ENGINEERING
TOMORROW

Danfoss

Installation Guide

Modbus RTU Card
VLT® Soft Starter MCD 600

Contents

1 Safety

1.1 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. Responsibility or liability is never accepted for direct, indirect, or consequential damage resulting from the use or application of this equipment.

1.2 Warnings

⚠ WARNING ⚠
SHOCK HAZARD Attaching or removing accessories while the soft starter is connected to mains voltage may cause personal injury. - Before attaching or removing accessories, isolate the soft starter from mains voltage.

⚠ WARNING ⚠
RISK OF PERSONAL INJURY AND EQUIPMENT DAMAGE Inserting foreign objects or touching the inside of the soft starter while the expansion port cover is open may endanger personnel and can damage the soft starter. - Do not insert foreign objects in the soft starter with the port cover open. - Do not touch the inside of the soft starter with the port cover open.

1.3 Important User Information

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

The installer is responsible for following all instructions in this manual and for following correct electrical practice.

Use all internationally recognized standard practice for RS485 communication when installing and using this equipment.

2 Installation

2.1 Installing the Expansion Card

Procedure

1. Push a small flat-bladed screwdriver into the slot in the center of the expansion port cover and ease the cover away from the soft starter.

2. Line up the card with the expansion port.

3. Gently push the card along the guide rails until it clicks into the soft starter.

Example:

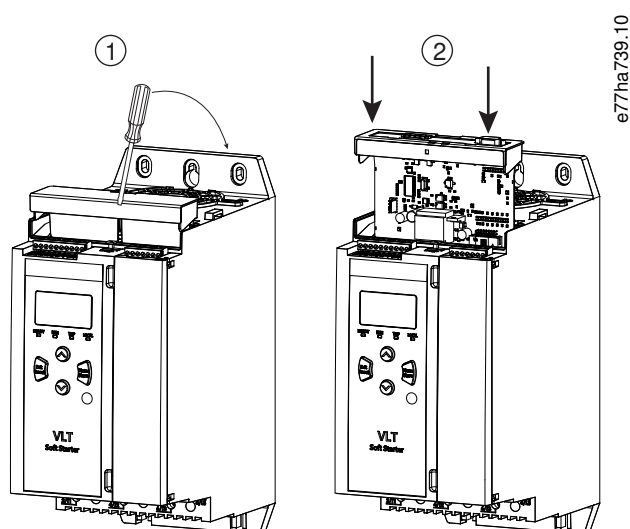**Illustration 1:   Installation of the Expansion Cards**

2.2 Connecting to the Network

Prerequisites:

The expansion card must be installed in the soft starter.

Procedure

1. Restore control power.

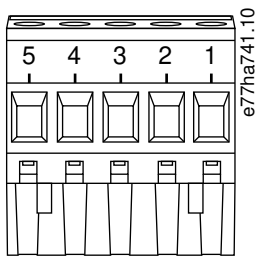2. Connect field wiring via the 5-way connector plug.

Example:

Illustration 2: 5-way Connector Plug

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

3 Operation

3.1 Prerequisites

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 manual.

3.2 Master Configuration

For standard Modbus 11-bit transmission, configure the master for 2 stop bits with no parity and 1 stop bit for odd or even parity.

For 10-bit transmission, configure the master for 1 stop bit.

In all cases, the master baud rate and slave address must match those set in *parameters 12-1* to *12-4*.

The data polling interval must be long enough for the module to respond. Short polling intervals may cause inconsistent or incorrect behavior, particularly when reading multiple registers. The recommended minimum polling interval is 300 ms.

3.3 Configuration

3.3.1 Modbus Network Settings

Set the network communication parameters for the card via the soft starter. For details on how to configure the soft starter, see the VLT® Soft Starter MCD 600 Operating Guide.

Table 1: Parameter Settings

Parameter	Parameter name	Description
12-1	*Modbus Address*	Sets the Modbus RTU network address for the soft starter.
12-2	*Modbus Baud Rate*	Selects the baud rate for Modbus RTU communications.
12-3	*Modbus Parity*	Selects the parity for Modbus RTU communications.
12-4	*Modbus Timeout*	Selects the timeout for Modbus RTU communications.

