ENGINEERING
TOMORROW

Operating guide

VLT® Soft Starter MCD 600

VLT®

Soft Starter

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1 Introduction

1.1 Product Description

The VLT® Soft Starter MCD 600 is an advanced digital soft start solution for 11–850 kW (15–1150 hp) motors. The soft starters provide a complete range of motor and system protection features and are designed for reliable performance in the most demanding installation situations.

1.2 Document Version

This manual is regularly reviewed and updated. All suggestions for improvement are welcome.

Table 1: Document Version

Edition	Remarks
AQ2614844215	Initial release

1.3 Additional Resources

Other resources are available to understand advanced soft starter functions and programming.

- Operating guides for operation with optional equipment.
- Installation guides for installing various accessories.

Supplementary publications and manuals are available from *www.danfoss.com/en/search/?filter=type%3Adocumentation*.

1.4 Approvals and Certifications
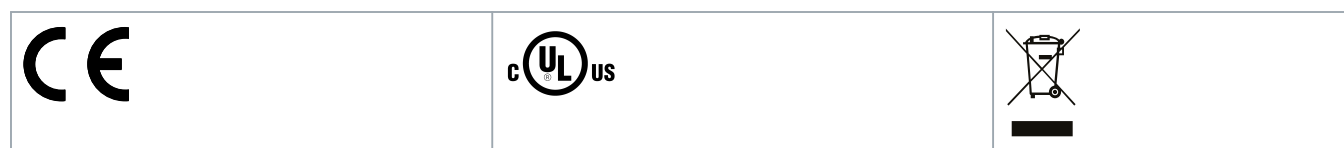
2 Safety

2.1 Safety Symbols

The following symbols are used in this manual:

> ⚠ **D A N G E R** ⚠
>
> Indicates a hazardous situation which, if not avoided, will result in death or serious injury.

> ⚠ **W A R N I N G** ⚠
>
> Indicates a hazardous situation which, if not avoided, could result in death or serious injury.

> ⚠ **C A U T I O N** ⚠
>
> Indicates a hazardous situation which, if not avoided, could result in minor or moderate injury.

> ⚠ **N O T I C E** ⚠
>
> Indicates a property damage message.

2.2 Qualified Personnel

Correct and reliable transport, storage, installation, operation, and maintenance are required for the trouble-free and safe operation of the soft starter. Only qualified personnel are allowed to install or operate this equipment.

Qualified personnel are defined as trained staff, who are authorized to install, commission, and maintain equipment, systems, and circuits in accordance with pertinent laws and regulations. Also, the qualifed personnel must be familiar with the instructions and safety measures described in this manual.

2.3 Safety Precautions

Safety precautions cannot cover every potential cause of equipment damage, but can highlight common causes of damage. It is the installer's responsibility to read and understand all instructions in this manual before installing, operating or maintaining the equipment, to follow good electrical practice including applying appropriate personal protective equipment, and to seek advice before operating this equipment in a manner other than described in this operating guide.

> ⚠ **N O T I C E** ⚠
>
> The VLT® Soft Starter MCD 600 is not user serviceable. The unit should only be serviced by authorized service personnel. Unauthorized tampering with the unit voids the product warranty.

⚠ WARNING ⚠

PROPER GROUNDING

It is the responsibility of the installer of the soft starter to provide proper grounding and branch circuit protection according to local electrical safety codes. Not providing proper grounding and branch circuit protection may lead to death, personal injury, or equipment damage.

- Disconnect the soft starter from mains voltage before carrying out repair work.

⚠ WARNING ⚠

UNINTENDED START

When the soft starter is connected to AC mains, DC supply, or load sharing, the motor can start at any time. Unintended start during programming, service, or repair work can result in death, serious injury or property damage. The motor can start with an external switch, a fieldbus command, an input reference signal from the LCP, or after a cleared fault condition.

- Press [Off/Reset] on the LCP before programming parameters.

- Disconnect the soft starter from the mains.

- Completely wire and assemble the soft starter, motor, and any driven equipment before connecting the soft starter to AC mains, DC supply, or load sharing.

- Fit the power supply to the soft starter with an isolating switch and a circuit-breaking device (for example a power contactor) controllable through an external safety system (for example an emergency stop or a fault detector).

⚠ CAUTION ⚠

POWER FACTOR CORRECTION

Connecting power factor correction capacitors to the output side will damage the soft starter.

- Do not connect power factor correction capacitors to the output of the soft starter. If static power factor correction is employed, it must be connected to the supply side of the soft starter.

⚠ CAUTION ⚠

SHORT CIRCUIT

The VLT® Soft Starter MCD 600 is not circuit proof.

- After severe overload or short circuit, the operation of the MCD 600 should be fully tested by an authorized service agent.

⚠ CAUTION ⚠

MECHANICAL DAMAGE FROM UNEXPECTED RESTART

The motor could restart after the causes of a shutdown are rectified, which may be dangerous for certain machines or installations.

- Ensure that appropriate arrangements are made against restarting after unscheduled stops of the motor.

⚠ WARNING ⚠

SAFETY OF PERSONNEL

The soft starter is not a safety device and does not provide electrical isolation or disconnection from the supply.

- If isolation is required, the soft starter must be installed with a main contactor.
- Do not rely on the start and stop functions for safety of personnel. Faults occurring in the mains supply, the motor connection, or the electronics of the soft starter can cause motor starts or stops.
- If faults occur in the electronics of the soft starter, a stopped motor may start. A temporary fault in the supply mains or loss of motor connection can also cause a stopped motor to start.
- To provide safety of personnel and equipment, control the isolation device through an external safety system.

⚠ NOTICE ⚠

- Before changing any parameter settings, save the current parameter to a file using MCD PC Software or the Save User Set function.

⚠ NOTICE ⚠

- Use the Auto-start feature with caution. Read all the notes related to auto-start before operation.

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.

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3 System Design

3.1 Feature List

Streamlined set-up process

- Configuration profiles for common applications.
- Built-in metering and inputs/outputs.

Easy-to-understand interface

- Multi-language menus and displays.
- Descriptive option names and feedback messages.
- Real-time performance graphs.

Supports energy efficiency

- IE3 compatible.
- 99% energy efficient when running.
- Internal bypass.
- Soft start technology avoids harmonic distortion.

Extensive range of models

- 20–579 A (nominal).
- 200–525 V AC.
- 380–690 V AC.
- Inside delta installation.

Extensive input and output options

- Remote control inputs (2 x fixed, 2 x programmable).
- Relay outputs (1 x fixed, 2 x programmable).
- Analog output.

Versatile starting and stopping options

- Scheduled start/stop.
- Adaptive control.
- Constant current.
- Current ramp.
- Pump clean.
- Timed voltage ramp soft stop.
- Coast to stop.
- DC brake.
- Soft brake.
- Reverse direction.

Customizable protection

- Motor overload.

- Excess start time.

- Undercurrent/overcurrent.

- Underpower/overpower.

- Current imbalance.

- Input trip.

- Motor thermistor.

Optional features for advanced applications

- Smart cards.

- Communication options:

  - DeviceNet.

  - EtherNet/IP.

  - Modbus RTU.

  - Modbus TCP.

  - PROFIBUS.

  - PROFINET.

3.2 Type Code
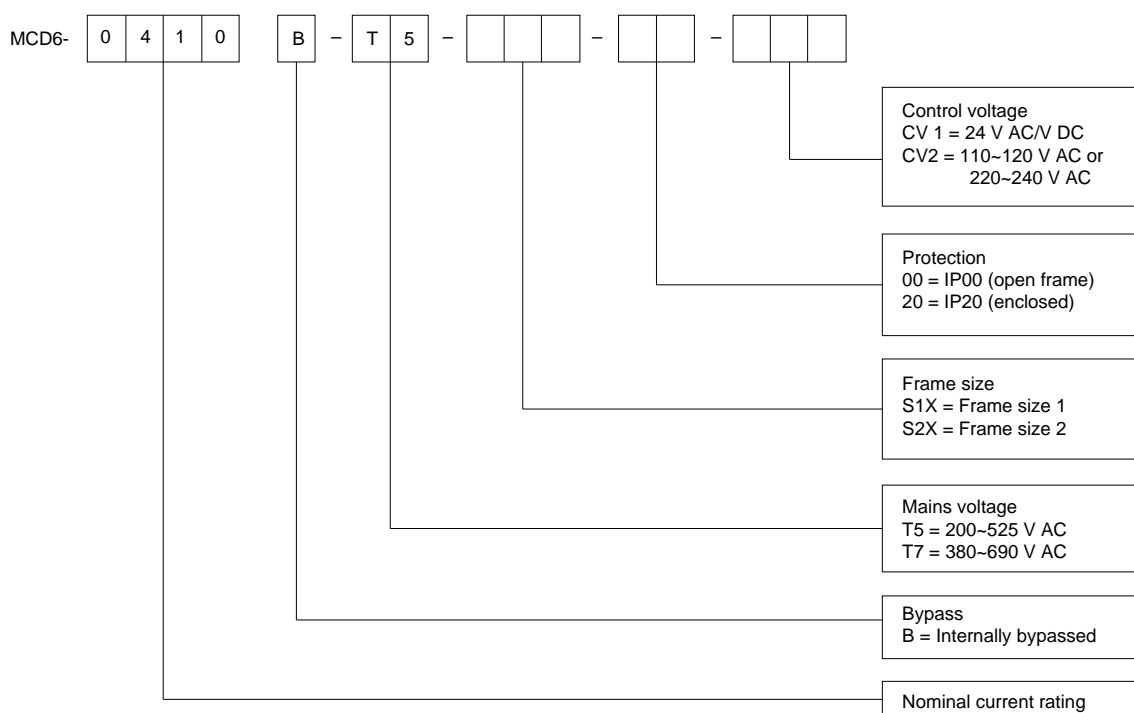
Illustration 1: Type Code String

3.3 Selection of Soft Starter Size

The size of the soft starter must match the motor and the application.

Select a soft starter that has a current rating at least equal to the motor's full load current rating (see motor nameplate) at the start duty.

The soft starter's current rating determines the maximum motor size it can be used with. The soft starter's rating depends on the number of starts per hour, the length and current level of the start, and the amount of time the soft starter is off (not passing current) between starts.

The soft starter's current rating is only valid when used in the conditions specified in the AC53b code - the soft starter may have a higher or lower current rating in different operating conditions.

3.4 Current Ratings (IEC Ratings)

> **⚠ NOTICE ⚠**
>
> Contact the local supplier for ratings under operating conditions not covered by these rating charts.
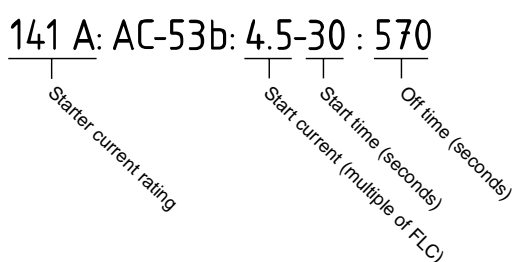
Illustration 2:   AC53b Format

> **⚠ NOTICE ⚠**
>
> All ratings are calculated at an altitude of 1000 m (3280 ft) and an ambient temperature of 40 ℃ (104 °F).

Table 2: In-line Installation, MCD6-0020B and MCD6-0042B

	3.0-10:350	3.5-15:345	4.0-10:350	4.0-20:340	5.0-5:355
MCD6-0020B	24	20	19	16	17
MCD6-0042B	52	42	39	35	34

Table 3: In-line Installation, MCD6-0069B and MCD6-0579B

	3.0-10:590	3.5-15:585	4.0-10:590	4.0-20:580	5.0-5:595
MCD6-0069B	69	69	69	62	65
MCD6-0086B	105	86	84	69	77
MCD6-0129B	135	129	126	103	115
MCD6-0171B	200	171	165	138	150

	3.0-10:590	3.5-15:585	4.0-10:590	4.0-20:580	5.0-5:595
MCD6-0244B	250	244	230	200	202
MCD6-0323B	397	323	311	263	289
MCD6-0527B	550	527	506	427	464
MCD6-0579B	580	579	555	470	508

Table 4: Inside Delta Installation

	3.0-10:350	3.5-15:345	4.0-10:350	4.0-20:340	5.0-5:355
MCD6-0020B	36	30	28	24	25
MCD6-0042B	78	63	58	52	51
	3.0-10:590	**3.5-15:585**	**4.0-10:590**	**4.0-20:580**	**5.0-5:595**
MCD6-0069B	103	103	103	93	97
MCD6-0086B	157	129	126	103	115
MCD6-0129B	202	193	189	154	172
MCD6-0171B	300	256	247	207	225
MCD6-0244B	375	366	345	300	303
MCD6-0323B	595	484	466	394	433
MCD6-0527B	825	790	759	640	696
MCD6-0579B	870	868	832	705	762

3.5 Dimensions and Weight
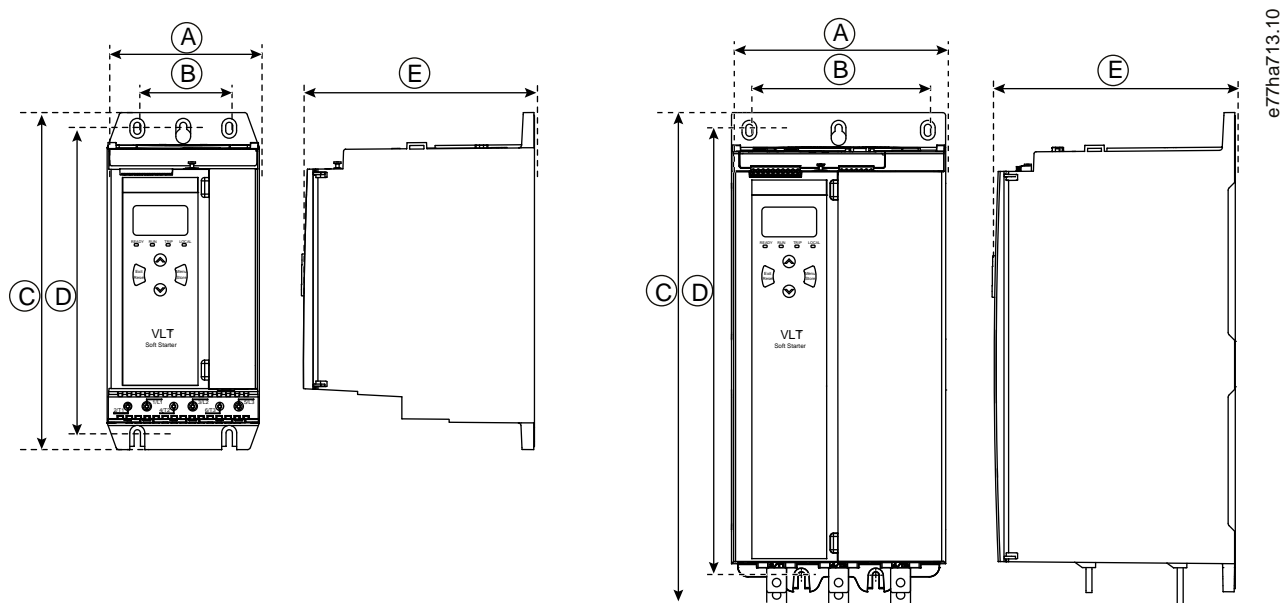
Illustration 3: Dimensions

Table 5: Dimensions and Weight

	Width [mm (in)]		Height [mm (in)]		Depth [mm (in)]	Weight [kg (lb)]
	A	B	C	D	E	
MCD6-0020B	152 (6.0)	92 (3.6)	336 (13.2)	307 (12.1)	231 (9.1)	4.8 (10.7)
MCD6-0042B						4.9 (10.9)
MCD6-0069B						
MCD6-0086B						5.5 (12.1)
MCD6-0129B						
MCD6-0171B	216 (8.5)	180 (7.1)	495 (19.5)	450 (17.7)	243 (9.6)	12.7 (28)
MCD6-0244B						
MCD6-0323B			523 (20.6)			15.5 (34.2)
MCD6-0527B						19 (41.9)
MCD6-0579B						

3.6 Physical Installation/Cooling Clearances
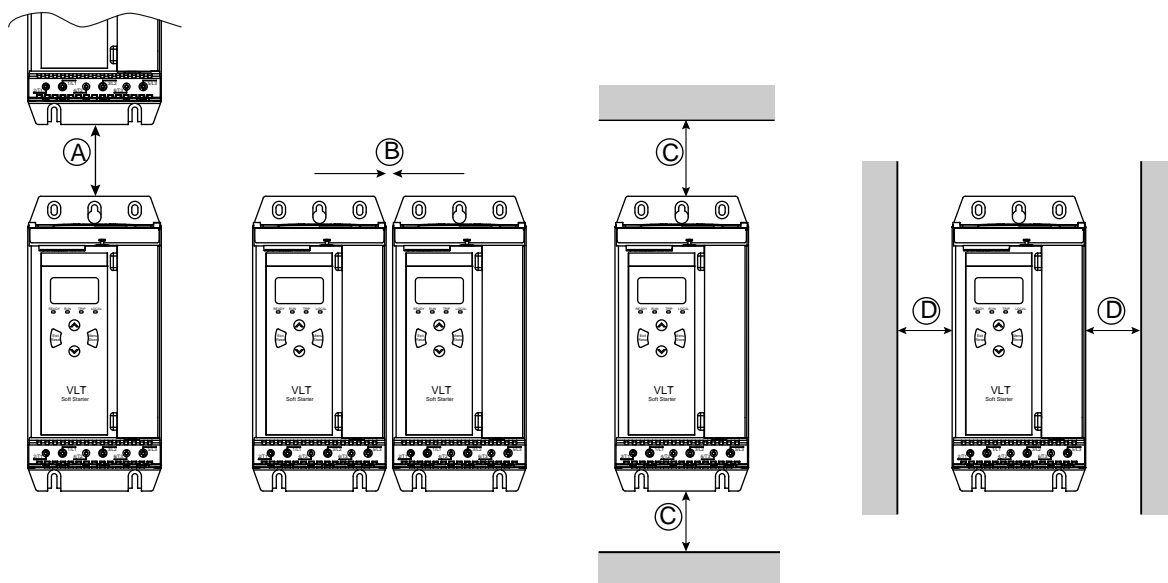
Illustration 4:   Clearances

Table 6: Cooling clearances

Clearance between soft starters		Clearance to solid surfaces	
A [mm (in)]	B [mm (in)]	C [mm (in)]	D [mm (in)]
>100 (3.9)	>10 (0.4)	>100 (3.9)	>10 (0.4)

3.7 Accessories

3.7.1 Expansion Cards

The VLT® Soft Starter MCD 600 offers expansion cards for users requiring additional inputs and outputs or advanced functionality. Each MCD 600 can support a maximum of 1 expansion card.

3.7.1.1 Smart Card

The smart card has been designed to support integration with pumping applications and provides the following additional inputs and outputs:

- 3 x digital inputs.
- 3 x 4–20 mA transducer inputs.
- 1 x RTD input.
- 1 x USB-B port.
- Remote LCP connector.

Ordering number: 175G0133

3.7.1.2 Communication Expansion Cards

The VLT® Soft Starter MCD 600 supports network communication via easy-to-install communication expansion cards. Each communication card includes a remote LCP connector port.

Table 7: Fieldbus Expansion Cards with Ordering Numbers

Option Card	Ordering Number
VLT® Soft Starter MCD 600 Modbus RTU	175G0127
VLT® Soft Starter MCD 600 PROFIBUS	175G0128
VLT® Soft Starter MCD 600 DeviceNet	175G0129
VLT® Soft Starter MCD 600 Modbus TCP	175G0130
VLT® Soft Starter MCD 600 EtherNet/IP	175G0131
VLT® Soft Starter MCD 600 PROFINET	175G0132
VLT® Soft Starter MCD 600 Pumpo	
VLT® Soft Starter MCD 600	

3.7.2 Remote LCP

The VLT® Soft Starter MCD 600 soft starters can be used with a remote LCP mounted up to 3 m (9.8 ft) away from the soft starter. Each expansion card includes an LCP connection port, or a dedicated LCP connector card is available.

Ordering number for the Remote LCP expansion card: 175G0134.

3.7.3 Finger Guard Kit

Finger guards may be specified for personal safety. Finger guards fit over the soft starter terminals to prevent accidental contact with live terminals. Finger guards provide IP20 protection when used with cable of diameter 22 mm or greater.

Finger guards are compatible with models MCD6-0171B ~ MCD6-0579B.

3.7.4 Soft Starter Management Software

The VLT® Motion Control Tool MCT 10 can help manage the soft starter. Contact the local supplier for more information.

Documentation for the VLT® Motion Control Tool MCT 10 can be downloaded from *www.danfoss.com/en/search/?filter=type %3Adocumentation*.

3.8 Main Contactor

A main contactor is recommended to protect the soft starter from voltage disturbances on the network while stopped. Select a contactor with an AC3 rating greater than or equal to the FLC rating of the connected motor.

Use the main contactor output (13, 14) to control the contactor.

For wiring of the main contactor, see illustration 12.

> ### ⚠ **WARNING** ⚠
>
> **SHOCK HAZARD**
>
> When the soft starter is wired in inside delta configuration, it results in a portion of the motor windings being connected to line power at all times (even when the soft starter is switched off). This situation may cause death or serious personal injury.
>
> - Always install a main contactor or shunt trip circuit breaker when connecting the soft starter in inside delta configuration.

3.9 Circuit Breaker

A shunt trip circuit breaker may be used instead of a main contactor to isolate the motor circuit if a soft starter trips. The shunt trip mechanism must be powered from the supply side of the circuit breaker or from a separate control supply.

3.10 Power Factor Correction

If power factor correction is used, use a dedicated contactor to switch in the capacitors.

To use the VLT® Soft Starter MCD 600 to control power factor correction, connect the PFC contactor to a programmable relay set to Run. When the motor reaches full speed, the relay closes and power factor correction is switched in.
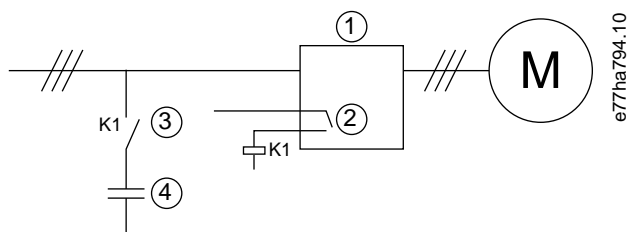
1	Soft starter	2	Programmable output (set=Run)
3	Power factor correction contactor	4	Power factor correction

Illustration 5:   Connection Diagram

⚠ **C A U T I O N** ⚠

EQUIPMENT DAMAGE

Connecting power factor correction capacitors to the output side will damage the soft starter.

-   Always connect power factor correction capacitors to the input side of the soft starter.

3.11   Short-circuit Protection Devices

When designing motor circuit protection schemes, IEC 947-4-1 standard on soft starters and contactors defines 2 types of coordination with respect to soft starters:

•   Type 1 coordination.

•   Type 2 coordination.

3.11.1   Type 1 Coordination

Type 1 coordination requires that, if there is a short-circuit on the output side of a soft starter, the fault must be cleared without risk of injury to personnel and damage to installations. There is no requirement that the soft starter must remain operational after the fault. For the soft starter to become operational again, repair and replacement of parts are requried.

HRC fuses (such as Ferraz/Mersen AJT fuses) can be used for Type 1 coordination according to IEC 60947-4-2 standard.

3.11.2   Type 2 Coordination

Type 2 coordination requires that, if there is a short-circuit on the output side of a soft starter, the fault must be cleared without risk of injury to personnel or damage to the soft starter.

Type 2 coordination has the advantage that after the fault is cleared, authorized personnel can replace the blown fuses and check contactors for any welding. The soft starter will then be operational again.

Semiconductor fuses for Type 2 circuit protection are additional to HRC fuses or MCCBs that form part of the motor branch circuit protection.

> ⚠ **CAUTION** ⚠
>
> **DC BRAKE**
>
> A high brake torque setting can result in peak currents up to motor DOL being drawn while the motor is stopping.
>
> - Ensure that protection fuses installed in the motor branch circuit are selected appropriately.

> ⚠ **CAUTION** ⚠
>
> **NO BRANCH CIRCUIT PROTECTION**
>
> Integral solid state short-circuit protection does not provide branch circuit protection.
>
> - Provide branch circuit protection in accordance with the National Electrical Code and any additional local codes.

3.12 IEC Coordination with Short-circuit Protection Devices

These fuses were selected based on a start current of 300% FLC for 10 s.

Table 8: IEC Fuses

	Nominal rating [A]	SCR I^2t (A^2s)	Type 1 coordination 480 V AC, 65 kA Bussmann NH fuse links	Type 2 coordination 690 V AC, 65 kA Bussmann DIN 43 653
MCD6-0020B	20	1150	40NHG000B	170M3010
MCD6-0042B	42	7200	80NHG000B	170M3013
MCD6-0069B	69	15000	100NHG000B	170M3014
MCD6-0086B	86	80000	160NHG00B	170M3015
MCD6-0129B	129	125000		170M3016
MCD6-0171B	171	320000	250NHG2B	170M3020
MCD6-0244B	244		315NHG2B	170M3021
MCD6-0323B	323	202000	400NHG2B	170M6009
MCD6-0527B	527	781000	630NHG3B	170M6012
MCD6-0579B	579			

3.13 UL Coordination with Short-circuit Protection Devices

3.13.1 Standard Fault Short-circuit Current Ratings

Suitable for use on a circuit capable of delivering not more than the stated level of amperes (symmetrical rms), 600 V AC maximum.

Table 9: Maximum Fuse Rating [A] - Standard Fault Short-Circuit Current

Model	Nominal rating [A]	3 cycle short cct rating @600 V AC [1]
MCD6-0020B	20	5 kA

Model	Nominal rating [A]	3 cycle short cct rating @600 V AC [1]
MCD6-0042B	42	10 kA
MCD6-0069B	69	
MCD6-0086B	86	
MCD6-0129B	129	
MCD6-0171B	171	18 kA
MCD6-0244B	244	
MCD6-0323B	323	
MCD6-0527B	527	30 kA
MCD6-0579B	579	

[1] Suitable for use in a circuit with the prospective current noted, when protected by any listed fuses or listed circuit breakers sized according to the NEC.

