

# Type B tripping characteristics

DFL8— Type B RCCBs

— to be used in conjunction with BS 7671 18th Edition  
UK Wiring Regulations for use by an "Appropriately  
Electrically Skilled Person" Part 2 BS7671

CBR DFL8  
BNK and BSK



Type B



# Contents

————— Using this data to select the appropriate Type b characteristic and sensitivity, please refer to pages 9.  
For additional information on RCD selection for specific applications, please refer to [www.doepke.co.uk](http://www.doepke.co.uk) - Technical Publications.

## Page ————— Type B characteristic and residual current sensitivity

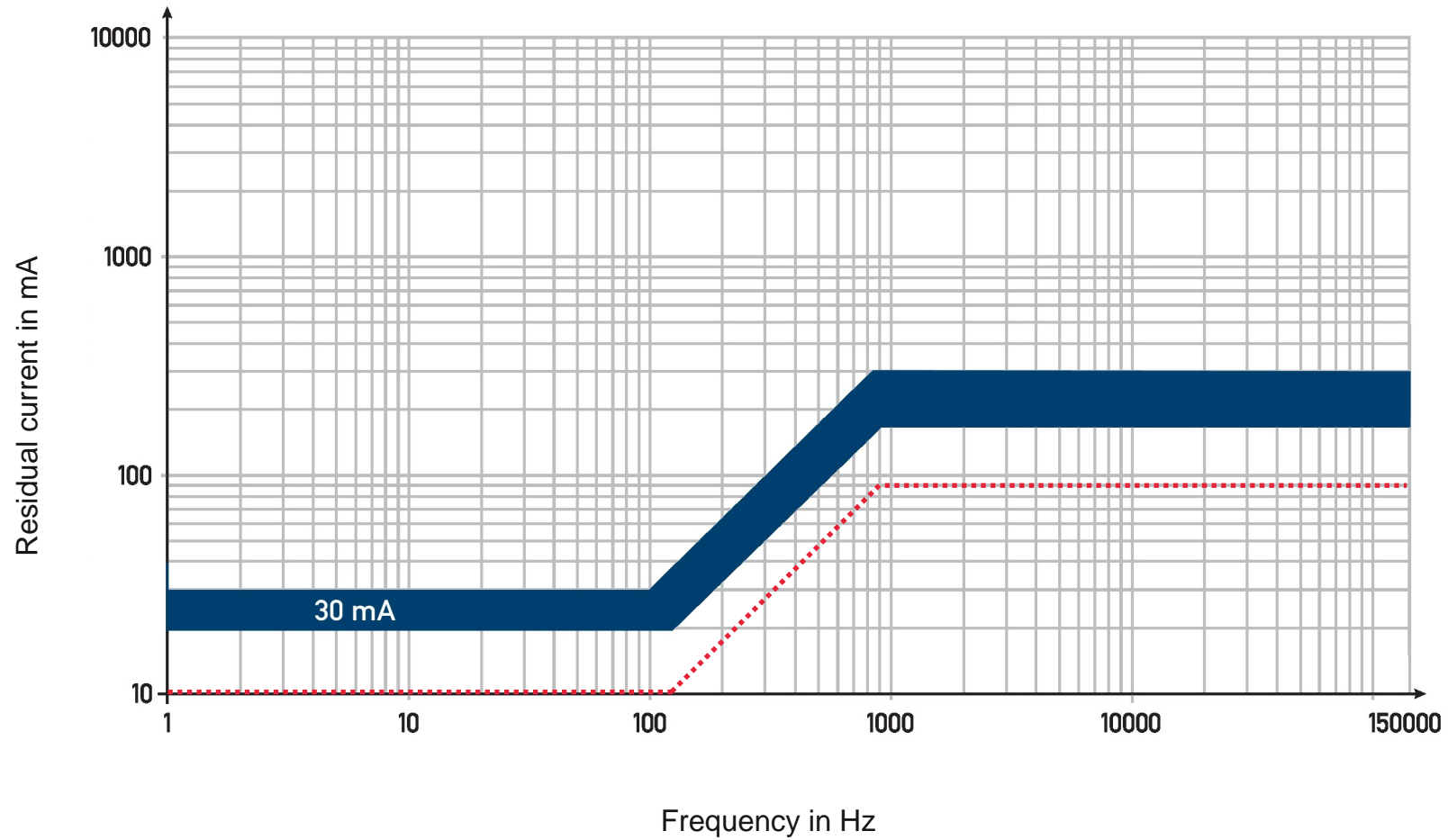
1.	—————	DFL8 B NK	30 mA
2.	—————	DFL8 B SK	30 mA
3.	—————	DFL8 B NK	X setting 300 mA
4.	-----		X setting 500 mA
5.	-----		X setting 1000 mA
6.	—————	DFL8 B SK	X setting 300 mA
7.	-----		X setting 500 mA
8.	-----		X setting 1000 mA
9.	—————	Residual current characteristic and BS7671 - 531.3.2	
10.	—————	DFL8 X Setting residual current and time characteristics	
11.	—————	DFL8 Setting thermal and magnetic current characteristics	
12.	—————	DFL8 Let-through characteristics	
13.	—————	DFL8 BNK Installation instructions	
14.	—————	DFL8 BSK Installation instructions	

\* Please contact the Doepke sales office for the availability of specific ratings:  
email "[sales@doepke.co.uk](mailto:sales@doepke.co.uk)" or ring "01628 829 133"

For additional information on RCD selection for specific applications, please refer to [www.doepke.co.uk](http://www.doepke.co.uk) - Technical Publications.

Type B characteristic curves  
Refer to page 9 for use

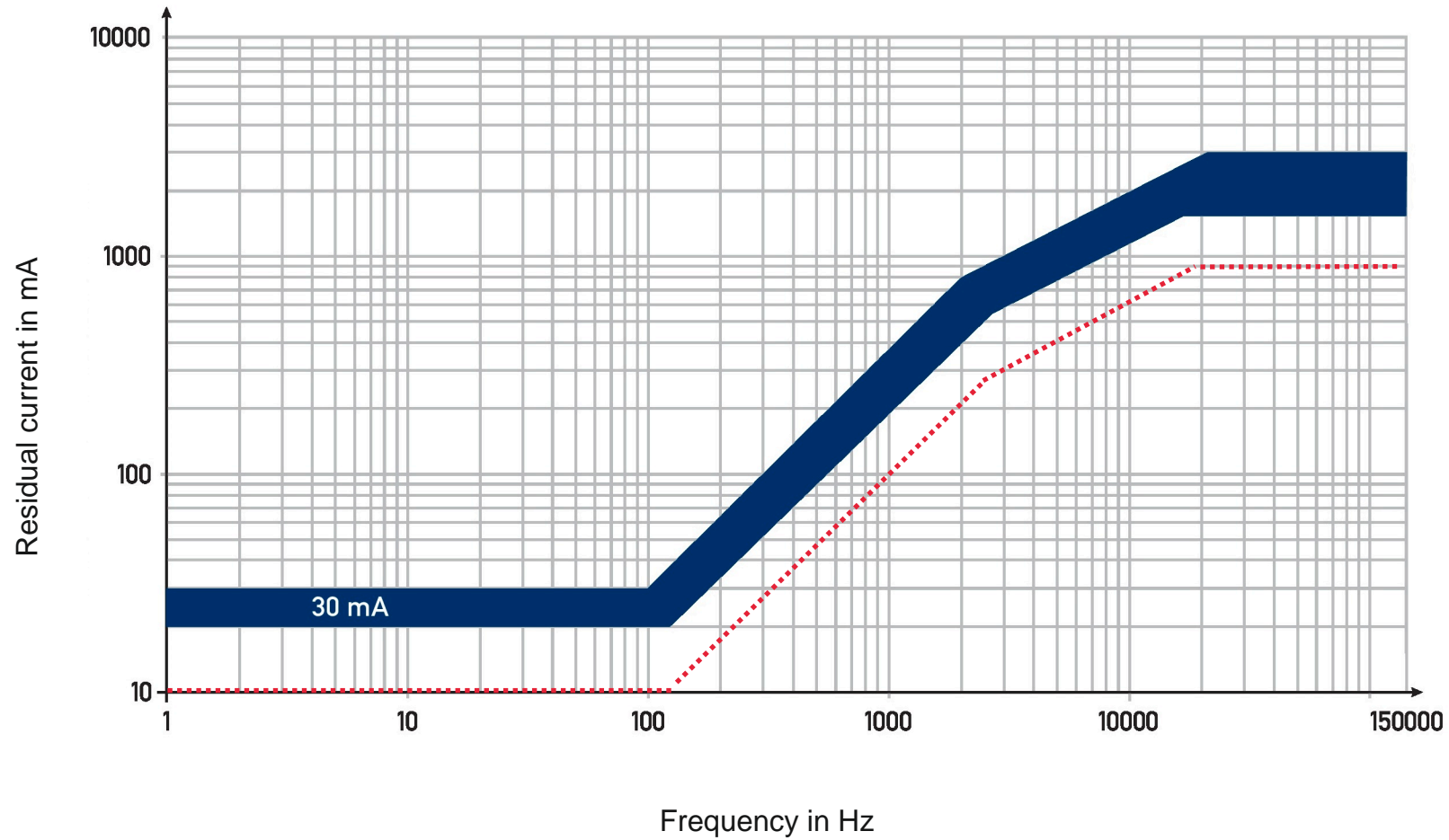
## DFL8 B NK / 30 mA Tripping current frequency response



