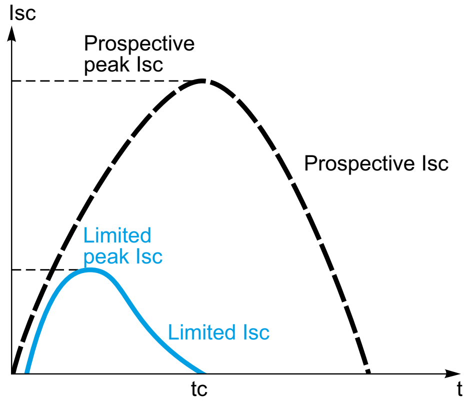
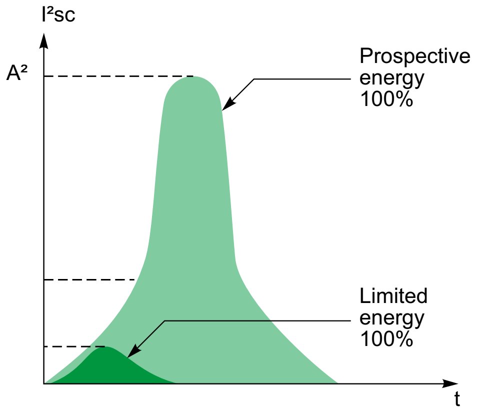
Short-circuit current limiting

DB125768



Prospective current and real limit current.

DB125767



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.

Selectivity of protection devices

The circuit breakers' current limiting capacity improves selectivity 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. Selectivity can thus be natural without having to install a time-delayed protection device upstream.

Acti9 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 Acti9 range have a top-level current limiting characteristic for modular devices.
This assures them of optimal protection of the entire power distribution system.

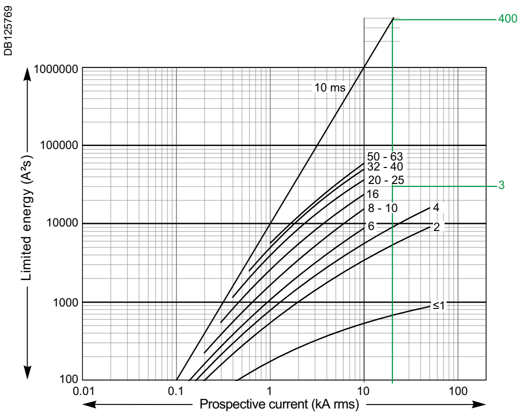
Short-circuit current limiting (cont.)

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 A²s), 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 A²s 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 kA²s
- the iC60N circuit breaker reduces this thermal stress to: 35 kA²s, 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 mm² and stresses in A²s.

S (mm²)		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 (mm²)		**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 mm² protected by a NG125L device?
The above table shows that the acceptable stress is 1.32×10^6 A²s. 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 A²s. (Curve on page 13).
The cable is therefore always protected up to the breaking capacity of the circuit breaker.

Short-circuit current limiting (cont.)

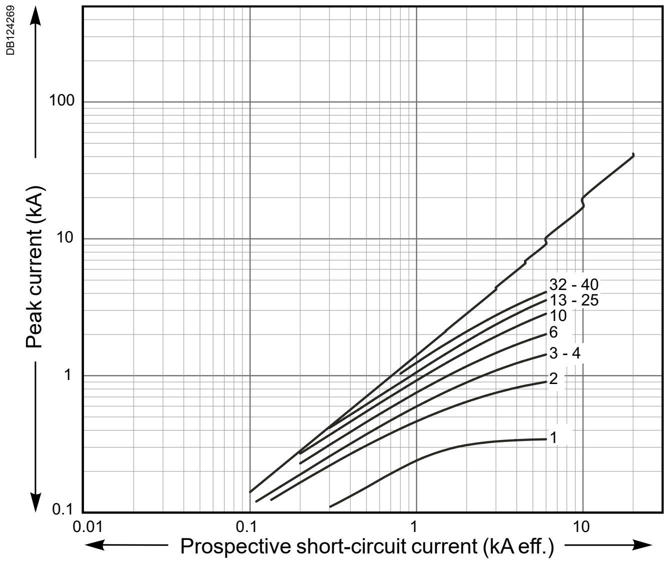
Ue: 380-415 V AC

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

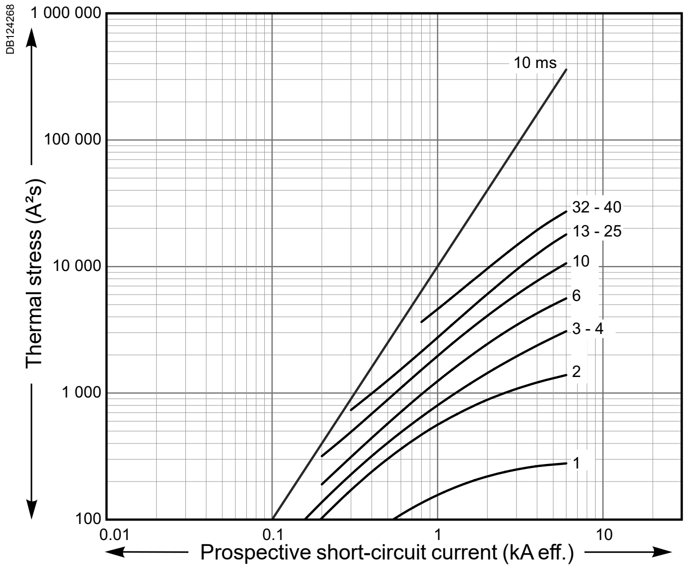
Acti9 iC40, iC40 ARC, iC40 + Vigi

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

Peak current



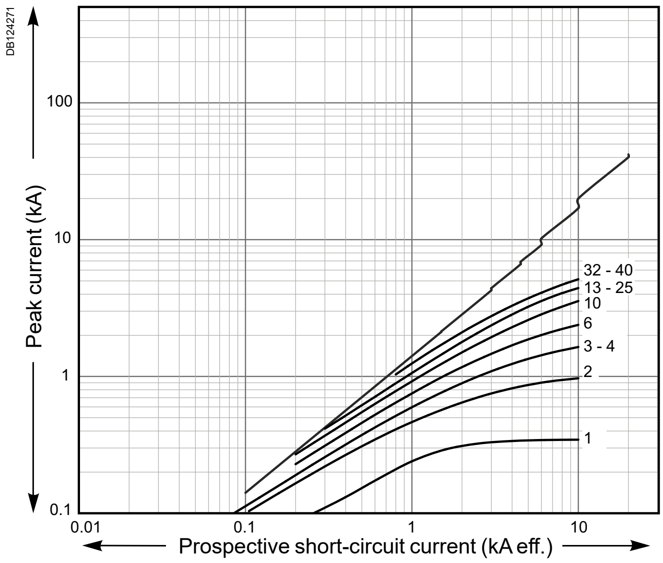
Thermal stress



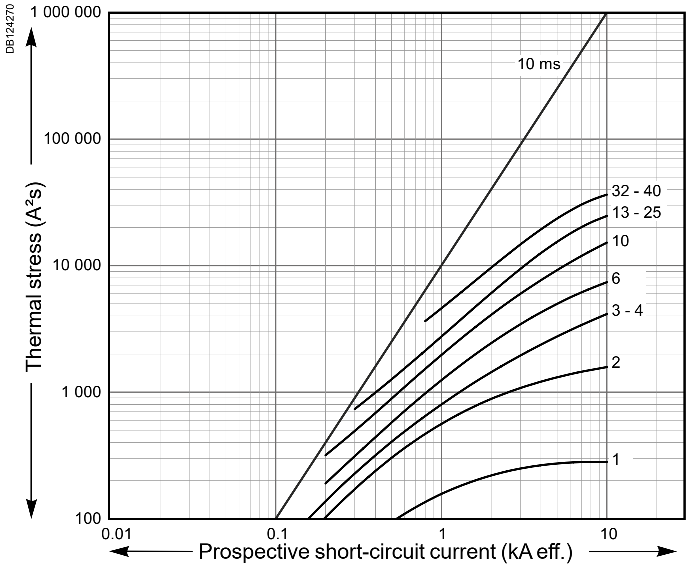
Acti9 iC40N, iC40N ARC, iC40N + Vigi

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

Peak current



Thermal stress



Short-circuit current limiting (cont.)

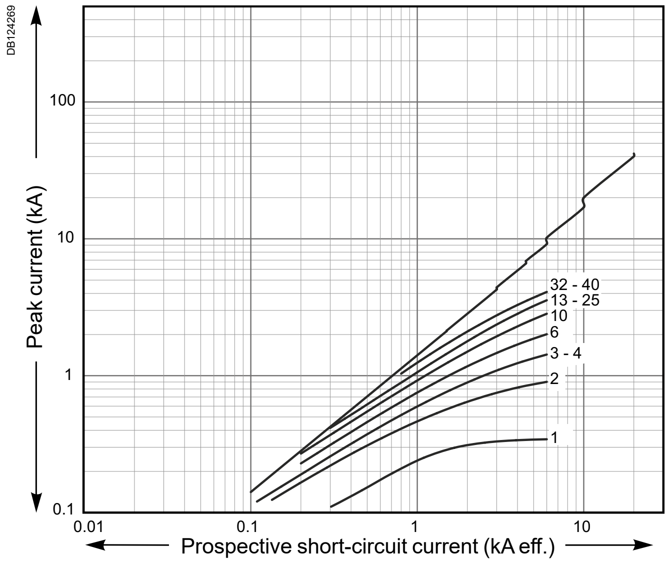
Ue: 380-415 V AC

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

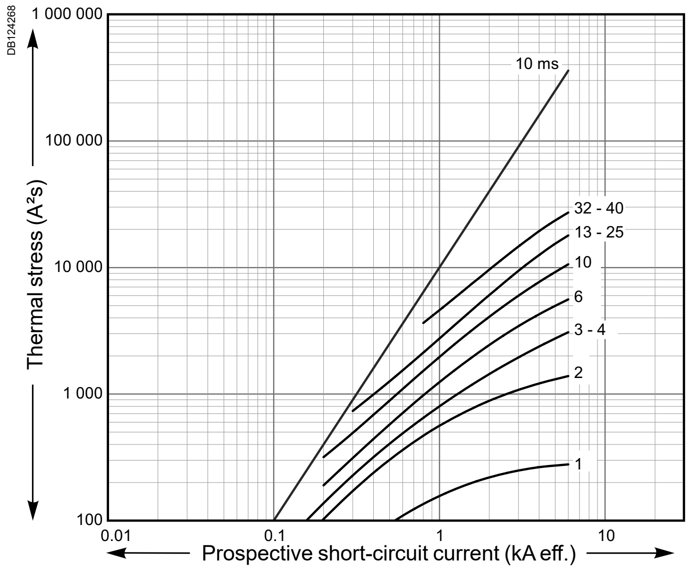
iDPN, iDPN + Vigi

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

Peak current



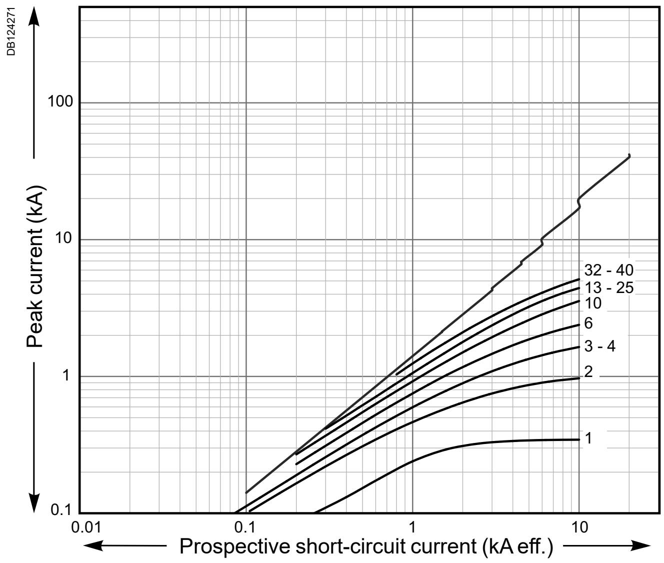
Thermal stress



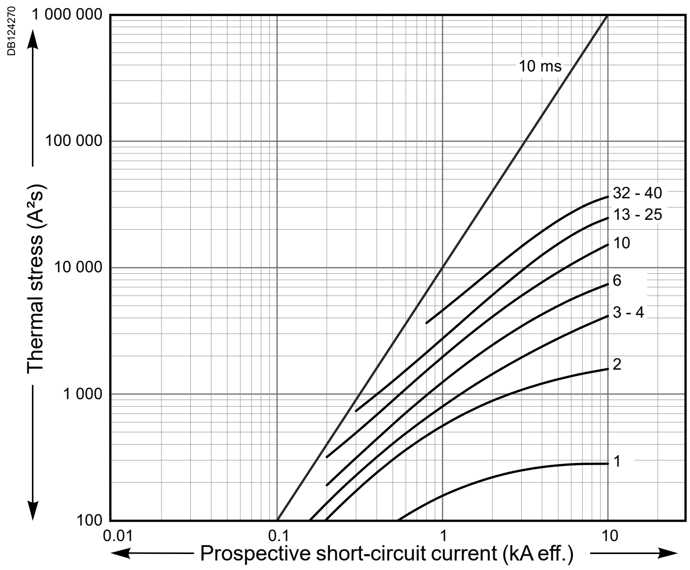
iDPN N, iDPN N + Vigi, iDPN N ARC

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

Peak current



Thermal stress



Short-circuit current limiting (cont.)

