Line protection by means of MCB's

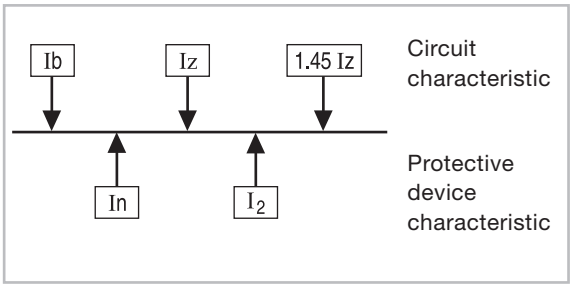
Protective devices shall be capable of breaking any overcurrent up to and including the prospective short-circuit current at the point where the device is installed. One of the protective devices complying with those conditions is the MCB.

Protection against overloads

According to IEC 60364-4-43 protective devices shall be provided to break any overload current flowing in the circuit conductors before such a current could cause a temperature rise detrimental to insulation, joints or surrounding goods to the conductors.

The operating characteristics of a device protecting a cable against overload shall satisfy the two following conditions:

$$I_B \leq In \leq Iz$$
$$I_2 \leq 1.45\, Iz$$



I_B= Current for which the circuit is designed.
I_Z= Continuous current carrying capacity of the cable.
In= Nominal current of the protective device.
I_2= Current ensuring effective operation of the protective device.

In and I_2 are values provided by the manufacturer of the protective device. Calculation of the cable cross section shall be done following the national wiring regulations as well as the IEC 60364-5-523 standard.

The maximum current admissible by the conductor (Iz) depends of following factors:
1. Conductor cross-section.
2. Insulation material.
3. Composition of the conductor.
4. Ambient temperature.
5. Emplacement and canalisation.

Protection of phase conductor
Protection of overcurrent shall be provided for all phase conductors; it shall cause the disconnection of the conductor in which the overcurrent is detected, but not necessarily of other live conductor except in the following cases:
In TT or TN systems, for circuits supplied between phases and in which the neutral conductor is not distributed, overcurrent detection need to be provided for one of the phase conductors, provided that the following conditions are simultaneously fulfilled:
- There is, in the same circuit or on the supply side a differential protection intended to cause disconnection of all the phase conductors;
- The neutral conductor is not distributed from an artificial neutral point of the circuit situated on the load side of the differential protective device.

In IT systems it is mandatory to protect all the phase conductors.

Protection of neutral conductor
IT system
In IT systems it is strongly recommended that the neutral conductor should not be distributed. However, when the neutral conductor is distributed, it is generally necessary to provide overcurrent detection for the neutral conductor of every circuit, which will cause the disconnection of all live conductors of the corresponding circuit, including the neutral conductor. This measure is not necessary if:
- The particular neutral conductor is effectively protected against short-circuit by a prospective device placed on the supply side.
- or if the particular circuit is protected by a RCD with a rated residual current not exceeding 0,15 times the current-carrying of the corresponding neutral conductor. This device shall disconnect all the live conductors of the corresponding circuit, including the neutral conductor.

TT & TN systems
Where the cross sectional area of the neutral conductor is at least equal or equivalent to that of the phase conductors, it is not neccesary to provide overcurrent detection for the neutral conductor or a disconnecting device for that conductor. Where the cross sectional area of the neutral conductor is less than that of the phase conductor, it is neccesary to provide overcurrent detection for the neutral conductor , appropiate to the cross-sectional area of that conductor; this connection shall cause the disconnection of the phase conductor, but not neccesarily of the neutral conductor.

However, overcurrent detection does not need to be provided for the neutral conductor if the following two conditions are simultaneously fulfilled:
- The neutral conductor is protected against short-circuit by the protective device for the phase conductors of the circuit, and
- The maximum current likely to traverse the neutral conductor is, in normal service, clearly less than the value of the current-carrying capacity of that conductor.

	$S_N=S_F$	$S_N<S_F$			
System	**III+N**	**III+N**	**III**	**I+N**	**II**
TN-C , PEN conductor	3P	3P	–	P	–
TN-S separate PE & N conductors	3PN	3PN	3P	PN	2P
TT	3PN+ RCD	3PN+ RCD	3P+ RCD	PN+ RCD	2P+ RCD
IT	4P	4P	3P	2P	2P
	3PN+ RCD				

S_N = Cross-section of neutral conductor
S_F = Cross-section of phase conductor
P = Protected pole
RCD = Residual current device
N = Neutral pole

Protection against short-circuit

According to IEC 60364 protective devices shall be provided to break any short-circuit current flowing in the circuit conductors before such a current could cause danger due to thermal and mechanical effects produced in conductors and connections.
To consider that an installation is well protected against short-circuits, it is required that the protective device complies with the following conditions:

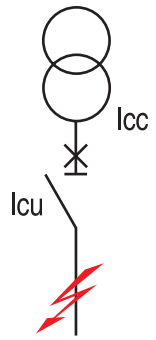
- The breaking capacity shall not be less than the prospective short-circuit current at the place of its installation.

Icu ≥ Icc

- Let-through energy I^2t smaller than admissible energy of the cable.

- According to IEC 60364-4-473 there are some cases where the omission of devices for protection against overload is recommended for circuits supplying current-used equipment where unexpected opening of the circuit could cause danger.
  Examples of such a cases are:
  - Excitation circuit of rotating machines.
  - Supply circuit of lifting magnets.
  - Secondary circuits of current transformers.

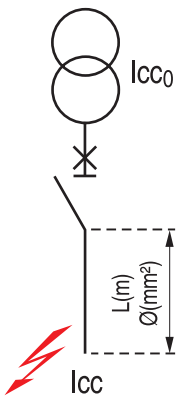
As in those cases the Iu>Iz, it is necessary to verify the short-circuit value at the point of the installation to ensure the protection (Icc min)



Icc: Maximum value of the short-circuit current in that point.

Icu: Short-circuit capacity of the protective device.

Calculation of Icc
The value of the short-circuit current flowing at the end of a cable depends on the short-circuit current flowing at the begining of the cable (transformer terminals), the cross section as well as its length.



Short-circuit current at the transformer terminals (Icc_0)
Three phase oil transformer - 400V

Transformer power kVA	Voltage Ucc in %	In A rms	Icc_0 kA rms
250	4	352	8.7
315	4	443	10.9
400	4	563	13.8
500	4	704	17.1
630	4	887	21.6
800	4.5	1126	24.1
1000	5	1408	27
1250	5.5	1760	30.4
1600	6	2253	35.5
2000	6.5	2816	40.5
2500	7	3520	46.6
3150	7	4435	57.6

Calculation of the short-circuit current in function of: Icc_0, cross-section and length of the conductor.
The following table provides information to calculate approximately the short-circuit current at a relevant point of the installation

Line protection - Copper conductor

mm²	Length of the line in m																								
1.5															0.9	1.3	1.6	3.1	6.2	7.8	9.4	13	16	31
2.5													1.0	1.3	1.6	2.1	2.6	5.1	10	13	16	21	26	51
4												0.8	1.6	2.1	2.5	3.4	4.2	8.2	16	21	25	34	42	82
6												1.2	2.5	3.1	3.8	5.1	6.4	12	25	31	38	51	64	123
10										0.8	1.1	2.1	4.1	5.2	6.3	8.4	11	21	41	52	63	84	106	205
16								0.8	1.0	1.3	1.7	3.3	6.6	8.3	10	13	17	33	66	83	100	135	170	329
25							1.1	1.3	1.6	2.1	2.6	5.1	10	13	16	21	26	51	103	130	157	211	265	514
35							1.5	1.8	2.2	3.0	3.7	7.2	14	18	22	30	37	72	144	182	219	295	371	719
50						1.0	2.2	2.6	3.1	4.2	5.3	10	21	26	31	42	53	103	205	259	314	422	530	
70						1.4	3.0	3.6	4.4	5.9	7.4	14	29	36	44	59	74	144	288	363	439	590	742	
95			0.8	0.9	1.0	2.0	4.1	4.9	6.0	8.0	10	20	39	49	60	80	101	195	390	493	596	801		
120		0.9	1.0	1.2	1.3	2.5	5.2	6.2	7.5	10	13	25	49	62	75	101	127	246	493	623	752			
150	0.8	1.0	1.1	1.3	1.4	2.7	5.6	6.8	8.2	11	14	27	54	68	82	110	138	268	536	677	818			
185	1.0	1.2	1.3	1.5	1.7	3.2	6.7	8.0	9.7	13	16	32	63	80	97	130	163	317	633	800	967			
240	1.2	1.5	1.7	1.9	2.1	3.9	8.3	10	12	16	20	39	79	100	120	162	203	394	789	996				
300	1.4	1.7	2.0	2.2	2.5	4.7	10	12	14	19	24	47	95	120	145	195	244	474	948					
400	1.6	1.9	2.2	2.4	2.7	5.1	11	13	16	21	26	51	103	130	157	211	265	514						
500	1.7	2.1	2.4	2.7	3.0	5.7	12	14	17	23	29	57	114	144	174	234	294	571						
625	1.8	2.1	2.5	2.8	3.1	5.8	12	15	18	24	30	58	117	147	178	240	301	584						
2x95	1.2	1.4	1.6	1.8	2.1	3.9	8.2	9.9	12	16	20	39	78	99	119	160	201	390	781	986				
2x120	1.5	1.8	2.1	2.3	2.6	4.9	10	12	15	20	25	49	99	125	150	202	254	493	986					
2x150	1.6	2.0	2.3	2.5	2.8	5.4	11	14	16	22	28	54	107	135	164	220	276	536						
2x185	1.9	2.3	2.7	3.0	3.3	6.3	13	16	19	26	33	63	127	160	193	260	327	633						
2x240	2.4	2.9	3.3	3.7	4.2	7.9	17	20	24	32	41	79	158	199	241	324	407	789						
3x95	1.8	2.2	2.5	2.8	3.1	5.9	12	15	18	24	30	59	117	148	179	240	302	585						
3x120	2.3	2.7	3.1	3.5	3.9	7.4	16	19	23	30	38	74	148	187	226	304	381	739						
3x150	2.5	3.0	3.4	3.8	4.2	8.0	17	20	25	33	41	80	161	203	245	330	415	804						
3x185	2.9	3.5	4.0	4.5	5.0	9.5	20	24	29	39	49	95	190	240	290	390	490	950						
3x240	3.6	4.4	5.0	5.6	6.2	12	25	30	36	49	61	118	237	299	361	486	610							

Icc at the origin of the cable (kA)	Short-circuit current at the end of the cable																							
100	94	93	92	91	90	83	70	66	62	55	49	33	20	16	14	11	8.8	4.7	2.4	1.9	1.6	1.2	1.0	0.5
90	85	84	84	83	82	76	65	62	58	52	47	32	19	16	14	11	8.7	4.7	2.4	1.9	1.6	1.2	1.0	0.5
80	76	76	75	74	74	69	60	57	54	48	44	31	19	16	14	11	8.6	4.7	2.4	1.9	1.6	1.2	1.0	0.5
70	67	67	66	66	65	61	54	52	49	44	41	29	18	15	13	10	8.5	4.6	2.4	1.9	1.6	1.2	1.0	0.5
60	58	57	57	57	56	54	48	46	44	40	37	27	18	15	13	10	8.3	4.6	2.4	1.9	1.6	1.2	0.9	0.5
50	49	48	48	48	47	45	41	40	38	35	33	25	17	14	12	9.8	8.1	4.5	2.4	1.9	1.6	1.2	0.9	0.5
40	39	39	39	39	38	37	34	33	32	30	28	22	15	13	12	9.3	7.8	4.4	2.3	1.9	1.6	1.2	0.9	0.5
35	34	34	34	34	34	33	30	30	29	27	26	21	15	13	11	9.0	7.6	4.4	2.3	1.9	1.6	1.2	0.9	0.5
30	29	29	29	29	29	28	27	26	25	24	23	19	14	**12**	11	8.6	7.3	4.3	2.3	1.8	1.5	1.2	0.9	0.5
25	25	25	24	24	24	24	23	22	22	21	20	17	12	11	9.9	8.2	7.0	4.2	2.3	1.8	1.5	1.2	0.9	0.5
20	20	20	20	20	20	19	18	18	18	17	17	14	11	10	9.0	7.5	6.5	4.0	2.2	1.8	1.5	1.1	0.9	0.5
15	15	15	15	15	15	15	14	14	14	13	13	12	9.4	9	7.8	6.7	5.9	3.7	2.1	1.7	1.5	1.1	0.9	0.5
10	9.9	9.9	9.9	9.9	9.9	9.8	9.6	9.5	9.4	9.2	9.1	8.3	7.1	7	6.2	5.5	4.9	3.3	2.0	1.6	1.4	1.1	0.9	0.5
7	7.0	7.0	7.0	7.0	6.9	6.9	6.8	6.8	6.7	6.6	6.5	6.1	5.5	5	4.9	4.4	4.1	2.9	1.8	1.5	1.3	1.0	0.8	0.5
5	5.0	5.0	5.0	5.0	5.0	5.0	4.9	4.9	4.9	4.8	4.8	4.5	4.2	4	3.8	3.5	3.3	2.5	1.7	1.4	1.2	1.0	0.8	0.5
4	4.0	4.0	4.0	4.0	4.0	4.0	3.9	3.9	3.9	3.9	3.8	3.7	3.4	3	3.2	3.0	2.8	2.2	1.5	1.3	1.2	0.9	0.8	0.4
3	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	2.9	2.9	2.9	2.8	2.7	3	2.5	2.4	2.3	1.9	1.4	1.2	1.1	0.9	0.7	0.4
2	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	1.9	1.9	2	1.8	1.7	1.7	1.4	1.1	1.0	0.9	0.8	0.7	0.4
1	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1	0.9	0.9	0.9	0.8	0.7	0.7	0.6	0.5	0.5	0.3

- Values shorter than 0.8m or longer than 1 km are not considered.
- All values are for voltage 400V.

Correction coefficient

Voltage	K
230V	0.58
660V	1.65

Example
Cable with cross section 95 mm² Cu, 45 m length, and short-circuit current at the transformer terminals of 30 kA.
Estimated short-circuit current of **12 kA** at the end of the cable.

Line protection - Aluminium conductor

mm²	Length of the line																								
1.5																	1.0	1.9	3.8	4.8	5.8	7.9	9.9	19	
2.5															0.8	1.0	1.3	1.6	3.2	6.4	8.1	9.7	13	16	32
4														1.0	1.3	1.6	2.1	2.6	5.1	10	13	16	21	26	51
6														1.5	1.9	2.3	3.1	3.9	7.6	15	19	23	31	39	76
10													1.3	2.5	3.2	3.9	5.2	6.6	13	25	32	39	52	66	127
16											0.8	1.1	2.0	4.1	5.2	6.2	8.4	11	20	41	52	62	84	105	204
25									0.8	1.0	1.3	1.6	3.2	6.4	8.1	9.7	13	16	32	64	81	97	131	164	319
35								0.9	1.1	1.4	1.8	2.3	4.5	8.9	11.3	14	18	23	45	89	113	136	183	230	446
50								1.3	1.6	1.9	2.6	3.3	6.4	13	16.1	19	26	33	64	127	161	195	262	329	637
70							0.9	1.9	2.3	2.7	3.7	4.6	8.9	18	22.5	27	37	46	89	178	225	272	366	460	892
95							1.2	2.5	3.1	3.7	5.0	6.2	12	24	30.6	37	50	62	121	242	306	370	497	625	
120						0.8	1.5	3.2	3.9	4.7	6.3	7.9	15	31	39	47	63	79	153	306	387	467	628	789	
150						0.9	1.7	3.5	4.2	5.1	6.8	8.6	17	33	42	51	68	86	166	333	420	508	683	858	
185				0.8	0.9	1.0	2.0	4.1	5.0	6.0	8.1	10	20	39	50	60	81	101	197	393	497	600	807		
240			0.9	1.0	1.2	1.3	2.4	5.2	6.2	7.5	10	13	24	49	62	75	100	126	245	490	618	747			
300		0.9	1.1	1.2	1.4	1.5	2.9	6.2	7.4	9.0	12	15	29	59	74	90	121	152	294	588	743	898			
400	1.2	1.4	1.6	1.8	2.0	3.8	8.0	9.5	12	16	19	38	76	95	115	155	195	378	756	954					
500	1.4	1.7	1.9	2.2	2.4	4.6	9.6	12	14	19	23	46	91	115	139	187	235	455	911						
625	1.7	2.0	2.3	2.6	2.9	5.5	12	14	17	23	28	55	110	139	168	226	283	550							
2x95		0.9	1.0	1.1	1.3	2.4	5.1	6.1	7.4	9.9	12	24	48	61	74	99	125	242	484	612	739	994			
2x120	0.9	1.1	1.3	1.4	1.6	3.1	6.4	7.7	9.3	13	16	31	61	77	93	126	158	306	612	773	934				
2x150	1.0	1.2	1.4	1.6	1.8	3.3	7.0	8.4	10	14	17	33	67	84	102	137	172	333	665	840					
2x185	1.2	1.4	1.7	1.9	2.1	3.9	8.3	9.9	12	16	20	39	79	99	120	161	203	393	786	993					
2x240	1.5	1.8	2.1	2.3	2.6	4.9	10	12	15	20	25	49	98	124	149	201	253	490	979						
3x95	1.1	1.3	1.5	1.7	1.9	3.6	7.6	9.2	11	15	19	36	73	92	111	149	187	363	727	918					
3x120	1.4	1.7	1.9	2.2	2.4	4.6	9.7	12	14	19	24	46	92	116	140	188	237	459	918						
3x150	1.5	1.8	2.1	2.4	2.6	5.0	11	13	15	20	26	50	100	126	152	205	257	499	998						
3x185	1.8	2.2	2.5	2.8	3.1	5.9	12	15	18	24	30	59	118	149	180	242	304	590							
3x240	2.2	2.7	3.1	3.5	3.9	7.3	15	19	22	30	38	73	147	186	224	301	379	734							

Icc$_o$ (kA)	Short-circuit current at the end of the cable																								
100	94	93	92	91	90	83	70	66	62	55	49	33	20	16	14	11	8.8	4.7	2.4	1.9	1.6	1.2	1.0	0.5
90	85	84	84	83	82	76	65	62	58	52	47	32	19	16	14	11	8.7	4.7	2.4	1.9	1.6	1.2	1.0	0.5
80	76	76	75	74	74	69	60	57	54	48	44	31	19	16	14	11	8.6	4.7	2.4	1.9	1.6	1.2	1.0	0.5
70	67	67	66	66	65	61	54	52	49	44	41	29	18	15	13	10	8.5	4.6	2.4	1.9	1.6	1.2	1.0	0.5
60	58	57	57	57	56	54	48	46	44	40	37	27	18	15	13	10	8.3	4.6	2.4	1.9	1.6	1.2	0.9	0.5
50	49	48	48	48	47	45	41	40	38	35	33	25	17	14	12	9.8	8.1	4.5	2.4	1.9	1.6	1.2	0.9	0.5
40	39	39	39	39	38	37	34	33	32	30	28	22	15	13	12	9.3	7.8	4.4	2.3	1.9	1.6	1.2	0.9	0.5
35	34	34	34	34	34	33	30	30	29	27	26	21	15	13	11	9.0	7.6	4.4	2.3	1.9	1.6	1.2	0.9	0.5
30	29	29	29	29	29	28	27	26	25	24	23	19	14	12	11	8.6	7.3	4.3	2.3	1.8	1.5	1.2	0.9	0.5
25	25	25	24	24	24	24	23	22	22	21	20	17	12	11	9.9	8.2	7.0	4.2	2.3	1.8	1.5	1.2	0.9	0.5
20	20	20	20	20	20	19	18	18	18	17	17	14	11	10	9.0	7.5	6.5	4.0	2.2	1.8	1.5	1.1	0.9	0.5
15	15	15	15	15	15	15	14	14	14	13	13	12	9.4	9	7.8	6.7	5.9	3.7	2.1	1.7	1.5	1.1	0.9	0.5
10	9.9	9.9	9.9	9.9	9.9	9.8	9.6	9.5	9.4	9.2	9.1	8.3	7.1	7	6.2	**5.5**	4.9	3.3	2.0	1.6	1.4	1.1	0.9	0.5
7	7.0	7.0	7.0	7.0	6.9	6.9	6.8	6.8	6.7	6.6	6.5	6.1	5.5	5	4.9	4.4	4.1	2.9	1.8	1.5	1.3	1.0	0.8	0.5
5	5.0	5.0	5.0	5.0	5.0	5.0	4.9	4.9	4.9	4.8	4.8	4.5	4.2	4	3.8	3.5	3.3	2.5	1.7	1.4	1.2	1.0	0.8	0.5
4	4.0	4.0	4.0	4.0	4.0	4.0	3.9	3.9	3.9	3.9	3.8	3.7	3.4	3	3.2	3.0	2.8	2.2	1.5	1.3	1.2	0.9	0.8	0.4
3	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	2.9	2.9	2.9	2.8	2.7	3	2.5	2.4	2.3	1.9	1.4	1.2	1.1	0.9	0.7	0.4
2	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	1.9	1.9	2	1.8	1.7	1.7	1.4	1.1	1.0	0.9	0.8	0.7	0.4
1	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1	0.9	0.9	0.9	0.8	0.7	0.7	0.6	0.5	0.5	0.3

Icc at the origin of the cable

- Values shorter than 0.8m or longer than 1 km are not considered.
- All values are for voltage 400V.

Correction coefficient

Voltage	K
230V	0.58
660V	1.65

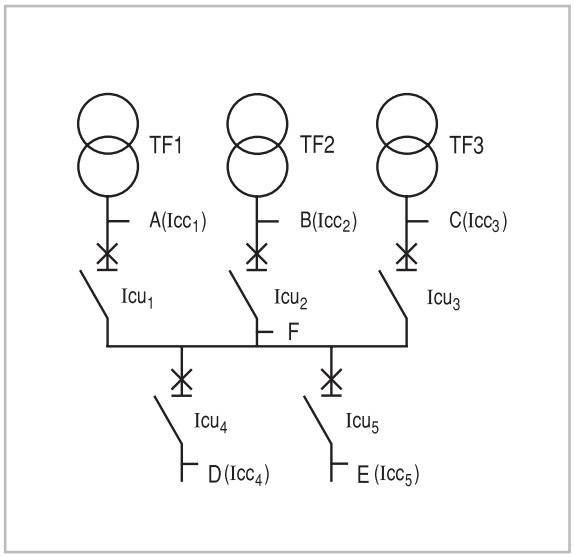
Example

Cable with cross section 150 mm² Al, 65 m length, and short-circuit current at the transformer terminals of 10 kA.
Estimated short-circuit current of **5.5 kA** at the end of the cable.

Transformers in parallel
In the case of several transformers in parallel there are some points of the installation where the Icc is the sum of the short-circuit currents provided by each transformer .

The short-circuit capacity of the protective devices shall be calculated taking into consideration the following criteria:

Short-circuit in A: $Icu_1 \geq Icc_2 + Icc_3$
Short-circuit in F: $Icu_2 \geq Icc_2$
Short-circuit in D: $Icu_4 \geq Icc_1 + Icc_2 + Icc_3$



Let-through energy
The standard IEC 60364 describes that the current limiting of the conductors (K^2S^2) shall be equal or greater than the let-throught energy (I^2t) quoted by the protective device. The K coefficient depends on the conductor insulation.
S is the cross section of the conductor.

$$I^2t \leq K^2S^2$$

Copper conductor

Insulation	PVC	Rubber	Polyethylene XLPE
K=	115	135	146
Cross section mm²	Maximum admissible value $K^2S^2 \times 10^3$		
1.5	30	41	48
2.5	83	114	133
4	212	292	341
6	476	656	767
10	1 323	1 823	2 132
16	3 386	4 666	5 457
25	8 266	11 391	13 323
35	16 201	22 326	26 112
50	33 063	45 563	53 290
70	64 803	89 303	104 448
95	119 356	164 481	192 377
120	190 440	262 440	306 950
150	297 563	410 063	479 610
185	452 626	623 751	729 540
240	761 760	1 049 760	1 227 802

Aluminium conductor

Insulation	PVC	Rubber	Polyethylene XLPE
K=	74	87	94
Cross section mm²	Maximum admissible value $K^2S^2 \times 10^3$		
10	548	757	884
16	1 402	1 938	2 262
25	3 423	4 731	5 523
35	6 708	9 272	10 824
50	13 690	18 923	22 090
70	26 832	37 088	43 296
95	49 421	68 310	79 745
120	78 854	108 994	127 238
150	123 210	170 303	198 810
185	187 416	259 049	302 412
240	315 418	435 974	508 954

Maximum protected cable length in the event of short-circuit (Icc minimum)

The following values are applicable in case that the protective device does not exist or is over-rated. They are calculated according to the formula:

$$Icc = \frac{0.8 \cdot U \cdot S}{1.5 \cdot \rho \cdot 2 \cdot L} \cdot K$$

U: Voltage 400V
0,8: Reduction coefficient due to impedances
S: Conductor cross section
ρ: Cu resistivity: 0.025 Ω mm^2/m
L: Conductor length
K: Correction coeffecient

It is possible to determinate the maximum cable length protected in the event of short-circuit current in function of:
- The nominal current
- The nominal voltage
- The conductor characteristic
- The magnetic tripping characteristic of the protective device

The short-circuit current at any point of the installation shall be high enough to disconnect the protective device.

