Feeder protection relay

SPAA 348 C

1MRS 750396-MBG

Issued: April 1999
Status: Updated
Version: B/09.11.2001
Data subject to change without notice

Features

- Directional overcurrent protection with three stages
- Two-stage sensitive directional earth-fault protection
- Automatic reclosing allowing from one to five auto-reclosures
- Special memory circuit for maintaining the stability and reliability of the directional measurement at close three-phase faults
- Remote control of circuit breaker via auto-reclose module
- Five external control inputs enabling, e.g. external initiation of auto-reclosing
- Seven freely configurable output relays and output relays for self-supervision and circuit breaker closing
- Four trip contacts for double-pole CB opening and double-pole CB closing
- Recording of measured data to be used for analyzing the network condition
- Serial interface for connecting the relay to higher-level data acquisition systems, local or remote control systems or other host systems
- Local fault indication by means of LED indicators with memory functions and the digital display
- High immunity to electrical and electromagnetic interference
- Continuous self-supervision of relay hardware and software for enhanced system reliability and availability
- Auto-diagnostic fault indication to facilitate fault location and repair
- Powerful software support for parameterization of the relay, for reading measured and recorded values, events, etc., and for storing readings
- Member of the SPACOM product family and ABB's Substation Automation system
- CE marking according to the EC directive for EMC

Application

The feeder protection relay SPAA 348 C is used in applications requiring directional phase overcurrent, directional short-circuit and directional earth-fault protection. Typically, the relay is used for the overcurrent and earth-fault protection of infeeders and busbars in distribution substations provided with multiple infeeders supplied via power transformers from the same high-voltage busbar system.

The relays are also applied for the selective short-circuit and earth-fault protection of parallel multiple feeders between substations and for feeder protection in ring-type and meshed distribution networks.

Further, directional relays are used for the protection of radial feeders supplied with a small back-feed of energy from a generator in the consumer end of the feeder.

Design

The feeder protection relay is provided with energizing inputs for three phase currents, one residual or neutral current and one residual voltage. The relay is also provided with five control inputs for external control signals such as blocking signals, CB position signals, auto-reclose control signals, etc. Further, the feeder protection relay is equipped with nine output relays for CB control, signalling, etc.

The feeder protection relay consists of a two-phase directional overcurrent relay module, a combined directional earth-fault and a residual overvoltage relay module and a multi-shot auto-reclose relay module. The modules are withdrawable as are the power supply module and the I/O relay module, which are located behind the system front panel.

The directional overcurrent relay module SPCJ 4D11 includes two protection units, i.e. a directional overcurrent unit and a circuit-breaker failure protection unit.

The two-phase, directional overcurrent unit comprises three overcurrent stages, i.e. a low-set stage I>, a high-set stage I>> and a super high-set stage I>>>. The low-set stage can be given definite time characteristic or inverse time characteristic while the high-set stages have a definite time characteristic. The operation of the direction measuring circuitry is secured even in close-up short-circuits, when the phase-to-phase voltage tends to approach zero.

The circuit-breaker failure protection unit is activated by the main trip signal of the overcurrent and earth-fault unit and it provides a second trip signal to be routed to a back-up circuit breaker if the main CB fails to operate.

The directional/non-directional earth-fault module SPCS 2D26 contains two protection units, i.e. an earth-fault unit and a circuit-breaker failure protection unit.

The earth-fault unit measures the residual/neutral current and the residual voltage and it can be given directional function or non-directional function. It features two protection stages, i.e. a low-set stage $I_{01}>$ and a high-set stage $I_{02}>$, both with definite time characteristic.

The earth-fault unit can also be set to measure the residual voltage alone. In this case the earth-fault unit forms a residual overvoltage protection unit with three protection stages, i.e. $U_{0b}>$, $U_{01}>$ and $U_{02}>$, all with definite time characteristic.

The flexible auto-reclose unit SPCT 5D54 can be started via the start and/or trip signals of the protection modules or an external control signal. The module has three start lines, which means that the module can be given several different auto-reclose sequences, depending on the signal starting the auto-reclose sequence. The module can perform five successive auto-reclose shots, provided the circuit breaker is capable of the same.

The auto-reclose module incorporates a number of counters for recording detailed auto-reclose statistics and an integrated circuit-breaker condition monitor which alarms, when the circuit breaker needs maintenance.