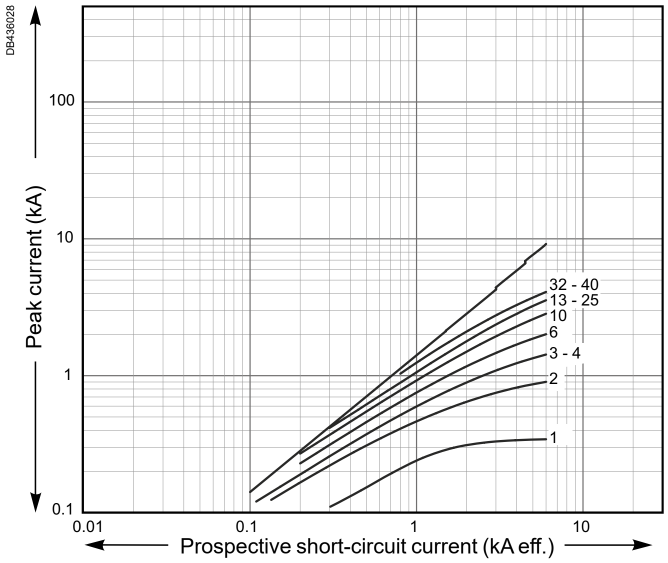
Ue: 380-415 V AC

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

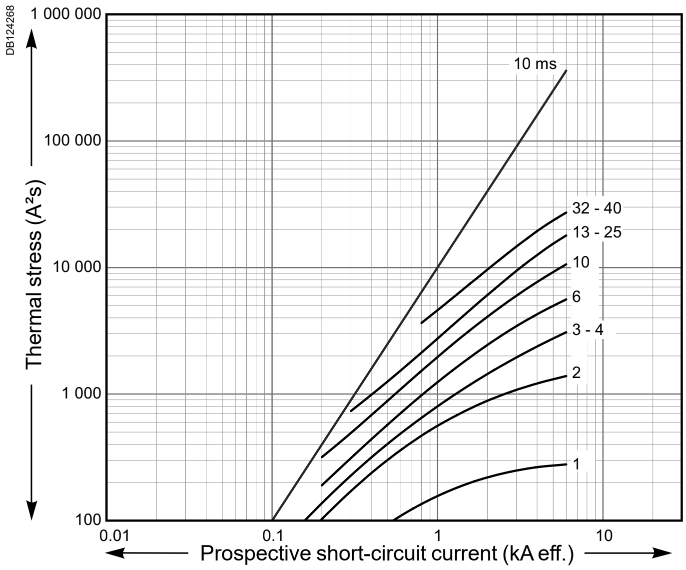
Acti9 iCV40N, iCV40N ARC

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

Peak current



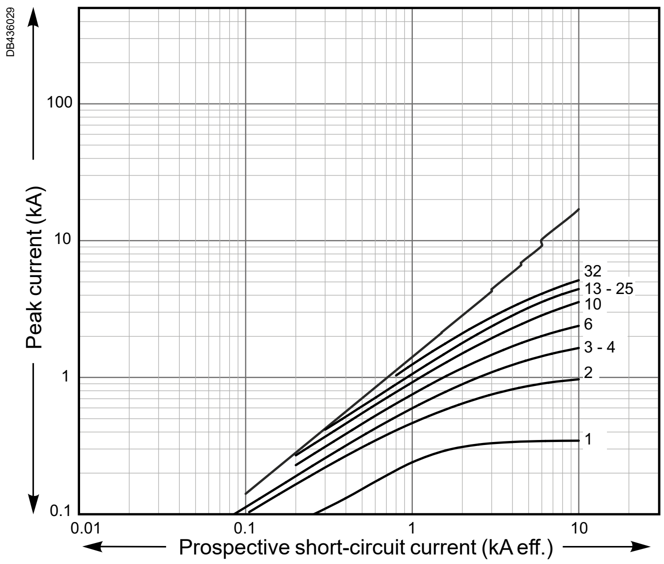
Thermal stress



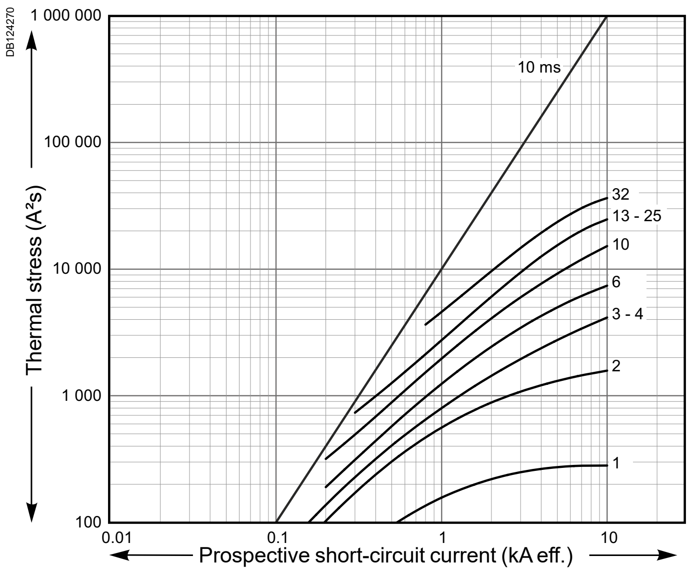
Acti9 iCV40H, iCV40H ARC

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

Peak current



Thermal stress



Short-circuit current limiting (cont.)

Ue: 380-415 V AC

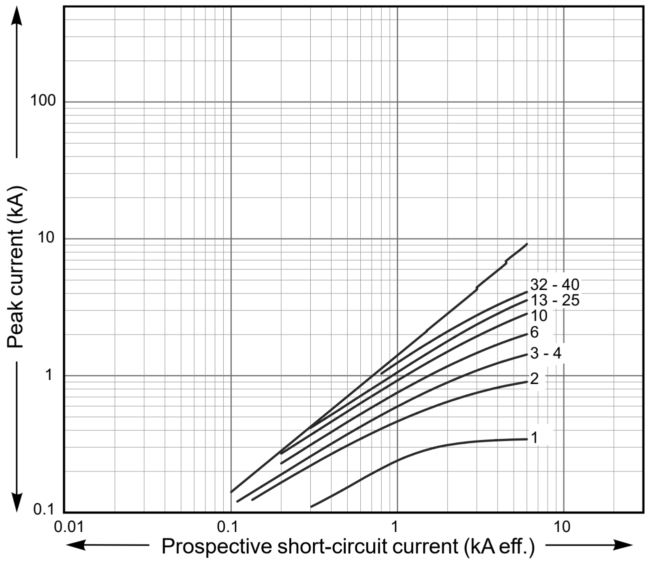
Limitation curves for network
Ue: 380-415 V AC (Ph/N 220-240 V AC)

iDPN N Vigi, iDPN N VigiARC

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

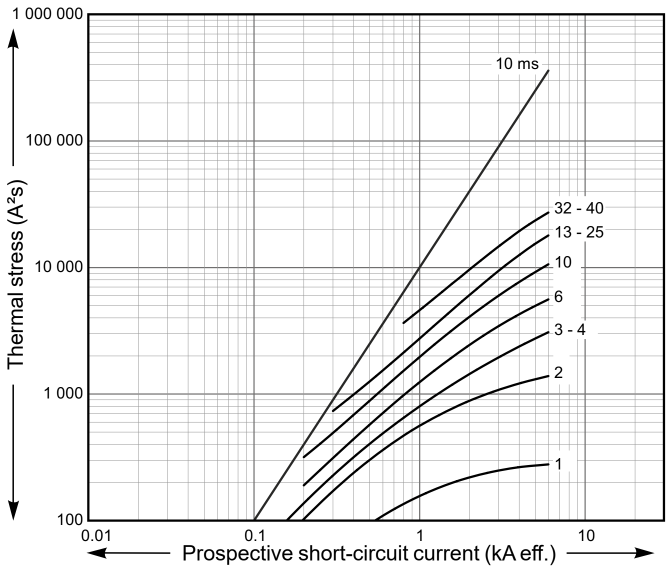
Peak current

DB124269



Thermal stress

DB124268

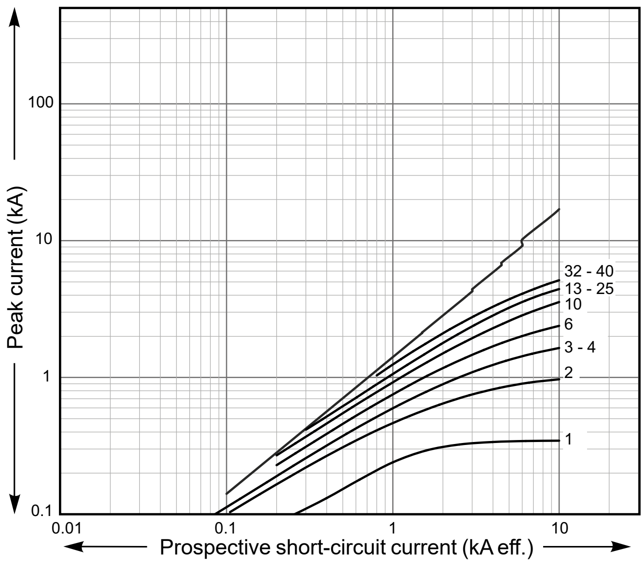


iDPN H Vigi, iDPN H VigiARC

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

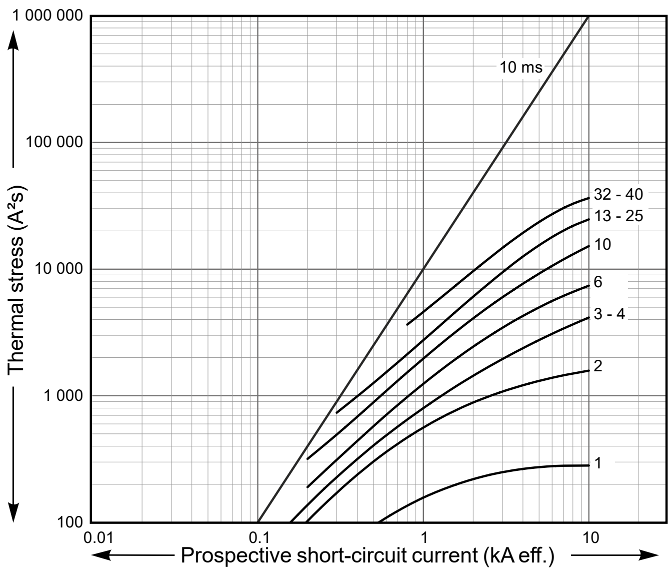
Peak current

DB124271



Thermal stress

DB124270



Short-circuit current limiting (cont.)

