Technical essay

S800

The use of high performance devices in low voltage distributions

ABB

Convincing: Efficiency S800.

Not just B-C-D: The S800 range.
The extensive S800 range provides the right High Performance MCB for high rated breaking capacities and many tripping characteristics. The units of the S800S series, both AC and DC types, operate in a nominal current range of between 10 and 125 A, covering short circuit requirements of up to 50 kA. For applications involving up to 36 kA – and of course those between 10 and 125 A – the S800N is the ideal solution.

Compact performance: The selectivity and back-up characteristics.
The high rated breaking capacity of 50 kA allows electric systems to be configured and operated in a simple and safe manner. Convincing selectivity characteristics for upstream power switches, such as the ABB Tmax, and excellent back-up protection for downstream MCBs, such as the ABB system pro M compact and smissline, make planning so simple. The compact dimensions enable a space saving form of energy distribution.

Does not let go: The interchangeable terminal adapter.
The standard version with interchangeable terminal adapter[1] guarantees a high level of flexibility and convenience. When placing orders, you can choose between cage-type terminal connections or ring-lug cable connections. Incorrect terminal attachment of the connections is reliably prevented by the «incorporated terminal shutter» integrated in the terminal body; this guarantees rapid and safe attachment of the connections.

On the safe side: Operating status display.
The trip position display[1] rapidly indicates the reason for the trip and shows clearly whether the High Performance MCB tripped in response to a thermal-magnetic trigger or as a manual action. This contact indicator provides an additional means of detecting the operating condition of the pair of contacts.

Simple and flexible: Accessories fitted by the customer.
A wide range of accessories allows the High Performance MCB to be added to in an individual way.
- The 9 millimetre wide auxiliary contact is fitted with two potential-free change-over contacts and a test function.
- Also its 9 millimetres in width, the combined auxiliary/signal contact provides two potential-free change-over contacts (one auxiliary contact and one signal contact), test functions for the auxiliary and signal contacts as well as a reset function for the signal contact.
- The two- to four-pole DDA block, which can be mounted on the side, is available with rated sensivities of between 30 mA and 1 A. You can of course select between AC and A types. As you would expect of ABB: selective RCD units and those with short delay are also available.
- It goes without saying that undervoltage and operating current triggers are available in a wide range of operating voltages.
- Separating neutral of up to 63 A, rotary drives with ergonomic rotary handles, busbars and locking devices round off the extensive product range.

Setting new standards: ABB quality.
Electrosuisse, a member of the European LOVAG, has product certification in accordance with IEC60947-2 and EN/IEC60898-1. The S800 High Performance MCB also comply with key international standards (IEC60947-2; EN 60898-1; UL489) and approvals (CCC; GOST-R; LR; DNV; RINA).

[1] *Only for S800S*

Hartmut Zander*

The use of high performance devices in low voltage distributions

As in the past, in low voltage distributions mainly fuses with high rupturing capacity (HRC) and, in the case of high rated currents, circuit breakers are used as overcurrent protection for downstream equipment. Due to their limited rated currents and because their short circuit breaking capacity is considered too low, miniature circuit breakers are used almost exclusively in electric distributions for the protection of final circuits. This is the case despite the fact, that today the industry produces miniature circuit breakers with rated currents of over 100 A and with rated short-circuit breaking capacities of up to 50 kA – so-called High Performance Miniature Circuit Breakers*. These are most suitable for use in low voltage distributions. They combine the advantages of easy and safe manual switching operation with low initial investment costs. This article is intended to demonstrate the possibilities regarding the use of these high performance devices in low voltage distributions. In particular the questions of selectivity to upstream and the back-up protection to downstream overcurrent protective devices are examined.*

High service requirements of low voltage distributions

The requirements of low voltage distributions by the users are well-known:

- In buildings used for industrial or commercial purposes, as high a percentage as possible of the interior space should be available for rent or sale. Building equipment and systems should therefore be as compact as possible and occupy only a small portion of the interior space.
- Down time and out of order of important building systems should be as short as possible. A high degree of availability and reliability is required of the electrical equipment. This calls for, among other things, clear fault indication and that service can quickly be restored after a malfunction has been eliminated – where possible even by remote control.
- The electrical equipment should be easy and safe to operate. This means, that switching and operation of the protective devices should be able to be handled by instructed persons or even by electrical laymen.
- And finally, the user of such equipment expects low overall operating costs (maintenance and repair costs).

These basic requirements of the user are enjoying increased importance in planning and layout of electrical systems in buildings. For these reasons the consultants responsible for low voltage distributions are advised to design the systems in accordance with these requirements and to select the most modern protective and switching devices available.

