User Manual for
SmartMQn Motor Monitor HS-MPXM

SmartMQn Motor Monitor OCS

MAN0851-01-EN

PREFACE

This manual explains how to use the SmartMQn Motor (HS-MPXM) OCS Modules.

Information in this document is subject to change without notice and does not represent a commitment on the part of Horner APG.

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LIMITED WARRANTY AND LIMITATION OF LIABILITY

Horner APG, LLC. ("HE-APG") warrants to the original purchaser that the SmartMQn Motor OCS module manufactured by HE-APG is free from defects in material and workmanship under normal use and service. The obligation of HE-APG under this warranty shall be limited to the repair or exchange of any part or parts which may prove defective under normal use and service within two (2) years from the date of manufacture or eighteen (18) months from the date of installation by the original purchaser whichever occurs first, such defect to be disclosed to the satisfaction of HE-APG after examination by HE-APG of the allegedly defective part or parts. THIS WARRANTY IS EXPRESSLY IN LIEU OF ALL OTHER WARRANTIES EXPRESSED OR IMPLIED INCLUDING THE WARRANTIES OF MERCHANTABILITY AND FITNESS FOR USE AND OF ALL OTHER OBLIGATIONS OR LIABILITIES AND HE-APG NEITHER ASSUMES, NOR AUTHORIZES ANY OTHER PERSON TO ASSUME FOR HE-APG, ANY OTHER LIABILITY IN CONNECTION WITH THE SALE OF THIS SmartMQn Motor OCS module. THIS WARRANTY SHALL NOT APPLY TO THIS SmartMQn Motor OCS module OR ANY PART THEREOF WHICH HAS BEEN SUBJECT TO ACCIDENT, NEGLIGENCE, ALTERATION, ABUSE, OR MISUSE. HE-APG MAKES NO WARRANTY WHATSOEVER IN RESPECT TO ACCESSORIES OR PARTS NOT SUPPLIED BY HE-APG. THE TERM "ORIGINAL PURCHASER", AS USED IN THIS WARRANTY, SHALL BE DEEMED TO MEAN THAT PERSON FOR WHOM THE SmartMQn Motor OCS module IS ORIGINALLY INSTALLED. THIS WARRANTY SHALL APPLY ONLY WITHIN THE BOUNDARIES OF THE CONTINENTAL UNITED STATES.

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To obtain warranty service, return the product to your distributor with a description of the problem, proof of purchase, post paid, insured and in a suitable package.

ABOUT PROGRAMMING EXAMPLES

Any example programs and program segments in this manual or provided on accompanying diskettes are included solely for illustrative purposes. Due to the many variables and requirements associated with any particular installation, Horner APG cannot assume responsibility or liability for actual use based on the examples and diagrams. It is the sole responsibility of the system designer utilizing the SmartMQn Motor OCS module to appropriately design the end system, to appropriately integrate the SmartMQn Motor OCS module and to make safety provisions for the end equipment as is usual and customary in industrial applications as defined in any codes or standards which apply.

Note: The programming examples shown in this manual are for illustrative purposes only. Proper machine operation is the sole responsibility of the system integrator.

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VISUAL MAP OF MAJOR TASKS AND THE KEY CHAPTERS TO ASSIST YOU

The following map is provided to show you the major types of tasks needed to be performed and the key chapters in this manual you need to refer to for information and help.

Directions: Major tasks are listed at the top of the map with the key chapters listed beneath that you need to consult in order to perform the tasks.

FIRST STEP of ANY TASK: DATASHEET			
Each SmartMQn Motor unit HS-MPXM is sent with a datasheet in the box. **The datasheet is the first document you need to refer to for model-specific information related to SmartMQn Motor models such as pin-outs, jumper settings, and other key installation information.** The web version of this manual has all of the SmartMQn Motor datasheets attached to it. Visit our website http://www.heapg.com to obtain updates to datasheets and user documentation.			
QUICK START	**INSTALLATION**	**PROGRAMMING**	**TROUBLESHOOTING**
Safety / Compliance page 10	**Safety / Compliance** page 10	**Safety / Compliance** page 10	**Safety / Compliance** page 10
Introduction page 12	**Introduction** page 12	**Introduction** page 12	**Introduction** page 12
	Mechanical Installation page 23	**System Settings** page 48	**Maintenance** page 86
	Electrical Installation page 29	**User Interface** page 56	**Troubleshooting** page 88
	Serial Comm page 32	**Removable Media** page 37	
	CAN Comm page 34	**High Speed I/O** page 39	
	Communication Options page 35	**Registers** page 82	

CHAPTER 1: SAFETY / COMPLIANCE

1.1 Safety Warnings and Guidelines

When found on the product, the following symbols specify:

Warning: Consult user documentation.

Warning: Electrical Shock Hazard.

WARNING: To avoid the risk of electric shock or burns, always connect the safety (or earth) ground before making any other connections.

WARNING: To reduce the risk of fire, electrical shock, or physical injury it is strongly recommended to fuse the voltage measurement inputs. Be sure to locate fuses as close to the source as possible.

WARNING: Replace fuse with the same type and rating to provide protection against risk of fire and shock hazards.

WARNING: In the event of repeated failure, do not replace the fuse again as a repeated failure indicates a defective condition that will not clear by replacing the fuse.

WARNING: Only qualified electrical personnel familiar with the construction and operation of this equipment and the hazards involved should install, adjust, operate, or service this equipment. Read and understand this manual and other applicable manuals in their entirety before proceeding. Failure to observe this precaution could result in severe bodily injury or loss of life.

- All applicable codes and standards need to be followed in the installation of this product.
- For I/O wiring (discrete), use the following wire type or equivalent: Belden 9918, 18 AWG or larger.

Adhere to the following safety precautions whenever any type of connection is made to the module.

- Connect the green safety (earth) ground first before making any other connections.
- When connecting to electric circuits or pulse-initiating equipment, open their related breakers. Do not make connections to live power lines.
- Make connections to the module first; then connect to the circuit to be monitored.
- Route power wires in a safe manner in accordance with good practice and local codes.
- Wear proper personal protective equipment including safety glasses and insulated gloves when making connections to power circuits.
- Ensure hands, shoes, and floor are dry before making any connection to a power line.
- Make sure the unit is turned OFF before making connection to terminals. Make sure all circuits are de-energized before making connections.
- Before each use, inspect all cables for breaks or cracks in the insulation. Replace immediately if defective.

1.2 Grounding

Grounding is covered in various chapters within this manual.

- For grounding specifications and testing for a good ground, refer **Chapter 4**.
- For panel grounding, refer to **Chapter 3**.

1.3 CE Compliance

To check for compliance and updates, visit our website at:

http://www.heapg.com/Pages/TechSupport/ProductCert.html

1.4 CT (Current) Inputs

The controller's current inputs are 1A full scale (10bit resolution) and require 0.1A CTs that allow 10x over-range.

Warning: Use of 1 or 5 Amp secondary CTs may damage the Controller .

The CT should be selected such that the Motor Full Load Current (FLC) is within 75 to 150% of the CTs rated primary.

Since the maximum Stall (51) protection function output setpoint is equal to 600% of the FLC, exceeding the CT rating by over 150% may prevent the activation of the Stall (51) protection function thus leaving the motor unprotected.

1.5 Relay Outputs

Warning: To protect the module and associated wiring from load faults, use external fuses. Fuses of lower current or fusing for the entire system need to be in place to assure the maximum current rating of the unit is not exceeded.

Warning: Connecting high voltage to any I/O pin can cause high voltage to appear at other I/O pins.

CHAPTER 2: INTRODUCTION

2.1 Visual Overview of SmartMQn Motor and Topics Covered in this Manual

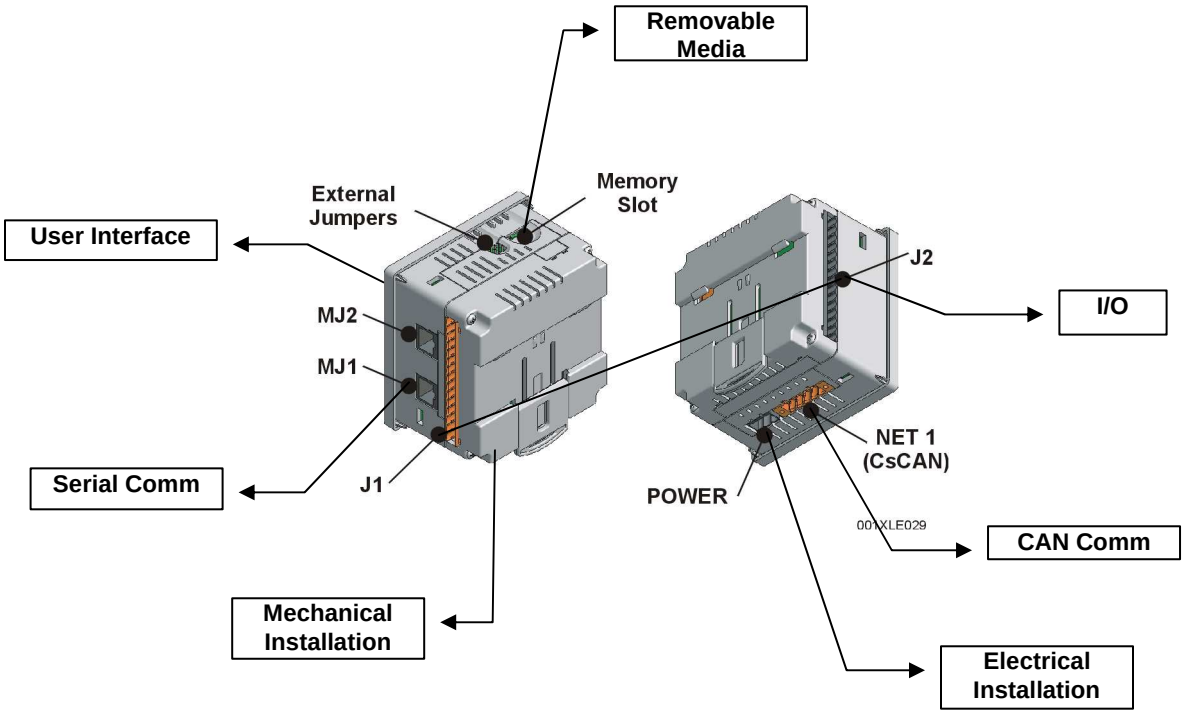


Figure 2.1 – Visual Overview of SmartMQn Motor and Topics of Interest Covered in the User Manual

2.1.1 Where to Find Information about the SmartMQn Motor

a. Datasheets - The **datasheets are the first documents you need to refer to for key information** related to specific SmartMQn Motor models. (A datasheet is provided in the box with your unit.)

The datasheets for all SmartMQn Motor (HS-MPXM) models are attached to the back of this manual on our website, and they are also available individually on the web.

Datasheets contain pin-outs, jumper settings and other model specific information.

b. User Manual -This manual provides general information that is common to SmartMQn Motor models and can be downloaded from our web. Visit our website http://www.heapg.com to obtain user documentation and updates.

Four main types of information are covered in the manual.

- Safety and Installation guidelines / instructions (Mechanical and Electrical)
- Descriptions of hardware features (Serial ports, Removable Media, Communication Options, etc.)
- Configuration and Use of the SmartMQn Motor Monitor OCS HS-MPXM
- Maintenance and Support

2.2 Connectivity to the SmartMQn Motor

The SmartMQn Motor Monitor HS-MPXM has tremendous capabilities for connecting to a variety of devices. The diagram below shows some examples of devices that can be used with the SmartMQn Motor.

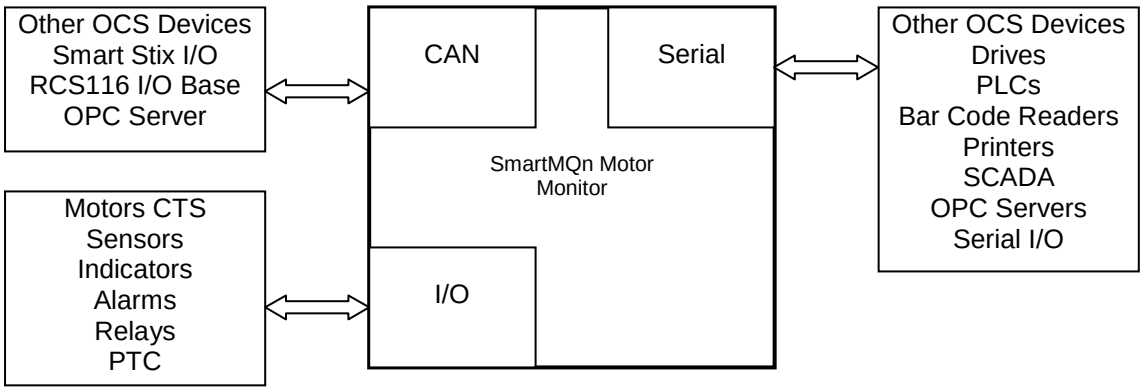


Figure 2.2 – Visual Overview of Types of Devices that can be connected to SmartMQn Motor

2.2 Features of SmartMQn Motor

The SmartMQn Motor is a low cost motor protection relay that can be added to an existing motor control installation (Monitor Mode) or added as an integral part of a new motor installation (Command Mode).

Using SmartMQn Motor, the user can access the functions of a traditional motor starter along with protection functions. The SmartMQn Motor is configurable in 3 different modes of operations, Controller, Monitor and M52 Modes. The user can configure SmartMQn Motor according to protection requirements / Motor specifications. The device has dedicated screens for configuring protection parameters. SmartMQn Motor acts as a protection relay, takes the current samples retrieved from motor circuits, thermal data from PTC circuits, compares the sample data with the configured value and trip / Alarm signals according to the configuration.

It is possible to integrate the controller with an external control circuit. The user can configure the inputs from an external control system to the SmartMQn Motor for alarm / trip. Various output signals / indications generated for different inputs to the SmartMQn Motor depend on user configurations and SmartMQn Motor *mode of operations*. In the Control mode of operation, the SmartMQn Motor can replace all external latching circuits and protect from faults during start and run time operations. The user can connect to an external control circuit by configuring SmartMQn Motor in Monitoring and M52 mode of operations.

The SmartMQn Motor comes mounted (as an option) in an enclosure with power supply and quick connect terminal strip or is sold ala carte for you to mount in an enclosure of your choice. The power supply input to the SmartMQn Motor is 120 to 240 Vac, 50 to 60 Hz single phase.

The SmartMQn Motor has the following features:

2.2.1 Status

Phase and Ground current (Phase Amps, Avg. Amps, Phase % of FLC, Average % of FLC)
Motor state [OFF, STArt, RUN, etc.]
Protection function accumulators [thermal (TOC), thermal (PTC), Starts/Hr, etc.]
Trip snapshot
Alarm log
Inhibit information
Motor run time

2.2.2 Control

Two auxiliary multifunction NO contacts
Dedicated Alarm output NO contact (monitor mode)
Dedicated NO/NC Latching Trip output (monitor mode)
Configurable Single and Dual coil control outputs (controller mode)
Three multifunction inputs
Dedicated 52 contact input
Trip reset (UI, terminal or network)
Emergency clear (UI only)
Local\remote control (UI, terminal)

2.2.3 Protection functions

- Incomplete start
- Excessive starts
- Circuit breaker failure
- Under current
- Over current
- Unbalance current
- Instantaneous over current
- Ground fault current
- Timed over current
- PTC Thermal protection
- Two inputs for external protective devices (94) [Multifunction input configuration]

Choice of action for most protection functions (None, Alarm, Trip or Both)
50mS response time

2.2.4 Trending

The small trend on the main screen displays a plot of the average current and a plot of the lowest leg. This trend shows approximately the past 3 seconds of data.

Pressing the Process button will toggle between data shown in different ways:

- First press displays data as bar graphs, meters and numeric data that may be scrolled through using the Up/Down arrow keys
- Second press displays data as trends that may be scrolled through using the Up/Down arrow keys
- Subsequent presses toggle between those two formats

The trends displayed show short-term and long term data as indicated by the time frame shown on the x-axis. The short-term trends show the last 5 seconds of data and are updated only when the screen is displayed. The longer-term trends are retentive and display data up to a trip condition before stopping, including the last 100 seconds, the last 16.5 minutes and the last 16.5 hours. A reset of the trip condition will restart these trends.

Current trends display Phase A, Phase B and Phase C currents together on a scale of 0-300% of FLC or Ground current on a scale of 0-100% of the Ground Trip set point. PTC trends display the PTC reading in 0-100% of a 3.2KOhm PTC.

2.2.5 Data Logging

Constant data logging to MicroSD occurs in the background as long as a MicroSD card is in place. However, there is an internal buffer that can store a small amount of data while the card is being replaced or is absent for a short amount of time.

A set of log files constantly log data every 10 seconds. The files are in comma-separated value (csv) format and are located in the 'Datalog' directory. The filename is in the format HHDDMM.csv where HH = the hour in 24-hour format, DD = day of the month, and MM = the month. Therefore, each file will contain up to one hour's worth of data before a new log file is started. All entries recorded to these logs include a time and date stamp as well as the measurements of all phase currents, ground current, average current and PTC reading.

Another set of log files record Alarm and Trip occurrences. The 'Alarmlog' and 'Triplog' directories contain these files. The filenames for these logs are in the format DDMMYY.csv where DD = the day of the month, MM = the month and YY = the 2-digit year. Therefore, each file will contain up to one day's worth of data before a new log file is started. All entries recorded to these logs include a time and data stamp, as well as a text description of the occurrence, measurements from all phase currents, ground current, average current and PTC reading.

2.2.6 Network

Modbus/CSCAN serial protocols
Read access to motor state and status
Read access to protection function accumulators
Write access to multifunction outputs (if configured)
Read access to multifunction inputs (if configured)
Motor Start/Stop control (controller mode –remote operation)

2.3 Monitoring Functions

The unit provides the following monitoring functions:

- Individual currents (amps and percentage of FLC)
- Average current (amps and percentage of FLC)
- Ground current (amps)
- Inhibit Time (excessive starts)
- Unbalance current percentage
- Thermal capacity percentage
- Current PTC percentage of limit

Data Monitoring:

- Front panel (numeric data)
- Front panel (graphical data: trends and bar graphs)
- Trend data stored to MicroSD memory card
- Available over network communications

2.4 Protection Functions

The unit provides the following protective functions, mostly with both alarm and trip support:

Incomplete Start Sequence

Breaker Monitor

Excessive starts

Underload

Overload (Stall)

Unbalance

Jam

Ground fault current

Timed Overload

PTC Thermal protection

Trip support:

NO/NC failsafe dry contact (to break external single coil contactor)

NO pulsing contact (to pulse external dual coil contactor open coil)

NC block start contact (to block external start on dual coil contactor close coil circuit)

Trip Relay Reset able from UI, Terminal or Network

Emergency Inhibit release for Overcurrent / Excessive starts (UI only)

2.5 Diagnostic Functions

Support for external alarm and trip indicators (terminal)

Trip snap shot (capture of currents and accumulators at trip time)

Alarm log

History log (trips and alarms)

Trend data (just before trip)

Trend data (programmed interval)

2.6 Control Functions (optional controller mode)

Dry NO contacts to drive single or dual coil contactor.