Data communication

The relay is provided with a serial interface on the rear panel. By means of a bus connection module type SPA-ZC 17 or SPA-ZC 21 the relay can be connected to the fibre-optic SPA bus. The bus connection module type SPA-ZC 21 is powered from the host relay, 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 relay communicates with higher-level data acquisition and control systems over the SPA bus.

Output relays and circuit breaker control

The feeder protection relay is provided with nine auxiliary output relays, four of which are heavy-duty output relays for the direct control of the circuit breaker. Single-pole or double-pole circuit breaker control can be used. One of the five signalling relays is permanently allocated for the self-supervision system. The function of the other four relays can be defined by the user.

Self-supervision

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

When a permanent internal relay fault is detected, the IRF indicator on the relay front panel 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 the display of the protection relay module. The fault code indicates the type of the fault that has been detected.

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, current inputs

Terminals		X0/25-27	X0/1-3 X0/4-6 X0/7-9 X0/25-26	X0/1-2 X0/4-5 X0/7-8
Rated current I_n		0.2 A	1 A	5 A
Thermal current withstand	continuously	1.5 A	4 A	20 A
	for 10 s	5 A	25 A	100 A
	for 1 s	20 A	100 A	500 A
Dynamic current withstand	Half-wave value	50 A	250 A	1250 A
Input impedance		<750 mΩ	<100 mΩ	<20 mΩ

Table 2: Energizing inputs, voltage inputs

Terminals	X0/13-14, 16-17, 28-29
Rated voltage U_n	100 V, 110 V or 120 V
Continuous voltage withstand	2 x U_n
Rated burden of voltage input at U_n	<0.5 VA
Rated frequency f_n, according to order	50 Hz or 60 Hz

Table 3: Output contact ratings

Type of contact		Tripping	Signalling
Terminals		X1/15-16, 11-12-13-14 X2/1-2, 3-4	X2/5-6, 7-8, 9-10-11 X2/12-13, 14-15-16
Rated voltage		250 V ac/dc	
Thermal withstand capability	Carry continuously	5 A	5 A
	Make and carry for 0.5 s	30 A	10 A
	Make and carry for 3 s	15 A	8 A
Breaking capacity for dc, when the control/ signalling circuit time constant L/R ≤ 40 ms, at the control voltage levels	220 V dc	1 A	0.15 A
	110 V dc	3 A	0.25 A
	48 V dc	5 A	1 A
Contact material		$AgCdO_2$	

Table 4: Control input, communication and power supply

External control input	Blocking inputs	Terminal numbers	X1/1-2, 3-4
	CB position message input	Terminal numbers	X1/5-6
	Auto-reclose feedback inputs	Terminal numbers	X1/7-8, 9-10
	Control voltage	Operative voltage range	18…250 V dc or 80…250 V ac
		Current drain of activated control input	2…20 mA
Data communication	Transmission mode		Fibre-optic serial bus
	Data code		ASCII
	Selectable data transfer rates		4800 or 9600 Bd
	Bus connection module, powered from the host relay	for plastic core cables	SPA-ZC 21 BB
		for glass fibre cables	SPA-ZC 21 MM
	Bus connection module, powered from the host relay or from an external power source	for plastic core cables	SPA-ZC 17 BB
		for glass fibre cables	SPA-ZC 17 MM
Auxiliary supply voltage	Terminal numbers	X0/61-62	
	Power supply and I/O modules, rated voltages and operative range	SPGU 240A1	110/120/230/240 V ac, 110/125/220 V dc, 80…265 V ac/dc
		SPGU 48B2	24/48/60 V dc, 18…80 V dc
	Power consumption	under quiescent conditions	~10 W
		under operating conditions	~15 W

Technical data (cont'd)

