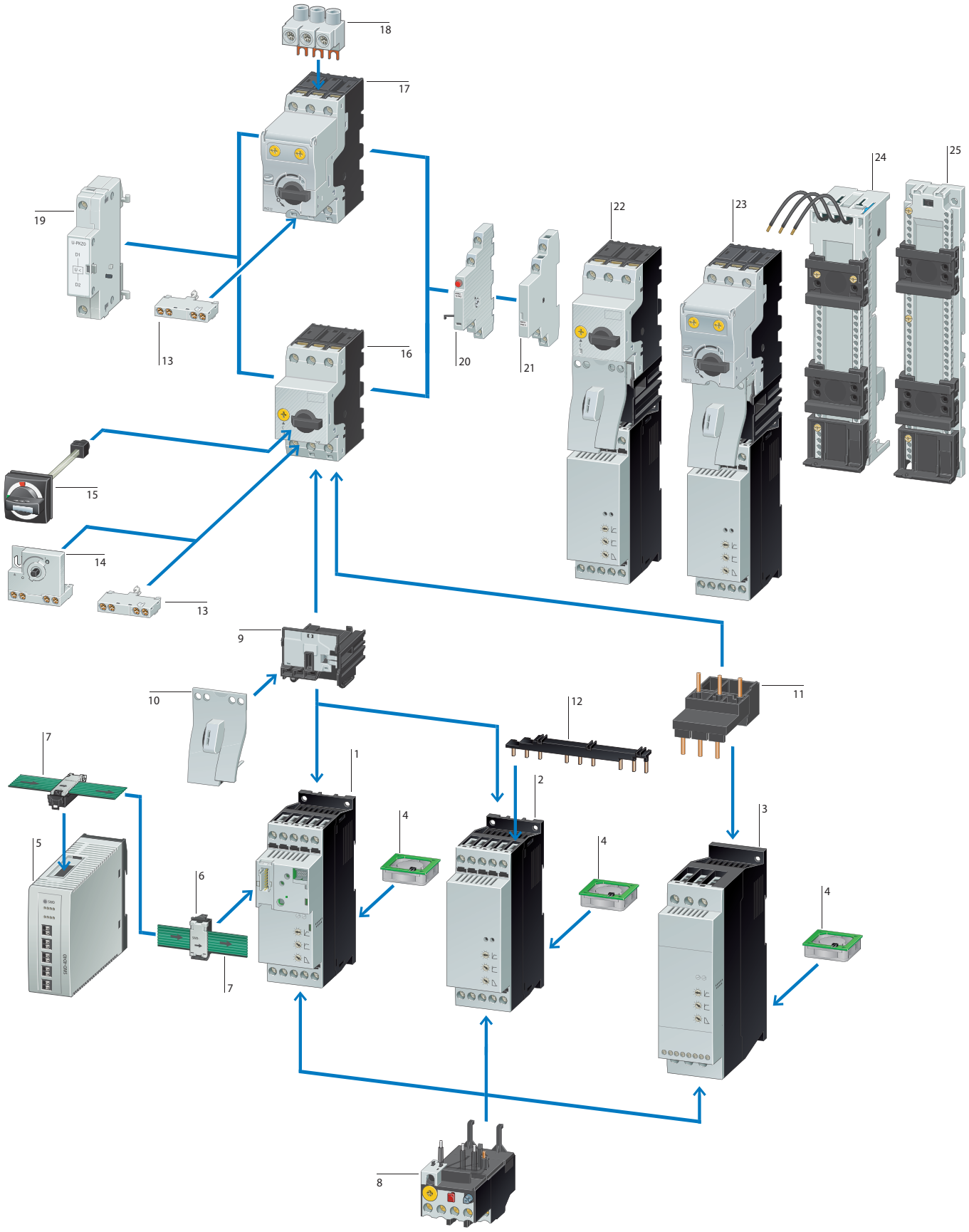
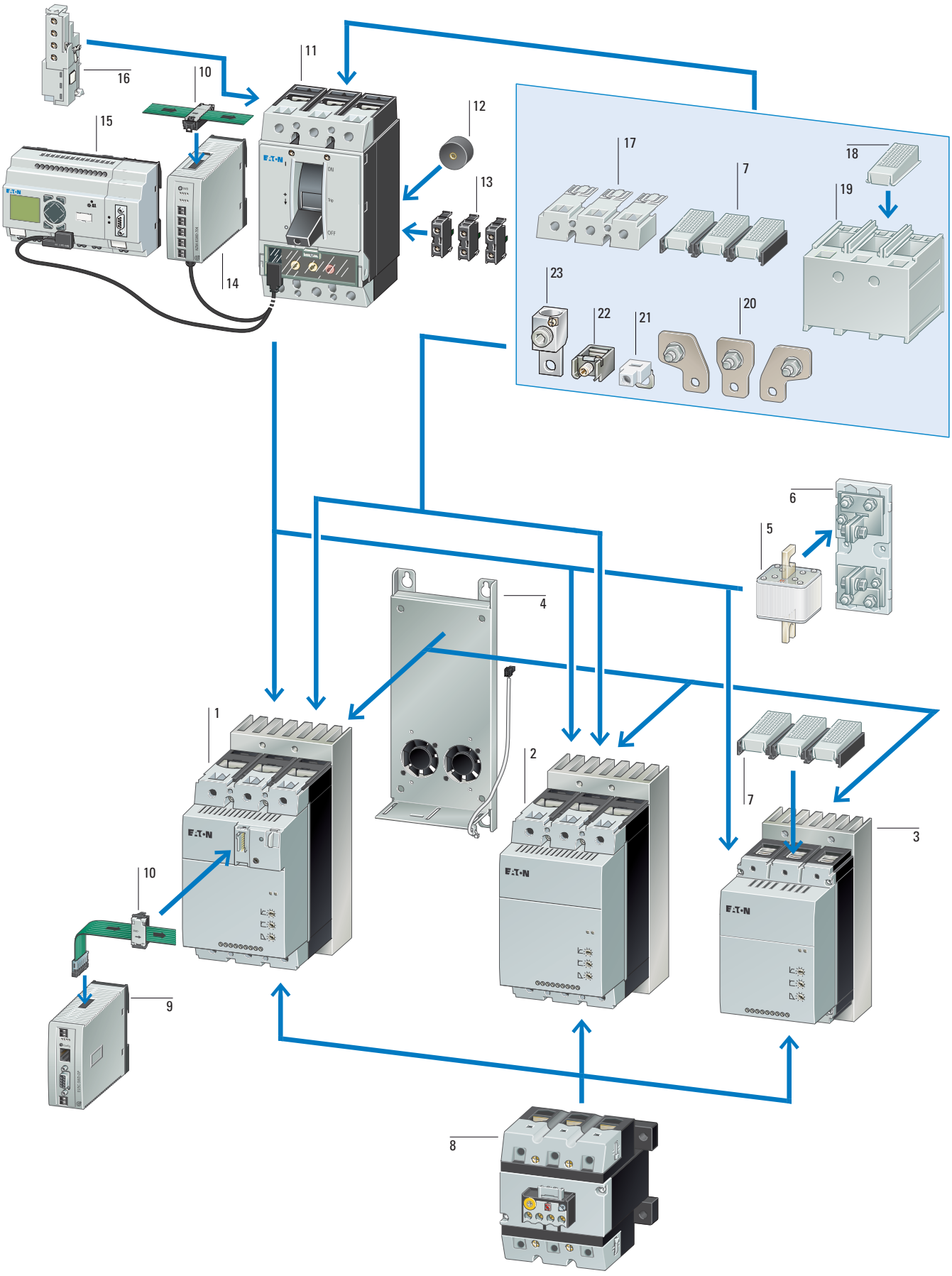
Soft Starter DS7 of System xStart – Soft at the Start, High on Torque

Soft starters have become a well-established alternative to the star-delta starter. This is where the DS7, featuring two-phase control and designed to work seamlessly with DILM and PKZ switchgear, comes in. The DS7 can be flexibly combined with other units and adds the ability to "start motors softly" to the switching, protection, and starting functions common to control panels. A patented method ensures that motor run-ups will be exceptionally soft while providing a higher torque than other available solutions. Longer service intervals and reduced operating costs are welcome side effects of this.

Designed for normal applications such as pumps, fans and small conveyors, the compact DS7 is ideal. The DS7 is also available with a SmartWire-DT connection to simplify wiring and enhance functionality as an automation solution.

System overview

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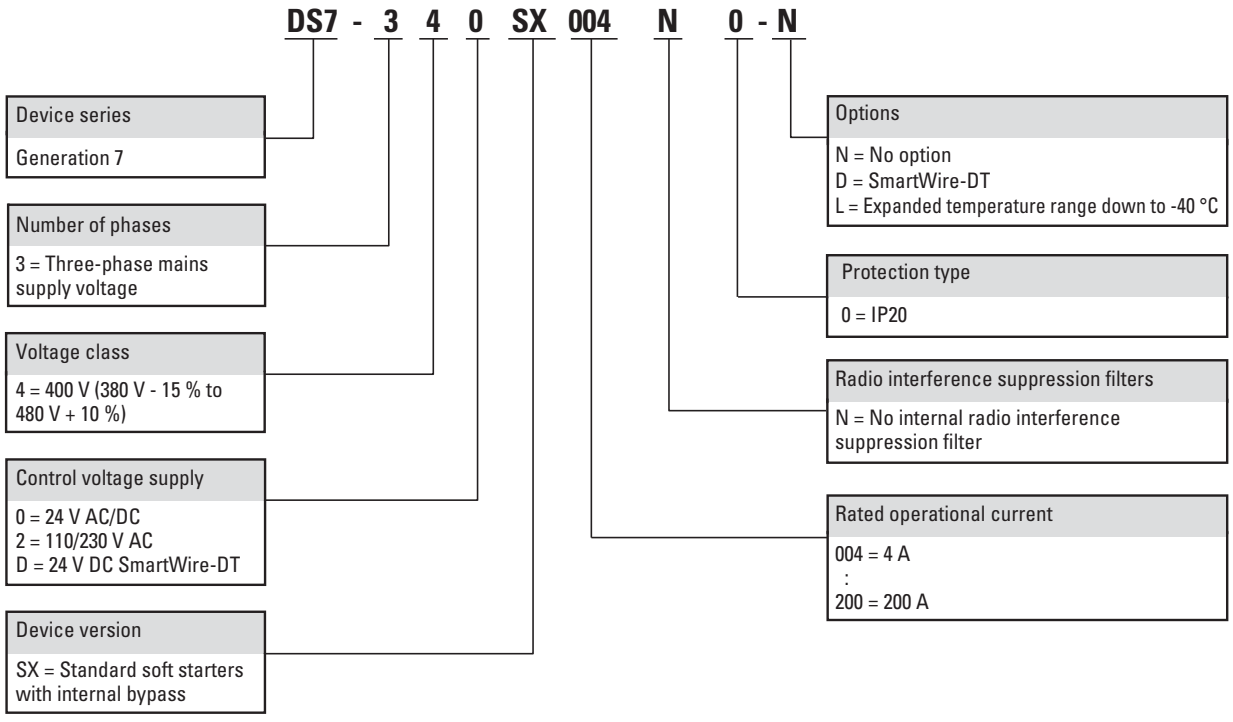
Key to type references



Description

Application

The DS7 series soft starters are two-phased controlled soft starters used for soft starting three-phase AC motors for applications with a normal operating frequency and a performance range of 3 to 200 A (1.1 to 110 kW with a 400 V mains voltage).
Closing transients and DC components during startup are effectively suppressed and guarantee even motor starting.
The special actuation method (asymmetrical trigger phase control) for the soft starter function avoids the DC components (Eaton patent) that would normally occur in two-phase-controlled soft starters. This suppresses the generation of an elliptical rotating field, which would cause uneven motor starting and increase the motor's acceleration. The true run behavior of the DS7 is therefore comparable with that of a three-phase controlled soft starter.

