MCS-8 REFRIG Manual

Revision 1.0
V8 SW & V1.5 HW
8 Comps, 48 ROs, 48 SIs & 6 AOs

The MCS Commitment

Our 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.

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1. Revision Page

Date	Author	Description of Changes
11-07-01	BWW	Create REFRIG V8 manual from Chiller Manual 3.0 SWV8 & hdw v1.5.doc
11-07-01	BWW	Removed Control Zone documentation – this logic is not supported in Ref V8.
11-09-01	BWW	Added documentation for Defrost states & setpoints
11-09-01	BWW	Added documentation for Dehumidification mode

2. Table of Contents

3. Introduction

3.1. About MCS's REF V8 Software Support

The REF V8 software, "REF R08.00-B" or greater supports:

Up to 8 reciprocating, and or scroll compressors,
Up to 4 steps of capacity control per compressor (3 unloaders),
Relay Outputs up to 48,
Analog Outputs up to 6,
Sensor Inputs up to 48,
Set Points up to 120,
Alarms up to 60.

REF R08.00-B software supports fixed step capacity systems. This includes support for reciprocating, scroll and screw compressors that do not have infinite slide control. This software must not be used with screw compressors that have infinite slide control.

3.2. About MCS's CHL V8 Hardware Support

The following MCS boards can be connected via the MCS-I/O network:

MCS-8 (8 RO - 8 SI - 1 AO with REF R8.00-B with a GAL 6.0 chip),
MCS-I/O (8 RO - 8 SI - 1 AO with IO 7.00-C with a GAL 5.0 chip),
MCS-RO8 (8 RO),
MCS-SI8 (8 SI),
MCS-SI16.(16 SI).

This provides flexibility in configuring the individual systems to obtain the desired number of points in the most economical way.

3.3. About this Manual

The purpose of this manual is to document MCS's REF V8 software for the MCS-8.

This manual documents how the REF V8 software functions. Since this is a large manual, it is structured in logical sections for ease of reference. The Table of Contents will guide you through the sections but you are urged to read the entire manual. This will provide an understanding of the capabilities of the MCS-8 and hopefully introduce other ways that you may benefit from the existing control strategies. Quick Reference sheets and MCS Specification sheets are provided in the appendixes.

This manual was created using Microsoft Office, Word 97. A copy of this manual is available on diskette.

An approved OEM of MCS may make copies and / or change any section of this manual to develop custom documentation for a site where an MCS-8 controller is installed. In this way, MCS supports the documentation requirements of individual customer sites.

3.4. About the MCS-8

The MCS-8 is a rugged microprocessor based controller that is designed for the hostile environment of the HVAC/R industry. It is designed to provide primary control, no mechanical controls; interface with building management systems; communicate both locally and remotely. The MCS-8 provides flexibility with set points and control options that can be selected prior to commissioning a system or when the unit is live and functioning. Displays, alarms and other interfaces are accomplished in a clear and simple language that informs the user as to the status of the controller.

The MCS-8 is designed to safeguard the system that is being controlled, eliminate the need for manual intervention and to provide a simple but meaningful man-machine-interface.

3.5. About PC Support Software for MCS-8

- **PC-Config** program provides the configuration file: points list, set points, options, etc. This program is user friendly with English questions and drop down menus. It is written in the Microsoft Visual Basic programming language. A manual created under Microsoft Office, Word 97, for Windows 95 is available on disk or hard copy.

- **PC-Connect** program provides both local and remote communications to the MCS-8 independent of the type of software. Through this program the status of the controller can be viewed and with proper authorization changes can be made to the system. Configuration files can be transmitted to or received from an MCS-8 unit. The MCS-8 automatically performs history logging; this program will graph selected items. This program is written in the Microsoft Visual C++ programming language. A general user's manual is available with this software package.

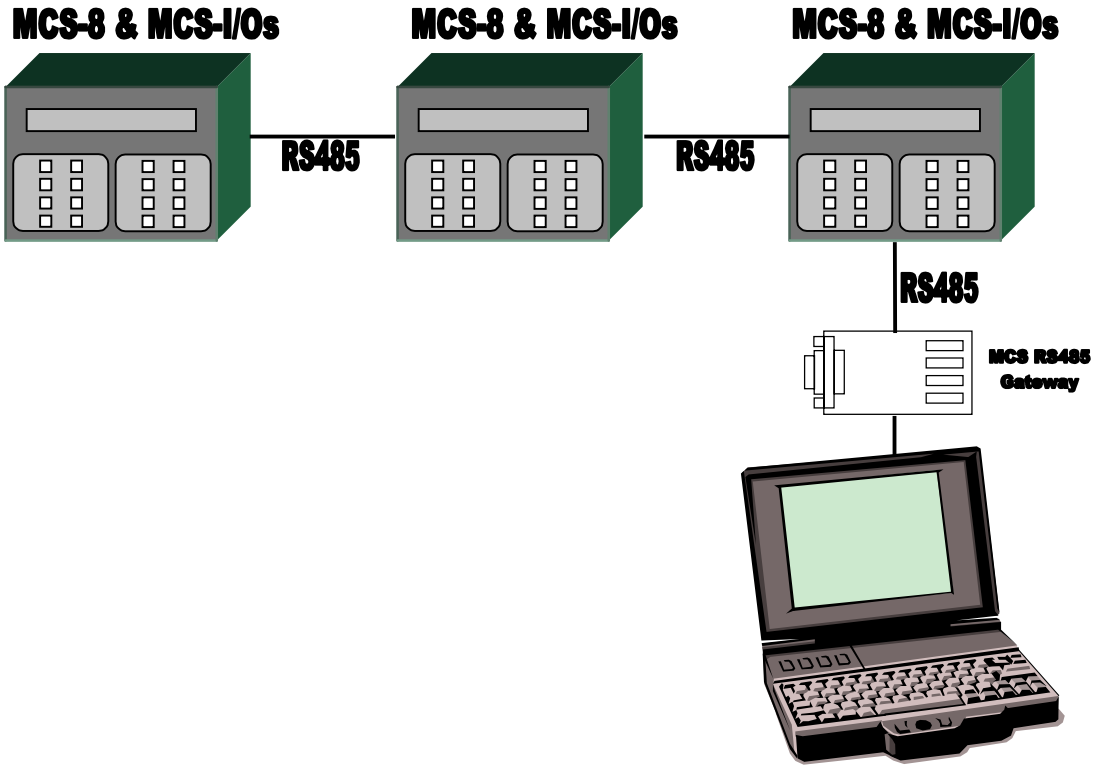
Both of these programs run under Windows 3.1 or greater and they make use of the Microsoft Windows Help function to assist the user.

3.6. MCS 485 Network

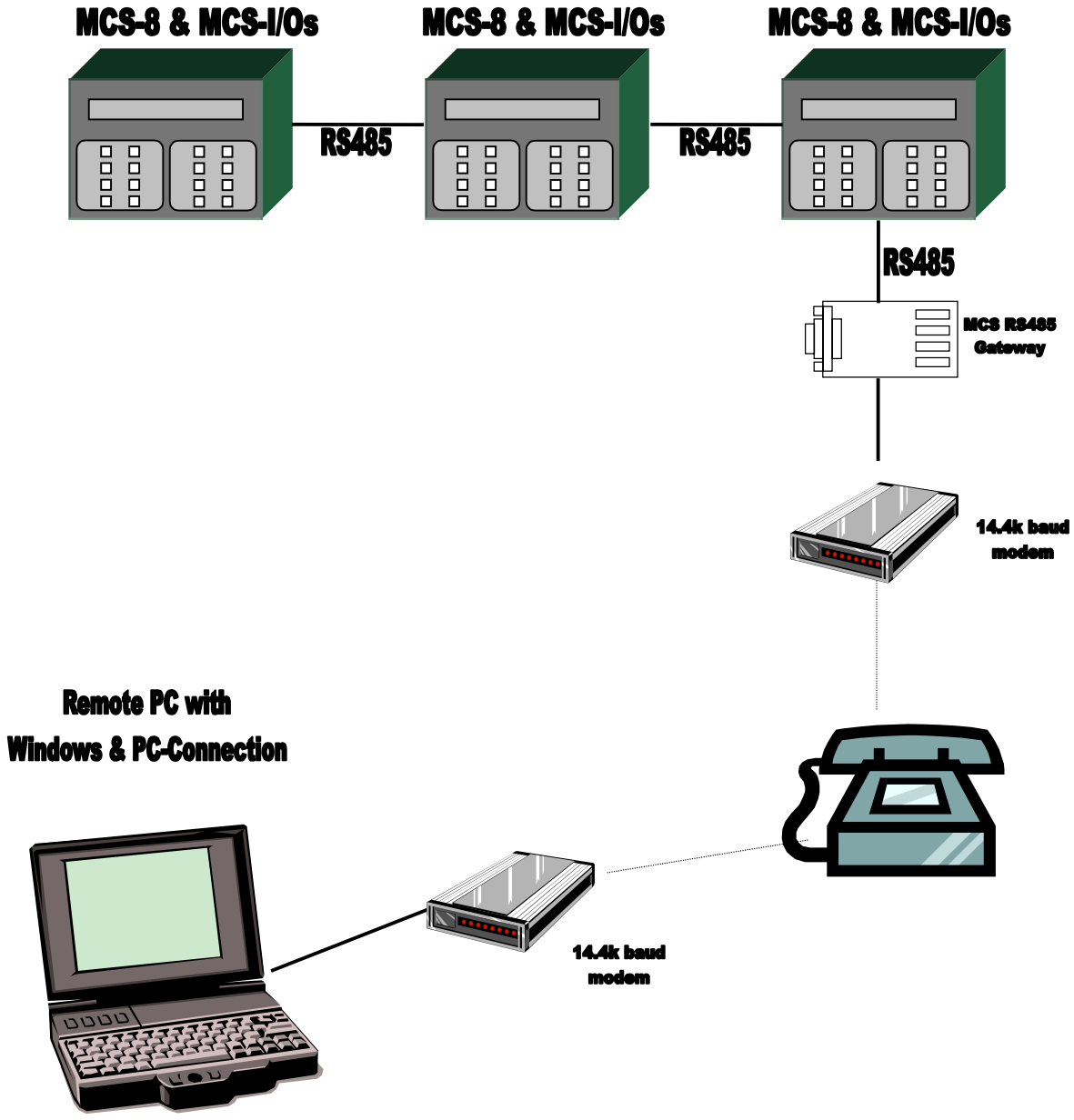
The MCS 485 Network can support up to 20 MCS-8 and its associated I/O's. Access to this network can be local or remote via a 14.4K Baud modem. There will be no degradation in the performance of the network. The PC connected to the network must be running Windows 3.1 or higher with PC-Connect providing the actual interface program.

Each MCS-8 in the network must be assigned a unique address when the configuration file is build using the PC-Config program. This address will be the key in establishing communications with the appropriate MCS-8 system. This address can be changed from the LCD / keypad of a unit.

3.6.1. MCS 485 Network Local PC Support Only



3.6.2. MCS 485 NETWORK REMOTE PC SUPPORT ONLY



4. Requirements for PC Software

To install and run the program we suggest the following system requirements:

Front End System Requirements

- Windows 95
- Pentium 166 MHz
- 2 Gigabyte hard disk with at least 25 Megabytes free
- 3 ½ " Floppy Disk Drive
- Super VGA display capable of displaying 256 colors
- 16 Megabytes of RAM or more is recommended
- 33.6k baud modem

Minimum System Required to Run Program

- Windows 3.1
- 486 66 MHz
- 500 Megabyte Hard Drive
- 3½" Floppy Drive
- VGA Display
- 8 Megabytes RAM
- 14.4k baud modem

5. MCS-8 Control States

We should consider the MCS-8 controller as a state computer, that is, decisions are made based upon set points, timers and sensor inputs, the controller moves from one state to another. The controller will change states to ensure the proper functioning of the unit.

As we review the various states, we must remember that a unit consists of a number of different parts or functions: the compressors and their related items such as unloaders hot gas bypasses, etc.; evaporator; and condensing functions. To control these functions the states will be divided into three sections:

- **Capacity Control States**
- **Circuit Control States**
- **Condenser Control States**

Both the CAPACITY CONTROL STATES and CIRCUIT CONTROL STATES are displayed on the 2x16 LCD. Press the SERVICE DIAGNOSTICS key until the option is the CONTROL STATUS, then press the ENTER key. The INCREASE and DECREASE keys can be used to scroll through the various state screens. Or it can be accessed via the PC-Connect program under status screen by clicking on the CONTROL STATUS button.

5.1. Control Status Display (from the MCS-8 keypad)

The following will be displayed:

A. The CURRENT STATE OF THE PACKAGE.
The 1st display shows the current capacity of the package and how long we have been at this level.

Line 1) `UNIT IS UNLOADED`
Line 2) `TIMER=00:02:14`

By pressing the + key you will get information on the accumulator. (Starts with the value in the set point 'STEP DELAY' and decrements down as a function of the difference between the target and the current value of the controlling sensor. (Usually leaving liquid). The second line provides the Rate of Change of the controlling sensor.

Line 1) `STEP DELAY=180`
Line 2) `RATE OF CHG+ 0.0`

By pressing the + key you will get information on the number of steps wanted on and the actual number of steps on. (They may be different if the system is waiting on a unit in safety or anti recycle.).