Table 5: Directional overcurrent relay module SPCS 4D11

Features		Low-set stage I>	High-set stage I>>	High-set stage I>>>
Operating mode		directional	directional or non-directional	non-directional
Start current	at definite time	0.3…5.0 × I_n	0.5…40.0 × I_n or ∞, infinite	2…40.0 × I_n or ∞, infinite
	at inverse time	0.3…2.5 × I_n	–	
Start time, typ.	directional	100 ms	100 ms	50 ms
	non-directional	–	60 ms	–
Operation characteristic	at definite time	0.1…300 s	0.04…300 s	0.04…30 s
	at inverse time (BS 142 and IEC 255-4)	Extremely inverse Very inverse Normal inverse Long-time inverse	–	
	special characteristic according to ABB practice	RI type inverse RXIDG type inverse	–	
	Time multiplier k	0.05…1.00	–	
Reset time, typ.		60 ms		
Drop-off/pick-up ratio, typ.		0.96		
Operate time accuracy		±2% of set value or ±25 ms		
Operate time accuracy class E at inverse time mode		5	–	
Operation accuracy		±3% of set value		
Setting range of basic angle φ_b		–	0°…-90°	–
Operation sector $\Delta\varphi$		–	±80°	–
Operation sector accuracy		–	±5°	–
Direction information delay, typ.		–	90 ms	–
Threshold current for angle measurement	pick-up	–	13% of I_n	–
	drop-off	–	10% of I_n	–
Threshold voltage for angle measurement	pick-up	–	8% of U_n	–
	drop-off	–	7% of U_n	–
Memory at sudden energizing voltage drop		–	~2.5 s	–

Table 6: Directional/non-directional earth-fault relay module SPCS 2D26

Features	Residual voltage stage U_{0b}	Low-set stage I_{01}> or U_{01}>	High-set stage I_{02}> or U_{02}>
Operation direction	–	forward or reverse	
Basic angle φ_b, selectable	–	-90°, -60°, -30° or 0°	
Operation sector $\Delta\varphi$	–	±80° or ±88°	
Mode of operation	–	directional or non-directional	
Start current	–	1.0…100% of I_n	1.0…100% of I_n or ∞, infinite
Start voltage	2.0…80.0% of U_n	2.0…80% of U_n	2.0…80% of U_n or ∞, infinite
Start time, typ.	60 ms	80 ms	
Operate time	0.1…300 s	0.1…300 s	
Reset time, typ.	60 ms	80, 100, 500 or 1000 ms	100 ms
Drop-off/pick-up ratio, typ.	0.96		
Operate time accuracy	±2% of set time or ±25 ms		
Operation accuracy	±3% of set voltage	±3% of set value + 0.0005 × I_n	

Table 7: Auto-reclose relay module SPCT 5D54

Number of auto-reclose shots	1…5
AR start delay time	0…10.0 s
Dead time	0.20…300 s
Discriminating time	0…30.0 s
Reclaim time	0.2…300 s
Final trip time	0.0…5.00 s
Length of CB close pulse	0.10…2.00 s
Length of CB open pulse	0.10…2.00 s
Operate time accuracy	±1% of set value or ±30 ms

Table 8: 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, class III)	Common mode	2.5 kV, 1 MHz
		Differential mode	1.0 kV, 1 MHz
	Fast transients (IEC 60255-22-4, class III and IEC 60801-4, level IV)	Power supply inputs	4 kV, 5/50 ns
		Other inputs	2 kV, 5/50 ns
	Electrostatic discharge test (IEC 60255-22-2 and IEC 60801-2, class III)	Air discharge	8 kV
		Contact discharge	6 kV
EMC tests	CE approved and tested according to		EN 50081-2 EN 50082-2
Mechanical environmental tests	Vibration test (IEC60255-21-1)		class 2
	Shock/bump test (IEC 60255-21-2)		class 2
	Seismic test (IEC 60255-21-3)		class 2
Environmental conditions	Service temperature range		-10…+55°C
	Transport and storage temperature range (IEC 60068-2-8)		-40…+70°C
	Temperature influence		0.2%/°C
	Damp heat test, cyclic (12 h + 12 h) (IEC 60068-2-30)		+55°C, RH=93…95%, 6 cycles
	Degree of protection by enclosure of flush mounting relay case (IEC 529)		IP 54
	Weight of fully equipped relay, including flush mounting relay case		6 kg

