Emotron TSA Softstarter

e m o t r o n

DEDICATED DRIVE

A **CG** Product

Emotron TSA softstarter

INSTRUCTION MANUAL - ENGLISH

Valid from Software version 1.27

Safety instructions

Congratulations for choosing a product from CG Drives & Automation!

Before you begin with the installation, commissioning or powering up the unit for the first time it is very important that you carefully study this instruction manual.
The following symbols can appear in this manual or on the product itself. Always read these first before continuing.

NOTE: Additional information as an aid to avoid problems.

⚠ **CAUTION!**
Failure to follow these instructions can result in malfunction or damage to the softstarter.

⚡ **WARNING!**
Failure to follow these instructions can result in serious injury to the user in addition to serious damage to the softstarter.

Safety

The softstarter should be installed in a cabinet or in an electrical control room.

- The device must be installed by trained personnel.

- Disconnect all power sources before servicing.

- Always use standard commercial fuses, slow blow e.g. gl, gG types, to protect the wiring and prevent short circuiting. To protect the thyristors against short-circuit currents, superfast semiconductor fuses can be used if preferred. The normal guarantee is valid even if superfast semiconductor fuses are not used.

Operating and maintenance personnel

1. Read the whole instruction manual before installing and putting the equipment into operation.

2. During all work (operation, maintenance, repairs, etc.) observe the switch-off procedures given in this instruction as well as any other operating instruction for the driven machine or system. See Emergency below.

3. The operator must avoid any working methods which reduce the safety of the device.

4. The operator must do what he can to ensure that no unauthorised person is working on the device.

5. The operator must immediately report any changes to the device which reduce its safety to the user.

6. The user must undertake all necessary measures to operate the device in perfect condition only.

Phase compensation capacitor

If a phase compensation capacitor is to be used, it must be connected at the inlet of the softstarter, not between the motor and the softstarter.

Installation of spare parts

We expressly point out that any spare parts and accessories not supplied by us have also not been tested or approved by us.

Installing and/or using such products can have a negative effect on the characteristics designed for your device. The manufacturer is not liable for damage arising as a result of using non-original parts and accessories.

Emergency

You can switch the device off at any time with the mains switch connected before the softstarter (both motor and control supply voltage must be switched off).

General warnings

⚡ **WARNING!**
Make sure that all safety measures have been taken before starting the motor in order to avoid personal injury.

⚡ **WARNING!**
Never operate the softstarter with the front cover removed.

⚡ **WARNING!**
Make sure that all safety measures have been taken before switching on the power supply.

Alarms

Never disregard an alarm. Always check and remedy the cause of an alarm.

Contents

1. Introduction

The Emotron TSA softstarter is intended for controlling the start and stop of standard three phase asynchronous motors. A built-in powerful digital signal processor (DSP) gives the softstarter high performance and very good control of the starting and stopping of the application.

Several options are available, listed in chapter 12. page 155, that enable you to customize the softstarter for your specific needs.

NOTE: Read this instruction manual carefully before installing, connecting or working with the softstarter.

Users

This instruction manual is intended for:

* installation engineers
* maintenance engineers
* operators
* service engineers

Motors

The softstarter is suitable for use with standard 3-phase asynchronous motors. Contact your supplier for details.

1.1   Delivery and unpacking

Check for any visible signs of damage. Inform your supplier immediately of any damage found. Do not install the softstarter if damaged.

Check that all items are present and that the type number is correct.

1.2   Using of the instruction manual

Check that the software version number on the first page of this manual matches the software version in the softstarter. See chapter 8.9.1 page 136.

With help of the index and the table of contents it is easy to track individual functions and find out how to use and set them.

The Quick Start Guide can be put in a cabinet so that it is always easy to access in case of an emergency.

1.3   Warranty

The warranty applies when the equipment is installed, operated and maintained according to instructions in this instruction manual. Duration of warranty is as per contract. Faults that arise due to faulty installation or operation are not covered by the warranty.

1.4   Type code number

Fig. 1 gives an example of the type code numbering used for the Emotron TSA softstarter. This identification will be required for type specific information when mounting and installing. The code number is located on the product label, on the right side of the unit (when viewed from the front).

TSA	52	-016	-23	N	N	N	—	A	A	—
Position number:										
1	2	3	4	5	6	7	8	9	10	11

Fig. 1   Type code number

Table 1

Position	Configuration	Description
1	Type	TSA
2	Main supply voltage	52 = Max 525 V mains 69 = Max 690 V mains
3	Current rating	016 = 16 A - - 1K8 = 1800 A
4	Control voltage	23=230 V
5	Option position 1	N=No option P=PTC/PT100 I=I/O board
6	Option position 2	N=No option P=PTC/PT100 I=I/O board
7	Communication option	N=No option A=Profinet IO 1-port B=Profinet IO 2-port D=DeviceNet E= EtherCAT G=EtherNet/IP 2-port M=Modbus/TCP P=Profibus R=RS485 U=USB
8	Supply type	— =Standard (Grounded net) I=IT-net (EMC not fulfilled)
9	Brand label	A=Standard
10	Software	A=Standard software
11	Standard	— =CE approved U=UL/cUL approved

1.5 Standards

The softstarters described in this instruction manual comply with the standards listed in Table 2. For the declarations of conformity and manufacturer's certificate, contact your supplier for more information or visit www.emotron.com or www.cgglobal.com.

1.5.1 Product standard for EMC

The Emotron TSA softstarter complies with the product standard EN(IEC) 60947-4-2: 2007. The standard Emotron TSA softstarters are designed to meet the EMC requirements according to:
Category C1 - Emotron TSA -frame sizes 1 & 2
Category C2 - Emotron TSA -frame sizes 3 & 4 .

Table 2   Standards

Market	Standard	Description
European	EMC Directive	2004/108/EC
	Low Voltage Directive	2006/95/EC
	WEEE Directive	2002/96/EC
All	EN 60204-1	Safety of machinery - Electrical equipment of machines Part 1: General requirements.
	EN(IEC)60947-4-2: 2007	Contactors and motor starters Part 3: EMC requirements and specific test methods. **EMC Directive: Declaration of Conformity and CE marking**
	EN(IEC)60947-4-2: 2007	Contactors and motor starters Safety requirements - Electrical, thermal and energy. **Low Voltage Directive: Declaration of Conformity and CE marking**
	IEC 60721-3-3	Classification of environmental conditions. Air quality chemical vapours, unit in operation. Chemical gases 3C3, Solid particles 3S1.
	DNV-GL	DNV-GL Marine standard
North & South American	UL508C	UL Safety standard for Power Conversion Equipment.
	UL 840	UL Safety standard for Power Conversion Equipment.
Russian	EAC	For all sizes

1.6 Dismantling and scrapping

The enclosures of the Emotron TSA softstarters are made from recyclable material such as aluminium, iron and plastic. Each softstarter contains a number of components demanding special treatment. The circuit boards contain small amounts of tin and lead. Any local or national regulations in force for the disposal and recycling of these materials must be complied with.

1.6.1 Disposal of old electrical and electronic equipment
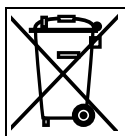
This symbol on the product or on its packaging indicates that this product shall be taken to the applicable collection point for the recycling of electrical and electronic equipment. By ensuring this product is disposed of correctly, you will help prevent potentially negative consequences for the environment and human health, which could otherwise be caused by inappropriate waste handling of this product. The recycling of materials will help to conserve natural resources. For more detailed information about recycling this product, please contact the local distributor of the product.

1.7   Glossary

1.7.1 Abbreviations and symbols

In this manual the following abbreviations are used:

Table 3   Abbreviations

Abbreviation/ symbol	Description
CP	Control panel, the programming and presentation unit on the softstarter
CB	Control board
I^2t	The amount of energy losses, heating up the motor.
PTC	Positive Temperature Coefficient (temperature sensor, also known as thermistor)
PB-PTC	Power board PTC input
RMS	Root Mean Square value
FLC	Full Load Current
DOL	Direct On-Line
EInt	Communication format
UInt	Communication format (Unsigned Integer)
Int	Communication format (Integer)
Long	Communication format (Integer Long)
SELV	Safety Extra Low Voltage
🔒	The function cannot be changed in run mode

1.7.2 Definitions

In this manual the following definitions are used:

Table 4   Definitions

Name	Description	Unit
I_{n_soft}	Nominal softstarter current	[A_{rms}]
I_{n_mot}	Nominal motor current	[A_{rms}]
P_{n_soft}	Nominal softstarter power	[kW] or [hp]
P_{n_mot}	Nominal motor power	[kW] or [hp]
T_n	Nominal motor torque*	[Nm] or [lb.ft]
n_{n_mot}	Nominal speed of motor	[rpm]
$\cos\varphi_n$	Nominal motor power factor	(dimensionless)
U	3-phase mains supply voltage	[V_{rms}]
U_{n_mot}	Nominal motor voltage	[V]

*) Calculation of nominal motor torque:

$$T_n[Nm] = \frac{9550 \times P_{n\ mot}[kW]}{n_{n\ mot}[rpm]}$$

$$T_n[lb\,ft] = \frac{5252 \times P_{n\ mot}[hp]}{n_{n\ mot}[rpm]}$$

2. Mounting

This chapter describes how to mount the Emotron TSA softstarter. Before mounting it is recommended that the installation is planned out:

- Be sure that the softstarter suits the mounting location.

- The mounting site must support the weight of the softstarter.

- Will the softstarter continuously withstand vibrations and/or shocks?

- Consider using a vibration damper.

- Check ambient conditions, ratings, required cooling air flow, compatibility of the motor, etc.

- Do you know how the softstarter will be lifted and transported?

Make sure that the installation is performed in accordance with the local safety regulations, and in accordance with DIN VDE 0100 for setting up power installations.

Care must be taken to ensure that personnel do not come into contact with live circuit components.

> **WARNING!**
> **Never operate the softstarter with the front cover removed.**

2.1 Installation in a cabinet

When installing the softstarter:

- Ensure that the cabinet will be sufficiently ventilated after the installation.

- Keep the minimum free space, as listed in Table 5.

- Ensure that air can flow freely from the bottom to the top.

> NOTE: When installing the softstarter, make sure it does not come into contact with live components. The heat generated must be dispersed via the cooling fins to prevent damage to the thyristors (free circulation of air).

The Emotron TSA softstarters are delivered as enclosed versions with front access cover. The units have top and bottom entry for cables etc., see Chapter 3. page 15.

2.1.1 Cooling

Table 5   Minimum free space

TSA Frame size	Minimum free space mm (in)		
	above*	below	at side
1			
2	100 (3.9)	100 (3.9)	0
3			
4			

*) Above: Cabinet roof to softstarter or softstarter to softstarter

2.2 Mechanical specifications and drawings

Table 6

TSA Frame size	Dimensions* H1/H2/H3 x W x D [mm (in)]	Mounting position [Vertical/ Horizontal]	Weight [kg(lb)]	Connection busbars and pressnut dimension [mm (in)]	PE screw	Cooling system	Protection class
1	246/296/340 x 126 x 188 (9.7/11.7/13.4 x 5 x 7.4)	Vertical	5.5 (12.1)	15 x 2 (0.59 x 0.08) M6 connection	M5	Convection	IP20
2		Vertical/ Horizontal	5.7 (12.6)			Fan	
3	285/323/380 x 196 x 235 (11.2/12.7/14.9 x 7.7 x 9.3)		13 (28.7)	20 x 5 (0.8 x 0.20) M10 connection	M8	Fan	IP20
4	378/411/514 x 254 x 260 (14.9/16.2/20.2 x 10 x 10.3)		23.5 (51.8)	40 x 10 (1.6 x 0.39) Ø 13 connection	M8	Fan	IP20

*) H1 = Height of enclosure.
    H2 = Total mounting height of unit.
    H3 = Total height including Cable covers.

Emotron TSA frame size 1 - 2
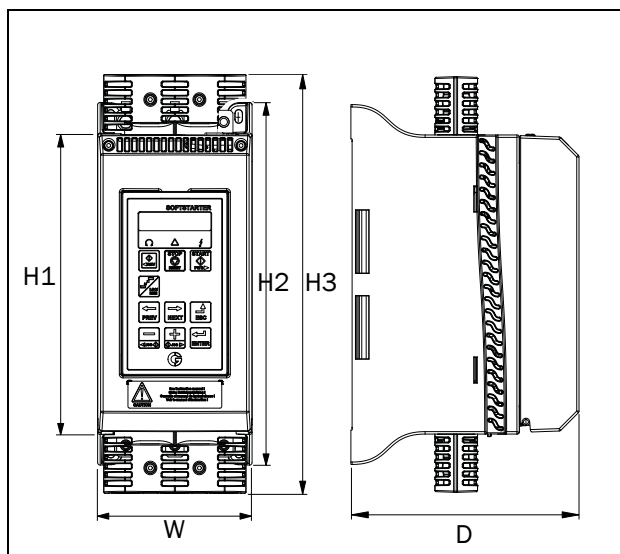
Fig. 2   Dimensions for Emotron TSA frame size 1 and 2.
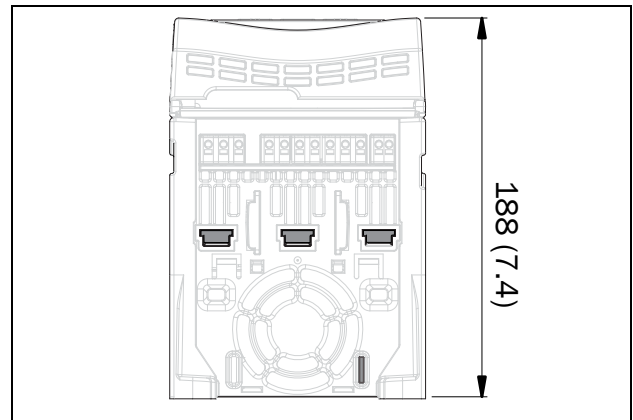
Fig. 3   Dimensions for Emotron TSA frame size 1 and 2, bottom view.

Emotron TSA frame size 3
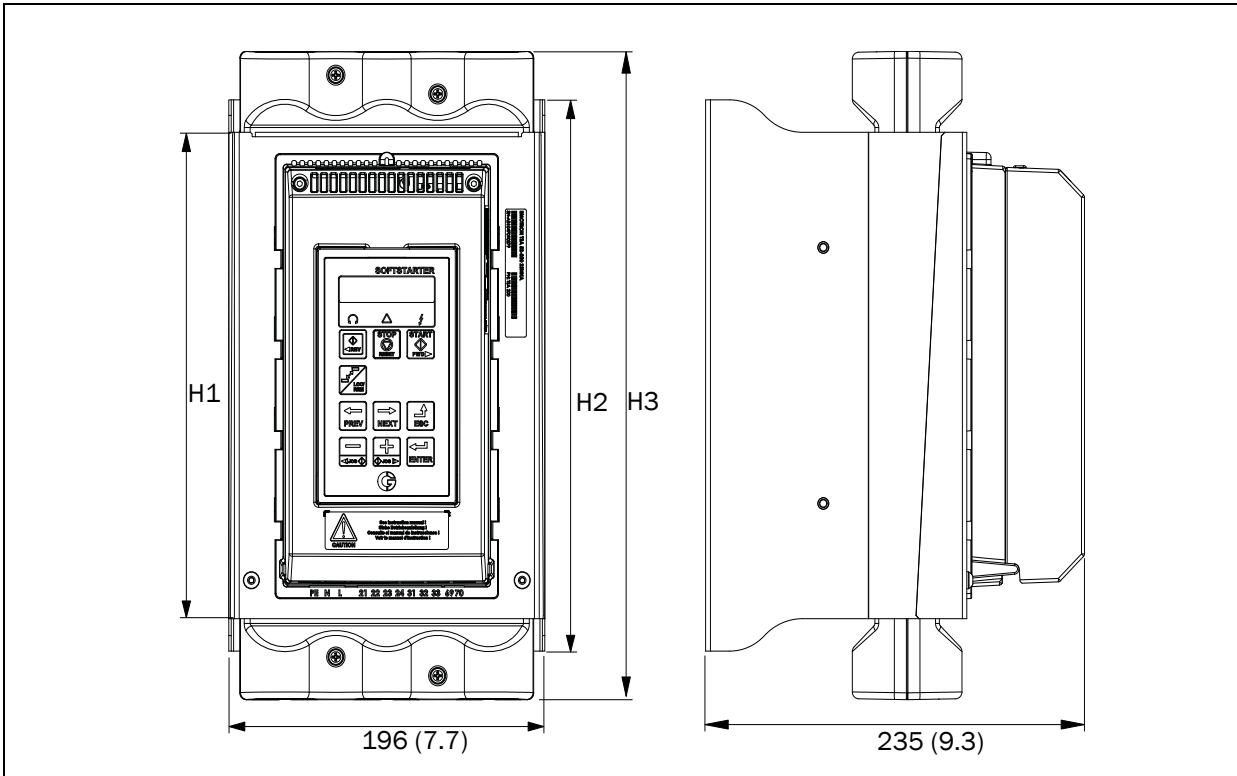
Fig. 4   Dimensions for Emotron TSA frame size 3.
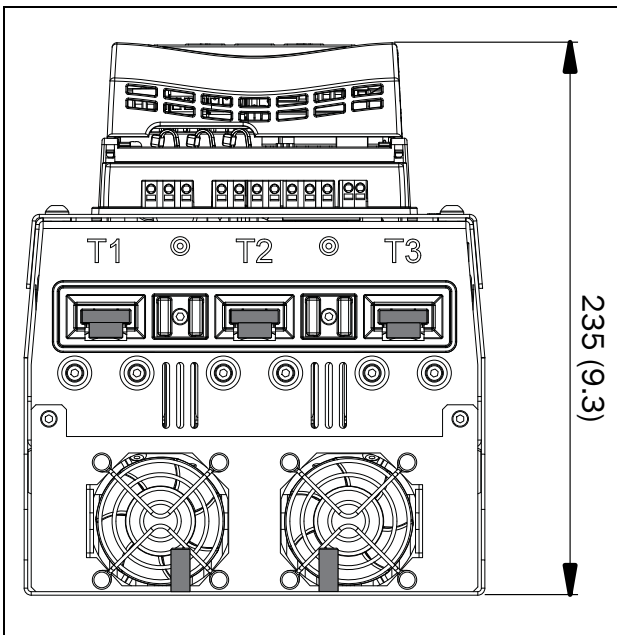
Fig. 5   Dimensions for Emotron TSA frame size 3, bottom view.

Emotron TSA frame size 4
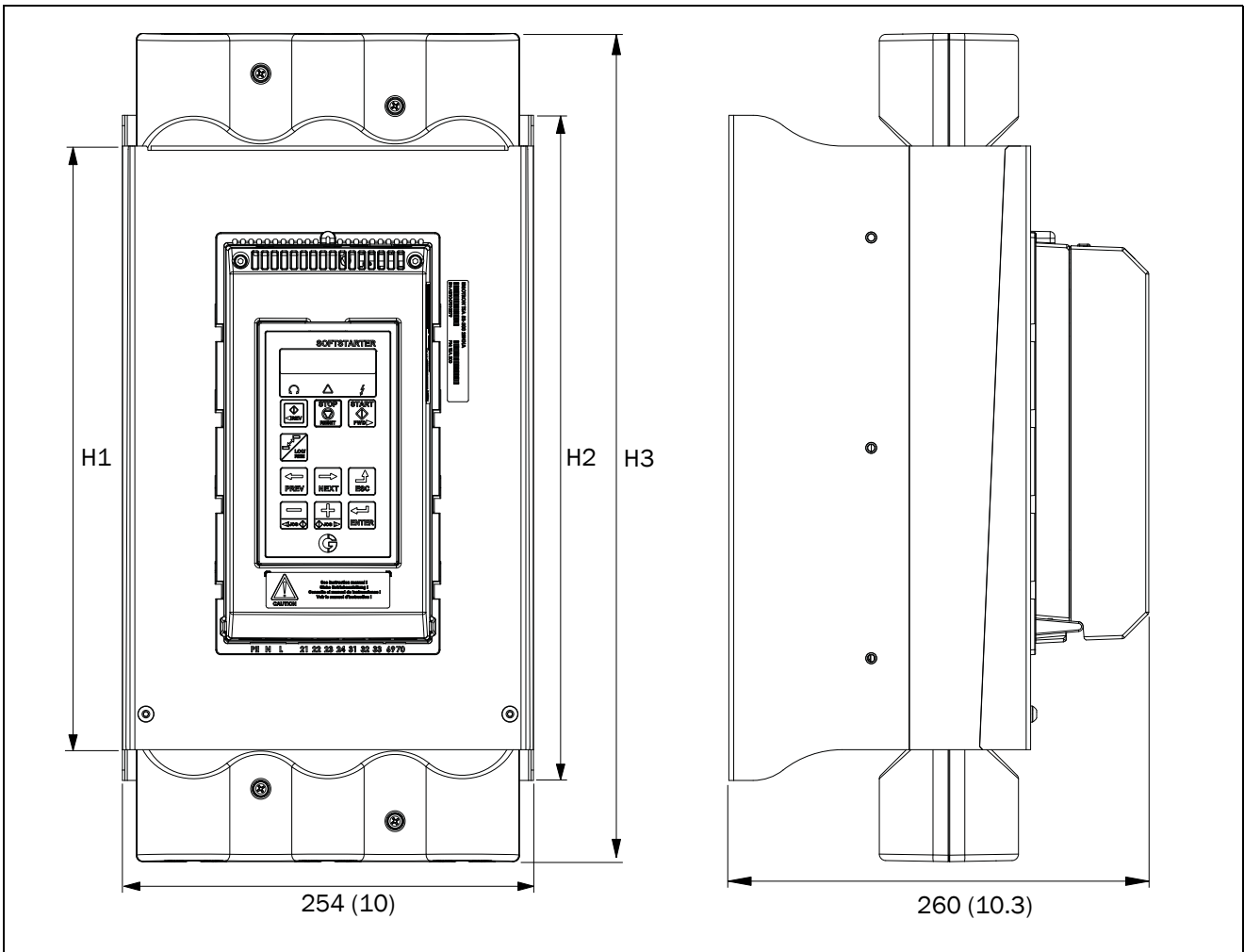
Fig. 6   Dimensions for Emotron TSA frame size 4 .
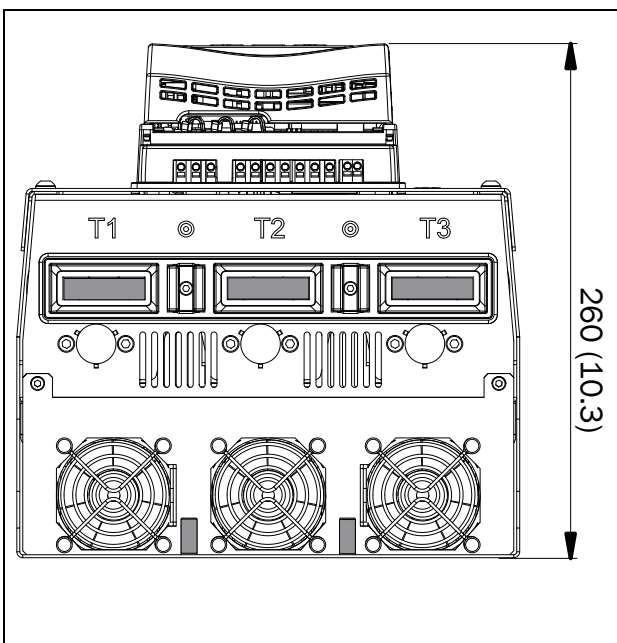
Fig. 7   Dimensions for Emotron TSA frame size 4, bottom view.

2.3 Mounting schemes

Emotron TSA frame size 1 - 2
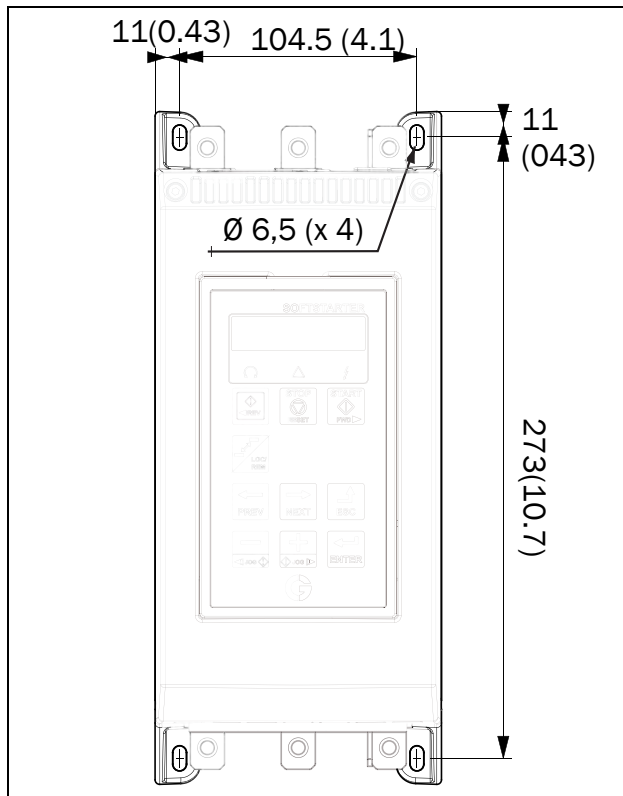
Fig. 8 Hole pattern for Emotron TSA frame size 1 and 2.

Emotron TSA frame size 3
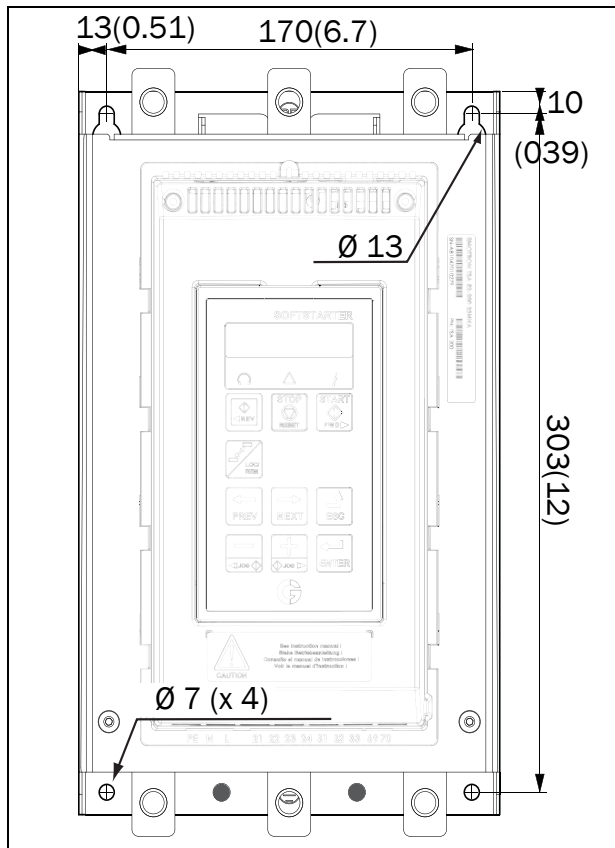
Fig. 9 Hole pattern for Emotron TSA frame size 3.

Emotron TSA frame size 4
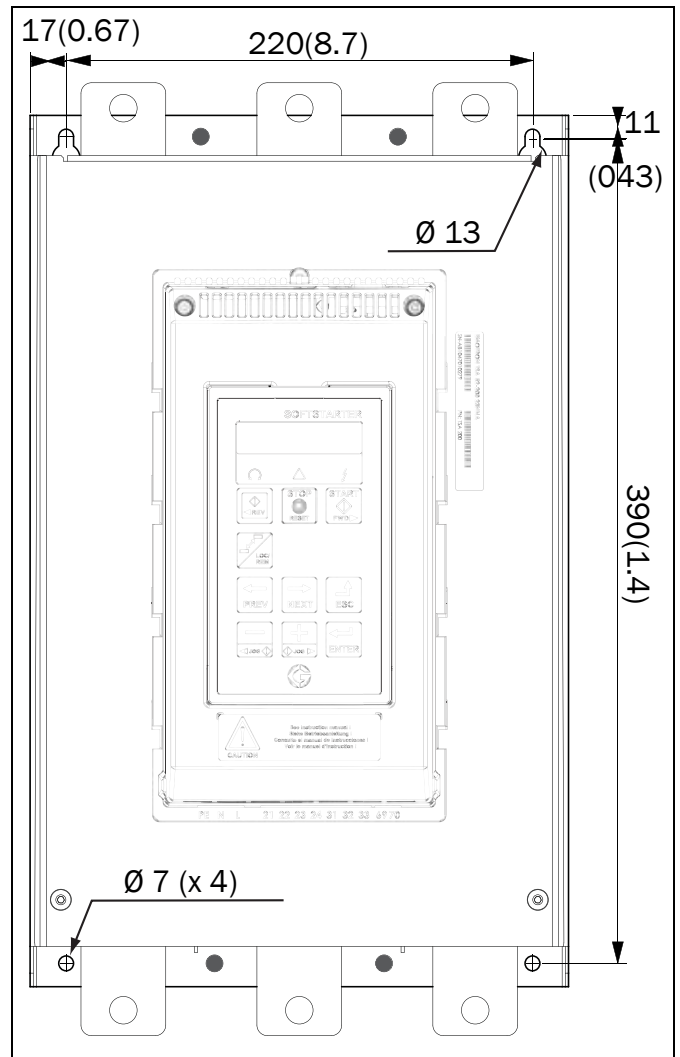
Fig. 10 Hole pattern for Emotron TSA frame size 4.

On our websites www.cgglobal.com and www.emotron.com it is possible to download a full-size template for positioning of the fixing holes.

3. Connections

The installation description in this chapter follows the EMC standards and the Machinery Directive.

If the softstarter is temporarily stored before being connected, please check the technical data for environmental conditions section 13.3, page 161. If the softstarter is moved from a cold storage room to the location where it is to be installed, condensation could appear on the unit. Allow the softstarter to become fully acclimatised and wait until any visible condensation has evaporated before connecting any supply voltages.

Cables

Dimension the mains and motor cables according to local regulations and the nominal current of the motor. It is possible to use either copper or aluminium cables.

It is not necessary to use shielded motor cables together with the Emotron TSA softstarter. This is due to its very low radiated emissions.
Neither is it necessary to use shielded mains supply cables for the Emotron TSA softstarter.

For control signal cables it is not mandatory to use shielded cables to fulfil the EMC regulations (section 1.5, page 6) but it is recommended in general to avoid disturbances.

NOTE: The Emotron TSA control-board is equipped with a ground plane to which shielded cables can be connected (see Fig. 17 on page 21).

NOTE: For UL-approval use 75°C copper wire only.

3.1 Mains and motor connections
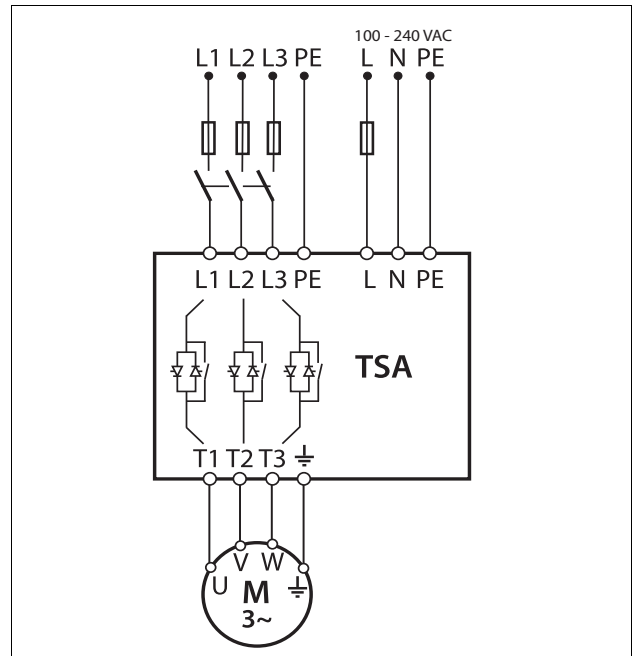
Fig. 11   Mains, motor and control supply voltage connection

Emotron TSA frame size 1 - 2
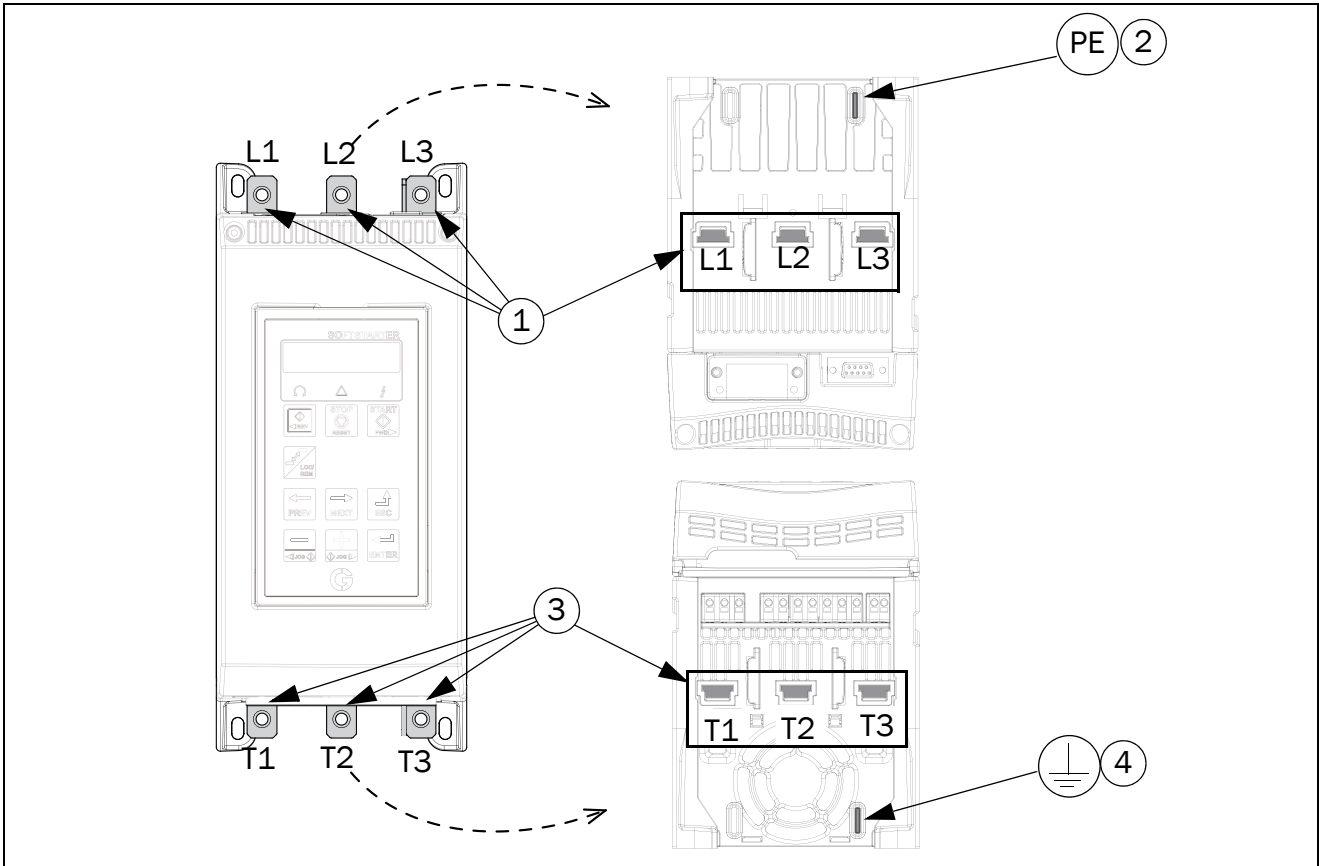
Fig. 12   Mains and motor connections for Emotron TSA Size 1-2.

1. 3-phase mains supply connection, **L1, L2, L3**

2. Protective earth (PE) connection for mains supply

3. Motor power supply connection **T1, T2, T3**

4. Motor earth, ⏚ connection

> ⚡ **WARNING!**
> **Leakage current may occur from the thyristors when a 3-phase mains supply is connected. Full voltage can be detected if no motor is connected.**

Table 7   Tightening torque for bolts [Nm (Lb-in)].

TSA Frame size	Tightening torque for bolts [Nm (Lb-in)]	
	Motor or mains cables	PE cable
1	8 (70)	5 (44)
2	8 (70)	5(44)

Emotron TSA frame size 3
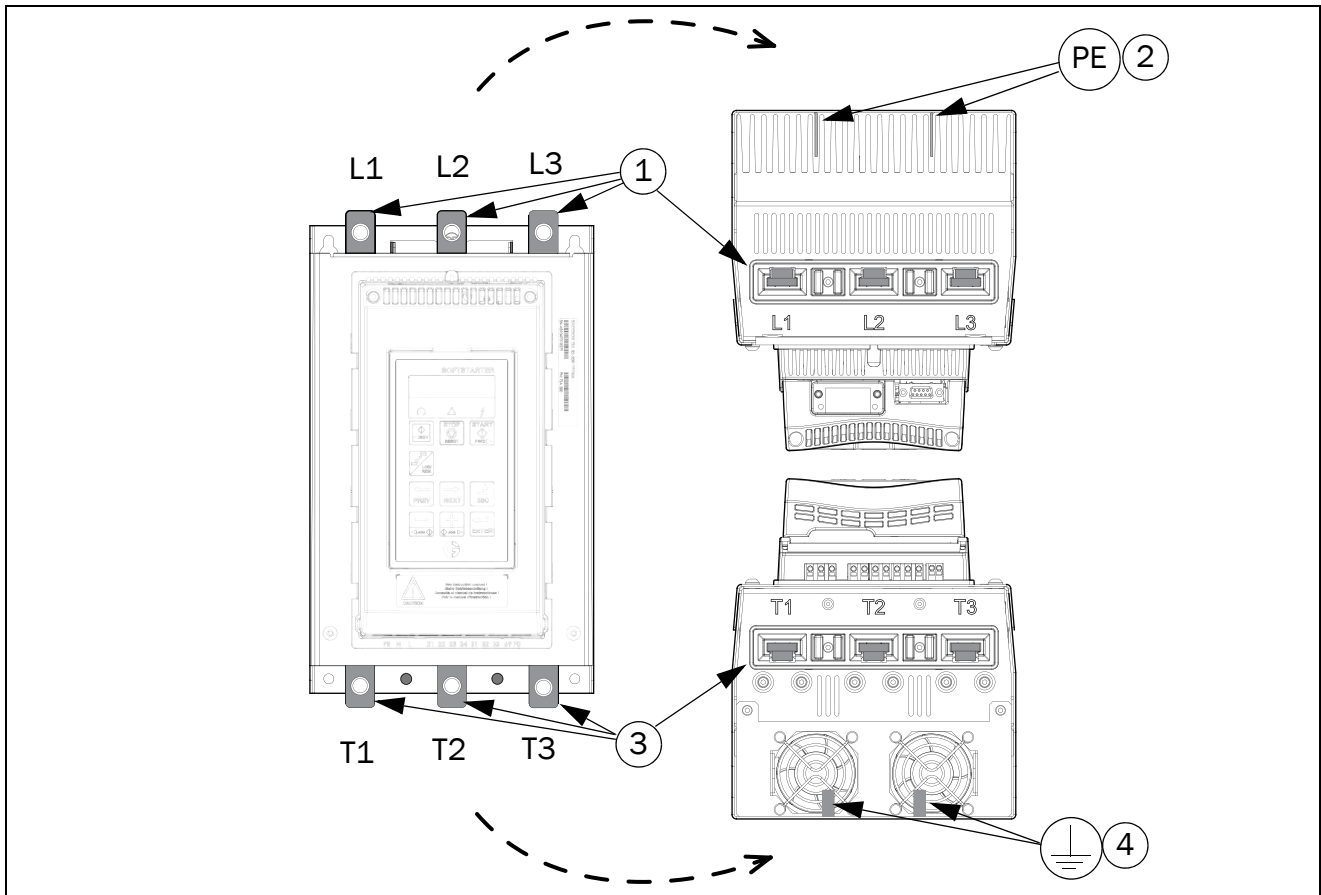
Fig. 13 Mains and motor connections for Emotron TSA Size 3.

1. 3-phase mains supply connection, **L1, L2, L3**

2. Protective earth (PE) connection for mains supply

3. Motor power supply connection **T1, T2, T3**

4. Motor earth, ⏚ connection

WARNING!
Leakage current may occur from the thyristors when a 3-phase mains supply is connected. Full voltage can be detected if no motor is connected.

Table 8   Tightening torque for bolts [Nm (Lb-in)].

TSA Frame size	Tightening torque for bolts [Nm (Lb-in)]	
	Motor or mains cables	PE cable
3	20 (177)	12 (106)

Emotron TSA frame size 4
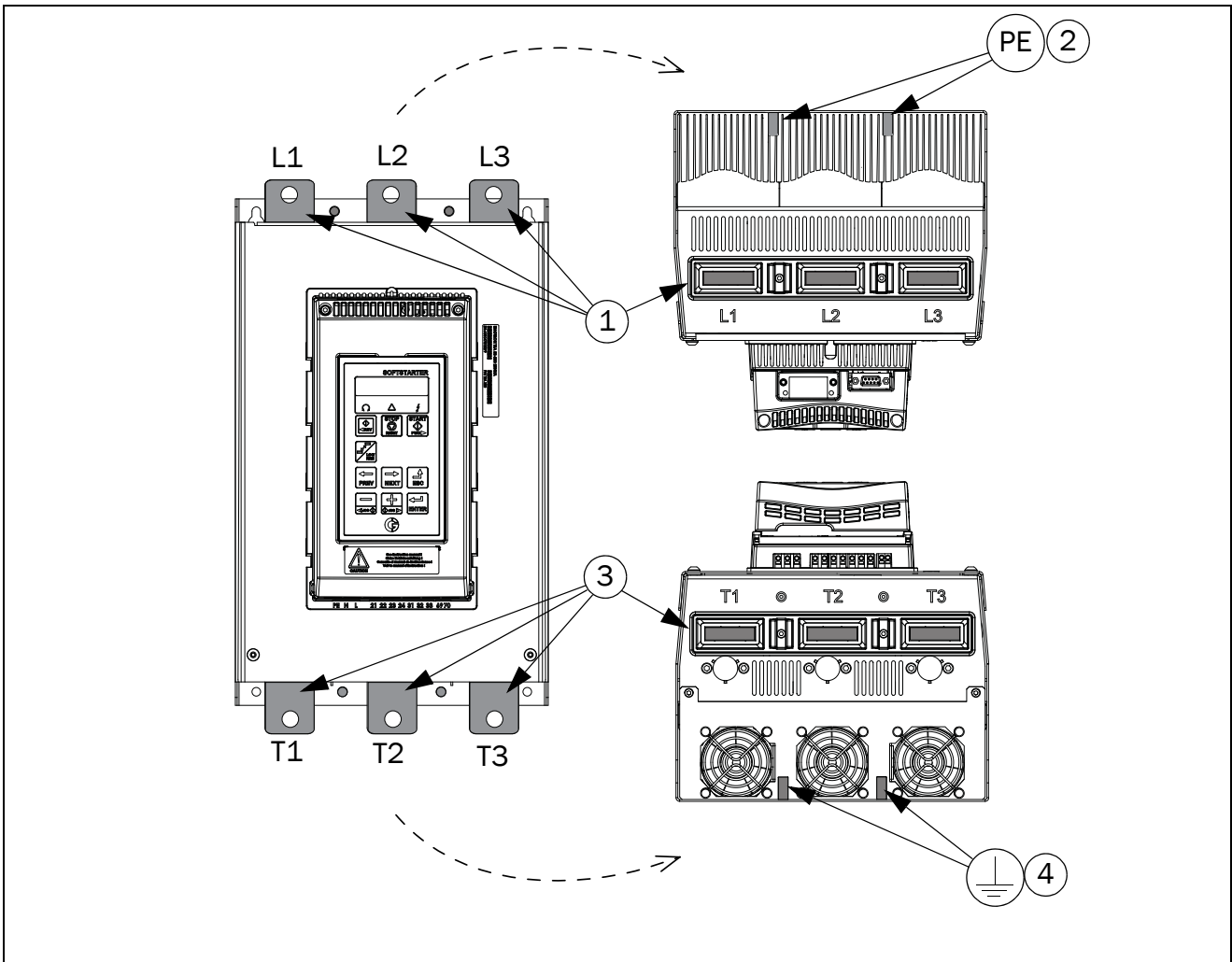
Fig. 14   Mains and motor connections for Emotron TSA Size 4.

1. 3-phase mains supply connection, **L1, L2, L3**

2. Protective earth (PE) connection for mains supply

3. Motor power supply connection **T1, T2, T3**

4. Motor earth, ⏚ connection

⚠️ **WARNING!**
Leakage current may occur from the thyristors when a 3-phase mains supply is connected. Full voltage can be detected if no motor is connected.

Table 9   Tightening torque for bolts [[Nm (Lb-in)].

TSA Frame size	Tightening torque for bolts [Nm (Lb-in)]	
	Motor or mains cables	PE cable
4	50 (442)	12 (106)

3.1.1 Busbar distances on Emotron TSA softatarter
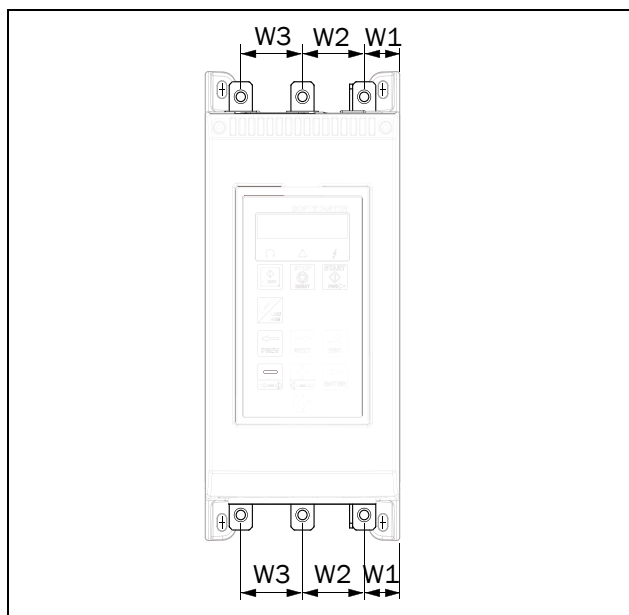
Fig. 15   Busbar distances general drawing

Table 10   Busbar distances.

TSA frame size	Dist. W1 [mm (in)]	Dist.W2 [mm (in)]	Dist.W3 [mm (in)]
1	23 (0.9)	40 (0.39)	40 (0.39)
2			
3	35 (0.9)	63 (2.48)	63 (2.48)
4	44 (0.9)	83 (3.27)	83 (3.27)

3.1.2 Cable covers

When the Mains and motor cables are connected, mount the cable covers according to Fig. 16.
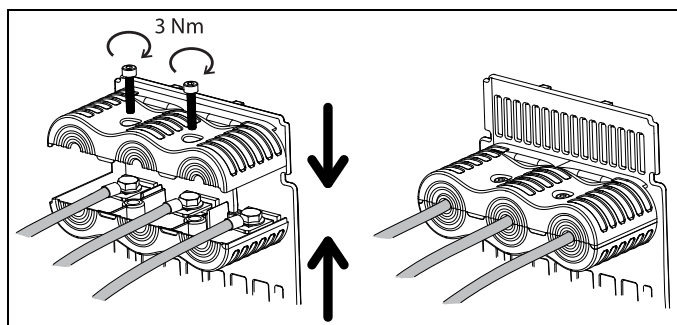
Fig. 16   How to mount the cable covers general drawing.

3.2 Board layout and connectors

This section contains general information about the power board and control board for each Emotron TSA size. For additional information about special conditions refer to section 4.4, page 36. For a description of the available options, go to chapter 12. page 155.

Isolation

The control board in the Emotron TSA product is a Separated Extra Low Voltage (SELV) circuit. This means that this board is safely separated from other circuits that carry higher voltages and is isolated from earth and protective earth conductors of other circuits. The PTC circuit on the power board is separated from the control board SELV circuit with a separation rated for:

• Double insulation when used in softstarters rated up to 525 VAC.

• Basic insulation when used in softstarters rated up to 690 VAC.

It is recommended that the PTC/PT100 sensors are always separated from live parts with at least basic insulation for the relevant voltage.

> **WARNING!**
> **For softstarters rated higher than 525 VAC, it is mandatory to have at least basic insulation from the temperature sensor towards live voltage.**
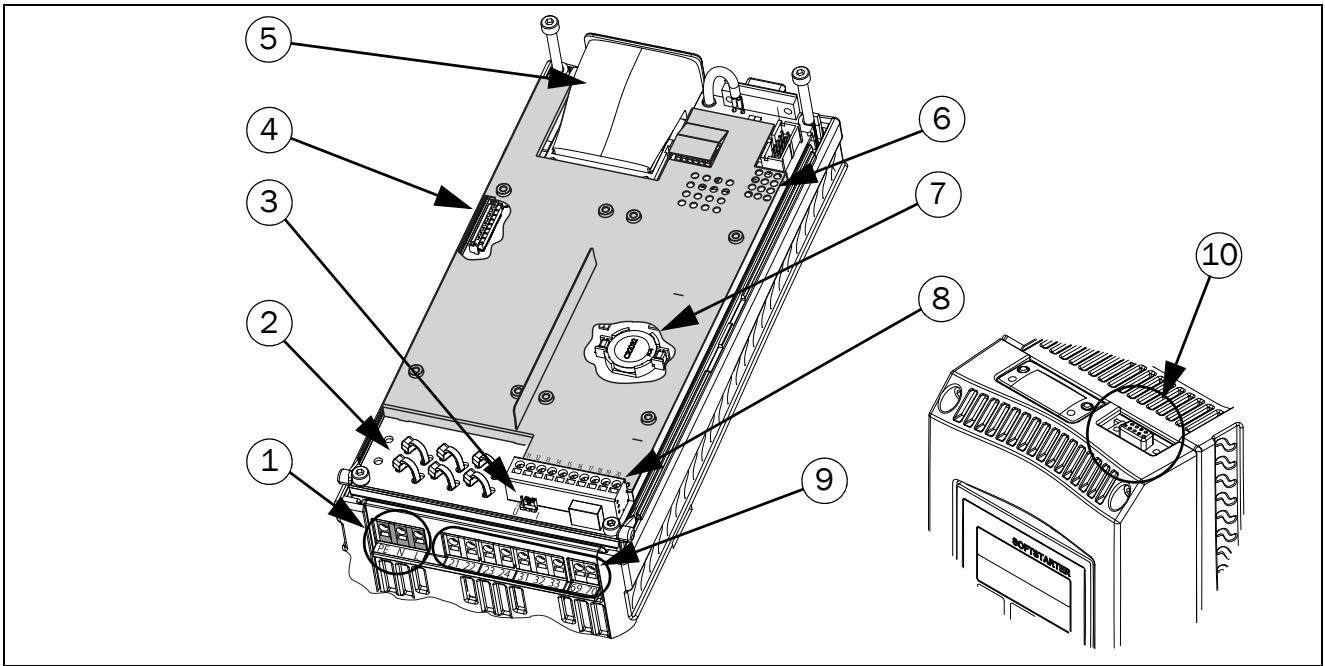
Fig. 17   Board layout for Emotron TSA .

Emotron TSA connections and details

1. Control supply voltage connection PE, N, L (power board).

⚠️ **WARNING!**
For safety reasons the protective earth (PE) for the control supply must be connected.

2. Earthing plane with slots for tie wraps for fixation and securing of control signal cables and option board cables. This plane is connected to earth for earthing of shielded option board cables.

3. S1 jumper for U/I selection of analogue input

4. Option board ribbon cable connector

5. Communication module (option)

6. LED indicators (visible through perforation):
   - Red and yellow for communication signals
   - Green indicating power on

7. Clock battery

8. Terminals for DigIn/AnIn/AnOut signals (control board)

9. Terminals for relay output signals and PTC connection (power board)

10. RS232, using 9-pin female D-sub connector. For temporary connection of a personal computer or connection of external control panel (option). For permanent connection of a personal computer you have to use one of the isolated communication option boards RS485 or USB, see also Note below.

NOTE: This RS232 connector is not galvanically isolated. It is therefore important that all externally connected equipment to the control board are on the same potential level. Otherwise equipment may be damaged! If uncertain, we advice you to use the isolated USB option instead or to use an isolated USB to RS232-converter.

Table 11   Control signal cable dimension and stripping lenght

TSA size	Max. Cable dimension [mm^2 (square feet)]	Recommended stripping length [mm (in)]
1 - 4	Flexible: 1.5 (16) Solid: 2.5 (27)	6 (0.23) (*

* When using Ferrules, suitable Ferrule length is 10-12 mm/ 0.39 - 0.47 in.

3.3 Control signal connections

WARNING!
The relay terminals 21-33 are single isolated. Do NOT mix SELV voltage with e.g. 230 VAC on these terminals.

A solution when dealing with mixed SELV/ system voltage signals is to install an additional I/O board option (see Chapter 12.3 page 155) and connect all SELV voltage signals to the relay terminals of this option board while connecting all 230VAC signals to the power board relay terminals 21 - 33.

Fig. 18   Control board and power board connections.

Table 12   Power board connections

Terminal		Function	Electrical characteristics
PE		Protective Earth	Protective grounding
N		Control supply voltage	100-240 VAC ±10%
L			
21	NO	Programmable relay 1. Factory setting is "Operation" with indication by closing contact on terminals 21 to 22.	1-pole closing contact (NO), 250 VAC 8 A or 24 VDC 8 A resistive, 250 VAC, 3 A inductive. Min. 100 mA. See Warning.
22	C		
23	NO	Programmable relay 2. Factory setting is "Off" with indication by closing contact on terminals 23 to 24.	1-pole closing contact (NO), 250 VAC 8 A or 24 VDC 8 A resistive, 250 VAC, 3 A inductive. Min. 100 mA. See Warning.
24	C		
31	NO	Programmable relay 3. Factory setting is "Trip". Indication by closing contact on terminals 31 to 32 and opening contact on 32 to 33.	1-pole change-over contact (NO/NC), 250 VAC 8A or 24 VDC 8A resistive, 250 VAC, 3A inductive. Min. 100 mA. See Warning.
32	C		
33	NC		
69-70		PTC Thermistor input	Alarm level 2.4 kΩ. Switch back level 2.2 kΩ.

Table 13   Control board connections

Terminal		Function	Electrical characteristics
11		Digital input 1. Factory setting is "Run FWD"	0-4 V --> 0; 8-27 V--> 1. Max. 37 V for 10 sec. Impedance: <3.3 VDC: 4.7 kΩ. - $\geq$3.3 VDC: 3.6 kΩ
12		Digital input 2. Factory setting is "Stop".	
13		Control signal supply voltage to analogue input.	+10 VDC ±5%. Max. current from +10 VDC: 10 mA. Short circuit-proof and overload-proof.
14		Analogue input, 0-10 V, 2-10 V, 0-20 mA and 4-20 mA. Factory setting is "4-20 mA". S1 jumper for U/I selection.	Impedance to terminal 15 (0 VDC) voltage signal: 20 kΩ, current signal: 250 Ω.
15		GND (common)	0 VDC signal ground
16		Digital input 3. Factory setting is "Set Ctrl 1"	0-4 V --> 0; 8-27 V--> 1. Max. 37 V for 10 sec. Impedance: <3.3 VDC: 4.7 kΩ. - $\geq$3.3 VDC: 3.6 kΩ
17		Digital input 4. Factory setting is "Reset"	
18		Control signal supply 1, voltage to digital input.	+24 VDC ±5%. Max. current from +24 VDC = 50 mA. Short circuit-proof and overload-proof.
19		Analogue output. Factory setting is "Current".	Analogue output contact: 0-10 V, 2-10 V; min load impedance 700 Ω 0-20 mA and 4-20 mA; max load impedance 500 Ω
20		Control signal supply 2, voltage to digital input.	+24 VDC ±5%. Max. current from +24 VDC = 50 mA. Short circuit-proof and overload-proof.

Fig. 19   Control cable feedthrough.

Earthing plane with slots for tie wraps

Shielded control signal cable

NOTE: Shielded control cables are not mandatory but in general recommended to avoid disturbances.

3.4   Wiring examples

Following Examples 1 - 3 are alternatives on how to start and stop Emotron TSA via digital inputs.

NOTE: The TSA is per default using edge controlled start/stop signals. Remember to change setting of menu [21A] if you wish to use level signal input.

Example 1 uses separate start and stop signals.
Examples 2-3 shows common start and stop signals.
Examples 4 - 6 shows connections with extended funtionality.

Start with the connecting the Mains supply, Control supply and motor cables as follows (common for all examples):

- Connect Protective Earth (PE) to earth bar marked PE and Motor earth to the earth bar marked ⏚ see chapter page 16.

- Connect the softstarter to the 3-phase mains supply (L1, L2 and L3) and the motor (T1, T2 and T3).

- Connect the control supply voltage (100-240 VAC) to terminals N and L and the protective earth wire to terminal PE.

NOTE: If local regulations state that a mains contactor must be used, relay R1 should control this see below. Always use standard commercial, slow blow fuses, e.g. gl or gG types, to protect the wiring and prevent short circuiting. To protect the thyristors against short-circuit currents, ultrafast semiconductor fuses can be used if preferred. The normal warranty is valid even if ultrafast semiconductor fuses are not used.
All signal inputs and outputs are galvanically insulated from the mains supply.

- If required, connect relay R1 (terminals 21 and 22) to the contactor – the softstarter then controls the mains contactor (for factory configuration of R1 see menu [551]).

Always ensure the installation complies with the appropriate local regulations.

Example 1: Separate Start- Stop-signals (3-wire connection).

- Closing (pulse) contact between terminal 18 (24 VDC) and terminal 11(DigIn1) gives Start.
  Opening (pulse) contact between terminal 18 (24 VDC) and terminal 12(DigIn2) gives Stop. To make Emotron TSA start, terminal 12 (DigIn2) must be connected to terminal 18 (24VDC).

NOTE: This alternative works with the factory default parameter settings.

NOTE: With this alternative the softstarter will not restart after a power failure. A new start pulse must be given.
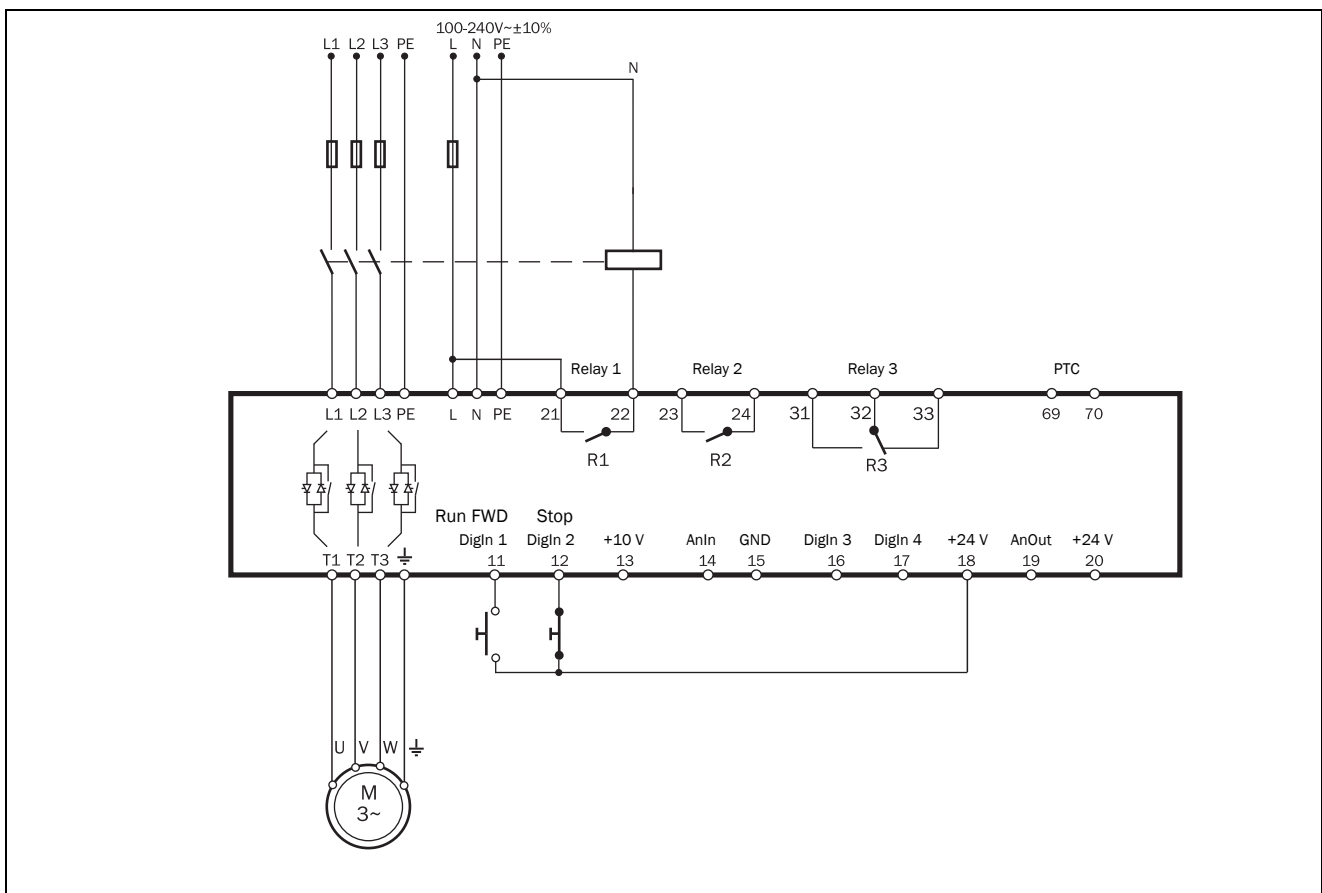
Fig. 20 Separate Start- Stop-signals (3-wire connection) wiring example.