⚠ **N O T I C E** ⚠

The Modbus RTU Card reads communications parameter settings from the soft starter when control power is applied. If parameters are changed in the soft starter, cycle control power for the new values to take effect.

3.3.2 Enabling Network Control

The soft starter only accepts commands from the expansion card if *parameter 1-1 Command Source* is set to *Network*.

⚠ **N O T I C E** ⚠

If the reset input is active, the soft starter does not operate. If a reset switch is not required, fit a link across terminals RESET, COM+ on the soft starter.

3.4   Feedback LEDs

LED status	Description
Off	The soft starter is not powered up.
On	Communication active.
Flashing	Communication inactive.

⚠ **N O T I C E** ⚠

If communication is inactive, the soft starter may trip on Network Communications. If *parameter 6-13 Network Communications* is set to *Soft Trip and Log* or *Trip Starter*, the soft starter requires a reset.

---

4 Modbus Registers

4.1 PLC Configuration

Use the tables in to map registers within the device to addresses within the PLC.

> ⚠ **N O T I C E** ⚠
>
> All references to registers mean the registers within the device unless otherwise stated.

4.2 Compatibility

The Modbus RTU Card supports 2 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 Danfoss for use with older soft starters. Some registers differ from those specified in the Modbus Protocol Specification.

4.3 Ensuring Safe and Successful Control

Data written to the device remains in its registers until the data is overwritten or the device is reinitialized.

If the soft starter should be controlled via *parameter 7-1 Command Override* or should be disabled via the reset input (terminals RESET, COM+), fieldbus commands should be cleared from the registers. If a command is not cleared, it is resent to the soft starter once fieldbus control resumes.

4.4 Parameter Management

Parameters can be read from and written to the soft starter.The Modbus RTU can read or write a maximum of 125 registers in 1 operation.

> ⚠ **N O T I C E** ⚠
>
> The total number of parameters in the soft starter may vary according to the model and parameter list of the soft starter. Attempting to write to a register not associated with a parameter returns an error code 02 (illegal data address). Read register 30602 to determine the total number of parameters in the soft starter.

> ⚠ **N O T I C E** ⚠
>
> Do not change the default values of the Advanced parameters (*parameter group 20-** Advanced Parameters*). Changing these values may cause unpredictable behavior in the soft starter.

4.5 Standard Mode

4.5.1 Command and Configuration Registers (Read/Write)

Table 2: Description of Read/Write Registers

Register	Description	Bits	Details
40001	Command (single write)	0–7	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
		8–14	Reserved
		15	Must = 1
40002	Reserved		
40003	Reserved		
40004	Reserved		
40005	Reserved		
40006	Reserved		
40007	Reserved		
40008	Reserved		
40009–40xxx	Parameter management (single or multiple read/ write)	0–15	Manage soft starter programmable parameters. See the VLT® Soft Starter MCD 600 Operating Guide for a complete parameter list.

4.5.2 Status Reporting Registers (Read Only)

> ⚠ **N O T I C E** ⚠
>
> For models MCD6-0063B and smaller (soft starter model ID 1~4), the current reported via communications registers is 10 times greater than the actual value.

Table 3: Description of Read Registers

Register	Description	Bits	Details
30003	Reserved		
30004	Reserved		
30005	Reserved		
30006	Reserved		
30007	Reserved		
30008	Reserved		
30600	Version	0–5	Binary protocol version
		6–8	Parameter list major version
		9–15	Product type code: 15 = MCD 600
30601	Model number	0–7	Reserved
		8–15	Soft starter model ID
30602	Changed parameter number	0–7	0 = No parameters have changed 1–255 = Index number of the last parameter changed
		8–15	Total number of parameters available in the soft starter
30603	Changed parameter value	0–15	Value of the last parameter that was changed, as indicated in register 30602

