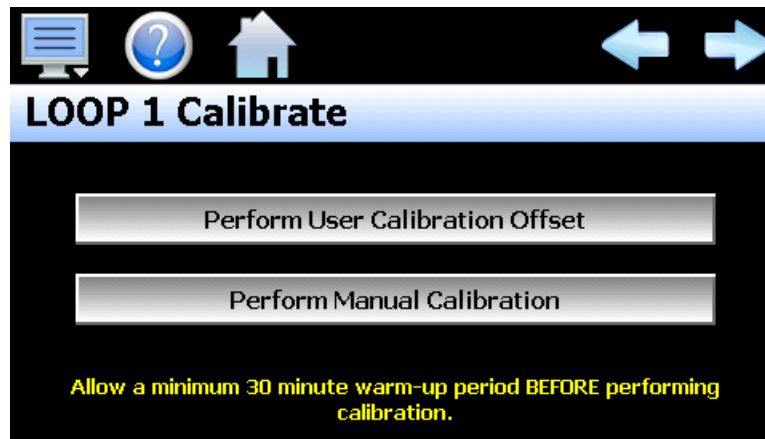
- ✓ Chinese Simplified
- ✓ Chinese Traditional
- ✓ English
- ✓ French
- ✓ German
- ✓ Italian
- ✓ Japanese
- ✓ Korean
- ✓ Portuguese
- ✓ Russian
- ✓ Spanish

**DISCLAIMER:** English is the default language for the MCT4 control system. All other language selections provided through translation from the English language. FDC does not guarantee the accuracy or validity of alternative language selections and shall not be liable for any damages or losses, whether direct, indirect, incidental, special, consequential or any other damages for misinterpretation of other languages. FDC offers a free, PC based application which allows the end user or OEM to create the translation files for the desired language selection. The translation files can then be copied to the MCT4 control system in order to provide a more accurate or desired translation.

## 10.5 Calibration

Each MCT4 loop control and limit control is calibrated at the factory before shipment; however, they can be recalibrated in the field with the use of proper calibration equipment. The user calibration offset provides the means for the end user or OEM to simply apply an offset to the factory calibration. Typical reasons for applying this offset may include the need to match a particular reference standard, to match the calibration to a particular transducer or sensor or to remove long term drift in the factory set calibration.

To access calibration, select “Inputs” from the Calibrate menu. When more than one loop and/or the limit control is installed, the left/right navigation arrows will be provided at the top right of the screen. This allows the user to scroll through each available loop and limit if installed.



Press the **Perform User Calibration Offset** button to access the settings for applying an offset to the loop or limit factory calibration. This is the recommended method of calibrating the inputs for users without special calibration equipment and is suitable for most applications.

Press the **Perform Manual Calibration** button to begin the factory calibration procedure for the selected loop or limit input. This option is NOT recommended for users with limited calibration experience. Special high accuracy equipment is required to properly calibrate the inputs to factory standards. Improper calibration could render the device inoperable and require it to be sent back to the factory for repair.

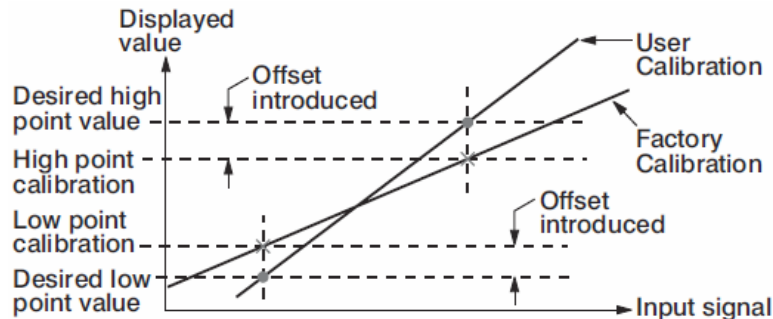
Prior to performing any calibration procedure, read the documentation carefully and understand the steps required to perform calibration. The loop and limit controls must be powered for a minimum of 30 minutes prior to performing calibration in order to ensure that they have warmed up and are at normal operating temperature.

Required calibration sources:

Thermocouple Input:	0 – 100mV and K-Type source $\pm$ 0.005% accuracy
RTD Input:	0 – 300ohm source $\pm$ 0.005% accuracy
Voltage Input:	0 – 10VDC source $\pm$ 0.005% accuracy
Milliamp Input:	0 – 20mA source $\pm$ 0.005% accuracy

**10.5.1 Loop Calibration Offset**

The calibration offset provides a two-point offset; a low point offset and a high point offset. The two-point offset constructs a straight line (linear calibration) between the two points. To insure greatest accuracy, it is best to calibrate with the two points at the minimum and maximum operating ranges for the system.



To begin calibration, send the low signal input to the loop control. If the process value does not match the reference signal, adjust the low point offset so that the process value matches the reference input signal. Press the button to switch to the high point offset and then apply the high signal input to the loop control. Adjust the high point offset if necessary in order to make the process value match the reference signal.

**Press the Done button to exit screen.**

**LOOP 1 Calibrate**

Process Value	20.2	Apply low scale input signal. Adjust low point offset until the process value is equal to the desired value.
Low Point Offset	0.0	

Press to Display/Adjust High Point Offset

Done

Once the high point offset has been adjusted, press the button to switch to the low point offset and again apply the low signal input to the loop control input. If the process value does not match the reference signal, adjust the low point offset again so that the process value matches the reference input signal. Again, press the button to return to the high point offset and apply the high signal input to the loop control. Adjust the high point offset if necessary in order to get the process value to match the high reference signal. This process may have to be repeated several times depending upon the amount of offset applied. Each time the low or high offset is adjusted, it can affect the opposite end of the calibration curve.

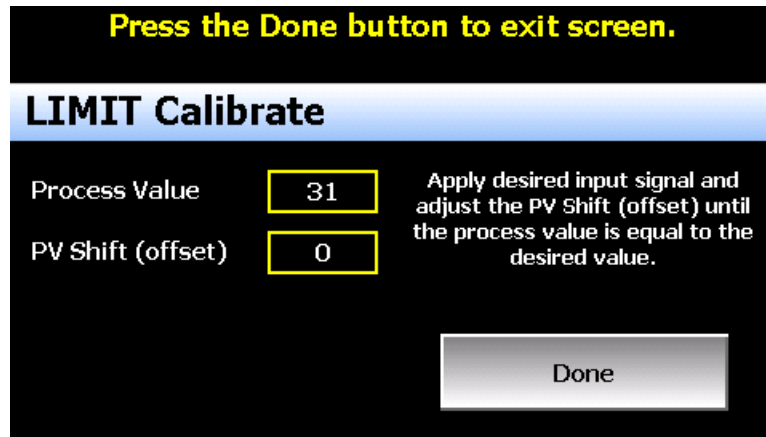
If the known calibration error of the loop input is the same at both the minimum and maximum operating range of the system, i.e., a linear offset, you can simply enter the difference between the reference signal and process value for both the low point offset value and high point offset value. If both the low and high point offsets match, it shifts the calibration curve thus applying the value of the low/high point offset equally across the entire range.

For example, if the range of operation is -50.0 to 350.0 degrees and the error between the reference signal and the process value is 0.7 at both the low and high range resulting in process values of -49.3 and 350.7, simply enter the value of -0.7 for both the low and high point offset. This will shift the curve equally at both ends of the curve so the resulting process values will be -50.0 and 350.0.

Once the calibration offset is complete, press the “Done” button to return to the main Calibration screen.

### 10.5.2 Limit Calibration Offset

The calibration offset provides a single point shift. If the limit control is used for high/low operation and the error differs from one end of the calibration curve to the other, the shift value can be used to split the difference between the two. This will make the error equal at both ends of the curve or it can be used to shift it to reduce error at one end of the curve; however, it will also increase the error at the opposite end of the curve.



To begin calibration, apply the desired reference signal to the limit control input. Adjust the PV Shift value to achieve the desired process value. Once the calibration offset is complete, press the “Done” button to return to the main Calibration screen.

### 10.5.3 Manual (Factory) Calibration

The manual calibration procedure is a two-step process for RTD and linear inputs and a three-step process for thermocouple inputs. Each step of the calibration procedure can be skipped which provides the user with a means to exit manual calibration without actually altering the calibration coefficients of the loop or limit control.

**CAUTION:**

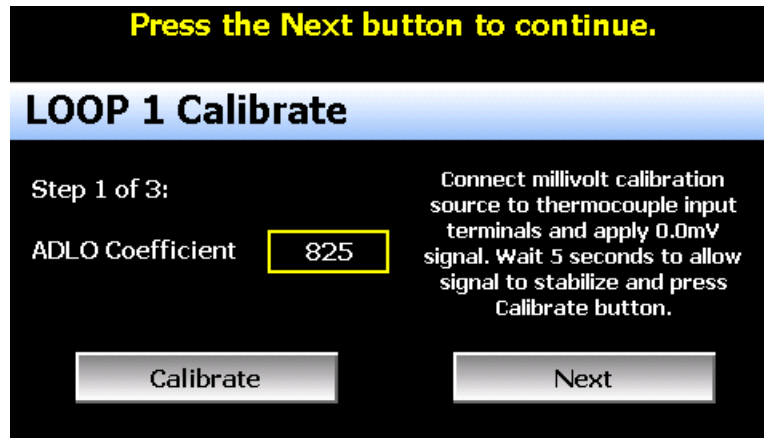


*Performing manual calibration will replace the factory calibration coefficients with new values. If calibration is performed incorrectly, it could introduce a large input error resulting in dangerous operating conditions if not detected or render the device inoperable requiring that it be sent back to the factory for repair. Prior to calibrating each coefficient, it is recommended that the current value be recorded. The calibration coefficients can be manually entered so if the calibration process fails, the previous values can be re-entered returning the unit to its previous operational state.*

#### 10.5.3.1 Thermocouple Input Calibration

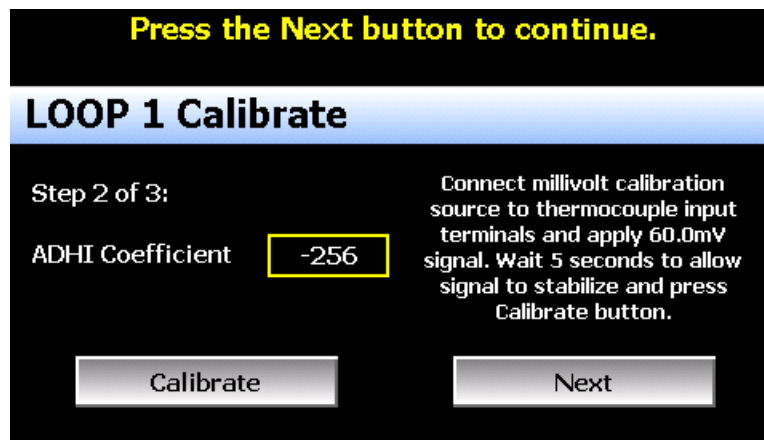
When the loop or limit control input is configured as a thermocouple input, pressing the “Perform Manual Calibration” button on the main Calibration screen will begin the thermocouple calibration procedure. The procedure is a three-step process and begins by calibrating the zero of the A to D converter.

To calibrate the input low coefficient, connect the millivolt source to the input terminals of the loop or limit control. Adjust the source signal to 0mV and allow several seconds for the source signal to stabilize. Record the current calibration coefficient value. Press the “Calibrate” button to calibrate the input low coefficient. A dialog will be shown indicating the new coefficient is being calculated. DO NOT alter the source signal during the process. Once complete, the dialog will close and the new coefficient value will be shown.



If the new coefficient value is -1999 or 1999, the calibration failed. Check the source connections and insure the proper signal is applied. Press the Calibrate button to repeat the process or press the coefficient display/entry field and enter the previous coefficient value recorded to return the loop/limit back to its previous state. To skip the input low coefficient calibration or to proceed to the next step after calibration has been performed, press the "Next" button.

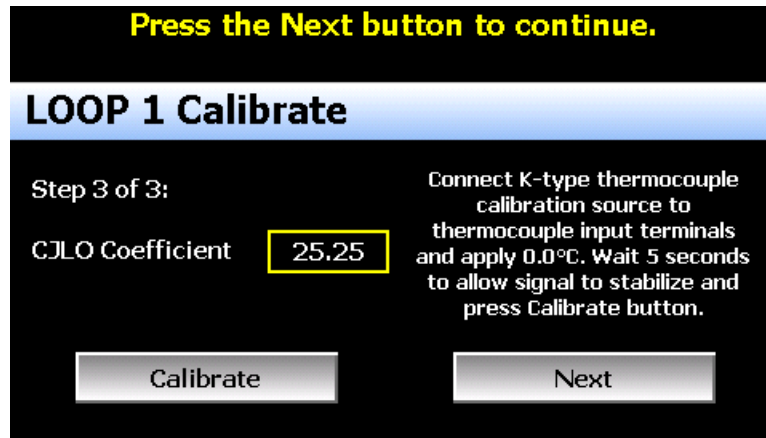
Step 2 of the procedure is calibrating the span of the A to D converter. To calibrate the input high coefficient, connect the millivolt source to the input terminals of the loop or limit control. Adjust the source signal to 60mV and allow several seconds for the source signal to stabilize. Record the current calibration coefficient value. Press the "Calibrate" button to calibrate the input high coefficient. A dialog will be shown indicating the new coefficient is being calculated. DO NOT alter the source signal during the process. Once complete, the dialog will close and the new coefficient value will be shown.



If the new coefficient value is -1999 or 1999, the calibration failed. Check the source connections and insure the proper signal is applied. Press the Calibrate button to repeat the process or press the coefficient display/entry field and enter the previous coefficient value recorded to return the loop/limit back to its previous state. To skip the input high coefficient calibration or to proceed to the next step after calibration has been performed, press the "Next" button. The final step of the procedure is calibrating the cold junction.

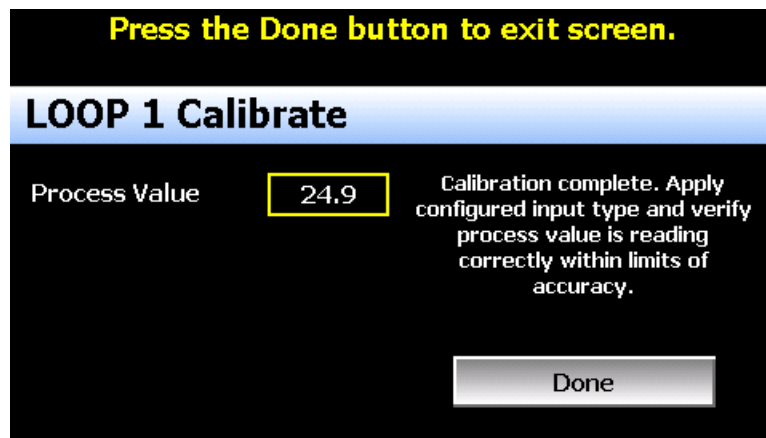
To calibrate the cold junction, a K-Type thermocouple is required. Connect the K-Type thermocouple source to the input terminals of the loop or limit control using K-Type thermocouple wire. Adjust the source signal to 0C and allow several seconds for the source signal to stabilize. Record the current calibration coefficient value. Press the "Calibrate" button to calibrate the cold junction. A dialog will be shown indicating the new coefficient is being calculated. DO NOT alter the source signal during the process. Once complete, the dialog will close and the new coefficient value will be shown.





If the new coefficient value is -5.00 or 40.00, the calibration failed. Check the source connections and insure the proper signal is applied. Press the Calibrate button to repeat the process or press the coefficient display/entry field and enter the previous coefficient value recorded to return the loop/limit back to its previous state. To skip the cold junction calibration or to complete the calibration procedure, press the “Next” button.

Once the calibration steps have been completed, connect a calibration source matching the type of input configured for the loop/limit control. Adjust the reference signal to the low and high end of the operational range to verify that the process value matches the reference signal within the accuracy limits for the input type.



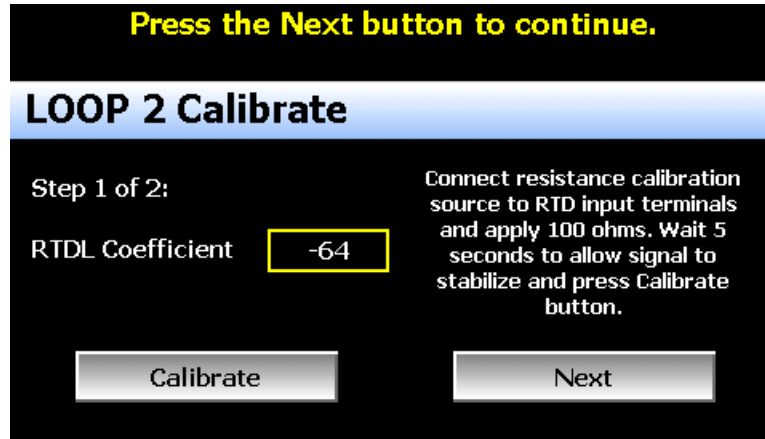
Once the input has been verified to display the proper value according to the input reference signal, reconnect the control sensor to the loop/limit control and press the “Done” button. This will return to the main Calibration screen.

### 10.5.3.2 RTD and Linear Input Calibration

When the loop or limit control input is configured with an RTD or linear input, pressing the “Perform Manual Calibration” button on the main Calibration screen will begin the calibration procedure for the configured input type. The procedure is a two-step process and begins by calibrating the zero of the A to D converter.

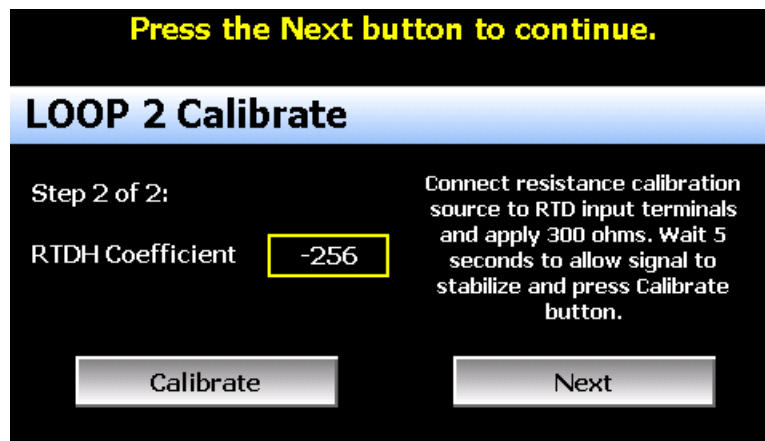
To calibrate the input low coefficient, connect the resistance source (for RTD input), voltage source (for voltage input) or milliamp source (for current input) to the input terminals of the loop or limit control. Adjust the source signal to 100 ohms (for RTD input), 0VDC (for linear voltage input) or 0mA (for current input) and allow several seconds for the source signal to stabilize. Record the current calibration coefficient value.

Press the “Calibrate” button to calibrate the input low coefficient. A dialog will be shown indicating the new coefficient is being calculated. DO NOT alter the source signal during the process. Once complete, the dialog will close and the new coefficient value will be shown.



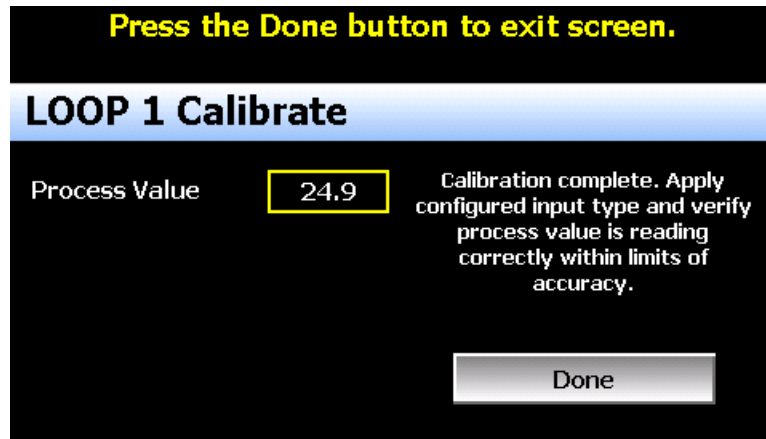
If the new coefficient value is -1999 or 1999, the calibration failed. Check the source connections and insure the proper signal is applied. Press the Calibrate button to repeat the process or press the coefficient display/entry field and enter the previous coefficient value recorded to return the loop/limit back to its previous state. To skip the input low coefficient calibration or to proceed to the next step after calibration has been performed, press the “Next” button.

Step 2 of the procedure is calibrating the span of the A to D converter. To calibrate the input high coefficient, adjust the resistance source to 300 ohms (for RTD input) or 20mA (for current input). If calibrating a voltage input, adjust the voltage source to 60mV for 0-60mV input, 1VDC for 0-1VDC input, 5VDC for 0-5/1-5VDC input or 10VDC for 0-10VDC input. Allow several seconds for the source signal to stabilize. Record the current calibration coefficient value and press the “Calibrate” button. A dialog will be shown indicating the new coefficient is being calculated. DO NOT alter the source signal during the process. Once complete, the dialog will close and the new coefficient value will be shown.



If the new coefficient value is -1999 or 1999, the calibration failed. Check the source connections and insure the proper signal is applied. Press the Calibrate button to repeat the process or press the coefficient display/entry field and enter the previous coefficient value recorded to return the loop/limit back to its previous state. To skip the input high coefficient calibration or to complete the calibration procedure, press the “Next” button.

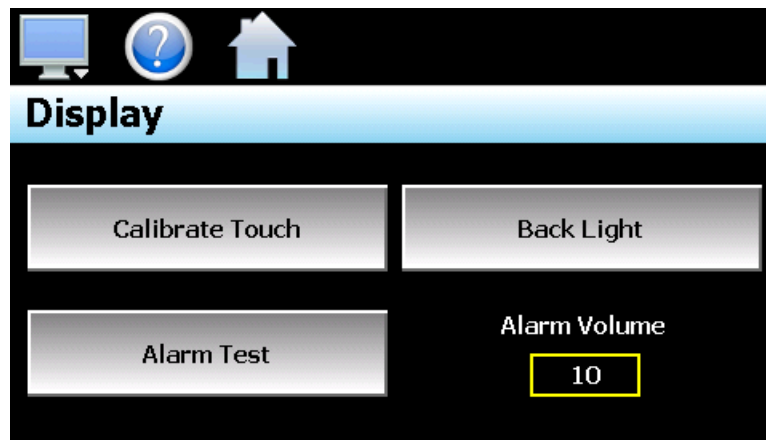
Once the calibration steps have been completed, adjust the reference signal to the low and high end of the operational range to verify that the process value matches the reference signal within the accuracy limits for the input type.



Once the input has been verified to display the proper value according to the input reference signal, reconnect the control sensor to the loop/limit control and press the “Done” button. This will return to the main Calibration screen.

## 10.6 Display Settings

The Display screen provides access to the touch screen calibration utility, back light settings and alarm volume adjustment.

