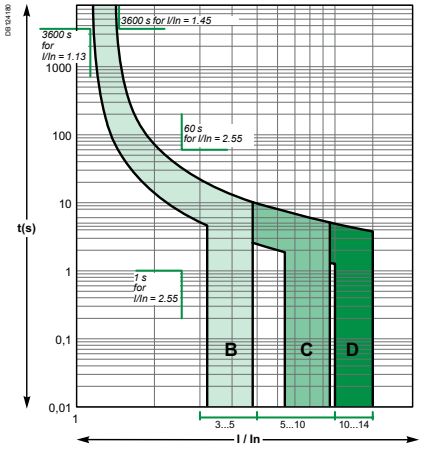
Tripping curves
According to IEC/EN 60898-1 standards

Alternative current 50/60 Hz

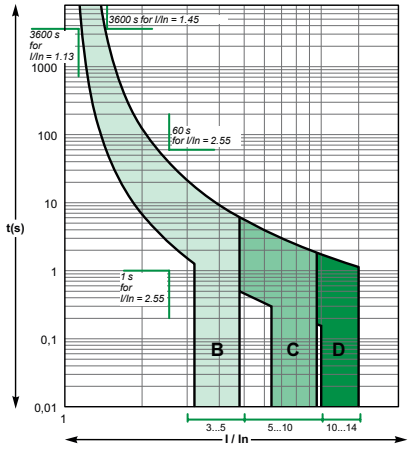
iC60a/N/H/L

According to IEC/EN 60898-1 (reference temperature 30°C)

Curves B, C, D rating up to 4 A



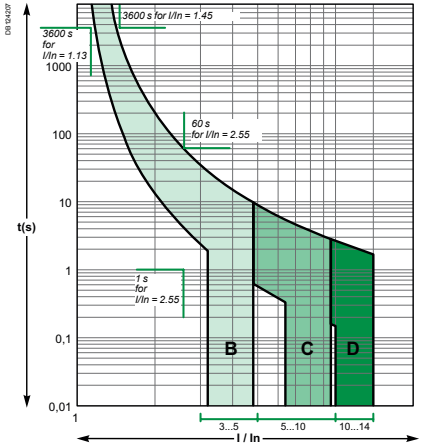
Curves B, C, D rating 6 A to 63 A



C120N/H

According to IEC/EN 60898-1 (reference temperature 30°C)

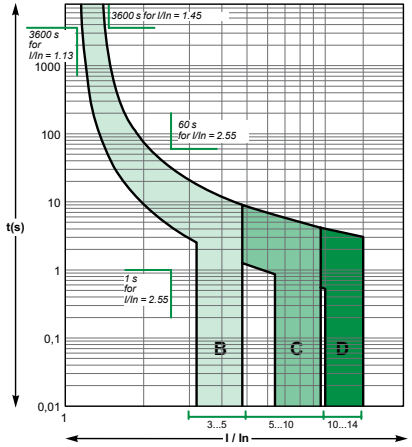
Curves B, C, D



DPN, DPN N (circuit-breaker and residual current device)

According to IEC/EN 60898-1 (reference temperature 30°C)

Curves B, C, D



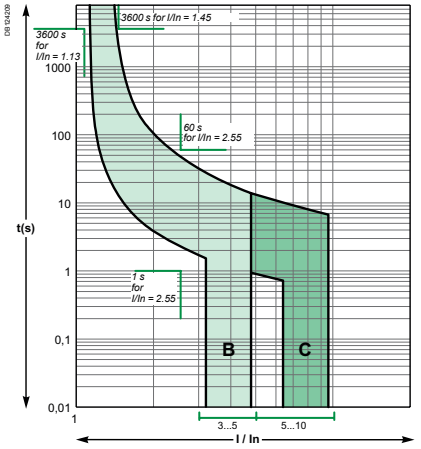
Tripping curves
According to IEC/EN 60898-1 standards

Alternative current 50/60 Hz

iK60

According to IEC/EN 60898-1 (reference temperature 30°C)

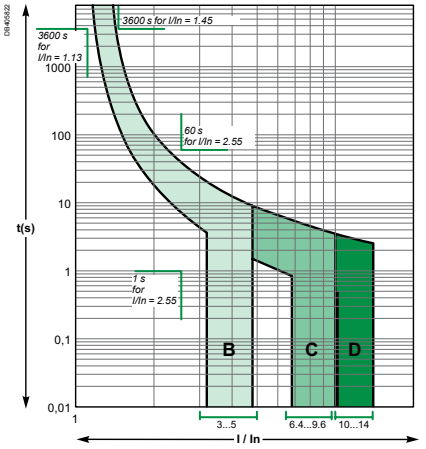
Curves B, C



C60

According to IEC/EN 60898-1 (reference temperature 30°C)

Curves B, C, D



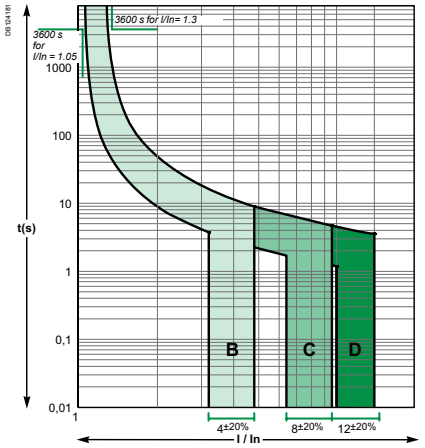
Tripping curves
According to IEC/EN 60947-2 standards

Alternative current 50/60 Hz

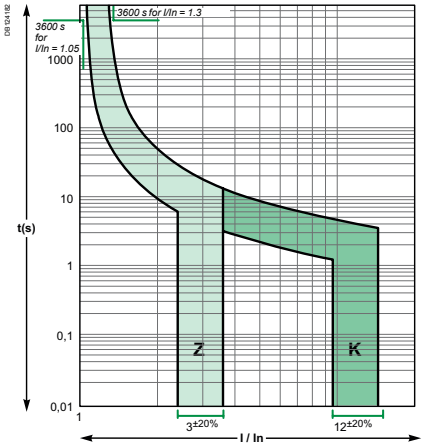
iC60N/H/L

According to IEC/EN 60947-2 (reference temperature 50°C)

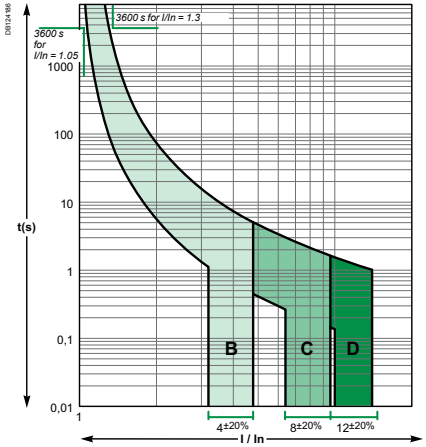
Curves B, C, D rating up to 4 A



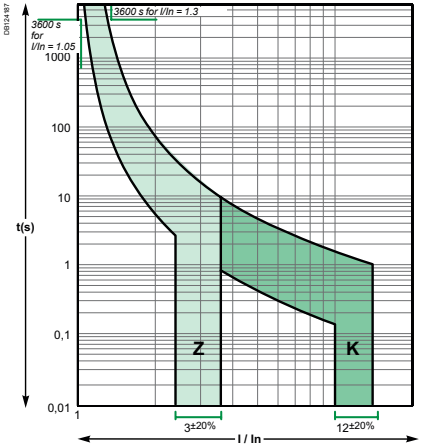
Curves Z, K rating up to 4 A



Curves B, C, D rating 6 A to 63 A



Curves Z, K rating 6 A to 63 A



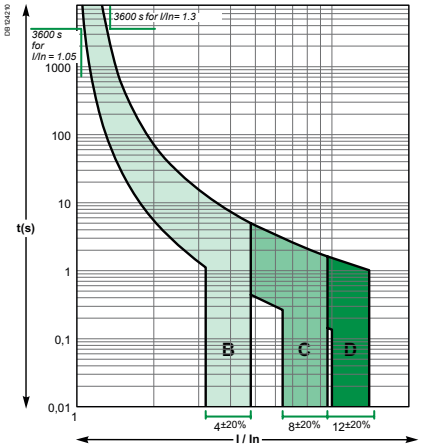
Tripping curves
According to IEC/EN 60947-2 standards