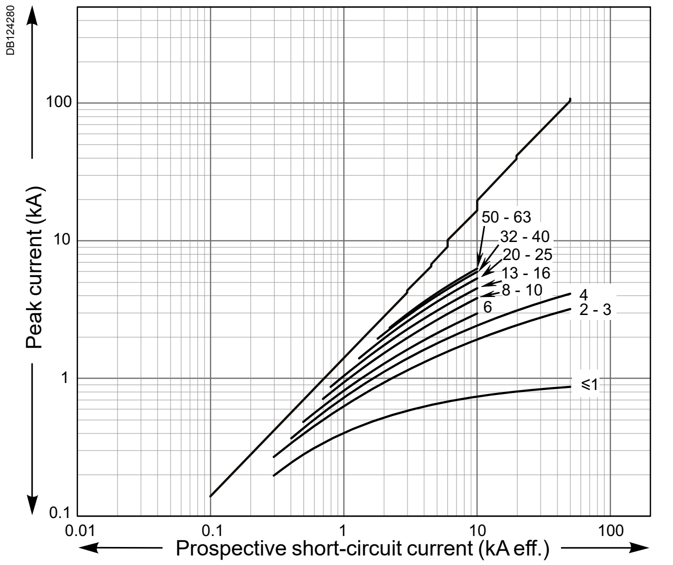
Ue: 380-415 V AC

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

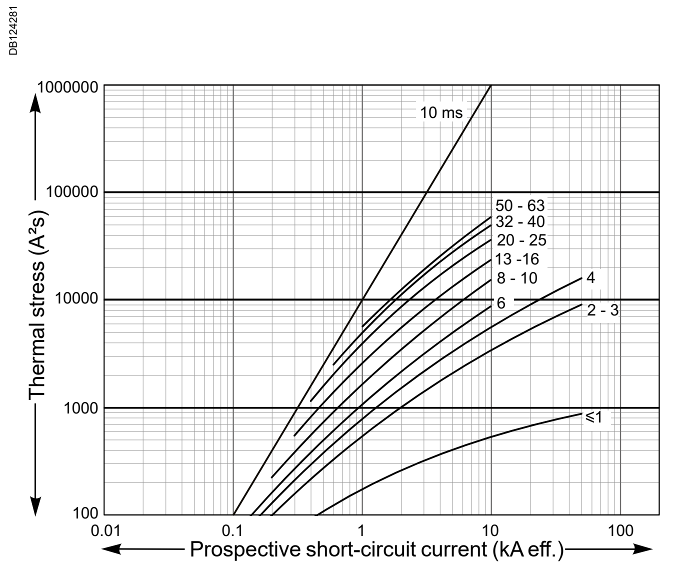
iC60N (1)

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

Peak current



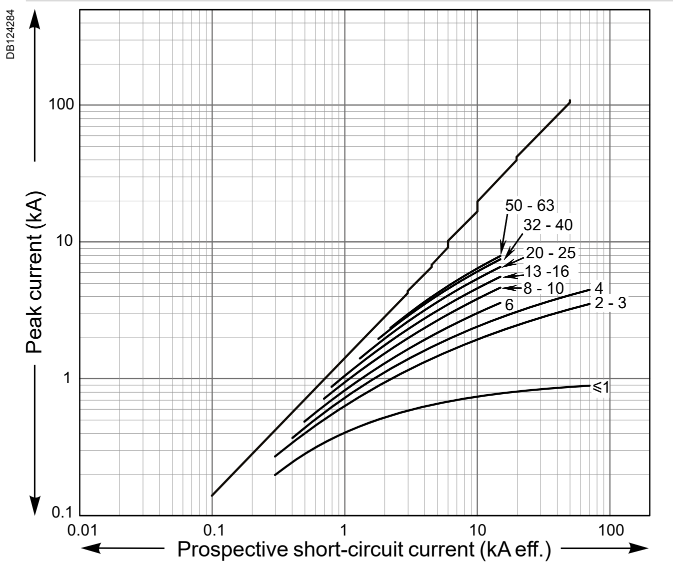
Thermal stress



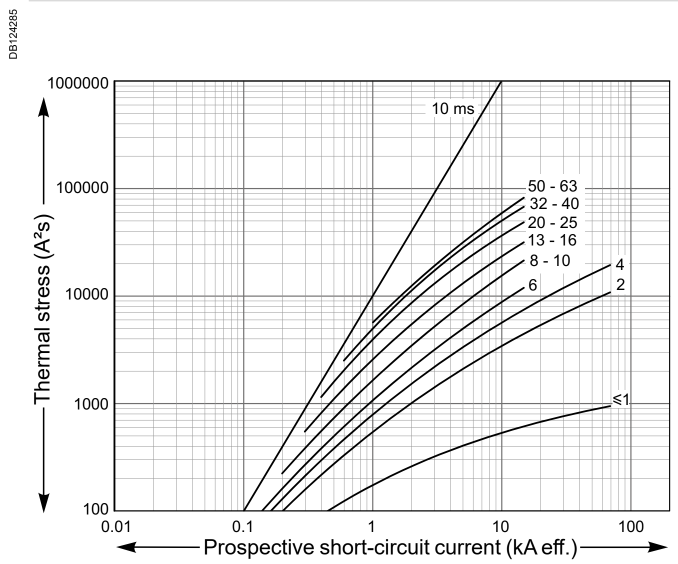
iC60H (1)

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

Peak current



Thermal stress



(1): Applicable for iC60 + ARC or iC60 + Vigi

Short-circuit current limiting (cont.)

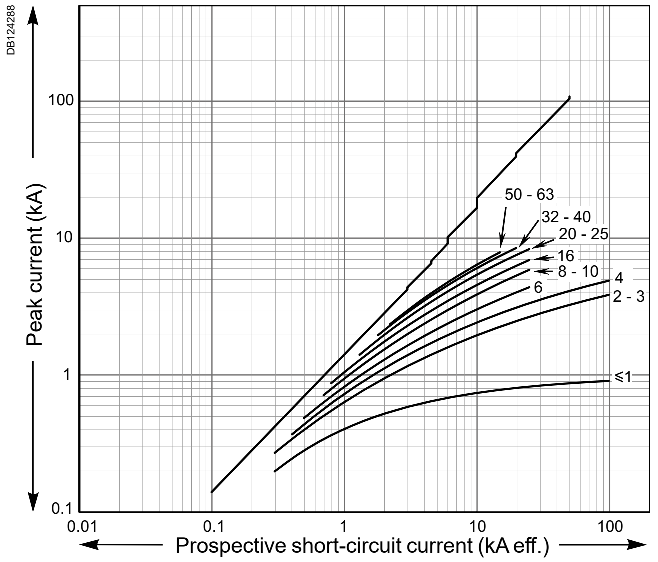
Ue: 380-415 V AC

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

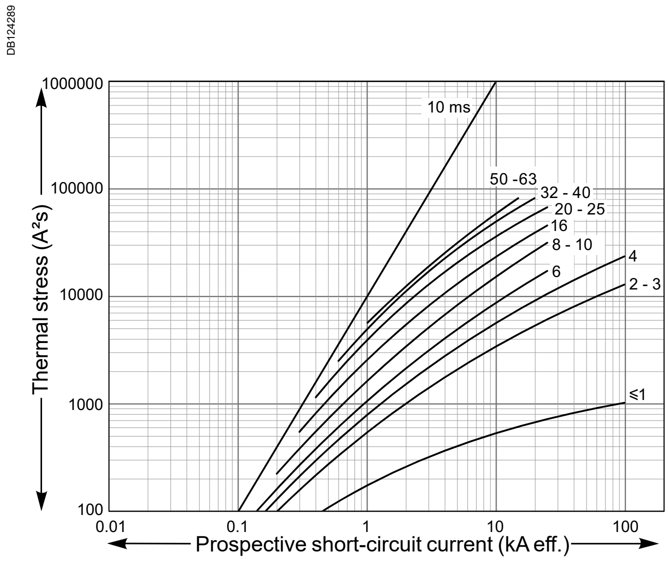
iC60L (1)

1P / 2P / 3P / 4P

Peak current



Thermal stress



(1): Applicable for iC60 + ARC or iC60 + Vigi

Short-circuit current limiting (cont.)

Ue: 380-415 V AC

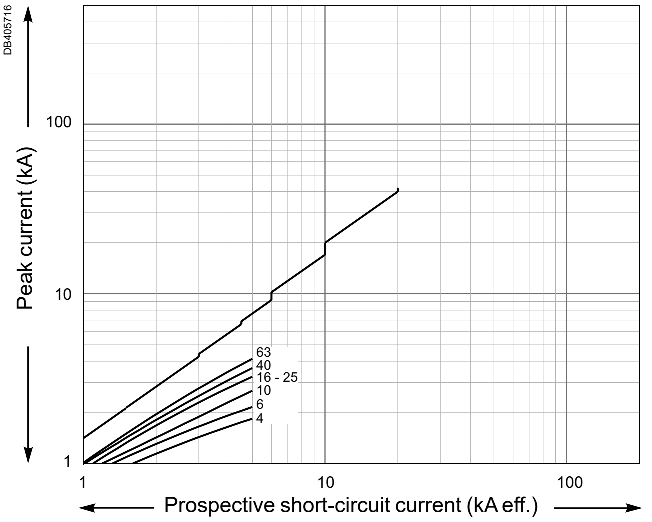
Limitation curves for network
Ue: 380-415 V AC (Ph/N 220-240 V AC)

C60a

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

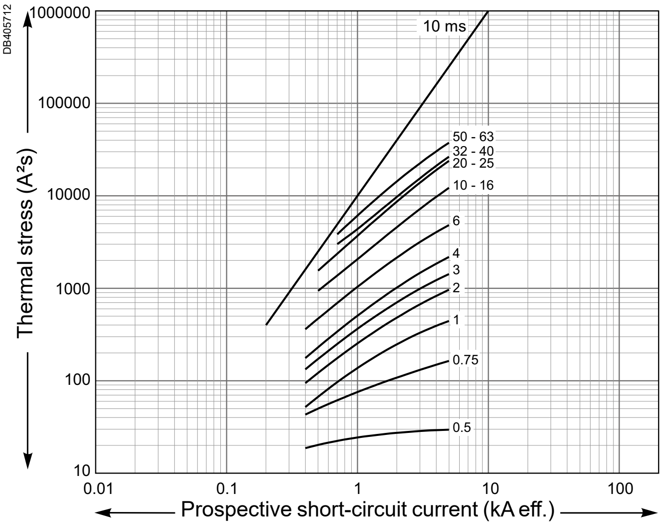
Peak current

DB405716



Thermal stress

DB405712

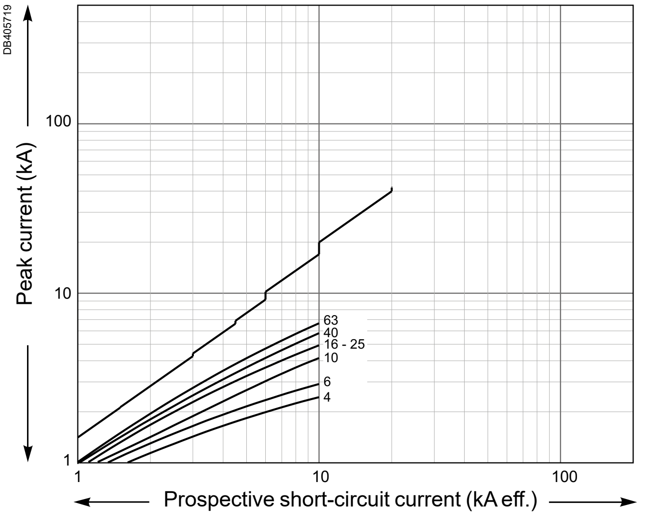


C60N

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

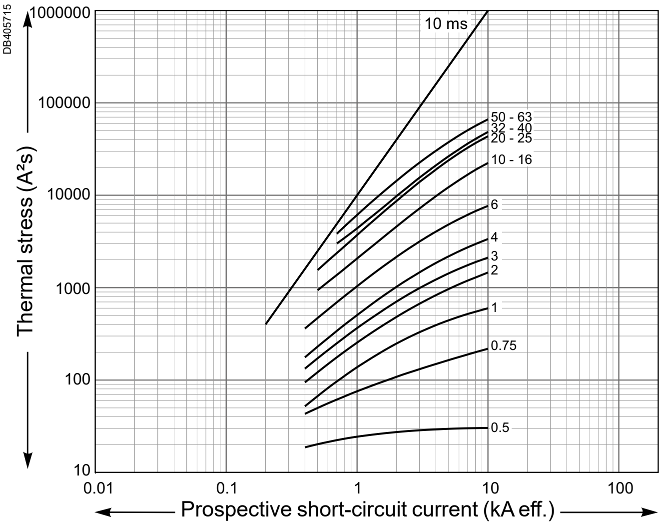
Peak current

DB405719



Thermal stress

DB405715



Short-circuit current limiting (cont.)