Register	Description	Bits	Details
30604	Starter state	0–4	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 = Uninitialized
			1 = Initialized
		7	Command source
			0 = Remote Keypad, Digital Input, Clock
			1 = Network
		8	0 = Parameters have changed since last parameter read
			1 = No parameters have changed
		9	0 = Negative phase sequence
			1 = Positive phase sequence
		10–15	Reserved
30605	Current	0–13	Average rms current across all 3 phases
		14–15	Reserved
30606	Current	0–9	Current (% motor FLC)
		10–15	Reserved
30607	Motor temperature	0–7	Motor thermal model (%)
		8–15	Reserved

Register	Description	Bits	Details
30608	Power	0–11	Power
		12–13	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
		14–15	Reserved
30609	% Power factor	0–7	100% = power factor of 1
		8–15	Reserved
30610	Voltage	0–13	Average rms voltage across all 3 phases
		14–15	Reserved
30611	Current	0–13	Phase 1 current (rms)
		14–15	Reserved
30612	Current	0–13	Phase 2 current (rms)
		14–15	Reserved
30613	Current	0–13	Phase 3 current (rms)
		14–15	Reserved
30614	Voltage	0–13	Phase 1 voltage
		14–15	Reserved
30615	Voltage	0–13	Phase 2 voltage
		14–15	Reserved
30616	Voltage	0–13	Phase 3 voltage
		14–15	Reserved
30617	Parameter list version number	0–7	Parameter list minor revision
		8–15	Parameter list major version
30618	Digital input state	0–15	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

Register	Description	Bits	Details
30619	Trip code	0–15	See [4.8 Trip Codes](#)
		8–15	Reserved
30620–30631	Reserved		

> ⚠ **NOTICE** ⚠
>
> Reading register 30603 (Changed parameter value) resets registers 30602 (Changed parameter number) and 30604 (Parameters have changed). Always read registers 30602 and 30604 before reading register 30603.

4.6 Legacy Mode

4.6.1 Registers

> ⚠ **NOTICE** ⚠
>
> For models MCD6-0063B and smaller (soft starter model ID 1~4), the current reported via communications registers is 10 times greater than the actual value.

> ⚠ **NOTICE** ⚠
>
> 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.

Table 4: Description of Registers in Legacy Mode

Register	Description	Bits	Details
40001	Reserved		
40002	Command (single write)	0–2	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
		3–15	Reserved

Register	Description	Bits	Details
40003	Soft starter state	0–3	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 = Uninitialized
			1 = Initialized
		7–15	Reserved
40004	Reserved		
40005	Motor current	0–7	Average 3-phase motor current (A)
		8–15	Reserved
40006	Motor temperature	0–7	Motor thermal model (%)
		8–15	Reserved
40007	Reserved		
40008	Reserved		
40009–40xxx	Parameter management (single or multiple read/ write)	0–7	Manage soft starter programmable parameters. See the VLT® Soft Starter MCD 600 Operating Guide for a complete parameter list.
		8–15	Reserved
40600	Version	0–5	Binary protocol version
		6–8	Parameter list version number
		9–15	Product type code:
			15 = MCD 600
40601	Model number	0–7	Reserved
		8–15	Soft starter model ID

Register	Description	Bits	Details
40602	Changed parameter number	0–7	0 = No parameters have changed 1–255 = Index number of the last parameter changed
		8–15	Total number of parameters available in the soft starter
40603	Changed parameter value	0–15	Value of the last parameter that was changed, as indicated in register 40602
40604	Starter state	0–4	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 = Uninitialized 1 = Initialized
		7	Command source 0 = Remote Keypad, Digital Input, Clock 1 = Network
		8	0 = Parameters have changed since last parameter read 1 = No parameters have changed
		9	0 = Negative phase sequence 1 = Positive phase sequence
		10–15	Reserved
40605	Current	0–13	Average rms current across all 3 phases
		14–15	Reserved
40606	Current	0–9	Current (% motor FLC)
		10–15	Reserved