To ensure the MCB disconnection, we needed to take into consideration the following table

Maximum protected cable length in case of short-circuit

For network 3x400 V without N, Tripping characteristic C (Im: 10 x In)

In (A)	0,5	1	2	4	6	10	16	20	25	32	40	50	63	80	100	125	160	250	400	630	800	1000	1250	1600	2000
S mm^2	Maximum protected length (m) for Cu conductor																								
1.5	1778	889	444	222	148	89	56	44	36	28	22														
2.5		1481	741	370	237	148	93	74	59	46	37	30	24												
4			1185	593	356	237	148	119	95	74	59	47	38	30											
6			1778	889	593	356	222	178	142	111	89	71	56	44	36										
10				1481	948	593	370	296	237	185	148	119	94	74	59	47									
16					1481	948	593	474	379	296	237	190	150	119	95	76	59								
25						1481	926	741	593	463	370	296	235	185	148	119	93								
35							1296	1037	830	648	519	415	329	259	207	166	130	83							
50							1852	1481	1185	926	741	593	470	370	296	237	185	119							
70									1659	1296	1037	830	658	519	415	332	259	166	104						
95										1759	1407	1126	**894**	704	563	450	352	225	141						
120											1778	1422	1129	889	711	569	444	284	178	113					
150											1932	1546	1227	966	773	618	483	309	193	123					
185												1827	1450	1142	914	731	571	365	228	145	114				
240													1806	1422	1138	910	711	455	284	181	142	114			
300														1709	1368	1094	855	547	342	217	171	137			
400														1852	1481	1185	926	593	370	235	185	148	119		
500															1646	1317	1029	658	412	261	206	165	132		
625															1684	1347	1052	673	421	267	210	168	135	105	
2x95													1787	1407	1126	901	704	450	281	179	141	113			
2x120														1778	1422	1138	889	569	356	226	178	142	114		
2x150														1932	1546	1237	966	618	386	245	193	155	124		
2x185															1827	1437	1142	731	457	290	228	183	146	114	
2x240																1462	1422	910	569	361	284	228	182	142	114
3x95															1689	1820	1056	676	422	268	211	169	135	106	
3x120																1351	1333	853	533	339	267	213	171	133	107
3x150																1707	1449	928	580	368	290	232	186	145	116
3x185																1855	1713	096	685	435	243	274	219	171	137
3x240																		365	853	542	427	341	273	213	171

Example
Network 3x400+N with a copper conductor of 95mm^2 cross-section and using as a protection device a MCB C63.
Maximum cable length:
Lmax= **894**x0.58x0.5=259m

Correction coefficients

Tripping characteristic	K1
Curve B	x 2
Curve D	x 0.5
Curve Im	x 10/Im

Voltage	K2
2 x 230 V	x 0.58
3 x 400V + N	x 0.58
230V Phase-N	x 0.58
3 x 400V + N/2	x 0.39

Conductor	K3
Aluminium	x 0.62

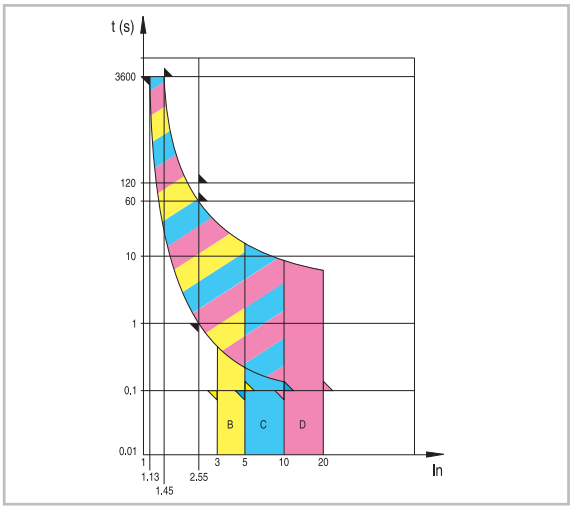
Cross section>120 mm^2	K4
120	x 0.90
150	x 0.85
185	x 0.80
240	x 0.75
300	x 0.72

Number of cables in parallel	K5
1	x 1.00
2	x 2.00
3	x 2.65
4	x 3.00
5	x 3.20

Characteristics according to EN/IEC 60898

Miniature Circuit Breakers are intended for the protection of wiring installations against both overloads and short-circuits in domestic or commercial wiring installations where operation is possible by uninstructed people.

Tripping characteristic curves B, C and D



Magnetic release

An electromagnet with plunger ensures instantaneous tripping in the event of short-circuit. The standard distinguishes three different types, following the current for instantaneous release: type B,C,D.

Icn (A)	Test current	Tripping time	Applications
B	3 x In 5 x In	0.1 < t < 45s (In ≤ 32A) 0.1 < t < 90s (In > 32A) t < 0.1s	Only for resistive loads such as: - electrical heating - water heater - stoves
C	5 x In 10 x In	0.1 < t < 15s (In ≤ 32A) 0.1 < t < 30s (In > 32A) t < 0.1s	Usual loads such as: - lighting - socket outlets - small motors
D	10 x In 20 x In	0.1 < t < 4s(**) (In ≤ 32A) 0.1 < t < 8s (In > 32A) t < 0.1s	Control and protection of circuits having important transient inrush currents (large motors)

** if In ≤ 10A, t < 8s

Thermal release

The release is initiated by a bimetal strip in the event of overload. The standard defines the range of releases for specific overload values. Reference ambient temperature is 30°C.

Test current	Tripping time
1.13 x In	t ≥ 1h (In ≤ 63A) t ≥ 2h (In > 63A)
1.45 x In	t < 1h (In ≤ 63A) t < 2h (In > 63A)
2.55 x In	1s < t < 60s (In ≤ 32A) 1 s < t < 120s (In > 32A)

Rated short-circuit breaking capacity (Icn)
Is the value of the short-circuit that the MCB is capable of withstanding in the following test of sequence of operations: O-t-CO

After the test the MCB is capable , without maintenance to withstand a dielectric strength test at a test voltage of 900V. Moreover the MCB shall be capable of tripping when loaded with 2.8 In within the time corresponding to 2.55 In but greater than 0.1s.

Service short-circuit breaking capacity (Ics)
Is the value of the short-circuit that the MCB is capable of withstanding in the following test of sequence of operations: O-t-CO-t-CO

After the test the MCB is capable , without maintenance to withstand a dielectric strength test at a test voltage of 1 500V. Moreover the MCB shall not trip when a current of 0.96 In. The MCB shall trip within 1h when current is 1.6 In.

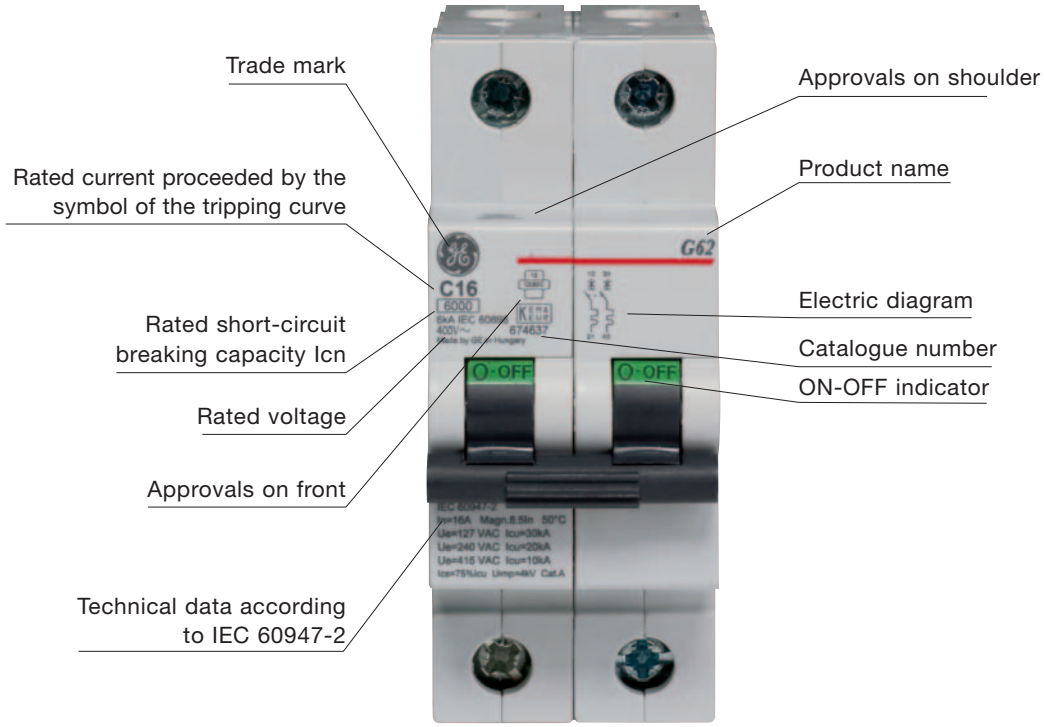
O - Represents an opening operation
CO - Represents a closing operation followed by an automatic opening.
t - Represents the time interval between two successive short-circuit operations: 3 minutes.

The relation between the Rated short-circuit capacity (Icn) and the Rated service short-circuit breaking capacity (Ics) shall be as follows:

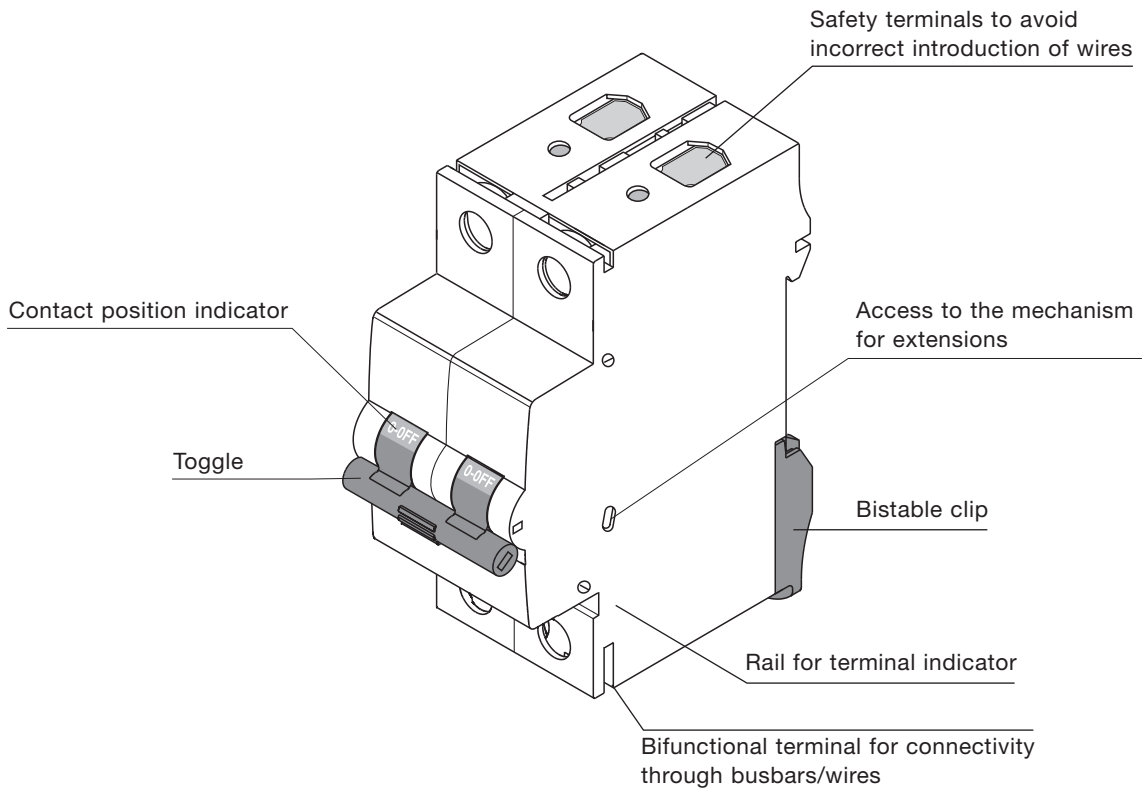
Icn (A)	Ics (A)
≤ 6000	6000
> 6000 ≤ 10000	0.75 Icn min. 6000
> 10000	0.75 Icn min. 7500

Information on product according to EN/IEC 60898

Example: 2P MCB C characteristic 16A



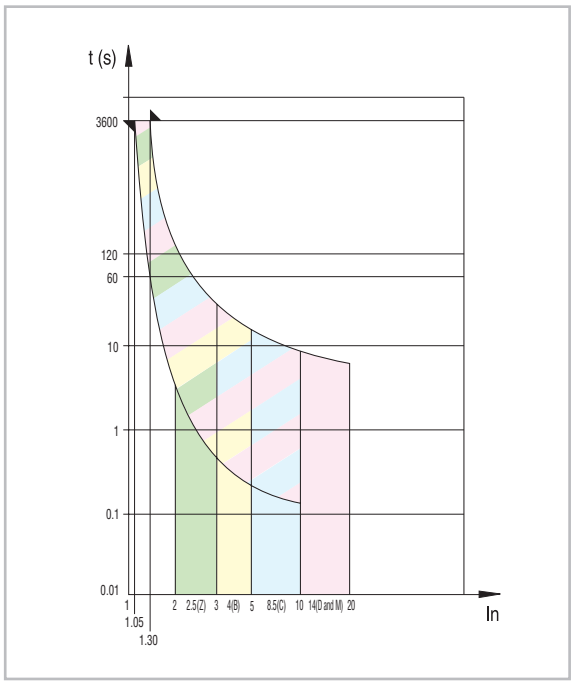
Use of an MCB



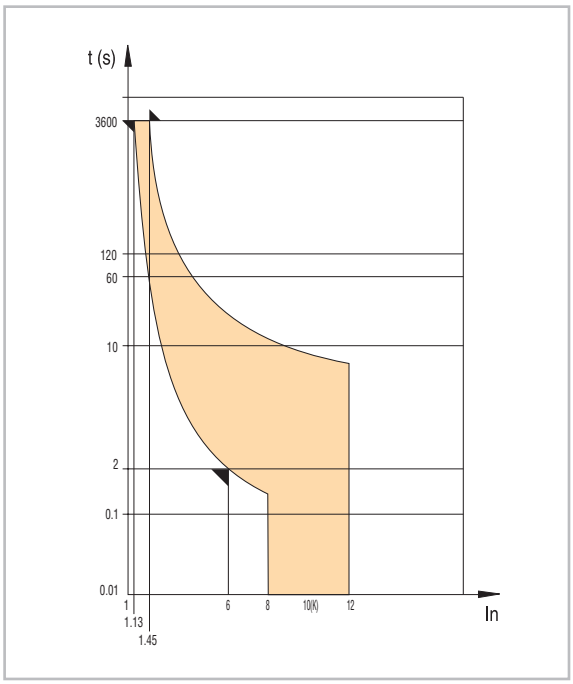
Characteristics according to EN/IEC 60947-2

Miniature Circuit Breakers are intended for the protection of the lines against both overloads and short-circuits in industrial wiring installations where normally operation is done by instructed people.

Tripping characteristic curves B, C, D and Z



Tripping characteristic curve K



Magnetic release
An electromagnet with plunger ensures instantaneous tripping in the event of short-circuit. The standard leaves the calibration of magnetic release to the manufacturer's discretion.

GE offers instantaneous tripping ranges:
- Z: 2.5 In
- B: 4 In
- C: 8.5 In (7.5 In for 63A)
- D and M: 14 In

Thermal release
The release is initiated by a bimetal strip in the event of overload. The standard defines the range of release for two special overload values.
Reference ambient temperature is:
- 50°C for G60 and G100 (B, C, D)
- 40°C for GT10 and GT25 (B, C, D)
- 40°C for EP100 and EP250 (Z)

Test current	Tripping time
1.05 x In	t ≥ 1h (In ≤ 63A) t ≥ 2h (In > 63A)
1.30 x In	t < 1h (In ≤ 63A) t < 2h (In > 63A)

Magnetic release
An electromagnet with plunger ensures instantaneous tripping in the event of short-circuit. The standard leaves the calibration of magnetic release to the manufacturer's discretion.

GE offers instantaneous tripping ranges:
- K: 10 In

Motors starting I = 6 In, tripping > 2s.

Thermal release
The release is initiated by a bimetal strip in the event of overload. The standard defines the range of release for two special overload values.
Reference ambient temperature is:
- 45°C for EP60 and EP100 (K)

Test current	Tripping time
1.13 x In	t ≥ 1h (In ≤ 63A) t ≥ 2h (In > 63A)
1.45 x In	t < 1h (In ≤ 63A) t < 2h (In > 63A)

Short-circuit test

Rated ultimate short-circuit breaking capacity (Icu)
Is the value of the short-circuit that the MCB is capable of withstanding in the following test of sequence of operations: O-t-CO

After the test the MCB is capable, without maintenance, to withstand a dielectric strength test at a test voltage of 1000V. Moreover the MCB shall be capable of tripping when loaded with 2,5 In within the time corresponding to 2 In but greater than 0.1s.

Rated service short-circuit breaking capacity (Ics)
Is the value of the short-circuit that the MCB is capable of withstanding in the following test of sequence of operations: O-t-CO-t-CO

After the test the MCB is capable, without maintenance, to withstand a dielectric strength test at a test voltage of twice its rated insulation voltage with a minimum of 1000V. A verification of the overload releases on In and moreover the MCB shall trip within 1h when current is 1.45 In
(for In < 63A) and 2h (for In > 63A).

O - Represents an opening operation
CO - Represents a closing operation followed by an automatic opening.
t - Represents the time interval between two successive short-circuit operations: 3 minutes.

Category A: Without a short-time withstand current rating.

Utilization category	Application with respect to selectivity
A	Circuit breakers not specifically intended for selectivity under short-circuit conditions with respect to other short-circuit protective devices in series on the load side, i.e. without an intentional short-time delay provided for selectivity under short-circuit conditions, and therefore without a short-time withstand current rating according to 4.3.5.4
B	Circuit breakers specifically intended for selectivity under short-circuit conditions with respect to other short-circuit protective devices in series on the load side, i.e. without an intentional short-time delay (which may be adjustable), provided for selectivity under short-circuit conditions. Such circuit-breakers have a short-time withstand current rating according to 4.3.5.4

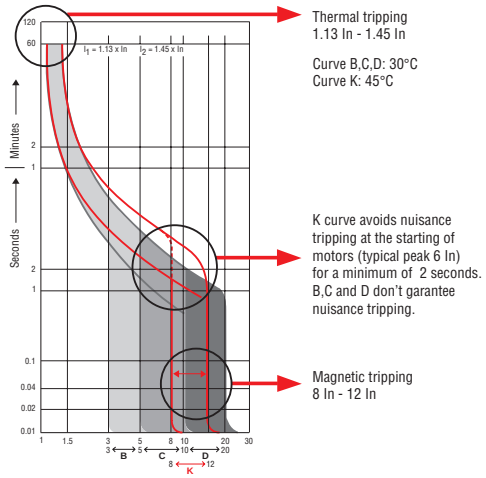
Tripping characteristic curves and their applications

B: Protection of generators, long distance cables, resistive loads, people protection in TN systems.
C: General purpose, resistive and inductive loads.
D: High inductive loads, transformers LV/LV with high peak current.
K: Motors, pumps, fans, transformers, lamps groups, avoiding nuisance tripping.
Z: Protection of electronic loads (semi conductors etc.) and secundary measurement circuits, long distance cables allowing cost saving with smaller section.

Circuits feeding motors

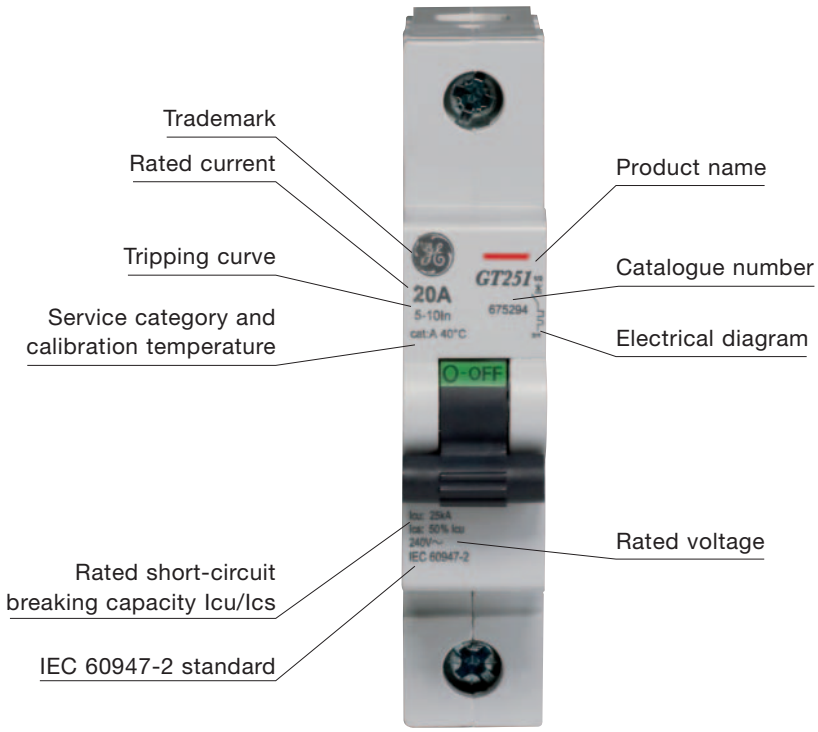
Advantages of K-curve protection

Curve K (EN/IEC 60947-2) versus B, C, D (EN/IEC 60898)

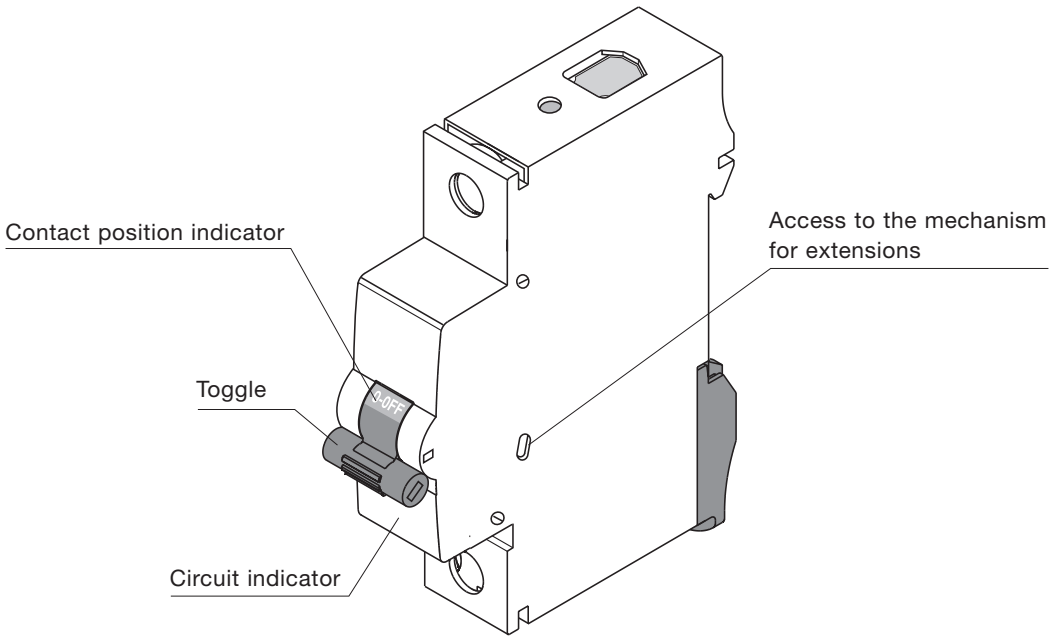


Information on product according to EN/IEC 60947-2

Example: EP250 1P 20A 5 to 10 Iu

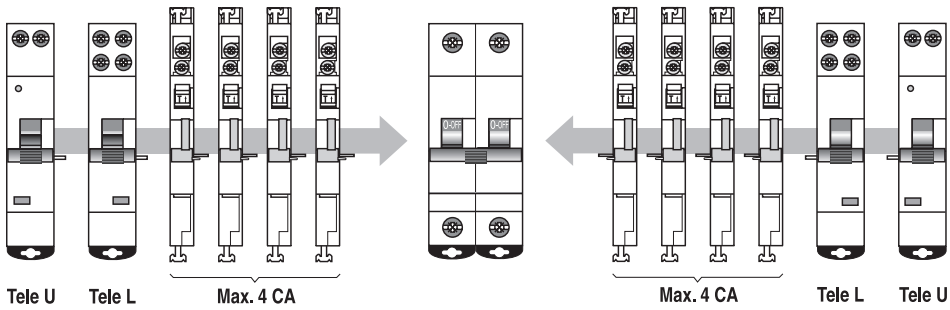


Use of an MCB



ACCESS TO THE MECHANISM FOR EXTENSIONS

Connection of the extensions.
It is possible to couple any auxiliary contact, shunt trip, undervoltage release or motor driver either on the right or the left hand side, following the stack-on configuration of the extensions in page T3.14

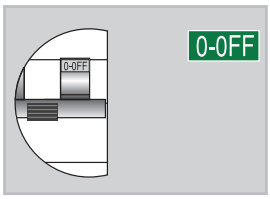


TOGGLE

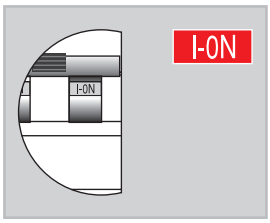
To switch the MCB ON or OFF

CONTACT POSITION INDICATOR

Printing on the toggle to provide information of the real contact position.



O-OFF
Contacts in open position. Ensure a distance between contacts > 4mm.



I-ON
Contacts in closed position. Ensure continuity in the main circuit.

Definitions related to MCB's

MCB= Miniature Circuit Breakers

Short-circuit (making and breaking) capacity
Alternating component of the prospective current, expressed by its r.m.s. value, which the circuit-breaker is designed to make, to carry for its opening time and to break under specified conditions.

Ultimate or rated short-circuit breaking capacity (Icn - EN/IEC 60898)
A breaking capacity for which the prescribed conditions, according to a specified test sequence do not include the capability of the MCB to carry 0.96 times its rated current for the conventional time.

Ultimate short-circuit breaking capacity (Icu - EN/IEC 60947-2)
A breaking capacity for which the prescribed conditions, according to a specified test sequence do not include the capability of the MCB to carry its rated current for the conventional time.

Service short-circuit breaking capacity (Ics - EN/IEC 60898)
A breaking capacity for which the prescribed conditions according to a specified test sequence include the capability of the MCB to carry 0.96 times its rated current for the conventional time.

Service short-circuit breaking capacity (Ics - EN/IEC 60947-2)
A breaking capacity for which the prescribed conditions according to a specified test sequence include the capability of the MCB to carry its rated current for the conventional time.

Prospective current
The current that would flow in the circuit, if each main current path of the MCB were replaced by a conductor of negligible impedance.