DFL8 B NK / 30 mA

Type B characteristic curves  
Refer to page 9 for use

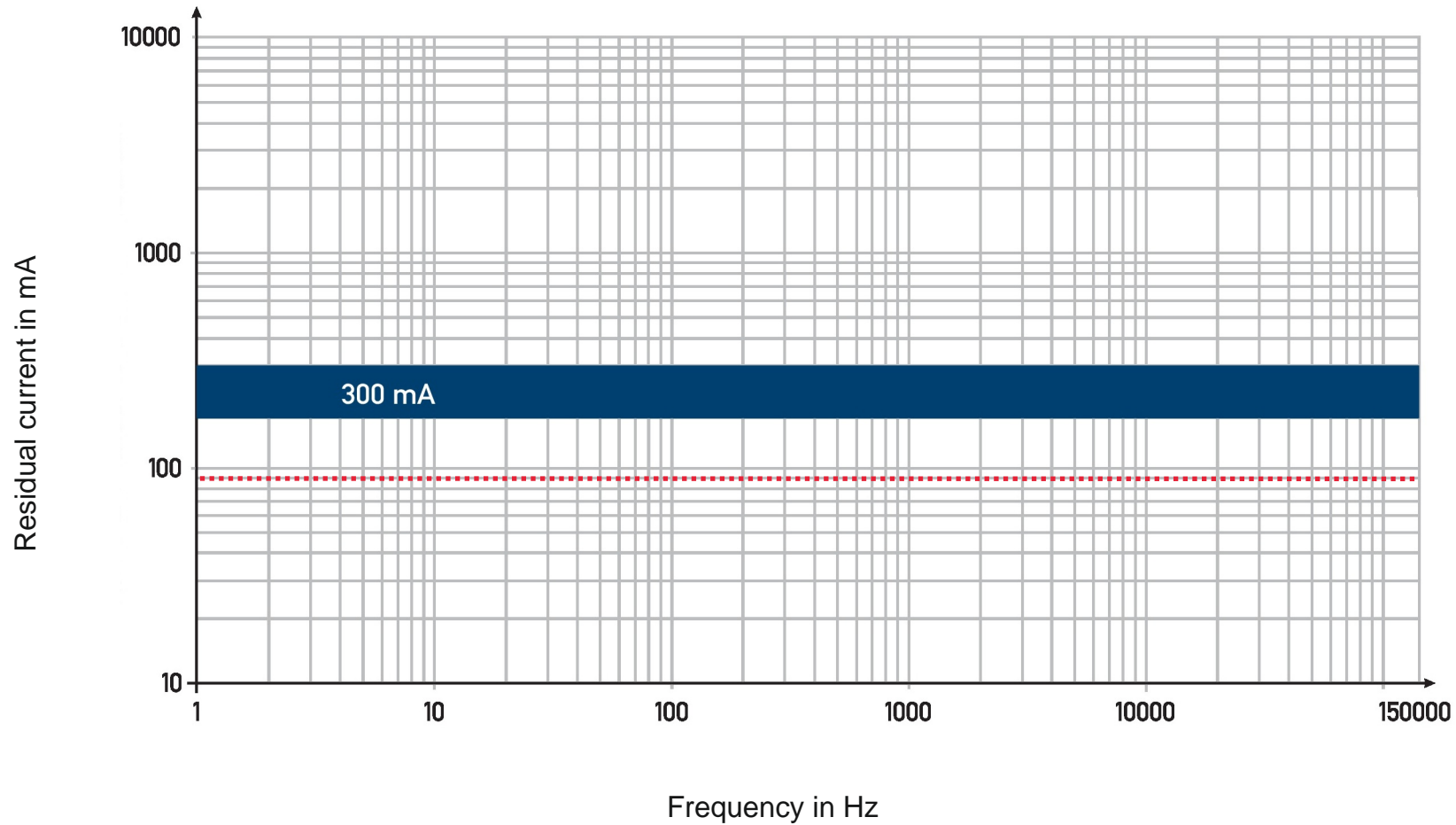
## DFL8 B SK / 30 mA Tripping current frequency response



DFL8 B SK / 30 mA

Type B characteristic curves  
Refer to page 9 for use

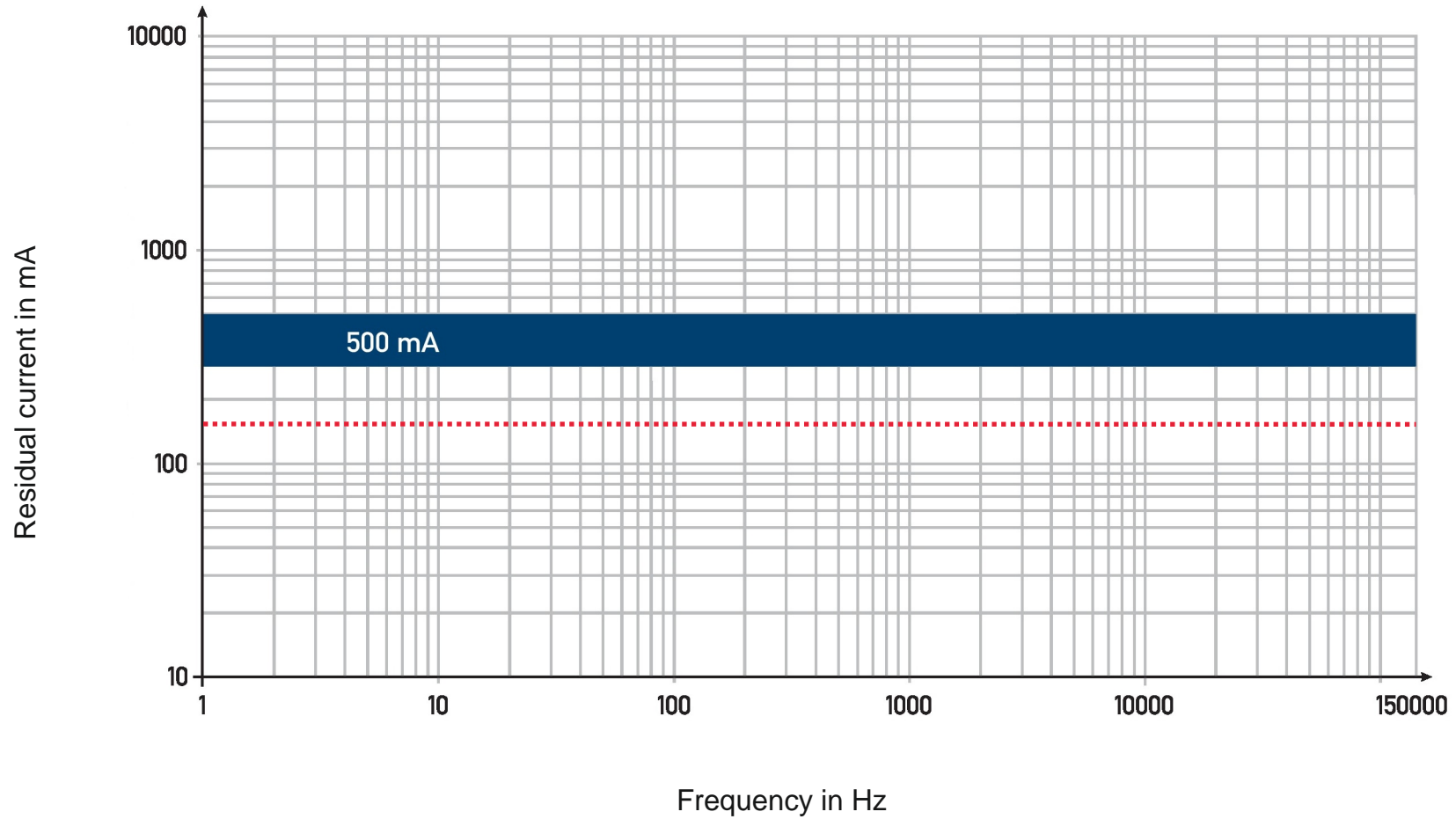
## DFL8 B NK X 300mA setting Tripping current frequency response



