

OPERATING INSTRUCTIONS

MCD Modbus Module

Order Code: 175G9000

■ Introduction

MCD 3000 and MCD 200 Series soft starters can be controlled and monitored across an RS485 serial communication network using the Modbus RTU and AP ASCII protocols.

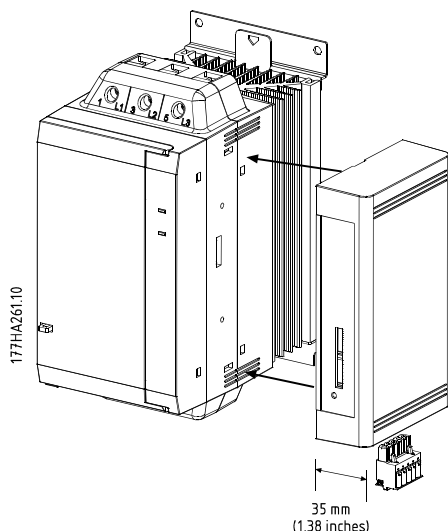
For users requiring simple control of an MCD 200 Series starter using Modbus RTU or AP ASCII, the instructions below describe the installation and operation of the Modbus Module. MCD 200 starters can also connect to the network via a correctly configured Remote Operator – see *Appendix A* for details.

MCD 3000 soft starters have AP ASCII protocol support built in – see the MCD 3000 Operating Instructions for details of message formats. The MCD 3000 supports Modbus RTU control when used in conjunction with a Remote Operator. This document describes Modbus messaging and *Appendix A* describes how to connect the Remote Operator.

■ Modbus Module Installation

To install the Modbus Module for use with MCD 200 Series starters:

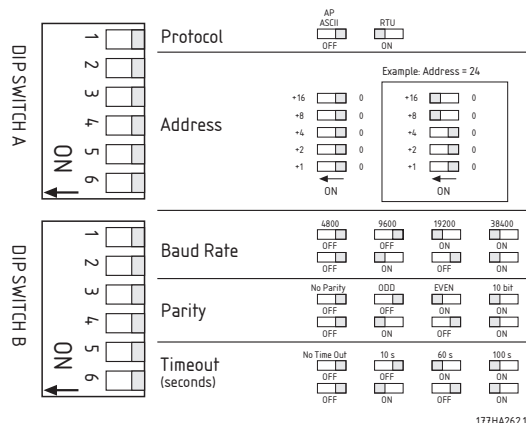
1. Remove control power and mains supply from the MCD 200.
2. Attach the Modbus Module to the starter as shown in the diagram below.
3. Apply control power to the MCD 200.



Control power and mains supply must be removed from the MCD 200 before attachment or removal of accessories. Failure to do so may result in equipment damage.

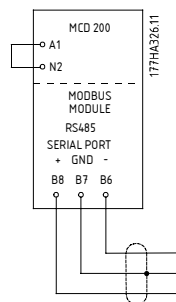
■ Adjustment

Network communication parameters must be set on the Modbus Module.



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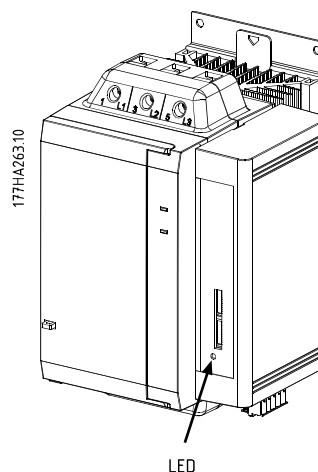
■ Connection



NB!

For the Modbus Module to operate correctly, a link must be fitted across terminals A1 and N2 on the starter.

■ Network Status LED



The Network Status LED indicates the state of the communications link between the module and the network. LED operation is as follows:

Off	On	Flashing
No connection	Healthy communications	Communication failure



NB!:

If a communication failure occurs, the starter will trip if the Communication Timeout function has been set. When communication is restored, the starter will require an independent Reset.

