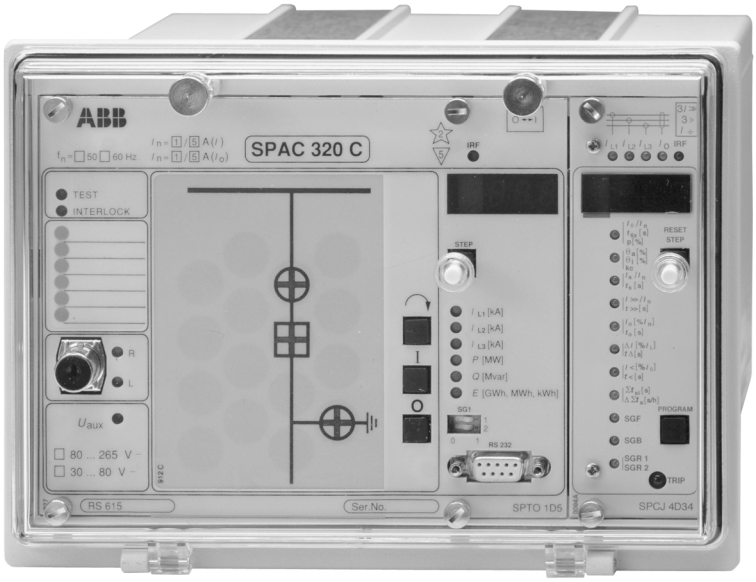
Motor feeder terminal

SPAC 320 C

Product Guide



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1MRS750370-MBG

Product Guide

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Features

- Versatile multifunction relay for the protection of circuit-breaker or contactor controlled a.c. motors
- The relay can also be used for the protection of feeders and transformers
- Three-phase thermal overload protection
- High-set overcurrent protection with instantaneous or definite time operation
- Phase unbalance and single-phasing protection with inverse time characteristic
- Fast operating incorrect phase sequence protection
- Sensitive earth-fault protection with definite time characteristic
- Undercurrent protection with definite time characteristic
- Several selectable motor start-up supervision methods
- Configurable feeder level interlocking system for preventing unpermitted switching operations
- Local and remote status indication of three switching devices
- Complete control module for local/remote control of one switching device
- Measurement and indication of phase current, energy and active and reactive power
- Serial interface for connecting the motor terminal to substation level and network control level systems
- Continuous self-supervision for maximum system reliability and availability
- Member of the SPACOM product family and ABB's Distribution Automation system

Application

The motor terminal type SPAC 320 C is designed to be used as a cubicle-oriented protection and local/remote control interface unit for one motor feeder. In addition to the protection, control and measurement functions, the motor terminal is provided with the data communication properties needed for the control of the switching devices of a motor feeder cubicle. Connection to higher-level substation control equipment is carried out via a fibre-optic serial bus.

Design

The motor terminal includes a relay module type SPCJ 4D34 for the protection functions and a control module type SPTO 1D5 for the control, measurement and supervision functions.

Protection relay module

The multi-function relay module SPCJ 4D34 continuously measures the phase currents and the neutral current of the motor feeder to be protected.

The multi-function relay module SPCJ 4D34 comprises seven units: a three-phase overcurrent unit, a thermal overload unit, a start-up supervision unit, a phase unbalance unit, an incorrect phase sequence unit, an undercurrent unit and a non-directional earth-fault unit.

The overcurrent unit holds a low-set stage I_s and a high-set stage I>>. The high-set stage provides short-circuit protection. The low-set stage can be used for start-up supervision or for time overcurrent protection.

The thermal unit supervises the thermal stress of the protected object during various load conditions. The unit provides thermal prior alarm and thermal tripping and it prevents the protected object from being re-energized, if the protected object is too hot to be successfully re-energized.

The start-up supervision can be realized according to several principles. It can be based on measuring the start time, on measuring the thermal stress at start-up or on the use of an external speed switch.

The phase unbalance unit protects the motor from the stress caused by an unbalanced network. The unit operates with inverse time characteristic. The operate time of the unit at full unbalance, i.e. at loss of one phase is 1 second.

The incorrect phase sequence protection has a factory-set operate time of 0.6 seconds.