Line 1) `STEPS WANTED= 0`
Line 2) `ACTUAL STEPS= 0`

If a infinite step compressor package: by pressing the + key you will get information on the % of FLA the screw wants to be loaded

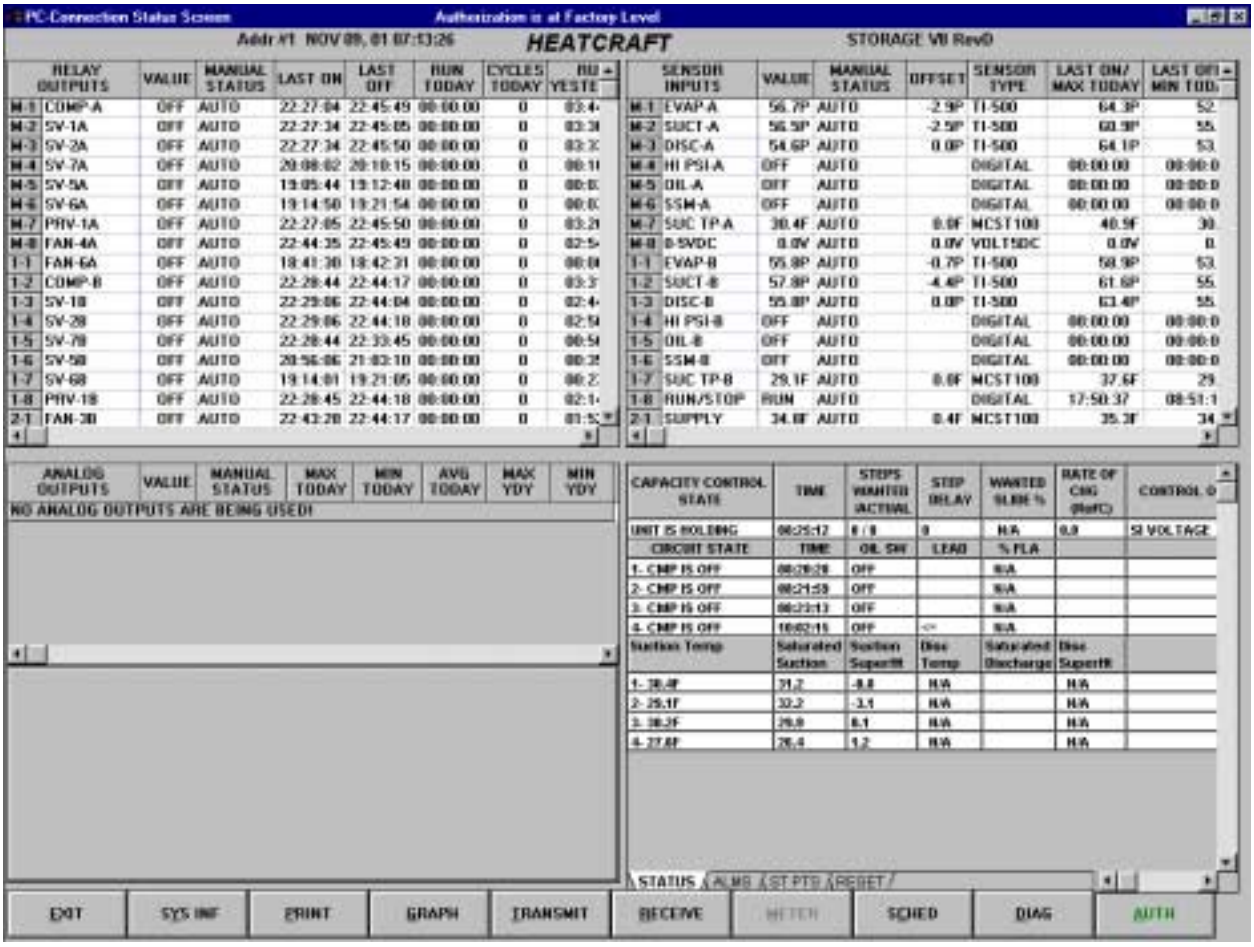
Line 1) `SLIDE WANTED= 48`
Line 2)

B. *The CURRENT STATE OF EACH CIRCUIT*
The display will show the circuit number, current state of this circuit, if available the FLA % and the time in this state. (An arrow will appear immediately after the circuit number to indicate the lead compressor.) This information will be repeated per circuit. CHL V8 software supports up to 8 circuits.

Line 1) 1←CMP IS OFF
Line 2) 48%FLA 00:22:12

5.2. Control Status Display (from the PC-Connect program)

The status of both the CAPACITY CONTROL STATES and CIRCUIT CONTROL STATES can be viewed from the PC-Connect program by accessing the CONTROL STATUS key under status screen. The following will be displayed:



CAPACITY CONTROL STATE	TIME	STEPS WANTED /ACTUAL	STEP DELAY	WANTED SLIDE %	RATE OF CHG (RofC)	CONTROL O
UNIT IS HOLDING	08:25:12	0 / 0	0	N/A	0.0	SI VOLTAGE
CIRCUIT STATE	TIME	OIL SW	LEAD	% FLA		
1- CMP IS OFF	08:20:28	OFF		N/A		
2- CMP IS OFF	08:21:59	OFF		N/A		
3- CMP IS OFF	08:23:13	OFF		N/A		
4- CMP IS OFF	10:02:15	OFF	<=	N/A		
Suction Temp	Saturated Suction	Suction SuperHt	Disc Temp	Saturated Discharge	Disc SuperHt	
1- 30.4F	31.2	-0.8	N/A		N/A	
2- 29.1F	32.2	-3.1	N/A		N/A	
3- 30.2F	29.9	0.1	N/A		N/A	
4- 27.6F	26.4	1.2	N/A		N/A	

Use your arrow keys to access all information (Active circuits will be displayed)

Information displayed:

Unit information:

- **CAPACITY CONTROL STATE** - State of unit
- **TIME** - time in that state, if the state is UNIT IN POWER UP time will decrement to zero
- **STEPS WANTD (ON)** - Number of steps wanted on
- **ACTUAL** - actual steps turned on
- **STEP DELAY** – time delay that is counted down. When the value reaches zero, the micro will determine if a change in the unit's capacity is required.
- **WANTED SLIDE %** - Wanted slide percentage
- **RATE OF CHNG** – Rate of Change of supply air temperature.

Circuit information (all active circuits will be displayed):

- **CIRCUIT NUMBER AND STATE** - Circuit number and state.
- **TIME** - time in that state, if the state is CMP ANTICYCLE time will decrement to zero.
  OIL DIFF - Oil differential pressure. Oil differential pressure is calculated as follows:
  Oil pressure minus Suction pressure
- **LEAD** - (←) indicates the lead compressor.
- **STEPS** – number of steps on or FLA %.

Circuit Super Heat information (all active circuits will be displayed):

- **Suction Temp** – Circuit number and current valve of the Suction Temperature, if available.
- **Saturated Suction**– Calculated Suction Saturated Temperature, if available. The Suction Pressure is converted into temperature based upon the type of refrigerant (R22, R134a, R407c, And R410a are supported).
- **Suction SuperHt** – Calculated Suction Super Heat, only available if both the Suction Temperature and the Suction Pressure are used. The calculation is Suction Temperature minus the Suction Saturated Temperature.
- **Disc Temp** – Discharge Temperature, if available.
- **Saturated Discharge**– Calculated Discharge Saturated Temperature, if available. The Discharge Pressure is converted into temperature based upon the type of refrigerant (R22, R134a, R407c, And R410a are supported).
- **Disc SuperHt** – Calculated Discharge Super Heat, only available if both the Discharge Temperature and the Discharge Pressure are used. The calculation is Discharge Temperature minus the Discharge Saturated Temperature.

6. MCS-8 Capacity Control States

UNIT IN POWER UP

This state is entered when the MCS-8 is powered up or the system has been reset. The system will remain in this state for the time specified in set point POWER DELAY, set point 23, or if not active for 60 seconds. In this state all points (RO's) are turned off. This is a time delay to insure the micro has stable power before turning any points on.

RUN/STOP SW OFF

This state is entered when the run stop switch is off, in the stop position. When the unit is in this state, the individual circuit states if active are moved to the CMP IS OFF state through the normal states. One capacity STEP will be moved per second.

SCHEDULED OFF

This state is entered when the schedule is calling for the package to be off. When the unit is in this state, the individual circuit states if active are moved to the CMP IS OFF state through the normal states. One capacity STEP will be moved per second.

AMBIENT OFF

This state is entered when the ambient temperature falls below the LOW AMB OFF set point #24 or is above the HIGH AMB OFF set point #26. System will remain in this state until the ambient temperature if low raises 5.0F or 2.5C degrees above the LOW AMB OFF set point value or if high drops 5.0F or 2.5C degrees below the HIGH AMB OFF set point value. When the unit is in this state, the individual circuit states if active are moved to the CMP IS OFF state through the normal staging function. One capacity STEP will be moved per second.

UNIT IN LOCKOUT

This state is entered whenever a critical situation is encountered that could cause harm to the unit package. Items such as freeze protect, no flow and emergency stop will force the system into this state. Lockouts can be reset without authorization from the keypad or PC-Connect program; however if the lockout condition has not been corrected, the system will again be forced into the LOCKOUT state. In this state, all RO's except ALARM RO and the oil heater RO for screws with and oil pump are turned OFF & placed in the 'LOCKOUT' state.

NO RUN- I/O LOST

This state will be entered whenever the MCS-8 loses communications with any of the I/O boards that are connected via the MCS I/O network. When this state is entered the system will generate an MCS I/O alarm which identifies which I/O is off-line and a lost IO shutdown alarm. The lockout-reset key must be depressed to reset the system, after the lost I/O has been corrected. In this state, all RO's except ALARM RO are turned OFF.

UNIT IS OFF

This state is entered when the system has moved from a STARTUP, DISABLE, LOCKOUT or LOST I/O state. The unit is now ready to move into an active state to meet the capacity required.

UNIT IS HOLDING

This state is entered when one of three conditions exists:

1) The control sensor reading is being maintained with in the control zone.

2) Control sensor reading is above the control zone but the Rate of Change is less than the value in the (MAX ROC-, #27) set point. This indicates that the temperature is decreasing toward the target at an acceptable speed. Therefore, no additional cooling is needed at this time.
3) The temperature is below the control zone but the Rate of Change is greater than the (MAX ROC+, #28) set point. This indicates that the temperature is increasing toward the target. Therefore, no reduction in cooling is needed at this time.

This state indicates that there is no need to add or subtract the cooling capacity of the unit. This state will be exited when more or less capacity is required.

UNIT UNLOADING

This state is entered when less capacity is required. Every second an adjustment is made to the step delay. When the delay reaches zero, the counter 'steps wanted' on is decreased by 1.

UNIT IS LOADING

This state is entered when more capacity is required. Every second an adjustment is made to the step delay. When the delay reaches zero, the counter 'steps wanted on' is increased by 1.

UNIT IS UNLOADED

This state is entered when all of the systems available capacity steps are off. The package is providing no cooling capacity, as none is required. The system is ready to react to cooling needs.

UNIT IS LOADED

This state is entered when all of the systems available capacity steps are on. The package is providing the maximum amount of cooling capacity.

7. MCS-8 Capacity Control States Sequence of Operations

After power is applied to the MCS-8 the following is the normal sequence of Capacity control States:

1. Unit in Power Up
2. Run/Stop SW OFF
   - If the Run/Stop switch is turn ON then the remain states sequence occurs.
3. Unit is Unloaded
4. Unit is Loading or Unit is Holding or Unit is Unloading
   - The micro will move between these three states as required by the voltage sensor input until Run/Stop switch is turned off. Once the Run/Stop switch is turned of the capacity control state will move to Unit is Unloading until Steps Wanted On equals zero. Then it will go back to Run/Stop SW OFF.

8. MCS-8 Circuit Control States

The action of the circuit control states actually result in more, less or no change in the amount of cooling capacity. The CAPACITY CONTROL STATES dictate how the individual circuits move within there states.

CMP IS OFF

This state is entered when no cooling capacity is required from this circuit or the prior state was CMP ANTICYCE, LOST IO LOCKED or SWITCHED OFF. In this state the circuit is ready to provide cooling capacity if needed. The system will remain for a minimum delay of 60 seconds in this state.

HI DISC HOLD

Refer to set points numbers 81, HI DISCH PSI; 82, HI DISC UNLD; 83, HI DISC RELD; 87, HI DISCH TMP; 88, HI DISCH UNLD; and 89, HI DISCH RELD.

This state is entered when a fully loaded circuit, that has more than one step, has encountered either a dangerously high discharge pressure or discharge temperature. One step of cooling capacity will be turned off. The circuit will remain in this state for a minimum of five minutes before returning to the LOADED state if the dangerous condition has been corrected.

LO SUCT HOLD

Refer to set points numbers 77, LOW SUCTION; 78, LO SUCT UNLD; and 79, LO SUCT RELD.

This state is entered when a fully loaded circuit, that has more than one step, has encountered a dangerously low suction pressure. One step of cooling capacity will be turned off. The circuit will remain in this state for a minimum of five minutes before returning to the LOADED state if the dangerous condition has been corrected.

CMP UNLOADED

This state only exists if a compressor has an unloader or Hot Gas Bypass solenoid. This state is when the minimum capacity is required from the compressor. In this state the compressor, liquid line solenoids, all unloaders, Hot Gas Bypass solenoid, and Differential Pressure regulating valve are ON and Hot Gas Defrost solenoids are OFF.

UNLD1/HGBP OFF

This state can only be entered for compressors with a HOT GAS BYPASS solenoid. In this state the HOT GAS BYPASS solenoid is off and all unloaders in the circuit are on.

PART LOADED

This state only exists if a compressor has two unloaders. This state is when the HOT GAS BYPASS solenoid, if it exists, is off, the first unloader solenoid is off and the second unloader solenoid is on.

CMP IS AT 100%

This state is when the compressor is fully loaded. In this state, the circuit is providing the maximum amount of cooling capacity. In this state the compressor, liquid line solenoids, and Differential Pressure regulating valve are ON and all unloaders, Hot Gas Bypass solenoid, and Hot Gas Defrost solenoids are OFF.

CMP PMP DOWN

This state is entered whenever the pump down switch has been turned on or if this circuit is no longer wanted on. The compressor is on and the liquid line solenoids are closed. This state is active until the suction pressure reaches the value in the set point 61; PMP DWN OFF or the time has exceeded the value in the set point 62, PMP DWN DELY. The circuit will then move to the ANTICYC state.

