DS7
Soft starter

Powering Business Worldwide

Emergency On Call Service
Please call your local representative:
http://www.eaton.com/moeller/aftersales
or
Hotline of the After Sales Service:
+49 (0) 180 5 223822 (de, en)
AfterSalesEGBonn@eaton.com

Original Operating Instructions
The German-language edition of this document is the original operating manual.

Translation of the original operating manual
All editions of this document other than those in German language are translations of the original German manual.

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See revision protocol in the "About this manual" chapter

Production: René Wiegand
Translation: globaldocs GmbH

Danger!
Dangerous electrical voltage!

Before commencing the installation

- Disconnect the power supply of the device.
- Ensure that devices cannot be accidentally restarted.
- Verify isolation from the supply.
- Earth and short circuit.
- Cover or enclose neighbouring units that are live.
- Follow the engineering instructions (AWA) of the device concerned.
- Only suitably qualified personnel in accordance with EN 50110-1/-2 (VDE 0105 Part 100) may work on this device/system.
- Before installation and before touching the device ensure that you are free of electrostatic charge.
- The functional earth (FE) must be connected to the protective earth (PE) or to the potential equalisation. The system installer is responsible for implementing this connection.
- Connecting cables and signal lines should be installed so that inductive or capacitive interference does not impair the automation functions.
- Install automation devices and related operating elements in such a way that they are well protected against unintentional operation.
- Suitable safety hardware and software measures should be implemented for the I/O interface so that a line or wire breakage on the signal side does not result in undefined states in the automation devices.
- Ensure a reliable electrical isolation of the low voltage for the 24 volt supply. Only use power supply units complying with IEC 60364-4-41 (VDE 0100 Part 410) or HD 384.4.41 S2.
- Deviations of the mains voltage from the rated value must not exceed the tolerance limits given in the specifications, otherwise this may cause malfunction and dangerous operation.
- Emergency stop devices complying with IEC/EN 60204-1 must be effective in all operating modes of the automation devices. Unlatching the emergency-stop devices must not cause restart.
- Devices that are designed for mounting in housings or control cabinets must only be operated and controlled after they have been installed with the housing closed. Desktop or portable units must only be operated and controlled in enclosed housings.

- Measures should be taken to ensure the proper restart of programs interrupted after a voltage dip or failure. This should not cause dangerous operating states even for a short time. If necessary, emergency-stop devices should be implemented.
- Wherever faults in the automation system may cause damage to persons or property, external measures must be implemented to ensure a safe operating state in the event of a fault or malfunction (for example, by means of separate limit switches, mechanical interlocks etc.).

Contents

0 About This Manual

This manual contains special information that you will need to connect a soft starter correctly and configure it to your requirements using the parameters. The details apply to the indicated hardware and software versions. The manual describes all construction sizes of the DS7 series soft starters. Differences and special characteristics of each rating level and construction size are listed accordingly.

0.1 List of revisions

The following significant amendments have been introduced since previous issues:

Publication date	Page	Key word	New	Modification	deleted
07/12	139	Chapter „SmartWire-DT“	✓		
	All	Complete revision	✓		
11/11	85	Size 2 (16 to 32 A) – Isolated relay contacts Size 3 and 4 (41 to 200 A) – Isolated relay contacts		✓	
06/11	All	Complete revision	✓	✓	
04/11	53	Configuration options of DS7	✓		
	210	Power supply dependent data (further)	✓		
	17	Power values		✓	
07/10		First issue			

0.2 Additional device manuals

Further information can be found in the following manuals:

On “Soft starter"

- “Soft Starter Design” – MN03902001Z-EN
  (previous description AWB8250-1346GB)

On “SmartWire-DT"

- “SmartWire-DT The System“ – MN05006002Z-EN
  (previous designation AWB2723-1617en)
- “SmartWire-DT Units” – MN05006001Z-EN
  (previous designation AWB2723-1613en)
- “SmartWire-DT Gateways” – MN05013002Z-EN
  (previous designation AWB2723-1612en)
- “XIOC Signal Modules” – MN05002002Z-EN
  (previous designation AWB2725-1452GB)

→ The above mentioned manuals and further information can be found in the internet:
http://www.eaton.com/moeller → Support

0.3 Sources

[1] Profile Drive Technology, PROFIdrive Technical Specification for PROFIBUS and PROFINET, Version 4.1, May 2006; Order No: 3.172

0.4 Target group

The content of the manual is written for engineers and electricians. A specialist knowledge of electrical engineering is needed for commissioning.

The chapter "SmartWire-DT" is intended for automation technicians and engineers. Detailed knowledge of the field bus systems used is presumed. In addition you should be familiar with the handling of the SmartWire-DT system.

0.5 Writing conventions

Symbols with the following meaning are used in this manual:

▶ indicates actions to be taken.

Indicates useful tips.

NOTICE

Warns about the possibility of material damage.

CAUTION

Warns of the possibility of hazardous situations that may possibly cause slight injury.

DANGER

Warns of hazardous situations that result in serious injury or death.

0.6 Abbreviations

The following abbreviations are used in this manual:

Abbreviation	Meaning
BG	Size („Baugröße")
DS	Default settings
DS7-SWD	DS7 soft starter with SmartWire-DT (simplified notation for devices with part no. DS7-34D…)
EMC	Electromagnetic compatibility
GND	Ground (0-V-potential)
LED	Light Emitting Diode (LED)
PDS	Power Drive System (magnet system)
RCD	Residual Current Device
SWD	SmartWire-DT
TOR	Top of Ramp
t-Start	Ramp time for start voltage
t-Stop	Ramp time for voltage reduction
U-Start	Start voltage
UL	Underwriters Laboratories
U_{LN}	Mains voltage
$+U_S/-U_S$	Control Voltage

0.7 Mains supply voltages

The rated operating voltages stated in the following table are based on the standard values.

In ring networks (as found in Europe) the rated operating voltage at the transfer point of the power supply companies is the same as the value in the consumer networks (e.g. 230 V or 400 V).

In star networks (as found in North America), the rated operating voltage at the transfer point of the utility companies is higher than in the consumer network.
Example: 120 V → 115 V, 240 V → 230 V, 480 V → 460 V.

The wide tolerance range of the DS7 soft starters allows for voltage drops of 10 % and a voltage drop of an additional 4 %, as well as an excess voltage of 10 % that are permissible in consumer supply networks.

The rated operational data of the mains voltage is always based on the mains frequencies 50/60 Hz (50 Hz - 5 % - 60 Hz +5 %).

0.8 Units

Every physical dimension included in this manual uses international metric system units, otherwise known as SI (Système International d'Unités) units. For the purpose of the equipment's UL certification, some of these dimensions are accompanied by their equivalents in imperial units.

Designation	US-American value	SI value	Conversion value	US-American designation
Length	1 inch (")	25.4 mm	0.0394	inch
Power	1 HP = 1.014 PS	0.7457 kW	1.341	horsepower
Torque	1 lbf in	0.113 Nm	8.851	pound-force inches
Temperature	1 °F (T_F)	-17.222 °C (T_C)	$T_F = T_C \times 9/5 + 32$	Fahrenheit
Speed	1 rpm	1 min^{-1}	1	Revolutions per minute
Weight	1 lb	0.4536 kg	2.205	pound

1 Device series DS7

1.1 Front View

The following two devices are used as examples of the DS7 series:

DS7-340SX032N0-N (left) – Without SmartWire-DT interface
DS7-34DSX032N0-D (right) – With SmartWire-DT interface

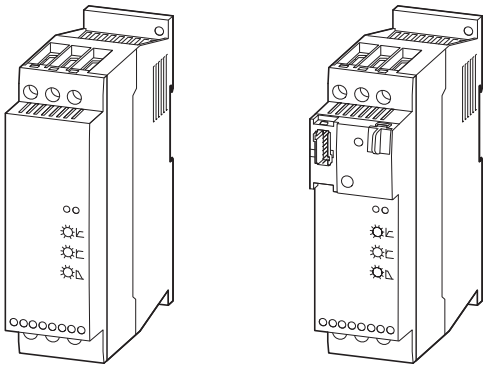


Figure 1: Front view of DS7 soft starter
Left: Without SmartWire-DT interface
Right: With SmartWire-DT interface

1.2 Features

DS7 series soft starters comply with the IEC/EN 60947-4-2 product standard and are provided with the following standard features:

Table 1: Features of the DS7 soft starters

Feature	Instance
Compact design	✓
Adjustable start voltage	✓
Separately adjustable ramp times for start and stop	✓
Digital inputs	✓ 1 (size 1), 2 (size 2, size 3, size 4)
Relay output	✓ 1 (size 1), 2 (size 2, size 3, size 4)
Standard controller card and parameters over the entire performance range	✓
Communication	✓ via SmartWire-DT (with types DS7-34D…-D)

1.3 System overview

The following figure shows a DS7 soft starter together with (optional) accessories.

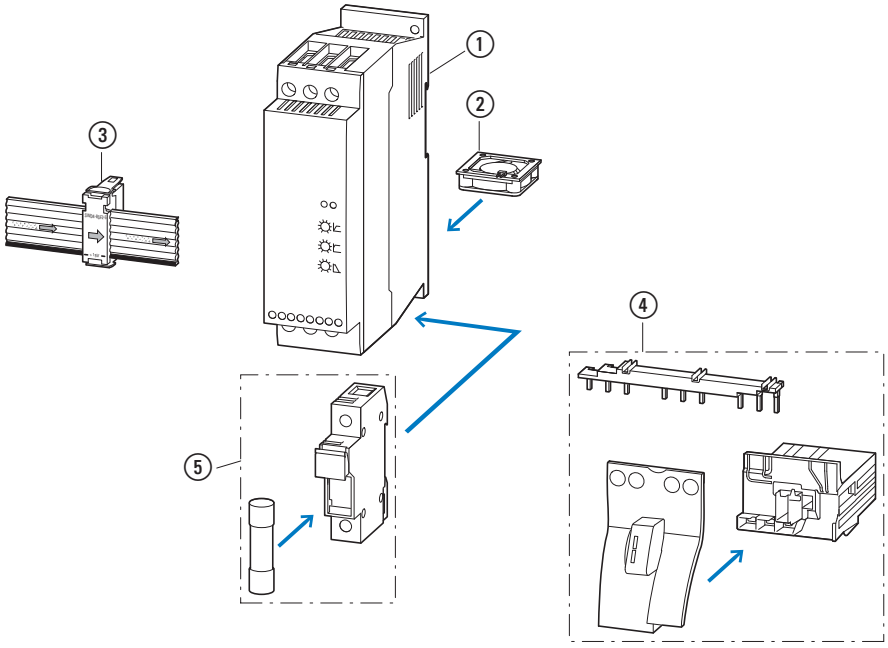


Figure 2: System overview, DS7 soft starters

① DS7 soft starters
② Device fan (DS7-FAN-…)
③ SmartWire-DT Communication System
④ Mounting accessories
⑤ Superfast semiconductor fuse and fuse base

1.4 Description

1.4.1 DS7-340…, DS7-342…

The following drawing shows a DS7 soft starter (without SmartWire-DT) of size 2.

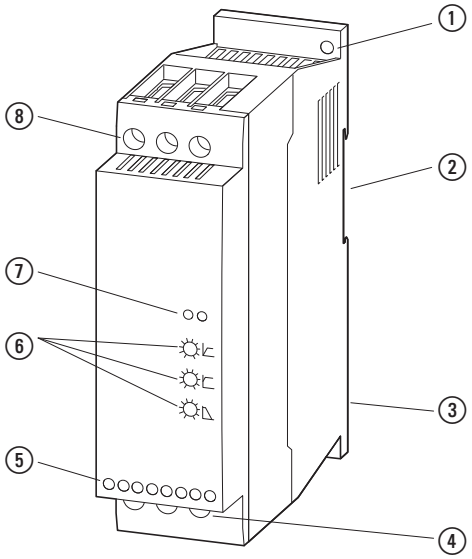


Figure 3: Description of the DS7-34…-N soft starter

① Fixing holes (screw fastening)
② Cutout for mounting on mounting rail (DIN EN 50022-35)
③ Device fan (mounting space on back)
④ Connection terminals of the power section, motor connection (2T1, 4T2, 6T3)
⑤ Control signal terminals
⑥ Potentiometer (U-Start, t-Start, t-Stop)
⑦ LEDs (RUN, error)
⑧ Connection terminals of the power section, mains voltage (1L1, 3L2, 3L3)

1.4.2 DS7-34D…

The following drawing shows a DS7-34D… soft starter with a SmartWire-DT connection (hereafter referred to with the abbreviation "DS7-SWD") of size 2.

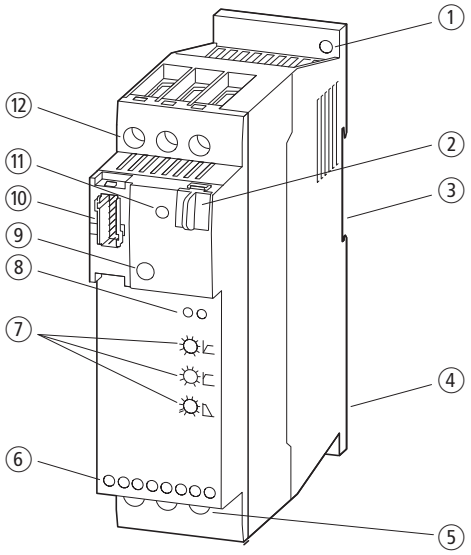


Figure 4: Description of the DS7-34D…-D soft starter

① Fixing holes (screw fastening)
② Data interface for PKE32-COM
③ Cutout for mounting on mounting rail (DIN EN 50022-35)
④ Device fan (mounting space on back)
⑤ Connection terminals of the power section, motor connection (2T1, 4T2, 6T3)
⑥ Control signal terminals
⑦ Potentiometer (U-Start, t-Start, t-Stop)
⑧ Light-emitting diodes (RUN, Error): DS7 diagnostic LEDs
⑨ 1-0-A switch
⑩ Connection for SmartWire-DT external device plug
⑪ LED: SWD diagnosis
⑫ Connection terminals of the power section, mains voltage (1L1, 3L2, 3L3)

→ The SmartWire-DT external device plug with an adapted SmartWire-DT ribbon cable is connected to the DS7-SWD soft starter via connection ⑩.
Detailed instructions on adapting the SmartWire-DT external device plug (SWD4-8SF2-5) to the 8-pole SmartWire-DT cable are provided in chapter "Fitting external device plugs SWD4-8SF2-5" in manual MN05006002Z-EN, "SmartWire-DT – The System".

→ SmartWire-DT diagnostic LED ⑪ shows the communication status, the status of the DS7-SWD soft starter, and the switching command via the SmartWire-DT system.
For more information on the SmartWire-DT diagnostic LED, refer to → Section 8.10.4, „SmartWire-DT diagnostic LEDs", page 203.

1.5 Key to part numbers

The soft starters of the DS7 series are assigned part numbers according to the following key to part numbers:

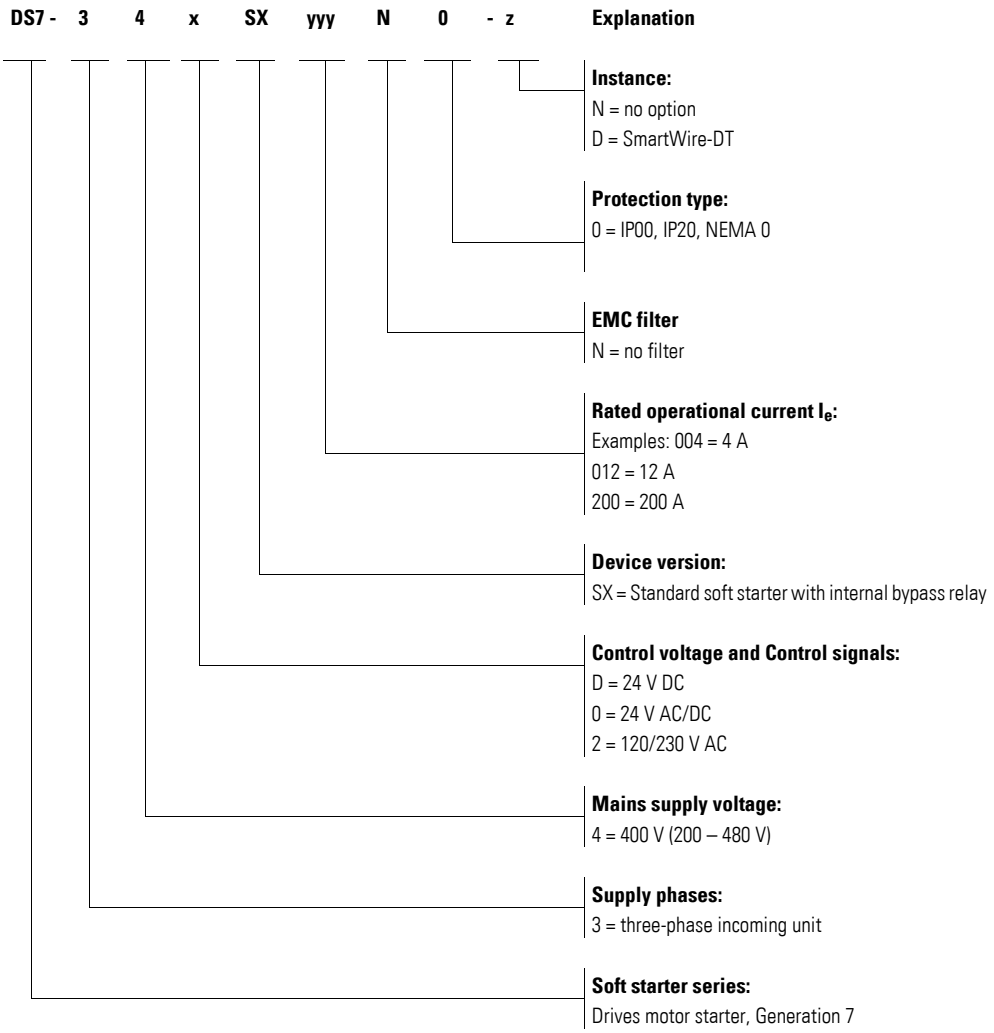
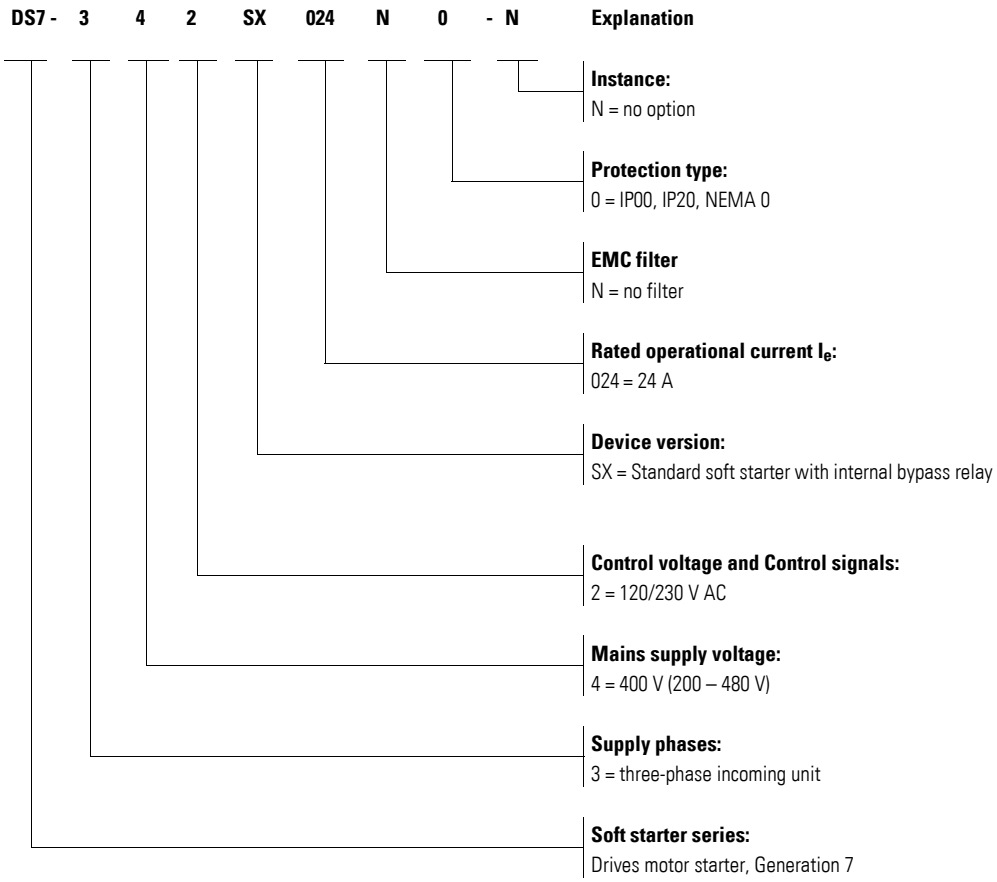


Figure 5: DS7 key to part numbers

Example key to part numbers

An example of the key to part numbers is shown below:



1.6 Checking the Delivery

Before opening the packaging go over the nameplate on the packaging and check for whether the delivered soft starter is the same part no. as the one you ordered.

The DS7 series soft starter are carefully packed and prepared for shipment. These devices should only be shipped in their original packaging with suitable transportation materials. Please take note of the labels and instructions on the packaging, as well as of those meant for the unpacked device.

Open the packaging with adequate tools and inspect the contents immediately after receipt in order to ensure that they are complete and undamaged.

The packaging must contain the following parts:

- A soft starter DS7-34…-N or DS7-34…-D
- an instructional leaflet IL (see table below).

If the delivered items are damaged, incomplete, or incorrect, please notify the responsible sales office immediately.

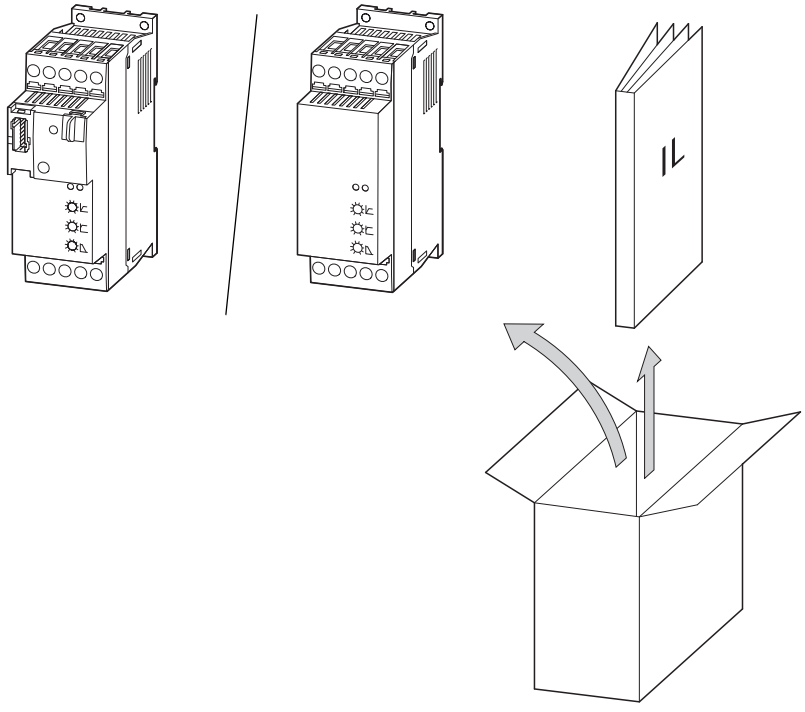


Figure 6: Equipment supplied

The soft starter version is indicated by its part number on the ratings plate.

The letters in the illustration below have the following meanings:

- x: Control voltage U_s or U_c
- yyy: Rated operational current I_e
- z: Options and versions

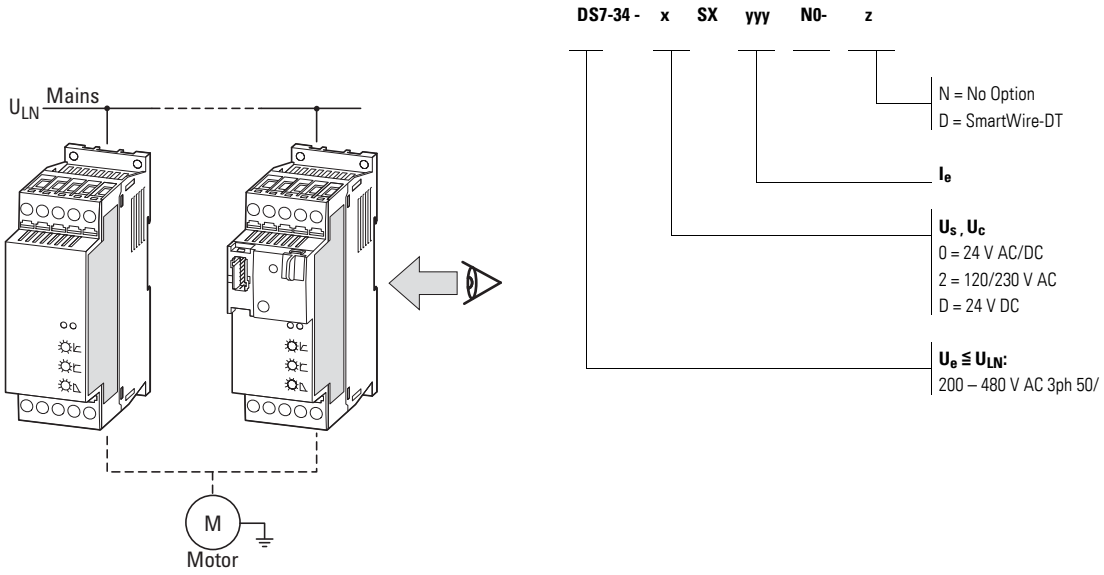


Figure 7: Position of rating plate and part number

The following instruction leaflets are available for the various sizes of soft starter DS7:

Table 2: Instructional leaflet for soft starter series DS7

instructional leaflet	Size	for device type	Rated operational current I_e [A]
IL03902003Z (previous designation AWA8250-2541)	BG1	DS7-34…SX004… DS7-34…SX007… DS7-34…SX009… DS7-34…SX012…	004 = 4 A 007 = 7 A 009 = 9 A 012 = 12 A
IL03902004Z (previous designation AWA8250-2542)	BG2	DS7-34…SX016… DS7-34…SX024… DS7-34…SX032…	016 = 16 A 024 = 24 A 032 = 32 A
IL03902005Z (previous designation AWA8250-2543)	BG3	DS7-34…SX041… DS7-34…SX055… DS7-34…SX070… DS7-34…SX081… DS7-34…SX100…	041 = 41 A 055 = 55 A 070 = 70 A 081 = 81 A 100 = 100 A
	BG4	DS7-34…SX135… DS7-34…SX160… DS7-34…SX200…	135 = 135 A 160 = 160 A 200 = 200 A

1.7 Technical data

1.7.1 Assigned motor power

The following motor outputs can be connected if using three-phase asynchronous motors and a load suitable for soft starters.

Table 3: Assigned rated motor outputs for three-phase asynchronous motors

Part no.	Soft starter's rated operational current		Assigned motor output[1] at				
	I_e (IEC)[2] [A]	I_e (UL)[3, 4] [A]	230 V 50 Hz [kW]	400 V 50 Hz [kW]	200 V 60 Hz [HP]	230 V 60 Hz [HP]	460 V 60 Hz [HP]
DS7-34xSX004N0-…	4	4.2	0.75	1.5	¾	1	2
DS7-34xSX007N0-…	7	7.6	1.5	3	2	2	5
DS7-34xSX009N0-…	9	9.6	2.2	4	2	3	5
DS7-34xSX012N0-…	12	14	3	5.5	3	3	10
DS7-34xSX016N0-…	16	17.5	4	7.5	5	5	10
DS7-34xSX024N0-…	24	25.3	5.5	11	7½	7½	15
DS7-34xSX032N0-…	32	34	7.5	15	10	10	25
DS7-34xSX041N0-…	41	42	11	22	10	15	30
DS7-34xSX055N0-…	55	54	15	30	15	20	40
DS7-34xSX070N0-…	70	68	15	37	20	25	50
DS7-34xSX081N0-…	81	80	22	45	25	30	60
DS7-34xSX100N0-…	100	96	30	55	30	30	75
DS7-34xSX135N0-…	135	130	30	75	40	50	100
DS7-34xSX160N0-…	160	156	45	90	50	60	125
DS7-34xSX200N0-…	200	192	55	110	60	75	150

1) Motor shaft output for normal four-pole internally and surface cooled three-phase asynchronous motors (1500 rpm at 50 Hz or 1800 rpm at 60 Hz)
2) IEC: Mains voltage = Motor voltage (at load) 230 V, 400 V
3) Reduced overload current acc. to UL 508C
4) Mains voltage 208 V / 240 V / 480 V ↔ motor voltage 200 V / 230 V / 460 V

The following motor outputs can be connected if using single-phase AC motors (asynchronous motor with capacitor) and a load suitable for soft starters in industrial applications.

Table 4: Assigned rated motor outputs for AC motors

Part no.	Soft starter's rated operational current		Assigned motor output[1] at			
	I_e (IEC)[2]	I_e (UL)[3, 4]	230 V 50 Hz	200 V 60 Hz	208 V 60 Hz	230 V 60 Hz
	[A]	[A]	[kW]	[HP]	[HP]	[HP]
DS7-34xSX004N0-…	4	4.2	0.37	¼	⅓	⅓
DS7-34xSX007N0-…	7	7.6	0.75	½	½	¾
DS7-34xSX009N0-…	9	9.6	1.1	¾	1	1
DS7-34xSX012N0-…	12	14	1.5	1	1½	1½
DS7-34xSX016N0-…	16	17.5	2.2	2	2	2
DS7-34xSX024N0-…	24	25.3	3	3	3	3
DS7-34xSX032N0-…	32	34	4	5	5	5

1) Motor shaft output for normal four-pole internal and surface-cooled AC motors (1500 rpm at 50 Hz or 1800 rpm at 60 Hz)
2) IEC: Mains voltage = Motor voltage (at load) 230 V
3) Reduced overload current acc. to UL 508C
4) Mains voltage 208 V / 240 V ↔ motor voltage 200 V / 230 V

→ For single-phase AC motors the rated operating current depends on mains frequency and capacitor.

Example:
240 V, 50/60 Hz, 1.5/2.1 A
1300/1350 rpm, CAP 5.0 µF

1.7.2 General data

General	
Product standard	IEC/EN 60 947-4-2
Approvals, certificates	CE, UL, CSA, CCC, Gost
Mounting position	vertical
Protection type	IP20 for the front and operator control and operating elements. IP20 on all sides in size 1 IP00 on all sides in size 2, 3, 4
Busbar tag shroud	Finger- and back-of-hand proof
Mechanical shock resistance	8 g/11 ms
Vibration resistance to EN 60721-3-2	2M2
Power section	
Rated operational voltage	200 – 480 V AC ±10 %
Mains frequency	50/60 Hz ±5 %
Overload cycle to EN 60947-4-2	AC53a: 3-5: 75-10
minimum load current	0.5 A
Rated impulse withstand voltage U_{imp} 1.2/50 µs	4 kV
Rated insulation voltage U_i	500 V
Overvoltage category/pollution degree	II/2
Control section	
Supply-/control voltage	Depending on variant: 24 V AC / 24 V DC (18 – 30 V ±0 %) 120 – 230 V AC (98 – 264 V ±0 %)
Mains frequency (with AC versions)	50/60 Hz ±5 %
Rated impulse withstand voltage U_{imp}	2.5 kV
Rated insulation voltage U_i	300 V
Overvoltage category	II
soft start functions	
Ramp times	
Acceleration	1 – 30 s
Delay	0 (= Fee coasting), 1 – 30 s
Start voltage (= switch-off voltage)	30 – 100 %
Controlling and signalling	
Control inputs	depending on variant 2 with size 1 4 with size 2 5 with size 3, size 4
Relays	depending on variant 1 with size 1 (non-isolated) 2 with size 2, 3, 4 (isolated)
LED	2 at DS7 without SWD (DS7-340…, DS7-342…) 3 at DS7 without SWD (DS7-34D…)

1.7.3 Device version

DS7 soft starters are classified in accordance with IEC 60947-4-2:2011, Table 1 (Functional possibilities of semiconductor motor control devices). The soft starters belonging to the DS7 series correspond to device version 1.

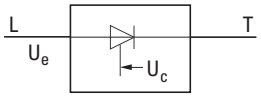


Figure 8: Semi-conductor–Motor–Controlgear

1.7.4 Permissible environmental conditions

The following shows the permissible values for the ambient influences on soft starters of the DS7 series.

Table 5: Permissible environmental conditions

Property		Value
Installation altitude[1)]		Up to 1000 m a.s.l.; higher than this up to 2000 m with a current reduction of 1 % I_e per 100 m
Temperature		
	Operation	-5 to +40 °C without current reduction, up to +60 °C with a current reduction of 1 % I_e per Kelvin, if the DS7-FAN-032 device fan is fitted up to +60 °C with a current reduction of 2 % I_e per Kelvin without device fan
	Storage	-25 up to +60 °C continuous
	Transport	-25 up to +60 °C continuous
Climatic proofing		damp heat, cyclic, to DIN IEC Part 68 2-10 damp heat constant to DIN IEC 68 Part 2-3
Permissible humidity rating		Relative air humidity 85 %, non condensing
Permissible pollution		Pollution degree 2 to EN 60947-1

1) Higher installation altitude upon request

1.8 Intended use

The devices of the DS7 series

- are not devices for household use, and are designed exclusively for use in commercial applications,
- can be used in the described system configurations in the industrial environment,
- are not machines in the sense of the EC Machinery Safety Directive,
- comply in a typical drive configuration with the requirements of the EU EMC Directive, the EU Low Voltage Directive, as well as the specified standards.

The soft starters of the DS7 series are electrical apparatus for installation in the control panels of electrical systems or machines. They are designed for the soft starting of single-phase or three-phase AC motors mounted in a machine or for assembly with other machine or plant components.

When installing in machines, the soft starters must not be commissioned until it is determined that the machine complies with the safety requirements of the Machinery Safety Directive 89/392/EC. The EN 60204 standard must also be observed here. Commissioning is only permitted if the requirements of the EMC Directive (89/336/EC) have been observed.

The soft starters of the DS7 series meet the requirements of the Low Voltage Directive 73/23/EC and the product standard EN 60947-4-2.

The user of the equipment is responsible for ensuring that the machine use complies with the relevant EU Directives. Any other usage constitutes improper use.

At the output of a DS7 soft starter (terminals U, V, W) you must not

- connect any capacitive load (e.g. phase compensation capacitors),
- do not connect any further soft starters (parallel connection on output side).

Observe the technical data and connection requirements. These are shown on the rating plate of the soft starter as well as in this documentation.

1.9 Maintenance and inspection

Soft starters DS7 are maintenance-free if the general rated operational data and the specific technical data (→ Section 1.7, „Technical data“) and version particulars are observed. External factors can, however, affect the lifespan and function of soft starters DS7.

We therefore recommend that the devices are checked regularly and the following maintenance measures are carried out at the specified intervals.

Maintenance measures	Maintenance interval
Clean cooling vents (cooling slits)	Please enquire
Check the fan function	6 - 24 months (depending on the environment)
Filter in the switching cabinet doors (see manufacturer specifications)	6 - 24 months (depending on the environment)
Check the tightening torques of the terminals (control signal terminals, power terminals)	Regularly
Check connection terminals and all metallic surfaces for corrosion	6 - 24 months; when stored, no more than 12 months later (depending on the environment)
Motor cable	According to manufacturer specifications, no later than 5 years

Individual subassemblies of soft starter DS7 can not be replaced or repaired.

1.10 Storage

If soft starter DS7 is stored before use, suitable ambient conditions must be ensured at the site of storage:

- Storage temperature: -25 - +60 °C,
- Relative average air humidity: < 85 %, no condensation.

1.11 Service and warranty

In the unlikely event that you have a problem with your soft starter DS7, please contact your local sales office.

When you call, have the following data ready:

- the exact part number (see ratings plate),
- the date of purchase,
- a detailed description of the problem that has occurred in connection with the soft starter DS7.

If some of the information printed on the rating plate is not legible, please state only the data which are clearly legible.

Information concerning the guarantee can be found in the Terms and Conditions Eaton Industries GmbH.

24-hour hotline: +49 (0)1805 223 822

E-Mail: AfterSalesEGBonn@eaton.com

1.12 Disposal

The soft starters of the DS7 series can be disposed of as electronic scrap in accordance with national regulations.

1.13 Selection criteria

The soft starter DS7 ③ is selected on the basis of the supply voltage U_{LN} of the supply network ① and the rated operational current of the assigned motor ②. The circuit type (Δ / Y) of the motor must be selected according to the supply voltage ①. The rated output current Ie of the soft starter must be greater than/equal to the rated motor current.

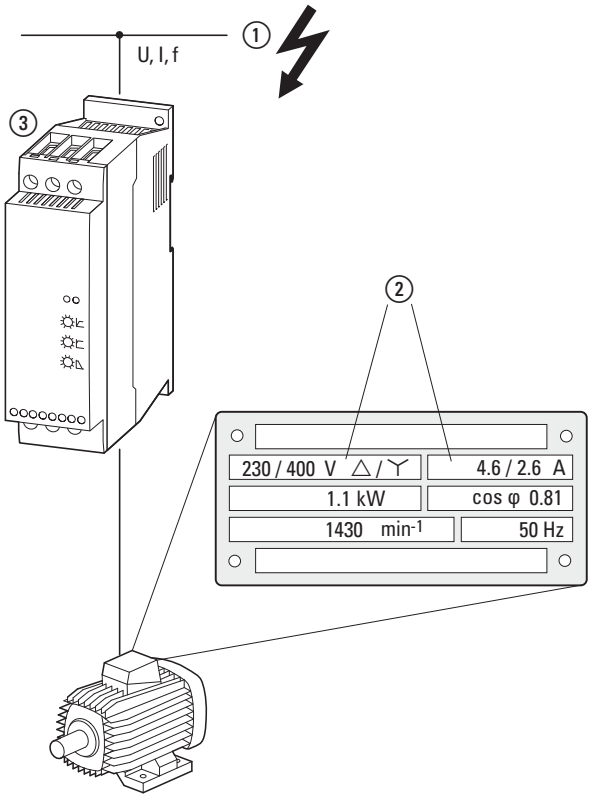


Figure 9: Selection criteria

When selecting the drive, the following criteria must be taken into account:

- Type of motor
  (e.g.three-phase asynchronous motor)
- Mains voltage = rated operating voltage of the motor
  (e.g. 3 AC ~ 400 V),
- Rated motor current (recommended value, dependent on the circuit type and the power supply),
- Load torque (quadratic, linear),
- Starting torque,
- Ambient air temperature (rated value +40 °C).

→ With heavy starting duty motors, the soft starter must be overdimensioned in terms of its overload capacity.

→ For single-phase AC motors (→ Page 18) soft starters are selected according to mains voltage (= rated motor voltage) and the motor rated current relative to the mains frequency.

1.14 Function

DS7 soft starters use phase control for controlling the voltage of the supply network smoothly from an adjustable start value up to 100 % of the rated value U_{LN}. This voltage control enables the inrush current of a three-phase asynchronous motor to be limited and its starting torque to be considerably reduced. This enables a smooth and jerk-free increase in torque, adjusted to the load behavior of the machine.

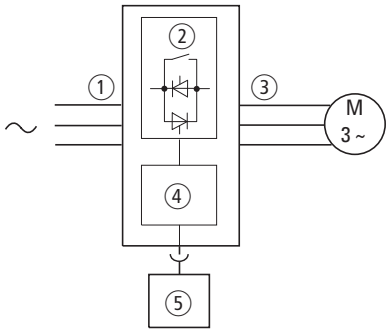


Figure 10: Function chart

① Mains supply voltage U_{LN} 3 × 200 V to 3 × 480 V
② Antiparallel thyristors in two phases with bypass contact for controlling the motor voltage
③ Output voltage U_2: three-phase, from an adjustable start voltage through a ramp function up to 100 % mains voltage with a constant supply frequency output current I_{2N}: 4 to 200 A at maximum ambient air temperature of +40 °C assigned motor shaft power P_2: 1.5 to 110 kW at 400 V or 3 to 150 HP at 480 V
④ Controller card for controlling the power section
This is used to initiate control commands and set the parameters.
⑤ SmartWire-DT interface (optional) for configuring parameters, control, and monitoring

→ The following limitations apply to single-phase AC motors:

① U_{LN}: 1 x 200 to 240 V
③ Output current I_{2N}: 4 up to 32 A
assigned motor shaft power P_2 at 230 V: 0.37 to 4 kW or 1/3 to 5 HP

Example illustration of current and torque over time for a motor start with a soft starter

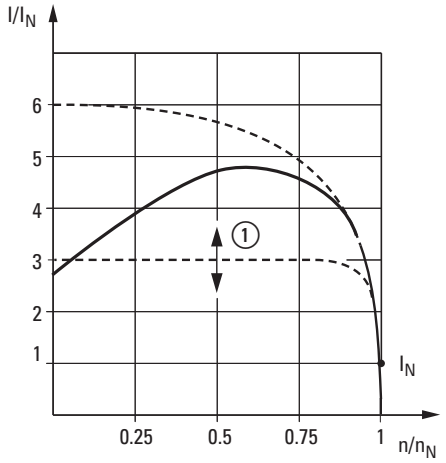


Figure 11: Reduced current rise

I_N = Rated operational current at the operating point
n_N = Rated speed at the operating point
① = adjustable current limit

In combination with electronic motor-protective circuit-breaker PKE and a SmartWire-DT connection soft starters DS7-34D…-D in sizes 1 and 2 a motor start with current limitation ① is also possible.

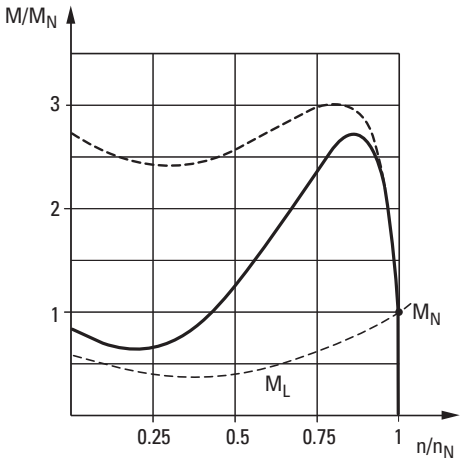


Figure 12: Reduced torque curve

M_N = Rated torque of the motor during operation
M_L = Load torque at the motor shaft
M_L < MN at motor start
$M_L \leqq M_N$ in continuous operation

The mechanical apparatus of a drive unit controlled with a DS7 soft starter are therefore accelerated very smoothly. This has a positive effect on the lifespan, operating behavior and operating processes, and prevents any adverse effects such as

- Impacting of cog edges in the gearbox,
- Pressure surge in pipe systems,
- Slipping of V belts or
- Jitter with conveyor systems.

The phase angle control of the supply voltage is implemented on the DS7 soft starter by means of anti-parallel thyristors which are bridged for continuous operation by so-called bypass contacts (TOR signal) after a time controlled voltage change (t-Start) has elapsed.

The transition resistance of these bypass contacts is considerably lower than the transition resistance of the power semiconductors. This reduces the heat dissipation in the soft starter and extends the lifespan of the power semiconductors.

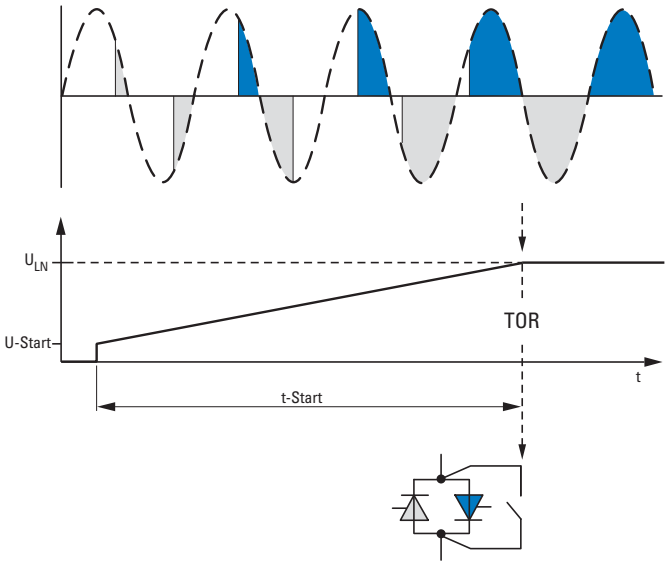


Figure 13: Phase control of the supply voltage

U_{LN} = mains supply voltage
U-Start = start voltage
t-Start = Ramp time of the voltage change at start
TOR (Top-of-Ramp) = signals the end of set ramp time t-Start (output voltage U_2 = mains connection voltage U_{LN}).
The internal bypass contacts then close.

As well as the time-controlled startup of a motor, the DS7 soft starter also enables a time-controlled reduction of the motor voltage and thus a controlled stopping of the motor. This type of stop function is primarily used for pumps in order to prevent pressure waves (water hammer). Jerky movements and therefore the wear on drive chains and drive belts as well as bearings and gears can be reduced.

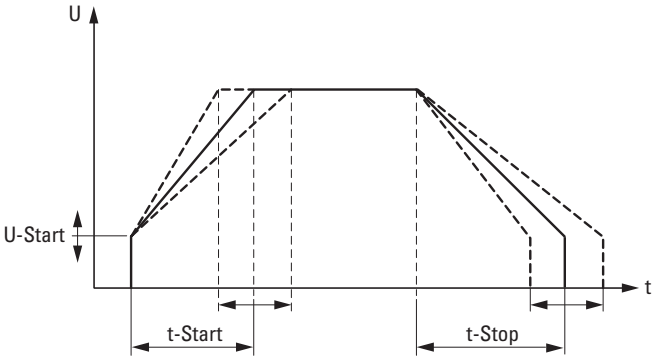


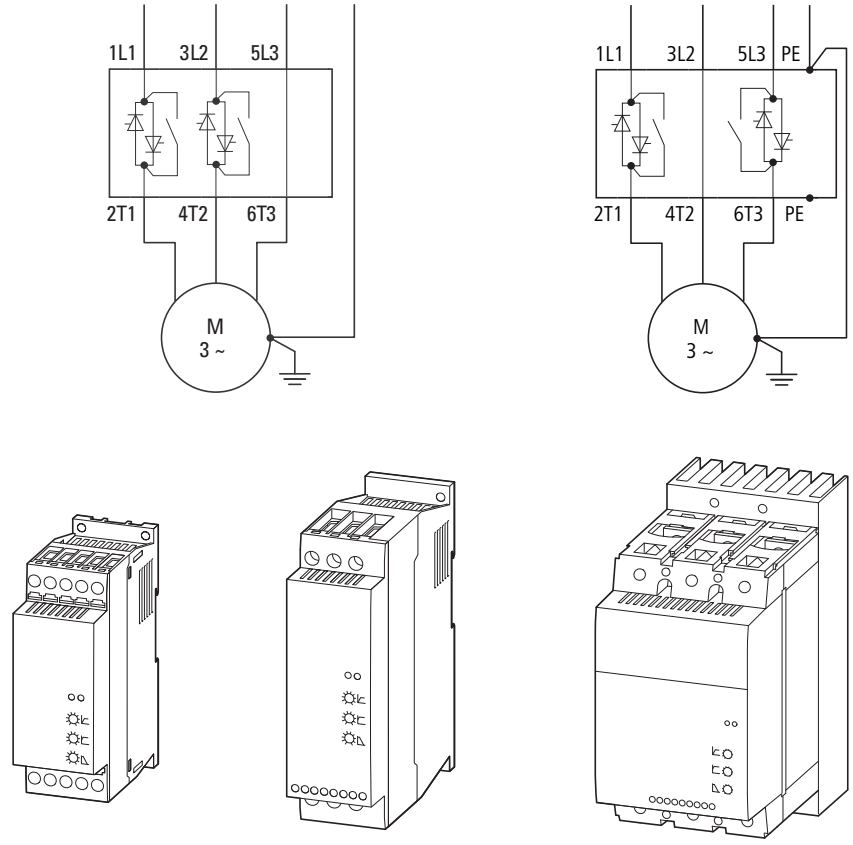
Figure 14: Time-based control of motor voltage with a soft starter

The acceleration time of a drive with a soft starter always depends on the load and the breakaway torques. The required breakaway torque can be set via the start voltage (U-Start). The ramp time (t-Start) for a linear voltage change should be as short as possible. The ramp time for the deceleration (t-Stop) must be greater than the load-dependent uncontrolled deceleration time of the machine.

For the power semiconductors in the soft starter, the controlled deceleration presents a similar load as the startup: If, for example, the deceleration ramp is activated on a soft starter with a maximum of 10 permissible starts per hour, the number of permissible starts is reduced to 5 per hour (plus 5 stops within this hour).

The output voltage of the soft starter determines the torque of the motor. At machine startup it must therefore be ensured that the selected starting voltage (U-Start) is not too low. Otherwise this may cause the motor to overheat excessively before it starts up.

The soft starters of the DS7 device series are two-phase controlled and are available in two variants in the power section (for size 1 and 2 or size 3 and 4).



Size 1 (4 to 12 A) Size 2 (16 to 32 A) Size 3 and 4 (41 to 200 A)

Figure 15: Sizes and variants in the power section

The asymmetrical thyristor trigger control that was developed and patented by Eaton (Moeller) for phase control (PCT/EP00/12938, 19.12.2000) prevents DC components and ensures optimum startup behavior. This control is integrated in the DS7 soft starters and is active during the start (t-Start) and stop ramp (t-Stop).

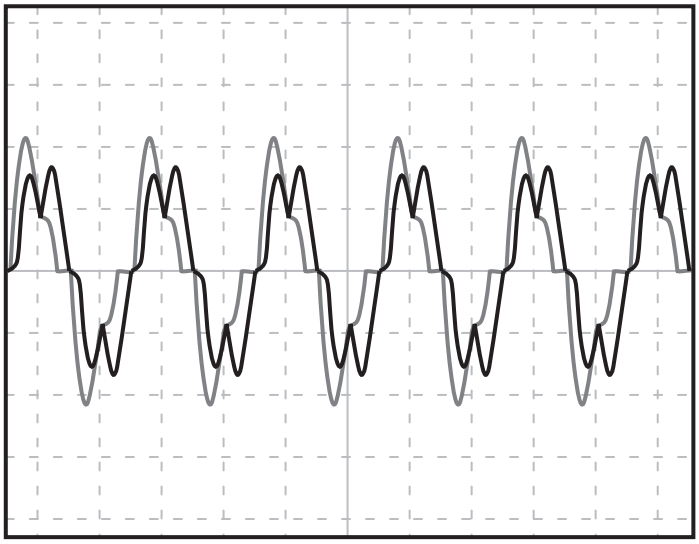


Figure 16: Current behaviour in the uncontrolled phase

Conventional method:

Symmetrical control with high DC components

New process from Eaton (Moeller):

Asymmetrical control without DC components

→ With two-phase controlled soft starters, physical conditions cause DC components to occur that cause the formation of an elliptical rotating field. This causes the motor to start up unevenly and the acceleration time is unnecessarily extended.

→ With single-phase connected three-phase motors with capacitors (Steinmetz circuit), system conditions always cause an elliptical rotating field which cannot be completely compensated by the asymmetrical trigger control.

2 Engineering

2.1 Selection of devices

The DS7 soft starters can be designed for standard motors in standard applications (such as pumps, fans, conveyor belts etc.) according to the technical data provided in the Appendix.

A more specific design is required for drives with a high starting torque or high inertia. The following information must be known for correct device selection:

- the overload cycle of the machine,
- The startup time for DOL starting or for star/delta starting,
- the maximum starting current,
- the load cycle,
- the load that the motor is required to drive.

The values of the moments of inertia must also be known for a more precise design. These values enable you to select the most suitable soft starter. The relevant procedure is described in the manual MN03902001Z-EN ("Design of Soft Starters") and applies generally to all Eaton soft starters. The necessary key data of the DS7 soft starter series that is also required for this design (rated operational current, overload capacity, root mean square current at nominal switching frequency) is provided in the Appendix in the technical data.

Connecting to a higher-level PLC through SmartWire-DT requires soft starters with part no. DS7-34D…-**D**… (hereafter referred to as "DS7-SWD"). These soft starters can be controlled, monitored and parameterized through SmartWire-DT.

In combination with a motor-protective circuit-breaker PKE, current can be monitored and additional protective functions can be activated through SmartWire-DT (→ Chapter 8, „SmartWire-DT").

Soft starters DS7-34D…-D can be operated **only** in combination with SmartWire-DT.
Their operation through control signal terminals is not possible.
With the 1-0-A switch manual DOL starting is possible with the switch in position 1 (→ Chapter 8, „SmartWire-DT").

2.2 EMC compliance

EMC = **E**lectro**m**agnetic **C**ompatibility

The IEC EN 60947-4-2 product standards allows for the limit value classes and measuring procedures of the IEC/CISPR11 or EN 55011 standard.

No other measures are required on the DS7 soft starter for the limitation of interference emission in accordance with EN 55011 limit value class A (industrial environment).

The devices of the DS7-340… (24 V AC/DC version) series furthermore meet the requirements of limit value class B (public environment) without any other measures required.

Note
This is a Class A product. In a domestic environment, this device may cause radio interference, in which case the user may be required to take adequate measures.

Figure 17: Note in accordance with DIN EN 60947-1 (VDE 0660-100): 2011-10 EN 60947-1: 2007 + A1: 2011, paragraph 5.3

2.3 Network configurations

DS7 soft starters can be used without restriction in the following network configurations:

- networks with a earthed or non-earthed star point,
- networks with an isolated star point (IT networks),
- networks with a grounded main pole.

2.4 Power connection

The power section should be protected according to the connection form used.

Cable and device protection on the supply side:

- Input AC… via standard fuses for cable protection or via motor-protective circuit-breaker.
- Fuses in UL compliant systems must be UL-approved.
- The rated operating voltages of the fuses must be suitable for the local mains voltage.
- No fuses are required on the motor side.

The following diagram shows the basic connection of motor and power section.

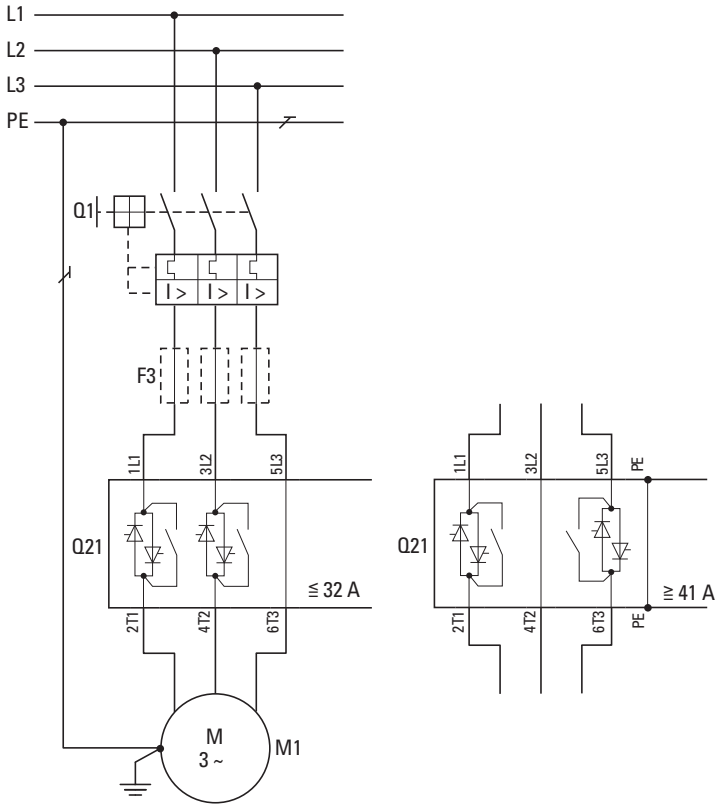


Figure 18: Power section and Motor connection

F3 = optional semiconductor fuse
Q1 = Cable protection + motor protection
Q21 = Soft starter
M1 = Motor

At the output of the soft starter (terminals 2T1, 4T2, 6T3) you must not

- Connect any capacitive load (e.g. phase compensation capacitors),
- Connect several soft starters in parallel,
- Feed a mains voltage or a voltage from a frequency inverter or other voltage sources.

2.5 Emergency switching off

Soft starters belonging to the DS7 series fall under safety category B as per EN 954-1. This means that certain faults may remain undetected (e.g., thyristor failure caused by overvoltage → permanently conductive).

If the machine has more stringent requirements in accordance with EN ISO 14121-1 "Safety of machines", additional (external) measures must be implemented in accordance with this standard.

2.6 Protective element

The devices are protected with fuse devices shown in the Appendix (→ Page 215). Different fuse devices are used depending on the type of coordination required.

2.6.1 Type 1 coordination

The protective switches or circuit-breakers stated are used for cable protection and motor protection. The soft starter may be damaged in the event of a short-circuit at the output terminals (motor connection 2T1, 4T2, 6T3).

2.6.2 Type 2 coordination

As well as the safety devices for type 1 coordination, superfast semiconductor fuses are also required for type 2 coordination. These protect the thyristors of the soft starter from damage in the event of a short-circuit at the output terminals (motor connection 2T1, 4T2, 6T3).

> *CAUTION*
> Semiconductor fuses cannot ensure a cable protection function.

The semiconductor fuses must be mounted externally on DS7 soft starters. The assigned fuse types are listed in the Appendix on page 215.

> *CAUTION*
> Protection against overvoltages in the supply network cannot be provided with superfast fuses!

2.7 Residual-current device (RCD)

Residual current devices (RCDs) protect persons and animals from the presence (not the creation!) of impermissibly high touch voltages. They prevent dangerous and fatal injuries caused by electrical accidents and also serve as fire prevention.

Size 1 and 2 soft starters of the DS7 series have no connection to the earth potential (PE). In size 3 and 4, the DS7 soft starters have an exposed heat sink which must be connected with the earth potential (PE).

