

Soft Starters: The better start in a gentle manner



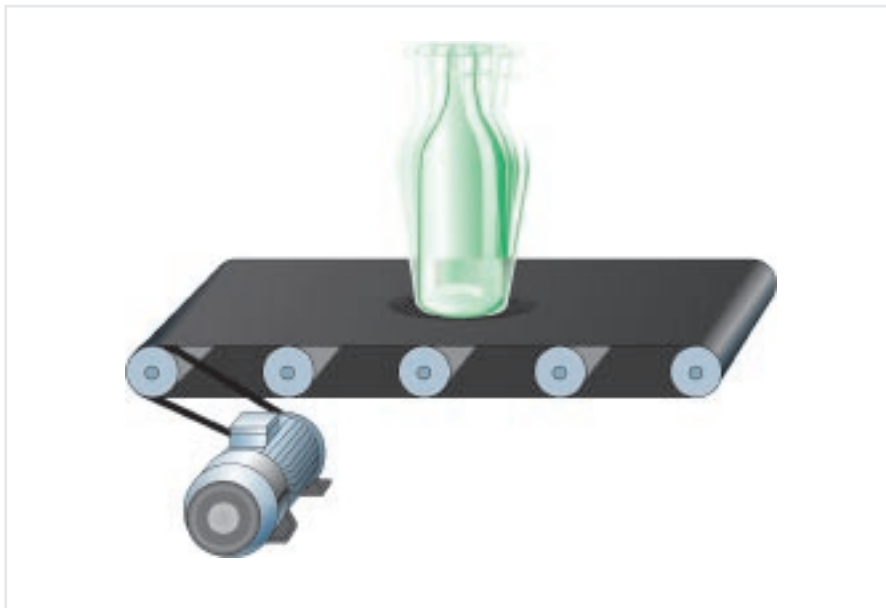
Product Information
Soft Starter DS4, DS6, DM4

Compact soft starters: System features of DS4, DS6

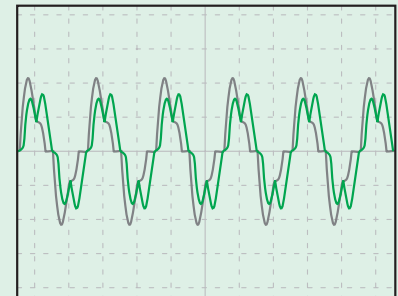


The three-phase motor is currently the optimum drive for simple and economic implementation of machine and system concepts. Nevertheless, a DOL start or a star-delta start is not always the best solution in many cases. If you want to avoid pressure hammers in pump systems, reduce starting currents with high inertia's or judder free starting in conveyor systems, soft starters offer the gentle alternative for almost every application for judder free and power network protected motor starts. And they reduce the operating costs in the company in more ways than just one.

Both the DS4 and DS6 series offer a complete product spectrum in the power range from 2.2 kW to 110 kW. The approvals with global standards make them devices suitable for world markets.



Current characteristic in the uncontrolled phase



Conventional methods:

■ Symmetrical control with high level of DC components

New process from Moeller:

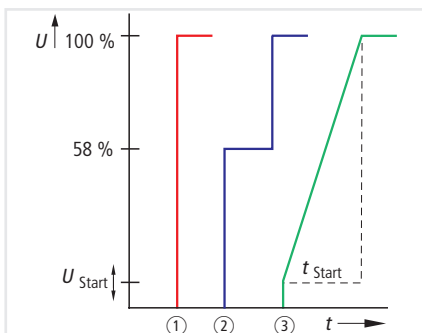
■ Asymmetric control without DC components

Staying steadfast through patented asymmetry

The conveyor belt starts without vibrations and operates smoothly using both the DS4 and DS6 soft starters. The asymmetrical trigger control developed and patented (PCT/EP00/12938, 19.12.2000) by

Moeller makes it possible. It avoids DC components which normally result on a two-phase controlled soft starter (see diagram). They suppress the formation of an elliptical rotating field, which leads to an irregular acceleration of the motor

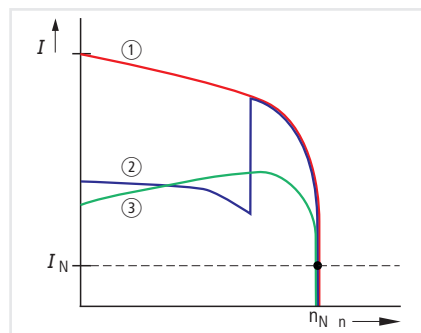
and which unnecessarily extends acceleration times. With the devices of the DS4 and DS6 series the start with asymmetrical trigger control is active in the start phase, with DS4-340-...-M(R) in uninterrupted operation also.



