



Medium Voltage Digital Soft Starter



Design

Technical data

Functions

Options

Spare parts

Commissioning

Documentation

Technical Comparison

Engineering: FAQs

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HRVS-DN Medium Voltage Digital Soft Starter for motor 200-20,000 kW



Basic circuit diagram



Standard cabinet IP32
(IP54 option)

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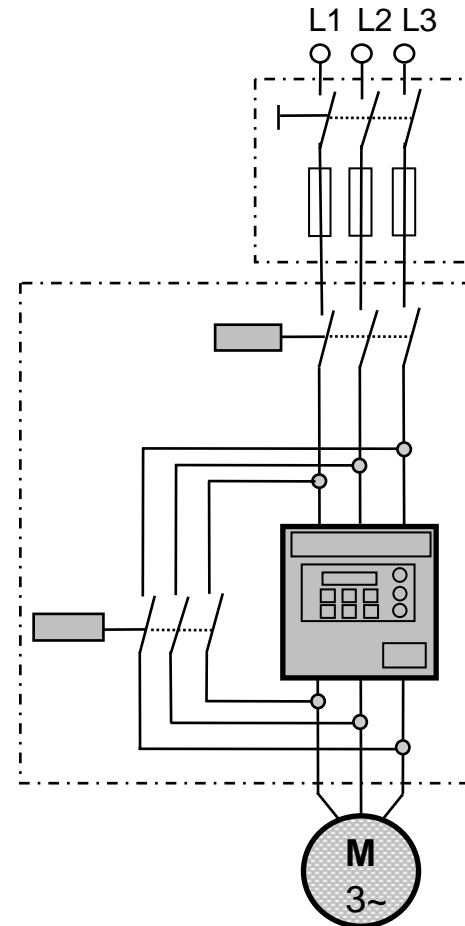
Supply panel

Line contactor

HV and LV section softstarter

Breaker

Squirrel-cage induction motor



Basic version

Option

Additional drive components



High-voltage section



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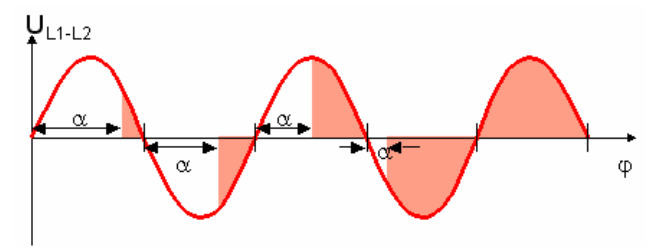
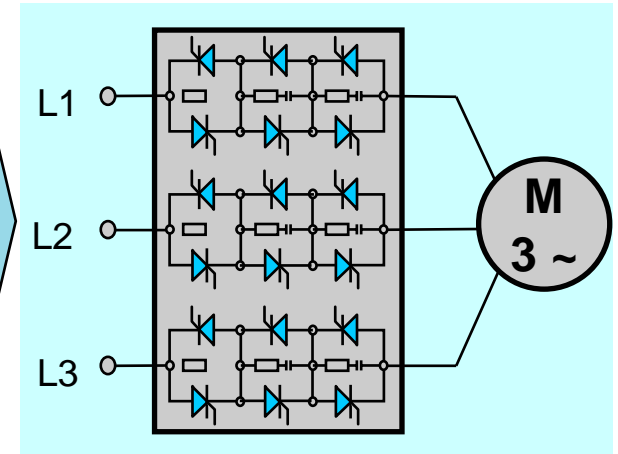
Engineering: FAQs

Line supply connection
Line contactor:
 Vacuum contactor

Softstarter, power section:
 2.3kV 12 thyristors
 3.3-6.6kV 18 thyristors

Breaker:
 Vacuum contactor
after the motor has been started, the softstarter is bypassed and is only switched-in again when the motor is to be stopped

Control terminal strip
Motor connection
Cable feed (from the bottom/top)





Low-voltage section (integrated in cabinet door)

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Signal lamps:

- Line breaker

position display

- Bypass ON
- Fault present
- Remote

Operator panel

Off / on button

Emergency OFF



Operator panel

Electronics box
 Parameterization
 Communications interface
 ModBus/Profibus

Switch/relay/ terminals

Transformer for control voltage



operator panel



Extremely easy to read, menu-prompted with simple logical operator control – the MV SST operator panel offers the highest degree of protection and user-friendliness.

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→ **Two-line display text,**
each 16 different characteristics

→ **Selectable languages:**
English, Germany,
French, Spanish



→ **8 LEDs to**
provide an
overview of the
operating status

→ **6 keys, menu-prompted software, standard setting**



general information



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Power semiconductor devices	Thyristors
Converter circuit configuration	IEC 146
Control (open-loop)	Fully-digital with 32-bit processor
Electrical isolation:	Fiber-optic cable
Power section - open and closed-loop control	
Ambient temperature:	
Operation	0 to 50°C
Transport and Storage	-10 to 50°C
Max. installation altitude	1000 m above sea level
Degree of protection, cabinet	IP32/IP54 (option)
Cooling type	Air cooling / forced air cooling
No. of switching operations per hour	4
Regulations/standards	IEC, EN, NEMA, EEE
Paint finish	RAL 7032



general information



Line supply frequency:
50 Hz/ 60Hz, $\pm 3\%$

Line supply voltage
tolerance: +10% - 30%

Auxiliary power supply :

1-ph. 110-120 V AC

1-ph. 220-240 V AC,
110 V DC

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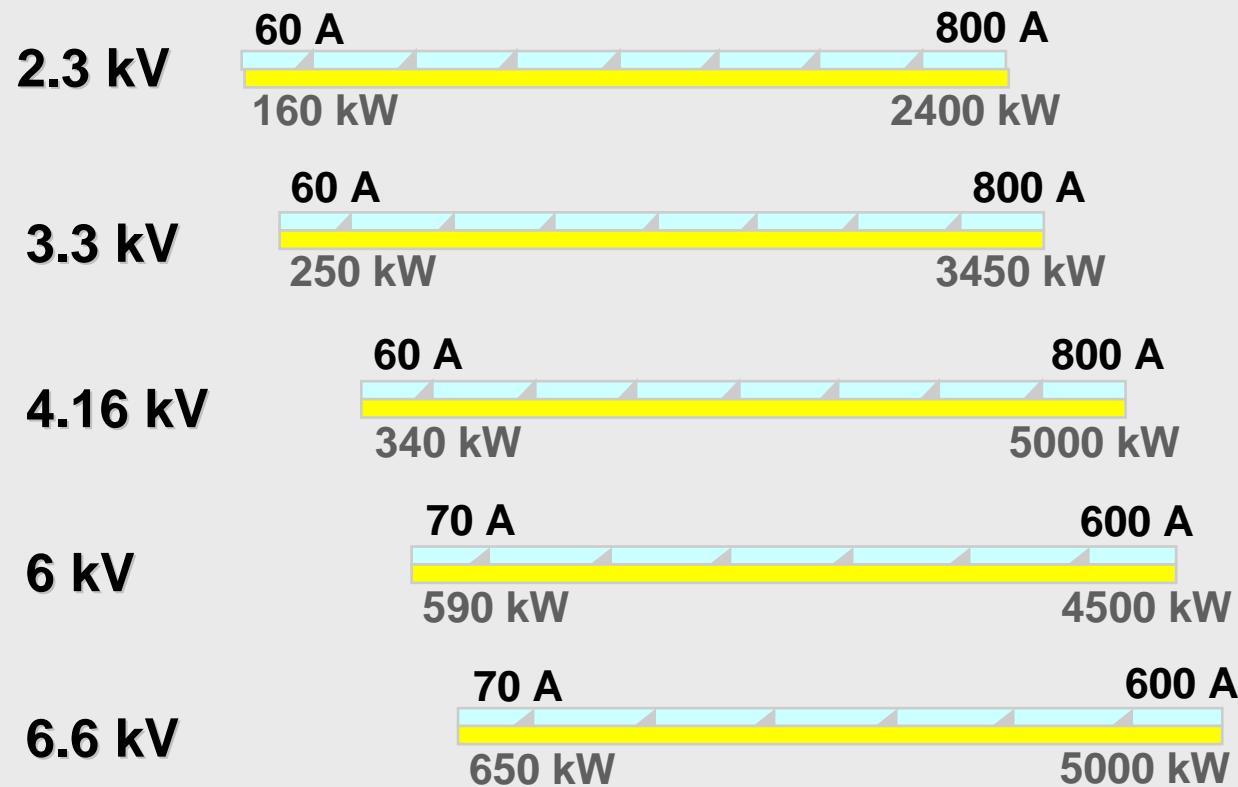
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Dimensions and weights - cabinet unit (IP32)

