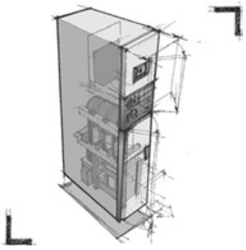
Application guide
2004



Motorpact

Types of motor starters

Each Motorpact unit is equipped with a comprehensive protection, control and measuring system comprising :
- *instrument transformers to measure the necessary electrical values (phase current, residual current, voltages, etc.)*
- *Sepam protection relay adapted to the application*
- *metering equipment*
- *low voltage auxiliary relays*

This guide will assist you to select the right Motorpact MV motor starter for your application.

PE50237

Choosing a motor starter depends on the application and on the network

- **the load :** application, constraints
- **the type of motor :** power, voltage, constraints
- **the network :** constraints.

LV or MV Motorstarter?

When compared to low voltage motor starters, MV motors and controllers can reduce installation and operating costs, by reducing the amount of copper required, since less current is used for the same power load.

Up to 350 kW, the motor is generally LV type. Between 350 and 500 kW, the choice will be economic, above 500 kW the motor is generally MV type.
The use of Variable Speed Drive increases the limit of LV motors up to 1500 kW.

une marque de Schneider Electric

Merlin Gerin

Select the right motor starter type

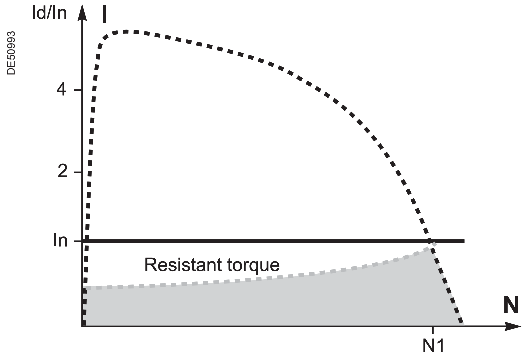


Fig. 1.

FVNR Full voltage (direct on line) motor starter

Applies the system line voltage to motor terminals to start a motor. The resulting inrush current can be high, ranging from 400 % to 1000 % of full load current. Figure 1 shows the typical inrush current of 600 %. Full voltage starting also provides high starting torque (about 150 % of full load torque).

Full voltage motor starters are the most widely used and meet most of applications.

Motorpact FVNR motor starter is particularly suitable, due to its simple and cost-effective design, compact footprint, easy operation and low maintenance.

Reduced Voltage motor starters

Starting with reduced voltage decreases the full load current (FLC) at the motor terminals in proportion to the voltage reduction while the full load torque (FLT) is reduced by the square of the voltage reduction.

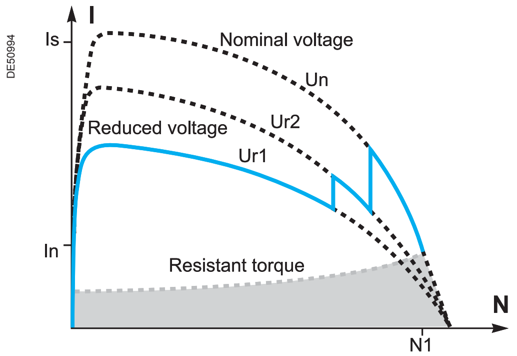


Fig. 2.

Example:
Voltage reduction = 65 %
Motor current reduction = 65 % x 600 % FLC = 390 % FLC
Torque reduction = $(65\ \%)^2$ x 150 % FLT = 63 % FLT
Reductions are done with either an **autotransformer,** a primary reactor or a **SoftStart electronic device.**

RAVT auto-transformer motor starter

It provides maximum starting torque with minimal line current. Due to transformer action, the line current will be 25 %, 42 % or 64 % of full voltage values for the 50 %, 65 % or 80 % taps,respectively.
The two methods of transitioning from full voltage to reduced voltage are open and closed transitions:

- open transition disconnects the motor from the power source for a brief time, allowing the motor to act as a generator. However, when reconnected, transients are produced that can damage the motor
- closed transition never disconnects the motor from the power source.

Motorpact RVAT auto-transformer motor starter uses the closed transition, or Korndorfer method.

