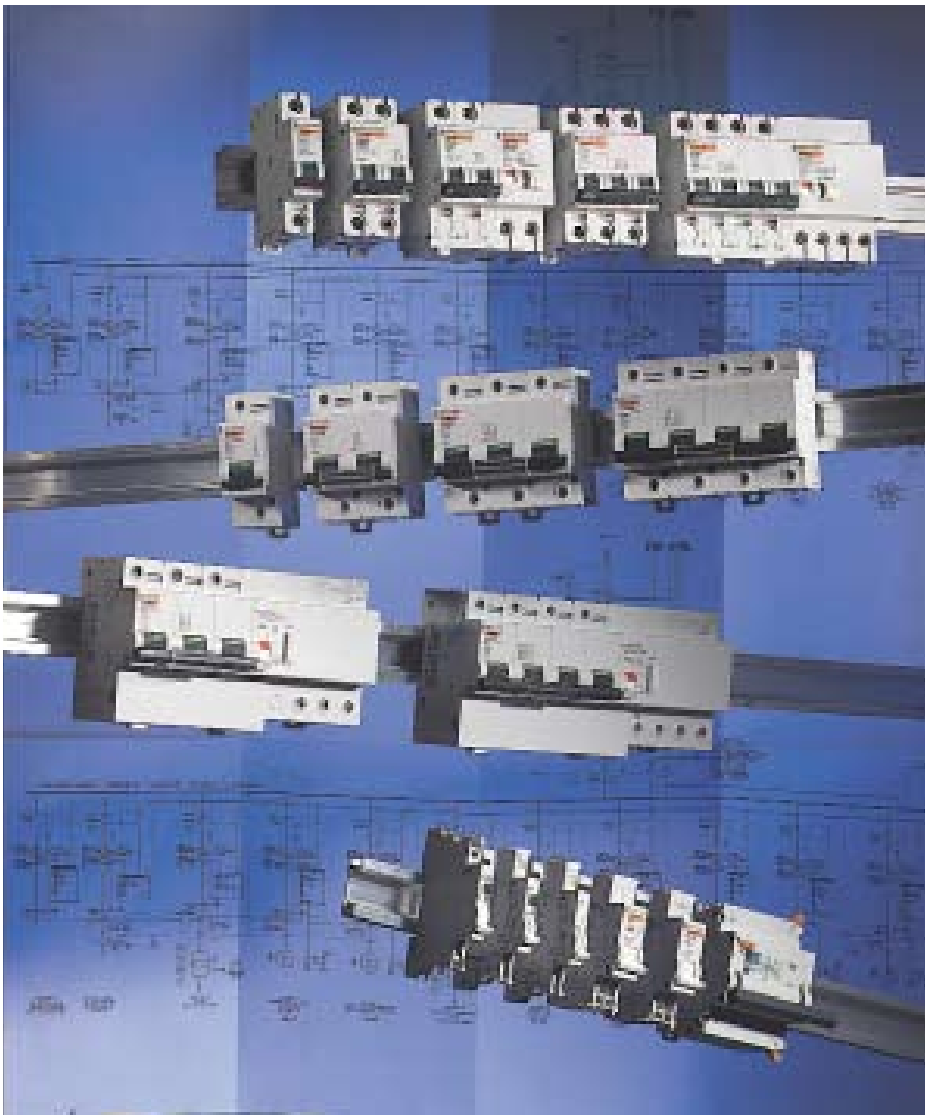
LV Circuit Breaker Application Guide



Schneider Electric

LV Circuit Breaker
Application Guide

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1.
overview of the modular offer

A circuit-breaker is chosen according to a number of criteria:
■ Utilisation:
□ AS/NZS 4898 switchboards accessible to inexperienced users,
□ AS 3947-2 , in all other installations (service sector, agricultural, industrial).
■ Technical data of the network at the point considered:
□ the earthing systems (TNS, TNC),
□ short-circuit current at the circuit-breaker installation point, which must always be less than the breaking capacity of this device,
□ network normal voltage.
■ Technical data of the circuit to be protected:
□ the circuit-breaker tripping curve:
- C curve: standard
- B curve: for a generator only able to supply a small short-circuit current
- curve D: when the starting current is high,
□ the number of poles imposed by the loads.

The earth leakage protection is determined according to the required level:
■ Protection against direct contacts (breakage or absence of the protective conductor): 10 mA or 30 mA.
■ Fire protection: 100 mA or 300 mA.
■ Protection against indirect contacts: 500 mA.
■ Reference standard: corresponds to that of the circuit-breaker
□ AS 3190: installations accessible to inexperienced users,
□ AS 3947-2: industrial standards.

circuit-breakers (AS 3947-2)

peculiarity	tripping curves				ratings (A)	number of poles	breaking capacity at 415 V (kA)
	C	B	D	MA	voltage Ue (V)		3 4.5 5 6 7.5 10 15 20 25 36 50
C60a	■				6…63 440	1	
C60N	■	■	■		0.5…63 440	1, 2, 3, 4	
C60H	■				0.5…63 440	1, 2, 3, 4	
C120N	■	■	■		63…125 440	1, 2, 3, 4	
C120H	■	■	■		10…125 440	1, 2, 3, 4	
NG125H	■				10…80 500	1, 2, 3, 4	
NG125LMA motor				■	4…80 500	2, 3	
C32H-DC direct current	■				1…40 125 V DC 250 V DC	1 2	

earth leakage modules (AS 3947-2)

basic circuit-breaker	residual current device integrated	residual current device combined	sensitivity instantaneous				selective Ⓢ			adjustable I/S*				adjustable I/S/D*			
				30 mA	300 mA	500 mA	300 mA	500 mA	1 A	300 mA	500 mA	1 A	3 A	300 mA	500 mA	1 A	3 A
DPN	**DPN Vigi**			■ ■													
C60N		**C60 Vigi**		■	■	■	■										
C60H		**C60 Vigi**		■	■	■	■	■	■								
C120N		**C120 Vigi**		■	■	■	■	■	■								
C120H		**C120 Vigi**		■	■	■	■	■	■								
NG125H		**NG125 Vigi**		■	■		■		■	■	■	■	■	■	■	■	■
NG125LMA		**NG125 Vigi**		■	■		■		■	■	■	■	■	■	■	■	■
C32H-DC																	

*I/S: instantaneous or selective
I/S/D: instantaneous, selective or delayed (150 ms).

1.
overview of the modular offer

circuit-breakers (AS/NZS 4898)

peculiarity	tripping curves C	B	D	ratings (A) voltage Ue (V)	number of poles	breaking capacity at 415 V (kA) 3 4.5 5 6 7.5 10 15 20 25 36 50
C60a	■			10…40 440	1, 2, 3, 4	
C60N	■	■		0.5…63 440	1, 2, 3, 4	
C60H	■			0.5…63 440	1, 2, 3, 4	
C120N	■	■	■	63…125 440	1, 2, 3, 4	
C120H	■	■	■	10…125 440	1, 2, 3, 4	

earth leakage modules (AS 3190, AS/NZS 61009)

basic circuit-breaker	residual current device combined	sensitivity instantaneous 30 mA	300 mA	500 mA	selective Ⓢ 300 mA
C60N	**C60 Vigi**	■	■	■	■
C60H	**C60 Vigi**	■	■	■	■
C120N	**C120 Vigi**	■	■	■	■
C120H	**C120 Vigi**	■	■	■	■

2.
selection of circuit breakers

heating & lighting circuit protection

The rating of the circuit breaker depends on the cross sectional area of the cables to be protected which are themselves defined by the utilisation current of the load

This utilisation current is:
■ **either given directly by the manufacturer.**
□ or calculated simply from the power rating and the utilisation voltage. Using the current, it is possible to determine the cross sectional area of the cables and the rating of the protection circuit breaker.

The selected rating is often taken just above the utilisation current in the list of available ratings. The tables below should be used to determine circuit breaker ratings in certain particular cases.

Table 1: heating apparatus and incandescent lighting
For each type of voltage supply, the utilisation current Ib is given as well as which rating to select.

$$Ib = \frac{P}{U}$$ for single phase and

$$Ib = \frac{P}{U\sqrt{3}}$$ for three phase

(1) Note: 3.5 kW.240 V single phase/20A or 6kW.240 V 3-phase/20A or 10kW.415 V 3-phase/20A = maximum power for remote controlled devices (reflex - contactor, etc) for incandescent lighting uses.

power (kW)	240V single phase		240V three phase		415V three phase	
	Ib (A)	rating (A)	Ib (A)	rating (A)	Ib (A)	rating (A)
1	4.5	6	2.6	3	1.44	2
1.5	6.8	10	4.0	4	2.17	3
2	9.0	10	5.2	6	2.9	4
2.5	11.3	16	6.6	10	3.6	4
3	13.9	16	7.8	10	4.3	6
3.5	15.8	20(1)	9.2	10	5	10
4	18.1	20	10.4	16	5.8	10
4.5	20.4	25	11.8	16	6.5	10
5	22.6	25	13.1	16	7.2	10
6	27.1	32	16.1	20(1)	8.7	10
7	31.6	32	18.3	20	10	16
8	36.2	40	20.9	25	11.5	16
9	40.7	50	23.5	25	13	16
10	45.2	50	26.1	32	14.4	20(1)

Table 2: fluorescent lighting
Depending on the power supply and the number and types of lighting units, the table gives circuit breaker rating based on the following assumptions:
n installation in an enclosure with an ambient temperature of 25˚C (derating coefficient = 0.8),
n power of ballast: 25% of tube power.
n power factor:
- 0.6 for non-compensated fluorescent lighting,
- 0.86 for compensated fluorescent lighting

circuit breakers mounted in an enclosure with an ambient exterior temperature of 25˚C: derating coefficient = 0.8.

single phase system: 240V
three phase + N system:415V between phases

types of lighting unit		power of number of lighting units per phase tubes (W)														
2 or 4-P c.b. rating			1	2	3	6	10	16	20	25	32	40	50	63	80	100
single phase non compensated		18	4	9	14	29	49	78	98	122	157	196	245	309	392	490
		36	2	4	7	14	24	39	49	61	78	98	122	154	196	245
		58	1	3	4	9	15	24	30	38	48	60	76	95	121	152
single phase compensated		18	7	14	21	42	70	112	140	175	225	281	351	443	562	703
		36	3	7	10	21	35	56	70	87	112	140	175	221	281	351
		58	2	4	6	13	21	34	43	54	69	87	109	137	174	218
two phase compensated	2x18=	36	3	7	10	21	35	56	70	87	112	140	175	221	281	351
	2x36=	72	1	3	5	10	17	28	35	43	56	70	87	110	140	175
	2x58=	118	1	2	3	6	10	17	21	27	34	43	54	68	87	109

Calculation: non compensated fluorescent lighting example (star connection)

$$\text{number} = \frac{(\text{rating} \times 0.8)\ (U \times 0.6)}{(P \times 1.25)}$$

three phase system (240V): delta system

types of lighting unit		power of number of lighting units per phase tubes (W)														
2 or 3-P c.b. rating			1	2	3	6	10	16	20	25	32	40	50	63	80	100
single phase non compensated		18	2	5	8	16	28	45	56	70	90	113	141	178	226	283
		36	1	2	4	8	14	22	28	35	45	56	70	89	113	141
		58	0	1	2	5	8	14	17	21	28	35	43	55	70	87
single phase compensated		18	4	8	12	24	40	64	81	101	127	162	203	255	324	406
		36	2	4	6	12	20	32	40	50	64	81	101	127	162	203
		58	1	2	3	7	12	20	25	31	40	50	63	79	100	126
two phase compensated	2x18=	36	2	4	6	12	20	32	40	50	64	81	101	127	162	203
	2x36=	72	1	2	3	6	10	16	20	25	32	40	50	63	81	101
	2x58=	118	0	1	1	3	6	10	12	15	20	25	31	39	50	63

Calculation: compensated fluorescent lighting example (delta connection)

$$\text{number} = \frac{(\text{rating} \times 0.8)\ (U \times 1.25)}{(P \times 1.25)} \times \frac{1.732}{3}$$

rating = rating of circuit breaker
P = power of tube
U = voltage

Table 3: high pressure discharge lamps
Table valid for 240V and 415V, with compensated or non-compensated ballast

mercury vapour + flourescent substance	rat. (A)
P ≤ 700W	**6**
P ≤ 1000W	**10**
P ≤ 2000W	**16**

mercury vapour + metallic halides	
P ≤ 375W	**6**
P ≤ 1000W	**10**
P ≤ 2000W	**16**

high pressure sodium vapour lamps	
P ≤ 400W	**6**
P ≤ 1000W	**10**

2.
C60 circuit breaker selection tables

type				C60a	C60N		C60H	
current rating (A)				6…63	1…63		1…63	
maximum voltage rating Ue (V)			AC	440				
			DC	60 V/pole				
min. voltage rating Ue min (V AC-DC)				12				
insulation voltage Ui (V)				500				
impulse voltage Uimp (kV)				6				
number of poles				1	1	2 3	1	2 3 4
breaking capacity AC								
AS/NZS 4898	Icn	240/415 V		4500	6000	6000	10000	10000
(A)	Ics	240/415 V		4500	6000	6000	7500	7500
AS 3947-2	Icu	130 V		10	20		30	
(kA)		240 V		5	10	20	15	30
		415 V		3	3	10	4	15
		440 V				6		10
	Ics			75 % Icu	75 % Icu		50 % Icu	
breaking capacity DC								
AS 3947-2	Icu	60 V (1P)		10	15		20	
(kA)[1]		125 V (2P)				20		25
		125 V (3P)				30		40
		250 V (4P)				40		50
fast closing				■	■	■	■	■
isolation with positive break indication				■	■	■	■	■
adaptable Vigi module						■		■
auxiliaries	OF, SD, OF+SD/OF			■	■	■	■	■
	MN, MNⓈ, MX-OF			■	■	■	■	■
	Tm			■	■	■	■	■
connection	screwdriver Ø (mm)			6.5 mm maximum blade (POSIDRIV No. 2)				
	tightening torque (N.m)			≤ 25 A: 2				
				≤ 63 A: 3.5				
	inlet dimension (mm)			H x L	Ø			
		≤ 25 A		8 x 6.9	(6.9)			
		≤ 63 A		8 x 8	(8.7)			
utilisation temperature (°C)				-5 to +60				
storage temperature (°C)				-40 to +70				
insulating material				self-extinguishing 960 °C				

[1] the number of poles participating in breaking is given between brackets

type			C60a		C60N			C60H		
thermal magnetic trip units			not interchangeable and not adjustable							
magnetic Im	curve		B	C	B	C	D	B	C	D
thermal In (A)		1				■		■	■	■
setting current at 30 °C		2				■		■	■	■
		4		■		■		■	■	■
		6		■		■		■	■	■
		10		■		■		■	■	■
		16		■		■		■	■	■
		20		■		■		■	■	■
		25		■		■		■	■	■
		32		■		■		■	■	■
		40		■		■		■	■	■
		50		■		■		■	■	■
		63		■		■		■	■	■

2.
C120 circuit breaker selection tables

type			C120N		C120H	
current rating (A)			63…125		10…125	
maximum voltage rating Ue (V)		AC	440			
		DC	125 V/pole			
minimum voltage rating Ue min (V AC-DC)			12			
insulation voltage Ui (V)			500			
impulse voltage Uimp (kV)			6			
number of poles			1	2 3 4	1	2 3 4
breaking capacity AC						
AS/NZS 4898 (A)	Icn	240/415 V	10000	10000	15000	15000
	Ics		7500		7500	
AS 3947-2 (kA)	Icu	130 V	20		30	
		230…240 V	10	20	15	30
		400…415 V	3(1)	10	4.5(1)	15
		440 V		6		10
	Ics		75 % Icu		50 % Icu	
breaking capacity DC						
AS 3947-2 (kA)(2)	Icu	125 V (1P)	15		25	
		125 V (2P)		25		30
		250 V (2P)		40		50
fast closing			■	■	■	■
isolation with positive break indication			■	■	■	■
adaptable Vigi module				■		■
auxiliaries	OF-SD, OF+SD/OF		■	■	■	■
	MN, MX-OF		■	■	■	■
	Tm		■	■	■	■
connection	screwdriver Ø (mm)		6.5 mm maximum blade (POSIDRIV No. 2)			
	tightening torque(N.m)		3.5			
	inlet dimension (mm)		H x L: 10 x 10			
utilisation temperature (°C)			-30 to +60			
storage temperature (°C)			-40 to +70			
insulating material			self-extinguishing 960 °C			

(1) 1-pole breaking capacity in the unearthed neutral IT system (double fault)
(2) the number of poles participating in breaking is given between brackets

type			C120N			C120H		
thermal magnetic trip units			not interchangeable and not adjustable					
magnetic Im	curve		B	C	D	B	C	D
thermal In (A)		10				■	■	■
setting current at 30 °C		16				■	■	■
		20				■	■	■
		25				■	■	■
		32				■	■	■
		40				■	■	■
		50				■	■	■
		63	■	■	■	■	■	■
		80	■	■	■	■	■	■
		100	■	■	■	■	■	■
		125	■	■	■	■	■	■

3.
technical data
C60-C120 Vigi module selection tables

type			Vigi C60	Vigi C120	
standard			AS 3190, AS3947-2, AS/NZS 61009 (EN 61009)		
class			**AC**	**AC**	
number of poles			2, 3, 4	2, 3, 4	
voltage rating Ue (V) at 50 Hz[1]			230…415 (+10, -20 %)		
current rating (A)			63	125	
sensitivity (IΔn) at 50 Hz (mA)		30	■	■	
instantaneous		300	■	■	
		500	■	■	
selective Ⓢ		300 Ⓢ	■		
resetting	simultaneous (by circuit-breaker)		■	■	
	separate		■	■	
utilisation temperature (°C)			-5, +60	-5, +60	
storage temperature (°C)			-40 to +70		
test button: minimum operating thresholds at 50 Hz (V)		130 V	102		
		230/415 V	176		
rated breaking and making capacity of the residual current device IΔm (EN 61009)			equal to the Icn of the associated circuit-breaker		
connection	screwdriver Ø		6.5 mm blade (POSIDRIV no. 2)		
	tightening torque (N.m)	≤ 25 A	2		3.5
		≤ 63 A	3.5		
terminal capacity (mm^2)		≤ 25 A	25		
Cu stranded cable		≤ 63 A	35		
		≤ 125 A			50

[1] other frequences, see 400 Hz table **page 34**

3.
technical data
auxiliary contacts and releases

OF 26924, SD 26927, OF + SD/OF 26929 auxiliary contacts

contact capacity (AS/NZS 3947-5)	AC	415 V	3
Ie (A)	cat. AC 12	240 V	6
	DC	24 V	6
	cat. DC 12	48 V	2
		60 V	1.5
		125 V	1.5

MX + OF 26946, 26947, 26949, MSU 26979, 26980 releases

catalogue number	**26946**				**26947**			**26948**	**26949**	**26979**	**26980**
	AC		**DC**		**AC**		**DC**	**AC DC**	**AC DC**	**AC**	**AC**
voltage (V) (+10, -20 %)	220	415	110	130	48	130	48	24	12	230	400
pick-up current (A)	0.20	0.30	0.07	0.07	0.46	1.5	0.23	5	1.7	0.2	0.3
control impulse duration (ms)	8									8	8
breaking time (ms)	20										
inrush power (VA)	50	120	10		22	200	22	120	20	50	120
minimum operating threshold (V)	80		60		30		20	16	5	285	285

MN 26960, 26961, 26962, MNS 26963 releases

catalogue number	**26960**	**26961**	**26962**	**26963**
	AC	**AC**	**DC**	**AC**
voltage (V)	220 240	48	48	220 240
hold current (A)	0.02 0.017	0.09	0.045	0.02 0.017
control circuit minimum opening time (ms)	3	3	3	200
power consumption (VA)	4.1	4.3	2	4.1
minimum pull-in voltage (V)	185	40	20	185
tripping voltage threshold (V)	between 0.35 and 0.70 Un			

operating temperature with power on (°C)		-20, +50
connection	screwdriver Ø (mm)	4 mm blade (POSIDRIV No. 1)
(2 x 2.5 mm^2 maxi)	tightening torque (N.m)	1

MNx 26969, 26971 releases

catalogue number	**26969**	**26971**
	AC	**AC**
voltage (V) (+10, -20 %)	230	400
pick-up current (A)	0.20	0.30
control impulse duration (ms)	8	
breaking time (ms)	20	
inrush power (VA)	50	120
operating threshold (V)	80	
hold current (A)	0.006	0.003
control circuit minimum opening time (ms)	3	3
power consumption (VA)	1.2	1.3
minimum pull-in voltage (V)	90	290
tripping voltage threshold (V)	tripping by pushbutton	
permanent consumption (VA)	1.4	1.7