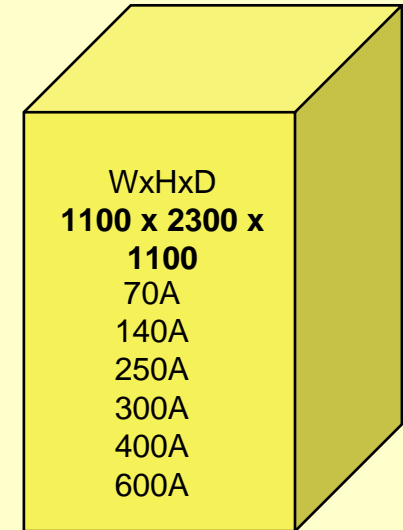
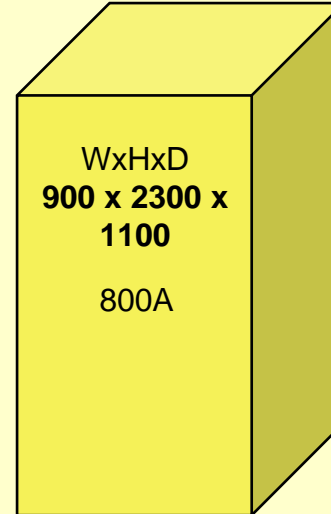
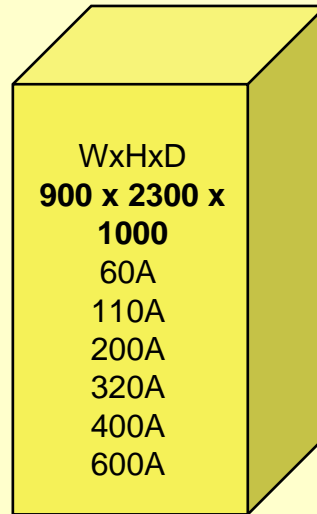


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Dimensions

2,3 kV – 4.16 kV

6 kV / 6.6 kV



Weights 2,3 kV

3,3 kV

4,16 kV

6,6 kV

60A	525 kg
110A	
200A	
320A	
400A	570 kg
600A	585 kg
800A	615 kg

60A	535 kg
110A	
200A	
320A	
400A	590 kg
600A	605 kg
800A	620 kg

60A	545 kg
110A	
200A	
320A	550 kg
400A	590 kg
600A	605 kg
800A	620 kg

70A	690 kg
140A	690 kg
250A	695 kg
300A	720 kg
400A	750 kg
600A	800 kg



Advantages for the customer with respect to DOL



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Protection against excessive mechanical stressing of the motor and driven load by using closed-loop torque control.

- Prevents pressure surges for pumps and piping systems,
- Permits jerk and surge-free motion of conveyor belts,
- Results in lower belt, chain, gearbox and bearing wear.



Extends the lifetime of the complete drive system, Reduces maintenance time and costs - therefore saving costs

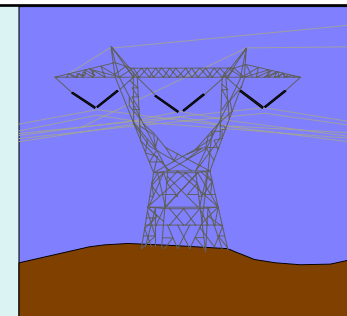


+
Drivenload



Protects against line supply fluctuations and dips as a result of current spikes.

- for weak line supplies
- when fed through transformers
- for diesel generator supplies

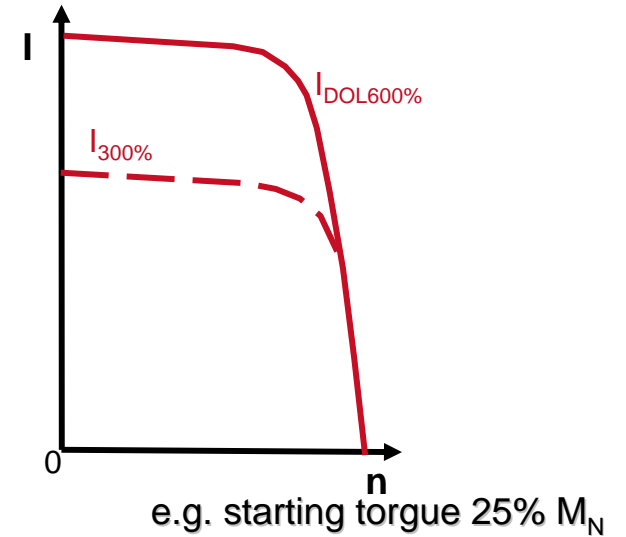
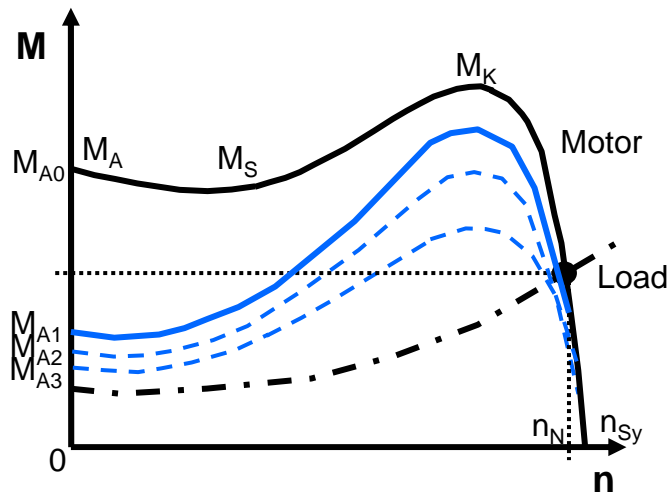