Conventional non-tripping current (Int)
A specified value of current which the circuit breaker is capable of carrying for a specified time without tripping.

Conventional tripping current (It)
A specified value of current which causes the circuit breaker to trip within a specified time.

Open position
The position in which the predetermined clearance between open contacts in the main circuit of the MCB is secured.

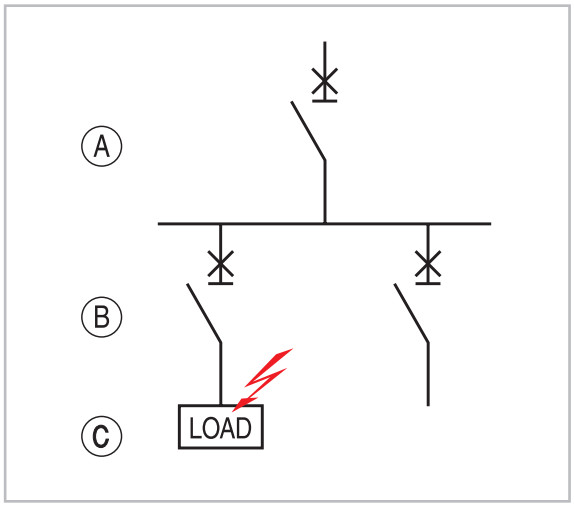
Closed position
The position in which the predetermined continuity of the main circuit of the MCB is secured.

Maximum prospective peak current (Ip)
The prospective peak current when the initiation of the current takes place at the instant which leads to the highest possible value.

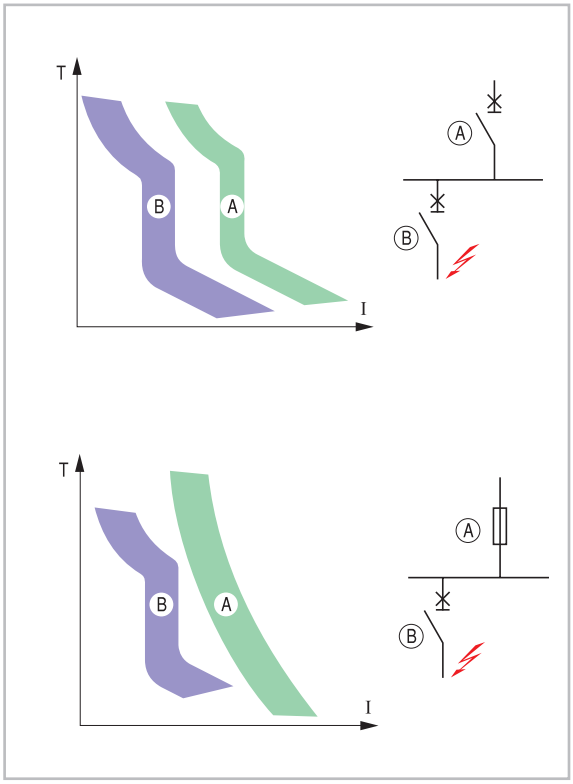
Notes

Selectivity

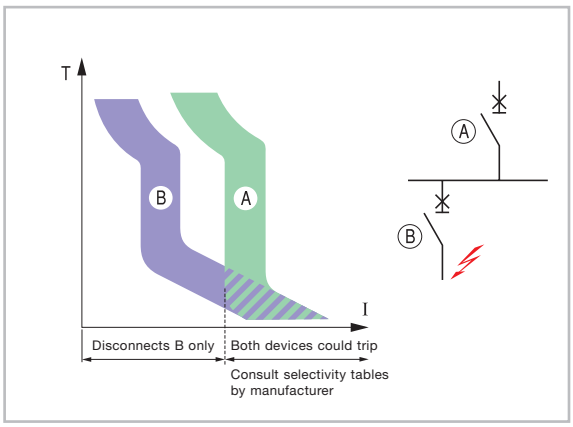
An installation with some protective devices in series (a protective device must be placed at the point where a reduction of the cross sectional area of the conductors or another change causes modification in the characteristics of the installation) is considered as selective when, in the event of short-circuit, the installation is interrupted only by the device which is immediately upstream of the fault point. Selectivity is ensured when the characteristic time/current of the upstream MCB (A) is above the characteristic time /current of the downstream MCB (B).
The let-through energy (I^2t) of the downstream protective device shall be lower than the one of the upstream protective device. Selectivity may be total or partial.



Total selectivity
Selectivity is total in the event of a short-circuit fault and only disconnects the protective device B immediately upstream of the fault point.



Partial selectivity
Selectivity is partial when the no disconnection of the protective device (A) is ensured only up to a certain level of the current.
In figure below is shown that selectivity is total up to the point of overlapping curves. From this point total selectivity can not be assured and selectivity curves based on tests by the manufacturer should be consulted.



Selectivity - Upstream MCB's / Downstream MCB's C or G & RCBO's DM

MCB's		Upstream Curve C											
		G60-G100-GT25								Hti			S90
Downstream	In	10A	16A	20A	25A	32A	40A	50A	63A	80A	100A	125A	10-100A
Curve B	6A	0.07	0.10	0.15	0.18	0.23	0.27	0.35	0.45	T	T	T	T
	10A	-	-	0.15	0.18	0.23	0.27	0.35	0.45	T	T	T	T
C45	16A	-	-	-	-	0.23	0.27	0.35	0.45	4.0	T	T	T
C60	20A	-	-	-	-	-	0.27	0.35	0.45	4.0	T	T	T
DM60	25A	-	-	-	-	-	0.27	0.35	0.45	3.5	1.5	1.5	T
DM100 (1)	32A	-	-	-	-	-	-	0.35	0.45	3.5	1.5	1.5	T
	40A	-	-	-	-	-	-	-	-	-	1.5	1.5	T

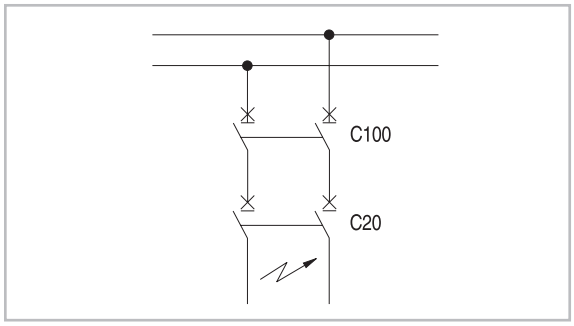
MCB's		Upstream Curve C											
		G60-G100-GT25								Hti			S90
Downstream	In	10A	16A	20A	25A	32A	40A	50A	63A	80A	100A	125A	10-100A
Curve B	6A	0.07	0.10	0.15	0.18	0.23	0.27	0.35	0.45	T	T	T	T
	10A	-	-	0.15	0.18	0.23	0.27	0.35	0.45	6.0	T	T	T
G60	16A	-	-	-	-	0.23	0.27	0.35	0.45	4.0	6.0	6.0	T
G100	20A	-	-	-	-	-	0.27	0.35	0.45	4.0	6.0	6.0	T
G250	25A	-	-	-	-	-	0.27	0.35	0.45	3.5	6.0	6.0	T
DME60	32A	-	-	-	-	-	0.27	0.35	0.45	3.5	6.0	6.0	T
DME100	40A	-	-	-	-	-	-	-	-	1.6	5.0	5.0	T
	50A	-	-	-	-	-	-	-	-	-	-	-	T
	63A	-	-	-	-	-	-	-	-	-	-	-	T

MCB's		Upstream Curve C											
		G60-G100-GT25								Hti			S90
Downstream	In	10A	16A	20A	25A	32A	40A	50A	63A	80A	100A	125A	10-100A
Curve C	2A	0.07	0.10	0.15	0.18	0.23	0.27	0.35	0.45	T	T	T	T
	3A	0.07	0.10	0.15	0.18	0.23	0.27	0.35	0.45	T	T	T	T
C45	4A	0.07	0.10	0.15	0.18	0.23	0.27	0.35	0.45	T	T	T	T
C60	6A	0.07	0.10	0.15	0.18	0.23	0.27	0.35	0.45	4.5	T	T	T
DM60	10A	-	-	0.15	0.18	0.23	0.27	0.35	0.45	4.5	T	T	T
DM100 (2)	16A	-	-	-	-	0.23	0.27	0.35	0.45	2.0	5.0	5.0	T
	20A	-	-	-	-	-	0.27	0.35	0.45	2.0	5.0	5.0	T
	25A	-	-	-	-	-	0.27	0.35	0.45	1.5	4.5	4.5	T
	32A	-	-	-	-	-	-	0.35	0.45	1.5	2.3	2.3	T
	40A	-	-	-	-	-	-	-	0.45	-	2.3	2.3	T

MCB's		Upstream Curve C											
		G60-G100-GT25								Hti			S90
Downstream	In	10A	16A	20A	25A	32A	40A	50A	63A	80A	100A	125A	10-100A
Curve C	0.5A	0.07	0.10	0.15	0.18	0.23	0.27	0.35	0.45	T	T	T	T
	1A	0.07	0.10	0.15	0.18	0.23	0.27	0.35	0.45	T	T	T	T
G30	2A	0.07	0.10	0.15	0.18	0.23	0.27	0.35	0.45	T	T	T	T
G45	3A	0.07	0.10	0.15	0.18	0.23	0.27	0.35	0.45	9.0	T	T	T
G60	4A	0.07	0.10	0.15	0.18	0.23	0.27	0.35	0.45	9.0	6.0	6.0	T
G100	6A	0.07	0.10	0.15	0.18	0.23	0.27	0.35	0.45	4.5	6.0	6.0	T
GT25	10A	-	-	0.15	0.18	0.23	0.27	0.35	0.45	4.5	6.0	6.0	T
DME60	16A	-	-	-	-	0.23	0.27	0.35	0.45	2.0	6.0	6.0	T
DME100	20A	-	-	-	-	-	0.27	0.35	0.45	2.0	**5.0**	5.0	T
	25A	-	-	-	-	-	0.27	0.35	0.45	1.5	4.5	4.5	T
	32A	-	-	-	-	-	-	0.35	0.45	1.5	2.3	2.3	T
	40A	-	-	-	-	-	-	-	0.45	-	2.3	2.3	T
	50A	-	-	-	-	-	-	-	-	-	-	-	T
	63A	-	-	-	-	-	-	-	-	-	-	-	T

(1) Icc limited to 6 kA for C60, DM60, DM100
(2) Icc limited to 10 kA for DM100
T = Total : selective untill the Icu of the downstream device

Example
A combination of an MCB C20 with an upstream MCB C100 guarantees selectivity up to a short-circuit level of **5** kA.



Selectivity - Upstream Fuses gL-gG / Downstream MCB's G60

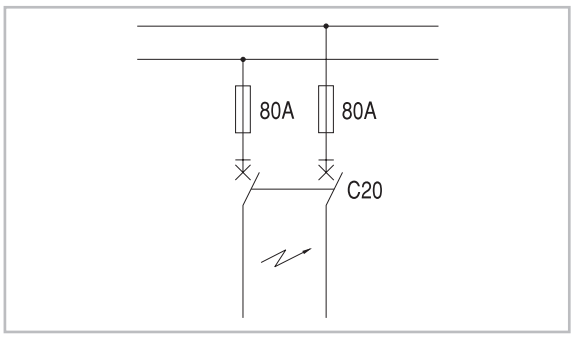
Downstream	In \ Upstream Fuses gG-gL	6A	10A	16A	20A	25A	35A	50A	63A	80A	100A	125A
Curve B	6A	-	-	-	-	1.2	3.0	4.0	6.0	6.0	6.0	6.0
	10A	-	-	-	-	0.9	1.6	3.0	4.8	6.0	6.0	6.0
G60	13A	-	-	-	-	0.9	1.5	2.7	4.2	6.0	6.0	6.0
DME60	16A	-	-	-	-	-	1.4	2.4	3.8	5.8	6.0	6.0
	20A	-	-	-	-	-	1.1	2.1	3.2	4.8	6.0	6.0
	25A	-	-	-	-	-	-	1.9	2.9	4.4	6.0	6.0
	32A	-	-	-	-	-	-	1.7	2.6	3.8	5.9	6.0
	40A	-	-	-	-	-	-	-	2.4	3.4	5.3	6.0
	50A	-	-	-	-	-	-	-	-	-	4.4	6.0
	63A	-	-	-	-	-	-	-	-	-	4.4	6.0

Downstream	In \ Upstream Fuses gG-gL	6A	10A	16A	20A	25A	35A	50A	63A	80A	100A	125A
Curve C	0.5	0.2	1.0	4.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0
	1A	0.1	0.3	1.0	4.4	6.0	6.0	6.0	6.0	6.0	6.0	6.0
G60	2A	-	0.2	0.4	0.7	0.8	5.3	6.0	6.0	6.0	6.0	6.0
DME60	4A	-	-	0.3	0.6	0.7	1.9	4.2	6.0	6.0	6.0	6.0
	6A	-	-	-	-	0.6	1.5	2.9	4.6	6.0	6.0	6.0
	10A	-	-	-	-	-	1.4	2.5	4.0	6.0	6.0	6.0
	13A	-	-	-	-	-	0.8	2.4	3.9	5.7	6.0	6.0
	16A	-	-	-	-	-	-	2.3	3.6	5.4	6.0	6.0
	20A	-	-	-	-	-	-	-	3.2	**4.6**	6.0	6.0
	25A	-	-	-	-	-	-	-	-	4.3	6.0	6.0
	32A	-	-	-	-	-	-	-	-	3.7	5.8	6.0
	40A	-	-	-	-	-	-	-	-	-	5.1	6.0
	50A	-	-	-	-	-	-	-	-	-	-	6.0
	63A	-	-	-	-	-	-	-	-	-	-	6.0

Downstream	In \ Upstream Fuses gG-gL	6A	10A	16A	20A	25A	35A	50A	63A	80A	100A	125A
Curve D	0.5	0.1	0.3	1.0	5.0	6.0	6.0	6.0	6.0	6.0	6.0	6.0
	1A	-	0.2	0.5	1.2	6.0	6.0	6.0	6.0	6.0	6.0	6.0
G60	2A	-	-	0.3	0.6	1.6	3.5	6.0	6.0	6.0	6.0	6.0
Type D	4A	-	-	-	-	0.8	2.0	3.6	6.0	6.0	6.0	6.0
	6A	-	-	-	-	0.6	1.7	2.8	5.0	6.0	6.0	6.0
	10A	-	-	-	-	-	-	2.3	3.7	5.4	6.0	6.0
	13A	-	-	-	-	-	-	-	3.6	5.0	6.0	6.0
	16A	-	-	-	-	-	-	-	-	4.8	6.0	6.0
	20A	-	-	-	-	-	-	-	-	-	6.0	6.0
	25A	-	-	-	-	-	-	-	-	-	6.0	6.0
	32A	-	-	-	-	-	-	-	-	-	-	-
	40A	-	-	-	-	-	-	-	-	-	-	-
	50A	-	-	-	-	-	-	-	-	-	-	-
	63A	-	-	-	-	-	-	-	-	-	-	-

Example

A combination of an MCB G62 C20 with an upstream fuse 80A guarantees selectivity up to a short-circuit level of **4.6** kA.



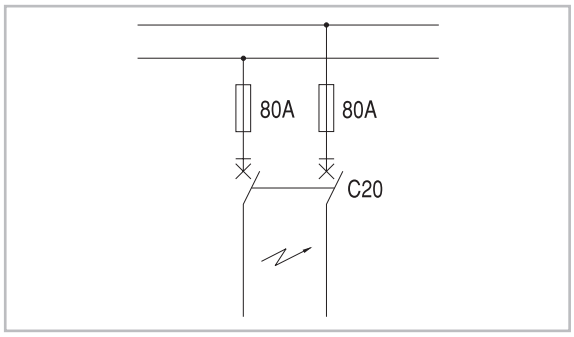
Selectivity - Upstream Fuses BS / Downstream MCB's G60

Downstream	Fuses In	Upstream Fuses BS1361 40A	63A	80A	100A	125A	160A
Curve B	6A	2.3	6.0	6.0	6.0	6.0	6.0
	10A	1.8	5.0	6.0	6.0	6.0	6.0
G60	16A	1.5	4.2	5.8	6.0	6.0	6.0
DME60	20A	1.3	3.4	4.8	5.3	6.0	6.0
	25A	-	3.2	4.3	4.7	6.0	6.0
	32A	-	2.8	3.8	4.2	6.0	6.0
	40A	-	2.7	3.6	4.0	5.6	6.0
	50A	-	-	-	3.7	5.3	6.0
	63A	-	-	-	3.2	4.5	6.0

Downstream	Fuses In	Upstream Fuses BS1361 40A	63A	80A	100A	125A	160A
Curve C	6A	2.0	5.3	6.0	6.0	6.0	6.0
	10A	1.6	4.2	5.5	6.0	6.0	6.0
G60	16A	1.4	3.8	5.0	5.7	6.0	6.0
DME60	20A	1.2	3.4	**4.2**	4.8	6.0	6.0
	25A	-	3.0	3.9	4.4	6.0	6.0
	32A	-	2.8	3.4	3.9	5.8	6.0
	40A	-	2.5	3.1	3.5	5.3	6.0
	50A	-	-	-	3.2	4.7	6.0
	63A	-	-	-	2.9	4.2	6.0

Downstream	Fuses In	Upstream Fuses BS1361 40A	63A	80A	100A	125A	160A
Curve D	6A	1.7	6.0	6.0	6.0	6.0	6.0
	10A	1.4	3.9	5.2	5.8	6.0	6.0
G60	16A	1.4	3.6	4.7	5.2	6.0	6.0
	20A	1.2	3.1	4.1	4.6	6.0	6.0
	25A	1.0	2.8	3.7	4.1	6.0	6.0
	32A	-	2.3	3.2	3.5	5.4	6.0
	40A	-	2.1	2.9	3.3	5.0	6.0
	50A	-	-	-	3.0	4.7	6.0
	63A	-	-	-	2.6	4.2	6.0

Example
A combination of an MCB G62 C20 with an upstream fuse 80A guarantees selectivity up to a short-circuit level of **4.2** kA.



Selectivity - Upstream Fuses gL-gG / Downstream MCB's G100

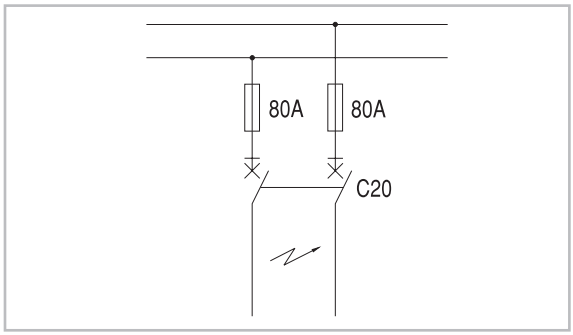
Downstream	In	Upstream Fuses gG-gL 6A	10A	16A	20A	25A	35A	50A	63A	80A	100A	125A	160A
Curve B	6A	-	-	-	-	0.7	1.7	3.5	5.7	10.0	10.0	10.0	10.0
	10A	-	-	-	-	0.6	1.6	3.0	4.8	7.3	10.0	10.0	10.0
G100	13A	-	-	-	-	0.5	1.5	2.7	4.2	6.5	10.0	10.0	10.0
DME100	16A	-	-	-	-	-	1.4	2.4	3.8	5.8	10.0	10.0	10.0
	20A	-	-	-	-	-	1.1	2.1	3.2	4.8	7.6	10.0	10.0
	25A	-	-	-	-	-	-	1.9	2.9	4.4	6.9	10.0	10.0
	32A	-	-	-	-	-	-	1.7	2.6	3.8	5.9	9.5	10.0
	40A	-	-	-	-	-	-	-	2.4	3.4	5.3	9.0	10.0
	50A	-	-	-	-	-	-	-	-	-	4.4	8.0	10.0
	63A	-	-	-	-	-	-	-	-	-	4.4	6.8	10.0

Downstream	In	Upstream Fuses gG-gL 6A	10A	16A	20A	25A	35A	50A	63A	80A	100A	125A	160A
Curve C	0.5	0.2	1.0	4.0	6.0	8.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0
	1A	0.1	0.3	1.0	4.4	7.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0
G100	2A	-	0.2	0.4	0.7	0.8	5.3	10.0	10.0	10.0	10.0	10.0	10.0
DME100	4A	-	-	0.3	0.6	0.7	1.9	4.2	10.0	10.0	10.0	10.0	10.0
	6A	-	-	-	-	0.6	1.5	2.9	4.6	7.5	10.0	10.0	10.0
	10A	-	-	-	-		1.4	2.5	4.0	6.2	10.0	10.0	10.0
	13A	-	-	-	-	-	0.8	2.4	3.9	5.7	9.7	10.0	10.0
	16A	-	-	-	-	-	-	2.3	3.6	5.4	7.3	10.0	10.0
	20A	-	-	-	-	-		-	3.2	4.6	6.8	10.0	10.0
	25A	-	-	-	-	-	-	-	-	4.3	5.8	10.0	10.0
	32A	-	-	-	-	-	-	-	-	3.7	5.1	9.0	10.0
	40A	-	-	-	-	-	-	-	-	-	-	8.5	10.0
	50A	-	-	-	-	-	-	-	-	-	-	7.0	10.0
	63A	-	-	-	-	-	-	-	-	-	-	6.4	10.0

Downstream	In	Upstream Fuses gG-gL 6A	10A	16A	20A	25A	35A	50A	63A	80A	100A	125A	160A
Curve D	0.5	0.1	0.3	1.0	5.0	7.5	10.0	10.0	10.0	10.0	10.0	10.0	10.0
	1A	-	0.2	0.5	1.2	7.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0
G100	2A	-	-	0.3	0.6	1.6	2.6	8.0	10.0	10.0	10.0	10.0	10.0
Type D	4A	-	-	-	-	0.8	1.8	3.6	8.0	10.0	10.0	10.0	10.0
	6A	-	-	-	-	0.6	1.7	2.8	4.5	7.3	10.0	10.0	10.0
	10A	-	-	-	-	-	-	2.3	3.6	5.5	10.0	10.0	10.0
	13A	-	-	-	-	-	-	-	3.3	5.3	8.5	10.0	10.0
	16A	-	-	-	-	-	-	-	-	5.0	7.7	10.0	10.0
	20A	-	-	-	-	-	-	-	-	-	6.8	10.0	10.0
	25A	-	-	-	-	-	-	-	-	-	6.1	8.0	10.0
	32A	-	-	-	-	-	-	-	-	-	-	6.8	10.0
	40A	-	-	-	-	-	-	-	-	-	-	-	10.0
	50A	-	-	-	-	-	-	-	-	-	-	-	10.0
	63A	-	-	-	-	-	-	-	-	-	-	-	9.5

Example

A combination of an MCB G102 C20 with an upstream fuse 80A guarantees selectivity up to a short-circuit level of **4.6** kA.