Alternative current 50/60 Hz

Reflex iC60N/H

According to IEC/EN 60947-2 (reference temperature 50°C)

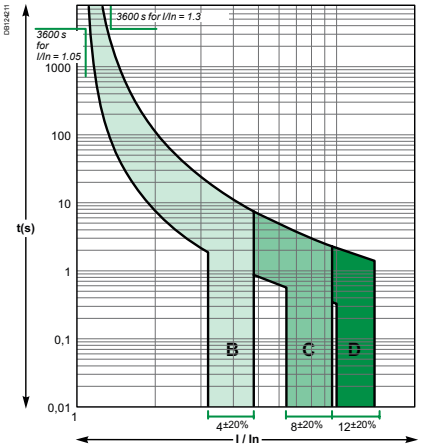
Curves B, C, D



NG125a/N/H/L

According to IEC/EN 60947-2 (reference temperature 40°C)

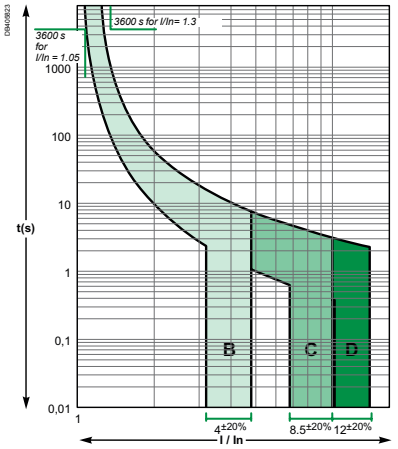
Curves B, C, D



C60

According to IEC/EN 60947-2 (reference temperature 50°C)

Curves B, C, D

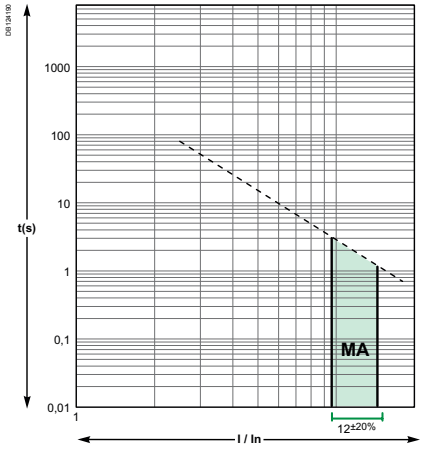


Tripping curves
According to IEC/EN 60947-2 standards

Motor curve

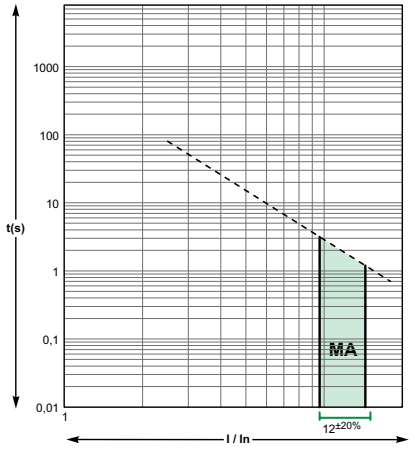
iC60L-MA
According to IEC/EN 60947-2

Curve MA



NG125L-MA
According to IEC/EN 60947-2

Curve MA

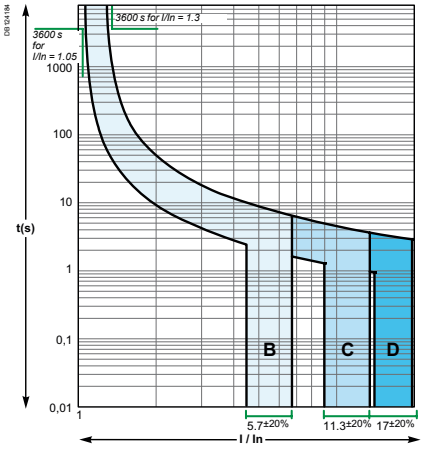


Tripping curves
According to IEC/EN 60947-2 standards

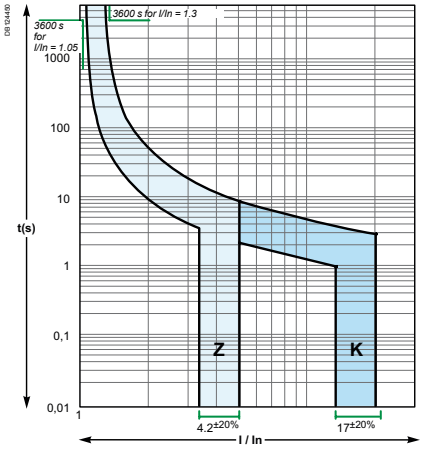
Direct current

iC60N/H/L
According to IEC/EN 60947-2 (reference temperature 50°C)