soft starting



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Torque reduction

$$\Rightarrow M_{\text{start}} \sim V_{\text{start}}^2$$

Current limiting

$$\Rightarrow I_{\text{start}} \sim V_{\text{start}}$$

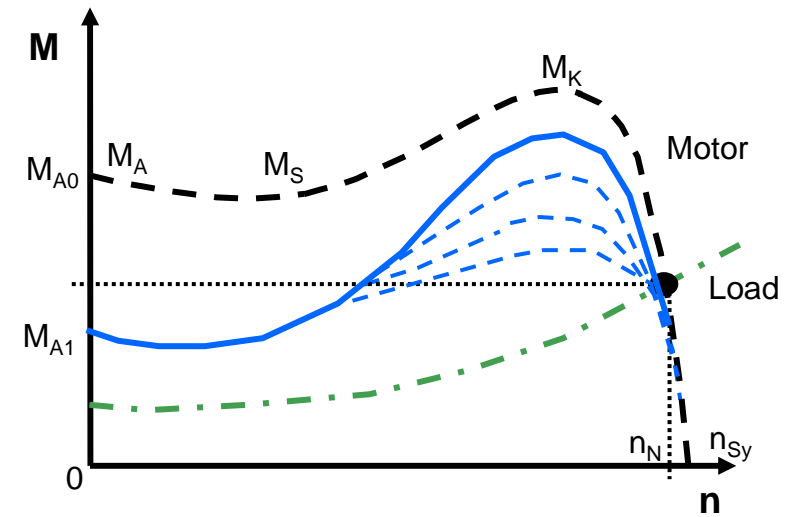
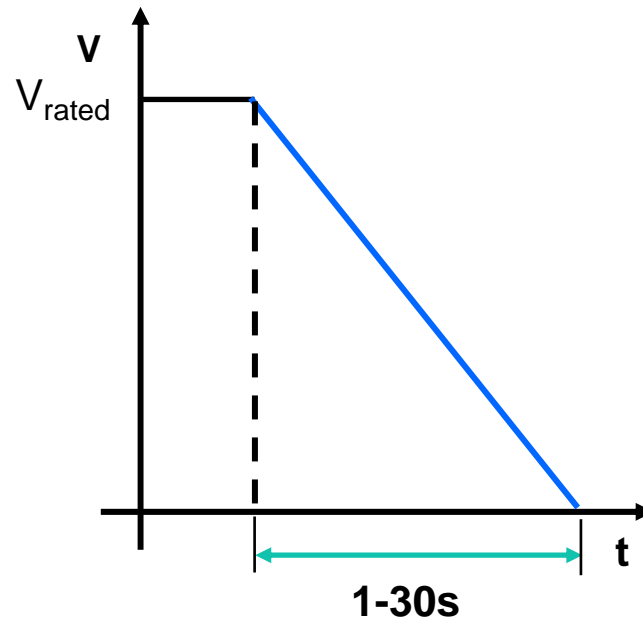


Soft stopping



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Soft stopping after a selectable time



--- Motor directly connected to the line supply
— with softstarter



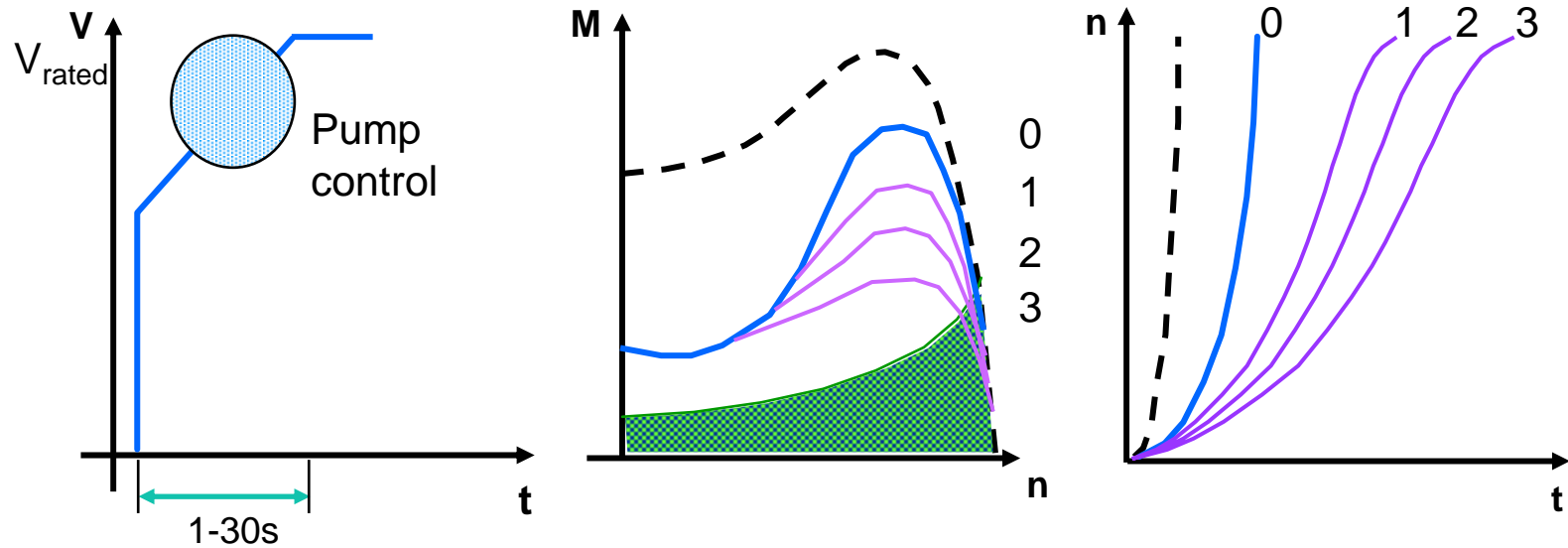
Special function



✓ Pump control when starting

Setting to prevent pressure surges (water hammer). Extends the lifetime of piping systems. (Allows one of four voltage ramps to be selected)

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- Motor directly connected to the line supply
- Softstarter - Standard
- Softstarter - Pump control



special settings

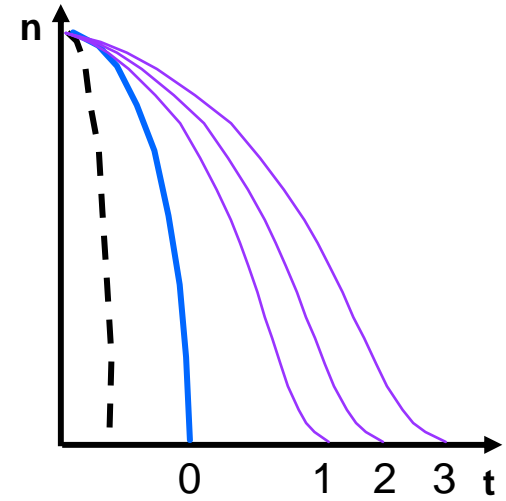
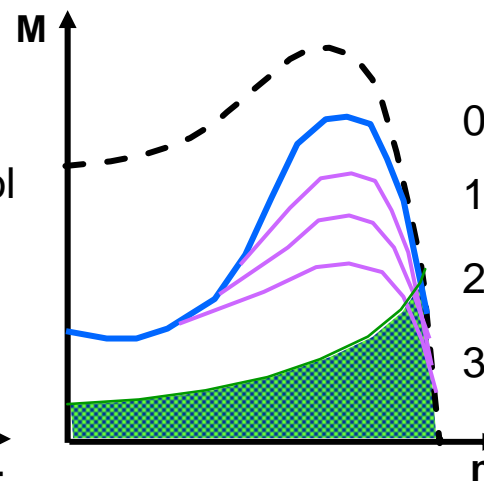
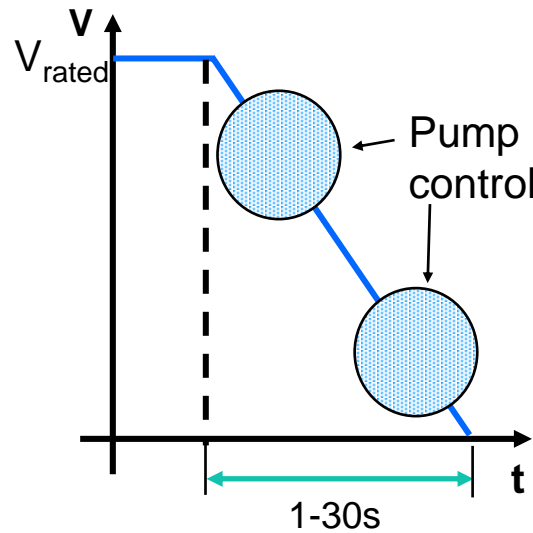