When using a DS7 soft starter, there is no leakage current at the motor feeder. Standard residual current devices (RCD part no. A) up to 30 mA can be used.

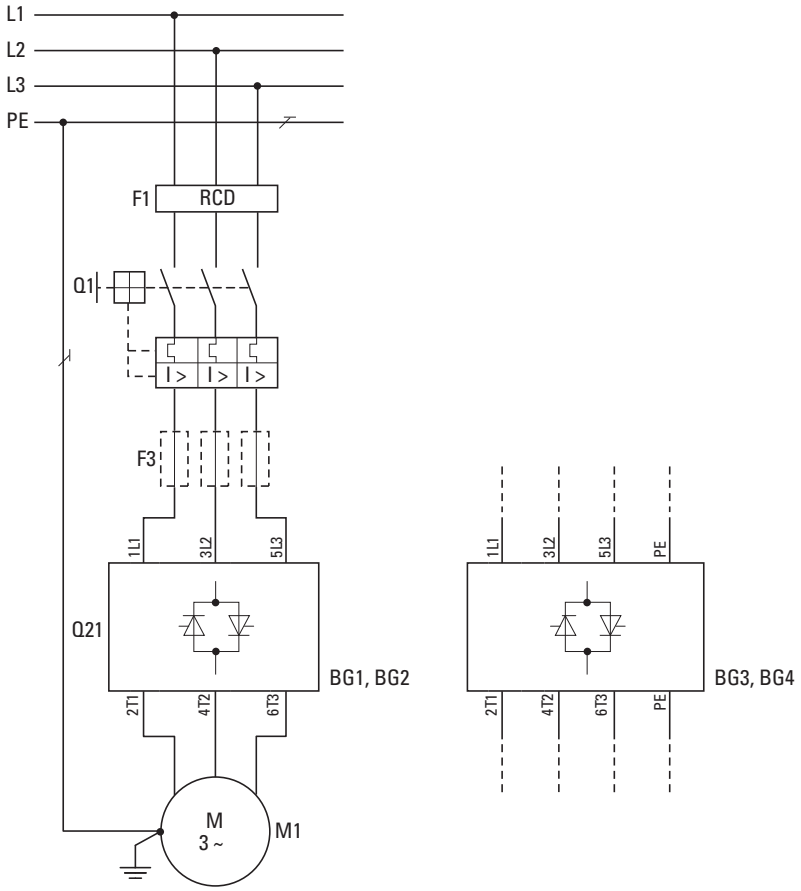


Figure 19: Motor feeder with RCD

F1: Residual current device (RCD)
F3 = optional semiconductor fuse
Q1 = Cable protection + motor protection
Q21 = Soft starter
M1 = Motor

2.8 Motor protection

The motor protection protects the three-phase asynchronous motor from thermal overload due to a mechanical overload or the failure of the motor cooling (fan) or the failure of a connection cable.

There are two basic ways of protecting the three-phase asynchronous motor from overload during operation: By

- monitoring of current consumption (motor-protective circuit-breaker, overload relay or bimetal relay) ,
- Direct temperature monitoring in the motor winding (PTC, thermistor).

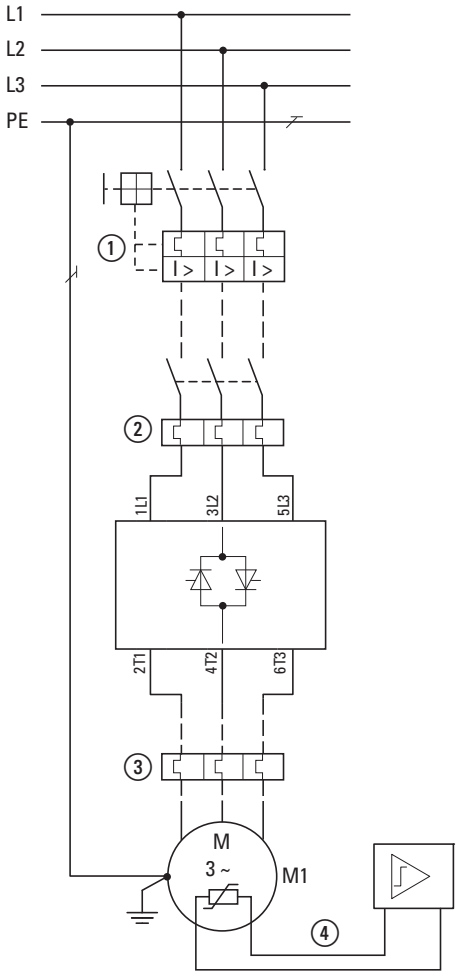


Figure 20: Possible motor protection variants

① Motor-protective circuit-breaker (PKZ, PKE, NZM) - disconnection with manual release
② Overload relay (ZB, ZEB) – here in combination with a contactor
③ Overload relay (ZB, ZEB) for indication of the thermal overload – can alternatively (①, ②) also be arranged on the mains side
④ Thermistor, PTC or positive temperature coefficient protection in the motor winding with external indication relay (EMT)

The combination of the motor protection variants ①, ② or ③ with the temperature monitoring variant ④ is also called full motor protection.

After a motor protective device has tripped, the soft starter and the protective device cannot be switched on again until it has cooled down. The reset depends on the temperature.

2.9 DS7-SWD and PKE motor-protective circuit-breakers

In combination with a motor-protective circuit-breaker PKE the soft starters DS7-SWD provide additional functions:

- Protection of soft starter DS7 against overload
- Adjustable current limit
- Overload function ZMR (on overload soft starter DS7 and not motor-protective circuit-breaker PKE switches off the load)
- Reading out current values through SmartWire-DT

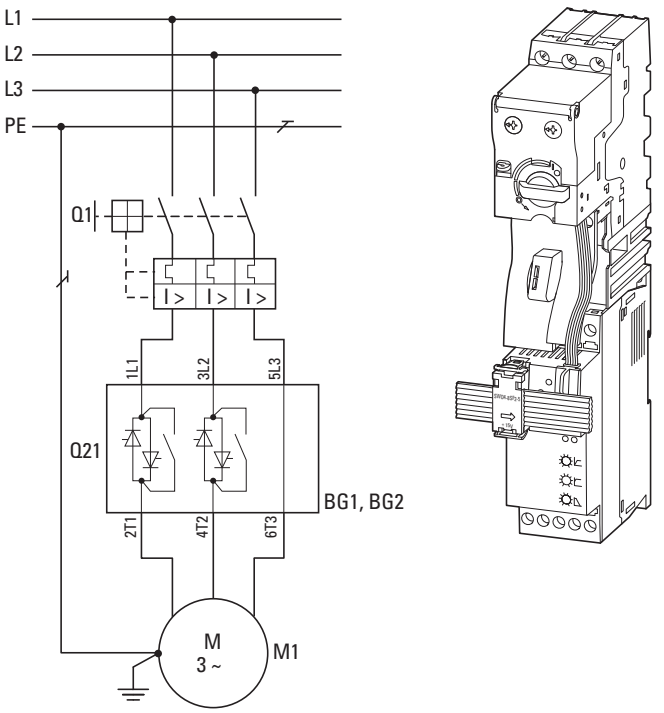


Figure 21: Motor-starter combination DS7-SWD and PKE

In combination with a soft starter DS7 only trip blocks PKE can be used for motor protection (PKE-XTUWA-32, PKE-XTUA-…). PKE trip block PKE-XTUCP-… for system protection must not be used in combination with a soft starter DS7! In combination with SmartWire-DT this can cause false tripping.

A motor-protective circuit-breaker PKE is connected to soft starter DS7-SWD through trip block PKE-XTUA-… with communication cable PKE32-COM. Data transfer is through the data interfaces of the PKE trip block.

When soft starter DS7-SWD is connected to a SmartWire-DT network, the soft starter transmits the data (current values) from the PKE trip block to a higher-level PLC.

2.10 Cables, contactors, line filters

The cables used must meet the requirements of locally applicable regulations at the site of installation.

Large dimensioned cables and contactors are required when frequent startups and high starting currents are expected. The load capacity limits of the contactors are listed in the relevant documentation. The appropriate assignment of mains contactor for the selected starting cycle of the soft starters is provided in annex under page 217.

The fuses and cable cross-sections to be selected for the incoming and outgoing cables are also listed there.

The specifications in the Appendix refer to:

- use in switch cabinets and machines,
- installation in the cable duct,
- a maximum ambient air temperature of +40 °C,
- normal starting frequency.

The fuses and conductor cross-sections depend on the rated operational current of the motor as well as the start cycle (operating frequency, overcurrent).

No line filters or chokes are needed.

→ In applications with an overdimensioned soft starter, the minimum connectable terminal capacity of the soft starter must be taken into account and the motor must be wired if necessary with a larger conductor cross-section.

→ When selecting the cable cross-section, take into account the voltage drop under load.
Compliance to further standards is the responsibility of the user.

2.11 Motor connection

DS7 soft starters enable the operation of different variants of three-phase asynchronous motors:

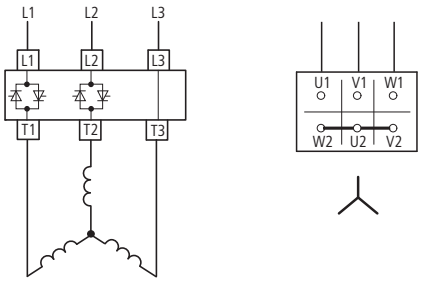
- Standard three-phase asynchronous motor,
- Pole-changing motors (Dahlander motors),
- Slipring rotor motors,
- External rotor motors (fan motors, roller drives),

Within this context, a standard motor refers to a four-pole, internally cooled or surface-cooled three-phase asynchronous motor with a speed of 1500 rpm at 50 Hz or 1800 rpm at 60 Hz.

2.11.1 Connection versions (star/delta)

Three-phase asynchronous motors can be connected to the DS7 soft starter in a star or delta circuit depending on the mains voltage. It is operated in an inline connection (with three connection cables).

Star connection



Delta circuit

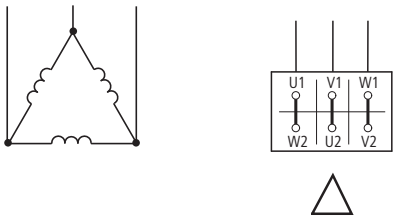


Figure 22: Permissible motor connection circuits
(shown for devices up to 32 A, furthermore, phase L2-T2 is connected through instead of L3-T3)

In a 3 × 400 V supply network, the following motors are generally operated:

- up to approx. 4 kW motor power can be switched in a star connection (230/**400 V**),
- over 4 kW motor power in a delta circuit (**400 V**/690 V).

Three-phase motors with a neutral point (star circuit) or motors with neutral conductor connection must not be connected to a DS7 soft starter (see Fig. 23), as one phase is always connected directly to the mains voltage and would cause impermissible heating of the motor.

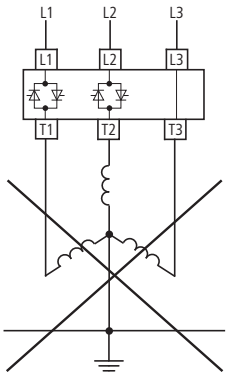


Figure 23: Not permissible neutral point earthing

2.11.2 Connection and phase sequence

The clockwise rotation of the motor shaft is achieved by connecting in phase sequence (clockwise rotating field with ascending numerical order of phases and ascending alphabetical order of terminal designations). The operating direction of the motor shaft is reversed by swapping round two connection phases.

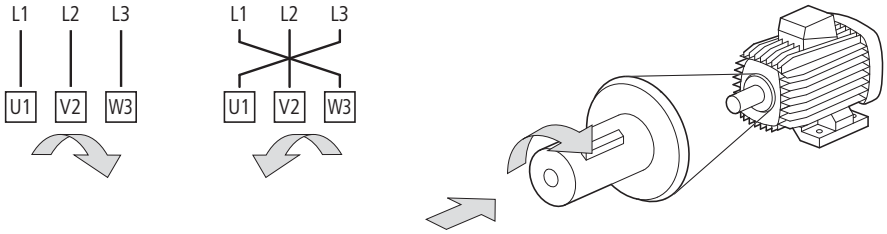


Figure 24: Operating direction with view on motor shaft

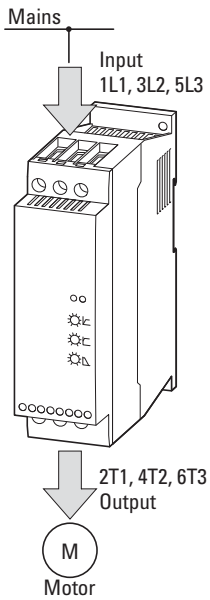


Figure 25: Connection and energy flow with soft starter DS7

For clockwise rotation motor and soft starter DS7 are connected as follows:

Table 6: Connection of Soft starters and motor

Mains	Soft starter input	Soft starter output	Motor
L1	1L1	2T1	U1
L2	3L2	4T2	V1
L3	5L3	6T3	W1
PE	in size 3 and size 4 only: PE, ⏚	in size 3 and size 4 only: PE, ⏚	PE, ⏚

The operational rotation reversal of the motor can be implemented by the DS7 soft starter in combination with a reversing contactor combination.

When reversing the operating direction, the output of the soft starter must be disabled before the reverse switching is carried out. The rotating field direction at the input is always the same as that at the output.(→ Chapter 7, „Connection examples“)

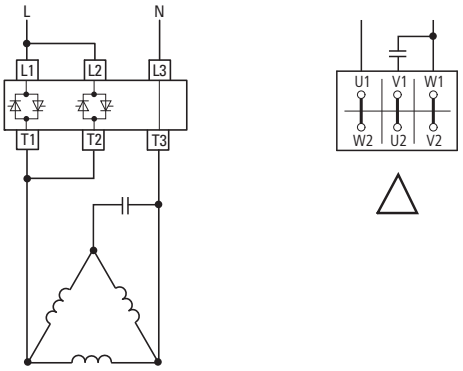
2.11.3 Delta connection

The in-delta circuit (soft starter’s thyristor connected in series with the individual motor windings and with six connection cables) is not permissible for a two-phase controlled soft starter DS7!

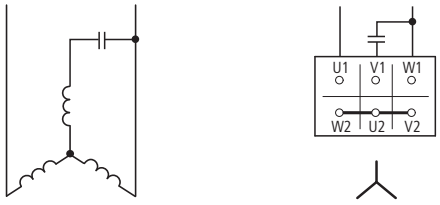
2.11.4 Connection of AC motors

AC motors can also be operated with the DS7 soft starters series. Only the version of the three-phase asynchronous motor with a capacitor (Steinmetz circuit) is considered suitable for industrial use.

Delta circuit



Star connection



Semi star circuit

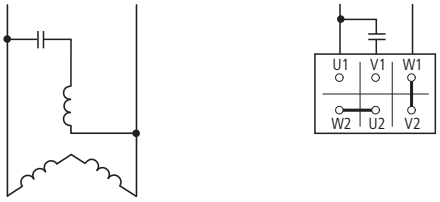


Figure 26: Permissible motor connection circuits when connecting to a single-phase AC supply system

In practice, single-phase motors up to an output of around 2.2 kW (230 V) are used. In the Steinmetz circuit, metal paper capacitors (450 V) with around 60 to 80 µF per kilowatt motor output are required (DIN 48501).

When connected to a single-phase AC supply, they form an auxiliary phase with a phase shift of around 90°. Compared to the required phase shift of 120° this causes an elliptical rotating field. As a result, the starting torque (M_A) is reduced to around 30 % of the rated-load torque (M_N). If a higher starting torque is required (90 – 100 %), additional starting capacitors must be used which are only switched for the startup phase, in parallel to the operation capacitor. During operation, the torque is around 70 % of the normal motor output.

In practical applications, three-phase asynchronous motors with capacitors (Steinmetz circuit) are only started with a soft starter on the single-phase AC supply if the load requires a reduced starting torque (such as with continuous flow machines, pumps or fans).

The operating direction determines the connection (L1 or N) of the auxiliary line with the capacitor.

2.11.5 Long motor supply cables

Soft starters DS7 set no limit on the maximum length of the motor cable.

When dimensioning the cable, the voltage drop caused by the cable length to the motor must be taken into account.

In practical applications, motor cable lengths up to approx. 100 m can be connected without any additional measures. Larger cable cross sections may be necessary above this length. From around 300 m upward, a detailed engineering (cable cross-section, overdimensioning of the soft starter etc.) is advisable.

2.11.6 Parallel motor connection

Several motors can be connected in parallel at the output of the DS7 soft starter. This does not, however, allow the behavior of the individual motors to be controlled. It must be taken into account that an even run-up of all motors cannot be ensured. If motors are mechanically interconnected, the load distribution is also uncertain. In this case, the entire drive torque may possibly only be supplied by a single motor, which may cause this motor to be overloaded. In this type of application, soft starters should be used for each single motor and the motors should be started with a current limiting function. With a DS7-SWD... soft starter this can only be implemented in conjunction with the networkable PKE motor-protective circuit-breaker. Alternatively, a soft starter of the DM4 series or its successor may be required.

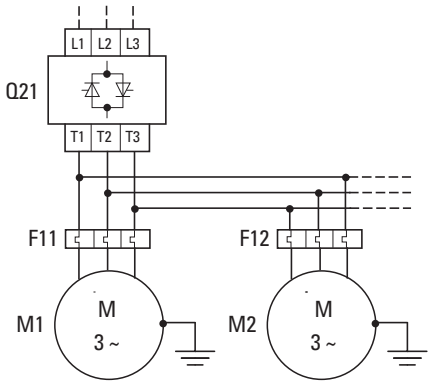


Figure 27: Parallel connection of multiple motors to a soft starter (variant 1)

The total current consumption of all connected motors must not exceed the rated operational current I_e of the soft starter. The overdimensioning of the soft starter is recommended if the individual motors have high starting currents.

Each motor must be protected from overcurrent and thermal overload (using overload relays and/or thermistor protection).

Motors with considerably different motor outputs (e.g. 1.5 kW and 11 kW) should not be connected in parallel to the output of a soft starter. Reason: Starting problems may occur in the motor with the lower output since this cannot provide the required torque. It is therefore advisable to only use motors with similar ratings (maximum deviation: one rating size).

Motor-protective circuit-breakers (Q11, Q12) can also be used here instead of the overload relays (F11, F12).

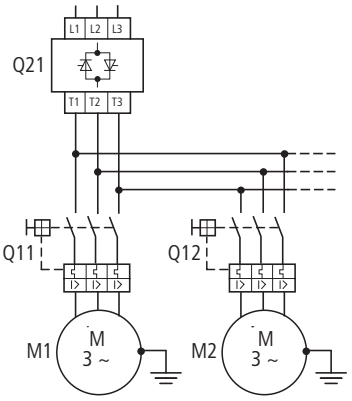


Figure 28: Parallel operation of multiple motors on a soft starter (variant 2)

The last connected motor must not be switched off in operation since the resulting voltage peaks may cause damage to the electronic components in the soft starter and thus to its failure.

2.11.7 Connecting motors

If an additional motor is connected in parallel to the soft starter's output during operation, a soft start is not executed for this motor. The starter must, however, then be able to supply the full starting current (approx. 6 to 8 times the rated motor current) in addition to the current for the other motors. Otherwise an overload occurs, which can destroy the soft starter.

2.11.8 Cascade circuit

The DS7 soft starters can be used to start several motors in sequence. This requires the observance of a specific switching sequence (→ Section 7, „Connection examples“).

→ When starting several motors with one soft starter the thermal load of the soft starter (start frequency, current load) must be taken into account.
If the starts occur closely in succession, the soft starter must be dimensioned larger (i.e. the soft starter must be designed with an accordingly higher load cycle).

2.11.9 Motors with power factor correction capacitor

If capacitors are to be used for power factor correction and thus to improve the power factor, they must be connected to the mains side of the soft starter.

The following figure shows on the right a safe arrangement.
During the startup and stop phase (generalized phase control), the power factor correction capacitor are disconnected. After the start time (t-Start) elapses, they are connected via the TOR signal of the soft starter and the capacitor contactor Q12, which disconnect them at the beginning of the stop time (t-Stop).

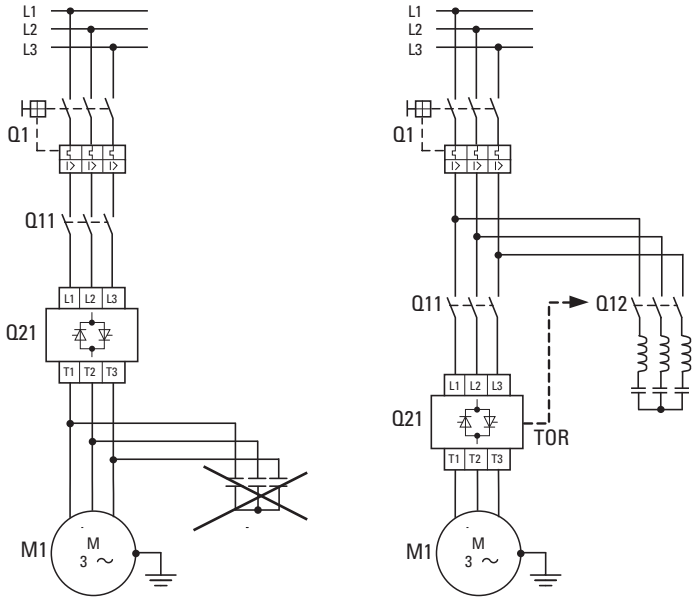


Figure 29: Reactive current compensated motor
Left: impermissible connection
Right: permissible connection

→ In networks with electronically controlled loads (e.g. soft starters), the compensation devices must always be connected with a series inductance.

CAUTION

The output of a soft starter must not be connected to any capacitive loads (capacitors)!
This would damage the soft starter.

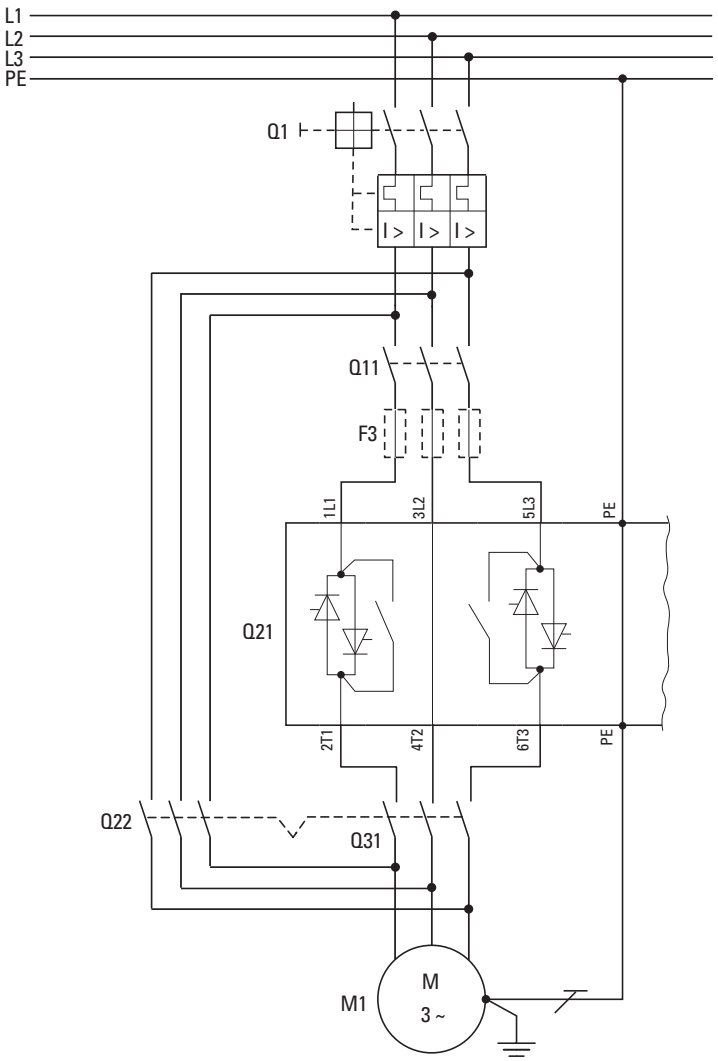
2.11.10 Bypass circuit

Devices of the DS7-34… series are already equipped with integrated bypass contacts. An external bypass is therefore not required.

2.11.11 Bypass circuit for emergency operation

In pump applications there is a frequent requirement for the bypass contactor to provide facility for emergency operation. A service switch is used to select between soft starter operation and DOL starter operation via a bypass contactor (Q22). This is used to fully isolate the soft starter. In this case, it is important that the output circuit is not opened during operation. An interlock ensures that a switchover is only possible after a stop. The electrical and/or mechanical interlocking of contactors Q22 and Q31 ensures a safe operating state.

Unlike simple bypass operation (parallel contact with the thyristors in continuous operation), the bypass contactor must be designed here in accordance with utilization category AC-3 since it must be able to start the motor directly. For a suitable contactor, the contactor recommended in the Appendix (→ Page 217) can be used.



Q1 = Cable protection

Q11 = Mains contactor

Q21 = Soft starter

Q22 = Bypass contactor/ Emergency operation protection

Q31 = Motor contactor

F3 = Semiconductor fuse for type 2 coordination, in addition to Q1

M1 = Motor

Figure 30: Power section – example: DS7 ≧ 41 A with bypass emergency operation

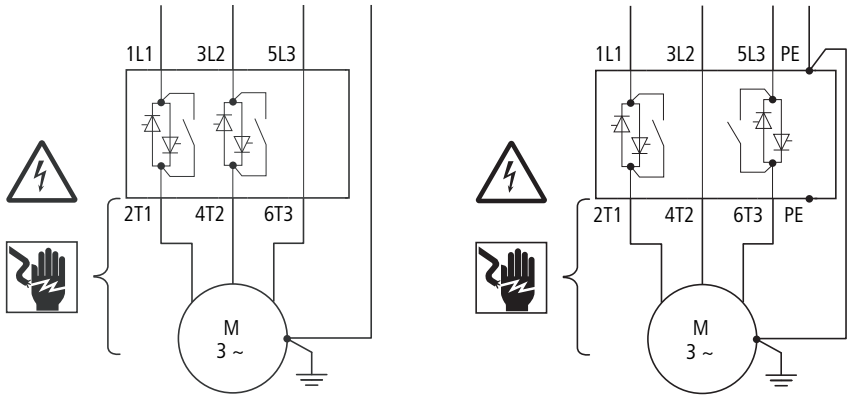
2.11.12 Repair and maintenance switch

Repair and maintenance switches isolate all phases of the connection cable to a motor. This prevents an inadvertent application of voltage and starting of a motor during repair or maintenance work.

The DS7 soft starter has a two-phase circuit with semiconductor elements in the power section, one phase is always connected through directly.

DANGER

In both the disabled and stop states of the soft starter when the mains voltage is present (terminals 1L1, 3L2, 5L3), there is also a dangerous voltage present at the output terminals (2T1, 4T2, 6T3) and therefore also on the motor cables and connection terminals of the motor (U, V, W)!



Size 1 and 2 (4 to 32 A) Size 3 and 4 (41 to 200 A)

Figure 31: Dangerous voltage

In Stop state a two-phase-controlled soft starter should therefore always be isolated from mains voltage on all three phases, for example with a contactor connected in series on the mains side.

If a control system does not provide this potential isolation, it is advisable to connect the motor through a repair or maintenance switch.

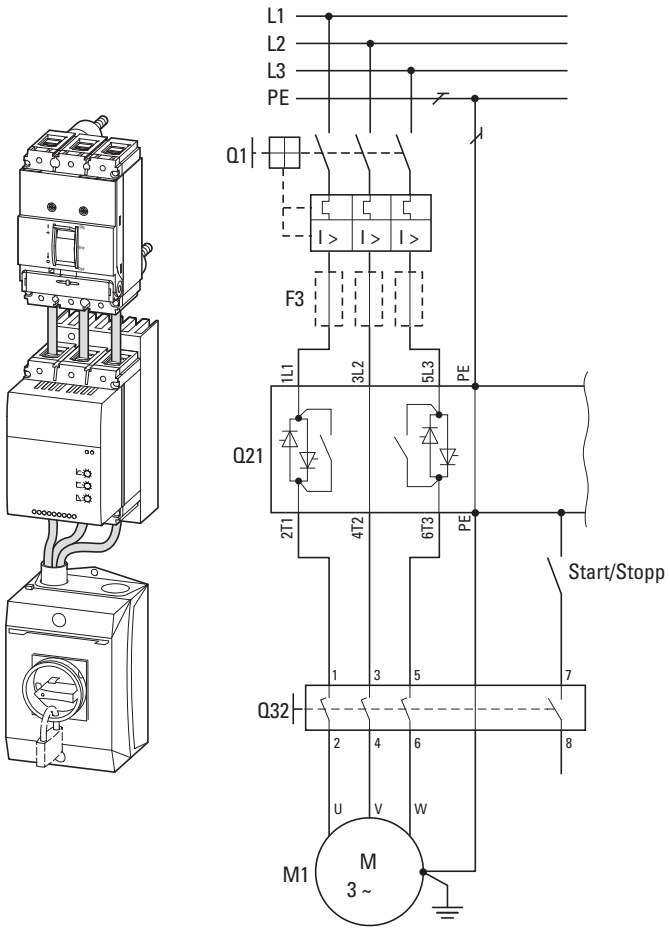


Figure 32: Connection example of the DS7 soft starter (Sz 3, Sz 4) with a maintenance/repair switch for the safe isolation for motor connection

2.12 Load cases

The DS7 soft starter is designed for a standard load cycle in accordance with AC-53a of the IEC/EN 60947-2-1 product standard. This means:

3-fold overcurrent for 5 seconds with a duty factor of 75 % and 10 starts per hour. For example: 4A: AC-53a: 3-5: 75-10

With applications such as water pumps (circulating pumps) the DS7 soft starter with the assigned rated operational current can be selected. When different operating frequencies, acceleration times and/or starting currents are involved, the thermal capacity of the DS7 soft starter must be taken into account in the design. In order to select the correct DS7 soft starter for the application, the Appendix (→ Page 213) provides overload curves for the different combinations of time, current and starts per hour.

2.12.1 Overload capability (load to AC-53a)

The table below shows the overload capability of the soft starter in accordance with the product standard IEC/EN 60 947-4-2. It shows:

X = Value of basic overcurrent in multiples of the rated device current
T_x = Duration of the overcurrent X in seconds
F = Duty factor within the load cycle in %
S = Number of permissible starts per hour

	Overcurrent X [×]	Overcurrent time T_x [s]	Duty factor F [%]	Starts per hour S
DS7-34…	3	5	75	10

2.12.2 Conversion of the overload capability to lower overcurrents

The stated cycle can be converted for lower overcurrents, but not for higher! The following formula is used to calculate the new time:

$$T_{xnew} = \frac{X^2 \times T_x}{X^2_{new}}$$

T_{xnew} = New permissible time for the new overcurrent X_{new}

X_{new} = Required overcurrent (must be less than the stated values)

Example

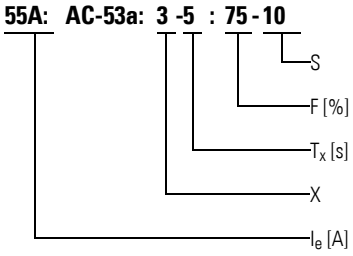
For X = 3, T_x = 5 s: With a reduced overcurrent (X = 2.5) a new permissible overcurrent duration T_{xnew} of 7.2 seconds is calculated.

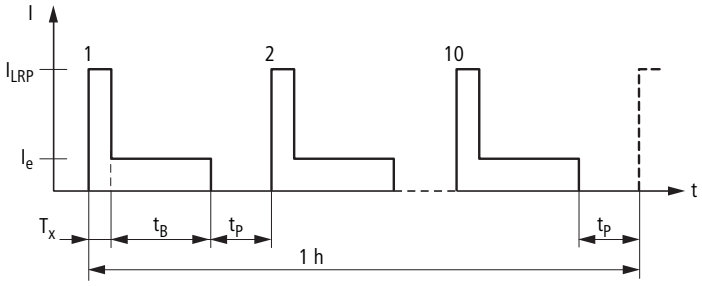
$$T_{xnew} = \frac{3^2 \times 5\,s}{2.5^2} = 7.2\,s$$

→ The parameters X x I_e, T and the number of starts allow any number of combinations of this load cycle with the same thermal load.

2.12.3 Different overload current

If load cycles or start frequencies are different, the following graphs can be used for reading the possible time current combination. The example shown here is a 30 kW motor (400 V, 55 A) with an assigned DS7-34xSX055… soft starter (55 A, rated operational current = motor current). The maximum starting current of 165 A (I_{LRP}) can be achieved for 5 s at 10 starts per hour (overload factor X = 3).





$F = 10/h, \quad 1\ h = 3600\ s \rightarrow T_x + t_B + t_P = 360\ s$

$$F = \frac{T_x + t_B}{T_x + t_B + t_P} \times 100\ \% \quad I$$

$$\frac{5\ s + 265\ s}{5\ s + 265\ s + 90\ s} \times 100\ \% = 75\ \%$$

$$X = \frac{I_{LRP}}{I_e} \rightarrow I_{LRP} = X \times I_e = 3 \times 55\ A = 165\ A$$

The prospective locked rotor current I_{LRP} is the motor current that occurs when the rated operating voltage is applied and the rotor is locked ($I_{LRP} = X \times I_e$).

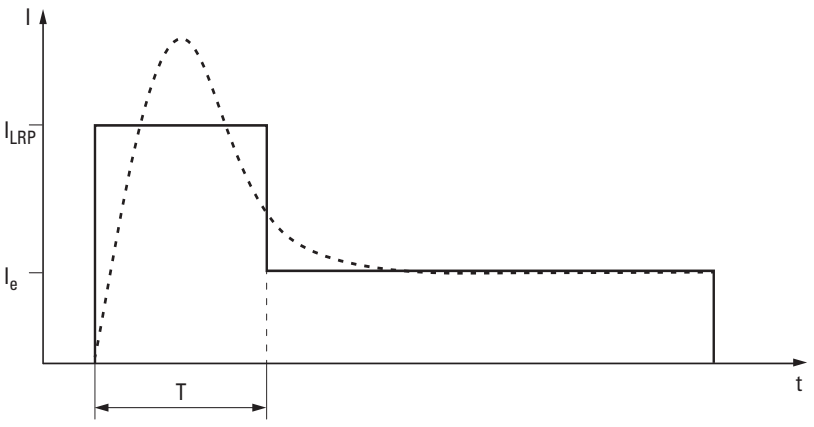


Figure 33: Real (dashed) and normalized load current

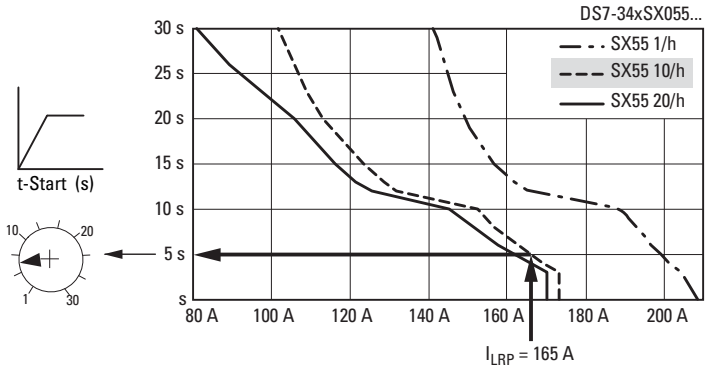


Figure 34: Overload current X = 3 with DS7-34xSX055…

If a higher overload current (e.g. X ~ 5) is required, the start conditions stated here require a DS7-34xSX100… (100 A) soft starter. The I_{LRP} value here is 300 A for 5 s at 10 starts per hour. The required X ~ 5 (5 x 55 A = 275 A) is thus fulfilled (X ~ 5.4).

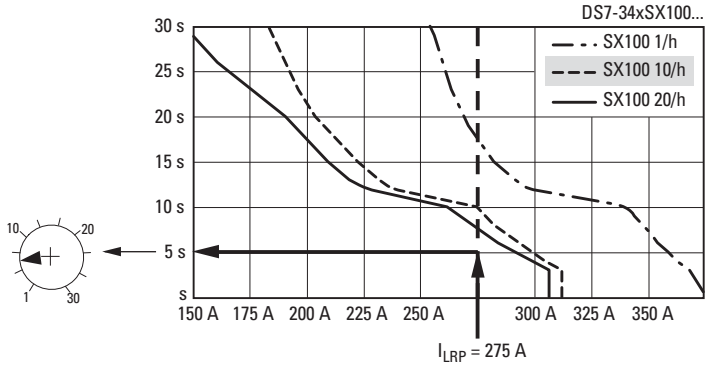
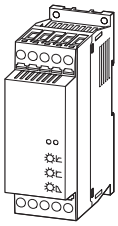
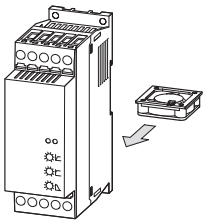
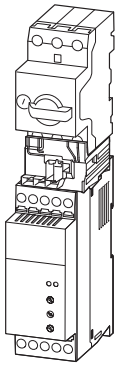
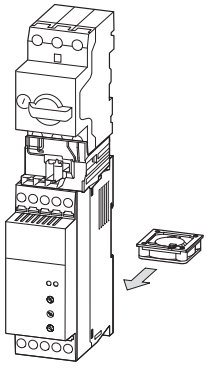


Figure 35: Overload current X = 5 with DS7-34xSX100…

At X = 5 (I_{LRP} = 275 A) the larger DS7-34xSX100… soft starter also allows

- 10 Starts per hour S with max. 10 s (T_X),
- 20 Starts per hour with max. 7 s (T_X).

2.12.4 Configuration options of DS7

	Special feature	Configuration	Current	Starts per hour	Applicable graph
Stand-alone setup **without** internal fan 	Standard setup	DS7	Rated operating current I_e stated on the device applies.	10	The graph applicable to this load cycle (10 starts per hour) applies. → Example I. (page 55)
Stand-alone setup of sizes 1 and 2 **with** internal fan 	Increased number of startups	DS7 (to 32 A) + DS7-FAN-032 (fan)	Rated operating current I_e stated on the device applies.	40	The graph applicable to this load cycle (10 starts per hour) applies. The number of starts per hour must be multiplied by the factor 4, i.e. 1, 10, 20 → 4, 40, 80 → Example II. (page 55)
Assembly with xStart components **without** fan 	Derating required	DS7 (to 32 A) + PKZM0-XDM12 or PKZM0-XM32DE, PKZ/PKE DILM12-XMCP/T or ZB…12/ZB32…	The next lower rated operating current I_e. applies.	10	The valid graph for the corresponding next smaller device model applies.[2] → Example III. (page 55)
Assembly with xStart components **with** fan 	No derating required	DS7 (to 32 A) + PKZM0-XDM12 or PKZM0-XM32DE, PKZ/PKE DILM12-XMCP/T or ZB…12/ZB32… + DS7-FAN-032 (fan)	The rated operational current I_e stated on the device applies.	10	The graph applicable to this load cycle (10 starts per hour) applies. → Example IV. (page 55)
	Increased number of startups Derating required	DS7 (to 32 A) + PKZM0-XDM12 or PKZM0-XM32DE, PKZ/PKE DILM12-XMCP/T or ZB…12/ZB32… + DS7-FAN-032 (fan)	The next lower rated operating current I_e. applies.	40	The valid graph for the corresponding next smaller device model applies.[2] The number of starts per hour must be multiplied by the factor 4, i.e. 1, 10, 20 → 4, 40, 80 → Example V. (page 55)

2.13 Design with different load cycles

The DS7 soft starter is designed for a standard load cycle in accordance with AC-53a of the IEC/EN 60947-2-1 product standard. This means:

3-fold overcurrent for 5 seconds with a duty factor of 75 % and 10 starts per hour. For example: 4A: AC-53a: 3-5: 75-10

With applications such as water pumps (circulating pumps) the DS7 soft starter with the assigned rated operational current can be selected. When different operating frequencies, acceleration times and/or starting currents are involved, the thermal capacity of the DS7 soft starter must be taken into account in the design. In order to select the correct DS7 soft starter for the application, the Appendix (→ Page 213) provides overload curves for the different combinations of time, current and starts per hour.

2.14 Overtemperature (Derating)

All rated operational data of the DS7 soft starter is based on a maximum ambient air temperature of +40 °C. The maximum permissible ambient temperature is +60 °C. Higher ambient temperatures (> +40 °C) require a reduced rated operational current I_e:

a) 2 percent per degree Kelvin for a stand-alone setup

b) One percent per Kelvin for a standalone setup with assigned device fan DS7-FAN-...

Example

Ambient air temperature ϑ = +50 °C → 10 K abnormal temperature rise

Soft starter DS7-34xSX032… → I_e = 32 A

a) without fan: 2 %, 10 K → 20 % I_e = 6.4 A

I_e (reduced) = 32 A - 6.4 A = 25.6 A

b) with fan: 1 %, 10 K → 10 % I_e = 3.2 A

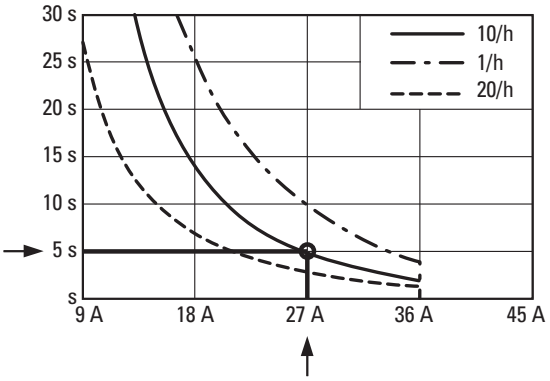
I_e (reduced) = 32 A - 3.2 A = 28.8 A

In combination with the xStart components, further reductions are necessary since the cooling air flow is impeded. The load cycle must then be recalculated (→ Section 2.15, „Example of other load cycles“).

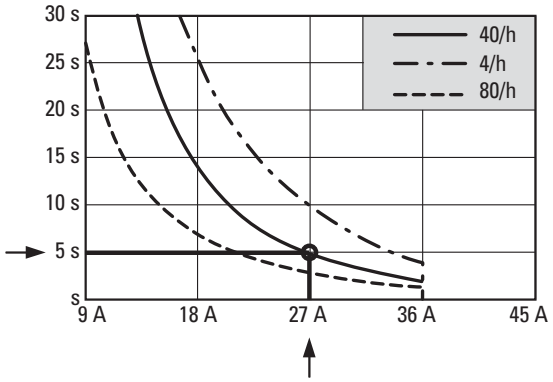
2.15 Example of other load cycles

Soft starter DS7-34xSX009…: 9 A AC-53a: 3-5: 75-10

I. Stand-alone setup without device fan

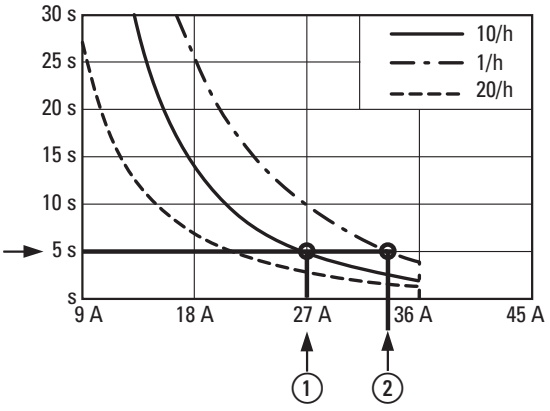


II. Stand-alone setup with DS7-FAN-032 device fan



III. Combination of xStart components without device fan

The overload curve of the DS7-34xSX007 soft starter applies to DS7-34xSX009….

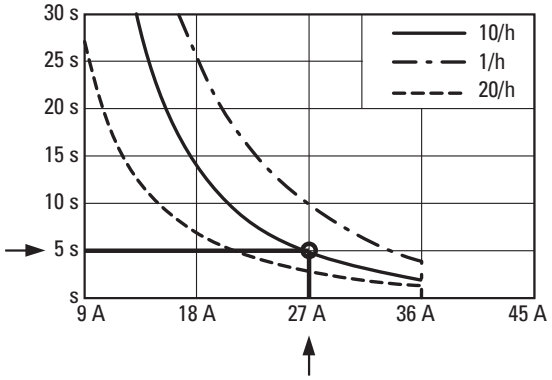


① At Tx = 5 s the permissible overcurrent factor here is reduced to around X = 2.2 (I_{RLP} = 20 A).

② I_{RLP} = 27 A: At Tx = 5 s and X = 3 one start per hour is permissible here.

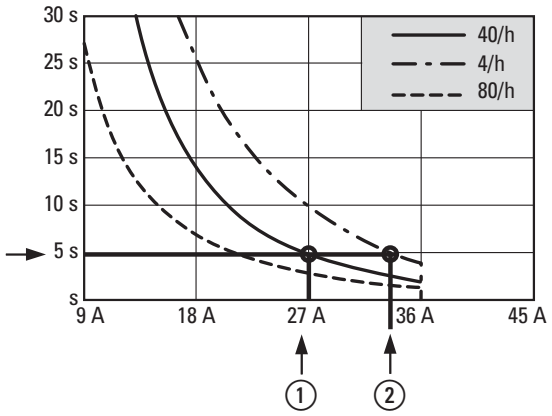
IV: Combination of xStart components with DS7-FAN-032 device fan

In this case, the standard values can be achieved (compare with I.).



V. Combination of xStart components with DS7-FAN-032 device fan and higher starting frequencies

If higher starting frequencies are required, the overload curves of the DS7-34xSX007 soft starter apply.



① At Tx = 5 s the permissible overcurrent factor is reduced to around X = 2.2 (I_{RLP} = 20 A) at a maximum of 40 starts per hour.

② I_{RLP} = 27 A: At Tx = 5 s and X = 3 a maximum of four starts per hour are permissible here.

→ The overload curves of the individual DS7 soft starter variants are listed in the Appendix on page 213.

3 Installation

3.1 Introduction

This chapter provides a description of the mounting and the electrical connection for the soft starter DS7.

→ While installing and/or mounting the soft starter, cover all ventilation slots in order to ensure that no foreign bodies can enter the device.

→ Perform all installation work with the specified tools and without the use of excessive force.

→ The DS7 soft starters must only be mounted on a non-combustible base.

Following are a series of installation examples designed to cover the entire DS7 series. The relevant mounting instructions are provided in the following instructional leaflets:

- IL03902003Z: For size 1 devices (4 – 12 A device current)
- IL03902004Z: For size 2 devices (16 – 32 A device current)
- IL03902005Z: For size 3 and 4 devices (41 – 200 A device current)

3.2 Mounting positions

The maximum permissible angle of inclination for all soft starters of the DS7 is 30°.

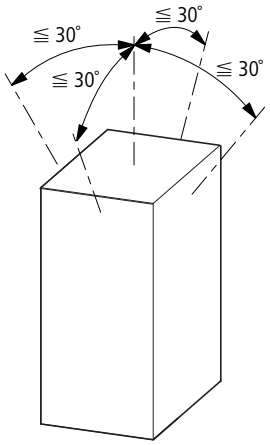


Figure 36: Vertical mounting position

→ A mounting that is turned by 180° (stood on its head) is not permissible.

3.3 Flush mounting in switch cabinet

The mounting should take into account the weight and dimensions of the soft starter. If necessary the appropriate technical resources (lifting cart or crane for large weights) and tools must be used. Improper handling or use of the wrong tools may cause damage to the soft starter.

The Soft starter DS7 is only designed for use as built-in device.

Take sufficient counter measures in the case of:

- Contaminated cooling air, such as dust, fluff, grease:
  This can cause short-circuits on the cards
  (counter measures: installation of filters, separate ventilation circuit).
- Aggressive gases:
  These can corrode circuit-board conductors
  (counter measures: flush mounting of filters, separate ventilation circuit).
- Contaminated filters:
  These can cause overheating
  (counter measure: regular cleaning).

To prevent overheating, observe the following points:

- Ensure the free flow of the cooling air both to and from the device.
- No devices that produce considerable amounts of heat in the proximity of the soft starter.
- Observe the mounting clearance above and below the soft starter as the temperature of the cooling air will otherwise reach impermissible values and the soft starter will switch off.

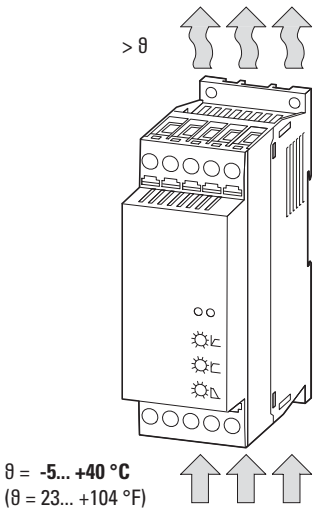


Figure 37: Cooling air supply

The supplied cooling air must have a temperature between -5 and +40 °C. A derating is required for higher temperatures (up to 60 .maximum)

- 2 percent of the rated operational current I_e per Kelvin (K) temperature rise from +40 °C
- 1 percent of the rated operational current I_e per Kelvin (K) temperature rise from +40 °C with device fan (DS7-FAN-…)

3.3.1 Increased cooling

The circulation of the cooling air at soft starter DS7 can be increased with an optional device fan DS7-FAN-…

This allows

- higher ambient temperatures,
- a more compact layout and a direct combination with other components,
- a higher number of starts per hour.

Device fans DS7-FAN-… are temperature-controlled and always run during the ramp times (t-Start and t-Stop) and continue to run until the heat sink has cooled down again. The fan then stops automatically.

It is advisable to install device fan DS7-FAN-… before installing soft starter DS7 in the basic device. This helps prevent additional steps for removal and changes in the installation.

DANGER

The device fan must only be mounted in a de-energized state.

The device fans are assigned according to the rated operational current (yyy) of the respective size.

Table 7: Assignment of device fans

Rated operational current (yyy)	Size	Device fan (type)	Arrangement
004 – 012	BG1	DS7-FAN-032	Flush mounting
016 – 032	BG2	DS7-FAN-032	Flush mounting
041 – 100	BG3	DS7-FAN-100	Undeframe
135 – 200	BG4	DS7-FAN-200	Undeframe

Technical data for device fans DS7-FAN…
→ section “9.5.4 Device fans”, page 221 and page 228.

3.3.1.1 DS7-FAN-032 device fan

The optional DS7-FAN-032 device can be fitted on the rear of the soft starter sizes 1 and 2 (i.e. devices up to 32 A).

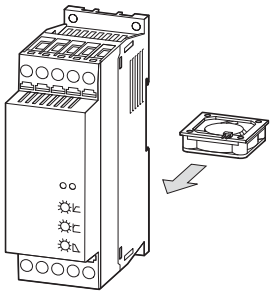


Figure 38: Fitting the fan (basic principle)

To do this, open the mounting space in the enclosure. Carefully break out the blanking plate with a flat screwdriver (see Fig. 39):

- ▶ Penetrate four thin plastic bars [1]
- ▶ Lever out [2] blanking plate [3]

> *NOTICE*
>
> Do not break through or discard blanking plate!
> It is reinserted for fastening after the device fan is fitted.

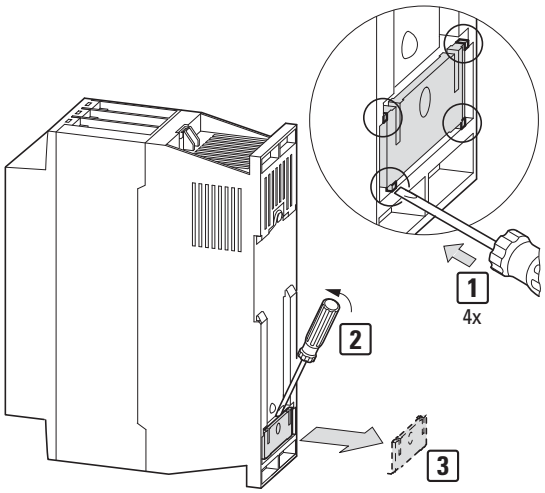


Figure 39: Step 1: Break out blanking plate

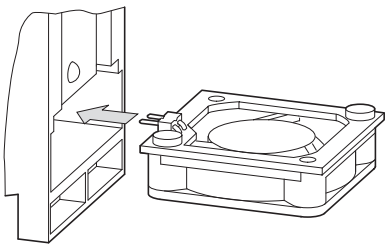


Figure 40: Step 2: Slide in fan DS7-FAN-032

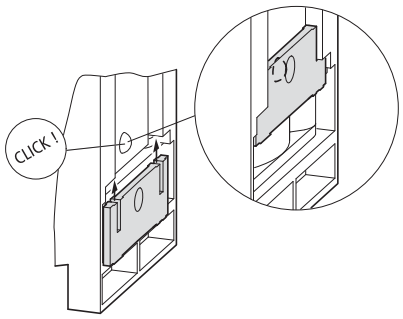


Figure 41: Step 3: Fastening the fan with the strap.

NOTICE

When inserting the device fan, make sure not to damage the fan's plug connections (pins) or connection cables.

To mount the DS7-FAN-032 device fan, place it on the bottom edge of the housing (plug connectors at the top left) and fully insert without the use of force. Then re-insert the previously removed blanking plate [3] (Fig. 39) from below until the round fixing point snaps into position (CLICK, Fig. 41).

To remove the device fan, lift up the blanking plate from the top (at the fixing point) using a flat screwdriver and slide out downwards. Then remove the device fan.

CAUTION

Do not damage the connection cables and plug contacts when removing the fan.

3.3.1.2 Device fan DS7-FAN-100 / DS7-FAN-200

Optional device fans DS7-FAN-100 and DS7-FAN-200 are mounted on the rear of soft starter DS7 and secured to the heat sink with four screws.

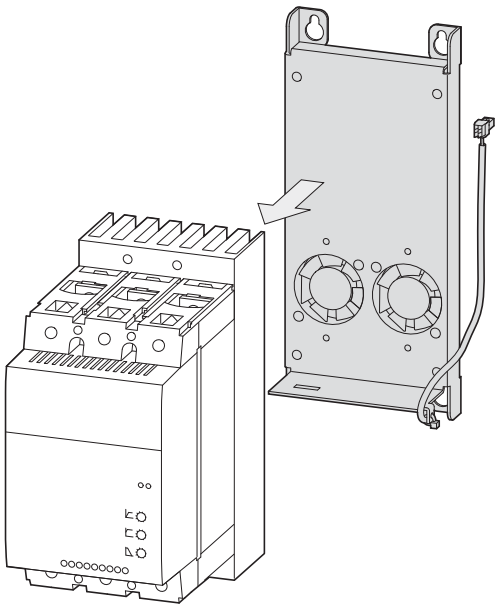


Figure 42: Fitting the fan (basic principle)

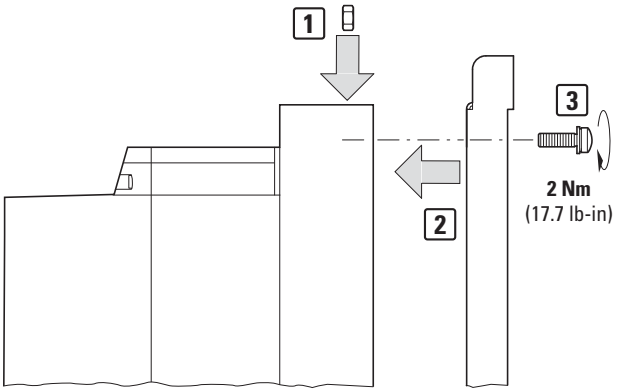


Figure 43: Fitting DS7-FAN100/DS7-FAN200

- Insert the nuts into the matching recesses in the cooling fins [1].
- Place fan DS7-FAN-100 or DS7-FAN-200 against the underside of the heat sink [2].
- Secure the fan with the screws [3]. The maximum tightening torque is 2 Nm.

The required nuts and screws are included with the fan.

The electrical cables of the fan are connected on the underside of the soft starter (right side above motor terminal 6T3). To make the connections, break out the terminal cover in the enclosure.

▶ Carefully insert a standard screwdriver (size 2.5 × 0.4 mm) into the opening to the left of the square cover [1] (to a depth of about 3 mm).

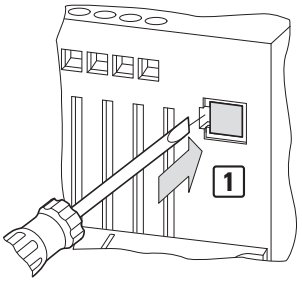


Figure 44: Insert standard screwdriver into opening.

▶ Release the cover by levering it [2].

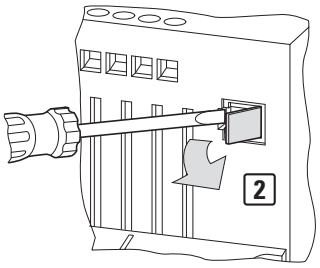


Figure 45: Loosen cover

▶ Remove the released blanking plate [3].

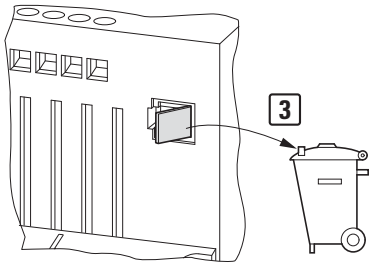


Figure 46: Remove the cover

→ The blanking plate can not be refitted.
Should the device fan be removed again, cover the connector with suitable material, such as insulating tape.

▶ Plug the device fan's plug into the opened connection opening [4] until the lower fixing point engages (CLICK).