Functions

Typical fields of application for Series DS7 soft starters are:
- Pump drives: pressure surges are prevented through soft starting. The mechanical load on the whole plant is reduced and its service life increases.
- Fan drives: soft starting keeps fan belts from slipping, preventing premature wear. This lowers operating costs and extends the system's lifespan.
- Conveyor belts: conveyor belts start running smoothly, instead of starting with a jolt. This ensures that any goods being conveyed do not topple over. Mechanical damage to the belt itself is avoided, making it more durable.

Features

- The ramp time can be adjusted by potentiometer within a range of 1 to 30 s (for starting) or 0 to 30 s (for stopping) with a potentiometer
- The start voltage (or start torque) can be adjusted within a range of 30 to 100 percent of the mains voltage with a potentiometer
- Significant reduction in switch-on current, achieved with a short soft start ramp time (min. 1 s) for lamp and heating loads
- Internal bypass relay: switches on automatically after the end of the ramp, bypassing the internal thyristors.
- This makes it possible to comply with radio interference level B without any additional measures.
- The motor's thermal load is smaller than it would be without asymmetric ignition control.
- Designed specifically for long cables

Documentation

Surface mounting and standard mounting procedures are described in the corresponding mounting instructions and in the manual.

Instructional leaflets:
IL03902003Z: for size 1 devices (up to 12 A motor output)
IL03902004Z: for size 2 devices (up to 32 A motor output)
IL03902005Z: for size 3, 4 devices (up to 200 A motor output)

Manual:
MN03901001Z

You can download the documentation for the DS7 soft starters from the Internet
at: www.moeller.net/support

Communication interface SmartWire-DT

Our SmartWire-DT interface completely eliminates the need for conventional control wiring. This has several advantages:
- No incorrect wiring
- Faster wiring
- Cost saving

The interface can be used to send control commands to the DS7-SWD and change and diagnose its parameter configuration; in addition, the control electronics can be powered via the SmartWire-DT cable. The device is controlled with one of three selectable profiles:
- A "start/stop" profile, which should already be familiar from the PKE motor-protective circuit-breaker and contactor combination
- An 8 bit-wide profile for the soft starter, which is provided the same way for the variable frequency drive and features more options
- A control profile comparable to a PROFIdrive profile, just like the one available for the variable frequency drive.

Regardless of the profile chosen, the DS7-SWD's parameters can be read and written to at any time by using acyclic services.
DS7-SWD makes it possible to read and write to all device parameters. The mechanisms of the parameter channel that is described for the drives in the PROFIdrive profile are used for this purpose. This profile provides a standardized parameter access method for variable frequency drives and soft starters.
It is also possible to overwrite the potentiometer settings on the DS7-SWD, which can come in handy, for instance, when a change made to the machine needs to be undone.

The DS7-SWD comes with a detailed diagnostic system with options that extend far beyond those of wired devices. In addition to having an error log, the DS7-SWD can detect and report nine different device faults.
A warning parameter reports any present alarm messages. Moreover, the response to each individual fault can be customized. Finally, there are 35 additional messages for communication errors. Using the DS7 in connection with the PKE opens up new functionalities that were previously thought impossible to implement with a low-cost soft starter and that were reserved to significantly more expensive devices. Combining a PKE unit and a DS7-SWD makes it possible to completely protect the DS7-SWD device against overloads. In addition, it provides a current limiting function and can report thermal capacity utilization levels to higher level controllers.

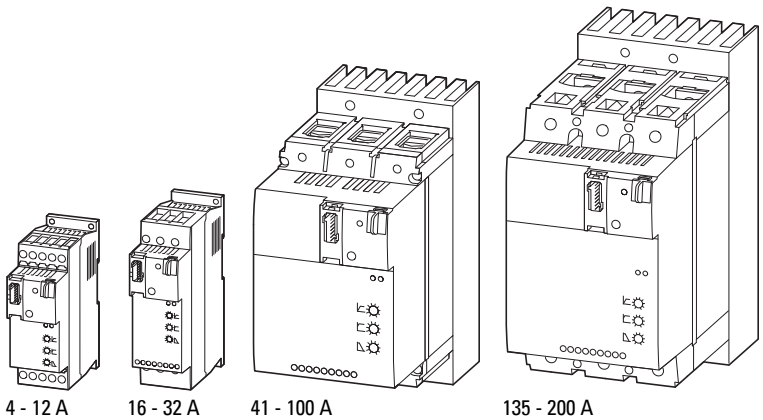
Expanded temperature range

DS7-340SX…-L soft starters can operate at temperatures as low as -40 °C.

Ordering

Rated operational current	Assigned motor rating		Part no.	Article no.	Price see price list	Part no.	Article no.	Price see price list	Std. pack
AC-53	at 400 V, 50 Hz	at 460 V, 60 Hz							
I_e	P	P							
A	kW	HP	**U_C 24 V AC/DC U_s 24 V AC/DC Standard temperature range**			**U_C 24 V AC/DC U_s 24 V AC/DC Expanded temperature range down to -40 °C**			
Soft starters									
Soft starters for three-phase loads Mains supply voltage (50/60 Hz) U_{LN} 200 - 480 V AC									
4	1.5	2	**DS7-340SX004N0-N**	134847		**DS7-340SX004N0-L**	171740		1 off
7	3	5	**DS7-340SX007N0-N**	134849		**DS7-340SX007N0-L**	171741		
9	4	5	**DS7-340SX009N0-N**	134910		**DS7-340SX009N0-L**	171742		
12	5.5	10	**DS7-340SX012N0-N**	134911		**DS7-340SX012N0-L**	171743		
16	7.5	10	**DS7-340SX016N0-N**	134912		**DS7-340SX016N0-L**	171744		
24	11	15	**DS7-340SX024N0-N**	134913		**DS7-340SX024N0-L**	171745		
32	15	25	**DS7-340SX032N0-N**	134914		**DS7-340SX032N0-L**	171746		
41	22	30	**DS7-340SX041N0-N**	134916		**DS7-340SX041N0-L**	171747		
55	30	40	**DS7-340SX055N0-N**	134917		**DS7-340SX055N0-L**	171748		
70	37	50	**DS7-340SX070N0-N**	134918		**DS7-340SX070N0-L**	171749		
81	45	60	**DS7-340SX081N0-N**	134919		**DS7-340SX081N0-L**	171750		
100	55	75	**DS7-340SX100N0-N**	134920		**DS7-340SX100N0-L**	171751		
135	75	100	**DS7-340SX135N0-N**	134921		**DS7-340SX135N0-L**	171752		
160	90	125	**DS7-340SX160N0-N**	134922		**DS7-340SX160N0-L**	171753		
200	110	150	**DS7-340SX200N0-N**	134923		**DS7-340SX200N0-L**	171754		
			U_C 110 - 230 V AC U_s 110 - 230 V AC			**U_C 24 V DC U_s 24 V DC**			
4	1.5	2	**DS7-342SX004N0-N**	134925		**DS7-34DSX004N0-D**	134943		1 off
7	3	5	**DS7-342SX007N0-N**	134927		**DS7-34DSX007N0-D**	134945		
9	4	5	**DS7-342SX009N0-N**	134928		**DS7-34DSX009N0-D**	134946		
12	5.5	10	**DS7-342SX012N0-N**	134929		**DS7-34DSX012N0-D**	134947		
16	7.5	10	**DS7-342SX016N0-N**	134930		**DS7-34DSX016N0-D**	134948		
24	11	15	**DS7-342SX024N0-N**	134931		**DS7-34DSX024N0-D**	134949		
32	15	25	**DS7-342SX032N0-N**	134932		**DS7-34DSX032N0-D**	134950		
41	22	30	**DS7-342SX041N0-N**	134934		**DS7-34DSX041N0-D**	134952		
55	30	40	**DS7-342SX055N0-N**	134935		**DS7-34DSX055N0-D**	134953		
70	37	50	**DS7-342SX070N0-N**	134936		**DS7-34DSX070N0-D**	134954		
81	45	60	**DS7-342SX081N0-N**	134937		**DS7-34DSX081N0-D**	134955		
100	55	75	**DS7-342SX100N0-N**	134938		**DS7-34DSX100N0-D**	134956		
135	75	100	**DS7-342SX135N0-N**	134939		**DS7-34DSX135N0-D**	134957		
160	90	125	**DS7-342SX160N0-N**	134940		**DS7-34DSX160N0-D**	134958		
200	110	150	**DS7-342SX200N0-N**	134941		**DS7-34DSX200N0-D**	134959		

Notes



4 - 12 A | 16 - 32 A | 41 - 100 A | 135 - 200 A

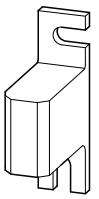
Information relevant for export to North America

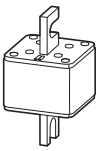
UL/CSA applies only for DS7…-N

Product Standards	IEC/EN 60947-4-2; GB 14048.6; UL 508; CSA-C22.2 No 0-M91; CSA-C22.2 No 14-05 CE marking
UL File No.	E251034
CSA File No.	2511305
CSA Class No.	321106
Suitable for	Branch circuits
Max. Voltage Rating	480 V
Degree of Protection	IP20; UL/CSA Type 1

Superfast semiconductor fuses

DIN 43653, 690/700 V (IEC/UL)
Inside micrometer 80 mm



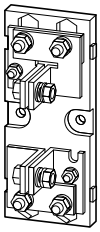


Rated device current A	Maximum power loss P_v W	Frame size	For use with	**Article no.**	**Price** see price list	Std. pack
16	5.5	000	DS7-34…SX004N0-…	**170M1359**		10 off
25	9	000	DS7-34…SX007N0-…	**170M1361**		
32	10	000	DS7-34…SX009N0-… DS7-34…SX012N0-…	**170M1362**		
50	15	000	DS7-34…SX016N0-…	**170M1364**		
63	16	000	DS7-34…SX024N0-…	**170M1365**		
80	19	000	DS7-34…SX032N0-…	**170M1366**		
125	26	S1*	DS7-34…SX041N0-… DS7-34…SX055N0-…	**170M3013**		
200	45	S1	DS7-34…SX070N0-… DS7-34…SX081N0-… DS7-34…SX100N0-…	**170M4008**		
315	58	S1	DS7-34…SX135N0-…	**170M4010**		
400	65	S2	DS7-34…SX160N0-… DS7-34…SX200N0-…	**170M5008**		

Information relevant for export to North America

Product Standards	IEC/EN 60269-4; UL 248-1; CSA-C22.2 No. 248.14; CE marking
UL File No.	E125085
UL Category Control No.	JFHR2
CSA File No.	053787_C_000
CSA Class No.	1422-30
North America Certification	UL recognized, CSA certified
Suitable for	semiconductor protection

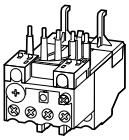
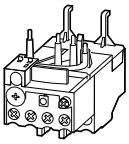
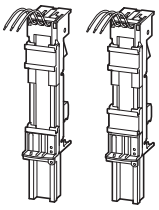
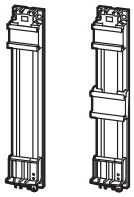
Fuse Bases

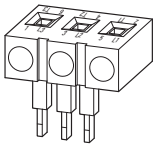
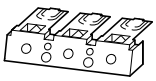
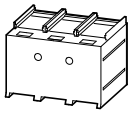


