Model MC10
RO Controller

Installation and Operating Manual

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Manual Revisions

Model MC10 RO Monitoring and Control System

Installation and Operating Manual

Issue	Date	Effective Pages	Description of Changes
Prototype	05/2000	-	Original Issue
Rev A	07/2000	-	Prototype Modifications
Rev B	01/2001	-	Symbols
Rev C	03/2001	-	Wiring Terminals
Rev D	03/2001	-	Changes to Menu Diagram
Rev E	05/2001	-	General Modifications
Rev F	05/2001	-	General Modifications
Rev G	09/2001	3-3, 3-4, 3-5	Data Logger Interval
Rev H	10/2001	-	Validation Modifications
Rev I	12/2001	1-4, 1-5, 3-2, Menu	Level Switch Operation
Rev J	11/2002	TOC, 1-2 thru 1-5, 2-2, 2-3, 2-4, 3-2 thru 3-7, Appdx	Changes for Software Version 3.1
Rev K	02/2004	Warranty Page, TOC, 1-2, 1-5, 1-6, 2-2 thru 2-5, 3-4, Appendix	Power and Wiring Notifications. **NOTE:** Pertains only to MC10s with Serial Number 1001000000000842 or higher.
Rev L	04/2004	Warranty Page, 1-2 thru 1-5, 2-2	Acceptable Power Ranges

Conventions and Symbols

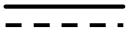
Special characters, listed and described below, are used in this documentation to emphasize certain information.

Note: Emphasizes additional information pertinent to the subject matter.

Warning: Emphasizes information about actions which may result in personal injury.

Caution: Emphasizes information about actions which may result in equipment damage.

The following electrical symbols may be used in this documentation.

Symbol	Meaning
	Direct current.
	Alternating current.
	Both direct and alternating current.
	Earth (ground) terminal.
	Frame or chassis terminal.

General Limited Warranty

Warranty

United States Filter Corporation ("USFilter") warrants the products manufactured by it against defects in materials and workmanship when used in accordance with the applicable instructions for a period of one year from the date of shipment of the products. USFilter MAKES NO OTHER WARRANTY, EXPRESSED OR IMPLIED. THERE IS NO WARRANTY OF MERCHANTABILITY OR FITNESS FOR A PARTICULAR PURPOSE. The warranty provided herein and the data, specifications and descriptions of USFilter products appearing in USFilter's published catalogs and product literature may not be altered except by express written agreement signed by an officer of USFilter. Representations, oral or written, which are inconsistent with this warranty or such publications are not authorized and if given, should not be relied upon. In the event of a breach of the foregoing warranty, USFilter's sole obligation shall be to repair or replace, at its option, any product or part thereof that proves defective in materials or workmanship within the warranty period, provided the customer notifies USFilter promptly of any such defect. The exclusive remedy provided herein shall not be deemed to have failed of its essential purpose so long as USFilter is willing and able to repair or replace any nonconforming USFilter product or part. USFilter shall not be liable for consequential damages resulting from economic loss or property damages sustained by a customer from the use of its products.

Failure to follow the instructions presented in this manual may compromise the safety features built into this product.

IMPORTANT NOTE: The MC10 is powered via a multi-tap transformer which allows it to operate on the following primary voltages (acceptable range):

115 VAC (108-130 VAC)
208 VAC (187-220 VAC)
230 VAC (216-254 VAC)

Voltages outside of these values will damage the MC10 power circuitry. Check primary line voltage before connecting power to the MC10. Do not alter factory wiring in the MC10. In areas susceptible to electrical surges, use an appropriate surge protector on the primary side of the transformer (See Appendix B).

For Product and Service Information

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MC 10 Overview

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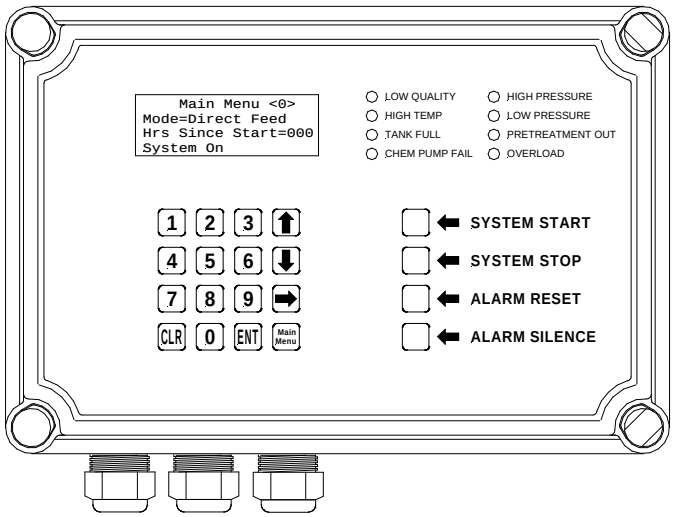
Introduction

The MC10 Reverse Osmosis Controller is designed to control and monitor the operating parameters of a single pump reverse osmosis water purification system. Information is displayed on a back-lit liquid crystal display, and on individual light-emitting diodes (LED). Functions and controls are operated through switches on the keypad.



Front View of Model MC10 RO System Controller

Features

The MC10 incorporates the following features:

- Temperature Compensated Conductivity Monitor with Percent Rejection and Adjustable Alarm Setpoint
- Water Temperature Monitor with Adjustable High Temperature Shutdown
- Three Modes of Operation: Stand-by, Tank Feed, and Direct Feed
- Pretreatment Interlock
- High Tank Level Shutdown
- Low Tank Level Restart
- Inlet Valve Control
- Chemical Feed Pump Control*
- Pump Control
- Low Feed Pressure Sensing with Automatic Reset
- High Pressure Sensing
- Autoflush with Adjustable Flush Interval and Duration
- Permeate Diversion Valve Output
- Alarm Output
- Sanitization Password Lockout
- Data Logging
- Ports for Expansion and Serial Communication*
- Modem for remote monitoring (Optional)*

* For use with non-medical VANTAGE RO systems only. (NOT for use with Med-RO systems.)

Specifications

The MC10 incorporates the following specifications:

Power Requirements: The controller can operate with following primary voltages (acceptable range). Depending upon the voltage being used, the power must be wired to the proper position on the power terminal strip near the transformer.

115 VAC (108-130 VAC)
208 VAC (187-220 VAC)
230 VAC (216-254 VAC)

Voltages outside of these values will damage the MC10 power circuitry. Check primary line voltage before connecting power to the MC10.

Environment: The controller can operate at a temperature from 0° to 55° C (32° to 131° F). Relative humidity must not exceed 95 percent.

Conductivity Monitor: The conductivity monitor measures the feed and product water quality and displays this information in uS/cm. The display is temperature compensated to 25° C (77° F). The controller calculates and displays the percent rejection of the system, and has an adjustable alarm setpoint.

Outputs

The MC10 is equipped with the following outputs:

Inlet Solenoid: A 24 VAC output is provided to power the inlet solenoid valve. This output always energizes 15 seconds before the pump turns on, and de-energizes 15 seconds after the pump turns off. All water systems equipped with this controller are also equipped with a compatible inlet solenoid valve. If the valve must be replaced it must function on 24 VAC and have a current load less than one ampere.

AutoFlush Valve: A 24 VAC output is provided to power the reject (Autoflush) solenoid valve. This output will energize during the flush cycle thus opening the valve and allowing flow to bypass the reject control valve. If the valve must be replaced it must function on 24 VAC and have a current load less than one ampere.

*Chemical Injection Pump**: A 24 VAC output is provided to control a chemical injection system. This output energizes before the main pump starts and de-energizes before the main pump shuts down. This output is intended to power a relay or some other low current device.

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Motor Starter: A 24 VAC output is included to provide controlled pump operation. This output powers the coil of the magnetic starter relay. This output is energized depending on other operating parameters. This output also has a maximum current rating of one ampere.

Permeate Diversion Valve: This is also a 24 VAC output. When the percent rejection of the system is below the setpoint, this output will be energized. This output is also energized during a flush. *This valve is not included with the system.* This output is intended to power a relay or some other low current device. The maximum current available is one ampere.

Alarm: This consists of a 108 db alarm horn mounted inside the MC10 enclosure. The horn is energized when the following conditions are present:

- Low Pressure Shutdown
- High Pressure Shutdown
- High Temperature Shutdown
- When Percent Rejection is Below Setpoint

All outputs are protected by positive temperature coefficient resistors (polyfuses). The polyfuses interrupt the current to the MC10 outputs should an overload condition occur on an output. The polyfuses will reset when power is turned off to the MC10 and the fuse is allowed to cool. This eliminates the need for replaceable fuses and prevents damage caused by the incorrect fuse being installed. The primary side of the transformer in the MC10 is also protected by a polyfuse.

Inputs

The MC10 is equipped with the following inputs:

Conductivity Sensors: There are four inputs for each conductivity sensor, two for the temperature detector (RTD) and two for the electrodes in the conductivity cell. Inputs are available for both the feed and product sensors. Using a sensor with a cell constant of 1.0 provides a detection range of 0-1000 uS/cm on the feed and 0-100 uS/cm on the permeate. Only sensors with a 1000 ohm RTD will work with this controller.

