nternal accessories

Auxiliary contacts

FD, FE & FG frame

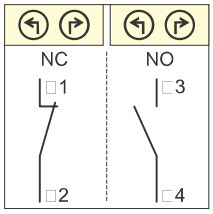
Auxiliary contact blocks are coveniently fitted into an auxiliary-device compartment, accessible by removing the breaker cover. This fully insulated compartment has several pouches, a number of which are reserved for contact blocks. To allow for a logical and traceable schematics each contact block has a pre-defined position within the auxiliary device compartment indicated by a symbol printed both on the breaker case and on the auxiliary device itself.
External wiring can be brought into the accessory compartment through - specifically designed and positioned - break-out openings in the breaker lid or can go through channels in the breaker rear. Once this is done the wiring can be stripped and easily connected to the box terminals on the internal accessories. These terminals are designed to connect wiring up to 2.5 mm^2.
To identify the correct mounting position within the accessory compartment symbols are moulded into the breaker and contact housing.
For Auxiliary switches suited for mounting on the right ↱ and on the left ↰.
For Bell Alarm switches Mechanism operated types Ⓜ
Trip unit operated types 🔔.

Numerous types are available all meeting the re uirement of the EN 60 947-5 and UL standards.
Each breaker type allows the use of three basic types indicating the breaker contact position, fault indication and trip position indication. For the FE FG frame draw-out execution a fourth type is available that indicates the plugged in, test or withdrawn position of the breaker in the draw-out chassis (carrage indication contacts).
Please take into account that when the contacts are not linked or mounted in the breaker, their function is reversed. *i,e. NO becomes NC and NC becomes NO.*

The contact numbering of each device is indicated in the shematics next to each photo. **eg. 5 or 6**
The intermediate cover of the breaker has a separate set of codes that indicate the number of the device when it is mounted in the breaker. **eg. 1 or 2**
The combination of these two codes provides a standardized coding system of each connection point(1). **eg. 15 or 26**

FAS/CA (open - closed indication)
They indicate the breaker contact status (open/closed).
The contact is mounted in a simple click-in block and is available in 4 different versions
- **FAS10L** auxiliary contact left mounted NO
- **FAS01R** auxiliary contact right mounted NC
- **FAS10L** auxiliary contact left mounted NO
- **FAS01R** auxiliary contact right mounted NC

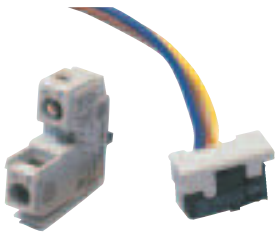
The FAS10 FAS01 contacts blocks are also used in kits as carriage indication contacts for the draw-out versions of the FE FG frame. Premounted sets, one with 1 NO indication contact per position (total 3 NO contacts) and a second with 1 NO and 1 NC contact per position (total 3 NO 3 NC contacts) are available. These sets come as easy to fit and connect field mountable kits.

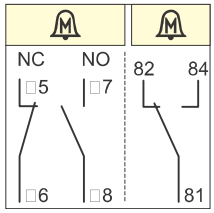


BAM/CDM (Bell alarm mec anism)
Indicates that the breaker has moved to it s Tripped position.
This can be caused by a fault (see BAT/CD contact), the operation of the push to trip button on the breaker front or a shunt or undervoltage release operation.

The contact is a simple click-in block and can only be placed in the BAM position inside the accessory compartment indicated by the symbol Ⓜ. By using a combination of the BAM and BA contacts it is possible to discriminate between the kind of fault the breaker has reacted to.

3 versions of bell alarm mechanisms are available
- **FABAM10** bell alarm mechanism NO for FE and FG frame
- **FABAM01** bell alarm mechanism NC for FE and FG frame
- **FABAM11** bell alarm mechanism (change over) only for FD frame
  (Is delivered with 0.75 mm^2 cables of 60 cm length).



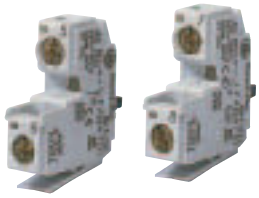


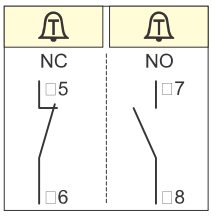
(1) See wiring diagram section for complete overview.

BAT/CD (Bell alarm trip unit)
Indicates that the breaker has detected a fault condition resulting in it moving to it s Tripped position. A Record Plus breaker trips on a fault condition due to a Trip Unit protection device or RCD operation. The operation of this device can be verified mechnically by depressing the RCD operation interface lever located below the Trip Unit.
The contact is a simple click-in block and can only be placed in the BAT position inside the accessory compartment (indicated by the symbol 🔔). By using a combination of the BAM and BAT contacts it is possible to discriminate between the kind of fault the breaker has reacted to.

4 versions are available
for general use
- **FABAT10** bell alarm trip NO
- **FABAT01** bell alarm trip NC

for use in FE frame thermal magnetic and magnetic only types
- **FEBAT10** bell alarm trip NO
- **FEBAT01** bell alarm trip NC





Performance

The contacts offer a combination of a high thermal current rating and can be used down to typical PLC operating levels of 12V 5 mA, AC/DC. The contacts are self-reansing and offer a life span e uivalent to or exceeding that of the breakers. The values mentioned here have been determined in accordance with the EN 60947-5-1 standard.

	AC (A)				DC (A)			
	FAS (no/nc)	BAT (no/nc)	BAM (co)	BAM (no/nc)	FAS (no/co)	BAT (no/nc)	BAM (co)	BAM (no/nc)
24V	10	10	10	10	2.5	2.5	4	2.5
48V	10	10	10	10	1.4	1.4	0.5	1.4
60V	10	10	10	10	1	1	0.3	1
110V	6	6	6	6	0.55	0.55	0.2	0.55
220V	3	3	3	3	0.27	0.27	0.1	0.27
380V	2	2	2	2	0.2	0.2	-	0.2
500V	1.5	1.5	-	1.5	-	-	-	-
600V	1.2	1.2	-	1.2	-	-	-	-

FK frame

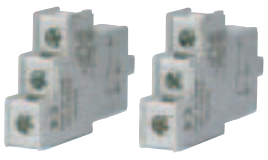
Optimized for use in the larger FK frame size mounting and connecting takes place in the same manner as in the FD, FE and FG frame sizes. The contact blocks are of the changeover type (form C) and are available in easy to mount click in devices with a bell alarm contact or auxiliary switch. A maximum of three auxiliary switches and one bell alarm contact can be mounted. To indicate the breaker position in the draw-out chassis (see page C.23 and C.24) a similar contact block is used.)

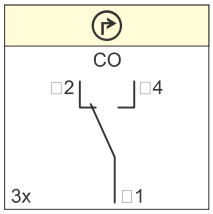
The contact numbering of each device is indicated in the shematics next to each photo. **eg. 5 or 6**

The intermediate cover of the breaker has a separate set of codes that indicate the number of the device when it is mounted in the breaker. **eg. 1 or 2**

The combination of these two codes provides a standardized coding system of each connection point. **eg. 15 or 26**

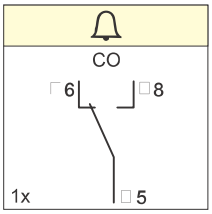
FAS/CA (open - closed)
They indicate the breaker contact status (open/closed). The contacts are mounted in a simple click-in block, of which a maximum of three fit into the auxiliary device compartment (right side).





FNS11R Auxiliary contact right mounted CO **BA/CD (Bell alarm)**
A contact that indicates that the breaker has tripped. The contact is mounted in a simple click-in block and fits into the auxiliary device compartment (right side).

FNBA11R Bell Alarm contact right mounted CO



Performance

The values mentioned here have been determined in accordance with the EN 60947-5-1 standard and apply for inductive loads.

	AC (A)		DC (A)	
	FAS (co)	BA (co)	FAS (co)	BA (co)
24V	10	10	2	2
48V	6	6	1.5	1.5
60V	6	6	1	1
110V	4	4	0.5	0.5
220V	3	3	0.25	0.25
400V	1.5	1.5	-	-

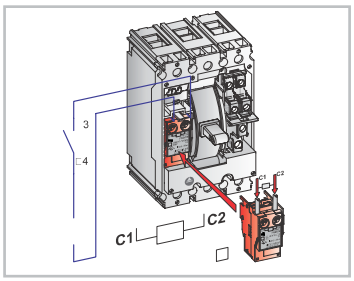
nternal Accessories

Releases

Shunt and undervoltage releases can be fitted easily and uickly in a specifically designed accessory compartment which is accessible by removing the breaker lid. This fully insulated compartment has several pouches one of which is reserved for a shunt or undervoltage release indicated by a symbol printed in the breaker case and on the auxiliary device itself. External wiring can be brought into the accessory compartment through - specifically designed and positioned - break out openings in the breaker lid, or can go through channels in the breaker rear. Once this is done the wiring can be stripped and easily connected to the box terminals on the internal accessories. These terminals are designed to connect wiring up to 2.5 mm^2.
The devices are designed to trip the breaker when its contacts are closed and the handle indicates the On position. When the breaker contacts are open and the breaker handle indicates Off or Trip activating the releases will have no effect.(1)

FD, FE & FG frame

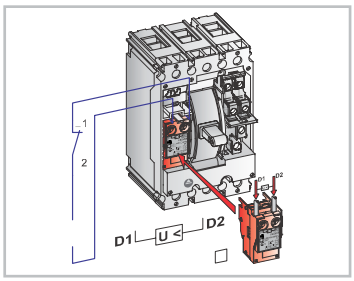
S unt release (SHT/EA)



The ***Record Plus*** shunt and undervoltage releases are common for all frame sizes up to 630A and all offer a uni ue combination of low power consumption and a kiss-free, lock out operation. Most types are common for e uivalent AC and DC ratings and all are available in a wide range of voltages. When the breaker is in the ON position and the shunt trip is activated the breaker will trip and its contacts will open. The device can be constantly activated at its nominal voltage allowing it to be used as a lock out coil. The connection clamps are marked C1 and C2. Switches, relay contacts and push buttons can be used to operate the shunt release. The use of illuminated push buttons is limited by the power that these lamps re uire to operate and the value that the shunt release re uires to trip. Here the maximum total consumption of the lamps may not exceed 2mA.

Voltage operational band	0.7 - 1.1 Un
Minimum pulse duration	10 msec
Total intervention time	50 msec

Undervoltage releases (UVR/MV)



When the breaker is in the ON position and the undervoltage release is deactivated the breaker will trip and its contacts will open. In de-energized status the device prevents the breaker contacts from moving and is suitable for use as a lock-out coil. The connection clamps are marked D1 and D2. De-energization of the device or a drop in its supply voltage to a value below the mentioned lower voltage limit will activate the device. To prevent voltage-dip-driven nuisance tripping an undervoltage release with time delay is available. An external DIN-rail mountable box contains a time delay unit with settable timings and is linked up with a DC UV undervoltage release. This version is only available for an AC voltage of 230/240V.

Voltage operation band (all types)	
deactivates between	0.35 - 0.7 Un
activates between	0.85 - 1.1 Un
minimum reaction time	10 msec
total intervention time (undelayed type)	50 msec
delayed version (extra delay)	settable 100 to 250 msec

Shunt release - Performance

Voltage rating	Current consumption mA		Power consumption mW/mVA	
	inrus	old	inrus	old
12V DC	200	200	2.4	2.4
24V AC/DC	150	150	3.6	3.6
48V AC/DC	60	60	2.88	2.88
110/130V AC/DC	40	40	4.8	4.8
220/240V AC 250V DC	20	20	4.6	4.6
440/440V AC	15	15	6.6	6.6
480V AC	15	15	7.2	7.2

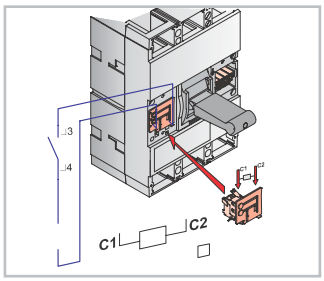
ndervoltage releases - Performance

Voltage rating	Current consumption mA		Power consumption mW/mVA	
	inrus	old	inrus	old
24V AC/DC	50	50	1.2	1.2
48V AC/DC	20	20	0.96	0.96
110/130V AC/DC	15	15	1.8	1.8
220/240V AC 250V DC	15	15	3.45	3.45
440/440V AC	15	15	6.6	6.6
480V AC	15	15	7.2	7.2

(1) Not applicable for FK Frame undervoltage release.

FK frame

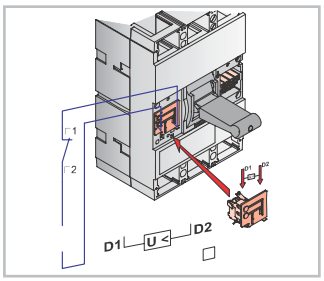
S unt release (SHT/EA)



When the breaker is in the ON postion and the shunt trip is activated the breaker will trip and its contacts will open. The device can be constantly activated at its nominal voltage allowing it to be used as a lock out coil.
The connection clamps are marked C1 and C2.
Switches, relay contacts and push buttons are used to operate the shunt release.

Voltage operational band	0.7 - 1.1 Un
Minimum pulse duration	10 msec
Total intervention time	50 msec

Undervoltage releases (UVR/MV)



When the breaker is in the ON position and the undervoltage release is deactivated the breaker will trip and its contacts will open. In de-energized status the device prevents the breaker contacts from moving and is suitable for use as a lock-out coil. The connection clamps are marked D1 and D2. De-energization of the device or a drop in its supply voltage to a value below the mentioned lower voltage limit will activate the device. To prevent voltage-dip-driven nuisance tripping an undervoltage release with time delay is available. An external DIN-rail mountable box contains a time delay unit with settable timings and is linked up with a DC UV undervoltage release. This version is only available for an AC voltage of 230/240V.

voltage operation band (all types)	
deactivates between	0.35 - 0.7 Un
activates between	0.85 - 1.1 Un
minimum reaction time	10 msec
total intervention time (undelayed type)	50 msec
delayed version (extra delay)	settable 100 to 250 msec

Shunt release - Performance

Voltage rating	Current consumption mA		Power consumption mW/mVA	
	inrus	old	inrus	old
24V AC/DC	12.5	1.3	300	30
48V AC/DC	6.3	0.6	300	30
110/130V AC/DC	2.3	0.2	300	30
220/240V AC 250V DC	1.2	0.1	300	30
380-400V AC	0.8	0.1	300	30

ndervoltage releases - Performance

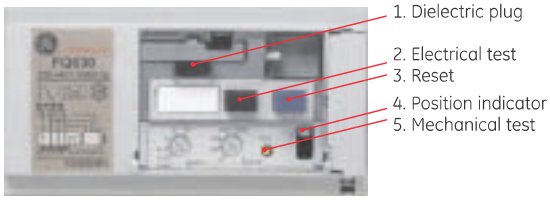
Voltage rating	Current consumption mA		Power consumption mW/mVA	
	inrus	old	inrus	old
24V DC	1.3	0.13	30	3
24V AC	1.3	0.13	30	3
48V DC	0.6	0.06	30	3
110-127V AC	0.2	0.02	30	3
230V AC	0.1	0.01	30	3
400-415V AC	0.1	0.01	30	3

External accessories

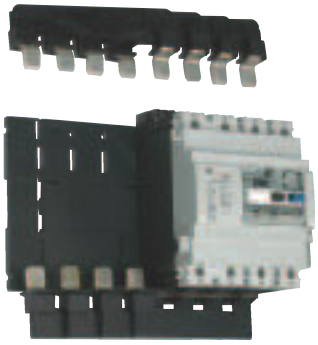
Residual current devices

A ***Record Plus*** circuit breaker can offer protection against earth leakage currents by using an add-on residual current device (RCD). A line of three and four pole completely integrated add-on devices are available as side mounted models (FD frame size) or as units that are fitted below the trip unit of the breaker (FD, FE and FG frame sizes). In all cases the RCD unit interfaces directly with the circuit breaker without the use of any secondary wiring or connections.
Each RCD has a sensor placed around the phase and neutral current paths that detects the vectorial sum of the phase and neutral currents. When this sum is no longer zero it is assumed that current is flowing to earth (residual current). If this value exceeds the threshold set on the RCD the breaker connected to the device is tripped.
The RCD unit s electrical power is supplied by the line voltage of the breaker it is linked to. By use of a multi-phase bridge the design still works when one phase and the neutral is present. A pouch on the RCD allows one to place one BAT contact NO or NC which allows a remote signal on earth faults.
A ***Record Plus*** breaker and an RCD combination can be connected like any stand-alone breaker and are available as fixed or plug-in devices. The mains connection interface of the RCD is an exact replica of the breaker connection area, thus allowing the use of all standard breaker terminals.

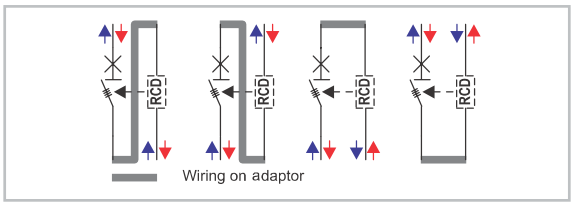
Designed to meet the latest IEC 947 (industrial), IEC 1009 (residential) and the IEC 755 standards, ***Record Plus*** RCDs are available in a version suited for side or bottom mounting as three and four pole units. The tamper free setting area illustrated below is common for the whole line and includes a mechanical and an electrical test option.



The mechanical test button tests the mechanical operation of the breaker and RCD unit without power, whereas the electrical option tests both the electrical and mechanical operation of the device. In order to allow for a dielectric test of the breaker and RCD combination without damaging the electronics, a so called dielectric disconnect plug unit is placed within the setting area. All devices have a setting area with a standard front cut-out of 45 mm. The device has numerous current and time settings and an override blocking the time settings when set to 30mA. The devices are class A, surge resistant (500A 8/20 mircoseconds) and are finished with a transparent, tamper-free cover.



The FD-frame RCD is available in two versions for mounting on the right hand side of the breaker or for mounting below the trip unit of the breaker. The side mounted type is available in two versions. The first one comes with a multifunctional DIN-rail mounting kit including a connection kit to link up the breaker and the RCD. The connection kit allows the user to feed the breaker and RCD assembly from a multitude of directions while placing the RCD up- or downstream. The second version of the side-mounted RCD is designed for screw mounting and comes with a simplified connection set (see sketch). Both side mounted devices are designed to accommodate a 45 or 64 mm cover plate cut-out. This allows usage in an environment with other DIN-modular devices or with other breakers.



The screw mounted type that only allows for two connection options is depicted on the right.

The FE- and FG-frame RCD units are designed to be mounted directly below the breaker trip unit area, thus forming an integrated circuit breaker plus RCD device. All bottom mounted devices are available as three and four pole units and have a setting area that is common for the whole line.

Programme overview

	FD I or S	FD (1)	FE (1)	FE (1)	FG (1)
	FD frame side mounted	FD frame mounted below breaker(1)	FE frame mounted below breaker(1)	FE frame mounted below breaker(1)	FG frame mounted below breaker(1)
In (A)	160	160	160	250	400/630
Number of poles	3-4	3-4	3-4	3-4	3-4
Delay at 2 Idn (msec)	Inst-60-150-300-600	Inst-60-150-300-600	Inst-60-150-300-600	Inst-60-150-300-600	Inst-60-150-300-600
Total tripping time at 2 x Idn (msec)	40-100-190-340-640	40-100-190-340-640	40-100-190-340-640	40-100-190-340-640	40-100-190-340-640
Available voltages (AC..50/60Hz)	220-440V / 440-690V	220-440V / 440-690V	220-440V / 440-690V	220-440V / 440-690V	220-440V / 440-690V
Idn setting (A)	0.03 - 0.3 - 1 - 3 - 10	0.03 - 0.3 - 1 - 3 - 10	0.03 - 0.3 - 1 - 3 - 10	0.03 - 0.3 - 1 - 3 - 10	0.03 - 0.3 - 1 - 3 - 10

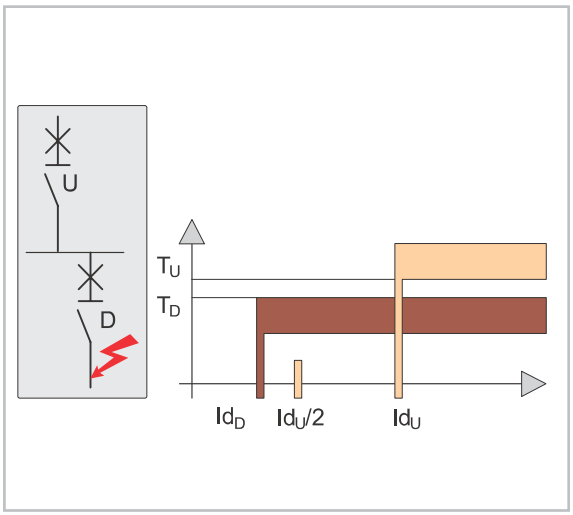
(1) Must be linked to the trip unit side of the breaker

Selectivity

To assure selectivity/discrimination between two residual current devices the following rules are applicable.

Id_U 2 x Id_D
Where Id_U is the threshold of the upstream device and Id_D that of the downstream one.

Tr_U To_D
Where Tr_U is the reaction time of the upstream device and To_D is the total opening time of the downstream device.
The table included here indicates where selectivity/discrimination can be achieved and takes into account the threshold and time settings of the devices.



Selectivity overview

outgoing / incoming	Idn (mA)	Elfa Plus S		F- RCD 60 ms			F- RCD 150 ms			F- RCD 300 ms			F- RCD 600 ms		
		300	1000	300	1000	3000	300	1000	3000	300	1000	3000	300	1000	3000
ElfaPlus	30	T	T	T	T	T	T	T	T	T	T	T	T	T	T
Inst. Type	300		T		T	T	T	T	T		T	T		T	T
	1000					T			T			T			T
ElfaPlus	30						T	T	T	T	T	T	T	T	T
S type	300							T	T		T	T		T	T
	1000								T			T			T
FD- RCD	30		T		T	T	T	T	T	T	T	T	T	T	T
set at inst.	300					T		T	T		T	T		T	T
	1000								T			T			T
FD- RCD	30						T	T	T	T	T	T	T	T	T
set at	300							T	T		T	T		T	T
60 msec.	1000								T			T			T
	3000														
FD- RCD	30									T	T	T	T	T	T
set at	300										T	T		T	T
150 msec.	1000											T			T
	3000														
FD- RCD	30												T	T	T
set at	300													T	T
300 msec.	1000														T
	3000														

T Total (or Full) selectivity

External accessories

Rotary handles

The ***Record Plus*** rotary handle is specifically designed to allow the user to change the linear motion of the breaker to a rotation over a 90 degree angle. This can be accomplished by simply adding an adaption box to the breaker front.
The design is universal for the whole breaker line and has the OFF position placed at 3 o clock and the ON position at 6 o clock. The third breaker position TRIP is located between the ON and the OFF position.
The design has room for two early closing and late opening contact blocks that, in order to save installation time, are delivered pre-mounted and pre-wired with a specific rotary-handle device.
Each ***Record Plus*** rotary handle is designed to allow the user to place one to three 5 to 8 mm padlocks or one keylock that can lock the breaker in OFF position.

Record Plus™ Rotary andles
Three operators types are available, one for direct breaker mounting, a device for through door or panel mounting and a third type where the operator is mounted on the door front.

All operators have a common operation moded and a clear position indication

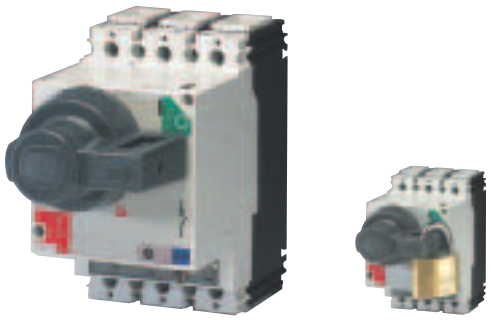
Breaker OFF - andle orizontal
Breaker ON - andle Vertical

The standard padlocking and keylocking mechanism can be bypassed to allow the breaker to be locked in other positions than OFF.

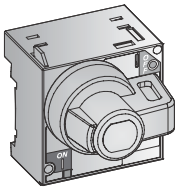
A special version is available with two normally open auxiliary contacts (FABAM10) that are pre-mounted and pre-wired with leads of 0.75 mm^2 and a length of 60 cm. The use of a through door rotary handle door flange is recommended.

An extra Ronis or Profalux key lock can be clicked into the handle front, thus allowing one to lock the breaker in the same manner as the padlocking device.
The Ronis key locks are available in a number of versions
- A version where each lock has a different key number
- A version where the user can choose one of six keys for several locks

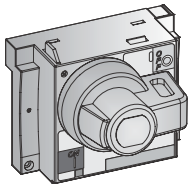
Record Plus™ rotary andle mounted directly on t e breaker front



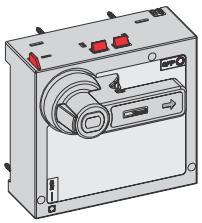
A specifically designed adaptor box with a handle is directly installed onto the breaker front. It is available in grey for normal applications and in a yellow/red execution for machine tool applications.