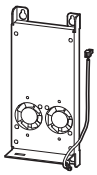
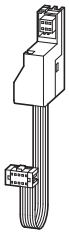
Dimensions (W x H x D) mm	For use with	**Article no.**	**Price** see price list	Std. pack
145 x 43 x 50	000, 00	**170H1007**		3 off
205 x 88 x 80	S1*, S1, S2, S3	**170H3004**		

Information relevant for export to North America

Product Standards	IEC/EN 60269-1; UL 512; CE marking
UL File No.	E14853
UL Category Control No.	IZLT2
North America Certification	UL listed
Suitable for	DIN 43653 fuses

	For use with	Part no. Article no.	Price see price list	Std. pack	Information relevant for export to North America
Overload relays					
	DS7-34…SX004…	**ZB12-4** 278438		1 off	Product Standards: UL 508; CSA-C22.2 No. 14; IEC/EN 60947-4-1; IEC/EN 60947-5-1; CE marking UL File No.: E29184 UL Category Control No.: NKCR CSA File No.: 12528 CSA Class No.: 3211-03 North America Certification: UL listed, CSA certified Suitable for: Branch circuits Max. Voltage Rating: 600 V AC Degree of Protection: IEC: IP20, UL/CSA Type: -
	DS7-34…SX007… DS7-34…SX009…	**ZB12-10** 278440			
	DS7-34…SX012…	**ZB12-12** 278441			
	DS7-34…SX016…	**ZB32-16** 278452			
	DS7-34…SX024…	**ZB32-24** 278453			
	DS7-34…SX032…	**ZB32-32** 278454			
Wiring set					
For DOL Starter					
 	DS7-34…SX004… DS7-34…SX007… DS7-34…SX009… DS7-34…SX012…	**PKZM0-XDM12** 283149		1 off	Product Standards: UL 508; CSA-C22.2 No. 14; IEC60947-4-1; CE marking UL File No.: E36332 UL Category Control No.: NLRV CSA File No.: 165628 CSA Class No.: 3211-05 North America Certification: UL listed, CSA certified
Electric contact module					
	DS7-34…SX016… DS7-34…SX024… DS7-34…SX032…	**PKZM0-XM32DE** 239349		5 off	Product Standards: UL 508; CSA-C22.2 No. 14; IEC60947-4-1; CE marking UL File No.: E36332 UL Category Control No.: NLRV CSA File No.: 165628 CSA Class No.: 3211-05 North America Certification: UL listed, CSA certified
Busbar adapters					
	PKZM0, PKE + DS7...004N... PKZM0, PKE + DS7...007N... PKZM0, PKE + DS7...009N... PKZM0, PKE + DS7...012N...	**BBA0L-25** 142526		1 off	
	PKZM0, PKE + DS7...016N... PKZM0, PKE + DS7...024N... PKZM0, PKE + DS7...032N...	**BBA0L-32** 142527		1 off	
Top-hat rail adapter					
45 mm wide adapter plate					
	PKZM0, PKE + DS7...004N... PKZM0, PKE + DS7...007N... PKZM0, PKE + DS7...009N... PKZM0, PKE + DS7...012N...	**PKZM0-XC45L** 142529		1 off	
	PKZM0, PKE + DS7...016N... PKZM0, PKE + DS7...024N... PKZM0, PKE + DS7...032N...	**PKZM0-XC45L/2** 142570		1 off	

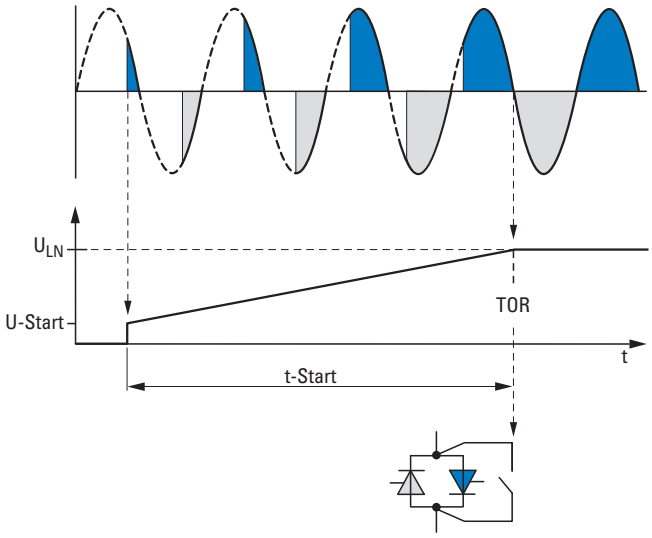
	For use with	Part no. Article no.	Price see price list	Std. pack	Notes	Information relevant for export to North America
Three-phase commoning links protected against accidental contact, short-circuit proof, U_e = 690 V, I_u = 35 A can be extended by rotating installation (∑ Iu ≦ 35 A)						
	DS7-34…SX004… DS7-34…SX007… DS7-34…SX009… DS7-34…SX012…	**DILM12-XDSB0/3** 240084		5 off	For the primary side of DS7 Suitable for 3 DS7 soft starters Length 112 mm	Product Standards: IEC/EN 60947-4-1; UL 508; CSA-C22.2 No. 14-05; CE marking UL File No.: E36332 UL Category Control No.: NLRV CSA File No.: 012528 CSA Class No.: 2411-03 North America Certification: UL listed, CSA certified
		**DILM12-XDSB0/4** 240085			For the primary side of DS7 Suitable for 4 DS7 soft starters Length 157 mm	
		**DILM12-XDSB0/5** 240086			For the primary side of DS7 Suitable for 5 DS7 soft starters Length 202 mm	
Incoming connection block						
	DS7-34…SX004… DS7-34…SX007… DS7-34…SX009… DS7-34…SX012…	**DILM12-XEK** 240083		5 off	For three-phase commoning link, protected against accidental contact, U_e = 690 V, I_u = 35 A. Connection cross section: Stranded 2.5…16 mm² Flexible with ferrule 2.5…16 mm² AWG14…8	Product Standards: IEC/EN 60947-4-1; UL 508; CSA-C22.2 No. 14-05; CE marking UL File No.: E36332 UL Category Control No.: NLRV CSA File No.: 012528 CSA Class No.: 2411-03 North America Certification: UL listed, CSA certified
Terminal cover						
knockout 	DS7-34…SX041… DS7-34…SX055… DS7-34…SX070… DS7-34…SX081… DS7-34…SX100…	**NZM1-XKSFA** 100780		1 off	-	UL/CSA certification not required
knockout 	DS7-34…SX135… DS7-34…SX160… DS7-34…SX200…	**NZM2-XKSFA** 104640		1 off	Type contains parts for a terminal located at top or bottom for 3 pole circuit-breakers. Enhancement of the busbar tag shroud (simple protection against contact with a finger). Protection when reaching into the cable connection area with the connection of cables in the box terminal. With 2 conductors max cross section 22 mm² or AWG4. Cannot be combined with NZM-XSTK control circuit terminal.	UL/CSA certification not required
	DS7-34…SX135… DS7-34…SX160… DS7-34…SX200…	**NZM2-XKSA** 260038		1 off	Type contains parts for a terminal located at top or bottom for 3 pole circuit-breakers. Insulation/protection against direct contact where cable lugs or busbars are connected or tunnel terminals are used. Included in the set with tunnel terminals. When using insulated conductor material to IP1X.	Product Standards: UL489; CSA-C22.2 No. 5-09; IEC60947, CE marking UL File No.: E31593 UL Category Control No.: DIHS CSA File No.: 22086 CSA Class No.: 1432-01 North America Certification: UL listed, CSA certified Suitable for: Refer to main component information

	For use with	Part no. Article no.	Price see price list	Std. pack	Notes	Information relevant for export to North America
IP2X protection against contact with a finger Type contains parts for a terminal located at top or bottom for 3 pole circuit-breakers. Enhancement of the busbar tag shroud to IP2X.						
For box terminal 	NZM2, PN2, N2	**NZM2-XIPK** 266773		1 off	Protection when reaching into the cable connection area with the connection of cables in the box terminal.With 2 conductors max cross section 25 mm² or AWG4. Cannot be combined with NZM-XSTK control circuit terminal.	UL/CSA certification not required
for cover NZM2-XKSA or NZM2 or NZM2...(C)NA und N(S)2...NA 	NZM2, PN2, N(S)2	**NZM2-XIPA** 266777		1 off	When mounting NZM2-..-(C)NA or NZM...-NA the following applies:with 2 conductors max cross section 25 mm² or AWG4.	UL/CSA certification not required
Mounting kit when using covers NZM1-XKSFA and NZM2-XKSA						
	DS7-34xSX041N0-x DS7-34xSX055N0-x DS7-34xSX070N0-x DS7-34xSX081N0-x DS7-34xSX100N0-x DS7-34xSX135N0-x DS7-34xSX160N0-x DS7-34xSX200N0-x	**DE6-MNT-NZM** 107323		1 off	-	
Device fans flush-mounted fan						
	DS7-34…SX004… DS7-34…SX007… DS7-34…SX009… DS7-34…SX012… DS7-34…SX016… DS7-34…SX024… DS7-34…SX032…	**DS7-FAN-032** 135553		1 off	flush-mounted fan	UL/CSA certification not required
	DS7-34…SX041… DS7-34…SX055… DS7-34…SX070… DS7-34…SX081… DS7-34…SX100…	**DS7-FAN-100** 169021			Bottom fans	
	DS7-34…SX135… DS7-34…SX160… DS7-34…SX200…	**DS7-FAN-200** 169022				
PKE communications cable 6 pole Prefabricated with two plugs For connecting the PKE to DS7-SWD						
	DS7…SWD	**PKE32-COM** 168970		1 off		
Switched-mode power supply units easyPOW Single-phase Nominal input voltage 100 - 240 V AC Rated output voltage 24 V DC (± 3%) Rated output current 1.25 A						
		**EASY400-POW** 212319		1 off		

Engineering

Generalized phase control of motor voltage

By means of generalized phase control, the soft starter adjusts the grid's voltage (U_{LN}smoothly from an adjustable start value to 100 % of the rated value U_{LN} .

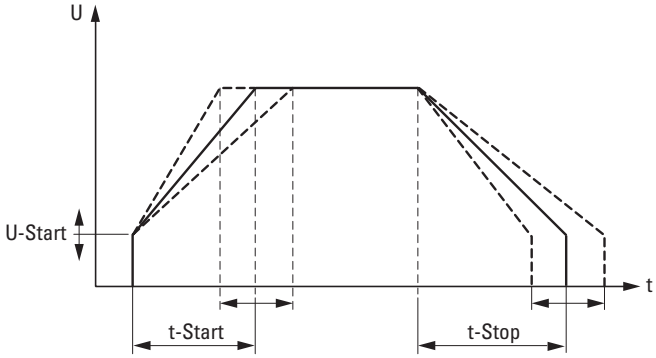


U_{LN}:Mains supply voltage
U-Start: start voltage
t-Start: Ramp time of the voltage change at start
TOR (Top of Ramp): Signals the end of the set "t-Start" ramp time (output voltage U_2 = Mains supply voltage U_{LN}). The internal bypass contacts are closed after this.

This voltage control enables the inrush current of a three-phase asynchronous motor to be limited and its starting torque to be reduced. This enables a smooth and jerk-free increase in torque, adjusted in line with the machine's load behavior. This has a positive effect on the lifespan, operating behavior, and operating processes of the mechanical equipment and prevents negative effects such as:

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

In DS7 and S801+/S811+ series soft starters, generalized phase control is achieved with anti-parallel thyristors that are bypassed for continuous operation by using bypass contacts (TOR = Top Of Ramp) after the time for a time-triggered 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.
As well as the time-controlled startup of a motor, the soft starter also enables a time-controlled reduction of the motor voltage and thus a controlled stopping of the motor.