Low Pressure Switch: This is a dry contact that signals the system to shut down if the pump suction pressure falls below the desired value. This is a normally open contact. When a circuit is not complete between the two terminals, the system will operate. If contact is made between the two terminals, the system will shut down. An LED will indicate when the system is in a state of low pressure shut down. The system will attempt to restart every thirty seconds. The system will make up to five attempts at restarting. The system must be able to run continuously for thirty seconds without sensing low pressure. If the controller still senses low pressure after the fifth restart, it will lock out and the alarm reset button must be pressed to resume operation.

High Pressure Switch: This is a dry contact that signals the system to shut down if the pump discharge or membrane pressure exceeds the desired value. This is a normally open contact. When an open circuit condition exists between the two terminals, the system will operate. If contact is made between the two terminals, the system will shut down. An LED will indicate when the system is in a state of high pressure shut down. The alarm reset button must be pressed to resume operation after a shutdown due to high pressure.

Tank Level: The controller has two inputs that accept the dry contacts for the high level and low tank level switches. If the controller is in the “Tank Feed” mode (see the “Settings menu” section of this manual for further discussion), these switches read the water level in the RO product storage tank and turn the pump ON or OFF depending on the level. Each switch should be installed in the tank so that the contacts close when the water level falls below that particular switch. An LED will indicate when the system is in a state of high tank level “Tank Full”, the pump will turn off and the “Tank Full” LED will begin to blink. The pump will remain off and the “Tank Full” LED will continue blinking until the water level drops below the low tank level switch (2 level switch operation).

The MC10 may be configured to use only one tank level (high tank level) switch. Again the system must be operated in the "Tank Feed" mode (see the "Settings menu" section of this manual for further discussion). When this configuration is being used, the "Tank Full" LED will indicate when the system is in a state of high tank level (level switch open). The system starts and stops based only upon high tank level and the "High Tank Startup Delay" setpoint. When the level drops (the switch closes), the system will re-start after the "High Tank Startup Delay" (see "Settings Menu" section of this manual for further discussion). The "Tank Full" LED will blink while the "High Tank Startup Delay" timer is timing.

Pretreatment Interlock: This is a dry contact that signals the system to shut down when a pretreatment device is not functioning or regenerating. This could be used on a water softener, multimedia filter, chemical feed pump, pressure differential switch on prefilters, etc. This contact is normally closed. When a circuit is complete between the two terminals the system will operate. If contact is broken the system will shut down. An LED will indicate when the system is shut down due to pretreatment interlock. The system will restart itself when the contact is closed.

Chemical Pump Failure:* This is a dry contact that signals the failure of the chemical injection system. This input differs from the "Pretreatment Interlock" in that it does not allow the system to restart. This contact is normally open. When an open circuit condition exists between the two terminals, the system will operate. If contact is made between the two terminals, the system will shut down. An LED will indicate when the system is shut down due to chemical pump failure.

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All input connections on the MC10 provide a supply voltage and are designed for dry contacts. **Do not apply voltage to the inputs as permanent damage may result.**

Mode

The MC10 is designed to operate in one of three modes. The mode of operation is selected from the Settings menu.

The ***stand-by mode*** is intended to place the system in a temporary non-operational mode. When the system is placed in this mode, it will perform a flush as scheduled by the amount of time entered for "Flush Interval" in the Settings data entry screen (See "Settings" section of this manual). The Flush Interval is the number of minutes between flushes. The Flush Duration is the total time in seconds that unit flushes. During a flush, the inlet, autoflush, and diversion solenoid valves are open and the high pressure RO pump and chemical pump (if applicable) are both running. The % Salt Rejection alarm is not activated during a flush. When the flush is complete, the pump will turn off and the inlet, flush, and diversion valves will close. The system will repeat this cycle based upon the time entered in the Flush Interval. (If the Flush Interval is set for zero the system will only flush on start up.) When the system is flushing, the amount of time remaining in the flush cycle will be indicated on the third line of the display. When the system is idle, the amount of time remaining until the next flush will be indicated.

The ***tank feed mode*** is intended to place the system in an operational mode when feeding a storage tank. When in this mode the system will shut down when the high tank level switch (not provided) has an open contact. The system will restart when the low level switch closes or after the High Tank Startup Delay interval if the system is not equipped with a low level tank switch (See "Settings" section of this manual). The flush cycle is also enabled in this mode. The controller will activate a flush when the system starts and at intervals while the tank is full. The Flush Interval and Duration are entered in the Settings menu (See "Settings" section of this manual). If the Flush Interval is set for zero the system will only flush on start up. When the system is autoflushing, the amount of time remaining in the flush will be indicated on the third line of the display.

The ***direct feed mode*** is intended to place the system in an operational mode when the system is feeding a distribution loop or another piece of equipment. In this mode the system will not flush and the tank level switch(es) is/are disregarded. When the system is in this mode, the total number of hours the system has been operated will be indicated on the last line of the display.

NOTE: Standby mode is selected from the Operating Mode screen (selection "1" from the Settings screen). Tank or Direct feed operation is selected from first setting (Index 0) from the list of settings accessed by selecting "2" from the Settings screen.

All three modes of operation are controlled by the System Start and System Stop keys. For example, if the system is put in *standby mode* and the System Start key is not pressed, the RO unit will not operate the flush cycles. This is the same for *tank feed* and *direct feed modes*, if the System Start key is not pressed, the RO unit will not operate. The system automatically stops the RO unit whenever a change between tank feed/direct feed and standby modes is made, requiring the operator to restart the RO unit. "SYSTEM STOP" key must be pressed prior to changing between tank feed and direct feed operation.

Controls

The MC10 is equipped with the following controls and indicators on the front panel of the controller.

- 4 x 20 LCD with LED Backlight
- Eight LED Indicators for Alarms and Status
- 20 Tactile Keys for Control and Data Entry

Expansion Port*

The MC10 is equipped with one RS-485 expansion port which allows it to be equipped with additional input modules for pressure and flow. The expansion port also allows data from the MC10 to be networked into a larger water treatment monitoring system. The RS-485 expansion port is the 6 pin, watertight connector located in the upper right hand corner of the left hand side of the MC10 enclosure. Use of the expansion port may require a software upgrade to the MC10.

Serial Port*

The MC10 is equipped with one RS-232 serial port which allows it to be equipped with an optional internal modem module for remote monitoring and downloading of data (program updates, default set points, etc.). The RS-232 serial port is also connected to the 5 pin, watertight connector located directly below the RS-485 expansion port on the left hand side of the MC10 enclosure. Connecting to the serial port on the side of the enclosure will automatically disconnect the internal modem.

Data Logging* The MC10 is designed to log data from the RO system. This data may be retrieved locally through the serial port connection or remotely if the MC10 unit is equipped with the optional modem. Remote communication and retrieval of logged data requires the use of AquaGraph PC software.

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Installation

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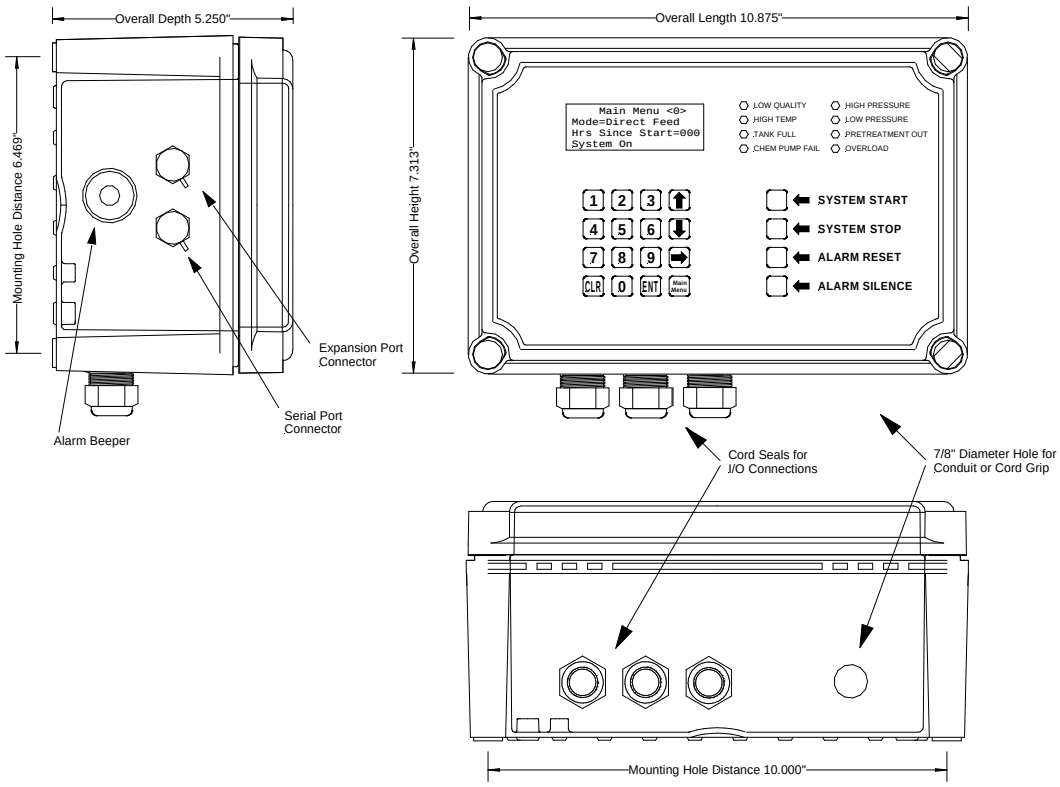
Environmental

The MC10 is equipped with a NEMA 4X enclosure for use in industrial environments subject to occasional exposure to water sprays and other wet conditions. The MC10 should not be used in explosive environments. General environmental specifications are listed below.