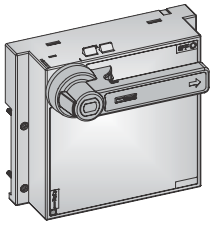
FD 63/160



FE 160/250

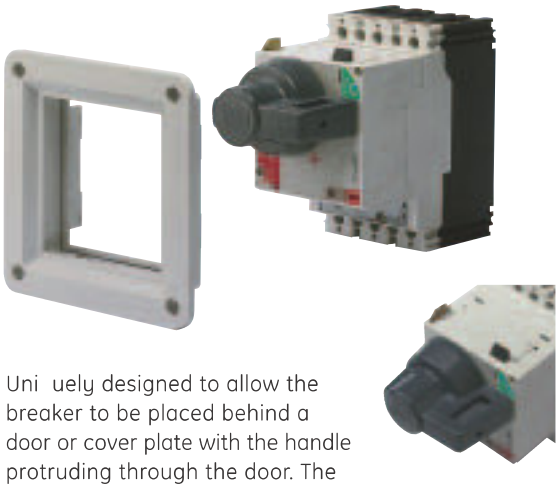


FG 400/630



FK 800-1600

Rotary handle for use through door or cover plate



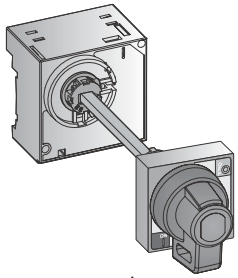
Uniquely designed to allow the breaker to be placed behind a door or cover plate with the handle protruding through the door. The rotary handle features a door-opening or cover-plate-removal prevention, interlock in the ON position and a mechanism that automatically trips the breaker if the door or cover plate is not present (a bypass is available). The rotary handle is available in grey for normal applications and in a yellow/red execution for machine-tool applications.

Rotary handle for panel or hinged door mounting

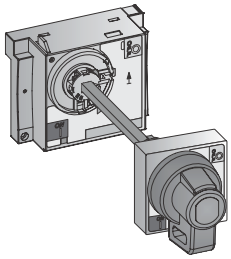
A handle and escutcheon is mounted on the door or panel front and connected to the breaker by an elongation shaft that goes into an adaptor box directly installed onto the breaker front. The design allows for a total depth of up to 350 mm (from the back of the breaker mounted behind the door or panel and the door front).
The handle is available in grey for normal applications and in a yellow/red execution for machine-tool applications. Interlocks that prevent the opening of the door while the breaker is ON (are standard). For override operation see red indicators on euchenon front.

All ***Record Plus*** rotary handles have the same standard single hole front door drilling and are specifically designed to tackle mounting issues as shaft droop and tolerance in user drillings.

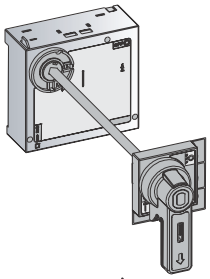
Available in grey or in yellow/red the device is supplied with an adaptor box for installation on the breaker front, a mounting position definer, a shaft, a handle with escutcheon for door or panel mounting and all necessary fixation hardware.
The door or panel mounted operating handle has a protection degree of IP54.



FD 63/160



FE 160/250



FG 400/630

FK 800-1600

External accessories

Rotary handles - accessories

Extension s aft set

- The long shaft set allows the user to install a breaker with a door or panel mounted rotary handle up to a depth of 600 mm, measured from the back of the breaker to the front of the door
- The set includes a shaft and a shaft droop prevention adapter
- Available for all frames

Flex operator pus to trip (Bowden cable)

- For the door/panel-mounted rotary handle accessory
- Allows the operation of the push-to-trip button from the door front by use of a bowden cable (cable NOT supplied).
- Available for FE FG Frame sizes

Keylock

An extra Ronis or Profalux key lock can be clicked into the handle front, thus allowing one to lock the breaker in the same manner as the padlocking device.
The Ronis key locks are available in a number of versions

- A version where each lock has a different key number
- A version where the user can choose one of six keys for several locks

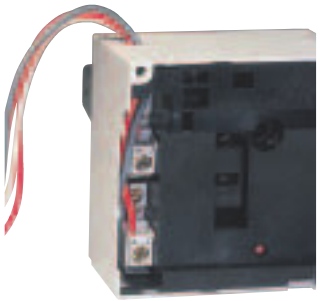
Draw-out adaptor

- For use with the door/panel mounted rotary handle with the standard or long shaft
- The device allows for the difference in breaker position in the draw-out device (depth difference, withdrawn and plugged in)
- The telescopic construction allows one to close the door or panel with the breaker in the withdrawn position
- Available for FE, FG and FK frame sizes

Side-by-side installation adapter boxes

- A set of covers that bridge the gap between breakers with rotary handles on use through cover plate
- Provides an aesthetically pleasing finish to the breaker fronts
- Available for FD and FE frame sizes

Auxiliary contacts



- Special rotary handle versions can be provided with two FABAM NO contacts. These close before the main contacts close and open after the main contacts open
- The contacts come pre-installed in the rotary handle and have 2 cables 0.75 mm^2, 60 cm long
- Available for FD, FE, FG and FK frame sizes

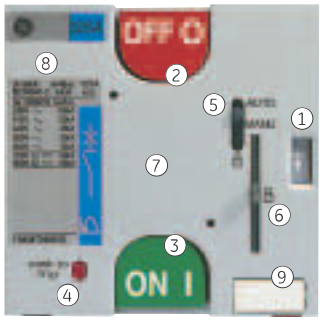
External accessories

Electrical operators

In order to allow a ***Record Plus*** circuit breaker to be operated electrically, front mounted electrical drives are available. These drives are designed for easy mounting onto the breaker front have have three clearley indicated positions OFF , ON and TRIPPED .
The Record Plus standard Electrical Operator offering covers a total of five different devices. For each frame size a field mountable execution is availabe, one for the FD frame (3-160A), one for the FE frame (3-250A), one for the FG frame (250-630A) and one for the FK frame (630-1600A).

For Hi end applications the Fk frame can be e uipped with a factory mounted electrical operator with an enhanced performane. Each device is easy to mount and connect whilst the connection diagrams allow a simple yet flexible application of the device.
The devices are connected by means of IPXXB box terminals accessible from the breaker front and located in the immediate vicinity of the terminals of the internal accessories. The box terminals allow for wiring with a cross section of 0.5 to 2.5 mm^2.

Operation

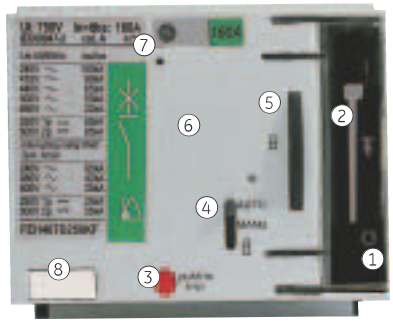


① Breaker Position Indicator - OFF- ON-Tripped-
② Breaker ON push-button
③ Breaker OFF push-button
④ Breaker uick Trip/OFF push-button
⑤ Manual-Automatic switch
⑥ Padlocking device (-O- Off only)
⑦ Area reserved for Optional field mountable KeyLock
⑧ Breaker data labels
⑨ Circuit indication label

FD frame operator
Designed to be used in a side by side configuration with the FE frame operators the breaker drive combination have the same depth whilst the cut-outs are of the same size.
Each Record Plus FD breaker is supplied with two extra data labels. This to indicate the breaker data on the operator front (standard labels are hidden once the device is mounted).

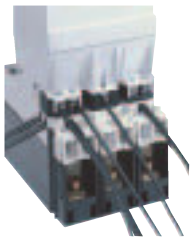
FD operators have two coils one to close the Record Plus device and a second to open. The operating panel has a Auto Manual position that will only allow local OFF ON operations when the switch is set to Manual.
In all conditions a recessed push to trip knob is available to allow for emergency disconnection of the device.

Padlocking or keylocking is possible in OFF position whilst each operator is supplied with a clear ON , OFF and TRIPPED position indicator and a space for a optional circuit indicator label.



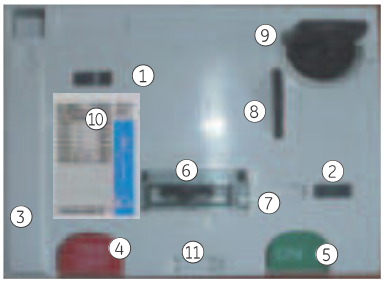
① Breaker Position Indicator - OFF- ON-Tripped-
② Breaker operating handle behind transparent door
③ Breaker uick Trip/OFF push-button
④ Manual-Automatic switch
⑤ Padlocking device (-O- Off only)
⑥ Area reserved for Optional field mountable KeyLock
⑦ Breaker data labels
⑧ Circuit indication label

FE frame operator
Designed to be used in a side by side configuration with the FD frame operators the breaker drive combination have the same depth whilst the cut outs are of the same size.
Each Record Plus FE breaker is supplied with two extra data labels. This to indicate the breaker data on the operator front (standard labels are hidden once the device is mounted).
FE operators are e uipped with a motor that changes direction to close or open the Record Plus devices. The operating panel has a Auto Manual position that only will allow acces to the manual operating handle when the switch is set to Manual (transparent cover can be opened).
In all conditions a recessed push to trip knob is available to allow for emergency disconnection of the device.
Padlocking or keylocking is possible in OFF position whilst each operator is supplied with a clear ON , OFF and TRIPPED position indicator and a space for a optional circuit indicator label.



Electrical operators

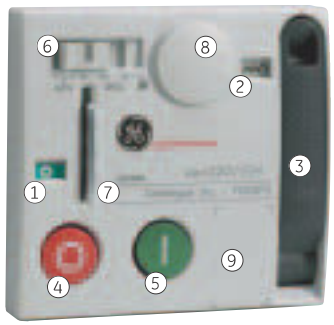
Operation



① Breaker Position Indicator -Tripped- -Non Tripped -
② Breaker Position Indicator -O- -I - (OFF or ON)
③ Breaker Manual -O- OFF handle (Pump mechanism)
④ Breaker uick Tripped/OFF push-button
⑤ Breaker -I- ON push-button
⑥ Sealable Manual-Automatic switch
⑦ Spring Charge Indicator
⑧ Padlocking device (-O- Off only)
⑨ Optional field mountable KeyLock
⑩ Breaker data labels
⑪ Circuit Indication label

FG frame Operator
A new Device, simple and easy to mount to all FG frame breakers in all situations. Each operator has a easy to use mounting interface allowing the device to be mounted in the field whilst allowing wiring access to all internal accessories. This mounting interface is linked to the electrical operator via a simple and easy to use hinging mechanism. After mounting and wiring simply close the hinging mechanism and the electrical operator is sturdily linked to the breaker. Suitable for all FG frame breakers each device is e uipped with a upgraded and comprehensive user interface.

FG operators have a motor to open the device and a closing coil. The operating panel has a Auto Manual position that only will allow use of the manual operating handle when the switch is set to Manual. In all conditions a recessed push to trip knob is available to allow for emergency dis-connection of the device.
Padlocking or keylocking is possible in OFF position whilst each operator is supplied with a clear ON , OFF indicator, a separate TRIPPED position indicator and a space for a optional circuit indicator label.



① Breaker Position Indicator -O- -I - (OFF, ON or Tripped)
② Operator Position Indicator Ready to Close/Open
③ Breaker Manual -O- OFF handle (Pump mechanism)
④ Breaker uick Tripped/OFF push-button
⑤ Standard version. Selector switch
(Manual only - Handle pump -OFF- or -ON-)
⑤ Enhanced version (depicted) ON coil actuator knob
⑥ Manual-Automatic-Lock switch
⑦ Padlocking device (-O- Off only)
⑧ Optional field mountable KeyLock
⑨ Breaker data labels

FK frame Operator
A new Device, simple and easy to mount to all FK frame breakers in all situations. Each operator has a easy to use mounting interface that replaces the original breaker cover and allows the Electrical Operator to be mounted in the field. The Electrical Operator is then simply screwed on to mounting interface linking it to the breaker mechanism. Suitable for 3 or 4 pole FK frame breakers with ratings of 630, 800. 1000, 1250 1600Amps each device is e uipped with a upgraded and comprehensive user interface.

Standard FK operators are e uipped with a motor that changes direction to close or open the Record Plus devices. The operating panel has a Auto Manual position that only will allow use of the manual operating handle when the switch is set to Manual.
A selector switch allows the user to switch between the use of the operating handle to switch OFF or ON. In all conditions a recessed push to trip knob is available to allow for emergency disconnection of the device.

Enhanced FK operators have a motor to open the device and a closing coil. The operating panel has a Auto Manual position that only will allow use of the manual operating handle when the switch is set to Manual. In all conditions a recessed push to trip knob is available to allow for emer-gency disconnection of the device.

All devices can be padlocked or keylocked in their OFF position whilst each operator is supplied with a clear ON , OFF and Tripped indicator.

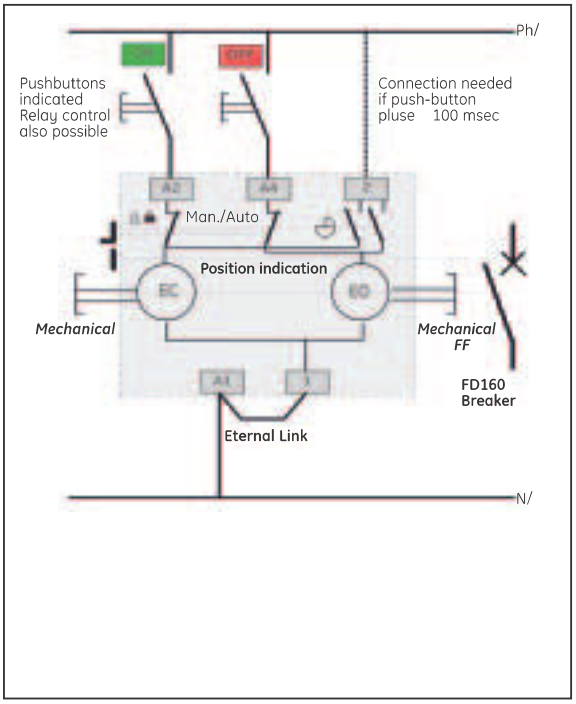
Speci cations

Record Plus Types	FD frame 3 or 4 pole	FD frame 3 or 4 pole	FD frame 3 or 4 pole	FD frame 3 or 4 pole	FD frame 3 or 4 pole
Electrical operator types	**FDEMF**	**FEEMF**	**FGEMF**	**FKEMF**	**FNEMF**
Mounting	Field	Field	Field	Field	Factory only
Rated voltages					
24V AC/DC				-	
48V AC/DC				-	
60V AC/DC				-	-
210-130V AC/DC				-	-
200-250V AC/DC				-	-
400-440V AC/DC				-	-
24V AC	-	-	-		-
48V AC	-	-	-		-
110V AC	-	-	-		
110V DC	-	-	-	-	
220V AC	-	-	-		
220V DC	-	-	-	-	
Power consumption					
During ON cycle	700VA/W	700VA/W	500VA/W	460VA..110VA	500VA/W
During OFF cycle by operator	700VA/W	700VA/W	500VA/W	460VA..110VA	500VA/W
During OFF tripped cycle by shunt release	max 7.5 mVA/mW	max 7.5 mVA/mW	max 7.5 mVA/mW	max 300 mVA/mW	max 300 mVA/mW
Power consumption					
AC15 24V	4A	4A	4A	4A	4A
AC15 230V	1A	1A	1A	1A	1A
Operating times					
ON via electrical operator	50 milliseconds	100 milliseconds	50 milliseconds	1.5 seconds	50 milliseconds
OFF via electrical operator	50 milliseconds	100 milliseconds	8 seconds	3 seconds	12 seconds
OFF via shunt release	50 milliseconds	50 milliseconds	50 milliseconds	50 milliseconds	50 milliseconds
Reset time between an OFF and ON pulse	80 milliseconds	100 milliseconds	8 seconds	1.5 seconds	12 seconds
Life span					
Mechanical endurance	100000	10000	5000	5000	5000
Operating fre uency (per hr.)	120	120	60	30	30

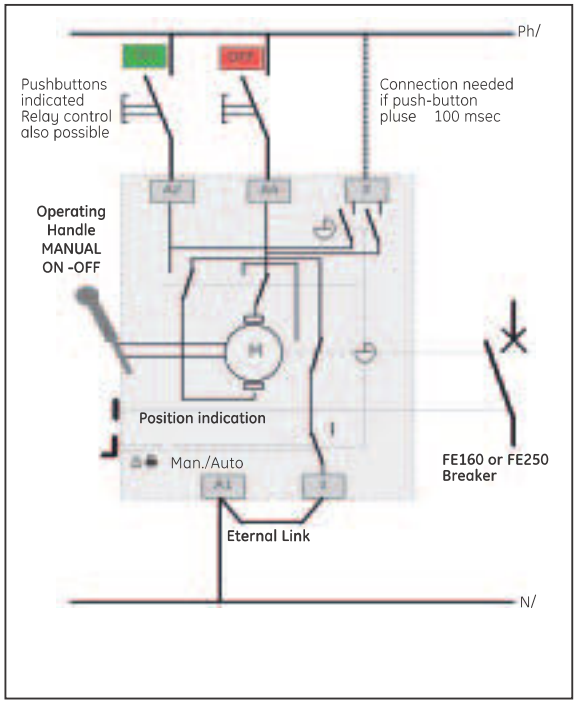
Electrical operators

Field mountable models schematics

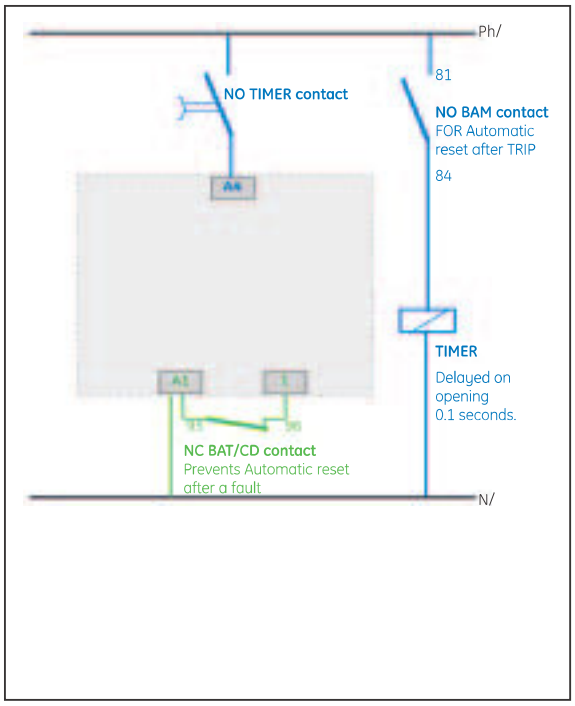
FD frame standard sc eme
For use with NON Automatic breakers or in cases where no RESET functionality is re uired.



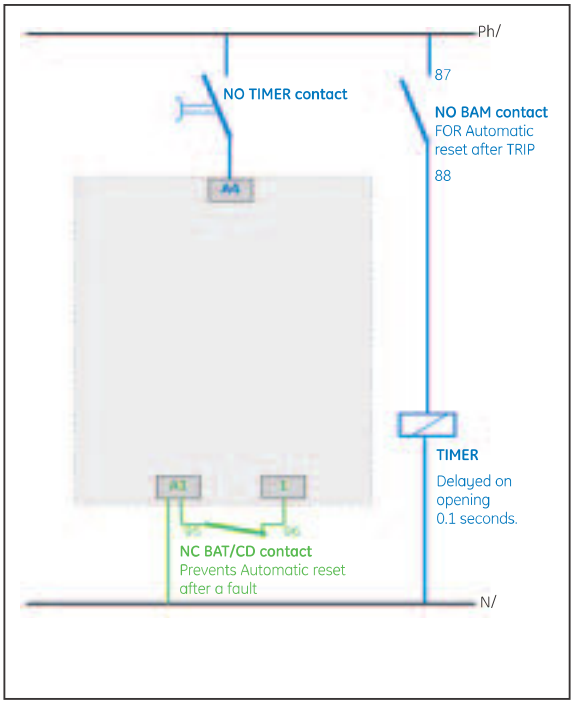
FE frame standard sc eme
For use with NON Automatic breakers or in cases where no RESET functionality is re uired.



FD frame alternate options
One or both of the options (depicted in blue and green) can be added to create the indicated functionality.



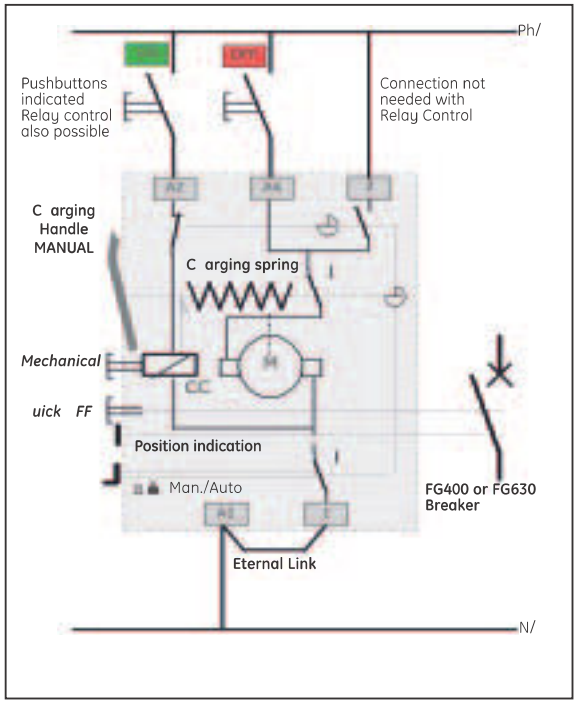
FE frame alternate options
One or both of the options (depicted in blue and green) can be added to create the indicated functionality.



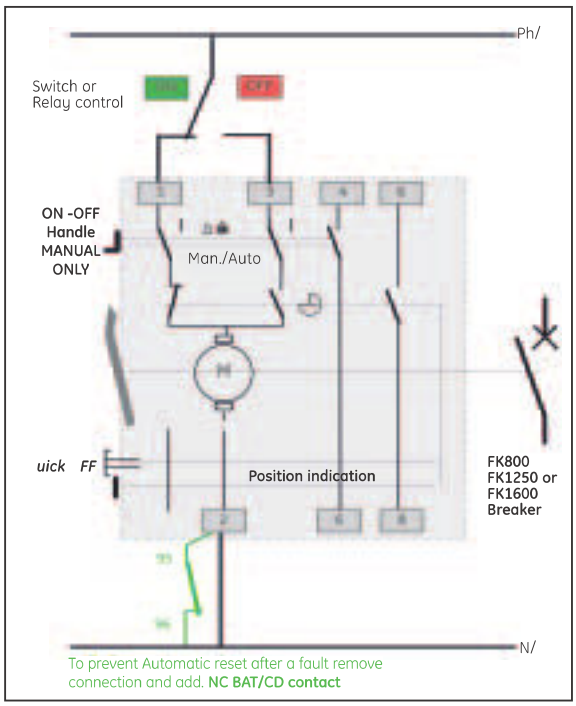
Electrical operators

Field mountable models schematics

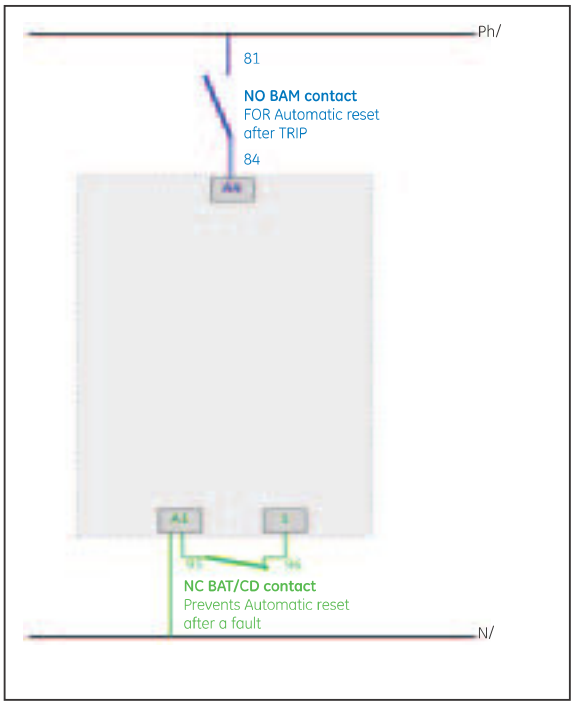
FG frame standard sc eme
For use with NON Automatic breakers or in cases where no RESET functionality is re uired.



FK frame standard sc eme for relay control
For use with NON Automatic breakers or in cases where no RESET functionality is re uired. Use alternate marked in green to black reset after a fault.



