MICRO CONTROL SYSTEMS

5580 Enterprise Pkwy.
Fort Myers, FL 33905

Office: 239-694-0089
Fax: 239-694-0031

www.mcscontrols.com

MicroMag-12

Basic Getting Started Manual

MicroMag Firmware V18.00
MicroMag Hardware Rev. 7.0 and greater

The MicroMag is a rugged microprocessor
based controller designed for the hostile environment
of the HVAC/R industry.
It is designed to be the primary manager
of the package it is controlling.

MCS Total Solution for all your Control Needs

RoHS Compliant

Energy Efficient and RoHS Compliant

The MCS Commitment is to provide practical solutions for the industries
needs and to be both a leader and partner in the effective use of microprocessor controls.

Micro Control Systems, Inc.

5580 Enterprise Parkway
Fort Myers, Florida 33905
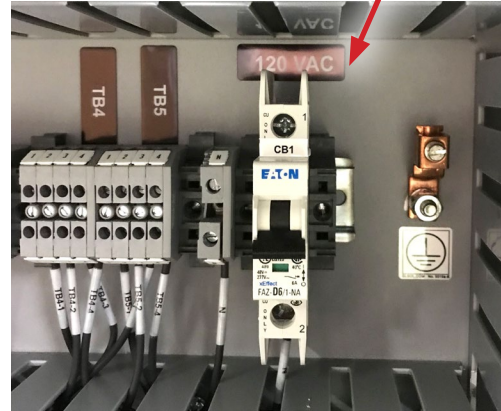PH:(239) 694-0089   FAX:(239) 694-0031
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Table of Contents

1.1. MICROMAG NEMA4 MOUNTED IN INDUSTIRAL CONTROL ENCLOSURER

MAIN CIRCUIT BREAKER
(inside cabinet)

Alarm Lamp:

The alarm lamp will be on when a unit lockout or compressor lockout has occurred:

Example of unit Lockout are Freeze Protect, Phase loss, Emergency stop

Examples of compressor lockout are Low Suction pressure, High Discharge Pressure, etc.

Unit Control Switch:

When in the stop position the MicroMag will perform a control shutdown of the unit.

When in the run position the MicroMag will control the unit to produce cool water.

Warning Lamp:

The warning lamp will be on when a compressor is in safety unloading/holding condition or compressor has trip on a safety but will be allowed to restart once safety delay time has expired.

Examples that turn on warning lamp, low suction unloading, high discharge unloading.

GROUND CONNECTIONS

- It is important to provide a good earth ground to the 120 VAC power input to the printed circuit boards.
- Do not jumper the ground connections to MCS boards. Each printed MCS board should have its ground wired <u>directly</u> to ground with a wire made as short as possible (12 AWG).

1.1.　Controller Installation Check

(Do after installing the controller)

- If any compressor is in Lockout, perform a Lockout Reset to clear.
- Relay Output Check - Once the microprocessor has been completely wired, a dry test of the wiring should be done. To accomplish this, use the following procedure:

  - Keep main power to compressors off. Keep high voltage breakers off or pull fuses to compressors.

  - Turn on the 12 VAC to the Micromag IPC but switching the main breaker to on position.

  - Turn on 120 VAC control power.

  - Get authorized on the MicroMag controller. (via the keypad or MCS-Connect.)

  - Put each Relay Output in 'MANUAL ON' and verify the appropriate contractor or solenoid turns on.

  - For Digital input make sure all sensor are in Auto and reading correctly. If possible cycle the actual digital input to make sure the reading on the micromag changes. Verify all Analog Sensors are within reasonable tolerances.

  - Remove the Packard connector from each pressure transducer. Verify the computer reads -99.9P on the correct sensor.

  - Calibrate pressure transducer offsets.

- For Analog output test each output by place the sensor in MANUAL and verify the device it is control acts correctly. Take care when place AO in Manual not to damage the unit.

- After testing all Outputs and Inputs, make sure all ROs, SIs and AOs are in 'AUTO' mode.

- If any compressor is in Lockout, perform a Lockout Reset to clear.

- All setpoints should be displayed on the MicroMag and reviewed for correctness. Specific attention should be paid to the following Setpoints:

  - Verify / set 'Full Load Amps'

  - Verify / set 'Target' (supply air / leaving liquid)

  - 'Low Suction, Freeze'

  - 'High Disc' based on water or air-cooled

  - 'Condenser' setpoints

- Once main power is ON verify the following:

  - All Relay Outputs are in 'AUTO' (Not 'Lockout')

  - Flow switch is 'ON' or 'YES'

  - RUN/STOP is in 'RUN'

  - When the compressor comes on, the LLS should open. (There may be a pre-pump out to eliminate liquid from reaching the compressor for direct expansion systems.)

  - Watch suction, discharge, amps etc. to verify the unit is running normally.

- Fine-tuning should now be done. (ROC, step delay, control zone, etc.)
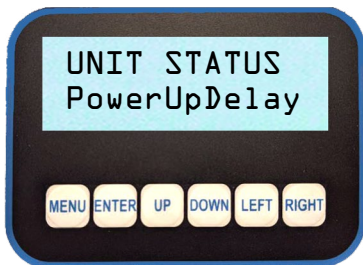
1. PowerUpDelay

This is a 60 second delay(setpoint #43 value) after power is applied to the unit. In this state all relay outputs are turned off. The power up delay is used to insure stable power before starting any compressors.
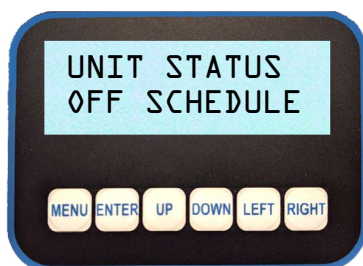
2. OFF SCHEDULE

The unit is off because to the operating schedule does not want the unit to run. In this state, all relays are turned off. The operating schedule can be viewed and adjusted in the Service Tool menu option.

3. OFF RUN/STOP

The unit is off because the Run/Stop switch is in the off position. In this state all relay outputs are turned off.
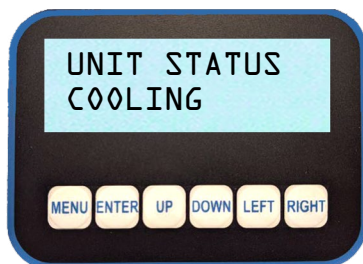
4. COOLING

The unit is in the cool mode and staging the compressors to maintain the controlling sensor within the control zone (Setpoint #8 defines the control zone).
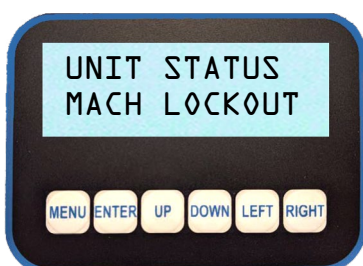
5. MACH LOCKOUT

This state is entered whenever a critical situation is encountered that could cause harm to the chiller. In this state, all Relay Outputs except the alarm are turned off and will read "LOCKOUT." Lockouts can be reset from the keypad or with the MCS-CONNECT program; however, if the lockout condition has not been corrected, the system will again be forced into this state.
Note - If the Lockout Reset is used more than 6 times in one day, the unit cannot be reset except with Factory authorization.
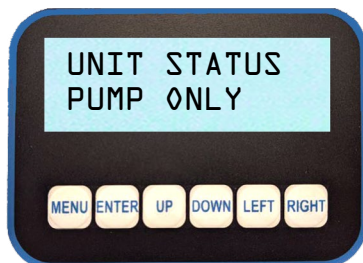
6. PUMP ONLY

This state is entered when all compressors have been shut down, either due to normal operating conditions or due to a lockout, and only the chilled water pump is running.

2.1. Authorized via the Keypad/LCD

Press **'Menu'** - Use **UP↑** to scroll to Password option
Press **'ENTER↵'** key.
Using '**UP↑, DOWN↓**', keys, to select/scroll number, press **Right key →** to move to next number
Press **'ENTER ↵'** key to accept.
The authorization level will be displayed if a valid pin number is entered.

**'Level Factory'
Authorization Accepted**

**'Invalid Pin'
Authorization Denied**
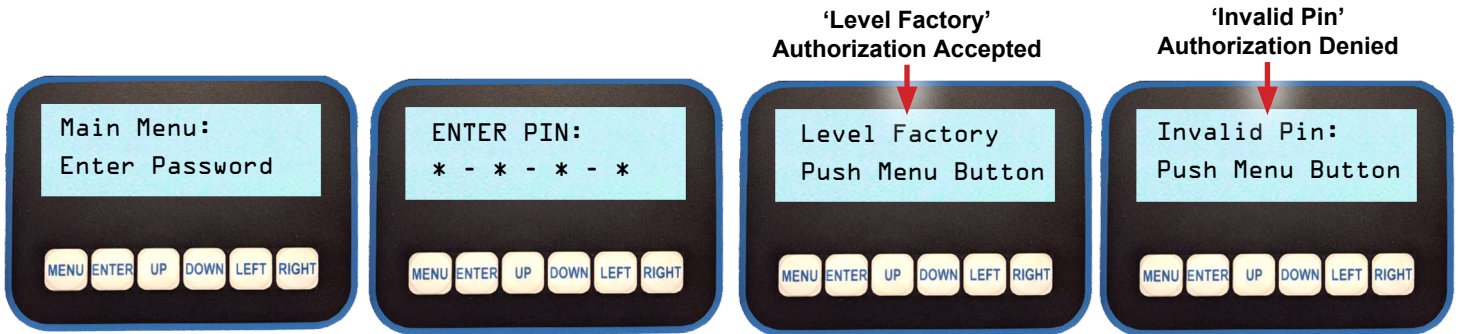
2.2. Authorized via MCS-CONNECT

1. Click on desired MicroMag in the Site Information screen.
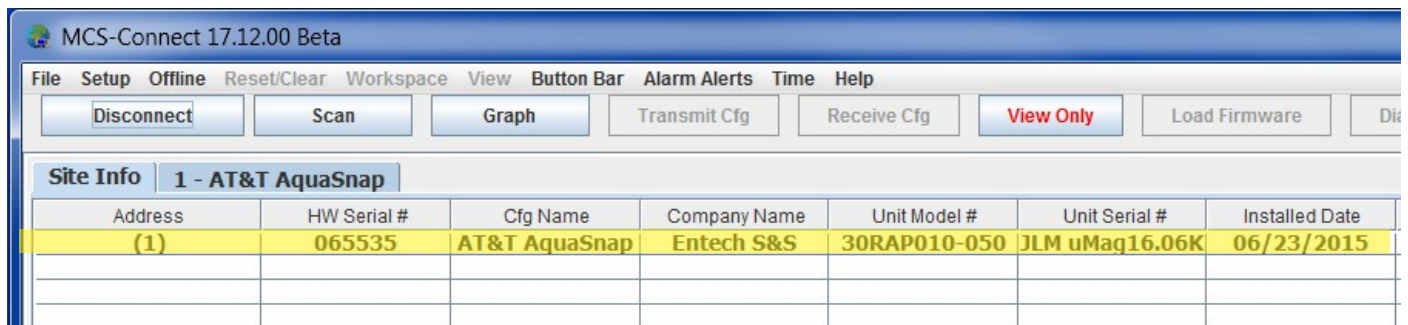
2. Click button 'VIEW ONLY" to get authorized to a higher level.
3. Enter the 4 digit password into the pop-up box and click ok (or press the enter key).
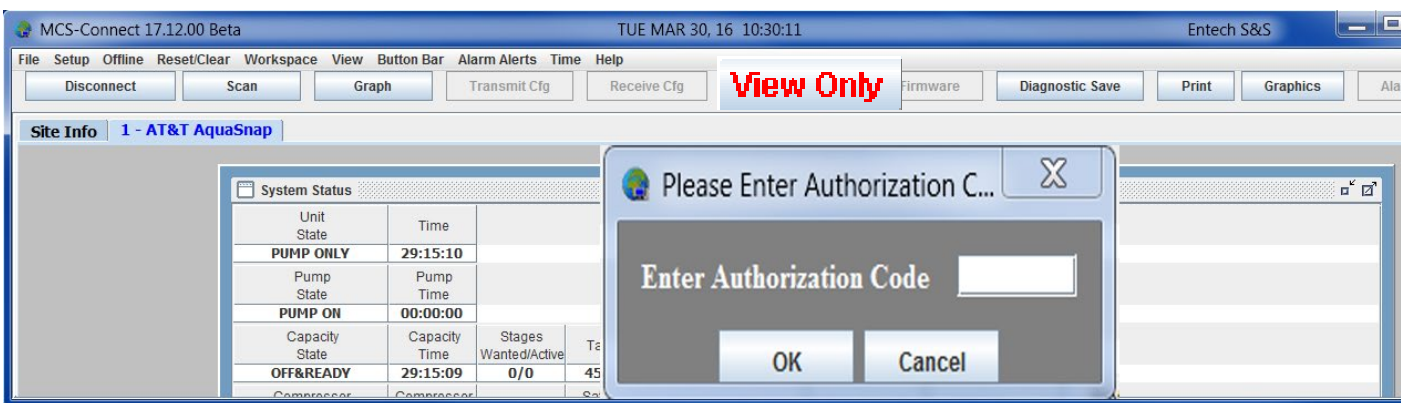
4. Depending on the authorization level, the button will change to one of the following displays, indicating if the password was accepted and what level.

