



# SIQUENCE, Universal Current-Sensitive RCCBs Type B and Type B+

BETA low-voltage circuit protection



**NEW: Type B+ for enhanced preventative fire protection!**

Frequency converters, medical devices and UPS systems are seeing increasing use in industry. Smooth DC residual currents or currents with low residual ripple may occur in the event of faults on these devices.

#### ■ More safety through SIQUENCE

Type A residual current protective devices are unable to detect these smooth DC residual currents. If a fault occurs, there is therefore no tripping and the desired protective function is no longer assured.

#### ■ Type B and Type B+ for optimal protection even with smooth DC residual currents

An additional transformer in the Type B and Type B+ UC-sensitive residual current protective devices ensures the desired protective function. Type B+ additionally offers enhanced, preventative fire protection by limiting the tripping value to 420 mA.

### Highlights

- Desired protective function assured for all types of residual current
- Type B has adapted tripping characteristic for greater operating safety
- Type B+ offers enhanced preventative fire protection
- Saving on wiring and installation costs when using RCBOs

# Residual current protective devices

## SIQUENCE, universal current-sensitive Type B, 5SM3, 5SU1

### Overview

Frequency converters, medical devices and UPS systems are seeing increasing use in industry. Smooth DC residual currents or currents with low residual ripple may occur in the event of faults on these devices.

Type A residual current protective devices are unable to detect these smooth DC residual currents. Furthermore, such smooth DC residual currents make Type A devices increasingly insensitive to AC residual currents and pulsating DC residual currents. If a fault occurs, there is therefore no tripping and the desired protective function is no longer assured.

UC-sensitive residual current protective devices of Types B and B+ have an additional transformer which is supplied with a control signal. It is therefore possible to evaluate the change of the transformer's operating range caused by smooth DC residual currents, ensuring the desired protective function.

### Benefits

- Universal current-sensitive residual current protective devices detect not only AC residual currents and pulsating DC residual currents, but also smooth DC residual currents, thus ensuring the desired protective function with all types of residual current.
- With Type B, the tripping characteristic is adapted to the increase of leakage currents at higher frequencies in systems with capacitive impedances and results in increased operating safety.
- Type B+ versions offer enhanced preventative fire protection and correspond to the prestandards DIN V VDE V 0664-110 and/or DIN V VDE V 0664-210 and VdS Directive 3501.
- The RCBO is a compact device for up to 125 A. It provides not only personnel, property and fire protection but also overload and short-circuit protection for cables. Wiring and mounting outlay is reduced as a result.


The residual current protective devices of Type B are suitable for use in three-phase current systems before input circuits with rectifiers. They are not intended for use in DC systems and in networks with operating frequencies other than 50 or 60 Hz.

The devices in this series are designed as residual current operated circuit breakers (RCCBs) up to 80 A and as residual current circuit breakers with integral overcurrent protection (RCBOs) for 100 A or 125 A in Characteristics C or D.

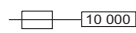



Type B+ residual current protective devices additionally offer enhanced, preventative fire protection. In these versions, the tripping value is limited to a maximum of 420 mA up to 20 kHz.







### Technical specifications

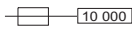


		RCCBs 5SM3		RCBOs 5SU1
<b>Standards</b>	Type B/ Type B+	IEC/EN 61008-1 (VDE 0664-10); VDE 0664-100; IEC/EN 61543 (VDE 0664-30); IEC 62423		IEC/EN 61009-1 (VDE 0664-20); VDE 0664-200; IEC/EN 61543 (VDE 0664-30); IEC 62423
		In addition for Type B+: DIN V VDE V 0664-110		In addition for Type B+: DIN V VDE V 0664-210
<b>Versions</b>		1P+N	3P+N	4P
<b>Tripping characteristic</b>		--	--	C, D
<b>Surge current withstand capability with current waveform 8/20 <math>\mu</math>s acc. to DIN VDE 0432-2</b>				
• Super resistant	kA	> 3	> 3	> 3
• Selective	kA	--	> 5	> 5
<b>Minimum operational voltage for test function operation</b>	V AC	150	150	150
<b>Rated voltages <math>U_n</math></b>	V AC	230	400	400, 480
<b>Rated frequency <math>f_n</math></b>	Hz	50 ... 60		
<b>Rated currents <math>I_n</math></b>	A	16, 25, 40, 63	25, 40, 63, 80	100, 125
<b>Rated residual currents <math>I_{\Delta n}</math></b>	mA	30, 300	30, 300, 500	30, 300
<b>Rated switching capacity</b>				
• $I_m$	A	800		--
• $I_{cn}$	kA	--		10
<b>Conductor cross-sections</b>				
• Solid and stranded	mm <sup>2</sup>	1.5 ... 25		6 ... 50
• Finely stranded, with end sleeve	mm <sup>2</sup>	1.5 ... 16		6 ... 35