Example of a complex low voltage distribution system

Today, buildings which are used for industrial or commercial purposes can require a relatively high amount of electrical energy and are in this case supplied by way of the public supply network medium-voltage power grid, possibly via the building’s own medium-voltage transformer station. Fig. 1 shows an example of a low voltage distribution system of this sort.

Three transformers with a power rating of 630 kVA each are supplied by the public 10 kV network. The main busbar (MB) is supplied via three air circuit breakers (ACBs). Individual parts of the building or areas with large energy demand are supplied by way of moulded case circuit breakers (MCCBs), the rated currents of which are selected in accordance with the requirements. Sub-distribution panels (SDP) are installed in the areas of large energy demand as the second-to-last distribution level, in which the protective and switching devices for the supply of the electric distribution are centralised. The electrical panel boards (PB) which are installed in each storey contain, among other things, the overcurrent protective devices for the final circuits. As a general rule, these are protected against overload and short circuit by way of miniature circuit breakers (MCBs). Tacking into account the operational requirements outlined at the outset, the question which overcurrent protective devices should be used in the sub-distribution panels is of prime interest. This will of course mainly depend on the necessary electrical requirements such as rated current and rated short-circuit breaking capacity.

* *Hartmut Zander,*
Engineering Consultant
ABB Switzerland Ltd
CMC Low Voltage Products

Using a simple short-circuit current calculation program, the maximum three pole short-circuit currents occurring at each busbar location and in the final circuit were derived for the case, that the isolater switches in the main busbar (MB) are closed and all three transformers are feeding the main busbar in parallel. This surely improbable, but still possible case determines the value of the short-circuit breaking capacity required for the protective devices at the individual distribution levels.

The overcurrent protective devices to be used in the sub distribution panels (SDP) in accordance with these calculations must possess a breaking capacity of at least 41 kA. The rated currents are expected to be around 100 A. Thus it appears that both HRC fuses and circuit breakers are suitable to be used as overcurrent protective devices. If however, the operational requirements concerning modern low voltage distribution systems which were outlined at the outset are taken into account, overcurrent protective devices with special features, the so-called High Performance Miniature Circuit Breakers (HPMCB, Table 1), should be selected.

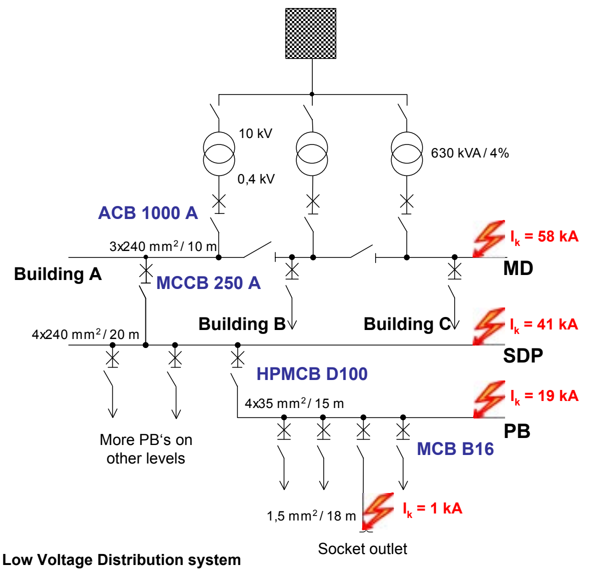

Fig. 1
Example for Low Voltage Distribution system

These are overcurrent protective devices in the usual outline with bimetal trip for the overload protection and electromagnetic trip for the short-circuit protection. Due to special design features, for example by way of a double break main contact system, these overcurrent protective devices have extremely short fault current interruption times, to reduce considerably the amount of let through energy in case of a short-circuit, and are therefore able to safely handle prospective (uninfluenced) short-circuit currents of up to 50 kA. These overcurrent protective devices are designed and manufactured by ABB for rated currents up to 125 A. They are available in single pole or multipole versions with the standardised trip characteristics and can be equiped with a wide range of accessories. Such overcurrent protective devices with special features (Fig. 2) are highly suitable for use in low voltage distribution systems in buildings, such as those described herein.

Looking at the design of the distribution system in accordance with Fig. 1, which now appears as a complete fuse-less system when using High Performance Miniature Circuit Breakers, thereby assuring the operational requirements of a high degree of availability and easy operation, two important questions remain:

Fig. 2
S800 High Performance MCB
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1. Is the selectivity of the series connected overcurrent protective devices assured?