Example 2: Common Start- Stop-signals (2-wire connection)

- Closing contact between terminal 18 (24 VDC) and terminal 11(DigIn1) and terminal 12 (DigIn2) gives Start.
  Opening the contact between terminal 18 (24 VDC) and terminal 11(DigIn1) and terminal 12(DigIn2) gives Stop.

NOTE: This alternative works with the factory default parameter settings.

NOTE: With this alternative the softstarter will restart after a power failure if the contact is still closed.
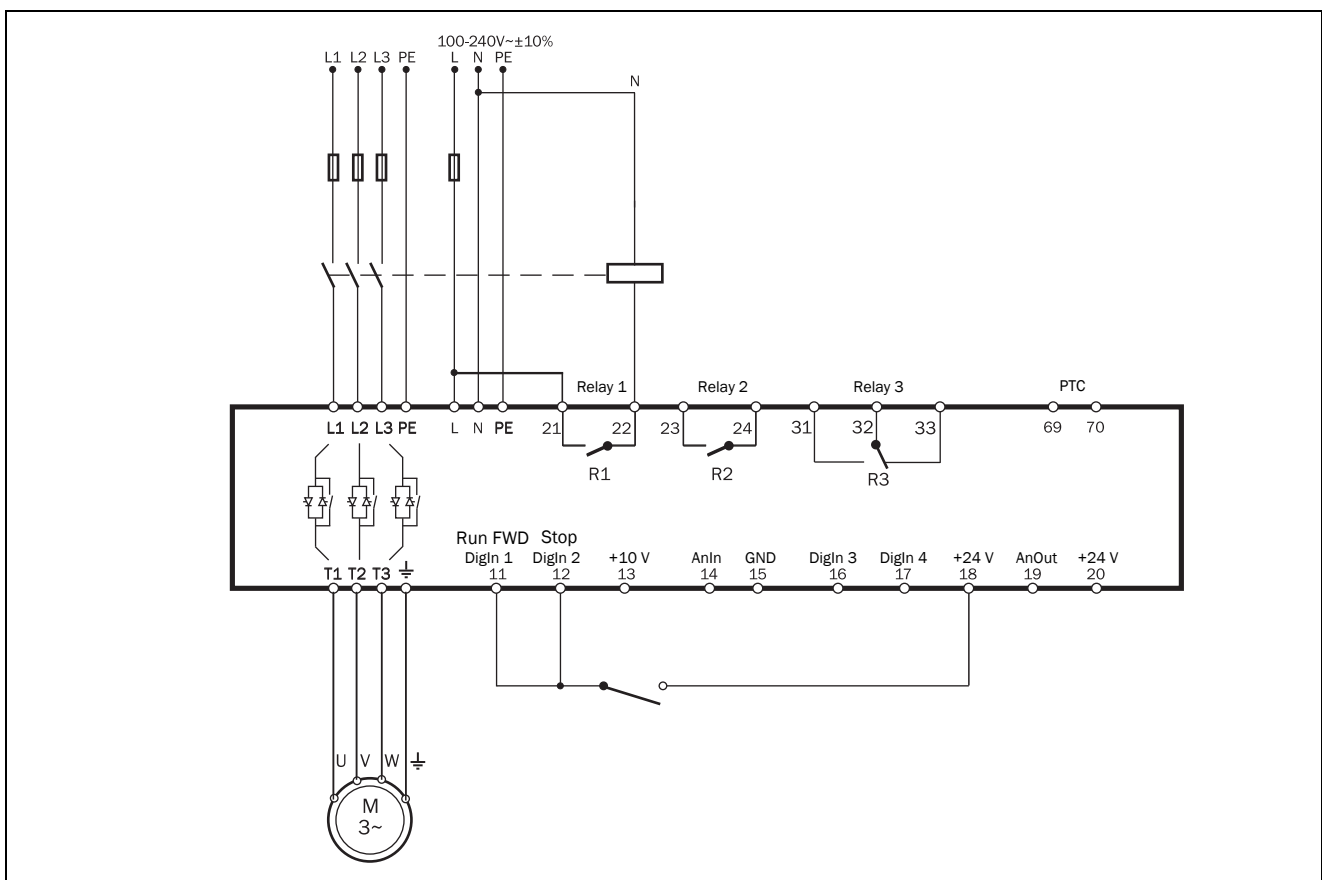
Fig. 21   Common Start- Stop-signals (2-wire connection) wiring example.

Example 3: Common Start- Stop-signals (2-wire connection)

- Closing contact between terminal 18 (24 VDC) and terminal 11(DigIn1) gives Start.
  Opening the contact between terminal 18 (24 VDC) and terminal 11(DigIn1) gives Stop.

NOTE: This alternative will not work with the factory default parameter settings.
Change parameters according to the table below.

Menu	Description	Setting
21A	Level/Edge	Level
522	Digital input 2 (terminal 12)	Off

NOTE: With this alternative the softstarter will restart after a power failure if the contact is still closed.
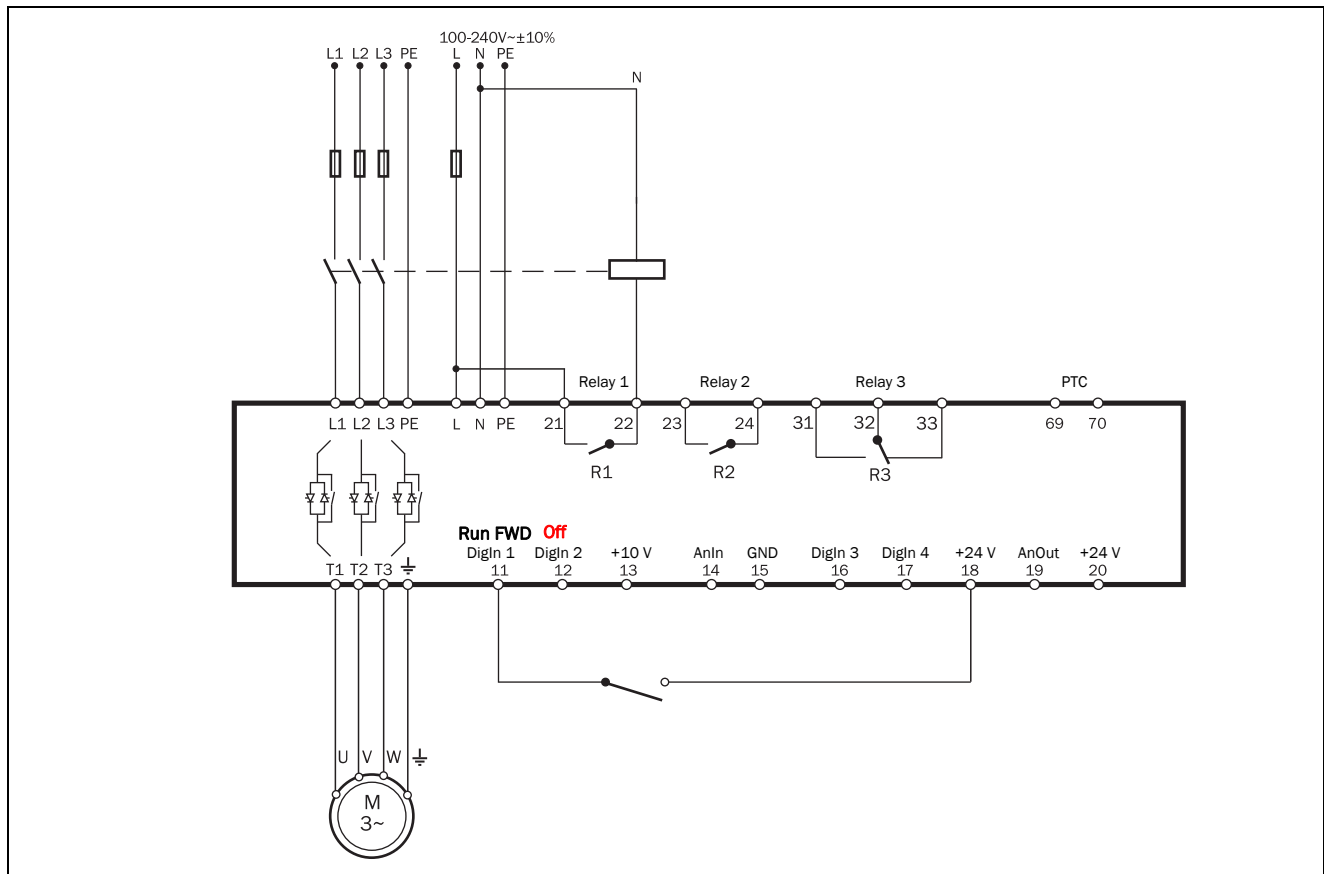
Fig. 22   Common Start- Stop-signals (2-wire connection) wiring example, Level control.

Example 4: Extended wiring

Fig. 23 gives a wiring example with the following functions: Emotron TSA will start when the pressure is under 4 bar and Stop when the pressure reaches 6 bar.

- Analogue start/stop via process value, see description on page 106.

- Analogue output, see section 8.5.3, page 109

- Motor PTC input, see description of Thermal motor protection in section 8.2.4, page 76.

Menu	Description	Setting
21A	Level/ Edge	Level
2331	PTC AA	Soft trip
321	Proc Source	F(AnIn)
322	Proc Unit	bar
325	Process Max	10.000
522	Digital input 2 (terminal 12)	Off
6111	CA1 Value	Process Val
6112	CA1 Level HI	6 bar
6113	CA1 Level LO	4 bar
561	VIU 1 Dest	Stop
562	VIU 1 Source	!A1
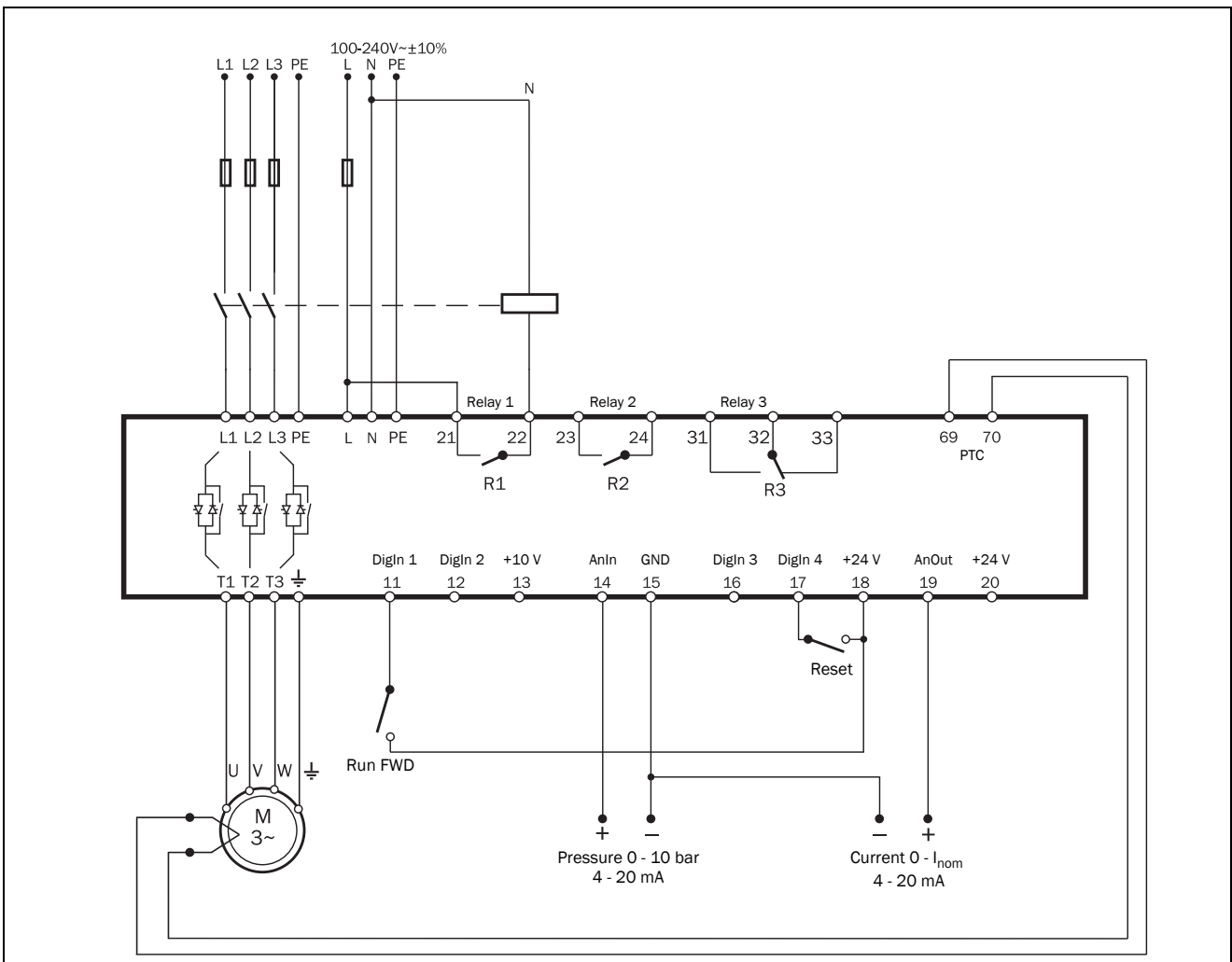
Fig. 23   Extended wiring example, using digital and analogue inputs and outputs.

Example 5: Reverse current brake wiring

The example in Fig. 24 shows the wiring for a reverse current brake functionality. For further settings, see the description for "Braking Method [344]" on page 95.

The contactors have to be controlled by the relay outputs of the softstarter. For relay settings, see menu [550] and Fig. 63, page 113. The relay (R1) for the first mains contactor (K1) is set to "RunSignalFWD" in menu [551], and will control the mains contactor (K1). The second mains contactor (K2) is controlled by relay (R2), that is set to "RevCurrBrake" in menu [552]. During start and full voltage operation the first contactor (K1) will be activated. For braking R1 will open and contactor (K2) will be activated via R2 to change the phase sequence.

Menu	Description	Setting
344	Brake Method	RevCurrBrk
551	Relay 1 (terminals 21 and 22)	RunSignalFWD
552	Relay 2 (terminals 23 and 24)	RevCurrBrake

WARNING!
If configured according to the description, relays R1 and R2 will never be activated at the same time. There is an adjustable time delay (set in menu [346]) for the change-over between the relays. However, **if the relays are not configured properly, they may be activated at the same time. By having electrical interlocking between the contactors, this risk is avoided.**
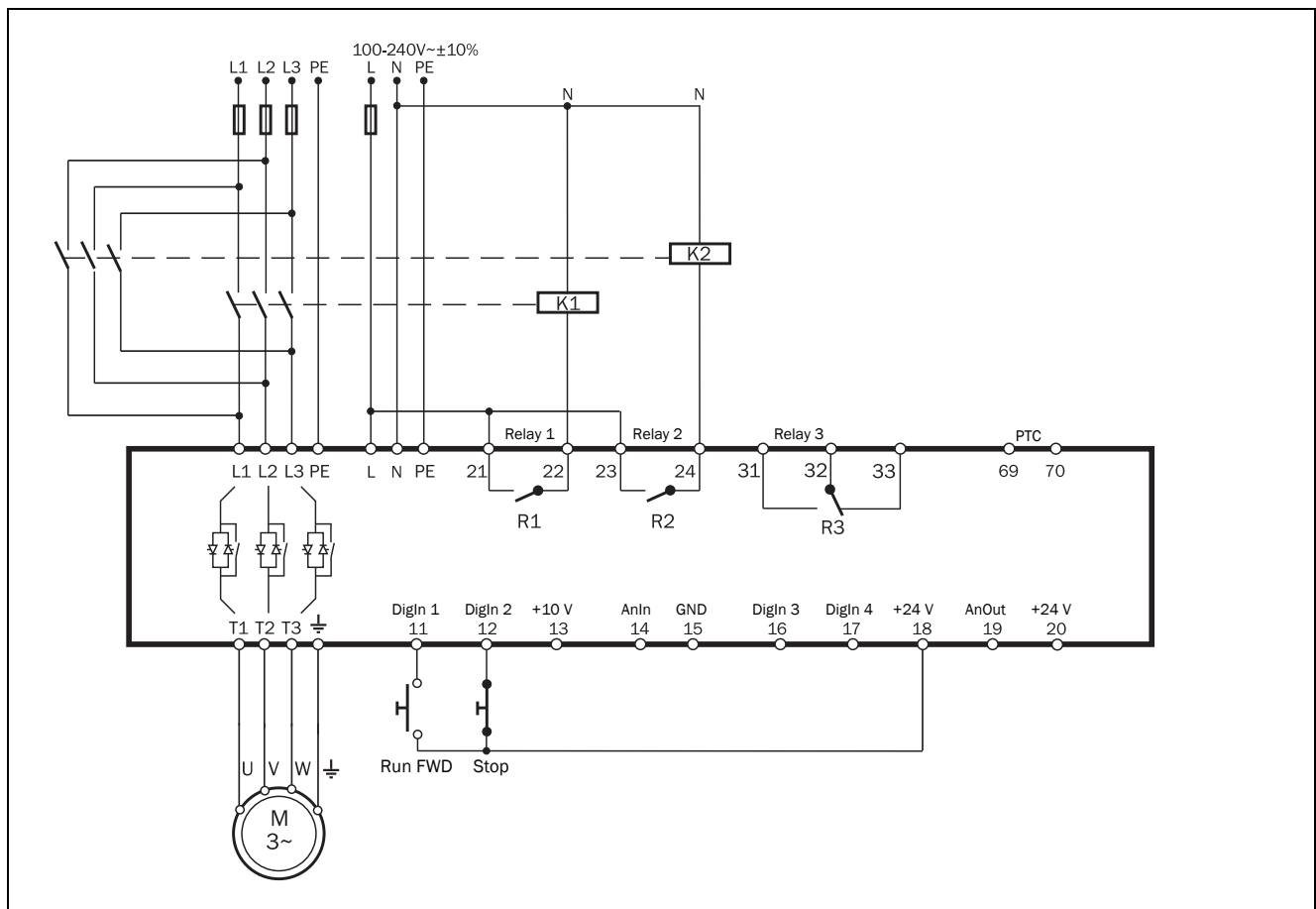
Fig. 24   Reverse current brake wiring example.

Example 6: Reverse start functionality

The digital inputs can be configured to enable starting a motor in two different directions with the use of the programmable relays R1 and R2. A connection example is shown in Fig. 25. For the following description of start forward/reverse functionality, the following settings for the digital inputs are assumed.

Menu	Description	Setting
219	Rotation	FWD+REV
523	DigIn3	Run REV
551	Relay 1	OperationFWD
552	Relay 2	OperationREV

.

CAUTION!
Very high torque/force can arise when the motor is reversed from running at full speed in one direction to running at full speed in the opposite direction.

WARNING!
If configured according to the description, relays R1 and R2 will never be activated at the same time. There is a time delay of 100 ms for the change-over between the relays. However, if the relays are not configured properly, they may be activated at the same time. By having electrical interlocking between the contactors, this risk is avoided.
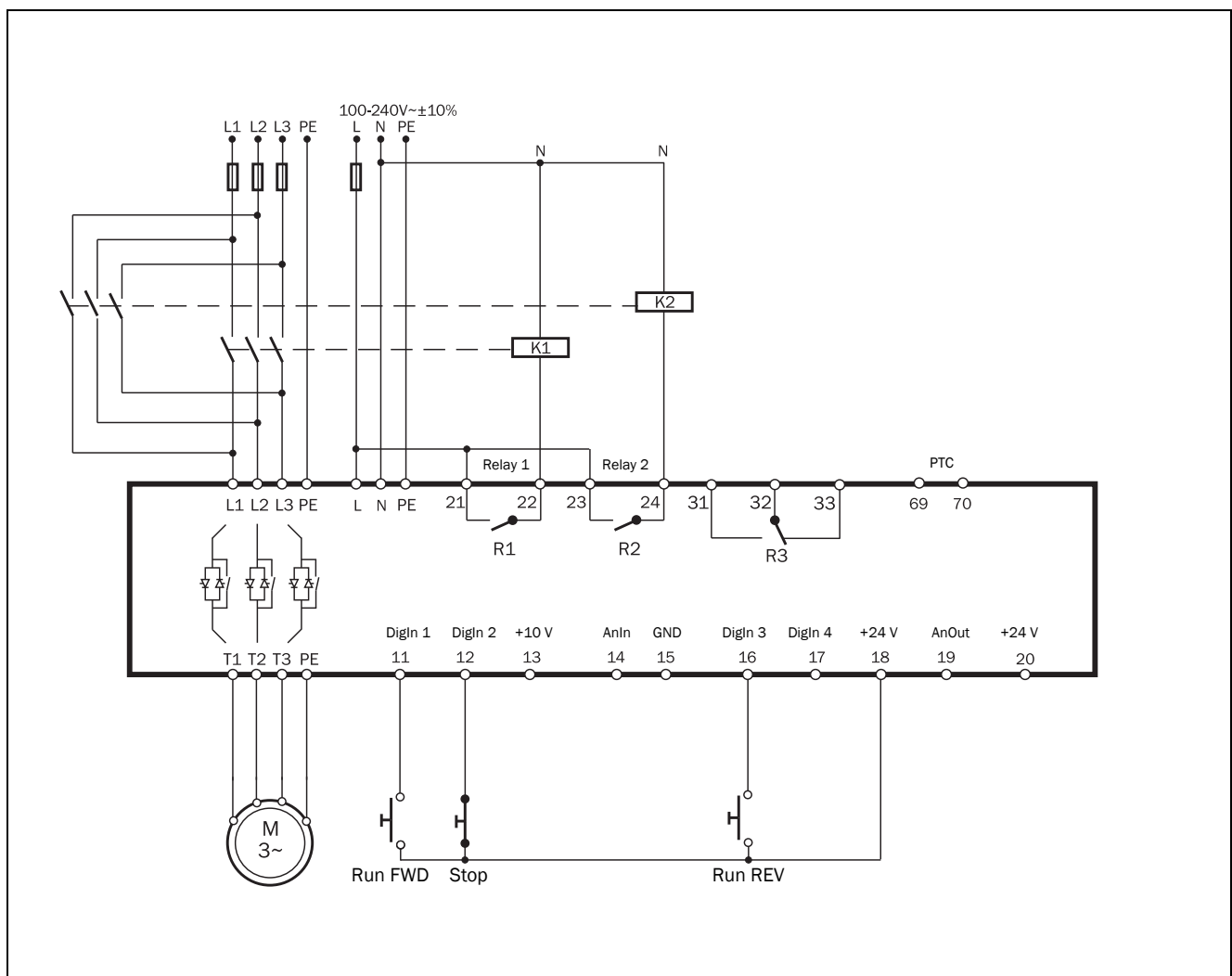
Fig. 25   Connection for start forward/reverse.

The functionality for both with or without reverse current brake functionality is as follows:

These examples are only valid with Edge control (default setting).

If DigIn 1 "RunFWD" is closed and DigIn 3 "RunREV" is open, the mains contactor (K1) for running in forward direction will be activated by relay R1, and the motor will start in forward direction. DigIn 1 "RunFWD" can be opened during forward running without any effect. If DigIn 2 "Stop" is opened, the stop according to settings in menu group [340] will be performed. When the stop is finished, the mains contactor for running forward (K1) will be deactivated by relay R1.
Exception is if Reverse current braking is selected in menu "[344] Brake Method". In this case contactor K1 will be deactivated when stop command is activated and contactor K2 is activated instead until stop is finished.

If DigIn 3 "RunREV" is closed while DigIn 1 "RunFWD" is open, the mains contactor for running in reverse direction (K2) will be activated by relay R2 and the motor will start in reverse direction. DigIn 3 "RunREV" can be opened during reverse running without any effect. If DigIn 2 "Stop" is opened, a stop according to the stop settings in menu group [340] will be performed. When the stop is finished, the mains contactor for reverse running (K2) will be deactivated by relay R2.

Exception is if Reverse current braking is selected in menu "[344] Brake Method". In this case contactor K2 will be deactivated when stop command is activated and contactor K1 is activated instead until stop is finished.

If both DigIn 1 "RunFWD" and DigIn 3 "RunREV" are closed at the same time, a stop is performed according to the stop settings in menu group [340]. In this case no start will be allowed.

4. Application guidelines

This chapter is a guide to selecting the correct softstarter rating and softstarter functionality for different applications.

To make the right choice the following tools are used:

The AC-53 norms
The AC-53 norms are defined in the EN(IEC) 60947-4-2:2007 standard for electronic softstarters. The purpose of these norms is to aid in selecting a softstarter with regards to duty cycle, starts per hour and maximum starting current.

The Applications Rating List
With this list the Emotron TSA softstarter rating type can be selected depending on the type of application uses, see Table 14, page 32.

The Applications Function List
This table gives an overview of the most common applications and their challenges. For each application Emotron TSA softstarter settings are proposed, with references to the menus used. See Table 15, page 34.

4.1 Softstarter dimensioning according to AC-53b

The EN(IEC) 60947-4-2:2007 standard defines AC-53b as a norm for dimensioning of softstarters for continuous running with a bypass contactor. This is the norm for which the Emotron TSA is designed.

AC-53b rating example
Explanation of the rating designation (see also Fig. 26):

$$70 \text{ A: AC-53b} \quad 3.0 - \quad 30 : 330$$
$$\textcircled{1} \qquad \textcircled{2} \qquad \textcircled{3} \quad \textcircled{4} \qquad \textcircled{5}$$

1. Rated current (FLC) of softstarter, [Ampere]

2. Classification (AC-53b for all Emotron TSA models)

3. Start current expressed as a multiple of FLC

4. Start time, [seconds]

5. Bypass time, [seconds]

The example concerns Emotron TSA model 52-070, used for a pump application. The rating designation indicates a current rating of 70 A with a start current ratio of 3.0 x FLC (210 A) for 30 seconds, and with a 330 seconds (5.5 minutes) interval between starts (current via bypass contactors).
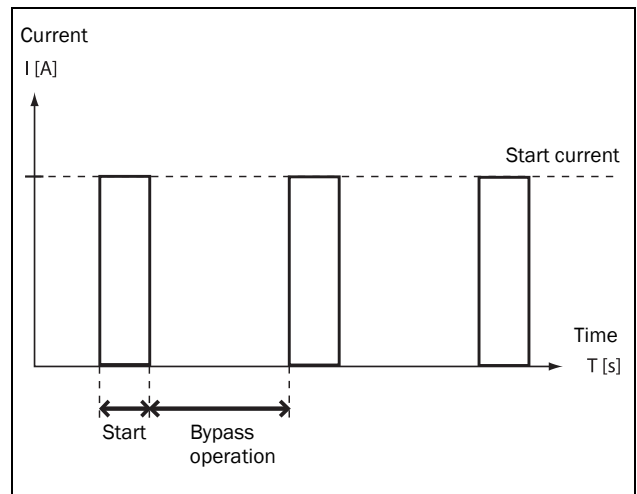
Fig. 26   Duty cycle.

4.2 Applications rating

According to the AC-53b norm a softstarter can have several current ratings. The Applications Rating List in Table 14, page 32 shows which rating that is recommended for the application.

The Emotron TSA model is selected depending on its model size and on the duty cycle of the application:

AC-53b ratings for Emotron TSA size 1:
- AC-53b 3.0-15:345 (normal duty with bypass)
- AC-53b 5.0-15:345 (heavy duty with bypass)

AC-53b ratings for Emotron TSA size 2 - 6:
- AC-53b 3.0-30:330 (normal duty with bypass)
- AC-53b 5.0-30:330 (heavy duty with bypass)

NOTE: To select softstarter size it is important to ensure that not only FLC (Full Load Current) is checked but also the starting requirements.

Example:
In the previous example, in which the Emotron TSA 52-070 is used for a pump application, the recommended rating is "normal duty" according to the Applications Rating List.

Applications Rating List

This list gives the typical rating type for the machine or application, divided in "normal duty" and "heavy duty" applications (both with bypass). If the machine or application is not in this list, try to identify a similar machine or application. If in doubt please contact your Emotron TSA supplier.

Example:

If the Emotron TSA 52-070 from the previous example is used in e.g. a roller mill application instead, it would be rated differently according to the Applications Rating List. Due to high starting current a roller mill is considered a heavy duty application, which places greater demands on the softstarter. The technical data (page 157) indicates that the TSA 52-070 is downrated to 42 A FLC for heavy duty applications. If an FLC current of about 70 A is required for the roller mill, it would be recommended to choose TSA model 52-140, for which the rated heavy duty current is 84 A.

Table 14   Applications Rating List

Applications rating for Emotron TSA softstarter		
Industry	**Normal duty cycle AC53b-3.0**	**Heavy duty cycle AC53b-5.0**
General & Water	Centrifugal pump Submersible pump Compressor, screw Compressor, reciprocating Fan Blower	Conveyor Mixer Agitator
Metals & Mining	Dust collector Grinder	Belt conveyor Hammer mill Rock crusher Roller conveyor Roller mill Tumbler Wire draw machine
Food processing	Bottle washer Slicer	Centrifuge Dryer Mill Palletiser
Pulp & Paper		Repulper Shredder Trolley
Lumber & Wood		Bandsaw Chipper Circular saw Debarker Planer Sander
Petrochemical		Ball mill Centrifuge Extruder Screw conveyor
Transport & Machine		Ball mill Grinder Material conveyor Palletiser Press Roller mill Rotary table Trolley Escalator

4.3 The Application Functions List

This list gives an overview of many different applications with their challenges and a possible solution within the functions of the Emotron TSA.

Description and use of the table:

"Application"

This column gives the various applications. If the machine or application is not found in this list, try to identify a similar machine or application. If in doubt please contact your supplier.

"Challenge"

This column describes possible challenges that are familiar for this kind of application.

"Emotron TSA Solution"

This column gives the possible solution for the challenge using one of the functions of the Emotron TSA.

"Menu/Chapter"

This column guides you to the menu, menu group, or manual section where you find a description of the settings for the function.
For instance "331=Sqr Torq Ctr", means: set menu [331] to "Sqr Torq Ctr."

Example: Hammer mill

- Linear torque control (menu [331], selection "Lin Torq Ctr") will give the best results.

- Torque boost to overcome high breakaway torque (menu [337], submenus [3371]and [3372]).

- Overload alarm function for jamming protection (menu [410] "Load Monitor", with submenus for maximum alarm)

Stop function reverse current brake (set "Stop Method" [341] to "Brake", and menu [344] to "Rev Curr Brk"). It is possible to set a "Reversed Current Braking Delay" in menu [346].

Table 15   Application Functions List

Application	Challenge	Emotron TSA Solution	Menu/Chapter
PUMP	Non-linear ramps	Square torque control for square loads	331=Sqr Torq Ctr 341=Sqr Torq Ctr
	Water hammer	Square torque control	340
	High current and peaks during starts	Square torque control	330
	Pump is going in wrong direction	Phase reversal alarm	444
	Dry running	Use load monitor minimum alarm	410
	High load due to dirt in pump	Use load monitor maximum alarm	410
COMPRESSOR	Mechanical shock for compressor, motor and transmissions	Linear torque control	330
	Small fuses and low current available.	Linear torque control and current limit at start.	331=Lin Torq Ctr 335
	Screw compressor going in wrong direction	Phase reversal alarm	444
	Damaged compressor if liquid ammonia enters the compressor screw.	Use load monitor maximum alarm	410
	Energy consumption due to compressor running unloaded	Use load monitor minimum alarm	410
BLOWER	Mechanical shock for blower, motor and transmissions. High start current requires large cables and fuses.	Torque control ensures smooth starts that minimise mechanical stress. Start current is minimised by torque-controlled start.	331=Lin Torq Ctr
CONVEYOR	Mechanical shocks for transmissions and transported goods.	Linear torque control	330
	Loading or unloading conveyors	Slow speed and accurate position control.	350 600
	Conveyor jammed	Use load monitor maximum alarm	410
	Conveyor belt or chain is off but the motor is still running	Use load monitor minimum alarm	410
	Starting after screw conveyor has stopped due to overload.	JOG in reverse direction and then starting in forward.	7.1, p. 49
	Conveyor blocked when starting	Locked rotor function	422
FAN	High starting current in end of ramps	Square torque control for square load characteristics	330
	Slivering belts.		
	Fan is going in wrong direction when starting.	Catching the motor and stopping smoothly to zero speed and then starting in right direction.	331=Sqr Torq Ctr
	Belt or coupling broken	Use load monitor minimum alarm	410
	Blocked filter or closed damper.		
PLANER	High inertia load with high demands on torque and current control.	Linear torque control gives linear acceleration and low starting current.	330
	Need to stop quickly both for emergency and production efficiency reasons.	Dynamic vector brake without contactor for medium loads.	341=Brake 344=Dyn Vect Brk 347
		Reverse current brake with external contactor for heavy loads.	341=Brake 344=Rev Curr Brk
	High speed lines	Conveyor speed set from planer shaft power analogue output.	530
	Worn out tool	Use load monitor maximum alarm	410
	Broken coupling	Use load monitor minimum alarm	410

Table 15   Application Functions List

Application	Challenge	Emotron TSA Solution	Menu/Chapter
ROCK CRUSHER	High inertia	Linear torque control gives linear acceleration and low starting current.	330
	Heavy load when starting with material	Torque boost	337
	Low power if a diesel powered generator is used.	Current limit at start	335
	Wrong material in crusher	Use load monitor maximum alarm	410
	Vibrations during stop	Dynamic vector brake without contactor	341=Brake 344=Dyn Vect Brk 347
BANDSAW	High inertia load with high demands on torque and current control.	Linear torque ramp gives linear acceleration and low starting current.	330
	Need to stop quickly.	Dynamic vector brake without contactor for medium loads.	341=Brake 344=Dyn Vect Brk 347
		Reverse current brake with external contactor for heavy loads.	341=Brake 344=RevCurr Brk
	High speed lines	Conveyor speed set from bandsaw shaft power analogue output.	530
	Worn out saw blade	Use load monitor maximum alarm	410
	Broken coupling, saw blade or belt	Use load monitor minimum alarm	410
CENTRIFUGE	High inertia load	Linear torque control gives linear acceleration and low starting current.	330
	Too high load or unbalanced centrifuge	Use load monitor maximum alarm	410
	Controlled stop	Dynamic vector brake without contactor for medium loads.	341=Brake 344=Dyn Vect Brk 347
		Reverse current brake with external contactor for heavy loads.	341=Brake 344=Rev Curr Brk
	Need to open centrifuge in a certain position.	Braking down to slow speed and then positioning control.	340, 350 600, 650
MIXER	Different materials. Note that it is possible to use the 4 parameter sets to prepare different settings for different materials.	Linear torque control gives linear acceleration and low starting current	330
	Need to control material viscosity	Shaft power analogue output	530
	Broken or damaged blades	Use load monitor maximum alarm	410
		Use load monitor minimum alarm	410
HAMMER MILL	Heavy load with high breakaway torque	Linear torque control gives linear acceleration and low starting current.	331=Lin Torq Ctr
		Torque boost in beginning of ramp.	337
	Jamming	Use load monitor maximum alarm	410
	Fast stop	Reverse current brake with reversing contactor for heavy loads.	341=Brake 344=Rev Curr Brk
	Motor blocked	Locked rotor function	422

4.4   Special conditions

4.4.1   Small motor or low load

The minimum load current for the Emotron TSA softstarter is 10% of the rated current for the softstarter. An exception is the TSA52-016 for which the minimum load current is 2 A.

Example: TSA52-056 with rated current of 56 A has a minimum current of 5.6 A.

Please note that this is "minimum load current" and not minimum rated motor current.
Note also that motor current can not be set below 25% of rated current for the Emotron TSA.

4.4.2   Ambient temperature below 0°C (32°F)

For ambient temperatures below 0 °C (32 °F) an electric heater or similar must be installed in the cabinet. The softstarter can be mounted remotely from the motor since the distance between the motor and the softstarter is not critical.

4.4.3   Pump control with softstarter and AC drive together

It is possible, e.g. in a pump station with two or more pumps, to use one Emotron FDU AC drive on one pump and softstarters on each of the other pumps. The flow of the pumps is then controlled by the pump control function in the Emotron FDU.

4.4.4   Starting with counter-clockwise (reverse) rotating loads

It is possible to start a motor clockwise (forward direction), even if the load and motor are rotating counterclockwise (reverse direction), e.g. fans.
Depending on the speed and the load "in the wrong direction", note that the current can be quite high.
If required, it is possible to limit the start currents by increasing the start time (menu [336]).

4.4.5   Running motors connected in parallel

When starting and running motors connected in parallel, the total amount of the motor current must be equal or lower than the rating of the connected softstarter. Please note that it is not possible to use the internal thermal motor protection or use other individual settings for each motor. For instance, the start ramp can only be set for an average starting ramp for all the connected motors. This means that the start time may differ from motor to motor. Similarly, the load monitor alarm levels/margins are applied for the average shaft power value of the connected motors. In order to work around this kind of problem, it could be necessary to deactivate a number of functions and alarms.

For motors connected in parallel, torque control is not recommended because of the risk of oscillation between the motors. Voltage control with or without current limit is recommended instead. The use of the braking functionality is not recommended for motors connected in parallel. Note, by using the Emotron TSA built in PTC plus optional PTC/PT100 boards it is possible to have individual PTC protection of up to 3 motors.

4.4.6   Running motors linked together

When starting and running motors mechanically linked together but with one softstarter connected to each motor, there are two kinds of operations available. The first is to start the motors at the same time using voltage control with or without current limit. The second is to start one motor first with torque or voltage control and after the motor has reached full speed, the voltage to the other motors is ramped up using voltage control.

4.4.7   Heat dissipation in cabinets

For guidelines regarding calculation of heat dissipation in cabinets, please contact your cabinet supplier. The required data is found in "Technical Data", Chapter 13. page 157.

4.4.8   Insulation test on motor

When testing the motor with high voltage e.g. insulation test, the softstarter must be disconnected from the motor. This is due to the fact that the softstarter will be seriously damaged by the high test voltage.

4.4.9   Operation above 1,000 m (3280 ft)

All ratings are stated for operation at maximum 1,000 m (3280 ft) over sea level.

If the softstarter is operated at 3,000 m (9843 ft) for example, it must be derated, and it is likely that a higher rated model than normal is required to fulfil the task. See further information in section 13.3.2, page 162.

4.4.10   Aggressive environment conditions

As standard the Emotron TSA is equipped with coated boards in order to reduce the risk for corrosion. For specification, see section 13.3, page 161.

4.4.11 IT earthing system

Emotron TSA Softstarter is as standard equipped with earthing system fulfilling the EMC requirements.

Distribution systems may be equipped with an IT isolated earthing system, which allows for an earth fault to occur without interruption of operation. For use in these systems, the Emotron TSA should be configured for IT-net supply type. The unit will then not fulfil the EMC requirements.

If you have a softstarter without IT net supply type, the softstarter can be rebuilt. Contact your local CG Drives & Automation service partner.

4.4.12 Earth fault relay

It is possible to use an earth fault relay to protect motor and cables. To avoid undesired tripping due to filter capacitor charging currents, choose an RCD Type B rated for 300 mA leakage current.
For Emotron SA size 1 and 2 (16 - 100A) there are no capacitors to ground so the leakage current to ground is less than 30 mA

4.4.13 Other control voltage

The power board must be connected to 100-240 VAC single phase control supply. If this is not available a transformer must be used. This transformer should be connected as in Fig. 27.
The transformer should be capable of supplying a power of 50 VA or more. This item is not included in the range of CG options.
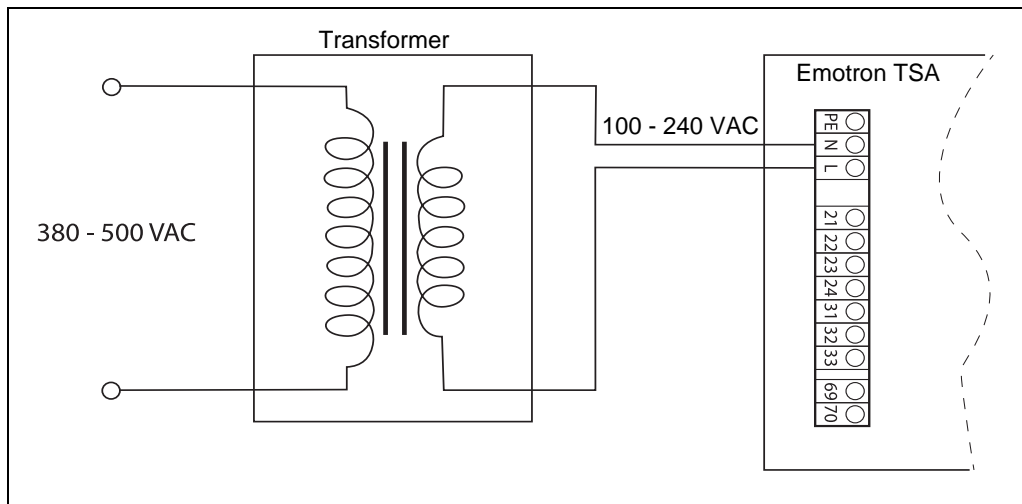
Fig. 27   Example of wiring when using transformer for 380 - 500 VAC

5. Getting started

This chapter is a step by step guide that will show you the quickest way to get the motor shaft turning. We will show you two examples: with remote control and control panel operation.

> ⚠️ **WARNING!**
> Mounting, wiring and setting the device into operation must be carried out by properly trained and qualified personnel.

5.1 Check list

- Check that the motor and supply voltage corresponds to the values on the rating plate of the softstarter.

- Mount the softstarter (Chapter 2. page 9).

- Connect the 3-phase mains supply cables to the connections on top of the softstarter (section , page 16).

- Connect the motor cables to the connections in the bottom of the softstarter.

- Connect control supply voltage.

- Ensure that the installation complies with the appropriate local regulations.

Remote (I/O) operation:
- Connect the I/O control cables (section 3.3, page 22).

> ⚠️ **WARNING!**
> Motor may start instantly!
> Please verify that parameter settings and I/O connections are according to desired function before connecting mains supply.

- Switch on the 3-phase mains supply voltage and control supply voltage.

- Select language (menu [211], section 8.2.1, page 69).

- Set the motor data (menu [220] - [227], section 8.2.3, page 73).

- Check / Set real time clock (menu [740], section 8.7.4, page 134)

- Perform a test run with external I/O start signal.

Control panel operation:
- Switch on the 3-phase mains supply voltage and control supply voltage.

- Select language (menu [211], section 8.2.1, page 69).

- Set the motor data (menu [220] - [227], section 8.2.3, page 73).

- Check / Set real time clock (menu [740], section 8.7.4, page 134)

- Select keyboard control (menu [2151], section 7.1.1, page 49).

- Perform a test run from the control panel.

5.2 Mains and motor connection.
Connect the softstarter between the 3-phase mains supply and the motor. For the respective connections, see the table below).

Dimension the mains and motor cables according to local regulations. The cables must be able to carry the motors load current (see "Technical data" on page 157).

Table 16   Mains and motor connection

L1, L2, L3 PE	Mains supply, 3-phase Protective earth
T1, T2, T3 ⏚	Motor output, 3-phase Motor earth

> ⚠️ **WARNING!**
> In order to work safely the mains earth must be connected to PE and the motor earth to ⏚ .

5.2.1 Connect the mains cables
The connection of the mains cables is shown in section 3.1, page 15.

5.2.2 Connect the motor cables
The connection of the motor cables is shown in section , page 16.

5.2.3 Connect the control supply voltage
The control supply voltage is connected to the terminals marked N and L on the power board (Chapter 3.2 page 20).

5.3 Default toggle loop

In order to make it easier to setup the initial data, there is a default toggle loop, see Fig. 28. This loop contains the necessary menus that need to be set before starting the softstarter the first time. Press the Toggle key to enter e.g. menu [740], then use the Enter key to go to the submenus ([741] and so forth) and enter the parameters. When you press the Toggle key again, the next toggle menu is displayed.
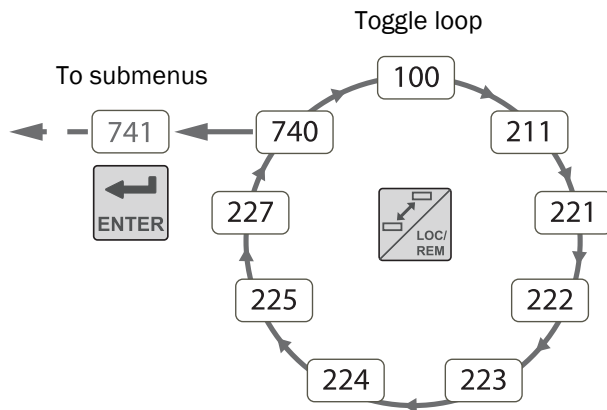
Fig. 28 Default toggle loop

5.4 Remote I/O operation

Generally, external signals are used to control the softstarter and the motor. This example demonstrates the set-up for a standard motor for which an external start button will be used.

Connect the control signal cables

It is recommended to use screened control signal cables with flexible wire up to 1.5 mm^2, or solid wire up to 2.5 mm^2.

The minimum wiring for remote controlled start is shown in section 3.4, page 23.

Switch on the voltage

Once the control supply voltage is switched on, the system is initiated, the display is lit and the internal fan (no fan in frame size 1) will run for 5 seconds.

Set the basic data

Use the default toggle loop, see Fig. 28. to enter the basic data, i.e. language, time, and motor data for the connected motor. The motor data is used in the calculation of complete operational data in the softstarter.

Change settings using the keys on the control panel. For further information about the control panel and menu structure, see Chapter 6. page 43.

Menu [100], "Preferred View" is displayed at start.

1. Press ⬜ to display menu [211] "Language".
    Select Language using the ➕ and ➖ keys.
    Confirm with ⏎.

2. Press ⬜ to display menu [221] "Motor Volts" and set nominal motor voltage. Change the value using the ➡ , ⬅ , ➕ and ➖ keys. Confirm with ⏎.

Perform in a similar way the following settings:

3. Set motor frequency [222].

4. Set motor power [223].

5. Set motor current [224].

6. Set motor speed [225].

7. Set power factor (cos φ) [227].

Following steps 8 - 10 are normally factory set to CET (Central European mean time). If this is OK for you continue to step 11.

8. Press ⬜ to display menu [740]"Clock setting".

9. Press ⏎ to display menu [741]" Time". Change the time using the ➡ , ⬅ , ➕ and ➖ keys. Confirm with ⏎.

10. Press ⏎ to display menu [742]" Date" and set date. Confirm with ⏎.

11. Switch off power supply.

12. Connect digital and analogue inputs/outputs.

13. Switch on power supply.

NOTE: For selection of other start method than the default "linear torque control", see section 7.1.2, page 35

Test run with external start command

Now the installation is finished, press the external start button (contact closed) to start the motor.

NOTE: When the internal bypass contactor is activated, three distinct clicks are heard.

To stop the motor, disconnect the start command (contact open).

NOTE: For selection of other stop method than the default "Coast", see section 7.1.2, page 35 and menu [341].

5.5 Control panel operation

A manual test run can be executed via the control panel. This example demonstrates the set-up to carry out for a standard motor.

Switch on the voltage

Once the control supply voltage is switched on, the system is initiated, the display is lit and the internal fan (no fan in frame size 1) will run for 5 seconds.

Set the basic data

Enter the basic data, i.e. language, time, and motor data for the connected motor. Perform this the same way as for "Remote I/O operation" on page 40.
Follow the steps 1 - 10.

Then press ⬆ until you return to menu [100],"Preferred View".

Select manual control

1. Press ➡ to display menu [200], "Main Setup".

2. Press ⬅ to display menu [210], "Operation".

3. Press ➡ until you get to menu [215] "Action Control", then press ⬅ to go to submenu [2151] "Run/Stop Control".

4. Select "Int keyb" using the key ➕.
   Press ⬅ to confirm.

Test run from control panel

Press the ⬥ key on the control panel to run the motor forward.

NOTE: When the internal bypass contactor is activated, three distinct clicks are heard.

To stop the motor, press the ⬥ key on the control panel.

NOTE: For selection of other stop method than the default "Coast", see section 7.1.2, page 35 and menu [341].

---

6. Operation via the control panel

The control panel displays the status of the softstarter and is used to set all the parameters. It is also possible to control the motor directly from the control panel.
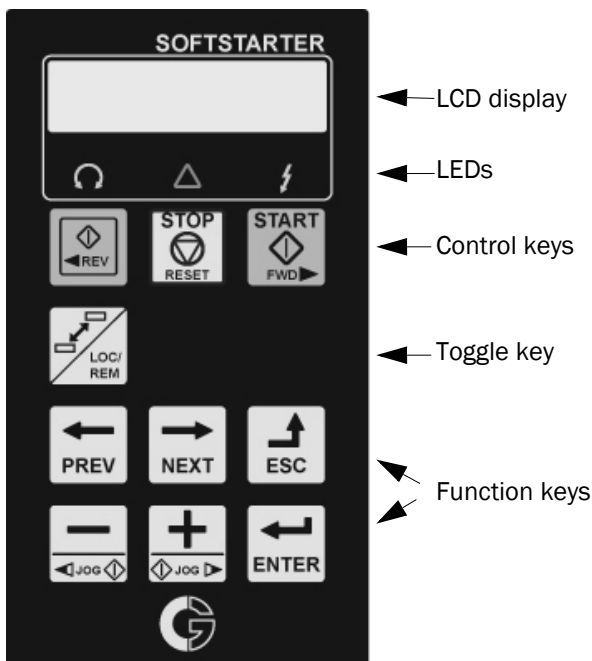
Fig. 29 Control panel

NOTE: The language in the display is as default set to English. To conform with the content of the Instruction manual change language in menu [211].

6.1 Display

The display is back lit and consists of 2 rows, each with space for 16 characters. The display is divided into six areas.

The different areas in the display are described below:

Fig. 30 LC display

Area A:	Shows the actual menu number (3 or 4 digits).
Area B:	Shows if the menu is in the Toggle loop (page 46), indicated with **T**, and/or if the softstarter is set for "Local" operation (page 47), indicated with **L**.
Area C:	Shows the abbreviated name of the active menu, e.g. menu or description of the contents.
Area D:	Shows the status of the softstarter (3 characters). The following status indications are possible: **Acc:** Motor accellerating **Dec:** Motor decellerating I^2t: Active I^2t motor protection **Run:** Motor runs at full speed **Jog:** Motor runs at jog speed **Trp:** Tripped **Stp:** Motor is stopped
Area E:	Shows active parameter set: **A,B**, **C**, or **D**; and if it is a motor parameter: M1, M2, M3, or M4. Shows a flashing cursor when altering a menu parameter. Also shows "S" to indicate soft trip, and "A" if max number of autoreset attempts is exceeded.
Area F:	Shows the setting or selection in the active menu (empty at 1st level and 2nd level menus). Shows warnings and alarm messages.

6.2 LED indicators

The three light emitting diodes below the display indicate the operation status of the softstarter and motor/machine (see Fig. 31). Depending on the operating mode the TRIP and RUN indicators will also flash to alert the user about a coming event or action. A description of the different LED signals is given in Table 17 below.
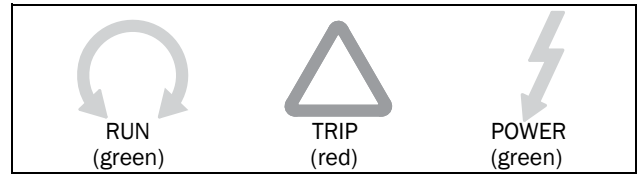
Fig. 31   LED indicators

Table 17   LED indication

LED symbol:	Status:			
	ON	**NORMAL FLASHING (2 Hz)***	**SLOW FLASHING (1 Hz)***	**OFF**
POWER (green)	Mains supply power on	------------	----------	Power off
TRIP (red)	Softstarter tripped, motor stopped	Warning and during Soft trip stop ramp	Awaiting autoreset of trip or Predictive i^2t thermal capacity reached. (simultaneously flashing RUN and TRIP LEDs)	No trip
RUN (green)	Running at full speed	Start and stop ramp		Motor stopped

*) Frequency: 1 Hz=1 flash per second; 2 Hz=2 flashes per second

6.3 Control keys

The control keys are used to give the START, STOP or RESET commands directly. As default the START and STOP keys are disabled and the commands are controlled remotely (from digital input).

To enable START commands (reverse and forward run) from the control keys, go to the description in section 7.1.1, page 49, menu [2151].

The RESET key is active by default. It will remain active as long as one of the keyboard alternatives is selected in menu [216]).

If the "Enable" function is programmed on one of the digital inputs, this input must be active to allow START/STOP commands from the control panel.

Table 18   Control key commands.

	START REVERSE RUN	Start with reversed (left) rotation. (Requires reversing contactor).
	STOP/RESET	Stop motor. Reset softstarter (after a trip).
	START FORWARD RUN	Start with forward (right) rotation.

NOTE: It is not possible to simultaneously activate the Run/Stop commands from the keyboard and remotely from the terminal strip. Exception is the Jog-function which can give a start command, see "Jog functions" on page 50.

6.4 Function keys

The function keys operate the menus and are also used for programming and read-outs of all the menu settings.

Table 19   Function key commands.

ENTER	ENTER	Step to lower menu level. Confirm a changed setting.
ESC	ESCAPE	Step to higher menu level. Ignore a changed setting (without confirming).
PREV	PREVIOUS	Step to previous menu within the same level. Move cursor one position to the left.
NEXT	NEXT	Step to next menu within the same level. Move cursor one position to the right.
— JOG	- (MINUS) or JOG REV	Decrease a value. Change a selection. Or: Jog reverse function.
+ JOG	+ (PLUS) or JOG FWD	Increase a value. Change a selection. Or: Jog forward function.

6.4.1 +/- key function

To manually change a value or a selection, or to enter a new value, the "+" and "-" keys are used. For this function to be active, the keyboard must be unlocked (as it is by default), menu [218].

Changing parameter selection

To change selection in a menu, press the "+" or "-" keys to scroll between the available alternatives. The cursor to the left (area E) is flashing while doing so. To confirm a selection, press ENTER, and the cursor will stop flashing.

Editing parameter values

Most of the parameters can be changed during operation without stopping the softstarter.

The parameters that can not be changed during operation are in this manual marked with a lock symbol: 🔒.

NOTE: If you try to change a function during operation that only can be changed when the motor is stopped, the message "Stop First" is displayed.

- To change a parameter value, press the "+" or "-" keys. The cursor to the left is flashing while the value is increased or decreased. If you keep the "+" or "-" keys pressed, the value will increase or decrease continuously.
- When altering large numbers you can also directly select a digit with the cursor using the PREV and NEXT keys, and change this with the "+" or "-" keys.
- Press the Toggle key to change the sign of the entered value (only valid for certain parameters). The sign of the value will also change when zero is passed.
- Press ENTER to confirm the value. The cursor to the left will stop flashing.
- Press ESC to leave the edit mode.

Entering lock code

The lock code in menu [218] is inserted in a similar way as changing parameter values by using the +/- keys, and the cursor is moved with the PREV key to the left, in order to enter the next symbol. When finished this is confirmed with ENTER.

NOTE: The lock code is fixed and set to 291.

NOTE: If the message "CP Locked!" is shown or if nothing happens when pressing the "+" or "-" key the control panel is locked, go to menu [218] to unlock the control panel.

6.4.2 Jog key function

The "+" and "-" keys can be programmed for jogging, enabling a manual jog start to be done from the control panel by pressing and holding the key.

To activate the jog key function, see instructions in "Jog functions" on page 50.

To deactivate the jog key function, unlock the keyboard in menu [218].

6.5 Toggle and Loc/Rem Key
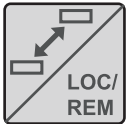
This key has two functions: toggling between selected menus, and switching between local and remote operation control.

If the key is programmed for "Toggle" (default in menu [2171]), it will only have the toggle function.

If the key is programmed for "Loc/Rem" in menu [2171], it can only be used to switch between local and remote control of the softstarter.

If the key is programmed for "Combined" in menu [2171], the key can be used for both functions in the following manner:

• Press and release to use the toggle function.

• Press and hold the toggle key for more than five seconds to enable the choice between Local or Remote function, see section "Loc/Rem function" on page 47.

When editing parameter values, the toggle key can be used to change the sign of the value.

6.5.1 Toggle function

Using the toggle function makes it possible to easily step through selected menus in a loop. The toggle loop can contain a maximum of ten menus. As default the toggle loop contains the menus needed for Getting Started. You can also use the toggle loop to create a quick-menu for the parameters that are most important to your specific application.

> NOTE: Do not keep the Toggle key pressed for more than five seconds without pressing either the "+", "-", or ESC key, as this may activate the Loc/Rem function of this key instead. See menu [2171].

Add a menu to the toggle loop

1. Go to the menu you want to add to the loop.

2. Press the Toggle key and keep it pressed while also pressing the "+" key.

3. Check that a "T" is shown to the right of the menu number (area B).

Delete a menu from the toggle loop

1. Go to the menu you want to delete using the toggle key.

2. Press the Toggle key and keep it pressed while pressing the "-" key.

3. Check that there is no longer a "T" symbol to the right of the menu number.

Delete all menus from the toggle loop

1. Press the Toggle key and keep it pressed while pressing the ESC key.

2. The message "Clear Loop?" is shown.

3. Confirm with ENTER to delete the menus in the loop.

Default toggle loop

Fig. 32 shows the default toggle loop. This loop contains the necessary menus that need to be set before starting the softstarter the first time. Press the Toggle key to enter e.g. menu [211], then use the NEXT key to go to the submenus ([212] and so forth) and enter the parameters. When you press the Toggle key again, the next toggle menu is displayed.
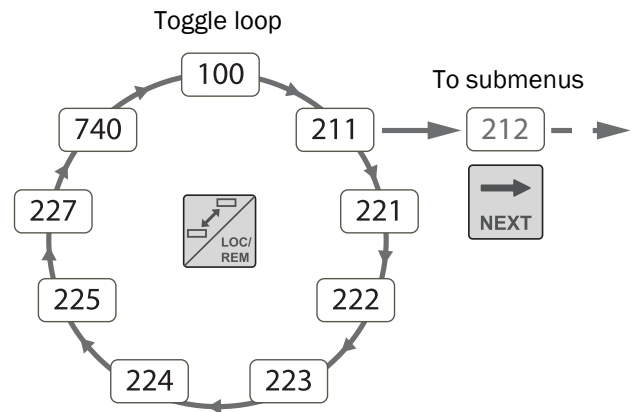
Fig. 32   Default toggle loop

Indication of menus in toggle loop

Menus included in the toggle loop are indicated with a T in area B of the display.

6.5.2 Loc/Rem function

With the Loc/Rem function you can change between local and remote control of the softstarter from the control panel. The Loc/Rem function of the key is as default set to "Toggle". , so this has to be changed. Enable the function in menu [2171]by selecting "Combined" or "Loc/Rem".

The function Loc/Rem can also be changed via DigIn, see menu "Digital inputs [520]".

Change control mode

1. Press the Loc/Rem key until "Local?" or "Remote?" is displayed,
   If you in menu [2171] selected "Combined", you have to press the button for 5 seconds.
   If you in menu [2171] selected "Loc/Rem" just press the button.

2. then confirm with ENTER,

3. or cancel with ESC.

When using the LOC/REM key it is important to define what "LOCAL" and "REMOTE" will mean:

Local mode

The "LOCAL" function is set up in the menu "Local Run Control" [2173], for which the factory default selection is "Keyboard". The actual status of the softstarter will not change, e.g. Run/Stop conditions will remain exactly the same. When the softstarter is set to Local operation, the display will show "L" in area B of the display (alternating with "T" if it is also a toggle loop menu).

Remote mode

The "REMOTE" function is defined in menu [2151] "Run/Stop Control", where default is "Remote".

To monitor the actual Local or Remote status of the softstarter control, a "Loc/Rem" signal is available for the Relays [550]. When the softstarter is set to "LOCAL", the signal on the relay will be active/high. In "REMOTE" the signal will be inactive/low.

6.6 The menu structure

The menu structure consists of 4 levels:

Main Menu 1st level	The first character in the menu number.
2nd level	The second character in the menu number.
3rd level	The third character in the menu number.
4th level	The fourth character in the menu number.

This structure is consequently independent of the number of menus per level.

For instance, a menu can have two selectable menus (Jog [350]), or it can have 12 selectable menus (Motor Data [220]).

