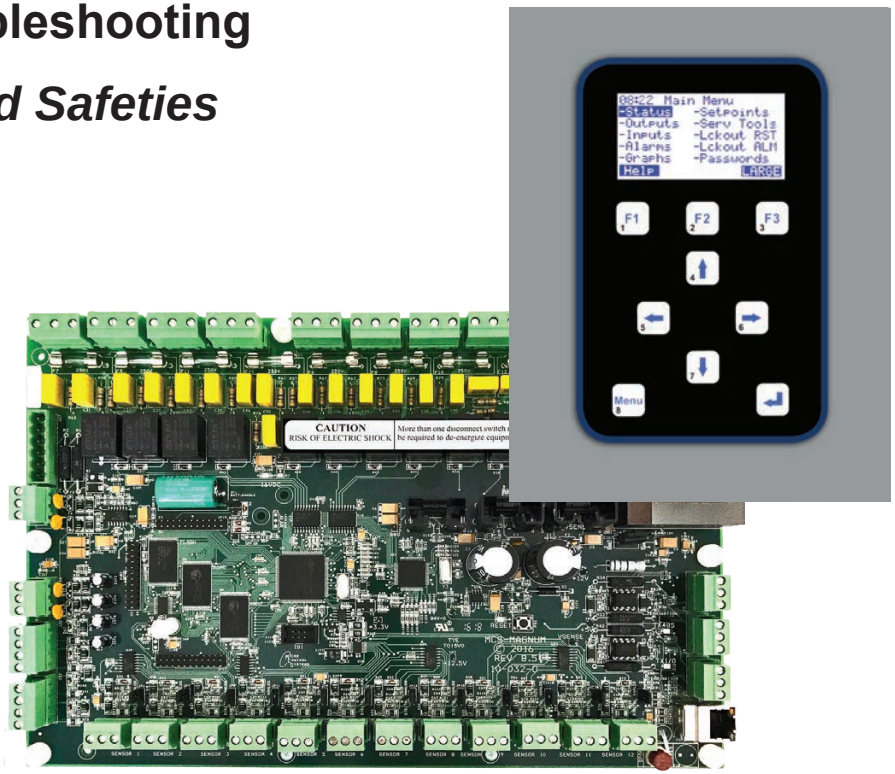
MCS-Magnum Controller System

Simplified Description and Troubleshooting

Plus MCS-MAGNUM Alarms and Safeties



Revision 2.05B

Revision 2017-11-07

The MCS Commitment

Our commitment is to provide practical solutions for the industry's needs and to be both a leader and a partner in the effective use of microprocessor controls.

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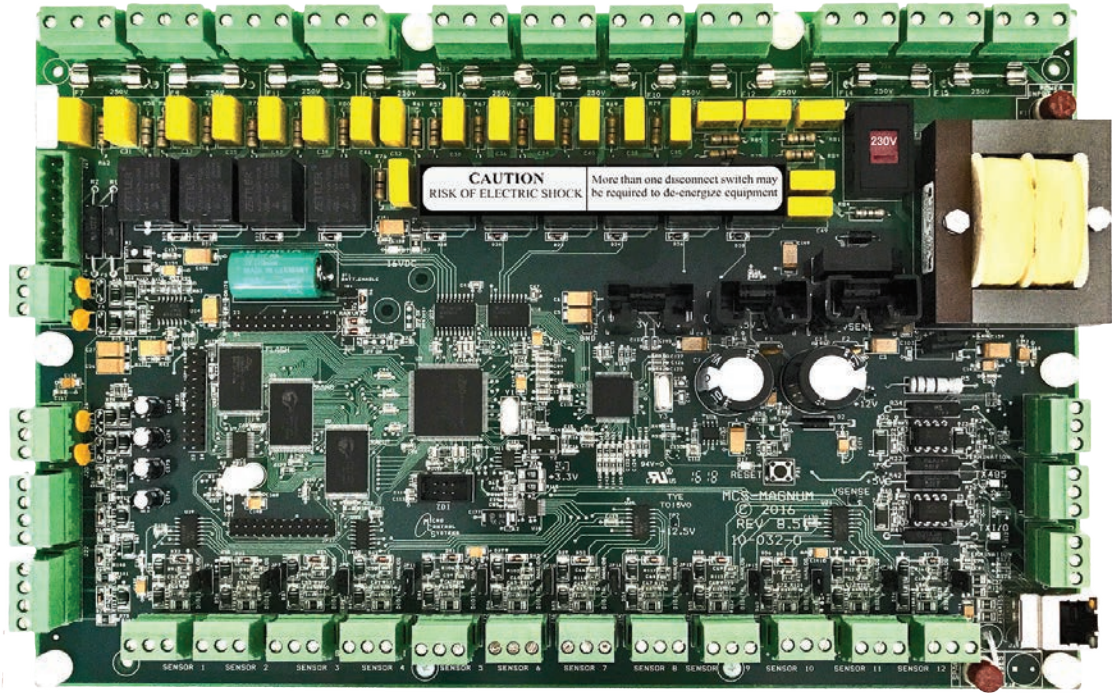