View Only   User   Service   Factory   Supervisor   Admin

Chapter - 3.   AUTHORIZATION FUNCTION

The authorization code is a special four-character code that enables access to the MicroMag controller. The code may consist of any valid alpha/numeric characters if the system is being accessed through MCS-CONNECT, however, the code must be numeric with values between 0 and 9 if it is to be entered through the Keypad/Display. Each MicroMag can have up to 10 different authorization codes, with four levels of authorization which provide differing levels of functionality. The authorization code and the associated level cannot be viewed or changed through the Keypad/Display or MCS-CONNECT, but only when the configuration file is opened in MCS-Config. The authorization codes should be protected and remain confidential, or unauthorized personnel may gain access to the system and perhaps cause irreparable damage.

Based upon the authorization level the following changes can be made through the Keypad/Display:

FUNCTION	VIEW	USER	SERVICE	SUPERVISOR	FACTORY	ADMIN
Sensor offsets	NO	NO	NO	YES	YES	YES
Clear alarm history	NO	NO	NO	NO	NO	YES
Clear point information	NO	NO	NO	NO	NO	YES
Date and time set	NO	NO	YES	YES	YES	YES
Day of week set	NO	NO	YES	YES	YES	YES
Change rotate SP 37 & 38	NO	NO	YES	YES	YES	YES
Change Manual/Auto settings	NO	NO	NO	YES	YES	YES
Change Setpoint values	*	*	*	*	YES	YES
Change operating schedules	NO	YES	YES	YES	YES	YES
Change holiday dates	NO	YES	YES	YES	YES	YES
Lockout Reset	**	**	**	**	YES	YES
Change RS485 network settings	NO	NO	NO	YES	YES	YES
Change Ethernet network settings	NO	YES	YES	YES	YES	YES
Transmit Software	NO	YES	YES	YES	YES	YES
Transmit/Receive Configuration	NO	NO	YES	YES	YES	YES

* Setpoints may have individual authorization levels; you must have the proper authorization to view or edit them.

**See the Setup screen of the configuration for authorization level(s) that are allowed unlimited resets per day.
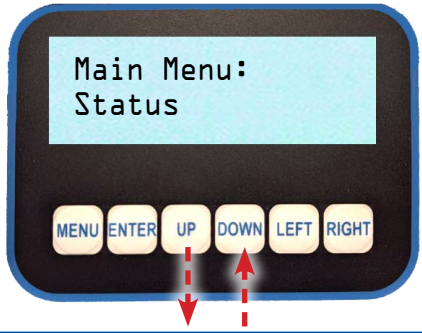
Authorization passwords with level below 'Auth Level Bypass' are allowed only a limited number of resets. Authorization passwords with level at and above 'Auth Level Bypass' are allowed unlimited lockout resets.

Max Lockout Resets per Day	6 ▾
Auth Level Bypass	Supervisor Level ▾

# MicroMag Keypad (Display from MicroMag-Nema4)

Main Menu: Status

Main Menu Status

'DOWN⬇ or UP ⬆' buttons moves thru the MENU

- Outputs - RO's, AO's, Inputs - SI's, Service Tools, Setpoints,
- Alarms /Events. Lockouts -Clear, Enter Password

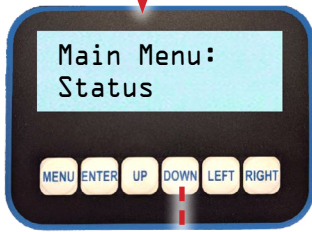**'MENU'** button moves back to Main Menu Status display

NOTE: LCD display can be setup in your configuration file to scroll the status of your controller continuously.

Main Menu: Status

Main Menu: Cooling

CAP:LOADING AZ ChuOut-TT5 50.0F
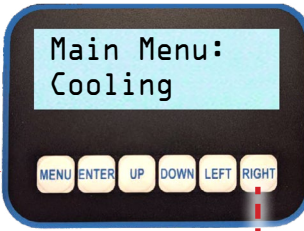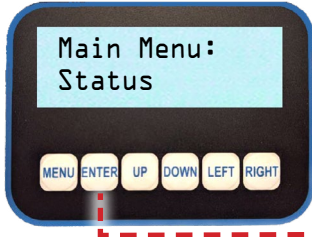
'ENTER ↵' button moves to the Status Section

'RIGHT or LEFT' button moves within that section

'MENU' button moves back to Main Menu Status display

Main Menu: Status

'DOWN⬇' button moves to the next Menu display

Main Menu Outputs - RO

M-1: SpareM-1 RO Status: OFF

'ENTER ↵' button moves to the first RO

'RIGHT or LEFT' button moves within that section

'MENU' button moves back to Main Menu Status display

Main Menu: Status

'DOWN⬇' button moves to the next Menu display

Main Menu Outputs - AO

M-1: Spare M-1 AO Value: 0.0%

'ENTER ↵' button moves to the first AO

'RIGHT ➔ or LEFT ←' button moves within that section

'MENU' button moves back to Main Menu Status display

MicroMag Keypad (Display from MicroMag-Nema4)

Main Menu:
Status

`MENU` `ENTER` `UP` `DOWN` `LEFT` `RIGHT`

'DOWN⬇' button moves to the next Menu display

Main Menu
Outputs - SI

`MENU` `ENTER` `UP` `DOWN` `LEFT` `RIGHT`

M-1: Spare M-1
SI Value: 0 M

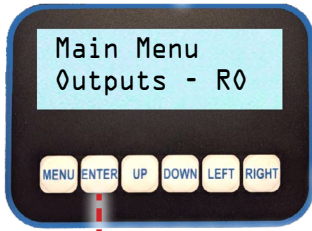`MENU` `ENTER` `UP` `DOWN` `LEFT` `RIGHT`

'ENTER ↵' button moves to the first SI

'RIGHT → or LEFT ←' button moves within that section

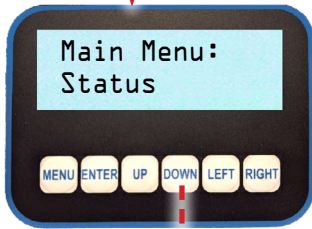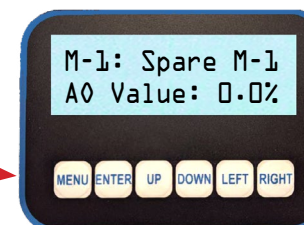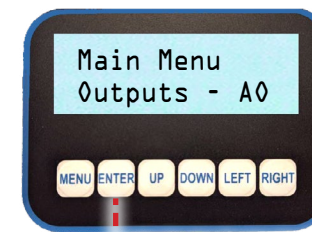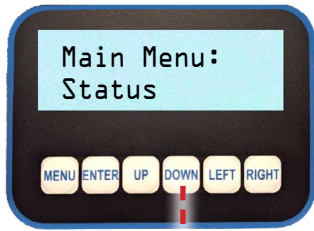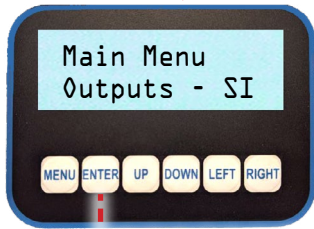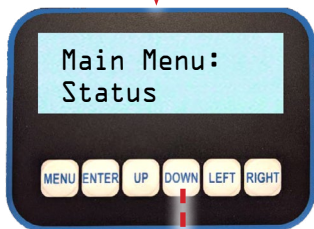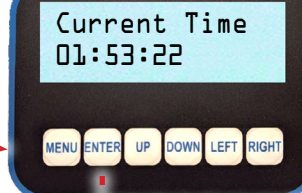**'MENU'** button moves back to Main Menu Status display

Main Menu:
Status

`MENU` `ENTER` `UP` `DOWN` `LEFT` `RIGHT`

'DOWN⬇' button moves to the next Menu display

Main Menu
Service Tools

`MENU` `ENTER` `UP` `DOWN` `LEFT` `RIGHT`

Service Menu:
Current Time

`MENU` `ENTER` `UP` `DOWN` `LEFT` `RIGHT`

Current Time
01:53:22

`MENU` `ENTER` `UP` `DOWN` `LEFT` `RIGHT`

Adjust Time
01:55:22

`MENU` `ENTER` `UP` `DOWN` `LEFT` `RIGHT`
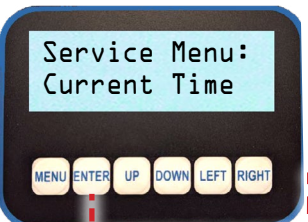
'ENTER ↵' button moves to the first Service Menu display

Press **'ENTER ↵'** button moves to show **'Current Time'**

Press **'ENTER ↵'** button, shows **'Adjust Time'** If authorized, use UP, DOWN, LEFT, RIGHT buttons to move thru display to change

Change Made
Press Any Button

`MENU` `ENTER` `UP` `DOWN` `LEFT` `RIGHT`
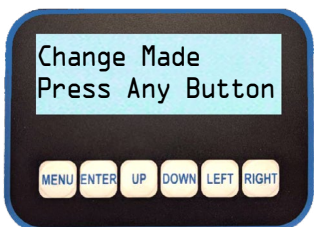
Press any button to save changes

SERVICE TOOLS DISPLAYS THAT CAN BE CHANGED IF AUTHORIZED:

1. Current Time and Date
2. Clear Alarms
3. Change Contrast
4. Change RS485 Address
5. Change RS485 Baud Rate
6. Change RS485 Protocol

7. Change BacNet ID
8. Reset BMS Ram
9. Run/Stop Default
10. Occupied Default
11. Clear Point Info
12. Clear Opp Schedule

13. Change Holidays
14. View System Info

VIEWING ALARMS AND EVENTS

Main Menu:
Status

MENU ENTER UP DOWN LEFT RIGHT

'DOWN⬇' button moves to the next Menu display

Main Menu
Alarms /Events

MENU ENTER UP DOWN LEFT RIGHT

1 High Amps 1
06-17   06;18;52

MENU ENTER UP DOWN LEFT RIGHT

2 LOCKOUT RESET
06-17   06;18;55

MENU ENTER UP DOWN LEFT RIGHT

'ENTER ↵' button moves to the first Alarm
'DOWN⬇' button moves thru Alarms

LOCKOUT - CLEAR

Main Menu:
Status

MENU ENTER UP DOWN LEFT RIGHT

'DOWN⬇' button moves to the next Menu display

Main Menu
Lockouts-Clear

MENU ENTER UP DOWN LEFT RIGHT

Lockouts Cleared
Press Any Button

MENU ENTER UP DOWN LEFT RIGHT

'ENTER ↵' button shows 'Lockouts Cleared - Press Any Button
'DOWN⬇' button moves thru Alarms

⚠ IMPORTANT **Lockout Reset requires Factory Level Authorization or higher**

Max Lockout Resets per day - 6

Authorization levels below 'Auth Level Bypass' are allowed only a limited number of resets.