	RCCBs 5SM3	RCCBs 5SU1
Terminal tightening torques for all devices Nm	2.5 ... 3.0	3.0 ... 3.5
Mains connection	Either top or bottom	
Mounting position	Any	
Degree of protection according to EN 60529 (VDE 0470-1)	IP20	
Touch protection according to EN 50274 (VDE 0660-514)	Finger and back-of-hand safe	
Service life, electrical and mechanical; (test cycle according to regulations)	> 10 000 switching cycles	
Storage temperature °C	-40 ... +75	
Ambient temperature °C	-25 ... +45, marked with 	
Resistance to climate acc. to IEC 60068-2-30	28 cycles (55 °C; 95 % rel. air humidity)	
CFC and silicone-free	Yes	

### Selection and ordering data (Dated 06/2009)

	Rated residual current $I_{\Delta n}$ mA	Rated current $I_n$ A	Max. permissible short-circuit series fuse  A	MW	DT	Order No.	PG	PU	PS <sup>1)</sup> / P. unit	Weight per PU approx. kg
								Unit(s)	Unit(s)	kg
<b>SIQUENCE RCCBs, Type B Super resistant <b>K</b></b>										
1P+N; 230 V AC; 50 ... 60 Hz										
	30	16	100	4	A	<b>5SM3 321-4</b>	015	1	1	0.590
		25				<b>5SM3 322-4</b>	015	1	1	0.590
		40				<b>5SM3 324-4</b>	015	1	1	0.588
		63				<b>5SM3 326-4</b>	015	1	1	0.591
300	16	100	4	A	<b>5SM3 621-4</b>	015	1	1	0.600	
	25				<b>5SM3 622-4</b>	015	1	1	0.600	
	40				<b>5SM3 624-4</b>	015	1	1	0.591	
	63				<b>5SM3 626-4</b>	015	1	1	0.586	
3P+N; 230 ... 400 V AC; 50 ... 60 Hz										
	30	25	100	4	A	<b>5SM3 342-4</b>	015	1	1	0.600
		40				<b>5SM3 344-4</b>	015	1	1	0.600
		63				<b>5SM3 346-4</b>	015	1	1	0.600
		80				<b>5SM3 347-4</b>	015	1	1	0.600
300	25	100	4	▶	<b>5SM3 642-4</b>	015	1	1	0.520	
	40				<b>5SM3 644-4</b>	015	1	1	0.520	
	63				<b>5SM3 646-4</b>	015	1	1	0.520	
	80				<b>5SM3 647-4</b>	015	1	1	0.520	
500	63	100	4	B	<b>5SM3 746-4</b>	015	1	1	0.520	
	80				<b>5SM3 747-4</b>	015	1	1	0.520	
<b>SIQUENCE RCCBs, Type B Selective <b>S</b></b>										
3P+N; 230 ... 400 V AC; 50 ... 60 Hz										
	300	63	100	4	B	<b>5SM3 646-5</b>	015	1	1	0.520
		80				<b>5SM3 647-5</b>	015	1	1	0.520
500	300	63	100	4	B	<b>5SM3 746-5</b>	015	1	1	0.520
		80				<b>5SM3 747-5</b>	015	1	1	0.520