Start Motor command (UI, Terminal or Network)

Stop Motor command (UI, Terminal or Network)

Local / Remote selection with local mode alarm option

Optional dry contacts for lighted panel indicators (multiplexed)

Optional dry contacts for network control of auxiliary devices (multiplexed)

2.7 Network Capability

Modbus support

CSCAN serial support

Read access to monitor data

Write access to reset and control data

Loss of network monitor (controller mode)

2.8 Modes of operations

The device can operate in 3 different modes of operation and in addition the user can set the controller for local and remote controller operations. Following are the different modes of operations:-

Controller Mode

Monitor Mode

M52 Mode

2.9 Industrial enclosure

24vdc supply

Quick connect terminal strips

2.10 Required and Suggested Accessories

The following list contains a sampling of required and suggested SmartMQn Motor accessories. Visit our website http://www.heapg.com to view updates on new products and accessories.

Note: The SmartMQn Motor HS-MPXM is not shipped with a programming cable in the box. To obtain a programming cable, order HE500CBL300.

Table 2.1 – SmartMQn Motor Accessories

Part Number	Description
HE-HSC	10/100 Ethernet option kit - field installable. Kit includes all parts necessary for internal installation within the SmartMQn Motor case, including a deeper plastic back cover adapted for Ethernet operation.
HE-XMC	13.4 k Telephone modem option kit - field installable. Kit includes all parts necessary for internal installation within the SmartMQn Motor case, including a deeper plastic back cover adapted for modem operation.
HE-MC1	Removable Media card - compatible with SmartMQn Motor. Card capacity is 256 MB or larger.
HE-MR1	Media Card Reader for HE-MC1. Portable device allows HE-MC1 to be plugged into the USB port of personal computers as a portable hard drive.
HE-X24-AS	Power supply 100-240VAC or 140-340VDC Switching supply that outputs 1.5 A / 3 A (HE-X24-AS/AL) at 24 VDC. Mounts on Standard DIN rail. Designed for X Family products.
HE-X24-AL	Power supply 100-240 VAC or 140-340 VDC Switching supply that outputs 1.5 A / 3 A (HE-X24-AS/AL) at 24VDC. Mounts on Standard DIN rail. Designed for X Family products.
HE500CBL300	OCS Programming Cable, 9-pin female (PC) to RJ-45 (OCS) - 6 feet.
HE500USB600	USB programming kit. Includes USB to RS-232 adapter, and 6-foot RS-232 cable with D-sub connections. Requires HE500CBL300 to program the SmartMQn Motor.
HE-XRC9	900MHz Modem Com Module equipped to sustain long range wireless links between devices.

2.11 Useful Documents and References

The following information serves as a *general* listing of Horner controller products and other references of interest with their corresponding manual numbers. Visit our website to obtain user documentation and updates.

Note: This list is not intended for users to determine which products are appropriate for their application; controller products differ in the features that they support. If assistance is required, refer to Technical Support (page **89**).	
Controllers	**Manual Number**
SmartMQn Motor Series (e.g., HS-MPXM…)	MAN0851
XLe/XLt Series (e.g., HE-XTxxx)	MAN0878
QX Series (e.g., HE-QXxxx)	MAN0798
NX Series (e.g., HE-NXxxx)	MAN0781
LX Series (e.g., LX-xxx; also covers RCS116)	MAN0755
Color Touch OCS (e.g., OCSxxx)	MAN0465
OCS (Operator Control Station) (e.g., OCS1xx / 2xx; Graphic OCS250)	MAN0227
Remote Control Station (e.g., RCS2x0)	
MiniOCS (e.g., HE500OCSxxx, HE500RCSxxx)	MAN0305
Other Useful References	**Manual Number**
CAN Networks	MAN0799
Cscape Programming and Reference	MAN0313
Wiring Accessories and Spare Parts Manual	MAN0347

2.12 Product Specifications

2.12.1 Electrical Specifications

Line Current / Frequency(Full load current)
- 1 to 2000 Amps (maximum full load current)
- 50 to 60 Hz

Starting Current/ Starting Characteristics
- 5 % to 100 % of Full load current
- Starts per hour 1 to 10
- Minimum Minutes between starts 0 – 240 minutes

2.12.2 Protection Specifications

Earth fault	
Ground CT Primary Current :	1- 100 A
Ground CT Secondary current:	0.1 A
Ground over current alarm set point:	0.1 to 25.0 A
Ground over current trip set point:	0.1 to 25 A
Ground over current delay before trip:	0-24 sec
Ground fault action:	OFF/ALARM/TRIP/BOTH
Overload Characteristics	
Overload current action:	OFF/ALARM/TRIP/BOTH
Overload current error action set point:	100 – 600 % (FLC)
Overload current trip set point :	100 – 600 % (FLC)
Overload current delay before trip :	0 – 240.0 sec
Under load Characteristics	
Under-load current action:	OFF/ALARM/TRIP/BOTH
Under-load current alarm set point:	10 – 90 % (FLC)
Under-load current trip set point:	10 – 90 % (FLC)
Under-load current delay before trip:	0 – 240.0 sec
Unbalanced load currents	
Unbalanced current action :	OFF/ALARM/TRIP/BOTH
Unbalanced current alarm set point :	5 – 50% (AVG)
Unbalanced current trip set point:	5 – 50% (AVG)
Unbalanced current delay before trip :	0 – 240.0 sec
Starting Characteristics	
Starts per hour :	1 - 10
Minimum Minutes between starts :	0 - 240 minutes
Start mode detection current :	5- 100 % of FLC
Running Characteristics	
Start to Run Detect/Error delay:	0 - 240 sec.
Start to Run Error action :	NON/ALARM/TRIP
Stop mode detection Current :	5 % to 100 % of FLC
Run Mode detection current :	25 to 250 % of FLC
Run Detection mode:	Timer/Current
Circuit Barker Error action :	NONE/ALARM
External E- Stop action:	ON/OFF
Stall/Blocked rotor	
Stall current action:	Off, Trip
Stall current trip set point:	100 – 600% (AVG)
Stall current delay before trip:	0 – 240.0 sec
Timed Over current action	
Timed over current action:	OFF/ALARM/TRIP/ALARM+TRIP
Timed over current ultimate set point:	101 – 125%
Timed over current NEMA class:	5 – 30 Class
Timed over current percent alarm:	25 – 100 %
Timed over current percent inhibit:	1 – 100%
Relay lockout time	
Accuracy :	+/- 1 Minute with control power applied

2.12.3 PTC

Thermistor inputs 6 No's of PTC can be connected in series (Do not add any additional PTCs once the normal temperature readings approach 1500 ohms (or approximately 50% of trip).

2.12.4 Controller Input /Output

Analog Current outputs

PROGRAMMABLE
OUTPUT 0-1mA 0-20mA 4-20 mA
MAX LOAD 2000 300 300
MAX OUTPUT 1.01mA 20.2mA 20.2Ma

2.12.5 Communication ports / protocols

See Chapters 5, 6 and 7

Type: RS485 2-wire, half duplex, isolated

Baud Rate: 9600, 19200
Protocol: Subset of Modbus® RTU
Functions: Read/write setpoints (03/16),
Read actual values (03/04)

2.12.6 Power Supply

Internal Fuse

CHAPTER 3: MECHANICAL INSTALLATION (FOR UNITS NOT SOLD WITH PANEL)

Note: Each SmartMQn Motor unit is sent with a datasheet in the box. **The datasheet is the first document you need to refer to for model-specific information related to SmartMQn Motor models such as pin-outs, jumper settings, and other key installation information.** The web version of this manual has all of the SmartMQn Motor datasheets attached to it. Visit our website to obtain datasheets, user documentation, and updates.

3.1 Overview

The mechanical installation greatly affects the operation, safety and appearance of the system. Information is provided to mechanically install the unit such as cut-out sizes, mounting procedures and other recommendations for the proper mechanical installation of the unit.

3.2 Mounting Requirements

SmartMQn Motor products can be mounted through a panel or on DIN rail.

3.2.1 Mounting Procedures (Installed in a Panel Door)

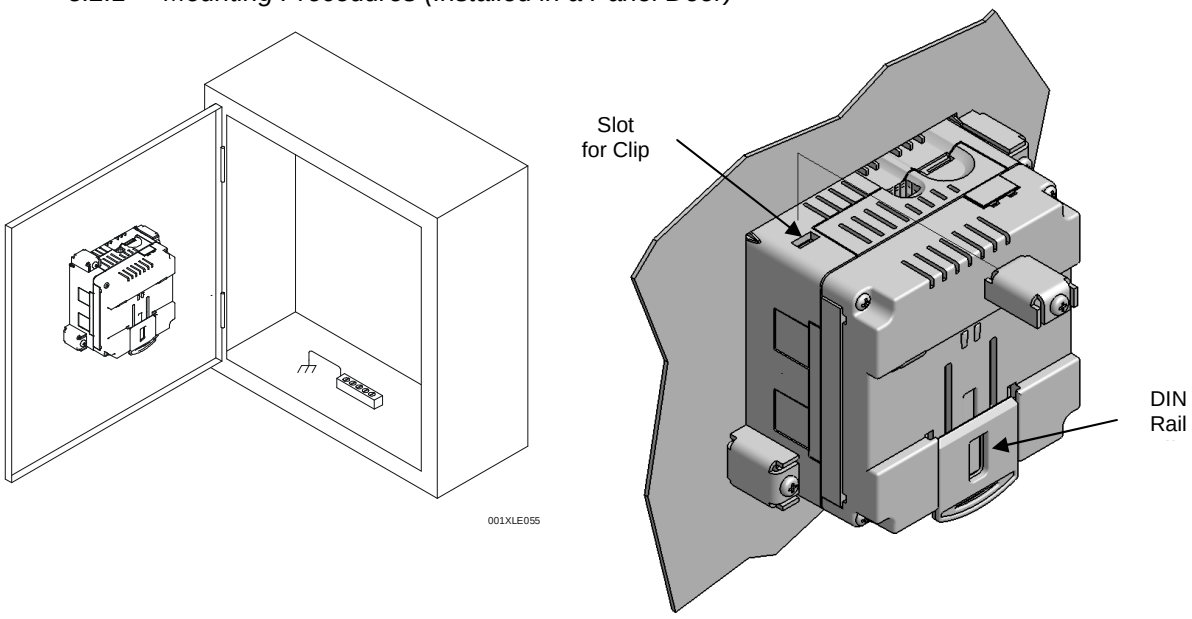


Figure 3.1 – Panel Mounting of the SmartMQn Motor and Close-up View of Back

Once the panel design has been completed using the criteria and suggestions in the following sections, use the following steps to panel mount the SmartMQn Motor.

1. Remove all connectors from the SmartMQn Motor unit.
2. Press the DIN rail clip up to make passing the unit through the cutout easier.
3. Make sure the gasket is installed on the SmartMQn Motor and is free from dust and debris. Check that the corners of the gasket are secure.
4. Pass the unit through the panel.
5. Insert the each of the four (4) mounting clips into the slots in the SmartMQn Motor case. One clip should be installed on each corner. Lightly tignten each screw so the clip is held in place.
6. Tighten the screws on the clips such that the gasket is compressed against the panel.

3.2.2 Mounting Procedures (Installed on DIN Rail)

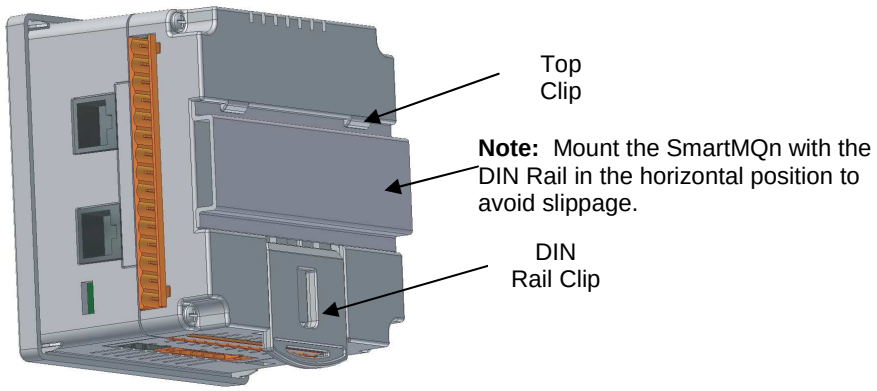


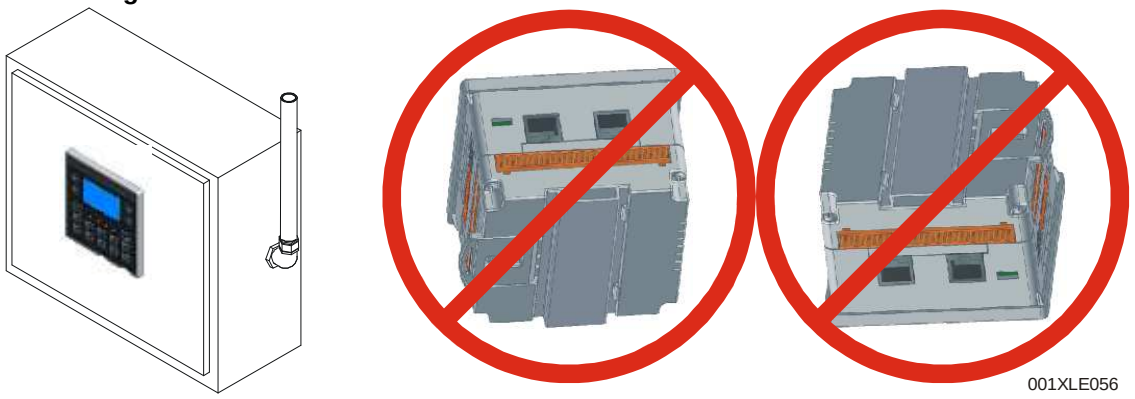
Figure 3.2 – DIN Rail Mounting of the SmartMQn Motor

The SmartMQn Motor is designed to clip onto standard 35 millimeter DIN rail. If your installation requires liquid or dust protection, make sure the SmartMQn Motor is placed in an appropriate sealed panel when mounting on DIN rail. Use the following steps to mount the SmartMQn Motor on DIN rail.

1. Move the DIN rail clip to the lower position.
2. Clip the "Top Clips" on the top of the DIN rail.
3. Press the unit into place and press the DIN rail clip up. A small flat-head screw driver can be used in the slot of the DIN rail clip if clearance is an issue.

Note: The DIN rail connection does <u>not</u> provide an earth ground. Refer to CHAPTER 4 for proper grounding information.

3.3 Mounting Orientation



NOTE: For panel or DIN rail mounting:
The orientation shown above provides for <u>optimum readability</u> of the screen and <u>ease of use</u> of the keypad.

CAUTION: For DIN Rail mounting:
To prevent the unit from slipping off the DIN Rail, do <u>not</u> install the unit on its sides as shown. Be sure the DIN Rail is in the horizontal position. .

Figure 3.3 – Orientation of SmartMQn Motor OCS

3.4 Panel Cut-Out

For installations requiring NEMA-type liquid and dust protection the panel cutout should be cut with a tolerance of ± 0.005” (0.1 mm). The SmartMQn Motor is designed to fit ¼ DIN panel openings. There are a number of punches and enclosures designed to accommodate opening of this size.

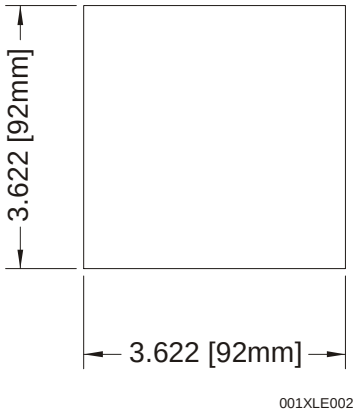


Figure 3.4 – SmartMQn Motor Panel Cut-out

3.5 Dimensions

SmartMQn Motor

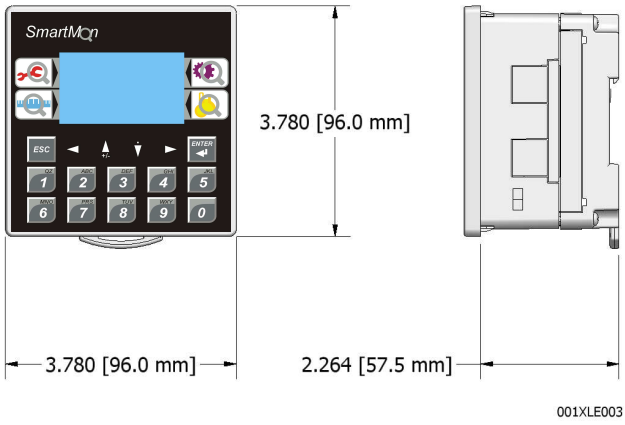


Figure 3.5 – SmartMQn Motor Dimensions

Note: When the communication add-on modules are installed such as Ethernet or Modem the depth of the product increases from 2.264 (57.5 mm) to 2.68 (68 mm).

3.6 Factors Affecting Panel Layout Design and Clearances

Warning: It is important to follow the requirements of the panel manufacturer and to follow all applicable electrical codes and standards.

The designer of a panel layout needs to assess the requirements of a particular system and to consider the following design factors.

3.6.1 Clearance / Adequate Space

Install devices to allow sufficient clearance to open and close the panel door.

Table 3.1 – Minimum Clearance Requirements for Panel Box and Door	
Minimum Distance between base of device and sides of cabinet	2 inches (50.80mm)
Minimum Distance between base of device and wiring ducts	1.5 inches (38.10mm)
If more than one device installed in panel box (or on door): Minimum Distance between bases of each device	4 inches between bases of each device (101.60mm)
When door is closed: Minimum distance between device and closed door (Be sure to allow enough depth for SmartMQn Motor.)	2 inches (50.80mm)

3.6.2 Grounding

Warning: Be sure to meet the ground requirements of the panel manufacturer and also meet applicable electrical codes and standards.

Panel box: The panel box needs to be properly connected to earth ground to provide a good common ground reference.

Panel door: Tie a low impedance ground strap between the panel box and the panel door to ensure that they have the same ground reference.

3.6.3 Temperature / Ventilation

Ensure that the panel layout design allows for adequate ventilation and maintains the specified ambient temperature range. Consider the impact on the design of the panel layout if operating at the extreme ends of the ambient temperature range. For example, if it is determined that a cooling device is required, allow adequate space and clearances for the device in the panel box or on the panel door.

3.6.4 Orientation

When panel-mounted, there are no orientation restrictions on the SmartMQn Motor. However, the orientation shown in Figure 3.3 provides for optimum readability of the screen and ease of use of the keypad. When DIN Rail mounted, observe the orientation shown in Figure 3.2.

3.6.5 Noise

Consider the impact on the panel layout design and clearance requirements if noise suppression devices are needed. Be sure to maintain an adequate distance between the SmartMQn Motor and noisy devices such as relays, motor starters, etc.

3.6.6 Shock and Vibration

The SmartMQn Motor has been designed to operate in typical industrial environments that may inflict some shock and vibration on the unit. For applications that may inflict excessive shock and vibration please use proper dampening techniques or relocate the SmartMQn Motor to a location that minimizes shock and/or vibration.

3.6.7 Panel Layout Design and Clearance Checklist

The following list provides highlights of panel layout design factors.

____ Meets the electrical code and applicable standards for proper grounding, etc.?

____ Meets the panel manufacturer's requirements for grounding, etc.?

___ Is the panel box properly connected to earth ground? Is the panel door properly grounded? Has the appropriate procedure been followed to properly ground the devices in the panel box and on the panel door?

____ Are minimum clearance requirements met? (See **Table 3.1**.) Can the panel door be easily opened and closed? Is there adequate space between device bases as well as the sides of the panel and wiring ducts?