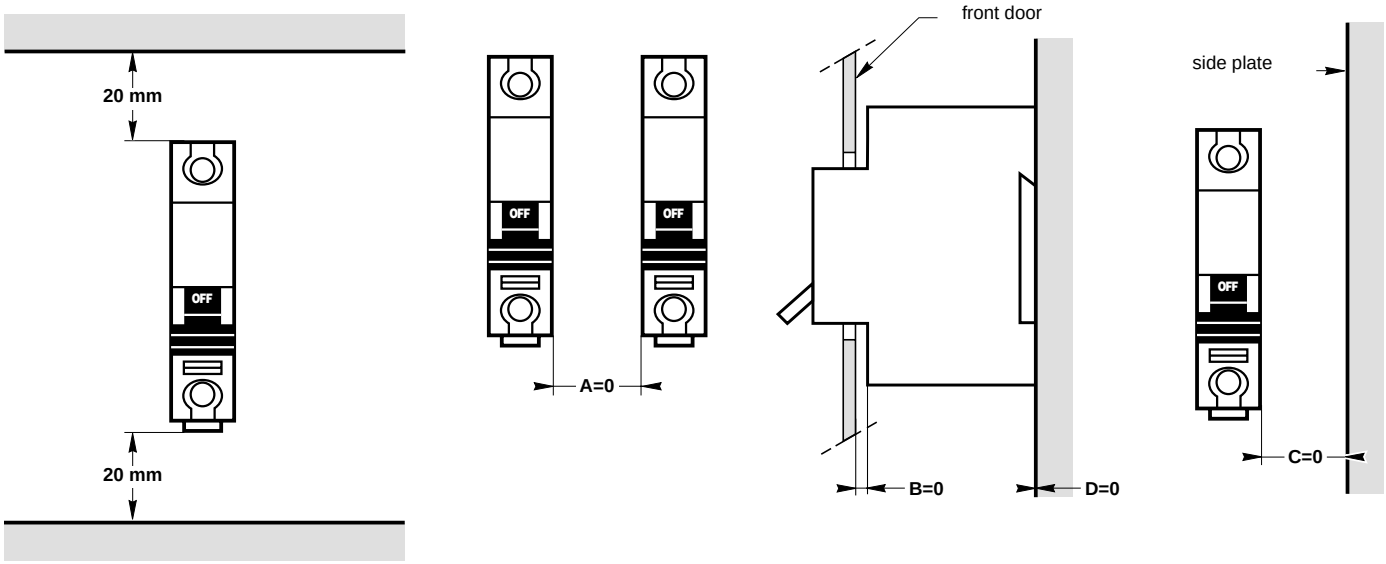
3.
technical data
utilisation limits-electrical clearances

utilisation limits

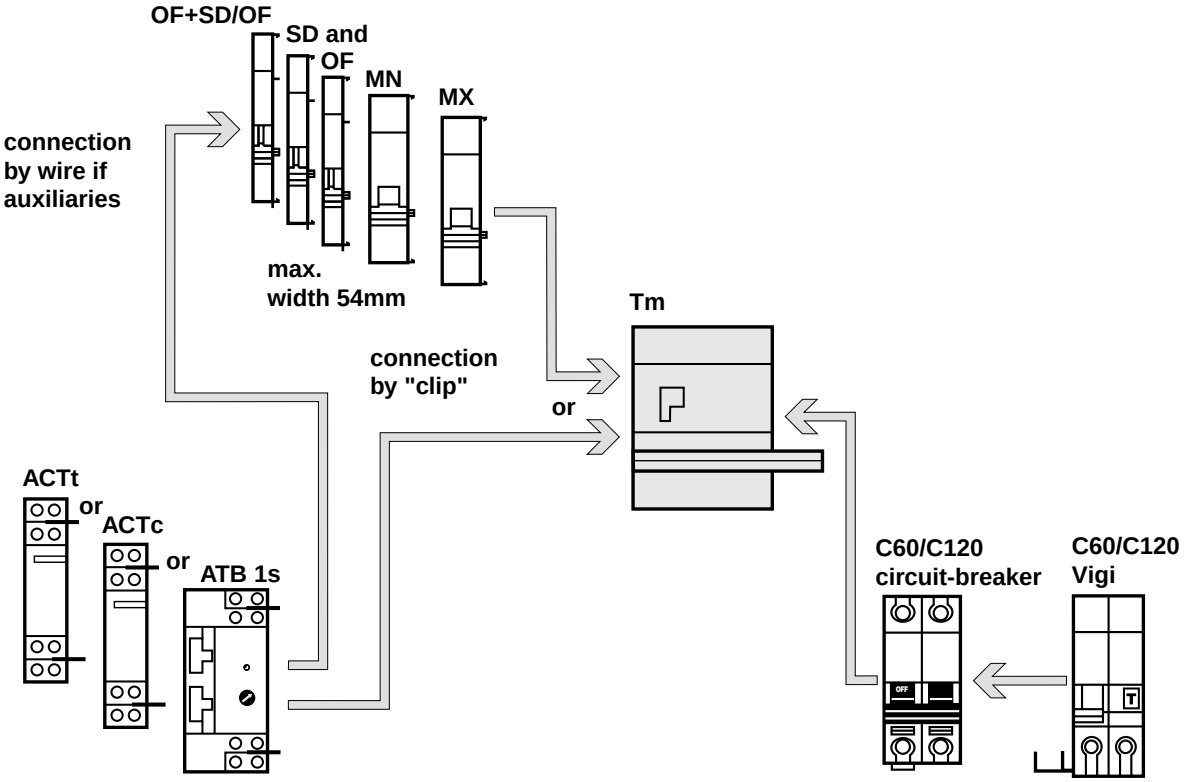
utilisation limits	C60/C120
vibrations (IEC 66826)	6 G
impacts (IEC 666-2-27)	30 G/11 ms

electrical clearances

blank metal plate



Tm remote control for C60/C120 combination rules



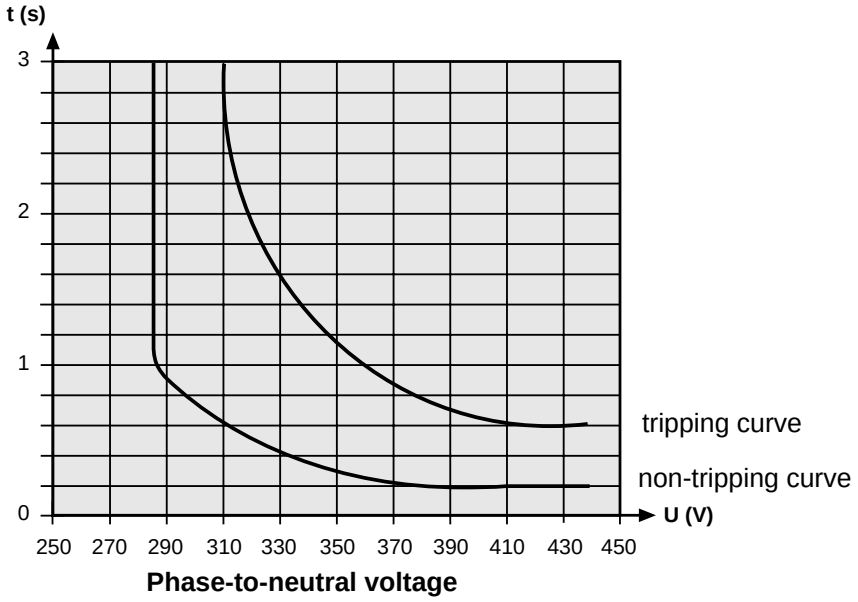
3.
technical data
MSU release

MSU voltage threshold release

associated with the DPN, C60 and C120 circuit-breaker or with the ID residual current circuit-breaker:

- causes tripping in event of network overvoltage linked to loss of the neutral upstream of the installation
- prevents reclosing until voltage drops to the normal threshold again.

tripping curve



automatic tripping values in event of overvoltage at power frequency between a phase and the neutral

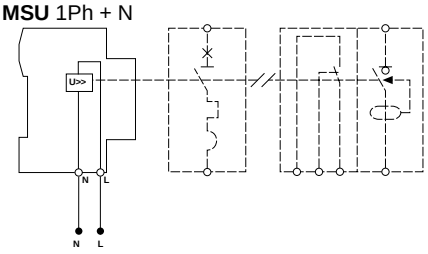
phase-to-neutral voltage (root mean square value in V)	minimum non-tripping time (in s)	maximum tripping time (in s)
≤285	no tripping	no tripping
310	0.6	2.5
360	0.4	1
410	0,2	0.6
440	0.2	0.6

application

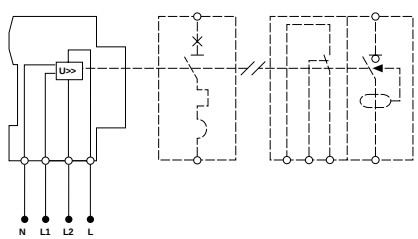
- remote opening of the electrical circuit by circuit-breaker tripping, should voltage rise for more than a few seconds.

connection

MSU 1Ph + N



MSU 3Ph + N



origin of the overvoltages

The MSU module detects overvoltages linked to breaking of the neutral, that may be caused by:

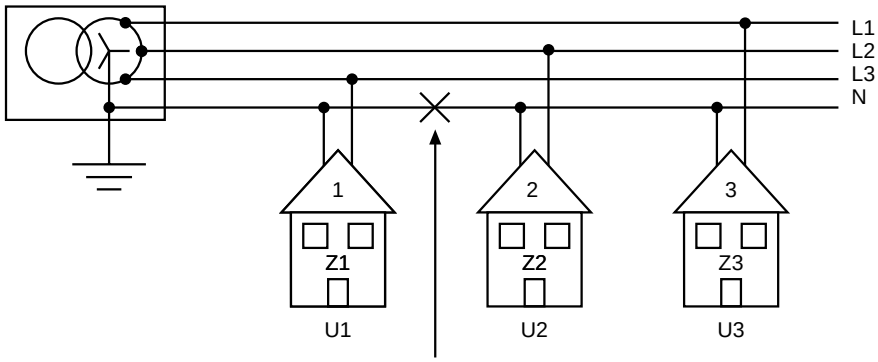
- presence of harmonics
- faulty connection
- operation or inspection accident

The appearance of voltages greater than nominal voltages in LV installations implies:

- device failure:
  - ☐ by temperature rise (reduction of lifetime)
  - ☐ by electrical breakdown (fire risk)
- safety and protection of users (load not supplied, but voltage present on phase).

Consideration of these concerns has led us to develop a specific module that opens the circuit-breaker or residual current circuit-breaker with which it is associated. This module allows continuous monitoring as close as possible to sensitive loads and areas.

diagram



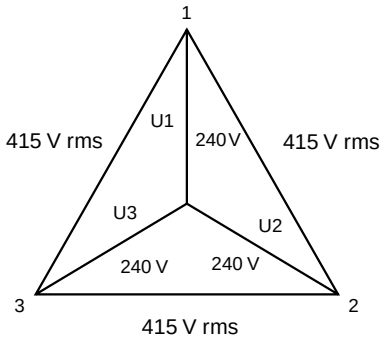
Should the neutral break, homes 2 and 3 are supplied with an artificial neutral, created by the downstream network.
Phase-to-neutral voltage is then distributed in the impedance ratio and may assume high values.

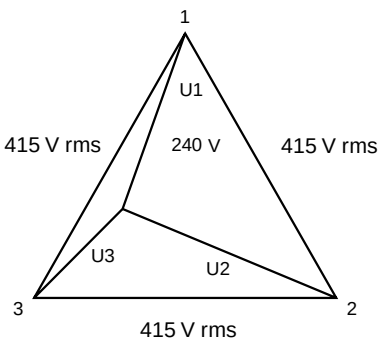
example

- in normal operation, each load (Z1, Z2, Z3) is supplied by a phase voltage
- should the neutral break, the loads (Z2 and Z3) will be serial-connected and supplied by U12 (mesh voltage equal to 400V)

There are then two possibilities:

- ☐ if Z2 = Z3 overvoltage does not occur and the load terminals are supplied with 230V
- ☐ if Z2 ≠ Z3 overvoltages and undervoltages occur



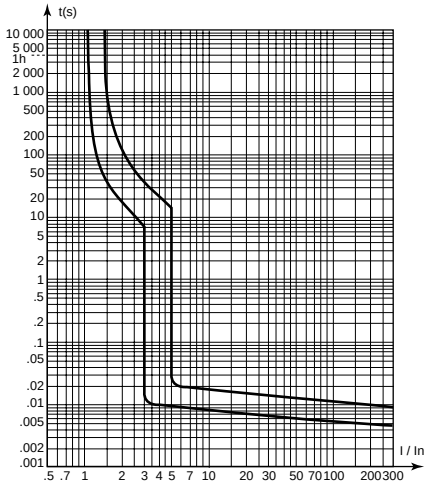


4.
tripping curves

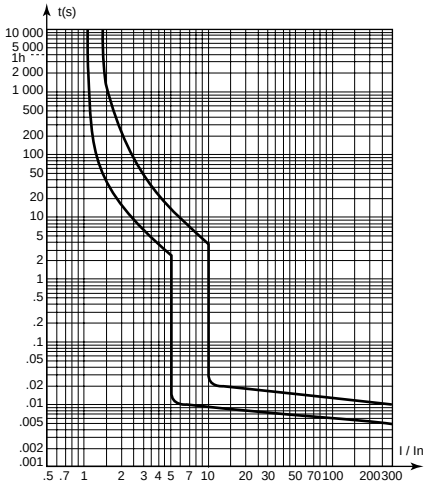
C60 circuit-breaker

B, C and D curves,
as in standard AS/NZS 4898
The operating range of the magnetic release is as follows:
■ for B curve: between 3 In and 5 In
■ for C curve: between 5 In and 10 In
■ for D curve: between10 In and14 In
The curves show the cold thermal tripping limits when poles are charged and the electromagnetic tripping limits with 2 charged poles.

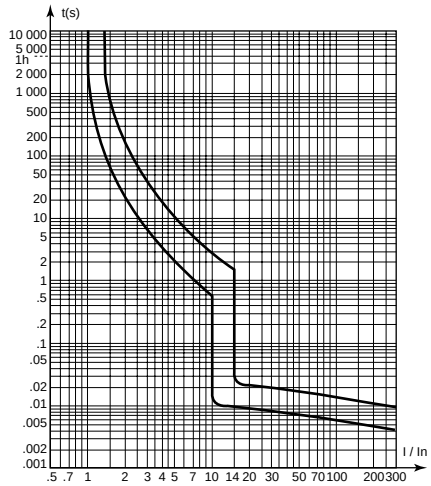
C60 B curve



C60 C curve



C60 D curve

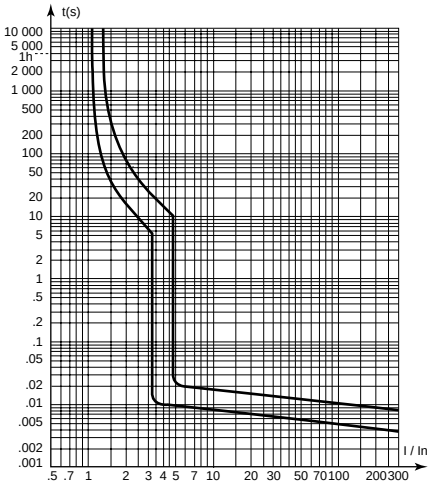


4.
tripping curves

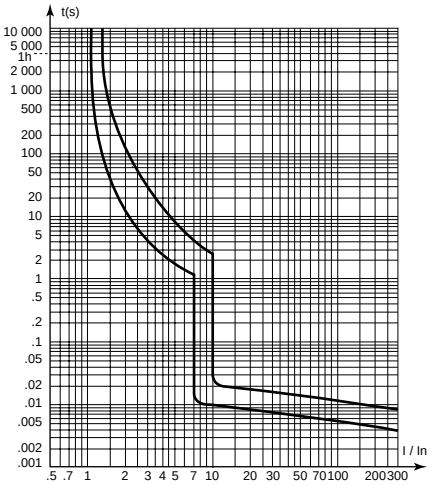
C60 circuit-breaker

B, C and D curves,
as in standard AS 3947.2
The operating range of the magnetic release is as follows:
■ for B curve: between 3.2 In and 4.8 In
■ for C curve: between 7 In and 10 In
■ for D curve: between 10 In and 14 In
The curves show the cold thermal tripping limits when poles are charged and the electromagnetic tripping limits with 2 charged poles.

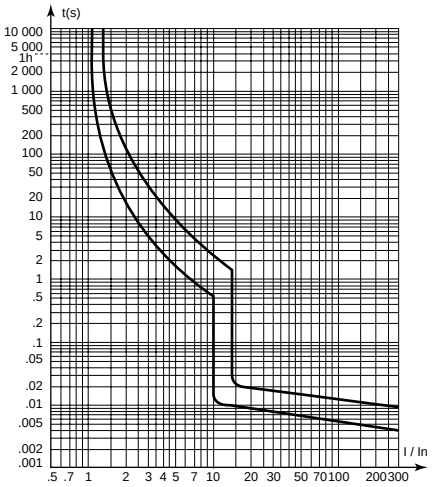
C60 B curve



C60 C curve



C60 D curve

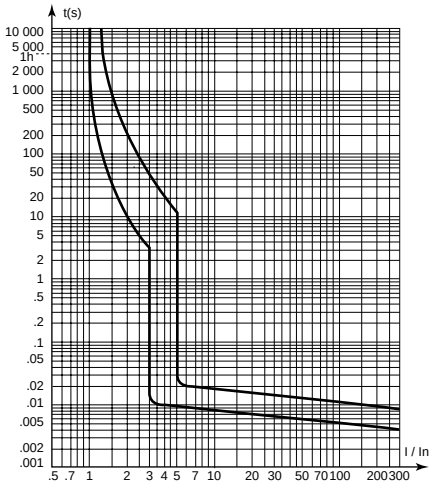


4.
tripping curves

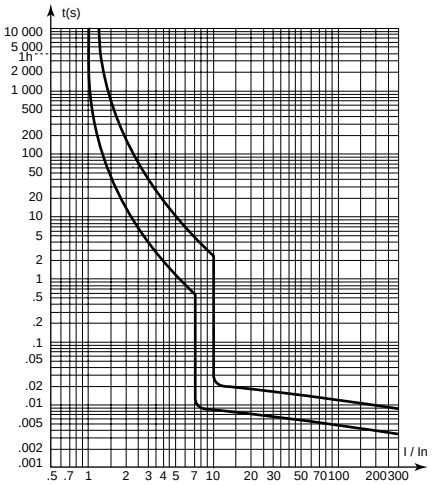
NC100 circuit-breaker

B, C, D and MA curves
as in standard AS 3947.2
The operating range of the magnetic release is as follows:
■ for B curve: between 3.2 In and 4.8 In
■ for C curve: between 7 In and 10 In
■ for D curve: between 10 In and 14 In
■ for MA curve: between 9.6 In and 14.4 In
The curves show the cold thermal tripping limits when poles are charged and the electromagnetic tripping limits with 2 charged poles.

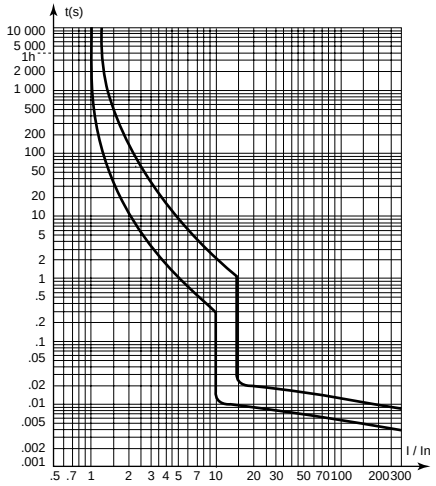
NC100 B curve



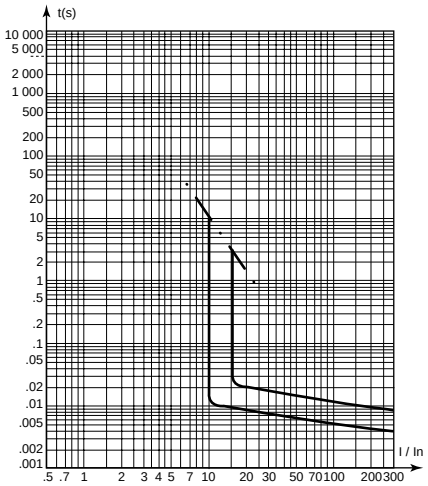
NC100 C curve



NC100 D curve



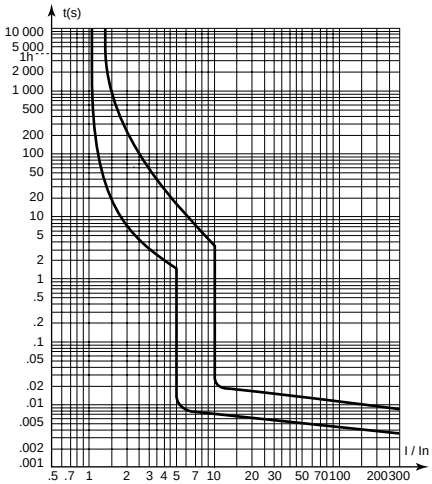
NC100 MA curve



DPN circuit-breaker

as in standard AS/NZS 4898
The operating range of the magnetic release is as follows:
■ for B curve: between 3 In and 5 In
■ for C curve: between 5 In and 10 In

DPN C curve (DPN Vigi)

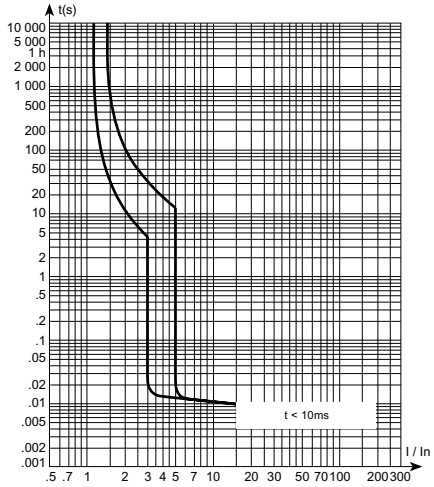


4.
tripping curves

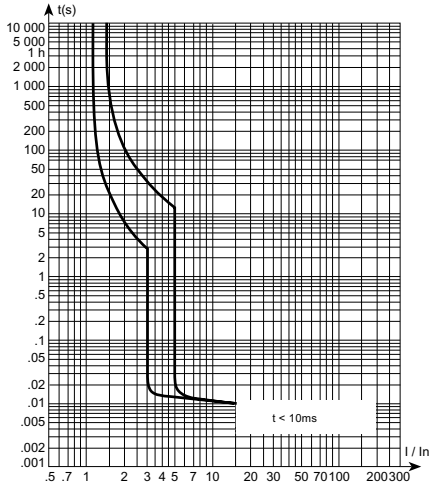
C120N, H circuit-breaker

B and C curve, as in standard AS/NZS 4898
D curve, as in standard AS 3947.2
The operating range of the magnetic release is as follows:
■ for B curve: between 3 In and 5 In
■ for C curve: between 5 In and 10 In
■ for D curve: between10 In and14 In
The curves show the cold thermal tripping limits when poles are charged and the electromagnetic tripping limits with 2 charged poles.