Block diagram

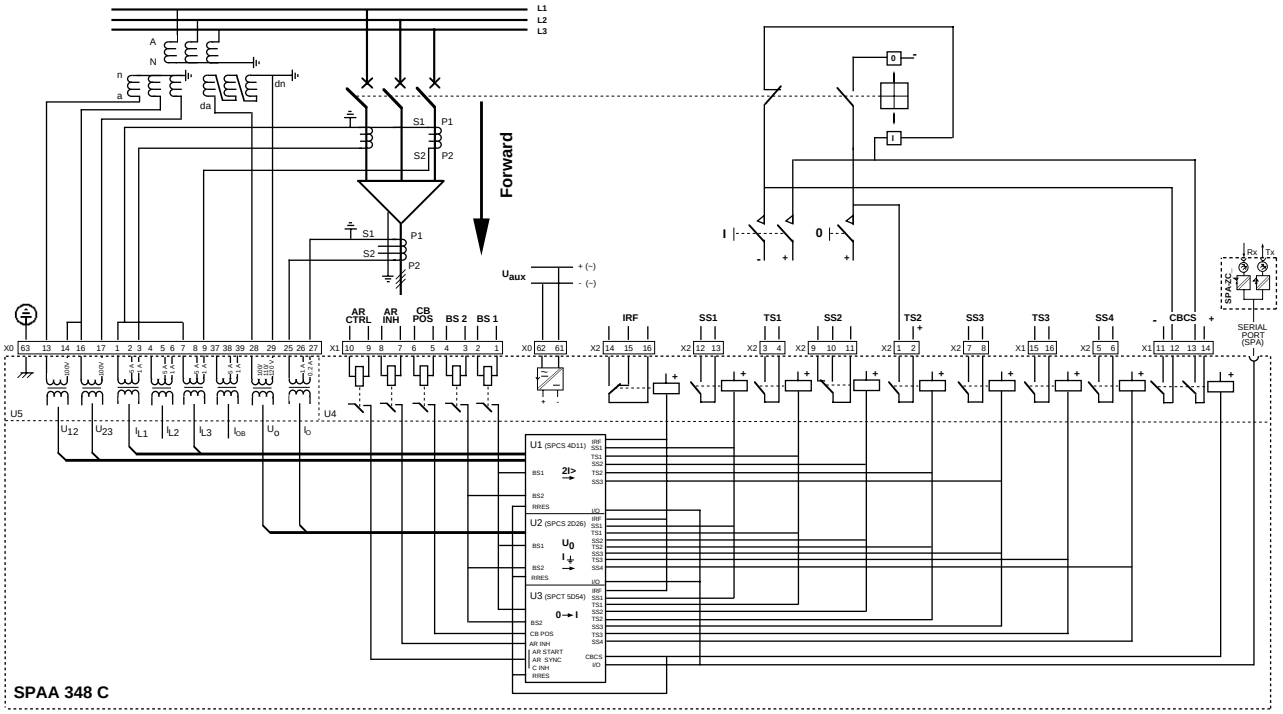


Fig. 1 Block diagram and sample connection diagram

Mounting and dimensions

Flush mounting

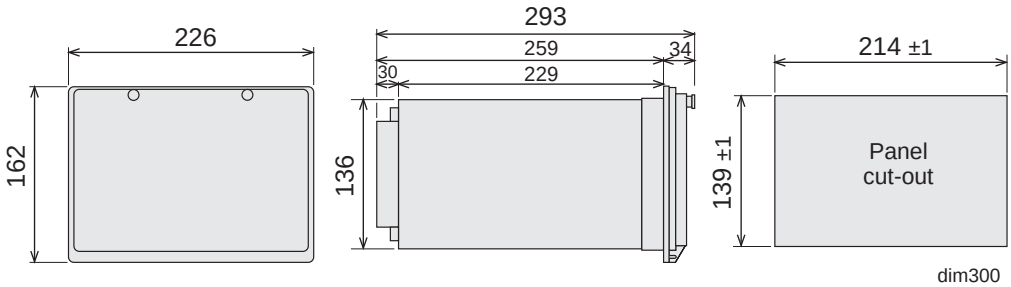
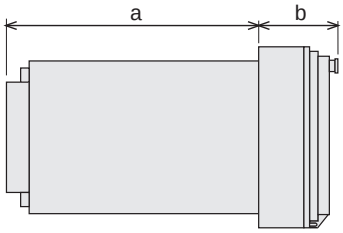


Fig. 2 Flush-mounting relay case (dimensions in mm)

Semi-flush mounting



Raising frame	a	b
SPA-ZX 301	219	74
SPA-ZX 302	179	114
SPA-ZX 303	139	154

SFM300_1

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 protection relays are to be mounted in 19 inch frames or cabinets. The ancillary mounting plate type SPA-ZX 304 accommodates two size 300 relays and type SPA-ZX 305 one size 300 relay.