3.13.2 High Fault Short-circuit Current Ratings

Table 10: Maximum Fuse Rating [A] - High Fault Short-circuit Current

Model	Nominal rating [A]	Short-circuit rating @480 V AC maximum	Listed fuse rating [A] [1]	Fuse class [1]
MCD6-0020B	20	65 kA	30	Any (J, T, K-1, RK1, RK5)
MCD6-0042B	42		60	
MCD6-0069B	69		80	
MCD6-0086B	86		125	J, T, K-1, RK1
MCD6-0129B	129		150	
MCD6-0171B	171		225	J, T
MCD6-0244B	244		300	
MCD6-0323B	323		450	Any (J, T, K-1, RK1, RK5)
MCD6-0527B	527		600	
MCD6-0579B	579		600	

[1] Suitable for use on a circuit capable of delivering not more than 65000 rms symmetrical amperes, 480 V AC maximum, when protected by fuses of the stated class and rating.

Table 11: Circuit Breakers - High Fault Short-circuit Current

Model	Nominal rating [A]	Breaker 1: Eaton (rating, A) [1]	Breaker 2: GE (rating, A) [1]	Breaker 3: LS (rating, A) [1] [2]
MCD6-0020B	20	HFD3030 (30 A)	SELA36AT0060 (60 A)	UTS150H-xxU-040 (40 A)
MCD6-0042B	42	HFD3060 (60 A)		UTS150H-xxU-060 (60 A)
MCD6-0069B	69	HFD3100 (100 A)	SELA36AT0150 (150 A)	UTS150H-xxU-100 (100 A)
MCD6-0086B	86	HFD3125 (125 A)		UTS150H-xxU-125 (125 A)
MCD6-0129B	129	HFD3150 (150 A)		UTS150H-xxU-150 (150 A)

Model	Nominal rating [A]	Breaker 1: Eaton (rating, A) [1]	Breaker 2: GE (rating, A) [1]	Breaker 3: LS (rating, A) [1][2]
MCD6-0171B	171	HFD3250 (250 A)	SELA36AT0250 (250 A)	UTS150H-xxU-250 (250 A)
MCD6-0244B	244	HFD3300 (300 A)	SELA36AT0400 (400 A)	UTS150H-xxU-300 (300 A)
MCD6-0323B	323	HFD3400 (400 A)	SELA36AT0600 (600 A)	UTS150H-xxU-400 (400 A)
MCD6-0527B	527	HFD3600 (600 A)		UTS150H-xxU-800 (800 A)
MCD6-0579B	579			UTS150H-NG0-800

[1] Suitable for use on a circuit capable of delivering not more than 65000 rms symmetrical amperes, 480 V AC maximum, when protected by circuit breaker models listed in this table.

[2] For LS circuit breakers, xx represents FM, FT, or AT.

3.14 Fuse Selection for Type 2 Coordination

Type 2 coordination is achieved by using semicondictor fuses. These fuses must be able to carry motor start current and have a total clearing I^2t less than the I^2t of the soft starter SCRs.

When selecting semiconductor fuses for VLT® Soft Starter MCD 600, use the I^2t values in table 12.

For further information on selecting semiconductor fuses, contact the local distributor.

Table 12: SCR Values for Semiconductor Fuses

Model	SCR I^2t [A^{2}s]
MCD6-0020B	1150
MCD6-0042B	7200
MCD6-0069B	15000
MCD6-0086B	80000
MCD6-0129B	125000
MCD6-0171B	320000
MCD6-0244B	
MCD6-0323B	202000
MCD6-0527B	781000
MCD6-0579B	

4 Specifications

4.1 Supply

Mains voltage (L1, L2, L3)	
MCD6-xxxxB-T5	200–525 V AC (±10%)
MCD6-xxxxB-T7	380–690 V AC (±10%)
Control voltage (A7, A8, A9)	
MCD6-xxxxB-xx-CV2 (A8, A9)	110–120 V AC (+10%/-15%), 600 mA
MCD6-xxxxB-xx-CV2 (A7, A9)	220–240 V AC (+10%/-15%), 600 mA
MCD6-xxxxB-xx-CV1 (A8, A9)	24 V AC/V DC (±20%), 2.8 A
Mains frequency	50–60 Hz (±5 Hz)
Rated insulation voltage to ground	600 V AC
Rated impulse withstand voltage	6 kV
Form designation	Bypassed or continuous, semiconductor motor starter form 1

4.2 Short-circuit Capability

Coordination with semiconductor fuses	Type 2
Coordination with HRC fuses	Type 1

4.3 Electromagnetic Capability (Compliant with EU Directive 2014/35/EU)

EMC Immunity	IEC 60947-4-2
EMC Emmissions	IEC 60947-4-2 Class B

4.4 Inputs

Input rating	Active 24 V DC, 8 mA approximately
Motor thermistor (TER-05, TER-06)	Trip >3.6 kΩ, reset >1.6 kΩ

4.5 Outputs

Relay outputs	10 A @ 250 V AC resistive, 5 A @ 250 V AC AC15 pf 0.3
Main contactor (13, 14)	Normally open
Relay output A (21, 22, 23)	Changeover
Relay output B (33, 34)	Normally open
Analog output (AO-07, AO-08)	
Maximum load	600 Ω (12 V DC @ 20 mA)
Accuracy	±5%

4.6 Environmental

Operating temperature	-10 to +60 °C (14–140 °F), above 40 °C (104 °F) with derating
Storage temperature	-25 to +60 °C (-13 to +140 °F)
Operating altitude	0–1000 m (0–3280 ft), above 1000 m (3280 ft) with derating
Humidity	5–95% relative humidity
Pollution degree	Pollution degree 3
Vibration	IEC 60068-2-6
Protection	
MCD6-0020B~MCD6-0129B	IP20
MCD6-0171B~MCD6-0579B	IP00

4.7 Heat Dissipation

During start	4.5 W per ampere
During run	
MCD6-0020B~MCD6-0042B	≤ 35 W approximately
MCD6-0069B~MCD6-0129B	≤ 50 W approximately
MCD6-0171B~MCD6-0244B	≤ 120 W approximately
MCD6-0323B~MCD6-0579B	≤ 140 W approximately

4.8 Motor Overload Protection

The default settings of *parameters 1D* to *1F* provide motor overload protection	Class 10, trip current 105% of FLA (full load amperage) or equivalent

4.9 Certification

CE	EN 60947-4-2
UL/C-UL	UL 508
Marine	Lloyds Marine No 1 specification
	ABS
	DNV

4.10 Operational Life (Internal Bypass Contacts)

Expected operational lifetime	100000 operations

5 Installation

5.1 Safety Instructions

See 2.3 Safety Precautions for general safety instructions.

⚠ WARNING ⚠

INDUCED VOLTAGE

Induced voltage from output motor cables that run together can charge equipment capacitors, even with the equipment turned off and locked out. Failure to run output motor cables separately or to use shielded cables could result in death or serious injury.

- Run output motor cables separately.

- Use shielded cables.

⚠ WARNING ⚠

UNINTENDED START

When the soft starter is connected to AC mains, DC supply, or load sharing, the motor can start at any time. Unintended start during programming, service, or repair work can result in death, serious injury or property damage. The motor can start with an external switch, a fieldbus command, an input reference signal from the LCP, or after a cleared fault condition.

- Press [Off/Reset] on the LCP before programming parameters.

- Disconnect the soft starter from the mains.

- Completely wire and assemble the soft starter, motor, and any driven equipment before connecting the soft starter to AC mains, DC supply, or load sharing.

- Fit the power supply to the soft starter with an isolating switch and a circuit-breaking device (for example a power contactor) controllable through an external safety system (for example an emergency stop or a fault detector).

5.2 Command Source

Start and stop the soft starter via the digital inputs, remote LCP, communication network, smart card, or scheduled auto-start/stop. Set up the command source via *Set-up Tools* or via *parameter 1A Command Source*.

If the remote LCP is installed, the [CMD/Menu] key provides shortcut access to the Command Source function in *Set-up Tools*.

5.3   Setting up the Soft Starter

Procedure

1. Mount the soft starter, see 3.6 Physical Installation/Cooling Clearances.

2. Connect control wiring, see 5.4.1 Input Terminals.

3. Apply control voltage to the soft starter.

4. Configure the application (listed in the Quick Set-up):

    A   Press [Menu].

    B   Press [Menu/Store] to open the Quick Set-up menu.

    C   Scroll through the list to find the application.

    D   Press [Menu/Store] to begin the configuration process, see 5.9 Quick Set-up.

5. Configure the application (not listed in the Quick Set-up):

    A   Press [Back] to return to the Menu.

    B   Press [▿] to scroll to the Main Menu and press [Menu/Store].

    C   Scroll to *Motor Details*, press [Menu/Store] twice, and edit *parameter 1B Motor Full Load Current*.

    D   Set *parameter 1B Motor Full Load Current* to match the motor full load current (FLC).

    E   Press [Menu/Store] to save the setting.

6. Press [Back] repeatedly to close the Main Menu.

7. (Optional) Use the built-in simulation tools to check that the control wiring is connected correctly, see 6.5 Run Simulation.

8. Power off the soft starter.

9. Connect the motor cables to the soft starter output terminals 2/T1, 4/T2, 6/T3.

10. Connect mains supply cables to the soft starter input terminals 1/L1, 3/L2, 5/L3, see 5.7 Power Terminations.

→   The soft starter is now ready to control the motor.

5.4   Inputs

⚠ CAUTION ⚠

The control inputs are powered by the soft starter. Do not apply external voltage to the control input terminals.

⚠ NOTICE ⚠

Cables to the control inputs must be segregated from mains voltage and motor cabling.

5.4.1 Input Terminals
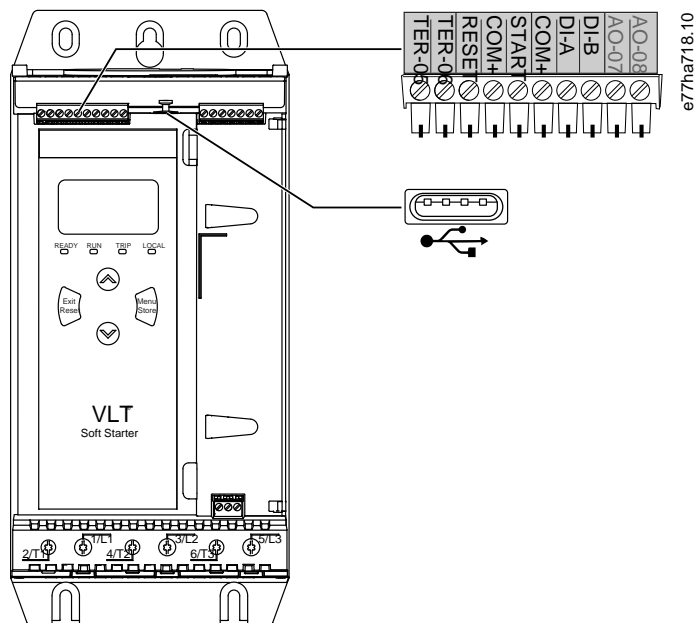
TER-05, TER-06 Motor thermistor input	**RESET, COM+** Reset input
START, COM+ Start/stop input	**DI-A, COM+** Programmable input A (default = Input trip (N/O))
DI-B, COM+ Programmable input B (default = Input trip (N/O))	USB port

Illustration 6: Input Terminals

5.4.2 Motor Thermistor

Motor thermistors can be connected directly to the VLT® Soft Starter MCD 600. The soft starter trips when the resistance of the thermistor circuit exceeds approximately 3.6 kΩ or drops below 20 Ω.

The thermistors must be wired in series. The thermistor circuit should be run in shielded cable and must be electrically isolated from ground and all other power and control circuits.

⚠ N O T I C E ⚠

The thermistor input is disabled by default, but activates automatically when a thermistor is detected. If thermistors have previously been connected to the MCD 600 but are no longer required, use the Thermistor Reset function to disable the thermistor. Thermistor reset is accessed via *Set-up Tools*.

5.4.3 Start/Stop

The VLT® Soft Starter MCD 600 requires 2-wire control.

e77ha721.10
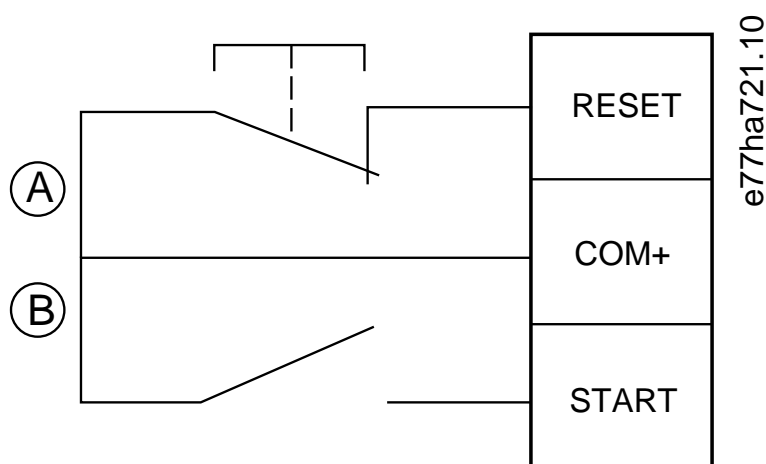
A Reset	**B** Start/stop

Illustration 7: Start/Stop Control Wiring

⚠ C A U T I O N ⚠

ATTEMPTED START

If the start input is closed when control voltage is applied, the soft starter will attempt to start.

- Check that the start/stop input is open before applying control voltage.

⚠ N O T I C E ⚠

The MCD 600 only accpets command from the control inputs if *parameter 1A Command Source* is set to *Digital Input*.

5.4.4 Reset/Starter Disable

The reset input (RESET, COM+) is normally closed by default. The soft starter does not start if the reset input is open. The display then shows *Not ready*.

If the reset opens while the soft starter is running, the soft starter removes power and allows the motor to coast to stop.

> ⚠ **N O T I C E** ⚠
>
> The reset input can be configured for normally open or normally closed operation. Make the selection in *parameter 7I Reset/Enable Logic*.

5.4.5 Programmable Inputs

The programmable inputs (DI-A, COM+ and DI-V, COM+) allow external equipment to control the soft starter. The operation of the programmable inputs is controlled by *parameters 7A* to *7H*.

5.4.6 USB Port

The USB port can be used to upload a configuration file, or download parameter settings and event log information from the soft starter. See 6.7 USB Save & Load for details.

5.5 Outputs

5.5.1 Output Terminals
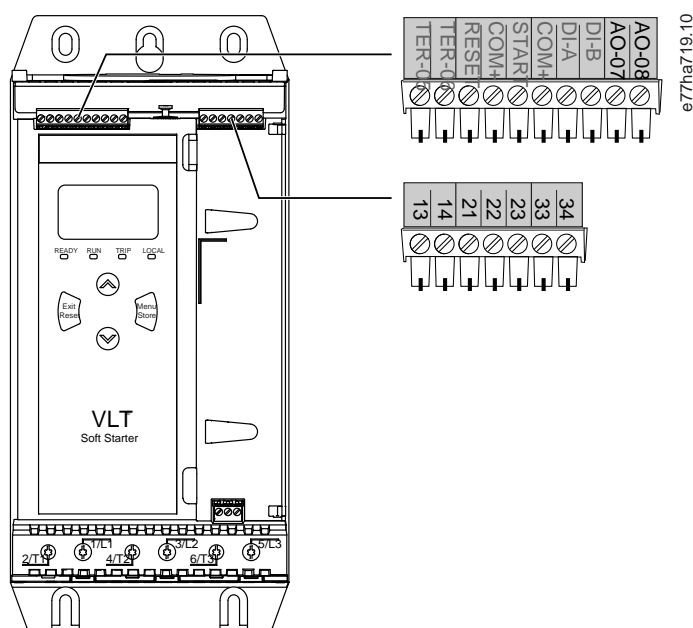
AO-07, AO-08	Analog output	**13, 14**	Main contactor output
21, 22, 23	Relay output A (default = Run)	**33, 34**	Relay output B (default = Run)

Illustration 8:   Output Terminals

5.5.2 Analog Output

The VLT® Soft Starter MCD 600 has an analog output, which can be connected to associated equipment to monitor motor performance. The operation of the analog output is controlled by *parameters 9A* to *9D*.

5.5.3 Main Contactor Output

The main contactor output (13, 14) closes as soon as the soft starter receives a start command and remains closed while the soft starter is controlling the motor (until the motor starts a coast to stop, or until the end of a soft stop). The main contactor output also opens if the soft starter trips.

> ⚠ **NOTICE** ⚠
>
> Some electronic contactor coils are not suitable for direct switching with PCB mount relays. Consult the contactor manufacturer/supplier to confirm suitability.

5.5.4 Programmable Outputs

The programmable outputs (21, 22, 23 and 33, 34) can report the status of the soft starter or can control associated equipment.

The operation of the programmable outputs is controlled by *parameters 8A* to *8F*.

5.6 Control Voltage

5.6.1 Control Voltage Terminals
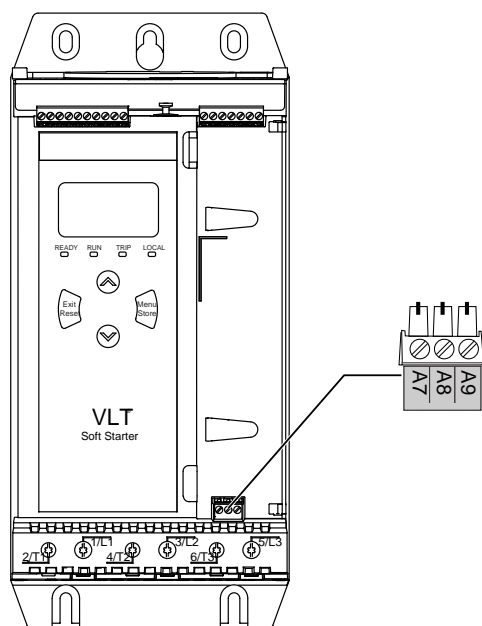
Illustration 9: Control Voltage Terminals

Connect the control supply according to the supply voltage being used.

- MCD6-xxxxB-xx-CV2 (110–120 V AC): A8, A9.
- MCD6-xxxxB-xx-CV2 (220–240 V AC): A7, A9.
- MCD6-xxxxB-xx-CV1 (24 V AC/V DC): A8, A9.

5.6.2 UL Compliant Installation

For MCD6-0171B to MCD6-0579B to be UL compliant, supplementary or branch circuit overcurrent protection must be used on the control circuit supply (A7, A8, A9) in accordance with the electrical code applicable at the installation location.

5.7 Power Terminations

> ⚠ **WARNING** ⚠
>
> **SHOCK HAZARD**
>
> Models MCD6-0171B ~ MCD6-0579B are IP00 and pose a risk of electrical shock if touching the terminals.
>
> - Install a finger guard kit on the soft starter.
> - Install the soft starters inside an enclosure.

The power input and output terminals for VLT® Soft Starter MCD 600 are at the bottom of the unit.

- Models MCD6-0020B~MCD6-0129B use cage clamps.
- Models MCD6-0171B~MCD6-0579B use busbars.

> ⚠ **NOTICE** ⚠
>
> Some units use aluminum busbars. When connecting power terminations, clean the surface contact area thoroughly (using an emery or stainless steel brush) and use an appropriate jointing compound to prevent corrosion.

Use only copper stranded or solid conductors, rated for 75 °C (167 °F).

Table 13: Power Terminations, MCD6-0020B~MCD6-0129B
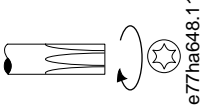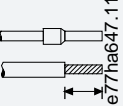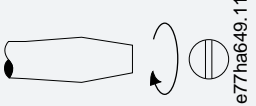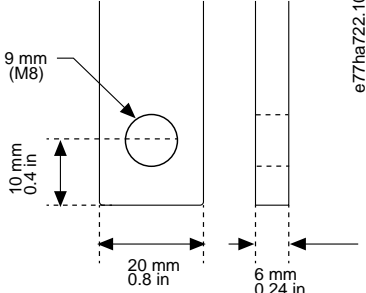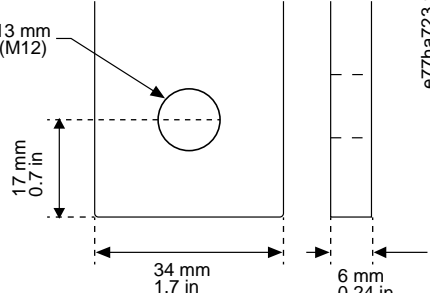
MCD6-0020B~MCD6-0129B			
	Cable size: 6–70 mm^2 (AWG 10–2/0) Torque: 4 (2.9 ft-lb)		Torx T20 x 150
	14 mm (0.55 in)		Flat 7 mm x 150

Table 14: Power Terminations, MCD6-0171B~MCD6-0244B and MCD6-0323B~MCD6-0579B

MCD6-0020B~MCD6-0129B		MCD6-0323B~MCD6-0579B	
	19 Nm (14 ft-lb)		66 Nm (49 ft-lb)

> ⚠ **N O T I C E** ⚠
>
> If the installation requires large diameter cables, it is possible to complete each termination with 2 smaller cables, 1 on each side of the busbar.

5.7.1   UL Compliant Installation

For models MCD6-0171B to MCD6-0579B to be UL compliant, use the recommended pressure terminal/connector.

Table 15: Recommended Lugs

Model	Recommended lugs part number
MCD6-0171B	OPHD 185-10
MCD6-0229B	
MCD6-0352B	OPHD 150-12
MCD6-0410B	
MCD6-0579B	OPHD 240-12

5.7.2   Motor Connection

The VLT® Soft Starter MCD 600 can be connected to the motor in-line or inside delta (also called 3-wire and 6-wire connection). When connecting in inside delta, enter the FLC for *parameter 1B Motor Full Load Current*. The MCD 600 automatically detects whether the motor is connected in-line or inside delta and calculates the correct inside delta current level.

> ⚠ **N O T I C E** ⚠
>
> If the soft starter is not detecting the motor connection correctly, use *parameter 20F Motor Connection*.

5.7.2.1 In-line Installation
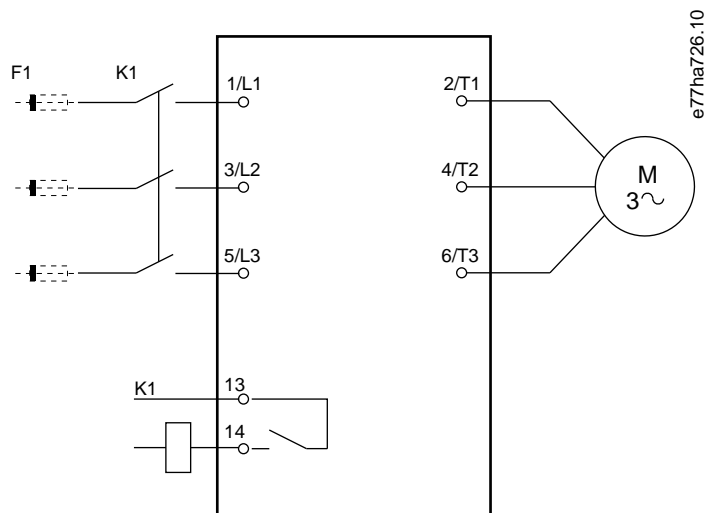
e77ha726.10

K1	Main contactor (strongly recommended)	F1	Fuses or circuit breaker (optional)
13, 14	Main contactor output		

Illustration 10:   Wiring of an In-line Installation

5.7.2.2 Inside Delta Installation
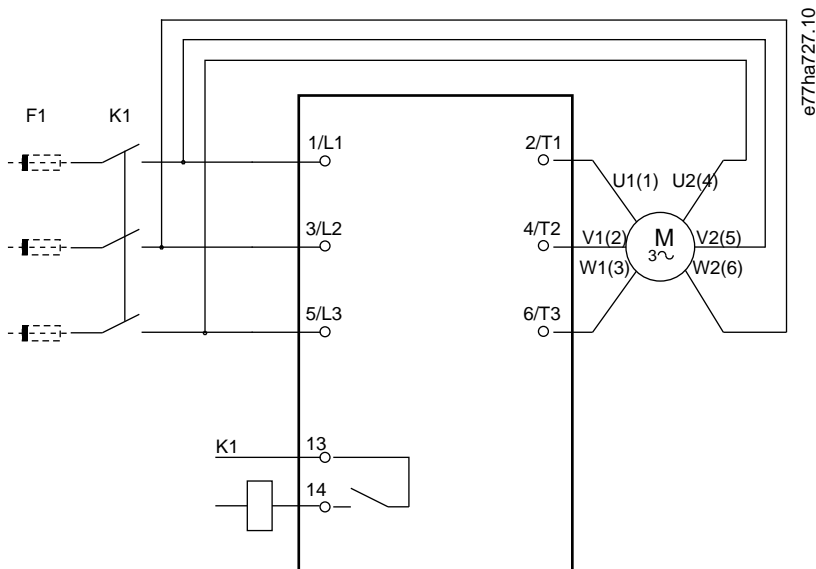
e77ha727.10

K1	Main contactor	F1	Fuses or circuit breaker (optional)
13, 14	Main contactor output		

Illustration 11:   Wiring of an Inside Delta Installation

5.8 Typical Installation

The VLT® Soft Starter MCD 600 is installed with a main contactor (AC3-rated). Control voltage must be supplied from the input side of the contactor.