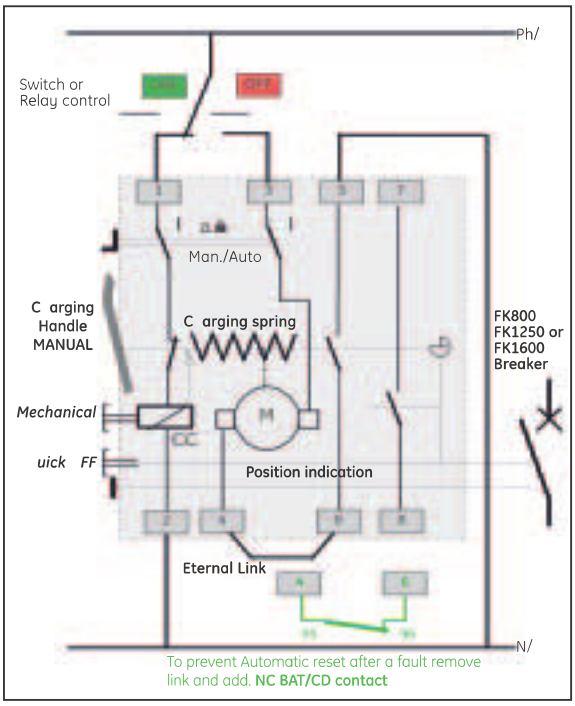
FG frame alternate options
One or both of the options (depicted in blue and green) can be added to create the indicated functionality.



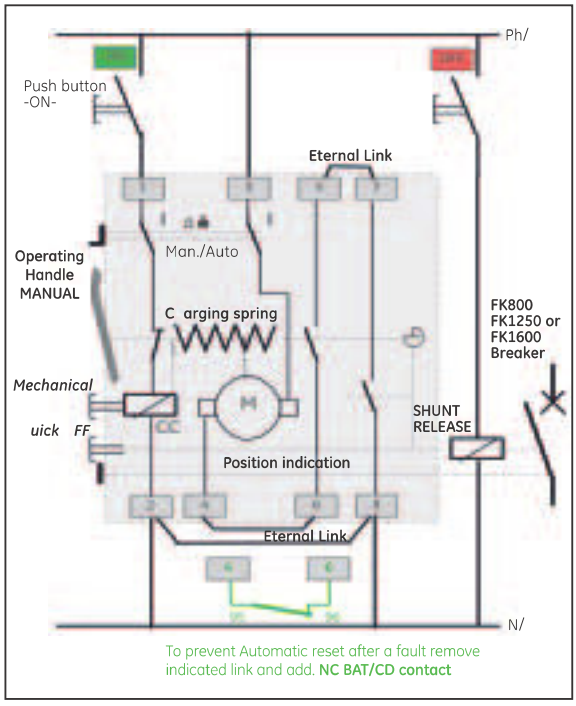
Electrical operators

Factory mountable models schematics

FK frame standard sc eme for relay control
For use with NON Automatic breakers or in cases where no RESET functionality is re uired. Use alternate marked in green to black reset after a fault.



FK frame standard sc eme for pus button control
For use with NON Automatic breakers or in cases where no RESET functionality is re uired. Use alternate marked in green to black reset after a fault.



External accessories

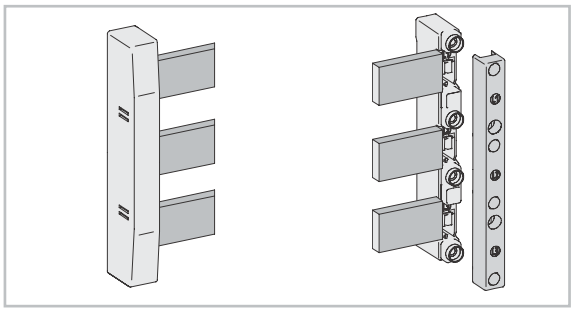
Connectivity - 60 mm system

three and four pole

Record Plus circuit breakers have been designed to be installed easily and uickly with conventional means. The devices can be screw mounted to a mounting plate or clicked to a symmectrical DIN rail and connected with busbars, cables, flex-bars and ring terminals in a multitude of configurarations.
Connectivity allows the user to limit the breaker installation to a few automateable tasks thus reducing the total costs. An adaptor device, specifically designed for the ***Record Plus*** breaker line and incorperating all the connection hardware, is fitted to the breaker using a few simple screws. Once mounted the adaptor is then simply plugged on to a three or four pole busbar system already installed in the switchboard.

Busbar system
Based on the generally used 60mm bar spacing standard, a 3 or 4 pole support allow the use of copper bars of the following standardized dimensions.

20 x 5 mm recommended for 250A
20 x 10 mm recommended for 400A
30 x 5 mm recommended for 400A
30 x 10 mm recommended for 630A



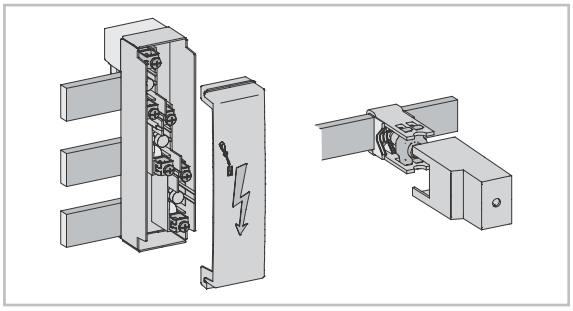
The busbar supports are delivered for uses with copper bars of 30 x 5 mm. By carefully removing material or by using the supplied spacer(s) the other standardized dimensions can be used.

By varying the distance between the supports it is possible to build a three or four pole busbar system with the following short circuit ratings

Busbar system

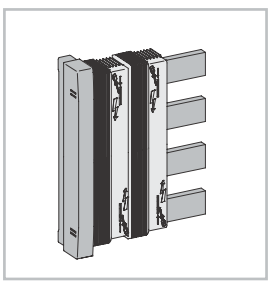
Support spacing	Busbar size (mm)	Peak wit stand Ipk (kA)	T ermal wit stand Icw (kA eff) 1 sec.
200 mm	20 x 5	46	21.9
	20 x 10	50	23.8
	30 x 5	58	27.6
300 mm	30 x 10	63	30.0
	20 x 5	40	19.0
	20 x 10	43	20.5
	30 x 5	52	24.8
400 mm	30 x 10	56	26.7
	20 x 5	35	16.7
	20 x 10	37	17.6
	30 x 5	47	22.4
	30 x 10	49	23.3

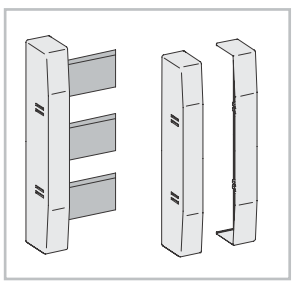
Mains connection
The system can be connected from the side or front. The front connection kit makes use of connection modules with connection lugs that are directly plugged on to the busbars. This module comes as a three and four pole unit and allows the connection of conductors from 1.5 to 70 mm^2.
The side connection kit is made up of single pole connectors with terminal covers that allow for the connection of Cu conductors with a cross section of 25 to 300 mm^2.



Busbar finis ing
Insulating covers are available to protect the user from inadvertent direct contact with the busbar system. These elements have a standard width of 50mm and can be coupled laterally offering variable width in order to cover the busbar not yet covered by breakers or feeding modules.

Endplate covers can be mounted to the busbar supports in order to provide complete protection against inadvertent contact to a busbar from the side.



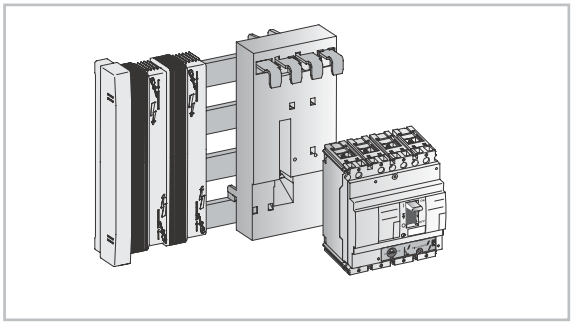


The system

For the ***Record Plus*** FD and FE frame adaptors exist rated at 160A (FD) and 250A (FE) and in a 3 and 4 pole version. Designed to allow the use of the breaker at its full rated breaking capacity of 150kA at 415V each unit is e uipped with a plug/hang on connection system allowing one to place it on the busbar system in one simple operation.

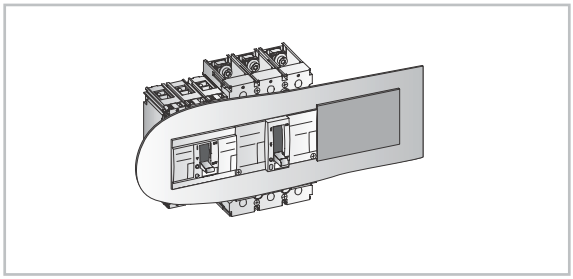
The adaptors have been tested to meet the most stringent re uirements and are e uipped with a mechanism allowing them to be removed as they were mounted.
Each adaptor is supplied with the necessary fixation hardware and a terminal shield to cover the connection between the breaker and the adaptor.

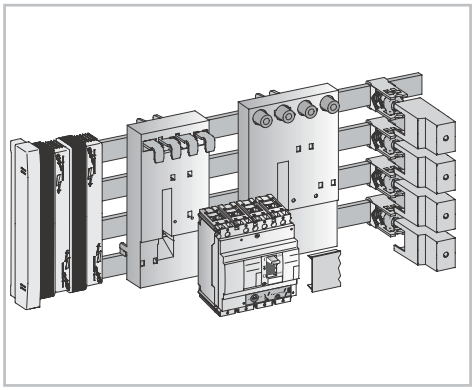
Adaptor
The breaker and adaptor mounting is simple and easy. The length of the 4 pole adaptor also allows the use of a bottom mounted RCD.

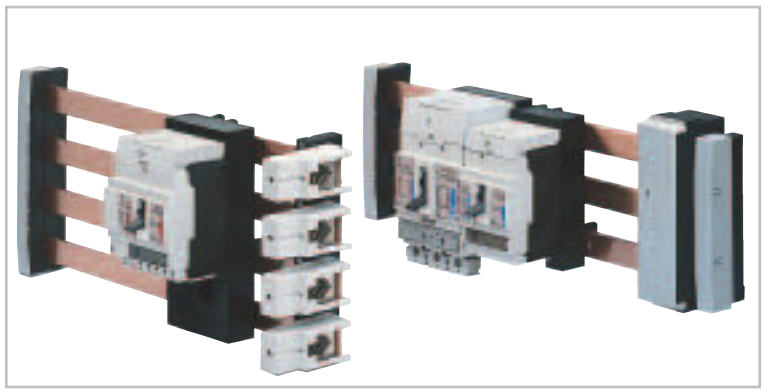


System
Each breaker is fixed on the adapter by means of two pretapped screws at the bottom and its main terminals at the top.
The breaker and adaptor combination is now uite simply plug/hung on to the busbars, connecting and fixing the breaker in one simple operation.
To allow for a flush-front finishing the adaptors have been designed to adapt to the difference in breaker depth and can be used with the standard FD and FE frame sizes (FD type without DIN-rail adaptor).

Finis ing
The system can be finished with a cover/trim plate that can be found in the GE enclosure/systems catalogue. To allow for a standard cut-out within the cover/trim plate a filler piece is available in lengths of of 1.2 m. This filler plate is adapted to the ***Record Plus*** standard front cut-out of 64 mm.

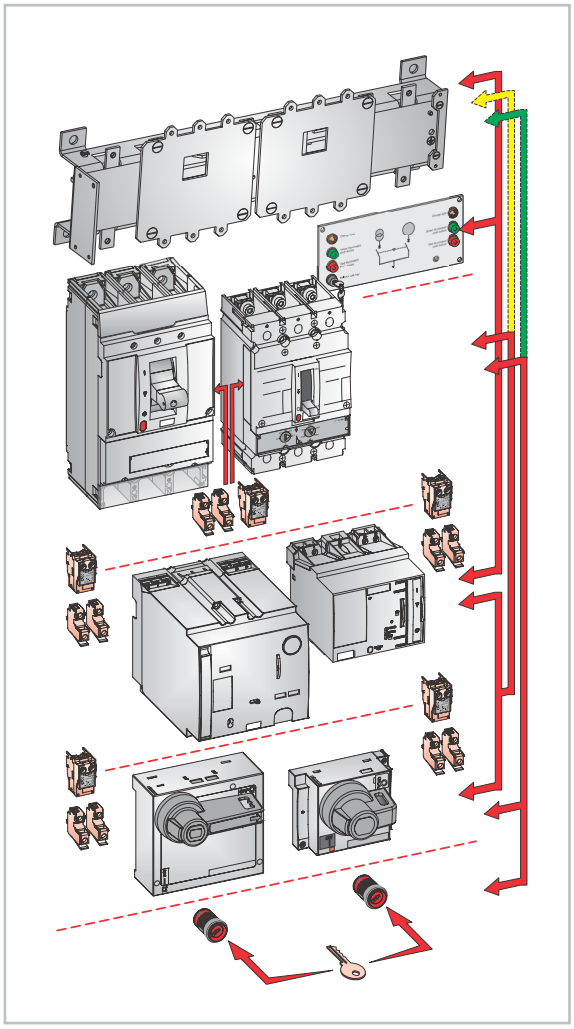






External accessories

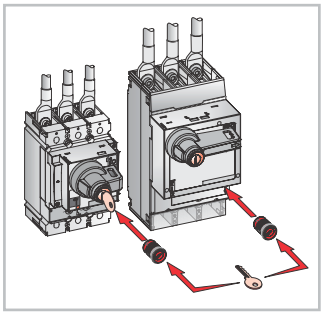
nterlocking systems



Mechanical interlocking

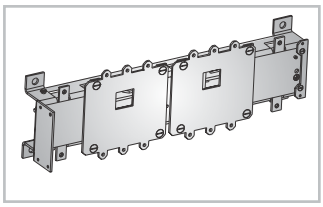
Record Plus circuit breaker are designed for use with a number of mechanical interlock systems suitable for use with thermal magnetic, magnetic only, non automatic and electronic circuit breakers. Each system only permits one of the two interlocked devices to be switched to the on position.

Two systems are available
Mechanical interlocking by e uipping both devices with a rotary handle and cylinderlocks with the same key number (2 locks one key).



As all breakers use the same RONIS 1104B lock type all breaker combinations are possible.

The use of an interlock unit mounted behind the two devices, here the breakers are fitted on to pre-assembled adapter plates that allow the breaker to interface with the interlock unit.

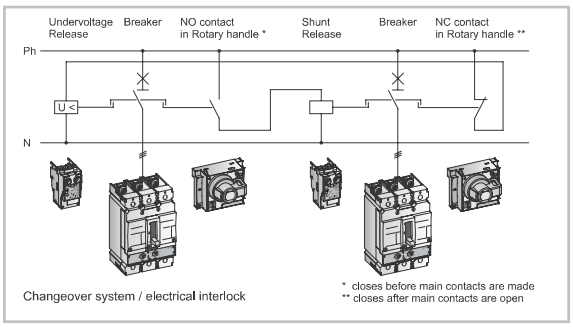


The device allows the interlocking of two breakers of e uivelant or different frame sizes. The following combinations are possible

- One 3 or 4 pole FE frame (10-250A)
  One 3 or 4 pole FE frame (10-250A)
- One 3 or 4 pole FG frame (100-630A)
  One 3 or 4 pole FG frame (100-630A)
- One 3 or 4 pole FK frame (320-1600A)
  One 3 or 4 pole FK frame (320-1600A)
- One 3 or 4 pole FG frame (100-630A)
  One 3 or 4 pole FE frame (10-250A)
- One 3 or 4 pole FK frame (320-1600A)
  One 3 or 4 pole FG frame (100-630A)

Electrical interlocking

Two devices can be electrically interlocked by using a combination of shunt and/or undervoltage releases with auxiliary contacts of the early closing and breaking type. The ***Record Plus*** undervoltage and shunt release are designed to allow their use as interlocking devices and use a twin coil actuator design. Rotary handle mechanisms are available with early closing and breaking auxiliary contacts.



Controllers

In order to use electrically and/or mechanically interlocked breakers in Automatic Transfer systems (ATS) two basic kinds of controllers are available. Each controller has a manual, automatic and locked position, a generator start up routine and a full set of pilot lights indicating the status of the system.

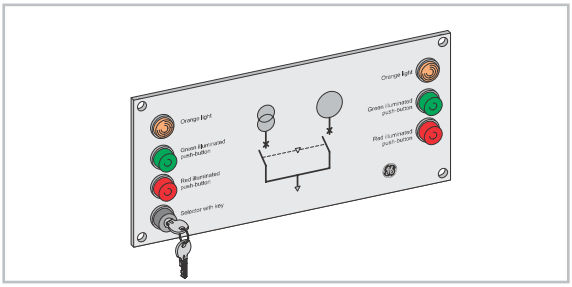
E model

Is available for change over systems with two devices. On a mains supply failure the mains device is disconnected and the secondary device switched on. When the mains supply returns, the controller keeps the secondary supply on line for a preset time of 10 seconds. It then opens the secondary breaker and closes the mains breaker. An emergency STOP order can be inputted on the terminals that will switch both the mains and secondary device to be switched OFF.

E plus model

Is available for changeovers with two devices. In addition to the standard E model features it allows for:

- Extra green pilot light indicates that the PLC is on line and functioning well.
- A generator start up command.
- An adjustable time delay on the generator start command initiation.
- Two connections allowing the input of a signal indicating that the supply of the generator set has reached it's nominal voltage. Only then will the mains device be disconnected and the secondary device switched on.
- An adjustable transfer and retransfer time between the different power supplies.
- Allows for the connection and disconnection of non priority loads when switching to the secondary supply.
- Built in communication.
- A terminal that allows the input of a start order of the generator set independent of the mains supply status. Here a change over cycle is initiated transferring from main to secondary supply.
- Adjustable cool down time of generator set.
- Remote retention of secondary supply
  Used to prevent unwanted power transfers and to prevent these occurring a to high a frequency.
  A specific potential free contact is dedicated to this function.
- Transfer to secondary supply option
  Used to start and keep the secondary supply on line independent of the presence of the mains voltage.
  A specific potential free contact is dedicated to this function.



Monitoring option

- Voltage monitoring relays
  4 terminals are supplied that allow the connection of a contact indicating that the chosen supply is available and meets the standards set by the relay.

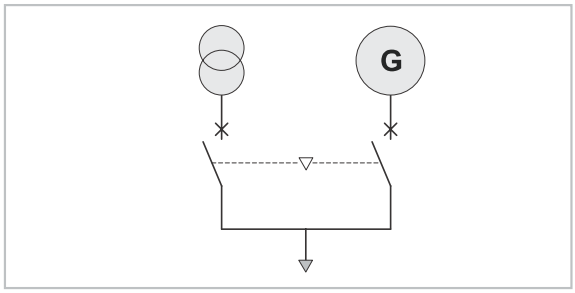
Controllers, performance

	E model	E plus model
Number of devices	2	2
Positions	Aut.- Man.- locked	Aut.- Man.- locked
Operating voltage	110 or 230V AC	110 or 230V AC
Power consumption	18VA	18VA
Mains voltage monitoring(1)	Optional	Optional
Time delay on generator set start signal	No	Adjustable 0.1 to 60 sec.
Time delay on transfer command after mains return	Fixed 10 sec.	Adjustable 0.1 to 15 min.
Remote order stop	included	included
Remote transfer order	No	included
Remote retention of secondary supply order	No	included
Non priority load switching	No	included
Cool down time gen. Set.		Adjustable 0.1 to 60 min.
Communication		RS232 / RS485

(1) Optionally, a built-in net and/or generator voltage monitor can be delivered with the controler

Automatic changeover

To assure the continuity of electrical supply within a low voltage installation it is desirable that on a failure of the mains voltage supply a secondary power source takes over. An automatic changeover device transfers the power supply from the main power source to a secondary supply when a voltage monitoring device detects a failure in the mains voltage.

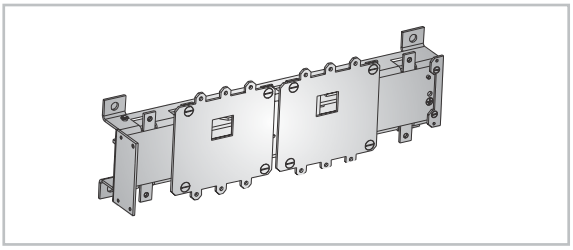


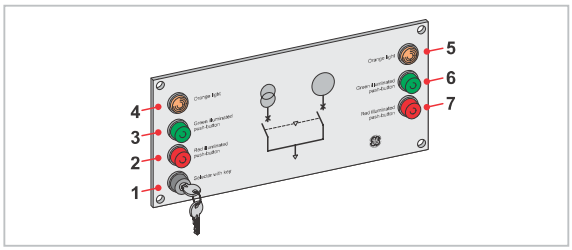
A two breaker system allows for a power transfer between a transformer and a generator set or two transformers.

Controller modes
A key operated switch (1) allows the selection of four different operational modes:

LOCKED	- All breakers remain in the position attained before this mode was initiated - The push buttons are disabled. - All automatic transfer functions are non functional.
MANUAL **E model**	- Taking the conditions normally applied to a transfer operation into account, the push buttons allow operation of the breakers. - Pressing the generator ON push button will only result in an operation of the breaker if the mains breaker is open and the generator is on line (voltage present).
E plus model	*On use of the E plus controller, pressing the generator 'ON' push button will give the generator an order to start. If second voltage is available an automatic transfer will be initiated from mains to generator supply. This operation can be cancelled by depressing the generator 'OFF' or mains 'ON' push button.*
E model	- Pressing the mains ON push button will only result in an operation of the breaker if the generator breaker is open and the mains is on line (voltage present).
E plus model	*On use of the E plus controller, pressing the mains 'ON' push button will initiate a automatic transfer from generator to mains supply. This operation can be cancelled by depressing the mains 'OFF' or generator 'ON' push button. If the mains voltage is not present, the cycle will not be carried out.*

The system consists of two electrically operated ***Record Plus*** moulded case circuit breakers equipped with a walking beam mechanical interlock and a controller that can be mounted in the front of the door or cover in which the breakers are installed.





AUTOMATIC	Depressing the push buttons that operate the breaker in the manual mode have no effect.
E model and *E plus model*	***Mains supply fails*** The system remains in its standby mode in which the mains breaker is ON and the secondary supply breaker (generator) is OFF. As soon as a signal is received that the secondary supply voltage is available the mains breaker is opened and the secondary supply breaker closed. If the secondary supply breaker does not close on the first command, two further closing orders will be given. If the breaker is still unable to close a fault is indicated.
E plus model	*Issues a start command to the secondary supply. This can be delayed up until 60 seconds after mains failure.*
E model	***Mains supply returns*** The system remains in its secondary mode. The secondary breaker (generator) is ON and the mains supply breaker is OFF for a period of 10 seconds. This delay is re-instated if the mains supply fails within this time frame. After this delay the secondary supply breaker is opened and the mains breaker closed. If the mains breaker does not close on the first command, two further closing orders will be given. If the breaker is still unable to close a fault is indicated.
E plus model	*Basic operation is the same. However the 10 second delay is upgraded to one that is adjustable from 0 to 15 minutes.*

Pilot lights

ORANGE (4)	Mains voltage present.
ORANGE (5)	Secondary supply voltage available.

Push-buttons with pilot lights

GREEN (3)	Constantly on: Mains breaker is OFF Blinking: Transfer to secondary supply underway **-OR-** Fault detected on closing mains breaker When the key selector switch is in it's manual position the push-button allows one to switch the mains breaker OFF
GREEN (6)	Constantly on: Secondary supply breaker is OFF Blinking: Transfer to mains supply underway **-OR-** Fault detected on closing Secondary supply breaker When the key selector switch is in it's manual position the push-button allows one to switch the Secondary supply breaker OFF
RED (2)	Constantly on: Mains breaker is ON . Blinking: Mains breaker has tripped due to an overcurrent (fault mode). When the key selector switch is in it's manual position the push-button allows one to switch the mains breaker ON
RED (7)	Constantly on: Secondary supply breaker is OF . Blinking: Secondary supply breaker has tripped due to an overcurrent (fault mode). When the key selector switch is in it's manual position the push-button allows one to switch the Secondary supply breaker ON

System performance

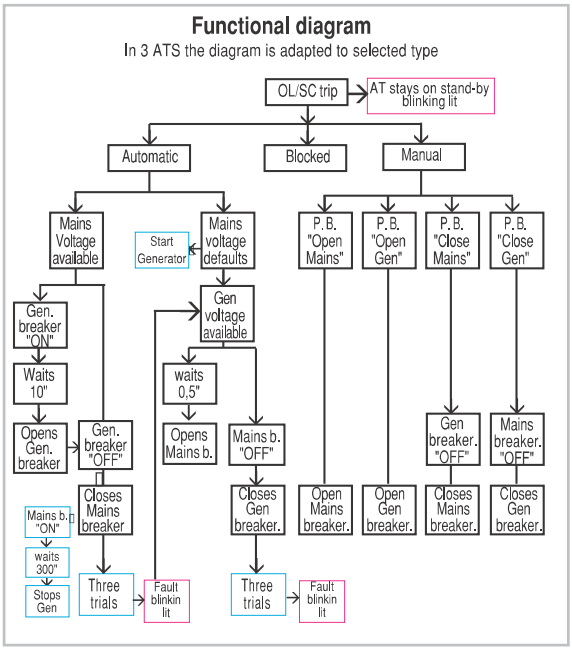
Breaker operation

Operating times (minimum)	FE frame	FG frame	FK frame
Opening (trip)	75 ms.	50 ms.	50 ms.
Closing (ON)	75 ms.	50 ms.	50 ms.
Reset plus OFF	2 sec.	5 sec.	12 sec.