NOTE: If there are more than 9 menus within one level, the numbering continues with alphabetic characters (A, B, C, ...).
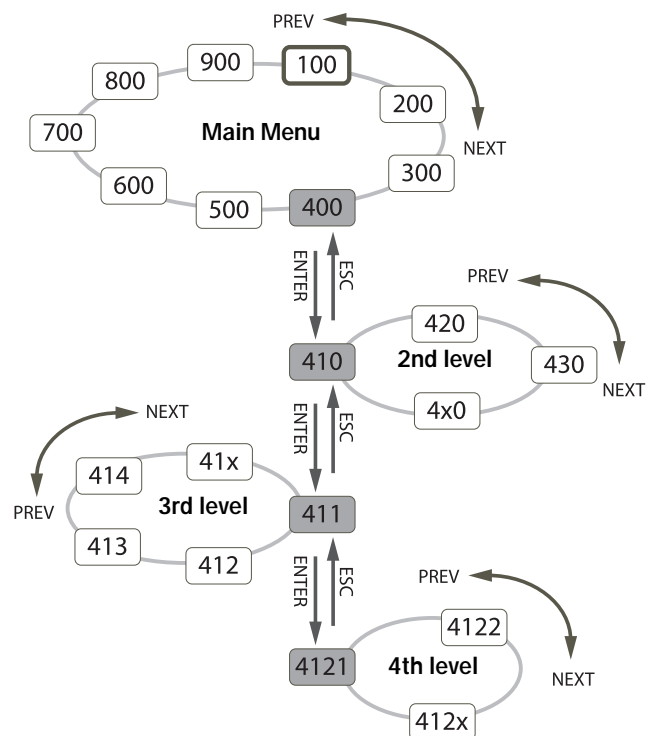
Fig. 33   Menu structure

6.6.1 The main menu

This section gives you a short description of the functions in the main menu. For a more detailed description of the contents under each main menu, see chapter 8. page 67.

100   Preferred View

Displayed at power-up, this menu shows two actual process data (electrical power and current as default). The menu is programmable for many other read-outs.

200   Main Setup

Here you find the main settings to get the softstarter operable, such as motor data, protection and communication settings.

300   Process

This menu contains settings more relevant to the application, such as start and stop settings using analogue Process value.

400   Process Protection

To protect the machine and process from damage, a number of protection settings, such as the load monitor, can be configured under this menu.

500   I/Os and Virtual Connections

Settings for inputs and outputs are entered here.

600   Logical Functions and Timers

A set of freely programmable blocks are available in this section.

700   View Operation and Status

In this menu you can view operational data (power, torque, current, etc.), and get status information about e.g. clock, date, inputs and outputs.

800   View Trip Log

Here you can see the last 9 trips in the trip memory.

900   System Data

This menu contains information on softstarter model and software version.

7.   Main features

This chapter contains descriptions of the main features of the Emotron TSA softstarter.

7.1   Setting Start, Stop and Run functions

7.1.1 Start and stop control

The start and stop control signals can be given from the control panel using the control keys, via remote control (i.e. programmable I/O), or via serial communication. Valid motor rotation direction is set in menu [219] (see Fig. 34). Follow the procedure in Fig. 35 for setting of the start and stop signals.
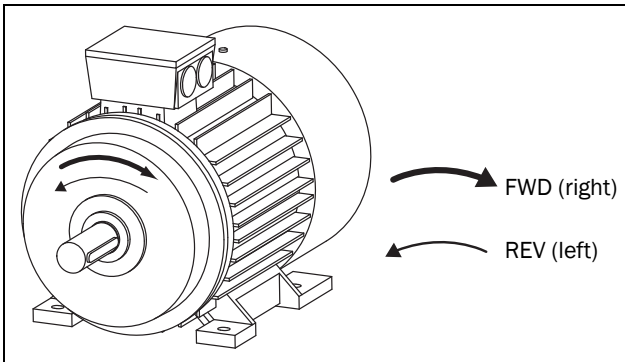
Fig. 34   Rotation direction.
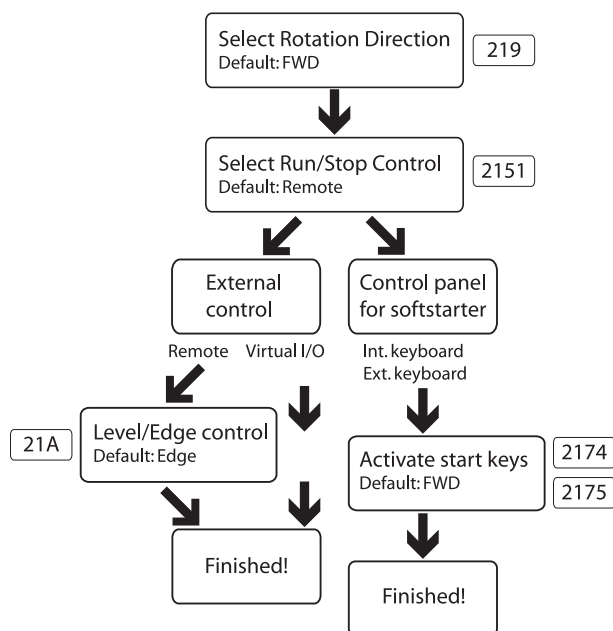
Fig. 35   Run/Stop decision tree

For configuration of programmable I/O, see the description for the respective input/output. For a list of the different possibilities, see section 7.4, page 61.

NOTE: If you try to give an incorrect command e.g. Run forward when rotation direction set in menu [219] is set to Run Reverse, nothing will happen or be indicated.

Local and remote control mode

An additional possibility for start and stop control is given with the LOC/REM function of the toggle key (setting "LOC/REM" in "Function Key" menu [2171]). It is up to the user to define the "REMOTE" and "LOCAL" functions in the menus for "Run/Stop Control" [2151] and "Local Run Control" [2173]. In that respect the LOC/REM key becomes a tool not just to alternate between the control panel and I/O control, but actually to quickly change between any two start and stop control locations. See description in section 6.5.2, page 47.

7.1.2 Start and stop methods

The methods for starting and stopping the motor are configured in the menus [330] "Start Setting" and [340] "Stop Setting". See descriptions in section 8.3.3, page 91.

It is also possible to apply a "Start Limitation" [234] as part of the actions used for protecting the motor. The functions for doing this are mainly related to time settings, e.g. limiting the numbers of starts per hour or securing a minimum time delay between starts. For guidelines regarding specific applications, refer to "The Application Functions List" on page 33.

If the load monitor function [410] is activated (page 56), it could be necessary to apply a load monitor start delay time [417] in order to avoid faulty alarms during start-up due to the high start current.

Spinbrake

Spinbrake is used to brake a freewheeling application to standstill, e.g. a fan which is rotating due to wind. Spinbrake can be selected as a function for a digital input [520], see section 8.5.2, page 108. Spinbrake can only be activated when the TSA is non-operational, i.e that Stp is shown in the display.

7.1.3 Jog functions

The Jog (slow speed) function can be activated via the control panel using the jog keys, via remote I/O control or via serial communication.

To select the method to activate the jog function, follow the procedure described in Fig. 36.
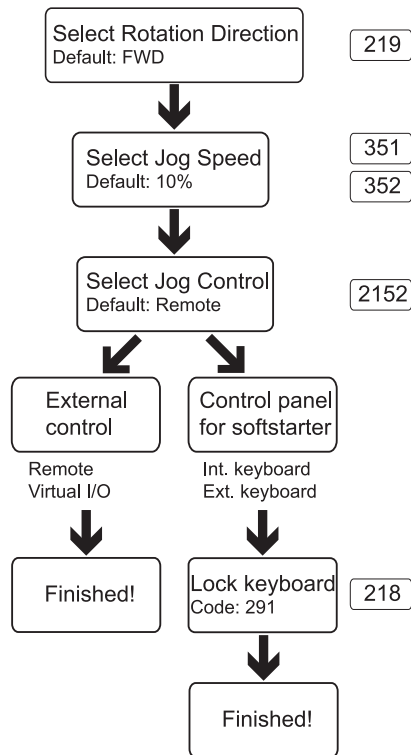
Fig. 36   Jog decision tree

It is necessary that the rotation direction settings for all parameters involved in the jog function correlate to each other. See Table 20 below.

Table 20   Jog settings depending on rotation direction

Menu	Forward Jog	Reverse Jog	Forward and reverse jog
219	FWD	REV	FWD+REV
351	10% [1]		10% [1]
352		10% [1]	10% [1]

1) Value that can be changed in the respective menu.

NOTE: To jog with the control panel jog keys, press and hold.

It is possible to adjust the rate of acceleration from standstill to the selected Jog speed level in menu "[353] Jog Ramp Rate" to achieve smooth Jog start.

There are also a couple of examples on how to apply time settings for jog by using logic functions, see page 63.

7.1.4 Start/Stop signal priority

A jog command has lower priority than a normal start command, meaning that if the softstarter is already running the motor, the jog command is ignored. If the softstarter is in jog mode, a normal start command will override this and start the motor to full speed.

An "Enable" command (setting via Digin [520]) has the highest priority and overrides both a normal start/stop command and a jog command. If "Enable" is inactive it will not be possible to execute a normal start or a jog start. The total priority order is listed in Table 21 below.

Table 21   Signal priority for digital inputs

Priority	Command
1	Enable
2	Stop
3	Run FWD and Run REV
4	Jog FWD and Jog REV
5	Spinbrake

7.1.5 Setting motor data

For optimal performance set motor data according to the motor's rating plate. The menus for this are found in section 8.2.3, page 73; menu group [220]. The motor data is handled as a parameter set (one of four: M1- M4). Motor M1 is selected as default and the motor data entered will be valid for motor M1. If different motors are used, the motor data must be saved under different motor data sets, selected in menu [212]. See also "Handling motor data in parameter sets" on page 52.

7.1.6 Process information

An external sensor, e.g. a 4-20mA pressure sensor can be connected to the analogue input and be used as process value for the TSA.

The process value can be configured to show a true SI value, e.g in [bar].See menu group [320].

It is also possible to let this reference value, depending on level, make an automatic start (or stop) of the TSA. For more information see example page 107.

If needed, the SI units can be changed to US units in menu [21C].

Please note that Motordata settings will be reset and thereby needs to be adjusted after changing units.

7.2 Working with parameter sets

Parameter sets can be used to set the softstarter up for different applications such as different motors used and connected, start and stop methods, alarm settings, control sources, etc.

With the four parameter sets different control options can be configured with respect to quickly changing the behaviour of the softstarter. It is possible to adapt the softstarter online to altered behaviour. This is based on the fact that at any desired moment any one of the four parameter sets can be activated during operation; via the digital inputs or the control panel.

A parameter set consists of virtually all changeable menus in the menu system. Exceptions are some menus that can only have one and the same value, regardless of the selected parameter set:
[211] Language, [2171] Function Key, [2173]Local run control, [218] Lock Code, [220] Motor data,[241] Select Set, [260] Serial Communication and [740] Real time clock. These menu settings are global, i.e. valid throughout the menu system.

> NOTE: Actual timer [630] values are common for all sets. When a set is changed the timer functionality will change according to the new set, but the timer value will stay unchanged.

The menus for parameter set handling are found in section 8.2.5, page 80, starting with menu [240].

The active parameter set is shown in the display to the lower left, and can also be viewed in menu [721] TSA Status. The detailed configuration for each set can be written down in the menu list that can be found in the end of this manual alternatively, you can download an excel parameter list to fill in from the web at www.cgglobal.com or www.emotron.com. Another solution for copying settings and data between different softstarter units is via PC, using the EmoSoftCom PC tool (option). See section 12.2, page 155.

7.2.1 Selection of parameter sets

The parameter sets can be selected via the control panel, via digital inputs or via serial communication. This is decided in menu [241] Select Set.

All digital and virtual inputs can be configured to select parameter sets. Fig. 37 shows the way the parameter sets could be activated via digital input, where for instance DigIn 3 [523] is set to "Set Ctrl 1" and DigIn 4 [524] is set to "Set Ctrl 2".
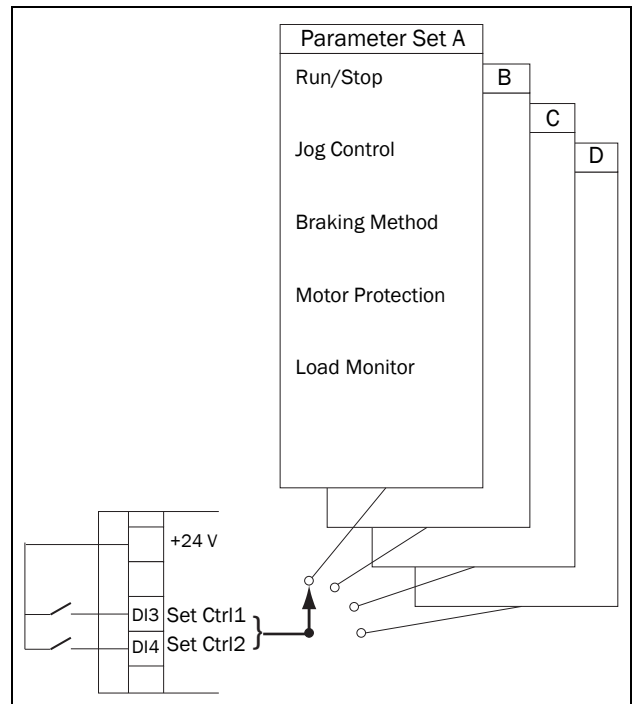
Fig. 37   Selecting the parameter sets via digital input

When the parameter sets are selected via digital inputs, they are activated as in Table 22. Activate the parameter changes via digital input by setting menu [241] to "DigIn".

Table 22   Parameter set

Parameter set	Set Ctrl 1	Set Ctrl 2
A	0	0
B	1	0
C	0	1
D	1	1

> NOTE: The selection via the digital inputs is immediately activated.

> NOTE: The default parameter set is parameter set A.

Example: Manual and automatic control

In an application manual control is used to prepare for service position. After service the process is switched to automatic control mode. This can be solved by using one set of parameters to activate manual control mode (i.e. control signals via I/O), and a second set of parameters to activate running in automatic control mode (i.e. control signals from PLC, e.g. via fieldbus).

7.2.2 Configuration of parameter sets

When the parameter set selection is done in menu [241], the settings for the particular application or control mode can be done. Parameter set A is default, which means that all changes done to the default settings in the menu system are saved under parameter set A.

To reset a parameter set to the default values, go to menu [243] Default>Set and choose the extent of the reset.

When working with several parameter sets it saves a lot of work if menu [242] Copy Set is used for copying sets, e.g. "A>B", "C>D", etc. This will copy the entire contents of a single parameter set to another parameter set, and you only need to change the desired differences in the new set.

7.2.3 Handling motor data in parameter sets

"Motor Data" (M1-M4) is a kind of parameter set in itself, see section 7.1.5, page 50. The motor data settings are gathered under a designated motor and belong to this.

To change the parameter set to one that includes changes in motor data it is therefore necessary to also change motor in Select Motor [212]. The following cases may exist:

One motor and one parameter set

This is the most common case. As default, all entered data will be saved under parameter set A and the motor data under motor data M1.

One motor and two parameter sets

This case is useful if you want to alternate between for instance two control sources, or two different starting or braking requirements.

Once default motor M1 is selected:

1. Select parameter set A in menu [241].

2. Enter motor data in menu [220].

3. Enter the settings for other parameters in set A.

4. If there are only minor differences between the parameter sets, you can copy parameter set A to parameter set B, menu [242].

5. Enter or change the settings for parameters, other than motor data, in set B.

Two motors and two parameter sets

This is useful if you have two different motors that are not intended to run at the same time. One motor must stop before changing to another motor.

1. Select parameter set A in menu [241].

2. Select motor M1 in menu [212].

3. Enter motor data and settings for other parameters.

4. Select parameter set B in menu [241].

5. Select M2 in menu [212].

6. Enter motor data and settings for other parameters.

7.2.4 Using the control panel memory

The control panel memory could come in handy when more than one Emotron TSA unit is used. The copy/load functions allows for transfer of data between the internal control board of the softstarter and the control panel, offering a quick solution for copying parameter sets and motor data to other softstarter units. The control panel can also be used for temporary storage or back-up copy of settings. For description of the menu selections and the copy/load function, see menus [244] and [245], page 81.

In order to enable transfer of data between Emotron TSA units, there are two different set-ups.

NOTE: The two softstarters must have the same software version. Check software version in menu [922].

Copy by moving control panel between units

To transfer data from one TSA unit to a second TSA unit via the standard TSA control panel (see Fig. 38):

1. Copy the settings from the internal control board of TSA unit 1 to the control panel, menu [244].

2. Switch off power for both TSA units, and dismount the front covers with built in control panel.

3. Disconnect the control panel cable connections from the control board sockets.

4. Connect the control panel cable of front cover 1 to TSA unit 2, using the socket for the internal control panel.

5. Switch on TSA unit 2 and load the desired settings from control panel 1 to the internal control board of TSA unit 2, using menu [245].
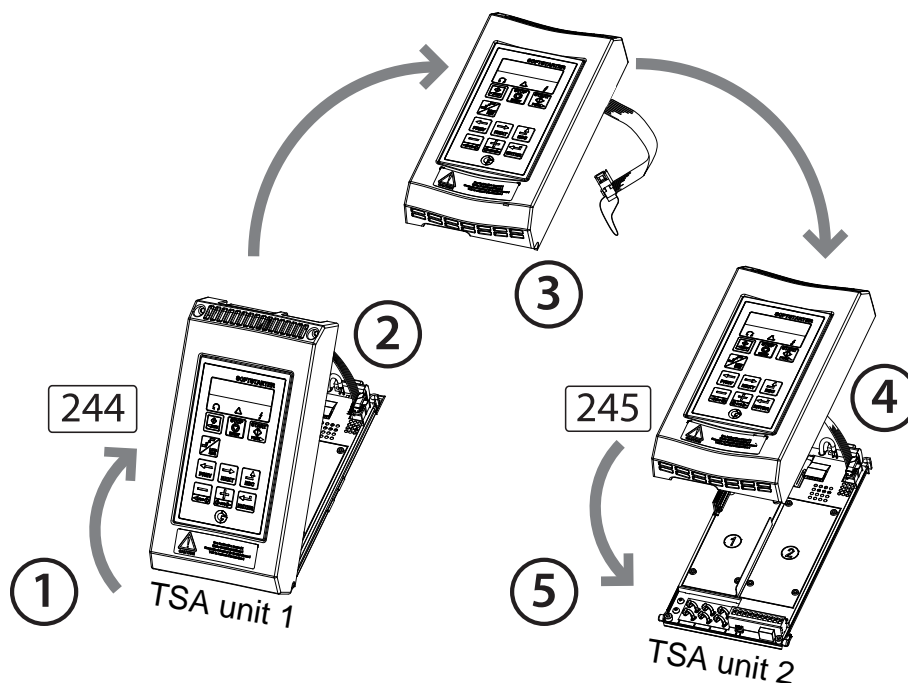
Fig. 38   Copy and load parameters between two Emotron TSA units via the control panel.

⚠ **WARNING!**
Switch off all power connections before opening the front cover.

Copy via external control panel

If an external control panel is available (option, page 155) there is no need to dismount the front covers when copying and loading data between two or more Emotron TSA units (see Fig. 39). The external control panel is usually mounted on the cabinet door.

NOTE: Loading from and copying to the softstarter is only possible when the softstarter is in stop mode.

---

1. Using the external control panel, copy the settings from the softstarter control board to the external control panel, menu [244].

2. Detach the external control panel from the cabinet of the source softstarter and attach it to the cabinet with the target softstarter.

3. Using the external control panel, load the settings from this to the internal control board of the target softstarter, menu [245].
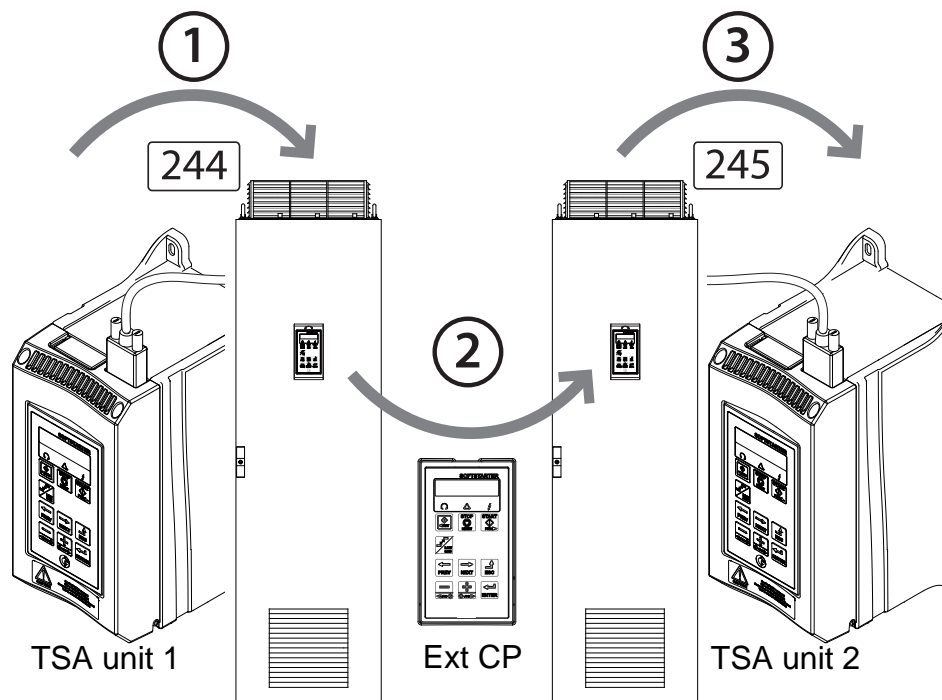
Fig. 39   Copy and load parameters between two Emotron TSA units using an external control panel (optional).

NOTE: Another solution for copying settings and data between different softstarter units is via PC, using the EmoSoftCom PC tool (option). See section 12.2, page 155.

7.3 Applying limitations, alarms and autoreset

In order to protect the softstarter and the connected devices, the process values are continously monitored. If one of these process values exceeds the safety limit an error/warning message is displayed. In order to avoid any possibly dangerous situations, the softstarter sets itself into a mode called "Trip" and the cause of the trip is shown in the display. Trips will always stop the softstarter.

7.3.1 Alarm types and actions

"Alarm"	Any faulty condition
"Trip"	Any action on a fault condition which leads to interruption of operation. Trips can be divided into hard and soft trips, see Table 23
"Warning"	Any action on a fault condition which does not lead to interruption of operation. Only used for indication purpose.

In general, an alarm may only be triggered when the softstarter is active (e.g. during ramping or full speed operation or during jogging slow speed). Exceptions are the temperature alarms, the external alarms and the communications alarms, which are always active.

For most alarms, different alarm actions can be chosen. Common for all alarm actions is that the alarm condition is shown in the display, via serial communication and at any relay programmed for the appropriate alarm functionality. An alarm condition is indicated on the LEDs as described in Chapter 6.2, page 44. The alarm actions are:

Table 23   Alarm actions

No action	No alarm condition is communicated.
Warning	A warning message is shown. Operation continues as usual.
Hard Trip	Softstarter is tripped. Operation is interrupted and restart is inhibited: - if the softstarter is inactive: Activation will not be allowed - if the softstarter is in operation: The motor coasts to a stop.
Soft Trip	Softstarter is tripped. A stop is executed in the same way as for normal operation i.e. using the same stop method. Restart is inhibited.

7.3.2 Alarm settings

To protect the motor, use the alarm settings and operation limitations in menu [230] "Motor Protection" with submenus. See section 8.2.4, page 76.

For protection of process, mains, and other external devices, you find load monitor functions and alarm settings in menu group [400]. See section 8.3, page 89.

Alarm actions for communication faults are set in menu [264].

7.3.3 Alarm indications

Depending on which alarm condition that is active, the following indications are given:

Warning
- The Trip LED indicator (red triangle) on the control panel is flashing with 2 Hz (see Table 17, page 44).
- Present warning message (will be cleared when the warning is removed)is displayed in menu [722] "Warning". See a list of possible warning messages in Table 36, page 132.
- The Warning relay or output is active (if selected function in menu [551], [552] or [553]).

Hard Trip
- The softstarter is in a tripped condition and the motor coasts down to a standstill.
- The Trip LED indicator (red triangle) is lit.
- The "TRP" status indication is displayed (area D of the display).
- The accompanying trip message is displayed in menu [810].
- The Trip relay or output is active (if selected function in menu [551], [552] or [553]).

Soft Trip
- The softstarter is in a tripped condition and the motor stops according to the set stop method for normal operation.

The softstarter is making a controlled stop. During the stopping:

- The accompanying trip message is displayed in menu [810], including an additional soft trip indicator "S" in area E of the display.
- The Trip LED indicator (red triangle) is flashing with 2 Hz.
- The Warning relay or output is active (if selected).

After standstill is reached:

- The Trip LED indicator (red triangle) is lit.
- The "TRP" status indication is displayed (area D of the display).
- The Trip relay or output is active (if selected function in menu [551], [552] or [553]).

Trip message

The trip message can be viewed in the menu "View Trip Log" [800], in which the nine most recent trip messages are stored ([810] to [890]). For every logged trip the date and time - from real time clock [740] - is displayed, along with the actual trip message according to the denotations in Table 36, page 132. The cause of the most recent or actual trip is indicated in menu [810].

To facilitate troubleshooting, data is copied from the operation and status menu groups [710] - [730] when a trip occurs. See a list of the stored parameters in Table 37, page 135. The stored parameters and their values are shown under menus [8X1] "Operation", [8X2] "Status", and [8X3] "Stored Values". To view the value, go down to menu level 4, i.e. 8XXX.

NOTE: When the trip is reset the trip indication will be removed from the control panel display, but remains in the trip message log [800].

7.3.4 Load monitor function

The load monitor menu [410] can be used to protect machines and processes against mechanical overload and underload, such as a conveyor belt or screw conveyor jamming, a belt failure on a fan, or a pump running dry. The load is determined by estimating the motor shaft power, while running.

There are two overload alarms, "Max Alarm" and "Max Pre-Alarm", and two underload alarms, "Min Alarm" and "Min Pre-Alarm". The load monitor function is not active during stop ramps, jogging or braking. For the start ramp you can choose to delay the activation of the load monitor by using start delay, menu [416].

It is common that the minimum and maximum alarms are set to give a soft or hard trip, while the pre-alarms are used to give an indication that an over- or underload situation may be close by displaying a warning message (e.g. "Mon MinPreAl").

If the operation has been interrupted due to a load monitor alarm, a reset and a new start signal is needed to continue operation. Autoreset for the load monitor alarms can be activated under menu [254]. For manual reset see "Manual reset" on page 60.

Load monitor alarm levels

There are two alternative ways to set the load monitor alarm levels:

1. Manual configuration, in which up to four "Alarm Levels" are set directly (Fig. 40).

2. "Autoset" configuration, for which the alarm levels are automatically set, based on "Normal Load" $\pm$ four "Alarm Margins" (Fig. 41).

Common for both methods is that the resulting alarm levels are given as a percentage that refers to the nominal motor power [223] (being 100%). However, the way to set the levels differs between the two methods:

NOTE: When using the load monitor, check that the nominal motor power is set properly in menu [223].

Manually set alarm levels

See Fig. 40. For the manual load monitor settings, the "Alarm Levels" [411] - [414] are set directly as a percentage of the nominal motor power (menu [223]). The actual shaft power is displayed in brackets together with the Alarm Level value to facilitate setting. See example on the right.

Example:

```
4112 MaxAlarmLev
Run A (104%) 116%
```
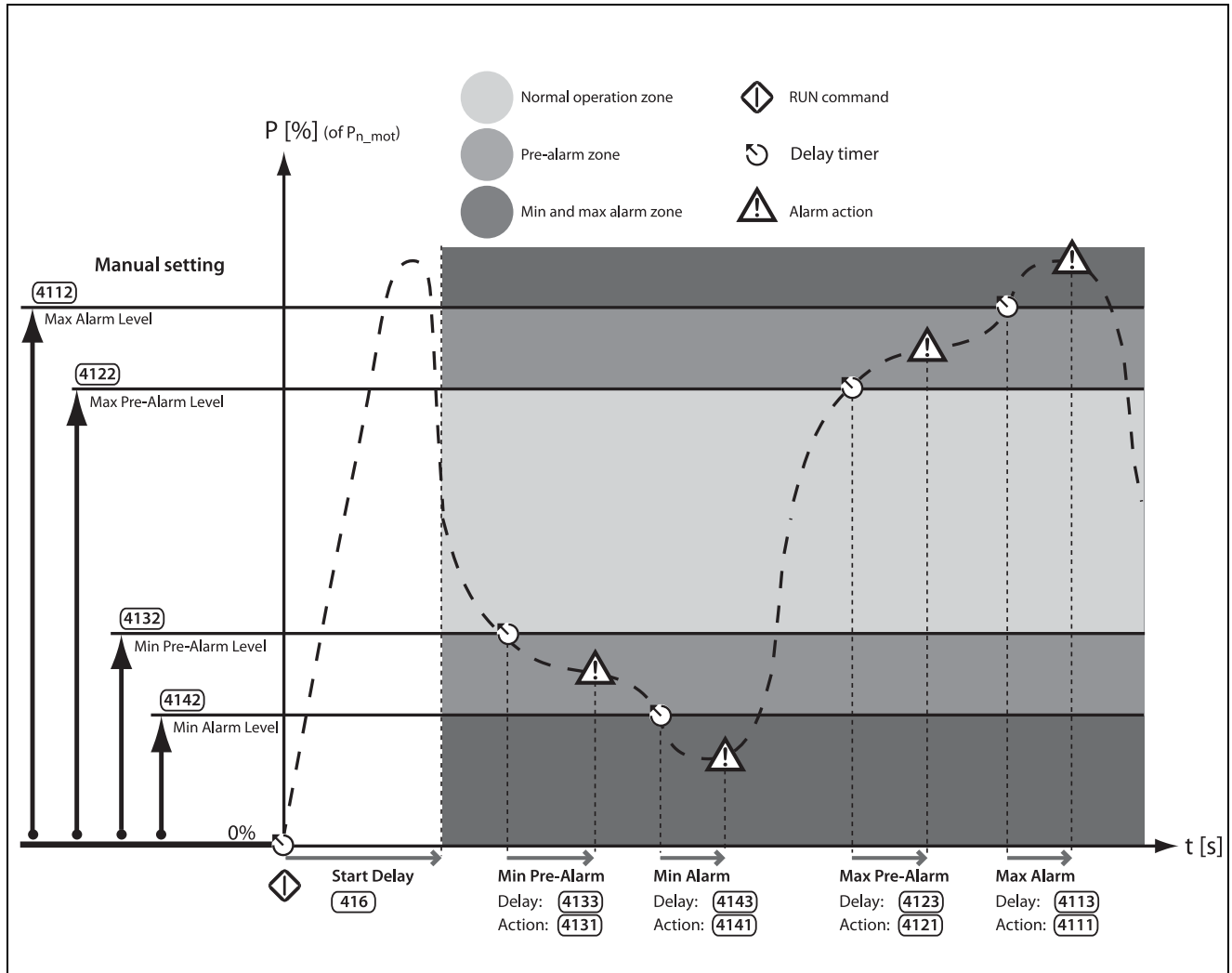

Fig. 40   Manually set load monitor alarm levels.

Autoset function with alarm margins

See Fig. 41. The quickest way to adapt the monitor to different load situations is to use the "Autoset" function, which automatically applies four "Alarm Margins" to a registered "Normal Load" level whilst the motor is running. The "Alarm Margins" are set as a percentage added to or subtracted from the "Normal Load", which is the shaft power during normal operation conditions. See calculations in Table 28, page 101. The "Normal Load" is expressed as a percentage of the nominal motor power (i.e. 100% normal load equals the motor power set in menu [223]).

The "Alarm Margins" are set under menu [417], and "Normal Load" is automatically registered when activating the autoset function in menu [4175] AutoSet Alarm. The actual "Normal Load" value can then be viewed in menu [4176].

Every time a new "Autoset Alarm" command is executed, the actual shaft power value will be updated as the "Normal Load" value, with the alarm levels following this.

Autoset can also be activated using a remote signal (edge-triggered) by setting the function of any digital input to "Autoset".

NOTE: A manual change of any of the "Alarm Levels" in [411] - [414] will override the "Autoset" monitor settings, and the "Normal Load" will be reset to "Off".

NOTE: When "Autoset" is used, set Alarm Levels will be overwritten in the menus [4112], [4122], [4132] and [4142].
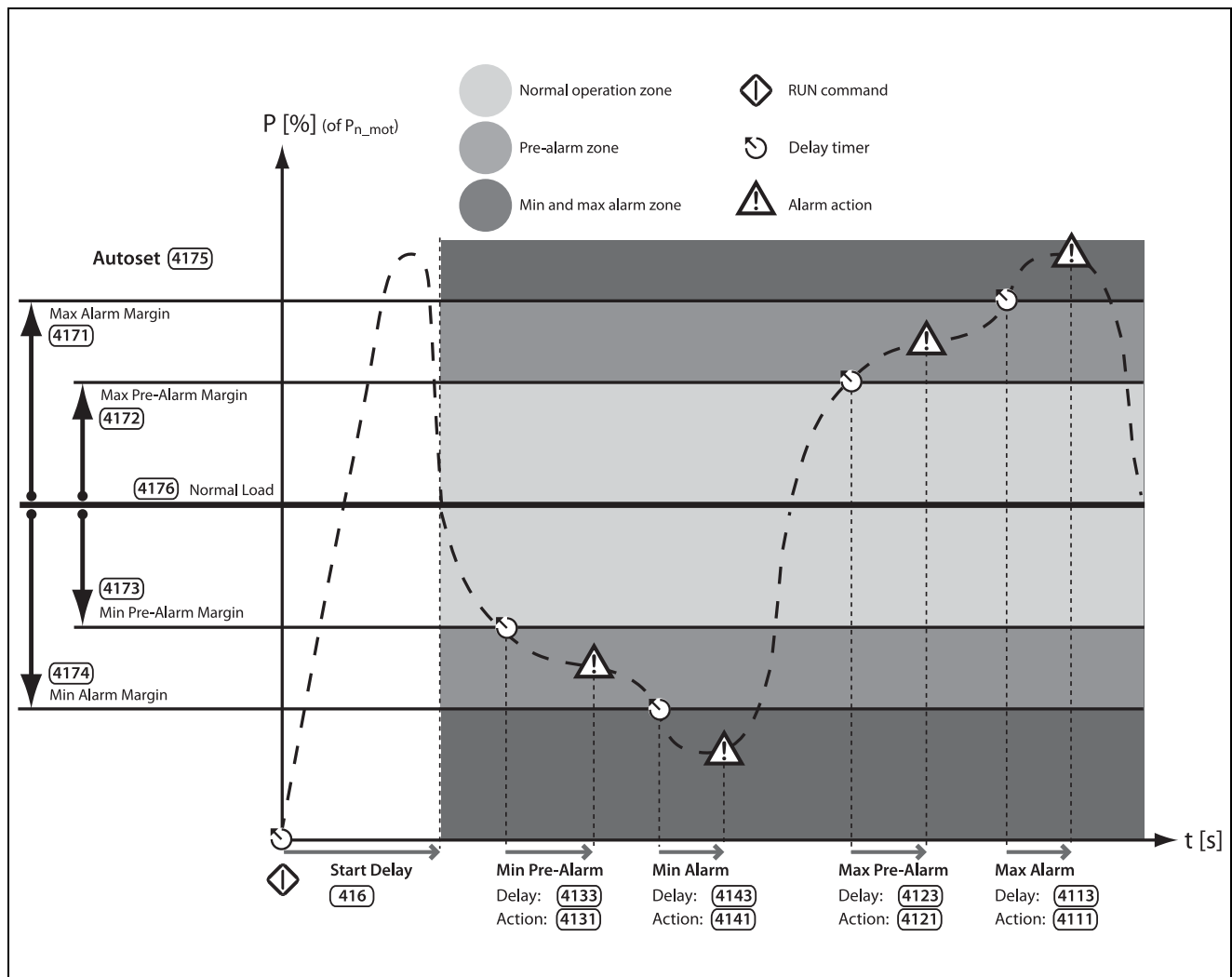
Fig. 41   Autoset load monitor alarm margins.

Load monitor alarm actions

All the alarms and pre-alarms can be independently configured to affect operation by applying an alarm action, e.g. a trip or a warning. See section 7.3.1, page 55. The alarm or pre-alarm status is available on the programmable relays if so configured (see menu [550] for more information).

The alarm actions for both the autoset alarm levels and the manually set alarm levels are configured in menu [4111], [4121], [4131] and [4141].

The corresponding "Alarm Delays", which will affect the alarm response time, are set in menu [4113], [4123], [4133] and [4143].

Load monitor during start-up

To avoid faulty alarms due to initial over- or underload situations at start, a "Start Delay" time can be applied for the load monitor. See menu [416], page 101.

NOTE: The load monitor alarms are disabled during jogging, braking, and stop ramp.

Example 1: Configuring alarm levels manually

Assume that the load monitor is intended to be blocked during the start-up procedure. A start delay of 30 seconds is therefore selected in menu [416], in order to allow the process to settle before the load monitoring becomes active.

In this case a pump must be protected from both overload and underload (e.g. cavitation) conditions, but no pre-alarms are needed. The alarm action for the pre-alarms ([4121] and [4131]) is therefore set to "No action". Furthermore, the alarm actions for Max alarm [4111] and Min alarm [4141] are set to "Soft Trip", with the corresponding alarm delays; 10 seconds in menu [4113] Max Alarm Delay, and 5 seconds in [4143] Min Alarm Delay.

Since the normal load condition (shaft power) for the pump is 50% of the nominal motor power [223], the Max Alarm Level [4112] is set to 70%. Finally the Min Alarm Level [4142] is set to 10%, which is reached during e.g. pump cavitation conditions.

This configuration results in the following sequence of events (as illustrated in Fig. 42):

A. The load monitor function is activated when the set start delay time (30 seconds) has expired.

B. A maximum level is exceeded, but since the load returns to a safe level within the set alarm delay time (i.e. <10 seconds) no alarm action is performed.

C. The maximum alarm level is exceeded again.

D. When the set alarm delay time (10 seconds) has expired, the maximum alarm action is executed (in this case a soft trip, as set in menu [4111]).
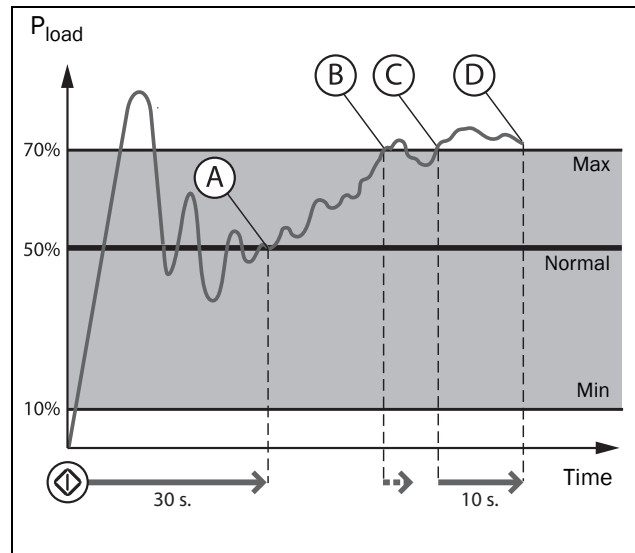
Fig. 42   Example 1: Manually set load monitor function.

Example 2: Auto-setting alarm levels

To block the load monitor during the start-up, a start delay of 30 seconds is selected in menu [416].

In this case a motor used in a conveyor application must be protected. It is only of interest to apply a maximum alarm and maximum pre-alarm, therefore the alarm actions for the minimum alarm [4141] and the minimum pre-alarm [4131] are set to "No action" (default). The Max Pre-Alarm Action [4122] is set to "Warning" and the Max Alarm Action [4111] is set to "Hard Trip". Then the Max Alarm Delay [4113] is set to 3 seconds, and the Max Pre-Alarm Delay [4123] to 0 seconds to get an instant warning when the load is increased. Menu [4171] Max Alarm Margin is set to 10%, and menu [4172] Max Pre-Alarm Margin is set to 5%, to indicate that an overload condition is close.

The motor is started and the actual shaft power is viewed to the left in menu [4175] Autoset Alarm. When the process has stabilised, this indicates that the normal load conditions take place at 60% of the nominal motor power [223]. The autoset of the alarm levels is done by selecting "Yes", followed by pressing "ENTER". "Autoset OK!" is displayed. The motor is now fully protected with a maximum alarm set to 70% (Normal Load + Max Alarm Margin, 60% + 10%) and a pre-alarm at 65% (Normal Load + Max Pre-Alarm Margin, 60% + 5%). The "Normal Load" value is viewed in menu [4176], along with the actual shaft power value.

The following events are noted (see Fig. 43):

A. The load monitor function is activated when the set start delay time (30 seconds) has expired.

B. The maximum pre-alarm level is exceeded, and immediately results in a warning message: "Mon MaxPreAl", as there is no alarm delay in this case.

C. The maximum alarm level is exceeded.

D. When the set maximum alarm delay time (3 seconds) has passed, the set maximum alarm action is executed, in this case a Hard trip, as set in menu [4111].
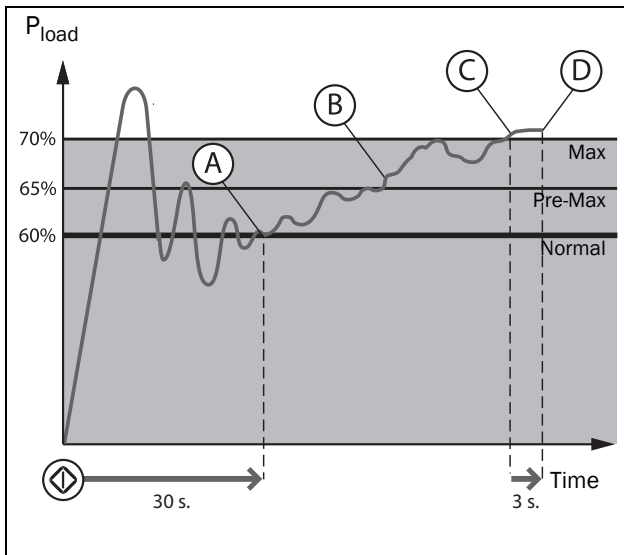
Fig. 43   Example 2: Autoset load monitor function.

7.3.5 Reset and autoreset

When the softstarter is tripped due to a failure, a reset command is required to make it possible to restart the softstarter. The reset command can come from any of the selected sources in menu [216] "Reset Control", or it can be automatically generated through settings in menu group [250] "Autoreset".

For the following explanations it is important to distinguish between "reset" and "restart". "Reset" means that the softstarter no longer is in a tripped condition, as confirmed by a removal of the alarm message in the display and LED is turned off. If the operation has been interrupted due to a tripped condition, the softstarter is prepared for a restart.

If an alarm occurs whose alarm action is configured for "Warning" (see description of alarm actions in Table 23, page 55), the indication will automatically be removed as soon as the warning condition disappears, i.e. no reset command is needed.

If the operation has been interrupted due to a trip, a reset signal and a new start signal may be needed to restart the motor.

Manual reset

The control source for the reset signal is selected in [216] "Reset Control". The RESET key on the control panel is activated by selecting one of the keyboard alternatives (enabled as default).

If controlled by digital input [520], or by virtual I/O [560], this is set by selecting "Reset" signal.

An output signal can be set by a relay [550] to "ManRst Trip" which is defined as any active trip condition that needs a manual reset.

> ⚡ **WARNING!**
> **If the input signal Run FWD/RunREV is active (high) and level-controlled start mode is selected, the motor will start at the reset command.**
> **Note that "level control" is not fulfilling the Machine directive**

Autoreset

For several alarms it is possible to automatically generate a reset command to overcome the fault condition. Providing that all other conditions are normal, the softstarter will then attempt to restart the operation (see Warning above). Only when the failure keeps on coming back, recurring at a defined number of times and therefore cannot be solved, will the unit give an alarm to inform the operator that attention is required.

The autoreset configuration is done in menu group [250] Autoreset, with submenus for Motor Protection Autoreset [252], Communication Error Autoreset [253], Process Protection Autoreset [254], Softstarter Protection Autoreset [255], and Mains Failure Autoreset [256].

Alternative 1
To enable the Autoreset function, "Reset" is selected on one of [520] Digital Inputs. The reset input must be constantly activated.

Alternative 2
To activate the autoreset function via Virtual I/O [560], "Reset" is selected in the destination menu for the internal connection. The source connection must be active (high).

In the menus for Relays [550] an output signal of the autoreset trip can be set, "AutoRst Trip". Relay is activated when the maximum number of autoresets is reached.

See more about remote reset control in Chapter 7.5.3, page 62.

To activate the autoreset function, Allowed Autoreset Attempts are set in [2511]. Once the maximum number of autoresets is reached, the softstarter will stay in fault condition, indicating that external assistance is required. The details of the autoreset counter can be found in "Autoreset Attempts [251]" on page 83.

Example: Autoreset for thermal overload

A motor is protected by an internal protection for thermal overload. When the protection is enabled, and a thermal overload condition has occurred, the softstarter will wait for the motor to cool down before resuming normal operation. In this case the estimated time for cooling down is 300 seconds. When the problem has occurred three times in a short period of time the softstarter will trip, It's time for the motor to cool down.

To do this:

- Enable the Autoreset function by making the reset input continuously high.

- Set maximum number of restarts to 3 in menu [2511].

- Activate Motor I^2t to be automatically reset; set menu [2521]to 300 s.

- Set relay 1, menu [551] to "AutoRst Trip" ; output signal will be active when the maximum number of restarts is reached and the softstarter stays in fault condition.

Example: Autoreset for undervoltage

In an application it is known that the main supply voltage sometimes disappears for a very short time, a so-called "dip". That will cause the softstarter to trip an "Undervoltage alarm". Using the Autoreset function, this trip will be reset automatically.

- Enable the Autoreset function by making the reset input continuously high.

- Activate the Autoreset function in menu [2511], Allowed Autoreset Attempts.

- The autoreset for the undervoltage alarm is activated in menu [2564]. The set delay time starts counting when the fault is gone.
  Voltage detection is only possible during operation so if the softstarter is stopped due to undervoltage, the delay time starts counting immediately.

7.4   Programmable I/O

There are a number of selectable functions for analogue and digital inputs and outputs, gathered under section 8.5, page 106.

- 1 analogue input [510]

- 1 analogue output [530]

- 4 digital inputs [520], with the possibility for up to 6 extra digital inputs if extended I/O option boards (max 2) are fitted.

- No digital outputs are available.

- 3 relays [550], with the possibility for up to 6 extra relays if extended I/O option boards (max 2) are fitted.

- There are also 8 virtual I/Os [560]

7.5   Remote control functions

Operation of the Run/Stop/Enable/Reset functions

As default, the run/stop commands are programmed for remote operation via the inputs on the terminal strip on the control board. Default for the reset control is both remote and keyboard.

With the parameter "Run/Stop Control" [2151] and "Reset Control" [216], these functions can also be selected for keyboard or bus communication control.

NOTE: The examples in this paragraph do not cover all possibilities. Only the default settings (factory) and the most relevant combinations are given.

7.5.1 Default settings of the Run/ Stop/Reset functions

The default settings are shown in Fig. 44. In this example the softstarter is started with DigIn 1 (Run FWD) and stopped with DigIn 2 (Stop). A reset after trip can be given with DigIn 4. The inputs are default set for edge control.
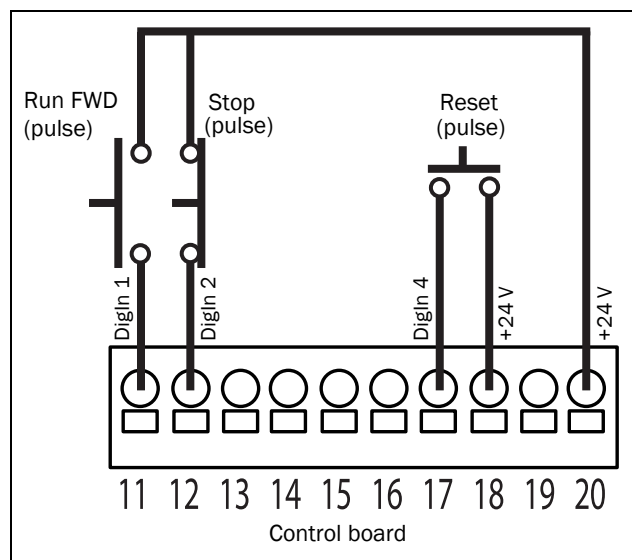
Fig. 44   Default setting Run/Reset commands.

7.5.2 Enable and Stop functions

Both functions can be used separately or simultaneously. The choice of which function is to be used depends on the application and the control mode of the inputs (Level/Edge [21A]).

> NOTE: In edge control mode, at least one digital input must be programmed to "Stop", because the "RunFWD" and "RunREV" commands are only able to start the softstarter.

Enable

The enable function is used as a start interlock. This means that if any input is set to "Enable", this input must be set to active (high) to allow any run command. When the input is low, the motor will coast to stop.

⚠ **CAUTION!**
If the Enable function is not programmed to a digital input, it is considered to be active internally.

Stop

If the input is set low (open), the softstarter will stop according to the selected stop method in menu [341].

7.5.3 Level / Edge operation after reset

If the softstarter is in stop mode due to a trip condition, the softstarter can be remotely reset by a pulse ("low" to "high" transition) on the "Reset" input on DigIn 4.
Depending on the selected control method, a restart takes place as follows:

Edge controlled "Run" inputs

After the "Reset" command is given a new "Run" command must be applied to start the softstarter again. The inputs are set for edge control as default. This means that an input is activated by a "low" to "high" transition or vice versa.

> NOTE: Edge controlled inputs comply with the Machine Directive (see Chapter 1.5.1, page 6), if the inputs are directly used for starting and stopping the machine.

The "Enable" and "Stop" inputs must be closed continuously in order to accept any run forward or run reverse command. The last edge (RunFWD or RunREV) is valid. If an edge-controlled start is activated it is also necessary to use an input for the stop command according to Fig. 44, page 61. Fig. 45 gives an example of a possible sequence.
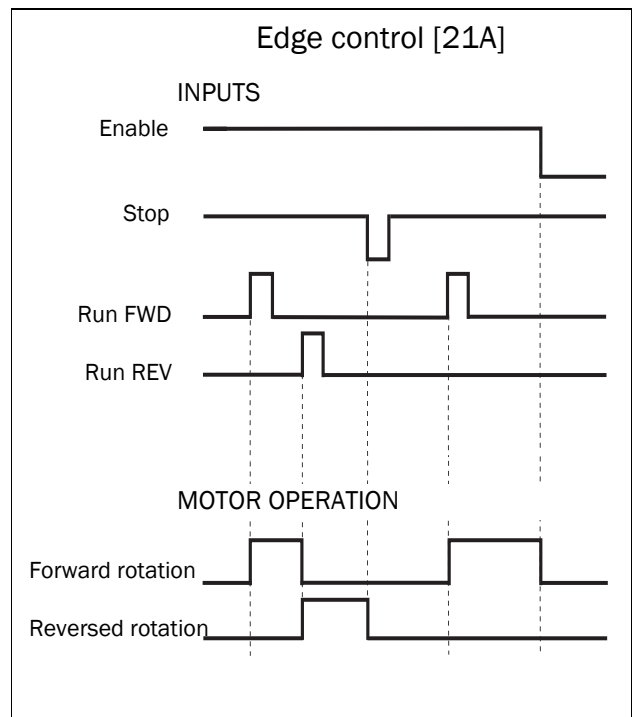
Fig. 45 Input and output status for edge control

Level controlled "Run" input

If the "Run" input remain in its position the softstarter will start immediately after the "Reset" command is given.

Autoreset is enabled if the "Reset" input is continuously active. The autoreset functions are programmed in menu "Autoreset" [240].

> NOTE: If the control commands are programmed for keyboard control or serial communication control, autoreset is not possible.

Menu "[21A] Level/Edge" must be set to "Level" to activate level control. This means that an input is activated by making the input continuously high. This method should be applied if a PLC is used to operate the softstarter, for instance.

⚠ **CAUTION!**
Level-controlled inputs DO NOT comply with the Machine Directive, if the inputs are directly used to start and stop the machine.

The Enable input must be continuously active in order to accept any run forward or run reverse command. If both RunFWD and RunREV inputs are active, then the softstarter stops according to the selected stop method in menu [341]. Fig. 46 gives an example of a possible sequence.
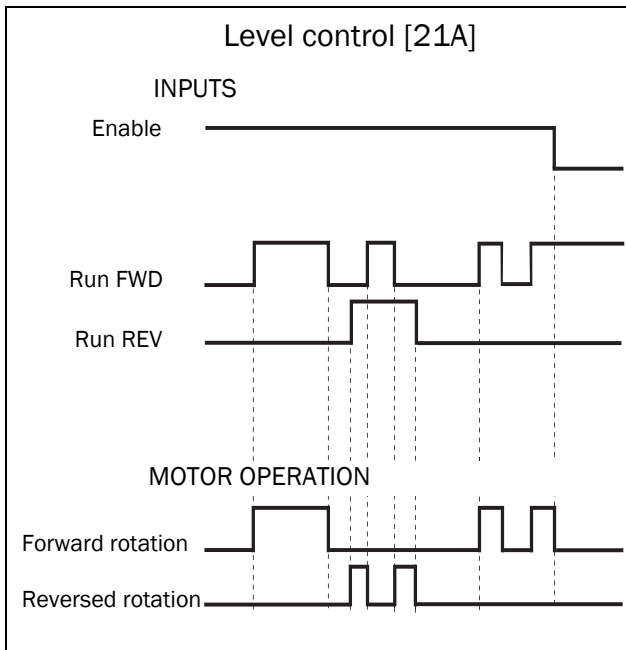
Fig. 46 Input and output status for level control

7.6 Logical functions

To enable logic signals to be programmed for different controlling or signalling functions (using AND/OR/EXOR operators), there are a number of functions available:

• 4 analogue comparators and 4 digital comparators [610]

• 4 logic functions [620]

• 4 timers [630]

• 4 SR flip-flops [640}

• 2 counters [650]

• 2 clocks [660]

See how to configure the logical functions in Chapter 8.6, page 116.

7.6.1 Jog speed at Start and /or Stop

It is possible to use logic functions to get Jog speed at start and /or stop using e.g. a counter or a timer. See following examples:

> **WARNING!**
> **Motor may start instantly!**
> **Please verify that parameter settings and I/O connections are according to desired function before switching on mains supply.**

Example 1

Jog speed at start and stop using a counter. This could be applicable when the application needs the motor to rotate at slow speed a specific number of revolutions. In this case we would like the motor to run with Jog speed 4 revolutions before start and then run at Jog speed 2 revolutions before stop.
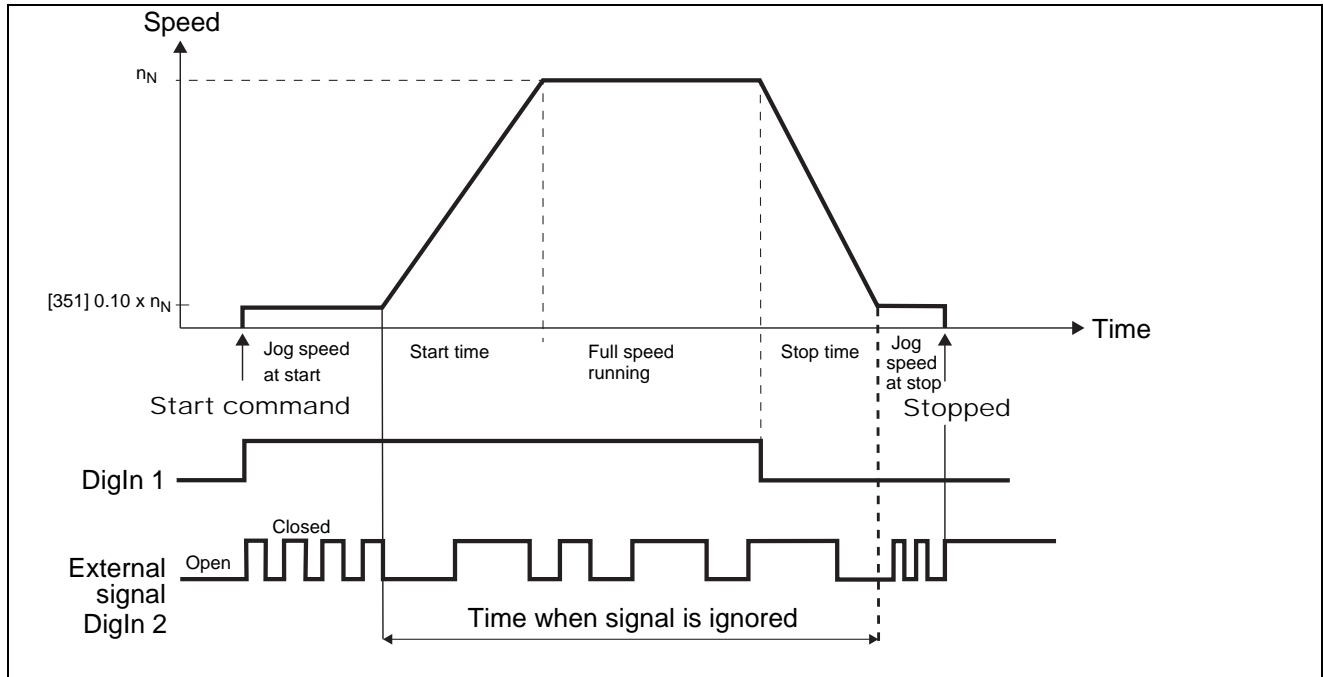
Fig. 47   Jog speed controlled by an external pulse signal.

Table 24   Parameter setting for Jog speed at start/stop using counter

Menu	Function	Setting	Comment
21A	Level /Edge	Level	
341	Stop method	Voltage Ctr, Lin Torq Ctr or Sqr Torq Ctr	Ramping to stop
351	JogSpd FWD	10%	Default setting
521	DigIn 1	Off	DigIn1 will be the RUN/STOP command via Virtual I/O1 (VIO 1)
522	DigIn 2	Off	DigIn2 will be pulse input via Counter 1 and 2 inputs (C1, C2 trig)
561	VIO 1 Dest	Jog FWD	Jog speed before run
562	VIO 1 Source	DigIn 1	Run signal/ start Jog speed
563	VIO 2 Dest	Run FWD	Run after Jog speed
564	VIO 2 Source	CTR 1	Output of counter 1 will start the normal Run
565	VIO 3 Dest	Jog FWD	Jog speed after run
566	VIO 3 Source	F1	The output of the Flip Flop 1 will start the slow speed at stop
6411	F1 mode	Set	
6412	F1 set	Dec	Triggered by ramping to stop
6413	F1 reset	CTR2	The output of counter 2 will reset Flop Flop 1 and stop the motor.
6151	CD1	DigIn 1	Start signal
6511	C1 Trig	DigIn 2	Pulse input
6512	C1 Reset	!D1	Stop command will reset counter 1
6513	C1 Trip Val	4	Number of pulses with Jog speed before run
6521	C2 trig	DigIn 2	Pulse input
6522	C2 Reset	Dec	Counter 2 is blocked until end of deceleration.
6523	C2 Trip Val	2	Number of pulses with Jog speed after run

Example 2

Jog speed at start and stop using a timer. This could be applicable when the application needs the motor to rotate at slow speed a specific time. In this case we would like the motor to run with Jog speed during 10 seconds before start and then run at Jog speed during 5 seconds before stop
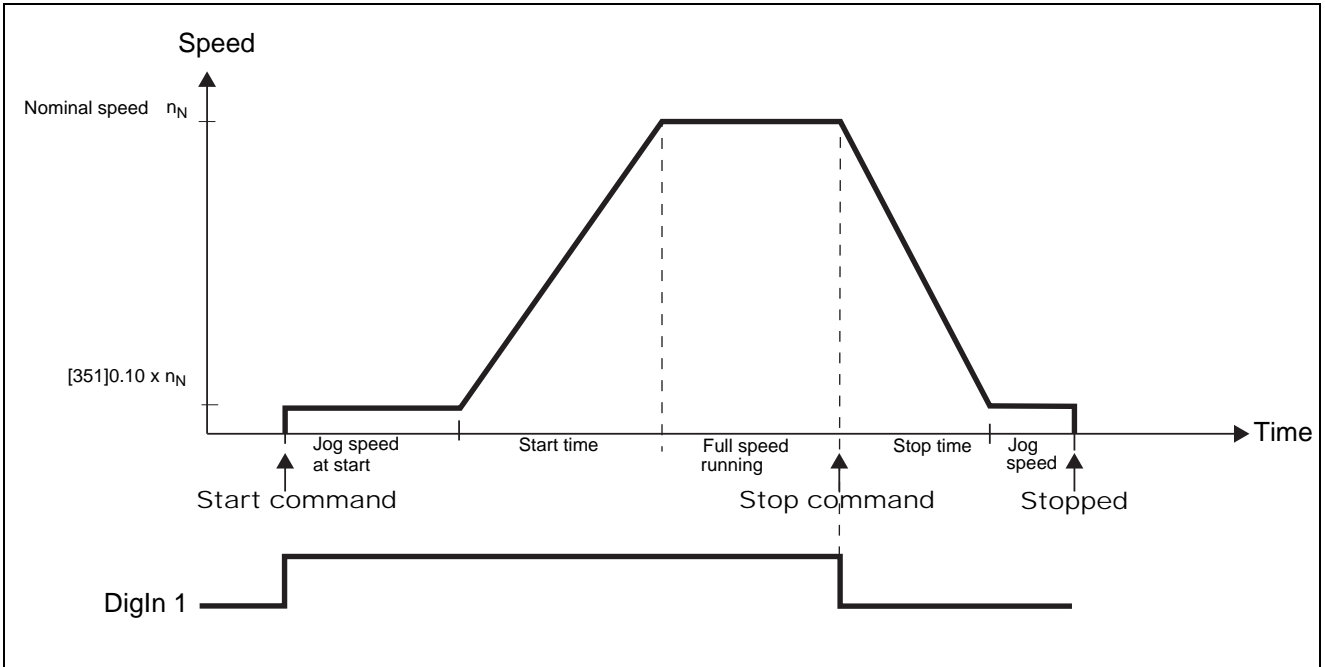
Fig. 48 Jog speed at start/Stop during a selected time period.