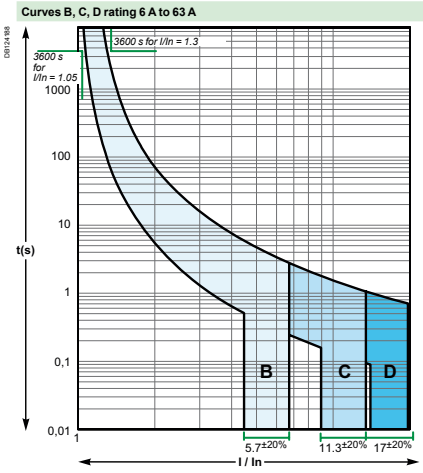
Curves B, C, D rating up to 4 A



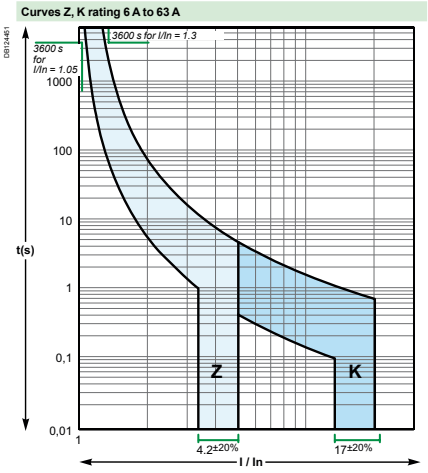
Curves Z, K rating up to 4 A



Curves B, C, D rating 6 A to 63 A



Curves Z, K rating 6 A to 63 A

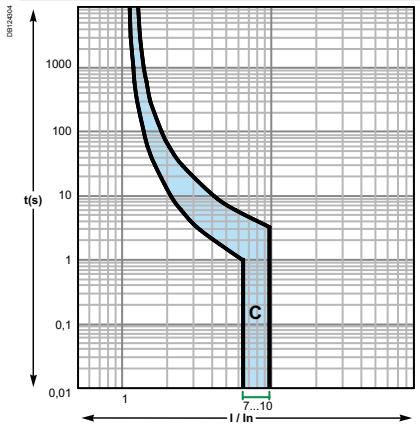


Tripping curves
According to IEC/EN 60947-2 standards

Direct current

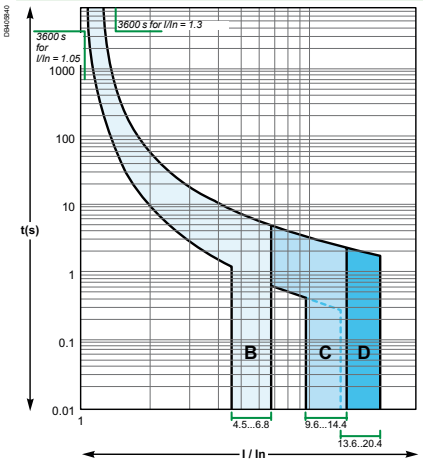
C60H-DC
According to IEC/EN 60947-2 (reference temperature 25°C)

Curve C



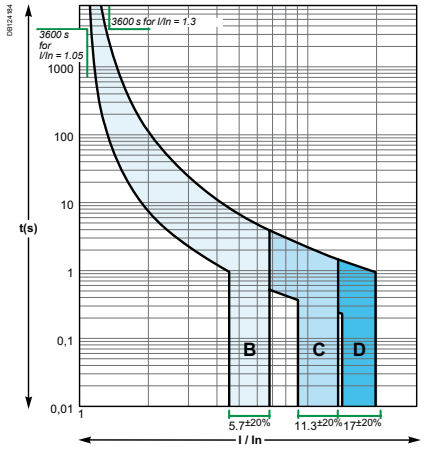
C60
According to IEC/EN 60947-2 (reference temperature 50°C)

Curves B, C, D

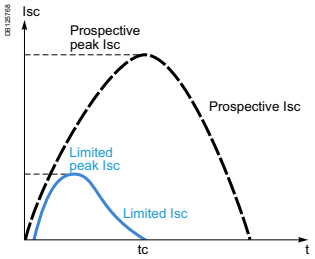


NG125a/N/H/L
According to IEC/EN 60947-2 (reference temperature 40°C)

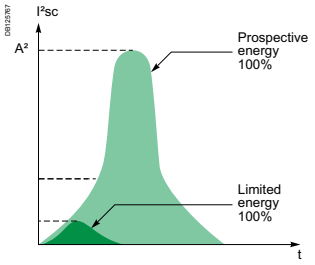
Curves B, C, D



Short-circuit current limiting



Prospective current and real limit current.



Definition
The limiting capacity of a circuit breaker is its ability to lessen the effects of a short circuit on an electrical installation by reducing the current amplitude and the dissipated power.

Benefits of limiting

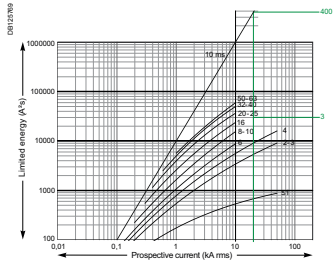
Long installation service life
Thermal effects
Lower temperature rise at the conductor level, hence increased service life for cables and all components that are not self-protected (e.g. switches, contactors, etc.)
Mechanical effects
Lower electrodynamic repulsion forces, hence less risk of deformation or breakage of electrical contacts and busbars.
Electromagnetic effects
Less interference on sensitive equipment located in the vicinity of an electric circuit.

Savings through cascading
Cascading is a technique derived directly from current limiting: downstream of a current-limiting circuit breaker it is possible to use circuit breakers of breaking capacity lower than the prospective short-circuit current (in line with the cascading tables). The breaking capacity is heightened thanks to current limiting by the upstream device. Substantial savings can be achieved in this way on switchgear and enclosures.

Discrimination of protection devices
The circuit breakers' current limiting capacity improves discrimination with the protection devices located upstream: this is because the required energy passing through the upstream protection device is greatly reduced and can be not enough to cause it to trip. Discrimination can thus be natural without having to install a time-delayed protection device upstream.

Acti 9 circuit breaker current limiting
Profiting from Schneider Electric's experience and expertise in the field of short-circuit current breaking, the circuit breakers of the Acti 9 range have a top-level current limiting characteristic for modular devices.
This assures them of optimal protection of the entire power distribution system.

Short-circuit current limiting (cont.)



Representation: Current limiting curves

The current limiting capacity of a circuit breaker is reflected by 2 curves which give, as a function of the prospective short-circuit current (current which would flow in the absence of a protection device):

- the real peak current (limited)
- the thermal stress (in A^2s), this value, multiplied by the resistance of any element through which the short-circuit current passes, gives the power dissipated by this element.

The straight line "10 ms" representing the energy A^2s of a prospective short-circuit current of a half-period (10 ms) indicates the energy that would be dissipated by the short-circuit current in the absence of limiting by the protection device (see example).

Example

What is the energy limited by an iC60N 25 A circuit breaker for a prospective short-circuit current of 10 kA rms. What is the quality of current limiting?

> as shown in the graph opposite:

- this short-circuit current (10 kA rms) is likely to dissipate up to 1,000 kA^2s
- the iC60N circuit breaker reduces this thermal stress to: 35 kA^2s, which is 22 times less.

Example of use: Stresses acceptable by the cables

The following table shows the thermal stresses acceptable by the cables depending on their insulation, their composition (Cu or Al) and their cross section. Cross-section values are expressed in mm^2 and stresses in A^2s.

S (mm^2)		1.5	2.5	4	6	10
PVC	Cu	2.97×10^4	8.26×10^4	2.12×10^5	4.76×10^5	1.32×10^6
	Al					5.41×10^5
PRC	Cu	4.10×10^4	1.39×10^5	2.92×10^5	6.56×10^5	1.82×10^6
	Al					7.52×10^5
S (mm^2)		**16**	**25**	**35**	**50**	
PVC	Cu	3.4×10^6	8.26×10^6	1.62×10^7	3.21×10^7	
	Al	1.39×10^6	3.38×10^6	6.64×10^6	1.35×10^7	
PRC	Cu	4.69×10^6	1.39×10^7	2.23×10^7	4.56×10^7	
	Al	1.93×10^6	4.70×10^6	9.23×10^6	1.88×10^7	

Example

Is a Cu/PVC cable of cross section 10 mm^2 protected by a NG125L device?

The above table shows that the acceptable stress is 1.32×10^6 A^2s. Any short-circuit current at the point where a NG125L device (Icu = 25 kA) is installed will be limited, with a thermal stress of less than 2.2×10^5 A^2s. (Curve on page 532).
The cable is therefore always protected up to the breaking capacity of the circuit breaker.

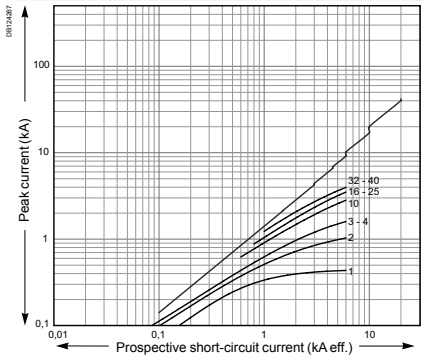
Short-circuit current limiting (cont.)