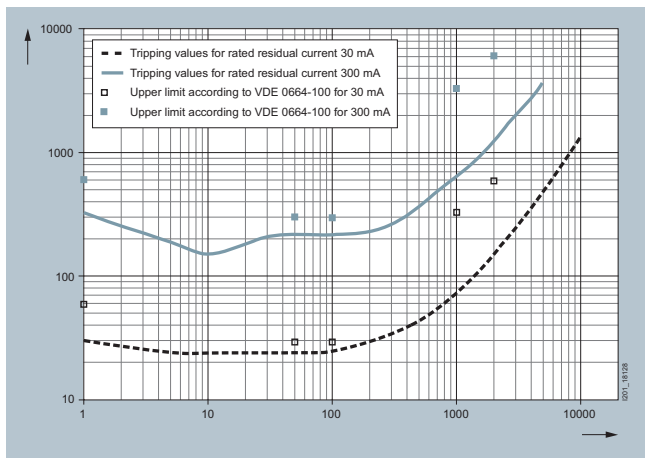
Rated residual current	Rated current	Max. permissible short-circuit series fuse	MW	DT	Order No.	PG	PU	PS <sup>*)</sup> /P. unit	Weight per PU approx.
$I_{\Delta n}$ mA	$I_n$ A	 A					Unit(s)	Unit(s)	kg
									
4P; 400 V AC; 50 ... 60 Hz									
Characteristic C									
30	100		11	B	<b>5SU1 374-7AK81</b>	017	1	1	2.050
	125			B	<b>5SU1 374-7AK82</b>	017	1	1	2.050
300	100		11	B	<b>5SU1 674-7AK81</b>	017	1	1	2.050
	125			B	<b>5SU1 674-7AK82</b>	017	1	1	2.050
Characteristic D									
30	100		11	B	<b>5SU1 374-8AK81</b>	017	1	1	2.050
300	100		11	B	<b>5SU1 674-8AK81</b>	017	1	1	2.050
4P; 480 V AC; 50 ... 60 Hz									
Characteristic C									
300	100		11	B	<b>5SU1 674-7CK81</b>	017	1	1	2.050
	125			B	<b>5SU1 674-7CK82</b>	017	1	1	2.050
									
4P; 400 V AC; 50 ... 60 Hz									
Characteristic C									
300	125		11	B	<b>5SU1 674-7BK82</b>	017	1	1	1.950
Characteristic D									
300	100		11	B	<b>5SU1 674-8BK81</b>	017	1	1	1.950
									
1P+N; 230 V AC; 50 ... 60 Hz									
NEU									
30	16	100	4	A	<b>5SM3 321-4KK14</b>	015	1	1	0.590
	25			A	<b>5SM3 322-4KK14</b>	015	1	1	0.590
	40			A	<b>5SM3 324-4KK14</b>	015	1	1	0.588
	63			A	<b>5SM3 326-4KK14</b>	015	1	1	0.591
300	16	100	4	A	<b>5SM3 621-4KK14</b>	015	1	1	0.600
	25			A	<b>5SM3 622-4KK14</b>	015	1	1	0.600
	40			A	<b>5SM3 624-4KK14</b>	015	1	1	0.591
	63			A	<b>5SM3 626-4KK14</b>	015	1	1	0.586
									
3P+N; 230 ... 400 V AC; 50 ... 60 Hz									
NEU									
30	25	100	4	A	<b>5SM3 342-4KK14</b>	015	1	1	0.582
	40			A	<b>5SM3 344-4KK14</b>	015	1	1	0.578
	63			A	<b>5SM3 346-4KK14</b>	015	1	1	0.581
	80			B	<b>5SM3 347-4KK14</b>	015	1	1	0.587
300	25	100	4	▶	<b>5SM3 642-4KK14</b>	015	1	1	0.592
	40			A	<b>5SM3 644-4KK14</b>	015	1	1	0.581
	63			A	<b>5SM3 646-4KK14</b>	015	1	1	0.576
	80			B	<b>5SM3 647-4KK14</b>	015	1	1	0.585
									
3P+N; 230 ... 400 V AC; 50 ... 60 Hz									
NEU									
300	63	100	4	B	<b>5SM3 646-5KK14</b>	015	1	1	0.578
	80			B	<b>5SM3 647-5KK14</b>	015	1	1	0.587