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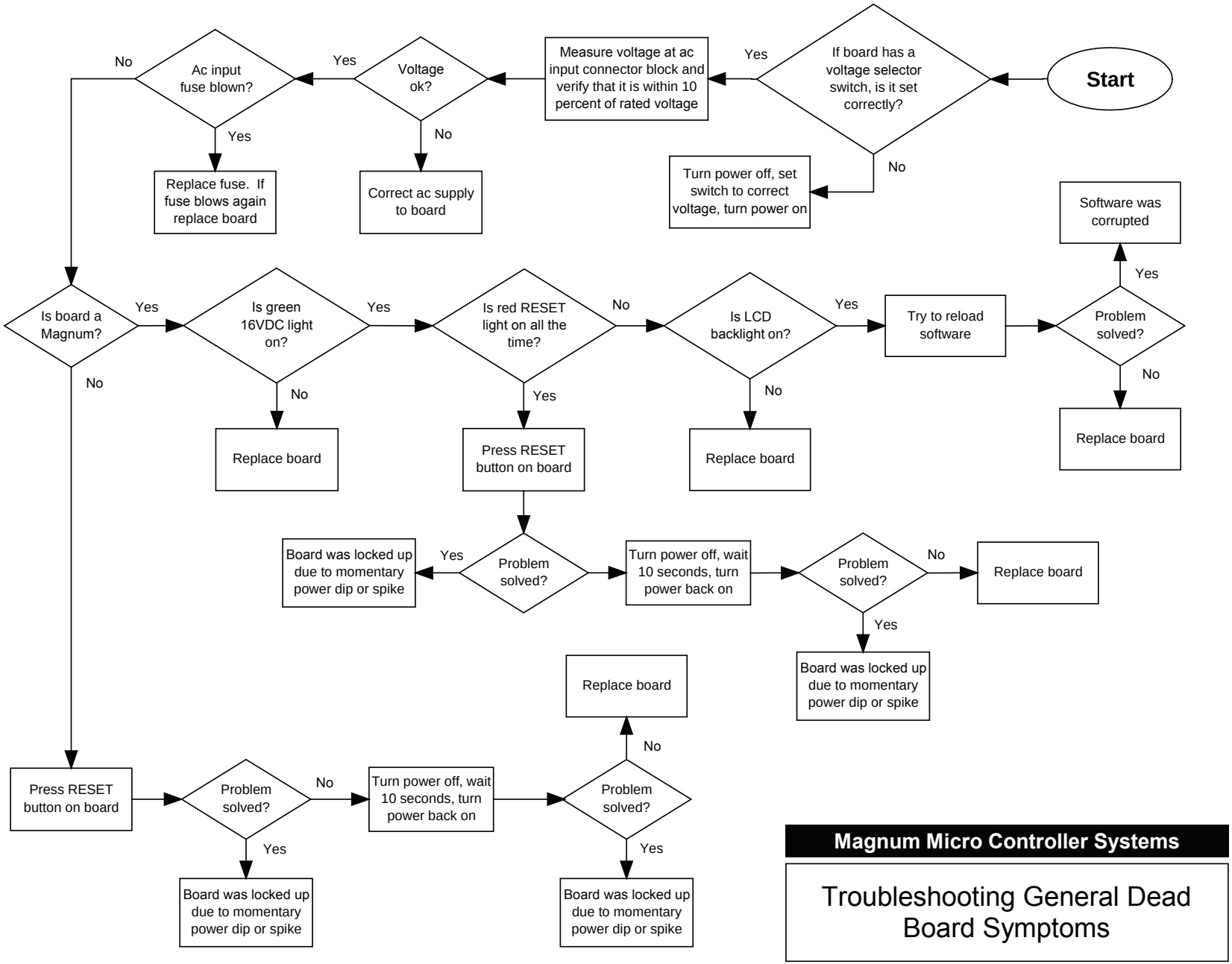

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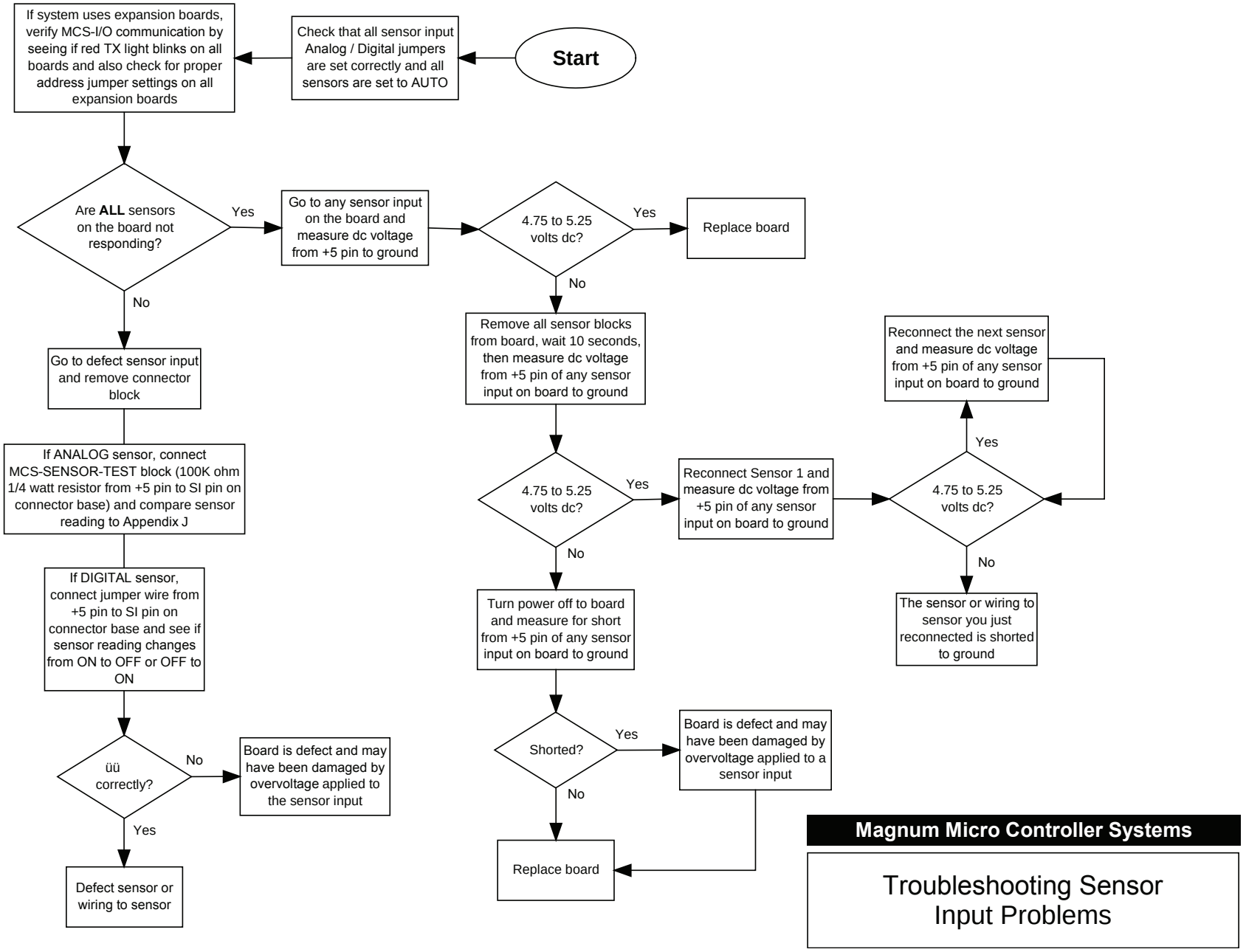