DFL8 B NK X 300mA setting

Type B characteristic curves  
Refer to page 9 for use

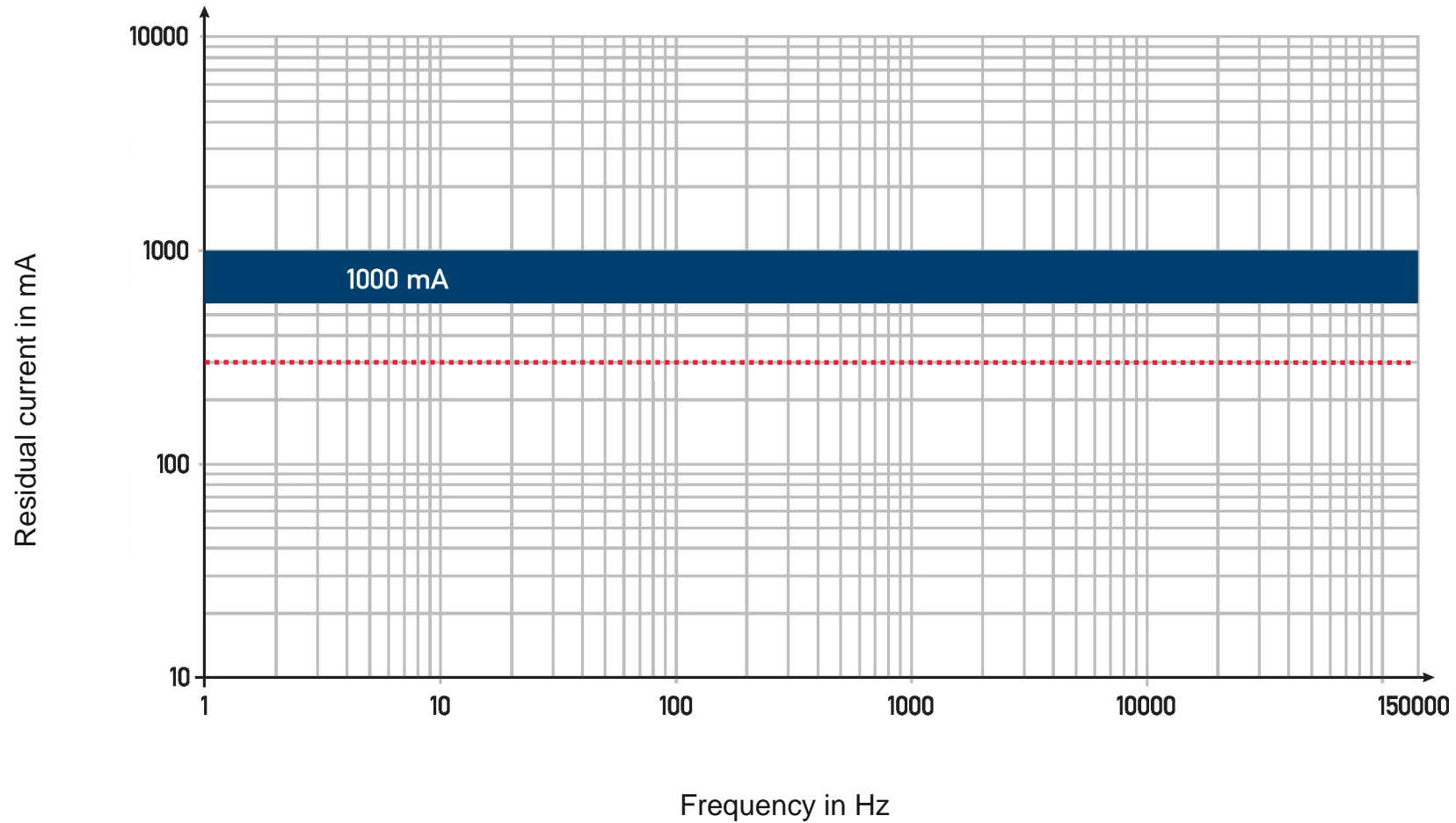
## DFL8 B NK X 500mA setting Tripping current frequency response



DFL8 B NK X 500mA setting

Type B characteristic curves  
Refer to page 9 for use

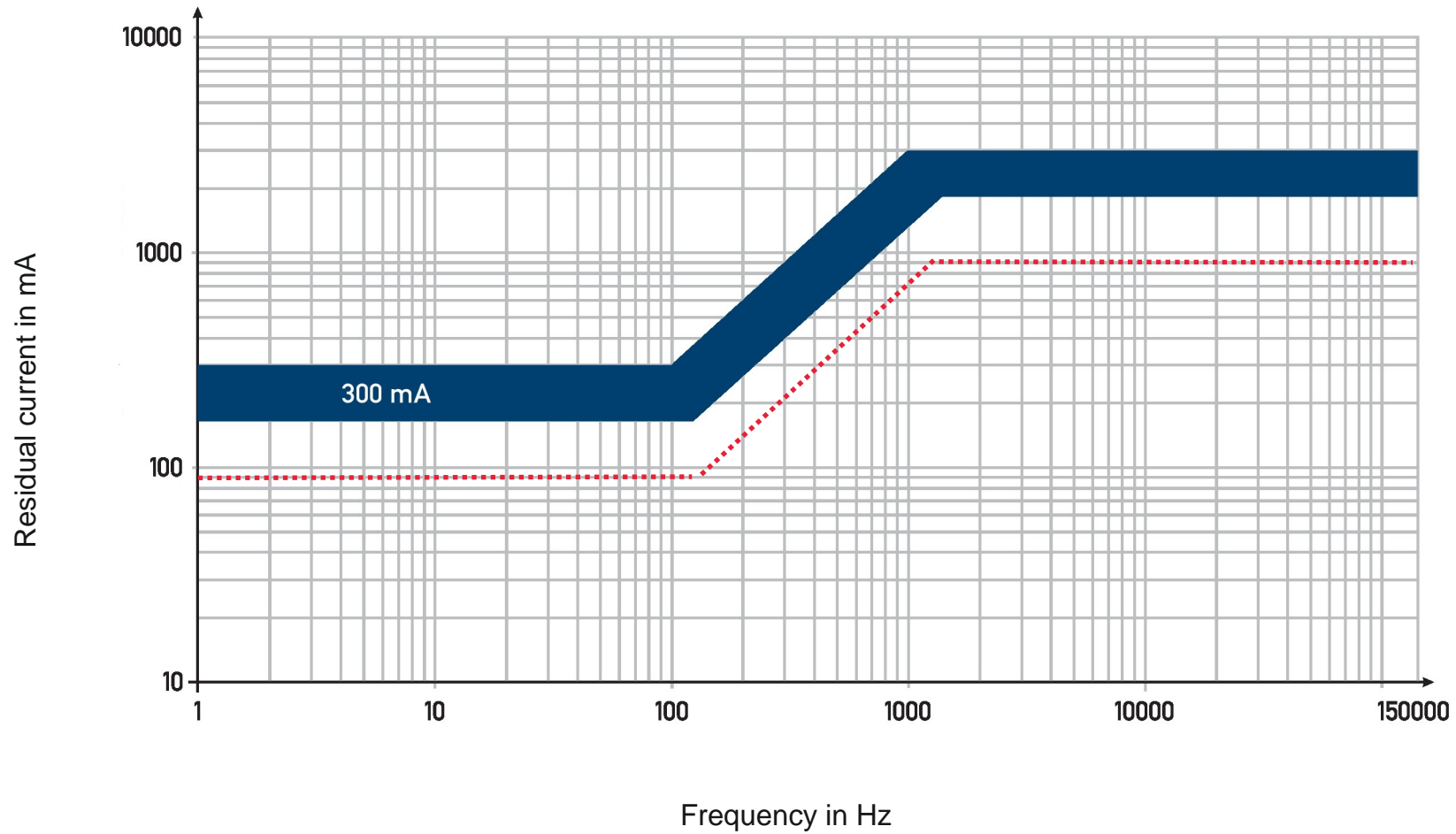
## DFL8 B NK X 1000mA setting Tripping current frequency response