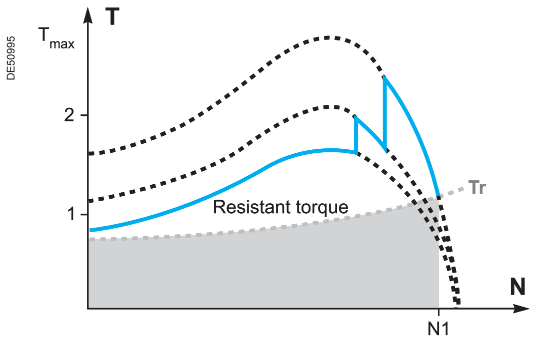


Fig. 3.

The **transition from reduced voltage to full voltage** on Motorpact motor starters can be based on current or time. The overcurrent relay of the Sepam 41 monitors the motor current.
When the motor current drops below the preset value, the relay signals the motor starter to switch to full voltage.
If the controller does not transition to full voltage in a preset time (acceleration time plus two seconds), an incomplete sequence relay signals the controller to stop.
Fig. 1 and fig. 2 show motor starting with auto-transformer, showing that the starting torque is lower than for full voltage.

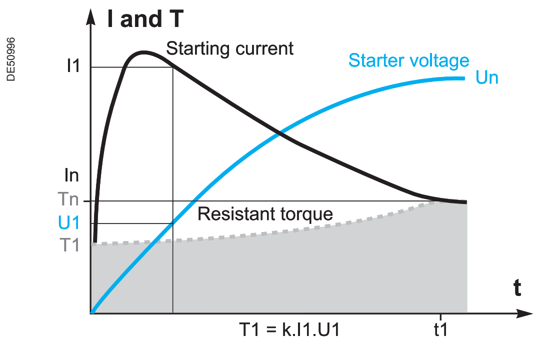


Fig. 4.

RVSS SoftStart motor starter

A central processing unit (CPU) controls the reduced voltage applied to the motor, by phase angle firing the SCR power module, and then slowly and gently increases torque through control of the voltage and current until the motor accelerates to full speed.

Motorpact RVSS SoftStart motor starter can have different starting settings:
Voltage ramp with current limit: the initial torque setting applies just enough voltage to the motor to cause the motor shaft to begin to turn. This voltage is gradually increased.
Constant current : the current is immediately increased to the Current Limit point and held here untill the motor reaches the full speed. The voltage is function of the necessary torque.
Torque regulation : control of the acceleration; current and voltage are function of the torque, see fig. 4 and fig. 5

