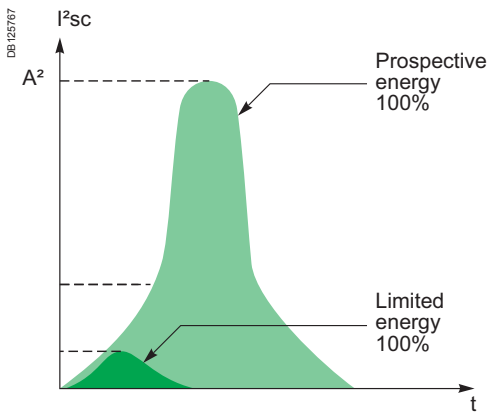


Prospective current and real limit current.



## 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.

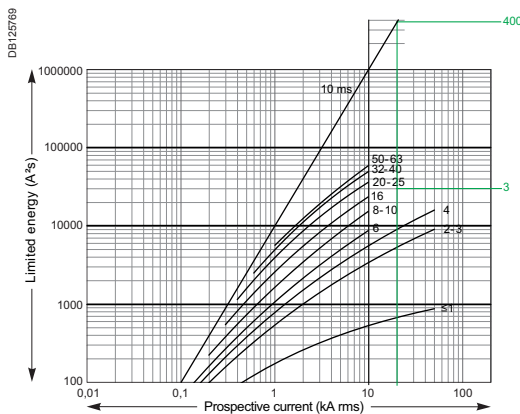
# Short-circuit current limiting (cont.)

## 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):

- b the real peak current (limited)
- b the thermal stress (in A<sup>2</sup>s), 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<sup>2</sup>s 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:

- b this short-circuit current (10 kA rms) is likely to dissipate up to 1,000 kA<sup>2</sup>s
- b the iC60N circuit breaker reduces this thermal stress to: 35 kA<sup>2</sup>s, 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<sup>2</sup> and stresses in A<sup>2</sup>s.

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

### Example

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

The above table shows that the acceptable stress is 1.32 x 10<sup>6</sup> A<sup>2</sup>s. Any short-circuit current at the point where a NG125L device (I<sub>cu</sub> = 25 kA) is installed will be limited, with a thermal stress of less than 2.2 x 10<sup>5</sup> A<sup>2</sup>s. (Curve on page 10).

The cable is therefore always protected up to the breaking capacity of the circuit breaker.

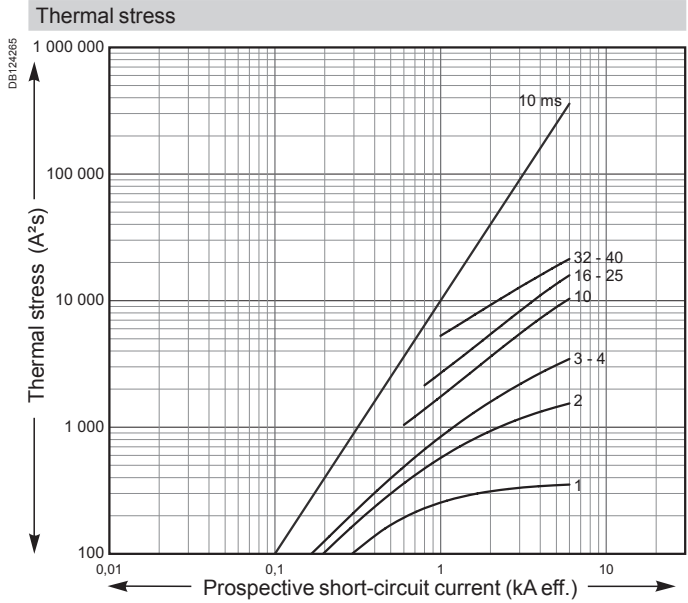
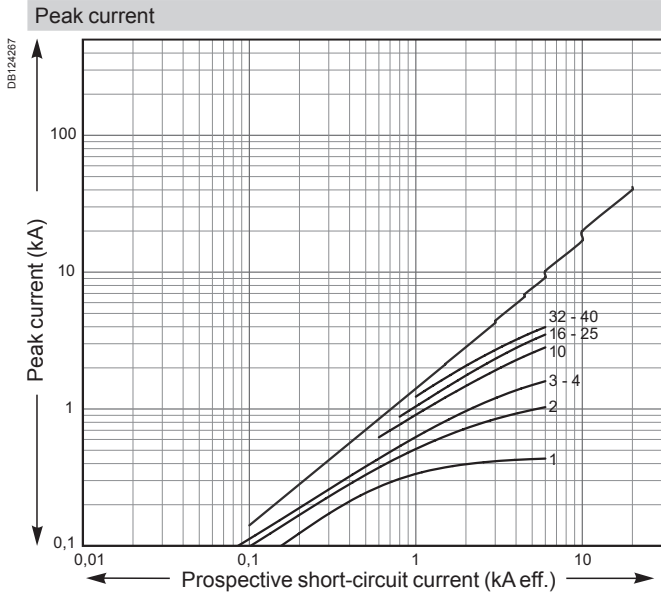
# Short-circuit current limiting (cont.)

## Limitation curves for network

Ue: 380-415 V AC (Ph/N 220-240 V AC)

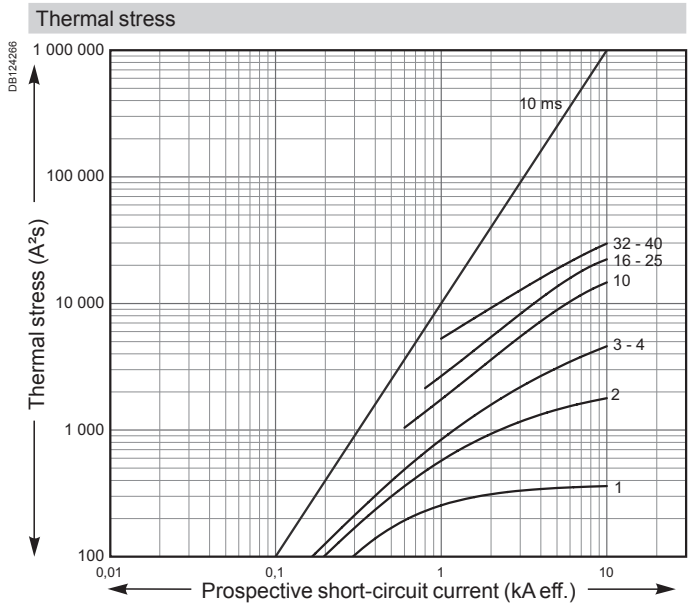
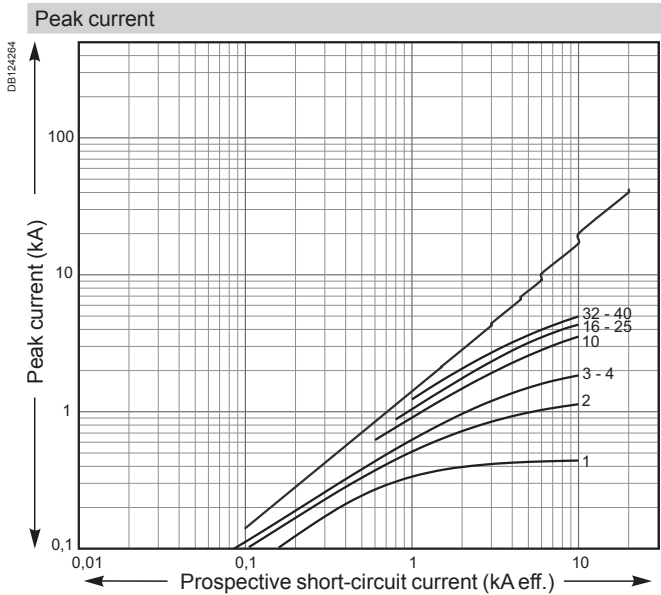
### DPN (MCB and RCBO)

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



### DPN N (MCB and RCBO)

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



# Short-circuit current limiting (cont.)

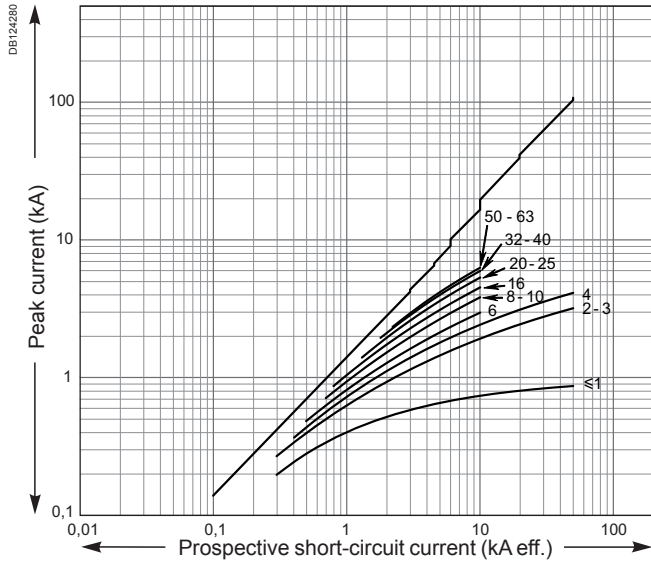
## Limitation curves for network

U<sub>e</sub>: 380-415 V AC (Ph/N 220-240 V AC)