Authorization levels at and above 'Auth Level Bypass' are allowed unlimited lockout resets.
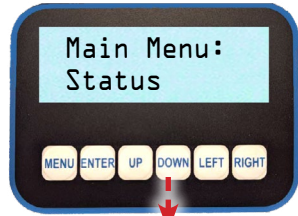
CHANGES TO A SETPOINT
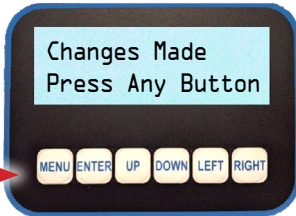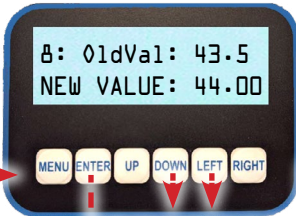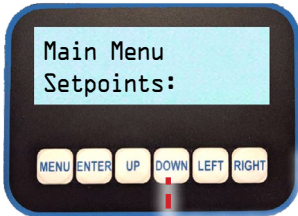
You must be authorized to make changes to setpoints

```
Higher Auth Req.
Press Any Key
```
MENU ENTER UP DOWN LEFT RIGHT

This screen will display if higher authorization is required

```
Main Menu:
Status
```
MENU ENTER UP DOWN LEFT RIGHT

'DOWN⬇' button moves to the next Menu display

SETPOINT - CHANGING TARGET VALUE

```
Main Menu
Setpoints:
```
MENU ENTER UP DOWN LEFT RIGHT

Press **'DOWN'** button for first setpoint

```
8:ChwOut TRGT
SPTT VAL: 43.5F
```
MENU ENTER UP DOWN LEFT RIGHT

Press **'ENTER'** to change setpoint

```
8: OldVal: 43.5
NEW VALUE: 44.00
```
MENU ENTER UP DOWN LEFT RIGHT

Use **'UP'** or **'DOWN'** to change value to setpoint, Press 'ENTER' button to accept value

```
Changes Made
Press Any Button
```
MENU ENTER UP DOWN LEFT RIGHT

Press **ANY BUTTON**

```
Main Menu
Setpoints:
```
MENU ENTER UP DOWN LEFT RIGHT

'DOWN⬇' button moves to the next Setpoint

SETPOINT - CHANGING ZONE VALUE

Zone: Deadband around target temp.

```
8:ChwOut TRGT
SPTT VAL: 43.5F
```
MENU ENTER UP DOWN LEFT RIGHT
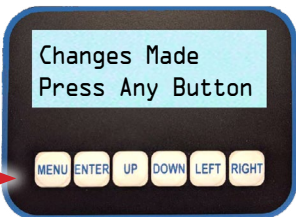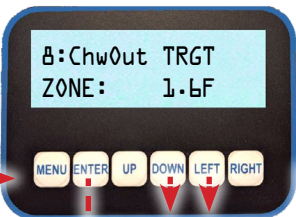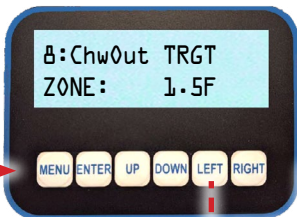
Press **'DOWN'** button for first setpoint, Press **'LEFT'** button to move to the ZONE setting

```
8:ChwOut TRGT
ZONE:    1.5F
```
MENU ENTER UP DOWN LEFT RIGHT

Display shows value set for the target ZONE

```
8:ChwOut TRGT
ZONE:    1.6F
```
MENU ENTER UP DOWN LEFT RIGHT

Use 'UP' or 'DOWN' buttons to change ZONE value for target

```
Changes Made
Press Any Button
```
MENU ENTER UP DOWN LEFT RIGHT

Press **ANY BUTTON** to accept value, New Value is accepted if authorized

Pressing **'LEFT or RIGHT'** buttons will move thru adjustments for this setpoint

---

```
Main Menu
Setpoints:
```
MENU ENTER UP DOWN LEFT RIGHT

'DOWN⬇' button moves to the next Setpoint
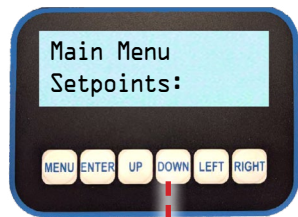
SETPOINT - CHANGING DELAY

Value: Delay before adjustment is made in seconds for cooling capacity control.

```
9:ChwStepDelay
SPTT VAL: 180s
```
MENU ENTER UP DOWN LEFT RIGHT
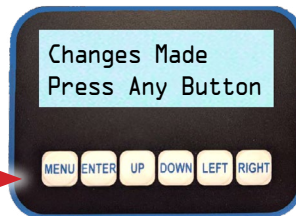
Press **'DOWN'** button for next setpoint, Press **'ENTER'** button to change value

```
9:OldVal:  180
NEW VALUE: 185
```
MENU ENTER UP DOWN LEFT RIGHT

Display shows value set for the STEP DELAY, Use **'UP'** or **'DOWN'** buttons to change the value

```
Changes Made
Press Any Button
```
MENU ENTER UP DOWN LEFT RIGHT

Press **'ENTER' button** to accept value, New Value is accepted if authorized

Pressing **'LEFT or RIGHT'** buttons will move thru adjustments for this setpoint

MCS MicroMag

Chapter - 4.   MCS-CONNECT

MCS-CONNECT software is part of the MCS Support System. Its purpose is to provide both local and re-mote communication for MCS micro controllers either by themselves, or as part of a network.

MCS-CONNECT supports the following controllers:

• MicroMag controller

• MCS-MAGNUM controller

MCS-CONNECT permits the user to monitor the status of the micro controller in real time and, with proper authori-zation, changes can be made to the system. In as fast as 10 seconds, configuration files can be transmitted to, or received from an MCS micro controller.

Another powerful feature of MCS-CONNECT is its ability to graph event history. Since MCS controllers auto-matically perform history logging, the user can select which inputs or outputs to graph and view the results either in real time, or over a user selectable period of time.

MCS-CONNECT supports the SAVE of history data in the GRAPH function as a *.txt file. This allows the user to bring the data up in MCS-CONNECT off line, or in a spreadsheet program such as Microsoft Excel.
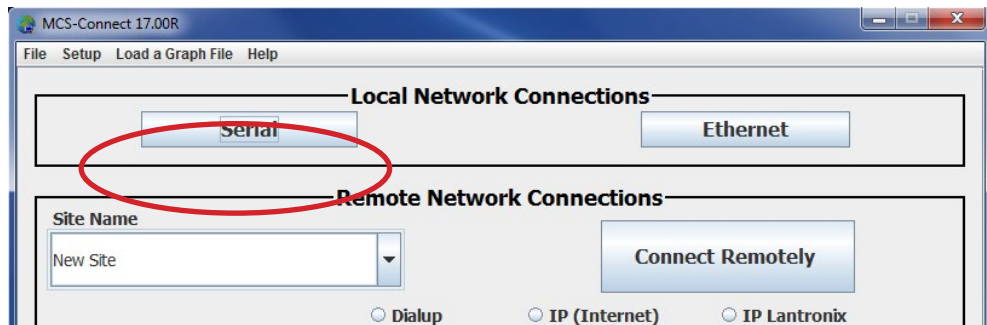
Updates for MCS-CONNECT can be downloaded directly from the MCS website under "Support", PC Software.

The program is available as Microsoft Windows based software or as Linux based software.

You can find complete installation and setup for MCS-CONNECT in the manual located on the MCS website.

4.1.   Scan for Controller

Once connected, click on the MCS-CONNECT program to open. If you are connected using the MCS-485-USB cable use the serial button to scan for the controller.

Next screen shows MCS-CONNECT scan for controller. Click anywhere in the row to open your controller.

MicroMag Rev. 1.0   13

Next screen shows 'Status screen" for the controller.

Standard Features

- Two lines by 16 characters LED-backlit display with a 6-button navigation menu
  - Displays current unit status and lockout alarms
  - Displays full range of sensor inputs, relay outputs, and setpoints
  - Suction / discharge pressure and superheat monitoring
  - Monitors compressor runtime and cycles per day
- Data logging capabilities, setpoint changes, and sensor calibration
- Alarm history of previous 99 alarms and events
- Capable of extracting data from the last 90 minutes of runtime
- Password authorization for setpoint changes
- NEMA4 gasket seal for extreme weather protection

Note

Changes, modifications,
and alarm resets require a
password to be entered first

The MicroMag is available as 12vdc system supported by a MCS-RO-Base, MCS-RO-Ext, MCS-SI-Base, MCS-SI-Ext expansion boards The system can support the following:

- Triac Output for a Digital Scroll
- Up to 26 Relay Outputs fused at 5 Amps
- up to 42 Sensor Inputs either Analog or Digital
- Up to 12 Analog Outputs (0/10 VDC or 10/0 VDC)