The undercurrent unit is used for the protection of motors at sudden loss of load in certain applications, such as conveyors and submersible pumps. The unit features definite time characteristic.

Control module

Status functions

The control module SPTO 1D5 is used for reading status information from the circuit breaker, the CB truck and the disconnectors of the switchgear cubicle to be controlled. The module indicates the status locally by means of LED indicators and transfers the status information to the substation control level via the fibre-optic SPA bus. The status of maximum three switching devices can be indicated.

Control functions

The control module is also used for controlling one switching device e.g. a circuit breaker, locally by means of push buttons on the front panel and remotely via open or close commands transmitted over the fibre-optic bus.

Additional binary inputs

In addition to status information, the control module is able to read other binary information, indicate it locally and transfer it to the substation control level. Six external binary signals can be wired to the motor terminal.

Interlocking

The control module includes a cubicle-oriented interlocking system which is freely programmable by the user. By writing an interlocking program the user defines under which conditions the object can be closed or opened. When an open or close command is given, the interlocking program decides whether the control command can be executed or has to be cancelled.

The trip signals generated by the protection relay module are not affected by the interlocking system.

Conditional direct output control

Normally, the circuit breaker control outputs are controlled by means of commands initiated by the operator and transmitted via the fibre-optic bus. However, the circuit breaker can also be automatically controlled by the logical direct output control program. This program reads the status of the status input channels, the binary input channels and the R/L key switch and carries out the programmed circuit breaker control functions and possible signalling functions, if the defined conditions are fulfilled.

Design (cont´d)

Measurement functions

The control module SPTO 1D5 and the multi-function relay module SPCJ 4D34 both measure analog signals.

The multi-function relay module measures three phase currents and neutral current. The module displays the current values locally and transmits the information to the remote control system via the SPA bus.

The control module SPTO 1D5 measures five analog signals: three phase currents, active and reactive power. The transformation ratio of the primary current transformers can be written to the control module to enable it to display the measured phase currents as primary values.

Active and reactive power is measured via two mA inputs using external measuring transducers. The mA signals are scaled to actual MW and Mvar values. The data is displayed locally and can be transmitted to the remote control system.

Active energy is measured in two ways: either by calculating the value from the power values measured or by using one of the inputs, i.e. input 7, as an energy measuring input. In the latter case, an external energy meter with pulse output will be needed. In both cases the measured energy value is displayed locally and, when required, transmitted to the remote control system.

Supervision functions

Self-supervision

The motor terminal incorporates a sophisticated self-supervision system with auto-diagnosis, which increases the availability of the motor terminal and the reliability of the system. The self-supervision system continuously monitors the hardware and the software of the motor terminal. The system also supervises the operation of the auxiliary supply module and the voltages generated by the module.

When the self-supervision system detects a permanent internal relay fault, the IRF indicator on the motor terminal is lit. At the same time the output relay of the self-supervision system operates and a fault message is transmitted to the higher-level system over the serial bus. Further, in most fault situations, a fault code is shown in one of the displays. The fault code indicates the type of the fault that has been detected.

Data communication

The motor terminal includes two serial communication ports, one on the front panel and the other on the rear panel.

The 9-pin RS 232 connection on the front panel is used for configuring the motor terminal and switching devices, for loading the feeder-oriented interlocking program and other data from a terminal or a PC.

The 9-pin RS 485 connection on the rear panel connects the motor terminal to the SPA bus by means of a bus connection module type SPA-ZC 17 or SPA-ZC 21. The bus connection module type SPA-ZC 21 is powered from the host terminal, whereas the bus connection module SPA-ZC 17 is provided with a built-in power unit, which can be fed from an external secured power source. The motor terminal communicates with higher-level data acquisition and control systems over the SPA bus.

Auxiliary supply voltage

The auxiliary supply of the relay is obtained from an internal plug-in type power supply module. Two auxiliary power module versions are available: type SPGU 240A1 for the supply voltage range 80…265 V ac/dc and type SPGU 48B2 for the supply voltage range 18…80 V dc. The power supply module forms the internal voltages required by the protection relay and the I/O module.