Changeover operation

Operating times (minimum)
The sum of the operating times of the chosen breaker combination plus the time values of the controller.

Functional diagram
In 3 ATS the diagram is adapted to selected type

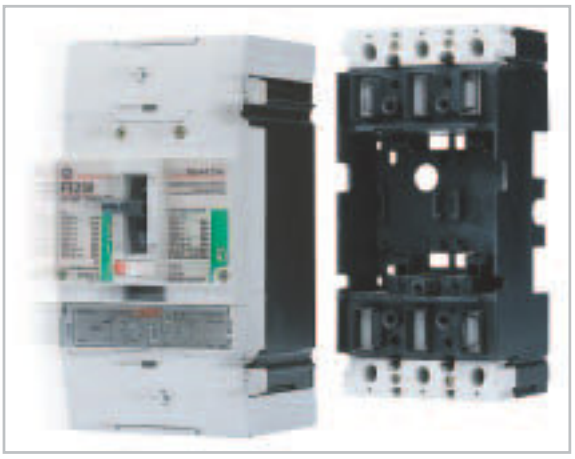


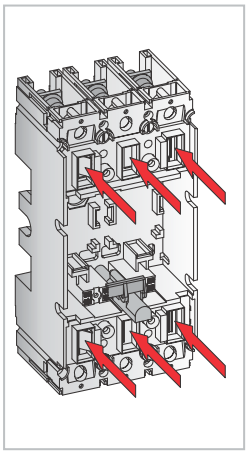
ersions

Plug-in

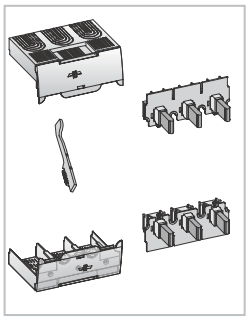
The ***Record Plus*** plug-in version allows quick, safe and easy interchange of breakers. It is made up of a standard fixed-front-connection breaker, a set of plugs, a trip mechanism fitted to the breaker and a monoblock base into which the breaker is plugged.
When the breaker is removed from the plug-in base it trips automatically (main contacts open) before the plug-in contacts in the base are disconnected.
The breaker can be operated (closed and opened) when removed from the plug-in base. On attempted insertion of a breaker in the On position into the plug-in base, the ***Record Plus*** breaker trips before the plug-in contacts in the base are connected.
The ***Record Plus*** plug-in version is available for:
FD frame sizes FD63/160 (maximum 125Amps)
FE frame sizes FE160/250 (maximum 250Amps)
FG frame sizes FG400/FG630 (maximum 630Amps)

FD and FE frame sizes equipped with bottom mounted RCD unit can also be transformed into the plug-in version. The mobile part of the plug-in version remains the same (plugs and trip mechanism do not change). The fixed plug-in base is of a different, elongated type and has a seperate catalogue number.





Mobile part



The mobile part that is fitted to the breaker is made up of a multi-pole set of plugs that displace the standard front connection. It also includes a trip interlock, that, when mounted, trips the breaker on its removal from the base. To prevent re-insertion under fault condition the same system also trips the breaker on re-insertion.
The set is completed with Tamper free terminal shields to prevent acess to live parts. The shields have specific areas designed to handle the device on insertion or removal.

Fixed part
A monoblock base that can be mounted to a backplate or on profiles and offers IPXXB protection for front access (FD - IP20, FE and FG - IP40).
It is designed to have exactly the same connection profile as the breaker it goes with, thus allowing the installation of all terminal shields and terminals that the standard breaker offers. These include rear and angular connectors, spreaders, customized ring terminal connectors and extenders.
The base is connected by re-ultilising the nut inserts and connection bolts supplied with the breaker.

Spares
Kits are available containing a number of trip interlock mechanisms, breaker nut inserts and connection bolts. The kits can be used in cases where the bases must be connected and where breakers have not (yet) been supplied.

Accessories
Several optional accessories are available. To allow the use of internal accessories in a plug-in configuration the wiring can be connected through plug and socket combinations. To prevent the incorrect insertion of a breaker of one amp rating into a socket pre wired for an other amp rating interchange prevention kits are available.

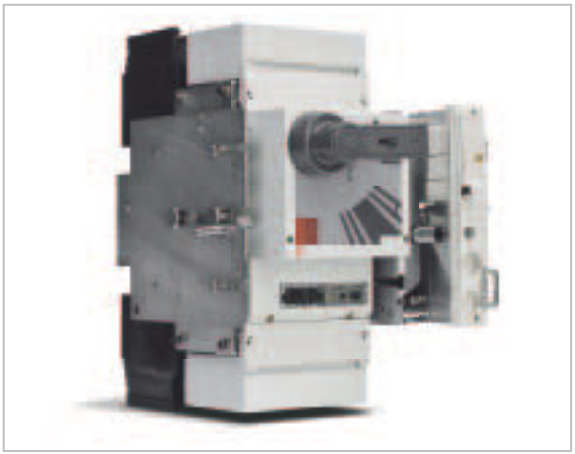
Please refer to page C.27.

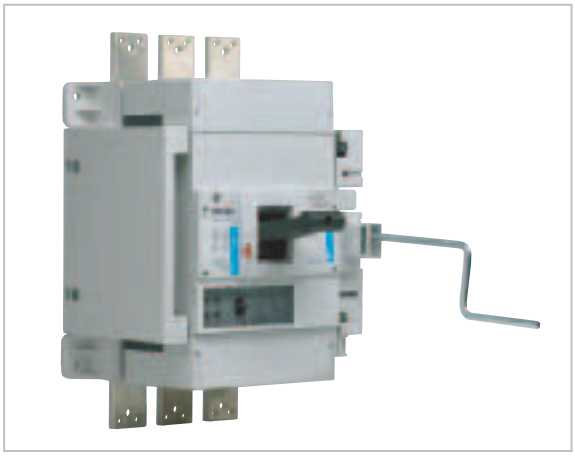
ersions

Plug-in

A draw-out version allows one to visibly and positively disconnect the mains supply from the installation.
Like on the plug-in device, interchanging breakers quickly, safely and effectively is one of the key features of ***Record Plus*** draw-out. It is made up of a breaker (standard fixed front connection version), a set of plugs and a trip mechanism that are fitted to the breaker, a monoblock base into which the breaker is plugged and a metal support cradle.

The cradle allows for placing the breaker in one of three positions:
Connected: Main and auxiliary contacts are fully connected to the base
Test/Disconnected: Main contacts are disconnected. Auxiliaries can be connected or disconnected. This allows for a complete test of the secondary wiring/functionality without having the mains connected.
Remove: Main and auxiliary contacts are fully disconnected from the metal support cradle and the plug-in base, the breaker can be removed.





FE frame (max. 250A) & FG frame (max. 630A)
The draw-out device is supplied as complete entity including a mobile and fixed part allowing the conversion of a standard fixed front connection breaker to a draw-out type.

Each kit contains a sturdy metal chassis with plug-in base that serves as a fixed part and a kit allowing the conversion of a fixed front connected breaker.

The moving part makes use of metal side supports, multi pole plugs that displace the standard breaker front connection system and a trip interlock system. The Trip interlock system has an **uni ue safety feature** that trips the breaker on removal from it's base and prevents re-insertion under fault condition by tripping the breaker. Two Tamper free terminal shields prevent acess to live parts.

The fixed component of the kit includes an integrated standard plug-in base encapsulated in a sturdy metal chassis. The base is connected by re-ultilising the nut inserts and connection bolts supplied with the breaker. All standard terminal shields terminals, rear connection facilities lugs available for the standard fixed front conection breaker can be used with this plug-in base.

see page C.25 for more details.

FK frame (max. 800A) & FK frame (max. 1600A)
The draw-out device is supplied as complete entity including a mobile and fixed part allowing the conversion of a standard fixed front connection breaker to a draw-out type.

Each kit contains a sturdy polyester l chassis with integrated plug-in base that serves as a fixed part and a kit allowing the conversion of a fixed front connected breaker.

The moving part makes use of metal side supports, multi pole plugs that displace the standard breaker front connection system and a trip interlock system. The Trip interlock system trips the breaker on removal from it's base. Two Tamper free terminal shields prevent access to live parts.

The cradle and plug-in base are integrated to form one moulded part. Two types exist one with FRONT and one with REAR connections both allowing the use of the standard connection lugs used on the device in fixed execution.

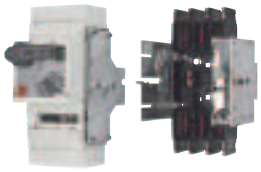
The FK frame draw-out system is always supplied with a door frame suitable for use as a through door solution and including a position indication system. The door frame allows the locking of the device in draw-out position with one or two Ronis 1104 B locks.

See Page C.27 for more details

ersions

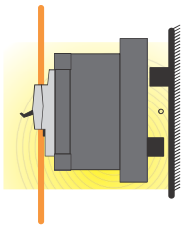
Draw-out, FE & FG frame

Standard draw-out device



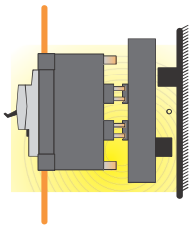
The draw-out device is supplied as complete entity including a mobile and fixed part allowing the conversion of a standard fixed front connection breaker to a draw-out type. It includes a racking handle and can be used behind door without any additional accesories.

Draw-out position Withdrawn



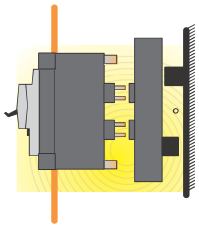
In this position the Mains and Auxiliary contacts are disconnected and the breaker can be removed from the chassis. Both the Mains and Auxiliary contacts are protected against inadvertent contact.

Draw-out position TEST



In this position the Mains contacts are disconnected and isolated from the network. The Auxiliary contacts are connected thus allowing the breaker's secondary circuits to be tested. When a plug and socket is used an MCCB style TEST position is achieved, with 8 pole draw-out disconnects an ACB style TEST position.

Draw-out position Inserted



In this position the Mains and Auxiliary contacts are connected.
A protection degree of IP40 is possible.

Draw-out device Accessories. Through door euchenon

The F-WE kit the device allows the breaker to be mounted behind a door whilst the draw-out eucheneon is located on the door front (three optional panel depths are possible).

The eucheneon offers the following facilities:
- racking handle storage area
- position indication Inserted - test - Withdrawn
- padlocking facility for a max. of three 5-8 mm padlocks.
- keylocking facility allowing the use of two Ronis or Profalux lock types.

Draw-out device Accessories. Through door options

The F-WT kit the allows the toggle handle operator and the draw-out eucheneon to be accessed on the door front.
The kit includes an elongated toggle handle, an extension frame, a doorflange and the through door eucheneon with it's locking and position indication features.

The F-WN kit allows the a through door Rotary handle operator and the draw-out eucheneon to be accessed on the door front.
The kit includes an extension frame, a doorflange and the through door eucheneon with it's locking and position indication features.

The F-WM kit allows the operating panel of a Record Plus Electrical operator and the draw-out eucheneon to be accessed on the door front.
The kit includes an extension frame, a doorflange and the through door eucheneon with it's locking and position indication features.

Draw-out device Accessories.
Door mounted Rotary handle option

The F-NRW kit allows the use of a door mounted rotary handle providing a depth adjustability between the inserted and withdrawn position. Combined with the F-WE kit the draw-out eucheneon and operating handle can be accessed on the door front.

Draw-out device Accessories.
Carriage Indication Contacts

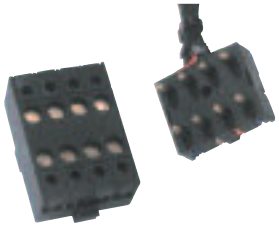
Two different sets are available one with 1 NO indication contact per position (total 3 NO contacts) and a second with 1 NO and 1 NC contact per position (total 3 NO 3 NC contacts).
These sets came as easy to fit and connect field mountable kits.

Draw-out, FE & FG frame

Accessories

Auxiliary disconnect plugs and sockets(1)

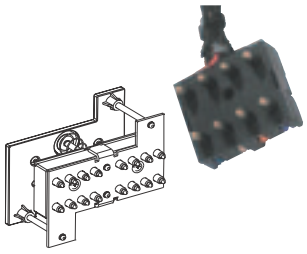
Plug-in FD FE & FG frame 8 pole plug(1)



A set made up of a plug screwed to the breaker back (mobile part) and a socket that clicks into the plug-in base (fixed part). The socket comes with connected colour coded wiring which allows for an easy identification of the connection points.The wiring can be passed through specifically designed channels that lead from the breaker rear into the accesory compartment.
The socket part can be wired out from the base with wiring up to 2.5 mm^2 (front access). Each unit has a total of 8 poles. The number of connectors that can be used per breaker frame size is as follows:

Frame size	FD63/160	FE160/250	FG400/630
Nos of units	1	2	3
Pin Codes (per connector)	1 - 8	1 - 8	1 - 8
Connector coding	X	X	X, Z

Draw-out FE & FG frame 8 pole plug(1)



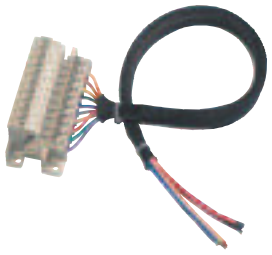
Meeting the same standard specifications as the 8 pole plug for the Plug-in version (see above) the kit now includes an adpated fixed part that allows an ACB TEST position to be created.

The accessory is available as 16 pole (2 - 8 pole units) or 24 pole kit (3 - 8 pole units). When mounted, this accessory allows the user to test the functionality of the installed accessories in the TEST position whilst allowing an easy connection and disconnection of the secondary circuits in the Inserted and Withdrawn position.

Frame size	FE160/250	FG400/630
Nos of units	2	3
Pin Codes (per connector)	1 - 8	1 - 8
Connector coding	X	X, Z

(1) In order to ensure a consistant and traceable wiring diagram of all internal accessories in each frame sizes a standard scheme is included in the wiring diagram chapter F of this catalogue (use is optional).

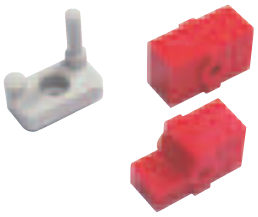
FD FE and FG frame - 10 pole type(1)



A set made up of a socket that can be attached to the plug-in base or a draw-out cradle and a plug with wiring that is connected to the accessories.
The set is used to allow for a test position on a draw-out breaker of the FE and FG frame sizes and as a supplementary connector for internal accessories on the FD and FE frame sizes.
Each plug and socket has a total of 10 poles.
The plug is fitted with supple wire, cross section 0.75 mm^2, length 60 cm. Maximum mounting per breaker size is:

Frame size	FD63/160	FE160/250	FG400/630
Nos of units	2	2	2
Pin Codes (per connector)	1 - 10	1 - 10	1 - 10
Connector coding	EL ER	EL ER	EL ER

Rating interchange prevention system



When a number of plug-in or withdrawable breakers (same frame different ratings) are installed in the same panel, it becomes necessary to determine which rating fits into which plug-in base. This to prevent overload in the cables/conductors connected to the base, the size of which are determined by the breaker trip unit value or setting.
A specifically designed ***Record Plus*** accessory prevents misinsertion of a wrongly configured breaker/trip-unit combination in the base.

The accessory consists of two parts (one code per breaker), one fixed on the base, the other on the rear of breaker. Depending on the placing of the red part in the plug-in base and the pin the user breaks out on the white part, up to 4 breakers can be equipped with this mutual rejection feature.

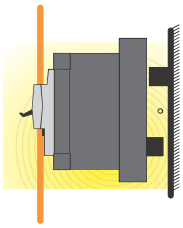
ersions

Draw-out, FK frame

Standard Draw-out device

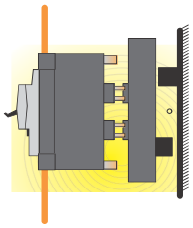
The draw-out device is supplied as complete entity including a mobile and fixed part allowing the conversion of a standard fixed front connection breaker to a draw-out type. It includes a racking handle and can be used behind or through door without any additional accessories. The draw-out device is available with front or Rear connections.

Draw-out position Withdrawn



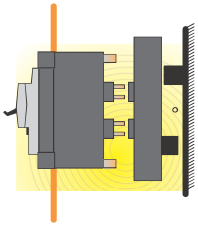
In this position the Mains and Auxiliary contacts are disconnected and the breaker can be removed from the chassis. Both the Mains and Auxiliary contacts are protected against inadvertent contact.

Draw-out position TEST



In this position the Mains contacts are disconnected and isolated from the network. The Auxiliary contacts are connected thus allowing the breaker's secondary circuits to be tested. With the standard 6 pole auxiliary disconnects an ACB style TEST position is possible.

Draw-out position Inserted



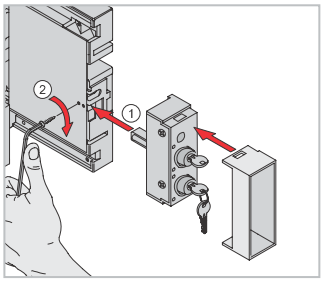
In this position the Mains and Auxiliary contacts are connected. A protection degree of IP40 is possible.

Operation

The standard device is supplied with a through door frame that with draw-out position indicators and the possibility of mounting one or two keylocks locking the device in it's drawn out position.

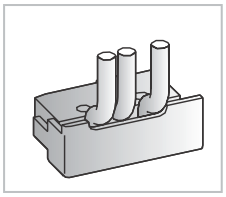
1.The Breaker is operated by an elongated toggle.(depicted)
2.The Breaker is operated by a Electrical Operator. For through door access of the electrical operator a door flange is required.
3.The Breaker is operated by a door or panel mounted Rotary Handle. A F-NRW kit allows the use of this handle providing a depth adjustability between the inserted and withdrawn position.

Eucheneon



Each draw-out device is supplied with a eucheneon, fitted on the right hand side of the door frame.
The device allows for the through door use of the draw-out racking handle and is equipped with a padlocking device allowing the user to lock the device in withdrawn position with up to three 5-8 mm padlocks. Optionally a keylock adaptor can be added allowing the uses of two keylocks offering the same locking facilities (recommended for behind door use).

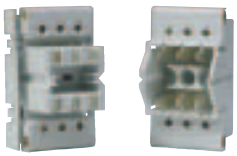
Carriage Indication Contacts



A maximum of two pre-wired change over contacts can be mounted in the fixed portion of the draw-out device One to indicate that the breaker is Withdrawn and a 2nd to indicate that the breaker is inserted.

Auxiliary Disconnect plugs and sockets 6 pole(1)

A 6 pole plug and socket system is available and is used to allow the auxiliary circuits to be connected and disconnected in the same manner as the poles. The plug sits on the back of the breaker and the socket clicks into the base.



On withdrawing and inserting the breaker the 6 pole plug and socket system only disconnects and connnects once the test position has been reached. This allowing for a test position without a seperate plug and socket. The FK socket part can be wired out from the base with wiring up to 1.5 mm^2 (front access).

Frame size	FK800/1600 3p	FK800/1600 4p
Nos of units	4	5
Pin codes (per connector)	1 - 6	1 - 6
Connector coding	X, , Z A	X, , Z, A B

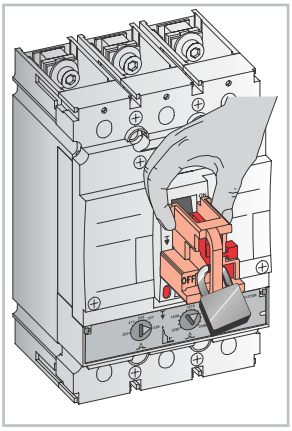
(1) In order to ensure a consistant and traceable wiring diagram of all internal accessories in each frame sizes a standard scheme is included in the wiring diagram chapter F of this catalogue (use is optional).

nstallation

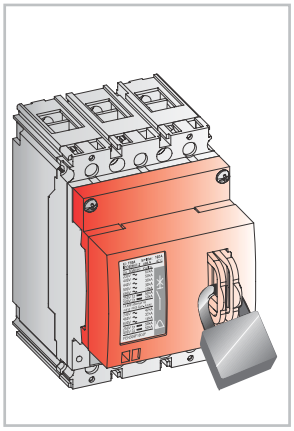
Padlocking device for toggle handle

To allow users to safely work on installations or installation segments protected by the ***Record Plus*** moulded case circuit breakers it is possible to padlock the devices in their OFF position.

This ensures a complete and safe isolation of the installation or installation segment from the power supply. Two different padlocking devices are available.



The ***Record Plus*** removable padlock is firmly attached to the breaker when it is padlocked and can be removed for use on another breaker when not in use. This accessory can be used with up to 3 padlocks of 5 to 8 mm. It is available in three different versions: one for the ***Record Plus*** FD and FE frame, one for the FG frame and a third for the FK frame.



A padlocking facility that is screwed on to the breaker front and normally remains mounted. This device allows the breaker to be locked in the OFF position with up to three padlocks of 5 to 8 mm. The device also covers the push to trip knob.
It is available in three different versions for the ***Record Plus*** FD, FE and FG frame.

Keylocking devices

Record Plus moulded case circuit breakers can also be locked in their OFF position by the use of a Keylock. This to allow users to work on installations or installation segments or to interlock one or more breakers. Keylocks are available for all Rotary handle devices, electrical operators and draw-out systems.

Pad- and Keylocking options, applicable for Record Plus Breakers

Overview	Frame size	Padlock		Standard Ronis key lock	Specifically numbered Ronis key lock	Profalux key lock
		Fixed	Removable			
Toggle operator Breaker locked in OFF position	FD Frame	A(1)	A			
	FE Frame	A(1)	A			
	FG Frame	A(1)	A			
	FK Frame	A(1)	A			
Directly mounted rotary handle Breaker locked in OFF position	FD Frame	S(1)		A	A	A
	FE Frame	S(1)		A	A	A
	FG Frame	S(1)		A	A	A
	FK Frame	S(1)		A	A	A
Through panel or door type of rotary handle Breaker locked in OFF position	FD Frame	S(1)		A	A	A
	FE Frame	S(1)		A	A	A
	FG Frame	S(1)		A	A	A
	FK Frame	S(1)		A	A	A
Panel or door mounted rotary handle Breaker locked in OFF position	FD Frame	S(1)		A	A	A
	FE Frame	S(1)		A	A	A
	FG Frame	S(1)		A	A	A
	FK Frame	S(1)		A	A	A
Electrical drive Breaker locked in OFF position	FD Frame	S		A		A
	FE Frame	S		A		A
	FG Frame	S		A		A
	FK Frame	S		A		A
Draw-out version Locked in Disconnected/Test (2) OR draw-out position	FE Frame	S		A		A
	FG Frame	S		A		A
	FK Frame	S		A		A

S standard feature, A accessory needed, empty box not foreseen
(1) the explicitly removing of a plastic part directly beneath the handle operator allows one to padlock or keylock in ON position (special applications).
(2) FE and FG Disconnected/test FK Draw-out position.

Door flanges

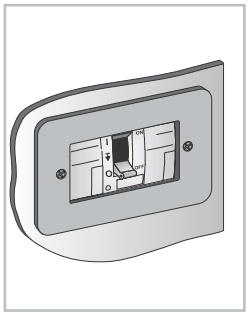
In order to provide an IP40 protection degree of the breaker when mounted through a door or cover plate door flanges are used. A door flange also improves the aesthetics of the cut-out in the door and allows for higher tolerances within the cut-out.

The devices are available for cut-outs with the toggle area, breaker front face, motor drive front face or on RCD operating panels. A second type of flange is used for rotary handles through door/cover allowing interlocks on the device to function correctly.

For ***Record Plus*** breakers installed through doors, cover plates or panels the following door flanges are available:

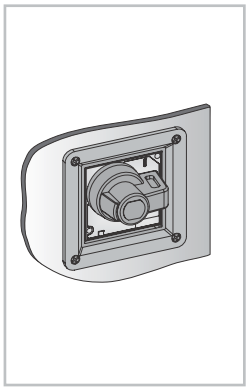
Toggle area
Fixation via front with 2 or 4 screws, universal for 3 and 4 pole breakers.