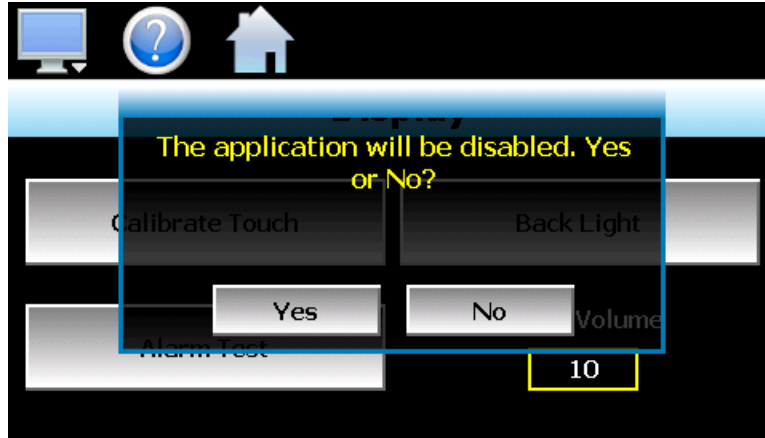


The **Alarm Volume** adjusts how loud the internal alarm buzzer of the MCT4 will be when activated under an alarm condition. The volume can be set from 0 (off) to 100. To edit the alarm volume, touch the entry field and enter the desired volume level. To test the buzzer, press the “Alarm Test” button.

### 10.6.1 Calibrate Touch

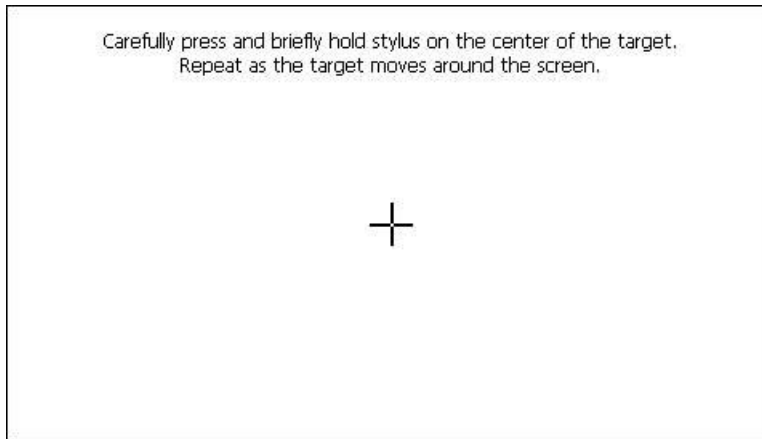
After extended use and many hours of operation, it may be necessary to recalibrate the touch screen of the MCT4. A typical sign that the screen may be out of adjustment, is inaccurate responses when attempting to press buttons, check boxes or adjust fields on the display. The calibration utility is provided in order to re-adjust the screen when this happens.

To begin the calibration process, press the “Calibrate Touch” button. An alert message will appear stating that the application will be disabled to perform the calibration procedure. Press “Yes” to continue.

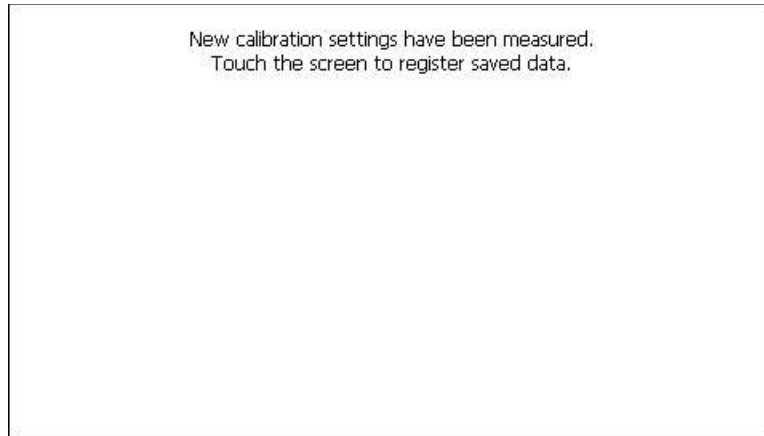


The calibration utility will start and crosshairs will appear on the screen. At each crosshair position, touch the screen at the center of the crosshairs. Repeat this for each position in order to set the calibration. The calibration requires five points, the center and four corners.

**NOTE:** *It is recommended that you use your finger rather than a stylus when calibrating the screen. The touch response will be more fluid after calibrating it with your finger.*



Once complete, the calibration utility will provide a notification message that the new calibration settings have been measured and to touch the screen to register the new calibration data; just touch anywhere on the screen to close the window and return to the MCT4 application to resume normal operation.

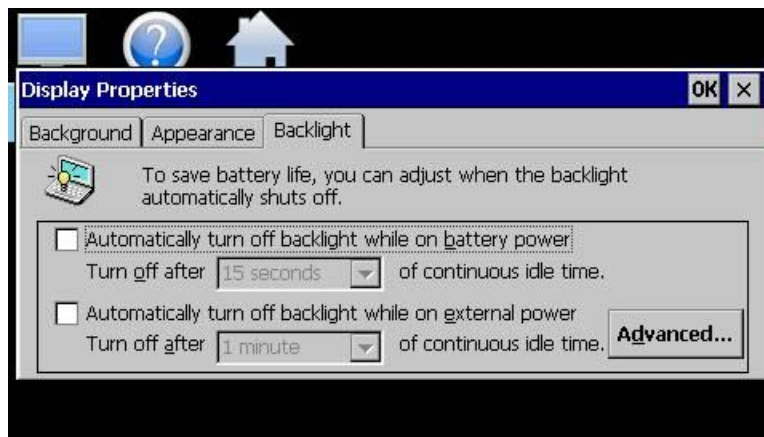


### 10.6.2 Backlight Settings

The backlight settings allow the user to adjust the screen brightness as well as set a time period for dimming the backlight after a period of inactivity which can extend the life of the display. To adjust the backlight settings, press the “Back Light” button. An alert message will appear stating that the application will be disabled to enter the backlight settings, press “Yes” to continue.

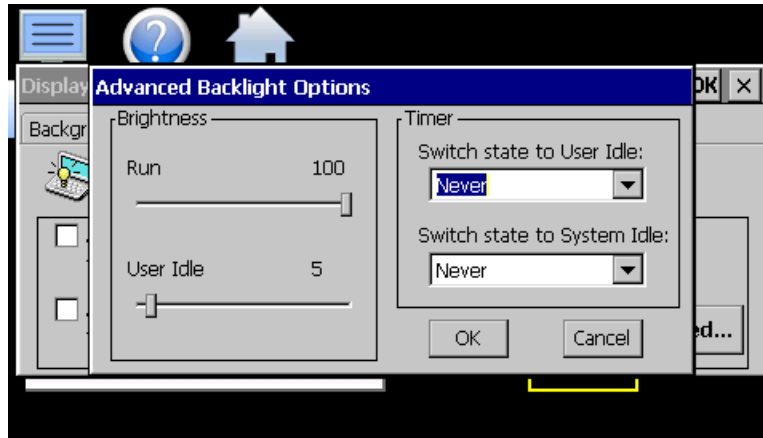
Select the “Backlight” tab from on the Display Properties window. Press the “Advanced...” button to access the settings for the backlight.

**NOTE:** The checkboxes on the Backlight tab for “Automatically turn off backlight while on battery power” and “Automatically turn off backlight while on external power” have no effect on backlight operation and should be left unchecked.



The brightness of the display during operation is set by adjusting the “Run” slider. The default setting is 100. The “User Idle” slider is used to adjust the brightness of the display during periods of inactivity. The default setting is 5. Use caution when adjusting the “Run” slider. It is possible to set the brightness to zero (0), in which case the screen will go black and you will be no longer able to see the settings. Should this occur, it is possible to tap the screen in the general area of the run slider. If you tap the screen in the proper position of the slider, it can set the slider to make the screen visible again. It is recommended that the slider not be adjusted below 20.

When adjusting the “User Idle” slider, the screen will temporarily adjust to the setting of the slider as you move it. If you choose a value of zero (0), the screen will go black. However, once you lift your finger, the screen will return to the “run” brightness level after a couple seconds.



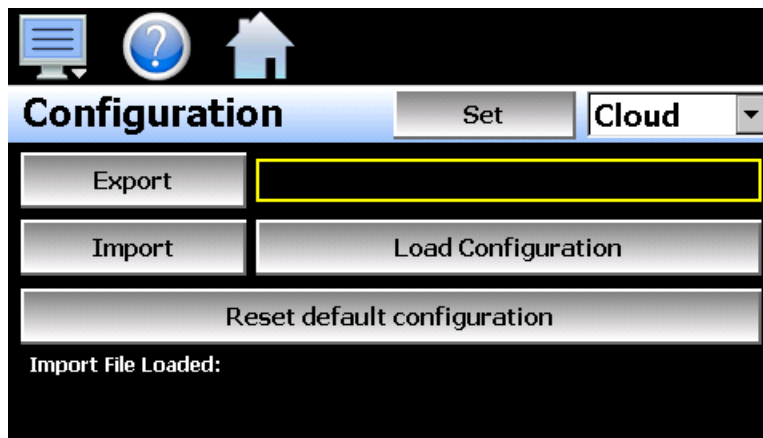
To enable the backlight dimming function, use the “Switch state to User Idle” drop-down menu and select a time period for no activity at which the screen should dim. The delay time can be set at fixed intervals from 1 minute up to 30 minutes. To disable the dimming feature, select “Never”.

Once all settings are complete, press the “OK” button and then press the “OK” button at the top right of the “Display Properties” window to return to the MCT4 application and begin normal operation.

## 10.7 Configuration

The Configuration utility allows the user to back up the entire configuration of the MCT4 and save it to a file for “safe keeping” in case of system damage due to a lightning strike, etc. The utility also allows the MCT4 to be configured with a push of a button by selecting from a list of preconfigured setups that could be created and saved on a USB memory device or remote server for loading a configuration to a new MCT4 system.

**IMPORTANT:** Do not import configuration files that are not intended for use with the current hardware configuration of the MCT4 as unexpected operation may result.



By default, the import/export procedure is set to operate via USB. To perform import/export operations from a remote server, use the drop-down menu to select “Cloud”. When “Cloud” is selected, a “Set” button will appear to the left of the drop-down menu. Pressing the button will display the Cloud setup screen where the remote server settings can be entered (See section 10.7.1 Cloud Server Settings). The settings only need to be entered once as they can be saved and used for any future import/export operations.

When the **Export** button is pressed, the MCT4 configuration data will be written to the USB memory device or remote server. The export file function will use the name entered in the text field to the right of the export button

and create a directory on the memory stick with that name, to contain the configuration data. The filename can be entered with up to 10 characters which permits multiple configurations to be identified and saved for later retrieval. The export files will be saved to a directory with a name format of “MCT4\_filename\_mm-dd-yyyy-hh-mm-ss” to identify the configuration according to the date and time it was created. This prevents multiple configuration files with the same name from overwriting previous files. It also allows the user to identify a backup of the MCT4 so that it could be reconfigured to a previous date if multiple back-ups are created.

If the export is being sent to a remote server, a single file is created with the format of “MCT4\_filename\_mm-dd-yyyy-hh-mm-ss.ccg”. The file is encrypted and automatically signed with a digital signature in order to protect it and prevent alteration of the file. Should a file be tampered with, it would fail the import, thus protecting the MCT4 from accepting a bad configuration file.

The **Import** button is used to configure the MCT4 according to the currently loaded configuration file. To load a configuration file, the USB memory device must first be inserted into the USB port (or the remote server has to be properly configured and the MCT4 connected to the internet when Cloud is selected). When the **Load Configuration** button is pressed, a list of available configuration files from the memory stick (or remote server) will be shown. Select the desired file from the list and press “Open” to load the file. Once the file is loaded, the import process can be started. Pressing the “Import” button will begin the process. When the import is complete, you must cycle power to the MCT4 in order for the new configuration data to be loaded into runtime memory for proper operation.

The **Reset default configuration** button can be used to clear the current MCT4 configuration and reset the system back to default values. This function clears all user and/or OEM configuration values and returns the system to an “as new” factory state allowing the system to be configured from scratch. This function is provided as a means to start over in the event that the system configuration has been altered to an unknown state and is not operating properly, and a known good configuration is not available to import. Rather than go through every setting of every feature to try and determine where the configuration error exists, this allows the system to be cleared so that it can be reconfigured from a clean slate.

**NOTE:** *The configuration functions do not affect the VNC server configuration. The enable state, VNC address, device name and password fields must be manually changed as these settings are specific to each device and must be set independently for proper VNC server operation over a network.*

*The network settings, i.e., DHCP/ Static IP address settings and control loop set points are also not saved to the configuration file. These settings must be done manually.*

### 10.7.1 Cloud Server Settings

The “Cloud” screen provides settings for the remote configuration FileWeb server. The screen is accessed by pressing the “Set” button on the Configuration screen. Note that the “Set” button is only shown when “Cloud” is selected for the import/export configuration location.

Press the Cancel or Save button to exit screen.

Cloud	Cancel	Save
IP Address	https://fdcutil.com/FDDataService.svc	
Server		
User Name	*****	
Password	*****	

The **IP Address** field is used to enter the IP address of the remote server site that MCT4 is to interface with.

The **User Name** field allows you to enter a user name for site access. When the MCT4 connects to the site, the user name will be used to identify the connection. The user name is required for FileWeb access.

The **Password** field is used in conjunction with the user name field and is for entering a password, so the MCT4 can access the site. A password is required for FileWeb access.

The **Server** field is used to enter additional directory information for the server (if desired) where the files are to be stored during import/export operation. The field can be left blank. By default, the MCT4 is hard coded to store files on the specified server in the “\configs\user name” directory. If an entry is made in the Server field, the path would be “\configs\user name\server”.

MCT4 Field Setup	FileWeb Server Setup
IP Address = https://fdctuil.com/FDDataService.svc	Actual named address of FileWeb server/service.
Server = <i>optional path</i>	<p>The FileWeb server/service must be configured with a root “\configs\” directory in order to use the MCT4 cloud import/export feature. The MCT4 is hard coded to transfer configuration files to the “configs” directory in the root of the server. This results in a typical file path of “\configs\userName”.</p> <p>If the Server field also contains an entry, the resulting path would be “\configs\userName\Server”.</p> <p>It is recommended that this field be left blank for the majority of users to insure all configuration files are stored in the base “configs” directory. When loading a configuration for import, only the files in the specified directory will be available for selection. If a configuration file was stored to a location specified by the Server field and the proper entry is not known, the user will be unable to select the proper configuration file for import.</p>
User Name = <i>userName</i>	Actual user name for login at FileWeb server (required).
Password = <i>userPassword</i>	Actual password for login at FileWeb server (required).

**NOTE:** Make sure proper permissions are set at the server for access/creation of directories and read/write access. Also check root directory structure at the server to identify the actual root that was created for the files since there can be additional layers created by the server field and displayed in the path (see Appendix section A.2 FTP, FileWeb, DataWeb Requirements/Installation for additional information).

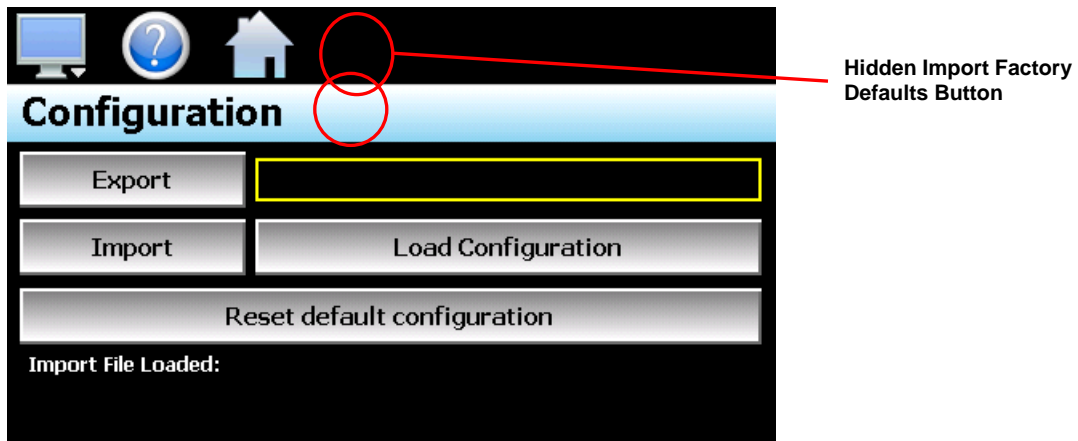
### 10.7.2 Importing an OEM Default Configuration

The “Reset default configuration” button loads a predefined configuration stored in memory on the MCT4. The factory configuration is “blank” meaning it will reset all attached loop control boards and limit control to the FDC factory defaults. All user and/or EOM configuration settings will be cleared which will require the user to reconfigure the entire device for the intended application.

For OEM manufacturers, the MCT4 provides a means of importing a default factory configuration. If an end user happens to make configuration changes that affect operation, or to insure the system is configured properly



to OEM specifications while providing customer support, the OEM configuration can be stored in the MCT4 and will be installed when the “Reset default configuration” button is pressed.



To import a factory default configuration, insert the USB memory device containing the desired configuration file. Next to the “Home” icon is a hidden button. Tap the location repeatedly 10 times within a period of 4 seconds. A dialog will be shown prompting to copy a configuration as factory defaults. When “Yes” is selected, the open file screen will be shown. Select the desired configuration file and press the “Open” button to import the file as factory defaults.

**NOTE:** *Importing a factory defaults file does not affect the current configuration of the unit. This only imports a configuration file as the factory defaults file.*

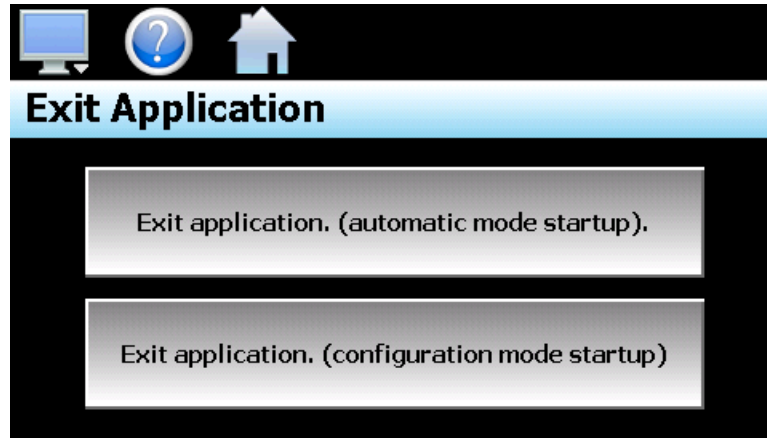
### 10.8 About MCT4

The “About” MCT4 screen provides operating system version numbers for the currently installed firmware and software of both the MCT4 HMI and loop control boards and limit device. This information should be recorded prior to any service request so that proper assistance can be provided for your control model.



### 10.9 Exit Application

The “Exit” Application screen allows the user to quit the MCT4 runtime software and return to the CE.Net operating system. This operation is NOT recommended with the exception of users who are in charge of system configuration due to the danger of editing or removing files by accident.



The **automatic mode startup** option will return the MCT4 to normal operation on the next power up.

The **configuration mode startup** option will start the MCT4 Configurator program on the next power up so that the user can access control loop and MCT4 configuration settings.

## 11 Communications

This section provides instructions on how to use the MCT4 communication interfaces. As a standard, the MCT4 is equipped with both an Ethernet interface and an RS232/485 serial interface for user communications.

### 11.1 Ethernet Communications

The MCT4 provides several options for remote control and monitoring over the Ethernet communications interface. The web server interface provides a monitor only connection, while the VNC server and Modbus TCP interfaces allow a user to manipulate and control the MCT4 remotely. The VNC interface allows the user to view and observe operation of the MCT4 display directly on their PC screen while the Modbus TCP interface allows the user to manipulate MCT4 operation via other devices and/or software capable of Modbus TCP communications.

**NOTE:** *In order to use Ethernet communications, the MCT4 must be properly connected to a network. To connect the MCT4 to a network, connect the touch screen's Ethernet port to your network using a standard CAT5 cable connection. Note that after connecting the network cable, it may be necessary to cycle power to the MCT4 in order for it to obtain a valid IP address.*

#### 11.1.1 Guide to Smart Networking Practices

The expansion of Ethernet onto the industrial floor has brought forth a new realm of possibilities from the gathering of information to the inherent control of equipment from anywhere around the world. The flexibility and convenience that this provides makes it a very desirable feature for new equipment. The MCT4 provides this ability, but there are considerations that must be taken by the end user to protect their equipment and investment.

Just like placing a personal computer on the internet opens it up to outside attack, placing your MCT4 on a network poses the same risk. The first thing to remember is this: The most likely cause of problems is not a hacker trying to sabotage your equipment, but more often to be related to the ubiquity of PCs with Ethernet cards, the ease with which your own co-workers can “hang stuff on the network”, and careless or nonexistent internal security measures. Accidental problems are more common than deliberate ones.

Allowing anyone access to the MCT4 by placing it on the office LAN, also opens the door for accidental shutdown, damage to equipment, loss of data, lost time, etc. This is possible even by the most well-intentioned co-workers. Thus, there are several steps that should be taken to minimize this risk.

The first is to never mix your office LAN with your control LAN. The control LAN should be a separate network that consists of your MCT4 controller(s) and possibly any other equipment that you may have that is related to the operation of the system. It should be separated from your office LAN by a firewall, or at minimum, a bridge or router. A control network and a business network have two entirely different purposes and their interaction should be closely controlled.

It is also unwise to assume that any Ethernet capable devices themselves have any security features at all. The MCT4 VNC server only provides minimal single-password based security access. Separating the control LAN from the office LAN using a firewall would increase security and only allow control access that is based on a combination of IP source address, destination address, and port number. This is by no means completely “hacker-proof”, but it should keep the well-meaning co-workers out.

Another hazard is connecting consumer “plug and play” devices to your control LAN. A printer for example, might flood the network with traffic in a “broadcast storm” as it tries to self-configure or advertise its presence to all nodes on the network. Faulty devices, for example defective NIC cards, can transmit large amounts of bad packets (i.e., runts, which are abnormally short Ethernet frames) into your network. Using switches instead of hubs will limit the effect of such problems.

The most commonly overlooked source of problems is cabling. Not all cables are created equal. Electrical noise generated by factory equipment or other electrical equipment in the area, could easily corrupt transmitted data over the network and cause devices to “lock up” or shut down the VNC server, both of which then require the MCT4 to be shut down and restarted to clear the problem.

Select the right cable for the environment. Shielded twisted pair (STP) cable is naturally more noise immune and is preferable to unshielded twisted pair or UTP in noisy situations. STP should have at least 40dB CMRR and less than 0.1pF capacitance unbalance per foot. Ground STP cable, making sure the ground is connected only at one end. CAT5 STP patch panels normally provide a grounding strip or bar. Hubs and switches don't provide grounding, use cables.