DFL8 B NK X 1000mA setting

Type B characteristic curves  
Refer to page 9 for use

## DFL8 B SK X 300mA setting Tripping current frequency response

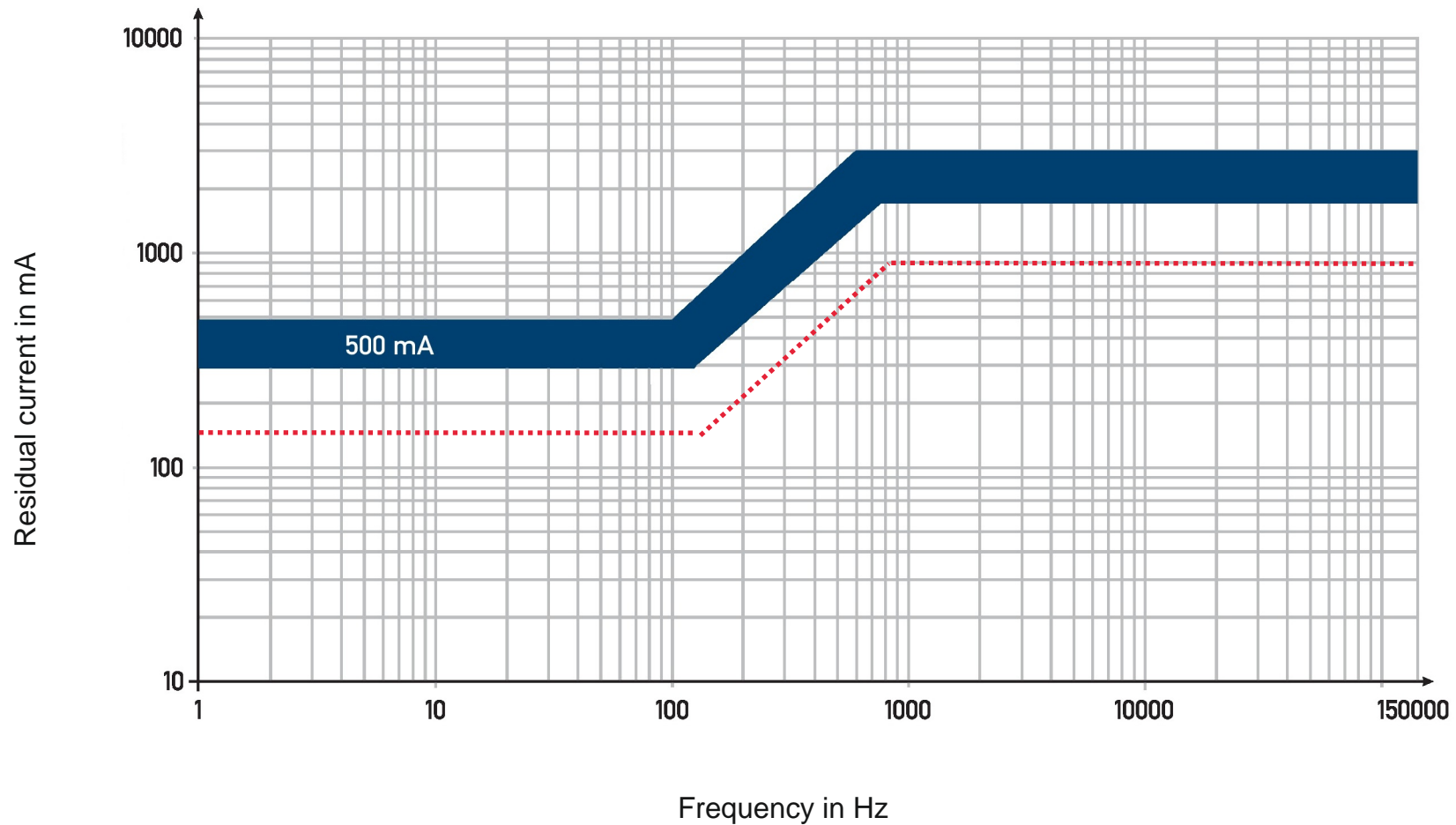


DFL8 B SK X 300mA setting



Type B characteristic curves  
Refer to page 9 for use

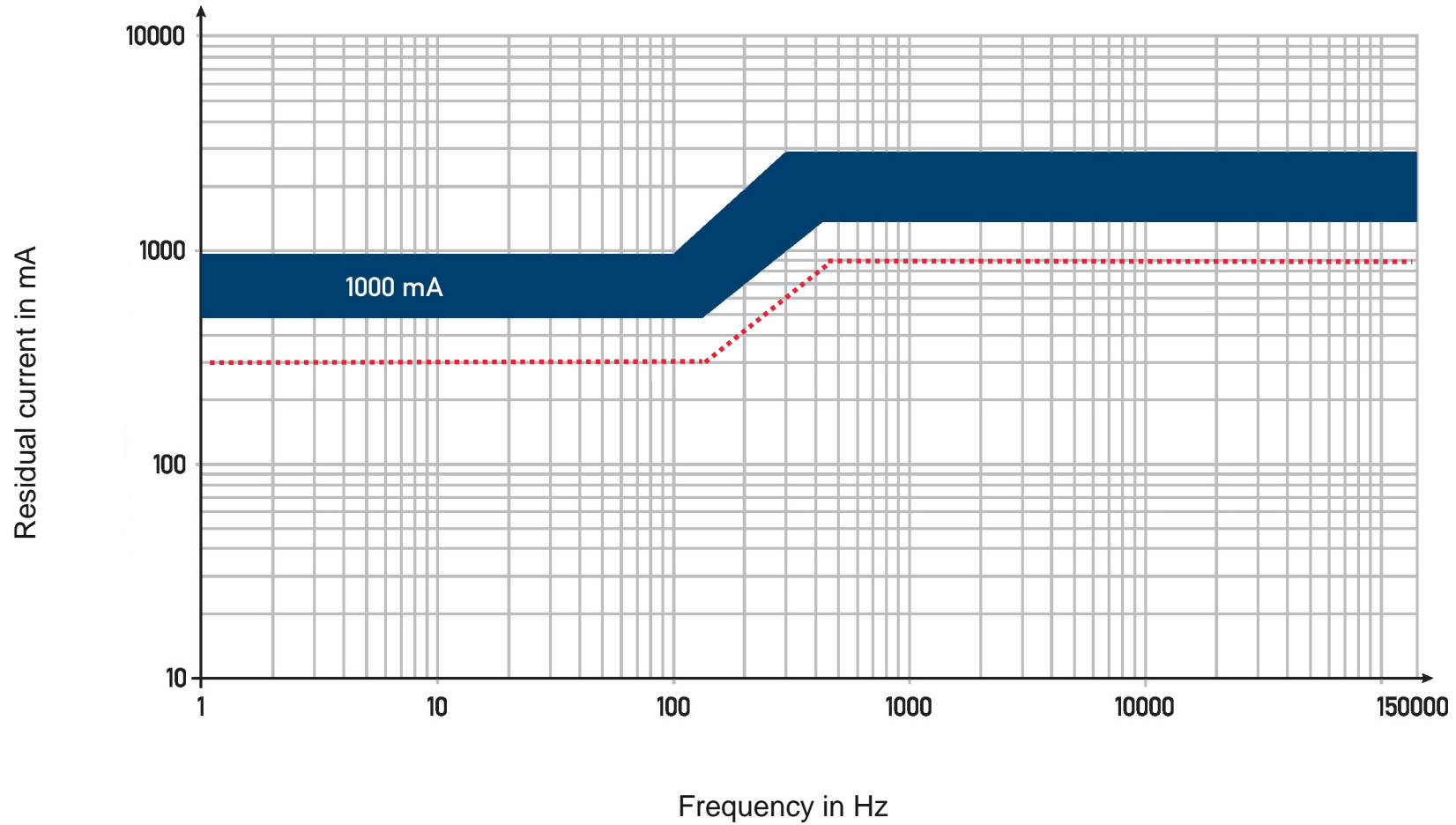
## DFL8 B SK X 500mA setting Tripping current frequency response



