DORMAN SMITH

Technical Data & Applications

OVER 130 YEARS OF ELECTRICAL EXCELLENCE

DORMAN SMITH

Dorman Smith Switchgear Limited

With over 130 years of experience in switchgear design and production Dorman Smith Switchgear Limited continues to provide high quality equipment for low-voltage electrical distribution and circuit protection.

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Compliance with International Standards

Dorman Smith branded products comply with internationally recognised technical and quality standards to ensure that each product is fully capable of meeting the relevant standard requirements for its intended use.

The IET Wiring Regulations (BS 7671) address the "Requirements for Electrical Installations" and dictates that all relevant products must comply with applicable British, International or Harmonised Standards according to the intended installation and application of the equipment. The BS 7671 document is commonly referred to as 'The Wiring Regulations'.

Products are type tested, manufactured, routinely tested and assembled in accordance and compliance with a number of relevant Harmonised Standards recognised by the electrical industry.

A Harmonised Standard is a European Standard formally presented by the European Committee for Electrotechnical Standardisation, CENELEC, to the European Commission and published in its official journal. These documents are denoted by the prefix EN (European Norm).

The products listed within this catalogue conform to appropriate electrical and mechanical standards as follows:

• MCB Distribution Boards	EN 61439-3
• Panel Boards	EN 61439-2
• MCBs	EN 60898
• MCCBs	EN 60947-2
• Switches	EN 60947-3
• RCCBs	EN 61008
• RCBOs	EN 61009
• Contactors	EN 61095

In addition to the above, and where appropriate, Dorman Smith branded products also comply with the relevant requirements of the standard for protection against physical, mechanical and liquid ingress as follows:

• Ingress Protection	EN 60529

Standard Terminology

The Harmonised Standard EN 60898 and the IET Wiring Regulations (BS7671) contain references to a set of adopted standard terminology for the principal device parameters with regard to MCBs. This terminology is also embraced by other standards with regard to MCCBs and switches (EN60947-2 and EN 60947-3).

The standard terminology relates to the following parameters:

Rated Operational Voltage, U_e
Rated Insulation Voltage, U_i
Rated Current, I_n
Rated Short Circuit Capacity, I_{cn}
Rated Service Short Circuit Breaking Capacity, I_{cs}
Rated Ultimate Breaking capacity, I_{cu}

Rated Voltage and Current

Rated Operational Voltage, U_e
The nominal voltage of the system should not exceed the stated value of U_e.
For example: single-pole U_e = 230/400V, three-pole U_e = 400V.

The standardised values of 230V and 230/400V have now replaced 220V, 240V, 220/380V and 240/415V across Europe.

Rated Insulation Voltage, U_i
This is the voltage upon which the dielectric properties are based, using tests at high voltage and mains frequency.

Unless otherwise stated, the rated insulation voltage is the value of the maximum rated voltage of the circuit breaker.

In no case shall the maximum rated voltage exceed the rated insulation voltage.

Rated Current, I_n
This is the current that the circuit breaker will carry continuously under specified conditions and upon which the time/current characteristics are based.

Unless otherwise stated, this value is based upon a reference ambient temperature of 30°C.

MCB Terminology

EN 60898 Standard refers to the following terms:

Short Circuit Capacity

Rated Short Circuit Capacity, I_{cn}
The calculated prospective fault current at the incoming terminals of the circuit breaker should not exceed the stated value. For example: I_{cn} = 10kA (marked 10000).

Service Short Circuit Breaking Capacity, I_{cs}
This value is the maximum level of fault current operation, after which further service of the device is assured without loss of performance. Note that there is no requirement for I_{cs} to be marked on the device.

There is a proscribed relationship between Ics and Icn, as follows:

For values of I_{cn} up to 6000A	$I_{cs} = I_{cn}$
For values of I_{cn} 6000A to 10000A	$I_{cs} = 0.75I_{cn}$ (but with a minimum value of I_{cs} = 6000A)
For values of I_{cn} above 10000A	$I_{cs} = 0.5I_{cn}$ (but with a minimum value of I_{cs} = 7500A)

MCCB Terminology

The EN 60947-2 Standards also refer to the following terms.

Isolation Suitability

These define the requirements for the suitability of circuit breakers to perform isolation duty by defining tests to which such units must comply. Conforming devices must carry a standard symbol mark to show that they are suitable for isolation duty. For example, all Dorman Smith circuit breakers are so marked.

Utilisation Categories

The utilisation category of a circuit breaker is stated with reference to whether or not it is specifically intended for discrimination by means of an intentional time delay with respect to other circuit breakers in series on the load side under short-circuit conditions.

Category A

This designates circuit breakers not specifically intended for selectivity with devices on the load side. Circuit breakers will discriminate only up to certain fault levels, above which discrimination with devices on the load side cannot be guaranteed.

Category B

This designates circuit breakers specifically intended for selectivity with devices on the load side. Such circuit breakers will incorporate some form of time delay.

EN 60947-2 recognises both a rated service and a rated ultimate short circuit breaking capacity for both Category A and Category B circuit breakers.

Rated Service Breaking Capacity, I_{cs}

In order to define this value, the circuit breakers under test must be subjected to a test sequence of:

I_{cs} = o – t – co - t – co, where:

- o = opening time under fault conditions
- t = time interval before re-closing (not more than 3 minutes)
- c = closing operation on to a fault

After this test sequence, dielectric, terminal temperature and over-current tests are to be applied. The circuit breaker must meet certain test parameters to ensure that the device has not deteriorated in performance and can be put back into service.

Rated Ultimate Breaking capacity, I_{cu}

In order to define this value, the circuit breakers under test must be subjected to a test sequence of:

I_{cu} = o – t– co.

After this test sequence, dielectric and over-current tests are to be applied.

The rated service breaking capacity (I_{cs}) applies to short circuit faults that could occur in practice; whereas the ultimate short circuit capacity (I_{cu}) is the maximum theoretical fault value of the installation at the point of connection.

The standard defines the ratio between the two values. I_{cs} will be shown as 25%, 50%, 75% or 100% of its I_{cu} value for Category A devices and 50%, 75% or 100% of I_{cu} for Category B devices.

A circuit breaker can remain in service after interrupting a short circuit up to its rated value of I_{cs}. However, where two or more faults occur between the I_{cs} and I_{cu} values, the capability of the device for continued operation must be verified.

Switch Terminology

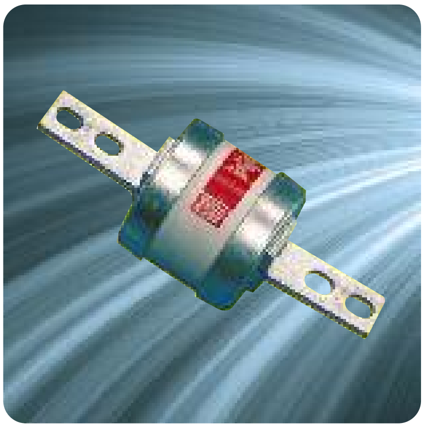
The EN 60947-3 Standard refers to the following terms:

Switch
A switch is a mechanical device capable of making, carrying and breaking current under normal circuit conditions.

Disconnector (Isolator)
A disconnector is a mechanical switching device that provides the function of circuit isolation.

Switch Disconnector
This device combines the functionality of the two foregoing devices; it provides making, carrying, breaking and isolation of current within a circuit.

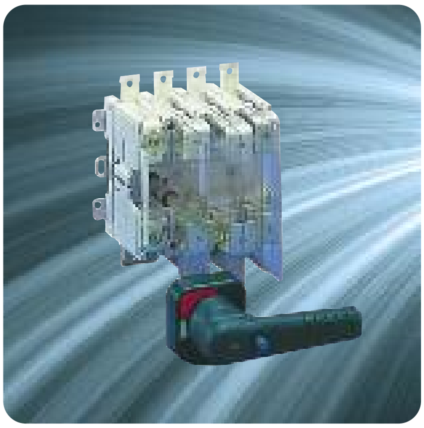
Fuses
Fuses can be combined with any of the above devices in any physical order. The inclusion of a fuse will add the functionality of overload and short circuit protection, breaking the circuit when the current flow is higher than that for which the circuit is rated.



Combination Devices
In order to enhance circuit protection, switches and fuses are often combined within a single device. The physical composition of the device can be identified by the literal position of the words in its description. For example, the word 'fuse' at the beginning of the device description identifies the fuse as forming part of the moving contact system, whereas placing it at the end of the description identifies the fuse as a static link.

Functional Summary

Term	Features provided	Features not provided
Switch	Current rating Operational and insulation voltage Making and breaking of load Short time current rating	Isolation Protection
Disconnector	Current rating Isolation Operational and insulation voltage Short time current rating	Protection Making/breaking capability
Fuse	Overload protection Short circuit protection	Switching



Suitability for Purpose
All of these devices have the ability to carry rated current either continuously or for a period of eight hours under defined conditions. Selection and specification of a specific device depends upon the circuit application

Switching Applications

For switching applications, the principal functions and capabilities include:

- **Making and breaking operation**
  A switch must have the ability to make or break defined load and overload currents at a rated operational voltage, for the useful life of the device.

- **Short circuit action**
  The device must have the capability of handling short circuit current and/or through fault and/or fault making.

- **Protection**
  The device must interrupt the circuit under overload and/or short circuit conditions.

- **Isolation**
  To meet this requirement, the device must ensure disconnection of the supply for safe downstream working. Facilities must be included for safety padlocking in the 'off' position, together with positive indication of the contact position.

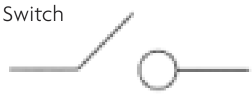
- **Neutral switching**
  Where the neutral is reliably earthed, it is accepted that the neutral need not be switched except in defined circumstances (e.g. the incoming switch disconnector in a consumer unit) even though the Wiring Regulations (BS 7671:2008) class the neutral as a current carrying conductor.

  In applications where the neutral cannot be confirmed as reliably earthed, the neutral should be switched simultaneously with the phase(s) or alternatively arranged to make before and break after the phase(s).

Function

Making and breaking current

Switch



Isolating

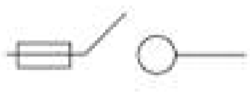
Disconnector

Making, breaking & isolating

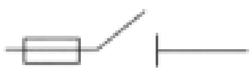
Switch-disconnector

Fuse Combination Unit

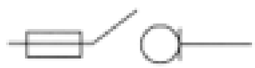
Switch-fuse



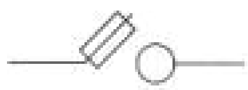
Disconnector-fuse



Switch-disconnector-fuse

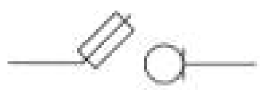


Fuse-switch



Fuse-disconnector

Fuse-switch-disconnector



Utilisation Category

The utilisation category defines the basic circuit conditions and the switching capability of the device.

Category	Circuit/application
AC20/DC20	Connecting and disconnecting under 'no load'. Assumes all switching operations are carried out by other capable devices before this device is operated.
AC21/DC21	Switching of resistive loads including moderate overloads. Suitable for purely resistive type loads. Device can switch 150% of its rated current under fault conditions.
AC22/DC22	Switching of mixed resistive/inductive loads, including moderate overloads. Suitable for mixed resistive/inductive loads. Device can switch 300% of its rated current under fault conditions.
AC23/DC23	Switching of highly inductive loads. These devices are provided principally as back-up to other means of switching, e.g. contactors. In the event of failure of the functional device, the AC23/DC23 device can safely interrupt a stalled motor current. Where devices are the only means of controlling individual motors they should comply with the requirements of Appendix A of the EN 60947-3 standard.

Note: Switch disconnectors for AC21/DC21, AC22/DC22 and AC23/DC23 categories also have to meet the requirements of AC20/DC20.

For specific and special applications such as switching of capacitors and tungsten lamps not covered by the EN 60947-3 standard, the manufacturer's advice should be sought.

Frequent and Infrequent Use

The designation 'A' or 'B' should be appended to utilisation categories to indicate the suitability for frequent or infrequent use in service. The 'Rule of Thumb' definition for full load current switching duty is:

Frequent (A): Up to five times a day for small devices, say up to 100 amps, and once per week for larger devices.

Infrequent (B): Once per week for the smaller devices and once per month for the larger devices.

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Miniature Circuit Breakers (MCBs)

In general terms, circuit breakers are thermal/magnetic electromechanical devices that provide current making, carrying and breaking functions and will 'trip' to interrupt a circuit under abnormal conditions. MCBs are equipped with positive contact indication flags: red indicates that the contact(s) are closed, green indicates the open state. The contact(s) will open when tripped due to abnormal circuit conditions or can be manually put into the open state by use of a handle.

These devices are used to provide protection and control of circuits against overload and short circuit conditions. Dorman Smith MCBs are supplied with various breaking capacities, particularly for ratings of 6kA and 10kA. The lower rated devices are used typically in domestic installations, e.g. in consumer units, whereas the higher rated devices are suitable for a range of commercial and industrial circuit protection applications.

The thermal and magnetic trip functions cater for different circuit abnormalities and operate as follows:

Thermal Trip Function

The purpose of this form of protection is to interrupt the circuit upon sensing an overload current. Typically, a bi-metallic strip is used such that it will deflect due to differential expansion of the dissimilar metals in response to the heating effect caused by the passage of current through it. The higher the current, the greater will be the heating effect and the more the deflection. At a preset point the physical deflection will be sufficient to actuate the tripping mechanism, opening the contact(s) and interrupting the circuit.

Magnetic Trip Function

The purpose of this form of tripping is to protect against the effects of short circuit fault currents. A wire coil or solenoid is used to provide this function, operating the trip mechanism when the over-current reaches a preset magnitude. As the fault current rapidly increases, the magnetic field also increases, energising the coil and moving a cam that is part of the contact assembly to fully open the contact(s) thereby interrupting the circuit.

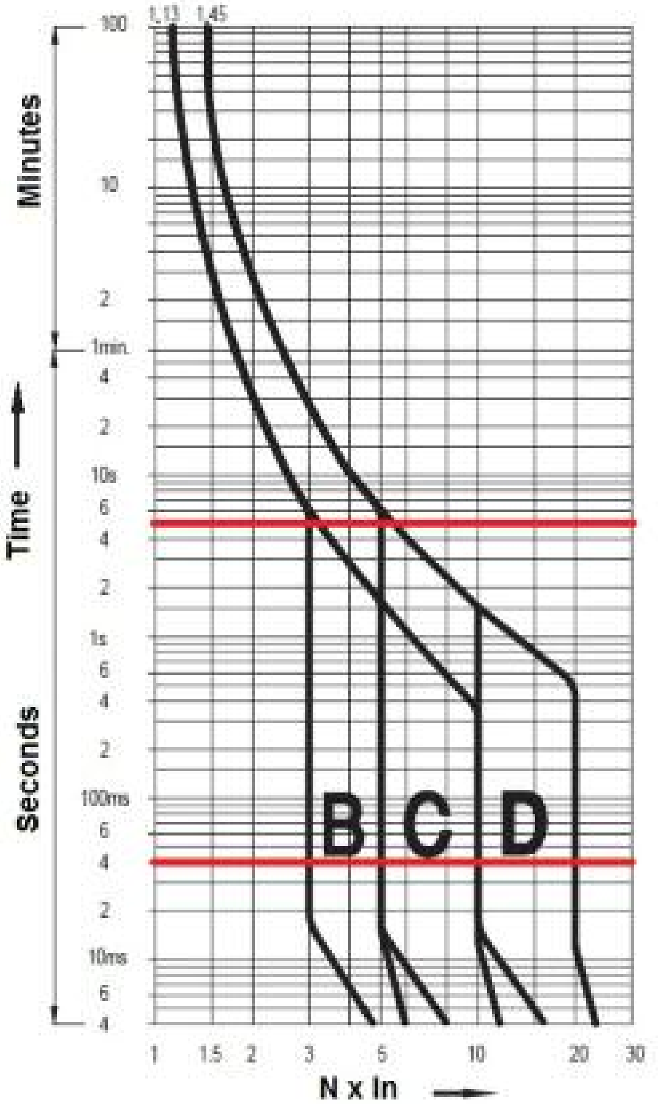
Characteristics

MCBs are designed according to one of three distinct tripping characteristics designated B, C or D. These designations relate to the magnetic trip setting and indicate the multiple of nominal current that will be tolerated by the device before tripping. The following table illustrates these characteristics with typical duties and applications. The nominal rated current is denoted by the symbol I_n.

Type	Magnetic trip	Application
B	3-5 I_n	Light duty, resistive loads
C	5-10 I_n	Fluorescent lights, small motors, inductive loads
D	10-20 I_n	Sodium lights, large motors (>3kW), large inductive loads

The tripping time for the thermal release is defined according to specific values of applied overload current, as follows:

Text current	Triping time
$1.13I_n$	>1h (I_n < 63A) >2h (I_n > 63A)
$1.45I_n$	<1h (I_n < 63A) <2h (I_n > 63A)
$2.55I_n$	1s<t<60s (I_n < 32A) 1s<t<120s (I_n > 32A)



MCB Add-on Functions
Various accessories can be added to MCBs to enable remote access and signalling. For example, the contact status could be relayed to an alarm annunciator panel or SCADA system; the circuit breaker could be controlled also from the SCADA system.

Auxiliary / Alarm Contact
Relaying of an MCB contact status or trip status can be achieved by the addition of an auxiliary / alarm contact, selected to suit the remote system input requirements.

Shunt Trip

The addition of a shunt trip allows remote access to the breaker operation, permitting the supervisory system to manually trip the breaker. The shunt trip actuator is a coil that is normally de-energised in the closed (on) state. When activated, the shunt trip will force the breaker to its 'off' state and the toggle handle and indicator flag will move to this corresponding position. Since the 'fail-safe' (i.e. non-powered) state of a shunt coil is with the breaker remaining closed, this precludes its use for emergency stop purposes. The interconnecting wiring could be open-circuit, for example, and would therefore not allow the shunt to open the breaker when the remote emergency switch is closed.

Under-voltage Release

If the supply voltage dropped to a low level and devices tripped, a dangerous situation could exist if the devices were automatically reset. For example, motors could suddenly restart or other operating machinery set in motion without warning. In the event that the mains voltage should drop significantly below its normal operating range, typically to less than 50%, an under-voltage release will force the breaker to its 'off' state and the toggle handle and indicator flag will move to this corresponding position. Only when the supply has returned to, typically, at least 85% of normal operating voltage will the under-voltage release allow the breaker to be closed.

If a break occurred in the interconnecting wiring in this case, the breaker would be tripped, just as if the voltage had fallen below the threshold value. For this reason, it is advisable to include an alarm function when using a UVR function. A UVR is the preferred choice for emergency stop applications.