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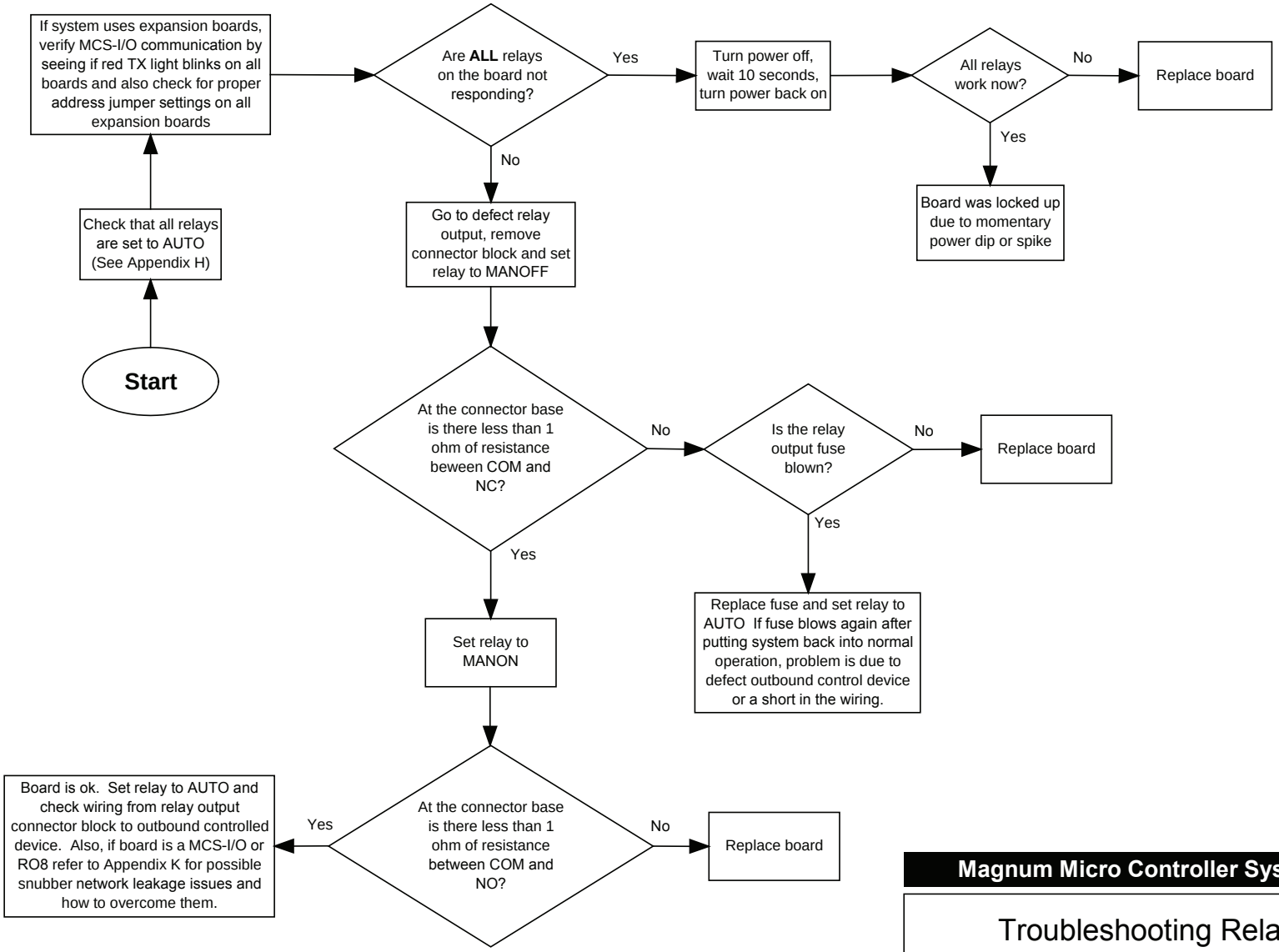
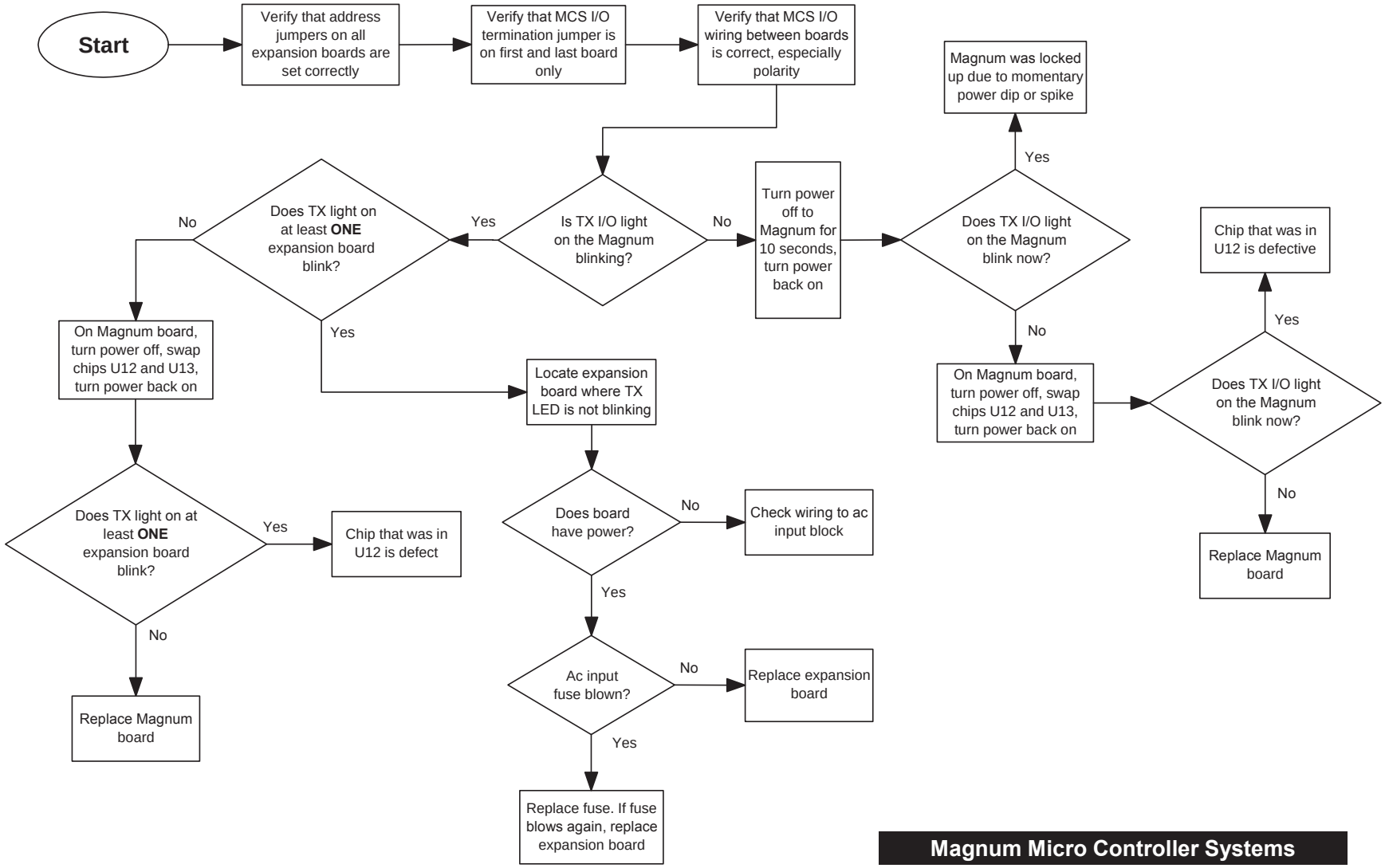