Projecting mounting

When projecting mounting is preferred, a relay case type SPA-ZX 317 is used. The relay case for projecting mounting is provided with front connectors.

SPA-ZX304
SPA-ZX305
SPA-ZX201

SPA-ZX306
SPA-ZX307
SPA-ZX317
SPA-ZX318

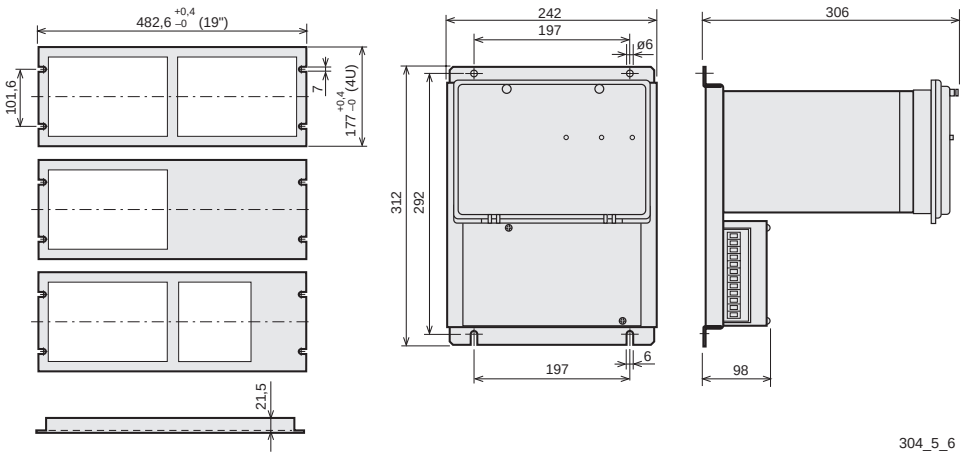


Fig. 4 Mounting cabinets and frames as well as projecting mounting (dimensions in mm)

Ordering

When ordering, please specify:

Ordering information	Ordering example
1. Type designation and quantity	SPAA 348 C, 5 pieces
2. Order number	RS 614 103-AA
3. Rated values	I_n=5 A, U_n=110 V, f_n=50 Hz
4. Auxiliary voltage	U_{aux}=110 V dc
5. Accessories	-
6. Special requirements	-

Order numbers

Feeder protection relay SPAA 348 C_	
SPAA 348 C complete	RS 614 103-AA, CA, DA, FA
SPAA 348 C1, no AR module	RS 614 104-AA, CA, DA, FA
SPAA 348 C2, no dir. E/F module	RS 614 105-AA, CA, DA, FA
SPAA 348 C3, no dir. E/F module and no AR module	RS 614 106-AA, CA, DA, FA
SPAA 348 C4, no O/C module	RS 614 107-AA, CA, DA, FA
SPAA 348 C5, no O/C and no AR module	RS 614 108-AA, CA, DA, FA
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:	AA equals f_n = 50 Hz and U_{aux} = 80…265 V ac/dc
	CA equals f_n = 50 Hz and U_{aux} = 18…80 V dc
	DA equals f_n = 60 Hz and U_{aux} = 80…265 V ac/dc
	FA equals f_n = 60 Hz and U_{aux} = 18…80 V dc

Feeder protection relay SPAA 348 C_ including a test adapter type RTXP18	
SPAA 348 C complete	RS 614 303-AA, CA, DA, FA
SPAA 348 C1, no AR module	RS 614 304-AA, CA, DA, FA
SPAA 348 C2, no dir. E/F module	RS 614 305-AA, CA, DA, FA
SPAA 348 C3, no dir. E/F module and no AR module	RS 614 306-AA, CA, DA, FA
SPAA 348 C4, no O/C module	RS 614 307-AA, CA, DA, FA
SPAA 348 C5, no O/C and no AR module	RS 614 308-AA, CA, DA, FA
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:	AA equals f_n = 50 Hz and U_{aux} = 80…265 V ac/dc
	CA equals f_n = 50 Hz and U_{aux} = 18…80 V dc
	DA equals f_n = 60 Hz and U_{aux} = 80…265 V ac/dc
	FA equals f_n = 60 Hz and U_{aux} = 18…80 V dc

References

Additional information

User’s manual and technical description “Feeder protection relay SPAA 348 C”	1MRS 750113-MUM EN

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