

INSTRUCTIONS

MODBUS RTU CARD

RIGHT FROM
THE START

AuCom
MOTOR CONTROL SPECIALISTS

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Product Compatibility

The Modbus RTU Card is suitable for use with EMX4e and EMX4i soft starters.

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.

Warnings



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.

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1. Important User Information

Observe all necessary safety precautions when controlling the soft starter remotely. Alert personnel that machinery may start without warning.

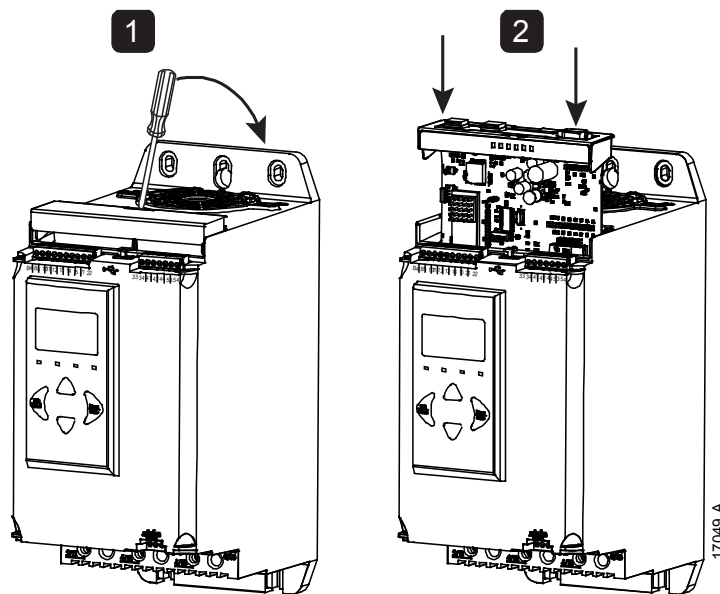
It is the installer's responsibility to follow all instructions in this manual and to follow correct electrical practice.

Use all internationally recognised standard practice for RS-485 communications when installing and using this equipment.

2. Installation

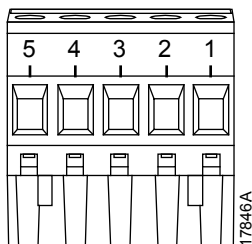
2.1 Installation Procedure

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.



2.2 Connecting to the 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

3. 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.

3.1 Master Configuration

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

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

In all cases, the Master baud rate and slave 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 300 ms.

3.2 Configuration

Modbus Network Settings

Network communication parameters for the card must be set via the soft starter. For details on how to configure the soft starter, refer to the soft starter user manual.

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

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, fit a link across terminals 10, 11 on the soft starter.

3.3 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.

4. Modbus Registers



NOTE

The available features and parameters 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.

4.1 PLC Configuration

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



NOTE

All references to registers mean the registers within the module unless otherwise stated.

4.2 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 card uses the same registers as AuCom's Modbus Module. Some registers differ from those specified in the Modbus Protocol Specification.

The mode of operation is determined by the values of bit 15 in register 40001.

4.3 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.

4.4 Parameter Management

Parameters can be read from and written to the starter. The Modbus RTU Card can read or write a maximum of 125 registers in one operation.



CAUTION

Do not change the default values of the Advanced parameters (parameter group 20). Changing these values may cause unpredictable behaviour in the soft starter.

4.5 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 = <i>Reserved</i> 10000000 = <i>Reserved</i>
		8 to 14	<i>Reserved</i>
		15	Must = 1
40002	<i>Reserved</i>		
40003	<i>Reserved</i>		
40004	<i>Reserved</i>		
40005	<i>Reserved</i>		
40006	<i>Reserved</i>		
40007	<i>Reserved</i>		
40008	<i>Reserved</i>		
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.

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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.

Register	Description	Bits	Details
30003	<i>Reserved</i>		
30004	<i>Reserved</i>		
30005	<i>Reserved</i>		
30006	<i>Reserved</i>		
30007	<i>Reserved</i>		
30008	<i>Reserved</i>		
30600	Version	0 to 5	Binary protocol version
		6 to 8	Parameter list version number
		9 to 15	Product type code: 12 = EMX4e 13 = EMX4i
30601	Model number	0 to 7	<i>Reserved</i>
		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 30252
30604	Starter state	0 to 4	0 = <i>Reserved</i>
			1 = Ready
			2 = Starting
			3 = Running
			4 = Stopping
		5 = Not ready (restart delay, restart temperature check, run simulation, reset input is open)	
5	1 = Warning		
		6 = Tripped	
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	<i>Reserved</i>
30605	Current	0 to 13	Average rms current across all three phases
		14 to 15	<i>Reserved</i>
30606	Current	0 to 9	Current (% motor FLC)
		10 to 15	<i>Reserved</i>
30607	Motor temperature	0 to 7	Motor thermal model (%)
		8 to 15	<i>Reserved</i>
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	<i>Reserved</i>
30609	% Power factor	0 to 7	100% = power factor of 1
		8 to 15	<i>Reserved</i>
30610	Voltage	0 to 13	Average rms voltage across all three phases
		14 to 15	<i>Reserved</i>
30611	Current	0 to 13	Phase 1 current (rms)
		14 to 15	<i>Reserved</i>
30612	Current	0 to 13	Phase 2 current (rms)
		14 to 15	<i>Reserved</i>
30613	Current	0 to 13	Phase 3 current (rms)
		14 to 15	<i>Reserved</i>
30614	Voltage	0 to 13	Phase 1 voltage
		14 to 15	<i>Reserved</i>
30615	Voltage	0 to 13	Phase 2 voltage
		14 to 15	<i>Reserved</i>
30616	Voltage	0 to 13	Phase 3 voltage
		14 to 15	<i>Reserved</i>
30617	Parameter list version number	0 to 7	Parameter list minor revision
		8 to 15	Parameter list major version

