INSTRUCTIONS

MODBUS RTU CARD

RIGHT FROM THE START

AuCom
MOTOR CONTROL SPECIALISTS

Contents

Compatibility

This manual is suitable for:

- Modbus RTU Card
- Modbus RTU Card with Ground Fault

These cards are suitable for use with EMX4e and EMX4i soft starters.

The available features may vary according to the model and version of the starter.

Disclaimer

The examples and diagrams in this manual are included solely for illustrative purposes. The information contained in this manual is subject to change at any time and without prior notice. In no event will responsibility or liability be accepted for direct, indirect or consequential damages resulting from the use or application of this equipment.

Failure to follow the information and instructions in this manual will void the warranty.

Warnings

It is the installer's responsibility to follow all instructions in this manual and to follow correct electrical practice.

WARNING
For your safety, isolate the soft starter from mains voltage before attaching or removing accessories.

WARNING
Inserting foreign objects or touching the inside of the starter while the expansion port cover is open may endanger personnel, and can damage the starter.
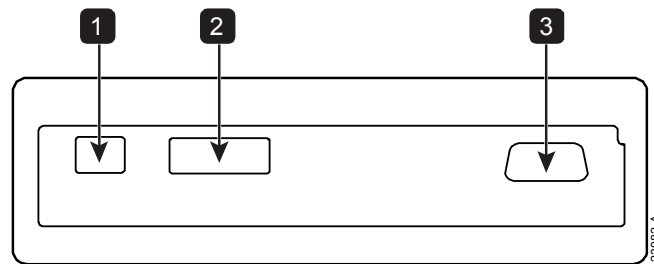
1. Installation

1.1 Installing the Expansion Card

1. Push a small flat-bladed screwdriver into the slot in the centre of the expansion port cover, and ease the cover away from the starter.
2. Line up the card with the expansion port. Gently push the card along the guide rails until it clicks into the starter.
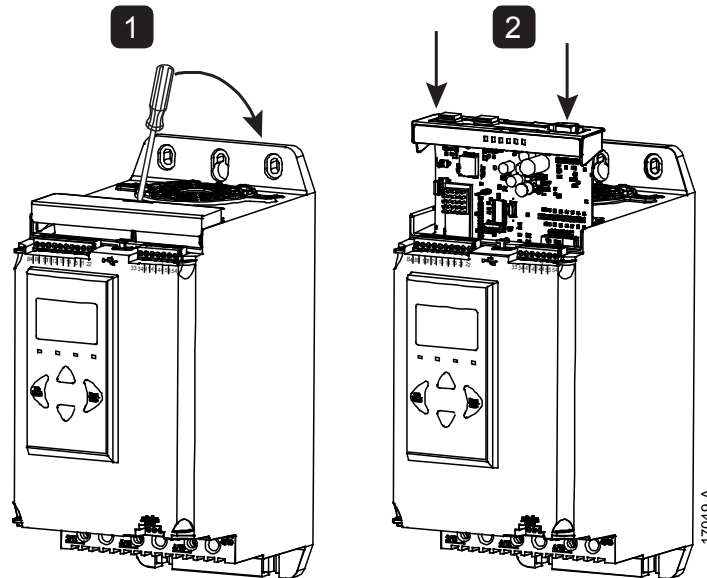
1.2 Connections

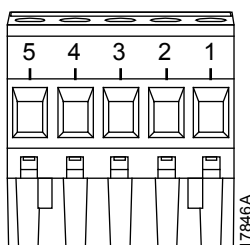|	
1	2 pin connector for ground fault CT (selected models)
2	Modbus network connection
3	DB9 connector for optional remote keypad

1.3 Connecting to the communication network

After the card is in place, control power can be restored and field wiring can be connected via the 5-way connector plug.

Pin	Function
1, 2	Data A
3	Common
4, 5	Data B

2.   Device Configuration

2.1   Configure network settings via the starter

Network communication parameters for the card should be set via the soft starter (via the Main Menu or by uploading a configuration file via USB Save & Load). For details on how to configure the soft starter, refer to the soft starter user manual.

Parameter	Parameter name	Description
12A	*Modbus Address*	Sets the Modbus RTU network address for the soft starter.
12B	*Modbus Baud Rate*	Selects the baud rate for Modbus RTU communications.
12C	*Modbus Parity*	Selects the parity for Modbus RTU communications.
12D	*Modbus Timeout*	Selects the timeout for Modbus RTU communications.

> **NOTE**
> The Modbus RTU Card will read communications parameter settings from the soft starter when control power is applied. If parameters are changed in the starter, control power must be cycled for the new values to take effect.