____ Is the panel box deep enough to accommodate the SmartMQn Motor?

____ Is there adequate ventilation? Is the ambient temperature range maintained? Are cooling or heating devices required?

____ Are noise suppression devices or isolation transformers required? Is there adequate distance between the base of the SmartMQn Motor and noisy devices such as relays or motor starters? Ensure that power and signal wires are not routed in the same conduit.

____ Are there other requirements that impact the particular system, which need to be considered?

NOTES

CHAPTER 4: ELECTRICAL INSTALLATION

Note: Each SmartMQn Motor unit is sent with a datasheet in the box. **The datasheet is the first document you need to refer to for model-specific information related to SmartMQn Motor models such as pin-outs, jumper settings, and other key installation information.** Visit our website to obtain datasheets, user documentation, and updates.

4.1 Grounding Definition

Ground: The term ***Ground*** is defined as a conductive connection between a circuit or piece of equipment and the earth. Grounds are fundamentally used to protect an application from harmful interference causing either physical damage such as by lightning or voltage transients or from circuit disruption often caused by radio frequency interference (RFI).

4.2 Ground Specifications

Ideally, a ground resistance measurement from equipment to earth ground is 0 ohms. In reality it typically is higher. The U.S. National Electrical Code (NEC) states the resistance to ground shall not exceed 25 ohms. Horner APG recommends less than 15 ohms resistance from our equipment to ground. Resistance greater than 25 ohms can cause undesirable or harmful interference to the device.

4.3 How to Test for Good Ground

In order to test ground resistance, a Ground Resistance Tester must be used. A typical Ground Resistance Meter Kit contains a meter, two or three wire leads, and two ground rods. Instructions are supplied for either a two-point or three-point ground test. **Figure 4.1** shows a two-point ground connection test.

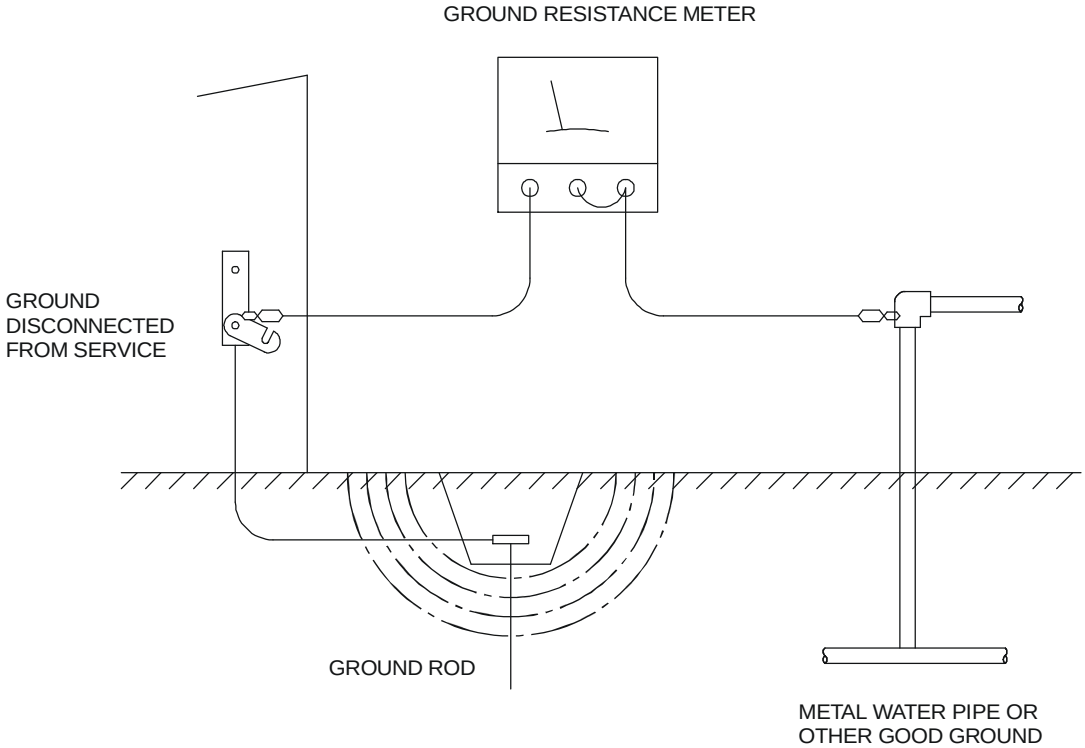
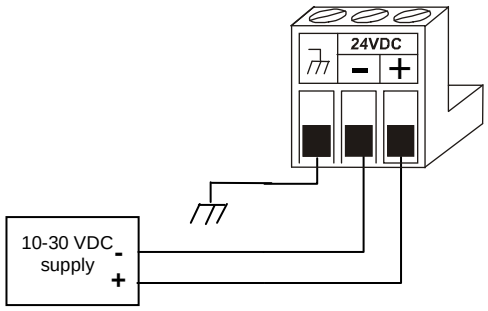


Figure 4.1 - Two-Point Ground Connection Test

4.4 Primary Power Port

Table 4.1 – Primary Power Port Pins		
Pin	**Signal**	**Description**
1	⏚	Frame Ground
2	0V	Input power supply ground
3	+24V	Input power supply positive voltage



Power Connector

Power Up:
Connect to Earth Ground.
Apply 10 – 30 VDC.
Screen lights up.
Torque rating 4.5 - 7 Lb-In
(0.50 – 0.78 N-m)

Figure 4.2 - Power Connector (Primary Power Port)

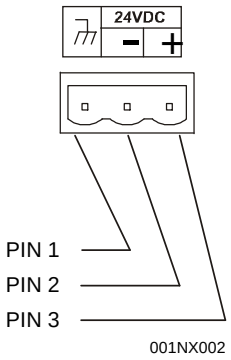


Figure 4.3 - As Viewed Looking at the SmartMQn Motor

4.5 External connections

Connecting input output signals and power supply.

4.5.1 AC Power

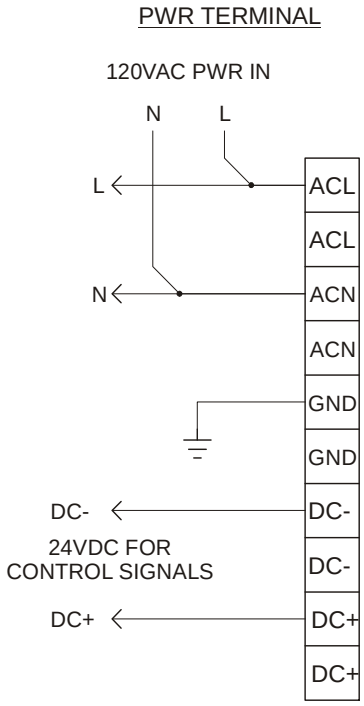


Figure 4.4 – Power Terminal in Enclosure, Factory Mounted SmartMQn Motor

CHAPTER 5: SERIAL COMMUNICATIONS

5.1 Overview

All SmartMQn Motor models provide two serial ports, which are implemented with 8-pin modular RJ45 connectors, and are labeled **MJ1** and **MJ2**. The MJ1 serial port is normally used for SmartMQn Motor programming by connecting it to the COM port of a PC running Cscape. In addition, both MJ1 and MJ2 can be used for application-specific communication, using a variety of standard data exchange protocols.

5.2 Port Descriptions

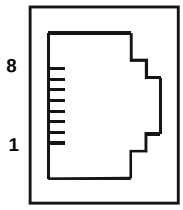
The MJ1 serial port contains both a half-duplex RS-485 interface and an RS-232 interface with RTS/CTS handshaking. **Note: MJ1 shares its serial port with the optional COM module, so when an optional Ethernet or Modem COM module is installed and active, the MJ1 connector is inactive.**

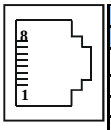
The MJ2 serial port contains both a full-duplex RS-485 interface and an RS-232 interface with no handshaking. Both the MJ1 and MJ2 RS-485 interfaces provide switchable termination and bias resistors internally.

5.3 Wiring

Figure 5.1 along with **Table 5.1** and **Table 5.2** show how the MJ1 and MJ2 serial port pins are assigned.

Note: MJ1 and MJ2 look the same but have different pin assignments and functions.





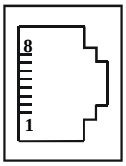
Pin	MJ1 Pins		MJ2 Pins	
	Signal	Direction	Signal	Direction
8	TXD	OUT	TXD	OUT
7	RXD	IN	RXD	IN
6	0 V	Ground	0 V	Ground
5*	+5 60mA	OUT	+5 60mA	OUT
4	RTS	OUT	TX-	OUT
3	CTS	IN	TX+	OUT
2	RX- / TX-	IN / OUT	TX-/RX-	IN
1	RX+ / TX+	IN / OUT	TX+/RX+	IN

Figure 5.1 – MJ Serial Port Connector

Table 5.1 – MJ1 Serial Port Pin Assignments			
Pin	**Signal**	**Signal Description**	**Direction**
1	RX/TX+	RS-485 Receive/Transmit Positive	In/Out
2	RX/TX–	RS-485 Receive/Transmit Negative	In/Out
3	CTS[1]	RS-232 Clear to Send	Out
4	RTS[1]	RS-232 Request to Send	In
5	+5	+5 Vdc 60mA max	Out
6	0V	Ground	–
7	TD[1]	RS-232 Transmit Data	In
8	RD[1]	RS-232 Receive Data	Out

Table 5.2 – – MJ2 Serial Port Pin Assignments			
Pin	**Signal**	**Signal Description**	**Direction**
1	RX+	RS-485 Receive Positive	In
2	RX–	RS-485 Receive Negative	In
3	TX+	RS-485 Transmit Positive	Out
4	TX–	RS-485 Transmit Negative	Out
5	+5*	+5 Vdc 60mA max	Out
6	0V	Ground	–
7	TD[1]	RS-232 Transmit Data	In
8	RD[1]	RS-232 Receive Data	Out

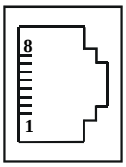
[1]Signals are labeled for connection to a DTE device



Pin	MJ2 Pins	
	Signal	Direction
8	TXD	OUT
7	RXD	IN
6	0 V	Ground
5*	+5 60mA	OUT
4	TX-	OUT
3	TX+	OUT
2	RX-	IN
1	RX+	IN

* +5 60mA maximum

Full Duplex Mode



Pin	MJ2 Pins	
	Signal	Direction
8	TXD	OUT
7	RXD	IN
6	0 V	Ground
5*	+5 60mA	OUT
4	TX-	OUT
3	TX+	OUT
2	TX-/RX-	IN/OUT
1	TX+/RX+	IN/OUT

* +5 60mA maximum

Half Duplex Mode

MJ2 Pinouts in Full and Half Duplex Modes

5.4 RS-485 Termination

Proper RS-485 termination minimizes reflections and improves reliability.

Both serial ports allow an internal 121-Ohm RS-485 termination resistor to be placed across pins 1 and 2. This can be done by installing a jumper. Please refer to the SmartMQn Motor data sheet for jumper locations.

In any case, only the two devices physically located at the endpoints of the RS-485 network should be terminated.

5.5 RS-485 Biasing

RS-485 biasing passively asserts a line-idle state when no device is actively transmitting, which is useful for multi-drop RS-485 networking.

Both serial ports allow internal 390-Ohm RS-485 bias resistors to be switched in, pulling pin 1 up to 3.3V and pulling pin 2 down to ground. The Set Serial Ports item in the System Menu can be used to enable RS-485 biasing. Also, an application graphics screen that writes to %SR164 can do the same thing. Setting %SR164.1 enables MJ1 biasing and setting %SR164.2 enables MJ2 biasing.

If biasing is used, it should be enabled in only one of the devices attached to the RS-485 network.

CHAPTER 6: CAN COMMUNICATIONS

Note: For additional CAN information, refer to the CAN Networks manual (MAN0799) on our website.

6.1 Overview

SmartMQn Motor models provide a CAN networking port, which is implemented with a 5-pin connector, labeled **NET1**.

Like the MJ1 serial port, the NET1 port can be used for SmartMQn Motor programming by connecting it to the CAN port of a PC running Cscape. The NET1 port also allows the SmartMQn Motor to exchange global data with other OCS/RCS controllers and to access remote Network I/O devices (SmartStix Modules).

6.2 Port Description

The SmartMQn Motor NET1 port implements the ISO 11898-2 physical layer and the CAN 2.0A data link layer standards. Also, since the NET1 port is powered by an internal isolated power supply, external CAN power is not required.

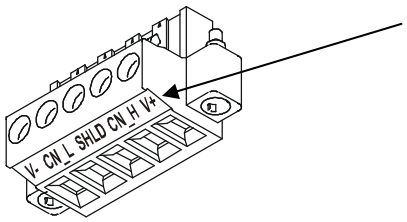
6.3 Wiring

Figure 6.1 and **Table 6.1** show how the NET1 port pins are assigned.

CAN Connector

Use the CAN Connector when using CsCAN network.

Torque rating 4.5 – 7 Lb-In (0.50 – 0.78 N-m)



Note: The V+ connection is not required on the SmartMQn Motor. The SmartMQn Motor network port is self-powered. Supporting devices can require this connection, and this pin can be used to land the extra wire required for those devices.

Figure 6.1 - NET1 Port Connector

Table 6.1 – NET1 Port Pin Assignments

Pin	Signal	Signal Description	Direction
1	V-	CAN Ground	–
2	CN_L	CAN Data Low	In/Out
3	SHLD	Shield Ground	–
4	CN_H	CAN Data High	In/Out
5	NC	No Connect	–

CHAPTER 7: COMMUNICATION OPTIONS

7.1 Overview

To supplement the built-in MJ1 and MJ2 serial ports, additional communication options are available. This is accomplished by installing a COM module internal to the SmartMQn Motor controller. Currently, there are two COM modules available for this purpose: Ethernet (HSC) and Modem (XMC).

7.1.1 MJ1 shares its serial port with the optional COM module, so when an Ethernet or Modem COM module is installed and active, the MJ1 connector is inactive.

Internal to the SmartMQn Motor, there is a CPU board, and up to two installed modules. Models HS000/XT000 and HS100/XT100 have no installed I/O or COM modules. All other models have an I/O module in Slot 1 and can have a user-installed COM module in Slot 2.

This chapter briefly describes both the Ethernet and Modem COM module options. For detailed information regarding these modules, please refer to the individual documents provided with the modules.

7.2 Ethernet COM Module (HSC) Option

An Ethernet COM module can be installed to allow Cscape programming of an SmartMQn Motor over a Local Area Network or over the Internet. In addition, the Horner OPC Server can be installed on a PC to allow other standard PC applications (such as database and spreadsheets programs) access to SmartMQn Motor register data.

The Ethernet COM module supports both 10 BaseT (10 MHz) and 100 BaseTx (100 MHz) as well as both half and full duplex communication. Both the connection speed and the duplex are auto-negotiated.

Although the physical connection between the Ethernet COM Module and the Local Area Network is done using a standard Ethernet cable (CAT5 or better with RJ45 modular plug), a **Serial Port Tunnel** protocol is employed that makes the Ethernet COM Module appear as a serial port to Cscape or OPC Server software running on the PC.

On the SmartMQn Motor end of the Serial Port Tunnel, the Ethernet COM module should be properly configured using the SmartMQn Motor System Menu (see CHAPTER 10). This configuration consists of making Ethernet the Default Programming Port and setting its target IP Address, Net Mask and optionally the Gateway IP Address. The Gateway IP Address is required if the SmartMQn Motor will be accessed from outside the Local Area Network (e.g. the Internet).

On the PC end of the Serial Port Tunnel, the PC should be connected to the Local Area Network (or to the Internet) and a **Com Port Redirector** driver must be installed on the PC and properly configured. The Com Port Redirector allows multiple “virtual” PC serial ports to be created and each one can be assigned to a different target device IP Address, thus allowing access to Ethernet COM modules in multiple SmartMQn Motor controllers.

After installing and configuring both the Ethernet COM module and the Com Port Redirector, Cscape or OPC Server software should be set up to communicate to one of the “virtual” serial ports, at which point they should function as if a “real” PC serial port was connected to the SmartMQn Motor MJ1 serial port.

7.3 Modem COM Module (XMC) Option

A Modem COM module can be installed to allow Cscape programming of an SmartMQn Motor over a dial-up network. In addition, the application ladder program can take control of the modem for application-specific modem communication.

The Modem COM module supports the standard AT command set and can connect to the dial-up network at speeds up to 13.4 KBaud. Connection speed is auto-negotiated. The Modem COM module connects to the dial-up network (phone line) via a cable with a standard RJ11 modular plug.

To enable Cscape programming via a dial-up network, the Modem COM module should first be configured as the Default Programming Port, using the SmartMQn Motor System Menu (see CHAPTER 10). Doing this puts the Modem COM module in auto-answer mode, so Cscape can call the SmartMQn Motor via a remote modem.

To program the ladder application to communicate via the Modem COM module, standard Cscape Serial and Modem function blocks can be used.

CHAPTER 8: REMOVABLE MEDIA

8.1 Overview

All SmartMQn Motor models provide a Removable Media slot, labeled **Memory**, which supports standard Micro SD Flash memory cards. Micro SD cards can be used to save and load applications, to capture graphics screens and to log data for later retrieval.

8.2 Micro SD Cards

When the Micro SD card format was introduced, it was originally called TransFlash. Cards labeled either Micro SD or TransFlash, with **up to 2.0 GB** of Flash memory, are compatible with the SmartMQn Motor Memory slot.

The SmartMQn Motor Memory slot is equipped with a "push-in, push-out" connector and a Micro SD card can be safely inserted into the Memory slot whether the SmartMQn Motor power is On or Off.

*To install a Micro SD card***:** Align its 8-pin gold edge connector down, facing the front of the SmartMQn Motor unit as shown in **Figure 8.1**; then carefully push it all the way into the Memory slot. Ensure that it clicks into place.

*To remove the Micro SD card***:** Push down on the top of the card gently to release the spring. The card pops up for removal.

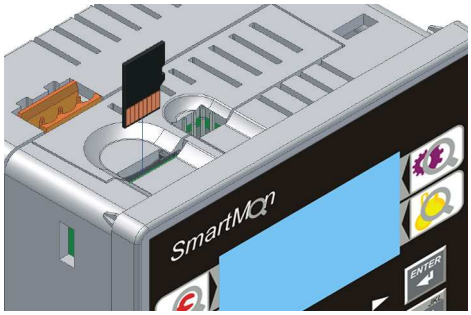


Figure 8.1 – Installing Removable Memory Card

8.3 Micro SD File System

The SmartMQn Motor Micro SD Memory slot uses the PC-compatible FAT16 File System. This means that a PC, with a Micro SD-compatible card reader, can read files that have been written by the SmartMQn Motor and can write files that can be read by the SmartMQn Motor.

However, the SmartMQn Motor does not support long filenames, but instead implements the 8.3 filename format. This means that all file and directory names must consist of up to 8 characters, followed by an optional dot, and an optional extension with up to 3 characters.

Directories and sub-directories can be nested up to 16 levels deep as long as each pathname string does not exceed 147 characters.