CMP ANTICYCE

This state is entered when the PMP DWN state has been completed. The circuit will stay in this state with all circuit points off for the period of time contained in set point 63, ANTI-CYCLE. The circuit will then move to the OFF state.

SWITCHED OFF

This state is entered after the circuit has been pumped down due to the pump down switch being on or if the circuit flow switch is off. In this state the compressor, and all related points, plus the liquid line are off. The circuit will not leave this state unless the pump down switch is turned off. If the pump down switch is turned off, the circuit state will be changed to the OFF state.

SAFETY TRIPPED

This state is entered when a safety trips but a lockout is not to be generated. An alarm is generated but the system will restart after the delay specified in the corresponding set point. If a second trip occurs within the time specified in the set point, the circuit will be placed in the CMP LOCK EDOUT state.

CMP LOCKED OUT

This state is entered when the Capacity Control State is LOCK OUT or a safety set point for this circuit has indicated that a critical situation has been encountered. Set points such as (LOW SUCTION #77) or (HI DISCH PSI #81) are examples of safety set points. Lockouts can be reset without authorization from the keypad or PC-Connect program; however if the lockout condition has not been corrected, the circuit will again be forced into the LOCKOUT state.

LOST IO LOCKED

This state is entered when the Capacity Control State is LOST IO. Lockout reset key will move the circuit to the OFF state. Lockouts can be reset without authorization from the keypad or PC-Connect program; however if the lockout condition has not been corrected, the circuit will again be forced into the LOCKOUT state.

HI AMP HOLD

This state is entered when a fully loaded circuit, that has more than one step, has encountered a dangerously high AMP draw. Refer to set points numbers 65 through 72 for FLA per circuit and 75 HI AMPS %. In this state, one step of cooling capacity will be turned off. The circuit will remain in this state for a minimum of five minutes before returning to the LOADED state if the dangerous condition has been corrected.

DEFROST EVAP#1

This state is entered when the evaporator pressure falls below a setpoint for 60 second indicating a need to defrost the evaporator coils. In this state the compressor, liquid line solenoid #2, and

defrost hot gas #1 solenoid are ON and liquid line solenoid #1, defrost hot gas solenoid #2, differential pressure regulating value, and the drain solenoid are OFF.

DRIP DOWN #1

This state is entered after evaporator #1 has finished it's hot gas defrost. This is a time delay to allow the water to drip down off the defrosted coil before turning back on the liquid line solenoid. In this state the compressor, and liquid line solenoid #2 are ON and liquid line solenoid #1, defrost hot gas #1 solenoid, defrost hot gas solenoid #2, differential pressure regulating value, and the drain solenoid are OFF.

DEFROST EVAP#2

This state is entered after the defrost cycle for evaporator #1 has finished it's cycle. In this state the compressor, liquid line solenoid #1, and defrost hot gas #2 solenoid are ON and liquid line solenoid #2, defrost hot gas solenoid #1, differential pressure regulating value, and the drain solenoid are OFF.

DRIP DOWN #2

This state is entered after evaporator #2 has finished it's hot gas defrost. This is a time delay to allow the water to drip down off the defrosted coil before turning back on the liquid line solenoid. In this state the compressor, and liquid line solenoid #1 are ON and liquid line solenoid #2, defrost hot gas #1 solenoid, defrost hot gas solenoid #2, differential pressure regulating value, and the drain solenoid are OFF.

9. MCS-8 Circuit Control States Sequence of Operations

After power is applied to the MCS-8 the following is the normal sequence of Capacity control States:

1. CMP IS OFF
   - If steps wanted on is greater than steps turned on then the remaining states occur.
2. CMP IS AT 100% - If defrost required then state move through the defrost cycle.
   - If steps wanted on is less steps turned on or Pump Down Switch is turned on then the remaining steps occur.
3. CMP PMP DOWN
4. CMP ANTICYCLE

10. MCS-8 Voltage SI Capacity Control Logic

This control strategy is based upon developing a series of cut in (turn on) and cut out (turn off) values for each capacity stage (step) in the system. When a cut in value has been reached or exceeded and the delay time between stages (steps) has been satisfied, the micro will turn on the next stage (step). Conversely, when a cut out value has been reached and the delay time between stages (steps) has been satisfied, the micro will turn off the last stage (step) that was turned on.

10.1. Voltage SI Control Method setpoints #1-18

#	NAME	DESCRIPTION
1	STAGE DELAY	Delay between stages being turned on.
2	STAGE CUT OUT	Off set used in calculating the cut out value. Subtracted from the stage cut in set points #3 through #18
3	STAGE 1 CUT IN	STAGE 1 cut in, set point value contains the value when this stage is turned on.
4	STAGE 2 CUT IN	STAGE 2 cut in, set point value contains the value when this stage is turned on.
5	STAGE 3 CUT IN	STAGE 3 cut in, set point value contains the value when this stage is turned on.
6	STAGE 4 CUT IN	STAGE 4 cut in, set point value contains the value when this stage is turned on.
7	STAGE 5 CUT IN	STAGE 5 cut in, set point value contains the value when this stage is turned on.
8	STAGE 6 CUT IN	STAGE 6 cut in, set point value contains the value when this stage is turned on.
9	STAGE 7 CUT IN	STAGE 7 cut in, set point value contains the value when this stage is turned on.
10	STAGE 8 CUT IN	STAGE 8 cut in, set point value contains the value when this stage is turned on.
11	STAGE 9 CUT IN	STAGE 9 cut in, set point value contains the value when this stage is turned on.
12	STAGE 10 CUT IN	STAGE 10 cut in, set point value contains the value when this stage is turned on.
13	STAGE 11 CUT IN	STAGE 11 cut in, set point value contains the value when this stage is turned on.
14	STAGE 12 CUT IN	STAGE 12 cut in, set point value contains the value when this stage is turned on.
15	STAGE 13 CUT IN	STAGE 13 cut in, set point value contains the value when this stage is turned on.
16	STAGE 14 CUT IN	STAGE 14 cut in, set point value contains the value when this stage is turned on.
17	STAGE 15 CUT IN	STAGE 15 cut in, set point value contains the value when this stage is turned on.
18	STAGE 16 CUT IN	STAGE 16 cut in, set point value contains the value when this stage is turned on.

10.2. Common Definitions

10.2.1. Targets, Stage Cut In Values

The control targets, stage cut in values, for up to 16 steps of capacity are specified in set points 3 through 18.

10.2.2. Stage Cut Out Values

The stage cut out values for each step of capacity is calculated by subtracting set point 2 from the individual step cut in value.

10.2.3. Step Delay

The step delay is contained in set point 1. This is the minimum time between changes in capacity.

10.2.4. Controlling Sensor

This is the sensor that has been specified in the PC-Config program as providing the control value. It will normally be either a voltage that is being provided by an external system, entering or leaving temperature or the suction pressure. The set points must be adjusted to agree with the controlling value.

11. MCS-8 Dehumidification Control Logic

Unit defaults to Cooling mode, however the system can be forced into Dehumidification mode by a digital input. The MCS-8 CFG must be setup to have a DEHUMIDIFICATION ENABLE input. When this input is ON the Unit is forced into Dehumidification mode. When the unit is in Dehumidification mode only one of the two evaporators is needed. This means that the second liquid line solenoid is OFF when in Dehumidification mode. While in Dehumidification mode the capacity control is still using the voltage input sensor to determine how many compressors, unloaders are required to run.

12. MCS-8 Defrost Control Logic

12.1. Defrost Introduction

The MCS-8 REFRIG V8 software incorporates an intelligent defrost control algorithm, that is to say it does not use fixed schedules for defrosting the evaporator coils. The defrost cycle is driven based on two sensors, the supply air temperature and the evaporator pressure. This way the defrost cycle is started as soon an evaporator 's coil is iced over and is no longer efficient. Also defrost cycle are only perform when an evaporator coil is iced over, thus eliminating unneeded defrost cycles. The MCS-8 allow for three duration based on type of defrost HI TEMP, MED TEMP, LO TEMP.

12.2. Defrost Setpoints

The actual supply temperature determines which type of defrost occurs. The following chart shows how the micro determines which type of defrost:

Type of Defrost	Evaporator Pressure	Defrost Time
High Temp – If actual supply temp > setpoint #101 DEF-HI TEMP	Setpoint #113 DEF-HI PSI	Setpoint #114 DEF-HI TIME
Med Temp – if actual supply temp > setpoint#102 DEF-MED TEMP	Setpoint #115 DEF-MED PSI	Setpoint #116 DEF-MED TIME
Low Temp – if actual supply temp <= setpoint#102 DEF-MED TEMP	Setpoint #117 DEF-LO PSI	Setpoint #118 DEF-LOW TIME

Based on the type of defrost the logic changes when the defrost starts and for how long it occurs. The micro compares the evaporator pressure to the evaporator setpoint determined by the type of defrost.

12.3. Cooling mode Defrost Cycle

The defrost logic controls each circuit/compressor independently. When the circuit's evaporator pressure is less than the setpoint for 60 seconds and the number of circuits in defrost is less than the MAX DEF EVAP setpoint #109 the defrost cycle is started for the circuit only. A defrost cycle consist of the following:

1. Place evaporator #1 in hot gas defrost for x minutes while using evaporator #2 for refrigeration, then
2. Drip down evaporator #1 for 2 minutes (setpoint #110 DRIP DOWN) while using evaporator #2 for refrigeration, then
3. Place evaporator #2 in hot gas defrost for x minutes while using evaporator #1 for refrigeration, then
4. Drip down evaporator #2 for 2 minutes (setpoint #110 DRIP DOWN) while using evaporator #1 for refrigeration.

Once a defrost cycle has been performed that circuit is not allowed to perform an another defrost cycle for the minimum of five minutes.

Once a defrost cycle has been started by any circuit the type of defrost for all circuit is locked until 10 minutes (setpoint #90 DEF TMP LOCK) after the defrost has completed. This prevents the heat being add by the defrost from changing the type of defrost perform by the other circuits.

12.4. Dehumidification mode Defrost Cycle

The defrost cycle when in dehumidification mode is the same as the cooling mode defrost cycle. There are only two different:

1. The evaporator pressure setpoint for starting the defrost does not change, it always looks to see if the evaporator pressure is less than setpoint #119 DEF-DEHUM to start a defrost cycles
2. The defrost time duration does not change, it always using setpoint #118 DEF-LO TIME.

13. MCS-8 Condenser Control Logic

13.1. Condenser Introduction

Control of common condenser, individual condensers per circuit or condensers that are shared between circuits are supported. The type of condenser plus the number of condenser points (RO's) are specified when building the configuration file. The system supports the following options:

1. **No Condenser** - No condenser specified.
2. **RO Step Common** - If RO Step Common condenser is specified, the highest discharge pressure from any one of the circuits on the system will be the controlling pressure.
3. **RO Step Individual** - If RO Step Individual condenser is specified, then the discharge pressure on that circuit will be the controlling pressure.
4. **RO Step Combined** - If RO Step Combined condenser is specified, then the highest discharge pressure from any one of the compressors on the shared circuits will be the controlling pressure (circuits 1&2 are shared; circuits 3&4 are shared, circuits 5&6 are shared, and circuits 7&8 are shared).
5. **Modulating Common**- If Modulating Common condenser is specified, the highest discharge pressure from any one of the circuits on the system will be the controlling pressure. A change to the modulating analog output position is calculated every 30 seconds based on the Rate of Change of the controlling discharge pressure.

The system will also support a variable speed fan for all three of the air type of condensers. Each circuit can support a variable speed fan.

13.2. RO Step Condenser Cut In – Out Logic

The air condenser set points are as follows:

Set point 45 CND STG1 ON - Condenser stage 1 cut in (ON).
Set point 46 CND STG1 OFF - Condenser stage 1 cut out (OFF).
Set point 47 CND DIFF ON - Differential between condenser stages for cut in (ON).
Set point 48 CND DIFF OFF - Differential between condenser stages for cut out (OFF).
Set point 49 CND MIN RUN - Minimum run time for a condenser stage

Condenser points, (i.e. fans), will be turned on based upon the value in set point (COND ST1 ON) #44, when the discharge pressure reaches this value the first condenser point is turned on. If additional condenser points exist, they will be turned on when the pressure exceeds the previous cut in value plus the value contained in (COND DIFF IN #47) set point. As the discharge pressure is reduced, the condenser points be turned off based upon the set point (COND ST1 OFF #46) value plus the condenser step times the value contained in (COND DIFF OUT #48) set point. The first step will be turned off based upon the valve in the set point (COND ST1 OFF).

Example Set point 45 CND STG1 ON = 180.0P
Set point 46 CND STG1 OFF = 150.P
Set point 47 CND DIFF IN = 30.0P
Set point 48 CND DIFF OFF = 15.0P

COND FAN1 ON @ 180.0 P DISCHARGE
COND FAN 1 OFF @ 150.0 P

COND FAN2 ON @ 210.0p (180.0 + 30.0)
COND FAN2 OFF @ 165.0p (150.0 +15.0)

COND FAN3 ON @ 240.0p (210.0 + 30.0)
COND FAN3 OFF @ 180.0p (165.0 + 15.0), etc.

13.3. RO Step Condenser With Variable Speed Fan

The set points for air condensers with for variable speed fan control are as follows:
Setpoint 54 CND MIN SPD - Minimum variable speed allowed.
Setpoint 55 CND MAX SPD - Maximum variable speed allowed.

The purpose of the variable speed fan is to reduce the cycling of the fans by adjusting the speed of the variable fan point. This control works in conjunction with the cut in and cut out logic of each circuit. The cut in and cut out logic turns on or off the various condenser fan points. When a fan is turned on, the speed of the variable point for that circuit is set to minimum allowed percentage. When a fan is turned off, the speed of the variable point is set to 75%.