Limitation curves for network
Ue: 380-415 V AC (Ph/N 220-240 V AC)

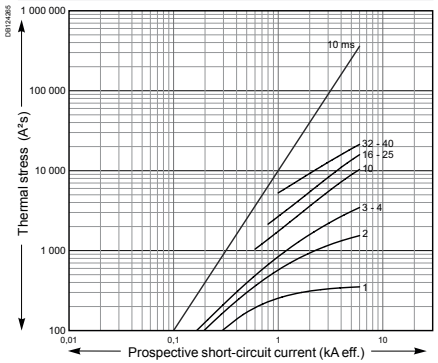
DPN (MCB and RCBO)

1P+N / 3P / 3P+N

Peak current



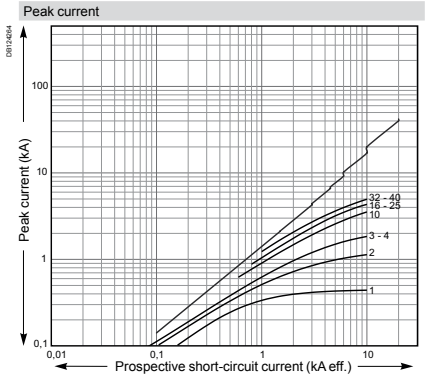
Thermal stress



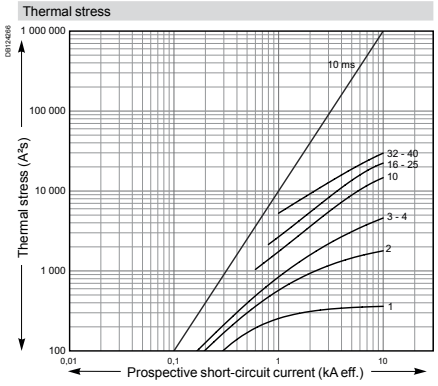
DPN N (MCB and RCBO)

1P+N / 3P / 3P+N

Peak current



Thermal stress



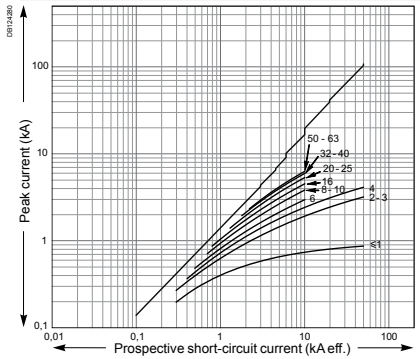
Short-circuit current limiting (cont.)

Limitation curves for network
Ue: 380-415 V AC (Ph/N 220-240 V AC)

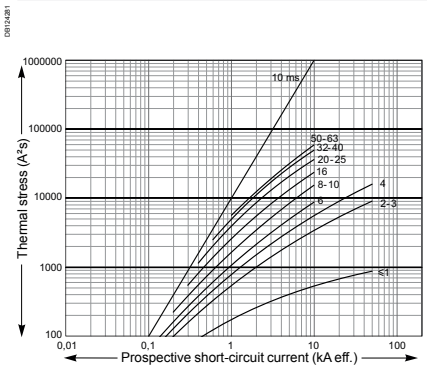
iC60N

1P / 1P+N / 2P / 3P / 4P

Peak current



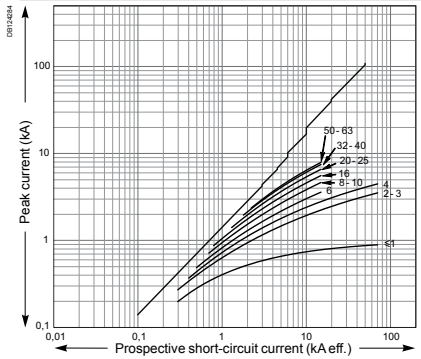
Thermal stress



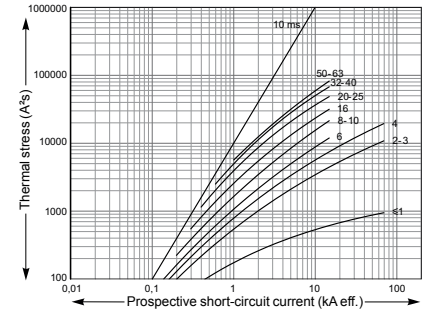
iC60H

1P / 1P+N / 2P / 3P / 4P

Peak current



Thermal stress



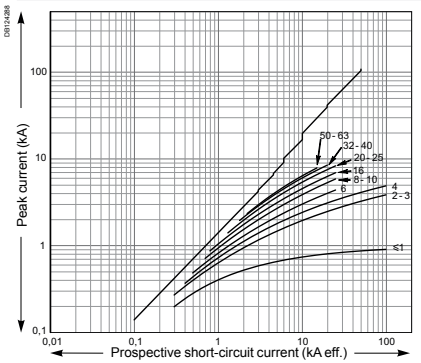
Short-circuit current limiting (cont.)

Limitation curves for network
Ue: 380-415 V AC (Ph/N 220-240 V AC)

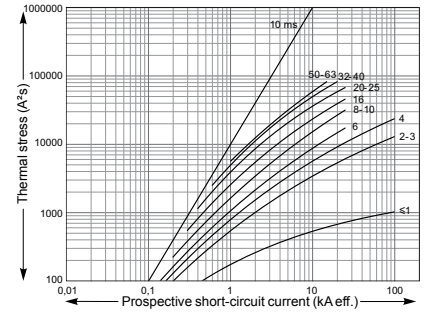
iC60L

1P / 2P / 3P / 4P

Peak current



Thermal stress



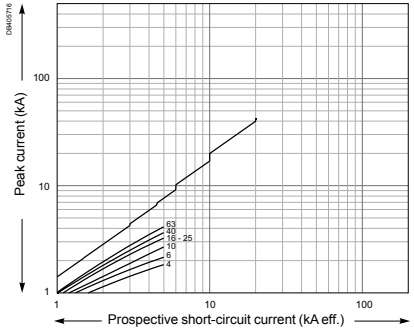
Short-circuit current limiting (cont.)

Limitation curves for network
Ue: 380-415 V AC (Ph/N 220-240 V AC)

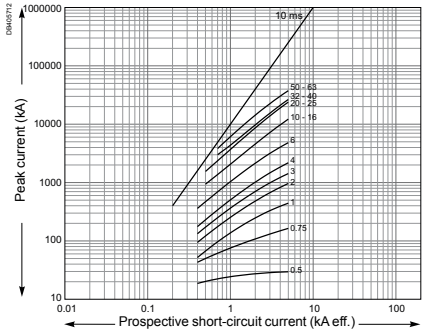
C60a

1P / 2P / 3P / 3P+N / 4P

Peak current



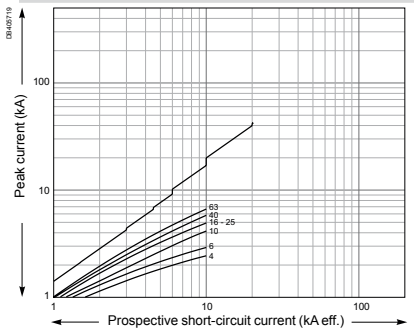
Thermal stress



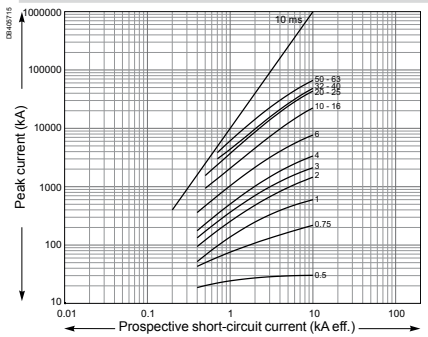
C60N

1P / 1P+N / 2P / 3P / 3P+N / 4P

Peak current



Thermal stress



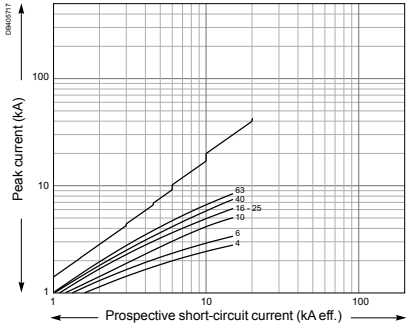
Short-circuit current limiting (cont.)