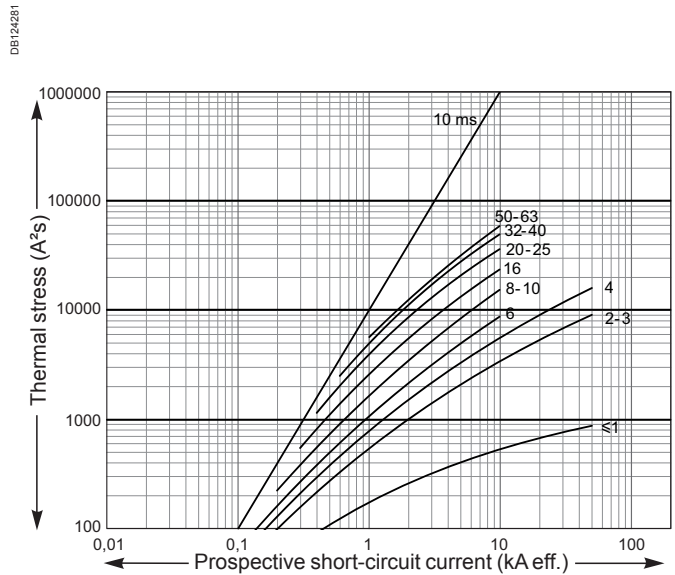
### iC60N

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

Peak current



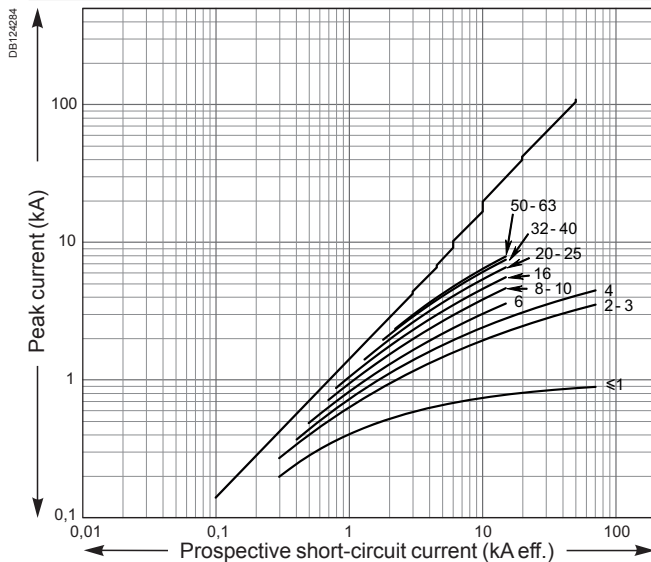
Thermal stress



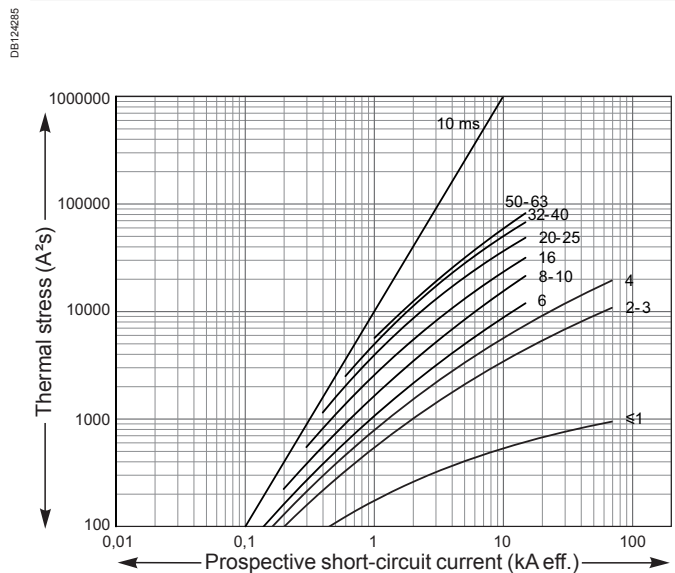
### iC60H

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

Peak current



Thermal stress



# Short-circuit current limiting (cont.)

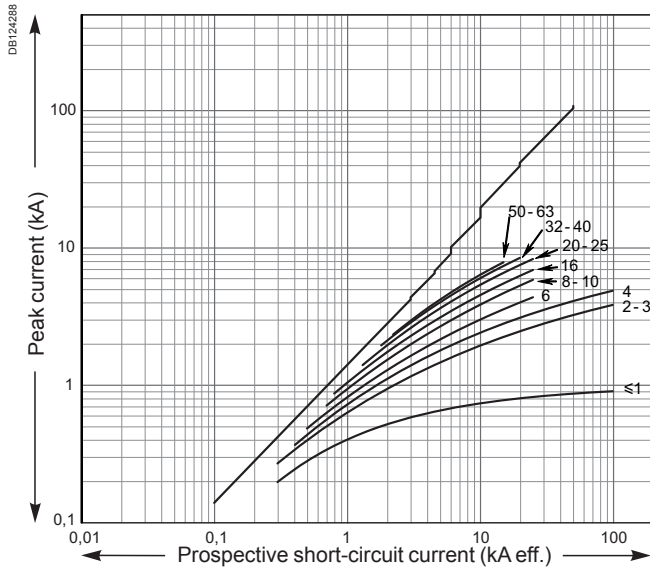
## Limitation curves for network

U<sub>e</sub>: 380-415 V AC (Ph/N 220-240 V AC)

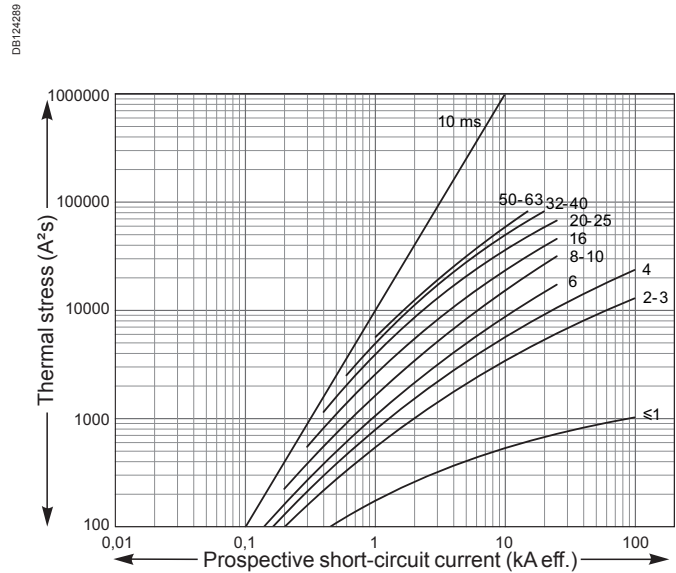
**iC60L**

1P / 2P / 3P / 4P

Peak current



Thermal stress



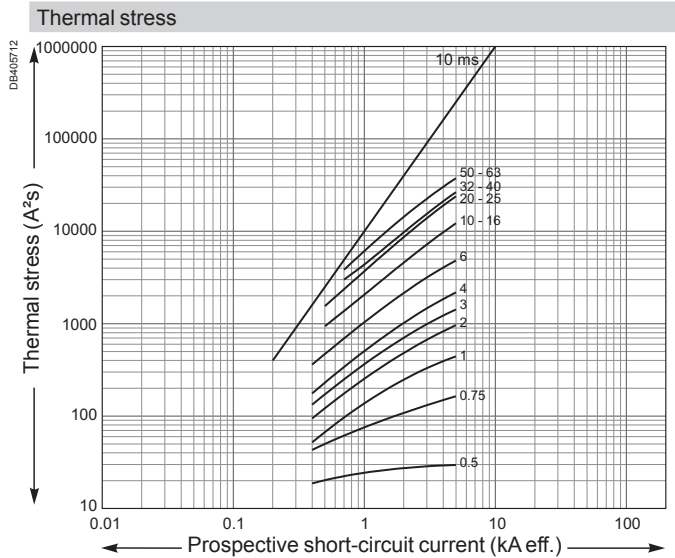
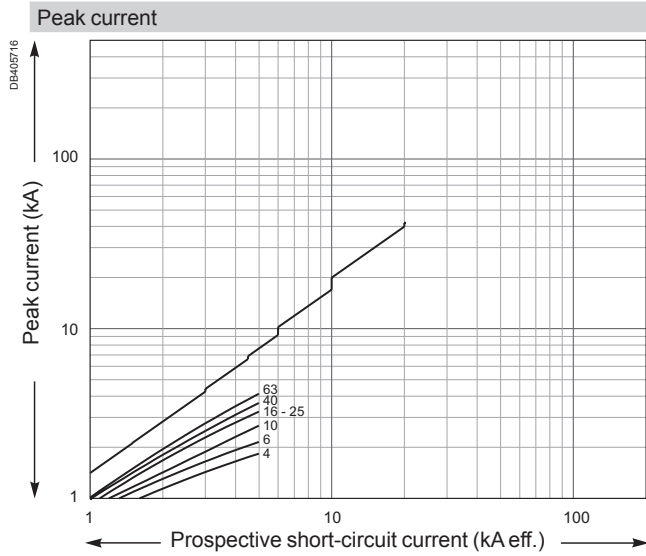
# Short-circuit current limiting (cont.)