Rated residual current	Rated current	Max. permissible short-circuit series fuse	MW	DT	Order No.	PG	PU	PS <sup>1)</sup> /P. unit	Weight per PU approx.
$I_{\Delta n}$ mA	$I_n$ A	 A						Unit(s)	Unit(s) kg
<b>SIQUENCE RCBOs, Type B+ Super resistant [K], rated switching capacity 10 kA</b>									
4P; 400 V AC; 50 ... 60 Hz 									
Characteristic C									
30	100		11	B	<b>5SU1 374-7DK81</b>	017	1	1	2,067
	125			B	<b>5SU1 374-7DK82</b>	017	1	1	2,053
300	100		11	B	<b>5SU1 674-7DK81</b>	017	1	1	2,069
	125			B	<b>5SU1 674-7DK82</b>	017	1	1	2,088
Characteristic D									
30	100		11	B	<b>5SU1 374-8DK81</b>	017	1	1	2,084
300	100		11	B	<b>5SU1 674-8DK81</b>	017	1	1	2,082
4P; 480 V AC; 50 ... 60 Hz									
Characteristic C									
300	100		11	B	<b>5SU1 674-7FK81</b>	017	1	1	2,050
	125			B	<b>5SU1 674-7FK82</b>	017	1	1	2,050
<b>SIQUENCE RCBOs, Type B+ Selective [S], rated switching capacity 10 kA</b>									
4P; AC 400 V; 50 ... 60 Hz 									
Characteristic C									
300	125		11	B	<b>5SU1 674-7EK82</b>	017	1	1	2,082
Characteristic D									
300	100		11	B	<b>5SU1 674-8EK81</b>	017	1	1	2,078

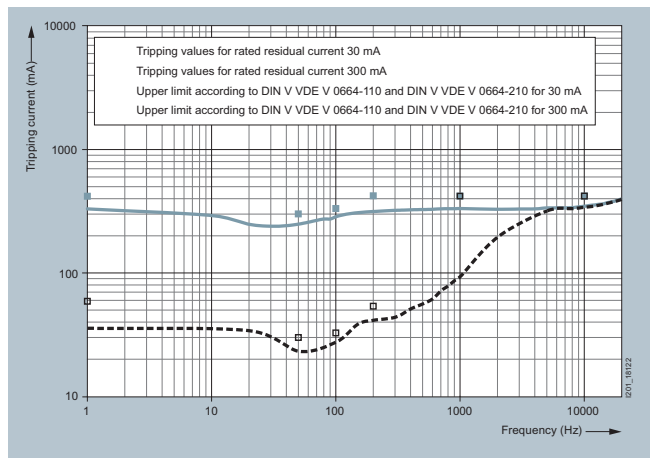


1) You can order this quantity or a multiple thereof.