	Type
FE frame	**FEFT**
FG frame	**FGFT**
FK frame	**FNFT**



Front face
Fixation via front with 4 screws, available for 3 and 4 pole breakers

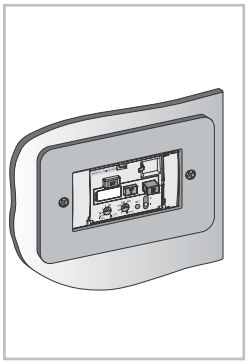
	Type
FD frame 3p	**FDFF3**
FD frame 4p	**FDFF4**
FE frame 3p	**FEFF3**
FE frame 4p	**FEFF4**



Rotary handle [1]
Fixation via front with 4 screws is required to allow use of the door lock in ON position with the through door/panel rotary handle type. Is available for:

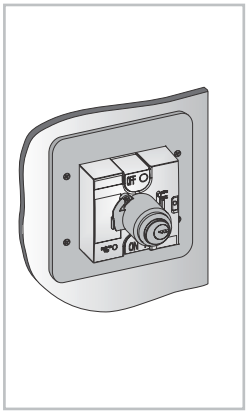
	Type
FD FE frame	**FDFH**
FG frame	**FGFH**
FK frame	**FNFH**

(1) Please use specifically designed compelte though door kits for the FE and FG frame draw-out system.(see page C.25)



RCD bottom mounted type
(universal for FD, FE and FG)
Fixation via front with 4 screws

	Type
FD frame 3p	**FDFF3**
FD frame 4p	**FDFF4**
FE frame 3p	**FDFF3**
FE frame 4p	**FDFF3**
FG frame 3p	**FDFF3**
FG frame 4p	**FDFF3**



Electrical operator
Fixation via front with 4 screws. The FK type can be used with the draw-out system.[1]

Available for:

	Type
FD frame	**FDFE**
FE frame	**FEFE**
FG frame	**FGFE**
FK frame	**FNFE**

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Terminal shields

Terminal shields are installed on the incoming or outgoing side of the breaker thus achieving a heightened protection degree, independent of the type of connection used. For fixed breakers with rear connnection or the plug-in or withdrawble versions of the ***Record Plus*** breaker the installion of short terminal shields is mandatory and they are normally supplied as part of the kit.

Record Plus terminal shields are equipped with a tamper free sealing facility and come in sets of two. They are available in a short or a long version and have been designed for use on the standard fixed front connection breaker or on the base used for plug-in breakers.
Each terminal shield is equipped with easy to remove breakouts to facilitate the connection of the breaker.

Short type(1)
For use with internal box clamps and rear connection.

Long type(2)

Short terminal shields

	FD	FE	FG	FK
With two terminal shields mounted Breaker heighth is increased by (mm)	20	30	60	40

(1) The FK short type is only supplied with rear connection kit.

ong terminal shields

	FD	FE	FG(2)	FK
With two terminal shields mounted Breaker heighth is increased by (mm)	97	122	83	160

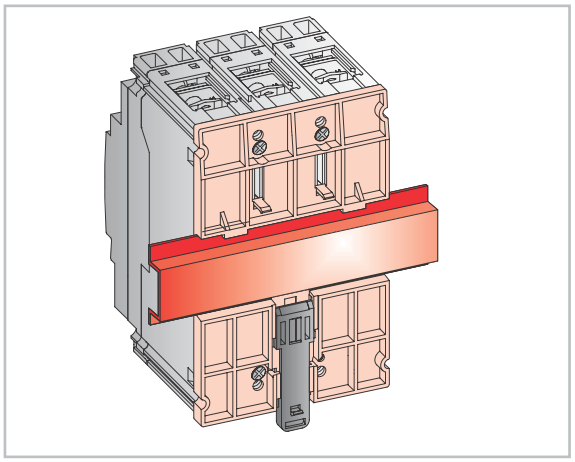
(2) The FG type is of medium length. Special long and widened version available on request.

Finger protection caps
Available only for the D frame box terminals, the caps prevent inadvertent contact with the connection terminals, thus providing the terminal and breaker with an IPXXB protection.
Finger protection caps come as standard with the magnetic only circuit breakers but they are also available in a set containing 12 pieces.

FD frame adaptors

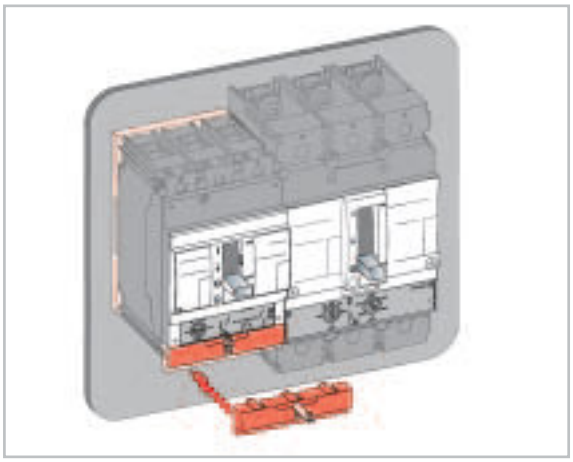
DIN-rail mounting

All ***Record Plus*** FD frame breakers can be installed on a (symmetric) DIN profile (EN50022) by using an adaptor. The DIN-rail adaptor is normally supplied with most breaker types but can also be purchased seperately.



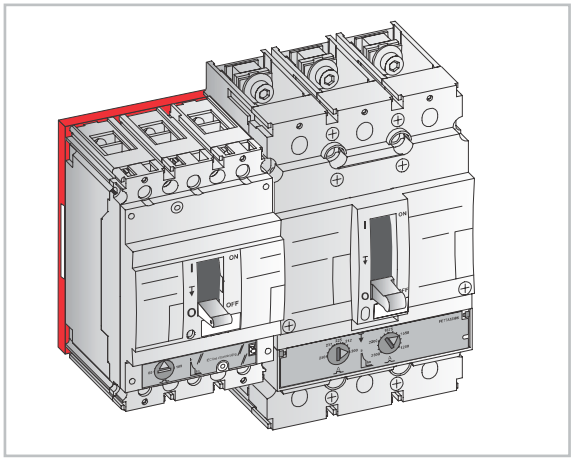
Adaptor - Cut-out filler

To use the cut-out with the breaker face and trip unit just apply the cut-out adaptor to the D frame trip unit. This sealable cover matches the cut-out perfectly and offers an aestheticly pleasing blending of both breaker fronts.



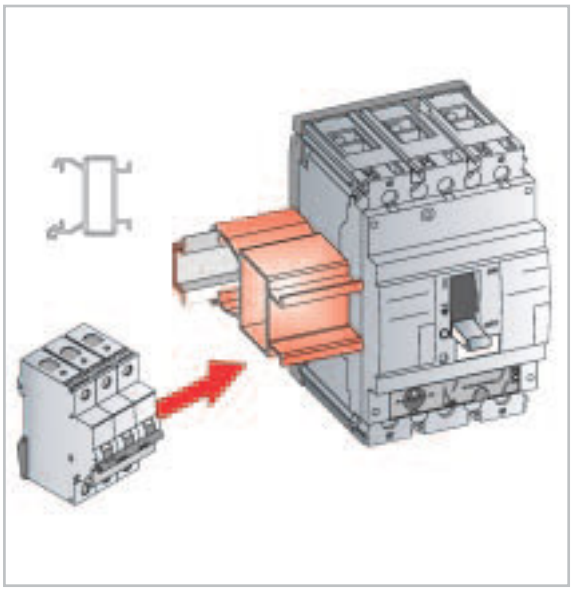
Side by side mounting with FE frame breakers

The FD frame DIN-rail adaptor has a second application: when mounted with its DIN-rail mounting feature facing the breaker rear it serves as a heightner. This change in depth of the D frame allows side by side mounting with E frames. When reversed the adaptor turns into a heightner that lifts the D frame, and all its cut-outs up to the E frame level. The 64 mm cut-out of the D and E frame now match up fully in height and depth.



Adapator - Side by side mounting with ElfaPlus MCB's

The FD frame has a 45 mm cut-out allowing it's use next to Elfa Plus MCB's and other modular devices. To bridge the diffference in depth between the FD frame and the modular devices a special heightning kit is available in a standard length of 354 mm.

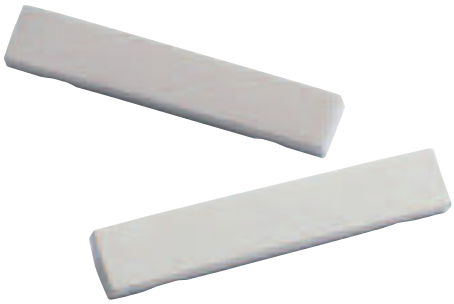


nstallation

Finishing covers

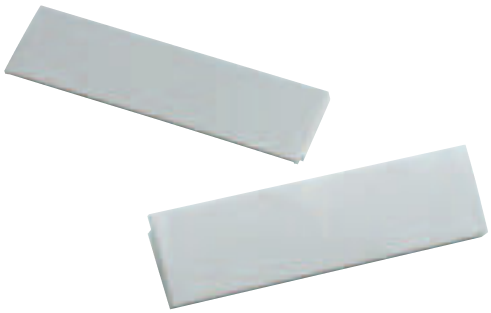
FD frame

For the ***Record Plus*** FDS, FDN, FDH and FDL types the finishing covers are standard. By adding both these covers and the finger protection caps the breaker has a protection degree of IP40.



FE, FG and FK frame

All ***Record Plus*** FE, FG and FK frame breakers come complete with finishing covers (for 3 or 4 pole versions). However, these covers are also available as seperate items.

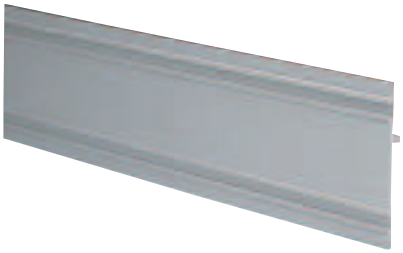


Circuit identification label

Located just under the toggle of every ***Record Plus*** circuit breaker there is an area allocated specifically to click in a circuit identification label.
A set contains 20 units that are common for all frame sizes.

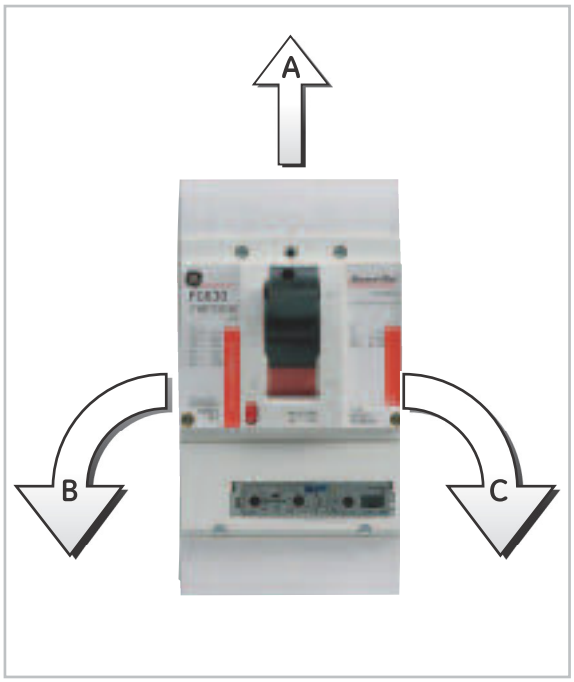
Cut-out filler plate

The FD FE frame sizes are designed for side by side mounting.The cut-out suited for use with both breaker types has a standard dimension of 64 mm. In order to fill in empty or reserve space in the trim/cover plate,a cut-out filler plate is available in a standardized length of 1.2 meters.



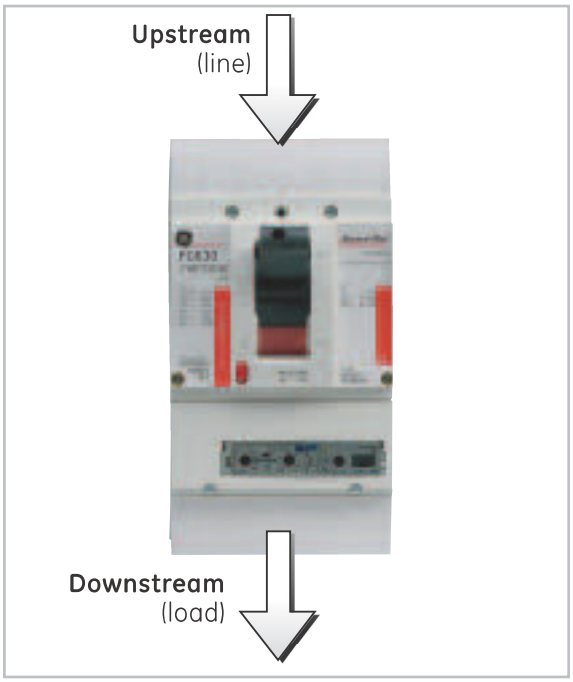
Mounting positions

Allowed mounting position per frame size



Breaker	Version	A	B	C
FD63/160	DIN rail	X	X	X
	Fix	X	X	X
	Plug-in	X	X	X
FE160 / FE250	Fix	X	X	X
	Plug-in	X	X	X
	Draw-out	X	X	X
FG400 / FG630	Fix	X	X	X
	Plug in	X	X	X
	Draw-out	X	X	X
FK800 / FK1600	Fix	X	X	X
	Draw-out	X	X	X

Breaker supply



Phase/phase voltage Un (AC/DC)	Supply side is	FD63/160 C E S	FD63/160 N H L	FE160 FE250	FG400 FG630	FK800 FK1600
220/240V	Upstream	A	A	A	A	A
	Downstream	A	A	A	A	A
500 V	Upstream	A	A	A	A	A
	Downstream	A	A	A	A	A
500V	Upstream	P	P	P	P	P
	Downstream	P	PB(1)	PB(2)	PB(2)	P

A Allowed
P Use of phase separators is obligatory.
PB Use of phase separators and backplate is obligatory.

(1) The use of the top cavity in the box terminal is mandatory.

(2) Applies for N type only H L types Upstream FEED ONL

Connections

Standard connection terminals

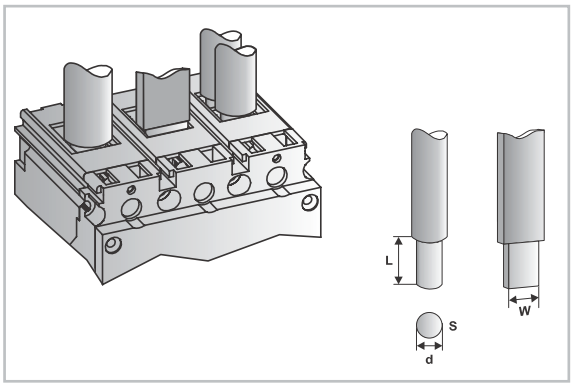
The ***Record Plus*** connection facilities have been designed with the user in mind.
Easy access to the area where the conductor must be placed, their generous dimensions and their inherent stability assure an easy connection.
Each of the standard connection options described here applies to the fixed breaker, its plug-in or draw-out base and the RCD associated with the frame size.

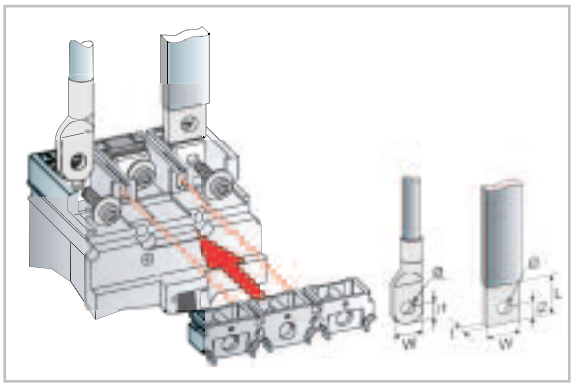
FD frame

The FD frame is equipped with box clamps allowing the direct connection of one or two cables. The clamps can also be used with flat bars up to a width of 12 mm. All non standard connection terminals as extenders, rear connections etc. are directly connected to these standard terminals. The breaker is always supplied with the clamps fully open, and they are equipped with a mechanism that prevents them from inadvertently closing whilst connecting.

FE frame

The FE frame size has a connection area specifically designed for the connection of busbars and/or cable lugs. The connection area is designed to allow for maximum access to the front of the terminal. Standard busbar sizes and cable lugs can be accommodated without accessories.
The connection pads have through holes and are supported by a simple slide-in fully insulated part that contains one steel nut per connection point. The connection bolts have an internal allen key profile allowing for ease of use in the relatively confined area just above the connection strap.
Non-standard connections as extenders are directly fitted onto the standard terminals. In other cases - like rear connections - the slide-in part is completely replaced.





FD frame box terminals [1]

	FDC & FDE types 100A	All other FD types
Single cavity lug Connection capacity mm^2	2.5 - 70	
Dual cavity lug	-	
Top cavity only Connection capacity mm^2	-	2.5 - 95
Bottom cavity only Connect. capacity mm^2	-	4 - 70
Both cavities Top Connection capacity mm^2	-	2.5 - 35
Bottom Connect. capacity mm^2	-	4 - 35
Strippable length L (mm)	17.5	17.5
W max (mm)	12	12
Tor ue (Allen key in breaker) (Nm max.)	6	8

(1) For aluminium conductors use external box clamps.

FE frame with removeable cover

	FE
W max (mm)	25
t max (mm)	5
i1 max (mm)	11.5
i2 max (mm)	9.8
Ø max (mm)	9.5
L Distance to insulation (min.)	25
Tor ue (Allen key in breaker) (Nm max.)	25

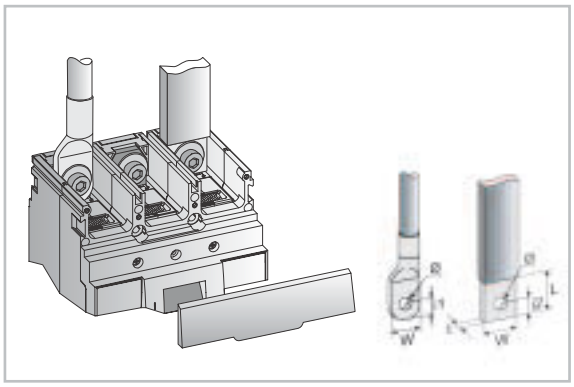
W Width of bar or ring terminal / lug
t Thickness of bar or lug
Hole diameter

FG frame

The FG frame size has a connection area specifically designed for the connection of busbars and/or box clamps. The connection area is designed to allow for maximum access to the front of the terminal. The connection pads have through holes without screw thread and are supported by a simple slide-in fully insulated part that contains one steel nut per connection point. The connection bolts have an internal allen key profile allowing for ease of use in the relatively confined area just above the connection strap.
Non-standard connections as extenders are directly fitted onto the standard terminals. In other cases - like rear connections - the slide-in part is completely replaced.

FK frame

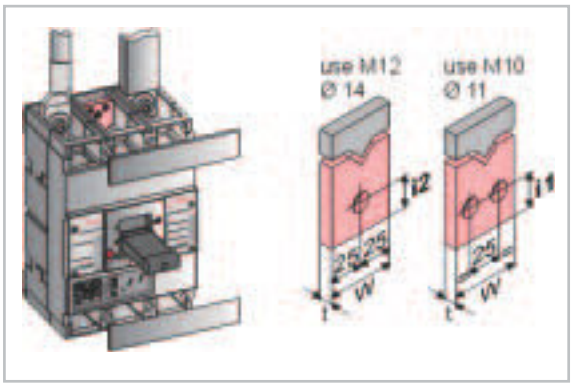
The FK frame has a connection area specifically designed for the connection of busbars. For the FK800 and FK1250 sizes the standard connection pads offer a choice of the use of 2 M10 or 1 M12 bolt. The FK 1600 type can use the same connection facility, but the use of specifically designed extended connection pads is advised.
All non standard connection options are fitted to the standard connection pads.



FG frame with removeable cover

	FG
W max (mm)	32
t max (mm)	12
i1 max (mm)	19
i2 max (mm)	17.5
Ø max (mm)	11
L Distance to insulation (min.)	33
Tor ue (Allen key in breaker) (Nm max.)	42

W Width of bar or ring terminal / lug
t Thickness of bar or lug
Hole diameter



FK frame with removeable cover

	FK
W max (mm)	50
t max (mm)	20
i1 max using 2 x M10 (mm)	32
i2 max using 1 x M12 (mm)	23
Ø max (mm)	2 x 11 or 1 x 14
Tor ue (Allen key in breaker) (Nm max. M10)	42
Tor ue (Allen key in breaker) (Nm max. M12)	48

W Width of bar or ring terminal / lug
t Thickness of bar or lug
Hole diameter

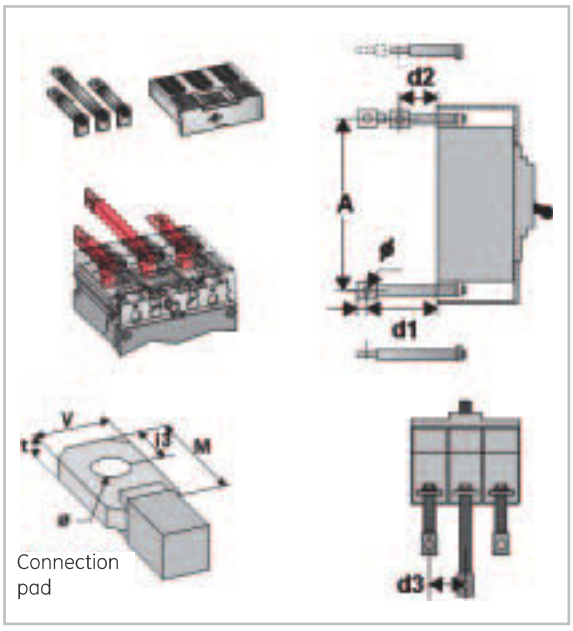
Connections

Rear connection facilities

A rear connection kit changes the standard connnection configuration of a fixed, plug-in or draw-out breaker from front to rear access. Delivered as a multi-pole set they allow an easy and quick change in configuration of the standard fixed-front connection breaker to a model where the connection is accessible from the rear.
Each kit is supplied with a short terminal shield to warrant a IPXXB protection from the breaker front.

FD frame

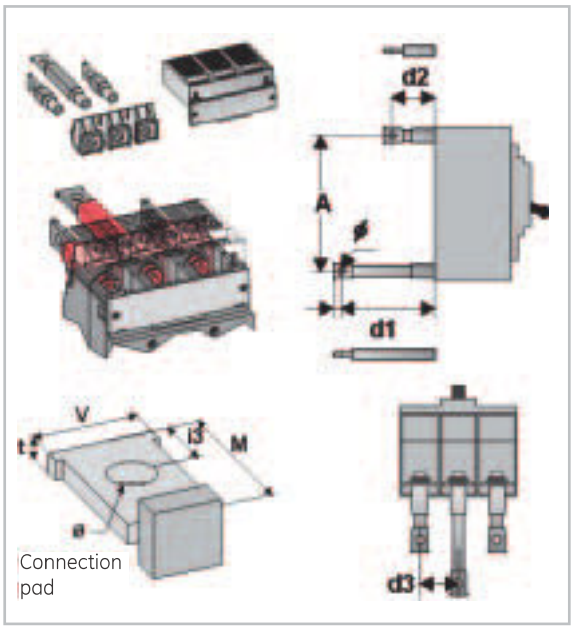
Available as a three or four pole set allowing for the configuration of one side of the breaker. The kits are made up of single pole connectors that are fitted to the standard cage terminal (top cavity). The rear connections are configured for use with busbars and can be rotated at a ninety degree angle to allow for different incoming busbar configurations. The connectors can be used with standard external box clamps, with or without phase barriers, and are supplied with a short terminal shield.



Connection pad

FE frame

Before a ***Record Plus*** FE frame size can be configured as a rear connected device, the front connection insulation part (nut plate) must be removed. The rear connection kit that consists of a multi-pole kit held in a rear connection support plate can then be simply slid into the room just vacated by the front connection part (nut plate). Available as a three or four pole set, it allows for the configuration of one side of the breaker. The rear connections are configured for use with busbars and can be rotated at a forty five or ninety degree angle to allow for different incoming busbar configurations. The connectors can be used with standard internal box clamps, with or without phase barriers, and are supplied with a short terminal shield.