## Limitation curves for network

U<sub>e</sub>: 380-415 V AC (Ph/N 220-240 V AC)

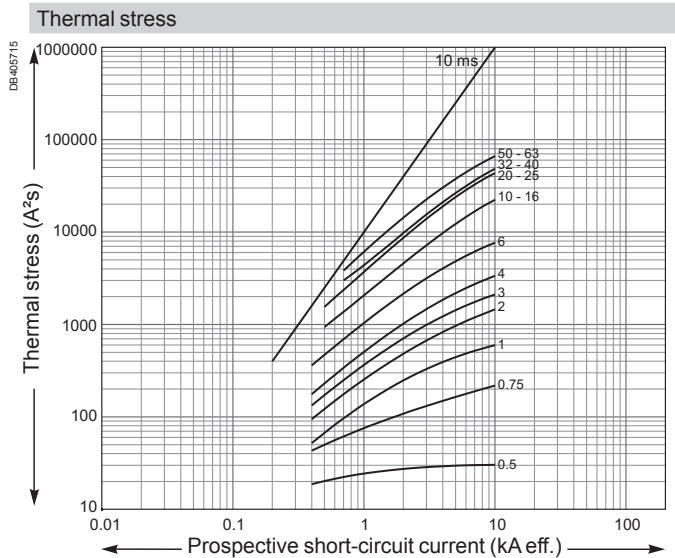
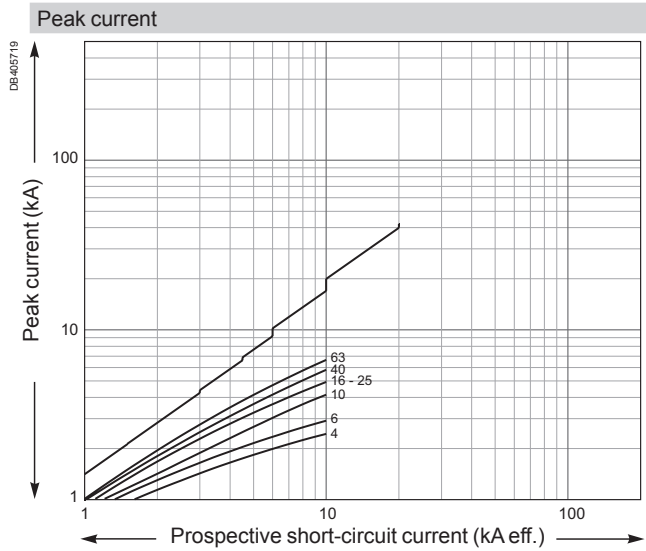
### C60a

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



### C60N

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

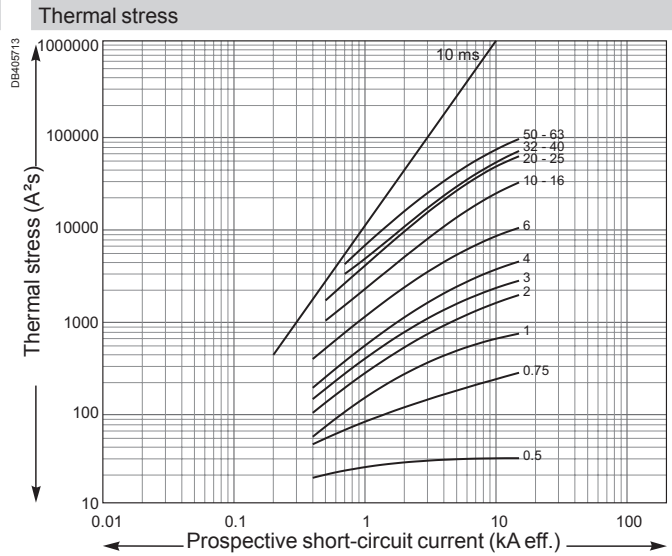
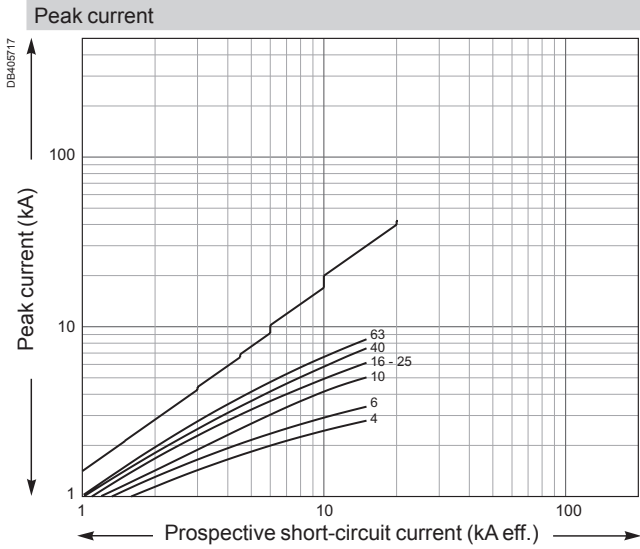


# Short-circuit current limiting (cont.)

## Limitation curves for network U<sub>e</sub>: 380-415 V AC (Ph/N 220-240 V AC)

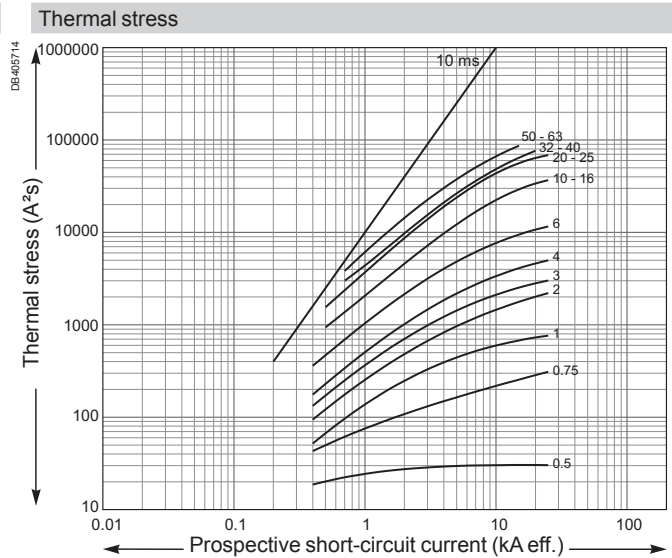
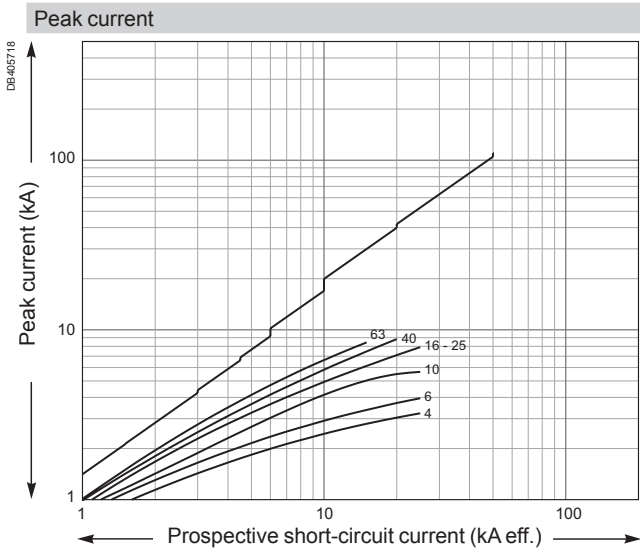
### C60H

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



### C60L

1P / 2P / 3P / 4P



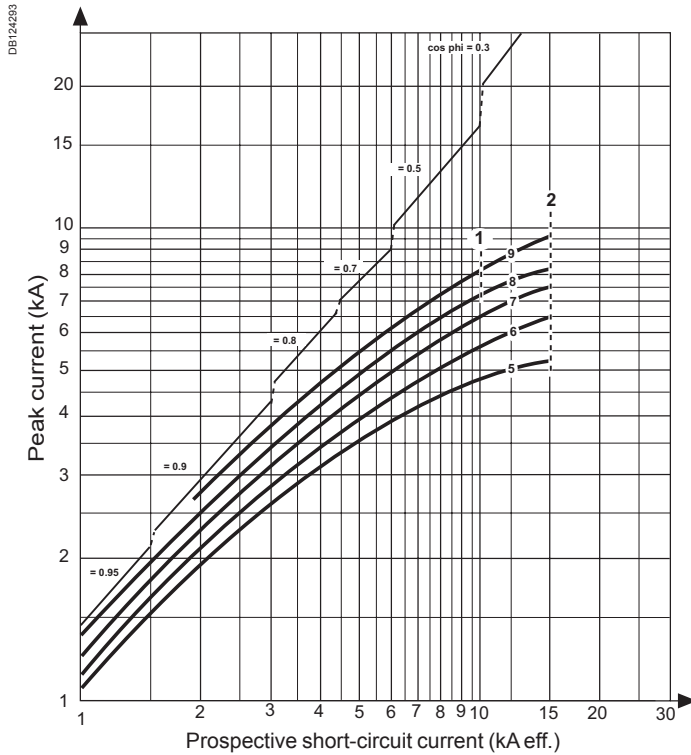
## Limitation curves for network

U<sub>e</sub>: 380-415 V AC (Ph/N 220-240 V AC)