Once a fan point has been turned on, the system will vary the fan speed for that circuit. This will be based upon where the discharge pressure is in relationship to turning the current fan point off and turning the next fan point on.

13.4. Modulating Condenser

The example is of a system with a water condenser. The water valve will be modulated.
The water condenser set points are as follows:

Set point	50 CND VLV TARG	- Discharge target pressure.
Set point	51 CND VLV DIV	- Condenser valve adjustment sensitivity.
Set point	52 CND VLV MIN	- Condenser valve minimum opening.
Set point	53 CND VLV ROC-	- Condenser max negative Rate of Change

Condenser water valve will be adjusted based upon the Rate of Change of the discharge pressure. The logic is setup to modulate a water valve using the analog output (0 to 10vdc), to maintain the discharge pressure (logic selects the highest discharge pressure from the running circuits).

Example	CND VLV TARG	=	190.0P
	CND VLV DIV	=	1
	CND VLV MIN	=	25%
	CND VLV ROC-	=	-5.0P

14. MCS-8 Set Point Definitions

14.1. Set point elements that can be viewed:

1) Number - the number is from 1 to 120, maximum number of set points that are supported. Only active set points will be displayed.
2) Name - the set point's name consists of up to 12 alphanumeric characters. The name is displayed following the number on the first line of the LCD display. The name of the set point can be changed to make it meaningful to the given application. **HOWEVER** the function of the set point will remain the same.
3) Value - this is the value or target of a set point. This value is displayed on the second line of the LCD display. With the proper authorization this value can be changed within limits that have been established by the PC-Config program.
4) Time - this is the time that the set point must be true before it will trip. E.g. a high discharge safety must have its value exceeded for this length of time before it will trip. This time is always in seconds and it is not displayed on the LCD and can only be seen via the PC-Connect program, it can be changed in both the PC-Connect and the PC-Config program.
5) Type - the type indicates the action that will be taken.

A list of set points and all their elements can be obtained from the PC-Config program.

14.2. Set point Types:

There are three different types of set points. The type determines the action that the system will take.

14.2.1. SETPOINT

This type of set point's value contains a target or provides information for some type of action. The time element in this type is not used. An example are the set points defined in sections 12.1 through 12.7.

14.2.2. LOCKOUT

This type of set point's value contains a safety level and the time that the safety must be violated before the safety will trip. Once a safety has tripped the system will take the appropriate action, shutting down the entire package or an individual circuit (compressor) depending on the purpose of the safety. The system will then wait the safety down time contained in that set point before trying to return the system to normal. If successful, the system will continue to operate. If a second trip occurs on the same set point with in the lock out delay time that is contained in that set point the system will move to a LOCKOUT state. This will require manual intervention to reset the system. With each safety trip, the system will generate an alarm, refer to Alarms and Safeties section of this manual.

The safety down time and the lock out delay time are unique for each set point. They can not be viewed in a live unit. They are set in the PC-Config program.

14.2.3. ALARM

This type is similar to the LOCKOUT set point except it will never cause a lock out. The system will continue to try to return to normal operation after waiting the safety down time. An ALARM set point type will never require manual intervention to reset the system.

15. MCS-8 Set Points

15.1. Voltage SI Control Method setpoints #1-18

#	NAME	DESCRIPTION
1	STAGE DELAY	Delay between stages being turned on.
2	STAGE CUT OUT	Off set used in calculating the cut out value. Subtracted from the stage cut in set points #3 through #18
3	STAGE 1 CUT IN	STAGE 1 cut in, set point value contains the value when this stage is turned on.
4	STAGE 2 CUT IN	STAGE 2 cut in, set point value contains the value when this stage is turned on.
5	STAGE 3 CUT IN	STAGE 3 cut in, set point value contains the value when this stage is turned on.
6	STAGE 4 CUT IN	STAGE 4 cut in, set point value contains the value when this stage is turned on.
7	STAGE 5 CUT IN	STAGE 5 cut in, set point value contains the value when this stage is turned on.
8	STAGE 6 CUT IN	STAGE 6 cut in, set point value contains the value when this stage is turned on.
9	STAGE 7 CUT IN	STAGE 7 cut in, set point value contains the value when this stage is turned on.
10	STAGE 8 CUT IN	STAGE 8 cut in, set point value contains the value when this stage is turned on.
11	STAGE 9 CUT IN	STAGE 9 cut in, set point value contains the value when this stage is turned on.
12	STAGE 10 CUT IN	STAGE 10 cut in, set point value contains the value when this stage is turned on.
13	STAGE 11 CUT IN	STAGE 11 cut in, set point value contains the value when this stage is turned on.
14	STAGE 12 CUT IN	STAGE 12 cut in, set point value contains the value when this stage is turned on.
15	STAGE 13 CUT IN	STAGE 13 cut in, set point value contains the value when this stage is turned on.
16	STAGE 14 CUT IN	STAGE 14 cut in, set point value contains the value when this stage is turned on.
17	STAGE 15 CUT IN	STAGE 15 cut in, set point value contains the value when this stage is turned on.
18	STAGE 16 CUT IN	STAGE 16 cut in, set point value contains the value when this stage is turned on.

15.2. Setpoints for Unit Control Options

19	BARREL HEATER	The barrel heater to turned on when the ambient temperature is less than this value and turned off when the ambient temperature is greater than this value plus 5.0°F (or 2.5°C)
20	Not Used	Not Used
21	Not Used	Not Used
22	LOW AMBIENT	If the ambient temperature is below this value the package will be disabled, unit state will be AMBIENT OFF. Once off on low ambient the unit will remain off until the ambient raises above this set point value by 5.0F (or 2.5C).
23	POWERUP DELAY	This is the time that the system will remain in the START UP state before moving to the next state.
24	HI AMBIENT	If the ambient temperature is above this value the package will be disabled, unit state will be AMBIENT OFF. Once off on high ambient the unit will remain off until the ambient drops below this set point value by 5.0F (or 2.5C).

15.3. Setpoints for Condenser Control

45	CND STG1 ON	Air cooled- When the discharge pressure is above this value, turn on the first stage of the condenser fans.
46	CND STG1 OFF	Air cooled- If stage 1 is on and the discharge pressure drops below this value turn off the first stage of condenser fans.
47	CND DIFF ON	Air cooled- Differential PSI to turn on the remaining stages of condenser fans.
48	CND DIFF OFF	Air cooled- Differential PSI to turn off the remaining stages of condenser fans.
49	CND MIN RUN	Air cooled- Once a condenser fan stage has been turned on, it will remain on for at least the amount of minutes specified in this set point.
50	CND VLV TARG	Water cooled- Target discharge pressure to maintain by integration and Rate of Change logic..
51	CND VLV DIV	Water cooled- Usually 1. Allows control of the amount the valve is adjusted. The larger the number the smaller the valve adjustment.
52	CND VLV MIN	Water cooled- Minimum valve opening percentage allowed.
53	CND VLV ROC-	Water cooled- Maximum negative discharge pressure Rate of Change allowed. If the actual rate of change is less then this set point then stop opening the valve. The absolute value of this set point also severs as the maximum positive rate of change allowed. If the actual rate of changes is greater than the absolute value of this setpoint then stop closing the valve.
54	CND MIN SPD	Minimum speed percentage for variable speed condenser control.
55	CND MAX SPD	Maximum speed percentage for variable speed condenser control.
56-59	Not Used	Not Used

15.4. Setpoints for Compressor Control

60	PMP DWN ON	When the continuous pump down option is specified and the compressor is off and the suction pressures exceed this value the compressor will go through a normal pump down sequence. Only used in CHL R08 software version.
61	PMP DWN OFF	This is the suction pressure value for turning off the compressor when in the PUMP DOWN state.
62	PMP DWN DELY	Maximum time delay (in seconds) that a compressor can remain in the PUMP DOWN state.
63	ANTI-CYCLE	This is the anti cycle time delay (in seconds). A circuit will remain in the ANTICYC state for this length of time.
64	COMP MIN RUN	This is the minimum run time (in minutes) for a compressor once it is turned on. This minimum run time is bypass only for the safeties.
65	FLA COMP#1	Full Load Amps for the compressor on circuit 1. For screw compressors, the ampere when the compressor is fully loaded. This value is used to calculate the compressor current FLA %, which is used to control the loading and unloading of the slide valve. For screw and all types of compressors, This value is used to calculate the high and the low ampere safeties limits. Refer to set points 75 and 76.
66	FLA COMP#2	Full Load Amps for the compressor on circuit 2. Refer in set point 65 for definition.
67	FLA COMP#3	Full Load Amps for the compressor on circuit 3. Refer in set point 65 for definition.
68	FLA COMP#4	Full Load Amps for the compressor on circuit 4. Refer in set point 65 for definition.
69	FLA COMP#5	Full Load Amps for the compressor on circuit 5. Refer in set point 65 for definition.
70	FLA COMP#6	Full Load Amps for the compressor on circuit 6. Refer in set point 65 for definition.
71	FLA COMP#7	Full Load Amps for the compressor on circuit 7. Refer in set point 65 for definition.
72	FLA COMP#8	Full Load Amps for the compressor on circuit 8. Refer in set point 65 for definition.
73	STARTER DLAY	Time delay (in seconds) Between the first and second relay being turned on. Used for part wind (typical value of 1) and star delta (typical value of 5) starter.
74	Not Used	Not Used

15.5. Setpoints for Compressor Safeties

75	HI AMPS	This set point is a percentage of the FLA; it is used to create the high amp draw limit. Depending on the circuit that is being tested; the value of this set point is multiplied by either the value in set points 65 through 72 to obtain the circuit's high limit. This value is tested in the high amp safety, if the amps exceed this value for the time specified in this set point the safety is tripped.
76	LO AMPS	This set point is a percentage of the FLA; it is used to create the low amp draw limit. Depending on the circuit that is being tested; the value of this set point is multiplied by either the value in set points 65 through 72 to obtain the circuit's low limit. This value is tested in the low amp draw safety, if the amps exceed this value for the time specified in this set point the safety is tripped.
77	LOW SUCTION	If active, the system checks for low suction pressure for each running compressor. The system will compare the suction pressure sensor reading to this value. It must be less than the value for the period of time specified in the set point before this set point will trip.
78	LO SUCT UNLD	The purpose of this set point is to take corrective action before a low suction pressure safety occurs. If a circuit has more than one step and it is fully loaded and if the suction pressure is less than the value of the safety set point (LOW SUCTION) plus the value of this set point, the system will turn off one step of capacity. An infinite step compressor will be forced to unload until the suction pressure raise above the calculated value. The circuit state will be changed to LO SUCT HOLD. The circuit will remain in this state for a minimum of 5 minutes. At that time, if the suction pressure has increased to a level greater then the value of set point LOW SUCTION plus the value of set point LOW SUCT RELD the compressor will return to normal control.
79	LOW SUCT RELD	See set point 78 description
80	UNSAFE SUCT	If active, the system checks for low suction pressure that is in a unsafe condition for each running compressor. The system will compare the suction pressure sensor reading to this value. It must be less than the value for the period of time specified in the set point before this set point will trip. Note the time period specified should be very short, 2-5 seconds. This safety set point trips the circuit to the LOCKOUT state immediately, no retry.
81	HI DISCH PSI	If active, the system checks for high discharge pressure condition for each running compressor. The system will compare the discharge pressure sensor reading to this value. It must be greater for the period of time specified in the set point before this safety will trip.
82	HI DISC UNLD	The purpose of this set point is to take corrective action before a high discharge pressure safety occurs. If a circuit has more than one step and it is fully loaded and its discharge pressure exceeds the value of the safety set point HI DISCH PSI (set point 81) minus this set point, the system will turn off one step of capacity. A screw compressor will be forced to unload until the discharge pressure falls below the calculated value. The circuit state will be changed to HI DISC HLD. The circuit will remain in this state for a minimum of 5 minutes. At that time if the discharge pressure has dropped below the value of the HI DISCH PSI minus the HI DISC RELD (set point 83) the compressor will return to normal control.
83	HI DISC RELD	This set point works in conjunction with set point 82. Refer to that set points description.
84	Not Used	Not Used
85	LO DISC PSI	If active, the system checks for low discharge pressure. The system will compare the sensor reading to this value. It must be less than the value for the period of time specified in the set point before a safety trip occurs.

86	Not Used	
87	HI DISCH TMP	If active, the system checks for high discharge temperature condition for each circuit that has at least one step on. The system will compare the discharge temperature sensor reading to this value. It must be greater for the period of time specified in the set point before this safety will trip.
88	HI DISC UNLD	The purpose of this set point is to take corrective action before a high discharge temperature safety occurs. If a circuit has more than one step and it is fully loaded and its discharge temperature exceeds the value of the safety set point HI DISCH TMP (set point 87) minus this set point, the system will turn off one step of capacity. A screw compressor will be force to unload until the discharge temperature falls below the calculated value. The circuit state will be changed to HI DISC HLD. The circuit will remain in this state for a minimum of 5 minutes. At that time if the discharge temperature has dropped below the value of the HI DISCH TMP minus the HI DISC RELD (set point 89) the compressor will return to normal control.
89	HDISC T RELD	This set point works in conjunction with set point 88. Refer to that set points description.
90	Not Used	
91	LOW OIL DIF	If active, the system checks for low differential oil pressure. The system will compare the calculated differential oil pressure to this value. It must be less than the value for the period of time specified in the set point before the safety will trip.
92	UNSAFE OIL	If active, the system checks for low differential oil pressure. The system will compare the calculated differential oil pressure to this value. It must be less than the value for the period of time specified in the set point before the safety will trip. The time delay for this set point should be very short 2-5 seconds. This safety trips to a lockout no retries are attempted. Manual intervention is required.
93	Not Used	Not Used
94	HI OIL TEMP	If active, the system checks for high oil temperature. The system will compare the oil temperature sensor reading to this value. It must be ON or greater for the period of time specified in the set point before this set point will trip. The sensor can be either an analog or digital input.
95	HI MTR TEMP	If active, the system checks for high motor temperature. This can be either a digital input or an analog input, the system will compare the sensor reading to this value. It must be ON or greater for the period of time specified in the set point before this set point will trip.
96	NO CMP PROOF	If this set point is active and there is a digital input indicated for compressor proof, when the compressor is on, the compressor proof will be checked for that circuit.
97	DIRTY FILTER	Only used for screw compressors. If the discharge pressure minus the oil filter pressure is less than this value for the time specified a safety trip will occur.
98-99	Not Used	
100	PHASE LOSS	Used of individual compressor phase loss safeties.
101-102	DEFROST	SEE DEFROST SETPOINT POINTS FOR DESCRIPTION.
103	LEAD COMP	Enables the user to specify the lead compressor. If a value is less than the maximum number of compressor the lead indicator is set to this value. If the value is zero then auto rotation is enabled.
104	COMP ROTATION	Specifies the number of days between rotation (setpoint #103 must be set to zero to enable auto rotation). If the value is zero then rotation will occur with every capacity cycle.