Environmental Specifications	
Specification	**Rating**
Storage Temperature	-20 to 70 Deg C
Ambient Operating Temperature	0 to 55 Deg C
Ambient Humidity	30% to 95 % Relative Humidity (Non-Condensing)

Mounting

The MC10 is designed to be mounted in a horizontal position on a flat surface by means of four mounting holes. Opening the front cover of the enclosure allows access to the mounting holes, access to the bottom holes requires temporary removal of the hinge assemblies. When mounting the MC10, sufficient room should be allowed on the side and bottom of the device for access to the I/O and serial port connections. Mounting dimensions are shown below.

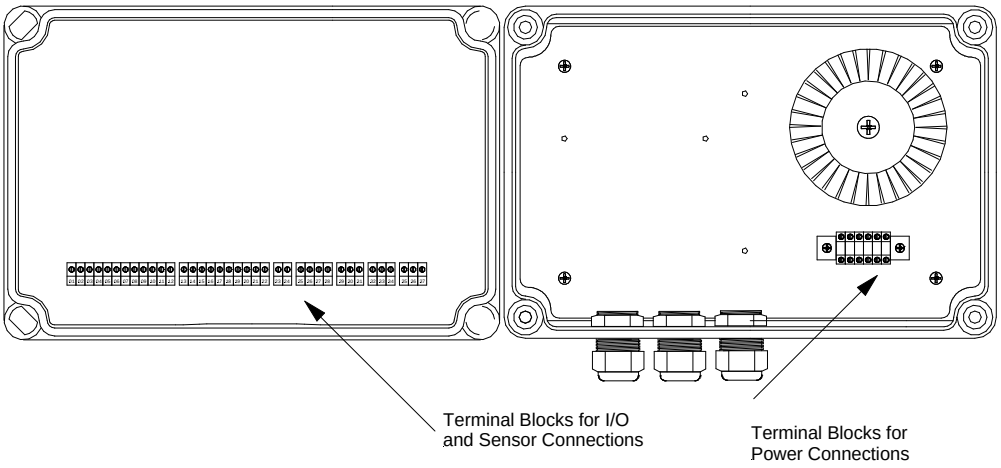


Ground

A good common ground reference (earth ground) is essential for proper operation of the MC10. A good earth ground or power circuit ground should be connected to the ground terminal block l on the enclosure backpanel.

Connections

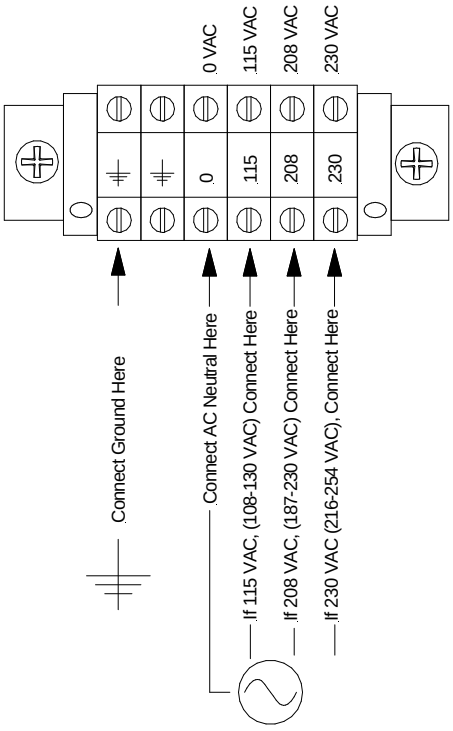
Screw terminals are provided for making connections for sensor inputs and power. Sensor and I/O terminals are located on the inside of the door of the MC10 enclosure. The terminals are numbered in ascending order from left to right. Power terminals are on the backpanel of the enclosure. Power should always be disconnected from the MC10 before making or changing any connections on these terminals.



Power

The incoming power is connected on the terminal blocks just below the transformer on the backpanel of the enclosure. The triple tap transformer will accept either 115, 208, or 230 volts AC (50 or 60 Hz). Depending upon the voltage being used, the power is connected to one of three terminals as illustrated. If 460 VAC is the only power source available, use a separate step-down transformer to lower the voltage to 230 VAC.

The MC10 transformer is equipped with an internal thermal fuse on the primary winding to prevent damage from overloads.



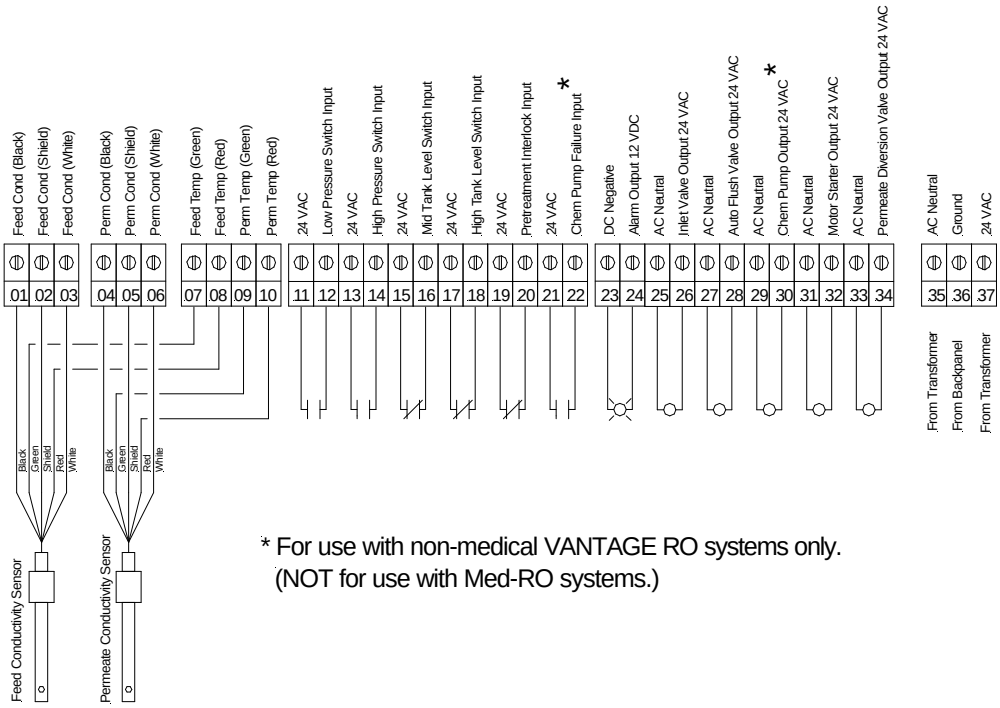
Always replace the terminal block cover after making the power connection.

Verify line voltage and check primary wiring (diagram at right) before applying power to the MC10. Primary voltages outside of the ranges shown at right will result in damage to the MC10 circuitry.

In locations subject to transient power surges, use a surge protector on the primary connections to the transformer. See Appendix B for more information on surge protection.

I/O

The wiring diagram for the input and output connections is shown below.



Outputs

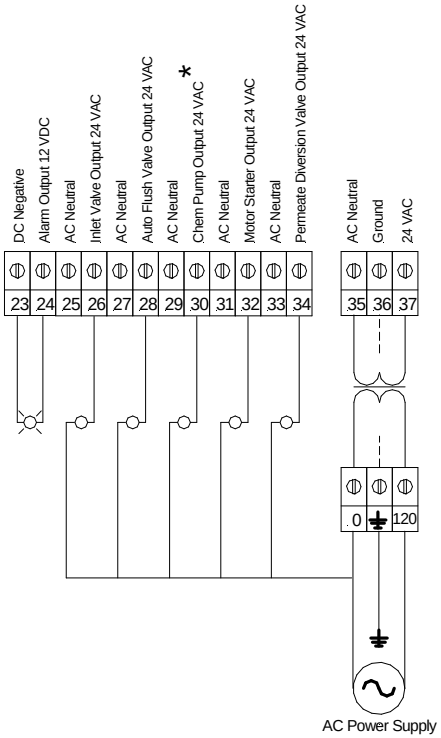
All outputs (with the exception of the external alarm) are 24 VAC, one amp maximum. Any device connected to an output should be rated for less than one amp at 24 VAC. An overload on any output will cause current to be interrupted to the output and an alarm condition will occur. If the transformer supplying the controller becomes overloaded, the controller will reboot. If the overload still exists after the controller reboots, the controller will shut down the system and log an overload alarm.