### C120N, H

1P / 2P / 3P / 4P

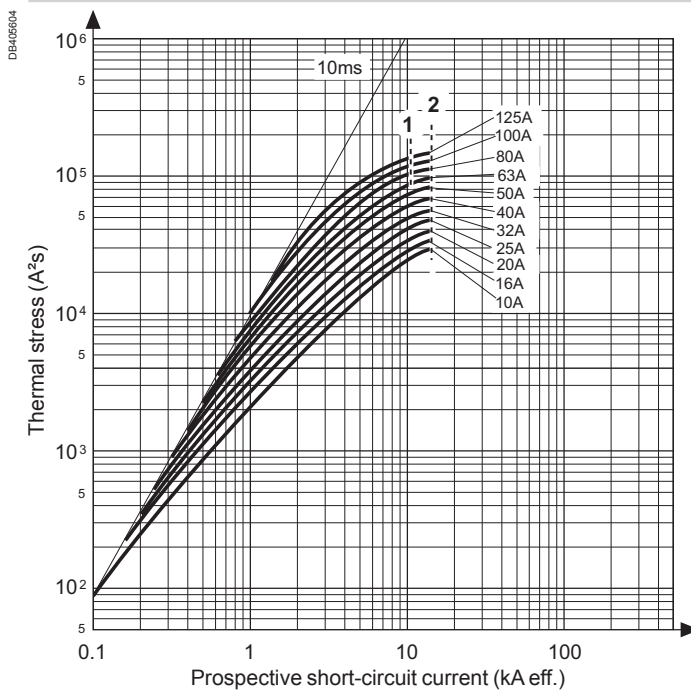
Peak current



b Circuit breaker type in accordance with the mark:

- v 1: C120N
- v 2: C120H
- v 5: 10-16 A
- v 6: 20-25 A
- v 7: 32-40 A
- v 8: 50-63 A
- v 9: 80-125 A

Thermal stress



b Circuit breaker type in accordance with the mark:

- v 1: C120N
- v 2: C120H



# Short-circuit current limiting (cont.)

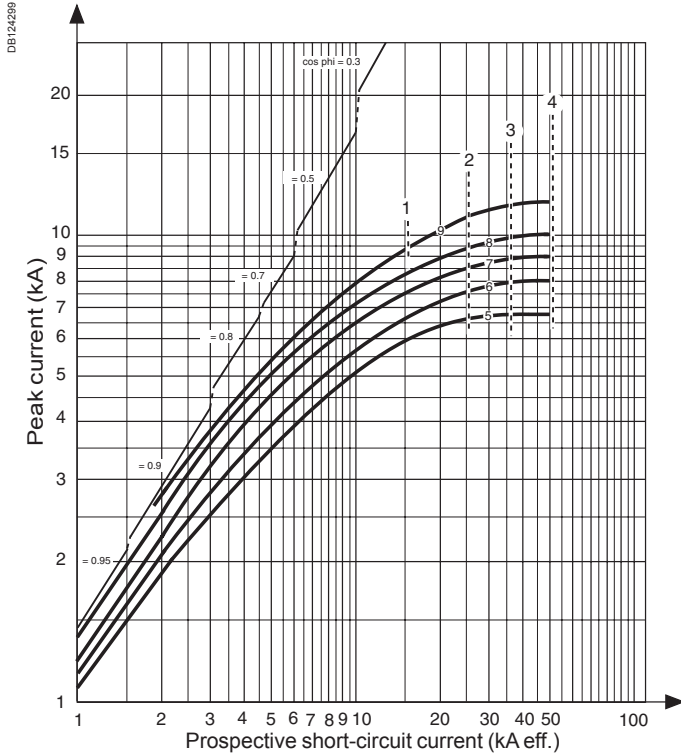
## Limitation curves for network

U<sub>e</sub>: 380-415 V AC (Ph/N 220-240 V AC)

NG125a, N, H, L

1P / 2P / 3P / 4P

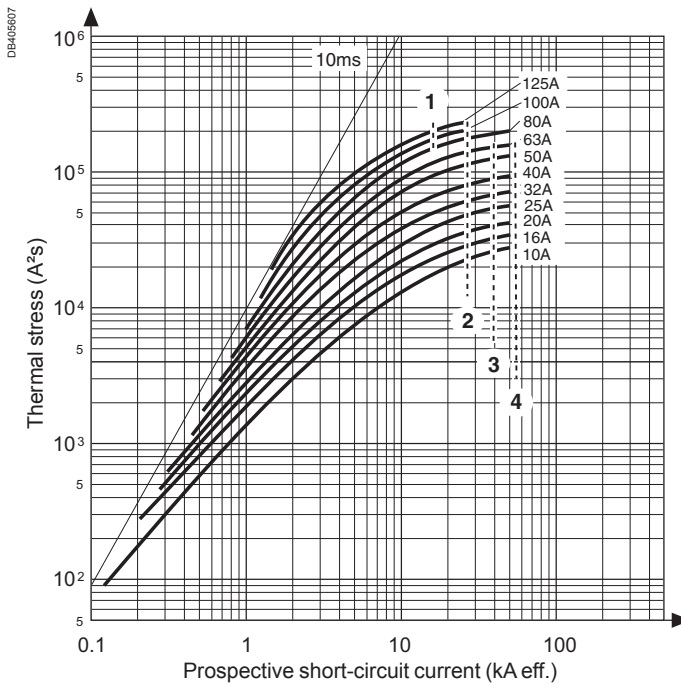
Peak current



b Circuit breaker type in accordance with the mark:

- v 1: NG125a
- v 2: NG125N
- v 3: NG125H
- v 4: NG125L
- v 5: 10 -16 A
- v 6: 20-25 A
- v 7: 32-40 A
- v 8: 50-63 A
- v 9: 80-125 A

Thermal stress



b Circuit breaker type in accordance with the mark:

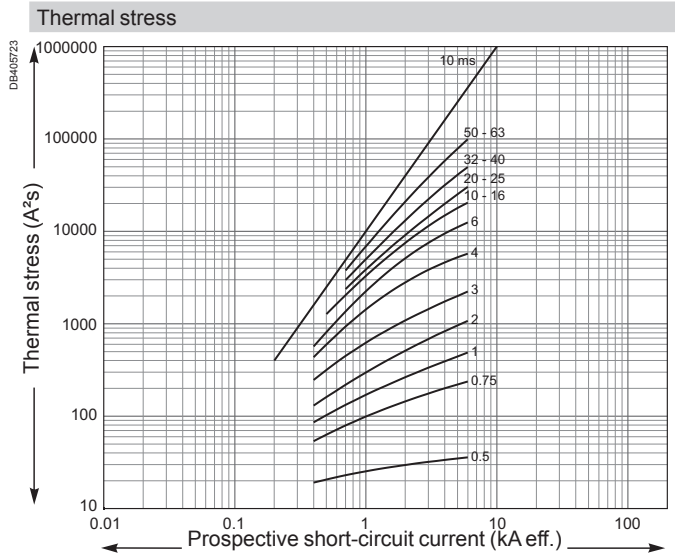
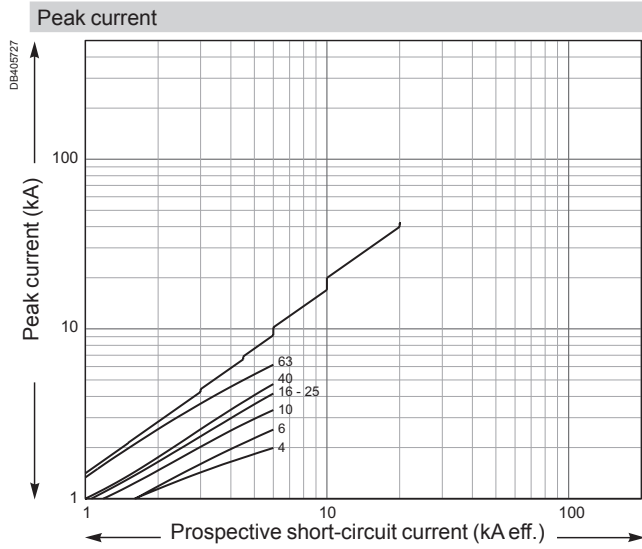
- v 1: NG125a 80-100-125 A
- v 2: NG125N
- v 3: NG125H
- v 4: NG125L