Limitation curves for network
Ue: 380-415 V AC (Ph/N 220-240 V AC)

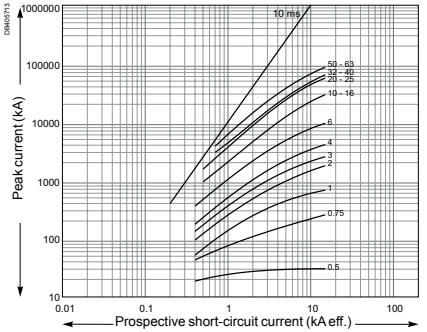
C60H

1P / 1P+N / 2P / 3P / 3P+N / 4P

Peak current



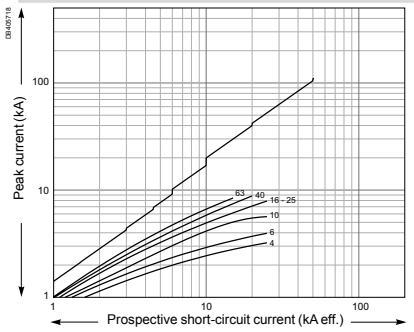
Thermal stress



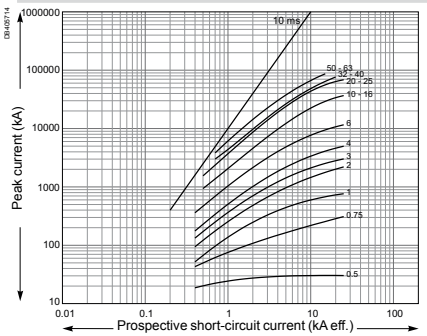
C60L

1P / 2P / 3P / 4P

Peak current



Thermal stress



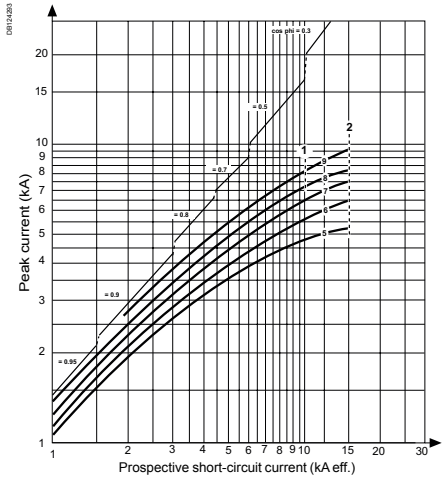
Short-circuit current limiting (cont.)

Limitation curves for network
Ue: 380-415 V AC (Ph/N 220-240 V AC)

C120N, H

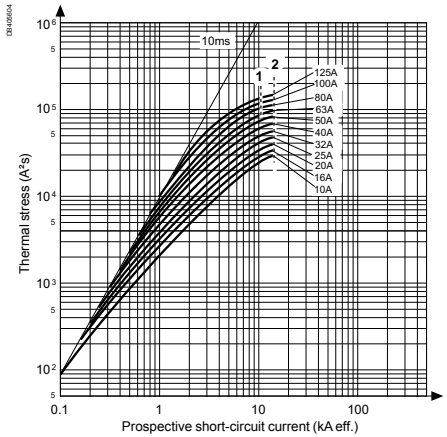
1P / 2P / 3P / 4P

Peak current



■ 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: 80-125 A

Thermal stress



■ Circuit breaker type in accordance with the mark:
- □ 1: C120N
- □ 2: C120H

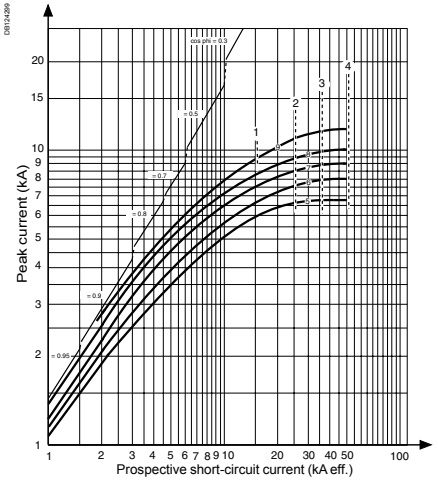
Short-circuit current limiting (cont.)

Limitation curves for network
Ue: 380-415 V AC (Ph/N 220-240 V AC)

NG125a, N, H, L

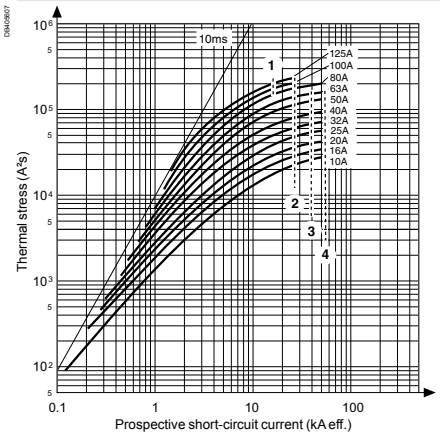
1P / 2P / 3P / 4P

Peak current



■ Circuit breaker type in accordance with the mark:
- □ 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: 80-125 A

Thermal stress



■ Circuit breaker type in accordance with the mark:
- □ 1: NG125a 80-100-125 A
- □ 2: NG125N
- □ 3: NG125H
- □ 4: NG125L

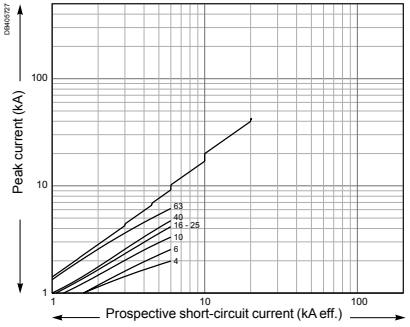
Short-circuit current limiting (cont.)

Limitation curves for network
Ue: 440 V AC

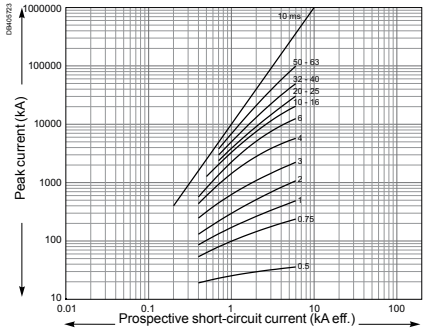
C60N

2P / 3P / 4P

Peak current



Thermal stress



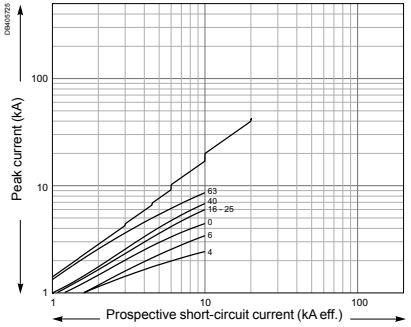
Short-circuit current limiting (cont.)