Motor voltage – softer start

- ① DOL start
- ② Star-delta start
- ③ Soft start

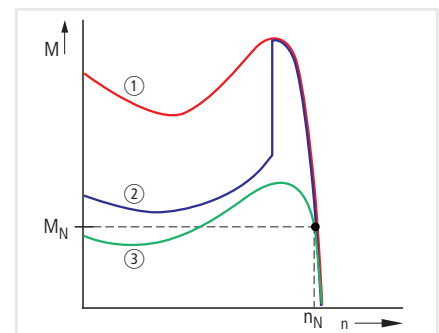
With a soft starter the motor voltage is reduced by phase angle variation and increased to the value of the mains voltage from an adjustable start voltage (U_{START}) within a preselected ramp time t_{START} . The soft run up and run down protects the coupled mechanical parts from abrupt loading, and avoids current peaks and voltage dips on the electrical power network.



Motor current – dampened peaks

- ① DOL start
- ② Star-delta start
- ③ Soft start

More and more electrical power supply companies demand conformity to defined current limit values. The loading of networks caused by high inrush currents should be avoided with DOL starting, or current peaks should be avoided with star-delta start, in order to prevent unwanted side-effects such as voltage dips. The adjustable current limitation of the soft starter is the ideal solution here.



Motor torque – reduced loading

- ① DOL start
- ② Star-delta start
- ③ Soft start

During switch on, fluctuations in the current and voltage cause problems on the power network. The resulting abrupt divergence's in torque cause stress for your machines. It leads to higher maintenance costs and effort and influences the quality of production. These disadvantages can be minimised by using a soft starter. It guarantees a more gentle torque progression and reduces your operating cost expenditure.

Soft starter DS4



Soft starter DS4-340

Application examples

- Three-phase resistive and inductive loads
- Soft switching of motor starters in transport and conveyor belts
- High switching cycles of motors in packaging machines
- Silent switching of light and heating in buildings
- Soft starting of pumps reduces the load on the entire installation (water impact)
- Solid-state switching of pumps in the extreme environments of chemical plants and filling stations
- Fast and silent control in the buildings field with reversing function with lift doors, garage gates and conveyor belts in the cooling and check-out area
- Smooth start that reduces wear on V-belts in fan drives

Power supply

110 – 500 V $\pm 10\%$, 50/60 Hz

Control voltage

15 – 30 VDC / 110 – 240 VAC, $\pm 15\%$

Power range

6 – 23 A (AC53, inductive load)

2.2 – 11 kW (motors)¹⁾

7.5 – 15 kW (with internal bypass)¹⁾

18.5 – 22 kW (with external bypass)¹⁾

¹⁾ assigned motor rating at 400 V

Performance characteristic

DS4-340-...-M(R)

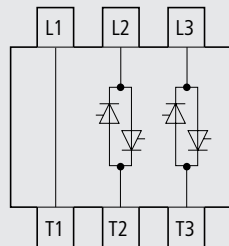
- AC53b, 600 starts per hour with 6-times starting current for 0.5 seconds
- AC53b, 20 starts per hour with 6-times starting current for 5 seconds

DS4-340-...-MX(R)

- AC53a, 10 starts per hour with 3-times starting current for 5 seconds

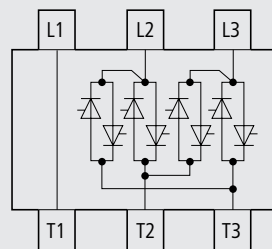
The two-phase controlled compact starter DS4 in various versions for standard applications up to 15 kW.

DS4-340-...-M



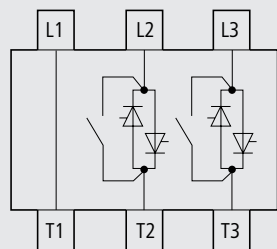
DOL starter 2.2 to 11 kW

DS4-340-...-MR



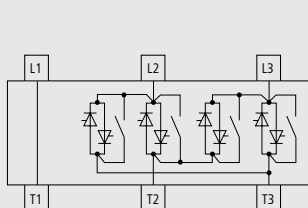
Reversing starter 2.2 to 11 kW

DS4-340-...-MX



Motor starter with internal bypass contacts 7.5 to 15 kW

DS4-340-...-MXR



Reversing starter with internal bypass contacts 7.5 to 15 kW

DS4 – controlled switching and starting

Common features

- Simple handling
- Terminals similar to contactor
- Mounting on top hat or DIN rails or fixing with screws
- Can be grouped side-by-side
- Degree of protection IP 20
- Heat sink integrated into enclosure
- Selective multi-voltage input for the control voltage
- Status indication via LED
- CE conformity
- UL approval (File No. E236856)