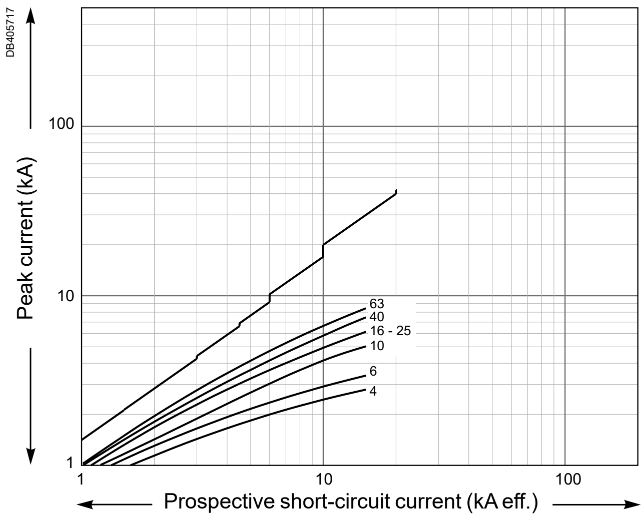
Ue: 380-415 V AC

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

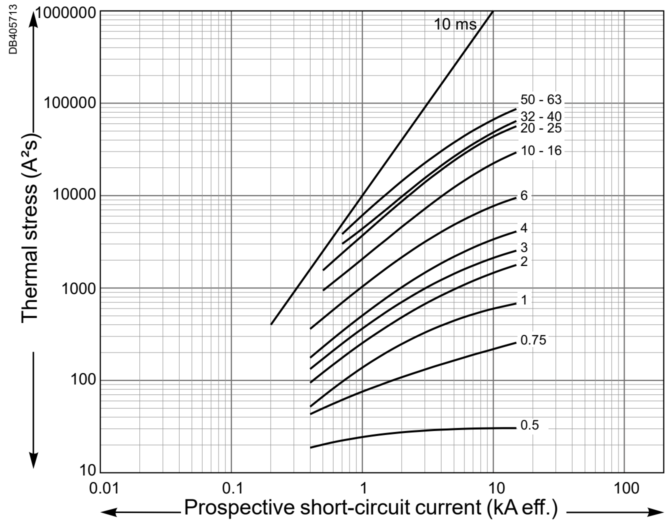
C60H

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

Peak current



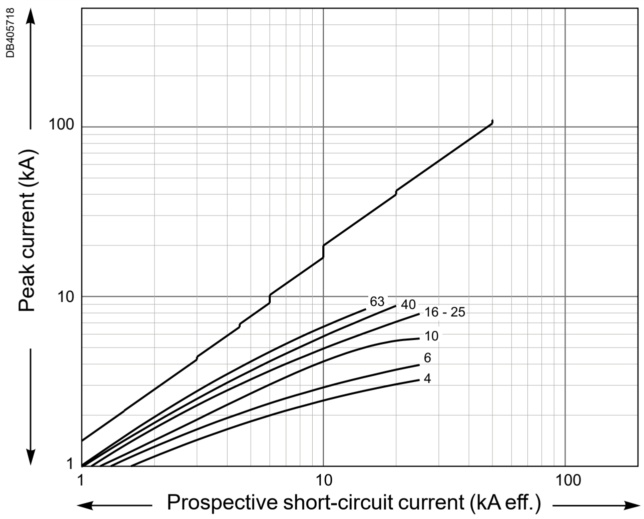
Thermal stress



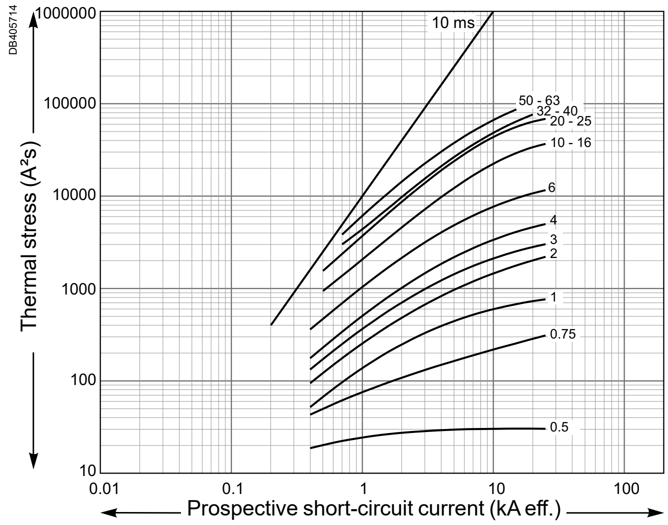
C60L

1P / 2P / 3P / 4P

Peak current



Thermal stress



Short-circuit current limiting (cont.)

Ue: 380-415 V AC

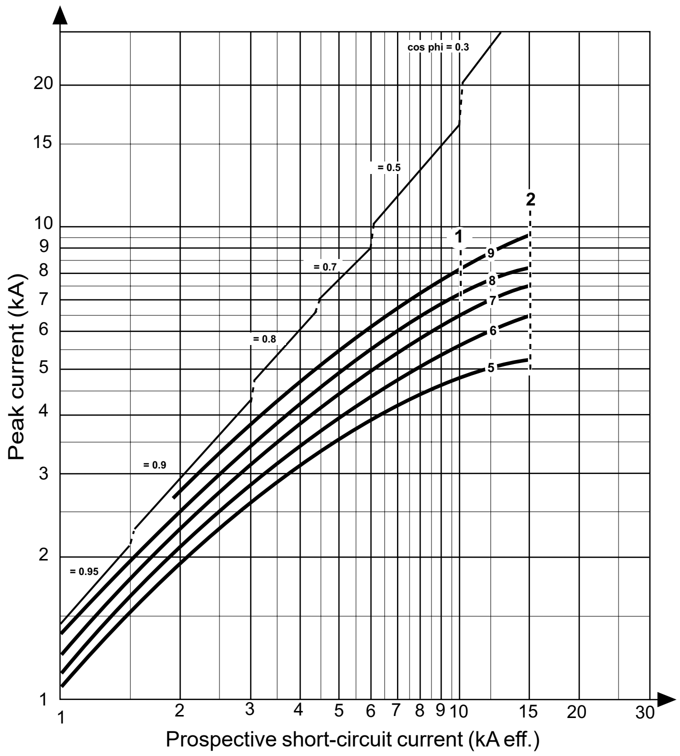
Limitation curves for network
Ue: 380-415 V AC (Ph/N 220-240 V AC)

C120N, H

1P / 2P / 3P / 4P

Peak current

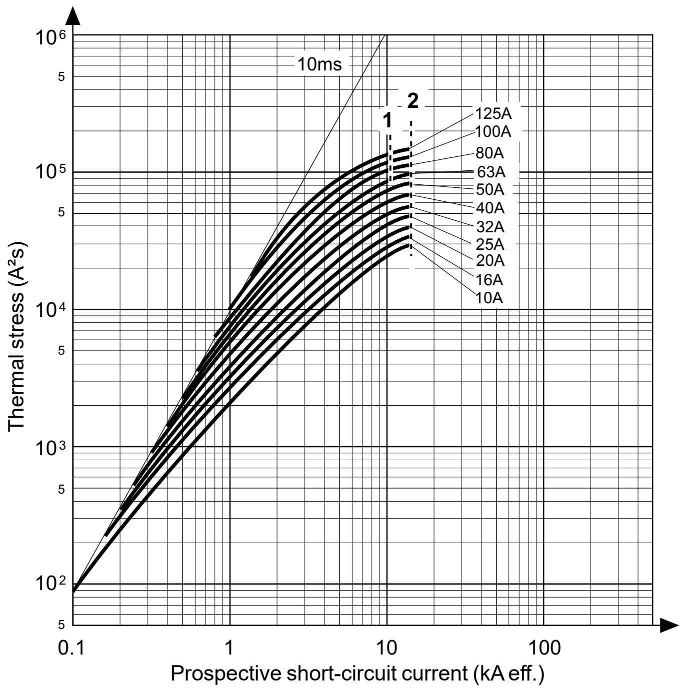
DB124293



- 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

DB405604



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

Short-circuit current limiting (cont.)

Ue: 380-415 V AC

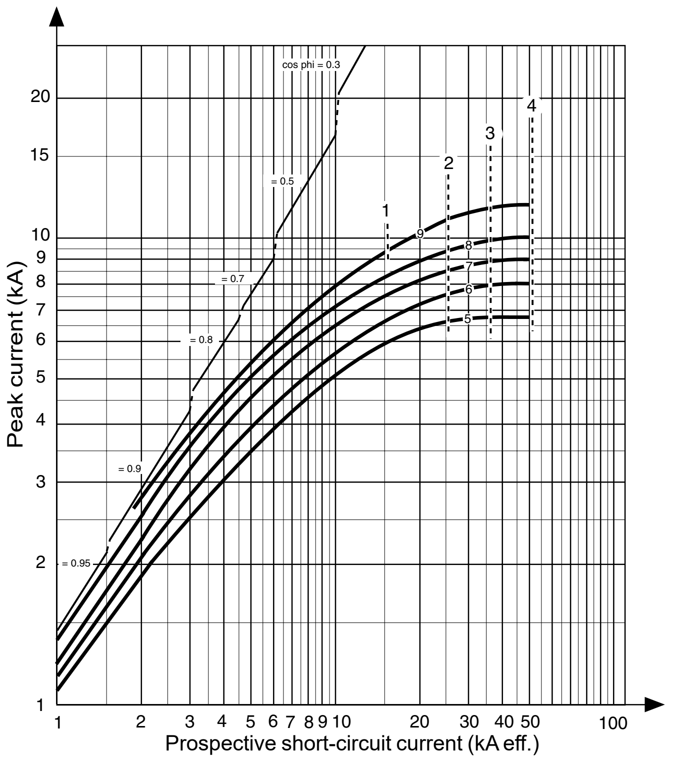
Limitation curves for network Ue: 380-415 V AC (Ph/N 220-240 V AC)

NG125a, N, H, L

1P / 2P / 3P / 4P

Peak current

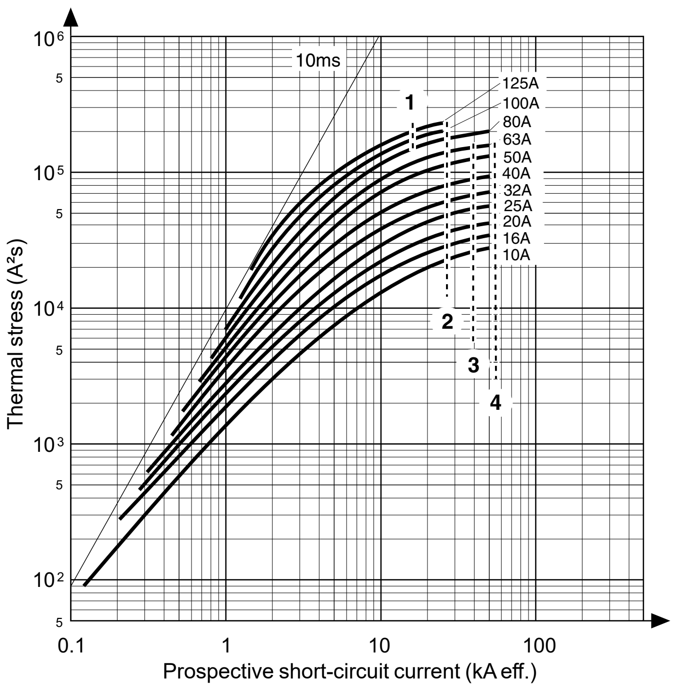
DB124299



- 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

DB405607



- 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.)