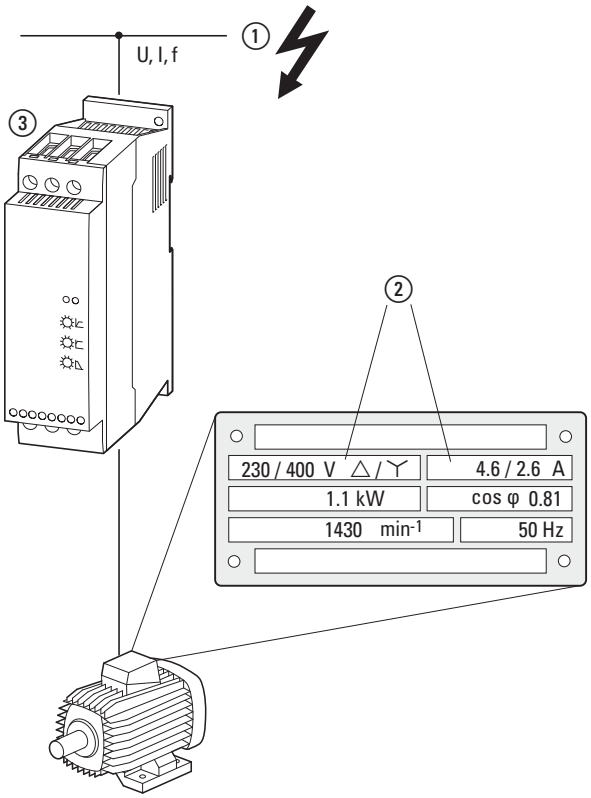
The output voltage of a soft starter determines the torque of the motor (M ~ U^2). Because of this, it is necessary to make sure that, when a machine starts up, the selected U-Start start voltage is not too low and the t-Start ramp time for the linear voltage change is set to be as short as possible.

Please note:

- Long ramp times (t-Start) will produce a soft startup behavior, but will also result in a higher thermal load on the thyristors
- A high start voltage (U-Start) will produce a higher torque and a high starting current
- Set the lowest possible start voltage and the shortest possible start ramps.

The following pages include application and setting configuration examples for DS7 soft starters.
If controlled deceleration is required, t-Stop must be set to a longer time than would be necessary for the machine to coast freely based on the load. For the thyristors, the controlled deceleration constitutes a load comparable to that produced during 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 will be reduced to five per hour (plus five stops within that hour).

Selection criteria



Soft starters ③ are selected based on the supply voltage of the corresponding grid ① (ULN) and the rated operational current of the assigned motor ②. The motor's circuit configuration (Δ/Y) must be selected in such a way that it matches the supply voltage. In addition, the soft starter's rated operational current (Ie) must be at least equal to that of the motor.

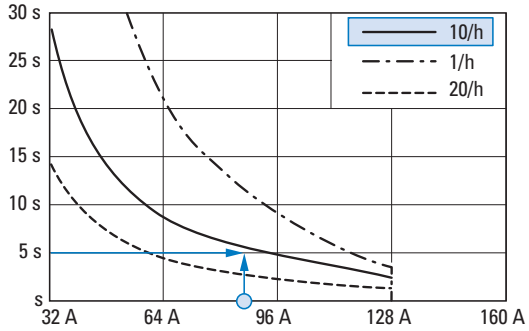
Additional selection criteria include:
- Ambient air temperature (rated value +40 °C)
- The number of starts per hour (< 10 starts, take stops into account)
- Load torque (quadratic, linear)
- Starting torque

Centrifugal pumps, centrifugal fans, simple and smooth-running conveyor belts and traction drives, and circular saws and ribbon saws are some of the typical applications for which soft starters are used. Reciprocating compressors, mixers, mills, crushers, and lifting gear are instead categorized as heavy starting duty machines. In this case, the soft starter must be oversized in terms of its overload capacity.

In the case of applications that are typical for a soft starter, such as water pumps (centrifugal pumps), and that feature comparable operational data (operating frequency, run-up time, and/or inrush currents) a soft starter can be assigned directly to the motor on the basis of the rated operational current.

Example:
- 15 kW Pump motor
- 400 V
- Rated operational current 29 A
- About three times the starting current (I_{LRP} = 87 A),
- A maximum of 10 starts per hour
- 5-second start-up time
- ambient air temperature 40 °C.

=> DS7-34…032… (I_e = 32 A)



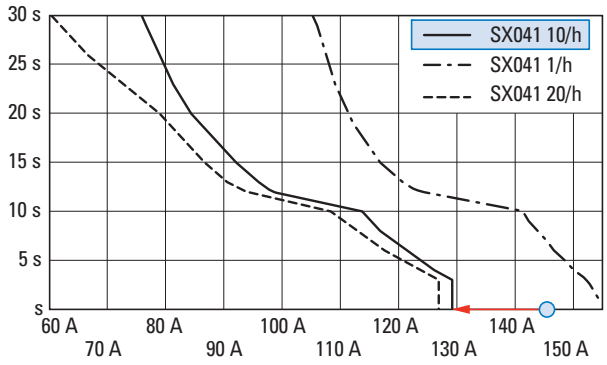
When different operating frequencies, run-up times and/or starting currents are involved, the thermal capacity of the DS7 soft starter must be taken into account in the design. This can be done by using the following diagrams or by calculating the I^2t values. These I^2t values define the corresponding load capacity and overload cycle and are defined in product standard IEC/EN 60947-4-2.

DS7-34…SX032…soft starter:
- 32A: AC-53a: 3-5: 75-10
- Rated operational current (I_e) 32 A
- Load cycle AC-53a
- 300% overcurrent for 5 seconds
- 75% duty factor with 10 starts per hour

The resulting I^2t value is: $(3 \times 32\ A)^2 \times 5\ s = 46.080\ A^2s$
The maximum I^2t value of the connected motor load must be smaller:
$(3 \times 29\ A)^2 \times 5\ s = 37.845\ A^2s$
Soft starter DS7-34…SX032… is the right choice for this application.

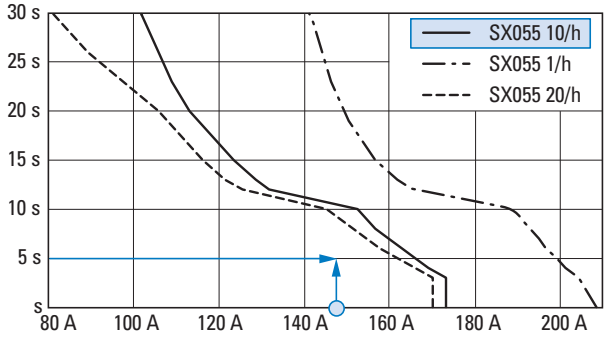
If the motor had a higher inrush current, e.g., 5 times the starting current, a more powerful soft starter would have to be selected:
- Motor inrush current: $I_{LRP} = 5 \times 29 = 145$ A, I^2t value = $(5 \times 29\ A)^2 \times 5\ s = 105.125\ A^2s$
- DS7-34…SX041…: 41A:
  AC-53a: 3-5: 75-10
  => $(3 \times 41\ A)^2 \times 5\ s = 75.645\ A^2s$

Soft starter DS7-34…SX041… cannot meet the required startup and load conditions required in this case.

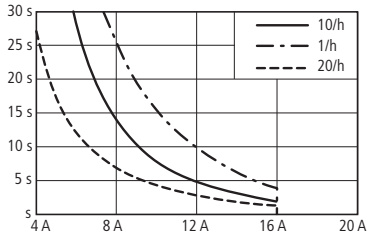


DS7-34…SX055…:
55A: AC-53a: 3-5: 75-10
=> $(3 \times 55\ A)^2 \times 5\ s = 136.125\ A^2s$
Soft starter DS7-34…SX055…, however, does meet the required startup and load conditions.

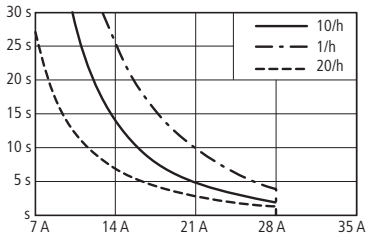
Note: As the following diagram shows, the DS7-34…SX055… unit can handle even more demanding startup and load requirements, e.g., up to 20 starts per hour and longer start-up times (up to 10 seconds).



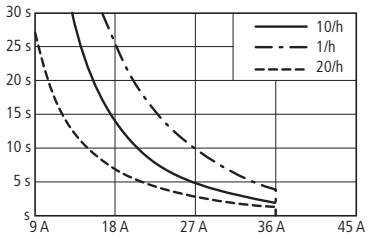
DS7-34...SX004...



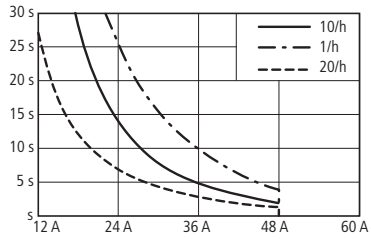
DS7-34...SX007...



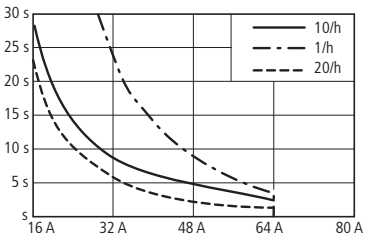
DS7-34...SX009...



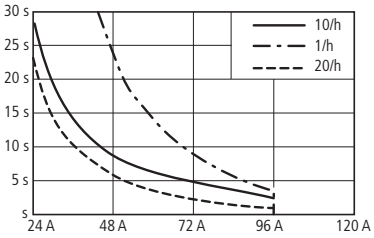
DS7-34...SX012...



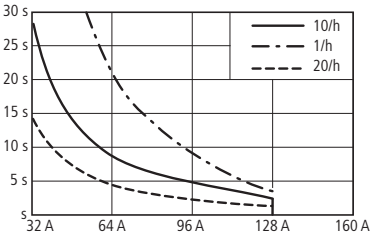
DS7-34...SX016...



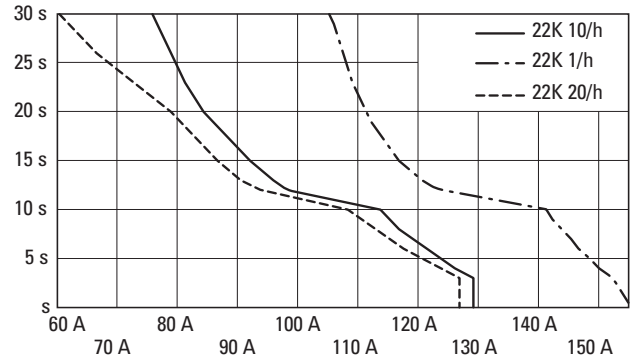
DS7-34...SX024...



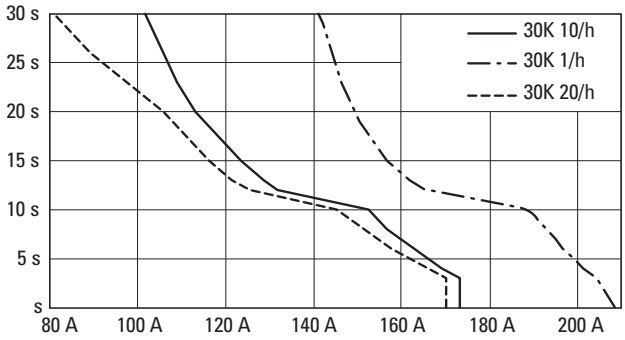
DS7-34...SX032E...