Effect of the ambient temperature on the tripping characteristic

I_n	Ambient temperature T/° C											
[A]	-40	-30	-20	-10	0	10	20	30	40	50	60	70
1	1,22	1,2	1,18	1,15	1,12	1,09	1,05	1	0,94	0,88	0,82	0,75
6	7,32	7,2	7,09	6,91	6,73	6,54	6,31	6	5,66	5,33	4,94	4,5
10	12,2	12	11,8	11,5	11,2	10,9	10,5	10	9,44	8,89	8,23	7,5
13	15,9	15,6	15,4	14,9	14,5	14,1	13,6	13	12,2	11,5	10,7	9,75
16	19,5	19,2	18,9	18,4	17,9	17,4	16,8	16	15,1	14,2	13,2	12
20	24,4	24	23,6	23	22,4	21,8	21	21	18,8	17,7	16,5	15
25	30,5	30	2,5	28,8	28	27,2	26,3	25	23,6	22,2	20,6	18,8
32	39	38,4	37,8	36,9	35,9	34,9	33,6	32	30,2	28,4	26,3	24
40	48,8	48	47,8	46,1	44,9	43,6	42	40	37,7	35,5	32,9	30
50	61	60	59,1	57,6	56,1	54,5	52,6	50	47,2	44,4	41,2	37,5
63	76,9	75,6	74,4	72,6	70,7	68,7	66,2	63	59,4	56	51,9	47,3

Correct factor is valid for current with times over 30s.

Energy Let-through

An important facet of circuit protection devices is the extent to which they limit the amount of electrical energy they allow to pass through them. This applies to fuses as well as to circuit breakers.

When an electric current flows through a resistance for a certain time, energy is produced in the form of heat. This thermal effect can be measured using the formula:

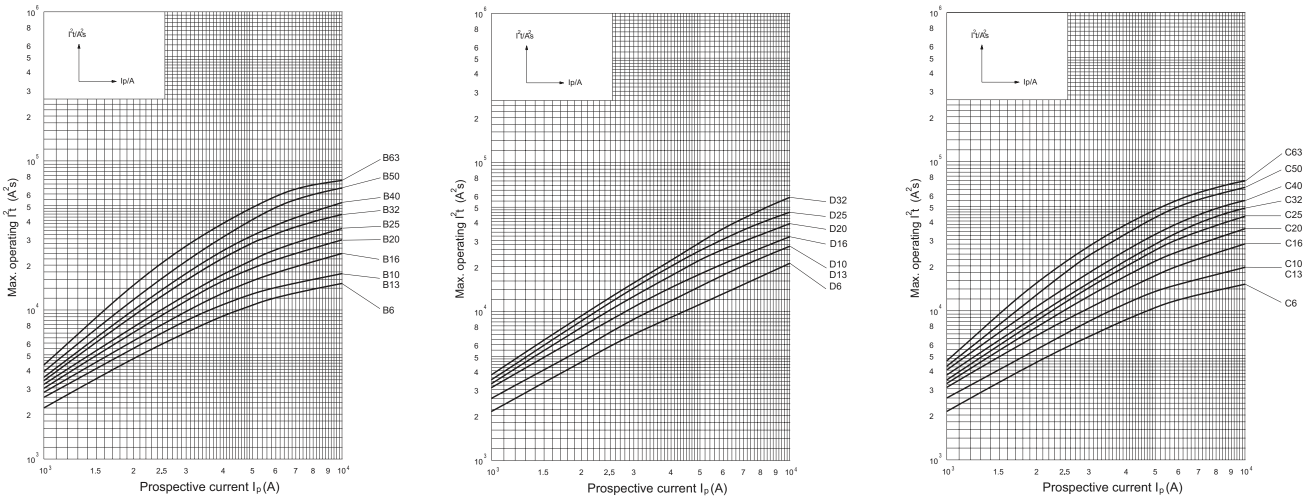
$I^2 \times R \times t$, to give a quantity in 'Watt seconds'. The unit of measurement for energy is the Joule, which is equivalent to one Watt second.

For all practical purposes, the resistance is treated as constant and negligible; therefore the commonly accepted term for energy let-through of a device is I^2t since this will always be proportional to the true thermal effect. The I^2t term is referred to as the Joule Integral since the results are expressed in integral form.

Under short-circuit fault conditions there is the potential for considerable energy to be let through by a circuit protection device. Knowledge of the energy let through characteristics of circuit protection devices is useful for comparison between different devices and also with regard to the selection of devices that are required to act in co-ordination to produce the levels of discrimination required for fault clearance.

The I^2t characteristics of circuit breakers are depicted as curves, graphed against values of prospective short-circuit current.

Energy Let-through Characteristics



The following table indicates the maximum energy let-through values permissible in each class, stated in Watt-seconds. In practice, compliance with the standard is checked on the circuit breakers with the highest applicable rated current within the range, normally 40A.

Rated short-circuit capacity	Current rating (A)	Class 1 I^2t max.	Class 2 I^2t max.		Class 3 I^2t max.	
		B type and C type	B type	C type	B type	C type
6kA	1-16	No	100,000	120,000	35,000	42,000
	20-32	limit	130,000	160,000	45,000	55,000
	40	specified	156,000	192,000	54,000	66,000
10kA	1-16		240,000	290,000	70,000	84,000
	20-32		310,000	370,000	90,000	110,000
	40		372,000	444,000	108,000	132,000

Maximum Zs for Loadlimiter MCBs

Current rating (A)	B Type MCB		C Type MCB		D Type MCB	
	0.4s	5s	0.4s	5s	0.4s	5s
6	7.28	7.28	3.64	6.27	1.81	6.27
10	4.37	4.37	2.19	3.76	1.09	3.76
13	3.35	3.35	1.67	2.90	0.84	2.90
16	2.73	2.73	1.36	2.35	0.67	2.35
20	2.19	2.19	1.09	1.88	0.54	1.88
25	1.75	1.75	0.87	1.50	0.44	1.50
32	1.36	1.36	0.67	1.17	0.33	1.17
40	1.09	1.09	0.54	0.94	0.27	0.94
50	0.87	0.87	0.44	0.75	0.22	0.75
63	0.69	0.69	0.34	0.59	0.17	0.59

Maximum Allowable Earth Loop Impedance Values in accordance with BS7671:2008 incorporating Amendment 3, 2015.

Minimum Fuse Rating for Discrimination

Current rating (A)	B Type MCB	C Type MCB	D Type MCB
	Fuse link rating (A)		
6	20	32	25
10	20	32	40
13	20	32	40
16	32	50	63
20	40	63	63
25	50	80	80
32	63	100	100
40	80	100	125
50	100	125	125
63	125	125	125

Maximum Back-up Fuse Rating for Protection

Current rating (A)	B Type MCB	C Type MCB	D Type MCB
	Fuse link rating (A)		
6	63	40	40
10	80	63	63
13	80	63	63
16	80	80	80
20	80	80	80
25	100	100	100
32	100	100	100
40	125	125	125
50	160	160	160
63	160	160	160

Residual Current Circuit Breakers

Currents of low magnitude caused by unintentional 'leakage' paths to earth can cause deterioration within circuit wiring and components with the potential to create a rapidly escalating situation that will permit the current to reach dangerous levels.

Special forms of circuit breakers are designed to use the detection of earth leakage or 'residual' current to limit the effects of this type of fault.

The generic term 'residual current device' is used to describe a range of circuit protection devices that include the functions of sensing and measurement of a leakage current, with subsequent tripping when the magnitude of the residual current reaches a preset level. The purpose of these devices is to protect human life, livestock, property and equipment against the escalation of earth fault currents to destructive magnitudes.

Two forms of technology are commonly employed in the design of residual current devices; electromagnetic and electronic. In both cases, a current transformer is used and is arranged such that normal current flows in the phase and neutral conductors cancel each other to produce a zero balance. The presence of any residual current will create an out-of-balance that can be used to signal the actuation of a mechanism for circuit interruption.

In the electromagnetic type, a trip relay is used as the actuation device. The relay is powered by the fault current and therefore requires no external power source.

With electronic devices internal signal amplification allows a much smaller current transformer to be used, reducing the physical size of the circuit breaker. In this case, however, the actuation power is derived from both the fault current and the mains power. Also, a separate earth reference connection may be required to ensure continuity of operation in the event that the mains neutral is lost.

Residual current devices are accorded a 'sensitivity' coding that indicates the level of residual current that would cause a trip action. Commonly, the available sensitivity ranges are 10mA, 30mA, 100mA and 300mA. In general, the 10mA and 30mA devices are used to protect human life, the 100mA and 300mA devices being applied to protect wiring, cabling and equipment.

The degree of electrocution that could take place when a fault arises depends upon the combined effects of the magnitude and duration of current flow. For sensitivity levels of 30mA and below, tripping must be instantaneous to protect human life. Longer periods of residual current flow can be tolerated by equipment and the trip action may not necessarily be required to interrupt the circuit instantaneously.

Residual Current Circuit Breaker

The RCCB device combines the functions of a switch with those of a residual current device. It is often used in place of an incoming switch disconnector with the advantage that it functions also as a residual current protection device. The disadvantage, however, is that a residual fault will cause the device to operate interrupting ALL downstream circuits even when these circuits remain in a healthy state.

Note that an RCCB should not be used as the sole means to provide complete protection. It has no overload or short circuit protection and must therefore be further protected by an upstream device having these capabilities. Frequently, the RCCB is used in consumer units and distribution boards to protect sub-circuits in a split load configuration. In these applications, the upstream back-up is provided by the Regional Electricity Company's local fuse.

Residual Current Breaker with Overload Protection

The RCBO combines the functions of an MCB with those of a residual current device. It will therefore provide protection against overload, short circuit and earth leakage.

RCBOs and RCCBs – General

These devices are furnished with a test push button on the front face of the module. Operation of this button will simulate the presence of a residual fault and the test should be made frequently, say once per month, to assure continued correct functionality of the device.

In addition to the range of sensitivities, RCBOs and RCCBs are available in two types, type AC and type A. These refer to the types of circuit for which the devices are suitable.

Type AC: for use with residual sinusoidal ac, whether applied as a step or ramp.

Type A: for use with either residual sinusoidal ac or residual chopped (pulsating) dc, whether applied as a step or ramp.

A time delay facility may also be included. This is denoted by 'S' included within the description and also marked on the device. This function is included in order to enable the device to be used as part of a circuit device discrimination (or selectivity) arrangement. Without the time delay, residual current circuit breakers cannot be easily used within a discrimination scenario due to their inherent rapid tripping in response to residual current detection.

Where as RCBOs are single module width devices used in place of or alongside MCBs in outgoing circuits. RCCBs are available in 2-pole and 4-pole forms and are readily used in single phase and three phase distribution systems where they can function as either incoming or outgoing ways.

Due to their low levels of sensitivity RCCBs are generally equipped with suppression filtering to avoid nuisance tripping that could be induced from disturbances in external or incoming circuits.

Modular Contactors

Contactors are simply electromechanically controlled switches. A contactor acts as an interposing relay which, when its coil is energised, operates one or more sets of contacts that are able to carry currents of sufficient magnitude to switch power equipment such as large banks of lights, highly inductive lamps, motors and large solenoids. The current required to operate the coil is minimal, therefore a contactor can be controlled by light duty contacts in a timer, pushbutton or other control device.

Generally, contactors have no latching facility, i.e. once the coil is de-energised the contact state returns to its normal condition. However, whilst there is no mechanical latching, electrical latching can be easily accomplished by using a separate relay contact to hold on the supply to the contactor's coil.

Selection Criteria
The correct choice of contactor depends upon a number of parameters within the intended application. These include:

- The form of power supply
- The magnitude of the power to be switched
- The type of load to be controlled
- The control voltage required
- The frequency of switching

Since the device operates by its coil being energised for possibly lengthy periods, considerable internal heat can be generated. For this reason, a venting insert must be placed between alternate pairs of contactors or between a contactor and any other adjacent circuit device.

Switching Capacity
Contactor ratings are stated for AC1 type loads only (resistive). Where the load to be switched differs from this, it is likely that the contactor will have to be de-rated to ensure its performance. If the load is dc, inductive or capacitive, the degree of de-rating may be considerable. The following contactor de-rating tables indicate the maximum power/current that can be switched according to the type of load to be controlled. The figures quoted are per phase and are based upon a 230V ac supply.

Modular Contractor Technical Data

	Type					EE2P20	EE4P25	EE4P40	EE4P63
General	Standards				IEC/EN 61095 , IEC/EN 60947-4-1, IEC/EN 60947-5-1				
	Module width					1	2	3	3
	Mechanical endurance				op. c.		3 x 10^6		
	Ambient temp.				°C		-5 ... +55		
	Storage temp.				°C		-30 ... +80		
	No. of contactors (side-by-side)		≤40 °C 40 - 55 °C			max. 3 max. 2	no limitation	max. 3 max. 2	max. 3 max. 2
	Contact reliability					17 V; ≤50 mA			
	Min. distance of open contacts				mm		3.6		
	Power dissipation per pole				W	1.7	2.2	4	8
	Overload current withstand capability				A	72	68	176	240
	Max. back-up fuse for short-circuit protection gL Coordination type 2			Iv	A	20	25	63	80
		DC-1						300	
	Max. operating frequency	AC-1/AC-3/AC-5b/AC-6b			op. c./h			600	
		AC-15						1,200	
		no load						3,000	
	Weight				kg	0.13	0.24	0.42	0.42
Main Circuit	Rated insulation voltage			Ui	V	230	440	400	400
	Rated impulse withstand voltage			Uimp	kV			4	
	Thermal current			ith	A	20	25	40	63
	Rated operational voltage			Ue	V	230		400	
	Rated frequency			f	Hz		50/60		
	Rated operational current	AC-1/AC-7a		Ie	A	20	25	40	63
	Operational power AC-1/AC-7a	1-pole	230 V			4	5.4	8.7	13.3
		3-pole	230 V	Pe	kW	-	9	16	24
		3-pole	400 V			-	16	26	40
	Electrical endurance	AC-1/AC-7a			op. c.	200,000		100,000	
	Rated operational current	AC-3/AC-7b		Ie	A	9	8.5	22	30
	Operational power	1-phase motor	230 V			1.3 only for NO[1)]	1.3[2)]	3.7[2)]	5[2)]
	AC-3/AC-7b	3-phase motor	230 V	Pe	kW	-	2.2	5.5	8.5
		3-phase motor	400 V			-	4	11	15
	Electrical endurance	AC-3/AC-7b			op. c.	300,000	500,000	150,000	150,000
	Switching of capacitors	AC-6b	230 V	C	QF	30	36	220	330
	Electrical endurance	AC-6b			op. c.	200,000		100,000	
	Rated operational current	DC-1							
	1-pole	U	e = 24 V DC			20	25	40	63
		U	e = 110 V DC	Ie	A	6	6	4	4
		U	e = 220 V DC			0.6	0.6	1.2	1.2
	2-poles connected in series	U	e = 24 V DC			20	25	40	63
		U	e = 110 V DC	Ie	A	10	10	10	10
		U	e = 220 V DC			6	6	8	8
	3-poles connected in series	U	e = 24 V DC			-	25	40	63
		U	e = 110 V DC	Ie	A	-	20	30	35
		U	e = 220 V DC			-	15	20	30
	4-poles connected in series	U	e = 24 V DC			-	25	40	63
		U	e = 110 V DC	Ie	A	-	20	40	63
		U	e = 220 V DC			-	15	40	63
	Electrical endurance	DC-1			op. c.		100000		
	Terminal capacity		rigid flexible		mm^2		1.5 ... 25 1.5 ... 16		
	Screw					M3,5		M5	
	Screw head					PZ1		PZ2	
	Tightening torque				Nm	1.2		3.5	

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Modular Contractor Technical Data continued

	Type					EE2P20	EE4P25	EE4P40	EE4P63
Auxiliary Contacts	Rated operational voltage			Ue	V	230		400	
	Rated insulated voltage			Ui	V	230		440	
	Rated impulse withstand voltage			Uimp	kV			4	
	Thermal current			Ith	A	20	25	40	63
	AC-15 Rated	1-phase	230 V	Ie	A	6	6	6	
	Operational Current	1-phase	400 V			-	4	4	
	Electrical endurance	AC-15			op. c.	300,000	500,000	150,000	150,000
Control Circuit	Range of control voltage			Uc	%			85 ... 110	
	Control voltage			Uc	V			230	
	Surge immunity test (1.2/50 Qs), acc. to IEC/EN 61000-4.5				kV			2	
	Coil consumption		switch-on operation		VA/W	12/10 2.8/1.2	33/25 5.5/1.6	5/5 5/5	5/5 5/5
	Make/break delays		make break		ms	15_25 10_30	10_30 10_30	15_20 35_45	15_20 35_45
	Terminal capacity		rigid flexible		S			1 ... 2.5 1 ... 2.5	
	Screw						M3,5		M3
	Screw head							PZ1	
	Tightening torque				Nm			0.6	

Switching of Lamps

Max. number of lamps per pole at 230 V 50 Hz

Type	Power (W)	Current (A)	C (QF)	EE2P20	EE4P25	EE4P40	EE4P63
Incandescent lamps (tungsten filament)	60	0.26	-	33	33	65	85
	100	0.44	-	20	20	40	50
	200	0.87	-	10	10	20	25
	500	2.17	-	3	3	8	10
	1000	4.35	-	1	1	4	5
Incandescent lamps uncompensated or series compensated	18	0.37	2.7	22	24	90	140
	24	0.35	2.5	22	24	90	140
	36	0.43	3.4	17	20	65	95
	58	0.67	5.3	14	17	45	70
Incandescent lamps lead-lag circuit	2 x 18	0.11	-	2 x 30	2 x 40	2 x 100	2 x 150
	2 x 24	0.14	-	2 x 24	2 x 31	2 x 78	2 x 118
	2 x 36	0.22	-	2 x 17	2 x 24	2 x 65	2 x 95
	2 x 58	0.35	-	2 x 10	2 x 14	2 x 40	2 x 60
Incandescent lamps parallel compensated	18	0.12	4.5	7	8	48	73
	24	0.15	4.5	7	8	48	73
	36	000	4.5	7	8	48	73
	58	0.32	7	4	5	31	47
Florescent lamps with electronic ballast units (EVG)	18	0.09	-	25	35	100	140
	36	0.16	-	15	20	52	75
	58	0.25	-	14	19	50	72
	2 x 18	0.17	-	2 x 12	2 x 17	2 x 50	2 x 70
	2 x 36	0.32	-	2 x 7	2 x 10	2 x 26	2 x 38
	2 x 58	0.49	-	2 x 7	2 x 9	2 x 25	2 x 36
High-pressure mercury-vapour lamps. Uncompensated	50	0.61	-	14	18	38	55
	80	0.01	-	10	13	29	42
	125	1.15	-	7	9	20	29
	250	2.15	-	4	5	10	15
	400	3.25	-	2	3	7	10
	700	005	-	1	2	4	6
	1000	008	-	1	1	3	4
High-pressure mercury-vapour lamps. Parallel compensated	50	0.28	7	4	5	31	47
	80	0.41	8	4	5	27	41
	125	0.65	10	3	4	22	33
	250	1.22	18	1	2	12	18
	400	1.95	25	1	1	9	13
	700	3.45	45	-	-	5	7
	1000	005	60	-	-	4	5