It's wise to be pessimistic about a cable's ability to reject noise from 230 VAC and 460 VAC power lines and electrically “noisy” equipment in the area. Capacitance imbalance in cables greater than 70pF per 100m can introduce harmonic distortion resulting in bit errors. The cost of cable is quite small compared to total equipment cost, so if you're looking to save money, this is not a place to do it. Choose a well-designed cable to minimize bit-error rate after installation, and that will give faster throughput with fewer glitches.

#### 11.1.1.1 The MCT4 and Network Security

When most people think of security, they think of anti-virus programs and continuous operating system updates to insure their system is running with the “latest-and-greatest” software. For consumer devices, this is well and good, but when it comes to industrial devices not so much. How many times has an update to the OS caused an issue with an existing program that for now some reason is not working correctly or crashes inexplicably. How about an anti-virus program updating its threat definitions and now sees an application as a potential threat and blocking it from operating? To have this occur on a control device could be catastrophic to a process. So how does the MCT4 address these concerns while still providing threat protection?

The MCT4 software validation uses a specific OS version and revision number as part of the validation process. WinCE is not the same as Win7, 10, etc. and does not support automatic updates since the OS must be installed in a specific portion of memory using a cable or SD with the device present. The OS layout is also specific to the hardware on the device. FDC has never had an update to the OS unless the hardware changed on our units which required a driver (mostly third party) for the new hardware. This also provides stability since this is an industrial device that provides specific functionality without most of the “overhead” of the OS's that full PC's run.

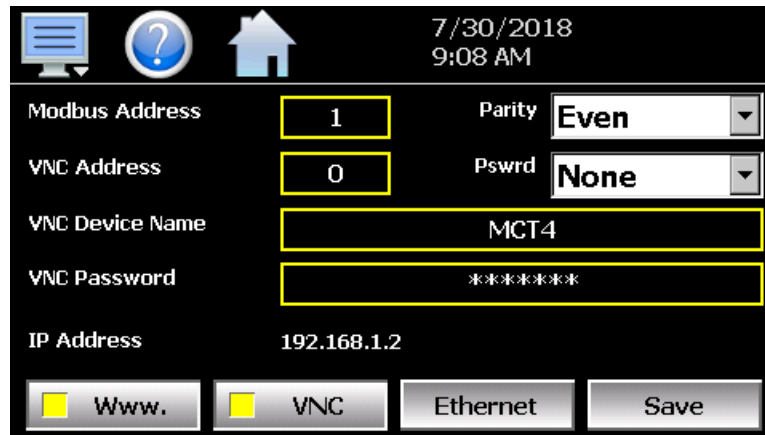
Most security issues arise from browsing or opening an email attachment that carries harmful code. The MCT4 does not support the addition of anti-virus software: however, the MCT4 does not have a browser or an email server to receive emails or attachments. The FTP, FileWeb and DataWeb interfaces are also client based only. They transmit files and data to remote servers, but do not receive.

The MCT4 writes data to a web page in memory that can be accessed by an external browser. This is a read only web page (from the remote browser) that contains process values, set points, event and current program data only. The internal web page data is written over with real time data every 30 seconds. The MCT4 does not read any data from its internal web page so any corruption of the web page would not affect MCT4 display/control operations. There are no passwords or sensitive data sent from the remote browser to the “read only” web page.

A virus to attack Windows CE would be difficult, but not impossible. Every Windows CE device is different (by manufacturer), so not an easy standard to write the virus against. The virus would need to be built for Windows CE and the CPU that the MCT4 runs, and the storage device doesn't have a standard name. There might be industrial devices that run anti-virus on their CE devices; however, FDC is not aware of any. As the saying goes, the best defense is a good offense. It is best to design a “smart network” to prevent intruders from gaining access in the first place than to try and fend them off once they are already in the door.

### 11.1.2 Using the Web Server

The MCT4 web server allows a user to remotely monitor operations anywhere via a PC's standard web browser. When enabled, the web server provides a detailed status page of the current operating conditions. The web server can be enabled and disabled by pressing the web server (Www.) button on the communications screen (select "Comms" from the Device\Settings\Set menu).



The screenshot shows a configuration screen for the MCT4 device. At the top right, the date and time are 7/30/2018 9:08 AM. The screen contains several input fields and buttons:

- Modbus Address:** A text box containing the number '1'.
- Parity:** A dropdown menu set to 'Even'.
- VNC Address:** A text box containing the number '0'.
- Pswrd:** A dropdown menu set to 'None'.
- VNC Device Name:** A text box containing 'MCT4'.
- VNC Password:** A text box containing '\*\*\*\*\*'.
- IP Address:** A text box containing '192.168.1.2'.

At the bottom, there are four buttons: 'Www.' (highlighted with a yellow square), 'VNC', 'Ethernet', and 'Save'.

You must use the assigned IP address to access the MCT4. The IP address is shown on the communications screen and is also included in the notifications list. Write down the IP address so you will have it later to enter into your web browser.

**NOTE:** Contact your network administrator prior to enabling the web server of the MCT4. Company policy may prohibit the use of web servers for security reasons. Future Design Controls is not responsible for the use of, nor makes any claims as to the security of the web server interface over your network. The use of the web server is the responsibility of the end user.

To access and view the MCT4 web page, enter the following link in your PC's browser address window: <http://IPaddress/MCT.html>. Using the IP address from the sample screen, the entry would be: <http://192.168.1.2/MCT.html>. The following example is typical of the MCT4 web page appearance. The web page updates automatically every 30 seconds and provides information on each individual control loop, ramp/soak program status, alarm status and system event status.

**FUTURE DESIGN CONTROLS - MCT4**  
BRIDGEVIEW, IL - 888-751-5444

**CONTROL DATA**

LOOP 1	PV = 26.9	SP = 24.0
LOOP 2	PV = 7.6	SP = 5.4
LIMIT	PV = 32	SAFE

**AUTOMATED PROGRAM**

Program Name	TEST2
Program Status	Inactive
Cycles Remaining	2
Total Steps	4
Current Step	1
Step Time Running	1.00
Remaining Step Time	1.00
LOOP 1 Target SP	24.0
LOOP 2 Target SP	5.4

**SYSTEM ALARMS**

---

**SYSTEM EVENTS**

EV1	OFF
EV2	OFF
EV3	OFF

### 11.1.3 Using the VNC Server

The MCT4 VNC server allows a user to remotely monitor and control MCT4 by directly viewing and manipulating the touch screen over the network. You must use the assigned IP address and VNC port number to access MCT4. The IP address is shown on the communications screen and is also included in the notifications list. Write down the IP address and port number so you will have it to enter into your VNC viewer.

There are many VNC viewers available for both PC and tablet use. Due to the ever-changing market and availability of such applications, it is not possible to test them all for compatibility or provide assistance for their use with the MCT4. It is the responsibility of the end user to test the chosen VNC client for compatibility with the MCT4 prior to putting the unit into service. If the VNC client viewer has compatibility issues with the MCT4, it can cause the VNC server to stop responding and/or shut down requiring power to be cycled to the MCT4 in order to reboot the system and restart the server.

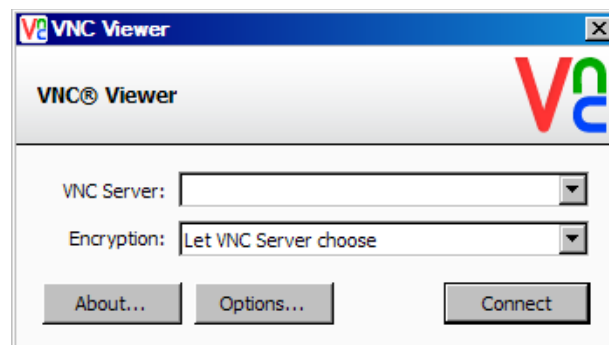
Future Design Controls has tested and recommends the use of RealVNC's viewer. It has been tested for compatibility with the MCT4 and a free version can be obtained from <http://www.realvnc.com/> for PC/MAC use. RealVNC does offer a version for the iPad that can be obtained through the App Store for a small fee. The App Store also offers a free VNC client called Remotix for the iPad. It has also been tested for compatibility with the MCT4.

**NOTE:** *Contact your network administrator prior to enabling the VNC server of the MCT4. Company policy may prohibit the use of VNC servers and/or viewers for security reasons. Future Design Controls is not responsible for the use of, nor makes any claims as to the security of the VNC server interface over your network. The use of the VNC server is the responsibility of the end user.*

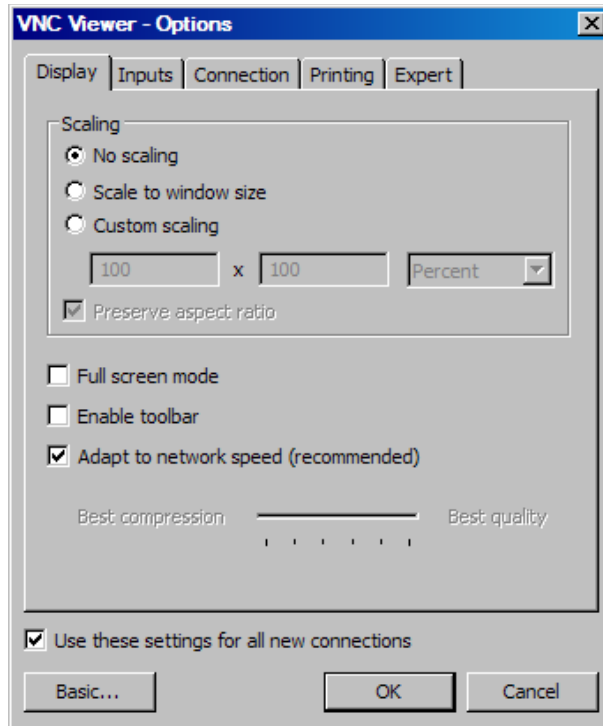
#### 11.1.3.1 Recommended VNC Viewer Settings (PC/MAC)

This section applies to setup of the recommended RealVNC viewer for PC/MAC. These settings have been tested and evaluated in order to provide the best performance and quickest response to user input when using the VNC viewer with the MCT4. After installing the VNC viewer software, it is recommended that the following changes be made to the default viewer settings.

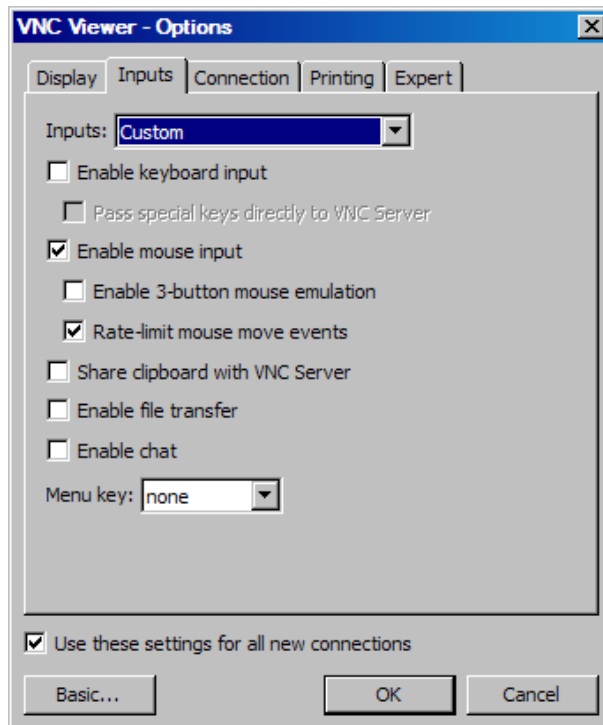
To begin, start the VNC viewer. Click on the “Options” button in order to open the VNC Viewer - Options window. Click on the “Advanced” button at the bottom left of the window in order to show the advanced setup options.



On the Display tab, make sure the scaling is set to “No scaling” and the checkbox for “Adapt to network speed (recommended)” is checked.

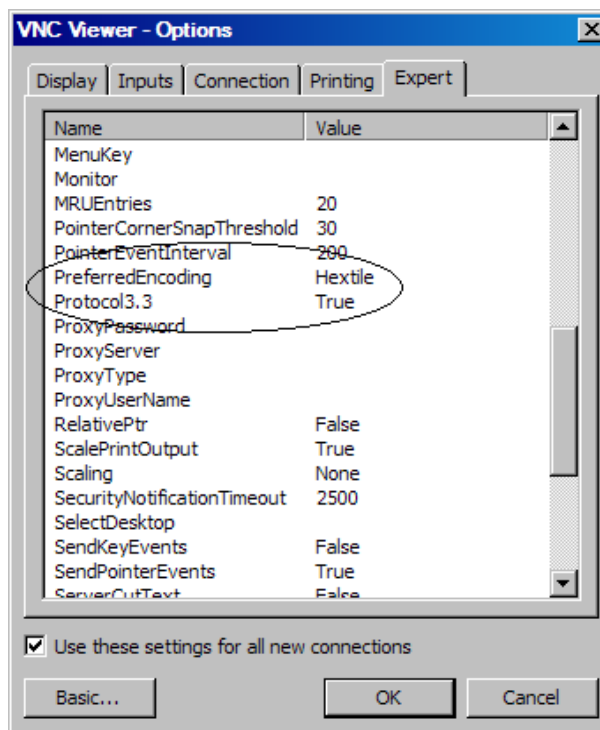


Next, select the Inputs tab and deselect all entries except for “Enable mouse input” and “Rate-limit mouse move events”. The “Inputs:” drop down selection box will automatically change to “Custom” when the settings are made.



Proceed to the Expert tab. Scroll down the list of settings until you find the “PreferredEncoding” and “Protocol3.3” options. Set the preferred encoding to Hextile and the Protocol 3.3 option to true. Verify that the “Use these settings for all new connections” checkbox at the bottom of the window is checked and click the OK button. This will set the selections to the default start settings for the VNC viewer.





### 11.1.3.2 Recommended VNC Viewer Settings for Tablets

The VNC clients for tablets have been found to offer limited flexibility for use with the MCT4. Most clients have default settings requiring security to be enabled on the server in order to connect. If you have trouble connecting with a VNC viewer through an iPad, iPhone or even an Android based phone, start by enabling the security on the MCT4 VNC server and be sure to enter those settings in the client viewer.

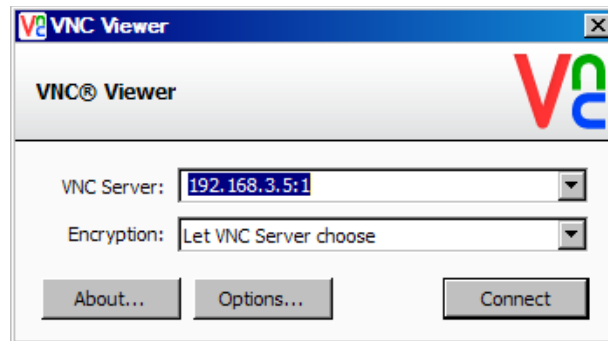
Color and encoding options can also affect the connectivity. If the client offers the option, leave color and encoding options to “automatically detect” or “server decides”. If the client is still unable to connect, try default encoding of Hextile and set the color option to limited colors such as 256-bit color. Future Design Controls does not write or create VNC clients (3rd party software), so final selection of client and testing is the end user responsibility. The following settings are provided as an example for the Remotix client for the iPad. When adding an MCT4 server to the Remotix client, use the following settings. Note that the VNC server in the MCT4 must have security enabled in order for this client to connect.

Connection Type: VNC  
 Host/IP: IP address of MCT4  
 Port: VNC address of MCT4 (5900 = 0, 5901 = 1, etc...)  
 Use SSH Tunnel: Off  
 VNC Authentication: VNC Password  
 VNC Password: VNC password of MCT4  
 VNC Server Type: AutoDetect  
 Operating System: Windows  
 Preferred Encodings: Hextile  
 Color Depth: 16 bits

11.1.3.3 Accessing the MCT4 through a VNC Viewer

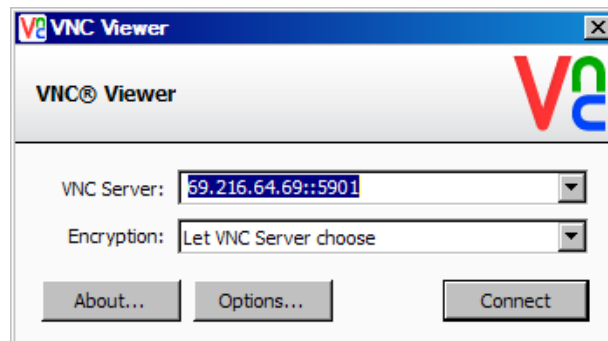
The following examples are based on the use of the RealVNC viewer for PC/MAC. Once the default settings have been entered, just enter the IP address and port number for the MCT4 and click the “Connect” button to access the MCT4 over the network.

Intranet Example: If the IP address assigned is 192.168.3.5 and the configured VNC Address is 1, from the PC’s VNC Viewer address field, enter '192.168.3.5:1' to access the device (address 1 relates to port 5901, address 2 to port 5902, etc., which is the port opened by the VNC server in order to allow communications with the MCT4 over the network).



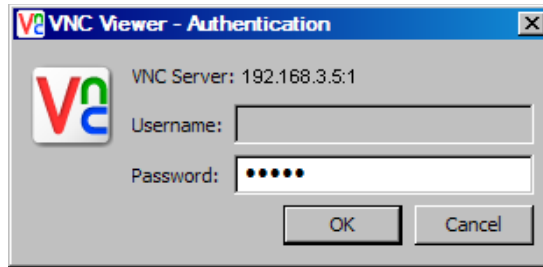
Internet Example: Internet connection usually requires a qualified network System Administrator. Typically, a permanent IP address and specific port address are assigned to the MCT4; support on this action is beyond the scope of this guide. Consult your network system administrator for assistance in setting up an Internet connection.

If the IP address of the LAN is 69.216.64.69 and the configured VNC Address is 1 (port 5901 has been opened and assigned to this specific MCT4 controller), from the remote PC (outside of the site Servers LAN), in the VNC Viewer address field enter '69.216.64.69::5901' to access the device (5901 relates to address 1, 5902 to address 2, 5903 to address 3, etc., note the double colon).

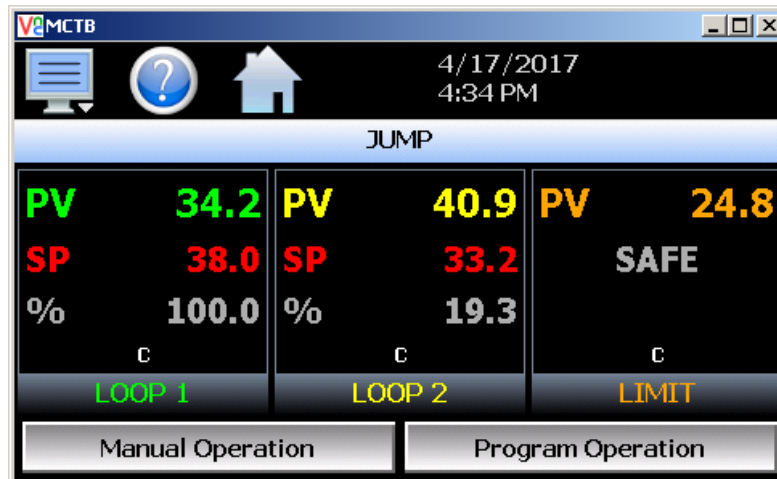


**NOTE:** The IP address shown on the communications screen of the MCT4 is the local LAN address and would not typically be used for an Internet connection.

Security Example: If the VNC server password is enabled on the MCT4 for either example above, upon pressing the “Connect” button to make the connection, the VNC viewer will prompt for the proper password. The connection will only be established once a valid password is entered.



Once the connection is established, the current MCT4 display will be shown on your desktop. The image will be a duplicate of what is on the MCT4. As you manipulate the screen, the display of the MCT4 will also be manipulated so that any local operator will be able to see what is happening and vice versa.



Multiple instances of the VNC viewer can be started on your PC. By running multiple viewers, you can have access to multiple MCT4 controllers right from your desktop. The heading of each VNC viewer window will use the “VNC Device Name” entry for the header. By entering a unique name for each MCT4, you can identify each VNC connection and know which system you are accessing.

The VNC viewer is meant to be used for short term control access to the MCT4. It is not meant for long term monitoring of system operation. If long term monitoring access is desired, use the built-in web server of the MCT4 or a PC with FDC software to monitor and control the MCT4 over its serial communications port. The web server interface and PC software is designed for long term monitoring and status updates.

Due to the nature of VNC operation, and for security reasons, the VNC viewer connection should not be left open on your desktop. The viewer connection should be opened in order to perform the necessary control and/or status check of system operation, and then closed once the task is complete. Accidental manipulation of the control or erroneous network activity could cause connection problems over the VNC interface and result in the VNC server shutting down and requiring the MCT4 to be restarted in order to regain access.

**NOTE:** Some viewers may also contain additional features for file transfer and other high-level functions. These functions are NOT compatible with the MCT4. Any attempt to use them may cause the MCT4 VNC server to malfunction and require power to be cycled in order to reboot the system. All viewers should be used ONLY to monitor and manipulate the MCT4 as if you were standing directly in front of the unit and touching the screen.

#### 11.1.4 Using Modbus TCP/IP Communications

The MCT4 Modbus TCP server interface allows a user to remotely monitor and control the MCT4 via another device or software application compatible with Modbus TCP/IP protocol. The acronym TCP stands for

Transmission Control Protocol while IP stands for Internet Protocol. These protocols are used together and handle the transfer of data over the internet. When Modbus information is sent using these protocols, the data is passed to the TCP layer where additional information is attached and then passed to the IP layer. The IP layer then places the data in a packet (or datagram) and transmits it.

Like the MCT4 Modbus serial interface, the TCP interface is always active; however, rather than using the Modbus Address on the communications screen as the slave address, the MCT4 IP address is used as the slave address. In order for Modbus TCP communications to function, the Master (or Client in Modbus TCP) establishes a connection with the Slave (or Server) using the IP address. In this case, the server is the MCT4. The MCT4 waits for an incoming connection from the client, and once a connection is established, the MCT4 then responds to queries from the client until the client closes the connection.

In order for a client to establish a connection with the MCT4, the following settings must be used by the client:

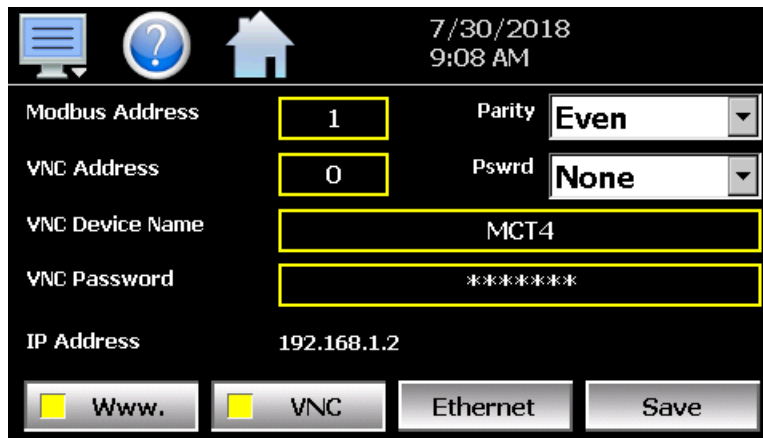
IP address (of slave) = MCT4 IP address as displayed on the Communications screen  
 Unit Identifier = MCT4 Modbus Address as displayed on the Communications screen.  
 Port Number = 502

**NOTE:** The implementation and/or use of a Modbus TCP client is outside the scope of this manual. For additional information regarding Modbus TCP/IP protocol there are many resources available online (<http://www.modbus.org/specs.php>) or consult the documentation provided with your client software application.