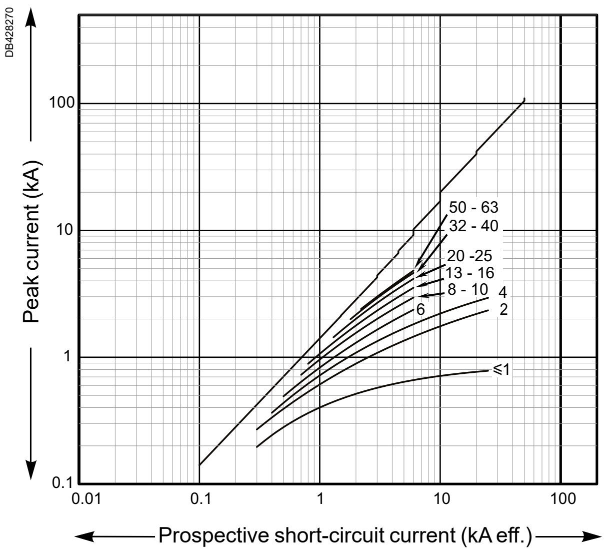
Ue: 440 V AC

Limitation curves for network Ue: 440 V AC

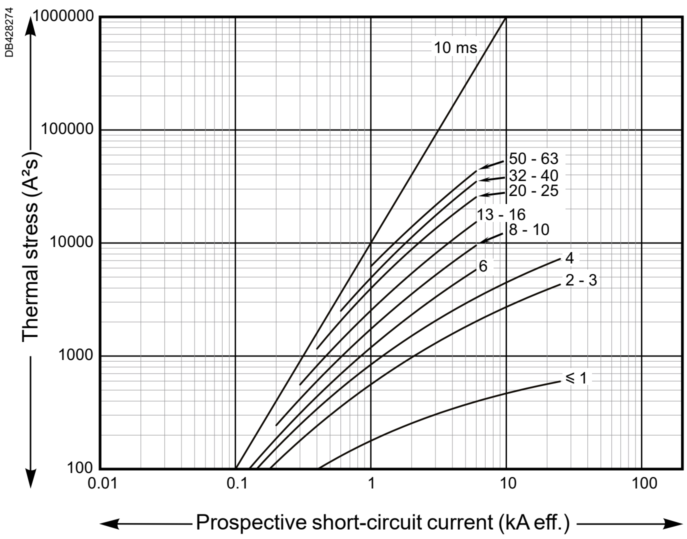
iC60N

3P / 4P

Peak current



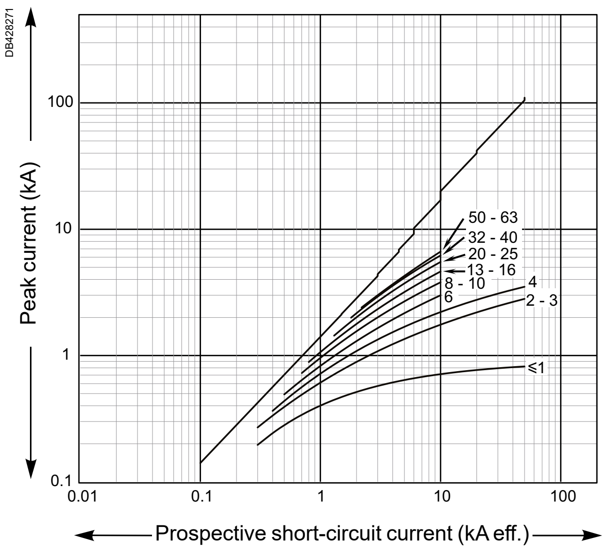
Thermal stress



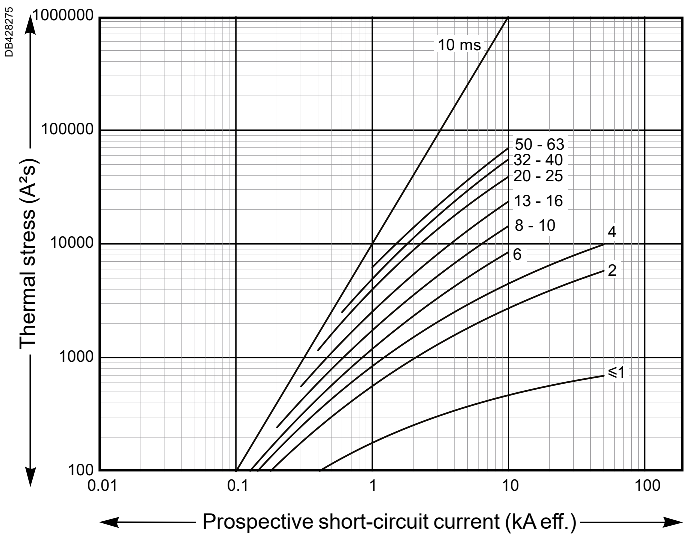
iC60H

3P / 4P

Peak current



Thermal stress



Short-circuit current limiting (cont.)

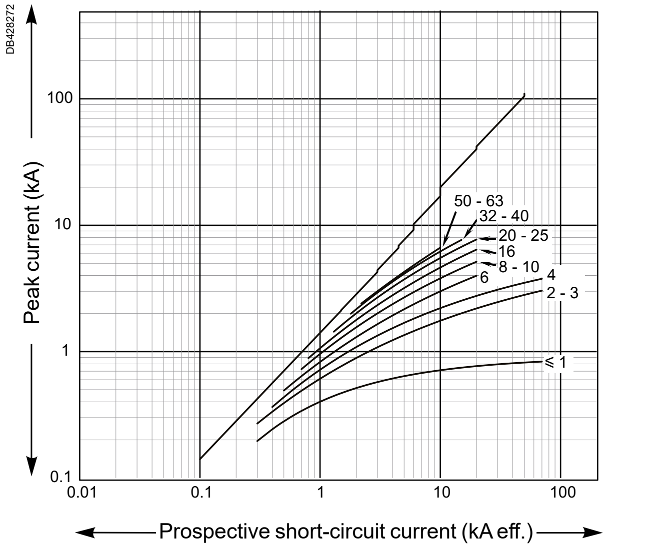
Ue: 440 V AC

Limitation curves for network Ue: 440 V AC

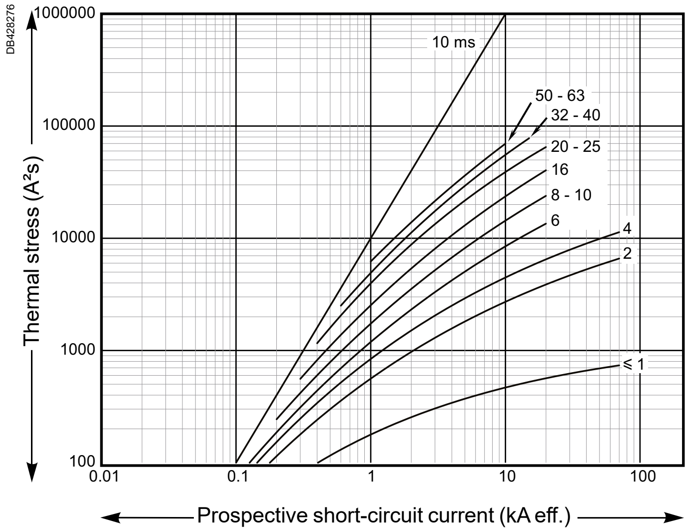
iC60L

3P / 4P

Peak current



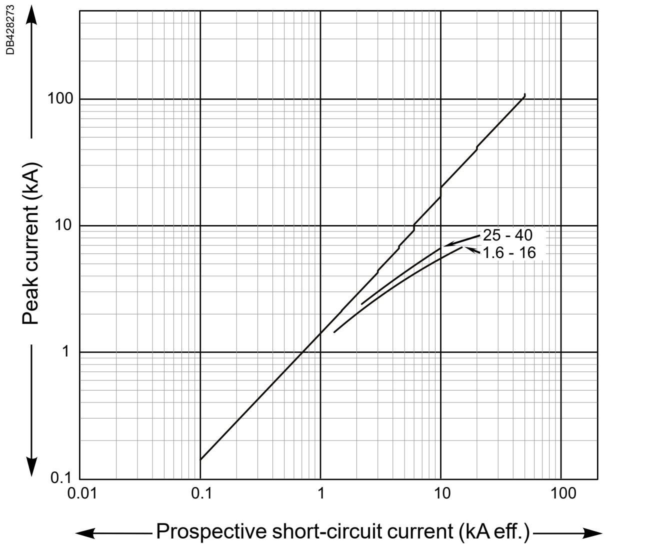
Thermal stress



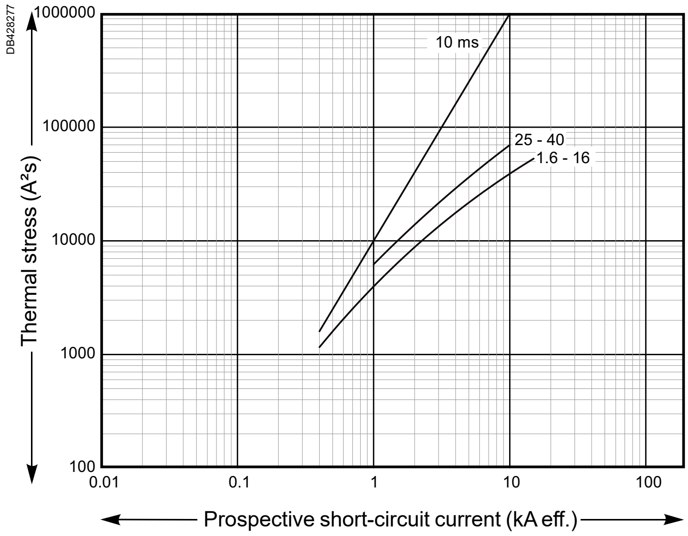
iC60LMA

3P / 4P

Peak current



Thermal stress



Short-circuit current limiting (cont.)

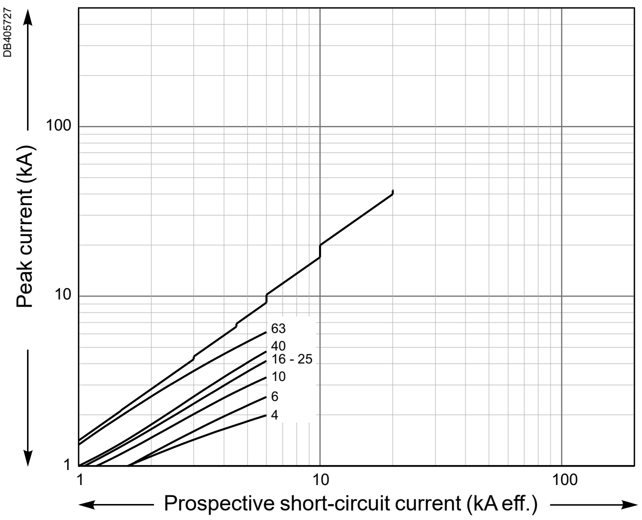
Ue: 440 V AC

Limitation curves for network
Ue: 440 V AC

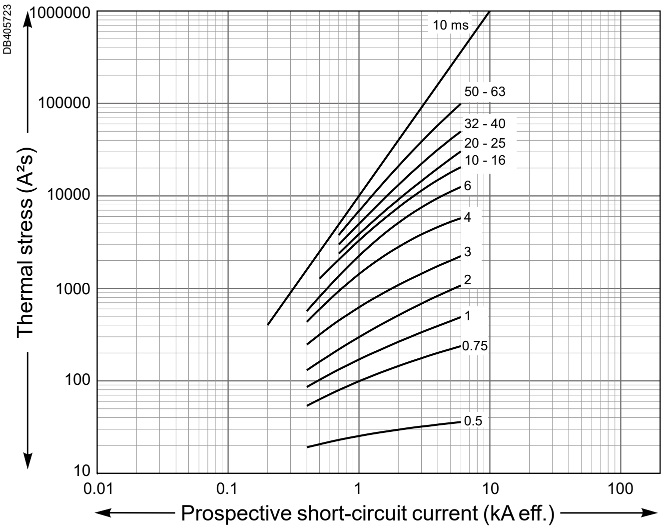
C60N

2P / 3P / 4P

Peak current



Thermal stress



Short-circuit current limiting (cont.)