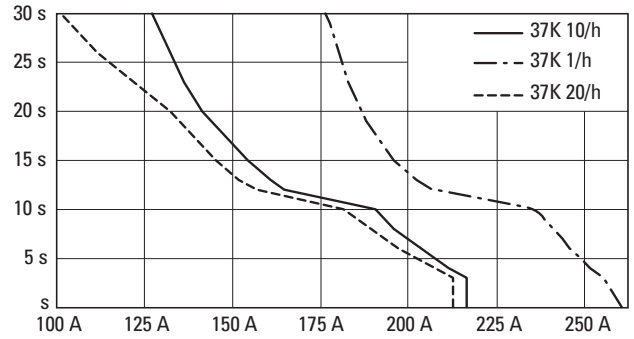
DS7-34...SX041N0-...



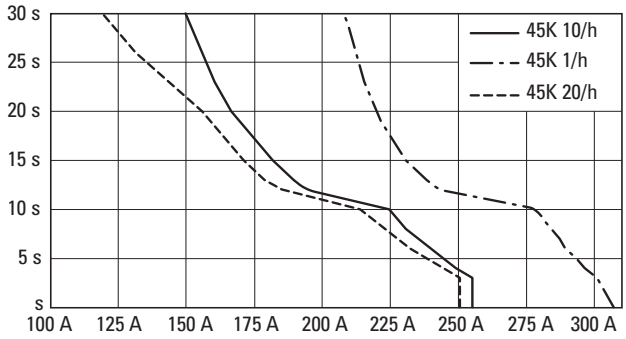
DS7-34...SX055N0-...



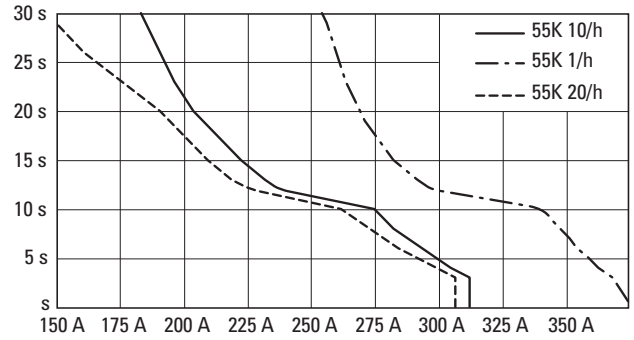
DS7-34...SX070N0-...



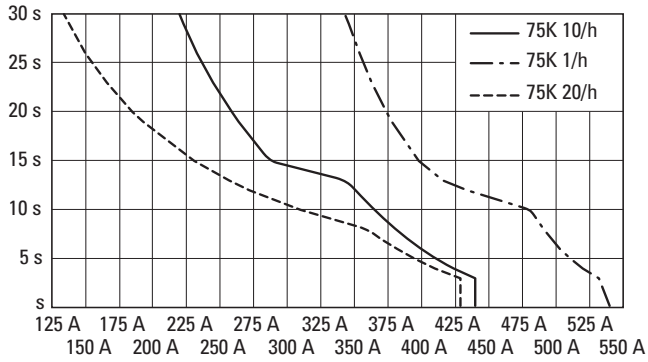
DS7-34...SX081N0-...



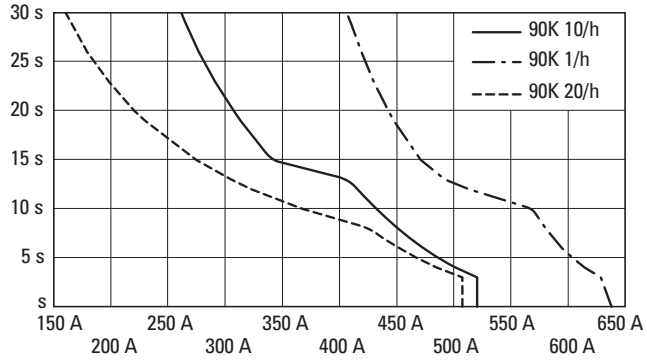
DS7-34...SX100N0-...



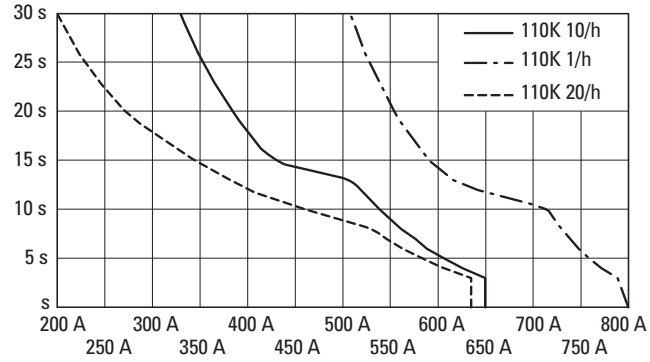
DS7-34...SX135N0-...



DS7-34...SX160N0-...

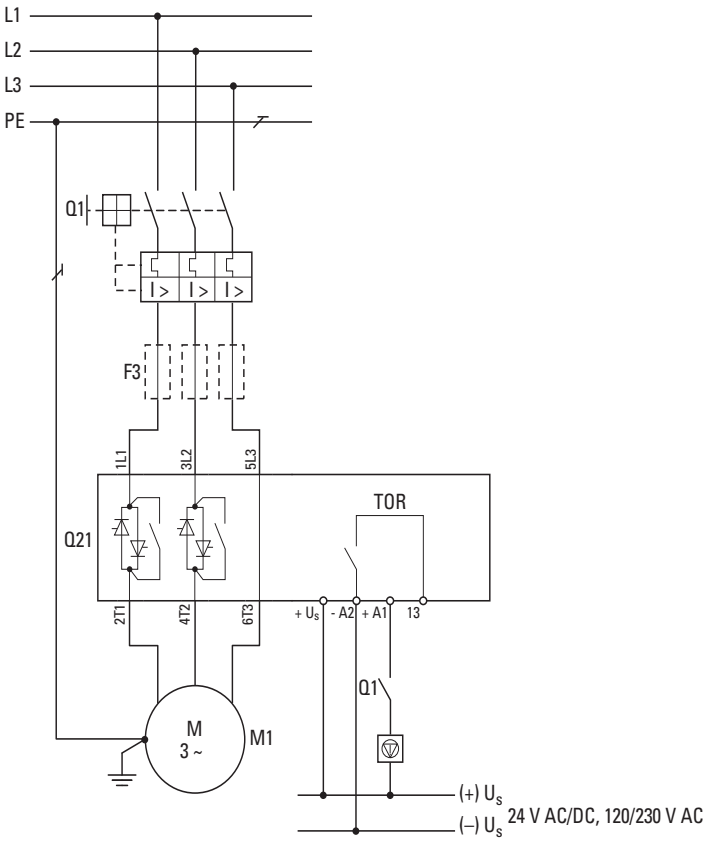


DS7-34...SX200N0-...

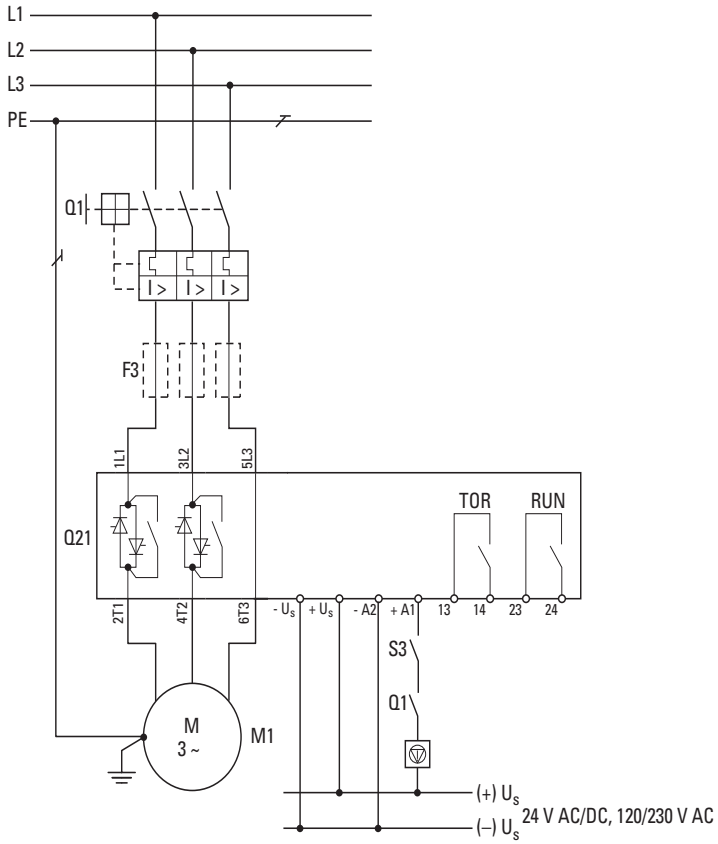


DS7

Standard connection
up to 12 A



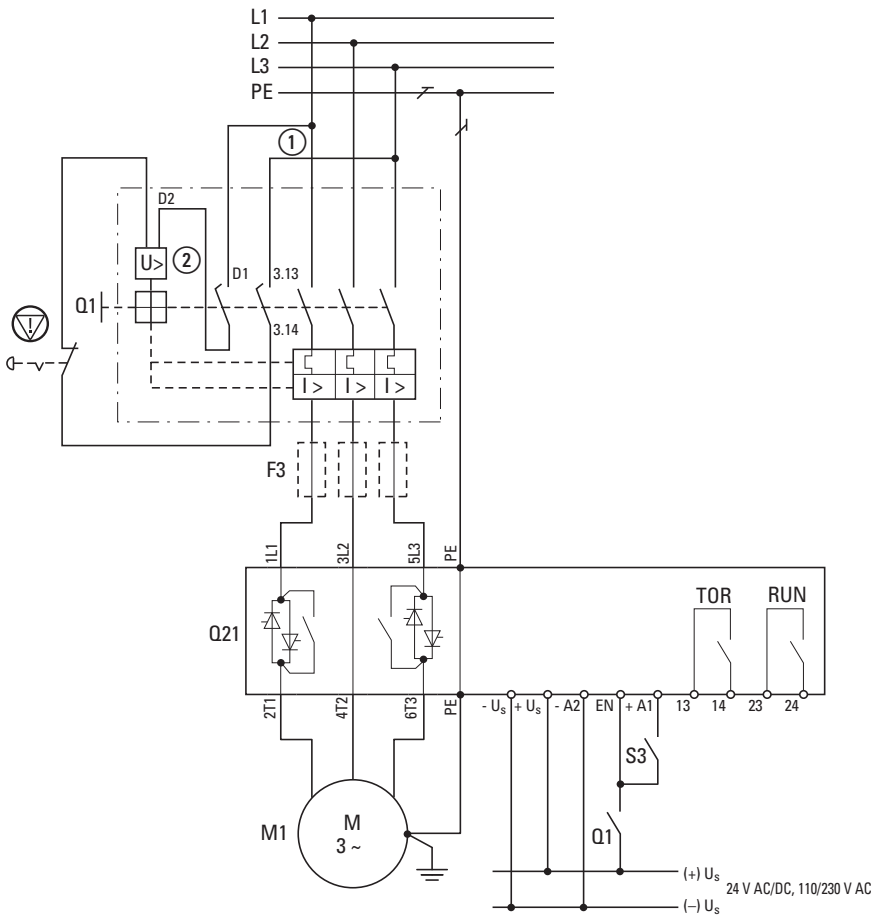
Standard connection
up to 32 A



Standard connection

41 - 200 A

With Emergency switching off function according to IEC/EN 60 204-1 and VDE 0113 Part 1