For a list of supported functions and data available over the Modbus TCP interface, see Appendix section A.1 Modbus Communications.

## 11.2 Serial Communications

The MCT4 serial interface uses Modbus RTU protocol. Any device used to communicate with the MCT4 over the serial interface must use this protocol. The interface can be configured to operate in either standard MCT4 mode or a simulated Watlow F4S/D mode.



When configured for the standard MCT4 interface, the communication address and parity can be set on the Web/Modbus/VNC. All other communication settings are fixed. The port settings of the device used to communicate with MCT4 must be set to match in order for the communications to take place.

Address: 1-247 (user selectable)  
 Baud Rate: 9600  
 Data Bits: 8  
 Stop Bits: 1

Parity: None, Odd, Even (user selectable)

When configured for the simulated Watlow F4S/D interface, only the communications address can be set. The parity setting is hidden and defaulted to “None” in order to be compatible with WatView software or other devices used to communicate with a Watlow F4S/D controller. The port settings of the device used to communicate with MCT4 must be set to match the standard F4 settings as follows:

Address: 1-247 (user selectable)  
Baud Rate: 19200  
Data Bits: 8  
Stop Bits: 1  
Parity: None

The Modbus address is used to identify the MCT4 on the serial link. When a multi-drop connection is used, each controller on the link must have a different address so that each one can be identified separately. If two or more MCT4 controllers have duplicate addresses, communications with those controllers will fail because they will each try to respond to the same message. For single MCT4 connections, the address only needs to match that of the commands being sent from the host device.

**IMPORTANT:** See Appendix section A.1 Modbus Communications for details on the available data and functions supported when using either the MCT4 or simulated Watlow F4S/D interface as functionality of the Watlow F4S/D interface is limited to features compatible with the MCT4 controller.

## 12 Alarm Codes and Troubleshooting

This section provides explanations of standard MCT4 alarms to help in diagnosing and resolving the alarm conditions. Note that the information provided here covers standard alarms only, and not alarms configured by the OEM. If you are unable to diagnose a problem through the use of this guide, contact your OEM for further assistance.



**Some of the troubleshooting procedures may require access to live circuitry. Dangerous accidental contact with line voltage may be possible. Only qualified service personnel should be allowed to perform these procedures.**

Alarm Monitor Description	Explanation/Corrective Action
" <i>tagname</i> " A to D converter failure	(error code 40) Indicates that the analog to digital converter in the loop or limit control indicated by " <i>tagname</i> " has failed. Return to factory for repair or replace.  <i>If the MCT4 is running a ramp/soak program when this alarm occurs, the program will be terminated if it occurs on either loop 1 or loop 2. If the alarm occurs on loop 3, the program will continue operation.</i>
Auto tune failed for " <i>tagname</i> ".	(error code 26) Indicates that auto tune was unable to execute properly for the loop control indicated by " <i>tagname</i> ". Verify that PB >0 and TI >0 before starting auto tune. Try manual tuning instead of auto tuning if the process has a very slow response.
" <i>tagname</i> " cold junction failure	(error code 30) Indicates that the cold junction compensation in the loop or limit control indicated by " <i>tagname</i> " has failed. Return to factory for repair or replace.
Communications error with " <i>tagname</i> ". Check cable.	Communication error occurred between the MCT4 base unit and installed PCM/HLM indicated by " <i>tagname</i> ". Verify that the PCM/HLM is properly installed in the base unit. Replace PCM/HLM card.
Data file error. SD card full or missing.	Indicates that data logging could not be started or has been stopped due to an issue in accessing the SD memory card. This will occur if the memory card does not have any remaining memory space available or the maximum number of files has been reached in the data log directory. Use the USB file utilities or FTP to backup (copy) and delete data files from the MCT4 in order to free up memory.  Verify that an SD card is properly inserted into the MCT4. Replace SD card.
" <i>tagname</i> " EEPROM failure	(error code 29) Indicates that the memory in the loop or limit control indicated by " <i>tagname</i> " has failed. Return to factory for repair or replace.
Email Error! Check cable or server down.	Indicates that the MCT4 was unable to send an alarm message through the mail server. Verify that the MCT4 is properly connected to the network and that the email settings and addresses are valid.

Alarm Monitor Description	Explanation/Corrective Action
FTP! Check cable or server down.	<p>Indicates that the FTP back-up attempt of the data files failed. Verify that the MCT4 is properly connected to the network and that the FTP settings are valid.</p> <p><i>If the MCT4 is not connected to a network, disable the FTP data back-up to prevent this alarm from occurring.</i></p>
Memory Error Please check SD card.	<p>Indicates that the SD card cannot be accessed when checking available memory space. Verify that an SD card is properly inserted into the MCT4. Replace SD card.</p>
NTP Ping Failed. Check Cable.	<p>Indicates that the MCT4 was unable to synchronize its clock with the selected time server. Verify that the MCT4 is properly connected to the network and the selected time server is accessible.</p> <p><i>If the MCT4 is not connected to a network, disable the NTS clock to prevent this alarm from occurring.</i></p>
"tagname" outputs 1 and 2 incorrectly configured.	<p>(error code 4) Indicates that the control loop configuration for the loop control indicated by "tagname" is not valid and must be corrected to clear the alarm. Check and correct setup values of output 2, PB, TI and output 1. If output 2 is required for cooling control, the control should use PID mode (PB &gt; 0, TI &gt; 0) and output 1 should use reverse mode (heat action), otherwise, don't use output 2 for cooling control.</p>
Program run error. "Loop 1" and "Loop 2" are not synchronized.	<p>Alarm applies to dual and triple loop MCT4 systems only and indicates that the running program (in each loop control) is operating with a difference of more than 1 minute between the programmed steps.</p> <p><b>NOTE:</b> <i>This alarm does not affect program operation. In order to clear the alarm, the program will have to be stopped. If the alarm will not clear, but the program indicates it is off, select "Stop" from the Program menu and then try to clear the alarm again.</i></p> <p><i>The timing accuracy of the MCT4 loop controls is ±30 seconds per month. This may cause one loop control to execute the program slightly faster than the other. For programs with long term operation, weeks or months, one loop may get significantly ahead of the other causing it to begin its next ramp or soak step ahead of the other affecting product or test results.</i></p> <p><i>Verify that the program end set point configuration for each loop is set to the same function. Verify that the event input functions (if used) are configured for the same function when program control functions are used.</i></p>
SD card damaged or missing.	<p>Indicates that the SD card cannot be accessed for USB file transfer. Verify that an SD card is properly inserted into the MCT4. Replace SD card.</p>
SD card filled. Please use USB file transfer.	<p>Indicates that a file was unable to be written due to lack of available free space on the memory card. Use the USB file utilities or FTP to backup (copy) and delete alarm, audit and data files from the MCT4 in order to free up memory. Can also occur if the SD card is missing/not properly inserted.</p>

Alarm Monitor Description	Explanation/Corrective Action
<p>"tagname" sensor break</p>	<p>Check sensor wiring for the loop or limit control indicated by "tagname". Verify lead connections. If sensor requires power, verify power to sensor.</p> <p><i>If the MCT4 is running a ramp/soak program when this alarm occurs, the program will be terminated if it occurs on either loop 1 or loop 2. If the alarm occurs on loop 3, the program will continue operation.</i></p>



## Appendix

### A.1 Modbus Communications

The MCT4 utilizes Modbus as its standard protocol and offers both Modbus RTU serial and Modbus TCP forms. This section provides information on the supported functions and data available over the Modbus interface. It is assumed that the user is already familiar with Modbus protocol and has a basic understanding of its implementation and use. For additional information and support, modbus.org (<http://modbus.org/tech.php>) provides an abundance of technical documents, standards and support applications.

Listed below are a few of the more common software packages that claim to support Modbus protocol. This list is provided as informational only. Contact the software manufacturer for more information on applying their software.

LabView by National Instruments  
 11500 N Mopac Expwy  
 Austin, TX 78759-3504  
 Phone 800-683-8411  
<http://www.natinst.com>

Wonderware by Wonderware  
 26561 Rancho Pkwy. South  
 Lake Forest, CA 92630  
 Phone 949-727-3200  
<http://www.wonderware.com>

SpecView by SpecView Corporation  
 13409 53<sup>rd</sup> Ave NW  
 Gig Harbor, WA 98332  
 Phone 253-853-3199  
<http://www.specview.com>

#### A.1.1 Supported Function Codes

Modbus bases its data model on a series of tables, each of which defines a particular range of values. In the case of the MCT4, all data is contained within the Holding Register data table. This means that all communication transactions between the MCT4 and the master (client) are performed using three command types. These include Read Holding Registers, Write Single Register and Write Multiple Registers.

		Function Codes	
		code	(hex)
16 bits access (word)	Read Holding Registers	03	03
	Write Single Register	06	06
	Write Multiple Registers	16	10

Function code 03 (read holding registers) is used to read the contents of a contiguous block of data registers from the MCT4. The request from the master specifies the starting register address and the number of registers. The response message from the MCT4 contains the value of each register requested (two bytes per register).

Function code 06 (write holding register) is used to write to a single data register in the MCT4. The request from the master specifies the address of the register to be written and the value. The response message from the MCT4 is an exact duplicate of the sent message (if completed successfully).

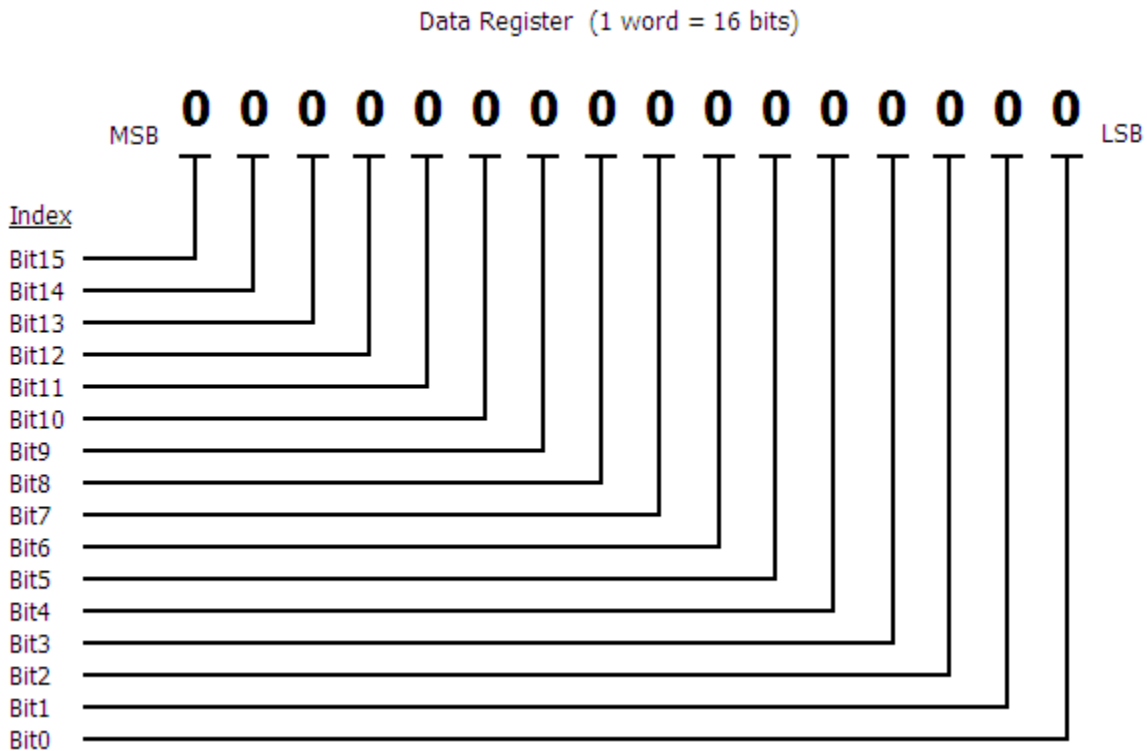
Function code 16 (write multiple registers) is used to write to a contiguous block of data registers in the MCT4. The request from the master specifies the starting register address to be written, the number of registers to write and two bytes of data for each register. The normal response message from the MCT4 returns the function code, starting address and quantity of data registers written.

**A.1.2 MCT4 Data Registers (Standard Interface)**

Some of the values contained in the MCT4 register base contain bit-oriented values. This means that each bit of the word indicates an on/off status for a specific setting or condition. In handling these values, it is recommended that the word be converted to its binary equivalent.

By converting the value to its binary equivalent, it produces a Boolean array of true [bit on (1)] and false [bit off (0)] values. This allows each bit to be examined individually. In the same manner, creating a Boolean array of 16 bits produces an equivalent hexadecimal value that can be sent to the MCT4 in order to set a control register.

For the purpose of this manual, parameters defined as bit oriented will have the function of each bit associated with the bit's index number in the data word. The index number is equal to that of a typical array function. Thus, an index number of zero, selects the first bit in the word (LSB). An index number of 1 selects the second bit in the word, and so on. This helps eliminate offset selection errors that may occur when coding software and using array functions to select which bit in the word that is required for examination.



*Adhere to the following lists of registers and their allowable data ranges. DO NOT attempt to write to any other register number than those listed. DO NOT write to registers that are for options your controller does not have. Failure to adhere to this requirement can result in erratic control and/or damage to equipment.*

**All register numbers are listed in relative values. To convert to absolute values, add 400001.**

A.1.2.1 Control Registers

Register Address	Parameter Description	Data *A Type	Range		*C Unit
			*B Low	*B High	
0 (0x0000)	System Offline/Busy Status	R	*B1	*B1	-
1 (0x0001)	Alarm Reset	R/W	0	1	-
2 (0x0002)	Automatic Program Out of Sync Alarm	R	0	1	-
3 (0x0003)	Loop Communication Alarm Status	R	*B2	*B2	-
4 (0x0004)	Loop Control Error Status	R	*B3	*B3	-
5 (0x0005)	Process Alarm Status	R	*B4	*B4	-
6 (0x0006)	Process Alarm Status	R	*B4	*B4	-
7 (0x0007)					
8 (0x0008)					
9 (0x0009)	Control Loop Manual Override	R/W	*B5	*B5	-
10 (0x000A)	Control Loop Autotune Activation	R/W	*B6	*B6	-
11 (0x000B)	<b>RESERVED – DO NOT</b> write to register				
12 (0x000C)	System Events	R/W	*B7	*B7	-
13 (0x000D)					
14 (0x000E)	Automatic Program Start Step Number	R/W	1	64	-
15 (0x000F)	Automatic Program Operating Status	R/W	*B8	*B8	-
16 (0x0010)	Program Name Characters 1 & 2	R	*B9	*B9	-
17 (0x0011)	Program Name Characters 3 & 4	R	*B9	*B9	-
18 (0x0012)	Program Name Characters 5 & 6	R	*B9	*B9	-
19 (0x0013)	Program Name Characters 7 & 8	R	*B9	*B9	-
20 (0x0014)	Program Name Characters 9 & 10	R	*B9	*B9	-
21 (0x0015)	Program Name Characters 11 & 12	R	*B9	*B9	-
22 (0x0016)	Program Name Characters 13 & 14	R	*B9	*B9	-
23 (0x0017)	Current Program Step	R	1	64	-
24 (0x0018)	Total Number of Steps	R	1	64	-
25 (0x0019)	Total Time of Step	R	0	99.59	-
26 (0x001A)	Time Remaining in Step	R	0	99.59	-
27 (0x001B)	Cycles Remaining for Current Jump Loop	R	1	10000	-
28 (0x001C)					
29 (0x001D)					
30 (0x001E)					
31 (0x001F)	Loop 1 Target Setpoint for Current Step	R	-32768	32767	*C1
32 (0x0020)	Loop 2 Target Setpoint for Current Step	R	-32768	32767	*C1
33 (0x0021)					
34 (0x0022)					
35 (0x0023)	Loop 1 Process Variable (PV)	R	-32768	32767	*C1
36 (0x0024)	Loop 1 Setpoint (SP)	R/W	-32768	32767	*C1

Register Address	Parameter Description	Data *A Type	Range		*C Unit
			*B Low	*B High	
37 (0x0025)	Loop 1 Percent Output (%Out)	R/W	-100.00	100.00	%
38 (0x0026)	Loop 1 Operational Status	R	*B10	*B10	-
39 (0x0027)	Loop 1 Error Code	R	*B11	*B11	-
40 (0x0028)	Loop 2 / Limit Process Variable (PV)	R	*B12	*B12	*C1
41 (0x0029)	Loop 2 Setpoint (SP)	R/W	-32768	32767	*C1
42 (0x002A)	Loop 2 Percent Output (%Out)	R/W	-100.00	100.00	%
43 (0x002B)	Loop 2 / Limit Operational Status	R	*B10	*B10	-
44 (0x002C)	Loop 2 / Limit Error Code	R	*B11	*B11	-
45 (0x002D)	Loop 3 / Limit Process Variable (PV)	R	*B12	*B12	*C1
46 (0x002E)	Loop 3 Setpoint (SP)	R/W	-32768	32767	*C1
47 (0x002F)	Loop 3 Percent Output (%Out)	R/W	-100.00	100.00	%
48 (0x0030)	Loop 3 / Limit Operational Status	R	*B10	*B10	-
49 (0x0031)	Loop 3 / Limit Error Code	R	*B11	*B11	-
50 (0x0032)					
51 (0x0033)	Alarm 1 Setpoint	R/W	*B13	*B13	*C1
52 (0x0034)	Alarm 2 Setpoint	R/W	*B13	*B13	*C1
53 (0x0035)	Alarm 3 Setpoint	R/W	*B13	*B13	*C1
54 (0x0036)	Alarm 4 Setpoint	R/W	*B13	*B13	*C1
55 (0x0037)	Alarm 5 Setpoint	R/W	*B13	*B13	*C1
56 (0x0038)	Alarm 6 Setpoint	R/W	*B13	*B13	*C1
57 (0x0039)	Alarm 7 Setpoint	R/W	*B13	*B13	*C1
58 (0x003A)	Alarm 8 Setpoint	R/W	*B13	*B13	*C1
59 (0x003B)	Alarm 9 Setpoint	R/W	*B13	*B13	*C1
60 (0x003C)	Alarm 10 Setpoint	R/W	*B13	*B13	*C1
61 (0x003D)	Alarm 11 Setpoint	R/W	*B13	*B13	*C1
62 (0x003E)	Alarm 12 Setpoint	R/W	*B13	*B13	*C1
63 (0x003F)	Alarm 13 Setpoint	R/W	*B13	*B13	*C1
64 (0x0040)	Alarm 14 Setpoint	R/W	*B13	*B13	*C1
65 (0x0041)	Alarm 15 Setpoint	R/W	*B13	*B13	*C1
66 (0x0042)	Alarm 16 Setpoint	R/W	*B13	*B13	*C1
67 (0x0043)	Alarm 17 Setpoint	R/W	*B13	*B13	*C1
68 (0x0044)	Alarm 18 Setpoint	R/W	*B13	*B13	*C1
69 (0x0045)	Alarm 19 Setpoint	R/W	*B13	*B13	*C1
70 (0x0046)					
71 (0x0047)	Loop 1 Input Units	R	*B14	*B14	-
72 (0x0048)	Loop 2 / Limit Input Units	R	*B14	*B14	-
73 (0x0049)	Loop 3 / Limit Input Units	R	*B14	*B14	-

**Notes:**

- \*A R/W Specifies readable / writable data, R specifies read only data and W specifies a write only control value.
- \*B The range of certain parameters are dependent upon system options. Consult the following range tables for information regarding the use of these parameters.

Reading bit-oriented parameters

The value contained in these parameters is dependent upon the combination of “on” bits (1). Therefore, only the individual status of each bit has meaning, not the value of the parameter.

Setting bit-oriented parameters

The value that must be written to these parameters is dependent upon the combination of “on” bits. Therefore, it is necessary to know the current value of the parameter before setting it so that only the bit status you want to update is changed. Otherwise, sending a value derived from only the bit you wish to set will turn off all other functions related to the other bits in the parameter.

\*B1

Parameter Value	Description
0	MCT4 is Online
1	Offline/Program Download in Progress

The status of this register should be used for information only, as a means of determining if the system is ready for operation.

\*B2

Parameter Value	Description
Bit0	Loop 1 Communications Error
Bit1	Loop 2 / Limit Communications Error
Bit2	Loop 3 / Limit Communications Error
Bit3 – Bit15	Not Assigned

**Note:** If a bit is on, check the corresponding loop / limit communication wiring/settings to determine the cause for the alarm.

For Bit1 and Bit2, the device associated with the error is dependent upon the system configuration. If the MCT4 is a single loop control with the limit installed, Bit1 will represent an error code on the limit control. If the MCT4 has two control loops configured, Bit1 will represent an error on loop 2 while Bit2 represents an error on the limit control.

\*B3

Parameter Value	Description
Bit0	Loop 1 Control Error
Bit1	Loop 2 / Limit Control Error
Bit2	Loop 3 / Limit Control Error
Bit3 – Bit15	Not Assigned

**Note:** If a bit is on, check the corresponding loop / limit operational status register to determine the cause for the alarm.

For Bit1 and Bit2, the device associated with the error is dependent upon the system configuration. If the MCT4 is a single loop control with the limit installed, Bit1 will represent an error code on the limit control. If the MCT4 has two control loops configured, Bit1 will represent an error on loop 2 while Bit2 represents an error on the limit control.

**\*B4**

Parameter Value	Description
Bit0	Alarm 1 Active
Bit1	Alarm 2 Active
Bit2	Alarm 3 Active
Bit3	Alarm 4 Active
Bit4	Alarm 5 Active
Bit5	Alarm 6 Active
Bit6	Alarm 7 Active
Bit7	Alarm 8 Active
Bit8	Alarm 9 Active
Bit9	Alarm 10 Active
Bit10	Alarm 11 Active
Bit11	Alarm 12 Active
Bit12	Alarm 13 Active
Bit13	Alarm 14 Active
Bit14	Alarm 15 Active
Bit15	Alarm 16 Active

**Note:** Alarms 1 through 16 are indicated in register 5. The number of alarms available in the system is dependent upon the configuration.

Parameter Value	Description
Bit0	Alarm 17 Active
Bit1	Alarm 18 Active
Bit2	Alarm 19 Active
Bit3 – Bit15	Not Assigned

**Note:** Alarms 17 through 19 are indicated in register 6. The register will be used to indicate alarm active status only when more than 16 alarms are configured.

**\*B5**

Parameter Value	Description
Bit0	Loop 1 Manual Mode
Bit1	Loop 2 Manual Mode
Bit2	Loop 3 Manual Mode
Bit3 – Bit15	Not Assigned

**Note:** When loop is in manual mode, the loop percentage of output can be set by writing to the corresponding loop percent output register.