Limitation curves for network
Ue: 440 V AC

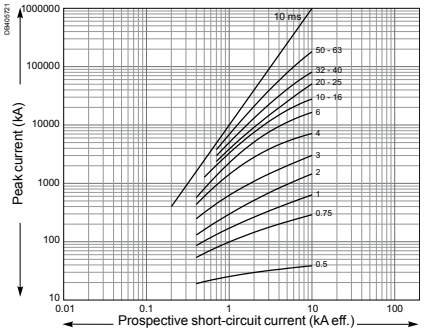
C60H

2P / 3P / 4P

Peak current



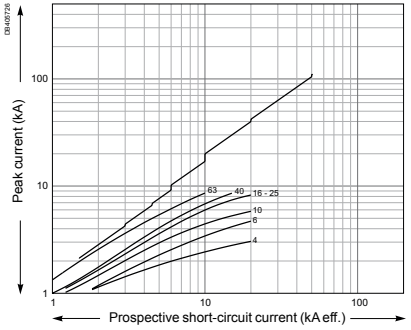
Thermal stress



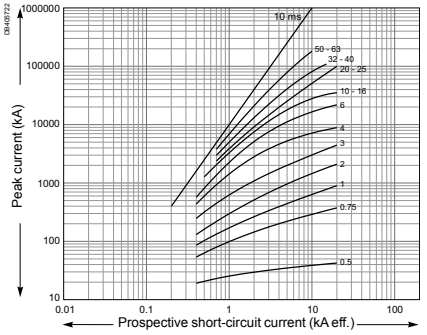
C60L

2P / 3P / 4P

Peak current



Thermal stress



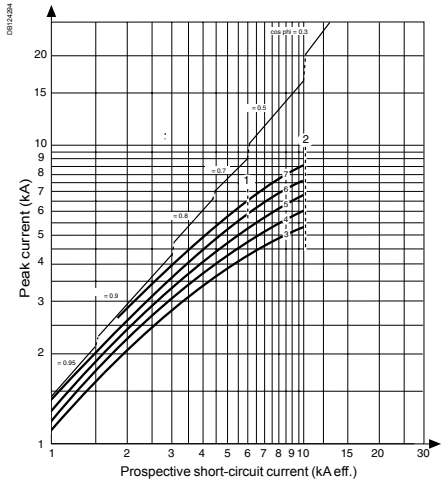
Short-circuit current limiting (cont.)

Limitation curves for network
Ue: 440 V AC

C120N, H

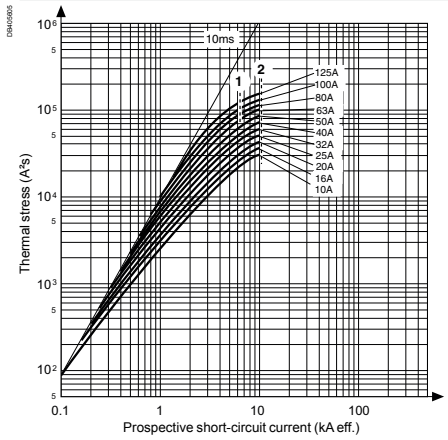
2P / 3P / 4P

Peak current



■ Circuit breaker type in accordance with the mark:
- □ 1: C120N
- □ 2: C120H
- □ 3: 0-16 A
- □ 4: 20-25 A
- □ 5: 32-40 A
- □ 6: 50-63 A
- □ 7: 80-125 A

Thermal stress



■ Circuit breaker type in accordance with the mark:
- □ 1: C120N
- □ 2: C120H

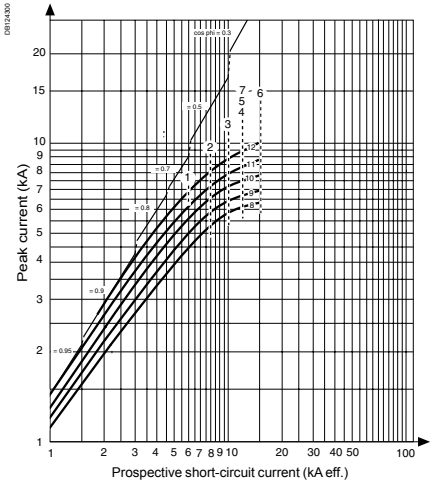
Short-circuit current limiting (cont.)

Limitation curves for network
Ue: 550 V AC

NG125a, N, H, L

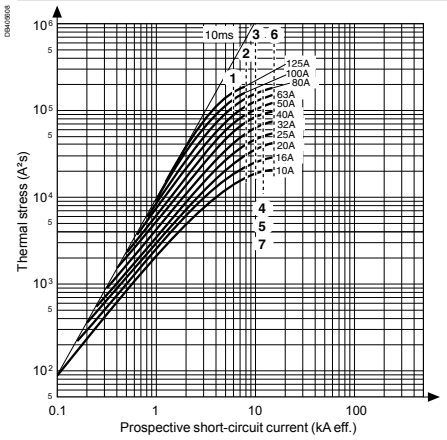
2P / 3P / 4P

Peak current



■ Circuit breaker type in accordance with the mark:
- □ 1: NG125a 3, 4P
- □ 2: NG125N 2, 3, 4P
- □ 3: NG125H 3, 4P
- □ 4-5: NG125H 2P/NG125L 3, 4P
- □ 6: NG125L 2P
- □ 7: NG125 LMA 2, 3, 4P
- □ 8: 10 -16 A
- □ 9: 20-25 A
- □ 10: 32-40 A
- □ 11: 50-63 A
- □ 12: 80-125 A

Thermal stress



■ Circuit breaker type in accordance with the mark:
- □ 1: NG125a 3, 4P
- □ 2: NG125N 2, 3, 4P
- □ 3: NG125H 3, 4P
- □ 4-5: NG125H 2P/NG125L 3, 4P
- □ 6: NG125L 2P
- □ 7: NG125LMA 2, 3, 4P

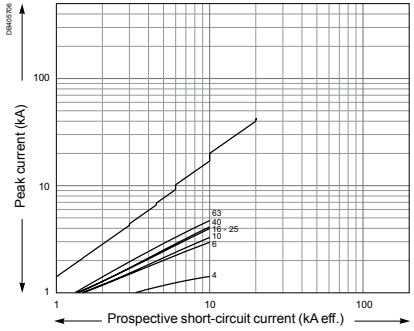
Short-circuit current limiting (cont.)