6.1.   MicroMag - Hardware Rev. 7.0 and greater- Firmware V18.00 and up
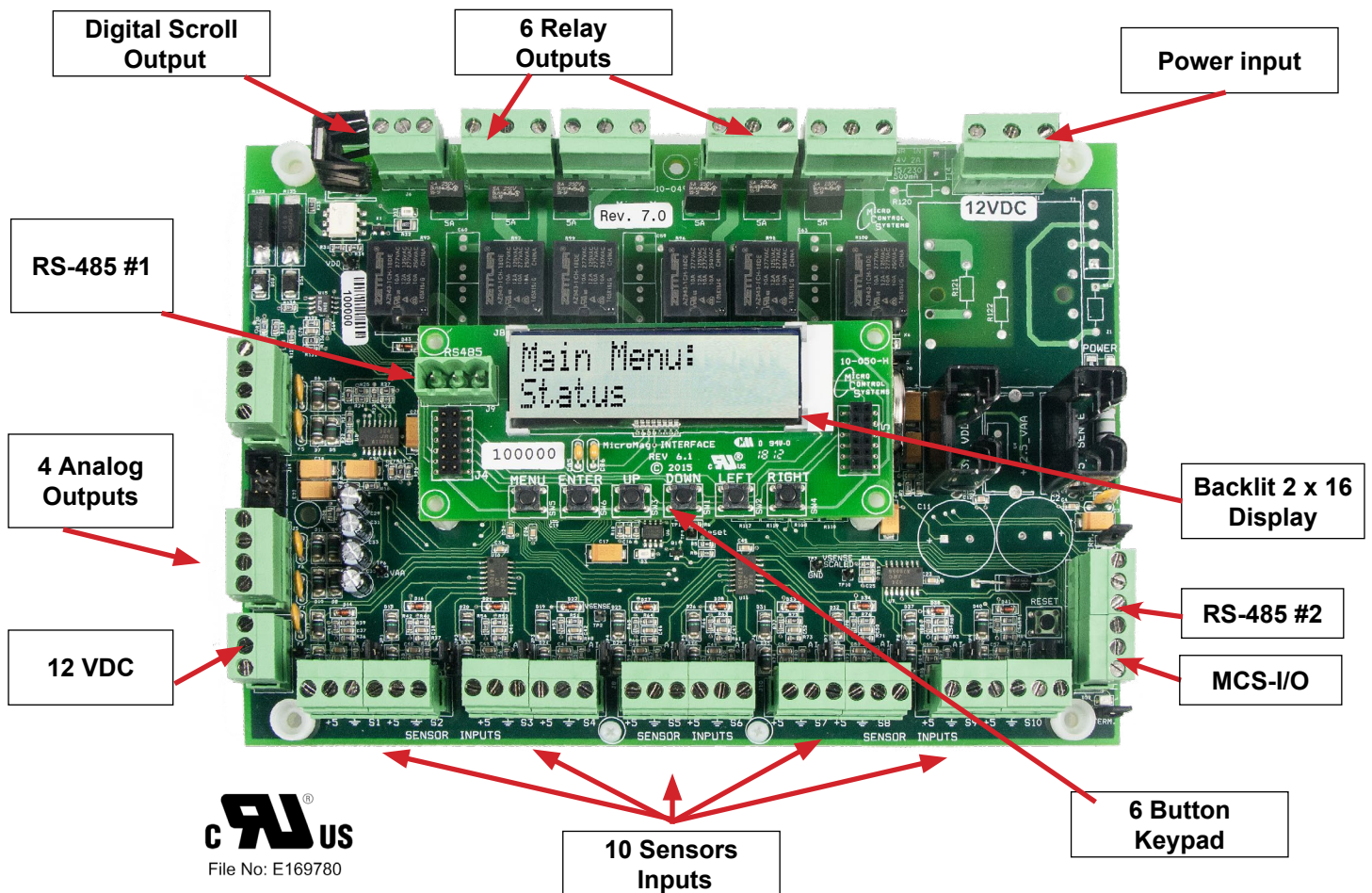
- Four Layer Printed Circuit Board with Power & Ground Plane for Noise Protection
- Six Relay Outputs, Fused @ 5 amps, Common & Normally Open Terminals Provided
- Ten Sensor Inputs (Analog or Digital) +5 VDC Power, Polyfuse Protected
- Four Analog Outputs provided, 0 to 10 VDC or 10 to 0 VDC, Polyfuse Protected
- +12 VDC provided for sensors where required, Polyfuse Protected
- Two RS-485 ports for BACnet MS/TP or Modbus RTU built in Communications
- MCS-I/O communications port to communicate to other I/O boards on this system
- A built in Boot Loader that allows MCS-CONNECT to load Firmware and Config's
- Program Flash = 512K, Aux Flash = 24K, Ram = 52K, DMA Ram = 4K, E² = 64K

6.2. MicroMag without Cover

Hardware Rev.7.0 & greater- 12vdc

8.50"l, 6.00"w, 2.10"h

Operating Temp.   ....-4°F to +158°F (-20°C to +70°C)
Sensor Inputs (SI)...........10 inputs 0-5vdc (10-bit A/D)
Relay Outputs (RO) ....6 outputs 5. 0amps @ 24 vac
Analog Outputs (AO) ......4 outputs 0-10vdc
MCS-I/O Comm Port.......1 @ 38,400 baud
RS-485 Comm Port ....2 @ 19,200 to 115,200 baud
Real Time Clock..............Battery backed
Input power.....................12vdc
Power Detection ....Automatic power fail reset
Keypad/LCD Display.......2 x 16 Backlit on I²C Bus
Keypad Layout...............6 keys (Menu, Enter, 4 direction)
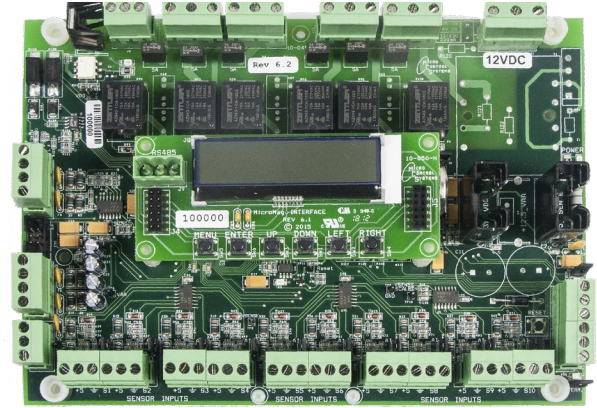
6.3. MicroMag with Cover

Comes with a Cover as shown in the photo on right. The cover is designed to mount on front of the circuit board or it can be mounted on the faceplate of your enclosure as shown below.

The LCD/Keypad is now REVERSIBLE
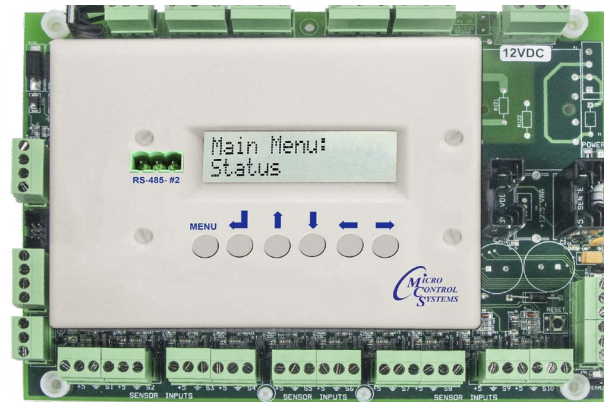
6.4. MicroMag-12-Nema 4

The MicroMag-12-NEMA4 is suitable for installation, both indoor and outdoor. Utilizing a gasket for an environment seal provides the unit with a NEMA 4 rating if installed in a NEMA4 enclosure.

7.1.   MCS-SI-BASE

The MCS-SI-BASE provides a flexible and cost effective way to allow sensor input and analog output expansion for the MicroMag. Each MCS-SI-BASE has a stand-alone microprocessor which communicates with the MicroMag over the MCS-I/O port at 38,400 baud. Because communication is over a RS-485 long distance two-wire differential network transmission system, the MCS-SI-BASE may be located up to 5,000 feet away. The MCS-SI-BASE board is powered by a 12VDC regulated power supply and has a automatic power fail reset system.
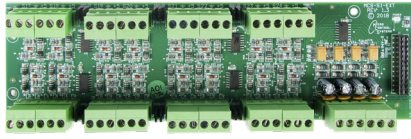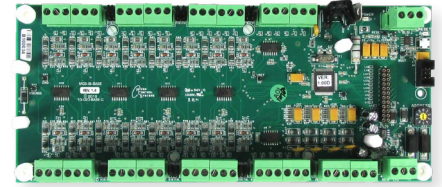
MCS-SI-EXT (Optional if installed)

MCS-SI-EXT can be paired with a MCS-SI-BASE to double the number of inputs and outputs. MCS-SI-EXT board is powered by the MCS-SI-BASE board once it is stacked on top.
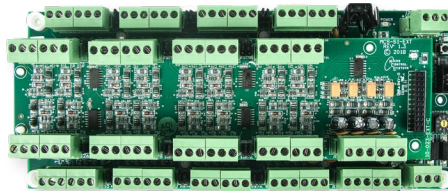
MCS-SI-EXT mounted to MCS-SI-BASE

7.2.   MCS-RO-BASE

The MCS-RO-BASE allows relay output expansion for the MicroMag. Each MCS-RO-BASE has a stand-alone microprocessor which communicates with a Micro-Mag over the MCS-I/O port at 38,400 baud. The MCS-RO-BASE board is powered by a 12VDC regulated power supply.
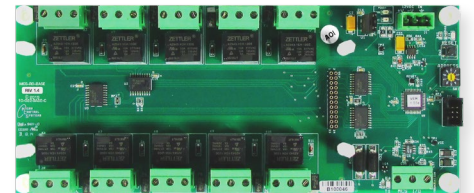
MCS-RO-EXT (Optional if installed)

MCS-RO-EXT can be paired with a MCS-RO-BASE to double the number of inputs and outputs. MCS-SI-EXT board is powered by the MCS-RO-BASE board once it is stacked on top
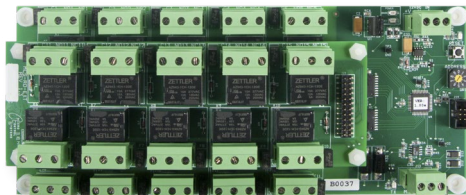
MCS-RO-EXT mounted to MCS-RO-BASE

RoHS Compliant

cULus
File No: E169780

7.3. MCS-IO-BASE ((Optional if installed)

The MCS-IO-BASE can provide sixteen extra sensors inputs, 10 relay outputs and four additional analog outputs that provide independent DC voltage outputs from 0 to 10vdc. These analog outputs are controlled by the Micromag.
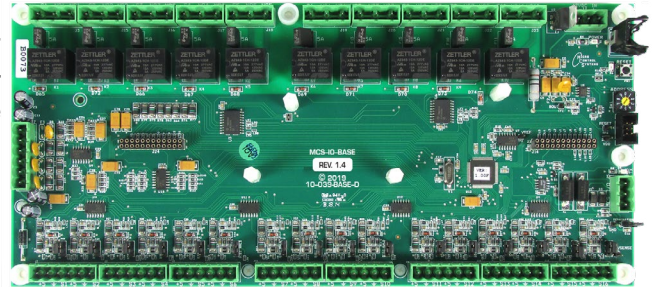
MCS-IO-EXT (Optional if installed)
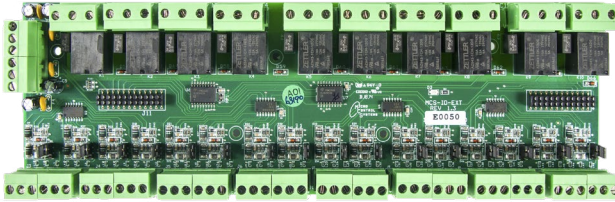
The MCS-IO-BASE allows one optional MCS-IO-EXT board to be stacked on top by using a board stacker header. Doing so will expand the number of sensors from 16 to 32, the number of analog outputs from 4 to 8, and the number of relays from 10 to 20 allowing twice the number of sensors, analog outputs, and relay outputs in the same footprint of one MCS-IO-BASE.
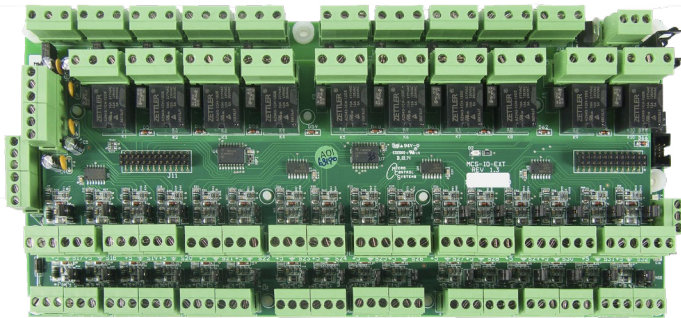
MCS-IO-EXT mounted to
MCS-IO-BASE

File No: E169780

8.1.   MicroMag's using MCS-CONNECT - MCS-USB-RS485

- Using MCS-USB-RS485 cable, connect Laptop to either RS-485 terminal #1 or #2 as shown.

- Open MCS-CONNECT, click on Serial and scan for MicroMag(s).