2. Is the overcurrent protective device in the final circuit protected by the upstream High Performance Mniature Circuit Breaker in the event, that the short-circuit occurs not at the end of the line – at the socket outlet – but, for instance at the load side terminal of the miniature circuit breaker (MCB) or at any point further down the line?

Abbreviation	Meaning
ACB	Air Circuit Breaker Open-design circuit breaker
MCCB	Moulded Case Circuit Breaker Compact circuit breaker – all active parts are integrated in a moulded casing
HPMCB	High Performance Miniature Circuit Breaker Overcurrent protection device with special features
MCB	Miniature Circuit Breaker Overcurrent protection device

Table 1 **Important abbreviations and their meanings**

Selectivity in case of an overcurrent in the final circuit

The selectivity of in series connected overcurrent protective devices in principal exists when their trip characteristic curves, which run within fixed time/current limits, neither touch nor intersect each other over their whole range. In the event of an overload, selectivity is obtained by different rated currents of the series connected protective devices. In general at least a factor of 1.6 against the direction of energy flow is considered sufficient. However, if necessary the various trip characteristics or operating class of the series connected protective devices must be taken into account.

The short-circuit selectivity cannot however be achieved by a simple difference of the rated currents of the series connected overload protective devices. At most this is a possibility in the event that HRC fuses of the same utilisation categoriy and of the same manufacturer are series connected. The selectivity of mechanical circuit breakers, e.g. for example moulded case circuit breakers or miniature circuit breakers, has certain limits regarding selectivity in case of a short circuit. Among other things this is due to the inertia of the moveable parts masses – even if small - which have to be put in motion when these devices operate. Due to this mass inertia the interruption times cannot be shortened indefinetly. The mass inertia of the moveable elements defines the so-called inherent operating delay. It cannot be decreased. In the area of inherent operating delay the time/current dependent behaviour of a mechanical circuit breaker is lost.

Fig. 3 highlights this problem. The principle trip characteristic curves of the overcurrent protective devices are shown in the time/current diagram. The curved zone of each of the trip characteristic curves represents the tripping range of the bimetal operation. The lower linear zone of the trip characteristic curves describes the tripping behaviour of the electromagnetic operation. It can be seen, that interruption times at high short circuit currents are only minimally shorter than those obtained within the operating range of the electromagnetic release.

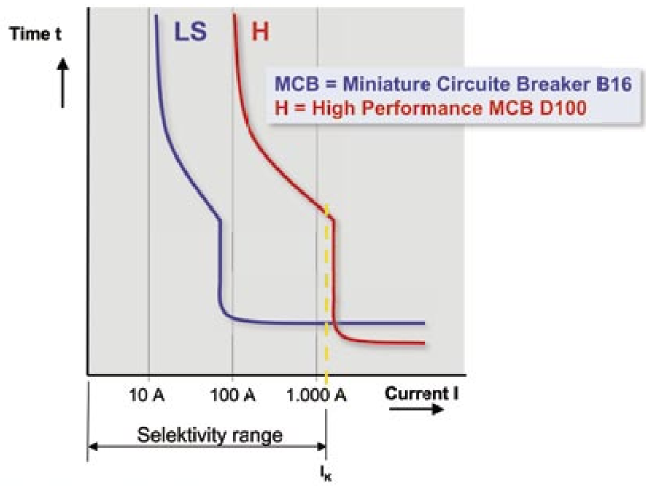


Fig. 3 **Specification of current selectivity**

High Performance Miniature Circuit Breaker (HPMCB) and the final circuit's miniature circuit breaker are series connected as in the example in Fig. 1. Due to the difference of the rated currents of the two protective devices, i.e. 16 A to 100 A against the direction of energy flow, the full selectivity of both protective devices is assured in the overload area (curved zone of the trip characteristic curves), as the two curves neither touch nor intersect each other.

In the range of operation of the electromagnetic trip, i.e. the zone in which the time/current characteristic curves run almost horizontally, the trip characteristics intersect in the case of higher currents. Above this point of intersection a selective interruption of the short-circuit current can not be guaranteed. The high performance device which is connected upstream will, from the point of intersection onwards, in any case interrupt the fault "more quickly" than the miniature circuit breaker of the final circuit.

The selectivity limit can however be influenced within a certain degree depending on the selection of the overcurrent protection device. The range of selectivity shown in Fig. 3 is larger or smaller depending on the difference of the rated currents and the difference of the trip characteristics of the series connected overcurrent protective devices. In order to achieve maximum selectivity, up to high short circuit currents, it is advisable to keep the difference between the rated currents as large as possible and to select for the upstream connected High Performance Miniature Circuit Breaker an electromagnetic release threshold as high as possible.