DFL8 B SK X 500mA setting

Type B characteristic curves  
Refer to page 9 for use

## DFL8 B SK X 1000mA setting Tripping current frequency response



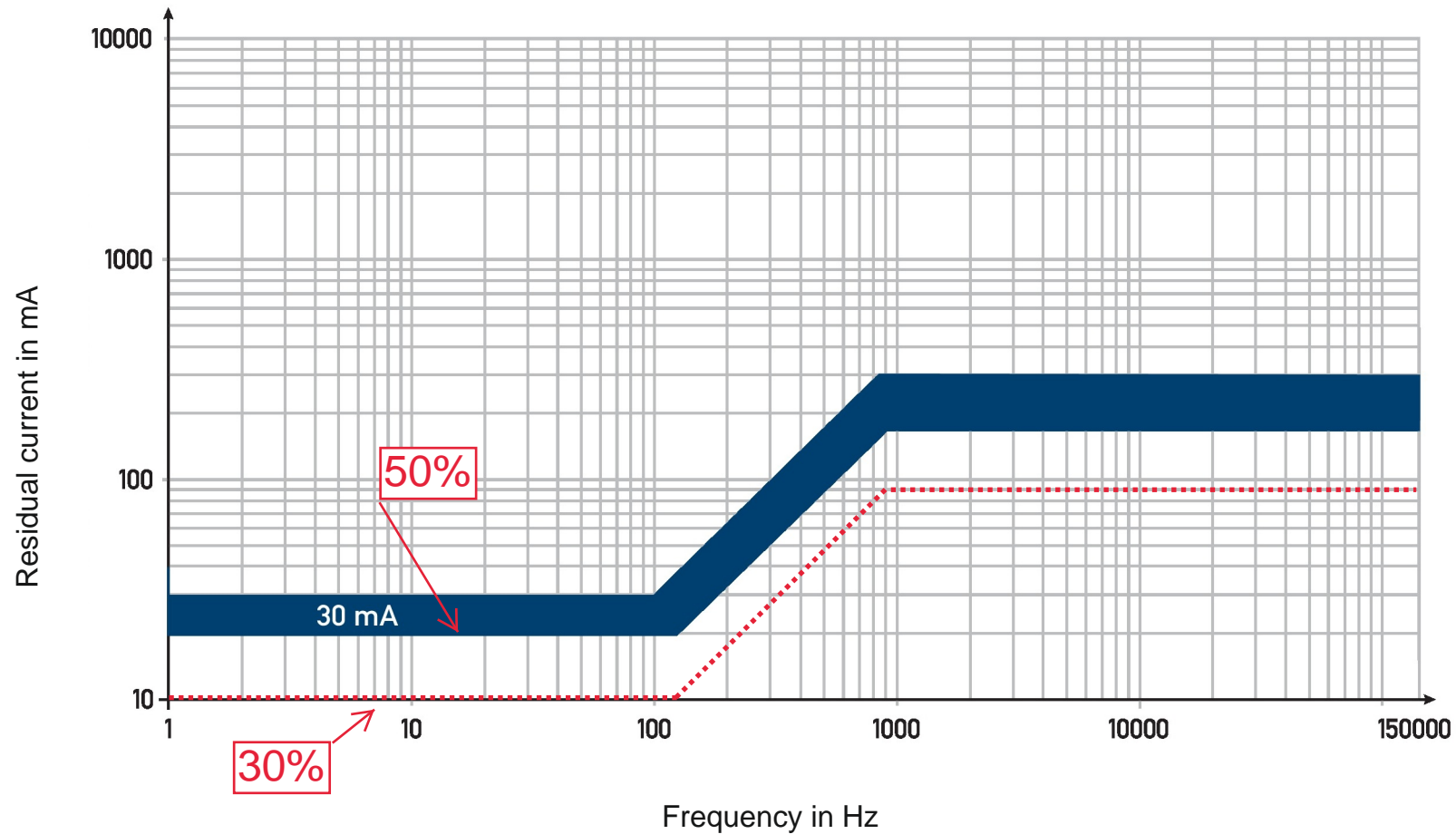
DFL8 B SK X 1000mA setting

## Example 1: BS 7671 Regulation 531.3.2. Unwanted Tripping

Example using 30 mA DFL8 BNK characteristic

531.3.2 (ii): To prevent unwanted tripping, total operational leakage current should not exceed 30% of the rated residual operating current - indicated by the red dotted line for the frequency range 1 < 150 kHz.

531.3.2 Note 2: RCDs may operate at any value of residual current in excess of 50% of the rated residual current - indicated by the blue area.



## DFL8 BNK X and BSK X Setting residual current and time characteristic

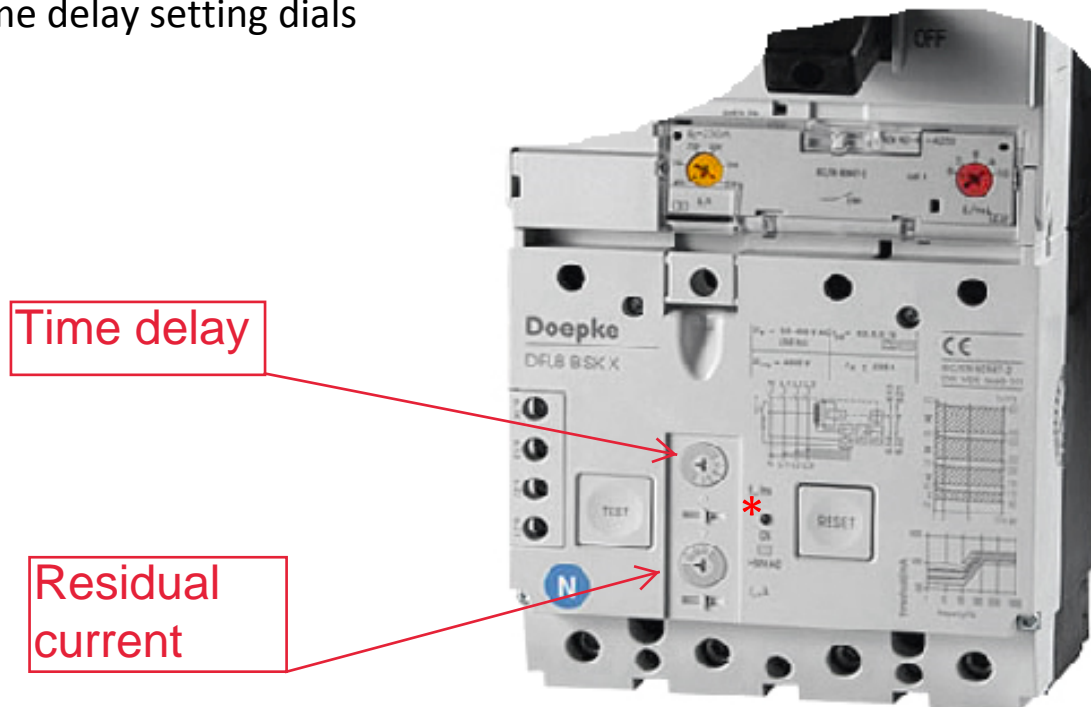
BS 7671 411.3.2 Automatic disconnection in case of a fault, for circuits not covered by 411.3.2.5

CBR Time delay setting adjusted to comply with Table 41.1 for circuits covered by 411.3.2 .2. See 411.4.4 Note 2.

For other TN or TT circuits refer to the appropriate clause.

The table below details the Time delay range settings, relating to 536.4.1.4 Note 3.

### Residual current and Time delay setting dials



Time delay range	
Range I	= 60 – 120 ms
Range II	= 150 – 250 ms
Range III	= 300 – 420 ms
Range IIII	= 450 – 600 ms

Residual current	
0.3	= 300 mA
0.5	= 500 mA
1.0	= 1000 mA

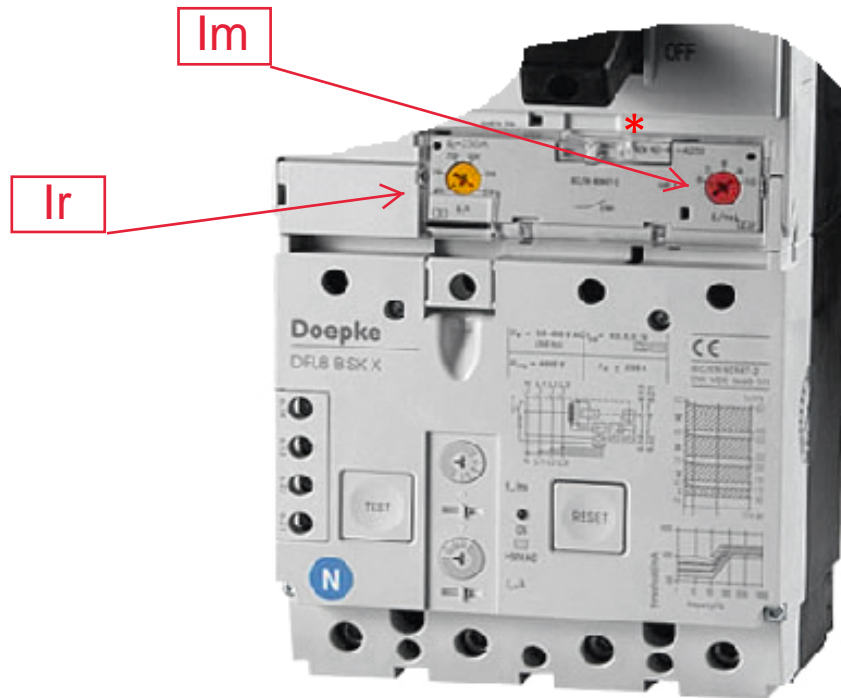
*\* After commissioning and testing: Fit lead seals to covers, to prevent unauthorised adjustment of settings.*