NOTES

CHAPTER 9: I/O

9.1 Discrete I/O Mapping

9.1.1 I/O Configuration

Prompt	Description	Range	Default
Contactor	Contactor type	Sngl | Dual	Sngl
Dual Period	Output Pulse Hold Time	.1 – 5.0 s	.5 s
Input 1	DI1 routing	Ext 1 | Start	Ext 1
Input 2	DI2 routing	Ext 2 | Stop	Ext 2
Input 3	Di3 routing (read only)	52a	52a
Input 4	DI4 routing	Ext 2 | Reset | Loc/Rmt	Reset
Output 1	Q1 action	Aux 1 Run R+A Alarm	Aux 1
Output 2	Q2 action	Aux 2 Stop S+T BS	Aux 2
Output 3	Q3 action – (read only) Action dependent on Mode and Coil settings	Alarm POn	
Output 4	Q4 Action– (read only) Action dependent on Mode and Coil settings	Trip PTrip Latch POff	
Lcl Src	Local Source	UI | Term | Net	UI
Rmt Src	Remote Source	UI | Term | Net	Net
Rmt Sel	Local/Remote Select point	Off | UI | Term	Off
Lcl Act	Local Selected action	None, Alm	None

9.1.2 Mode Configuration

Prompt	Description	Range	Default
P CT Ratio	Phase CT primary current	1 – 1000 A	450
P CT Sec	Phase CT secondary current (read only)		.1A
G CT Ratio	Ground CT primary current	1 – 100 A	50
G CT Sec	Ground CT secondary current (read only)		.1A
SmartMQn Motor Mode	Monitor (current), Monitor (52A), Control (	Mon | M52 | Cntr	Mon
FLC	Full load (rated) current	1 – 2000 A	50 A
STA Setpt	Start mode detection current (mon only)	5 – 100 (FLC)	10 %
OFF Setpt	Stop mode detection current (mon only)	5 – 100 (FLC)	5 %
SPH Cnt	Starts per hour	1 – 10	0
MBS Cnt	Minimum Minutes between starts	0 – 240 min	0 min
Reserved			
Reserved			
RUN Det Sel	Run detection mode	Timer | Current	Current
RUN Setpt	Run mode detection current	25 – 250% (FLC)	100 %
RUN Delay	STA-to-RUN detect/error delay	0 – 240.0 sec	10.0 sec
RUN Err Act	STA-to-RUN error action (48)	None, Alarm, Trip	Alarm
Reserved			
CB Act	Circuit Breaker error action (mon only)	None | Alm	None
ESP Act	External E-Stop action (ctrl only)	None | Alm	None

9.1.3 Current Configuration

Prompt	Description	Range	Default
U/L Act	Under-load current action	Off , Alm, Trip, A+T	Off
U/L Alm	Under-load current alarm setpoint	10 – 90 % (FLC)	40 %
U/L Trip	Under-load current trip setpoint	10 – 90 % (FLC)	30 %
U/L Delay	Under-load current delay before trip	0 – 240.0 sec	10.0 sec
O/L Act	Overload current action	Off , Alm, Trip, A+T	Off
O/L Alm	Overload current error action	100 – 600 % (FLC)	200 %
O/L Trip	Overload current trip setpoint	100 – 600 % (FLC)	250 %
O/L Delay	Overload current delay before trip	0 – 240.0 sec	10.0 sec
U/B Act	Unbalanced current action	Off, Alm, Trip, A+T	Trip
U/B Alm	Unbalanced current alarm setpoint	5 – 50% (AVG)	10%
U/B Trip	Unbalanced current trip setpoint	5 – 50% (AVG)	15 %
U/B Delay	Unbalanced current delay before trip	0 – 240.0 sec	5.0 sec
STL Act	Stall current action	Off, Trip	Trip
Reserved			
STL Trip	Stall current trip setpoint	100 – 600% (AVG)	600%
STL Delay	Stall current delay before trip	0 – 240.0 sec	10.0 sec
TOC Act	Timed over current action	Off, Alm, Trip, A+T	Trip
TOC USP	Timed over current ultimate setpoint	101 – 125%	105%
TOC Class	Timed over current NEMA class	5 – 30 Class	10
TOC Alm	Timed over current percent alarm	25 – 100 %	75%
TOC Inh	Timed over current percent inhibit	1 – 100%	15%
GRD Act	Ground current action	Off, Alm, Trip, A+T	Off
GRD Alm	Ground over current alarm setpoint	0.1 – 25.0 A	5 A
GRD Trip	Ground over current trip setpoint	0.1 – 25.0 A	10 A
GRD Delay	Ground over current delay before trip	0 – 24.0 sec	1.0 sec

9.1.4 Thermal Configuration

Prompt	Description	Range	Default
PTC Temp Act	PTC Exceeded Nominal Rating Action	None, Alm, Trip	None
PTC Open Act	PTC Short or Open circuit detection	None, Alm, Trip	None

9.1.5 External Configuration

Prompt	Description	Range	Default
Aux1 Delay	Auxiliary input delay before error	0 – 240.0 sec	None
Aux1 Action	Auxiliary input error action (94)	None, Alm, Trip	None
Aux2 Delay	Auxiliary input delay before error	0 – 240.0 sec	None
Aux2 Action	Auxiliary input error action (94)	None, Alm, Trip	None

9.1.6 Network Configuration

Prompt	Description	Range	Default
Net Fail Act	Network Failure action (cmd only)	None | Alm | Halt	None
MB Addr	Set the Modbus Slave Address	1 – 253	None
MB Rate	Set the Modbus Slave Baud	9600 | 19200	None
MB Port		RS232 | RS486	None
MB Par En	Enable Modbus Slave Parity	None | Enabled	None
MB Par Bit	Set Modbus Slave Parity Type	Odd | Even	None

9.2 Discrete I/O – Monitor Mode / Single Contactor Example

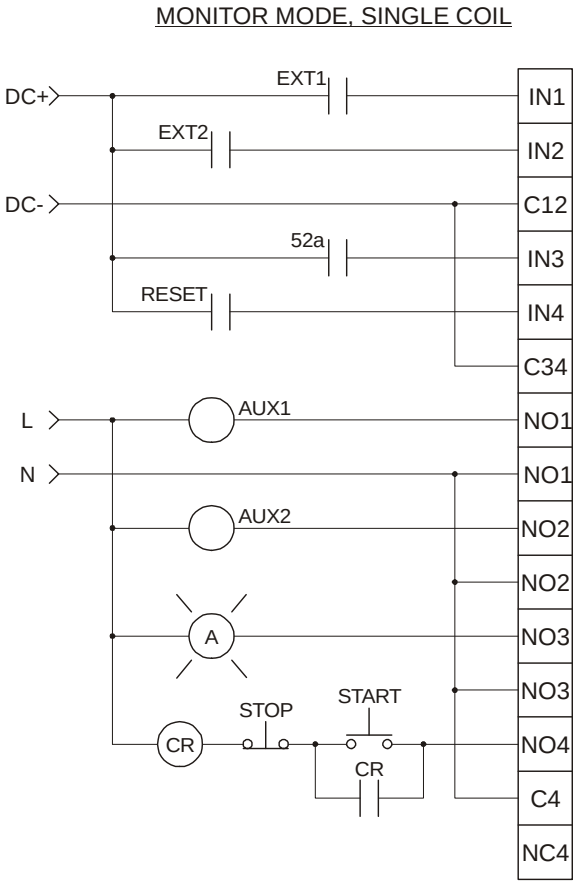


Figure 9.1 – Monitor Mode Wiring Example 1, SmartMQn Motor J2

9.3 Discrete I/O – Monitor Mode / Dual Contactor Example

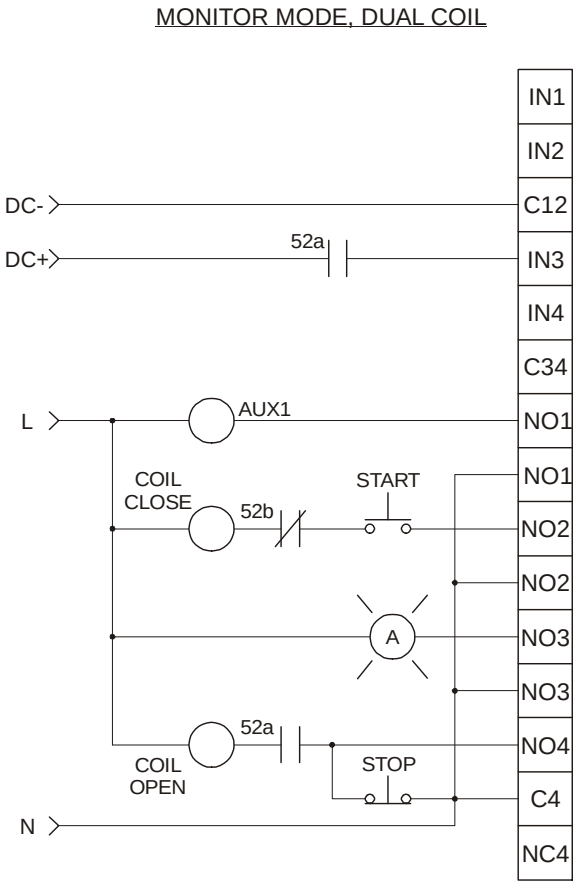


Figure 9.2 – Monitor Mode Wiring Example 2, SmartMQn Motor J2

9.4 Discrete I/O – Controller Mode / Single Contactor Example

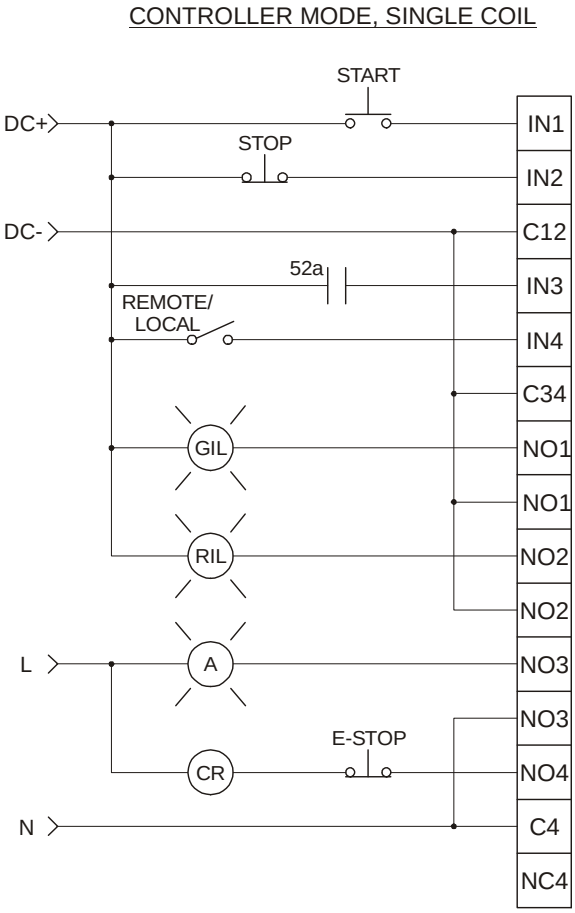


Figure 9.3 – Controller Mode Wiring Example 1, SmartMQn Motor J2

9.5 Discrete I/O – Controller Mode / Dual Contactor Example

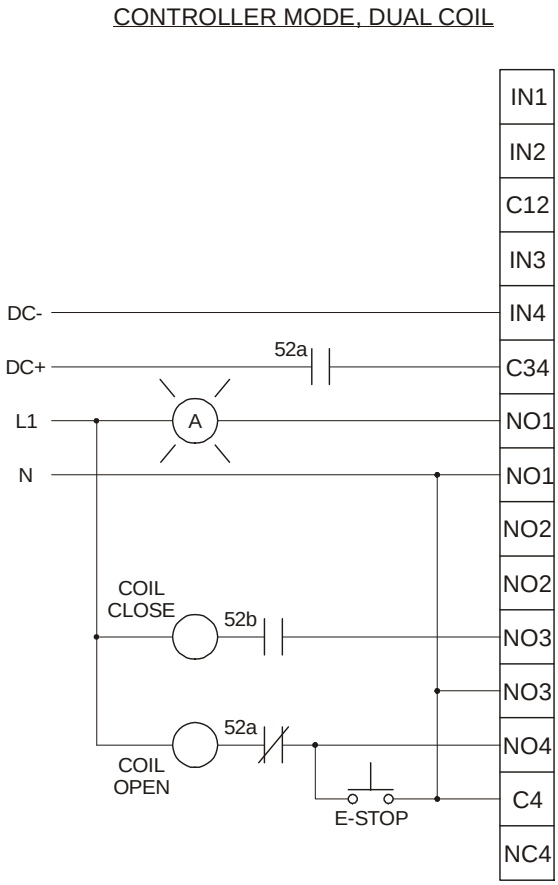


Figure 9.4 – Monitor Mode Wiring Example 2, SmartMQn Motor J2

9.6 CT Connection

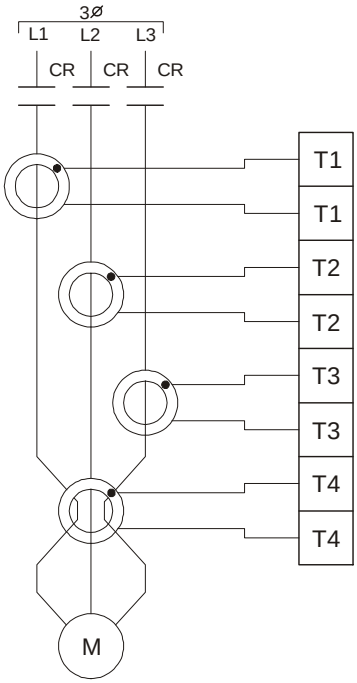


Figure 9.5 – CT Connection Wiring Example, SmartMQn Motor J1

9.7 PTC connection

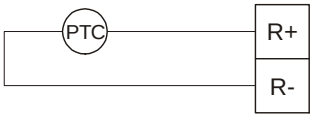


Figure 9.5 – PTC Connection Wiring Example, SmartMQn Motor J1

CHAPTER 10: SYSTEM SETTINGS AND ADJUSTMENTS

10.1 System Menu - Overview

The SmartMQn Motor controller has a built-in System Menu, which lets the user view System Settings and make adjustments. To start the System Menu, press the ↓ and ↑ keys at the same time (or set %SR3 to 1), which will display the Main Menu, as shown in **Figure 10.1**. Then use the ↓ and ↑ keys to select a **Main Menu** item and press **Enter** to display the item's sub menu.

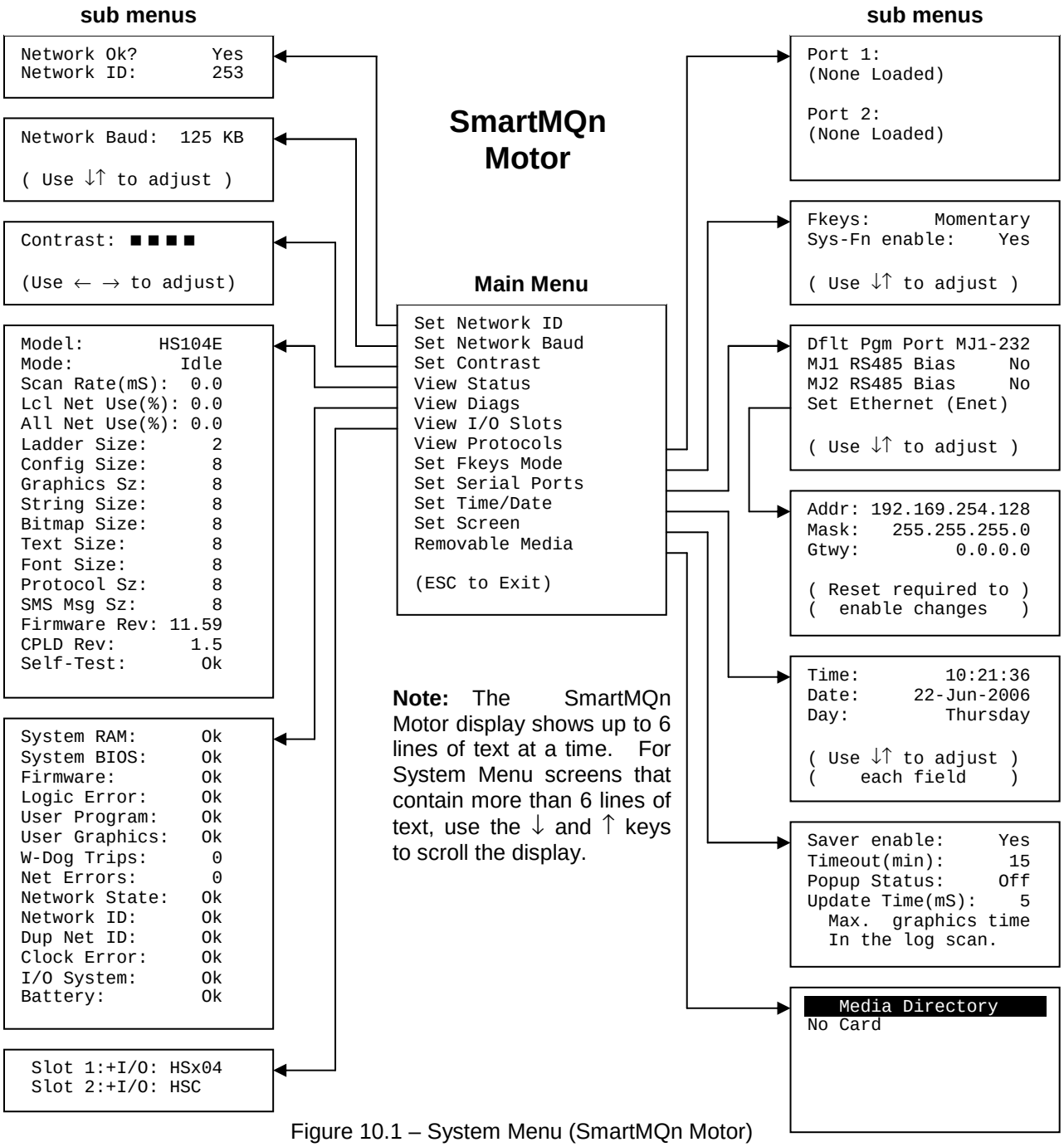


Figure 10.1 – System Menu (SmartMQn Motor)

10.2 System Menu – Navigation and Editing

As mentioned above, the System Menu is started by pressing the ↓ and ↑ keys at the same time for the SmartMQn Motor. Then, either press ESC to exit the System Menu, or use the ↓ and ↑ keys to select an item and press **Enter** to display the item's sub menu.

A sub menu generally shows a list of System Settings and their values. After opening a sub menu, if any of its System Settings are editable, the first System Setting that can be edited is highlighted. If desired, the ↓ and ↑ keys can be used to select a different System Setting to be edited.

At this point, either press **ESC** to exit the sub menu (returning to the Main Menu) or press **Enter** to edit the highlighted System Setting. If **Enter** is pressed, the System Setting's value will be highlighted, indicating that it is ready to be modified.

When modifying a System Setting's value, use either the arrow keys (← → ↓ ↑) or the numeric keys to select a new value.

The arrow keys are used to edit System Settings that have just a few possible values. Each time the arrow key is pressed, a new possible value is displayed. When the desired value appears, press the **Enter** key to save it; otherwise press the **ESC** key to cancel the edit.

The numeric keys are normally used to enter numeric System Settings. In addition, to edit a single numeric digit, use the ← or → key to select the digit and then either press a numeric key or use ↓ or ↑ to modify the digit. In any case, after entering the new desired value, press the **Enter** key to save it; otherwise press the **ESC** key to cancel the edit.

10.3 System Menu – Details

The following sections describe each of the sub menus in detail.

10.3.1 Set Network ID

The Network ID sub menu only appears for SmartMQn Motor models that have CAN ports. This sub menu displays two System Settings of which only **Network ID** is editable.