In the example a rated current of 100 A and a D-type trip characteristic was selected for the High Performance Miniature Circuit Breakers. The final circuit's miniature circuit breaker has a rated current of 16 A and a B-type trip characterisitic. If selected in this manner, a selectivity – in this case we are talking about a "current selectivity" – is guaranteed up to a short-circuit current in excess of 1000 A. Thus a selective operation can be expected in the case of a three pole short-circuit current of approximately 1000 A generated at the final circuit's socket outlet, as in the example.

As the current of selectivity limit remains significantly under the breaking capacity of the downstream miniature circuit breaker – it amounts to 10 kA – we are in this case talking about a “partial selectivity”. In view of optimum service continuity of the electrical supply, this “partial selectivity” is absolutely sufficient in most distribution systems, even in the case of a fault. The prospective short-circuit currents involved in a worst case condition only occur in less than 1% of all faults.

Selectivity

exists between series connected overcurrent protective devices, e.g. miniature circuit breakers (MCBs) when, in the event of an operational overload or in the event of a short-circuit, only the overcurrent protective device which is nearest to the fault location trips.

However, the selection of the rated current and the trip characteristics for the upstream High Performance Miniature Circuit Breakers from the point of view of short-circuit selectivity also defines the cable cross sectional area between the sub-distribution panel and the panel boards in each storey (see Fig. 1). In order to ensure that the overcurrent protection is guaranteed in all conditions, this cable may need to have a larger cross-sectional area as this may be necessary for reasons of the current carrying capacity or by considering the maximum allowable voltage drop. In terms of optimising the equipment costs consideration between rated current and trip characteristic of the upstream High Performance Miniature Circuit Breakers is therefore advisable.

If, as in the example, short circuit-currents of around 1000 A in the final circuit are to be expected, then it would be sufficient to design the range of selectivity up to the expected current value in accordance with Fig. 3. Table 2 contains co-ordination data of High Performance Miniature Circuit Breakers of the S800 type from ABB company connected upstream and miniature circuit breakers with normal trip characteristic and rated currents downstream. It can be seen, that for a 50 A High Performance Miniature Circuit Breaker with D-type characteristic, the current of selectivity limit is 1100 A. A wider range of selectivity is achievable by using a HPMCB with 63 A rated current (current of selectivity limit 1400 A).
It should then still be verified whether this rated current lies above the expected operating current in the line feeding the electrical panel boards ($I_B < I_N$). The manufacturers of the protective devices such as ABB company supply either in their product catalogs or on request informations for selectivity co-ordination similar to those in Table 2.

Downstream MCB		Upstream S800 S / N HPMCB					
Characteristics		D					
	Rated current in A	40	50	63	80	100	125
B, C	10	800	1100	1400	2800	3900	7400
B, C	13	800	1100	1400	2500	3300	5600
B, C	16	800	1100	1400	2500	3300	5600
B, C	20	800	1100	1300	2300	3000	4700
B, C	25	800	1100	1300	2300	3000	4700
B, C	32	no selectivity	900	1100	1900	2400	3700
B, C	40	no selectivity	no selectivity	1100	1900	2400	3700
B, C	50	no selectivity	no selectivity	no selectivity	1500	1900	2300
B, C	63	no selectivity	no selectivity	no selectivity	no selectivity	1700	2300
		Current of selectivity limit in A					

Table 2 **Co-ordination table “Selectivity” HPMCB to MCB**

Some of the “current of selectivity limit” values contained in these co-ordination tables lie considerably above the individual threshold value of the electromagnetic trip of the upstream High Performance Miniature Circuit Breakers. The highest expected current of selectivity limit in case of a D-type trip characteristic would correspond to the highest permissible trip value of the magnetic release, e.g. twenty times rated current. However the current of selectivity limit in fact lies considerably above the maximum operating value of the magnetic trip, as can be seen from Table 2. The reason for this is, that at the moment the contacts separate inside the miniature circuit breaker which protects the final circuit, an electric arc is drawn between the contacts which considerably limits the value of the short-circuit current, even before the magnetic release of the High Performance Miniature Circuit Breaker is activated. It has to be noted, that the information given in the co-ordination tables are “prospective” values. As the current is limited at the instant of the contact separation, the “prospective” current of selectivity limit can be set higher. These facts were confirmed in numerous practical laboratory tests.