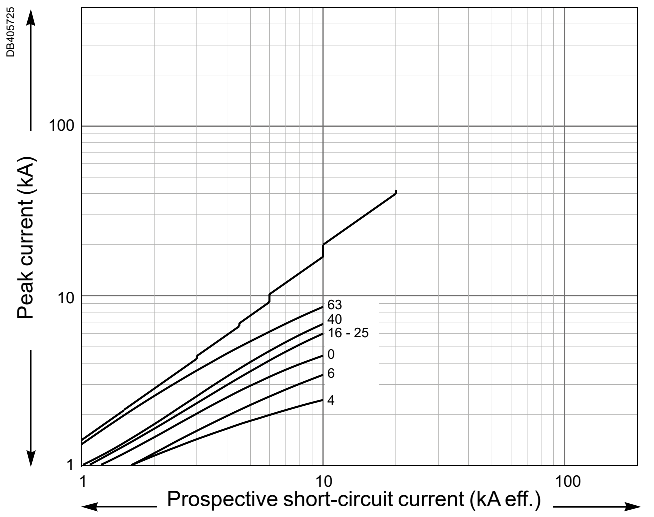
Ue: 440 V AC

Limitation curves for network
Ue: 440 V AC

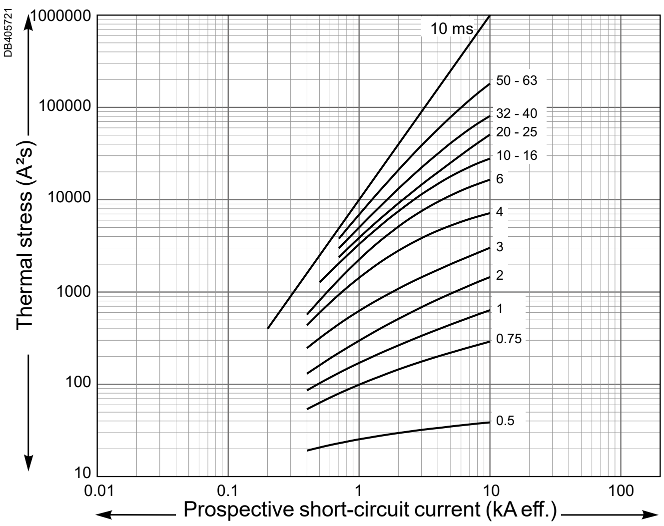
C60H

2P / 3P / 4P

Peak current



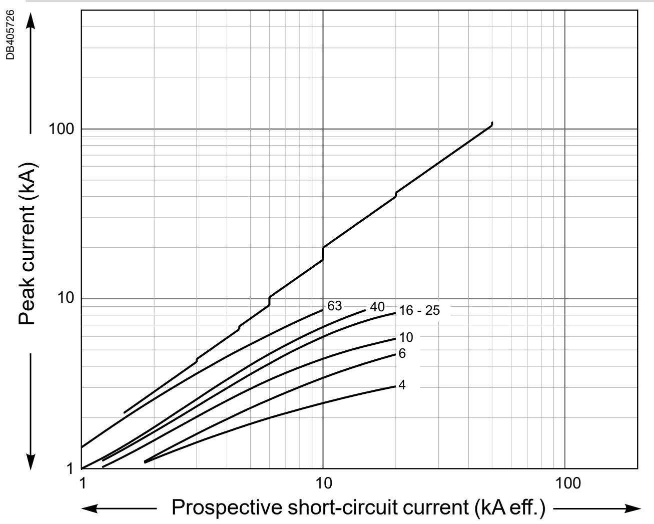
Thermal stress



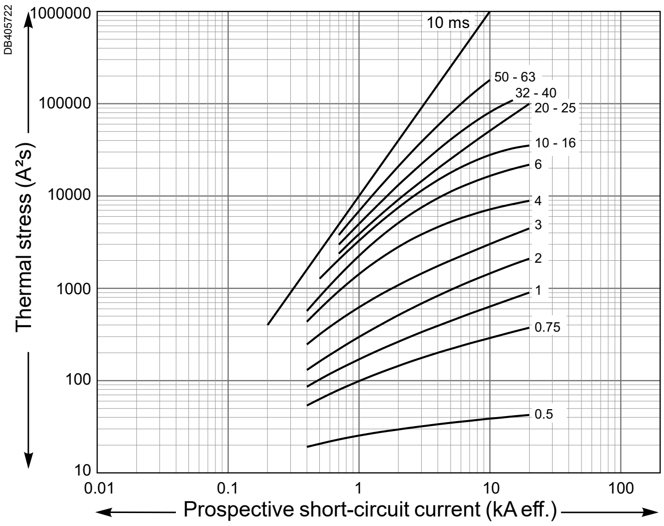
C60L

2P / 3P / 4P

Peak current



Thermal stress



Short-circuit current limiting (cont.)
Ue: 440 V AC

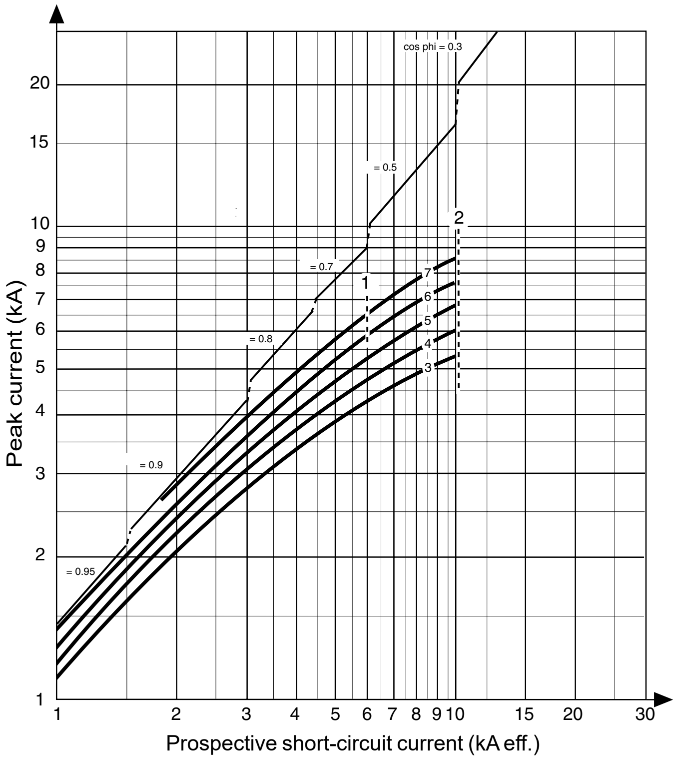
Limitation curves for network
Ue: 440 V AC

C120N, H

2P / 3P / 4P

Peak current

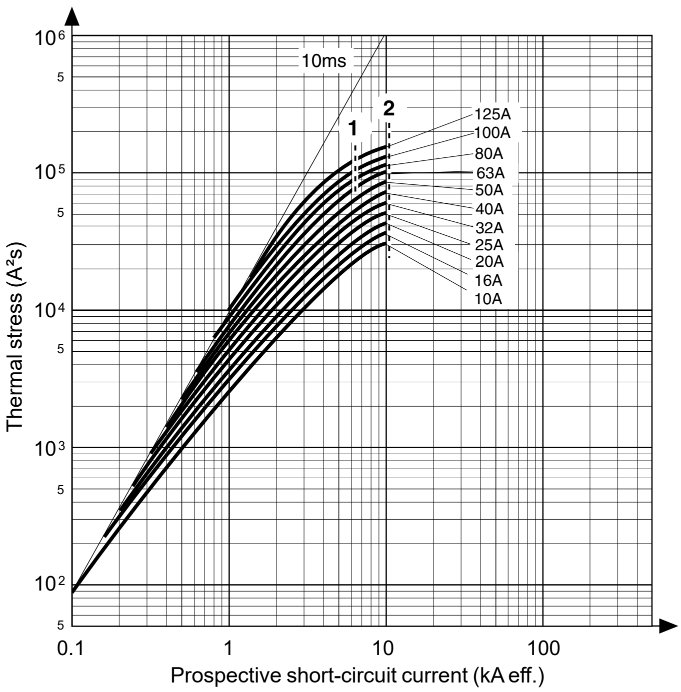
DB124294



- 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

DB405605



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

Short-circuit current limiting (cont.)

Ue: 500 V AC

Limitation curves for network

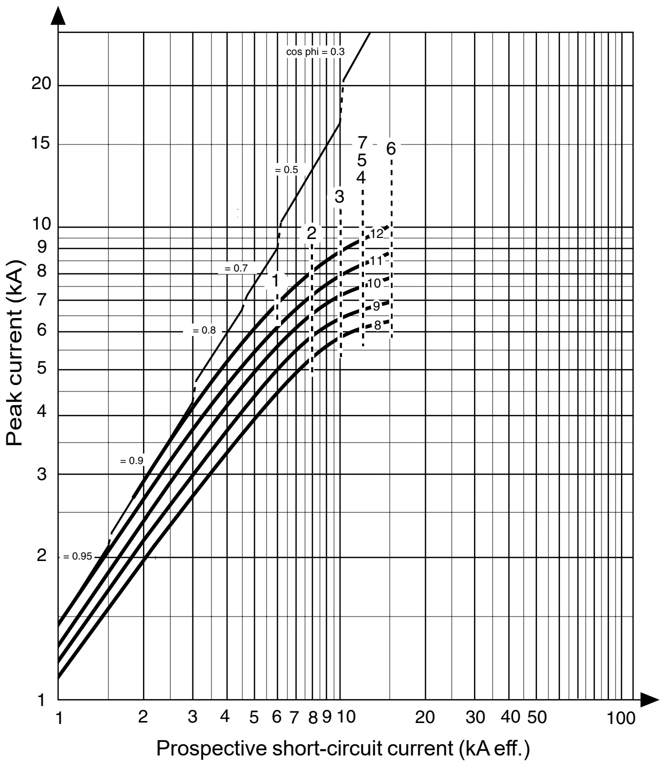
Ue: 500 V AC

NG125a, N, H, L

2P / 3P / 4P

Peak current

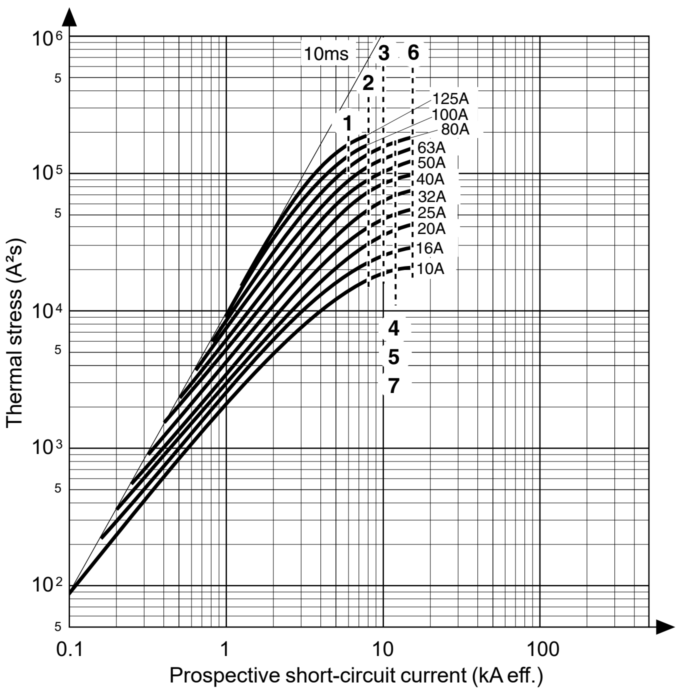
DB124300



- 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

DB405608



- 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.)

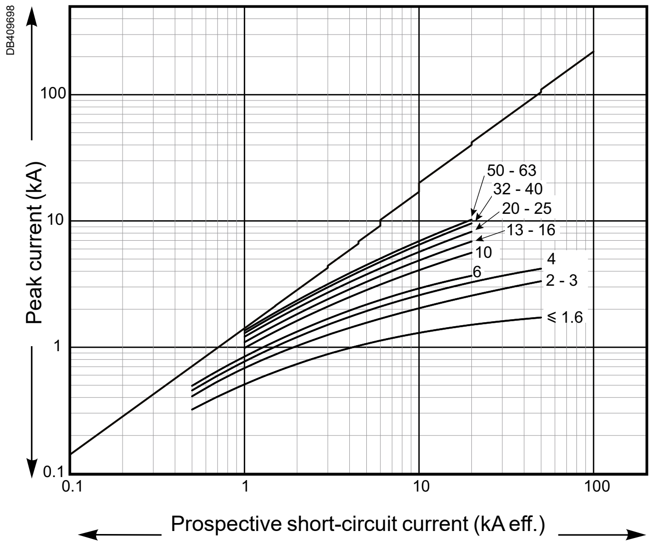
Ue: 220-240 V AC

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

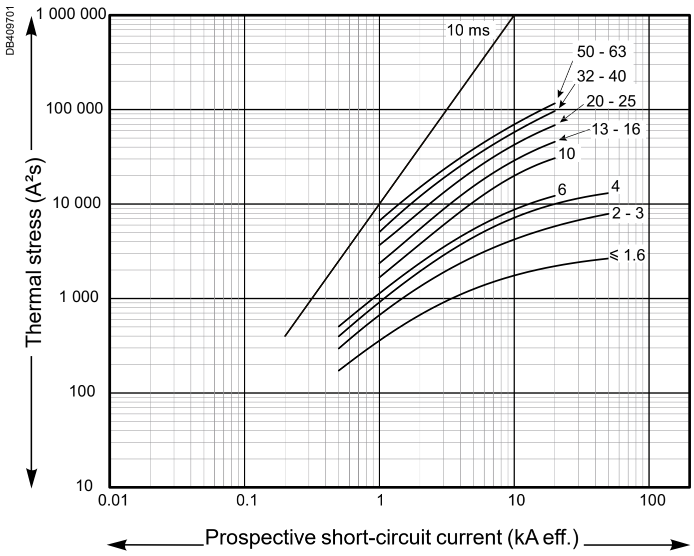
iC60N

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

Peak current



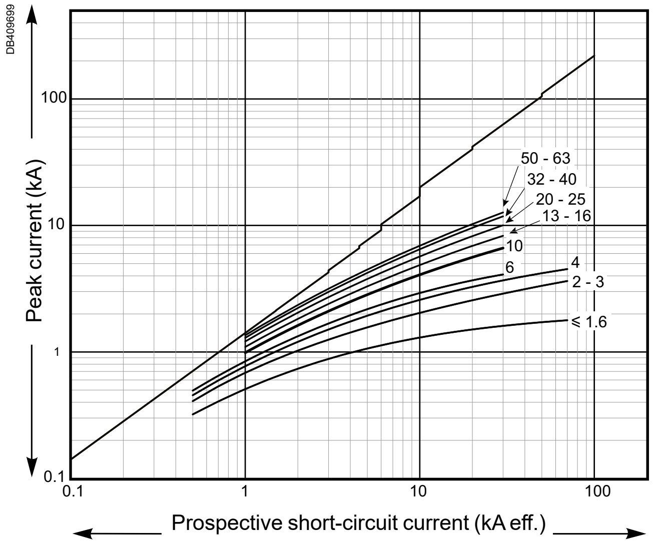
Thermal stress



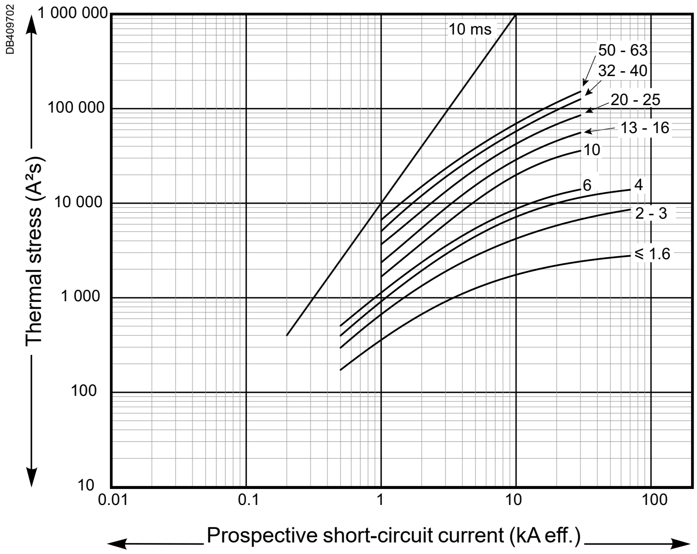
iC60H

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

Peak current



Thermal stress



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Short-circuit current limiting (cont.)