Table 25   Parameter setting for Jog speed at start/stop during a selected time period.

Menu	Function	Setting	Comment
21A	Level /Edge	Level	
341	Stop method	Voltage Ctr, Lin Torq Ctr or Sqr Torq Ctr	Ramping to stop
351	JogSpd FWD	10%	Default setting
521	DigIn 1	Off	DigIn1 will be the RUN/STOP command via Virtual I/O1 (VIO 1)
522	DigIn 2	Off	Disable default stop
561	VIO 1 Dest	Jog FWD	Jog speed before Run
562	VIO 1 Source	DigIn 1	Run signal/ start Jog speed
563	VIO 2 Dest	Run FWD	Run after Jog
564	VIO 2 Source	T1Q	Timer 1 Output will give a Run command
565	VIO 3 Dest	Jog FWD	Jog speed after Run
566	VIO 3 Source	F1	Output Flip Flop 1 will start the Jog speed
6151	CD1	Dec	Deceleration detection via digital comparator 1
6311	Timer1 trig	DigIn 1	Timer 1 start at Run command
6312	Timer mode	Delay	
6313	Timer1 Dly	10,0	Jog time before run
6321	Timer2 trig	F1	Triggered by by negative flank of "Dec"
6322	Timer2 mode	Delay	Reset Flip Flop 1 and stop the motor
6323	Timer2 Dly	5,0 s	Jog time before stop
6411	F1 mode	Edge	
6412	F1 set	!D1	Negative flank of "Dec"
6413	F1 reset	T2Q	Reset when "Jog speed after run" has ended

8. Functionality

This chapter describes the menus and parameters in the software. You will find a short description of each function and information about default values, ranges, etc.
A menu list with default values and the most important communication settings is found in Appendix 1 at the end of this manual.
At www.emotron.com or www.cgglobal.com, in the download area, you can also find a complete communication information list and a menu list with space for parameter set notes.

Function	Menu number	Description	See section
Preferred view	100	Menu display settings.	8.1, page 69
Operation setup	210	Basic settings for language, key functionality, control source.	8.2.1, page 69
Motor data	220	Setting of data for the used motor.	8.2.3, page 73
Motor protection	230	Motor and softstarter thermal protections.	8.2.4, page 76
Parameter set handling	240	Selection and configuration of parameter sets.	8.2.5, page 80
Autoreset	250	Automatic reset of active alarms and restart of the softstarter.	8.2.6, page 83
Serial communication	260	Serial communication settings for the data transfer.	8.2.7, page 86
Process settings	300	Process value settings for analogue signal start/stop functions.	8.3, page 89
Process protection	400	Protection associated with the process and mains. Load monitor settings.	8.4, page 98
I/O settings	500	Input and output settings for control and monitoring.	8.5, page 106
Analogue input	510		8.5.1, page 106
Digital inputs	520		8.5.2, page 108
Analogue output	530		8.5.3, page 109
Relays	550		8.5.4, page 112
Virtual I/Os	560		8.5.5, page 115
Logic and timers	600	Settings for logical functions and timers.	8.6, page 116
Operation status	700	Viewing of operation parameter values.	8.7, page 129
Trip log	800	Viewing of trip messages and trip data.	8.8, page 135
System data	900	Emotron TSA model, software and hardware version. Service information.	8.9, page 136

> **WARNING!**
> **Motor may start instantly!**
> **Please verify that parameter settings and I/O connections are according to desired function before switching on mains supply.**

Description of menu table layout

🔒 ①		③	332 Init Torque
Read-only ②			Stp🅰 10%
Default:		④	
⑤	⑥	⑦	

1. Menu cannot be changed during operation.

2. Menu only for viewing.

3. Menu information as displayed on control panel.
   For explanation of display text and symbols, see section 6.1, page 43.

4. Factory setting of menu.

5. Available settings for the menu, listed selections.

6. Communication integer value for the selection.
   For use with communication bus interface (only if selection type parameters).

7. Description of selection alternative or range (min - max value).

Example:

		2175 REV key	
		Stp🅰 Off	
Default:		Off	
Off	0	REV key deactivated	
REV	1	REV key activated	

Menu [2175] "REV key" has two available selections, "Off" and "REV", that indicate if the REV key is activated or not. The factory (default) setting is "Off".
To change selection or value via the control panel, the "+" and "-" keys are used (see section 6.4.1, page 45).
Confirm by pressing the "Enter" key to save the selection.

For bus communication, the integer value 0 is used to select "Off" in the example. Integer 1 represents "REV".
To change selection by bus communication refer to the description in Chapter 9. page 139.

Resolution of settings

The resolution for all range settings described in this chapter is 3 significant digits (unless stated otherwise). Table 26 shows the resolutions for 3 significant digits.

Table 26

3 Digit	Resolution
0.01-9.99	0.01
10.0-99.9	0.1
100-999	1
1,000-9,990	10
10,000-99,900	100

8.1 Preferred View [100]

This menu is displayed at every power-up. During operation, the menu [100] will automatically be displayed when the keyboard is not operated for 5 minutes. The automatic return function will be switched off when the Toggle and STOP/RESET keys are pressed simultaneously for 5 seconds. As default the electrical power and current values are displayed (example in the figure below):

Fig. 49 Default initial display.

```
┌────────────────────────┐
│ 100              0kW    │
│ StpА            0.0A    │
└────────────────────────┘
```

Menu [100], "Preferred View" displays the settings made in menu [110], "1st Line", and [120], "2nd Line".

Read-only	┌─────────────────────────┐ │ 100 (1st Line) │ │ StpА (2nd Line) │ └─────────────────────────┘

8.1.1 1st Line [110]

This menu sets the content of the upper row in the menu [100] "Preferred View. If "Process Value" is selected, the menu shows the value of the selected process source in menu [321]."

	┌──────────────────────────┐ │ **110 1st Line** │ │ **StpА El Power** │ └──────────────────────────┘	
Default:	El Power	
Dependent on menu		
Process Val	0	Process value
Torque	2	Torque
Shaft Power	4	Shaft power
El Power	5	Electrical power
Current	6	Current
Heatsink Tmp	10	Heatsink temperature
Motor Temp	11	Motor temperature
SoftstStatus	12	Softstarter status
Run Time	13	Run Time
Energy	14	Energy

8.1.2 2nd Line [120]

Sets the content of the lower row in the menu [100] "Preferred View". Same selection as in menu [110].

	┌──────────────────────────┐ │ **120 2nd Line** │ │ **StpА Current** │ └──────────────────────────┘
Default:	Current

8.2 Main Setup [200]

The "Main Setup" menu contains the most important settings to get the softstarter operational and set up for the application. It includes different sub menus concerning the control of the unit, motor data and protection, utilities and automatic reset of faults. This menu will instantaneously adapt to installed options and show the required settings.

8.2.1 Operation setup [210]

Selections concerning the used motor, softstarter mode, control signals and serial communication are described in this submenu and is used to set the softstarter up for the application.

Language [211]

Select the language used in the control panel display. Once the language is set, this selection will not be affected by the "Load Default" command.

	┌──────────────────────────┐ │ **211 Language** │ │ **StpА English** │ └──────────────────────────┘	
Default:		English
English	0	English selected
Svenska	1	Swedish selected
Nederlands	2	Dutch selected
Deutsch	3	German selected
Français	4	French selected
Español	5	Spanish selected
Русский	6	Russian selected
Italiano	7	Italian selected
Česky	8	Czech selected
Türkçe	9	Turkish selected

Select Motor [212]

This menu is used if you have more than one motor in your application. Select the motor to define. It is possible to define up to four different motors, M1 to M4, in the softstarter. For parameter set handling including motor sets M1 - M4, see section 8.2.5, page 80.

	┌──────────────────────────┐ │ **212 Select Motor** │ │ **StpА M1** │ └──────────────────────────┘	
Default:		M1
M1	0	
M2	1	Motor Data [220] is connected to selected motor.
M3	2	
M4	3	

Action Control [215]

These menus are used to select the source for run and stop commands and for jog control. This is described in section 7.1, page 49.

Run/Stop Control [2151]

This menu is used to select the control source for run and stop commands.

	2151 Run/Stp Ctrl StpA Remote	
Default:	Remote	
Remote	0	Start/stop command via digital input or Virtual I/O.
Int+Ext keyb	1	Start/stop command via internal or external control panel.
Com	2	Start/stop command via serial communication.
Int keyb	5	Start/stop command via internal control panel.
Ext keyb	6	Start/stop command via external control panel.

Jog Control [2152]

In this menu the control source for the jog function is selected. If the Jog FWD and Jog REV keys are to be used, one of the keyboard alternatives must be selected in this menu, and the keyboard must be locked in menu [218]. See section 7.1.3, page 50 for settings regarding the jog functions.

	2152 Jog Ctrl StpA Remote	
Default:	Remote	
Remote	0	Jog command via digital input or Virtual I/O.
Int+Ext keyb	1	Jog command via internal or external control panel.
Com	2	Jog command via serial communication.
Int keyb	5	Jog command via internal control panel.
Ext keyb	6	Jog command via external control panel.

Reset Control [216]

When the softstarter is in alarm condition, a reset command is required to make it possible to restart the softstarter. Use this function to select the source of the reset signal. The keyboard alternatives in this menu enable both external and internal control panels to be used. For autoreset settings, see menu group [250] "Autoreset". See also section 7.3.5, page 60 about reset and autoreset functions.

WARNING!
If the input signal Run FWD/RunREV is active (high) and level-controlled start mode is selected, the motor will start at the reset command.
Note that "level control" is not fulfilling the Machine directive

	216 Reset Ctrl Stp A Remote+Keyb	
Default:	Remote+Keyb	
Remote	0	Reset command via digital input or Virtual I/O.
Keyboard	1	Reset command via internal or external control panel (RESET key).
Com	2	Reset command via serial communication.
Remote+ keyb	3	Reset command via digital input or control panel (internal or external).
Com+keyb	4	Reset command via serial communication or control panel (internal or external).
Rem+keyb +com	5	Reset command via digital input, control panel (internal or external), or serial communication.

Key functionality [217]

Menu group that sets the functions of the keys on the control panel. See section 6.4, page 45.

Function Key [2171]

The Toggle key on the keyboard (see section 6.5, page 46) has two functions that can be activated in this menu. As default the key is set to operate as a toggle key that moves you easily through the selected menus in the toggle loop.
The "Loc/Rem" function of the key allows you to easily switch between local and normal operation mode (see page 47). If set to "Off", the function is disabled.
The "Loc/Rem" function can also be changed via digital input. See menu [520].

		2171 FunctionKey Stp A Toggle
Default:		Toggle
Off	0	No function
Toggle	1	Toggle function
Loc/Rem	2	Local/Remote control mode function
Combined	3	Both Toggle function and Local/Remote control mode function. See explanation in 6.5.1.

Local Run Control [2173]

The "Local" mode of the "Loc/Rem" functionality is defined in this menu (see also page 47). When the softstarter is in "Local" operation mode, the display shows " L ".

		2173 LocRunCtrl Stp A Keyboard
Default:		Keyboard
Remote	1	Local start/stop command via digital input or Virtual I/O. Defined in menu [2151].
Keyboard	2	Local start/stop command via control panel (internal or external).
Com	3	Local start/stop command via serial communication.

FWD key [2174]

The START/FWD key gives a start with forward (right) rotation if the function is activated in this menu. The rotation direction must also be permitted in menu [219] "Rotation"

		2174 FWD key Stp A FWD
Default:		FWD
Off	0	FWD key deactivated
FWD	1	FWD key activated

REV key [2175]

The REV key gives a start with reverse (left) rotation if activated in this menu. The function requires a reversing contactor.
The rotation direction must also be permitted in menu [219] "Rotation".

		2175 REV key Stp A Off
Default:		Off
Off	0	REV key deactivated
REV	1	REV key activated

Lock Code [218]

To prevent the keyboard being used or to change the setup of the softstarter and/or process control, the keyboard can be locked with a password. This menu, "Lock Code" [218], is used to lock and unlock the keyboard. Enter the password "291" to lock/unlock the keyboard operation (see section 6.4.1, page 45). If the keyboard is not locked (default) the selection "Lock Code?" will appear. If the keyboard is already locked, the selection "Unlock Code?" will appear.
When the keyboard is locked, parameters can be viewed but not changed. The control keys (START REV/FWD, and STOP/RESET) and the jog keys (JOG REV/FWD) can still be used if their functions are set to be controlled from the keyboard and the keys are activated. (it is possible to select e.g. Start REV to be Off or REV in menu [2175] above).

		218 Lock Code? Stp A 0
Default:		0
Range:		0–9999

Rotation [219]

Overall limitation of motor rotation direction

This function limits the overall rotation to reverse or forward direction, or to allow both directions. This limit is prior to all other selections, e.g. if the rotation is limited to forward direction, a REV command will be ignored. To be able to allow reverse and forward rotation we assume that the motor is connected according to section , page 16.

In this menu you set the allowed rotation for the motor.

```
┌─────────────────────────────┐
│ 219 Rotation                │
│ Stp A                  FWD   │
└─────────────────────────────┘
```

Default:		FWD
FWD	1	Limited to forward (right) rotation. REV key, JOG REV key, and reverse commands are disabled.
REV	2	Limited to reverse (left) rotation. FWD key, JOG FWD key, and forward commands are disabled. See note below.
FWD+REV	3	Both rotation directions allowed. See note below.

NOTE: When reversed rotation is selected ("REV" or "FWD+REV" in menu [219]), this requires phase reversal contactors. See Fig. 25, page 29.

NOTE: Jog reverse does not require any phase reversal contactor.

8.2.2 Remote signal Level/Edge [21A]

In this menu you select the type of control used for the input signals for RunFWD, RunREV and RESET that are operated via the digital inputs on the terminal strip. The input signals are default set for edge-control, and the input signals will be activated by the "low to high" or in some cases "high to low" transition of the input. When level-control is selected, the input signals will be active as long as the input is kept high or low (see description of selections menu [21A] below). See also section 7.5, page 61.

NOTE: In edge control mode, at least one digital input must be programmed to "Stop", because the "RunFWD" and "RunREV" commands are only able to start the softstarter.

```
┌─────────────────────────────┐
│ 21A Level/Edge              │
│ Stp A              Edge      │
└─────────────────────────────┘
```

Default:		Edge
Level	0	The inputs are activated or deactivated by a continuous high or low signal. Is commonly used if, for example, a PLC is used to operate the softstarter.
Edge	1	The inputs are activated by a transition; for Run and Reset from "low" to "high" and for Stop from "high" to "low".

⚠ **CAUTION!**
Level controlled inputs DO NOT comply with the Machine Directive if the inputs are directly used to start and stop the machine.

NOTE: Edge controlled inputs can comply with the Machine Directive (see Chapter 1.5.1 page 6) if the inputs are directly used to start and stop the machine.

Units [21C]

In this menu you select the units which will represent the different parameter values in the menus, including those read via serial communication.

SI units

When "SI" is selected, the default units will be:

• Power [kW]

• Torque [Nm]

• Temperature [°C]

Nominal motor frequency is preset to 50 Hz, and the nominal values on motor data are preset according to SI standards.

US units

The corresponding default values for US-units will be:

• Power [hp]

• Torque [lb.ft]

• Temperature [°F]

Nominal motor frequency will be preset to 60 Hz, and the default nominal values on motor data (e.g. voltage) are adapted to US standards.

See also 1.7.2 Definitions, and Table 27, page 74.

21C Units		
Stp A		SI

Default:		SI
SI	0	SI-units
US	1	US-units

⚡ **WARNING!**
When the "Units" setting is changed, this will also affect the factory settings of the motor.

8.2.3   Motor Data [220]

In this menu you enter the motor data to adapt the softstarter to the connected motor. This will increase the control accuracy as well as different read-outs and analogue output signals. Some of the default motor data is derived from the setting in menu [21C].

Motor M1 is selected as default and motor data entered will be valid for motor M1. If you have more than one motor you need to select the correct motor in menu [212] before entering motor data.

🔒 **NOTE 1: The parameters for motor data cannot be changed during operation (marked with a lock symbol here).**

NOTE 2: The default factory settings are for a standard 4-pole motor according to the nominal current and power of the softstarter. The softstarter can run the motor even if motor data is not adapted to the actual motor, but the performance will not be optimal.

NOTE 3: Parameter sets cannot be changed during operation if they are set for different motors.

NOTE 4: Motor Data in the different sets M1 to M4 can be reverted to default setting in menu [243], Default>Set.

For more information about handling of motor data and parameter sets, see section 7.2.3, page 52.
For explanation of the different abbreviations used in this chapter, see Chapter 1.7.2 page 7

Nominal Motor Voltage [221]

Set the nominal motor voltage, U_{n_mot}.

```
 🔒        ┌──────────────────────────┐
           │ 221 Motor Volts          │
           │ Stp A M1:          400V  │
           └──────────────────────────┘
```

Default:	400 V for SI-units 460 V for US-units
Range:	100-700 V
Resolution	1 V

NOTE: The Motor Volts value will always be stored as a 3 digit value with a resolution of 1 V.

Nominal Motor Frequency [222]

Set the nominal motor frequency.

```
 🔒        ┌──────────────────────────┐
           │ 222 Motor Freq           │
           │ Stp A M1:          50Hz  │
           └──────────────────────────┘
```

Default:	50 Hz for SI-units 60 Hz for US-units
Range:	50 or 60 Hz

Nominal Motor Power [223]

The range for P_{n_mot} depends on the nominal softstarter power P_{n_soft}. It must be set within the range 25 - 400% of the softstarter power Pn_soft. If parallel motors, set the sum of the motor power. See nominal data for CG motors in Table 27.

```
 🔒        ┌──────────────────────────────┐
           │ 223 Motor Power              │
           │ Stp A M1:     (P_n_mot) kW   │
           └──────────────────────────────┘
```

Default:	P_{n_mot}
Range:	25-400% x P_{n_soft}, default see Table 27, page 74.
Resolution	3 significant digits

Table 27   Nominal data for CG motors complying to IE2 class of IEC 60034-30.

Softstarter nominal current [A]	Default nominal power @ 400 V SI-units [kW]	Default nominal speed @ 50 Hz SI-units [rpm]	Default nominal power @ 460 V US-units [hp]	Default nominal speed @ 60Hz US-units [rpm]
16	7.5	1,440	10	1,730
22	11	1,460	15	1,750
30	15	1,460	20	1,750
36	18.5	1,465	25	1,760
42	22	1,465	30	1,760
56	30	1,465	40	1,760
70	37	1,480	50	1,780
85	45	1,475	60	1,770
100	55	1,480	75	1,780
140	75	1,480	100	1,780
170	90	1,480	125	1,780
200	110	1,485	150	1,780
240	132	1,485	200	1,780
300	160	1,490	250	1,790
360	200	1,490	300	1,790
450	250	1,490	350	1,790
560	315	1,490	450	1,790
630	355	1,490	500	1,790
710	400	1,490	600	1,790
820	450	1,490	700	1,790
1,000	560	1,490	800	1,790
1,400	800	1,490	1,000	1,790
1,800	1,000	1,490	1,500	1,790

Nominal Motor Current [224]

Set the nominal motor current. If parallel motors, set the value as sum of motors current.

🔒	**224 Motor Curr** **Stp A M1: (I$_{n\_mot}$) A**	
Default:	I$_{n\_mot}$=I$_{n\_soft}$ (see Note 2, page 73 and Table 27 above)	
Range:	25 - 200% x I$_{n\_soft}$ [A] depending on Emotron TSA model.	

NOTE: The default settings are for a standard 4-pole motor according to the nominal power of the softstarter.

I$_{n\_soft}$ is the nominal softstarter current, value according to Table 27.

Nominal Motor Speed [225]

Set the nominal (full load) asynchronous motor speed.

🔒	**225 Motor Speed** **Stp A M1: (n$_{n\_mot}$) rpm**	
Default:	n$_{n\_mot}$ (see Note 2, page 73 and Table 27)	
Range:	500 - 3,600 rpm	
Resolution	1 rpm, 4 sign digits	

Nominal Motor Poles [226]

This menu appears only when the nominal speed of the motor is ≤500 rpm. Here shall then the actual number of poles be entered.

🔒	**226 Motor Poles** **Stp A M1: 4**	
Default:	4	
Range:	2-144	

Nominal Motor Cos φ [227]

Set the nominal Motor cosphi (power factor).

🔒	**227 Motor Cosφ** **Stp A M1: 0.86**	
Default:	0.86 (see Note 2, page 73)	
Range:	0.50 - 1.00	

Motor Ventilation [228]

Parameter for setting the type of motor ventilation. This affects the characteristics of the I^{2}t motor protection by lowering the actual overload current.

🔒	**228 Motor Vent** **Stp A M1: Self**	
Default:		Self
None	0	Limited I^{2}t overload curve.
Self	1	Normal I^{2}t overload curve.
Forced	2	Expanded I^{2}t overload curve.

When the motor has no cooling fan, select "None". For a motor with a shaft mounted fan, select "Self". When the motor has an external cooling fan, select "Forced".

8.2.4 Motor protection [230]

This function protects the motor against overload based on the standard IEC 60947-4-2. For general information on different alarm settings, see section 7.3, page 55.

Predictive I^{2}t function

Based on how much the used thermal capacity (I^{2}t) has increased during the most recent starts, a prediction of the next start is made. If there is no room for another start, the start will be delayed until a start attempt results in a successful start (estimated motor temperature is cooled down). This delay time is indicated by the two LED's "Trip" and "Run" are slowly flashing (1 Hz) simultaneously, see also Chapter 6.2 page 44.

In addition to this, the message "Used Th Cap" will be shown in the display if no key on the control panel is pressed within 15 seconds.

WARNING!
If level-control is used (i.e. "Level" selection in menu [21A]), the motor will automatically continue to make a new start attempt, without notice.

Motor I^{2}t Alarm [231]

This function makes it possible to protect the motor from overload as published in the standard IEC 60947-4-2. The alarm limit is set according to the levels defined by the "Motor I^{2}t Class" in menu [2313]. Once exceeded, an alarm will occur and the action chosen in menu [2311] is performed. The alarm remains active until the I^{2}t value is below 95% before allowing a reset or an autoreset (see more detailed description in menu [2521]).

Motor I^{2}t Alarm Action [2311]

```
2311 Mot I2t AA
Stp AM1:   Soft Trip
```

Default:		Soft Trip
No action	0	I^{2}t motor protection is not active.
Hard Trip	1	
Soft Trip	3	For a definition, see Table 23, page 55
Warning	4	

Motor I^{2}t Current [2312]

This menu enables both downrating and uprating (use of motors with a service factor >1.00) of the thermal motor protection.

```
2312 Mot I2tCurr
Stp AM1:      100%
```

Default:	100%
Range:	0-150% of the nominal motor current I$_{n\_mot}$ [224]

Motor I^{2}t Class [2313]

Classification according to IEC60947-4-2, defining the starting capacities of the motor in order to avoid thermal overload.

In this menu an internal protection class can be chosen, which enables internal thermal motor protection. With this setting a thermal curve as set out in Fig. 50 is configured. The motor's thermal capacity is calculated continuously based on the chosen curve. If the thermal capacity exceeds 100% an alarm occurs and the action chosen in menu [2311] is performed. The alarm remains active until the motor model cools down to 95% of its thermal capacity. The used thermal capacity is shown in menu [2314]

```
2313 Mot I²tClass
Stp AM1:          10
```

Default:		Size 1: 10 A Size 2 and up: 10
2	0	Class 2
3	1	Class 3
5	2	Class 5
10 A	3	Class 10 A
10	4	Class 10
20	5	Class 20
30	6	Class 30
40	7	Class 40
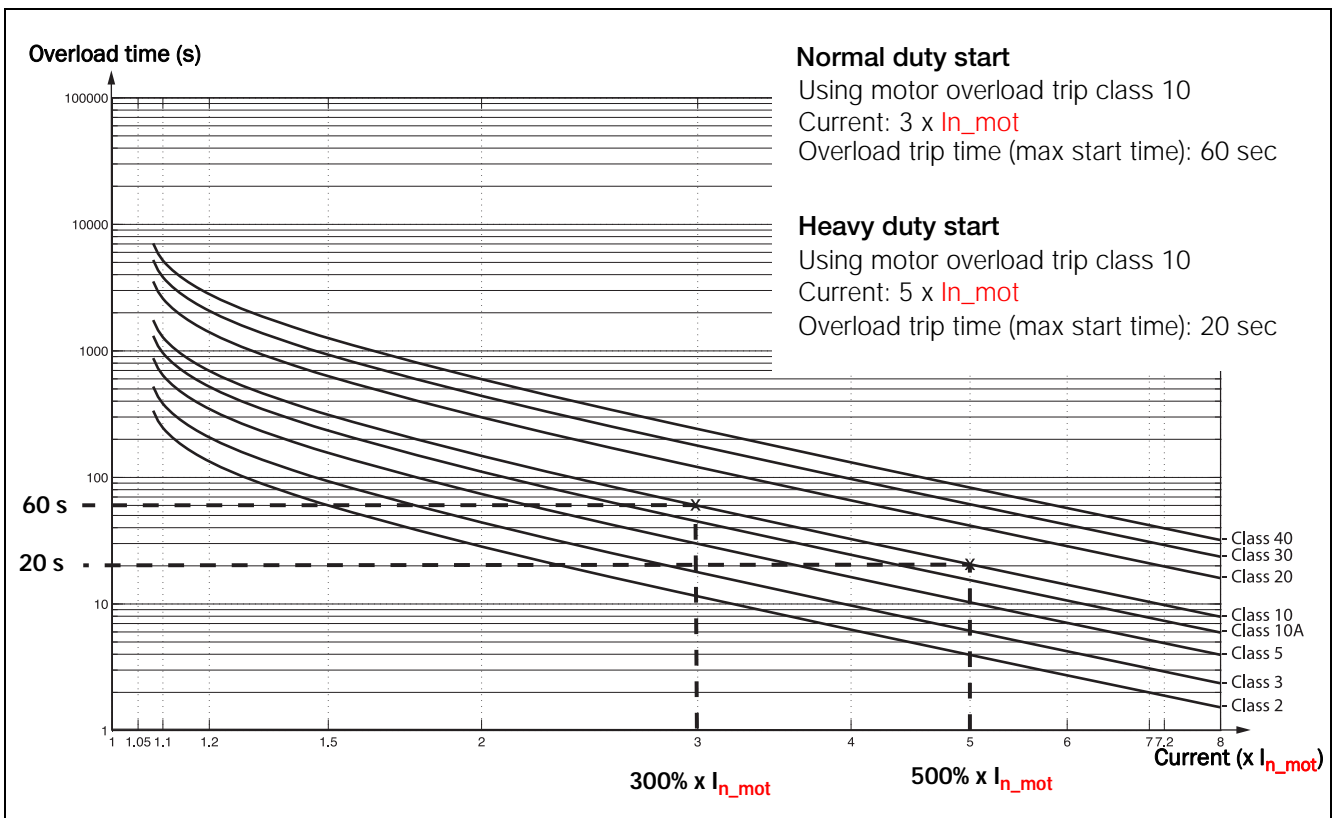
Fig. 50   The thermal curve

Used Thermal Capacity [2314]

This menu shows the used thermal capacity of the motor, i.e. the actual I^2t value divided by the maximum I^2t value, expressed in (%) .

Read-only	2314 Used Th Cap Stp **A**M1: XX%

PT100 Alarm[232]

The PT100 menus are only shown if a PT100 option board is connected.

PT100 Alarm Action [2321]

		2321 PT100 AA Stp **A**M1: No Action
Default:		No Action
No Action	0	For a definition, see Table 23, page 55
Hard Trip	1	
Soft Trip	3	
Warning	4	

Motor Class [2322]

Only visible if the PTC/PT100 option board is installed. Set the class of motor used. The trip levels for the PT100 sensor will automatically be set according to the setting in this menu.

		2322 Motor Class Stp **A**M1: F 140°C
Default:		F 140°C
A 100°C	0	
E 115°C	1	
B 120°C	2	
F 140°C	3	
F Nema 145°C	4	
H 165°C	5	

PT100 Inputs [2323]

Two PT100 option boards (B1 and B2) may be connected, enabling up to six PT100 inputs. With menu [2323] "PT100 Inputs", you can select which PT100 inputs that should be supervised, i.e. which are allowed to generate a trip/warning when the temperature exceeds the limit set in menu [2322] "Motor Class".

PT100 input 1, 2 and 3 are equal to input terminal 1, 2 and 3 on the first PT100 option board (B1). PT100 input 4, 5 and 6 are equal to input terminal 1, 2 and 3 on the second PT100 option board (B2).

Note that the supervised inputs must be selected in a sequence without gaps, i.e. if you like to have only one input supervised (selection PT100 1) you must use input 1 on board one (B1).

If you wish to have four PT100 inputs supervised (selection PT100 1-4) you must use input 1-3 on option board one (corresponding to input 1-3) and the first input of board 2 (corresponding to input 4).

All PT100 inputs are displayed in operation menu [71B] PT100 B1 1, 2, 3 and [71C] PT100 B2 1, 2, 3, regardless of the menu selection.

		2323 PT100Inputs Stp **A**M1: PT100 1-3
Default:		PT100 1-3
PT100 1	0	Channel 1 used for PT100 protection
PT100 1-2	1	Channel 1-2 used for PT100 protection
PT100 1-3	2	Channel 1-3 used for PT100 protection
PT100 1-4	3	Channel 1-4 used for PT100 protection
PT100 1-5	4	Channel 1-5 used for PT100 protection
PT100 1-6	5	Channel 1-6 used for PT100 protection

PTC Alarm [233]

The PTC alarm menus are always shown as there is an integrated PTC input on the power board (PB-PTC) terminal 69 and 70, as standard.

PTC Alarm Action [2331]

		2331 PTC AA Stp **A**M1: No action
Default:		No action
No action	0	For a definition, see Table 23, page 55.
Hard Trip	1	
Soft Trip	3	
Warning	4	

PTC Inputs [2332]

Two additional PTC option inputs can be handled. The settings are therefore "PB-PTC" for the on-board PTC, "PB-PTC&Opt1", and "PB-PTC&Opt1-2".

```
┌─────────────────────────────────┐
│  2332 PTC Inputs                │
│  Stp A M1:          PB-PTC      │
└─────────────────────────────────┘
```

Default:		PB-PTC
PB-PTC	0	On-board power board PTC used for protection, terminal 69 and 70
PB-PTC &Opt1	1	PB-PTC and PTC input on option B1 used for protection
PB-PTC &Opt1-2	2	PB-PTC and PTC input on options B1 and B2 used for protection

Start Limitation [234]

The start limitation could be used to protect the motor by limiting the numbers of starts per hour or securing a minimum time delay between starts.
A start limitation alarm can only be reset when the alarm condition is gone.

The actual time left until the next start is allowed is shown in the status menu [72G] "Time to Next Start".

Start Limitation Alarm Action [2341]

Start limitation is enabled in this menu by choosing a proper alarm action, used as thermal protection for the motor. Autoreset is available for all start limitation alarms, menu [2552].

```
┌─────────────────────────────────┐
│  2341 StartLim AA               │
│  Stp A          No action       │
└─────────────────────────────────┘
```

Default:		No action
No action	0	
Hard Trip	1	For a definition, see Table 23, page 55
Warning	4	

Number of starts per hour [2342]

In this menu the allowed number of starts per hour can be set. If this number is exceeded, an alarm occurs and the action chosen in menu [2341] is performed.
The alarm is active until the hour has expired. After reset a new start is allowed. The first hour is counted directly from the first start of the motor, whereas the following hour is counted not directly, but from the moment a new start is done, i.e. no rolling hour.

```
┌─────────────────────────────────┐
│  2342 Starts/h                  │
│  Stp A M1:              10       │
└─────────────────────────────────┘
```

Default:	10
Range:	1 - 99

Minimum time between starts [2343]

In this menu a minimum time between consecutive starts can be set. If a new start attempt is made before the minimum time is expired an alarm will occur and the action chosen in menu [2341] is performed. It is not possible to reset the alarm until the chosen minimum time has expired and a new start is allowed.

```
┌─────────────────────────────────┐
│  2343 MinTBtwStrt               │
│  Stp A M1:             Off       │
└─────────────────────────────────┘
```

Default:	Off
Range:	1 - 60 min

Time to next start [2344]

In this menu the time to the next allowed start is shown. Counts down from set value in menu [2343].

Read only	2344 TimTNxtStrt Stp A M1: min
Unit	minutes
Resolution:	1 min

Phase Loss

Autoreset is available for single phase loss alarm, menu [2561].

Multiple phase loss

A multiple phase loss always results in a hard trip. Multiple phase loss alarm is only enabled during operation. If there is an external phase loss (mains supply), this is not indicated before an alarm delay of 2 seconds.

Single phase loss

The alarm action on single phase loss can be set in menu [235]. This will take place if the phase loss lasts for more than 2 seconds. Single phase loss supervision is only active during operation.

Single Phase Loss Alarm Action [235]

The action on a single phase loss is set in this menu. The relevant action is performed when any phase is lost for more than 2 seconds.

```
235 SnglPhLossAA
Stp A         Hard Trip
```

Default:		Hard Trip
Hard Trip	1	For a definition, see Table 23, page 55.
Warning	4	

Current Limit Alarm Action [236]

This alarm is only active if there is a current limit coupled to the start method (settings in [331] and [335]). An alarm is activated if the current still is at the current limit when the start time has expired. This indicates that the motor has not yet reached full speed. Autoreset is available for this function, menu [2525].

```
236 CurrLim AA
Stp A         Hard Trip
```

Default:		Hard Trip
No action	0	For a definition, see Table 23, page 55.
Hard Trip	1	
Soft Trip	3	
Warning	4	

8.2.5 Parameter set handling [240]

Parameter sets are used if an application requires different settings for different modes. See detailed description in "Working with parameter sets", page 51.
There are four available parameter sets that can be individually configured.
The selected motor (M1 - M4) [212] decides the parameter settings for the motor data in menu group [220]. See instructions in Handling motor data in parameter sets, page 52.

Select Set [241]

Here you select the parameter set, directly or from where the selection is going to be controlled. Every menu included in the parameter sets is designated A, B, C or D depending on the active parameter set. This is shown in the lower left area of the display, i.e. with an **A** as default. The active set is also showed in [721] "TSA Status".
The parameter sets can be changed during operation. However, if the sets are using different motors (M1 to M4) the set will be changed only when the motor is stopped.

```
241 Select Set
Stp A                    A
```

Default:		A
A	0	
B	1	Fixed selection of one of the 4 parameter sets A, B, C or D.
C	2	
D	3	
DigIn	4	Parameter set is selected via a digital input. Define which digital input in menu [520], Digital Inputs.
Com	5	Parameter set is selected via serial communication.
Option	6	The parameter set is set via an option. Only available if the option can control the selection.

NOTE: The parameter set cannot be changed during run if the parameter set includes change of the motor set (M1-M4).

Copy Set [242]

This function copies the content of a parameter set into another parameter set, e.g. A>B means that the content of parameter set A is copied into parameter set B.

```
┌─────────────────────────────────┐
│  242 Copy Set                   │
│  Stp A              A>B         │
└─────────────────────────────────┘
```

Default:		A>B
A>B	0	Copy set A to set B
A>C	1	Copy set A to set C
A>D	2	Copy set A to set D
B>A	3	Copy set B to set A
B>C	4	Copy set B to set C
B>D	5	Copy set B to set D
C>A	6	Copy set C to set A
C>B	7	Copy set C to set B
C>D	8	Copy set C to set D
D>A	9	Copy set D to set A
D>B	10	Copy set D to set B
D>C	11	Copy set D to set C

NOTE: The actual value of menus for viewing are not stored.

Load Default Values Into Set [243]

With this function different levels of factory settings can be selected for the four parameter sets. When loading the default settings, all changes made on the Emotron TSA softstarter are set to factory settings. This function also includes selections for loading default settings to the four different motor data sets.

```
┌─────────────────────────────────┐
│  243 Default>Set                │
│  Stp A                   A      │
└─────────────────────────────────┘
```

Default:		A
A	0	Only the selected parameter set will revert to its default settings.
B	1	
C	2	
D	3	
ABCD	4	All four parameter sets will revert to the default settings.
Factory	5	All settings, except [211], [221]-[228], [261] and [923], will revert to the default settings.
M1	6	Only the selected motor set will revert to its default settings.
M2	7	
M3	8	
M4	9	
M1M2M3 M4	10	All four motor sets will revert to default settings.

Copy all settings to control panel [244]

All the settings, including the motor data, can be copied between the control board memory and a control panel, (external or internal). This can be useful when transferring settings to a second softstarter unit, for instance.

To put the copy/load function into practice, see different setups in section 7.2.4, page 52.

If two control panels are connected to the softstarter (using an optional external control panel), only one at a time can be used for copying or loading data. While transferring data to one control panel, the other control panel is temporarily disabled.

NOTE: Start commands will be ignored during copying or loading.

NOTE: The control panel will be temporarily locked while copying or loading data to the internal control panel.
If the on-board RS-232 port is connected to a PC or to an external control panel this will also be temporarily locked.

To copy settings from the control board to a control panel, use the actual control panel and set [244] "Copy to CP" to "Copy". This will copy all user parameter settings stored in the control board, and erase any corresponding settings previously stored in the control panel. While the data is transferred, "Copy" is flashing on the control panel from which the command was activated, while the other control panel will be temporarily inactive. When finished, "Transfer OK!" is displayed, and it will be possible to give a new command from any of the control panels.

🔒	244 Copy to CP Stp A No Copy	
Default:	No Copy	
No Copy	0	Nothing will be copied
Copy	1	Copy all settings

NOTE: The actual value of menus for viewing will not be copied into control panel memory set.

Load settings from control panel [245]

This function can load single or multiple parameter sets and motor data from the actual control panel to the softstarter control board memory. This is carried out much in the same way as when copying. The selected parameter sets from the control panel are copied to the corresponding parameter sets in the softstarter control board, i.e. A to A, B to B, M1 to M1, and so on. The different choices are listed below.
If a second control panel is connected, this will not be affected when loading from the first control panel.

🔒	245 Load from CP Stp A No Copy	
Default:	No Copy	
No Copy	0	Nothing will be loaded.
A	1	Data from parameter set A is loaded.
B	2	Data from parameter set B is loaded.
C	3	Data from parameter set C is loaded.
D	4	Data from parameter set D is loaded.
ABCD	5	Data from parameter sets A, B, C and D are loaded.
A+Mot	6	Parameter set A and Motor 1 data are loaded.
B+Mot	7	Parameter set B and Motor 1 data are loaded.
C+Mot	8	Parameter set C and Motor 1 data are loaded.
D+Mot	9	Parameter set D and Motor 1 data are loaded.
ABCD+Mot	10	Parameter sets A, B, C, D and Motor 1, data are loaded.
M1	11	Data from motor 1 is loaded.
M2	12	Data from motor 2 is loaded.
M3	13	Data from motor 3 is loaded.
M4	14	Data from motor 4 is loaded.
M1M2M3 M4	15	Data from motor 1, 2, 3 and 4 are loaded.
All	16	All data is loaded from the control panel.

NOTE: Loading or copying will not affect the value in menus for viewing.

8.2.6 Autoreset [250]

With these menus an autoreset of alarms can be configured. The benefit of this feature is that occasional trips that do not affect the process will be automatically reset and the uptime of your application will be maximized. Autoreset requires an Autoreset signal, see further Chapter 7.3.5 page 60 and menu [521]Digital input 1" /Reset in Chapter 8.5.2 page 108. When an autoreset condition is active this is indicated with the two LEDs "Trip" and "Run" are flashing simultaneously, see Chapter 6.2 page 44. The system message "Autoreset" will also be shown in the display.

> **WARNING!**
> **If the input signal Run FWD/RunREV is active (high) and level-controlled start mode is selected, the motor will start at the reset command. See also section 7.5.3, page 62.**

> **Note that "level control" is not fulfilling the Machine directive**

Autoreset Attempts [251]

Any number set above 0 activates the autoreset for those alarms where Autoreset is enabled ([2561] - [2564]). This means that after a trip, the softstarter will reset the alarm condition automatically according to the number of attempts selected. No reset will take place unless all conditions are normal.
If the counter for "Actual Autoreset Attempts" [2512] contains more trips than the allowed number of attempts selected in menu [2511], the autoreset cycle will be interrupted. No autoreset will then take place.
For every 10 minutes that have passed without any new trip the autoreset counter is counting down one count.
If the maximum number of trips has been reached, the trip message time is marked with an "A". Date and time is alternating:

```
830 OVERVOLT
Trp        A 15:45:12
```

```
830 OVERVOLT
Trp      A 2013-04-17
```

The example above shows the 3rd trip memory menu [830]. An overvoltage trip took place 15:45:12 on 2013-04-17, at which time the allowed number of autoreset attempts was exceeded.

If the autoreset counter has reached the set maximum, the softstarter must be reset by a normal reset. See example below:

- Number of allowed autoreset attempts [2511]= 5.
- Within 10 minutes 6 trips occur.
- At the 6th trip there is no autoreset, because the autoreset counter allows only 5 attempts to autoreset a trip.

- To reset the autoreset counter, give a new reset command (from one of the sources for reset control selected in menu [216]). In this case with [216]= Remote, disable the Digital input and re enable it again.
- The autoreset counter is now zeroed.

Number of Allowed Autoreset attempts [2511]

```
2511 AllowedArst
Stp A           Off
```

Default:	Off (no autoreset)
Range:	0–10 attempts

Number of Actual Autoreset attempts [2512]

In this menu the status of the internal autoreset counter is shown. If no new trips occur, the autoreset counter is decreased with one count for every tenth minute.

Read-only	2512 ActualArst Stp A 0
Default:	0

> **NOTE: An autoreset is delayed by the remaining delay time.**

Motor Protection Autoreset [252]

Menu group for automatic reset of motor protection alarms.

Motor I^2t protection autoreset [2521]

The delay counter starts counting when the I^2t value is low enough to allow for a new start. This means that first the internal thermal motor model will require time for cooling down to a thermal capacity of 95% (if internal thermal motor protection is enabled). Then the delay time set in this menu is added on to this time. When the delay time has elapsed, the alarm will be reset.

```
2521 Motor I²t
Stp A           Off
```

Default:		Off
Off	0	Off
1–3600	1–3600	1–3,600 s

PT100 autoreset [2522]

The delay counter starts counting when all PT100 inputs are below the set temperature in menu [2322].

```
┌─────────────────────────────────┐
│        2522 PT100               │
│        Stp A          Off       │
└─────────────────────────────────┘
```

Default:		Off
Off	0	Off
1–3600	1–3600	1–3,600 s

PTC autoreset [2523]

The delay counter starts counting when all PTC values are below their respective limit. This means that if e.g. only the internal power board PTC (PB-PTC) is present, the PTC resistance has to go down to 2,260 Ohm before the delay time to autoreset starts counting down. I.e. the total time until autoreset is performed is the time until PTC reaches 2,260 ohm + the set delay time in menu [2523].

For corresponding resistance limits regarding PTC option boards, please refer to the PTC/PT100 board 2.0 instruction manual.

```
┌─────────────────────────────────┐
│        2523 PTC                 │
│        Stp A          Off       │
└─────────────────────────────────┘
```

Default:		Off
Off	0	Off
1–3600	1–3600	1–3,600 s

Locked Rotor autoreset [2524]

In this menu the delay time for an autoreset of a locked rotor alarm is set. As a locked rotor cannot be detected in stopped state, the delay time starts counting immediately after the alarm action has been executed. When the delay time has elapsed, the alarm will be reset.

```
┌─────────────────────────────────┐
│        2524 LockedRotor         │
│        Stp A          Off       │
└─────────────────────────────────┘
```

Default:		Off
Off	0	Off
1–3600	1–3600	1–3,600 s

Current Limit autoreset [2525]

In this menu the delay time for an autoreset of a current limit alarm is set. As a current limit fault condition cannot be detected in stopped state, the delay time starts counting immediately after the alarm action has been executed. When the delay time has elapsed, the alarm will be reset.

```
┌─────────────────────────────────┐
│        2525 Curr Lim            │
│        Stp A          Off       │
└─────────────────────────────────┘
```

Default:		Off
Off	0	Off
1–3600	1–3600	1–3,600 s

Communication Error autoreset [253]

The delay counter starts counting as soon as communication is reestablished.

```
┌─────────────────────────────────┐
│        253 ComErrArst           │
│        Stp A          Off       │
└─────────────────────────────────┘
```

Default:		Off
Off	0	Off
1–3600	1–3600	1–3,600 s

NOTE: An autoreset is delayed by the remaining ramp time.

Process Protection Autoreset [254]

When the load monitor function is used, menu group [410], the following settings for autoreset can be done.

Load Monitor Max Alarm autoreset [2541]

The delay counter starts counting immediately.

```
┌─────────────────────────────────┐
│        2541 MaxAlarm            │
│        Stp A          Off       │
└─────────────────────────────────┘
```

Default:		Off
Off	0	Off
1–3600	1–3600	1–3,600 s

Load Monitor Max Pre-Alarm autoreset [2542]

The delay counter starts counting immediately.

		2542 MaxPAlarm Stp **A** Off
Default:		Off
Off	0	Off
1–3600	1–3600	1–3,600 s

Load Monitor Min Pre-Alarm autoreset [2543]

The delay counter starts counting immediately.

		2543 MinPAlarm Stp **A** Off
Default:		Off
Off	0	Off
1–3600	1–3600	1–3,600 s

Load Monitor Min Alarm autoreset [2544]

The delay counter starts counting immediately.

		2544 MinAlarm Stp **A** Off
Default:		Off
Off	0	Off
1–3600	1–3600	1–3,600 s

External Alarm 1 autoreset [2549]

The delay counter starts counting as soon as the relevant external alarm input is inactive.

		2549 Ext Alarm 1 Stp **A** Off
Default:		Off
Off	0	Off
1–3600	1–3600	1–3,600 s

External Alarm 2 autoreset [254A]

The delay counter starts counting as soon as the relevant external alarm input is inactive.

		254A Ext Alarm 2 Stp **A** Off
Default:		Off
Off	0	Off
1–3600	1–3600	1–3,600 s

Softstarter Protection autoreset [255]

For alarms that are present to protect the softstarter, the following settings for autoreset can be done.

Overtemperature autoreset [2551]

In this menu the delay time for autoreset is set for a softstarter overheated alarm. The delay time starts counting when the fault is removed. This means the softstarter has to be cooled down. When the delay time has elapsed, the alarm will be reset.

		2551 Overtemp Stp **A** Off
Default:		Off
Off	0	Off
1–3600	1–3600	1–3,600 s

Start Limitation autoreset [2552]

The delay counter starts counting when the time to next allowed start, set in menu [2354], has decreased to zero.

		2552 Start Limit Stp **A** Off
Default:		Off
Off	0	Off
1–3600	1–3600	1–3,600 s

Mains failure autoreset [256]

The following menus are intended for autoreset of different mains fault conditions.

Phase Input loss autoreset [2561]

As a phase input failure cannot be detected in a stopped state, the delay time counter starts counting immediately after the alarm action has been executed. When the delay time has elapsed, the alarm will be reset.

```
┌─────────────────────────────────┐
│      2561 Phase Input           │
│  Stp A              Off         │
└─────────────────────────────────┘
```

Default:		Off
Off	0	Off
1–3600	1–3600	1–3,600 s

Voltage Unbalance autoreset [2562]

In this menu the delay time for an autoreset of a voltage unbalance alarm [431] is set. The delay time starts counting when the fault is removed. The voltage unbalance supervision is not enabled in stopped state and therefore the delay time starts counting immediately after the alarm action has been executed. When the delay time has elapsed, the alarm will be reset.

```
┌─────────────────────────────────┐
│      2562 Volt unbal            │
│  Stp A              Off         │
└─────────────────────────────────┘
```

Default:		Off
Off	0	Off
1–3600	1–3600	1–3,600 s

Overvoltage autoreset [2563]

In this menu the delay time for an autoreset of an overvoltage alarm [432] is set. The delay time starts counting when the fault is removed. The overvoltage supervision is not enabled in stopped state and therefore the delay time starts counting immediately after the alarm action has been executed. When the delay time has elapsed, the alarm will be reset.

```
┌─────────────────────────────────┐
│      2563 Overvolt              │
│  Stp A              Off         │
└─────────────────────────────────┘
```

Default:		Off
Off	0	Off
1–3600	1–3600	1–3,600 s

Undervoltage autoreset [2564]

In this menu the delay time for an autoreset of an undervoltage alarm [433] is set. The delay time starts counting when the fault is removed. The undervoltage supervision is not enabled in stopped state and therefore the delay time starts counting immediately after the alarm action has been executed. When the delay time has elapsed, the alarm will be reset.

```
┌─────────────────────────────────┐
│      2564 Undervolt             │
│  Stp A              Off         │
└─────────────────────────────────┘
```

Default:		Off
Off	0	Off
1–3600	1–3600	1–3,600 s

8.2.7 Serial Communication [260]

In this menu we configure parameters for the serial communication options.

The RS485 and USB option (com type setting USB/RS485 in menu [261]) uses the standard Modbus RTU protocol with a selectable baudrate in menu [2621] and Modbus address [2622].

In addition to this, there are also a number of fieldbus options available, e.g. Profibus/DeviceNet/ModbusTCP/ Profinet IO etc. When using a fieldbus option, menu [261] Com Type must be set to Fieldbus. The detailed fieldbus configuration is contained in menu [263] Fieldbus and its Submenus.

The com type RS232, is reserved for future RS232 options but is also used to perform a soft reset of the Fieldbus module, which is required after e.g. node address configuration in many cases (network dependant).

For more information see Chapter 9. page 139 and respective option manual.

There is also the onboard (CB) RS232, which is always active with fixed baudrate 9600 and fixed address =1, see Chapter 3.2 page 20.

Communication Type [261]

Select communication type .

```
┌─────────────────────────────────┐
│      261 Com Type               │
│  Stp A            RS232         │
└─────────────────────────────────┘
```

Default:		RS232
RS232	0	RS232 Currently only used for Fieldbus reset, see Note below. Also reserved for future RS232 option.
Fieldbus	1	Fieldbus option mounted (e.g. Profibus, DeviceNet, Modbus/TCP or EtherCAT*)
USB/ RS485/BT	2	USB, RS485 or Bluetooth* option mounted

NOTE: Toggling the setting from Fieldbus to RS232 in this menu will perform a soft reset (re-boot) of the Fieldbus module.

*) EtherCAT and Bluetooth are future options.

Modbus RTU [262]

Set up the parameters for Modbus/RTU) communication.

```
262 Modbus RTU
Stp
```

Baudrate [2621]

Set the baud rate for the communication.

> NOTE: This baud rate is valid only for communication via the RS485 and USB options.

```
2621 Baudrate
Stp A              9600
```

Default:	9600	
2400	0	
4800	1	
9600	2	
19200	3	Selected baudrate
38400	4	
57600	5	
115200	6	

Address [2622]

Enter the unit address for the softstarter.

> NOTE: This address is valid only for communication via the RS485 and USB options.

```
2622 Address
Stp A                  1
```

Default:	1
Selection:	1–247

Fieldbus [263]

Set up the parameters for fieldbus communication.

```
263 Fieldbus
Stp A
```

Address [2631]

Enter or view the unit/node address of the softstarter. Read & Write access for Profibus and DeviceNet. Read-only for EtherCAT*.

```
2631 Address
Stp A                 62
```

Default:	62
Range:	Profibus 0–126, DeviceNet 0–63
Node address valid for Profibus(RW), DeviceNet (RW) and EtherCAT* (RO).	

*) EtherCAT is a future option.

Process Data Mode [2632]

Enter the mode of process data (cyclic data). For further information, see the Fieldbus option manual.

```
2632 PrData Mode
Stp A            Basic
```

Default:		Basic
None	0	Control/status information is not used.
Basic	4	4 byte process data control/status information is used.

Read/Write [2633]

Select "Read/Write" to control the softstarter over a fieldbus network. For further information, see the Fieldbus option manual.

```
2633 Read/Write
Stp A                 RW
```

Default:		RW
RW	0	Read & Write
Read	1	Read-only
Valid for process data. Select "Read" (read-only) for logging process without writing process data. Select "RW" in normal cases to control inverter.		

Additional Process Values [2634]

Define the number of additional process values sent in cyclic messages.

```
2634 AddPrValues
Stp A                  0
```

Default:	0
Range:	0-8

Communication Fault [264]

Main menu for communication fault/warning settings. For further details please see the Fieldbus option manual.

Communication Fault Alarm Action [2641]

Selects action if a communication fault is detected.
The following applies:
If RS232 or USB/RS485/BT is selected, the softstarter will execute the selected action if there is no communication for the time set in parameter [2642] "ComFlt Time".
If Fieldbus is selected, the softstarter will execute the selected action if:

1. the internal communication between the control board and fieldbus option is lost for the time set in menu [2642] "ComFlt Time".

2. a serious network error has occurred.

		2641 ComFlt AA Stp **A** No action
Default:		No action
No action	0	No communication supervision.
Hard Trip	1	
Soft Trip	3	For a definition, see Table 23, page 55.
Warning	4	

NOTE: Menu [2151] or [2152] must be set to COM to activate the communication fault function supervision.

Communication Fault Time [2642]

Defines the delay time for the trip/warning.

	2642 ComFlt Time Stp **A** 0.5s
Default:	0.5 s
Range:	0.1-15 s

Ethernet [265]

Settings for Ethernet module (Modbus/TCP, Profinet IO). For further information, see the Fieldbus option manual.

NOTE: The Ethernet module must be re-booted to activate the below settings, for example by toggling parameter [261] from fieldbus to RS232 and back. Non-initialised settings are indicated by a flashing display text.

IP Address [2651]

	2651 IP Address 0. 0. 0. 0
Default:	0.0.0.0

MAC Address [2652]

Read only	2652 MAC Address Stp **A** 000000000000
Default:	A unique number for the Ethernet module.

Subnet Mask [2653]

	2653 Subnet Mask 0. 0. 0. 0
Default:	0.0.0.0

Gateway [2654]

	2654 Gateway 0. 0. 0. 0
Default:	0.0.0.0

DHCP [2655]

	2655 DHCP Stp **A** Off
Default:	Off
Selection:	On/Off

Fieldbus Signals [266]

Defines modbus mapping for additional process values. For further information, see the Fieldbus option manual.

FB Signal 1 - 16 [2661]-[266G]

Used to create a block of parameters which are read/written via communication. 1 to 8 read + 1 to 8 write parameters possible. Modbus addresses are entered, the actual numbers are found in Appendix 1: Menu List.

	2661 FB Signal 1 Stp A 0
Default:	0
Range:	0-65535

Fieldbus Status [269]

Sub menus showing status of fieldbus parameters. For detailed information, please see the Fieldbus option manual.

	269 FB Status Stp
Read-only	

8.3   Process [300]

These parameters are mainly adjusted to create a process signal used for analogue start/stop. The input signal is rescaled in order to be used for viewing in SI-units or as a signal for the analogue comparators. The read-out actual value depends on the selected process source, [321}.

8.3.1   View Process Value [310]

This menu is only visible if a process source is selected in menu [321] Process Source (i.e. by default the menu is not shown).
When selected, the actual value of the active (on-line) process signal is viewed here.

	310 ProcessValue Stp 0
Read-only	
Dependent on:	Process Source [321] and Process Unit [322]
All modes	Min according to menu [324] - max according to menu [325]

8.3.2   Process Settings [320]

With these settings, the softstarter process value can be set up to fit the application. The process value in menus [110], [120], [310], and [711] all use the process unit selected in [322] for the application, e.g. rpm, bar, or m3/h.

Process Source [321]

Selection of the signal source for the process value used to start and stop of the motor. The signal levels are given in menus [324] and [325]. The process source can be set to act as a function of the process signal on analogue input, via a communication bus, or temperature input via a PT100 board.
The selection F(x) indicates that a process unit and scaling is needed, set in menus [322]-[325]. This makes it possible to e.g. use pressure sensors to measure flow etc. If F(AnIn) is used, "Process Val" must be selected in menu [511].

		321 Proc Source Stp A Off
Default:		Off
Off	0	No process source selected.
F(AnIn)	1	Function of analogue input.
F(Bus)	7	Function of communication value.

NOTE: If F (Bus) is chosen in menu [321], see section 9.5 Process value, page 140.

Process Unit [322]

Selection of the unit for the process value. This menu is only visible if a process source is selected in menu [321] "Process Source".

```
┌─────────────────────────────────┐
│      322 Proc Unit              │
│   Stp A              Off        │
└─────────────────────────────────┘
```

Default:		Off
Off	0	No unit selection
%	1	Percent
°C	2	Degrees Centigrade
°F	3	Degrees Fahrenheit
bar	4	Pressure in bar
Pa	5	Pressure in Pascal
Nm	6	Torque
Hz	7	Frequency
rpm	8	Revolutions per minute
m^3/h	9	Cubic metres per hour
gal/h	10	Gallons per hour
ft^3/h	11	Cubic feet per hour
User	12	User defined unit

User-defined Unit [323]

This menu is only displayed if "User" is selected in menu [322]. The function enables the user to define a unit with six symbols. Use the PREV and NEXT keys to move the cursor to the required position. Then use the + and - keys to scroll down the character list. Confirm the character by moving the cursor to the next position by pressing the NEXT key.

Character	No. for serial comm.	Character	No. for serial comm.
Space	0	m	58
0–9	1–10	n	59
A	11	ñ	60
B	12	o	61
C	13	ó	62
D	14	ô	63
E	15	p	64
F	16	q	65
G	17	r	66
H	18	s	67
I	19	t	68
J	20	u	69
K	21	ü	70
L	22	v	71
M	23	w	72
N	24	x	73

Character	No. for serial comm.	Character	No. for serial comm.
O	25	y	74
P	26	z	75
Q	27	å	76
R	28	ä	77
S	29	ö	78
T	30	!	79
U	31	¨	80
Ü	32	#	81
V	33	$	82
W	34	%	83
X	35	&	84
Y	36	·	85
Z	37	(	86
Å	38	)	87
Ä	39	*	88
Ö	40	+	89
a	41	,	90
á	42	-	91
b	43	.	92
c	44	/	93
d	45	:	94
e	46	;	95
é	47	<	96
ê	48	=	97
ë	49	>	98
f	50	?	99
g	51	@	100
h	52	^	101
i	53	_	102
í	54	°	103
j	55	2	104
k	56	3	105
l	57		

Example:

Create a user unit named "kPa".

1. When in the menu [323] press ![plus key] to show the cursor.
2. Press ![NEXT key] to move the cursor to the rightmost position.
3. Press ![plus key] until the character "a" is displayed.
4. Press ![PREV key].
5. Then press the ![plus key] until "P" is displayed and press ![PREV key].
6. Repeat until you have entered "kPa". Confirm with ![ENTER key].

323 User Unit **Stp A**	
Default:	No characters shown

Process Minimum [324]

This menu is only visible if a process source is selected in menu [321].
This function sets the process value that corresponds to the minimum input signal.

324 Process Min **Stp A 0.000**	
Default:	0.000
Range:	0.000-10000 -10000– +10000 (F(AnIn, F(Bus), PT100)

Process Maximum [325]

This menu is only visible if a process source is selected in menu [321].
The function sets process value that corresponds to the maximum input signal.

325 Process Max **Stp A 10.00**	
Default:	10.00
Range:	0.000-10000

8.3.3 Start setting [330]

Submenu with all the functions for starting.

Start method [331]

The available start methods are:

Linear or Square Torque Control

A properly configured torque-controlled start will lead to a linear speed increase and low starting current without current peaks. Fig. 51 shows the torque ramps for linear torque control and square torque control. The "Initial Torque" value is set in menu [332] and the value for "End Torque at Start" is set in menu [333].
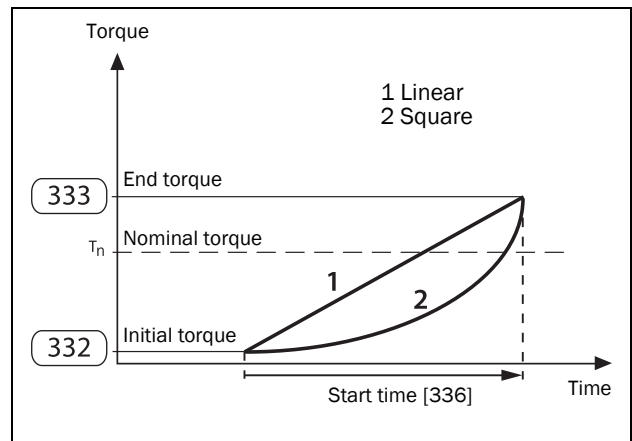
Fig. 51   Torque control at start

NOTE:

- **Set the initial torque so the motor will start running immediately.**
  If the torque is set too high, there will be a higher start current peak.

- **Set End torque at Start so the real ramp time is according to the set ramp time.**
  If set too high, the start time will be shorter than the set Start time, this will cause a higher current than necessary.
  If set too low, there will be a current peak at the end of the start ramp. This current peak can cause problems with fuses or circuit breakers.