**\*B6**

Parameter Value	Description
Bit0	Loop 1 in Auto Tune
Bit1	Loop 2 in Auto Tune
Bit2	Loop 3 in Auto Tune
Bit3 – Bit15	Not Assigned

**Note:** Auto tune may not be available depending upon the loop configuration. If auto tune operation is not available, the bit for the loop will automatically turn off after being set.

When auto tune completes normally, the bit for the loop will automatically turn off indicating that tune is complete. To terminate an auto tune in progress, turn off the bit for the desired loop.

**\*B7**

Parameter Value	Description
Bit0	Event 1
Bit1	Event 2
Bit2	Event 3
Bit3	Event 4
Bit4	Event 5
Bit5	Event 6
Bit6	Event 7
Bit7	Event 8
Bit8	Event 9
Bit9 – Bit15	Not Assigned

**Note:** Not all system events may be available on your system. Event names and functions are defined by system configuration. Consult your system documentation or contact your OEM for information on event use.

**\*B8**

Parameter Value	Description
0	Automatic Program Start (On)
1	Automatic Program Hold
2	Automatic Program Halt (Off)

**\*B9**

Parameter Value	High Order Byte	Low Order Byte	Description
Range Low	32	32	Program Name Character (ASCII Table)
Range High	126	126	Program Name Character (ASCII Table)

See the ASCII character chart in Section 3.1 for the character representation of these values.

**Example**

Read command of registers 16 to 22 from the MCT4 returns the following values:

Register Values: 0x74 53    0x72 6F    0x20 65    0x65 54    0x74 73    0x20 20    0x20 20  
 ASCII Equivalent:    t S            r o            e            e T            t s

Assemble the ASCII characters in order from low to high byte starting with register 16 in order to assemble the automatic program name: "Store Test". Note that null characters are not used in the program name. A space (0x20) will be used in place of a null character to maintain the 14-character name length if the program name is not 14 characters long.

**\*B10**

Parameter Value	Description
Bit0	Program Run Mode / Limit Ou1
Bit1	Program Hold Mode / Limit Out2
Bit2	Static Mode
Bit3	Auto Tune Mode
Bit4	Manual Mode
Bit5	Off Mode
Bit6	Failure Transfer
Bit7	Automatic Program Ramp Up
Bit8	Automatic Program Ramp Down
Bit9	Automatic Program Soak
Bit10	Alarm 1 Active
Bit11	Alarm 2 Active
Bit12	Alarm 3 Active
Bit13	Event 1 On
Bit14	Event 2 On
Bit15	Event 3 On

**Note:** The “alarm active” and “event on” status bits cannot be used for determining alarm or event status. The alarm and event activation are based upon loop configuration. To monitor alarm and event status, use registers 5 and 12 respectively.

For **limit controls**, only Bit0 and Bit1 are used. The bits represent the active state of the limit output. When the bit is on (1), the output is on. When the bit is off (0), the output is off. Under normal conditions Bit0 will be on indicating a non-limit condition. The status of Bit1 is dependent upon the alarm configuration of output 2.

**\*B11**

Parameter Value	Description
0	No Error
4	Illegal Setup Values
10	Comm Error – Bad Function Code
11	Comm Error – Register Out of Range
14	Comm Error – Write Read Only Data
15	Comm Error – Out of Range Data
25	Holdback Time Out
26	Auto Tune Error
27	Input Type Requires Calibration
29	EEPROM Error
30	Cold Junction Failure
39	Sensor Break
40	A to D Failure

**\*B12**

Parameter Value	Range Low	Range High
Loop PV	-32768	32767
Limit PV	-19999	45536

**Note:** The process value for loop controls is read directly as a short, i.e., a 16-bit signed integer with the range of -32768 to 32767.

For the **limit control**, the process value is read as an unsigned integer, i.e., a 16-bit unsigned integer with a range of 0 to 65535. In order to convert the value read to the actual process value, subtract 19999 from the value read from the limit control. This results in a value of -19999 to 45536.



\*B13

Parameter Value	Input Units	Range Low	Range High
Loop Alarm SP	Deg C	-18000	18000
	Deg F	-32768	32767
	Process	-32768	32767
Limit Alarm SP	Deg C	-11280	25120
	Deg F	-19999	45536
	Process	-19999	45536

**Note:** The alarm set point value for loop controls is read/written directly as a short, i.e., a 16-bit signed integer with the range of -32768 to 32767.

For the **limit control**, the alarm set point value is read/written as an unsigned integer, i.e., a 16-bit unsigned integer with a range of 0 to 65535. In order to convert the value read/written to the limit control to the proper display value, subtract 19999 from the value read or add 19999 to the value prior to writing it. This results in a value within the overall range of -19999 to 45536.

\*B14

Parameter Value	Description
0	Centigrade
1	Fahrenheit
2	Process Units

**Note:** When the loop or limit input type is linear (process units), the units of measure are based on the OEM configuration.

\*C1 The units of measure and range of a loop or limit control is dependent upon the configuration of the input and/or the units of temperature selection (Celsius or Fahrenheit) of the MCT4. The decimal point position for the loop or limit input is an implied value based on the configuration of the input. Thus, a register value of 345 can represent an actual process value of 345, 34.5, 3.45 or 0.345 depending upon the decimal point configuration of the loop or monitor input.

A.1.2.2 Automatic Program Registers

The automatic program parameters are a separate group of registers that are used to load programs into the MCT4. The manner in which the program steps are configured and sent to the MCT4 is specific and must be followed exactly.

Each program step consists of 14 data registers. The program must be written one step at a time, using a multiple write command (0x10) to write the data for all 14 registers at once. This allows programs to be stored as two-dimensional arrays, of which code can be written to simply index through the array step-by-step and transmit the program file to the MCT4.

The first 14 registers of the program contain specific settings related to the program. These include hold back limits, ramp units, dwell units, the program name and the length of the program (number of steps).

Register Address	Parameter Description	Data *D Type	Range *E		*F Unit
			Low	High	
100 (0x0064)	Hold Back Limit Loop 1	W	*E1	*E1	PV
101 (0x0065)					
102 (0x0066)	Ramp Units	W	*E2	*E2	-
103 (0x0067)	Dwell Units	W	*E3	*E3	-
104 (0x0068)	Hold Back Limit Loop 2	W	*E1	*E1	PV
105 (0x0069)					
106 (0x006A)	Total Number of Steps	W	1	64	-
107 (0x006B)	Program Name (Chars 1 & 2)	W	*E4	*E4	-
108 (0x006C)	Program Name (Chars 3 & 4)	W	*E4	*E4	-
109 (0x006D)	Program Name (Chars 5 & 6)	W	*E4	*E4	-
110 (0x006E)	Program Name (Chars 7 & 8)	W	*E4	*E4	-
111 (0x006F)	Program Name (Chars 9 & 10)	W	*E4	*E4	-
112 (0x0070)	Program Name (Chars 11 & 12)	W	*E4	*E4	-
113 (0x0071)	Program Name (Chars 13 & 14)	W	*E4	*E4	-

The following 14 registers of the automatic program contain the data for step 1 of the program.

Register Address	Parameter Description	Data *D Type	Range *E		*F Unit
			Low	High	
114 (0x0072)	Step Number*	W	0	63	-
115 (0x0073)	Step Type	W	*E5	*E5	-
116 (0x0074)	Ramp Target Setpoint Loop 1	W	-32768	32767	PV
117 (0x0075)	Ramp Time or Ramp Rate	W	0	5999	-
118 (0x0076)	Event Selections 1, 2, 3	W	*E6	*E6	-
119 (0x0077)	Holdback Type Loop 1	W	*E7	*E7	-
120 (0x0078)	Dwell Time	W	0	9999	-
121 (0x0079)	Jump Step	W	0	63	-
122 (0x007A)	Jump Cycles	W	1	9999	-
123 (0x007B)	Final Setpoint Loop 1	W	-32768	32767	PV
124 (0x007C)	Ramp Target Setpoint Loop 2	W	-32768	32767	PV
125 (0x007D)	Event Selections 4, 5, 6	W	*E8	*E8	-
126 (0x007E)	Holdback Type Loop 2	W	*E7	*E7	-
127 (0x007F)	Final Setpoint Loop 2	W	-32768	32767	PV

\*The **Step Number** must be offset by 1 when writing step data to the MCT4. Steps 1-64 will be sent with the step number as a value of 0-63 (-1 offset).

**All remaining steps of the program follow the same format and data structure as is represented for step one above. Up to the following 882 registers are used to contain the additional step data of the program as required for steps 2 through 64. Since few if any programs will contain the maximum of 64 steps, it is only necessary to write the step data for the number steps used in the automatic program.**

128 (0x0080) – 141 (0x008D)      Program Step 2 Data Registers  
 142 (0x008E) – 155 (0x009B)      Program Step 3 Data Registers  
 156 (0x009C) – 169 (0x00A9)      Program Step 4 Data Registers  
 170 (0x00AA) – 183 (0x00B7)      Program Step 5 Data Registers  
 184 (0x00B8) – 197 (0x00C5)      Program Step 6 Data Registers  
 198 (0x00C6) – 211 (0x00D3)      Program Step 7 Data Registers  
 212 (0x00D4) – 225 (0x00E1)      Program Step 8 Data Registers  
 226 (0x00E2) – 239 (0x00EF)      Program Step 9 Data Registers

-----  
 through

-----  
 996 (0x03E4) – 1009 (0x03F1)      Program Step 64 Data Registers

**Notes:**

\*D      W Specifies write only data.

\*E1

Parameter Value	Temperature Units °C	Temperature Units °F	Process Units
Range Low	0	0	0
Range High	555	999	999

\*E2

Parameter Value	Description
0	Hours and Minutes
1	Minutes and Seconds
2	Units/Minute
3	Units/Hour

**Note:** DO NOT use ramp units of units/minute or units/hour on a dual loop system. Since step time is defined by the ramp rate and the change in set point, the program will get out of sync between each loop causing an automatic program run error.

\*E3

Parameter Value	Description
0	Hours and Minutes
1	Minutes and Seconds

\*E4      See note \*B9 in Section 5.1 for information on the range of this parameters.

\*E5

Parameter Value	Description
0	Ramp
1	Soak
2	Jump
3	End

**Note:** The last step of an automatic program must be an end step. If the last step is not an end step, the program will not run correctly and/or a program download error will occur and the program will not operate.

\*E6

Parameter Value	Description
Bit0	Event 1
Bit1	Event 2
Bit2	Event 3
Bit3 – Bit15	Not Assigned

**Note:** The available system events are based on the configuration of the MCT4. Only event outputs configured on loops 1 and 2 can be controlled via the program. Any events configured to loop 3 outputs will not function during program operation.

\*E7

Parameter Value	Description
0	Holdback Disabled
3	Deviation Band Holdback

\*E8

Parameter Value	Description
Bit0	Event 4
Bit1	Event 5
Bit2	Event 6
Bit3 – Bit15	Not Assigned

**Note:** The available system events are based on the configuration of the MCT4. Only event outputs configured on loops 1 and 2 can be controlled via the program. Any events configured to loop 3 outputs will not function during program operation.

\*F The unit PV means that the unit of the parameter is the same as the unit of PV (the loop configuration).

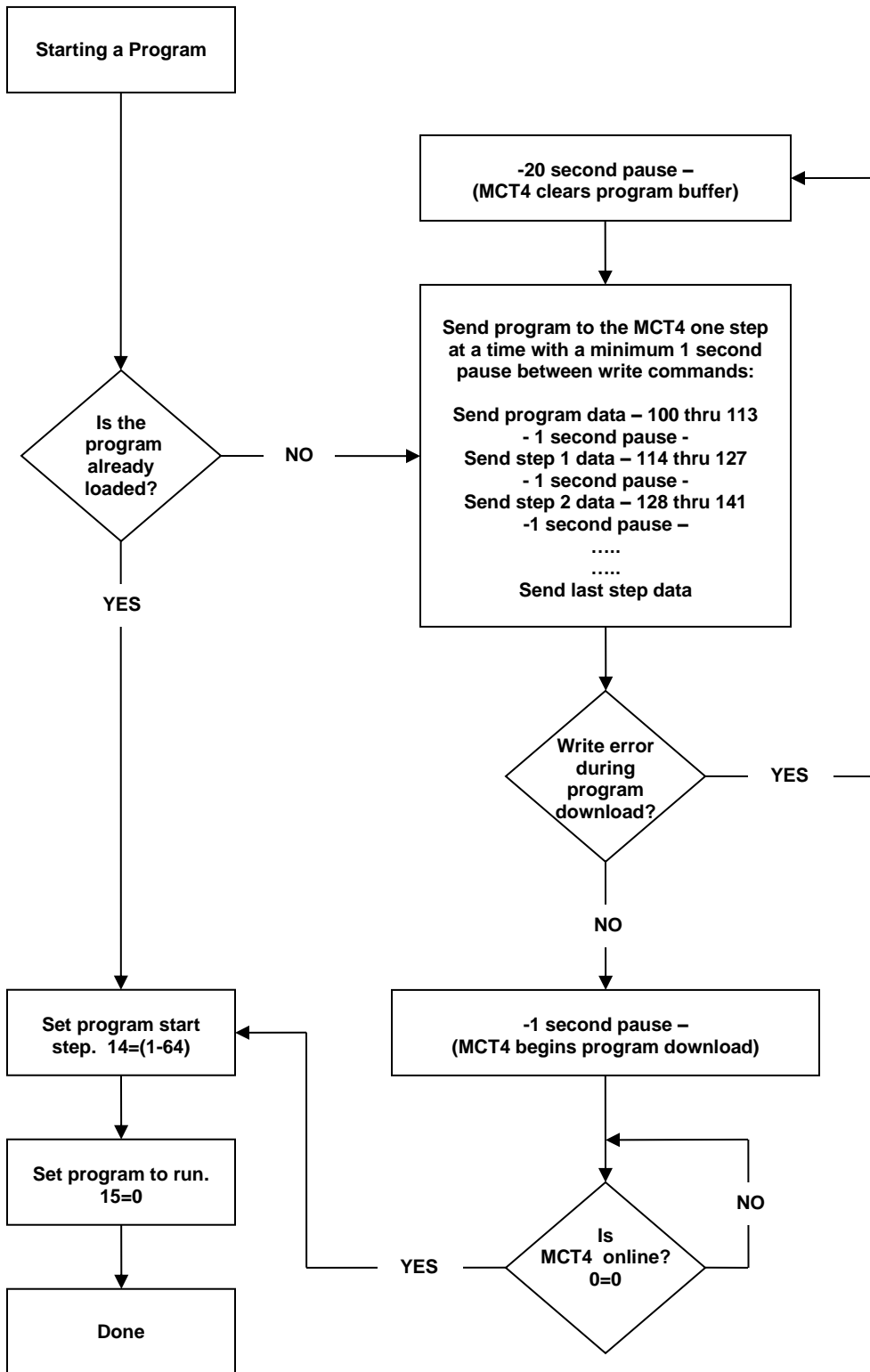
**Use caution when loading an automatic program to the MCT4. You must insure that the decimal point scaling and units of measurement in the program match the loop configuration. Loading a program with a temperature set point of 80 will result in a control temperature of 8.0°F if the MCT4 control is in degrees Fahrenheit with a decimal resolution of 1 for the loop control. However, if the MCT4 is set for degrees Centigrade with a decimal resolution of 0 for the loop control, it will result in a control temperature of 80°C (176°F).**

### A.1.2.3 Starting an Automatic Program

Automatic programs are sent to the MCT4 in a step-by-step process. The download sequence must be followed in proper order and must complete without errors to be valid. If a write error is detected during the transfer of a program from a PC to the MCT4 (no response from MCT4 or NACK returned), the program download must be aborted and restarted.

The MCT4 is automatically placed into program transfer mode when the first group of registers containing the program specific data is sent (registers 100-113). The MCT4 then begins looking for the number of steps of the program to be sent as was set in register 106. As each step is received, it increments the count. Once all steps have been received, the MCT4 downloads the program to the loop control program memory. During this transfer, register 0 will be set to 1 to indicate that the process is taking place. Once the register value returns to zero, the automatic program is ready to be started.

If an error occurs during the transfer process from the PC to the MCT4, the program transfer process should be stopped at the PC. The data sent to the MCT4 was either corrupted in transmission or not received properly. It is not possible to resend the failed step because it is not known if any of the previous data was received by the MCT4 properly. On the transmission error, the MCT4 will enter a 15 second timeout process. At the end of the timeout period, the buffer will be cleared and the program can be resent. In order to ensure that the new download begins properly, induce a 20 second wait period on the host PC after the failed transmission attempt to ensure that enough time has elapsed.



### A.1.3 MCT4 Simulated F4S/D Interface Option

The MCT4 simulated Watlow F4S/D interface mode allows the MCT4 to appear as a Watlow F4 controller to Watlow's Watview software. This allows the MCT4 to be placed on an existing serial communication link with other F4 controllers already communicating with WatView or another software package. This eliminates the need for users already familiar with their existing software to learn another software package in order to communicate with the MCT4. It also allows for the replacement or upgrade of older, individual F4 controllers without having to implement a complete changeover.

This section targets the functionality provided by the MCT4 F4S/D interface, and not the specifics on how to interface with a Watlow F4S/D controller. It is assumed that users who choose to use this interface mode are already familiar with or have an existing F4 installation and wish to continue its use while integrating the MCT4 into that installation base. For specifics on how to communicate with a Watlow F4 controller or to obtain the full list of communications registers, see the Series F4S/D User's Manual available from Watlow's website (<http://www.watlow.com/-/media/Documents/User-Manuals/f4pe-E.pdf>).

#### A.1.3.1 F4S/D Supported Control/Monitoring Data Registers

The following table of data registers represents active (functional) data registers for the F4 interface that are used by the MCT4 for control/monitoring. While the MCT4 provides the full register base of a Watlow F4S/D to insure compatibility with WatView, many of the registers are non-functional. The purpose of the interface is to allow control/monitoring and not configuration/setup of the MCT4.

Register Address	Parameter Description	Data *A Type	Range		*C Unit
			*B Low	High	
100 (0x0064)	Input 1 Value, Status	R	-32768	32767	*C1
101 (0x0065)	Input 1 Error, Status	R	*B1	*B1	-
102 (0x0066)	Alarm 1, Status	R	*B2	*B2	-
103 (0x0067)	% Power Output 1A, Status	R	0	100.00	%
104 (0x0068)	Input 2 Value, Status	R	-32768	32767	*C1
105 (0x0069)	Input 2 Error, Status	R	*B1	*B1	-
106 (0x006A)	Alarm 2, Status	R	*B2	*B2	-
107 (0x006B)	% Power Output 1B, Status	R	0	100.00	%
108 (0x006C)	Input 3 Value, Status	R	-32768	32767	*C1
109 (0x006D)	Input 3 Error, Status	R	*B1	*B1	-
111 (0x006F)	% Power Output 2A, Status	R	0	100.00	%
115 (0x0073)	% Power Output 2B, Status	R	0	100.00	%
200 (0x00C8)	Operation Mode, Status	R	*B3	*B3	-
300 (0x012C)	Set Point 1, Value	R/W	-32768	32767	*C1
302 (0x012F)	Alarm Low Set Point and Deviation, Alarm 1	R/W	*B4	*B4	*C1
303 (0x0130)	Alarm High Set Point and Deviation, Alarm 1	R/W	*B4	*B4	*C1
305 (0x0131)	Autotune Channel 1	R/W	*B5	*B5	-

Register Address	Parameter Description	Data *A Type	Range		*C Unit
			*B Low	High	
311 (0x0137)	Clear Error 1, Key Press Simulation	W	*B6	*B6	-
312 (0x0138)	Clear Alarm 1, Key Press Simulation	W	*B6	*B6	-
313 (0x0139)	Silence Alarm 1, Key Press Simulation	W	*B6	*B6	-
319 (0x013F)	Set Point 2, Value	R/W	-32768	32767	*C1
321 (0x0141)	Alarm Low Set Point and Deviation, Alarm 2	R/W	*B4	*B4	*C1
322 (0x0142)	Alarm High Set Point and Deviation, Alarm 2	R/W	*B4	*B4	*C1
324 (0x0144)	Autotune Channel 2	R/W	*B5	*B5	-
330 (0x014A)	Clear Error 2, Key Press Simulation	W	*B6	*B6	-
331 (0x014B)	Clear Alarm 2, Key Press Simulation	W	*B6	*B6	-
332 (0x014C)	Silence Alarm 2, Key Press Simulation	W	*B6	*B6	-
602 (0x025A)	Set Point Low Limit, Analog Input 1	R	-32768	32767	*C1
603 (0x025B)	Set Point High Limit, Analog Input 1	R	-32768	32767	*C1
606 (0x025E)	Decimal Point, Analog Input 1	R	0	3	-
608 (0x0260)	Process Units, Analog Input 1	R	*B7	*B7	-
612 (0x0264)	Set Point Low Limit, Analog Input 2	R	-32768	32767	*C1
613 (0x0265)	Set Point High Limit, Analog Input 2	R	-32768	32767	*C1
616 (0x0268)	Decimal Point, Analog Input 2	R	0	3	-
618 (0x026A)	Process Units, Analog Input 2	R	*B7	*B7	-
901 (0x006F)	°F or °C, System	R	0	1	-
1205 (0x04B5)	Guaranteed Soak Band, Channel 1	R/W	*B8	*B8	*C1
1209 (0x04B9)	Resume a Profile, Key Press Simulation	W	*B6	*B6	-
1210 (0x04BA)	Hold a Profile, Key Press Simulation	W	*B6	*B6	-
1212 (0x04BC)	Guaranteed Soak Band, Channel 2	R/W	*B8	*B8	*C1



Register Address	Parameter Description	Data *A Type	Range		*C Unit
			*B Low	High	
1217 (0x04C1)	Terminate a Profile, Key Press Simulation	W	*B6	*B6	-
2000 (0x07D0)	Digital (Event) Output 1, Condition	R/W	0	1	-
2010 (0x07DA)	Digital (Event) Output 2, Condition	R/W	0	1	-
2020 (0x07E4)	Digital (Event) Output 3, Condition	R/W	0	1	-
2030 (0x07EE)	Digital (Event) Output 4, Condition	R/W	0	1	-
2040 (0x07F8)	Digital (Event) Output 5, Condition	R/W	0	1	-
2050 (0x0802)	Digital (Event) Output 6, Condition	R/W	0	1	-
2060 (0x080C)	Digital (Event) Output 7, Condition	R/W	0	1	-
2070 (0x0816)	Digital (Event) Output 8, Condition	R/W	0	1	-
3100 (0x0C1C) -thru- 3109 (0x0C25)	Name, Digital (Event) Output 1 (10 characters)	R	*B9	*B9	-
3110 (0x0C26) -thru- 3119 (0x0C2F)	Name, Digital (Event) Output 2 (10 characters)	R	*B9	*B9	-
3120 (0x0C30) -thru- 3129 (0x0C39)	Name, Digital (Event) Output 3 (10 characters)	R	*B9	*B9	-
3130 (0x0C3A) -thru- 3139 (0x0C43)	Name, Digital (Event) Output 4 (10 characters)	R	*B9	*B9	-
3140 (0x0C44) -thru- 3149 (0x0C4D)	Name, Digital (Event) Output 5 (10 characters)	R	*B9	*B9	-
3150 (0x0C4E) -thru- 3159 (0x0C57)	Name, Digital (Event) Output 6 (10 characters)	R	*B9	*B9	-
3160 (0x0C58) -thru- 3169 (0x0C61)	Name, Digital (Event) Output 7 (10 characters)	R	*B9	*B9	-
3170 (0x0C62) -thru- 3179 (0x0C6B)	Name, Digital (Event) Output 8 (10 characters)	R	*B9	*B9	-
3200 (0x0C80) -thru- 3209 (0x0C89)	Name, Alarm 1 (10 characters)	R	*B9	*B9	-

Register Address	Parameter Description	Data *A Type	Range		*C Unit
			*B Low	*B High	
3210 (0x0C8A) -thru- 3219 (0x0C93)	Name, Alarm 2 (10 characters)	R	*B9	*B9	-
3500 (0x0DAC) -thru- 3509 (0x0DB5)	Name, Profile 1 (10 characters)	R	*B9	*B9	-
4100 (0x1004)	Profile Number, Current Status	R	1	1	-
4101 (0x1005)	Profile Step Number, Current Status	R	1	64	-
4102 (0x1006)	Profile Step Type, Current Status	R	*B10	*B10	-
4111 (0x100F)	Digital (Event) Output 1, Current Status	R	0	1	-
4112 (0x1010)	Digital (Event) Output 2, Current Status	R	0	1	-
4113 (0x1011)	Digital (Event) Output 3, Current Status	R	0	1	-
4114 (0x1012)	Digital (Event) Output 4, Current Status	R	0	1	-
4115 (0x1013)	Digital (Event) Output 5, Current Status	R	0	1	-
4116 (0x1014)	Digital (Event) Output 6, Current Status	R	0	1	-
4117 (0x1015)	Digital (Event) Output 7, Current Status	R	0	1	-
4118 (0x1016)	Digital (Event) Output 8, Current Status	R	0	1	-
4119 (0x1017)	Hours Remaining, Ramp/Soak Step	R	0	99	-
4120 (0x1018)	Minutes Remaining, Ramp/Soak Step	R	0	59	-
4121 (0x1019)	Seconds Remaining, Ramp/Soak Step	R	0	59	-
4122 (0x101A)	Set Point Channel 1, Current Profile Status	R	-32768	32767	*C1
4123 (0x101B)	Set Point Channel 2, Current Profile Status	R	-32768	32767	*C1
4126 (0x101E)	Jump Count, Current Profile Status	R	1	10000	-

**Notes:**

Parameter descriptions with designations of “analog input 1”, “analog input 2”, “analog input 3”, etc. refer to MCT4 data values for loop 1, loop 2 or loop 3. The limit control, if installed, is not compatible with the Watlow communications interface. Its process value and alarm set points are not accessible.