Motor starters in combination



Softer escalator start

Soft starter DS6 – the compact „in-line“ - starter up to 110 kW



Soft starter DS6-340-...-MX

With its compact design, the DS6 provides a two phase controlled motor start for assigned ratings from 18.5 to 110 kW, with the same simple handling features as the DS4.

The performance spectrum is spread across just two sizes. The dimensions and the terminals correspond with the tried and tested Moeller standard from the circuit-breakers NZM1 (up to 55 kW) and NZM2 (up to 110 kW).

Application examples

- Three-phase inductive loads
- Noiseless and soft switching of motor starters in transport and conveyor belts
- Soft starting of pumps reduces the load on the entire installation (water impact)
- Solid-state switching of pumps in the extreme environments of chemical plants and filling stations
- Smooth start that reduces wear on V-belts in fan drives

Power supply

230 – 460 V $\pm 10\%$, 50/60 Hz

Control voltage

24 VDC, $\pm 15\%$

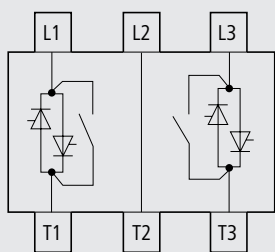
Performance range

18.5 – 110 kW (with internal bypass) assigned motor rating at 400 V

Performance characteristic DS6-340-...-MX

- AC53a, 10 starts per hour with 3-times starting current for 5 seconds

DS6-340-...-MX



Motor starter with internal bypass contacts 18.5 to 110 kW



DOL-start, without delay (t_{START})



Operation with acceleration and delay time (t_{START} , t_{STOP})



Operation with direction or rotation



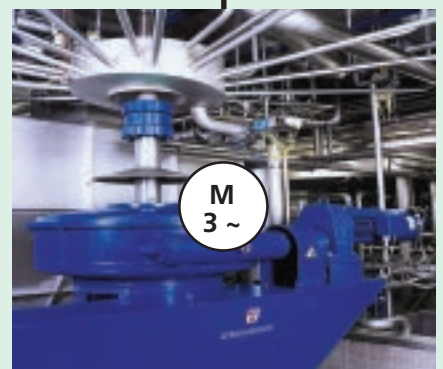
Reversing starter, two directions of rotation

DS6 – controlled switching and starting

Common features

- Simple handling
- Connection terminals suitable for circuit-breakers (NZM1, NZM2)
- Can be grouped side-by-side
- Degree of protection IP 20
- Status indication via LED
- CE conformity
- UL, CSA and CCC approvals

Motor starters in combination

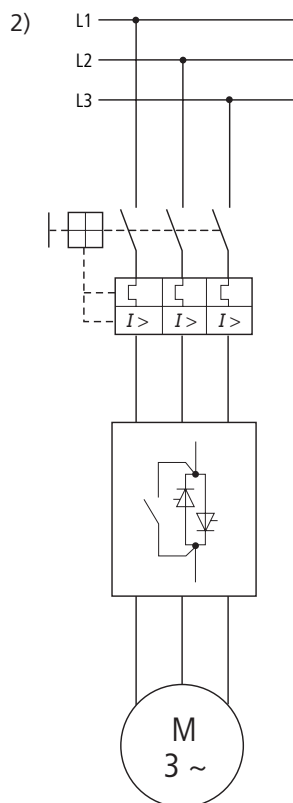


DS6 – Technical data

Soft starters for three-phase power supply, low operating frequency (5 s, 3x I_e, 10 starts)