✓ Pump control when stopping

Point 1: Allows one of three voltage ramps to be selected

Point 2: If the motor torque < load torque

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- - Motor directly connected to the line supply
 — Softstarter - Standard
 — Softstarter - Pump control



special settings



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Pump control

Setting to prevent pressure surges extends the lifetime of piping systems (allows one of four voltage ramps to be selected)

Second parameter set

Permits a second start-stop characteristic, can be set for motor current, power-on voltage, starting current and starting-stopping time.

Kick start

To overcome breakaway torques,

Electronic shear bolts

If the driven load is suddenly braked, 200 - 850% I_{rated} , with adjustable delay from 0.5 - 5s

Diesel generator line supply

Allows drive to accelerate when connected to supplies with voltage and frequency fluctuations

Tach. inputs

Closed-loop torque and speed control



Start & stop parameters - soft starting (1)



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The starting torque is reduced by specifying the starting voltage.

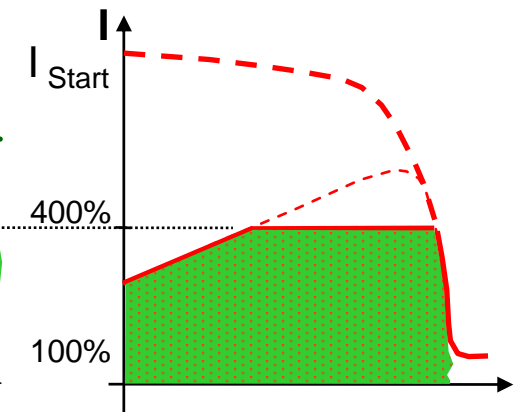
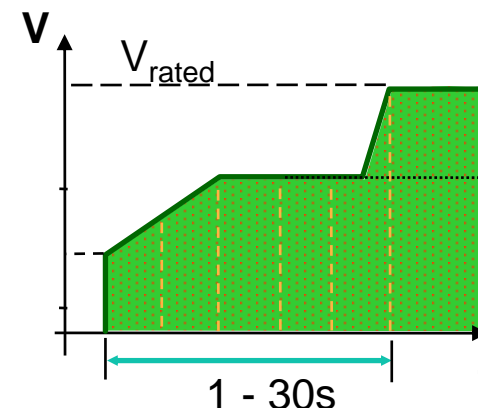
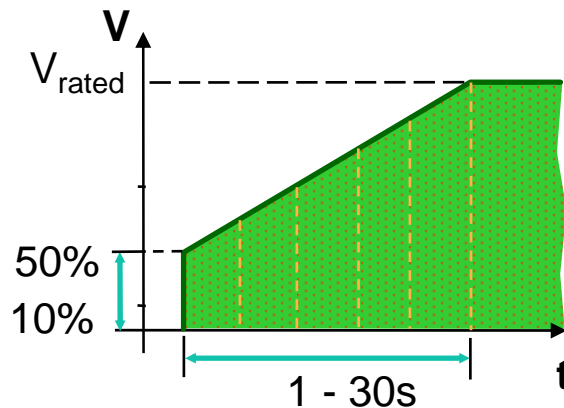
10-50% V_{rated}

adjustable starting time:

1-30s

The starting voltage and starting current (inrush current) are limited.

100-400% I_{rated}





Start & stop parameters - soft starting (2)



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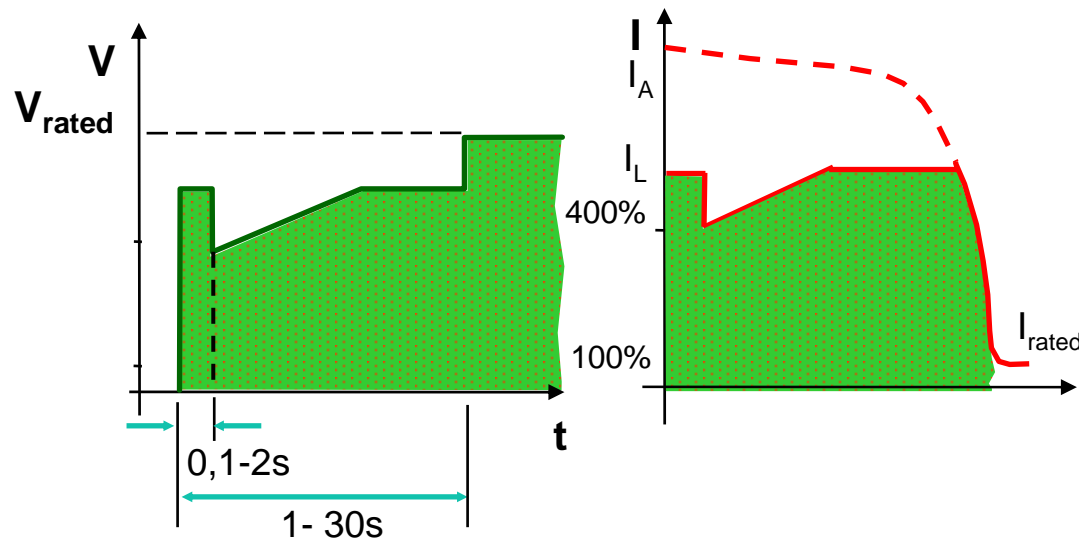
Engineering: FAQs

Kick-start - with the required breakaway torque.