Network Ok?	Yes	= NET1 connected to a CAN network and functioning properly
	No	= Not ready to communicate on CAN network
Network ID:	1 to 253	= This node's CsCAN Network ID; must be unique on network

10.3.2 Set Network Baud

The Network Baud sub menu only appears for SmartMQn Motor models that have CAN ports. This sub menu displays just one System Setting and it is editable.

Network Baud?	125 KB	= 125 KBaud CAN network
	250 KB	= 250 KBaud CAN network
	500 KB	= 500 KBaud CAN network
	1 MB	= 1 MBaud CAN network

10.3.3 Set Contrast

The Set Contrast sub menu displays just one System Setting and it is editable.

Contrast: ■ ■ ■ ■	= Current display contrast setting

10.3.4 View Status

The View Status sub menu displays up to 17 System Settings. The **Lcl Net Use %** and **All Net Use %** System Settings only appear for SmartMQn Motor models that have CAN ports. Only the **Mode** System Setting is editable.

Model:	HSxyyz	= 5 or 6 character Model number of this SmartMQn Motor unit x is 1 for models that have a CAN port; 0 = no CAN port yy indicates the installed I/O module; 00 = no I/O module z indicates the installed COM module; N = no COM module
Mode:	Idle	= SmartMQn Motor is in Idle mode
	DoIo	= SmartMQn Motor is in Do I/O mode
	Run	= SmartMQn Motor is in Run mode
Scan Rate(mS):	0.0	= SmartMQn Motor is not in Run mode
	0.1 to 999.9	= Average number of mS for each ladder scan
Lcl Net Use %:	0.0 to 100.0	= CAN network bandwidth % used by this SmartMQn Motor node
All Net Use %:	0.0 to 100.0	= CAN network bandwidth % used by all nodes
Ladder Size:	x	= Number of bytes in application ladder program
Config Size:	x	= Number of bytes in application I/O configuration
Graphics Sz:	x	= Number of bytes in application graphic screens
String Size:	x	= Number of bytes in application string table
Bitmap Size:	x	= Number of bytes in application bitmaps
Text Size:	x	= Number of bytes in application text tables
Font Size:	x	= Number of bytes in application font tables
Protocol Sz:	x	= Number of bytes in application downloaded protocols
SMS Msg Sz:	x	= Number of bytes in application SMS protocol configuration
Firmware Rev:	xx.yy	= Current firmware version
CPLD Rev:	x.y	= Current CPLD (Complex Programmable Logic Device) version
Self-Test:	Ok	= All power-on self-tests passed
	Fault	= One or more power-on self-tests failed

10.3.5 View Diags

The View Diags sub menu displays up to 14 System Diagnostics, all of which are not editable. The **Net Errors, Network State, Network ID** and **Dup Net ID** System Diagnostics only appear for SmartMQn Motor models that have CAN ports (HS1xx).

The first five System Diagnostics are critical. If any of them indicate a Fault condition, the SmartMQn Motor will not enter or remain in Run mode, and the problem must be investigated and corrected.

System Ram:	Ok	= System RAM power-up self-test passed
	Fault	= System RAM power-up self-test failed
System BIOS:	Ok	= System BIOS power-up self-test passed
	Fault	= System BIOS power-up self-test failed
Firmware:	Ok	= Firmware power-up self-test passed
	Fault	= Firmware power-up self-test failed
Logic Error:	Ok	= All executed ladder instructions are legal for loaded firmware
	Fault	= A ladder instruction not supported by firmware was found
User Program:	Ok	= Ladder program and I/O configuration loaded successfully
	Fault	= Ladder program or I/O configuration not loaded or load failed

The last nine System Diagnostics are informational. If any of them indicate a Warning condition, the SmartMQn Motor can still enter and remain in Run mode, but the problem should be investigated and corrected.

User Graphics:	Ok	= Application graphics objects loaded successfully
	Fault	= Application graphics objects not loaded or load failed
W-Dog Trips:	0	= Watchdog timer has not tripped since the last power-up
	x	= Number of times watchdog timer has tripped
Net Errors:	0	= No CAN network bus-off errors have occurred
	x	= Number of CAN network bus-off errors that have occurred
Network State:	Ok	= At least one other node was found on the CAN network
	Warning	= No other nodes were found on the CAN network
Network ID:	Ok	= This node's CAN Network ID is in the range 1 to 253
	Warning	= This node's CAN Network ID was out of range at power-up
Dup Net ID:	Ok	= This node's Network ID is unique on the CAN network
	Warning	= This node's Network ID is duplicated in another node
Clock Error:	Ok	= Time and date have been set
	Warning	= Time and date need to be set
I/O System:	Ok	= I/O configuration matches the installed I/O and COM modules
	Warning	= I/O configuration needs updating to match installed modules
Battery:	Ok	= Backup battery operating properly
	Warning	= Backup battery needs to be replaced

10.3.6 View I/O Slots

The View I/O Slots sub menu displays two System Settings, both of which are not editable.

Internal to the SmartMQn Motor, there is a CPU board, and up to two installed modules. All models have an I/O module in Slot 1 and can have a user-installed COM module in Slot 2.

Depending on which I/O module is installed and which I/O module has been configured by Cscape, one of the following six System Settings should appear for Slot 1:

Slot 1: I/O: Empty	= No I/O module installed or configured
Slot 1:*Unsupported	= Unsupported I/O module installed
Slot 1:-I/O Missing	= No I/O module installed but an I/O module is configured
Slot 1:+I/O: HSxyy	= yy I/O module installed but no I/O module configured
Slot 1:?I/O: HSxyy	= yy I/O module installed but another I/O module configured
Slot 1: I/O: HSxyy	= yy I/O module installed and configured properly

Depending on the COM module that is installed and the COM module that has been configured by Cscape, one of the following six System Settings appears for Slot 2:

Slot 2: I/O: Empty	= No COM module installed or configured
Slot 2:*Unsupported	= Unsupported COM module installed
Slot 2:-I/O Missing	= No COM module installed but a COM module is configured
Slot 2:+I/O: XzC	= z COM module installed but no COM module configured
Slot 2:?I/O: XzC	= z COM module installed but another COM module configured
Slot 2: I/O: XzC	= z COM module installed and configured properly

10.3.7 Set Fkeys

The Set Fkeys sub menu displays two System Settings, both of which are editable.

Fkeys:	Momentary	= %K1-10 bits go On & Off as F1-F10 are pressed & released
	Toggle	= %K1-10 bits toggle each time F1-F10 are pressed
SYS_Fn enable:	Yes	= Reset and all clear system functions enabled
	No	= Reset and all clear system functions disabled

10.3.8 Set Serial Ports

The Set Serial Ports sub menu displays three System Settings, all of which are editable, and one optional item. For the **Dflt Pgm Port** System Setting, only MJ1-232 can be selected, unless either an Ethernet (HSC) or a Modem (XMC) COM module is installed. Also, the **Set Ethernet (Enet)** item only appears if an Ethernet COM module is installed.

Dflt Pgm Port:	MJ1-232	= MJ1 RS232 port is the default programming port
	Enet	= Ethernet COM module is the default programming port
	Modem	= Modem COM module is the default programming port
MJ1 RS485 Bias:	No	= MJ1 RS485 bias resistors are not switched in
	Yes	= MJ1 RS485 bias resistors are switched in
MJ2 RS485 Bias:	No	= MJ2 RS485 bias resistors are not switched in
	Yes	= MJ2 RS485 bias resistors are switched in

Set Ethernet (Enet) = Select and press **Enter** to setup the Ethernet COM module

10.3.9 Set Ethernet (Enet)

The Set Ethernet (Enet) sub menu displays three System Settings, all of which are editable. The values shown below are the default values. Note that if **Gtwy** is set to 0.0.0.0, Ethernet communication will be confined to the local network.

Addr:	192.168.254.128	= IP Address for installed Ethernet COM module
Mask:	255.255.255.0	= Net Mask for installed Ethernet COM module
Gtwy:	0.0.0.0	= Gateway device IP Address for installed Ethernet COM module

10.3.10 Set Time/Date

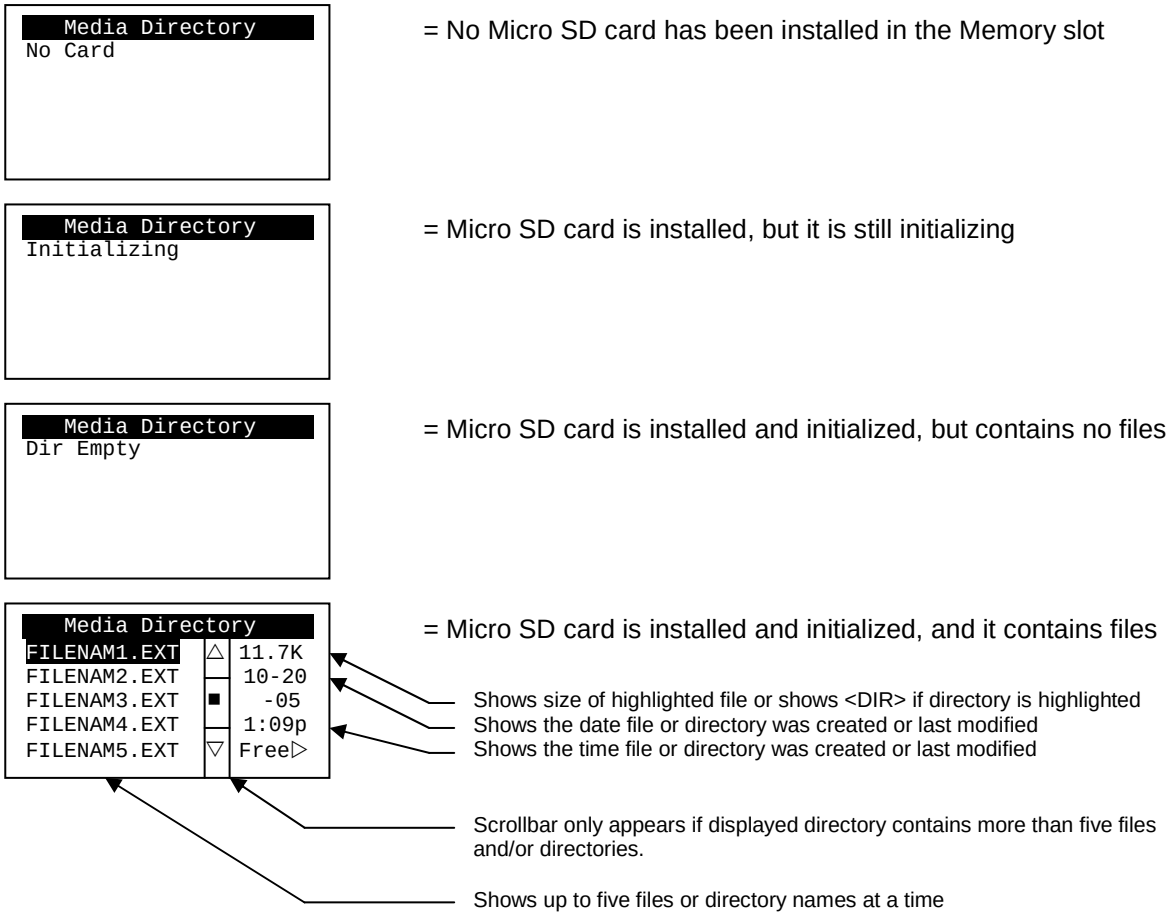
The Set Time/Date sub menu displays three System Settings. **Time** and **Date** are editable, and **Day** is automatically calculated from the **Date** setting. Note that **Time** and **Date** are split into three editable fields each. Use ← or → to select a field and then use ↓ or ↑ to edit the field.

Time:	10:21:36	= Current time (hours:minutes:seconds in 24-hour format)
Date:	22-Jun-2006	= Current date (day-month-year)
Day:	Thursday	= Current day of week calculated from the Date setting

Note: After changing the Ethernet Addr, Mask, or Gtwy, the SmartMQn Motor must be power-cycled (or reset) before the changes take effect.

10.3.11 Removable Media

The Removable Media sub menu displays the Removable Media Manager (see CHAPTER 8). After selecting Removable Media from the Main Menu, one of four sub menu screens will appear:



If the Removable Media Manager displays files or directories, as in the last example above, there are several options available:

If → is pressed, the number of total and free bytes is displayed. Then, pressing ← returns to the normal file and directory display.

If a soft key (on either side of the display) is pressed, a pop-up window appears on the right side of the display, showing the function key options as follows:

F1 Delete	= Delete the highlighted file or directory
F2 DelAll	= Delete all files and directories
F3 Format	= Format the Micro SD card
F4 SavPgm	= Save SmartMQn Motor application to DEFAULT.PGM
Esc Cancel	= Cancel current operation (back up one screen)

Pressing the soft key again or pressing ESC returns to the normal file and directory display.

If a directory name is highlighted, pressing **Enter** will switch to that directory showing its files and sub-directories. In a sub-directory, highlighting **..** (dot dot) and pressing **Enter** will move up one directory.

NOTES

CHAPTER 11: USER INTERFACE AND OPERATION

11.1 Screen Navigation

The screen navigation on the SmartMQn Motor is quite flexible. Basic methods will be described here. Control programming can be used to create complex screen navigation techniques.

One form of screen navigation is the **Jump Screen** graphics object. This object is typically tied to a soft key (One of the four keys to the sides of the display for the SmartMQn Motor and at the bottom of the screen for the SmartMQn Motor). Pressing the soft key will switch to the screen that is programmed.

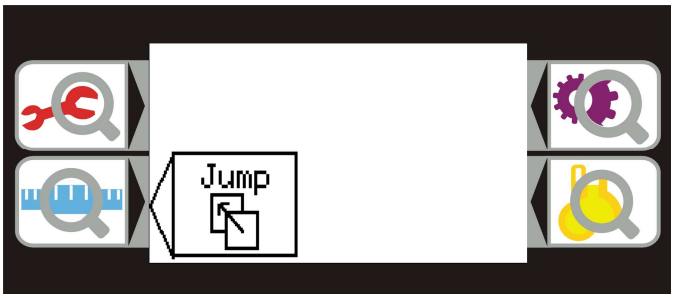


Figure 11.1 – Typical Screen Jump Object (SmartMQn Motor)

11.2 Using Editable Screen Objects

When a screen contains editable objects, one of the objects will be selected by default. Selected objects will be outlined with a dotted line. The arrow keys can be used to navigate the editable objects and allow selection of an object to edit. When the object to be edited is selected press the **Enter** button. This enters the objects editing mode.

The most common editable object is the numeric object.

11.3 Configuration

The SmartMQn Motor front panel consists of a status display for showing the operational status, trends, and online measurements along with buttons for navigating through various configuration menus. The status display consists of four independent parts and each part is attached with function keys. Following are the function keys / Status display:

- Alarms
- Measurements
- Trends/ Graphs
- Control

Each part of the status display shows different messages according to the operational status of the motor. Using the function keys attached with status display screen, the user can navigate through different menu items.

Figure 11.2 - Function Keys and Status Display

11.4 Front Panel Buttons and Navigation

The Configuration / setting Menu is attached with function keys. The user can trigger / open the main menu by pressing the function keys. The main menu item has sub menus which can be navigated by using the four arrow keys (up, down, left and right). Press **ESC** to exit the sub menu (returning to the Main Menu) or press **Enter** to edit the highlighted System Setting.

The numeric keys are normally used to enter numeric System Settings. In addition, to edit a single numeric digit, use the ← or → key to select the digit and then either press a numeric key or use ↓ or ↑ to modify the digit. In any case, after entering the new desired value, press **Enter** to save it; otherwise press **ESC** to cancel the edit.

Following are the Main Configuration Menu categories:

- I/O
- Mode
- Current
- Thermal
- External
- Communications
- Password
- Reset Hours

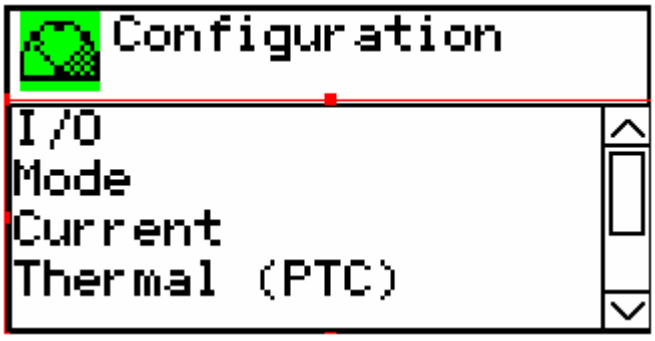


Figure 11.3 – Configuration Menu

11.5 I/O Menu

The sub menu items of the I/O Menu are for interfacing/ synchronizing the SmartMQn Motor with external control circuit and configuring for remote/ Local control operations. Following are the sub menu items of the I/O Menu.

sub menu Prompt	Description
Contactor	Configuration for Single Coil and Dual coil operation
Dual Period	Output pulse hold time
Input 1, Input 2, Input 3 and Input 4,	External input Signals to interface SmartMQn Motor with external control circuit.
Output 1, Output 2, Output 3 and Output 4	Out put signal to interface SmartMQn Motor with external circuit.
Lcl Src	Source for control signal in local control
Rmt Src	Source for control signal in remote control
Rmt Sel	Local/Remote Select point
Rmt Act	Local/ Remote Selected action

11.6 Mode Menu

The sub menu items of the Mode Menu are for configuring SmartMQn Motor Mode of operation, Multiplication factor for Current Transformer (CT) and Motor full load current etc.

sub menu Prompt	Description
Phase CT ratios and CT secondary current	Line Current Transformer configuration for SmartMQn Motor
Ground CT Ratio and Ground CT Secondary current	Ground Current Transformer configuration for SmartMQn Motor
SmartMQn Motor Mode of operation	Configure SmartMQn Motor for different mode of operation, different modes are :- Monitor (current), Monitor (52A), Controller
FLC (Full load Current)	Full load (rated) current for the motor under control/ Protection.
STA Set point	Start mode detection current (mon only)
OFF Set point	Stop mode detection current (mon only)
SPH Count	Starts per hour
MBS Count	Minimum Minutes between starts
RUN Detection Mode	Configure SmartMQn Motor for detection of motor RUM mode , User can configure SmartMQn Motor for motor RUN by Timer / Current
RUN Set point	Configure SmartMQn Motor for Run mode detection current
RUN Delay	Configure SmartMQn Motor for Start -to-Run detect / error delay
RUN Err Act	Configure SmartMQn Motor for Start-to-Run error action, For error signal User can configure SmartMQn Motor for Alarm/ Trip / None
CB Action	Circuit Breaker error action
ESP Action	External Emergency Stop action

11.7 Current Menu

Most of the sub menu items of the Current menu are for protection relay setting. Following are the sub menus for the Current Menu:

Prompt	Description
U/L Action , U/L Alarm ,U/L Trip U/L Delay	Protection relay setting for under load relay
O/L Action, O/L Alarm ,O/L Trip O/L Delay	Protection relay setting for Overload relay
U/B Action , U/B Alarm ,U/B Trip U/B Delay	Protection relay setting for Unbalanced relay current
STL Action , STL Trip, STL Delay	Protection relay setting for Blocked rotor relay
TOC Action , TOC USP, TOC Class, TOC Alarm ,TOC Inhibit	Protection relay setting for Timed over current relay (inverse current protection current relay)
GRD Action, GRD Alarm , GRD Trip, GRD Delay	Protection relay setting for Ground fault protection relay.