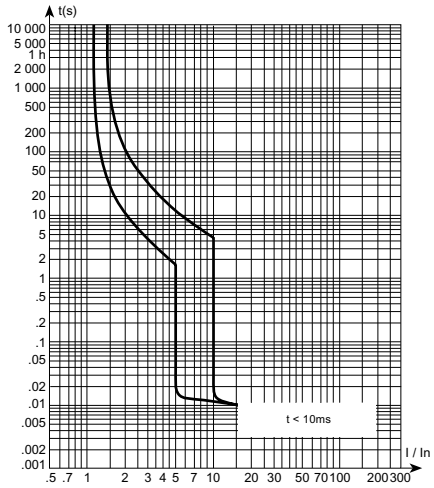
C120N B curve



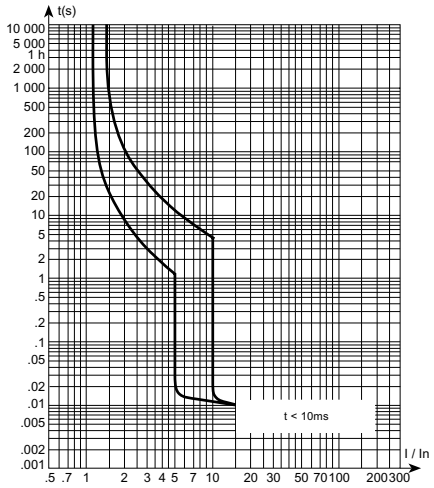
C120H B curve



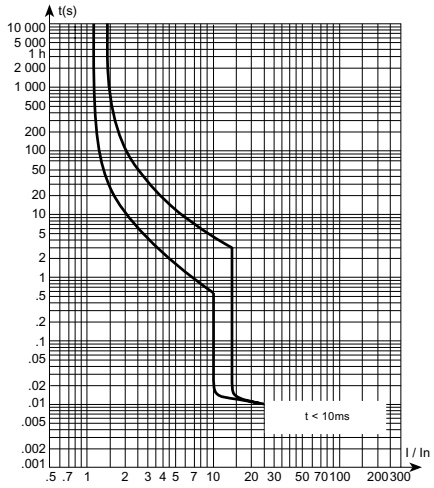
C120N C curve



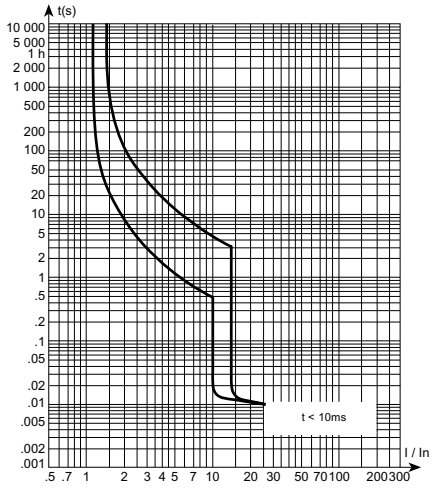
C120H C curve



C120N D curve



C120H D curve



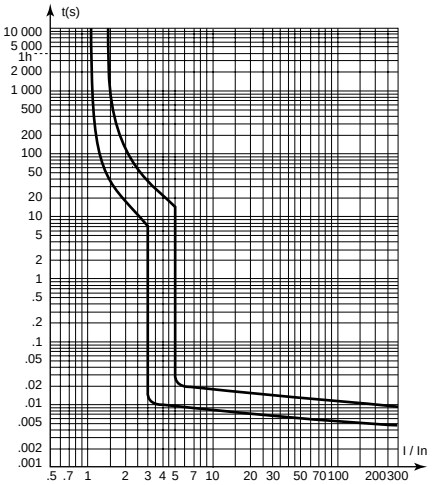
4.
tripping curves

NG125 circuit-breaker
80, 100 and 125 A

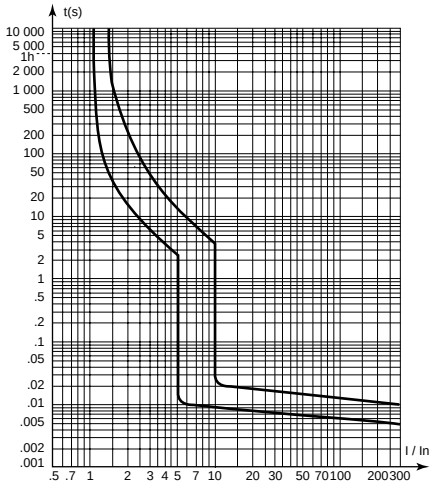
B, C and D curves
as in standard AS 3947.2
The operating range of the magnetic trip unit is as follows:
- for B curve: between 3 In and 5 In
- for C curve: between 5 In and 10 In
- for D curve: between 10 In and 14 In
- for MA curve: between 9.6 In and 14.4 In

The curves show the cold thermal tripping limits when poles are charged and the electromagnetic tripping limits with 2 charged poles.

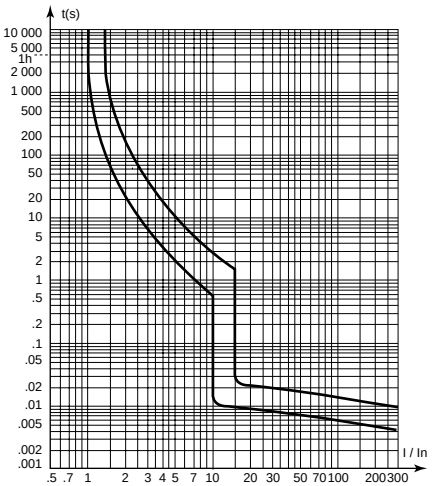
NG125 B curve



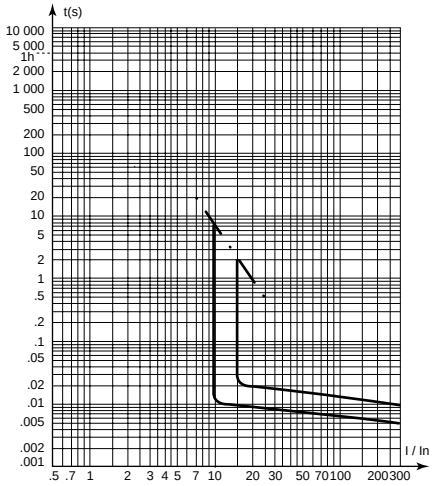
NG125 C curve



NG125 D curve



NG125 MA curve



4.
discrimination of earth leakage protection devices

tripping thresholds and discrimination of the multi 9 Vigi

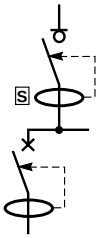
practical rule

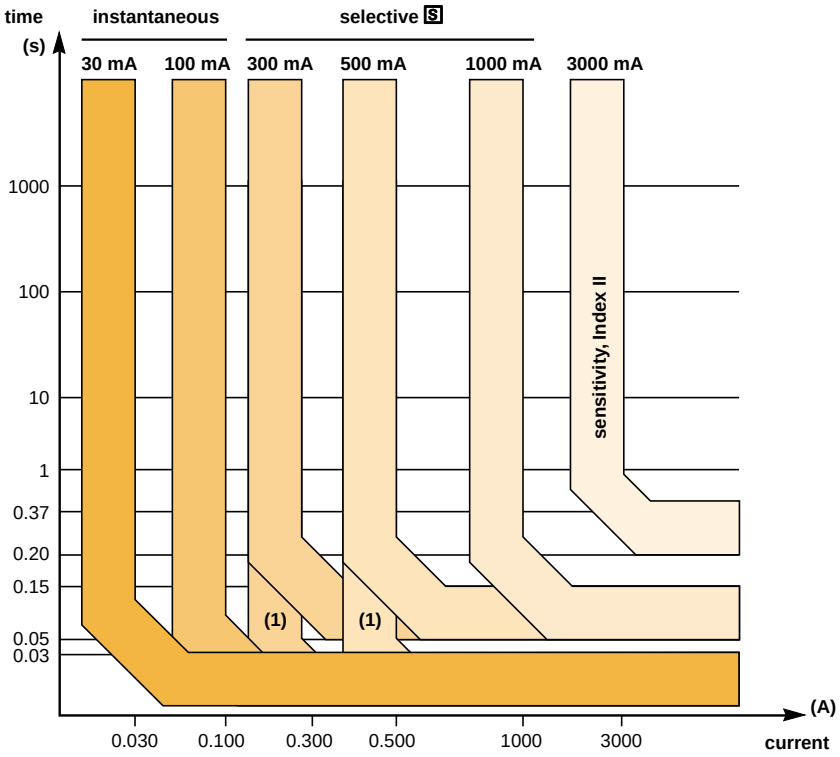
■ **sensitivity**

upstream IΔn > than downstream 2IΔn.

■ **time:**

upstream non-response time ≥ 1.2 times the total opening time of the downstream device.





(1) instantaneous version

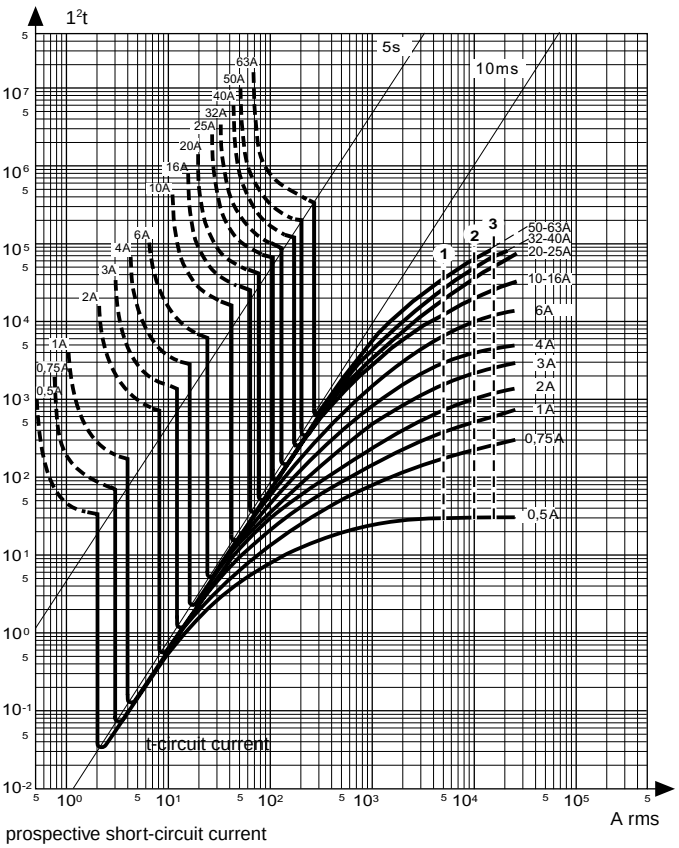
5.
thermal stress and peak current limitation curves

thermal stress limitation

C60a, N, H, L (B curve) 240/415 V

■ Ue:
□ 240 V with 1P
□ 415 V with 2, 3, 4P
■ circuit-breaker type in accordance with the mark:
□ 1: C60a
□ 2: C60N
□ 3: C60H

limited thermal stress



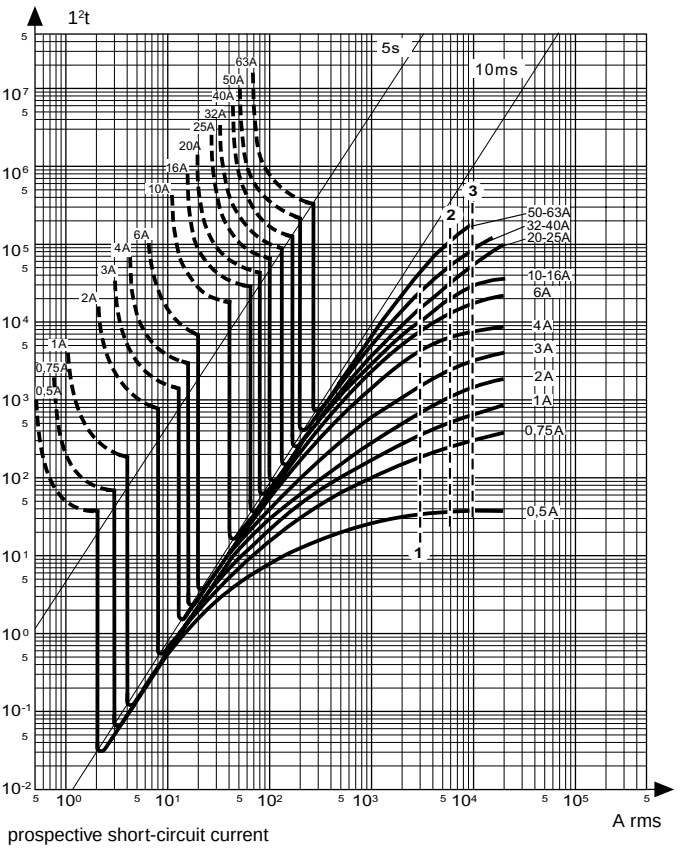
prospective short-circuit current

thermal stress limitation

C60a, N, H, L (B curve) 440 V

■ Ue:
□ 440 V with 2, 3, 4P
■ circuit-breaker type in accordance with the mark:
□ 1: C60a
□ 2: C60N
□ 3: C60H

limited thermal stress



prospective short-circuit current

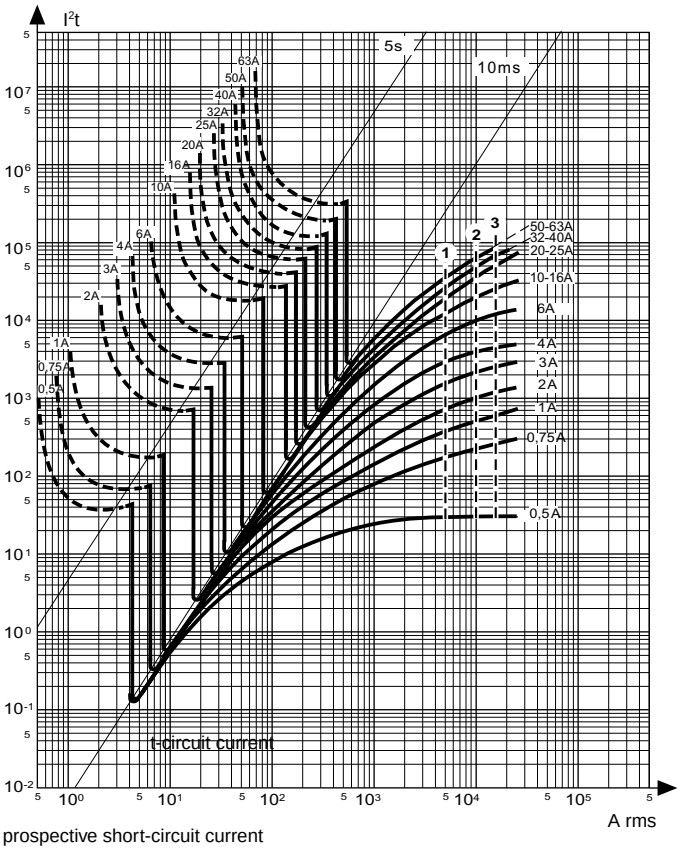
5.
thermal stress and peak current limitation curves

thermal stress limitation

C60a, N, H, L (C curve) 240/415 V

■ Ue:
□ 240 V with 1P
□ 415 V with 2, 3, 4P
■ circuit-breaker type in accordance with the mark:
□ 1: C60a
□ 2: C60N
□ 3: C60H

limited thermal stress



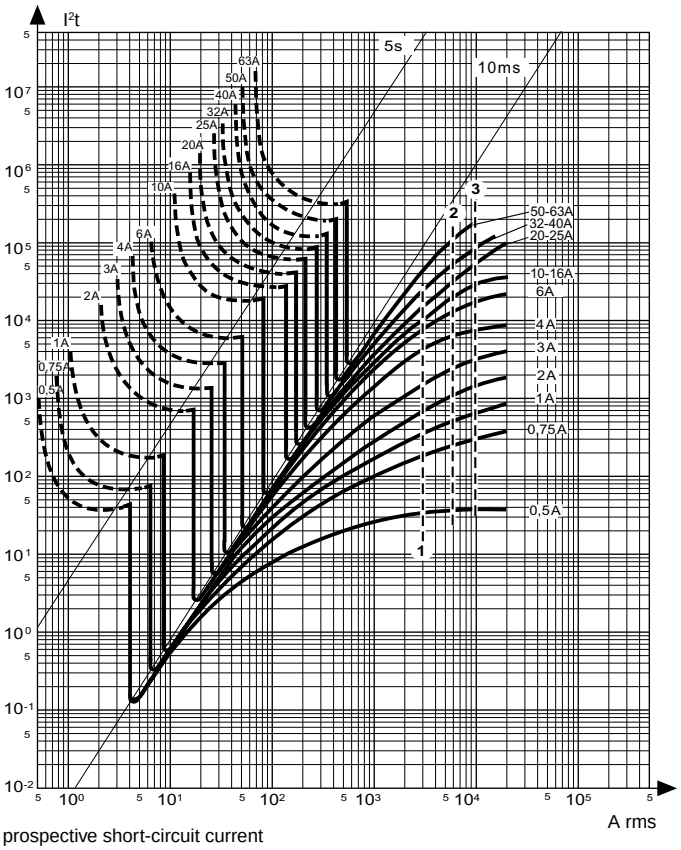
prospective short-circuit current

thermal stress limitation

C60a, N, H, L (C curve) 440 V

■ Ue:
□ 440 V with 2, 3, 4P
■ circuit-breaker type in accordance with the mark:
□ 1: C60a
□ 2: C60N
□ 3: C60H

limited thermal stress



prospective short-circuit current

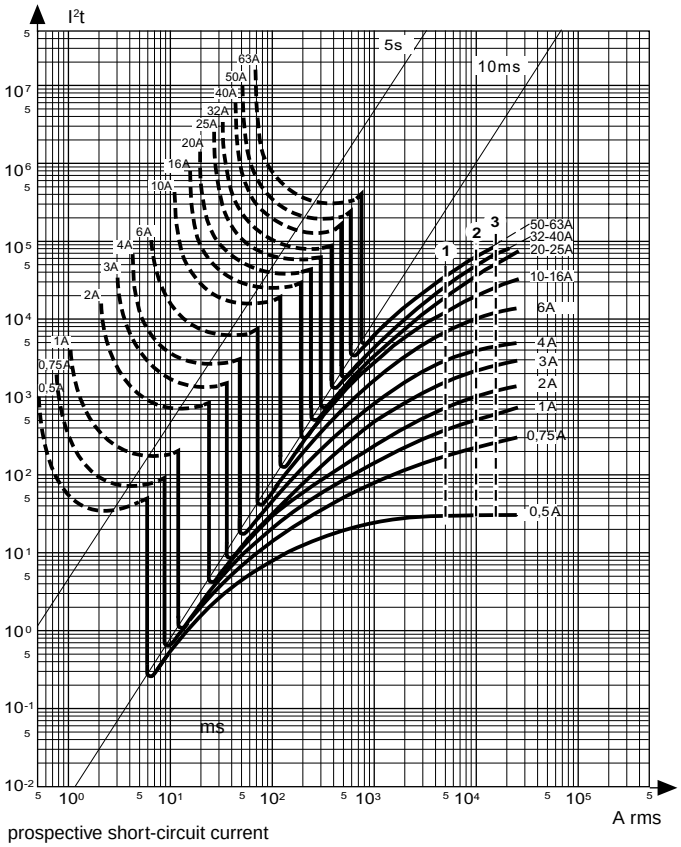
5.
thermal stress and peak current limitation curves

thermal stress limitation

C60a, N, H, L (D curve) 240/415 V

■ Ue:
□ 240 V with 1P
□ 415 V with 2, 3, 4P
■ circuit-breaker type in accordance with the mark:
□ 1: C60a
□ 2: C60N
□ 3: C60H

limited thermal stress



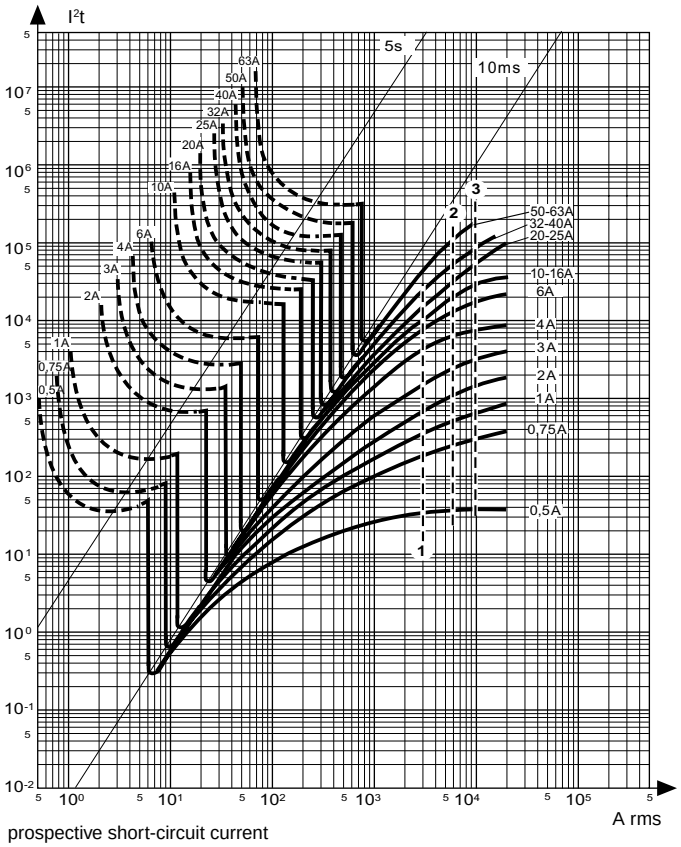
prospective short-circuit current

thermal stress limitation

C60a, N, H, L (D curve) 440 V

■ Ue:
□ 440 V with 2, 3, 4P
■ circuit-breaker type in accordance with the mark:
□ 1: C60a
□ 2: C60N
□ 3: C60H

limited thermal stress



prospective short-circuit current

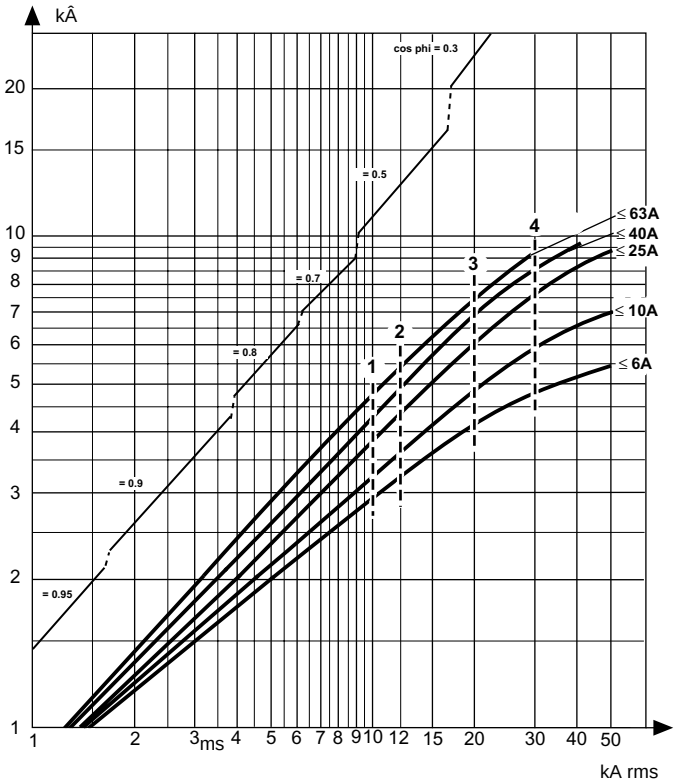
5.
thermal stress and peak current limitation curves

peak current limitation

C60a, N, H, L
240 V

■ Ue:
□ 240 V with 2, 3, 4P
■ circuit-breaker type in accordance with the mark:
□ 1: C60a
□ 2: C60N
□ 3: C60N-B
□ 4: C60H-C, D

limited peak current



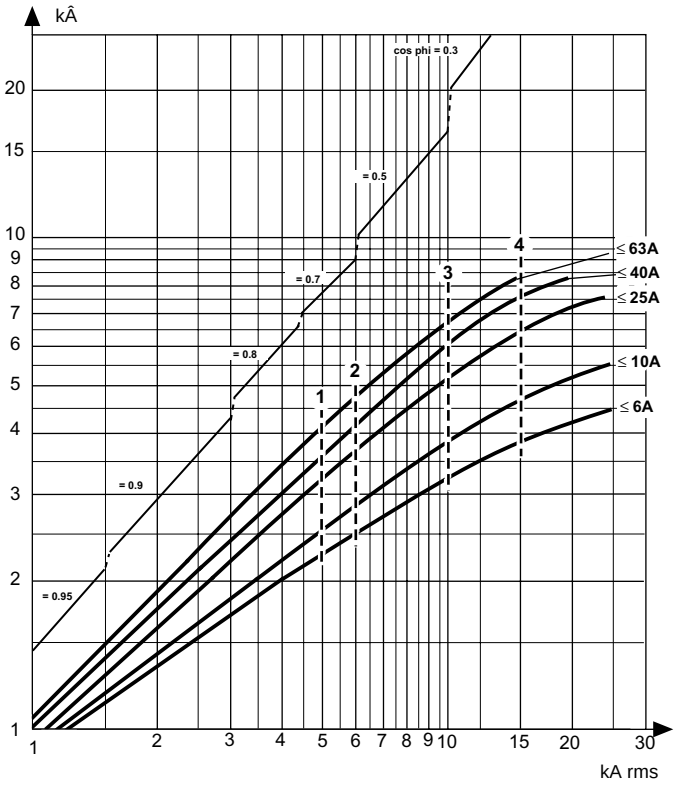
prospective short-circuit current

peak current limitation

C60a, N, H, L, LMA
240/415 V

■ Ue:
□ 240 V with 1P
□ 415 V with 2, 3, 4P
□ 415 V C60LMA with 2, 3P
■ circuit-breaker type in accordance with the mark:
□ 1: C60a
□ 2: C60N
□ 3: C60N
□ 4: C60H-D