Voltage Control

Voltage control is selected when a linear voltage ramp is desired. The thyristor switch on time will be ramped up linearly, from "Initial Voltage", menu [334], up to full mains voltage. See Fig. 52.
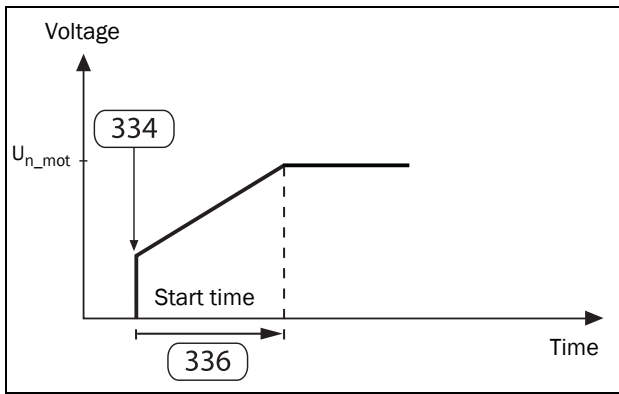
Fig. 52 Initial voltage and start time.

Direct on-line start, DOL

If this alternative is selected the motor can be started as if it was connected directly to the mains (when current limit [335] disabled) or alternatively using a very fast ramp see chapter Direct on-line start DOL with current limit, page 93 (when current limit [335] enabled).

For this type of operation:

Check whether the motor can accelerate the required load (DOL start). This start method can also be used with malfunctioning thyristors in case an emergency start is required.
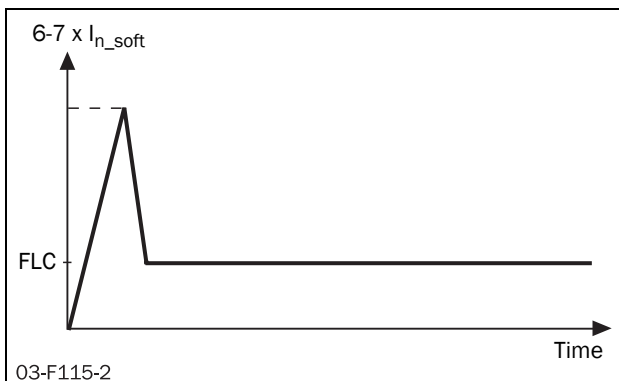
Fig. 53 DOL start.

331 Start Method Stp **A** Lin Torq Ctr		
Default:		Lin Torq Ctr
Lin Torq Ctr	1	The motor torque is controlled according to a linear ramp, set in menu [332] and [333].
Sqr Torq Ctr	2	The motor torque is controlled according to a square ramp, set in menu [332] and [333].
Voltage Ctr	3	The motor voltage is controlled according to a linear voltage ramp, menu [334].
DOL	4	Direct online

Initial Torque [332]

Used with start method linear/square torque control.

332 Init Torque Stp **A** 10%	
Default:	10%
Range:	0 - 250% of T_n

End Torque at Start [333]

Used with start method linear/square torque control.

333 EndTorqueSt Stp **A** 150%	
Default:	150%
Range:	0 - 250% of T_n

Initial Voltage [334]

Used with start method voltage control. Sets the initial voltage level, i.e. the ramp starts ramping from this output voltage level up to full voltage. See Fig. 52, page 92.

334 Init Volt Stp **A** 30%	
Default:	30%
Range:	0 - 90% of U_{n_mot} [221]

Current Limit [335]

A current limit can be added to all starting methods. This regulates the current during the start ramp until full voltage is reached. The start attempt is continued during the set start time in menu [336]. Should the current still be at the current limit when the start time has expired, this will be indicated by a trip or warning message depending on the alarm action set in menu [236]"Current Limit Alarm Action".

Linear or square torque ramp with current limit

The motor torque is controlled according to either a linear or a square ramp as selected in menu [331].

The current limit regulator is activated when the current is reaching the chosen value in [335], and switched off when full output voltage is reached, or the start time has expired [336].

Should the current fall to a value below the set current limit, the current limit controller will be deactivated, and the torque ramp reactivated. The ramp slope will increase above

the original slope to accomplish a start within the set start time. See Fig. 54.
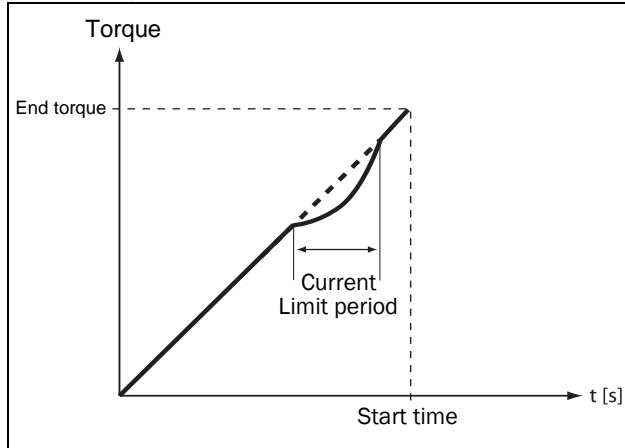
Fig. 54   Torque ramp with current limit period.

Voltage ramp with current limit

The voltage period is increased linearly during the set start time, from a value corresponding to the minimum allowed voltage period plus the value set as start voltage, to full mains voltage.

The current limit regulator is activated when the current is reaching the chosen value in [335], to be switched off when full output voltage is reached, or the start time has expired [336].

Should the current fall to a value below the set current limit, the current controller will be deactivated, and the voltage ramp reactivated.

When the current limit controller is deactivated (below current limit), the voltage ramp slope will increase above the original slope to accomplish a start within the set start time.

Direct on-line start DOL with current limit

This could also be called "pure current limit start".

As "Voltage ramp with Current limit" but with fixed ramp time of 6 seconds.
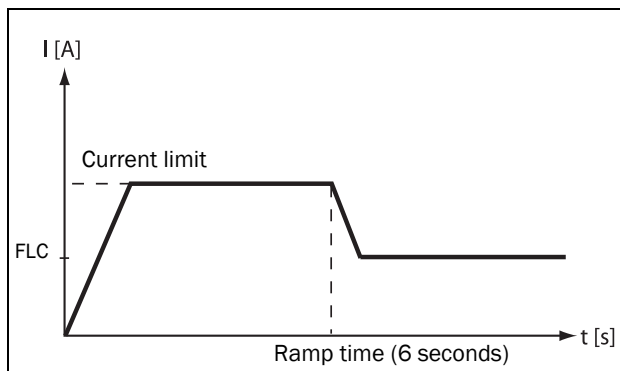
Fig. 55   Direct on-line start in combination with current limit at start.

If the regulator still is in active mode when the start time expires, a "Current Limit" alarm is issued, and the alarm action set in menu [236] is executed.

335 Curr Limit Stp A Off	
Default:	Off
Range:	Off, 150 - 500% of I_{n_mot} [224]

NOTE: Even though the current limit can be set as low as 150% of the nominal motor current value [224], this minimum value cannot be used generally. If the current limit is set too low in relation to the application's requirements, the motor will not be able to accelerate the load.

NOTE: Check that the nominal motor current is set properly in menu [224] if the current limit functionality is used.

Start Time [336]

The start time is defined as the time during which a start attempt is done. After the start time has elapsed, the TSA will automatically go into bypass mode (exception: current limit alarm condition). Make sure the start time is long enough for your application so that the end reference value (e.g. [333] EndTorqueSt for torque ramp) can be reached just before start time has elapsed. This usually requires some trimming. This menu is directly accessible for all start methods in menu [331] except "DOL". However, if combined with a current limit in menu [335], the start time function is also available for "DOL".

336 Start Time Stp A 10s	
Default:	10 s
Range:	1 - 60 s

Torque Boost [337]

In specific applications torque boost is required for the start. The torque boost parameter enables a high torque to be obtained by providing a high current for 0.1-2 seconds at start. This enables a soft start of the motor even if the break away torque is high at the start. An example is crushing mills applications etc.
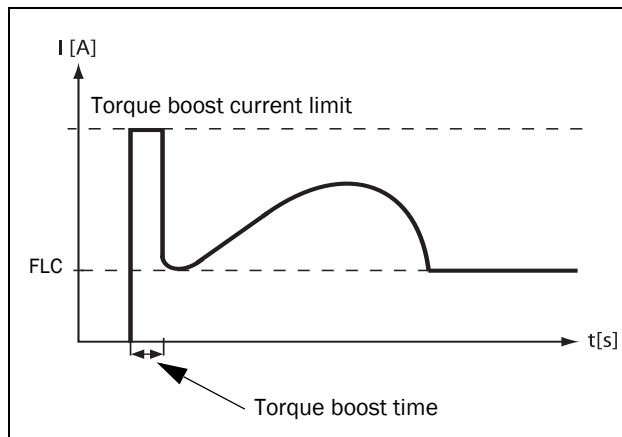
Fig. 56   Torque boost principle.

Torque boost may be activated before the start ramp. The current regulator is activated immediately, and the current is controlled to be at the set "Torque Boost Current Limit" [3371] for the set "Torque Boost Time" [3372]. See Fig. 56. If "torque boost" is used, the total start time is prolonged with the "Torque Boost Time" [3372].

Torque Boost Current Limit [3371]

```
          3371 TB CurrLim
          Stp A              Off
```

Default:	Off
Range:	Off, 300 - 700% of I_{n_mot} [224]

Torque Boost Time [3372]

```
          3372 TB Time
          Stp A            1.0s
```

Default:	1.0 s
Range:	0.1 - 2.0 s

8.3.4   Stop Setting [340]

Stopping is always initiated by triggering of the thyristors to take over the current when the internal bypass contact is opened. When the current is correctly flowing through the thyristors, the selected stop method is executed.

Stop Method [341]

The available stop methods are:

Linear or Square Torque Control

A torque-controlled stop could be used when a sudden stop of the motor could harm the application. The motor torque is controlled according to either a linear or a square ramp, from the actual torque value to the set "End Torque at Stop" in menu [342]. See Fig. 57 below.
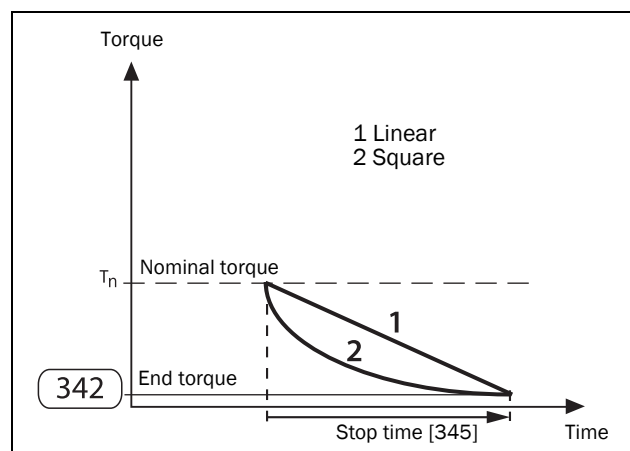
Fig. 57   Torque control at stop

> **Note:** Set the End Torque at Stop so the motor stops according to the set ramp time.
> When the ramp time has passed, the motor will coast if still rotating.

Voltage Control

If a linear voltage-ramp is preferred for the stop, "Voltage Ctr" is selected as stop method in menu [341]. First the voltage is reduced to the set "Step Down Voltage at Stop" [343]. Then a linear ramp will be followed until the minimum allowed switch-on period is reached, the duration decided by "Stop Time" [345]. See Fig. 58, page 95.

Coast

The voltage is switched off and the motor is allowed to coast to a stop.

Brake

Braking may be used in applications where the motor needs to be stopped quickly. When this selection is made, the braking method ("Dynamic Vector Brake" or "Reverse Current Brake") can be activated in menu [344].

341 Stop Method		
Stp **A** Coast		
Default:	4	Coast
Lin Torq Ctr	1	The motor torque is controlled according to a linear ramp.
Sqr Torq Ctr	2	The motor torque is controlled according to a square ramp.
Voltage Ctr	3	The motor voltage is controlled according to a linear voltage ramp.
Coast	4	The motor coasts to a stop.
Brake	5	Braking method as activated in menu [344].

End Torque at Stop [342]

This menu sets the end torque value when one of the torque control functions is chosen in menu [341].

342 EndTorqueStp	
Stp **A** 0%	
Default:	0%
Range:	0 - 100% of T_n

Step Down Voltage at Stop [343]

This setting is available when "voltage control" is chosen in [341]. The switch-on period will step down to an intermediate value, from where it will follow a linear voltage ramp down to the minimum allowed switch-on period. The duration of the ramp is set in "Stop Time" [345].

343 StepDwnVolt	
Stp **A** 100%	
Default:	100%
Range:	0 - 100% of U_{n_mot} [221]
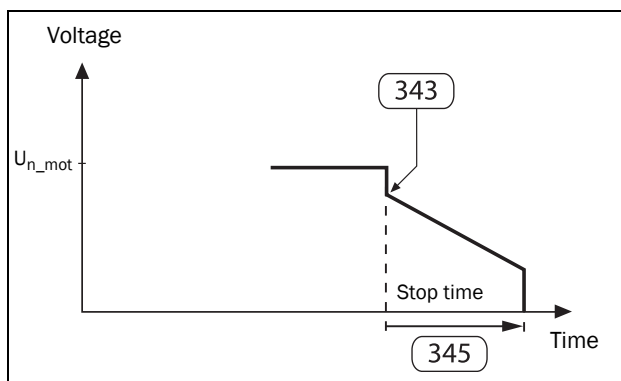
Fig. 58   Step down voltage at stop.

Braking Method [344]

This menu is available when "Brake" is chosen in [341]. However, before applying a high braking torque it should be checked whether the motor, the gear or belt drive, and the load can withstand the high mechanical forces. To avoid harmful vibrations, it is generally recommended to select the lowest braking torque possible that still fulfils the demands for a short braking time.

Note: It is the high braking torque that results in short stop time, not the stop time set in menu [345].

Dynamic Vector Brake

With dynamic vector brake, the braking torque applied to the motor will increase with decreasing speed. Dynamic vector brake can be used for all loads not rotating too close to synchronous speed when the motor voltage is switched off. This is valid for most applications, as the load speed usually decreases because of frictional losses in gears or belt drives when the voltage is switched off. However, this method is less suitable for loads with very high inertia, in which case the reverse current brake is more efficient.
When the dynamic vector brake is used, no additional connections or contactors are needed.
The actual speed is detected, and when this is above the limit set in menu [349] the dynamic vector brake is executed. For lower speeds the DC brake is activated.

Reverse Current Brake

This braking method is especially suitable for quickly stopping heavy loads with high inertia. A very high braking torque can be applied to the motor even close to synchronous speed. The braking is accomplished by phase-reversal of the current. To enable this, two external mains contactors are needed which are controlled by the relay outputs of the softstarter The connection is showed in Fig. 24, page 28.

During start and full voltage operation the first contactor (K1) will be activated. For braking, K1 will be opened and the second contactor (K2) will be activated to change the phase sequence. For safety reasons it is possible to set a delay time between these two signals in menu [346].

To activate the braking method, "Reverse Current Brake" must also be selected in menu [344]. The actual speed is detected, and the reverse current brake is active until the speed is below the limit set in menu [349]. For lower speeds the DC brake is activated.

DC brake (at low speed)

At low speed the DC brake mode is activated until the stop time in [345] has elapsed. In DC-brake mode only two phases (L2 and L3) are active.
The DC brake will automatically be deactivated when the motor has stopped or when the stop time has expired. Optionally an external rotation sensor can be connected via

digital input [520], using logical functions to end the DC braking. See section 8.6, page 116.

```
┌─────────────────────────────────┐
│  344 Brake Method               │
│  Stp A       DynVectBrk         │
└─────────────────────────────────┘
```

Default:	0	DynVectBrk
DynVectBrk	0	Dynamic Vector Brake
RevCurrBrk	1	Reverse Current Brake

NOTE: If several softstarters are supplied from the same power line and the braking functionality is used, the softstarters should be connected with different phase sequences, i.e. L1-L2-L3 on the first unit, L2-L3-L1 on the next and so on.

In addition to the braking methods described here, there is also a spinbrake. functionality available as a digital input. See Spinbrake, page 49.

Stop Time [345]

"Stop Time" is defined as the time during which a stop attempt is done. This function is available for all stop methods except for "Coast".

NOTE: When using brake as stop method, the stop time given in menu [345] is NOT the time during which a full stop is completed. It is a time-out function for a stop attempt. The time set shall be longer than actual braking time.

```
┌─────────────────────────────────┐
│  345 Stop Time                  │
│  Stp A              10s         │
└─────────────────────────────────┘
```

Default:	10 s
Range:	0 – 120s

Reverse Current Braking Delay [346]

A delay time for the reverse current brake function can be set in this menu. When the relay configured for "RunSignalFWD" has been deactivated, the relay configured for "RevCurrBrake" will not be activated until after the set time delay.

⚠ **CAUTION!**
If you set delay time to 0 and do not have electrical interlocking between the contactors, this could result in short-circuit.

```
┌─────────────────────────────────┐
│  346 RevC Brk Dly               │
│  Stp A             0.5s         │
└─────────────────────────────────┘
```

Default:	0.5 s
Range:	0 – 120s

Braking Strength [347]

The braking strength for the selected brake method in menu [344] is set in this menu. The value is expressed as a percentage of the available braking power (dependent on motor characteristics).

```
┌─────────────────────────────────┐
│  347 Brk Strength               │
│  Stp A              50%         │
└─────────────────────────────────┘
```

Default:	50 %
Range:	20 – 100%

DC Braking Strength [348]

The strength of the DC brake is set here, the value expressed as a percentage of the maximum available DC braking power.

```
┌─────────────────────────────────┐
│  348 DCB Strength               │
│  Stp A              30%         │
└─────────────────────────────────┘
```

Default:	30 %
Range:	20 – 80%

Switch to DC Brake [349]

Here you set the speed at which the braking method should be switched to DC brake. The speed is expressed as a percentage of the nominal motor speed.

349 SwitchToDCB **Stp A** **30%**	
Default:	30 %
Range:	20 – 80% of nominal motor speed [225]

8.3.5   Jog [350]

For setting of the jog function, see section 7.1.3, page 50. The jog function can be activated by a start via the keyboard, digital input ("Remote") or communication option, menu [2152] "Jog Control", page 70.

For the "Remote" activation of the jog command, the digital input must be set to "Jog FWD" and/or "Jog REV" in menu [520].

For information about the jog keys on the control panel, see section 6.4.2, page 45.

NOTE: For the jog function to be available, the rotation direction must be allowed in [219].

NOTE: When jogging (in any direction) relay function Operation FWD will be active. Jog utilizes vector control of the motor and does therefore NOT require any external contactor for reverse direction, like in the case with reverse start.
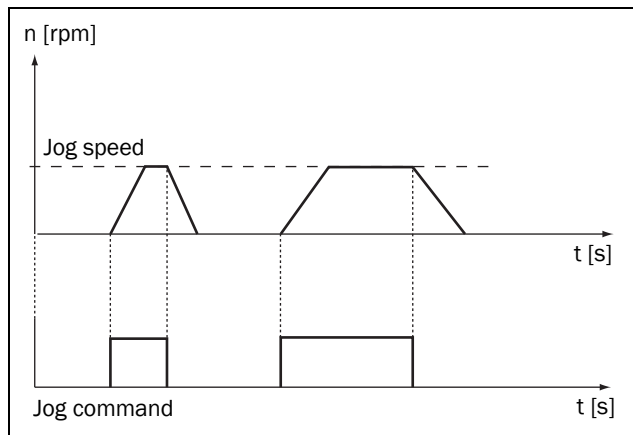
Fig. 59   Jog command

Jog Speed Forward [351]

351 JogSpd FWD **Stp A** **10%**	
Default:	10%
Range:	1- 30% of nominal motor speed [225]

Jog Speed Reverse [352]

```
┌─────────────────────────────────┐
│  352 JogSpd REV                 │
│  Stp A               10%        │
└─────────────────────────────────┘
```

Default:	10%
Range:	1- 30% of nominal motor speed [225]

Jog Ramp Rate [353]

Setting the Jog Ramp Rate allows e.g. positioning of saw/cutter during slow (Jog) speed. The jog speed will increase or decrease towards the set jog reference speed with the set ramp rate.

```
┌─────────────────────────────────┐
│  352 Jog RampRate               │
│  Stp A             0.2s/%       │
└─────────────────────────────────┘
```

Default:	0.2 s/%
Range:	0.1 . 10.0 s/%

8.4 Load Monitor and Process Protection [400]

8.4.1 Load Monitor [410]

The functions in this menu enable the softstarter to be used as a load monitor. See explanation in section 7.3.4, page 56. The alarm actions for alarms and pre-alarms can be chosen independently of each other in menus [4111], [4121], [4131], and [4141]. The corresponding alarm delays are set in menus [4113], [4123], [4133], and [4143].

- Manual settings of the "Alarm Levels" are done in menus [4112], [4122], [4132], and [4142].

- Settings of the Autoset "Alarm Margins" are done in menus [4171]- [4174], and the "Autoset Alarm" is activated in menu [4175] when running at what is considered to be the "Normal Load".

All alarm levels are calculated and expressed as a percentage that refers to the nominal motor power (menu [223]), i.e. 100% equals the nominal motor power.
It is possible to choose whether the load monitor shall be active or not during start, using the start delay function in menu [416].

See detailed explanation of the load monitor function (including examples) in section 7.3.4, page 56. For more information regarding alarms, trips and warning. See section 8.2.4, page 76.

Maximum Alarm [411]

These menus contain the settings for the load monitor maximum alarm.

Maximum Alarm Action [4111]

Setting of the wanted alarm behaviour when a "Maximum Alarm" has been detected.

```
┌─────────────────────────────────┐
│  4111 MaxAlarmAct               │
│  Stp A          No Action       │
└─────────────────────────────────┘
```

Default:		No Action
No Action	0	
Hard Trip	1	For a definition, see Table 23, page 55.
Soft Trip	3	
Warning	4	

Maximum Alarm Level [4112]

In this menu the set "Maximum Alarm Level" is shown (on the right-hand side of the display - area F). At the same time the actual value of the shaft power (%) is viewed on the left-hand side of the display (area F), the value within brackets. Since the actual shaft power is always visible in this menu, it allows you to easily setup a suitable maximum alarm level. The value of the maximum alarm level is given as a percentage of the nominal motor power [223], i.e. a step of 1% is equal to 1% of the nominal motor power. If the actual shaft power (shown within brackets in the display) exceeds the set alarm level, the "Maximum Alarm Delay" timer, menu [4113], will start counting down. If the shaft power is still above the limit when the delay time has elapsed, an alarm will be generated according to the selected "Maximum Alarm Action" in menu [4111].

This menu can be set manually to the required alarm level, or it can be set indirectly, by performing an "Autoset". See further information in Fig. 40, page 57. .

4112 MaxAlarmLev Run A (P$_{shaft}$%) 116%	
Default:	116%
Range:	0 - 200% of nominal motor power [223]

Example:

The "Max Alarm Level" is set to 80%. This means that when the output shaft power exceeds 80% of the nominal motor power, the alarm delay timer starts counting down.

Maximum Alarm Delay [4113]

When the load level exceeds the alarm level for a continuous period longer than the set "Max Alarm Delay" time, the selected "Maximum Alarm Action" in menu [4111] is activated.

4113 MaxAlarmDel Stp A 0.5s	
Default:	0.5 s
Range:	0.1 - 90 s

Maximum Pre-Alarm [412]

These menus contain the settings for the load monitor maximum pre-alarm.

Maximum Pre-Alarm Action [4121]

Setting of the alarm behaviour when a "Maximum Pre-Alarm" has been detected.

4121 MaxPreAlAct Stp A No Action		
Default:		No Action
No Action	0	
Hard Trip	1	For a definition, see Table 23, page 55.
Soft Trip	3	
Warning	4	

Maximum Pre-Alarm Level [4122]

The value of the maximum pre-alarm level is given as a percentage of the nominal motor power [223]. When the actual shaft power (shown within brackets in the display) exceeds this level, the "Maximum Pre-Alarm Delay" timer, menu [4123], will start counting down. When the delay time has elapsed, an alarm will be generated according to the selected "Maximum Pre-Alarm Action" in menu [4121]. This menu can be set manually to the required alarm level, or it can be set indirectly, by performing an "Autoset". See further information in Fig. 40, page 57.

4122 MaxPreAlLev Run A (P$_{shaft}$%) 108%	
Default:	108%
Range:	0 - 200% of nominal motor power [223]

Maximum Pre-Alarm Delay [4123]

When the load level exceeds the alarm level for a continuous period longer than the set "Max Pre-Alarm Delay" time, the selected "Maximum Pre-Alarm Action" in menu [4121] is activated.

4123 MaxPreAlDel Stp A 0.5s	
Default:	0.5 s
Range:	0.1–90 s

Minimum Pre-Alarm [413]

These menus contain the settings for the load monitor minimum pre-alarm.

Minimum Pre-Alarm Action [4131]

Setting of the alarm behaviour when a "Minimum Pre-Alarm" has been detected.

		4131 MinPreAlAct Stp A No Action	
Default:		No Action
No Action	0	
Hard Trip	1	For a definition, see Table 23, page 55.
Soft Trip	3	
Warning	4	

Minimum Pre-Alarm Level [4132]

The value of the minimum pre-alarm level is given as a percentage of the nominal motor power [223]. When the actual shaft power (shown within brackets in the display) falls to a value below this level, the "Minimum Pre-Alarm Delay" timer, menu [4133], will start counting down. When the delay time has elapsed, an alarm will be generated according to the selected "Minimum Pre-Alarm Action" in menu [4131].

This menu can be set manually to the required alarm level, or it can be set indirectly, by performing an "Autoset". See further information in Fig. 40, page 57.

	4132 MinPreAlLev Run A (P$_{shaft}$%) 92%
Default:	92%
Range:	0 - 200% of nominal motor power [223]

Example:

The "Min Pre-Alarm Level" is set to 40%. This means that when the shaft power falls to a value below 40% of the nominal motor power, the alarm delay timer starts counting down.

Minimum Pre-Alarm Delay [4133]

When the load level falls below the alarm level for a continuous period longer than the set "Min Pre-Alarm Delay" time, the selected "Minimum Pre-Alarm Action" in menu [4131] is activated..

	4133 MinPreAlDel Stp A 0.5s
Default:	0.5 s
Range:	0.1–90 s

Minimum Alarm [414]

These menus contain the settings for the load monitor minimum alarm.

Minimum Alarm Action [4141]

Setting of the alarm behaviour when a "Minimum Alarm" has been detected.

		4141 MinAlarmAct Stp A No Action	
Default:		No Action
No Action	0	
Hard Trip	1	For a definition, see Table 23, page 55.
Soft Trip	3	
Warning	4	

Minimum Alarm Level [4142]

The value of the minimum alarm level is given as a percentage of the nominal motor power [223]. When the actual shaft power (shown within brackets in the display) falls to a value below this level, the "Minimum Alarm Delay" timer, menu [4143], will start counting down. When the delay time has elapsed, an alarm will be generated according to the selected "Minimum Alarm Action" in menu [4141].

This menu can be set manually to the required alarm level, or it can be set indirectly, by performing an "Autoset". See further information in Fig. 40, page 57.

	4142 MinAlarmLev Run A (P$_{shaft}$%) 84%
Default:	84%
Range:	0 - 200% of nominal motor power [223]

Minimum Alarm Delay [4143]

When the load level falls below the alarm level for a continuous period longer than the set "Min Alarm Delay" time, the selected "Minimum Alarm Action" in menu [4141] is activated.

```
4143 MinAlarmDel
Stp A          0.5s
```

Default:	0.5 s
Range:	0.1 - 90 s

Start Delay [416]

This setting can be used to e.g. override an alarm during the start-up procedure. The selected time will delay the activation of the load monitor alarms after the run command.

```
416 Start Delay
Stp A           10s
```

Default:	10 s
Range:	1 - 999 s

Autoset [417]

This is an alternative procedure to set up the alarm levels automatically which is based on the shaft power level at the moment of the "Autoset".

NOTE: If you have manually configured the alarm levels in menus [4112], [4122], [4132], and [4142], you do not need to do any settings in this menu or its sub-menus.

When autoset is performed, the actual value of the shaft power is stored to menu [4176] Normal Load. The alarm levels are then recalculated as follows:

Table 28   Load monitor alarm levels

	Alarm Level	Calculation
Overload	[4112] MaxAlarmLev	[4176] Normal Load + [4171] MaxAlarmMar
	[4122] MaxPreAlLev	[4176] Normal Load + [4172] MaxPreAlMar
Underload	[4132] MinPreAlLev	[4176] Normal Load - [4173] MinPreAlMar
	[4142] MinAlarmLev	[4176] Normal Load - [4174] MinAlarmMar

NOTE: Changing any alarm margin without performing Autoset will NOT affect the alarm levels.

After performing autoset, you can view the actual alarm level settings in menus [4112], [4122], [4132], and [4142].

NOTE: A manual change of any alarm level will override the last performed autoset, and menu [4176] Normal Load will be set to "Off".

The alarm actions for all load monitor alarms, both manual and autoset, are configured in menus [4111], [4121], [4131], and [4141]; and the corresponding alarm delays are set in menus [4113], [4123], [4133], and [4143].

Autoset is also available via digital input [520].

Maximum Alarm Margin [4171]

This autoset menu sets the band above the Normal Load [4176] that does not generate a maximum alarm. The set "Max Alarm Margin" percentage is added on to the percentage of the "Normal Load". The resulting percentage is where the maximum alarm level is put, related to nominal motor power [223].

NOTE: Changing any margin without performing autoset will NOT affect the alarm levels.

```
4171 MaxAlarmMar
Stp A           16%
```

Default:	16%
Range:	0–100% of nominal motor power [223]

Example:

The "Maximum Alarm Margin" is set to 16%. The actual shaft power at the moment of performing autoset is 45%. The new maximum alarm will be set to 61%, which means that the "Maximum Alarm Delay" timer in menu [4113] will start counting down when the actual shaft power exceeds 61% (equal to 61% of the nominal motor power [223]). When the alarm delay time has elapsed, a maximum alarm could be generated, depending on the setting in menu [4111] Max Alarm Action.

Maximum Pre-Alarm Margin [4172]

This autoset menu sets the band above the Normal Load [4176] that does not generate a maximum pre-alarm. The set Max Pre-Alarm Margin percentage is added on to the percentage of the "Normal Load". The resulting percentage is where the maximum pre-alarm level is put, related to nominal motor power [223].

```
4172 MaxPreAlMar
Stp A            8%
```

Default:	8%
Range:	0 - of nominal motor power [223]

Minimum Pre-Alarm Margin [4173]

This autoset menu sets the band below the "Normal Load" [4176] that does not generate a minimum pre-alarm. The set Min Pre-Alarm Margin percentage is subtracted from the percentage of the "Normal Load". The resulting percentage is where the minimum pre-alarm level is put, related to nominal motor power [223].

```
┌──────────────────────────────┐
│   4173 MinPreAlMar           │
│   Stp A              8%      │
└──────────────────────────────┘
```

Default:	8%
Range:	0 - 100% of nominal motor power [223]

Example:

The "Min Pre-Alarm Margin" is set to 10%. In the above example with a Normal Load of 45%, this will result in a minimum pre-alarm level at 35% of the nominal motor power. The "Minimum Pre-Alarm Delay" in menu [4133] will start as soon as the actual shaft power has dropped to below 35% of the nominal motor power [223], and the action set in menu [4131] Min Pre-Alarm Action will be executed when the delay time has elapsed.

Minimum Alarm Margin [4174]

This autoset menu sets the band below the Normal Load [4176] that does not generate a minimum alarm. The set Min Alarm Margin percentage is subtracted from the percentage of the "Normal Load". The resulting percentage is where the minimum alarm level is put, related to nominal motor power [223].

```
┌──────────────────────────────┐
│   4174 MinAlarmMar           │
│   Stp A              16%     │
└──────────────────────────────┘
```

Default:	16%
Range:	0 - of nominal motor power [223]

Autoset Alarm [4175]

When autoset is performed, the actual value of the shaft power will be used as a basis when setting the alarm levels. Autoset is performed by choosing "Yes" and confirming by pressing "ENTER". The message "Autoset OK!" is displayed (alternatively "Failed!" if the command does not succeed). To return to the menu display, press any key.

When autoset is performed, the actual shaft power, shown to the left in the menu display, is stored to menu [4176] Normal Load, and the alarm levels are recalculated according to the description for menu [417] Autoset. A new autoset command will overwrite previously used alarm levels. Autoset can also be triggered by a remote signal, setting the function of any digital input to "Autoset". Note that this signal is edge-triggered.

When performing an autoset the motor must be running with the load that needs to be recorded.

NOTE: The motor must be running for the Autoset procedure to succeed. A non-running motor or an unfinished start delay generates a "Failed!" message.

```
┌──────────────────────────────┐
│   4175 AutoSet Alrm          │
│   Run A(P_shaft)%        No  │
└──────────────────────────────┘
```

Default:		No
No	0	
Yes	1	

Normal Load [4176]

This menu is read-only. If the menu shows "Off", the Autoset settings are deactivated, and the manually set alarm levels in menu [4112], [4122], [4132], and [4142] are applied.

If the menu shows a number, this is equal to the load level (shaft power) at the time of performing the autoset. The alarm levels have also been calculated based on this level ± the autoset margins.

```
┌──────────────────────────────┐
│   4176 Normal Load           │
│   Stp A             Off      │
└──────────────────────────────┘
```

Read-only	
Default:	Off
Range:	Off (Autoset deactivated) 0 - 200% of nominal motor power [223]

Example:

The menu shows 78%. This means that an autoset command was last performed at a load level of 78% of the nominal motor power [223], and the corresponding alarm levels have been setup according to the margins set in menus [4171] - [4174].

8.4.2 Process protection [420]

External Alarm [421]

The external alarm functionality is used to generate an alarm depending on the state of an external alarm signal. Each of the digital inputs can be configured for "Ext. Alarm 1" or "Ext. Alarm 2". If any digital input is configured for an external alarm signal, deactivating (low) this input will cause an external alarm to occur if the external alarm is enabled in the corresponding menu ([4211] or [4212]).

NOTE: If more than one digital input is configured for the same external alarm signal, deactivating (low) any of these inputs will generate an alarm if this is enabled in the corresponding menu for the external alarm.

External Alarm 1 Alarm Action [4211]

The following alarm actions are available for external alarm:

		4211 ExtAlarm1AA Stp A Hard Trip
Default:		Hard Trip
No Action	0	For a definition, see Table 23, page 55.
Hard Trip	1	
Soft Trip	3	
Warning	4	

External Alarm 2 Alarm Action [4212]

		4212 ExtAlarm2AA Stp A Hard Trip
Default:		Hard Trip
No Action	0	For a definition, see Table 23, page 55.
Hard Trip	1	
Soft Trip	3	
Warning	4	

Rotor Locked [422]

This alarm is used to avoid high motor current due to a mechanically locked rotor. If the operation has been interrupted due to a locked rotor alarm, the alarm must be reset in order to restart the motor. An autoreset command can be set for the locked rotor alarm. See menu [2524].

Locked Rotor Alarm Action [4221]

		4221 LockRot AA Stp A No Action
Default:		No Action
No Action	0	For a definition, see Table 23, page 55.
Hard Trip	1	
Soft Trip	3	
Warning	4	

Locked Rotor Time [4222]

In this menu the time delay for detection of a locked rotor is set. If the motor current exceeds its upper limit (menu [4223]) for longer than the set "Locked Rotor Time", this will cause an alarm and the action selected in menu [4221] will be executed.

		4222 LockRotTime Stp A M1: 5s
Default:	5 s	
Range:	0.1 - 10 s	

Locked Rotor Current [4223]

The current limit is by default 4.8 times the nominal motor current (menu [224]) but can be changed here.

		4223 LockRotCurr Stp A M1: 480%
Default:	480% (4.8 x I_{n_mot})	
Range:	100% - 1000% (1.0 x I_{n_mot} - 10.0 x I_{n_mot})	

8.4.3 Mains Protection [430]

The Emotron TSA continuously monitors the mains voltage. This means the motor can easily be protected from over- and undervoltage as well as from voltage unbalance conditions. A phase reversal alarm is also available.

Voltage Unbalance Alarm [431]

Under this menu the settings for a voltage unbalance alarm are selected.

Voltage Unbalance Alarm Action [4311]

In this menu the alarm action for a voltage unbalance alarm is selected. The following alarm actions are available:

4311 VoltUnbal AA Stp A No Action		
Default:		No Action
No Action	0	For a definition, see Table 23, page 55.
Hard Trip	1	
Soft Trip	3	
Warning	4	

Voltage Unbalance Level [4312]

Here the maximum allowed voltage unbalance level is entered, expressed as a percentage of the nominal motor voltage. As soon as the difference between any two line voltages exceeds this setting for a time period equal to the delay time set in menu [4313], a voltage unbalance alarm will occur and the action selected in menu [4311] will be executed.

4312 UnbalLevel Stp A 10%	
Default:	10% of the nominal motor voltage [221].
Range:	2 - 25% of the nominal motor voltage [221].

Voltage Unbalance Alarm Delay [4313]

In this menu the response delay for the voltage unbalance alarm, as set in [4311] and [4312], is selected.

4313 VoltUnbDel Stp A 1s	
Default:	1 s
Range:	1 - 90 s

Over-Voltage Alarm [432]

Under this menu the settings for an overvoltage alarm are selected.

Over-Voltage Alarm Action [4321]

In this menu the alarm action for an overvoltage alarm is selected. The following alarm actions are available:

4321 OverVolt AA Stp A No Action		
Default:		No Action
No Action	0	For a definition, see Table 23, page 55.
Hard Trip	1	
Soft Trip	3	
Warning	4	

Over-Voltage Level [4322]

Here the voltage level for an overvoltage alarm is entered, expressed as a percentage of the nominal motor voltage. As soon as any line voltage exceeds this voltage level for a time period equal to the set delay time in menu [4323], an overvoltage alarm will occur and the action selected in menu [4321] will be executed.

4322 OverV Level Stp A 115%	
Default:	115% of nominal motor voltage [221].
Range:	100 - 150% of nominal motor voltage [221].

Over-Voltage Alarm Delay [4323]

In this menu the response delay for the voltage alarm, as set in [4321] and [4322], is selected.

4323 OverV Del Stp A 1s	
Default:	1s
Range:	1 - 90 s

Under-Voltage Alarm [433]

In this menu group the settings for an undervoltage alarm are selected.

Under-Voltage Alarm Action [4331]

In this menu the alarm action for the undervoltage alarm is selected. The following alarm actions are available:

```
┌─────────────────────────────────────┐
│    4331 UnderVolt AA                 │
│    Stp A        No Action            │
└─────────────────────────────────────┘
```

Default:		No Action
No Action	0	
Hard Trip	1	For a definition, see Table 23, page 55.
Soft Trip	3	
Warning	4	

Under-Voltage Level [4332]

Here the voltage level for an undervoltage alarm is entered, expressed as a percentage of the nominal motor voltage. As soon as any line voltage falls below this voltage level for a time period equal to the set delay time in menu [4333], an undervoltage alarm will occur and the action selected in menu [4331] will be executed.

```
┌─────────────────────────────────────┐
│    4332 UnderV Level                 │
│    Stp A            85%              │
└─────────────────────────────────────┘
```

Default:	85% of nominal motor voltage [221].
Range:	75 - 100% of nominal motor voltage [221].

Under-Voltage Alarm Delay [4333]

In this menu the response delay for the voltage unbalance alarm, as set in [4431] and [4432], is selected

```
┌─────────────────────────────────────┐
│    4333 UnderV Del                   │
│    Stp A             1s              │
└─────────────────────────────────────┘
```

Default:	1s
Range:	1 - 90 s

Phase Reversal Alarm [434]

If this function is activated, an alarm will be issued if the wrong phase sequence is detected prior to a start.

Phase Reversal Alarm Action [4341]

In this menu the alarm action for a phase reversal alarm is selected. The softstarter will detect the phase sequence prior to each start attempt. If the actual phase sequence does not match the allowed phase sequence set in menu [4342], the action chosen in this menu will be executed.

To enable the phase reversal alarm, a motor has to be connected and the mains voltage has to be switched on. The alarm is only valid at starting attempts.

```
┌─────────────────────────────────────┐
│    4341 PhaseRevAA                   │
│    Stp A        No Action            │
└─────────────────────────────────────┘
```

Default:		No Action
No Action	0	
Hard Trip	1	For a definition, see Table 23, page 55.
Soft Trip	3	
Warning	4	

Allowed Phase Sequence [4342]

In this menu the allowed phase sequence is selected.

```
┌─────────────────────────────────────┐
│    4342 AllowedSequ                  │
│    Stp A           L123             │
└─────────────────────────────────────┘
```

Default:	L123
Selection:	L123 and L321

8.5 I/O [500]

Main menu with all the settings of the standard inputs and outputs of the softstarter.

8.5.1 Analogue Input [510]

Submenu with all settings for the analogue inputs.

Analogue Input Function [511]

Sets the function for the Analogue input. Scale and range are defined by "AnIn Advanced" settings in menu [513].

```
511 AnIn Fc
Stp A    Process Val
```

Default:		Process Val
Off	0	Input is not active.
Process Val	3	The input value equals an actual process value and can be used as comparator input for creating a start signal. It can also be used to display and view the actual process value.

NOTE: When "AnIn Fc" is set to "Off", the connected signal will still be available for "Comparators" [610].

Analogue Input Setup [512]

The analogue input setup is used to configure the analogue input in accordance with the signal used that will be connected to the analogue input. With this selection the input can be determined as current (4-20 mA) or voltage (0-10 V) controlled input. Other selections are available for using a threshold (live zero), or a user defined input range.
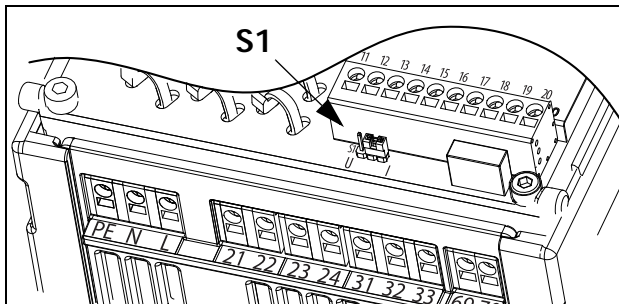
Fig. 60 Select voltage or current input with jumper S1.

NOTE: The selection of voltage or current input is done with S1. When the jumper is in voltage mode only the voltage menu items are selectable. With the jumper in current mode only the current menu items are selectable.

```
512 AnIn Setup
Stp A        4-20mA
```

Default:		4-20 mA
Dependent on		Setting of jumper S1
4–20mA	0	The current input has a fixed threshold (Live Zero) of 4 mA and controls the full range for the input signal.
0–20mA	1	Normal full current scale configuration of the input that controls the full range for the input signal.
User mA	2	The scale of the current controlled input, that controls the full range for the input signal. Can be defined by the advanced AnIn Min and AnIn Max menus.
0–10V	4	Normal full voltage scale configuration of the input that controls the full range for the input signal.
2–10V	5	The voltage input has a fixed threshold (Live Zero) of 2 V and controls the full range for the input signal.
User V	6	The scale of the voltage controlled input, that controls the full range for the input signal. Can be defined by the advanced AnIn Min and AnIn Max menus.

NOTE: Always check the needed set up when the setting of S1 is changed; selection will not adapt automatically.

Analogue Input Advanced [513]

NOTE: The different menus will automatically be set to either "mA" or "V", based on the selection in "AnIn Setup" [512].

```
513 AnIn Advan
Stp A
```

AnIn Min [5131]

Parameter to set the minimum value of the external reference signal. Only visible if [512] = "User mA/V".

```
5131 AnIn Min
Stp A      0V/4.00mA
```

Default:	Min (0 V/4.00 mA)
Range:	0.00–20.00 mA 0–10.00 V

AnIn Max [5132]

Parameter to set the maximum value of the external reference signal. Only visible if [512] = "User mA/V."

```
5132 AnIn Max
Stp    10.0V/20.00mA
```

Default:	Max (10.00 V/20.00 mA)
Range:	0.00–20.00 mA 0–10.00 V

AnIn Function Min [5134]

With "AnIn Function Min" the physical minimum value is scaled to selected process unit. The default scaling is dependent of the selected function of AnIn [511].

```
5134 AnIn FcMin
Stp A              Min
```

Default:		Min
Min	0	Min value
Max	1	Max value
User-defined	2	Define user value in menu [5135]

AnIn Function Value Min [5135]

With "AnIn Function VaMin" you define a user-defined value for the signal. Only visible when user-defined is selected in menu [5134].

```
5135 AnIn VaMin
Stp A           0.000
```

Default:	0.000
Range:	-10,000.000 – 10,000.000

AnIn Function Max [5136]

With "AnIn Function Max" the physical maximum value is scaled to selected process unit. The default scaling is dependent of the selected function of AnIn [511].

```
5136 AnIn FcMax
Stp A              Max
```

Default:		Max
Min	0	Min value
Max	1	Max value
User-defined	2	Define user value in menu [5137]

AnIn Function Value Max [5137]

With "AnIn Function VaMax" you define a user-defined value for the signal. Only visible when user-defined is selected in menu [5136].

```
5137 AnIn VaMax
Stp A           0.000
```

Default:	0.000
Range:	-10,000.000 – 10,000.000

NOTE: With "AnIn Min", "AnIn Max", "AnIn Function Min" and "AnIn Function Max" settings, loss of feedback signals (e.g. voltage drop due to long sensor wiring) can be compensated to ensure an accurate process signal.

Example:

Process sensor is a sensor with the following specification:
Range: 0–3 bar
Output: 2–10 mA
Analogue input should be set up according to:
[512] AnIn Setup = User mA
[5131] AnIn Min = 2 mA
[5132] AnIn Max = 10 mA
[325] Process Max= 3.000 bar
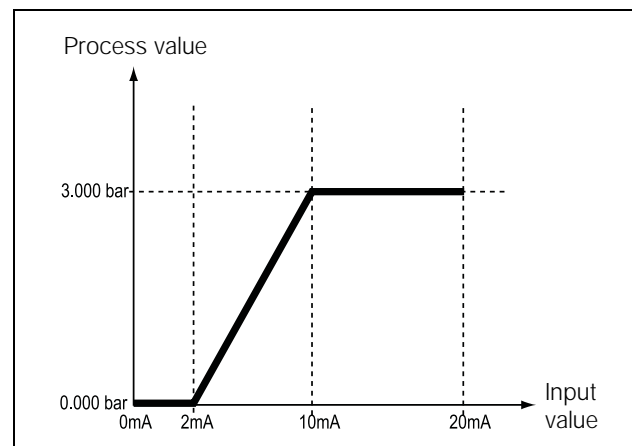
Fig. 61   Analogue input settings, example with Process sensor.

AnIn Filter [5139]

If the input signal is unstable, the filter can be used to stabilise the signal. See Fig. 62. This will result in a 63% change of the input signal within the set "AnIn Filter time" (T). After 5 times the set time (i.e. 5xT), AnIn will have reached 100% of the input change.

```
┌─────────────────────────────────┐
│      5139 AnIn Filt             │
│   Stp A            0.100s       │
└─────────────────────────────────┘
```

Default:	0.100 s
Range:	0.001 – 10.0 s
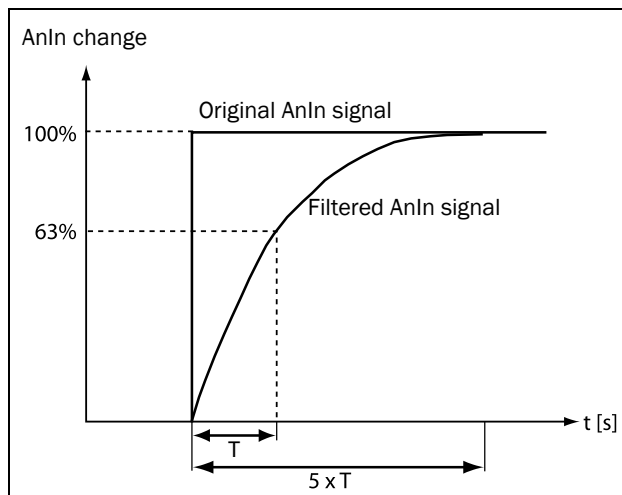
Fig. 62

AnIn Enable [513A]

Parameter for enable/disable analogue input selection via digital inputs (DigIn set to function "AnIn Select").

```
┌─────────────────────────────────┐
│      513A AnIn Enabl            │
│   Stp A               On        │
└─────────────────────────────────┘
```

Default:		On
On	0	AnIn is always active
!DigIn	1	AnIn is only active if the digital input is low.
DigIn	2	AnIn is only active if the digital input is high.

8.5.2 Digital Inputs [520]

Submenu with all the settings for the digital inputs.

> NOTE: Additional inputs will become available when the I/O option boards are connected.

Digital Input 1 [521]

To select the function of the digital input.
On the standard control board there are four digital inputs. If the same function is programmed for more than one input, that function will be activated according to "OR" logic if nothing else is stated.

```
┌─────────────────────────────────┐
│      521 DigIn 1                │
│   Stp A            Run FWD      │
└─────────────────────────────────┘
```

Default:		Run FWD
Off	0	The input is not active.
Stop	1	Stop command according to the selected Stop mode in menu [340]. **NOTE: The Stop command is active low.** **NOTE: Activated according to "AND" logic.**
Reset	2	Reset command. To reset a Trip condition and to enable the Autoreset function. **NOTE: Normal reset is always Edge controlled. Auto reset is Level controlled**
Enable	3	Enable command. General start condition to run the softstarter. If made low during running, the output of the softstarter is cut off immediately, causing the motor to coast to zero speed. **NOTE: If none of the digital inputs are programmed to "Enable", the internal enable signal is set active.** **NOTE: Activated according to "AND" logic.**
Run FWD	4	Run forward command.
Run REV	5	Run reverse command. External contactors required.
Jog FWD	6	Activates the Jog forward function. Gives a run command with set Jog speed and direction, menu [350]. **NOTE: Always level controlled even though edge control may be chosen in menu [21A].**
Jog REV	7	Activates the Jog reverse function. Gives a run command with set Jog speed and direction, menu [350]. **NOTE: Always level controlled even though edge control may be chosen in menu [21A].**
Set Ctrl 1	8	Activates other parameter set. See Table 29 for selection possibilities.
Set Ctrl 2	9	Activates other parameter set. See Table 29 for selection possibilities.
Loc/Rem	10	Activates local mode defined in [2173].

AnIn Select	11	Activates/deactivates analogue input defined in [513A].
Autoset	12	Activates autoset of load monitor alarm levels according to menu group [417]. **NOTE: Always edge controlled even though level control may be chosen in menu [21A].**
Spinbrake	13	See description Spinbrake, page 49. Can be activated from inactive state (softstarter stopped but motor rotating).
Ext. Alarm 1	16	Be aware that if there is nothing connected to the input, the softstarter will trip at "External Alarm 1" immediately. **NOTE: The External Alarm 1 is active low.** **NOTE: Activated according to "OR" logic.** See menu [2549].
Ext. Alarm 2	17	Be aware that if there is nothing connected to the input, the softstarter will trip at "External Alarm 2" immediately. **NOTE: The External Alarm 2 is active low.** See menu [254A].
Timer 1	18	Timer 1 [6311] will be activated on the rising edge of this signal.
Timer 2	19	Timer 2 [6321] will be activated on the rising edge of this signal.
Timer 3	20	Timer 3 [6331] will be activated on the rising edge of this signal.
Timer 4	21	Timer 4 [6341] will be activated on the rising edge of this signal.

Table 29

Parameter Set	Set Ctrl 1	Set Ctrl 2
A	0	0
B	1	0
C	0	1
D	1	1

NOTE: To activate the parameter set selection, menu 241 must be set to DigIn.

Digital Input 2 [522] to Digital Input 4 [524]

Same function as DigIn 1[521]. Default setting for DigIn 2 [522] is "Stop". For DigIn 3 [523] the default is "Set Ctrl 1" and for DigIn 4 [524] the default is "Reset".

Additional digital inputs [529] to [52E]

Additional digital inputs with I/O option board installed, "B1 DigIn 1" [529] - "B2 DigIn 3" [52E]. "B" stands for "board", 1 and 2 is the number of the board which is related to the position of the I/O option board on the option mounting plate. The functions and selections are the same as for "DigIn 1" [521]. Default settings are "Off".

8.5.3   Analogue Output [530]

Submenu with all settings for the analogue output. Selections can be made from application and softstarter values, in order to visualise actual status. Analogue output can also be used as a mirror of the analogue input.

Analogue Output Function [531]

Sets the function for the analogue output. Scale and range are defined by "AnOut Advanced" settings [533].

531 AnOut Fc **Stp A Current**		
Default:		Current
Off	0	Analogue output not active.
Torque	2	Actual torque.
Process Val	3	Actual process value according to Process feedback signal.
Shaft Power	4	Actual shaft power.
Current	6	Actual current.
El power	7	Actual electrical power.
AnIn	10	Mirror of received signal value on AnIn.
Line Voltage	14	Mains supply
Used Th Cap	15	Used thermal capacity

Analogue Output Setup [532]

Preset scaling and offset of the output configuration.

```
┌─────────────────────────────────┐
│ 532 AnOut Setup                 │
│ Stp A            4-20mA         │
└─────────────────────────────────┘
```

Default:		4-20mA
4–20mA	0	The current output has a fixed threshold (Live Zero) of 4 mA and controls the full range for the output signal.
0–20mA	1	Normal full current scale configuration of the output that controls the full range for the output signal.
User mA	2	The scale of the current controlled output that controls the full range for the output signal. Can be defined by the advanced AnOut Min and AnOut Max menus.
0 - 10V	4	Normal full voltage scale configuration of the output that controls the full range for the output signal.
2–10V	5	The voltage output has a fixed threshold (Live Zero) of 2 V and controls the full range for the output signal.
User V	6	The scale of the voltage controlled output that controls the full range for the output signal. Can be defined by the advanced AnOut Min and AnOut Max menus.

NOTE: When "AnIn" is selected in menu [531], the setup of the "AnOut" [532] has to be set to 0-10 V or 0-20 mA. When the "AnOut Setup" is set to e.g. 4-20 mA, the mirroring is not working correctly.

Analogue Output Advanced [533]

With the functions in the "AnOut Advanced" menu, the output can be completely defined according to the application needs. The menus will automatically be adapted to "mA" or "V", according to the selection in "AnOut Setup" [532].

```
┌─────────────────────────────────┐
│ 533 AnOut Advan                 │
│ Stp A                           │
└─────────────────────────────────┘
```

Analogue Output Minimum [5331]

This parameter is automatically displayed if "User mA" or "User V" is selected in menu "AnOut Setup" [532]. The menu will automatically adapt to current or voltage setting according to the selected setup. Only visible if [532] = "User mA/V".

```
┌─────────────────────────────────┐
│ 5331 AnOut Min                  │
│ Stp A            4.00mA         │
└─────────────────────────────────┘
```

Default:	4.00 mA
Range:	0.00 – 20.00 mA, 0 – 10.00 V

Analogue Output Maximum [5332]

This parameter is automatically displayed if "User mA" or "User V" is selected in menu "AnOut Setup" [532]. The menu will automatically adapt to current or voltage setting according to the selected setup. Only visible if [532] = "User mA/V".

```
┌─────────────────────────────────┐
│ 5332 AnOut Max                  │
│ Stp A            20.00mA        │
└─────────────────────────────────┘
```

Default:	20.00 mA
Range:	0.00–20.00 mA, 0–10.00 V

AnOut Function Minimum [5334]

With "AnOut Function Min" the physical minimum value is scaled to selected presentation. The default scaling is dependent of the selected function of AnOut [531].

```
┌─────────────────────────────────┐
│ 5334 AnOutFcMin                 │
│ Stp A               Min         │
└─────────────────────────────────┘
```

Default:		Min
Min	0	Min value
Max	1	Max value
User Defined	2	Define user value in menu [5335]

Table 30 shows corresponding values for the min and max selections depending on the function of the analogue output [531].

Table 30

AnOut Function	Min Value	Max Value
Process Value	Process Min [324]	Process Max [325]
Shaft Power	0 W	Motor Power [223]
Current	0 A	Motor Current [224]

Table 30

AnOut Function	Min Value	Max Value
El Power	0 W	Motor Power [223]
Output Voltage	0 V	Motor Voltage [221]
Torque	0 %	250 %
AnIn	AnIn Function Min	AnIn Function Max

Example

Select the AnOut function to "Shaft Power" in menu [531].
Use default value for Analogue Output setup menu [532] = 4-20 mA.
Set "AnOutFcMax" [5336] to "User Defined" and "AnOutVaMax" [5337] = 150 kW.
This results in an analogue output signal 4 mA to 20mA: corresponding to a range of 0 W to 150 kW.
This principle is valid for all Min to Max settings.

AnOut Function Value Minimum [5335]

With "AnOutVaMin" you define a user defined value for the signal. Only visible when "User Defined" is selected in menu [5334].

```
5335 AnOutVaMin
Stp A        0.000
```

Default:	0.000
Range:	-10,000.000–10,000.000

AnOut Function Maximum [5336]

With "AnOut Function Min" the physical minimum value is scaled to selected presentation. The default scaling is dependent on the selected function of AnOut [531]. See Table 30, page 110.

```
5336 AnOutFcMax
Stp A            Max
```

Default:		Max
Min	0	Min value
Max	1	Max value
User defined	2	Define user value in menu [5337]

NOTE: It is possible to set AnOut up as an inverted output signal by setting "AnOut Min" > "AnOut Max".

AnOut Function Value Maximum [5337]

With "AnOut FunctionVaMax" you define a user-defined value for the signal. Only visible when "User-defined" is selected in menu [5334].

```
5337 AnOutVaMax
Stp A        0.000
```

Default:	0.000
Range:	-10,000.000–10,000.000

8.5.4 Relays [550]

Submenu with all the settings for the relay outputs. The relay mode selection makes it possible to establish a "fail safe" relay operation by using the normal closed contact to function as the normal open contact.

NOTE: Additional relays will become available when I/O option boards are connected. Maximum 2 boards with 3 relays each.

Relay 1 [551]

Sets the function for the relay output 1.

		551 Relay 1 Stp A Operation
Default:		Operation
Off	0	Output is not active and constantly low.
On	1	Output is made constantly high, i.e. for checking circuits and trouble shooting.
Operation	2	Motor is active, See Fig. 63
No Operation	3	Inverted operation
Bypass mode	4	Bypass activated. See Fig. 63
Acc/Dec	5	The speed is increasing or decreasing along the acc. ramp/dec. ramp.
No Trip	6	No Trip condition active.
Trip	7	A Trip condition is active.
AutoRst Trip	8	Autoreset trip condition active.
Warning	9	A Warning condition is active.
Ready	10	The softstarter is ready for operation and to accept a start command. This means that the softstarter is powered up and ready to start.
I>I$_{n\_mot}$	11	The output current is higher than the motor nominal current [224], reduced according to Motor ventilation [228]. See Chapter 8.2.4 page 76.
RevCurrBrake	12	The output is used to control a contactor for reverse current brake.
LoadMonAlarm	13	Max or min alarm condition active (trip or warning).
Pre Alarm	14	Max or min pre-alarm condition active (trip or warning).
Max Alarm	15	Max alarm condition active (trip or warning).
Max PreAlarm	16	Max pre-alarm condition active (trip or warning).
Min Alarm	17	Min alarm condition active (trip or warning).

Min PreAlarm	18	Min pre-alarm condition active (trip or warning).
CA 1	19	Analogue comparator 1 output.
!A1	20	Analogue comp 1 inverted output.
CA 2	21	Analogue comparator 2 output.
!A2	22	Analogue comp 2 inverted output.
CA 3	23	Analogue comparator 3 output.
!A3	24	Analogue comp 3 inverted output.
CA 4	25	Analogue comparator 4 output.
!A4	26	Analogue comp 4 inverted output.
CD 1	27	Digital comparator 1 output.
!D1	28	Digital comp 1 inverted output.
CD 2	29	Digital comparator 2 output.
!D2	30	Digital comp 2 inverted output.
CD 3	31	Digital comparator 3 output.
!D3	32	Digital comp 3 inverted output.
CD 4	33	Digital comparator 4 output.
!D4	34	Digital comp 4 inverted output.
T1Q	35	Logic timer 1 output
!T1Q	36	Inverted logic timer 1 output
T2Q	37	Logic timer 2 output
!T2Q	38	Inverted logic timer 2 output
T3Q	39	Logic timer 3 output
!T3Q	40	Inverted logic timer 3 output
T4Q	41	Logic timer 4 output
!T4Q	42	Inverted logic timer 4 output
L1	43	Logic output 1.
!L1	44	Logic output 1 inverted.
L2	45	Logic output 2.
!L2	46	Logic output 2 inverted.
L3	47	Logic output 3.
!L3	48	Logic output 3 inverted.
L4	49	Logic output 4.
!L4	50	Logic output 4 inverted.
F1	51	Flip-flop output 1.
!F1	52	Flip-flop output 1 inverted.
F2	53	Flip-flop output 2.
!F2	54	Flip-flop output 2 inverted.
F3	55	Flip-flop output 3.
!F3	56	Flip-flop output 3 inverted.
F4	57	Flip-flop output 4.
!F4	58	Flip-flop output 4 inverted.
CTR1	59	Counter output 1.
!CTR1	60	Counter output 1 inverted.