The discrete outputs on the MC10 are 24VAC only. The neutral or common wire from the output loads (e.g., solenoid valves) can not be bussed to the incoming power supply neutral (See figure on page 2-4).

The external alarm output is 12 VDC, 100 mA maximum. This output is designed to drive small loads such as indicator lights or small alarm horns.

Avoid using excessively large wire (larger than 18 AWG) on the outputs since it may prevent the enclosure door from closing properly. All wires from the outputs must pass through the grommet in the cord seal. Any unused openings in the grommet must be sealed with plugs to maintain the watertight characteristics of the enclosure.

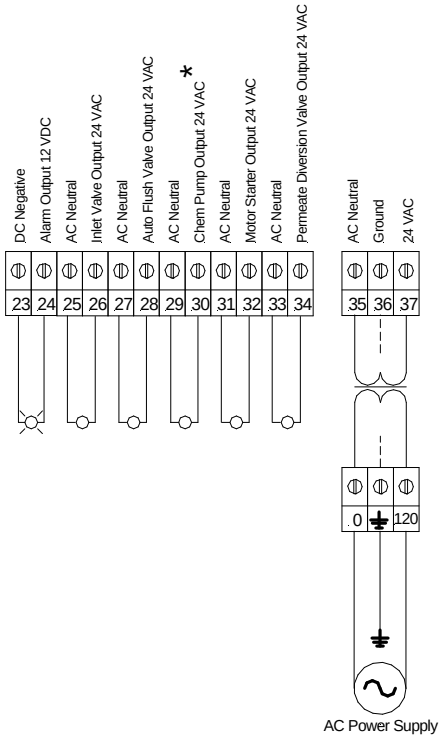
Incorrect Wiring



The solenoid coils are referenced to high voltage power supply.

DO NOT BUSS THE NEUTRAL TO THE INCOMING POWER SUPPLY NEUTRAL.

Correct Wiring



The solenoid coils are referenced to 24VAC after the MC10 transformer.

Inputs

All inputs should be dry contacts rated for 24 VAC**. Do not apply voltage to the inputs.** Input voltage to the contacts is supplied by the MC10.

Avoid using excessively large wire (larger than 18 AWG) on the inputs since it may prevent the enclosure door from closing properly. All wires from the inputs must pass through the grommet in the cord seal. Any unused openings in the grommet must be sealed with plugs to maintain the watertight characteristics of the enclosure.

Low Pressure Switch: This is a dry contact that signals the system to shut down if the pump suction pressure falls below the desired value. This is a normally open contact. When a circuit is not complete between the two terminals, the system will operate. If contact is made between the two terminals, the system will shut down.

High Pressure Switch: This is a dry contact that signals the system to shut down if the pump discharge or membrane pressure exceeds the desired value. This is a normally open contact. When an open circuit condition exists between the two terminals, the system will operate. If contact is made between the two terminals, the system will shut down.

Pretreatment Interlock: This input is designed to be normally closed. If a pretreatment interlock input is not being connected, a wire jumper must be installed between the two terminals at Input 5. Since the input is normally closed, multiple devices may wired to this input in series.

Chemical Pump Failure:* This is a dry contact that signals the failure of the chemical injection system. This is a normally open contact. When an open circuit condition exists between the two terminals, the system will operate. If contact is made between the two terminals, the system will shut down.

Tank Level Switches: The MC10 is designed to be used with one or two tank level switches. Switches should be wired in the normally closed position (the switch contacts close when the water level drops below the switch). When using two switches, a low-level tank switch starts the system (in Tank Feed mode) and a high-level switch stops the system. When using one switch, the switch connected must be a high-level switch. The switch will stop the system at high level. When the level drops (the switch closes), the system will re-start after the "High Tank Startup Delay", in minutes (See "Settings" section of this manual) that has been configured into the Settings data entry screen. The controller must be configured for one or two switch operation in the Settings menu (See "Settings" section of this manual).

Conductivity

The MC10 is designed to monitor conductivity by means of a standard two electrode conductivity cell. Cells with constants of 1.0 must be used. When using a 1.0 cell, the conductivity range will be 0-1000 uS/cm and the feed and 0-100 uS/cm on the permeate. The cells should be equipped with a two-wire, 1000 ohm Platinum RTD.

Conductivity cells should be connected by means of Belden cable no. 8724 or equivalent. When routing the conductivity cables, stay clear of AC cables, motors, or other sources of electrical interference. Never run sensor cables in the same conduit with AC cables.

Modem*

The optional modem for the MC10 is housed inside the MC10. The modem is connected by plugging the ribbon cable connector onto the dual row connector located on the I/O board under the I/O cover plate. The modem is equipped with a standard RJ connector for connection to an analog phone line. **Do not connect the MC10 modem to an intra-office digital phone line.** Damage to the modem can occur. Once connected to a modem, the MC10 can be accessed by means of Windows-based AquaGraph software for remote monitoring or data retrieval.

* For use with non-medical VANTAGE RO systems only.
(NOT for use with Med-RO systems.)

Operation

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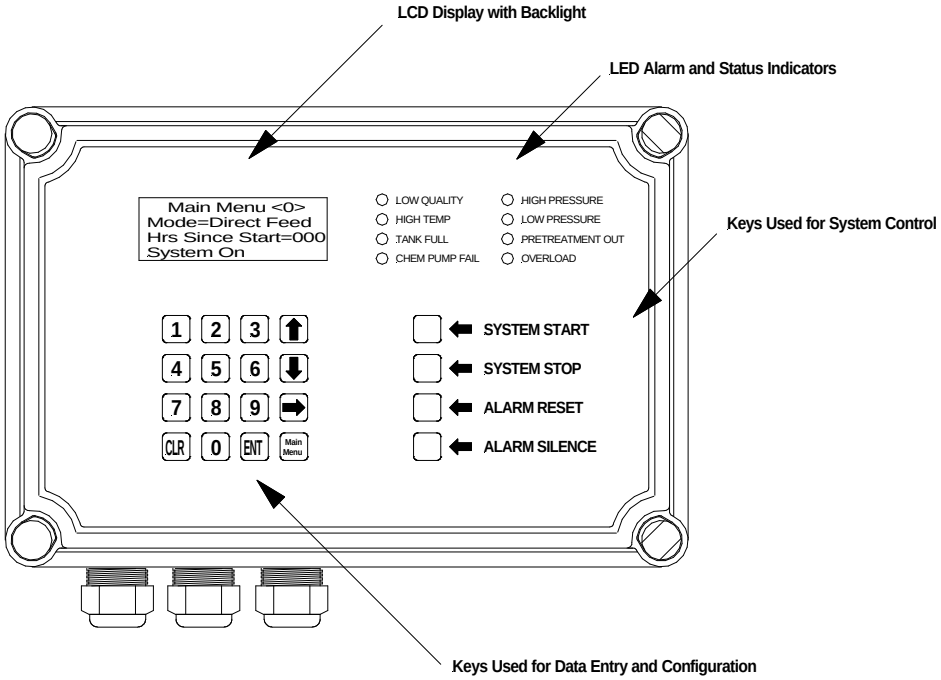
Controls

The MC10 is housed in a NEMA 4X enclosure with a membrane keypad. Indicators include a 4 line x 20 character LCD with LED backlight and eight high intensity LED indicators for alarm conditions. The control features of the MC10 are illustrated below.



Keypad

The membrane keypad contains 20 tactile keys which are used for a number of control and data entry functions.

System Start: Pressing this key starts the system. If the Direct Feed mode has been chosen, pressing the System Start key immediately initiates the startup sequence. If the Tank Feed mode has been chosen, pressing this key will not initiate the startup sequence unless the tank is below high-level. Pressing this key in Stand-By mode will initiate the flush sequence of flush cycles.

System Stop: Pressing this key stops the system and essentially turns all functions off.

Alarm Reset: Pressing this key resets the system after an alarm shut down for low pressure, high pressure, low quality, high temperature, overload, or chemical injection failure (VANTAGE RO systems only).

Alarm Silence: Pressing this key silences the alarm horn for 120 seconds. The system will still shut down if the alarm condition does not correct itself before the shutdown delay expires (See "Settings" section of this manual).

Up Arrow, Down Arrow, Right Arrow: These keys are used to move through the display screens and for data entry purposes.

*ENT***:** This key is used to confirm (ENTER) the various setting values.

*CLR***:** This key is used to clear an erroneous data entry. The data must be cleared before pressing the ENT key.

Numbers 0-9: These keys are used for data entry as well as for accessing various screens directly or for making other selections.

LED Indicators The eight LED indicators are used to indicate various status and alarm conditions.

*Chem Pump Failure**: Indicates when the system is experiencing failure of the chemical injection system. The system will shut down after the chem pump failure time delay expires.

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Pretreatment Interlock: Indicates when the system is shut down due to external pretreatment equipment.

Tank Full: **LED Solid** - Indicates when the storage tank is full. **LED Blinking** – The tank level is transitioning between the High and Low Tank levels. The system will only shut down when in the Tank Feed mode.

Low Quality: Indicates that the percent rejection is below the alarm setpoint.

