

Inrush currents

When LV/LV transformers are switched on, very high inrush currents are produced which must be taken into account when choosing overcurrent protection devices. The peak value of the first current wave often reaches 10 to 15 times the rated rms current of the transformer and may reach values of 20 to 25 times the rated current even for transformers rated less than 50 kVA.

Selecting the protection

Merlin Gerin has conducted an extensive test programme to optimise the protection of LV/LV transformers.

The Compact and Masterpact circuit breakers detailed in the following tables offer the following advantages:

- protection of the transformer in the event of abnormal overloads
- no nuisance tripping when the primary winding is energised
- unimpaired electrical endurance of the circuit breaker.

The transformers used for the tests are standard. The values in the tables have been calculated for a crest factor of 25. These tables indicate the circuit breaker and trip unit to be used depending on:

- the primary supply voltage (230 V or 400 V)
- the type of transformer (single-phase or three-phase).

They correspond to the most frequent case in which the primary is wound externally ⁽¹⁾.

The type of circuit breaker to be used (i.e. N, H or L) depends on the breaking capacity required at the point of installation.

Protection using a Compact circuit breaker (1st peak $\leq 25 I_n$)

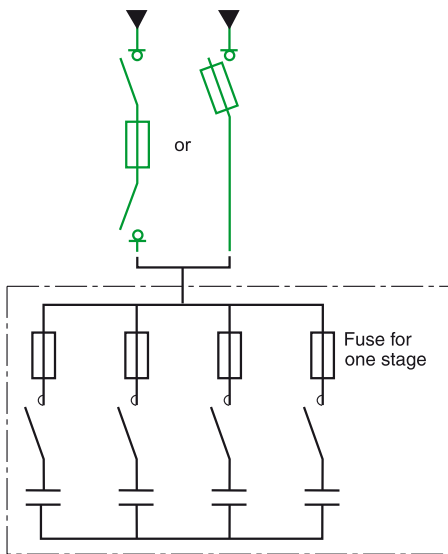
Compact NS100 to NS250 equipped with TM-D thermal-magnetic trip unit					
Transformer rating (kVA)			Protective device		
230/240 V 1-phase	230/240 V 3-phases 400/415 V 1-phase	400/415 V 3-phases	Circuit breakers	Trip unit	I_r max setting
3	5 to 6	9 to 12	NS100N/H/L	TM16D	1
5	8 to 9	14 to 16	NS100N/H/L	TM25D	1
7 to 9	13 to 16	22 to 28	NS100N/H/L	TM40D	1
12 to 15	20 to 25	35 to 44	NS100N/H/L	TM63D	1
16 to 19	26 to 32	45 to 56	NS100N/H/L	TM80D	1
18 to 23	32 to 40	55 to 69	NS160N/H/L	TM100D	1
23 to 29	40 to 50	69 to 87	NS160N/H/L	TM125D	1
29 to 37	51 to 64	89 to 111	NS250N/H/L	TM160D	1
37 to 46	64 to 80	111 to 139	NS250N/H/L	TM200D	1

Compact NS100 to NS1600 / Masterpact equipped with STR and Micrologic trip unit					
Transformer rating (kVA)			Protective device		
230/240 V 1-phase	230/240 V 3-phases 400/415 V 1-phase	400/415 V 3-phases	Circuit breakers	Trip unit	I_r max setting
4 to 7	6 to 13	11 to 22	NS100N/H/L	STR22SE 40	0.8
9 to 19	16 to 30	27 to 56	NS100N/H/L	STR22SE 100	0.8
15 to 30	05 to 50	44 to 90	NS160N/H/L	STR22SE 160	0.8
23 to 46	40 to 80	70 to 139	NS250N/H/L	STR22SE 250	0.8
37 to 65	64 to 112	111 to 195	NS400N/H	STR23SE/53UE 400	0.7
37 to 55	64 to 95	111 to 166	NS400L	STR23SE/53UE 400	0.6
58 to 83	100 to 144	175 to 250	NS630N/H/L	STR23SE/53UE 630	0.6
58 to 150	100 to 250	175 to 436	NS630bN/bH-NT06H1	Micrologic 5.0/6.0/7.0	1
74 to 184	107 to 319	222 to 554	NS800N/H-NT08H1-NW08N1/H1	Micrologic 5.0/6.0/7.0	1
90 to 230	159 to 398	277 to 693	NS1000N/H-NT10H1-NW10N1/H1	Micrologic 5.0/6.0/7.0	1
115 to 288	200 to 498	346 to 866	NS1250N/H-NT12H1-NW12N1/H1	Micrologic 5.0/6.0/7.0	1
147 to 368	256 to 640	443 to 1108	NS1600N/H-NT16H1-NW16N1/H1	Micrologic 5.0/6.0/7.0	1
184 to 460	320 to 800	554 to 1385	NW20N1/H1	Micrologic 5.0/6.0/7.0	1
230 to 575	400 to 1000	690 to 1730	NW25H2/H3	Micrologic 5.0/6.0/7.0	1
294 to 736	510 to 1280	886 to 2217	NW32H2/H3	Micrologic 5.0/6.0/7.0	1

(1) For other windings, please consult us.

If a circuit breaker upstream of a transformer with a transformation ratio of 1 and a rated power of less than 5 kVA is subject to nuisance tripping, before choosing a circuit breaker with a higher rating, invert the input and the output of the transformer (the inrush current may be doubled if the primary is wound internally rather than externally).

DB116216



Capacitor-bank protection.

056639



Rectimat 2 capacitor bank.

Protection of capacitors

It is necessary to take into account:

- permissible variations in the fundamental voltage and in harmonic content
The increase in the current rating for the protection device may reach 30 %.

- variations due to capacitor tolerances.

The increase in the current rating for the protection device may reach 15 % (but only 5 % for Rectiphase capacitors).

Given the above, the generally required correction factor ranges from 1.6 to 2.

For Rectiphase capacitor banks, an optimised factor of only 1.4 may be used for standard banks.

Protection table for fixed or automatic capacitor banks

400/415 V		
Capacitor (kVAR)	gG fuse-link rating	Fupact
10 kVAR	20 A	INF●32 / INF40
20 kVAR	40 A	INF●63 / INF40
30 kVAR	63 A	INF●63
50 kVAR	100 A	INF●125
60 kVAR	125 A	INF●125
80 kVAR	160 A	INF●250
105 kVAR	250 A	INF●250
150 kVAR	315 A	INF●400
210 kVAR	450 A	INF●630
315 kVAR	670 A	INF●800

690 V		
Capacitor (kVAR)	gG fuse-link rating	Fupact
10 kVAR	16 A	INF●32 / INF40
20 kVAR	32 A	INF●32 / INF40
30 kVAR	40 A	INF●63 / INF40
50 kVAR	63 A	INF●63
60 kVAR	80 A	INF●125
80 kVAR	100 A	INF●125
105 kVAR	125 A	INF●160
150 kVAR	200 A	INF●250
210 kVAR	250 A	INF●400
315 kVAR	400 A	INF●400
405 kVAR	500 A	INF●630
450 kVAR	560 A	INF●630
495 kVAR	630 A	INF●800
540 kVAR	670 A	INFp800