CTR2	61	Counter output 2.
!CTR2	62	Counter output 2 inverted.
CLK1	63	Clock output 1 (Clock logic [660]).
!CLK1	64	Clock output 1 inverted.
CLK2	65	Clock output 2 (Clock logic [660]).
!CLK2	66	Clock output 2 inverted.
Run Signal	67	Run command is active.
Loc/Rem	68	Local/Rem mode indication Local = 1, Remote = 0
Acc	69	Motor Accelerating
Dec	70	Motor Decelerating
DigIn 1	71	Digital input 1 active
DigIn 2	72	Digital input 2 active
DigIn 3	73	Digital input 3 active
DigIn 4	74	Digital input 4 active
RunSignalFWD	75	Copy of input start command signal Run FWD. For contactor control when reverse current braking used, see chapter 3.4 Example 3.
RunSignalREV	76	Copy of input start command signal Run REV. For contactor control when reverse current braking used with reverse direction operation.
OperationFWD	77	Motor running in forward (+) / clockwise direction. Used for the forward contactor control in fwd/rev applications. **Note! Active during jog in any direction.**
OperationREV	78	Motor running in reverse (-) / counter clockwise direction. Used for the reverse contactor control in fwd/rev applications.
ManRst Trip	79	Any active trip condition that needs a manual reset
Trip (ex LM)	81	A trip condition is active (except load monitor)
Overvolt	90	Overvoltage alarm active (trip or warning)
Com Error	97	Communication error active (trip or warning)
Com Active	98	Fieldbus communication active.
Overtemp	101	Softstarter overtemperature condition is active (trip)
PTC Alarm	103	PTC alarm active (trip or warning)
PT100 Alarm	104	PT100 alarm active (trip or warning)
I^2t	105	I^2t alarm active (trip or warning)

Ext Alarm 1	106	Ext Alarm 1 active
Ext Alarm 2	107	Ext Alarm 2 active
At Zero Spd	113	Zero speed detection signal calculated by control software. Activated only when motor standstill has been detected after braking to stop. This Zero speed detection only works if stop method Brake or Spin brake is selected. **Note: Signal does not indicate standstill at power on.**
Supply Fault	114	Sum alarm for supply voltage. Activated if Multi/Phase fault, Over/Under voltage or phase reversal (trip or warning). **Note! Trips are latched until reset..**
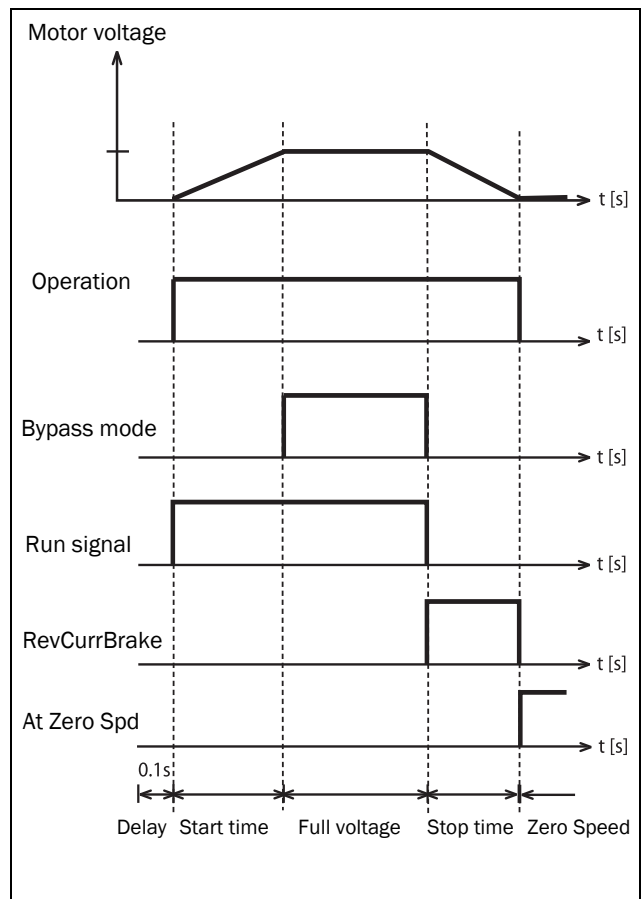
Fig. 63 Relay function example for start and braking cycle.

Relay 2 [552]

> NOTE: The definitions described here are valid for the active output condition.

This menu sets the function for the relay output 2.

	552 Relay 2 **Stp A** **Off**
Default:	Off
Selection:	Same selection as in menu Relay 1 [551], page 112.

Relay 3 [553]

This menu sets the function for the relay output 3.

	553 Relay 3 **Stp A** **Trip**
Default:	Trip
Selection:	Same selection as in menu Relay 1 [551], page 112.

Board Relay [554] to [559]

These additional relays are only visible if an I/O option board is fitted in slot 1 or 2. The outputs are named "B1 Relay 1" - "B1 Relay 3" and "B2 Relay 1" - "B2 Relay 3". "B" stands for "board" and 1 and 2 is the number of the board which is related to the position of the I/O option board on the option mounting plate. The functions and selections are the same as for "Relay 1" [551]. Default settings are "Off".

> NOTE: Visible only if optional board is detected or if any input/output is activated.

Relay Advanced [55D].

	55D Relay Advan **Stp A**

Relay 1 Mode [55D1]

		55D1 Relay1 Mode **Stp A** **N.O**
Default:		N.O
N.O	0	The normal open contact of the relay will be activated when the function is active.
N.C	1	The normally closed contact of the relay will act as a normal open contact. The contact will be opened when function is not active and closed when function is active.

Relay Modes [55D2] to [55DC]

Same function as for "Relay 1 Mode" [55D1]. Default settings are "N.O".

8.5.5 Virtual I/Os [560]

Virtual connections are used for wireless connection of a digital output function to a digital input function. The available signals and control functions can be used to create your own specific functions.

In these menus you find functions to enable eight internal connections of comparators, timers, SR flip-flops, counters, and digital signals, without occupying physical digital inputs or relay outputs.

Example: Start delay

The motor will start in forward direction 10 seconds after DigIn1 is activated (high). DigIn1 has a time delay of 10 s. Starting from default Factory settings:

Menu	Parameter	Setting
[21A]	Level/Edge	Level
[521]	DigIn1	Off
[522]	DigIn 2	Off
[561]	VIO 1 Dest	Run FWD
[562]	VIO 1 Source	T1Q
[6311]	Timer1 Trig	DigIn 1
[6312]	Timer1 Mode	Delay
[6313]	Timer1 Delay	0:00:10

NOTE: When a digital input and a virtual destination are set to the same function, this function will act as an OR logic function.

Virtual Connection 1 Destination [561]

With this function the destination of the virtual connection is established. When a function can be controlled by several sources, e.g. "VIO Destination" or "Digital Input", the function will be controlled in conformity with "OR logic". See section 8.5.2, page 108 (Digital Input) for descriptions of the different selections.

```
561 VIO 1 Dest
Stp A            Off
```

Default:	Off
Selection:	Same selections as in menu Digital Input 1 [521], page 108.

Virtual Connection 1 Source [562]

With this function the source of the virtual connection is defined. See "Relays [550]", page 112 for description of the different selections.

```
562 VIO 1 Source
Stp A            Off
```

Default:	Off
Selection:	Same selection as in menu Relay 1 [551], page 112.

Virtual Connections 2-8 [563] to [56G]

Same function as "Virtual Connection 1" [561] and [562]. Default settings are "Off".

8.6 Logical Functions and Timers [600]

In the "Logic&Timers" menu [600] you access comparators, logic functions, SR flip-flops, timers, and counters, enabling conditional signals to be programmed for control or signalling features. This gives you the ability to compare different signals and values in order to generate monitoring/controlling features.

All these functions are updated in 8 milliseconds intervals.

8.6.1 Comparators [610]

The comparator function makes it possible to monitor different internal signals and values, and to visualise (via digital relay outputs) when a specific value or status is reached or established. The output signals of the comparators can be logically tied together to yield a logical output signal.

All the output signals can be programmed to the relay outputs or used as a source for the virtual connections [560]. For each digital and analogue comparator it is possible to apply a "Set Delay" and a "Reset Delay"; functions that could be used to delay or extend the output signal.

Analogue Comparator Setup [611] - [614]

There are 4 analogue comparators that compare any available analogue value with two adjustable levels. The two levels available are "Level HI" and "Level LO". There are also two analogue comparator types, selected in menu "Comparator Type", an analogue comparator with hysteresis and an analogue window comparator.

The analogue hysteresis type comparator uses the two available levels to create a hysteresis for the comparator between setting and resetting the output. This function gives a clear difference in switching levels, which lets the process adapt until a certain action is started. With such a hysteresis, even an unstable analogue signal can be monitored without getting a nervous comparator output signal. Another feature is the possibility to get a fixed indication that a certain level has been passed. The comparator can latch by setting "Level LO" to a higher value than "Level HI".

The analogue window comparator uses the two available levels to define the window in which the analogue value should be within for setting the comparator output.

Digital Comparator Setup [615] - [618]

There are also 4 digital comparators that compare any available digital signals.

Setup Analogue Comparator 1 [611]

Analogue comparator 1, parameter group.

Analogue Comparator 1, Value [6111]

Selection of the analogue value for "Analogue Comparator 1" (CA1).

The analogue comparator compares the selectable analogue value in menu [6111] with the constant "Level HI" in menu [6112], and the constant "Level LO" in menu [6113].

In menu Comparator Type [6114] "Hysteresis" or "Window" can be selected. For the hysteresis function, when the value exceeds the upper limit level high, the output signal CA1 is set high and !A1 low. See Fig. 64. When the value decreases below the lower limit, the output signal CA1 is set low and !A1 high.
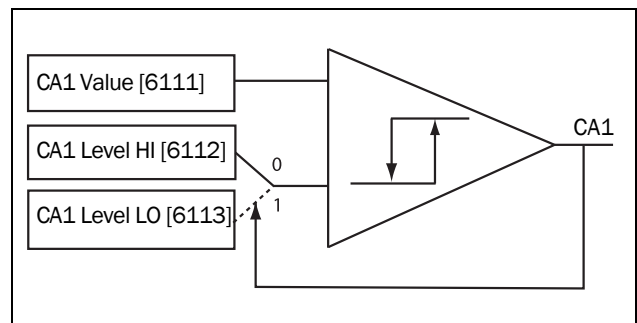
Fig. 64 Analogue comparator type "Hysteresis"

For the window type comparator, when the value is between the lower and upper levels, the output signal value CA1 is set high and !A1 low. See Fig. 65. When the value is outside the band of lower and upper levels, the output CA1 is set low and !A1 high.
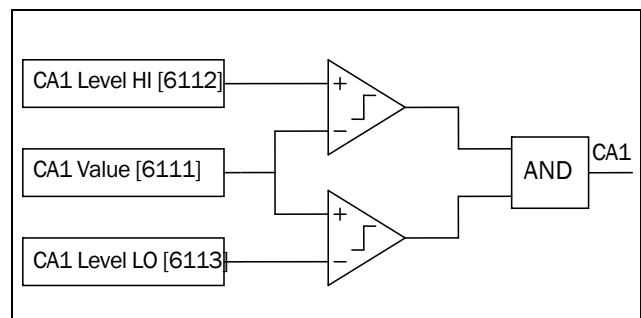
Fig. 65 Analogue comparator type "Window"

The output signal can be programmed as a virtual connection source and to the relay outputs.

6111 CA1 Value		
Stp A		**Current**

Default:		Current
Process Val	0	
Torque	1	%
Shaft Power	2	kW
El Power	3	kW
Current	4	A
Heatsink Tmp	5	°C
PT100_1	6	°C
PT100_2	7	°C
PT100_3	8	°C
Energy	9	kWh
Run Time	10	h
Mains Time	11	h
AnIn	12	%
PT100_4	13	°C
PT100_5	14	°C
PT100_6	15	°C

Example:

An analogue level sensor with current signal, 4-20 mA, is connected to the analogue input. See table below.
When the signal on AnIn goes above 60%, the CA output signal is activated (high), and when the signal on AnIn goes below 40%, the CA output signal is deactivated (low) again. The output of CA1 is used as a virtual connection source that controls the virtual connection destination Run FWD.

Menu	Function	Setting
21A	Level/Edge	Level
511	AnIn Function	Process value
512	AnIn Setup	4-20 mA
522	DigIn2	Off
6111	CA1 Value	AnIn
6112	CA1 Level HI	60% (12 mA/20 mA x 100%)
6113	CA1 Level LO	40% (8 mA/20 mA x 100%)
6114	CA1 Type	Hysteresis
561	VIO 1 Dest	Run FWD
562	VIO 1 Source	CA1
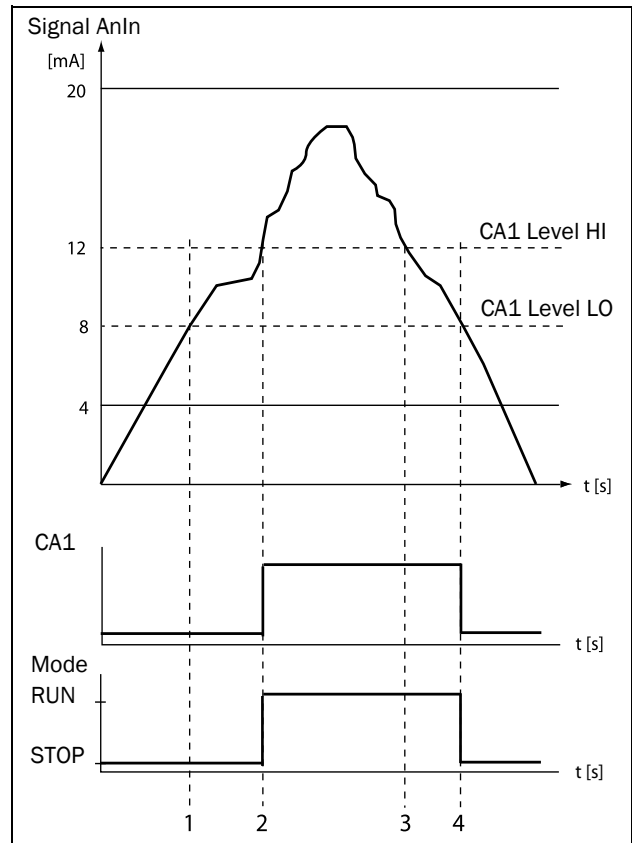
Fig. 66

No.	Description
1	The reference signal passes the Level LO value from below (positive edge), the comparator CA1 output stays low, mode = STOP.
2	The reference signal passes the Level HI value from below (positive edge), the comparator CA1 output is set high, mode = RUN.
3	The reference signal passes the Level HI value from above (negative edge), the comparator CA1 output stays high, mode = RUN.
4	The reference signal passes the Level LO value from above (negative edge), the comparator CA1 output = STOP.

Analogue Comparator 1, Level High [6112]

Sets the analogue comparator high level, with range according to the selected value in menu [6111].

6112 CA1 LevelHI **Stp A 30.0**	
Default:	30.0
Range:	1=1 W, 0.1 A, 0.1 V, 1%, 0.1°C, 1 kWh, 1h, or 0.001 in [322]

Example

This example describes, both for hysteresis and window type comparators, the normal use of the constant level high and low. The function is used for temperature control. Follow the step by step explanation in Table 31 and Table 32.

Menu	Function	Setting
325	Process Max	Temperature: 100°C
6111	CA1 Value	PT100_1 (°C)
6112	CA1 Level HI	50°C
6113	CA1 Level LO	40°C
6114	CA1 Type	Window

Fig. 67
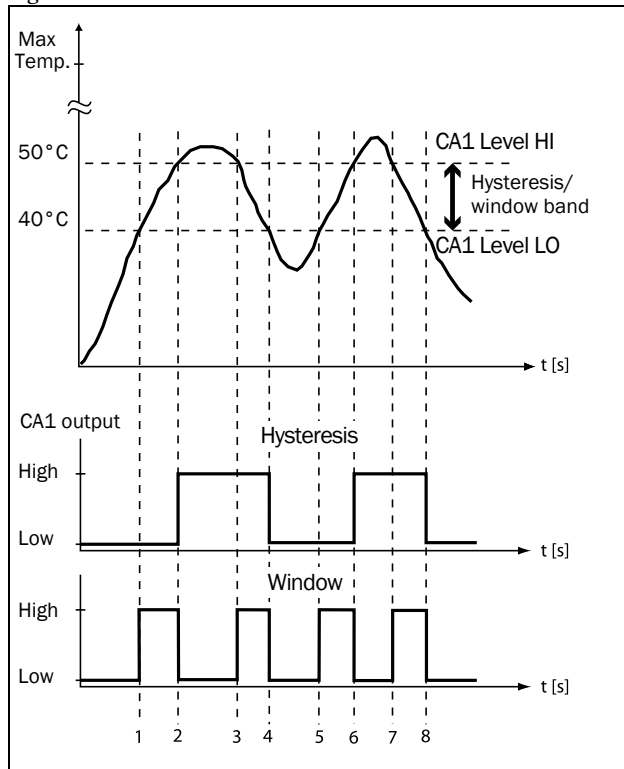
Table 31 Comments to Fig. 67 regarding "Hysteresis" selection.

No.	Description	Hysteresis
1	The reference signal passes the Level LO value from below (positive edge), the comparator CA1 does not change, output stays low.	—
2	The reference signal passes the Level HI value from below (positive edge), the comparator CA1 output is set high.	↑
3	The reference signal passes the Level HI value from above (negative edge), the comparator CA1 does not change, output stays high.	—
4	The reference signal passes the Level LO value from above (negative edge), the comparator CA1 is reset, output is set low.	↓
5	The reference signal passes the Level LO value from below (positive edge), the comparator CA1 does not change, output stays low.	—
6	The reference signal passes the Level HI value from below (positive edge), the comparator CA1 output is set high.	↑
7	The reference signal passes the Level HI value from above (negative edge), the comparator CA1 does not change, output stays high.	—
8	The reference signal passes the Level LO value from above (negative edge), the comparator CA1 is reset, output is set low.	↓

Table 32   Comments to Fig. 67 regarding "Window" selection.

No.	Description	Window
1	The reference signal passes the Level LO value from below (signal inside Window band), the comparator CA1 output is set high.	↑↑
2	The reference signal passes the Level LO value from above (signal outside Window band), the comparator CA1 is reset, output is set low.	↓↓
3	The reference signal passes the Level HI value from above (signal inside Window band), the comparator CA1 output is set high.	↑↑
4	The reference signal passes the Level LO value from above (signal outside Window band), the comparator CA1 is reset, output is set low.	↓↓
5	The reference signal passes the Level LO value from below (signal inside Window band), the comparator CA1 output is set high.	↑↑
6	The reference signal passes the Level HI value from below (signal outside Window band),the comparator CA1 is reset, output is set low.	↓↓
7	The reference signal passes the Level HI value from above (signal inside Window band), the comparator CA1 output is set high.	↑↑
8	The reference signal passes the Level LO value from above (signal outside Window band), the comparator CA1 is reset, output is set low.	↓↓

Analogue Comparator 1 Level Low [6113]

Sets the analogue comparator low level, with unit and range according to the selected value in menu [6111].

6113 CA1 LevelLO **Stp A 20.0**	
Default:	20.0
Range:	See [6112].

Analogue Comparator 1 Type [6114]

Selects the analogue comparator type, i.e. hysteresis or window type. See Fig. 64 and Fig. 65, page 116.

	6114 CA1 Type **Stp A Hysteresis**	
Default:		Hysteresis
Hysteresis	0	Hysteresis type comparator
Window	1	Window type comparator

Analogue Comparator 1 Set Delay [6116]

The output signal for the analogue comparator 1 is delayed with the set value in this menu. See Fig. 68.

6116 CA1 Set Dly **Stp A 0:00:00.0**	
Default:	0:00:00.0 (hours:minutes:seconds)
Range:	0:00:00.0–9:59:59.9
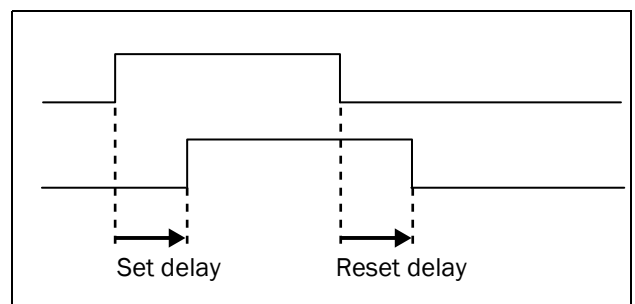
Fig. 68   Set/reset delay of output signal.

Analogue Comparator 1 Reset Delay [6117]

The reset of the output signal for the analogue comparator 1 is delayed with the set time in this menu. See Fig. 68.

	6117 CA1 Res Dly Stp **A** 0:00:00.0
Default:	0:00:00.0 (hours:minutes:seconds)
Range:	0:00:00.0–9:59:59.9

Analogue Comparator 1 Timer Value [6118]

The actual timer value for analogue comparator 1 is viewed in this menu.

Read only	6118 CA1 Tmr Val Stp **A** 0:00:00.0

Setup Analogue comparators 1 - 4 [612] - [614]

Refer to the descriptions for analogue comparator 1.

Setup Digital Comparator 1 [615]

Digital comparators, parameter group.

Digital Comparator 1 Input [6151]page 135

Selection of the input signal for digital comparator 1 (CD1). The output signal CD1 is set high if the selected input signal is active. See Fig. 69.

The output signal can be programmed to the relay outputs or used as a source for the virtual connections [560].

	6151 CD1 Stp **A** Operation
Default:	Operation
Selection:	Same selection as in menu Relay 1 [551], page 112.
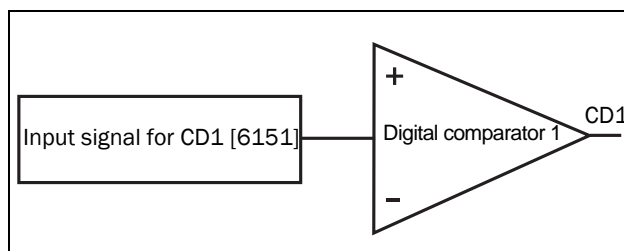
Fig. 69   Digital comparator.

Digital Comparator 1 Set Delay [6152]

The activation of the output signal for the digital comparator 1 is delayed with the set value in this menu. See also Fig. 68, page 119.

	6152 CD1 Set Dly Stp **A** 0:00:00.0
Default:	0:00:00.0 (hours:minutes:seconds)
Range:	0:00:00.0–9:59:59.9

Digital Comparator 1 Reset Delay [6153]

The reset of the output signal for the digital comparator 1 is delayed with the set value in this menu. See also Fig. 68, page 119.

	6153 CD1 Res Dly Stp **A** 0:00:00.0
Default:	0:00:00.0 (hours:minutes:seconds)
Range:	0:00:00.0–9:59:59.9

Digital Comparator 1 Timer Value [6154]

The actual timer value for digital comparator 1 is viewed in this menu.

Read only	6154 CD1 Tmr Val Stp **A** 0:00:00.0

Setup Digital Comparators 2 - 4 [616]-[618]

Refer to the description of Digital Comparator 1. Default for CD2 [6161] is "DigIn 1". For CD3 [6171] the default is "Trip", and for CD4 [6181] the default is "Ready".

8.6.2 Logic outputs [620]

Logic 1 [621]

By means of an expression editor, the input signals can be logically combined into the logics function to create a logic output signal.

The expression editor has the following features:
- The following input signals can be used:
  CA1-CA4, CD1-CD4, L1-L4, T1Q-T4Q, F1-F4, and CTR1-CTR2.

- The following inverted input signals can be used:
  !A1-!A4, !D1-!D4, !L1- !L4, !T1Q-!T4Q, !F1-!F4, and !CTR1-!CTR2.

- The following logical operators are available:
  "+" : OR operator
  "&" : AND operator
  "^" : EXOR operator

Expressions according to the following truth table can be made (see also the example below):

Input		Result		
A	**B**	**& (AND)**	**+ (OR)**	**^(EXOR)**
0	0	0	0	0
0	1	0	1	1
1	0	0	1	1
1	1	1	1	0

The output signal can be programmed to the relay outputs or used as a virtual connection source [560].

The logic expression must be programmed by means of the menus [6211] to [621B], and its actual appearance can be viewed in menu [621], with example below:

Read-only	**621 Logic 1** **Stp ((0&1)&0)&0**

Menu [621]shows the actual values of the four selected input signals set in menus [6212], [6214], [6216] and [6218].

Logic 1 Expression [6211]

Selection of execution order of the logic expression for the Logic 1 function:

	6211 L1 Expr **Stp A ((1.2).3).4**	
Default:	((1.2).3).4	
((1.2).3).4	0	Default execution order, see explanation below.
(1.2).(3.4)	1	Alternative execution order, see explanation below.

- Parentheses ( ) show the order in which the Logic 1 Inputs are combined, according to [6211].

- 1, 2, 3, and 4, represent the Logic 1 Input signals selected in menu [6212], [6214], [6216], and [6218].

- The dots stand for the Logic 1 Operators (&, +, or ^), whose values are selected in menus [6213], [6215], and [6217].

To build the Logic 1 expression using the default selection in menu [6211], the execution order is as follows:

1. Input 1 is combined with Input 2 using Operator 1.

2. Input 3 is combined with the expression (1.2), using Operator 2.

3. Input 4 is combined with the result of (1.2).3, using Operator 3.

The alternative execution order leads to:

1. Input 1 is combined with Input 2 using Operator 1.

2. Input 3 is combined with Input 4 using Operator 3.

3. Expression (1.2) is combined with expression (3.4), using Operator 2.

Example:

Input 1 = CA1, set in menu [6212]
Input 2 = F1, menu [6214]
Input 3 = T1Q, menu [6216]
Input 4 = !A2, menu [6218]
Operator 1 = & (AND), set in menu [6213]
Operator 2 = + (OR), menu [6215]
Operator 3 = & (AND), menu [6217]

The following expression is created, using the menus above:

$$CA1\&F1+T1Q\&!A2$$

With the default setting for L1 Expression this is representing:

$$((CA1\&F1)+T1Q)\&!A2$$

Let's use the following values on the input signals as an example:

CA1=1 (active/high)
F1= 1 (active/high)
T1Q = 1 (active/high)
!A2 = 0 (inactive/low)

With the respective values inserted the resulting logic expression is:

621 Logic 1 **Stp   ((1&1)+1)&0**

which is equal to 0.

With the alternative execution order for the L1 Expression this is representing:

$$(CA1\&F1)+(T1Q\&!A2)$$

With the above values inserted the resulting logic expression now becomes:

```
621 Logic 1
Stp      (1&1)+(1&0)
```

which is equal to 1.

Logic 1 Input 1 [6212]

In this menu the first input for the Logic 1 function is selected. The same selections are valid for [6214] L1 Input 2, [6216] L1 Input 3, and [6218] L1 Input 4.

This table is also valid for the input signals in logic functions 2 [622], 3 [623], and 4 [624], however default values vary. See Menu List in Appendix 1.

Note that a logic function can not directly use itself as an input signal, e.g. for the L1 Input, it will not be possible to choose L1 or !L1.

	6212 L1 Input 1 **Stp A** **CA1**	
Default:		CA1
CA1	0	Analogue comparator 1 output.
!A1	1	Analogue comp 1 inverted output.
CA2	2	Analogue comparator 2 output.
!A2	3	Analogue comp 2 inverted output.
CA3	4	Analogue comparator 3 output.
!A3	5	Analogue comp 3 inverted output.
CA4	6	Analogue comparator 4 output.
!A4	7	Analogue comp 4 inverted output.
CD1	8	Digital comparator 1 output.
!D1	9	Digital comp 1 inverted output.
CD2	10	Digital comparator 2 output.
!D2	11	Digital comp 2 inverted output.
CD3	12	Digital comparator 3 output.
!D3	13	Digital comp 3 inverted output.
CD4	14	Digital comparator 4 output.
!D4	15	Digital comp 4 inverted output.
L1	16	Logic output 1. Not used for Logic 1.
!L1	17	Logic output 1 inverted. Not used for Logic 1.
L2	18	Logic output 2. Not used for Logic 2.
!L2	19	Logic output 2 inverted. Not used for Logic 2.
L3	20	Logic output 3. Not used for Logic 3.

!L3	21	Logic output 3 inverted. Not used for Logic 3.
L4	22	Logic output 4. Not used for Logic 4.
!L4	23	Logic output 4 inverted. Not used for Logic 4.
T1Q	24	Logic timer 1 output
!T1Q	25	Inverted logic timer 1 output
T2Q	26	Logic timer 2 output
!T2Q	27	Inverted logic timer 2 output
T3Q	28	Logic timer 3 output
!T3Q	29	Inverted logic timer 3 output
T4Q	30	Logic timer 4 output
!T4Q	31	Inverted logic timer 4 output
F1	32	Flip-flop output 1.
!F1	33	Flip-flop output 1 inverted.
F2	34	Flip-flop output 2.
!F2	35	Flip-flop output 2 inverted.
F3	36	Flip-flop output 3.
!F3	37	Flip-flop output 3 inverted.
F4	38	Flip-flop output 4.
!F4	39	Flip-flop output 4 inverted.
CTR1	40	Counter output 1.
!CTR1	41	Counter output 1 inverted.
CTR2	42	Counter 2 output.
!CTR2	43	Counter output 2 inverted.

Logic 1 Operator 1 [6213]

In this menu the first operator for the Logic 1 function is selected.

	6213 L1 Op 1 **Stp A** **&**	
Default:		&
.	0	When · (dot) is selected, the Logic 1 expression is finished (when two or three expressions are tied together).
&	1	&=AND
+	2	+=OR
^	3	^=EXOR

Logic 1 Input 2 [6214]

In this menu the second input for the Logic 1 function is selected.

```
6214 L1 Input 2
Stp A              !A2
```

Default:	!A2
Selection:	Same selection as in menu Logic 1 Input 1 [6212], page 122.

Logic 1 Operator 2 [6215]

In this menu the second operator for the Logic 1 function is selected.

```
6215 L1 Op 2
Stp A                 &
```

Default:		&
·	0	When · (dot) is selected, the Logic 1 expression is finished (when two or three expressions are tied together).
&	1	&=AND
+	2	+=OR
^	3	^=EXOR

Logic 1 Input 3 [6216]

In this menu the third input for the Logic 1 function is selected.

```
6216 L1 Input 3
Stp A             CA3
```

Default:	CA3
Selection:	Same selection as in menu Logic 1 Input 1 [6212], page 122.

Logic 1 Operator 3 [6217]

In this menu the third operator for the Logic 1 function is selected.

```
6217 L1 Op 3
Stp A                 &
```

Default:		&
·	0	When · (dot) is selected, the Logic 1 expression is finished (when two or three expressions are tied together).
&	1	&=AND
+	2	+=OR
^	3	^=EXOR

Logic 1 Input 4 [6218]

In this menu the fourth input for the Logic 1 function is selected.

```
6218 L1 Input 4
Stp A             CA4
```

Default:	CA4
Selection:	Same selection as in menu Logic 1 Input 1 [6212], page 122.

Logic 1 Set Delay [6219]

The activation of the output signal for the Logic 1 function is delayed with the set value in this menu. Compare to Fig. 68, page 119.

```
6219 L1 Set Dly
Stp A        0:00:00.0
```

Default:	0:00:00.0 (hours:minutes:seconds)
Range:	0:00:00.0–9:59:59.9

Logic 1 Reset Delay [621A]

The reset of the output signal for the Logic 1 function is delayed with the set value in this menu. Compare to Fig. 68, page 119.

```
621A L1 Res Dly
Stp A        0:00:00.0
```

Default:	0:00:00.0 (hours:minutes:seconds)
Range:	0:00:00.0–9:59:59.9

Logic 1 Timer Value [621B]

The actual timer value for logic 1 is viewed in this menu.

Read-only	**621B L1 Tmr Val** **Stp A 0:00:00.0**

Logic 2 - 4 [622] - [624]

Refer to the descriptions for Logic 1. For default values see Menu List in Appendix 1.

8.6.3   Timers [630]

The timer function can be used as a delay timer, as an interval timer with separate "on" and "off " times (alternate mode), or as a way to prolong a signal (on-time mode). The selected trigger signal starts the timer function, and the signal is converted according to the mode settings, resulting in the timer output signal (T1Q - T4Q).
In "Delay" mode, the activation of the timer output signal will be delayed in comparison to the trigger signal. The timer output signal is activated (high) when the set delay time has expired. See Fig. 70. The timer output signal will however follow the trigger signal when this is deactivated (low) again.
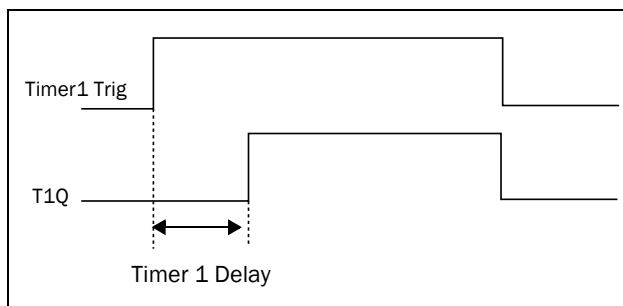
Fig. 70   Delay timer mode.

In "Alternate" mode, the timer output signal will switch automatically between high (Timer T1) and low (Timer T2), according to set interval times. See Fig. 71. When the trigger signal is deactivated (low) again, the timer output signal will also be deactivated (low).
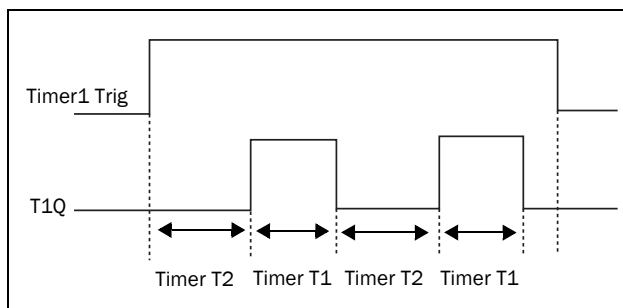
Fig. 71   Alternate timer mode.

The function of the "On-time" mode is to extend an activated (high) timer output signal in comparison to the trigger signal. See Fig. 72.
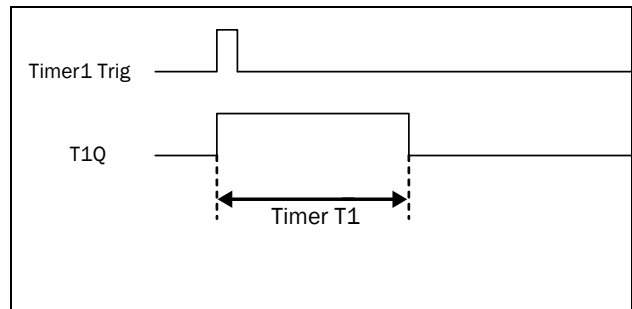
Fig. 72   On-time timer mode.

The timer output signals (T1Q - T4Q) can be programmed to the relay outputs used in logic functions [620], or be used as a virtual connection source [560].

NOTE: The actual timers are common for all parameter sets. If the actual parameter set is changed, the timer functionality will change according to the settings, but the timer value will stay unchanged. So initialisation of the timer might differ for a set change compared to normal triggering of a timer.

Timer 1 [631]

Parameter group for Timer 1.

Timer 1 Trigger [6311]

Selection of the trigger signal for the timer function.

	6311 Timer1 Trig **Stp A Off**
Default:	Off
Selection:	Same selections as in menu Relay 1 [551], page 112.

Timer 1 Mode [6312]

Selection of the conversion of the trigger signal, according to the descriptions in Fig. 70 - Fig. 72.

	6312 Timer1 Mode **Stp A Delay**	
Default:		Delay
Off	0	Timer off.
Delay	1	Delays the activation of the output signal according to menu [6313].
Alternate	2	Interval timer for output signal according to menus [6314] and [6315].
On-time	3	Prolongs the activation of the output signal according to menu [6314].

Timer 1 Delay [6313]

This menu is only visible when "Timer Mode "[6312] is set to "Delay". When Timer 1 is triggered in menu [6311], the set value in this menu will delay the activation of the Timer 1 output signal, T1Q.

	6313 Timer1 Dly **Stp A** 0:00:00.0
Default:	0:00:00.0 (hours:minutes:seconds)
Range:	0:00:00.0–9:59:59.9

Timer 1 T1 [6314]

This menu sets the "on" time for the "Alternate" and "On-time" modes in menu [6312] (only visible when one of these two modes has been selected).

If "Alternate" mode is selected and Timer 1 is triggered on signal set up in [6311], the timer will automatically keep switching from the "on" time ([6314] "Timer 1 T1") to the "off" time ([6315]"Timer 1 T2"). Hence the output signal T1Q will alternate between active, "on", and inactive, "off". See Fig. 71.

If "On-time" mode is selected in [6312] and Timer 1 is triggered in [6311], the timer will extend the activation ("on" time) of the output signal T1Q to the set value in [6314]"Timer 1 T1". See Fig. 72.

	6314 Timer1 T1 **Stp A** 0:00:00.0
Default:	0:00:00.0 (hours:minutes:seconds)
Range:	0:00:00.0–9:59:59.9

Timer 1 T2 [6315]

In this menu the "off" time in the "Alternate" mode is set.

	6315 Timer1 T2 **Stp A** 0:00:00.0
Default:	0:00:00.0 (hours:minutes:seconds)
Range:	0:00:00.0–9:59:59.9

Timer 1 Value [6316]

This menu shows the actual value of the timer.

Read-only	**6316 Timer1 Val** **Stp A** 0:00:00.0

Timer 2 - 4 [632] - [634]

Refer to the descriptions for Timer 1.

8.6.4 SR Flip-flops [640]

The flip-flop function is a memory circuit that can be used to store data concerning state. The output from a flip-flop is dependent not only on its current input, but also on its state at the moment this is received (hence previous input status also matters).

The set/reset flip-flop circuit has two input signals, SET and RESET, that control the state of an output signal, OUT. When none of the input signals are active (i.e. both are =0), the flip-flop will keep its current value.

When only one of the input signals is active (=1), this will directly decide the status of the output signal. Consequently if SET=1 (active) and RESET=0 (inactive), the SET command is given to the output signal, OUT. This will result in a signal change from inactive to active (=1), if not already in an active state.

Conversely, if SET=0 (inactive) and RESET=1 (active), the RESET command is given to the output signal, OUT, causing this to be deactivated (=0).

Flip-flop priority mode

When both input signals are in an active state simultaneously, i.e. SET=1 and RESET=1, a priority function decides which signal will influence the output signal. There are three different priority settings available for the flip-flop function, selected in the menu for "Flip-flop Mode". Examples of the different priority settings are presented in Fig. 73.
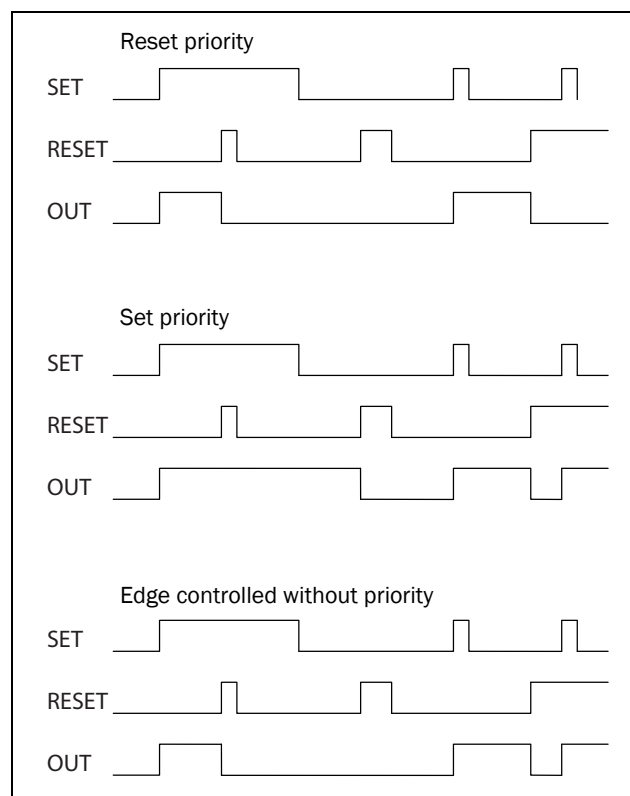
Fig. 73 Programmable flip-flop modes.

Reset priority

"Reset priority" means that if both input signals are active, it will be the RESET command that is obeyed, causing the output signal to become inactive (=0). See Table 33.

Table 33   Truth table for Reset priority

SET	RESET	OUT
0	0	- (no change)
0	1	0 (reset)
1	0	1 (set)
1	1	0 (reset)

Set priority

For "Set priority" the determining input signal is SET. Should both input signals be active, this is resulting in an activated (=1) output signal. See Table 34.

Table 34   Truth table for Set priority

SET	RESET	OUT
0	0	- (no change)
0	1	0 (reset)
1	0	1 (set)
1	1	1 (set)

Edge controlled without priority

The third setting is "Edge controlled", for which no input signal has priority over the other. The output signal follows any of the two input signals (still providing they are at a positive edge). The most recent registered activity decides the output. See Table 35.

Should both inputs become activated simultaneously, there will not be any change; the output signal will just keep its earlier status.

NOTE: The input signals are updated in intervals of 8 milliseconds, therefore the signal changes are considered simultaneous if the difference is less than 8 ms.

Table 35   Truth table for Edge control without priority

SET	RESET	OUT
0	0	- (no change)
↗1	0/1	1 (set)
0/1	↗1	0 (reset)
↗1	↗1	No change

Flip-flop 1 [641]

Functions for SR flip-flop 1.

Flip-flop 1 Mode [6411]

Priority setting of input signals for flip-flop 1.

```
6411 F1 Mode
Stp A          Reset
```

Default:		Reset
Reset	0	Reset priority.
Set	1	Set priority.
Edge	2	Edge controlled without priority.

Flip-flop 1 Set [6412]

Selection of SET input signal for flip-flop 1.

```
6412 F1 Set
Stp A          Off
```

Default:	Off
Selection:	Same selections as in menu Relay 1 [551], page 112.

Flip-flop 1 Reset [6413]

Selection of RESET input signal for flip-flop 1.

```
6413 F1 Reset
Stp A          Off
```

Default:	Off
Selection:	Same selections as in menu Relay 1 [551], page 112.

Flip-flop 1 Set Delay [6414]

The SET input signal for flip-flop 1 is delayed with the set value in this menu.

```
6414 F1 Set Dly
Stp A      0:00:00.0
```

Default:	0:00:00.0 (hours:minutes:seconds)
Range:	0:00:00.0–9:59:59.9

Flip-flop 1 Reset Delay [6415]

The RESET input signal for Flip-flop 1 is delayed with the set value in this menu.

	6415 F1 Res Dly **Stp A**　　　**0:00:00.0**
Default:	0:00:00.0 (hours:minutes:seconds)
Range:	0:00:00.0–9:59:59.9

Flip-flop 1 Timer Value [6416]

This menu shows the actual value of the flip-flop 1 timer.

Read-only	**6416 F1 Tmr Val** **Stp A**　　　**0:00:00.0**
Default:	0:00:00.0 (hours:minutes:seconds)
Range:	0:00:00.0–9:59:59.9

Flip-flop 2 - 4 [642] - [644]

Refer to the descriptions for flip-flop 1. Default for [6421]"F2 Mode" is "Reset". For [6431]"F3 Mode" the default is "Set", and for [6441] "F4 Mode" the default is "Edge".

8.6.5　Counters [650]

The counter function counts pulses and can signal on a selected output when the counter reaches a specified level. The counter counts up on the positive edges of the trigger signal, and it is zeroed when the reset signal is active. When the counter value equals the trip value, the counter output signal (CTR1 or CTR2) is activated. See Fig. 74.

CTR1= Counter 1 output signal
6511= Counter 1 Trigger
6512= Counter 1 Reset
6513= Counter 1 Trip Value
6519= Counter 1 Value
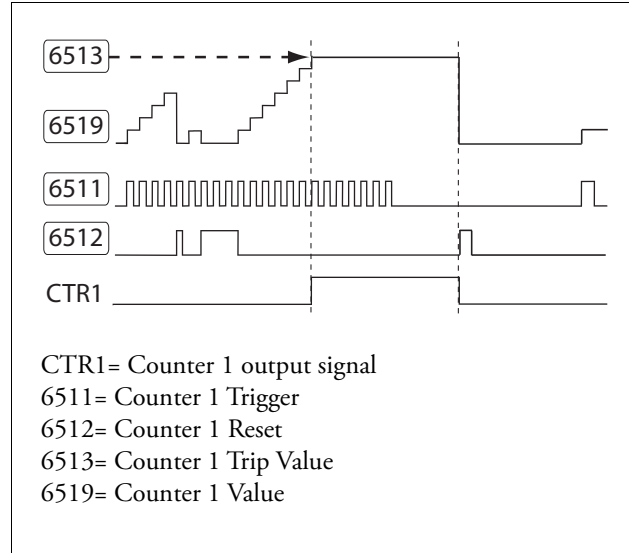
Fig. 74　Counters, principle.

Counter 1 [651]

Counter 1 parameter group.

651 Counter 1 **Stp A**

Counter 1 Trigger [6511]

The selected signal is used as a trigger signal for counter 1. Counter 1 is incremented by 1 on every positive edge of the trigger signal.

NOTE: Maximum counting frequency is 8 Hz.

	6511 C1 Trig **Stp A**　　　　**Off**
Default:	Off
Selection:	Same selections as in menu Relay 1 [551], page 112.

Counter 1 Reset [6512]

The selected signal is used as a reset signal for counter 1. When the reset signal is activated (high), this will zero counter 1, and the counter will remain at zero as long as the reset signal is active (high).

> NOTE: Reset input has top priority.

	6512 C1 Reset Stp **A** Off
Default:	Off
Selection:	Same selections as in menu Relay 1 [551], page 112.

Counter 1 Trip Value [6513]

In this menu counter 1 is set to a trip value. When the counter value equals the trip value, the counter 1 output signal (CTR1) is activated (high).

> NOTE: Value 0 means that counter output is always high.

	6513 C1 Trip Val Stp **A** 0
Default:	0
Range:	0 - 10,000

Counter 1 Value [6514]

This menu shows the actual value of counter 1.

> NOTE: Counter 1 value is common for all parameter sets.

> NOTE: The value is lost at power down.

	6514 C1 Value Stp **A** 0
Read-only	
Default:	0
Range:	0 - 10,000

Counter 2 [652]

Refer to description for Counter 1 [651].

8.6.6   Clock Logic [660]

There are two Clock functions, Clock 1 and Clock 2. Each clock with separate settings for Time on, Time Off, Date on, Date Off and Weekday. These clocks can be used for activating/deactivating desired functions via Relay, digital output or Virtual I/O (For example creating start and stop commands).

Clock 1 [661]

The time, date and weekday for clock 1 are set in these submenus.

Read-only	661 Clock 1 Stp **A**

Clock 1 Time On [6611]

Time when the clock 1 output signal (CLK1) is activated.

	6611 Clk1TimeOn Stp **A** 0:00:00
Default:	0:00:00 (hours:minutes:seconds)
Range:	0:00:00–23:59:59

Clock 1 Time Off [6612]

Time when the clock 1output signal (CLK1) is deactivated.

	6612 Clk1TimeOff Stp **A** 0:00:00
Default:	0:00:00 (hours:minutes:seconds)
Range:	0:00:00–23:59:59

Clock 1 Date On [6613]

Date when the clock 1 output signal (CLK1) is activated.

	6613 Clk1DateOn Stp **A** 2013-01-01
Default:	2013-01-01
Range:	YYYY-MM-DD (year-month-day)

Clock 1 Date Off [6614]

Date when the clock output signal (CLK1) is deactivated. Note that if "Clk1DateOff" is set to an earlier date than "Clk1DateOn", the result will be that the clock is not deactivated at the set date.

```
┌─────────────────────────────────┐
│  6614 Clk1DateOff                │
│  Stp A       2013-01-01          │
└─────────────────────────────────┘
```

Default:	2013-01-01
Range:	YYYY-MM-DD

Clock 1 Weekday [6615]

Weekdays when the clock function is active. Having entered the editing mode, select or unselect the desired weekdays with the cursor using the PREV and NEXT keys on the control panel. Confirm by pressing ENTER. Exit the editing mode and the activated weekdays will be viewed in the menu display. The deactivated weekdays are replaced by a dash mark "-" (e.g. "MTWTF - -").

```
┌─────────────────────────────────┐
│  6615 Clk1Weekday                │
│  Stp A           MTWTFSS         │
└─────────────────────────────────┘
```

Default:	MTWTFSS (all activated)
Range:	Monday, Tuesday, Wednesday, Thursday, Friday, Saturday, Sunday.

NOTE: Please make sure that the correct time and date settings are done for the real time clock, menu group [740] "Clock".

Example 1:
The output CLK1 shall be active Mondays to Fridays on working hours, e.g. 08:00-17:00. This signal is used to start e.g. a fan with virtual I/O.

Menu	Text	Setting
6611	Clk1TimeOn	08:00
6612	Clk1TimeOff	17:00
6613	Clk1DateOn	2013-02-01 (date in the past)
6614	Clk1DateOff	2099-12-31 (Date in the future)
6615	Clk1Weekday	MTWTF- -
561	VIO 1 Dest	Run FWD
562	VIO 1 Source	Clk1

Example 2:
The output CLK1 shall be active on weekends, all day.

Menu	Text	Setting
6611	Clk1TimeOn	0:00:00
6612	Clk1TimeOff	23:59:59
6613	Clk1DateOn	2013-02-01 (date in the past)
6614	Clk1DateOff	2099-12-31 (Date in the future)
6615	Clk1Weekday	- - - - - SS
561	VIO 1 Dest	Run FWD
562	VIO 1 Source	Clk1

Clock 2 [662]

Refer to the description for Clock 1 [661].

8.7 Operation/Status [700]

Menu with parameters for viewing all actual operational data, such as speed, torque, power, etc.

8.7.1 Operation values [710]

Process Value [711]

This menu displays the actual value of the active process signal, i.e. the same value as in menu [310].

```
┌─────────────────────────────────┐
│  711 Process Val                 │
│  Stp                             │
└─────────────────────────────────┘
```

Read-only	
Unit	Depends on selected process unit [322].
Resolution	Speed: 1 rpm, 4 digits Other units: 3 digits

Torque [713]-[714]

These menus displays the actual shaft torque, expressed with different units in the two menus:

```
┌─────────────────────────────────┐
│  713 Torque                      │
│  Stp            0.0Nm            │
└─────────────────────────────────┘
```

Read-only	
Unit:	Nm
Resolution:	0.1 Nm

```
┌─────────────────────────────────┐
│  714 Torque                      │
│  Stp               %             │
└─────────────────────────────────┘
```

Read-only	
Unit:	%
Resolution:	1 %

Shaft power [715]- [716]

These menus displays the actual shaft power, expressed with different units in the two menus:

```
┌─────────────────────────────────┐
│  715 Shaft Power                 │
│  Stp              0W             │
└─────────────────────────────────┘
```

Read-only	
Unit:	W
Resolution:	1W

```
┌─────────────────────────────────┐
│  716 Shaft Power                 │
│  Stp               %             │
└─────────────────────────────────┘
```

Read-only	
Unit:	%
Resolution:	1%

Electrical Power [717]

This menu displays the actual electrical output power.

Read-only	717 El Power Stp kW	
Unit:	kW	
Resolution:	1 W	

RMS Current [718]

This menu displays the RMS (root mean square) value of the output current.

Read-only	718 RMS Current Stp A	
Unit:	A	
Resolution:	0.1 A	

Line Main Voltage [719]

This menu displays the RMS value of the mains voltage.

Read-only	719 L Main Volt Stp V	
Unit:	V	
Resolution:	1 V	

Heatsink Temperature [71A]

This menu displays the actual heatsink temperature.

Read-only	71A Heatsink Tmp Stp °C	
Unit:	°C	
Resolution:	0.1°C	

PT100B1 123 [71B]

This menu displays the actual PT100 temperature for the first PT100 option board (B1), corresponding to input 1, 2, and 3. See menu PT100 Inputs [2323], page 78.

Read-only	71B PT100B1 123 Stp °C	
Unit:	°C	
Resolution:	1°C	

PT100B2 123 [71C]

This menu displays the actual PT100 temperature for the second PT100 option board (B2), corresponding to input 4, 5, and 6. See menu PT100 Inputs [2323], page 78.

Read-only	71C PT100B2 123 Stp °C	
Unit:	°C	
Resolution:	1°C	

Current I1- I3 [71D]-[71F]

These menus displays the actual output current in the three phases.

Read-only	71D Current I1 Stp A	
Unit:	A	
Resolution:	0.1 A	

L12, L13 and L23 Voltage [71G]-[71I]

These menus displays the actual voltage.

Read-only	71G L12 Voltage Stp V	
Unit:	V	
Resolution:	1 V	

Phase Sequence [71J]

This menu displays the phase sequence of the mains voltage.

Read-only	71J Phase Seq Stp L123	
Range:		
L - - -	0	Can not be detected.
L123	1	
L321	2	

Used Thermal Capacity [71K]

This menu displays the used thermal capacity.

Read-only	71K Used Th Cap Stp %	
Unit:	%	
Resolution:	1%	

8.7.2 Status [720]

TSA Status [721]

This menu indicates the overall status of the softstarter.

Read-only	721 TSA Status Stp 1/222/333

Fig. 75 Softstarter status

Display position	Function	Status value
1	Parameter Set	A, B, C, D
222	Operation	**- - -** (stopped) **-Thy** (ramp/brake with thyristors) **-Bpy** (full speed reached, running with bypass enabled)
333	Source of Run/ Stop command	**-Rem** (remote) **-Key** (keyboard - external or internal or both) **-Com** (communication option)

Integer values and bits used:

Bit	Integer representation
1 - 0	Active Parameter Set, where: 0=A, 1=B, 2=C, 3=D.
4 - 2	Operation: 0=Stopped 1=Thyristor driven motor 2=Bypass driven motor
7 - 5	Source of Run/Stop command, where: 0=Rem, 1=Keyboard (internal + external), 2=Com, 3=Spare, 4=VIO, 5=Internal keyboard, 6=External keyboard.
15 - 8	Reserved for future use.

Example: "A/- - - /Key"

This means:

A:	Parameter Set A is active.
---:	Operation is stopped.
Key:	Run/Stop command source is both internal and external keyboard (in this example bit 7-5 → 1).

Integer interpretation for "A/---/Key" is "0/0/1".

In bit format this is presented as:

Bit no.							
7	6	5	4	3	2	1	0 LSB
0	0	1	0	0	0	0	0
Key (1)			- - - (0)			A (0)	
Source of Run/Stop command = Int + Ext keyboard (1)			Operation = Stopped (0)			Parameter Set= A (0)	

Warning [722]

This menu displays the actual warning condition. If no warning is active the message "No Error" is displayed. A warning occurs if the softstarter is close to a trip condition but still in operation. During a warning condition the red trip LED will flash, as long as the warning is active.

Read-only	722 Warning Stp (warning message)

The following warning or trip messages are possible:

Table 36   Trip and warning messages

Communication integer value	Trip / warning message
0	No Error
1	Motor I²t
2	PTC
3	Locked rotor
4	Ext Alarm 1
5	Ext Alarm 2
6	Curr limit (current limit)
7	Start limit
8	Comm error (communication error)
9	Pt100
10	(reserved for future use)
11	(reserved for future use)
12	Mon MaxAlarm (load monitor max alarm)
13	Mon MaxPreAl (load monitor max pre-alarm)
14	Mon MinPreAl (load monitor min pre-alarm)
15	Mon MinAlarm (load monitor min alarm)
16	Over temp (over temperature)
17	(reserved for future use)
18	(reserved for future use)
19	Phase loss (single phase loss)
20	M Phase loss (multiple phase loss)
21	Under voltag (under voltage)
22	Mot termOpen (motor terminal open)
23	Current Unbal (current unbalance)
24	CtrlSupFault (control voltage supply fault)
25	(reserved for future use)
26	Int error1-NTC (internal error 1)
27	Phase rev (phase reversal)
28	(reserved for future use)
29	Int Error2-AD (internal error 2)
30	Over voltag (over voltage)
31	Volt Unbal (voltage unbalance)

Digital Input Status [723]

This menu indicates the status of the digital inputs. See example in Fig. 76.
1   DigIn 1
2   DigIn 2
3   DigIn 3
4   DigIn 4
The positions 1 - 4 (on the display, from left to right) indicate the status of the associated input (DigIn 1 - DigIn 4):
1   High
0   Low
The example in Fig. 76 indicates that DigIn 2 and DigIn 4 are active at this moment.

Read-only	**723 DigIn Status** **Stp 0101**

Fig. 76   Digital input status example

Relay Status [724]

This menu indicates the status of the relays. See Fig. 77.
RE indicates the status of the relays on position:
1   Relay1
2   Relay2
3   Relay3
The status of the associated output is shown.
1   High
0   Low
The example in Fig. 77 indicates that Relay 1 is active. Relay 2 and Relay 3 are not active.

Read-only	**724 RelayStatus** **Stp RE 100**

Fig. 77   Relay status example

Analogue Input Status [725]

This menu indicates the status of the analogue input.

Read-only	**725 AnalogueIn** **Stp 65%**

Fig. 78   Analogue input status example

The status of the input is shown in [%], so the example in Fig. 78 indicates that AnIn is active and has a 65% input value.

NOTE: The shown percentage is an absolute value based on the maximum value of the in- or output; so related to either to 10 V or 20 mA.

Analogue Output Status [726]

This menu indicates the status of the analogue output.

```
                    726 AnalogueOut
Read-only
                    Stp            65%
```

Fig. 79 Analogue output status example

The status of the output is shown in [%], so the example indicates that AnOut is active and has a 65% output value.

> NOTE: The shown percentage is an absolute value based on the maximum value of the in- or output, so related to either to 10 V or 20 mA.

If 4-20 mA output is used for example, the value 20% equals 4 mA.

I/O Board Status B1 - B2 [727] - [728]

This menu indicates the status for the additional I/O on option boards 1 (B1) and 2 (B2).

```
                    728 IO StatusB2
Read-only
                    Stp    RE 000 DI100
```

Fig. 80 I/O board status example

Analogue comparator status 1 - 4 [72A]

This menu indicates the active analogue comparators (CA1 - CA4).

```
                    72A CA1-4
Read-only
                    Stp          0000
```

Digital comparator status 1 - 4 [72B]

This menu indicates the active digital comparators (CD1 - CD4).

```
                    72B CD1-4
Read-only
                    Stp          0000
```

Logic function status 1 - 4 [72C]

This menu indicates the active logic outputs (L1 - L4).

```
                    72C Logic 1-4
Read-only
                    Stp          0000
```

Timer status 1- 4 [72D]

This menu indicates the active timers (T1Q - T4Q).

```
                    72D Timer 1-4
Read-only
                    Stp          0000
```

SR Flip-flop status 1 - 4 [72E]

This menu indicates the active flip-flops (F1 - F4).

```
                    72E FlipFlop1-4
Read-only
                    Stp          0000
```

Counter status 1 - 2 [72F]

This menu indicates the active counters (CTR1 - CTR2).

```
                    72F Counter 1-2
Read-only
                    Stp            00
```

Time to next start [72G]

This menu indicates the time left to the next allowed start if at least one of the choices under menu [235] Start Limitation is activated (i.e. number of starts per hour or minimum time between starts.

```
                    72G TtoNxtStart
Read-only
                    Stp          0Min
```

8.7.3   Stored Values [730]

The shown values are the actual values built up over time. Values are stored at power down and updated again at power up.

Run Time [731]

This menu displays the total time that the softstarter has been in the run mode.

Read-only	731 Run Time Stp h:mm:ss
Unit:	h: mm:ss (hours: minutes: seconds)
Range:	00: 00: 00–262143: 59: 59

Reset Run Time [7311]

This menu resets the run time counter. The stored information will be erased and a new registration period will start.

	7311 Reset RunTm Stp 🄰 No
Default:	No
No	0	
Yes	1	

NOTE: After reset the setting automatically reverts to "No".

Mains time [732]

This menu displays the total time that the softstarter has been connected to the mains supply. This timer cannot be reset.

Read-only	732 Mains Time Stp hh:mm:ss
Unit:	hh: mm:ss (hours: minutes: seconds)
Range:	00: 00: 00–262143: 59: 59

Energy [733]

This menu displays the total energy consumption since the last energy reset [7331] took place.

Read-only	733 Energy Stp kWh
Unit:	Wh (shows Wh, kWh, MWh or GWh)
Range:	0 Wh–999,999 GWh

Reset Energy [7331]

This menu resets the energy counter. The stored information will be erased and a new registration period will start.

	7331 Rst Energy Stp 🄰 No
Default:	No
Selection:	No, Yes

8.7.4   Real time clock settings [740]

This menu group displays actual time and date. The menus are quickly accessed from the default toggle loop. See Fig. 32, page 46.

Time and date are factory set to CET (Central European mean time). Adjust if required in following Submenus.

Time [741]

Actual time, displayed as HH:MM:SS. Adjustable setting.

	741 Time Stp 00:00:00
Unit:	hh:mm:ss (hours: minutes: seconds)

Date [742]

Actual date, displayed as YYYY-MM-DD. Adjustable setting.

	742 Date Stp 2014-01-28
Unit:	YYYY-MM-DD (year-month-day)

Weekday [743]

Display of actual weekday.

Read-only	743 Weekday Stp Monday

8.8 View Trip Log [800]

Main menu with parameters for viewing all the logged trip data. In total the softstarter saves the last 9 trips in the trip memory. The trip memory refreshes on the FIFO principle (First In, First Out). Every trip in the memory is logged on actual date and the time. At every trip, the actual values of several parameters are stored and available for troubleshooting.

See section 7.3.1, page 55 for an explanation of the different alarm types.

8.8.1 Trip Message Log [810]

The trip log displays the cause of the trip and what time it occurred (based on the actual time in [740]). The display is showing actual trip message and alternates between showing date and time when the trip occured.