Site Info	1 - 2COMP/2CKT								
Address	HW Serial #	Cfg Name	Company Name	Unit Model #	Unit Serial #	Installed Date	Cfg Vers	Firmware Vers	Cfg Date
(1)	065535	2COMP/2CKT	SKM,SHARJ...	APMR-6201...	AS0000149-...	07/19/2020	18	SKM 18.00Oe	06/04/2021

- Select tab for a unit to see details of that MicroMag

MicroMag   Laptop

Can connect to terminal #1 or #2

MCS-USB-RS485
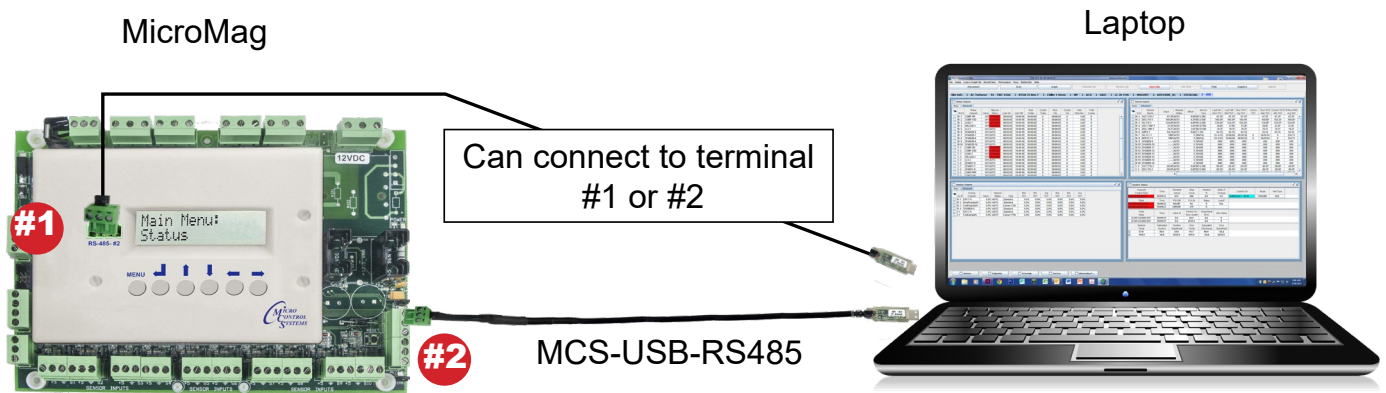
8.2. Multiple MicroMag's using MCS-CONNECT - RS485 and MCS-Touchscreen

- Uses MicroMag RS-485 #2 communications terminal
- Two wire shielded cable wired in straight line (NO STAR)
- Open MCS-CONNECT, click on Serial and scan for MicroMag(s)
- Select tab of MicroMag you want to view.

MicroMag

RS-485 Connection

#2

MCS Touchscreen

32 MicroMag's is Maximum

8.3.   Multiple MicroMag's, over Internet using MCS-Connect & MCS-ETHERNET-RS485

- MCS-Connect maximum is 32 MicroMag's

- Uses MicroMag RS-485 #2 communications terminal

- Two wire shielded cable wired in straight line (NO STAR)

- At either end of RS-485 network install MCS-ETHERNET-RS485 to convert to Ethernet

- Connect to MCS-Ethernet-RS485 using MCS-Connect via IP Address

- Select the tab of MicroMag you want to view

- Select tab for a unit to see details of that MicroMag

MCS-ETHERNET-RS485

- The MicroMag RS-485 port can be used to connect to the Internet using a MCS-ETHERNET-RS485 and internet static IP address

Chapter - 9.   MicroMag Chiller Modes Of Operations

The MicroMag Chiller firmware allows support of the following HVAC modes of operations:

Mode	Description
Cooling	Stages capacity up/down to maintain target temperature.
Off	The unit will be off if run/stop sensor input is in stop.

9.1.   MicroMag Scheduling

The MicroMag software consists of the following scheduling capabilities:

Schedule Type	Description
Weekly	Two (2) Start/Stop schedules per day
Holidays	Scheduling for 8 holidays with two (2) Start/Stops

9.2.   MicroMag Proof of Flow

The MicroMag firmware support of the Proof of Flow:(Hardwired to sensor input)

Options	Description
Proof of Flow switch	Should use an isolation relay on the flow switch., optional part to order or provided by others, uses 5 vdc from MicroMag

9.3.   MicroMag Warning Notification

The MicroMag firmware supports both Warnings and Alarms. There are adjustable set points for all functions. If the circuit trips it goes into a safety the first time. If it fails twice on the same circuit and the same failure within 2 hours the circuit locks out. A manual Lockout/Clear is required. Alarms are posted in the Alarm List.

- The last 100 Warnings/Alarms are available to view via the 2 x 16 MicroMag display.
- Alarms can be viewed via MCS-Connect on a Laptop or Touchscreen.
- An Alarm relay out is a hardwired option.

Options	Description
Warnings	Warnings are potential failures in which the MicroMag is taking corrective action - Low Suction PSI (Requires Suction Pressure Transducer) - Hi Discharge PSI (Requires Suction Pressure Transducer) - Low suction Temp (Requires Suction Temp Sensor per circuit) - Hi Discharge Temp (Requires Discharge Temp sensor per circuit) - Low Amp/No Start (Requires amp sensor per circuit) - Information Sensor failures

9.4. MicroMag Alarm Notification

Options	Description

Alarms	• **Unsafe suction (Requires Suction Pressure Transducer)**
	• **All critical Sensor failures required for control.**
	• **Information Sensor failures**
	• **The 2nd time the following failures occur within 2 hours (User settable):**
	    o **Low Suction PSI (Requires Suction Pressure Transducer)**
	    o **Hi Discharge PSI (Requires Suction Pressure Transducer)**
	    o **Low suction Temp (Requires Suction Temp Sensor per circuit)**
	    o **Hi Discharge Temp (Requires Discharge Temp sensor per circuit)**
	    o **Low Amp/No Start (Requires amp sensor per circuit)**

9.5. MicroMag Lockout Alarm Information

The MicroMag firmware supports two options for capacity control staging:

Options	Description
Lockout Alarm	**The last four safety/lockout alarms have additional runtime data saved. The runtime data saved is the value of every input/output/state point for the last 30 second prior to the safety/lockout.**

9.6. MicroMag Chiller - Control On

The MicroMag firmware supports two capacity control stating:

Options	Description
Entering Temperature	**Hardwired input temperature sensor**
Leaving Temperature	**Hardwired input temperature sensor**

9.7. MicroMag Data Trending

The MicroMag firmware supports the storage of ALL INPUTS & OUTPUTS for trending both Static and Dynamic.

Options	Description
Static Trending	**The MicroMag supports Static Trending as follows:** • **The most current 300 samples** • **Selective sample time. (At Config time or real time via MCS-Connect** • **Use MCS-Connect to retrieve the Static Trending date and plot in graph format.**
Dynamic Trending	**With MCS-Connect you can select Dynamic graphing. (Sec. by Sec.)**

9.8. MicroMag Compressor Types

The MicroMag firmware supports the following:

Options	Description
Compressors	• **Up to 6 Compressors, compressor types supported:** • **Fixed Scroll.** • **Digital Scroll,** • **VFD Scroll,** • **Multi-Stage Comp with Up to 4 stages per compressor for Loaders or Unloaders** • **Anti-Cycle. set points, OFF to ON and ON to ON are provided. (On to ON regulates the maximum number of starts per hour the compressor can have)** • **Cooling is enabled when the Chilled Water temperature rises above the set point plus the control zone.** • **Additional digital scrolls can be controlled by adding an MCS-DIGITAL-SCROLL-INTERFACE for each Digital Scroll controlled via an Analog Output from the MicroMag.**

10.1. Power Up

If the unit is not in a Lockout condition, it will start in the Power Up stage. After completing this stage the water pump will be started. Once the water pump starts, no other functions can be initialized until water flow has been established and the minimum supply startup time,60 seconds has elapsed.

10.2. Operational Modes

Cooling mode is selected at configuration time.

The following are ways to initiate the Occupied Mode of operation for the MicroMag Controller:

- Internal week schedule
- Push button Override on a Zone Temperature Sensor(MCS-Thermostat)
- Remote Forced Occupied contact closure
- BMS written Forced Occupied

10.2.1   UNOCCUPIED OPERATION

Night Setback values are used for Cooling.

10.2.2   SCHEDULING

Has an internal clock that provides 7 days and 1 holiday scheduling with 2 start/stops per day.

Allows scheduling of up to 8 holiday periods per year.

Cooling: is initialized after unit water flow has been established. The cooling pre-delay time is specified and must be satisfied before continuing.

Off: The unit mode will be off when the unit RUN/STOP indicates a stop.

10.2.3   Cooling Mode

When the temperature enable sensor rises above the cooling set point the cooling status will be enabled. The configuration may allow a delay before the cooling output is energized. Cooling will continue to run provided the safeties of the cooling Set Points are satisfied and the temperature enable set point has not been achieved. Note: If the Mode Enable and the Cooling Target sensor are both being used the Cooling Target set point will be utilized as Mode Enable.

10.2.4   Capacity Control

Cooling capacity will be controlled by the difference between the cooling target and the cooling control temperature. Loading of the compressor will continue until it reaches 100%. The amount of temperature difference between the cooling temperature set point and the actual sensor temperature will determine the compressor loading (Rate of Change). The greater the difference, the more aggressive the loading time will be. The configuration settings will allow you to control multiple compressors.

10.2.5   Condenser Fan

While the system is in the cooling mode and the discharge pressure exceeds the Condenser Target PSI Set Point the condenser fan will operate based on the configuration. The condenser fan can be set up with a combination of Analog and Relay Output configurations.

1. Supply Freeze

This alarm will trip if the fluid out temperature drops below the value of Setpoint #86. The chiller will lock-out and all Relay Outputs will be disabled to avoid damage to the chiller.
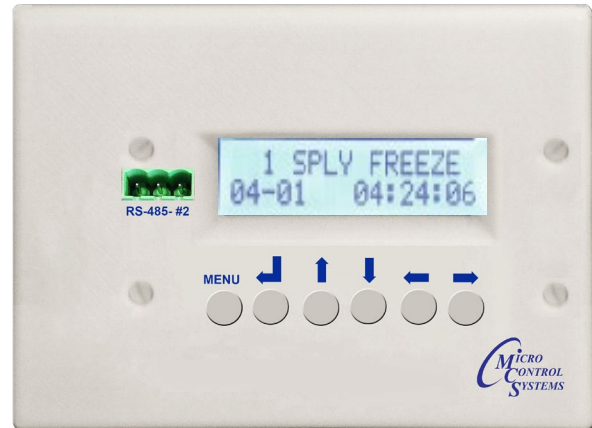
Possible Causes	Solutions
Sensor fault on fluid out	See Appendix B to troubleshoot
Setpoint #86 is incorrect for operating conditions	Change setpoint to a lower value IMPORTANT! If supply fluid is water, do NOT change setpoint to a value lower than 40°F (4.5°C) as the liquid may freeze and cause severe damage to the chiller!
Ambient temperature is cold enough to affect fluid temperatures	Verify insulation thickness is suitable for the lowest ambient operating temperature Add more glycol to lower freezing point, and then adjust Setpoint #86 accordingly
Lack of flow through the evaporator	Check that all valves are opened and that there are no blockages or restrictions in the strainer (shown to the right) or process plumbing

2. Low Suction Superheat

Option alarm, requires suction pressure and suction temperature to calculate suction superheat.

This alarm will trip if the suction superheat falls below the value of Setpoint #67 for an allotted time. When suction superheat drops too low, liquid refrigerant could enter the compressor, causing damage. If the compressor has low suction superheat, a LOW SUCT SPHT alarm will display. Typically next trip is setup for 2 hours, but is adjustable.
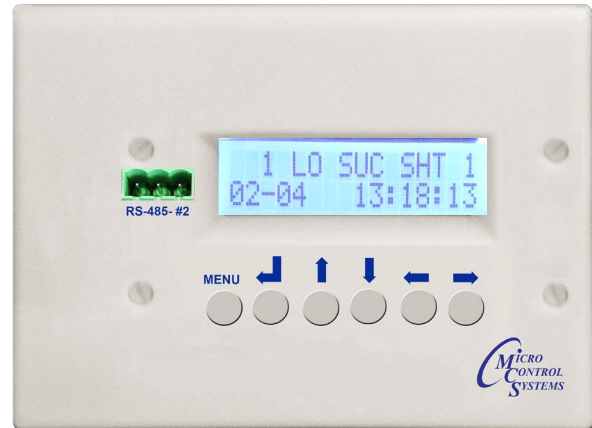
Possible Causes	Solutions
Sensor fault on suction pressure or temperature	See Appendix B to troubleshoot
Lack of a load	Verify the chiller has a heat load
Lack of fluid flow	Confirm active flow to the chiller Ensure y-strainer (shown to the right) and process plumbing are free of blockages or restrictions, and that all ball valves are opened
EXV	Verify superheat reading with physical gauges Adjust the EXV Replace if needed
Refrigerant Overcharge	Contact Supervisor

3. High Suction Superheat

This Alarm uses the suction superheat calculation to determine whether a compressor has high suction superheat. If the compressor has high suction super-heat, it will be put in Safety and a HI SUC SHT Alarm will be posted.