Magnum Micro Controller Systems

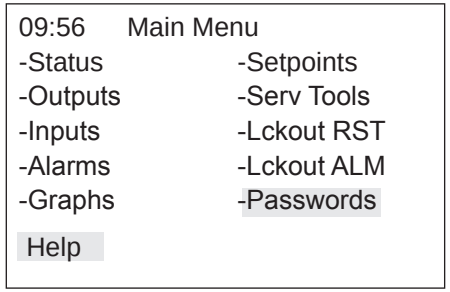
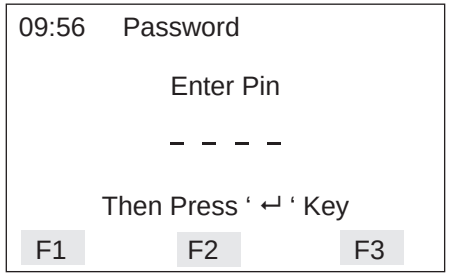
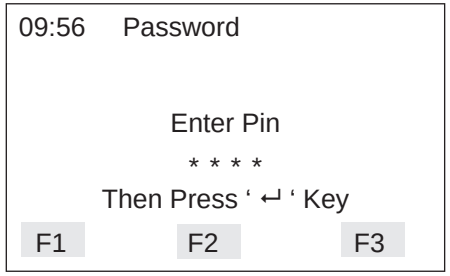
Troubleshooting Relay Output Problems

1.4. Troubleshooting Lost I/O Communication Problems



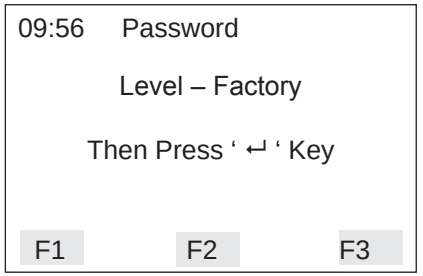
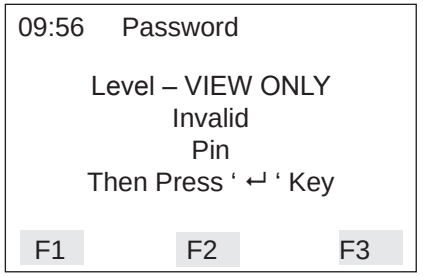
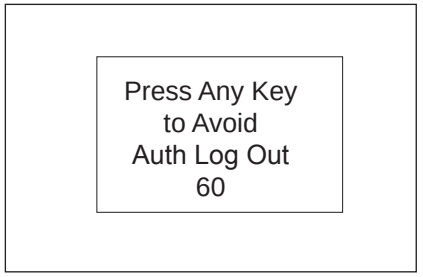
Appendix A

1.5. Entering Authorization Codes to Log In and Out of a Magnum

First, at the Main Menu use the arrow keys to navigate to Passwords:	
Next, press the Enter key. You will see the following:	
Now enter the proper four-digit authorization code. Each **-** is changed to a ***** as numbers are entered. After you have keyed in the numbers, press the Enter key.	

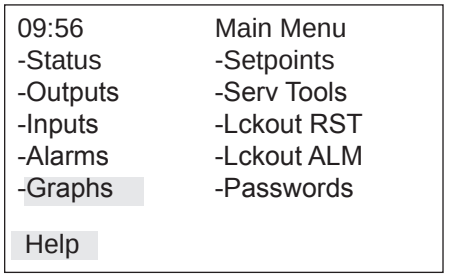
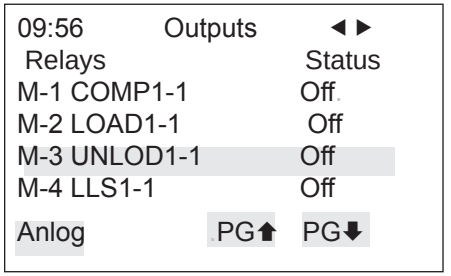
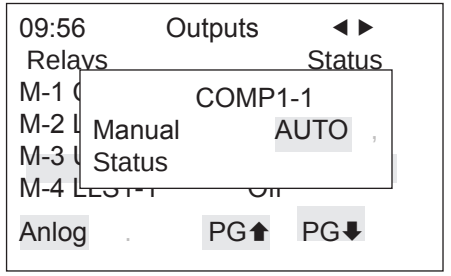
Appendix A (continued)

1.6. Entering Authorization Codes to Log In and Out of a Magnum

The Magnum will tell you if it accepted your code and the level of authorization. For example, if you entered a valid factory authorization code you will see the following:	
If you entered an invalid authorization code you will see the following:	
Once you are logged in you can log out immediately by simply entering any invalid authorization code. If you are logged in and no keys are pressed for more than 15 minutes the Magnum will automatically log you out, warning you shortly before with how many seconds remaining as shown here:	