	Assigned motor rating at 400 V	Assigned motor rating at 460 V	Rated operational current ¹⁾		Soft starter function		
			Device	Motor	Contactor and motor protection ²⁾	Mains contactor (optional) ³⁾	Mains contactor (optional) ⁴⁾
Type	kW	HP	A	I _e A	Type	Type	Type
DS6-340-22K-MX	18.5	25	41	36	NZMN1-M40 / PKZM4-40	DILM40	ZB65-40+ZB65-XEZ
DS6-340-22K-MX	22	30	41	41	NZMN1-M50 / PKZM4-50	DILM50	ZB65-40+ZB65-XEZ
DS6-340-30K-MX	30	40	55	55	NZMN1-M63 / PKZM4-58	DILM65	ZB65-57+ZB65-XEZ
DS6-340-37K-MX	37	50	68	68	NZMN1-M80	DILM80	ZB150-70/KK
DS6-340-45K-MX	45	60	81	81	NZMN1-M100	DILM95	ZB150-100/KK
DS6-340-55K-MX	55	75	99	99	NZMN1-M100	DILM115	ZB150-100/KK
DS6-340-75K-MX	75	100	135	134	NZMN2-M160	DILM150	ZB150-150/KK
DS6-340-90K-MX	90	125	160	160	NZMN2-M200	DILM185	Z5-160/FF250
DS6-340-110K-MX	110	150	200	196	NZMN2-M200	DILM225	Z5-220/FF250

- Notes:**
- ¹⁾ Rated operational current related to the stated load cycle.
 - ²⁾ States the required circuit-breaker for the defined load cycle. With other switching operations (operating frequency, overcurrent, overcurrent time, duty factor) this value changes and must be matched accordingly. The same applies with higher motor currents.
 - ³⁾ A mains contactor is not necessary. Isolating characteristics to VDE can only be assured via the stated circuit-breaker.
 - ⁴⁾ An external overload relay is necessary, if the main circuit is not to be disconnected with an overload but rather a controlled soft stop is required.



Compact „in-line“ starter –Soft starter DS6 in a system

In conjunction with the mounting and connection accessories of the circuit-breaker series NZM, the devices of the DS6 series provide the opportunity for compact electronic motor starters up to 110 kW²⁾.

The terminals on the NZM can be optimally matched to those of the DS6 with the spacers NZM1/2-XAB.

Soft starting: Improved operating comfort, simple handling

Soft starting: the modern alternative to star-delta starters

Electronic soft starters fulfil the customer demand for an impact free rise in torque and a determined reduction in current during the start phase. You control the power supply of the three-phase motor in the start phase so that the motor matches the load behaviour of the load machine. The mechanical equipment is accelerated with the minimum of stress as a result. The operating behaviour and the work processes are influenced positively which means that negative influences are avoided such as:

- Impacting of cog edges in the gearbox,
- Reduction of the water hammers in pipe systems,
- Slipping of V-belts,
- Jitter with conveyor systems.

The product standard for the area of soft starters is the IEC / EN 60 947-4-2.

Design versions

Generally a distinction is made between two design versions:

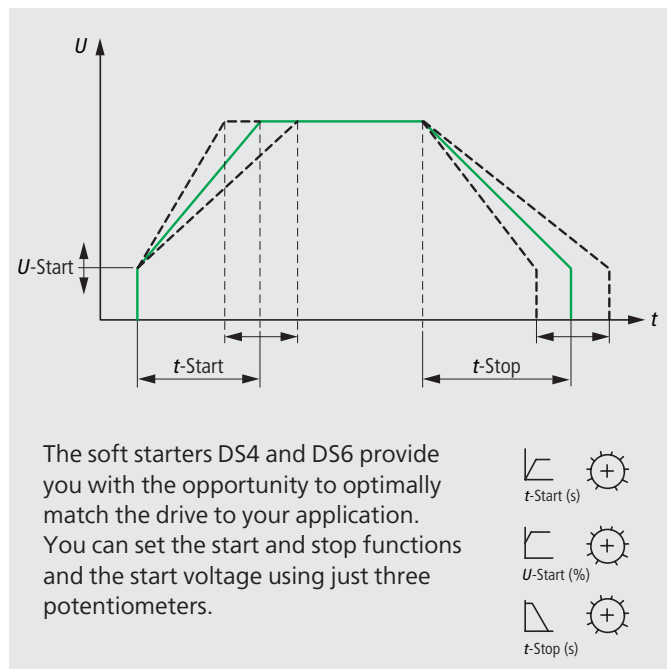
- For simple tasks:
 - Use with small ratings.
 - These devices prove their value with simple applications where smooth, judder free operation is desired in the start phase.
 - Simple handling.
 - Compact construction type
 - Simple power components, mainly two-phase controlled.
- For complex tasks:
 - Performance range up to approx. 900 kW (compact devices), for system engineering up to the MW range.
 - Monitoring devices (mains, device)
 - Motor protection devices
 - Parametric programming for optimised matching to the starter machine function
 - Control commands
 - Signal contacts
 - Optional communication via fieldbus connection

The Moeller soft starters fulfil the demands placed by the ZVEI: for "Switchgear, switchgear systems, industrial controls". DS4 and DS6 for simple tasks and DM4 for complex tasks.