limited peak current



prospective short-circuit current

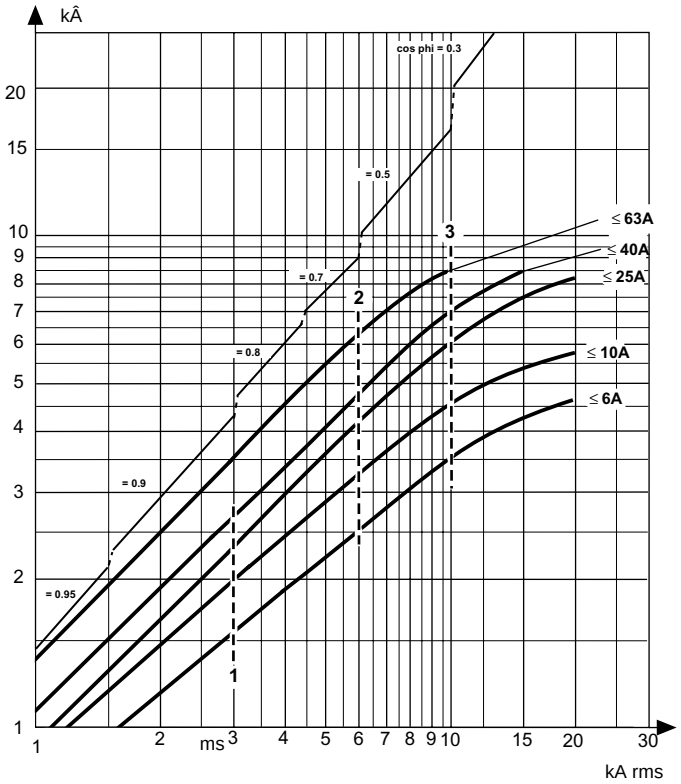
5.
thermal stress and peak current limitation curves

peak current limitation

C60a, N, H, L
440 V

■ Ue:
□ 440 V with 2, 3, 4P
■ circuit-breaker type in accordance with the mark:
□ 1: C60a
□ 2: C60N
□ 3: C60H

limited peak current



prospective short-circuit current

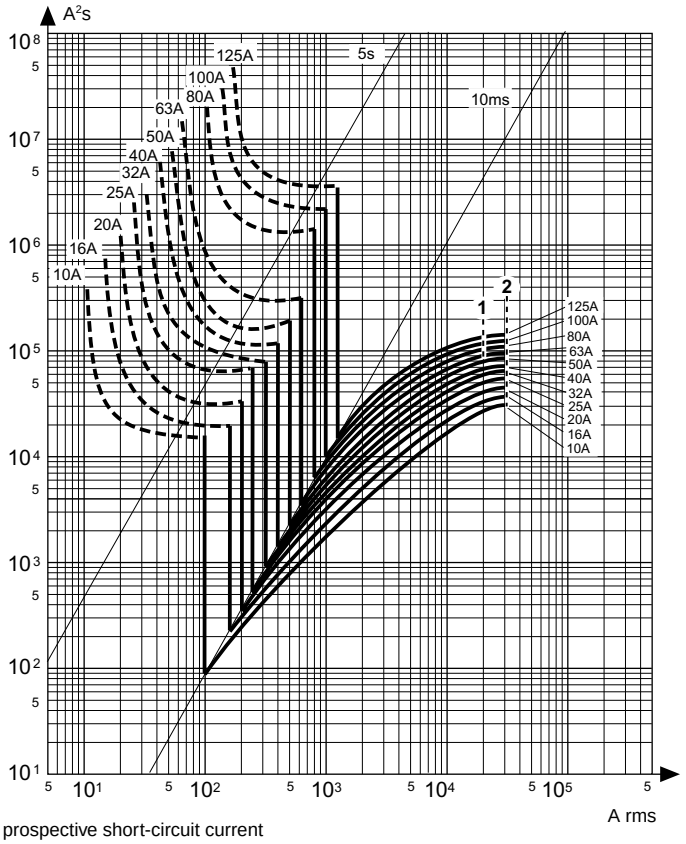
5.
thermal stress and peak current limitation curves

thermal stress limitation

C120N, H (C curve) 240 V

■ Ue:
□ 240 V with 2, 3, 4P
■ circuit-breaker type in accordance with the mark:
□ 1: C120N
□ 2: C120H

limited thermal stress



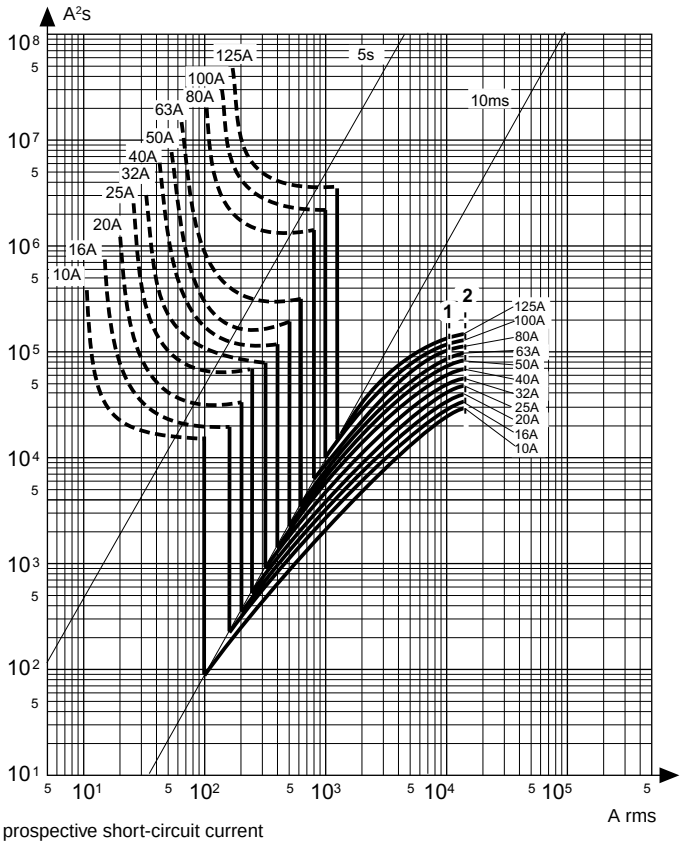
prospective short-circuit current

thermal stress limitation

C120N, H (C curve) 240/415 V

■ Ue:
□ 240 V with 1P
□ 415 V with 2, 3, 4P
■ circuit-breaker type in accordance with the mark:
□ 1: C120N
□ 2: C120H

limited thermal stress



prospective short-circuit current

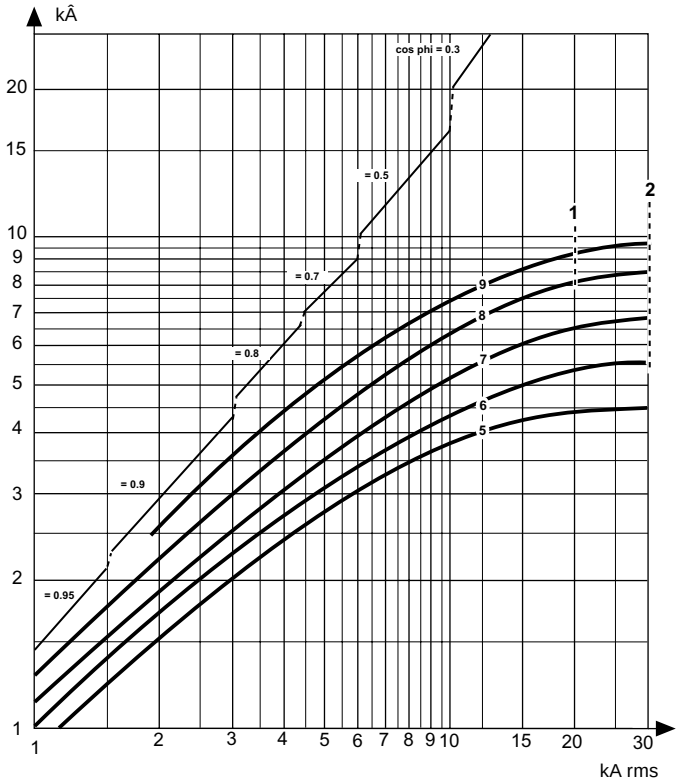
5.
thermal stress and peak current limitation curves

peak current limitation

C120N, H
240 V

■ Ue:
□ 240 V with 2, 3, 4P
■ circuit-breaker type in accordance with the mark:
□ 1: C120N
□ 2: C120H
□ 5: 10-16 A
□ 6: 20-25 A
□ 7: 32-40 A
□ 8: 50-63 A
□ 9: 80-100-125 A

limited peak current



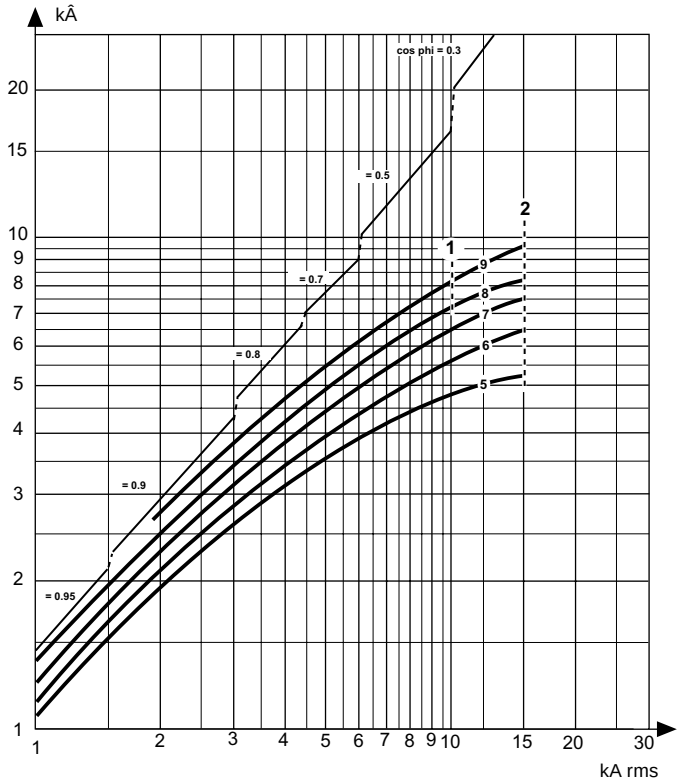
prospective short-circuit current

peak current limitation

C120N, H
240/415 V

■ Ue:
□ 240 V with 1P
□ 415 V with 2, 3, 4P
■ circuit-breaker type in accordance with the mark:
□ 1: C120N
□ 2: C120H
□ 5: 10-16 A
□ 6: 20-25 A
□ 7: 32-40 A
□ 8: 50-63 A
□ 9: 80-100-125 A

limited peak current



prospective short-circuit current

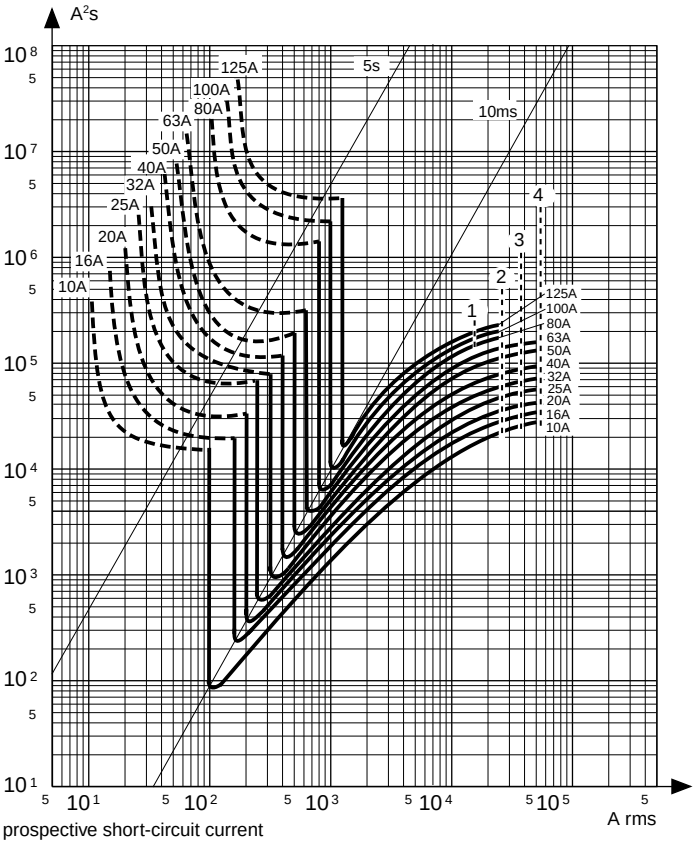
5.
thermal stress and peak current limitation curves

thermal stress limitation

NG125, N, H, L (C curve) 240 V

■ Ue:
□ 240 V with 2, 3, 4P
■ circuit-breaker type in accordance with the mark:
□ 1: NG125a 80-100-125 A
□ 2: NG125N
□ 3: NG125H
□ 4: NG125L

limited thermal stress

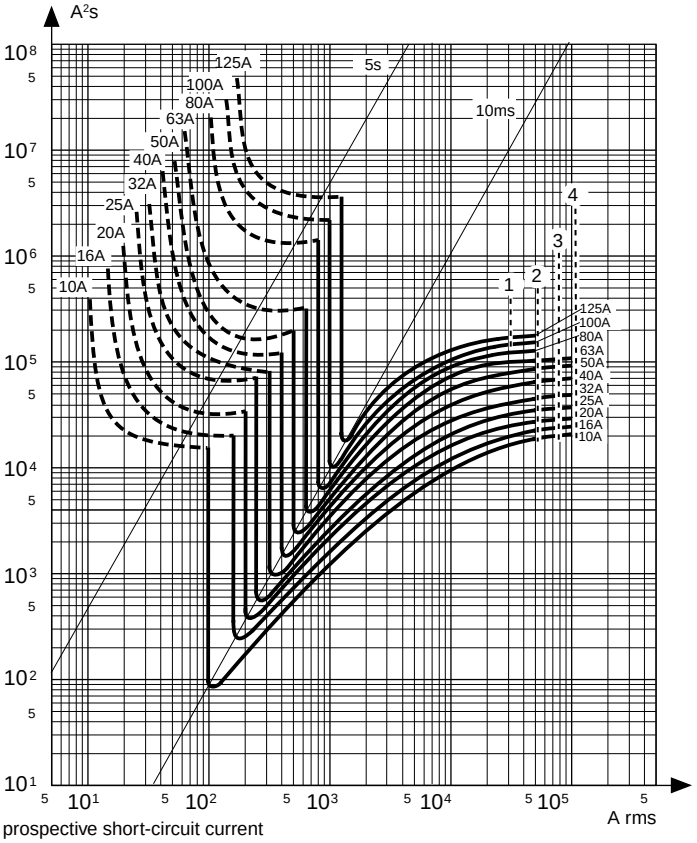


thermal stress limitation

NG125, N, H, L (C curve) 240/415 V

■ Ue:
□ 240 V with 1P
□ 415 V with 2, 3, 4P
■ circuit-breaker type in accordance with the mark:
□ 1: NG125a 80-100-125 A
□ 2: NG125N
□ 3: NG125H
□ 4: NG125L

limited thermal stress

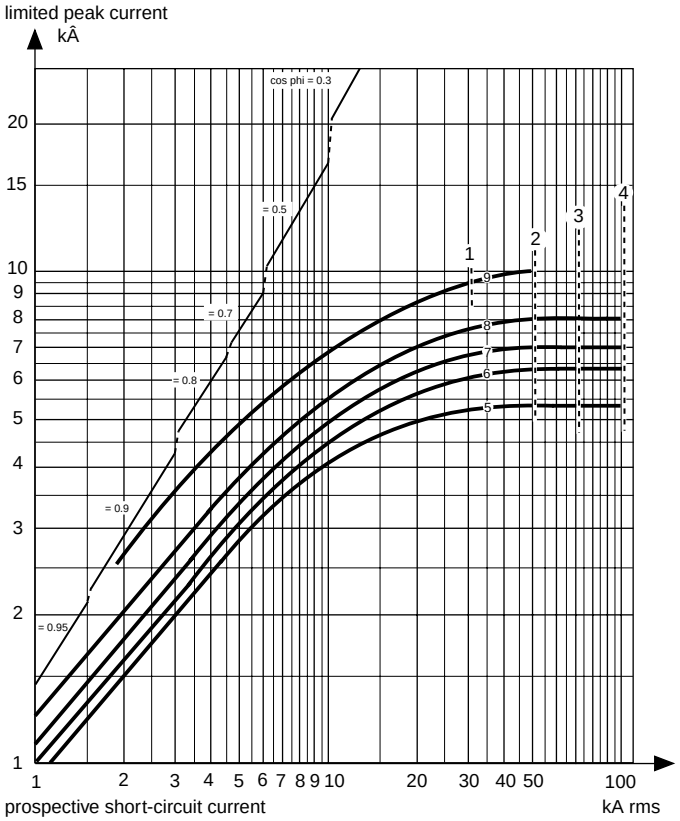


5.
thermal stress and peak current limitation curves

peak current limitation

NG125a, N, H, L 240 V

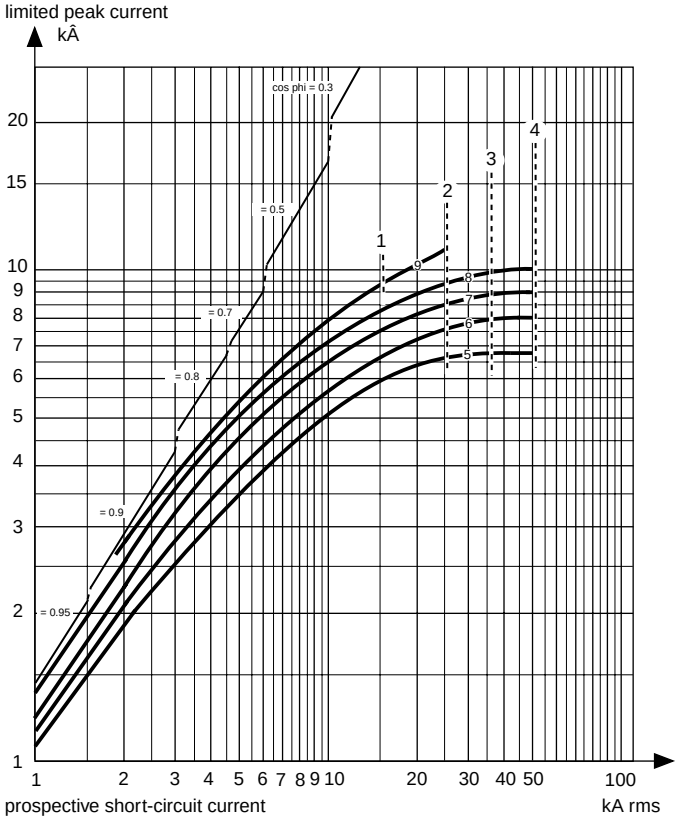
■ Ue:
□ 240 V with 2, 3, 4P
■ legend:
□ 1: NG125a
□ 2: NG125N
□ 3: NG125H
□ 4: NG125L
□ 5: 10-16 A
□ 6: 20-25 A
□ 7: 32-40 A
□ 8: 50-63 A
□ 9: 80-100-125 A



peak current limitation

NG125a, N, H, L 240/415 V

■ Ue:
□ 240 V with 1P
□ 415 V with 2, 3, 4P
■ legend:
□ 1: NG125a
□ 2: NG125N
□ 3: NG125H
□ 4: NG125L
□ 5: 10-16 A
□ 6: 20-25 A
□ 7: 32-40 A
□ 8: 50-63 A
□ 9: 80-100-125 A



6.
temperature derating

according to ambient temperature

The maximum permissible current in a circuit-breaker depends on the ambient temperature where the circuit-breaker is placed.

Ambient temperature is the temperature inside the enclosure or switchboard in which the circuit-breakers are installed.
The reference temperature is in the coloured column for the various circuit-breakers.