The compressor will Lockout if this Alarm occurs more than once in the preset number of hours.
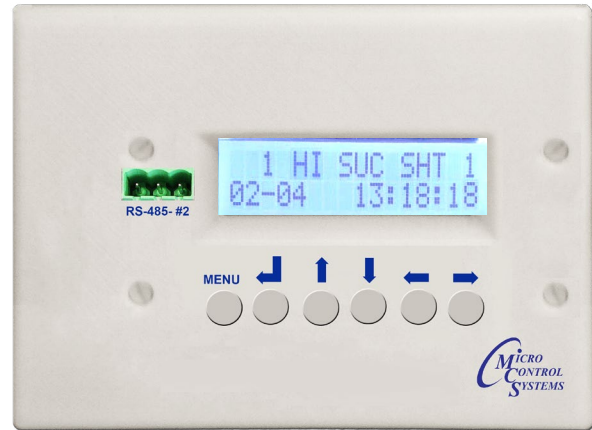
Possible Causes	Solutions
Sensor fault on suction pressure or temperature	See Appendix B to troubleshoot
Faulty Metering Device	Troubleshoot metering device, power heads if EXV, EXV Driver settings, EXV operation.
Excessive load	Refer to unit design for return water temps
Poor Insulation	Check that the suction temp sensor is insulated and not being affected by ambient conditions
Refrigerant Overcharge	Contact Supervisor

4. High Discharge Temp

This Alarm uses the discharge temperature sensor to determine whether a compressor has high discharge temperature. If the compressor has high discharge temperature, it will LOCKOUT and a HI DIS TEMP Alarm will be posted.
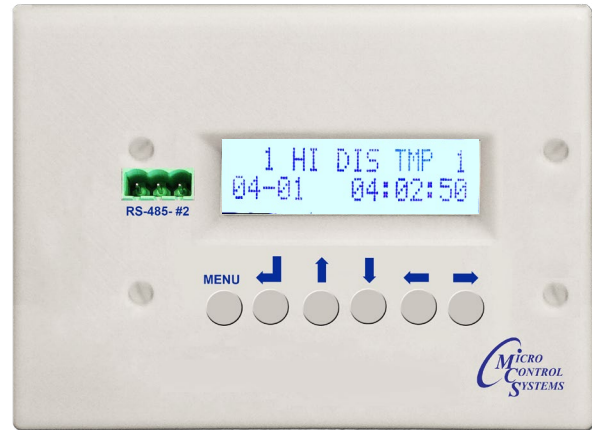
Possible Causes	Solutions
Sensor Fault on Discharge Temp sensor	See appendix B to troubleshoot
High Suction Superheat	Check metering device operation, and superheat target
Excessive load	Refer to unit design for return water temps
Liquid injection	Check to see if unit is equipment with liquid injection and it is working
Refrigerant Undercharge	Contact Supervisor

5. Low Amp. %

This alarm looks at the compressor FLA%, if the FLA% falls below the value of the low amp setpoint for longer than the time frame, the compressor will be shut down and a "LOW AMPS" alarm generated.
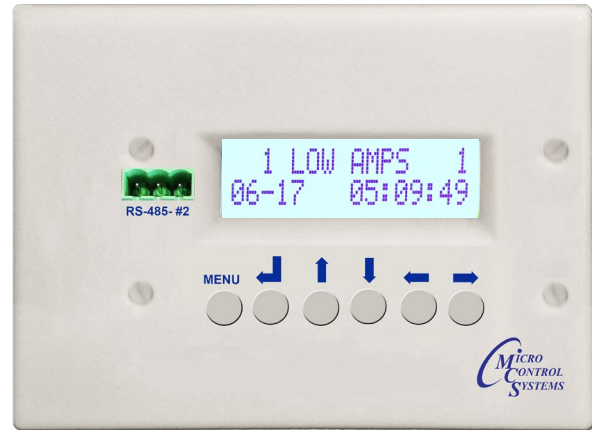
Possible Causes	Solutions
Sensor fault on compressor Current transformer	See appendix B to troubleshoot
Compressor not running	Check compressor control voltage circuit, mechanical overloads, line voltage circuit., mechanical high motor temperature protector, mechanical high pressure system
Refrigerant Undercharge	Contact supervisor

6. High Amp. %

This alarm looks at the compressor amps, if the compressor amps rise above the FLA setpoint times the value of the High Amps setpoint, the compressor will be locked out and a "HIGH AMPS" alarm generated. EG: FLA Setpoint value of 100 amps, and a high amps setpoint value of 125% would = a FLA% trip point of 125 amps (100a x 125%=125a)
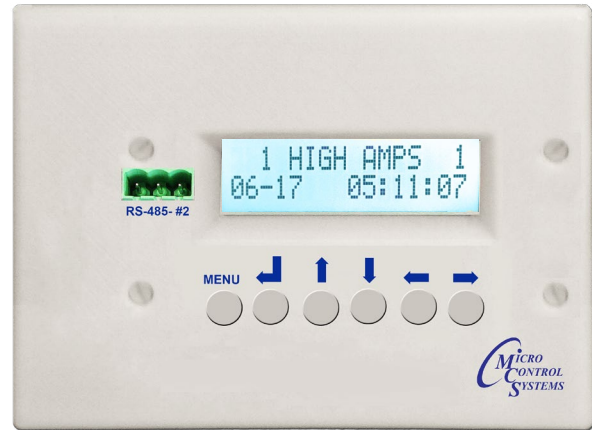
Possible Causes	Solutions
Compressor locked rotor	Check compressor for locked rotor conditions
Compressor windings	Check compressor for shorted or grounded windings
Motor Starter	Check is contacts on motor starter are good, check 3 phases to motor
Refrigerant Overcharge	Contact Supervisor

7. Compressor Overload Fault

If the compressor has a digital fault point, the logic will look at the status of this point. If the fault input triggers, the logic will shut down the compressor and generate a "Compressor Overload" alarm.
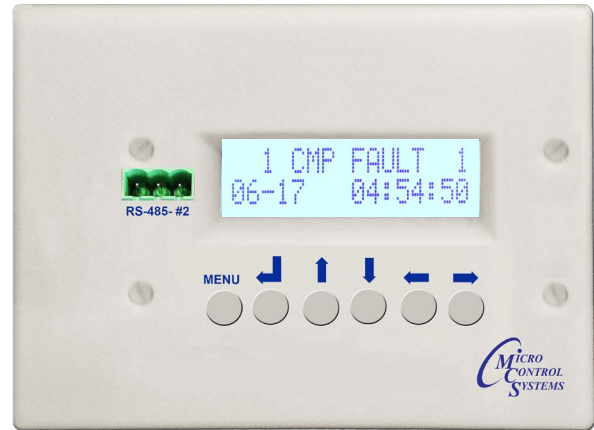
Possible Causes	Solutions
Open Circuit	Check sensor circuit for proper wiring, opens, or loose terminals
Motor Module	Check for flash codes on the motor module (if equipped

8. Condenser Overload Fault

If the condenser has fault contacts, the logic will monitor the status of these contacts. If the contacts are triggered, the condenser and compressor will be shut down and a "Condenser Overload" alarm will be generated.
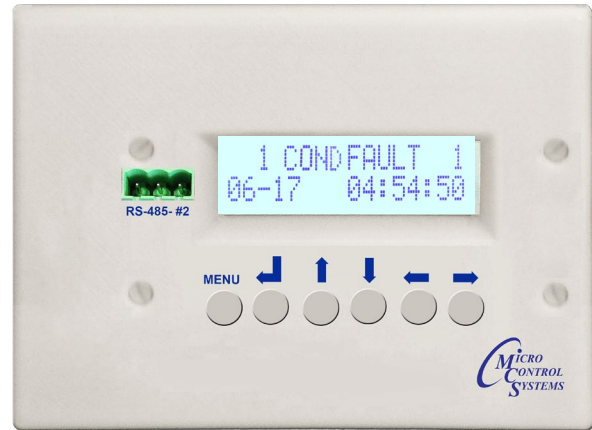
Possible Causes	Solutions
Open Circuit	Check sensor circuit for proper wiring, opens, or loose terminals
Condenser Overloads	Check condenser overloads, VFD faults, for proper operation

9. High Discharge Pressure

This alarm will trip if the discharge pressure rises above the value of Setpoint #70. If the compressor has high discharge pressure, it locks out the compressor and the HI DIS PSI alarm will display.

MCS typically allows two trip before lockout, same as the low suction superheat alarm about. these setting are adjustable. One trip lockout, or two trip lockout in X hours. are the options.

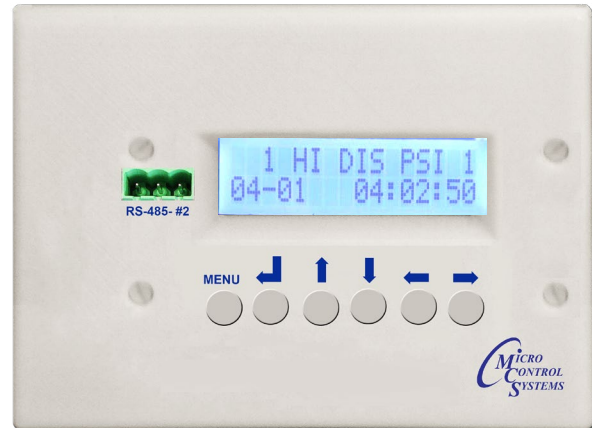| Possible Causes	Solutions
Sensor fault on discharge pressure	See Appendix B to troubleshoot
Condenser panels removed	Clean or replace condenser coils
Condenser blocked (Air-cooled)	Poor installation location (overhang, other equipment installed too close, wall, fence or other object is within 3' of the chiller blocking airflow
Fans not running (Air-cooled)	Verify fuses are not blown Carefully, with ONLY an insulated screwdriver, bump the condenser contactor at the circled spot to see if fans turn on (right picture)
Restriction in cooling water (Water-cooled)	Confirm that all valves are opened Adjust regulator
Refrigerant Overcharge	Contact Supervisor

10. Low Discharge Pressure

This alarm will trip if the discharge pressure drops below the value of Setpoint #69. If the compressor has low discharge pressure, it will lockout and display the LO DIS PSI alarm.