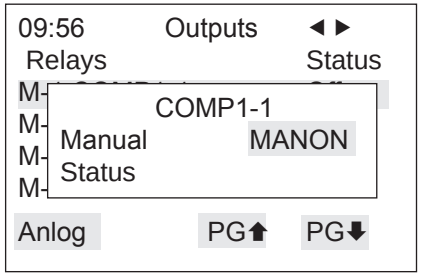
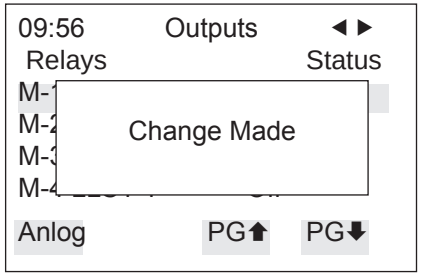
Appendix B

1.1. Manually Turning On and Off a Magnum Relay Output

Note: If a relay is in a Lockout state you cannot manually turn it on or off. First, after logging into the Magnum with your authorization code (see Appendix A), use the arrow keys to navigate to Outputs:	
Next, use the up and down arrow keys to highlight the relay you want to turn on or off:	
Now press the Enter key. You should see something similar to the following:	

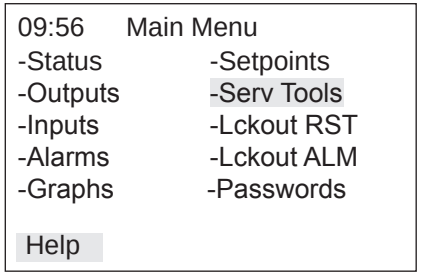
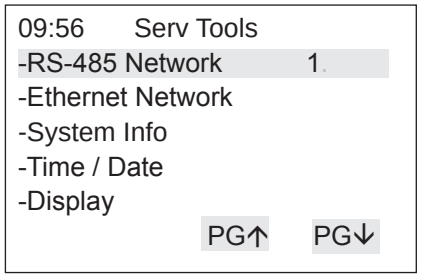
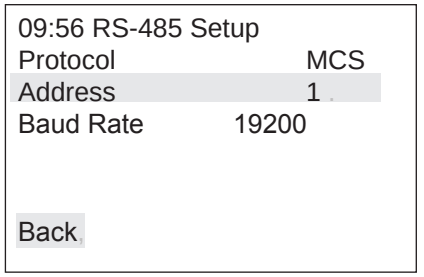
Appendix B (continued)

1.2. Manually Turning On and Off a Magnum Relay Output

Use the up and down arrow keys to cycle through the three modes for the relay output: **AUTO**, **MANON** or **MANOFF** Stop when you reach the one you want:	
Finally, press the Enter key to make the change. In our example the relay output is now manually turned on as shown here: ***Remember to return the relay output to AUTO mode when you are done!***	

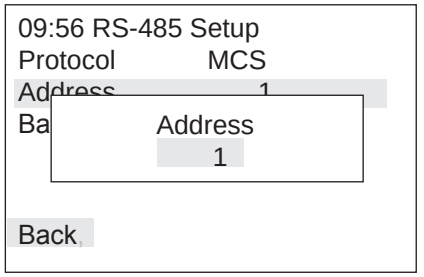
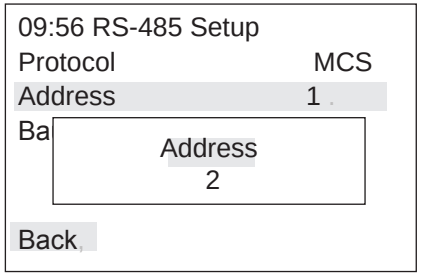
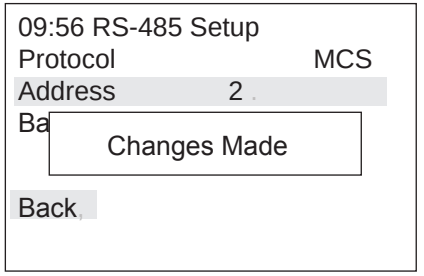
Appendix C

1.1. Determining and Changing the Network Address of a Magnum

First, at the Main Menu use the arrow keys to navigate to **Serv Tools**:	
Next, press the Enter key. You will see the following:	
Use the up and down arrow keys to highlight **Address**:	

Appendix C (continued)

1.2. Determining and Changing the Network Address of a Magnum

Now press the Enter key. You should see something similar to the following:	
Use the up and down arrow keys to select the Address number:	
Finally, press the Enter key to make the change. In our example the RS-485 network address has been changed from 1 to 2:	

Appendix D

1.1. Sensor Input Reference Table

To troubleshoot analog sensor input problems and determine where the problem is, simply remove the sensor input connector block of the input you want to test and plug in a MCS-SENSOR-TEST block. If you do not have a MCS-SENSOR-TEST block you can connect a 100K ohm 1% ¼ watt resistor between the +5 and S1 pins of the suspect sensor input on the board with the original sensor connector block removed.

After you have done this, compare the reading displayed by the Magnum with the table of the most common sensor types on the right. If the reading is close to what is found in the table for that particular sensor type you can safely assume that the board is functioning normally and that the problem lies with the sensor itself of the wiring from the sensor to the board.

Sensor Type	Reading
600VAC4	337.8V
A FLW %	-99.9%
A100x2	-99.9A
A250x2	-99.9A
AIR AVG	-99.9A
AKS31R5	-98.8P
AKS32-2	71.6P
AKS32-5	179.0P
AMPS100	-99.9A
AMPS250	-99.9A
ATPE500	999.9F
CARR-5K*	77.0F
CDUCT'Y	499u
CFM .25	-999c
CFM 1in	-999c
C-I AMB	-99.9F
C-I FLW	-999
C-I IN	-99.9F

Sensor Type	Reading
C-I OUT	-99.9F
CT-100	57.0A
CT10010	5.6A
CT10017	99.3A
CT100d2	28.5A
CT100d3	19.0A
CT100d5	76.7F
CT100d7	-99.9A
CT100x2	115.0A
CT10d25	2.1A
CT-1500*	865.0A
CT-250	143.5A
CT25017	248.6A
CT250x2	287.6A
CT300	149.7A
CT300d10	15.0A
CT300d2	75.4A
CT300d5	30.1A