Technical data

Table 1: Energizing inputs, phase current measurement

Terminals		X0/1-3, 4-6, 7-9	X0/1-2, 4-5, 7-8
Rated current I_n		1 A	5 A
Thermal withstand capability	continuously	4 A	20 A
	for 1 s	100 A	500 A
Dynamic current withstand capability	Half-wave value	250 A	1250 A
Input impedance		<100 mΩ	<20 mΩ
Rated frequency f_n, according to order		50 Hz or 60 Hz	

Table 2: Energizing inputs, residual current measurement

Terminals		X0/25-27	X0/25-26
Rated current I_n		1 A	5 A
Thermal withstand capability	continuously	4 A	20 A
	for 1 s	100 A	500 A
Dynamic current withstand capability	Half-wave value	250 A	1250 A
Input impedance		<100 mΩ	<20 mΩ
Rated frequency f_n, according to order		50 Hz or 60 Hz	

Table 3: External inputs

mA inputs	Terminals	Active power	X3/1-2
		Reactive power	X3/3-4
	Input current range		-20 mA…0…20 mA
Binary inputs	Terminals	CHANNEL 1…3, four-pole inputs	X2/8-14, 9-14, 10-14, 11-14, 12-14 and 13-14
		CHANNEL 4…9, single-contact inputs	X2/1-5, 2-5, 3-5, 4-5, 6-7 and X1/10-11
	Control input voltage range	input module SPTR 3B12	80…265 V dc
		input module SPTR 3B13	30…80 V dc
	Current consumption at activation		2…20 mA
Energy pulse counter input, CHANNEL 7	Terminals		X2/4-5
	Maximum control frequency		25 Hz
	Input voltage range	input module SPTR 3B12	80…265 V dc
		input module SPTR 3B13	30…80 V dc
	Current consumption at activation		2…20 mA
Blocking input, CHANNEL 8	Terminals		X2/6-7
	Input voltage range	input module SPTR 3B12	80…265 V dc
		input module SPTR 3B13	30…80 V dc
	Current consumption at activation		2…20 mA

Technical data (cont´d)

Table 4: Output contact ratings

Type of contact		CB control	Signalling	Restart inhibit
Terminals		X0/65-66, 85-86	X1/1-2-3, 4-5, 6-7 and 8-9	X0/74-75
Rated voltage		250 V ac/dc		
Thermal withstand capability	Carry continuously	5 A	5 A	5 A
	Make and carry for 0.5 s	30 A	10 A	30 A
	Make and carry for 3 s	15 A	8 A	15 A
Breaking capacity for dc, when the control/signalling circuit time constant L/R ≤ 40 ms, at the control voltages	220 V dc	1 A	0.15 A	1 A
	110 V dc	3 A	0.25 A	3 A
	48 V dc	5 A	1 A	5 A
Contact material		$AgCdO_2$		
Control output operating mode	When operated by the control module	Pulse shaping	–	–
	Control pulse length	0.1…100 s	–	–

Table 5: Data communication

Rear panel	Connection		RS 485, 9-pin, female
	Bus connection module for rear connection	for plastic core cables	SPA-ZC 21 BB
		for glass fibre cables	SPA-ZC 21 MM
	Bus connection module for separate mounting	for plastic core cables	SPA-ZC 17 BB
		for glass fibre cables	SPA-ZC 17 MM
Front panel	Connection		RS 232, 9-pin, female
	Data code		ASCII
	Selectable data transfer rates		4800 or 9600 Bd

Table 6: Auxiliary supply modules

Type of module	Operative range	SPGU 240A1	80…265 V ac/dc
		SPGU 48B2	18…80 V dc
	Power consumption	under quiescent conditions	~10 W
		under operating conditions	~15 W

Technical data (cont´d)