MCS typically allows two trip before lockout, same as the low suction superheat alarm about. these setting are adjustable. One trip lockout, or two trip lockout in X hours. are the options.
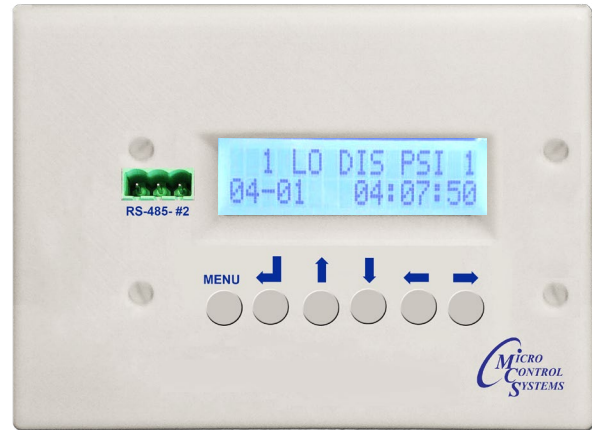
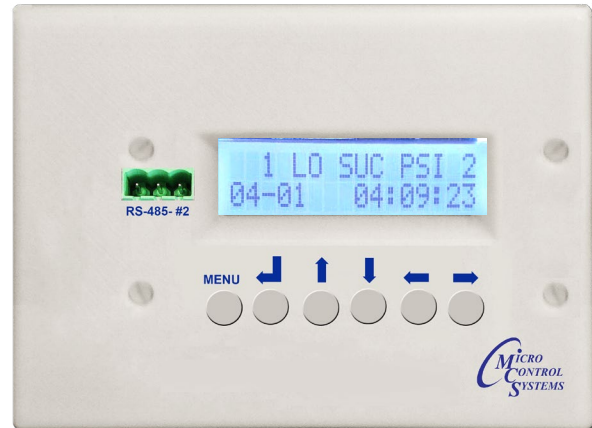| Possible Causes	Solutions
Sensor fault on discharge pressure	See Appendix B to troubleshoot
Condenser fans not cycling properly	Check Setpoint #17 to ensure enough head pressure is being built
Flooded head pressure controls (Receivers only)	Adjust the ORI valve for a higher receiver pressure setting
Refrigerant charge is low	Check for refrigerant leak Contact Supervisor to determine the charge

11. Low / Unsafe Suction Pressure

The low suction pressure alarm will trip if the suction pressure drops below the value of Setpoint #62. If the compressor has low suction pressure, it will lockout and display the LO SUC PSI alarm. The unsafe suction pressure alarm will trip if the suction pressure drops below the value of Setpoint #64. This alarm warns of critically low suction pressure and will lockout the compressor on that circuit.
Can be one or two trips before lockout.
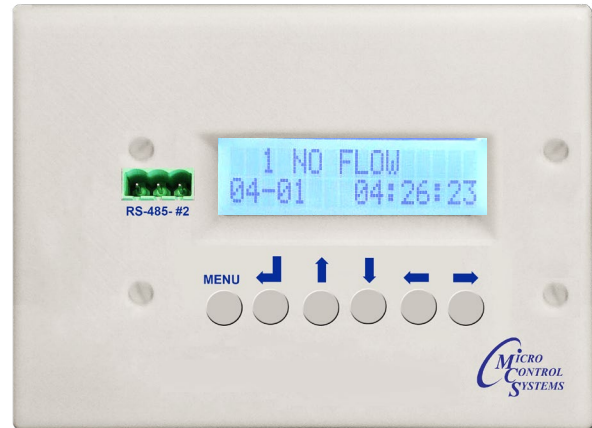Unsafe lockout 1st time, no option for 2 trip before lockout.

Possible Causes	Solutions
Sensor fault on suction pressure	See Appendix B to troubleshoot
Liquid line blocked/restricted	Check that all valves are open between the condenser and EXV, and that filter dryer is not blocked. Ensure EXV is opening and is set properly
Lack of load/flow	Ensure y-strainer and process plumbing are free of blockages or restrictions, and that all ball valves are opened Ensure heat load is present
Setpoint #62 is incorrect for operating conditions	Check with Supervisor, then change setpoint to a lower value
Defective EXV valve	Shut down system, fully backseat EXV then front-seat EXV. Set EXV back to the operating position. If operating problems persist, call Supervisor
Refrigerant charge is low	Check for refrigerant leak Contact Supervisor to determine the charge

12. No Flow

This alarm will trip if the Flow Switch on the evaporator detects no flow for the allotted amount of time (Setpoint 120). With this alarm tripped, the compressors will each shut down until flow is reestablished.

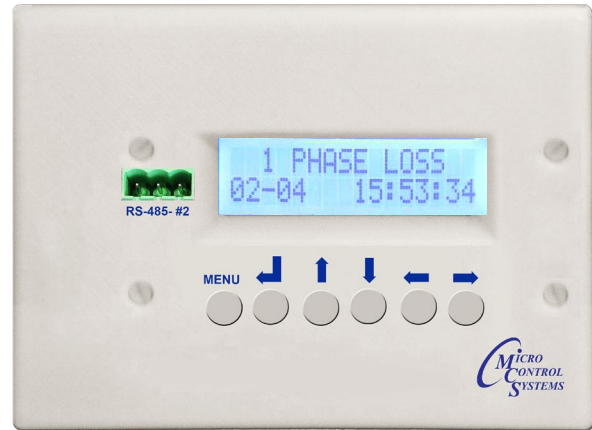No flow can be auto restart as stated here or lockout set in config.

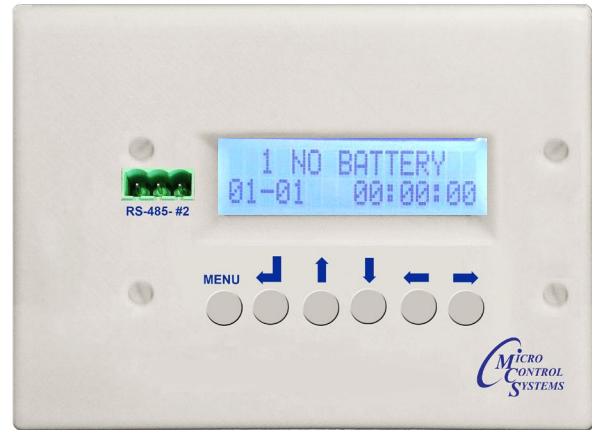| Possible Causes	Solutions
Flow switch is not reading	The flow switch is out of adjustment. Isolate, then remove from the pipe and clean sensor. Air is present in the chilled fluid lines. Purge air from the system No fluid in the tank or low fluid levels Ensure y-strainer and process plumbing are free of blockages or restrictions, and that all ball valves are opened Check for a loose wire on flow sensor terminal block, and check that MicroMag is outputting 5VDC
Pump not operating correctly	Verify pump is running Check for any blown fuses. Verify that the overload relay has not been tripped Check pump phasing to ensure it is rotating in the proper direction

13. Phase Loss

Option, requires phase loss sensor.

This alarm will trip if the chiller has lost phase, forcing the chiller to temporarily shut down until any faults are cleared on the phase monitor.

Possible Causes	Solutions
Problem with 12 VAC	Check Power Supply output to make sure it is outputting 12VAC to the phase monitor. If not, make sure the transformer inputs are set up for the correct line voltage Verify that all wires are connected securely to the Power Supply and to the phase monitor. Check for any blown fuses.
Problem with 5VDC MicroMag output	Ensure MicroMag is outputting 5VDC from the sensor terminal If MicroMag is not outputting 5VDC, call Supervisor for assistance
Fault on Phase Monitor	See Appendix C to troubleshoot (Phase monitor is shown to the right)

14. No Battery

This alarm will trip if the internal battery voltage is too low or if it has been removed.

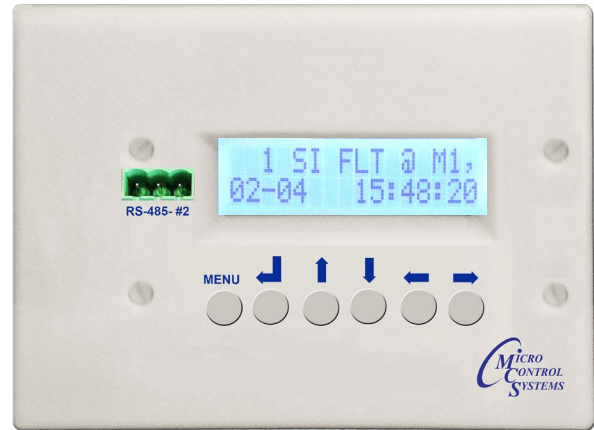| Possible Causes	Solutions
Battery on MicroMag missing or depleted	Reinstall or replace the battery (BR2032 or CR2032 coin cell battery)
Problem with 5VDC MicroMag output	Ensure MicroMag is outputting 5VDC from the sensor terminal If MicroMag is not outputting 5VDC, call Supervisor for assistance
Time and date are inaccurate	Adjust the date and time (see Appendix E)

15. Sensor Fault

This alarm will occur whenever a sensor input is
not receiving any feedback from its sensor.
If a sensor or wire is disconnected from the MicroMag,
the input will read -99.9 and if a sensor is shorted,
it will read 999.9.
Typically, -99.9 or 999.9 is correct, but these values
are configurable.

Possible Causes	Solutions
Sensor fault	See Appendix B to troubleshoot

Cooling States

- **COOL INIT** - Cooling is in initialization mode

- **UNLOADING AZ** - Control sensor is above the zone, the capacity control is unloading because the rate of change (ROC) is dropping too quick and we could overshoot the control zone (ie ROC value is less than 2x min ROC setpoint)

- **LOADING AZ** - Control sensor is above the control zone and rate of change is not dropping quick enough so capacity control is loading.

- **HOLDING AZ** - Control sensor is above the control zone and rate of change(ROC) is dropping quick enough (Min ROC setpoint) so the capacity control is holding.

- **UNLOADING BZ** - Control sensor is below the control zone, the capacity control is unloading because the rate of change (ROC) is not increasing quick enough .

- **LOADING BZ** - Control sensor is below the control zone and rate of change is rising too quick so capacity control is loading.

- **HOLDING BZ** - Control sensor is below the control zone and rate of change(ROC) is rising quick enough.

- **UNLOADING IZ** - Control sensor is in the zone, the capacity control is unloading because the rate of change (ROC) is dropping too quick.

- **LOADING IZ** - Control sensor is in the control zone and rate of change is rising too quick so capacity control is loading.

- **HOLDING IZ** - Control sensor is in the control zone and the Rate of Change is low.

- **OFF & READY** - The cooling is off but ready to run.

- **DISABLED** - The cooling is disabled, during power up, during smoke alarm, run/stop switch is off

- **NO FLOW** - The cooling is off because there is no flow.

- **LOCKED OUT** - The cooling is locked out on safety.

- **SUPERVISOR** (BMS) - BMS controls the staging.
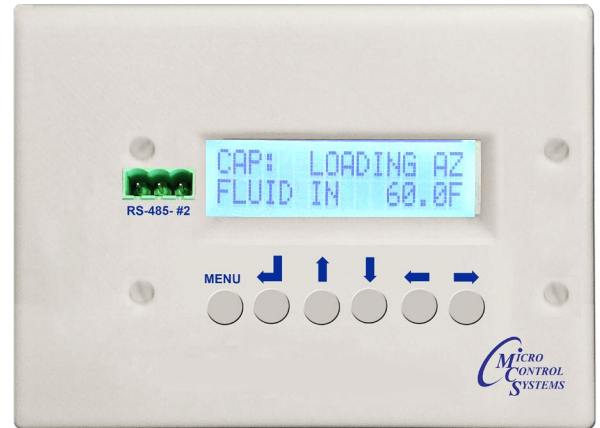
LEGEND

AZ = ABOVE ZONE
BZ = BELOW ZONE
IZ = IN ZONE
ROC = RATE OF CHANGE
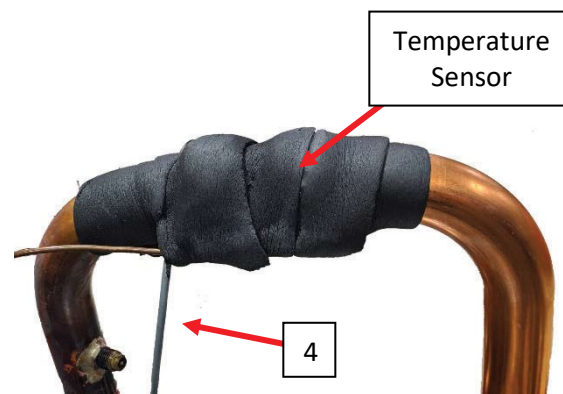
Diagnosing Sensor Errors

Pressure Sensor

1. Check sensor inputs. If the sensor is reading a value of -99.9 (sensor or wire disconnected, the value is shown to the right) or 999.9 (shorted wire), jump to step 2b

2. Verify sensor accuracy

   a. Verify sensor with refrigerant pressure gauges.

   b. Ensure the MicroMag is outputting +5VDC at the "+5" sensor input port (measured between "+5 ⏚").

   c. Make sure sensor is set to analog "A".