The main contactor is controlled by the main contactor output (13, 14).
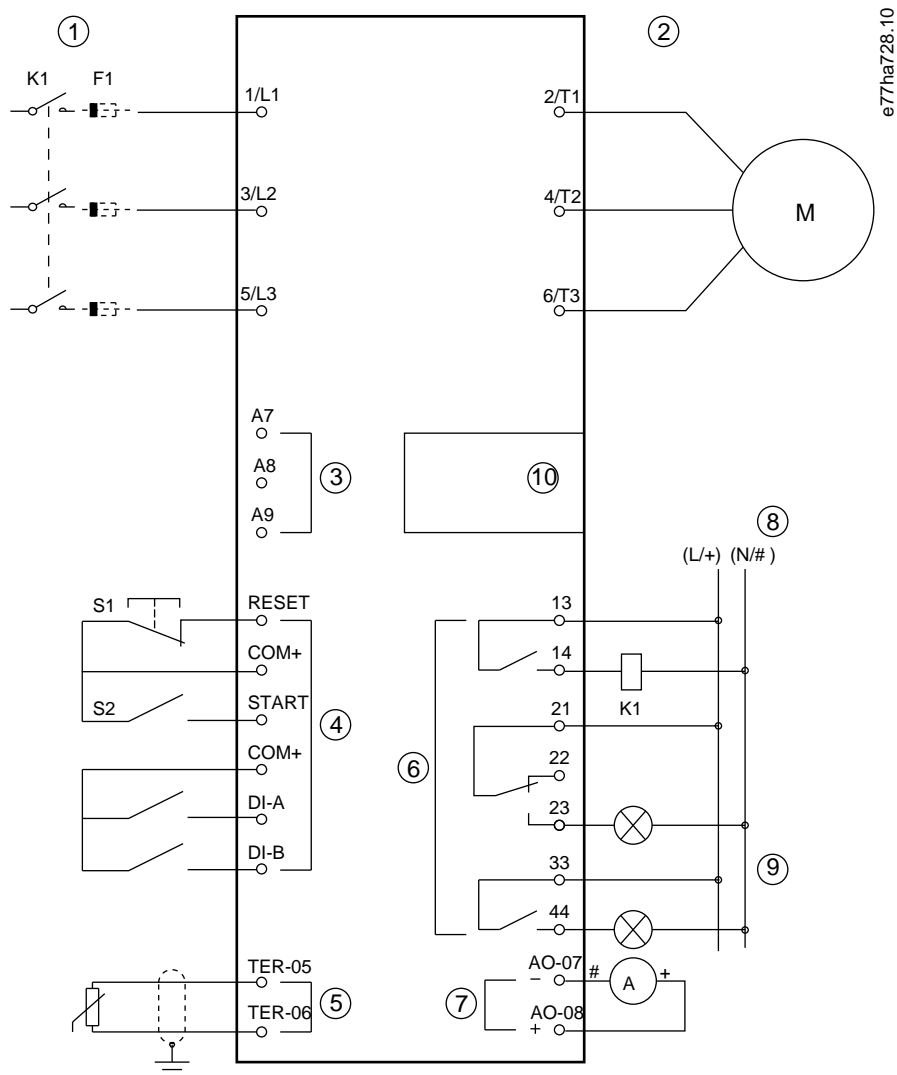
1	Three-phase supply	**2**	Motor
3	Control voltage (soft starter)	**4**	Digital inputs
5	Motor thermistor input	**6**	Relay outputs
7	Analog output	**8**	Control voltage (external equipment)
9	Pilot lamps	**10**	Communications/smart card expansion port
K1	Main contactor	**F1**	Semiconductor fuses
RESET, COM+ (S1)	Reset	**START, COM+ (S2)**	Start/stop

DI-A, COM+ Programmable input A (default = Input trip (N/O))		**DI-B, COM+** Programmable input B (default = Input trip (N/O))		
TER-05, TER-06 Motor thermistor input		**13, 14** Main contactor output		
21, 22, 23 Relay output A (default = Run)		**33, 34** Relay output B (default = Run)		
AO-07, AO-08 Analog output				

Illustration 12: Installation Example

5.9 Quick Set-up

The Quick Set-up makes it easy to configure the soft starter for common applications. The VLT® Soft Starter MCD 600 guides through the most common installation parameters and suggests a typical setting for the application. Adjust each parameter to suit the exact requirements.

All other parameters remain at default values. To change other parameter values or review default settings, use the Main Menu (see 10.4 Parameter List for details).

Always set *parameter 1B Motor Full Load Current* to match the motor nameplate FLC.

Table 16: Suggested Settings for Common Applications

Application	Start mode	Start ramp time [s]	Initial current [%]	Current limit [%]	Adaptive start profile	Stop mode	Stop time [s]	Adaptive stop profile
Pump centrifugal	Adaptive control	10	200	500	Early acceleration	Adaptive control	15	Late deceleration
Pump bore	Adaptive control	3	200	500	Early acceleration	Adaptive control	3	Late deceleration
Pump hydraulic	Constant current	2	200	350	n/a	Coast to stop	n/a	n/a
Fan damped	Constant current	2	200	350	n/a	Coast to stop	n/a	n/a
Fan undamped	Constant current	2	200	450	n/a	Coast to stop	n/a	n/a
Compressor screw	Constant current	2	200	400	n/a	Coast to stop	n/a	n/a
Compressor recip	Constant current	2	200	450	n/a	Coast to stop	n/a	n/a
Conveyor	Constant current	5	200	450	n/a	Coast to stop	n/a	n/a
Bow thruster	Constant current	5	100	400	n/a	Coast to stop	n/a	n/a
Bandsaw	Constant current	2	200	450	n/a	Coast to stop	n/a	n/a

⚠ **NOTICE** ⚠

The adaptive start and stop profile settings only apply when using adaptive control. The settings are ignored for all other start and stop modes.

6 Set-up Tools

6.1 Introduction

Set-up Tools includes options to load or save parameters to a backup file, set the soft starter's network address, check the status of the inputs and outputs, reset the thermal models, or test operation using the *Run Simulation*.

To access *Set-up Tools*, press [Menu] to open the Main Menu and then select *Set-up Tools*.

6.2 Setting Date and Time

Procedure

1. Press [Menu] to open the menu.
2. Select *Set-up Tools*.
3. Scroll to *Set Date & Time*.
4. Press [Menu/Store] to enter edit mode.
5. Press [Menu/Store] and [Back] to select which part of the date or time to edit.
6. Press [⌃] and [⌄] to change the values.
7. Press [Menu/Store] after the last digit to save the setting.

→ When the action has been completed, the screen briefly shows a confirmation message, then returns to the previous menu level.

6.3 Command Source

Start and stop the soft starter via the digital inputs, remote LCP, communication network, smart card, or scheduled auto-start/stop. Set up the command source via *Set-up Tools* or via *parameter 1A Command Source*.

If the remote LCP is installed, the [CMD/Menu] key provides shortcut access to the Command Source function in *Set-up Tools*.

6.4 Commissioning

Commissioning allows starting and stopping the soft starter via the LCP. Press [⌃] [⌄] to select a function, then press [Menu/Store] to send the selected command to the soft starter. The available functions are:

- Quick stop (coast to stop)/reset.
- Start.
- Stop.

6.5 Run Simulation

Context:

The Run Simulation simulates a motor starting, running, and stopping to confirm that the soft starter and associated equipment have been installed correctly.

⚠ **N O T I C E** ⚠

Disconnect the soft starter from mains voltage.

The simulation is only available when the soft starter is in ready state.

Procedure

1. Press [Menu] and select *Set-up Tools*.

2. Scroll to *Run Simulation* and press [Menu/Store].
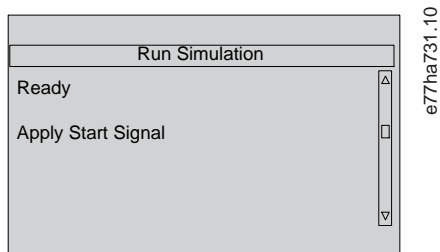
3. Apply a start command from the selected command source.

   → The soft starter simulates its prestart checks and closes the main contactor relay. The Run LED flashes.

   ⚠ **N O T I C E** ⚠

   If mains voltage is connected, an error message is shown.

4. Press [Menu/Store].

   → The soft starter simulates starting. The Run LED flashes.

5. Press Menu/Store.

   → The soft starter simulates running.

6. Apply a stop command from the selected command source.

   → The soft starter simulates stopping. The Run LED flashes.

7. Press [Menu/Store].

   → The Ready LED flashes and the main contactor relay opens.

8. Press [Menu/Store].

   → The soft starter activates then deactivates each programmable output.

6.6 Load/Save Settings

Context:

The *Load/Save Settings* allows:

- Resetting the soft starter parameters to default values.
- Load parameter settings from an internal file.
- Save the current parameter settings to an internal file.

The internal file contains default values until a user file is saved.

Procedure

1. Press [Menu] and select *Set-up Tools*.

2. Scroll to *Load/Save Settings* and press [Menu/Store].
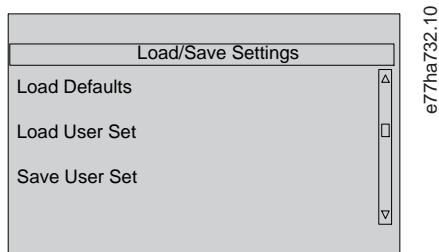
3. Scroll to the required function and press [Menu/Store].

4. At the confirmation prompt, select *Yes* to confirm or *No* to cancel.

5. Press [Menu/Store] to proceed.

→ When the action has been completed, the screen birefly shows a confirmation message, then returns to the previous menu level.

6.7 USB Save & Load

The *USB Save & Load* menu allows:

- Saving parameter settings and all event log entries to an external file (CSV format).
- Saving parameter settings to an external file (proprietary format).
- Loading parameter settings from a previously saved external file.
- Loading custom messages to show on the LCP when a programmable input is active.

⚠ NOTICE ⚠

The VLT® Soft Starter MCD 600 supports FAT32 file systems. The MCD 600 USB functions are not compatible with NTFS file systems.

6.7.1 Save and Load Procedure

Procedure

1. Connect the external drive to the USB port.

2. Press [Menu] and select *Set-up Tools*.

3. Scroll to *USB Save & Load* and press [Menu/Store].
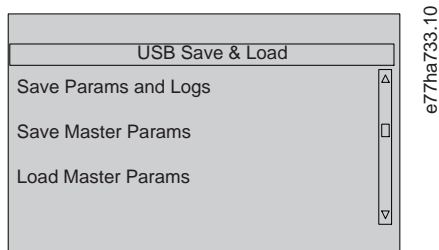
4. Scroll to the required function and press [Menu/Store].

5. At the confirmation prompt, select *Yes* to confirm or *No* to cancel.

6. Press [Menu/Store] to proceed.

→   When the action has been completed, the screen briefly shows a confirmation message, then returns to the previous menu level.

6.7.2 File Locations and Formats

Save parameters and logs

The soft starter creates a directory at the top level of the USB drive, named with the soft starter serial number. The event log and parameter settings are saved as individual CSV files, and the soft starter's software and system information are saved to a text file.

Save master parameters

The soft starter creates a file called Master_Parameters.par and stores it on the USB drive.

Load master parameters

The soft starter loads the file Master_Parameters.par from the top level of the USB drive. The files can be created or edited using VLT® Motion Control Tool MCT 10.

Load custom message

The soft starter loads the files Custom_Message_A.txt and Custom_Message_B.txt from the top level of the USB drive.
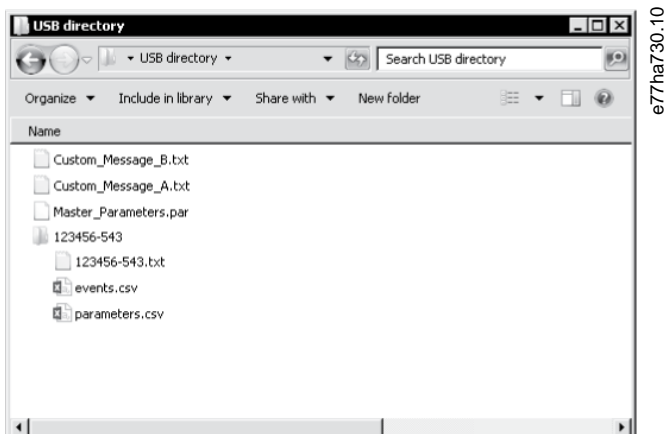
Illustration 13:   USB Directory

6.8 Auto-start/Stop

Context:

The soft starter can be configured to automatically start and/or stop the motor at a particular time, or run it in cycles of a specified duration.

The *Auto-Start/Stop* function in *Set-up Tools* gives quick access to the auto-start/stop parameters.

Procedure

1. Press [Menu] and select *Set-up Tools*.

2. Scroll to *Auto-Start/Stop* and press [Menu/Store].
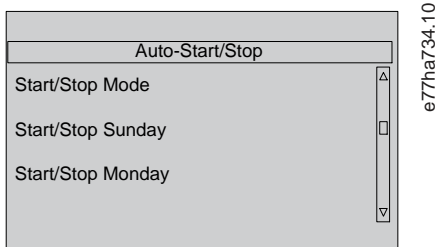
3. Scroll to the desired function and press [Menu/Store].

4. Adjust the settings as required:

    A   Press [Menu/Store] and [Back] to select which information to edit.

    B   Press [△] [▽] to change the value.

    Press [Menu/Store] to save changes. The soft starter confirms the changes.

    Press [Back] to cancel the changes.

6.9 Network Address

To use the VLT® Soft Starter MCD 600 on an Ethernet network, separate addresses must be configured for:

- IP address.
- Gateway address.
- Subnet mask.

6.9.1 Setting a Network Address

Procedure

1. Press [Menu] and select *Set-up Tools*.

2. Scroll to *Network Address* and press [Menu/Store].

3. Scroll to the required function and press [Menu/Store].

Set IP Address

192.168.000.002
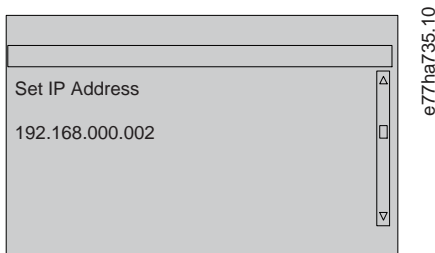
4. The 1st digit of the address will be highlighted.

5. Press [Back] and [Menu/Store] to select which digit to alter.

6. Press [∆] [∇] to change the value.

7. Press [Menu/Store] after the last digit to save the setting.

→ When the action has completed, the screen briefly shows a confirmation message, then returns to the previous menu level.

⚠ **N O T I C E** ⚠

The network address can also be set by using *parameters 12H* to *12S*.

⚠ **N O T I C E** ⚠

To configure the soft starter for use with other communication protocols, use *parameters 12A* to *12G*.

6.10 Digital I/O State

Digital I/O State

Inputs: 0100

Outputs: 100
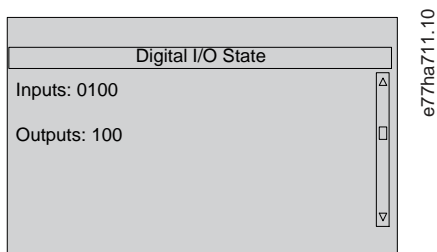
Illustration 14:   Digital I/O Status Screen
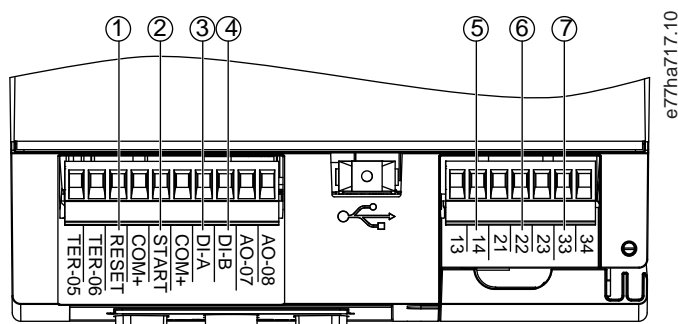
1	RESET, COM+: Reset input	**2**	START, COM+: Start/stop input
3	DI-A, COM+: Programmable input A	**4**	DI-B, COM+: Programmable input B
5	13, 14: Main contactor output	**6**	21, 22, 23: Relay output A
7	33, 34: Relay output B		

Illustration 15:   Location of Digital I/Os

6.11 Analog I/O State

The topline of the screen shows the state of the motor thermistor input. The bottom line of the screen shows the value of the analog output.
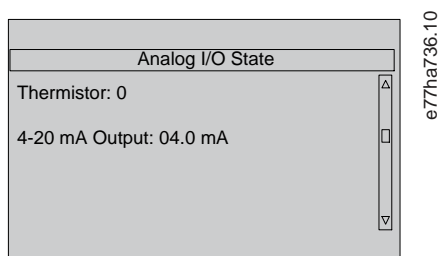
Illustration 16:   Analog I/O Status Screen

Thermistor input

S	Short
H	Hot
C	Cold
O	Open

6.12 Serial Number & Rating

The top line of the screen shows the product name.

The middle line shows the unit's serial number.

The bottom line of the screen shows the model number.
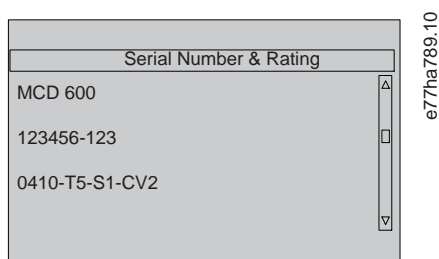
Illustration 17:   Serial Number & Rating Screen

6.13   Software Versions

The software version screen reports the version of each software component of the soft starter:

- User interface
- Motor control
- Remote LCP (if connected)
- Parameter list
- Bootloader
- Expansion card (if fitted)

⚠ N O T I C E ⚠

Updated software, including alternative languages, can be loaded into the soft starter via the USB port if required. Contact the local supplier for further information.

6.14   Thermistor Reset

The thermistor input is disabled by default, but activates automatically when a thermistor is detected. If themistors have previously been connected to the soft starter but are no longer required, use the thermistor reset function to disable the thermistor.

6.15   Reset Thermal Model

The thermal modeling software in the soft starter constantly monitors the motor performance. This allows the soft starter to calculate the motor temperature and ability to start successfully at any time.

The thermal model can be reset if required.

⚠ N O T I C E ⚠

REDUCED MOTOR LIFETIME

Resetting the motor thermal model compromises thermal model protection and may compromise motor life.

- ‒ Only reset the thermal model in an emergency.

7 Logs

7.1 Introduction

The Logs Menu provides information on events, trips, and soft starter performance.

To access the Logs Menu on the local LCP, press [Menu] and select *Logs*. On the remote LCP, press [Logs].

7.2 Event Log

The Event Log stores details of the most recent trips, warnings, and operations (including starts, stops, and configuration changes).

Event 1 is the most recent and event 384 is the oldest stored event.

> ⚠ **N O T I C E** ⚠
>
> The Event Log can be exported to an external file for analysis away from the soft starter.

See 6.7.2 File Locations and Formats.

7.3 Counters

The counters store statistics on the soft starter operation:

- Hours run (lifetime and since counter was last reset).
- Number of starts (lifetime and since counter was last reset).
- Number of times the thermal model has been reset.

7.3.1 Viewing the Counters

Procedure

1. Open the *Logs*, see 7.1 Introduction.
2. Scroll to *Counters* and press [Menu/Store].
3. Press [▵] and [▿] to scroll through the counters.
4. Press [Menu/Store] to view details.
5. To reset a counter, press [Menu/Store] then press [▵] and [▿] to select *Reset*/*Do Not Reset*.
6. Press [Store] to confirm the action.
7. Press [Menu/Store] to close the counter and return to *Logs*.

8 LCP and Feedback

8.1 The LCP

Illustration 18: Local LCP

1	Four-line display for status and programming details.				2	Status LEDs.
3	Menu navigation keys:	Back: Exit the menu or parameter, or cancel a parameter change. This key also resets a trip.	Menu/Store: Enter a menu or parameter, or save a parameter change.	Arrows: Scroll to the next or previous menu or parameter, change the setting of the current parameter, or scroll through the status screens.		

e77ha716.10

1	Four-line display for status and programming details.		

3	Menu navigation keys:	Back: Exit the menu or parameter, or cancel a parameter change.	Menu/Store: Enter a menu or parameter, or save a parameter change.	Arrow keys: Scroll to the next or previous menu or parameter, change the setting of the current parameter, or scroll through the status screens.
5	Local control keys.			

2	Status LEDs.			
4	Shortcut to the command source menu in *Set-up Tools*.			
6	Shortcut keys for quick access to common tasks:	Logs: Open the Logs Menu.	Graph: Select which graph to view, or pause/restart the graph (hold longer than 0.5 s).	Tools: Open the *Set-up Tools*.

Illustration 19:   Remote LCP

8.2 Remote LCP

The remote LCP can be used to control the soft starter if *parameter 1A Command Source* is set to *Remote Keypad*.

- If the remote LCP is not selected as the command source, [Start], [Stop], and [Reset] have no effect.
- The menu navigation keys and display on the remote LCP are always active.
- If a key is pressed on the soft starter remote LCP, the display on the remote LCP updates to match.

> ⚠ **N O T I C E** ⚠
>
> The remote LCP can be safely connected or removed while the soft starter is running. It is not necessay to remove mains or control voltage.

> ⚠ **N O T I C E** ⚠
>
> If *parameter 1A Command Source* is set to *Remote Keypad*, removing the remote LCP causes a trip.

8.3 Adjusting the Display Contrast

Context:

> ⚠ **N O T I C E** ⚠
>
> The local and remote LCPs can be adjusted independently.

1. Press and hold [Back].

2. Press [⌃] to lighten the display, or press [⌄] to darken the display.

8.4 Soft Starter Status LEDs
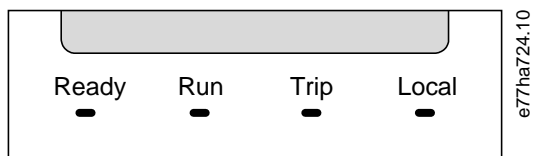
Illustration 20:   Status LEDs

Table 17: LED Descriptions

LED name	On	Flashing
Ready	The motor is stopped and the soft starter is ready to start.	The motor is stopped and the soft starter is not ready to start: • Waiting for the restart delay (*parameter 5P Restart Delay*). • The thermal models indicate that the soft starter and/or motor are too hot to start safely. • The reset input (RESET, COM+) is open.
Run	The motor is in run state (receiving full voltage).	The motor is starting or stopping.
Trip	The soft starter has tripped.	The soft starter is in warning state.
Local	The soft starter is controlled via a remote LCP.	–

If all LEDs are off, the soft starter is not receiving control voltage.

8.5 Displays

8.5.1 Soft Starter Information

At power-up, the soft starter information screen shows details of the soft starter rating, software versions, and serial number.
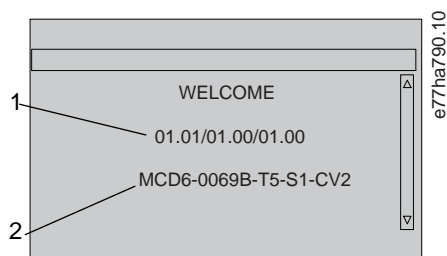
1	Software versions: User interface, motor control, remote LCP	2	Model code: Current rating, mains voltage, frame size, control voltage (remote LCP software version is only shown when a remote LCP is connected)

Illustration 21: Welcome Screen

8.5.2 Configurable Feedback Screens

Select which information to show on the display. To switch between the 2 configurable screens, press [▲] and [▼].
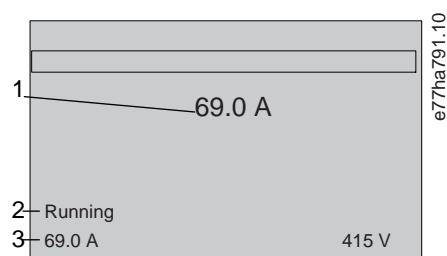
1	Motor running current	2	Soft starter status
3	*Parameter 10H User Parameter 1* and *parameter 10I User Parameter 2*		

Illustration 22: Soft Starter Status Screen
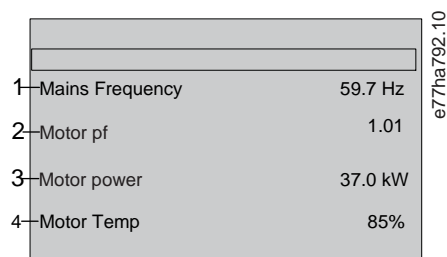
1	*Parameter 10J User Parameter 3* (default: Mains frequency)	2	*Parameter 10K User Parameter 4* (default: Power factor)

3	*Parameter 10L User Parameter 5* (default: Motor running power)	**4**	*Parameter 10M User Parameter 6* (default: Motor temperature)

Illustration 23: User-configurable Screen

8.5.3 Operating Feedback Screens

The operating feedback screens show the motor running current on the top half of the screen. To select which information is shown on the lower half, press [ᴧ] and [ᴠ].

• Real-time line current on each phase.

• Last start information.

• Date and time.
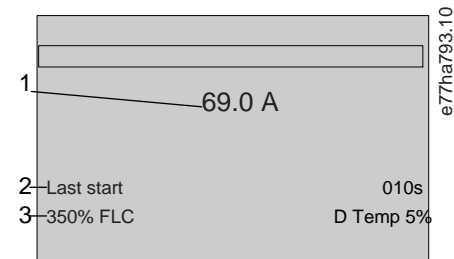
1	Motor running current	**2**	Start duration (seconds)
3	Maximum start current drawn (as a percentage of motor full load current)/calculatedrise in motor temperature		

Illustration 24: Operating Feedback Screens

8.5.4 Performance Graph

The performance graph provides a real-time display of operating performance. Use *parameters 10B* to *10E* to format the graph.

The display on the main LCP shows information for motor current.
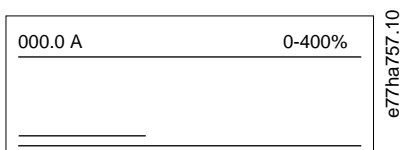
If a remote LCP is connected, press [Graph] to change the graph data. The graph can show:

• Motor current.

• Motor temperature.

• Motor pf.

• Analog input data from the smart card (if installed).

9 Operation

9.1 Start, Stop, and Reset Commands

The VLT® Soft Starter MCD 600 can be started and stopped via the digital inputs, remote LCP, communication network, smart card, or scheduled auto-start/stop. The command source can be set via the *Set-up Tools*, or using *parameter 1A Command Source*.

- The MCD 600 only accepts start and reset commands from the designated command source.
- The MCD 600 accepts stop commands from the designated command source, but can be forced to stop by opening the reset input, or by opening the start/stop input during an auto-start/stop cycle.
- The programmable input can be used to override the selected command source (see *parameter 7A Input A Function*).

9.2 Command Override

The programmable input (DI-A, COM+) can be used to override the command source for situations where the normal control mechanism has been lost. Set *parameter 7A Input A Function* to the alternative control source (for example *Command Override: Keypad*).

While the input is active, the soft starter only accepts commands from the selected override source. To restore control to the command source selected in *parameter 1A Command Source*, reopen the input.