Sensor Type	Reading
CT300x17	256.5A
CT300x2	287.0A
CT500	287.6A
CT50017	498.2A
CT50035	931.0A
CT500x2	575.3A
CT750	429.4A
CT800	448.0A
DEC1NOCH	-99.9
DEC2NOCH	-9.99
DEMAND%*	87.5%
DIFF100	-99.9P
ECLIP-1	-99.9P
ECLIP-2	100.0P
ECLIP-5	250.2O
HB350	174.9P
HB700	350.0P
HUMD	54.0%

Appendix D (continued)

1.2. Sensor Input Reference Table

Sensor Type	Reading
HUMD2	54.0%
LD1000	500p
M 50-KW	43.6K
M 75-KW	65.1K
M100-KW	86.6K
MCS 667	100.0P
MCS CO2	1001p
MCS-200	100.0P
MCS-500	100.0P
MCST100	77.0F
MCSX400	99.9P
MCSX500	99.9P
MEDIA-5	-99.9P
METER P	-999p
PT 1000*	169.0F
PT100	213.1F
R22 PPM	500p
REF LVL	50%
ROSE300	113.0P
ROSE500	188.6P
RPM'S	-999R
S FLW T	-999%
S TMP T	-999F
SAFMAG	-99.9G

Sensor Type	Reading
STAEFA	-99.9”
STAT 50	23.5”
STAT CO2	-999p
STAT.25	-9.99”
STAT0.2	0.07”
STAT1 %	1233.6%
STAT1 F	1233.6%
STAT2 %	4.8%
STAT2 F	-99.9F
STAT3 %	-99.9%
STAT3 F	-99.9F
STAT4 %	-99.9%
STAT4 F	-99.9F
STATIC.2ib	0.10”
STATIC1	-99.9”
STATIC3	-99.9”
STATIC5	1.8”
STATIC5iB	2.50”
T100LOW	.999p
TI-150	60.3P
TI-150A	75.0P
TI-2ACE	110.2A
TIACE17	190.8A
TONS 1DEC	-99.9T

Sensor Type	Reading
VAC-600	326.6V

Magnum Alarms and Safeties

1.1. There are four types of alarms that are generated by the Magnum control logic:

- Information only alarms,
- Magnum system alarms and
- Chiller Setpoint safety alarms
- TurboCor Compressor Alarms

All alarms have the same format. The alarm is identified and is date/time stamped. Alarms can be viewed from the Magnum keypad by selecting the 'Alarms' from the main menu, or through MCS-Connect.

1.2. Information Only Alarms

1.2.1 System Generated Alarms

The following alarms are generated to provide 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** – Generated when power to the Magnum was lost.
- **POWER RETURNED** – Generated when power to the Magnum returned.
- **HW DATE INVALID** – The date contained/read from the hardware real time clock chip is not valid. Check battery voltage, it should be > 2.0 vdc.
- **HW TIME INVALID** – The time contained/read from the hardware real time clock chip is not valid. Check battery voltage, it should be > 2.0 vdc.
- **SW DATE INVALID** – The date contained/read from the software clock is not valid.
- **SW TIME INVALID** - The time contained/read from the software clock is not valid.
- **RAM INTEGRITY** – the data contained in the battery-backed up RAM memory may be corrupted. This does not stop the Magnum from running. It means the historical data may be incorrect (run times, cycles, min/max values, and trend/graph data).
- **WATCHDOG RESET** – The Magnum has reset itself because of improper operator of the Magnum board. Please consult the manufacturer if this alarm has occurred.
- **LOST A/D CONVTR** – The Magnum microprocessor has lost communications to the Analog to Digital converter chip (chip that converts sensor voltages to a digital number). Check for a shorted sensor that may cause
- **LOST DISPLAY** – Generated when communication to the Keypad/Display is lost.
- **CF INIT ERROR** – The Compact Flash card that was installed cannot be initialized and therefore cannot be used. Replace the Compact Flash card with one that works.
- **BATTERY FAILED** – Generated when Magnum is not getting power from the Battery.

1.2.2 User Initiated Alarms

The following alarms indicate that an individual took action: (Most require proper authorization)

- **LOCKOUT RESET** – Generated when a user resets a compressor other unit from a locked condition.
- **COMPUTER RESET** – Generated when the manual reset button on the Magnum is pressed.
- **ALARMS CLEARED** – Generated when a user clears the alarm history.
- **STPT CHANGED** – Generated when a user makes a change to a Setpoint; the number of the Setpoint will also be displayed with the alarm.
- **RO TO** (Selected Condition) – Generated when a user manually changes the condition of a Relay Output (either AUTO, MANON, or MANOFF).
- **AO TO** (Selected Condition) – Generated when a user changes the condition of an Analog Output (either AUTO or MANUAL. If MANUAL, then a dialog box will appear to input the number value).
- **SI TO** (Selected Condition) – Generated when a user changes the condition of a Sensor Input (If a digital input, then either AUTO, MANON, or MANOFF. If an analog input, then either AUTO or MANUAL. If MANUAL, then a dialog box will appear to input the number value).
- **POINT INFO CLEAR** – Generated when a user clears all point information (run times, cycles, min/max values, etc.).
- **CLOCK SET** – Generated when a user makes a change to the Magnum real time clock.
- **CFG DOWNLOADED** – Generated when a user uploads a new configuration file into the Magnum.
- **ETHERNET CHANGE** – Generated when a user makes a change to the Ethernet settings through the Keypad/Display.
- **RS485 CHANGED** – Generated when a user makes changes to the RS485 address through the Keypad/Display.
- **CF CARD INSERTED** – Generated when a user inserts a Compact Flash memory card into the Magnum.
- **CF CARD REMOVED** – Generated when a user removes a Compact Flash memory card from the Magnum.

1.2.3 Automatic Alarms

The following alarms indicate an action that the Magnum made automatically:

- **ROTATED LEAD** – Generated when the Magnum automatically rotates the Lead Compressor.
- **DAYLIGHT SAVINGS** – Generated when the Magnum automatically changes the real time clock to adjust for Daylight Savings Time.

1.3. Magnum System Alarms

1.3.1 **Configuration Alarms**

These alarms indicate a problem with the configuration file in the system. The system is not operational and a new configuration must be transmitted to the unit through MCS-Connect.

- **INVALID CONFIG** – Checksums are incorrect.