Selectivity - Upstream Fuses BS / Downstream MCB's G100

Downstream	Fuses In	Upstream Fuses BS1361 40A	63A	80A	100A	125A	160A
Curve B	6A	2.3	6.8	10.0	10.0	10.0	10.0
	10A	1.8	5.0	7.0	8.0	10.0	10.0
G100	16A	1.5	4.2	5.8	6.5	9.6	10.0
DME100	20A	1.3	3.4	4.8	5.3	7.5	10.0
	25A	-	3.2	4.3	4.7	7.0	10.0
	32A	-	2.8	3.8	4.2	6.0	10.0
	40A	-	2.7	3.6	4.0	5.6	10.0
	50A	-	-	-	3.7	5.3	10.0
	63A	-	-	-	3.2	4.5	10.0

Downstream	Fuses In	Upstream Fuses BS1361 40A	63A	80A	100A	125A	160A
Curve C	6A	2.0	5.3	6.0	6.0	6.0	10.0
	10A	1.6	4.2	5.5	6.0	6.0	10.0
G100	16A	1.4	3.8	5.0	5.7	6.0	10.0
DME100	20A	1.2	3.4	4.2	4.8	6.0	10.0
	25A	-	3.0	3.9	4.4	6.0	10.0
	32A	-	2.8	3.4	3.9	5.8	10.0
	40A	-	2.5	3.1	3.5	5.3	10.0
	50A	-	-	-	3.2	4.7	10.0
	63A	-	-	-	2.9	4.2	9.4

Downstream	Fuses In	Upstream Fuses BS1361 40A	63A	80A	100A	125A	160A
Curve D	6A	1.7	10.0	10.0	10.0	10.0	10.0
	10A	1.4	3.9	5.2	5.8	8.8	10.0
G100	16A	1.4	3.6	4.7	5.2	7.6	10.0
	20A	1.2	3.1	4.1	4.6	6.8	10.0
	25A	1.0	2.8	3.7	4.1	6.1	10.0
	32A	-	2.3	3.2	3.5	5.4	10.0
	40A	-	2.1	2.9	3.3	5.0	10.0
	50A	-	-	-	3.0	4.7	10.0
	63A	-	-	-	2.6	4.2	9.6

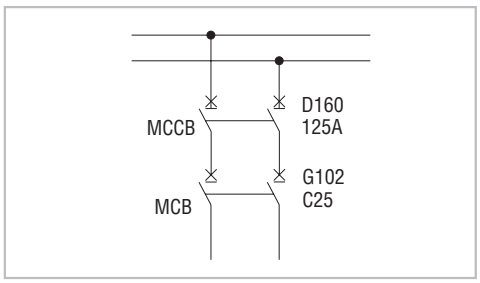
Selectivity - Upstream MCCB's Record / Downstream MCB's ElfaPlus

Upstream / Downstream		D125-D125L							D160 - D250 - DH 160 - DH250 - D160L - D250L								D400 - DH400 - D400L				D400S DH400S	D630 DH630 D630L DH800	D630S DH630S D800S	D1250 D1250S
		16A	25A	40A	63A	80A	100A	125A	25A	40A	63A	100A	125A	160A	200A	250A	200A	250A	320A	400A	All	All	All	All
	(A)																							
Curve B	6	0.5	2.0	3.2	3.5	T	T	T	4.0	T	T	T	T	T	T	T	T	T	T	T	T	T	T	T
	10		1.6	2.0	2.8	T	T	T	2.5	T	T	T	T	T	T	T	T	T	T	T	T	T	T	T
C45-60 /	16			1.2	1.4	4.0	T	T		3.0	T	T	T	T	T	T	T	T	T	T	T	T	T	T
DM60-100	20			1.2	1.4	4.0	T	T			T	T	T	T	T	T	T	T	T	T	T	T	T	T
(1)	25				1.3	3.5	1.5	1.5			3.0	T	T	T	T	T	T	T	T	T	T	T	T	T
	32				1.3	3.5	1.5	1.5				T	T	T	T	T	T	T	T	T	T	T	T	T
	40				1.3	3.5	1.5	1.5				T	T	T	T	T	T	T	T	T	T	T	T	T
Curve B	6	0.5	2.0	3.2	3.5	T	T	T	4.0	T	T	T	T	T	T	T	T	T	T	T	T	T	T	T
	10		1.6	2.0	2.8	6.0	T	T	2.5	6.0	7.5	T	T	T	T	T	T	T	T	T	T	T	T	T
G60 /	16			1.2	1.4	4.0	6.0	6.0		3.5	6.0	T	T	T	T	T	T	T	T	T	T	T	T	T
DME60	20			1.2	1.4	4.0	6.0	6.0		3.5	4.5	T	T	T	T	T	T	T	T	T	T	T	T	T
	25				1.3	3.5	6.0	6.0			4.5	T	T	T	T	T	T	T	T	T	T	T	T	T
	32				1.3	3.5	6.0	6.0			3.0	7.5	T	T	T	T	T	T	T	T	T	T	T	T
	40					1.6	5.0	5.0			2.0	7.5	7.5	T	T	T	T	T	T	T	T	T	T	T
	50											6.0	7.5	T	T	T	T	T	T	T	T	T	T	T
	63											6.0	7.5	T	T	T	T	T	T	T	T	T	T	T
Curve B	6	0.5	2.0	3.2	3.5	10.0	10.0	10.0	4.0	T	T	T	T	T	T	T	T	T	T	T	T	T	T	T
	10		1.6	2.0	2.8	6.0	10.0	10.0	2.5	6.0	7.5	T	T	T	T	T	T	T	T	T	T	T	T	T
G100 /	16			1.2	1.4	4.0	6.0	6.0		3.5	6.0	10.0	T	T	T	T	T	T	T	T	T	T	T	T
DME100	20			1.2	1.4	4.0	6.0	6.0		3.5	4.5	10.0	T	13.0	T	T	T	T	T	T	T	T	T	T
	25				1.3	3.5	6.0	6.0			4.5	10.0	10.0	13.0	T	T	T	T	T	T	T	T	T	T
	32				1.3	3.5	6.0	6.0			3.0	7.5	10.0	10.0	10.0	T	T	T	T	T	T	T	T	T
	40					1.6	5.0	5.0			2.0	7.5	7.5	10.0	10.0	T	T	T	T	T	T	T	T	T
	50											6.0	7.5	10.0	10.0	T	T	T	T	T	T	T	T	T
	63											6.0	7.5	10.0	10.0	T	T	T	T	T	T	T	T	T
Curve B	6	0.5	2.0	3.2	3.5	10.0	10.0	10.0	4.0	T	T	T	T	15.0	T	T	T	T	T	T	T	T	T	T
	10		1.6	2.0	2.8	6.0	10.0	10.0	2.5	6.0	7.5	T	T	15.0	T	T	T	T	T	T	T	T	T	T
GT25	16			1.2	1.4	4.0	6.0	6.0		3.5	6.0	10.0	T	15.0	T	T	T	T	T	T	T	T	T	T
	20			1.2	1.4	4.0	6.0	6.0		3.5	4.5	10.0	T	13.0	15.0	T	T	T	T	T	T	T	T	T
	25				1.3	3.5	6.0	6.0			4.5	10.0	10.0	13.0	15.0	15.0	T	T	T	T	T	T	T	T
	32				1.3	3.5	6.0	6.0			3.0	7.5	10.0	10.0	10.0	15.0	T	T	T	T	T	T	T	T
	40					1.6	5.0	5.0			2.0	7.5	7.5	10.0	10.0	15.0	T	T	T	T	T	T	T	T
	50											6.0	7.5	10.0	10.0	15.0	T	T	T	T	T	T	T	T
	63											6.0	7.5	10.0	10.0	15.0	T	T	T	T	T	T	T	T

(1) Icc limited to 6 kA for C60, DM60
Icc limited to 10 kA for DM100
T = Total : selective untill the Icu of the downstream device
OR the Icu of the upstream device

Example

A combination of an MCB G102 C25 with an upstream D160 160A guarantees selectivity up to a short-circuit level of **10** kA.



Selectivity - Upstream MCCB's Record / Downstream MCB's ElfaPlus

Downstream \ Upstream		D125-D125L							D160 - D250 - DH 160 - DH250 - D160L - D250L								D400 - DH400 - D400L				D400S DH400S	D630 DH630 D630L DH800	D630S DH630S D800S	D1250 D1250S
		16A	25A	40A	63A	80A	100A	125A	25A	40A	63A	100A	125A	160A	200A	250A	200A	250A	320A	400A	All	All	All	All
	(A)																							
Curve C	2	0.5	2.0	3.5	4.5	T	T	T	3.5	T	T	T	T	T	T	T	T	T	T	T	T	T	T	T
	3	0.5	2.0	3.5	4.5	T	T	T	1.6	5.0	T	T	T	T	T	T	T	T	T	T	T	T	T	T
C 45-60 /	4	0.3	1.2	1.8	1.6	T	T	T	1.5	2.0	5.0	T	T	T	T	T	T	T	T	T	T	T	T	T
DM 60-100	6		1.2	1.8	1.6	4.5	T	T		1.0	4.0	T	T	T	T	T	T	T	T	T	T	T	T	T
(1)	10		1.2	1.4	1.5	4.5	T	T			2.5	T	T	T	T	T	T	T	T	T	T	T	T	T
	16			1.0	1.2	2.0	5.0	5.0			2.5	T	T	T	T	T	T	T	T	T	T	T	T	T
	20			1.0	1.2	2.0	5.0	5.0			2.0	T	T	T	T	T	T	T	T	T	T	T	T	T
	25			0.4	0.8	1.5	4.5	4.5			2.0	T	T	T	T	T	T	T	T	T	T	T	T	T
	32				0.5	1.5	2.3	2.3				T	T	T	T	T	T	T	T	T	T	T	T	T
	40						2.3	2.3				T	T	T	T	T	T	T	T	T	T	T	T	T
Curve C	6		1.2	1.7	1.6	4.5	T	T		1.0	T	T	T	T	T	T	T	T	T	T	T	T	T	T
	10		1.2	1.4	1.5	4.5	T	T			T	T	T	T	T	T	T	T	T	T	T	T	T	T
G45	16			1.0	1.2	2.0	T	T			4.5	T	T	T	T	T	T	T	T	T	T	T	T	T
	20			1.0	1.2	2.0	T	T			4.5	T	T	T	T	T	T	T	T	T	T	T	T	T
	25			0.4	0.8	1.5	4.5	4.5			3.0	T	T	T	T	T	T	T	T	T	T	T	T	T
	32				0.5	1.5	2.3	2.3			3.0	T	T	T	T	T	T	T	T	T	T	T	T	T
	40						2.3	2.3			2.0	T	T	T	T	T	T	T	T	T	T	T	T	T
Curve C	0.5	1.5	6.0	8.0	10.0	10.0	10.0	10.0	9.0	10.0	6.0	T	T	T	T	T	10.0	T	T	T	T	T	T	T
	1	1.5	6.0	8.0	10.0	10.0	10.0	10.0	9.0	10.0	6.0	T	T	T	T	T	10.0	T	T	T	T	T	T	T
G60 /	2	0.5	2.0	3.5	4.5	10.0	10.0	10.0	3.5	9.0	6.0	T	T	T	T	T	10.0	T	T	T	T	T	T	T
DME60	3	0.5	2.0	3.5	4.5	9.0	10.0	10.0	1.6	5.0	6.0	T	T	T	T	T	10.0	T	T	T	T	T	T	T
	4	0.3	1.2	1.8	1.6	9.0	6.0	6.0	1.5	2.0	6.0	T	T	T	T	T	10.0	T	T	T	T	T	T	T
	6		1.2	1.8	1.6	4.5	6.0	6.0		1.0	6.0	T	T	T	T	T	10.0	T	T	T	T	T	T	T
	10		1.2	1.4	1.5	4.5	6.0	6.0			6.0	T	T	T	T	T	10.0	T	T	T	T	T	T	T
	16			1.0	1.2	2.0	5.0	5.0			4.5	T	T	T	T	T	10.0	T	T	T	T	T	T	T
	20			1.0	1.2	2.0	5.0	5.0			4.5	T	T	T	T	T	10.0	T	T	T	T	T	T	T
	25			0.4	0.8	1.5	4.5	4.5			3.0	T	T	T	T	T	10.0	T	T	T	T	T	T	T
	32				0.5	1.5	2.3	2.3			3.0	7.5	T	T	T	T	10.0	10.0	T	T	T	10.0	T	T
	40						2.3	2.3			2.0	7.5	7.5	T	T	T	10.0	10.0	T	T	T	10.0	T	T
	50										2.0	4.5	6.0	T	T	T	10.0	10.0	T	T	T	10.0	T	T
	63											4.5	6.0	T	T	T	10.0	10.0	T	T	T	10.0	T	T
Curve C	0.5	1.5	6.0	8.0	10.0	10.0	10.0	10.0	9.0	10.0	6.0	10.0	10.0	13.0	T	T	10.0	T	T	T	T	T	T	T
	1	1.5	6.0	8.0	10.0	10.0	10.0	10.0	9.0	10.0	6.0	10.0	10.0	13.0	T	T	10.0	T	T	T	T	T	T	T
G100 /	2	0.5	2.0	3.5	4.5	10.0	10.0	10.0	3.5	9.0	6.0	10.0	10.0	13.0	T	T	10.0	T	T	T	T	T	T	T
DME100	3	0.5	2.0	3.5	4.5	9.0	10.0	10.0	1.6	5.0	6.0	10.0	10.0	13.0	T	T	10.0	T	T	T	T	T	T	T
	4	0.3	1.2	1.8	1.6	9.0	6.0	6.0	1.5	2.0	6.0	10.0	10.0	13.0	T	T	10.0	T	T	T	T	T	T	T
	6		1.2	1.8	1.6	4.5	6.0	6.0		1.0	6.0	10.0	10.0	13.0	T	T	10.0	T	T	T	T	T	T	T
	10		1.2	1.4	1.5	4.5	6.0	6.0			6.0	10.0	10.0	13.0	T	T	10.0	T	T	T	T	T	T	T
	16			1.0	1.2	2.0	5.0	5.0			4.5	10.0	10.0	13.0	T	T	10.0	T	T	T	T	T	T	T
	20			1.0	1.2	2.0	5.0	5.0			4.5	10.0	10.0	10.0	T	T	10.0	T	T	T	T	T	T	T
	25			0.4	0.8	1.5	4.5	4.5			3.0	10.0	10.0	10.0	10.0	T	10.0	T	T	T	T	T	T	T
	32				0.5	1.5	2.3	2.3			3.0	7.5	10.0	10.0	10.0	T	10.0	10.0	T	T	T	10.0	T	T
	40						2.3	2.3			2.0	7.5	7.5	10.0	10.0	T	10.0	10.0	T	T	T	10.0	T	T
	50										2.0	4.5	6.0	10.0	10.0	T	10.0	10.0	T	T	T	10.0	T	T
	63											4.5	6.0	10.0	10.0	T	10.0	10.0	T	T	T	10.0	T	T
Curve C	0.5	1.5	6.0	8.0	10.0	10.0	10.0	10.0	9.0	10.0	6.0	10.0	10.0	13.0	15.0	15.0	10.0	T	T	T	T	T	T	T
	1	1.5	6.0	8.0	10.0	10.0	10.0	10.0	9.0	10.0	6.0	10.0	10.0	13.0	15.0	15.0	10.0	T	T	T	T	T	T	T
	2	0.5	2.0	3.5	4.5	10.0	10.0	10.0	3.5	9.0	6.0	10.0	10.0	13.0	15.0	15.0	10.0	T	T	T	T	T	T	T
	3	0.5	2.0	3.5	4.5	9.0	10.0	10.0	1.6	5.0	6.0	10.0	10.0	13.0	15.0	15.0	10.0	T	T	T	T	T	T	T
	4	0.3	1.2	1.8	1.6	9.0	6.0	6.0	1.5	2.0	6.0	10.0	10.0	13.0	15.0	15.0	10.0	T	T	T	T	T	T	T
	6		1.2	1.8	1.6	4.5	6.0	6.0		1.0	6.0	10.0	10.0	13.0	15.0	15.0	10.0	T	T	T	T	T	T	T
	10		1.2	1.4	1.5	4.5	6.0	6.0			6.0	10.0	10.0	13.0	15.0	15.0	10.0	T	T	T	T	T	T	T
	16			1.0	1.2	2.0	5.0	5.0			4.5	10.0	10.0	13.0	15.0	15.0	10.0	T	T	T	T	T	T	T
	20			1.0	1.2	2.0	5.0	5.0			4.5	10.0	10.0	10.0	15.0	15.0	10.0	T	T	T	T	T	T	T
	25			0.4	0.8	1.5	4.5	4.5			3.0	10.0	10.0	10.0	10.0	15.0	10.0	T	T	T	T	T	T	T
	32				0.5	1.5	2.3	2.3			3.0	7.5	10.0	10.0	10.0	15.0	10.0	10.0	T	T	T	10.0	T	T
	40						2.3	2.3			2.0	7.5	7.5	10.0	10.0	15.0	10.0	10.0	T	T	T	10.0	T	T
	50										2.0	4.5	6.0	10.0	10.0	15.0	10.0	10.0	T	T	T	10.0	T	T
	63											4.5	6.0	10.0	10.0	15.0	10.0	10.0	T	T	T	10.0	T	T
Hti	80													1.9	2.4	2.5	7.0	T	T	T	6.5	T	T	T
	100														2.4	2.5	7.0	T	T	T	6.5	T	T	T
	125															2.5	7.0	T	T	T	6.5	T	T	T

(1) Icc limited to 6 kA for C60, DM60
Icc limited to 10 kA for DM100
T = Total : selective untill the Icu of the downstream device
OR the Icu of the upstream device

Selectivity - Upstream MCCB's Record Plus / Downstream MCB's Redline

Upstream / Downstream	In (A)	Record Plus™ type																				
		FD160E							FD160S							FD160N, H & L						
		40	50	63	80	100	125	160	40	50	63	80	100	125	160	40	50	63	80	100	125	160
		Selectivity limit in kA																				
Redline G60 B/C curve	≤16	0.6	2.5	T	T	T	T	T	T	T	T	T	T	T	T	T	T	T	T	T	T	T
	20	0.6	2.5	3	T	T	T	T	3.5	T	T	T	T	T	T	3.5	T	T	T	T	T	T
	25	-	0.8	1.2	T	T	T	T	1.6	3.5	T	T	T	T	T	1.6	3.5	T	T	T	T	T
	32	-	-	1.2	3	T	T	T	-	-	T	T	T	T	T	-	-	T	T	T	T	T
	40	-	-	-	3	4	T	T	-	-	-	T	T	T	T	-	-	T	T	T	T	T
	50	-	-	-	1.2	1.5	T	T	-	-	-	3.5	T	T	T	-	-	-	3.5	T	T	T
	63	-	-	-	-	1.5	2	T	-	-	-	-	T	T	T	-	-	-	-	T	T	T
G100 B/C curve	≤16	0.6	2.5	6	6	T	T	T	T	T	T	T	T	T	T	T	T	T	T	T	T	T
	20	0.6	2.5	2.5	6	8	T	T	3.5	T	T	T	T	T	T	3.5	T	T	T	T	T	T
	25	-	0.8	1.2	6	6	T	T	1.6	3.5	T	T	T	T	T	1.6	3.5	T	T	T	T	T
	32	-	-	1.2	3	6	8	T	-	-	6	6	T	T	T	-	2.5	T	T	T	T	T
	40	-	-	-	3	4	6	6	-	-	-	6	T	T	T	-	-	T	T	T	T	T
	50	-	-	-	1.2	1.5	6	6	-	-	-	3.5	8	T	T	-	-	-	3.5	T	T	T
	63	-	-	-	-	1.5	2	2	-	-	-	-	8	T	T	-	-	-	-	8	T	T
GT25 B/C curve	≤16	0.6	2.5	6	6	10	T	T	10	10	T	T	T	T	T	10	10	T	T	T	T	T
	20	0.6	2.5	3	6	8	T	T	3.5	10	T	T	T	T	T	3.5	10	T	T	T	T	T
	25	-	0.8	1.2	6	6	10	T	1.6	3.5	15	15	T	T	T	1.6	3.5	15	15	T	T	T
	32	-	-	1.2	3	6	8	10	-	-	6	6	10	T	T	-	-	10	10	T	T	T
	40	-	-	-	3	4	6	6	-	-	-	6	10	T	T	-	-	10	10	15	T	T
	50	-	-	-	1.2	1.5	6	6	-	-	-	3.5	8	10	T	-	-	-	3.5	10	T	T
	63	-	-	-	-	1.5	2	2	-	-	-	-	8	10	T	-	-	-	-	8	T	T
Hti - B/C curve	80	-	-	-	-	-	1.9	1.9	-	-	-	-	-	2.5	2.5	-	-	-	-	-	2.5	2.5
	100	-	-	-	-	-	-	1.9	-	-	-	-	-	-	2.5	-	-	-	-	-	-	2.5
S90 - C curve	≤32	0.6	0.8	0.9	1.2	1.5	1.9	1.9	0.8	1	1.2	15	15	15	15	0.8	1	1.2	15	15	15	15
	40	-	-	0.9	1.2	1.5	1.9	1.9	-	-	1.2	15	15	15	15	-	-	1.2	15	15	15	15
	50	-	-	-	1.2	1.5	1.9	1.9	-	-	-	15	15	15	15	-	-	-	15	15	15	15
	63	-	-	-	-	1.5	1.9	1.9	-	-	-	-	15	15	15	-	-	-	-	15	15	15
	80	-	-	-	-	-	1.9	1.9	-	-	-	-	-	15	15	-	-	-	-	-	15	15
	100	-	-	-	-	-	-	1.9	-	-	-	-	-	-	15	-	-	-	-	-	-	15

* T = Total: selective unil the lowest Icu value of the two devices placed in series.

Selectivity - Upstream MCCB's Record Plus / Downstream MCB's Redline

Upstream / Downstream	In (A)	Record Plus™ type																
		FE160N, H & L - TML					FE160N, H & L - TMLD			FE160N, H & L - SMR1			FE250N, H & L - TMLD			FE250N, H & L - SMR1		
		63	80	100	125	160	100	125	160	63	125	160	125	160	200&250	125	160	250
		Selectivity limit in kA																
Redline	**≤20**	T	T	T	T	T	T	T	T	T	T	T	T	T	T	T	T	T
G60 B/C curve	**25**	1.2	T	T	T	T	T	T	T	T	T	T	T	T	T	T	T	T
	32	1.2	3	T	T	T	T	T	T	T	T	T	T	T	T	T	T	T
	40	-	3	4	T	T	T	T	T	-	T	T	T	T	T	T	T	T
	50	-	1.2	1.5	T	T	T	T	T	-	T	T	T	T	T	T	T	T
	63	-	-	1.5	2	T	-	T	T	-	T	T	T	T	T	T	T	T
G100 B/C curve	**≤16**	6	6	T	T	T	T	T	T	T	T	T	T	T	T	T	T	T
	20	2.5	6	8	T	T	T	T	T	T	T	T	T	T	T	T	T	T
	25	1.2	6	6	T	T	T	T	T	T	T	T	T	T	T	T	T	T
	32	1.2	3	6	8	T	T	T	T	T	T	T	T	T	T	T	T	T
	40	-	3	4	6	6	T	T	T	T	T	T	T	T	T	T	T	T
	50	-	1.2	1.5	6	6	T	T	T	-	T	T	T	T	T	T	T	T
	63	-	-	1.5	2	2	-	T	T	-	T	T	T	T	T	T	T	T
GT25 B/C curve	**≤16**	6	6	10	T	T	T	T	T	T	T	T	T	T	T	T	T	T
	20	2.5	6	8	T	T	T	T	T	T	T	T	T	T	T	T	T	T
	25	1.2	6	6	10	T	T	T	T	T	T	T	T	T	T	T	T	T
	32	1.2	3	6	8	10	T	T	T	T	T	T	T	T	T	T	T	T
	40	-	3	4	6	6	T	T	T	T	T	T	T	T	T	T	T	T
	50	-	1.2	1.5	6	6	T	T	T	-	T	T	T	T	T	T	T	T
	63	-	-	1.5	2	2	-	T	T	-	T	T	T	T	T	T	T	T
Hti - B/C curve	**80**	-	-	-	1	2	-	T	T	-	T	T	-	T	T	-	T	T
	100	-	-	-	-	2	-	-	T	-	-	T	-	T	T	-	T	T
	125	-	-	-	-	-	-	-	T	-	-	T	-	-	T	-	-	T
S90 - C curve	**≤32**	0.6	0.8	0.95	1.2	1.5	T	T	T	T	T	T	T	T	T	T	T	T
	40	-	-	0.9	1.2	1.5	T	T	T	T	T	T	T	T	T	T	T	T
	50	-	-	-	1.2	1.5	T	T	T	-	T	T	T	T	T	T	T	T
	63	-	-	-	-	1.5	-	T	T	-	T	T	T	T	T	T	T	T
	80	-	-	-	-	1.5	-	T	T	-	T	T	-	T	T	-	T	T
	100	-	-	-	-	-	-	-	T	-	-	T	-	T	T	-	T	T

* T = Total: selective unil the lowest Icu value of the two devices placed in series.

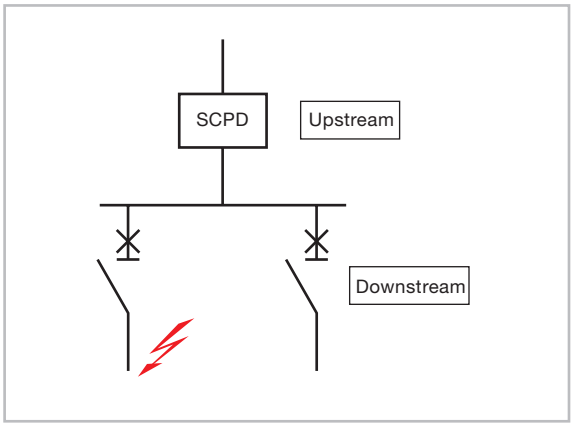
Association (back-up protection)

Association consist the use of an MCB with lower breaking capacity than the presumed one at the place of its installation. If another protective device installed upstream is co-ordinated so that the energy let-through by these two devices does not exceed that which can be withstood without damage by the device placed downstream and the conductor protected by these devices.

In the event of short-circuit, both protective devices will disconnect, therefore the selectivity between them is considered as partial.

Association reduces the cost of the installation in case of high short-circuit currents.

To obtain association between a breaker and a protective device, several conditions linked to the components characteristic must be fullfilled. Those have been defined by calculation and testing.