Low Pressure: Indicates that the system has experienced low pump feed pressure. The system will shut down after the low pressure time delay expires. The system will automatically restart up to five times after a low pressure shutdown. After the fifth attempt, the "ALARM RESET" key must be pressed before restarting.

High Pressure: Indicates that the system has experienced high pump or membrane pressure. The system will shut down after the high pressure time delay expires.

High Temperature: Indicates that the system has experienced high feed water temperature. The system will shut down after the high temperature shutdown time delay expires.

Overload Condition: Indicates that the system has experienced an overload condition on one of the outputs. It will also indicate if the controller transformer has been overloaded due to excessive loads on multiple outputs. The system will shut down after the overload time delay expires. In the case of a transformer overload, the system will shut down and the indicator will illuminate if the controller "reboots" due to an overloaded condition.

Sequence

The normal startup and shut down sequence for the system is listed below. In Direct Feed mode, this sequence is initiated when the System Start key is pressed. While in Direct Feed mode, the system will not shut down unless the System Stop key is pressed or an alarm occurs. In Tank Feed mode, this sequence will be initiated every time the system starts and stops as controlled by tank level. When in Tank Feed mode, this sequence will also be used for the autoflush cycles with the addition of the activation of the autoflush solenoid valve. When in Stand-By mode, this sequence is used for the autoflush cycles with the addition of the activation of the autoflush solenoid valve.

Startup	*Shutdown*
Open Inlet Valve	Stop Pump
Open Autoflush Valve (during autoflush sequence only)	Fifteen Second Delay
Start Chemical Feed (VANTAGE RO systems only)	Close Inlet Valve
Ten Second Delay	Close Autoflush Valve (if open)
Start Pump	

The autoflush sequence is activated only in the Tank Feed and Stand-By modes of operation. Autoflush interval and duration are controlled by the interval and duration presets configured into the MC10 in the Settings menu.

Screens

The MC10 displays data and operating status by means of a number of screens displayed on the LCD. Specialized screens are also used for configuring the system and for entering setpoints, time delays, deadbands, etc. The screens displayed by the MC10 are illustrated at the end of this manual.

Main Menu

The Main Menu consists of two screens which are accessed using the up and down arrow keys. The Main Menu screen displays the current operating mode, run status, and either hours since start (Direct Feed mode) or autoflush information (Standby mode). Only current operating mode and run status will be indicated while in Tank Feed mode. The Main Menu screen also allows the user to access other screens.

Status Screen

Status screen is accessed by pressing the number 2 on the keypad from the second Main Menu screen. The Status screen displays the total run time (RT) indicated as tenths of 1000 hours (As an example 0.2573 is the same as 257.3 hours).

Quality Screen

Quality screen is accessed by pressing the number 3 on the keypad from the second Main Menu screen. The Quality screen displays the feed conductivity (FCnd), permeate conductivity (PCnd), feed temperature (in degrees C), and percent rejection (%SR).

Alarm Log

Alarm Log screen is accessed by pressing the number 4 on the keypad from the second Main Menu screen. The user may tab through the alarm log by using the up and down arrow keys. The Alarm Log will hold up to 256 alarms along with the time and date of the alarm. In the event that Alarm Log needs to be cleared, press the right arrow key on the keypad. The user is prompted for the access code to clear the Alarm Log (factory default access code = 12345).

Settings Screen

Settings screen is accessed by pressing the number 5 on the keypad from the second Main Menu screen. The Settings screen itself has six selections. The first selection, number 0 on the keypad, allows the user to set the time (hours, minutes and seconds), date (day, date, month and year) access (factory default access code = 12345) and sanitize lockout (factory default sanitize lockout code = 12345) codes. The access code must be used to enter the Clock Settings screen or Main Settings

screen. If the user re-enters either of these screens within 240 seconds of exiting, it is not necessary to enter the access code.

The MC10 maintains time on a 24 hour clock (i.e., military style). The hours, minutes, and seconds are changed on separate screens by entering the appropriate number and pressing "ENTER". Date, month, and year are entered in the same fashion. The MC10 also requires that the day of the week be entered (Sunday = 1, Saturday = 7).

The second selection from the Settings Screen, number 1 key, allows the user to change the operating mode of the MC10; Sanitize, Standby or Operating (Tank/Direct Feed) modes. The third selection, number 2 key, allows access to the Settings data entry screens. The user is prompted for the access code to enter sub menu 0 (Clock) or 2 (Settings) of the Settings screen (factory default access code = 12345).

NOTE: Standby mode is selected from the Operating Mode screen (selection "1" from the Settings screen). Tank or Direct feed operation is selected from first setting (Index 0) from the list of settings accessed by selecting "2" from the Settings screen.

The fourth selection, number 3 key, automatically initializes the modem. This only needs to be done one time after a modem is installed in the controller. The fifth selection, number 4 key, allows the user to select the data log interval. The sixth selection, number 5 key, erases the data currently in the data logger.

Upon entering the Settings data entry screens (by pressing "2" from the main Settings screen), the user will have the option of entering an index number for a particular setting. This enables the user to go directly to a particular setting without scrolling through the entire list of settings. Alternatively, the user may scroll through the settings with the up and down arrow keys.

Settings Table

The table below lists the index number of all of the Settings data entry screens, the abbreviation used on the screen, the full name of the setting, and any other pertinent information on that particular setting. **NOTE**: Where required, the right arrow key is used to enter the decimal point.

MC10 Settings						
Index	**Screen Name**	**Full Name**	**Range**	**Format**	**Default Setting**	**Details**
0†	Feed	Tank or Direct Feed	0 or 1	0	**1**	Allows the user to choose between tank feed or direct feed operation. Enter 0 for tank feed or 1 for direct feed.
1	Low Salt Rjct SP %	Low Salt Rejection Setpoint	80-100	00.0	**90**	Setpoint (in %) which activates the alarm for low salt rejection.
2	Low Salt Rjct DB %	Low Salt Rejection Deadband	0-20	00.0	**0.5**	Deadband (in %) through which the salt rejection value must increase to release the low salt rejection alarm.
3	Low Salt Rjct TDsec	Low Salt Rejection Time Delay	1-255	000	**1**	Delay (in seconds) before the low salt rejection alarm is activated once the current value falls below the setpoint.
4	Low Salt Rjct SDsec	Low Salt Rejection Shut Down Delay	1-255	000	**1**	Delay (in seconds) before the system shuts down after the low salt rejection alarm is activated.
5	Perm Divert SP %	Permeate Diversion Setpoint	80-100	00.0	**80**	Salt rejection setpoint (in %) which activates the permeate diversion valve.
6	Perm Divert DB %	Permeate Diversion Deadband	0-20	0.0	**1.0**	Deadband (in %) through which the salt rejection value must increase before the permeate diversion valve is released.

7	Perm Divert TD Sec	Permeate Diversion Time Delay	1-255	000	**15**	Delay (in seconds) before the permeate diversion valve is activated once the current value falls below the setpoint.
8	High Temp SP DegC	High Temperature Setpoint	0-45	00	**32**	Temperature setpoint (in deg C) which activates the high temperature alarm.
9	High Temp DB DegC	High Temperature Deadband	0.1-10	0.0	**3**	Deadband (in deg C) through which the temperature value must pass before the high temperature alarm is released.
10	High Temp TD Sec	High Temperature Time Delay	1-255	000	**20**	Delay (in seconds) before the high temperature alarm is activated once the current value rises above the setpoint.
11	High Temp Shtdwn Sec	High Temperature Shut Down Delay	1-255	000	**10**	Delay (in seconds) before the system shuts down after the high temperature alarm is activated.
12	High Tank Lvl TD Sec	High Tank Level Time Delay	1-255	000	**5**	Delay (in seconds) before the system shuts down for high tank level.
13†	Low Tank Swtch EN	Low Tank Switch Enable	0 or 1	0	**1**	Allows the system to be configured with or without a low tank level switch. Enter "1" to enable (low tank level switch present) or "0" to disable (low tank level not being used) this feature.
14	Hi Tnk Startup Sec	High Tank Level Restart Time Delay	1-1000	000	**30**	Delay (in seconds) before the system will restart after the tank level drops below the high tank level switch. This feature is only used when the system is configured for operation without a low tank level switch.
15	Low Tank Lvl TD Sec	Low Tank Level Time Delay	1-255	000	**5**	Delay (in seconds) before the system restarts (in Tank Feed mode) when the level drops below the low tank level switch.
16	High Pressure TD Sec	High Pressure Time Delay	1-255	000	**5**	Delay (in seconds) before the system shuts down for high pressure.
17	Low Pressure TD Sec	Low Pressure Time Delay	0-255	000	**5**	Delay (in seconds) before the system shuts down for low pressure.
18	Overload TD Sec	Overload Time Delay	1-255	000	**2**	Delay (in seconds) before the system shuts down for output overload.
19	Pretrt Intlk TD Sec	Pretreatment Interlock Time Delay	1-255	000	**2**	Delay (in seconds) before the system shuts down for pretreatment interlock.
20*	Chem Pump TD Sec	Chemical Pump Failure Time Delay	0-100	000	**2**	Delay (in seconds) before the system shuts down for failure of the chemical injection pump.
21†	Flush Interval Min	Auto Flush Interval	0-90	000	**60**	Interval (in minutes) between autoflush cycles. Interval flush is disabled if this value is set to "0".
22	Flush Duration Sec	Auto Flush Duration	1-360	000	**180**	Duration (in seconds) of each autoflush cycles.
23	Feed CND Standard	Feed Conductivity Standard	10-3000	0000	**NA**	With these settings, the user can calibrate the conductivity inputs to a standard solution. See Calibration section for more information.
24	Perm CND Standard	Permeate Conductivity Standard	0-1000	00.0	**NA**	
25	Feed Temp Zero	Feed Temperature Zero Calibration	1-1500	000	**NA**	This setting allows the temperature sensor in the feed conductivity cell to be calibrated to zero degrees C. Only qualified users following the procedures documented in the Calibration section of this manual should adjust this setting.