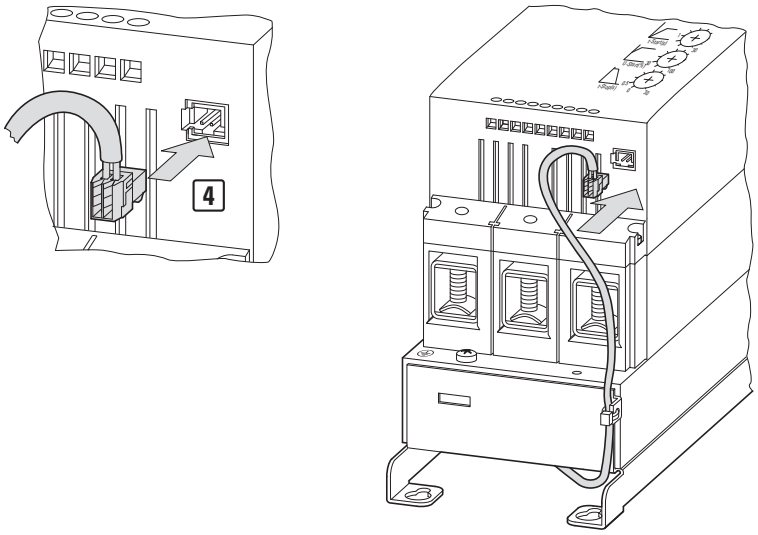


Figure 47: Inserting fan connector

NOTICE

When inserting the fan connector, make sure not to damage the fan's plug connections (pins) or connection cables.

→ The device fan is temperature-controlled and always runs during the ramp times (t-Start and t-Stop) and continues to run until the heat sink has cooled down again. The fan then automatically stops.

3.3.2 Mounting instructions (sizes 1 and 2)

3.3.2.1 Free surrounding areas

On soft starters DS7 sizes 1 and 2 (up to 32 A) a mounting clearance of 25 mm must be maintained at the front. A top and bottom clearance of 75 mm each is required. When only smaller clearances are available, derating is necessary or the optional fan DS7-FAN-032 can be used.
All sizes can be mounted directly next to each other.
Side clearance is not required to other devices that do not themselves require clearance at the sides.

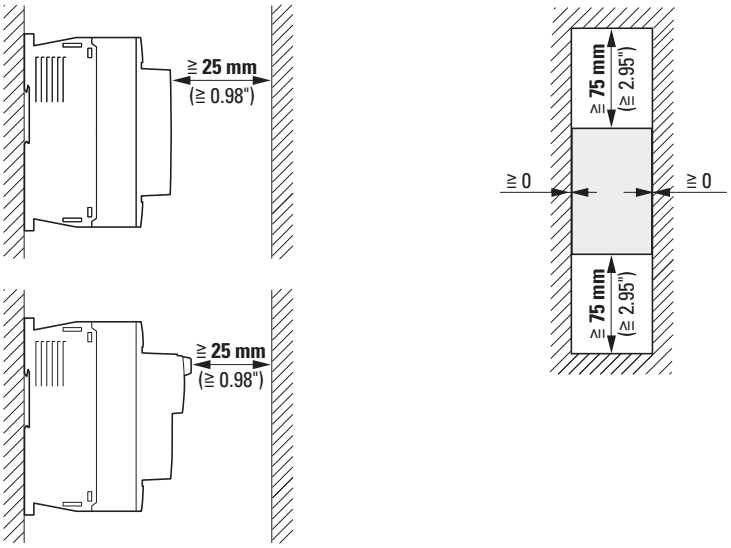


Figure 48: Installation clearances for devices up to 32 A
Top: Devices without SmartWire-DT; bottom: Devices with SmartWire-DT

If the point if installation is subject to continuous vibration or shocks, design measures must be taken for dampening, such as through the use of vibration dampers.

3.3.2.2 Fitting on mounting plate

The DS7 soft starters are screwed onto the switch cabinet wall (mounting plate). The control signal terminals and the operator control and display elements must face the front. The screw fixing is completed with at least two diagonally arranged flat head screws. The use of washers and split washers is recommended.

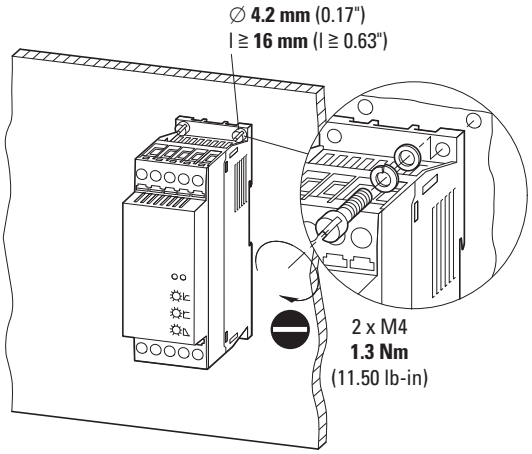


Figure 49: Bolting to mounting plate (example for size 1)

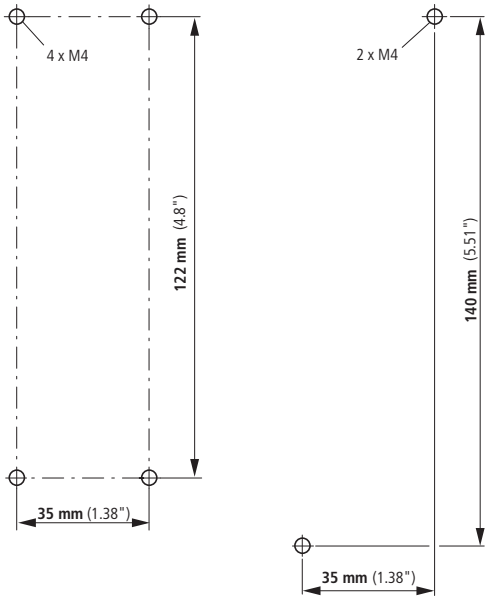


Figure 50: Drilling dimensions

3.3.2.3 Surface mounting on mounting rail

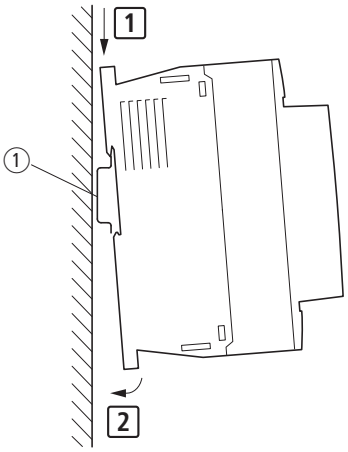


Figure 51: Fixing to the mounting rail

Place the DS7 soft starter onto the mounting rail from above [1], push down [2] and let it snap into position.

Removing it requires using a little force from above:
In order to remove the soft starter, pull the lower housing edge forward and lift the soft starter upwards and off the mounting rail.

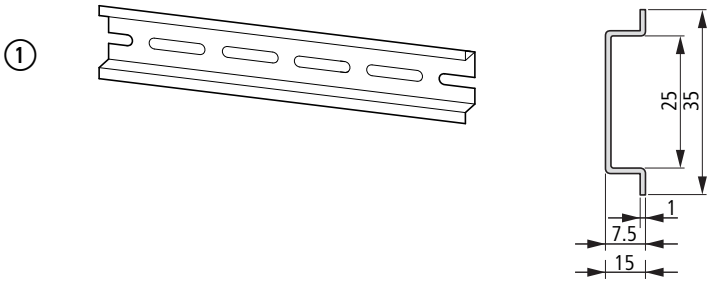


Figure 52: Mounting rail conforming with IEC/EN 60715

3.3.2.4 Size 1: Surface mounting with PKZ or PKE

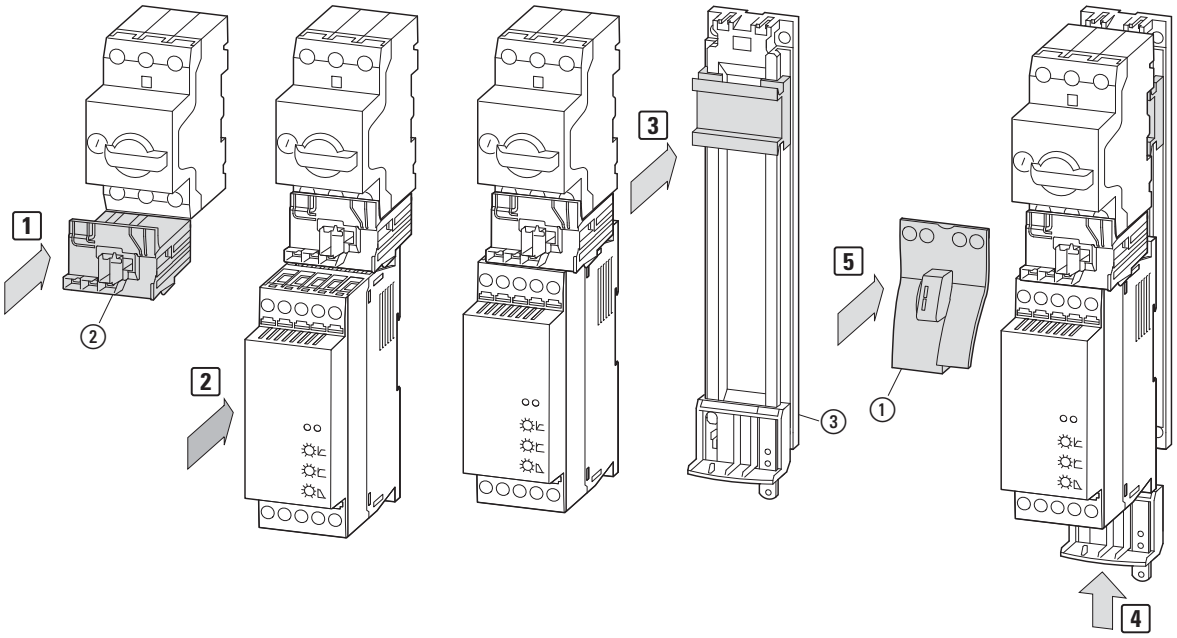


Figure 53: Mounting of size 1 devices (up to 12 A)

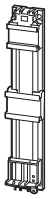
The size 1 DS7 soft starter (up to 12 A) can be connected directly to a PKZ or PKE motor-protective circuit-breaker. This electronic motor-starter combination can be mounted directly on a mounting plate, a mounting rail or on busbar adapter. Accessories required:

- PKZM0-XDM12 wiring kit for connecting a DS7 soft starter directly to a PKZ or PKE motor-protective circuit-breaker

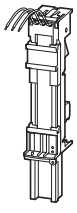
 = ①

 = ②

- optional, variant 1:
  PKZM0-XC45L top-hat rail adapter

 = ③

- optional, variant 2:
  BBA0L-25 busbar adapter

 = ③

3.3.2.5 Size 2: Surface mounting with PKZ or PKE

This is implemented in the same way as the surface mounting for size 1 and the required accessories:

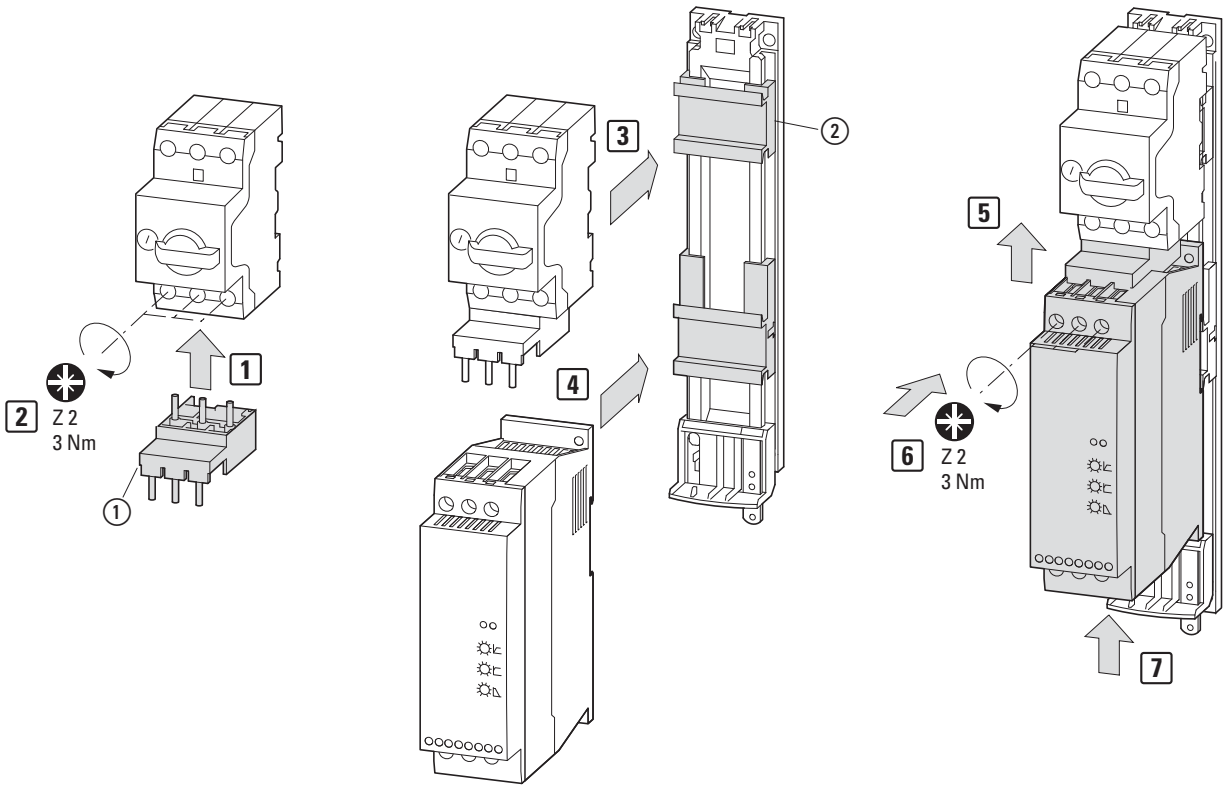
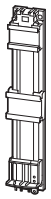


Figure 54: Mounting of size 2 devices (up to 32 A)

- PKZM0-XM32DE electric contact module for connecting a DS7 soft starter directly to a PKZ or PKE motor-protective circuit-breaker

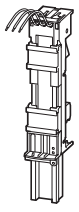
= ①

- optional, variant 1: PKZM0-XC45L/2 top-hat rail adapter



= ②

- optional, variant 2: BBA0L-32 busbar adapter



= ②

3.3.3 Mounting instructions (Sizes 3 and 4)

3.3.3.1 Free surrounding areas

With sizes 3 and 4 (41 to 200 A), a mounting clearance of 5 mm to the front of the DS7 soft starter must be maintained. A top and bottom clearance of 75 mm each is required.

If the clearance is smaller, the device must be derated or an optional device fan DS7-FAN-100 (for size 3) or DS7-FAN-200 (for size 4) must be used.

When combined with the NZM1 or NZM2 motor-protective circuit-breaker and the NZM1/2-AB spacers, the mininum clearance ① between the DS7 soft starter and the NZM motor-protective circuit-breaker is:

- ≧ 25 mm for NZM1 (size 3),
- ≧ 35 mm for NZM2 (size 4).

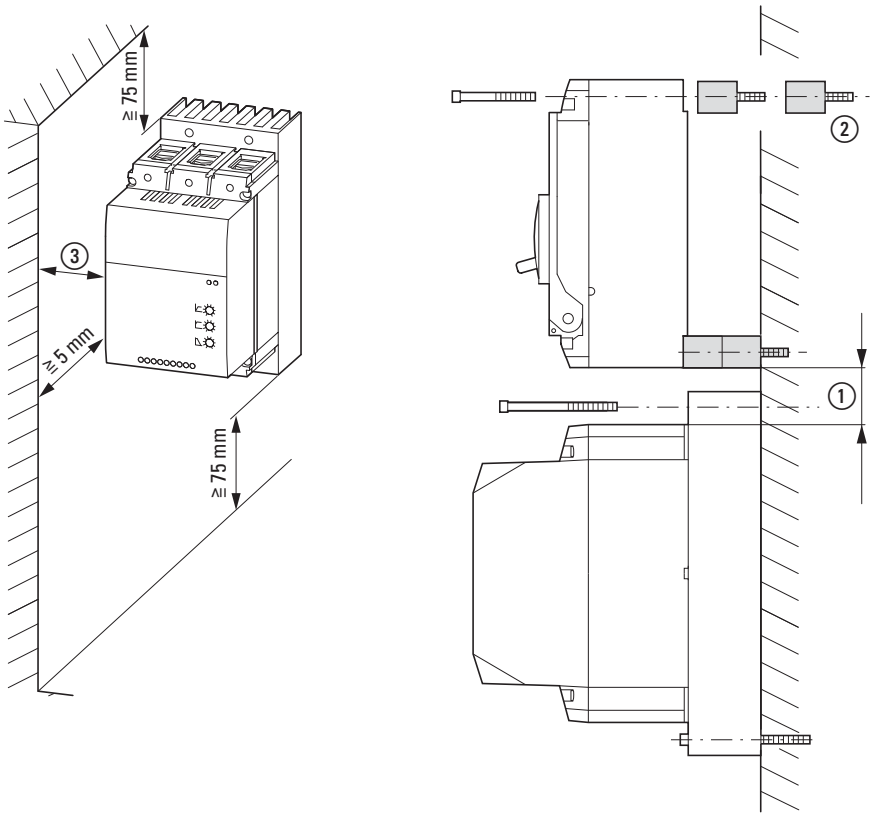


Figure 55: Mounting NZM + DS7 for sizes 3 and 4 (from 41 A)

The spacers ② are fitted underneath the NZM motor-protective circuit-breakers and allow the required thermal air circulation for the heat sink of the soft starter.

The spacers are not supplied with the DS7 soft starter.

The following are required:

- for NZM1 (DS7 devices up to 100 A):
  4 = 1 x NZM1/2-XAB plus 2 M4 x 50 screws,
- for NZM2 (DS7 devices up to 200 A):
  16 = 4 x NZM1/2-XAB plus 4 M4 x 85/20 screws.

Side clearance ③ is not required to other devices that do not themselves require clearance at the sides. A side clearance of 5 mm is required in combination, for example, with an NZM2 motor-protective circuit-breaker.

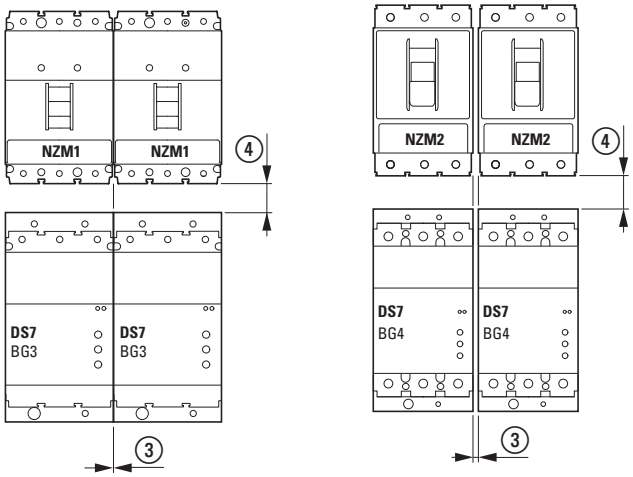
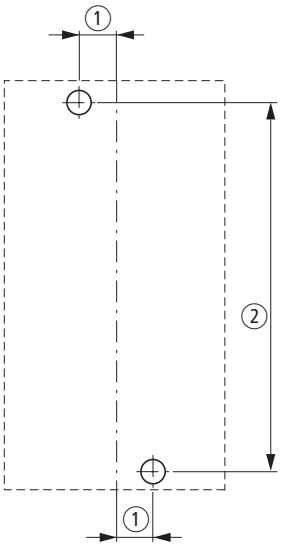


Figure 56: Lateral clearances in combination with motor-protective circuit-breakers NZM

③ DS7 + NZM1: ≧ 0
④ ≧ 25 mm (0.98“)
③ DS7 + NZM2: ≧ 5 mm (≧ 0.197“)
④ ≧ 35 mm (3.38“)

3.3.3.2 Fitting on mounting plate

The DS7 soft starters in sizes 3 and 4 must be screw fastened vertically on a heat conductive non-combustible mounting plate. The control signal terminals and the operating and indication elements must face the front. The screw fixing is completed with at least two diagonally arranged flat head screws. The use of washers and split washers is recommended.



Size 3 (up to 100 A)
① = 22.5 mm
② = 161 mm

Size 4 (up to 200 A)
① = 15 mm
② = 200 mm

Figure 57: Drilling dimensions

In combination with optional device fan DS7-FAN-100 or DS7-FAN-200 the drilling dimensions deviate.
See the dimension drawings on page 228.

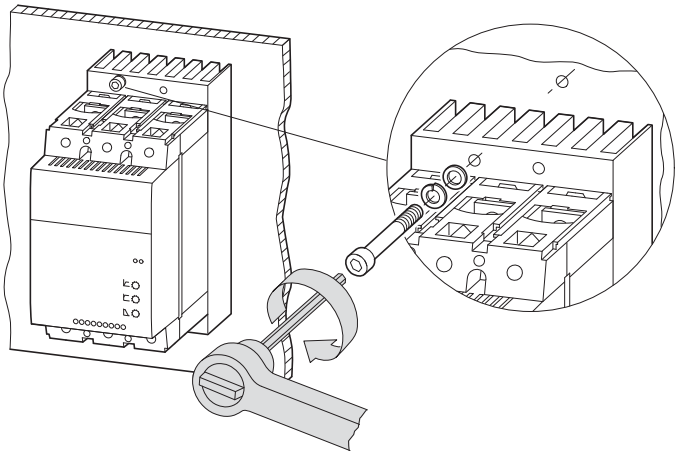
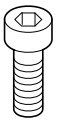


Figure 58: Fitting on mounting plate, DS7 soft starter (sizes 3 and 4)




Part no.		mm	inch	Nm	lb-in
DS7-34…SX041N0 DS7-34…SX055N0 DS7-34…SX070N0 DS7-34…SX081N0 DS7-34…SX100N0	2 x M5 x ≧ 55	4	0.16	9	80
DS7-34…SX135N0 DS7-34…SX160N0 DS7-34…SX200N0	2 x M6 x ≧ 65	5	0.2	14	123

3.4 Electrical Installation

CAUTION

Carry out wiring work only after the Soft starter has been correctly mounted and secured.

DANGER

Electric shock hazard - risk of injuries!
Carry out wiring work only if the unit is de-energized.

NOTICE

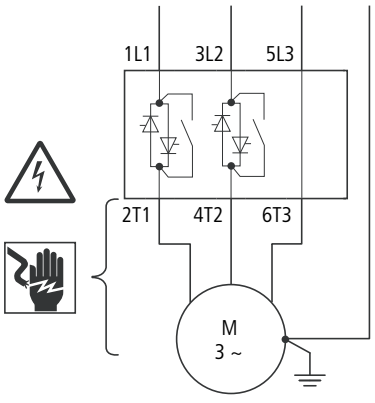
Fire hazard!
Only use cables, protective switches, and contactors that feature the indicated permissible nominal current value.

NOTICE

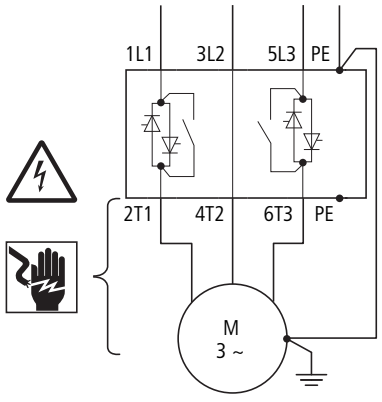
The devices contain components that are sensitive to electrostatic charges. Before undertaking work near the terminals, personnel must discharge themselves (i.e. by touching a PE fixing screw or another grounded metal surface in the control panel).

DANGER

The power section of the soft starter contains semiconductor components. These do not have any isolation between the supply and the load. Small leakage currents are always therefore present. An upstream disconnector must therefore be switched off before working on the soft starter or motor.



Size 1 and 2 (4 to 32 A)



Size 3 and 4 (41 to 200 A)

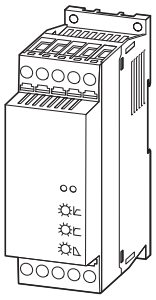
3.4.1 Connection to power section

Size 1 (4 – 12 A)

L1 → 1/L1

L2 → 3/L2

L3 → 5/L3



2/T1 → U

4/T2 → V

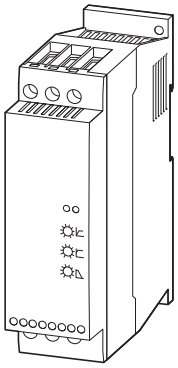
6/T3 → W

Size 2 (16 – 32 A)

L1 → 1/L1

L2 → 3/L2

L3 → 5/L3



2/T1 → U

4/T2 → V

6/T3 → W

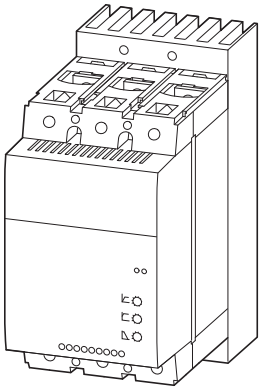
Size 3 and Size 4 (41 – 200 A)

L1 → 1/L1

L2 → 3/L2

L3 → 5/L3

PE → PE ⏚

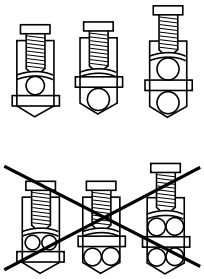


2/T1 → U

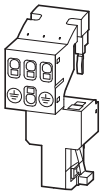
4/T2 → V

6/T3 → W

PE → PE ⏚



For size 1, the motor connection can optionally be implemented via the DILM12-XMCP/T motor feeder plug.



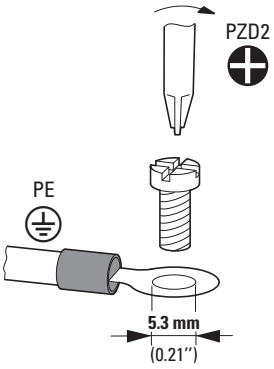
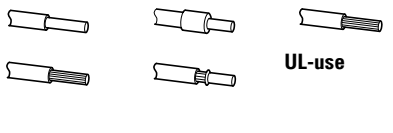


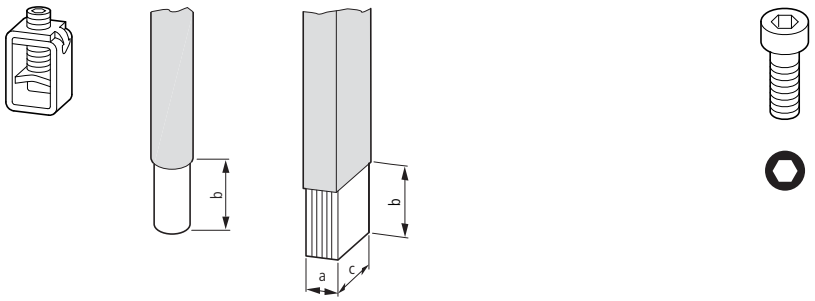
Figure 59: Pluggable motor connection for size 1

Table 8: Terminal capacities for size 1 and 2



	mm²	mm²	AWG	mm	inch			Nm	lb-in
Size 1	0.75 - 4	0.75 - 2.5	18 - 10	10	0.39	1 x 6	PZ2	1.2	10.62
DS7…004… DS7…007… DS7…009… DS7…012…	2 x 0.75 - 3.5	2 x 0.75 - 2.5	2 x 21 - 20	10	0.39	1 x 6	PZ2	1.2	10.62
?Frame size 2	0.75 - 16	0.75 - 16	18 - 6	10	0.39	1 x 6	PZ2	3.2	28.32
DS7…016… DS7…024… DS7…032…	2 x 0.75 - 10	2 x 0.75 - 10		10	0.39	1 x 6	PZ2	3.2	28.32

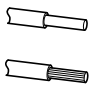
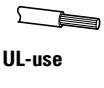
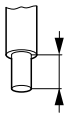
Table 9: Terminal capacities for size 3 and 4



	IEC			UL-use						
	a [mm]	b [mm]	c [mm]	a [inch]	b [inch]	c [inch]	mm	inch	Nm	lb-in
?Frame size 3	10 - 70 mm² 2 x 6 - 25 mm² 2 - 9 x 9 x 0.8 mm			AWG12-2/0 2 - 9 x 0.35 x 0.03 inch						
DS7…041… DS7…055… DS7…070… DS7…081… DS7…100…	1.6 - 7.2	16.5	9	0.06 - 0.28	0.65	0.35	4	0.16	9	80
?Frame size 4	4 - 185 mm² 2 x 4 - 70 mm² 2 x 9 x 0.8 mm - 10 x 16 x 0.8 mm			AWG12 - 350 MCM 2 x 0.35 x 0.03 inch 10 x 0.63 x 0.03 inch						
DS7…135… DS7…160… DS7…200…	1.6 - 8	22	9 -16	0.006 - 0.31	0.87	0.35 - 0.63	5	0.2	14	123

3.4.2 Connection in control section

Table 10: Terminal capacity control section

			 UL-use							
	mm²	**mm²**	**AWG**	**mm**	**inch**			**Nm**	**lb-in**
Size 1	0.75 - 4	0.75 - 2.5	18 - 10	10	0.39	1 x 6	PZ2	1.2	10.62
DS7…004… DS7…007… DS7…009… DS7…012…	2 x 0.75 - 3.5	2 x 0.75 - 2.5	2 x 21 - 20	10	0.39	1 x 6	PZ2	1.2	10.62
Frame size 2	0.5 - 2.5	0.5 - 1.5	21 - 16	6	0.24	0.6 x 3.5	PZ2	0.4	3.54
DS7…016… DS7…024… DS7…032…	2 x 0.5 - 1.0	2 x 0.5 - 0.75	2 x 21 - 20	6	0.24	0.6 x 3.5		0.4	3.54
Frame size 3	0.5 - 2.5	0.5 - 1.5	21 - 16	6	0.24	0.6 x 3.5	PZ2	0.4	3.54
DS7…041… DS7…055… DS7…070… DS7…081… DS7…100…	2 x 0.5 - 1.0	2 x 0.5 - 0.75	2 x 21 - 20	6	0.24	0.6 x 3.5		0.4	3.54
Frame size 4	0.5 - 2.5	0.5 - 1.5	21 - 16	6	0.24	0.6 x 3.5	PZ2	0.4	3.54
DS7…135… DS7…160… DS7…200…	2 x 0.5 - 1.0	2 x 0.5 - 0.75	2 x 21 - 20	6	0.24	0.6 x 3.5		0.4	3.54

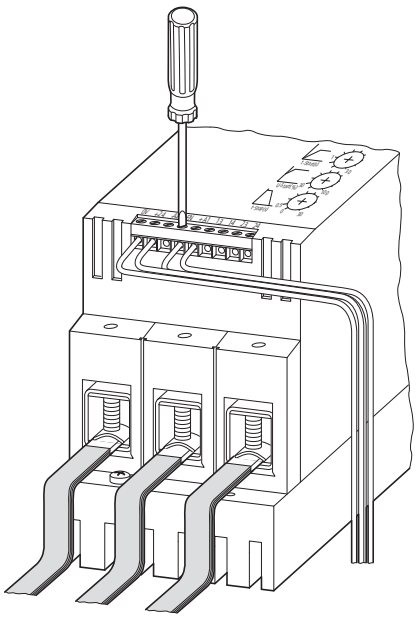


Figure 60: Example for size 3 and 4

Unlike with frequency inverters, the screen earth kit of the motor cables is not required.

Lay the control cables ② spatially separated from the power cables ① and if possible only cross at right angles.
This particularly applies to 24 V control voltages.
The control cables do not have to be shielded.

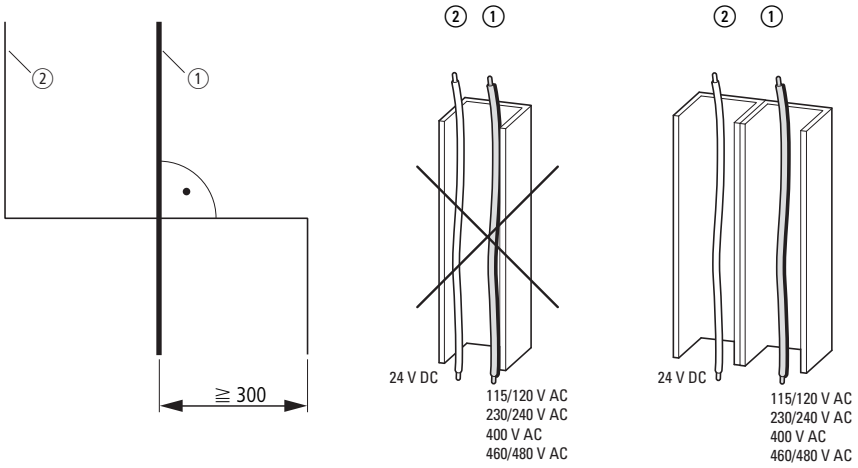


Figure 61: Laying control cables

① Power cable L1, L2, L3, U, V, W
② Control cables: $+U_S$, $-U_S$, +A1, -A2, EN, 13, 14, 23, 24

3.4.3 Connection SmartWire-DT

Connect the SWD external device plug with the adapted SmartWire-DT ribbon cable.

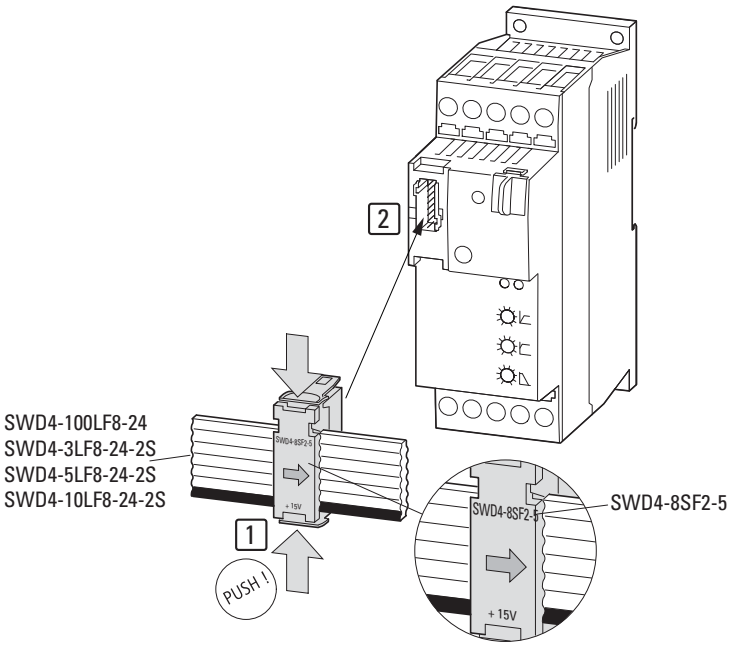


Figure 62: Connecting the SmartWire-DT external device plug with the adapted ribbon cable

> *NOTICE*
>
> Do not install or remove the SWD4-8SF2-5 SmartWire-DT external device plug without switching off the supply and control voltages first!

3.4.3.1 PKE32-COM communication cable

To connect a motor-protective circuit-breaker PKE (sizes 1 and 2 only) with trip block PKE-XTU(W)A-… to a soft starter DS7-SWD (size 1 or 2), communication cable PKE32-COM is required. It provides the communication link between soft starter DS7-SWD and PKE trip block PKE-XTU(W)A-… The data transfer is through the data interfaces of PKE trip block and soft starter DS7-SWD.

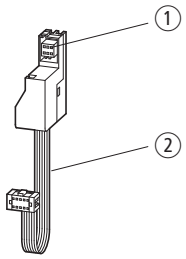
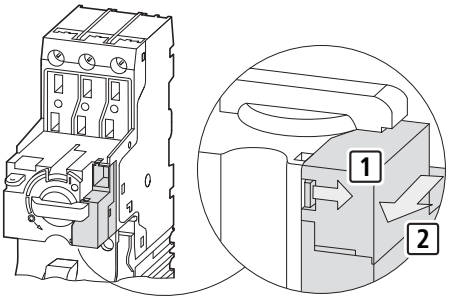


Figure 63: PKE32-COM communication cable

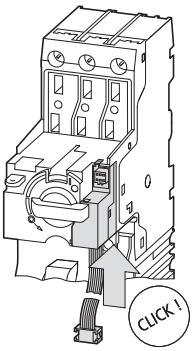
① Connector for PKE-XTU(W)A-… trip block
② Data cable with connector for soft starter DS7-SWD

In order to connect a PKE motor-protective circuit-breaker with a PKE32-COM communication cable, the following additional installation steps for the DS7-SWD soft starter are required on top of the standard installation procedure (see figures 53 and 54):

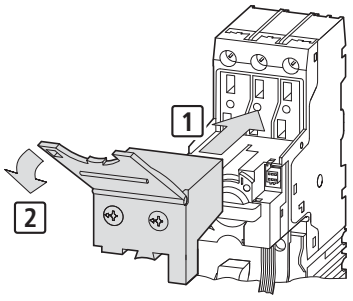
▶ Remove the empty module on the PKE basic device.



▶ Connect the PKE32-COM communication cable to the PKE basic device.

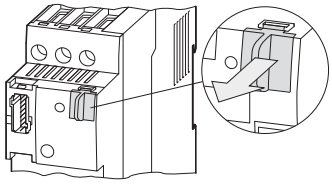


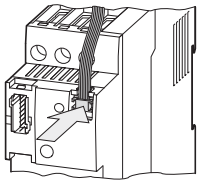
▶ Fit the PKE trip block for motor protection:
PKE-XTUWA-32 or PKE-XTUA-…



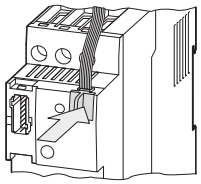
→ PKE trip block PKE-XTUCP-… for system protection must not be used in combination with a soft starter DS7!

▶ Remove the communication interface cover on the DS7-SWD soft starter (please lift the cover!) and connect the PKE32-COM communication cable.





▶ Put the communication interface cover back in place.



3.4.4 Functions of control signal terminals

This section describes the functions of the control signal terminals.

Table 11: Function of control signal terminals

Terminal	Size				Description
	1	2	3	4	
$+U_s$	✓	✓	✓	✓	Regulator supply voltage (positive pole) • DS7-340…: +24 V DC, +10 %/-15 %, 150 mA 24 V AC, +10 %/-15 %, 150 mA, 50/60 Hz • DS7-342…: 120 – 230 V AC, +10 %/-15 %, 100 mA at 230 V, 50/60 Hz
$-U_s$		✓	✓	✓	Reference potential (0 V) for $+U_s$
+A1	✓	✓	✓	✓	Control input start/stop (positive pole) Same voltage level as $+U_s$ Low level: 0 - 3 V; High level: 4.6 – $+U_s$ Current drain: DS7-340…: 1.6 mA at 24 V DS7-342…: 4 mA at 230 V
-A2	✓	✓	✓	✓	Reference potential (0 V) for +A1 With size 1 also reference potential for relay contact 13 (TOR)
EN			✓	✓	Control input, controller enable (enable, positive pole) EN must be actuated before +A1. If the t-Stop function is used, EN should not be disconnected until after the RUN signal has been deactivated. If EN is deactivated in RUN mode, the drive will execute an uncontrolled stop.
13	(✓)	✓	✓	✓	Relay contact, N/O TOR (Top-of-Ramp) 230 V AC, 1 A, AC 11 **Notice!** For size 1 the switched voltage (TOR: 13/-A2) must be of the same type (AC/DC) and level (24 V/230 V) as the control voltage: $+U_s$ = +A1 = 13, reference potential -A2
14		✓	✓	✓	Common contact of TOR relay contact (control terminal 13)
23		✓	✓	✓	Relay contact, N/O RUN (RUN signal) 230 V AC, 1 A, AC 11
24		✓	✓	✓	Common contact of RUN relay contact (control terminal 23)

3.4.5 Control section power supply

The control section of soft starter DS7 can be supplied with the following voltages through terminals $+U_S$/$-U_S$ (sizes 2, 3 and 4) or $+U_S$/-A2 (size 1):

- 24 V DC/AC at DS7-34**0**…
- 120 – 230 V AC at DS7-34**2**…
- 24 V DC bei DS7-34**D**…

Soft starters DS7-34D…-D can be supplied directly through the SmartWire-DT ribbon cable.

→ At a high load on the PSU supplying the SWD (many modules, signaling lamps, soft starters) soft starter DS7 can also be supplied with control voltage through control signal terminals U_S or further SmartWire-DT PSUs (gateway EU5C-SWD-PF…). If power is fed through control signal terminals U_S the 24 V connection on the SWD gateway must be switched off.

→ Ensure that the regulator supply voltage and the control signals always have the same potential and are supplied from the same voltage source.

NOTICE

A soft starter DS7-34D…-D **must not** be supplied with voltage through the SmartWire-DT ribbon cable and control terminal U_S **at the same time**! A potential difference can cause the device to be destroyed!

NOTICE

On soft starters size 1 terminals $+U_S$, +A1 and 13 (through contact TOR) have a common reference potential (-A2). The switched voltage (TOR) and the control voltages ($+U_S$, +A1) **must** be the same here!

3.4.6 Internal device voltages

The DS7 soft starters do not provide any internal voltage.

3.4.7 Ground control voltage

All control signal terminals of the DS7 soft starter are galvanically isolated from the power section. Connecting the control voltage on the DS7 soft starter to earth is not necessary.

→ If control voltage earthing requirements must be complied with (e.g., Safety of machinery – Electrical equipment of machines, EN 60204) earthing must be implemented at the power supply source (control transformer, power supply unit).

3.4.8 Relay contacts

The soft starters of the DS7 series are provided with one or two relays with an N/O contact depending on the current range. The relays are galvanically isolated from the power section.

Table 12: Relay outputs, function

Relays (Control terminal)	designation	Function
13/14 or -A2/13	**TOR**	Top-of-ramp: Signals operation with full voltage on the motor (top of start ramp reached).
23/24	**RUN**	Operating signal during ramp time (t-Start, t-Stop), as well as during continuous operation (= TOR) **Note**: This relay is only installed in devices of sizes 2, 3 and 4.

In applications in which the relay contacts (TOR, RUN) control external contactors, the contactor coil must be connected in order to increase interference immunity:

- for AC voltage with an RC filter,
- for DC voltage with free-wheel diode.

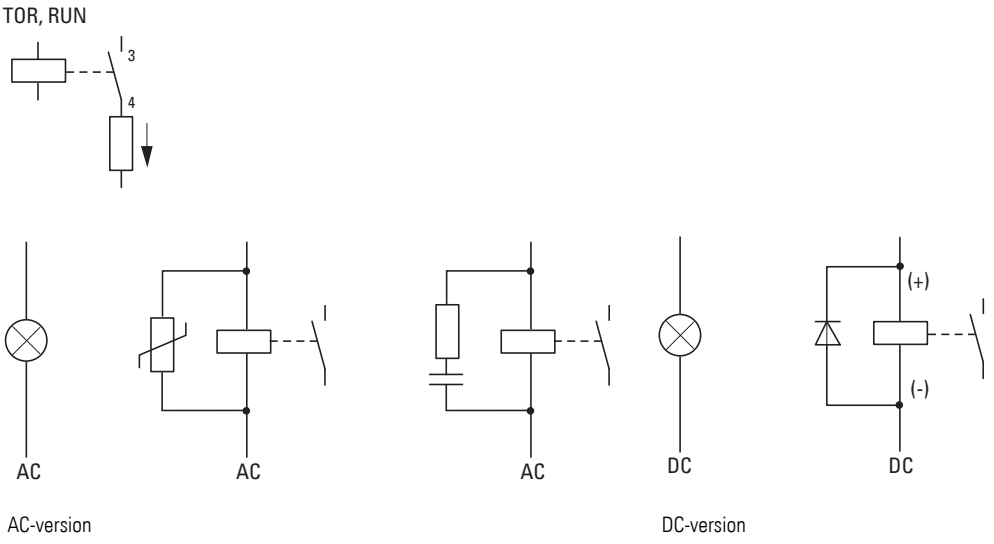


Figure 64: Relay contacts with permissible load and recommended connection

The illustration below shows the operating points for the Run signals at relay contacts TOR (13/14) and RUN (23/24).

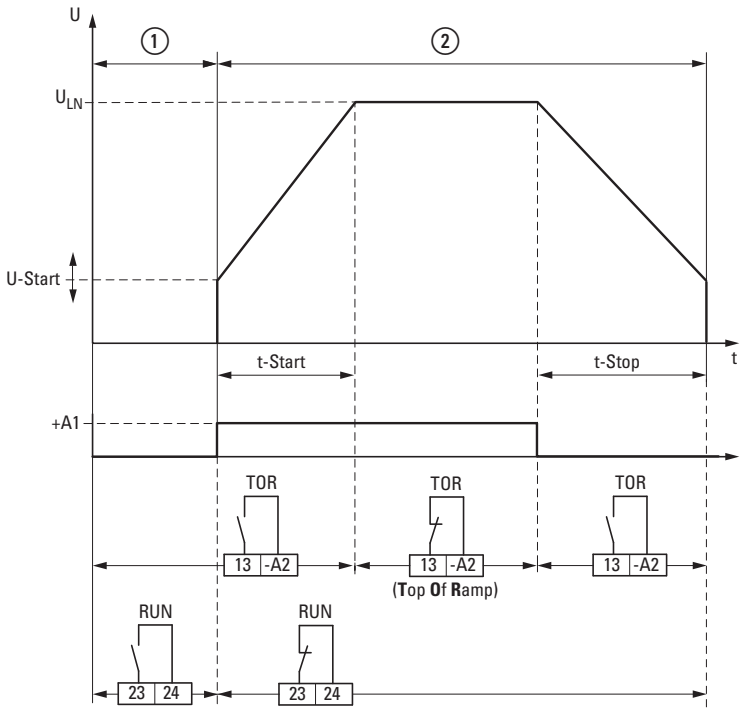


Figure 65:Contact position of relay (example: DS7 size 2)

① Ready to start

② Run

Soft starters of the size 1 (up to 12 A) have no RUN relay. The TOR relay has different terminal designations in this size and is non-isolated (-A2) against the control voltage.

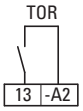


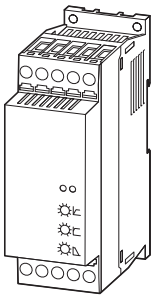
Figure 66: TOR relays in size 1

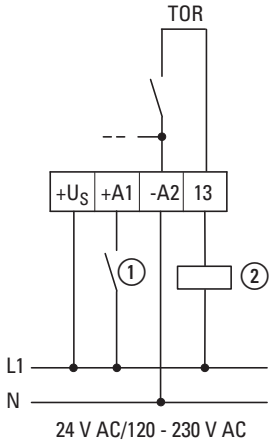
The RUN relay (control signal terminal 23/24 sizes 2, 3 and 4 only) closes together with the start command at control signal terminal +A1. The start ramp (t-Start) is enabled around 100 ms later. This makes it possible to switch an optional mains contactor on and off via the RUN relay. If there is no voltage present at the power section by this changeover time of 100 ms, the DS7 soft starter switches off with the "phase failure" fault signal.

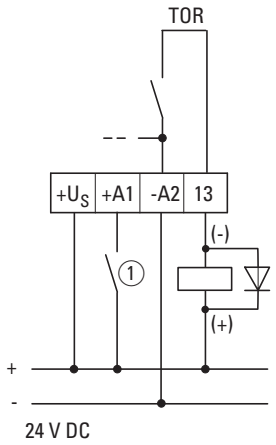
The TOR relay (control terminal 13/14 or 13/-A2 on size 1) is energized after the set time t-Start (contact closes). The TOR contact opens again (relay drops out) when the Start command at control terminal +A1 is switched off or soft starter DS7 detects a fault.

3.4.9 Relay contacts - connection examples

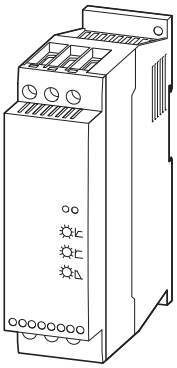
Size 1 (4 to 12 A) – Non-isolated relay contact

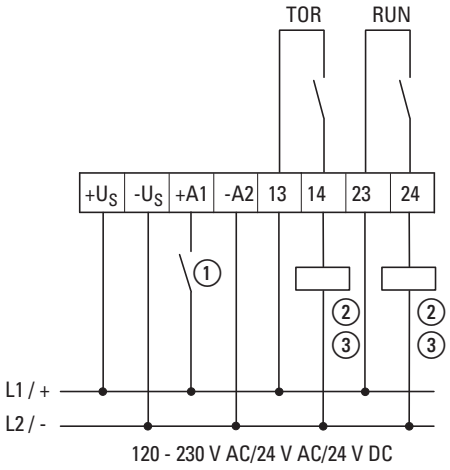




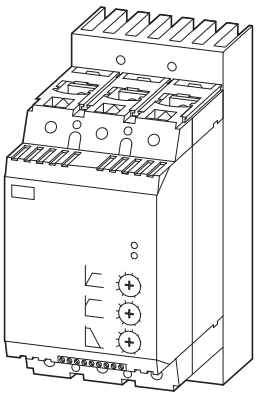


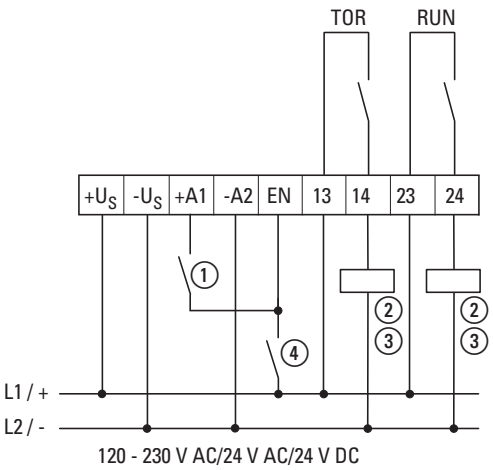
Size 2 (16 to 32 A) – Isolated relay contacts





Size 3 and 4 (41 to 200 A) – Isolated relay contacts



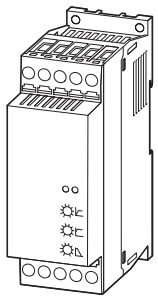


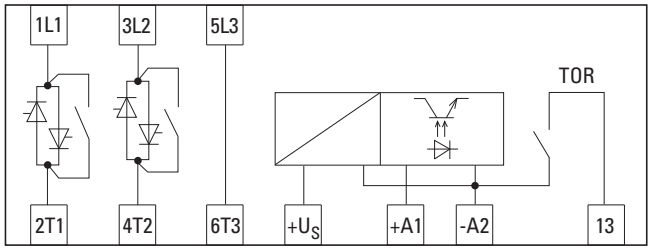
① Start/Stop signal
② Load with AC voltage
③ Load with control voltage (DC)
④ Controller enable (EN = Enable)

3.5 Block diagrams

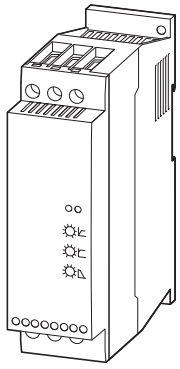
The number and arrangement of the control terminals in the individual sizes vary according to the power.

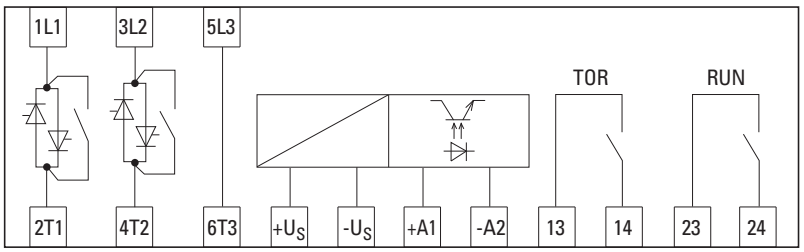
Size 1 (4 – 12 A)



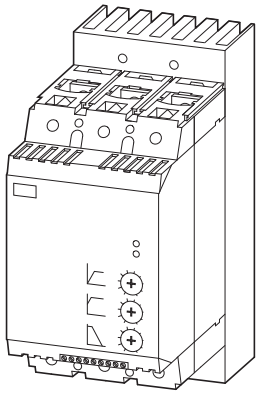


Size 2 (16 – 32 A)





Size 3 and 4 (41 – 200 A)



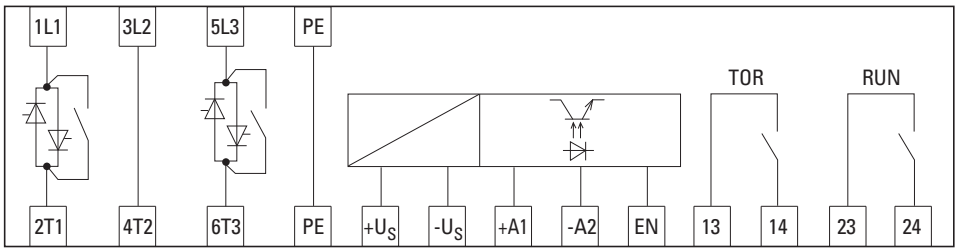


Figure 67: Block diagrams

3.6 Insulation test

The soft starters of the DS7 series are tested, delivered and require no additional testing.

CAUTION

On the control signal and the connection terminals of the soft starter, no leakage resistance tests are to be performed with an insulation tester.

If insulation testing is required in the power circuit of the motor feeder, you must consider the following measures.

- **Checking the motor cable insulation**
  Disconnect the motor cable from the terminals 2/T1, 4/T2 and 6/T3 from the soft starter and from the motor (U, V, W). The insulation resistance of the motor cable between the individual phase conductors and between each phase conductor and the protective conductor can be measured. The insulation resistance must be greater than 1 MΩ.
- **Checking the mains cable insulation**
  Disconnect the mains cable from the mains power supply and from the connection terminals 1/L1, 3/L2 and 5/L3 of the soft starter. The insulation resistance of the mains cable between the individual phase conductors and between each phase conductor and the protective conductor can be measured. The insulation resistance must be greater than 1 MΩ.
- **Checking the motor insulation**
  Disconnect the motor cable from the motor (U, V, W) and open the bridge circuits (star or delta) in the motor terminal box. The insulation resistance can then be measured between the individual motor windings. The measurement voltage must at least match the rated operating voltage of the motor but is not to exceed 1000 V.
  The insulation resistance must be greater than 1 MΩ.

Consider the notes from the motor manufacturer in testing the insulation resistance.

4 Operation

4.1 Checklist for commissioning

Before commissioning the DS7 soft starter, make sure to check the following (using the check list):

No.	Activity	Note
1	Installation and wiring completed as specified in the relevant instructional leaflets (→ Table 2, Page 16) and this manual.	
2	All wiring and line section leftovers, as well as all the tools used, have been removed from the soft starter's and the drive motor's proximity.	
3	All terminals in the power section and in the control section were tightened with the specified torque.	
4	The lines connected to the output terminals of the soft starter (2/T1, 4/T2, 6/T3) are not short-circuited and are not connected to ground (PE).	
5	The heat sink of soft starters size 3 and 4 is correctly earthed (PE).	
6	All electrical connections and switchgears in the power section were implemented properly and were designed in line with the corresponding requirements.	
7	Each single phase of the supply voltage (L1, L2, L3) is protected with a fuse.	
8	Soft starter and motor are adapted to the mains voltage (i.e. the rated operational data on the nameplate and the “star” and “delta” connection have been checked).	
9	The quality and volume of cooling air are in line with the environmental conditions required for the soft starter and the motor.	
10	All connected control cables comply with the corresponding stop conditions (e.g., switch in OFF position).	
12	The effective direction of a coupled machine will allow the motor to start.	
13	All emergency switching off functions and safety functions are in an appropriate condition.	

No.	Activity	Note
14	**DS7-SWD** On connection to SmartWire-DT the control voltage must be switched on (SWD LED lit green) and the user address set on the SWD bus.	
15	**DS7-SWD** Control voltage U_S, U_C must correspond with the indicated rated voltage of soft starter DS7 (see the ratings plate).	
16	**DS7-SWD** The address for soft starter DS7-SWD through SmartWire-DT is assigned automatically through the gateway by pressing the configuration button.	

DANGER

Hazardous voltage!
The safety instructions on pages I and II must be followed.

4.2 Commissioning

The soft starters DS7-34… are factory-set such that a performance-assigned 4-pole standard motor can be operated in a typical soft starter application without further settings.

CAUTION

Make sure that there is no danger in starting the motor. Disconnect the driven machine if there is a danger in an incorrect operating state.

CAUTION

Before switching on the soft starter, check whether the permissible ambient conditions have not been exceeded and that there is no moisture inside the device. Storing the soft starter in a cool place for example may cause moisture to occur. If moisture has penetrated the device, ensure that it is completely dried.

CAUTION

The electrical installation and commissioning must only be carried out by suitably qualified personnel.
The user is responsible for ensuring suitable earthing and cable protection for the incoming unit in accordance with local and national regulations.
The motor must be protected from overloads!

In addition, soft starters belonging to the DS7-34D… series also feature a 1-0-A switch that can be used to manually switch the soft starter on and off.

The positions of the 1-0-A switch have the following functions:

- 1: DS7-SWD = ON;
- 0: DS7-SWD = OFF;
- A: Control through SmartWire-DT (PNU 928.0) or through control signal terminals/potentiometers.

The 1-0-A switch can be used for starting and stopping the motor only if soft starter DS7-34D... is supplied with 24 V DC through the SmartWire-DT ribbon cable or the control signal terminals U_S.

→ For more information on the DS7-SWD's 1-0-A switch, see → Section 8.3, „1-0-A switch“.

4.3 Potentiometer settings

The soft starters can be adapted to the application only with the three potentiometers **t-Start**, **U-Start** and **t-Stop**. No other settings are required for operation apart from these potentiometer settings.

On soft starters DS7-SWD these potentiometer settings an be adjusted with parameters.

→ Section 8.9, „Programming“ explains how to configure the DS7-SWD soft starter's parameters.