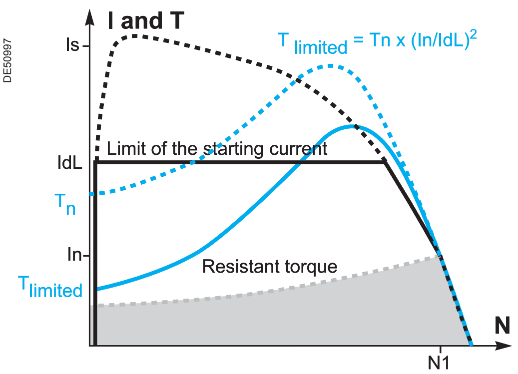
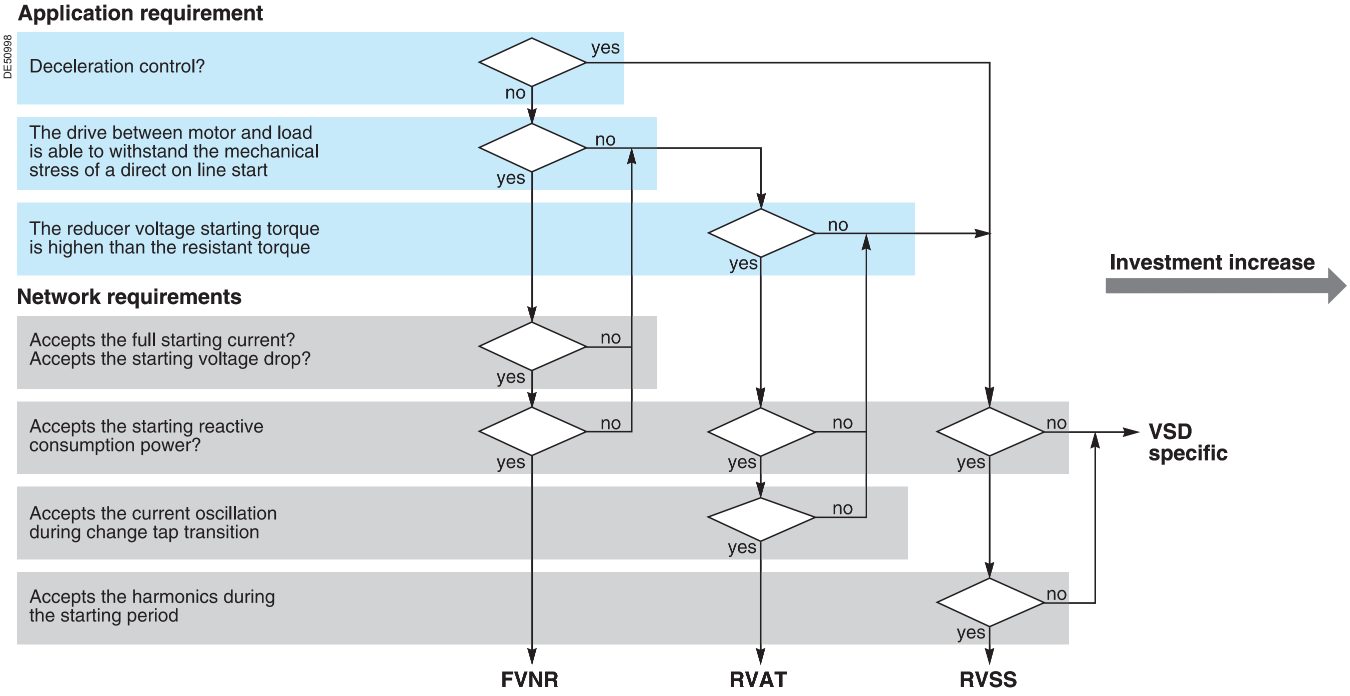


Fig. 5.

Select the right MV motor starter type



FVNR motorstarter

You have to know:	Example
Motor characteristics:	
Rated power	**Pn = 800 kW**
Rated voltage	Un = 5500 V
Efficiency x power factor	0.84
Starting torque/rated torque ratio on full voltage	Cs/Cn = 0.8
Starting/rated current ratio on full voltage	Is/In = 5
Torque/speed curve	
Driven machine characteristics	
Breakaway torque	
Load torque/speed	0.2 Cn
Network (incoming transfo) supply	
Power	Pt = 3 MVA
Maximum autorized inrush power	St = 6 MVA
Other loads supplied from the switchboard	1200 kVA/ cos φ = 0.87

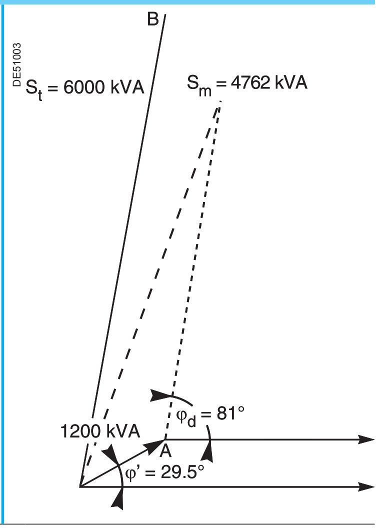
Calculation
motor apparent power at the beginning
of the start

$$Sm = \frac{Pn}{\cos\varphi} \times \frac{Is}{In}$$

$$Sm = \frac{800}{0.84} \times 5$$

Sm = 4762 kVA
where,with power factor on starting :
$\cos\varphi_d = 0.15$, ie $\varphi_d = 81°$
This power is vectorially added to the power delivered by the network on the different feeders.
The total value of the apparent power required by the network is graphically deduced from the following: S_t