See a list of the possible trip messages in Table 36, page 132. When a trip occurs the operation and status menus [710] and [720]are copied to the trip message log. There are nine trip message logs [810]–[890]. When the tenth trip occurs the oldest trip message will be erased.

> NOTE: After the reset of a trip, the previous menu will appear.

8x0 Trip Message Trp hh:mm:ss	
Unit: Alternating	hh:mm:ss (hours: minutes: seconds) YYYY-MM-DD (year-month-day)

Example:

The display is showing actual trip message and alternates between showing date and time when the trip occurred

```
830 Locked Rotor
Trp          09:12:14
```

```
830 Locked Rotor
Trp          2013-04-17
```

For fieldbus integer value of trip message, see Table 36, page 132 (menu [722]).

Trip message [8111]-[8133]

The information from the status menus are copied to the trip message log when a trip occurs.

Table 37   Stored trip message parameters

Trip menu	Copied from	Description
	8.7.1 Operation values [710]	
8111	711	Process Value
8113	713	Torque (Nm)
8114	714	Torque (%)
8115	715	Shaft Power (W)
8116	716	Shaft Power (%)
8117	717	El Power
8118	718	RMS Current
8119	719	L Main Volt
811A	71A	Heatsink Temp
811B	71B	PT100B1 123
811C	71C	PT100B2 123
811D	71D	Current I1
811E	71E	Current I2
811F	71F	Current I3
811G	71G	L12 Voltage
811H	71H	L13 Voltage
811I	71I	L23 Voltage
811J	71J	Phase Seq
811K	71K	Used Thermal Cap
	8.7.2 Status [720]	
8121	721	TSA Status
8122	723	Digital input status
8123	724	Relay status
8124	725	Analogue input status
8125	726	Analogue output status
8126	727	I/O status option board B1
8127	728	I/O status option board B2
8129	72A	Analogue comparator 1 - 4
812A	72B	Digital comparator 1 - 4
812B	72C	Logic function status 1-4
812C	72D	Timer status 1-4
812D	72E	Flip-flop status 1-4
812E	72F	Counter status 1-2
812F	72G	Time to next start

Table 37   Stored trip message parameters

Trip menu	Copied from	Description
	8.7.3 Stored Values [730]	
8131	731	Run time
8132	732	Mains time

8.8.2   Trip Messages [820] - [890]

Same information as for menu [810].

8.8.3   Reset Trip Log [8A0]

This menu resets the content of the 9 trip memories.

		8A0 Reset Trip L Stp No
Default:		No
No	0	
Yes	1	

NOTE: After the reset the setting goes automatically back to "NO". The message "OK" is displayed for 2 sec.

8.9   System Data [900]

Main menu for viewing all the softstarter system data.

8.9.1   TSA Data [920]

TSA Type [921]

This menu shows the Emotron TSA type according to the type code. The options are indicated on the product label of the softstarter. See section 1.4, page 5.

```
921             TSA
Stp      TSA52-016
```

Fig. 81   Type number example.

Example:

TSA-series suited for 525 V mains supply, and a rated output current of 16 A.

NOTE: If the control board is not configured, then "Set type" is shown.

Software [922]

This menu shows the software version number of the softstarter. Fig. 82 gives an example.

```
922 Software
Stp V1.20
```

Fig. 82   Software version example.

Table 38   Information for Modbus and Profibus number, software version

Bit	Example	Description
7–0	30	Minor version
13–8	4	Major version
15–14	0	Release type: 0: V, release version 1: P, pre-release version 2: β, Beta version 3: α, Alpha version

Table 39   Information for Modbus and Profibus number, option version

Bit	Example	Description
7–0	07	Minor option version
15–8	03	Major option version

NOTE: It is important that the software version displayed in menu [922] is the same software version number as the software version number written on the title page of this instruction manual. If not, the functionality as described in this manual may differ from the functionality of the softstarter.

Build Info [9221]

Software version created, Date and time.

	9221 Build Info Stp	
Default:	YY:MM:DD:HH:MM:SS	

Unit Name [923]

Option to enter a name of the unit for service use or customer identity. The function enables the user to define a name with max 12 characters. Press the + / - keys to enter graphic symbols from the same list as for User-defined Unit [323], page 90. See also "Editing parameter values", page 45.

	923 Unit Name Stp	
Default:	No characters shown	

9. Serial communication

The softstarter provides the possibility of different types of serial communication.

- Modbus RTU via RS232, RS485, USB and BT
- Fieldbuses such as Profibus DP and DeviceNet
- Industrial Ethernet such as Modbus/TCP, Profinet IO and EtherCAT

See "12. Options" on page 155 for available communication option boards.

9.1 Modbus RTU

There is an asynchronous unisolated RS232 serial communication interface on top of the Emotron TSA unit. It is also possible to use the isolated RS485 or USB option boards (if installed).
The protocol used for data exchange is Modbus RTU protocol, originally developed by Modicon. The softstarter acts as a slave with address 1 in a master-slave configuration. The communication is half-duplex. It has a standard non return zero (NRZ) format.

The baud rate is fixed to 9600 with fixed address = 1 (on-board RS232 port), but it is adjustable for the USB and RS485 option boards.

The character frame format (always 11 bits) has:

- one start bit
- eight data bits
- two stop bits
- no parity

It is possible to temporarily connect a personal computer with for example the software EmoSoftCom (programming and monitoring software) to the RS232 connector on top of the Emotron TSA unit. This can be useful when copying parameters between softstarters, etc. For permanent connection of a personal computer you have to use one of the isolated communication option boards RS485 or USB, see also Note below.

> NOTE: The built in RS232 port on top of the Emotron TSA unit is not galvanically isolated.
> It is therefore important that all externally connected equipment to the control board are on the same potential level. Otherwise equipment may be damaged!
> If uncertain, we advice you to use the isolated USB option instead or to use an isolated USB to RS232-converter.

> **WARNING!**
> Correct and safe use of a RS232 connection depends on the ground pins of both ports having the same potential. Problems can occur when connecting two ports of e.g. machinery and computers where both ground pins have not the same potential. This may cause hazardous ground loops that can destroy the RS232 ports.
>
> The on-board RS232 connection is not galvanically isolated.
>
> The RS485 and USB option boards from CG Drives & Automation are galvanically isolated.
>
> Note that the on-board RS232 connection can safely be used in combination with commercially available isolated USB to RS232 converters.

9.2 Parameter sets

Communication information for the different parameter sets.

The different parameter sets in the softstarter have the following DeviceNet instance numbers, Profibus slot/index numbers, Profinet IO index and EtherCAT index numbers:

Param. set	Modbus/ DeviceNet Instance number	Profibus Slot/Index	Profinet IO index	EtherCAT index (hex)
A	43001– 43899	168/160 to 172/38	19385 - 20283	4bb9 - 4f3b
B	44001– 44899	172/140 to 176/18	20385 - 21283	4fa1 - 5323
C	45001– 45899	176/120 to 179/253	21385 - 22283	5389 - 5706
D	46001– 46899	180/100 to 183/233	22385 - 23283	5771 - 5af3

Parameter set A contains parameters 43001 to 43899. The parameter sets B, C and D contain the same type of information. For example parameter 43123 in parameter set A contains the same type of information as 44123 in parameter set B.

9.3 Motor data

Communication information for the different motors.

Motor	Modbus/ DeviceNet Instance number	Profibus Slot/ Index	Profinet IO index	EtherCAT index (hex)
M1	43041– 43048	168/200 to 168/207	19425 - 19432	4be1 - 4be8
M2	44041– 44048	172/180 to 174/187	20425 - 20432	4fc9 - 4fd0
M3	45041– 45048	176/160 to 176/167	21425 - 21432	53b1 - 53b8
M4	46041– 46048	180/140 to 180/147	22425 - 22432	5799 - 57a0

M1 contains parameters 43041 to 43048. The M2, M3, and M4 contain the same type of information. For example parameter 43043 in motor M1 contains the same type of information as 44043 in M2.

9.4 Start and stop commands

Set start and stop commands via serial communication. Requires that menu [2151] Run/Stop Control is set to "Com".

Modbus/DeviceNet Instance number	Function
42901	Reset
42902	Run, active together with either Run FWD or Run REV to perform start. (1=Run, 0=Stop)
42903	Run FWD (1=Active)
42904	Run REV (1=Active)

9.5 Process value

It is also possible to send the Process value feedback signal over a bus (e.g. from a process or temperature sensor).

Set menu "Process Source [321]" to F(Bus). Use following parameter data for the process value:

Default	0
Range	-16384 to 16384
Corresponding to	-100% to 100% process value

Communication information

Modbus /DeviceNet Instance number	42906
Profibus slot /Index	168/65
Profinet IO index	19290
Fieldbus format	Int
Modbus format	Int

9.6 Description of the EInt formats

A parameter with Eint format can be represented in two different formats (F), either as a 15 bit unsigned integer format (F= 0) or a Emotron floating point format (F=1). The most significant bit (B15) indicates the format used. See detailed description below.
All parameters written to a register may be rounded to the number of significant digits used in the internal system.

The matrix below describes the contents of the 16-bit word for the two different EInt formats:

```
B15 B14 B13 B12 B11 B10 B9 B8 B7 B6 B5 B4 B3 B2 B1 B0
F=1 e3  e2  e1  e0  m10 m9 m8 m7 m6 m5 m4 m3 m2 m1 m0
F=0 B14 B13 B12 B11 B10 B9 B8 B7 B6 B5 B4 B3 B2 B1 B0
```

If the format bit (B15) is 0, then all bits may be treated as a standard unsigned integer (UInt).

If the format bit is 1, then the number is interpreted as:

Value = M * 10^E, where M=m10..m0 represents a two- complement signed mantissa and E= e3..e0 represents a two- complement signed exponent.

NOTE: Parameters with EInt format may return values both as 15 bit unsigned integer (F=0) or in Emotron floating point (F=1).

Example, resolution
If you write the value 1004 to a register and this register has 3 significant digits, it will be stored as 1000.

In the Emotron floating point format (F=1), one 16-bit word is used to represent large (or very small numbers) with 3 significant digits.

If data is read or written as a fixed point (i.e. no decimals) number between 0-32767, the 15 bit Unsigned integer format (F=0) may be used.

Detailed description of Emotron floating point format

```
e3-e0 4-bit signed exponent. Gives a value
range:
-8..+7 (binary 1000 .. 0111)
m10-m0 11-bit signed mantissa. Gives a
value range:
-1024..+1023 (binary
10000000000..01111111111)
```

A signed number should be represented as a two-complement binary number, like below:

Value Binary

```
-8 1000
-7 1001
..
-2 1110
-1 1111
0 0000
1 0001
2 0010
..
6 0110
7 0111
```

The value represented by the Emotron floating point format is $m \cdot 10e$.

To convert a value from the Emotron floating point format to a floating point value, use the formula above.

To convert a floating point value to the Emotron floating point format, see the C-code example below.

Example, floating point format
The number 1.23 would be represented by this in Emotron floating point format,

```
F EEEE MMMMMMMMMMM
1 1110 00001111011
F=1 -> floating point format used
E=-2
M=123
```

The value is then $123 \times 10^{-2} = 1.23$

Example 15bit unsigned integer format
The value 72.0 can be represented as the fixed point number 72. It is within the range 0-32767, which means that the 15-bit fixed point format may be used.

The value will then be represented as:

```
B15 B14 B13 B12 B11 B10 B9 B8 B7 B6 B5 B4 B3 B2 B1 B0
0   0   0   0   0   0   0  0  0  1  0  0  1  0  0  0
```

Where bit 15 indicates that we are using the fixed point format (F=0).

Programming example:

```
typedef struct
{
  int m:11; // mantissa, -1024..1023
  int e: 4; // exponent -8..7
  unsigned int f: 1; // format, 1->special emoint format
}    eint16;
//----------------------------------------------------------------------
unsigned short int float_to_eint16(float value)
{
  eint16 etmp;
  int dec=0;

  while (floor(value) != value && dec<16)
  {
    dec++; value*=10;
  }
  if (value>=0 && value<=32767 && dec==0)
    *(short int *)&etmp=(short int)value;
  else if (value>=-1000 && value<0 && dec==0)
  {
    etmp.e=0;
    etmp.f=1;
    etmp.m=(short int)value;
  }
  else
  {
    etmp.m=0;
    etmp.f=1;
    etmp.e=-dec;
    if (value>=0)
      etmp.m=1; // Set sign
    else
      etmp.m=-1; // Set sign
    value=fabs(value);
    while (value>1000)
    {
      etmp.e++; // increase exponent
      value=value/10;
    }
    value+=0.5; // round
    etmp.m=etmp.m*value; // make signed
  }
 return (*(unsigned short int *)&etmp);
}
//----------------------------------------------------------------------
float eint16_to_float(unsigned short int value)
{
  float f;
  eint16 evalue;

  evalue=*(eint16 *)&value;
  if (evalue.f)
  {
    if (evalue.e>=0)
      f=(int)evalue.m*pow10(evalue.e);
    else
      f=(int)evalue.m/pow10(abs(evalue.e));
  }
  else
    f=value;

  return f;
}
//----------------------------------------------------------------------
```

10. Softstarter theory

In this chapter different starting methods for induction motors are explained and compared. The functionality of softstarters with torque control and their advantages and limitations compared to other starting methods are explained.

First a brief account of the background theory of starting induction motors will be given in section 10.1. Thereafter the different starting methods based on the usage of reduced voltage will be described and compared. This chapter will also cover softstarters with torque control. In section 10.3, some common starting methods based on other physical principles are explained. With this information some limitations of the reduced voltage starters will become clear. In section 10.4 there is a brief analysis of which applications may benefit from using a softstarter.

10.1 Background theory

The following two sections deal with motors with squirrel-cage rotors. In contrast to a wound rotor, the squirrel-cage rotor consists of straight conductors, which are short-circuited together at both ends.

When such a motor is connected directly to the line voltage it will typically draw a starting current of about 5 to 8 times its nominal current while the resulting starting torque will be about 0.5 to 1.5 times its nominal torque. In the following picture a typical starting characteristic is shown. The x-axis represents the speed relative to the synchronous speed while the y-axis shows the torque and the current respectively, with those quantities normalised to their nominal values. The dashed line indicates the nominal values.
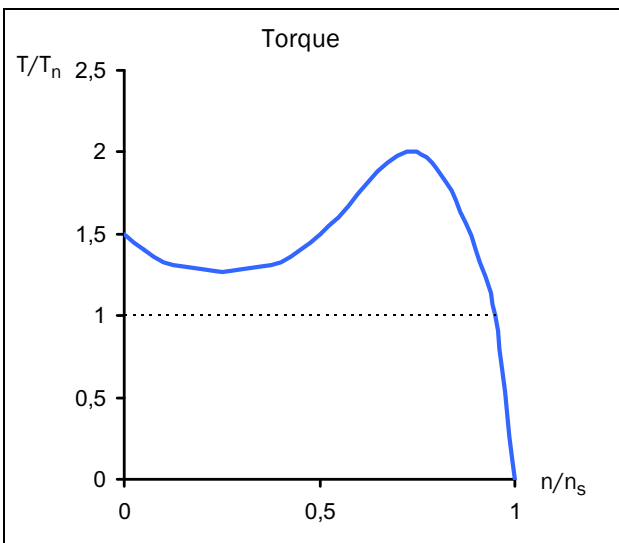
Fig. 83   *Typical torque characteristics for the DOL start*
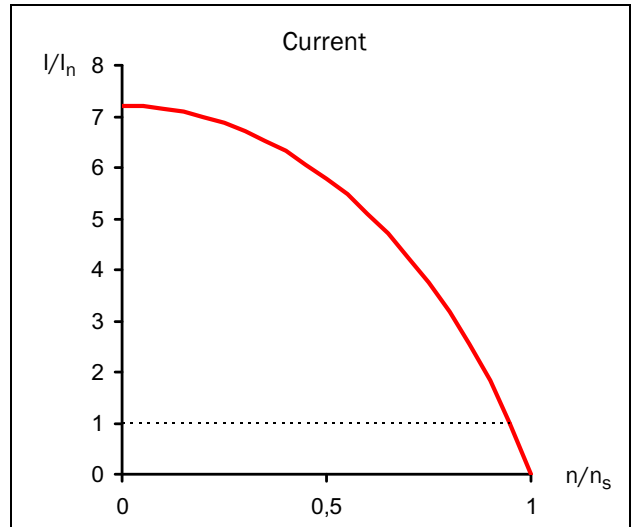
Fig. 84   *Typical current characteristics for the DOL start*

For many industrial applications direct on-line starting is not convenient, as the supply in this case has to be dimensioned to deliver the unnecessarily high starting current. Moreover, most applications do not gain anything from the high starting torque. Instead there is a risk of mechanical wear or even damage because of the resulting jerk at speedup.

The acceleration torque is determined by the difference between motor and load torque. The figure below shows some typical torque characteristics for constant speed applications. For comparative purposes, the induction motors' torque characteristic is added to the diagram.
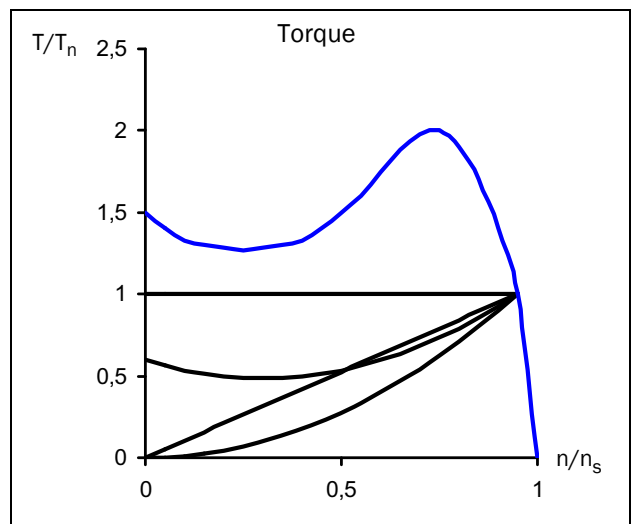
Fig. 85   *Typical load torque characteristics*

Typical applications with constant load are elevators, cranes and conveyors. Linear load characteristics are typical for calender rollers and various smoothing machines, whereas quadratic correlation between speed and torque is typical for pumps and fans. Some applications like conveyors or screws may need an initial torque boost. However, for many applications it can be seen that the torque needed is much lower than the torque delivered by the induction motor in a DOL start.

A common method to reduce both starting torque and current is to decrease the motor voltage during starting. The following figure shows how the motor's torque and current characteristics are changed when the supply voltage is reduced.

$$T \sim I^2$$
$$I_{LV} = 1/2\ I_{DOL} \rightarrow T_{LV} \approx 1/4\ T_{DOL}$$
$$I_{LV} = 1/3\ I_{DOL} \rightarrow T_{LV} \approx 1/9\ T_{DOL}$$

LV=low voltage
DOL=Direct on line

This relationship is the base for any starting method using reduced voltage. It can be seen that the possibility of reducing the starting current depends on the correlation between the motor's and the load's torque characteristic. For the combination of an application with very low starting load and a motor with very high starting torque, the starting current may be reduced significantly by means of decreasing the voltage during start. However, for applications with high starting load it may – depending on the actual motor – not be possible to reduce the starting current at all.
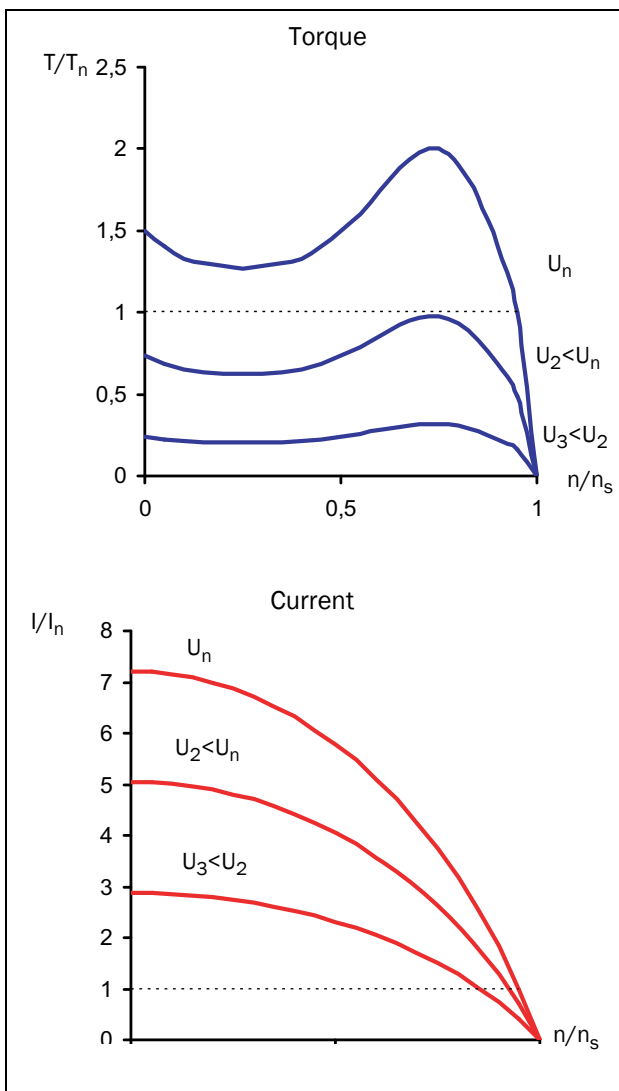
Fig. 86   Reduced voltage start

A general rule of thumb is that the torque at each operating point is roughly proportional to the square of the current. This means when the motor current is decreased by a factor of two by means of reducing the supply voltage, the torque delivered by the motor will be decreased by a factor of four (approximately).

10.2 Reduced voltage starting

This section describes different starting methods which are based on the reduced-voltage principle explained above. A pump and its quadratic torque characteristic are used as an example.

The star-delta starter is the simplest example of a reduced voltage starter. The motor phases are first star connected; at about 75% of nominal speed the phase connection is then changed to delta. To enable star-delta start, both ends of all three motor windings have to be available for connection. Moreover, the motor has to be dimensioned for the (higher) voltage in the delta connection. The following figure shows the resulting torque and current characteristics.
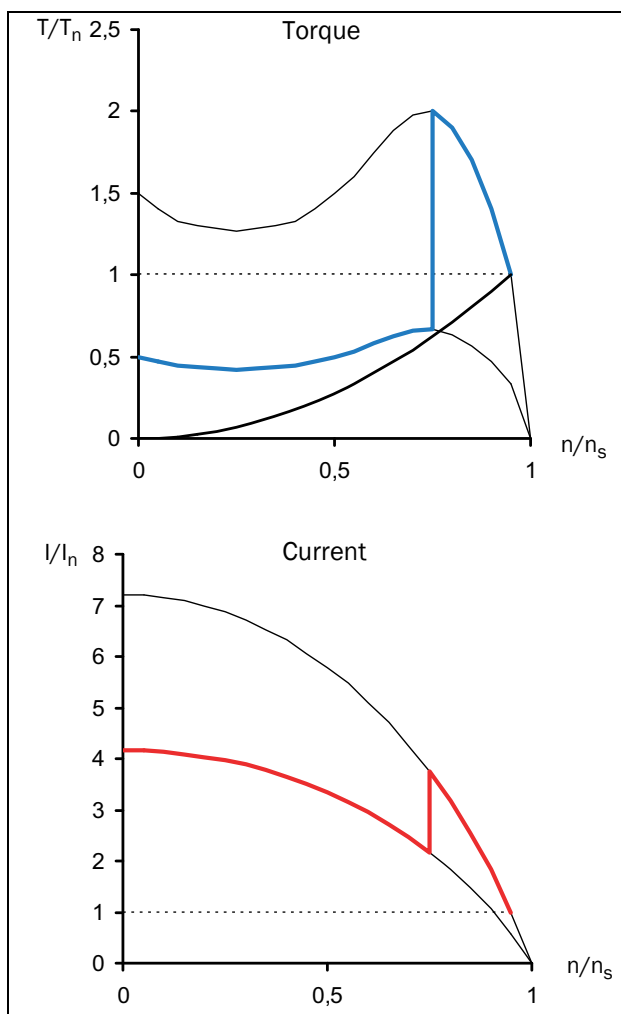
Fig. 87   Star-delta start

The disadvantage of the star-delta start is that it cannot be adapted to a special application. Both the voltage in star and in delta connections are defined by the supply, and the resulting starting performance depends on the motor's DOL characteristic. For some applications the star-delta starter cannot be used as the resulting torque in a star connection is too low to start rotating the load. On the other hand for low load applications further savings of starting current are impossible even though a big torque reserve is available. Moreover, the resulting abrupt rise of torque first at start and

later when changing from star to delta connection may contribute to mechanical wear. The high transient currents during start-delta transition create unnecessary excess heat in the motor.

Better performance is achieved with a voltage ramp start, which a simple electronic softstarter can provide. The voltage is increased linearly from an initial value to the full supply voltage by means of phase angle control. The resulting torque and current characteristics are shown in the following figure.
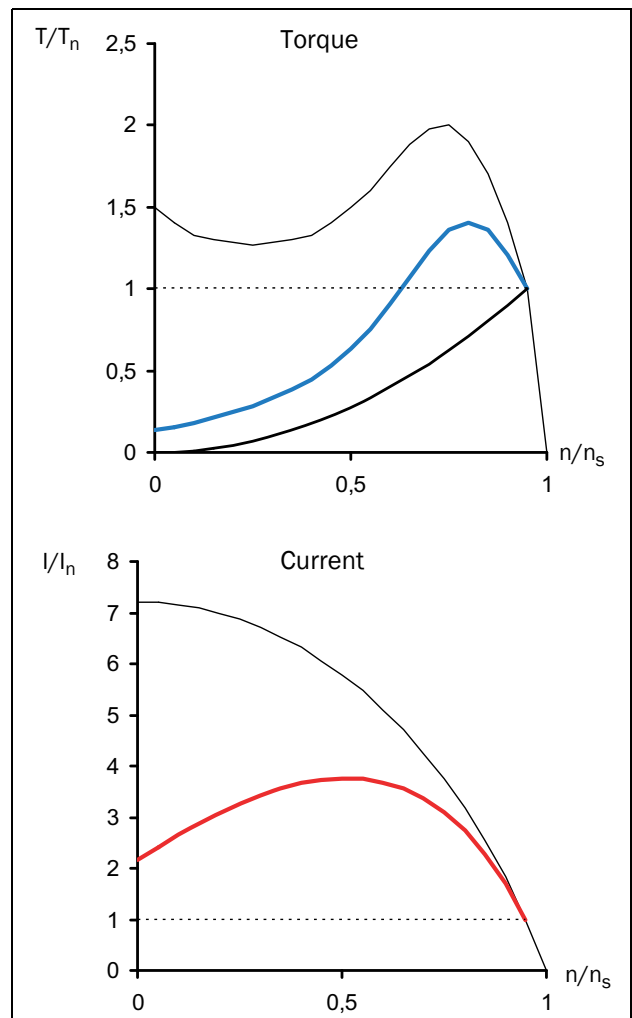
Fig. 88   Soft starting – voltage ramp

Obviously a much smoother start is realised compared to the star-delta start and the starting current is decreased.

A softstarter is often used to keep the starting current below a desired level. For the example above, setting a current limit of three times the nominal current may be desirable. The following figure shows the resulting torque and current characteristics.
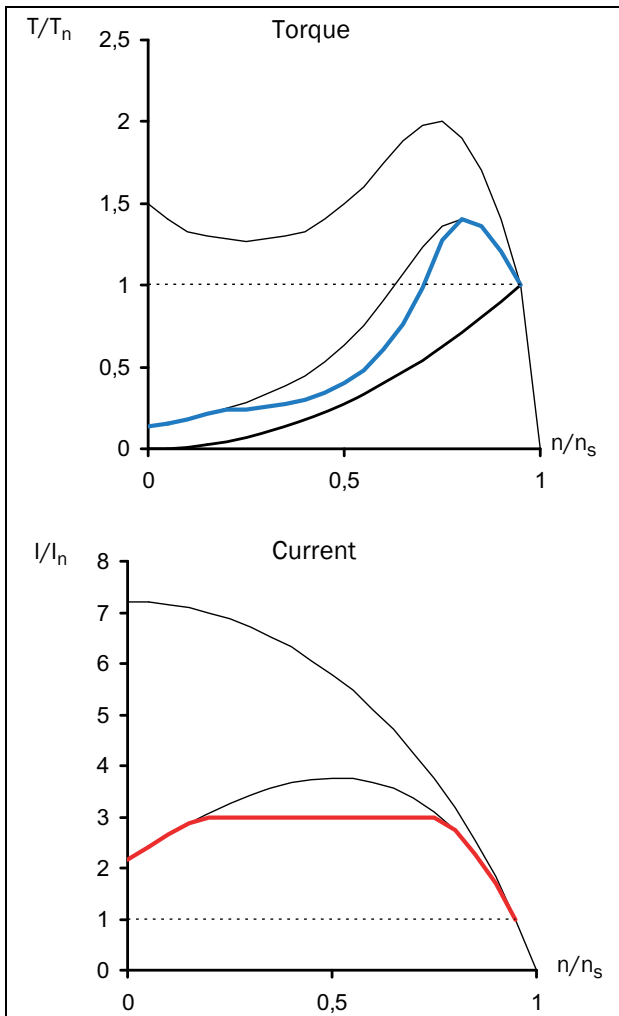
Fig. 89   Soft starting – voltage ramp with current limit

Once again the figure illustrates that the resulting performance depends on the combination of motor and load characteristics. In the example above the motor torque is close to the load torque at about half speed. This means for some other applications with different load characteristics (for example a linear torque-speed correlation) this particular motor would need more than three times the nominal current to start.

The most sophisticated electronic softstarters use torque control, which results in an almost constant acceleration during the start. A low starting current is also achieved. However, this start method also uses reduced motor voltage and the quadratic correlation between current and torque described in the first section of this chapter is still valid. This means, the lowest possible starting current is determined by the combination of motor and load characteristics.
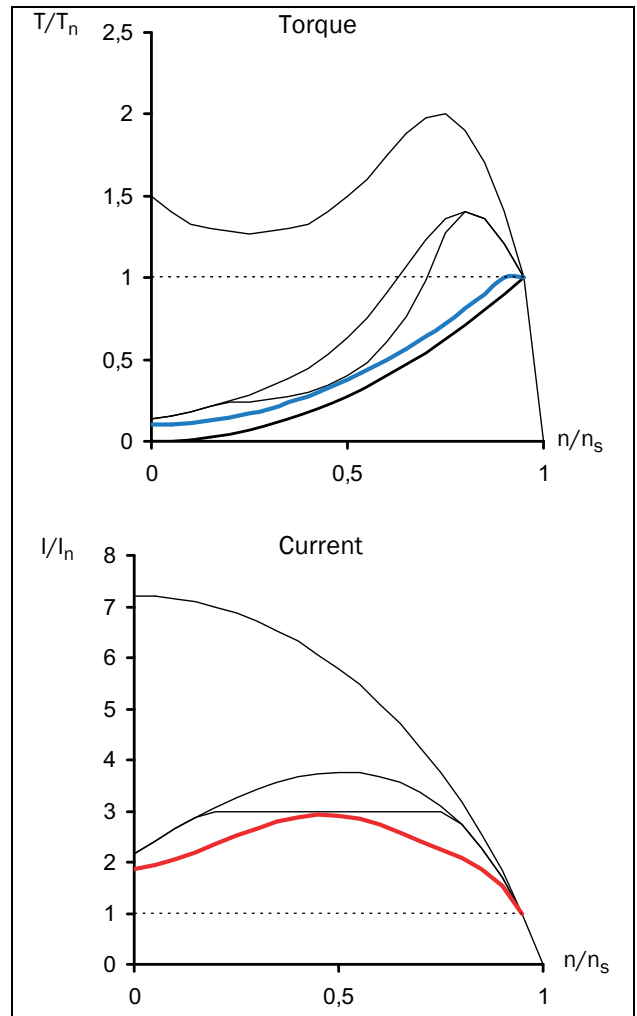
Fig. 90   Soft starting – torque control

For optimal starting performance, correct setting of the softstarter's parameters such as initial torque and end torque at start and start time is important. The choice of parameters is explained in detail in section 8.3.3, page 91.

10.3 Other starting methods

In contrast to the preceding sections of this chapter, which focused on squirrel-cage motors, slip-ring motors are dealt with later on. A slip-ring motor is equipped with a wound rotor; one end of each rotor winding is available for external connection via slip-rings. These motors are often optimised for rotor resistance starting, i.e. with short-circuited rotor windings they develop a very low torque at an extremely high current. For starting, external resistances are connected to the rotor windings. During the start, the resistance value is decreased in several steps until the rotor windings are short-circuited at nominal speed. The following figure shows typical torque and current characteristics for a slip-ring motor during the start with an external rotor-resistance starter.
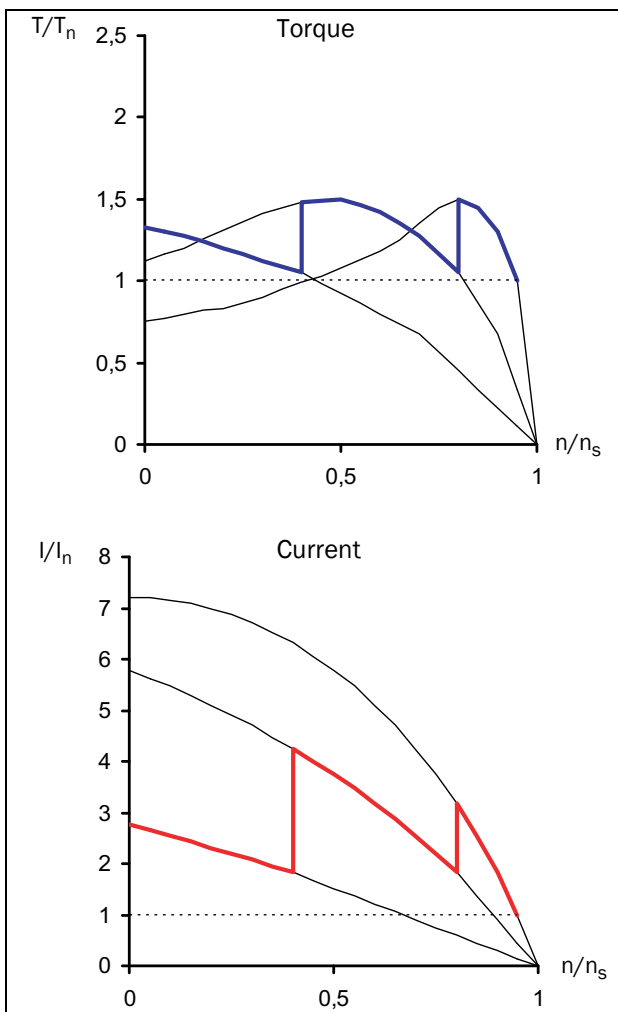
Fig. 91 Rotor-resistance starting

Because of the low starting torque it is often not possible to short-circuit the rotor windings and replace the rotor-resistance starter with a softstarter. However, it is always possible to use a frequency inverter instead. The following illustration shows how the torque and current characteristics are affected when the stator frequency is changed.
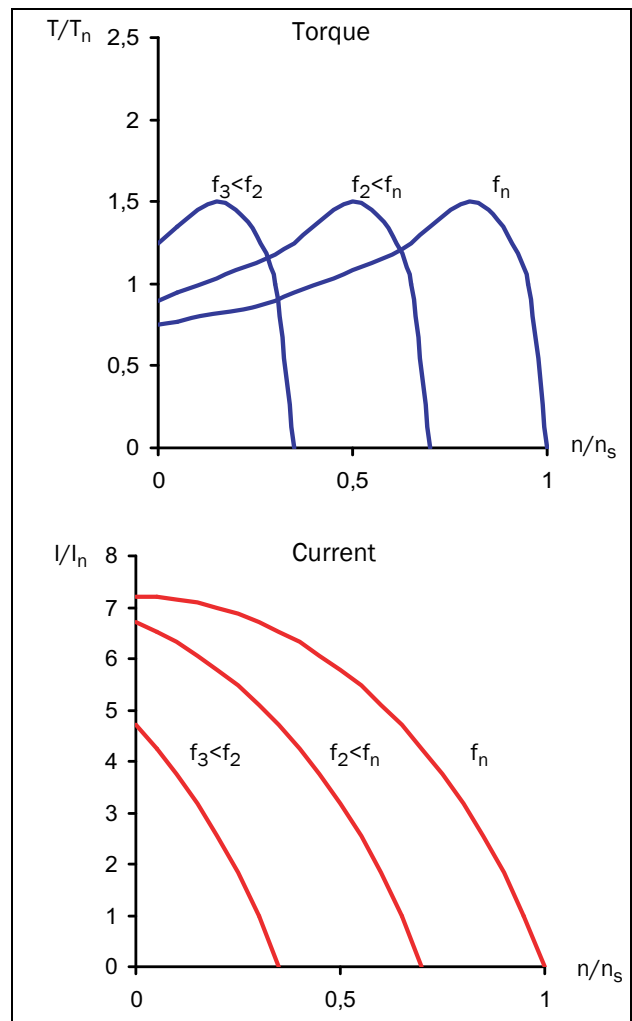
Fig. 92 Voltage/frequency regulation

Thus, such a motor can be started with a quite simple frequency inverter with voltage-frequency regulation. This solution is also valid for all other applications, which for some reason (high load torque compared to motor torque etc.) cannot be started by a softstarter.

10.4 Use of softstarters with torque control

To determine if a specific application benefits from using a softstarter at all, the correlation between the motor's torque characteristic during the start and the load's requirements has to be evaluated. As it can be seen from the examples above, the application will only benefit from using a softstarter if the load torque during the start is clearly below the motor's starting capacity. However, loads with a high initial release torque may also benefit from a softstarter. In this case an initial torque boost can be used, thereafter the start ramp is continued reducing the starting current considerably.

The benefit can be maximised when using a softstarter with torque control. To be able to configure the torque control parameters for optimal performance, the load characteristics (linear, square or constant load, need of initial release torque) must be known. In this case a proper torque control method (linear or square) can be chosen and torque boost can be enabled if needed.

11. Troubleshooting, Diagnoses and Maintenance

For a description of the different alarm states, see "Alarm indications" on page 55.

11.1 Trip conditions, causes and remedial action

The table later on in this section must be seen as a basic aid to find the cause of a system failure and how to solve any problems that arise. Although the softstarter gives a certain trip message it is not always easy to find the right cause of the failure. Good knowledge of the complete system is therefore necessary. Contact your supplier if you have any questions.

Failures occurring during commissioning or shortly after commissioning are most likely to be caused by incorrect settings or even bad connections.

Failures or problems occurring after a reasonable period of failure-free operation can be caused by changes in the system or in its environment (e.g. wear).

Failures that occur regularly for no obvious reasons are generally caused by electromagnetic interference. Be sure that the installation fulfils the demands for installation stipulated in the EMC directives. See section 1.5.1, page 6.

Sometimes the so-called "Trial and error" method is a quicker way to determine the cause of the failure. This can be done at any level, from changing settings and functions to disconnecting single control cables or replacing entire units.

The "Trip Message Log" [800] can be useful for determining why certain trips recur at certain moments. The trip log records the time of the trip in relation to the run time counter. Under each trip message the values of a number of parameters are saved. See Table 37, page 135.

> **WARNING!**
> If it is necessary to open the softstarter or any part of the system (motor cable housing, conduits, electrical panels, cabinets, etc.) in order to inspect or take measurements as suggested in this instruction manual, it is absolutely necessary to read and follow the safety instructions in the manual.

11.1.1 Technically qualified personnel

Installation, commissioning, demounting, making measurements, etc., of or at the softstarter may only be carried out by personnel technically qualified for the task.

11.1.2 Opening the softstarter

> **WARNING!**
> Always switch off the mains and control supply voltage if it is necessary to open the softstarter.

The connections for the control signals and the switches are isolated from the mains voltage. Always take adequate precautions before opening the softstarter.

11.2 Maintenance

The Emotron TSA softstarter is designed to require a minimum of servicing and maintenance. There are however some things which must be checked regularly:

- Keep the unit clean and cooling efficient (clean air inlets, heatsink profile, parts, components, etc)
- For model size 2 and up there is an internal fan that should be inspected and cleaned from dust if necessary.
- If softstarters are built into cabinets, also check and clean the dust filters of the cabinets regularly.
- Check external wiring, connections and control signals.
- Check tightening of all terminal screws regularly, especially important are power and motor cable connections.

Clock battery

If the internal Clock battery (see chapter "Emotron TSA connections and details" on page 21) needs to be replaced, the type is CR 2032, 3 V .
Recommended brands are Varta and Renata (max. 70 °C).

For more information on maintenance, please contact your CG Drives & Automation service partner.

Precautions to take with a connected motor

If work must be carried out on a connected motor or on the driven machine, the mains voltage must always first be disconnected from the softstarter.

11.3 Troubleshooting list

Table 40   Alarms with possible causes and remedies.

Trip/warning message (and indicator)	Alarm Action /Menu		Possible cause	Remedy
Comm error	No action Hard trip Soft trip Warning	2641	Error on serial communication/ Fieldbus (option).	Check cables and connection of the serial communication. Check all settings with regard to the communication. Restart the equipment including the softstarter. For details, see Fieldbus Manual.
CP locked!			Control panel is locked for settings.	Unlock control panel in menu [218]. Enter unlock code "291".
CtrlSupFault	Hard trip		Control voltage supply fault.	Check control supply voltage level.
Curr limit	No action Hard trip Soft trip Warning	236	Current limit parameters are perhaps not matched to the load and motor.	Increase the start time (menu [336]) and/or the current limit at start (menu [335]).
Curr Unbal			Motor, Bypass or thyristor fault	Service needed. Contact your local Emotron TSA supplier.
Ext Alarm 1	No action Hard trip Soft trip Warning	4211	External trip connected to digital input active: active low function on the input.	Check the equipment that initiates the external input. Check the programming of the digital inputs, menu [520].
Ext Alarm 2	No action Hard trip Soft trip Warning	4212	External trip connected to digital input active: active low function on the input.	Check the equipment that initiates the external input. Check the programming of the digital inputs, menu [520].
Int error 1-NTC	Hard trip		Internal alarm NTC(Negative Temp. Coeficient) on power board is shorted or open circuit.	Service needed. Contact your local Emotron TSA supplier.
Int error 2-AD	Hard trip		Internal alarm (AD =analog->digital converter)	Service needed. Contact your local Emotron TSA supplier.
Locked rotor	No action Hard trip Soft trip Warning	422	Torque limit at motor standstill: Mechanical blocking of the rotor.	Check for mechanical problems at the motor or the machinery connected to the motor. Set [4221] Locked rotor alarm to "No action". Adjust Locked Rotor time [4222] and Locked Rotor Current [4223]
Mon MaxAlarm	No action Hard trip Soft trip Warning		Max alarm level (overload) has been reached [4112].	
Mon MaxPreAl	No action Hard trip Soft trip Warning		Max pre-alarm level (overload) has been reached [4122].	Check the load condition of the machine. Check the monitor setting in section 8.4, page 98.
Mon MinAlarm	No action Hard trip Soft trip Warning		Min alarm level (underload) has been reached [4142].	
Mon MinPreAl	No action Hard trip Soft trip Warning		Min pre-alarm level (underload) has been reached [4132].	
Motor I^2t (Area D: I^2t)	No action Hard trip Soft trip Warning	2311	I^2t value is exceeded. Overload on the motor according to the prog-rammed I^2t settings.	Check for mechanical overload on the motor or the machinery (bearings, gearboxes, chains, belts, etc.). Change the Motor I^2t Current setting in menu [2312]. Check setting of menu [228] Motor Vent, which affects I^2t behaviour.

Table 40   Alarms with possible causes and remedies.

Trip/warning message (and indicator)	Alarm Action /Menu		Possible cause	Remedy
Mot termOpen (motor terminal open)	Hard trip		Open motor contact, cable or motor winding. Thyristor shorted Bypass contactor welded contacts	Check wiring between softstarter and motor. Initiate a restart. If the alarm appears again, contact your local Emotron TSA supplier.
M Phase loss			2 or 3 phases lost in mains supply voltage.	Check fuses and mains supply.
Over temp	Hard trip		Heatsink temperature too high: Too high ambient temperature of the softstarter. Insufficient cooling. Too high current. Blocked or stuffed fans.	Check the cooling of the softstarter cabinet. Check the functionality of the built-in fans (No Fan in Frame size 1). The fans must switch on automatically if the heatsink temperature gets too high. At power up the fans are briefly switched on. Check softstarter and motor rating. Clean fans.
Over voltage	No action Hard trip Soft trip Warning	4321	Too high 3-phase mains supply voltage.	Check the 3-phase main supply voltage. Remove the interference cause or use other main supply lines.
Phase loss	No action Hard trip Soft trip Warning	235	Single phase loss. Fuse broken.	Check fuses and mains supply. Check that terminal screws are tightened.
Phase rev	No action Hard trip Soft trip Warning	4341	Incorrect phase sequence on 3-phase main supply.	Swap L2 and L3 input phases. Check setting of menu [4342] Allowed Sequence.
Predictive I^2t	Warning		New start not possible due to motor temperature is too high.	Start is inhibited until motor has cooled down.
PT100	No action Hard trip Soft trip Warning	2321	Motor PT100 elements exceeds maximum level. Self-cooled motor at low speed, too high load. NOTE: Only valid if option board PTC/PT100 is used.	Check on mechanical overload on the motor or the machinery (bearings, gearboxes, chains, belts, etc.). Check the motor cooling system. Set alarm action to "Off".
PTC	No action Hard trip Soft trip Warning	2331	Motor thermistor (PTC) exceeds maximum level. Self-cooled motor at low speed, too high load.	If motor overheated, wait for it to cool down. Check on mechanical overload on the motor or the machinery (bearings, gearboxes, chains, belts, etc.) Check the motor cooling system. Set alarm action to "No action".
Start limit	No action Hard trip Soft trip Warning	2341	Number of starts per hour exceeded, min time between starts not kept.	Wait and start again. Perhaps the number of starts per hour could be decreased or the number of allowed starts per hour could be increased in menu [2342] or the min time between starts could be increased (menu [2343]).
Stop first!			During start, stop and jog, changing certain parameters is not permitted.	Set parameters during standstill.
Under voltage	No action Hard trip Soft trip Warning	4331	Too low 3-phase mains supply voltage. Mains voltage dip due to starting other major power consuming machines on the same line.	Make sure all three phases are properly connected and that the terminal screws are tightened. Check that the 3-phase mains supply voltage is within the limits set in menu group [433]. Use other mains supply lines if dip is caused by other machinery.

Table 40   Alarms with possible causes and remedies.

Trip/warning message (and indicator)	Alarm Action /Menu		Possible cause	Remedy
Volt unbalance	No action Hard trip Soft trip Warning	4311	Mains supply voltage unbalance.	Check 3-phase mains supply. Check settings in menu [4312] and [4313].

Table 41   Observations without fault indication with possible causes and remedies.

Observation	Fault indication	Cause	Remedy
The display is not illuminated.	None	No control supply voltage.	Switch on the control supply voltage. If display still not illuminated, check cable between Control Panel and Control Board.
Softstarter does not react to start command	- - - -	Start command comes perhaps from incorrect control source. (I.e. start from control panel when remote control is selected).	Give start command from correct control source as configured in menu [2151] and [2152]. Check if any digital input is set to function "Enable".
The motor jerks etc.	When starting, motor reaches full speed but it jerks or vibrates.	If "Torque control" is selected, it is necessary to input motor data into the system.	Configure nominal motor data in menu group [220]. Select the proper torque control alternative in menu [331] (linear or square) according to the load characteristic. Select a correct initial- and end torque at start in menus [332] and [333].
		Start time too short.	Increase start time [336].
		If voltage control is used as start method, the initial voltage at start may be too low. Starting voltage incorrectly set.	Adjust initial voltage at start [334].
		Motor too small in relation to rated current of softstarter.	Use a smaller model of the softstarter.
		Motor too large in relation to load of softstarter.	Use larger model of softstarter.
		Starting voltage not set correctly.	Readjust the start ramp.
			Select the current limit function.
	Starting or stopping time too long.	Ramp times not set correctly.	Readjust the start and/or stop ramp time.
		Motor too large or too small in relation to load.	Change to another motor size.
The monitor function does not work.	No or false alarm or pre-alarm.	It is necessary to input nominal motor data for this function. Set alarm levels not valid.	Input nominal motor data in menus [221]-[228]. Adjust alarm levels and response delays.
The alarm can not be reset.			Check reset control in menu [216]. The alarm can only be reset if the alarm condition is removed. E.g. PTC, PT100 or over temperature alarm can only be reset after the temperature is decreased.

12. Options

The available standard options are briefly described here. Some of the options have their own instruction or installation manual. For more information please contact your supplier.

NOTE: Emotron TSA softstarters have as standard coated control boards and coated option boards.

12.1 External control panel

Part number	Description
01-5406-00	Panel kit complete including panel

The option may be useful, for example for mounting control panel in a cabinet door (Fig. 93). Maximum distance between softstarter and external control panel is 3 metres.
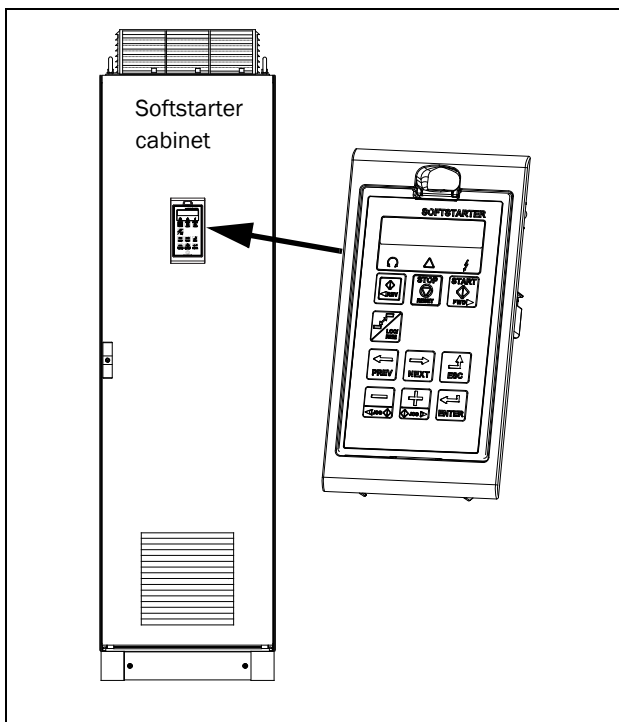
Fig. 93   External control panel in mounting cassette.

12.2 EmoSoftCom

EmoSoftCom is an optional software that runs on a personal computer. It can also be used to load parameter settings from the softstarter to the PC for backup and printing. Recording can be made in oscilloscope mode. Please contact CG Drives & Automation sales for further information.

12.3 I/O Board

Part number	Description
01-3876-51	I/O option board 2.0

Each I/O option board 2.0 provides three extra relay outputs and three extra isolated digital inputs (24V). This option is described in a separate manual. Maximum two option boards can be mounted (I/O or PTC/PT100)

12.4 PTC/PT100

Part number	Description
01-3876-58	PTC/PT100 2.0 option board

The PTC/PT100 2.0 option board for connecting motor thermistors and max 6 PT100 elements to the softstarter is described in a separate manual. Maximum two option boards can be mounted (I/O or PTC/PT100)

12.5 Serial communication and fieldbus

Part number	Description	From TSA Software version (See menu [922])
01-5385-54	TSA Isolated RS485 module	1.0X
01-5385-55	TSA Profibus module	1.0X
01-5385-56	TSA DeviceNet module	1.0X
01-5385-59	TSA Modbus/TCP module	1.0X
01-5385-60	TSA EtherCAT module	1.26
01-5385-61	TSA Profinet IO 1-port module	1.0X
01-5385-62	TSA Profinet IO 2-port module	1.0X
01-5385-63	TSA Isolated USB module	1.0X
01-5385-64	TSA EtherNet IP 2-port module	1.25

For communication with the softstarter there are several option modules. There are different options for Fieldbus communication and two serial communication options with galvanic isolation, the RS485- and USB option. These options are described in a separate manual.

13. Technical data

Table 42 Technical data for Emotron TSA52/69-016 to -030.

Emotron TSA Size 1 model:	TSA52/69-016		TSA52/69-022		TSA52/69-030	
Duty[1]	Normal	Heavy	Normal	Heavy	Normal	Heavy
Rated current I_{n_soft} [A]	16	10	22	12	30	18
Motor size P_{n_mot} 400 V [kW] - TSA52-###	7.5	4	11	5.5	15	7.5
Motor size P_{n_mot} 460 V [hp] - TSA52-###	10	5	15	7.5	20	10
Motor size P_{n_mot} 525 V [kW] - TSA52-###	11	5.5	15	7.5	18.5	11
Motor size P_{n_mot} 575 V [hp] - TSA69-###	15	7.5	20	10	25	15
Motor size P_{n_mot} 690 V [kW] - TSA69-###	11	7.5	18.5	11	22	15
Recommended load fuses [A][2]	25	25	35	35	40	40
Total power loss for TSA unit at rated motor power, in bypass mode [W]	16	15	17	15	19	16
Total average power loss for TSA unit if 10 starts/hour [W]	35	34	39	37	45	43
Dimensions H1/H2 x W x D [mm (in)][3]	246/340 x 126 x 188 (9.7/13.4 x 5 x 7.4)					
Mounting position	Vertical					
Weight [kg]	5.5					
Busbar for cable connection [mm (in)]	15 x 2 (0.59 x 0.08), M6 connection. Possible to use either Cu or Al cables.					
Cooling system	Convection					
Protection class	IP20					
UL short circuit rating	5 kA					

Table 43 Technical data for Emotron TSA52/69-036 to -056.

Emotron TSA Size 1 model:	TSA52/69-036		TSA52/69-042		TSA52/69-056	
Duty[1]	Normal	Heavy	Normal	Heavy	Normal	Heavy
Rated current I_{n_soft} [A]	36	21	42	25	56	33
Motor size P_{n_mot} 400 V [kW] - TSA52-###	18.5	7.5	22	11	30	15
Motor size P_{n_mot} 460 V [hp] - TSA52-###	25	15	30	20	40	25
Motor size P_{n_mot} 525 V [kW] - TSA52-###	22	11	30	15	37	22
Motor size P_{n_mot} 575 V [hp] - TSA69-###	30	20	40	25	50	30
Motor size P_{n_mot} 690 V [kW] - TSA69-###	30	18.5	37	22	45	30
Recommended load fuses [A][2]	50	50	63	63	80	80
Total power loss for TSA unit at rated motor power, in bypass mode [W]	20	17	21	18	25	19
Total average power loss for TSA unit if 10 starts/hour [W]	49	46	51	48	61	56
Dimensions H1/H2 x W x D [mm (in)][3]	246/340 x 126 x 188 (9.7/13.4 x 5 x 7.4)					
Mounting position	Vertical					
Weight [kg (lb)]	5.5 (12.1)					
Busbar for cable connection [mm (in)]	15 x 2 (0.59 x 0.08), M6 connection. Possible to use either Cu or Al cables.					
Cooling system	Convection					
Protection class	IP20					
UL short circuit rating	5 kA					

1) Normal duty: Start current = 3 x I_{n_soft} , Start time = 15 s (Size 1) or 30 s (Size 2- 4), 10 starts/hour,
   Heavy duty: Start current = 5 x I_{n_soft} , Start time = 15 s (Size 1) or 30 s (Size 2- 4), 10 starts/hour.
2) Fuse data for Semi-conductor fuses, see Table 48.
3) H1=Height of enclosure, H2= Total height.

Table 44 Technical data for Emotron TSA52/69-070 to -100.

Emotron TSA Size 2 model:	TSA52/69-070		TSA52/69-085		TSA52/69-100	
Duty[1]	Normal	Heavy	Normal	Heavy	Normal	Heavy
Rated current I_{n_soft} [A]	70	42	85	51	100	60
Motor size P_{n_mot} 400 V [kW] - TSA52-###	37	22	45	22	55	30
Motor size P_{n_mot} 460 V [hp] - TSA52-###	50	30	60	40	75	40
Motor size P_{n_mot} 525 V [kW] - TSA52-###	45	22	55	30	75	37
Motor size P_{n_mot} 575 V [hp] - TSA69-###	60	40	75	50	100	60
Motor size P_{n_mot} 690 V [kW] - TSA69-###	55	37	75	45	90	55
Recommended load fuses [A][2]	100	100	125	125	160	160
Total power loss for TSA unit at rated motor power, in bypass mode [W]	28	21	33	23	38	26
Total average power loss for TSA unit if 10 starts/hour [W]	102	95	114	105	133	122
Dimensions H1/H2 x W x D [mm (in)][3]	246/340 x 126 x 188 (9.7/13.4 x 5 x 7.4)					
Mounting position	Vertical/Horizontal					
Weight [kg (lb)]	5.7 (12.6)					
Busbar for cable connection [mm (in)]	15 x 2 (0.59 x 0.08), M6 connection. Possible to use either Cu or Al cables.					
Cooling system	Fan					
Protection class	IP20					
UL short circuit rating	10 kA					

Table 45 Technical data for Emotron TSA52/69-140 to -200.

Emotron TSA Size 3 model:	TSA52/69-140		TSA52/69-170		TSA52/69-200	
Duty[1]	Normal	Heavy	Normal	Heavy	Normal	Heavy
Rated current I_{n_soft} [A]	140	84	170	102	200	120
Motor size P_{n_mot} 400 V [kW] - TSA52-###	75	45	90	55	110	55
Motor size P_{n_mot} 460 V [hp] - TSA52-###	100	60	125	75	150	100
Motor size P_{n_mot} 525 V [kW] - TSA52-###	90	55	110	75	132	75
Motor size P_{n_mot} 575 V [hp] - TSA69-###	125	75	150	100	200	125
Motor size P_{n_mot} 690 V [kW] - TSA69-###	132	75	160	90	200	110
Recommended load fuses [A][2]	200	200	224	224	250	250
Total power loss for TSA unit at rated motor power, in bypass mode [W]	43	30	52	34	61	38
Total average power loss for TSA unit if 10 starts/hour [W]	167	155	204	188	233	212
Dimensions H1/H2 x W x D [mm (in)][3]	285/380 x 196 x 235 (11.2/14.9 x 7.7 x 9.3)					
Mounting position	Vertical/Horizontal					
Weight [kg (lb)]	13 (28.7)					
Busbar for cable connection [mm (in)]	20 x 5 (0.8 x 0.20), M10 connection. Possible to use either Cu or Al cables.					
Cooling system	Fan					
Protection class	IP20					
UL short circuit rating	18 kA					

1) Normal duty: Start current = 3 x I_{n_soft} , Start time = 15 s (Size 1) or 30 s (Size 2-4), 10 starts/hour,
   Heavy duty: Start current = 5 x I_{n_soft} , Start time = 15 s (Size 1) or 30 s (Size 2-4), 10 starts/hour.
2) Fuse data for Semi-conductor fuses, see Table 48.
3) H1=Height of enclosure, H2= Total height.

Table 46 Technical data for Emotron TSA52/69-240 to -450.

Emotron TSA Size 4 model:	TSA52/69-240		TSA52/69-300		TSA52/69-360		TSA52/69-450	
Duty[1]	Normal	Heavy	Normal	Heavy	Normal	Heavy	Normal	Heavy
Rated current I_{n_soft} [A]	240	144	300	180	360	216	450	270
Motor size P_{n_mot} 400 V [kW] - TSA52-###	132	75	160	90	200	110	250	132
Motor size P_{n_mot} 460 V [hp] - TSA52-###	200	100	250	125	300	150	350	200
Motor size P_{n_mot} 525 V [kW] - TSA52-###	160	90	200	132	250	160	315	180
Motor size P_{n_mot} 575 V [hp] - TSA69-###	250	150	300	150	350	200	450	250
Motor size P_{n_mot} 690 V [kW] - TSA69-###	250	132	315	160	355	200	450	250
Recommended load fuses [A][2]	315	315	355	355	400	400	500	500
Total power loss for TSA unit at rated motor power, in bypass mode [W]	55	37	69	43	84	50	109	62
Total average power loss for TSA unit if 10 starts/hour [W]	269	251	350	327	377	346	474	431
Dimensions H1/H2 x W x D [mm (in)][3]	373/512 x 254 x 260 (14.9/20.2 x 10 x 10.3)							
Mounting position	Vertical/Horizontal							
Weight [kg (lb)]	23.5 (51.8)							
Busbar for cable connection [mm (in)]	40 x 10 (1.6 x 0.39), Ø 13 connection. Possible to use either Cu or Al cables.							
Cooling system	Fan							
Protection class	IP20							
UL short circuit rating	30 kA							

1) Normal duty: Start current = 3 x I_{n_soft} , Start time = 15 s (Size 1) or 30 s (Size 2-4), 10 starts/hour,
   Heavy duty: Start current = 5 x I_{n_soft} , Start time = 15 s (Size 1) or 30 s (Size 2-4), 10 starts/hour.
2) Fuse data for Semi-conductor fuses, see Table 48.
3) H1=Height of enclosure, H2= Total height.

13.1 General electrical specifications

Table 47 General electric specifications.