SCPD: Short-Circuit Protective Device

Upstream: Fuses / Downstream: MCB's Redline Icc max 100 kA*

*80 kA, 400V with 10 x 38 cartridge fuses

Downstream: MCB's ElfaPlus		Upstream: fuses			
Series	In	Type gG		Type aM	
	(A)	min. rating (A)	max. rating (A)	min. rating (A)	max. rating (A)
Curve C	1	4	–	2	–
	2	8	63	4	63
	3	10	63	6	63
	6	20 (10*)	80	10 (10*)	63
G60	10	25 (16*)	80	16 (6*)	80
G100	16	40 (20*)	80	20 (10*)	80
GT25	20	50 (32*)	100	25 (16*)	80
	25	63 (40*)	100	32 (20*)	80
	32	80 (50*)	100	40 (25*)	100
	40	100 (50*)	125	50 (32*)	125
	50	125 (63*)	160	63 (40*)	160
	63	160 (80*)	160	80 (50*)	160
Hti	80	160	200	125	125
	100	200	200	125	125
	125	250	250	125	125

* In case of MCB with B characteristics

Back-up - Upstream MCB's Redline / Downstream MCB's Redline

Voltage 400/415V, Icc max. In kA

Downstream			Upstream					
			G60	G100	GT25	GT25	GT25	Hti
	Icu (kA)		10kA	15kA	25kA	20kA	15kA	10kA
		In (A)	0.5 ... 63	0.5 ... 63	< 32	32 ... 40	50 ... 63	80 ... 60
G45	6	6 ... 40	10	15	25	20	15	10
G60	10	0.5 ... 63	-	15	25	20	15	-
G100	15	0.5 ... 63	-	-	25	20	15	-

Voltage 230/240V, Icc max. In kA

Downstream			Upstream					
			G60	G100	GT25	GT25	GT25	Hti
	Icu (kA)		20kA	30kA	50kA	40kA	30kA	16kA
		In (A)	0.5 ... 63	0.5 ... 63	< 25	32 ... 40	50 ... 63	80 ... 125
C45	5	2 ... 32	20	30	50	40	30	16
C60	6	2 ... 32	20	30	50	40	30	16
DM60	10	6 ... 40	-	30	50	40	30	-
DM100	15	6 ... 40	-	-	50	40	30	-
G45	10	6 ... 40	20	30	50	40	30	16
G60-DME60	20	0.5 ... 63	-	30	50	40	30	-
G100-DME100	30	0.5 ... 63	-	-	50	40	30	-

Back-up - Upstream MCCB's Record / Downstream MCB's Redline

Voltage 230/240V, Icc max. In kA

Downstream			Upstream												
			D125	D125L	D160	DH160	D160L	D250	DH250	D250L	D400	DH400	D400L	D630	DH630	D630L
	Icu (kA)		100kA	130kA	70kA	80kA	130kA	70kA	80kA	130kA	50kA	70kA	130kA	70kA	80kA	130kA
		In (A)														
C45	5	2 ... 32	10	10	-	-	-	-	-	-	-	-	-	-	-	-
C60	6	2 ... 32	15	15	-	-	-	-	-	-	-	-	-	-	-	-
G45	10	6 ... 40	40	90	40	45	45	40	40	40	-	-	-	-	-	-
G60-DME60	20	0.5 ... 63	50	130	50	50	50	50	50	50	22	22	25	22	22	22
G100-DME100	30	0.5 ... 63	70	130	60	65	100	65	60	75	50	50	25	22	22	22
GT25	50	< 25	80	130	70	80	100	70	80	100	50	50	70	-	-	-
GT25	40	> 32	80	130	65	65	100	65	65	100	50	50	70	-	-	-
GT25	30	> 32	80	130	65	65	100	65	65	100	50	50	70	-	-	-
Hti	15	80 ... 125	30	130	30	30	100	30	30	100	30	30	30	-	-	-

Voltage 400/415V, Icc max. In kA

Downstream			Upstream														
			D125	D125L	D160	DH160	D160L	D250	DH250	D250L	D400	DH400	D400L	D630	DH630	D630L	D800	DH800
	Icu (kA)		25kA	100kA	30kA	50kA	100kA	35kA	50kA	100kA	35kA	50kA	100kA	35kA	50kA	100kA	50kA	70kA
		In (A)																
G45	6	6 ... 40	15	50	20	30	40	25	30	40	-	-	-	-	-	-	-	-
G60	10	0.5 ... 63	22	100	30	40	50	35	40	50	22	22	25	22	22	25	22	22
G100	15	0.5 ... 63	22	100	30	40	50	35	40	50	22	22	25	22	22	25	22	22
GT25	25	0.5 ... 63	22	100	30	40	50	35	40	50	-	-	25	-	-	-	-	-
GT25	20	0.5 ... 63	22	100	30	40	50	35	40	50	-	-	25	-	-	-	-	-
GT25	15	0.5 ... 63	22	100	30	40	50	35	40	50	-	-	25	-	-	-	-	-
Hti	10	80 ... 125	25	50	15	15	50	15	15	50	-	-	20	-	-	-	-	-

Back-up - Upstream RecordPlus / Downstream Redline

Voltage 230/240V, Icc max. In kA

Downstream			Upstream							
			FD160E	FD160S	FD160N	FD160H	FD160L	FE250N	FE250H	FE250L
	Icu (kA)		36kA	50kA	85kA	100kA	200kA	85kA	100kA	200kA
		In (A)								
C45	5	2 ... 32	10	10	10	-	-	-	-	-
C60	10	2 ... 32	15	15	15	-	-	-	-	-
G45	10	6 ... 40	15	15	15	-	-	-	-	-
G60	20	0.5 ... 63	22	25	36	85	85	36	85	85
G100	30	0.5 ... 63	30	36	50	100	100	50	100	100
GT25	50	≤ 25	36	50	85	100	100	85	100	100
GT25	40	32-40	30	36	65	100	100	65	100	100
GT25	30	50-63	25	30	50	100	100	50	100	100
Hti	15	80 ... 125	25	30	50	100	100	50	100	100
S90	25	10 ... 100	36	50	85	100	100	85	100	100

Voltage 400/415V, Icc max. In kA

Downstream			Upstream							
			FD160E	FD160S	FD160N	FD160H	FD160L	FE250N	FE250H	FE250L
	Icu (kA)		25kA	30kA	50kA	80kA	150kA	50kA	80kA	150kA
		In (A)								
G45	5	6 ... 40	10	15	15	-	-	-	-	-
G60	10	0.5 ... 63	15	22	30	36	40	30	36	40
G100	15	0.5 ... 63	20	25	36	40	50	36	40	50
GT25	25	≤ 25	-	30	40	50	50	40	50	50
GT25	20	32-40	-	30	36	40	50	36	40	50
GT25	15	50-63	-	25	36	40	50	36	40	50
Hti	10	80 ... 125	15	25	36	40	50	36	40	50
S90	25	10-100	-	25	36	40	50	36	40	50

Selectivity: Upstream MCB S90 / Downstream Redline

Voltage 400/415V, Icc max. In kA

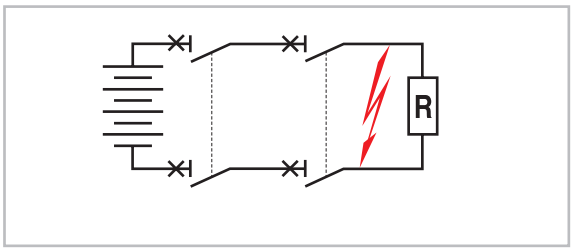
Downstream			Upstream	
			S90	S90H
	Icu (kA)		25kA	50kA
		In (A)	≤ 100	≤ 80
EP60	10	0.5 ... 63	20	40
EP100	15	0.5 ... 63	25	50
EP250	25	≤ 25	25	50
EP250	20	32-40	25	50
EP250	15	50-63	25	50

Use in DC

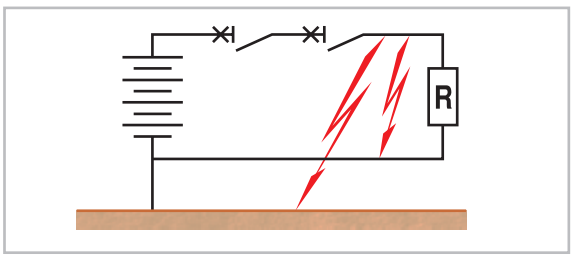
Selection criteria
The selection of an MCB to protect a D.C. installation depends on the following parameters:
- The nominal current
- The nominal voltage of the power supply, which determines the number of poles to switch the device
- The maximum short-circuit current, to determine the short-circuit capacity of the MCB
- Type of power supply

In the event of an insulation fault, it is considered as an overload when one pole or an intermediate connection of the power supply is connected to earth, and the conductive parts of the installation are also connected to earth.

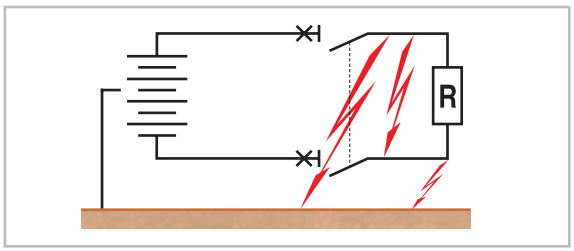
Insulated generator
In insulated generators there is no earth connection, therefore an earth leakage in any pole has no consequence. In the event of fault between the two poles (+ and –) there is a short-circuit in the installation which value will depend on the impedance of the installation as well as of the voltage Un.
Each polarity shall be provided with the appropriate number of poles.



Generator with one earthed pole
In the event of a fault occuring in the earthed pole (-) there is no consequence. In the event of a fault between the two poles (+ and -) or between the pole + and earth, then there is a short-circuit in the installation which value depends on the impedance of the installation as well as of the voltage Un. The unearthed pole (+) shall be provided with the necessary numbers of poles to break the maximum short-circuit.



Generator with centre point earth connection
In the event of short-circuit between any pole (+ or -) and earth, there is a Isc<Isc max because the voltage is Un/2. If the fault occurs between the two poles there is a short-circuit in the installation which value depends on the impedance of the installation as well as the voltage Un.
Each polarity shall be provided with the necessary number of poles to break the maximum short-circuit at Un/2.



Use of standard MCB in DC (acc. to IEC 60947-2)
For MCB's designed to be used in alternating current but used in installations in direct current, the following should be taken into consideration:
- For protection against overloads it is necessary to connect the two poles to the MCB. In these conditions the tripping characteristic of the MCB in direct current is similar in alternating current.
- For protection against short-circuits it is necessary to connect the two poles to the MCB. In these conditions the tripping characteristic of the MCB in direct current is 40% higher than the one in alternating current.

Use of special MCB (UC) in DC (acc. to IEC 60898-2) (UC= Universal Current)
For MCB's designed to work in both alternating and direct current, it is necessary to respect the polarity of the terminals since the device is equipped with a permanent magnet.

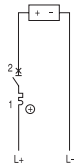
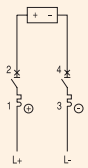
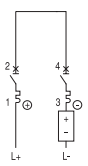
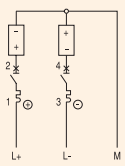
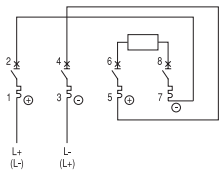
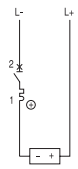
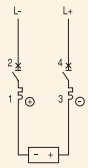
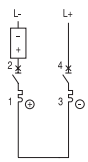
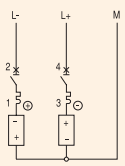
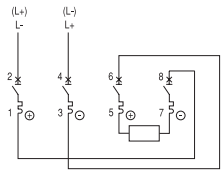
Use in DC selection table

Series	Rated current (A)	≤ 60 V 1 pole Icu (kA)	≤ 125 V 2 poles in series Icu (kA)	250 V 1 pole Icu (kA)	440 V 2 poles in series Icu (kA)
G60(1)	0.5....63A	20	25	-	-
G100(1)	0.5....63A	25	30	-	-
GT10(1)	0.5....63A	20	25	-	-
EP100UC	6....25A	-	-	6	6

(1) Nominal voltage for G60/G100/GT10: 48/110VDC
Maximum voltage for G60/G100/GT10: 53/120VDC

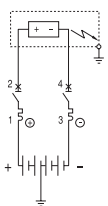
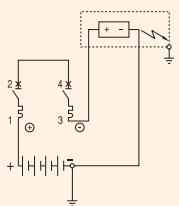
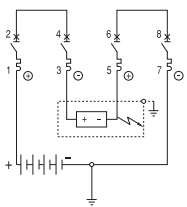
Installation of MCB's series EP100 UC in direct current

Example of utilisation for maximum voltage between lines according to the number of poles

MCB's	EP 100 UC 1P	EP 100 UC 2P			EP 100 UC 4P *
Maximum voltage between lines	250 V ⎓	250 V ⎓	440 V ⎓	440 V ⎓	440 V ⎓ (poles inversion)
Maximum voltage between lines and earth	250 V ⎓	250 V ⎓	440 V ⎓ (1)	250 V ⎓	250 V ⎓
Power supply at bottom terminals					
Power supply at top terminals					

(1) Negative pole connected to earth * On request

Example of utilisation for different voltages between line and earth than between two lines

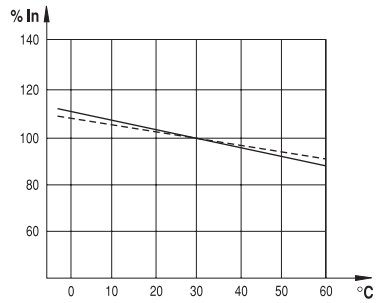
MCB's	EP 100 UC 2P		EP 100 UC 4P *
Maximum voltage between lines	440 V ⎓ Multipole breaking	440 V ⎓ Multipole breaking	440 V ⎓ Multipole breaking
Maximum voltage between lines and earth	250 V ⎓ Generator with centre point earth connection	440 V ⎓ Generator without earth connection or with one earthed pole	440 V ⎓ Generator without earth connection or with one earthed pole
			

* On request

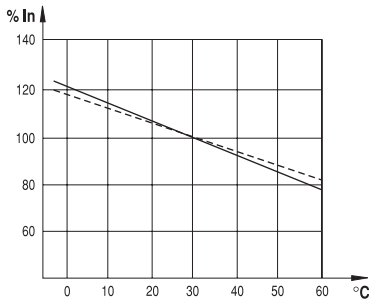
Influence of ambient air temperature on the rated current

The thermal callibration of the MCB's was carried out at ambient temperature of 30°C. Ambient temperatures different from 30°C influence the bimetal and this results in earlier or later thermal tripping.

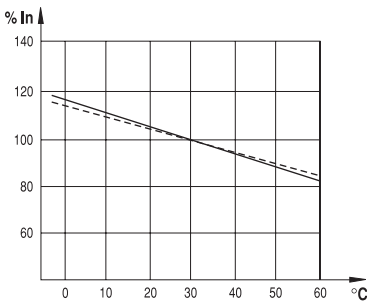
0,5 - 6A



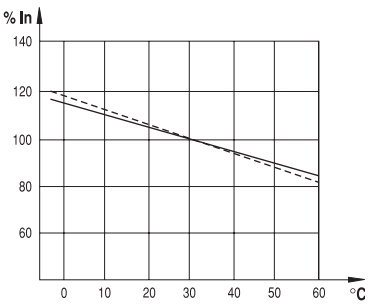
10A



16 - 40A



50 - 63A



——— : 1P (Single pole)
- - - - - - - : mP (Multipole)

Influence of air temperature (IEC/EN 60898)

1 pole	Calibrated at 30°C						
In	0°	10°	20°	30°	40°	50°	60°
0.5	0.57	0.55	0.52	0.5	0.48	0.46	0.43
1	1.13	1.11	1.04	1	0.96	0.91	0.87
2	2.27	2.22	2.09	2	1.91	1.82	1.73
3	3.40	3.32	3.13	3	2.87	2.73	2.60
4	4.53	4.43	4.18	4	3.82	3.65	3.47
6	6.80	6.65	6.27	6	5.73	5.47	5.20
10	12.33	11.56	10.78	10	9.23	8.45	7.67
16	18.67	17.78	16.89	16	15.11	14.23	13.34
20	23.33	22.22	21.11	20	18.89	17.78	16.67
25	29.17	27.78	26.39	25	23.62	22.23	20.84
32	37.33	35.56	33.78	32	30.23	28.45	26.68
40	46.67	44.44	42.23	40	37.79	35.57	33.35
50	57.50	55.00	52.50	50	47.50	45.00	42.50
63	72.45	69.30	66.15	63	59.85	56.70	53.55

n poles	Calibrated at 30°C						
In	0°	10°	20°	30°	40°	50°	60°
0.5	0.55	0.53	0.52	0.5	0.49	0.47	0.46
1	1.09	1.06	1.03	1	0.97	0.94	0.91
2	2.18	2.12	2.06	2	1.94	1.88	1.82
3	3.27	3.18	3.09	3	2.91	2.82	2.73
4	4.36	4.24	4.12	4	3.88	3.76	3.64
6	6.54	6.36	6.18	6	5.82	5.64	5.46
10	11.67	11.11	10.56	10	9.45	8.89	8.33
16	17.81	17.42	16.71	16	15.29	14.58	13.87
20	22.27	21.78	20.89	20	19.11	18.23	17.34
25	27.83	27.22	26.11	25	23.89	22.78	21.67
32	35.63	34.84	33.42	32	30.58	29.16	27.74
40	44.53	43.56	41.78	40	38.23	36.45	34.68
50	59.50	56.33	53.17	50	46.83	43.67	40.50
63	74.97	70.98	66.99	63	59.01	55.02	51.03

Tripping current as a function of the frequency

All the MCB's are designed to work at frequencies of 50-60 Hz, therefore to work at different values, consideration must be given to the variation of the tripping characteristics. The thermal tripping does not change with variation of the frequency but the magnetic tripping values can be up to 50% higher than the ones at 50-60 Hz.
For DC current magnetic tripping is 50% higher.

Tripping current variation

60Hz	100Hz	200Hz	300Hz	400Hz
1	1.1	1.2	1.4	1.5

Power losses

The power losses are calculated by measuring the voltage drop between the incoming and the outgoing terminals of the device at rated current.

Power losses per pole MCB Series G

In (A)	Voltage drop (V)	Energy loss Pw (W)	Resistance Z (mOhm)
0.5	2.23	1.12	4458.00
1	1.27	1.27	1272.00
2	0.62	1.24	310.00
3	0.52	1.56	173.00
4	0.37	1.49	93.00
6	0.26	1.57	43.60
8	0.16	1.24	19.40
10	0.16	1.56	15.60
13	0.16	2.01	11.90
16	0.16	2.57	10.10
20	0.14	2.76	6.90
25	0.13	3.19	5.10
32	0.10	3.07	3.00
40	0.10	4.00	2.50
50	0.09	4.50	1.80
63	0.08	5.16	1.30

Power losses per pole MCB Series Hti

In (A)	Voltage drop (V)	Energy loss Pw (W)	Resistance Z (mOhm)
80	0.08	6.00	0.90
100	0.08	7.50	0.75
125	0.08	9.50	0.60

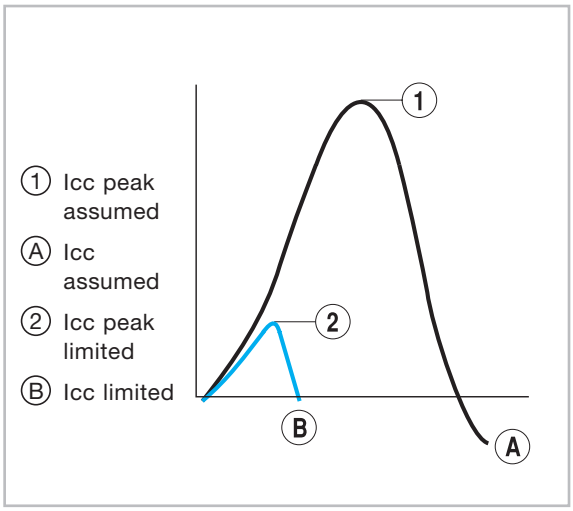
Power losses per pole MCB Series C

In (A)	Voltage drop (V)	Energy loss Pw (W)	Resistance Z (mOhm)
2	0.82	1.60	400.00
4	0.57	2.30	144.00
6	0.21	1.30	36.10
10	0.13	1.30	13.00
16	0.11	1.80	7.03
20	0.14	2.80	7.00
25	0.10	2.50	4.00
32	0.09	3.00	2.93

Limitation curves

Let-through energy I^2t
The limitation capacity of a MCB in short-circuit conditions, is its capacity to reduce the value of the let-through energy that the short-circuit would be generating.

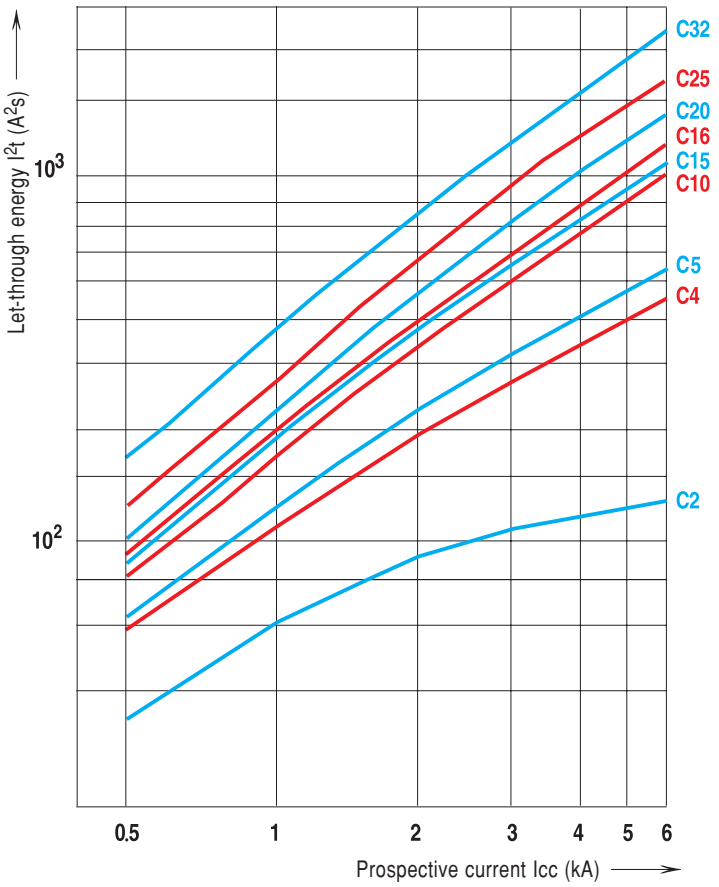
Peak current Ip
It is the value of the maximum peak of the short-circuit current limited by the MCB.