* For use with non-medical VANTAGE RO systems only.
(NOT for use with Med-RO systems.)

† System must be shut down to change these settings.

26	Feed Temp Span DegC	Feed Temperature Span Calibration	1-60	00.0	**NA**	This setting allows the temperature sensor in the feed conductivity cell to be calibrated to a known temperature at span value. Only qualified users following the procedures documented in the Calibration section of this manual should adjust this setting.
27	Perm Temp Zero	Permeate Temperature Zero Calibration	1-1500	000	**NA**	This setting allows the temperature sensor in the permeate conductivity cell to be calibrated to zero degrees C. Only qualified users following the procedures documented in the Calibration section of this manual should adjust this setting.
28	Perm Temp Span DegC	Permeate Temperature Span Calibration	1-60	00.0	**NA**	This setting allows the temperature sensor in the permeate conductivity cell to be calibrated to a known temperature at span value. Only qualified users following the procedures documented in the Calibration section of this manual should adjust this setting.

Sanitization Lock

From the Operating Mode screen, the user may select “Sanitization Lock”; Main Menu <1> screen, select keypad number 5 (Settings), select keypad number 1 (Mode), select keypad number 1 (San lock). The user will then be prompted to enter the sanitization access code to lock out the system. After entering the code and pressing the ENT key, the RO unit will be placed in the Sanitization lockout mode. If the RO is currently operating, the RO unit will immediately shutoff, the controller display will indicate MODE=Sntz Lock and MIN (minutes) since Lock. If the RO unit is not currently running, regardless of mode of operation, all operation sequencing will immediately cease, the RO unit will placed in a controls level lockout condition and the controller display will indicate MODE=Sntz Lock and MIN (minutes) since Lock. This prevents the system from operating from a controls standpoint while sanitizing agents are present.

The controller must be powered up (display illuminated) for the sanitization feature to operate properly, in the event that power is interrupted during a sanitization procedure, the controller will remain locked out of service.

Following the sanitization process, pressing any of the arrow keys or the green “MAIN MENU” key on the keypad will prompt the operator to enter the unit sanitization lockout code, “LOCKOUT RESTART”, “Enter Access Code” will be displayed. The operator must enter the five digit sanitization lockout code to exit the sanitization lockout mode. Following this RO unit may once again be operated in any of the three available normal operating modes.

Refer to the RO unit Operation and Maintenance manual accompanying the unit for proper sanitization precautions, proper materials and procedures.

Diagnostic Screens

From the Main Menu <1> screen, the user may select a number of diagnostic screens. The following may by accessed from the Main Diagnostic screen:

Press “1” to view the serial number of the controller, software version, and serial port status.

Press “2” to view the raw analog values for conductivity and temperature.

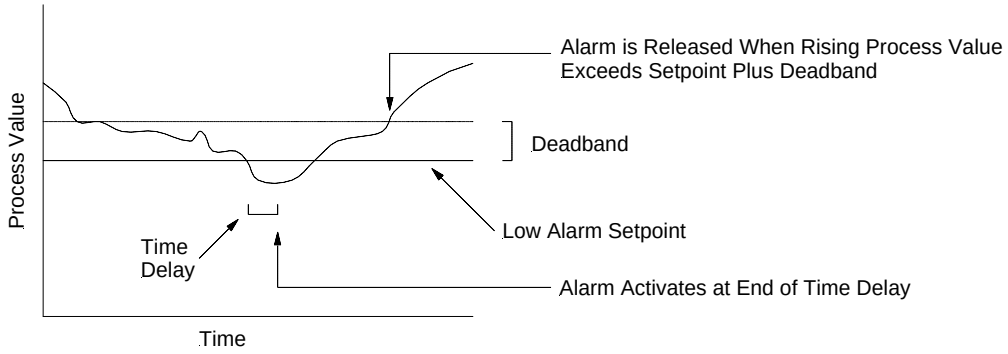
Press “3” to view the status of the digital inputs. Use the Up and Down Arrow keys to view all of the inputs.

Press “4” to view the status of the digital outputs. Use the Up and Down Arrow keys to view all of the outputs.

Press “5” to check the operation of the keypad. Each key press will be displayed on the screen. Press the Main Menu key twice to return to the Main Menu.
IMPORTANT: System Start and System Stop keys do not function while in keypad diagnostic mode.

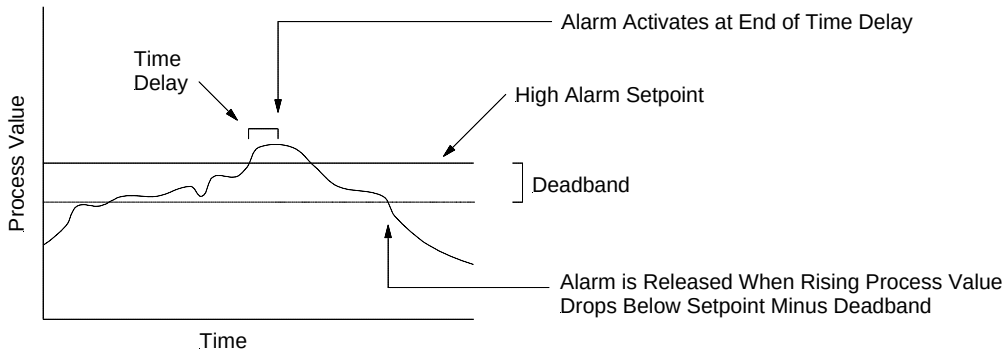
Time Delays

Time delays and deadbands are used to control the action of the MC10 alarms. These are described below.



The illustration above shows the action of a low alarm setpoint on a falling value.

The high setpoint works in the same manner except the deadband is below the setpoint.



Calibration

4

Introduction

A number of parameters monitored by the MC10 must be periodically calibrated for optimum performance and accuracy. These are outlined below.

MC10 Calibration			
Parameter	**Method of Calibration**	**Settings Index Number**	**Recommended Calibration Frequency**
Feed Conductivity	Calibration with Conductivity Standard Solution	23	One to Three Months Depending Upon Sample Condition
Permeate Conductivity	Calibration with Conductivity Standard Solution	24	
Feed Temperature Zero	Calibration to Zero Degrees C	25	Six Months
Feed Temperature Span	Calibration to Known Temperature	26	
Permeate Temperature Zero	Calibration to Zero Degrees C	27	
Permeate Temperature	Calibration to Known Temperature	28	

Conductivity

The conductivity inputs of the MC10 should be calibrated using a known standard solution. Value of the standard should be in the upper area of the range of the conductivity being measured by the MC10.

In cases of low conductivity (< 50 uS/cm) it may be necessary to calibrate the sensor and its associated input channel in situ. This is done by following the same general procedure as outlined below for calibration to a standard solution with one exception. In situ calibration requires that the sensor be left mounted in the process line. Instead of using a standard solution, a sample from the process line is tested with a calibrated meter. This measured conductivity value of the process fluid is used in lieu of a standard solution value.

The following procedure should be used for calibrating the MC10 to a solution of known conductivity.

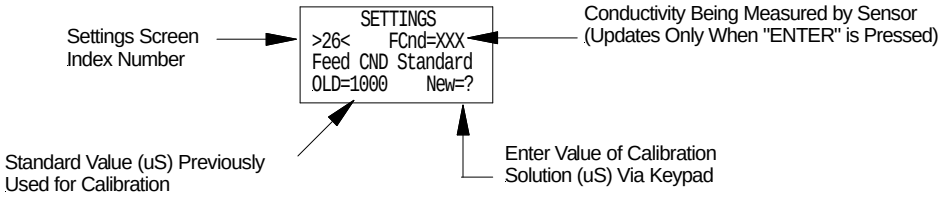
Step One – Rinse or soak the sensor in deionized water. Dry the sensor and place it in a solution of known conductivity. This may be a standard solution provided a laboratory supply company or a water sample which has been measured by a calibrated conductivity meter. Make sure that the conductivity value of the calibration solution is within the upper range of the MC10 conductivity channel. Allow the sensor to equalize to the solution temperature for a few minutes before proceeding with the next step.