Table 7: Motor protection relay module SPCJ 4D34

Thermal overload unit	Full load current I_θ	0.50…1.50 × I_n
	Weighting factor for thermal unit curves p	20…100%
	Safe stall time setting t_{6x}, i.e. trip time at locked rotor from cold motor	2.0…120 s
	Cooling time multiplier k_c, for motor at standstill	1…64 × τ_h (τ_h = heating time constant)
	Thermal prior alarm level θ_a	50…100% of θ_t (θ_t = thermal trip level)
	Motor restart inhibit level θ_i	20…80% of θ_t
	Thermal initialization level on restoration of auxiliary supply	70% of θ_t, i.e. hot motor
Start-up supervision unit	Start current I_s	1.0…10.0 × I_n
	Start-up time t_s	0.3…80.0 s
	Two operation principles	definite time principle (I & t)
		thermal stress principle (I^2 × t)
High-set phase overcurrent unit	Start current I>>	0.5…20.0 × I_n or ∞, infinite
	Operate time t>>	0.04…30.0 s
Earth-fault unit	Start current I_0>	1.0…100% of I_n
	Operate time t_0>	0.05…30.0 s
Phase unbalance/incorrect phase sequence unit	Start current ΔI	10…40% of I_L (I_L = Load current)
	Operate time t_Δ, at lowest possible setting, i.e. 10%	20…120 s
	Operation characteristic	Inverse time
	Operate time at 100% phase unbalance (single phasing)	1 s
	Operate time at incorrect phase sequence	600 ms
Undercurrent unit	Start current I<	30…80% of I_q
	Operation inhibit level	<12% of I_q
	Operate time t<	2…600 s
Cumulative start-up time counter unit	Restart inhibit level of cumulative start time counter Σ_{tsi}	5…500 s
	Countdown rate of start-up time counter $\Delta\Sigma t_s/\Delta t$	2…250 s/h

Table 8: Control module SPTO 1D5

Control functions	status indication for three objects (e.g. circuit breaker, CB truck, disconnectors, earth switches) user-specific configuration remote or local control (open and close) for one object user-configurable cubicle-related interlocking scheme
Measurement functions	phase currents, measuring range 0…2.5 × I_n phase current measuring accuracy better than ±1% of I_n active and reactive power measurement via mA inputs, external measuring transducers are needed mA measuring input current range -20 mA…0…20 mA power measuring accuracy better than ±1% of maximum value of measuring range energy measurement via pulse counter input or by calculating the measured power local and remote reading of measured data as scaled values

Technical data (cont´d)

Table 9: Tests and standards

Test voltages	Dielectric test voltage (IEC 60255-5)		2 kV, 50 Hz, 1 min
	Impulse test voltage (IEC 60255-5)		5 kV, 1.2/50 μs, 0.5 J
	Insulation resistance (IEC 60255-5)		>100 MΩ, 500 V dc
Disturbance tests	HF disturbance test (IEC 60255-22-1)	Common mode	2.5 kV, 1 MHz
		Differential mode	1.0 kV, 1 MHz
	Fast transients (IEC 26055-22-4 and IEC 61000-4-4)	Power supply inputs	4 kV, 5/50 ns
		Other inputs	2 kV, 5/50 ns
	Electrostatic discharge test (IEC 60255-22-2 and IEC 61000-4-2)	Air discharge	8 kV
		Contact discharge	6 kV
Environmental conditions	Service temperature range		-10…+55°C
	Transport and storage temperature range (IEC 60068-2-8)		-40…+70°C
	Damp heat test, cyclic (12 h + 12 h) (IEC 60068-2-30)		+55°C, RH=93…95%, 6 cycles
	Degree of protection when panel mounted		IP 54
	Weight of fully equipped relay		~5 kg