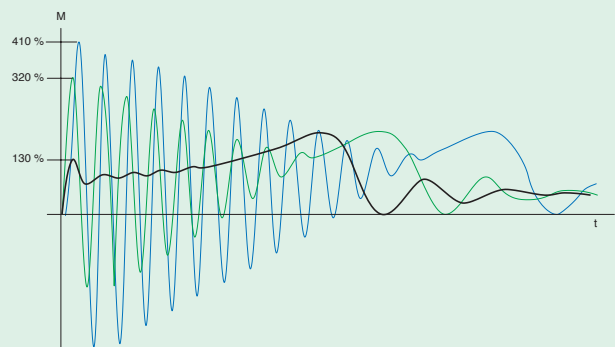
DOL method avoids premature fatigue of the mechanical components

Conventional mechanical contactors and semiconductor contactors cause transient currents with direct switch on (without start time ramp). These lead to a high level of torque oscillation in the motor (see the diagram). These oscillations have two effects:

- Premature mechanical fatigue (couplings, shafts, bearings) and can even lead to a rupture of the coupling,
- Braking torque's during acceleration which can lead to unwanted delays during run up.



Torque progression with various starting methods



Conventional methods:

- : Switching at the zero point
- : Switching on the phase

New process with direct-on-line starter (DOL) from Moeller:

- : DS4-340-M(R)

*) DOL= direct-on-Line

The DOL-method (Direct-On-Line) developed by Moeller avoids these oscillations. Motor and mechanical components are treated with care. The drive starts more smoothly and faster than with other start methods. This direct motor start without a start ramp is possible with the devices of the DS4-340-...-M(R) series.

Soft starter DS4 and DS6 with internal bypass



More performance for the same size – Soft starters with internal bypass.
Softer start as an alternative to the star-delta combination, lower-loss continuous operation.
The devices of the DS4-340-MX(R) and DS6-340-MX series feature internal bypass contacts. They can thus be assigned with higher motor ratings for a smaller size. The internal bypass is automatically switched in after the acceleration ramp and bridges the internal thyristors with uninterrupted operation. The motor current is conducted via low-loss internal contacts in uninterrupted operation.

Technical data

	DS4-340-M	DS4-340-MR	DS4-340-MX	DS4-340-MXR	DS6-340-MX	DM4-340
Power section	Thyristors in two phases	Thyristors in two phases, internal phase change for reversing function	Thyristors in two phases, bypass	Thyristors in two phases, internal phase change for reversing function	Thyristors in two phases, bypass	Thyristors in three phases
Mains supply voltage U_{LN} (45-65 Hz \pm 0%)	110–500 V AC \pm 10%				230 – 460 V AC \pm 10%	
Control voltage	24 V DC, 230 V AC				24 V DC	24 V DC, 230 V AC
Rated operational current AC-53 AC-51	6 – 23 A 11 – 41 A	6 – 23 A	16 – 31 A	16 – 31 A	41 – 200 A	16 – 900 A
Assigned motor rating (at 400 V)	2.2 – 11 kW	2.2 – 11 kW	7.5 – 15 kW	7.5 – 15 kW	18.5 – 110 kW	7.5 – 500 kW 11 – 900 kW
Overload cycle	600 operations h with $6 \times I_N$ for 0.5 s 3000 operations h with $6 \times I_N$ for 0.1 s / 20 starts / h with $6 \times I_N$ for 0.5 s		10 starts / h with $3 \times I_N$ for 5 s			10 starts / h with $3.5 \times I_N$ for 35 s
Internal bypass	–	–	●	●	●	–
Reversing contactor function	–	●	–	●	–	–
Product standard	IEC/EN 60 947-4-2 IEC/EN 60 947-4-3	IEC/EN 60 947-4-2	IEC/EN 60 947-4-2	IEC/EN 60 947-4-2	IEC/EN 60 947-4-2	IEC/EN 60 947-4-2
Degree of protection	IP 20	IP 20	IP 20	IP 20	IP 20	IP 20
Changeover time with reversing contactors (change from 100% FWD to 100% REV)	–	> 300 ms (semiconductor contactor) > 1000 ms (soft start)	–	> 1000 ms (soft start)	–	–
Field of application						
Three-phase resistive and inductive loads	●	●	–	–	–	●
Three-phase motors	●	●	●	●	●	●
Functions						
Fast and silent switching (semiconductor contactor)	●	●	–	–	–	–
Soft start / soft stop	●	●	●	●	●	●
Reversing contactor function	–	●	–	●	–	–
Suppression of DC components with motors	●	●	●	●	●	●
Potential isolation between power section and control	●	●	●	●	●	●
Approvals	UL, CSA	UL, CSA	UL, CSA	UL, CSA	UL, CSA CCC	UL, cUL
Storage temperature	-25 to +55 °C					
Operating temperature	0 to 40 °C					
Altitude	Up to 1000 m above sea level, above 1000 m with current derating (2.5% / 100 m)					