3. Check for loose wire on sensor terminal block of MicroMag and verify wiring is in the correct sequence.

4. Check the sensor cable for any signs of damage.

5. Ensure sensor harness is securely connected to pressure transducer.

6. Verify that pressure sensor is completely screwed into Schrader valve on the pipe.

7. Check to make sure Schrader valve is depressing.

Pressure Transducer
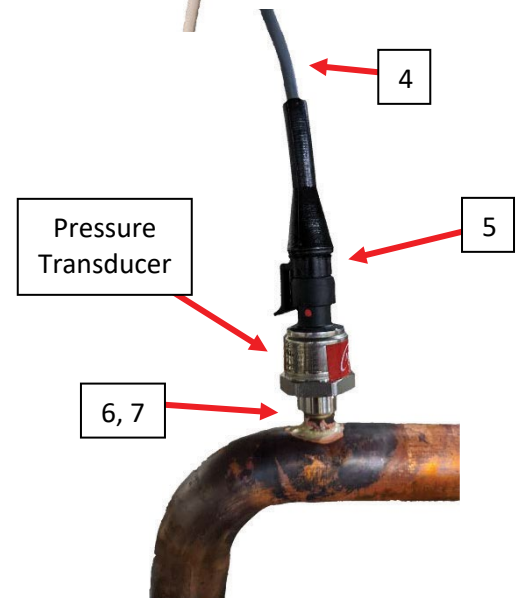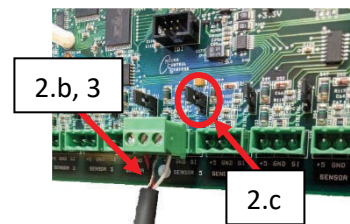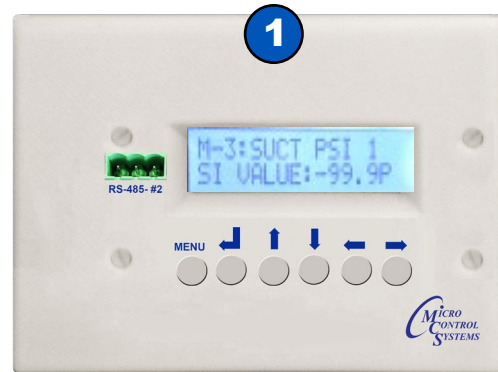
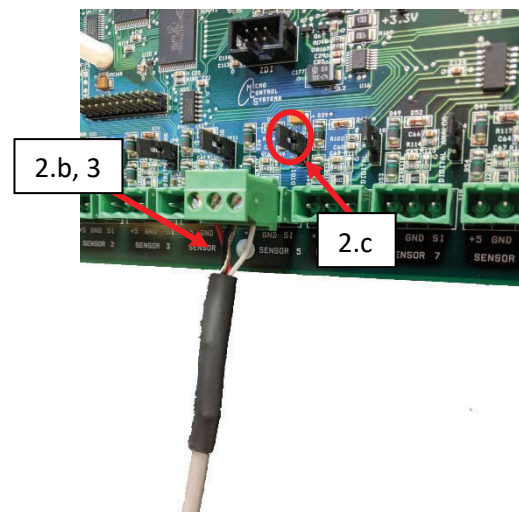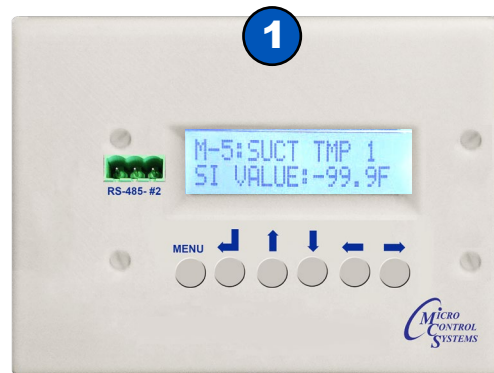## Temperasture Sensor

1. Check sensor inputs. If the sensor is reading a value of -99.9 (sensor or wire disconnected, the value is shown to the right) or 999.9 (short-ed wire), jump to step 2b.

2. Verify sensor accuracy.

   a. Verify sensor with temperature probe.

   b. Ensure the MicroMag is output-ting +5VDC at the "+5" sensor input port (measured between "+5 ⏚").

   c. Make sure sensor is set to analog "A".

3. Check for loose wire on sensor terminal block of MicroMag and verify wiring is in the correct sequence.

4. Check the sensor cable for any signs of damage.

M-5:SUCT TMP 1
SI VALUE:-99.9F

2.b, 3

2.c

Temperature Sensor

4

Phase Monitor Faults (if installed)

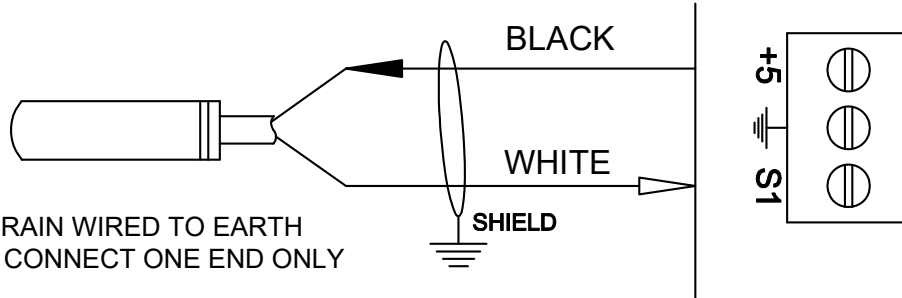| Fault	Solutions

Load Side Phase Loss
Missing phase on the load side
	1. Re-energize the contactor
	2. If the fault reappears after the load energizes:
	  a. Turn all power OFF
	  b. Check all load side connections
	  c. Check the contacts of the contactor for debris or excess carbon

Load Side Phase Rev Load phases not shifted by 120°	1. Turn OFF all power 2. Swap any 2 phases on the load side of the phase monitor 3. Re-apply power
Load Phase Unbalance Voltage unbalance between load phases	1. Press the READ button to observe the present load voltages. Check system for unbalance cause. 2. Increase the fault interrogation time if necessary 3. Increase the percent unbalance setting if necessary
Line Side Over Voltage Average phase voltage above maximum	1. Check system for over-voltage cause 2. Increase the percent over-voltage setting if necessary 3. Increase the fault interrogation time if necessary
Line Side Phase Loss Missing phase on the line side	1. Press and hold the READ button on the phase monitor or use an AC voltmeter to carefully measure all three phase-phase line voltages (example: Line 1 Line 2, Line 2 Line 3, Line 3 Line 1) 2. Repair the missing phase

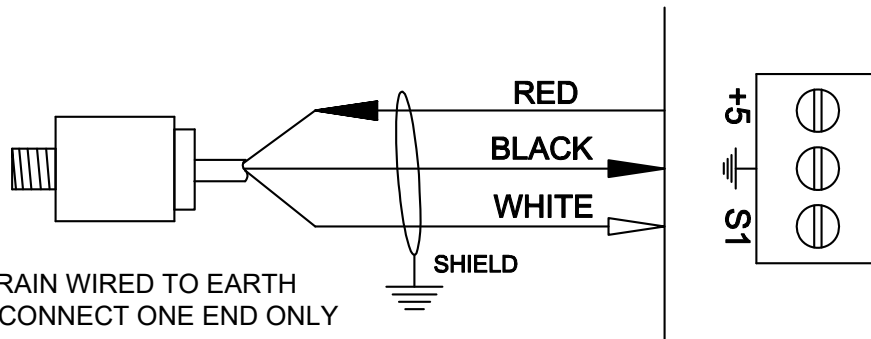| Fault	Solutions
Line Phase Reversal Line phases not shifted by 120°	1. Turn OFF all power 2. Swap any 2 phases on the line side of the phase monitor 3. Re-apply power
Line Phase Unbalance Voltage unbalance between phases	1. Press the READ button to observe the present load voltages. Check system for unbalance cause 2. Increase the fault interrogation time if necessary 3. Increase the percent unbalance setting if necessary
Line Under Voltage Average phase voltage below minimum	1. Check system for under-voltage cause 2. Increase the percent under-voltage setting if necessary 3. Increase the fault interrogation time if necessary

TEMPERATURE SENSOR (MCS-T100)

BLACK

WHITE

SHIELD

+5

S1

IMPORTANT

SHIELD DRAIN WIRED TO EARTH
GROUND CONNECT ONE END ONLY

PRESSURE SENSURE (MCS-XXX)

RED

BLACK

WHITE

SHIELD

+5

S1

IMPORTANT

SHIELD DRAIN WIRED TO EARTH
GROUND CONNECT ONE END ONLY

LOAD 3

LOAD 2

LOAD 1

LINE 3

LINE 2

LINE 1

FUSE

FUSE

FUSE

L1

L2

L3

SETUP READ FAULT

6   5   4   3   1

SI GND +5

SHIELD DRAIN WIRED TO
EARTH GROUND

LOAD

IMPORTANT

SHIELD DRAIN WIRED
TO EARTH GROUND
CONNECT ONE END ONLY

NOTES

NOTES

NOTES
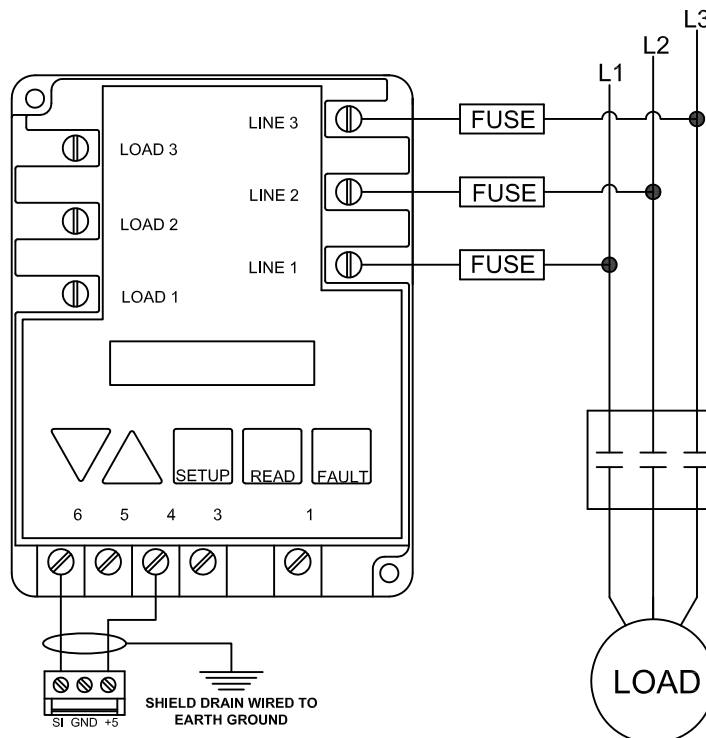
Revision Page

Date	Author	Description of Changes
06-11~24-2021	DEW	Created MicroMag Getting Started Manual Ver. 1.0

MICRO CONTROL SYSTEMS

Providing HVAC/R Control Solutions Worldwide

5580 Enterprise Pkwy. Fort Myers, FL 33905

Office: (239) 694-0089

Fax: (239) 694-0031

www.mcscontrols.com