See page T1.33 up to T1.44

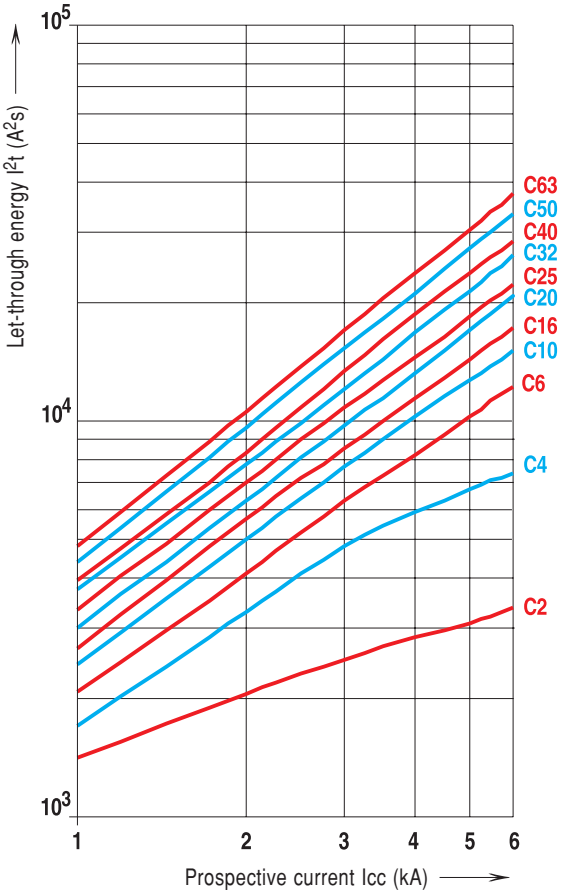
C45-C60 Curve 1P+N / 1 module

I^2t Let-through energy at 230V



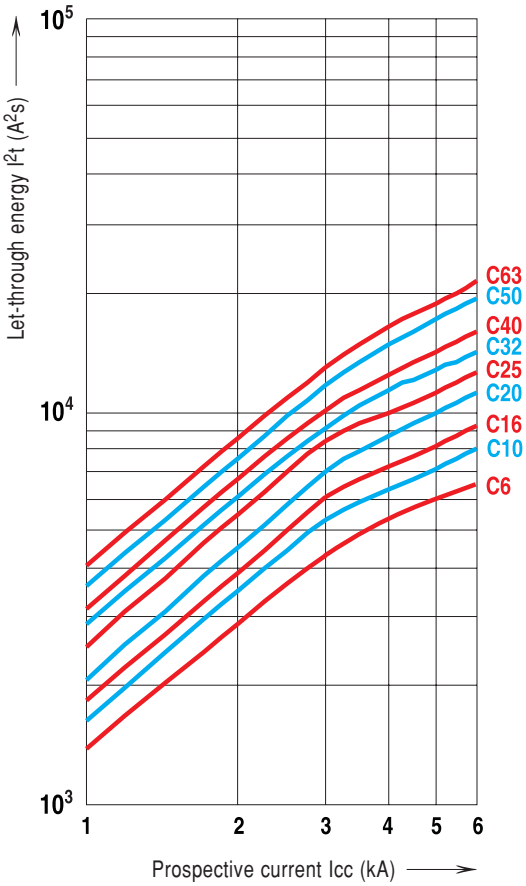
G45 Curve C 1P, 1P+N, 2P, 3P, 4P

I^2t Let-through energy at 230/400 V

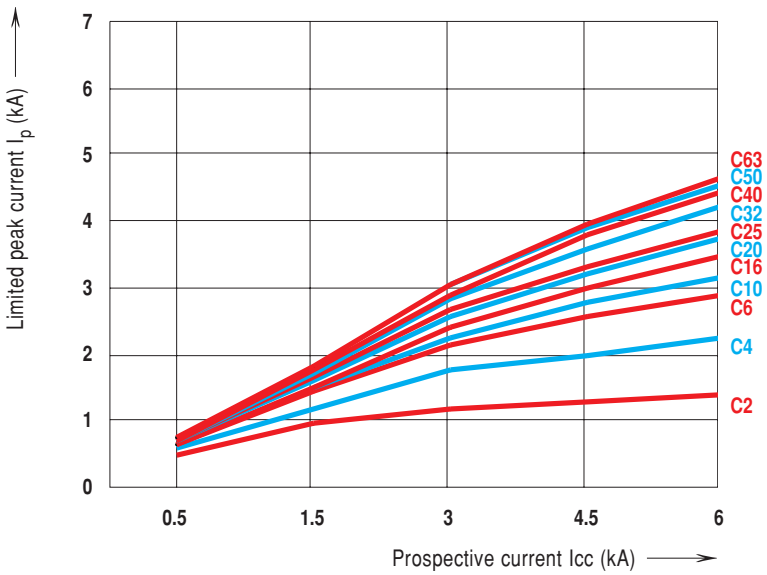


G45 Curve C 2P

I^2t Let-through energy at 230 V

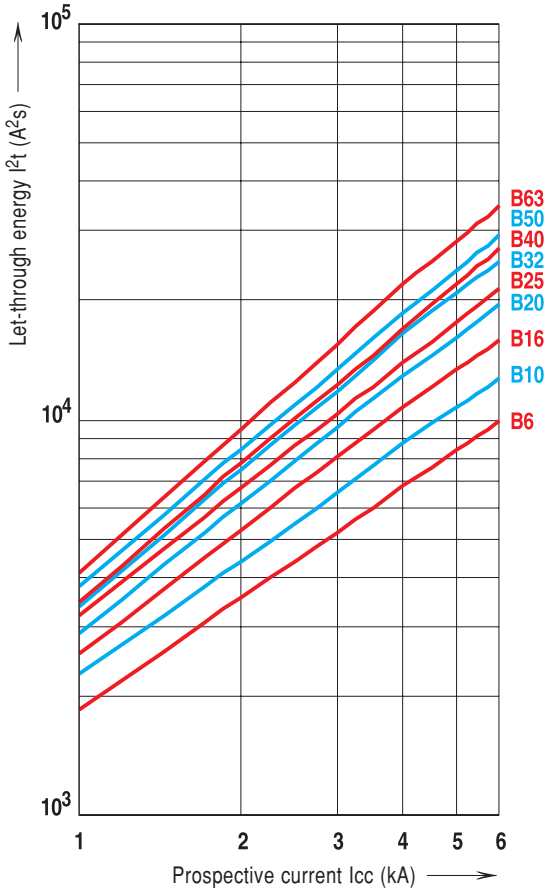


Ip Limited peak current at 230/400 V



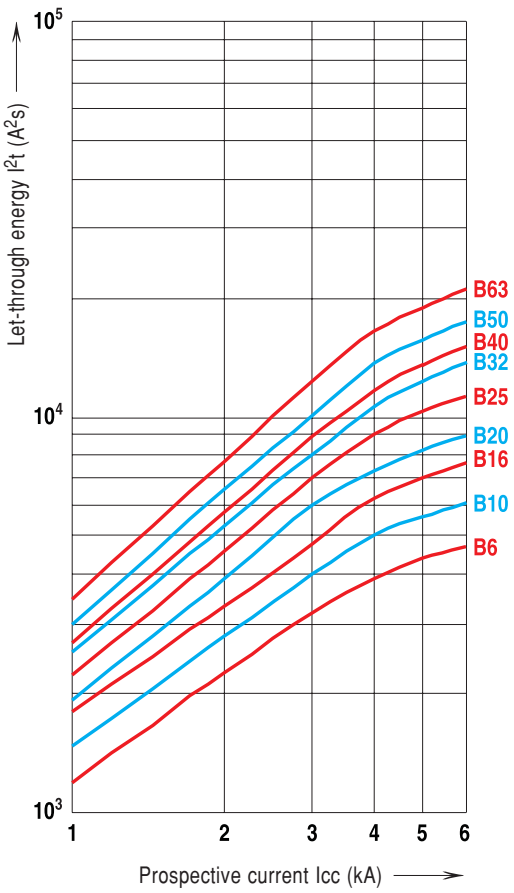
G45 Curve B 1P, 1P+N, 2P, 3P, 4P

I^2t Let-through energy at 230/400 V

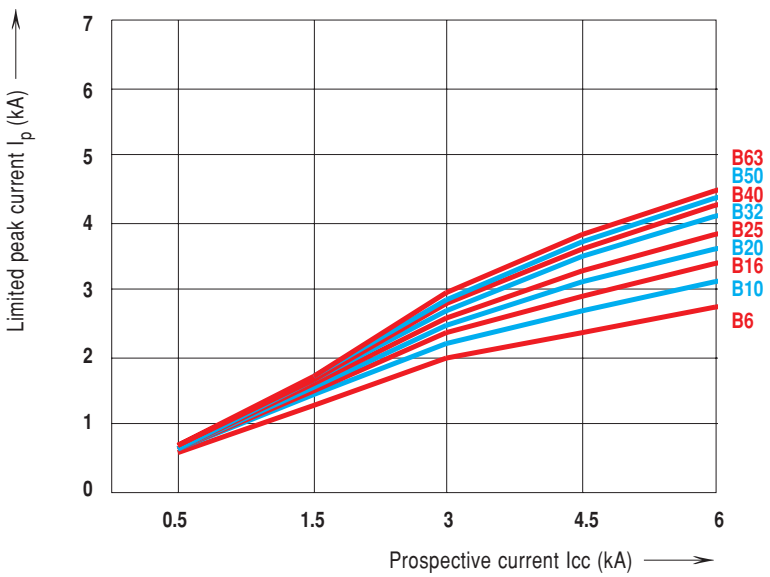


G45 Curve B 2P

I^2t Let-through energy at 230 V

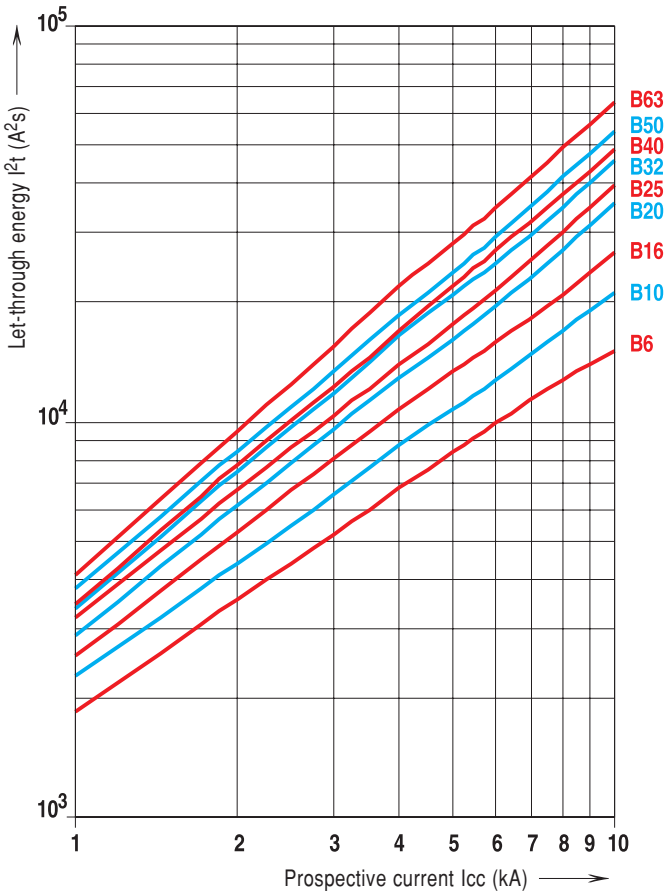


Ip Limited peak current at 230/400 V



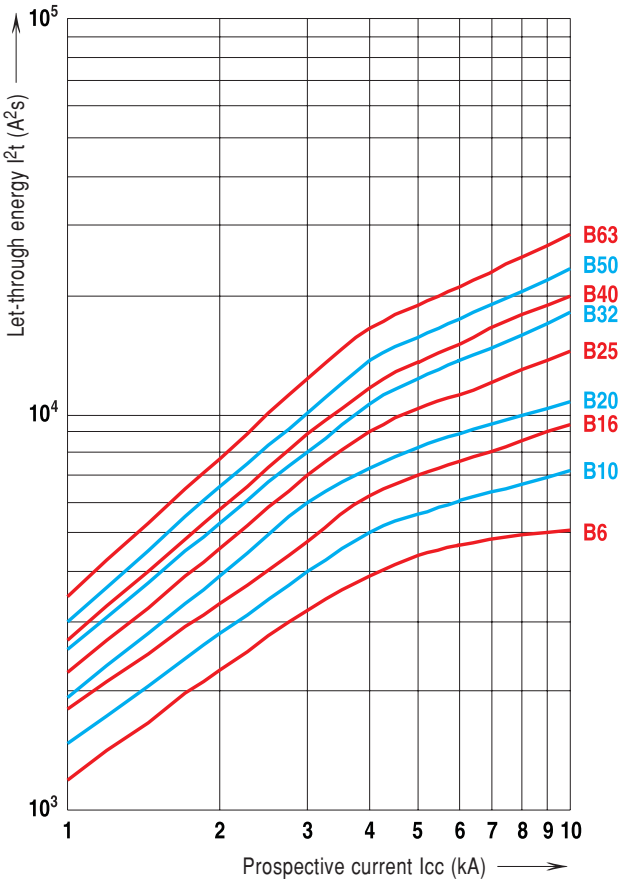
G60 Curve B 1P, 1P+N, 2P, 3P, 4P

I^2t Let-through energy at 230/400 V

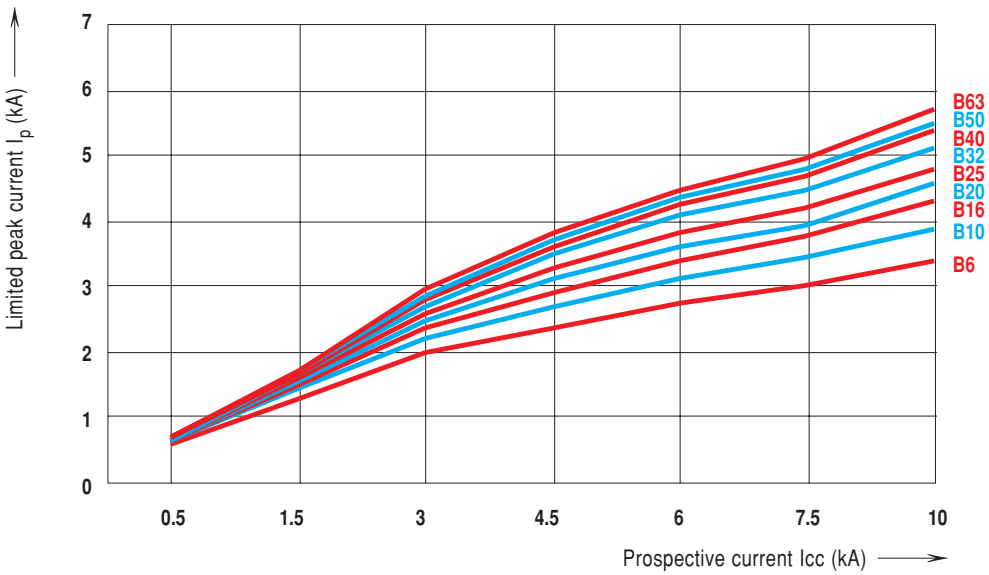


G60 Curve B 2P

I^2t Let-through energy at 230 V

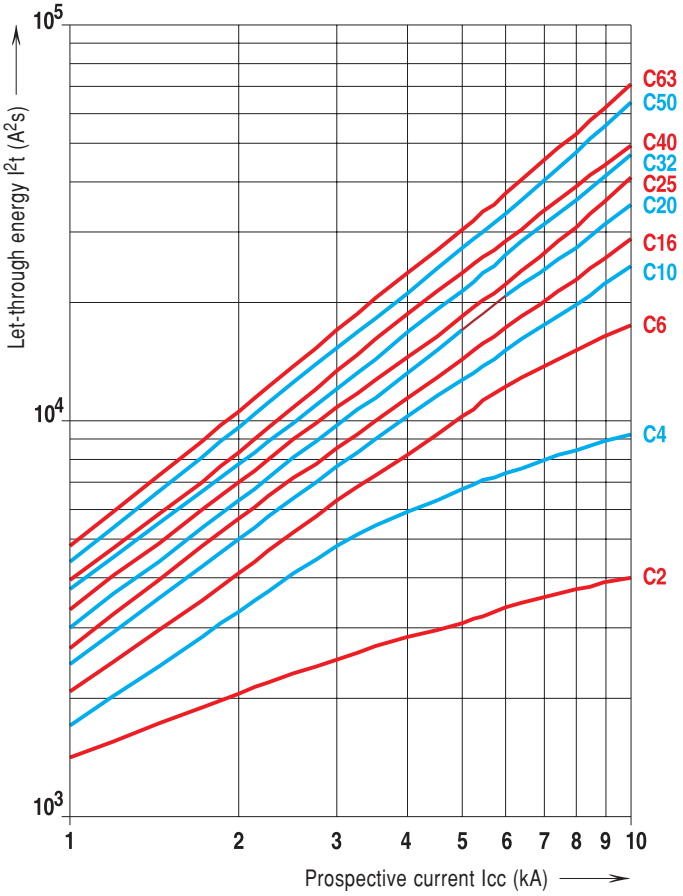


Ip Limited peak current at 230/400 V



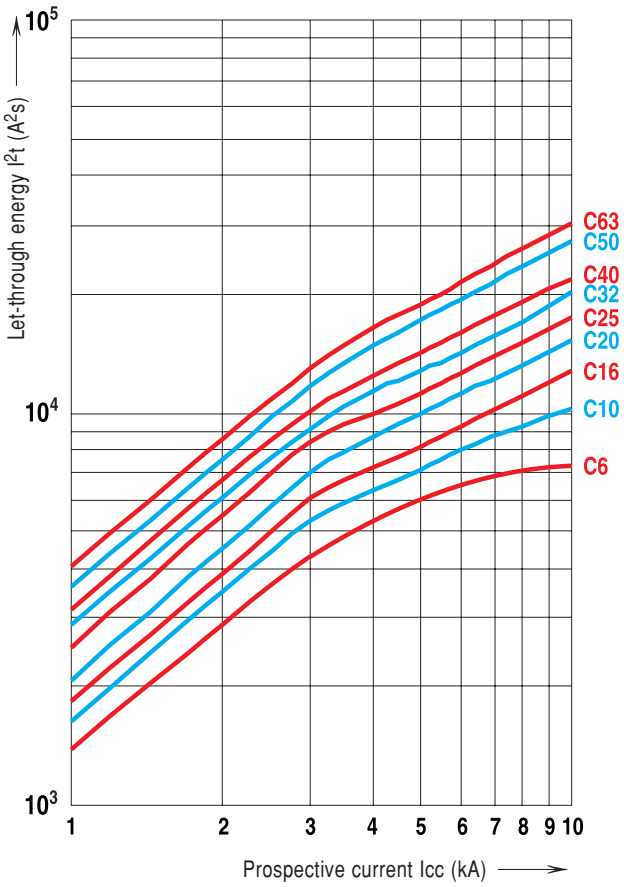
G60 Curve C 1P, 1P+N, 2P, 3P, 4P

I^2t Let-through energy at 230/400 V

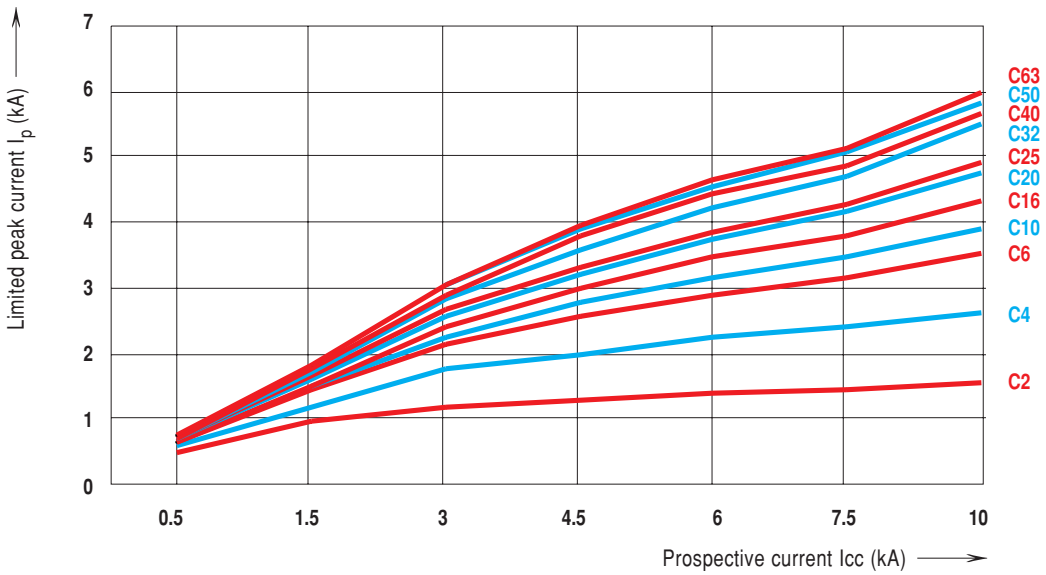


G60 Curve C 2P

I^2t Let-through energy at 230 V

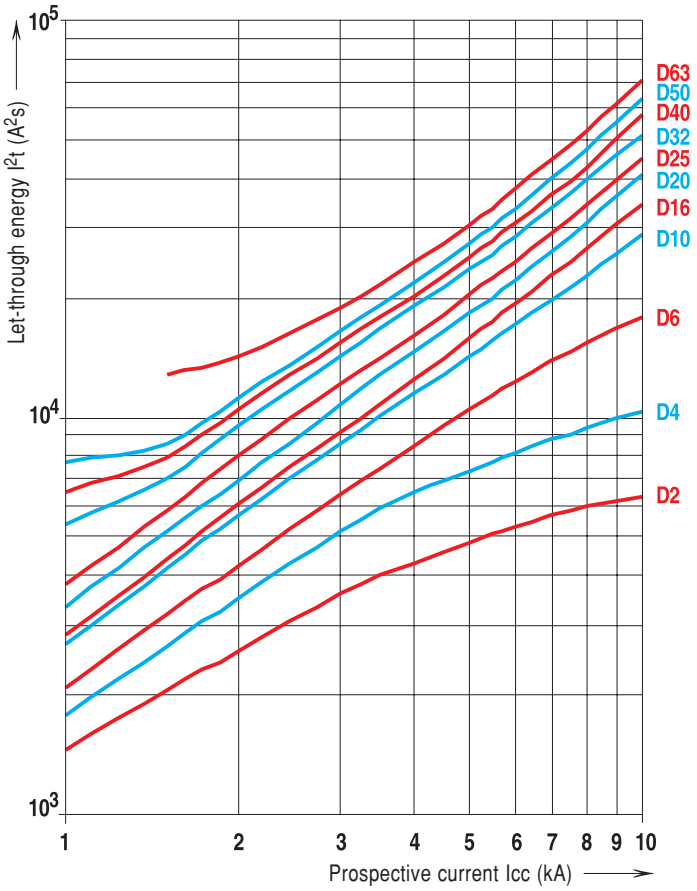


Ip Limited peak current at 230/400 V



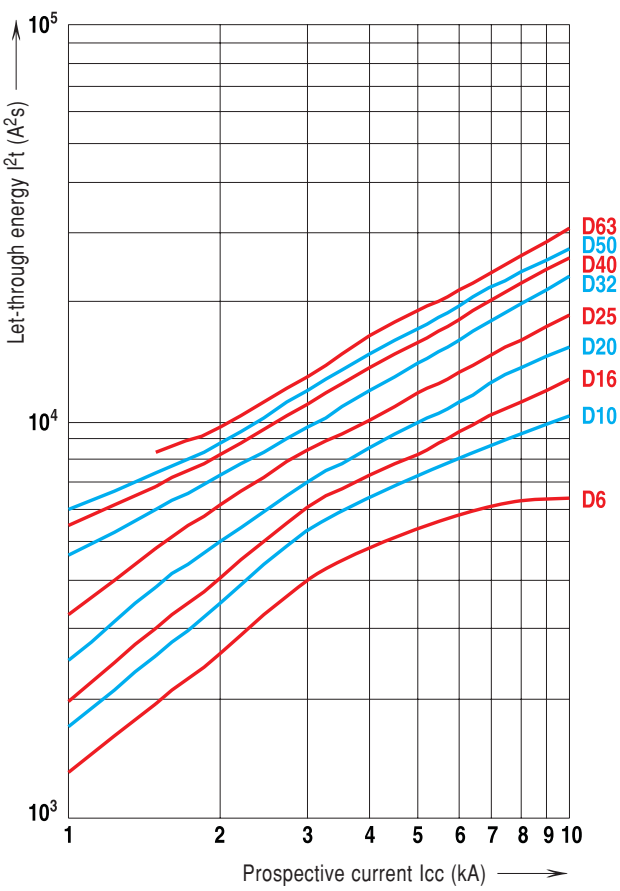
G60 Curve D 1P, 1P+N, 2P, 3P, 4P

I^2t Let-through energy at 230/400 V

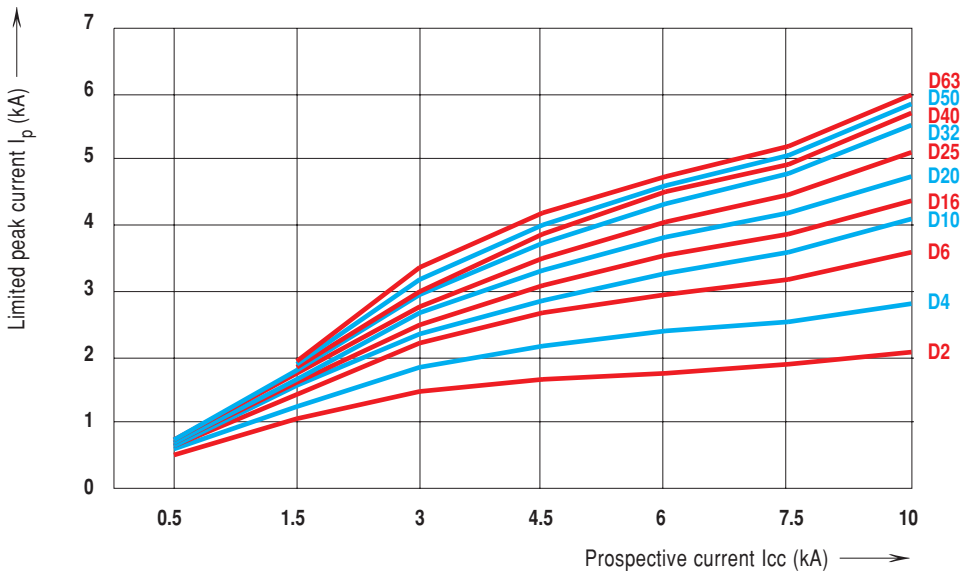


G60 Curve D 2P

I^2t Let-through energy at 230 V

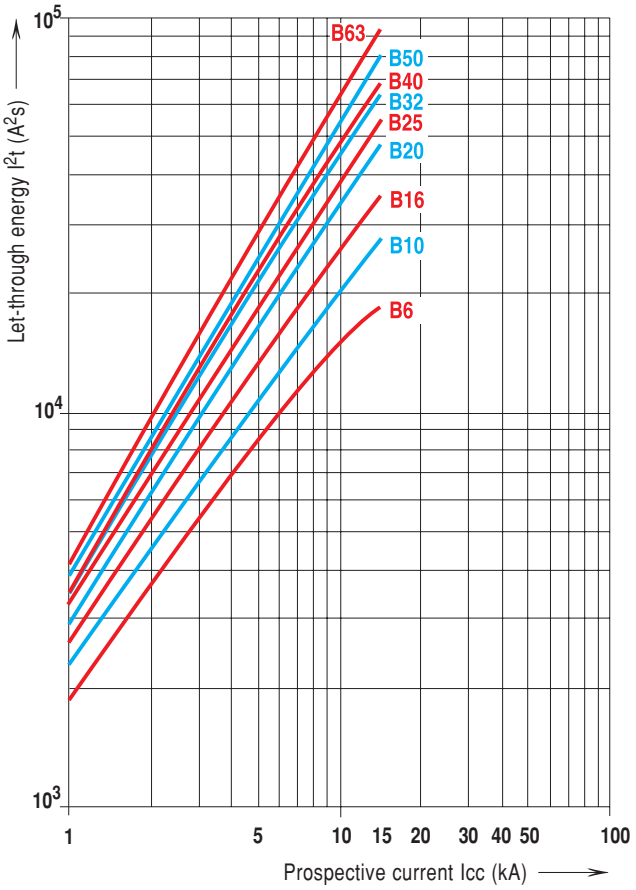


Ip Limited peak current at 230/400 V



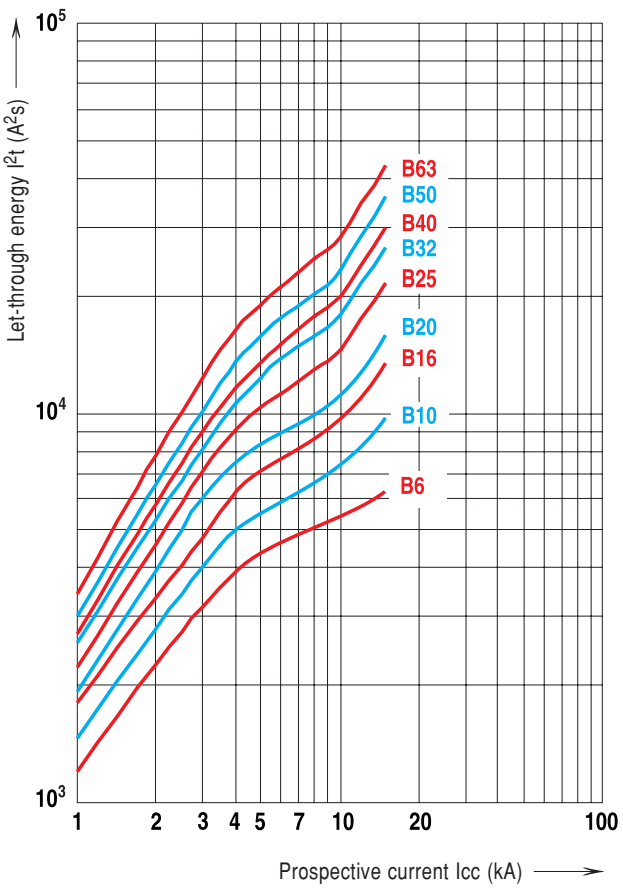
G100 Curve B 1P, 1P+N, 2P, 3P, 4P

I^2t Let-through energy at 230/400 V

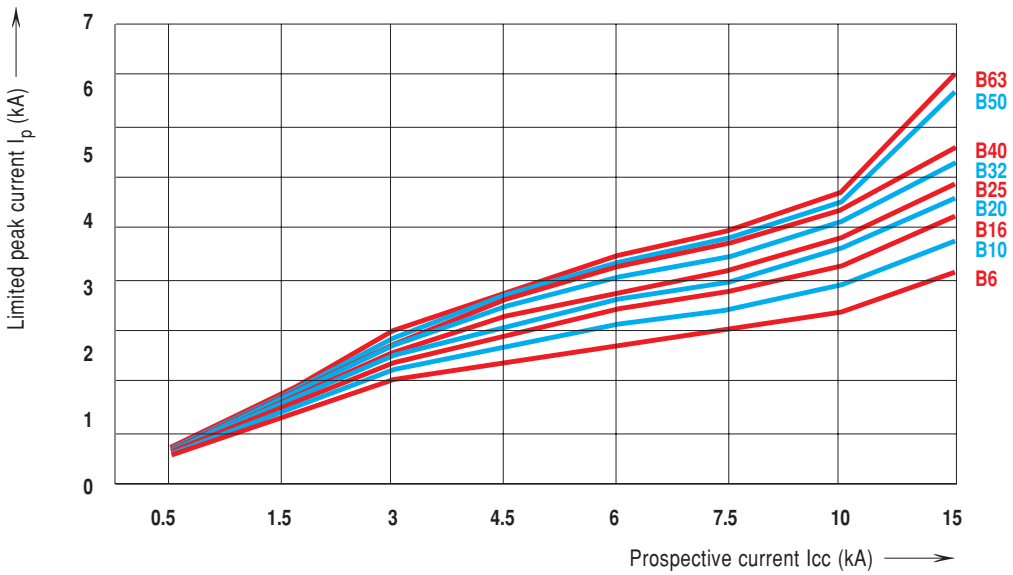


G100 Curve B 2P

I^2t Let-through energy at 230 V

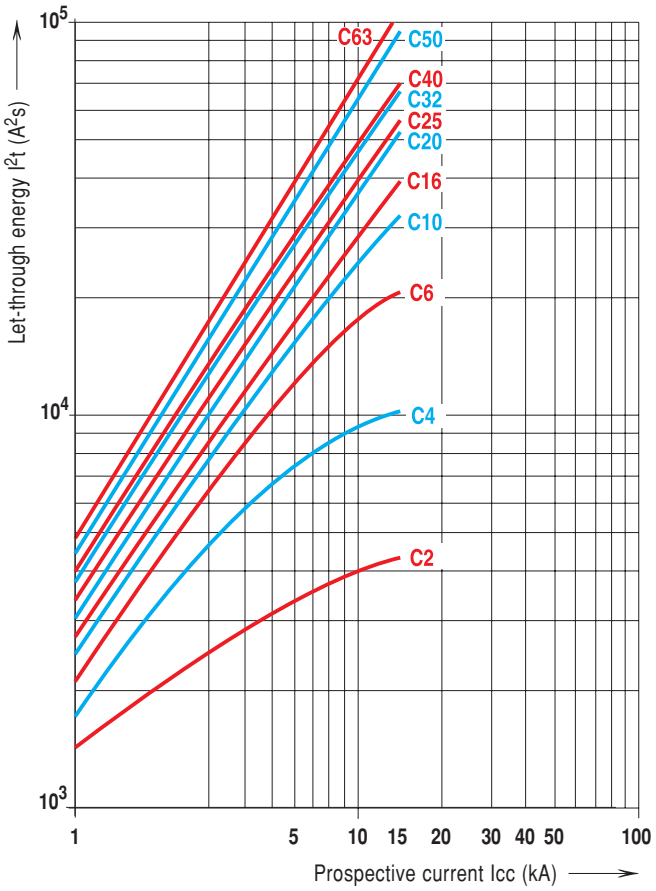


Ip Limited peak current at 230/400 V



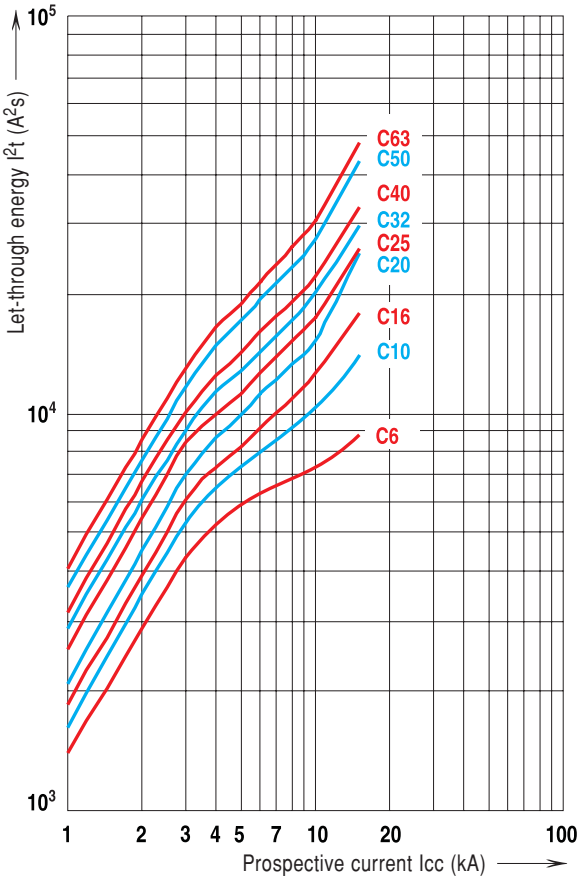
G100 Curve C 1P, 1P+N, 2P, 3P+N

I^2t Let-through energy at 230/400 V

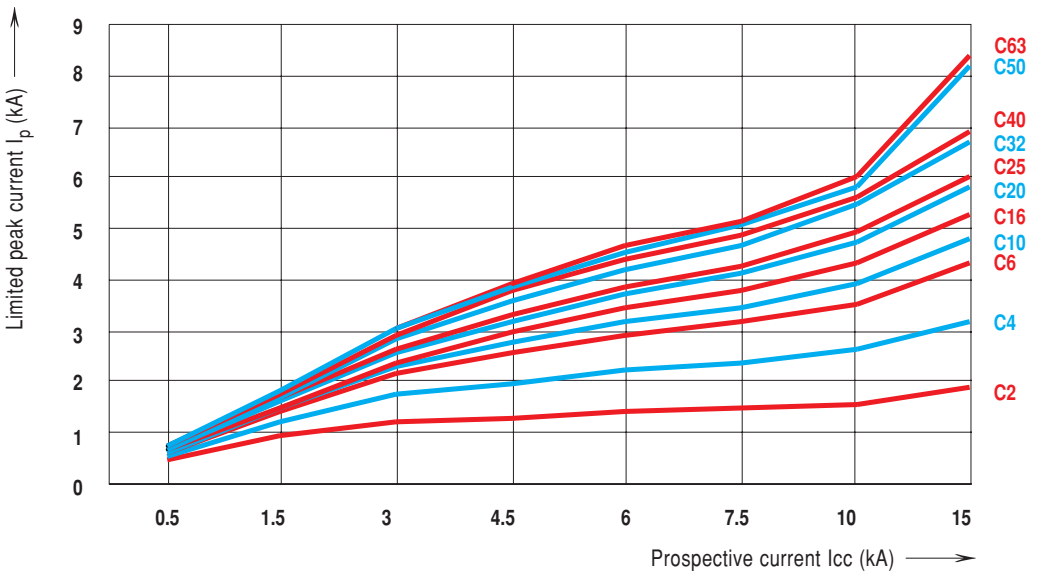


G100 Curve C 2P

I^2t Let-through energy at 230 V

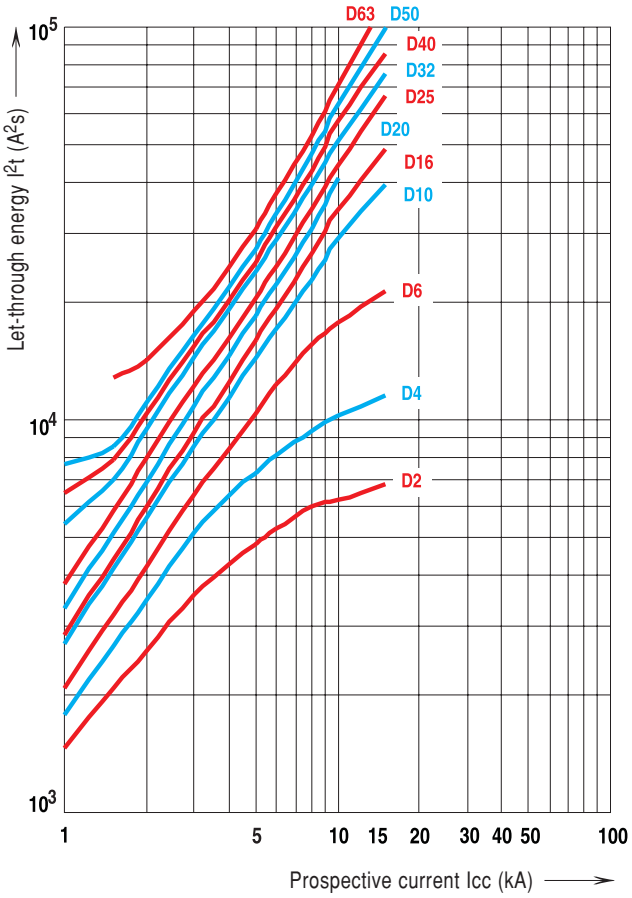


Ip Limited peak current at 230/400 V



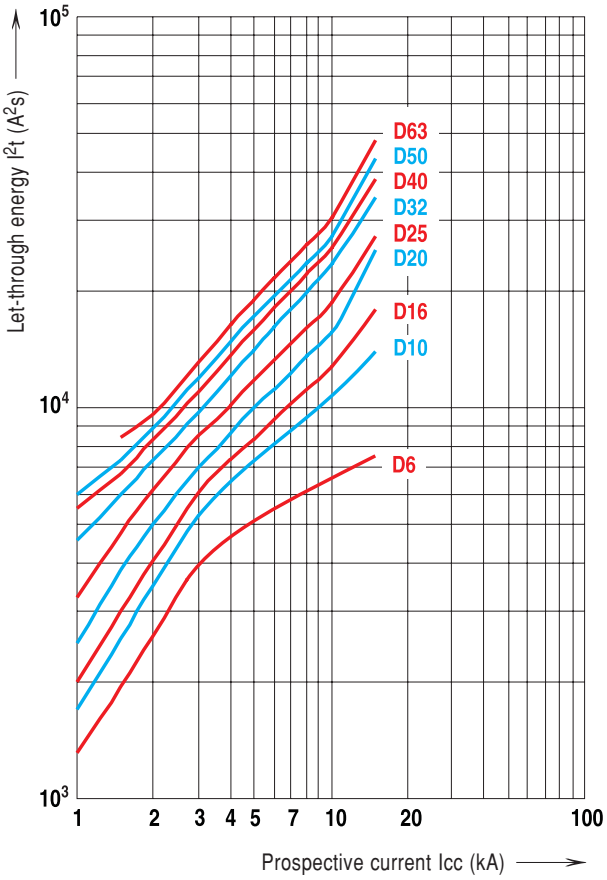
G100 Curve B 1P, 1P+N, 2P, 3P, 4P

I^2t Let-through energy at 230/400 V

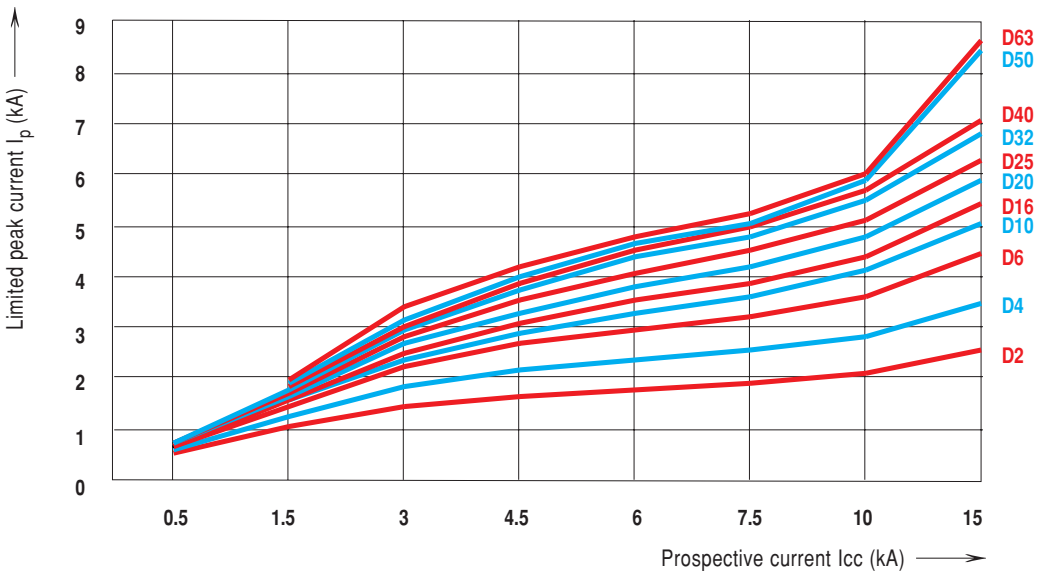


G100 Curve B 2P

I^2t Let-through energy at 230 V

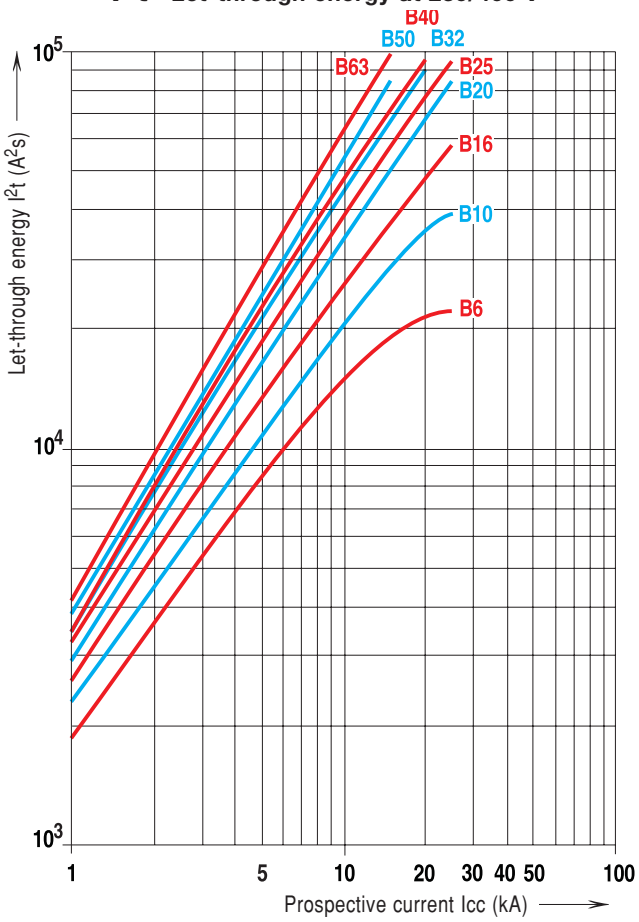


Ip Limited peak current at 230/400 V



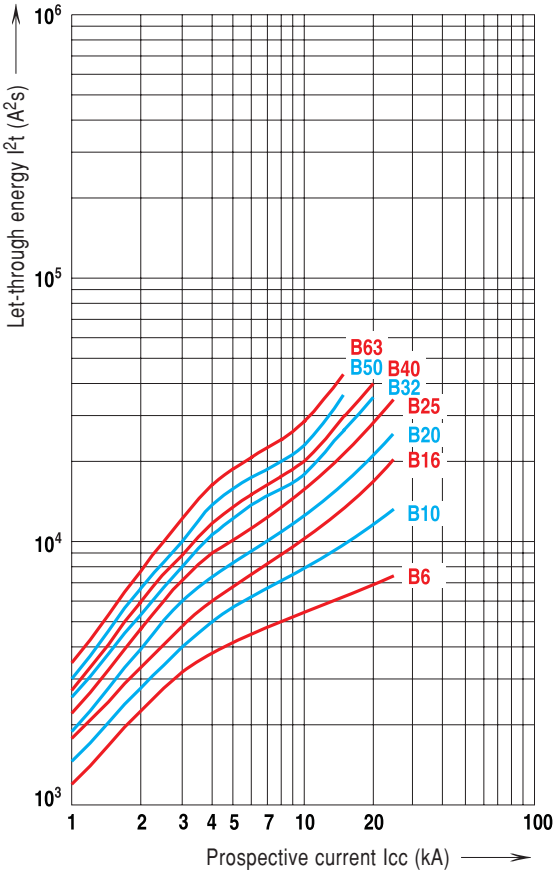
GT25 Curve B 1P, 2P, 3P, 4P

I^2t Let-through energy at 230/400 V

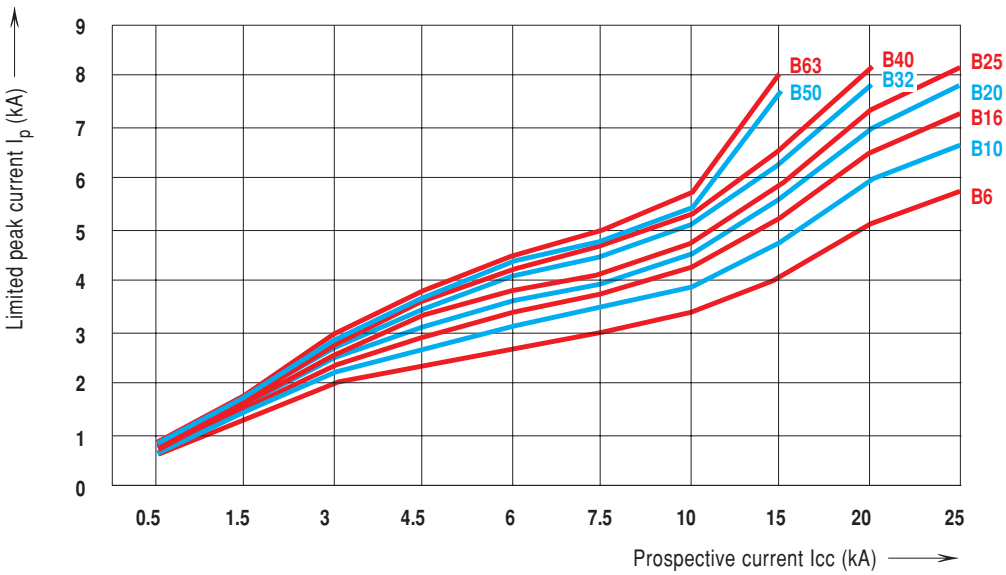


GT25 Curve B 2P

I^2t Let-through energy at 230 V

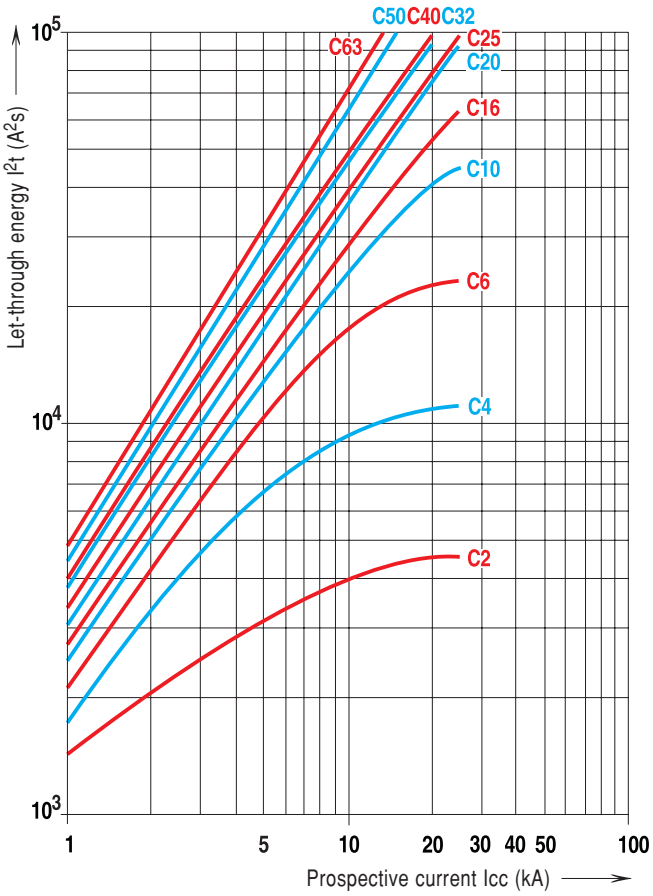


Ip Limited peak current at 230/400 V



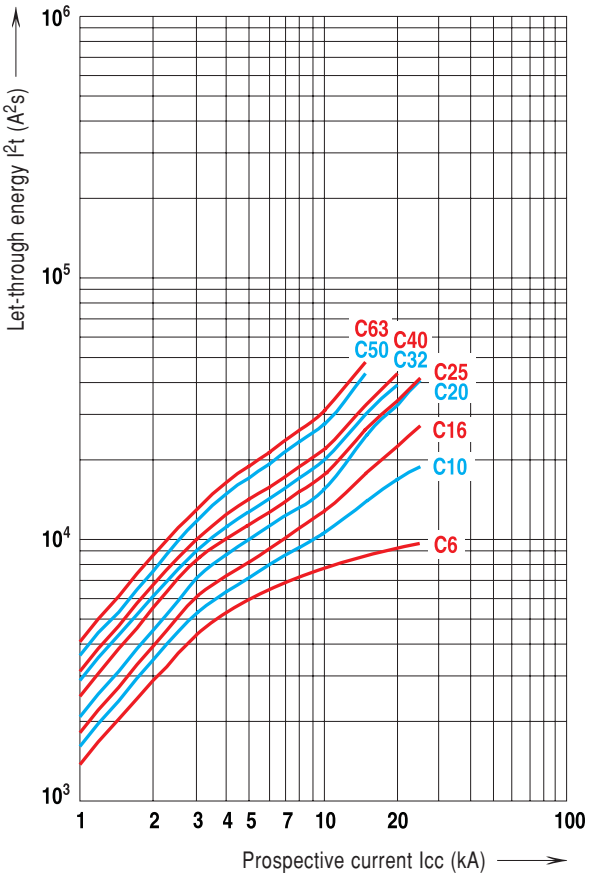
GT25 Curve C 1P, 2P, 3P, 4P

I^2t Let-through energy at 230/400 V

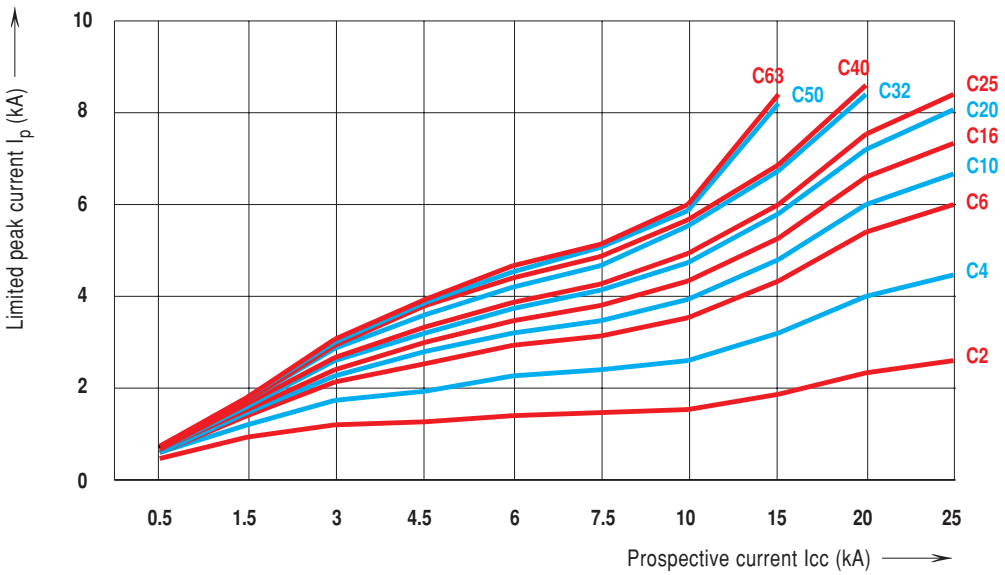


GT25 Curve C 2P

I^2t Let-through energy at 230 V

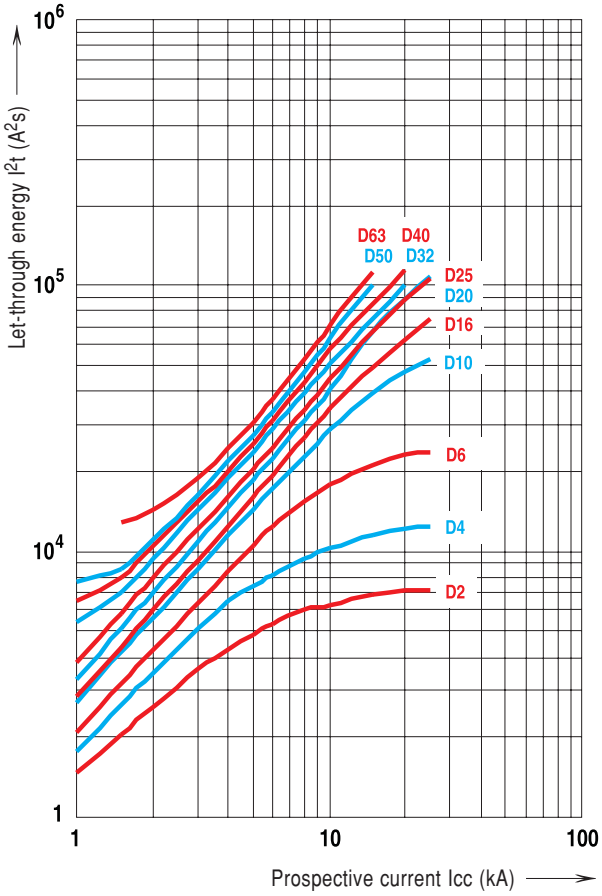


Ip Limited peak current at 230/400 V



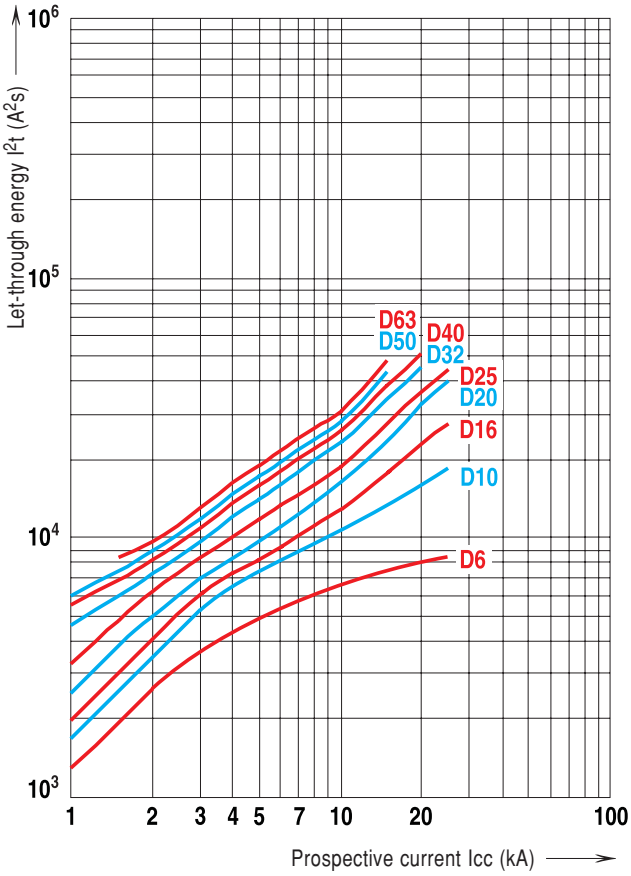
GT25 Curve D 1P, 2P, 3P, 4P

I^2t Let-through energy at 230/400 V

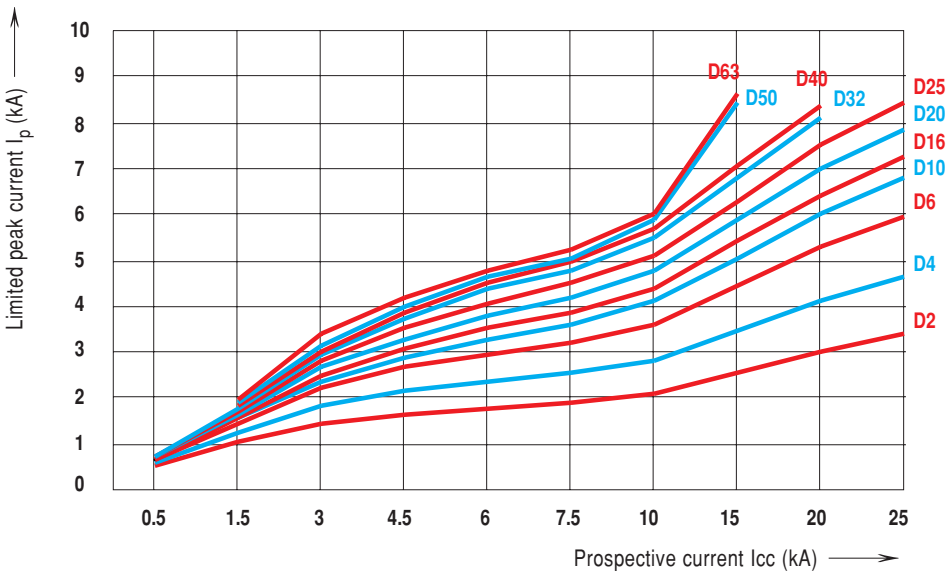


GT25 Curve D 2P

I^2t Let-through energy at 230 V



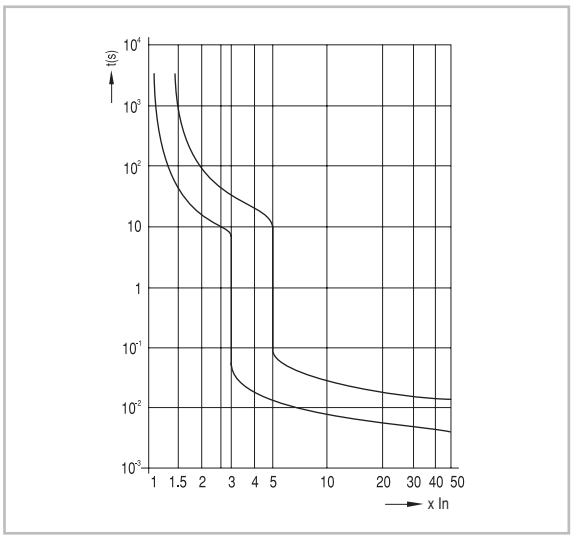
Ip Limited peak current at 230/400 V



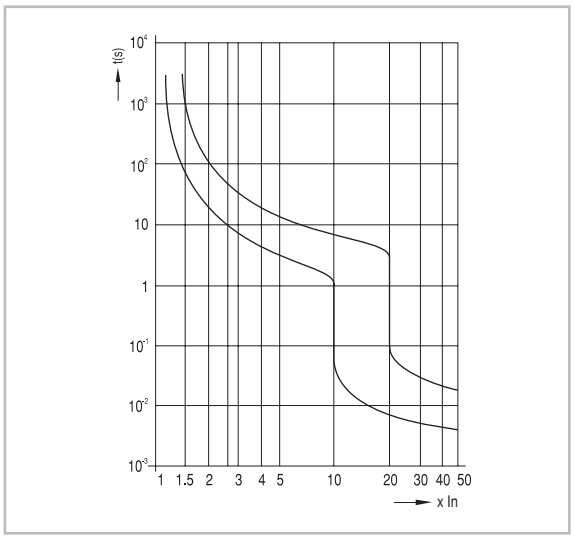
Tripping curves acc. EN/IEC 60898

The following tables show the average tripping curves of the GE MCB's based on the thermal calibration as well as the magnetic characteristic.

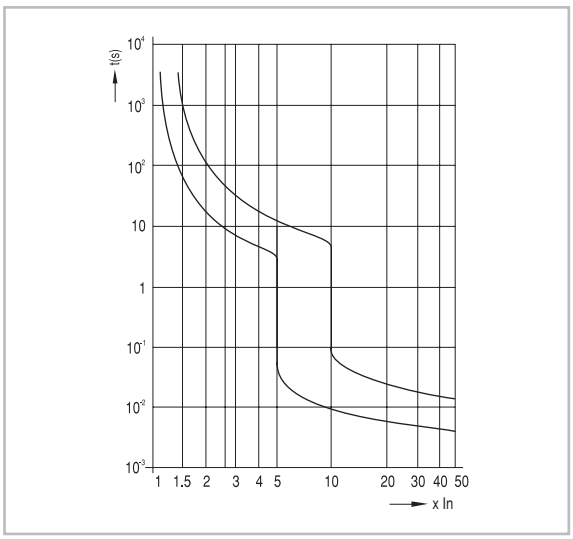
Curve B



Curve D



Curve C



Selective circuit breaker S90

Application

The selective circuit breaker ElfaPlus S90 often serves as gang switches in distribution boards with the highest demand on selectivity and operating convenience.
The ElfaPlus S90 are used as higher protection element in a installation with different MCB's.

The S90 breaker are equipped additional to the main current path with another two circuits:
- Parallel current path that contains a resistor R for current limitation.
- Measuring circuit with magnet impulses to close the main contact

Function

The selective main circuit breaker ElfaPlus S90 is a miniature circuit breaker employed as superordinate protective element in series with traditional MCB's. The unit, in order to switch selectively has in addition to the main current path (fig. 1) another paralelle current path with a currentlimiting resistor R and a measuringcircuit with a solnenoid drive to close the main contact.

Manual closing (fig. 1 and fig. 2)