**Characteristic curves**

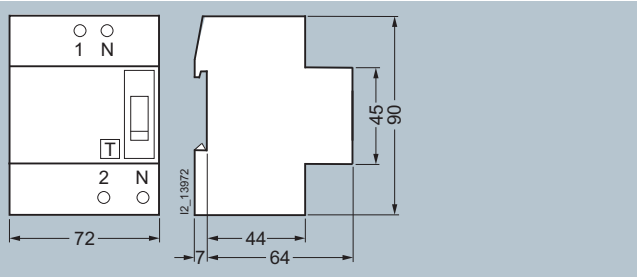


Tripping current as a function of frequency for Type B

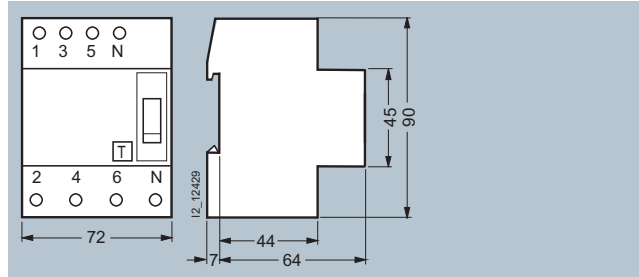


Tripping current as a function of frequency for Type B+

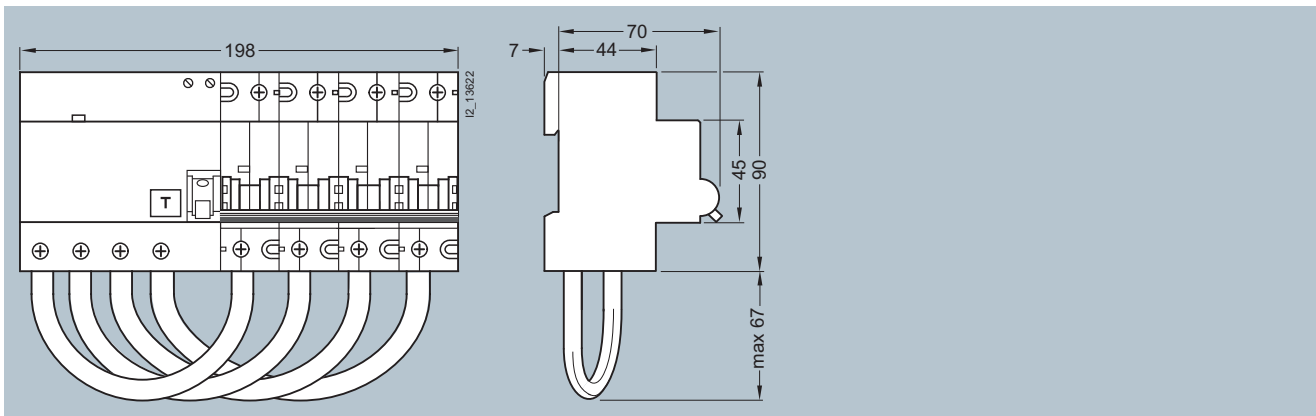
**Dimensional drawings**



SIQUENCE RCCBs, Type B and Type B+  
1P+N, 4 MW

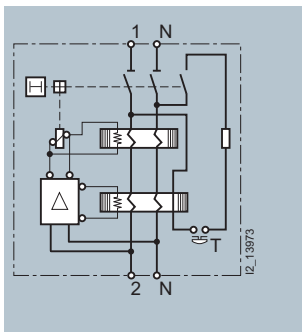


SIQUENCE RCCBs, Type B and Type B+  
3P+N, 4 MW

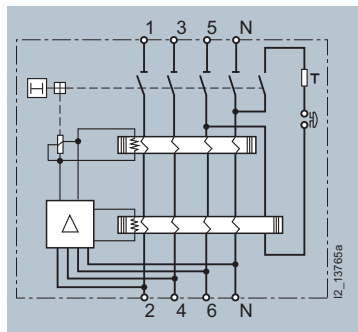


SIQUENCE RCBOs, Type B and Type B+  
4P, 11 MW

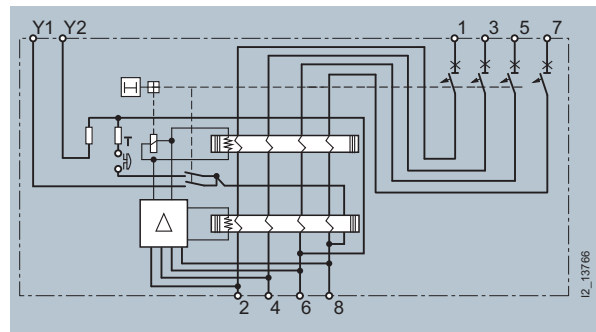
**Schematics**



SIQUENCE, RCCBs Type B and Type B+  
1P+N, 4 MW



SIQUENCE, RCCBs Type B and Type B+  
3P+N, 4 MW



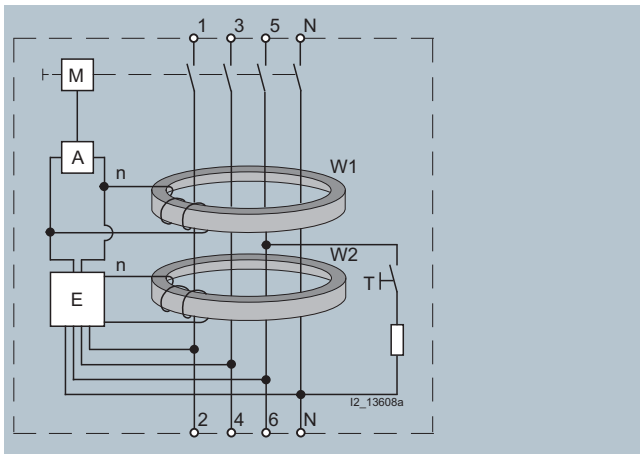
SIQUENCE, RCBOs Type B and Type B+  
4P, 11 MW