Modular Contractor Switching of Lamps continued

Type	Power (W)	Current (A)	C (QF)	EE2P20	EE4P25	EE4P40	EE4P63
Halogen metal-vapour lamps. Uncompensated	35	0.53	-	18	22	43	60
	70	001	-	10	12	23	32
	150	002	-	5	7	12	18
	250	003	-	3	4	7	10
	400	004	-	3	3	6	9
	1000	010	-	1	1	2	3
	2000	16.5	-	-	-	1	1
Halogen metal-vapour lamps. Parallel compensated	35	0.25	6	5	6	36	50
	70	0.45	12	2	3	18	25
	150	0.75	20	1	1	11	15
	250	002	33	-	1	6	9
	400	003	35	-	1	6	8
	1000	006	95	-	-	2	3
	2000	012	148	-	-	1	2
Halogen metal-vapour lamps with electronic ballast unit PCI 50-125 x In lamp for 0.6 ms	20	000	integrated	9	9	18	20
	35	000	integrated	6	6	11	13
	70	0.36	integrated	5	5	10	12
	150	001	integrated	4	4	8	10
Transformers for halogen metal-vapour lamps	20	-	-	40	52	110	174
	50	-	-	20	24	50	80
	75	-	-	13	16	35	54
	100	-	-	10	12	27	43
	150	-	-	7	9	19	29
	200	-	-	5	6	14	23
	300	-	-	3	4	9	14
High-pressure sodium-vapour lamps. Uncompensated	150	002	-	5	6	17	22
	250	003	-	3	4	10	13
	400	005	-	2	2	6	8
	1000	10.3	-	-	1	3	3
High-pressure sodium-vapour lamps. Parallel compensated	150	0.83	20	1	1	11	16
	250	002	33	-	1	6	10
	400	002	48	-	-	4	6
	1000	006	106	-	-	2	3
Halogen metal-vapour lamps with electronic ballast unit PCI 50-125 x In lamp for 0.6 ms	20	000	integrated	9	9	18	20
	35	000	integrated	6	6	11	13
	70	0.36	integrated	5	5	10	12
	150	001	integrated	4	4	8	10
Low-pressure sodium-vapour lamps. Uncompensated	18	0.35	-	22	27	71	90
	35	002	-	7	9	23	30
	55	002	-	7	9	23	30
	90	002	-	4	5	14	19
	135	004	-	3	4	10	13
	180	003	-	3	4	10	13
Low-pressure sodium-vapour lamps. Compensated	18	0.35	5	6	7	44	66
	35	0.31	20	1	1	11	16
	55	0.42	20	1	1	11	16
	90	0.63	26	1	1	8	12
	135	0.94	45	-	-	5	8
	180	1.16	40	-	-	4	7
			Lumilux T5				
LUMILUX* Fluorescent lamps T5 with electronic ballast unit (EVG)	22	0.11		22	30	80	110
	40	0.21	FC	12	15	40	60
	55	0.28		8	12	30	45
	14	0.08		30	40	105	150
	21	0.11	HE	22	30	80	115
	28	0.14		18	22	60	90
	35	0.18		14	18	48	70
	24	0.12		20	26	70	100
	39	0.20		12	16	42	62
	49	0.24	HO	10	14	35	52
	54	0.27		9	13	32	47
	80	0.39		6	8	22	32
	2 x 22	0.23		2 x 11	2 x 15	2 x 40	2 x 55
	2 x 40	0.42	2 x FC	2 x 6	2 x 7	2 x 20	2 x 30
	2 x 55	0.55		2 x 4	2 x 6	2 x 15	2 x 22
	2 x 14	0.15		2 x 15	2 x 20	2 x 52	2 x 75
	2 x 21	0.22	2 x HE	2 x 11	2 x 15	2 x 40	2 x 57
	2 x 28	0.28		2 x 9	2 x 11	2 x 20	2 x 45
	2 x 35	0.36		2 x 7	2 x 9	2 x 24	2 x 35
	2 x 24	0.24		2 x 10	2 x 13	2 x 35	2 x 50
	2 x 39	0.39		2 x 6	2 x 8	2 x 21	2 x 31
	2 x 49	0.48	2 x HO	2 x 5	2 x 7	2 x 17	2 x 26
	2 x 54	0.54		2 x 4	2 x 6	2 x 16	2 x 23
	2 x 80	0.74		2 x 3	2 x 4	2 x 11	2 x 16

* Lumilux is a trademark of OSRAM Ctmbh

Moulded Case Circuit Breakers

The operation and application of the MCCB is similar to that of the MCB, however this device has the air-break mechanism contained within a moulded case housing made from a very robust non-conducting material. Generally, MCCBs exhibit much higher breaking capacities and rated current than their smaller counterparts and can be used to perform full isolation duty. Consequently, MCCBs are employed in both incoming and outgoing circuits. MCCBs are constructed to a particular frame size and typically provide rated current in the range 16-1600A.

These devices can be equipped with adjustable thermal and magnetic tripping mechanisms to cater for overload and short circuit protection to meet the requirements for isolation and Category A discrimination duty. Dorman Smith electronic MCCBs provide adjustable long, short and instantaneous trip functions, allowing more complex overall tripping characteristics to be configured, allowing these devices to be used for isolation and Category B discrimination requirements. (Refer to page 4 for Category definitions).

Devices equipped with the full range of adjustable trips for long, short and instantaneous durations are generally referred to as 'LSI-MCCBs' to distinguish them from the L and I only versions employed for Category A devices.

The range of accessories that can be added to MCCBs is similar to that given in the section dealing with MCBs, including shunt trips, under-voltage releases and various forms of auxiliary contacts. The physical size of triple-pole and four-pole MCCBs allows these accessories to be internally mounted, although there are some restrictions with regard to combinations of these that can be co-mounted. For example, either a shunt trip or under-voltage release can be incorporated, but not both. Also, due to the much larger physical size of these devices compared with MCBs, additional safety features normally include interphase barriers and terminal shrouds to provide IP2X ingress protection at the terminals.

The tripping operation of some MCCBs is different from that of MCBs in that there are three distinct positions of the toggle or handle. Whereas MCBs are either 'on' or 'off', MCCBs have a central position when they are tripped. As a further safety feature, the coloured flags indicating the 'on' and 'off' states are masked in the tripped state. The breaker can be reset only after it has been set into the fully 'off' state.

MCCBs are equipped with a test pushbutton that allows periodic testing of the mechanical tripping mechanism. As in the case of a fault trip, the device must be moved into the 'off' position before it can be reset following a test.

These devices conform to EN 60947-2 therefore the definitions that apply to some parameters differ from those of EN 60898 that apply to miniature circuit breakers. These differences are explained in the section covering MCB and MCCB Terminology.

Motor Control Applications

The MCCB is a viable means of providing motor control switching. A high magnetic or instantaneous trip level is normally required for motor control applications and the Dorman Smith Loadline range of MCCBs have maximum levels in the order of 10 to 13 times the rated current.

The range of circuit breakers for each frame size includes a basic switch disconnector version, generally in both triple-pole and four-pole variants. Devices of this type are sometimes referred to as 'non-auto MCCBs'.

MCCB Maximum Cable Sizes

Loadline Range	Using Standard Lug (mm²)	Using Reduced Palm Width Lug (mm²)	Using Cable Clamps (mm²)	Lug size
YB1	N/A	N/A	70	N/A
YA2	35	95	50	M8
YA3	95	150	120	M8
YB3	95	150	120	M8
YA5	95	185	240	M10
YA6	240	300	N/A	2 x M12
YA7	300	300	N/A	2 x M12
YA8	300	300	N/A	2 x M12

Notes:
Two cables per phase can be installed for the YA6, YA7 and YA8 MCCBs, depending on mounting of the device.

The cable sizes for the YA6 MCCBs assume that the terminal extensions supplied with the Dorman Smith enclosures are fitted. If not then these are available as optional accessories.

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Loadline YA/YB Frame MCCBs for Motor Starting (400Vac)

Motor rating	Motor full load current	Sub-transient starting current	Breaker frame	Breaker rated current	Breaker instantaneous trip threshold (set on max.)
P(Kw)	Ie(A)	Id"(A)		In(A)	Ii (lower tolerance) (A)
0.37	1.2	14	YB1	25	480
0.55	1.6	19	YB1	25	480
0.75	2	24	YB1	25	480
1.10	2.8	34	YB1	25	480
1.50	3.7	44	YB1	25	480
2.20	5.3	64	YB1	25	480
3.00	7	84	YB1	25	480
4.00	9	108	YB1	25	480
5.50	12	144	YB1	25	480
7.50	16	192	YB1	25	480
9.00	20	240	YB1	25	480
11.00	23	276	YB1	32	480
15.00	30	360	YB1	40	480
18.50	37	444	YB1	63	800
22.00	43	516	YB1	63	800
30.00	59	708	YB1	80	800
37.00	72	864	YB1	100	1200
45.00	85	1020	YB1	100	1200
0.37	1.2	14	YA2/YA3	20	192
0.55	1.6	19	YA2/YA3	20	192
0.75	2	24	YA2/YA3	20	192
1.10	2.8	34	YA2/YA3	20	192
1.50	3.7	44	YA2/YA3	20	192
2.20	5.3	64	YA2/YA3	20	192
3.00	7	84	YA2/YA3	20	192
4.00	9	108	YA2/YA3	20	192
5.50	12	144	YA2/YA3	20	192
7.50	16	192	YA2/YA3	32	307
9.00	20	240	YA2/YA3	32	307
11.00	23	276	YA2/YA3	50	480
15.00	30	360	YA2/YA3	50	480
18.50	37	444	YA2/YA3	50	480
22.00	43	516	YA2/YA3	63	605
30.00	59	708	YA2/YA3	100	960
37.00	72	864	YA2/YA3	125	1200
45.00	85	1020	YA2/YA3	125	1200
18.50	37	444	YB3	50	520
22.00	43	516	YB3	63	655
30.00	59	708	YB3	100	1040
37.00	72	864	YB3	100	1040
45.00	85	1020	YB3	125	1300
55.00	105	1260	YB3	160	1664
75.00	140	1680	YB3	200	2080
55.00	105	1260	YA3	160	1664
75.00	140	1680	YA3	250	2000
90.00	170	2040	YA5	250	2400
110.00	210	2520	YA5	400	3840
132.00	224	2688	YA5	400	3840
150.00	255	3060	YA5	400	3840

Notes
1 In›Ie
2 Ii/lower › Id"

The above table is suitable for DOL and Star Delta starting.

Discrimination

In the context of power distribution schemes, the term 'discrimination' (sometimes referred to as 'selectivity') describes a hierarchy of circuit devices that are arranged such that a single upstream circuit breaker can fan out to several downstream devices to act in a co-ordinated fashion should a fault occur. Under fault conditions, only the upstream protective device closest to the fault should operate to clear the fault, leaving all other healthy circuits operable. This is especially important in installations where circuit failures could be life-threatening, such as in hospitals.

The concept of discrimination is similar to that of cascading, the prime difference being in the objectives of the application. Whereas discrimination is used to ensure continuity of supply to sub-circuits by limiting the disconnection to the faulted sub-circuit alone, cascading is used to buffer downstream protective devices against the effects of high prospective short circuit currents. In both cases, the protective devices are specifically selected to meet the criteria for the type of co-ordination required.

When the selected devices are properly matched to fulfil the ideal discrimination principle described above, the co-ordinating devices are said to achieve 'total' discrimination. In many practical installations, however, a partial discrimination may be satisfactory for safe continuity of supply, with an added advantage of cost savings due to selecting a lower rated upstream circuit breaker.

Discrimination between two circuit breakers arranged in series may be based on either current or time. Where the magnitude of the fault current is to be used as the critical factor for selection, the co-ordination in this case is termed 'current discrimination'. Where the basis for selection is the duration over which the upstream device can withstand the fault current, the selection is to achieve 'time discrimination'. In some cases, time discrimination can be achieved by using an upstream device that has a built-in time delay.

Current Discrimination

In general, the basis for current discrimination is that the downstream protective device will have a lower current rating than the upstream device. It should also have a lower instantaneous tripping point. The discrimination tables that follow highlight the consequential increase in discrimination level as the differential in current ratings between the devices increases.

Time Discrimination

Discriminating by time between two devices in series relies on the operation of the upstream device being delayed at least until the downstream circuit breaker has tripped to clear the fault. The clearing time of the downstream device must be less than the time setting of the upstream device and the upstream device must also be capable of withstanding the fault current for the full duration of its time setting. There is generally no problem in achieving these conditions where the upstream device is a Category B circuit breaker specifically designed for this type of co-ordination duty.

Time/Current Characteristics

Comparison of the time/current characteristic graphs of the two devices proposed can give a quick check on their suitability for co-ordination in both current and time discrimination cases. Ideally, there should be no overlap of the respective curves to achieve total discrimination. If, however, the instantaneous portion of the curves do intersect, a partial discrimination will be achieved at the current level projected from the intersect point.

In the tables that follow, total discrimination is indicated by the letter 'T' in appropriate boxes. Total discrimination applies for all fault levels up to the lower breaking capacity of the two devices in co-ordination. Where a value is contained in any of the boxes, this indicates a partial discrimination of that value of current limit. If no discrimination is possible, this is shown by a dash symbol.

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Discrimination Tables

Upstream Electronic ACB

	Frame Rating	Model	Breaking Capacity	Z2 800A STD Capacity	Z2 800A High Capacity	Z2 1250A STD Capacity	Z2 1250A High Capacity	Z2 1600A STD Capacity	Z2 1600A High Capacity	Z2 2000A STD Capacity	Z2 2000A High Capacity	Z3 2500A STD Capacity	Z3 2500A High Capacity	Z3 3200A STD Capacity	Z3 3200A High Capacity	Z3 4000A STD Capacity
				65kA	80kA	65kA	80kA	65kA	80kA	65kA	80kA	85kA	100kA	85kA	100kA	100kA
Downstream MCCB	125A	YA2S Thermal/Mag	36kA	T	T	T	T	T	T	T	T	T	T	T	T	T
		YA2J Thermal/Mag	65kA	T	T	T	T	T	T	T	T	T	T	T	T	T
	160A	YB1N Thermal/Mag	25kA	T	T	T	T	T	T	T	T	T	T	T	T	T
		YB1S Thermal/Mag	40kA	T	T	T	T	T	T	T	T	T	T	T	T	T
	250A	YB3N Thermal/Mag	25kA	T	T	T	T	T	T	T	T	T	T	T	T	T
		YA3S Thermal/Mag	36kA	T	T	T	T	T	T	T	T	T	T	T	T	T
		YB3S Thermal/Mag	40kA	T	T	T	T	T	T	T	T	T	T	T	T	T
		YA3J Thermal/Mag	65kA	T	T	T	T	T	T	T	T	T	T	T	T	T
	400A	YA5N Thermal/Mag	25kA	T	T	T	T	T	T	T	T	T	T	T	T	T
		YA5H Thermal/Mag	50kA	T	T	T	T	T	T	T	T	T	T	T	T	T
		YA5H Electronic	50kA	T	T	T	T	T	T	T	T	T	T	T	T	T
		YA5J Thermal/Mag	65kA	T	T	T	T	T	T	T	T	T	T	T	T	T
		YA5K Electronic	70kA	T	T	T	T	T	T	T	T	T	T	T	T	T
	800A	YA6H Thermal/Mag	50kA	T	T	T	T	T	T	T	T	T	T	T	T	T
		YA6H Electronic	50kA	T	T	T	T	T	T	T	T	T	T	T	T	T
		YA6J Electronic	70kA	T	T	T	T	T	T	T	T	T	T	T	T	T
		YA6K Thermal/Mag	70kA	T	T	T	T	T	T	T	T	T	T	T	T	T
	1250A	YA7H Electronic	50kA	-	-	T	T	T	T	T	T	T	T	T	T	T
	1250A	YA7K Electronic	70kA	-	-	T	T	T	T	T	T	T	T	T	T	T
	1600A	YA8H Electronic	50kA	-	-	-	-	T	T	T	T	T	T	T	T	T
	1600A	YA8K Electronic	85kA	-	-	-	-	T	T	T	T	T	T	T	T	T

T= Total Selectivity

All ACBs have instantaneous trip set to NON and the MCR set to ON. Assumes all ACB time settings are greater than MCCB. The above table is in accordance with IEC 60947-2, Annex A.

Upstream Electronic MCCB

	Frame Rating	Model	Breaking Capacity	400A YA5H-Electronic	400A YA5K-Electronic	800A YA6H-Electronic	800A YA6K-Electronic	1250A YA7H-Electronic	1250A YA7K-Electronic	1600A YA8H-Electronic	1600A YA8K-Electronic
				50kA	70kA	50kA	70kA	50kA	70kA	50kA	85kA
Downstream MCCB	125A	YA2S Thermal/Mag	36kA	T	T	T	T	T	T	T	T
		YA2J Thermal/Mag	65kA	T	T	T	50	T	T	T	T
	250A	YA3S Thermal/Mag	36kA	T	T	T	T	T	T	T	T
		YA3J Thermal/Mag	65kA	T	T	36	36	T	T	T	T
	400A	YA5N Thermal/Mag	25kA	-	-	T	T	T	T	T	T
		YA5H Thermal/Mag	50kA	-	-	25	25	T	T	T	T
		YA5H Electronic	50kA	-	-	25	25	36	36	T	T
		YA5J Thermal/Mag	70kA	-	-	25	25	36	36	T	50
		YA5K Electronic	70kA	-	-	25	25	36	36	T	50
	800A	YA6S Thermal/Mag	36kA	-	-	-	-	-	-	20	20
		YA6H Thermal/Mag	50kA	-	-	-	-	-	-	20	20
		YA6H Electronic	50kA	-	-	-	-	-	-	20	20
		YA6K Thermal/Mag	70kA	-	-	-	-	-	-	20	20
		YA6K Electronic	70kA	-	-	-	-	-	-	20	20

T= Total Selectivity

All pick-up current and time delay settings to be set at maximum on upstream MCCBs. Partial discrimination level is in kA. The above table is in accordance with IEC 60947-2, Annex A, at 400Vac.

Note that 'partial discrimination' infers that, above the current limit value indicated, it is possible that both devices could trip, resulting in disconnection of other sub-circuits and loss of supply continuity to those areas of the distribution system.