Voltage pulse 80% V_{rated} ,

Adjustable pulse length

0,1-2s



Softstart with
breakaway
pulse voltage
ramp and
voltage limiting



Start & stop parameters - soft stopping



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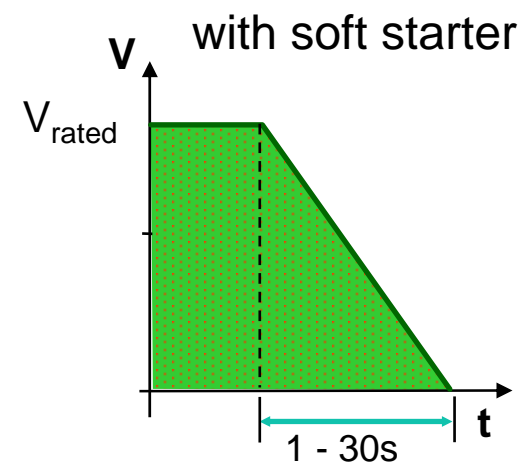
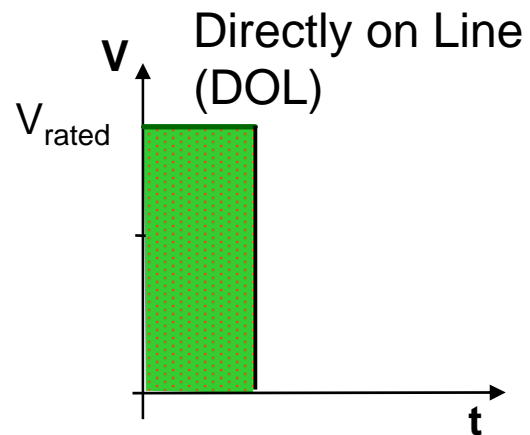
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Adjustable stopping time:
1-30s





Motor and softstarter protection (1)



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Protective functions to protect the starter:

Thermal heatsink monitoring, bypass open, overcurrent protection, electronic shear bolts and electronic overload protection with selectable characteristics.

Motor protection using an MPR 2000 motor protection relay with 5/10 PT100 inputs

Function: Motor protection and monitoring

Motor protection:

Current monitoring:

- Too many successive starts
- Time exceeded when starting
- Undercurrent
- Overcurrent
- Load increase
- Blocked motor
- Short-circuit
- Thermal overload
- Current fluctuations
- Ground fault

Voltage monitoring:

- Under voltage
- Over voltage
- Phase failure
- Phase sequence interchanged

Current+voltage monitoring:

- Power reduction

Temperature monitoring

General monitoring:

- External data monitoring



Motor and softstarter protection (2)



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Motor protection using an MPR 2000 motor protection relay with 5/10 PT100 inputs

Monitoring:

Measuring data:

- Phase and line supply voltage
- Phase current
- Ground fault
- Power factor
- Temperature sensing (PT100/PTC)

Calculated data:

- Starting time
- Stopping time
- Non-symmetrical current
- Motor load as % of the starter I_{rated}

Statistical data:

- Motor operating hours
- Number of starts (complete)
- Number of stops (complete)
- Last acceleration time
- Last starting current

Fault data

- Last trip
- Last alarm
- Phase current
- Ground fault
- Phase voltage

The motor protection relay has a serial interface which allows the preset setpoint parameters to be changed locally (on-site).



Option and Accessories



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- +L01 Supply cabinet, complete (with off-load disconnect and fuses etc.)
- +L02 ModBus communications interface
- +L03 Profibus communications interface
- +L04 Top-mounted fan, air entry fr. below w/ filter elements+
LV mot.prot.cct.-brkr
- +L87 MPR 2000 motor protection relay, 5 PT100 inputs
- +L88 MPR 2000 motor protection relay, 10 PT100 inputs
- +L89 Motor protection monitoring, MPC 2000
- +L90 400V auxiliary voltage for the function test (LV motor test)
- +L91 460V auxiliary voltage for the function test (LV motor test)
- +L92 525V auxiliary voltage for the function test (LV motor test)
- +L93 575V auxiliary voltage for the function test (LV motor test)
- +L94 690V auxiliary voltage for the function test (LV motor test)
- +M09 Special paint finish (paint thickness)
- +M10 Tinned cooper bar
- +M54 Degree of protection IP 54
- +M66 Suitable for marine applications
- +M67 For multi-motor drives, plain text data required



Spare parts



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- +R01** Spare parts package (small)
- +R02** Spare parts package (medium)
- +R03** Spare parts package (large)
without option Motor Protection Relay (MPR2000) and
Motor Protection & Controller (MPC2000)
- +R04** Spare parts package (large)
with option Motor Protection Relay (MPR2000)
- +R05** Spare parts package (large)
with option Motor Protection & Controller (MPC2000)



As packages (+R01/+R02/+R03,+R04,+R05)

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- Phase block
- Control section, softstarter
- MPR200 motor protection relay, 5 PT100 inputs
- MPR200 motor protection relay, 10 PT100 inputs
- MPC 2000 motor monitoring device
- Vacuum contactor
- CT
- PT
- Control voltage transformer
- Clocked power supply unit for the pulse power supply
- 1 set of small parts (lamps, 10m fiber-optic cable and terminals)

+R01	1x phase module Control module 1x vacuum contactor
+R02	2 x phase modules Control module 1x vacuum contactor CT PT Power supply
+R03 +R04 with MPR2000 +R05 with MPC2000	2 x phase modules Control module 2x vacuum contactors CT PT Power supply Control voltage transformer Firing board, 1 set of small parts



Commissioning



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Feature - simple installation/mounting:

When installing/mounting, only low amount of cabling is required both on the motor as well as on the line supply side.

Feature - simple commissioning:

The most important parameters are already set for the particular application in the factory.

Only the motor rating plate data has to be entered.

The individual parameters can be set-up locally or in the plant according to the customers data.

The settings are easy as a result of the user-friendly operator panel.



Documentation



Documentation when the equipment is shipped - this will be adapted to the specifications of the the standard document guidelines:

- Safety instructions/information
- Description
- Circuit diagrams
- Mounting/installation instructions
- Commissioning instructions
- Parameter lists
- Operating instructions
- Repair instructions
- Spare parts list
- Logbook/test certificate
- Supplementary instruction manual (options)

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Compared to conventional solutions



Starting transformer and mode of operation

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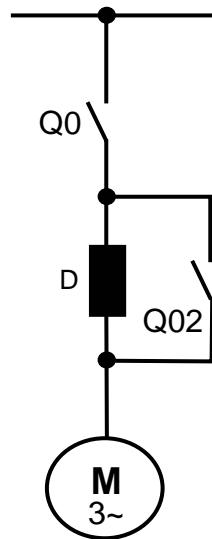
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$$I \sim M^2$$

When the current is linearly reduced, the torque is reduced according to a square law

Switching sequence:

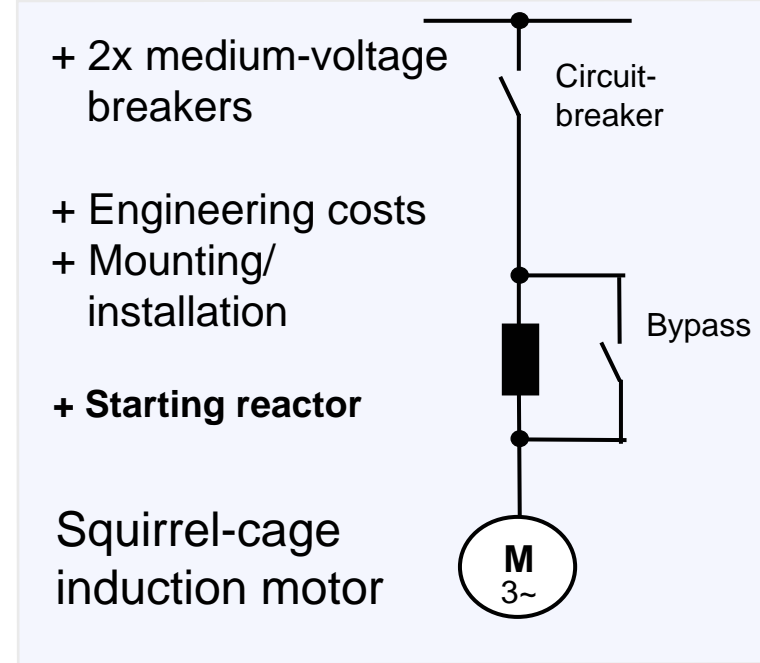
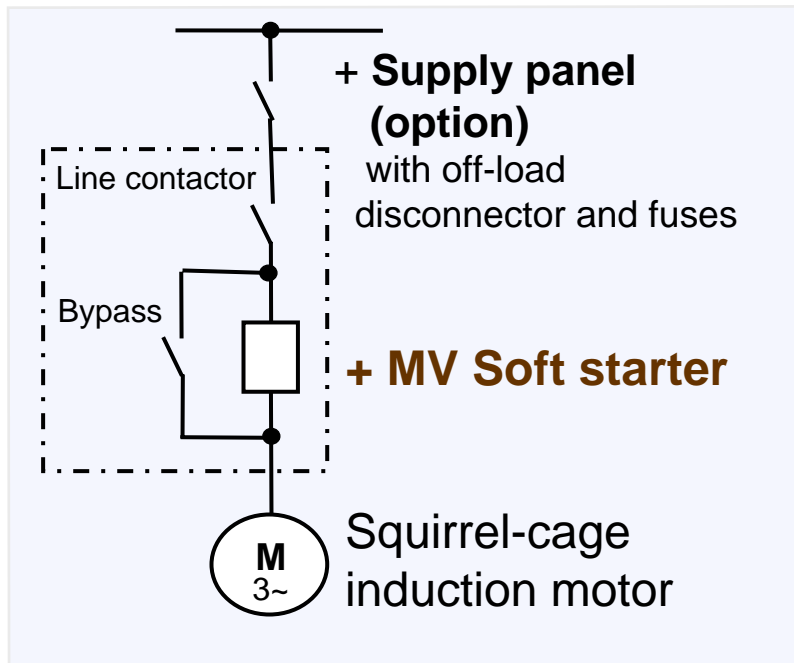
- 1) Breaker Q0 is closed, the motor starts via the reactor.
- 2) After starting, the reactor coil is bypassed by breaker Q02.



Compared to conventional solutions

System comparison, MV SST to reactor starting

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Compared to conventional solutions



Starting transformers and mode of operation

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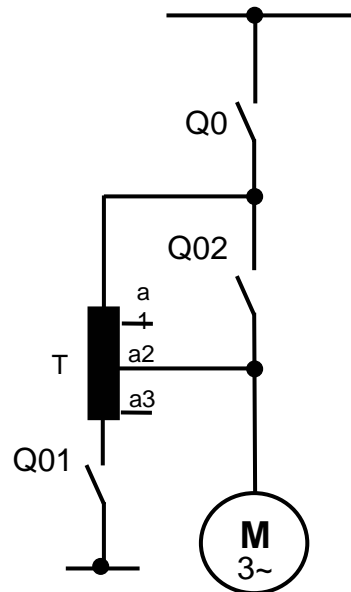
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I ~ M

Starting current (line side) and starting torque decrease in the same ratio.

Switching sequence:

- 1) The motor starts via the starting transformer with breakers Q0 and Q01 closed. Bypass breaker Q02 is open.
- 2) Breaker Q01 is only opened after the motor has accelerated, and then bypass breaker Q02 is closed.

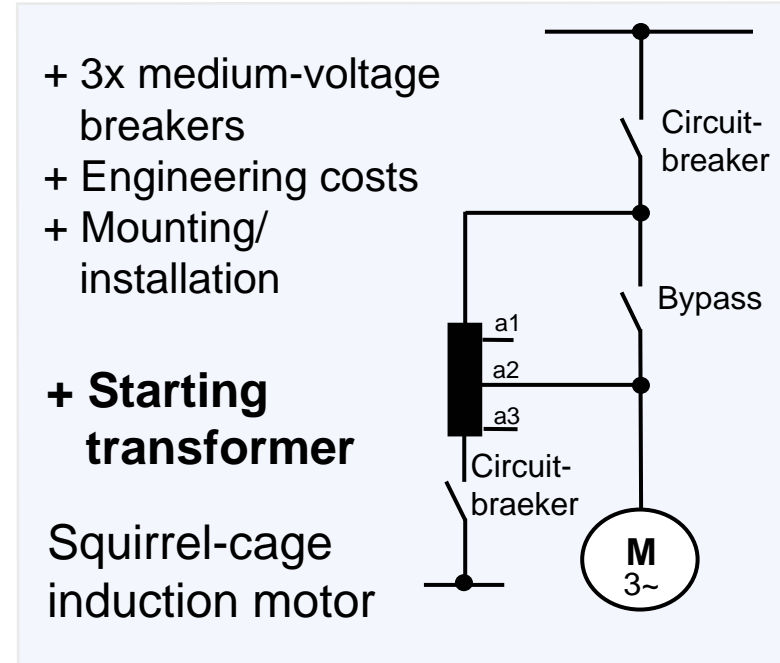
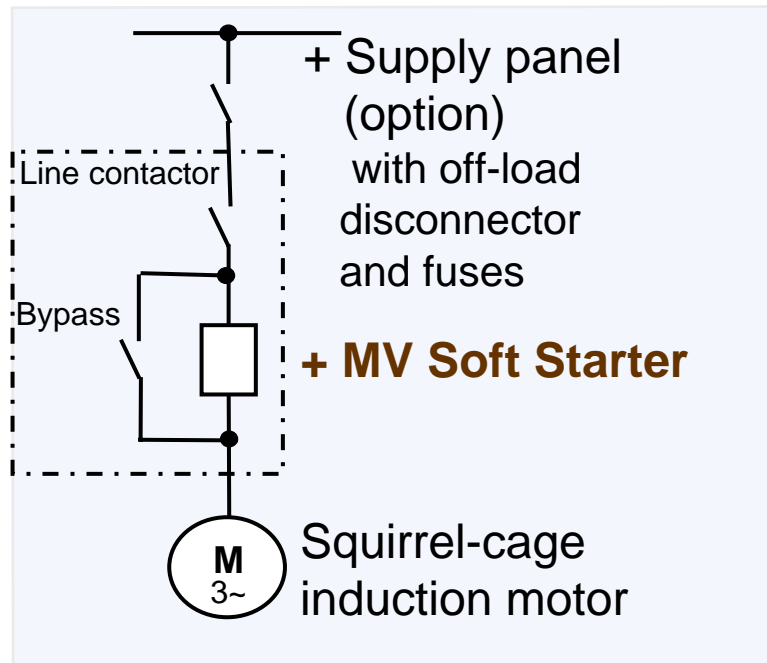
The costs involved are significant which makes it more expensive than reactor starting.