The maximum inrush authorised is 6000 kVA.
direct starting is possible



Required technical data to order an auto-transformer motor starter

You have to know:

Motor characteristics

Rated power
Rated voltage
Efficiency x power factor
Starting torque/rated torque ratio on full voltage
Starting/rated current ratio on full voltage
Torque/speed curve

Driven machine characteristics

Breakaway torque
Load torque/speed

Network (incoming transfo) supply

Power
Maximum autorized inrush power

Other loads supplied from the switchboard

Required technical data to order a SoftStart motor starter

You have to know:

Motor characteristics

Rated power
Rated voltage
Efficiency x power factor
Starting torque/rated torque ratio on full voltage
Starting/rated current ratio on full voltage
Torque/speed curve

Driven machine characteristics

Breakaway torque
Load torque/speed

Network (incoming transfo) supply

Power
Maximum autorized inrush power

Other loads supplied from the switchboard

Fuse selection

Service voltage (kV)	Starting current (A) (Id/In = 6)	Normal current (A)	Minimum sensor rating (sec. 1A)	LPCT	Starting duration (seconds)					
					5	5	10	10	20	20
					Number of starts per hour					
					6	12	6	12	6	12
3.3	2400	400		Valid with all ratings	2 x 250					
	2200	366			2 x 250	2 x 250	2 x 250	2 x 250	2 x 250	
	2000	333			2 x 250	2 x 250	2 x 250	2 x 250	2 x 250	
	1800	300			2 x 250	2 x 250	2 x 250	2 x 250	2 x 250	2 x 250
	1410	235.0	250		2 x 200	2 x 250	2 x 250	2 x 250	2 x 250	2 x 250
	1290	215.0	250		2 x 200	2 x 200	2 x 200	2 x 250	2 x 250	2 x 250
	1140	190.0	200		250	2 x 200	2 x 200	2 x 250	2 x 250	2 x 250
	1030	171.7	200		250	2 x 200	2 x 200	2 x 250	2 x 250	2 x 250
	890	148.3	150		250	250	250	2 x 200	2 x 200	2 x 200
	790	131.7	150		250	250	250	250	250	250
	710	118.3	150		250	250	250	250	250	250
	640	106.7	150		250	250	250	250	250	250
6.6	610	101.7	150		200	250	250	250	250	250
	540	90.0	100		200	200	200	250	250	250
	480	80.0	100		160	200	200	200	200	250
	440	73.3	75		160	200	200	200	200	200
	310	51.7	75		160	160	160	160	160	160
	280	46.7	50		125	160	160	160	160	160
	250	41.7	50		125	160	160	160	160	160
	240	40.0	50		125	125	125	160	160	160
	230	38.3	50		125	125	125	160	160	160
	210	35.0	50		125	125	125	125	125	160
	180	30.0	50		125	125	125	125	125	125
	170	28.3	50		125	125	125	125	125	125
	160	26.7	50		125	125	125	125	125	125
	148	24.7	50		125	125	125	125	125	125
	133	22.2	50		125	125	125	125	125	125
	120	20.0	50		125	125	125	125	125	125
	110	18.3	50		125	125	125	125	125	125
	98	16.3	(1)		125	125	125	125	125	125
	88	14.7	(1)		125	125	125	125	125	125
	83	13.8	(1)		125	125	125	125	125	125
	73	12.2	(1)		125	125	125	125	125	125

(1) If CT's are required:

■ *the CT's ratio must be selected in accordance with the fuses characteristics in order keep the thermal image protection (30/1 CT's available):*
□ *sensor rating is generally choosen higher than motor normal current x 1.3 (then "most probable choice")*
□ *thermal image protection (ANSI 49) setting requires "sensor rating < 3 x Motor normal current"*
□ *minimum sensor ratings must be selected taking into account the max fuse rating of the line in order to ensure that the accuracy limit current is higher than I3 (minimum clearing current).*

it is necessary to delay the tripping of the contactor.

Note:

■ *fuses are 442 mm long*
■ *fuses are only for short circuit protection*
■ *for starting currents lower than 170 A, we recommend 125 A Fusarc CF fuses with LPCT.*

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