Block diagram

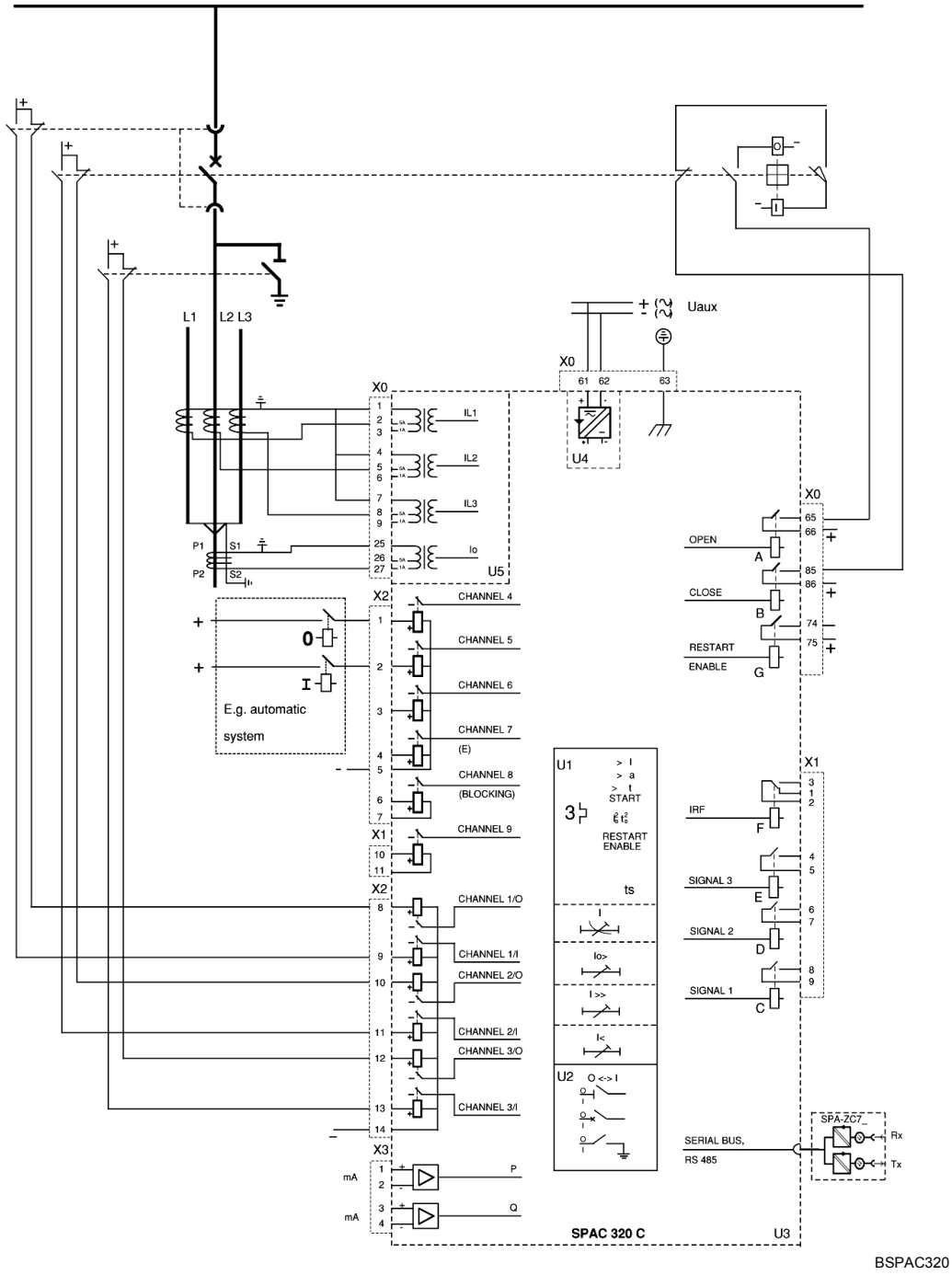

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Fig. 1 Block diagram and sample connection diagram

Mounting and dimensions

Flush mounting

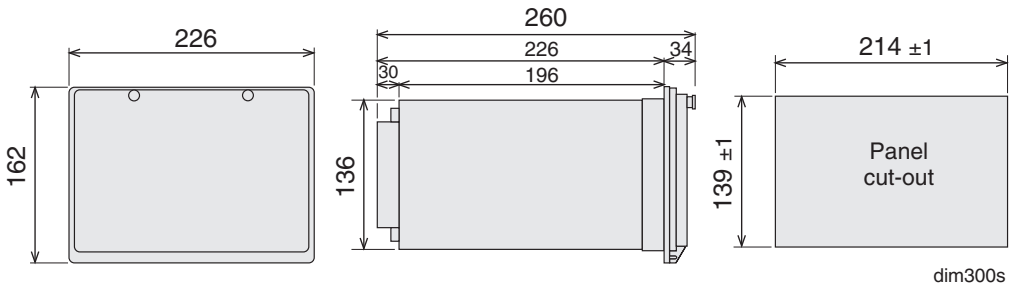
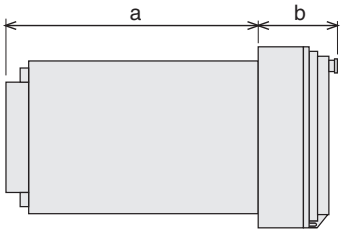