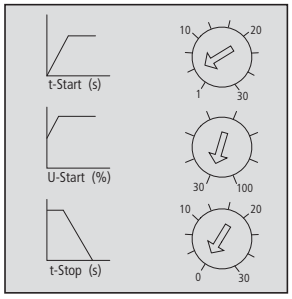


Figure 68: Arrangement of potentiometers

Table 13: Default potentiometer settings

Potentiometer	Value	Function	DS	PNU	
				Index	DS
U-Start	30 – 100 %	Start voltage at which the ramp function is started	30 %	11	4915
t-Start	1 – 30 s	Time in which the voltage is increased from the value U-Start to 100 % with a linear time ramp	5 s	111	50
t-Stop	0 – 30 s	Time in which the voltage is reduced from 100 % to the value U-Start with a linear time ramp	0 s	114	0

4.3.1 Function and operating principle

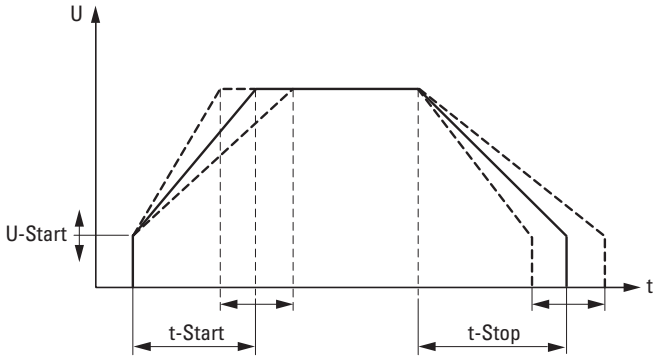


Figure 69: Time-based control of motor voltage with a soft starter

4.3.1.1 U-Start

The start voltage U-start determines the torque of the motor. Low values produce soft starting and a higher thermal load of the motor. If the voltage is too low, the motor may not start immediately. In this case, the voltage should be set higher in order to avoid any unnecessary heating of the motor.

The start voltage determines the torque of the motor in a quadratic ratio. Values less than 30 % mains voltage U_{LN} do not, therefore, make sense. This value corresponds with about 10 % of the starting torque of a motor in direct mains operation. In a star-delta circuit the motor starts with about 30 % starting torque.

Set starting voltage U-Start high enough that the motor starts to turn as soon as the start signal is issued. This prevents unnecessary heating of the motor.

4.3.1.2 t-Start

In starting time t-Start the motor voltage is increased from starting value U-Start to 100 % U_{LN}, to gently accelerate the motor. If this starting time is too long, the motor and the soft starter are subjected to high thermal loads. This can cause the safety devices to trip. The starting time should therefore be as short as possible.

Depending on load and load cycle a greater number of starts are possible with shorter starting times. Conversely, longer starting times reduce the possible number of starts per hour.

The ramp time should always be set to meet the requirements of the machine. Examples:

- With conveyor belts select a time so that the transported goods do not topple.
- With belt drives, the time should be selected so that the belts do not slip.

Some drives (e.g. a motor in idle operation or unloaded drives) reach the rated speed already at the beginning or during the soft start ramp. In this case, the t-Start setting must be reduced in such a way that any unnecessary motor heating will be avoided.

4.3.1.3 t-Stop

In practice stop ramp t-Stop is used mainly for pumps, conveyors and belt drives and prevents, for example, conveyed goods, such as bottles, from tipping over, belts from slipping and knocking in water pipes through closing valves.

With all other applications, the parameter t-Stop can also be set to zero in order to prevent any unnecessary temperature rise in the motor.

A soft stop ramp has the same temperature characteristics as a start. It also therefore causes the heating of the soft starter and motor, and must be taken into account when determining the starting frequency. The stop ramp terminates at a set value of U-Start. A correct setting will cause the minimum torque to be generated at which the motor still turns. At lower voltages (torques), the machine remains at standstill due to losses or friction.

The stop ramp is activated by the removal of the start signal (Low signal at control signal terminal +A1). The drive then runs down to the value of the start voltage (U-Start) with the set stop time (t-Stop). When this is reached, the soft starter switches off the output. If the motor still is still turning, it performs an uncontrolled stop from this point. The default soft stop time is 0 s, i.e. the motor performs an uncontrolled stop.

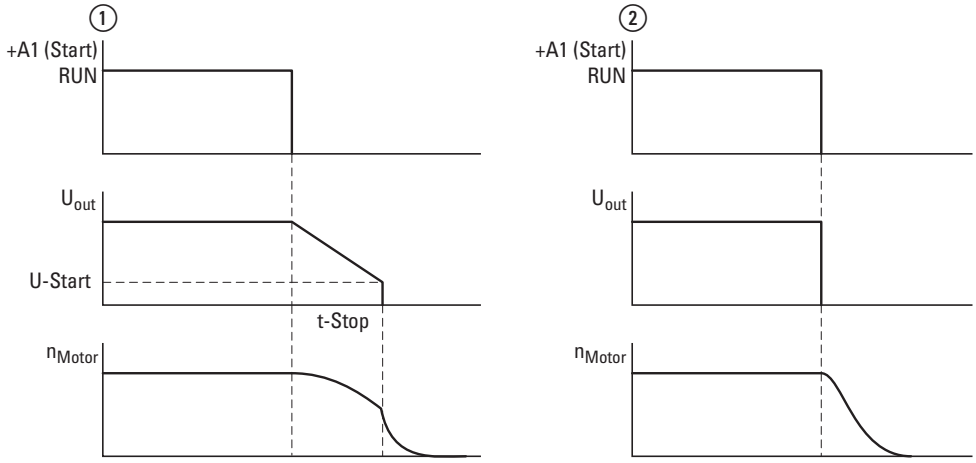


Figure 70: Operation with ① and without ② soft stop

① With stop ramp (+A1 = OFF, t-Stop > 0)

② Without stop ramp (+A1 0 OFF, t-Stop = 0 s) or through control signal terminal EN (frame sizes 3 and 4) or through SmartWire-DT with t-Stop = 0

In the case of size 3 and 4 (I_e ≧ 41 A) devices, the stop command without a ramp function can also be achieved by turning off the EN (Enable) control signal.

In the case of devices with SmartWire-DT, the stop command can also be activated, with or without a soft stop, via SmartWire-DT. For more information, see → Chapter 8, „SmartWire-DT“.

If the start command (+A1) is activated again during the soft stop ramp (time t-Stop active), the soft stop is aborted and a soft start is carried out from the current output voltage and start ramp (t-Start).

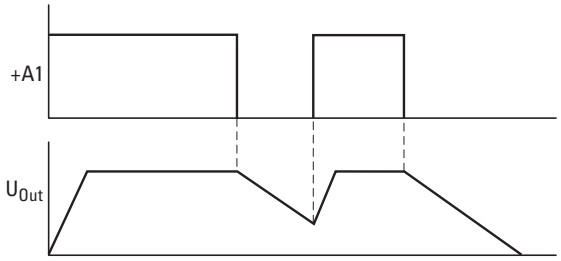
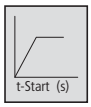


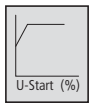
Figure 71: Changing start signal +A1

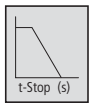
For size 3 and 4 (Ie ≧ 41 A) devices without SmartWire-DT, the EN (Enable) signal must remain activated. For devices with SmartWire-DT, see → Chapter 8, „SmartWire-DT“.

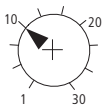
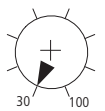
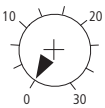
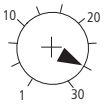
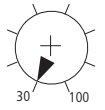
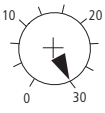
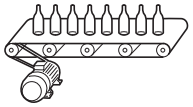
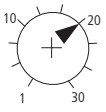
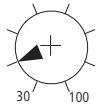
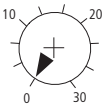
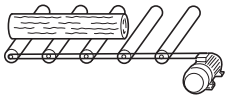
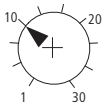
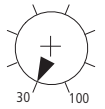
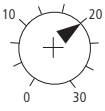
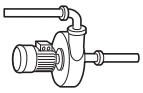
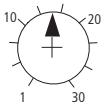
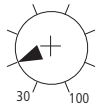
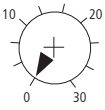
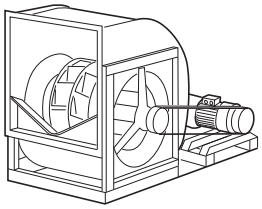
4.3.2 Examples

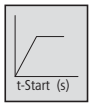
The illustrations below show settings that have proven to be good in practice for standard applications:

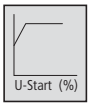


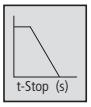




t-Start [s]	U-Start [%]	t-Stop [s]	Application examples	
~10 	~30 	0 		J → 0 Low flywheel mass
~25 	~30 	~30 		Conveyor belt with loose belt
~20 	~40 	0 		Roller conveyers
~10 	~30 	~20 		Centrifugal pump
~15 	~40 	0 		Fan general (building) with belt drive







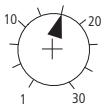
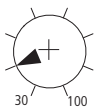
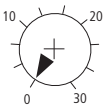
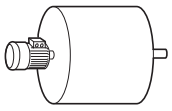
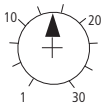
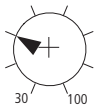
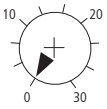
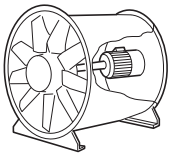
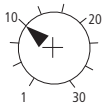
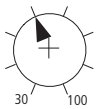
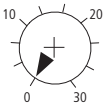
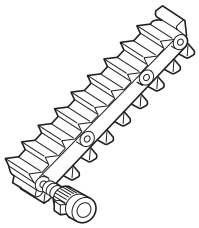
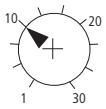
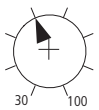
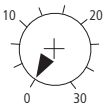
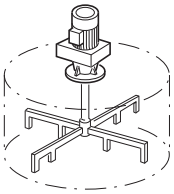
t-Start [s]	U-Start [%]	t-Stop [s]	Application examples	
~18 	~40 	0 		J → ∞ High flywheel mass → Soft starter DS7 should have a higher rating than the assigned motor.
~15 	~50 	0 		Tunnel fan Axial fan → Soft starter DS7 should have a higher rating than the assigned motor.
~10 	~60 	0 		Bulk conveyor Escalator
~10 	~60 	0 		Mixers Agitators → Soft starter DS7 should have a higher rating than the assigned motor.

Figure 72: Recommended settings per application

For soft starters DS7-SWD these settings can be made with parameters (PNU) (→ Section 8.9.5.2, „Acyclic DS7 soft starter data“, page 177.

4.4 Commissioning instructions

No.	Activity
1	Adjust the potentiometer or the U-Start parameter according to the recommendation from the previous table or set t-Start to about 50% (15 s) and t-Stop to minimum (0 = uncontrolled deceleration.
2	Starting After a maximum time of one second, the motor should start to turn, otherwise deactivate the start signal (or on devices from 41 A the Enable signal) immediately. If the motor has turned, proceed with point 3. If the motor has not started, increase U-Start by around 10 % (to around 40 %). Wait a minute for cooling and repeat step 1.
3	Optimizing t-Start: The motor should accelerate evenly from standstill to rated speed at rated load. When it has reached rated speed, the set ramp time should have completed ($U_2 = U_{LN}$, = TOR).
4	Repeat the start procedure. After each start wait five minutes to allow cooling.
5	Run-up optimization • If the drive accelerates faster than the set ramp time (t-Start), shorten this as much as this application allows. • If the drive takes longer to accelerate than the set ramp time, increase the value of t-Start unless the soft starter's load cycle is exceeded. • If the acceleration time is longer than the limits set in step 4 or 5, let the soft starter cool down for 5 minutes, increase the ramp time and proceed with step 4.
6	If a stop ramp is required, the set t-Stop time should be longer than the run-down time of the machine to achieve an effect. As a soft stop produces a current increase, observe the soft starter's thermal output capacity (load cycle) (number of starts per hour). In terms of thermal output the stop ramp must be treated the same as a start.

If the required settings for an application exceed the permissible load cycle of the soft starter, a larger device must be selected accordingly.

The soft starter heats up during starting. To avoid overheating, observe the required cooling times. If frequent starts are made in normal operation, the soft starter may have to be overdimensioned and/or the optional fan DS7-FAN… must be used. See annex "Technical data". For further information with application and dimensioning examples see manual MN03902001Z-EN, "Soft Starter Design".

4.5 Starting a motor

The motor accelerates at the set values when the start command (high signal) is applied at control terminal +A1. With size 3 and 4, the EN signal must be present before +A1. The actual acceleration time can differ from the set values, depending on the load. After the start is completed, the soft starter switches to the operating phase.

4.6 Operation

Switching on the motor side is permissible for a safety disconnection (emergency switching off).

DANGER

On no account must you open the device if the supply voltage is switched on. Danger!

DANGER

Soft starters are electrical apparatus for use in power installations in industrial applications. During operation hazardous live parts and hot surfaces are present on the soft starter. These present a risk of serious injury!

DANGER

The impermissible removal of the required cover, improper installation or incorrect operation of the motor or soft starter can cause the failure of the device and serious injury and/or material damage.

DANGER

If the device displays an error message, this must be examined carefully. If a hardware fault is indicated, it is possible that not all phases of the soft starter have disconnected. Before working on the device or motor, they must be securely isolated beforehand from the mains supply without fail (e.g. switch off circuit-breaker).

If the drive is not isolated from the supply when stationary (mains contactor, main switch), it may start up accidentally in the event of a malfunction. Even if the motor is stationary, the terminals are still energized (leakage current across the thyristors, uncontrolled phase)

DANGER

One phase to the motor is internally bridged, which means that a supply phase is still directly present at the motor even when it is switched off. Danger in the event of contact!

4.7 LED indicators

The LEDs indicate the DS7 soft starter's operating state. The shades of grey used in the diagram below have the following meaning:

= Green RUN LED

= Red Error LED

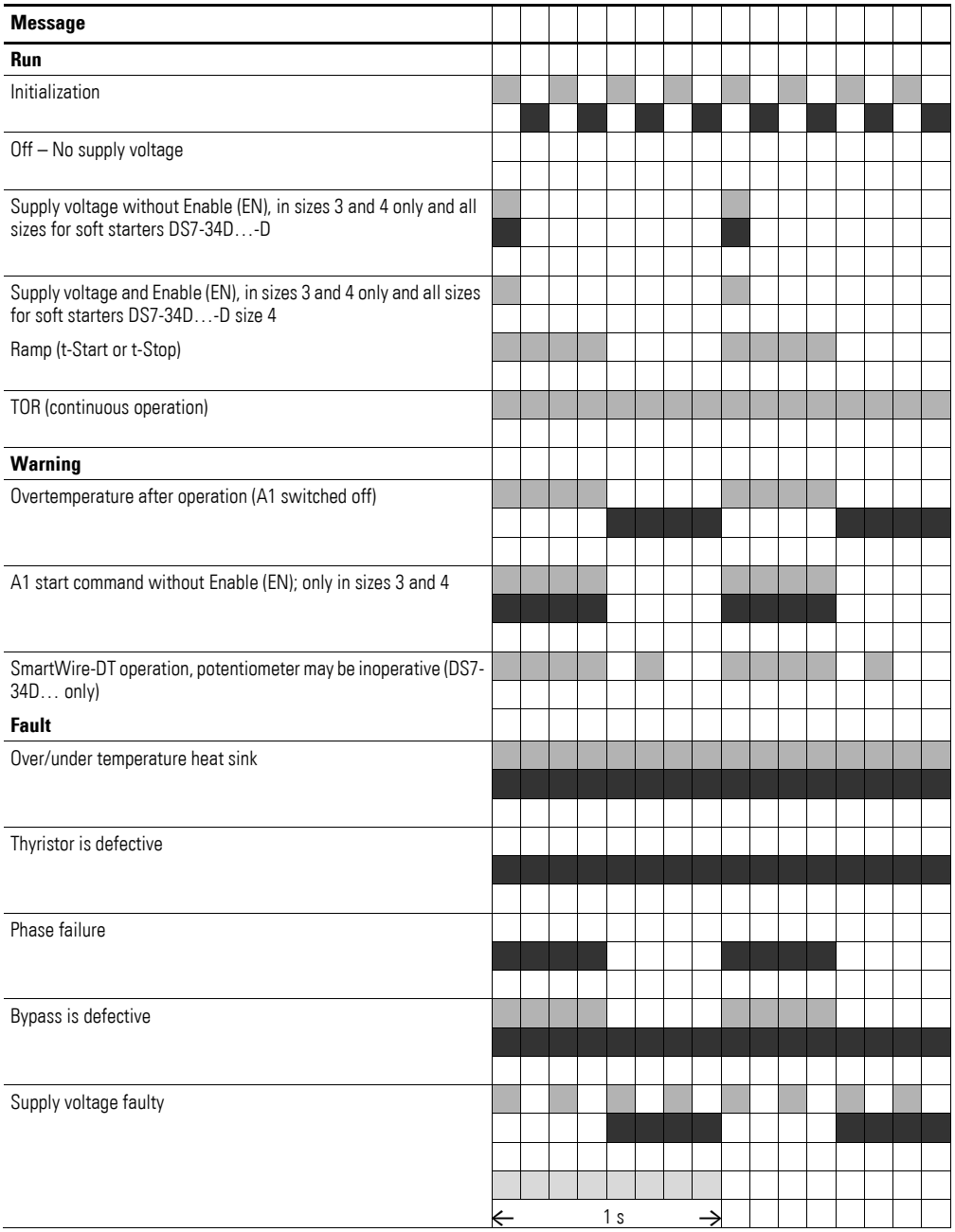


Figure 73: LED signals

The following operating signals and error messages show additional LED indicator modes.

When control voltage U_S is switched on, the DS7 soft starter starts an initialization routine. During this phase, both LEDs (RUN, Error) may light up simultaneously for a short time.

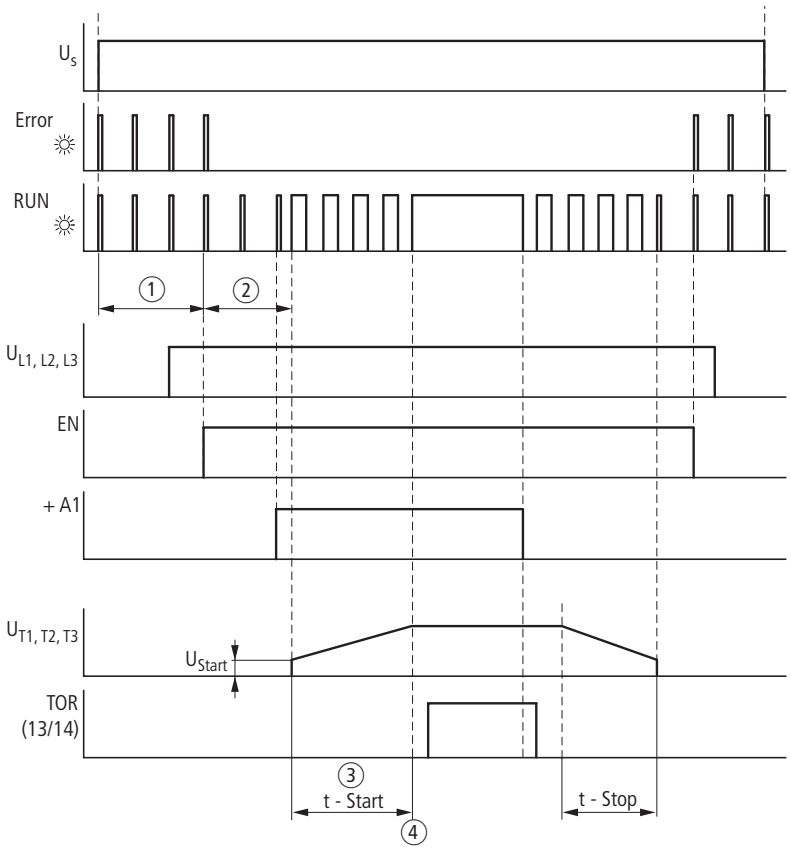


Figure 74: Actuation signals and LEDs

① Initialization
② Ready
③ Acceleration phase
④ Top of ramp reached (TOR signal)

The top of the ramp, TOR (i.e., after the t-Start time has elapsed), and the actual motor acceleration can have different durations. The actual acceleration time will depend on the load and the motor, and even with the same identical t-Start setting may result in different times if the loads change.

4.7.1 Operating state indication

The operating states of soft starters DS7 are indicated by two LEDs on the basic device:

- RUN = Operating signal (green)
- Error = fault message (red)

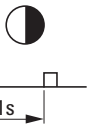
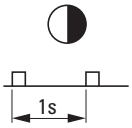
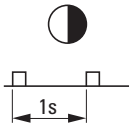
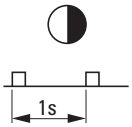
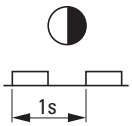
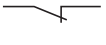
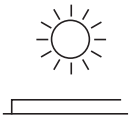
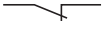
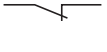
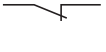
This document uses the following symbols in order to represent the operating states:


Off


on - LED lit


flashing - indication with different flash frequencies

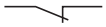
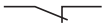
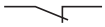
Table 14: LEDs during operation

	LED display		relay contact		
	RUN (green)	**Error (red)**	**TOR** 13/-A2 (size 1)	**TOR** 13/14 (size 2, size 3, size 4)	**RUN** 23/24 (size 2, size 3, size 4)
U_S = 0 No control voltage (+U_S/-U_S)					
U_S Control voltage "On"					
Only in sizes 3 and 4 Control voltage U_S on, without EN enable signal					
Only in sizes 3 and 4 Control voltage U_S on and EN enable signal					
Ramp (t-Start, t-Stop)					
TOR continuous operation					

4.7.2 Indication on DS7-34D…-D

In combination with SmartWire-DT the RUN and Error LEDs on soft starters DS7-34D…-D indicate the following in addition to → Section 4.7.1, „Operating state indication“:

Table 15: LED indicators on DS7-34D…-D

	LED display		relay contact		
	RUN (green)	**Error (red)**	**TOR** 13/-A2 (size 1)	**TOR** 13/14 (size 2, size 3, size 4)	**RUN** 23/24 (size 2, size 3, size 4)
No control voltage through the SmartWire-DT connection	○	○			
Control voltage U_S through the SmartWire-DT connection Without Enable or Start signal (both LEDs flash)	◑	◑			
Control through SmartWire-DT connection (Run signal on t-Start, TOR and t-Stop)	◑	○			

→ The indication of the SWD diagnostic LED is described in → Chapter 8, „SmartWire-DT“.

4.7.3 Indications in the event of faults

Error messages will always cause the TOR and RUN relays to be switched off.

Table 16: LED during fault scenario

	LED indicators		Relay contacts		
	RUN (green)	**Error (red)**	**TOR**	**TOR**	**RUN**
			13/-A2 (size 1)	13/14 (size 2, size 3, size 4)	23/24 (size 2, size 3, size 4)
Warnings					
Overtemperature after STOP (before new start command)					
Start without Enable (EN) (only with size 3 and 4)					
Error Messages					
Temperature error The heat sink temperature is outside of the permissible limit values.					
Thyristor fault Failure of one or several thyristors in the power section					
Phase failure Phase fault in the mains voltage (L1, L2, L3)					
Bypass fault (relay contact faulty)					
Fault in the control voltage (U_s)					

4.7.4 Error messages

The following events are detected as faults and cause the soft starter to switch off. All events are signaled with the Error LED. The RUN and TOR relays will then be switched off (OFF).

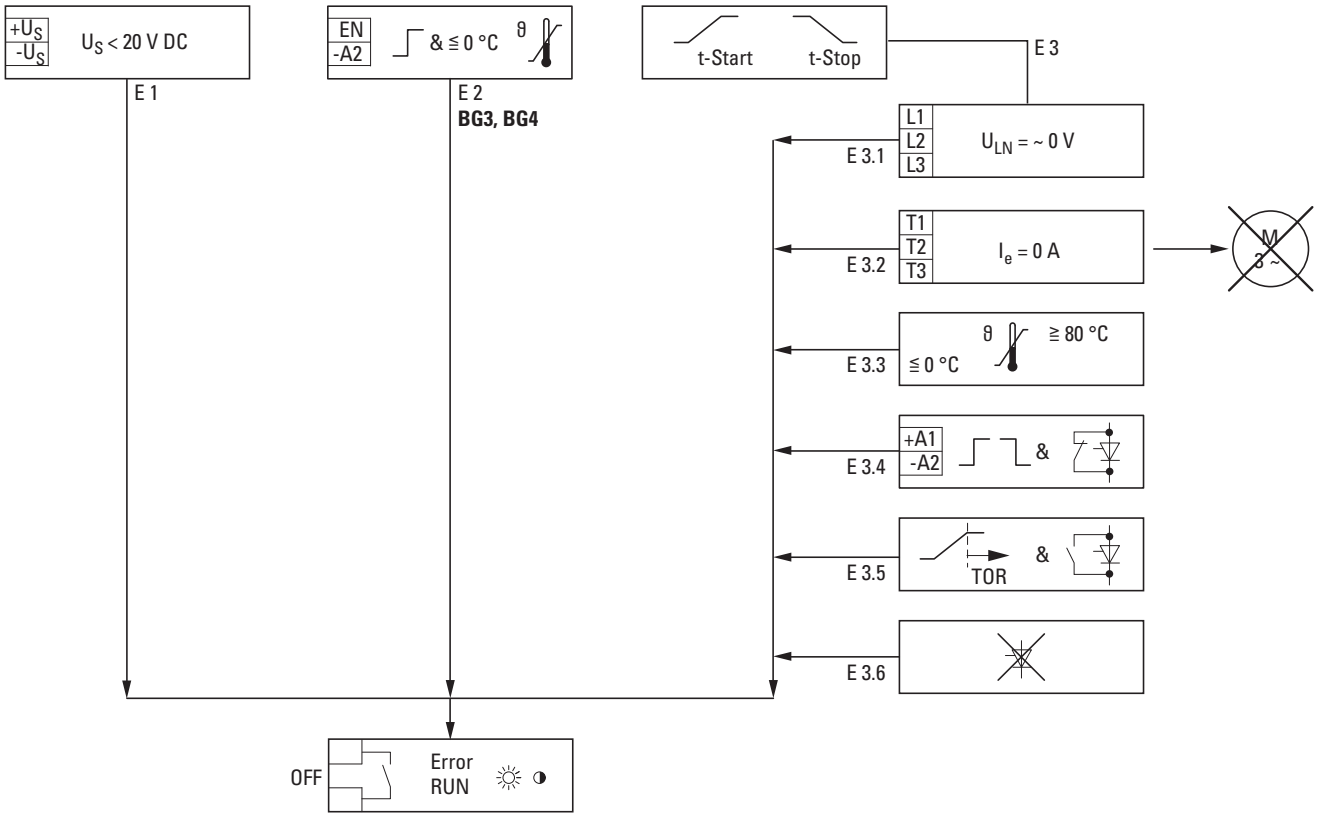


Figure 75: Error Messages

On soft starters DS7-34D…-D faults are transmitted individually and with additional information through the SWD connection (→ Chapter 8, „SmartWire-DT“).

4.7.4.1 Error messages on start

Start (ramp) indicates the phase during which +A1 (and EN in sizes 3 and 4) is activated and ramp time t-Start is active. This operating state is identical to the phase in which, during continuous operation (TOR), control input +A1 is switched off and delay ramp t-Stop (≧ 1) is active. The following error messages may be issued in this operating state (start):

Table 17: Error messages on start

Message	Fault	Possible causes	Remedy
Phase fault (E3.1)	One phase missing on the mains side	Fuse fault	Change fuse
		Wiring defective	Control Wiring
Zero current detection (E3.2)	I_e = 0 A No current flow or current has fallen below the thyristors' holding current (~ 0.5 A)	A motor is not connected or the motor cable is broken	Check connection to T1, T2, T3
Heat sink overtemperature/ undertemperature (E3.3)	Heat sink temperature ≦ 0 °C or ≧ +80 °C	Device still overheated from last start/stop	Wait for cool-down time to elapse; use fan (DS7-FAN-032) if necessary
		Excessively high control cabinet temperature; fan filter soiled	Monitor the temperature in the control cabinet
		Undertemperature; ambient temperature is too cold	Heat up the room or control cabinet and monitor the temperature
Bypass contact not opening (E3.4)	• Bypass will not switch or respond • Bypass contact still closed when a start command is sent to +A1 • Bypass contact does not open when +A1 is switched off	Overload	Replace device; check dimensioning
		Short-circuit in soft starter output	Check motor circuit
Bypass contact does not close at TOR (E3.5)	The bypass contact is not closed after ramp time t-Start (= TOR) elapses	• Internal fault in soft starter • Defective control section or relay	Replace device
Thyristor is defective (E3.6)	• Fuse fault • Unbalanced phase currents (> 30 %) • Different voltage magnitude between input (L1, L2, L3) and output (T1, T2, T3) during operation (TOR)	Soft starter was overloaded during last stop Thyristor destroyed	Replace device; check dimensioning
		Lightning	Exchange device; install lightning protection in the installation
Supply voltage faulty (E1)	Excessively low voltage for regulator supply (U_s < 20 VDC)	Overload of the external power supply unit	Check dimensioning and overload of the power supply unit
		Supply voltage not available	Check control signals for switching the supply voltage; install interlocks for start command if necessary
No Enable (EN); only in sizes 3 and 4 (E2)	An enable signal is not sent when EN is activated	Heat sink temperature ≦ 0 °C	Heat up the room or control cabinet and monitor the temperature

4.7.4.2 Error messages during operation

Error messages during operation are signaled with the Error and RUN LEDs. The RUN and TOR relays are switched off when this happens (OFF).

The following error messages may be issued during operation (RUN, TOR):

Table 18: Error messages during operation

Message	Fault	Possible causes	Remedy
Heat sink overtemperature/ undertemperature (E3.3)	Heat sink temperature ≦ 0 °C or ≧ +80 °C	Device still overheated from last start/stop	Wait for cool-down time to elapse; use fan (DS7-FAN-032) if necessary
		Excessively high control cabinet temperature; fan filter soiled	Monitor the temperature in the control cabinet
		Undertemperature; ambient temperature is too cold	Heat up the room or control cabinet and monitor the temperature
Supply voltage faulty (E1)	Excessively low voltage for regulator supply (U_S < 20 VDC)	Overload of the external power supply unit	Check dimensioning and overload of the power supply unit
		Supply voltage not available	Check control signals for switching the supply voltage; install interlocks for start command if necessary

A phase fault can be detected only during the start ramp (t-Start). When the start ramp has completed (TOR), a phase failure can no longer be detected.

→ The mains frequency is not monitored during operation. This makes it possible to ensure a reliable operating behavior even under difficult conditions, such as those that are prevalent when there is an unstable generator (mains – supply voltage). Proper operation can only be ensured within the permissible limits of 50/60 Hz ±5 %.

5 Diagnostics

The housing of the DS7 soft starter does not have to be opened for diagnostics and fault detection tasks. The design of the soft starter does not allow for it to be opened, and this may cause lasting damage to the housing.
All possible fault causes can be determined by means of the relevant indicators (LEDs, relays) or by taking measurements at the connection terminals.
Soft starters DS7-34D…-D can also be diagnosed through SmartWire-DT (by reading out parameters).

5.1 Fault retrieval

The following information provides help in fault detection and troubleshooting. Some possible faults are described below.

5.1.1 Motor not starting

Possible causes:

- Start signal (+A1) not present.
- Enable signal (EN) not present (only with size 3 and 4).
- No Start or Enable signal through SmartWire-DT (DS7-SWD only).
- Mains voltage (U_{LN}) not present.
- Regulator supply voltage (U_S) not present.
- Ramp too (t-Start) long.
- Start voltage (U-Start) too low.
- DS7 diagnostics LED (Error) lights up.

5.1.2 Motor stops immediately after start completed

Possible causes:

- Switch off due to error message (Error), e.g. phase fault or frequency fault.
- Start signal (+A1) and/or enable signal (EN, only size 3 and 4) were deactivated.
- The connection or signal transmission through SmartWire-DT has a fault or is interrupted (DS7-SWD only).

5.1.3 Motor running unevenly

Possible causes:

- Motor output/motor current too low (<< 1.5 kW at 400 V)
- too low centrifugal masses or no load on motor.
- oscillating loads.
- Belt slip (check load and belt tension).

5.1.4 Motor consuming too much current

Possible causes:

- motor overload.
- Ramp too (t-Start) long.
- start voltage too low (U-Start).
- start voltage too high (U-Start).

5.1.5 Connected motor overheating

Possible causes:

- Ramp too (t-Start) long.
- too many starts in succession.
- start voltage too high (U-Start).
- Heavy starting duty with this motor rating not or only not sufficiently allowed for when selected.

5.2 Acknowledgment of error messages

Potential fault sources can be determined by checking the indications and flashing frequencies of the RUN and Error LEDs and using tables 14 to 17. Once the source of a fault has been fixed or eliminated, a restart can be carried out

Certain error messages can be acknowledged during operation if

- The control signal on terminal +A1 is switched off and then back on
- The corresponding bits are set again if SmartWire-DT-based control is used.

6 Parameter setting

6.1 Operating principles

Soft starters are operated as follows:

- Soft starters DS7-340… and DS7-342… through control terminals,
- soft starters DS7-34D…-D through SmartWire-DT.

Soft starters DS7 can be adapted to the application through parameter settings (DS7-34D…-D) or with the potentiometers on the device front. All settings are saved as parameters.

The connection examples shown in the following chapter are based on the standard versions of soft starter DS7. Additional functions of the communications-capable versions of the DS7 soft starters (DS7-34D…-D) are described in
→ Chapter 8, „SmartWire-DT“.

6.2 Default settings of the basic device

The soft starters of the DS7 series are factory set so that no settings are required for standard applications.

The most important default settings are listed below.

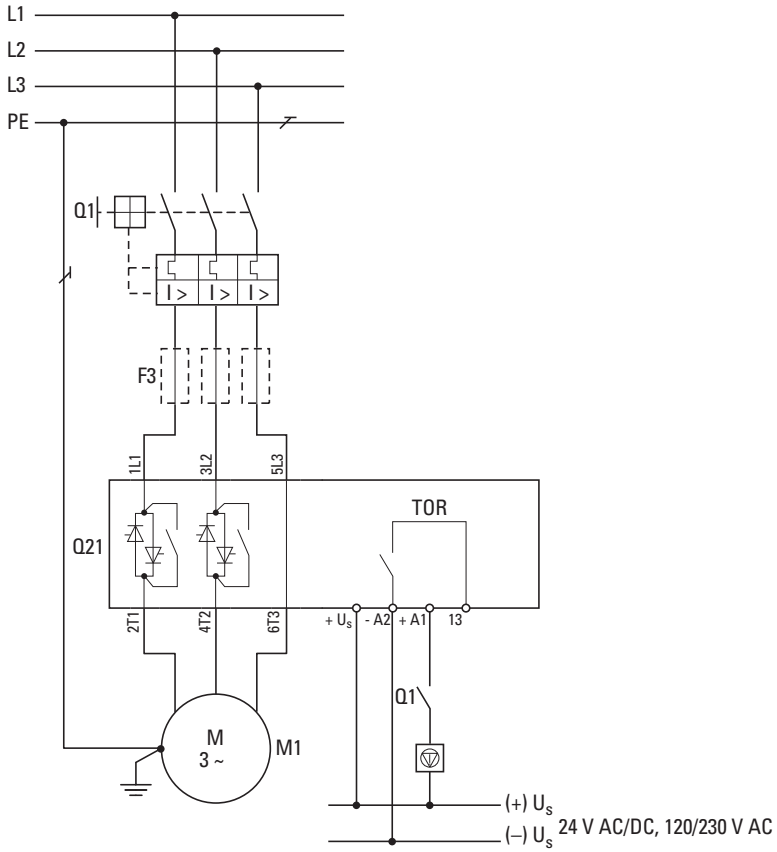
Table 19: DS7 soft starter default settings

terminal, function	Default settings
+A1	Start/stop
EN (only sizes 3 and 4)	Controller enable
Ramp times	t-Start: ~5 s t-Stop: 0 s
Start voltage	~30 %
Relay K1	TOR (Top-of-Ramp)
Relay K2 (for devices from 16 A)	RUN = operating signal

7 Connection examples

7.1 Size 1 (4 – 12 A)

7.1.1 Connection without soft stop ramp



Direct motor start

Q1 = Cable and motor protection

Start enable (+A1) uncontrolled stop of the motor on deactivation

F3 = optional semiconductor fuse for type of coordination 2

Figure 76: Standard connection without soft stop

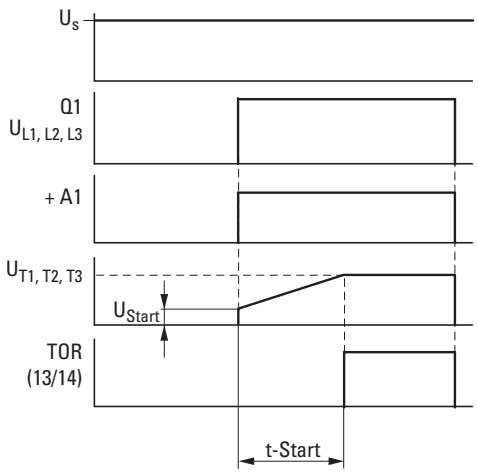
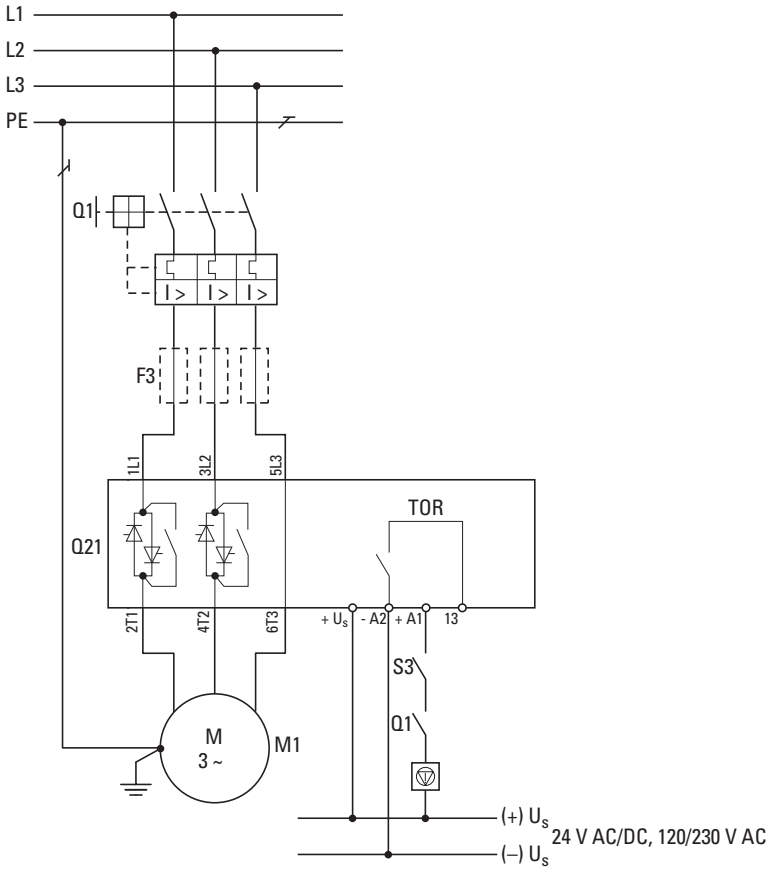


Figure 77: Flow diagram - without soft stop

7.1.2 Connection with soft stop ramp



Start/stop operation

Q1 = Cable and motor protection

Start enable (+A1) uncontrolled stop of the motor on deactivation

F3 = optional semiconductor fuse for type of coordination 2

S3: Start/stop

Figure 78: Standard connection with Soft stop

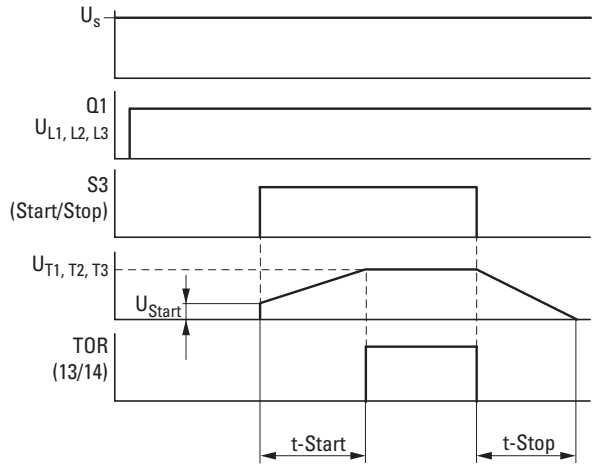
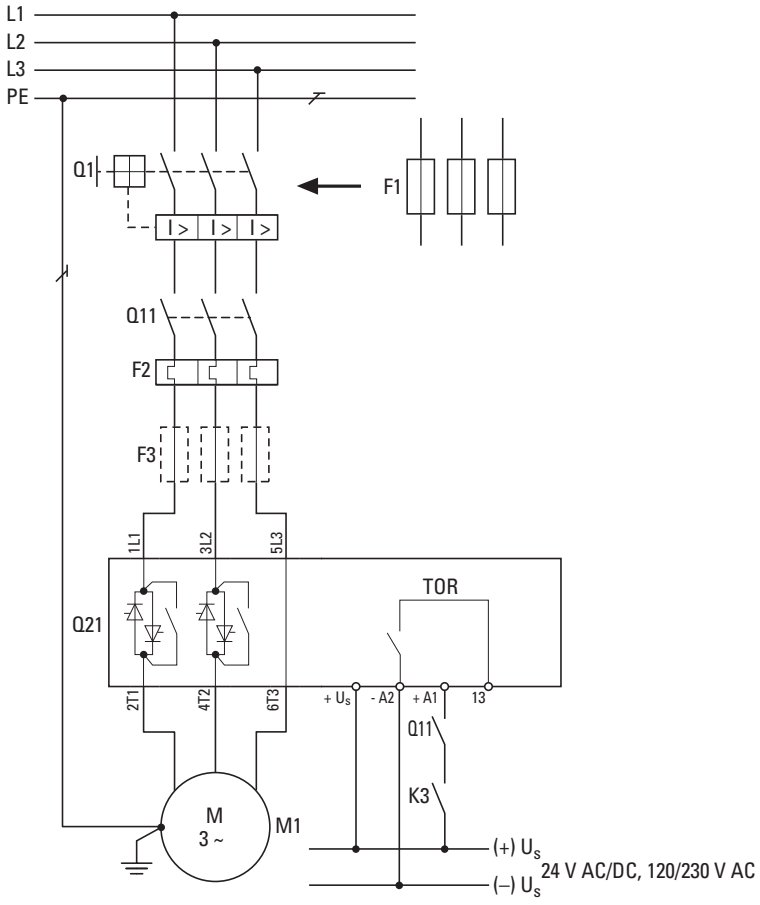


Figure 79: Flow diagram - with soft stop

7.1.3 Standard connection with upstream mains contactor and soft stop ramp



Q1, F1 = Cable and motor protection

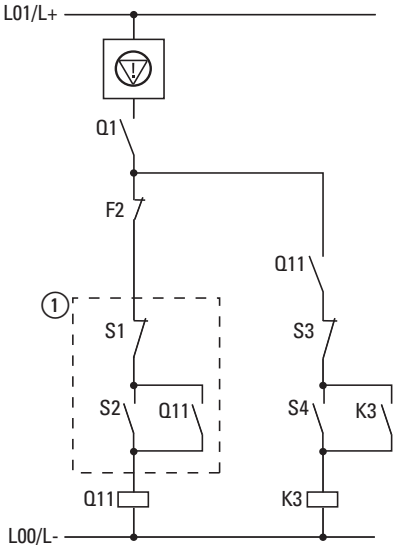
Q11 = Mains contactor

F2 = motor protection

F3 = Optional semiconductor fuse for type 2 coordination , in addition to Q1 or F1

Setting: t-Stop > 0

Figure 80: Standard connection with mains contactor



① Control section for the mains contactor Q11

During operation, the deactivation via S1 causes an uncontrolled stop of the motor.

Figure 81: Control section with mains contactor

7.1.4 Simple change of rotation

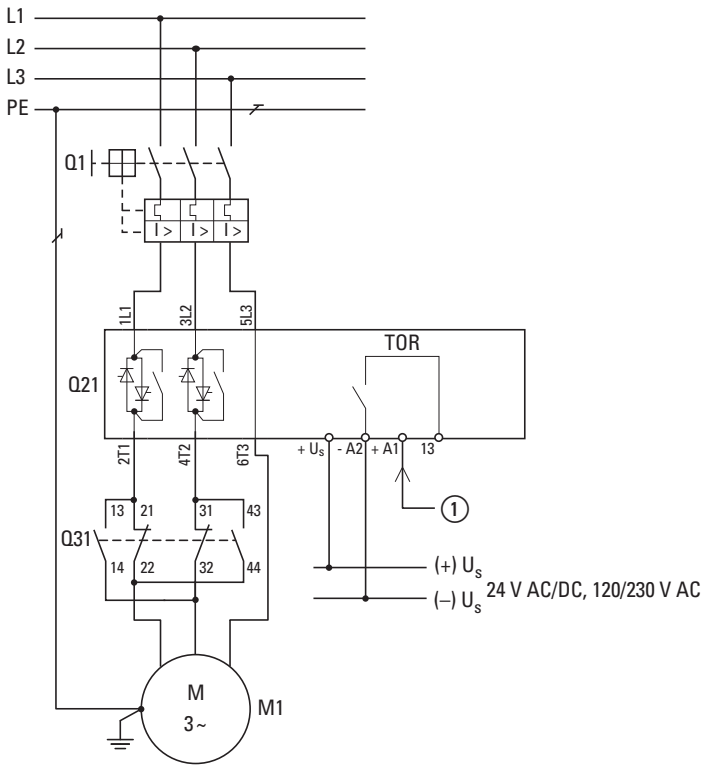


Figure 82: Change of rotation

Example for accessories required:

S3 = M22-WRK… selector switch with three switch positions
Q31 = DILA-22(…) contactor + DILA… auxiliary contact module

In position R (FWD) S3 switches the enable signal ① to the DS7 soft starter (control terminal +A1) via the contact 23/24. The operating direction is reversed with S3 via the zero position (off) to position L (REV).
The contactor Q31 is activated and switches the enable signal ① via the auxiliary contact 53/54 to the DS7 soft starter (control terminal +A1).

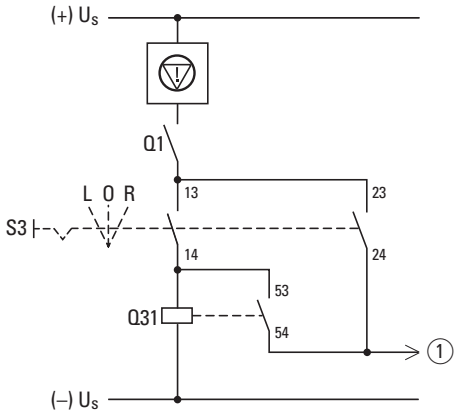
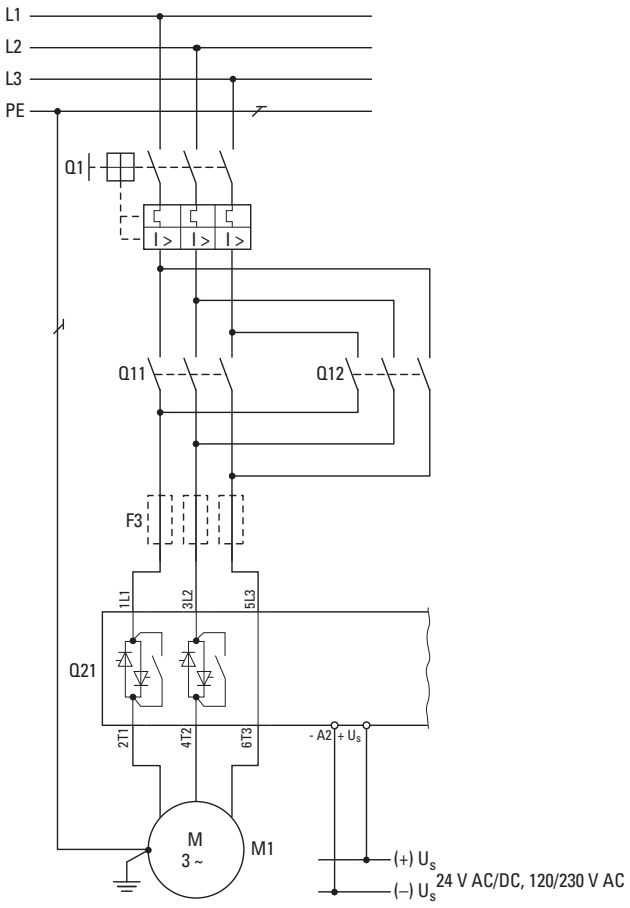


Figure 83: Activation of reversing contactor

7.1.5 Rotation direction reversal with soft stop ramp



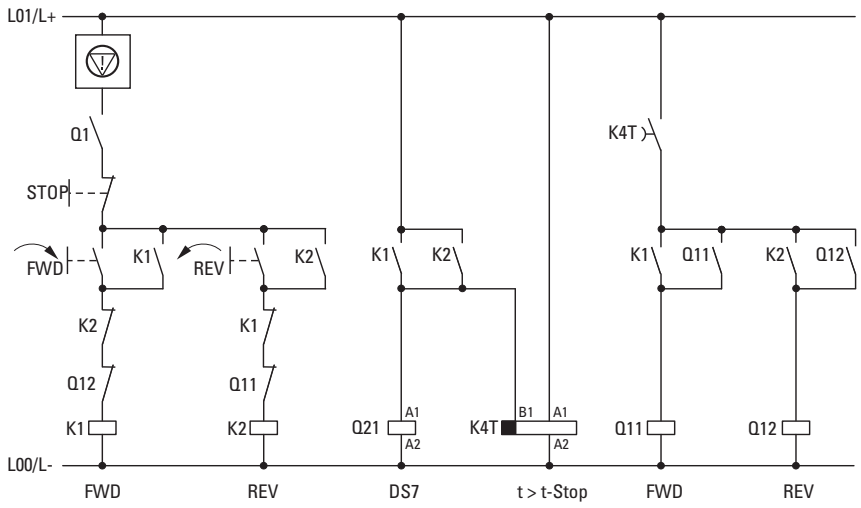
Q1 = Cable and motor protection

Q11 = mains contactor FWD (clockwise rotating field)

Q12 = mains contactor REV (anticlockwise rotating field)

F3 = optional semiconductor fuse for type 2 coordination in addition to Q1

Figure 84: Rotation direction reversal with ramp



K4T: Simulated RUN signal - an off-delayed timing relay (type ETR2) and simulates here the RUN signal. The reset time must be greater than the stop time (t-Stop) set on the DS7 soft starter. Switching to the other operating direction is only possible after the value set here has elapsed. The soft stop is also active here after an emergency-stop command.

Figure 85: Control section Bidirectional operation

The control voltages (U_S) of the DS7 soft starter and the contactor control must have the same potential: 24 V DC/AC or 120/230 V AC

7.1.6 Rotation direction reversal with MSC-R, without soft stop ramp

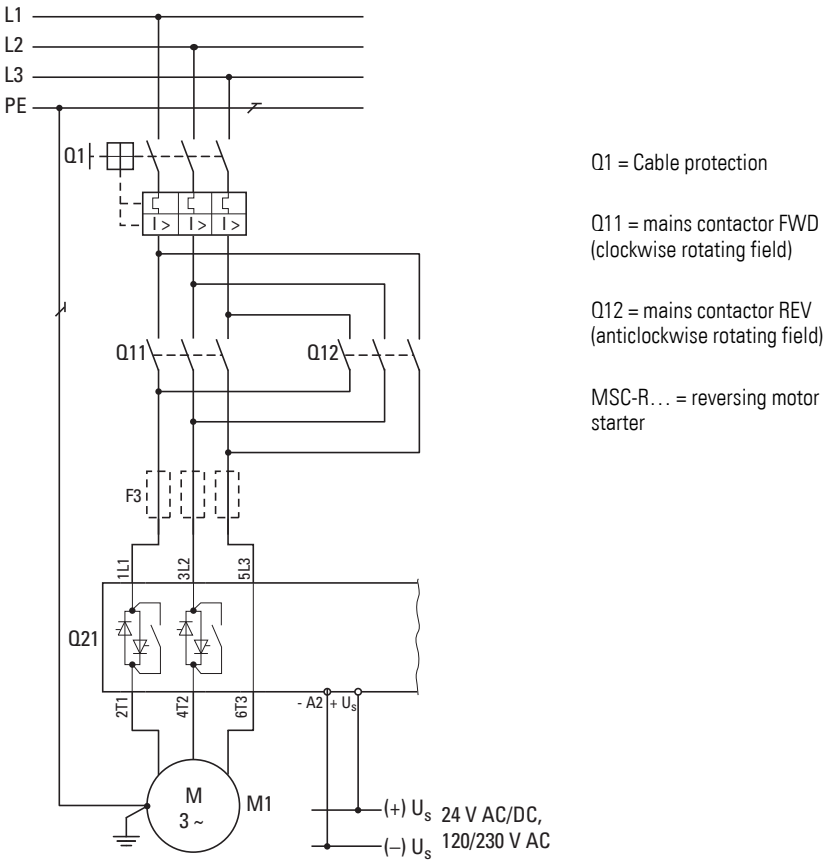


Figure 86: Rotation direction reversal without ramp

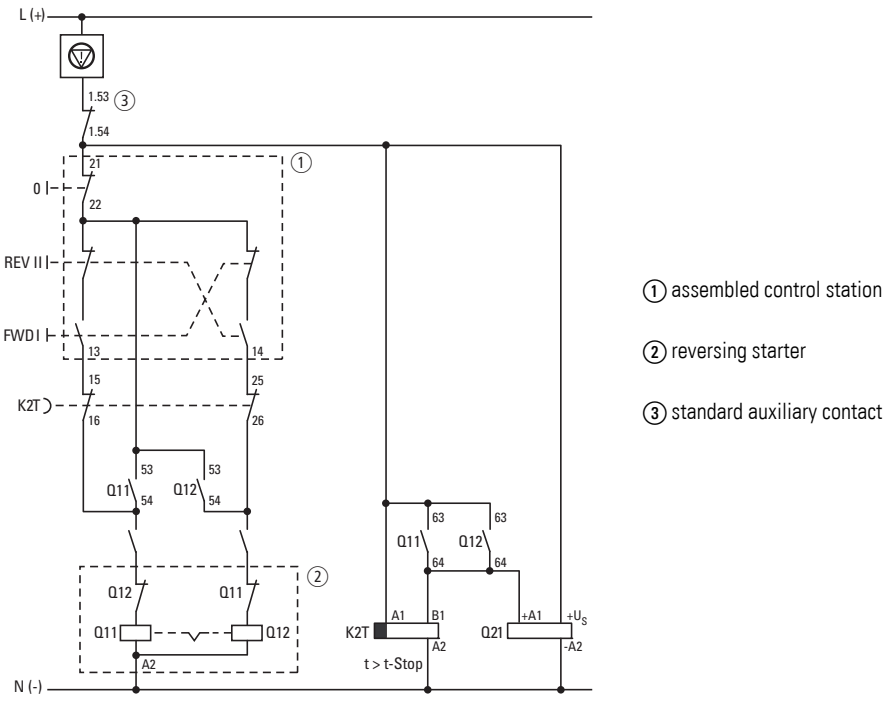
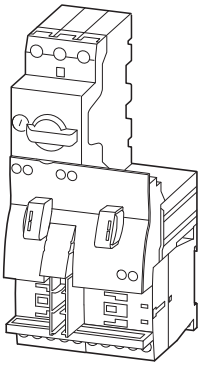
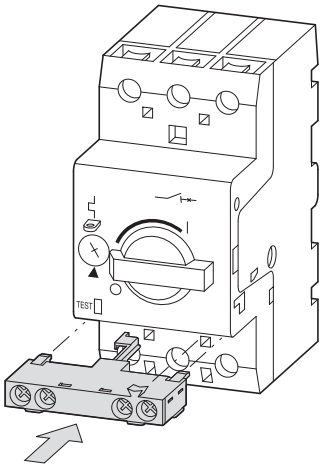


Figure 87: Control section bidirectional operation with ramp

The control voltages (U_S) of the DS7 soft starter and the contactor control must have the same potential: 24 V DC/AC or 120/230 V AC

Q1, Q11, Q12 = MSC-R motor starter combination is a compact device with electrical and mechanical interlocking. The NHI-E-10-PKZ0 auxiliary contact ③ is added to Q1 for cable and motor protection.

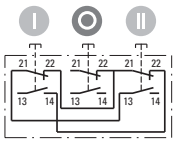




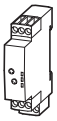
② reversing starter MSC-R…

③ standard auxiliary contact (grey) NHI-E-10-PKZ0

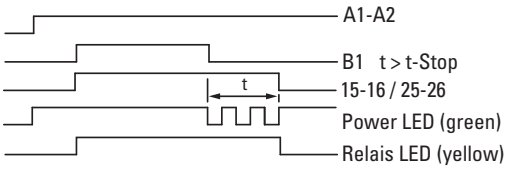
Two DILA-XHI20 auxiliary contact modules are added to the reversing contactors Q11 and Q12. The 53/54 NO contact is used for the self-maintaining of Q11 and Q12; NO contact 63/64 actuates the timing relay K2T and the soft starter Q21. The pushbutton actuators 0, I, II as a complete device (M22-I3-M1) for surface mounting ① enable the rotation direction change.