Compared to conventional solutions



System comparison, MV SST to transformer starting



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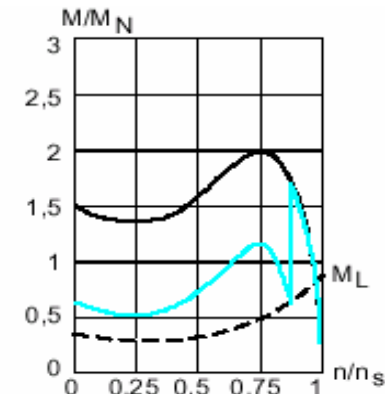
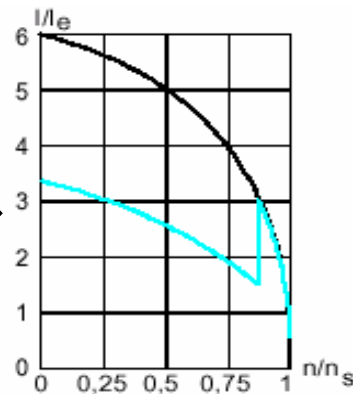


Compared to conventional solutions

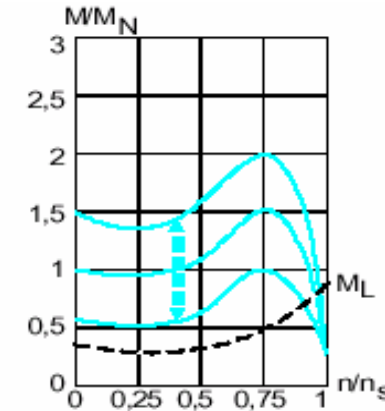
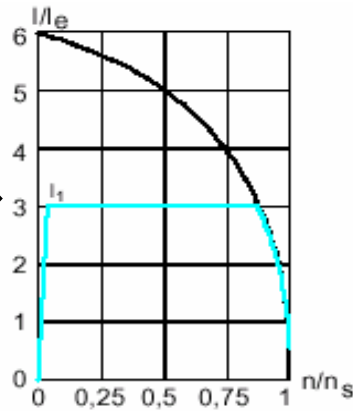


The current and torque characteristics

Starting transformer



Soft starting



High current peaks can still be identified for starting transformers.



Compared with conventional starting Equipment Slipping motor with starter

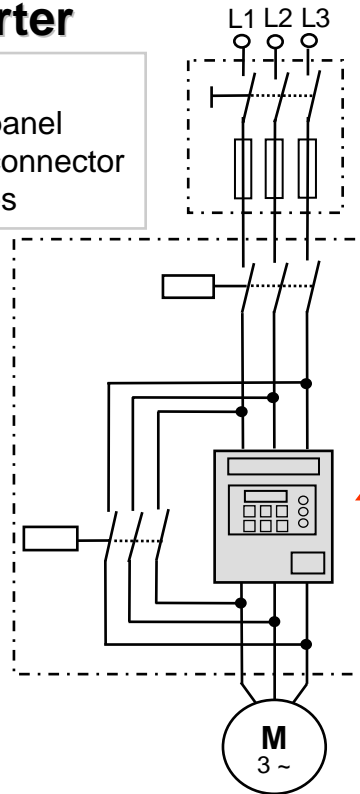


Squirrel-cage induction motor

Slipping rotor

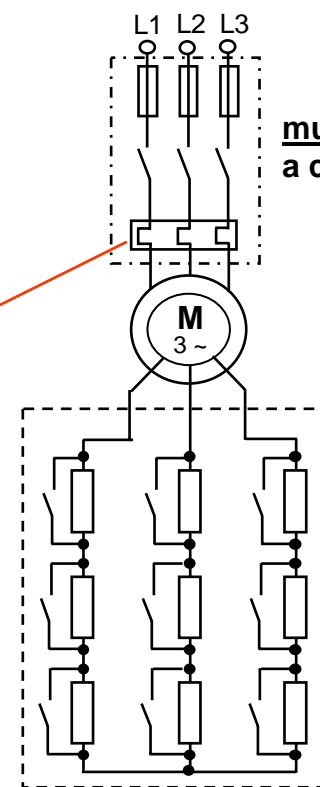
Softstarter

Option:
Supply panel with disconnecter and fuses



Starter

must be
a circuit-breaker!



Series resistors
in a star configuration

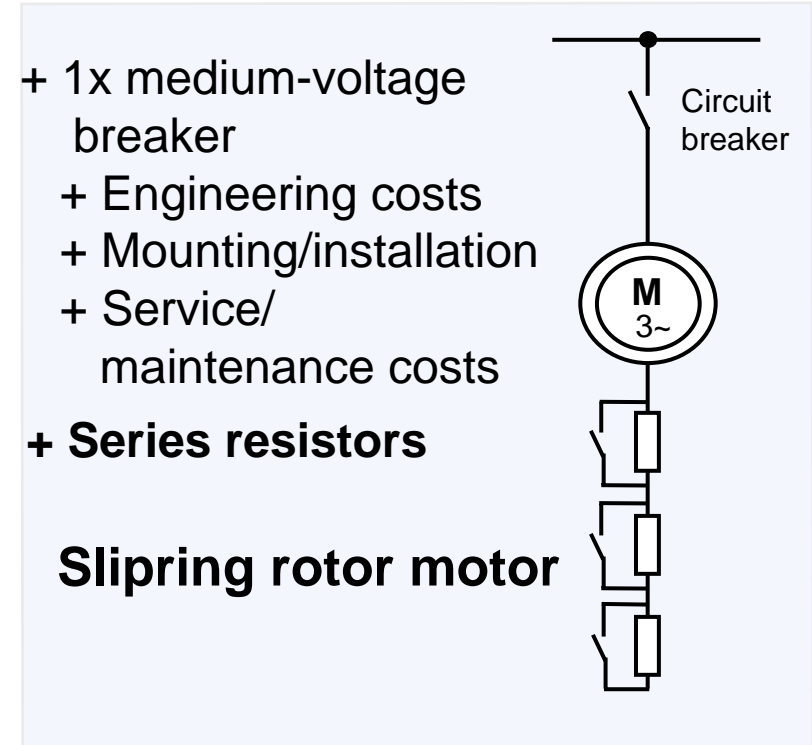
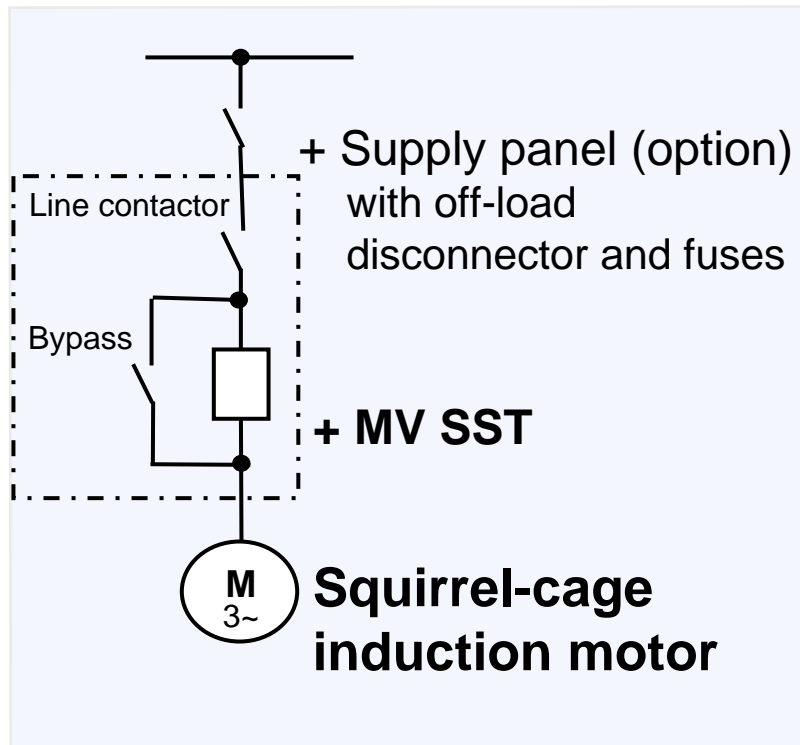
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Compared to conventional solutions