2.2   Enabling network control

The soft starter will only accept commands from the Modbus RTU Card if parameter 1A *Command Source* is set to 'Network'.

> **NOTE**
> If the reset input is active, the starter will not operate. If a reset switch is not required, use parameter 7I to set the reset input to normally open or fit a link across terminals 10, 11 on the soft starter.

3.   Client Configuration

For standard Modbus 11-bit transmission, the client must be configured for 2 stop bits with no parity and 1 stop bit for odd or even parity.

For 10-bit transmission, the client must be configured for 1 stop bit.

In all cases, the client baud rate and server address must match those set in parameters 12A~12D.

The data polling interval must be long enough for the module to respond. Short polling intervals may cause inconsistent or incorrect behaviour, particularly when reading multiple registers. The recommended minimum polling interval is 100 ms.

3.1   PLC configuration

Use the register tables below to map registers within the device to addresses within the PLC.

4. Ground fault protection

📄 **NOTE**
Ground fault protection is only available on ground fault enabled cards, with soft starters running a compatible version of software. Contact your supplier for assistance.

4.1 Overview

The Modbus RTU Card can detect ground current and trip before the equipment is damaged.

Ground fault protection requires a 1000:1 or 2000:1 current transformer (not supplied). The CT should be rated 1 VA or 5 VA. The soft starter can be configured to trip at 1 A~50 A. If ground fault current rises above 50 A, the soft starter will trip immediately.

Parameter 40C *Ground Fault Active* selects when ground fault protection is active.

4.2 Connect the CT to the ground fault inputs

To use ground fault protection, a common mode current transformer (CT) must be installed around all three phases. Use a 1000:1 or 2000:1 CT with rating of 1 VA or 5 VA and set parameter 40E *Ground Fault CT Ratio* to match. Connect the CT to the ground fault terminals (G1, G2, G3).

For maximum protection, the CT should be installed on the input side of the soft starter.

4.3 Configure ground fault protection settings

Ground fault protection settings must be set in the soft starter.

Parameter	Parameter name	Description
40A	*Ground fault trip level*	Sets the trip point for ground fault current protection.
40B	*Ground fault trip delay*	Slows the soft starter's response to ground fault, avoiding trips due to momentary fluctuations.
40C	*Ground fault trip active*	Selects when a ground fault trip can occur.
40D	*Ground fault action*	Selects the soft starter's response to the protection event.
40E	*Ground fault CT ratio*	Set to match the ratio of the ground current measuring CT.

5. Operation

The Modbus RTU Card must be controlled by a Modbus client (such as a PLC) which complies with the Modbus Protocol Specification. For successful operation, the client must also support all functions and interfaces described in this document.

> **NOTE**
> The available features and parameter details may vary according to the model and software version of the starter. Refer to the soft starter user manual for details of parameters and supported features.

5.1 Ensuring Safe and Successful Control

Data written to the device will remain in its registers until the data is overwritten or the device is reinitialised.

If the soft starter may be controlled via Command Override (parameter 7A) or may be disabled via the reset input (terminals 10, 11) fieldbus commands should be cleared from the registers. If a command is not cleared, it will be re-sent to the starter once fieldbus control resumes.

5.2 Feedback LEDs

LED Status	Description
Off	Soft starter not powered up
On	Communication active
Flashing	Communication inactive

> **NOTE**
> If communication is inactive, the soft starter may trip on Network Communications. If parameter 6M *Network Communications* is set to 'Soft Trip and Log' or 'Trip Starter', the soft starter will require a reset.

6. Modbus Registers

> **NOTE**
> The available features and parameter details may vary according to the model and software version of the starter. Refer to the soft starter user manual for details of parameters and supported features.

> **NOTE**
> All references to registers mean the registers within the card unless otherwise stated.

6.1 Compatibility

The Modbus RTU Card supports two modes of operation.

- In Standard Mode, the card uses registers defined in the Modbus Protocol Specification.
- In Legacy Mode, the device uses the same registers as the clip-on Modbus Module, supplied by AuCom for use with older soft starters. Some registers differ from those specified in the Modbus Protocol Specification.

6.2 Standard Mode

Command and Configuration Registers (Read/Write)

Register	Description	Bits	Details
40001	Command (single write)	0 to 7	To send a command to the starter, write the required value: 00000000 = Stop 00000001 = Start 00000010 = Reset 00000100 = Quick stop (coast to stop) 00001000 = Forced communication trip 00010000 = Start using Parameter Set 1 00100000 = Start using Parameter Set 2 01000000 = *Reserved* 10000000 = *Reserved*
		8 to 14	*Reserved*
		15	Must = 1
40002 ~ 40008	*Reserved*		
40009 ~ 40xxx	Parameter management (single or multiple read/write)	0 to 15	Manage soft starter programmable parameters. Refer to the relevant soft starter literature for a complete parameter list.