DFL8 Setting thermal and magnetic current characteristics for ratings ( $I_n$ ) : 100A, 160A, 200A, 250A

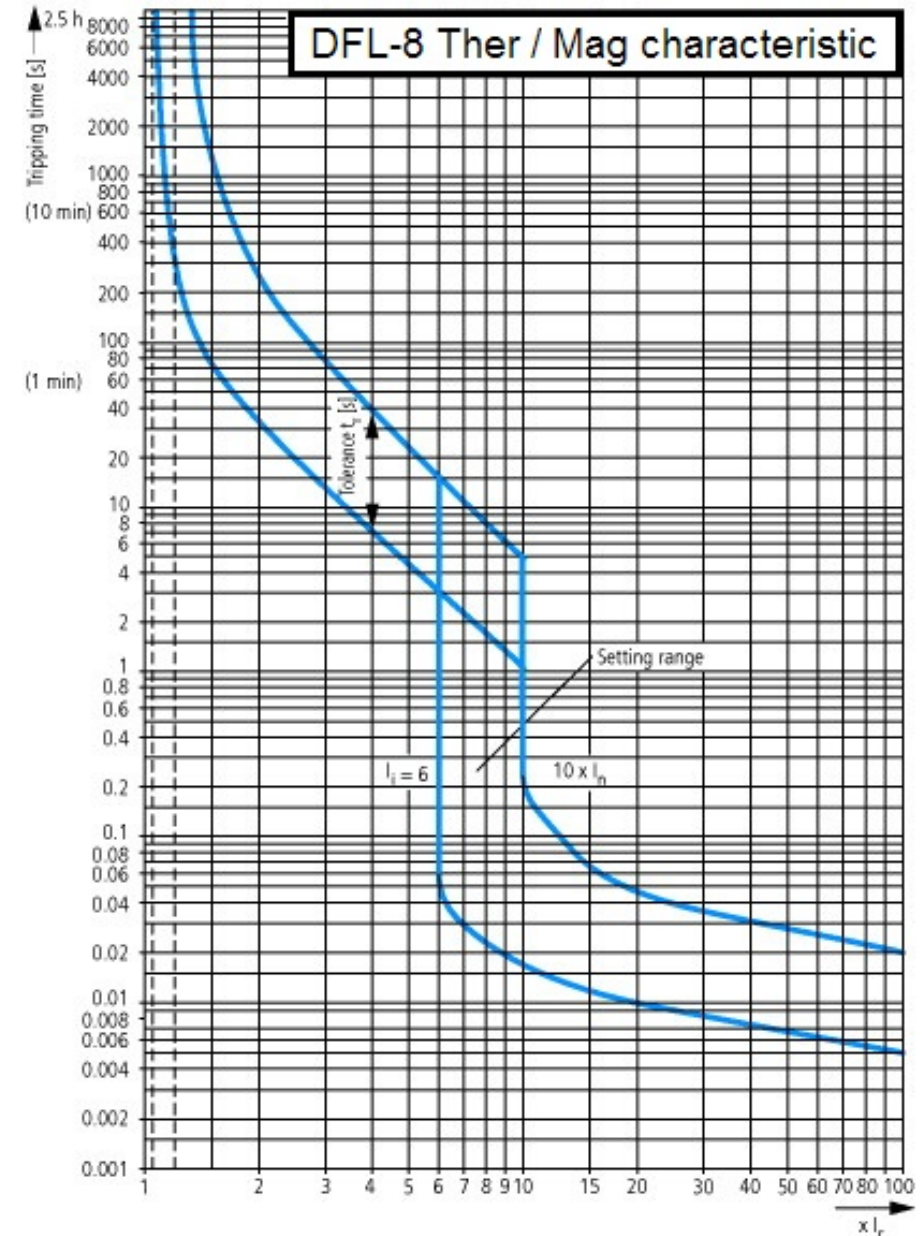
Thermal overload setting:  $I_r = 0.8 - 1 \times I_n$

Magnetic short-circuit setting :  $I_m = 6 - 10 \times I_n$

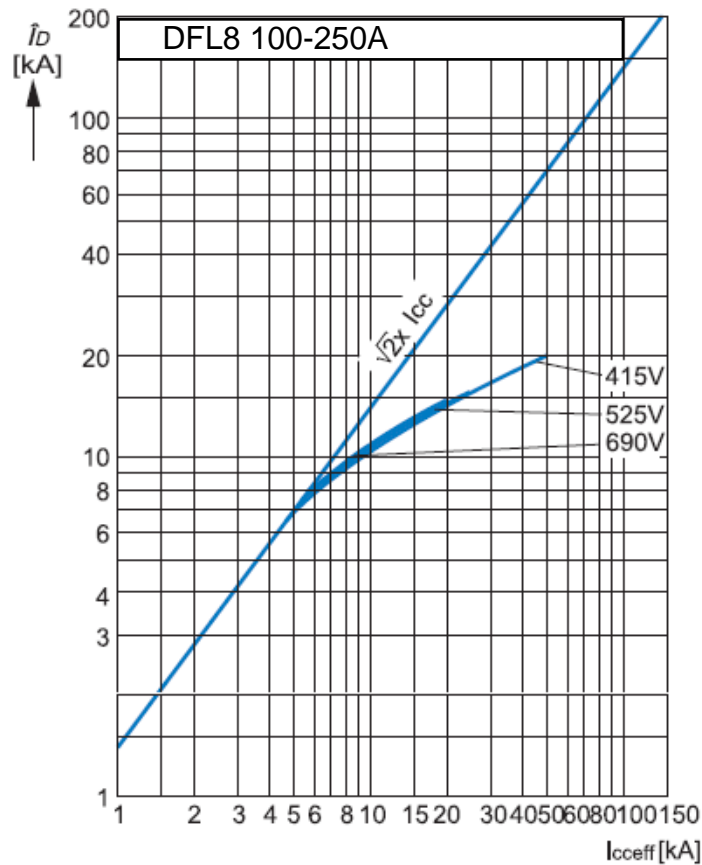
Thermal and Magnetic setting dials



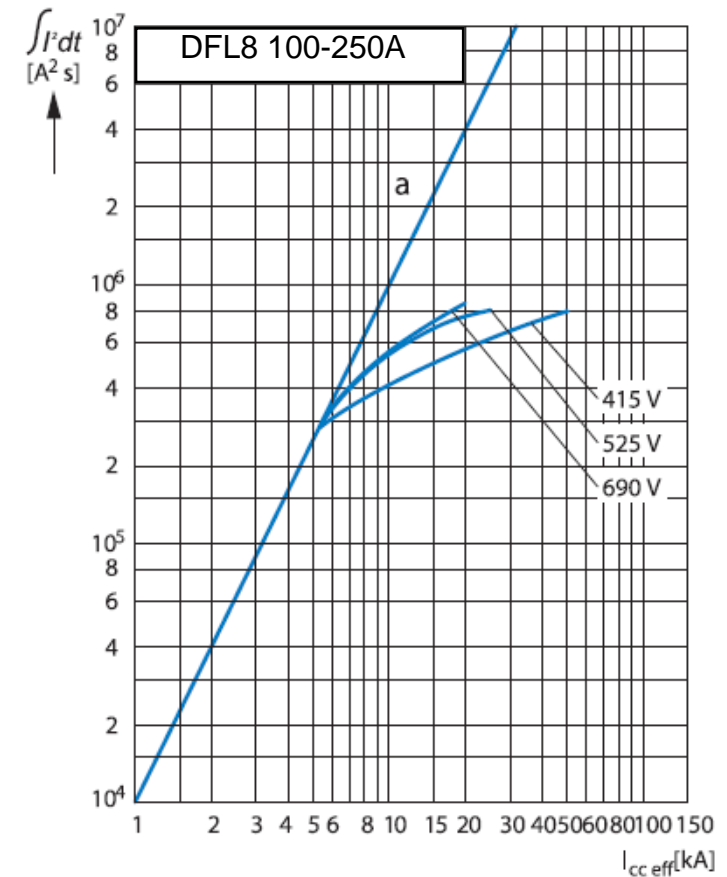
*\* After commissioning and testing: Fit lead seals to covers, to prevent unauthorised adjustment of settings.*



## DFL8 - Let-through characteristics



Let-through current



Let-through energy

# Installation and Operating Instructions for DFL 8 B NK and DFL 8 B NK X CBRs with Residual Current Protection

## Electrical connection:

**Make sure that the current flow direction is correct**, i.e. the input supply must be connected to the lower terminals. Route all live wires, (L1, L2, L3 and the neutral wire MP/N) through the device  
Aluminum conductors should be scraped clean and greased immediately prior to connecting.