9.3 Auto-start/Stop

The soft starter can be configured to automatically start and/or stop the motor at a particular time, or run it in cycles of a specified duration.

> ⚠ **N O T I C E** ⚠
>
> Start delay, restart delay, and auto-reset delay all apply to auto-start operation.

9.3.1 Clock Mode

The soft starter can start and/or stop the motor once per day.

For clock mode to operate:

- *Parameter 4A Auto-Start/Stop Mode* must be set to *Enable*.
- *Parameter 1A Command Source* must be set to *Clock*.
- The reset input must be closed.
- The start input (START, COM+) must be active. This allows the soft starter to be stopped via the digital inputs in an emergency.

Clock mode operation is controlled by *parameters 4D* to *4X*.

9.3.2 Timer Mode

The soft starter can automatically stop the motor after a specified run time, then restart it after a specified off (stopped) time. The soft starter repeats the cycle while the start signal remains active.

For timer mode to operate:

- *Parameter 4A Auto-Start/Stop Mode* must be set to *Enable*.
- *Parameter 1A Command Source* must be set to *Timer*.
- The reset input must be closed.
- The first start must be commanded by a start signal.

Timer mode operation is controlled by *parameters 4B* to *4C*.

9.4 PowerThrough

PowerThrough allows the soft starter to control the motor even if the soft starter is damaged on 1 phase. The VLT® Soft Starter MCD 600 uses 2 phase control techniques to soft start and soft stop the motor.

> ⚠ **N O T I C E** ⚠
>
> The soft starter trips on Lx-Tx Shorted on the first start attempts after control power is applied. PowerThrough does not operate if control power is cycled between starts.

- PowerThrough is only available with in-line installations. If the soft starter is installed inside delta, PowerThrough will not operate.
- PowerThrough remains active until *3-Phase Control Only* is reselected. While operating in PowerThrough, the trip LED flashes and the display indicates *2 Phase - Damaged SCR*.
- PowerThrough operation does not support adaptive control soft starting or soft stopping. In PowerThrough, the soft starter automatically selects constant current soft starting and timed voltage ramp soft stopping. If PowerThrough is enabled, *Parameters 2C* and *2D* must be set appropriately.

> ⚠ **N O T I C E** ⚠
>
> PowerThrough uses a 2-phase soft start technology and additional care is required when sizing circuit breakers and protection. Contact the local supplier for assistance.

9.5 Emergency Mode

Emergency mode allows the soft starter to run the motor and ignore trip conditions.

Emergency mode is controlled via a programmable input (input A DI-A, COM+ or input B DI-B, COM+) and *parameter 7A Input A Function/parameter 7E Input B Function* must be set to *Emergency Mode*. A closed circuit across DI-A, COM+ activates emergency mode. When the soft starter receives a start command, it continues to run until a stop command is received, ignoring all trips and warnings.

Emergency mode can be used in conjunction with any command source.

> ⚠ **N O T I C E** ⚠
>
> Although emergency mode operation satisfies the functionality requirements of fire mode, Danfoss does not recommend its use in situations that require testing and/or compliance with specific standards as it is not certified.

> ⚠ **N O T I C E** ⚠
>
> **REDUCED EQUIPMENT LIFETIME**
>
> Continued use of emergency mode is not recommended. Emergency mode may compromise the soft starter and/or motor life as all protections and trips are disabled. Using the soft starter in emergency mode voids the product warranty.
>
> - Do not run the soft starter in emergency mode continuously.

9.6 Auxiliary Trip

An external trip circuit (such as a low pressure alarm switch for a pumping system) can be used to trip the soft starter and stop the motor. The external circuit is connected to a programmable input (input A DI-A, COM+ or input B DI-B, COM+). To control the behavior of the trip, set the following parameters:

- *Parameter 7A Input A Function*: Select *Input Trip (N/O)*.

- *Parameter 7B Input A Trip*: Set as required. For example, *Run Only* limits the input trip to when the soft starter is running only.

- *Parameter 7C Input A Trip Delay*: Sets a delay between the input activating and the soft starter tripping.

- *Parameter 7D Input A Initial Delay*: Sets a delay before the soft starter monitors the state of the input after the start signal. For example, a delay may be requried to allow time for pipeline pressure to build up.

- *Parameter 7J Input A Name*: Select a name, for example *Input A Trip* (optional).

9.7 Typical Control Methods

The requirements for an application differ between each installation, but the methods listed below are often a good starting point for common applications.

Table 18: Typical Control Methods

Application	Start mode	Start ramp time [s]	Initial current (%FLC)	Current limit (%FLC)	Stop mode	Stop time [s]
Bow thruster	Constant current	5	100	400	Coast to stop	n/a
Centrifuge (separator)	Constant current	1	200	450	Coast to stop	n/a
Chipper	Constant current	1	200	450	Coast to stop	n/a
Compressor - reciprocating - loaded	Constant current	1	200	450	Coast to stop	n/a
Compressor - reciprocating - unloaded	Constant current	1	200	400	Coast to stop	n/a
Compressor - screw - loaded	Constant current	1	200	400	Coast to stop	n/a
Compressor - screw -. unloaded	Constant current	1	200	350	Coast to stop	n/a
Conveyor - horizontal	Constant current	5	200	400	TVR soft stop	10
Conveyor - inclined	Constant current	2	200	450	Coast to stop	n/a
Conveyor - vertical (bucket)	Constant current	2	200	450	Coast to stop	n/a

Application	Start mode	Start ramp time [s]	Initial current (%FLC)	Current limit (%FLC)	Stop mode	Stop time [s]
Crusher - cone	Constant current	1	200	350	Coast to stop	n/a
Crusher - jaw	Constant current	1	200	450	Coast to stop	n/a
Crusher - rotary	Constant current	1	200	400	Coast to stop	n/a
Debarker	Constant current	1	200	350	Coast to stop	n/a
Fan - axial (damped)	Constant current	1	200	350	Coast to stop	n/a
Fan - axial (undamped)	Constant current	1	200	450	Coast to stop	n/a
Fan - centrifugal (damped)	Constant current	1	200	350	Coast to stop	n/a
Fan - centrifugal (undamped)	Constant current	1	200	450	Coast to stop	n/a
Fan - high pressure	Constant current	1	200	450	Coast to stop	n/a
Mill - ball	Constant current	1	200	450	Coast to stop	n/a
Mill - hammer	Constant current	1	200	450	Coast to stop	n/a
Pump - bore	Adaptive control (early acceleration)	3	n/a	500	Adaptive control (late deceleration)	3
Pump - centrifugal	Adaptive control (early acceleration)	10	n/a	500	Adaptive control (late deceleration)	15
Pump - hydraulic	Constant current	2	200	350	Coast to stop	n/a
Pump - positive displacement	Adaptive control (constant acceleration)	10	n/a	400	Adaptive control (constant deceleration)	10
Pump - submersible	Adaptive control (early acceleration)	5	n/a	500	Adaptive control (late deceleration)	5
Saw - bandsaw	Constant current	1	200	450	Coast to stop	n/a
Saw - circular	Constant current	1	200	350	Coast to stop	n/a
Shredder	Constant current	1	200	450	Coast to stop	n/a

9.8 Soft Start Methods

9.8.1 Constant Current

Constant current is the traditional form of soft starting, which raises the current from 0 to a specified level and keeps the current stable at that level until the motor has accelerated.

Constant current starting is ideal for applications where the start current must be kept below a particular level.
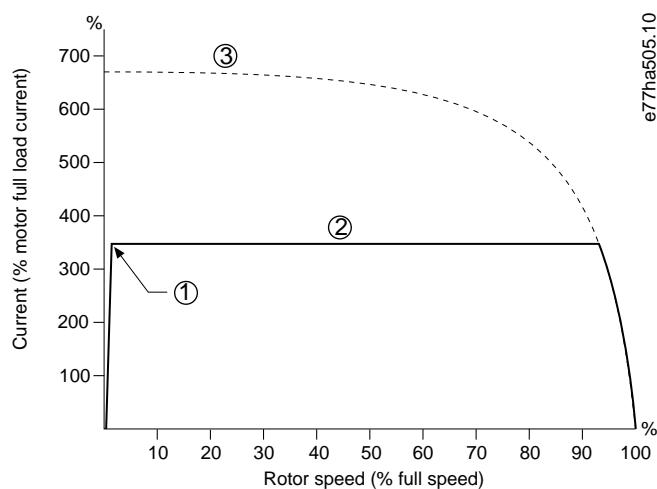
1	Initial current (set in *parameter 2C Initial Current*)	**2**	Current limit (set in *parameter 2D Current Limit*)
3	Full voltage current		

Illustration 26:   Example of Constant Current

9.8.2 Constant Current with Current Ramp

Current ramp soft starting raises the current from a specified starting level (1) to a maximum limit (3) over an extended period of time (2).

Current ramp starting can be useful for applications where:

- The load can vary between starts (for example a conveyor which may start loaded or unloaded). Set *parameter 2C Initial Current* to a level that will start the motor with a light load and set *parameter 2D Current Limit* to a level that will start the motor with a heavy load.
- The load breaks away easily, but starting time needs to be extended (for example a centrifugal pump where pipeline pressure needs to build up slowly).
- The electricity supply is limited (for example a generator set), and a slower application of load will allow greater time for the supply to respond.
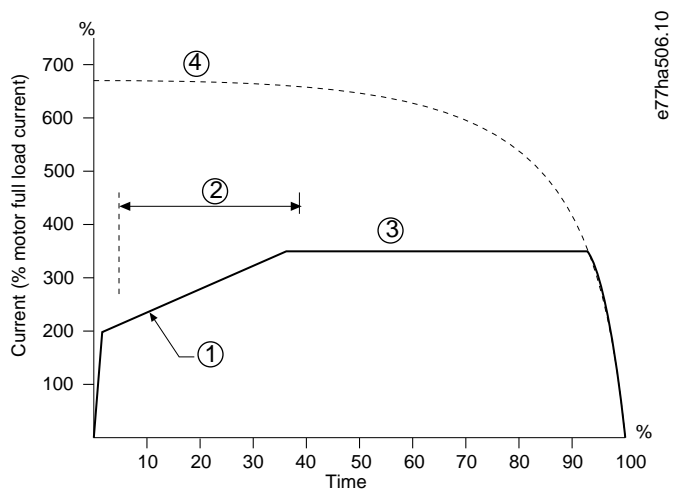
1	*Parameter 2C Initial Current*	2	*Parameter 2B Start Ramp Time*
3	*Parameter 2D Current Limit*	4	Full voltage current

Illustration 27: Example of Current Ramp Soft Starting

9.8.3 Adaptive Control for Starting

In an adaptive control soft start, the soft starter adjusts the current in order to start the motor within a specified time and using a selected acceleration profile.

> ⚠ **N O T I C E** ⚠
>
> The soft starter applies the current limit on all soft starts, including adaptive control. If the current limit is too low or the start ramp time (set in *parameter 2B Start Ramp Time*) is too short, the motor may not start successfully.
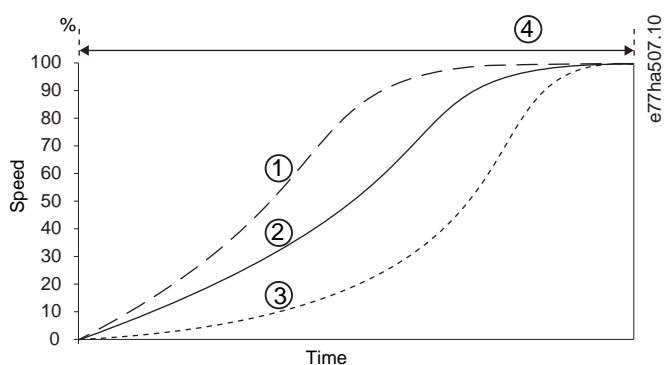
1	Early acceleration	2	Constant acceleration
3	Late acceleration	4	*Parameter 2B Start Ramp Time*

Illustration 28: Example of Adaptive Control Start (Parameter 2E Adaptive Start Profile)

9.8.3.1 Fine-tuning Adaptive Control

If the motor does not start or stop smoothly, adjust *parameter 2L Adaptive Control Gain*. The gain setting determines how much the soft starter adjusts future adaptive control starts and stops, based on information from the previous start. The gain setting affects both starting and stopping performance.

- If the motor accelerates or decelerates too quickly at the end of a start or stop, increase the gain setting by 5–10%.

- If the motor speed fluctuates during starting or stopping, decrease the gain setting slightly.

> ⚠ **N O T I C E** ⚠
>
> The soft starter tunes adaptive control to match the motor. Changing the following parameters resets adaptive control and the first start/stop cycle uses constant current start/timed voltage ramp stop: *Parameter 1B Motor Full Load Current*, *parameter 2D Current Limit*, and *parameter 2L Adaptive Gain*.

9.8.4 Constant Current with Kickstart

Kickstart provides a short boost of extra torque at the beginning of a start, and can be used in conjunction with current ramp or constant current starting.

Kickstart can be useful to help start loads that require high breakaway torque but then accelerate easily (for example helical rotor pumps).
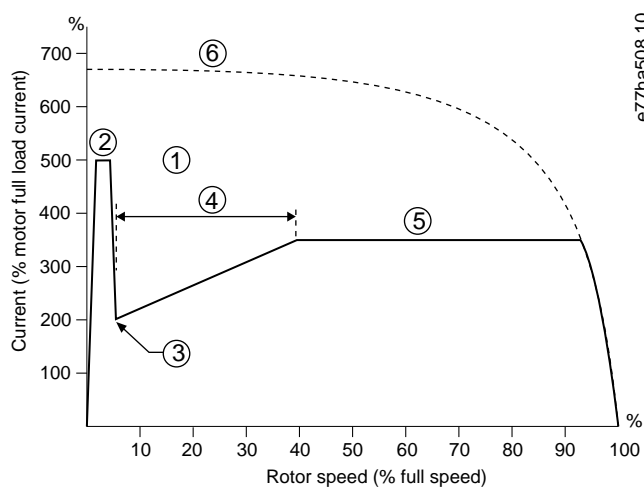
1	*Parameter 2G Kickstart Level*	2	*Parameter 2F Kickstart Time*
3	*Parameter 2C Initial Current*	4	*Parameter 2B Start Ramp Time*
5	*Parameter 2D Current Limit*	6	Full voltage current

Illustration 29: Example of Kickstart used with Constant Current

9.9 Stop Methods

9.9.1 Coast to Stop

Coast to stop lets the motor slow at its natural rate with no control from the soft starter. The time required to stop depends on the type of load.

9.9.2 Timed Voltage Ramp

Timed voltage ramp (TVR) reduces the voltage to the motor gradually over a defined time. This can extend the stopping time of the motor and may avoid transients on generator set supplies.

> ⚠ **N O T I C E** ⚠
>
> The load may continue to run after the stop ramp is complete.
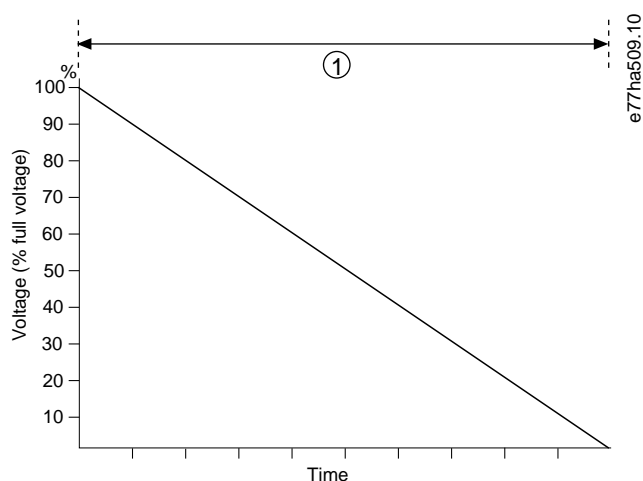
Illustration 30:   Example of TVR

9.9.3 Adaptive Control for Stopping

In an adaptive control soft stop, the soft starter controls the current in order to stop the motor within a specified time and using a selected deceleration profile. Adaptive control can be useful in extending the stopping time of low inertia loads.

If adaptive control is selected, the first soft stop uses TVR. This allows the soft starter to learn the characteristics of the connected motor. This motor data is used by the soft starter during subsequent adaptive control stops.

> ⚠ **N O T I C E** ⚠
>
> Adaptive control does not actively slow the motor down and does not stop the motor faster than a coast to stop. To shorten the stopping time of high inertia loads, use a brake.

<div style="border:1px solid #888; padding:8px;">

⚠ **N O T I C E** ⚠

Adaptive control controls the motor's speed profile, within the programmed time limit. This may result in a higher level of current than traditional control methods.

</div>

If replacing a motor connected to a soft starter programmed for adaptive control starting or stopping, the soft starter has to learn the characteristics of the new motor. Change the value of *parameter 1B Motor Full Load Current* or *parameter 2L Adaptive Control Gain* to initiate the relearning process. The next start will use constant current and the next stop will use TVR.
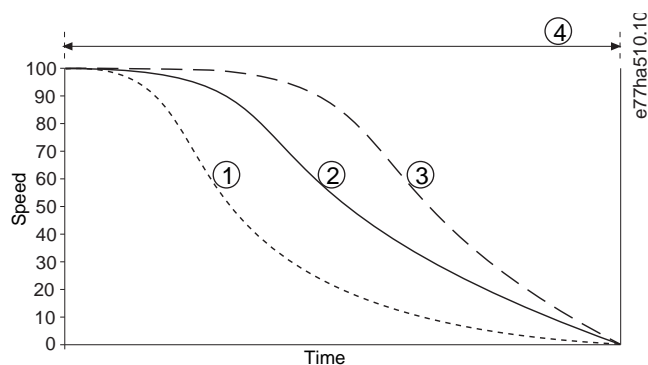
1	Early deceleration	**2**	Constant deceleration
3	Late deceleration	**4**	*Parameter 2J Stop Time*

Illustration 31:   Example of Adaptive Control Stop (Parameter 2K Adaptive Stop Profile)

Adaptive control is ideal for pumping applications where it can minimize the damaging effects of fluid hammer. Test the 3 profiles to identify the best profile for the application.

Adaptive stop profile	**Application**
Late deceleration	High-head systems where even a small decrease in motor/pump speed results in a rapid transition between forward flow and reverse flow.
Constant deceleration	Low to medium head, high-flow applications where the fluid has high momentum.
Early deceleration	Open pump systems where fluid must drain back through the pump without driving the pump in reverse.

9.9.4 DC Brake

A brake reduces the time required to stop the motor.

During braking, an increased noise level from the motor may be audible. This is a normal part of motor braking.

<div style="border:1px solid #888; padding:8px;">

⚠ **N O T I C E** ⚠

When using DC brake, the mains supply must be connected to the soft starter (input terminals L1, L2, and L3) in positive phase sequence.

</div>

> ⚠ **N O T I C E** ⚠
>
> **MOTOR DAMAGE**
>
> If the brake torque setting is too high, the motor stops before the end of the brake time and the motor will suffer unnecessary heating, which could result in damage. A high brake torque setting can also result in peak currents up to motor DOL being drawn while the motor is stopping.
>
> - Careful configuration is required to ensure safe operation of the soft starter and the motor.
>
> - Ensure that protection fuses installed in the motor branch circuit are selected appropriately.

> ⚠ **N O T I C E** ⚠
>
> **RISK OF OVERHEATING**
>
> Brake operation causes the motor to heat faster than the rate calculated by the motor thermal model.
>
> - Install a motor thermistor or allow sufficient restart delay (set in *parameter 5P Restart Delay*).
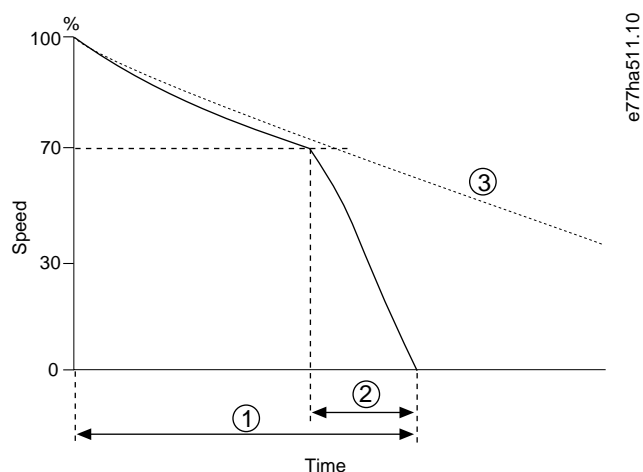
1	*Parameter 2J Stop Time*	2	*Parameter 2P Brake Time*
3	Coast to stop time		

Illustration 32:   Example of Brake Time

Parameter settings:

- *Parameter 2I Stop Mode*: Set to *DC Brake*.

- *Parameter 2J Stop Time*: This is the total braking time (1) and must be set sufficiently longer than the brake time (in *parameter 2P DC Brake Time*) to allow the prebraking stage to reduce motor speed to approximately 70%. If the stop time is too short, braking will not be successful and the motor will coast to stop.

- *Parameter 2O DC Brake Torque*: Set as required to slow the load. If set too low, the motor will not stop completely and will coast to stop after the end of the braking period.

- *Parameter 2P DC Brake Time*: Set this parameter to approximately 1 quarter of the programmed stop time. This sets the time for the full brake stage (2).

9.9.5 DC Brake with External Zero-speed Sensor

For loads which may vary between braking cycles, install an external zero-speed sensor to ensure that the soft starter ends DC braking when the motor has reached a standstill. This avoids unnecessary motor heating.

Configure DC brake for the longest braking time required, and also set *parameter 7A Input A Function* to *Zero Speed Sensor*. When the motor reaches a standstill, the zero-speed sensor opens the circuit across DI-A, COM+ and the soft starter terminates the stop.

9.9.6 Soft Brake

For applications with high inertia and/or variable load requiring the maximum possible braking torque, the soft starter can be configured for soft braking.

The soft starter uses a changeover relay to control forward run and braking contactors. While braking, the soft starter reverses the phase sequence to the motor and supplies reduced current, gently slowing the load.

When motor speed approaches 0, the zero-speed sensor (A2) stops the soft starter and opens the braking contactor (K2).

Soft braking can be used with both the primary and secondary motor sets and must be configured separately for each.

Parameter settings:

- *Parameter 2I Stop Mode*: Set to *Soft Brake*.
- *Parameter 2Q Brake Current Limit*: Set as required to slow the load.
- *Parameter 2R Soft Brake Delay*: Controls the time the soft starter waits after a stop signal is received, before it begins to supply braking current to the motor. Set to allow time for K1 and K2 to switch.
- *Parameter 7A Input A Function*: Set to *Zero Speed Sensor*.
- *Parameter 8A Relay A Function*: Set to *Soft Brake Relay*.
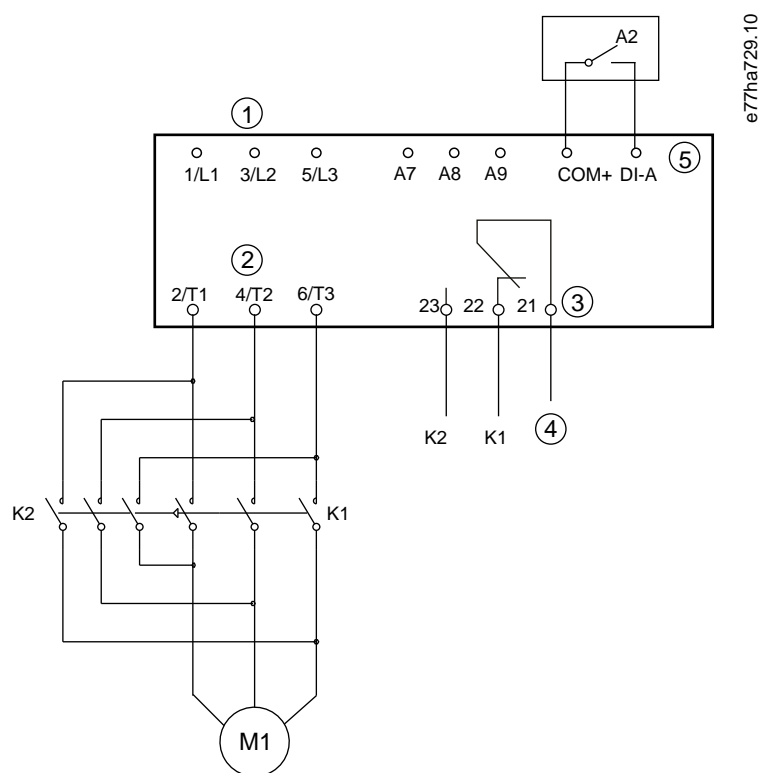
1	Three-phase supply	**2**	Motor terminals
3	Relay A output	**4**	K1/K2 coil supply
5	Programmable input A	**K1**	Line contactor (Run)
K2	Line contactor (Brake)	**A2**	Zero-speed sensor

Illustration 33: Wiring Example for Soft Braking

9.10 Pump Clean

The soft starter can perform a pump clean function before soft starting the motor. This can help dislodge debris from the impeller.

Pump clean starts the motor in reverse then forward direction, then stops the motor. Pump clean can be configured to repeat the process up to 5 times. After the specified number of cleaning cycles, the soft starter performs the programmed soft start.

Pump clean operation is controlled by the start/stop input (START, COM+). A programmable input must be set to pump clean (see *parameter 7A Input A Function* for details) and the input must be closed when the start signal is applied.

> ⚠ **N O T I C E** ⚠
>
> Do not enable pump clean on pumps that cannot operate in reverse direction.
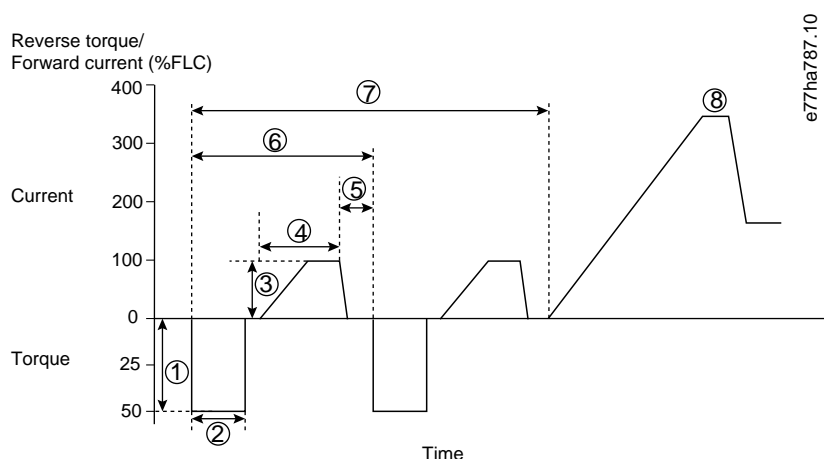
1	*Parameter 11A Reverse Torque*	2	*Parameter 11B Reverse Time*
3	*Parameter 11C Forward Current Limit*	4	*Parameter 11D Forward Time*
5	*Parameter 11F Pump Stop Time*	6	Cleaning cycle
7	*Parameter 11G Pump Clean Cycles*	8	Programmed soft start

Illustration 34: Pump Clean

9.11 Reverse Direction Operation

The soft starter can control a reversing contactor to operate the motor in reverse direction. When reverse operation is selected, the soft starter performs a soft start using the opposite phase sequence from normal operation.