= EMERGENCY SWITCHING OFF

Q 1 = Cable and motor protection (NZM (NZM1, NZM2)

Q21 = Soft starter DS7

M1 = Motor

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

① Control circuit terminal

② Undervoltage release with early-make auxiliary contact

assigned Motor output at		Rated operational current[1]		Part no. Soft starters (device to be selected)	Soft starter function
400 V	480 V	Motor	Soft starters		Cable protection[2]
P	P	I_e	I_e		Type "1" coordination
kW	HP	A	A		
				Soft starters for three-phase mains connection, low operating frequency (5 s, 3 x I_e, 10 starts/h)	
1.5	2	3.6	4	**DS7-34xSX004N0-x**	PKZM0-4 (+ CL-PKZ0)
3	3	6.6	7	**DS7-34xSX007N0-x**	PKZM0-10 (+ CL-PKZ0)
4	5	8.5	9	**DS7-34xSX009N0-x**	PKZM0-10 (+ CL-PKZ0)
5.5	7.5	11.3	12	**DS7-34xSX012N0-x**	PKZM0-12 (+ CL-PKZ0)
7.5	10	15.2	16	**DS7-34xSX016N0-x**	PKZM0-16 (+ CL-PKZ0)
11	15	21.7	24	**DS7-34xSX024N0-x**	PKZM0-25 (+ CL-PKZ0)
15	20	29.3	32	**DS7-34xSX032N0-x**	PKZM0-32 (+ CL-PKZ0)
22	25	41	41	**DS7-34xSX041N0-x**	NZMN1-M50 / PKZM4-50
30	30	55	55	**DS7-34xSX055N0-x**	NZMN1-M63 / PKZM4-58
37	40	68	70	**DS7-34xSX070N0-x**	NZMN1-M80
45	50	81	81	**DS7-34xSX081N0-x**	NZMN1-M100
55	60	99	100	**DS7-34xSX100N0-x**	NZMN1-M100
75	75	134	135	**DS7-34xSX135N0-x**	NZMN2-M160
90	100	160	160	**DS7-34xSX160N0-x**	NZMN2-M200
110	125	196	200	**DS7-34xSX200N0-x**	NZMN2-M200

Notes

[1] Rated operational current based on the load cycle specified here.

[2] Used to specify the circuit-breaker required for the specified load cycle. At different duty cycles (operating frequency, overcurrent, overcurrent time, duty factor), this value changes and must then be adapted accordingly.

[3] An external overload relay is required if the main contacts should not be disconnected in the event of an overload and a controlled soft stop is desired instead.

[4] A mains contactor is not required. Disconnection characteristics in accordance with VDE can only be ensured with the specified circuit-breaker.

[5] The superfast semiconductor fuses protect the soft starter from short circuits on the motor side. This can not, however, prevent damage caused by voltage peaks, for example through lightning strike.

Soft starter function with soft stop in case of overload		Mains contactor	Semiconductor contactor (optional, in addition to the protective devices for type 1 coordination, required for type 2 coordination)[5]	
Cable protection[2] Type "1" coordination	overload relay[3]	optional[4]	Fuses Number x Part no.	Fuse holders Number x Part no.
PKM0-4 (+ CL-PKZ0)	ZB12-4	DILM7	3 × 170M1359	3 x 170H1007
PKM0-10 (+ CL-PKZ0)	ZB12-10	DILM9	3 × 170M1361	3 x 170H1007
PKM0-10 (+ CL-PKZ0)	ZB12-10	DILM9	3 × 170M1362	3 x 170H1007
PKM0-12 (+ CL-PKZ0)	ZB12-12	DILM12	3 × 170M1362	3 x 170H1007
PZM0-16 (+ CL-PKZ0)	ZB32-16	DILM17	3 × 170M1364	3 x 170H1007
PZM0-25 (+ CL-PKZ0)	ZB32-24	DILM25	3 × 170M1365	3 x 170H1007
PZM0-32 (+ CL-PKZ0)	ZB32-32	DILM32	3 × 170M1366	3 x 170H1007
NZMN1-M50 / PKZM4-50	ZB65-40+ZB65-XEZ	DILM50	3 × 170M3013	3 x 170H3004
NZMN1-M63 / PKZM4-58	ZB65-57+ZB65-XEZ	DILM65	3 × 170M3013	3 x 170H3004
NZMN1-M80	ZB150-70/KK	DILM80	3 × 170M4008	3 x 170H3004
NZMN1-M100	ZB150-100/KK	DILM95	3 × 170M4008	3 x 170H3004
NZMN1-M100	ZB150-100/KK	DILM115	3 × 170M4008	3 x 170H3004
NZMN2-M160	ZB150-150/KK	DILM150	3 × 170M4010	3 x 170H3004
NZMN2-M200	Z5-160/FF250	DILM185	3 × 170M5008	3 x 170H3004
NZMN2-M200	Z5-220/FF250	DILM225	3 × 170M5008	3 x 170H3004

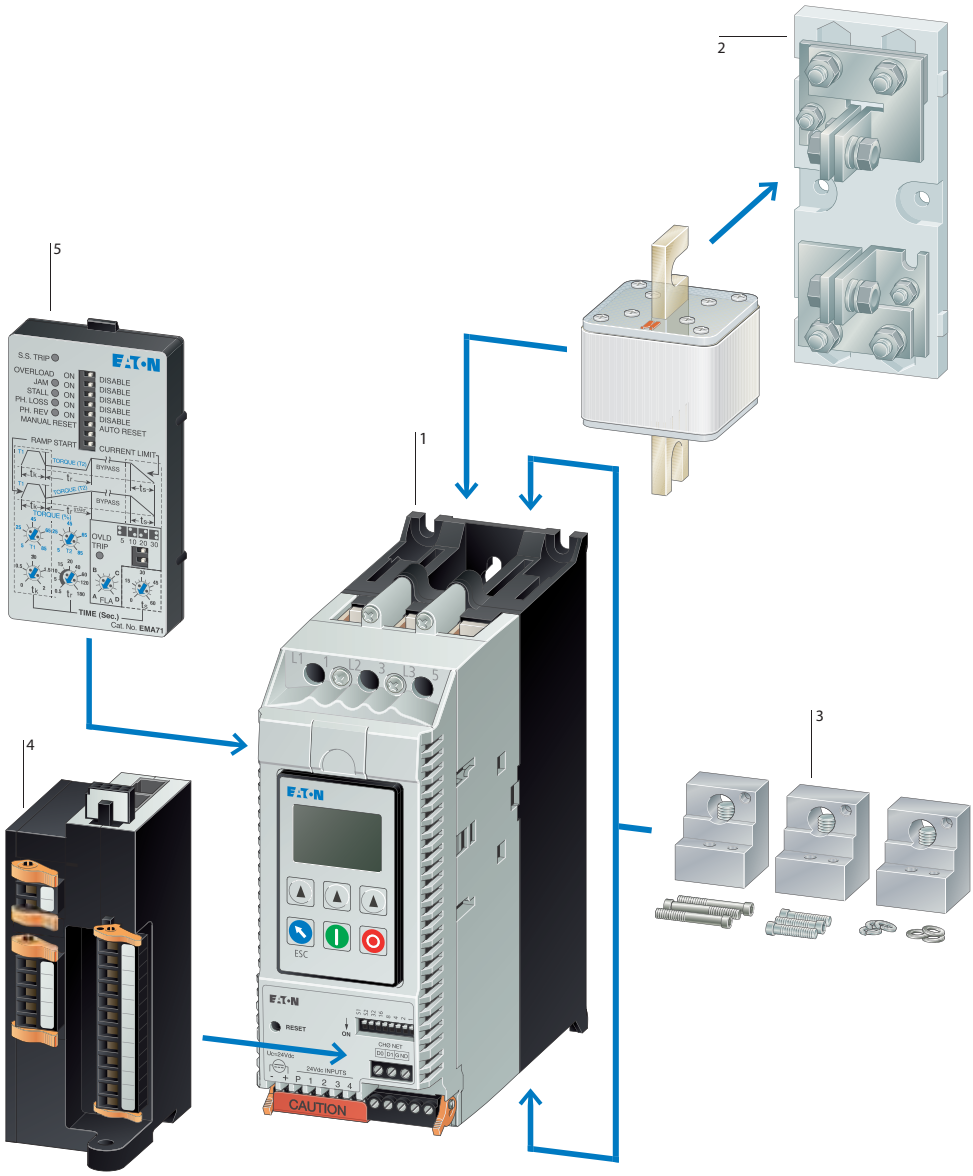
S801+/S811+ Soft Starters – a Powerful Presence in a Small Design

The unparalleled performance and features behind S801+ and S811+ soft starters build upon the proven capabilities of our soft starter series. With only five frame sizes and rated operational currents of 37 A to 850 A for supply voltages of 200 V to 690 V, S801+ and S811+ units are some of the world's smallest compact soft starters.

These three-phase-controlled soft starters, which feature an internal bypass and comprehensive monitoring and protection mechanisms, provide a soft start and ensure that three-phase motors can remain in continuous operation safely and reliably even in applications with large load torques.

S801+ soft starters are designed with standard applications in mind and make a strong case with their ease of use, while S811+ devices feature a digital control and display unit that provides access to advanced functions for sophisticated applications. In addition, S811+ units can be used not only in a standard line (outside the delta) configuration, but also with an inside-the-delta configuration.

System overview



S801+ / S811+ → page 121	1
Superfast semiconductor fuses → page 104	2
Terminal blocks → page 124	3
EtherNet/IP - Modbus/TCP adapter → page 123	4
External keypad → page 123	5

Description

The soft starters in series S801+ assure reliable operation even under tough and challenging ambient conditions. This series makes a compelling case as a result of its ease of use and is the perfect choice for standard applications such as pumps, fans, compressors, and conveyor belts.

S801+ soft starters have three-phase control and are equipped with internal bypass contacts for continuous operation.With their comprehensive protection and monitoring functions, S801+ soft starters ensure a soft startup, as well as safe and reliable continuous operation, for three-phase motors with rated operational currents of 11 A to 850 A when working with mains voltages of 200 V to 600 V. For example, when used in pump applications, they prevent water impact by using controlled deceleration (soft stop control) and torque monitoring, significantly reducing the mechanical loads exerted on pump systems in the process.

Essential features S801+ / S811+

- Rated operational current: 37 - 850 A
- Parameterizable overload settings: 31–100%
- Adjustable overload classes: class 5, 10, 20, 30
- Base setting: 15 s start ramp, 4 starts per hour, 300% starting current at 40 °C ambient temperature
- Allocated motor outputs for in-line connection:
  – 7.5 - 250 kW (3~ 230 V)
  – 18.5 - 450 kW (3~ 400 V)
- Ambient air temperature: -30 °C to +50 °C
- any required mounting position
- Degree of protection with compact design (IP20 optional)
- 5 compact designs
- Adjustable torque control
- Adjustable kick start
- Efficient use of power achieved with internal bypass contacts during continuous operation
- 24-V control voltage:
  – External supply required
  – 1 A continuous current
  – 10 A Inrush current (peak value for 150 ms)

S801+ specific characteristics

- Microswitches and potentiometers make it easy to configure these soft starters

S811+ series soft starters provide all the features and characteristics of S801+ soft starters, plus expanded functionality and an operating unit (DIM = digital interface module).
With the S811+, motors can be connected using the standard line configuration or using the delta circuit (inside-the-delta configuration / six-wire connection). Using an inside-the-delta configuration will reduce the current flowing through the soft starter by approximately 42%. This way, a 58 A soft starter can be used to start and run a motor with a rated operational current of 100 A, for example.