# Short-circuit current limiting (cont.)

## Limitation curves for network U<sub>e</sub>: 440 V AC

**C60N**

**2P / 3P / 4P**

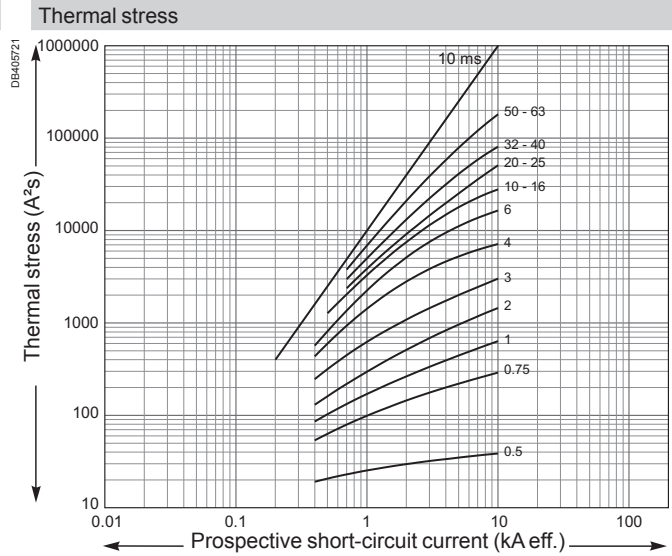
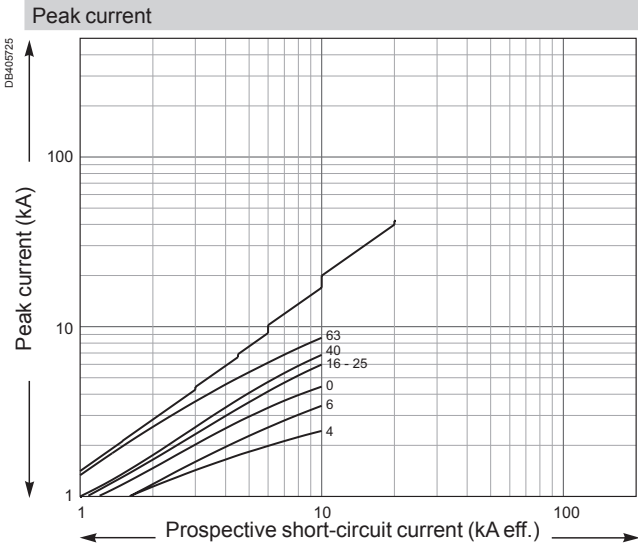


# Short-circuit current limiting (cont.)

## Limitation curves for network U<sub>e</sub>: 440 V AC

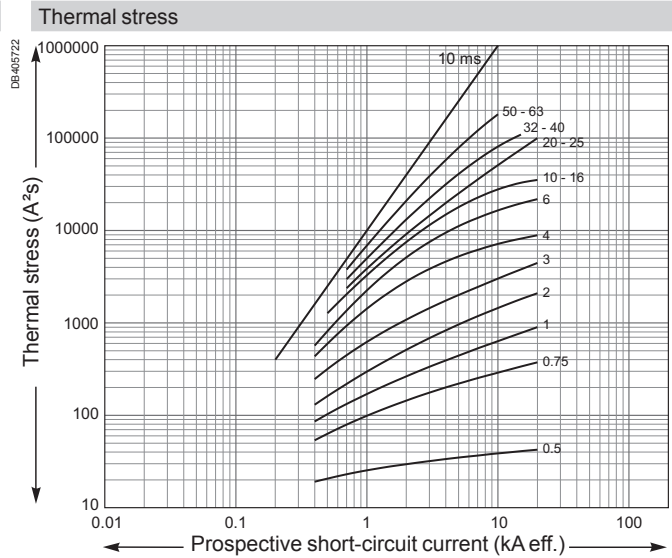
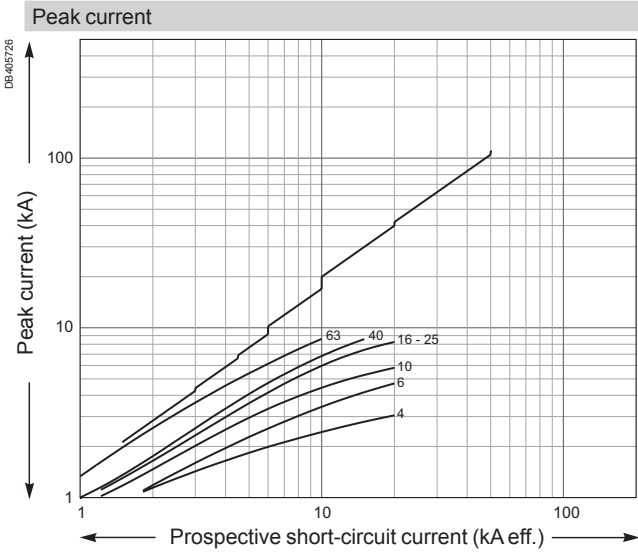
### C60H

2P / 3P / 4P



### C60L

2P / 3P / 4P

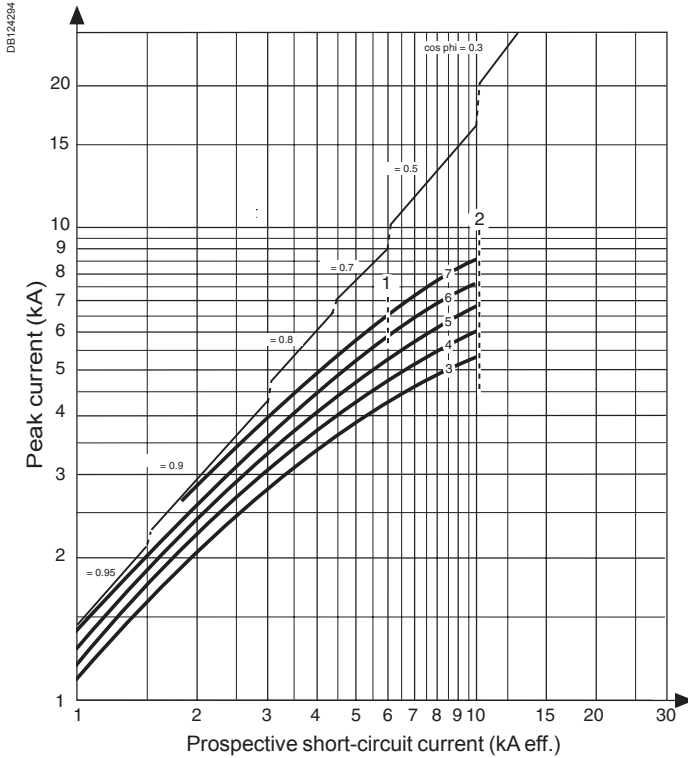


## Limitation curves for network U<sub>e</sub>: 440 V AC

### C120N, H

2P / 3P / 4P

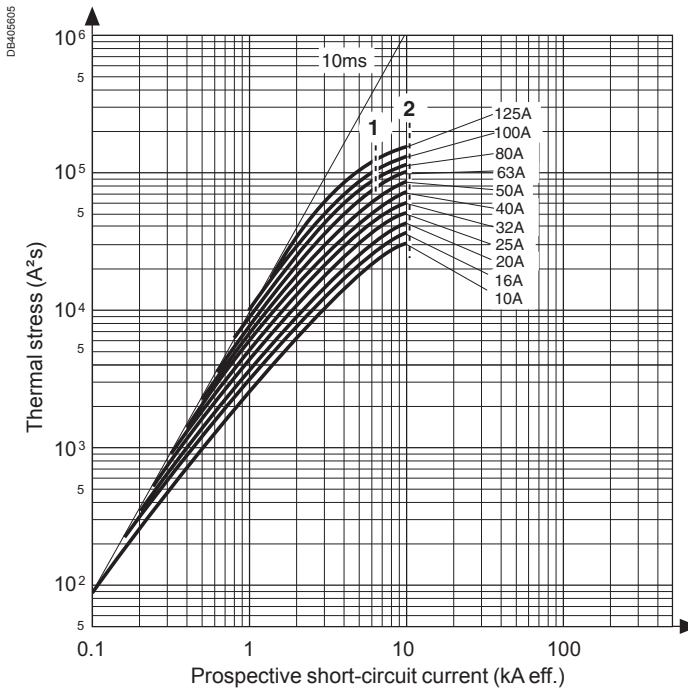
Peak current



b Circuit breaker type in accordance with the mark:

- v 1: C120N
- v 2: C120H
- v 3: 0-16 A
- v 4: 20-25 A
- v 5: 32-40 A
- v 6: 50-63 A
- v 7: 80-125 A

### Thermal stress



b Circuit breaker type in accordance with the mark:

- v 1: C120N
- v 2: C120H

# Short-circuit current limiting (cont.)

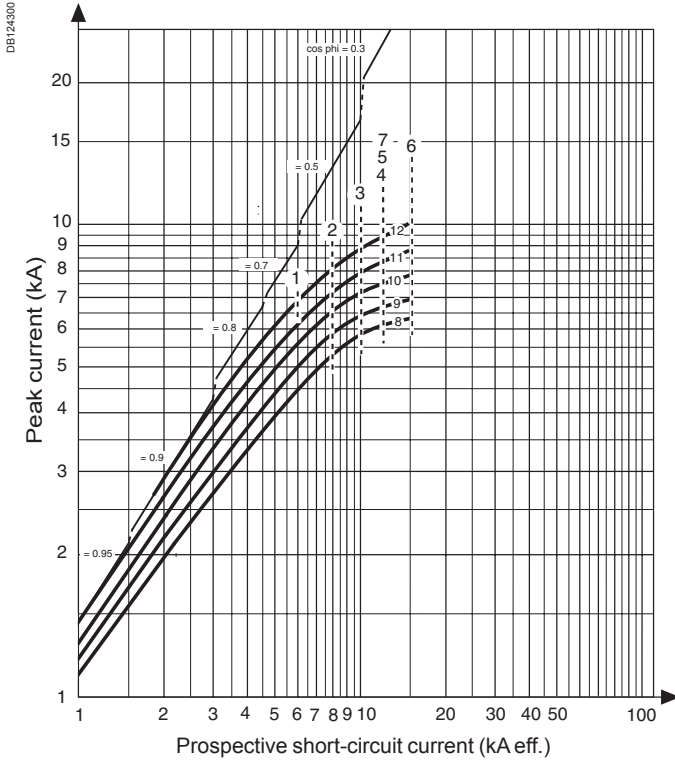
## Limitation curves for network

U<sub>e</sub>: 550 V AC

**NG125a, N, H, L**

**2P / 3P / 4P**

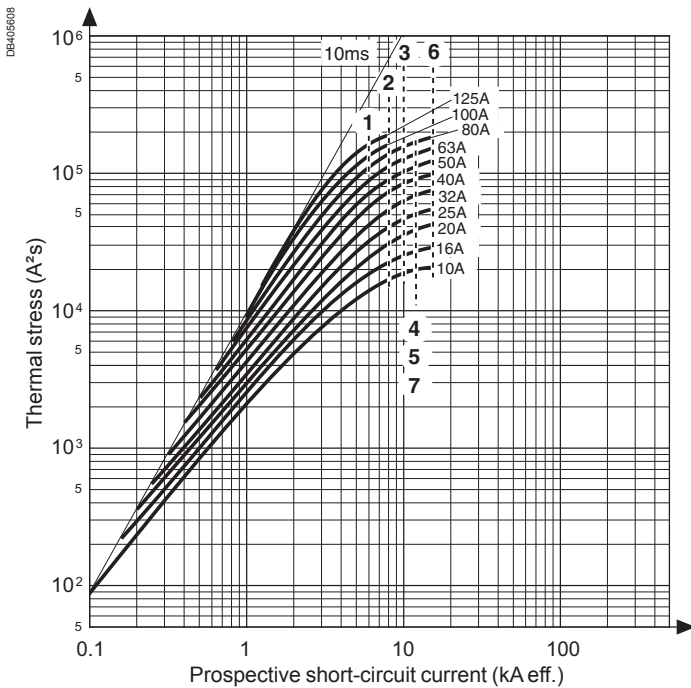
Peak current



b Circuit breaker type in accordance with the mark:

- v 1: NG125a 3, 4P
- v 2: NG125N 2, 3, 4P
- v 3: NG125H 3, 4P
- v 4-5: NG125H 2P/NG125L 3, 4P
- v 6: NG125L 2P
- v 7: NG125 LMA 2, 3, 4P
- v 8: 10 -16 A
- v 9: 20-25 A
- v 10: 32-40 A
- v 11: 50-63 A
- v 12: 80-125 A

Thermal stress



b Circuit breaker type in accordance with the mark:

- v 1: NG125a 3, 4P
- v 2: NG125N 2, 3, 4P
- v 3: NG125H 3, 4P
- v 4-5: NG125H 2P/NG125L 3, 4P
- v 6: NG125L 2P
- v 7: NG125LMA 2, 3, 4P

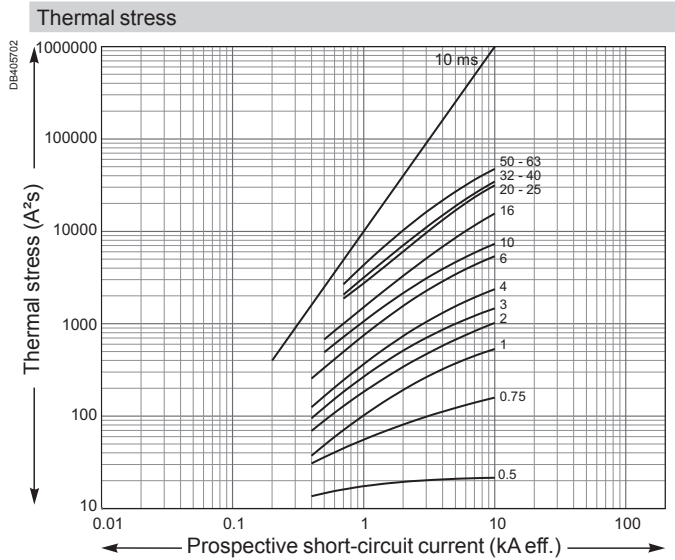
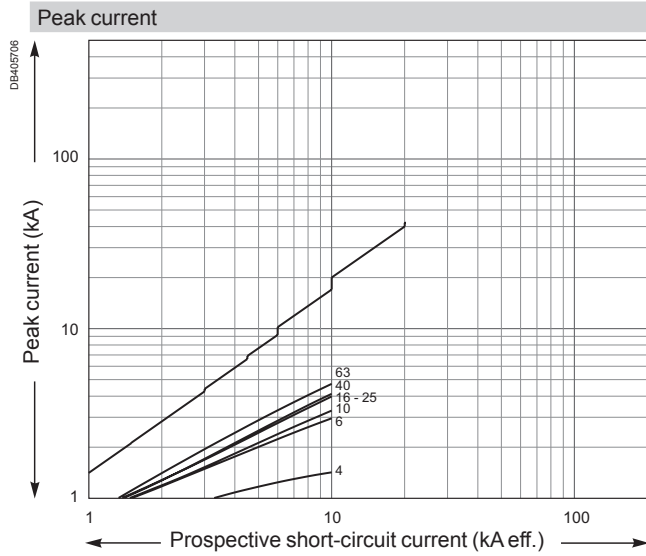
# Short-circuit current limiting (cont.)

## Limitation curves for network

U<sub>e</sub>: 220-240 V AC (Ph/N 110-130 V AC)

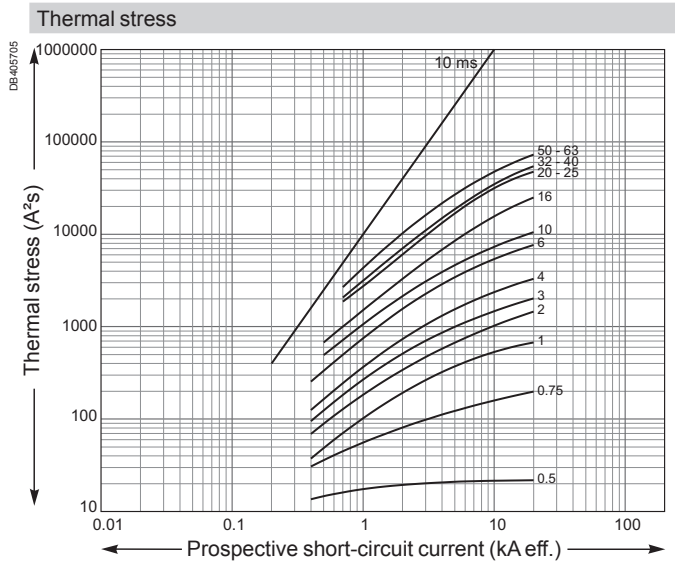
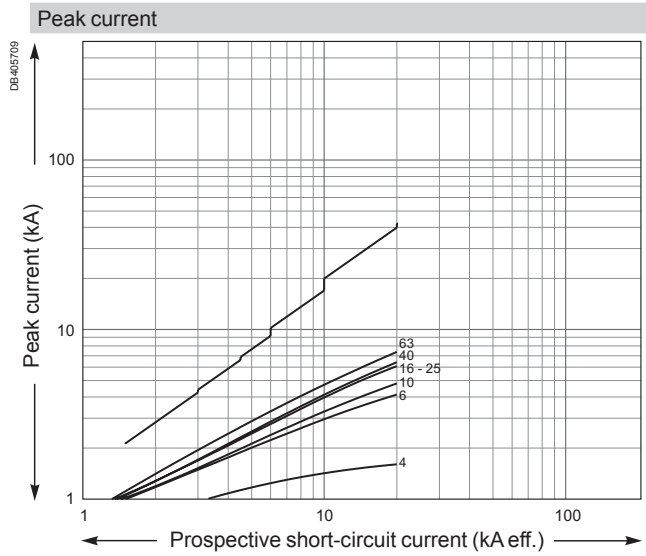
### C60a