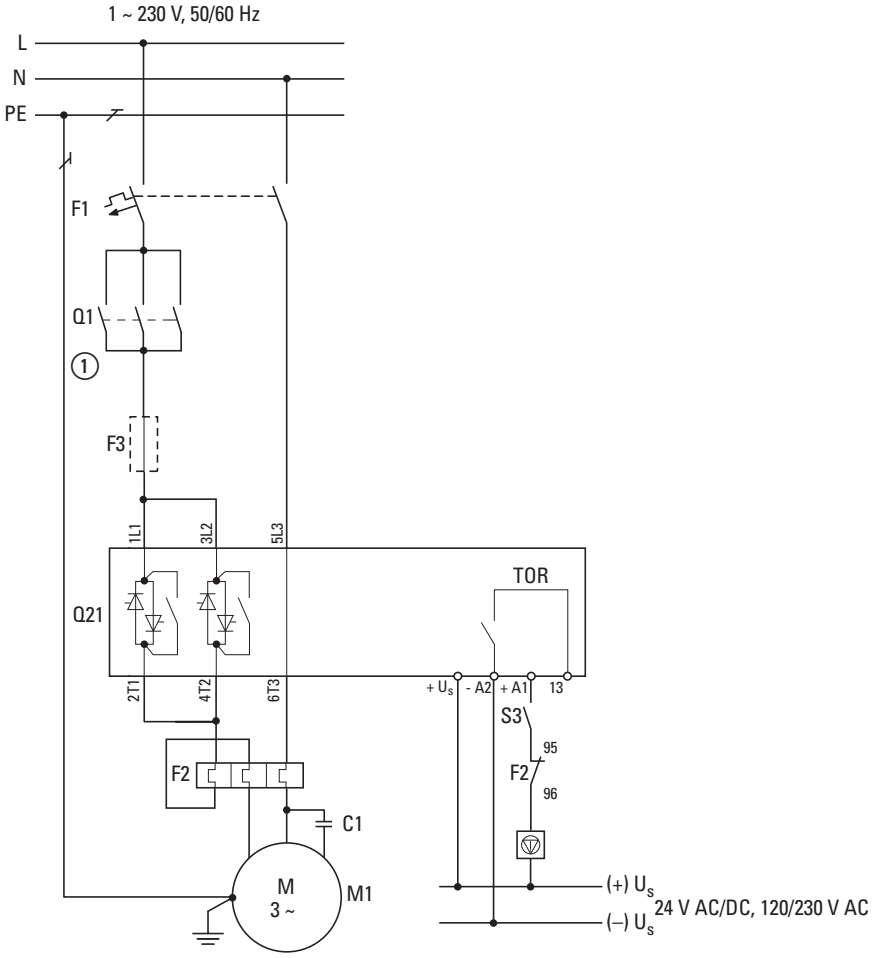
① Contact sequence
M22-I3-M1 assembled control station



K4T is an off-delayed timing relay (part no. ETR2) and simulates here the RUN signal. The reset time must be greater than the stop time (t-Stop) set on the DS7 soft starter. Switching to the other operating direction is only possible after the value set here has elapsed. The soft stop is also active here after an emergency-stop command.



7.1.7 Connection for ac motor



C1 = Startup and operating capacitor

F1 = Cable and short-circuit protective device (FA2-B…/1N)

F2 = Overload relay

F3 = optional semiconductor fuse for type 2 coordination, in addition to F1

Q1 = mains contactor (optional) (example for ①: DILM7 + DILM12-XP1)

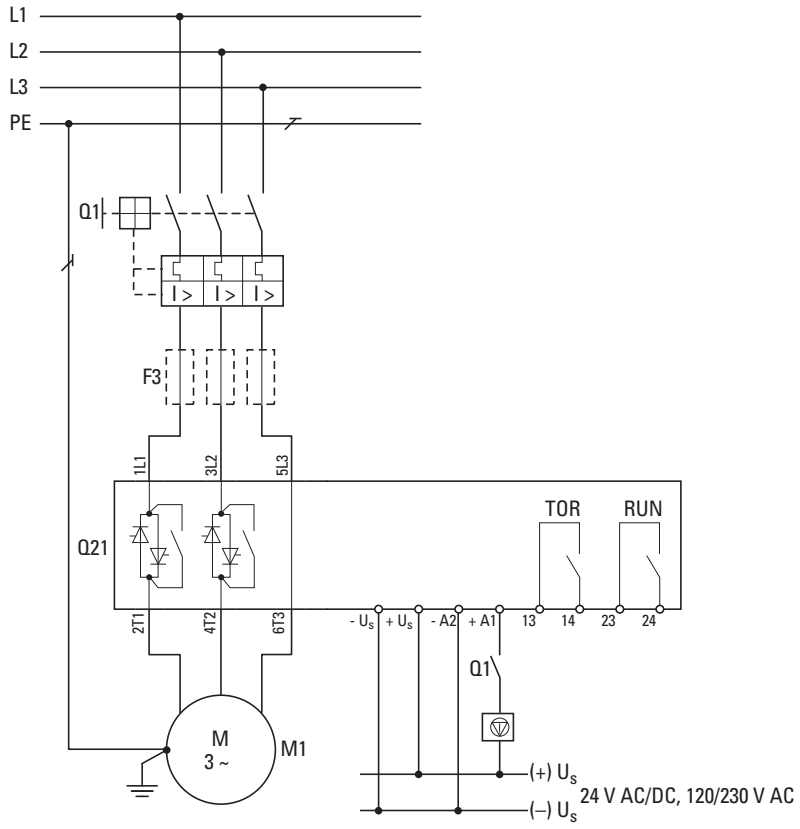
Q21 = Soft starter

S3 = Start/stop-switch

Figure 88: AC motor in Steinmetz circuit

7.2 Size 2 (16 – 32 A)

7.2.1 Connection without soft stop ramp



Direct motor start

Q1 = Cable and motor protection

Start enable (+A1) uncontrolled stop of the motor on deactivation

F3 = optional semiconductor fuse for type of coordination 2

Figure 89: Standard connection without soft stop

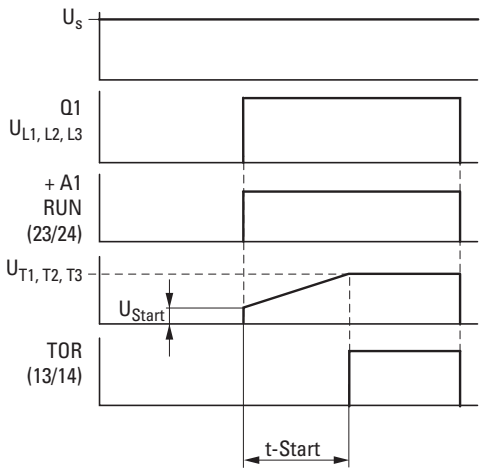
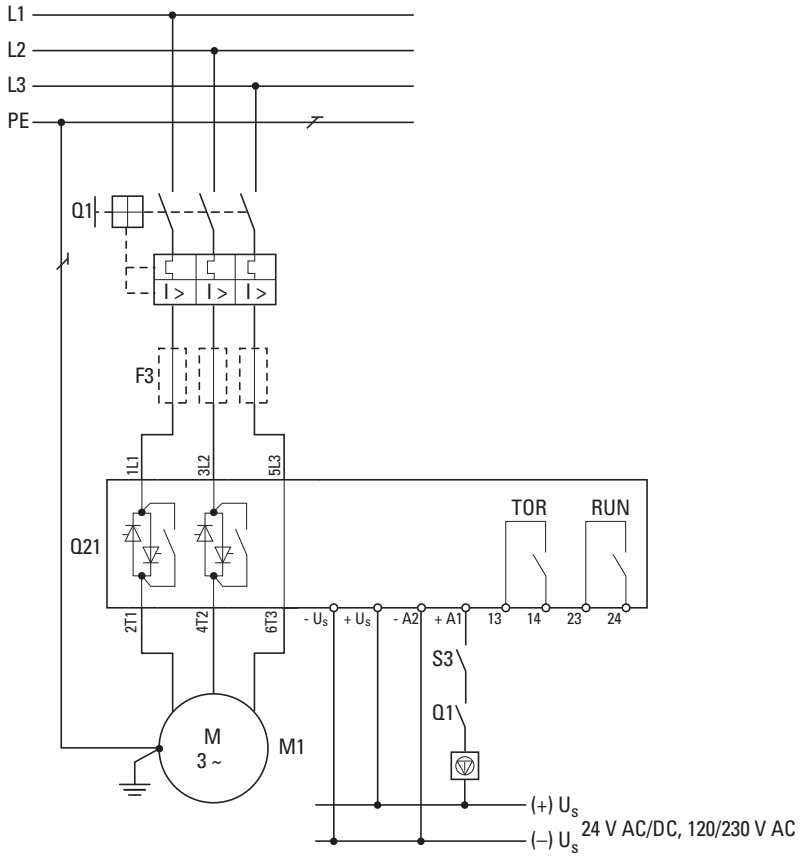


Figure 90: Flow diagram - without soft stop

7.2.2 Connection with soft stop ramp



Start/stop operation

Q1 = Cable and motor protection

Start enable (+A1) uncontrolled stop of the motor on deactivation

F3 = optional semiconductor fuse for type of coordination 2

S3: Start/stop

Figure 91: Standard connection with Soft stop

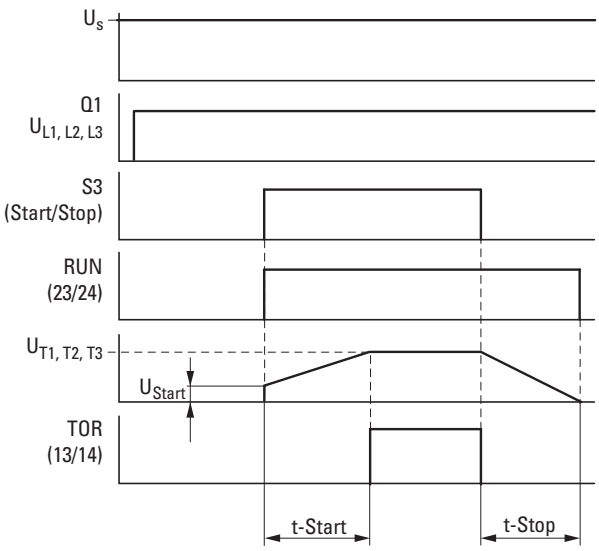
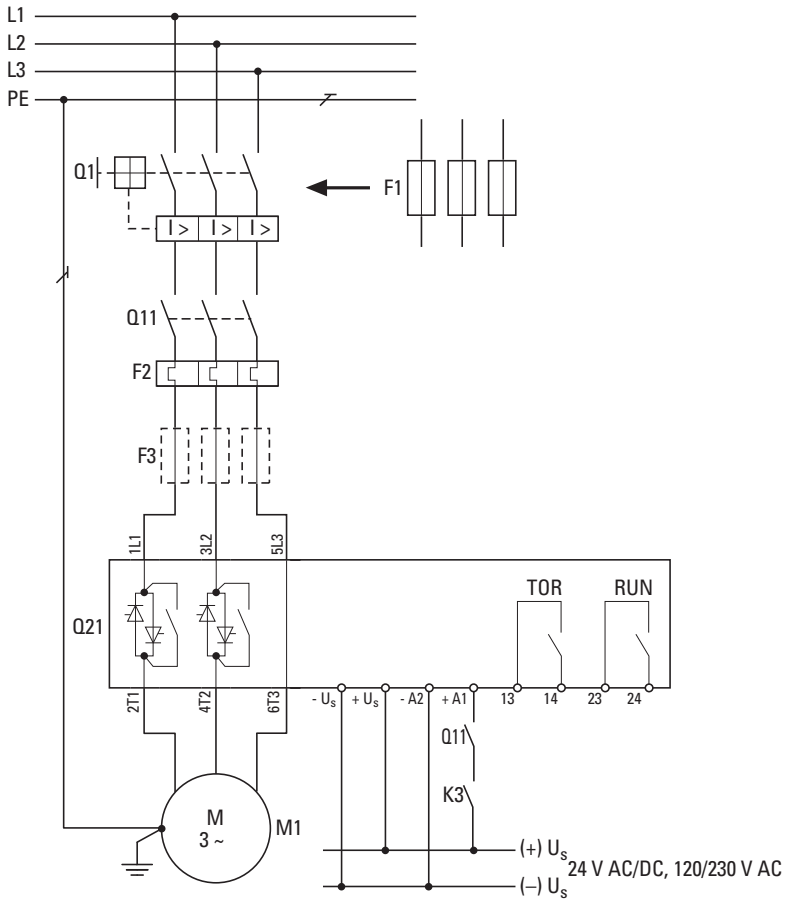


Figure 92: Flow diagram - with soft stop

7.2.3 Standard connection with upstream mains contactor and soft stop ramp



Start/stop operation

Q1, F1 = Cable and motor protection

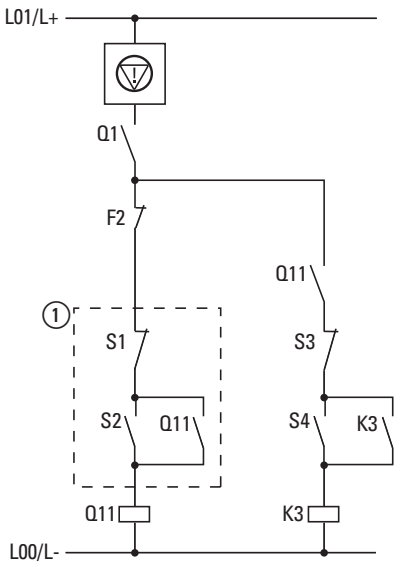
Q11 = Mains contactor

F2 = motor protection

F3 = Optional semiconductor fuse for type 2 coordination , in addition to Q1 or F1

Setting: t-Stop > 0

Figure 93: Standard connection with Soft stop



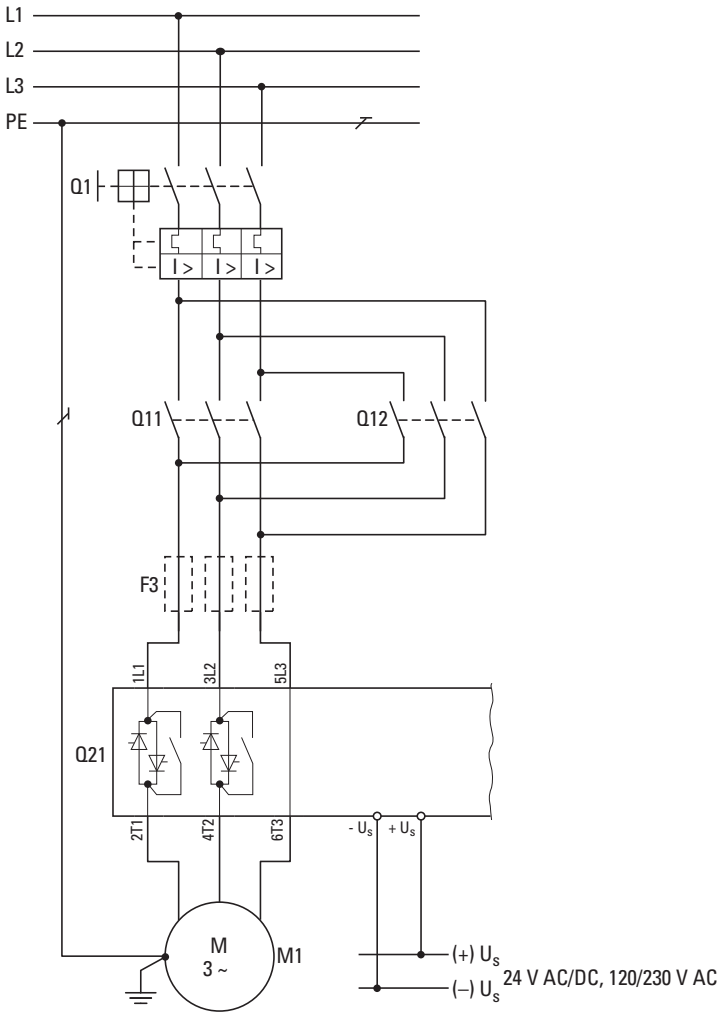
① Control section for the mains contactor Q11

During operation, the deactivation via S1 causes an uncontrolled stop of the motor.

S1 = Off
S2 = On
S3 = Soft stop
S4 = start

Figure 94: Control section with mains contactor

7.2.4 Rotation direction reversal with soft stop ramp



Q1 = Cable and motor protection

Q11 = mains contactor FWD (clockwise rotating field)

Q12 = mains contactor REV (anticlockwise rotating field)

F3 = optional semiconductor fuse for type 2 coordination in addition to Q1

Figure 95: Rotation direction reversal with ramp

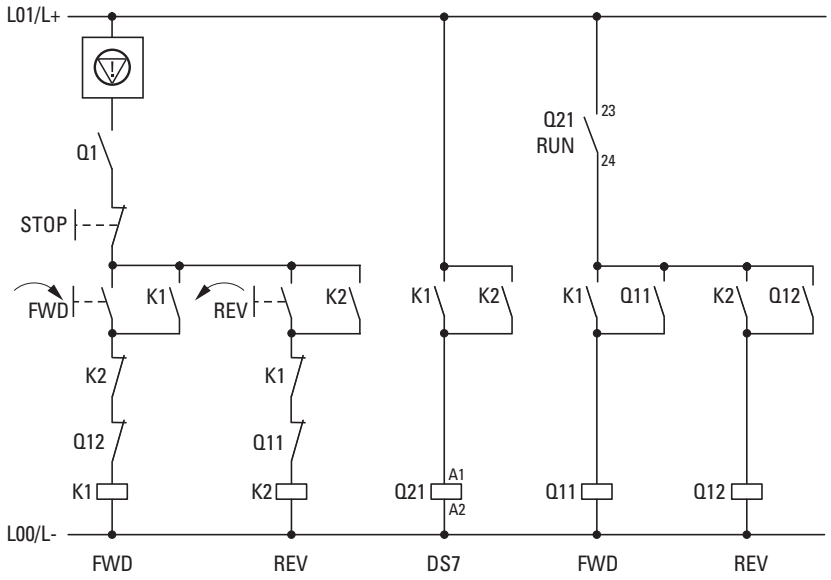


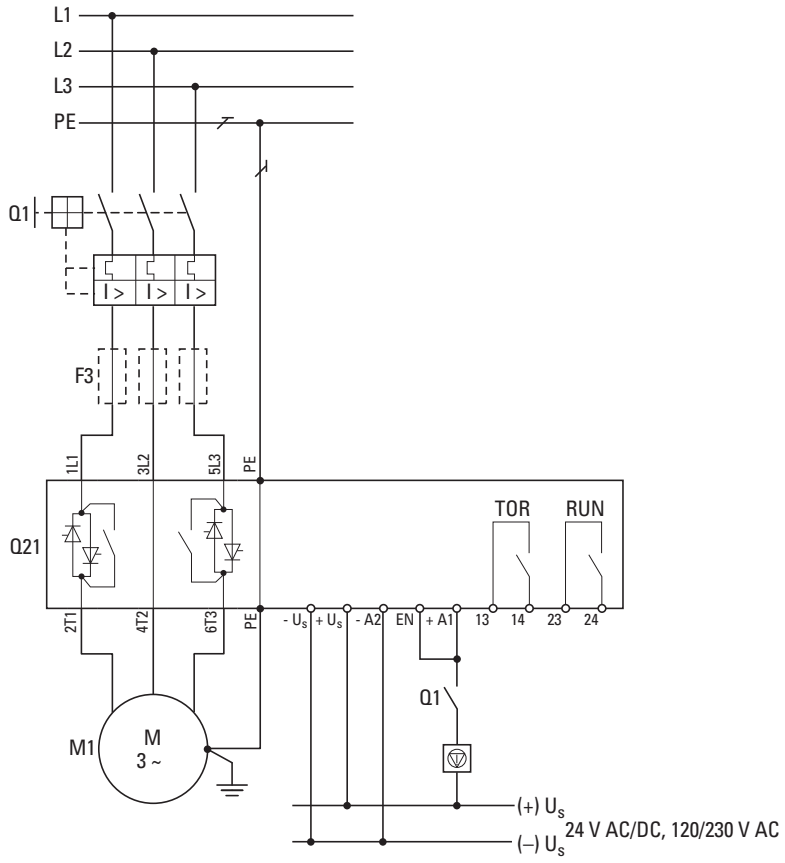
Figure 96: Control section Bidirectional operation

The RUN relay (Q21:23/24) only enables the rotation direction change (phase change) after the soft stop time (t-Stop) has elapsed.

The soft stop is also active here after an emergency-stop command.

7.3 Size 3 and 4 (41 – 200 A)

7.3.1 Connection without soft start ramp



Direct motor start

Q1 = Cable and motor protection

Q21 = Soft starter

Start enable (+A1) uncontrolled stop of the motor on deactivation

F3 = optional semiconductor fuse for type of coordination 2

M1 = Motor

Figure 97: Standard connection without soft stop

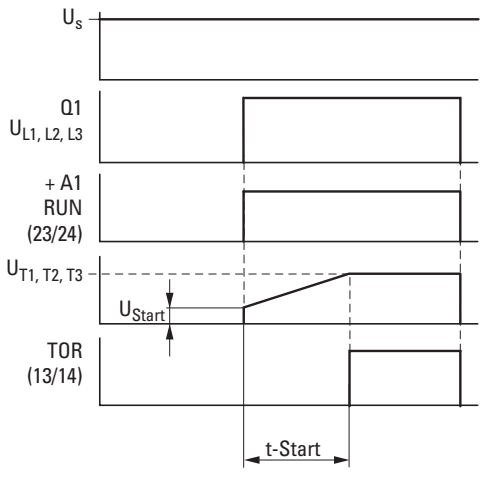
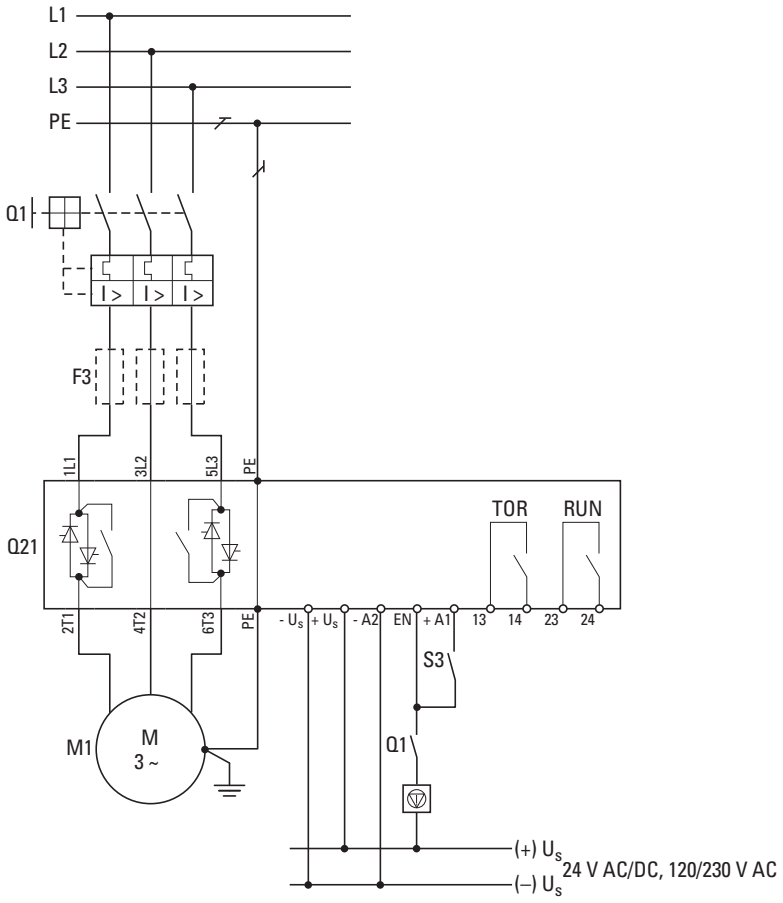


Figure 98: Flow diagram - without soft stop

7.3.2 Connection with soft start ramp



Start/stop operation

Q1 = Cable and motor protection

Start enable (+A1) uncontrolled stop of the motor on deactivation

F3 = optional semiconductor fuse for type of coordination 2

S3: Start/stop

Figure 99: Standard connection with Soft stop

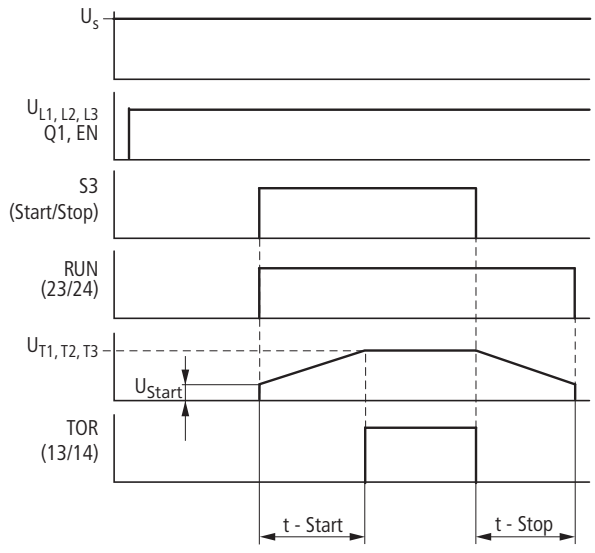
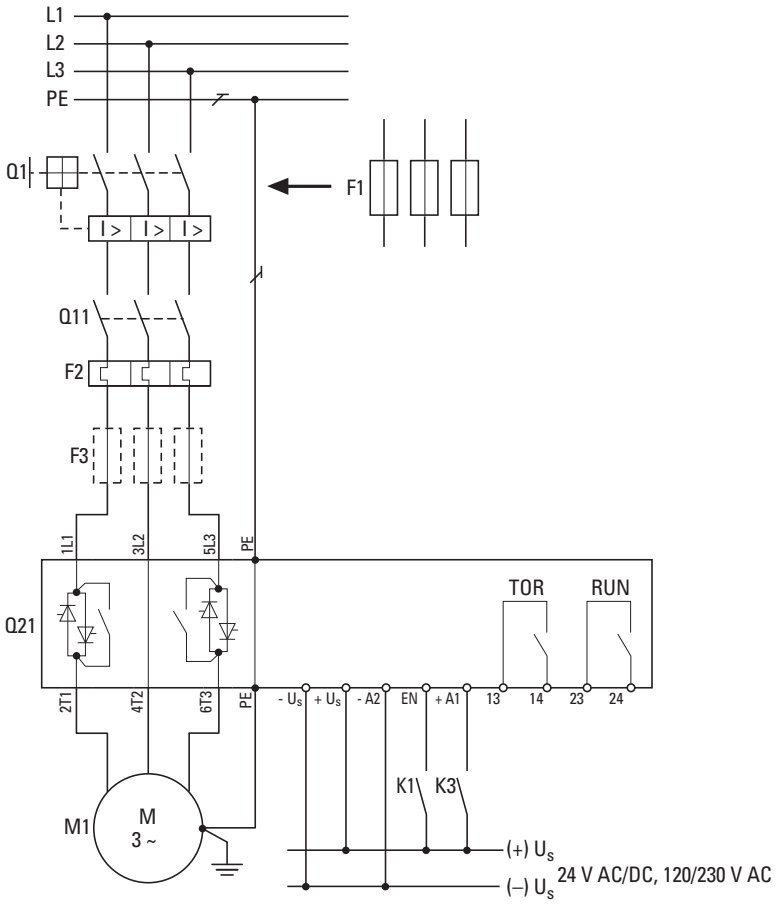


Figure 100:Flow diagram - with soft stop

7.3.3 Standard connection with upstream mains contactor and soft stop ramp



Q1; F1: cable protection

F2: motor protection

F3 = optional semi-conductor fuse for type 2 coordination in addition to (optional) Q1

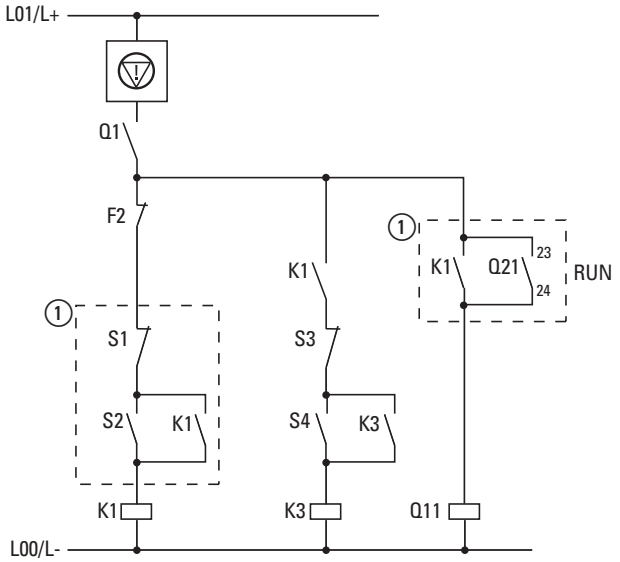
K1: Controller enable

K3: Start/stop

Q11: Mains On/Off

Q21: Soft starters

Figure 101:Standard connection with mains contactor



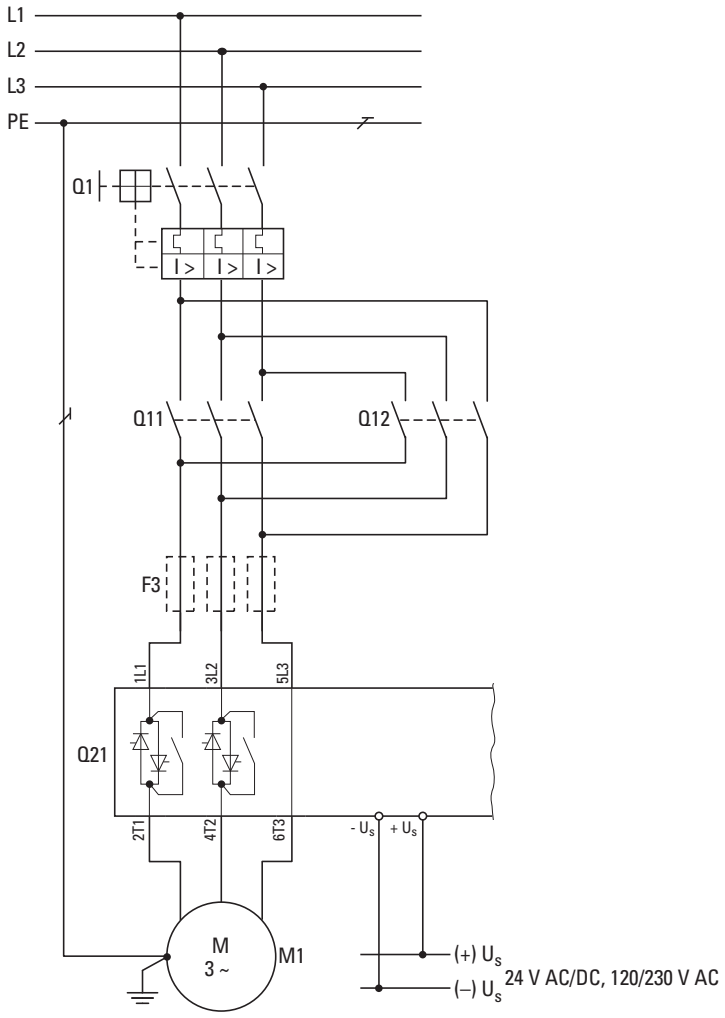
① Control section for the mains contactor Q11

During operation, the deactivation via S1 causes an uncontrolled stop of the motor.
The RUN relay (Q21:23/24) monitors the switching operation (no undefined operating state).

S1 = Off
S2 = On
S3 = Soft stop
S4 = start

Figure 102:Control section with mains contactor

7.3.4 Rotation direction reversal with soft stop ramp



Q1 = Cable and motor protection

Q11 = mains contactor FWD (clockwise rotating field)

Q12 = mains contactor REV (anticlockwise rotating field)

F3 - Optional semiconductor fuse for type 2 coordination, in addition to Q1

Figure 103:Rotation direction reversal with ramp

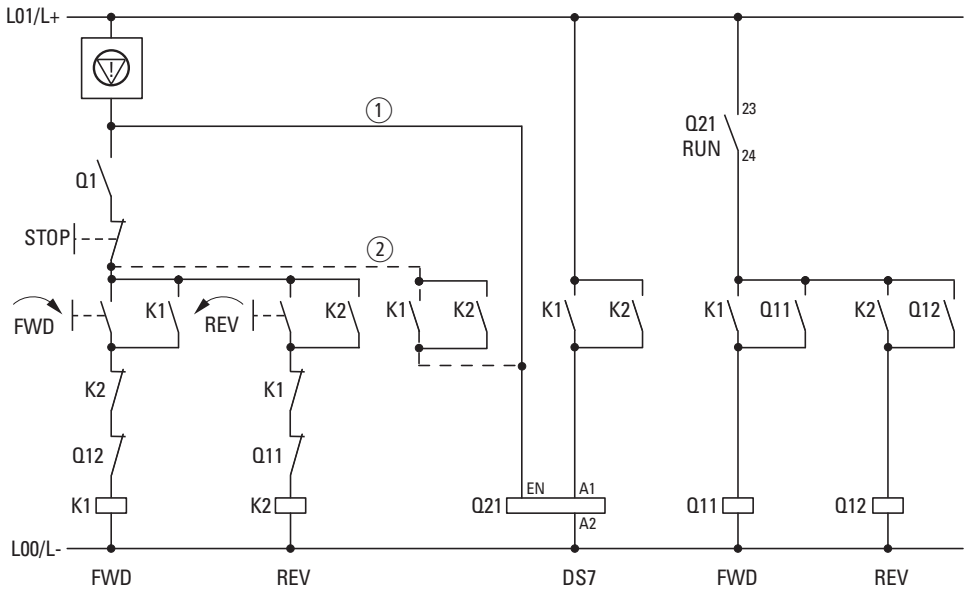


Figure 104:Control section Bidirectional operation

Terminal models:

① with Soft stop

② without Soft stop

The RUN relay (Q21:23/24) only enables the rotation direction change (phase change) after the soft stop time (t-Stop) has elapsed.

The soft stop is also active here after an emergency-stop command.

7.3.5 Compact motor starter with maintenance switch

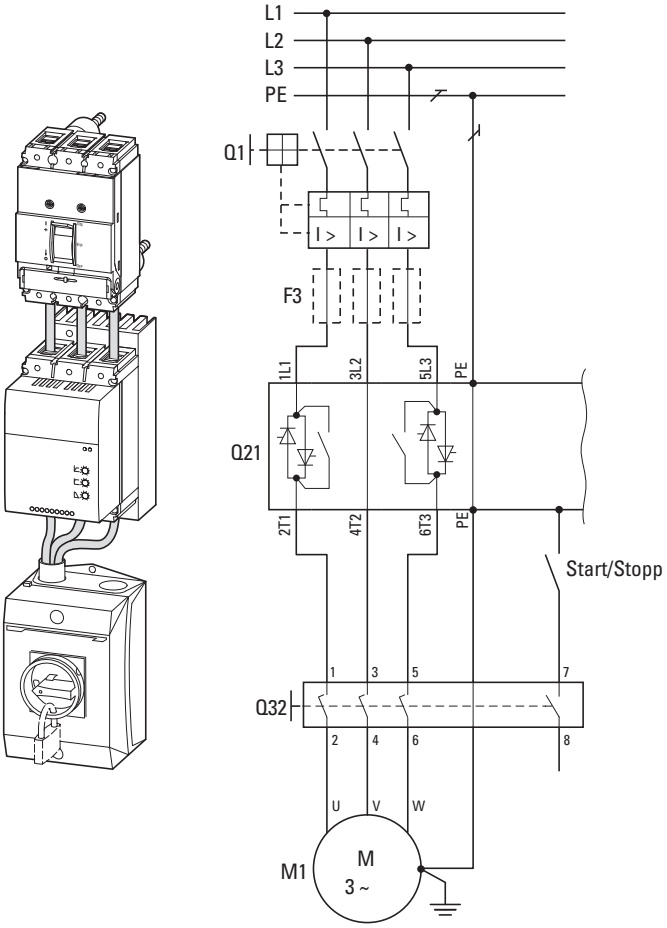


Figure 105:Motor starter with repair/maintenance switch

DS7 soft starter, NZM circuit-breaker and P3 maintenance switch

Q1 = Cable and motor protection

Q21 = DS7 soft starter

Q32 = Maintenance switch (local)

F3 = optional semiconductor fuse for type 2 coordination (in addition to Q1)

M1 = Three-phase motor

7.3.6 DS7 soft starter and NZM circuit-breaker with emergency-stop function to IEC/EN 60204 and VDE 0113 Part 1

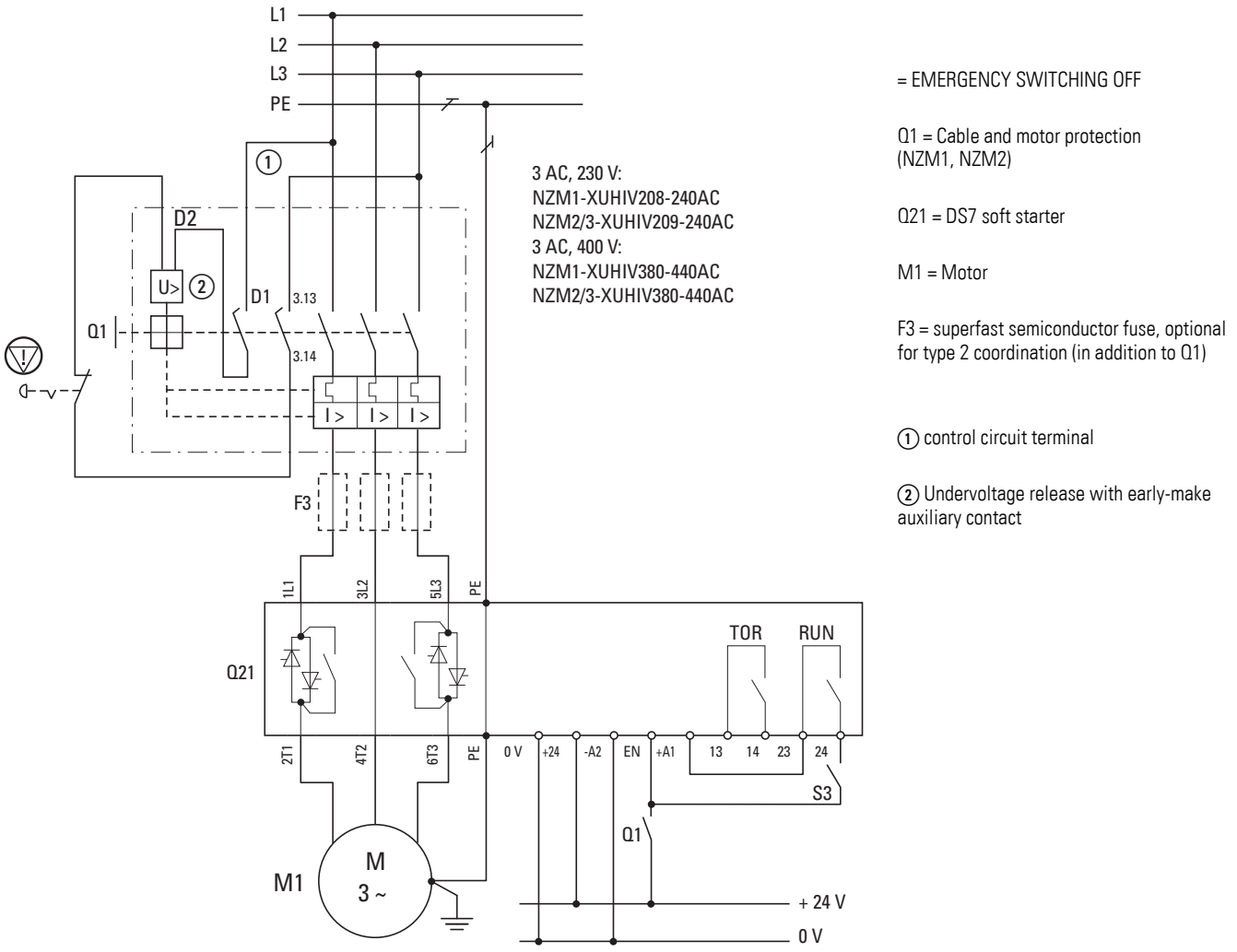


Figure 106:Soft starter with emergency-stop function

7.3.7 Bypass circuit for emergency operation

Devices of the DS7-34… series are equipped with integrated bypass contacts. External bypass contacts are therefore not required for standard operation.

In pump applications the bypass circuit is often required to provide emergency operation capability. A service switch (key switch) is used to select the bypass circuit between soft starter operation and DOL starter operation. This is used to fully isolate the soft starter.

In this case, it is important that the output circuit is not opened during operation. The interlocks in the controller ensure that a switchover is only possible after a stop.

Unlike the simple bypass operation, in this case the bypass contactor must be designed in accordance with utilization category AC-3. For a suitable contactor, see our recommended mains contactor in the Appendix (→ Page 215).

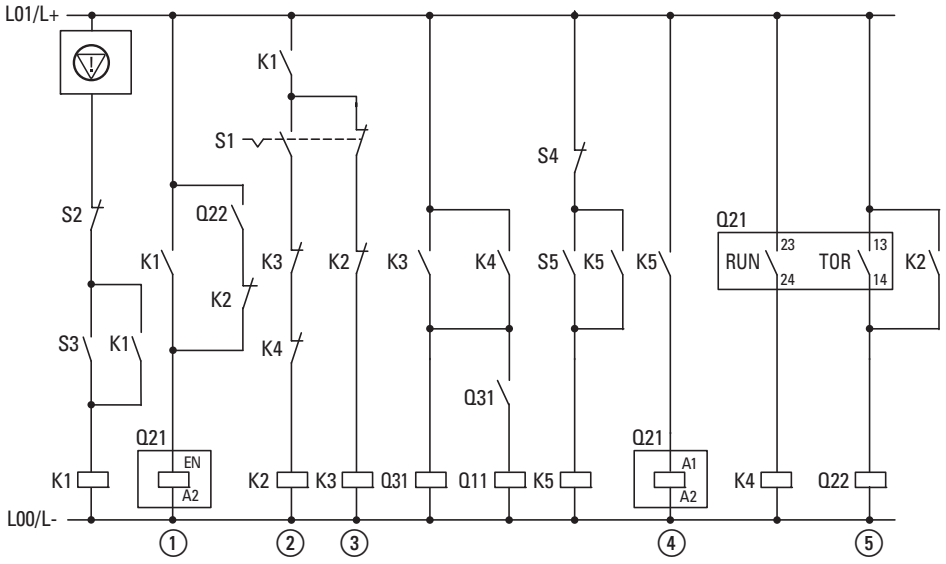
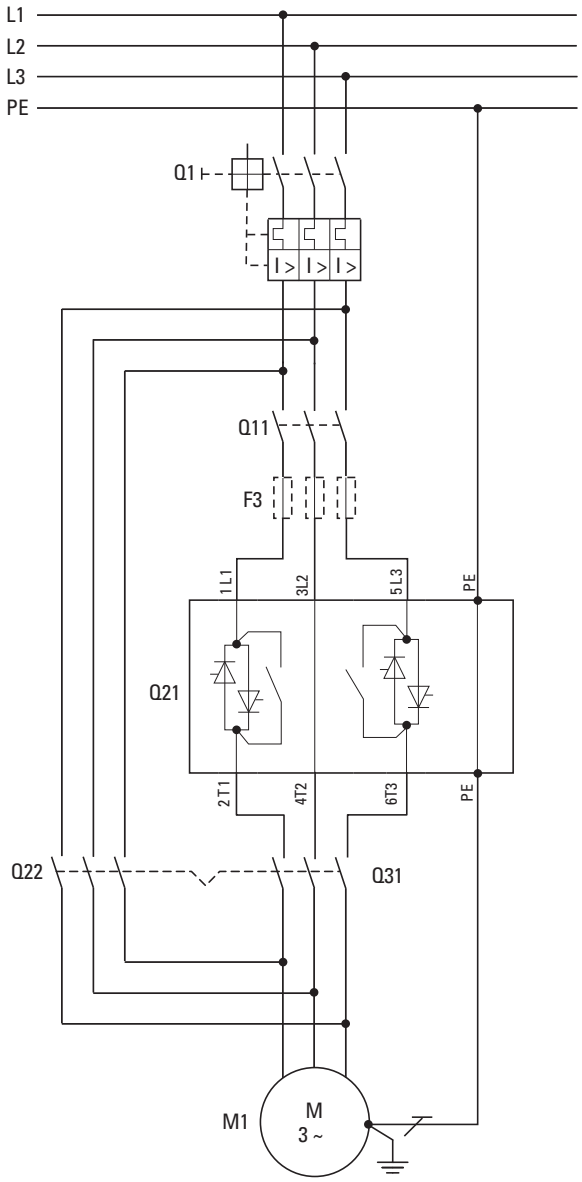


Figure 107:Actuation with bypass emergency operation – pump operation

① Enable
② Automatic operation (soft starter)
③ Manual/bypass operation
④ Soft starter/Soft stop
⑤ Bypass contactor

S1 = Operating mode selector switches
S2 = Off
S3 = On
S4 = Stop (Soft starter)
S5 = Start (Soft starter)

The electrical and/or mechanical interlocking of contactors Q22 and Q31 ensures safe operating states.



Q1 = Cable and motor protection

Q11 = Mains contactor

Q21 = Soft starter

Q31 = Motor contactor

Q22 = Bypass contactor/Emergency operation protection

F2 = superfast semiconductor fuse for type of coordination 2 (optional), in addition to Q1

M1 = Motor

Figure 108:Power section with bypass emergency operation – (pump operation)

→ The control system shown here can also be used for the DS7 soft starters in size 2 (16 to 32 A).

7.3.8 Starting several motors sequentially with a soft starter

When starting several motors one after the other using a soft starter, keep to the following changeover sequence:

▶1.Start using soft starter
▶2.Switch on bypass contactor Qn2 via TOR
▶3.Block soft starter
▶4.Switch soft starter output with Qn1 to the next motor
▶5.Restart

When starting several motors with one soft starter the thermal load of the soft starter (starting frequency, current load) must be taken into account.
If the starts occur closely in succession, the soft starter must be dimensioned larger (i.e. the soft starter must be designed with an accordingly higher load cycle).

Due to the thermal design of the DS7 soft starters, we recommend the use of an (optional) fan when using a DS7 series device for starting several motors.

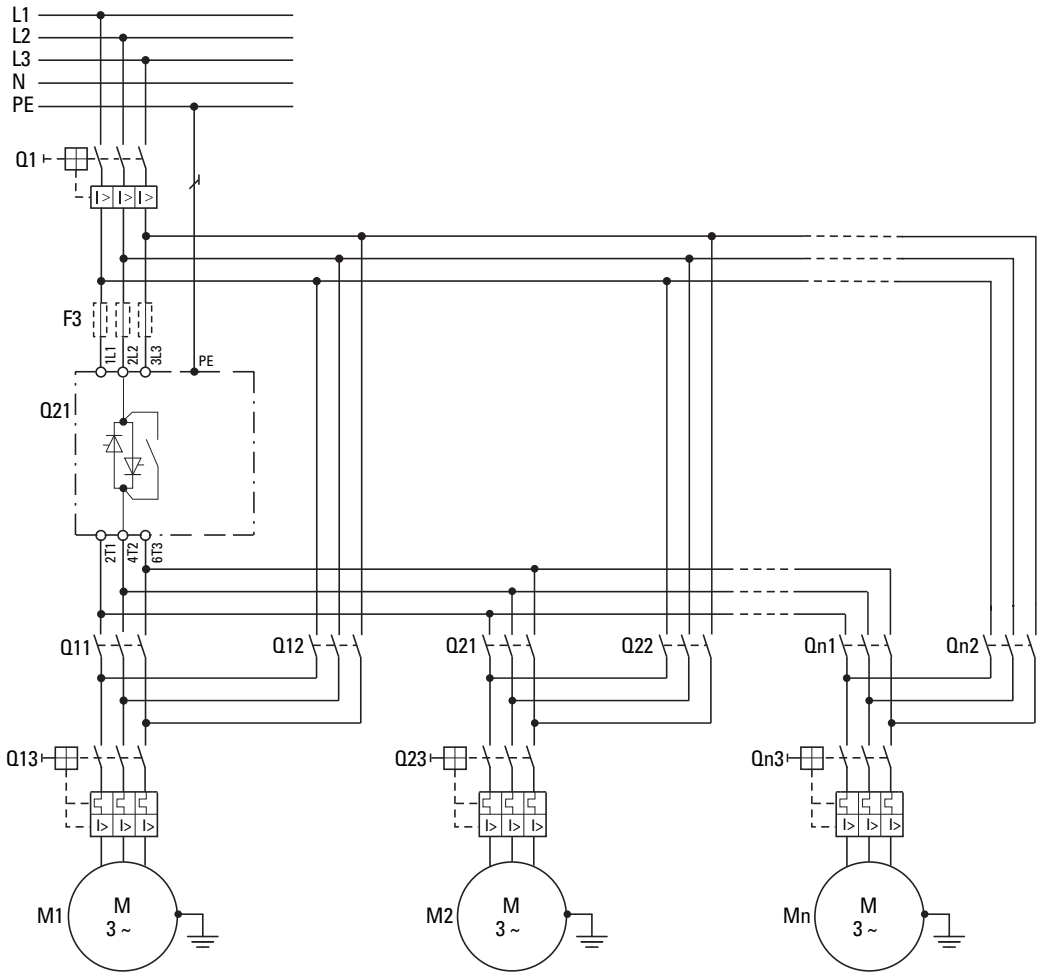


Figure 109:Power section, motor cascade

F3 = Superfast semiconductor fuse for type 2 coordination, in addition to Q1 (optional)
Q1 = cable protection through circuit-breaker or fuse (F1)
Q2 = Soft starter DS7
Qn1 = Contactor (1, 2, n)
Qn2 = Supply bypass contactor for motor (1, 2, n)
Qn3 = Motor protection (motor-protective circuit-breaker
or current transformer-operated overload relay)
Mn = Motor (1, 2, n)

→ The control system shown here can also be used for the DS7 soft starters in size 2 (16 to 32 A).

→ The "thermal motor protection" (Q13, Q23, Qn3) can also be ensured with current transformer-operated overload relays (see → Section 2.11.6, „Parallel motor connection", Page 43).

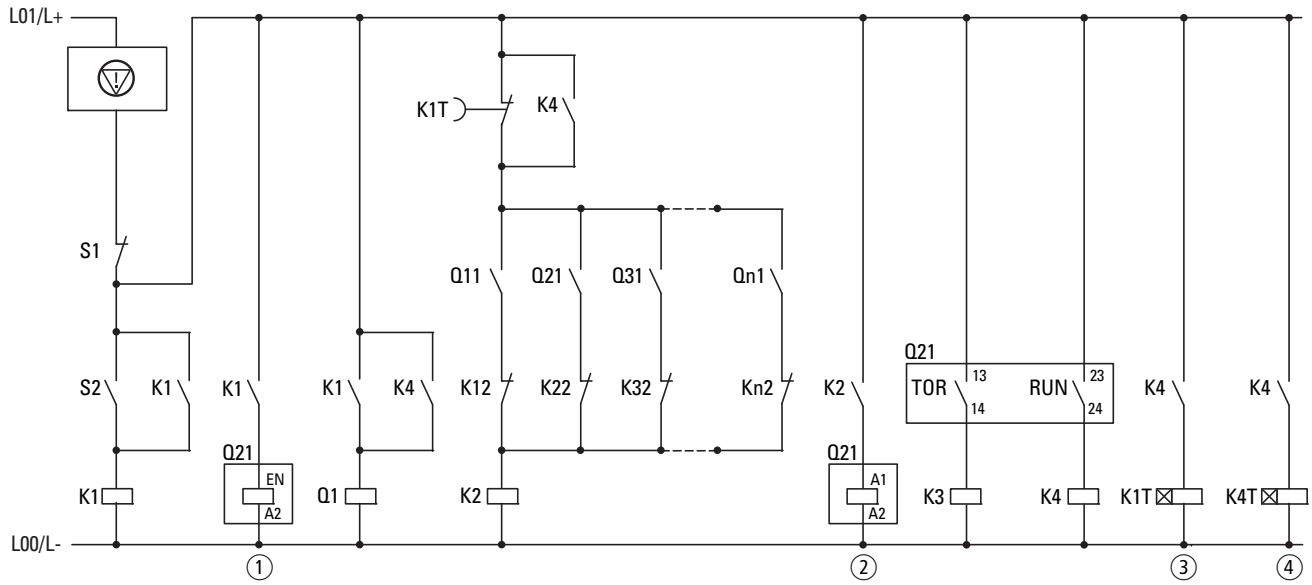


Figure 110:Actuation, motor cascade, part 1

① Enable
② Soft starter/Soft stop
③ Starting frequency monitoring.
Set the timing relay so that the soft starter is not thermally overloaded.
The appropriate time relates to the admissible operating frequency of the selected soft starter.
Otherwise select the soft starter so that the required times are achievable.
④ Set the timing relay to 2 s off-delay. This ensures that the next motor branch is not connected when a soft starter is running.

N/C contact S1 switches all motors off at the same time.

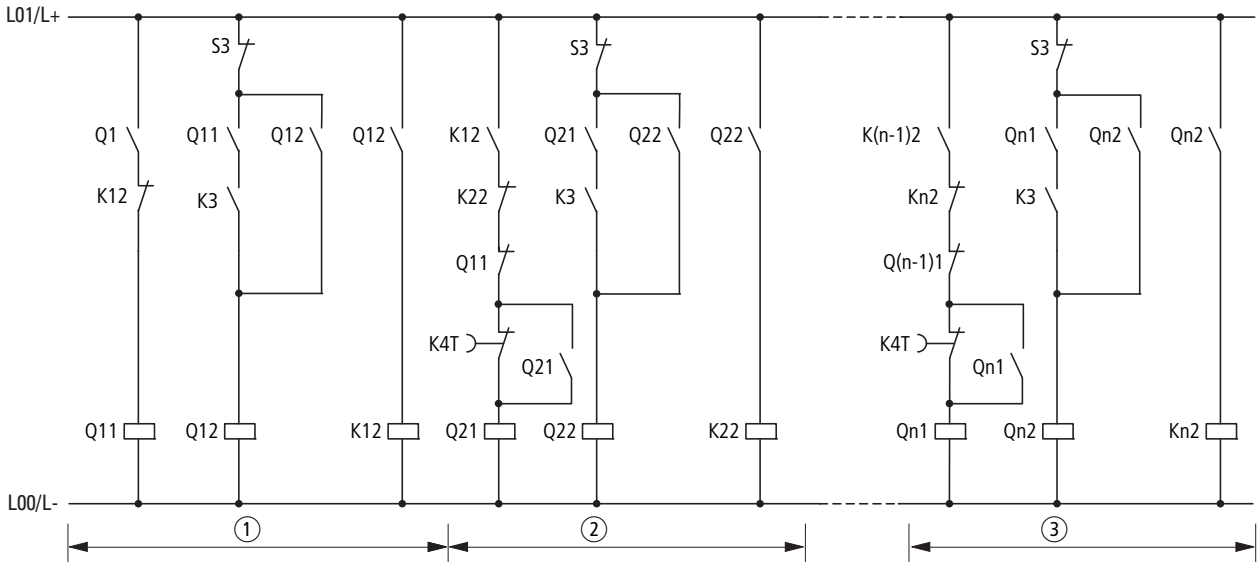


Figure 111:Actuation, motor cascade, part 2

① Motor 1
② Motor 2
③ Motor n

The N/C contact S3 is required if motors also have to be switched off individually.

8 SmartWire-DT

8.1 Introduction

The SmartWire-DT connection system is an intelligent bus system and makes possible the reliable and easy connection of switching devices, pilot devices and I/O components with overriding bus systems. The components that are connected with the SmartWire-DT system are controlled with SmartWire-DT masters or connected to, for example, PROFIBUS-DP or CANopen communication networks through gateways.

With the SmartWire-DT system up to 99 modules can be connected to form a network. Modules can include SmartWire-DT I/O modules or SmartWire-DT modules for contactors or pilot devices. The electrical connection is effected via a special 8-pole connecting lead and the relevant plugs.

Soft starters with part no. DS7-34D…-**D** (abbreviated "DS7-SWD" here) can be connected to a SmartWire-DT bus system and therefore to a higher-level PLC. Through SmartWire-DT the soft starters can be controlled, monitored and parameterized.

Depending on the specific model and field of application, DS7-SWD soft starters can be combined and operated together with an NZM circuit-breaker, a PKZ motor-protective circuit-breaker, or a PKE electronic motor-protective circuit-breaker as a safety device. In addition, it is also possible to connect a PKE motor-protective circuit-breaker to SmartWire-DT via a DS7-SWD soft starter and to read its information this way as well. For this purpose, the PKE motor-protective circuit-breaker features an electronic trip block with its own communication module.

This chapter uses the original English terms that appear throughout a variety of specifications (e.g., SmartWire-DT, PROFIdrive). → Section 8.4, „Abbreviations"

8.2 Profiles in DS7-SWD

Table 20: Profiles for soft starter DS7-SWD

Profile	Name	Description
1	DS7-SWD PKE1	PKE profile 1, Start/Stop bit for DS7
2	DS7-SWD PKE2	PKE profile 2, Start/Stop bit for DS7
3	DS7-SWD PKE3	PKE profile 3, Start/Stop bit for DS7
4	DS7-SWD PKE1-8Bit	PKE profile 1, controlling the DS7 in an additional byte (control word) at the end of the message
5	DS7-SWD PKE2-8Bit	PKE profile 2, controlling the DS7 in an additional byte (control word) at the end of the message
6	DS7-SWD PKE3-8Bit	PKE profile 3, controlling the DS7 in an additional byte (control word) at the end of the message
7	DS7-SWD PKE1-PD 2x16Bit	PKE profile 1, controlling the DS7 in two additional words (one control word and one analog value word) at the end of the message
8	DS7-SWD PKE2-PD 2x16Bit	PKE profile 2, controlling the DS7 in two additional words (one control word and one analog value word) at the end of the message
9	DS7-SWD PKE3-PD 2x16Bit	PKE profile 3, controlling the DS7 in two additional words (one control word and one analog value word) at the end of the message
10	DS7-SWD 8Bit	Controlling the DS7 in an additional byte (control word) without PKE
11	DS7-SWD PD 2x16Bit	Controlling the DS7 in two additional words (one control word and one analog value word) without PKE

In all profiles an acyclic data transfer with soft starter DS7-SWD is possible with profile "Base Mode Parameter Access".

8.3 1-0-A switch

Soft starters of the DS7-SWD series feature a 1-0-A switch that can be used to manually switch the soft starter on and off.

