

Modbus RTU

Communications option
for EMX4e/EMX4i soft starters

User Guide



BENSHAW

Applied Motor Controls

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Product Compatibility

This expansion card is suitable for use with EMX4e and EMX4i soft starters.

| Product description | Soft starter name |
|---------------------|-------------------|
| Basic model | EMX4e |
| Advanced model | EMX4i |

Parameter Management

Parameter lists vary according to the model and version of soft starter.

Refer to the relevant soft starter literature for a complete parameter list.

For the latest manuals and software, please visit our website.

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1 **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.

2 **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.

3 **Important User Information**

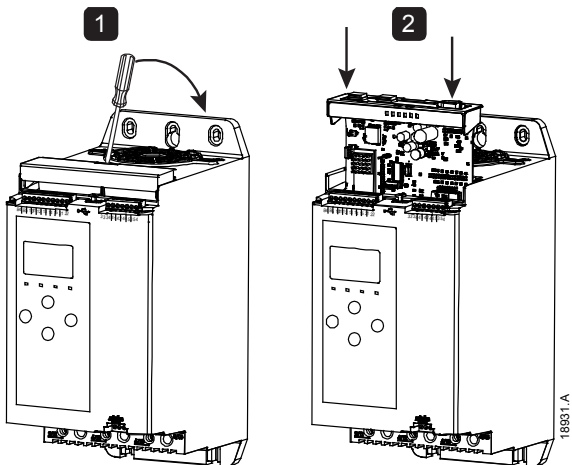
It is the installer's responsibility to follow all instructions in this manual and to follow correct electrical practice.

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

4 Installation

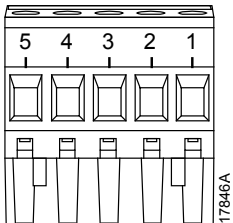
4.1 Installing the Expansion Card

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.



4.2 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 |

5 Device Configuration

5.1 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, see 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.

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

6 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.

6.1 PLC Configuration

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

7 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.

7.1 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.

7.2 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.

8 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 module unless otherwise stated.

8.1 Compatibility

The Modbus RTU Card supports two modes of operation.

- In Standard Mode, the device 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 The Manufacturer for use with older soft starters. Some registers differ from those specified in the Modbus Protocol Specification.

8.2 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 00001100 = 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. See 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 Card can read or write a maximum of 125 registers in one operation.



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 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).

| 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 major version |
| | | 9 to 15 | Product type code: 12 = basic model 13 = advanced model |
| 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 30602 |
| 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) 6 = Tripped 7 = Programming mode 8 = Jog forward 9 = Jog reverse |

| Register | Description | Bits | Details |
|----------|-------------------------------|----------|--|
| | | 5 | 1 = Warning |
| | | 6 | 0 = Uninitialised 1 = Initialised |
| | | 7 | Command source 0 = Remote Keypad, Digital Input, 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 |

| 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 (Refer to note) 3 = Input A 4 = Input B 5 to 15 = <i>Reserved</i> |
| 30619 | Trip code | 0 to 7 | See <i>Trip Codes</i> on page 11 |
| | | 8 to 15 | <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.

**NOTE**

The reset input is normally closed by default. If parameter 71 *Reset/Enable Logic* is set to normally open, the reported state will be inverted (0 = closed, 1 = open).

8.3 Legacy Mode

Registers

**NOTE**

For models 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 | <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> |

| Register | Description | Bits | Details |
|---------------------|---|---------|--|
| 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> |
| 40006 | Motor temperature | 0 to 7 | Motor thermal model (%) |
| | | 8 to 15 | <i>Reserved</i> |
| 40007 | <i>Reserved</i> | | |
| 40008 | <i>Reserved</i> | | |
| 40009 ~ 40xxx | Parameter management (single or multiple read/write) | 0 to 7 | Manage soft starter programmable parameters. See 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 = basic model 13 = advanced model |
| 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 |

| Register | Description | Bits | Details |
|----------|-------------------|----------|---|
| 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 Input, 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> |
| 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> |

| Register | Description | Bits | Details |
|-------------|-------------------------------|----------|---|
| 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 |
| 40618 | Digital input state | 0 to 15 | For all inputs, 0 = open, 1 = closed (shorted) 0 = Start/Stop 1 = <i>Reserved</i> 2 = Reset (Refer to note) 3 = Input A 4 = Input B 5 to 15 = <i>Reserved</i> |
| 40619 | Trip code | 0 to 7 | See <i>Trip Codes</i> on page 11 |
| | | 8 to 15 | <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.

**NOTE**

The reset input is normally closed by default. If parameter 71 *Reset/Enable Logic* is set to normally open, the reported state will be inverted (0 = closed, 1 = open).

Examples

Command: Start

| Message | Starter Address | Function Code | Register Address | 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 Address | 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 Address | 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.

8.4 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 |

| Trip Code | Description |
|-----------|--|
| 12 | Input A trip |
| 13 | FLC too high |
| 14 | Unsupported option (function not available in inside delta) |
| 15 | Communications card fault |
| 16 | Network communication |
| 18 | Overvoltage |
| 19 | Undervoltage |
| 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 |
| 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). |

8.5 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) |

9 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

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



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