Parameter Management

Parameters can be read from and written to the starter. The Modbus RTU protocol limits read/write operations to a maximum of 125 registers at one time. The registers must be consecutive.

⚠ **CAUTION**
Changing the values of the Advanced parameters (parameter group 20) may cause unpredictable behaviour in the soft starter. Consult your local supplier before adjusting the Advanced parameters.

Status Reporting Registers (Read Only)

📄 NOTE

For models EMX4x-0064B and smaller (soft starter model ID 1~4), the current reported via communications registers is 10 times greater than the actual value (displayed on the keypad).

📄 NOTE

Frequency reported via communications is 10 times greater than the actual value.

Register	Description	Bits	Details
30003 ~ 30008	*Reserved*		
30600	Product information	0 to 5	Binary protocol version
		6 to 8	*Reserved*
		9 to 15	Product type code: 12 = EMX4e 13 = EMX4i
30601	Model number	0 to 7	*Reserved*
		8 to 15	Soft starter model ID
30602	Changed parameter number	0 to 7	0 = No parameters have changed 1~255 = Index number of the last parameter changed
		8 to 15	Total number of parameters available in the starter
30603	Changed parameter value	0 to 15	Value of the last parameter that was changed, as indicated in register 30602
30604	Starter state	0 to 4	0 = *Reserved* 1 = Ready 2 = Starting 3 = Running 4 = Stopping 5 = Not ready (restart delay, restart temperature check, run simulation, reset input is open) 6 = Tripped 7 = Programming mode 8 = Jog forward 9 = Jog reverse
		5	1 = Warning
		6	0 = Unintialised 1 = Initialised

Register	Description	Bits	Details
		7	Command source 0 = Remote Keypad, Digital Inputs, Clock 1 = Network
		8	0 = Parameter(s) have changed since last parameter read 1 = No parameters have changed
		9	0 = Negative phase sequence 1 = Positive phase sequence
		10 to 15	*Reserved*
30605	Current	0 to 13	Average rms current across all three phases
		14 to 15	*Reserved*
30606	Current	0 to 9	Current (% motor FLC)
		10 to 15	*Reserved*
30607	Motor temperature	0 to 7	Motor thermal model (%)
		8 to 15	*Reserved*
30608	Power	0 to 11	Power
		12 to 13	Power scale 0 = Multiply power by 10 to get W 1 = Multiply power by 100 to get W 2 = Power (kW) 3 = Multiply power by 10 to get kW
		14 to 15	*Reserved*
30609	% Power factor	0 to 7	100% = power factor of 1
		8 to 15	*Reserved*
30610	Voltage	0 to 13	Average rms voltage across all three phases
		14 to 15	*Reserved*
30611	Current	0 to 13	Phase 1 current (rms)
		14 to 15	*Reserved*
30612	Current	0 to 13	Phase 2 current (rms)
		14 to 15	*Reserved*
30613	Current	0 to 13	Phase 3 current (rms)
		14 to 15	*Reserved*
30614	Voltage	0 to 13	Phase 1 voltage
		14 to 15	*Reserved*
30615	Voltage	0 to 13	Phase 2 voltage
		14 to 15	*Reserved*
30616	Voltage	0 to 13	Phase 3 voltage
		14 to 15	*Reserved*
30617	Parameter list version number	0 to 7	Parameter list minor revision
		8 to 15	Parameter list major version

Register	Description	Bits	Details
30618	Digital Input state	0 to 15	For all inputs, 0 = open, 1 = closed (shorted) 0 = Start/Stop 1 = *Reserved* 2 = Reset 3 = Input A 4 = Input B 5 to 15 = *Reserved*
30619	Trip code	0 to 7	Refer to Trip Codes on page 16
		8 to 15	*Reserved*
30620	*Reserved*		
30621	Frequency	0 to 15	Frequency (Hz)
30622	Ground current	0 to 15	Ground current (A)
30620~ 30631	*Reserved*		

> **NOTE**
> Reading register 30603 (Changed parameter value) will reset registers 30602 (Changed parameter number) and 30604 (Parameters have changed). Always read registers 30602 and 30604 before reading register 30603.

> **NOTE**
> The reset input is normally closed by default. If parameter 7I *Reset/Enable Logic* is set to normally open, the reported state will be inverted (0 = closed, 1 = open).

6.3 Legacy Mode

Registers

📋 **NOTE**

For models EMX4x-0064B and smaller (soft starter model ID 1~4), the current reported via communications registers is 10 times greater than the actual value (displayed on the keypad).