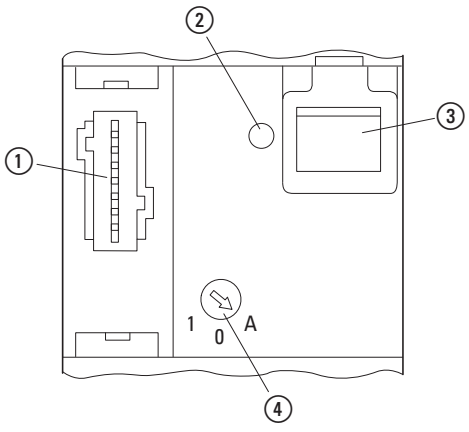


Figure 112: Control section with mains contactor

① Connection for SmartWire-DT external device plug
② LED: SWD diagnosis
③ Data interface for PKE32-COM
④ 1-0-A switch

The 1-0-A switch's positions are as follows:

- 1: Soft starter DS7-SWD switched on
- 0: Soft starters DS7-SWD switched off
- A: switching command via SmartWire-DT

The overload relay function (ZMR) will only be active in the 1-0-A switch's A position. The overload relay function will be disabled in positions 1 and 0.

8.4 Abbreviations

The following abbreviations are used throughout this chapter:

Abbreviation	Meaning
ACKR	Acknowledge required
DO	Drive Object
EU5C-SWD-CAN	SmartWire-DT gateway for connecting to a CANopen master
EU5C-SWD-DP	SmartWire-DT gateway for connecting to a PROFIBUS master
GSD	Device master data
ID	Identifier
PDU	Protocol Data Unit
PLC	Programmable Logic Controller
PNU	Parameter Number
PROFIBUS	Process Field Bus
RFG	Ramp function generator
SWD	SmartWire-DT

8.5 Response time on the bus

The response time of soft starter DS7-SWD on the bus is about 150 ms. With two bus users the response time increases to about 50 ms; with 50 bus users it is about 400 ms.

8.6 Interoperability

8.6.1 Gateways

The DS7-SWD soft starter's interoperability is guaranteed with the following SmartWire-DT gateway firmware versions (and higher):

Table 21: Firmware versions of SmartWire-DT gateways

SmartWire-DT gateway	Firmware Version
EU5C-SWD-CAN	V 1.20
EU5C-SWD-DP	V 1.20

The firmware of the SmartWire-DT gateway can be updated using the SWD-Assist program. This program, as well as the required firmware versions, can be downloaded for free on the Internet at:
http://downloadcenter.moeller.net

8.6.2 Fieldbus description files

The DS7-SWD's interoperability is guaranteed with the following versions (and later versions) of the fieldbus description files for the corresponding gateway:

Table 22: Compatible DS7-SWD fieldbus description files

SmartWire-DT gateway	Description file
EU5C-SWD-CAN	EU5C-SWD-CAN_V120.eds
EU5C-SWD-DP (Intel-based CPU)	Moed14.gsd
EU5C-SWD-DP (Motorola-based CPU)	Moeld14.gsd

These and other fieldbus description files can be found on the Internet at: http://downloadcenter.moeller.net

8.6.3 SWD-Assist

The SWD-Assist program provides valuable support in the engineering of your SmartWire-DT topology. SWD-Assist is software that runs under operating systems Windows 2000 (SP 4), Windows XP, Windows Vista (32-bit) or Windows 7 and relieves you of the planning work required for an SWD topology.

DS7-SWD soft starters can be used in SWD-Assist version V 1.60 and higher.

The SWD-Assist program can be downloaded for free on the Internet at: http://downloadcenter.moeller.net

8.7 Part numbers

The following models belonging to the DS7 series of soft starters are capable of communicating with SmartWire-DT:

Table 23: DS7 models for connecting to SmartWire-DT

Size	Part no. DS7…
1	DS7-34DSX004N0-D
	DS7-34DSX007N0-D
	DS7-34DSX009N0-D
	DS7-34DSX012N0-D
2	DS7-34DSX016N0-D
	DS7-34DSX024N0-D
	DS7-34DSX032N0-D
3	DS7-34DSX041N0-D
	DS7-34DSX055N0-D
	DS7-34DSX070N0-D
	DS7-34DSX081N0-D
	DS7-34DSX100N0-D
4	DS7-34DSX135N0-D
	DS7-34DSX160N0-D
	DS7-34DSX200N0-D

8.8 Replacing soft starters

If you replace a DS7-SWD soft starter in a supply system, you will have to press the configuration button after replacing it and switching on the voltage. This ensures that the new soft starter is assigned a network address.

DANGER

Before replacing a DS7-SWD soft starter, make sure to switch off the voltage and the entire SmartWire-DT system!

NOTICE

If a DS7-SWD soft starter is replaced, the order of SmartWire-DT modules must not be altered.

8.9 Programming

8.9.1 Introduction

The SmartWire-DT system can transfer cyclic, acyclic and diagnostic data. The number of cyclic data bytes is variable and is defined with profiles.

The devices (soft starters DS7-SWD with or without PKE motor-protective circuit-breaker) are designed such that they comply with the following profiles and standards:

- PROFIdrive profile
- the PKE profiles already implemented in the PKE-SWD-032 connection,
- The standard specified by SmartWire-DT.

The appropriate profile can be selected by the user.

8.9.2 State diagrams

The state diagrams used below correspond to PROFIdrive profile 4.1 and are adapted in line with the relevant profiles. The grey boxes in the figures represent the current state (S = State) with the help of the input bytes. The white boxes represent the transition conditions with the help of the relevant output byte bits. Dots are used to indicate priority levels. The more dots a transition has, the higher its priority.

Process data level (PNU 928.0)

- 0 (local): Control via control signal terminals and potentiometer.
  - Sizes 1 to 4: A1 control signal terminal corresponds to the EN_Set bit.
  - Sizes 1 and 2: Since there is no EN control signal terminal, there is an automatic transition from S3 to S4.
  - Sizes 3 and 4: EN control signal terminal corresponds to the EN_Op bit.
- 1 (network): Control via SmartWire-DT.

If the ZMR function is active, the EN_Op bit will be overwritten with a 0 in all profiles as long as there is an overload. More information on the ZMR function
→ Section 8.9.3, „Cyclic data“, page 153

For the available parameter numbers (PNU), see
→ Section 8.9.5, „acyclic data“, page 176

The illustrations below show the state diagrams that depend on PNU 928.0 and on the selected profile. The graphics show the following states:

Status of soft starter DS7

Signal to soft starter DS7

8.9.2.1 Local – State diagram for sizes 1 and 2

If a size 1 or 2 DS7-SWD soft starter is used with **PNU 928.0 = 0**, the state diagram shown below will apply. The transition from S3 to S4 is automatic.

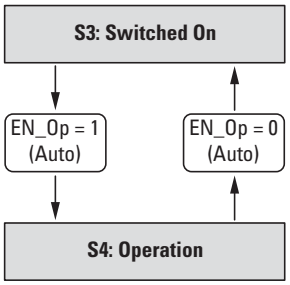


Figure 113: State diagram: Local (sizes 1 and 2)

8.9.2.2 Local – State diagram for sizes 3 and 4

If a size 3 or 4 DS7-SWD soft starter is used with **PNU 928.0 = 0**, the state diagram shown below will apply. The transition from S3 to S4 takes place when the EN control signal terminal is switched.

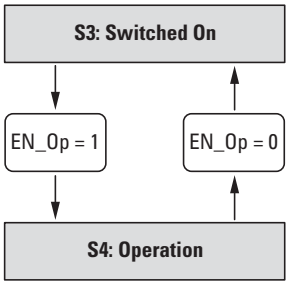


Figure 114: State diagram: Local (sizes 3 and 4)

8.9.2.3 Local – S4: Operation

If a DS7-SWD of any size is used with **PNU 928.0 = 0**, the state diagram shown below will apply. The transitions take place when the A1 control signal terminal is switched.

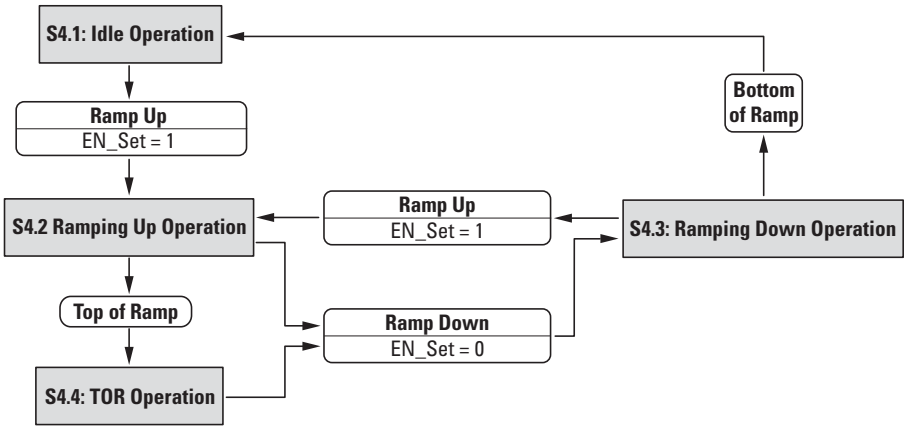


Figure 115: State diagram: Local – S4

8.9.2.4 Network – State diagram for profiles 1–3

If profile 1, to 3 (DS7 as Contactor) is used with **PNU 928.0 = 1**, the state diagram shown below will apply. The transition from S3 to S4 is automatic.

8.9.2.5 Network – S4: Operation, profiles 1–3

If profile 1, to 3 (DS7 as Contactor) is used with **PNU 928.0 = 1**, the state diagram shown below will apply. The transitions will take place when the state of the DS7 start/stop bit is changed.

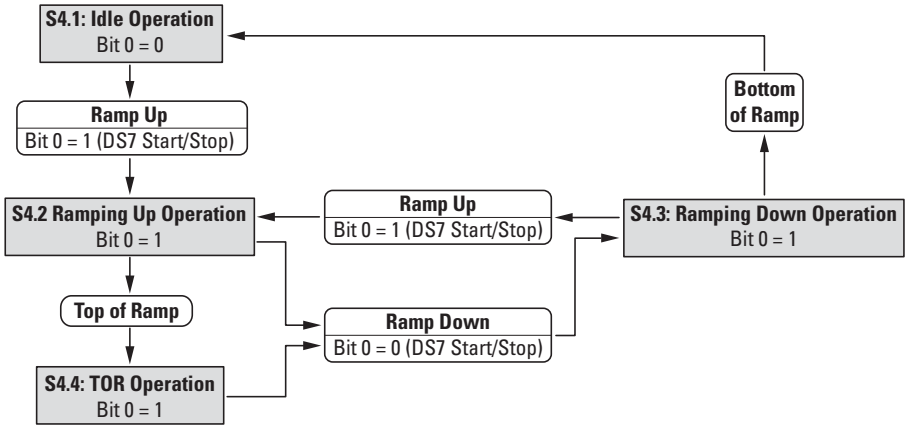


Figure 116: State diagram: Network – S4 (profiles 1–3)

8.9.2.6 Network – State diagram for profiles 4, 5, 6, 10

If profile 4, 5, 6, or 10 (**Short**) is used with **PNU 928.0 = 1**, the state diagram shown below will apply.

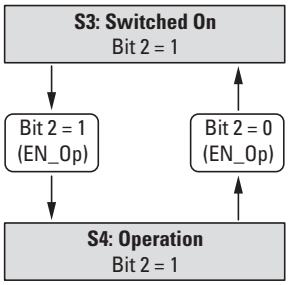


Figure 117: State diagram: Network (profiles 4, 5, 6, 10)

8.9.2.7 Network – S4: Operation, profiles 4, 5, 6, 10

If profile 4, 5, 6, or 10 (**Short**) is used with **PNU 928.0 = 1**, the state diagram shown below will apply. The transitions will take place when the state of the EN_Set bit is changed.

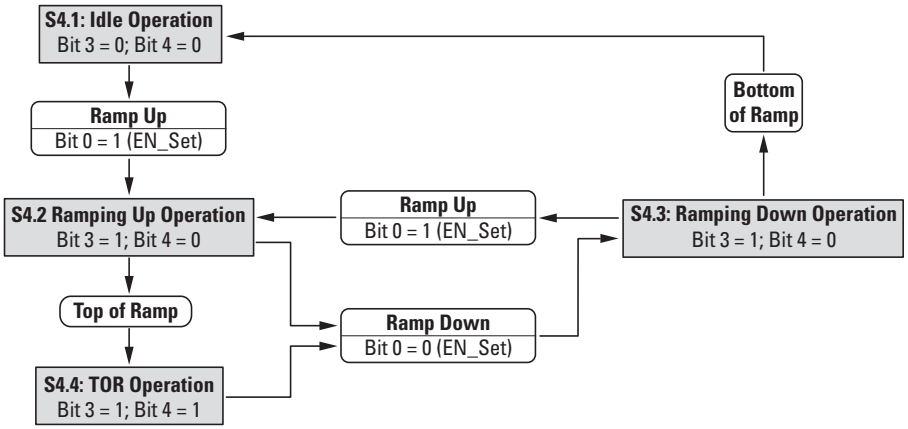


Figure 118: State diagram: Network – S4 (profiles 4, 5, 6, 10)

8.9.2.8 Network – State diagram for profiles 7, 8, 9, 11

If profile 7, 8, 9, or 11 (**Long**) is used with **PNU 928.0 = 1**, the state diagram shown below will apply.

In addition to the transition conditions shown below, the Ctl_PLC bit needs to be set in the output byte.

For more information on the Ctl_Req and Ctl_PLC bits, see → Section 8.9.3, „Cyclic data“.

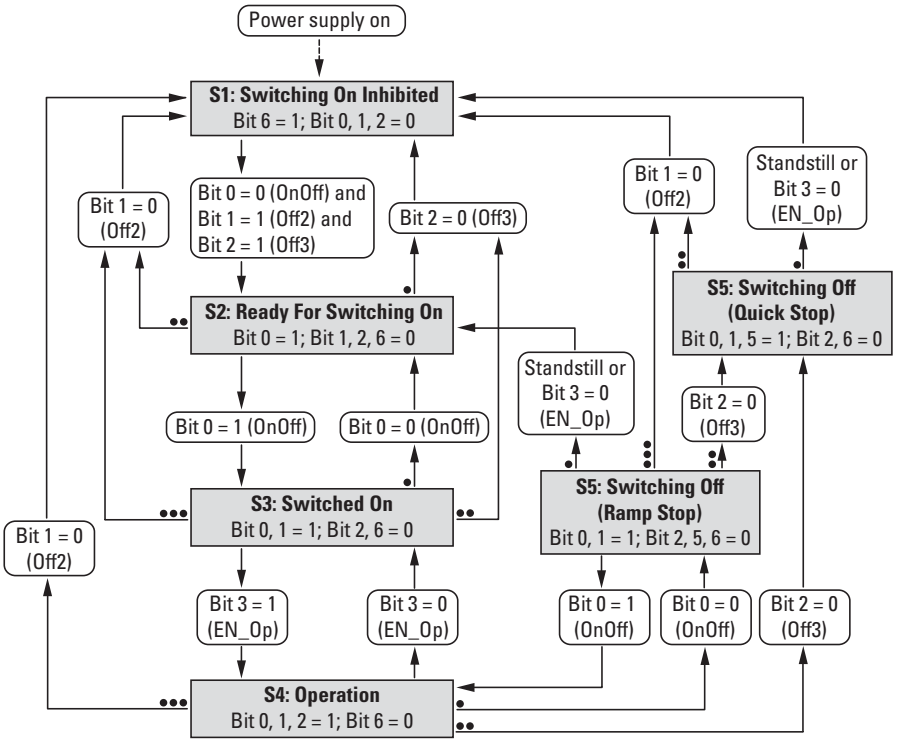


Figure 119: State diagram: Network (profiles 7, 8, 9, 11)

8.9.2.9 Network – S4: Operation, profiles 7, 8, 9, 11

If profile 7, 8, 9, or 11 (**Long**) is used with **PNU 928.0 = 1**, the state diagram shown below will apply. The transitions will take place when the corresponding bits' state is changed.

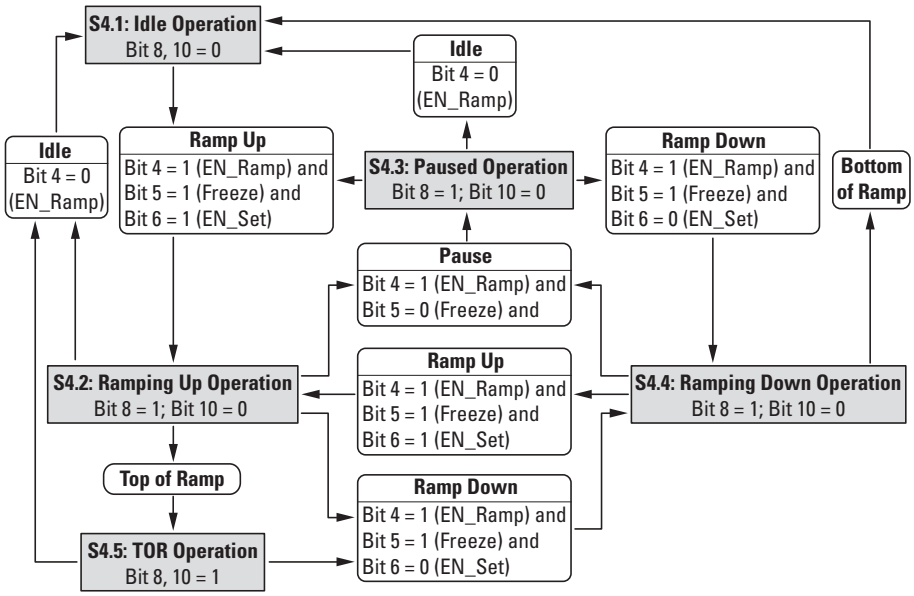


Figure 120: State diagram: Network – S4 (profiles 7, 8, 9, 11)

8.9.2.10 General state diagram for profiles 1–3

The state diagram shown below is used in profiles 1 to 3 (DS7 as Contactor). The transition from S3 to S4 is automatic.

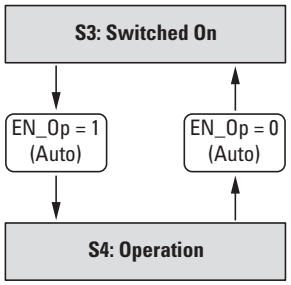


Figure 121: General state diagram (profiles 1 – 3)

8.9.2.11 State S4: Operation: Profiles 1–3

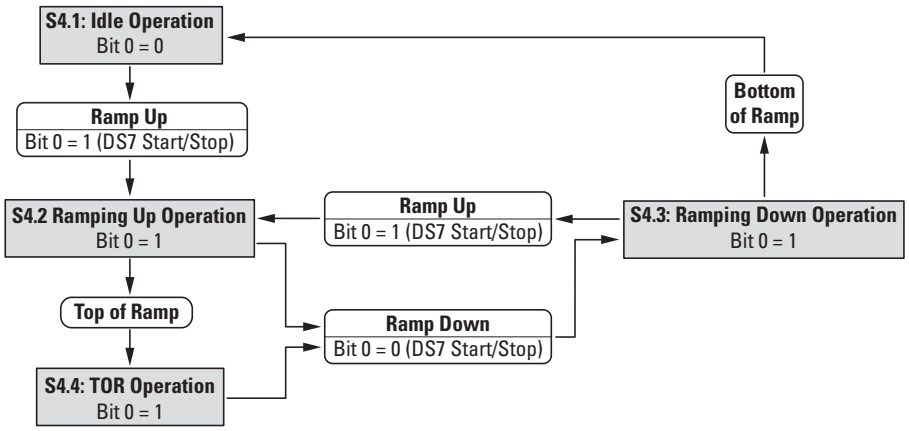


Figure 122: S4 operation (profiles 1 – 3)

8.9.2.12 General state diagram: Profiles: 4, 5, 6, 10

The state diagram shown below is used in profiles 4 to 6, and 10 (Short).

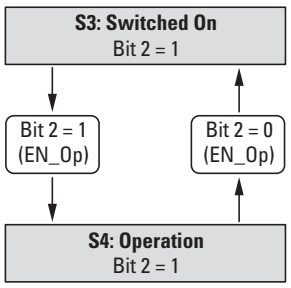


Figure 123: General state diagram (profiles 4, 5, 6, 10)

8.9.2.13 State S4: Operation: Profiles 4, 5, 6, 10

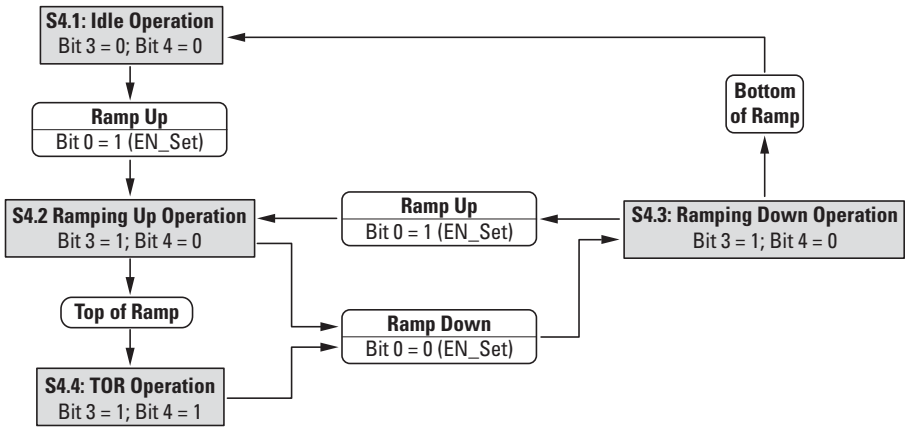


Figure 124: S4: Operation (profile 4, 5, 6, 10)

8.9.2.14 General state diagram: Profiles 7, 8, 9, 11

The state diagram shown below is used in profiles 7 to 9, and 11 (Long). In addition to the transition conditions shown below, the Ctl_PLC bit needs to be set in the output byte.

For more information on the Ctl_Req and Ctl_PLC bits, see → Section 8.9.3, „Cyclic data“, page 153.

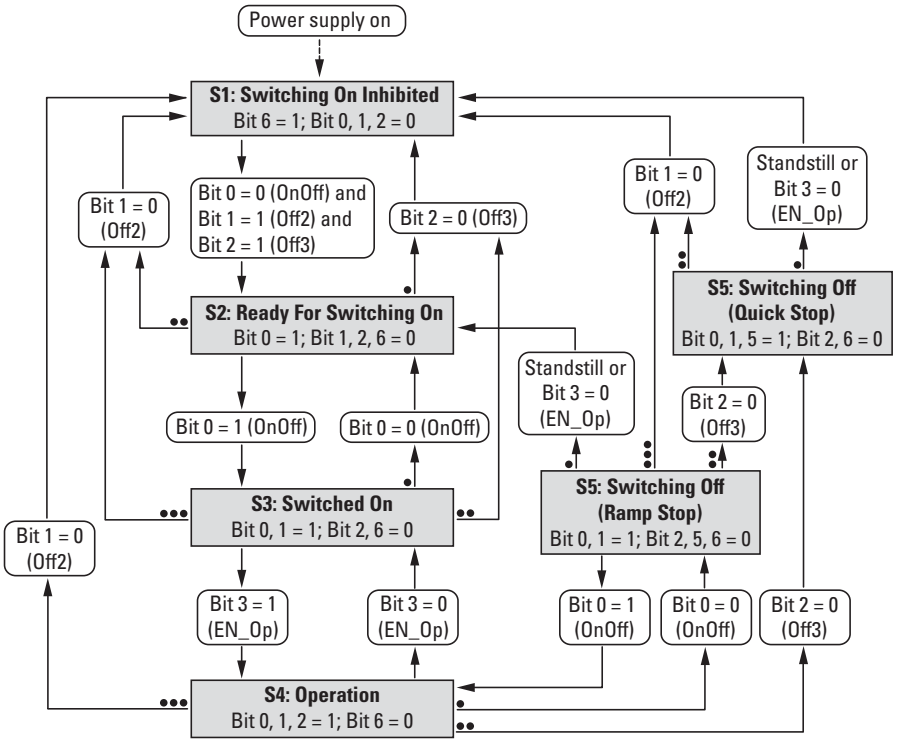


Figure 125: General state diagram (profiles 7, 8, 9, 11)

8.9.2.15 State S4: Operation: Profiles 7, 8, 9, 11

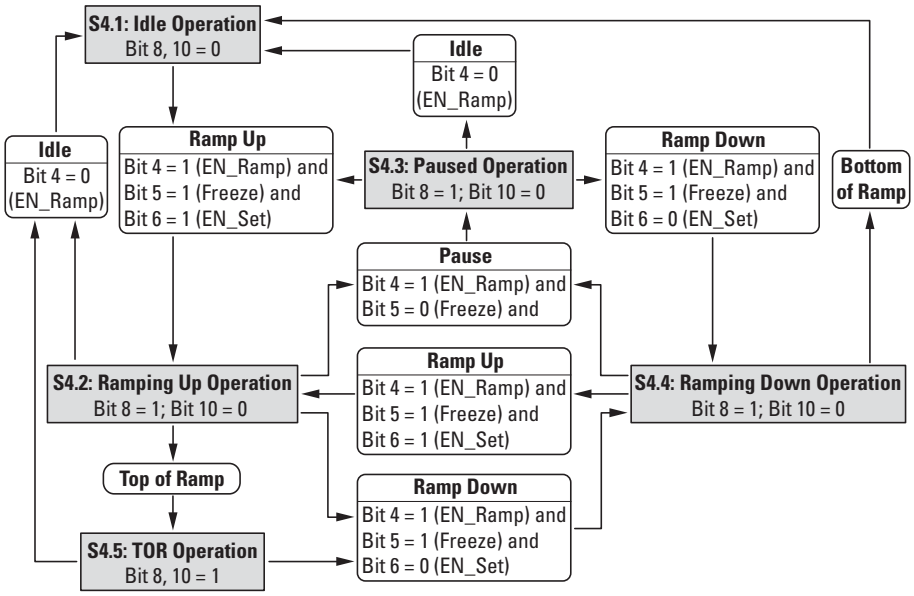


Figure 126: S4 operation (profiles 7, 8, 9, 11)

8.9.3 Cyclic data

8.9.3.1 Introduction

The number of cyclic I/O (process) data bytes of soft starter DS7-SWD can be adapted to the application with various profiles, which can be selected in the hardware/control configuration program (for example SWD-Assist).

A total of eleven cyclic profiles are available. The following sections describe these profiles in detail.

Profiles 1 to 9 are designed for operating a DS7-SWD soft starter with a PKE motor-protective circuit-breaker:

- Profiles 1 to 3 (DS7 as Contactor): DS7-SWD PKE1 to DS7-SWD PKE3
  This group supports the operation of a DS7-SWD soft starter, which behaves like a contactor in this case. Accordingly, these profiles match the motor starter profiles for the PKE-SWD-32 motor-protective circuit-breaker.
- Profiles 4 to 6 (Short): DS7-SWD PKE1-8bit to DS7-SWD PKE3-8bit
  This group complements the motor starter profiles with the I/O-link profile.
  Control and status data will be processed as per the I/O-link profile.
- Profiles 7 to 9 (Long): DS7-SWD PKE1-PD 2x16 bit to DS7-SWD PKE3-PD 2x16 bit
  This group adds the PROFIdrive profile to the motor starter profiles such as the PNO has defined for the cyclic exchange of data with drives.
  Control and status data are processed according to the PROFIdrive profile.

Profiles 10 and 11 are designed for operating a DS7-SWD soft starter without a PKE motor-protective circuit-breaker:

- Profile 10 (Short): DS7-SWD 8 bit
- Profile 11 (long): DS7-SWD PD 2 × 16-bit = word

Profile 11 will be set by default.

When using profiles 10 and 11, a DS7-SWD soft starter > 32 A can also be used optionally with an upstream NZM as a safety device.

Table 24: Profiles

Profile		Input bytes (status)										Output bytes (control)						Bytes
No.	Name	0	1	2	3	4	5	6	7	8	Σ	0	1	2	3	4	Σ	Σ
1	DS7-SWD PKE1	DS7/ PKE	PKE								2	DS7/ PKE					1	3
2	DS7-SWD PKE2	DS7/ PKE	PKE	PKE	PKE						4	DS7/ PKE					1	5
3	DS7-SWD PKE3	DS7/ PKE	PKE	PKE	PKE	PKE					5	DS7/ PKE					1	6
4	DS7-SWD PKE1-8Bit	DS7/ PKE	PKE	DS7							2+1	PKE	DS7				1+1	5
5	DS7-SWD PKE2-8Bit	DS7/ PKE	PKE	PKE	PKE	DS7					4+1	PKE	DS7				1+1	7
6	DS7-SWD PKE3-8Bit	DS7/ PKE	PKE	PKE	PKE	PKE	DS7				5+1	PKE	DS7				1+1	8
7	DS7-SWD PKE1-PD 2x16Bit	DS7/ PKE	PKE	DS7	DS7	DS7	DS7				2+4	PKE	DS7	DS7	DS7	DS7	1+4	11
8	DS7-SWD PKE2-PD 2x16Bit	DS7/ PKE	PKE	PKE	PKE	DS7	DS7	DS7	DS7		4+4	PKE	DS7	DS7	DS7	DS7	1+4	13
9	DS7-SWD PKE3-PD 2x16Bit	DS7/ PKE	PKE	PKE	PKE	PKE	DS7	DS7	DS7	DS7	5+4	PKE	DS7	DS7	DS7	DS7	1+4	14
10	DS7-SWD 8Bit	DS7	DS7								1+1	DS7	DS7				1+1	4
11	DS7-SWD PD 2x16Bit	DS7	DS7	DS7	DS7	DS7					1+4	DS7	DS7	DS7	DS7		4	9

DS7-SWD soft starters can also be operated, without a PKE motor-protective circuit-breaker, with a PKZ or an NZM as a safety device.

For additional information on how to connect a DS7-SWD to a PKE motor-protective circuit-breaker with a trip block, consult manual MN05006001Z-EN, "SmartWire-DT Units".

8.9.3.2 Input (status) profiles 1 – 3

Profiles 1, 2 and 3 have up to five input and one output byte.

The number of cyclic input bytes can be adapted with different profiles for the module (→ Table 24, page 154).

Byte 0:

Status information: DS7, PKE, PKE-SWD-32

7	**6**	**5**	**4**	**3**	**2**	**1**	**0**
SUBST	PRSNT	–	DIAG	A2	A1	P	C

Data Bit	**designation**	**Meaning**
0	DS7 run	0: Stop soft starter DS7-SWD 1: Run DS7-SWD soft starter
1	STAT (PKE)	0: PKE tripped 1: PKE Powered up
2, 3	A1, A2	1-0-A switch on DS7-SWD soft starter: 00: not defined 10: Position A: Automatic (commands via SmartWire-DT/ terminal) 01: Position 0: DS7 stop 11: Position 1: DS7 operation
4	DIAG	Soft starter diagnostics: 0: no diagnostic alarm 1: Diagnostic alarm present
5	–	Not used
6	PRSNT	Presence of DS7-SWD soft starter: 0: Device not present 1: Device present
7	SUBST	Presence of a universal module: 0: configured module present 1: universal module M22-SWD-NOP(C) present

Byte 1:

Set value I_r, trip reasons, acknowledge signal

7	6	5	4	3	2	1	0
ACKR	TRIPR	TRIPR	TRIPR	I_r	I_r	I_r	I_r

Data Bit	designation	Meaning	Notes
0 – 3	I_r	Set value I_r	Table 25, page 157
4 – 6	TRIPR = Trip reason	Trip reason	Table 26, page 158
7	ACKR = Acknowledge required	ZMR manual function acknowledgement required 0: No acknowledgement required 1: Acknowledgement of overload required	→ Section , „Overload relay function (ZMR)“, page 161

Byte 2:

Motor current [%]

7	6	5	4	3	2	1	0
I-REL	I-REL	I-REL	I-REL	I-REL	I-REL	I-REL	I-REL

Data Bit	designation	Meaning	Notes
0 - 7	I-REL	Motor current [%]	→ Section , „Motor current [%] PKE (I_REL)“, page 159

Byte 3:

Thermal motor image [%]

7	6	5	4	3	2	1	0
TH	TH	TH	TH	TH	TH	TH	TH

Data Bit	designation	Meaning	Notes
0 - 7	TH	Thermal motor image [%]	→ Section , „Thermal motor map on PKE (TH)“, page 159

Byte 4:

Type of trip block, set time-lag class

7	6	5	4	3	2	1	0
–	–	CLASS	CLASS	CLASS	TYPE	TYPE	TYPE

Data Bit	designation	Meaning		
0 – 2	TYPE	Part no. of PKE trip block		
		Value [hex]	PKE-	Trip block
		0	XTUA-1.2	0.3 – 1.2 A
		1	XTUA-4	1.0 – 4.0 A
		2	XTUA-12	3.0 – 12 A
		3	XTUA-32	8.0 – 32 A
		4	XTUWA-32	8.0 – 32 A (width 55 mm)
		5	XTUWA-65	16.0 – 65A
3 – 5	CLASS	set PKE time lag		
		Value [hex]	Long delay time	Time
		0	Class 5	146.2 s
		1	Class 10	292.5 s
		2	Class 15	438.7 s
		3	Class 20	585.0 s
		4	test	0
6, 7	–	Not used		

Set rated operational current I_r on PKE

The overload release value set on the PKE basic device (adjustable with a selector switch) is reproduced by bit field Ir (input byte 1, bits 0 to 3). The value of this bit field represents the absolute current value of the overload release, which depends on the selected PKE trip block. Bit field Ir has the following meaning for the different PKE trip blocks:

Table 25: Absolute value of set rated operational current on the PKE

Ir value	Set rated operational current I_r [A] on the PKE				
[hex]	PKE-XTUA-1.2	PKE-XTUA-4	PKE-XTUA-12	PKE-XTU(W)A-32	PKE-XTUA-65
0	0.30	1.00	3.0	8.0	16.0
1	0.33	1.10	3.3	8.8	17.6
2	0.36	1.20	3.6	9.7	19.4
3	0.40	1.30	4.0	10.5	21.3
4	0.43	1.42	4.3	11.5	23.0
5	0.47	1.55	4.7	12.5	24.8
6	0.50	1.70	5.0	13.5	26.8
7	0.56	1.90	5.6	15.0	30.0
8	0.63	2.10	6.3	17.0	33.6
9	0.70	2.40	7.0	19.0	37.7
A	0.77	2.60	7.7	20.5	40.9
B	0.83	2.80	8.3	22.0	44.4
C	0.90	3.00	9.0	24.0	48.1

Ir value	Set rated operational current I_r [A] on the PKE				
[hex]	PKE-XTUA-1.2	PKE-XTUA-4	PKE-XTUA-12	PKE-XTU(W)A-32	PKE-XTUA-65
D	1.00	3.30	10.0	27.0	53.3
E	1.10	3.70	11.0	29.0	58.6
F	1.20	4.00	12.0	32.0	65.0

PKE trip reason (TRIPR)

In the event of a malfunction or interruption of the main circuits, the reason for the interruption will be indicated by the TRIPR bit field.

The following trip reasons are possible:

Table 26: Trip reasons PKE (TRIPR)

Value [hex]	Meaning
0	Not defined
1	Overload → PKE motor-protective circuit-breaker has switched off
2	Short-circuit → PKE motor-protective circuit-breaker has switched off
3	Phase failure/phase unbalance → Switched off at 100 % of thermal motor map (TH)
4	Test position on PKE-XTUA → PKE motor-protective circuit-breaker has switched off
5	Overload with activated ZMR function → The DS7-SWD soft starter has switched off The value of the thermal motor map (TH) is still greater than 100 % after the unit is switched off.
6	Remote tripping
7	Not used

Trip reasons 1, 2, 3, and 4 for the PKE motor-protective circuit-breaker have the following effects on the DS7-SWD soft starter:

- Profiles 1, 2, 3: The DS7-SWD soft starter will be stopped.
  After the PKE motor-protective circuit-breaker is switched back on, the soft starter can be switched back on with the DS7 start/stop 1 command.
- Profiles 4, 5, 6: The DS7-SWD soft starter will be stopped.
  After the PKE motor-protective circuit-breaker is switched back on, the soft starter can be reset with the FaultAck = 1 command. The soft starter will be switched on again directly depending on the position of the EN_Set and EN_Op bits.
- Profiles 7, 8, 9 and 11: Soft starter DS7-SWD stops.

After the PKE motor-protective circuit-breaker is switched back on, the fault can be reset with the FaultAck = 1 command and the soft starter can be switched back on with the relevant bits.

With the exception of trip reason "05_{hex} Overload with activated ZMR function" the transmitted trip reasons will be reset if the main contacts of the PKE motor-protective circuit-breaker are closed back again and a current flow is sensed through the PKE trip block. The "05_{hex} Overload with activated ZMR function" trip reason will be reset as soon as the thermal motor map (TH) falls below a value of 100 %.

The "03_{hex} Phase failure/Phase unbalance" message will be set if a phase current difference of 50 % is measured between the maximum measured phase current and the relevant phase. The message will be reset as soon as the phase current difference falls below 25 %.

The "Phase failure/Phase unbalance" message will not necessarily cause the main circuits to be interrupted. In order to protect the connected motor in the event of a phase failure or phase unbalance, the tripping time in the event of an overcurrent will be reduced to 40 % of the value used when the phase load is balanced. The main circuits will be interrupted early.

The "Test" position on the PKE trip block and remote tripping via the R-TRIP output bit causes a trip if a phase current of at least 85 % of the minimum marker of the adjustable overload release on the PKE trip block flows through all three main circuits (example: for device PKE-XTUA-4 I_r = 1 A → I_{min} = 0.85 x 1 A = 0.85 A).

Motor current [%] PKE (I_REL)

The DS7-SWD soft starter uses input byte 2 to provide the current motor current to the PKE motor-protective circuit-breaker. The motor current is represented as a relative value within a range of 0 % (00_{hex}) to 255 % (FF_{hex}). The relative value is calculated as the value of the maximum measured phase current relative to the set current value of the overload release. The accuracy of the relative current indication depends on the measured phase current relative to the PKE trip block's current range. For a sufficiently accurate measurement of the phase current, a phase current of at least 85 % of the adjustable overload release on the PKE trip block must be flowing. The maximum measuring accuracy of the transferred relative current value is 5 %.

Thermal motor map on PKE (TH)

Depending on the current range and the actual current flow, the PKE motor-protective circuit-breaker calculates the thermal state of the motor and provides it as a data byte. The thermal load of the motor is mapped via input byte 3. The value is displayed as a relative value in the ranges 0 % (00_{hex}) to 255 % (FF_{hex}).

The main circuits are interrupted as a result of a motor overload if the thermal motor image is 110 %. In the event of phase failure or phase unbalance, the main circuits are interrupted at a value of 100 % of the thermal motor image. In the event of a phase unbalance and trip caused by an overload, the value of the thermal motor image is raised from 100 % to 110 %.

8.9.3.3 Profiles 1 – 3: Outputs (control)

Output byte 0 is mapped as follows on SmartWire-DT.

Table 27: Profiles 1 to 3: Output byte 0

Byte:	BIT	designation	Meaning
0	0	DS7 start/stop	0: DS7 stop 1: DS7 operation
	1	R_TRIP	Remote tripping PKE: 0: no PKE remote tripping 1: PKE remote tripping (rising edge: 0 → 1) → Section , „Remote tripping function for PKE (R_TRIP)“
	2	ZMR	DS7 ZMR on/off: 0: Deactivation of ZMR function 1: Activation of ZMR function → Section , „Overload relay function (ZMR)“
	3	ZMR_HA	ZMR operating mode manual/automatic of DS7: 0: ZMR function: Manual operating mode 1: ZMR function: Automatic operating mode → Section , „ZMR function (ZMR_HA): “Manual” mode“, → Section , „ZMR function (ZMR_HA): “Automatic” mode“
	4 – 7	–	Not used

→ To acknowledge faults, change the DS7 start/stop bit from 1 to 0.

Remote tripping function for PKE (R_TRIP)

In a combination of motor-protective circuit-breaker PKE and soft starter DS7-SWD connected via communication connection PKE32-COM the remote tripping function does not cause the motor-protective circuit-breaker PKE to open. Instead, the “external fault” message is output at the soft starter and a response defined with parameter PNU 840.9000 (External Fault) is initiated. By default the soft starter then stops. If the soft starter does not respond to the external fault, the motor-protective circuit-breaker trips.

The “Remote trip PKE basic device” command is supported by the following PKE trip block versions (and later versions).

Part no. of PKE trip block	Version
PKE-XTUA-1.2 PKE-XTUA-4 PKE-XTUA-12 PKE-XTUA-32	05
PKE-XTUWA-32	01
PKE-XTUA-65	01

The remote tripping function is only available in profiles 1 to 9 (profiles for operation with a PKE motor-protective circuit-breaker).

The remote tripping function is activated by output byte 0, bit 1 (R_TRIP). Soft starter DS7-SWD stops and input byte 1 bits 4 to 6 (trip indication) continually indicates a remote tripping.

Overload relay function (ZMR)

In the event of an overload, the ZMR overload relay function makes it possible to switch off the motor not by tripping the PKE motor-protective circuit-breaker, but by switching off the DS7-SWD soft starter instead as soon as the PKE motor-protective circuit-breaker's thermal motor model reaches a value of 110 %.

The ZMR function will only be active if the manual/automatic switch on the DS7-SWD communication module is set to A = Automatic.

If the ZMR function is deactivated by the host during a ZMR-triggered trip, the soft starter remains in a tripped state until the thermal motor model is below 100 %. During this time the differential trip indication outputs 5_{hex}.

In the event of a malfunction in the communications between the soft starter and the motor-protective circuit-breaker, or whenever the soft starter is switched on, the ZMR function in the motor-protective circuit-breaker will be deactivated; the motor-protective circuit-breaker will trip by itself.

Activation is through output byte 0 bit 2. For safety reasons this function is active only if it remains continuously (cyclically) enabled via the host.

In the event of a phase unbalance and activated ZMR function, the value of the thermal motor image is raised from 100 % to 110 % after a trip. The availability of the switched-off DS7-SWD soft starter will be restored when the value falls below 100 %.

The control bits for activating and deactivating the ZMR function are only found in profiles 1 to 9 (profiles for operation with PKE).

DANGER

Never disconnect the communication link between the motor-protective circuit-breaker PKE-SWD-32 and the PKE trip block after an overload with activated ZMR function, as this can cause soft starter DS7-SWD to be switched on if a switching command is present.

ZMR function (ZMR_HA): "Manual" mode

Output byte 0, bit 3 (ZMR manual mode/automatic operation) can be used from the host to define, for the ZMR function, whether the DS7 soft starter should be automatically switched back on after an overload shutdown caused by the ZMR function once the overload (= thermal motor model in PKE motor-protective circuit-breaker < 100 %) is no longer present. If not (i.e., "manual" mode), the overload will have to be acknowledged. Input byte 1, bit 7 (ACKR) is used to indicate to the host that an acknowledgment is required. The bit is set if the PKE signals a thermal motor model ≧ 110 % and the ZMR function is in "manual" mode.

During an overload, i.e., thermal motor model ≧ 110 %, this is signalled with a value of 5_{hex} in input byte 1 in the differential trip indication in bits 4 to 6.

The user can use both pieces of information to determine that a trip operation caused by the ZMR function has occurred and to find out whether the thermal overload is still present.

It can be acknowledged by switching soft starter DS7-SWD or by changing the ZMR operating mode:

- For profiles 1 to 3: By setting bit 0 (DS7 start/stop) in output byte 0 to 0 (stop)
- For profiles 4 to 6: By setting bit 0 (EN_Set) in output byte +1 (Short) to 0 (deactivate setpoint value)
- For profiles 7 to 9: By setting bit 6 (EN_Set) in output bytes 1 and 2 to 0 (do not activate setpoint value)
- Or for profiles 1 to 9: By setting bit 3 (ZMR mode) in output byte 0 to 1 (ZMR "automatic" mode) and then, optionally, setting it back to 0 ("manual"). This will reset bit 7 (ACKR) in input byte 1 – independently of the thermal motor model.

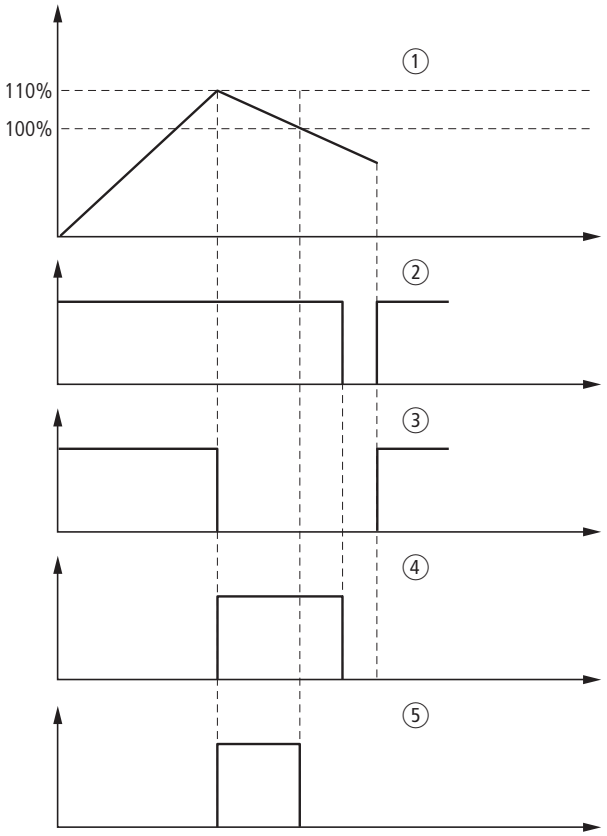


Figure 127: Acknowledgement of ZMR mode Manual with "DS7 OFF" command

① Thermal motor image
② Switching command for soft starter DS7-SWD
③ Switching state of soft starter DS7-SWD
④ ACKR bit field status
⑤ Trip indication: Overload with activated ZMR function

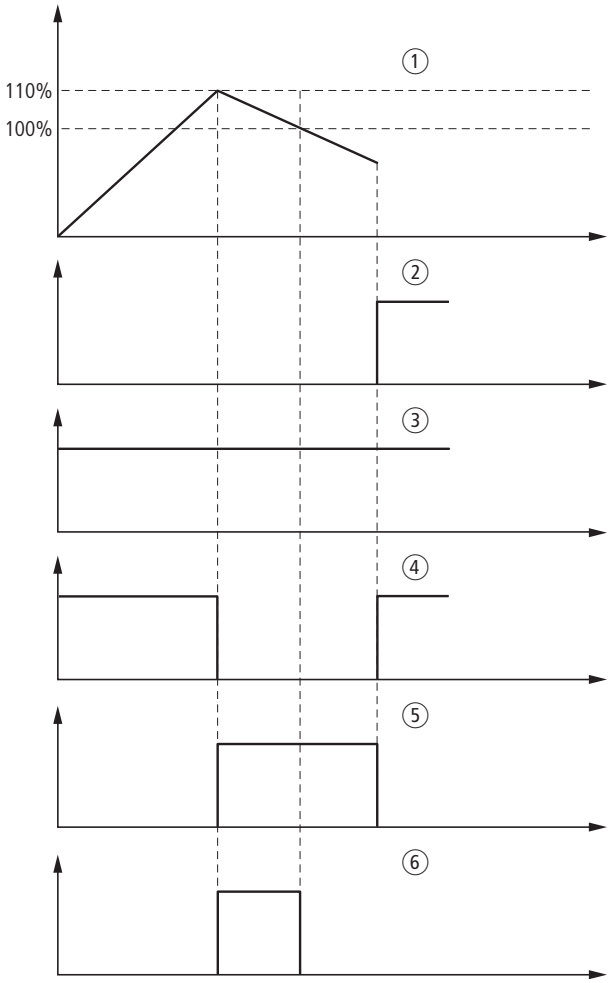


Figure 128: Acknowledgement of manual ZMR mode by changing the ZMR mode

① Thermal motor image
② ZMR M/A bit field status
③ Switching command for soft starter DS7-SWD
④ Switching state of soft starter DS7-SWD
⑤ ACKR bit field status
⑥ Trip indication: Overload with tripped ZMR function

NOTICE

The ZMR function can be deactivated only when the thermal motor image falls below the 100 % mark.

The soft starter can be switched on only when the Acknowledge bit is reset and the thermal motor model in motor-protective circuit-breaker PKE is below 100 %. Bits 4 to 6 of input byte 1 in the differential trip indication then carries the value 0_{hex}.

In the "manual" ZMR mode, the soft starter will be stopped when the ZMR function has been activated and the PKE signals a request for switching off the DS7-SWD.

ZMR function (ZMR_HA): "Automatic" mode

With the ZMR in Automatic mode soft starter DS7-SWD is ready to restart as soon as the thermal image drops below 100 %. ZMR operating mode Automatic is activated by setting output bit ZMR M/A (output byte 0 bit 3).

DANGER

If the switch on command for soft starter DS7-SWD is sent with the ZMR in Automatic mode, the motor starts up automatically when the thermal motor image falls below 100 %.

The illustration below shows the switching performance of soft starter DS7-SWD on overload with the ZMR in Automatic mode.

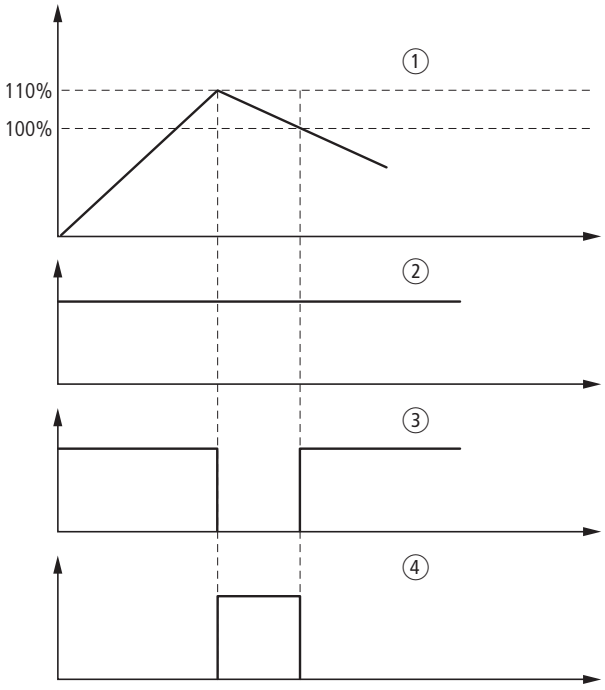


Figure 129: "Automatic" ZMR operating mode

① Thermal motor model
② Switching command for soft starter DS7-SWD
③ Switching state of soft starter DS7-SWD
④ Trip reason: Overload with activated ZMR function

Input byte 1, bit 7 (ACKR acknowledgment) is not active in automatic mode.

8.9.3.4 Profile 4 – 6: Inputs (status)

Input bytes are mapped as follows on SmartWire-DT.

Profiles 4, 5 and 6 correspond with profile 1, 2 and 3 but contain an additional status byte:

Profile 4 = profile 1 (2 bytes) + DS7 status (1 byte)

Table 28: Profiles 4 to 6: input bytes

Byte:	BIT	designation	Meaning
0	0		Not used
	1 – 7		→ Section 8.9.3.2, „Input (status) profiles 1 – 3“, page 155
1			
2			
3			
4			
+1 (DS7 status)	0	ERR	Error present 0: no error 1: Error
	1	WARN	Warning present: 0: no warning 1: Warning
	2	RDY	Ready, switched on: 0: not switched on 1: switched on
	3	RUN	DS7 Run, power part active: 0: Stop (power section inactive) 1: Running (power section active)
	4	TOR	Top of ramp: 0: Top of start ramp not reached 1: Top of start ramp reached
	5	CL	Current limit: 0: Current limit not reached 1: Current limit reached
	6, 7	–	Not used

8.9.3.5 Profiles 4 – 6: Outputs (control)

Output bytes 0 and 1 (Short) are mapped as follows on SmartWire-DT.

Table 29: Profiles 4 to 6: Output bytes 0 and 1

Byte:	BIT	designation	Meaning
0	0	–	Not used
	1 – 7		See: Profiles 1–3: Output byte 0 → Section 8.9.3.3, „Profiles 1 – 3: Outputs (control)“
1 (DS7 control)	0	EN_Set	Enable Setpoint, DS7 Start/Stop: EN_Set enables the setpoint value and starts or stops the motor with the ramp function. 0: (deactivate setpoint value) 1: (activate setpoint value)
	1	–	Not used
	2	EN_Op	Operation released: 0: Stop (immediate disconnection of the output) 1: Operation
	3	FaultAck	Fault Acknowledge 0: Do not acknowledge current fault 1: Acknowledge current fault (rising edge: 0 → 1)
	4 – 7	–	Not used

8.9.3.6 Profiles 7 – 9: Inputs (status)

Input bytes are mapped as follows on SmartWire-DT.

Table 30: Profiles 7 – 9: Input bytes

Byte:	BIT	designation	Meaning
0			→ Section 8.9.3.2, „Input (status) profiles 1 – 3“, page 155
1			
2			
3			
4			
+2 (Long)	0	RSO	Ready For Switching On: S2 0: Not ready for switching on 1: Ready for switching on
	1	RDY	Ready to operate; switched on: S3 0: not ready for operation 1: ready for operation
	2	EN	Enabled; operation: S4 0: Stop 1: Operation
	3	ERR	Error present 0: no error 1: Error
	4	C_Stop	Free run-down, output de-energized (coast stop) 0: no free run-down 1: free run-down
	5	Q_Stop	Quick stop, shortest ramp 0: No quick stop 1: Quick stop
	6	SOI	Reclosing lockout (switching on inhibited: S1) 0: No switch-on inhibit 1: Switch-on inhibit
	7	WARN	Warning present: 0: no warning 1: Warning
	8	RUN	DS7 run, power part active 0: Stop 1: Operation
	9	Ctl_Req	Control requested to PLC Is set if PNU 928.0 = 1. 0: Not ready for remote control 1: Ready for remote control
	10	TOR	Top of ramp: 0: Top of start ramp not reached 1: Top of start ramp reached
	11	CL	Current limit: 0: Current limit not reached; voltage ramp OK 1: Current limit reached; voltage ramp frozen
	12	–	Not used
+2 (Long)	0 – 7	Load_LB	Utilization capacity %: LB: Low Byte / HB: High Byte Corresponds to I_REL with expanded value range: 0000_{hex} – $FFFF_{hex}$ (i.e., 0 – 800 %) → Section , „Motor current [%] PKE (I_REL)“
	8 – 15	Load_HB	

Ctl_Req / Ctl_PLC

The Ctl_Req bit (Control requested: Control via PLC requested) will be set automatically if PNU 928.0 = 1 (control via network).
After this, the application can be used to set the Ctl_PLC bit (Control by PLC) in output bytes 0 and 4. It will not be possible to use the state diagram with the control bits in output bytes 0 and 4 until this is done.

If bit Ctl_PLC = 0 when using control via the network (PNU 928.0 = 1), the DS7-SWD soft starter will switch to fail-safe mode. This will make all bytes +4 (Long) invalid (= 0). The DS7-SWD soft starter will switch to state S5 (Switching Off). After this, a quick stop or coast stop will follow; then a change to state S1.

8.9.3.7 Profiles 7 – 9: Outputs (control)

Output bytes 0 and 4 are mapped onto SmartWire-DT as follows. Profiles 7, 8 and 9 correspond with profiles 1, 2 and 3 but contain two additional words: Profile 4 = profile 1 (2 bytes) + DS7 status (2 words)

Table 31: Profiles 7 to 9: Output bytes 0 and 4

Byte:	BIT	designation	Meaning
0			See: Profile 1 – 3: Output byte 0→ Section 8.9.3.3, „Profiles 1 – 3: Outputs (control)"
+2 (DS7 status)	0	OnOff	On/Off 0: Normal stop (with configured ramp time) 1: Operation
	1	Off2	Coast Stop: Off 2 0: Coast stop (switch off output voltage) 1: no free run-down
	2	Off3	Quick Stop: Off3 0: Quick stop (shortest ramp) 1: no quick stop
	3	EN_Op	Operation released 0: Stop 1: Operation
	4	EN_Ramp	Enable ramp generator 0: Reset ramp (setpoint value = 0) 1: Release ramp
	5	Freeze	Freeze ramp 0: Freeze ramp (the ramp generator's current output value is frozen) 1: Do not freeze ramp
	6	EN_Set	Enable Setpoint, DS7 Start/Stop: EN_Set enables the setpoint value and starts or stops the motor with the ramp function. 0: Do not enable setpoint value 1: activate setpoint value
	7	FaultAck	Fault Acknowledge 0: Do not acknowledge current fault 1: Acknowledge current fault (rising edge: 0 → 1)
	8	–	Not used
	9	–	Not used
	10	Ctl_PLC	PLC assumes control (Control by PLC) 0: no control via PLC 1: Control via PLC
	11 – 14	–	Not used
	15	ExtFault	External fault: If the bit is set, the DS7 stops with a selected PNU 840 function. The behavior is the same as for a transition of the Enable signal from 1 to 0, except that soft starter DS7 switches to Error state (input bytes n + 4: bit 3). The external fault can be reset just like any other fault (with Fault acknowledge (bit 7) or by switching the supply voltage off and on). 0: no external fault 1: external fault
+2 (reserved)	0 – 15		Not used

8.9.3.8 Profile 10: Inputs (status)

Input bytes 0 and 1 (Short) are mapped as follows on SmartWire-DT.