■ **Modbus Register**

Register Address	Type	Description												
40002 Command	Single Write	1 = Start 2 = Stop 3 = Reset 4 = Quick Stop 5 = Forced Comms Trip												
40003 Starter Status	Single Read	<table border="1"> <thead> <tr> <th>Bit</th> <th>Description</th> </tr> </thead> <tbody> <tr> <td>0 to 3</td> <td>1 = Ready 2 = Starting 3 = Running 4 = Stopping 5 = Restart Delay ** 6 = Tripped 7 = Programming Mode **</td> </tr> <tr> <td>4</td> <td>1 = Positive phase rotation detected</td> </tr> <tr> <td>5</td> <td>1 = Current exceeds the FLC **</td> </tr> <tr> <td>6</td> <td>0 = Uninitialised 1 = Initialised (Bit 4 is only valid if Bit 6 = 1)</td> </tr> <tr> <td>7</td> <td>0 = Remote Operator status OK 1 = Remote Operator fault</td> </tr> </tbody> </table>	Bit	Description	0 to 3	1 = Ready 2 = Starting 3 = Running 4 = Stopping 5 = Restart Delay ** 6 = Tripped 7 = Programming Mode **	4	1 = Positive phase rotation detected	5	1 = Current exceeds the FLC **	6	0 = Uninitialised 1 = Initialised (Bit 4 is only valid if Bit 6 = 1)	7	0 = Remote Operator status OK 1 = Remote Operator fault
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40004 Trip Code	Single Read	Requests the trip status of the soft starter 255 = No Trip 0 = Shorted SCR ** 1 = Excess Start Time * 2 = Motor Overload * 3 = Motor Thermistor * 4 = Phase Imbalance * 5 = Supply Frequency 6 = Phase Rotation * 7 = Instantaneous												

Register Address	Type	Description						
		Overcurrent ** 8 = Power Circuit Fault 9 = Undercurrent ** 10 = Starter Overtemperature ** 11 = Motor Connection Error ** 13 = FLC Range Error ** 15 = Comms Failure between starter and module 16 = Comms Failure between module and network						
40005 Current	Single Read	*						
40006 Temperature	Single Read	*						
40007 Product Type and Version	Single Read	<table border="1"> <thead> <tr> <th>Bit</th> <th>Description</th> </tr> </thead> <tbody> <tr> <td>0 to 2</td> <td>Parameter List Version</td> </tr> <tr> <td>3 to 7</td> <td>1 = MCD 3000 4 = MCD 200</td> </tr> </tbody> </table>	Bit	Description	0 to 2	Parameter List Version	3 to 7	1 = MCD 3000 4 = MCD 200
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40008 RS485 Protocol Version **	Single Read	RS485 Protocol Version						
40009 to 40061 Starter Parameters 1 to 53 **	Multiple Read or Single Write	Upload or download parameters from the starter (see MCD 3000 Operating Instructions for details)						

* Only available on MCD 202 and MCD 3000 units.

** Only available on MCD 3000 units.

■ **Modbus Hex Functions**

MCD soft starters support two functions:

- 03 (Multiple Read)
- 06 (Single Write)

MCD soft starters do not accept broadcast functions.



NB!:

Command, Starter Status, Trip Code, Motor Current, Motor Temperature, Product Type/Version, RS485 Protocol Version and Parameter Upload must be sent individually (i.e. one data word request at a time).

Least significant bit is transmitted first.

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, CRC2

Starter Status: Running

Message	Starter Address	Function Code	Address / Bytes Read	Number / Value	CRC
In	20	03	40003	1	CRC1, CRC2
Out	20	03	2	xxxx0011	CRC1, CRC2

Trip Code: Motor Overload

Message	Starter Address	Function Code	Address / Bytes Read	Number / Value	CRC
In	20	03	40004	1	CRC1, CRC2
Out	20	03	2	00000010	CRC1, CRC2

Download Parameter from Starter (MCD 3000 only) –
Read Parameter 3, Initial Current, 350%

Message	Starter Address	Function Code	Address / Bytes Read	Number / Value	CRC
In	20	03	40011	1	CRC1, CRC2
Out	20	03	2	350	CRC1, CRC2