📋 **NOTE**

Legacy Mode reports read-only status information in registers 40003 onwards, to match the register definitions of the clip-on Modbus Module. Identical data is also available via registers 30003 onwards.

Register	Description	Bits	Details
40001	*Reserved*		
40002	Command (single write)	0 to 2	To send a command to the starter, write the required value: 1 = Start 2 = Stop 3 = Reset 4 = Quick stop (coast to stop) 5 = Forced communication trip 6 = Start using Parameter Set 1 7 = Start using Parameter Set 2
		3 to 15	*Reserved*
40003	Starter state	0 to 3	1 = Ready 2 = Starting 3 = Running 4 = Stopping (including braking) 5 = Restart delay (including temperature check) 6 = Tripped 7 = Programming mode 8 = Jog forward 9 = Jog reverse
		4	1 = Positive phase sequence (only valid if bit 6 = 1)
		5	1 = Current exceeds FLC
		6	0 = Unintialised 1 = Initialised
		7 to 15	*Reserved*
40004	*Reserved*		
40005	Motor current	0 to 7	Average rms current across all three phases
		8 to 15	*Reserved*

Register	Description	Bits	Details
40006	Motor temperature	0 to 7	Motor thermal model (%)
		8 to 15	*Reserved*
40007	*Reserved*		
40008	*Reserved*		
40009 ~ 40xxx	Parameter management (single or multiple read/write)	0 to 7	Manage soft starter programmable parameters. Refer to the relevant soft starter literature for a complete parameter list.
		8 to 15	*Reserved*
40600	Product information	0 to 5	Binary protocol version
		6 to 8	*Reserved*
		9 to 15	Product type code: 12 = EMX4e 13 = EMX4i
40601	Model number	0 to 7	*Reserved*
		8 to 15	Soft starter model ID
40602	Changed parameter number	0 to 7	0 = No parameters have changed 1~255 = Index number of the last parameter changed
		8 to 15	Total number of parameters available in the starter
40603	Changed parameter value	0 to 15	Value of the last parameter that was changed, as indicated in register 40602
40604	Starter state	0 to 4	0 = *Reserved* 1 = Ready 2 = Starting 3 = Running 4 = Stopping 5 = Not ready (restart delay, restart temperature check, run simulation, reset input is open) 6 = Tripped 7 = Programming mode 8 = Jog forward 9 = Jog reverse
		5	1 = Warning
		6	0 = Unintialised 1 = Initialised
		7	Command source 0 = Remote Keypad, Digital Inputs, Clock 1 = Network

Register	Description	Bits	Details
		8	0 = Parameter(s) have changed since last parameter read 1 = No parameters have changed
		9	0 = Negative phase sequence 1 = Positive phase sequence
		10 to 15	*Reserved*
40605	Current	0 to 13	Average rms current across all three phases
		14 to 15	*Reserved*
40606	Current	0 to 9	Current (% motor FLC)
		10 to 15	*Reserved*
40607	Motor temperature	0 to 7	Motor thermal model (%)
		8 to 15	*Reserved*
40608	Power	0 to 11	Power
		12 to 13	Power scale 0 = Multiply power by 10 to get W 1 = Multiply power by 100 to get W 2 = Power (kW) 3 = Multiply power by 10 to get kW
		14 to 15	*Reserved*
40609	% Power factor	0 to 7	100% = power factor of 1
		8 to 15	*Reserved*
40610	Voltage	0 to 13	Average rms voltage across all three phases
		14 to 15	*Reserved*
40611	Current	0 to 13	Phase 1 current (rms)
		14 to 15	*Reserved*
40612	Current	0 to 13	Phase 2 current (rms)
		14 to 15	*Reserved*
40613	Current	0 to 13	Phase 3 current (rms)
		14 to 15	*Reserved*
40614	Voltage	0 to 13	Phase 1 voltage
		14 to 15	*Reserved*
40615	Voltage	0 to 13	Phase 2 voltage
		14 to 15	*Reserved*
40616	Voltage	0 to 13	Phase 3 voltage
		14 to 15	*Reserved*
40617	Parameter list version number	0 to 7	Parameter list minor revision
		8 to 15	Parameter list major version

Register	Description	Bits	Details
40618	Digital Input state	0 to 15	For all inputs, 0 = open, 1 = closed (shorted) 0 = Start/Stop 1 = *Reserved* 2 = Reset 3 = Input A 4 = Input B 5 to 15 = *Reserved*
40619	Trip code	0 to 7	Refer to Trip Codes on page 16
		8 to 15	*Reserved*
40620~ 40631	*Reserved*		

📄 **NOTE**
Reading register 40603 (Changed parameter value) will reset registers 40602 (Changed parameter number) and 40604 (Parameters have changed). Always read registers 40602 and 40604 before reading register 40603.