Discrimination Tables (continued)

Upstream Thermal Magnetic YA Frame MCCB

		YA2S (36kA) or YA2J (65kA)								YA3S (36kA) or YA3J (65kA)											YA5N (25kA) YA5H (50kA) YA5J (70kA)	
	In	16A	20A	32A	50A	63A	80A	100A	125A	16A	20A	32A	50A	63A	80A	100A	125A	160A	200A	250A	250A	400A
Downstream K Series MCB (Type B, C & D)	6A	166	260	T	T	T	T	T	T	166	260	T	T	T	T	T	T	T	T	T	T	T
	10A	-	260	420	T	T	T	T	T	-	260	420	T	T	T	T	T	T	T	T	T	T
	16A	-	-	420	650	T	T	T	T	-	-	420	650	T	T	T	T	T	T	T	T	T
	20A	-	-	420	650	1000	1000	T	T	-	-	420	650	1000	1000	T	T	T	T	T	T	T
	25A	-	-	-	650	1000	1000	T	T	-	-	-	650	1000	1000	T	T	T	T	T	T	T
	32A	-	-	-	650	1000	1000	1500	T	-	-	-	650	1000	1000	1500	T	T	T	T	T	T
	40A	-	-	-	-	1000	1000	1500	2000	-	-	-	-	1000	1000	1500	2000	T	T	T	T	T
	50A	-	-	-	-	-	-	1500	2000	-	-	-	-	-	-	1500	2000	3000	T	T	T	T
	63A	-	-	-	-	-	-	1500	2000	-	-	-	-	-	-	1500	2000	3000	2600	T	T	T

Upstream Thermal Magnetic YB Frame MCCB

		YB1N (25kA) or YB1S (40kA)								YB3N (25kA) or YB3S (40kA)				
	In	25A	32A	40A	63A	80A	100A	125A	160A	100A	125A	160A	200A	250A
Downstream K Series MCB (Type B, C & D)	6A	1000	1000	1000	3000	3000	5000	5000	6000	T	T	T	T	T
	10A	1000	1000	1000	2000	2000	4000	4000	5000	T	T	T	T	T
	16A	600	600	600	2000	2000	3000	3000	4000	T	T	T	T	T
	20A	600	600	600	2000	1500	3000	3000	4000	T	T	T	T	T
	25A	-	600	600	1500	1500	2500	2500	3000	T	T	T	T	T
	32A	-	-	600	1500	1500	2500	2500	3000	9000	T	T	T	T
	40A	-	-	-	1500	1500	2500	2500	3000	8000	9000	T	T	T
	50A	-	-	-	1500	1500	2500	2500	3000	7000	8000	9000	T	T
	63A	-	-	-	-	1500	2500	2500	3000	6000	7000	8000	9000	T

T= Total Selectivity

Partial discrimination level is in amps. The above tables are in accordance with IEC 60947-2, Annex A, at 400Vac.

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Short-circuit Discrimination Levels Between an Upstream Fuse and downstream MCB

Where a high prospective fault level exists at the MCB distribution point, discrimination at short-circuit levels should be considered. This will require comparison of the device I^2t characteristics at the relevant prospective fault level.

Discrimination will be obtained at all fault levels for which the MCB total operating I^2t is lower than the pre-arcing I^2t of the device closer to the supply.

The data for typical cartridge fuses can be extracted from graphs and is presented in the following tables.

MCB, type B Current rating (A)	Fuse Sizes								
	20	25	35	50	63	80	100	125	160
6	0.5	0.8	1.7	3.1	7.0	10.0	10.0	10.0	10.0
10	0.4	0.7	1.4	2.3	3.4	4.8	7.5	10.0	10.0
13		0.7	1.4	2.3	3.4	4.8	7.5	10.0	10.0
16			1.3	2.0	2.9	4.2	6.0	9.5	10.0
20				1.9	2.7	3.8	5.6	8.5	10.0
25				1.8	2.6	3.6	5.4	8.0	10.0
32					2.4	3.2	4.2	6.8	10.0
40						3.2	4.2	6.8	9.5
50							3.8	5.7	8.5
63							3.8	5.7	8.5

MCB, type C Current rating (A)	Fuse Sizes								
	20	25	35	50	63	80	100	125	160
6	0.5	0.8	1.7	3.1	7.0	10.0	10.0	10.0	10.0
10			1.4	2.3	3.4	4.8	7.5	10.0	10.0
13				2.3	3.4	4.8	7.5	10.0	10.0
16				2.0	2.9	4.2	6.0	9.5	10.0
20					2.7	3.8	5.6	8.5	10.0
25						3.6	5.4	8.0	10.0
32							4.2	6.8	10.0
40							4.2	6.8	9.5
50								5.7	8.5
63								5.7	8.5

MCB, type D Current rating (A)	Fuse Sizes								
	20	25	35	50	63	80	100	125	160
6	0.7	1.7	3.0	5.9	6.0	6.0	6.0	6.0	6.0
10			1.3	2.2	3.6	6.0	6.0	6.0	6.0
13				1.7	2.5	4.0	6.0	6.0	6.0
16				1.6	2.2	3.1	4.6	6.0	6.0
20					2.2	3.1	4.6	6.0	6.0
25						3.1	4.6	6.0	6.0
32						2.6	3.5	6.0	6.0
40							3.5	6.0	6.0
50								6.0	6.0
63								5.5	6.0

Cascading

Cascading is sometimes referred to as 'back-up protection'. The technique of cascading is used to allow circuit breakers with a breaking capacity lower than the value of prospective short-circuit current at the connection point to be used when these are positioned downstream of a current-limiting circuit breaker of higher breaking capacity. The net result of this arrangement is that the downstream device acquires an enhanced 'installed' breaking capacity, therefore a less expensive, lower breaking capacity breaker can be used.

The upstream circuit breaker must have the normally required breaking capacity for its point of installation however, when combined with another circuit breaker downstream, the two devices in series will be able to clear a larger fault. For example: if a 10A, 6kA MCB is place downstream of a YA frame MCCB rated at 125A and 25kA, the MCB will have an installed breaking capacity of 14kA. Similarly, a 10A, 10kA MCB downstream of a YA frame MCCB rated at 250A and 25kA will have an installed breaking capacity of 25kA.

It should be noted that the cascading technique is not limited to only two devices in series. The important point is that it is the upstream device that is limiting the current to a value that can be interrupted by the following device, so that the pattern of paired devices can be repeated many times in an hierarchy of devices.

The following tables give 'installed breaking capacity' values of downstream circuit breakers for both the MCCB/MCB and MCCB/MCCB pairings of cascaded devices. Note that all values shown are at 400V ac. The values for the installed breaking capacities are given in kA.

Upstream YA2/YA3 MCCB

	Current Rating	Frame Rating	125A		250A	
		Model	YA2S T/Mag	YA2J T/Mag	YA3S T/Mag	YA3J T/Mag
		Breaking capacity	36kA	65kA	36kA	65kA
Downstream S Series MCB	6A	6kA	14	14	12	12
	10A	6kA	14	14	12	12
	16A	6kA	14	14	12	12
	20A	6kA	14	14	12	12
	32A	6kA	14	14	12	12
	40A	6kA	12	12	10	10
	50A	6kA	12	12	10	10
	63A	6kA	12	12	10	10

Upstream YA2/YA3 MCCB

	Current Rating	Frame Rating	125A		250A	
		Model	YA2S T/Mag	YA2J T/Mag	YA3S T/Mag	YA3J T/Mag
		Breaking capacity	36kA	65kA	36kA	65kA
Downstream K Series MCB	6A	10kA	30	30	25	25
	10A	10kA	30	30	25	25
	16A	10kA	30	30	25	25
	20A	10kA	30	30	25	25
	32A	10kA	30	30	25	25
	40A	10kA	30	30	23	23
	50A	10kA	30	30	23	23
	63A	10kA	30	30	23	23

Upstream YB1 MCCB

	Current Rating	Model	YB1N T/Mag							YB1S T/Mag						
		Rating	25A	40A	63A	80A	100A	125A	160A	25A	40A	63A	80A	100A	125A	160A
		Breaking Capacity	25kA							40kA						
Downstream S Series MCB (Type B, C & D)	6A	6kA	14	14	14	14	14	14	14	14	14	14	14	14	14	14
	10A	6kA	14	14	14	14	14	14	14	14	14	14	14	14	14	14
	16A	6kA	14	14	14	14	14	14	14	14	14	14	14	14	14	14
	20A	6kA	14	14	14	14	14	14	14	14	14	14	14	14	14	14
	25A	6kA		14	14	14	14	14	14		14	14	14	14	14	14
	32A	6kA		14	14	14	14	14	14		14	14	14	14	14	14
	40A	6kA			14	14	14	14	14			14	14	14	14	14
	50A	6kA			14	14	14	14	14			14	14	14	14	14
	63A	6kA				14	14	14	14				14	14	14	14

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Upstream YB1 MCCB

Downstream K Series MCB (Type B, C & D)

Current Rating	Model	YB1N T/Mag							YB1S T/Mag						
	Rating	25A	40A	63A	80A	100A	125A	160A	25A	40A	63A	80A	100A	125A	160A
	Breaking Capacity	25kA							40kA						
6A	10kA	25	25	25	25	20	20	20	40	40	40	40	30	30	25
10A	10kA	25	25	25	25	20	20	20	40	40	40	40	30	30	25
16A	10kA	25	25	25	25	20	20	20	40	40	40	40	30	30	25
20A	10kA	25	25	25	25	20	20	20	40	40	40	40	30	30	25
25A	10kA		25	25	25	20	20	20		40	40	40	30	30	25
32A	10kA		25	25	25	20	20	20		40	40	40	30	30	25
40A	10kA			25	25	20	20	20			40	40	30	30	25
50A	10kA			25	25	20	20	20			40	40	30	30	25
63A	10kA				25	20	20	20				40	30	30	25

Upstream YB3 MCCB

Downstream S Series MCB (Type B, C & D)

Current Rating	Model	YB3N T/Mag					YB3S T/Mag				
	Rating	100A	125A	160A	200A	250A	100A	125A	160A	200A	250A
	Breaking Capacity	25kA					40KA				
6A	6kA	10	10	10	10	10	12	12	12	12	12
10A	6kA	10	10	10	10	10	12	12	12	12	12
16A	6kA	10	10	10	10	10	12	12	12	12	12
20A	6kA	10	10	10	10	10	12	12	12	12	12
25A	6kA	10	10	10	10	10	12	12	12	12	12
32A	6kA	10	10	10	10	10	12	12	12	12	12
40A	6kA	5	5	5	5	5	10	10	10	10	10
50A	6kA	5	5	5	5	5	10	10	10	10	10
63A	6kA	5	5	5	5	5	10	10	10	10	10

Upstream YB3 MCCB

Downstream K Series MCB (Type B, C & D)

Current Rating	Model	YB3N T/Mag					YB3S T/Mag				
	Rating	100A	125A	160A	200A	250A	100A	125A	160A	200A	250A
	Breaking Capacity	25kA					40KA				
6A	10kA	20	20	20	20	20	25	25	25	25	25
10A	10kA	20	20	20	20	20	25	25	25	25	25
16A	10kA	20	20	20	20	20	25	25	25	25	25
20A	10kA	20	20	20	20	20	25	25	25	25	25
25A	10kA	20	20	20	20	20	25	25	25	25	25
32A	10kA	20	20	20	20	20	25	25	25	25	25
40A	10kA	20	20	20	20	20	25	25	25	25	25
50A	10kA	20	20	20	20	20	25	25	25	25	25
63A	10kA	20	20	20	20	20	25	25	25	25	25

Cascade fault level is expressed in kA. The above tables are in accordance with IEC 60947-2, Annex A, at 400Vac.

Upstream YA2/YA3 MCCB

Downstream YA2/YA3 MCCB

Frame Rating	Model	Breaking capacity	YA2S T/Mag	YA2J T/Mag	YA3S T/Mag	YA3J T/Mag
			36kA	65kA	36kA	65kA
125A	YA2S T/Mag YA2J T/Mag	36kA 65kA	- -	65 -	- -	65 -
250A	YA3S T/Mag YA3J T/Mag	36kA 65kA	- -	- -	- -	65 -

Cascade fault level is expressed in kA. The above tables are in accordance with IEC 60947-2, Annex A, at 400Vac.

Upstream YA5, YA6, YA7 or YA8 MCCB

Downstream YA2/YA3/YA5 MCCB

Frame Rating	Model	Breaking capacity	400A				800A					1250A		1600A	
			YA5H T/Mag	YA5H Elec	YA5J T/Mag	YA5K Elec	YA6S T/Mag	YA6H T/Mag	YA6H Elec	YA6K T/Mag	YA6K Elec	YA7H Elec	YA7K Elec	YA8H Elec	YA8K Elec
			50kA		70kA		36kA	50kA		70kA		50kA	70kA	50kA	85kA
125A	YA2S T/Mag YA2J T/Mag	36kA 65kA	50 -		65 70		- -	50 -		50 70		- -	- -	- -	- -
250A	YA3S T/Mag YA3J T/Mag	36kA 65kA	50 -		65 70		- -	50 -		70 70		- -	- -	- -	- -
400A	YA5N T/Mag YA5H T/Mag YA5J T/Mag	25kA 50kA 70kA	36 - -		50 70 -		30 - -	36 - -		50 70 -		36 - -	36 70 -	36 - -	36 70 85

Cascade fault level is expressed in kA. The above tables are in accordance with IEC 60947-2, Annex A, at 400Vac.

System Sizing and Diversity

The adequacy of sizing and rating of power distribution systems is important to ensure supply continuity and safety in operation. A number of design parameters must be taken into account in order to ensure that the supply and safety requirements are met. These include busbar ratings, short-circuit fault levels and circuit utilisation.

Once the overall loading requirements have been established, and the supply transformer selected, consideration of the circuit distribution systems follows. Distribution enclosures and their busbar systems are pre-tested to accepted norms of through-fault levels, typically 16kA, 25kA, 35kA, 50kA and 80kA. These shortcircuit ratings alone will limit the choice of switchboard, panel board or distribution board. The selection of the type and size of enclosure to be used will then depend upon the busbar current rating needed, together with availability of sufficient circuit ways of the correct type for the circuits and sub-circuits to be supplied.

The busbar current rating is generally chosen to be sufficient to supply full load, plus some safety factor. For example, if the full load is expected to be 750 amps, an enclosure with a busbar rating of 800 amps may be selected. Once the busbar current rating has been nominated, the incoming device for that group of circuits will be matched to the rating. In the example cited, the incoming device would be rated at 800 amps. More than one incoming device may be required to effect proper circuit protection and isolation, such as a switch disconnector in series with a thermal fuse. In this case, the fuse link will provide the protection and the disconnector will permit isolation. Alternatively, a moulded case circuit breaker (MCCB) employed as the incoming device will provide both protection and isolation.

The size and type of circuits to be supplied will further refine the eventual choice of distribution system. Automatic or manual circuit disconnection will point to an enclosure suitable for either circuit breakers or switch-fuse devices. If the requirement is for automatic disconnection, prospective fault levels at the connection point may dictate that an MCCB must be used, rather than an MCB of the same current rating.

Finally, consideration is given to the degree of circuit utilisation capacity, often referred to as 'diversity'. Notwithstanding the limitations of the busbar system and the matched protection provided by the incoming device, the outgoing circuit ways may be configured with individual circuit protection devices having an aggregate rated current capacity in excess of the rating of the incomer.

The basis for this approach is that it is often reasonable to assume that not all circuits will be supplying their rated current at the same time. In this case, a 'diversity factor' is applied during the design stage to give an overall service capacity for the outgoing circuits. The maximum current rating divided by the diversity factor will give the maximum aggregate 'fitted' current allowed. The following table lists the factors that may be applied subject to the number of outgoing circuits to be supplied.

Taking the example of a 400A panel board with 400A MCCB incomer and 6 outgoing circuits, a diversity factor of 0.7 would allow outgoing MCCBs with an aggregate of 570A capacity to be installed. The individual circuits would be protected at the level of current rating of each MCCB, with the incomer providing ultimate protection at 400A. To allow for the possibility of future expansion of a distribution system, an allowance for 25% spare capacity is often included when applying a diversity factor to the initial design

Number of circuits	MCCB panel boards to EN 61439-2	MCB distribution boards to EN 61439-3
2-3	0.9	0.8
4-5	0.8	0.7
6-9	0.7	0.6
10+	0.6	0.5

Prospective Short-circuit Current

The Prospective Short-circuit Current, or PSC, is the theoretical maximum fault current that could exist at any point within a complete circuit distribution system.

The magnitude of the fault current at any particular point is calculated on the basis of a 'bolted' (virtually permanent) fault path at that point and therefore assumes a constant voltage, continuous current supply feeding the fault. Using this assumption, the PSC that could possibly exist at the bolted fault path would be limited only by the sum of the circuit impedances of the complete current path, from high voltage feed to the supply transformer through to the bolted connection point. Since this assumption cannot be fulfilled in practice (for example, the voltage will not remain constant) the value of calculated PSC can never be exceeded in a practical scheme.

The foregoing commentary is particularly relevant to larger commercial and industrial networks, where many sub-systems are present and often, many sub-circuits within these. For more compact arrangements, such as domestic installations, where the distribution scheme is contained within one or more consumer units, the situation is much simpler. The Regional Electricity Companies generally agree on a fixed fault level of 16kA at the local zone supply distribution point to one or more dwellings. Those dwellings that lie some distance from the zone origin point of the distributed supply will have reduced PSC due to the higher impedance of the longer run of service cable. Consumer units should therefore have a minimum conditional short-circuit rating of 16kA. When an MCB trips, the combination of forced contact separation and rapid arc extinction produces a limiting effect on the fault current such that it will be adequately handled within the normal 6kA breaking capacity of MCBs fitted to domestic installations.

PSC at the origin point

In practice and with consideration of the total distribution network; the breaking capacity of an individual circuit device would normally be less than that calculated for the origin point of the scheme.

PSC at the connection point

The breaking capacity of individual devices must be greater than (or at least equal to) the PSC at the specific point of their connection within a scheme. Conversely, where the circuit device breaking capacity is greater than the PSC at origin, there is no need for further measurement or calculation in this regard.

The PSC at any particular connection point can be estimated, calculated, or determined by measurement of the circuit impedance at that point. Measurement of the circuit impedances at all relevant connection points can be a laborious exercise; the calculation method is generally used since this can be readily carried out using one of a number of available computer software packages.

PSC by calculation

The magnitude of the short-circuit current (rms value of the ac component) at the connection point will depend upon:

- The PSC at the origin point.
- The total resistance in the circuit between the origin point and the relevant circuit reference point.
- Whether the short-circuit condition is considered as phase-phase, phase-neutral or phase-earth.