Reverse operation is controlled by the start/stop input (START, COM+). A programmable input must be set to reverse direction (*parameter 7A Input A Function*) and an output must be set to reversing contactor (*parameter 8A Relay A Function*).

The input must be closed when the start signal is applied. The soft starter keeps the reverse relay in the same state until the end of the starting/stopping cycle.

> ⚠ **NOTICE** ⚠
>
> The first start after the direction is changed will be constant current.

> ⚠ **NOTICE** ⚠
>
> If phase sequence protection is required, install the reversing contactor on the output (motor) side of the soft starter.
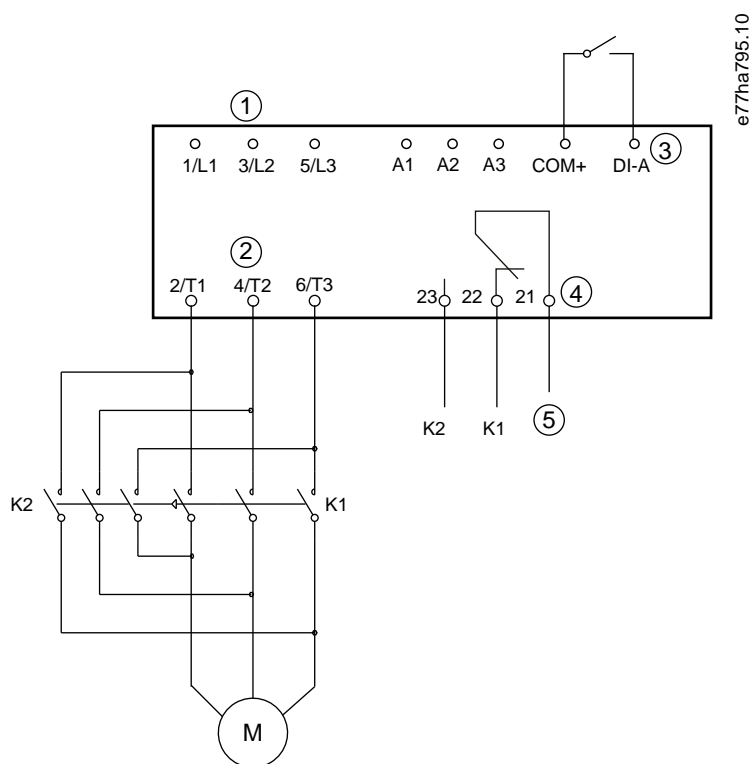
1	Three-phase supply	**2**	Motor terminals
3	Programmable input A (set=Reverse direction)	**4**	Relay output A (set=Reversing contactor)
5	K1/K2 coil supply	**K1**	Forward run contactor
K2	Reversing contactor		

Illustration 35: Connection Diagram

9.12 Jog Operation

Jog runs the motor at reduced speed to allow alignment of the load or to assist servicing. The motor can be jogged in either forward or reverse direction.

Jog is only available when the soft starter is controlled via the digital inputs (*parameter 1A Command Source* set to *Digital Input*). To operate in jog, a programmable input must be set to jog (see *parameter 7A Input A Function* for details) and the input must be closed when the start signal is applied.

⚠ **N O T I C E** ⚠

REDUCED MOTOR COOLING

Slow speed running is not intended for continuous operation due to reduced motor cooling. Jog operation causes the motor to heat faster than the rate calculated by the motor thermal model.

- Install a motor thermistor or allow sufficient restart delay (*parameter 5P Restart Delay*).

The maximum available torque for jog forward is approximately 50–75% of motor FLT depending on the motor. When the motor is jogged in reverse, the torque is approximately 25–50% of FLT.

Parameter 2H Jog Torque and *parameter 3J Jog Torque-2* control how much of the maximum available jog torque the soft starter applies to the motor.

> **⚠ NOTICE ⚠**
>
> Torque settings above 50% may cause increased shaft vibration.
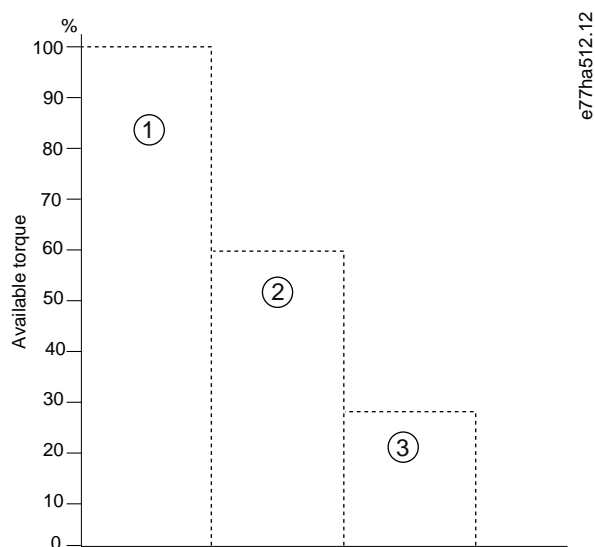
1	Motor FLT	**2**	Jog forward maximum torque
3	Jog reverse maximum torque		

Illustration 36: Available Torque in Jog Operation

9.13 Inside Delta Operation

When connecting in inside delta, enter the value of the FLC in *parameter 1B Motor Full Load Current*. The soft starter automatically detects whether the motor is connected in-line or inside delta and calculates the correct inside delta current level.

Adaptive control, jog, brake, and PowerThrough functions are not supported with inside delta (6-wire) operation. If these functions are programmed when the soft starter is connected inside delta, the behavior is given as below.

Adaptive control start	The soft starter performs a constant current start.
Adaptive control stop	The soft starter performs a TVR soft stop if *parameter 2J Stop Times* is >0 s. If *parameter 2J Stop Times* is set to 0 s, the soft starter performs a coast to stop.
Jog	The soft starter issues a warning with the error message *Unsupported option*.
DC brake	The soft starter performs a coast to stop.
Soft brake	The soft starter performs a coast to stop.
PowerThrough	The soft starter trips with the error message *Lx-Tx Shorted*.

⚠ NOTICE ⚠

When connectedin in inside delta, the soft starter does not detect phase loss on T2 during run.

⚠ NOTICE ⚠

If the soft starter is not correctly detecting the motor connection, use *parameter 20F Motor Connection*.

9.14 Secondary Motor Set

The soft starter can be programmed with 2 separate motor profiles with independent starting and stopping configurations. This is ideal for situations where the motor may start in 2 different conditions (such as loaded and unloaded conveyors), or multi-motor or duty/standby applications.

The soft starter uses the secondary motor settings to control a start when instructed via a programmable input (see *parameter 7A Input A Function* and *parameter 7E Input B Function*).

⚠ NOTICE ⚠

The motor thermal model is less accurate if the soft starter controls 2 separate motors.

10 Programmable Parameters

10.1 Main Menu

Use the Main Menu to view and change programmable parameters that control how the soft starter operates.

To open the Main Menu, press [Main Menu] while viewing the monitoring screens.

10.2 Changing Parameter Values

Procedure

1. Scroll to the parameter in the Main Menu.
2. Press [Menu/Store] to enter edit mode.
3. Press [⌃] or [⌄] to change parameter settings.

> Pressing [⌃] or [⌄] once increases or decreases the value by 1 unit. If the key is held for longer than 5 s, the value increases or decreases at a faster rate.

Press [Store] to save changes. The setting shown on the display is saved and the LCP returns to the parameter list.

Press [Back] to cancel changes. The LCP asks for confirmation, then returns to the parameter list without saving the changes.

10.3 Adjustment Lock

Use *parameter 10G Adjustment Lock* to prevent users from changing parameter settings.

If a user attempts to change a parameter value when the adjustment lock is active, the following error is shown: *Access Denied. Adj Lock is On*.

10.4 Parameter List

Table 19: Parameter List

Parameter group number	Parameter group name	Default setting
1	**Motor Details**	
1A	Command Source	Digital Input
1B	Motor Full Load Current	Model dependent
1C	Motor kW	0 kW
1D	Locked Rotor Time	00:10 (mm:ss)
1E	Locked Rotor Current	600%
1F	Motor Service Factor	105%
1G	Reserved	–
2	**Motor Start/Stop**	
2A	Start Mode	Constant Current
2B	Start Ramp Time	00:10 (mm:ss)

Parameter group number	Parameter group name	Default setting
2C	Initial Current	200%
2D	Current Limit	350%
2E	Adaptive Start Profile	Constant Acceleration
2F	Kickstart Time	000 ms
2G	Kickstart Level	500%
2H	Jog Torque	50%
2I	Stop Mode	TVR Soft Stop
2J	Stop Time	00:00 (mm:ss)
2K	Adaptive Stop Profile	Constant Deceleration
2L	Adaptive Control Gain	75%
2M	Multi Pump	Single Pump
2N	Start Delay	00:00 (mm:ss)
2O	DC Brake Torque	20%
2P	DC Brake Time	00:01 (mm:ss)
2Q	Brake Current Limit	250%
2R	Soft Brake Delay	400 ms
3	**Motor Start/Stop 2**	
3A	Motor Full Load Current-2	Model dependent
3B	Motor kW-2	0 kW
3C	Start Mode-2	Constant Current
3D	Start Ramp Time-2	00:10 (mm:ss)
3E	Initial Current-2	200%
3F	Current Limit-2	350%
3G	Adaptive Start Profile-2	Constant Acceleration
3H	Kickstart Time-2	000 ms
3I	Kickstart Level-2	500%
3J	Jog Torque-2	50%
3K	Stop Mode-2	TVR Soft Stop
3L	Stop Time-2	00:00 (mm:ss)
3M	Adaptive Stop Profile-2	Constant Deceleration
3N	Adaptive Control Gain-2	75%
3O	Multi Pump-2	Single Pump
3P	Start Delay-2	00:00 (mm:ss)
3Q	DC Brake Torque-2	20%
3R	DC Brake Time-2	00:01 (mm:ss)

Parameter group number	Parameter group name	Default setting
3S	Brake Current Limit-2	250%
3T	Soft Brake Delay-2	400 s
4	**Auto-Start/Stop**	
4A	Auto-Start/Stop Mode	Disable
4B	Run Time	00:00 (hh:mm)
4C	Stopped Time	00:00 (hh:mm)
4D	Sunday Mode	Start/Stop Disable
4E	Sunday Start Time	00:00 (hh:mm)
4F	Sunday Stop Time	00:00 (hh:mm)
4G	Monday Mode	Start/Stop Disable
4H	Monday Start Time	00:00 (hh:mm)
4I	Monday Stop Time	00:00 (hh:mm)
4J	Tuesday Mode	Start/Stop Disable
4K	Tuesday Start Time	00:00 (hh:mm)
4L	Tuesday Stop Time	00:00 (hh:mm)
4M	Wednesday Mode	Start/Stop Disable
4N	Wednesday Start Time	00:00 (hh:mm)
4O	Wednesday Stop Time	00:00 (hh:mm)
4P	Thursday Mode	Start/Stop Disable
4Q	Thursday Start Time	00:00 (hh:mm)
4R	Thursday Stop Time	00:00 (hh:mm)
4S	Friday Mode	Start/Stop Disable
4T	Fridday Start Time	00:00 (hh:mm)
4U	Friday Stop Time	00:00 (hh:mm)
4V	Saturday Mode	Start/Stop Disable
4W	Saturday Start Time	00:00 (hh:mm)
4X	Saturday Stop Time	00:00 (hh:mm)
5	**Protection Levels**	
5A	Current Imbalance	30%
5B	Current Imbalance Delay	00:03 (mm:ss)
5C	Undercurrent	20%
5D	Undercurrent Delay	00:05 (mm:ss)
5E	Overcurrent	400%
5F	Overcurrent Delay	00:00 (mm:ss)
5G	Undervoltage	350 V

Parameter group number	Parameter group name	Default setting
5H	Undervoltage Delay	00:01 (mm:ss)
5I	Overvoltage	500 V
5J	Overvoltage Delay	00:01 (mm:ss)
5K	Underpower	10%
5L	Underpower Delay	00:01 (mm:ss)
5M	Overpower	150%
5N	Overpower Delay	00:01 (mm:ss)
5O	Excess Start Time	00:20 (mm:ss)
5P	Restart Delay	00:10 (mm:ss)
5Q	Starts per Hour	0
5R	Phase Sequence	Any Sequence
6	**Protection Actions**	
6A	Auto-Reset Count	0
6B	Auto-Reset Delay	00:05 (mm:ss)
6C	Current Imbalance	Soft Trip and Log
6D	Undercurrent	Soft Trip and Log
6E	Overcurrent	Soft Trip and Log
6F	Undervoltage	Soft Trip and Log
6G	Overvoltage	Soft Trip and Log
6H	Underpower	Log Only
6I	Overpower	Log Only
6J	Excess Start Time	Soft Trip and Log
6K	Input A Trip	Soft Trip and Log
6L	Input B Trip	Soft Trip and Log
6M	Network Communications	Soft Trip and Log
6N	Remote Keypad Fault	Soft Trp and Log
6O	Frequency	Soft Trip and Log
6P	Phase Sequence	Soft Trip and Log
6Q	Motor Overtemperature	Soft Trip and Log
6R	Motor Thermistor Circuit	Soft Trip and Log
6S	Shorted SCR Action	3-Phase Control Only
6T	Battery/Clock	Soft Trip and Log
7	**Inputs**	
7A	Input A Function	Input Trip (N/O)
7B	Input A Trip	Operating Only

Parameter group number	Parameter group name	Default setting
7C	Input A Trip Delay	00:00 (mm:ss)
7D	Input A Initial Delay	00:00 (mm:ss)
7E	Input B Function	Input Trip (N/O)
7F	Input B Trip	Operating Only
7G	Input B Trip Delay	00:00 (mm:ss)
7H	Input B Initial Delay	00:00 (mm:ss)
7I	Reset/Enable Logic	Normally Closed (N/C)
7J	Input A Name	Input A Trip
7K	Input B Name	Input B Trip
8	**Relay Outputs**	
8A	Relay A Function	Run
8B	Relay A On Delay	00:00 (mm:ss)
8C	Relay A Off Delay	00:00 (mm:ss)
8D	Relay B Function	Run
8E	Relay B On Delay	00:00 (mm:ss)
8F	Relay B Off Delay	00:00 (mm:ss)
8G	Low Current Flag	50%
8H	High Current Flag	100%
8I	Motor Temperature Flag	80%
8J	Main Contactor Time	400 ms
9	**Analog Output**	
9A	Analog Output A	Current (% FLC)
9B	Analog A Scale	4–20 mA
9C	Analog A Maximum Adjustment	100%
9D	Analog A Minimum Adjustment	000%
10	**Display**	
10A	Language	English
10B	Temperature Scale	Celsius
10C	Graph Timebase	30 s
10D	Graph Maximum Adjustment	400%
10E	Graph Minimum Adjustment	0%
10F	Current Calibration	100%
10G	Adjustment Lock	Read & Write
10H	User Parameter 1	Current
10I	User Parameter 2	Motor Voltage

Parameter group number	Parameter group name	Default setting
10J	User Parameter 3	Mains Frequency
10K	User Parameter 4	Motor pf
10L	User Parameter 5	Motor Power
10M	User Parameter 6	Motor Temp (%)
11	**Pump Clean**	
11A	Reverse Torque	20%
11B	Reverse Time	00:10 (mm:ss)
11C	Forward Current Limit	100%
11D	Forward Time	00:10 (mm:ss)
11E	Pump Stop Mode	Coast to Stop
11F	Pump Stop Time	00:10 (mm:ss)
11G	Pump Clean Cycles	1
12	**Communication Card**	
12A	Modbus Address	1
12B	Modbus Baud Rate	9600
12C	Modbus Parity	None
12D	Modbus Timeout	Off
12E	Devicenet Address	0
12F	Devicenet Baud Rate	125kB
12G	Profibus Address	1
12H	Gateway Address	192
12I	Gateway Address 2	168
12J	Gateway Address 3	0
12K	Gateway Address 4	100
12L	IP Address	192
12M	IP Address 2	168
12N	IP Address 3	0
12O	IP Address 4	2
12P	Subnet Mask	255
12Q	Subnet Mask 2	255
12R	Subnet Mask 3	255
12S	Subnet Mask 4	0
12T	DHCP	Disable
12U	Location ID	0
20	**Advanced**	

Parameter group number	Parameter group name	Default setting
20A	Tracking Gain	50%
20B	Pedestal Detect	80%
20C	Bypass Contactor Delay	150 ms
20D	Model Rating	Model dependent
20E	Screen Timeout	1 minute
20F	Motor Connection	Auto-detect
30	**Pump Input Configuration**	
30A	Pressure Sensor Type	None
30B	Pressure Units	kPa
30C	Pressure at 4 mA	0
30D	Pressure at 20 mA	0
30E	Flow Sensor Type	None
30F	Flow Units	liters/second
30G	Flow at 4 mA	0
30H	Flow at 20 mA	0
30I	Units per Minute at Max Flow	0
30J	Pulses per Minute at max Flow	0
30K	Units per Pulse	0
30L	Depth Sensor Type	None
30M	Depth Units	metres
30N	Depth at 4 mA	0
30O	Depth at 20 mA	0
31	**Flow Protection**	
31A	High Flow Trip Level	10
31B	Low Flow Trip Level	5
31C	Flow Start Delay	00:00:500 (mm:ss:ms)
31D	Flow Response Delay	00:00:500 (mm:ss:ms)
32	**Pressure Protection**	
32A	High Pressure Trip Level	10
32B	High Pressure Start Delay	00:00:500 (mm:ss:ms)
32C	High Pressure Response Delay	00:00:500 (mm:ss:ms)
32D	Low Pressure Trip Level	5
32E	Low Pressure Start Delay	00:00:500 (mm:ss:ms)
32F	Low Pressure Response Delay	00:00:500 (mm:ss:ms)
33	**Pressure Control**	

Parameter group number	Parameter group name	Default setting
33A	Pressure Control Mode	Off
33B	Start Pressure Level	5
33C	Start Response Delay	00:00:500 (mm:ss:ms)
33D	Stop Pressure Level	10
33E	Stop Response Delay	00:00:500 (mm:ss:ms)
34	**Depth Protection**	
34A	Depth Trip Level	5
34B	Depth Reset Level	10
34C	Depth Start Delay	00:00:500 (mm:ss:ms)
34D	Depth Response Delay	00:00:500 (mm:ss:ms)
35	**Thermal Protection**	
35A	Temperature Sensor Type	None
35B	Temperature Trip Level	40
36	**Pump Trip Action**	
36A	Pressure Sensor	Soft Trip and Log
36B	Flow Sensor	Soft Trip and Log
36C	Depth Sensor	Soft Trip and Log
36D	High Pressure	Soft Trip and Log
36E	Low Pressure	Soft Trip and Log
36F	High Flow	Soft Trip and Log
36G	Low Flow	Soft Trip and Log
36H	Flow Switch	Soft Trip and Log
36I	Well Depth	Soft Trip and Log
36J	RTD/PT100 B	Soft Trip and Log

10.5 Parameter Group 1-** Motor Details

Table 20: 1A - Command Source

Option		Function
		Selects the command source for controlling the soft starter.
*	Digital input	The soft starter accepts start and stop commands from the digital inputs.
	Network	The soft starter accepts start and stop commands from the communication expansion card.
	Remote LCP	The soft starter accepts start and stop commands from the remote LCP.
	Clock	The soft starter accepts starts and stops as scheduled in *parameters 4A* to *4x*.
	Smart card	The soft starter accepts start and stop commands from the smart card.

Option		Function
	Smart card + clock	The soft starter accepts start commands from the smart card if they are within the operating schedule set in *parameters 4A* to *4X*. A stop command from the smart card is accepted regardless of the schedule.
	Timer	After a start signal is received, the soft starter starts and stops the motor according to the timers set in *parameter 4B Run Time* and *parameter 4C Stopped Time*.

Table 21: 1B Motor Full Load Current

Range		Function
	Model dependent	Matches the soft starter to the FLC of the motor. Set to the FLC rating shown on the motor nameplate.

Table 22: 1C Motor kW

Range		Function
*0	0–9999 kW	Sets the running power of the connected motor in kilowatts. This setting is the basis for power reporting and protection.

Table 23: 1D Locked Rotor Time

Range		function
*10 s	0:01–2:00 (minutes:seconds)	Sets the maximum length of time the motor can sustain locked rotor current from cold before reaching its maximum temperature. Set according to the motor datasheet.

Table 24: 1E Locked Rotor Current

Range		Function
*600%	400–1200% FLC	Sets the locked rotor current of the connected motor as a percentage of full load current. Set according to the motor datasheet.

Table 25: 1F Motor Service Factor

Range		Function
*105%	100–130%	Sets the motor service factor used by the thermal model. If the motor runs at full load current, it will reach 100%. Set according to the motor datasheet. ⚠ **N O T I C E** ⚠ *Parameters 1D* to *1F* determine the trip current for motor overload protection. The default settings of *Parameters 1D* to *1F* provide motor overload protection: Class 10, trip current 105% of FLA (full load amperage) or equivalent.

Table 26: 1G Reserved

Range		Function
		This parameter is reserved for future use.

10.6 Parameter Group 2-** Motor Start/Stop

Table 27: 2A - Start Mode

Option		Function
		Selects the soft start mode.
		⚠ **NOTICE** ⚠ The VLT® Soft Starter MCD 600 applies the current limit on all soft starts, including adaptive control. If the current limit is too low or the start ramp time (*parameter 2B Start Ramp Time*) is too short, the motor may not start successfully.
*	Constant Current	
	Adaptive Control	

Table 28: 2B - Start Ramp Time

Range		Function
* 10 s	0:01–3:00 (minutes:seconds)	Sets the total start time for an adaptive control start or the ramp time for current ramp starting (from the initial current to the current limit).

Table 29: 2C - Initial Current

Range		Function
*200%	100–600% FLC	Sets the initial start current level for current ramp starting as a percentage of motor full load current. Set so that the motor begins to accelerate immediately after a start is initiated. If current ramp starting is not required, set the initial current equal to the current limit.

Table 30: 2D - Current Limit

Range		Function
* 350%	100–600% FLC	Sets the current limit for constant current and current ramp soft starting as a percentage of motor full load current.

Table 31: 2E - Adaptive Start Profile

Option		Function
		Selects which profile the VLT® Soft Starter MCD 600 uses for an adaptive control soft start.
		⚠ **NOTICE** ⚠ The MCD 600 applies the current limit on all soft starts, including adaptive control. If the current limit is too low or the start ramp time (*parameter 2B Start Ramp Time*) is too short, the motor may not start successfully.
	Early Acceleration	
*	Constant Acceleration	
	Late Acceleration	

Table 32: 2F - Kickstart Time

Range		Function
*0000 ms	0–2000 ms	Sets the kickstart duration. A setting of 0 disables kickstart.

Table 33: 2G - Kickstart Level

Range		Function
* 500%	100–700% FLC	Sets the level of the kickstart current. ⚠ **N O T I C E** ⚠ Kickstart subjects the mechanical equipment to increased torque levels. Ensure that the motor, load, and couplings can handle the additional torque before using this feature.

Table 34: 2H - Jog Torque

Range		Function
* 50%	20–100%	The VLT® Soft Starter MCD 600 can jog the motor at a reduced speed, which allows precise positioning of belts and flywheels. Jog can be used for either forward or reverse operation. Set the current limit for jog operation.

Table 35: 2I - Stop Mode

Option		Function
		Selects the stop mode.
	Coast To Stop	
*	TVR Soft Stop	
	Adaptive Control	
	DC Brake	
	Soft Brake	

Table 36: 2J - Stop Time

Range		Function
* 0 second	0:00–4:00 (minutes:seconds)	Sets the time for soft stopping the motor using TVR or adaptive control. If a main contactor is installed, the contactor must remain closed until the end of the stop time. Use the main contactor output (13, 14) to control the main contactor.

Table 37: 2K - Adaptive Stop Profile

Option		Function
		Selects which profile the VLT® Soft Starter MCD 600 uses for an adaptive control soft stop.
	Early Deceleration	
*	Constant Deceleration	

Option		Function
	Late Deceleration	

Table 38: 2L - Adaptive Control Gain

Range		Function
* 75%	1–200%	Adjusts the performance of adaptive control. This setting affects both starting and stopping control.

Table 39: 2M - Multi Pump

Option		Function
		Adjusts the performance of adaptive control to suit installations with multiple pumps connected to a common outlet manifold.
*	Single Pump	
	Manifold Pump	

Table 40: 2N - Start Delay

Range		Function
* 0 s	0:00–60:00 (minutes:seconds)	Sets a delay after the soft starter receives a start command before it starts the motor.

Table 41: 2O - DC Brake Torque

Range		Function
* 20%	20–100%	Sets the amount of brake torque the soft starter uses to slow the motor.

Table 42: 2P - DC Brake Time

Range		Function
* 1 s	0:01–0:30 (minutes:seconds)	Sets the duration for DC injection during a braking stop.

Table 43: 2Q - Brake Current Limit

Range		Function
* 250%	100–600% FLC	Sets the current limit for soft brake.

Table 44: 2R - Soft Brake Delay

Range		Function
*400 ms	400–2000 ms	Sets the time the soft starter waits after a stop signal is received before it begins to supply braking current to the motor. Set to allow time for K1 and K2 to switch.

10.7 Parameter Group 3-** Motor Start/Stop-2

The parameters in this group control the operation of the secondary configuration of the motor. Use the programmable input to select the active motor set.