C60a, C60N, C60H: B and C curves

temperature (°C)	20	25	30	35	40	45	50	55	60
rating (A)									
1	1.05	1.02	**1.00**	0.98	0.95	0.93	0.90	0.88	0.85
2	2.08	2.04	**2.00**	1.96	1.92	1.88	1.84	1.80	1.74
3	3.18	30.9	**3.00**	2.91	2.82	2.70	2.61	2.49	2.37
4	4.24	4.12	**4.00**	3.88	3.76	3.64	3.52	3.36	3.24
6	6.24	6.12	**6.00**	5.88	5.76	5.64	5.52	5.40	5.30
10	10.6	10.3	**10.0**	9.70	9.30	9.00	8.60	8.20	7.80
16	16.8	16.5	**16.0**	15.5	15.2	14.7	14.2	13.8	13.3
20	21.0	20.6	**20.0**	19.4	19.0	18.4	17.8	17.4	16.8
25	26.2	25.7	**25.0**	24.2	23.7	23.0	22.2	21.5	20.7
32	33.5	32.9	**32.0**	31.4	30.4	29.8	28.4	28.2	27.5
40	42.0	41.2	**40.0**	38.8	38.0	36.8	35.6	34.4	33.2
50	52.5	51.5	**50.0**	48.5	47.4	45.5	44.0	42.5	40.5
63	66.2	64.9	**63.0**	61.1	58.0	56.7	54.2	51.7	49.2

C60H: D curve

temperature (°C)	20	25	30	35	40	45	50	55	60
rating (A)									
1	1.10	1.08	1.05	1.03	**1.00**	0.97	0.95	0.92	0.89
2	2.18	2.14	2.08	2.04	**2.00**	1.96	1.90	1.86	1.80
3	3.42	3.30	3.21	3.12	**3.00**	2.88	2.77	2.64	2.52
4	4.52	4.40	4.24	4.12	**4.00**	3.88	3.72	3.56	3.44
6	6.48	6.36	6.24	6.12	**6.00**	5.88	5.76	5.58	5.46
10	11.4	11.1	10.7	10.4	**10.0**	9.60	9.20	8.80	8.40
16	17.9	17.4	16.9	16.4	**16.0**	15.5	15.0	14.4	13.9
20	22.2	21.6	21.2	20.6	**20.0**	19.4	18.8	18.2	17.6
25	27.7	27.0	26.5	25.7	**25.0**	24.2	23.5	22.7	21.7
32	35.2	34.2	33.6	32.9	**32.0**	31.0	30.4	29.4	28.4
40	44.4	43.6	42.4	41.2	**40.0**	38.8	37.6	36.4	34.8
50	56.0	54.5	53.0	51.5	**50.0**	48.5	46.5	45.0	43.0
63	71.8	69.9	67.4	65.5	**63.0**	60.4	57.9	55.4	52.9

6.
temperature derating

according to ambient temperature (continued)

DPN Vigi

temperature (°C)	20	25	30	35	40	45	50	55	60
rating (A)									
1	1.04	1.02	**1**	0.98	0.96	0.93	0.91	0.89	0.86
2	2.08	2.04	**2**	1.96	1.91	1.87	1.82	1.77	1.72
3	3.16	30.8	**3**	2.92	2.83	2.75	2.66	2.57	2.47
6	6.26	6.13	**6**	5.87	5.73	5.60	5.45	5.31	5.16
10	10.5	10.2	**10**	9.75	9.49	9.23	8.96	8.67	8.38
16	16.8	16.4	**16**	15.6	16.2	14.8	14.3	14.9	13.4
20	21	20.5	**20**	19.5	19	18.5	17.9	17.4	16.8
25	26.1	25.5	**25**	24.4	23.9	23.3	22.7	22.1	21.4
32	33.4	32.7	**32**	31.2	30.5	29.7	28.9	28	27.1
40	41.6	41.8	**40**	39.2	38.3	37.4	36.5	35.6	34.6

C32H - DC

temperature (°C)	20	25	30	35	40	45	50	55	60
rating (A)									
1	1.1	1.1	1	1	**1**	0.95	0.9	0.9	0.9
2	2.2	2.2	2.1	2.1	**2**	1.95	1.9	1.8	1.7
3	3.3	3.3	3.2	3.1	**3**	2.9	2.8	2.7	2.6
6	6.6	6.5	6.3	6.1	**6**	5.8	5.7	5.5	5.3
10	11	10.7	10.5	10.3	**10**	9.7	9.5	9	8.5
16	17.6	17.4	17	16.5	**16**	15.4	15	14.4	13.9
20	22	21.5	21	20.5	**20**	19.5	19	18.5	18
25	27.5	27	26	25.5	**25**	24	23.5	23	22
32	35.5	35	34	33	**32**	31	30	29	28
40	44.5	43.5	42.5	41	**40**	38.5	37	36	34

NG125

temperature (°C)	20	25	30	35	40	45	50	55	60
rating (A)									
10	11	10.75	10.5	10.25	**10**	9.75	9.5	9.25	9
16	17.6	17.2	16.8	16.4	**16**	15.6	15.2	14.8	14.4
20	22	21.5	21	20.5	**20**	19.5	19	18.5	18
25	27.5	26.87	26.25	25.62	**25**	24.37	23.75	23.12	22.5
32	35.2	34.4	33.6	32.8	**32**	31.2	30.4	29.6	28.8
40	44	43	42	41	**40**	39	38	37	36
50	55	53.75	52.5	51.25	**50**	48.75	47.5	46.25	45
63	69.3	67.72	66.15	64.57	**63**	61.42	59.85	58.27	56.7
80	88	86	84	82	**80**	78	76	74	72
100	110	107.5	105	102.5	**100**	97.5	95	92.5	90
125	137.5	134.3	131.2	128.1	**125**	121.8	118.7	121.8	112.5

6.
temperature derating

according to ambient temperature (continued)

C120
according AS/NZS 4898

temperature (°C)	20	25	30	35	40	45	50	55	60
rating (A)									
10	10.8	10.4	**10**	9.6	9.2	8.7	8.2	7.7	7.2
16	17.0	16.5	**16**	15.5	14.9	14.3	13.7	13.1	12.4
20	21.5	20.7	**20**	19.2	18.4	17.6	16.7	15.7	14.8
25	27.3	26.2	**25**	23.7	22.4	21.0	19.5	17.8	16.0
32	34.3	33.2	**32**	30.8	29.5	28.2	26.8	25.4	23.8
40	43.3	41.7	**40**	38.3	36.4	34.5	32.5	30.3	28.0
50	54.4	52.2	**50**	47.7	45.2	42.6	39.8	36.9	33.6
63	68.1	65.6	**63**	60.3	57.5	54.5	51.3	48.0	44.4
80	85.9	83.0	**80**	76.9	73.6	70.2	66.6	62.8	58.7
100	109.1	104.7	**100**	95.1	90.0	84.5	78.7	72.4	65.4
125	136.7	131.0	**125**	118.7	112.1	105.0	97.4	89.2	80.1

according AS 3947

temperature (°C)	20	25	30	35	40	45	50	55	60
rating (A)									
10	11.7	11.3	11	10.5	**10.0**	9.5	9.0	8.4	7.8
16	18.6	18.0	17	16.9	**16.3**	15.6	15.0	14.3	13.6
20	23.4	22.6	22	21.0	**20.1**	19.2	18.2	17.2	16.1
25	29.8	28.6	27	25.9	**24.4**	22.9	21.2	19.4	17.5
32	37.4	36.2	35	33.6	**32.2**	30.8	29.2	27.7	26.0
40	47.2	45.4	44	41.7	**39.7**	37.6	35.4	33.0	30.5
50	59.3	56.9	55	52.0	**49.3**	46.4	43.4	40.2	36.7
63	74.2	71.5	69	65.7	**62.6**	59.4	56.0	52.3	48.4
80	93.7	90.5	87	83.8	**80.2**	76.5	72.6	68.4	64.0
100	118.9	114.1	109	103.7	**98.1**	92.1	85.7	78.9	71.3
125	149.0	142.8	136	129.4	**122.1**	114.4	106.2	97.2	87.3

residual current circuit-breakers

The thermal (overload) protection device placed upstream of the residual current circuit-breaker must take into account the values listed in the table below.

temperature (°C)	25	30	40	50	60
rating (A)					
25	32	30	**25**	23	20
40	46	44	**40**	36	32
63	75	70	**63**	56	50
80	95	90	**80**	72	65
100	123	120	**100**	105	90
125	135	133	**125**	128	110

according to the installation mode

When several simultaneously operating circuit-breakers are mounted side by side in a small enclosure, the temperature rise inside the enclosure causes a reduction in current rating. You must then assign the rating (already derated if necessary according to ambient temperature) a downrating factor of 0.8.

6.
temperature derating

example

According to the ambient temperature and installation mode, the table below shows how to determine for a C60a:
■ the service currents not to exceed for a 20 A rating (reference temperature: 30 °C)
■ the ratings to be chosen (in bold) to allow a 20 A service current.

service current not to exceed (A)

Installation conditions		C60 only		Several C60a in the same enclosure (calculate using the downrating factor given below)	
temperature (°C)		30 °C	40 °C	30 °C	40 °C
	nominal rating (A)	**real rating (A)**	**real rating (A)**	**real rating (A)**	**real rating (A)**
C60a	20	20	19	20 x 0.8 = 16	19 x 0.8 = 15.2
	25	25	23.7	25 x 0.8 = 20	23.7 x 0.8 = 18.96
	32	32	30.4	32 x 0.8 = 25.6	30 x 0.8 = 24

6.
power loss
circuit breakers and switches

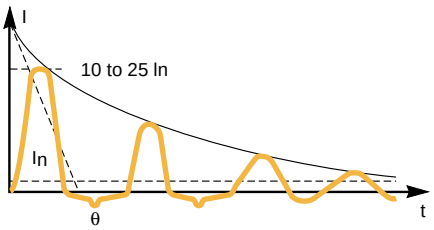
How much power is lost per pole?

The table below gives the power loss of the devices in Watts for each rating, per pole, for the rated current:

rating	1	1.6	2	2.5	3	4	6	6.3	10	12.5	16	20	25	32	40	50	63	80	100	125	
circuit-breakers																					
DPN							2		3		3.4		3.7	4.7							
C60	2.3		2.5		2.4	2.4	3		2		2.6		2.9	3	3.5	4.6	4.5	6.6			
C120									1.7		2.3	2.65	2.7	3.8	3.6	4.5	4.8	4.5	6	8	
NG125									2		2.5	3	3.2	3.5	4	4.7	5.5	6	7	9	
NG125LMA		1.5		3		3		2	2		2.5	3	3.2	3.5	4	4.7	5.5	6	7	9	
switches																					
NG125NA																		5.5	6	7	9

7.
protection of LV/LV transformers

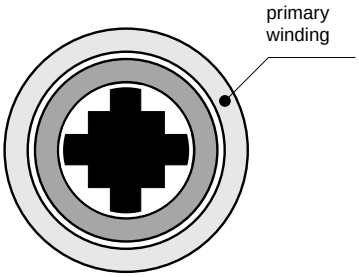
current inrushes on energisation



On energisation of LV/LV transformers, very high current inrushes occur which must be taken into consideration when choosing the overcurrent protection device.
The peak value of the first current wave frequently reaches 10 to 15 times the transformer rated rms current and may, even for powers less than 50 kVA, reach values 20 to 25 times the rated current. This transient switch-on current is damped in a few milliseconds.

The transformers used for testing are standardised devices. Their main technical data are reviewed in the tables overleaf. These tables, drawn up for a primary supply voltage of 400 V or 230 V, for three-phase or single-phase transformers, indicate the circuit-breaker (type and rating) to be used according to transformer power. They correspond to the most frequent case where the primary winding is wound outside (1).

choice of protection



Merlin Gerin has carried out an extensive series of tests in order to optimise LV/LV transformer protection. The circuit-breakers proposed in the tables overleaf enable:
- the transformer to be protected against abnormal overloads.
- nuisance tripping to be prevented on energisation of the primary winding.
- the circuit-breaker to retain its electrical durability.

(1) Please consult us for all other cases.
For transformers with a ratio of 1 and a power < 5 kVA, in the event of nuisance tripping of the upstream circuit-breaker, before moving to the circuit-breaker's higher rating, reverse the power supply and the load (switch-on current varies from simple to double according to whether the primary winding is wound inside or outside).

7.
protection of LV/LV transformers

three-phase transformers
(400 V primary)

transformer		D curve circuit-breaker		
P (kVA)	In (A)	Usc (%)	type	rating or trip unit
5	7.9	4.9	C60 / NC100 / C120 / NG125	10
6.3	9	4.9	C60 / NC100 / C120 / NG125	16
8	11.5	4.3	C60 / NC100 / C120 / NG125	20
10	14.4	5.9	C60 / NC100 / C120 / NG125	25
12.5	18	5.2	C60 / NC100 / C120 / NG125	32
16	23	4.9	C60 / NC100 / C120 / NG125	40
20	29	5.6	C60 / NC100 / C120 / NG125	40
25	36	5.3	C60 / NC100 / C120 / NG125	50
31.5	45.4	5	NC100 / C120 / NG125	63
40	57.7	5	NC100 / C120 / NG125	80
50	72.1	5	NC100 / C120 / NG125	100
63	108	5	C120 / NG125	125

three-phase transformers
(230 V primary)

transformer		D curve circuit-breaker		
P (kVA)	In (A)	Usc (%)	type	rating or trip unit
5	12.5	4.9	C60 / NC100 / C120 / NG125	20
6.3	15.8	4.9	C60 / NC100 / C120 / NG125	25
8	20	4.3	C60 / NC100 / C120 / NG125	32
10	25	5.9	C60 / NC100 / C120 / NG125	40
12.5	31	5.2	C60 / NC100 / C120 / NG125	40
16	40	4.9	C60 / NC100 / C120 / NG125	50
20	50.2	5.6	C60 / NC100 / C120 / NG125	63
25	62.7	5.3	NC100 / C120 / NG125	80
32	80	5.3	C120 / NG125	100

single-phase transformers
(400 V primary)

transformer		D curve circuit-breaker		
P (kVA)	In (A)	Usc (%)	type	rating or trip unit
1	5	5.2	C60	6
1.6	4	4	C60 / NC100 / C120 / NG125	10
2.5	6.25	3	C60 / NC100 / C120 / NG125	16
4	10	2.1	C60 / NC100 / C120 / NG125	20
5	12.5	1.9	C60 / NC100 / C120 / NG125	32
6.3	15.7	5	C60 / NC100 / C120 / NG125	40
8	20	5	C60 / NC100 / C120 / NG125	50
10	25	5	C60 / NC100 / C120 / NG125	63
12.5	31.2	5	C60 / NC100 / C120 / NG125	63
16	40	4.5	NC100 / C120 / NG125	80
20	50	4.5	NC100 / C120 / NG125	100
25	62.7	5.3	C120 / NG125	125

single-phase transformers
(230 V primary)

transformer		D curve circuit-breaker		
P (kVA)	**In (A)**	**Usc (%)**	**type**	**rating or trip unit**
0.1	0.4	13	C60	1
0.16	0.7	10.5	C60	2
0.25	1.1	9.5	C60	3
0.4	1.8	7.5	C60	4
0.63	2.8	7	C60	6
1	4.5	5.2	C60 / NC100 / C120 / NG125	10
1.6	7	4	C60 / NC100 / C120 / NG125	16
2.5	11	3	C60 / NC100 / C120 / NG125	20
4	18	2.1	C60 / NC100 / C120 / NG125	25
5	22	5	C60 / NC100 / C120 / NG125	32
6.3	27.4	5	C60 / NC100 / C120 / NG125	63
8	34.8	5	NC100 / C120 / NG125	80
10	43.5	5	NC100 / C120 / NG125	100
12.5	54.3	5	NC100 / C120 / NG125	100
16	65.6	5	C120 / NG125	125

8.
utilisation in 400Hz

Most multi 9 and Compact circuit-breakers can be used on 400 Hz networks.
Short-circuit currents at the terminals of the 400 Hz generators do not normally exceed 4 times nominal current.
Consequently there are seldom any breaking capacity problems.

Multi 9 circuit-breakers

■ no thermal derating

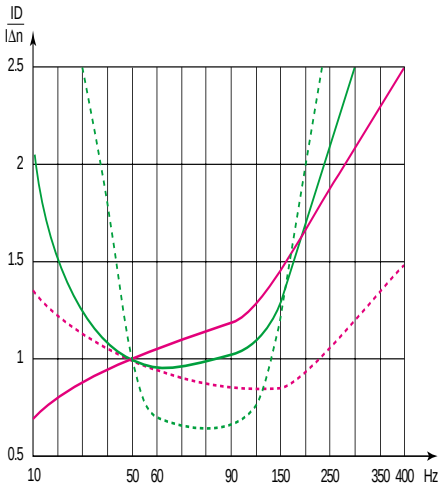
■ **C120 and NG125 circuit breakers are not suitable for 400Hz applications.**

■ increase in magnetic thresholds:
□ coefficient of 1.5 for DPN, DPN N and DPNa
□ coefficient of 1.48 for C60
□ coefficient of 1.40 for NC100

■ the residual current devices in the multi 9 range can be used on 400 Hz networks. Note that the threshold in mA varies according to network frequency (see curves below).

ID

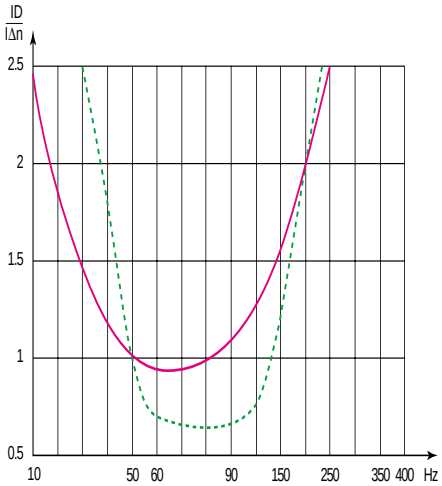
variation curves of the operating residual current



class	rating (A)	curve number sensitivity (mA) 10	30	100	300	sens. (A) 1 A	3 A
ID							
AC	25	2	1	-	1	-	-
	25-40	-	1	1	1	-	-
	63-80-100	-	2	1	1	-	-
all types							
S		-	-	-	2	-	-

DPN Vigi

variation curves of the operating residual current

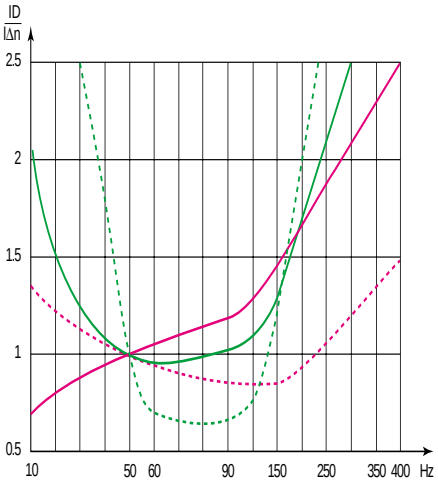


class	rating (A)	curve number sensitivity (mA) 10	30	300
DPN Vigi				
AC	25	8	8	8

8.
utilisation in 400Hz

C60 Vigi

variation curves of the operating residual current



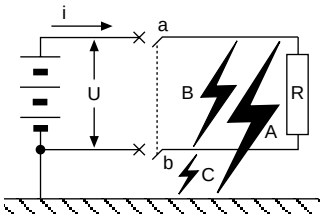
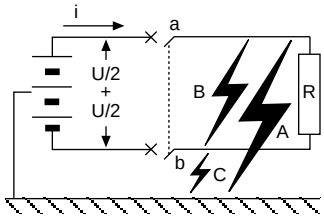
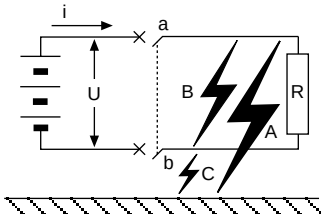
class	rating (A)	curve number sensitivity (mA) 10	30	100	300	sens. (A) 1 A	3 A
110/220 V - 50 Hz C60 Vigi							
AC	25	2	1	1	-	-	
	63	-	2	1	-	-	
2, 3 and 4P 220/415 V - 50 Hz C60 Vigi							
AC	25	2	1	1	-	-	
	40-63	-	2	1	-	-	
all types							
S		**-**	**4**	**2**	**2**	**-**	

Note:
In 400 Hz, threshold variation means there is a risk of the residual current device test circuit failing to operate when the test button is pressed.
According to international publications (IEC 60479-2), the human body is less sensitive to current flow at 400 Hz, so that, despite frequency desensitisation of residual current devices, the latter continue to provide protection of persons. The method for choosing residual current devices in 400 Hz is thus the same as in 50 Hz.

9.
circuits supplied with DC current
choosing a circuit breaker

The choice of circuit-breaker type, for protection of a DC installation, depends mainly on the following criteria:

- nominal current which is used to choose current rating
- nominal voltage which is used to determine the number of serial-connected poles contributing to breaking
- the maximum short-circuit current at the installation point, used to define breaking capacity
- the type of network (see below)

types of network		**earthed networks**		**unearthed networks**
		the source has an earthed polarity	the source has an earthed mid-point	
diagrams and various possible faults				
analysis of each fault	fault **A**	maximum Isc only the positive polarity is concerned	Isc close to maximum Isc only the positive polarity is concerned at half voltage U/2	no effect
	fault **B**	maximum Isc both polarities are concerned	maximum Isc both polarities are concerned	maximum Isc both polarities are concerned
	fault **C**	no effect	same as fault A but this time the negative polarity is concerned	no effect
the most unfavourable case		fault A	faults A and C	fault B
distribution of the breaking poles		all the poles effectively contributing to breaking are serial-connected on the positive polarity (1) (2)	on each polarity provide the number of poles required to break maximum Isc at voltage U/2	distribute the number of poles required for breaking on each polarity

(1) or negative if it is the positive polarity that is earthed
(2) provide an additional pole on the earthed polarity if the aim is isolation

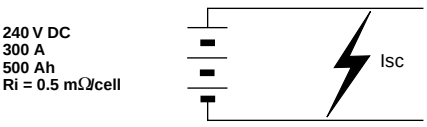
short-circuit current at the terminals of an accumulator battery

When its terminals are short-circuited, an accumulator battery delivers a current given by Ohm's law:

$$Isc = \frac{Vb}{Ri}$$

Vb = maximum discharge voltage (battery charged at 100 %).
Ri = internal resistance equivalent to all the cells (value normally given by the manufacturer according to battery Ampere/hour capacity).

Example
What is the short-circuit current at the terminals of a stationary battery with the following characteristics:
- capacity: 500 Ah
- maximum discharge voltage: 240 V (110 x 2.2 V cells)
- discharge current: 300 A
- backup time: 1/2 hour
- internal resistance: 0.5 mΩ per cell



Answer
$Ri = 110 \times 0.5.10^{-3} = 55.10^{-3}$

$$Isc = \frac{240}{55.10^{-3}} = 4.4 \text{ kA}$$

As shown in the calculation above, short-circuit currents are relatively small.
Note: if internal resistance is not known, the following approximate formula can be used: Isc = kC where C is the battery capacity expressed in Ampere/hour and k is a coefficient close to 10 and in all cases always less than 20.