The maximum PSC at the origin can be calculated from the following formula:

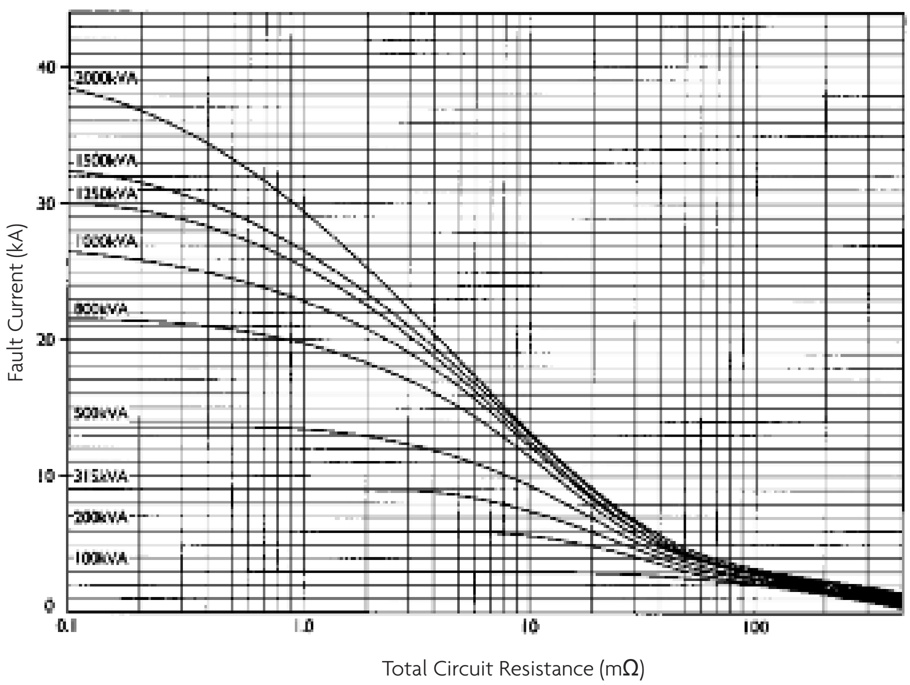
$$\text{PSC (kA)} = \frac{\text{Supply transformer rating (kVA) x 100}}{\sqrt{3}\text{ x secondary voltage x \% transformer reactance}}$$

PSC by estimation

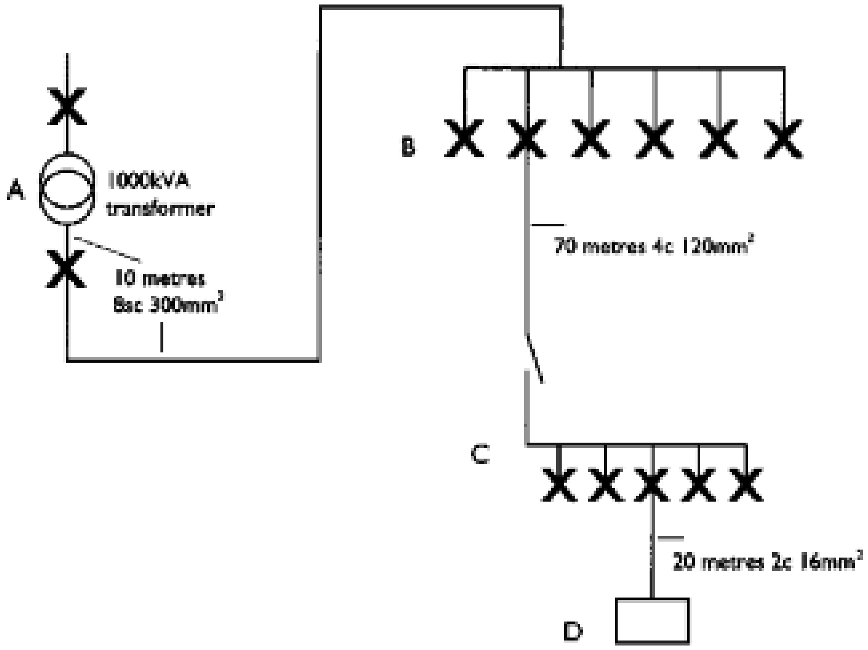
To estimate the PSC, first calculate the total resistance in the LV circuit by determining the sizes and lengths of cables between the supply source and the point under consideration. Next, use the following table to find the cable resistances and summate these to obtain the total resistance. Finally, use this value to read off the estimated PSC from the following graph.

Maximum Resistance of Copper Conductors at 20°C (milli ohms)

Nominal cross sectional area (mm²)	Cable length (m)											
	5	10	15	20	30	40	50	60	70	80	90	100
1	90.50	181.00										
1.5	60.50	121.00	182.00									
2.5	37.10	74.10	111.00	148.00								
4	23.10	46.10	69.20	92.20	138.00							
6	15.40	30.80	46.20	61.60	92.40	123.00						
10	9.15	18.30	27.50	36.60	54.90	73.20	91.50	110.00				
16	5.75	11.50	17.30	23.00	34.50	46.00	57.20	69.00	80.50	92.00		
25	3.64	7.27	10.90	14.50	21.80	29.10	36.40	43.60	50.90	58.20	65.40	72.70
35	2.62	5.24	7.86	10.48	15.70	21.00	26.20	31.40	36.70	41.90	47.20	52.40
50	1.94	3.87	5.81	7.74	11.60	15.50	19.40	23.20	27.10	31.00	34.80	38.70
70	1.34	2.68	4.02	5.36	8.04	10.70	13.40	16.10	18.80	21.40	24.10	26.80
95	0.96	1.93	2.86	3.86	5.79	7.72	9.65	11.60	13.50	15.40	17.40	19.30
120	0.77	1.53	2.30	3.06	4.59	6.12	7.65	9.18	10.70	12.20	13.80	15.30
150	0.62	1.24	1.86	2.48	3.72	4.96	6.20	7.44	8.68	9.92	11.20	12.40
185	0.49	1.00	1.49	1.98	2.97	3.96	4.96	5.96	6.94	7.93	8.92	9.91
240	0.38	0.75	1.13	1.51	2.26	3.02	3.77	4.52	5.28	6.03	6.79	7.54
300	0.30	0.60	0.90	1.20	1.80	2.40	3.00	3.60	4.20	4.80	5.40	6.00
400	0.23	0.47	0.70	0.94	1.41	1.88	2.35	2.85	3.29	3.76	4.23	4.70
500	0.18	0.37	0.55	0.73	1.10	1.46	1.83	2.20	2.56	2.93	3.29	3.66
630	0.14	0.28	0.42	0.57	0.85	1.13	1.42	1.78	2.15	2.51	2.88	3.25



PSC in a typical installation



Note that the values on the graph assume a symmetrical fault across the three phases. In a single circuit, for line-neutral faults, the cable resistance value given in the table should be doubled.

The following values of PSC would be obtained at the various circuit points marked in the above diagram:

Point 'A'	PSC = approximately 27kA	
Point 'B'	Two cables per phase, therefore halve the value. Resistance from 'A' to 'B' With reference to the graph PSC can be assumed to be 25kA	 = 0.3 Milli ohms
Point 'C'	Resistance from 'A' to 'B' Resistance from 'B' to 'C' Total circuit resistance 'A' to 'C' With reference to the graph PSC can be assumed to be 12kA	= 0.3 Milli ohms = 10.7 Milli ohms = 11.0 Milli ohms
Point 'D'	Resistance from 'A' to 'B' Resistance from 'B' to 'C' Resistance from 'C' to 'D' (Double the value for the 2-core cable) Total circuit resistance 'A' to 'D' With reference to the graph PSC can be assumed to be 3kA	= 0.3 Milli ohms = 10.7 Milli ohms = 46.0 Milli ohms = 57.0 Milli ohms

Earth Fault Protection

One of the most common means of protecting persons against the effects of high voltages and currents is by insulating the wiring and components. Most earth faults occur when some part of the insulation has broken down, creating the possibility of causing electric shock through indirect contact with the faulty circuit. The breakdown of insulation can often cause all or part of an enclosure or frame to become 'live' by raising conductive parts to a hazardous voltage level. Touching any of the exposed parts of the enclosure or frame would then be highly dangerous and would most likely cause an electric shock.

Whilst protective devices may open quickly to minimise the possibility of high currents flowing for any significant length of time, additional measures are necessary to limit the potential earth fault current at source. In some cases fault current limiting resistors or inductors may be installed at the transformer star point however, in all cases, it is important to ensure that the impedance of circuit conductors is kept to a minimum so that the voltage developed under fault conditions will be restricted. The earth fault loop impedance is denoted Zs and is an important circuit design parameter.

Circuit designs must always ensure that the magnitude of the fault current will be sufficient to trip the over-current protective devices within acceptable times as stated in the IEE Wiring Regulations. Circuit breakers are designed to trip and therefore disconnect faulted circuits very quickly. The design value of tripping time is generally expressed in the form of a graph that maps current against time and any practical scheme can be checked against this value to ascertain conformance with the requirements.

The fault current can be established very simply using Ohm's law, as follows:

$$\text{Fault current} = \frac{\text{Minimum phase to earth voltage}}{\text{Zs}}$$

Once this value is known, the corresponding maximum tripping time can be read from the relevant device's time/current characteristic graph and the result compared with that given within the Wiring Regulations. In general, the higher the nominal voltage of an installation, the shorter will be the required disconnection time. For fixed equipment installations, the maximum disconnection time is stated as 5 seconds, whereas it is 0.4 seconds for portable equipment. The Regulations define 'portable' as including fixed outlet sockets that may be used to supply apparatus that is movable or portable when in use.

The following table illustrates the maximum Zs allowable for MCBs to achieve the specified disconnection times.

Current rating (A)	B type		C type		D type	
	0.4s	5s	0.4s	5s	0.4s	5s
6	7.28	7.28	3.64	6.27	1.81	6.27
10	4.37	4.37	2.19	3.76	1.09	3.76
13	3.35	3.35	1.67	2.90	0.84	2.90
16	2.73	2.73	1.36	2.35	0.67	2.35
20	2.19	2.19	1.09	1.88	0.54	1.88
25	1.75	1.75	0.87	1.50	0.44	1.50
32	1.36	1.36	0.67	1.17	0.33	1.17
40	1.09	1.09	0.54	0.94	0.27	0.94
50	0.87	0.87	0.44	0.75	0.22	0.75
63	0.69	0.69	0.34	0.59	0.17	0.59

The table on the left is based on maximum allowable Earth loop impedance values in accordance with BS7671:2008 incorporating Amendment 3, 2015.

Since the complete loop impedance is the sum of the individual impedances of the supply transformer winding, circuit phase conductor and protective circuit conductor, the total may be higher than that specified for in-time disconnection for the protection device proposed. In these cases, several solutions may be possible to overcome or at least assist in achieving compliance.

- The supply cable may be replaced by one with greater cross sectional area
- The short-circuit tripping threshold of the device may be set to a lower value (if it is adjustable)
- A Residual Current Device could be used to replace the circuit breaker in question

The following tables indicate the maximum Zs for Dorman Smith's range of MCCBs. Using these tables obviates the need to determine the suitability of a device by reference to its time/current characteristic graph.

Zs Values for YB1 and YA2 MCCBs

Maximum Allowable Earth Loop Impedance Values, in accordance with BS7671:2008 incorporating Amendments 3, 2015

MCCB Reference	Instantaneous (Ii) Protection Setting	Zs values @ 230Vac		
		In	0.4 sec	5 sec
YB1 1P Fixed Thermal / Fixed Magnetics YB1N, 25 kA		16	0.30	1.14
		20	0.30	0.91
		25	0.30	0.73
		32	0.30	0.57
		40	0.30	0.46
		50	0.30	0.36
		63	0.18	0.29
		80	0.18	0.23
		100	0.12	0.18
		125	0.12	0.15
YB1 3P & 4P Adjustable Thermal / Fixed Magnetics YB1N, 25kA YB1S, 40kA		25	0.30	0.72
		32	0.30	0.54
		40	0.30	0.44
		63	0.18	0.27
		80	0.18	0.20
		100	0.12	0.17
		125	0.12	0.12
		160	0.11	0.11
YA2 1P Fixed Thermal / Fixed Magnetics YA2N, 25kA		16	0.87	1.24
		20	0.70	0.95
		25	0.56	0.78
		32	0.44	0.59
		40	0.35	0.48
		50	0.28	0.40
		63	0.22	0.31
		80	0.17	0.25
		100	0.14	0.19
		125	0.11	0.15
YA2 3P & 4P Adjustable Thermal / Adjustable Magnetics YA2S, 36kA YA2J, 65kA	MIN	20	1.52	1.81
	MAX	20	0.76	1.11
	MIN	32	0.95	0.95
	MAX	32	0.48	0.63
	MIN	50	0.61	0.62
	MAX	50	0.30	0.30
	MIN	63	0.48	0.48
	MAX	63	0.24	0.24
	MIN	100	0.30	0.30
	MAX	100	0.15	0.15
	MIN	125	0.24	0.24
	MAX	125	0.15	0.15

Zs Values for YA3, YB3 and YA5 MCCBs

Maximum Allowable Earth Loop Impedance Values, in accordance with BS7671:2008 incorporating Amendment 3, 2015

MCCB Reference	Instantaneous (Ii) Protection Setting	Zs values @ 230Vac		
		In	0.4 sec	5 sec
YA3 1P Fixed Thermal		16	1.14	1.22
/ Fixed Magnetics		20	0.91	1.00
YA3N, 25kA		25	0.73	0.78
		32	0.57	0.59
		40	0.46	0.48
		50	0.36	0.39
		63	0.29	0.31
		80	0.23	0.25
		100	0.18	0.20
		125	0.14	0.16
		160	0.11	0.12
YA3 3P & 4P Adjustable	MIN	20	1.52	1.81
Thermal / Adjustable	MAX	20	0.76	1.11
Magnetics	MIN	32	0.95	0.95
YA3S, 36kA	MAX	32	0.48	0.63
YA3J, 65kA	MIN	50	0.61	0.62
	MAX	50	0.30	0.30
	MIN	63	0.48	0.48
	MAX	63	0.24	0.24
	MIN	100	0.30	0.30
	MAX	100	0.15	0.15
	MIN	125	0.24	0.24
	MAX	125	0.12	0.15
	MIN	160	0.19	0.19
	MAX	160	0.09	0.11
	MIN	200	0.15	0.15
	MAX	200	0.07	0.07
	MIN	250	0.12	0.12
	MAX	250	0.07	0.07
YB3 3P & 4P Adjustable	FIXED	50	0.28	0.28
Thermal / Adjustable	FIXED	63	0.22	0.22
Magnetics	MIN	100	0.36	0.36
YB3N, 25kA	MAX	100	0.14	0.14
YB3S, 40kA	MIN	125	0.29	0.29
	MAX	125	0.11	0.11
	MIN	160	0.22	0.22
	MAX	160	0.09	0.09
	MIN	200	0.18	0.18
	MAX	200	0.07	0.07
	MIN	250	0.14	0.14
	MAX	250	0.07	0.07
YA5 3P & 4P Adjustable	MIN	250	0.121	0.121
Thermal/Adjustable	MAX	250	0.061	0.061
Magnetic YA5N, 25kA	MIN	400	0.076	0.076
YA5H, 50kA	MAX	400	0.038	0.038
YA5 3P & 4P Electronic	Short time (Isd) Protection Setting			
YA5J-E, 65kA	MIN	250	0.304	0.304
YA5K-E, 70kA	MAX	250	0.076	0.076
	MIN	400	0.190	0.190
	MAX	400	0.048	0.048

Zs values for YA6, YA7 and YA8 MCCBs
Maximum Allowable Earth Loop Impedance Values, in accordance with BS7671:2008 incorporating Amendment 3, 2015

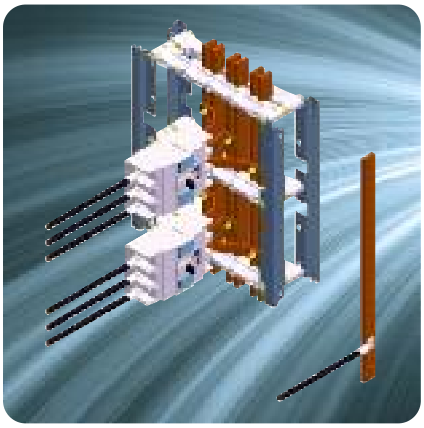
Loadline MCCBs	Instantaneous (Ii) Protection Setting	Zs Values @ 230Vac		
		In	0.4 sec	5 sec
YA6 3P & 4P Adjustable Thermal/Adjustable Magnetics YA6H, 50kA YA6K, 70kA	MIN (YA6H Only)	400	0.058	0.058
	MAX (YA6H Only)	400	0.029	0.029
	MIN	630	0.058	0.058
	MAX	630	0.029	0.029
	MIN	800	0.046	0.046
	MAX	800	0.023	0.023
YA6 3P and 4P Electronic YA6H-E, 50kA YA6K-E, 70kA	Short time (Isd) Protection Setting			
	MIN	630	0.121	0.121
	MAX	630	0.030	0.030
	MIN	800	0.095	0.095
	MAX	800	0.024	0.024
YA7 3P & 4P Electronic YA7H-E, 50kA YA7K-E, 70kA	Short time (Isd) Protection Setting			
	MIN	1250	0.061	0.061
	MAX	1250	0.015	0.015
YA8 3P & 4P Electronic YA8H-E, 50kA YA8K-E, 85kA	Short time (Isd) Protection Setting			
	MIN	1600	0.048	0.048
	MAX	1600	0.012	0.012

Loadline YA/YB Thermal and Magnetic Adjustment Settings

Loadline YB Frame Thermal/Magnetic MCCBS			
MCCB Frame/Type	Rated Current In (A)	Magnetic Trip Current (Ii) Adjustment	Thermal Trip Current (Ir) Adjustment
YB1N (1 pole)	16, 20, 25, 32, 40, 50	600A FIXED	FIXED
	63, 80	1000A FIXED	
	100, 125	1500A FIXED	
YB1N & YB1S	25, 32, 40	600A FIXED	0.63 x In, 0.8 x In, 1.0 x In
	63, 80	1000A FIXED	
	100, 125	1500A FIXED	
	160	1600A FIXED	
YB3N & YB3S	50	650A FIXED	0.63 x In, 0.8 x In, 1.0 x In
	63	819A FIXED	
	100, 125, 160, 200	5 x In - 13 x In	
	250	5 x In - 11 x In	

Loadline YA Frame Thermal/Magnetic MCCBS			
MCCB Frame/Type	Rated Current In (A)	Magnetic Trip Current (Ii) Adjustment	Thermal Trip Current (Ir) Adjustment
YA2N (1 pole)	16	208A FIXED	FIXED
	20	260A FIXED	
	25	325A FIXED	
	32	420A FIXED	
	40	520A FIXED	
	50	650A FIXED	
	63	820A FIXED	
	80	1040A FIXED	
	100	1300A FIXED	
	125	1550A FIXED	
YA2S & YA2J	20, 32, 50, 63, 100	6 x In - 12 x In	0.63 x In, 0.8 x In, 1.0 x In
	125	6 x In - 10 x In	
YA3N (1 pole)	16	160A FIXED	FIXED
	20	200A FIXED	
	25	250A FIXED	
	32	320A FIXED	
	40	400A FIXED	
	50	500A FIXED	
	63	630A FIXED	
	80	800A FIXED	
	100	1000A FIXED	
	125	1250A FIXED	
	160	1600A FIXED	
YA3S	20, 32	6 x In - 12 x In	0.63 x In, 0.8 x In, 1.0 x In
YA3J	50, 63, 100, 125	6 x In - 12 x In	0.63 x In, 0.8 x In, 1.0 x In
	160, 200	6 x In - 13 x In	
	250	6 x In - 10 x In	
YA5N, YA5H & YA5J	250,400	6 x In - 12 x In	0.63 x In, 0.8 x In, 1.0 x In
YA6H	400	7.875 x In - 15.75 x In	FIXED
YA6H & YA6K	630, 800	5 x In - 10 x In	0.63 x In, 0.8 x In, 1.0 x In

Forms of Separation



The principle of separation applied to multi-cubicle switchboards and panel boards is the achievement of a high degree of safety for equipment and people during normal operation and to promote safe working during commissioning and service. The resulting concept is one of functional separation and segregation of live parts of the system into sub-units by the use of barriers or partitions.