Connection pad

FD frame rear connection

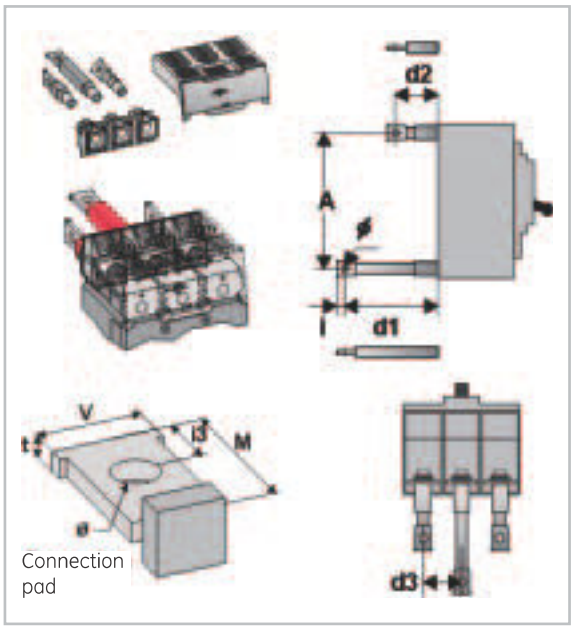
	FD
A vertical distance between connections	150
d1 breaker depth with long rear connections	90
d2 breaker depth with short rear connections	45
d3 pole spacing	27
V (mm)	14
t (mm)	4
i3 (mm)	10
M (mm)	22
Ø hole max (mm)	7
Tor ue (Allen key in breaker) (Nm max.)	8
Tor ue of connection bolt M6 (Nm max).	8

FE frame rear connection

	FE
A vertical distance between connections	140
d1 breaker depth with long rear connections	98
d2 breaker depth with short rear connections	48
d3 pole spacing	35
V (mm)	17.4
t (mm)	4
i3 (mm)	13
M (mm)	30
Ø hole max (mm)	9
Tor ue (Allen key in breaker) (Nm max.)	15
Tor ue of connection bolt M8 (Nm max).	25

FG frame

Before a ***Record Plus*** FG frame can be configured as a rear connected device, the front connection isolation part (nut plate) must be removed. The rear connection kit that consists of a multi-pole kit held in a rear connection support plate can then be simply slid into the room just vacated by the front connection part. Available as a three or four pole set, it allows for the configuration of one side of the breaker. The rear connections are configured for use with busbars and can be rotated at a ninety degree angle to allow for different incoming busbar configurations. The connectors can be used with or without phase barriers, and are supplied with a short terminal shield.



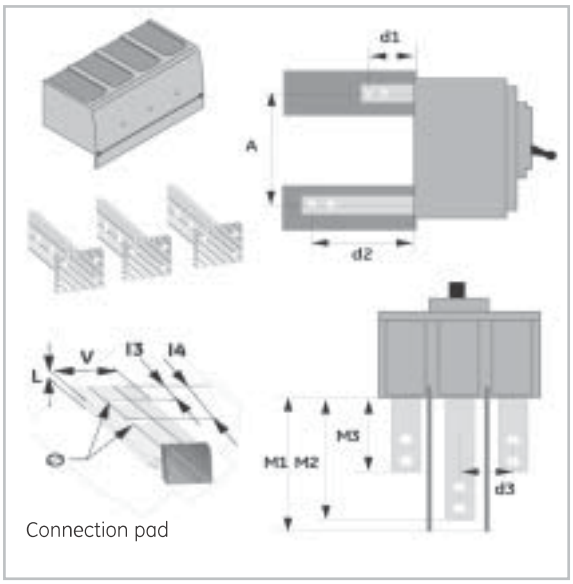
Connection pad

FG frame rear connection

	FG
A vertical distance between connections	229
d1 breaker depth with long rear connections	115
d2 breaker depth with short rear connections	50
d3 pole spacing	45
V (mm)	30
t (mm)	8
i3 (mm)	15
M (mm)	35
Ø hole max (mm)	13
Tor ue (Allen key in breaker) (Nm max.)	22
Tor ue of connection bolt M12 (Nm max).	42

FK frame

Available as a three or four pole set allowing for the configuration of the load or line side of the breaker. The kits are made up of single pole connectors that are screwed to the underside of the standard connection pad. The rear connections are configured for use with busbars and allow for different incoming busbar configurations with a option of rotating them at a ninety degree angle for edgewise busbar connection. The connectors are supplied with phase separators and a short terminal shield.



Connection pad

FK frame rear connection

	FK
A - (mm) vertical distance between connections	273
M1 - (mm) additional breaker depth with Phase seperators	188
M2 - (mm) add. breaker depth with LONG rear connections	163
M3 - (mm) add. breaker depth with SHORT rear connections	98
d1 - (mm) breaker rear to out connection hole .. short connect.	85
d2 - (mm) breaker rear to out connection hole .. long connect.	150
d3 - (mm) breaker pole spacing	70
V - (mm) connection pad width	40
L - (mm) connection pad thickness	12
I3 - (mm) rear of connection pad to hole 1	32
I4 - (mm) center of hole 1 to hole 2	32
Ø - (mm) connection hole size (diameter)	14
tor ue (Allen key in breaker Nm. max.	14

Connections

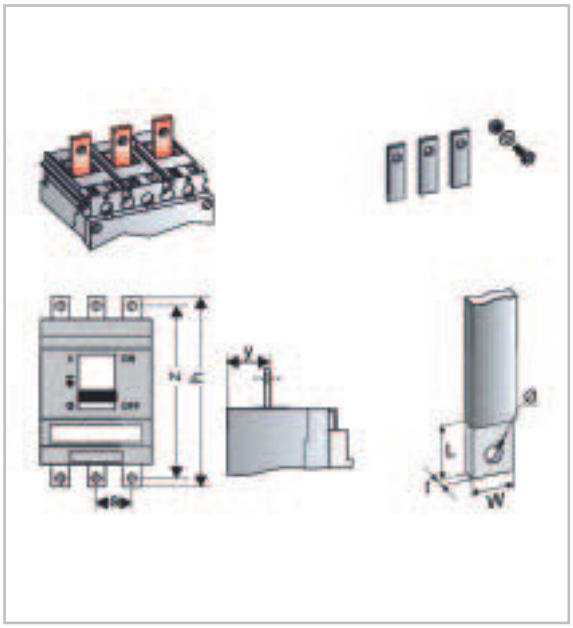
ptional connection terminals

To allow for the different connection options in the different applications of the ***Record Plus*** circuit breaker a large variety of different connection lugs, terminals and multiple connectors are available. These are available as a three or four pole set allowing for the configuration of one side of the breaker. The kits are made up of single pole connectors that are fitted to the standard breaker terminal. The connectors are supplied with all the necesssary connection and fixation hardware.

Extender
Extends the standard connection point to the exterior of the breaker body. ***Record Plus*** extenders are normally used when the busbars and cables that are needed to connect the breaker exceed the possibilities of the standard connection facility or when the use of external box clamps is required.

FD frame & FE frame

The single pole connectors that are fitted to the standard terminal (FD frame top cavity of box clamp).
The connectors can be used with standard external box clamps, with or without phase barriers.(1)



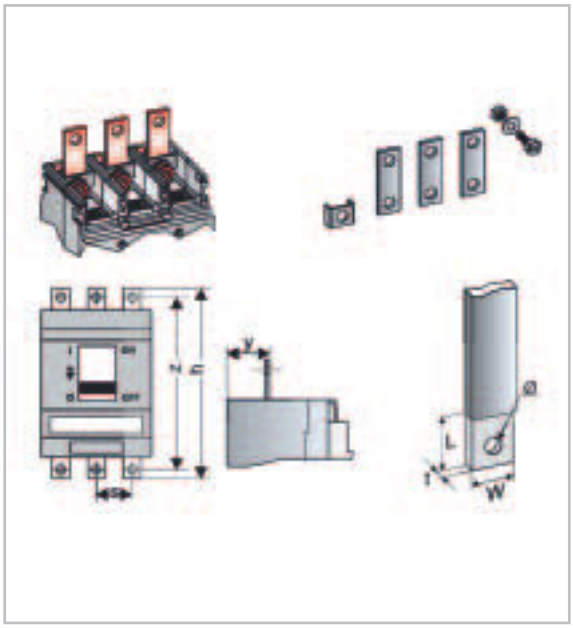
FD & FE extenders

	FD	FE
h heigth dimension of breaker with extenders at its top AND bottom.	190	230
z (mm)	170	212
s (mm)	27	35
y max (mm)	28.5	25.5
W max (mm)	14	20
t max (mm)	5	8
L max (mm)	16	18
Ø hole max (mm)	7	9
Tor ue (Allen key in breaker) (Nm max.)	8	25
Tor ue of connection bolt (Nm max).	8	25

(1) Use is recommended

FG frame & FK frame

The single pole connectors that are fitted to the standard terminal.
The connectors can be used with standard external box clamps, with or without phase barriers.(1)



FG & FK extenders

	FG	FK
h heigth dimension of breaker with extenders at its top AND bottom.	354	452
z (mm)	314	408
s (mm)	52.5	100
y max (mm)	29.5	56
W max (mm)	30	50
t max (mm)	12	20(10)(3)
L max (mm)	32	-
Ø hole max (mm)(2)	13	2 x 11
Tor ue (Allen key in breaker) (Nm max.)	42	M10-42
Tor ue of connection bolt (Nm max).	42	M10-42

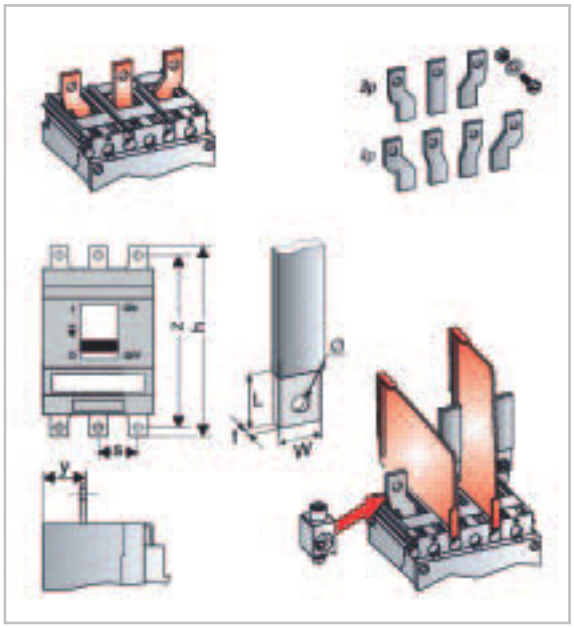
(1) Use is recommended
(2) Two holes in each connection pad.
(3) 1600A, parallel 10mm bus.

Spreaders

Increase the pole spacing of the breaker they are used to extend the standard connection points to the exterior of the breaker body. ***Record Plus*** spreaders are normally used when the busbars and cables that are needed to connect the breaker exceed the possibilities of the standard connection facility or when external lugs are needed. Available for:

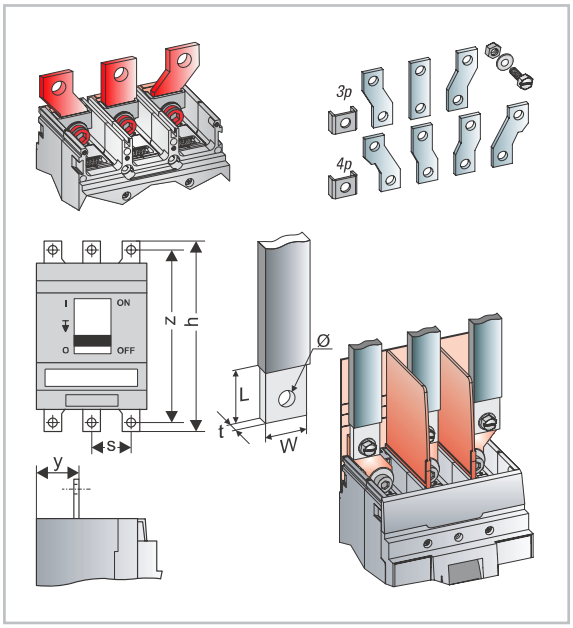
FD frame & FE frame

The single pole connectors that are fitted to the standard terminal (FD frame top cavity of box clamp). The connectors can be used with standard external lugs, with or without phase barriers.(1)



FG frame & FK frame

The single pole connectors that are fitted to the standard terminal.
The connectors can be used with standard external lugs, with or without phase barriers.(1)



FD & FE spreaders

	FD	FE
h heigth dimension of breaker with extenders at its top AND bottom.	190	230
z (mm)	170	212
s (mm)	27	35
y max (mm)	18.5	25.5
W max (mm)	14	18
t max (mm)	5	8
L max (mm)	16	18
Ø hole max (mm)	7	9
Tor ue (Allen key in breaker) (Nm max.)	8	25
Tor ue of connection bolt (Nm max).	8	25

(1) Use is recommended

FG & FK spreaders

	FG	FK
h heigth dimension of breaker with extenders at its top AND bottom.	354	452
z (mm)	314	408
s (mm)	52.5	100
y max (mm)	29.5	56
W max (mm)	30	50
t max (mm)	12	20(10)(3)
L max (mm)	32	-
Ø hole max (mm)(2)	13	2 x 11
Tor ue (Allen key in breaker) (Nm max.)	42	M10-42
Tor ue of connection bolt (Nm max).	42	M10-42

(1) Use is recommended
(2) Two holes in each connection pad.
(3) 1600A, parallel 10mm bus.

Connections

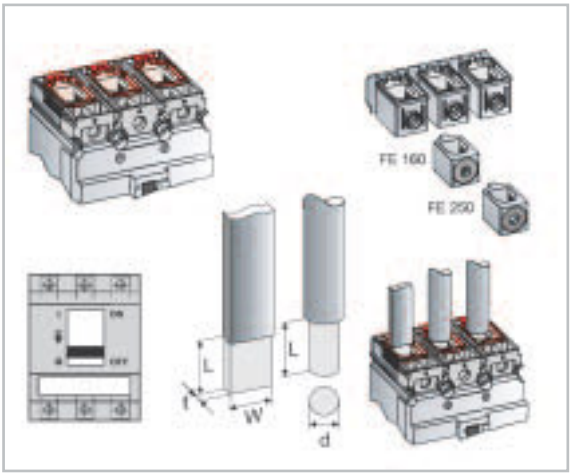
ptional connection - box clamps

Record Plus breakers are designed to save space and time in mounting when compared to conventional switch gear. To achieve the same savings in the connecting process the ***Record Plus*** line includes a series of lugs meeting the newest and highest standards in ease of connection and durability.
The terminals are suitable for conductors of copper and aluminium and meet both the newest version of the EN 60497 standards and the relevant UL486a and b regulations.

Internal box clamps
Fit onto the breaker without changing its profile or external dimensions. Available as a three or four pole set allowing the line or load side of the breaker to be equipped. The set consists of multi-pole units that displace the standard connection configuration. The sets can also be used on the plug-in / draw-out base and RCD units.
All clamps are suitable for copper and aluminium conductors.

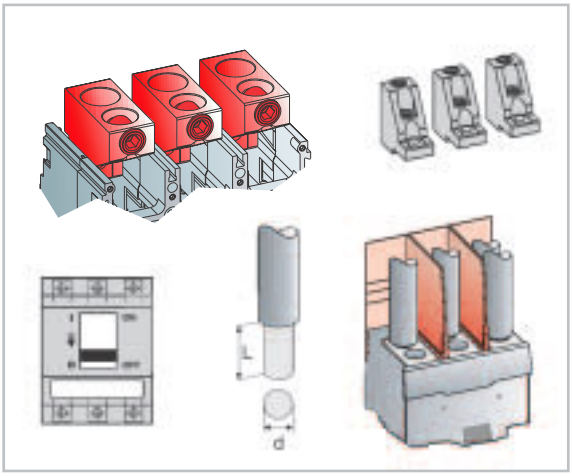
FE frame (FE160 & FE250)

The set consists of basic 3 or 4 pole pole units that displace the standard connection configuration (FE frame nut plate). The internal box clamps are used in the same way on the plug-in / draw-out base and RCD units. All types can also be mounted to extenders, spreaders or rear connection pads.



FG frame & FK frame

The set consists of basic single pole units that displace are mounted above the standard connection pad (FG and FK frame). Each box terminal allows the connection of two to four cable cores per item. The internal lugs are used in the same way on the plug-in / draw-out base and RCD units. All types can also be mounted to extenders, spreaders or rear connection pads and can be used with or without phase barriers.



FE internal box clamps

	FE160	FE250
h heigth dimension of breaker with box clamps mounted at top and bottom.	the same as breaker	
L max (mm)	18	18
d max (mm)	16	17.5(1)
S max (mm²)	2.5 - 95	16 - 150
L distance to insulation (min.)	21	25
Tor ue (Allen key on clamp) (Nm max.)	30	30

(1) Most standard 185 mm² cable sections will also fit into this lug (hole diameter 17.5 mm)

FG & FK internal box clamps

	FG	FK(2)	FK(3)
h heigth dimension of breaker with box clamps mounted at top and bottom.	333	381	354
S max (mm²)	25 - 240 for L1 50 - 300 for L2	240	240
Hole L1 distance to insulation L (min.)	22	-	-
Hole L2 distance to insulation L (min.)	40	-	-
Distance to insulation L (min.)	-	27.5	36
Tor ue (Nm max.)	31(L_1) 42(L_2)	31	31

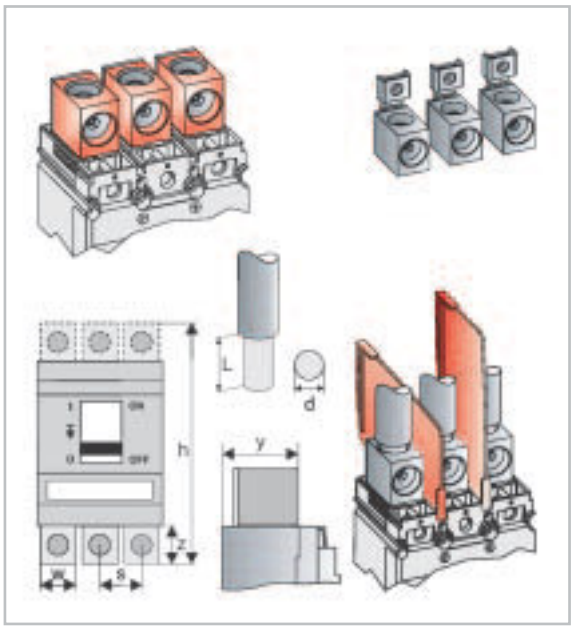
(2) Terminal for 3 cables
(3) Terminal for 4 cables

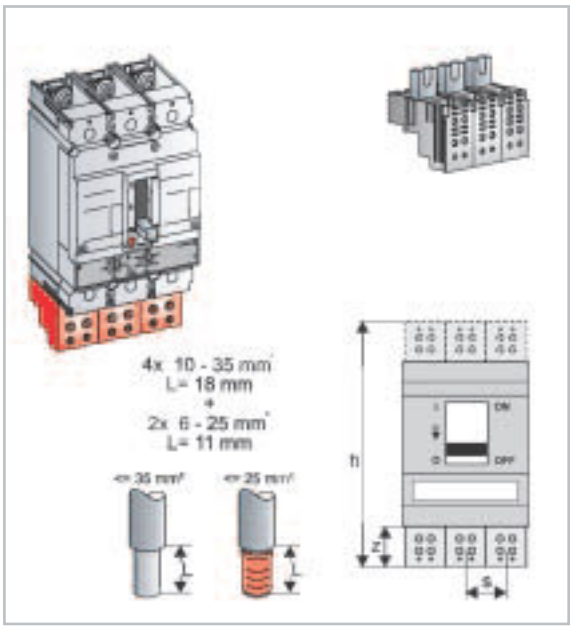
External box clamps

To accomodate for larger cross sections ***Record Plus*** clamps can be used in combination with extenders and/or spreaders. They are available as a three or four pole set allowing the line or load side of the breaker to be equipped. Each set consists of basic single pole units with phase seperators.

FE frame distribution terminal

Specifically designed to allow the use of the ***Record Plus*** FE frame as a mains device with cables distributing the load over multiple outgoing circuits (or lines of multiple outgoing circuits). The lugs are available as a three or four pole set allowing the line or load side of the breaker to be equipped. The sets consist of a number of fully isolated single pole units that can be assembled into a multipole distribution block before they are mounted on the breaker. Each lug allows for a maximum of four 6-25 mm^2 or two 10-35 mm^2 copper conductors.





FD & FE external box clamps

	FD	FE
h heigth dimension of breaker with box clamps mounted at top and bottom.	190	270
z (mm)	30	50
s (mm)	27	35
w (mm)	18.5	30
y (mm)	50	55.5
S max (mm^2)	4 - 95	70 - 185
L distance to insulation (min.)	20	20
Tor ue (Allen key in breaker) (Nm max.)	8	25
Tor ue on connection bolt (Nm max.)	17	25

FE distribution terminal

	FE
h heigth dimension of breaker with box clamps mounted at top and bottom.	250
z (mm)	60
s max (mm)	35
Tor ue (Allen key in breaker) (Nm max.)	25
L distance to insulation (min.) - 35 mm^2	18
L distance to insulation (min.) - 25 mm^2	11
Tor ue on connection bolt (Nm max.) - 35 mm^2	6
Tor ue on connection bolt (Nm max.) - 25 mm^2	3

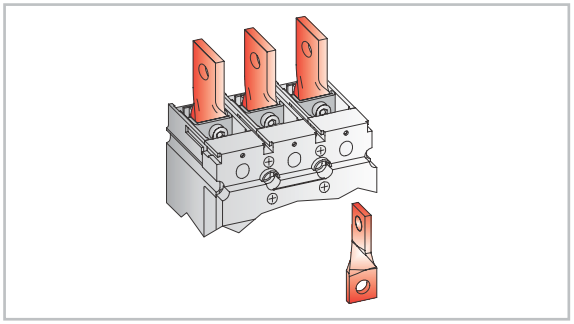
Connections

ptional connection terminals - extender variants

The ***Record Plus*** circuit breaker can be equiped with several variants of the standard extender design. These are available as a three or four pole set allowing for the configuration of one side of the breaker. The kits are made up of single pole connectors that are fitted to the standard breaker terminal. The connectors are supplied with all the necesssary connection and fixation hardware.

Extender twisted

The twisted version extends the standard connection point to the exterior of the breaker body and twists the connection area from horizontal to vertical. It is normally used when the connecting busbars are turned 90 degrees and with ring terminals.

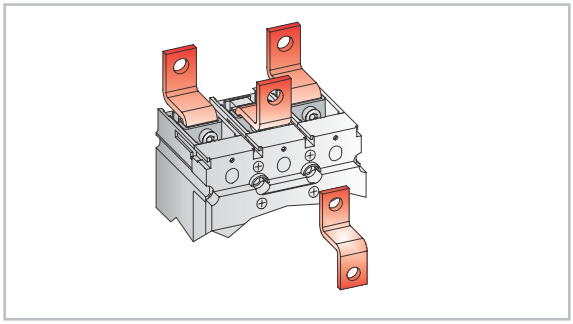


Twisted extenders

	FD	FE	FG
h heigth dimension of breaker with extenders at its top AND bottom.	190	230	354
Ø hole max (mm)	7	9	13
Tor ue (Allen key in breaker) (Nm max.)	8	25	42

Extender heightened

Extends the standard connection points to the exterior of the breaker body and places them at different heights. ***Record Plus*** extenders are normally used when the busbars and cables that are needed to connect the breaker exceed the possibilities of the standard connection facility, when external lugs are needed or to interconnect several breakers on the incoming side.

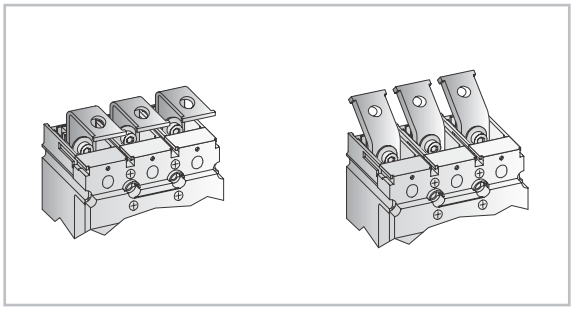


eightened extenders

	FD	FE
h heigth dimension of breaker with extenders at its top AND bottom.	190	230
Ø hole max (mm)	7	9
Tor ue (Allen key in breaker) (Nm max.)	8	25

Extender angled

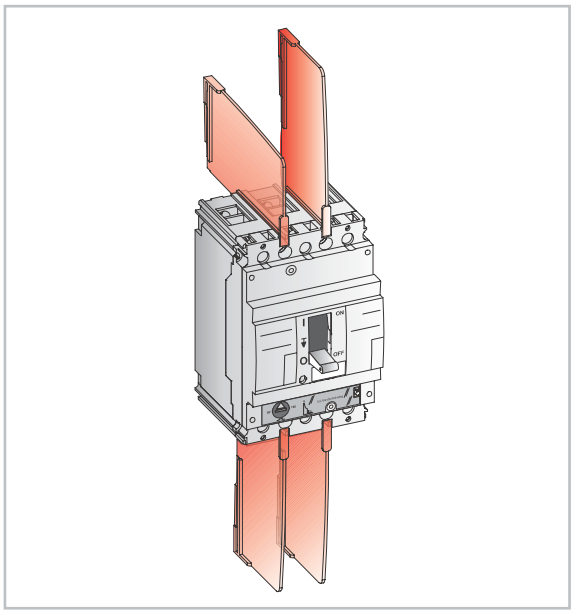
Two more extender variants exist for the FE frame type only with a connection area set at forty five or ninety degrees. The hole dimensions and reqiuired torques are the same as those required for the heightened extenders.