Back-up protection for the final circuit

The considerations outlined above concerning short-circuit selectivity made up to now assume that the short-circuit occurs at the end of the line feeding the final circuit, that is, at the socket outlet. In such a fault condition the three pole short-circuit current amounts to approximately 1000 A, as calculated in the example. If however the point of fault is located at the load side terminal of the miniature circuit breaker (MCB) protecting the final circuit or somewhere along the line feeding the socket outlet, then short-circuit currents considerably in excess of the breaking capacity of the miniature circuit breaker of, for example 10kA, are to be expected. In this case the upstream overcurrent protective device – e.g. the High Performance Miniature Circuit Breaker – must ensure both the protection of the miniature circuit breaker as well as the protection of the downstream equipment affected by the short-circuit, for example the line of the final circuit.

This protective function is described as “back-up protection“. When back-up protection is required, then of course, selectivity between the series connected overcurrent protective devices is no longer assured. The protection of important equipment and facilities has priority over service continuity.

Back-up protection

of series connected overcurrent protective devices, e.g. miniature circuit breakers, occurs when, in the event that the breaking capacity of the miniature circuit breaker directly upstream from the fault location is exceeded, the upstream circuit breaker, e.g. a High Performance Miniature Circuit Breaker, interrupts and takes over the protection of the overstressed miniature circuit breaker and of the faulty electric circuit. In this case both overcurrent protective devices will interrupt. However, both are still fully operational even after having cleared the fault.

In our example of a low voltage distribution system (Fig. 1), in the event of short-circuit currents above the selectivity limit – that is, from approximately 3300 A upwards - the High Performance Miniature Circuit Breaker (HPMCB) in the sub-distribution panel interrupts and takes over the short-circuit protection function of the downstream equipment up to its rated breaking capacity of 50 kA. However, as described the miniature circuit breaker in the final circuit has a breaking capacity of 10 kA. Back-up protection by the upstream high performance device is not really required in the case of short-circuit currents just above 3300 A. However, the protective function occurs automatically as the result of the selectivity limit.

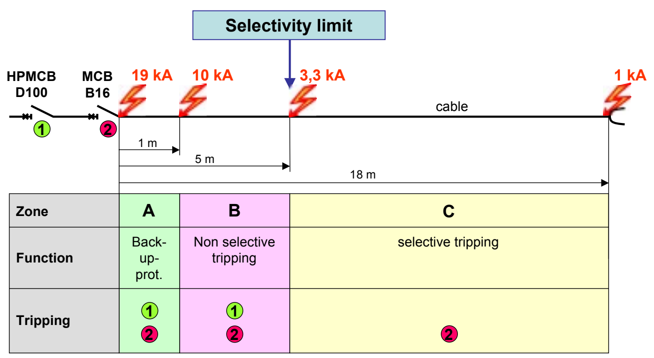


Fig. 4 Short circuit at the end of the line feeding

Let us now have a look at the conditions of the short-circuit protection at various points of fault location in the final circuit. In the event of a short-circuit – we shall continue to consider only three pole bolted short-circuits – at the load side terminals of the miniature circuit breaker which is protecting the final circuit, a short-circuit current of approximately 19 kA has to be expected. Of course, the miniature circuit breaker is overstressed to interrupt such a fault current due to its rated breaking capacity of 10 kA. The upstream overcurrent protective device – our High Performance Miniature Circuit Breaker – must take over the task to interrupt the fault current as back-up protection. It will not have any difficulties to handle such short- circuit currents. This also applies for fault currents in the zone “A” of the electric circuit diagram (Fig. 4).

If the short-circuit takes place approximately one metre down the line (in the direction of energy flow), the value of the three pole short-circuit current at this point only just amounts to 10 kA due to the impedance of the wire, which of course has a cross sectional area of only 1.5 mm^2. The task of clearing this fault could now be taken over by the final circuit's miniature circuit breaker without any problem. Back-up protection would not be required. However the expected short-circuit currents on this location – zone "B" according to Fig. 4 – exceed the current of selectivity limit of 3300 A. Thus the two upstream overload protective devices will trip and the fault will be cleared.

Thus approximately the first five metres down the line there is no selectivity in the event of a three pole short-circuit. This length would in practice in most cases correspond to the length of the supply line to the socket outlet or other equipment. In this zone there is only a very small risk of a mechanical damage of the line. The occurrence of a three pole short-circuit during normal operation is therefore quite negliable for this part of the supply line, meaning that the absence of selectivity in case of such a fault does not necessarily pose a real crucial issue of service continuity. In addition it should also be noted that most of the short-circuits that occur are single pole short-circuits, that is, the short-circuit of a line conductor with protected earth or the neutral conductor. These single pole short-circuit currents are considerably lower than the three pole fault currents. For such a case also the lengths of the zones of no selectivity, "A" and "B" of the supply line in accordance with circuit diagram of Fig. 4 are shorter, meaning that the possibility of a non-selective fault interruption is further reduced.