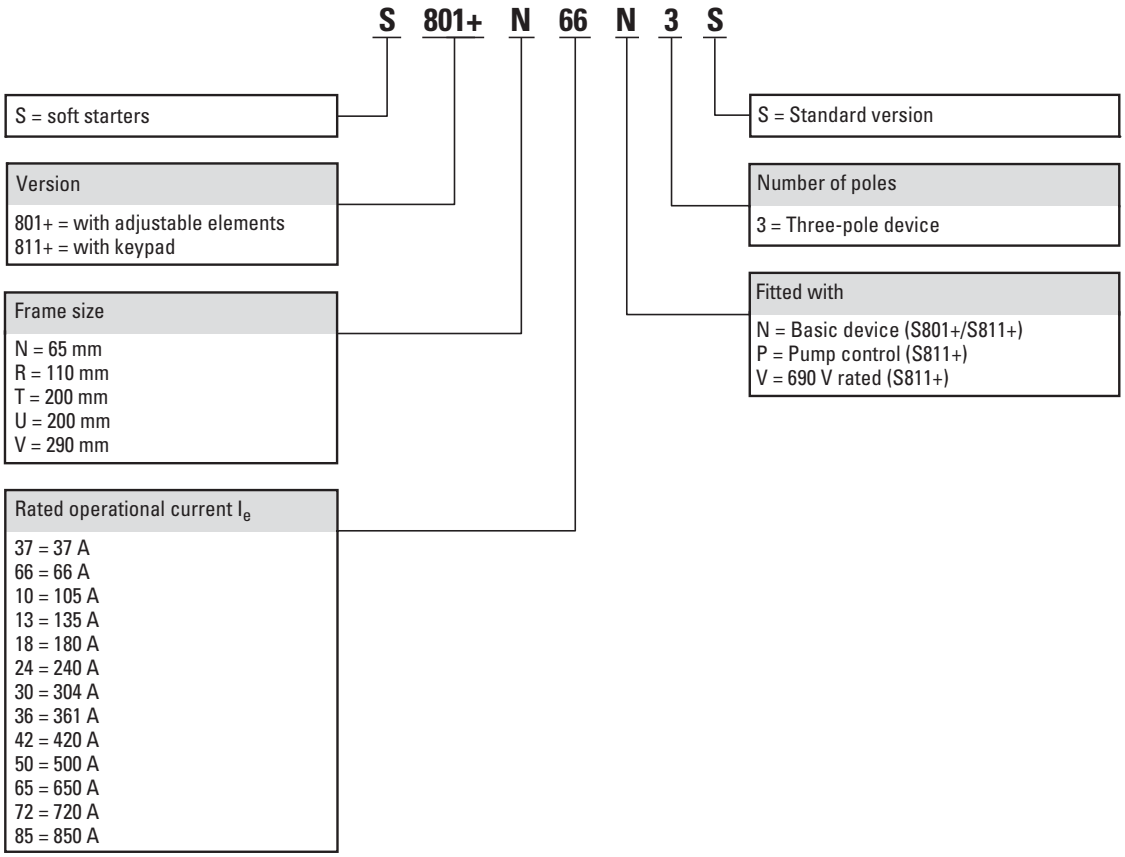
Important operating unit characteristics (S811+)

- Language-neutral LCD display with backlight
- Easy to use and configure with function keys
- System parameter configuration
- Diagnostic and monitoring options
- Reading display (e.g., L1, L2, L3 phase currents)
- Error Display
- Offset placement (mounted on door), connection via plug-in patch cord with RJ11 plug
- Front IP54

S811+ specific characteristics

- Mains voltage up to 690 V
- Allocated motor outputs for in-line connection:
  – 7.5 - 250 kW (3~ 230 V)
  – 18.5 - 450 kW (3~ 400 V)
  – 160 - 710 kW (3~ 690 V)
- Special pump control algorithm with prolonged soft stop ramp
- In-delta connection, see "Engineering, connecting examples"
- RS485 Modbus Connection
- EtherNet-IP/Modbus-TCP with option C441 (communication adapter).

Key to type references



UL/CSA

Information relevant for export to North America

	S801+N..., S801+R..., S801+T... (600 V) **S811+N..., S811+R..., S811+T... (600 V)**	**S801+U..., S801+V... bis 850 A (600 V)** **S811+U..., S811+V... bis 850 A (600 V)**
Product Standards	IEC/EN 60947-4-2; UL 508; CSA C22.2 No. 14; CE marking	IEC/EN 60947-4-2; UL 508; CSA C22.2 No. 14; CE marking
UL File No.	E202571	E202571
UL CCN	NMFT	NMFT
CSA File No.	LR 353	LR 353
CSA Class No.	3211-06, 2411-01	3211-06
NA Certification	UL Listed, CSA Certified	UL Listed, CSA Certified
Conditions of Acceptability	None	None
Suitable for	Branch Circuits, not as BCPD	Branch Circuits, not as BCPD
Max. Voltage Rating	600 Vac	600 Vac
Degree of Protection	IP20 with kit	IP20 with kit

	S811+...V3S (690 V)
Product Standards	IEC/EN 60947-4-2; UL 508; CE marking
UL File No.	E202571
UL CCN	NMFT
CSA File No.	
CSA Class No.	
NA Certification	UL Listed
Conditions of Acceptability	None
Suitable for	Branch Circuits, not as BCPD
Max. Voltage Rating	690 Vac
Degree of Protection	IP20 with kit

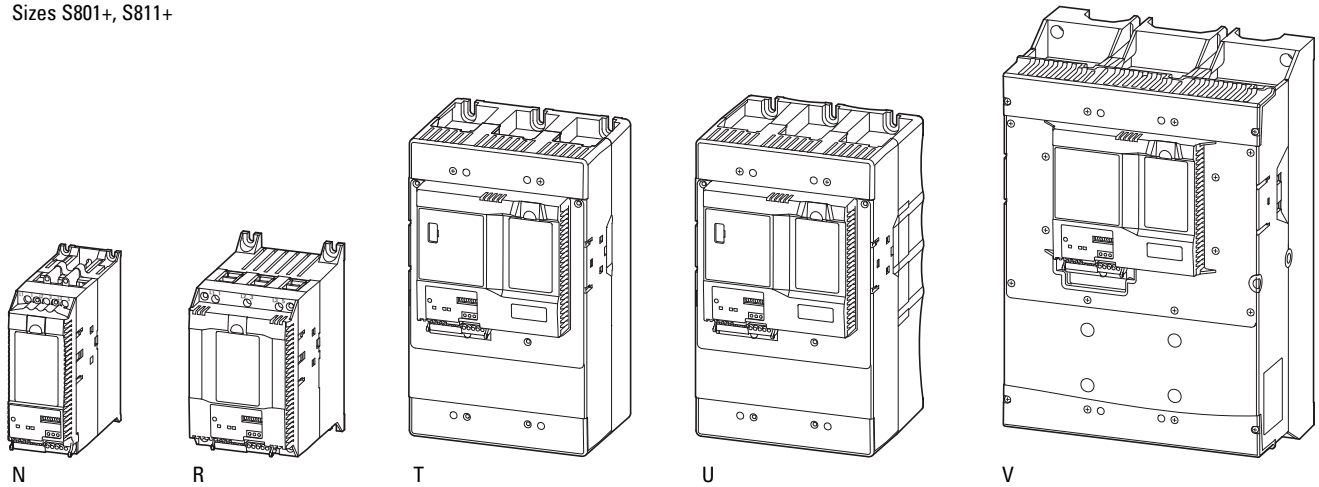
Ordering

Frame size	Rated operational current AC-53 I_e A	Assigned motor rating at 230 V, 50 Hz kW	at 230 V, 60 Hz HP	at 400 V, 50 Hz kW	at 460 V, 60 Hz HP	Part no.	Article no.	Price see price list	Std. pack
Soft starters									
Supply voltage U_s: 24 V DC Control voltage U_C: 24 V DC With internal bypass contacts Terminal blocks for the terminals are required for frame sizes T, U, and V -> Accessories									
Soft starters for three-phase loads Mains supply voltage (50/60 Hz) U_{LN}: 200 - 600 V AC In-line circuit									
N	37	7.5	10	18.5	25	**S801+N37N3S**	169852		1 off
	66	18.5	20	30	50	**S801+N66N3S**	169853		
R	105	30	40	55	75	**S801+R10N3S**	169854		
	135	37	50	75	100	**S801+R13N3S**	169855		
T	180	55	60	90	150	**S801+T18N3S**	169856		
	240	75	75	132	200	**S801+T24N3S**	169857		
	304	90	100	160	250	**S801+T30N3S**	169858		
U	361	110	125	200	300	**S801+U36N3S**	169859		
	420	132	150	200	350	**S801+U42N3S**	169860		
V	361	110	125	200	300	**S801+V36N3S**	169863		
	420	132	150	200	350	**S801+V42N3S**	169864		
	500	160	200	250	400	**S801+V50N3S**	169865		
	650	200	250	315	500	**S801+V65N3S**	169866		
	720	250	-	400	600	**S801+V72N3S**	169867		
	850	-	-	450	600	**S801+V85N3S**	169868		
Soft starter for three-phase loads, with control unit Mains supply voltage (50/60 Hz) U_{LN}: 200 - 600 V AC In-line configuration/In-delta configuration									
N	37	7.5	10	18.5	25	**S811+N37N3S**	168976		1 off
	66	18.5	20	30	50	**S811+N66N3S**	168978		
R	105	30	40	55	75	**S811+R10N3S**	168980		
	135	37	50	75	100	**S811+R13N3S**	168982		
T	180	55	60	90	150	**S811+T18N3S**	168984		
	240	75	75	132	200	**S811+T24N3S**	168987		
	304	90	100	160	250	**S811+T30N3S**	168990		
U	361	110	125	200	300	**S811+U36N3S**	169869		
	420	132	150	200	350	**S811+U42N3S**	169870		
V	361	110	125	200	300	**S811+V36N3S**	168993		
	420	132	150	200	350	**S811+V42N3S**	168996		
	500	160	200	250	400	**S811+V50N3S**	168999		
	650	200	250	315	500	**S811+V65N3S**	169002		
	720	250	-	400	600	**S811+V72N3S**	169005		
	850	-	-	450	600	**S811+V85N3S**	169008		

Notes **Information relevant for export to North America → Page 120**

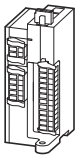
Frame size	Rated operational current AC-53 I_e A	Assigned motor rating at 230 V, 50 Hz kW	at 230 V, 60 Hz HP	at 400 V, 50 Hz kW	at 460 V, 60 Hz HP	at 690 V, 50 Hz kW	Part no.	Article no.	Price see price list	Std. pack
Soft starters										
Supply voltage U_s: 24 V DC Control voltage U_C: 24 V DC With internal bypass contacts Terminal blocks for the terminals are required for frame sizes T, U, and V -> Accessories										
Soft starter for three-phase loads, with control unit and pump algorithm Mains supply voltage (50/60 Hz) U_{LN}: 200 - 600 V AC In-line configuration/In-delta configuration										
N	37	7.5	10	18.5	25	-	**S811+N37P3S**	168977		1 off
	66	18.5	20	30	50	-	**S811+N66P3S**	168979		
R	105	30	40	55	75	-	**S811+R10P3S**	168981		
	135	37	50	75	100	-	**S811+R13P3S**	168983		
T	180	55	60	90	150	-	**S811+T18P3S**	168985		
	240	75	75	132	200	-	**S811+T24P3S**	168988		
	304	90	100	160	250	-	**S811+T30P3S**	168991		
U	361	110	125	200	300	-	**S811+U36P3S**	169872		
	420	132	150	200	350	-	**S811+U42P3S**	169873		
V	361	110	125	200	300	-	**S811+V36P3S**	168994		
	420	132	150	200	350	-	**S811+V42P3S**	168997		
	500	160	200	250	400	-	**S811+V50P3S**	169000		
	650	200	250	315	500	-	**S811+V65P3S**	169003		
	720	250	-	400	600	-	**S811+V72P3S**	169006		
	850	-	-	450	600	-	**S811+V85P3S**	169009		
Soft starter for three-phase loads, with control unit and pump algorithm, for 690-V grids Mains supply voltage (50/60 Hz) U_{LN}: 200 - 690 V AC In-line circuit										
T	180	55	60	90	150	160	**S811+T18V3S**	168986		1 off
	240	75	75	132	200	200	**S811+T24V3S**	168989		
	304	90	100	160	250	250	**S811+T30V3S**	168992		
V	361	110	150	200	300	315	**S811+V36V3S**	168995		
	420	132	150	200	350	400	**S811+V42V3S**	168998		
	500	160	200	250	400	500	**S811+V50V3S**	169001		
	650	200	250	315	500	630	**S811+V65V3S**	169004		
	720	250	-	400	600	630	**S811+V72V3S**	169007		
	850	-	-	450	600	710	**S811+V85V3S**	169010		