If the selective circuit breaker is manually switched-on, first of all the contact K2 closes and the operating current flows via the parallel current path. At the same time contact K3 and hence the measuring circuit are closed (fig. 1). Only then is the main contact K1 closed and the operating current flows via the main current path (fig. 2). As the parallel current path owing to resistor R has a higher resistance than the main current path, no mentionable current continues to flow there. On K1 closing, K3 in the measuring circuit is reopened.

Fig. 1 Manual closing: K2 and K3 close

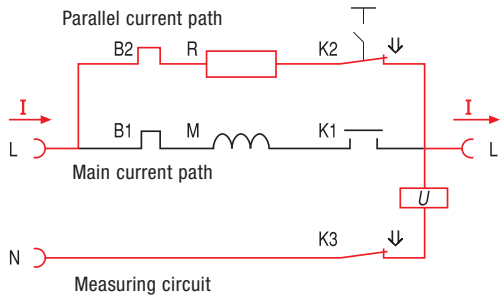
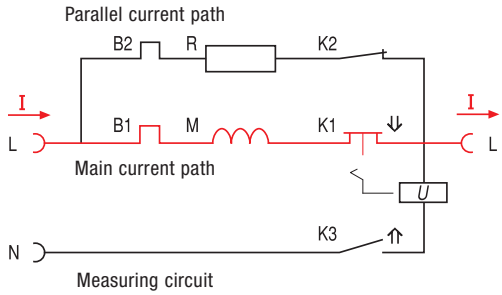
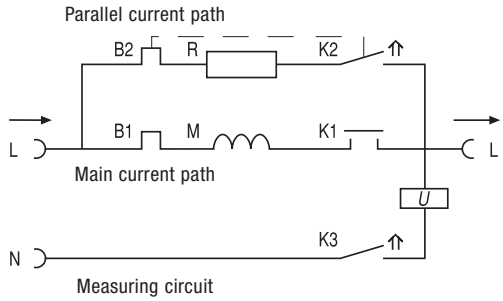


Fig. 2 No fault main contact:
K1 closes, K3 opens (K1-K2 closed)



Fault closure lockout (fig. 3)
If the MCB is closed onto an existing fault, the measuring circuit that measures the voltage between line and neutral at the output of the ElfaPlus S90,prevents the main contact K1 closing. The breaker can not be closed onto the fault and no high current can flow. After a short time contacts K1 and K3 are reopened due to the bimetal trip B2 and the current limited by resistor R in the parallel current path (maximum 5 times rated current) is interrupted.
This fault closure lockout thus protects the installation but also the operating personel.

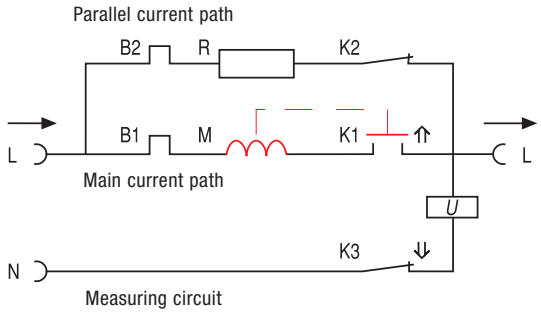
Fig. 3 Existing fault: K1 does not close. B1 opens K2 and k3 after max. 1s.



Selective fault tripping (fig. 4 and fig. 2)
If the selective circuit is switched-on (K1 closed) and a fault occurs downstream of an MCB, the fault current is interrupted either by the MCB alone or with the help of the operating main contact K1. Contact K2 remains closed, and current can still flow via parallel current path, even when the arc at the main contact K1 is quenched (fig. 4).
If the downstream MCB has isolated the fault from the installation, in the ElfaPlus S90 the main contact is reclosed (fig. 2). Loads lying parallel to the faulted circuit are immediatelly supplied with current, at first via the parallel current path and shortly after again via the main current path.

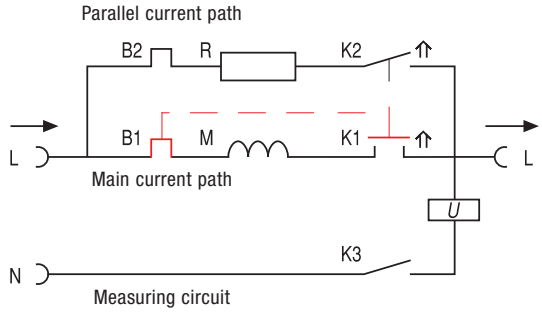
Fault upstream of MCB (fig. 4 and fig. 3)
If the fault occurs between the ElfaPlus S90 and the downstream MCB (or if some reasons a fault behind a miniature circuit breaker is not cleared by it), after quenching of the arc a current limited by resistor R still flows at the contact point K1 via the parallel current path (fig. 4) untill contact K2 is also opened due to the bimetal B2 (fig. 3)

Fig. 4 Fault while unit closed:
K1 opens and K3 closes



Opening on overload (fig. 5)
If an overload current flows fot too long, the bimetal trip B1 in the main current path operates and opens contact K1 and K2 in the main and parallel current paths.

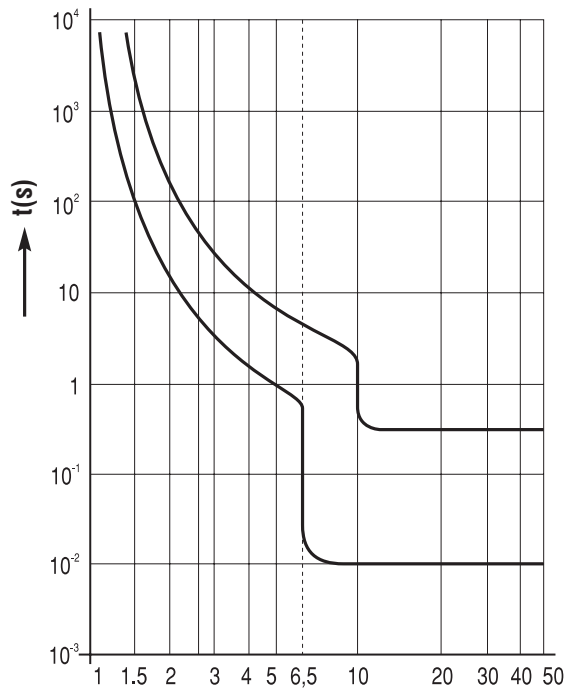
Fig. 5 Overload:
B1 opens and K1 and K2



Manual opening
On manual opening the contacts are opened not only in the main current path but also in the parallel current path (K1 and K2)

Tripping curve

Curve C according to EN/IEC 60898



Text for specifiers

MCB Series G60/100

- According to EN/IEC 60898 standard
- For DIN rail mounting according to DIN EN/IEC 50022; EN/IEC 50022; future EN/IEC 60715; IEC 60715 (top hat rail 35 mm)
- Grid distance 35 mm
- Working ambient temperature from -25°C up to +50°C
- Approved by CEBEC, VDE, KEMA, IMQ...
- 1 pole is a module of 18 mm wide
- Nominal rated currents are: 0.5/1/2/3/4/6/10/13/16/20/25/32/40/50/63 A
- Tripping characteristics: B,C,D,K
- Number of poles: 1P, 1P+N, 2P, 3P, 3P+N, 4P
- The short-circuit breaking capacity is: 3/4,5/6/10kA, energy limiting class 3
- Terminal capacity from 1 up to 35mm^2 rigid wire or 1,5 up to 25 mm^2 flexible wire.
- Screw head suitable for flat or Pozidriv screwdriver
- Can be connected by means of both pin or fork busbars on bottom terminals
- The toggle can be sealed in ON or OFF position
- Rapid closing
- Both incoming and outgoing terminals have a protection degree of IP20 and they are sealable
- Isolator function thanks to the printing Red/Green on the toggle.
- Maximum voltage between two phases; 440V~
- Maximum voltage for utilisation in DC current: 48 V 1P and 110 V 2P
- Two position rail clip
- Mechanical shock resistance 40g (direction x, y, z) minimum 18 shocks 5 ms halfsinusoidal acc. to IEC 60068-2-27
- Vibrations resistance: 3g (direction x, y, z) minimum 30 min. according to IEC 60068-2-6
- Extensions can be added on both left or right hand side
    - Auxiliary contact
    - Shunt trip
    - Undervoltage release
    - Motor operator
    - Panel board switch
- MCB's have a circuit indicator for easy circuit identification