11.8 Thermal (PTC) Menu

Using sub menu items of the Thermal menu, the user can configure Thermal Relay of SmartMQn Motor. Following are the sub menu items for Thermal Relay:

Prompt	Description
PTC Temperature Action	PTC Exceeded Nominal Rating Action
PTC Open Action	PTC Short or Open circuit detection

11.9 External Protective Device Menu

Using sub menu items of the External protective device menu, the user can synchronize SmartMQn Motor with the external control circuit.

Prompt	Description
Aux1 Delay/ Action	Configuration for actions and delays on enabled Input 1 signal
Aux2 Delay / Action	Configuration for actions and delays on enabled Input 2 signal

11.10 Communications Menu

Using sub menu items of Communications menu, the user can configure SmartMQn Motor for communication with external controllers either serially or through a network.

Prompt	Description
Net Fail Act	Network Failure action
MB Address	Set the Modbus Slave Address
MB Rate	Set the Modbus Slave Baud
MB Port	Selection for Rs 232/ RS 485 ports
MB Parity Enable	Enable Modbus Slave Parity
MB Par Bit	Set Modbus Slave Parity Type

11.11 Password Menu

Using sub menu items of Password menu, the user can configure / set password for SmartMQn Motor operation.

Prompt	Description
Config	

11.12 Reset Hours Menu

Using sub menu items of Reset Hours menu, the user can reset the accumulated running hours in SmartMQn Motor.

Prompt	Description
Reset Hours	To reset the accumulated running hours

11.13 Front Panel Access to Monitor Values

The Main screen of SmartMQn Motor is divided into four portions. Each portion displays operational/ Control status for the following: - Motor Operational Status, Trends/ Graphs, Measurements/Indications and Alarms/ History. The OCS also provides function keys for these items.

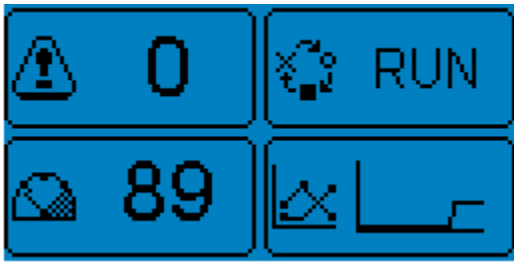


Figure 11.4 – Status Display

11.14 Motor Operational Status

The Motor State section of the main display shows the state of the motor. The method used to detect the current motor state depends on the SmartMQn Motor Mode configuration and the type of motor feedback selected.

SmartMQn Motor can be configured to operate in either monitor mode or controller mode (SmartMQn Motor Mode). M*onitor* mode is provided for passive monitoring in which the SmartMQn Motor is typically inserted in an existing control circuit and the protective functions break an external latching circuit with a trip relay. C*ontroller* mode is provided for active control in which the SmartMQn Motor typically replaces most of the control circuitry and directly drives the contactor (circuit breaker).

Both modes require feedback to determine the actual state of the contactor. In monitor mode, this feedback is selectable between external contacts on the contactor (52A) and/or current draw (SmartMQn Motor Mode). In controller mode, only the external contact option is available.

The following describes the indicated motor states and how the mode and method is used to determine that state.

*11.14.1 **STA**rt (motor starting)*

STArt mode determination is based on the current setting of the SmartMQn Motor Mode:

Monitor Mode (current sample only)

STArt mode is determined when the average current reaches START threshold value (STA Setpt).

> Note that if the average current drops below the STOP threshold while in STArt mode, the SmartMQn Motor reverts to OFF mode.

M52 (monitor mode using 52A contact)

STArt mode is determined when **either** the 52A contact input closes or the average current reaches the START threshold value.

Note that if the 52A contact opens and the average current is below the STOP threshold value while in STArt mode, the SmartMQn Motor reverts back to OFF mode.

Controller Mode

Initiate **ON** mode is set when the SmartMQn Motor is commanded to start. The output is then energized and if the 52A contact does not close within 1 second, a contactor stuck OFF **trip** is generated (output is released and mode transitions to TRiP).

Once the contactor is determined closed, the state transition to **STA**rt mode is complete.

Note that if the 52A contact opens in STArt mode without a corresponding STOP command, the SmartMQn Motor de-energizes the motor to stop and optionally enters EStoP mode (see EStoP mode description below).

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*11.14.2 **RUN** (motor running)*

RUN mode detection can be configured to be determined from a timer and/or current draw (RUN Det). When *timer* mode is selected, the SmartMQn Motor determines run condition when **either** the timer expires or the average current exceeds the RUN threshold (RUN Setpt) by 10% and then drops below the RUN threshold. Alternately, when *current* mode is selected, the timer is ignored and current value alone determines RUN mode.

When using *current* mode, the timer may be alternately used for start sequence verification. For more details on start sequence completion, see protection functions for more details.

*11.14.3 **OFF** (motor stopped)*

OFF mode determination is based on the current setting of the SmartMQn Motor Mode:

.

Monitor Mode (current sample only)

OFF mode is determined when the average current drops below the OFF threshold value (OFF Setpt setting of configuration menu).

M52 (monitor mode using 52A contact)

OFF mode is determined when **both** the 52A contact input opens and the current drops below the OFF threshold.

Controller Mode

Initiate **OF**f mode is set when the SmartMQn Motor is commanded to stop. The output is then de-energized and if the 52A contact does not open within a 1 second delay, a contactor stuck ON **trip** is generated.

Note that if the 52A contact opens in RUN mode without a corresponding STOP command, the SmartMQn Motor de-energizes the motor to stop and optionally enters EStoP mode (see EStoP mode description below).

*11.14.4 **TRiP** (stopping motor due to fault)*

The SmartMQn Motor transitions to TRIP mode when a protection function has activated the trip function while in STArt or RUN mode. The SmartMQn Motor sets the trip relay output (monitor mode) or issues a motor stop command (command mode), provides front panel indication of the TRIP state and records the reason for the trip in the trip snapshot. The SmartMQn Motor remains in TRIP state until trip is reset (front panel, terminal or network)

Note that in monitor mode, the SmartMQn Motor provides optional breaker state verification when entering TRiP state by continuing to monitor the 52A contact and/or the current. If breaker OPEN operation cannot be verified (52A closed and/or current still present) the TRP indication on the main display screen will flash. For more details on circuit breaker monitoring, see protection functions below.

*11.14.5 **INH**ibit (motor start inhibited)*

The SmartMQn Motor transitions to the INHIBIT mode immediately after determining that the motor has stopped and an immediate START would violate some protective feature. In this case, the SmartMQn Motor changes the mode to INHIBIT and sets the Trip relay (monitor mode) or prevents commands to start the motor (command mode); however, no alarm is recorded.

The feature is used primarily for the Starts per hour (SPH), Minutes between starts (MBS) and thermal capacity protective functions. Each of these protective functions maintains an accumulator. Once the accumulator drops to zero (or allow setpoint), INHIBIT mode is released and the SSM transitions to STOP mode and resets the Trip relay.

Inhibit mode for dual coil contactors requires an additional connection of the external start circuit through the BS output.

*11.14.6 **ES**to**P** (motor stopped externally)*

EStoP mode is only available when the SmartMQn Motor is in controller mode. When enabled (ESP Detect), the SmartMQn Motor transitions to EStoP mode if the 52A contact opens and the SmartMQn Motor has NOT commanded the motor to stop. On this transition, the EStoP mode is latched and the motor is commanded to stop. The EStoP mode must be reset in the same manner as a trip to transition back to OFF mode to allow motor starting. When enabled, EStoP action also generates an alarm.

*11.14.7 **I**nitiating **ON** (activating motor contactor)*

ION mode is only available when the SmartMQn Motor is in control mode. This mode checks for validation of the contactor closing after commanded to do so.

*11.14.8 **I**nitiating **OF**f (deactivating motor contactor)*

IOF mode is only available when the SmartMQn Motor is in control mode. This mode checks for validation of the contactor opening after commanded to do so.

11.15 Trends and graphs

The Main Status screen contains a Trend/ Graphs for Load current. The device provides dedicated trends screens for Load current for each phase, Neural current, Stator Winding temperature for each phase. The user can navigate to different trend screens from the main trend screen.

11.16 Measurements

The Main Status screen contains a text based indicator display for Load current. The device provides dedicated indicator screens in different formants (Text and indicator) for Load current for each phase, unbalanced current, and Stator Winding temperature for each phase. The user can navigate to different screens from the main screen.

11.17 Alarms

11.17.1 Alarm Menu

A protective function (when enabled) can generate either an alarm or a trip condition based on the user configuration. By using menus and submenus of Alarm menu, the user will get the details about trip, alarm and inhibit signal generated by the control system. The user can reach the alarm menu by using function keys.

Menu	Description	sub menu	Description
Reset	Reset the trip, Alarm and inhibit signal generated by SmartMQn Motor	NIL	
View Trip	This menu and its submenus will provide details about Trip signal generated. All sub menu items are read-only, shows the status/ details of motor parameters.	Date	Date of Trip signal generated
		Time	Time of Trip signal generated
		Avg	Average value of phase currents (as % of Full load current) at the time of trip
		TOC	Time Over Current
		PTC	PTC Temp Sensor
		U/B	Unbalanced current, (as % of average full load current).
		GRD	Ground Fault current in Amps at the time of trip
		Ia	Phase A current in Amps at the time of trip
		Ib	Phase B current in Amps at the time of trip
		Ic	Phase C current in Amps at the time of trip
View Alarm	It display all the alarms which are all activated, Alarms will reset automatically if triggering condition is vanished.	Nil	
View Inhibits	This displays the inhibit signal generated. Inhibit indication will reset automatically if triggering condition is vanished.	SPH Delay	This radio button will be enabled if the protection function related to start per hour is triggered.
		TOC	This radio button will be enabled if the protection function related to Timed over current action is triggered.
		PTC	This radio button will be enabled if the protection function related to Positive Temperature Coefficient action is triggered.
		Emergency Clear	Some protective functions maintain accumulators that when containing above a certain level will prevent further motor starts (Inhibits).
View History	Shall display history of operations along with Time/ Date tag	Nil	

11.18 Measurement Menu

Using the menu and sub menu of measurement menu, a user can set different controller / protection parameters and view the real time data. Different menu items are described bellow:-

Menu	Description	sub menu	Description
View Data	View Real time data in text format, all the sub menu items are read only.	Avg	Average value of phase currents (as % of Full load current).
		TOC	Timed over current value as a percentage of full load current
		PTC	PTC value as a percentage of maximum resistance
		U/B	Unbalanced current as a percentage of full load current.
		Avg	Average value of currents in Amps
		Phase A	Phase A current in Amps
		Phase B	Phase B current in Amps
		Phase C	Phase C current in Amps
		GND	Neutral current in Amps
		Hrs	Hours of operation
View Graphic Data	Graphical representation following parameters : - Load currents of each phase, Average value of currents, TOC data, PTC data and Unbalanced current.	Nil	
Set Configuration	sub menus of this menu will allow the user to configure the control system for different modes of operations, calibrations of input signals, communication setting etc.	I/O	Configuration for inputs to SmartMQn Motor
		Mode	Configuration of SmartMQn Motor mode of operation
		Current	Current data setting for SmartMQn Motor protection relay
		Thermal	Thermal data setting for protection relay
		External	SmartMQn Motor Configuration for signals from external control system
		Communications	SmartMQn Motor Configuration for communication with external system.
		Password	Configuring SmartMQn Motor for password.
		Reset Hours	Reset the operating time
Version		Nil	Firmware version

11.19 Control Menu

Menu item	Description
Start Motor	This command will start the motor, before giving the start command to motor, the SmartMQn Motor will ask for confirmations. The system will allow the user to start from SmartMQn Motor depending upon the Remote selection configuration and Remote/local setting of control menu.
Stop Motor	This command will stop the motor, before giving stop command to motor, the SmartMQn Motor will ask for confirmations. The system will allow the user to start from SmartMQn Motor depending upon the Remote selection configuration and Remote/local setting of control menu.
Remote/Local	This command will allow the user to change remote/ Local setting.

11.20 Trend Menu

The small trend on the main screen displays a plot of the average current and a plot of the lowest leg. This trend shows approximately the past 3 seconds of data.

Pressing the Process button will toggle between data shown in different ways:

- First press displays data as bar graphs, meters and numeric data that may be scrolled through using the Up/Down arrow keys
- Second press displays data as trends that may be scrolled through using the Up/Down arrow keys
- Subsequent presses toggle between those two formats

The trends displayed show short-term and long term data as indicated by the time frame shown on the x-axis. The short-term trends show the last 5 seconds of data and are updated only when the screen is displayed. The longer-term trends are retentive and display data up to a trip condition before stopping, including the last 100 seconds, the last 16.5 minutes and the last 16.5 hours. A reset of the trip condition will restart these trends.

Current trends display Phase A, Phase B and Phase C currents together on a scale of 0-300% of FLC or Ground current on a scale of 0-100% of the Ground Trip set point. PTC trends display the PTC reading in 0-100% of a 3.2KOhm PTC.

11.20.1 Data logging

Constant data logging to MicroSD occurs in the background as long as a MicroSD card is in place. However, there is an internal buffer that can store a small amount of data while the card is being replaced or is absent for a short amount of time.

A set of log files constantly log data every 10 seconds. The files are in comma-separated value (csv) format and are located in the ‘Datalog’ directory. The filename is in the format HHDDMM.csv where HH = the hour in 24-hour format, DD = day of the month, and MM = the month. Therefore, each file will contain up to one hour’s worth of data before a new log file is started. All entries recorded to these logs include a time and date stamp as well as the measurements of all phase currents, ground current, average current and PTC reading.

Another set of log files record Alarm and Trip occurrences. The ‘Alarmlog’ and ‘Triplog’ directories contain these files. The filenames for these logs are in the format DDMMYY.csv where DD = the day of the month, MM = the month and YY = the 2-digit year. Therefore, each file will contain up to one day’s worth of data before a new log file is started. All entries recorded to these logs include a time and data stamp, as well as a text description of the occurrence, measurements from all phase currents, ground current, average current and PTC reading.

11.21 Mode Description

There are three different modes of operation: - Controller, Monitor (Monitor mode using current sample) and M52 (Monitor mode using 52 A contact feed back). Signals used for generating various status indications and commands from the controller to external control system are dependent on selected mode on controller. Various I/O signals and operational status indications in different mode of operation are tabulated bellow.

Operational Status			
Motor State Display	**Monitor mode**	**M52**	**Controller mode**
STA (motor starting)	STArt mode is determined when the average current reaches START threshold value, Line current feed back to controller is used as reference signal. (Please find STA set point menu in Mode configuration)	STArt mode is determined when **either** the S52 contact input closes or the average current reaches the START threshold value.	STArt mode is determined when the SmartMQn Motor is commanded to start.
RUN (motor running)	RUN mode detection can be configured to be determined from a timer and/or current draw (RUN Det). When *timer* mode is selected. The SmartMQn Motor determines run condition when **either** the timer expires or the average current exceeds the RUN threshold (RUN Setpt) by 10% and then drops below the RUN threshold. Alternately, when *current* mode is selected, the timer is ignored and current value alone determines RUN mode.		
OFF (motor stopped)	OFF mode is determined when the average current drops below the OFF threshold value (OFF Setpt setting of configuration menu)	OFF mode is determined when both the 52 A contact input opens and the current drops below the OFF threshold.	Initiate OFf mode is set when the SmartMQn Motor is commanded to stop. The output is then de-energized and if the 52A contact does not open within a 1 second delay, a contactor stuck ON trip is generated.
TRiP (stopping motor due to fault)	The SmartMQn Motor transitions to TRIP mode when a protection function has activated the trip function while in STArt or RUN mode. Provides front panel indication of the TRIP state and records the reason for the trip in the trip snapshot. The SmartMQn Motor remains in TRIP state until trip is reset, SmartMQn Motor provides optional breaker state verification by continuing to monitor the 52A contact and/or the current.		The SmartMQn Motor transitions to TRIP mode when a protection function has activated the trip function while in STArt or RUN mode. Provides front panel indication of the TRIP state and records the reason for the trip in the trip snapshot. issues a motor stop command and The SmartMQn Motor remains in TRIP state

		until trip is reset
INH (motor start inhibited)	The SmartMQn Motor transitions to the INHIBIT mode immediate after determining that the motor has stopped and an immediate START would violate some protective feature. In this case, the SmartMQn Motor changes the mode to INHIBIT and sets the Trip relay. Enabling of the signals is according to Starts per hour (SPH), Minutes between starts (MBS) and thermal capacity protective functions	Condition for Transition to this mode is same as that of Monitor/ M52 mode of operation. If this Condition persists and SmartMQn Motor is in controller mode of operation, SmartMQn Motor prevents commands to start the motor.
ESto**P** (motor stopped externally)	Not Applicable	When enabled (ESP Detect), the SmartMQn Motor transitions to EStoP mode if the S52 contact opens and the SmartMQn Motor has NOT commanded the motor to stop. On this transition, the EStoP mode is latched and the motor is commanded to stop.
ION (activating motor contactor)	Not Applicable	This mode checks for validation of the contactor closing after commanded to do so
IOFf (deactivating motor contactor)	Not Applicable	This mode checks for validation of the contactor opening after commanded to do so

Input Output configurations				
Input/Output	Configuration Option available	Description for Monitor Mode of operation	Description for M/52 mode operation	Description for Controller mode
I1	Ext.1 Error	External protection function 1 input		
	Start	Not Applicable		Terminal input to command start (active high)
I2	Ext.2 Error	External protection function 2 input		
	Stop	Not Applicable		Terminal input to command stop (active low)
I3	52A Contact	Sense feed back from Circuit breaker contactor		
I4	Ext. Error 2	External protection function 2 input		
	Reset	Terminal input to reset (trip, alarm, etc)		Terminal input to switch control to remote point
	Rmt	Not Applicable		
O1	Aux 1	Auxiliary output 1 controlled by network		
	Run	Indication that motor commanded to run		

	R+A	Run w/flash if alarm present	
O2	Aux 2	Auxiliary output 2 controlled by network	
	Stop	Indication that motor commanded to stop	
	S+T	Stop w/flash if trip present	
	BS	Block Start (typically used with dual coil contactor)	
O3	Action dependent Coil settings. If the contactor is configured for single or dual coil SmartMQn Motor will generate an alarm along with activation.		Action dependent Coil settings. If the contactor is configured for single coil it will generate an alarm along with activation. If the contactor is configured for dual coil Start relay is pulsed on RUN command along with activation.
O4	Action dependent Coil settings. If the contactor is configured for single coil, the SmartMQn Motor will generate a Trip signal (Fail Safe) along with activation.(i.e. Control circuit is broke until Reset). If the contactor is configured for duel coil, the SmartMQn Motor will generate a Pulse Trip signal (Non Fail Safe) along with activation.(i.e. posing the stop relay).		If the contactor is configured for single controller will generate a Latch (Control circuit is made on RUN command and broke on STOP or TRIP) in case of dual coil it will generate a pulse Off Signal (Stop relay is pulsed on STOP or TRIP)

11.22 Protection Function Overview

The current drawn by an induction motor during motor start will always be high, perhaps one to two-hundred percent of full load current and will drop when the speed reaches operating RPM. When the load increases and RPM drops, load current increases and power factor will also decrease. These operating conditions necessitate the requirement for a protection system for induction motor. The SmartMQn Motor supports most of the protection functions specified by IEC and NEMA.