Parameter descriptions with designations of “alarm 1” and “alarm 2” refer to the first to alarms configured in the MCT4 that are loop alarms. The limit control, if installed, is not compatible with the Watlow communications interface. Its process value and alarm set points are not accessible. If an alarm in the MCT4 is configured to the limit device, it will be skipped and the next alarm in series that is configured to a loop will be used. For example, if alarms 1 and 2 are configured to the limit device, and soft alarms 3 and 4 are configured to loops 1 and 2, the soft alarms will be used for alarms 1 and 2.

The MCT4 can provide up to 9 events. The Watlow communications interface only supports events 1 through 8.

\*A R/W Specifies readable / writable data, R specifies read only data and W specifies a write only control value.

\*B The range of certain parameters are dependent upon system options. Consult the following range tables for information regarding the use of these parameters.

\*B1

Parameter Value	Description
0	No error
5	Indicates loop input sensor trouble

\*B2

Parameter Value	Description
0	No alarm
1	High alarm
2	Low alarm

**Note:** The MCT4 can provide up to 19 alarms depending upon configuration; however, the Watlow F4 is only equipped with two alarms. Thus, only the MCT4 alarms 1 and 2, if configured, are able to be monitored.

\*B3

Parameter Value	Description
0	Profile off
1	Profile Pre-run
2	Profile Run
3	Profile Hold

**Note:** The profile "pre-run" value is used to indicate that the MCT4 is either offline or downloading a profile to the loop control boards. Therefore, do not attempt to write a profile to the MCT4 or perform control actions while the profile mode is in "pre-run".

\*B4

Parameter Value	Deviation Alarm	Process Alarm
Range Low	-18000	SP Low
Range High	18000	SP High

\*B5

Parameter Value	Description
0	Auto tune off
1	Auto tune on

**Note:** Auto tune may not be available depending upon the loop configuration. If auto tune operation is not available, auto tune will automatically turn off after being set. The Watlow F4 contains multiple PID sets which can be tuned while the MCT4 supports only one (PID Set 1).

\*B6

Key press simulation values accept a write of any data value to perform their action.

**\*B7**

Parameter Value	Description
0	Temperature
3	Process units

**\*B8**

Parameter Value	Temperature Units °C	Temperature Units °F	Process Units
Range Low	1	1	1
Range High	555	999	999

**\*B9**

Range limited to standard printable ASCII characters [0-9], [A-Z], etc.

**\*B10**

Parameter Value	Description
1	Ramp Time
3	Soak
4	Jump
5	End

- \*C1** The units of measure and range of an input is dependent upon the configuration of the input and/or the units of temperature selection (Celsius or Fahrenheit) of the MCT4. The decimal point position for the input is an implied value based on the decimal point selection for the input. Thus, a register value of 345 can represent an actual process value of 345, 34.5, 3.45 or 0.345 depending upon the decimal point configuration of the input.

### A.1.3.2 F4S/D Supported Profile Step Data Registers

The following table of data registers provides the list of all data registers associated with downloading profiles to a Watlow F4S/D. Not all of the F4S/D functionality is provided by the MCT4, so registers that are shown “grayed out” in the list represent those functions NOT supported by the MCT4 automatic program operation.

The MCT4 is compatible with the profile editor of WatView or any other software that follows the proper sequence for downloading profiles to an F4. When a profile is downloaded to the MCT4, it will automatically ignore the non-supported functions so a special profile editor is not required. For the proper method of downloading profiles to an F4 controller, reference the Profile Programming Procedures in section 7, Communications, of the Watlow F4S/D User Manual.

Register Address	Parameter Description	Data *D Type	Range		*F
			*E Low	*E High	Unit
4000 (0x0FA0)	Profile Number	R/W	1	1	-
4001 (0x0FA1)	Profile Step Number	W	1	64	-
4002 (0x0FA2)	Profile Edit Action	W	*E1	*E1	-
4003 (0x0FA3)	Profile Step Type	W	*E2	*E2	-
4004 (0x0FA4)	Autostart Profile Date or Day				
4005 (0x0FA5)	Autostart, Date (month)				
4006 (0x0FA6)	Autostart, Date (day)				
4007 (0x0FA7)	Autostart, Date (year)				
4008 (0x0FA8)	Autostart, Day (of week)				
4009 (0x0FA9)	Autostart/Ramp/Soak Time (hours)	W	0	99	*F1
4010 (0x0FAA)	Autostart/Ramp/Soak Time (minutes)	W	0	59	*F1
4011 (0x0FAB)	Autostart/Ramp/Soak Time (seconds)	W	0	59	*F1
4012 (0x0FAC)	Wait/Don't Wait, Ramp/Soak Steps				
4013 (0x0FAD)	Wait For Event 1, Ramp/Soak Steps				
4014 (0x0FAE)	Wait For Event 2, Ramp/Soak Steps				
4015 (0x0FAF)	Wait For Event 3, Ramp/Soak Steps				
4016 (0x0FB0)	Wait For Event 4, Ramp/Soak Steps				
4021 (0x0FB5)	Wait For Analog 1, Ramp/Soak Steps				
4022 (0x0FB5)	Wait For Analog 1, Value, Ramp/Soak Steps				
4023 (0x0FB6)	Wait For Analog 2, Ramp/Soak Steps				
4024 (0x0FB7)	Wait For Analog 2, Value, Ramp/Soak Steps				
4025 (0x0FB8)	Wait For Analog 3, Ramp/Soak Steps				
4026 (0x0FB9)	Wait For Analog 3, Value, Ramp/Soak Steps				
4030 (0x0FBE)	Event Output 1, Ramp/Soak Steps	W	0	1	-
4031 (0x0FBF)	Event Output 2, Ramp/Soak Steps	W	0	1	-
4032 (0x0FC0)	Event Output 3, Ramp/Soak Steps	W	0	1	-
4033 (0x0FC1)	Event Output 4, Ramp/Soak Steps	W	0	1	-
4034 (0x0FC2)	Event Output 5, Ramp/Soak Steps	W	0	1	-
4035 (0x0FC3)	Event Output 6, Ramp/Soak Steps	W	0	1	-

Register Address	Parameter Description	Data *D Type	Range		*F Unit
			*E Low	High	
4036 (0x0FC4)	Event Output 7, Ramp/Soak Steps				
4037 (0x0FC5)	Event Output 8, Ramp/Soak Steps				
4043 (0x0FCB)	Rate, Ramp Rate Step				
4044 (0x0FCC)	Ramp Set Point Channel 1, Ramp Time Step	W	-32768	32767	*F2
4045 (0x0FCD)	Ramp Set Point Channel 2, Ramp Time Step	W	-32768	32767	*F2
4046 (0x0FCE)	Channel 1 PID Set, Ramp/Soak Steps				
4047 (0x0FCF)	Channel 2 PID Set, Ramp/Soak Steps				
4048 (0x0FD0)	Guaranteed Soak Channel 1, Ramp/Soak Steps	W	0	1	-
4049 (0x0FD1)	Guaranteed Soak Channel 2, Ramp/Soak Steps	W	0	1	-
4050 (0x0FD2)	Jump to Profile, Jump Step				
4051 (0x0FD3)	Jump to Step, Jump Step	W	1	64	-
4052 (0x0FD4)	Jump Repeats, Jump Step	W	1	999	-
4060 (0x0FDC)	End Action, End Step				
4061 (0x0FDD)	End Idle Setpoint Channel 1, End Step	W	-32768	32767	*F2
4062 (0x0FDE)	End Idle Setpoint Channel 2, End Step	W	-32768	32767	*F2

**Notes:**

The MCT4 supports up to 9 events, but only events configured to loops 1 and 2 can be controlled by the profile. If events are configured to loop 3, they cannot be controlled via a profile

\*D R/W Specifies readable / writable data and W specifies a write only control value.

**\*E1**

Parameter Value	Description
1	Create profile
2	Insert step
3	Delete current profile
4	Delete step
5	Start profile
255	Delete all profiles

**Note:** The MCT4 only supports the create profile and start profile commands. When a value of 1 is written to the register, the MCT4 is placed in profile receive mode in which all following write commands are seen as profile data. Once the end step is detected, the profile receive mode will end.

When a value of 5 is written to the register, the MCT4 will start the currently loaded profile if it is not already running.

Any other non-supported command will be ignored.

**\*E2**

Parameter Value	Description
1	Ramp time
2	Ramp rate
3	Soak
4	Jump
5	End

**Note:** The MCT4 does not support the ramp rate step type. DO NOT send profiles to the MCT4 with steps programmed for ramp rate or unexpected operation may occur.

\*F1 The MCT4 automatic program steps are entered locally using a time range of hours/minutes or minutes/seconds. The MCT4 cannot be programmed with step times of hours/minutes/seconds. Therefore, when programming remotely via an F4S/D profile editor, all ramp type steps and soak type steps must be programmed in either hours/minutes or minutes/seconds. The MCT4 will then select the proper range time range for ramp/soak steps when downloading to its loop control boards based on the maximum time programmed in any of the steps of that type in the profile.

For example, if all ramp steps have time entries of only minutes and seconds, the MCT4 will select time units of minutes/seconds for the profile ramp steps. However, if a ramp step is programmed with a non-zero entry for hours, all ramp steps will operate on a time base of hours and minutes. Any ramp steps that were then programmed with a minutes/seconds entry will ignore the seconds and only use the minutes. This may cause unexpected profile operation so be sure to program all profile ramp/soak steps accordingly.

\*F2 The units of measure and range of an input is dependent upon the configuration of the input and/or the units of temperature selection (Celsius or Fahrenheit) of the MCT4. The decimal point position for the input is an implied value based on the decimal point selection for the input. Thus, a register value of 345 can represent an actual process value of 345, 34.5, 3.45 or 0.345 depending upon the decimal point configuration of the input.

#### A.1.3.3 Limitations of Program Download/Operation (IMPORTANT - Please Read!)

The section covers the rules of use when sending F4S/D based profiles to the MCT4 controller. These rules must be followed in order to insure proper profile operation especially when using the Profile Editor tool of WatView software. WatView's operation cannot be altered to comply with the manner in which the MCT4 operates, so it is up to the end user to ensure that profiles are created and sent to the MCT4 properly.

#### **Sending Profiles to the MCT4**

The Watlow F4S/D controller is capable of storing up to 40 profiles with up to 256 steps. The MCT4 stores profiles differently, therefore, only one profile (profile 1) can be sent to the MCT4 at a time. If another profile is sent, it overwrites the previous profile.

When using the WatView Profile Editor, DO NOT attempt to "read profile image from controller". Selecting this function will cause WatView to get stuck in an infinite loop and the program will have to be shut down manually and possibly require a reboot of the PC. The MCT4 does not support the read of a profile from its memory. Only profile download is supported.

Thus, when using WatView software or other profile editing software made for the F4, profiles must be stored on the PC as separate profile images with each containing a single profile. That single profile can then be downloaded when required. Note that profiles cannot exceed 64 steps. If a profile exceeds 64 steps (including the end step), the download will fail without notice to the user and the previous profile will remain loaded in memory on the MCT4.

Also, due to limitations of WatView software, the profile name shown on control and status screens in WatView, do not reflect the actual profile name currently running in the MCT4. If a user were to select and run a profile locally at the MCT4, the name field data registers of the serial interface are updated to show the correct profile name; however, WatView does not read them and update its display fields dynamically. It only uses the names of the profile image currently loaded in WatView for the controller. Thus, the user must be sure that when a profile is downloaded or started from WatView, that the local MCT4 interface displays the correct profile name to insure the desired profile is running.

When a profile is sent to the MCT4 over the serial interface, upon receiving the last step, the MCT4 must then download the profile to its loop control boards. During this process, the operating mode register (200) will indicate a pre-run status (1) for the profile. When the profile state returns to profile off (0), the download is complete and the profile can be started.

### **Setting Proper Step Times**

Ramp rate steps are not supported by the MCT4, even if configured as a single loop controller (F4S). Thus, all profiles must be programmed with ramp time steps. In addition, the MCT4 ramp/soak steps must be configured in hours/minutes or minutes/seconds only. Steps cannot be programmed with an entry of hours/minutes/seconds.

In order for the MCT4 to run the profile correctly, it automatically configures itself to use the best time format based on the programming for all ramp and soak steps. For example, if all ramp steps have only entries for minutes and seconds (all hour entries are 0), the MCT4 will select minutes/seconds for the ramp step time format. However, if a single ramp step has a non-zero entry for hours, it will use the hours/minutes status registers for operation. This causes any steps that were configured with only minutes and seconds, to discard the seconds entry and only use the minutes. This can cause unexpected profile operation.

It is then necessary to insure that when a profile is created using the Profile Editor of WatView, that all ramp steps use the same entry fields for time and all soak steps use the same entry fields for time. That means that if any step of your profile must operate for at least 1 hour, you will have to use hours/minutes for all other steps of that type. Any entries for seconds will be ignored. Note that a step time of 0 can be entered under any circumstance, so if you have to use the hours/minutes range and a step time of 1 minute is too long, you can enter 0.

### **Setting Final Setpoints**

If the MCT4 is configured to end its automatic program with a final setpoint, you must set the F4 end step type to idle. This then allows you to set the idle setpoints of the end step in the WatView Profile Editor. If you do not do this, the setpoints default to their low limit value and the system will assume these setpoints upon the end step of the program.

### **Starting A Profile**

When starting a profile, there is no need to set the profile number as the MCT4 has only one profile loaded and available for run at a time. It is then only necessary to send the step to start the profile on (4001 = 1 to 64), and then set the profile to run (4002 = 5).



## A.2 FTP, FileWeb, DataWeb Requirements/Installation

### A.2.1 Introduction

The following describes the system requirements and components for the FDC Cloud service and website. The FDC cloud service provides the ability to upload data from FDC devices to cloud storage for backup and/or further analysis. The website provides the ability to verify data, uploads, and to manage users.

### A.2.2 System Overview

There are four server components; the data transfer service (FDDataService), the website (FDDataWeb), the FTP server, and a MySQL database. FDDataService and FDDataWeb are Microsoft .Net services, and use Microsoft Internet Information Services (IIS) as a web platform. The MySQL (Can be SQL, Oracle, etc.) database stores user configuration information as well as providing cloud data storage if desired.

### A.2.3 System Requirements

A Microsoft Windows server is required, with the following minimum capabilities:

- Windows Server 2008 or greater
- 2 GB RAM or greater
- 2 Cores or greater
- 40GB Storage or greater (this will vary depending on the user's expected uploads)
- .Net framework version 4.5 or greater
- MySQL 5.6 or greater

The server should be setup to provide the web server role.

### A.2.4 FDC Cloud “Server” Services

Future Design Controls does not provide direct support or hosting services; however, third party support is available from our partner **Mooseworks Software** which can provide:

1. Complete site and installation without hosting charges (includes FDC site with custom banner, site setup, all code/data model definitions and manual). User provides the server and hosting credentials including domain name and https certificate.
  2. Purchase of #1 above with hosting using Amazon Web Services (AWS). AWS T2 small server with 30GB storage. User provides the domain name and https certificate. Support cost on a yearly basis.
  3. Purchase of #1 above with no hosting but support of client server at customer facility or customer selected location. Support cost on a yearly basis for web service and application.
  4. DIY documentation – interface/data model definitions and server setup directions. DIY experience recommendations include installation and configuration of web servers, web services, SQL language and HTML/.NET code. Support packages for DIY documentation can be purchased in 5, 10 and 25 hour increments.
- Custom development services:
    - Fixed pricing available for well-defined systems.
    - Time and material options available for less defined, continuous engagements.

For more information please see the MCT Cloud Services document or contact FDC support for assistance.

### A.3 Profile Recovery Detail

The following will provide a detailed explanation of program recovery operation for the MCT4.

#### Program Power Recovery

##### 1. Static Mode

When power is cycled the program will be terminated. The current control set point and manual events will return to the previous static set point and event activation that were used prior to the program being started.

##### 2. Continue From SP

When power is cycled the program will resume operation in the same step with the same event activation and step time that were present at the time of power interruption. The accuracy of time recovery will be from the beginning of each step and every 6 minutes into the step. The set point; however, is dependent upon step type.

- a. When recovery occurs on a ramp step, the set point and time remaining in the step will return to the values at the last save interval. If less than 6 minutes into the step, the step will resume from the beginning of the step. If more than 6 minutes into the step, the step will return to the last 6 minute interval that elapsed (from the beginning of the step) and resume from the set point and time remaining at that moment the save occurred.
- b. When recovery occurs on a soak step, the time remaining in the step will return to the last save interval. If less than 6 minutes into the step, the step will resume from the beginning of the step. If more than 6 minutes into the step, the step will return to the last 6 minute interval that elapsed (from the beginning of the step) and resume from the time remaining at that moment the save occurred.

The set point will return to the programmed soak set point, i.e., the set point of the previous ramp step in the program. If a program is started on a soak step, the set point is defined by the “setpoint at start of automatic program setting.” However, on recovery, the set point is defined by the programmed set point which may be different from the original soak set point at the start of the program.

**Example:** A program is started on step 2 which is a soak step. The “current control setpoint” (static set point) is chosen as the starting program set point. If the static set point is 25, the program will begin and soak at the set point of 25. On power recovery, the set point will go to the set point defined by the program, so if step 1 of the program is a ramp to 50, the set point will be 50 on power recovery and the program will finish the remainder of the soak time with a set point of 50.

##### 3. Continue From PV

When power is cycled the program will resume operation in the same step with the same event activation that was present at the time of power interruption. The set point and time remaining; however, are dependent upon step type.

- a. When recovery occurs on a ramp step, the program will resume with the control set point equal to the current process value.

- i. If the process value has not exceeded the target set point for the ramp step, the time remaining will be dependent upon the programmed ramp rate and the difference between the process value and the target set point of the step. If ramp time units are used, i.e., MM.SS or HH.MM, the ramp rate is calculated by using the difference between the set point of the previous step and the set point of the current ramp step divided by the step time to get a rate of change in units/time.

**Example:** A program is started on step 3 which is a ramp step to -50 in 10 minutes. The “current control setpoint” (static set point) is chosen as the starting program set point. If the static set point is 25, the program will begin and start ramping the set point from 25 to the target set point of -50 over a period of 10 minutes (a ramp rate of 7.5/minute). On power recovery, if the process value is -3, the control set point will be set to -3.

The program will then begin ramping from -3 to the target set point of -50. The time remaining for the ramp is then determined by the programmed ramp rate. If step 1 of the program is a ramp to 50, and step 2 is a soak at 50, the programmed ramp rate was from step 2 at 50 to step 3 of -50 in 10 minutes. That is a total of 100 over a period of 10 minutes which is a ramp rate of 10/minute. Since the difference between the process value and target set point is 47, the time remaining will be 4 minutes and 42 seconds. Thus, the program will continue ramp step 3 from -3 to -50 over a period of 4 minutes and 42 seconds.

Note that when starting on step 1 of a program which is a ramp step, the previous set point will be the set point as defined by the “setpoint at start of automatic program” selection.

- ii. If the process value has exceeded the target set point for the programmed ramp step, i.e., the programmed ramp was increasing the set point to 50 and the process value is >50 or the ramp step was decreasing the set point down to -50 and the process value is < -50 on power recovery, the time remaining for the step will be the time remaining at the last save interval. If less than 6 minutes had elapsed into the step at the time of power loss, the step time will be the original time remaining from the beginning of the step. If more than 6 minutes into the step, the step will return to the last 6 minute interval that elapsed (from the beginning of the step) and resume from the time remaining at that moment the save occurred. The program will then ramp from the current process value to the target set point of the step over the remaining time.
- b. When recovery occurs on a soak step, the time remaining in the step will return to the last save interval. If less than 6 minutes into the step, the step will resume from the beginning of the step. If more than 6 minutes into the step, the step will return to the last 6 minute interval that elapsed (from the beginning of the step) and resume from the time remaining at that moment the save occurred.

The set point will return to the programmed soak set point, i.e., the set point of the previous ramp step in the program. If a program is started on a soak step, the set point is defined by the “setpoint at start of automatic program setting.” However, on recovery, the set point is defined by the programmed set point which may be different from the original soak set point at the start of the program.