## More information

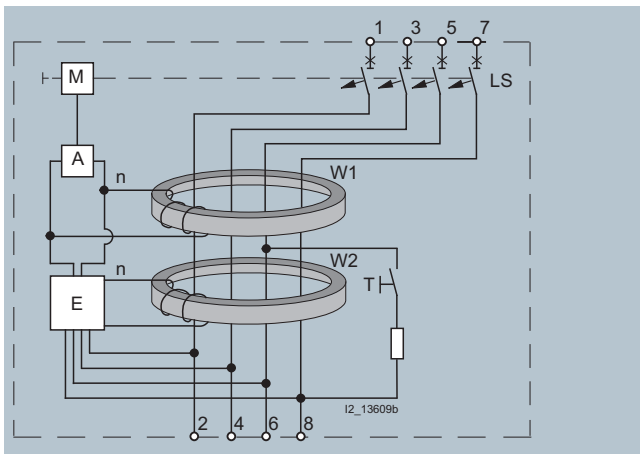
### Device setup

Universal current-sensitive protective devices are based on a pulse-current-sensitive circuit-protection device with tripping independent of line voltage, supplemented with an auxiliary unit for the detection of smooth DC residual currents. The diagrams below show the basic design.

The summation current transformer W1 monitors the electrical system for AC and pulse current-type residual currents. The summation current transformer W2 detects the smooth DC residual currents and, in the event of a fault, relays the tripping command through electronic unit E to release A, which uses the mechanics to disconnect the circuit.



Design of RCCBs Type B and Type B+



Design of RCBOs Type B and Type B+

<b>M</b>	Mechanics of the RCCB
<b>MCB</b>	MCB part
<b>A</b>	Release
<b>E</b>	Electronics for tripping in the event of smooth DC residual currents
<b>n</b>	Secondary winding
<b>W1</b>	Summation current transformer for detection of sinusoidal residual currents
<b>W2</b>	Summation current transformer for detection of smooth DC residual currents
<b>T</b>	Test equipment

### Method of operation

The universal current-sensitive residual current protective devices work independent of the supply voltage compliant with requirements in Germany for Type A according to DIN VDE 0664-100.

A voltage supply is required solely for the detection of smooth DC residual currents by a second transformer. This is done from all system cables and is dimensioned so that the electronics still reliably trip even with a voltage reduction to 50 V.

This ensures tripping for smooth DC residual currents, as long as such residual current waveforms can occur, even in the event of faults in the electrical power supply, e.g. an N-conductor break. This means that the pulse-current-sensitive switch part, which trips regardless of line voltage, will still reliably trigger the tripping operation - even in the highly unlikely event that two outer conductors and the neutral conductor fail - if the remaining intact outer conductor presents a fire hazard due to a ground fault.

The residual current protective devices of Type B are suitable for use in three-phase current systems before input circuits with rectifiers. They are not intended for use in DC systems and in networks with operating frequencies other than 50 or 60 Hz.

RCBOs are a combination of an RCCB and a miniature circuit breaker for up to 125 A in a single compact device.

It thus provides not only personnel, property and fire protection but also overload and short-circuit protection for cables. The mechanics of the residual current protective device act on the tripping unit of the miniature circuit breaker, which disconnects the circuit.

### Protective effect at high frequencies

In addition to the described residual current waveforms (AC residual currents, pulsating and smooth DC residual currents), AC residual currents with a wide range of frequencies may also occur on electronic equipment such as rectifiers in frequency converters or computer tomographs as well as at the outgoing terminal of a frequency converter.

Tripping limits can adopt different values depending on the protection objective to be reached with the residual current protective device.

To date, medical statements with regard to the risk of ventricular fibrillations can only be made up to 1 kHz. On versions with a rated residual current of max. 30 mA the tripping values remain below the permissible limit for ventricular fibrillations. No reliable statements can be made on other effects of thermal or electrolytic influence on the human organism.

For this reason, additional protection (protection against direct contact) exists only for frequencies up to 100 Hz.

For higher frequencies, leakage protection (protection against indirect contact) must be implemented under consideration of the frequency response of the residual current protective device, the maximum permissible touch voltages up to 50 V and permissible grounding resistance derived from this information.

In terms of leakage protection, the residual current protective devices of Type B and their increase in tripping values in step with frequency provide the advantage of greater operational reliability because the capacitive leakage currents also increase with the frequency and can result in unwanted tripping.

Requirements for frequencies up to 2 kHz are defined in the device regulations for Type B in E DIN VDE 0664-100 (RCCBs) and E DIN VDE 0664-200 (RCBOs).