To use the secondary motor data, set *parameter 7A Input A Function* to *Motor Set Select* and close the input before a start command is given. The soft starter checks which motor data to use at a start and will use that motor data for the entire start/stop cycle.

> ⚠ **NOTICE** ⚠
>
> The VLT® Soft Starter MCD 600 is not suitable for controlling 2 separate motors. The secondary parameter set should only be used for a secondary configuration of the primary motor.

Table 45: 3A - Motor Full Load Current-2

Range		Function
	Model dependent	Sets the secondary motor's full load current.

Table 46: 3B - Motor kW-2

Range		Function
* 0	0–9999 kW	Sets the running power of the secondary motor in kilowatts.

Table 47: 3C - Start Mode-2

Option		Function
		Selects the soft start mode.
*	Constant Current	
	Adaptive Control	

Table 48: 3D - Start Ramp Time-2

Range		Function
*10 s	0:01–3:00 (minutes:seconds)	Sets the total start time for an adaptive control start or the ramp time for current ramp starting (from the initial current to the current limit).

Table 49: 3E - Initial Current-2

Range		Function
*200%	100–600% FLC	Sets the initial start current level for current ramp starting as a percentage of motor full load current. Set so that the motor begins to accelerate immediately after a start is initiated. If current ramp starting is not required, set the initial current equal to the current limit.

Table 50: 3E - Initial Current-2

Range		Function
*350%	100–600% FLC	Sets the current limit for constant current and current ramp soft starting as a percentage of motor full load current. ⚠ **N O T I C E** ⚠ The VLT® Soft Starter MCD 600 applies the current limit on all soft starts, including adaptive control. If the current limit is too low or the start ramp time (*parameter 2B Start Ramp Time*) is too short, the motor may not start successfully.

Table 51: 3G - Adaptive Start Profile-2

Option		Function
		Selects which profile the VLT® Soft Starter MCD 600 uses for an adaptive control soft start.
	Early Acceleration	
*	Constant Acceleration	
	Late Acceleration	

Table 52: 3H - Kickstart Time-2

Range		Function
* 0000 ms	0–2000 ms	Sets the kickstart duration. A setting of 0 disables kickstart.

Table 53: 3I - Kickstart Level-2

Range		Function
*500%	100–700% FLC	Sets the level of the kickstart current.

Table 54: 3J - Jog Torque-2

Range		Function
*50%	20–100%	Sets the current limit for jog operation.

Table 55: 3K - Stop Mode-2

Option		Function
		Selects the stop mode.
	Coast To Stop	
*	TVR Soft Stop	
	Adaptive Control	
	DC Brake	

Option		Function
	Soft Brake	

Table 56: 3L - Stop Time-2

Range		Function
*0 s	0:00–4:00 (minutes:seconds)	Sets the time for soft stopping the motor using TVR or adaptive control. If a main contactor is installed, the contactor must remain closed until the end of the stop time. Use the main contactor output (13, 14) to control the main contactor.

Table 57: 3M - Adaptive Stop Profile-2

Option		Function
		Selects which profile the soft starter uses for an adaptive control soft stop.
	Early Deceleration	
*	Constant Deceleration	
	Late Deceleration	

Table 58: 3N - Adaptive Control Gain-2

Range		Function
*75%	1–200%	Adjusts the performance of adaptive control. This setting affects both starting and stopping control.

Table 59: 3O - Multi Pump-2

Option		Function
		Adjusts the performance of adaptive control to suit installations with multiple pumps connected to a common outlet manifold.
*	Single Pump	
	Manifold Pump	

Table 60: 3P - Start Delay-2

Range		Function
* 0 s	0:00–60:00 (minutes:seconds)	Sets a delay after the starter receives a start command before it starts the motor.

Table 61: 3Q - DC Brake Torque-2

Range		Function
*20%	20–100%	Sets the amount of brake torque the soft starter uses to slow the motor.

Table 62: 3R - DC Brake Time-2

Range		Function
*1 s	0:01–0:30 (minutes:seconds)	Sets the duration for DC injection during a braking stop.

Table 63: 3S- Brake Current Limit-2

Range		Function
*250%	100–600% FLC	Sets the current limit for soft brake.

Table 64: 3T - Soft Brake Delay-2

Range		Function
*400 ms	400–2000 ms	Sets the time the soft starter waits after a stop signal is received, before it begins to supply braking current to the motor. Set to allow time for K1 and K2 to switch.

10.8 Parameter Group 4-** Auto-Start/Stop

Table 65: 4A - Auto-Start/Stop Mode

Option		Function
		Enable or disable auto-start/stop operation.
*	Disable	
	Enable Clock Mode	
	Enable Timer Mode	

Table 66: 4A - Auto-Start/Stop Mode

Range		Function
*00:00	00:00–23:59 hh:mm	Sets the duration for the soft starter to run after a timer mode auto-start.

Table 67: 4C - Stopped Time

Range		Function
*00:00	00:00–23:59 hh:mm	Sets the duration for the soft starter to remain stopped when operating in timer mode.

Table 68: 4D - Sunday Mode

Option		Function
		Enables or disables auto-start/stop for Sunday.
*	Start/Stop Disable	Disables auto-start/stop control. Any times scheduled in *parameter 4E Sunday Start Time* or *parameter 4F Sunday Stop Time* are ignored.
	Start Only Enable	Enables auto-start control. Any auto-stop times scheduled in *parameter 4F Sunday Stop Time* are ignored.
	Stop Only Enable	Enables auto-stop control. Any auto-start times scheduled in *parameter 4E Sunday Start Time* are ignored.
	Start/Stop Enable	Enables auto-start and auto-stop control.

Table 69: 4E - Sunday Start Time

Range		Function
*00:00	00:00–23:59	Sets the auto-start time for Sunday (24-hour format).

Table 70: 4F - Sunday Stop Time

Range		Function
*00:00	00:00–23:59	Sets the auto-stop time for Sunday (24-hour format).

Table 71: 4G - Monday Mode

Option		Function
		Enables or disables auto-start/stop for Monday.
*	Start/Stop Disable	Stop Only Enable
	Start Only Enable	Start/Stop Enable

Table 72: 4H - Monday Start Time

Range		Function
*00:00	00:00–23:59	Sets the auto-start time for Monday (24-hour format).

Table 73: 4I - Monday Stop Time

Range		Function
*00:00	00:00–23:59	Sets the auto-stop time for Monday (24-hour format).

Table 74: 4J - Tuesday Mode

Option		Function
		Enables or disables auto-start/stop for Tuesday.
*	Start/Stop Disable	
	Start Only Enable	
	Stop Only Enable	
	Start/Stop Enable	

Table 75: 4K - Tuesday Start Time

Range		Function
*00:00	00:00–23:59	Sets the auto-start time for Tuesday (24-hour format).

Table 76: 4M- Wednesday Mode

Option		Function
		Enables or disables auto-start/stop for Wednesday.

Option		Function
*	Start/Stop Disable	
	Start Only Enable	
	Stop Only Enable	
	Start/Stop Enable	

Table 77: 4N- Wednesday Start Time

Range		Function
*00:00	00:00–23:59	Sets the auto-start time for Wednesday (24-hour format).

Table 78: 4O- Wednesday Stop Time

Range		Function
*00:00	00:00–23:59	Sets the auto-stop time for Wednesday (24-hour format).

Table 79: 4P- Thursday Mode

Option		Function
		Enables or disables auto-start/stop for Thursday.
*	Start/Stop Disable	
	Start Only Enable	
	Stop Only Enable	
	Start/Stop Enable	

Table 80: 4Q- Thursday Start Time

Range		Function
*00:00	00:00–23:59	Sets the auto-start time for Thursday (24-hour format).

Table 81: 4R- Thursday Stop Time

Range		Function
*00:00	00:00–23:59	Sets the auto-stop time for Thursday (24-hour format).

Table 82: 4S - Friday Mode

Option		Function
		Enables or disables auto-start/stop for Friday.
*	Start/Stop Disable	
	Start Only Enable	
	Stop Only Enable	
	Start/Stop Enable	

Table 83: 4T - Friday Start Time

Range		Function
*00:00	00:00–23:59	Sets the auto-start time for Friday (24-hour format).

Table 84: 4U - Friday Stop Time

Range		Function
*00:00	00:00–23:59	Sets the auto-stop time for Friday (24-hour format).

Table 85: 4V - Saturday Mode

Option		Function
		Enables or disables auto-start/stop for Saturday.
*	Start/Stop Disable	
	Start Only Enable	
	Stop Only Enable	
	Start/Stop Enable	

Table 86: 4W - Saturday Start Time

Range		Function
*00:00	00:00–23:59	Sets the auto-start time for Saturday (24-hour format).

Table 87: 4X - Saturday Stop Time

Range		Function
*00:00	00:00–23:59	Sets the auto-stop time for Saturday (24-hour format).

10.9 Parameter Group 5-** Protection Levels

Table 88: 5A - Current Imbalance

Range		Function
*30%	10–50%	Sets the trip point for current imbalance protection.

Table 89: 5B - Current Imbalance Delay

Range		Function
*3 s	0:00–4:00 (minutes:seconds)	Slows the soft starter's response to current imbalance, avoiding trips due to momentary fluctuations.

Table 90: 5C - Undercurrent

Range		Function
*20%	0–100%	Sets the trip point for undercurrent protection as a percentage of motor full load current. Set to a level between the motor's normal working range and the motor's magnetizing (no load) current (typically 25–35% of FLC). A setting of 0% disables undercurrent protection.

Table 91: 5D - Undercurrent Delay

Range		Function
* 5 s	00–4:00 (minutes:seconds)	Slows the soft starter's response to undercurrent, avoiding trips due to momentary fluctuations

Table 92: 5E - Overcurrent

Range		Function
*400%	80–600%	Sets the trip point for overcurrent protection as a percentage of motor full load current.

Table 93: 5F - Overcurrent Delay

Range		Function
* 0 s	0:00–1:00 (minutes:seconds)	Slows the soft starter's response to overcurrent, avoiding trips due to momentary overcurrent events.

Table 94: 5G - Undervoltage

Range		Function
*350	100–1000 V	Sets the trip point for undervoltage protection. Set as required.

⚠ **N O T I C E** ⚠

Voltage protections will not operate correctly until the soft starter is in Run mode.

Table 95: 5H - Undervoltage Delay

Range		Function
* 1 s	0:00–1:00 (minutes:seconds)	Slows the soft starter's response to undervoltage, avoiding trips due to momentary fluctuations.

Table 96: 5I - Overvoltage

Range		Function
*500	100–1000 V	Sets the trip point for overvoltage protection. Set as required.

Table 97: 5J - Overvoltage Delay

Range		Function
* 1 s	0:00–1:00 (minutes:seconds)	Slows the soft starter's response to overvoltage, avoiding trips due to momentary fluctuations.

Table 98: 5K - Underpower

Range		Function
*10%	10–120%	Sets the trip point for underpower protection. Set as required.

Table 99: 5L - Underpower Delay

Range		Function
*1 s	0:00–1:00 (minutes:seconds)	Slows the soft starter's response to underpower, avoiding trips due to momentary fluctuations.

Table 100: 5M - Overpower

Range		Function
*150%	80–200%	Sets the trip point for overpower protection. Set as required.

Table 101: 5N - Overpower Delay

Range		Function
* 1 s	0:00–1:00 (minutes:seconds)	Slows the soft starter's response to overpower, avoiding trips due to momentary fluctuations.

Table 102: 5O - Excess Start Time

Range		Function
*20 s	0:00–4:00 (minutes:seconds)	Excess start time is the maximum time the soft starter will attempt to start the motor. If the motor does not transition to Run mode within the programmed limit, the soft starter will trip. Set for a period slightly longer than required for a normal healthy start. A setting of 0 disables excess start time protection.

Table 103: 5P - Restart Delay

Range		Function
*10 s	00:01–60:00 (minutes:seconds)	The soft starter can be configured to force a delay between the end of a stop and the beginning of the next start. During the restart delay period, the display shows the time remaining before another start can be attempted.

Table 104: 5Q - Starts per Hour

Range		Function
*0	0–10	Sets the maximum number of starts the soft starter will attempt in a 60-minute period. A setting of 0 disables this protection.

Table 105: 5R - Phase Sequence

Option		Function
		Selects which phase sequences the soft starter allows at a start. During its pre-start checks, the soft starter examines the sequence of the phases at its input terminals and trips if the actual sequence does not match the selected option.
*	Any Sequence	
	Positive only	
	Negative Only	⚠ **N O T I C E** ⚠ When using DC brake, the mains supply must be connected to the soft starter (input terminals L1, L2, L3) in positive phase sequence and *parameter 2-1 Phase Sequence* must be set to *Positive Only*.

10.10   Parameter Group 6-** Protection Action

Table 106: 6A - Auto-Reset Count

Range		Function
*0	0-5	Sets how many times the soft starter auto-resets if it continues to trip. The reset counter increases by 1 each time the soft starter auto-resets, and resets after a successful start. Setting this parameter to 0 disables auto-reset.

Table 107: 6B - Auto-Reset Delay

Range		Function
*5 s	0:05–15:00 (minutes:seconds)	Sets a delay before the soft starter auto-resets a trip.

Table 108: 6C - Current Imbalance

Option		Function
		Selects the soft starter's response to each protection. All protection events are written to the event log.
*	Soft Trip and Log	The soft starter stops the motor as selected in *parameter 2I Stop Mode* or *parameter 3K Stop Mode*, then enters trip state. The trip must be reset before the soft starter can restart.
	Soft Trip and Reset	The soft starter stops the motor as selected in *parameter 2I Stop Mode* or *parameter 3K Stop Mode*, then enters trip state. The trip resets after the auto-reset delay

Option		Function
	Trip Starter	The soft starter removes power and the motor coasts to stop. The trip must be reset before the soft starter can restart.
	Trip and Reset	The soft starter removes power and the motor coasts to stop. The trip resets after the auto-reset delay.
	Warn and Log	The protection is written to the event log and the display shows a warning message, but the soft starter continues to operate.
	Log Only	The protection is written to the event log but the soft starter continues to operate.

Table 109: 6D - Undercurrent

Option		Function
		Selects the soft starter's response to the protection event.
*	Soft Trip and Log	
	Soft Trip and Reset	
	Trip Starter	
	Trip and Reset	
	Warn and Log	
	Log Only	

Table 110: 6E - Overcurrent

Option		Function
		Selects the soft starter's response to the protection event.
*	Soft Trip and Log	
	Soft Trip and Reset	
	Trip Starter	
	Trip and Reset	
	Warn and Log	
	Log Only	

Table 111: 6F - Undervoltage

Option		Function
		Selects the soft starter's response to the protection event.
*	Soft Trip and Log	
	Soft Trip and Reset	
	Trip Starter	
	Trip and Reset	
	Warn and Log	
	Log Only	

Table 112: 6G - Overvoltage

Option		Function
		Selects the soft starter's response to the protection event.
*	Soft Trip and Log	
	Soft Trip and Reset	
	Trip Starter	
	Trip and Reset	
	Warn and Log	
	Log Only	

Table 113: 6H - Underpower

Option		Function
		Selects the soft starter's response to the protection event.
	Soft Trip and Log	
	Soft Trip and Reset	
	Trip Starter	
	Trip and Reset	
	Warn and Log	
*	Log Only	

Table 114: 6I - Overpower

Option		Function
		Selects the soft starter's response to the protection event.
	Soft Trip and Log	
	Soft Trip and Reset	
	Trip Starter	
	Trip and Reset	
	Warn and Log	
*	Log Only	

Table 115: 6J - Excess Start Time

Option		Function
		Selects the soft starter's response to the protection event.
*	Soft Trip and Log	
	Soft Trip and Reset	
	Trip Starter	

Option		Function
	Trip and Reset	
	Warn and Log	
	Log Only	

Table 116: 6K - Input A Trip

Option		Function
		Selects the soft starter's response to the protection event.
*	Soft Trip and Log	
	Soft Trip and Reset	
	Trip Starter	
	Trip and Reset	
	Warn and Log	
	Log Only	

Table 117: 6L - Input B Trip

Option		Function
		Selects the soft starter's response to the protection event.
*	Soft Trip and Log	
	Soft Trip and Reset	
	Trip Starter	
	Trip and Reset	
	Warn and Log	
	Log Only	

Table 118: 6M - Network Communications

Option		Function
		Selects the soft starter's response to the protection event.
		If set to *Stop*, the soft starter performs a soft stop, then can be restarted without a reset.
*	Soft Trip and Log	
	Soft Trip and Reset	
	Trip Starter	
	Trip and Reset	
	Warn and Log	
	Log Only	
	Stop	

Table 119: 6N - Remote Keypad Fault

Option		Function
		Selects the soft starter's response to the protection event.
*	Soft Trip and Log	
	Soft Trip and Reset	
	Trip Starter	
	Trip and Reset	
	Warn and Log	
	Log Only	

Table 120: 6O - Frequency

Option		Function
		Selects the soft starter's response to the protection event.
*	Soft Trip and Log	
	Soft Trip and Reset	
	Trip Starter	
	Trip and Reset	
	Warn and Log	
	Log Only	

Table 121: 6P - Phase Sequence

Option		Function
		Selects the soft starter's response to the protection event.
*	Soft Trip and Log	
	Soft Trip and Reset	
	Trip Starter	
	Trip and Reset	
	Warn and Log	
	Log Only	

Table 122: 6Q - Motor Overtemperature

Option		Function
		Selects the soft starter's response to the protection event.
*	Soft Trip and Log	
	Soft Trip and Reset	
	Trip Starter	

Option		Function
	Trip and Reset	
	Warn and Log	
	Log Only	

Table 123: 6R - Motor Thermistor Circuit

Option		Function
		Selects the soft starter's response to the protection event.
*	Soft Trip and Log	
	Soft Trip and Reset	
	Trip Starter	
	Trip and Reset	
	Warn and Log	
	Log Only	

Table 124: 6S - Shorted SCR Action

Option		Function
		Selects whether the soft starter allows PowerThrough operation, if the soft starter is damaged on 1 phase. The soft starter uses 2-phase control, allowing the motor to continue operating in critical applications.
*	3-Phase Control Only	
	PowerThrough	

For more details on PowerThrough operation, see 9.4 PowerThrough.

Table 125: 6T - Battery/Clock

Option		Function
		Selects the soft starter's response to the protection event.
*	Soft Trip and Log	
	Soft Trip and Reset	
	Trip Starter	
	Trip and Reset	
	Warn and Log	
	Log Only	

10.11   Parameter Group 7-** Inputs

Table 126: 7A - Input A Function

Option		Function
		Selects the function of Input A.
	Command Override: Network	Overrides the setting of *parameter 1A Command Source* and sets the command source to the communications network.
	Command Override: Digital	Overrides the setting of *parameter 1A Command Source* and sets the command source to the digital inputs.
	Command Override: Keypad	Overrides the setting of *parameter 1A Command Source* and sets the command source to the remote LCP.
*	Input Trip (N/O)	A closed circuit across DI-A, COM+ trips the soft starter.
	Input Trip (N/C)	An open circuit across DI-A, COM+ trips the soft starter.
	Emergency Mode	A closed circuit across DI-A, COM+ activates emergency mode. When the soft starter receives a start command, it continues to run until a stop command is received, ignoring all trips and warnings.
	Jog Forward	Activates jog operation in a forward direction.
	Jog Reverse	Activates jog operation in reverse direction.
	Zero Speed Sensor	An open circuit across DI-A, COM+ indicates to the soft starter that the motor has reached a standstill. The soft starter requires a normally open zero-speed sensor.
	Motor Set Select	A closed circuit across DI-A, COM+ instructs the soft starter to use the secondary motor configuration for the next start/stop cycle.
	Reverse Direction	A closed circuit across DI-A, COM+ instructs the soft starter to reverse the phase sequence for the next start.
	Pump Clean	Activates the pump clean function.

Table 127: 7B - Input A Trip

Option		Function
		Selects when an input trip can occur.
	Always Active	A trip can occur at any time when the soft starter is receiving power.
*	Operating Only	A trip can occur while the soft starter is running, stopping, or starting.
	Run Only	A trip can only occur while the soft starter is running.

Table 128: 7C - Input A Trip Delay

Range		Function
*0 s	0:00–4:00 (minutes:seconds)	Sets a delay between the input activating and the soft starter tripping.

Table 129: 7D - Input A Initial Delay

Range		Function
* 0 s	00:00–30:00 (minutes:seconds)	Sets a delay before an input trip can occur.
		The initial delay is counted from the time a start signal is received.
		The state of the input is ignored until the initial delay has elapsed.

Table 130: 7E - Input B Function

Option		Function
		Selects the function of Input B. See *parameter 7A Input A Function* for details.
*	Input Trip (N/O)	
	Input Trip (N/C)	
	Emergency Mode	
	Jog Forward	
	Jog Reverse	
	Zero Speed Sensor	
	Motor Set Select	
	Reverse Direction	
	Pump Clean	

Table 131: 7F - Input B Trip

Option		Function
		Selects when an input trip can occur.
	Always Active	
*	Operating Only	
	Run Only	

Table 132: 7G - Input B Trip Delay

Range		Function
* 0 s	0:00–4:00 (minutes:seconds)	Sets a delay between the input activating and the soft starter tripping.

Table 133: 7H - Input B Initial Delay

Range		Function
* 0 s	00:00–30:00 (minutes:seconds)	Sets a delay before an input trip can occur.
		The initial delay is counted from the time a start signal is received.
		The state of the input is ignored until the initial delay has elapsed.

Table 134: 7I - Reset/Enable Logic

	Option	Function
		Selects whether the reset input (RESET, COM+) is normally open or normally closed.
*	Normally Closed	
	Normally Open	**⚠ NOTICE ⚠** If the reset input is active, the soft starter will not operate.

Table 135: 7J - Input A Name

	Option	Function
		Selects a message for the LCP to show when Input A is active. The custom message can be loaded via the USB port.
*	Input A Trip	
	Low Pressure	
	High Pressure	
	Pump Fault	
	Low Level	
	High Level	
	No Flow	
	Starter Disable	
	Controller	
	PLC	
	Vibration Alarm	
	Field Trip	
	Interlock Trip	
	Motor Temp	
	Motor Prot	
	Feeder Prot	
	Custom Message	

Table 136: 7K - Input B Name

	Option	Function
		Selects a message for the LCP to show when Input B is active.
*	Input B Trip	
	Low Pressure	
	High Pressure	

Option		Function
	Pump Fault	
	Low Level	
	High Level	
	No Flow	
	Starter Disable	
	Controller	
	PLC	
	Vibration Alarm	
	Field Trip	
	Interlock Trip	
	Motor Temp	
	Motor Prot	
	Feeder Prot	
	Custom Message	

10.12 Parameter Group 8-** Relay Outputs

Table 137: 8A - Relay A Function

Option		Function
		Selects the function of Relay A. Relay A is a changeover relay.
	Off	Relay A is not used.
	Ready	The relay is closed when the soft starter is in Ready state.
*	Run	The Run output closes when the soft start is complete (when the starting current drops below 120% of the programmed motor full load current) and remains closed until the beginning of a stop (either soft stop or coast to stop).
	Warning	The relay closes when the soft starter issues a warning.
	Trip	The relay closes when the starter trips.
	Low Current Flag	The relay closes when the low current flag activates while the motor is running (see *parameter 8G Low Current Flag*).
	High Current Flag	The relay closes when the high current flag activates while the motor is running (see *parameter 8H High Current Flag*).
	Motor Temperature Flag	The relay closes when the motor temperature flag activates (see *parameter 8I Motor Temperature Flag*).
	Soft Brake Relay	The relay closes when the soft starter receives a stop signal, and remains closed until the end of soft brake.

Option		Function
	Reversing Contactor	The relay controls an external contactor, for reverse operation.

Table 138: 8B - Relay A On Delay

Range		Function
* 0 s	0:00–5:00 (minutes:seconds)	Sets the delay for changing the state of Relay A.

Table 139: 8C - Relay A Off Delay

Range		Function
* 0 s	0:00–5:00 (minutes:seconds)	Sets the delay for changing the state of Relay A.

Table 140: 8D - Relay B Function

Option		Function
		Selects the function of Relay B (normally open).
		See *parameter 8A Relay A Function* for details.
	Off	
	Ready	
*	Run	
	Warning	
	Trip	
	Low Current Flag	
	High Current Flag	
	Motor Temperature Flag	
	Soft Brake Relay	
	Reversing Contactor	

Table 141: 8E - Relay B On Delay

Range		Function
* 0 s	0:00–5:00 (minutes:seconds)	Sets the delay for closing Relay B.

Table 142: 8F - Relay B Off Delay

Range		Function
* 0 s	0:00–5:00 (minutes:seconds)	Sets the delay for re-opening Relay B.

Table 143: 8G - Low Current Flag

Range		Function
* 50%	1–100% FLC	The soft starter has low and high current flags to give early warning of abnormal operation. The current flags can be configured to indicate an abnormal current level during operation, between the normal operating level and the undercurrent or instantaneous overcurrent trip levels. The flags can signal the situation to external equipment via 1 of the programmable outputs. The flags clear when the current returns within the normal operating range by 10% of the programmed flag value. Set the level at which the low current flag operates, as a percentage of motor full load current.

Table 144: 8H - High Current Flag

Range		Function
*100%	50–600% FLC	Sets the level at which the high current flag operates as a percentage of motor full load current.

Table 145: 8I - Motor Temperature Flag

Range		Function
* 80%	0–160%	The soft starter has a motor temperature flag to give early warning of abnormal operation. The flag can indicate that the motor is operating above its normal operating temperature but lower than the overload limit. The flag can signal the situation to external equipment via 1 of the programmable outputs. Set the level at which the motor temperature flag operates as a percentage of the motor's thermal capacity.

Table 146: 8J - Main Contactor Time

Range		Function
*400 ms	100–2000 ms	Sets the delay period between the soft starter switching the main contactor output (terminals 13, 14) and beginning the pre-start checks (before a start), or entering the not ready state (after a stop). Set according to the specifications of the main contactor used.

10.13   Parameter Group 9-** Analog Output

Table 147: 9A - Analog Output A

Option		Function
		Selects which information will be reported via the analog output.
*	Current (% FLC)	Current as a percentage of motor full load current.
	Motor Temp (%)	The motor's temperature, calculated by the thermal model.
	Motor pf	Motor power factor, measured by the soft starter.
	Motor Power (%kW)	Motor power, as a percentage of the programmed power.
	Heat Sink Temperature (°C)	The soft starter's temperature, measured at the heat sink.