**Example:** A program is started on step 2 which is a soak step. The “current process value” is chosen as the starting program set point. If the process value is 37, the program will begin and soak at the set point of 37 matching the process value. On power recovery, the set point will go to the set point defined by the program, so if step 1 of the program is a ramp to 25, the set point will be 25 on power recovery and the program will finish the remainder of the soak time with a set point of 25.

## A.4 MCT4 Base Unit Specifications

### Technical Specifications

Description	Details
Size	4.3"
Resolution (W X H in pixels)	480 x 272
Display type	TFT, Wide touch Screen
Colors	65,536
Touch screen Type	Resistive analog
Active display area (W X H mm)	95 X 54
MTBF back light at 25 0C	30,000 hrs.
Backlight	LED
Brightness Adjustment	Yes
Screen Saver	Yes
Language Fonts	Yes

### Main Hardware

Description	Details
Processor, CPU speed	ARM Cortex-A8, 1Ghz
Flash Memory(ROM)	128 MB
SDRAM(RAM)	256 MB
Operating system	WinCE 6.0
Real Time Clock	Yes
Buzzer	Yes
SD card slot	Yes

### Communication Ports/Interfaces

Description	Details
RS232C / RS485, DB9 Male	1
Ethernet 10/100 Mbps, RJ45	1
USB Host	1
RS485, screw terminal	1

### General Specifications

Description	Details
Rated Voltage	110/220 VAC (24 VDC)
Power supply	90-250 VAC (11-26 VDC)
Rated Current	0.8A AC (3.27A DC)
Power Consumption	36VA (15W)
Outer dimensions (W X H X D mm)	122 X 100 X 134
Mounting depth (mm)	123
Panel cut (W X H mm)	91 <sup>+1</sup> X 91 <sup>+1</sup>
Protection	IP66/NEMA 4X front, IP20 housing and terminals
Front bezel, housing	Plastic, plastic
Installation	Panel Mount
Net Weight (Kg)	0.65

## Standards, Certificates and Approvals

Description	Details
UL approval	UL 61010-1 and CSA C22.2 No.61010-1-12
Low Voltage Directive	2014/35/EU
EMC Directive	2014/30/EU
Requirements for Emission	EN 61326-1:2013
Tick mark for Australia	AS/NZS CISPR 11:2004
FCC	FCC Part 15, Subpart B, Class A

**NOTE:** The table above shows the approvals that may be available.

## Base Standards for EMC & Safety

Description	Details
Electrostatic discharge	IEC 61000-4-2: 2008
Radiated radio-frequency electromagnetic fields	IEC 61000-4-3: 2006 + A1:2007 + A2:2010
Electrical fast transient/burst	IEC 61000-4-4: 2012
Surge	IEC 61000-4-5: 2014
Conducted disturbances induced by radio-frequency fields	IEC 61000-4-6: 2014
Power frequency magnetic field	IEC 61000-4-8: 2009
Voltage dips, short interruptions and voltage variations	IEC 61000-4-11: 2004
Emission from Electromagnetic fields	CISPR 11:2009 + A1:2010 Class A
Harmonics Current	IEC61000-3-2:2014
Voltage Fluctuation and Flicks	IEC61000-3-3:2013
Requirements for Safety	EN61010-1:2013

## Protective class

Description	Details
Standard enclosures	IP 66/NEMA 4X (Front), IP20 housing and terminals

## Operating conditions

Description	Details
Temperature	0C to + 50C
Relative Humidity	10% to 90%, no condensation
Altitude	2000 meters maximum
Pollution	Degree 2
Sinusoidal vibration conforming to IEC 60068-2-6	10 to 58Hz: 0.75mm amplitude 58 to 150Hz: 1g 1oct/min. 10 sweeps
Shock conforming to IEC 60068-2-29	3 shocks per direction 11ms 10g

**NOTE:** In temperatures below 0°C, the response time of liquid crystal display becomes slower and color of the display will be darker than normal. Do not operate in ambient temperature less than 0°C.

### LCD specifications

Description	Details
Touch operations	1,000,000 times using R 0.8 Polyacetal stylus with force 250g
Vibration test	10-55 Hz, Stroke: 1.5mm, 2 hrs. for each direction of X, Y, Z
Shock test	100G, 6ms, +/- X, +/- Y, +/- Z, 3 times for each direction
Typical viewing angle	Vertical (up/down), 50° / 70° Horizontal (left/right), 70° / 70°

### Transport & Storage conditions

Description	Details
Temperature	-20C to + 60C
Relative Humidity	10% to 90%, no condensation
Altitude	2000 meters maximum
Sinusoidal vibration conforming to IEC 60068-2-6	5 to 16.8 Hz: 3.5 mm amplitude 16.8 to 150 Hz: 2g 1oct/min. 40 sweeps
Shock conforming to IEC 60068-2-29	3 shocks per direction 11ms 15g

**WARNING:** ***Cancer and Reproductive Harm:** This warning is intended to address certain Prop 65 chemicals that may be found in Future Design Controls products. These products can expose you to chemicals including lead and lead compounds which are known to the State of California to cause cancer, birth defects or other reproductive harm.*



## A.5 PCM/HLM Module Specifications

### \*INPUT SPECIFICATIONS:

Type	Range	Accuracy @ 24 C	Input Impedance
J	-120 C 1000 C (-184 F 1832 F)	+/-2 C	2.2 Mohms
K	-200 C 1370 C (-328 F 2498 F)	+/-2 C	2.2 Mohms
T	-250 C 400 C (-418 F 752 F)	+/-2 C	2.2 Mohms
E	-100 C 900 C (-148 F 1652 F)	+/-2 C	2.2 Mohms
B	0 C 1820 C (-32 F 3308 F)	+/-2 C (200-1820 c)	2.2 Mohms
R	0 C 1767.8 C (-32 F 3214 F)	+/-2 C	2.2 Mohms
S	0 C 1767.8 C (-32 F 3214 F)	+/-2 C	2.2 Mohms
N	-250 C 1300 C (-418 F 2372 F)	+/-2 C	2.2 Mohms
L	-200 C 900 C (-328 F 1652 F)	+/-2 C	2.2 Mohms
C	0 C 2315 C (32 F 4199 F)	+/-2 C	2.2 Mohms
P	0 C 1395 C ( 32 F 2543 F)	+/-2 C	2.2 Mohms
PT100 (DIN)	-210 C 700 C (-346 F 1292 F)	+/-0.4 C	1.3 Kohms
PT100 (JIS)	-200 C 600 C (-328 F 1112 F)	+/-0.4 C	1.3 Kohms
MV	-8mV 70mV	+/-0.05%	2.2 Mohms
MV	-3mV 27mA	+/-0.05%	70.5 Mohms
V	-1.3V 11.5V	+/-0.05%	302 Kohms

<b>Resolution:</b>	18 bits
<b>Sampling Rate:</b>	5 times / second
<b>Maximum Rating:</b>	-2VDC minimum, 12VDC maximum (1 minute for mA input)
<b>Temperature Effect:</b>	A1.5uV/ C for all inputs except mA input A3.0uV/ C for mA input
<b>Sensor Lead Resistance Effect:</b>	T/C: 0.2uV/ohm 3-wire RTD: 2.6 C/ohm of resistance difference of two leads 2-wire RTD: 2.6 C/ohm of resistance sum of two leads
<b>Sensor Break Responding Time:</b>	Within 4 seconds for TC, RTD and mV inputs, 0.1 second for 4-20 mA and 1 - 5VDC inputs.
<b>Burn-out Current:</b>	200 nA
<b>Common Mode Rejection Ratio (CMRR):</b>	120dB
<b>Normal Mode Rejection Ratio (NMRR):</b>	55dB
<b>Sensor Break Detection:</b>	Sensor open for TC, RTD and mV inputs, Sensor short for RTD input below 1 mA for 4-20 mA input, below 0.25VDC for 1 - 5VDC input, unavailable for other inputs.
<b>Electrical Isolation:</b>	Optical isolation; 1500V~ (ac) minimum, between input signals and power supply circuit.

### OUTPUT SPECIFICATIONS:

**Relay Rating:** 2A/240 VAC, life cycles 200,000 for resistive load  
**Pulsed Voltage:** Source Voltage 5V @30mA, current limiting resistance 66 ohms  
 Source Voltage 14V@40mA, current limited at 70mA

### Linear Output (PCM):

**Resolution:** 15 bits  
**Output Regulation:** 0.02% for full load change  
**Output Settling Time:** 0.1 sec. (stable to 99.9%) Isolation  
**Breakdown Voltage:** 1000 VAC  
**Temperature Effect:** +/- 0.01% of span per degree C

### Analog Retransmission (PCM):

**Output Signal:** 4-20 mA, 0-20 mA,  
0 - 5VDC, 1 - 5VDC, 0 - 10VDC  
**Resolution:** 15 bits  
**Accuracy:** +/-0.05% of span +/-0.0025%/ C Load  
**Resistance:** 0 - 500 ohms (for current output)  
10K ohms minimum (for voltage output)  
**Output Regulation:** 0.01% for full load change  
**Output Settling Time:** 0.1 sec. (stable to 99.9%)  
**Isolation Breakdown Voltage:** 1000 VAC min. Integral  
**Linearity Error:** +/-0.005% of span  
**Temperature Effect:** +/-0.0025% of span per degree C  
**Saturation Low:** 0 mA (or 0 VDC)  
**Saturation High:** 22.2 mA (or 5.55VDC, 11.1VDC min)  
**Linear Output Range:** 0-22.2mA (0-20mA or 4-20mA)  
**Volts DC:** 0 - 5.55VDC (0 - 5VDC, 1 - 5VDC)  
0 - 11.1VDC (0 - 10VDC)

### CONTROL FUNCTION (PCM):

**Control Action:** Direct and reverse  
**Proportional Band:**  
 Temperature: 0.1 to 500C (0.1 to 900F)  
 Linear Input: 0.1 to 900.0  
**Reset (Auto):** 0 to 3600 seconds  
**Rate (Derivative):** 0 to 900.0 seconds  
**PB Offset:** 0 to 100%  
**Dual PID Heat/Cool (bimodal):**  
 Cool Proportional Band 50 to 300% of heat PB  
 Proportional Deadband -36.0% to +36.0% of heat PB  
**Time Proportioning Cycle Time:**  
0.1 to 90 seconds  
**On-Off / Alarm Hysteresis (PCM/HLM):**  
0.1 to 50C (0.1 to 90.0F)

### EVENT INPUT SPECIFICATIONS:

**Logic Low:** -10V minimum, 0.8V maximum  
**Logic High:** 2V minimum, 10V maximum

### APPROVAL STANDARDS:

**UL / cUL:** UL 61010C-1  
**EN:** EN 61010-1 (IRC-1010-1)  
**EMC:** EMC 61326  
**RoHS:** RoHS 2.0 Compliant, W.E.E.E.  
**FM (HLM):** FM temperature limit switch - indicating

\* When subject to the necessary field calibration, the MCT4 is suitable for use in Nadcap applications in all furnace classes as defined in AMS2750E clause 3.3.1.

**A.5.1 PCM Parameter Description**

Parameter Notation	Parameter Description	Range	Default Value
SP	Controller (Static Mode) Set point value	Low: SPLO High: SPHI	77 F
ASP1	Set point for alarm 1	Low: -32768 High: 32767	18 F
ASP2	Set point for alarm 2	Low: -32768 High: 32767	18 F
ASP3	Set point for alarm 3	Low: -32768 High: 32767	18 F
INPT	Input sensor selection	J type T/C K type T/C E type T/C B type T/C R type T/C S type T/C N type T/C L type T/C C type T/C P type T/C PT 100 ohms DIN curve PT 100 ohms JIS curve 4-20 mA linear current input 0-20 mA linear current input 0-60 mV linear millivolt input 0-1V linear voltage input 0-5V linear voltage input 1-5V linear voltage input 0-10V linear voltage input	J
UNIT	Input unit selection	Degree C Degree F Process	Fahrenheit
DP	Decimal point selection	No decimal point 1 decimal digit 2 decimal digits 3 decimal digits	No decimal point
INLO	Input low scale value ( <i>linear inputs only</i> )	Low: -32768 High: INHI - 50	0
INHI	Input high scale value ( <i>linear inputs only</i> )	Low: INLO + 50 High: 32767	100



Parameter Notation	Parameter Description	Range	Default Value
FILT	Input filter	0 second time constant 0.2 second time constant 0.5 second time constant 1 second time constant 2 second time constant 5 second time constant 10 second time constant 20 second time constant 30 second time constant 60 second time constant	0.5 second
EIFN	Event input function	None Automatic program run Automatic program hold Automatic program abort Failure transfer Automatic program advance next step Automatic program run/hold Loop status input Alarm input	None
SPLO	Low Limit of Set Point	Low: -32768 High: SPHI	0 F
SPHI	High Limit of Set Point	Low: SPLO High: 32767	1000 F
OUT1	Output 1 Function	None Heating on-off control Heating time proportioning Heating linear control Colling on-off control Cooling time proportioning Cooling linear control	None
O1FT	Out 1 Failure Transfer	BPLS (bumpless transfer)  0.0 ~ 100.0% to continue output 1 control function as the unit fails  OFF (0) or ON (1) for alarm or event output.	0
O1HY	Output 1 ON-OFF Control Hysteresis	Low: 0.1 High: 90.0 F (50.0 C)	0.2 F
CYC1	Output 1 cycle time	Low: 0.1 High: 90.0 sec.	18.0
OP1L	Low Limit Value for Output 1	Low: 0 High: 100.0%	0
OP1H	High Limit Value for Output 1	Low: 0 High: 120.0%	100
PB	Proportional Band #1	Low: 0.0 High: 900.0 F (500.0 C)	18 F

Parameter Notation	Parameter Description	Range	Default Value
TI	Integral Time #1	Low: 0 High: 3600 sec.	100
TD	Derivative Time #1	Low: 0.0 High: 900.0 sec	25.0
OFST	Offset value for proportional control (TI must = 0)	Low: 0 High: 100.0 %	25.0
OUT2	Output Function 2	None Cooling time proportioning Cooling linear control Alarm output Reverses alarm output Event output DC power supply output	None
O2FT	Output 2 Failure Transfer	BPLS (bumpless transfer)  0.0 ~ 100.0 % to continue output 1 control function as the unit fails  OFF (0) or ON (1) for alarm or event output.	0
CYC2	Output 2 Cycle Time	Low: 0.1 High: 90.0 sec.	18.0
CPB	Cooling Proportional Band	Low: 50 High: 300%	100
DB	Heating - Cooling Deadband	Low: -36.0 High: 36.0%	0
OP2L	Low Limit Value for Output 2	Low: 0 High: 100.0 %	0
OP2H	High Limit Value for Output 2	Low: 0 High: 120.0 %	100
OUT3	Output 3 Function	None Alarm output Reverse alarm output Event output DC power supply output	None
O3FT	Output 3 Failure Transfer	OFF: Output off as unit fails ON: Output on as unit fails	OFF
OUT4	Output 4 Function	None Alarm output Reverse alarm output Event output Retransmit process value Retransmit setpoint value DC power supply output	None
O4FT	Output 4 Failure Transfer	OFF: Output off as unit fails ON: Output on as unit fails	OFF

Parameter Notation	Parameter Description	Range	Default Value
OP4L	Low Limit Value for	Low: 0 High: 100.0 %	0
OP4H	High Limit Value for	Low: 0 High: 120.0 %	100
REL4	Retransmission Low Scale Value for Output 4	Low: -32768 High:32767	0 F
REH4	Retransmission High Scale Value for Output 4	Low: -32768 High:32767	100 F
ALF1	Alarm 1 Function <i>(when alarm is selected under OUT1 Function)</i>	Process high alarm Process low alarm Deviation high alarm Deviation low alarm Deviation band high/low alarm End of automated program Hold mode Static mode	Deviation high alarm
A1MD	Alarm 1 Operation Mode	Normal Alarm action Latching alarm action Hold alarm action Latching and hold alarm action	Normal alarm action
A1HY	Alarm 1 Hysteresis	Low: 0.1 High: 90.0 F (50.0 C)	0.2 F
ALF2	Alarm 2 Function <i>(when alarm is selected under OUT2 Function)</i>	Process high alarm Process low alarm Deviation high alarm Deviation low alarm Deviation band high/low alarm End of automated program Hold mode Static mode	Deviation high alarm
A2MD	Alarm 2 Operation Mode	Normal Alarm action Latching alarm action Hold alarm action Latching and hold alarm action	Normal alarm action
A2HY	Alarm 2 Hysteresis	Low: 0.1 High: 90.0 F (50.0 C)	0.2 F
ALF3	Alarm 3 Function <i>(when alarm is selected under OUT3 Function)</i>	Process high alarm Process low alarm Deviation high alarm Deviation low alarm Deviation band high/low alarm End of automated program Hold mode Static mode	Deviation high alarm
A3MD	Alarm 3 Operation Mode	Normal Alarm action Latching alarm action Hold alarm action Latching and hold alarm action	Normal alarm action

Parameter Notation	Parameter Description	Range	Default Value
A3HY	Alarm 3 Hysteresis	Low: 0.1 High: 90.0 F (50.0 C)	0.2 F
STAR	Set Point Value at Start of Program	Current process value (PV) Controller set point (SP)	Current control setpoint
END	Set Point Value at End of Program	Final set point of program Current control setpoint	Current control setpoint
PFR	Power Fail Recovery	Continue program from last SP Continue program from PV Static mode	Static mode

**A.5.2 HLM Parameter Description**

Parameter Notation	Parameter Description	Range	Default Value
HSP1	High Limit Setpoint 1	Low: HSPL High: HSPH	110 F
LSP1	Low Limit Setpoint 1	Low: LSPL High: LSPH	0 F
SP2	Setpoint 2 value for output 2	Low: -19999 High: 45536	110 F
INPT	Input sensor selection	J type T/C K type T/C E type T/C B type T/C R type T/C S type T/C N type T/C L type T/C C type T/C P type T/C PT 100 ohms DIN curve PT 100 ohms JIS curve 4-20 mA linear current input 0-20 mA linear current input 0-60 mV linear millivolt input 0-1V linear voltage input 0-5V linear voltage input 1-5V linear voltage input 0-10V linear voltage input	J
UNIT	Input unit selection	Degree C Degree F Process	Fahrenheit

Parameter Notation	Parameter Description	Range	Default Value
RESO	Decimal point selection	No decimal point 1 decimal digit 2 decimal digits 3 decimal digits	No decimal point
INLO	Input low scale value <i>(linear inputs only)</i>	Low: -19999 High: INHI	0
INHI	Input high scale value <i>(linear inputs only)</i>	Low: INLO High: 45536	100
SHIF	PV shift (offset) value	Low: -360.0 F (-200.0 C) High: 360.0 F (200.0 C)	0.0
FILT	Input filter	0 second time constant 0.2 second time constant 0.5 second time constant 1 second time constant 2 second time constant 5 second time constant 10 second time constant 20 second time constant 30 second time constant 60 second time constant	0.5 second
OUT1	Output 1 Function	High limit control Low limit control High/Low limit control	High limit control
O1HY	Output 1 Hysteresis	Low: 0.1 High: 18.0 F (10.0 C)	0.2 F
HSPL	Lower Limit of High Limit SP	Low: -19999 High: HSPH	0 F
HSPH	Upper Limit of High Limit SP	Low: HSPL High: 45536	1000 F
LSPL	Lower Limit of Low Limit SP	Low: -19999 High: LSPH	0 F
LSPH	Upper Limit of Low Limit SP	Low: LSPL High: 45536	1000 F
OUT2	Output Function 2	None DC power supply output Alarm output Limit annunciator	None
ALFN	Alarm Function <i>(when alarm output is selected under OUT2 Function)</i>	Process value high alarm Process value low alarm	Process value high alarm
ALMD	Alarm Operation Mode	Normal Alarm action Latching alarm action	Normal alarm action

Parameter Notation	Parameter Description	Range	Default Value
ALHY	Alarm Hysteresis	Low: 0.1 High: 18.0 F (10.0 C)	0.2 F
ALFT	Alarm Failure Transfer	Output off as unit fails Output on as unit fails	Output on as unit fails
A2MD	Alarm 2 Operation Mode	Normal Alarm action Latching alarm action Hold alarm action Latching and hold alarm action	Normal alarm action
EIFN	Event Input Function	None Remote Reset	None
DISP	Display Format	Display SAFE Display high limit setpoint Display low limit setpoint	Display SAFE

## A.6 Power Supply Specifications

### DIN Rail Mount Power Supply Specifications

Model	24V DC output	PS5R-VD24	
Output Capacity		60W	
Rated Input Voltage (Single-phase two-wire) <sup>1</sup>		100 to 240V AC (Voltage range: 85 to 264V AC/100 to 370V DC) (Load ≤ 80% at 100-105V DC)	
Frequency		50/60 Hz	
Input	Input Current (Typ.)	100V AC	1.3A
		230V AC	0.8A
	Inrush Current (Typ.) (Ta=25°C, cold start)	100V AC	18A
		230V AC	45A
	Leakage Current	120V AC	0.5mA max.
		230V AC	1.0mA max.
	Efficiency (Typ.) (at rated output) <sup>2</sup>	100V AC	86%
230V AC		86%	
Power Factor (Typ.)	100V AC	—	
	230V AC	—	
Rated Voltage/Current		24V/2.5A	
Adjustable Voltage Range		±10%	
Output Holding Time (Typ.) (at rated output)	100V AC	13ms	
	230V AC	105ms	
Start Time (at rated input and output)		800 ms max.	
Rise Time (at rated input and output)		200ms max.	
Output	Input Fluctuation	0.4% max.	
	Load Fluctuation	1.0% max.	
	Temperature Change	0.05%/°C max. (-10 to +55°C)	
Regulation	Ripple (including noise)	4% p-p max. (-25 to -10°C)	
		1.5% p-p max. (-10 to +0°C)	
		1% p-p max. (0 to +55°C)	
Overcurrent Protection		105% min. (auto reset)	
Operation Indicator		LED (green)	
Dielectric Strength	Between input and output terminals	3,000V AC, 1 minute	
	Between input and ground terminals	2,000V AC, 1 minute	
	Between output and ground terminals	500V AC, 1 minute	
Insulation Resistance		Between input and output terminals: 100MΩ min. (500V DC megger) Between input and ground terminals: 100MΩ min. (500V DC megger)	
Operating Temperature <sup>4</sup> (No freezing)		-25 to +70°C	
Operating Humidity (no condensation)		20 to 90% RH	
Storage Temperature (No freezing)		-25 to +75°C	
Storage Humidity (no condensation)		20 to 90% RH	
Vibration Resistance		10 to 55Hz, amplitude 0.375mm, 2 hours each in 3 axes (when used with BNL6 end clips)	
Shock Resistance		300 m/s <sup>2</sup> (30G), 3 times each in 6 directions	
Expected Life <sup>5</sup>		8 years minimum (at the rated input, 50% load, operating temperature +40°C, standard mounting direction)	
EMC	EMI	EN61204-3 (Class B)	
	EMS	EN61204-3 (industrial)	
Safety Standards		UL508 (Listing), UL1310 Class 2, ANSI/ISA-12.12.01 CSA C22.2 No. 107.1, 213, 223 EN60950-1, EN50178	

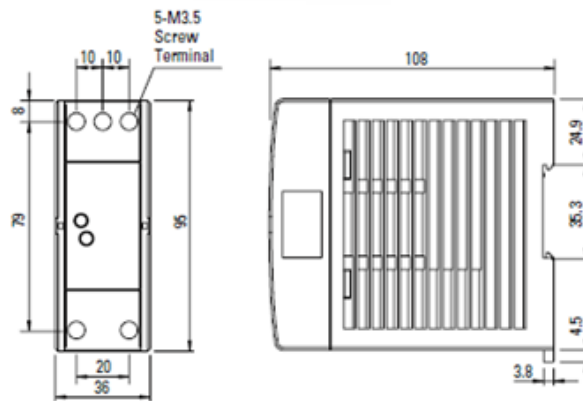
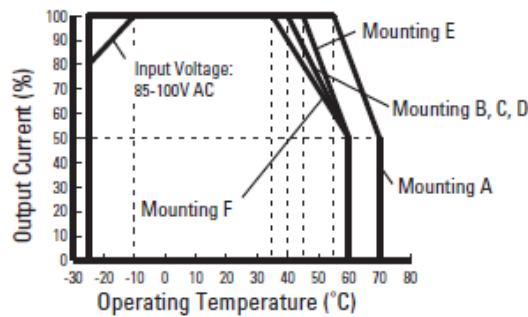
Other Standard	SEMI F47 (at 208V AC input only)
Degree of Protection	IP20 (EN60529)
Dimensions (mm)	95H x 36W x 108D
Weight (approx.)	260g
Terminal Screw	M3.5

\*At normal temperature and humidity unless otherwise specified.  
 Note 1: DC input voltage is not subject to safety standards. When using on DC input, connect a fuse to the input terminal for DC input protection.  
 Note 2: Under stable state.  
 Note 3: PS5R-VB05 (5V DC/2.0A) is 10W (Up to 3.0A at Ta = 0 to 40°C. Not subject to safety standards above 2.0A.)  
 Note 4: See the output derating curves.  
 Note 5: Calculation of the expected life is based on the actual life of the aluminum electrolytic capacitor. The expected life depends on operating conditions.