Type B+ residual current protective devices are now also available for enhanced preventative fire protection. They meet all the requirements of the familiar Type B, but up to 20 kHz they remain below the tripping value of 420 mA in accordance with the product standards DIN VDE V 0664-110 (RCCBs) and DIN VDE V 0664-210 (RCBOs) and VdS Directive 3501.

It is recommended to use residual current protective devices of Type B+ when this is demanded for locations exposed to fire hazards in accordance with DIN VDE 0100-482.

**Versions**

Super resistant **K**  
Short-time delayed tripping in the case of transient leakage currents. High surge current withstand capability: > 3 kA.

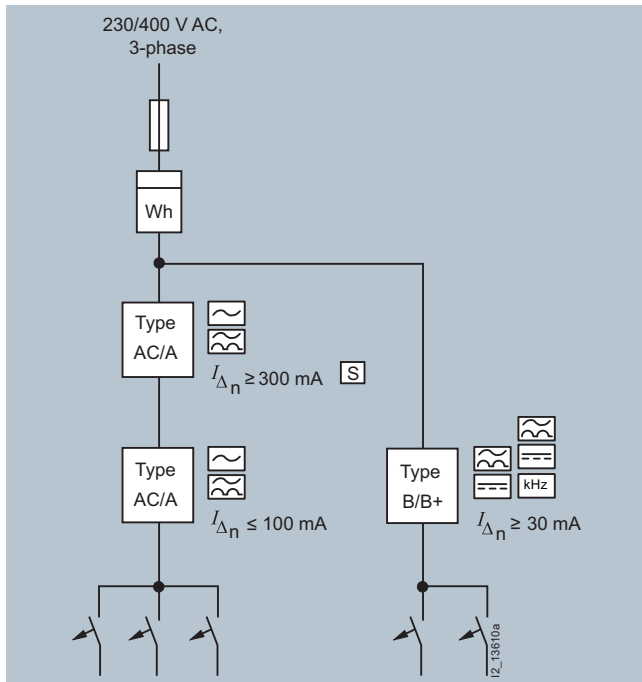
Selective **S**:  
Can be used as upstream group switch for selective tripping contrary to a downstream, instantaneous or super resistant RCCB.

**Configuration**

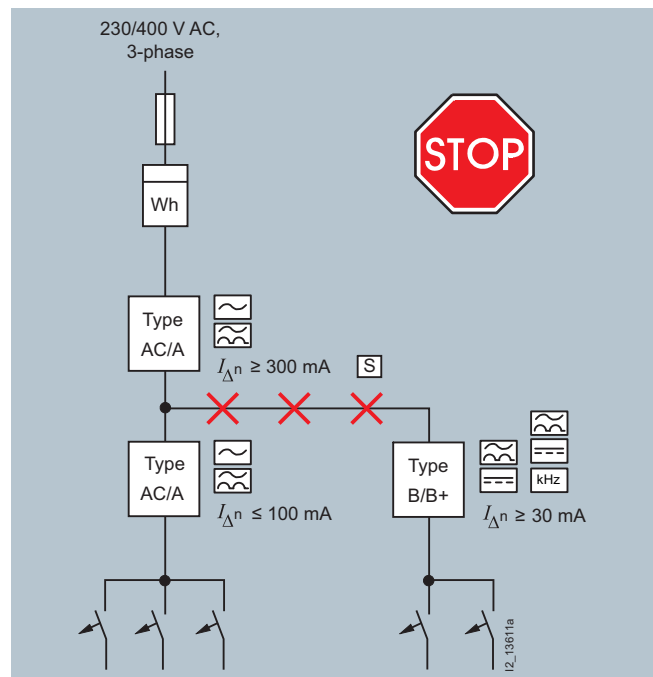
DIN VDE 0100-530 "Selection of protective devices" also describes the configuration of systems with residual current protective devices.

EN 50178 (DIN VDE 0160) "Equipping power installations with electronic equipment" describes, among other things, how to select the type of residual current protective device suitable.

When configuring and installing electrical installations, electrical loads that can generate smooth DC residual currents in the event of a fault must be assigned a separate electrical circuit with a universal current-sensitive residual current protective device (Type B or Type B+):



It is not permitted to branch electrical circuits with these types of electrical loads after pulse-current-sensitive residual current protective devices (type A):



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