The user can operate the induction motors at different operating points according to the capacity of motor and load requirements. The SmartMQn Motor has several specific protective functions that monitor current and/or other conditions to generate an error if the monitored parameter is out of the permissible range. Each protective function has a corresponding Action parameter that is used to specify if the error is to be ignored, the error generates an alarm, or the error generates a trip.

Alternately, some protective functions are able to generate both an alarm and trip errors based on separate alarm and trip set points. In this case, the Action parameter is used to specify if both errors are ignored, only the alarm is to be generated, only the trip is to be generated, or both the alarm and trip is to be generated.

The difference between alarm and trip actions is described below:

Trip Actions:

- Motor is halted
- TRP motor status is displayed on main display screen
- Snapshot of motor parameters is displayable on *View Trip* screen
- Bit signifying specific trip condition is set in TRP Status network register
- Trip entry [T] is recorded in history log

Alarm Actions:

- Alarm output is set (if enabled)
- Number of alarms (flashing) is displayed on main display screen
- Alarm entry [A] is recorded in alarm log and displayable on *View Alarm*s screen
- Bit signifying specific alarm condition is set in ALM Status network register
- Alarm entry [A] is recorded in history log

Some protective functions are also capable of inhibiting the motor from being started until a condition that would result in a trip is removed.

Inhibit Actions:

- Trip relay opened (monitor mode) or Run command blocked (controller mode)
- INH motor status is displayed on main display screen
- Inhibit condition (and associated accumulator) is displayed on *View Inhibit* screen
- Bit signifying inhibit mode is set in Status network register

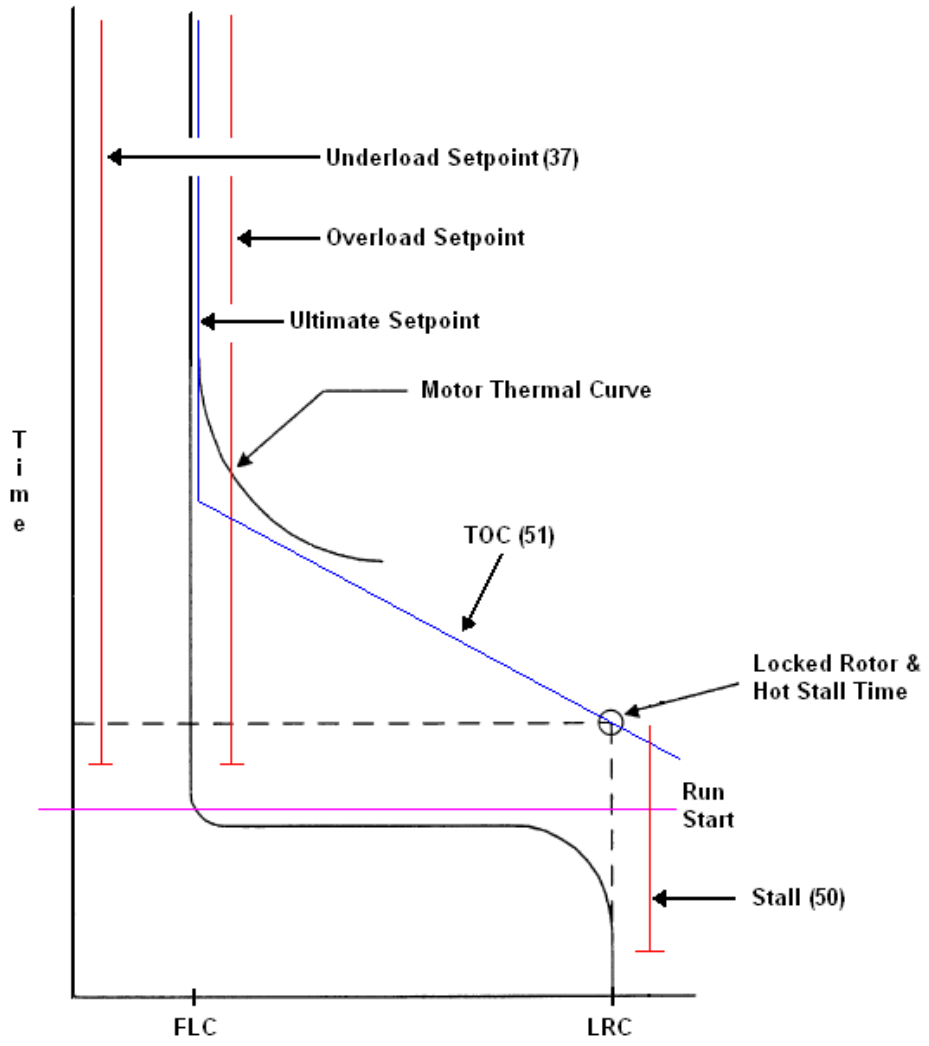


Figure 11.5 – Protection Curve

11.23 Alarm Output and Reset

The protective function alarm action must be enabled. The alarm function is typically used to give early warning that a trip is about to occur. If a protective function alarm occurs, the alarm contactor is closed. Most of the alarms clear automatically when the alarm condition is removed.

11.24.1 Alarm functions:

Group 1	Alarm Item
1	Un Balanced Current
1	Stall Current
1	Timed Over Current
1	GRD Over current
1	PTC over Temperature
1	PTC open
1	Eternal Device1
1	External Device 2
1	CB stuck Close
1	CB stuck Open
1	Local Mode
1	Network Fail
2	EXCD MAX START
2	Incomplete SEQ
2	UNDER current
2	Over Current
2	UN BAL Current
2	STALL current
2	Timed Over Current
2	GRD over current
2	PTC over temp
2	PTC open
2	Eternal Device1
2	External Device 2
2	CB Stuck Open
2	CB Stuck Close

11.24 Trip Output and Reset

The protective function trip action must be enabled. If a protective function trip occurs, the trip is latched and remains latched until an explicit reset. Reset may be activated from any control point (UI, Terminal or Network) regardless of Local / Remote operation. Depending on the SmartMQn Motor_Mode configuration, a trip may open contacts (single coil mode) or pulse the open coil (dual coil mode).

11.25 Inhibit and Emergency Clear

Timed overcurrent (51) and excessive start protective functions maintain accumulators that when charged inhibit starting. PTC Thermal can also inhibit starting once the PTC resistance exceeds the setpoint. Emergency Clear clears those protective functions from the accumulators, so that motor can be started.

11.26 Incomplete Start Sequence (48)

This protective function may be enabled to ensure that the normal starting sequence has completed within the specified time. The determination of RUN mode is required since certain protection functions are disabled until RUN mode is achieved.

This protective feature is enabled if *current* detection is specified as the RUN mode detection selection (Run Det Sel) and the run action (RUN Act) is set to either trip or alarm. Once the SmartMQn Motor detects STArt mode, the RUN Delay timer is started with the timeout set to RUN Delay. If the timer completes before RUN mode is achieved (see Motor status description above), an incomplete sequence error occurs. Depending on the RUN action (RUN Err Act), the error may cause an alarm or trip condition.

Note that if configured for alarm action, an alarm (RUN_Act = Alm) remains latched until the next start is attempted or the user initiates a reset.

11.27 Breaker Monitor

The SmartMQn Motor provides monitoring of the 52A contact or current (based on SmartMQn Motor Mode) to determine if contactor (circuit breaker) is controlling the motor as expected. Circuit breaker error is determined differently based on the current SmartMQn Motor Mode as described below.

11.27.1 Monitor Mode (current only)

If the SmartMQn Motor enters TRIP mode, it attempts to determine if the contactor (circuit breaker) has actually tripped. If **any** of the phases are above the STOP Current Threshold after the CB Delay expires, a CB error is generated. Depending on the CB action (CB Err Act), the error may be ignored or generate an alarm.

Note that if configured for alarm action, an alarm (CB Err Act = Alarm) remains latched until the next CB command is issued or the user initiates a reset.

11.27.2 M52 (monitor mode using 52A contact)

If the SmartMQn Motor enters TRIP mode, it attempts to determine if the breaker has actually tripped. If either the 52A contact or **any** of the phase currents are above the STOP current threshold when the CB Delay time expires, a CB error is generated. Depending on the CB action (CB Err Act), the error may be ignored or generate an alarm.

Note that if configured for alarm action, an alarm (CB Err Act = Alarm) remains latched until the next CB command is issued or the user initiates a reset.

11.27.3 Command Mode

When the SmartMQn Motor commands the contactor to a specific state, it attempts to determine if the contactor has responded to the request. If the 52A contact does not reflect the same state as the command within 1 second following the command, a CB stuck open or CB stuck closed Trip is always generated.

11.28 Excessive starts

This protective function may be enabled to prevent heat build up due to repetitive starts. This function may be enabled to limit the starts per hour (SPH), the minutes between starts (MBS), or both.

The SPH portion prevents more than the specified number of starts (SPH Cnt) within a one-hour period. The MBS portion prevents concurrent starts before the specified number of minutes (MBS Cnt) has elapsed. On each OFF-to-STArt transition, the SmartMQn Motor calculates the number of minutes that must pass before the next start is attempted. This number of minutes is maintained in the Inhibit Minutes Remaining (IMR) accumulator and is decremented every minute.

The Inhibit Minutes Remaining (IMR) accumulator is readable either through the front panel *View Inhibits* menu or through the network.

If Inhibit Minutes Remaining are present and the motor enters OFF mode, the SmartMQn Motor immediately transitions to the INHibit mode and sets the trip relay (prevents starts). However, no alarm or trip condition is enunciated. Once the remaining minutes decrements to zero, the SmartMQn Motor transitions to the OFF mode and the trip relay is released.

To disable this feature, set both the SPH Cnt and the MBS Cnt configuration parameters to zero.

The Inhibit Minutes Remaining accumulator is in **non-volatile memory** and is preserved through a power-cycle. When power is restored, the Inhibit Minutes Remaining contains the last value when power was lost.

Note that Inhibit Minutes Remaining accumulator is reset with the *Emergency Clear* function. Emergency clear is for emergency conditions and motor may be damaged by disabling this function through Emergency Clear.

11.29 Overload (or Jam)

This protective function may be enabled to generate an alarm, trip or both if the **maximum** current exceeds the alarm (O/L Alarm) or trip (O/L Trip) setpoint for the specified period of time (O/L Delay). This detection is usually used in determining if the motor loading has been increased due to a process problem such as failing bearings or jammed load. This function is only active in **RUN** mode (see Figure 1 above)

11.30 Underload

This protective function may be enabled to generate an alarm, trip or both if the **average** current drops below the alarm (U/L Alarm) or trip (U/L Trip) setpoint for the specified period of time (U/L Delay). This detection is usually used in determining if the motor loading has been reduced due to a process problem such as blocked pumps or broken shafts. This function is only active in **RUN** mode (see Figure 1 above)

11.31 Unbalance

This protective function may be enabled to generate an alarm, trip or both if a single phase deviates from the **average** current more than the alarm (U/B Alarm) or trip (U/B Trip) setpoint for the specified period of time (U/B Delay). This detection is usually used in determining if one of the phases has become shorted or open (due to a blown fuse). This function is active during **STAR**t and **RUN** modes.

Note that once the average current drops below FLC, unbalance is calculated against FLC instead of average current to prevent nuisance trips during start.

11.32 Stall

This protective function may be enabled to generate a trip if the **maximum** current exceeds the trip (STL Trip) setpoint for the specified period of time (STL Delay). This function is usually used in conjunction with TOC for startup and locked rotor protection. This function is active during **RUN** and **STA**rt modes (see Figure 1 above).

11.33 Ground fault current

This protective function may be enabled to generate an alarm, trip or both if the ground current exceeds the alarm (GRD Alarm) or trip (GRD Trip) setpoint for the specified period of time (GND Delay). This function is active during **RUN** and **STA**rt modes.

11.34 Current Timed Overload

This protective function may be enabled to generate a trip if the **thermal** accumulator reaches 100% and/or enabled to generate an alarm if the thermal accumulator reached the specified alarm value (TOC Alarm).

Thermal accumulation is based on simple inverse time-current characteristics using selectable NEMA I^2T class curves selectable from 5 to 30 in units of one. Thermal accumulation reaches 100% at the class specified *time* if current is maintained at 600% of FLC. It is suggested that the user (tune) the curve just below the Locked Current Amps and Hot stall delay. Thermal accumulation begins to increment at the I^2C rate once the current (percent of FLC) meets or exceeds the Ultimate Trip Setpoint (TOC USP). The thermal accumulator is clamped (limited) to 100%.

Thermal reduction is based on an exponential decay rate, which takes approximately 120 times the class (time) for the output to drop to zero. Thermal reduction begins to decrement at the exponential delay once the current drops below FLC.

This protective function may be enabled to generate an alarm if the thermal accumulator reaches the alarm (TOC Alarm) setpoint.

Inhibit action may be enabled by setting the inhibit setpoint (TOC Inhibit) to the percentage of thermal accumulation to which a motor start action should be inhibited. Once the thermal accumulation drops below that setpoint, the inhibit action is removed.

The thermal accumulator is in **non-volatile memory** and is preserved through a power-cycle. When power is restored, the thermal accumulator contains the last value when power was lost.

Note that the Thermal accumulator is reset with the *Emergency Clear* function. Emergency clear is for emergency conditions and disabling this function through Emergency Clear may damage motor.

The Thermal accumulator is readable either through the front panel *View Inhibits* menu or through the network.

11.35 PTC Thermal protection

This protective function may be enabled to generate an alarm or trip if an installed Positive Temperature Coefficient (PTC) thermistor reaches or exceeds its switch point temperature. PTCs are often installed in a motor's rotor or stator to provide thermal protection.

PTC Thermistors quickly exceed 250 ohms (typical) once the temperature rises above the nominal rating (switch point) of the PTC. The error set and reset setpoints are factory set at approximately 3200 and 1600 ohms (respectively). Depending on the PTC action (PTC_Act), the error may cause an alarm or trip condition. If the PTC action is set to trip, the temperature (resistance) exceeds the setpoint, and the motor is in STOP mode, the SmartMQn Motor enters INHibit mode until the temperature (resistance) drops below the reset point.

Note, up to 6 PTC Thermistors may be placed in series to provide multiple protection points. PTCs may vary in cold temperature resistance depending on switch point and manufacture. The amount of resistance provided by the connected PTCs is available in both an ohms register and a percentage of trip value. As PTCs are added in series, the normal temperature resistance will rise. Do not add any additional PTCs once the normal temperature readings approach 1500 ohms (or approximately 50% of trip).

Note that a PTC error can be reset with the *Emergency Clear* function if it is below the upper setpoint. Emergency clear is for emergency conditions and disabling this function through Emergency Clear may damage the motor.

The Thermal accumulator is accessible either through the front panel *View Inhibits* menu or through the network.

This protective function may be enabled to also generate an alarm or trip if a connection to the installed PTC thermistor is open or shorted (PTC Open Det).

11.36 Remote Protection Device

Two external inputs (I1 and I2) can optionally be connected to external protective devices. Each external input has a separate error action (Ext n Action) and delay timer (Ext n Delay). Depending on the error action, the error may cause an alarm or trip condition. Error is disabled (reset) when the SmartMQn Motor is not in **STA**rt or **RUN** modes. External input status is available through network status for use other than alarm or trip. The user can configure the SmartMQn Motor.

11.37 Control Function Overview

Digital Inputs (3 are selectable by user)

Inputs	Monitor Mode
I1	Ext.1 Error | Start
I2	Ext.2 Error | Stop
I3	52A Contact
I4	Ext. Error 2 | Reset | Rmt

Ext 1:	External protection function 1 input
Ext 2:	External protection function 2 input
Start:	Terminal input to command start (active high)
Stop:	Terminal input to command stop (active low)
52A:	Sense input from contactor
Reset:	Terminal input to reset (trip, alarm, etc)
Rmt:	Terminal input to switch control to remote point

Two User Definable outputs

Outputs	Options
NO1	Aux 1 | Run | R+A
NO2	Aux 2 | Stop | S+T | BS

Aux 1:	Auxiliary output 1 controlled by network
Aux 2:	Auxiliary output 2 controlled by network
Run:	Indication that motor commanded to run
R+A:	Run w/flash if alarm present
Stop:	Indication that motor commanded to stop
S+T:	Stop w/flash if trip present
BS:	Block Start (typically used with dual coil contactor)

Two Outputs defined by current setting of SmartMQn Motor_Mode and Contactor type

SmartMQn Motor Mode	Contactor	NO3	NO/NC4
Mon/M52	Single	Alarm	Trip (Fail Safe)
Mon/M52	Dual	Alarm	Pulse Trip (Non Fail Safe)
Ctrl	Single	Alarm	Latch
Ctrl	Dual	Pulse On	Pulse Off

Alarm:	Active with alarm is present
Trip:	Control circuit is broke until Reset.
Pulse Trip:	Stop relay is pulsed
Latch:	Control circuit is made on RUN command and broken on STOP or TRIP.
Pulse On:	Start relay is pulsed on RUN command
Pulse Off:	Stop relay is pulsed on STOP or TRIP

11.38 External Protective Function Inputs

Digital Inputs 1,2 and 4 can be configured to allow up to two external protective devices to provide alarm or trip operation. Additional configuration is required to specify the actual Action (alarm or trip) and the optional Delay.

11.39 Start/Stop Terminal Inputs

Digital Inputs 1 and 2 can be configured to allow terminal control of the motor (controller mode only). When enabled, an external contact (NO) can control the Start operation and external contact (NC) can control the Stop operation. Additional configuration is required to specify if terminal control is associated with the local or remote operation.

11.40 Contact Input

Digital Input 3 is dedicated for input from the controlled contactor normally open contact. This input is enabled when the SmartMQn Motor_Mode is set to either M52 or Controller.

11.41 Reset Terminal Input

Digital Input 4 can be configured to allow terminal control of the reset function. When enabled, a momentary external contact (NO) can generate a reset.

Note that all configured sources of reset are always enabled (in parallel) regardless of the local/remote setting.

11.42 Remote / Local Terminal Input

Digital Input 4 can be configured to allow terminal control of the remote/local function. When enabled, an external contact (NO) can force remote operation. Additional configuration is required to specify the remote / local control point (UI or terminal).

11.43 Auxiliary Output 1 and 2

Outputs (NO1 and NO2) can be configured to allow control from the network control register.

11.44 Start / Stop Indicator Output

Outputs (NO1 and NO2) can be configured to indicate the status of the motor through an external indicator. Options are also available to flash if alarm or trip conditions are present.

11.45 Block Start (BS) Output

Output (NO2) can be configured as an NC (fail-safe) contact that breaks when the SmartMQn Motor is in Trip, Inhibit or E-stop state. This contact can be used to inhibit the external starting circuit of a dual coil configuration.

11.46 Alarm Output

Output (NO3) is dedicated (and NO1 optionally) to indicating an alarm. This output is active only when alarms exist (not active if Tripped and no alarms present). The alarm action is reset automatically once all alarms are removed. This output is typically used to activate an external enunciator.

Note that this output is disabled when the SmartMQn Motor_Mode is set to controller and Contactor type is set to Dual Coil.

11.47 Trip Output (monitor mode)

In monitor mode, output (NO/NC4) is dedicated to indicating a trip (in monitor mode) and behaves differently based on the Contactor setting. When the contactor type is set to Single Coil, the trip output is an NC Fail-Safe contact that breaks when either a Trip condition exists or power is removed from the SmartMQn Motor. When the contactor type is set to Dual Coil, the output activates for Dual Period when a Trip condition occurs.

Note that the trip action can be reset from the front panel, external inputs or the network.