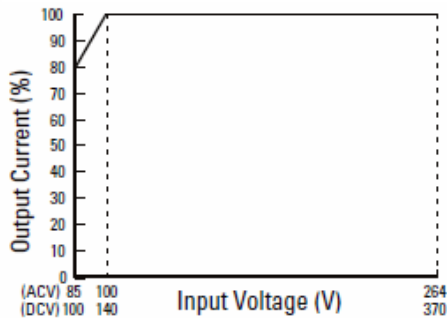
### Operating Temperature vs. Output Current

Conditions: Natural air cooling (Operating temperature is the temperature around the switching power supply.)

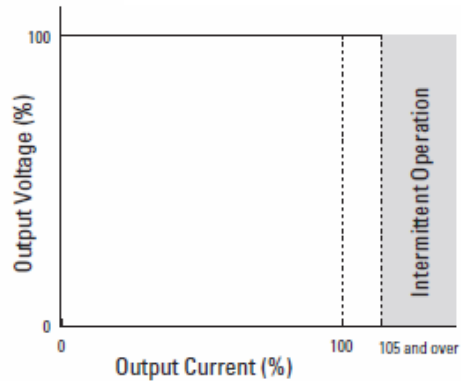
#### PS5R-VD24



#### Input Voltage vs. Output Current Ta=25°C

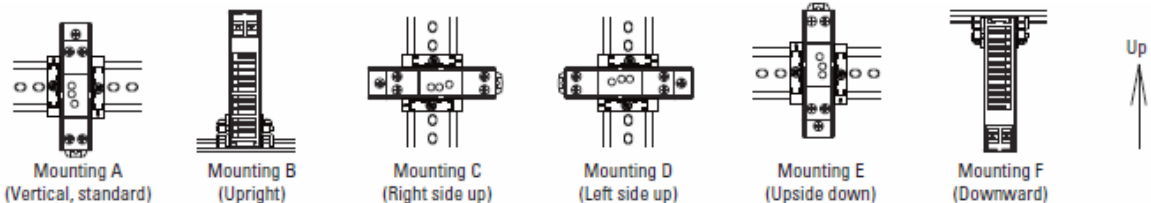


#### Overcurrent Protection Characteristics



#### Operating Temperature Approved by Safety Standards

UL508, CSA C22.2 No.107.1, ANSI/ISA12.12.01, EN60950-1, EN50178					
Mounting A	Mounting B	Mounting C	Mounting D	Mounting E	Mounting F
55	40	40	40	45	35





## Open Frame Power Supply Specifications

Description		Power Supplies	[50W] PS3X-D24	
Input	Rated Input Voltage		100 to 240V AC	
	Voltage Range (Note 1)		88 to 264V AC / 125 to 375V DC	
	Frequency		47 to 63 Hz	
	Input Current		1.3A max.	
	Inrush Current (Ta = -25°C, ACV cold start)	at 115V AC		30A max.
		at 230V AC		50A max.
	Leakage Current			1.5mA max.
Efficiency (Typ.) (230V AC at input/rated output)	5V		—	
	12V		81%	
	24V		84%	
Output	Rated Voltage/Current		24V, 2.2A	
	Adjustable Voltage Range		±10%	
	Output Holding Time		23 ms typ. (100V AC) 60 ms minimum (230V AC)	
	Start Time		1000 ms max. (230V AC input, rated output)	
	Rise Time		30 ms max. (230V AC input, rated output)	
	Regulation	Input Fluctuation		0.5% max.
		Overvoltage Fluctuation		5V: ±2% max. 12V, 24V: ±1% max.
		Temperature Fluctuation		0.04% / °C max. (-10 to +45°C)
	Ripple (including noise)	-20 to -10°C		—
		-10 to 0°C		24V: 300mV max.
PS3X-B, C: 0 to +50°C PS3X-D, Q, E: 0 to +45°C			24V: 150mV max.	
Supplementary Functions	Overcurrent Protection		105% min. (auto reset) (Note 2)	
	Overvoltage Protection		Intermittent operation or output off at 115% min. (Note 3)	
	Operation Indicator		green LED	
Dielectric Strength	Between input and output terminals		3000V AC, 1 minute	
	Between input and ground terminals		2000V AC, 1 minute	
	Between output and ground terminals		500V DC, 1 minute	
Insulation Resistance			100MΩ minimum, 500V DC megger (between input and output terminals, between input and ground terminals)	
Operating Temperature			-10 to +70°C (no freezing, see output derating)	
Operating Humidity			20 to 85% RH (no condensation)	
Storage Temperature			-40 to +85°C (no freezing)	
Storage Humidity			10 to 95% RH (no condensation)	
Vibration Resistance			10 to 55 Hz, 20m/s <sup>2</sup> constant, 2 hours each in 3 axes	
Shock Resistance			200m/s <sup>2</sup> , 1 shock each in 3 axes	
EMC	EMI		EN55022 Class B	
	EMS		EN55024	
Safety Standards			IEC/EN60950-1, UL60950-1, CSA C22.2 No. 60950-1	
Dimensions (H × W × D) (mm)			82H × 35W × 99D	
Weight (approx.)			340g	
Terminal Screw			M3.5	

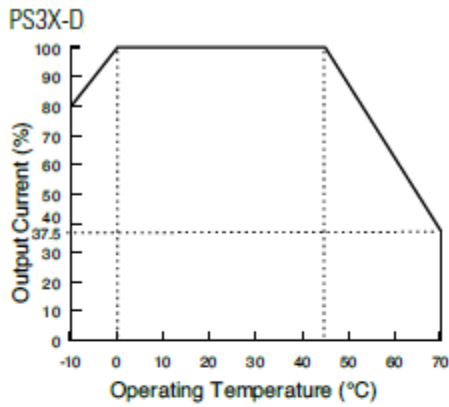
Note 1: See "Output Current vs. Input Voltage" characteristics next page. Not subject to safety standards. When using DC input, connect a fuse to the input terminal for DC input protection.

Note 2: Overload for 30 seconds or longer may damage the internal elements.

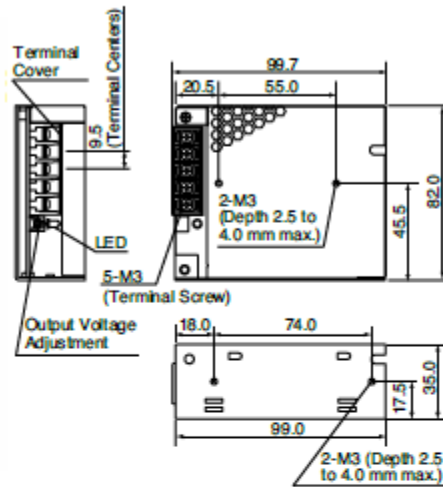
Note 3: One minute after the output has been turned off, turn on the AC input again.

**Operating Temperature vs. Output Current (Derating Curves)**

Conditions: Natural air cooling (operating temperature is the temperature around the power supply)

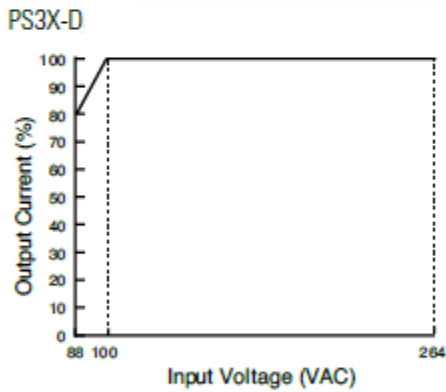


**Dimensions (mm)**

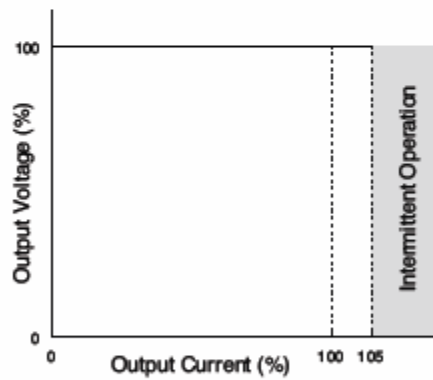


PS3X-D12, -D24	
PS3X-005, -012, -024	

**Output Current vs. Input Voltage (TA = 25°C)**

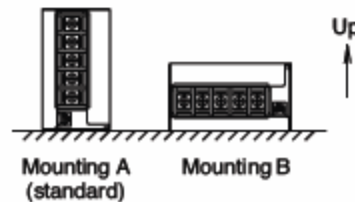


**Overcurrent Protection Characteristics**



**Operating Temperature by Safety Standards**

Power Supplies	UL/EN60950-1
	Mounting A, B
PS3X-D24	45°C



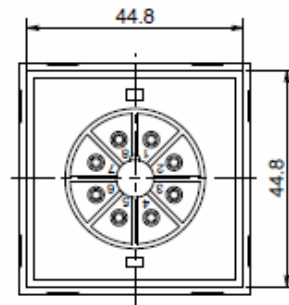
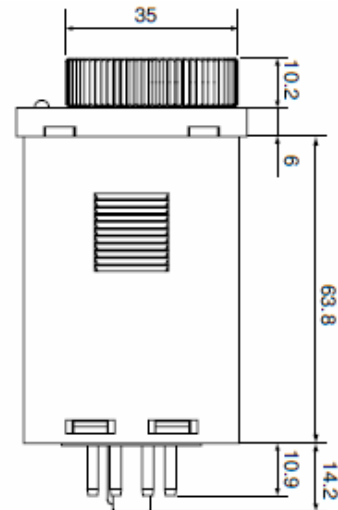
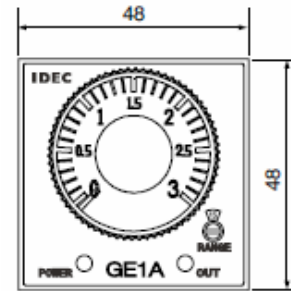
**A.7 Power-On Delay Relay Specifications**

**[GE1A-C10HA110]**



**Specifications**

Rated Operating Voltage	24V AC/DC 100 to 120V AC 220 to 240V AC	
Voltage Tolerance	AC: 85 to 110% DC: 90 to 110%	
Contact Rating	240V AC/5A 24V DC/5A	
Contact Form	DPDT or SPDT+ instantaneous SPDT	
Repeat Error	±0.2% ±10msec maximum	
Voltage Error	±0.5% ±10msec maximum	
Temperature Error	±3% maximum	
Setting Error	±10% maximum	
Reset Time	0.1 sec maximum	
Insulation Resistance	100MΩ minimum (500V DC megger)	
Dielectric Strength	Between power and output terminals: 1,500V AC, 1 minute Between contact circuits: 750V AC, 1 minute	
Vibration Resistance	Damage limits: Amplitude 0.75mm, 10 to 55 Hz Operating extremes: Amplitude 0.5mm, 10 to 55 Hz	
Shock Resistance	Damage limits: 500m/s <sup>2</sup> (Approx. 50G)	
Power Consumption	GE1A-B	24V AC type: 1.6 VA
		24V DC type: 1.0W
		110V AC type: 3.8 VA
	GE1A-C	220V AC type: 7.7 VA
		24V AC type: 2.0 VA
		24V DC type: 0.8W
GE1A-C	110V AC type: 3.5 VA	
	220V AC type: 8.0 VA	
	Electrical Life	100,000 operations minimum (at full rated load)
Mechanical Life	10,000,000 operations minimum	
Operating Temperature	-10 to +55°C (without freezing)	
Operating Humidity	35 to 85% RH (without freezing)	





## A.8 Ordering Specifications

Enter a number in each box which corresponds to the specifications desired when ordering the MCT4 with PCM and/or HLM modules.

**MCT4** -   -  -  -  -

**Software Type** -----

01: MCT4 (SD-4M4)  
 XX: Special Order Code

**Power Input** -----

4: 90-250VAC 50/60Hz  
 5: 11-26VAC/DC

**Module Type Slot 1** -----

0: None  
 Pxxxx: Process Control Module (PCM Matrix)

**Module Type Slot 2** -----

0: None  
 Pxxxx: Process Control Module (PCM Matrix)  
 Hxxx: High Limit Module (HLM Matrix)

**Module Type Slot 3** -----

0: None  
 Pxxxx: Process Control Module (PCM Matrix)  
 Hxxx: High Limit Module (HLM Matrix)

**Documentation** -----

0: None  
 C: CD  
 U: USB Memory Stick

**Special Order Code** -----

00: None  
 XX: Special Order Code

### Part number examples:

**MCT4-014-P1111-P1111-H111-000**

MCT4 with 2 process control modules and a high limit module. Standard software. 90-250VAC 50/60HZ. Each process control module (slot #1 and #2) is equipped with 4 relay outputs. Slot 3 has a high-limit module installed equipped with 2 relay outputs. No special order code.

**MCT4-AB5-P3311-H111-0-000**

MCT4 with 1 process control module and a high limit module. Special software code "AB". 11-26VAC/VDC. PCM#1 module equipped with 4-20mA in outputs 1 and 2 and relays in outputs 3 and 4. Slot 2 has a high limit module installed with 2 relay outputs. Slot 3 is empty and not used. No special order code.

**MCT4-014-P1111-0-0-0AN**

MCT4 with 1 process control module. Standard software. 90-250VAC 50/60 HZ. Process control module (slot #1) is equipped with 4 relay outputs. Slot 2 and 3 are empty and not used. "AN" special order code.

**PCM MATRIX**

Enter a number in each box which corresponds to the hardware required when ordering the Process Control Module (PCM).

**P**

PCM Modules can be installed in slots 1, 2 or 3

**OUTPUT 1**

- 0: None
- 1: Relay 2A/240VAC (Form A)
- 2: Pulsed voltage to drive SSR, 5V/30mA
- 3: 0-20mA/4-20mA isolated output (OM99-3)
- 4: 0-10V isolated output (OM99-5)
- C: Pulse voltage to drive SSR, 14V/40mA (OM99-7)

**OUTPUT 2**

- 0: None
- 1: Relay 2A/240VAC (Form A)
- 2: Pulsed voltage to drive SSR, 5V/30mA
- 3: 0-20mA/4-20mA isolated output (OM99-3)
- 4: 0-10V isolated output (OM99-5)
- 7: Transmitter power supply 20VDC/25mA (DC99-1)
- 8: Transmitter power supply 12VDC/40mA (DC99-2)
- A: Transmitter power supply 5VDC/80mA (DC99-3)
- C: Pulse voltage to drive SSR, 14V/40mA (OM99-7)

**OUTPUT 3**

- 0: None
- 1: Relay 2A/240VAC (Form A)
- 2: Pulsed voltage to drive SSR, 5V/30mA
- 7: Transmitter power supply 20VDC/25mA (DC99-1)
- 8: Transmitter power supply 12VDC/40mA (DC99-2)
- A: Transmitter power supply 5VDC/80mA (DC99-3)
- C: Pulse voltage to drive SSR, 14V/40mA (OM99-7)

**OUTPUT 4**

- 0: None
- 1: Relay 2A/240VAC (Form A)
- 2: Pulsed voltage to drive SSR, 5V/30mA
- 3: Retransmit 0-20mA/4-20mA (OM99-3)
- 4: Retransmit 0-10VDC (OM99-5)
- 7: Transmitter power supply 20VDC/25mA (DC99-1)
- 8: Transmitter power supply 12VDC/40mA (DC99-2)
- A: Transmitter power supply 5VDC/80mA (DC99-3)
- C: Pulse voltage to drive SSR, 14V/40mA (OM99-7)

PCM Modules support Universal Analog Signal Inputs T/C-RTD, mA and VDC.  
Hardware configuration is via board DIP switch.  
Default hardware configuration is T/C-RTD

## HLM MATRIX

Enter a number in each box which corresponds to the hardware required when ordering the High Limit Module (HLM).

<p><b>Signal Input*</b></p> <p>1: Thermocouple: J, K, T, E, B, R, S, N, L, C, P, PT100 DIN, PT100 JIS, 0-60mV</p> <p>2: Voltage 0-1VDC</p> <p>3: Voltage 0-10VDC</p> <p>4: Current 0-20mA (4-20mA)</p> <p>5: Voltage 0-5VDC (1-5VDC)</p> <p><b>OUTPUT 1</b></p> <p>0: None</p> <p>1: Relay 2A/240VAC (Form C)</p> <p>2: Pulsed voltage to drive SSR, 5V/30mA</p> <p>C: Pulse voltage to drive SSR, 14V/40mA (OM99-7)</p> <p><b>OUTPUT 2</b></p> <p>0: None</p> <p>1: Relay 2A/240VAC (Form C)</p> <p>2: Pulsed voltage to drive SSR, 5V/30mA</p> <p>7: Transmitter power supply 20VDC/25mA (DC99-1)</p> <p>8: Transmitter power supply 12VDC/40mA (DC99-2)</p> <p>A: Transmitter power supply 5VDC/80mA (DC99-3)</p> <p>C: Pulse voltage to drive SSR, 14V/40mA (OM99-7)</p>	<p><b>H</b> <input style="width: 40px; height: 20px; border: 1px solid blue;" type="text"/> <input style="width: 40px; height: 20px; border: 1px solid blue;" type="text"/> <input style="width: 40px; height: 20px; border: 1px solid blue;" type="text"/></p>	<p>HLM Modules can be installed in:</p> <ul style="list-style-type: none"> <li>- Slot 2 for 1 loop system</li> <li>- Slot 3 for 2 loop system</li> </ul>
--	---	--

HLM signal input order codes #1, #3 and #4 are hardware configurable via DIP switch. Recalibration is required when switching between signal input types. HLM modules ordered with signal input order code #2 or #5 cannot be reconfigured.

\* HLM configured with Signal Inputs 0-60mV, 0-1VDC, 0-5V/1-5DC, 0-10VDC or 0-20/4-20mA are NOT FM approved.

## Control System Options *(ordered separately as needed)*

### Power Supply (input 100-240VAC / Output 24VDC)

DIN Rail Mount: PS5R-VD24 60W power supply (2.5A)  
Open Frame: PS3X-D24AFG 50W power supply (2.2A)

Note: Either of the above will power the MCT4 (24VDC power option)

### System Reset Timer

GE1A-C10HA110/SR2P-06 Reset Timer and socket (DIN RAIL)

Note: Timer is recommended for proper restart on 24VDC powered units due to power fluctuations in power supply outputs that can occur during momentary power interruptions (<500ms).

### USB Memory Stick

UDF115-8GB 8GB High Capacity USB Memory Stick (3VDC)

### Replacement SD Memory Card

SD-4M4 8GB High Capacity SD Memory Card (preloaded with MCT4 application software)

### Printed Operators Manual *(available online at [www.futuredesigncontrols.com/MCT4](http://www.futuredesigncontrols.com/MCT4))*

Part Number [\(MCT4 4.3 User Manual.pdf\)](#)

MCT4 4.3 User Manual

### USB Cables & Accessories

WPUS-BAX-05M USB panel mount adapter  
WPCVR-USB USB waterproof IP67 cover (for above)

### Replacement Terminal Blocks

Power Input Part #: 10343-1203A-01-10  
COM2 Part #: 10343-1202B-10-00  
PCM Part #: 10343-1216B-03-00  
HLM Part #: 10343-1216B-10-00

### Retaining Screws (used to secure PCM/HLM in MCT4 base unit)

Part #: 10483-00300400701, M3 x 4 screw (package of 4)



## A.9 Support and Warranty Information

### SOFTWARE VERSIONS FOR FDC- MCT4 Control System

The software version levels for the MCT4 Control system can be viewed in the offline system setup, from the System menu; select "About". Both the HMI (Human Machine Interface – color touch screen) and loop/limit control firmware and software versions will be displayed.



When obtaining replacement parts or to get assistance for setup and/or troubleshooting purposes, it is important to have this information available to insure that your request is processed properly and in a timely manner. It is recommended that this information be written down and kept in a readily accessible location along with this manual, so that it is available when required.

CE Net Version: \_\_\_\_\_ CE Image Version: \_\_\_\_\_  
 HMI Version: \_\_\_\_\_ CE BSP Version: \_\_\_\_\_  
 Loop 1 Version: \_\_\_\_\_ Loop2 /Limit Version: \_\_\_\_\_ Loop3 /Limit Version: \_\_\_\_\_



**The CE Net version of the HMI, and firmware versions of the loop and limit controls of the MCT4 control system are proprietary and only available directly from Future Design Controls.**

**Using similar or like components obtained from a source other than Future Design Controls will cause unexpected operation and/or malfunction of the MCT4 control system. Any attempts to do so will be at the user's own risk and void any and all claims or warranties with Future Design Controls.**

**In addition, installing Future Design MCT4 software on hardware not obtained directly from Future Design is a violation of the software license agreement. See the Future Design Software License agreement on the following page. By installing and/or using the MCT4 Control System, you are accepting the terms of the software license.**

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