- **INVALID CFG VER** – The version number of the configuration is invalid.
- **INVALID CFG TYPE** – The configuration type does not match the software type.

1.3.2 MCS Local Network Alarms

These alarms indicate problems with the MCS local network:

- **LOST SI COMM #_** / LOST RO COMM #_–Generated when communications to a Sensor Input or Relay Output board is lost. The number of the board will be displayed with the alarm. The system can be accessed but will be in a NO RUN- I/O LOST state.
- **MCS-STAT OFFLINE** – The Magnum has lost communications to the MCS-STAT.
- **LOST IO SHUTDOWN** – Generated when Magnum is running and there are no communications to one or more of the I/O boards. The system can be accessed but will be in a NO RUN- I/O LOST state.
- **LOST I/O RESTART** – Generated when the Magnum does an automatic reset once I/O communications are restored.

1.3.3 Key Sensors Alarms

These alarms indicate a problem with a key sensor, it is either shorted or open. The alarm will contain ALARM followed by the 10-character name of the sensor. The following sensors related to the entire system are tested:

- **Leaving temperature:** If failed, then Lock Out the system.
- **Returning temperature:** If failed, then alarm only no Lock Out.
- **Ambient temperature:** If failed, then alarm only no Lock Out.

The following compressor sensors are tested. If they fail, then that compressor only is locked out:

- Suction pressure and temperature
- Discharge pressure and temperature
- Oil pressure and temperature
- Motor temperature (if an analog input)

1.3.4 Emergency Stop Alarm

- **EMERGENCY STOP** – Generated when the emergency stop switch has been turned on. The system can be accessed but is in a Lock Out state.

1.4. Setpoint safety alarms

The Magnum algorithm incorporates a number of safety checks, based on Setpoints, preventing unsafe conditions that could potentially cause damage to the system. When a safety trips the circuit will be in a SAFETY TRIPPED state. The circuit will remain in this state for the time in the ‘Safety Down Time (min)’ cell and then move to the CMP ANTICYCLE or CMP IS OFF state where the compressor will be allowed to run again if required. If the same safety trip occurs again within the time in the ‘Lockout Delay Hrs’ cell since the first trip, the circuit will be set to CMP LOCKED OUT state, which requires a manual reset to restart the compressor. If the lockout delay time is set to zero, the Magnum will generate a lockout condition the first time that the safety occurs.

1.4.1 Sensor Inputs Used With Magnum Setpoint Safeties:

- Suction Pressure(Analog or Digital)
- Discharge Pressure (Analog or Digital)
- Oil Pressure (Analog or Digital)
- Oil Differential Pressure (Calculated value)
- Oil Temperature (Analog or Digital)
- Discharge Temperature (Analog or Digital)
- Motor Temperature (Analog or Digital)
- Motor Amps (Analog or Digital)
- Motor Fault (Analog or Digital)
- Liquid Temperature (Analog Only)
- Compress Proof (Digital Only)
- Flow Switch (Digital Only)

1.4.2 Setpoint safeties

For a safety trip to occur, both the Sensor Input and the associated Setpoint must be active. If a safety trips, the alarm name will consist of the Setpoint name plus additional identification such as point number, compressor number, or 30 second history leading up to the trip if applicable.

Note: Most safeties are checked only if the compressor is running, however if the safety is always checked it will be noted.

The following is a list of safeties that are incorporated in the standard chiller algorithm control. These safeties are checked every second. For a system with multiple circuits, each one is tested individually. If a safety trip occurs, only that respective compressor will be affected, the others will continue to function normally.

Freeze Protection (SAFETY IS ALWAYS CHECKED)

If the leaving temperature drops below the Setpoint value then the entire system will Lock Out and a FREEZE alarm will be generated. There is also an option to have one freeze protect for each individual circuit. Refer to section 11 Setpoint #111.

No Flow Protection

If a flow switch is used, then the entire system will be Locked Out if Setpoint #105 is active. If the Setpoint is inactive, the Magnum will determine if there is a second pump, if so it will be started. Else, the system will shut down and automatically restart when the flow switch is on, indicating flow has returned. There is also an option to have a flow switch for each individual circuit. Refer to section 11 Setpoint #105.

Phase Loss Protection

Phase loss, as indicated by the phase loss monitor, will result in the entire system being Locked Off and a phase loss alarm will be generated. If Setpoint #166 is inactive the Magnum will wait for 2 seconds before the Lock Out occurs. The alarm will be PHASE LOSS and no restart will be attempted. If Setpoint #166 is active, the name of the Setpoint will be in the message. Refer to section 11 Setpoint #166.

Low Differential Oil Pressure

This safety is designed to meet the compressor manufacturer requirements on oil pressure. For the first 5 seconds following a compressor start (60 seconds if Hitachi screw compressor) this safety is NOT checked. For the next 30 seconds, if the oil differential pressure drops below ½ of the value of the Setpoint or the digital input turns ON for the time specified in the 'Time (sec)' field of that Setpoint, then the circuit 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 Setpoint and it remains there for the time specified in the 'Time (sec)' field, then the compressor will be Locked Out and a low oil alarm generated. This safety is checked for when the compressor is on and not in a Pump Down state. Refer to section 11 Setpoint #91.

Low Suction Pressure

If the suction pressure drops below the value of the Setpoint or the digital input turns ON for the time specified in the 'Time (sec)' field, the compressor will be locked out and a LOW SUCTION alarm generated. This safety is bypassed when the compressor is in a Pump Down state. This safety can also be used as a freeze protection based upon the suction pressure. When this safety trip occurs, all compressors in the same suction group will react in the same manner. Refer to section 11 Setpoint #77.

Unsafe Suction Pressure

This safety is similar to the low suction pressure safety, except it is often set up with a lower value and a shorter safety time. If the suction pressure drops below the value of the Setpoint or the digital input turns ON for the time specified in the 'Time (sec)' field of that Setpoint, then the circuit will be Locked Out and a UNSAFE SUCTION alarm generated. This safety will always cause a Lock Out on the first trip, requiring a manual reset. This safety is bypassed when the compressor is in a Pump Down state. When this safety trip occurs, all compressors in the same suction group will react the same. Refer to section 11 Setpoint #80.

High Discharge Pressure (SAFETY IS ALWAYS CHECKED)

If the discharge pressure rises above the value of the Setpoint or the digital input turns ON for the time specified in the 'Time (sec)' field of that Setpoint, then the circuit will be locked out and a HIGH DISCHARGE alarm generated. Refer to section 11 Setpoint #81.