Limitation curves for network
Ue: 220-240 V AC (Ph/N 110-130 V AC)

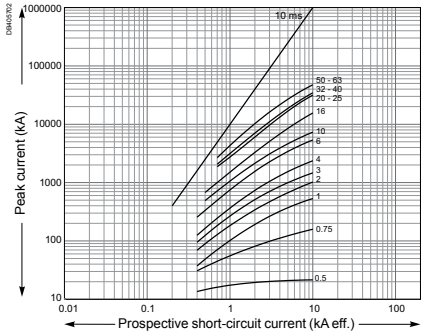
C60a

1P / 2P / 3P / 3P+N / 4P

Peak current



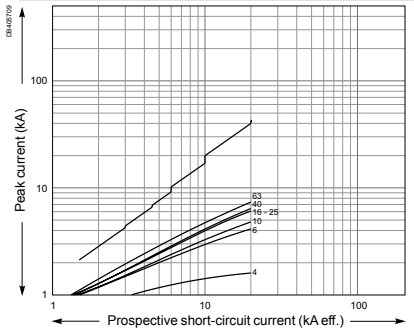
Thermal stress



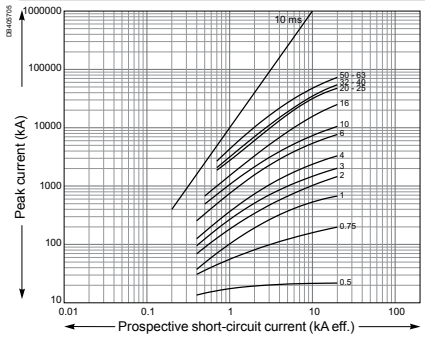
C60N

1P / 1P+N / 2P / 3P / 3P+N / 4P

Peak current



Thermal stress



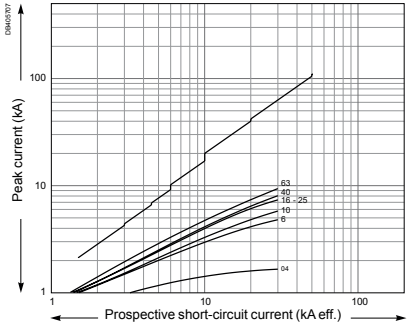
Short-circuit current limiting (cont.)

Limitation curves for network
Ue: 220-240 V AC (Ph/N 110-130 V AC)

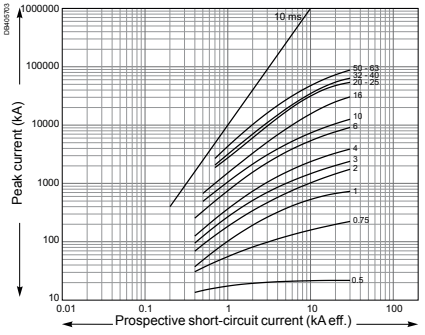
C60H

1P / 1P+N / 2P / 3P / 3P+N / 4P

Peak current



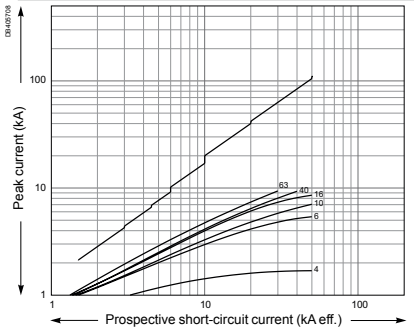
Thermal stress



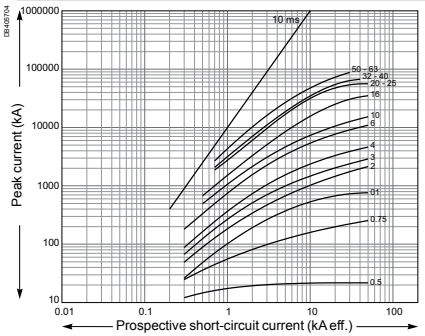
C60L

1P / 2P / 3P / 4P

Peak current



Thermal stress



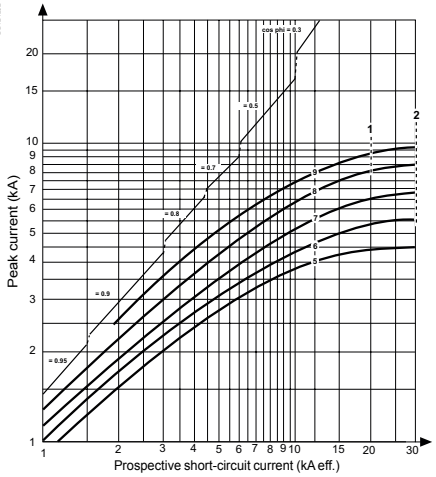
Short-circuit current limiting (cont.)

Limitation curves for network
Ue: 220-240 V AC (Ph/N 110-130 V AC)

C120N, H

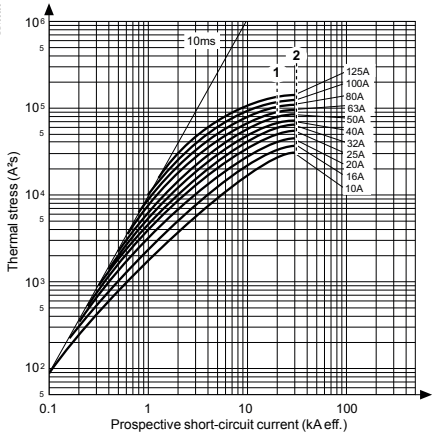
1P / 2P / 3P / 4P

Peak current



■ 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: 80-125 A

Thermal stress



■ Circuit breaker type in accordance with the mark:
- □ 1: C120N
- □ 2: C120H

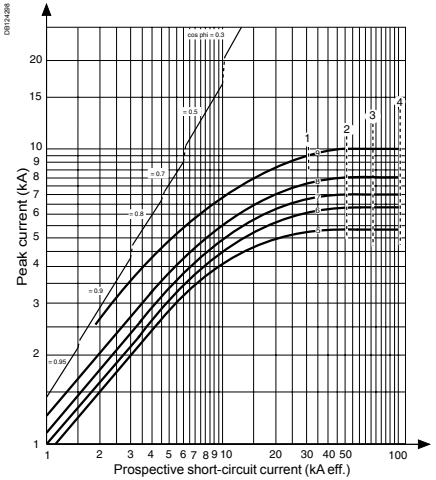
Short-circuit current limiting (cont.)

Limitation curves for network
Ue: 220-240 V AC (Ph/N 110-130 V AC)

NG125a, N, H, L

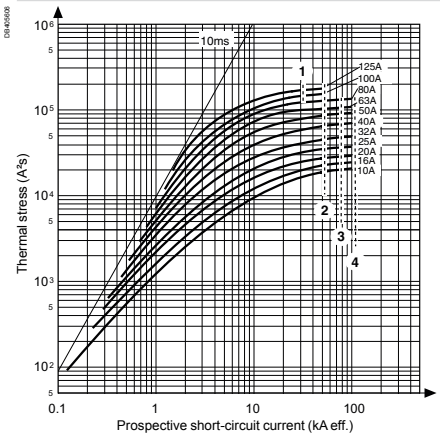
1P / 2P / 3P / 4P

Peak current



■ Circuit breaker type in accordance with the mark:
- □ 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: 80-125 A

Thermal stress



■ Circuit breaker type in accordance with the mark:
- □ 1: NG125a 80-100-125 A
- □ 2: NG125N
- □ 3: NG125H
- □ 4: NG125L

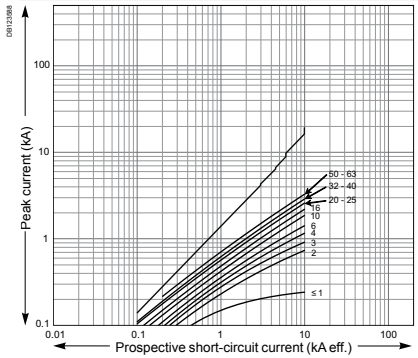
Short-circuit current limiting (cont.)