Soft starter DM4: Communication-capable motor starter with internal motor protection function



The high-value soft starter of the DM4 series can be individually matched to the demands of the respective application and provides soft starting in its most comfortable form. A determined reduction of the motor current in the start phase and an application specific parameterization guarantees optimum matching to the properties of the motor. The DM4 can be used with the "inline" connection method up to 500 kW or the "in-delta" connection method up to 900 kW. The integrated motor protection functions guarantee safe operation of your three-phase motor.

Simple handling is guaranteed by the application selector switch with pre-settings for the 10 most frequent standard applications. The highest level of operating comfort is provided by the optional communication modules such as the keypad or the fieldbus connection to PROFIBUS DP.

Soft starter DM4



Soft starter DM4-340

Application examples

- Internal current limitation limits the current peaks with circular saws, ribbon saws, agitators, mills and crushers at motor start
- High lifespan and low wear with fans and pump drives
- Controlled start and stop with conveyor drives prevents damage to the transported goods and premature wear in frequently spacious and extensive systems
- As a three-phase regulator for control of heating and lighting systems as well as for inrush current limitation with transformers
- With remote diagnostics and fieldbus interfacing in chemical plants

Power supply

230 – 460 V ± 10 %, 50/60 Hz

Control voltage

14 – 230 VAC, ± 15 %

Performance range

16 – 900 A (AC 53a, inductive load)

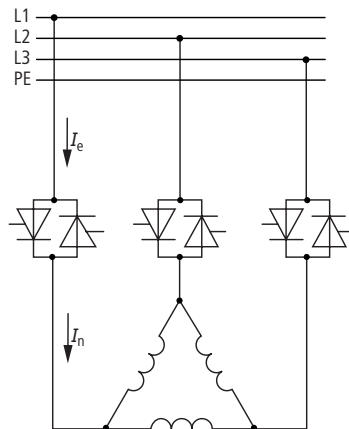
7.5 – 500 kW (in-line configuration)¹⁾

11 – 900 kW (in-delta configuration)¹⁾

¹⁾ assigned motor rating 400 V

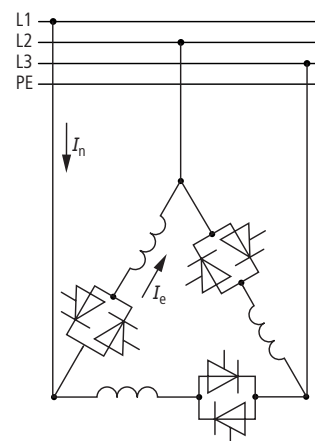
Product feature

- Application selector switch with 10 standard applications
- Programmable relays and analogue outputs
- Internal motor protection function (I²t monitoring)
- Motor protection (Thermistor input)
- Function expansion with communication cards
- Analog setpoint setting



In-line configuration

- Rated current I_e of the DM4 corresponds to the motor current I_n
- 3 cables to the motor



In-delta configuration

- Rated current I_e of the DM4 corresponds to 58 % of the motor current I_n
- 6 cables to the motor (as with a star-delta starter)

Advantages of the "In-delta configuration"

In this circuit configuration the individual phases of the DM4 are connected in series with the individual motor windings (6 conductor connections as with the star-delta starter). The soft starter must only conduct about 58 % of the rated motor current. This ensures the use of a significantly smaller device.

Optional communication

Soft starters DM4 provide intelligent communication features by the insertion of optional keypads, serial interfaces or PROFIBUS DP interfacing.



Keypad DE4-KEY-2 with plain text display



Serial interface DE4-COM-2X with RS232 and RS485 connection



Fieldbus connection DE4-NET-DP2 for direct connection to PROFIBUS DP (DIN 19245 part 1 and 3)



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