15.6. Setpoints for Unit Safeties

111	FREEZE	If active, the system checks for freeze protection. The system will compare the chilled water out temperature to this value. It must be less than the value for the period of time specified in the set point before this safety will trip.
112	NO STOP	This set point is used to insure that a compressor is actually off when the system has called for it to be off. The value of the set point contains a percentage of the FLA COMP set points 65-72. If the compressor ampere is greater then this percentage of the FLA setpoint for the period specified the compressor is still running and the entire unit is locked out and a NO STOP alarm is generated. If a Control power relay is setup then it will be turned off when this safety trips.

15.7. Setpoints for Defrost

90	DEF TMP LOCK	Time duration, in minutes, to lock in the current type of defrost to avoid falsely changing the setpoints due to a raise in supply temperature caused by the heat added during a defrost cycle.
101	DEF-HI TEMP	The lower boundary for determining a HI TEMP defrost type.
102	DEF-MED TEMP	The lower boundary for determining a MED TEMP defrost type
109	MAX DEF EVAP	The maximum number of circuits allowed in defrost at the same time.
110	DRIP DOWN	Time duration, in minutes, to hold the liquid line solenoid off after hot gas defrost to allow time for the water to drip down off the coil.
113	DEF-HI PSI	The evaporator pressure setpoint for starting a HI TEMP defrost.
114	DEF-HI TIME	Time duration, in minutes, for a HI TEMP hot gas defrost
115	DEF-MED PSI	The evaporator pressure setpoint for starting a MED TEMP defrost.
116	DEF-MED TIME	Time duration, in minutes, for a MED TEMP hot gas defrost
117	DEF-LO PSI	The evaporator pressure setpoint for starting a LO TEMP defrost.
118	DEF-LO TIME	Time duration, in minutes, for a LO TEMP hot gas defrost
119	DEF-DEHUM	The evaporator pressure setpoint for starting a DEHUM defrost.

16. MCS-8 AUTHORIZATION FUNCTION

The authorization code is a special four-character code that enables access in to the MCS-8 system. The code must be numeric with values between 1 and 8 if it is to be entered from the Keypad/Display. If the system is being accessed via PC-Connect program, the code may consist of any valid alpha/numeric characters. Each system can have up to 15 different authorization codes. This provides the capability of issuing different codes to different people if desired. There are four levels of authorization, which provide different capabilities with in the system. The authorization code and the associated level can not be displayed or viewed in an MCS-8 system. These are established when building the configuration file in the PC-Config program. The authorization codes must be protected and remain confidential, if they are compromised unauthorized personnel can gain access to the system.

From the Keypad/Display the following changes can be made based upon the authorization level:

FUNCTION	VIEW	SERVICE	SUPERVI-SORY	FACTORY
SENSOR OFFSETS	NO	YES	YES	YES
SENSOR DIAGOSTICS	NO	YES	YES	YES
CLEAR ALARM HISTORY	NO	NO	NO	YES
CLEAR POINT INFORMATION	NO	NO	NO	YES
DATE & TIME SET	YES	YES	YES	YES
DAY OF WEEK SET	YES	YES	YES	YES
CHANGE NO FLOW LOCKOUT OR SHUT DOWN	NO	NO	NO	YES
CHANGE ROTATE YES OR NO	NO	NO	NO	YES
CHANGE MANUAL/AUTO SETTINGS	NO	NO	YES	YES
CHANGE SET POINT VALUES*	NO	YES	YES	YES
CHANGE OPERATING SCHEDULES	NO	YES	YES	YES
CHANGE HOLIDAY DATES	NO	YES	YES	YES
LOCK OUT RESET	YES	YES	YES	YES

*Note - before a set point can be changed the set point must be able to be viewed.

17. MCS-8 Standard Control Options

The following options are specified in the PC-Config program when building the configuration. These options are used to personalize the system to meet the individual control requirements.

17.1. General Options

- Control method can be based upon the control zone strategy or upon a voltage input that indicates the number of stages to be on.
- The control temperature can specify either the return or leaving sensor.
- Specify if the anti recycle timer should start when the compressor is turned on or turned off. (All circuits)
- Number of circuits, maximum of eight.
- Alarm RO, generate an ALARM RO. This point will be turned on when ever an alarm is generated.
- Specify auto rotation for circuits.
- Low and/or high ambient shut down.

17.2. Compressor Options

- Type of compressors:
  - Reciprocating with oil,
  - Reciprocating with out oil,
  - Screw with oil,
  - Scroll,

- Four compressor steps per circuit can be supported. Compressor plus three additional steps of either compressors or unloaders and hot gas bypass points. Note, compressor safeties relate to a circuit. If multiple compressors are on a circuit and a safety trips all compressor on that circuit will be turned off.

- Specify that part winding, two RO points will be used with fixed step compressors, the first RO will be turned on with the second RO being turn on the number of seconds later that is specified in set point #73. (By circuit) If not part winding, only allocate one RO point for the compressor.

- Type of pump down, when the compressor is off, continuous will cause the compressor to be turned on if the suction pressure rises above the set point value. Else, the compressor will be pumped down only when the compressor is being turned off. Note, when the compressor is started the liquid line solenoid is not opened until the suction pressure reaches the value that is contained in the pump down set point. A liquid line solenoid is required. (All circuits)

17.3. Condenser Options

- Number of condensing stages.
- Type of condenser:
  - None,
  - RO Step Common (all compressors monitored for discharge pressure),
  - RO Step Individual per circuit (compressor on circuit monitored for discharge pressure),
  - RO Step Combined, circuits 1 & 2 and circuits 3 & 4 will share a condenser (compressor on related circuits monitored for discharge pressure),
  - All of the RO Step type condenser can have a variable speed fan per circuit,

- Modulating Common. This is usually used to control a water condenser with a value that will be modulated depending on the rate of change of the discharge pressure

17.4. Unit Barrel Heater Options

- Unit Barrel Heater, if specified a heater for the unit barrel will be controlled based upon ambient temperature and set point #19, BARREL HEATER.

17.5. Hot Gas Bypass

HOT GAS BYPASS used as the 1st stage of capacity.

17.6. On/Off Switches

- The following digital input switches can be associated with the system, their action will affect the unit or an individual circuit, then action will only affect that circuit:

- Flow switch, if off the system has lost flow. The system wills either lock out, if NO FLOW set point is active, or shut down, if NO FLOW set point is inactive.

- Pump down switch, if on and the compressor is off, will not start the compressor. If the compressor is on, the system moves to the pump down state to begin the process of turning off the compressor(s) in normal steps.

- Run/Stop, if off the system will not run. This is usually wired to a RUN/STOP switch that is manually positioned. If the system is running, the system moves all circuits (compressor) to off in normal steps.

- Network Run/Stop, if off the system will not run. This input is provided by another system that resides on the network. It functions in the same matter as the Run/Stop switch.

- Emergency Stop switch, if on, the system will be shut down immediately and will remain disabled until the switch is off.

17.7. Low Suction Holding

This option is activated when the set point #78, LO SUCT UNLD, is active. The purpose of this option is to take corrective action prior to a safety being tripped. When the suction pressure is below the value calculated by adding the value of this set point to the value of the LOW SUCTION set point for the time specified, the system will take the following action:

- For a fixed step compressor, the system will turn off one step of capacity associated with that compressor. The circuit (compressor) state will be LO SUCT HOLD. The circuit will remain in that state until the capacity control indicates that another step is to be unloaded or if after 5 minutes the suction pressure has turned to normal.

Normal pressure is the value calculated by adding the value of the LO SUCT RELD set point 79 to the value of the LOW SUCTION set point 77.

Refer to set point #78 and 79 for additional information.

17.8. High Discharge Pressure Holding

This option is activated when the set point #82, HI DISC UNLD, is active. The purpose of this option is to take corrective action prior to a safety being tripped. When the discharge pressure is above the value calculated by subtracting the value of this set point from the value of the HI DISCH PSI set point for the time specified, the system will take the following action:

- For a fixed step compressor, the system will turn off one step of capacity associated with that compressor. The circuit (compressor) state will be HI DISC HOLD. The circuit will remain in that state until the capacity control indicates that another step is to be unloaded or if after 5 minutes the discharge pressure has turned to normal.

Normal pressure is the value calculated by subtracting the value of the HI DISC RELD set point 83 to the value of the HI DISC PSI set point 81.

Refer to set point #82 and 83 for additional information.

17.9. High Discharge Temperature Holding

This option is activated when the set point #88, HI DISC UNLD, is active. The purpose of this option is to take corrective action prior to a safety being tripped. When the discharge temperature is above the value calculated by subtracting the value of this set point from the value of the HI DISCH TMP set point for the time specified, the system will take the following action:

- For a fixed step compressor, the system will turn off one step of capacity associated with that compressor. The circuit (compressor) state will be HI DISC HOLD. The circuit will remain in that state until the capacity control indicates that another step is to be unloaded or if after 5 minutes the discharge temperature has turned to normal.

Normal pressure is the value calculated by subtracting the value of the HI DISC RELD set point 89 to the value of the HI DISC TMP set point 87.

Refer to set point #88 and 89 for additional information.

17.10. High Ampere Holding

This option is activated when the set point #75, HI AMPS %, is active. The purpose of this option is to take corrective action prior to a safety being tripped. When the amp draw is with in one-half of the calculated HI AMP safety value, the system will take the following action:

For a fixed step compressor, the system will turn off one step of capacity associated with that compressor. The circuit (compressor) state will be HI AMP HOLD. The circuit will remain in that state until the capacity control indicates that another step is to be unloaded or if after 5 minutes the amp draw has turned to normal.

17.11. Control Power Relay –No Stop

This option provides the capability of interrupting the power supply to the compressors in the system. A relay output, referred to as the control relay, must be wired so that when it is off no power reaches the compressors. This is a safety measure that will insure that the compressors are off then the system calls for them to be off. The relay output must be indicated in the PC-Config program and set point 112, NO STOP, must be active. The system will continually monitor the amp draw of compressors that the system has in an off state. The system will calculate the minimum amp draw by multiplying the FLA for that compressor times the percentage value in the NO STOP set point. If the amp draw is greater than this value for the time specified; the system will turn the

control relay off, generate a NO STOP alarm and place the system in a lockout state. This provides an additional level of protection.

17.12. Part Wind or Star Delta Starter

Either a part winding or star delta type of compressor starter is supported. This option is specified in the PC-Config program and will require two successive relay output points. When this option is specified, set point #73, STARTER DLAY, must contain the delay in seconds before the second relay output is turned on. This delay is normally 1 second for part winding or 5 seconds for a star delta starter. With this option, when a compressor is to be turned on, the first relay output is turned on and the system will wait the time specified in set point 73 before the second relay output is turned on.

17.13. Low & High Ambient Shutdown

The system supports both a low and a high ambient shut down. This option requires an ambient temperature sensor and both LOW AMB OFF set point (#24) and HIGH AMB OFF set point (#26). The AMBIENT OFF state is entered when the ambient temperature falls below the LOW AMB OFF set point (#24) or is above the HIGH AMB OFF set point (#26). The system will remain in this state until the ambient temperature raises 5.0F (or 2.5C) above the LOW AMB OFF set point value or drops 5.0F (or 2.5C) below the HIGH AMB OFF set point value. When the unit is in this state, the individual circuit states if active are moved to the CMP IS OFF state through the normal staging function. One capacity STEP will be moved per second.

17.14. English or Metric sensor readings

The system supports either English or Metric sensor readings, this is specified in the PC-Config program. All sensor values and all software-coded offsets are automatically converted into the option selected and displayed with the appropriate character. The following table contains the display character:

SENSOR READING	ENGLISH CHARACTER	METRIC CHARACTER
Temperature	F	C
Pressure – Gage Reading	P	B
Pressure – Absolute Reading	p	b
Humidity	%	%
Digital or Switch		
Amp or CT	A	A
Voltage	V	V
Refrigeration Level	%	%

NOTE: Set point values are **NOT** automatically adjusted. They must be set up for the proper method of sensor readings. Their display character will be automatically adjusted.

17.15. Compressor Auto Rotation

The auto rotation option is selected by setting the value in set point #103, LEAD COMP to zero. If this value is not zero, it will contain the number of the lead circuit (compressor) and auto rotation is disabled. Note this set point can be manually changed to force a different compressor as the lead compressor or to enable auto rotation.

When this option is enabled, the system will rotate the compressors based upon the value in set point # 104, CMP ROTATION.

If set point # 104 value is zero, rotation will occur with every complete capacity cycle and the next compressor will be selected as the lead compressor.

Else, the value is the number of days between rotation. At midnight the system will check if it is time to rotate compressors. If yes, the system will check the run hours on each compressor and select the one with the least amount of run hours to be the lead compressor.

If set point # 104 is set up as an ALARM type of set point, a compressor rotation message will be generated each time a compressor is rotated.