Parameter	Description
General	
Mains supply voltage	200-525 V, +10%/-15% 200-690 V, +10%/-15%
Mains and Control supply frequency	50/60 Hz, ±10%
Number of fully controlled phases	3
Control supply voltage	100-240 V +10%/-15%, Single phase
Power consumption for control supply voltage	20 VA for TSA52/69-16 to 52/69-56, 25 VA for TSA52/69-70 to 52/69-100 30 VA for TSA52/69-140 to 52/69-240 40 VA for TSA52/69-300 to 52/69-450
Fuse for control supply	Max 10 A
Control signal inputs	
Digital input voltage	0-4 V->0, 8 -27 V->1
Digital input impedance to GND (0 VDC)	<3.3 VDC: 4.7 kΩ ≥3.3 VDC: 3.6 kΩ
Analogue input voltage/current	0-10 V, 2-10 V, 0-20 mA, 4-20 mA
Analogue input impedance to GND (0 VDC)	Voltage signal 20 kΩ, Current signal 250 Ω
Control signal outputs	
Output relays contact	8 A, 250 VAC or 24 VDC resistive load; 3 A, 250 VAC inductive load.
Analogue output voltage/current	0-10 V, 2-10 V, 0-20 mA, 4-20 mA
Analogue output load impedance	Voltage signal min. load 700 Ω, current signal max. load 700 Ω
Control signal supply	
+24 VDC	+24 VDC+5%. Max current 50 mA. Short circuit and overload proof.

13.2 Semi-conductor fuses

Always use standard commercial fuses to protect the wiring and prevent short circuiting. To protect the thyristors against short-circuit currents, superfast semiconductor fuses can be used if preferred.

Use fuses with I^2t values lower or equal to Table 48.

Table 48 Semi-conductor fuses data.

TSA model:	Semi-conductor fuse	
	A	I^2t (fuse) at 700 V
-016	50	1 500
-022	70	2 800
-030	100	3 600
-036	125	6 900
-042	150	11 000
-056	175	14 000
-070	250	42 000
-085	300	55 000
-100	400	99 000
-140	500	160 000
-170	600	222 000
-200	700	332 000
-240	800	433 000
-300	1000	950 000
-360	1200	1 470 000
-450	1400	1 890 000

13.3 Environmental conditions

Normal operation	
Ambient temperature	0°C to 40°C (32 °F - 104 °F) (Max 55°C (131°F) by derating 2%/°C (1.1%/ degree F) in excess of 40°C (104 °F), see 13.3.1).
Atmospheric pressure	86 - 106 kPa (12.5 - 15.4 PSI)
Relative humidity	Max 95%, non-condensing
Altitude	Max 1,000 m (3280 ft) (Max 4,000 m (13123 ft) by derating 1%/100 m(328 ft) in excess of 1,000 m (3280 ft); with I/O board max 2,000 m (6562 ft), see 13.3.2).
Vibrations	According to IEC 60721-3-3: Mechanical conditions, class 3M4 (2 - 9 Hz, 3.0 mm (0.00984 ft) and 9 - 20 Hz, acc. 1 g (0.035 oz) (10 m/s^2)
Contamination	According to IEC 60721-3-3: Chemically active substances, class 3C3 (conformal coating - all printed circuit boards are coated) Mechanically active substances, class 3S1 (no sand; dust <0.01 mg/m^3, deposited <0.4 mg/(m^2*h)) Biological conditions, class 3B1 (no risk for harmful biological attacks - mould, fungus, animals, etc)
Storage	
Ambient temperature	-25°C to +70°C (-13 to +104 °F)
Atmospheric pressure	86 - 106 kPa (12.5 - 15.4 PSI)
Relative humidity	Max 95%, non-condensing

13.3.1 Derating at high temperature

The Emotron TSA softstarter is made for operating at maximum 40°C (104 °F) ambient temperature without derating.

Above this temperature it is necessary to ensure that insufficient cooling does not impair the performance of the softstarter, therefore a derating is done.

At temperatures of above 40°C (104 °F), the derating of the nominal current is 2% per centigrade (1.1%/ degree F). The Emotron TSA softstarter can be operated at an ambient temperature of up to 55°C (131 °F), in which case it can only be operated at 70% of the nominal current.

Example:
A motor with the following data is going to be used in an ambient temperature of 50°C (12 °F):

Voltage: 400 V
Current: 70 A (normal duty)
Power: 37 kW

Due to the high temperature the TSA model 52-070 will no longer be adequate for the purpose.

Derating 2%/°C is calculated for a temperature of 10°C above the rated:

10°C x 2% = 20%

Hence the nominal current must be derated by 20%.

To select a model that is adapted to the derating demands, the next higher rated model is checked, TSA52-085, rated for 85 A nominal current:

85 A - (20% x 85 A) = 68 A, which is lower than the required 70 A.

An even higher rated model is checked, TSA52-100, rated for 100 A nominal current:

100 A - (20% x 100 A) = 80 A, which is well above the required 70 A, and therefore TSA52-100 is the model to be selected in this case.

13.3.2 Derating at high altitude

The Emotron TSA softstarter can operate at an altitude up to 1,000 m (3280 ft) without derating.
Above 1,000 m (3280 ft) the thinner air will have several negative effects on the performance of the softstarter, therefore a derating is done.

For elevations in excess of 1,000 m (3280 ft), the derating of the nominal current is 1% per 100 m (328 ft). The Emotron TSA softstarter can be operated up to 4,000 m (13123 ft), in which case it can only be operated at 70% of the nominal current it was originally constructed for.

NOTE: If the unit has an I/O board the maximum altitude with derating is 2,000 m.

Example:
A motor with the following data is going to be used at 2,100 m (6890 ft) altitude:

Voltage: 400 V
Current: 42 A (normal duty)
Power: 22 kW

Due to the high altitude the TSA model 52-042 will no longer be adequate for the purpose.

The derating 1%/100 m 2%/°C (0.55%/ degree F) is calculated for the altitude above the rated:

2,100 - 1,000 (6890 - 3280 ft) = 1,100 meters (3610 ft) above rated altitude, that gives:

(1,100 m/100 m) x 1% = 11%

Hence the nominal current must be derated by 11%.

The next higher rated model, TSA52-056, rated for 56 A nominal current, will be derated to:

56 A - (11% x 56 A) = 49.8 A, which is well above the required 42 A, and therefore TSA52-056 could be selected in this case.

13.4 Control power- and I/O signal connectors

Table 49 Power board connections.

Terminal		Function	Electrical characteristics
PE		Protective Earth	Protective grounding
N		Control supply voltage	100-240 VAC ±10%
L			
21	NO	Programmable relay 1. Factory setting is "Operation" with indication by closing contact on terminals 21 to 22.	1-pole closing contact (NO), 250 VAC 8 A or 24 VDC 8 A resistive, 250 VAC, 3 A inductive. Min. 100 mA. See Warning.
22	C		
23	NO	Programmable relay 2. Factory setting is "Off" with indication by closing contact on terminals 23 to 24.	1-pole closing contact (NO), 250 VAC 8 A or 24 VDC 8 A resistive, 250 VAC, 3 A inductive. Min. 100 mA. See Warning.
24	C		
31	NO	Programmable relay 3. Factory setting is "Trip". Indication by closing contact on terminals 31 to 32 and opening contact on 32 to 33.	1-pole change-over contact (NO/NC), 250 VAC 8A or 24 VDC 8A resistive, 250 VAC, 3A inductive. Min. 100 mA. See Warning.
32	C		
33	NC		
69-70		PTC Thermistor input	Alarm level 2.4 kΩ. Switch back level 2.2 kΩ.

Table 50 Control board connections.

Terminal		Function	Electrical characteristics
11		Digital input 1. Factory setting is "Run FWD"	0-4 V --> 0; 8-27 V--> 1. Max. 37 V for 10 sec. Impedance: <3.3 VDC: 4.7 kΩ. - $\geq$3.3 VDC: 3.6 kΩ
12		Digital input 2. Factory setting is "Stop".	
13		Control signal supply voltage to analogue input.	+10 VDC ±5%. Max. current from +10 VDC: 10 mA. Short circuit-proof and overload-proof.
14		Analogue input, 0-10 V, 2-10 V, 0-20 mA and 4-20 mA/digital input. S1 jumper for U/I selection.	Impedance to terminal 15 (0 VDC) voltage signal: 20 kΩ, current signal: 250 Ω.
15		GND (common)	0 VDC signal ground
16		Digital input 3. Factory setting is "Set Ctrl 1"	0-4 V --> 0; 8-27 V--> 1. Max. 37 V for 10 sec. Impedance: <3.3 VDC: 4.7 kΩ. - $\geq$3.3 VDC: 3.6 kΩ
17		Digital input 4. Factory setting is "Reset"	
18		Control signal supply 1, voltage to digital input.	+24 VDC ±5%. Max. current from +24 VDC = 50 mA. Short circuit-proof and overload-proof.
19		Analogue output. Factory setting is "Current".	Analogue output contact: 0-10 V, 2-10 V; min load impedance 700 Ω 0-20 mA and 4-20 mA; max load impedance 700 Ω
20		Control signal supply 2, voltage to digital input.	+24 VDC ±5%. Max. current from +24 VDC = 50 mA. Short circuit-proof and overload-proof.

WARNING!
The same external supply voltage level (max 24 VDC or max 250 VAC) must be used for all three output relays (terminals 21-33).
Do not mix AC and DC voltage.
Make sure to use the same voltage level within this terminal section, otherwise the softstarter may be damaged.

Index

Appendix 1: Menu List

This is a list of the Emotron TSA menu parameters and their factory settings, along with communication settings for the most important bus formats. Complete lists with communication data and parameter set information could be downloaded from www. cgglobal.com or www.emotron.com.

Menu Parameters		Default settings	Customer settings				Modbus Inst. DeviceNet no.	Fieldbus format	Modbus format	Notes
			A	B	C	D				
100	StartWindow						9999			page 69
110	1st Line	El Power					43001	UInt	UInt	
120	2nd Line	Current					43002	UInt	UInt	
200	Main Setup									page 69
210	Operation									page 69
211	Language	English					43011	UInt	UInt	
212	Select Motor	M1					43012	UInt	UInt	
215	Action Ctrl									
2151	Run/Stp Ctr	Remote					43015	UInt	UInt	
2152	JogCtrl	Remote					43008	UInt	UInt	
216	Reset Ctrl	Remote+Keyb					43016	UInt	UInt	
217	Key Func									
2171	FunctionKey	Toggle					43735	UInt	UInt	
2173	LocRunCtrl	Keyboard					43010	UInt	UInt	
2174	FWD key	FWD					43736	UInt	UInt	
2175	REV key	Off					43737	UInt	UInt	
218	Lock Code?	0					43018	UInt, 1=1	UInt	
219	Rotation	FWD					43019	UInt	UInt	
21A	Level/Edge	Edge					43020	UInt	UInt	
21C	Units	SI					43750	UInt	UInt	
220	Motor Data									page 73
221	Motor Volts	[Motor] V					43041	Long, 1=0.1V	EInt	
222	Motor Freq	50Hz					43042	Long, 1=1Hz	EInt	

Menu Parameters		Default settings	Customer settings				Modbus Inst. DeviceNet no.	Fieldbus format	Modbus format	Notes
			A	B	C	D				
223	Motor Power	[Motor] W					43043	Long, 1=1W	EInt	
224	Motor Curr	[Motor] A					43044	Long, 1=0.1A	EInt	
225	Motor Speed	[Motor] rpm					43045	UInt, 1=1rpm	UInt	
226	Motor Poles	[Motor]					43046	Long, 1=1	EInt	
227	Motor Cosφ	[Motor]					43047	Long, 1=0.01	EInt	
228	Motor Vent	Self					43048	UInt	UInt	
230	Mot Protect									page 76
231	Mot I²t Alrm									
2311	Mot I²t AA	Soft Trip					43061	UInt	UInt	
2312	MotI²tCurr	100%					43062	Long, 1=1%	EInt	
2313	MotI²tClass	10					43758	UInt	UInt	
2314	Used Th Cap						31021	Long, 1=0.1%	EInt	
232	PT100 Alarm									
2321	PT100 AA	No action					43064	UInt	UInt	
2322	Motor Class	F 140°C					43065	UInt	UInt	
2323	PT100Inputs	PT100 1-3					43761	UInt	UInt	
233	PTC Alarm									
2331	PTC AA	No action					43762	UInt	UInt	
2332	PTC Inputs	PbPTC					43763	UInt	UInt	
234	StartLimit									
2341	StartLim AA	No action					43751	UInt	UInt	
2342	Starts/h	10					43752	UInt, 1=1	UInt	
2343	MinTBtwStrt	Off					43753	UInt, 1=1min	UInt	
2344	TimTNxtStrt	min					43754	UInt, 1=1min	UInt	
235	SnglPhLossAA	Hard Trip					43755	UInt	UInt	
236	CurrLim AA	Hard Trip					43756	UInt	UInt	
240	Set Handling									page 83
241	Select Set	A					43022	UInt	UInt	

Menu Parameters		Default settings	Customer settings				Modbus Inst. DeviceNet no.	Fieldbus format	Modbus format	Notes
			A	B	C	D				
242	Copy Set	A>B					43021	UInt	UInt	
243	Default>Set	A					43023	UInt	UInt	
244	Copy to CP	No Copy					43024	UInt	UInt	
245	Load from CP	No Copy					43025	UInt	UInt	
250	Autoreset									page 83
251	AutorstAtt									
2511	AllowedArst	Off					43071	UInt, 1=1	UInt	
2512	ActualArst	0					43069	UInt, 1=1	UInt	
252	MotProtArst									
2521	Motor I²t	Off					43073	Long, 1=1s	EInt	
2522	PT100	Off					43078	Long, 1=1s	EInt	
2523	PTC	Off					43084	Long, 1=1s	EInt	
2524	LockedRotor	Off					43086	Long, 1=1s	EInt	
2525	Curr Lim	Off					43772	Long, 1=1s	EInt	
253	ComErrArst	Off					43089	Long, 1=1s	EInt	
254	ProcProtArst									
2541	MaxAlarm	Off					43093	Long, 1=1s	EInt	
2542	MaxPAlarm	Off					43099	Long, 1=1s	EInt	
2543	MinPAlarm	Off					43070	Long, 1=1s	EInt	
2544	MinAlarm	Off					43091	Long, 1=1s	EInt	
2549	Ext Alarm 1	Off					43080	Long, 1=1s	EInt	
254A	Ext Alarm 2	Off					43097	Long, 1=1s	EInt	
255	SoftStrtProt									
2551	Over temp	Off					43072	Long, 1=1s	EInt	
2552	Start limit	Off					43771	Long, 1=1s	EInt	
256	MainsFailure									
2561	Phase input	Off					43773	Long, 1=1s	EInt	
2562	Volt Unbal	Off					43096	Long, 1=1s	EInt	

Menu Parameters		Default settings	Customer settings				Modbus Inst. DeviceNet no.	Fieldbus format	Modbus format	Notes
			A	B	C	D				
2563	OverVolt	Off					43077	Long, 1=1s	EInt	
2564	Undervolt	Off					43088	Long, 1=1s	EInt	
260	Serial Com									page 86
261	Com Type	RS232					43031	UInt	UInt	
262	Modbus RTU									
2621	Baudrate	9600					43032	UInt	UInt	
2622	Address	1					43033	UInt, 1=1	UInt	
263	Fieldbus									
2631	Address	62					43034	UInt, 1=1	UInt	
2632	PrData Mode	Basic					43035	UInt	UInt	
2633	Read/Write	RW					43036	UInt	UInt	
2634	AddPrValues	0					43039	UInt, 1=1	UInt	
264	Com Fault									page 88
2641	ComFltAA	No action					43037	UInt	UInt	
2642	ComFlt Time	0,5s					43038	Long, 1=0.1s	EInt	
265	Ethernet									page 88
2651	IP Address	**0**.0.0.0					42701	UInt, 1=1	UInt	
		0.**0**.0.0					42702	UInt, 1=1	UInt	
		0.0.**0**.0					42703	UInt, 1=1	UInt	
		0.0.0.**0**					42704	UInt, 1=1	UInt	
2652	MAC Address	**00**0000000000					42705	UInt, 1=1	UInt	
		00**00**00000000					42706	UInt, 1=1	UInt	
		0000**00**000000					42707	UInt, 1=1	UInt	
		000000**00**0000					42708	UInt, 1=1	UInt	
		00000000**00**00					42709	UInt, 1=1	UInt	
		0000000000**00**					42710	UInt, 1=1	UInt	

Menu Parameters		Default settings	Customer settings				Modbus Inst. DeviceNet no.	Fieldbus format	Modbus format	Notes
			A	B	C	D				
2653	Subnet Mask	0.0.0.0					42711	UInt, 1=1	UInt	
		0.0.0.0					42712	UInt, 1=1	UInt	
		0.0.0.0					42713	UInt, 1=1	UInt	
		0.0.0.0					42714	UInt, 1=1	UInt	
2654	Gateway	0.0.0.0					42715	UInt, 1=1	UInt	
		0.0.0.0					42716	UInt, 1=1	UInt	
		0.0.0.0					42717	UInt, 1=1	UInt	
		0.0.0.0					42718	UInt, 1=1	UInt	
2655	DHCP	Off					42719	UInt	UInt	
266	FB Signal									page 89
2661	FB Signal 1	0					42801	UInt, 1=1	UInt	
2662	FB Signal 2	0					42802	UInt, 1=1	UInt	
2663	FB Signal 3	0					42803	UInt, 1=1	UInt	
2664	FB Signal 4	0					42804	UInt, 1=1	UInt	
2665	FB Signal 5	0					42805	UInt, 1=1	UInt	
2666	FB Signal 6	0					42806	UInt, 1=1	UInt	
2667	FB Signal 7	0					42807	UInt, 1=1	UInt	
2668	FB Signal 8	0					42808	UInt, 1=1	UInt	
2669	FB Signal 9	0					42809	UInt, 1=1	UInt	
266A	FB Signal10	0					42810	UInt, 1=1	UInt	
266B	FB Signal11	0					42811	UInt, 1=1	UInt	
266C	FB Signal12	0					42812	UInt, 1=1	UInt	
266D	FB Signal13	0					42813	UInt, 1=1	UInt	
266E	FB Signal14	0					42814	UInt, 1=1	UInt	
266F	FB Signal15	0					42815	UInt, 1=1	UInt	
266G	FB Signal16	0					42816	UInt, 1=1	UInt	

Menu Parameters		Default settings	Customer settings				Modbus Inst. DeviceNet no.	Fieldbus format	Modbus format	Notes
			A	B	C	D				
269	FB Status									page 89
2691	Board Type						31081	UInt, 1=1	UInt	
2692	SUP-bit						31082	UInt, 1=1	UInt	
2693	State FB						31083	UInt, 1=1	UInt	
2694	Serial Nbr						31084	UInt, 1=1	UInt	
2695	FirmwareVer						31085	UInt, 1=1	UInt	
2696	CRC errors						31086	UInt, 1=1	UInt	
2697	MSG errors						31087	UInt, 1=1	UInt	
2698	TOUT ctr						31088	UInt, 1=1	UInt	
2699	FB Input						31089	UInt, 1=1	UInt	
269A	FB Output						31090	UInt, 1=1	UInt	
269B	Last instno						31091	UInt, 1=1	UInt	
300	Process									page 89
310	ProcessValue						31002	Long, 1= see Notes	EInt	1=0.001, 1rpm, 1%, 1°C, 0.001 as set in [322]
320	Proc Setting									
321	Proc Source	Off					43302	UInt	UInt	
322	Proc Unit	Off					43303	UInt	UInt	
323	User Unit	0					43304	UInt	UInt	
							43305	UInt	UInt	
							43306	UInt	UInt	
							43307	UInt	UInt	
							43308	UInt	UInt	
							43309	UInt	UInt	
324	Process Min	0					43310	Long, 1= see Notes	EInt	1=0.001, 1rpm, 1%, 1°C, 0.001 as set in [322]
325	Process Max	10					43311	Long, 1= see Notes	EInt	1=0.001, 1rpm, 1%, 1°C, 0.001 as set in [322]

Menu Parameters		Default settings	Customer settings				Modbus Inst. DeviceNet no.	Fieldbus format	Modbus format	Notes
			A	B	C	D				
330	StartSetting									page 91
331	Start Method	Lin Torq Ctr					43701	UInt, 1=1	UInt	
332	Init Torque	10%					43702	UInt, 1=1%	UInt	
333	EndTorqueSt	150%					43703	UInt, 1=1%	UInt	
334	Init Volt	30%					43704	UInt, 1=1%	UInt	
335	Curr Limit	Off					43705	UInt, 1=1%	UInt	
336	Start Time	10s					43706	UInt, 1=1s	UInt	
337	Torque Boost									
3371	TB CurrLim	Off					43707	UInt, 1=1%	UInt	
3372	TB Time	1s					43708	UInt, 1=0.1s	UInt	
340	StopSetting									page 94
341	Stop Method	Coast					43721	UInt, 1=1	UInt	
342	EndTorqueStp	0%					43722	UInt, 1=1%	UInt	
343	StepDwnVolt	100%					43723	UInt, 1=1%	UInt	
344	BrakeMethod	DynVectBrk					43724	UInt, 1=1	UInt	
345	Stop Time	10s					43725	UInt, 1=1s	UInt	
346	RevC Brk Dly	0,5s					43726	UInt, 1=0.001s	UInt	
347	Brk Strength	50%					43727	UInt, 1=1%	UInt	
348	DCB Strength	15%					43728	UInt, 1=1%	UInt	
349	SwitchToDCB	30%					43729	UInt, 1=1%	UInt	
34A	DCBrkPhases									
350	Jog									page 97
351	JogSpd FWD	10%					43731	UInt, 1=1%	UInt	
352	JogSpd REV	10%					43732	UInt, 1=1%	UInt	
353	Jog RampRate	0,2 s/%					43734	UInt, 1=0,1s/%	UInt	
400	Monitor/Prot									page 98
410	Load Monitor									
411	Max Alarm									

Menu Parameters		Default settings	Customer settings				Modbus Inst. DeviceNet no.	Fieldbus format	Modbus format	Notes
			A	B	C	D				
4111	MaxAlarmAct	No action					43775	UInt	UInt	
4112	MaxAlarmLev	116%					43776	Long, 1=1%	EInt	
4113	MaxAlarmDel	0,5s					43330	Long, 1=0.1s	EInt	
412	MaxPreAlarm									page 99
4121	MaxPreAlAct	No action					43777	UInt	UInt	
4122	MaxPreAlLev	108%					43778	Long, 1=1%	EInt	
4123	MaxPreAlDel	0,5s					43331	Long, 1=0.1s	EInt	
413	MinPreAlarm									
4131	MinPreAlAct	No action					43779	UInt	UInt	
4132	MinPreAlLev	92%					43742	Long, 1=1%	EInt	
4133	MinPreAlDel	0,5s					43332	Long, 1=0.1s	EInt	
414	Min Alarm									page 100
4141	MinAlarmAct	No action					43743	UInt	UInt	
4142	MinAlarmLev	84%					43744	Long, 1=1%	EInt	
4143	MinAlarmDel	0,5s					43333	Long, 1=0.1s	EInt	
416	Start Delay	10s					43324	Long, 1=1s	EInt	
417	Autoset									
4171	MaxAlarmMar	16%					43326	Long, 1=1%	EInt	
4172	MaxPreAlMar	8%					43327	Long, 1=1%	EInt	
4173	MinPreAlMar	8%					43328	Long, 1=1%	EInt	
4174	MinAlarmMar	16%					43329	Long, 1=1%	EInt	
4175	AutosetAlrm	No					43334	UInt	UInt	
4176	Normal Load	Off					43335	UInt, 1=1	UInt	
420	Process prot									page 103
421	Ext Alarm									
4211	ExtAlarm1AA	Hard Trip					43081	UInt	UInt	
4212	ExtAlarm2AA	Hard Trip					43764	UInt	UInt	
422	Rotor Locked									

Menu Parameters		Default settings	Customer settings				Modbus Inst. DeviceNet no.	Fieldbus format	Modbus format	Notes
			A	B	C	D				
4221	LockRot AA	No action					43362	UInt	UInt	
4222	LockRotTime	5,0s					43757	UInt, 1=0.1s	UInt	
4223	LockRotCurr	480%					43759	UInt, 1=1%	UInt	
430	Mains Prot									page 104
431	Volt Unbal									
4311	VoltUnbalAA	No action					43765	UInt	UInt	
4312	UnbalLevel	10%					43560	UInt, 1=1%	UInt	
4313	VoltUnbDel	1s					43561	UInt, 1=1s	UInt	
432	OverVolt									
4321	OverVoltAA	No action					43766	UInt	UInt	
4322	OverV Level	115%					43562	UInt, 1=1%	UInt	
4323	OverV Del	1s					43563	UInt, 1=1s	UInt	
433	UnderVolt									
4331	UnderVoltAA	No action					43767	UInt	UInt	
4332	UnderVLevel	85%					43564	UInt, 1=1%	UInt	
4333	UnderV Del	1s					43565	UInt, 1=1s	UInt	
434	PhseReversal									
4341	PhaseRevAA	No action					43768	UInt	UInt	
4342	AllowedSequ	L123					43566	1=1		
500	I/Os									page 106
510	An Inputs									page 106
511	AnIn Fc	Process Val					43201	UInt	UInt	
512	AnIn Setup	4-20mA					43202	UInt	UInt	

Menu Parameters		Default settings	Customer settings				Modbus Inst. DeviceNet no.	Fieldbus format	Modbus format	Notes
			A	B	C	D				
513	AnIn Advan									
5131	AnIn Min	4mA					43203	Long, 1=0.01	EInt	
5132	AnIn Max	20mA					43204	Long, 1=0.01	EInt	
5134	AnIn FcMin	Min					43206	UInt	UInt	
5135	AnIn VaMin	0					43541	Long, 1= see Notes	EInt	1=0.001, 1rpm, 1%, 1°C, 0.001 as set in [322]
5136	AnIn FcMax	Max					43207	UInt	UInt	
5137	AnIn VaMax	0					43551	Long, 1= see Notes	EInt	1=0.001, 1rpm, 1%, 1°C, 0.001 as set in [322]
5139	AnIn Filt	0,1s					43209	Long, 1= 0.001s	EInt	
513A	AnIn Enabl	On					43210	UInt	UInt	
520	Dig Inputs									page 108
521	DigIn 1	Run FWD					43241	UInt	UInt	
522	DigIn 2	Stop					43242	UInt	UInt	
523	DigIn 3	Set Ctrl 1					43243	UInt	UInt	
524	DigIn 4	Reset					43244	UInt	UInt	
529	B1 DigIn 1	Off					43501	UInt	UInt	
52A	B1 DigIn 2	Off					43502	UInt	UInt	
52B	B1 DigIn 3	Off					43503	UInt	UInt	
52C	B2 DigIn 1	Off					43504	UInt	UInt	
52D	B2 DigIn 2	Off					43505	UInt	UInt	
52E	B2 DigIn 3	Off					43506	UInt	UInt	
530	An Outputs									page 109
531	AnOut Fc	Current					43251	UInt	UInt	
532	AnOut Setup	4-20mA					43252	UInt	UInt	
533	AnOut Advan									
5331	AnOut Min	4mA					43253	Long, 1=0.01	EInt	
5332	AnOut Max	20mA					43254	Long, 1=0.01	EInt	

Menu Parameters		Default settings	Customer settings				Modbus Inst. DeviceNet no.	Fieldbus format	Modbus format	Notes
			A	B	C	D				
5334	AnOutFcMin	Min					43256	UInt	UInt	
5335	AnOutVaMin	0					43545	Long, 1= see Notes	EInt	1W, 0.1Hz, 0.1A, 0.1V, 1rpm, 1% or 0.001 as set in [322]
5336	AnOutFcMax	Max					43257	UInt	UInt	
5337	AnOutVaMax	0					43555	Long, 1= see Notes	EInt	1W, 0.1Hz, 0.1A, 0.1V, 1rpm, 1% or 0.001 as set in [322]
550	Relays									page 112
551	Relay 1	Operation					43273	UInt	UInt	
552	Relay 2	Off					43274	UInt	UInt	
553	Relay 3	Trip					43275	UInt	UInt	
554	B1 Relay 1	Off					43511	UInt	UInt	
555	B1 Relay 2	Off					43512	UInt	UInt	
556	B1 Relay 3	Off					43513	UInt	UInt	
557	B2 Relay 1	Off					43514	UInt	UInt	
558	B2 Relay 2	Off					43515	UInt	UInt	
559	B2 Relay 3	Off					43516	UInt	UInt	
55D	Relay Advan									
55D1	Relay1 Mode	N.O					43276	UInt	UInt	
55D2	Relay2 Mode	N.O					43277	UInt	UInt	
55D3	Relay3 Mode	N.O					43278	UInt	UInt	
55D4	B1R1 Mode	N.O					43521	UInt	UInt	
55D5	B1R2 Mode	N.O					43522	UInt	UInt	
55D6	B1R3 Mode	N.O					43523	UInt	UInt	
55D7	B2R1 Mode	N.O					43524	UInt	UInt	
55D8	B2R2 Mode	N.O					43525	UInt	UInt	
55D9	B2R3 Mode	N.O					43526	UInt	UInt	
560	Virtual I/Os									page 115
561	VIO 1 Dest	Off					43281	UInt	UInt	
562	VIO 1 Source	Off					43282	UInt	UInt	

Menu Parameters		Default settings	Customer settings				Modbus Inst. DeviceNet no.	Fieldbus format	Modbus format	Notes
			A	B	C	D				
563	VIO 2 Dest	Off					43283	UInt	UInt	
564	VIO 2 Source	Off					43284	UInt	UInt	
565	VIO 3 Dest	Off					43285	UInt	UInt	
566	VIO 3 Source	Off					43286	UInt	UInt	
567	VIO 4 Dest	Off					43287	UInt	UInt	
568	VIO 4 Source	Off					43288	UInt	UInt	
569	VIO 5 Dest	Off					43289	UInt	UInt	
56A	VIO 5 Source	Off					43290	UInt	UInt	
56B	VIO 6 Dest	Off					43291	UInt	UInt	
56C	VIO 6 Source	Off					43292	UInt	UInt	
56D	VIO 7 Dest	Off					43293	UInt	UInt	
56E	VIO 7 Source	Off					43294	UInt	UInt	
56F	VIO 8 Dest	Off					43295	UInt	UInt	
56G	VIO 8 Source	Off					43296	UInt	UInt	
600	Logic&Timers									page 116
610	Comparators									
611	CA1 Setup									
6111	CA1 Value	Current					43400	UInt	UInt	
6112	CA1 LevelHI	30					43401	Long, 1= see Notes	EInt	1W, 0.1Hz, 0.1A, 0.1V, 1rpm, 1%, 0.1°C, 1kWh, 1h or 0.001 as set in [322]
6113	CA1 LevelLO	20					43402	Long, 1= see Notes	EInt	1W, 0.1Hz, 0.1A, 0.1V, 1rpm, 1%, 0.1°C, 1kWh, 1h or 0.001 as set in [322]
6114	CA1 Type	Hysteresis					43403	UInt	UInt	
6116	CA1 Set Dly	00:00:00					43405	UInt, 1=1h	UInt	
							43406	UInt, 1=1m	UInt	
							43407	UInt, 1=0.1s	UInt	

Menu Parameters		Default settings	Customer settings				Modbus Inst. DeviceNet no.	Fieldbus format	Modbus format	Notes
			A	B	C	D				
6117	CA1 Res Dly	00:00:00					43408	UInt, 1=1h	UInt	
							43409	UInt, 1=1m	UInt	
							43410	UInt, 1=0.1s	UInt	
6118	CA1 Tmr Val	00:00:00					42600	UInt, 1=1h	UInt	
							42601	UInt, 1=1m	UInt	
							42602	UInt, 1=0.1s	UInt	
612	CA2 Setup									page 120
6121	CA2 Value	Current					43411	UInt	UInt	
6122	CA2 LevelHI	30					43412	Long, 1= see Notes	EInt	1W, 0.1Hz, 0.1A, 0.1V, 1rpm, 1%, 0.1°C, 1kWh, 1h or 0.001 as set in [322]
6123	CA2 LevelLO	20					43413	Long, 1= see Notes	EInt	1W, 0.1Hz, 0.1A, 0.1V, 1rpm, 1%, 0.1°C, 1kWh, 1h or 0.001 as set in [322]
6124	CA2 Type	Hysteresis					43414	UInt	UInt	
6126	CA2 Set Dly	00:00:00					43416	UInt, 1=1h	UInt	
							43417	UInt, 1=1m	UInt	
							43418	UInt, 1=0.1s	UInt	
6127	CA2 Res Dly	00:00:00					43419	UInt, 1=1h	UInt	
							43420	UInt, 1=1m	UInt	
							43421	UInt, 1=0.1s	UInt	
6128	CA2 Tmr Val	00:00:00					42603	UInt, 1=1h	UInt	
							42604	UInt, 1=1m	UInt	
							42605	UInt, 1=0.1s	UInt	
613	CA3 Setup									page 120
6131	CA3 Value	Current					43422	UInt	UInt	
6132	CA3 LevelHI	30					43423	Long, 1= see Notes	EInt	1W, 0.1Hz, 0.1A, 0.1V, 1rpm, 1%, 0.1°C, 1kWh, 1h or 0.001 as set in [322]

Menu Parameters		Default settings	Customer settings				Modbus Inst. DeviceNet no.	Fieldbus format	Modbus format	Notes
			A	B	C	D				
6133	CA3 LevelLO	20					43424	Long, 1= see Notes	EInt	1W, 0.1Hz, 0.1A, 0.1V, 1rpm, 1%, 0.1°C, 1kWh, 1h or 0.001 as set in [322]
6134	CA3 Type	Hysteresis					43425	UInt	UInt	
6136	CA3 Set Dly	00:00:00					43427	UInt, 1=1h	UInt	
							43428	UInt, 1=1m	UInt	
							43429	UInt, 1=0.1s	UInt	
6137	CA3 Res Dly	00:00:00					43430	UInt, 1=1h	UInt	
							43431	UInt, 1=1m	UInt	
							43432	UInt, 1=0.1s	UInt	
6138	CA3 Tmr Val	00:00:00					42606	UInt, 1=1h	UInt	
							42607	UInt, 1=1m	UInt	
							42608	UInt, 1=0.1s	UInt	
614	CA4 Setup									page 120
6141	CA4 Value	Current					43433	UInt	UInt	
6142	CA4 LevelHI	30					43434	Long, 1= see Notes	EInt	1W, 0.1Hz, 0.1A, 0.1V, 1rpm, 1%, 0.1°C, 1kWh, 1h or 0.001 as set in [322]
6143	CA4 LevelLO	20					43435	Long, 1= see Notes	EInt	1W, 0.1Hz, 0.1A, 0.1V, 1rpm, 1%, 0.1°C, 1kWh, 1h or 0.001 as set in [322]
6144	CA4 Type	Hysteresis					43436	UInt	UInt	
6146	CA4 Set Dly	00:00:00					43438	UInt, 1=1h	UInt	
							43439	UInt, 1=1m	UInt	
							43440	UInt, 1=0.1s	UInt	
6147	CA4 Res Dly	00:00:00					43441	UInt, 1=1h	UInt	
							43442	UInt, 1=1m	UInt	
							43443	UInt, 1=0.1s	UInt	
6148	CA4 Tmr Val	00:00:00					42609	UInt, 1=1h	UInt	
							42610	UInt, 1=1m	UInt	

Menu Parameters		Default settings	Customer settings				Modbus Inst. DeviceNet no.	Fieldbus format	Modbus format	Notes
			A	B	C	D				
							42611	UInt, 1=0.1s	UInt	
615	CD1 Setup									page 120
6151	CD1	Operation					43444	UInt	UInt	
6152	CD1 Set Dly	00:00:00					43445	UInt, 1=1h	UInt	
							43446	UInt, 1=1m	UInt	
							43447	UInt, 1=0.1s	UInt	
6153	CD1 Res Dly	00:00:00					43448	UInt, 1=1h	UInt	
							43449	UInt, 1=1m	UInt	
							43450	UInt, 1=0.1s	UInt	
6154	CD1 Tmr Val	00:00:00					42612	UInt, 1=1h	UInt	
							42613	UInt, 1=1m	UInt	
							42614	UInt, 1=0.1s	UInt	
616	CD2 Setup									page 120
6161	CD2	DigIn 1					43451	UInt	UInt	
6162	CD2 Set Dly	00:00:00					43452	UInt, 1=1h	UInt	
							43453	UInt, 1=1m	UInt	
							43454	UInt, 1=0.1s	UInt	
6163	CD2 Res Dly	00:00:00					43455	UInt, 1=1h	UInt	
							43456	UInt, 1=1m	UInt	
							43457	UInt, 1=0.1s	UInt	
6164	CD2 Tmr Val	00:00:00					42615	UInt, 1=1h	UInt	
							42616	UInt, 1=1m	UInt	
							42617	UInt, 1=0.1s	UInt	
617	CD3 Setup									page 120
6171	CD3	Trip					43458	UInt	UInt	
6172	CD3 Set Dly	00:00:00					43459	UInt, 1=1h	UInt	
							43460	UInt, 1=1m	UInt	
							43461	UInt, 1=0.1s	UInt	

Menu Parameters		Default settings	Customer settings				Modbus Inst. DeviceNet no.	Fieldbus format	Modbus format	Notes
			A	B	C	D				
6173	CD3 Res Dly	00:00:00					43462	UInt, 1=1h	UInt	
							43463	UInt, 1=1m	UInt	
							43464	UInt, 1=0.1s	UInt	
6174	CD3 Tmr Val	00:00:00					42618	UInt, 1=1h	UInt	
							42619	UInt, 1=1m	UInt	
							42620	UInt, 1=0.1s	UInt	
618	CD4 Setup									page 120
6181	CD4	Ready					43465	UInt	UInt	
6182	CD4 Set Dly	00:00:00					43466	UInt, 1=1h	UInt	
							43467	UInt, 1=1m	UInt	
							43468	UInt, 1=0.1s	UInt	
6183	CD4 Res Dly	00:00:00					43469	UInt, 1=1h	UInt	
							43470	UInt, 1=1m	UInt	
							43471	UInt, 1=0.1s	UInt	
6184	CD4 Tmr Val	00:00:00					42621	UInt, 1=1h	UInt	
							42622	UInt, 1=1m	UInt	
							42623	UInt, 1=0.1s	UInt	
620	Logics									page 121
621	Logic 1									
6211	L1 Expr	((1.2).3).4					43472	UInt	UInt	
6212	L1 Input 1	CA1					43473	UInt	UInt	
6213	L1 Op 1	&					43474	UInt	UInt	
6214	L1 Input 2	!A2					43475	UInt	UInt	
6215	L1 Op 2	&					43476	UInt	UInt	
6216	L1 Input 3	CA3					43477	UInt	UInt	
6217	L1 Op 3	&					43478	UInt	UInt	
6218	L1 Input 4	CA4					43479	UInt	UInt	

Menu Parameters		Default settings	Customer settings				Modbus Inst. DeviceNet no.	Fieldbus format	Modbus format	Notes
			A	B	C	D				
6219	L1 Set Dly	00:00:00					43480	UInt, 1=1h	UInt	
		00:00:00					43481	UInt, 1=1m	UInt	
		00:00:00					43482	UInt, 1=0.1s	UInt	
621A	L1 Res Dly						43483	UInt, 1=1h	UInt	
							43484	UInt, 1=1m	UInt	
							43485	UInt, 1=0.1s	UInt	
621B	L1 Tmr Val						42624	UInt, 1=1h	UInt	
							42625	UInt, 1=1m	UInt	
							42626	UInt, 1=0.1s	UInt	
622	Logic 2									page 124
6221	L2 Expr	((1.2).3).4					43486	UInt	UInt	
6222	L2 Input 1	CA1					43487	UInt	UInt	
6223	L2 Op 1	&					43488	UInt	UInt	
6224	L2 Input 2	!A2					43489	UInt	UInt	
6225	L2 Op 2	&					43490	UInt	UInt	
6226	L2 Input 3	CA1					43491	UInt	UInt	
6227	L2 Op 3	&					43492	UInt	UInt	
6228	L2 Input 4	!A2					43493	UInt	UInt	
6229	L2 Set Dly	00:00:00					43494	UInt, 1=1h	UInt	
							43495	UInt, 1=1m	UInt	
							43496	UInt, 1=0.1s	UInt	
622A	L2 Res Dly	00:00:00					43497	UInt, 1=1h	UInt	
							43498	UInt, 1=1m	UInt	
							43499	UInt, 1=0.1s	UInt	
622B	L2 Tmr Val	00:00:00					42627	UInt, 1=1h	UInt	
							42628	UInt, 1=1m	UInt	
							42629	UInt, 1=0.1s	UInt	

Menu Parameters		Default settings	Customer settings				Modbus Inst. DeviceNet no.	Fieldbus format	Modbus format	Notes
			A	B	C	D				
623	Logic 3									page 124
6231	L3 Expr	((1.2).3).4					43780	UInt	UInt	
6232	L3 Input 1	CA1					43781	UInt	UInt	
6233	L3 Op 1	&					43782	UInt	UInt	
6234	L3 Input 2	!A2					43783	UInt	UInt	
6235	L3 Op 2	&					43784	UInt	UInt	
6236	L3 Input 3	CA3					43785	UInt	UInt	
6237	L3 Op 3	&					43786	UInt	UInt	
6238	L3 Input 4	CA4					43787	UInt	UInt	
6239	L3 Set Dly	00:00:00					43788	UInt, 1=1h	UInt	
							43789	UInt, 1=1m	UInt	
							43790	UInt, 1=0.1s	UInt	
623A	L3 Res Dly	00:00:00					43791	UInt, 1=1h	UInt	
							43792	UInt, 1=1m	UInt	
							43793	UInt, 1=0.1s	UInt	
623B	L3 Tmr Val	00:00:00					42630	UInt, 1=1h	UInt	
							42631	UInt, 1=1m	UInt	
							42632	UInt, 1=0.1s	UInt	
624	Logic 4									page 124
6241	L4 Expr	((1.2).3).4					43794	UInt	UInt	
6242	L4 Input 1	CA1					43795	UInt	UInt	
6243	L4 Op 1	&					43796	UInt	UInt	
6244	L4 Input 2	!A2					43797	UInt	UInt	
6245	L4 Op 2	&					43798	UInt	UInt	
6246	L4 Input 3	CA1					43799	UInt	UInt	
6247	L4 Op 3	&					43800	UInt	UInt	
6248	L4 Input 4	!A2					43801	UInt	UInt	

Menu Parameters		Default settings	Customer settings				Modbus Inst. DeviceNet no.	Fieldbus format	Modbus format	Notes
			A	B	C	D				
6249	L4 Set Dly	00:00:00					43802	UInt, 1=1h	UInt	
							43803	UInt, 1=1m	UInt	
							43804	UInt, 1=0.1s	UInt	
624A	L4 Res Dly	00:00:00					43805	UInt, 1=1h	UInt	
							43806	UInt, 1=1m	UInt	
							43807	UInt, 1=0.1s	UInt	
624B	L4 Tmr Val	00:00:00					42633	UInt, 1=1h	UInt	
							42634	UInt, 1=1m	UInt	
							42635	UInt, 1=0.1s	UInt	
630	Timers									page 124
631	Timer1									
6311	Timer1 Trig	Off					43808	UInt	UInt	
6312	Timer1 Mode	Delay					43809	UInt	UInt	
6313	Timer1 Dly	00:00:00					43810	UInt, 1=1h	UInt	
							43811	UInt, 1=1m	UInt	
							43812	UInt, 1=0.1s	UInt	
6314	Timer1 T1	00:00:00					43813	UInt, 1=1h	UInt	
							43814	UInt, 1=1m	UInt	
							43815	UInt, 1=0.1s	UInt	
6315	Timer1 T2	00:00:00					43816	UInt, 1=1h	UInt	
							43817	UInt, 1=1m	UInt	
							43818	UInt, 1=0.1s	UInt	
6316	Timer1 Val	00:00:00					42636	UInt, 1=1h	UInt	
							42637	UInt, 1=1m	UInt	
							42638	UInt, 1=0.1s	UInt	
632	Timer2									page 125
6321	Timer2 Trig	Off					43819	UInt	UInt	
6322	Timer2 Mode	Delay					43820	UInt	UInt	

Menu Parameters		Default settings	Customer settings				Modbus Inst. DeviceNet no.	Fieldbus format	Modbus format	Notes
			A	B	C	D				
6323	Timer2 Dly	00:00:00					43821	UInt, 1=1h	UInt	
							43822	UInt, 1=1m	UInt	
							43823	UInt, 1=0.1s	UInt	
6324	Timer2 T1	00:00:00					43824	UInt, 1=1h	UInt	
							43825	UInt, 1=1m	UInt	
							43826	UInt, 1=0.1s	UInt	
6325	Timer2 T2	00:00:00					43827	UInt, 1=1h	UInt	
							43828	UInt, 1=1m	UInt	
							43829	UInt, 1=0.1s	UInt	
6326	Timer2 Val	00:00:00					42639	UInt, 1=1h	UInt	
							42640	UInt, 1=1m	UInt	
							42641	UInt, 1=0.1s	UInt	
633	Timer3									page 125
6331	Timer3 Trig	Off					43830	UInt	UInt	
6332	Timer3 Mode	Delay					43831	UInt	UInt	
6333	Timer3 Dly	00:00:00					43832	UInt, 1=1h	UInt	
							43833	UInt, 1=1m	UInt	
							43834	UInt, 1=0.1s	UInt	
6334	Timer3 T1	00:00:00					43835	UInt, 1=1h	UInt	
							43836	UInt, 1=1m	UInt	
							43837	UInt, 1=0.1s	UInt	
6335	Timer3 T2	00:00:00					43838	UInt, 1=1h	UInt	
							43839	UInt, 1=1m	UInt	
							43840	UInt, 1=0.1s	UInt	
6336	Timer3 Val	00:00:00					42642	UInt, 1=1h	UInt	
							42643	UInt, 1=1m	UInt	
							42644	UInt, 1=0.1s	UInt	

Menu Parameters		Default settings	Customer settings				Modbus Inst. DeviceNet no.	Fieldbus format	Modbus format	Notes
			A	B	C	D				
634	Timer4									page 125
6341	Timer4 Trig	Off					43841	UInt	UInt	
6342	Timer4 Mode	Delay					43842	UInt	UInt	
6343	Timer4 Dly	00:00:00					43843	UInt, 1=1h	UInt	
							43844	UInt, 1=1m	UInt	
							43845	UInt, 1=0.1s	UInt	
6344	Timer4 T1	00:00:00					43846	UInt, 1=1h	UInt	
							43847	UInt, 1=1m	UInt	
							43848	UInt, 1=0.1s	UInt	
6345	Timer4 T2	00:00:00					43849	UInt, 1=1h	UInt	
							43850	UInt, 1=1m	UInt	
							43851	UInt, 1=0.1s	UInt	
6346	Timer4 Val	00:00:00					42645	UInt, 1=1h	UInt	
							42646	UInt, 1=1m	UInt	
							42647	UInt, 1=0.1s	UInt	
640	Flip flops									page 125
641	Flip flop 1									
6411	F1 mode	Reset					43852	UInt	UInt	
6412	F1 set	Off					43853	UInt	UInt	
6413	F1 reset	Off					43854	UInt	UInt	
6414	F1 Set Dly	00:00:00					43855	UInt, 1=1h	UInt	
							43856	UInt, 1=1m	UInt	
							43857	UInt, 1=0.1s	UInt	
6415	F1 Res Dly	00:00:00					43858	UInt, 1=1h	UInt	
							43859	UInt, 1=1m	UInt	
							43860	UInt, 1=0.1s	UInt	

Menu Parameters		Default settings	Customer settings				Modbus Inst. DeviceNet no.	Fieldbus format	Modbus format	Notes
			A	B	C	D				
6416	F1 Tmr Val	00:00:00					42648	UInt, 1=1h	UInt	
							42649	UInt, 1=1m	UInt	
							42650	UInt, 1=0.1s	UInt	
642	Flip flop 2									page 127
6421	F2 mode	Reset					43861	UInt	UInt	
6422	F2 set	Off					43862	UInt	UInt	
6423	F2 reset	Off					43863	UInt	UInt	
6424	F2 Set Dly	00:00:00					43864	UInt, 1=1h	UInt	
							43865	UInt, 1=1m	UInt	
							43866	UInt, 1=0.1s	UInt	
6425	F2 Res Dly	00:00:00					43867	UInt, 1=1h	UInt	
							43868	UInt, 1=1m	UInt	
							43869	UInt, 1=0.1s	UInt	
6426	F2 Tmr Val	00:00:00					42651	UInt, 1=1h	UInt	
							42652	UInt, 1=1m	UInt	
							42653	UInt, 1=0.1s	UInt	
643	Flip flop 3									page 127
6431	F3 mode	Set					43870	UInt	UInt	
6432	F3 set	Off					43871	UInt	UInt	
6433	F3 reset	Off					43872	UInt	UInt	
6434	F3 Set Dly	00:00:00					43873	UInt, 1=1h	UInt	
							43874	UInt, 1=1m	UInt	
							43875	UInt, 1=0.1s	UInt	
6435	F3 Res Dly	00:00:00					43876	UInt, 1=1h	UInt	
							43877	UInt, 1=1m	UInt	
							43878	UInt, 1=0.1s	UInt	

Menu Parameters		Default settings	Customer settings				Modbus Inst. DeviceNet no.	Fieldbus format	Modbus format	Notes
			A	B	C	D				
6436	F3 Tmr Val	00:00:00					42654	UInt, 1=1h	UInt	
							42655	UInt, 1=1m	UInt	
							42656	UInt, 1=0.1s	UInt	
644	Flip flop 4									page 127
6441	F4 mode	Edge					43879	UInt	UInt	
6442	F4 set	Off					43880	UInt	UInt	
6443	F4 reset	Off					43881	UInt	UInt	
6444	F4 Set Dly	00:00:00					43882	UInt, 1=1h	UInt	
							43883	UInt, 1=1m	UInt	
							43884	UInt, 1=0.1s	UInt	
6445	F4 Res Dly	00:00:00					43885	UInt, 1=1h	UInt	
							43886	UInt, 1=1m	UInt	
							43887	UInt, 1=0.1s	UInt	
6446	F4 Tmr Val	00:00:00					42657	UInt, 1=1h	UInt	
							42658	UInt, 1=1m	UInt	
							42659	UInt, 1=0.1s	UInt	
650	Counters									page 127
651	Counter 1									
6511	C1 Trig	Off					43888	UInt	UInt	
6512	C1 Reset	Off					43889	UInt	UInt	
6513	C1 Trip val	0					43890	UInt, 1=1	UInt	
6514	C1 Value						31070	UInt, 1=1	UInt	
652	Counter 2									
6521	C2 Trig	Off					43891	UInt	UInt	
6522	C2 Reset	Off					43892	UInt	UInt	
6523	C2 Trip val	0					43893	UInt, 1=1	UInt	
6524	C2 Value						31071	UInt, 1=1	UInt	

Menu Parameters		Default settings	Customer settings				Modbus Inst. DeviceNet no.	Fieldbus format	Modbus format	Notes
			A	B	C	D				
660	Clock logic									page 128
661	Clock 1									
6611	Clk1TimeON	00:00:00					43600	Long, 1=1h	EInt	
							43601	Long, 1=1m	EInt	
							43602	Long, 1=1s	EInt	
6612	Clk1TimeOff	00:00:00					43603	Long, 1=1h	EInt	
							43604	Long, 1=1m	EInt	
							43605	Long, 1=1s	EInt	
6613	Clk1DateOn	0					43606	Long, 1=1	EInt	
6614	Clk1DateOff	0					43609	Long, 1=1	EInt	
6615	Clk1Weekday	0					43612	UInt, 1=1	UInt	
662	Clock 2									page 129
6621	Clk2TimeON	00:00:00					43615	Long, 1=1h	EInt	
							43616	Long, 1=1m	EInt	
							43617	Long, 1=1s	EInt	
6622	Clk2TimeOff	00:00:00					43618	Long, 1=1h	EInt	
							43619	Long, 1=1m	EInt	
							43620	Long, 1=1s	EInt	
6623	Clk2DateOn	0					43621	Long, 1=1	EInt	
6624	Clk2DateOff	0					43624	Long, 1=1	EInt	
6625	Clk2Weekday	0					43627	Long, 1=1	EInt	
700	Oper/Status									page 129
710	Operation									
711	Process Val						31002	Long, 1= see Notes	EInt	1rpm, 1%, 1°C, 0.001 as set in [322]
713	Torque						31003	Long, 1=0.1Nm	EInt	
714	Torque						31004	Long, 1=1%	EInt	
715	Shaft Power						31005	Long, 1=1W	EInt	

Menu Parameters		Default settings	Customer settings				Modbus Inst. DeviceNet no.	Fieldbus format	Modbus format	Notes
			A	B	C	D				
716	Shaft Power						31006	UInt, 1=1%	UInt	
717	El Power						31007	Long, 1=1W	EInt	
718	RMS Current						31008	Long, 1=0.1A	EInt	
719	L main volt						31009	Long, 1=0.1V	EInt	
71A	Heatsnk Tmp						31010	Long, 1=0.1°C	EInt	
71B	PT100B1 123						31011	Long, 1=1°C	EInt	
							31012	Long, 1=1°C	EInt	
							31013	Long, 1=1°C	EInt	
71C	PT100B2 123						31014	Long, 1=1°C	EInt	
							31015	Long, 1=1°C	EInt	
							31016	Long, 1=1°C	EInt	
71D	Current I1						31017	Long, 1=0.1A	EInt	
71E	Current I2						31018	Long, 1=0.1A	EInt	
71F	Current I3						31019	Long, 1=0.1A	EInt	
71G	L12 voltage						31020	Long, 1=0.1V	EInt	
71H	L13 voltage						31021	Long, 1=0.1V	EInt	
71I	L23 voltage						31022	Long, 1=0.1V	EInt	
71J	Phase seq.						31023	UInt	UInt	
71K	Used Th Cap						31024	Long, 1=0.1%	EInt	
720	Status									page 131
721	TSA Status						31025	UInt	UInt	
722	Warning						31026	UInt	UInt	
723	DigInStatus						31027	UInt, 1=1	UInt	
724	RelayStatus						31028	UInt, 1=1	UInt	
725	AnalogueIn						31029	Long, 1=1%	EInt	
726	AnalogueOut						31030	Long, 1=1%	EInt	
727	IO StatusB1						31031	UInt, 1=1	UInt	
728	IO StatusB2						31032	UInt, 1=1	UInt	

Menu Parameters		Default settings	Customer settings				Modbus Inst. DeviceNet no.	Fieldbus format	Modbus format	Notes
			A	B	C	D				
72A	CA1-4						31050	UInt, 1=1	UInt	
72B	CD1-4						31051	UInt, 1=1	UInt	
72C	Logic 1-4						31052	UInt, 1=1	UInt	
72D	Timer 1-4						31053	UInt, 1=1	UInt	
72E	FlipFlop1-4						31072	UInt, 1=1	UInt	
72F	Counter 1-2						31073	UInt, 1=1	UInt	
72G	TtoNxtStart						31036	UInt, 1=1min	UInt	
730	Stored Val									page 134
731	Run Time	00:00:00					31074	Long, 1=1h	EInt	
							31075	Long, 1=1m	EInt	
							31076	Long, 1=1s	EInt	
7311	Reset RunTm	No					7	UInt	UInt	
732	Mains Time	00:00:00					31077	Long, 1=1h	EInt	
							31078	Long, 1=1m	EInt	
							31079	Long, 1=1s	EInt	
733	Energy	...kWh					31080	Long, 1=1Wh	EInt	
7331	Rst Energy	No					6	UInt	UInt	
740	Clock									page 134
741	Time	00:00:00					42920	Long, 1=1h	EInt	
							42921	Long, 1=1m	EInt	
							42922	Long, 1=1s	EInt	
742	Date	0					42923	Long, 1=1	EInt	
743	Weekday	Monday					42926	Long	EInt	
744	DST	No					43058	UInt	UInt	
800	View TripLog									page 135
810	(Trip log list 1)									
810	Trip Message						31101	UInt, 1=1	UInt	
811	Operation									

Menu Parameters		Default settings	Customer settings				Modbus Inst. DeviceNet no.	Fieldbus format	Modbus format	Notes
			A	B	C	D				
8111	Process Val						31102	Long, 1= see Notes	EInt	1rpm, 1%, 1°C, 0.001 as set in [322]
8113	Torque						31104	Long, 1=0.1Nm	EInt	
8114	Torque						31105	Long, 1=1%	EInt	
8115	Shaft Power						31106	Long, 1=1W	EInt	page 135
8116	ShaftPower%						31107	UInt, 1=1%	UInt	
8117	El Power						31108	Long, 1=1W	EInt	
8118	RMS Current						31109	Long, 1=0.1A	EInt	
8119	L main volt						31110	Long, 1=0.1V	EInt	
811A	Heatsnk Tmp						31111	Long, 1=0.1°C	EInt	
811B	PT100B1 123						31112	Long, 1=1°C	EInt	
							31113	Long, 1=1°C	EInt	
							31114	Long, 1=1°C	EInt	
811C	PT100B2 123						31115	Long, 1=1°C	EInt	
							31116	Long, 1=1°C	EInt	
							31117	Long, 1=1°C	EInt	
811D	Current I1						31118	Long, 1=0.1A	EInt	
811E	Current I2						31119	Long, 1=0.1A	EInt	
811F	Current I3						31120	Long, 1=0.1A	EInt	
811G	L12 voltage						31121	Long, 1=0.1V	EInt	
811H	L13 voltage						31122	Long, 1=0.1V	EInt	
811I	L23 voltage						31123	Long, 1=0.1V	EInt	
811J	Phase seq.						31124	UInt	UInt	
811K	Used Th Cap						31125	Long, 1=0.1%	EInt	
812	Status									page 135
8121	TSA Status						31126	UInt	UInt	
8122	DigInStatus						31127	UInt, 1=1	UInt	
8123	RelayStatus						31128	UInt, 1=1	UInt	

Menu Parameters		Default settings	Customer settings				Modbus Inst. DeviceNet no.	Fieldbus format	Modbus format	Notes
			A	B	C	D				
8124	AnalogueIn						31129	Long, 1=1%	EInt	
8125	AnalogueOut						31130	Long, 1=1%	EInt	
8126	IO StatusB1						31131	UInt, 1=1	UInt	
8127	IO StatusB2						31132	UInt, 1=1	UInt	
8129	CA1-4						31134	UInt, 1=1	UInt	
812A	CD1-4						31135	UInt, 1=1	UInt	
812B	Logic 1-4						31136	UInt, 1=1	UInt	
812C	Timer 1-4						31137	UInt, 1=1	UInt	
812D	FlipFlop1-4						31138	UInt, 1=1	UInt	
812E	Counter 1-2						31139	UInt, 1=1	UInt	
812F	TtoNxtStart						31140	UInt, 1=1min	UInt	
812G	Time	00:00:00					31141	Long, 1=1h	EInt	
							31142	Long, 1=1m	EInt	
							31143	Long, 1=1s	EInt	
812H	Date						31144	Long, 1=1	EInt	
813	Stored Val									page 135
8131	Run Time	00:00:00					31147	Long, 1=1h	EInt	
							31148	Long, 1=1m	EInt	
							31149	Long, 1=1s	EInt	
8132	Mains Time	00:00:00					31150	Long, 1=1h	EInt	
							31151	Long, 1=1m	EInt	
							31152	Long, 1=1s	EInt	

Menu Parameters		Default settings	Customer settings				Modbus Inst. DeviceNet no.	Fieldbus format	Modbus format	Notes
			A	B	C	D				
820	(Trip log list 2)									page 136
830	(Trip log list 3)									
840	(Trip log list 4)						Same parameters as for menu group 810 (Trip log list 1). Communication data in Appendix 2.			
850	(Trip log list 5)									
860	(Trip log list 6)									
870	(Trip log list 7)									
880	(Trip log list 8)									
890	(Trip log list 9)									
8A0	Reset Trip L	No					8	UInt	UInt	page 136
900	System Data									page 136
920	TSA Data									
921	TSA Type	-					42300	UInt, 1=1	UInt	
922	Software						31038	UInt	UInt	
							31039	UInt	UInt	
9221	Build Info						31040	UInt	UInt	
							31041	UInt	UInt	
							31042	UInt	UInt	
							31043	UInt	UInt	
							31044	UInt	UInt	
							31045	UInt	UInt	
923	Unit Name	0					42301	UInt	UInt	
							42302	UInt	UInt	
							42303	UInt	UInt	
							42304	UInt	UInt	
							42305	UInt	UInt	
							42306	UInt	UInt	

Menu Parameters		Default settings	Customer settings				Modbus Inst. DeviceNet no.	Fieldbus format	Modbus format	Notes
			A	B	C	D				
							42307	UInt	UInt	
							42308	UInt	UInt	
							42309	UInt	UInt	
							42310	UInt	UInt	
							42311	UInt	UInt	
							42312	UInt	UInt	

Appendix 2: Trip message communication data

		Trip log list
Modbus Instance no/ DeviceNet no:	31101-31154	810
	31201-31254	820
	31301-31354	830
	31401-31454	840
	31501-31554	850
	31601-31654	860
	31701-31754	870
	31801-31854	880
	31901-31954	890
		Trip log list
Profibus slot/index	121/245-122/43	810
	122/90-122/143	820
	122/190-122/243	830
	123/35-123/88	840
	123/135--123/188	850
	123/235-124/33	860
	124/80-124/133	870
	124/180-124/233	880
	125/25-125/78	890
		Trip log list
Profinet IO index	1101-1154	810
	1201-1254	820
	1301-1354	830
	1401-1454	840
	1501-1554	850
	1601-1654	860
	1701-1754	870
	1801-1854	880
	1901-1954	890
Fieldbus format	See respective parameter.	
Modbus format		