## Functional design and application:

DFS 8B NK and DFL 8B NK X models are AC-DC sensitive CBRs for detecting Type B residual currents. They consist of a mains voltage-independent function for detecting sinusoidal AC and pulsating DC residual currents at 50 Hz, or 60 Hz, plus a mains voltage-dependent function for detecting type B residual currents within a frequency range of 0 Hz to 150 kHz. These units are not intended for use in DC networks.

For **fault protection** across the complete detected frequency range (0 < 150 kHz), with a maximum contact voltage of **50 V or 25 V** as per **BS7671 411.4.4**, the earth resistance required must be as listed in the following table:

Model Range Type	Max. Contact Voltage 25 V	max. Contact Voltage 50 V
DFL 8 B NK < 300 mA < 150 kHz	83 Ω	167 Ω
DFL 8 B NK X < 1000 mA < 150 kHz	25 Ω	50 Ω

The tripping current for a DFL 8B NK with a rated residual operating current of 30 mA and 300 mA < 150 kHz is less than 300 mA as required by **532.2** (fire protection). Inverter loads (power electronic converters) may have leakage currents > 150 mA within the required detection range of the RCD. In designs where RCD protection is required to meet 532.2, check with the inverter manufacture on the suitability of the equipment to be used in an installation e.g. leakage current compatible with the required limits for leakage current.

## Tests and functional checks:

Refer to BS7671 Chapter 64. Providing the DFL8 has been installed correctly as above and switched-off, insulation tests may be performed on the load side (top side of the DFL8). An insulation test while the DFS 8B NK is switched on, or an insulation test on the input side, will damage the DFL8 e.g. test / reset function not working, Type B protection function destroyed, invalidating the warranty.

A functional test of the CBR itself can be carried out by pressing test button T when mains voltage is applied and should be carried out regularly, as per the installation requirements. The green LED signals that the internal operating voltage is sufficient for Type B, AC, A residual current detection. If the LED is extinguished, only tripping for Type AC and A residual currents occur. The internal power supply of the DFS 8B NK is via the lower terminals. At least any 2 of the conductors must have an AC voltage of more than 50V applied in order to ensure Type B residual current detection.

## Important notes regarding the operation of electronic equipment (e.g. frequency converters, inverters etc.):

1. Electronic equipment and its associated EMC protective provisions, e.g. integrated or in series-connected EMC filters, length of shielded motor cables, incorrect selection of inverter switching frequency can produce high leakage currents.
2. To avoid unwanted tripping, the sum of the leakage currents for equipment connected downstream of the DFL 8B NK should not exceed the recommendations in 531.3.2, i.e. 30% of the residual current characteristic across the generated frequency spectrum for the leakage current. *Contact the manufacturers of the electronic equipment for information on leakage currents.*
3. Shielded motor cable length, above the manufacturer's tested recommendations produce high leakage currents resulting in unwanted tripping of the DFL8. Contact the manufacture for advise on design, e.g. use of a sine output filter etc.
4. Conventional 3-lead EMC filters should only be used on the associated electronic equipment connected downstream. Under no circumstances should any other single-phase loads, e.g. lighting, be connected at the output side of the EMC filter!
5. The switching (chopper) frequencies of the inverter must not be a multiple of the associated EMC filter frequency, as this could produce a resonant circuit leading to excessively high leakage currents. Only use EMC filters and switching frequencies recommended by the inverter manufacture.

## Application and warning notes:

To ensure safe operation the following notes and warnings should be observed.

1. Installation may only be carried out by an authorized, trained technician who is familiar with the applicable national design regulations.
2. CBRs may only be stored and operated in a dry, dust-free environment (suitable enclosure, correctly installed, appropriate glanding, cover closed). Corrosive atmospheres are also to be avoided.
3. The operator should be made aware of the necessary routine testing using test button T.
4. Tripping due to impulse voltage-triggered leakage currents cannot be completely ruled out, even with surge current resistant CBRs. In cases where disconnection of the power supply could endanger persons or livestock, or cause damage to property, the residual current protection should therefore be provided by means of selective CBRs with higher surge current resistance and in series-connected SPDs. In special cases the switch status should be monitored using an auxiliary contact at the CBR plus an appropriate warning facility.
5. Opening the device renders the warranty null and void!

**Technical Data DFL 8B NK (X)**

Rated current $I_n$	100 A	125 A	160 A	200 A	250 A
Rated residual operating current $I_{\Delta n}$ DFL 8 B NK DFL 8 B NK X	0,03 A settable: 0.3 A; 0.5 A; 1.0 A				
Detection range of residual current	~ 0-150 kHz (Supply 50 Hz)				
Rated operating voltage $U_n$	230/400 V AC				
Rated frequency	50 Hz				
Min. operating voltage for detecting Type A/AC residual currents for detecting Type B residual currents	0 V (mains voltage-independent) 50 V AC				
Internal consumption	max. 2.5 - 3 W				
Working range of test circuit	50 V AC – 400 V AC				
Number of poles	4-pole				
Dissipated power $P_V$ (typ.)	35 W	43 W	55 W	72 W	85 W
Short-circuit fuse to VDE 0636/IEC 60269-1	250 A/gL				
Response characteristics DFL 8 B NK DFL 8 B NK X (settable)[2 x $I_{\Delta n}$ ]	1 x $I_{\Delta n} \leq 300$ ms; 5 x $I_{\Delta n} \leq 40$ ms Range I = 60 – 120 ms Range II = 150 – 250 ms Range III = 300 – 420 ms Range IIII = 450 – 600 ms				
Non-trip delay time DFL 8 B NK DFL 8 B NK X (settable)[2 x $I_{\Delta n}$ ]	no delay feature Range I = <60 ms Range II = <150 ms Range III = <300 ms Range IIII = <450 ms				
Rated short circuit disconnecting capacity limit $I_{cu}$	50 kA				
Rated operation short circuit disconnecting capacity $I_{cs}$	50 kA				
Rated short-circuit connection and disconnection capacity $I_{\Delta m}$	50 kA				
Surge current resistance	Verification of CBR resistance to unintentional response due to surge currents caused by impulse voltages EN 60947-2:2003 (B.8.6)				
Impact resistance	20 g /20 ms duration (IEC 60068-2-27)				
Vibration resistance	1.0 g (f = 2 - 100 Hz) (IEC 60068-2-6)				
Enclosure protection type	IP 20				
Positioning	vertical, or tilted 90°				
Input side	below				
Ambient temperature	-25°C to +70°C				
Environmental testing	IEC 60068				
Dry heat	IEC 60068-2-2				
Humid heat constant cyclic	IEC 60068-2-78 IEC 60068-2-30				
Terminal dia. for CU leads single-wire multi-wire	1 x (2.5 mm <sup>2</sup> – 16 mm <sup>2</sup> ); 2 x (4 mm <sup>2</sup> – 16 mm <sup>2</sup> ) 1 x (25 mm <sup>2</sup> – 185 mm <sup>2</sup> ); 2 x (27 mm <sup>2</sup> – 70 mm <sup>2</sup> )				
Tightening torque of fastening screws	14 Nm				
Service life, mechanical	> 2,000 switching cycles				
Service life, electrical	> 2,000 switching cycles				
Design requirements overload trip residual current trip	VDE 0660 / EN 60947-2 VDE 0660 / EN 60947-2 Appendix B				
Electromagnetic compatibility	EN 60947-2 Appendix J				
Weight	approx. 5,600 g				

<b>Auxiliary switch</b>					
Loading capacity	AC-15: 230 V / 6 A; 400 V / 4 A; 500 V / 2 A DC-13: 24 V / 3 A; 110 V / 0,8 A; 220 V / 0,3 A				
Rated impulse voltage resistance $U_{imp}$	6 kV				
Rated insulation voltage $U_i$	500 V				
Terminal dia. single and multi-wire with wire end caps	1 x (0.75 mm <sup>2</sup> -2.5 mm <sup>2</sup> ) ; 2 x (0.75 mm <sup>2</sup> -1.5 mm <sup>2</sup> )				
Tightening torque	≤ 0.8 Nm				



# Installation and Operating Instructions for DFL 8 B SK and DFL 8 B SK X CBRs with Residual Current Protection

## Electrical connection:

**Make sure that the current flow direction is correct**, i.e. the input supply must be connected to the lower terminals. Route all live wires, (L1, L2, L3 and the neutral wire MP/N) through the device  
Aluminum conductors should be scraped clean and greased immediately prior to connecting.