In general, separation should provide enhanced safety by:

- Protecting against contact with the live parts of adjacent functional units
- Preventing the passage of solid foreign bodies from one section of an assembly to an adjacent one

Various elements of an assembly must be considered for separation from neighbouring live sections, such as busbars, terminals and functional units. The specific form of their separation can be achieved in several ways according to the particular application and the requirements for access for maintenance. The minimum degree of protection to be achieved at each barrier or partition is to IP2X as specified in the Ingress Protection standard EN 60529. Typically, this may include:

- PVC sleeving, wrapping or plastic coating of conductors
- Insulated terminal shrouds or PVC 'boots'
- Rigid insulated barriers or partitions
- Compartments formed from earthed metal
- A device's integral housing

There are several forms of separation, indicated by numbered category and subcategory; however the requirements for the degree of separation need to be carefully considered since the cost increases significantly with increased degree.

The principal categories are:

Form 1 – No separation
Typical applications are where the assembly is to be placed in a secure location and where failure will cause little or no additional disruption to other areas being supplied by that particular assembly.

Form 2 – Separation of busbars from functional units
Applications may be similar to those of Form 1 but where it is important that a fault need not affect all functional units being supplied by the same busbar system.

Form 3 – Separation of busbars from functional units and the functional units from one another, but not their terminations
This form should be applied where it is important to provide protection from internal live parts and where failure of functional units being supplied from the same busbar would cause unacceptable disruption.

Form 4 – Separation of busbars from functional units and the functional units from one another, including their terminals
This form should be applied where it is important to provide protection from internal live parts and where failure of functional units being supplied from the same busbar would cause unacceptable disruption. Because all the terminations are separated, it is possible to isolate and work on a single functional unit.

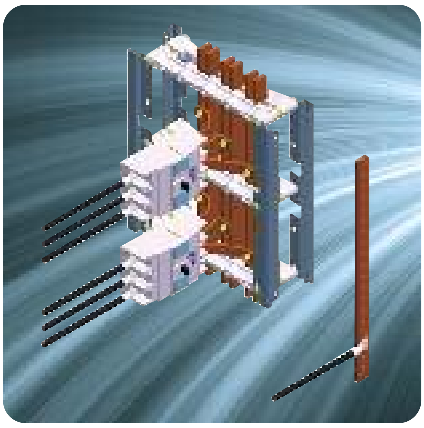
Dorman Smith 'LF-type' panel board systems are supplied in Form 2 as standard, with Form 4 versions achieved with simple conversion kits. However, other separation forms can be provided in special cases.

With the exception of Form 1, the other separation forms have sub-categories that permit permutations of the general form to be configured according to the requirements for specific applications and to allow the accommodation of different types of protection method. The exact form of separation provided on an assembly is a matter for agreement between the manufacturer and the end user.

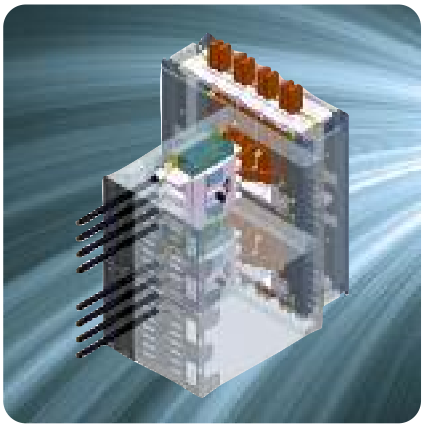
DORMAN SMITH

Sub-categories of Separation Forms

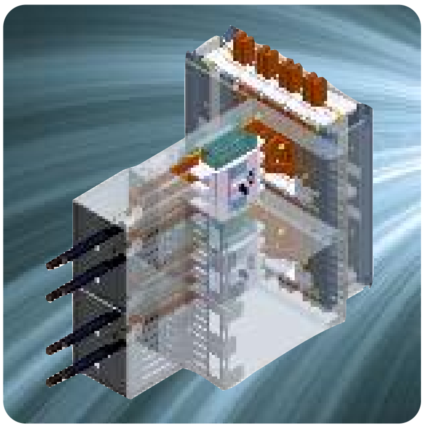
Main criteria	Sub criteria	Form	Type	Construction
No separation		1		
Separation of busbars from the functional units	Terminals for external conductors not separated from busbars	2a		
	Terminals for external conductors separated from busbars	2b	1	Busbar separation by insulated coverings
			2	Busbar separation by rigid barriers
Separation of busbars from the functional units and separation of all functional units from one another.	Terminals for external conductors not separated from busbars	3a		
Separation of the terminals for external conductors from functional units but not from each other	Terminals for external conductors separated from busbars	3b	1	Busbar separation by insulated coverings
			2	Busbar separation by rigid barriers
Separation of busbars from the functional units and separation of all functional units from one another including terminals for external conductors which are an integral part of the functional unit	Terminals for external conductors in the same compartment as the associated functional unit	4a	1	Busbar separation by insulated coverings. Cables may be glanded elsewhere
			2	Busbar separation by rigid barriers. Cables may be glanded elsewhere
			3	All separation by rigid barriers The termination for each functional unit has its own integral glanding facility
	Terminals for external conductors not in the same compartment as the associated functional unit but in individual, separate, enclosed protected spaces or compartments	4b	4	Busbar separation by insulated coverings. Cables may be glanded elsewhere
			5	Busbar separation by rigid barriers. Terminals may be separated by insulated coverings and glanded in common cabling chambers
			6	All separation by rigid barriers Cables are glanded in common cabling chambers
			7	All separation by rigid barriers The termination for each functional unit has its own integral glanding facility



Form 3a Group Mounted



Form 4a Type 2 Compartmentalised



Form 4b Type 6 Compartmentalised

Ingress Protection

The EN 60529 standard describes a system for classifying degrees of protection against the ingress of foreign bodies and harmful liquids. It is intended that this standard is applied to enclosures of low voltage (LV) electrical equipment. The classification scheme comprises a designation prefixed by the upper case letters 'IP', followed by two numerals.

The first numeral designates the degree of protection with regard to solid objects; the second numeral indicates the degree of protection against the ingress of liquid.

Compliance to the standard is intended to:

- Protect persons against access to hazardous parts inside enclosures and protect the equipment inside the enclosure against the ingress of solid foreign objects.
- Protect the equipment inside the enclosure against harmful ingress of liquids.

First Number	Protection against ingress of solid objects or dust	Equivalent
0	No protection	
1	50mm diameter solid foreign object	Back of hand
2	12.5mm diameter solid foreign object	Finger
3	2.5mm diameter solid foreign object	Tool
4	1mm diameter solid foreign object	Wire
5	Limited ingress of dust (no harmful deposit)	Wire
6	Total protection against dust ingress	Wire
X	Not tested	-

Second Number	Protection against the ingress of water	Equivalent
0	No protection	
1	Against vertically falling water drops	Vertical drips
2	As in 1, but with enclosure tilted 15 degrees from vertical	Slanted dripping to 15 degrees from vertical
3	Against spray to 60 degrees from vertical – limited ingress permitted	Limited spray
4	Against splashing from any direction – limited ingress permitted	Splashing from any direction
5	Against low pressure jets from any direction – limited ingress permitted	Hosing jets from any direction
6	Against strong jets from any direction	Power hosing from any direction
7	Against immersion up to one metre	Temporary immersion
8	Against prolonged immersion under pressure	Continuous immersion
X	Not tested	-

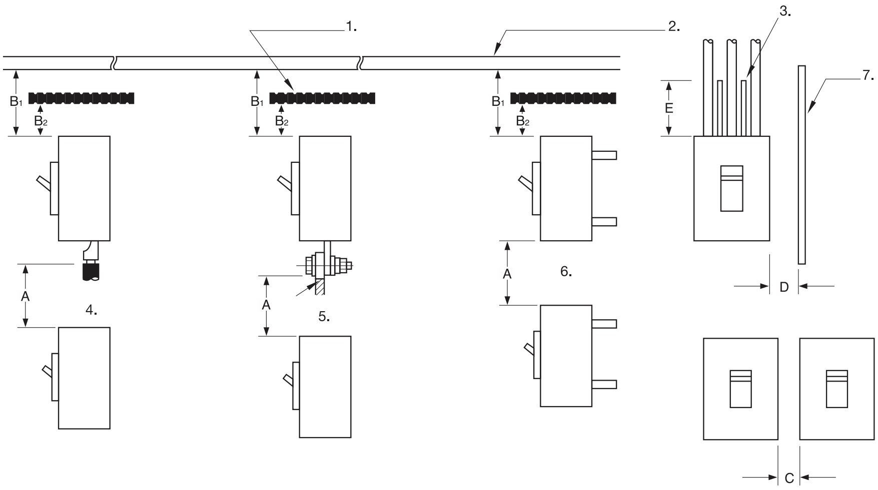
For assemblies for indoor use where there is no requirement for the protection against ingress of water, the following IP codes are preferred: IP00, IP2X, IP3X, IP4X, IP5X, IP6X.

Additional Letter of IP code	Protection of persons against access to hazardous (live or moving) parts inside the enclosure
A	Back of hand (50mm diameter)
B	Standard jointed test finger (12mm diameter, 80mm length)
C	Tool 2.5mm diameter, 100mm length
D	Wire 1.0mm diameter, 100mm length

Insulation Distances for Loadline YA Frame MCCBs

The insulation distances between an MCCB and adjacent earthed metal parts and insulators shown in the diagram below must be maintained to prevent arcing faults occurring due to conductive ionised gases. In cases where requirements differ from those illustrated here, the greater distance must be maintained. Where two different YA frame devices are installed one above the other, the insulation distance between the two should be as for the lower size of MCCB.

Exposed conductors must be insulated up to the barrier terminals. Interphase barriers or terminal covers are recommended. However, if terminal covers are used, the exposed conductor must be insulated until it overlaps the terminal cover.



1. Insulation plate
2. Top plate (earthed metal)
3. Interphase barriers
4. Front connected MCCB
5. Front connected MCCB with terminal bar
6. Rear connected type or plug-in type
7. Side panel (earthed metal)

A. Distance from lower breaker to exposed live part of upper breaker terminal (front connected type) or from lower breaker to end face of upper breaker (rear connected or plug-in type)
B1. Distance from end face of breaker to top plate
B2. Distance from end face of breaker to insulation plate
C. Gap between breakers
D. Distance from side of breaker to side panel
E. Dimensions of insulation over exposed conductors

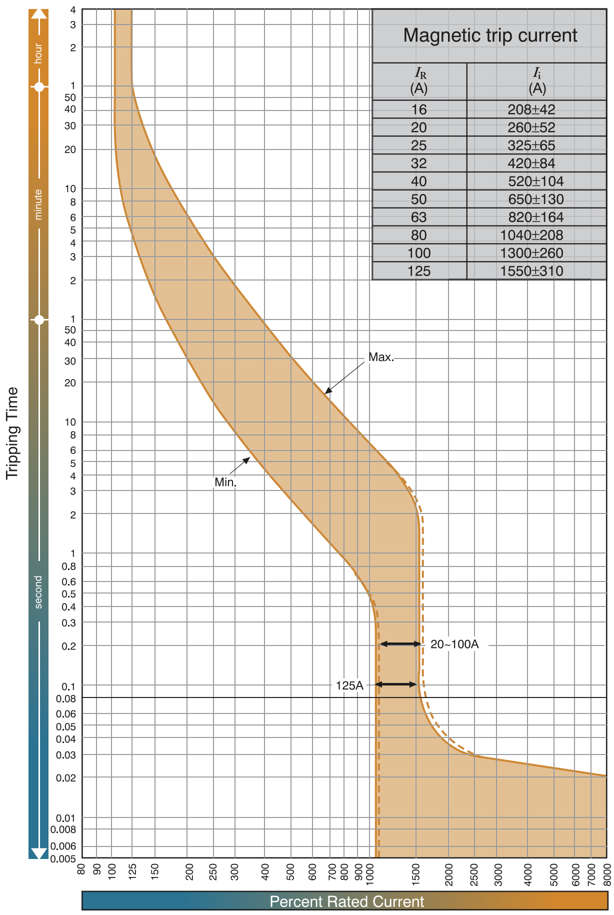
Please see the chart on the next page for the required insulation distances.

Insulation distance for Loadline YA and YB Frame MCCBs

MCCB		Distances					
Frame size	Poles	A	B1	B2	C	D	E
YA2N	1	50	10	10	0	25	*(1)
YA2N	3/4	50	10	10	0	25	*(1)
YA2S	3/4	50	10	10	0	25	*(1)
YA2J	3/4	75	45	25	0	25	*(1)
YB1N	1	50	40	40	0	50	*(1)
YB1N	3/4	50	50	10	0	25	*(1)
YB1S	3/4	50	50	10	0	25	*(1)
YA3N	1	50	40	30	0	25	*(1)
YA3N	3/4	50	40	30	0	25	*(1)
YA3S	3/4	50	40	30	0	25	*(1)
YA3J	3/4	100	80	30	0	25	*(1)
YB3N	3/4	50	40	40	0	50	*(1)
YB3S	3/4	50	50	40	0	50	*(1)
YA5N	3/4	100	80	40	0	30	*(1)
YA5N	3/4	100	80	40	0	30	*(1)
YA5J	3/4	100	80	40	0	30	*(1)
YA5K-E	3/4	100	80	40	0	30	*(1)
YA6S	3/4	120	100	80	0	80	*(1)
YA6H	3/4	120	100	80	0	80	*(1)
YA6H-E	3/4	120	100	80	0	80	*(1)
YA6K	3/4	150	120	80	0	80	*(1)
YA6K-E	3/4	150	120	80	0	80	*(1)
YA7H-E	3/4	150	120	80	0	80	*(1)
YA7K-E	3/4	150	120	80	0	80	*(1)
YA8H-E	3/4	150	120	100	0	100	*(1)
YA8K-E	3/4	150	120	100	0	100	*(1)

***Note:** (1) Insulate the exposed conductor until it overlaps the mouldied case at the terminal or terminal cover

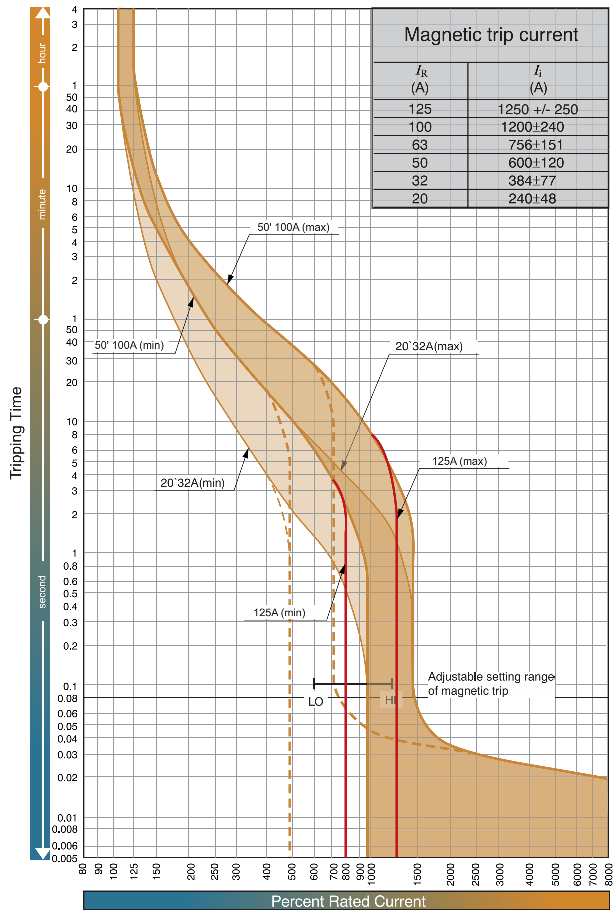
Loadline YA2 Frame MCCB Characteristics



Magnetic trip current

I_R (A)	I_i (A)
16	208±42
20	260±52
25	325±65
32	420±84
40	520±104
50	650±130
63	820±164
80	1040±208
100	1300±260
125	1550±310