Due to the partial selectivity described (current selectivity) – the selectivity limit lies at approximately 3300 A – the high performance device interrupts the short-circuit occurring in the zones "A" and "B" in accordance with Fig. 4. This protection device does not, however, fulfill the requirements of energy limitation category 3. But it does not have to, as it has been designed for other short-circuit currents. If the 100 A High Performance Miniature Circuit Breaker with D-type characteristic had to directly protect the 1.5 mm^2 supply line in the event of a 10 kA short-circuit, the wire insulation would be stressed with a let through energy of 56,000 A^2s. This value can be determined from the let through energy curves in Fig. 5.

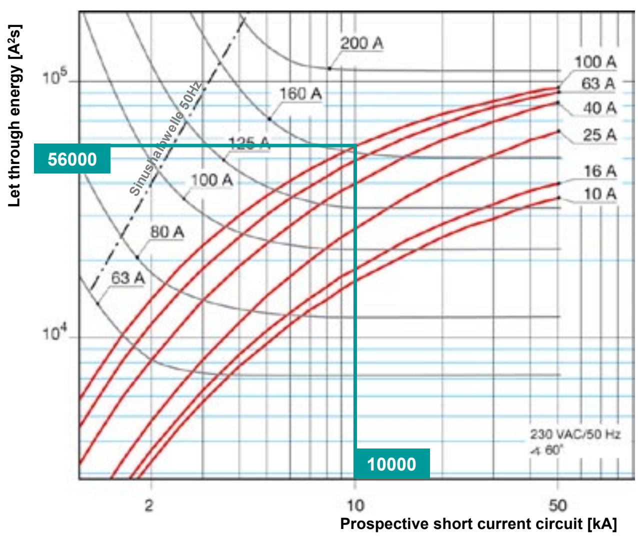


Fig. 5 **S800 Let through energy curves (selective rated currents)**

However, effective short-circuit protection is, in accordance with IEC 60364-4-43, only possible if the let through energy (I^2t) in case of a short-circuit is less than the maximum allowable short-time energy (k^2S^2) for the wire insulation to be protected:

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

The let through energy of the short-circuit protective devices can be obtained from the let through energy curves or tables provided by the individual manufacturer. The allowable short-time energy k^2S^2 for the line to be protected can be determined from the so-called rated short-time current density k and from its cross sectional area S. Values for k are given for example in IEC 60364-5-54. The PVC-insulated copper line in the final circuit to be protected in our example possesses a permissible k^2S^2 of approximately 29.800 A^2s.

We can therefore establish that in the case of a short-circuit current of 10 kA the upstream High Performance Miniature Circuit Breaker would not be able to protect effectively the line in the final circuit. It is only the joint operation of miniature circuit breakers (MCB) and upstream High Performance Miniature Circuit Breakers (HPMCB) which, due to their characteristics enable them to limit the current and therefore the let through energy. This allows effective short-circuit protection of the entire downstream system. However, in this case selectivity – as already described – is no longer assured above 3300 A, the current of selectivity limit.

Selectivity and back-up protection to the main distribution

Let us now take a look at the overcurrent protective device connected upstream from the High Performance Miniature Circuit Breakers (HPMCB) and consider their selectivity and back-up protection behaviour.

Generally, a circuit breaker is connected upstream from the High Performance Miniature Circuit Breakers in the main distribution to take care of the customer requirements stated at the outset. In our example we have chosen a moulded case circuit breaker (MCCB) with a rated current of 250 A. It corresponds to utilisation category B and is therefore especially designed for selectivity towards downstream overcurrent protective devices.

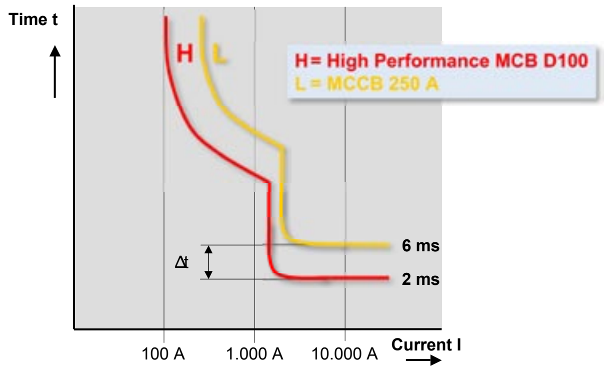


Fig. 6 **Specification of time selectivity**

With regards to selectivity in the case of an overload it can be said that full selectivity can be expected due to the difference in rated current of the downstream High Performance Miniature Cicuit Breaker of 100 A. There are no points of intersection between the two thermal trip characteristics.