Limitation curves for direct current network

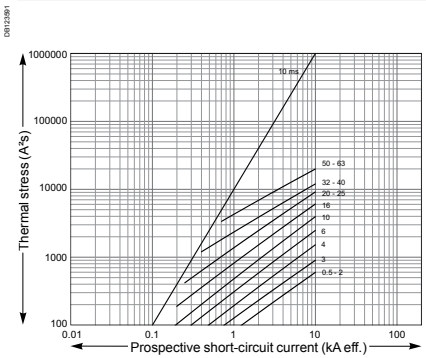
C60H-DC curve C

1P (220 V) - 2P (440 V)

Peak current



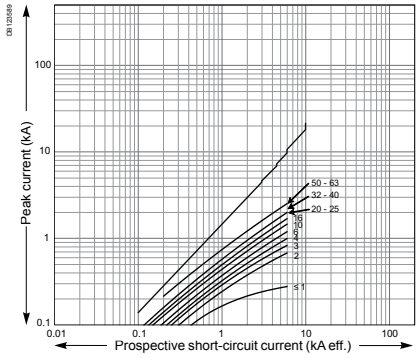
Thermal stress



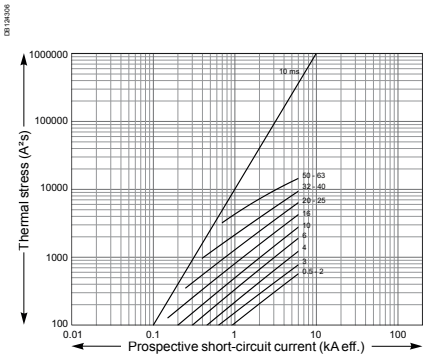
C60H-DC curve C

1P (250 V DC) - 2P (500 V DC)

Peak current



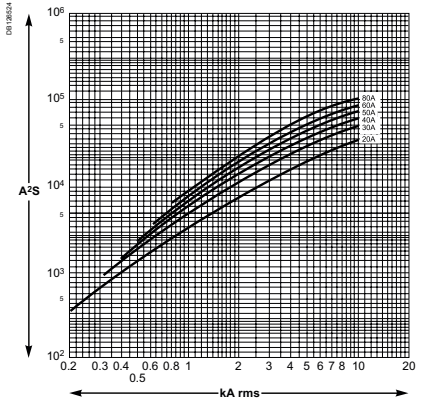
Thermal stress



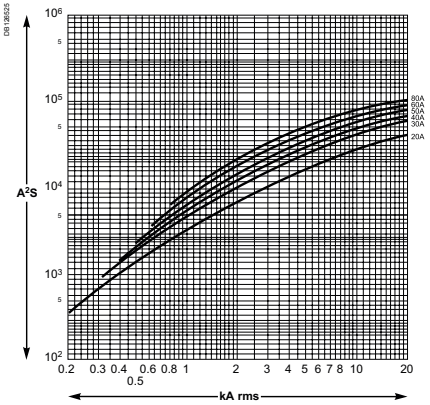
Short-circuit current limitation for C120

Thermal stress curve C

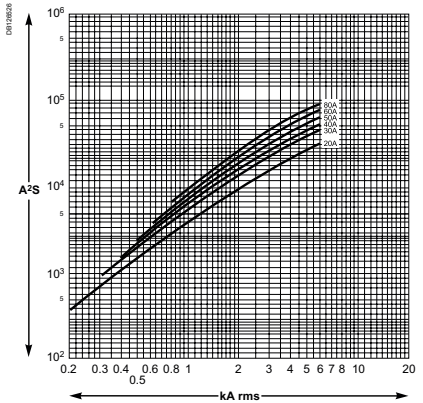
Ue: 240 V ~ 1P
Ue: 415 V ~ 2, 3P



Ue: 240 V ~ 2, 3P



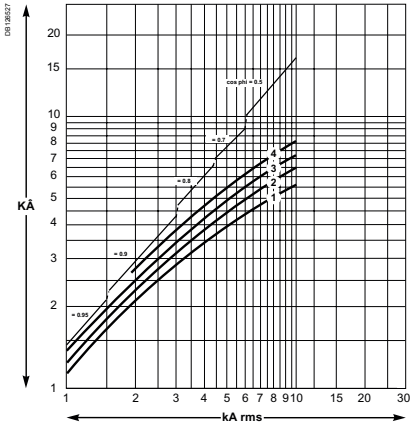
Ue: 440 V ~ 2, 3P



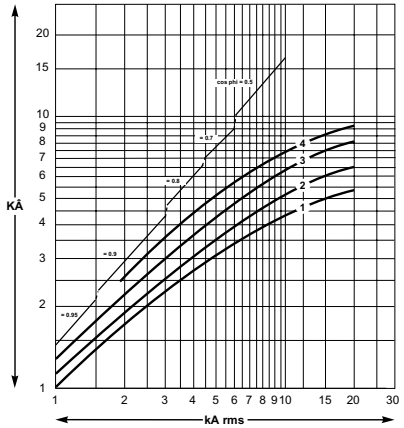
Short-circuit current limitation for C120

Peak current - 1P: 20 A - 2P: 30-40 A - 3 P: 50-60 A - 4P: 80 A

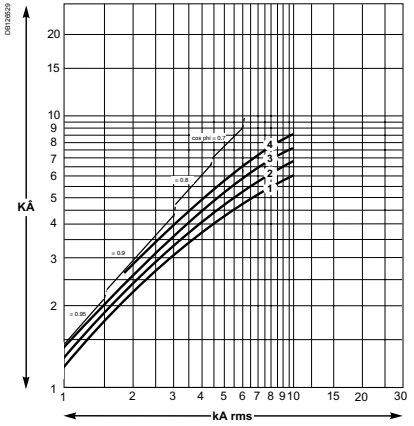
Ue: 240 V ~ 1P
Ue: 415 V ~ 2, 3P



Ue: 240 V ~ 2, 3P



Ue: 440 V ~ 2, 3P



Tripping curves for C120

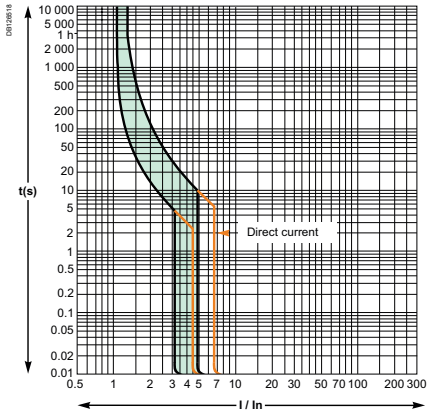
Tripping curves IEC 60947-5 / GB 14048-2

The operating range of the magnetic trip unit is included for:
- curve B: between 3.2 In and 4.8 In
- curve C: between 7 In and 10 In
- curve D: between 10 In and 14 In.

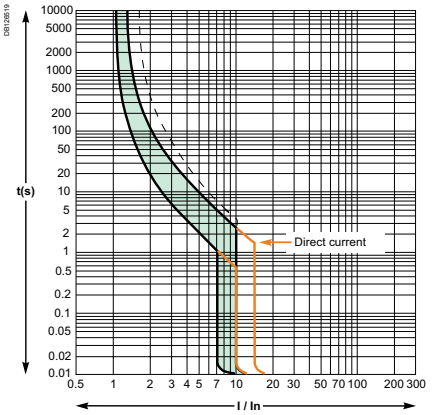
The curves show:
- the cold thermal tripping limits (25 °C), charged poles
- the electromagnetic tripping limits, 2 charged poles

C120

Curve B



Curve C



Curve D