Phase separators and Back plates

Phase separators

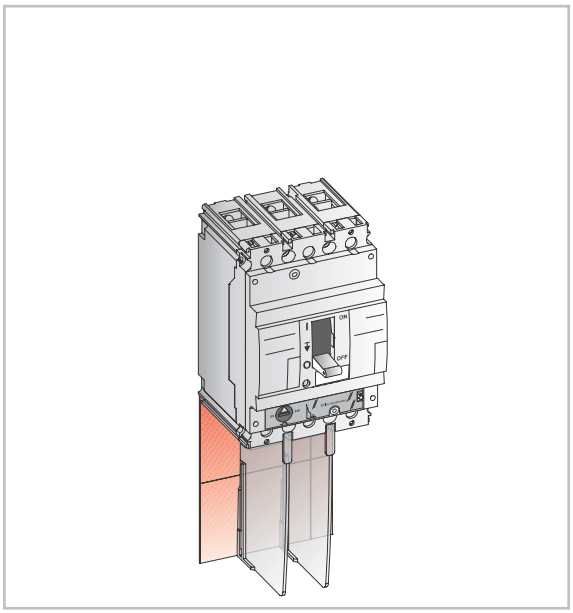
Depending on the rated voltage and the type of connector, the use of phase separators is preferable and in some cases mandatory.
Record Plus phase seperators are simply slid into slots in the breaker housing. To allow for an easy installation of the connectors they are made of flexible material. They can be mounted in two ways, to allow for front and rear connection.
They ensure a correct dielectric separation of the different connection terminals.
For the ***Record Plus*** FD, FE, FG and FK frame, phase separators are available in one set containing 12 pieces.



Back plates

Back plates are always used in association with phase separators. Normally used at voltages above 500V they prevent breaker venting from leading to dielectric issues. They also can be used when externally mounted connectors no longer meet the required clearance distances to a metal back plate.

A back plate suitable for 3 and 4 pole breakers is available. The required size is easily achieved by breaking off parts along a pre-cut line.



E 60 4 -2 Standard

Circuit Breaker type		FD160		FD160						FE160		
Denomination		N	H	C	E	S	N	H	L	N	H	L
Poles	Number of	1		3,4			2(1),3,4			3,4		
Rated insulation voltage	Ui (Volts)	750		500	750	750	750			750		
Rated impulse withstand voltage	Uimp (Kilovolt)	3		6	8	8	8			8		
Rated operational voltage Ue	Volts AC	240		500	690	690	690			690		
	Volts DC	250		-	-	500	500			500		
ine Protection device												
Category of use		A		A			A			A		
Suitable for use as a isolator	Positive ON OFF	yes		yes			yes			yes		
Rated current Ith Ie	A at 40 C	160		160			160			160		
Ultimate breaking capacity Icu (kA)	230/240V AC	25	50	25	40	50	85	100	200	85	100	200
	400/415V AC	-	-	18	25	36	50	80	150	50	80	150
	440V AC	-	-	14	14	25	30	65	130(4)	42	65	130
	500V AC	-	-	10	12	18	22	36	50(4)	30	50	100
	690V AC	-	-	-	4,5	6	8	10	12	10	22	75
	250V DC Single pole	-	50	-	-	25	40	65	100	50	85	100
	500V DC Two Pole	-	-	-	-	25	40	65(2)	100(2)	50	85(2)	100(2)
Service breaking capacity Ics (Icu)	500V	100%	100%	75%	75%	100%	100%	100%	100%	100%	100%	100%
	690V AC	-	-	-	-	50%	50%	50%	50%	100%	75%	25%
Making capacity Icm (kA peak)	400/415V AC	-	-	36	52,5	75	110	176	330	110	176	330
	500V AC	-	-	17	24	36	46	75	110	63	110	220
Single phase breaking capacity I_{IT} (kA)	230V AC	25	50	16	25	30	50	80	150	50	80	150
	400/415V AC	-	-	-	4,5	6	8	10	12	15	22	36
Endurance (CO operations)	Mechanical	10000		10000			25000			40000		
	Electrical at In	5000		5000			10000			20000		
	Electrical at In/2	10000		10000			20000			30000		
Endurance (On-Tripped operations)	Mechanical	4000		4000			10000			16000		
Trip Units	Interchangeable	no		no			no			yes		
	Thermal Magnetic line	LTM								LTM		
	Thermal Magnetic generator						GTM			GTM		
	Thermal Magnetic discriminating						LTMD			LTMD		
	Magnetic Only						Mag Break™			Mag Break™		
	Electronic discriminating									SMR1		
	Electronic enhanced											

EMA AB-1 Standard

3 ph Interruption rating	240V AC	-	-	-	-	50	65	100	-	100	150	200
	480V AC	-	-	-	-	25	36	50	-	50	65	130
	600V AC	-	-	-	-	6	8	10	-	25	36	42

E 60 4 -3 Standard

Non Automatic Circuit Breaker/Switch type		FD160			FE160		
Denomination		- 63A			- 160A		
Rated current In (class AC23)	220V AC to 690V AC	63			160	160	
Rated making capacity	Icm (kA peak)	1,7			2,8	4,2	
Short-term withstand current Icw (A)	Icw eff. 1 second	1,2			2	3	
	Icw eff. 3 seconds	1,2			2	3	

E 60 4 -4 Standard

se in motor circuits							
Rated current Ith	A at 65 C			125		150	
Endurance (CO operations)	Mechanical			25000		40000	
	Electrical at In class AC23			10000		20000	
	Operations per hour			120		120	
Protection	Short Circuit only (separate overload device)			Mag Break™		Mag Break™	
	Overload class 10 and Short circuit					SMR1	
	Max In (A) class 10			100		150	
	Max In (A) class 30			50		150	
	Earth fault unit (differential)			Optional FD type		Optional FE type	

nstallation

Circuit Breaker or Switch type		FD160			FE160		
Number of poles		1	3	4	3		4
Mounting	On symmetrical DIN Rail	yes	yes	yes	no		no
	Fixed	yes	yes	yes	yes		yes
	Plug-in	no	yes	yes	yes		yes
	Draw-out	no	no	no	yes		yes
Connection	Front	yes	yes	yes	yes		yes
	Rear	yes	yes	yes	yes		yes
Dimensions (w x h x d) mm	Fixed front connection	27x130 x85	81x130 x85	108x130 x85	105x170 x95		140x265 x115
Weights (kg)	Fixed front connection	0,4	0,9	1,3	1,5		2

(1) N type only
(2) 3 poles are needed.
(3) 2 poles are needed
(4) The 160Amp current rating of the L type is limited to 65kA at 440v 36kA at 500V.

	FE250			FG400			FG630			FK800			FK1250			FK1600	
V	N	H	L	N	H	L	N	H	L	N	H	L	N	H	L	N	H
	3,4			3,4			3,4			3,4			3,4			3,4	
690	750			750			750			1000			1000			1000	
8	8			8			8			8			8			8	
500	690			690			690			690			690			690	
250	500			500			500			500			500			500	
	A			B			B(5)			B			B			B	
	yes			yes			yes			yes			yes			yes	
	250			400			630			800			1250			1600	
65	85	100	200	90	100	200	85	100	200	85	100	170	85	100	170	85	100
36	50	80	150	50	80	150	50	80	150	50	80	100	50	80	100	50	80
25	42	65	130	42	65	130	42	65	130	42	50	80	42	50	80	42	50
18	30	50	100	30	50	100	30	50	100	36	42	50	36	42	50	36	42
-	10	15	22	10	22	75(7)	10	22	40(7)	20	25	30	20	25	30	20	25
25	50	85	100							50	80	100	50	80	100	-	-
-	50	85(2)	100(2)							36	50	65	36	50	65	-	-
100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%
-	100%	75%	50%	100%	75%	25%	100%	75%	50%	100%	100%	75%	100%	75%	50%	100%	75%
75	110	176	330	110	176	330	110	176	330	110	176	220	110	176	220	110	176
36	63	110	220	63	110	220	63	110	220	75	110	220	75,6	110	220	75	110
36	50	80	150	50	80	150	50	80	150	50	80	150	50	80	150	50	80
-	10	15	22	10	(6)	(6)	10	(6)	(6)	20	25	30	20	25	30	20	25
10000	25000			20000			20000			10000			10000			10000	
5000	10000			7500			5000			4000			3000			2000	
10000	20000			15000			10000			8000			6000			4000	
4000	10000			8000			8000			4000			3000			2000	
	yes			yes			yes			yes			yes			yes	
LTM										LTM			LTM				
	GTM																
	LTMD																
	Mag Break™			Mag Break™													
	SMR1			SMR1									SMR1e				
	SMR2			SMR2									SMR 1s & g				

65	**100**	**150**	**200**	**100**	**150**	**200**	**100**	**150**	**200**	**85**	-	-	**85**	-	-	**85**	-
36	**50**	**65**	**130**	**50**	**65**	**130**	**50**	**65**	**130**	**42**	-	-	**42**	-	-	**42**	-
22	**25**	**36**	**42**	**25**	**36**	**42**	**25**	**36**	**42**	**25**	-	-	**25**	-	-	**25**	-

	FE250			FG400			FG630			FK800			FK1250			FK1600	
	250			400			630			800			1250			1600	
	5,7			7,1			9,2			14,1			21,2			28,3	
	4			5			6,5			10			15			20	
	4			5			6,5			10			15			20	

	230			400			500			720			1000				
	25000			20000			20000			10000			10000				
	10000			7500			5000			4000			3000				
	120			120			60			60			60				
	Mag Break™			Mag Break™			Mag Break™			Mag Break™			Mag Break™				
	SMR1			SMR1 or SMR2			SMR1 or SMR2										
	225			400			500			720			1000				
	225			400			500			720			1000				
	Optional FE type			Optional FG type			Optional FG type										

	FE250			FG400			FG630			FK800			FK1250			FK1600	
	3		4	3		4	3		4	3		4	3		4	3	4
	no		no	no		no	no		no	no		no	no		no	no	no
	yes		yes	yes		yes	yes		yes	yes		yes	yes		yes	yes	yes
	yes		yes	yes		yes	yes		yes	yes		yes	yes		yes	yes	yes
	yes		yes	yes		yes	yes		yes	yes		yes	yes		yes	yes	yes
	yes		yes	yes		yes	yes		yes	yes		yes	yes		yes	yes	yes
	yes		yes	yes		yes	yes		yes	yes		yes	yes		yes	yes	yes
	105x170		140x265	140x265		185x265	140x265		185x265	210x320		280x320	210x320		280x320	210x320	280x320
	x95		x115	x115		x115	x115		x115	x160		x160	x160		x160	x160	x160
	1,5		2,0	4,5		6,0	4,5		6,0	12,2		15,1	18,0		23,4	18,0	23,4

(5) Limited to 500Amp
(6) Please contact your nearest GE Sales Office

(7) At a voltage of 690V the uses of a long widened Shield is mandatory (see page D.9)

Power dissipation

Standards

The standard for low voltage equipment is defined in the EN 60439-1, the EN 50298 and the IEC 60890. These provide a theoretical method to calculate the temperature rise within an enclosure. The main element in these calculations is the power dissipation of the equipment installed. By totalizing this value for all the installed devices, connections, cables and busbars it is possible to calculate the temperature rise within the enclosure. Here, for normal applications a temperature rise within the enclosure of 50 Kelvin is assumed.
The absolute value of this temperature may not exceed 70 C (the sum of the ambient temperature in Celsius and the temperature rise in Kelvin).

Use

An enclosure manufacturer can provide the exact data on the allowable power dissipation within a certain enclosure. The values depend on the enclosure type, the ventilation it offers and on where the components are located within this enclosure. The example here is based on the GE Modula 630 enclosure type. The table indicates the temperature rise within a certain enclosure dimension. This at the top and middle of the enclosure in function of the installed heat dissipation (products) in Watt.

Mounted on wall - Temperature rise Kelvin

DISSIPATION	500x500		500x750		750x500		750x750		750x1000		750x1250		1000x500		1000x750		1000x1000		1000x1250		1250x750		1250x1000	
(Watt)	Middle	Top	Middle	Top	Middle	Top	Middle	Top	Middle	Top	Middle	Top	Middle	Top	Middle	Top	Middle	Top	Middle	Top	Middle	Top	Middle	Top
10	4	5	4	4	4	5																		
20	8	9	7	7	6	8	5	6	4	5			5	7										
30	11	13																						
40	13	16	11	13	11	14	9	11	7	9	6	7	9	13	7	9	5	7	5	6	5	8		
50	16	19																						
60	19	22	16	18	16	19	12	16	10	12	8	10	12	18	10	13	7	10	6	8	8	11	6	8
70	21	25																						
80	23	28	20	23	20	24	15	20	12	16	10	12	16	22	12	16								
90	26	31																						
100	28	33	24	27	23	29	18	23	15	19	12	14	19	27	14	19	11	14	9	12	11	16	9	13
120	32	38	28	31	27	33	21	27					22	31	17	23								
140	37	44	31	35	31	38	24	31	19	24	15	19	25	35	19	26	15	19	12	16	15	21	12	16
160	41	48	35	39	34	42	27	34					27	39	21	28								
180	45	53	38	43	38	46	29	38	24	30	19	23	30	43	23	31	18	23	15	19	18	25	15	20
200	49	58	42	47	41	51	32	41					33	47	25	34								
220	53	63	45	51	44	55	34	44	28	35	22	27	35	50	27	37	21	27	18	23	21	30	18	24
240			48	55	47	58	37	47					38	54	29	39								
260			52	58	51	62	39	51	32	40	25	31	40	58	31	42	24	31	20	26	24	34	20	27
280							42	54					43	61	33	45								
300							44	57	36	45	28	35	45	65	35	47	27	35	23	29	27	38	23	30
350							50	64	40	51	32	40	51	73	40	53	30	39	26	33	31	43	25	34
400									45	57	36	44			44	59	34	44	29	37	34	48	28	38
450									49	62	39	48			48	65	37	48	32	40	38	53	31	42
500											43	53			53	71	40	53	34	44	41	58	34	46
550											46	57					44	57	37	47	45	63	37	49
600											49	61					47	61	40	51	48	67	39	53
650											53	65					50	65	42	54	51	72	42	57
700																			45	57			45	60
750																			48	61			47	63
800																			50	64			50	67

Record Plus™ Power dissipation

The power dissipation tables included here indicate the DC resistance of the ***Record Plus*** breakers in cold condition.The power dissipation per pole can be calculated with this value and the average current flowing within the circuit (formula I^2R).

The tables indicate the Watt loss per pole based on the maximum current load of the breaker. To calculate the total Watt loss for a three or four pole breaker these values are multiplied by three.

for circuits with a high 3rd harmonic content, please contact us

Power Dissipation - FD160 frame 63A

		Thermal magn. type (LTM LTMD GTM)							Mag Break™ (MO)						Switch (Y)
	In (A)[1]	16	20	25	32	40	50	63	3	7	13	20	30	50	63
Fixed version	R in mΩ per pole	10.00	6.50	4.00	2.50	2.00	1.60	1.40	200.00	55.00	18.00	1.20	1.20	0.53	0.50
	Dissipation Watt single pole	2.56	2.60	2.50	2.56	3.20	4.00	5.56	1.80	2.70	2.81	0.48	1.08	1.33	1.98
	Dissipation Watt three poles	7.68	7.80	7.50	7.68	9.60	12.00	16.67	5.40	8.09	8.44	1.44	3.24	3.98	5.95
Plug-in version	R in mΩ per pole	10.07	6.57	4.07	2.57	2.07	1.67	1.47	200.07	55.07	18.07	1.27	1.27	0.60	0.57
	Dissipation Watt single pole	2.58	2.63	2.54	2.63	3.31	4.18	5.83	1.80	2.70	2.82	0.51	1.14	1.50	2.26
	Dissipation Watt three poles	7.73	7.88	7.63	7.90	9.94	12.53	17.50	5.40	8.10	8.47	1.52	3.43	4.50	6.79
Fixed version with RCD	R in mΩ per pole	10.08	6.58	4.08	2.58	2.08	1.68	1.48	200.08	55.08	18.08	1.28	1.28	0.61	0.58
	Dissipation Watt single pole	2.58	2.63	2.55	2.64	3.33	4.20	5.87	1.80	2.70	2.83	0.51	1.15	1.53	2.30
	Dissipation Watt three poles	7.74	7.90	7.65	7.93	9.98	12.60	17.62	5.40	8.10	8.48	1.54	3.46	4.58	6.91
Plug-in version with RCD	R in mΩ per pole	10.15	6.65	4.15	2.65	2.15	1.75	1.55	200.15	55.15	18.15	1.35	1.35	0.68	0.65
	Dissipation Watt single pole	2.60	2.66	2.59	2.71	3.44	4.38	6.15	1.80	2.70	2.84	0.54	1.22	1.70	2.58
	Dissipation Watt three poles	7.80	7.98	7.78	8.14	10.32	13.13	18.46	5.40	8.11	8.51	1.62	3.65	5.10	7.74

Power Dissipation - FD160 frame 63A

		Thermal magn. type (LTM LTMD GTM)						Mag Break™ (MO)			Switch (Y)
	In (A)			80	100	125	160		80	100	160
Fixed version	R in mΩ per pole			0.85	0.75	0.53	0.53		0.53	0.53	0.50
	Dissipation Watt single pole			5.44	7.50	8.28	13.57		3.39	5.30	12.80
	Dissipation Watt three poles			16.32	22.50	24.84	40.70		10.18	15.90	38.40
Plug-in version	R in mΩ per pole			0.92	0.82	0.60	0.60		0.60	0.60	0.57
	Dissipation Watt single pole			5.89	8.20	9.38	15.36		3.84	6.00	14.59
	Dissipation Watt three poles			17.66	24.60	28.13	46.08		11.52	18.00	43.78
Fixed version with RCD	R in mΩ per pole			0.93	0.83	0.61	0.61		0.61	0.61	0.58
	Dissipation Watt single pole			5.95	8.30	9.53	15.62		3.90	6.10	14.85
	Dissipation Watt three poles			17.86	24.90	28.59	46.85		11.71	18.30	44.54
Plug-in version with RCD	R in mΩ per pole			1.00	0.90	0.68	0.68		0.68	0.68	0.65
	Dissipation Watt single pole			6.40	9.00	10.63	17.41		4.35	6.80	16.64
	Dissipation Watt three poles			19.20	27.00	31.88	52.22		13.06	20.40	49.92

Power Dissipation - FE160 frame

		Thermal magn. type (LTMD GTM)									Switch (Y)
	In (A)	25	32	40	50	63	80	100	125	160	160
Fixed version	R in mΩ per pole	6.30	2.80	2.80	2.10	1.45	1.20	0.81	0.77	0.63	0.40
	Dissipation Watt single pole	3.94	2.87	4.48	5.25	5.76	7.68	8.10	12.03	16.00	10.24
	Dissipation Watt three poles	11.81	8.60	13.44	15.75	17.27	23.04	24.30	36.09	48.00	30.72
Plug-in version	R in mΩ per pole	6.37	2.87	2.87	2.17	1.52	1.27	0.88	0.84	0.70	0.47
	Dissipation Watt single pole	3.98	2.94	4.59	5.43	6.03	8.13	8.80	13.13	17.79	12.03
	Dissipation Watt three poles	11.94	8.82	13.78	16.28	18.10	24.38	26.40	39.38	53.38	36.10
Fixed version with RCD	R in mΩ per pole	6.38	2.88	2.88	2.18	1.53	1.28	0.89	0.85	0.71	0.48
	Dissipation Watt single pole	3.99	2.95	4.61	5.45	6.07	8.19	8.90	13.28	18.05	12.29
	Dissipation Watt three poles	11.96	8.85	13.82	16.35	18.22	24.58	26.70	39.84	54.14	36.86
Plug-in version with RCD	R in mΩ per pole	6.45	2.95	2.95	2.25	1.60	1.35	0.96	0.92	0.78	0.55
	Dissipation Watt single pole	4.03	3.02	4.72	5.63	6.35	8.64	9.60	14.38	19.84	14.08
	Dissipation Watt three poles	12.09	9.06	14.16	16.88	19.05	25.92	28.80	43.13	59.52	42.24

		Mag Break™ (MO)										FE160 frame electronic type (SMR1)			
	In (A)[1]	3	7	13	20	30	50	80	100	125	160	25	63	125	160
Fixed version	R in mΩ per pole	410.00	110.00	13.30	13.20	3.60	1.70	0.60	0.60	0.40	0.40	0.40	0.40	0.40	0.40
	Dissipation Watt single pole	3.69	5.39	2.08	5.28	3.24	4.25	3.84	6.00	6.25	6.25	0.25	0.25	1.59	6.25
	Dissipation Watt three poles	11.07	16.17	6.23	15.84	9.72	12.75	11.52	18.00	18.75	18.75	0.75	0.75	4.76	18.75
Plug-in version	R in mΩ per pole	410.07	110.07	13.37	13.27	3.67	1.77	0.67	0.67	0.47	0.47	0.47	0.47	0.47	0.47
	Dissipation Watt single pole	3.69	5.39	2.09	5.31	3.30	4.43	4.29	6.70	7.34	7.34	0.29	0.29	1.87	7.34
	Dissipation Watt three poles	11.07	16.18	6.27	15.92	9.91	13.28	12.86	20.10	22.03	22.03	0.88	0.88	5.60	22.03
Fixed version with RCD	R in mΩ per pole	410.08	110.08	13.38	13.28	3.68	1.78	0.68	0.68	0.48	0.48	0.48	0.48	0.48	0.48
	Dissipation Watt single pole	3.69	5.39	2.09	5.31	3.31	4.45	4.35	6.80	7.50	7.50	0.30	0.30	1.91	7.50
	Dissipation Watt three poles	11.07	16.18	6.27	15.94	9.94	13.35	13.06	20.40	22.50	22.50	0.90	0.90	5.72	22.50
Plug-in version with RCD	R in mΩ per pole	410.15	110.15	13.45	13.35	3.75	1.85	0.75	0.75	0.55	0.55	0.55	0.55	0.55	0.55
	Dissipation Watt single pole	3.69	5.40	2.10	5.34	3.38	4.63	4.80	7.50	8.59	8.59	0.34	0.34	2.18	8.59
	Dissipation Watt three poles	11.07	16.19	6.30	16.02	10.13	13.88	14.40	22.50	25.78	25.78	1.03	1.03	6.55	25.78

(1) All 3A magnetic only ratings can be used at 3.5A

Power Dissipation - FE250 frame

		Thermal magn. type (LTMD GTM)						Switch (Y)
	In (A)			125	160	200	250	250
Fixed version	R in mΩ per pole			0.67	0.53	0.40	0.33	0.30
	Dissipation Watt single pole			10.47	13.57	16.00	20.63	18.75
	Dissipation Watt three poles			31.41	40.70	48.00	61.88	56.25
Plug-in version	R in mΩ per pole			0.73	0.59	0.46	0.39	0.36
	Dissipation Watt single pole			11.41	15.10	18.40	24.38	22.50
	Dissipation Watt three poles			34.22	45.31	55.20	73.13	67.50
Fixed version with RCD	R in mΩ per pole			0.74	0.60	0.47	0.40	0.37
	Dissipation Watt single pole			11.56	15.36	18.80	25.00	23.13
	Dissipation Watt three poles			34.69	46.08	56.40	75.00	69.38
Plug-in version with RCD	R in mΩ per pole			0.80	0.66	0.53	0.46	0.43
	Dissipation Watt single pole			12.50	16.90	21.20	28.75	26.88
	Dissipation Watt three poles			37.50	50.69	63.60	86.25	80.63

		Mag Break™ (MO)			FE250 frame Electronic type (SMR1)			
	In (A)	160	200	250	125	160	250	
Fixed version	R in mΩ per pole	0.33	0.33	0.33	0.30	0.30	0.30	
	Dissipation Watt single pole	8.45	13.20	20.63	4.69	7.68	18.75	
	Dissipation Watt three poles	25.34	39.60	61.88	14.06	23.04	56.25	
Plug-in version	R in mΩ per pole	0.39	0.39	0.39	0.36	0.36	0.36	
	Dissipation Watt single pole	9.98	15.60	24.38	5.63	9.22	22.50	
	Dissipation Watt three poles	29.95	46.80	73.13	16.88	27.65	67.50	
Fixed version with RCD	R in mΩ per pole	0.40	0.40	0.40	0.37	0.37	0.37	
	Dissipation Watt single pole	10.24	16.00	25.00	5.78	9.47	23.13	
	Dissipation Watt three poles	30.72	48.00	75.00	17.34	28.42	69.38	
Plug-in version with RCD	R in mΩ per pole	0.46	0.46	0.46	0.43	0.43	0.43	
	Dissipation Watt single pole	11.78	18.40	28.75	6.72	11.01	26.88	
	Dissipation Watt three poles	35.33	55.20	86.25	20.16	33.02	80.63	

Power Dissipation - FG400 & FG 630 frame

		FG400/630 frame electronic type (SMR1 & 2)				Mag Break™ (MO)		Switch (Y)	
	In (A)	250	400	500	630	400	500	400	630
Fixed version	R in mΩ per pole	0.11	0.11	0.10	0.10	0.11	0.10	0.11	0.10
	Dissipation Watt single pole	6.88	17.60	25.00	39.69	17.60	23.75	17.60	39.69
	Dissipation Watt three poles	20.63	52.80	75.00	119.07	52.80	71.25	52.80	119.07
Plug-in/Draw-out version	R in mΩ per pole	0.13	0.13	0.12	0.12	0.13	0.12	0.13	0.12
	Dissipation Watt single pole	8.13	20.80	30.00	47.63	20.80	30.00	20.80	47.63
	Dissipation Watt three poles	24.38	62.40	90.00	142.88	62.40	90.00	62.40	142.88
Fixed version with RCD	R in mΩ per pole	0.16	0.16	0.15	0.15	0.16	0.15	0.16	0.15
	Dissipation Watt single pole	10.00	25.60	37.50	59.54	25.60	37.50	25.60	59.54
	Dissipation Watt three poles	30.00	76.80	112.50	178.61	76.80	112.50	76.80	178.61
Plug-in/Draw-out version with RCD	R in mΩ per pole	0.17	0.17	0.17	0.17	0.17	0.17	0.17	0.17
	Dissipation Watt single pole	10.31	26.40	41.25	65.49	26.40	41.25	26.40	65.49
	Dissipation Watt three poles	30.94	79.20	123.75	196.47	79.20	123.75	79.20	196.47

Power Dissipation - FK800, FK1250 & FK1600 frame

		Thermal magn. type (LTM)				Mag Break™ (MO)		Switch (Y)		
	In (A)	630	800	1000	1250	800	1250	800	1250	1600
Fixed version	R in mΩ per pole	0.04	0.04	0.04	0.04	0.02	0.02	0.02	0.02	0.01
	Dissipation Watt single pole	15.88	25.60	35.00	54.69	12.80	23.44	12.80	31.25	25.60
	Dissipation Watt three poles	47.63	76.80	105.00	164.06	38.40	70.31	38.40	93.75	76.80
Draw-out version	R in mΩ per pole	0.07	0.07	0.07	0.07	0.05	0.05	0.05	0.05	0.04
	Dissipation Watt single pole	27.78	44.80	65.00	101.56	32.00	70.31	32.00	78.13	102.40
	Dissipation Watt three poles	83.35	134.40	195.00	304.69	96.00	210.94	96.00	234.38	307.20

		FK800 1250-1600 frame electronic type (SMR1e s & g)			
	In (A)	800	1000	1250	1600
Fixed version	R in mΩ per pole	0.04	0.04	0.04	0.03
	Dissipation Watt single pole	25.60	35.00	54.69	76.80
	Dissipation Watt three poles	76.80	105.00	164.06	230.40
Draw-out version	R in mΩ per pole	0.07	0.07	0.07	0.06
	Dissipation Watt single pole	25.60	35.00	54.69	76.80
	Dissipation Watt three poles	76.80	105.00	164.06	230.40

otes

Derating

Thermal magnetic trip units

The ambient temperature in the direct vicinity of a protective device has an influence on its current carrying properties.