Table 32: Profile 10: Input bytes 0 and 1

Byte:	BIT	designation	Meaning
0	0, 1	–	Not used
	2, 3	A1, A2	1-0-A switch on DS7: 00: not defined 10: Position A: Automatic (commands via SmartWire-DT/ control signal terminal) 01: Position 0: DS7 stop 11: Position 1: DS7 operation
	4	DIAG	0: no diagnostic alarm 1: Diagnostic alarm present
	5	–	Not used
	6	PRSNT	0: Device not present 1: Device present
	7	SUBST	0: configured module present 1: universal module M22-SWD-NOP(C) present
1	0	ERR	Error present 0: no error 1: Error
	1	WARN	Warning present: 0: no warning 1: Warning
	2	RDY	Ready, switched on: 0: not switched on 1: switched on
	3	RUN	DS7 Run, power part active: 0: Stop (power section inactive) 1: Running (power section active)
	4	TOR	Top of ramp: 0: Top of start ramp not reached 1: Top of start ramp reached
	5	CL	Current limit: 0: Current limit not reached 1: Current limit reached
	6, 7	–	Not used

8.9.3.9 Profile 10: Outputs (control)

Output bytes 0 and 1 (Short) are mapped as follows on SmartWire-DT.

Table 33: Profile 10: Output bytes 0 and 1

Byte:	BIT	designation	Meaning
0 (DS7 control)	0	EN-Set	Enable Setpoint, DS7 Start/Stop: EN_Set enables the setpoint value and starts or stops the motor with the ramp function. 0: (deactivate setpoint value) 1: (activate setpoint value)
	1	–	Not used
	2	EN_Op	Operation released: 0: Stop (immediate disconnection of the output) 1: Operation
	3	FaultAck	Fault Acknowledge 0: Do not acknowledge current fault 1: Acknowledge current fault (rising edge: 0 → 1)
	4 – 7	–	Not used
1	0 – 7	–	Not used

Byte 1 is only needed for internal SmartWire-DT-specific functions.

8.9.3.10 Profile 11: Inputs (status)

Input bytes 0 to 4 are mapped as follows on SmartWire-DT.

Table 34: Profile 11: Input bytes 0 to 4

Byte:	BIT	designation	Meaning
0	0, 1	–	Not used
	2, 3	A1, A2	1-0-A switch on DS7: 000: not defined 10: Position A: Automatic (commands via SmartWire-DT/control signal terminal) 01: Position 0: DS7 stop 11: Position 1: DS7 operation
	4	DIAG	0: no diagnostic alarm 1: Diagnostic alarm present
	5	–	Not used
	6	PRSNT	0: Device not present 1: Device present
	7	SUBST	0: configured module present 1: universal module M22-SWD-NOP(C) present
1, 2	0	RSO	Ready For Switching On: S2 0: Not ready for switching on 1: Ready for switching on
	1	RDY	Ready to operate; switched on: S3 0: not ready for operation 1: ready for operation
	2	EN	Enabled; operation: S4 0: Stop 1: Operation
	3	ERR	Error present 0: no error 1: Error
	4	C_Stop	Free run-down, output de-energized (coast stop) 0: no free run-down 1: free run-down
	5	Q_Stop	Quick stop, shortest ramp 0: No quick stop 1: Quick stop
	6	SOI	Reclosing lockout (switching on inhibited: S1) 0: No switch-on inhibit 1: Switch-on inhibit
	7	WARN	Warning present: 0: no warning 1: Warning
	8	RUN	DS7 run, power part active 0: Stop 1: Operation
	9	Ctl_Req	Control requested to PLC Is set if PNU 928.0 = 1. 0: Not ready for remote control 1: Ready for remote control

Byte:	BIT	designation	Meaning
1, 2	10	TOR	Top of ramp: 0: Top of start ramp not reached 1: Top of start ramp reached
	11	CL	Current limit: 0: Current limit not reached; voltage ramp OK 1: Current limit reached; voltage ramp frozen
	12	–	Not used
3, 4	0 – 7	Load_LB	Utilization capacity %: LB: Low byte; HB: High byte Corresponds to I_REL with expanded value range: 0000_{hex} – $FFFF_{hex}$ (i.e., 0 – 800 %) → Section , „Motor current [%] PKE (I_REL)"
	8 – 15	Load_HB	

8.9.3.11 Profile 11: Outputs (control)

Output bytes 0 + 4 are mapped as follows on SmartWire-DT.

Table 35: Profile 11: Output bytes 0 + 4

Word	BIT	designation	Meaning
0	0	OnOff	On/Off 0: Normal stop (with configured ramp time) 1: Operation
	1	Off2	Coast Stop: Off 2 0: Coast stop (switch off output voltage) 1: no free run-down
	2	Off3	Quick Stop: Off3 0: Quick stop (shortest ramp) 1: no quick stop
	3	EN_Op	Operation released 0: Stop 1: Operation
	4	EN_Ramp	Enable ramp generator 0: Reset ramp (setpoint value = 0) 1: Release ramp
	5	Freeze	Freeze ramp 0: Freeze ramp (the ramp generator's current output value will be frozen) 1: Do not freeze ramp
	6	EN_Set	Enable Setpoint, DS7 Start/Stop: EN_Set enables the setpoint value and starts or stops the motor with the ramp function. 0: Do not enable setpoint value 1: activate setpoint value
	7	FaultAck	Fault Acknowledge 0: Do not acknowledge current fault 1: Acknowledge current fault (rising edge: 0 → 1)
	8	–	Not used
	9	–	Not used
	10	Ctl_PLC	PLC assumes control (Control by PLC) 0: no control via PLC 1: Control via PLC
	11 – 14	–	Not used
	15	ExtFault	External Fault If the bit is set, the DS7-SWD stops with a selected PNU 840 function. The behavior is the same as for a transition of the Enable signal from 1 to 0, except that soft starter DS7-SWD switches to Error state (input bytes n + 4: bit 3). The external fault can be reset just like any other fault (with Fault acknowledge (bit 7) or by switching the supply voltage off and on). 0: no external fault 1: external fault
1	0 – 15		Not used

8.9.4 Cyclic data via PROFIBUS-DP

For information on the subject of the "transfer of cyclic data", consult manual MN05013002Z-EN, "SmartWire-DT Gateways".

8.9.5 acyclic data

For normal soft starter operation the acyclic data is not required. This section therefore addresses programming experts.

8.9.5.1 Introduction

Acyclic communications are used to read/write parameters and diagnostics in the DS7-SWD soft starter and, optionally, in the PKE motor-protective circuit-breaker; they can take place at the same time as cyclic data is being transferred. This means that acyclic communications are independent from the selected profile.

In this case, the SWD coordinator (client) communicates acyclically with the DS7-SWD soft starter (server) and, optionally, with the PKE motor-protective circuit-breaker. Communications are always initiated by the client.

In order for acyclic data to be transmitted and diagnostic activities to be performed, the higher-level PLC must feature acyclic services.
The programmable EASY802-DC-SWD and EASY806-DC-SWD switchgear and controlgear do not feature acyclic services!

8.9.5.2 Acyclic DS7 soft starter data

The following table lists the various available parameters (PNUs). These parameters are transmitted via the parameter channel described in the following section.

PNU Index	PNU Subindex	Access rights	designation	Data type	Meaning	Value range	DS	User setting
Manufacturer Specific								
11	0	rw	U-Start	N2	Start voltage	30 – 100 % 4915 – 16384	30 % 4915	
11	1	ro	U-StartPoti	N2	Start voltage via potentiometer. If device control (PNU 928) = local, this value will overwrite PNU 11.0.	30 – 100 % 4915 – 16384	–	
12	0	rw	U-StartEnd	N2	U-start-end: The maximum ramp voltage is reproduced here as a percentage. Maximum reached: 100 %	30 – 100 % 4915 – 16368	100 % 16348	
13	0	rw	U-StopStart	N2	U-stop-start: In the event of a soft stop, the voltage will fall down to the value set here; the stop ramp will start	30 – 100 % 4915 – 16368	100 % 16348	
14	0	rw	U-Stop	N2	U-Stop: Minimum ramp voltage (soft stop end); minimum reached = 0 %	30 – 100 % 4915 – 16384	30 % 4915	
111	0	rw	t-Start	T2	Start time	1 – 30 s 10 – 300	5 s 50	
111	1	ro	t-Start-Poti	T2	Start time via potentiometer. If device control (PNU 928) = local, this value will overwrite PNU 111.0.	1 – 30 s 10 – 300	–	
112	0	rw	TOR-Delay	D2	Time between top of ramp and TOR bit	150 – 400 ms 24576 – 65535	150 ms 24576	
113	0	rw	Stop-Delay	D2	Stop delay: Time between TOR and start of stop ramp	150 – 400 ms 24576 – 65535	150 ms 24576	
114	0	rw	t-Stop	T2	Stop Time	0 – 30 s 0 – 300	0 s 0	
114	1	ro	t-StopPoti	T2	Stop time via potentiometer. If device control (PNU 928) = local, this value will overwrite PNU 114.0.	0 – 30 s 0 – 300	–	
202	0	ro	DS7 part no.	OctetString	DS7 article no.	0 – 255	–	
203	0	ro	HW version	Unsigned16	Hardware version	0.00 – 655.35 0 – 65535	0.00 0	
206	0	ro	SW version	Unsigned16	Software version	0.00 – 655.35 0 – 65535	–	
210	0	rw	I_m	Unsigned16	Rated motor current I_m from rating plate: X = I_m x 10 X = Read/written value The value is used to calculate the current limit (PNU 281.1). It must be sent by the PLC if it is different from the DS7's rated operational current I_e. (I_e is used as a default setting.)	0 – 65535	0	
280	0	ro	I_e	Unsigned16	Rated operational current I_e of soft starter: X = I_e x 10 X = value read here	0 – 65535	–	

PNU Index	PNU Subindex	Access rights	designation	Data type	Meaning	Value range	DS	User setting
281	1	rw	CurrentLimit	Unsigned16	Current limit: A current limit can be implemented here by using a PKE. If the configured limit value is reached, the DS7-SWD will freeze the voltage ramp and set the CL bit in the SWD input byte (profiles 7, to 9, and 11). PNU 681.0 activates and deactivates the current limit. If the PKE does not deliver any current, but PNU 681.0 = 1 and the DS7-SWD is running, the DIAG2 bit will be set and, in profiles 4 to 11, the WARN bit will be set as well. Calculation: Current limit = X x I_e X (default: 30 (3.0)) = Adjustable factor. Range: 0 (0)–80 (8.0) Rated motor current I_m (PNU 210.0) is used for calculating the current limit within this context. The value is independent from the PKE motor-protective circuit-breaker and from the DS7-SWD soft starter model.	0 – 800 % 65535	300 % 24576	
290	0	ro	IeBreakerMax	Unsigned16	Maximum current of PKE: X = IeBreaker x 10 X = Value read here	0 – 65.5 A 0 – 65535	0 A 0	
310	0	ro	Profiles	Unsigned16	Profile being used	0 – 12	10	
514	1	ro	IeBreaker	Unsigned16	Current PKE current: Corresponds to I_REL of the cyclic input data with an expanded value range	0 – 800 % 0 – 65535	0	
681	0	rw	SetCurrentLimit	Unsigned8	Activate current limit: 0: Current limit activated 1: Current limit deactivated	0; 1	0	
722	0	ro	T-HeatsinkStatus	Unsigned8	Heat sink status: 0: OK 1: Overheated	0; 1	0	
722	1	ro	TempLimitStatus	Unsigned8	Heat sink limit value status: 0: Ready for next start 1: Heat sink still too hot → DS7-SWD soft starter not ready for standard load cycle in next start (three times the current for 5 s)	0; 1	0	
723	0	ro	OverloadStatus	Unsigned8	Overload status: 0: No overload 1: Overload	0; 1	0	
723	1	ro	OverloadLimitStatus	Unsigned8	Overload limit value status: The overload limit value status refers to PNU 823.1 0: Overload limit value not reached 1: Overload limit value reached → Possible impending overload fault	0; 1	0	
750	0	ro	InputStatusA1	Unsigned8	Current status of control signal terminal A1: 0: No voltage being applied 1: Voltage being applied	0; 1	–	

PNU Index	PNU Subindex	Access rights	designation	Data type	Meaning	Value range	DS	User setting
750	1	ro	InputStatusEN	Unsigned8	Current status of EN control signal terminal: 0: No voltage being applied 1: Voltage being applied	0; 1	–	
751	0	ro	RelaisStatusTOR	Unsigned8	TOR relay status: 0: Not activated 1: Activated	0; 1	0	
751	1	ro	RelaisStatusRUN	Unsigned8	RUN relay status: 0: Not activated 1: Activated	0; 1	0	
820	0	ro	StartCounter	Unsigned32	Counter for the number of starts	0 – 2^{32} - 1	–	
821	0	ro	RunTime	T4	Service life counter (RUN): Counts how long the DS7-SWD soft starter is switched on (RUN)	0 – 2^{32} - 1	–	
821	1	ro	PowerOnTime	T4	Mains voltage counter: Counts how long mains voltage (L1, L2, L3) is applied at the DS7-SWD soft starter	0 – 2^{32} - 1	–	
821	2	ro	SupplyOnTime	T4	Supply duration counter: Counts how long control voltage (24 V via terminal or SmartWire-DT) is applied	0 – 2^{32} - 1	–	
822	0	ro	HeatsinkTemp	Integer16	Heat sink temperature	-255 – 255 °C -32768 – 32767	0 °C 0	
822	1	ro	ElectronicTemp	Integer16	Electronics temperature	-255 – 255 °C -32768 – 32767	0 °C 0	
823	0	ro	Overload	N2	Current overload as a percentage: If the current current is lower/higher than the DS7-SWD's rated operational current, the value will fall/increase. If 100 %: PNU 723.0 = 1	0.00 – 200.00 % 0 – 65535	0 % 0	
823	1	rw	OverloadLimit	N2	Overload limit value as a percentage: If the value for PNU 823.0 exceeds the adjustable limit value here, PNU 723.1 will be set to 1.	0.00 – 100.00 % 0 – 65535	25 % 16383	
840			FaultReaction		Fault response: The response to specific faults can be set in each subindex: 0: No fault response → Continue operation 1: Set WARN bit → Continue operation and generate a warning 2: Set DIAG and ERR bits → Stop with ramp 3: Set DIAG and ERR bits → Quick stop 4: Set DIAG and ERR bits → Coast stop			
840	4230	rw	HeatsinkOverUnderTemp	Unsigned16	Over/under temperature heat sink	0 – 4	2	
840	4240	rw	ElectronicsOverTemp	Unsigned16	Overtemperature Electronic	0 – 4	2	
840	4250	rw	ThyristorOverTemp	Unsigned16	Overtemperature, thyristor (I^2t)	0 – 4	4	
840	5110	rw	SupplyVoltageFault	Unsigned16	Supply voltage error	0 – 4	4	
840	5410	rw	ThyristorFault	Unsigned16	Thyristor error	0 – 4	4	
840	5460	rw	BypassDefective	Unsigned16	(Internal) bypass defective	0 – 4	4	

PNU Index	PNU Subindex	Access rights	designation	Data type	Meaning	Value range	DS	User setting
840	6310	rw	PhaseLoss	Unsigned16	Phase failure	0 – 4	4	
840	7500	rw	CommunicationFault	Unsigned16	erroneous communication	0 – 4	4	
840	9000	rw	ExternalFault	Unsigned16	External fault	0 – 4	4	
860			Warnings	Unsigned32	Alerts If bit WARN = 1 in profiles 7, 8, 9, 11, a warning is active. The warning can be read in PNU 860.0. Reading the warning will only be possible as long as the warning is active. Warnings in bits 16 to 24 are only generated if the fault response for the corresponding fault is (PNU 840.X) = 1. Example: PNU 860.0: Bit 20 = 1 → Thyristor fault	0 – 4294967295		
860		ro	NoCurrentFeedback	Unsigned32	no current recording: Generated if the current limit (PNU 681.0) is activated and the DS7-SWD soft starter has the RUN status.	2^0	2^0	
860		ro	OvertempForNextStart	Unsigned32	Overtemperature in next start: The heat sink is still too hot for a new start; however, continuous operation can be continued.	2^1	2^1	
860		ro	StartWithoutEnable	Unsigned32	Start without EN signal: Start command active, but not EN signal present yet	2^2	2^2	
860		ro	HeatsinkOverUnderTemp	Unsigned32	Over/under temperature heat sink	2^{16}	2^{16}	
860		ro	ElectronicsOverTemp	Unsigned32	Overtemperature Electronic	2^{17}	2^{17}	
860		ro	ThyristorOverTemp	Unsigned32	Overtemperature, thyristor (I^2t)	2^{18}	2^{18}	
860		ro	SupplyVoltageFault	Unsigned32	Supply voltage error	2^{19}	2^{19}	
860		ro	ThyristorFault	Unsigned32	Thyristor error	2^{20}	2^{20}	
860		ro	BypassDefective	Unsigned32	Bypass is defective	2^{21}	2^{21}	
860		ro	PhaseLoss	Unsigned32	Phase failure	2^{22}	2^{22}	
860		ro	CommunicationFault	Unsigned32	erroneous communication	2^{23}	2^{23}	
860			ExternalFault	Unsigned32	External fault	2^{24}	2^{24}	
Profile-specific								
927	0	rw	ParameterAccess	Unsigned16	Parameter level: Defines the parameter level. Changes are only possible if the DS7-SWD soft starter is stopped (state S1 or S2): 0: Local parameters (control signal terminals and potentiometer) 1: Parameters via network 2: Parameters via network (except for potentiometer parameters), local potentiometer	0 – 2	2	

PNU Index	PNU Subindex	Access rights	designation	Data type	Meaning	Value range	DS	User setting
928	0	rw	ProcessDataAccess	Unsigned16	Process data level: Defines the process data level. Changes are only possible if the DS7-SWD soft starter is stopped (state S1 or S2): 0: Local control (control signal terminals and potentiometer) 1: Control via network 2: not used 3: not used 4: Control through network – on loss of communication automatic switch to local control (corresponds with PNU 928 = 0). Switch back to network control as soon as communication is re-established.	0 – 4	1	
947	0		NewestFaultNumber	Unsigned16	Fault Number Fault numbers, listed chronologically	0 – 65535	0	
947	1			Unsigned16		0 – 65535	0	
947	2			Unsigned16		0 – 65535	0	
947	3			Unsigned16		0 – 65535	0	
947	4			Unsigned16		0 – 65535	0	
947	5			Unsigned16		0 – 65535	0	
947	6			Unsigned16		0 – 65535	0	
947	7		OldestFaultNumber	Unsigned16		0 – 65535	0	
952	0	ro	FaultSituationCounter	Unsigned16	Error counter Number of faults that have occurred since the last reset	0 – 65535		
962	0	ro	SamplingTime	TimeDifference	Scan time: Time required to calculate T2, T4, and D2.	0 – 2^{32} - 1	100	
964	0	ro	Manufacturer	Unsigned16	Device identification (DriveUnitIdentification)	0 – 65535	265	
964	1	ro	DriveUnitType	Unsigned16	Device type	0 – 65535	16	
964	2	ro	Version (Software)	Unsigned16		0 – 65535	–	
964	3	ro	Firmware Date (year)	Unsigned16		0 – 65535	–	
964	4	ro	Firmware Date (day/month)	Unsigned16		0 – 65535	–	
964	5	ro	DriveObject	Unsigned16	Object Number	0 – 65535	1	
965	0	ro	ProfileNumber	OctetString	Profile identification: Profile number + version	0 – 255	41	
965	1	ro	VersionNumber	OctetString		0 – 255	3	
970	0	rw	DO-FactorySettings	Unsigned16	Default settings: 1: Restore default setting Note: The default setting will not be saved in a non-volatile manner in the parameters that can be saved; PNU 971.0 can be used for this purpose	0; 1	0	
971	0	rw	DO-SaveParameter	Unsigned16	Save parameter: 1: Saves all parameters in a non-volatile manner (only PNUs marked as capable of being saved)	0; 1	0	
972	0	rw	PowerOnReset	Unsigned16	Carries out a reset.	0; 1	0	

PNU Index	PNU Subindex	Access rights	designation	Data type	Meaning	Value range	DS	User setting
976	0	rw	FactorySettings	Unsigned16	Sets all parameters to their default values.	0; 1	0	
977	0	rw	SaveParameters	Unsigned16	Saves all parameters to internal memory.	0; 1	0	

PNU Index	PNU Subindex	Access rights	designation	Data type	Meaning	Value range	DS	User setting
980		ro	DefinedParameters	Unsigned16	Defined parameters: List of PNUs being used. Each subindex contains a PNU. If the subindex holds a 0, the end of the list has been reached.	0 – 65535	–	
980	0	ro	U-Start	Unsigned16	Start of list			
980	1	ro	U-StartEnd	Unsigned16				
980	2	ro	U-StopStart	Unsigned16				
980	…	ro		Unsigned16				
980	n - 1	ro	DO-Save parameter	Unsigned16				
980	n	ro	End of list	Unsigned16	End of list			

Fire-Mode

In normal operation each error message causes the soft starter to switch off.

With Fire mode active all protective functions can be disabled. In this state the soft starter would continue to run until it was destroyed. The Fire mode is activated by setting the fault response to "no response". This is done by setting all subindexes of parameter PNU 840 to zero.

The Fire mode can be used only in profiles 7, 8, 9 and 11.
Bus monitoring must also be active.

The last seven faults are saved in the device.

DANGER

When the Fire mode is programmed there is a risk of injury and material damage as the soft starter can no longer be controlled and remains active.

PNU 927.0 (Parameter level)

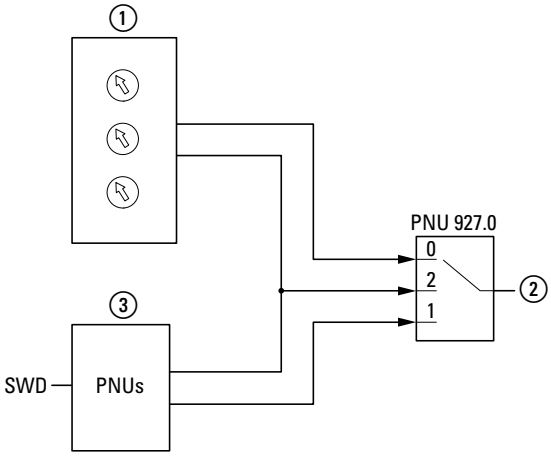


Figure 130: PNU 927.0

① Potentiometer
② Parameter soft starters DS7-SWD
③ acyclic data

PNU 928.0 (process data level)

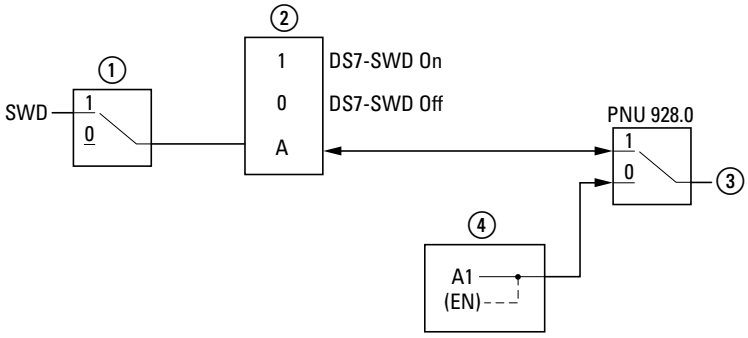


Figure 131: PNU 928.0

① Bit 10: Ctl_PLC (only applicable for 7, 8, 9, 11 profiles)
② 1-0-A switch
③ DS7-SWD soft starter process data
④ Control signal terminals

When parameter PNU 928 is set to 0 (default is 1), it can be operate through the terminals (the device then behaves like a soft starter DS7 without SmartWire-DT connection). The soft starter's data can, however, still be read through SmartWire-DT.

If soft starter DS7-SWD is operated through control signal terminals, it must not be supplied with the 24 V from SmartWire-DT as it could otherwise incur damage.

8.9.5.3 Acyclic PKE motor-protective circuit-breaker data

In addition to cyclic input and output bytes, the DS7-SWD soft starter makes it possible to read the following acyclic PKE data. The parameter channel described in the following section is not required for transmitting the data.

Table 36: Available data

Index	Byte:	BIT	designation	Description		
1	0	0 – 7	I_REL	Relative motor current PKE : Set rated operational current on PKE $00_{hex} – FF_{hex}$ (i. e. 0 – 255 %		
2	0	0 – 7	TH	PKE thermal motor map (specified as a percentage)		
3	0	0 – 2	TYPE	Part no. of PKE trip block		
				Value [hex]	PKE-	Trip block
				0	XTUA-1.2	0.3 – 1.2 A
				1	XTUA-4	1.0 – 4.0 A
				2	XTUA-12	3.0 – 12 A
				3	XTUA-32	8.0 – 32 A
				4	XTUWA-32	8.0 – 32 A (width 55 mm)
				5	XTUWA-65	16.0 – 65 A
		3 – 5	CLASS	set PKE time lag		
				Value [hex]	Long delay time	Time
				0	Class 5	146.2 s
				1	Class 10	292.5 s
				2	Class 15	438.7 s
				3	Class 20	585.0 s
				4	test	0
		6, 7	–	Not used		

For a description of acyclic communications with the PKE motor-protective circuit-breaker via PROFIBUS-DP, see → Section 8.9.8, „Acyclic data via PROFIBUS-DP: PKE“.

8.9.6 Acyclic parameter channel for DS7-SWD soft starter

8.9.6.1 Introduction

The acyclic parameter channel is used in order to configure the parameters of the DS7-SWD soft starter; it corresponds to PROFIdrive profile.
The following sections describe the parameter channel's functions.

8.9.6.2 Protocol

The DS7-SWD soft starter's actual task is to map the protocol in such a way that SmartWire-DT can handle the parameter channel in a fully transparent manner. Regardless of whether data should be read or written, the first request from the coordinator will always be a write request. A parameter request is used to define whether the job is a read or a write job. After the write request is transmitted (contains read or write job), a write response without data will be expected. After this, the coordinator, prompted by the higher-level PLC's application, will poll the DS7 with read requests. The DS7 will acknowledge the read requests negatively (Error: state-conflict) until the read response is completed and the DS7 can send a response (read job: with data / write request: without data).

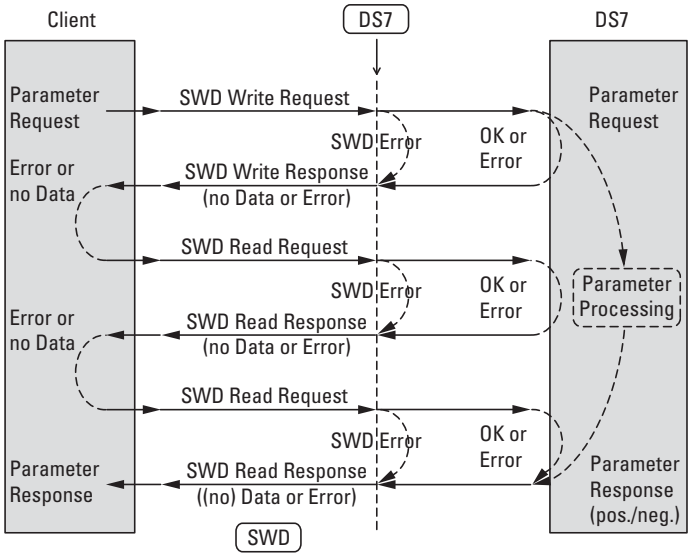


Figure 132: Acyclic parameter channel protocol

8.9.6.3 SmartWire-DT write request – Read job

Only individual parameter reading is supported (i.e., array and multiple parameter reading is not supported). The parameter request's frame length is set at 10 bytes.

Various objects can be transmitted in the parameter channel – these objects are identified by what is referred to as a PNU (parameter number) and a subindex. The write request includes a declaration that specifies that the job is a read job.

Byte:	designation	Description
0	Request Reference	Request identification: Unique identification for a request/response pair for the master. The master can increment the identification number for each new request in the application. It will be echoed by the DS7-SWD soft starter after this. 01_{hex} – FF_{hex} (i. e. 1_{dez} – 255_{dez})
1	Request ID	Request ID: The type of request is specified here. 01_{hex}: Read request
2	DO-ID	Drive-Object-ID: 00_{hex}
3	No. of paramters	Number of parameters: Only individual parameter processing is supported. 01_{hex}
4	Attribute	Attribute: Defines which object type should be accessed. 10_{hex} (16_{dez}): Value
5	No. of Elements	Number of elements: Number of vector elements or length of the string being accessed. PNU 0 up to PNU 999: 00_{hex} (only for subindex 0) PNU 0 to PNU 999 (without 202): 01_{hex}
6, 7	Parameter number	Parameter number (PNU): Address of the parameter that should be accessed 0000_{hex} – $FFFF_{hex}$ (i. e. 0_{dez} – 65535_{dez})
8, 9	Subindex	Subindex: Address of the parameter's first field element or start of the text 0000_{hex} – $FFFF_{hex}$ (i. e. 0_{dez} – 65535_{dez})

→ In this case, the number of bytes is always 10.

8.9.6.4 SmartWire-DT write request – Write job

Only individual parameter writing is supported (i.e., array and multiple parameter writing is not supported). The maximum parameter request frame length is set at 16 bytes. The maximum length of a writable parameter is one double word. All kinds of objects can be transmitted in the parameter channel – these objects are identified by what is referred to as a PNU (parameter number) and a subindex. The write request includes a declaration that specifies that the job is a write job.

Byte:	Designation	Description
0	Request Reference	Request identification: Unique identification for a request/response pair for the master. The master can increment the identification number for each new request in the application. The DS7-SWD will then echo it. 01_{hex} – FF_{hex} (i. e. 1_{dez} – 255_{dez})
1	Request ID	Request ID: The type of request is specified here. 02_{hex}: Write job
2	DO-ID	Drive-Object-ID: 00_{hex}
3	No. of Paramters	Number of parameters: Only individual parameter processing is supported. 01_{hex}
4	Attribute	Attribute: Defines which object type should be accessed. $10h_{ex}$ (16_{dez}): Value
5	No. of Elements	Number of elements: Address of the parameter that should be accessed PNU 0 up to PNU 999: 00_{hex} (only for subindex 0) PNU 0 up to PNU 999: 01_{hex}
6, 7	Parameter number	Parameter number (PNU): Address of the parameter that should be accessed 0000_{hex} – $FFFF_{hex}$ (i. e. 0_{dez} – 65535_{dez})
8, 9	Subindex	Subindex: Address of the parameter's first field element or start of the text 0000_{hex} – $FFFF_{hex}$ (i. e. 0_{dez} – 65535_{dez})
10	Format	Format: 01_{hex} – $7C_{hex}$ (→ 01_{dez} – 124_{dez}): Data types
11	No. of Values	Number of values: Number of values being accessed. 01_{hex}
12 – (15)	Value	Value: Specifies the value of the parameter being accessed. The length depends on the format and can be a maximum of 4 bytes. 00000000_{hex} – $FFFFFFFF_{hex}$ (i. e. 0_{dez} – 4294967295_{dez})

→ In this case, the number of bytes is variable (13, 14, or 16) and will depend on the selected format.

The valid formats (byte 10) for the DS7-SWD soft starter from PROFIdrive profile are marked in the following table:

Data type	Code (dez)	Code (hex)	DS7-SWD	Number of bytes
Standard				
Boolean	1	1		
Integer8	2	2		
Integer16	3	3	X	2
Integer32	4	4		
Unsigned8	5	5	X	1
Unsigned16	6	6	X	2
Unsigned32	7	7	X	4
FloatingPoint	8	8		
VisibleString	9	9		
OctetString	10	A	X	1 – X
TimeOfDay (with date indication)	12	C		
TimeDifference	13	D	X	4
Date	50	32		
TimeOfDay without date indication	52	34		
TimeDifference with date indication	53	35		
TimeDifference without date indication	54	36		
Additional				
Zero	64	40	X	0
Byte:	65	41	X	1
Word	66	42	X	2
Double word	67	43	X	4
Error	68	44	X	2
Profile-specific				
N2 Normalized value (16 Bit)	113	71	X	2
N4 Normalized value (32 Bit)	114	72		
V2 Bit sequence	115	73	X	2
L2 Nibble	116	74		
R2 Reciprocal time constant	117	75		
T2 Time constant (16 Bit)	118	76	X	2
T4 Time constant (32 Bit)	119	77	X	4
D2 Time constant	120	78	X	2
E2 Fixed point value (16 Bit)	121	79		
C4 Fixed point value (32 Bit)	122	7A		
X2 Normalized value, variable (16 Bit)	123	C7		
X4 Normalized value, variable (32 Bit)	124	7C		

TimeDifference (13_{dez})

The value used by the DS7-SWD soft starter for TimeDifference is stored in the Sampling Time (PNU 962) parameter.

Data type	Code (dez)	Code (hex)	Bytes	Value range	Resolution
TimeDifference	13	D	2	$0 \leqq i \leqq 4294967295$	$2^{-31} \triangleq 0.021$ ms

Example:

100 ms = 4971_{dez} = $136B_{hex}$

86400000 ms (= 1 day) = 4294967295_{dez} = $FFFFFFFF_{hex}$

Normalized value: N2, N4

Data type	Code (dez)	Code (hex)	Bytes	Value range	Resolution
N2 Normalized value (16 Bit)	113	71	2	$-200\ \% \leqq i \leqq (200 - 2^{-14})\ \%$	$2^{-14} \triangleq 0.0061\ \%$
N4 Normalized value (32 Bit)	114	72	4	$-200\ \% \leqq i \leqq (200 - 2^{-30})\ \%$	$2^{-30} \triangleq 9.3 \times 10^{-8}\ \%$

Example:

- N2 Normalized value (16 Bit):
  0 % = 0_{dez} = 0_{hex} , 100 % = 16348_{dez} = 4000_{hex}
- N4 Normalized value (32 Bit):
  0 % = 0_{dez} = 0_{hex} , 100 % = 1073741824_{dez} = 4000_{hex}

For coding, the most significant bit (MSB) comes directly after the SN bit (sign bit) in the first octet.

- SN = 0: Positive numbers, including zero
- SN = 1: Negative numbers

Octet	Bit 8	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1
1	SN	2^{-0}	2^{-1}	2^{-2}	2^{-3}	2^{-4}	2^{-5}	2^{-6}
2	2^{-7}	2^{-8}	2^{-9}	2^{-10}	2^{-11}	2^{-12}	2^{-13}	2^{-14}
3	2^{-15}	2^{-16}	2^{-17}	2^{-18}	2^{-19}	2^{-20}	2^{-21}	2^{-22}
4	2^{-23}	2^{-24}	2^{-25}	2^{-26}	2^{-27}	2^{-28}	2^{-29}	2^{-30}

Bit sequence: V2

In this bit string, 16 variables of type BOOLEAN are represented in two octets.

Code: $115_{dez} = 73_{hex}$

Octet	Bit 8	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1
1	15	14	13	12	11	10	9	8
2	7	6	5	4	3	2	1	0

Time constant: D2

Values of time data type D2 always refer to a specific, constant scan time T_a. This time Ta is the shortest scan time (defined in PNU 962) and is required here in order to evaluate D2.

The value for D2 can be calculated as follows:

$D2 = i \times T_a/16384$

Data type	Code (dez)	Code (hex)	Byte:	Value range	Resolution
D2 Time constant	120	78	1	$0 \leqq i \leqq (2 - 2^{-14}) \times T_a$	$2^{-14} \times T_a$

Time constant: T2, T4

Values of time data types T2 and T4 always refer to a specific, constant scan time T_a, which is the shortest possible scan time (defined in PNU 962). It is required here to calculate T2 and T4.

The following formula applies: $T2 = i \times T_a$; $T4 = i \times T_a$

Data type	Code (dez)	Code (hex)	Byte:	Value range	Resolution
T2 Time constant (16 Bit)	118	76	1	$0 \leqq i \leqq 32767 \times T_a$	T_a
T2 Time constant (32 Bit)	119	77	2	$0 \leqq i \leqq 4294967295 \times T_a$	T_a

8.9.6.5 SmartWire-DT write response

The DS7 soft starter will respond to a received SmartWire-DT write request with a SmartWire-DT write response.

The following SmartWire-DT write responses are possible:

- SmartWire-DT write response(+) – Without data or errors if the DS7 soft starter has understood the SmartWire-DT write request
- SmartWire-DT write request(-) – Error. If an error has occurred, the write response will contain an error. These errors are bus-specific and are explained in the corresponding sections.

For the various possible errors, see → Section 8.9.7, „Acyclic data via PROFIBUS-DP: DS7“.

8.9.6.6 SmartWire-DT read request

After receiving a positive SmartWire-DT write response, it is possible to start polling SmartWire-DT read requests. If a write job has been transmitted previously, information regarding the write status will be requested; in the case of a read job, the data will be requested.

8.9.6.7 SmartWire-DT read response

The SmartWire-DT read request will be acknowledged until there is a SmartWire-DT read response.

The following SmartWire-DT read responses are possible

- SmartWire-DT read response(-) – Error
  - If there is an error related to addressing (index)
  - The DS7-SWD soft starter cannot be reached
  - If the response from the DS7-SWD is still pending
- SmartWire-DT read response(+) – Parameter channel error
  - If the error concerns the PROFIdrive parameter channel
- SmartWire-DT read response(+) – Without data
  - If the DS7-SWD soft starter has completed the response for a write job
- SWD read response(+) – With data
  - If the DS7-SWD soft starter has completed the response for a read job

The following sections go into the various possible SmartWire-DT read responses in greater detail.

SmartWire-DT read response(-) – Error

If an error has occurred, the read response will contain an error. These errors are bus-specific and are explained in the corresponding sections.

SmartWire-DT read response(+) – Parameter channel error

If there is an error in the parameter channel, a positive SmartWire-DT read response(+) – Parameter channel error will be generated. The error will be contained either in a write job or a read job.

Byte:	designation	Description
0	Request Reference	Request identification: Is echoed
1	Response-ID	Response ID: 81_{hex}: Read job(-); 82_{hex}: Write job(-)
2	DO-ID	Drive-Object-ID: Is echoed
3	No. of Parameters	Number of Parameters: 01_{hex}
4	Format	Format: 44_{hex}: Error
5	No. of Values	Number of values: 01_{hex}
6 – 9	Error Number	Fault number: 00_{hex} – 23_{hex}

The following table lists the PROFIdrive profile's parameter channel errors. The various faults that are possible with a soft starter DS7-SWD are marked (column "DS7-SWD").

Table 37: Parameter channel errors with PROFIdrive

Faultnumber [hex]	Designation	Description	Supplementary information	DS7-SWD
00	Invalid parameter number	Attempting to access a non-available parameter	0	✓
01	Parameter value cannot be changed	Attempting to have write access to a parameter that cannot be modified	Subindex	✓
02	Value below lower limit or above upper limit	Attempting to have write access with a value outside the value range	Subindex	✓
03	Bad subindex	Attempting to access to a non-available subindex in a string or array parameter	Subindex	✓
04	Not an array	Attempting to use a subindex in order to access a parameter without index	0	
05	Incorrect data type	Attempting to access a parameter with a value not corresponding to the parameter's data type	0	✓
06	Setting not allowed	Write access with a non-zero value not allowed	Subindex	✓
07	Description element cannot be modified	Attempting to have write access to a description element that cannot be modified	Subindex	
08	Reserved	–	–	
09	No description data available	Attempting to access a non-available description. The value is not available.	0	✓
0A	Reserved	–	–	
C0	No usage rights	Attempting to have write access without write permissions	0	✓
0C	Reserved	–	–	
0D	Reserved	–	–	
0E	Reserved	–	–	
0F	No text array available	Attempting to access a non-available text array	0	
10	Reserved	–	–	

Faultnumber [hex]	Designation	Description	Supplementary information	DS7-SWD
11	Request cannot be carried out due to operating status	Access is temporarily not possible	0	✓
12	Reserved	–	–	
13	Reserved	–	–	
14	Value not permitted	Attempting to have write access with a value that is within the value range, but that is not permitted due to other reasons (parameter with defined values)	Subindex	✓
15	Request too long for acyclic communication channel	The length of the current request exceeds the maximum permitted length of the acyclic communication channel.	0	
16	Parameter address not permissible	Not permissible or non-supported value for attribute, No. of elements, parameter number, subindex, or a combination thereof	0	✓
17	Format not permissible	Write request: Invalid format or format not permissible for this parameter	0	
18	No. of values are not consistent	Write request: The number of values in the parameter data does not match the number of values for the parameter address.	0	
19	DO does not exist	Attempting to access a non-existing drive object	0	✓
20	Parameter text element cannot be changed	Attempting to have write access to a parameter text element without write permissions	Subindex	
21	Not permissible request ID	unsupported service		✓
22	Response too long for parameter manager	The length of the current response exceeds the parameter manager's parameter processing capacity		
23	Multiple parameter access not permissible	Is not supported.		✓
…-64	Reserved	–		
65-FF	manufacturer specific	–		

SmartWire-DT read response(+) – Without data

As soon as the DS7-SWD soft starter has completed the response for a write job, it will send a SmartWire-DT read response(+) – without data.

Byte:	Designation	Description
0	Request Reference	Request identification: Is echoed
1	Response-ID	Response ID: 02_{hex}: Write job (+)
2	DO-ID	Drive-Object-ID: Is echoed
3	No. of Parameters	Number of Parameters: 01_{hex}

SmartWire-DT read response(+) – With data (all PNUs)

As soon as the DS7-SWD soft starter has completed the response for a read job for the range PNU 0 – PNU 999 (without PNU 202), it will send a SmartWire-DT read response(+) – with data.

Byte:	Designation	Description
0	Request Reference	Request identification: Is echoed
1	Response-ID	Response ID: 01_{hex}: Read job (+)
2	DO-ID	Drive-Object-ID: Is echoed
3	No. of Parameters	Number of Parameters: 01_{hex}
4	Format	Format: 01_{hex} – $7C_{hex}$ (i. e. 01_{dez} – 124_{dez})
5	No. of Values	Number of values: 01_{hex} : value
6 – 9	Value	Value: Specifies the value of the parameter being accessed. The length depends on the format and can be a maximum of 4 bytes. 00000000_{hex} – $FFFFFFFF_{hex}$ (i. e. 0_{dez} – 4294967295_{dez}) Content of PNU 0–PNU 999 (without PNU 202)

SmartWire-DT read response(+) – With data (PNU 202)

As soon as the DS7-SWD soft starter has completed the response for a PNU 202 read job, it will send a SmartWire-DT read response(+) – with data.

Byte:	Designation	Description
0	Request Reference	Request identification: Is echoed
1	Response-ID	Response ID: 01_{hex}: Read job (+)
2	DO-ID	Drive-Object-ID: Is echoed
3	No. of Parameters	Number of Parameters: 01_{hex}
4	Format	Format: $0A_{hex}$ (= 10_{dez})
5	No. of Values	Number of values: 01_{hex}: value
6 – 25	Value	Value: Specifies the value of the parameter being accessed The length depends on the format and can be a maximum of 20 bytes. Content of PNU 202

8.9.7 Acyclic data via PROFIBUS-DP: DS7

8.9.7.1 Introduction

Acyclic communications with a slave via PROFIBUS-DP can basically be established by a Class 1 master and a Class 2 master simultaneously. This means that the DS7-SWD soft starter will need to handle acyclic requests and responses from/to both masters.

For more information on the subject of the transfer of acyclic data, consult the MN05013002Z-EN manual, "SmartWire-DT Gateways".

8.9.7.2 Addressing

The parameter channel is embedded as a payload data block in the acyclic PROFIBUS write/read PDUs.

The acyclic data objects of a slave are addressed via slots and indexes on the PROFIBUS. SWD maps the slot to the SWD module address. The parameter channel is always addressed with index 47.

8.9.7.3 Protocol

Acyclic services (index-based addressing and payload data) are mapped the same way on SmartWire-DT by the PROFIBUS-DP gateway (EU5C-SWD-DP). As a result, the parameter channel can be used in a fully transparent manner by SmartWire-DT modules.

The following diagram shows the protocol between the PROFIBUS-DP master, PROFIBUS-DP gateway, and DS7-SWD soft starter.

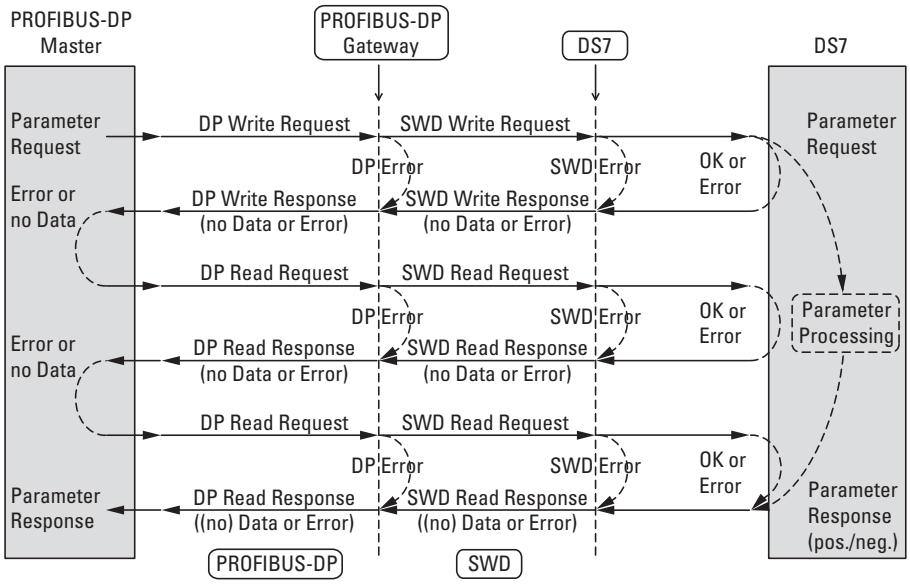


Figure 133: Acyclic PROFIBUS-DP parameter channel protocol

8.9.7.4 SmartWire-DT write response(-) – Error

This section shows the various possible device-specific errors that can occur during communications via the acyclic parameter channel with PROFIBUS-DP.

The following table describes the various possible errors that can be contained in the SmartWire-DT write response(-) – error.

Error Type	Error code	Description
Error_Code_1	$A1_{hex}$	Write error: Only reading allowed for indexes 1–3 (PKE motor-protective circuit-breaker).
Error_Code_1	$A2_{hex}$	DS7-SWD soft starter cannot be reached.
Error_Code_1	$B0_{hex}$	There is no valid index.
Error_Code_1	$B1_{hex}$	Parameter request block too long.
Error_Code_1	$B5_{hex}$	Parameter access temporarily not permissible due to internal processes.

In the case of XSoft-CoDeSys, only error code 54dec (representing the errors listed above) can be output via function blocks XDPMV1_READ and XDPMV1_WRITE when using a PROFIBUS-DP master.

→ For more information, see → Section 8.9.6, „Acyclic parameter channel for DS7-SWD soft starter“, page 187.

8.9.7.5 SmartWire-DT read response(-) – Error

This section shows the various possible device-specific errors that can occur during communications via the acyclic parameter channel with PROFIBUS-DP.

The following table describes the various possible errors that can be contained in the SmartWire-DT read response(-) – error.

Error Type	Error code	Description
Error_Code_1	$A1_{hex}$	Write error: Only reading allowed for indexes 1–3 (PKE motor-protective circuit-breaker).
Error_Code_1	$A2_{hex}$	DS7-SWD soft starter cannot be reached.
Error_Code_1	$B0_{hex}$	There is no valid index.
Error_Code_1	$B5_{hex}$	Parameter access temporarily not permissible due to internal processes

In the case of XSoft-CoDeSys, only error code 54dec (representing the errors listed above) can be output via function blocks XDPMV1_READ and XDPMV1_WRITE when using a PROFIBUS-DP master.

→ For more information, see → Section 8.9.6, „Acyclic parameter channel for DS7-SWD soft starter“, page 187.

→ For more information on the subject of acyclic data access blocks for PROFIBUS-DP, consult manual MN05010002Z-EN, “Function Blocks for CoDeSys”.

8.9.8 Acyclic data via PROFIBUS-DP: PKE

8.9.8.1 Introduction

Acyclic communications with a slave via PROFIBUS-DP can basically be established by a Class 1 master and a Class 2 master. This means that the PKE motor-protective circuit-breaker needs to handle acyclic requests and responses from and to the masters via the DS7-SWD soft starter.

8.9.8.2 Addressing

The PKE motor-protective circuit-breaker provides three objects for acyclic read access. These objects are addressed with index 1, index 2, index 3; as a result, they can be separated from index 47, which is used to address the DS7-SWD soft starter's PROFIdrive objects.

8.9.8.3 Protocol

The DS7-SWD soft starter is used to map the protocol in such a way that it is also possible to access the PKE motor-protective circuit-breaker acyclically via SmartWire-DT.

In order to perform a read operation, the coordinator sends a read request. As a response, the requested data or an error message (as the case may be) is sent directly by the PKE motor-protective circuit-breaker via the DS7-SWD soft starter.

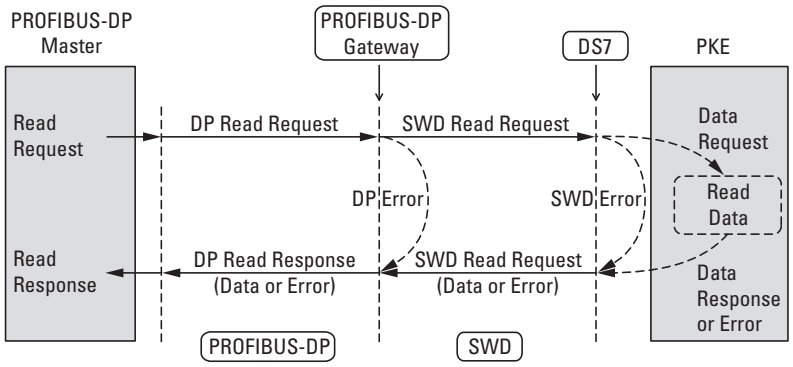


Figure 134: Protocol for communication between PROFIBUS-DP master and motor-protective circuit-breaker PKE via DS7-SWD

→ For further information about acyclic data transfer, see manual MN05013002Z-EN, “SmartWire-DT Gateways”.

8.10 SmartWire-DT diagnostics

The DS7-SWD soft starter sends diagnostic messages for itself and, optionally, for the PKE motor-protective circuit-breaker.

Basically, a distinction must be drawn between:

- Basic diagnostics (basic SmartWire-DT diagnostics)
- Advanced diagnostics (advanced SmartWire-DT diagnostics)
- PROFIdrive parameter channel diagnostics

PROFIdrive parameter channel diagnostics are shown with error messages or warnings in the cyclic profile with PROFIdrive (profiles 7, 8, 9, 11).

8.10.1 Basic SWD Diagnostics

A pending diagnostic message from the DS7-SWD soft starter will be signalled as a collective diagnostic in the cyclic profile with input byte 0, bit 4 (DIAG). A device response, if any, will be described in the advanced diagnostics.

In addition, in profiles 4 to 11, the following bits

- ERR (DS7-SWD stops) or
- WARN (no response from DS7-SWD)

in the corresponding input bytes are used to show whether there are any diagnostic messages (i.e., errors or warnings).

After the cause of the fault is fixed, you can acknowledge a fault (ERR) as follows:

- Profiles 1 to 3: DS7 start/stop 1 → 0
- Profiles 4 to 11: FaultAck = 1
- 1-0-A switch in position 0

Warnings (WARN) cannot be acknowledged, since they are simply messages without an ensuing response (from the DS7-SWD soft starter).

The diagnostic data that corresponds to the PROFIdrive profile can be sent at any time regardless of the profile chosen. It is provided via the acyclic services of the relevant bus system.

For available diagnostic messages FaultBuffer: PNU 947 subindexes 0 to 7 → Section 8.9.5, „acyclic data“, page 176

8.10.2 Advanced SmartWire-DT diagnostics

When there is a collective diagnostic (input byte 0, bit 4 (DIAG)), the DS7-SWD soft starter will provide advanced diagnostic messages:

Motor-protective circuit-breaker diagnostic messages (profiles 1 to 9)

The following are the messages generated by the PKE motor-protective circuit-breaker.

Table 38: PKE motor-protective circuit-breaker diagnostic messages

Value [hex]	Meaning	Remedy	Notes
3	No communications Between DS7-SWD soft starter and PKE trip block	Check whether the PKE trip block being used is a PKEXTUA-… trip block. Check the PKE32-COM connections and reconnect the device if necessary.	The DS7-SWD can continue to be used in this state. The main circuits are isolated by the PKE in the event of an overload. In this case, an activated overload function (ZMR) will no longer have any effect.

Soft starter diagnostic messages (profiles 1 to 11)

The following are the messages generated by the DS7-SWD soft starter.

Table 39: DS7-SWD soft starter diagnostic messages

Value [hex]	Meaning	Remedy	Notes
14	Internal communication problem in soft starter	• If the error continues, switch the supply voltage off/on • Check EMC • Replace soft starter	
15	no unambiguous position of the 1-0-A switch for more than 4 seconds	Move the 1-0-A switch to one of the three defined positions.	Input byte 0, bit field 2..3 A1, A2 is used to signal a value of 00_{hex}. For more information, see below.
19	There is a DS7-SWD soft starter warning.	Read warning PNU 860.0 and fix the cause	Corresponds to the WARN bit in the corresponding input byte
1 A	There is a DS7-SWD soft starter fault.	• Read fault PNU 944 to PNU 952 • Fix the fault and acknowledge the error message	Corresponds to the ERR bit in the corresponding input byte

Diagnostic alarm 15_{hex}

If the 1-0-A switch does not assume a clear position for longer than 4 seconds, the DS7-SWD soft starter will be switched off and generate the following error messages:

- DIAG,
- ERR (only profiles 4 to 11),
- Diagnostic alarm 15_{hex} (→ Table 39).

In addition, the module's SmartWire-DT diagnostic LED will flash green (frequency: 3 Hz).

8.10.2.1 Advanced SmartWire-DT diagnostics via PROFIBUS

For information on the subject of advanced diagnostics, consult manual MN05013002Z-EN, "SmartWire-DT Gateways".

For basic information on diagnostics via PROFIBUS-DP masters, consult manual MN05002002Z-EN, "XI/OC Signal Modules". The manual also contains explanations regarding the access of the diagnostic data of a PROFIBUS-DP slave module.

8.10.3 PROFIdrive diagnostics

Diagnostic data that corresponds to the PROFIdrive profile can be sent at any time regardless of the profile that has been chosen. It is provided via the acyclic parameter channel of the relevant bus system.

The ERR and WARN bits in corresponding input bytes 4 to 11 are used to show whether there are any diagnostic messages present (i.e., errors or warnings).

You can acknowledge faults (ERR) as follows:

- Profiles 1 to 3: DS7 start/stop 1 → 0
- Profiles 4 to 11: FaultAck = 1

Warnings (WARN) cannot be acknowledged, since they are simply messages without a response (from the DS7-SWD soft starter).

Available diagnostic messages (warnings PNU 860.0 and faults PNU 944 to PNU 952) → Section 8.9.5, „acyclic data".

8.10.4 SmartWire-DT diagnostic LEDs

The following table shows the information that can be determined based on the SmartWire-DT diagnostic LEDs.