If we consider the shape of the two time/current characteristic curves of both series connected protective devices in Fig. 6, we can see, that also in the zone of operation of the electromagnetic release no points of intersection between the two curves exist. As a result, selectivity is also guaranteed in the case of a short-circuit at least to the point at which the maximum breaking capacity of the High Performance Miniature Circuit Breaker is reached (e.g. 50 kA).

This selectivity is achieved by way of the considerably different interruption times of the protective devices in the event of a short-circuit. While the High Performance Miniature Circuit Breaker is able to interrupt short-circuit currents within a total clearing time of approximately 2 ms due to the relatively small masses of the movable parts, a moulded case breaker usually requires considerably longer, for example at least double the interruption time of the High Performance Miniature Circuit Breaker. This time difference, shown in Fig. 6 as t, is used for clearing the fault selectively. This type of selectivity is called „time selectivity". If a moulded case circuit breaker with short-circuit trips which are able to be time-set is used in the main distribution, this time selectivity can be directly set with the necessary values.

In our example the moulded case circuit breakers (MCCB) in the main distribution and the High Performance Miniature Circuit Breakers (HPMCB) in the sub-distribution panels are selective in case of a short-circuit up 50 kA, the breaking capacity of the High Performance Miniature Circuit Breaker. The manufacturers of the protective devices supply co-ordination tables which allow the design engineer to choose overcurrent protective devices in view of their short-circuit selectivity. Table 3 shows an example of such a co-ordination table.

Downstream HPMCB S800		Upstream MCCB Typ Tmax-T3, N or S, I_u = 250 A					
Characteristics	Rated current / default values	80 A	100 A	125 A	160 A	200 A	250 A
B, C, D, K	32	7.5	10	20	36	36	50
	40		10	20	36	36	50
	50			15	36	36	50
	63				36	36	50
	80		No selectivity			36	50
	100						50
	125						50
		Current of selectivity limit in kA					

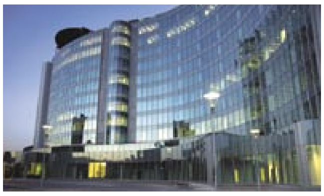
Table 3 **Co-ordination table "Selectivity" MCCB to HPMCB**

The question of the upstream moulded case circuit breaker providing back-up protection for the High Performance Miniature Circuit Breakers in the sub-distribution panels is of no importance in our example. In accordance with the short-circuit current calculation, at the point of installation of the high performance device a maximum three pole short-circuit current of 41 kA occurs. The High Performance Miniature Circuit Breaker with its breaking capacity of 50 kA is capable to interrupt any possible short-circuit currents. Special consideration regarding back-up protection is therefore not required.

Summary

High Performance Miniature Circuit Breakers, that are miniature circuit breakers with especially high interrupting capacity, excellent selectivity and energy limiting properties, are particularly suitable to be used as protective devices for overload and short-circuit protection in low voltage distribution systems. Anywhere a large amount of electric power has to be distributed inside a big building, High Performance Miniature Circuit Breakers are recommended to be used in the sub distribution panels. Rated currents of up to 125 A and rated breaking capacities of up to 50 kA fulfill the normal requirements at this distribution level. The demands of today's users of electrical equipment, such as small distribution panel size, combined with low investment costs, high availability, simple and safe operation together with low maintenance costs are fulfilled in an excellent way. The use of HRC fuses in low voltage distribution systems is no longer necessary. In many cases, possibly more expensive moulded case circuit breakers can be substituted with great advantage by using High Performance Miniature Circuit Breakers.

Versatile: The potential applications.



Commercial buildings.

Airports, hospitals, office blocks: wherever there are large numbers of people coming and going, reliable power supplies are of particular importance. For example in the International Financial Center «101» in Taipei, the world's highest office block where around 10 000 people work or in Hartsfield-Jackson Atlanta International Airport (USA) through which more than 80 million passengers pass every year. High Performance MCB such as the S800 ensure that personal injury and damage to property is avoided in the event of short circuits.

Power stations.

Virtually nothing runs without electricity. With a total of more than 3 400 000 megawatts of power, power stations around the globe ensure that the world keeps moving. High Performance MCB such as the S800 will protect your infrastructure – and therefore all your staff and machines involved in the production of electricity.

The chemical and petrochemical industry.

The chemical and petrochemical industry contributes significantly to everyday modern life. Whether you think of health (medicines, diagnostics), food (fertilisers, plant care products, additives), clothes (dyes, fibres) or mobility (fuel) – their products ensure our quality of life and jobs. Over 2 million in the European Union alone. High Performance MCB such as the S800 safeguard production output.