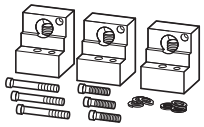
Sizes S801+, S811+

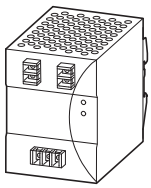


N R T U V

Information relevant for export to North America → Page 120

Description		For use with	Part no. Article no.	Price see price list	Std. pack	Information relevant for export to North America
Control unit						
With adjusting elements (potentiometer, microswitch)		S801+	**EMA71** 144346		1 off	Product Standards IEC/EN 60947-4-2; UL 508; CSA C22.2 No. 14; CE marking UL File No. E202571 CSA File No. LR 353 Conditions of Acceptability UL unlisted component, CSA Investigated Component
With illuminated LCD display With control buttons and function keys Front IP54 RJ11 plug, 6-pin		S811+	**EMA91** 144570			
Cover						
Protection for installation space in S811+ if the control unit is set up externally.		S801+	**EMA68** 144556		1 off	
Mounting frame						
For mounting the EMA91 control unit externally with surface mounting (e.g., installation in control panel door).						
with connection cable RJ11, 6 pole	1 m	EMA91	**EMA69A** 144557		1 off	Product Standards IEC/EN 60947-4-2; UL 508; CSA C22.2 No. 14; CE marking UL File No. E202571 UL Category Control No. NMFT2 CSA File No. LR 353 CSA Class No. 3211-06 North America Certification UL listed, CSA certified
	1.5 m	EMA91	**EMA69B** 144558			
	2 m	EMA91	**EMA69C** 144559			
	3 m	EMA91	**EMA69D** 144560			
Fieldbus modules						
Ethernet-IP/Modbus-TCP 		S811+	**C441V** 172306		1 off	Product Standards IEC/EN 60947-4-1; UL 508; CSA C22.2 No. 14; CE marking UL File No. E1230 UL Category Control No. NKCR CSA File No. LR 353 CSA Class No. 3211-03 North America Certification UL listed, CSA certified Max. Voltage Rating 240 Vac (auxiliary contacts)
PROFIBUS-DP		S811+	**C441QS** 184746		1 off	Product Standards CSA C22.2 No. 14; CE marking UL File No. E1230 UL Category Control No. NKCR CSA File No. LR 353 CSA Class No. 3211-03 North America Certification UL listed, CSA certified Max. Voltage Rating 240 Vac (auxiliary contacts)
DeviceNet		S811+	**C441LS** 184747		1 off	
Control terminal strip						
Spare part		S801+, S811+	**EMA75** 144561		1 off	

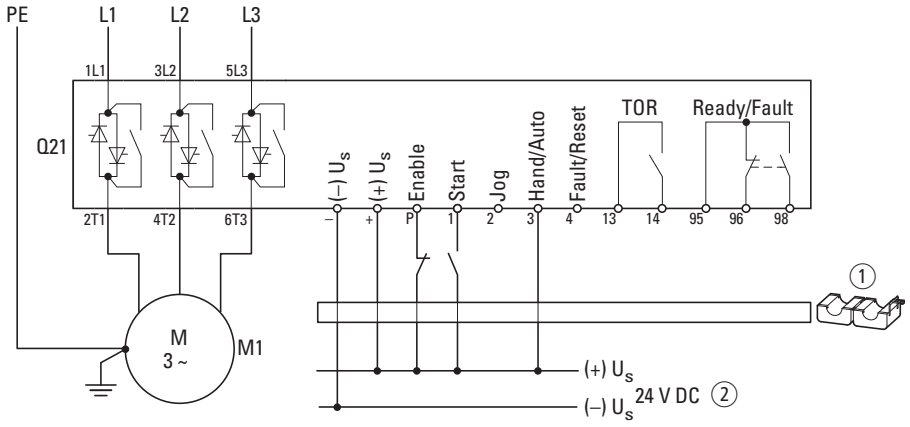
Description	For use with	Part no. Article no.	Price see price list	Std. pack	Information relevant for export to North America
Terminal blocks					
Tools with dimensions in inches required 1 set required for each connection side. 					
Terminal capacities					
2 x 4-1/0MCM, 2 x 25-50 mm²	S801+, S811+, frame sizes T and U	**EML22** 127661		1 off	Product Standards UL508, CSA C22.2 No. 65 UL File No. E202571 UL Category Control No. NMFT CSA File No. LR 353 CSA Class No. 6223-02 North America Certification UL listed, CSA certified
4/0-500 MCM, 120-240 mm² S801+, S811+, frame sizes T and U		**EML23** 127662			
2 x 4/0-500 MCM, 2 x 120-240 mm² S801+, S811+, frame sizes T and U		**EML24** 127663			
1 x 2/0-300 MCM, 1 x 70-150 mm² S801+, S811+, frame sizes T and U		**EML25** 127664			
2 x 2/0-300 MCM, 2 x 70-150 mm² S801+, S811+, frame sizes T and U		**EML26** 127665			
2 x 4/0-500 MCM, 2 x 120-240 mm² S801+, S811+, frame size V	S801+, S811+, frame size V	**EML28** 127666			
4 x 4/0-500 MCM, 4 x 120-240 mm² S801+, S811+, frame size V		**EML30** 127667			
6 x 4/0-500 MCM, 6 x 120-240 mm² S801+, S811+, frame size V		**EML32** 127668			
4 x 2/0-300 MCM, 4 x 70-150 mm² S801+, S811+, frame size V		**EML33** 127669			

	Description	For use with	Part no. Article no.	Price see price list	Std. pack	Information relevant for export to North America
terminal shroud						
	For increasing the degree of protection to IP20 1 set required for each connection side.	S801+, S811+, frame size N	**SS-IP20-N** 171990		1 off	
		S801+, S811+, frame size R	**SS-IP20-R** 171991			
		S801+, S811+, frame sizes T und U	**SS-IP20-TU** 171992			
		S801+, S811+, frame size V	**SS-IP20-V** 158650			
TVSS						
	SMD metal-oxide varistors (MOVs) with connection cables for the grid and motor connection sides	S801+, S811+, up to 600 V	**EMS39** 127671		1 off	Product Standards UL 508; CSA C22.2 No. 14 UL File No. E202571 CSA File No. LR 353 Conditions of Acceptability UL and CSA Investigated Component Max. Voltage Rating 1000 V_{ac} 3 ph
		S811+, up to 690 V	**EMS41** 127672			
Power supplies PSG						
Rated output voltage 24 V DC (± 2%) Rated output current 10 A						
	Nominal input voltage 100 - 240 V AC 125 - 250 V DC Single-phase		**PSG240E24RM** 172893			
	Nominal input voltage 3 x 400 - 500 V AC Three-phase		**PSG240F24RM** 172884			

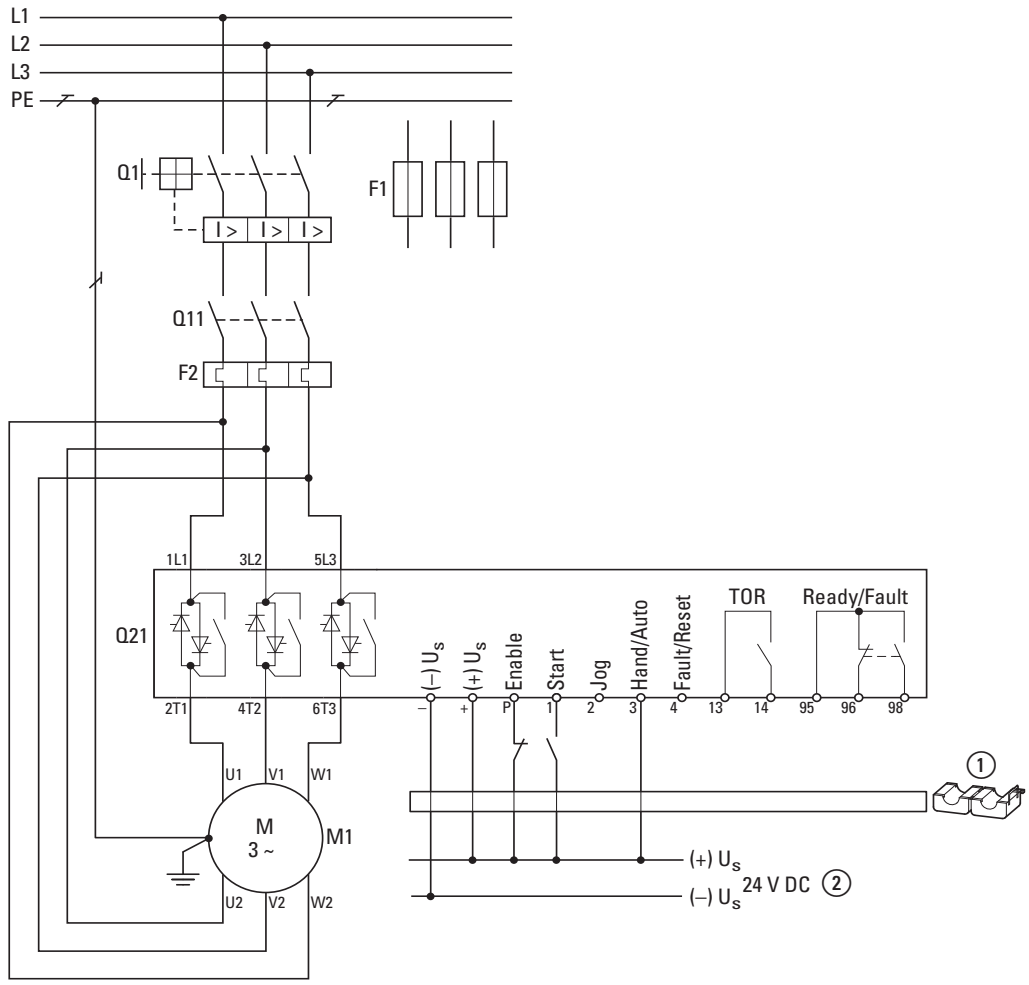
Engineering

Connection examples for S811+…N3S

Standard connection (in-line connection)



Delta circuit (inside-the-delta circuit)



① Snap-on ferrite core, included as standard
② External control voltage (24 VDC) required, I_S 1 A, I_{Peak} = 10 A for 150 ms when bypass contacts are switched
Short-circuit and cable protection: Q1 circuit-breakers or F1 fuses.

Motor	IEC	NEMA
	U1-V1-W1	T1-T2-T3
	U2-V2-W2	T4-T5-T6