18. MCS-8 Alarms and Safeties

18.1. Introduction

There are three types of alarms that are generated by the MCS-8 control logic:

- Information only alarms,
- MCS-8 system alarms and
- Unit set point safety alarms.

All of the alarms have the same format. The alarm is identified and it is date time stamped. Alarms can be viewed from the MCS-8 by pressing the ALARM STATUS (4) key or from the PC-Connect program.

18.2. Information only alarms

18.2.1. System generated alarms

The following alarms are generated to provided information; they will not cause a change in the control algorithm such as a lock out condition or a relay output being forced off.

- POWER FAILED
- POWER RETURNED
- COMPUTER RESET
- BATTERY FAILED
- LCD FAILURE
- HW DATE INVALID
- HW TIME INVALID
- SW DATE INVALID
- SW TIME INVALID
- RAM INTEGRITY
- WATCHDOG RESET

18.2.2. Alarms as a result of individual action

The following alarms indicate that an individual took action:

- ALARMS CLEARED
- STPT CHANGED
- RO MANUAL
- AO MANUAL
- SI MANUAL
- POINT INFO CLEAR
- CLOCK SET
- CFG DOWNLOADED

18.2.3. Alarms generated by the control algorithm

The following alarms indicate that the control algorithm took action:

- ROTATED LEAD
- DAYLIGHT SAVINGS

18.3. MCS-8 system alarms

18.3.1. Alarms are generated by the MCS-8 control algorithm:

18.3.1.1.Configuration problem alarms

These alarms indicate a problem with the configuration file that has been loaded into the system. The system is not operational, a configuration must be transmitted to the unit form PC-Connect or the Config chip must be replaced with a valid one.

- INVALID CONFIG. (check sums are incorrect)
- INVALID CFG VER (version number of the configuration is invalid)
- INVALID CFG TYPE (the type does not agree with software, unit software with a home unit configuration)

18.3.1.2.MCS local network problem alarms

These alarms indicate problems with the MCS local network, the system can be accessed but the system is in a lock out state, LOST I/O.

- MCS-RO#1 LOST (#1-5) – Communication problem with a relay output board.
- MCS-SI#1 LOST (#1-5) – Communication problem with a sensor input board.
- LOST IO SHUTDOWN – Unit locked out because of communication problem.

18.3.1.3.Key sensors problem alarms

This alarm indicate a problem with a key sensor, it is either shorted or open. The alarm will contain ALARM followed by the 8-character name of the sensor.

The following sensors related to the entire system are tested:

- ambient temperature, if failed: alarm only no lock out

The following circuit sensors are tested. If they fail that circuit only is locked out.

- suction pressure and temperature
- discharge pressure and temperature
- oil pressure and temperature
- motor temperature (if it is an analog input device)

18.3.1.4.EMERGENCY STOP alarm

This alarm indicates that the emergency stop switch has been turned on. The system can be accessed but the entire system is in a lock out state.

- EMERGENCY STOP

18.4. Set point safety alarms.

18.4.1. Introduction

The MCS-8 unit algorithm incorporates a number of safety checks to ensure that the various components that make up the unit are not damaged. These types of safeties are based upon set points. When a safety trips for the first time, the compressor will be set to “SAFETY TRIPPED” state. The compressor will remain in “SAFETY TRIPPED” state for ten minutes and then move to the “CMP IS OFF” state where the compressor will be allowed to run if required. If the same safety trips occurs again within two hours of the first trip, the compressor will be set to “CMP LOCKED OUT” state, which requires a manual reset to restart the compressor. In this matter the MCS-8 attempts to take corrective action to protect the compressors but avoid nuisance trips.

The time in the safety state and the time between safeties are specified in the individual set points. This enables the times to be unique for each lock out set point.

18.4.2. Sensor inputs used in conjunction with MCS-8 set point safeties:

Suction Pressure

Pressure transducer to read the suction pressure. (Optional digital input)

Discharge Pressure

Pressure transducer to read the discharge pressure. (Optional digital input)

Oil Pressure

Pressure to read the oil pressure (optional digital input)

Oil Differential Pressure

Calculated valve of the oil pressure as follows:

- Fixed step compressors, oil psi minus suction psi
- Screws with oil pump, Oil psi minus discharge psi
- Screws without oil pump, discharge psi minus suction psi

Oil Temperature

Either a temperature sensor or a digital input that indicates when a high temperature condition exists.

Discharge Temperature

Either a temperature sensor or a digital input that indicates when a high temperature condition exists.

Motor Temperature

Either a temperature sensor or a digital input that indicates when a high temperature condition exists.

Motor Amps

Sensor input that measures AMP draw of the compressor. (optional digital input)

Motor Fault

A digital input that indicates when a motor fault condition exists or an analog sensor that will read resistance value. If an analog sensor, a setpoint is required that contains the resistance value that the sensor will indicate on safety trip. This is a general fault indicator, that may have been caused by high temperature, amp draw etc.

Compress Proof

A digital input that when on indicates that a compressor is running.

Flow Switch

A digital input that indicates that flow through the unit barrel exists. There can be one switch per unit or one for each circuit.

18.4.3. Set point safeties

For a safety to be interrogated, both the associated sensor input and the lockout set point must be active. If a safety trips, the alarm name will consist of the set point name plus additional identification such as point number or circuit number if applicable.

The system exercises “smart” safety testing in the following manner:

If a safety applies to a circuit and it is an active lockout type of a set point, the first time this safety trips an alarm will be generated and the circuit will be shut down and placed in a safety state. After ten minutes the system will reactivate this circuit if the safety condition is no longer true. If the same safety trips within two hours, the circuit will be locked off and a manual intervention is required.

The time in the safety state and the time between safeties are specified in the individual set points. This enables the times to be unique for each lock out set point.

The following are a list of safeties that are incorporated in the standard unit algorithm control for fixed step compressors. These safeties are checked every second. Note, for a multiple circuit system, each circuit is tested individually. If a safety condition exists, action will be taken with that circuit only, other circuits will continue to function.

Freeze Protection

If the leaving liquid temperature drops below the set point value the system, and all circuits, will enter a lockout state and a freeze notification alarm will be generated. You have the option of one freeze protect for the package or individual freeze protections by circuit. This is selected at PC-Config time.

Phase Loss Protection

Phase loss, as indicated by the phase loss monitor, will result in the system and all circuits being locked off and a phase loss notification alarm will be generated. No set point is required.

Emergency Stop

Emergency stop, as indicated by the emergency stop switch, will result in the system and all circuits being locked off and an emergency stop notification alarm will be generated. No set point is required.

Low Differential Oil Pressure

This safety is designed to meet the compressor manufacturer requirements on oil pressure. For the first 5 (60 seconds if setup as Hitachi screw compressors) seconds following a compressor start

this safety is NOT checked. For the next 30 seconds, if the oil differential pressure drops below ½ of the value of the set point or the digital input turns ON and it remains there for the time specified in the safety time of that set point, the compressor will be locked out and a low oil alarm generated. After this time period, if the oil differential pressure drops below the value of the set point and it remains there for the time specified in the safety time, the compressor will be locked out (as described in section 'Unit set point safety alarms.') and a low oil alarm generated. This enables the set point value and the safety time to be much tighter. This safety is interrogated when the compressor is on and not in a pump down state.

Low Suction Pressure

If the suction pressure drops below the value of the set point or the digital input turns ON and it remains there for the time specified in the safety time, the compressor will be locked out and a low suction alarm generated. For the first 5 minutes after the compressor has started the safety time is extend by 2 minutes, this enables the set point safety time to be set much tighter for normal operation. This safety is bypassed when the compressor is in the "CMP PUMP DOWN" state. This safety can also be used as a freeze protection based upon the suction PSI.

Unsafe Suction Pressure

This safety is similar to the low suction pressure safety except this set point can be set up with a lower value and a very short safety time. If the suction pressure drops below the value of the set point or the digital input turns ON and it remains there for the time specified in the safety time of that set point, the compressor will be locked out and a low suction alarm generated. This safety will always cause a lock out on the first trip requiring a manual reset to restart the compressor. For the first 5 minutes after the compressor has started the safety time is extend by twice the normal time delay, this enables the set point safety time to be set much tighter for normal operation. . This safety is bypassed when the compressor is in the "CMP PUMP DOWN" state.

Low Discharge Pressure

If the discharge pressure drops below the value of the set point and it remains there for the time specified in the safety time of that set point, the compressor will be locked out and a low discharge alarm generated.

High Discharge Pressure

If the discharge pressure raised above the value of the set point or the digital input turns ON and it remains there for the time specified in the safety time of that set point, the compressor will be locked out and a high discharge alarm generated.

High Discharge Temperature

If the discharge temperature analog input raises above the value of the set point or the digital input turns ON and it remains there for the time specified in the safety time, the compressor will be locked out and a high temperature alarm generated.

HI Motor Temp or Motor Fault

If the high motor temperature input raises above the value of the set point or the digital input turns ON and it remains there for the time specified in the safety time, the compressor will be locked out and a high motor temperature or motor fault alarm generated.

Hi Oil Temp

If the oil temperature raises above the value of the set point or the digital input turns ON and it remains there for the time specified in the safety time of that set point, the compressor will be locked out and a high oil temperature alarm generated.

Hi Motor Amp

If the ampere analog input raises above the value of the set point or the digital input turns ON and it remains there for the time specified in the safety time of that set point, the compressor will be locked out and a high motor amp alarm generated. This safety is bypassed for the first 3 seconds after a compressor has started.

Low Motor Amp

If the ampere analog input drops below the value of the set point and it remains there for the time specified in the safety time of that set point, the compressor will be locked out and a low motor amp alarm generated. This alarm can be used to indicate low refrigerant. This safety is bypassed for the first 3 seconds after a compressor has started.

No Compress Proof

If a compressor is called to be on and the compressor proof input is off (this is a digital input), a NO COMP PROOF alarm will be generated.

Dirty Oil Filter (Fixed Step Compressors only)

If the difference between the discharge pressure minus the oil pressure is above the value of the set point and it remains there for the time specified in the safety time of that set point a dirty oil filter alarm generated. If the difference raise 20.0 above the set point then the compressor is locked out on the first trip requiring a manual reset to restart the compressor.

19. MCS-8 OEM Factory Checkout Procedure

19.1. Visual Check

- 120 VAC power wiring
- Jumper settings
  - sensor input
  - address
  - MCS communication termination
  - EEPROM write protection
- Sensor Wiring
- MCS-IO Communication Wiring
- LCD Connector (dot to mark on the board)
- Keypad Connector (dot to mark on the board)
- Chips
  - Master software and chip
  - I/O software
- RO Wiring

Ensure that the EMG stop is on (closed position) or run/stop input off so that the unit will not run after power applied to micro.

19.2. MCS Power On (Compressor Power off)

- MCS System on
- LCD on and valid display - “MCS Initialization” then default screen
- Communications light blinking if I/O units
- Get AUTHORIZED
- Check board version number: SERVICE DIAGNOSTICS/UNIT INFORMATION/HARDWARE VERSION/ENTER (if change is required)
- Check sensor readings
- Manually bump (on then off) each point (take care your in control)

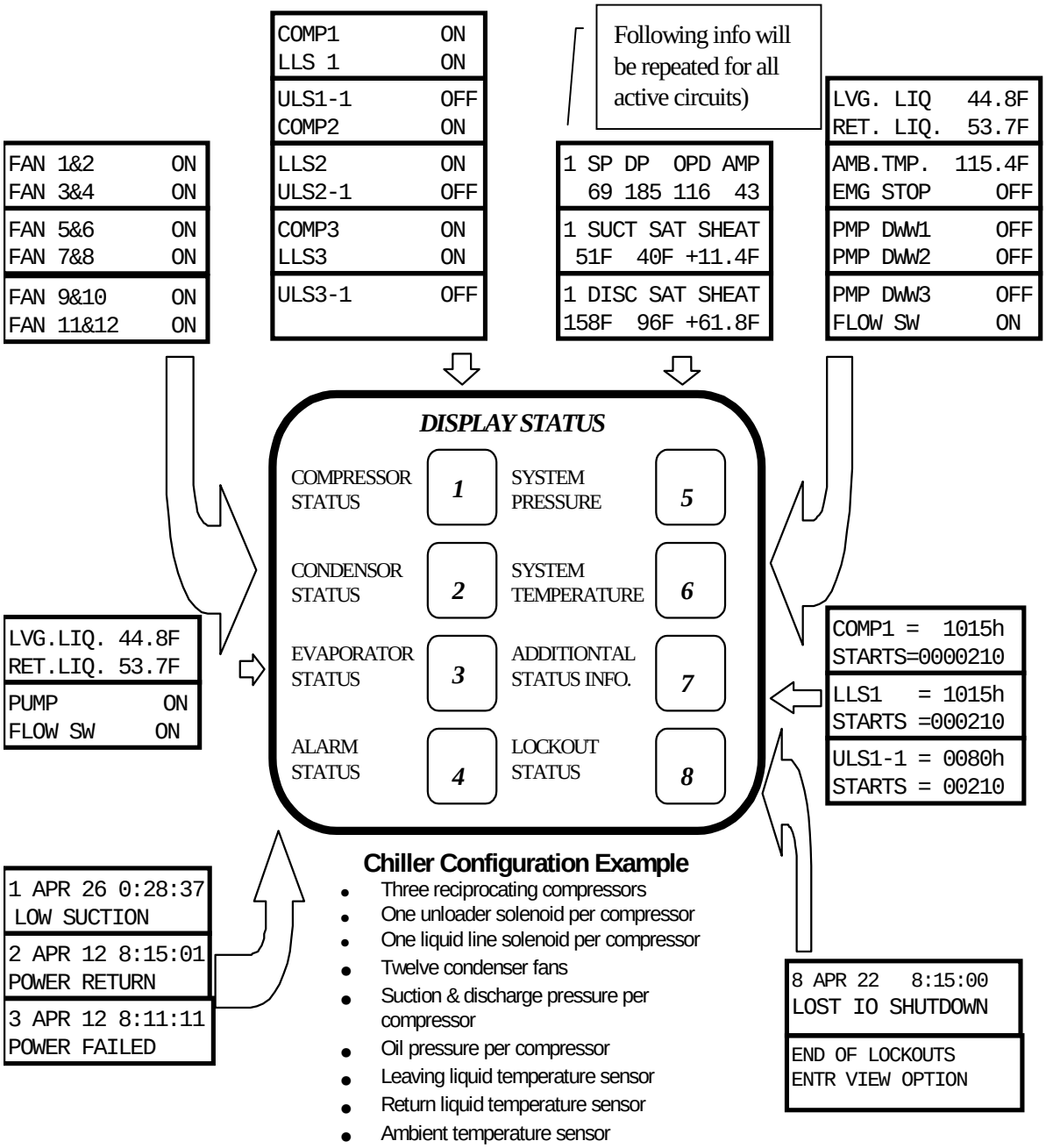
20. MCS-8 Compressor relay output sequence (examples)