Transport systems.

The increasing levels of performance provided by rail, boat and machine means ever higher short circuit currents. Reliable and powerful protection for people and property is therefore needed. High Performance MCB such as the S800 provide this protection. For example on the «Queen Mary II», the world's largest passenger ship, where 2500 kilometres of electrical cables have been laid – for 80 000 lights, 3000 telephones, 8800 loudspeakers, 5000 fire detectors and 8350 automatic sprinkler systems.

IT and telecommunications industry.

Communication links people, creates jobs and makes everyday life more interesting. Our lives revolve around communication. IT and telecom specialists around the world are tirelessly looking for ways to make the exchange of data a simpler process. For example, calls are made on millions of mobile phones: by around 1.5 billion people around the world in 2004. High Performance MCB such as the S800 protect the infrastructure of the IT and telecoms industry so that information can flow unhindered. Anytime. Anywhere.

Belgium
ABB ELECTRO n.v.
Hoge Wei, 27
1930 Zaventem
Belgium
Telephone +32 (0) 27 18 63 11
Telefax +32 (0) 27 18 66 66

www.abb.be

Brasil
ABB Ltda
av. dos Autonomistas, 1496
06020-902-Osasco-SP
Brasil
Telephone +55 (0) 80 00 14 91 11
Telefax +55 (11) 36 88 99 77

www.abb.com.br

Czech Republic
ABB s.r.o.
Herspická 13
61900 Brno
Czech Republic
Telephone +420 54 31 45 50 3
Telefax +420 54 32 43 48 9

www.abb.cz/elsynn

Denmark
ABB AS
Meterbuen 33
2740 Skovlunde
Denmark
Telephone +45 44 50 44 50
Telefax +45 44 50 44 60

www.abb.dk

Finland
ABB OY
Domestic Sales
P.O. Box 182
00381 Helsinki
Finland
Telephone +358 10 22 20 00
Telefax +358 10 22 22 91 3

www.abb.fi

France
ABB Entrelec
300 rue des Prés Seigneurs
ZA La Boisse – BP 90145
01124 Montluel Cedex
France
Telephone +33 (0) 437 40 40 00
Telefax +33 (0) 437 40 43 01

www.abb.fr

Great Britain
ABB Limited
Grovelands House
Longford Road
Exhall, Coventy, CV7 9ND
England
Telephone +44 (0) 24 76 36 85 00
Telefax +44 (0) 24 76 36 44 99

www.abb.com/lowvoltage

Ireland
Asea Brown Boveri Ltd.
Belgrad Road, Tallaght
Dublin 24
Ireland
Telephone +35 31 40 57 30 0
Telefax +35 31 40 57 33 2

www.abb.com/lowvoltage

Italy
ABB SACE S.p.A.
Line Protection Devices
Viale dell'Industria, 18
20010 Vittuone (MI)
Italy
Telephone +39 02 90 34 1
Telefax: +39 02 90 34 76 09

www.abb.it

Netherland
ABB b.v.
Automation Products
Marten Meesweg 5
3068 AV Rotterdam
Postbus 301
3000 AH Rotterdam
Netherland
Telephone +31 (0) 10 40 78 91 1
Telefax +31 (0) 10 40 78 09 0

www.abb.nl

Norway
ABB AS Automation Technology
Products Division
P.O. Box 797 Brakeroya
3002 Drammen
Norway
Telephone +47 32 24 80 00
Telefax +47 32 24 79 34

www.abb.no

Russian Federation
ABB Industrial & Building Systems Ltd.
23 Profsojuznaya St.
117418 Moscow
Russian Federation
Telephone +7 (095) 91 39 69 6, 96 02 20 0
Telefax: +7 (095) 91 39 69 5
E-mail: ruibs@ru.abb.com

www.abb.ru

Spain
ABB Automation Products, S.A.
c/Torrent d'Olla, 220
08012 Barcelona
Spain
Telephone +34 93 48 42 10 4
Telefax +34 93 48 42 20 1

www.abb.es

Sweden
ABB Automation
Technologies Cewe Control
Muturgräd 20
72161 Västeras
Sweden
Telephone +46 (0) 21 32 07 00
Telefax +46 (0) 21 12 60 01

www.abb.se

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ABB Switzerland Ltd.
CMC Low Voltage Products
Fulachstrasse 150
CH-8201 Schaffhausen
Telephone +41 (0)58 586 41 11
Telefax +41 (0)58 586 42 22
E-mail: cmc@ch.abb.com

www.abb.ch