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Register	Description	Bits	Details
30618	Digital Input state	0 to 15	For all inputs, 0 = open, 1 = closed (shorted) 0 = Start/Stop 1 = <i>Reserved</i> 2 = Reset 3 = Input A 4 = Input B 5 to 15 = <i>Reserved</i>
30619	Trip code	0 to 7 8 to 15	Refer to Trip Codes on page 13 <i>Reserved</i>
30620~ 30631	<i>Reserved</i>		



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.

4.6 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.



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	<i>Reserved</i>		
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	<i>Reserved</i>
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 = Uninitialised 1 = Initialised
		7 to 15	<i>Reserved</i>
40004	<i>Reserved</i>		
40005	Motor current	0 to 7	Average 3-phase motor current (A)
		8 to 15	<i>Reserved</i>

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Register	Description	Bits	Details
40006	Motor temperature	0 to 7	Motor thermal model (%)
		8 to 15	<i>Reserved</i>
40007	<i>Reserved</i>		
40008	<i>Reserved</i>		
40009 ~ 40200	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	<i>Reserved</i>
40600	Version	0 to 5	Binary protocol version
		6 to 8	Parameter list version number
		9 to 15	Product type code: 12 = EMX4e 13 = EMX4i
40601	Model number	0 to 7	<i>Reserved</i>
		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 = <i>Reserved</i> 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 = Uninitialised 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 ³
		9	0 = Negative phase sequence 1 = Positive phase sequence
		10 to 15	<i>Reserved</i>
40605	Current	0 to 13	Average rms current across all three phases
		14 to 15	<i>Reserved</i>
40606	Current	0 to 9	Current (% motor FLC)
		10 to 15	<i>Reserved</i>
40607	Motor temperature	0 to 7	Motor thermal model (%)
		8 to 15	<i>Reserved</i>
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	<i>Reserved</i>
40609	% Power factor	0 to 7	100% = power factor of 1
		8 to 15	<i>Reserved</i>
40610	Voltage	0 to 13	Average rms voltage across all three phases
		14 to 15	<i>Reserved</i>
40611	Current	0 to 13	Phase 1 current (rms)
		14 to 15	<i>Reserved</i>
40612	Current	0 to 13	Phase 2 current (rms)
		14 to 15	<i>Reserved</i>
40613	Current	0 to 13	Phase 3 current (rms)
		14 to 15	<i>Reserved</i>
40614	Voltage	0 to 13	Phase 1 voltage
		14 to 15	<i>Reserved</i>
40615	Voltage	0 to 13	Phase 2 voltage
		14 to 15	<i>Reserved</i>
40616	Voltage	0 to 13	Phase 3 voltage
		14 to 15	<i>Reserved</i>
40617	Parameter list version number	0 to 7	Parameter list minor revision
		8 to 15	Parameter list major version

INSTRUCTIONS

Register	Description	Bits	Details
40618	Digital Input state	0 to 15	For all inputs, 0 = open, 1 = closed (shorted) 0 = Start/Stop 1 = <i>Reserved</i> 2 = Reset 3 = Input A 4 = Input B 5 to 15 = <i>Reserved</i>
40619	Trip code	0 to 7 8 to 15	Refer to Trip Codes on page 13 <i>Reserved</i>
40620~ 40631	<i>Reserved</i>		



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.

4.7 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.

4.8 Trip Codes

Trip Code	Description
0	No trip
1	Excess start time
2	Motor overload
3	Motor thermistor
4	Current imbalance
5	Frequency
6	Phase sequence
7	Instantaneous 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	Forced network trip
17	Internal fault
18	Overvoltage
19	Undervoltage
23	Parameter out of range

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Trip Code	Description
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
59	Instantaneous overcurrent
60	Rating Capacity
70	Current Read Err L1
71	Current Read Err L2
72	Current Read Err L3
73	Remove Mains Volts (mains voltage connected in run simulation)
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).

4.9 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	Slave device error	An error occurred while trying to perform the requested function
6	Slave device busy	The adapter is busy (for example writing parameters to the starter)

5. Specifications

- **Connections**

Soft starter 6-way pin assembly
Network 5-way male and unpluggable female connector (supplied)
Maximum cable size 2.5 mm²

- **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



7 1 0 - 1 6 4 9 9 - 0 0 B