9.
circuits supplied with DC current
choosing a circuit breaker

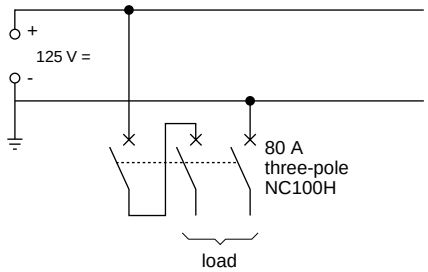
choosing DC circuit-breakers

type	rated current (A)	breaking capacity (kA) (L/R ≤ 0.015 s) (the number of poles contributing to breaking is given in brackets)								overload protection (thermal)	magnetic threshold overrating coefficient
		24/48 V	60 V	125 V	125 V	250 V	500 V	750 V	1000 V		
multi 9											
C32H-DC(1)	1-2-3-6-10-16-20-25-32-40	20 (1P)		10 (1P)	20 (2P)	10 (2P)				special DC	special DC
XC40	10-15-20-25-32-38	15 (1P)		20 (2P)	45 (3P)	50 (4P)				ditto AC	1.43
C60a	10-16-20-25-32-40	10 (1P)		10 (2P)	20 (3P)	25 (4P)				ditto AC	1.38
C60N	6-10-16-20-25-32-40-50-63	15 (1P)		20 (2P)	30 (3P)	40 (4P)				ditto AC	1.38
C60H	1-2-3-4-6-10-16-20-25-32-40-50-63	20 (1P)		25 (2P)	40 (3P)	50 (4P)				ditto AC	1.38
C60L	1-2-3-4-6-10-16-20-25-32-40-50-63	25 (1P)		30 (2P)	50 (3P)	60 (4P)				ditto AC	1.38
NC100H	50-63-80-100	20 (1P)		30 (2P)	40 (3P)	20 (4P)				ditto AC	1.42
NC100LH	10-16-20-25-32-40-50-63	50 (1P)		50 (1P)		50 (1P)	50 (3P)			ditto AC	1.42
C120N	63-80-100-125	15 (IP)	15(IP)	15(IP)	25(2P)	40(2P)					
C120H	10-16-20-25-32-40-50-63-80-100-125	25(IP)	25(IP)	25(IP)	30(2P)	50(2P)					
NG125N	10-16-20-25-32-40-50-63-80-100-125		25 (1P)	25 (1P)		25 (2P)	25 (4P)			ditto AC	1.42
NG125H	10-16-20-25-32-40-50-63-80-100-125		36 (1P)	36 (1P)		36 (2P)	36 (4P)			ditto AC	1.42
NG125L	10-16-20-25-32-40-50-63-80-100-125		50 (1P)	50 (1P)		50 (2P)	50 (4P)			ditto AC	1.42
compact											
NS100N	16-25-40-63-80-100	50 (1P)		50 (1P)		50 (1P)	50 (2P)			protection by thermal magnetic trip unit identical to the trip units used in AC current	
NS100H	16-25-40-63-80-100	85 (1P)		85 (1P)		85 (1P)	85 (2P)				
NS100L	16-25-40-63-80-100	100 (1P)		100 (1P)		100 (1P)	100 (2P)				
NS160N	80-100-125-160	50 (1P)		50 (1P)		50 (1P)	50 (2P)				
NS160H	80-100-125-160	85 (1P)		85 (1P)		85 (1P)	85 (2P)				
NS160L	80-100-125-160	100 (1P)		100 (1P)		100 (1P)	100 (2P)				
NS250N	160-200-250	50 (1P)		50 (1P)		50 (1P)	50 (2P)				
NS250H	160-200-250	85 (1P)		85 (1P)		85 (1P)	85 (2P)				
NS250L	160-200-250	100 (1P)		100 (1P)		100 (1P)	100 (2P)				
NS400H	MP1/MP2	85 (1P)		85 (1P)		85 (1P)	85 (2P)			thermal inoperative, provide an external relay (if necessary)	special MP1/MP2/MP3 P21/P41 DC current (2) trip units
NS630H	MP1/MP2/MP3	85 (1P)		85 (1P)		85 (1P)	85 (2P)				
C1251N-DC	P21/P41-1250	50 (1P)		50 (1P)		50 (2P)	50 (3P)	25 (3P)			
masterpact											
M10-DC	1000	100 (3P)		100 (3P)		100 (3P)	100 (3P)	50 (4P)	50 (4P)		dina(3)1.5 to 20 kA
M20-DC	2000	100 (3P)		100 (3P)		100 (3P)	100 (3P)	50 (4P)	50 (4P)		dina(3)1.5 to 20 kA
M40-DC	4000	100 (3P)		100 (3P)		100 (3P)	100 (3P)	50 (4P)	50 (4P)		dina(3)1.5 to 20 kA
M60-DC	6000	100 (4P)		100 (4P)		100 (4P)					dina(3) 9 to 40 kA
M80-DC	8000	100 (4P)		100 (4P)		100 (4P)					dina(3) 9 to 40 kA

(1) the C32H-DC special DC circuit-breaker is equipped with a permanent magnet, which requires strict respect of polarities
(2) for memory:
MP1 Im adjustable from 800 to 1600 A
MP2 Im adjustable from 1200 to 2500 A
MP3 Im adjustable from 2000 to 4000 A
P21-1250 Im adjustable from 1600 to 3200 A
P41-1250 Im adjustable from 3200 to 6400 A
(3) there are 7 versions of the dina 1500/3000 A trip units - 3/6 kA - 6/12 kA - 12/20 kA - 9/18 kA - 12/24 k A - 20/40 kA.
Note: the masterpact switches, HI type in the three-pole version with a rating from M08 to M63, can be used in DC up to 125 V DC (one pole on the positive polarity, one pole on the negative polarity and one pole not used).

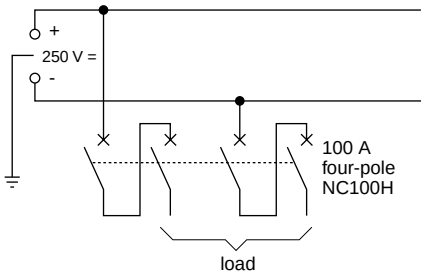
examples

How to provide protection of a 80 A outgoer on a 125 V DC network whose negative polarity is earthed: Isc = 15 kA?



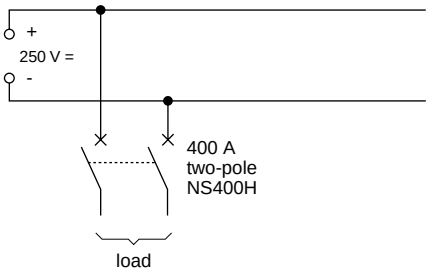
The above chart informs us that a NC100H (30 kA, 2P, 125 V) circuit-breaker must be used.
The chart on the previous page informs us that both poles must be placed on the positive polarity.
An additional pole can be placed on the negative polarity to guarantee isolation.

How to provide protection of a 100 A outgoer on a 250 V DC network whose mid-point is earthed: Isc = 15 kA?



Each pole will be subjected to a maximum of U/2 = 125 V.
The above chart informs us that a NC100H (30 kA, 2P, 125 V) or NS100N (50 kA, 1P, 125 V) or NS160N (50 kA, 1P, 125 V) circuit-breaker must be used.
The chart on the previous page informs us that both poles must contribute to breaking at the voltage 125 V.

How to provide protection of a 400 A outgoer on a 250 V DC unearthed network: Isc = 35 kA?



The above chart informs us that a NS400H (85 kA, 1P, 250 V) circuit-breaker must be used. At least 2 poles must contribute to breaking
The chart on the previous page informs us that the number of poles required for breaking must be distributed over each polarity.

10.
determination of short circuit current

calculation of Isc

Maximum short-circuit current downstream of an MV/LV transformer

The values indicated in the table below correspond to a bolted 3-phase short-circuit across the LV terminals of an MV/LV transformer connected to a network with a short-circuit power of 500 MVA.

	transformer kVA rating							
433 V (1)	**50**	**100**	**160**	**250**	**315**	**400**	**500**	**630**
In (A)	66.7	133.3	213.3	333.3	420.0	533.3	666.7	840
Isc (kA)	1.7	3.3	5.3	8.3	10.5	13.3	16.7	21.0
Usc (%)	4	4	4	4	4	4	4	4

	transformer kVA rating						
433 V (1)	**750**	**1000**	**1250**	**1500**	**2000**	**2500**	**3150**
In (A)	1000	1333	1667	2000	2667	3333	4200
Isc (kA)	22.2	26.7	30.3	33.3	41.0	47.6	60.0
Usc (%)	4.5	5	5.5	6	6.5	7	7

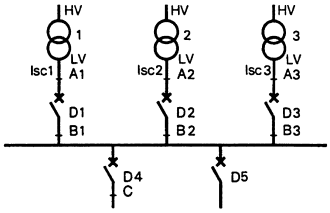
Selecting incoming or outgoing circuit-breakers according to the number and kVA rating of source transformers

The selection of a circuit-breaker protecting a circuit mainly depends on:

- the rated current of the source or of the load which determines the rating of the equipment,
- the maximum short-circuit current at the point of installation which determines the minimum breaking capacity of the equipment.

Eg. If transformers 1, 2 & 3 were rated at 630kVA each, circuit breakers D1, D2 & D3 must have a breaking capacity ≥ 42kA.

Circuit breakers D4 & D5 must have a breaking capacity ≥ 63kA.
(Note: Special precautions to be taken when cascading with several transformers in parallel. See p 234 of Compact Catalogue ABTED397054EN).



For the case involving several transformers in parallel (2):

- the incoming circuit-breaker D1 must have a breaking capacity higher than the larger of the following 2 values:
  - ☐ either Isc1 (for a short-circuit in B1),
  - ☐ or Isc2 + Isc3 (for a short-circuit in A1),
- the outgoing circuit-breaker D4 must have a breaking capacity higher than Isc1 + Isc2 + Isc3.

Notes:

(1) Rated voltage between phases of the transformer under noload conditions.

(2) To connect several transformers in parallel, the transformers should have the same Usc, the same transformation ratio and the same coupling.
The power ratio between the 2 transformers should be a maximum of 2.

estimation of Isc

The tables quickly give a good evaluation of the short circuit current at a point in the network when the short circuit current upstream the CSA, constitution and length of the cable are known.
To obtain more precise values, particularly in the case of major installations, a detailed calculation has to be carried out. In addition, the cascading technique enables a circuit breaker with a breaking capacity less than the prospective short-circuit current to be installed downstream provided a current limiting circuit breaker is fitted upstream.
The values are calculated using the resistivity of copper at 25°C.
Example
In the 415V switchboard, choose on the line corresponding to the cable cross-sectional area: 70 sq. mm, the nearest lower value to the cable length: 75m. The crossing of this column with the line which corresponds to the nearest higher value of the upstream short-circuit current Isc1=40kA, gives the required short-circuit current value: 8kA.

CSA per phase conductor (mm²)	Length of cable (m)																								
1.5														0.8	1	1.3	1.6	3	6.5	8	9.5	13	16	32
2.5													1	1.3	1.6	2.1	2.6	5	10	13	16	21	26	50
4												0.8	1.7	2.1	2.5	3.5	4	8.5	17	21	25	34	42	85
6												1.3	2.5	3	4	5	6.5	13	25	32	38	50	65	130
10										0.8	1.1	2.1	4	5.5	6.5	8.5	11	21	42	55	65	85	110	210
16								0.9	1	1.4	1.7	3.5	7	8.5	10	14	17	34	70	85	100	140	170	340
25						1	1.3	1.6	2.1	2.6	5	10	13	16	21	26	50	100	130	160	210	260		
35						1.5	1.9	2.2	3	3.5	7.5	15	19	22	30	37	75	150	190	220	300	370		
50					1.1	2.1	2.7	3	4	5.5	11	21	27	32	40	55	110	210	270	320				
70					1.5	3	3.5	4.5	6	7.5	15	30	37	44	60	75	150	300	370					
95				0.9	1	2	4	5	6	8	10	20	40	50	60	80	100	200	400					
120		0.9	1	1.1	1.3	2.5	5	6.5	7.5	10	13	25	50	65	75	100	130	250						
150	0.8	1	1.1	1.2	1.4	2.7	5.5	7	8	11	14	27	55	70	80	110	140	270						
185	1	1.1	1.3	1.5	1.6	3	6.5	8	9.5	13	16	32	65	80	95	130	160	320						
240	1.2	1.4	1.6	1.8	2	4	8	10	12	16	20	40	80	100	120	160	200	400						
300	1.5	1.7	1.9	2.2	2.4	5	9.5	12	15	19	24	49	95	120	150	190	240							

Upstream Isc (kA)	Downstream Short circuit current (kA)																							
100	94	94	93	92	91	83	71	67	63	56	50	33	20	17	14	11	9	5	2.4	2	1.6	1.2	1	0.5
90	85	85	84	83	83	76	66	62	58	52	47	32	20	16	14	11	9	4.5	2.4	2	1.6	1.2	1	0.5
80	76	76	75	75	74	69	61	57	54	49	44	31	19	16	14	11	9	4.5	2.4	2	1.6	1.2	1	0.5
70	67	67	66	66	65	61	55	52	49	45	41	29	18	16	14	11	9	4.5	2.4	1.9	1.6	1.2	1	0.5
60	58	58	57	57	57	54	48	46	44	41	38	27	18	15	13	10	8.5	4.5	2.4	1.9	1.6	1.2	1	0.5
50	49	49	48	48	48	46	42	40	39	36	33	25	17	14	13	10	8.5	4.5	2.4	1.9	1.6	1.2	1	0.5
40	39	39	39	39	39	37	35	33	32	30	29	22	15	13	12	9.5	8	4.5	2.4	1.9	1.6	1.2	1	0.5
35	34	34	34	34	34	33	31	30	29	27	26	21	15	13	11	9	8	4.5	2.3	1.9	1.6	1.2	1	0.5
30	30	29	29	29	29	28	27	26	25	24	23	19	14	12	11	9	7.5	4.5	2.3	1.9	1.6	1.2	1	0.5
25	25	25	25	24	24	24	23	22	22	21	20	17	13	11	10	8.5	7	4	2.3	1.9	1.6	1.2	1	0.5
20	20	20	20	20	20	19	19	18	18	17	17	14	11	10	9	7.5	6.5	4	2.2	1.8	1.5	1.2	1	0.5
15	15	15	15	15	15	15	14	14	14	13	13	12	9.5	8.5	8	7	6	4	2.1	1.8	1.5	1.2	0.9	0.5
10	10	10	10	10	10	10	9.5	9.5	9.5	9.5	9	8.5	7	6.5	6.5	5.5	5	3.5	2	1.7	1.4	1.1	0.9	0.5
7	7	7	7	7	7	7	7	7	6.5	6.5	6.5	6	5.5	5	5	4.5	4	2.9	1.8	1.6	1.3	1.1	0.9	0.5
5	5	5	5	5	5	5	5	5	5	5	5	4.5	4	4	4	3.5	3.5	2.5	1.7	1.4	1.3	1.1	0.8	0.5

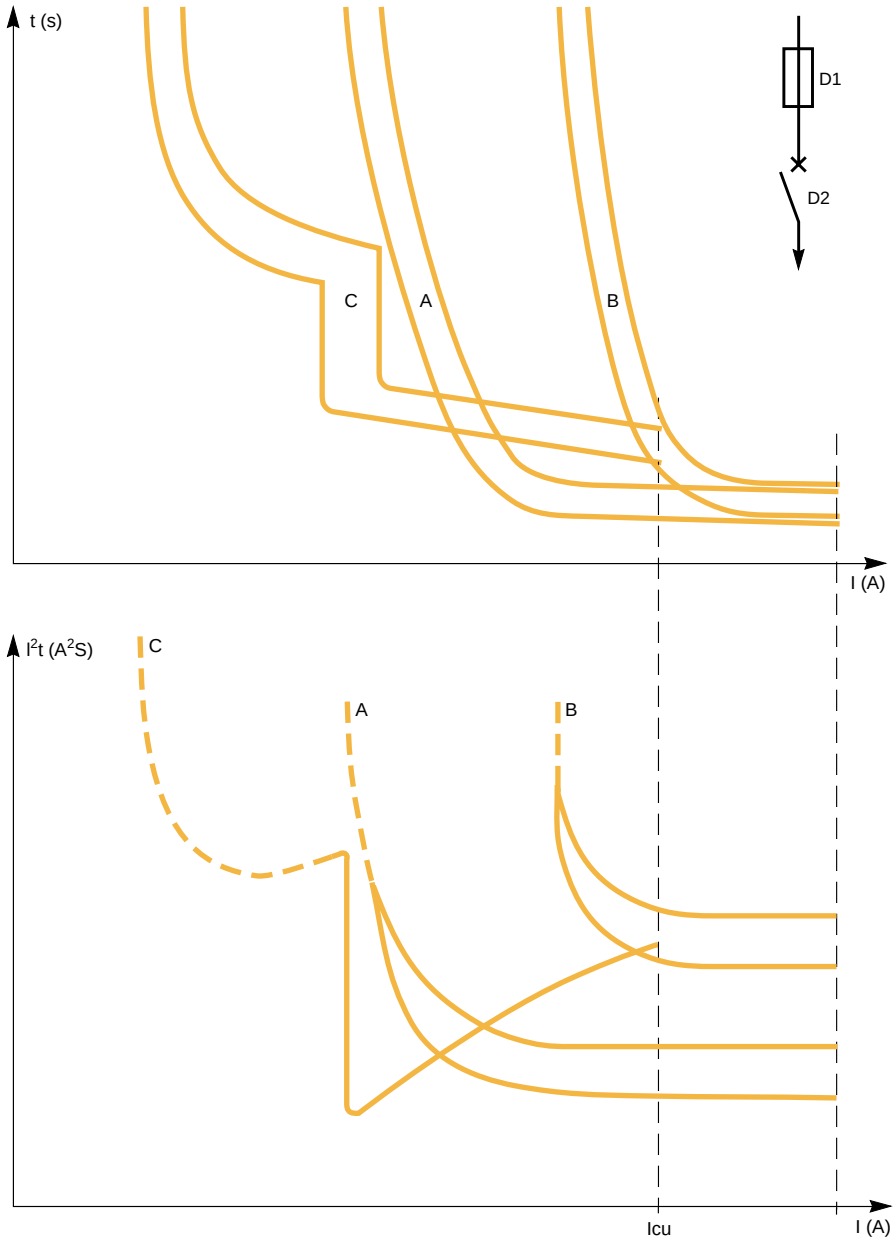
11.
coordination
upstream: fuse
downstream: circuit breaker

Combination rules

upstream fuse + downstream circuit-breaker

discrimination
Discrimination is guaranteed by:
■ placing a fuse upstream with the lowest possible rating,
□ its value is determined by the magneto-thermal tripping characteristics of the downstream circuit-breaker.
■ ensuring that the lower threshold of the fuse is greater than the highest threshold of the circuit-breaker.

cascading
Cascading is guaranteed by:
■ placing a fuse upstream with the highest possible rating.
□ its value is determined by the pre-arcing characteristic of the fuse
□ if it is too high, cascading will not occur, and the circuit-breaker alone will protect the circuit.
■ ensure that:
□ the thermal stress (I^2t) and the current limited by the fuse (Â) are compatible with the breaking capacity of the circuit-breaker only,
□ the maximum thermal stress of the circuit-breaker (Icu) is equal to the pre-arcing thermal stress of the upstream fuse.



I prospective short-circuit current
Icu rated ultimate breaking capacity of the circuit-breaker
A fuse with the lowest possible rating ensuring total time discrimination and partial current discrimination
B fuse with the highest possible rating ensuring protection of the downstream circuit beyond the ultimate breaking capacity of the circuit-breaker
C circuit-breaker operating characteristic (breaking time / current and I^2t / current)

Note:
A is estimated to be the lower limit
B and C are estimated to be the upper limits.

11-1.
backup
upstream: C60, NC100, NG125, NS100 or NS160
downstream: isolator

short-circuit current withstand of the circuit-breaker / switch combination
standard: IEC 947.2
unit: kA rms

upstream	circuit-breaker																
	C60				NC100	C120		NG125			NS100			NS160		
	a	N	H	L	H	N	H		H	L	N	H	L	N	H	L
downstream																
Multi 9 switch (240 V)																
I 20	6.5	6.5	6.5	6.5	3	3	4.5		4.5	4.5						
I 32	5.5	5.5	5.5	5.5	3	3	4.5		4.5	4.5						
I 40 - 63	7	7	7	7	5	5	6.5		6.5	6.5						
I 100 - 125					7	7	15		15	15						
Multi 9 switch (415 V)																
I 20	4.5	4.5	4.5	4.5	2	2	3		3	3						
I 32	4	4	4	4	2	2	3		3	3						
I 63	5	5	5	5	3	3	6		6	6						
I 100					5	5	10		10	10						
NG125NA																
63 - 80 A					10	10	16		36	50	25	36	36	25	25	25
100 A					10	10	16		36	50	25	70	70	36	70	70
125 A					10	10	16		36	50				36	70	70
Interpact switch (415 V)																
INS40		10	10	10	10	10	16		36	50	25	36	36	25	25	25
INS63		10	10	10	10	10	16		36	50	25	36	36	25	25	25
INS100					10	10	16		36	50	25	70	70	36	70	70
INS125					10	10	16		36	50				36	70	70
INS160					10	10	16		36	50				36	70	70

switch making capacity
use a circuit-breaker with a rating equal to that of the switch
unit: KÂ (peak)

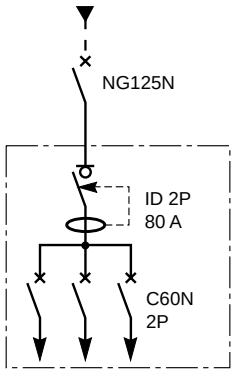
upstream	circuit-breaker										
	C60				NC100	C120		NG125		
	a	N	H	L	H	N	H	N	H	L
downstream										
Switch (240 V AC)										
≤ 40	21	42	63	84	42	42	63	105	154	220
50/63	21	42	63	63	42	42	63	105	154	220
100/125						42	63	105	154	220
Switch (415 V AC)										
≤ 40 A	10.5	21	32	42	21	21	32	53	75	105
50/63 A	10.5	21	32	32	21	21	32	53	75	105
100 A					21	21	32	53	75	105
125 A						21	32	53	75	105

11-1.
backup
upstream: C60, NC100, C120, NG125 circuit breaker or fuses
downstream: ID, RCCB residual current circuit breakers

residual current circuit-breaker

■ One of the choice criteria for this device is coordination with the short-circuit protection device (SCPD) installed upstream.
■ It must have the following protections:
□ **electrodynamic** against short-circuits developing downstream, as its short-circuit withstand is limited,
□ **overload** (see thermal protection)
■ when combined with downstream circuit-breakers in the same switchboard produced using proper procedures, it is accepted that its short-circuit current withstand is also guaranteed by the downstream circuit-breakers as in the following table.