Table 148: 9B - Analog A Scale

Range		Function
		Selects the range of the analog output.
	0–20 mA	
*	4–20 mA	

Table 149: 9C - Analog A Maximum Adjustment

Range		Function
* 100%	0–600%	Calibrates the upper limit of the analog output to match the signal measured on an external current measuring device.

Table 150: 9D - Analog A Minimum Adjustment

Range		Function
* 0%	0–600%	Calibrates the lower limit of the analog output to match the signal measured on an external current measuring device.

10.14 Parameter Group 10-** Display

Table 151: 10A - Language

Option		Function
		Selects which language the LCP shows to display messages and feedback.
*	English	
	Chinese	
	Español	
	Deutsch	
	Português	
	Français	
	Italiano	
	Russian	

Table 152: 10B - Temperature Scale

Option		Function
		Selects whether the soft starter displays temperatures in degrees Celsius or Fahrenheit.
*	Celsius	
	Fahrenheit	

Table 153: 10C - Graph Timebase

Option		Function
		Sets the graph time scale.
		The graph will progressively replace the old data with new data.
*	30 seconds	
	1 minute	
	30 minutes	
	1 hour	

Table 154: 10D - Graph Maximum Adjustment

Range		Function
* 400%	0–600%	Adjusts the upper limit of the performance graph.

Table 155: 10E - Graph Minimum Adjustment

Range		Function
*0%	0–600%	Adjusts the lower limit of the performance graph.

Table 156: 10F - Current Calibration

Range		Function
*100%	85–115%	Calibrates the soft starter's current monitoring circuits to match an external current metering device. Use the following formula to determine the necessary adjustment: $$\text{Calibration}\,(\%) = \frac{\text{Current shown on soft starter display}}{\text{Current measured by external device}}$$

Table 157: 10G - Adjustment Lock

Option		Function
		Selects whether the LCP will allow parameters to be changed via the Main Menu.
*	Read & Write	Allows users to alter parameter values in the Main Menu.
	Read Only	Prevents users altering parameter values in the Main Menu. Parameter values can still be viewed.

Table 158: 10H - User Parameter 1

Option		Function
		Selects which information is shown on the main monitoring screen.
	Blank	Shows no data in the selected area, allowing long messages to be shown without overlapping.
*	Current	Average rms current across all 3 phases.
	Motor Voltage	Average rms voltage across all 3 phases.

Option		Function
	P1 Voltage	Phase 1 voltage.
	P2 Voltage	Phase 2 voltage.
	P3 Voltage	Phase 3 voltage.
	Mains Frequency	The average frequency measured on 3 phases.
	Motor pf	The motor's power factor, measured by the soft starter.
	Motor Power	The motor's running power in kilowatts.
	Motor Temp (%)	The motor's temperature, calculated by the thermal model.
	Hours Run	The number of hours the motor has run via the soft starter.
	Number of Starts	The number of starts the soft starter has completed since the start counter was last reset.
	Pump Pressure	The pressure at the pump, as configured in *parameters 30B* to *30D*. This information is only available if the smart card is installed.
	Pump Flow	The flow at the pump, as configured in *parameters 30F* to *30K*. This information is only available if the smart card is installed.
	Well Depth	The depth of the well, as configured in *parameters 30M* to *30O*. This information is only available if the smart card is installed.
	Pump Temperature	The pump temperature, as measured by the PT100. This information is only available if the smart card is installed.
	Analog Output Value	The value of the analog output (see *parameter group 9-** Analog Output*).
	Heat Sink Temperature	The soft starter's temperature measured at the heat sink.
	Bypass Model (%)	The percentage of thermal capacity remaining in the bypass contactor.
	SCR Temperature	The temperature of the SCRs calculated by the thermal model.
	Rating Capacity (%)	The thermal capacity available in the soft starter for its next start.

Table 159: 10I - User Parameter 2

Option		Function
		Selects which information is shown on the main monitoring screen. See *parameter 10H User Parameter 1* for details.
*	Motor Voltage	See *parameter 10H User Parameter 1* for details.

Table 160: 10J - User Parameter 3

Option		Function
		Selects which information is shown on the programmable monitoring screen. See *parameter 10H User Parameter 1* for details.
*	Mains Frequency	See *parameter 10H User Parameter 1* for details.

Table 161: 10K - User Parameter 4

Option		Function
		Selects which information is shown on the programmable monitoring screen. See *parameter 10H User Parameter 1* for details.
*	Motor pf	See *parameter 10H User Parameter 1* for details.

Table 162: 10L - User Parameter 5

Option		Function
		Selects which information is shown on the programmable monitoring screen. See *parameter 10H User Parameter 1* for details.
*	Motor Power	See *parameter 10H User Parameter 1* for details.

Table 163: 10M - User Parameter 6

Option		Function
		Selects which information is shown on the programmable monitoring screen. See *parameter 10H User Parameter 1* for details.
*	Motor Temp (%)	See *parameter 10H User Parameter 1* for details.

10.15 Parameter Group 11-** Pump Clean

Table 164: 11A - Reverse Torque

Range		Function
* 20%	20–100%	Sets the torque level for reverse jog operation during pump clean.

Table 165: 11B - Reverse Time

Range		Function
* 10 s	0:00–1:00 (minutes:seconds)	Sets the time for the starter to operate in reverse jog during a pump clean cycle.

Table 166: 11C - Forward Current Limit

Range		Function
*100%	100–600% FLC	Sets the current limit for forward start operation during pump clean.

Table 167: 11D - Forward Time

Range		Function
* 10 s	0:00–1:00 (minutes:seconds)	Sets the time for the soft starter to run the motor after a forward start during a pump clean cycle.

Table 168: 11E - Pump Stop Mode

Option		Function
		Selects the stop mode for pump clean.
*	Coast To Stop	
	TVR Soft Stop	
	Adaptive Control	

Table 169: 11F - Pump Stop Time

Range		Function
* 10 s	0:00–1:00 (minutes:seconds)	Sets the stopping time for the starter during a pump clean cycle.

Table 170: 11G - Pump Clean Cycles

Range		Function
* 1	1–5	Sets how many times the soft starter repeats the pump clean cycle.

10.16   Parameter Group 12-** Communication Card

Table 171: 12 A - Modbus Address

Range		Function
* 1	1–254	Sets the Modbus RTU network address for the soft starter.

Table 172: 12B - Modbus Baud Rate

Option		Function
		Selects the baud rate for Modbus RTU communications.
	4800	
*	9600	
	19200	
	38400	

Table 173: 12C - Modbus Parity

Option		Function
		Selects the parity for Modbus RTU communications.
*	None	
	Odd	
	Even	
	10-bit	

Table 174: 12D - Modbus Timeout

Option		Function
		Selects the timeout for Modbus RTU communications.
*	Off	
	10 seconds	
	60 seconds	
	100 seconds	

Table 175: 12E - Devicenet Address

Range		Function
*0	0–63	Sets the DeviceNet network address for the soft starter.

Table 176: 12F - Devicenet Baud Rate

Option		Function
		Selects the baud rate for DeviceNet communications.
*	125 kB	
	250 kB	
	500 kB	

Table 177: 12G - Profibus Address

Range		Function
*1	1–125	Sets the PROFIBUS network address for the soft starter.

Table 178: 12H - Gateway Address

Range		Function
*192	0–255	Sets the 1st component of the network gateway address. The gateway address is set using *parameters 12H* to *12K* and the default address is 192.168.0.100.

Table 179: 12I- Gateway Address 2

Range		Function
*168	0–255	Sets the 2nd component of the network gateway address.

Table 180: 12J- Gateway Address 3

Range		Function
*0	0–255	Sets the 3rd component of the network gateway address.

Table 181: 12k- Gateway Address 4

Range		Function
*100	0–255	Sets the 4th component of the network gateway address.
		⚠ N O T I C E ⚠
		The network address can also be set via the Network Address options in *Set-up Tools*.

Table 182: 12L- IP Address

Range		Function
*192	0–255	Sets the 1st component of the soft starter's IP address for Ethernet communications. The IP address is set using *parameter 12L* to *12O* and the default address is 192.168.0.2.

Table 183: 12M- IP Address 2

Range		Function
*168	0–255	Sets the 2nd component of the soft starter's IP address for Ethernet communications.

Table 184: 12N- IP Address 3

Range		Function
*0	0–255	Sets the 3rd component of the soft starter's IP address for Ethernet communications.

Table 185: 12O- IP Address 4

Range		Function
*2	0–255	Sets the 4th component of the soft starter's IP address for Ethernet communications.
		⚠ N O T I C E ⚠
		The network address can also be set via the Network Address options in the *Set-up Tools*.

Table 186: 12P - Subnet Mask

Range		Function
*255	0–255	Sets the 1st component of the network subnet mask for Ethernet communications. The subnet mask is set using *parameters 12P* to *12S* and the default mask is 255.255.255.0.

Table 187: 12Q - Subnet Mask 2

Range		Function
*255	0–255	Sets the 2nd component of the network subnet mask for Ethernet communications.

Table 188: 12R - Subnet Mask 3

Range		Function
*255	0–255	Sets the 3rd component of the network subnet mask for Ethernet communications.

Table 189: 12S - Subnet Mask 4

Range		Function
*0	0–255	Sets the 4th component of the network subnet mask for Ethernet communications. ⚠ **N O T I C E** ⚠ The network address can also be set via the Network Address options in the *Set-up Tools*.

Table 190: 12T - DHCP

Option		Function
		Selects whether the communications card will accept an IP address assigned by DHCP.
*	Disable	
	Enable	⚠ **N O T I C E** ⚠ DHCP addressing is available with Modbus TCP and Ethernet/IP. DHCP addressing is not supported with PRO-FINET.

Table 191: 12U - Location ID

Range		Function
*0	0–65535	Sets the soft starter's unique location ID.

10.17 Parameter Group 20-** Advanced

Table 192: 20A - Tracking Gain

Range		Function
*50%	1–200%	Fine-tunes the behavior of the adaptive control algorithm.

Table 193: 20B - Pedestal Detect

Range		Function
* 80%	0–200%	Adjusts the behavior of the adaptive control algorithm for soft stop.

Table 194: 20C - Bypass Contactor Delay

| Range		Function
*150 ms	100–2000 ms	Sets the soft starter to match the bypass contactor closing/opening time. Set according to the specifications of the bypass contactor used. If this time is too short, the soft starter will trip.

Table 195: 20D- Model Rating

Range		Function
*Model dependent	0020~0580	The soft starter's internal model reference, as shown on the silver label on the side of the unit. **⚠ NOTICE ⚠** This parameter can only be adjusted by authorized servicing agents.

Table 196: 20E- Screen Timeout

Option		Function
		Sets the timeout for the menu to automatically close if no LCP activity is detected.
*	1 minute	
	2 minutes	
	3 minutes	
	4 minutes	
	5 minutes	

Table 197: 20F - Motor Connection

Option		Function
		Selects whether the soft starter will automatically detect the format of the connection to the motor.
*	Auto-detect	
	In-line	
	Inside delta	

10.18 Parameter Group 30-** Pump Input Configuration

Table 198: 30A - Pressure Sensor Type

Option		Function
		Selects which type of sensor is associated with the pressure sensor input on the smart card.
*	None	
	Switch	
	Analog	

Table 199: 30B - Pressure Units

Option		Function
		Selects which units the sensor will use to report the measured pressure.
	Bar	
*	kPa	
	Psi	

Table 200: 30C - Pressure at 4 mA

Range		Function
*0	0–5000	Calibrates the soft starter to the 4 mA (0%) level of the pressure sensor input.

Table 201: 30D - Pressure at 20 mA

Range		Function
*0	0–5000	Calibrates the soft starter to the 20 mA (100%) level of the pressure sensor input.

Table 202: 30E - Flow Sensor Type

Option		Function
		Selects which type of sensor is associated with the flow sensor input on the smart card.
*	None	
	Switch	
	Analog	
	Pulses per minute	
	Pulses per unit	

Table 203: 30F - Flow Units

Option		Function
		Selects which units the sensor will use to report the measured flow.
*	liters/second	
	liters/minute	

Option		Function
	gallons/second	
	gallons/minute	

Table 204: 30G - Flow at 4 mA

Range		Function
*0	0–5000	Calibrates the soft starter to the 4 mA (0%) level of the flow sensor input.

Table 205: 30H - Flow at 20 mA

Range		Function
*0	0–5000	Calibrates the soft starter to the 20 mA (100%) level of the flow sensor input.

Table 206: 30I - Units per Minute at Max Flow

Range		Function
*0	0 – 5000	Calibrates the soft starter to the maximum flow volume of the flow sensor.

Table 207: 30J - Pulses per Minute at Max Flow

Range		Function
*0	0 – 20000	Calibrates the soft starter to the maximum flow volume of the flow sensor.

Table 208: 30K - Units per Puls

Range		Function
*0	0 – 1000	Set to match how many units the flow sensor will measure for each pulse.

Table 209: 30L - Depth Sensor Type

Option		Function
		Selects which type of sensor is associated with the depth sensor input on the smart card.
*	None	
	Switch	
	Analog	

Table 210: 30M - Depth Units

Option		Function
		Selects which units the sensor will use to report the measured depth.
*	meters	
	feet	

Table 211: 30N - Depth at 4 mA

Range		Function
*0	0–1000	Calibrates the soft starter to the 4 mA (0%) level of the depth sensor input.

Table 212: 30O - Depth at 20 mA

Range		Function
*0	0–1000	Calibrates the soft starter to the 20 mA (100%) level of the depth sensor input.

10.19 Parameter Group 31-** Flow Protection

⚠ **N O T I C E** ⚠

The parameters in this group are only active if a smart card is installed.

Flow protection uses termianls B33, B34 or C23, C24 on the smart card.

Table 213: 31A - High Flow Trip Level

Range		Function
*10	0–5000	Sets the trip point for high flow protection.

Table 214: 31B - Low Flow Trip Level

Range		Function
* 5	1–5000	Sets the trip point for low flow protection.

Table 215: 31C - Flow Start Delay

Range		Function
*00:00:500 ms	00:00:100–30:00:000 mm:ss:ms	Sets a delay before a flow protection trip can occur. The delay is counted from the time a start signal is received. The flow level is ignored until the start delay has elapsed.

Table 216: 31D - Flow Response Delay

Range		Function
* 00:00:500 ms	00:00:100–30:00:000 mm:ss:ms	Sets a delay between the flow passing the high or low flow trip levels, and the soft starter tripping.

10.20 Parameter Group 32-** Pressure Protection

⚠ **N O T I C E** ⚠

The parameters in this group are only active if a smart card is installed.

Pressure protection uses terminals B23, B24 or C33, C34, C44 on the smart card.

Table 217: 32A - High Pressure Trip Level

Range		Function
*10	0–5000	Sets the trip point for high pressure protection.

Table 218: 32B - High Pressure Start Delay

Range		Function
* 0.5 s	00:00:100 – 30:00:000 mm:ss:ms	Sets a delay before a high pressure protection trip can occur. The delay is counted from the time a start signal is received. The pressure is ignored until the start delay has elapsed.

Table 219: 32C - High Pressure Response Delay

Range		Function
* 0.5 s	00:00:100–30:00:000 mm:ss:ms	Sets a delay between the pressure passing the high pressure trip level, and the soft starter tripping.

Table 220: 32D - Low Pressure Trip Level

Range		Function
* 5	0–5000	Sets the trip point for low pressure protection.

Table 221: 32E - Low Pressure Start Delay

Range		Function
* 0.5 s	00:00:100–30:00:000 mm:ss:ms	Sets a delay before a low pressure protection trip can occur. The delay is counted from the time a start signal is received. The pressure is ignored until the start delay has elapsed.

Table 222: 32F - Low Pressure Response Delay

Range		Function
* 0.5 s	00:00:100–30:00:000 mm:ss:ms	Sets a delay between the pressure passing the low pressure trip level, and the soft starter tripping.

10.21 Parameter Group 33-** Pressure Control

> ⚠ **N O T I C E** ⚠
>
> The parameters in this group are only active if a smart card is installed.

Pressure control uses terminals B23, B24 on the smart card. Use an anlog 4–20 mA sensor.

Table 223: 33A - Pressure Control Mode

Option		Function
		Selects how the soft starter uses data from the pressure sensor to control the motor.
*	Off	The soft starter does not use the pressure sensor to control soft starting.
	Falling Pressure Start	The soft starter starts when the pressure drops below the level selected in *Parameter 33B Start Pressure Level*.
	Rising Pressure Start	The soft starter starts when the pressure rises above the level selected in *Parameter 33B Start Pressure Level*.

Table 224: 33B - Start Pressure Level

Range		Function
* 5	1–5000	Sets the pressure level to trigger the soft starter to perform a soft start.

Table 225: 33C - Start Response Delay

Range		Function
* 0.5 s	00:00:100–30:00:000 mm:ss:ms	Sets a delay between the pressure passing the pressure control start level, and the soft starter performing a soft start.

Table 226: 33D - Stop Pressure Level

Range		Function
* 10	0–5000	Sets the pressure level to trigger the soft starter to stop the motor.

Table 227: 33E - Stop Response Delay

Range		Function
* 0.5 s	00:00:100–30:00:000 mm:ss:ms	Sets a delay between the pressure passing the pressure control stop level, and the soft starter stopping the motor.

10.22　Parameter Group 34-** Depth Protection

⚠ **N O T I C E** ⚠
The parameters in this group are only active if a smart card is installed.

Depth protection uses terminals B13, B14 or C13, C14 on the smart card.

Table 228: 34A - Depth Trip Level

Range		Function
* 5	0–1000	Sets the trip point for depth protection.

Table 229: 34B - Depth Reset Level

Range		Function
* 10	0–1000	Sets the level for the soft starter to auto-reset a depth trip.

Table 230: 34C - Depth Start Delay

Range		Function
* 0.5 s	00:00:100–30:00:000 mm:ss:ms	Sets a delay before a depth protection trip can occur. The delay is counted from the time a start signal is received. The depth input is ignored until the start delay has elapsed.

Table 231: 34D - Depth Response Delay

Range		Function
* 0.5 s	00:00:100–30:00:000 mm:ss:ms	Sets a delay between the depth passing the depth protection trip level, and the soft starter tripping.

10.23 Parameter Group 35-** Thermal Protection

> ⚠ **NOTICE** ⚠
>
> The parameters in this group are only active if a smart card is installed.

Table 232: 35A - Temperature Sensor Type

Option		Function
		Selects which type of sensor is associated with the temperature sensor input on the smart card.
*	None	
	PTT100	

Table 233: 35B - Temperature Trip Level

Range		Function
* 40 °C	0–240 °C	Sets the trip point for temperature protection. Use *Parameter 10B Temperature Scale* to configure the temperature scale.

10.24 Parameter Group 36-** Pump Trip Action

Table 234: 36A - Pressure Sensor

Option		Function
		Selects the soft starter's response if it detects a fault with the pressure sensor.
*	Soft and Trip Log	
	Soft Trip and Reset	

	Option	Function
	Trip Starter	
	Trip and Reset	
	Warn and Log	
	Log Only	

Table 235: 36B - Flow Sensor

	Option	Function
		Selects the soft starter's response if it detects a fault with the flow sensor.
*	Soft Trip and Log	
	Soft Trip and Reset	
	Trip Starter	
	Trip and Reset	
	Warn and Log	
	Log Only	

Table 236: 36C - Depth Sensor

	Option	Function
		Selects the soft starter's response if it detects a fault with the depth sensor.
*	Soft Trip and Log	
	Soft Trip and Reset	
	Trip Starter	
	Trip and Reset	
	Warn and Log	
	Log Only	

Table 237: 36D - High Pressure

	Option	Function
		Selects the soft starter's response if the pressure exceeds the high pressure trip level (*parameter 32A High Pressure Trip Level*) or the high pressure switch sensor closes.
*	Soft Trip and Log	
	Soft Trip and Reset	
	Trip Starter	
	Trip and Reset	
	Warn and Log	
	Log Only	

Table 238: 36E - Low Pressure

	Option	Function
		Selects the soft starter's response if the pressure drops below the low pressure trip level (*parameter 32D Low Pressure Trip Level*) or the low pressure sensor switch closes.
*	Soft Trip and Log	
	Soft Trip and Reset	
	Trip Starter	
	Trip and Reset	
	Warn and Log	
	Log Only	

Table 239: 36F - High Flow

	Option	Function
		Selects the soft starter's response if the flow exceeds the high flow trip level (*parameter 31A High Flow Trip Level*).
*	Soft Trip and Log	
	Soft Trip and Reset	
	Trip Starter	
	Trip and Reset	
	Warn and Log	
	Log Only	

Table 240: 36G - Low Flow

	Option	Function
		Selects the soft starter's response if the flow drops below the low flow trip level (set in *parameter 31B Low Flow Trip Level*).
*	Soft Trip and Log	
	Soft Trip and Reset	
	Trip Starter	
	Trip and Reset	
	Warn and Log	
	Log Only	

Table 241: 36H - Flow Switch

	Option	Function
		Selects the soft starter's response if the flow sensor closes (switch type sensors only).
*	Soft Trip and Log	

	Option	Function
	Soft Trip and Reset	
	Trip Starter	
	Trip and Reset	
	Warn and Log	
	Log Only	

Table 242: 36I - Well Depth

	Option	Function
		Selects the soft starter's response if the depth drops below the depth trip level (*parameter 34A Depth Trip Level*) or the depth switch sensor closes.
*	Soft Trip and Log	
	Soft Trip and Reset	
	Trip Starter	
	Trip and Reset	
	Warn and Log	
	Log Only	

Table 243: 36J - RTD/PT100 B

	Option	Function
		Selects the soft starter's response to the protection event.
*	Soft Trip and Log	
	Soft Trip and Reset	
	Trip Starter	
	Trip and Reset	
	Warn and Log	
	Log Only	

11 Application Examples

11.1 Smart Card - Pump Control and Protection

The VLT® Soft Starter MCD 600 smart card is ideal for appplications with extensive external inputs, such as pumping situations where external sensors provide additional protection to the pump and motor.

In this example, the MCD 600 controls a bore pump via scheduled start/stop operation. The control panel is fitted with a 3-way selector allowing Auto Run, Stop, or Manual Run. Three 4–20 mA transducers are used to monitor water depth, pipe pressure, and flow.
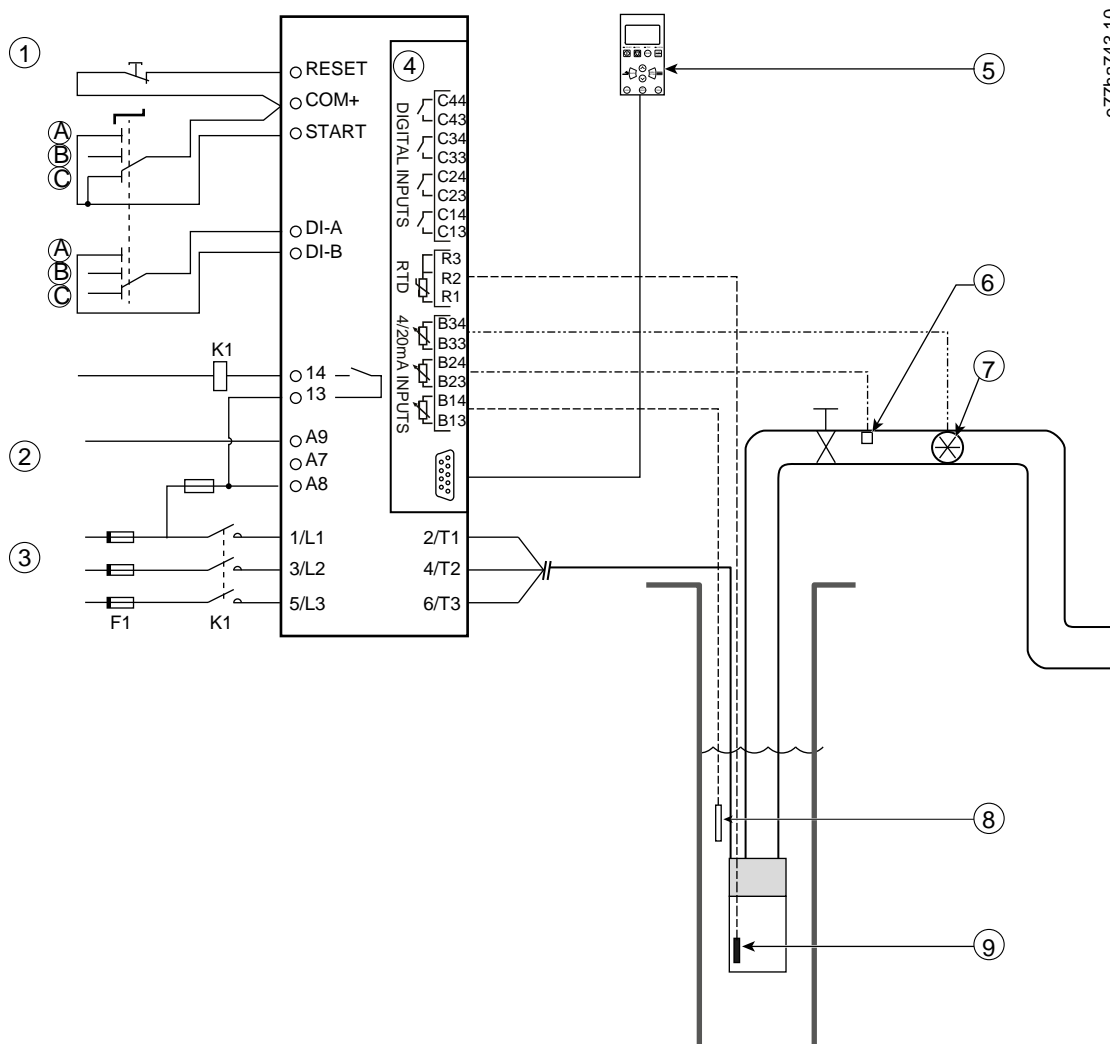
1	Digital inputs	**2**	Control voltage
3	Three-phase supply	**4**	Smart card
5	Remote LCP (optional)	**6**	Pressure sensor
7	Flow sensor	**8**	Depth sensor
9	Temperature sensor	**A**	Manual start

B	Manual stop	**C**	Automatic operation (scheduled start/stop)
K1	Main contactor	**RESET, COM+**	Reset input
START, COM+	Start/stop input	**DI-A, COM+**	Programmable input A (set = Command Override: Digital)
13, 14	Main contactor output	**R1, R2, R3**	Motor temperature protection
B33, B34	Flow protection	**B23, B24**	Pressure protection
B13, B14	Depth protection		

Illustration 37:   Application Example, Pump Control and Protection

Parameter settings:

- *Parameter 1A Command Source*: Select *Smart Card + Clock*.
- *Parameters 4A* to *4X Auto-Start/Stop*: Set as required.
- *Parameter 7A Input A Function*: Select *Command Override: Digital*.
- *Parameters 30A* to *30O Pump Input Configuration*: Set as required.
- *Parameter 31A* to *31D Flow Protection*: Set as required.
- *Parameter 32A* to *32F Pressure Protection*: Set as required.
- *Parameter 34A* to *34D Depth Protection*: Set as required.
- *Parameter 35A* to *35B Thermal Protection*: Set as required.