20.1. Reciprocating Compressor

- COMP 1A Compressor 1 1st contractor
- COMP 1B (optional) Compressor 1 2nd contractor (split winding makes 1 sec. after A)
- LLS 1 Liquid line solenoid Evaporator #1
- LLS 2 Liquid line solenoid Evaporator #2
- UNLD1-1 (optional) unloader 1
- UNLD1-2 (optional) unloader 2
- HGB1 (optional) Hot gas bypass capacity control solenoid
- DRIAN1 Hot gas coil drain solenoid
- HGAS1 Hot gas defrost for evaporator #1
- HGAS2 Hot gas defrost for evaporator #2

21. MCS-8 Keypad/Display Quick Reference- *STATUS KEYS*

- No authorization is required in the DISPLAY STATUS section for viewing information.
- Pressing a key selects the 1st two lines of data. Repressing the same key selects the next two lines, etc.
- The ALARM STATUS displays all alarms and lockouts while LOCKOUT STATUS displays only active lockouts.
- The "+" and "-" keys may be used with alarm & lockout status to allow scrolling.
- If one or more Micro Control Expansion units are connected to a Micro Control Center the data will be presented in a continuous sequence. ADDITIONAL STATUS information shows names, total, run hours and starts for all RO's.
- SYSTEM PRESSURE displays information by circuit, SP suction pressure, DP discharge pressure, OPD oil pump differential, AMP or motor fault.
- LOCKOUT STATUS for lockouts caused by either suction discharge oil or amps, the actual value at the time of the lockout of the associated sensor is displayed.

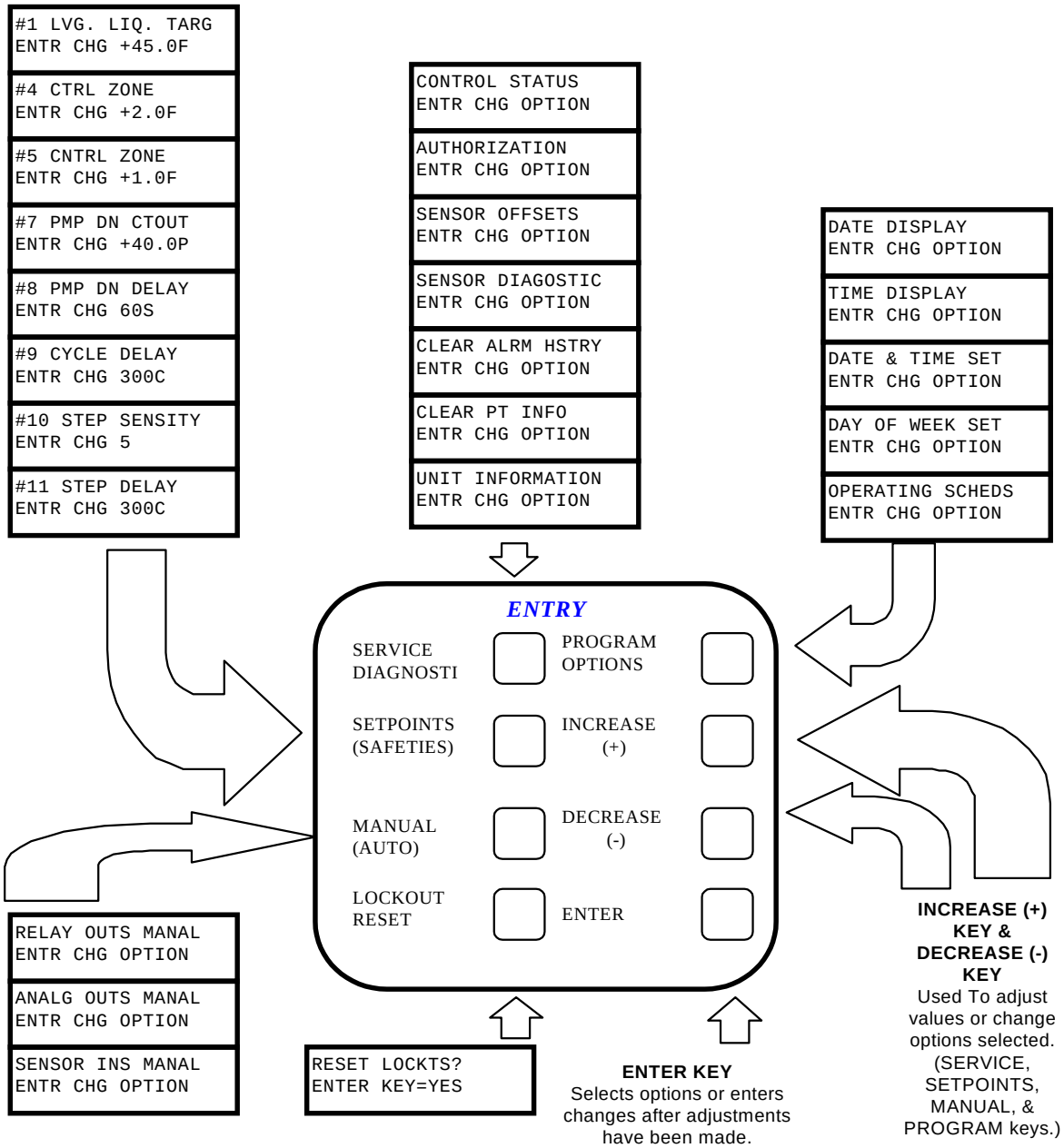


Chiller Configuration Example

- Three reciprocating compressors
- One unloader solenoid per compressor
- One liquid line solenoid per compressor
- Twelve condenser fans
- Suction & discharge pressure per compressor
- Oil pressure per compressor
- Leaving liquid temperature sensor
- Return liquid temperature sensor
- Ambient temperature sensor

22. MCS-8 Keypad/Display Quick Reference-*ENTRY KEYS*

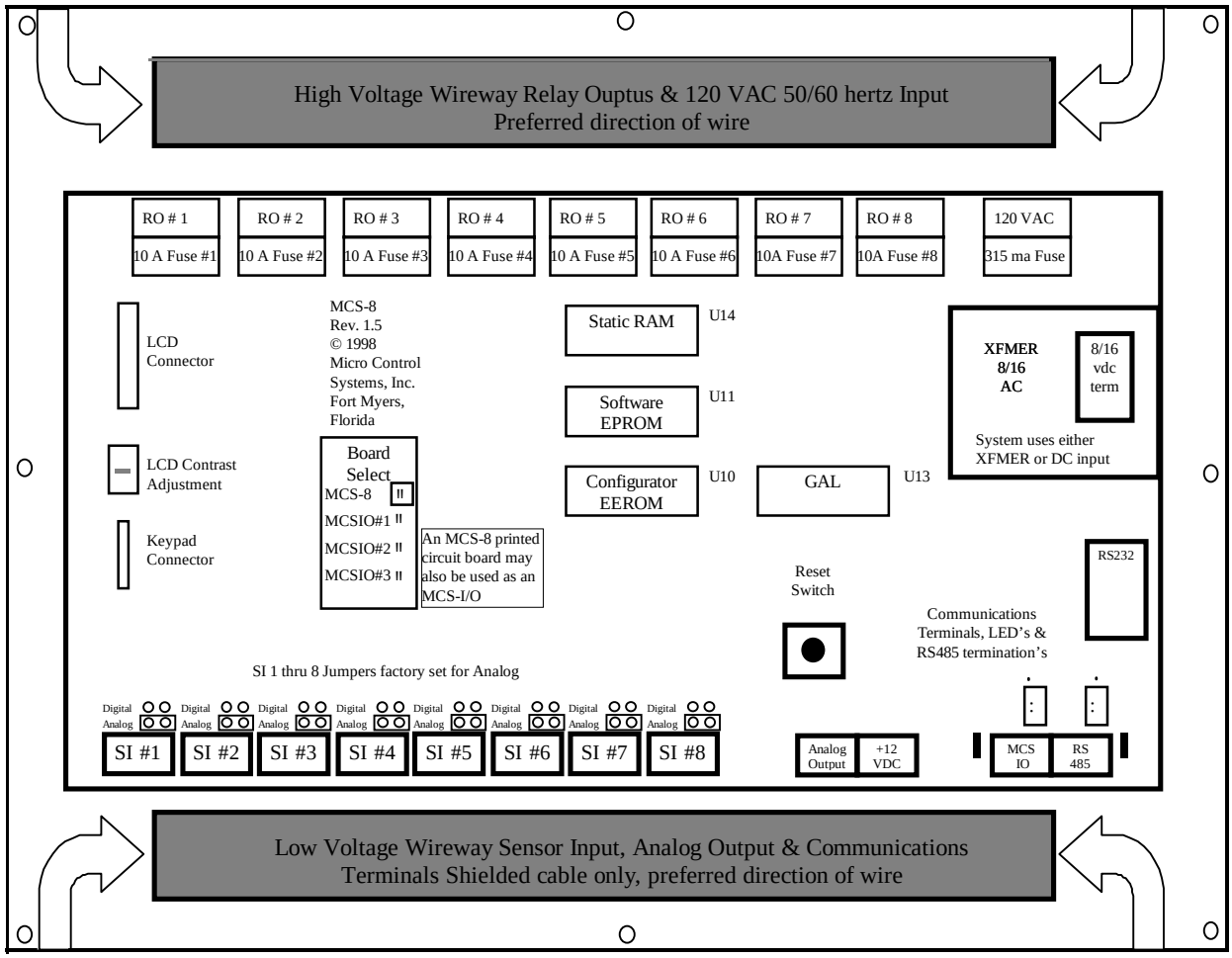
- The ENTRY keys (SERVICE, SETPOINT,MANUAL and PROGRAM) provide menu items, some of which when selected will present sub menus.
- When making value changes the INCREASE (+) & DECREASE (-) keys may be held for continuous updating.
- Enter authorization code at the authorization function within the SERVICE DIAGNOSTIC key menu.
- Different items will appear depending on the package configuration and options selected.
- Units may be English or Metric.
- The clock is factory set at EST or EDST based on time of year.



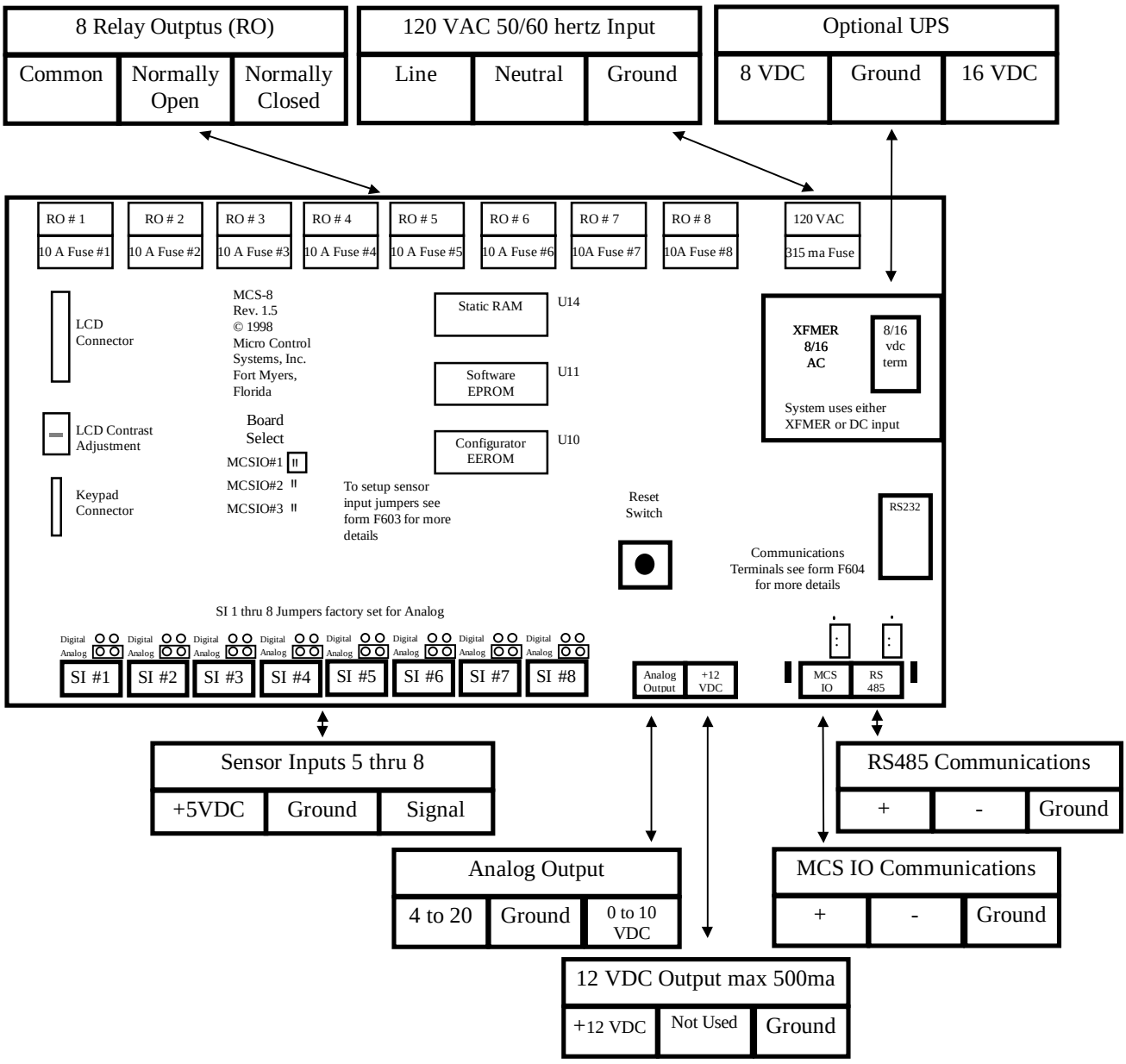
23. MCS-8 & I/O Quick Reference Sheet

Wiring Guide Notes

- Relay Outputs (RO) 120 VAC 10 amps.
- SI 1-4 factory set for 4 wire differential inputs. (0 to 100 mvolts dc)
- SI 5-8 factory set for MCS-T100 temperature inputs. (0 to 5 volts dc)
- All analog inputs must have shield tied to GND.
- MCS-8 factory set address to MCS-8.
- MCS-I/O factory set address to MCSIO address 1.
- Detail of MCS-8 and I/O items next page.