Upload Parameter to Starter (MCD 3000 only) –
Write Parameter 17, Soft Stop Profile, set = 3

Message	Starter Address	Function Code	Address / Bytes Read	Number / Value	CRC
In	20	06	40025	3	CRC1, CRC2
Out	20	03	40025	3	CRC1, CRC2

■ Modbus Error Codes

The error codes defined for MCD starters are:

Code	Description	Example
01	Illegal function code	Function other than 03 or 06
02	Illegal data address	Not in range 40002-40255
03	Not readable data	Register not allowed for data reading
04	Not writable data	Register not allowed for data writing
05	Data boundary fault	Multiple data transfer across data boundary, or data size more than 127
06	Invalid command code	Writing "6" into 40002
07	Illegal parameter read	Invalid parameter number
08	Illegal parameter write	Invalid parameter number, read only, or hidden parameter
09	Unsupported command	Writing parameter with starter running (not applicable for MCD 200)
10	Local communication error	Communication error between Modbus slave and starter



NB!:

Some of the above codes are different from those defined in Modbus Application Protocol Specification available on www.modbus.org.

■ AP ASCII

This section describes AP ASCII control of MCD 200 soft starters. For details of AP ASCII message formats for MCD 3000 soft starters, see the MCD 3000 Operating Instructions.

The message fragments used in communicating with the soft starter are shown in the table below. The message fragments may be assembled into complete messages as described in the sections that follow.



NB!:

Data transmitted to and from the starter must be in 8 bit ASCII, no parity, 1 stop bit.

Message Fragment Type	ASCII Character String or (Hexadecimal Character String)
Send Address	EOT [nn] [lrc] ENQ or (04h [nn] [lrc] 05h)
Send Command	STX [ccc] [lrc] ETX or
Send Request	(02h [ccc] [lrc] 03h)
Receive Data	STX [dddd] [lrc] ETX or (02h [dddd] [lrc] 03h)
Receive Status	STX [ssss] [lrc] ETX or (02h [ssss] [lrc] 03h)
ACK	ACK or (06h)
NAK	NAK or (15h)
ERR	BEL (07h)

nn = two byte ASCII number representing the soft starter address where each decimal digit is represented by n.

lrc = two byte longitudinal redundancy check in hexadecimal.

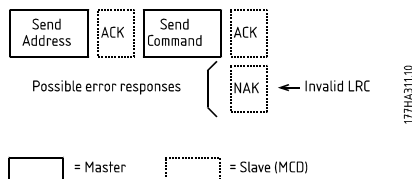
ccc = three byte ASCII command number where each character is represented by c.

dddd = four byte ASCII number representing the current or temperature data where each decimal digit is represented by d.

ssss = four byte ASCII number. The first two bytes are ASCII zero. The last two bytes represent the nibbles of a single byte of status data in hexadecimal.

Commands

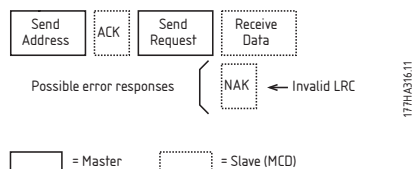
Commands can be sent to the MCD 200 using the following format:



Command	ASCII	Comment
Start	B10	Initiates a start
Stop	B12	Initiates a stop
Reset	B14	Resets a trip state
Coast to stop	B16	Initiates an immediate removal of voltage from the motor. Any soft stop settings are ignored
Forced comms trip	B18	Causes a communications trip

Status Retrieval

Starter status can be retrieved from the MCD 200 using the following format:

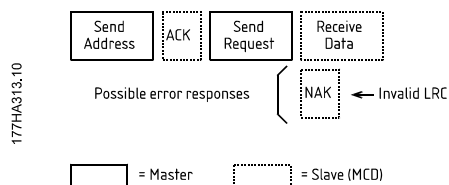


Request	ASCII	Receive Status (ssss)												
Trip Code	C18	Requests the trip status of the starter. 255 = No Trip 1 = Excess Start Time * 2 = Overcurrent * 3 = Motor Thermistor * 4 = Phase Imbalance * 5 = Supply Frequency 6 = Phase Rotation * 8 = Power Circuit Fault 15 = Comms Failure between starter and module 16 = Comms Failure between module and network												
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★ Only available on MCD 202 units.