Low Discharge Pressure

If the discharge pressure drops below the value of the Setpoint for the time specified in the 'Time (sec)' field, the compressor will be Locked Out and a LOW DISCHARGE alarm generated. Refer to section 11 Setpoint #85.

High Discharge Temperature (SAFETY IS ALWAYS CHECKED)

If the discharge temperature analog input rises above the value of the Setpoint or the digital input turns ON for the time specified in the 'Time (sec)' field, the compressor will be Locked Out and a HIGH TEMPERATURE alarm generated. Refer to section 11 Setpoint #87.

High Motor Temperature or Motor Fault (SAFETY IS ALWAYS CHECKED)

If the high motor temperature input rises above the value of the Setpoint or the digital input turns ON for the time specified in the 'Time (sec)' field, the circuit will be Locked Out and a HIGH MOTOR TEMPERATURE or MOTOR FAULT alarm generated. Refer to section 11 Setpoint #95.

High Oil Temperature

If the oil temperature rises above the value of the Setpoint or the digital input turns ON for the time specified in the Time (sec)' field, the compressor will be locked out and a HIGH OIL TEMPERATURE alarm generated. Refer to section 11 Setpoint #94.

High Motor Amperage

If the amperage analog input rises above the value of the compressor's respective FLA Setpoint #171 – 190 times the value of Setpoint #75 or the digital input turns ON for the time specified in the Time (sec)' field, then the circuit will be Locked Out and a HIGH MOTOR AMP alarm generated. Refer to section 11 Setpoint #75.

Low Motor Amperage

If the amperage analog input drops below the value of the compressor's respective FLA Setpoint #171 – 190 times the value of Setpoint #76 or the digital input turns ON for the time specified in the Time (sec)' field, then the circuit will be Locked Out and a LOW MOTOR AMP alarm will be generated. Refer to Setpoint #76.

No Compressor Proof

If a compressor is called to be on and the compressor proof digital input is OFF, a NO COMP PROOF alarm will be generated. Refer to section 11 Setpoint #96.

High Oil Seal Temperature (Screw Compressors only)

If the oil seal temperature analog input rises above the value of the Setpoint for the time specified in the Time (sec)' field, then the circuit will be Locked Out and a HIGH OIL SEAL alarm generated. This safety is bypassed when the compressor is in a Pump Down state. Refer to section 11 Setpoint #93.

Dirty Oil Filter (Fixed Step Compressors only)

If the difference between the discharge pressures minus the oil pressure is above the value of the Setpoint for the time specified in the Time (sec)' field, a DIRTY OIL FILTER alarm will generate. Refer to section 11 Setpoint #97.

Low Discharge Superheat

If the discharge superheat is below the value in Setpoint for the time specified in the Time (sec)' field, then the circuit will be Locked Out and a LOW DISCHARGE SUPERHEAT alarm will be generated. Refer to section 11 Setpoint #84.

1.5. TurboCor Compressor Alarms

Inverter Temperature Fault (Hex code =0x0001)

The measured Inverter Temperature has exceeded either the Alarm or Fault limit, probably due to insufficient inverter cooling.

Discharge Temperature Fault (Hex code =0x0002)

The measured Discharge Temperature has exceeded either the Alarm or Fault limit, probably due to insufficient charge (not enough gas).

Suction Pressure Fault (Hex code =0x0004)

The measured Suction Pressure has exceeded either the Alarm or Fault limit, probably due to insufficient charge or insufficient system load.

Discharge Pressure Fault (Hex code =0x0008)

The measured Discharge Pressure has exceeded either the Alarm or Fault limit, probably due to a faulty condenser. *Instantaneous lock out at fault level.

3 Phase Over Current Fault (Hex code =0x0010)

The estimated Mains Supply voltage has exceeded either the Alarm or Fault limit, probably due to excessive system load on mains supply (usually the compressor is pumping liquid). *Instantaneous lock out at fault level.

Cavity Temperature Fault (Hex code =0x0020)

The measured Cavity Temperature has exceeded either the Alarm or Fault limit, probably due to insufficient motor cooling (shaft cavity).

Leaving Fluid Temperature Fault (Hex code =0x0040)

The measured Air / Water Temperature has exceeded either the Alarm or Fault limit, probably due to insufficient air / water flow.

Pressure Ratio Fault (Hex code =0x0080)

The measured Compression Ratio of Discharge and Suction has exceeded either the Alarm or Fault limit, probably due to faulty condenser or insufficient load on the evaporator.

Generic Bearing/Motor/Compressor Fault (Hex code =0x0100)

If the Motor Fault Word, 40106, or the Bearing Fault Word, 40098, is different from 0, then the Generic Compressor Fault is triggered.

Sensor Fault (Hex code =0x0200)

If the following measured degrees Celsius are surpassed, a Sensor Fault is triggered. The pressure values are in kPa:

40105 Inverter Temperature>100 or < 0

40037 Cavity Temperature>100 or < -20

40034 Suction Temperature>100 or < -30

40036 Discharge Temperature>110 or < -30

40046 Leaving Water Temperature>100 or < -20

40031 Suction Pressure>1200 or < -30

40033 Discharge Pressure>3500 or < -30

SCR Temperature Fault (Hex code =0x0400)

The measured SCR Temperature has exceeded either the Alarm or Fault limit. Probably due to insufficient SCR plate cooling.

Lock Out Fault (Hex code =0x0800)

If any (or a combination of) the Faults listed below occurs more than 3 times (reg. 40262) within 30 minutes (reg. 40263), a “Lock Out Fault” occurs:

- Inverter Temperature trip
- SCR Temperature trip
- Motor Current High trip
- Inverter Error Signal Active trip
- Rotor May Be Locked trip
- Motor Back emf trip

*Instantaneous lock outs:

- Discharge Pressure
- 3 Phase Over-Current

Winding Temperature Fault (Hex code =0x1000)

The measured motor winding temperature has exceeded 155ºC.

Superheat Fault (Hex code =0x2000)

The Fault limit is based on the suction pressure and temperature values. There is no time delay on this fault or alarm. The difference between the fault limit and alarm limit is the dead band for the control.

Reserved (Hex code =0x4000)

Reserved (Hex code =0x8000)

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