Example
2P ID + downstream C60 combination
Isc withstand: 25kA.



electrodynamic protection
short-circuit current (kA rms)

upstream		circuit-breaker												gI or gG fuse (a)							
		DPN	C60a	C60N	C60H	C60L	NC100H	C120	NG125N	NC100L	NC100LS NG125H		NC100LH	16	25	32	40	50	63	80	100
downstream residual current circuit-breakers																					
2 P (220…240 V)																					
	25 A	6	10	16	20	45	10		15	20	20	20	20	100	100	100	80	50	30	20	10
	40 A	6	10	16	20	45	10		15	20	20	20	20	100	100	100	80	50	30	20	10
	63 A			16	20	30	10	10	15	20	20	20	20	100	100	100	80	50	30	20	10
	80/100 A						10	10	15	20	20	20	20	100	100	100	80	50	30	20	10
4 P (380…415 V)																					
	25 A		6	8	10	25	7		15	15	18	20	20	100	100	100	80	50	30	20	10
	40 A		6	8	10	20	7		15	15	18	20	20	100	100	100	80	50	30	20	10
	63/80 A			8	10	15	7	7	15	15	18	20	20	100	100	100	80	50	30	20	10
	100 A						5	7	15	7	8	20	10	100	100	80	50	30	10	3	3

11-1.
backup
upstream: DS/DIN fuses
downstream: C60, V40H, QO, Isolator, ID RCCB's

upstream: BS/DIN fuses (415V)
downstream: multi 9 MCB's

UPSTREAM FUSE					
"Inc" (kA)	**T type (BS88 or gG)**			**HRC DIN type**	
	125A	160A	200A	160A	200A
63kA	C60N C60H V40H QOE (rcd/mcb) QO---EC10				
50kA		C60N C60H V40H QOE (rcd/mcb) QO---EC10	C60N C60H V40H QOE (rcd/mcb) QO---EC10	C60N C60H	C60N C60H
"Is"	2.3kA	3.0kA	3.8kA	3.8kA	4.5kA

This table is based on test data and complies with the requirements for switchboards to AS3439-1 (referenced standards AS3947.2, AS/NZS4898). tests were carried out using GEC fuses.
Refer to AS3000 wiring rules, Clauses 2.4.4.3 and 2.8.3.3.1 regarding requirement for back up protection and control.
Fuse ratings are maximum sizes.
Where 200A fuses and C60 MCB's are used in association, it is recommended that in the event of a fault where the fuses are blown, that the downstream MCB should be inspected.

upstream: gG or BS fuses (240/415V)
downstream: multi 9 I isolators

	upstream gG or BS fuses	**20A**	**32A**	**63A**	**100A**	**125A**
downstream						
(kA rms)	I 20	8				
	I 32		8			
	I 40-63			10		
	I 100				6	
	I 125					6

upstream: gG or BS fuses (240/415V)
downstream: multi 9 ID RCCB's

	upstream gG or BS fuses	**25A**	**40A**	**63A**	**80A**
downstream					
(kA rms)	ID25	100			
	ID40		80		
	ID63			30	
	ID80				20

11-2.
IEC 60947.2 cascading
230...240V

upstream: multi 9
downstream: multi 9
reinforced breaking capacity (kA)

upstream		DPN	C60a	C60N	C60H	C120N	C120H	NG125H	NG125LMA
downstream									
	rated breaking capacity	6	10	20	30	20	30	70	100
DPN	6		**10**	**15**	**20**	**15**	**20**	**40**	**50**
C60a	10		**20**	**30**	**20**	**30**	**40**	**50**	
C60N	20			**30**		**30**		**50**	**70**
C60H	30							**70**	**70**
C60L (≤25)	50							**70**	**100**
C60L (32-40)	40							**70**	**100**
C60L (50-63)	30							**70**	**100**
C120N	20				**30**		**30**	**50**	**70**
C120H	30							**70**	**70**
NG125H	70								**100**

upstream: Compact NS
downstream: multi 9
reinforced breaking capacity (kA)

upstream		NSA160N	NS100N	NS100H	NS100L	NS160N	NS160H	NS160L	NS250N	NS250H	NS250L
downstream											
	rated breaking capacity	50	85	100	150	85	100	150	85	100	150
C60a	10	**25**	**30**	**80**	**80**	**30**	**40**	**40**	**30**	**40**	**40**
C60N	20	**25**	**40**	**100**	**60**	**50**	**60**	**60**	**50**	**60**	**60**
C60H	30	**25**	**50**	**100**	**80**	**60**	**80**	**80**	**60**	**80**	**80**
C120N	20	**25**	**50**	**60**	**60**		**30**	**30**	**25**	**30**	**30**
C120H	30	**25**	**50**	**80**	**80**				**25**	**25**	
NG125H	70			**85**	**100**		**85**	**85**		**70**	**70**
NG125L/MA	100			**100**	**150**		**100**	**100**		**85**	**85**

11-2.
IEC 60947.2 cascading
400...415V

upstream: multi 9
downstream: multi 9
reinforced breaking capacity (kA)

upstream		C60N	C60H	C60L			C120N	C120H	NG125a	NG125N	NG125H	NG125L NG125LMA
				⩽ 25 A	32/40 A	50/63 A						
downstream												
	rated breaking capacity	10	15	25	20	15	10	15	16	25	36	50
C60a	5	10	15	25	20	15	10	15	15	15	20	25
C60N	10		15	25	20	15		15		25	25	36
C60H	15			25						25	36	36
C120N	10		15	25	20	15		15		25	25	36
C120H	15			25						25	36	36
NG125H	36											50

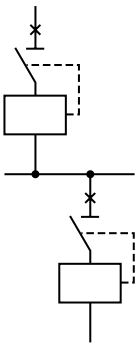
upstream: Compact NS
downstream: multi 9
reinforced breaking capacity (kA)

upstream		NS100 N NSA160N	NS100H	NS100L	NS160N	NS160H	NS160L	NS250N	NS250H	NS250L
downstream										
	rated breaking capacity	25	70	150	36	70	150	36	70	150
C60N	6	25	30	30	25	30	30	25	30	30
C60H (≤ 40A)	10	25	50	50	30	50	50	30	40	40
C60H (50-63A)	10	25	40	40	30	40	40	30	40	40
(NC100H)	10	25	30	30	25	30	30	25	30	30
C120N	10	25	25	25	25	25	25	25	25	25
C120H	15	25	25	25	25	25	25	25	25	25
NG125H	36		50	100		50	70		36	50
NG125L/MA	50		70	150		70	100		50	70

11-3.
discrimination

conditions for using discrimination tables between 2 distribution circuit-breakers

For each combination of two circuit-breakers, the discrimination tables indicate whether discrimination is total (coloured area).
When discrimination is partial, the table indicates the maximum value of the fault current for which discrimination is ensured. For fault currents in excess of this value, both devices trip at the same time.

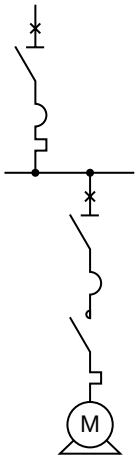


downstream circuit-breaker
The values indicated in the tables are guaranteed irrespective of the settings.

upstream circuit-breaker
The values indicated in the tables are guaranteed provided that the following conditions are met:
■ thermal magnetic trip units: highest thermal and magnetic settings
■ STR22SE/STR23SE electronic trip units: short delay settings ⩾ 1.5 times the downstream short-circuit protection setting (magnetic or instantaneous)
■ STR53UE electronic trip units:
□ short delay setting ⩾ 1.5 times the downstream short-circuit protection setting,
□ time delay index > downstream trip unit time delay index

conditions for using discrimination tables between a circuit-breaker and a motor protection and control assembly

When discrimination is partial, the table indicates the maximum value of the fault current for which discrimination is ensured. For fault currents in excess of this value, both devices trip at the same time



downstream device
The values indicated in the tables are guaranteed irrespective of the settings.

upstream device
The tables give the discrimination limits for the various trip unit ratings.
The values indicated in the tables are guaranteed provided that the following conditions are met:
■ thermal magnetic trip units:
highest magnetic setting, highest thermal setting, ⩾ 3 times the rating of the downstream trip unit or thermal relay
■ STR22SE/STR23SE and STR53UE electronic trip units:
□ short delay setting ⩾ 1.5 times the downstream short-circuit protection setting (magnetic or instantaneous)
□ short time delay index (if STR53UE) > downstream device time delay index
□ long delay setting ⩾ 3 times the rating of the downstream trip unit or thermal relay.

11-3.
discrimination
upstream: NG125H/C120N, H, B, C curves
downstream: DPN

upstream		**NG125 H,** C curve										
In (A)		10	16	20	25	32	40	50	63	80	100	125
downstream	rating											
discrimination limit (A)												
DPN	1	**300**	**500**	**700**	**1000**	**1500**	**2000**	**2500**	**T**	**T**	**T**	**T**
B, C curves	2	**150**	**300**	**500**	**700**	**1000**	**1500**	**2000**	**T**	**T**	**T**	**T**
	3	**80**	**140**	**300**	**500**	**700**	**1000**	**1500**	**T**	**T**	**T**	**T**
	6			**170**	**400**	**500**	**700**	**800**	**3000**	**T**	**T**	**T**
	10				**200**	**350**	**500**	**600**	**1800**	**3000**	**T**	**T**
	16					**270**	**340**	**450**	**1250**	**2000**	**3300**	**3700**
	20						**320**	**400**	**1000**	**1600**	**2500**	**3700**
	25							**400**	**800**	**1300**	**2100**	**3700**
	32								**600**	**1000**	**1800**	**2700**
	40									**700**	**1600**	**2400**

The above table indicates the discrimination limits in the following cases:
- phase-to-neutral short-circuit on a 240 V single-phase distribution network, downstream of a 3 Ph + N or single-phase network.

"T" total discrimination, up to the breaking capacity of the downstream circuit-breaker.

11-3.
discrimination
upstream: NG125H/C120N, H, B, curves
downstream: C60 N, H, L, L-MA

upstream		**NG125 H/ C120 N, H,** B curve										
In (A)		10	16	20	25	32	40	50	63	80	100	125
downstream	rating											
discrimination limit (A)												
C60N	0.5	**T**	**T**	**T**	**T**	**T**	**T**	**T**	**T**	**T**	**T**	**T**
B, C, curves	0.75	**T**	**T**	**T**	**T**	**T**	**T**	**T**	**T**	**T**	**T**	**T**
	1	**550**	**700**	**1500**	**2200**	**3100**	**3500**	**4000**	**T**	**T**	**T**	**T**
	2	**300**	**450**	**700**	**1500**	**2100**	**2500**	**2800**	**4500**	**T**	**T**	**T**
	3	**150**	**300**	**300**	**950**	**1500**	**1600**	**1800**	**4000**	**T**	**T**	**T**
	4		**150**	**200**	**600**	**1200**	**1300**	**1400**	**3400**	**T**	**T**	**T**
	6			**150**	**400**	**950**	**1000**	**1000**	**2800**	**5000**	**T**	**T**
	10					**600**	**600**	**750**	**2500**	**4000**	**5500**	**T**
	16							**600**	**2100**	**3500**	**4500**	**5500**
	20									**2500**	**3500**	**4500**
	25									**1600**	**2500**	**3500**
	32											**2800**
	40											**2500**
	50											
	63											
discrimination limit (A)												
C60 H, L	0.5	**10000**	**10000**	**10000**	**10000**	**10000**	**10000**	**10000**	**10000**	**10000**	**10000**	**10000**
B, C, curves	0.75	**10000**	**10000**	**10000**	**10000**	**10000**	**10000**	**10000**	**10000**	**10000**	**10000**	**10000**
	1	**550**	**700**	**1500**	**2200**	**3100**	**3500**	**4000**	**6000**	**7000**	**10000**	**10000**
	2	**300**	**450**	**700**	**1500**	**2100**	**2500**	**2800**	**4500**	**6000**	**8000**	**10000**
	3	**150**	**300**	**300**	**950**	**1500**	**1600**	**1800**	**4000**	**6000**	**7000**	**10000**
	4		**150**	**200**	**600**	**1200**	**1300**	**1400**	**3400**	**6000**	**6000**	**8000**
	6			**150**	**400**	**950**	**1000**	**1000**	**2800**	**5000**	**6000**	**6500**
	10					**600**	**600**	**750**	**2500**	**4000**	**5500**	**6000**
	16							**600**	**2100**	**3500**	**4500**	**5500**
	20									**2500**	**3500**	**4500**
	25									**1600**	**2500**	**3500**
	32											**2800**
	40											**2500**
	50											
	63											
discrimination limit (A)												
C60N	0.5	**T**	**T**	**T**	**T**	**T**	**T**	**T**	**T**	**T**	**T**	**T**
D curve	0.75	**T**	**T**	**T**	**T**	**T**	**T**	**T**	**T**	**T**	**T**	**T**
	1	**550**	**700**	**1500**	**2200**	**3100**	**3500**	**4000**	**T**	**T**	**T**	**T**
	2		**450**	**700**	**1500**	**2100**	**2500**	**2800**	**4500**	**T**	**T**	**T**
	3			**300**	**950**	**1500**	**1600**	**1800**	**4000**	**T**	**T**	**T**
	4					**1200**	**1300**	**1400**	**3400**	**T**	**T**	**T**
	6							**1000**	**2800**	**5000**	**T**	**T**
	10									**4000**	**5500**	**T**
	16									**3500**	**4500**	**5500**
	20											**4500**
	25											**3500**
	32											
	40											
	50											
	63											
discrimination limit (A)												
C60H, L	1	**550**	**700**	**1500**	**2200**	**3100**	**3500**	**4000**	**6000**	**7000**	**10000**	**10000**
D, MA curves	2		**450**	**700**	**1500**	**2100**	**2500**	**2800**	**4500**	**6000**	**8000**	**10000**
	3			**300**	**950**	**1500**	**1600**	**1800**	**4000**	**6000**	**7000**	**10000**
	4					**1200**	**1300**	**1400**	**3400**	**6000**	**6000**	**8000**
	6							**1000**	**2800**	**5000**	**6000**	**6500**
	10									**4000**	**5500**	**6000**
	16									**3500**	**4500**	**5500**
	20											**4500**
	25											**3500**
	32											
	40											
	50											
	63											

The above tables indicate the discrimination limits in the following cases:
- phase-to-neutral short-circuit on a 230 V single-phase distribution network, downstream of a 3 Ph + N or single-phase network.
- short-circuit between two phases on a three-phase distribution network with a nominal voltage of 230 V.

"T" total discrimination, up to the breaking capacity of the downstream circuit-breaker.

11-3.
discrimination (short circuit under 240V)
upstream: NG125N, H, L / C120N, H, C, curves
downstream: C60 N, H, L, L-MA

upstream		**NG125 N, H, L / C120 N, H,** C curve										
In (A)		10	16	20	25	32	40	50	63	80	100	125
downstream	rating											
discrimination limit (A)												
C60N	0.5	T	T	T	T	T	T	T	T	T	T	T
B, C, Z curves	0.75	T	T	T	T	T	T	T	T	T	T	T
	1	800	1000	2000	3000	4500	T	T	T	T	T	T
	2	400	600	1000	2000	3000	3500	4000	T	T	T	T
	3	200	400	400	1300	2100	2300	2500	T	T	T	T
	4		200	300	900	1600	1800	2000	T	T	T	T
	6			200	500	1300	1400	1500	4000	T	T	T
	10				300	800	900	1000	3500	T	T	T
	16					500	650	800	3000	5000	T	T
	20						400	700	2000	3600	5500	T
	25							500	1000	2200	3500	5000
	32								700	1500	2500	4000
	40									1300	1800	3600
	50										1500	2500
	63											2100
discrimination limit (A)												
C60 H, L	0.5	10000	10000	10000	10000	10000	10000	10000	10000	10000	10000	10000
B, C, Z curves	0.75	10000	10000	10000	10000	10000	10000	10000	10000	10000	10000	10000
	1	800	1000	2000	3000	4500	5500	7000	10000	10000	10000	10000
	2	400	600	1000	2000	3000	3500	4000	6000	10000	10000	10000
	3	200	400	400	1300	2100	2300	2500	6000	10000	10000	10000
	4		200	300	900	1600	1800	2000	5000	8000	10000	10000
	6			200	500	1300	1400	1500	4000	6500	8500	10000
	10				300	800	900	1000	3500	6000	6500	8000
	16					500	650	800	3000	5000	6000	7000
	20						400	700	2000	3600	5500	6000
	25							500	1000	2200	3500	5000
	32								700	1500	2500	4000
	40									1300	1800	3600
	50										1500	2500
	63											2100
discrimination limit (A)												
C60N	0.5	T	T	T	T	T	T	T	T	T	T	T
D curve	0.75	T	T	T	T	T	T	T	T	T	T	T
	1	800	1000	2000	3000	4500	T	T	T	T	T	T
	2		600	1000	2000	3000	3500	4000	T	T	T	T
	3			400	1300	2100	2300	2500	T	T	T	T
	4				900	1600	1800	2000	T	T	T	T
	6					1300	1400	1500	4000	T	T	T
	10						900	1000	3500	T	T	T
	16							800	3000	5000	T	T
	20								2000	3600	5500	T
	25									2200	3500	5000
	32										2500	4000
	40											3600
	50											
	63											
discrimination limit (A)												
C60H, L	1	800	1000	2000	3000	4500	5500	7000	10000	10000	10000	10000
D, K, MA curves	2		600	1000	2000	3000	3500	4000	8000	10000	10000	10000
	3			400	1300	2100	2300	2500	7000	10000	10000	10000
	4				900	1600	1800	2000	5000	8000	10000	10000
	6					1300	1400	1500	4000	6500	8500	10000
	10						900	1000	3500	5500	6500	8000
	16							800	3000	5000	6000	7000
	20								2000	3600	5500	6000
	25									2200	3500	5000
	32										2500	4000
	40											3600
	50											
	63											

The above tables indicate the discrimination limits in the following cases:
- phase-to-neutral short-circuit on a 240 V single-phase distribution network, downstream of a 3 Ph + N or single-phase network.
- short-circuit between two phases on a three-phase distribution network with a nominal voltage of 240 V.

"T" total discrimination, up to the breaking capacity of the downstream circuit-breaker.

11-3.
discrimination (short circuit under 240V)
upstream: NG125H/C120N, H, D curves
downstream: C60 N, H, L, L-MA

upstream		**NG125 H / C120 N, H,** D curve										
In (A)		10	16	20	25	32	40	50	63	80	100	125
downstream	rating											
discrimination limit (A)												
C60N	0.5	T	T	T	T	T	T	T	T	T	T	T
B, C curves	0.75	T	T	T	T	T	T	T	T	T	T	T
	1	900	1100	2300	3400	5000	6000	T	T	T	T	T
	2	450	700	1100	2300	3400	4000	4500	6000	T	T	T
	3	250	450	450	1500	2400	2600	2800	6000	T	T	T
	4		200	350	1000	1800	2000	2300	6000	T	T	T
	6			250	600	1500	1600	1700	4500	6000	T	T
	10				350	900	1000	1200	4000	6000	T	T
	16					600	750	900	3400	5600	6000	T
	20						500	800	2300	4000	6000	T
	25							600	1200	2500	4000	5500
	32								800	1700	2800	4500
	40								600	1500	2200	4000
	50										1700	2800
	63											2300
discrimination limit (A)												
C60 H, L	0.5	10000	10000	10000	10000	10000	10000	10000	10000	10000	10000	10000
B, C curves	0.75	10000	10000	10000	10000	10000	10000	10000	10000	10000	10000	10000
	1	900	1100	2300	3400	5000	6000	7000	10000	10000	10000	10000
	2	450	700	1100	2300	3400	4000	4500	8000	10000	10000	10000
	3	250	450	450	1500	2400	2600	2800	7000	8000	10000	10000
	4		200	350	1000	1800	2000	2300	6000	6500	10000	10000
	6			250	600	1500	1600	1700	4500	6000	8500	10000
	10				350	900	1000	1200	4000	6000	6500	10000
	16					600	750	900	3400	5600	6000	8000
	20						500	800	2300	4000	6000	7000
	25							600	1200	2500	4000	5500
	32								800	1700	2800	4500
	40								600	1500	2200	4000
	50										1700	2800
	63											2300
discrimination limit (A)												
C60N	0.5	T	T	T	T	T	T	T	T	T	T	T
D curve	0.75	T	T	T	T	T	T	T	T	T	T	T
	1	900	1100	2300	3400	5000	6000	T	T	T	T	T
	2		700	1100	2300	3400	4000	4500	6000	T	T	T
	3			450	1500	2400	2600	2800	6000	T	T	T
	4				1000	1800	2000	2300	6000	T	T	T
	6					1500	1600	1700	4500	6000	T	T
	10						1000	1200	4000	6000	T	T
	16							900	3400	5600	6000	T
	20								2300	4000	6000	T
	25								1200	2500	4000	5500
	32										2800	4500
	40											4000
	50											
	63											
discrimination limit (A)												
C60H, L	1	900	1100	2300	3400	5000	6000	7000	10000	10000	10000	10000
D, MA curves	2		700	1100	2300	3400	4000	4500	8000	10000	10000	10000
	3			450	1500	2400	2600	2800	7000	8000	10000	10000
	4				1000	1800	2000	2300	6000	6500	10000	10000
	6					1500	1600	1700	4500	6000	8500	10000
	10						1000	1200	4000	6000	6500	10000
	16							900	3400	5600	6000	8000
	20								2300	4000	6000	7000
	25								1200	2500	4000	5500
	32										2800	4500
	40											4000
	50											
	63											

The above tables indicate the discrimination limits in the following cases:
- phase-to-neutral short-circuit on a 240 V single-phase distribution network, downstream of a 3 Ph + N or single-phase network.
- short-circuit between two phases on a three-phase distribution network with a nominal voltage of 240 V.

"T" total discrimination, up to the breaking capacity of the downstream circuit-breaker.

11-3.
discrimination (short circuit under 415V)
upstream: NG125N, H, / C120N, H, B curves
downstream: C60 N, H, L, L-MA

upstream		**NG125 H/ C120 N, H,** B curve										
In (A)		10	16	20	25	32	40	50	63	80	100	125
downstream	rating											
discrimination limit (A)												
C60N	0.5	**T**	**T**	**T**	**T**	**T**	**T**	**T**	**T**	**T**	**T**	**T**
B, C curves	0.75	**T**	**T**	**T**	**T**	**T**	**T**	**T**	**T**	**T**	**T**	**T**
	1	**200**	**300**	**450**	**700**	**1000**	**1300**	**1600**	**2800**	**3500**	**5000**	**T**
	2	**100**	**220**	**300**	**450**	**550**	**900**	**1260**	**2500**	**3000**	**4500**	**T**
	3	**60**	**150**	**220**	**350**	**450**	**700**	**1150**	**2300**	**2600**	**4000**	**4500**
	4		**100**	**150**	**250**	**400**	**650**	**1000**	**2000**	**2300**	**3300**	**4000**
	6			**120**	**200**	**300**	**500**	**700**	**1750**	**2000**	**3000**	**3500**
	10					**200**	**300**	**600**	**1100**	**1500**	**2600**	**3300**
	16							**450**	**700**	**1000**	**2300**	**2900**
	20									**800**	**1900**	**2500**
	25									**700**	**1700**	**2200**
	32											**1550**
	40											**1100**
	50											
	63											
discrimination limit (A)												
C60 H, L	0.5	**6000**	**6000**	**6000**	**6000**	**6000**	**6000**	**6000**	**6000**	**6000**	**6000**	**6000**
	0.75	**6000**	**6000**	**6000**	**6000**	**6000**	**6000**	**6000**	**6000**	**6000**	**6000**	**6000**
	1	**200**	**300**	**450**	**700**	**1000**	**1300**	**1600**	**2800**	**3500**	**5000**	**6000**
B, C curves	2	**100**	**220**	**300**	**450**	**550**	**900**	**1260**	**2500**	**3000**	**4500**	**6000**
	3	**60**	**150**	**220**	**350**	**450**	**700**	**1150**	**2300**	**2600**	**4000**	**4500**
	4		**100**	**150**	**250**	**400**	**650**	**1000**	**2000**	**2300**	**3300**	**4000**
	6			**120**	**200**	**300**	**500**	**700**	**1750**	**2000**	**3000**	**3500**
	10					**200**	**300**	**600**	**1100**	**1500**	**2600**	**3300**
	16							**450**	**700**	**1000**	**2300**	**2900**
	20									**800**	**1900**	**2500**
	25									**700**	**1700**	**2200**
	32											**1550**
	40											**1100**
	50											
	63											
discrimination limit (A)												
C60N	0.5	**T**	**T**	**T**	**T**	**T**	**T**	**T**	**T**	**T**	**T**	**T**
	0.75	**T**	**T**	**T**	**T**	**T**	**T**	**T**	**T**	**T**	**T**	**T**
	1	**200**	**300**	**450**	**700**	**1000**	**1300**	**1600**	**2800**	**3500**	**5000**	**T**
D curve	2		**220**	**300**	**450**	**550**	**900**	**1260**	**2500**	**3000**	**4500**	**T**
	3			**220**	**350**	**450**	**700**	**1150**	**2300**	**2600**	**4000**	**4500**
	4					**400**	**650**	**1000**	**2000**	**2300**	**3300**	**4000**
	6							**700**	**1750**	**2000**	**3000**	**3500**
	10									**1500**	**2600**	**3300**
	16									**1000**	**2300**	**2900**
	20											**2500**
	25											**2200**
	32											
	40											
	50											
	63											
discrimination limit (A)												
C60H, L	1	**200**	**300**	**450**	**700**	**1000**	**1300**	**1600**	**2800**	**3500**	**5000**	**6000**
D, MA curves	2		**220**	**300**	**450**	**550**	**900**	**1260**	**2500**	**3000**	**4500**	**6000**
	3			**220**	**350**	**450**	**700**	**1150**	**2300**	**2600**	**4000**	**4500**
	4					**400**	**650**	**1000**	**2000**	**2300**	**3300**	**4000**
	6							**700**	**1750**	**2000**	**3000**	**3500**
	10									**1500**	**2600**	**3300**
	16									**1000**	**2300**	**2900**
	20											**2500**
	25											**2200**
	32											
	40											
	50											
	63											

The above tables indicate the discrimination limits in the following cases:
- short-circuit between two phases on a three-phase 240/415 V distribution network .