Register	Description	Bits	Details
40607	Motor temperature	0–7	Motor thermal model (%)
		8–15	Reserved
40608	Power	0–11	Power
		12–13	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
		14–15	Reserved
40609	% Power factor	0–7	100% = power factor of 1
		8–15	Reserved
40610	Voltage	0–13	Average rms voltage across all 3 phases
		14–15	Reserved
40611	Current	0–13	Phase 1 current (rms)
		14–15	Reserved
40612	Current	0–13	Phase 2 current (rms)
		14–15	Reserved
40613	Current	0–13	Phase 3 current (rms)
		14–15	Reserved
40614	Voltage	0–13	Phase 1 voltage
		14–15	Reserved
40615	Voltage	0–13	Phase 2 voltage
		14–15	Reserved
40616	Voltage	0–13	Phase 3 voltage
		14–15	Reserved
40617	Parameter list version number	0–7	Parameter list minor revision
		8–15	Parameter list major version

Register	Description	Bits	Details
40618	Digital input state	0–15	For all inputs, 0 = open, 1 = closed (shorted) 0 = Start/Stop 1 = Reserved 2 = Reset 3 = Input A 4 = Input B 5–15 = Reserved
40619	Trip code	0–7	See 4.8 Trip Codes
		8–15	Reserved
40620–40631	Reserved		

> ⚠ **N O T I C E** ⚠
>
> Reading register 40603 (Changed parameter value) resets registers 40602 (Changed parameter number) and 40604 (Parameters have changed). Always read registers 40602 and 40604 before reading register 40603.

4.7 Examples

Table 5: Command: Start

Message	Soft starter address	Function code	Register address	Data	CRC
In	20	06	40002	1	CRC1, CRC2
Out	20	06	40002	1	CRC1, CRC2

Table 6: Soft Starter State: Running

Message	Soft starter address	Function code	Register address	Data	CRC
In	20	03	40003	1	CRC1, CRC2
Out	20	03	2	xxxx0011	CRC1, CRC2

Table 7: Trip Code: Motor Overload

Message	Soft starter address	Function code	Register address	Data	CRC
In	20	03	40004	1	CRC1, CRC2
Out	20	03	2	00000010	CRC1, CRC2

Table 8: Download Parameter from Soft Starter - Read Parameter 5 (Parameter 1-5 Locked Rotor Current), 600%

Message	Soft starter address	Function code	Register	Data	CRC
In	20	03	40013	1	CRC1, CRC2
Out	20	03	2 (bytes)	600	CRC1, CRC2

Table 9: Upload Single Parameter to Soft Starter - Write Parameter 61 (Parameter 2-9 Stop Mode), set =1

Message	Soft starter address	Function code	Register	Data	CRC
In	20	06	40024	1	CRC1, CRC2
Out	20	06	40024	1	CRC1, CRC2

Table 10: Upload Multiple Parameters to Soft Starter - Write Parameters 9, 10, 11 (Parameters 2-2 to 2-4) Set to Values of 15 s, 300%, and 350%, Respectively

Message	Soft 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

⚠ NOTICE ⚠

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 1st parameter.

4.8 Trip Codes

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
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)

Code	Description
34	SCR overtemperature
35	Battery/clock
36	Thermistor circuit
47	Overpower
48	Underpower
56	LCP 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 the local supplier with the fault code (x).

4.9 Modbus Error Codes

Code	Description	Example
1	Illegal function code	The adapter or soft starter does not support the requested function.
2	Illegal data address	The adapter or soft starter does not support the specified register address.
3	Illegal data value	The adapter or soft starter does not support 1 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 soft starter).

5 Specifications

5.1 Connections

Soft starter	6-way pin assembly
Network	5-way male and unpluggable female connector (supplied)
Maximum cable size	2.5 mm^2 (14 AWG)

5.2 Settings

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

5.3 Certification

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

Index

Danfoss A/S
Ulsnaes 1
DK-6300 Graasten
vlt-drives.danfoss.com