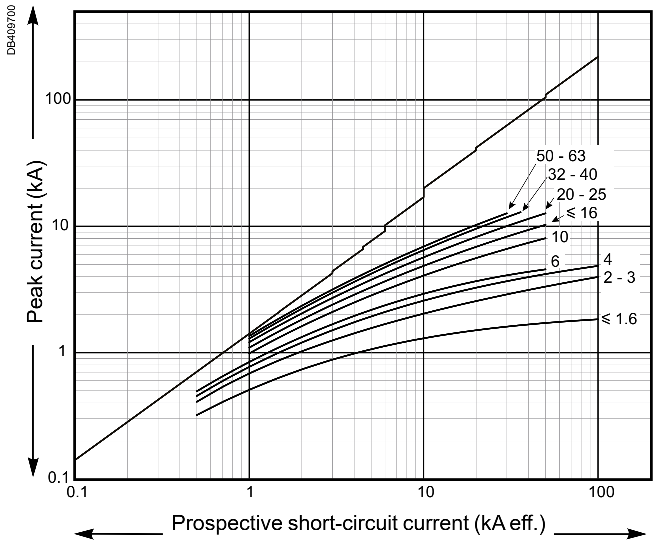
Ue: 220-240 V AC

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

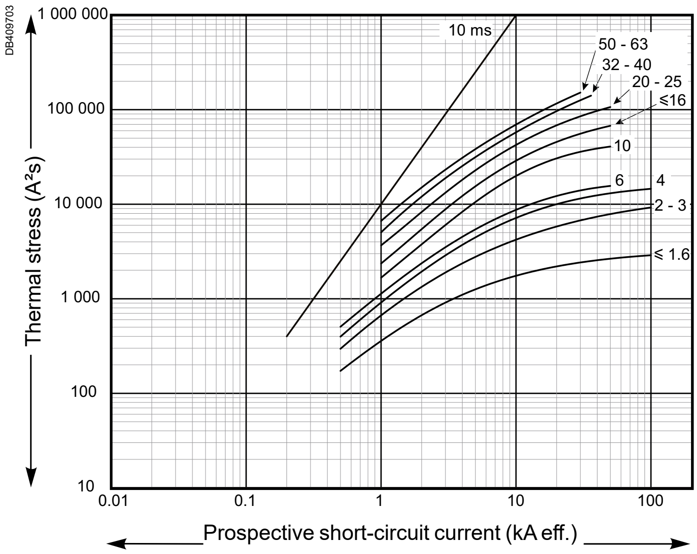
iC60L

1P / 2P / 3P / 4P

Peak current



Thermal stress



Short-circuit current limiting (cont.)

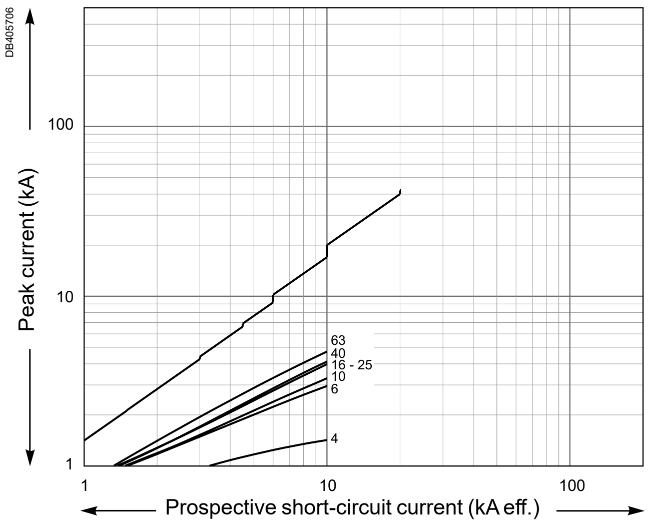
Ue: 220-240 V AC

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

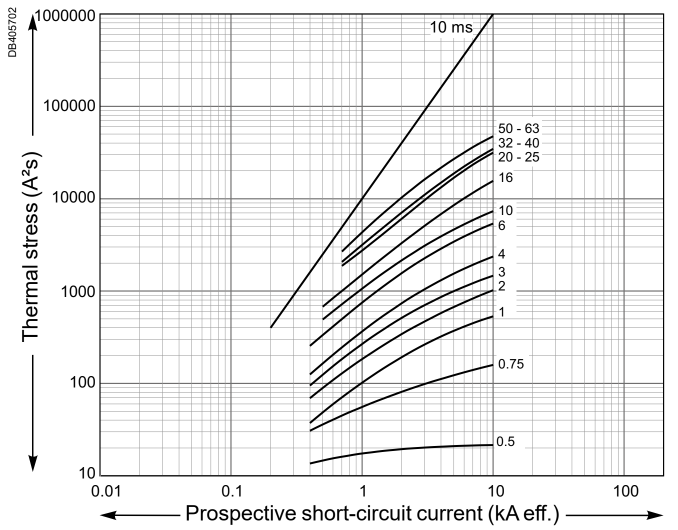
C60a

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

Peak current



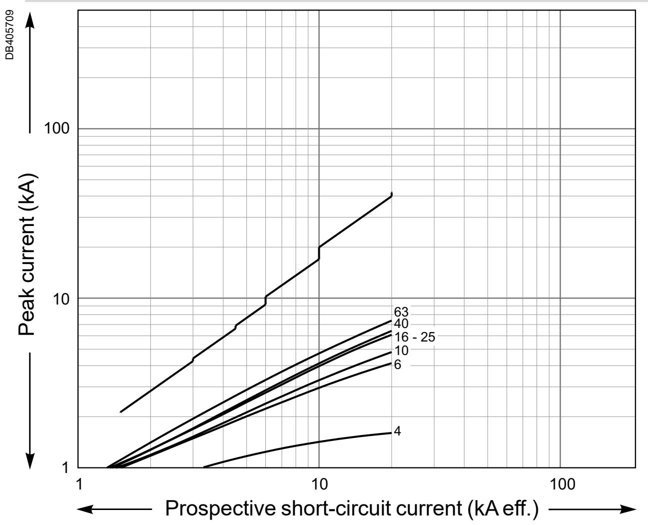
Thermal stress



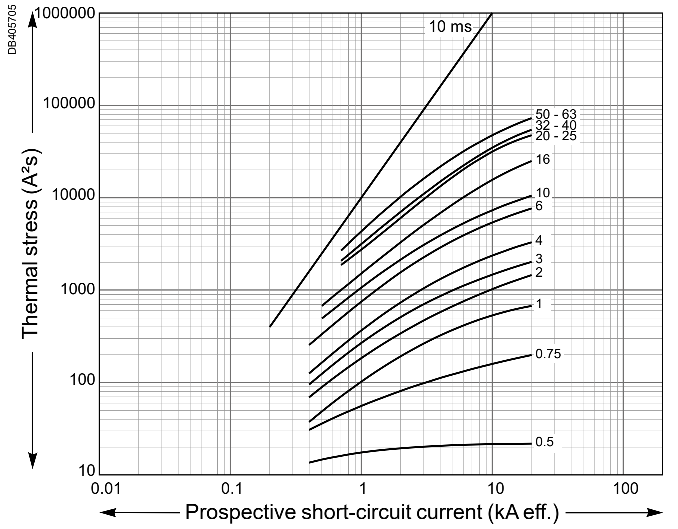
C60N

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

Peak current



Thermal stress



Short-circuit current limiting (cont.)

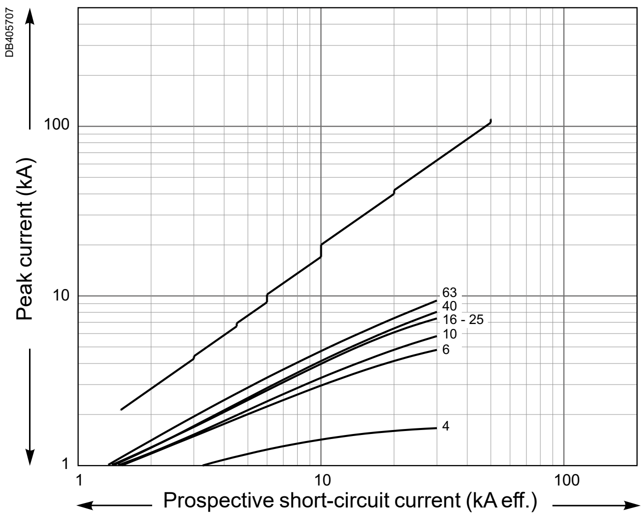
Ue: 220-240 V AC

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

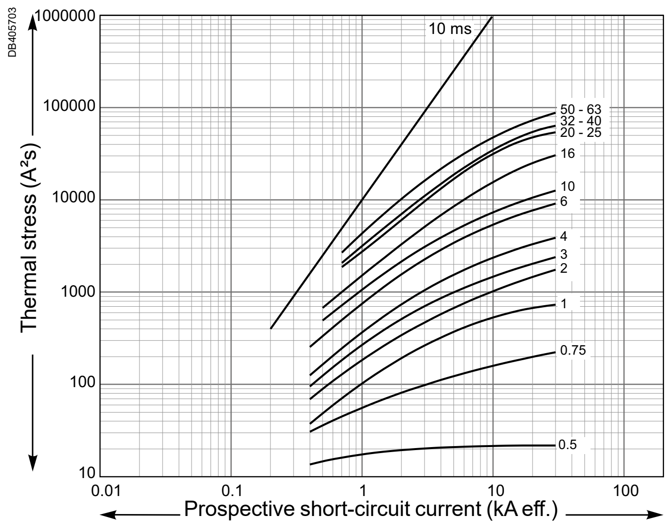
C60H

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

Peak current



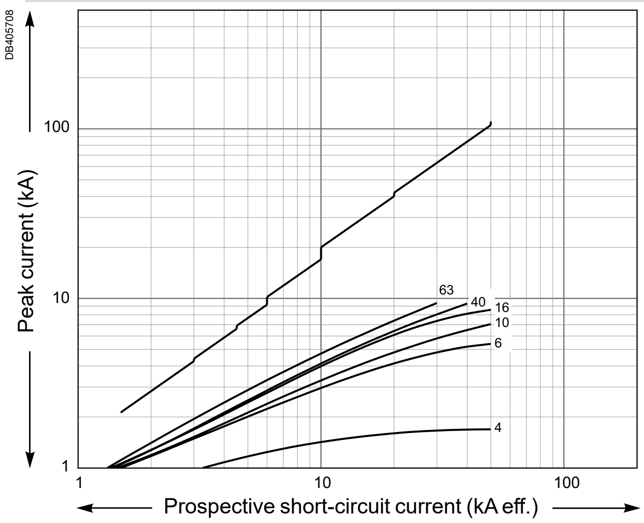
Thermal stress



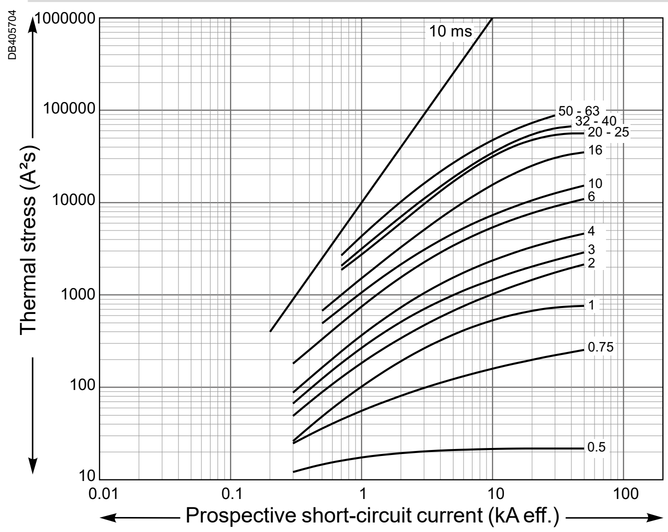
C60L

1P / 2P / 3P / 4P

Peak current



Thermal stress



Short-circuit current limiting (cont.)