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



### C60N

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



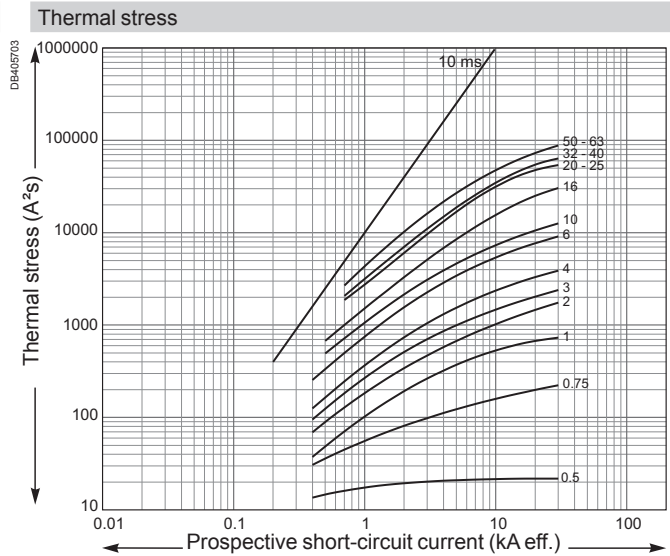
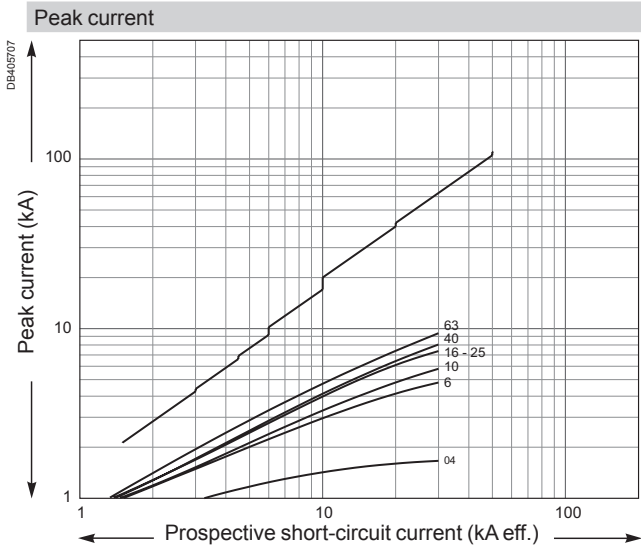
# Short-circuit current limiting (cont.)

## Limitation curves for network

U<sub>e</sub>: 220-240 V AC (Ph/N 110-130 V AC)

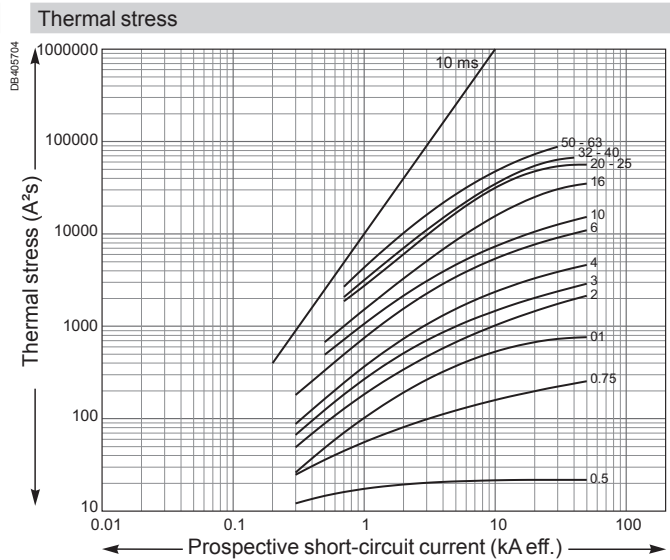
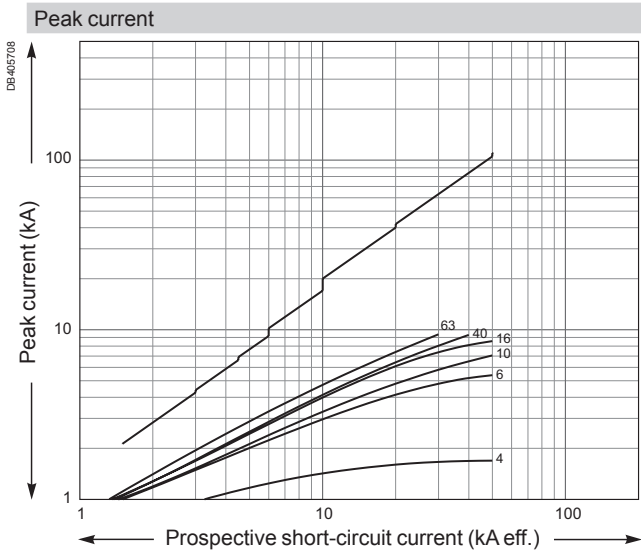
### C60H

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



### C60L

1P / 2P / 3P / 4P



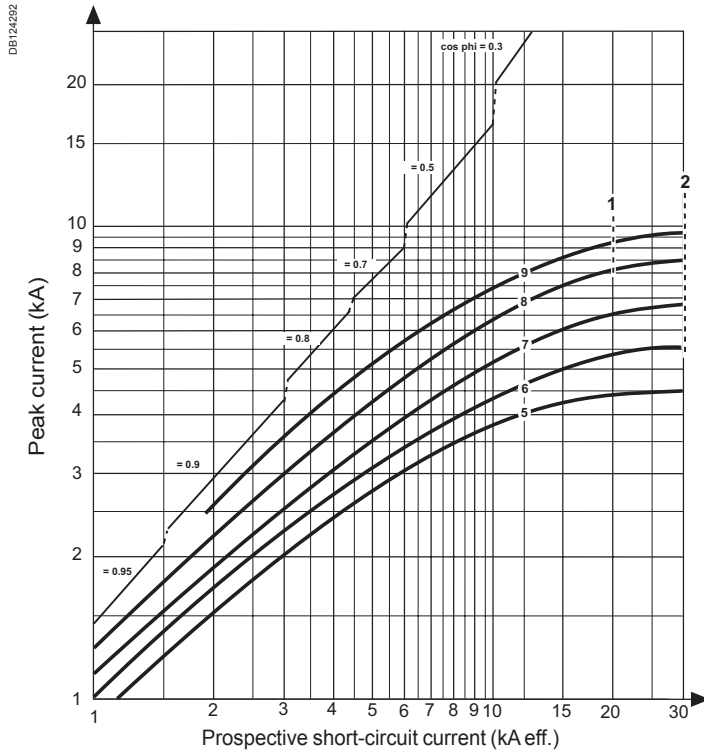
## Limitation curves for network

U<sub>e</sub>: 220-240 V AC (Ph/N 110-130 V AC)

### C120N, H

1P / 2P / 3P / 4P

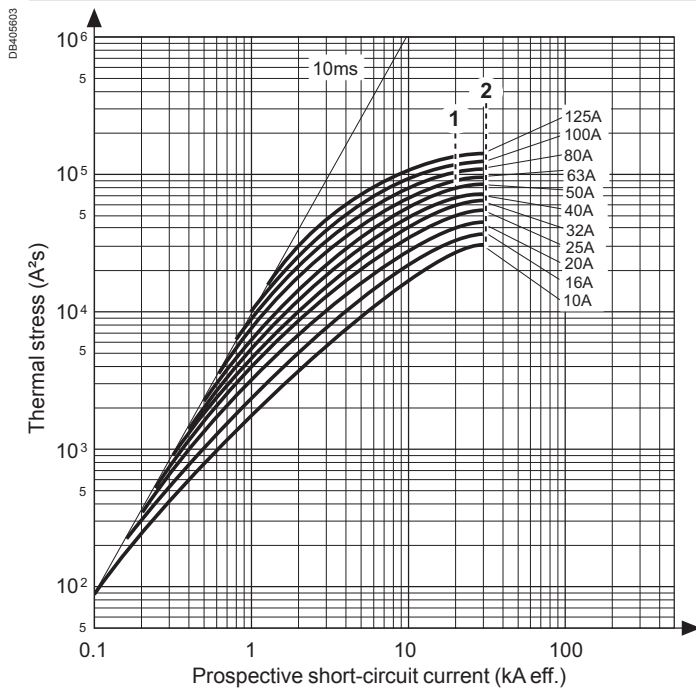
Peak current



b Circuit breaker type in accordance with the mark:

- v 1: C120N
- v 2: C120H
- v 5: 10-16 A
- v 6: 20-25 A
- v 7: 32-40 A
- v 8: 50-63 A
- v 9: 80-125 A

Thermal stress



b Circuit breaker type in accordance with the mark:

- v 1: C120N
- v 2: C120H



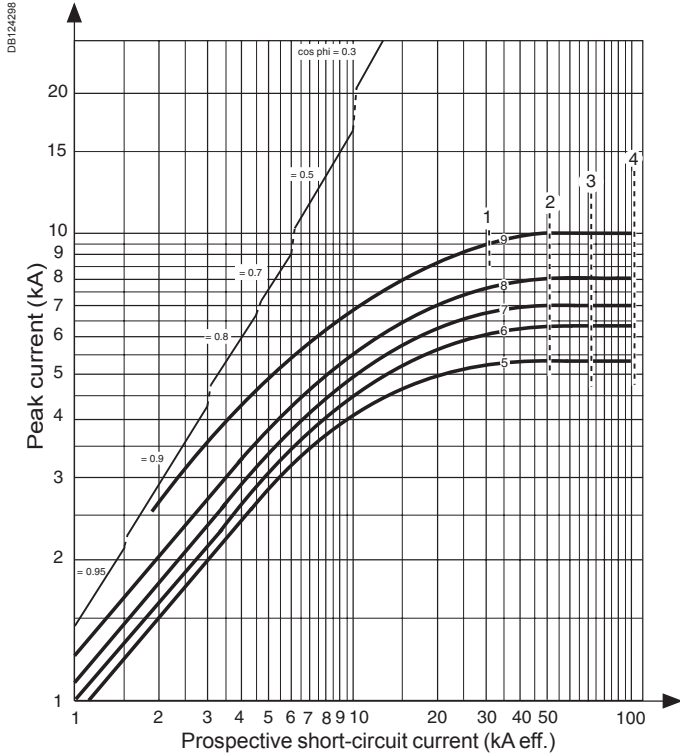
# Short-circuit current limiting (cont.)

## Limitation curves for network U<sub>e</sub>: 220-240 V AC (Ph/N 110-130 V AC)

**NG125a, N, H, L**

**1P / 2P / 3P / 4P**

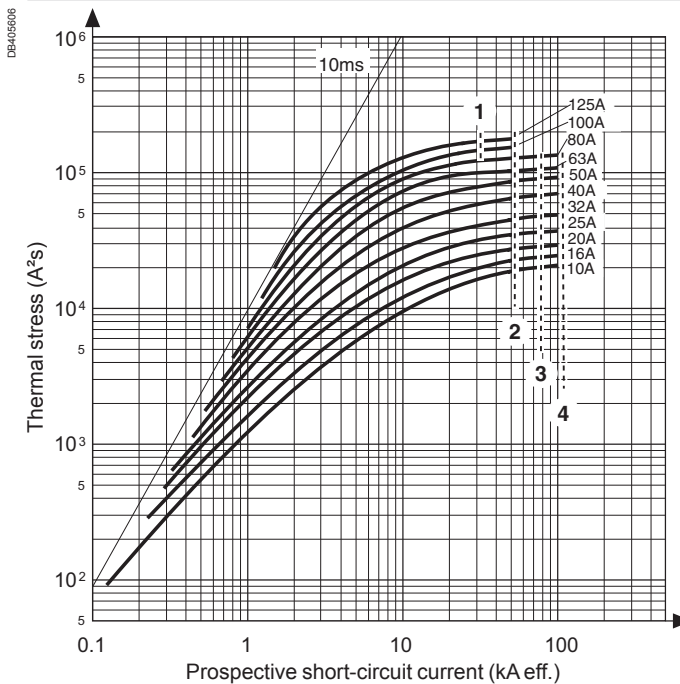
**Peak current**



b Circuit breaker type in accordance with the mark:

- v 1: NG125a
- v 2: NG125N
- v 3: NG125H
- v 4: NG125L
- v 5: 10-16 A
- v 6: 20-25 A
- v 7: 32-40 A
- v 8: 50-63 A
- v 9: 80-125 A

**Thermal stress**



b Circuit breaker type in accordance with the mark:

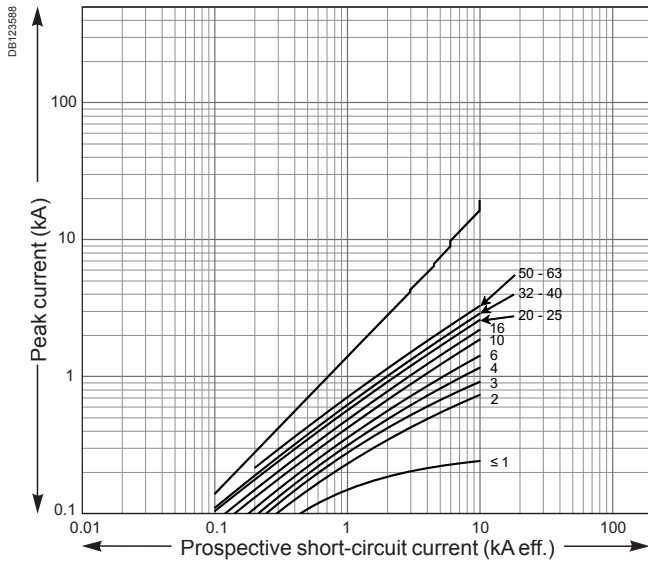
- v 1: NG125a 80-100-125 A
- v 2: NG125N
- v 3: NG125H
- v 4: NG125L

## Limitation curves for direct current network

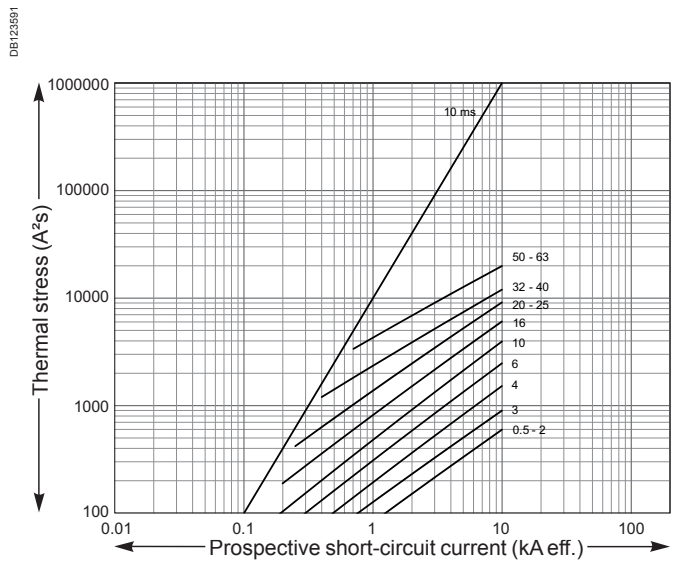
### C60H-DC curve C

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

Peak current



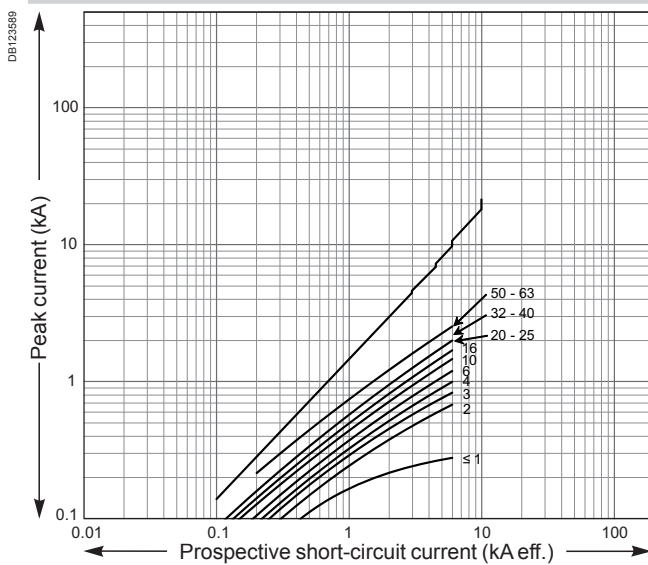
Thermal stress



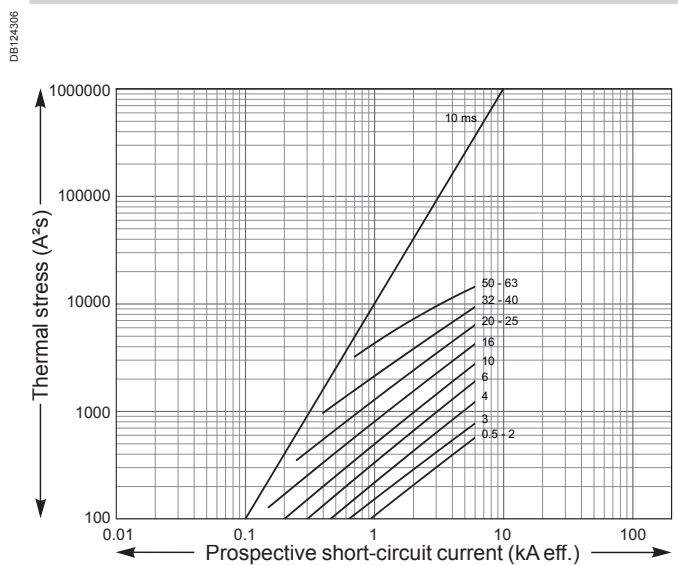
### C60H-DC curve C

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

Peak current



Thermal stress





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
<b>Indice</b>	<b>Date</b>	<b>Modification</b>	<b>Name</b>