Table 40: SmartWire-DT diagnostic LED indications

Color LED	Switch command	Position 1-0-A switch	Health	Message
			off	No power supply
Orange	Provided	A	Continuous light	Device is operating error-free:
			flashing (3 Hz)	Diagnostics
Green	not available	1 or 0 or A	Continuous light	Device is operating error-free.

			flashing (1 Hz)	• addressing process in progress
				  ◦ After powering on the gateway
				  ◦ After pressing the configuration button on the gateway
				• Module not present in current configuration
				• invalid type

			flashing (3 Hz)	Diagnostics

Switching command present

For the orange SmartWire-DT diagnostic LED, the "switching command present" message means the following:

- Profiles 1 to 3: DS7 start/stop = 1
- Profiles 4, 5, 6 and 10: EN_Set and EN_Op = 1.
- Profiles 7, 8, 9, 11: OnOff =1, Off2 =1, Off3 = 1, EN_Op = 1, EN_Ramp = 1, Freeze = 1, EN_Set = 1, Ctl_PLC = 1

Diagnostics

If the "Diagnostics" message appears, input byte 0, bit 4 (DIAG) will be set to 1 as well. The message has the following meaning:

- Profiles 1 to 9: There is an advanced diagnostic alarm for soft starter DS7 or motor-protective circuit-breaker PKE.
- Profiles 10 and 11: There is an advanced diagnostic message for the DS7-SWD soft starter

8.11 Fieldbus description files

These and other fieldbus description files can be found at:
http://downloadcenter.moeller.net

8.11.1 Example of a GSD file

The listing below is an example of the contents of a GSD file (Moel4d14.gsd) for PROFIBUS-DP and a soft starter DS7-SWD for SmartWire-DT gateway EU5C-SWD-DP:

```
; Eaton Industries GmbH
; Device: SmartWire-DT gateway
; Version: 04
; Date: 27.01.2012
; GSD version: 1.03
; Author: Thiessmeier
; Description: GSD file for SmartWire-DT gateway, Intel-based PLC
; Change to GSD version 1.02: PKE-SWD amended
; Change to GSD version 1.03: DS7-SWD amended
; Change to GSD version 1.03: SWD adapter for Phoenix Contactron amended
; Copyright (c) 2010 by Eaton Industries GmbH
;=========================================================

#Profibus_DP

GSD_Revision= 5

Vendor_Name= Eaton Industries GmbH
Model_Name= EU5C-SWD-DP V1 (Int)
Revision= V 1.10
Ident_Number= 0x4D14
Protocol_Ident= 0 ; PROFIBUS-DP
Station_Type= 0 ; DP-Slave
FMS_supp= 0
Hardware_Release= Hardware release: V 1.00
Software_Release= Software release: V 1.20

9.6_supp= 1
19.2_supp= 1
93.75_supp= 1
187.5_supp= 1
500_supp= 1
1.5M_supp= 1
3M_supp= 1
6M_supp= 1
12M_supp= 1

MaxTsdr_9.6= 60
MaxTsdr_19.2= 60
MaxTsdr_93.75= 60
MaxTsdr_187.5= 60
MaxTsdr_500= 100
MaxTsdr_1.5M= 150
MaxTsdr_3M= 250
MaxTsdr_6M= 450
MaxTsdr_12M= 800

Redundancy= 0
Repeater_Ctrl_Sig= 2
24V_Pins= 0
```

```
Info_Text = DPV1 Gateway for SmartWire-DT. For PLCs, whose internal data is coded according to
Intel format; e.g. Moeller XC200

Bitmap_Device = KM4D14_N
Bitmap_Diag = KM4D14_D
Bitmap_SF = KM4D14_D

; The following functions are tested during certification
Freeze_Mode_supp= 0
Sync_Mode_supp= 0
Auto_Baud_supp= 1
Fail_safe = 1
Set_Slave_Add_supp= 0

; Slave belongs to switchgear family
Slave_Family= 2

; Slave implemented with PROFIBUS-DP-ASIC VPC3+ C.
Implementation_Type= VPC3+

Ident_Maintenance_supp= 1
.
.
.
Following are the contents relevant to DS7-SWD.
.
.
.
Modules= DS7-SWD PKE1 0x91, 0x20, 0x00, 0x00
50
Ext_Module_Prm_Data_Len=4
Ext_User_Prm_Data_Const(0)=0x01, 0x40
Ext_User_Prm_Data_Ref(2) = 3
Ext_User_Prm_Data_Ref(2) = 20
Ext_User_Prm_Data_Const(3)=0x00
Info_Text = SWD-Interface for DS7. Cyclic data according PKE profile 1
; Standard ID format
; 2 Byte E + 1 Byte A
EndModule

Modules= DS7-SWD PKE2 0x93, 0x20, 0x00, 0x00
51
Ext_Module_Prm_Data_Len=4
Ext_User_Prm_Data_Const(0)=0x01, 0x40
Ext_User_Prm_Data_Ref(2) = 3
Ext_User_Prm_Data_Ref(2) = 20
Ext_User_Prm_Data_Const(3)=0x00
Info_Text = SWD-Interface for DS7. Cyclic data according PKE profile 2
; Standard ID format
; 4 Byte E + 1 Byte A
EndModule

Modules= DS7-SWD PKE3 0x94, 0x20, 0x00, 0x00
52
Ext_Module_Prm_Data_Len=4
Ext_User_Prm_Data_Const(0)=0x01, 0x40
Ext_User_Prm_Data_Ref(2) = 3
Ext_User_Prm_Data_Ref(2) = 20
Ext_User_Prm_Data_Const(3)=0x00
Info_Text = SWD-Interface for DS7. Cyclic data according PKE profile 3
; Standard ID format
; 5 Byte E + 1 Byte A
EndModule
```

```
Modules= DS7-SWD PKE1-8Bit 0x92, 0xA1, 0x00, 0x00
53
Ext_Module_Prm_Data_Len=4
Ext_User_Prm_Data_Const(0)=0x01, 0x40
Ext_User_Prm_Data_Ref(2) = 3
Ext_User_Prm_Data_Ref(2) = 20
Ext_User_Prm_Data_Const(3)=0x00
Info_Text = SWD-Interface for DS7. Cyclic data according PKE profile 1, additional 8-Bit
control/status for DS7
; Standard ID format
; 3 Byte E + 2 Byte A
EndModule

Modules= DS7-SWD PKE2-8Bit 0x94, 0xA1, 0x00, 0x00
54
Ext_Module_Prm_Data_Len=4
Ext_User_Prm_Data_Const(0)=0x01, 0x40
Ext_User_Prm_Data_Ref(2) = 3
Ext_User_Prm_Data_Ref(2) = 20
Ext_User_Prm_Data_Const(3)=0x00
Info_Text = SWD-Interface for DS7. Cyclic data according PKE profile 2, additional 8-Bit
control/status for DS7
; Standard ID format
; 5 Byte E + 2 Byte A
EndModule

Modules= DS7-SWD PKE3-8Bit 0x95, 0xA1, 0x00, 0x00
55
Ext_Module_Prm_Data_Len=4
Ext_User_Prm_Data_Const(0)=0x01, 0x40
Ext_User_Prm_Data_Ref(2) = 3
Ext_User_Prm_Data_Ref(2) = 20
Ext_User_Prm_Data_Const(3)=0x00
Info_Text = SWD-Interface for DS7. Cyclic data according PKE profile 3, additional 8-Bit
control/status for DS7
; Standard ID format
; 6 Byte E + 2 Byte A
EndModule

Modules= DS7-SWD PKE1-PD 2x16Bit 0x91, 0xD1, 0x20, 0xE1
56
Ext_Module_Prm_Data_Len=4
Ext_User_Prm_Data_Const(0)=0x01, 0x40
Ext_User_Prm_Data_Ref(2) = 3
Ext_User_Prm_Data_Ref(2) = 20
Ext_User_Prm_Data_Const(3)=0x00
Info_Text = SWD-Interface for DS7. Cyclic data according PKE profile 1, additional 16-Bit
control/status and 16-Bit analog value for DS7 (derived from Profidrive Profile 4.1)
; Standard ID format
; 2 I bytes + 2 I words + 1 O byte + 2 O words
EndModule

Modules= DS7-SWD PKE2-PD 2x16Bit 0x93, 0xD1, 0x20, 0xE1
57
Ext_Module_Prm_Data_Len=4
Ext_User_Prm_Data_Const(0)=0x01, 0x40
Ext_User_Prm_Data_Ref(2) = 3
Ext_User_Prm_Data_Ref(2) = 20
Ext_User_Prm_Data_Const(3)=0x00
Info_Text = SWD-Interface for DS7. Cyclic data according PKE profile 2, additional 16-Bit
control/status and 16-Bit analog value for DS7 (derived from Profidrive Profile 4.1)
; Standard ID format
; 4 I bytes + 2 I words + 1 O byte + 2 O words
EndModule
```

```
Modules= DS7-SWD PKE3-PD 2x16Bit 0x94, 0xD1, 0x20, 0xE1
58
Ext_Module_Prm_Data_Len=4
Ext_User_Prm_Data_Const(0)=0x01, 0x40
Ext_User_Prm_Data_Ref(2) = 3
Ext_User_Prm_Data_Ref(2) = 20
Ext_User_Prm_Data_Const(3)=0x00
Info_Text = SWD-Interface for DS7. Cyclic data according PKE profile 3, additional 16-Bit
control/status and 16-Bit analog value for DS7 (derived from Profidrive Profile 4.1)
; Standard ID format
; 5 I bytes + 2 I words + 1 O byte + 2 O words
EndModule

Modules= DS7-SWD 8Bit 0x91, 0x21, 0x00, 0x00
59
Ext_Module_Prm_Data_Len=4
Ext_User_Prm_Data_Const(0)=0x01, 0x40
Ext_User_Prm_Data_Ref(2) = 3
Ext_User_Prm_Data_Ref(2) = 20
Ext_User_Prm_Data_Const(3)=0x00
Info_Text = SWD-Interface for DS7. Cyclic data 8-Bit control/status for DS7
; Standard ID format
; 2 Byte E + 2 Byte A
EndModule

Modules= DS7-SWD PD 2x16Bit 0x10, 0xD1, 0xE1, 0x00
60
Ext_Module_Prm_Data_Len=4
Ext_User_Prm_Data_Const(0)=0x01, 0x40
Ext_User_Prm_Data_Ref(2) = 3
Ext_User_Prm_Data_Ref(2) = 20
Ext_User_Prm_Data_Const(3)=0x00
Info_Text = SWD-Interface for DS7. Cyclic data 16-Bit control/status and 16-Bit analog value
for DS7 (derived from Profidrive Profile 4.1)
; Standard ID format
; 1 I byte + 2 I words + 2 O words
EndModule

Modules= EM SWD-ADAPTER 0x30, 0x00, 0x00, 0x00
61
Ext_Module_Prm_Data_Len=4
Ext_User_Prm_Data_Const(0)=0x02, 0x01
Ext_User_Prm_Data_Ref(2) = 3
Ext_User_Prm_Data_Ref(2) = 20
Ext_User_Prm_Data_Const(3)=0x00
Info_Text = SWD adapter for Phoenix Contactron Hybrid Motorstarter
; Standard ID format
; 1 byte E/A
EndModule

;-- DPV1 ------------------------------------------------------------

DPV1_Slave              = 1

C1_Read_Write_supp          = 1
C2_Read_Write_supp          = 1
C1_Max_Data_Len           = 120
C2_Max_Data_Len           = 120
C1_Response_Timeout         = 300 ; in units of 10ms
C2_Response_Timeout         = 300 ; in units of 10ms
C1_Read_Write_required        = 0
C2_Read_Write_required        = 0
C2_Max_Count_Channels        = 1
Max_Initiate_PDU_Length       = 68
```

```
Diagnostic_Alarm_supp        = 0
Process_Alarm_supp          = 0
Pull_Plug_Alarm_supp         = 0
Status_Alarm_supp          = 0
Update_Alarm_supp          = 0
Manufacturer_Specific_Alarm_supp   = 0
Extra_Alarm_SAP_supp         = 0
Alarm_Sequence_Mode_Count      = 0
Alarm_Type_Mode_supp         = 0
Diagnostic_Alarm_required      = 0
Process_Alarm_required        = 0
Pull_Plug_Alarm_required       = 0
Status_Alarm_required        = 0
Update_Alarm_required        = 0
Manufacturer_Specific_Alarm_required = 0

; DPV1_Data_Types           = 0 ; optional
WD_Base_1ms_supp          = 1
Check_Cfg_Mode           = 0

;-------------------------------------------------------------------
```

9 Appendix

9.1 Standards

The relevant standards for the DS7 soft starters are listed below:

Table 41: Standards and EMC

Standard type	Standard	Titles	Limit Values
Model	IP 20 to IEC/EN 60947-1 (EN 60529)		
Interference immunity	IEC/EN 61000-4-2	Electrostatic discharge	8 kV air discharge 4 kV Contactdischarge
	IEC/EN 61000-4-3	Electromagnetic fields Frequency range 80 to 1000 MHz	10 V/1 m
	IEC/EN 61000-4-6	High frequency field Frequency range 0.15 to 80 MHz, 80 % amplitude modulated	140 dB (µV)
	IEC/EN 61000-4-4	Fast transients, Burst on power terminals	2 kV/5 kHz
		Burst on bus and control cables	2 kV/5 kHz
	IEC/EN 61000-4-5	Surge voltage test, supply cable	2 kV phase - earth 1 kV phase - phase
Emitted interference	IEC/EN 60947-4-2	Radio interference, housing and network	Class A for use in industrial environment, class A1 (all devices) Class B for use in public supply systems (only for DS7-340… devices (24 V AC/DC))
Insulation resistance	IEC/EN 60947-1	Insulation resistance test	Appendix K
Permissible pollution	IEC/EN 60947-1	Insulation of air and creepage distances	Pollution degree 2
Permissible humidity rating	IEC/EN 60947-1	Relative humidity	85 %,no condensation

9.2 Applicable product standards and approvals

Document type	Name
Product standard	EN/IEC 60947-4-2
Approvals	• UL (UL 508) • CSA (CSA C22.2 No 14-05) • CCC (GB 14048.6) • Gost • Gost-R
Markings	• CE marking for LVD (Low-Voltage Directive) • EMC (Electromagnetic compatibility - EMC Directive) **Note:** In preparation for DS7-34D… (DS7-SWD) devices

UL certification

The soft starters DS7 are UL-certified in all frame sizes:

Certificate Number 20120406-E251034
Report Reference E251034-20110330
Issue Date 2012-APRIL-06

Learn more at www.ul.com.

9.3 Specific technical data

The technical data is divided up into data applicable to all devices and data applicable to specific device series and device types.

9.3.1 Power supply dependent data

		Supply voltage U_c		
		24 V AC/DC	**120/230 V AC**	**+24 V**
		DS7-340…	**DS7-342…**	**DS7-34D… (SmartWire-DT)**
General				
Radio interference level		"B"	"A" group 1	"B"
Actuating circuit				
Regulator supply voltage U_s				
Voltage	V	+24 +10 % / -15 %	120 -15 % to 230 +10 %	+24 DC – +10 %/-15 %
Frequency at V AC	Hz	(50/60)	50/60	
Current consumption no-load losses (without device fan)	mA	50	50	50
Current consumption operation (without device fan)	mA	130	100	130
Current consumption peak performance (Close bypass contacts, without device fan)	mA	130	130	130
Fan current consumption (operation)	mA	50	50	50
Control voltage range U_c				
DC operated	V DC	24 +10 %/-15 %		24 +10 %/-15 %
AC operated	A DC	24 +10 %/-15 %	120 -15% to 230 +10 %	
Current consumption per input (+A1, EN)	mA	1.6	4	1.6
Pick-up voltage (High signal)				
DC operated	V DC	+17.3 – +27		+17.3 – +27
AC operated	V AC	17.3 – +27	~ 100 – 253	
Drop-out voltage (Low signal)				
DC operated	V DC	0 – +3		0 – +3
AC operated	V AC	0 – +3	0 – 28	
Pick-up time				
DC operated	ms	250		250
AC operated	ms	250	250	
Drop out delay				
DC operated	ms	350		350
AC operated	ms	~0	350	

9.3.2 Terminal capacity, control cables, actuating circuit

The following technical data depends on size.

		Construction size 1: 4 to 12 A	Construction size 2: 16 to 32 A	Construction size 3: 41 to 100 A	Construction size 4: 135 to 200 A
General					
Dimensions (W x H x D)	mm	45 x 130 x 95	45 x 150 x 118	93 x 175 x 139	108 x 215 x 178
Weight	kg	0.35	0.4	1.8	3.7
Terminal capacity					
Cables (box terminal)					
Solid	mm^2	1 x (0.75 – 4) 2 x (0.75 – 2.5)	1 x (0.75 – 16) 2 x (0.75 – 10)	1 x (25 – 70) 2 x (6 – 25)	1 x (4 – 185) 2 x (4 – 70)
Flexible with ferrule	mm^2	1 x (0.75 – 2.5) 2 x (0.75 – 2.5)	1 x (0.75 – 16) 2 x (0.75 – 10)		
Stranded	mm^2		1 x 16 2 x 16	1 x (25 – 70) 2 x (6 – 25)	1 x (4 – 185) 2 x (4 – 70)
Solid or stranded	AWG	1 x (18 – 10) 2 x (18 – 10)	1 x (14 – 8) 2 x (14 – 8)	1 x (12 – 2/0)	1 x (12 – 350 mcm 2 x (12 – 00)
Flat conductor	min, mm			2 x 9 x 0.8	2 x 9 x 0.8
	max, mm			9 x 9 x 0.8	10 x 16 x 0.8
Tightening torque	N/m	1.2	3.2	9 (> 10 mm^2); 6 (≦ 10 mm^2)	14 (> 10 mm^2); 5 (≦ 10 mm^2)
Control cables					
Solid	mm^2	1 x (0.75 – 4) 2 x (0.75 – 2.5)	1 x (0.75 – 4) 2 x (0.75 – 1.5)	1 x (0.75 – 4) 2 x (0.75 – 1.5)	1 x (0.75 – 4) 2 x (0.75 – 1.5)
Flexible with ferrule	mm^2	1 x (0.75 – 2.5) 2 x (0.75 – 2.5)	1 x (0.75 – 2.5) 2 x (0.75 – 1.5)	1 x (0.75 – 2.5) 2 x (0.75 – 1.5)	1 x (0.75 – 2.5) 2 x (0.75 – 1.5)
Stranded	mm^2				
Solid or stranded	AWG	1 x (18 – 10) 2 x (18 – 10)	1 x (18 – 14) 2 x (18 – 16)	1 x (18 – 14) 2 x (18 – 16)	1 x (18 – 14) 2 x (18 – 16)
Tightening torque	N/m	1.2	0.6	0.6	0.6
Screwdriver (flat blade)	mm	0.6 x 3.5	0.6 x 3.5	0.6 x 3.5	0.6 x 3.5
Actuating circuit					
Relay outputs					
Count		1 (TOR)	2 (TOR, RUN)	2 (TOR, RUN)	2 (TOR, RUN)
Max. voltage range	V AC/DC	= U_s	250	250	250
Max. load current	A	1	1	1	1

9.3.3 Heat dissipation P_V

The heat dissipation P_V of the soft starter depends on the operating state of the connected motor.

The values in Table 42 refer to the rated operation of the motor sizes (motor rating, 4 pole three-phase asynchronous motor) at an ambient air temperature of +40 °C.

Table 42: Heat dissipation

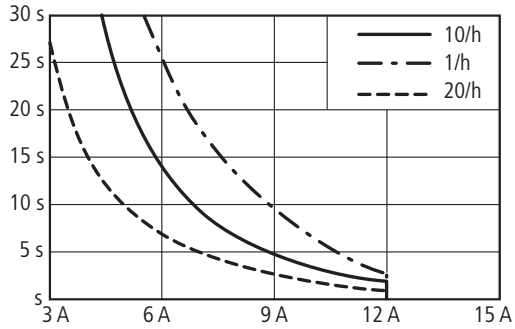
Part no.		DC versions		AC versions	
	Rated operational current	Heat dissipation in standby	Heat dissipation at rated load cycle	Heat dissipation in standby	Heat dissipation at rated load cycle
	[A]	[W]	[W]	[W]	[W]
DS7-34xSX004N0-…	4	0.7	5	1.5	5
DS7-34xSX007N0-…	7	0.7	5	1.5	6
DS7-34xSX009N0-…	9	0.7	6	1.5	7
DS7-34xSX012N0-…	12	0.7	7	1.5	8
DS7-34xSX016N0-…	16	0.7	7	1.5	7
DS7-34xSX024N0-…	24	0.7	9	1.5	10
DS7-34xSX032N0-…	32	0.7	12	1.5	13
DS7-34xSX041N0-…	41	0.7	7	1.5	8
DS7-34xSX055N0-…	55	0.7	9	1.5	10
DS7-34xSX070N0-…	70	0.7	11	1.5	12
DS7-34xSX081N0-…	81	0.7	13	1.5	14
DS7-34xSX100N0-…	100	0.7	16	1.5	17
DS7-34xSX135N0-…	135	0.7	24	1.5	25
DS7-34xSX160N0-…	160	0.7	30	1.5	31
DS7-34xSX200N0-…	200	0.7	42	1.5	43

The start produces currents above the rated operational current. All enclosure types in which the Soft starter is to be installed must have the required power loss capacity. Depending on the ramp time set and the current limitation, this current can be present for several seconds. The resulting heat dissipation must in this case be allowed for in the housing design.

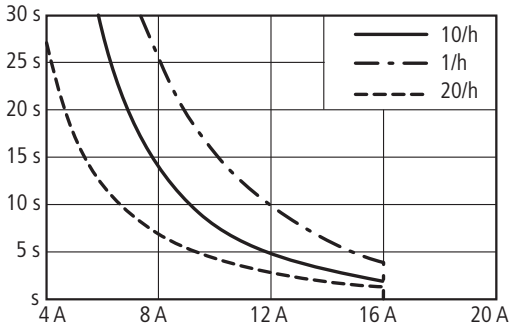
9.4 Conversion to other load cycles

Rated operational current up to 32 A

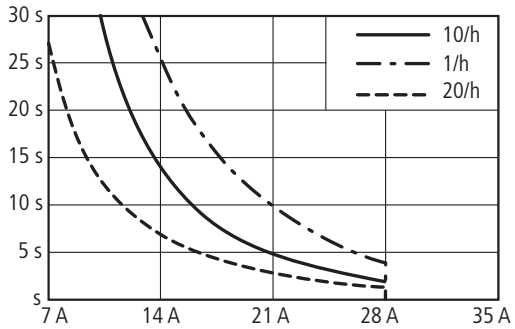
DS7-34xSX003…



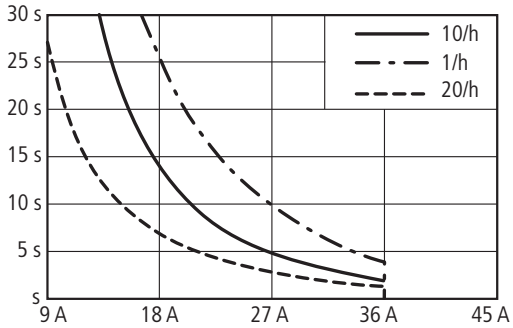
DS7-34xSX004…



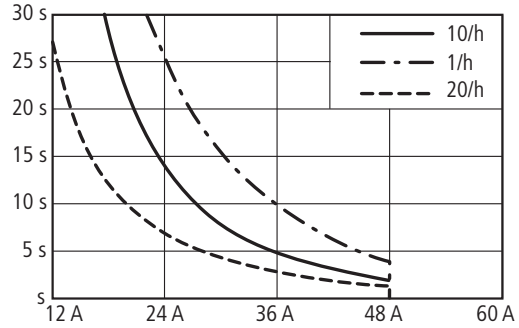
DS7-34xSX007…



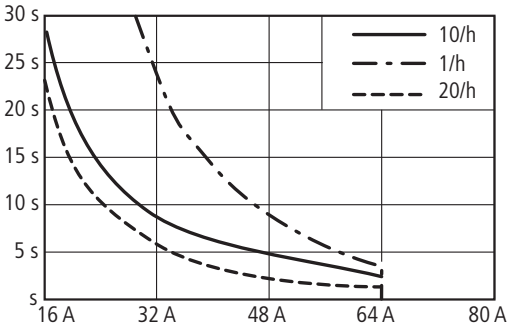
DS7-34xSX009…



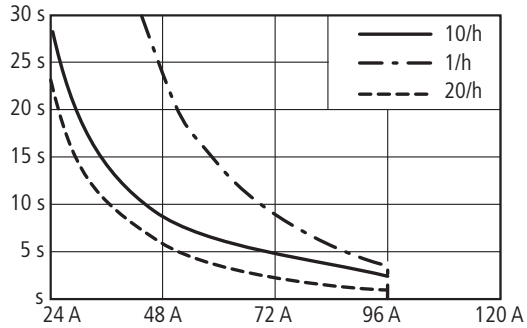
DS7-34xSX012…



DS7-34xSX016…



DS7-34xSX024…



DS7-34xSX032E…

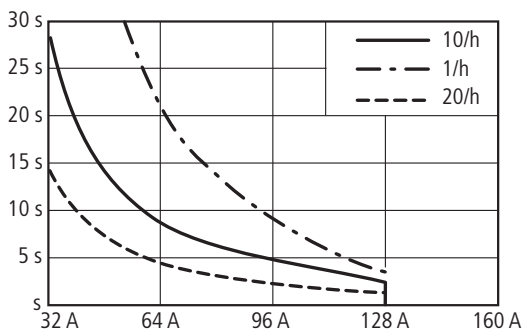
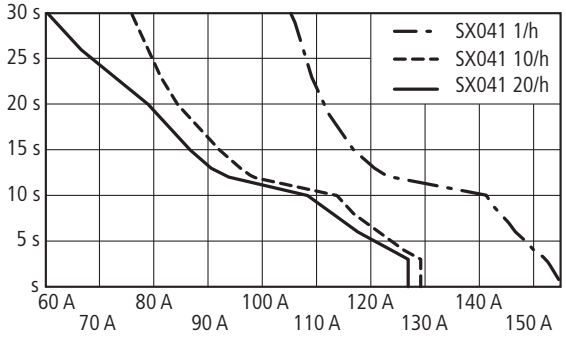


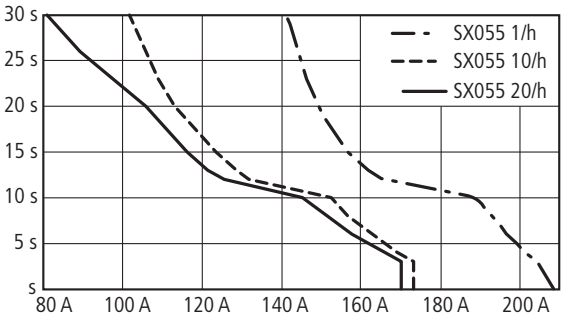
Figure 135: Current overload curves, Stand-alone setup without fan

Rated operational current from 41 A

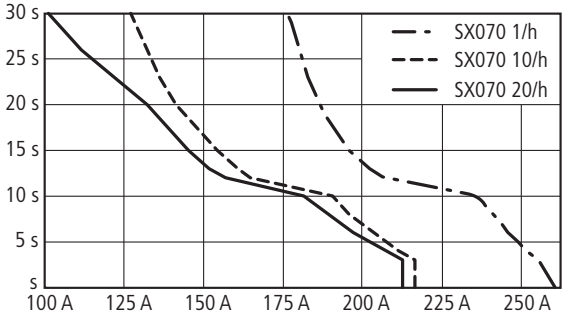
DS7-34xSX041…



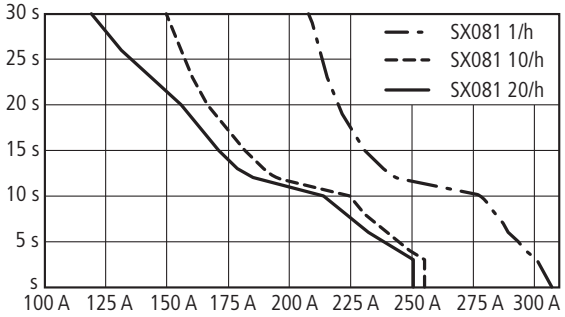
DS7-34xSX055…



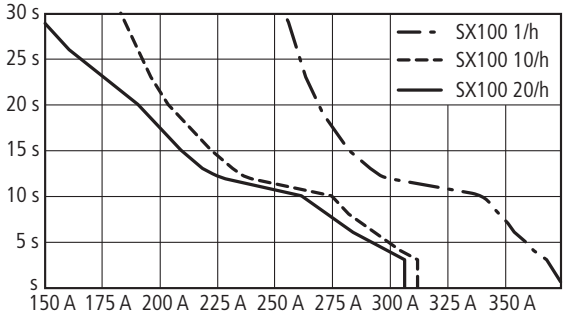
DS7-34xSX070…



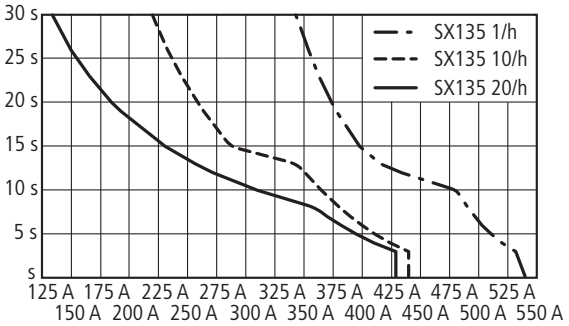
DS7-34xSX081…



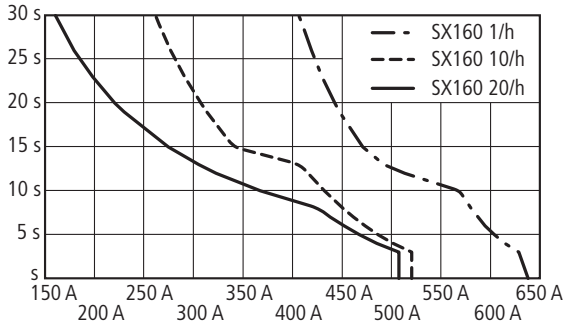
DS7-34xSX100…



DS7-34xSX135…



DS7-34xSX160…



DS7-34xSX200…

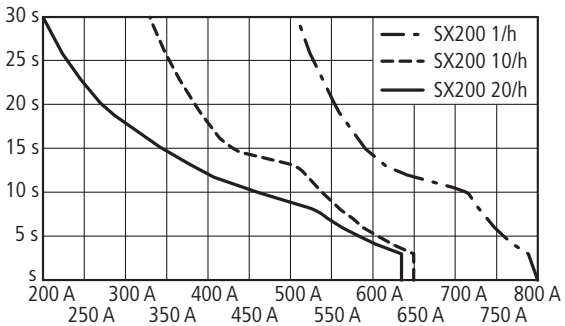


Figure 136: Current overload curves, Stand-alone setup without fan

9.5 Accessories

9.5.1 Protection, short-circuit strength

Table 43: Fuses, semiconductor fuses

Part no.	Type "1" coordination		Type 2 coordination	
	Cable and motor protection (I_q ≦ 50 kA)[1]	Cable and motor protection (I_q ≦ 100/150 kA)	Superfast semi-conductor fuses in addition to fuses for type 1 coordination	Fuse holders for semiconductor fuse
	Part no.	Part no.	Number x Part no.	Number x Part no.
DS7-34xSX004N0-…	PKZM0-4	PKZM0-4	3 x 50.179.06-16	3 x 51.060.04
DS7-34xSX007N0-…	PKZM0-10	PKZM0-10	3 x 50.140.06-25	3 x 51.060.04
DS7-34xSX009N0-…	PKZM0-10	PKZM0-10	3 x 20.282.20-32	3 x 21.189.01
DS7-34xSX012N0-…	PKZM0-12	PKZM0-12 + CL-PKZ0[2]	3 x 20.282.20-32	3 x 21.189.01
DS7-34xSX016N0-…	PKZM0-16	PKZM0-16 + CL-PKZ0[2]	3 x 50.140.06-50	3 x 51.060.04
DS7-34xSX024N0-…	PKZM0-25	PKZM0-25 + CL-PKZ0[2]	3 x 50.140.06-63	3 x 51.060.04
DS7-34xSX032N0-…	PKZM0-32	PKZM0-32 + CL-PKZ0[2]	3 x 50.140.06-80	3 x 51.060.04
DS7-34xSX041N0-…	NZMN1-M50 / PKZM4-50	NZMH1-M50	3 x 20.282.20-100	3 x 21.189.01
DS7-34xSX055N0-…	NZMN1-M63 / PKZM4-58	NZMH1-M63	3 x 20.282.20-125	3 x 21.189.01
DS7-34xSX070N0-…	NZMN1-M80	NZMH1-M80	3 x 20.610.32-200	3 x 21.313.02
DS7-34xSX081N0-…	NZMN1-M100	NZMH1-M100	3 x 20.610.32-200	3 x 21.313.02
DS7-34xSX100N0-…	NZMN1-M100	NZMH1-M100	3 x 20.610.32-200	3 x 21.313.02
DS7-34xSX135N0-…	NZMN2-M160	NZMH2-M160	3 x 20.610.32-350	3 x 21.313.02
DS7-34xSX160N0-…	NZMN2-M200	NZMH2-M200	3 x 20.610.32-400	3 x 21.313.02
DS7-34xSX200N0-…	NZMN2-M200	NZMH2-M200	3 x 20.610.32-500	3 x 21.313.02

1) Rated conditional short-circuit current Iq with PKZM…; rated short-circuit breaking capacity Icu with NZM… (according to IEC/EN 60947) for 230 V/400 V and with type 1 and 2 coordination. Intrinsic safety range – backup protection is not required.

2) + CL-PKZ0 = required current limiter

Tables 44 to 46 provide additional information regarding superfast semiconductor fuses

Table 44: Cylindrical fuse-links

	Part no. (article no.)	Rated operational current [A]	max. heat dissipation P_V [W]	Size/ fixing centres [mm]	Required fuse base Part no.
	50.179.06-16 (232077)	16	5	10 x 38	51.063.04
	50.140.06-25 (138284)	25	7	22 x 58	51.060.04
	50.140.06-50 (232079)	50	15	22 x 58	51.060.04
	50.140.06-63 (232080)	63	16	22 x 58	51.060.04
	50.140.06-80 (232081)	80	18	22 x 58	51.060.04

Table 45: NH0…-fuse-links

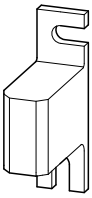
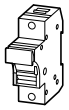
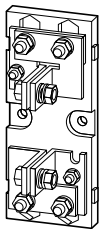
	Part no. (article no.)	Rated operational current [A]	max. heat dissipation P_V [W]	Size/ fixing centres [mm]	Required fuse base Part no.
	20.282.20-32 (138285)	32	9	80	21.189.01
	20.282.20-100 (106654)	100	22	80	21.189.01
	20.282.20-125 (232087)	125	24	80	21.189.01
	20.610.32-200 (106475)	200	44	80	21.313.02
	20.610.32-350 (221161)	350	61	80	21.313.02
	20.610.32-400 (106476)	400	70	80	21.313.02
	20.610.32-500 (221163)	500	72	80	21.313.02

Table 46: Fuse bases for superfast semiconductor fuses

	Part no. (article no.)	Size/ fixing centres [mm]	For fuse-link Part no.
	51.063.04 (232082)	10 x 38	50.179.06-16
	51.060.04 (232084)	22 x 58	50.140.06-25 50.140.06-50 50.140.06-63 50.140.06-80
	21.189.01 (232064)	80	20.282.20-32 20.282.20-100 20.282.20-125
	21.313.02 (232076)	80	20.610.32-200 20.610.32-350 20.610.32-400 20.610.32-500

→ If possible, install semiconductor fuses in the immediate vicinity of the soft starter (short connection wires).

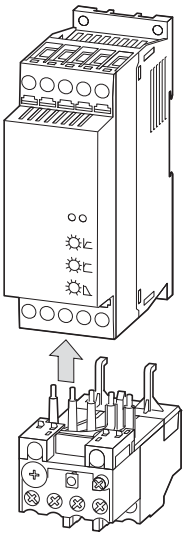
→ Semiconductor fuses must be installed on all three phases (L1, L2, L3).

→ Each fuse-link requires a fuse base.

9.5.2 Protection, overload relay, optional mains contactor

Part no.	Soft starter function with soft stop in case of overload		Optional mains contactor
	Line protection[1]	Overload relays2[2]	
DS7-34xSX004N0-…	PKM0-4 (+ CL-PKZ0)[3]	ZB12-4	DILM7
DS7-34xSX007N0-…	PKM0-10 (+ CL-PKZ0)	ZB12-10	DILM7
DS7-34xSX009N0-…	PKM0-10 (+ CL-PKZ0)	ZB12-10	DILM9
DS7-34xSX012N0-…	PKM0-12 (+ CL-PKZ0)	ZB12-12[4]	DILM12
DS7-34xSX016N0-…	PKM0-16 (+ CL-PKZ0)	ZB32-16	DILM17
DS7-34xSX024N0-…	PKM0-25 (+ CL-PKZ0)	ZB32-24	DILM25
DS7-34xSX032N0-…	PKM0-32 (+ CL-PKZ0)	ZB32-32[4]	DILM32
DS7-34xSX041N0-…	NZMN1-M50 / PKZM4-50	ZB65-40 + ZB65-XEZ	DILM50
DS7-34xSX055N0-…	NZMN1-M63 / PKZM4-58	ZB65-57 + ZB65-XEZ	DILM65
DS7-34xSX070N0-…	NZMN1-M80	ZB150-70/KK	DILM80
DS7-34xSX081N0-…	NZMN1-M100	ZB150-100/KK	DILM95
DS7-34xSX100N0-…	NZMN1-M100	ZB150-100/KK	DILM115
DS7-34xSX135N0-…	NZMN2-M160	ZB150-150/KK	DILM150
DS7-34xSX160N0-…	NZMN2-M200	Z5-160/FF250	DILM185
DS7-34xSX200N0-…	NZMN2-M200	Z5-220/FF250	DILM225

1) Used to specify the circuit-breaker required for the specified load cycle.
For other switching cycles (operating frequency, overcurrent, overcurrent time, duty factor), this value changes and must be modified accordingly.
2) Used to specify the circuit-breaker required for the specified load cycle.
For other switching cycles (operating frequency, overcurrent, overcurrent time, duty factor), this value changes and must be modified accordingly.
3) (+CL-PKZ0) = optional current limiter
4) The ZB12 or ZB32 overload relay can be fitted directly to a DS7 soft starter.



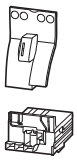
→ Further information on the overload relays is provided in the Eaton "Main Industrial Catalog 2010" (HPL0200-2010en-EN) in chapter 6 or on the Internet at:
http://www.eaton.com/moeller → Support → Catalog overview

9.5.3 System accessories

System accessories make installation easier and expand the options offered by the DS7 soft starter.

→ More information on system accessories can be found in the Eaton online catalog at:
http://www.eaton.com/moeller → Support → Catalog Overview

- **Wiring kit**
  Used to connect a size 1 DS7 soft starter directly to a PKZ or PKE motor-protective circuit-breaker.



PKZM0-XDM12 (283149) for use with:

DS7-34…SX004…
DS7-34…SX007…
DS7-34…SX009…
DS7-34…SX012…

→ Section 3.3.2.4, „Size 1: Surface mounting with PKZ or PKE“, page 68

- **Electric contact module**

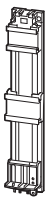
  Used to connect a size 2 DS7 soft starter directly to a PKZ or PKE motor-protective circuit-breaker·

PKZM0-XM32DE (239349) for use with:

DS7-34…SX016…
DS7-34…SX024…
DS7-34…SX032…

→ Section 3.3.2.5, „Size 2: Surface mounting with PKZ or PKE“, page 69

- **Top-hat rail adapter**
  45 mm-wide adapter plate (can be grouped) designed for mechanically mounting a PKZ or PKE motor-protective circuit-breaker and a size 1 or 2 DS7 soft starter.



PKZM0-XC45L (142529) for use with:

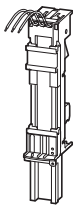
PKZM0, PKE + DS7…004N…
PKZM0, PKE + DS7…007N…
PKZM0, PKE + DS7…009N…
PKZM0, PKE + DS7…012N…

PKZM0-XC45L/2 (142570) for use with:

PKZM0, PKE + DS7…004N…
PKZM0, PKE + DS7…007N…
PKZM0, PKE + DS7…009N…
PKZM0, PKE + DS7…012N…
PKZM0, PKE + DS7…016N…
PKZM0, PKE + DS7…024N…
PKZM0, PKE + DS7…032N…

→ Section 3.3.2.4, „Size 1: Surface mounting with PKZ or PKE“, page 68
→ Section 3.3.2.5, „Size 2: Surface mounting with PKZ or PKE“, page 69

- **Busbar adapter**
  The 45 mm busbar adapter is suitable for connecting busbars with an interval between busbar centres of 60 mm and a bar thickness of 5 or 10 mm. They can be grouped and are designed for mechanically mounting a PKZ or PKE motor-protective circuit-breaker and a size 1 or 2 DS7 soft starter.



BBA0L-25 (142526) for use with:

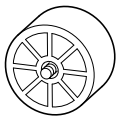
PKZM0, PKE + DS7…004N…
PKZM0, PKE + DS7…007N…
PKZM0, PKE + DS7…009N…
PKZM0, PKE + DS7…012N…

BBA0L-25 (142527) for use with:

PKZM0, PKE + DS7…004N…
PKZM0, PKE + DS7…007N…
PKZM0, PKE + DS7…009N…
PKZM0, PKE + DS7…012N…
PKZM0, PKE + DS7…016N…
PKZM0, PKE + DS7…024N…
PKZM0, PKE + DS7…032N…

→ Section 3.3.2.4, „Size 1: Surface mounting with PKZ or PKE“, page 68
→ Section 3.3.2.5, „Size 2: Surface mounting with PKZ or PKE“, page 69

- **Spacer**
  Spacers for NZM1 and NZM2 (when using size 3 or 4 DS7 soft starters) make it possible to quickly and cost-effectively pull up the circuit-breakers to the soft starters' connection height and to ensure uninterrupted thermal air circulation via the heat sink.
  Two spacers are required for each fixing screw. They are supplied in a set with 4 units:
  NZM1: 1 x NZM1/2-XAB; NZM2: 4 x NZM1/2-XAB



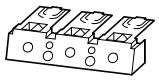
NZM1/2-XAB (260203) for use with:

NZM1(-4), PN1(-4), N(S)1(-4)
NZM2(-4), PN2(-4), N(S)2(-4)

→ Section 3.3.3, „Mounting instructions (Sizes 3 and 4)“, page 70

- **Terminal cover (knockout)**
  Used to increase the degree of protection against contact to IP2X and to provide protection when reaching into the connection area while connecting cables in the box terminal for size 4 DS7 soft starters. If there are two conductors, the maximum cross-sectional area is 22 mm^2 / AWG 4.
  Cannot be combined with NZM-XSTK control circuit terminal.

  Note: DE6-MNT-NZM mounting kit required

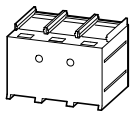


  NZM2-XKSFA (104640) for use with:

  NZM2, PN2, N(S)2
  DS7-34…SX135…
  DS7-34…SX160…
  DS7-34…SX200

- **Cover**
  Protection against accidental contact for size 4 DS7 soft starters when connecting cable lugs, busbars, or using tunnel terminals . When using insulated conductor material to IP1X.

  Note: DE6-MNT-NZM mounting kit required



  NZM2-XKSA (260038**)** for use with:

  DS7-34…SX135…
  DS7-34…SX160…
  DS7-34…SX200…

- **Mounting kit**
  When using terminal covers NZM2-XKSFA and NZM2-XKSA for size 4 DS7 soft starters

  DE6-MNT-NZM (107323) for use with:

  DS7-34xSX135N0-x
  DS7-34xSX160N0-x
  DS7-34xSX200N0-x

- **IP2X protection against finger contact for box terminal**
  For size 4 DS7 soft starters for box terminals; used to increase the protection against contact to IP2X. Protection when reaching into the cable connection area with the connection of cables in the box terminal. If there are two conductors, the maximum cross-sectional area is 25 mm^2 / AWG 4.
  Cannot be combined with NZM-XSTK control circuit terminal.

  NZM2-XIPK (266773) for use with:

  DS7-34…SX135…
  DS7-34…SX160…
  DS7-34…SX200…

- **IP2X protection against finger contact for cover**
  For size 2 DS7 soft starters and NZM2-XKSA cover

NZM2-XIPA (266777) for use with:

DS7-34…SX135…
DS7-34…SX160…
DS7-34…SX200…

More information on SmartWire-DT can be found in the Eaton online catalog at: http://www.eaton.com/moeller → Support → Catalog Overview

9.5.4 Device fans

Device fan DS7-FAN-… provides the soft starter DS7 with

- an increased load cycle,
- operation at higher ambient temperatures,
- an extended starting time (t-start),
- a higher number of starts per hour.

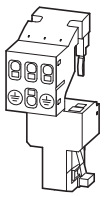
DS7-FAN-032 (135553) for use with:
DS7-34…SX004…
DS7-34…SX007…
DS7-34…SX009…
DS7-34…SX012…
DS7-34…SX016…
DS7-34…SX024…
DS7-34…SX032…

DS7-FAN-100 (169021) for use with:
DS7-34…SX041…
DS7-34…SX055…
DS7-34…SX070…
DS7-34…SX081…
DS7-34…SX100…

DS7-FAN-200 (169022) for use with:
DS7-34…SX135…
DS7-34…SX160…
DS7-34…SX200…

9.5.5 Motor feeder plug

Makes it possible to use a plug-in motor feeder with size 1 DS7 soft starters.



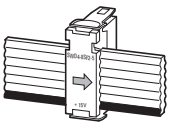
DILM12-XMCP/T (121770) for use with:

DS7-34…SX004…
DS7-34…SX007…
DS7-34…SX009…
DS7-34…SX012…

Wiring of the motor feeder plug:
→ Instructional leaflet IL03407054Z (previously AWA2100-2690), "Motor feeder plug wiring kit DILM12-XMCE, DILM12-XMCP/E, DILM12-XMCP/T, XTCEXMCEB, XTCEXMCPEB, XTCEXMCPTB"

As PDF document on the Internet:
http://www.eaton.com/moeller → Support → Instructional leaflet AWA/IL (search term: 03407054)

9.5.6 SmartWire-DT



Cable, plug, tool etc.

More information on SmartWire-DT can be found in the Eaton online catalog at: http://www.eaton.com/moeller → Support → Catalog Overview

9.6 Dimensions

The mounting should take into account the weight and dimensions of the soft starter. For this use the necessary technical equipment and tools.
Improper handling or use of the wrong tools may cause damage to the soft starter.

Size 1

DS7-34…SX…	Ø [mm]	Weight [kg]
…003…	4	DS7-340…: 0.3
…004…		DS7-340…: 0.3
…005…		DS7-34D…-D: 0.33
…007…		
…009…		
…012…		

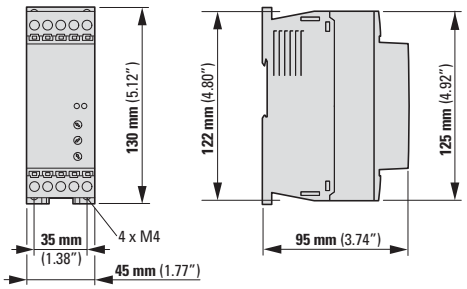


Figure 137: Dimension drawing DS7 without SWD – Size 1 (up to 12 A)

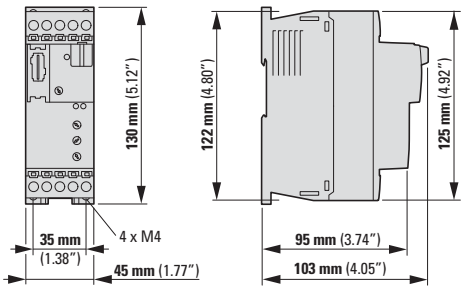


Figure 138: Dimension drawing DS7 with SWD – Size 1 (up to 12 A)

Size 2

DS7-34…SX…	Ø [mm]	Weight [kg]
…016…	4	0.4
…024…		
…032…		

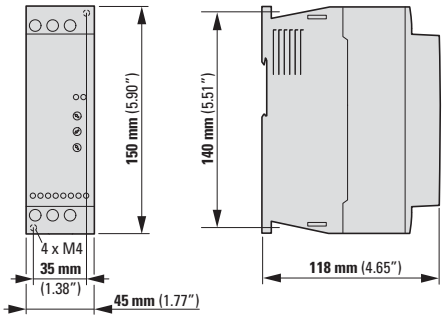


Figure 139: Dimension drawing DS7 without SWD – Size 2 (16 – 32 A)

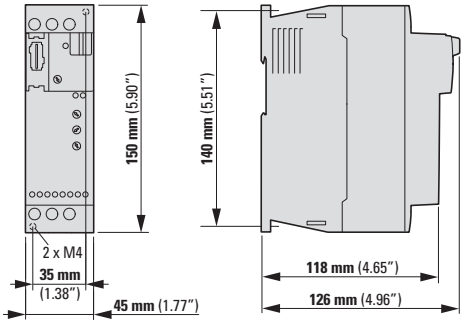


Figure 140: Dimension drawing DS7 with SWD – Size 2 (16 – 32 A)

Size 3

DS7-34…SX…	Ø [mm]	Weight [kg]
…036…	4	1.8
…041…		
…055…		
…070…		
…081…		
…100…		

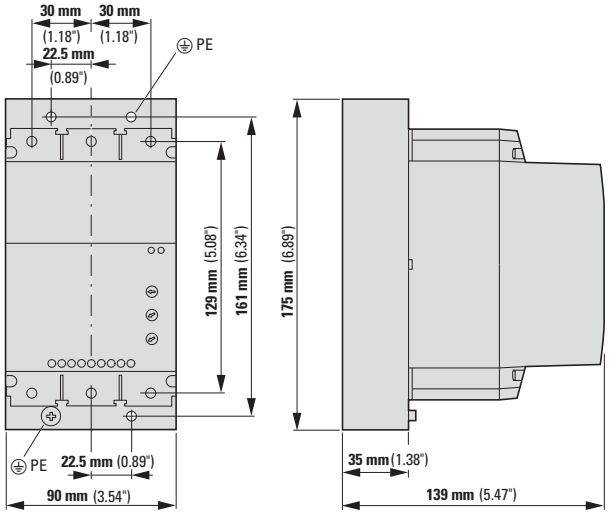


Figure 141: Dimension drawing DS7 without SWD – Size 3 (41 – 100 A)

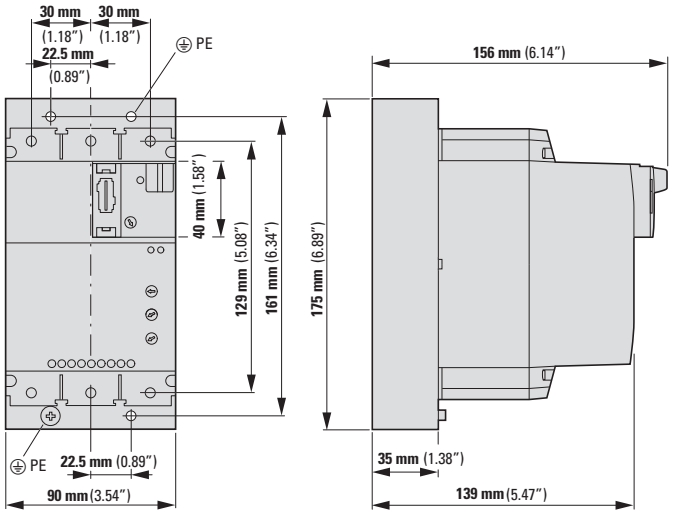


Figure 142: Dimension drawing DS7 with SWD – Size 3 (41 – 100 A)

Size 4

DS7-34…SX…	Ø [mm]	Weight [kg]
…135…	5	3.4
…160…		
…200…		

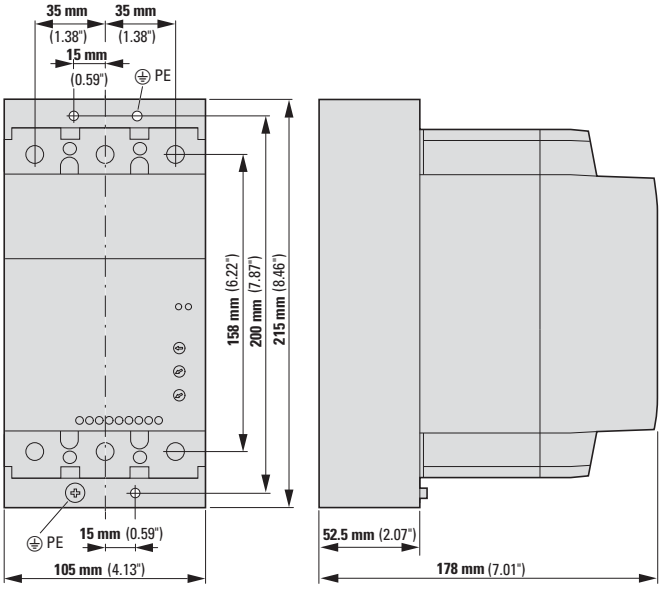


Figure 143: Dimension drawing DS7 without SWD – Size 4 (135 – 200 A)

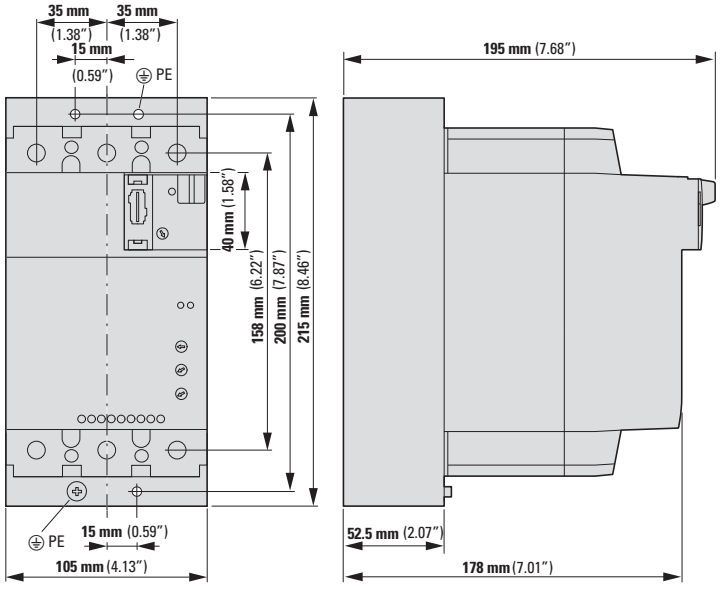
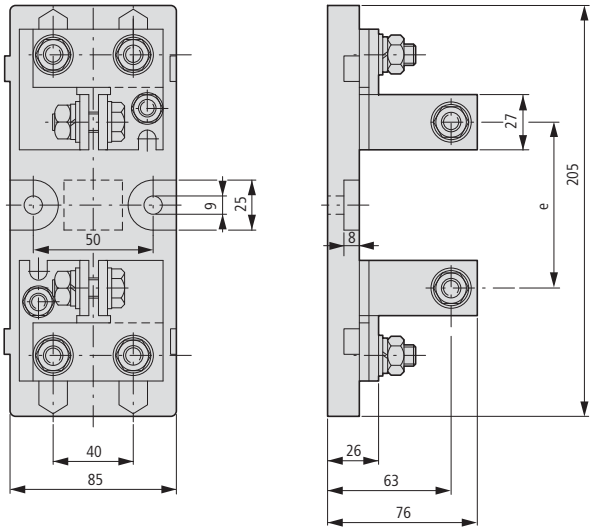


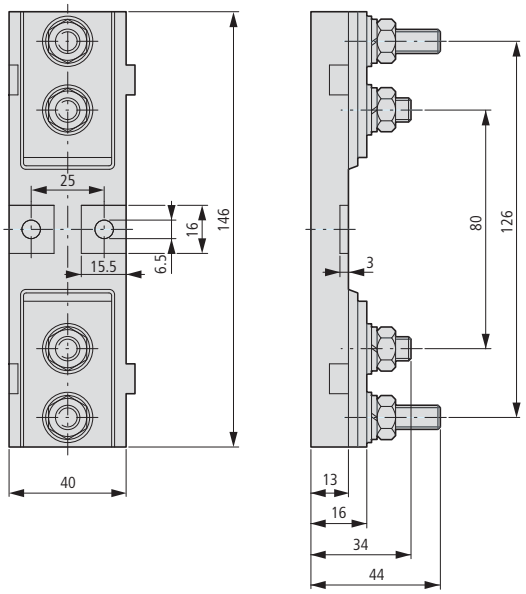
Figure 144: Dimension drawing DS7 with SWD – Size 4 (135 – 200 A)

Fuse base/fuse holder

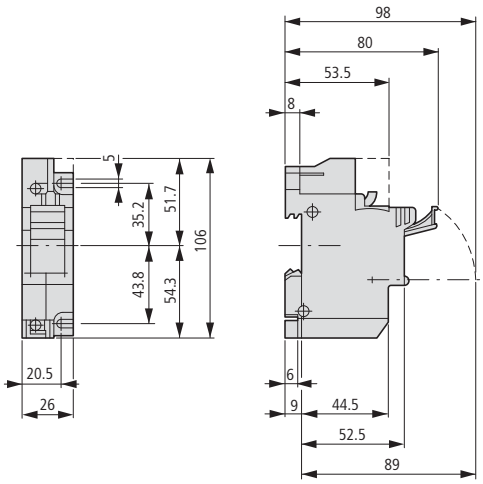
21.313.02



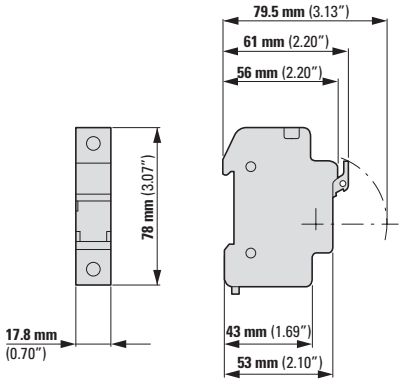
21.189.01



51.060.04

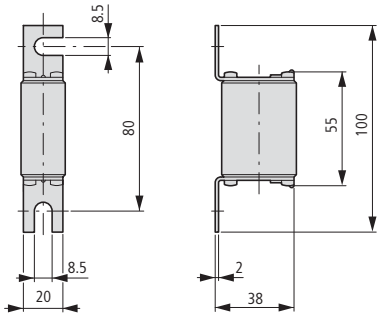


51.063.04

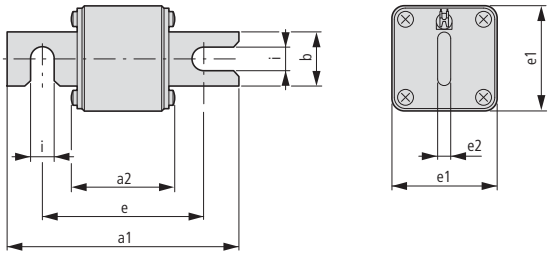


Fuses

20.282.20-…

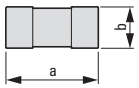


20.610.32-…



Part no.	a1	a2	b	e	e1	e2	i
20.610.32-200	109	47.5	26	76	51	6	11
20.610.32-350	109	47.5	26	76	51	6	11
20.610.32-400	109	47.5	26	76	51	6	11
20.610.32-500	109	47.5	26	76	51	6	11

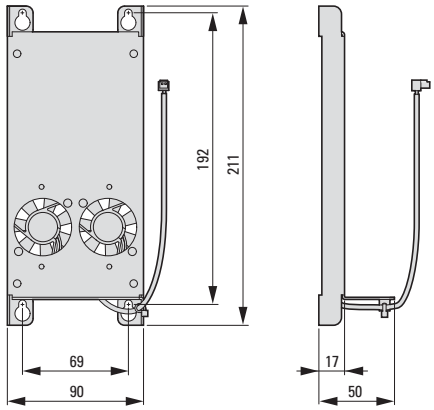
50.179.06-…



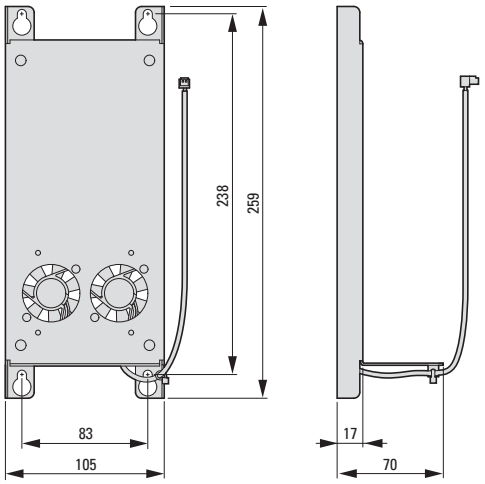
Part no.	a	b
50.179.06-16	38	10
50.140.06-25	58	20
50.140.06-50	58	20
50.140.06-63	58	20
50.140.06-80	58	20

Device fan DS7-FAN-…

DS7-FAN-100



DS7-FAN-200



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