24. MCS-8 & I/O – Terminal Block Details

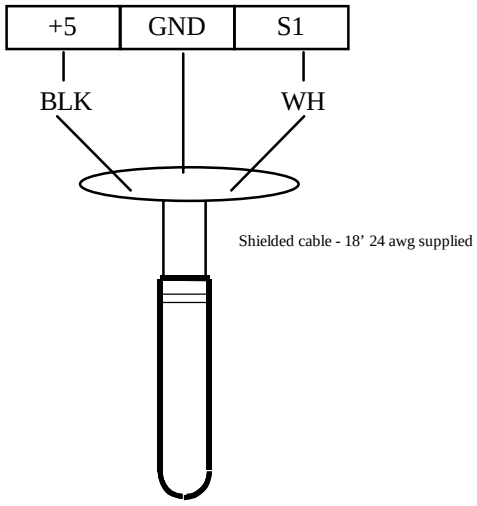


25. MCS-8 Sensors Quick Reference Sheet– Temp./Humd. Sensors

MCS-T100 (SI #1 through 8, REV 1.5 & higher)

1. Connects to 1 of MCS Sensor Inputs 1through 8
2. Shielded cable GND drain must be connected to SI 'GND'
3. Temp MCS-8 SI (inputs 1-8) jumper setting is 'ANALOG'

MCS Sensor Input Terminal Strips

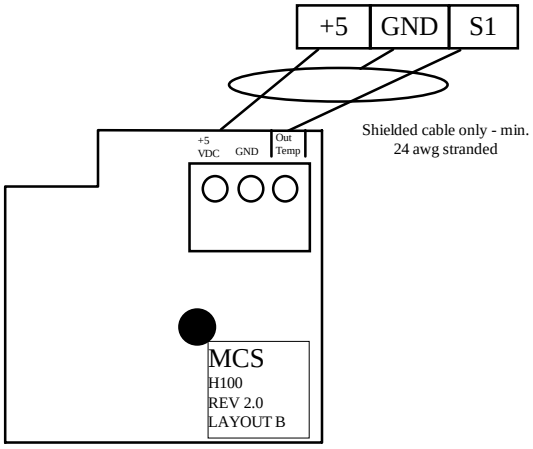


MCS-T100

MCS-ZONE (SI #1 through 8, REV 1.5 & higher)

1. Connects to 1 of MCS Sensor Inputs 1 through 8
2. Shielded cable GND drain must be connected to SI 'GND'
3. Temp MCS-8 SI (inputs 1-8) jumper setting is 'ANALOG'

MCS Sensor Input Terminal Strips
SENSOR (x)

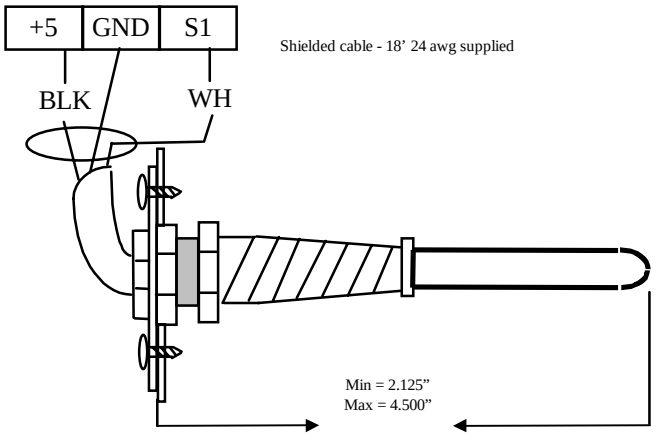


MCS-ZONE

MCS-SAIR (SI #1 through 8, REV 1.5 & higher)

1. Connects to 1 of MCS Sensor Inputs 1through 8
2. Shielded cable GND drain must be connected to SI 'GND'
3. Temperature MCS-8 SI (input 1-8) jumpers setting to Analog'
4. Minimum extension inside duct 2.25"
5. Normal extension, as shown, 4.00".

MCS Sensor Input Terminal Strips

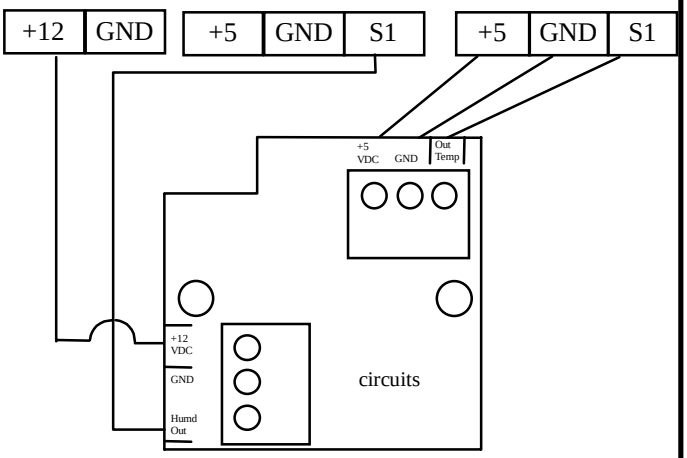


MCS-SAIR

MCS-HUMD (SI #1 through 8, REV 1.5 & higher)

1. Connects to 2 of MCS Sensor Inputs 1 through 8
2. Humidity MCS-8 SI (input 1-8) jumper setting is ANALOG'
3. +5 vdc & GND are common (only one connection required)
4. Temp. MCS-8 SI (input 1-8) jumper setting is 'ANALOG'
5. Shielded cable GND drain must be connected to SI 'GND'

MCS Sensor Input Terminal Strips
+12 OUT SENSOR (x1) SENSOR(x2)



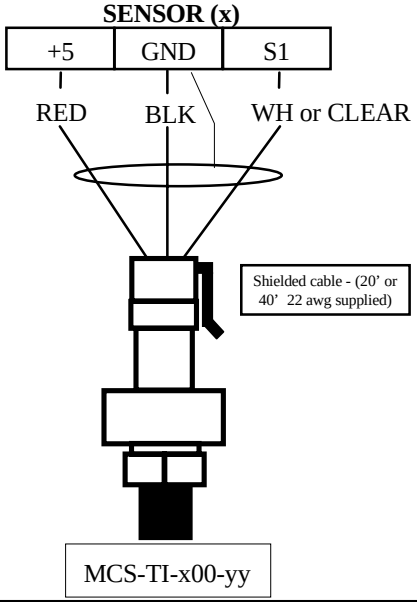
MCS-H100

26. MCS-8 Sensors Quick Reference Sheet - Pressure Sensor & Digital inputs

MCS-TI-500-xx (SI #1 thru 8, REV 1.5 & higher)

1. MCS-TI-500-xx pressure transducer (3 wire 0-5 vdc)
2. Wiring for 3 wire to SI# 1 through 8
3. Jumper settings for SI# 1 through 8 is 'ANALOG'
4. Pressure range 0 - 500 psi

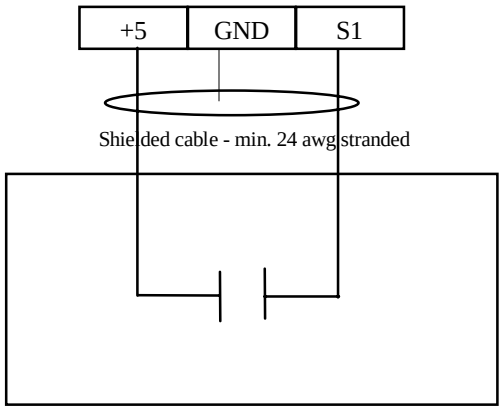
MCS Sensor Input Terminal Strips
SENSOR (x)



Dry Contact's (SI#1 through 8, REV 1.5 & higher)

1. Digital inputs for use on sensor inputs (SI 1-8)
2. Dry Contact MCS-8 SI (input 1-8) jumper setting is 'DIGITAL'
3. Verify with sensor diagnostic under service on keypad
4. Shielded cable GND drain must be connected to SI "GND"

MCS Sensor Input Terminal Strips
Sensor (x)

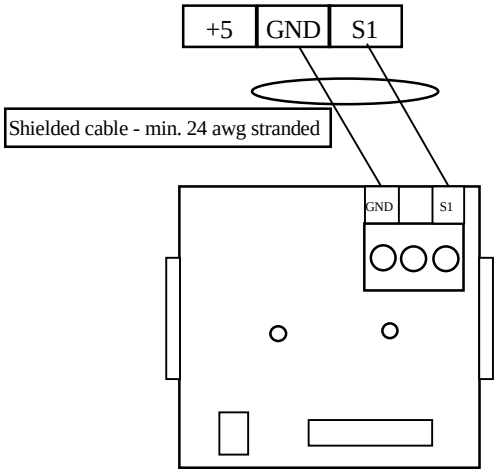


MCS DRY CONTACT DI (SI 1-8)

MCS-CT-xxx (SI #1 through 8, REV 1.5 & higher)

1. Connects to 1 of MCS sensor inputs 1 through 8
2. The current transformer may be 100:5 or 250:5
3. The size of the CT (xxx) must be larger than FLA
4. AMPS jumper setting is 'ANALOG'
5. For wiring only remove terminal block. DO NOT REMOVE PRINTED CIRCUIT BOARD.

MCS Sensor Input Terminal Strip Sensor (x)



MCS-CT-xxx

27. MCS-8 Trouble Shooting Quick Reference Sheet

PROBLEM	POTENTIAL SOLUTION
A sensor input reads -99.9	This indicates an open sensor input signal or 5 VDC problem. • Check sensor wiring for missing wire or poor connection. • Check sensor for bad sensor. If less than 5 VDC is on the sensor 5 VDC terminal block, the problem is with probably a shorted sensor. (A poly-fuse protests the board) • Remove all sensor input terminals. • Wait about 1 min. or until 5 VDC restored at sensor input. • Connect terminals 1 at time until short reappears.
A sensor input reads +999.9	This indicates a shorted sensor input signal. • Check sensor wiring for +5VDC shorted to signal etc. • Check sensor for bad sensor.
A sensor is reading more than 3% off	This indicates the sensor needs to be calibrated. (You need to have a valid Auth code to change sensor offsets) • Press Service Diagnostics, press until LCD display s sensor offset option • Press enter, 1st SI number & offset appears (i.e. Suct 1 = 0.0) • Scroll using "increase(+)/decrease(-)" keys to find sensor to be calibrated • Press enter, use the "increase(+)/decrease(-)" keys to change the calibration value. When value is correct, press enter.
'MCS CONTROLLER INITIALIZATION' on LCD display.	Indicates Micro in constant reset. • Check incoming power > 105 VAC or 22 VAC
Top row of LCD display all bars & 2nd row blank.	Indicates software chip problem possible. • Possible U11 software version incorrect or chip bad. • Possible U13 GAL chip incorrect or chip bad. • Possible bad connection or cable between LCD and MCS8
LCD blank.	Indicates bad connection. • Connector J2 on MCS not on or offset on connector. • Resistor adjustment VR1 out of adjustment.
Lost I/O	Indicates communications problem. • Verify RS485 LED blinking. • Verify termination jumper J6 only on at MCS-8 & last I/O. • Verify MCS-8 & I/O address's set correctly. • Verify wiring from MCS-8 to each I/O correct. • Check fuses/120 VAC on I/O units
Invalid reading on one sensor input.	This indicates an input problem with 1 sensor. • Verify jumper settings correct for that SI.
Changes to MCS not being made.	This indicates inability to write to chip U10. • Verify 'EEP WRITE ENABLE' jumper W6 is on. • Not authorized
Invalid authorization	This indicates an invalid auth number. Follow steps below for proper authorization • Press SERVICE DIAGNOSTICS key until the authorization option appears • Press the ENTER key • From the "Display Status" press keys corresponding to your authorization number. • Press ENTER

PROBLEM	POTENTIAL SOLUTION
SI from AMPS board 10 A low.	This indicates a problem with this SI only. • Jumper setting on this SI in wrong position. • Incorrect sensor type used.
INVALID CONFIG VER	Indicates layout of CFG wrong. • CFG layout for different version than software chip U11.
INVALID CONFIG TYPE	Indicates U10 CFG incompatible with U11 software. • Example U10 CFG for home while U11 for unit.
INVALID CONFIG	Indicates Checksum invalid • Reload CFG
Sensor input believed invalid (Under Sensor Diagnostic Sub Menu)	• Verify Berg jumpers using Quick Reference Sheets • Check board version number • Check wiring of sensor