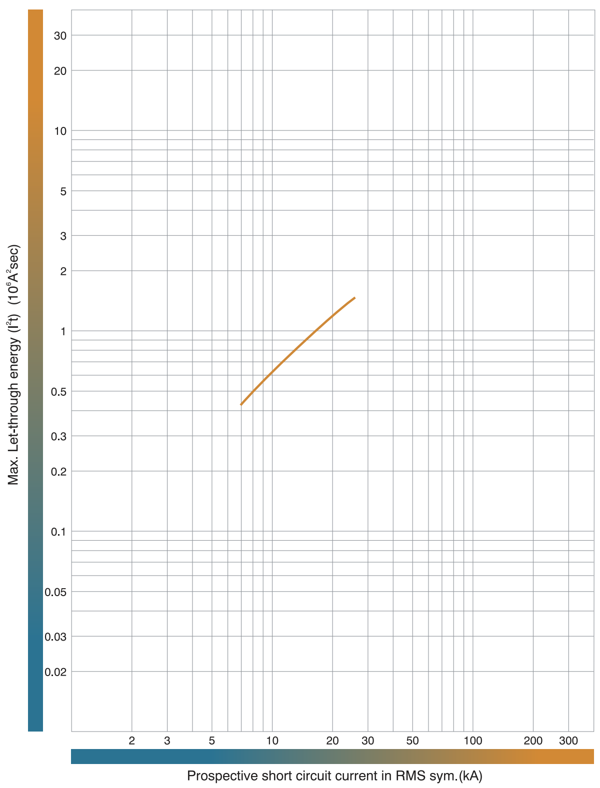
YA2 1-pole Time/Current Characteristic



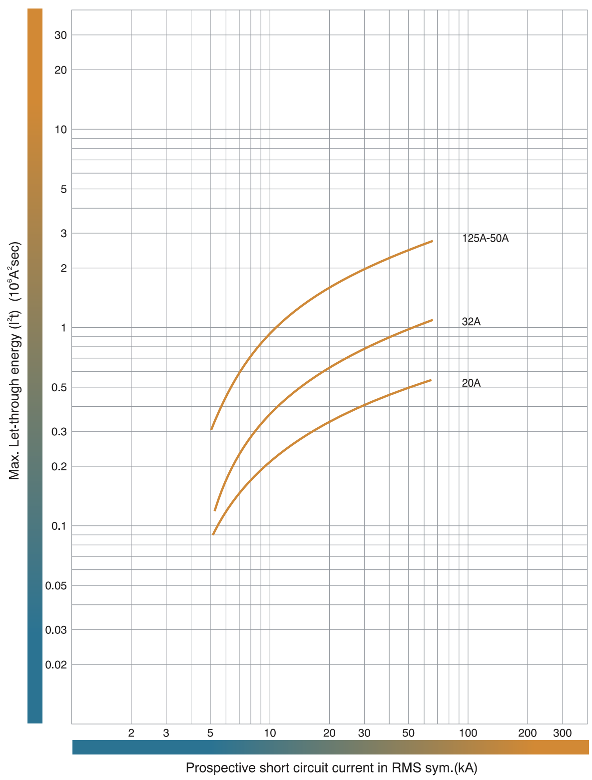
Magnetic trip current

I_R (A)	I_i (A)
125	1250 +/- 250
100	1200±240
63	756±151
50	600±120
32	384±77
20	240±48

YA2 3 and 4-pole Time/Current Characteristic

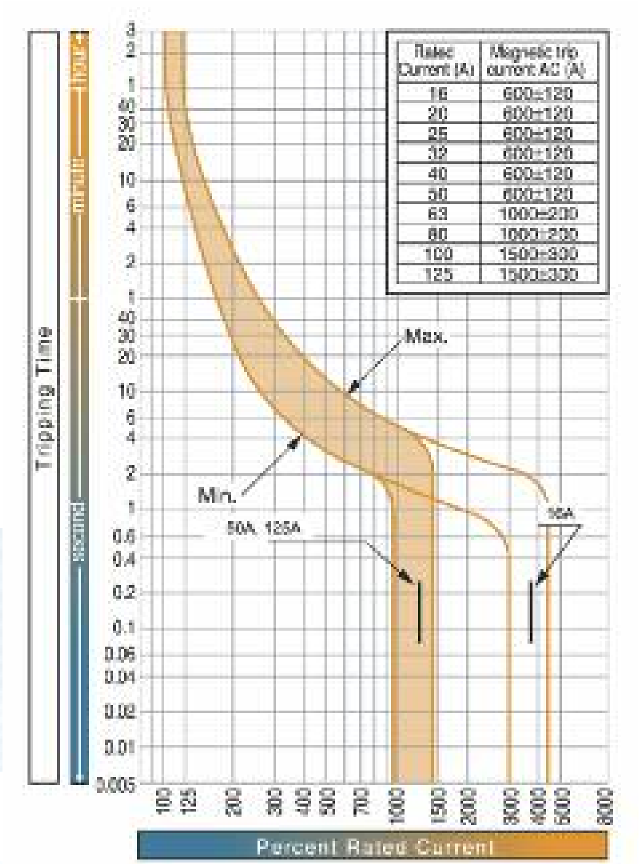


YA2 1-pole Energy Let-through



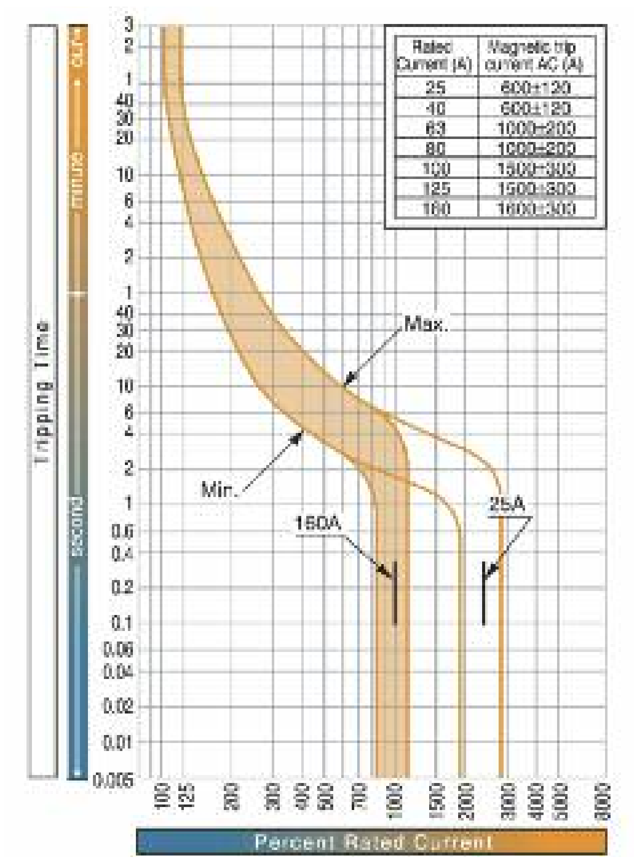
YA2 3 and 4-pole Energy Let-through

Loadline YB1 & YB3 Frame MCCB Characteristics



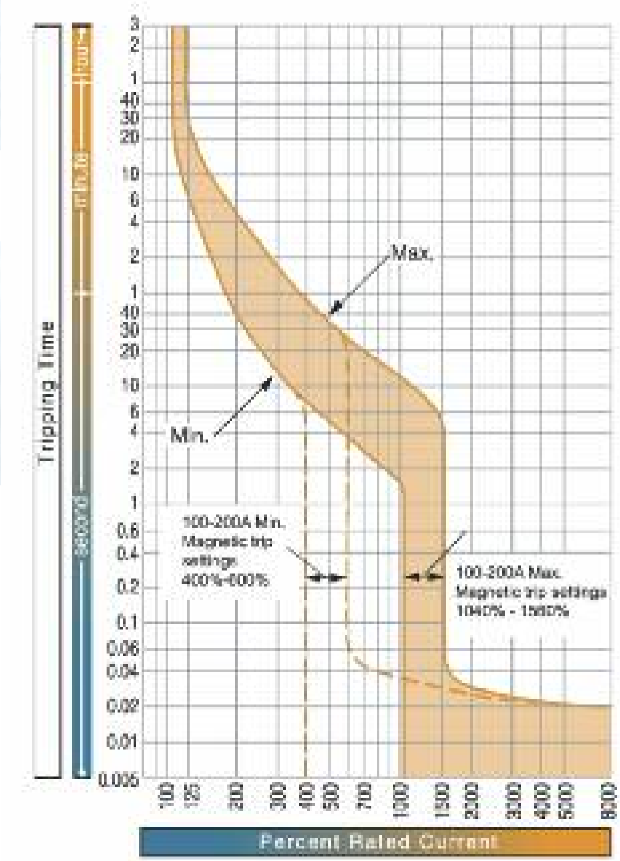
Rated Current (A)	Magnetic trip current AC (A)
16	600±120
20	600±120
25	600±120
32	600±120
40	600±120
50	600±120
63	1000±200
80	1000±200
100	1500±300
125	1500±300

YB1 1-pole Time/Current Characteristics

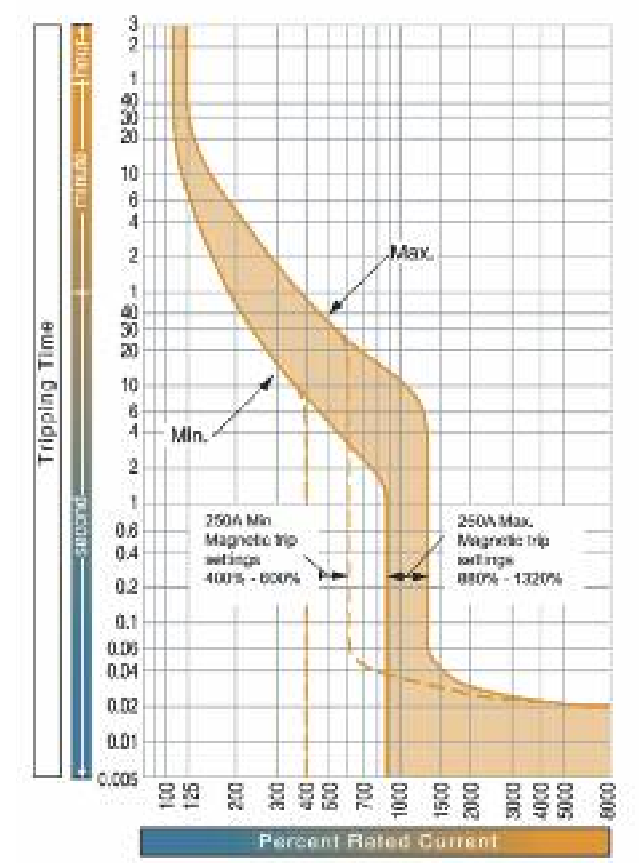


Rated Current (A)	Magnetic trip current AC (A)
25	600±120
40	600±120
63	1000±200
80	1000±200
100	1500±300
125	1500±300
160	1600±300

YB1N, YB1S 3 and 4-pole Time/Current Characteristics

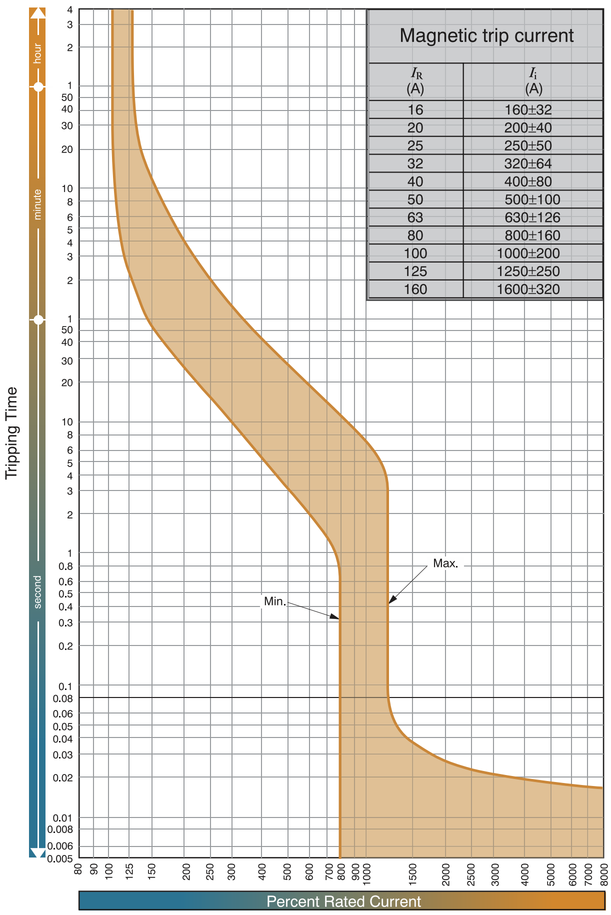


YB3N & YB3S 3 and 4-pole Time/Current Characteristics up to 200A



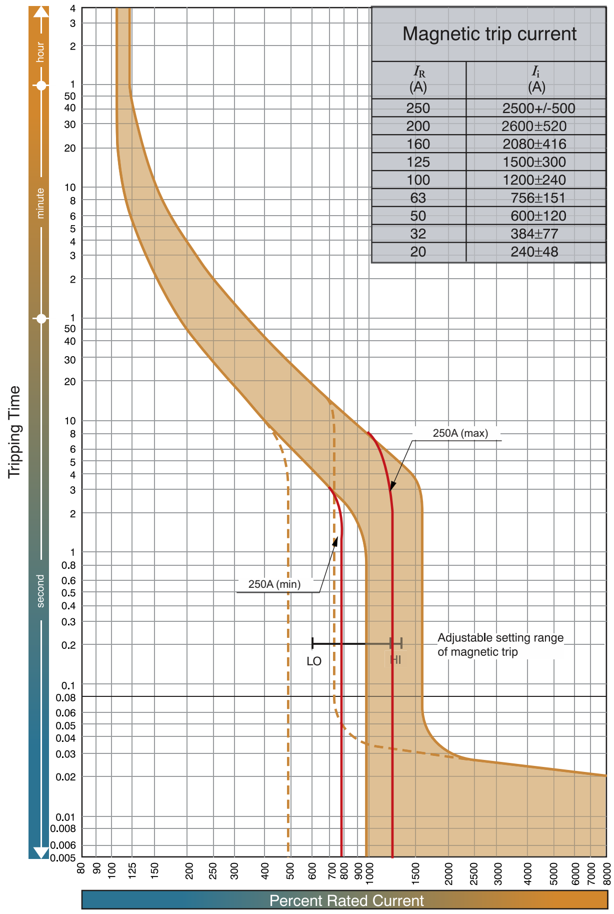
YB3N & YB3S 3 and 4-pole Time/Current Characteristics for 250A

Loadline YA3 Frame MCCB Characteristics



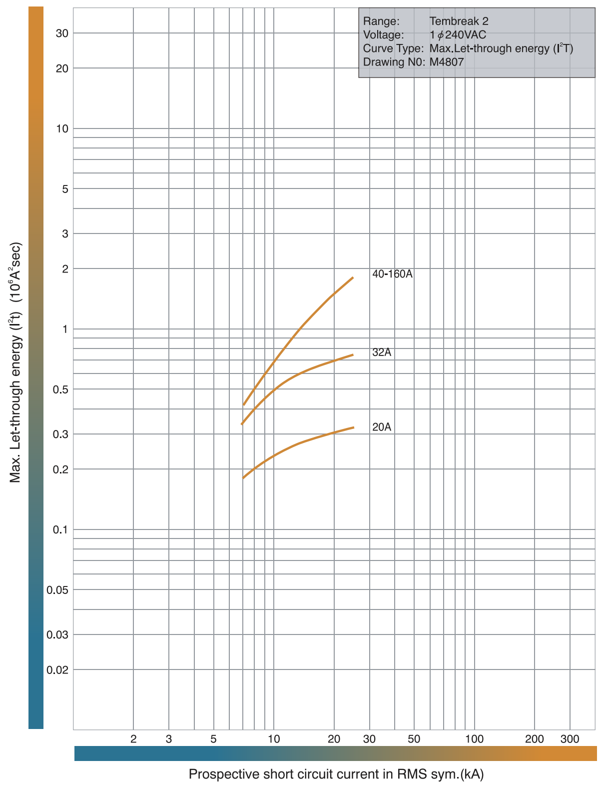
I_R (A)	I_i (A)
16	160±32
20	200±40
25	250±50
32	320±64
40	400±80
50	500±100
63	630±126
80	800±160
100	1000±200
125	1250±250
160	1600±320

YA3 1-pole Time/Current Characteristic

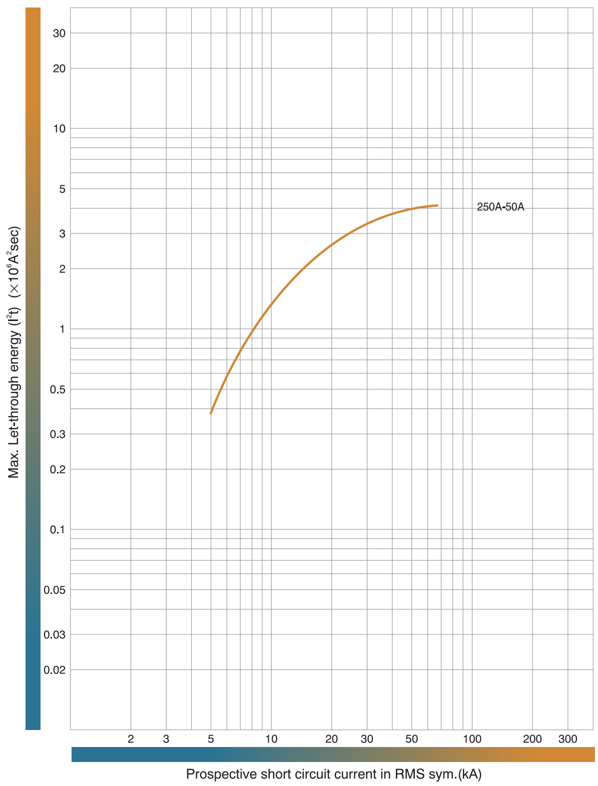


I_R (A)	I_i (A)
250	2500+/-500
200	2600±520
160	2080±416
125	1500±300
100	1200±240
63	756±151
50	600±120
32	384±77
20	240±48

YA3 3 and 4-pole Time/Current Characteristic



YA3 1-pole Energy Let-through



YA3 3 and 4-pole Energy Let-through

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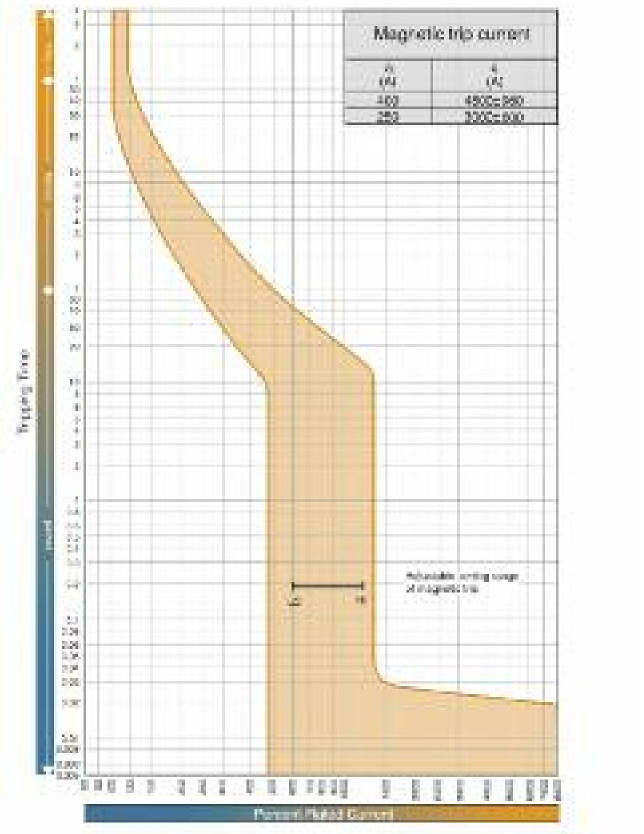
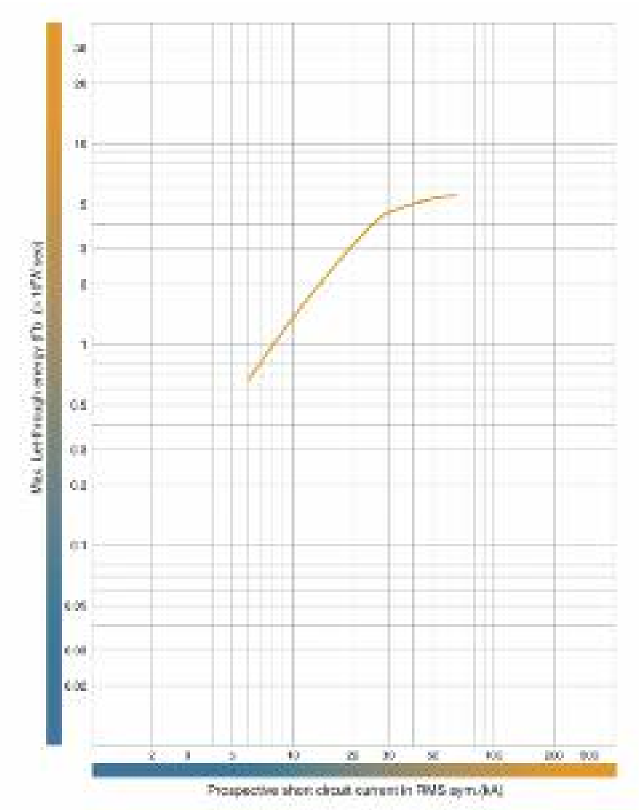
Loadline YA5 Frame MCCB Characteristics