11.48 Latch / Pulse Output (controller mode)

In controller mode, output (NO/NC4) is dedicated to driving an external contactor. For dual coil configurations, output NO3 is also used.

To reduce external components and to allow for local and remote control, the SmartMQn Motor can be configured (SmartMQn Motor Mode) for controller mode. When in controller mode, the SmartMQn Motor is expected to be part of the motor's start/stop circuitry. Two circuit configurations are available: Single coil (latch) and Dual coil (pulsing).

When the SmartMQn Motor is used in controller mode, the 52A contact (separate set of dry breaker contacts) must be available to the SmartMQn Motor such that it may determine the current status of the motor contactor and detect any external break in the circuit (i.e. E-Stop).

In controller mode, Start / Stop commands can be accepted from two of three possibilities (Front panel, Terminal or Network) depending on the user configuration. When two sets of control points are defined for the local and remote sources (Lcl/Rmt Src), they may be switched through the Local/Remote selector (Lcl Act).

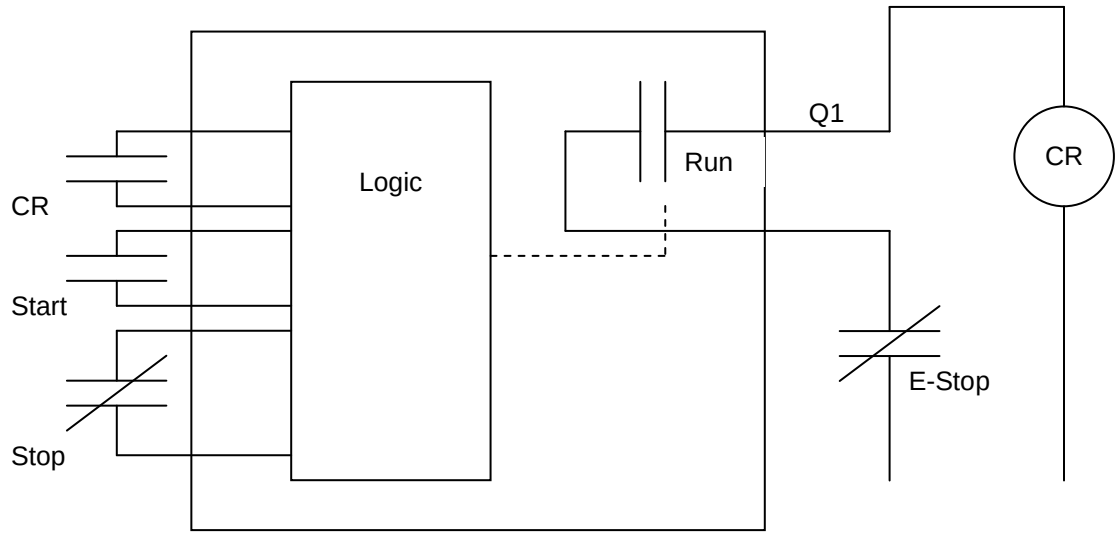
Note that the control circuit is opened (or stop pulsed) if Trip, Inhibit or E-Stop condition is detected.

If configured for dual coil (pulsing), the actual pulse duration is defined by the Output Pulse Hold Time (PHT) parameter.

11.49 Reset Operation

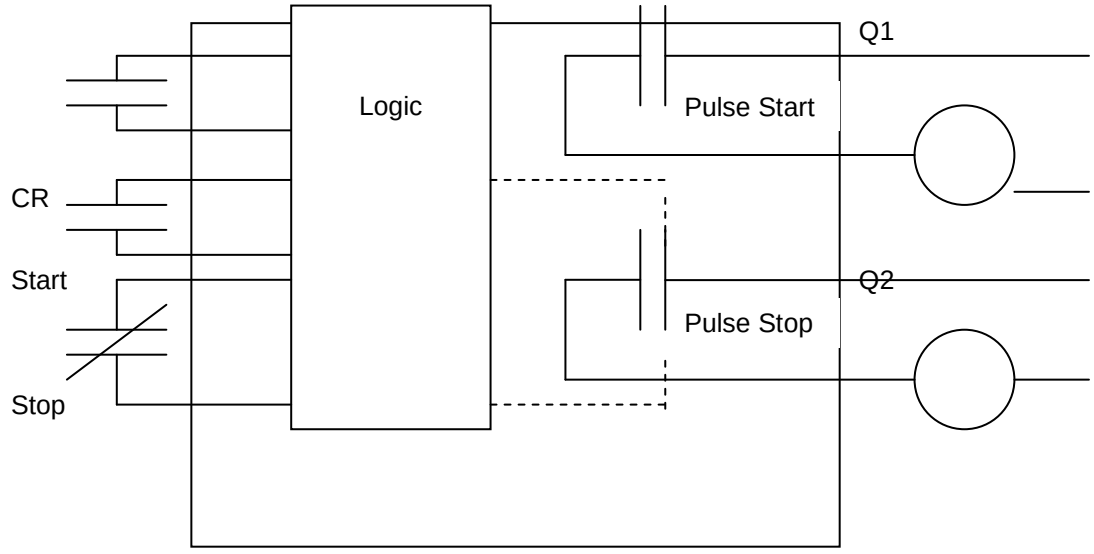
After a protection function *trip*, the SmartMQn Motor must be reset manually to release the latched condition. This may be accomplished through the front panel, optional terminal input or over the network. Reset is recognized from all three sources regardless of local/remote mode. If a trip condition still exists at reset time (i.e. PTC thermal capacity), the motor state changes to INHibit and remains in that state until the trip/inhibit condition no longer exists.

11.50 Control Single Coil (latch)



11.6 – Control Single Coil Latch Wiring Diagram

11.51 Control Dual Coil (pulse)



11.6 – Control Dual Coil Pulse Wiring Diagram

Notes:

1. CR (52) feedback contact is absolutely required
2. Physical Start connection is optional (Term source) and is usually NO pushbutton
3. Physical Stop connection is optional (Term source) and is usually NC pushbutton
4. If physical inputs are not present, control may be from front panel or network
5. Trip / Inhibit / E-Stop will de-energize single circuit latch or pulse dual circuit STOP output
6. For dual coil output, the PWT parameter defines the pulse time.

11.52 Local / Remote Operation

The SmartMQn Motor can be configured for either Local Only or Remote/Local Mode. The user must configure which control points (UI, Terminal or Network register) are assigned to the local and (optionally) to the remote location. To enable Remote/Local operation, the actual Rmt/Lcl selector point must be specified for either the UI or Terminal (Rmt Sel).

When configured for Remote/Local mode, remote operation is considered the normal control point. The local point is made active by setting local action from the front panel or an option digital input. Once Local control is selected, control is passed to the local point and an optional alarm can be generated (Lcl Act) to alert the user that remote access is locked out.

When configured for Remote/Local mode, an indicator is present on the main screen indication, which is currently active (Rmt/Lcl). When Remote operation is selected, the Rmt indicator flashes if a valid communication is not detected (see Net Timer).

NOTES

CHAPTER 12: REGISTERS

12.1 Register Definitions

When programming the SmartMQn Motor, data is stored in memory that is segmented into different types. This memory in the controller is referred to as registers. Different groups of registers are defined as either bits or words (16 bits). Multiple registers can usually be used to handle larger storage requirements. For example 16 single bit registers can be used to store a Word or two 16 bit registers can be used to store a 32-bit value. Below is a list of the type of registers found in the SmartMQn Motor.

%M Retentive Bit
Retentive single-bit registers.

%Q Digital Output
Single-bit output registers. Typically, these bits are connected to an actuator, indicator light or other physical outputs.

%QG Global Digital Output
Specially defined single-bit outputs that go to the network.

%R General Purpose Register
Retentive 16-bit registers.

%S System Bit
Single-bit bit coils predefined for system use.

%SR System Register
16-bit registers predefined for system use.

%T Temporary Bit
Non-retentive single-bit registers.

For additional information on system bits and registers, refer to the on-line help found in Cscape.

12.2 Register Access

CSCAN protocols may use the AI/AQ registers as designated below to access **status or command** registers.

Modbus protocols require conversion to 30000 and 40000 addresses as follows:

30001 (input register) = %AI1
40001 (holding register) = %AQ1

It is NOT recommended that the user access **configuration** registers from the network. Should that be required in the future, the recommended procedure would be as follows:

1. Command bit loads current configuration registers to a temporary buffer.
2. Changes are made to specific registers in temporary buffer.
3. Command bit causes the temporary registers to be validated.
4. If temporary buffer registers are valid, they are loaded to actual register location

A network monitor is provided when the SMARTMQN MOTOR is in controller mode.

12.3 Modbus Support

Modbus slave operation can be enabled on MJ2. The following frame protocols are supported in both RS232 and RS485:

19,200, RTU, N, 1	9,600, RTU, N, 1
19,200, RTU, E, 1	9,600, RTU, E, 1
19,200, RTU, O, 1	9,600, RTU, O, 1

12.4 Net Timer

If enabled and the SMARTMQN MOTOR is in controller mode, a variable (NET_TMR) may be written from the network on a continual basis. If the network connection is lost, and the SMARTMQN MOTOR decrements that variable to zero (subtracts one every second and then halts the motor and displays an alarm. The master determines the length of the timeout by the value written to the variable (seconds).

12.5 Status Registers

Designation	Description	Range (format)	Register
AI1	Analog Input (raw data)		AI0001
Reserved	Raw input data		
Model	Model or mode	0	AI0048
Software	Version number	0xhhll	AI0049
Status	0001 – Stop 0002 – Run 0004 – Alarm 0008 – Block Start 0010 – Trip 0020 – Inhibit 0040 – E-Stop 0080 – reserved 0100 – reserved 0200 – reserved 0400 – reserved 0800 - reserved 1000 – Remote Control 2000 – reserved 4000 – Ext Error 1 (direct) 8000 – Ext Error 2 (direct)		AI0050
Mtr Mode	OFF: Motor stopped STA: Motor starting RUN: Motor running TRP: Error detected IHB: Motor inhibited ESP: E-Stop ION: Initiate On Sequence (ctrl only) IOF: Initiate Off Sequence (ctrl only)	0 1 2 3 4 5 6 7	AI0051
ALM status 1	Errors causing alarms 0001: E-stop (alarm only) 0002: Incomplete Start Sequence 0004: Under current error 0008: Over current error		AI0052

	0010: reserved 0020: Unbalance current error 0040: Stall current error 0080: reserved 0100: Timed over-current 0200: GRD over-current 0400: PTC over-temperature 0800: PTC open device 1000: Ext.1 Device 2000: Ext.2 Device 4000: CB Stuck Open 8000: CB Stuck Close		
ALM Status 2	0001: Local 0002: Network failure (ctrl only) 0004: reserved 0008: reserved 0010: reserved 0020: reserved 0040: reserved 0080: reserved 0100: reserved 0200: reserved 0400: reserved 0800: reserved 1000: reserved 2000: reserved 4000: reserved 8000: reserved		AI0053
TRP Status 1	Error causing TRIP – first is latched Matches ALM Status 1 above		AI0054
TRP Status 2	Error causing TRIP Matches ALM Status 2 above		AI0055
RHRS	# Run Hours	xxxxxxxx (Dint)	AI0056
Reserved			AI0058
Reserved			AI0060
IMR	Inhibit minutes remaining	Minutes	AI0062
U/B percent	Unbalanced current percentage (of Trip)	xxx%	AI0063
TOC percent	Timed over current accumulator	xxx%	AI0064
PTC percent	PTC Percent of 3.2k Threshold	xxx%	AI0065
PTC Res	PTC Resistance	xxxx ohms	AI0066
GRD percent	Ratio of GRD Current / GRD Trip Setpoint	xxx%	AI0067
IAVG percent	Percent of FLC	xxx %	AI0068
IA percent	“	“	AI0069
IB percent	“	“	AI0070
IC percent	“	“	AI0071
U/B percent	Unbalanced current percentage (of Avg)	xxx%	AI0072
IGRD		Amps	AI0073
IAVG	Average of 3 phase currents	Amps	AI0074
IA	Phase currents	Amps	AI0075
IB	“	“	AI0076
IC	“	“	AI0077
Reserved			AI0081
TS Date	Trip Snapshot Date		AI0082
TS Time	Trip Snapshot Time		AI0085

TS Trip	Trip Snapshot Fault		AI0088
TS Avg	Trip Snapshot average current		AI0090
TS U/B	Trip Snapshot Unbalanced percentage		AI0091
TS TOC	Trip Snapshot TOC percentage		AI0092
TS PTC	Trip Snapshot PTC percentage		AI0093
TS GRD	Trip Snapshot GRD Current		Ai0094
TS A current	Trip Snapshot A phase Current		AI0095
TS B current	Trip Snapshot B phase Current		AI0096
TS C current	Trip Snapshot C phase Current		AI0097

12.9 Control Registers

Prompt	Description	Range (format)	Reg
NET CMD	0001 – Run (^ ON) 0002 – Stop (0 – OFF, 1 – ON) 0010 – Reset (^ ON) 1000 – Aux 1 (0 – OFF, 1 – ON) 2000 – Aux 2 (0 – OFF, 1 – ON)		AQ0050
NET TMR	Count down seconds	xxxxx sec	AQ0051

CHAPTER 13: MAINTENANCE

13.1 Firmware Updates

The SmartMQn Motor products contain field updatable firmware to allow new features to be added to the product at a later time. Firmware updates should only be performed when a new feature or correction is required.

13.2 Backup Battery

The SmartMQn Motor contains a run-time battery monitor that checks the voltage of the internal lithium battery. This battery is used to run the real-time clock and maintains retentive registers when power is disconnected.

Under normal conditions the battery in the SmartMQn Motor should last 7 to 10 years. Higher operating temperatures or variations in batteries may reduce this time.

13.2.1 Indications the battery needs replacing

The SmartMQn Motor indicates the battery is low, failed or missing in a variety of ways. At power-up, an error message is displayed indicating the low or missing battery. The user program can monitor the battery using %SR55.12. This bit will turn on if the battery is low or missing. The system menu also contains a battery status message under the diagnostics sub menu (see the chapter on System Settings and Adjustments).

13.2.2 Battery Replacement

Warning: Lithium Batteries may explode or catch fire if mistreated
Do not recharge, disassemble, heat above 100 deg.C (212 deg.F) incinerate, or puncture.

Warning: Disposal of lithium batteries must be done in accordance with federal, state, and local regulations. Be sure to consult with the appropriate regulatory agencies *before* disposing batteries. In addition, do not re-charge, disassemble, heat or incinerate lithium batteries.

Warning: Do not make substitutions for the battery. Be sure to only use the authorized part number to replace the battery.

The SmartMQn Motor uses a CR2450B coin lithium battery produced by a variety of manufacturers.

Below are the steps to replace the battery.

1. Make sure the user program and any data stored in retentive memory is backed up.
2. Disconnect all power from the SmartMQn Motor unit including I/O power.
3. Remove the four screws on the back of the SmartMQn Motor unit and remove the back cover.
4. Remove the I/O board (if present) by lifting it straight up.
5. Remove the old battery. It may require a small flat blade screwdriver to lift it from the holder.
6. Dispose of the battery properly; see the above warning on disposal regulations.
7. Slide the new battery into the holder. Make sure the battery is inserted with the proper polarity. The top tab of the battery holder should contact the positive (+) terminal of the battery.
8. Place the I/O board back into the case by aligning the connecting and pressing straight down.
9. Place the back cover back on the unit.
10. Place the screw back into the hole and turn the screw slowly counter clockwise until “clicks” into the threads. This will prevent the screw from being cross threaded. Now turn the screw clockwise until the cover is firmly secured. Repeat this process for all four (4) screws.
11. Apply power to the unit. Check that the battery error is no longer reported. If the unit still reports the error, remove the battery immediately and contact Technical Support (page 89).

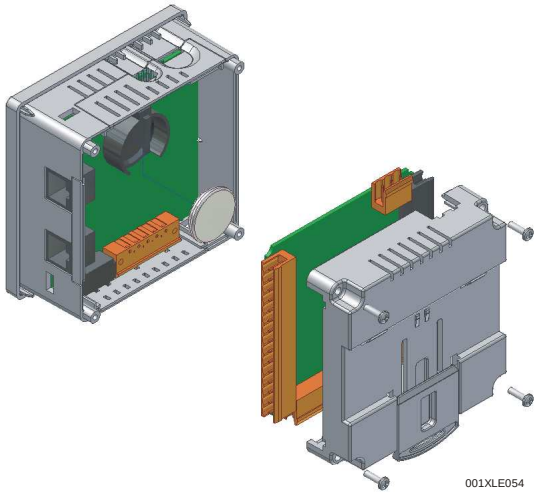


Figure 13.1 – Replacing the back-up battery

CHAPTER 14: TROUBLESHOOTING / TECHNICAL SUPPORT

Chapter 15 provides commonly requested **troubleshooting information and checklists** for the following topics.

- Connecting to the SmartMQn Motor controller
- Local controller and local I/O
- CsCAN Network
- Removable media

In the event that this information is not what you need, please contact Technical Support at the locations indicated at the end of this chapter.

14.1 CsCAN Network

For complete information on setting up a CsCAN network, refer to CAN Networks manual (MAN0799) by visiting our website (page 89) for the address to obtain documentation and updates.

Network status, node ID, errors, and baud rate in the controller system menu are all in reference to the CsCAN network. These indications can provide performance feedback on the CsCAN network and can also be used to aid in troubleshooting. Refer to CHAPTER 10 for full details on the system menu.

14.1.1 CsCAN Network Troubleshooting Checklist

1. Use the proper Belden wire type or equivalent for the network as specified in MAN0799.
2. The SmartMQn Motor does not provide 24VDC to the network. An external voltage source must be used for other devices such as SmartStix I/O.
3. Check voltage at both ends of the network to insure that voltage meets specifications of attached devices.
4. Proper termination is required. Use 121-ohm (or 120-ohm) resistors at each end of the network. The resistors should be placed across the CAN_HI and CAN_LO terminals.
5. Measure the resistance between CAN_HI and CAN_LO. If the network is properly wired and terminated there should be around 60 ohms.
6. Check for duplicate node ID's.
7. Keep proper wires together. One twisted pair is for V+ and V- and the other twisted pair is used for CAN_HI and CAN_LO.
8. Make sure the baud rate is the same for all controllers on the network.
9. Assure shields are connected at one end of each segment -- they are not continuous through the network.
10. Do not exceed the maximum length determined by the baud rate and cable type.
11. Total drop length for each drop should not exceed 6m (20 feet). A drop may include more than one node. The drop length adds to the overall network length.
12. Network should be wired in "straight line" fashion, not in a "star" pattern.
13. In applications requiring multiple power supplies, make sure the V- of all supplies is connected together and to earth ground at one place only.
14. In some electrically noisy environments it may be necessary to add repeaters to the network. Repeaters can be used to add additional nodes and/or distance to the network and protect the signal against noisy environments. The Horner APG repeater is part # HE200CGM100.

14.2 Removable Media

14.2.1 Basic Troubleshooting

Description	Action
SmartMQn Motor does not read media card.	The media card should be formatted with the SmartMQn Motor.
SmartMQn Motor will not download project file.	Make sure the project file is saved as a .pgm file and not a .csp file.

14.3 Technical Support Contacts

For manual updates and assistance, contact Technical Support at the following locations:

North America:
(317) 916-4274
www.heapg.com
email: techsppt@heapg.com

Europe:
(+) 353-21-4321-266
www.horner-apg.com
email: techsupport@hornerirl.ie

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