Important

Please note:

- Temperature and conductivity are combined in one sensor.
- If temperature and conductivity are both being calibrated, always calibrate the temperature first.
- Be careful not to damage (avoid excessive twisting, bending, etc.) the sensor leads when removing the sensor from the pipe fitting.
- Never reuse standard solutions. Always dispense the solution from its container and dispose of the solution after using it.
- Use clean containers (triple rinsed with deionized water) for holding the calibration solution.

Step Two – Go to the appropriate Settings data entry screen (23 or 24). Enter the value of the calibration solution via the keypad. Press ENTER. A new measured value will appear on the screen.



If the value displayed on the screen does not match the value entered for the calibration solution, let the sensor equalize for a few more minutes and repeat Step Two.

Troubleshooting

If problems occur during calibration, please check the following:

- Ensure that the Settings screen corresponds to the sensor being calibrated.
- Check the condition of the sensor. Make sure that the electrode surfaces are not damaged, corroded, or fouled.
- Make sure that the sensor is suitable for use with the MC10. Verify that the cell constant is in the correct range and that the sensor is equipped with the proper temperature element (1000-Ohm Platinum RTD).
- Check the condition of the sensor wiring and that the sensor leads are properly connected to the MC10 terminals.
- Verify that the calibration solution is the correct conductivity value and that the value is within the range of the conductivity input being calibrated.
- Refer to the Troubleshooting Section of the manual for more information.

Temperature

The temperature elements in the conductivity sensors are calibrated in a similar fashion as the conductivity sensors. Follow these steps for temperature calibration.

Step One – Place the conductivity sensor in an ice bath. Allow the sensor to equalize for a few minutes.

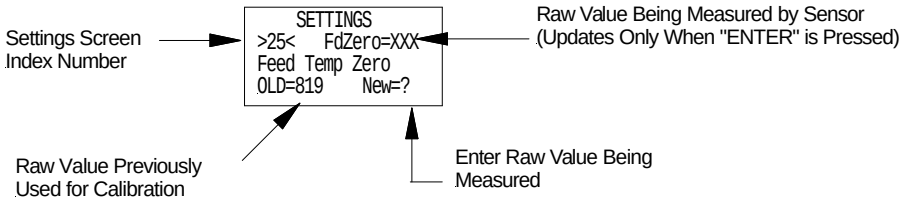
Important

Please note:

- Temperature and conductivity are combined in one sensor.
- If temperature and conductivity are both being calibrated, always calibrate the temperature first.

- Be careful not to damage (avoid excessive twisting, bending, etc.) the sensor leads when removing the sensor from the pipe fitting.
- The conductivity standard solution may be used for temperature calibration when combining the temperature and conductivity calibrations.

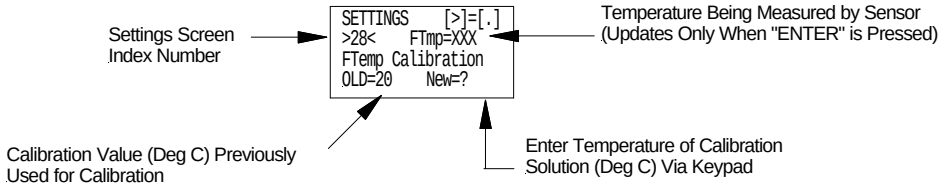
Step Two – Go to the appropriate Settings data entry screen (25 or 27). The following screen will appear:



The screen will display the raw analog value being measure from the temperature sensor. Enter this value from the keypad and press ENTER. The value shown near the top of the screen should match the value entered. If not, wait a minute longer and re-enter the number.

Step Three – Place the conductivity sensor in a water sample at approximately the same temperature as that being monitored in the process. Measure the temperature with a laboratory grade thermometer. Allow the sensor to equalize to the solution temperature for a few minutes before proceeding with the next step.

Step Four – Go to the appropriate Settings data entry screen (26 or 28). Enter the temperature of the calibration solution via the keypad. Press ENTER. A new measured value will appear on the screen.



If the value displayed on the screen does not match the value entered for the calibration solution, let the sensor equalize for a few more minutes and repeat Step Two.

Troubleshooting If problems occur during calibration, please check the following:

- Ensure that the Settings screen corresponds to the sensor being calibrated.
- Check the condition of the sensor. Make sure that the electrode surfaces are not damaged, corroded, or fouled.
- Make sure that the sensor is suitable for use with the MC10. Verify that the sensor is equipped with the proper temperature element (1000-Ohm Pt RTD).
- Check the condition of the sensor wiring and that the sensor leads are properly connected to the MC10 terminals.
- Refer to the Troubleshooting Section of the manual for more information.

Troubleshooting

5

The MC10 Reverse Osmosis Controller is designed for ease of maintenance and minimum service. Since the highest quality of electronic semiconductor components are used in this design, it is not likely that circuit malfunctions or failures will occur. It is our recommendation that service be limited to identifying malfunctions at the board level and that component level troubleshooting be referred to ***USFilter***'s Technical Support Department (see the phone number listed on the cover of this manual.)
It is our experience that field failures which most frequently occur are:

- Improper or broken wiring connections
- Incorrect wiring of magnetic starter
- Improper grounding
- Cable run is too long
- Water in connectors
- Dirty cell electrodes
- Defective conductivity/temperature probes

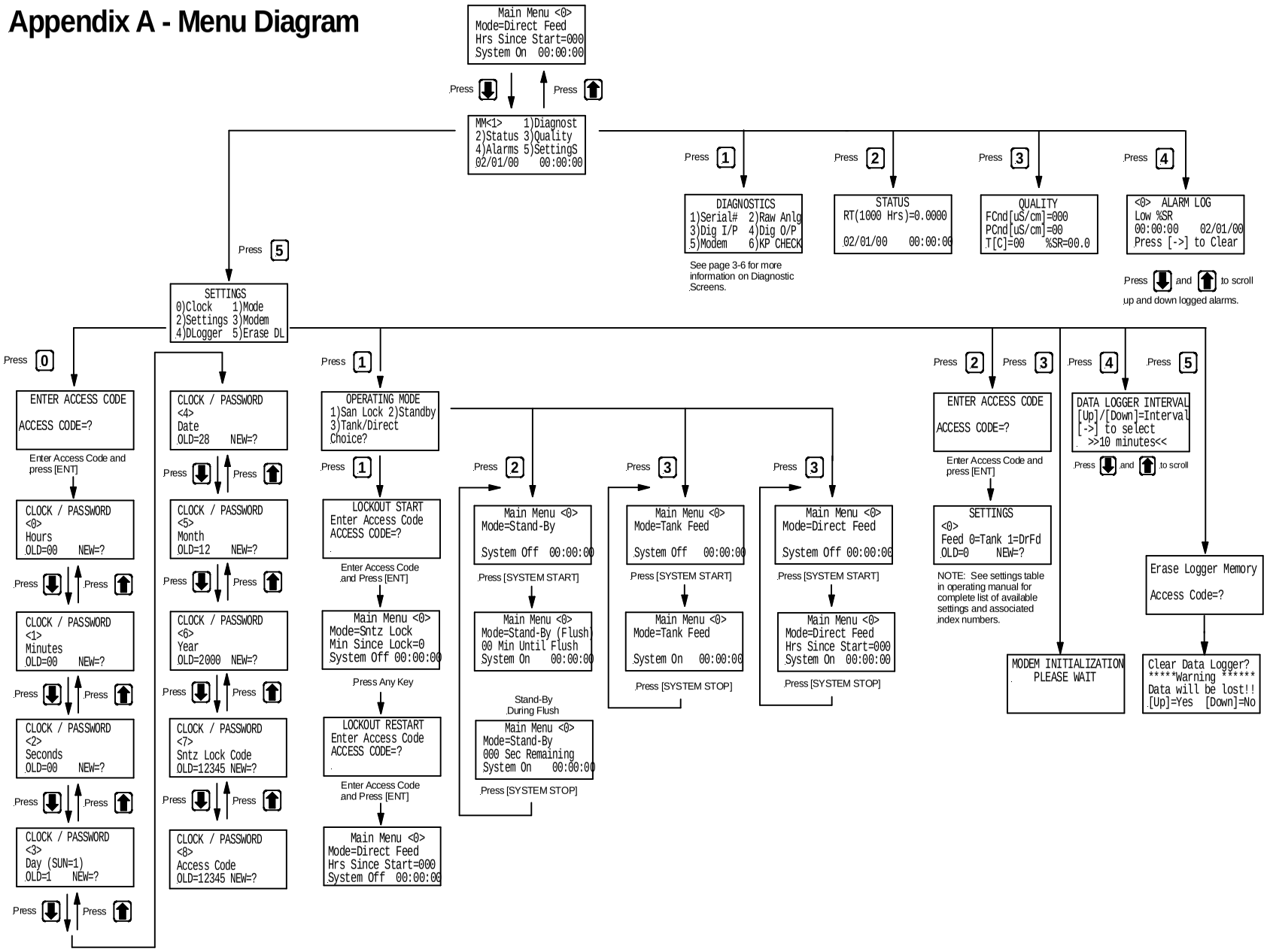
Troubleshooting

	Type of Problem		Possible Cause or Solution
1.	Motor draws too much current and trips magnetic starter.	1.	Motor overloaded, pump not rotating freely.
		2.	Bearing defective.
		3.	Power distribution not even, check voltages and current draw on each leg.
		4.	Check pin connectors.
		5.	Current imbalance (3-phase only)
		6.	Loss of power on 1 leg (3-phase only)
2.	Controller shuts down on low pressure, but pressure in line is okay.	1.	Check setting of pressure switch.
		2.	Check pressure switch wiring, must be wired normally closed.