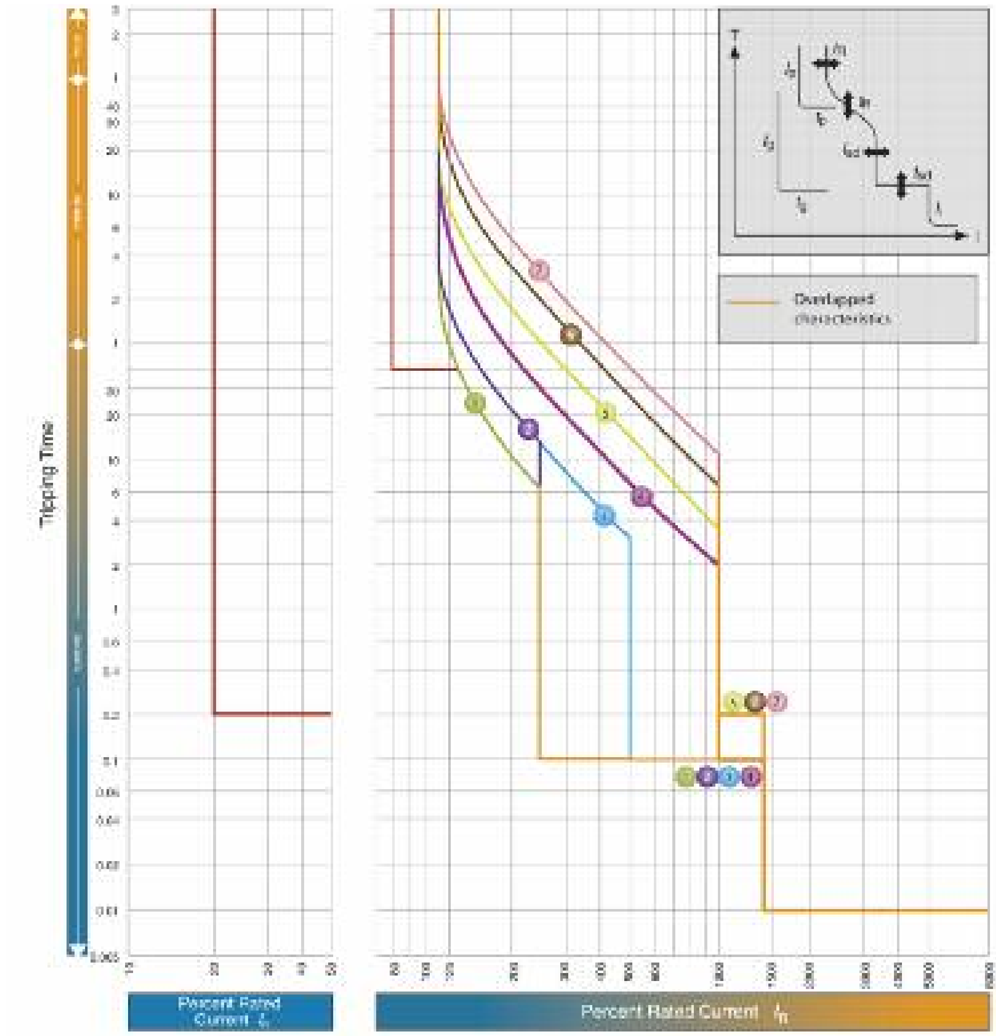


YA5 3 and 4-pole Time/Current Curve (Thermal / Magnetic)



YA5 3 and 4-pole Energy Let-through

Loadline YA5 Frame MCCB Characteristics



YA5 3 and 4-pole Time/Current Curve (Electronic)

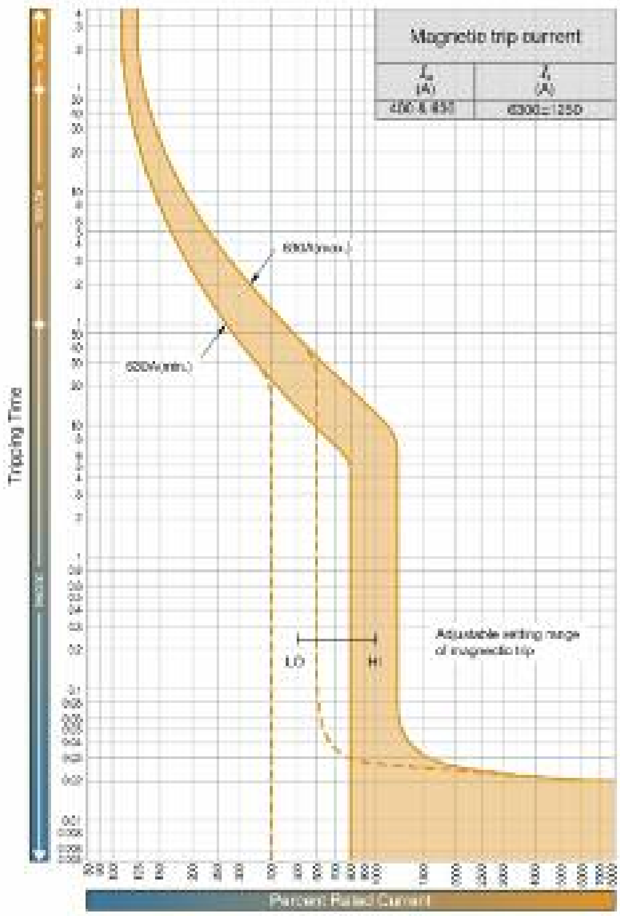
I_n = 400A; 250A Note (1)

	I_R (A)								
	LTD Pick-up current	I_R	xI_n	0.4	0.5	0.63	0.8	0.9	0.95	1.0
	Characteristics		No.	1	2	3	4	5	6	7
Standard	LT	t_R	(s)	11	21	21	5	10	19	29
				at 200% x I_R			at 600% x I_R			
	ST	I_{sd}	xI_R	2.5		5	10			
		t_{sd}	(s)	0.1				0.2		
	INST	I_i	xI_R	14(Max: 13 x I_n) Note (2)						
Option	PTA	I_p	xI_R	0.8						
		t_p	(s)	40						
	GF Note(4)	I_g	xI_n	0.2						
		t_g	(s)	0.2						
	NP	I_N	xI_R	1.0/0.5 Note (3)						
		t_N	(s)	t_N=t_R						

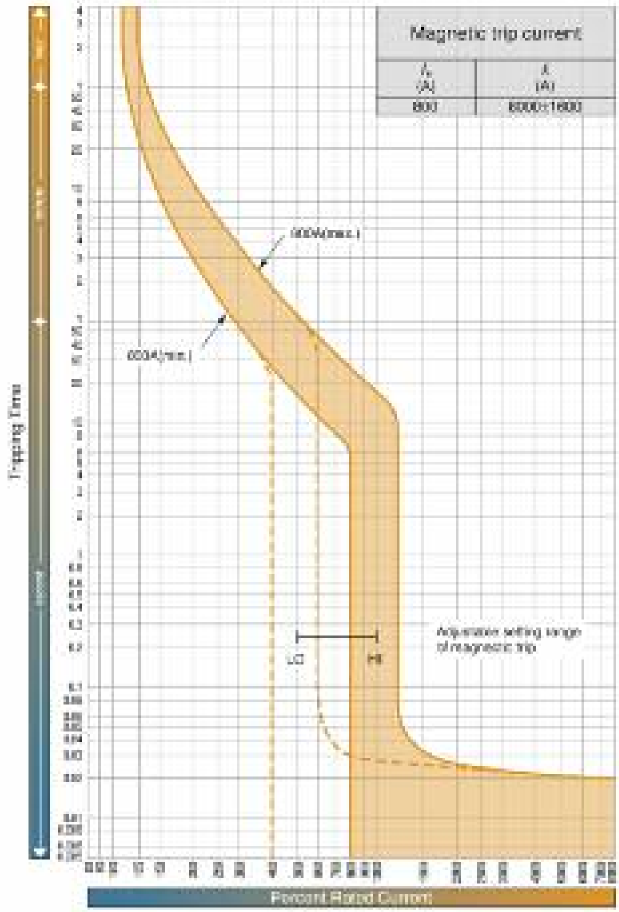
Note

(1) GF is not available when In is 250A. (2) I_i max. = 13 x I_n. (3) 1.0 x I_R or 0.5 x I_R can be selected. Characteristic of neutral protection (t_N vs. I_N) is identical to characteristic of phase protection (t_R vs. I_R). (4) When you specify GF on MCCBs with 3 poles the terminal block is automatically fitted to connect with the external neutral CT for 3 phases 4 wires system.

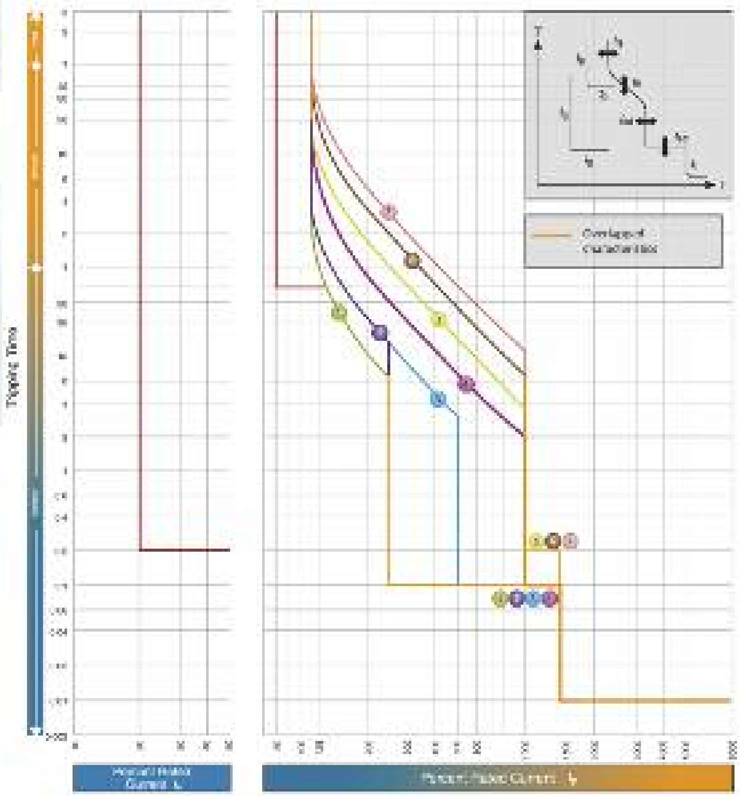
Loadline YA6 Frame MCCB Characteristics



YA6 Time/Current Curve (Thermal / Magnetic 400A-630A)



YA6 Time/Current Curve (Thermal / Magnetic 800A)

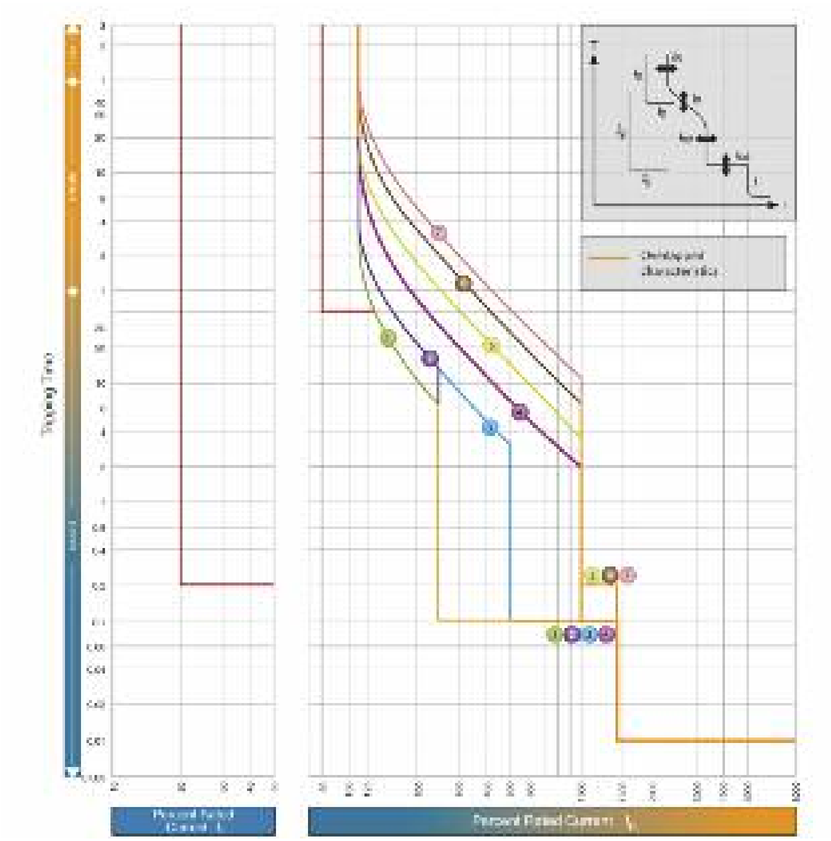


YA6 Time/Current Curve (Electronic 630-800A)

YA6 In = 630A, 800A

Ground fault: lg = 0.2 x In and tg = 0.2 seconds

Loadline YA7 Frame MCCB Characteristics



YA7 Time/Current Characteristic

YA7 In = 1250A

	I_R (A)									
	LTD Pick-up current	I_R	x In	0.4	0.5	0.63	0.8	0.9	0.95	1.0
	Characteristics		No.	1	2	3	4	5	6	7
Standard	LT	t_R	(s)	11	21	21	5	10	19	29
				at 200% x I_R			at 600% x I_R			
	ST	I_{sd}	x I_R	2.5		5	10			
		t_{sd}	(s)	0.1				0.2		
	INST	I_i	x I_R	14(Max: 12 x I_n) Note (1)						
Option	PTA	I_P	x I_R	0.8						
		t_P	(s)	40						
	GF Note(3)	I_g	x I_n	0.2						
		t_g	(s)	0.2						
	NP	I_N	x I_R	1.0/0.5 Note(2)						
		t_N	(s)	$t_N = t_R$						

Note
(1) I_i max. = 12 x I_n. (2) 1.0 x I_R or 0.5 x I_R can be selected. Characteristic of neutral protection (t_N vs. I_N) is identical to characteristic of phase protection (t_R vs. I_R). (3) When you specify GF on MCCBs with 3 poles the terminal block is automatically fitted to connect with the external neutral CT for 3 phases 4 wires system.

Ground fault: Ig = 0.2 x In and tg = 0.2 seconds

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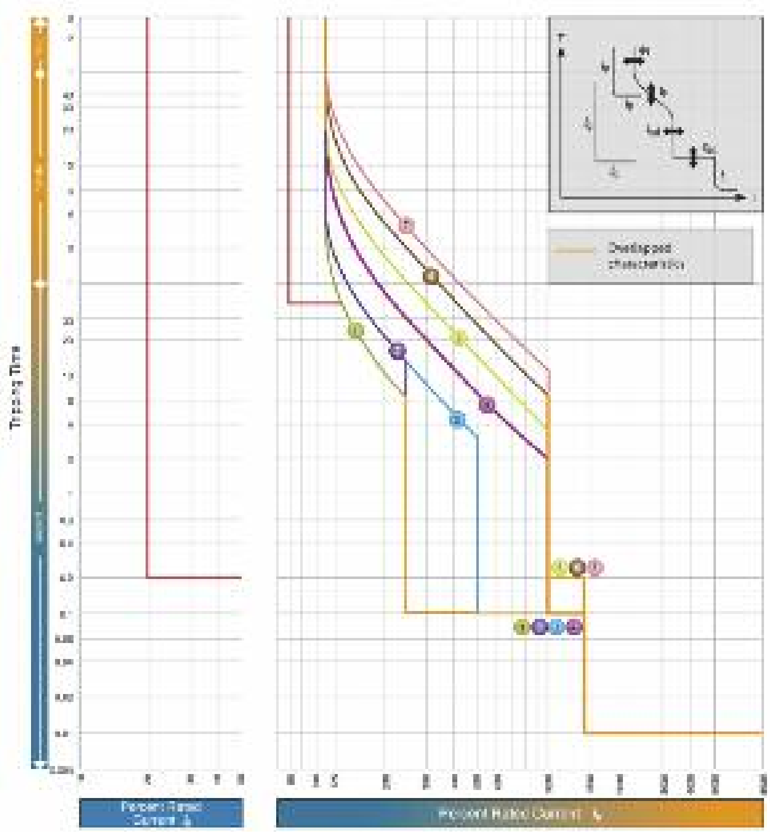
Loadline YA8 Frame MCCB Characteristics



YA8 Time/Current Characteristic

YA8 In = 1600A

	I_R (A)									
	LTD Pick-up current	I_R	xI_n	0.4	0.5	0.63	0.8	0.9	0.95	1.0
	Characteristics		No.	1	2	3	4	5	6	7
Standard	LT	t_R	(s)	11	21	21	5	10	19	29
				at 200% x I_R			at 600% x I_R			
	ST	I_{sd}	xI_R	2.5		5	10			
		t_{sd}	(s)	0.1				0.2		
	INST	I_i	xI_R	14(Max: 12 x I_n) Note (1)						
Option	PTA	I_p	xI_R	0.8						
		t_p	(s)	40						
	GF Note(3)	I_g	xI_n	0.2						
		t_g	(s)	0.2						
	NP	I_N	xI_R	1.0/0.5 Note(2)						
		t_N	(s)	t_N=t_R						

Note

(1) I_i max. = 12 x I_n. (2) 1.0 x I_R or 0.5 x I_R can be selected. Characteristic of neutral protection (t_N vs. I_N) is identical to characteristic of phase protection (t_R vs. I_R). (3) When you specify GF on MCCBs with 3 poles the terminal block is automatically fitted to connect with the external neutral CT for 3 phases 4 wires system.

Ground fault: lg = 0.2 x In and tg = 0.2 seconds

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