Ue: 220-240 V AC

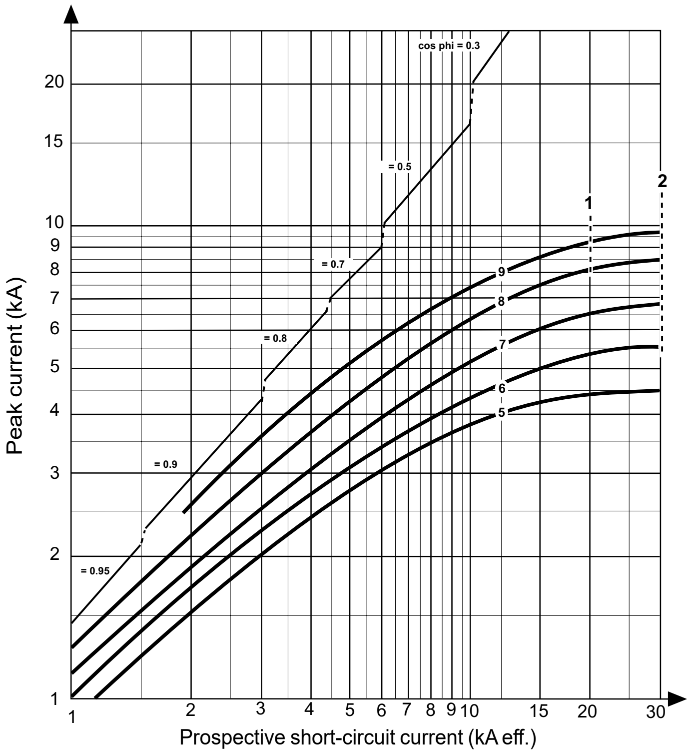
Limitation curves for network Ue: 220-240 V AC (Ph/N 110-130 V AC)

C120N, H

1P / 2P / 3P / 4P

Peak current

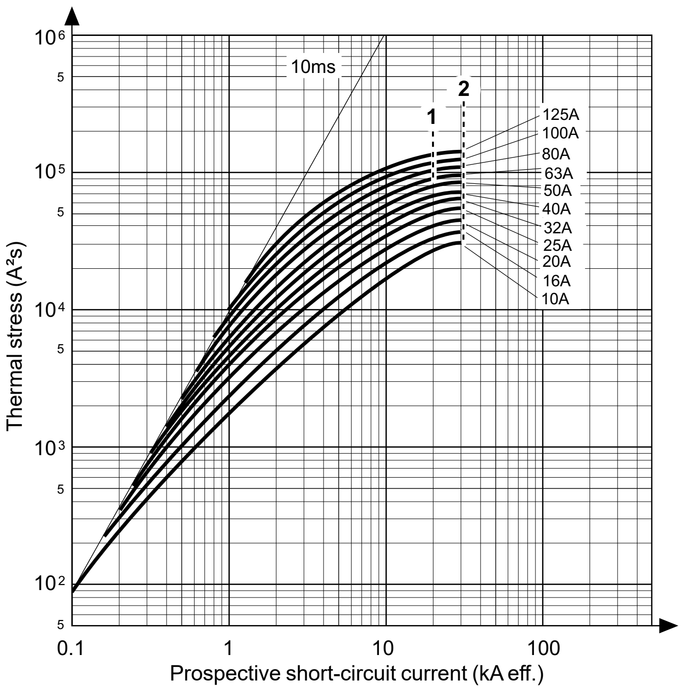
DB124292



- 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

DB405603



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

Short-circuit current limiting (cont.)

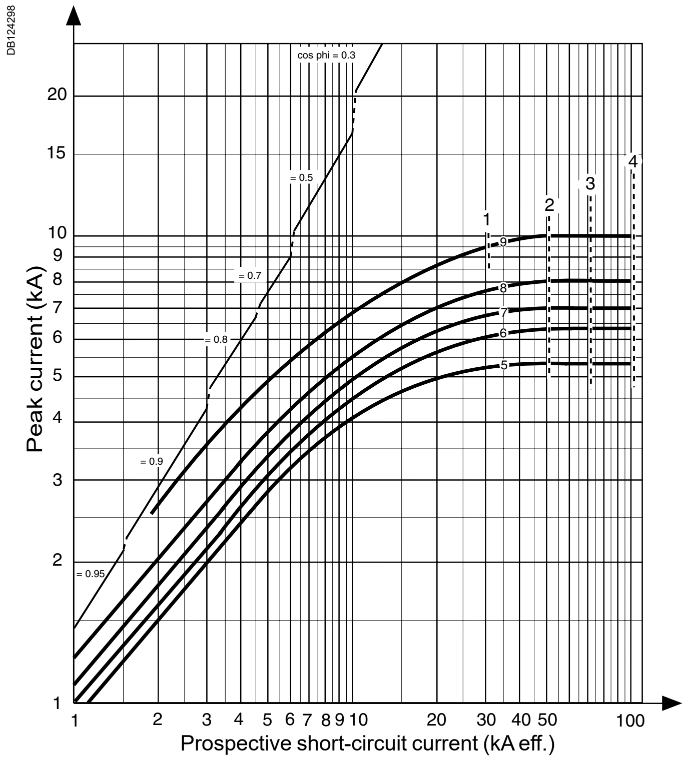
Ue: 220-240 V AC

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

NG125a, N, H, L

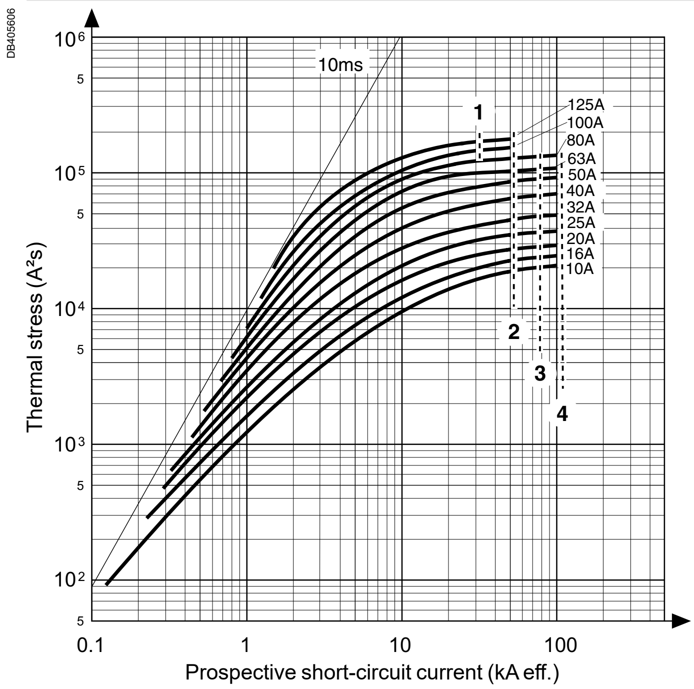
1P / 2P / 3P / 4P

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.)

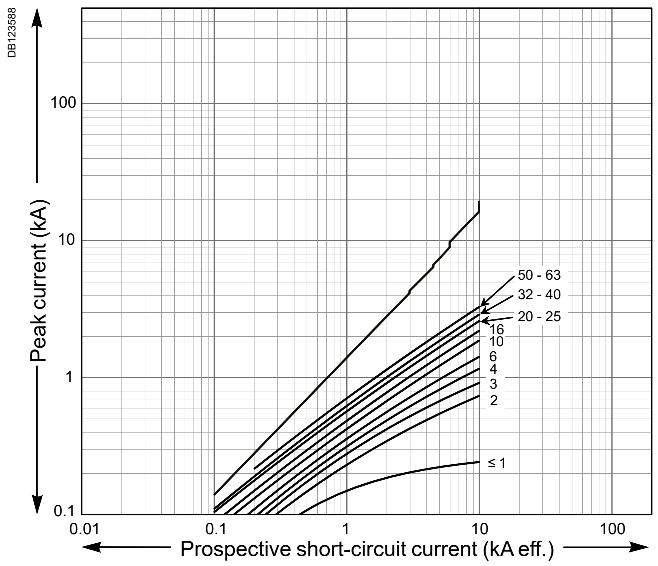
Direct current network

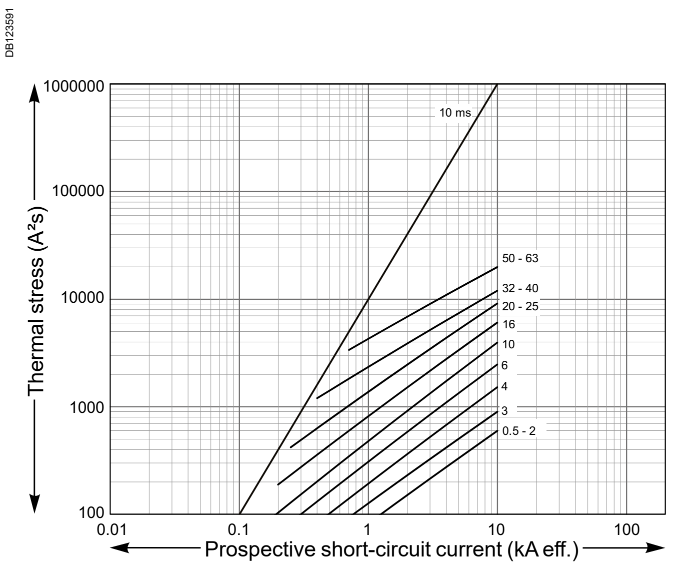
Limitation curves for direct current network

C60H-DC curve C

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

Peak current	Thermal stress

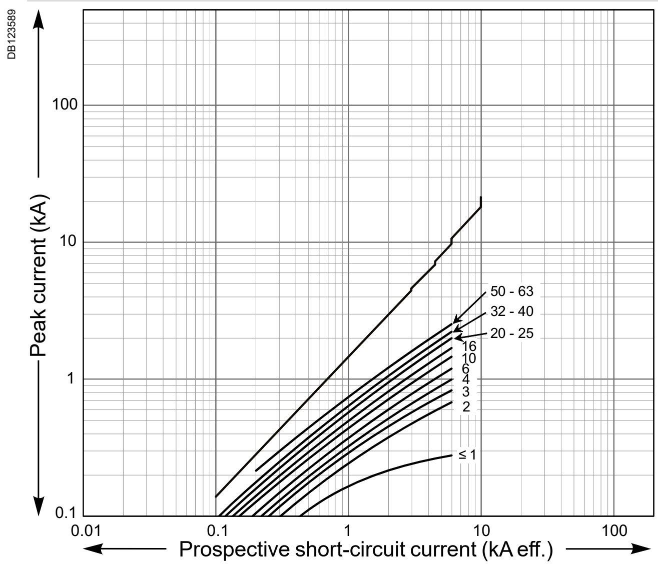


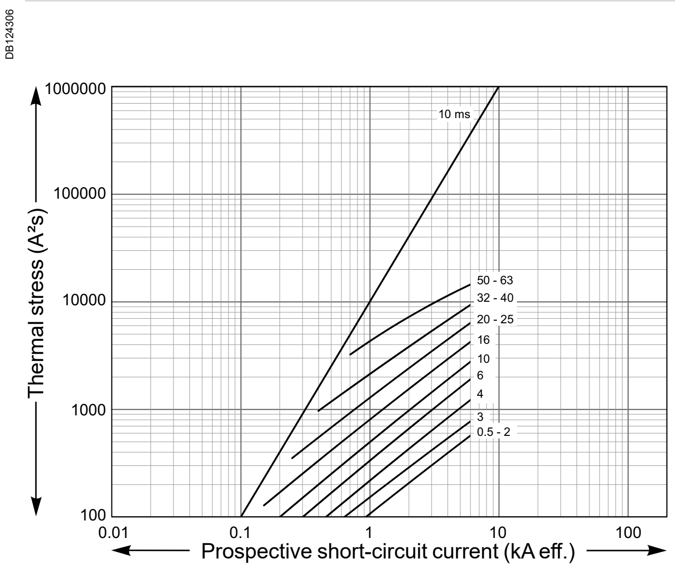


C60H-DC curve C

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

Peak current	Thermal stress





Short-circuit current limiting (cont.)

Evolutions

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Indice	Date	Modification	Name
3.3	14/10/2020	Add RCBO curves pages 6,7. Remove 40A from iCV40H, iCV40H ARC curves	I. Flaubert
3.2	25/05/2018	Add Acti9 iC40, iCV40, iC40N and iCV40N curves - Add 13 A rating in iC60N and iC60H curves.	Sonovision
3.1	14/09/2017	Added iC60 curves for 440 V pages 11 to 15	Sonovision
3.0	03/04/2017	New charte	Sonovision
2.7	14/12/2016	Added iC60 curves for 220-240 V pages 7-8	Sonovision
2.6	22/10/2015	Changed DPN, DPN N curves page 4	Sonovision
2.5	29/07/2013	in thermal stress graphs change "peak current" by "thermal stress"	JPM
2.4	17/07/2012	Changed number of poles and pages order	Sedoc
2.3	13/07/2012	Add C60 curves	Sedoc
2.2	4/07/2012	Deleted iDPN, iK60 curves	Sedoc
2.1	06/06/2012	Change texts and curves	Sedoc
2.0	21/06/2011	InDesign CS5 - Add C60H-DC, C120 and NG125 curves	Sedoc
1.0	22/11/2010	Creation	Sedoc