📄 **NOTE**
The reset input is normally closed by default. If parameter 7I *Reset/Enable Logic* is set to normally open, the reported state will be inverted (0 = closed, 1 = open).

6.4 Examples

Command: Start

Message	Starter Address	Function Code	Register	Data	CRC
In	20	06	40002	1	CRC1, CRC2
Out	20	06	40002	1	CRC1,CRC 2

Starter state: Running

Message	Starter Address	Function Code	Register	Data	CRC
In	20	03	40003	1	CRC1, CRC2
Out	20	03	2	xxxx0011	CRC1, CRC2

Trip code: Motor overload

Message	Starter Address	Function Code	Register	Data	CRC
In	20	03	40004	1	CRC1, CRC2
Out	20	03	2	00000010	CRC1, CRC2

Download parameter from starter
Read Parameter 5 (1E *Locked Rotor Current*), 600%

Message	Starter Address	Function Code	Register	Data	CRC
In	20	03	40013	1	CRC1, CRC2
Out	20	03	2 (bytes)	600	CRC1, CRC2

Upload single parameter to starter
Write Parameter 16 (2I *Stop Mode*), set = 1

Message	Starter Address	Function Code	Register	Data	CRC
In	20	06	40024	1	CRC1, CRC2
Out	20	06	40024	1	CRC1, CRC2

Upload multiple parameters to starter

Write Parameters 9, 10, 11 (parameters 2B *Start Ramp Time*, 2C *Initial Current*, 2D *Current Limit*). Set to values of 15 seconds, 300%, 350% respectively.

Message	Starter Address	Function Code	Register	Data	CRC
In	20	16	40017,3	15, 300, 350	CRC1, CRC2
Out	20	16	40017,3	15, 300, 350	CRC1, CRC2

> **NOTE**
> This function can only be used to upload consecutive parameters. The Register field indicates the number of parameters to be uploaded, and the register number of the first parameter.

6.5 Trip Codes

Trip Code	Description
255	No trip
1	Excess start time
2	Motor overload
3	Motor thermistor
4	Current imbalance
5	Frequency
6	Phase sequence
7	Overcurrent
8	Power loss
9	Undercurrent
10	Heatsink overtemperature
11	Motor connection
12	Input A trip
13	FLC too high
14	Unsupported option (function not available in inside delta)
15	Communications card fault
16	Network communications
18	Overvoltage
19	Undervoltage
20	Ground fault
23	Parameter out of range
24	Input B trip
26	L1 phase loss
27	L2 phase loss
28	L3 phase loss
29	L1-T1 shorted
30	L2-T2 shorted
31	L3-T3 shorted
33	Time-overcurrent (Bypass overload)
34	SCR overtemperature
35	Battery/clock
36	Thermistor circuit
47	Overpower
48	Underpower
56	Keypad disconnected
57	Zero Speed Detect
58	SCR Itsm

Trip Code	Description
59	Instantaneous overcurrent
60	Rating Capacity
70	Current Read Err L1
71	Current Read Err L2
72	Current Read Err L3
74	Motor Connection T1
75	Motor Connection T2
76	Motor Connection T3
77	Firing Fail P1
78	Firing Fail P2
79	Firing Fail P3
80	VZC Fail P1
81	VZC Fail P2
82	VZC Fail P3
83	Low Control Volts
84~96	Internal fault x. Contact your local supplier with the fault code (X).

6.6 Modbus Error Codes

Code	Description	Example
1	Illegal function code	The adapter or starter does not support the requested function
2	Illegal data address	The adapter or starter does not support the specified register address
3	Illegal data value	The adapter or starter does not support one of the received data values
4	Server error	An error occurred while trying to perform the requested function
6	Server busy	The adapter is busy (for example writing parameters to the starter)

7. Specifications

- **Connections**

  Soft starter .... 6-way pin assembly
  Network .... 5-way male and unpluggable female connector (supplied)
  Maximum cable size .... 2.5 mm^2

- **Settings**

  Protocol .... Modbus RTU, AP ASCII
  Address range .... 0 to 254
  Data rate (bps) 4800, 9600, 19200, 38400
  Parity .... None, Odd, Even, 10-bit
  Timeout .... None (Off), 10 s, 60 s, 100 s

- **Certification**

  RCM .... IEC 60947-4-2
  CE .... EN 60947-4-2
  RoHS .... Compliant with EU Directive 2011/65/EU