System comparison, MV SST squirrel-cage induction motor with slipring rotor motor with starter

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Compared with conventional starting Equipment Slipping motor with starter



Squirrel-cage induction motor

Slipping motor

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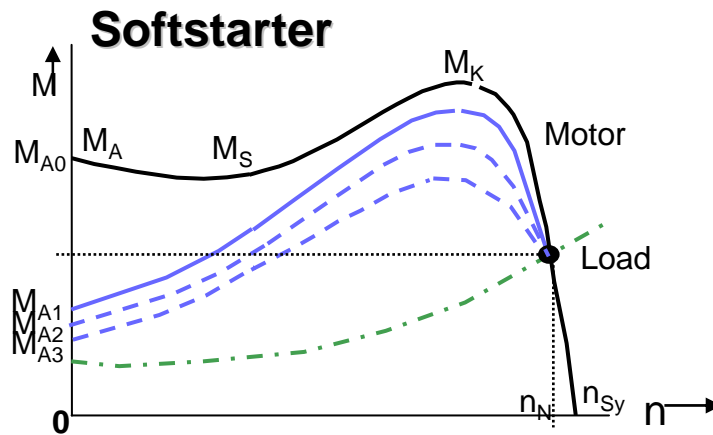
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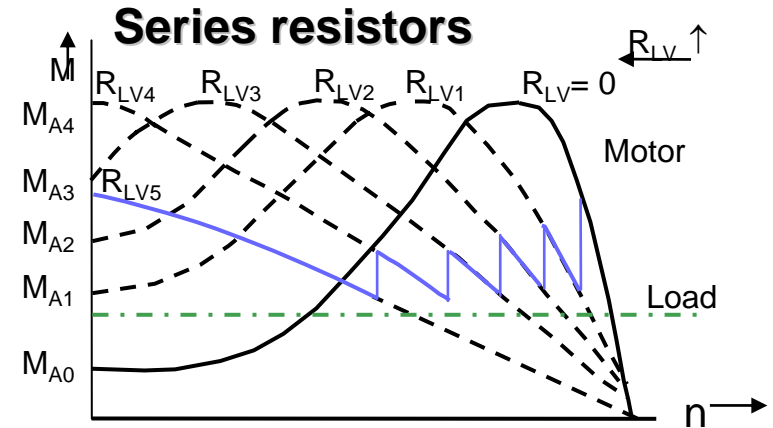
Technical Comparison

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MV Soft starter reduces the starting torque

$$\frac{M_A}{M_N} = 0,25 \text{ to } 1$$



The starting torque is adjusted by matching the starting resistance to the rotor resistance.

$$\frac{M_A}{M_N} = 0,25 \text{ bis } \frac{M_K}{M_N} (\text{approx. } 2,5-3,5)$$



Compared with conventional starting Equipment Slipping motor with starter



Squirrel-cage induction motor

Slipping motor

Softstarter

$$I_{\text{start}} \sim V_{\text{start}}$$

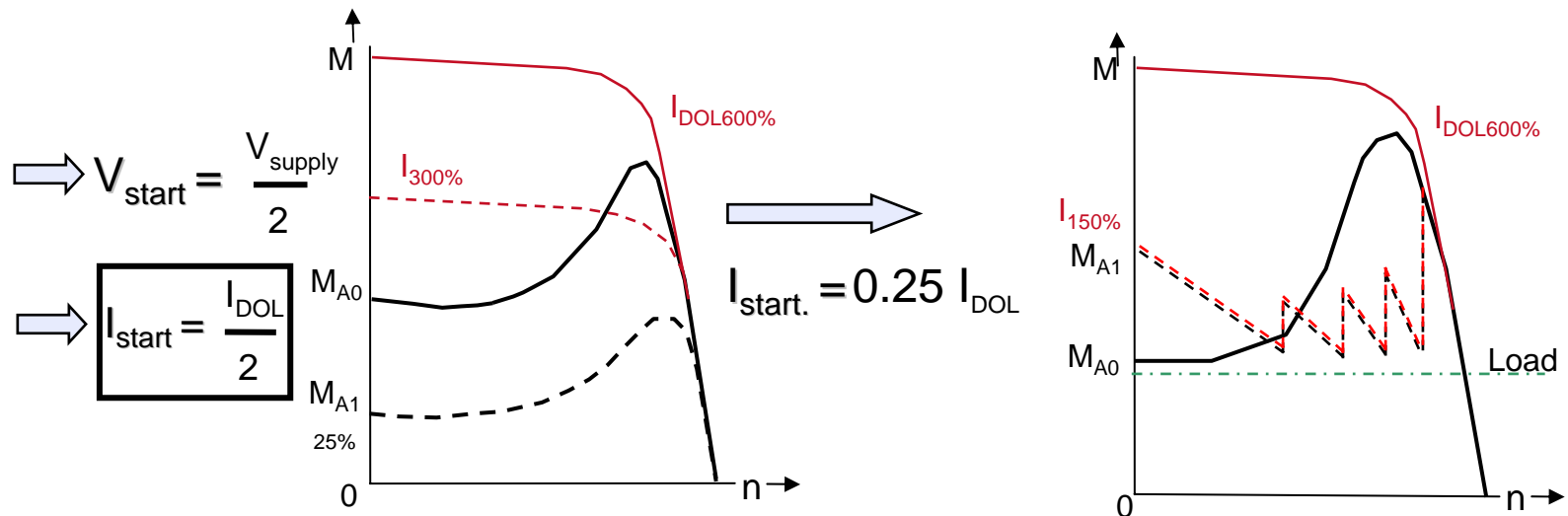
$$M_{\text{start}} \sim V_{\text{start}}^2$$

Starting torque 25% M_N

Series resistors

$$I_{\text{start}} \sim M$$

Starting torque 25% M_N



Engineering: FAQs

Technical Comparison



Customer advantages over conventional solutions



Design

Technical data

Functions

Options

Spare parts

Commissioning

Documentation

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Engineering: FAQs

Costs are saved when integrating into the drive system as follows:

- Bypass is already integrated including the control,
- Circuit-breakers are not required because there is a line contactor
- Comprehensive motor protection is already included in the standard cabinet,
- Standard motors are used (Siemens and 3rd-party motors),

=> Lower engineering costs,

=> Lower cabling costs => low mounting/installation costs,

=> Lower service/maintenance costs,

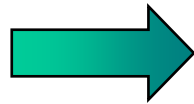
 **Better price/performance ratio**



Customer advantages over conventional solutions



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- Technical Comparison**
- Engineering: FAQs



SIMOSTART MV can be easily integrated into the process automation using the ModBus or Profibus communications interface,



Flexibility as a result of a parameterization:

- The starting system can be adapted to all line supply conditions and production processes,
- Can be used for all squirrel-cage induction motors in the HV area.



Excellent starting and stopping characteristics,

- No current peaks when changing-over after acceleration



Closed-loop soft coast down control possible,



Customer advantages over conventional solutions



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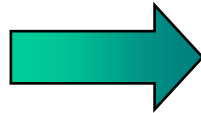
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Special settings possible:

- (Pump control, kick-start, second parameter set, tachometer input....)



Compact type of construction,



Low weight.