	Type of Problem		Possible Cause or Solution
		3.	Defective switch, contacts can be corroded or diaphragm could be defective.
		4.	Make sure wiring from controller to pressure switch are shielded wires. Also route wire away from any AC lines or motor windings.
		5.	Inlet to pressure switch is obstructed.
3.	Motor starter trips repeatedly.	1.	Verify wiring to and from coil and controller.
		2.	Verify that the overload relay is set according to rating specified on motor nameplate.
		3.	Check the secondary voltage on the transformer (should be 24 VAC ± 2 volts).
4.	Controller display shows “System On” but system does not run.	1.	Verify wiring.
		2.	Check motor starter for overload.
		3.	Controller is in Tank Mode and tank is full.
		4.	Controller is in Stand-By Mode and system is between auto flush cycles.
5.	RO Controller shuts off, does not restart, and no alarm indication is present.	1.	Possible brown out, or power outage reset the controller to “System Off”.
6.	RO Controller shuts down on high temperature even though the temperature is below setpoint.	1.	Calibrate temperature sensor.
		2.	Check sensor wiring.

	Type of Problem		Possible Cause or Solution
9.	Conductivity monitor shows reading to be higher than known solution.	1.	Check calibration of each cell.
		2.	Sensor electrode not fully immersed.
		3.	Air bubbles in sensing area.
		4.	Fouled sensor.
		5.	Defective sensor wiring.
		6.	Relocate sensor.
		7.	Clean sensor electrode.
		8.	Check sensor wiring.
10.	Conductivity monitor does not respond to known solution.	1.	Calibrate sensors.
		2.	Check/replace sensors.
		3.	Check/replace leads to sensors.
11.	Conductivity monitor shows low reading for known conductivity changes.	1.	Sensor electrode obstructed.
		2.	Inadequate solution circulation.
		3.	Clean or relocate sensor.
12.	Conductivity reading is erratic.	1.	Faulty sensor.
		2.	Faulty sensor wiring.
		3.	Moisture in cables.

Appendix A - Menu Diagram

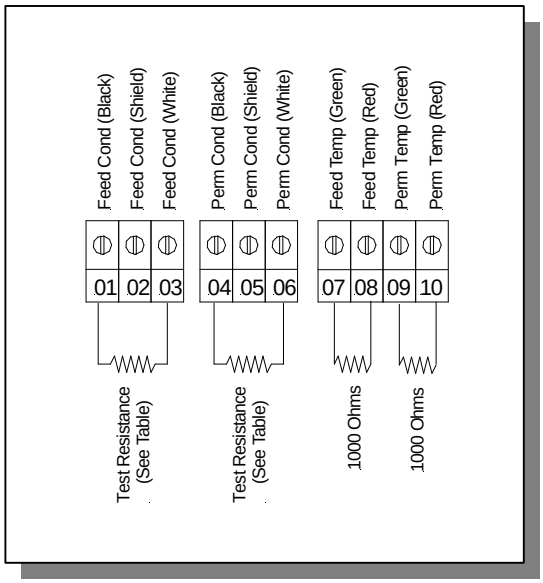


Appendix B - Technical Bulletins

Testing Conductivity Inputs

Problems with conductivity readings are generally a result of fouled sensors, bad temperature detectors in the sensor, or electrical interference. In order to verify the proper operation of conductivity inputs by isolating the sensors, it is possible to simulate inputs using resistors. To conduct this test, you will need the following:

- Two 1000 Ohm Resistors for Simulation of RTD Inputs
- Two Resistors for Conductivity Simulation per the Table Shown Below
- Small Screwdriver



Step 1 – Disconnect power to the controller and remove the conductivity sensor connections to terminals 01 through 10. Mark the conductivity sensor leads so they may be properly re-installed after the test is complete.

Step 2 – Install a 1000 Ohm resistor across terminals 07 and 08 and across terminals 09 and 10. This will simulate 0 degrees C on the temperature inputs.

Step 3 – Install resistors across the conductivity inputs (terminals 01 & 03 and 04 & 06). See the table below to determine the appropriate resistance to use.

Controller Range	Test Resistance	Temperature Resistance	Proper Displayed Temperature Value	Proper Displayed Conductivity Value
0-1000 uS (K=1.0)	1000 Ohms	1000 Ohms	0 Deg C	2000 uS
0-100 uS (K=1.0)	10,000 Ohms	1000 Ohms	0 Deg C	200 uS

Step 4 – Compare the displayed conductivity to that shown in the table to determine if the conductivity inputs are working properly. NOTE: It is common to have some variation due to calibration changes in the controller. If test values differ greatly from those in the table, check the calibration settings in the controller. If calibration changes do not produce the proper values as shown above, contact RODI Systems for further assistance. If the test values match those shown in the above table, check the sensor for fouling. Also check the sensor cable for damage.

Transient Surge Suppression

Since its introduction, a number of the MC10 units have been damaged by transient voltages. Units damaged by transient voltages may exhibit the following symptoms: Unit will not power-up, discrete inputs show ON and then OFF with no switch contact change, conductivity and/or temperature values bounce significantly or do not change at all, keypad buttons do not work, and unit displays odd alarms or error codes.

A transient voltage can be defined as any change in voltage, such as a spike, which is unexpected, undesirable, and often destructive. Transient voltages are less than 8.3 milli-seconds in duration and can range from a few milli-volts to 18,000 volts in a normal working environment. More destructive transient voltages can be generated by electrostatic discharges, inductive switching, motor commutation, nuclear electro-magnetic pulses, and lightning. The latter two sources generate voltage spikes into the millions of volts.[1]

Transient voltages are common through out the US, however they are more common in certain geographic areas and may be exacerbated by environmental aspects such as: multiple story buildings, building ground surface area larger than 38,000 ft.^{2}, and buildings located more than 2000 ft. from a utility substation. The MC10 has built in power conditioning equipment; however it will not suppress all transients.

A transient surge protector is a device which is typically used to protect electronic equipment from damage or destruction caused by transient voltages and surge currents. These destructive transients most often attack equipment through power input lines, signal input and output lines, data lines, and any other wire coming into or going out of a chassis containing electronics.[1]

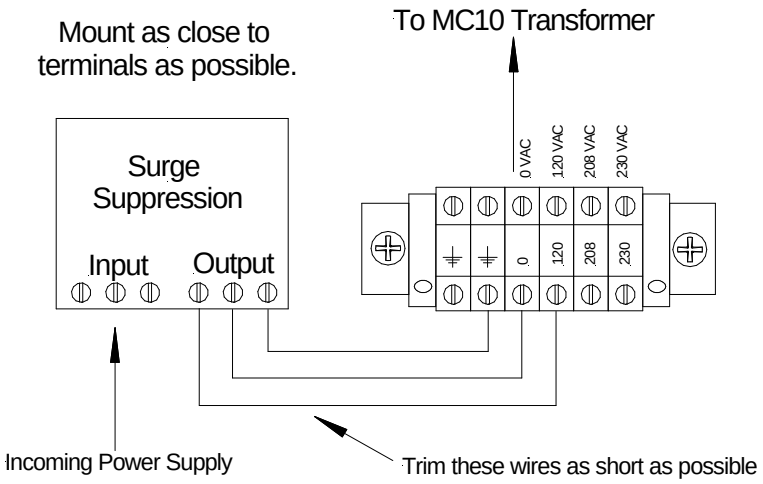
Many companies sell transient surge protection devices. A list of some of these companies is shown below. The list is provided for informational purposes only. No specific testing has been performed on these products and the performance of these products is not guaranteed to be effective when used with the MC10.

Surge Suppression Manufacturers

- Innovative Technology www.itvss.com
- EFI www.efinet.com
- APC www.apc.com
- Tripp-Lite www.tripplite.com
- Panamax www.panamax.com
- Transtector www.transtector.com
- Maxivolt www.maxivolt.com

The surge suppressor should be connected to the primary side of the MC10 transformer as close to the MC10 power terminal blocks as possible. The conductors between the surge suppressor and the MC10 terminal blocks should be kept as short as possible.

[1] Axiomatic Technologies Corporation



Discrete I/O Wiring

A quality transient surge suppressor limits the amplitude of transient over-voltages on the input power; however this does not eliminate the potential damage as a result of voltages that enter through the input and output wiring. The discrete inputs on the MC10 monitor dry contact switches rated for 24VAC. The inputs are sinking inputs meaning that the current travels from the MC10 through the switch contact and to the 24VAC neutral. DO NOT APPLY VOLTAGE TO THE MC10 INPUTS.

The use of surge suppressors may prevent damage due to transient surges and extend the life of the MC10. The use of a surge suppressor does not replace the need for a quality earth ground, a “clean” power supply, and good electrical wiring practices.