"T" total discrimination, up to the breaking capacity of the downstream circuit-breaker.

11-3.
discrimination (short circuit under 415V)
upstream: NG125H/C120N, H, C curves
downstream: C60 N, H, L, L-MA

upstream		**NG125 H / C120 N, H,** C curve										
In (A)		10	16	20	25	32	40	50	63	80	100	125
downstream	rating											
discrimination limit (A)												
C60N	0.5	T	T	T	T	T	T	T	T	T	T	T
B, C curves	0.75	T	T	T	T	T	T	T	T	T	T	T
	1	300	450	600	1000	1600	2000	2500	T	T	T	T
	2	150	300	450	600	800	1300	2000	T	T	T	T
	3	80	200	300	450	600	1000	1600	5000	T	T	T
	4		160	250	350	500	1000	1600	4000	5000	T	T
	6			170	300	400	800	1200	2500	4000	T	T
	10				210	270	500	800	1000	3200	5000	T
	16					270	400	600	1000	1600	3600	5500
	20						340	500	800	1200	3000	4000
	25							420	600	1000	2500	3200
	32								530	1000	1600	2500
	40									680	1000	1600
	50										850	1300
	63											1200
discrimination limit (A)												
C60 H, L	0.5	6000	6000	6000	6000	6000	6000	6000	6000	6000	6000	6000
	0.75	6000	6000	6000	6000	6000	6000	6000	6000	6000	6000	6000
	1	300	450	600	1000	1600	2000	2500	6000	6000	6000	6000
B, C curves	2	150	300	450	600	800	1300	2000	6000	6000	6000	6000
	3	80	200	300	450	600	1000	1600	5000	6000	6000	6000
	4		160	250	350	500	1000	1600	4000	5000	6000	6000
	6			170	300	400	800	1200	2500	4000	6000	6000
	10				210	270	500	800	1000	3200	5000	6000
	16					270	400	600	1000	1600	3600	5500
	20						340	500	800	1200	3000	4000
	25							420	600	1000	2500	3200
	32								530	1000	1600	2500
	40									680	1000	1600
	50										850	1300
	63											1200
discrimination limit (A)												
C60N	0.5	T	T	T	T	T	T	T	T	T	T	T
	0.75	T	T	T	T	T	T	T	T	T	T	T
	1	300	450	600	1000	1600	2000	2500	T	T	T	T
D curve	2		300	450	600	800	1300	2000	T	T	T	T
	3			300	450	600	1000	1600	5000	T	T	T
	4				350	500	1000	1600	4000	5000	T	T
	6					400	800	1200	2500	4000	T	T
	10						500	800	1000	3200	5000	T
	16							600	1000	1600	3600	5500
	20								800	1200	3000	4000
	25									1000	2500	3200
	32										1600	2500
	40											1600
	50											
	63											
discrimination limit (A)												
C60H, L	1	300	450	600	1000	1600	2000	2500	6000	6000	6000	6000
D, MA curves	2		300	450	600	800	1300	2000	6000	6000	6000	6000
	3			300	450	600	1000	1600	5000	6000	6000	6000
	4				350	500	1000	1600	4000	5000	6000	6000
	6					400	800	1200	2500	4000	6000	6000
	10						500	800	1000	3200	5000	6000
	16							600	1000	1600	3600	5500
	20								800	1200	3000	4000
	25									1000	2500	3200
	32										1600	2500
	40											1600
	50											
	63											

The above tables indicate the discrimination limits in the following cases:
- short-circuit between two phases on a three-phase 240/415 V distribution network .

"T" total discrimination, up to the breaking capacity of the downstream circuit-breaker.

11-3.
discrimination (short circuit 415V)
upstream: NG125H/C120N, H, D curves
downstream: C60 N, H, L, L-MA

upstream		**NG125 H/ C120 N, H,** D curve										
In (A)		10	16	20	25	32	40	50	63	80	100	125
downstream	rating											
discrimination limit (A)												
C60N	0.5	T	T	T	T	T	T	T	T	T	T	T
B, C curves	0.75	T	T	T	T	T	T	T	T	T	T	T
	1	400	550	900	1400	1900	2400	3000	T	T	T	T
	2	200	400	550	900	1200	1600	2100	T	T	T	T
	3	130	250	350	650	900	1300	1900	T	T	T	T
	4		140	270	450	700	1100	1700	4000	T	T	T
	6			220	400	600	900	1300	3000	4300	T	T
	10				260	500	600	900	2000	3300	T	T
	16					370	500	700	1400	2000	4300	T
	20						450	600	1100	1800	3500	4500
	25							500	1000	1300	3000	3600
	32								800	1300	1800	2600
	40								500	1000	1300	2200
	50										1100	1800
	63											1500
discrimination limit (A)												
C60 H, L	0.5	6000	6000	6000	6000	6000	6000	6000	6000	6000	6000	6000
	0.75	6000	6000	6000	6000	6000	6000	6000	6000	6000	6000	6000
	1	400	550	900	1400	1900	2400	3000	6000	6000	6000	6000
B, C curves	2	200	400	550	900	1200	1600	2100	6000	6000	6000	6000
	3	130	250	350	650	900	1300	1900	6000	6000	6000	6000
	4		140	270	450	700	1100	1700	4000	6000	6000	6000
	6			220	400	600	900	1300	3000	4300	6000	6000
	10				260	500	600	900	2000	3300	6000	6000
	16					370	500	700	1400	2000	4300	6000
	20						450	600	1100	1800	3500	4500
	25							500	1000	1300	3000	3600
	32								800	1300	1800	2600
	40								500	1000	1300	2200
	50										1100	1800
	63											1500
discrimination limit (A)												
C60N	0.5	T	T	T	T	T	T	T	T	T	T	T
	0.75	T	T	T	T	T	T	T	T	T	T	T
	1	400	550	900	1400	1900	2400	3000	T	T	T	T
D curve	2	200	400	550	900	1200	1600	2100	T	T	T	T
	3		250	350	650	900	1300	1900	T	T	T	T
	4			270	450	700	1100	1700	4000	T	T	T
	6				400	600	900	1300	3000	4300	T	T
	10					500	600	900	2000	3300	T	T
	16						500	700	1400	2000	4300	T
	20								1100	1800	3500	4500
	25								1000	1300	3000	3600
	32									1300	1800	2600
	40										1300	2200
	50											1800
	63											
discrimination limit (A)												
C60H, L	1	400	550	900	1400	1900	2400	3000	6000	6000	6000	6000
D, MA curves	2	200	400	550	900	1200	1600	2100	6000	6000	6000	6000
	3		250	350	650	900	1300	1900	6000	6000	6000	6000
	4			270	450	700	1100	1700	4000	6000	6000	6000
	6				400	600	900	1300	3000	4300	6000	6000
	10					500	600	900	2000	3300	6000	6000
	16						500	700	1400	2000	4300	6000
	20								1100	1800	3500	4500
	25								1000	1300	3000	3600
	32									1300	1800	2600
	40										1300	2200
	50											1800
	63											

The above tables indicate the discrimination limits in the following cases:
- short-circuit between two phases on a three-phase 240/415 V distribution network .

"T" total discrimination, up to the breaking capacity of the downstream circuit-breaker.

11-3.
discrimination

upstream: NG125H/C120N, H, B, C curves
downstream: NG125, C120

upstream		**NG125 H/ C120 N, H,** B curve										
In (A)		10	16	20	25	32	40	50	63	80	100	125
downstream	rating											
discrimination limit	(A)	40	64	80	100	128	160	200	252	320	400	500
NG125	10	■	■	■	■	■	■	■	■	■	■	■
C120	16				■	■	■	■	■	■	■	■
B curve	20					■	■	■	■	■	■	■
	25						■	■	■	■	■	■
	32							■	■	■	■	■
	40								■	■	■	■
	50									■	■	■
	63										■	■
	80											■
	100											
discrimination limit	(A)					128	160	200	252	320	400	500
NG125	10					■	■	■	■	■	■	■
C120	16							■	■	■	■	■
C curve	20								■	■	■	■
	25									■	■	■
	32										■	■
	40											■
	50											
	63											
	80											
	100											
discrimination limit	(A)							200	252	320	400	500
NG125	10							■	■	■	■	■
C120	16									■	■	■
D curve	20										■	■
	25											■
	32											
	40											
	50											
	63											
	80											
	100											

upstream		**NG125 H/ C120 N, H,** C curve										
In (A)		10	16	20	25	32	40	50	63	80	100	125
downstream												
discrimination limit	(A)	80	128	160	200	256	320	400	504	640	800	1000
NG125	10		■	■	■	■	■	■	■	■	■	■
C120	16				■	■	■	■	■	■	■	■
B curve	20					■	■	■	■	■	■	■
	25						■	■	■	■	■	■
	32							■	■	■	■	■
	40								■	■	■	■
	50									■	■	■
	63										■	■
	80											■
	100											
discrimination limit	(A)	80	128	160	200	256	320	400	504	640	800	1000
NG125	10		■	■	■	■	■	■	■	■	■	■
C120	16				■	■	■	■	■	■	■	■
C curve	20					■	■	■	■	■	■	■
	25						■	■	■	■	■	■
	32							■	■	■	■	■
	40								■	■	■	■
	50									■	■	■
	63										■	■
	80											■
	100											
discrimination limit	(A)					256	320	400	504	640	800	1000
NG125	10					■	■	■	■	■	■	■
C120	16						■	■	■	■	■	■
D curve	20								■	■	■	■
	25									■	■	■
	32										■	■
	40											■
	50											
	63											
	80											
	100											

■ discrimination zone

11-3.
discrimination

upstream: NG125H/C120N, H, D curve
downstream: NG125, C120

upstream		**NG125 H/ C120 N, H,** D curve										
In (A)		10	16	20	25	32	40	50	63	80	100	125
downstream	rating											
discrimination limit	(A)		192	240	300	384	480	600	756	960	1200	1500
NG125	10											
C120	16											
B curve	20											
	25											
	32											
	40											
	50											
	63											
	80											
	100											
discrimination limit	(A)		192	240	300	384	480	600	756	960	1200	1500
NG125	10											
C120	16											
C curve	20											
	25											
	32											
	40											
	50											
	63											
	80											
	100											
discrimination limit	(A)		192	240	300	384	480	600	756	960	1200	1500
NG125	10											
C120	16											
D curve	20											
	25											
	32											
	40											
	50											
	63											
	80											
	100											

discrimination zone

11-3.
discrimination
upstream: Compact NS
downstream: DPN, C60, C120, NG125

upstream		NS100N/H/L		NS160N/HL				NS250N/H/L			NS100N/H/L - NS160N/H/L NS250N/H/L			
		TM-D trip unit									STR22SE trip unit			
In (A)		80	100	80	100	125	160	160	200	250	100	160	200	250
downstream	rating (A)													
DPNa, DPN N	⩽40		1.2											
C60a	⩽50		1.2								1.2			
	63		1.2								1.2			
C60N	⩽25	1.2	1.2								1.2			
	32/50	1.2	1.2								1.2			
	63	1.2	1.2								1.2			
C60H	⩽25	1.2	1.2								1.2			
	32/50	1.2	1.2								1.2			
	63		1.2								1.2			
C60L	⩽25	1.2	1.2								1.2			
	50	1.2	1.2	15							1.2			
	63		1.2								1.2			
C120N	⩽50	1.2	1.2								1.2			
C120H	63		1.2								1.2			
	80													
	100													
	125													
		1.2	1.2								1.2			
NG125H	25/32	1.2	1.2								1.2			
	40	1.2	1.2								1.2			
	50	1.2	1.2	7	7	7	7				1.2	2.5	2.5	2.5
	63		1.2		4	4	4				1.2	2.5	2.5	2.5
	80					2.5	2.5					2.5	2.5	2.5
	100						25					2.5	2.5	2.5
	125												2.5	2.5
NG125L	⩽ 16	1.2	1.2								1.2			
	20	1.2	1.2								1.2			
	25/32	1.2	1.2								1.2			
	40	1.2	1.2								1.2			
	50	1.2	1.2	10	10	10	10				1.2	2.5	2.5	2.5
	63		1.2		7	7	7				1.2	2.5	2.5	2.5
	80					4	4					2.5	2.5	2.5

total discrimination but Isc max. = downstream circuit-breaker Icu
1.2 discrimination limit = 1.2 kA
no discrimination

11-3.
discrimination
upstream: BS88 fuses
downstream: C120N, H, B, C, D curves

upstream		**BS88 fuses**																
In (A)		2	4	6	10	16	20	25	32	35	40	50	63	80	100	125	160	200
downstream	In (A)																	
Isc max. (kA)														80	80	80	80	80
C120N	63													1600	2000	2500	5000	T
B curve	80														1800	2200	4800	T
	100															1800	4000	7000
	125																3200	6000
downstream	In (A)																	
Isc max. (kA)																80	80	80
C120N	63															2500	6000	T
C curve	80																4800	T
	100																	7000
	125																	
downstream	In (A)																	
Isc max. (kA)																	80	80
C120N	63																6000	T
D curve	80																	T
	100																	7000
	125																	
downstream	In (A)																	
Isc max. (kA)							80	80	80	80	80	80	80	80	80	80	80	80
C120H	10						350	500	700	1100	1800	2500	4500	6000	7000	10000	T	T
B curve	16								600	950	1500	2000	3800	4700	5500	8500	T	T
	20									800	1200	1800	3000	4000	4500	7000	T	T
	25										1000	1500	2500	3000	3500	5000	T	T
	32											1200	2000	2500	3000	4200	T	T
	40												1800	2100	2500	3500	10000	T
	50													1800	2200	3000	7500	T
	63													1600	2000	2500	6000	T
	80														1800	2200	4800	10000
	100															1800	4000	7000
	125																3200	6000
downstream	In (A)																	
Isc max. (kA)									80	80	80	80	80	80	80	80	80	80
C120H	10								700	1100	1800	2500	4500	6000	7000	10000	T	T
C curve	16										1500	2000	3800	4700	5500	8500	T	T
	20											1800	3000	4000	4500	7000	T	T
	25												2500	3000	3500	5000	T	T
	32													2500	3000	4200	T	T
	40													2100	2500	3500	10000	T
	50														2200	3000	7500	T
	63															2500	6000	T
	80																4800	10000
	100																	7000
	125																	
downstream	In (A)																	
Isc max. (kA)									80	80	80	80	80	80	80	80	80	80
C120H	10								700	1100	1800	2500	4500	6000	7000	10000	T	T
D curve	16											2000	3800	4700	5500	8500	T	T
	20												3000	4000	4500	7000	T	T
	25													3000	3500	5000	T	T
	32													2500	3000	4200	T	T
	40														2500	3500	10000	T
	50															3000	7500	T
	63																6000	T
	80																	10000
	100																	7000
	125																	

"T" total discrimination, up to the breaking capacity of the downstream circuit-breaker.

11-3.
discrimination
upstream: BS88 fuses
downstream: NG125 H

upstream	In (A)	BS88 fuses																
		2	4	6	10	16	20	25	32	35	40	50	63	80	100	125	160	200
downstream	In (A)																	
									100	100	100	100	100	100	100	36	36	36
NG125H	10								1100	1700	2800	4100	8500	10000	16000	30000		
C curve	16									1200	2000	3000	5800	7000	10000	18000		
	20										1500	2400	4400	5000	7000	12000		
	25											2000	3400	4000	5000	8000		
	32												2600	3000	3800	5500	30000	
	40													2600	3000	4000	15000	
	50													2000	2600	3200	8000	22000
	63														2000	2600	6200	14000
	80																4800	9000
	100																	7000
	125																	

total discrimination
3000 discrimination limit = 3 000A
no discrimination

11-4. cascading (back-up) and enhanced discrimination at 415V

With traditional circuit breakers, cascading between two devices generally results in no discrimination.
With Compact NS circuit breakers, the discrimination characteristics in the tables remain applicable and are in some cases even enhanced. Protection discrimination is ensured for short-circuit currents greater than the rated breaking capacity of the circuit breaker and even, in some cases, for its enhanced breaking capacity. In the latter case, **protection discrimination is total**, i.e. only the downstream device trips for any and all possible faults at its point in the installation.

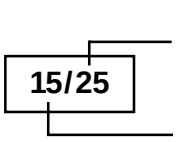
Example
Consider a combination between:
- a Compact NS250N with trip unit TM250D
- a Compact NS100N with trip unit TM100D.

The discrimination tables* indicate total discrimination. Protection discrimination is therefore ensured up to the breaking capacity of the NS100N, i.e. **25 kA**.
The cascading tables indicate an enhanced breaking capacity of **36 kA**.
The enhanced discrimination tables indicate that in a cascading configuration, discrimination is ensured up to **36 kA**, i.e. for any and all possible faults at that point in the installation.

*Refer page 235 of Compact catalogue (ABTED397054EN) for discrimination tables.

Enhanced discrimination tables

For each combination of two circuit breakers, the tab



downstream device breaking capacity enhanced by cascading

The shaded background indicates that the two values are equal, i.e. for all faults likely to occur downstream, only the downstream device trips (total discrimination).

enhanced selectivity limit

Technical principle

Enhanced discrimination is the result of the exclusive Compact NS Roto-active breaking technique which operates as follows:
- due to the short-circuit current (electrodynamic forces), the contacts in both devices simultaneously separate. The result is major limitation of the short-circuit current;
- the dissipated energy provokes the reflex tripping of the downstream device, but is insufficient to trip the upstream device.

Upstream circuit breaker: Compact NS160 to NS250. Downstream circuit breaker: Multi 9

Upstream		**NS160N**				**NS250N**			**NS160H/L**				**NS250H/L**		
		36 kA				**36 kA**			**70/150 kA**				**70/150 kA**		
	trip unit	**TM-D**													
Downstream	rating	80	100	125	160	160	200	250	80	100	125	160	160	200	250
C60N 6 kA	≤16	25/25	25/25	25/25	25/25	25/25	25/25	25/25	30/30	30/30	30/30	30/30	30/30	30/30	30/30
or	20 - 25	25/25	25/25	25/25	25/25	25/25	25/25	25/25	30/30	30/30	30/30	30/30	30/30	30/30	30/30
QOE 10 kA	32 - 40	15/25	25/25	25/25	25/25	25/25	25/25	25/25	15/30	30/30	30/30	30/30	30/30	30/30	30/30
	50	15/25	25/25	25/25	25/25	25/25	25/25	25/25	15/30	30/30	30/30	30/30	30/30	30/30	30/30
	63		25/25	25/25	25/25	25/25	25/25	25/25		30/30	30/30	30/30	30/30	30/30	30/30
C60H 10 kA	≤16	30/30	30/30	30/30	30/30	30/30	30/30	30/30	50/50	50/50	50/50	50/50	40/40	40/40	40/40
or	20 - 25	30/30	30/30	30/30	30/30	30/30	30/30	30/30	50/50	50/50	50/50	50/50	40/40	40/40	40/40
V40H 10 kA	32 - 40	15/30	30/30	30/30	30/30	30/30	30/30	30/30	15/50	50/50	50/50	50/50	40/40	40/40	40/40
	50	15/30	30/30	30/30	30/30	30/30	30/30	30/30	15/40	40/40	40/40	40/40	30/30	30/30	30/30
	63		30/30	30/30	30/30	30/30	30/30	30/30		40/40	40/40	40/40	30/30	30/30	30/30
C120N 10kA	<=40	25/25	25/25	25/25	25/25	25/25	25/25	25/25	25/25	25/25	25/25	25/25	25/25	25/25	25/25
C120H 15kA	50	2.5/25	2.5/25	2.5/25	2.5/25	25/25	25/25	25/25		2.5/25	2.5/25	2.5/25	25/25	25/25	25/25
	63		2.5/25	2.5/25	2.5/25	25/25	25/25	25/25		2.5/25	2.5/25	2.5/25	25/25	25/25	25/25
	80				2.5/25	25/25	25/25	25/25				2.5/25	25/25	25/25	25/25
	100				2.5/25	25/25	25/25	25/25				2.5/25	25/25	25/25	25/25
	125						25/25	25/25						25/25	25/25
	trip unit	**STR22SE**													
Downstream	rating	100		160		250			100		160		250		
C60N 6 kA	≤63	1.2/25		25/25		25/25			1.2/30		30/30		30/30		
QOE 10 kA	≤63	1.2/25		25/25		25/25			1.2/30		30/30		30/30		
C60H 10 kA	≤40	1.2/25		30/30		30/30			1.2/40		50/50		40/40		
C60H 10 kA	50-63	1.2/25		30/30		30/30			1.2/40		40/40		40/40		
V40H 10kA	≤40A	1.2/25		30/30		30/30			1.2/40		50/50		40/40		
C120N 10kA	<=25	25/25		25/25		25/25			25/25		25/25		25/25		
C120H 15kA	32-40			25/25		25/25					25/25		25/25		
	50-63			2.5/25		25/25					2.5/25		25/25		
	80-100					25/25							25/25		

Upstream		**NS160H**				**NS250H**			**NS160L**				**NS250L**		
		70 kA				**70 kA**			**150 kA**				**150 kA**		
	trip unit	**TM-D or STR22SE**													
Downstream	rating	80	100	125	160	160	200	250	80	100	125	160	160	200	250
NG125H	16	50/50	50/50	50/50	50/50	50/50	50/50	50/50	100/100	100/100	100/100	100/100	100/100	100/100	100/100
36kA	20	50/50	50/50	50/50	50/50	50/50	50/50	50/50	30/100	100/100	100/100	100/100	100/100	100/100	100/100
	25 - 32	50/50	50/50	50/50	50/50	50/50	50/50	50/50	15/100	30/100	100/100	100/100	100/100	100/100	100/100
	40	50/50	50/50	50/50	50/50	50/50	50/50	50/50	5/100	15/100	30/100	100/100	100/100	100/100	100/100
	50	2.5/50	2.5/50	2.5/50	2.5/50	50/50	50/50	50/50	2.5/100	2.5/100	2.5/100	30/100	100/100	100/100	100/100
	63		2.5/50	2.5/50	2.5/50	50/50	50/50	50/50		2.5/100	2.5/100	2.5/100	100/100	100/100	100/100
	80				2.5/50	50/50	50/50	50/50				2.5/100		100/100	100/100

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