11.2 Smart Card - Level-controlled Pump Activation

The VLT® Soft Starter MCD 600 smart card can be used to control start/stop activation of the soft starter, based on information from external inputs.

In this example, the MCD 600 controls a pump which fills a tank with maximum and minimum water levels. A pressure sensor is used to monitor the level of water in the tank and trigger the pump to fill the tank when water drops below the minimum level, and shut off the pump when the maximum water level is reached.

A 3-way selector switch allows the user to override sensor-based control and manually start and stop the motor.

Illustration 38:   Application Example, Level-controlled Pump Activation
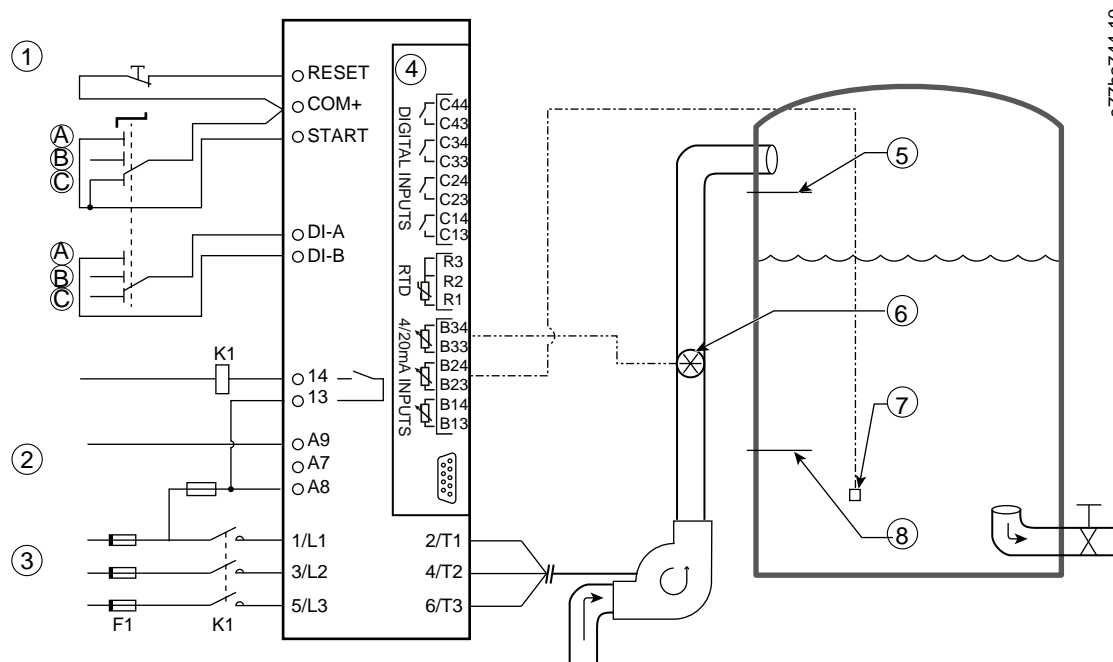
1	Digital inputs	**2**	Control voltage
3	Three-phase supply	**4**	Smart card
5	Maximum water level	**6**	Flow sensor
7	Pressure sensor	**8**	Minimum water level
K1	Main contactor	**RESET, COM+**	Reset input
START, COM+	Start/stop input	**DI-A, COM+**	Programmable input A (set = Command Override: Digital)
13, 14	Main contactor output	**B33, B34**	Flow protection
B23, B24	Pressure or depth-based control		

Parameter settings:

- *Parameter 1A Command Source*: Select *Smart Card*.
- *Parameter 7A Input A Function*: Select *Command Override: Digital*.
- *Parameters 30A* to *30O Pump Input Configuration*: Set as required.
- *Parameter 31A* to *31D Flow Protection*: Set as required.
- *Parameter 33A* to *33E Pressure Control*: Set as required.

12 Troubleshooting

12.1 Protection Responses

When a protection condition is detected, the soft starter writes this to the event log and may also trip or issue a warning. The soft starter's response depends on the settings in *parameter group 6-** Protection Action*.

Some protection responses cannot be adjusted by the user. These trips are usually caused by external events (such as phase loss) or by a fault within the soft starter. These trips do not have associated parameters and cannot be set to *Warn or Log*.

If the soft starter trips, identify and clear the condition that triggered the trip, then reset the soft starter before restarting. To reset the soft starter, press [Reset] on the LCP or activate the reset remote input.

If the soft starter has issued a warning, it resets itself once the cause of the warning has been resolved.

12.2 Trip Messages

Table 244: Trip Messages

Display	Possible cause/suggested solution
2-phase Damaged SCR	This message is shown if the soft starter has tripped on *Lx-Tx shorted* during the prestart checks and PowerThrough is enabled. It indicates that the soft soft starter now operates in PowerThrough mode (2-phase control only). Check for either a shorted SCR or a short within the bypass contactor. Related parameter: • *Parameter 6S Shorted SCR Action.*
Battery/clock	A verification error has occurred on the real-time clock, or the back-up battery voltage is low. If the battery is low and the power is off, date/time settings are lost. Reprogram the date and time. The battery is not removable. To replace the battery, the main control PCB must be replaced. Related parameter: • *Parameter 6T Battery Clock.*
Bypass overload	This trip is not adjusted. Bypass overload protection protects the soft starter from severe operating overloads while running. The soft starter trips if it detects overcurrent at 600% of the contactor rating. Related parameters: None.
Current imbalance	Problems with the motor, the environment, or the installation can cause current imbalance, such as: • An imbalance in the incoming mains voltage. • A problem with the motor windings. • A light load on the motor. • A phase loss on mains terminals L1, L2, or L3 during Run mode. • An SCR that has failed open circuit. A failed SCR can only be diagnosed accurately by replacing the SCR and checking the soft starter performance. Related parameters: • *Parameter 5A Current Imbalance.* • *Parameter 5B Current Imbalance Delay.* • *Parameter 6C Current Imbalance.*
Current read err lx	Where X is 1, 2, or 3. Internal fault (PCB fault). The output from the current transformer circuit is not close enough to 0 when the SCRs are turned off. Contact the local Danfoss supplier for advice. Related parameters: None.
Depth sensor	The smart card has detected a fault with the depth sensor. Related parameters: • *Parameter 30L Depth Sensor Type.* • *Parameter 36C Depth Sensor.*

Display	Possible cause/suggested solution
EEPROM fail	An error occurred loading data from the EEPROM to RAM when the LCP powered up. If the problem persists, contact the local distributor. Related parameters: None.
Excess start time	Excess start time trip can occur under the following conditions: • *Parameter 1B Motor Full Load Current* is not appropriate for the motor. • *Parameter 2D Current Limit* has been set too low. • *Parameter 2B Start Ramp Time* has been set greater than the setting for *parameter 5O Excess Start Time*. • *Parameter 2B Start Ramp Time* is set too short for a high inertia load when using adaptive control. Related parameters: • *Parameter 1B Motor Full Load Current*. • *Parameter 2B Start Ramp Time*. • *Parameter 2D Current Limit*. • *Parameter 3D Start Ramp Time-2*. • *Parameter 3F Current Limit-2*.
Firing fails px	Where X is phase 1, 2, or 3. The SCR did not fire as expected. Check for faulty SCRs and internal wiring faults. Related parameters: None.
FLC too high	If the soft starter is connected to the motor using inside delta configuration, the soft starter may not be correctly detecting the connection. Contact the local supplier for advice. Related parameters: • *Parameter 20F Motor Connection*
Flow sensor	The smart card has detected a fault with the flow sensor. Related parameters: • *Parameter 30E Flow Sensor Type*. • *Parameter 36B Flow Sensor*.
Flow switch	The flow switch sensor (smart card terminals C23, C24) has closed. Related parameters: • *Parameter 30E Flow Sensor Type*. • *Parameter 36H Flow Switch*.
Frequency	This trip is not adjustable. The mains frequency is outside of the specified range. Check for other equipment in the area that could be affecting the mains supply, particularly frequency converters and switch mode power supplies (SMPS). If the soft starter is connected to a generator-set supply, the generator may be too small or could have a speed control problem. Related parameter: • *Parameter 6O Frequency*.
Heat sink overtem-perature	• Check that bypass contactors are operating. • Check that cooling fans are operating (MCD6-0064B~MCD6-0579B). • If mounted in an enclosure, check if ventilation is adequate. • Mount the VLT® Soft Starter MCD 600 vertically. Related parameters: None.
High flow	The flow sensor connected to the smart card has activated high-flow protection. Related parameters: • *Parameter 30E Flow Sensor Type*. • *Parameter 30G Flow at 4 mA*. • *Parameter 30H Flow at 20 mA*. • *Parameter 31A High Flow Trip Level*. • *Parameter 31C Flow Start Delay*. • *Parameter 31D Flow Response Delay*. • *Parameter 36F High Flow*.

Display	Possible cause/suggested solution
High pressure	The pressure sensor connected to the smart card has activated high-flow protection. Related parameters: • *Parameter 30A Pressure Sensor Type*. • *Parameter 30C Pressure at 4 mA*. • *Parameter 30D Pressure at 20 mA*. • *Parameter 32A High Pressure Trip Level*. • *Parameter 32B High Pressure Start Delay*. • *Parameter 32C High Pressure Response Delay*. • *Parameter 36D High Pressure*.
Input A trip Input B trip	The programmable input is set to a trip function and has activated. Resolve the trigger condition. Related parameters: • *Parameter 7A Input A Function*. • *Parameter 7B Input A Trip*. • *Parameter 7C Input A Trip Delay*. • *Parameter 7D Input A Initial Delay*. • *Parameter 7E Input B Function*. • *Parameter 7F Input B Trip*. • *Parameter 7G Input B Trip Delay*. • *Parameter 7H Input B Initial Delay*.
Instant overcurrent	This trip is not adjustable. The current on all 3 phases has exceeded 7.2 times the value of *parameter 1B Motor Full Load Current*. Causes can include a locked rotor condition or an electrical fault in the motor or cabling. Related parameters: None.
Internal fault X	Where X is a number. This trip is not adjustable. The soft starter has tripped on an internal fault. Contact the local supplier with the fault code (X).
Internal fault 88	The soft starter firmware does not match the hardware.
LCP disconnected	*Parameter 1A Command Source* is set to *Remote Keypad*, but the soft starter cannot detect a remote LCP. If a remote LCP is installed, check that the cable is firmly connected to the soft starter. If no remote LCP is installed, change the setting of *parameter 1A Command Source*. Related parameters: • *Parameter 1A Command Source*.
L1 phase loss L2 phase loss L3 phase loss	This trip is not adjustable. During prestart checks, the soft starter has detected a phase loss as indicated. In run state, the soft starter has detected that the current on the affected phase has dropped below 2% of the programmed motor FLC for more than 1 s. This current drop indicates that either the incoming phase or connection to the motor has been lost. For the soft starter and the motor, check: • The supply connections. • The input connections. • The output connections. Related parameters: None.
L1-T1 shorted L2-T2 shorted L3-T3 shorted	During prestart checks, the soft starter has detected a short-circuited SCR or a short circuit within the bypass contactor as indicated. Consider using PowerThrough to allow operation until the soft starter can be repaired. Related parameters: • *Parameter 6S Shorted SCR Action*.

Display	Possible cause/suggested solution
Low control volts	The soft starter has detected a drop in the internal control voltage. • Check the external control supply (terminals A7, A8, A9) and reset the soft starter. If the external control supply is stable: • Check if the 24 V supply on the main control PCB is faulty; or • Check if the bypass driver PCB is faulty. Contact the local supplier for advice. This protection is not active in ready state. Related parameters: None.
Low flow	The flow sensor connceted to the smart card has activated low flow protection. Related parameters: • *Parameter 30E Flow Sensor Type*. • *Parameter 30G Flow at 4 mA*. • *Parameter 30H Flow at 20 mA*. • *Parameter 31B Low Flow Trip Level*. • *Parameter 31C Flow Start Delay*. • *Parameter 31D Flow Response Delay*. • *Parameter 36G Low Flow*.
Low pressure	The pressure sensor connected to the smart card has activated low pressure protection. Related parameters: • *Parameter 30A Pressure Sensor Type*. • *Parameter 30C Pressure at 4 mA*. • *Parameter 30D Pressure at 20 mA*. • *Parameter 32D Low Pressure Trip Level*. • *Parameter 32E Low Pressure Start Delay*. • *Parameter 32F Low Pressure Response Delay*. • *Parameter 36E Low Pressure*.
Low water	The depth sensor connected to the smart card has activated depth protection. Related parameters: • *Parameter 30L Depth Sensor Type*. • *Parameter 30N Depth at 4 mA*. • *Parameter 30O Depth at 20 mA*. • *Parameter 34A Depth Trip Level*. • *Parameter 34B Depth Reset Level*. • *Parameter 34C Depth Start Relay*. • *Parameter 36I Well Depth*.
Motor Connection Tx	Where X is 1, 2, or 3. The motor is connected correctly to the soft starter. • Check individual motor connections to the soft starter for power circuit continuity. • Check connections at the motor terminal box. This trip is not adjustable. Related parameters: None.

Display	Possible cause/suggested solution
Motor over-load	The motor has reached its maximum thermal capacity. The following can cause overload: • The soft starter protection settings do not match the motor thermal capacity. • Excessive starts per hour or start duration. • Excessive current. • Damage to the motor windings. Resolve the cause of the overload and allow the motor to cool. Related parameters: • *Parameter 1B Motor Full Load Current*. • *Parameter 1D Locked Rotor Time*. • *Parameter 1E Locked Rotor Current*. • *Parameter 1F Motor Service Factor*. • *Parameter 5O Excess Start Time*. • *Parameter 6J Excess Start Time*. ⚠ **N O T I C E** ⚠ *Parameters 1D* to *1F* determine the trip current for motor overload protection. The default settings of *parameters 1D* to *1F* provide motor thermal protection Class 10, trip current 105% of FLA, or equivalent.
Motor thermistor	The motor thermistor input has been enabled and: • The resistance at the thermistor input has exceeded 3.6 kΩ for more than 1 s. • The motor winding has overheated. Identify the cause of the overheating and allow the motor to cool before restarting. • The motor thermistor input has been opened. ⚠ **N O T I C E** ⚠ If thermistors have previously been connected to the soft starter but are no longer required, use the thermistor reset function to disable the thermistor. Related parameters: • *Parameter 6Q Motor Overtemperature*.
Network communication	The network master has sent a trip command to the soft starter, or there could be a network communication problem. Check the network for causes of communication inactivity. Related parameters: • *Parameter 6M Network Communications*.
Not ready	• The reset input may be active. If the reset input is active, the soft starter will not operate. • The soft starter may be waiting for the restart delay to elapse. The length of the restart delay is controlled by *parameter 5P Restart Delay*. Related parameters: • *Parameter 5P Restart Delay*.
Overcurrent	The overcurrent has exceeded the level set in *parameter 5E Overcurrent* for longer than the time set in *parameter 5F Overcurrent Delay*. Causes can include a momentary overload condition. Related parameters: • *Parameter 5E Overcurrent*. • *Parameter 5F Overcurrent Delay*. • *Parameter 6E Overcurrent*.

Display	Possible cause/suggested solution
Overpower	The motor has experienced a sharp rise in power. Causes can include a momentary overload condition which has exceeded the adjustable delay time. Related parameters: • *Parameter 5M Overpower*. • *Parameter 5N Overpower Delay*. • *Parameter 6I Overpower*.
Overvoltage	There has been a voltage surge on the mains. Causes can include problems with a transformer tap regulator of off-loading of a large transformer load. Related parameters: • *Parameter 5I Overvoltage*. • *Parameter 5J Overvoltage Delay*. • *Parameter 6G Overvoltage*.
Parameter out of range	This trip is not adjustable. • A parameter value is outside the valid range. The LCP indicates the first invalid parameter. • An error occurred loading data from the EEPROM to RAM when the LCP powered up. • The parameter set or values in the LCP do not match the parameters in the soft starter. • *Load User Set* has been selected but no saved file is available. Reset the fault. The soft starter loads the default settings. If the problem persists, contact the local distributor. Related parameters: None.
Phase sequence	The phase sequence on the soft starter mains terminals (L1, L2, L3) is not valid. Check the phase sequence on L1, L2, and L3, and ensure that the setting in *parameter 5R Phase Sequence* is suitable for the installation. Related parameters: • *Parameter 5R Phase Sequence*. • *Parameter 6P Phase Sequence*.
Power loss	This trip is not adjustable. The soft starter is not receiving mains supply on 1 or more phases when a start command is given. Check that the main contactor closes when a start command is given and remains closed until the end of a soft stop. Check the fuses. If testing the soft starter with a small motor, it must draw at least 2% of its minimum FLC setting on each phase. Related parameters: None.
Pressure sensor	The smart card has detected a fault with the pressure sensor. Related parameters: • *Parameter 30A Pressure Sensor Type*. • *Parameter 36A Pressure Sensor*.
Rating capacity	The soft starter is operating beyond its safe capacity. Allow the soft starter to cool. Related parameters: None.
RTD circuit	The smart card has detected a fault with the RTD sensor, or the RTD has activated temperature protection. Related parameters: • *Parameter 35B Temperature Trip Level*. • *Parameter 36J RTD/PT100 B*.
SCR Itsm	The SCR current surge rating has been exceeded. Related parameters: None.
SCR over-temperature	The temperature of the SCRs, calculated by the thermal model, is too high to allow further operation. Wait for the soft starter to cool. Related parameters: None.
Starter communication	There is a problem with the connection between the soft starter and the optional communications module. Remove and reinstall the card. If the problem persists, contact the local distributor. Related parameters: None.

Display	Possible cause/suggested solution
Starts per hour	The soft starter has already attempted the maximum number of starts in the last 60 minutes. Wait before attempting another start. To determine when the waiting perriod will end, review the log. Related parameters: • *Parameter Starts per Hour*.
Thermistor cct (thermistor circuit)	The thermistor input has been enabled and: • The resistance at the input has dropped below 20 Ω (the cold resistance of most thermistors is above this value) or • A short circuit has occurred. Check and resolve this condition. Related parameters: None.
Time - overcurrent	The soft starter is internally bypassed and has drawn high current during running. (The 10 A protection curve trip has been reached, or the motor current has risen to 600% of the motor FLC setting.) Related parameters: None.
Undercurrent	The motor has experienced a sharp drop in current, caused by loss of load. Causes can include broken components (shafts, belts, or couplings) or a pump running dry. Related parameters: • *Parameter 5C Undercurrent*. • *Parameter 5D Undercurrent Delay*. • *Parameter 6D Undercurrent*.
Underpower	The motor has experienced a sharp drop in power, caused by loss of load. Causes can include broken components (shafts, belts, or couplings), or a pump running dry. Related parameters: • *Parameter 5K Underpower*. • *Parameter 5L Underpower delay*. • *Parameter 6H Underpower*.
Undervoltage	Mains voltage has dropped below the level selected. Causes can include an undersized supply or adding a large load to the system.
Unsupported option	The selected function is not available (for example jog is not supported in inside delta configuration). Related parameters: None.
VZC fail px	Where X is 1, 2, or 3. Internal fault (PCB fault). Contact the local Danfoss supplier for advice. Related parameters: None.
Zero speed detect	The zero-speed detect input has not closed within the expected duration of a soft stop. • Check that the zero-speed sensor is operating correctly. • Check that *parameter 2Q Brake Current Limit* and *parameter 5O Excess Start Time* are appropriate for the application. Related parameters: • *Parameter 2Q Brake Current Limit*. • *Parameter 3S Brake Current Limit-2* • *Parameter 5O Excess Start Time*.

12.3 General Faults

See <u>table 245</u> for situations where the soft starter does not operate as expected but neither trips nor issues a warning.

Table 245: General Faults

Symptom	Probable cause/suggested solution
The soft starter is not ready.	The reset input may be active. If the reset input is active, the soft starter does not operate.
Simul on display	The soft starter is running simulation software. This software is intended for demonstration purposes only and is not suitable for controlling a motor. Contact the local supplier for advice.
The soft starter does not respond to the [Start] and [Reset] keys.	The soft starter only accepts commands from the LCP if *parameter 1A Command Source* is set to *Remote Keypad*. Check that the Local LED on the soft starter is on.
The soft starter does not respond to commands from the control inputs.	• The soft starter only accepts commands from the inputs if *parameter 1A Command Source* is set to *Digital Input*. Check the setting of *parameter 1A Command Source*. • The control wiring may be incorrect. Check that the remote start, stop, and reset inputs are configured correctly (see 5.4.3 Start/Stop) for details. • The signal to the remote inputs may be incorrect. Test the signaling by activating each input in turn.
The soft starter does not respond to a start command from either the LCP or the digital inputs.	• The soft starter may be waiting for the restart delay to elapse. *Parameter 5P Restart Delay* controls the length of the restart delay. • The motor may be too hot to allow a start. The soft starter only allows a start when it calculates that the motor has sufficient thermal capacity to complete the start successfully. Wait for the motor to cool, before attempting another start. • The reset input may be active. If the reset input is active, the soft starter does not operate. • The soft starter may be waiting for control signals via the communications network (*parameter 1A Command Source* set to *Network*). • The soft starter may be waiting for a scheduled auto-start (*parameter 1A Command Source* set to *Clock*).
Erratic and noisy motor operation	If the soft starter is connected to the motor using inside delta configuration, the soft starter may not be detecting the connection corrcetly. Contack the local supplier for advice.
Remote LCP shows *Awaiting data*	The LCP is not receiving data from the control PCB. Check the cable connection.
The soft starter does not control the motor correctly during start.	• Start performance may be unstable when using a low motor FLC setting (*parameter 1B Motor Full Load Current*). • Install power factor correction (PFC) capacitors on the supply side of the soft starter. Disconnect the capacitors during starting and stopping. To control a dedicated PFC capacitor contactor, connect the contactor to a programmable relay set to Run. • High levels of harmonics on the mains supply side can affect the soft starter performance. If drives are installed nearby, check that they are properly grounded and filtered.
Motor does not reach full speed.	• If the start current is too low, the motor does not produce enough torque to accelerate to full speed. The soft starter may trip on excess start time. ⚠ **N O T I C E** ⚠ Make sure that the motor starting parameters are appropriate for the application and that the intended motor starting profile is used. If a programmable input is set to *Motor Set Select*, check that the corresponding input is in the expected state. • Check if the load is jammed. Check the load for severe overloading or a locked rotor situation.

Symptom	Probable cause/suggested solution
Soft stop ends too quickly.	• The soft stop settings may not be appropriate for the motor and load. Review the settings. • If the motor is lightly loaded, soft stop has limited effect.
After selecting adaptive control, the motor used an ordinary start and/or the second start was different to the first.	• The first adaptive control start is actually constant current so that the soft starter can learn from the motor characteristics. Subsequent starts use adaptive control.
PowerThrough does not operate when selected	• The soft starter trips on Lx-Tx Shorted on the first start attempt after control power is applied. PowerThrough does not operate if control power is cycled between starts.
Parameter settings cannot be stored.	• Make sure to save the new value by pressing [Store] after adjusting a parameter setting. If pressing [Back], the change will not be saved. The soft starter does not show a confirmation. • Check that *parameter 10G Adjustment Lock* is set to *Read & Write*. If the parameter is set to *Read Only*, settings can be viewed but not changed.
USB full	• The USB drive may not have enough free space available for the selected function. • The file system on the USB drive may not be compatible with the soft starter. The VLT® Soft Starter MCD 600 supports FAT32 file systems. The USB functions of the MCD 600 are not compatible with NTFS file systems.
USB missing	A USB function has been selected in the menu, but the product cannot detect a USB drive. Check that the USB drive has been inserted in the port.
File missing	• A USB function has been selected in the menu, but the required file cannot be found. • Save/load master parameters uses a file called Master_Parameters.par at the top level of the USB drive. For these functions to work correctly, do not move or rename this file.
File not valid	A USB function has been selected in the menu, but the file is not valid.
File empty	A USB function has been selected in the menu and the file has been found, but it does not contain the expected content.
Rating not valid	The value selected for *parameter 20D Model Rating* does not match the soft starter. Set *parameter 20D Model Rating* to match the rating shown on the soft starter nameplate label (on the side of the unit).

13 Appendix

13.1 Symbols and Abbreviations

°C	Degrees Celsius
°F	Degress Fahrenheit
AC	Alternating current
DC	Direct current
DOL	Direct on-line
EMC	Electromagnetic campatibility
FLA	Full load amperage
FLC	Full load current
FLT	Full load torque
IP	Ingress protection
LCP	Local control panel
PCB	Printed circuit board
PELV	Protective extra low voltage
PFC	Power factor correction
SCCR	Short-circuit current rating
TVR	Timed voltage ramp

13.2 Conventions

- Numbered lists indicate procedures.
- Bulleted and dashed lists indicate listings of other information where the order of the information is not relevant.
- Bolded text indicates highlighting and section headings.
- Italicized text indicates the following:
  - Cross-reference.
  - Link.
  - Footnote.
  - Parameter name.
  - Parameter option.
  - Parameter group name.
- All dimensions in drawings are in metric values (imperial values in brackets).
- An asterisk (*) indicates the default setting of a parameter.

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