## Functional design and application:

DFS 8B SK and DFL 8B SK X models are AC-DC sensitive CBRs for detecting Type B residual currents. They consist of a mains voltage-independent function for detecting sinusoidal AC and pulsating DC residual currents at 50 Hz, or 60 Hz, plus a mains voltage-dependent function for detecting type B residual currents within a frequency range of 0 Hz to 150 kHz. These units are not intended for use in DC networks.

For **fault protection** across the complete detected frequency range (0 < 150 kHz), with a maximum contact voltage of **50 V or 25 V** as per **BS7671 411.4.4**, the earth resistance required must be as listed in the following table:

Model Range Type	Max. Contact Voltage 25 V	max. Contact Voltage 50 V
DFL 8 B SK < 150 kHz	8.3 Ω	16.6 Ω

The DFL 8B SK residual operating current for frequencies > 1 kHz < 150 kHz is in the region of 3 amps (refer to the individual tripping current frequency response characteristics). This ensures its insensitivity to higher leakage currents in the upper frequency range for Inverter loads (power electronic converters) with high operational leakage currents. The 30mA BSK characteristic limits currents below the IEC60479-2 cardiac fibrillation limits for AC currents < 150kHz. Sustained contact with currents >300 mA can result in irreversible thermal tissue damage.

## Tests and functional checks:

Refer to BS7671 Chapter 64. Providing the DFL8 has been installed correctly as above and switched-off, insulation tests may be performed on the load side (top side of the DFL8). An insulation test while the DFS 8 B SK is switched on, or an insulation test on the input side, will damage the DFL8 e.g. test / reset function not working, Type B protection function destroyed, invalidating the warranty.

A functional test of the CBR itself can be carried out by pressing test button T when mains voltage is applied and should be carried out regularly, as per the installation requirements. The green LED signals that the internal operating voltage is sufficient for Type B, AC, A residual current detection. If the LED is extinguished, only tripping for Type AC and A residual currents occur. The internal power supply of the DFS 8 B SK is via the lower terminals. At least any 2 of the conductors must have an AC voltage of more than 50V applied in order to ensure Type B residual current detection.

## Important notes regarding the operation of electronic equipment (e.g. frequency converters, inverters etc.):

1. Electronic equipment and its associated EMC protective provisions, e.g. integrated or in series-connected EMC filters, length of shielded motor cables, incorrect selection of inverter switching frequency can produce high leakage currents.
2. To avoid unwanted tripping, the sum of the leakage currents for equipment connected downstream of the DFL 8 B SK should not exceed the recommendations in 531.3.2, i.e. 30% of the residual current characteristic across the generated frequency spectrum for the leakage current. *Contact the manufacturers of the electronic equipment for information on leakage currents.*
3. Shielded motor cable length, above the manufacturer's tested recommendations produce high leakage currents resulting in unwanted tripping of the DFL8. Contact the manufacturer for advice on design, e.g. use of a sine output filter etc.
4. Conventional 3-lead EMC filters should only be used on the associated electronic equipment connected downstream. Under no circumstances should any other single-phase loads, e.g. lighting, be connected at the output side of the EMC filter!
5. The switching (chopper) frequencies of the inverter must not be a multiple of the associated EMC filter frequency, as this could produce a resonant circuit leading to excessively high leakage currents. Only use EMC filters and switching frequencies recommended by the inverter manufacturer.

## Application and warning notes:

To ensure safe operation the following notes and warnings should be observed.

1. Installation may only be carried out by an authorized, trained technician who is familiar with the applicable national design regulations.
2. CBRs may only be stored and operated in a dry, dust-free environment (suitable enclosure, correctly installed, appropriate glanding, cover closed). Corrosive atmospheres are also to be avoided.
3. The operator should be made aware of the necessary routine testing using test button T.
4. Tripping due to impulse voltage-triggered leakage currents cannot be completely ruled out, even with surge current resistant CBRs. In cases where disconnection of the power supply could endanger persons or livestock, or cause damage to property, the residual current protection should therefore be provided by means of selective CBRs with higher surge current resistance and in series-connected SPDs. In special cases the switch status should be monitored using an auxiliary contact at the CBR plus an appropriate warning facility.
5. Opening the device renders the warranty null and void!

**Technical Data DFL 8B SK (X)**

Rated current $I_n$	100 A	125 A	160 A	200 A	250 A
Rated residual operating current $I_{\Delta n}$ DFL 8 B SK DFL 8 B SK X	0,03 A settable: 0.3 A; 0.5 A; 1.0 A				
Detection range of residual current	~ 0-150 kHz (Supply 50 Hz)				
Rated operating voltage $U_n$	230/400 V AC				
Rated frequency	50 Hz				
Min. operating voltage for detecting Type A/AC residual currents for detecting Type B residual currents	0 V (mains voltage-independent) 50 V AC				
Internal consumption	max. 2.5 - 3 W				
Working range of test circuit	50 V AC – 400 V AC				
Number of poles	4-pole				
Dissipated power $P_V$ (typ.)	35 W	43 W	55 W	72 W	85 W
Short-circuit fuse to VDE 0636/IEC 60269-1	250 A/gL				
Response characteristics DFL 8 B SK DFL 8 B SK X (settable)[2 x $I_{\Delta n}$ ]	1 x $I_{\Delta n} \leq 300$ ms; 5 x $I_{\Delta n} \leq 40$ ms Range I = 60 – 120 ms Range II = 150 – 250 ms Range III = 300 – 420 ms Range IIII = 450 – 600 ms				
Non-trip delay time DFL 8 B SK DFL 8 B SK X (settable)[2 x $I_{\Delta n}$ ]	no delay feature Range I = <60 ms Range II = <150 ms Range III = <300 ms Range IIII = <450 ms				
Rated short circuit disconnecting capacity limit $I_{cu}$	50 kA				
Rated operation short circuit disconnecting capacity $I_{cs}$	50 kA				
Rated short-circuit connection and disconnection capacity $I_{\Delta m}$	50 kA				
Surge current resistance	Verification of CBR resistance to unintentional response due to surge currents caused by impulse voltages EN 60947-2:2003 (B.8.6)				
Impact resistance	20 g /20 ms duration (IEC 60068-2-27)				
Vibration resistance	1.0 g (f = 2 - 100 Hz) (IEC 60068-2-6)				
Enclosure protection type	IP 20				
Positioning	vertical, or tilted 90°				
Input side	below				
Ambient temperature	-25°C to +70°C				
Environmental testing	IEC 60068				
Dry heat	IEC 60068-2-2				
Humid heat constant cyclic	IEC 60068-2-78 IEC 60068-2-30				
Terminal dia. for CU leads single-wire multi-wire	1 x (2.5 mm <sup>2</sup> – 16 mm <sup>2</sup> ); 2 x (4 mm <sup>2</sup> – 16 mm <sup>2</sup> ) 1 x (25 mm <sup>2</sup> – 185 mm <sup>2</sup> ); 2 x (27 mm <sup>2</sup> – 70 mm <sup>2</sup> )				
Tightening torque of fastening screws	14 Nm				
Service life, mechanical	> 2,000 switching cycles				
Service life, electrical	> 2,000 switching cycles				
Design requirements overload trip residual current trip	VDE 0660 / EN 60947-2 VDE 0660 / EN 60947-2 Appendix B				
Electromagnetic compatibility	EN 60947-2 Appendix J				
Weight	approx. 5,600 g				

<b>Auxiliary switch</b>					
Loading capacity	AC-15: 230 V / 6 A; 400 V / 4 A; 500 V / 2 A DC-13: 24 V / 3 A; 110 V / 0,8 A; 220 V / 0,3 A				
Rated impulse voltage resistance $U_{imp}$	6 kV				
Rated insulation voltage $U_i$	500 V				
Terminal dia. single and multi-wire with wire end caps	1 x (0.75 mm <sup>2</sup> -2.5 mm <sup>2</sup> ) ; 2 x (0.75 mm <sup>2</sup> -1.5 mm <sup>2</sup> )				
Tightening torque	≤ 0.8 Nm				

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