Data Retrieval

Data can be retrieved from the MCD 202 using the following format (data retrieval is not supported on MCD 201 units):



Request	ASCII	Receive Data (dddd)
Current	D10	Requests motor current. The data is four byte decimal ASCII. Minimum value is 0000 A, maximum value 9999 A.
Temperature	D12	Requests the calculated value of the motor thermal model as a % of Motor Thermal Capacity. The data is four byte decimal ASCII. Minimum value is 0000%. Trip point is 0105%.

Calculating the Checksum (LRC)

Each command string sent to and from the starter includes a checksum. The form used is the longitudinal redundancy check (LRC) in ASCII hex. This is an 8-bit binary number represented and transmitted as two ASCII hexadecimal characters.

To calculate LRC:

1. Sum all ASCII bytes
2. Mod 256
3. 2's complement
4. ASCII convert

For example Command String (Start):

ASCII STX B 1 0
or 02h 42h 31h 30h

ASCII	Hex	Binary	
STX	02h	0000 0010	
B	42h	0100 0010	
1	31h	0011 0001	
0	30h	0011 0000	
	A5h	1010 0101	SUM (1)
	A5h	1010 0101	MOD 256 (2)
	5Ah	0101 1010	1's COMPLEMENT
	01h	0101 1011	+ 1 =
	5Bh	0101 1011	2's COMPLEMENT (3)
ASCII	5 B		ASCII CONVERT (4)
or	35h 42h		LRC CHECKSUM

The complete command string becomes:

ASCII STX B 1 0 5 B ETX
or 02h 42h 31h 30h 35h 42h 03h

To verify a received message containing an LRC:

1. Convert last two bytes of message from ASCII to binary.
2. Left shift 2nd to last byte four bits.
3. Add to last byte to get binary LRC.
4. Remove last two bytes from message.
5. Add remaining bytes of message.
6. Add binary LRC.
7. Round to one byte.
8. The result should be zero.

Response or status bytes are sent from the MCD 200 as an ASCII string:

STX [d1]h [d2]h [d3]h [d4]h LRC1 LRC2 ETX
d1 = 30h
d2 = 30h
d3 = 30h plus upper nibble of status byte right shifted by four binary places
d4 = 30h plus lower nibble of status byte

For example status byte = 1Fh, response is:

STX 30h 30h 31h 46h LRC1 LRC2 ETX

■ Appendix A – Modbus Control via Remote Operator

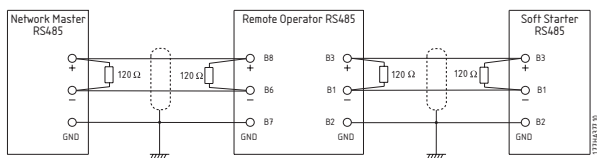
To control a soft starter via an RS485 serial communication network using the Remote Operator, connect the Remote Operator to the network as described in the following sections.

Grounding and Shielding

Twisted pair data cable with earth shield is recommended. The cable shield should be connected to a GND device terminal at both ends and one point of the site protective earth.

Termination Resistors

In long cable runs prone to excessive noise interference, termination resistors should be installed. This resistance should match the cable impedance (typically 120 Ω). Do not use wire wound resistors.



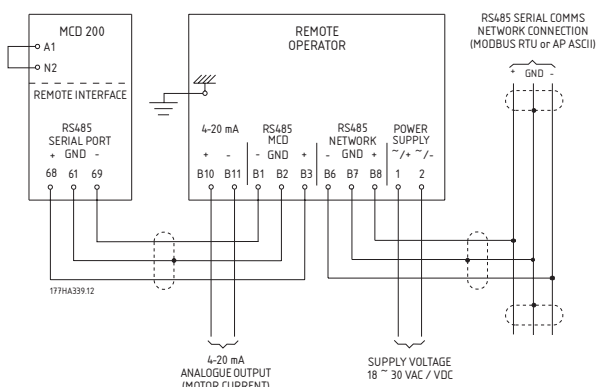
RS485 Data Cable Connection

Daisy chain connection is recommended. This is achieved by parallel connections of the data cable at the actual device terminals.