- Add-on RCD can be coupled

MCB Series GT25

- According to EN/IEC 60947.2 standard
- For DIN rail mounting according to DIN EN/IEC 50022; EN/IEC 50022; future EN/IEC 60715; IEC 60715 (top hat rail 35 mm)
- Working ambient temperature from -25°C up to +50°C
- 1 pole is a module of 18 mm wide
- Nominal rated currents are: 0,5/1/2/3/4/6/10/13/16/20/25/32/40/50/63 A
- Tripping characteristics: B,C
- Number of poles: 1P, 2P, 3P, 4P
- The short-circuit capacity is: 10/15/25/50 kA
- Terminal capacity from 1 up to 35mm^2 rigid wire or 1,5 up to 25 mm^2 flexible wire
- Screw head suitable for flat or Pozidriv screwdriver
- Can be connected by means of both pin or fork busbars on bottom terminals
- The toggle can be sealed in ON or OFF position
- Rapid closing
- Both incoming and outgoing terminals have a protection degree of IP20 and they are sealable
- Isolator function thanks to the printing Red/Green on the toggle.
- Maximum voltage between two phases; 440V~
- Maximum voltage for utilisation in DC current: 48 V 1P and 110 V 2P
- Two position rail clip
- Mechanical shock resistance 40g (direction x, y, z) minimum 18 shocks 5 ms halfsinusoidal acc. to IEC 60068-2-27
- Vibrations resistance: 3g (direction x, y, z) minimum 30 min. according to IEC 60068-2-6
- Extensions can be added on both left or right hand side
    - Auxiliary contact
    - Shunt trip
    - Undervoltage release
    - Motor operator
    - Panel board switch
- MCB's have a circuit indicator for easy circuit identification
- Add-on RCD can be coupled

MCB Series EP100 UC

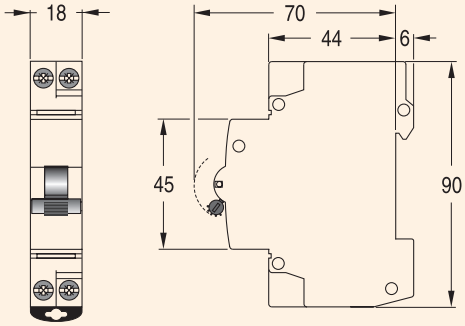
- According to EN/IEC 60898-2 standard
- For DIN rail mounting according to DIN EN/IEC 50022; EN/IEC 50022; future EN/IEC 60715; IEC 60715 (top hat rail 35 mm)
- Grid distance 35 mm
- Working ambient temperature from -25°C up to +50°C
- 1 pole is a module of 18 mm wide
- Nominal rated currents are: 0,5/1/2/3/4/6/10/13/16/20/25/32/40/50/63 A
- Tripping characteristics: B, C
- Number of poles: 1P, 2P
- The short-circuit breaking capacity is: 6 kA, "energy limiting" class 3
- Terminal capacity from 1 up to 35mm^2 rigid wire or 1,5 up to 25 mm^2 flexible wire
- Screw head suitable for flat or Pozidriv screwdriver
- Can be connected by means of both pin or fork busbars on top or bottom terminals
- The toggle can be sealed in ON or OFF position
- Rapid closing
- Both incoming and outgoing terminals have a protection degree of IP20 and they are sealable
- Isolator function thanks to the printing Red/Green on the toggle.
- Maximum voltage: 1P - 250 V ⎓
  2P - 440 V ⎓ . Poles in series
- Two position rail clip
- Mechanical shock resistance 40g (direction x, y, z) minimum 18 shocks 5 ms halfsinusoidal according to IEC 60068-2-27
- Vibrations resistance: 3g (direction x, y, z) minimum 30 min. according to IEC 60068-2-6
- Extensions can be added on both left or right hand side
  - Auxiliary contact
  - Shunt trip
  - Undervoltage release
  - Motor operator
  - Panel board switch
- MCB's have a circuit indicator for easy circuit identification
- Add-on RCD can be coupled

MCB Series Hti

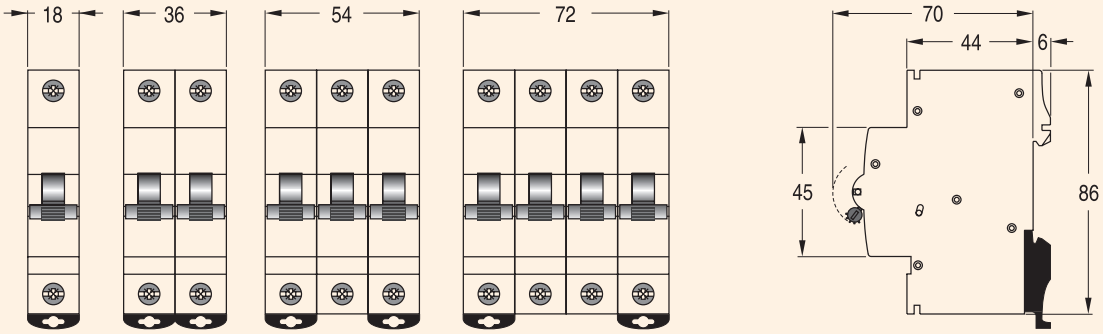
- According to EN/IEC 60947.2 standard
- For DIN rail mounting according to DIN EN/IEC 50022; EN/IEC 50022; future EN/IEC 60715; IEC 60715 (top hat rail 35 mm)
- Working ambient temperature from -25°C up to +50°C
- 1 pole is a module 1,5 module (27mm)
- Nominal rated currents are: 80/100/125A
- Tripping characteristics: B, C, D
- Number of poles: 1P, 2P, 3P, 4P
- The short-circuit capacity is: 10kA
- Terminal capacity from 2,5 up to 70mm^2
- The toggle can be sealed in ON or OFF position
- Both incoming and outgoing terminals have a protection degree of IP20 and they are sealable
- Isolator function thanks to the printing red/green on the toggle. It can be used as main switch
- Maximum voltage between two phases: 440V~
- Two position rail clip
- Mechanical shock resistance 40g (direction x, y, z) minimum 18 shocks 5 ms halfsinusoidal according to IEC 60068-2-27
- Extensions can be added
  - Auxiliary contact
  - Shunt trip
- Endurance:
  - Mechanical: 10.000 operations
  - Electrical: 4000 operations
- Add-on RCD can be coupled

Dimensional drawings

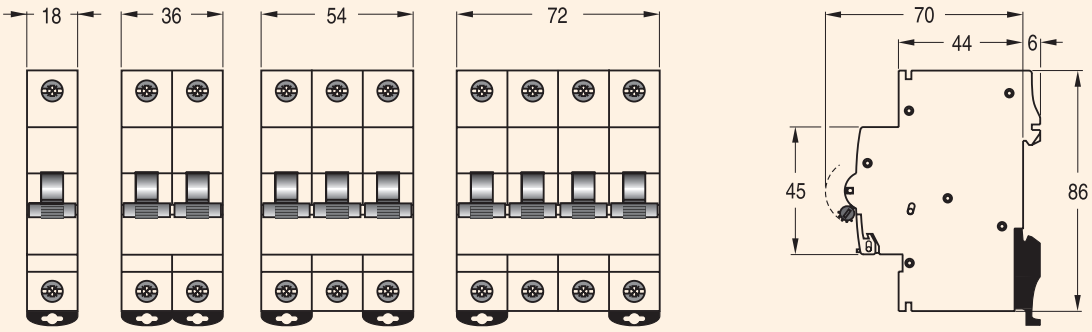
Miniature Circuit Breakers - Series C



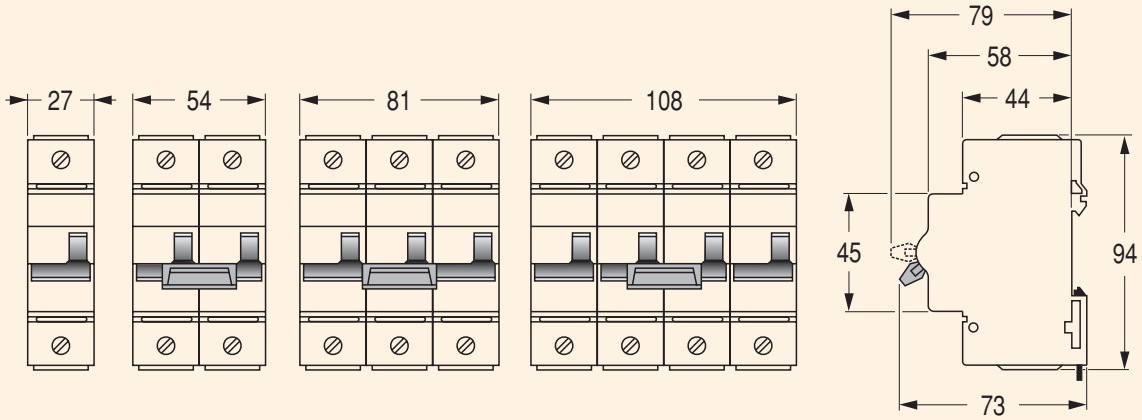
Miniature Circuit Breakers - Series G & GT



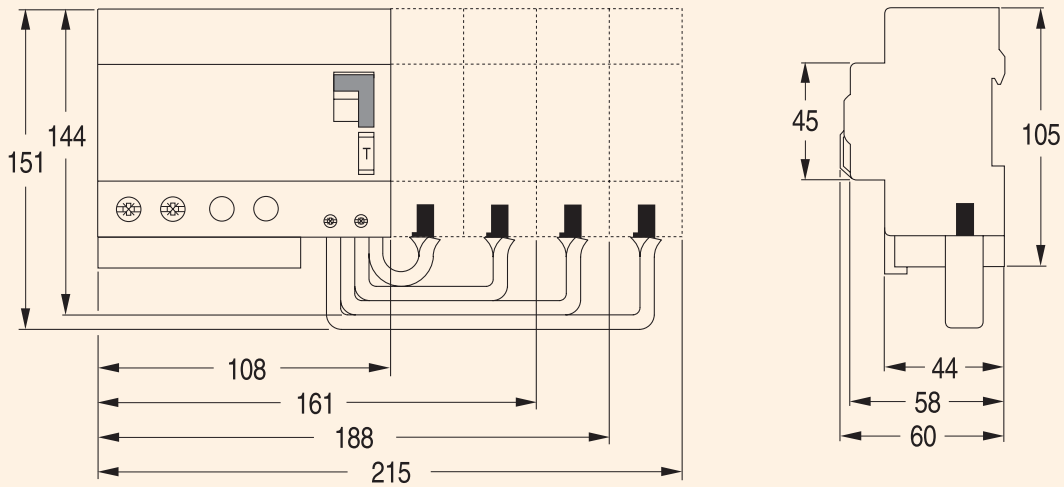
Miniature Circuit Breakers - Series EP100 UC



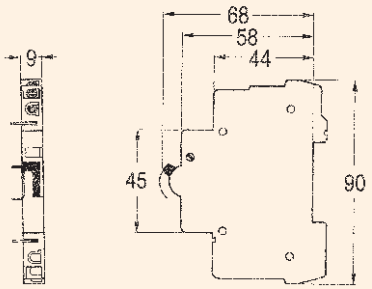
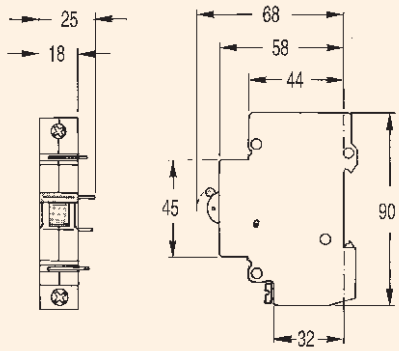
Miniature Circuit Breakers - Series Hti



Add-on RCD's for Series Hti



Auxiliary contact - Series Hti



Shunt trip - Series Hti