Fig. 2 Flush-mounting relay case (dimensions in mm)

Semi-flush mounting



Raising frame	a	b
SPA-ZX 311	186	74
SPA-ZX 312	146	114
SPA-ZX 313	106	154

SFM300_s

Fig. 3 Semi-flush mounting relay case (dimensions in mm)

Mounting in 19 inch cabinets and frames

An ancillary mounting plate, height 4U (~177 mm), is recommended to be used when the feeder terminals are to be mounted in 19 inch frames or cabinets. The ancillary mounting plate type SPA-ZX 304 accommodates two size 300 feeder terminals and type SPA-ZX 305 one size 300 feeder terminal.

Projecting mounting

When projecting mounting is preferred, a relay case type SPA-ZX 316 is used. The relay case for projecting mounting is provided with front connectors.

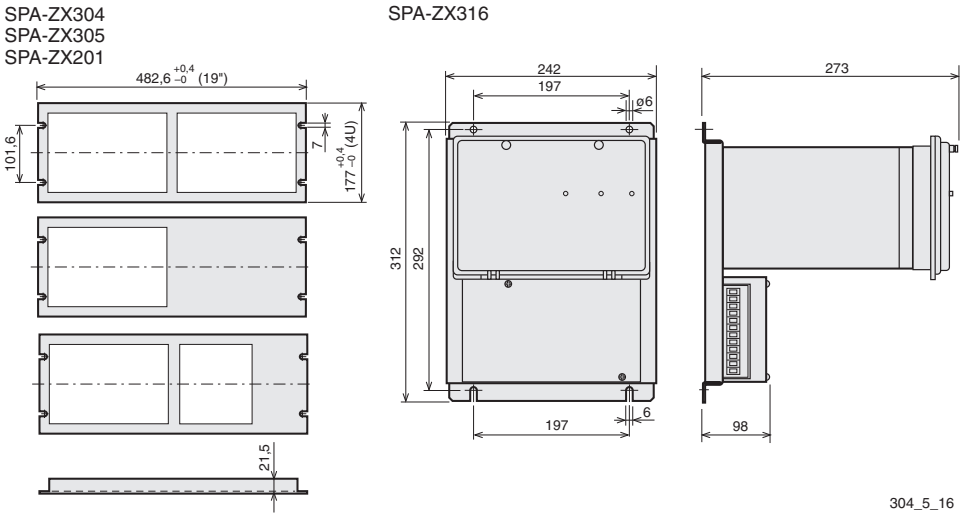


Fig. 4 Mounting cabinets and frames as well as projecting mounting (dimensions in mm)

Ordering

When ordering, please specify:

Ordering information	Ordering example
1. Type designation and quantity	SPAC 320 C, 5 pieces
2. Order number	RS 615 005-AB
3. Rated values	I_n=5 A, f_n=50 Hz
4. Auxiliary voltage	U_{aux}=110 V dc
5. Accessories	-
6. Type of configuration plate	-
7. Special requirements	-

Order numbers

Feeder terminal SPAC 320 C without test adapter	RS 615 005-AB, CB, DB, FB
Feeder terminal SPAC 320 C including test adapter RTXP 18	RS 615 205-AB, CB, DB, FB
The last two letters of the order number indicate the rated frequency f_n and the auxiliary voltage U_{aux} of the relay as follows:	AB equals f_n = 50 Hz and U_{aux} = 80…265 V ac/dc
	CB equals f_n = 50 Hz and U_{aux} = 18…80 V dc
	DB equals f_n = 60 Hz and U_{aux} = 80…265 V ac/dc
	FB equals f_n = 60 Hz and U_{aux} = 18…80 V dc

References

Additional information

Manual “Motor protection terminal SPAC 320”	1MRS 750739-MUM EN

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