Remote Operator RS485 Network Connection Specifications

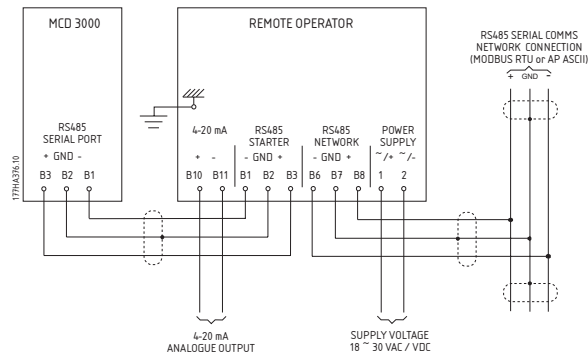
Input Impedance: 12 kΩ
 Common Mode Voltage Range: -7 to +12 V
 Input Sensitivity: +/- 200 mV
 Minimum Differential Output Voltage:
 1.5 V (with max loading of 54 Ω)

Using the Remote Operator with MCD 200



Using the Remote Operator with MCD 3000

In order to operate correctly on the network, the MCD 3000 must be set for local operation only (i.e. set Parameter 20 = 2). The Remote Operator's default communication protocol setting is AP ASCII.



The RS485 Network Timeout setting on the Remote Operator applies to the link between the Remote Operator and the network. This can be set to any value between 0 and 100 seconds.

The Serial Timeout setting on the MCD 3000 (Parameter 24) applies to communications between the Remote Operator and the starter. See the MCD 3000 Operating Instructions for soft starter configuration details.

■ Configuration

The Remote Operator must be configured to operate on the network. In order to access Programming Mode, the Remote Operator must be powered up when the soft starter is in "off" mode.

Programming Procedure

1. Enter Programming Mode by holding down the Data/Prog Pushbutton for four seconds. The value of the first parameter will be displayed.
2. If required, use the Stop/+ and Reset/- pushbuttons to adjust parameter values.
3. Use the Data/Prog Pushbutton to confirm the setting and move to the next parameter.

The Remote Operator will exit Programming Mode when the Data/Prog Pushbutton is pressed after Parameter 8.



NB!:

There is a 20 second timeout when the Remote Operator is in Programming Mode. Programming Mode will automatically close if no input is registered for 20 seconds. Any changes already made will be saved.

Par. No	Parameter	Default Setting	Adjustable Range
1	RS485 Network Baud Rate	4 (9600 baud)	2 = 2400 baud 3 = 4800 baud 4 = 9600 baud 5 = 19200 baud 6 = 38400 baud
2	RS485 Network Satellite Address	20	1 to 99
3	RS485 Network Time Out	0 seconds (Off)	0 to 100 seconds
4	RS485 Network Protocol	1 (AP ASCII)	1 = AP ASCII protocol 2 = Modbus RTU protocol
5	Modbus Protocol Parity	0 (no parity)	0 = no parity 1 = odd parity 2 = even parity 3 = 10 bit
6	Motor FLC (A)	10	1 to 2868
7	Analogue Output 4 mA Offset (%)	100	80 to 120
8	Start/Stop/Quick Stop disable	0	0 = Remote Operator and Network start, stop, quick stop function enabled. 1 = Remote Operator start, stop, quick stop function enabled. Network start, stop, quick stop function disabled. ** 2 = Remote Operator start, stop, quick stop function disabled. Network start, stop, quick stop function enabled. * 3 = Remote Operator start, stop, quick stop function disabled. Network start, stop, quick stop function disabled. ***

★ Remote Operator Reset/- Pushbutton is always enabled.

★★ RS485 Network reset and forced communication trip functions are always enabled.