The ***Record Plus*** breakers with thermal magnetic and magnetic only protection units as the MO, LTM and LTMD types can be used at currents and temperatures as indicated in the table.

Maximum permissable current at an ambient temperature of

		Fixed breaker							Plug-in or draw-out breaker						
Type	In (A)	40 C	45 C	50 C	55 C	60 C	65 C	70 C	40 C	45 C	50 C	55 C	60 C	65 C	70 C
FD160 FE160 & FE250	**16**	16.0	15.5	15.0	14.6	14.1	13.6	13.1	15.0	14.6	14.1	13.7	13.2	12.8	12.3
	25	25.0	24.3	23.5	22.8	22.0	21.3	20.5	23.5	22.8	22.1	21.4	20.7	20.0	19.3
	32	32.0	31.0	30.1	29.1	28.2	27.2	26.2	30.1	29.2	28.3	27.4	26.5	25.6	24.7
	40	40.0	38.8	37.6	36.4	35.2	34.0	32.8	37.6	36.5	35.3	34.2	33.1	32.0	30.8
	50	50.0	48.5	47.0	45.5	44.0	42.5	41.0	47.0	45.6	44.2	42.8	41.4	40.0	38.5
	63	63.0	61.1	59.2	57.3	55.4	53.6	51.7	59.2	57.4	55.7	53.9	52.1	50.3	48.6
	80	80.0	77.6	75.2	72.8	70.4	68.0	65.6	75.2	72.9	70.7	68.4	66.2	63.9	61.7
	100	100	97.0	94.0	91.0	88.0	85.0	82.0	94.0	91.2	88.4	85.5	82.7	79.9	77.1
FD160	**125**	125	121	118	114	110	106	103	118	114	110	107	103	100	96
	160	160	155	150	146	141	136	131							
FE160 & FE250	**125**	125	121	118	114	110	106	103	118	114	110	107	103	100	96
	160	160	155	150	146	141	136	131	150	146	141	137	132	128	123
	200	200	194	188	182	176	170	164	188	182	177	171	165	160	154
	250	250	243	235	228	220	213	205	235	228	221	214	207	200	193
FK800 & FK1250	**630**	630	611	592	573	554	536	517	630	611	563	545	527	509	491
	800	800	776	752	728	704	680	656	800	760	714	692	669	646	623
	1000	1000	970	940	910	880	850	820	1000	950	893	865	836	808	779
	1250	1250	1213	1175	1138	1100	1063	1025	1250	1188	1116	1081	1045	1009	974
FD63 & FD160 FE160 & FE250 with RCD	**16**	16.0	15.5	15.0	14.6	14.1	13.6	13.1	15.0	14.6	14.1	13.7	13.2	12.8	12.3
	25	25.0	24.3	23.5	22.8	22.0	21.3	20.5	23.5	22.8	22.1	21.4	20.7	20.0	19.3
	32	32.0	31.0	30.1	29.1	28.2	27.2	26.2	30.1	29.2	28.3	27.4	26.5	25.6	24.7
	40	40.0	38.8	37.6	36.4	35.2	34.0	32.8	37.6	36.5	35.3	34.2	33.1	32.0	30.8
	50	50.0	48.5	47.0	45.5	44.0	42.5	41.0	47.0	45.6	44.2	42.8	41.4	40.0	38.5
	63	63.0	61.1	59.2	57.3	55.4	53.6	51.7	59.2	57.4	55.7	53.9	52.1	50.3	48.6
	80	80.0	77.6	75.2	72.8	70.4	68.0	65.6	75.2	72.9	70.7	68.4	66.2	63.9	61.7
	100	100	97.0	94.0	91.0	88.0	85.0	82.0	94.0	91.2	88.4	85.5	82.7	79.9	77.1
FD160 with RCD	**125**	119	115	110	108	97	101	97	110	107	104	101	97	94	91
	160	152	147	141	138	125	129	125	141	137	133	129	124	120	116
FE160 & FE250 with RCD	**125**	125	121	118	114	110	106	103	118	114	110	107	103	100	96
	160	152	147	141	138	125	129	125	141	137	133	129	124	120	116
	200	190	184	177	173	156	162	156	177	171	166	161	156	150	145
	250	238	230	221	216	195	202	195	221	214	208	201	194	188	181

Derating

Electronic trip units

Electronic trip units are less sensitive to fluctuations in ambient temperature than thermal magnetic trip units. However, to prevent the device and its environment from exceeding their design values, certain limits must be taken into account. The table indicates the maximum values to which the LT or overload protection of the electronic trip unit of the ***Record Plus*** breaker can be set. This at ambient temperatures from 40 to 70 C.

Maximum permissable current at an ambient temperature of

		Fixed breaker							Plug in or draw-out breaker						
Type	Is[1](A)	40 C	45 C	50 C	55 C	60 C	65 C	70 C	40 C	45 C	50 C	55 C	60 C	65 C	70 C
FE160	25	25	25	25	25	25	25	25	25	25	25	25	25	25	25
	63	63	63	63	63	63	63	63	63	63	63	63	63	63	63
	125	125	125	125	125	125	125	125	125	125	125	125	125	125	125
	160	160	160	156	152	148	144	160	156	152	148	144	140	136	
FE250	125	125	125	125	125	125	125	125	125	125	125	125	125	125	125
	160	160	160	160	160	160	160	160	156	152	148	144	140	136	
	250	250	250	244	238	231	225	250	244	238	231	225	219	213	
FG400	250	250	250	250	250	250	250	250	250	250	250	250	250	250	250
	350	350	350	350	350	350	350	350	350	350	350	350	350	350	340
	400	400	400	400	390	380	370	360	400	390	380	370	360	350	340
FG630	400	400	400	400	400	400	400	400	400	400	400	400	400	400	400
	500	500	500	500	500	500	500	500	500	500	500	500	500	500	481
	630	630	614	599	583	567	551	536	583	568	554	539	524	510	481
FK800	800	800	800	760	760	760	680	-	760	741	722	703	722	646	-
FK1250	1000	1000	1000	950	950	900	850	-	950	950	903	879	855	808	-
	1250	1250	1250	1188	1188	1125	1000	-	1188	1158	1128	1098	1069	950	-
FK1600	1600	1600	1600	1520	1440	1408	1280	-	1600	1536	1444	1408	1368	1216	-
FE160 with RCD	25	25	25	25	25	25	25	25	25	25	25	25	25	25	25
	63	63	63	63	63	63	63	63	63	63	63	63	63	63	63
	125	125	125	125	125	125	125	125	125	125	125	125	125	125	106
	160	160	156	152	148	144	141	137	152	148	144	141	137	133	129
FE250 with RCD	125	125	125	125	125	125	125	125	125	125	125	125	125	125	125
	160	160	160	160	160	160	160	160	160	160	160	160	160	160	160
	250	250	244	238	244	238	231	225	238	232	226	220	214	208	202
FG400 with RCD	250	250	250	250	250	250	250	250							
	350	350	350	350	341	333	324	315							
	400	400	370	360	350	340	330	320							
FG630 with RCD	400	400	400	400	400	400	400	400							
	500	500	500	500	500	500	481	468							
	630	568	554	539	524	510	481	468							

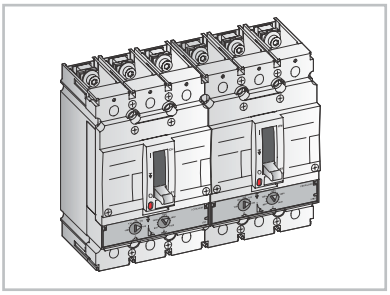
(1) Is Sensor rating

Clearances

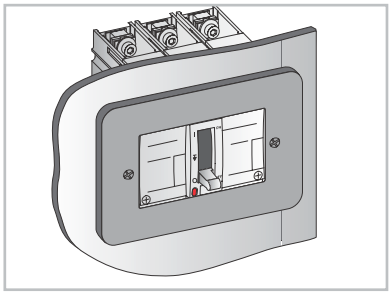
Minimum distances

A modern circuit breaker is designed to interrupt high short-circuit currents in a very limited time frame. In doing so the breaker vents gas and and a limited amount of conductive fragments.

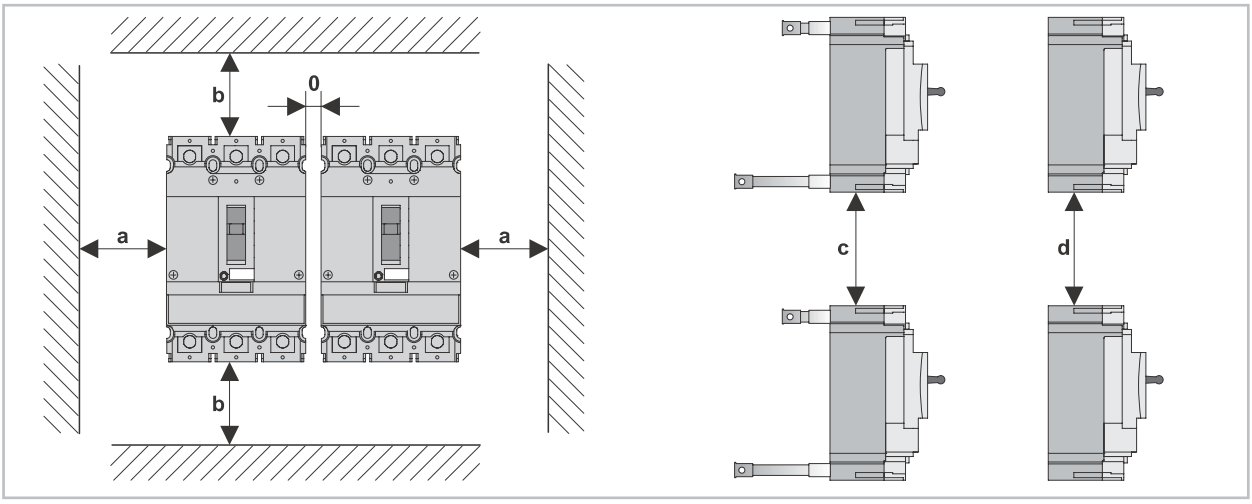
The ***Record Plus*** circuit breaker has been designed to limit the venting phenomanae to a minimum. However, it is necessary to take the following minimum distances into account:



Minimum Distance between two side by side mounted ***Record Plus*** Breakers 0 mm



Minimum Distance to a front panel from a ***Record Plus*** Breakers
0 mm
Protection degree on breaker front
IP40



Minimum Distances

Type			Distances in mm a	b	c	d
FD160	To painted metal, non conductive materials and isolated conductors.		0	15		
	To unpainted metal	Voltage 480V	3	35		
		Voltage 600V(1)	5	(2)		
		Voltage 690V(1)	15	(2)		
	To breaker housing				35	35
	To conductors potruding from breaker				35	35
FE160 & FE250	To painted metal, non conductive materials and isolated conductors.		0	20		
	To unpainted metal	Voltage 480V	5	35		
		Voltage 600V(1)	10	(2)		
		Voltage 690V(1)	20	(2)		
	To breaker housing				35	35
	To conductors potruding from breaker				35	35
FG400 & FG630	To painted metal, non conductive materials and isolated conductors.		0	30		
	To unpainted metal	Voltage 480V	5	60		
		Voltage 600V(1)	10	(2)		
		Voltage 690V(3)	20	(2)		
	To breaker housing				60	60
	To conductors potruding from breaker				60	60
FK800 FK 800 & FK1600	To painted metal, non conductive materials and isolated conductors.		0	40		
	To unpainted metal	Voltage 480V	15	80		
		Voltage 600V	20	80		
		Voltage 690V	30	80		
	To breaker housing				140	140
	To conductors potruding from breaker				140	140

(1) The use of phase seperators and back plates is obligatory.
(2) Size determined by phase seperators.
(3) At 690Volts the FG400L FG630L must have the power supply connected to the breaker ON side (Line). In this application the use of the widened terminal shield is compulsory.

ndividual mounting of Record Plus in enclosures

Record Plus breakers can be placed in enclosures for use as individually wall mounted feeder units. In order to ensure a reliable and practical solution each of the combinations mentioned here have been defined by strenous testing. Here the properties of all components, and their use as a combination have been taken into account. For all other application of the ***Record Plus*** in individually mounted enclosures, please contact us.

VMS thermoplastic box IP65 with transparent cover.
The use of short or long terminal covers for the breaker is mandatory.

Breaker and terminal covers always have to be ordered separately.
Short-circuit rating: 20kA, 440V

MS, thermoplastic housing P65 with opa ue cover

Record Plus Breaker(1) In (A)	Breaker type	Rotary handle type	Housing		
			Size	Type	Ref. nr.
125A	FD160 with and without RCD	FDNRC	440 x 320 x 254	VMS43 extension frame	**855085**
160A	FE160	FENRC	440 x 320 x 254	VMS43 extension frame	**855087**
160A	FE160 with RCD	FENRC	640 x 320 x 254	VMS63 extension frame	**855088**
250A	FE250	FENRC	440 x 320 x 254	VMS43 extension frame	**855087**
250A	FE250 with RCD	FENRC	640 x 320 x 254	VMS63 extension frame	**855088**
400A	FG400 or FG 630	FGNRC	(2)	(2)	**(2)**
630A	FG400 or FG630 with RCD	FGNRC	(2)	(2)	**(2)**

PolySafe glass fibre reinforced Polyester cabinet IP65 with door.
When using ***Record Plus*** Breaker in polyester cabinets for outdoor use we recommend encapsulating the breaker in a VMS box.
Breaker, terminal covers and mounting plate for the external housing have to be ordered separately.
Short-circuit rating: 20kA, 440V(3)

PolySafe, glass fibre reinforced polyester cabinet P65

Record Plus Breaker(1) In (A)	Breaker type	Internal housing VMS		External housing Polysafe	
		Size	Ref. nr.	Size	Ref. nr.
125A	FD160 w/out RCD	440 x 320 x 254	**855085(3)**	750 x 500 x 320	**883008**
160A	FE160 w/out RCD	640 x 320 x 254	**855087 / 855088(3)**	750 x 500 x 320	**883008**
250A	FE250 w/out RCD	640 x 320 x 254	**855087 / 855088(3)**	750 x 500 x 320	**883008**
400A	FG400 or FG 630	FGNRC	**(2)**	(2)	**(2)**
630A	FG400 or FG630 with RCD	FGNRC	**(2)**	(2)	**(2)**

(1) Ambient temperature max. 30 degrees centigrade.
(2) Please contact us.
(3)The use of short or long terminal covers on the breaker is mandatory

Current limitation

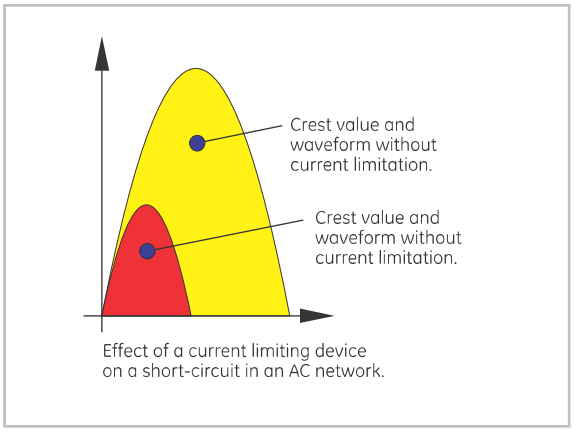
A short-circuit is an overcurrent with a value only limited by the impedance of the fault circuit itself. This impedance is determined by a number of factors the main ones of which are the available power that a network can supply and the impedance of the conductors within the fault circuit.

In modern hi-power electrical distribution networks very high prospective fault levels of 100kA or more can occur. High prospective short-circuit current values can cause issues in a number of areas:

Electrodynamic forces
These are proportional to the square of the crest current value.
The electrodynamical forces due to the crest current value can seriously damage equipment as busbar systems and their supports, downstream switchgear etc.
Current limiting devices limit the crest value of the short-circuit current and thus reduce theses forces.

Magnetic fields
A high level short-circuit produces magnetic fields that prevent electrical equipment as meters and computers from operating correctly.

Thermal stress (heat)
Thermal stress is proportional to the square of the effective current value.
The thermal stress limit of cable isolation, busbar supports and other electrical equipment can be expressed as an A^2S value. This electrical energy value must be kept within certain pre-defined limits to prevent overheating.
To avoid or to limit the effects of these issues the use of current limiting devices is advisable.



Effect of a current limiting device on a short-circuit in an AC network.

Thermal stress in Electrical conductors
Cable have thermal stress limits normaly expressed in a A^2S value that depend on the cable s cross section and its isolation. They are limited to prevent the insulation conductor from exceeding their limit temperature.
Clause 434.5.2 of the IEC 60364 4d. 03 - 2008 defines that for protection devices interrupting within 0.1 seconds (t 0.1 second) and current limiting devices as Record Plus, the following formula applies:

$$K^2 \times S^2$$

K: factor provided in the standard depends on the material that the conductor is made of and it s insulation
S: cross section of the conductor

If the protection device is NOT current limiting.
Clause 434.5.2 of the IEC 60364 4d. 03 - 2008 applies.
Here for interruption times up to 5 seconds, the regulation requires that the following formula is met.

$$t \quad (K * S/I)^2$$

Terminology
t: Duration of the short-circuit in seconds.
K: Factor provided by the standard depending on the material the conductor is made of and it s insulation.
S: Cross Section of the conductor.
I: Effective short-circuit current. (r.m.s value)

K factors in accordance with the EC 60364-4-43 ed.03

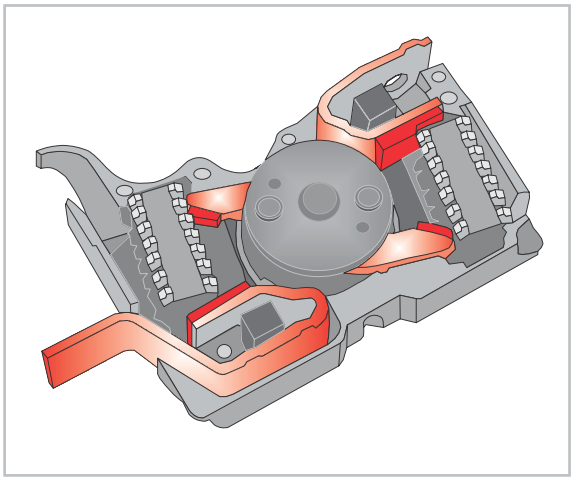
Insulation & maximum temperature	Copper (Cu)	Aluminium (Al)
PVC - 70 300 sq.mm	115	76
PVC - 70 300 sq.mm	103	68
PVC - 90 300 sq.mm	100	86
PVC - 90 300 sq.mm	86	57
XLPE EPR 90	143	94
Rubber 60	141	93
Mineral, bare unsheathed 105	135 or 115(1)	-

(1) The 115 value is be used for conductors exposed to touch.

Maximum permissible thermal stress in conductors

Insulation	Core	Cross section in s . mm & maximum permissible thermal stress in A^2s															
		1.5	2.5	4	6	10	16	25	35	50	70	95	120	150	185	240	300
		x10^4	x10^4	x10^4	x10^4	x10^6	x10^6	x10^6	x10^6	x10^6	x10^8	x10^8	x10^8	x10^8	x10^8	x10^8	x10^8
PVC - 70	Cu	2.976	8.266	21.160	47.610	1.323	3.386	8.266	16.201	33.063	0.648	1.194	1.904	2.976	4.526	7.618	9.548
	Al	1.300	3.610	9.242	20.794	0.578	1.479	3.610	7.076	14.440	0.283	0.521	0.832	1.300	1.977	3.327	4.162
PVC - 90	Cu	2.250	6.250	16.000	36.000	1.000	2.560	6.250	12.250	25.000	0.490	0.903	1.440	2.250	3.423	5.760	6.656
	Al	1.664	4.623	11.834	26.626	0.740	1.893	4.623	9.060	18.490	0.362	0.667	1.065	1.664	2.531	4.260	2.924
XLPE & EPR 90	Cu	4.601	12.781	32.718	73.616	2.045	5.532	12.781	25.050	51.123	1.002	1.846	2.945	4.601	6.999	11.779	17.893
	Al	1.988	5.523	14.138	31.810	0.884	2.262	5.523	10.824	22.090	0.433	0.797	1.272	1.988	3.024	5.090	7.784
Rubber 60	Cu	4.473	12.426	31.810	71.572	1.988	5.090	12.426	24.354	49.703	0.974	1.794	2.863	4.473	6.804	11.451	17.893
	Al	1.946	5.406	13.838	31.136	0.865	2.214	5.406	10.595	21.623	0.424	0.781	1.245	1.946	2.960	4.982	7.784
Mineral bare 105 k 135	Cu	4.101	11.391	29.160	65.610	1.823	4.666	11.391	22.326	45.563	0.893	1.645	2.624	4.101	6.238	10.498	16.403
Mineral bare 105 k 115	Cu	2.976	8.266	21.160	47.610	1.323	3.386	8.266	16.201	33.063	0.648	1.194	1.904	2.976	4.526	7.618	11.903

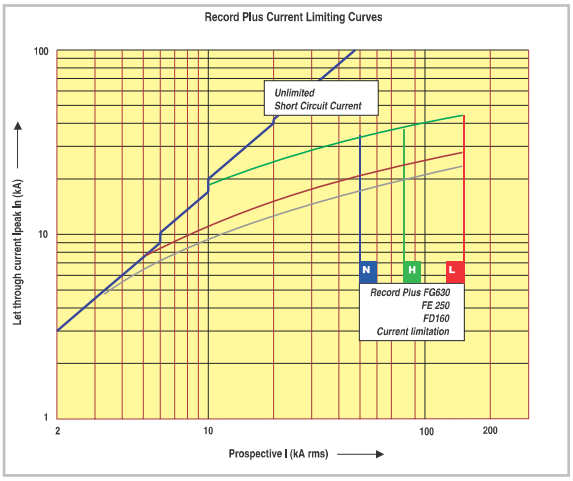
Record Plus MCCB's revolutionary design is equipped with dual contacts placed in a rotary configuration that enables the device to provide the highest available interruption ratings in the smallest possible size. When the breaker reacts it does so with more than twice the speed and force of conventional breakers, thus providing excellent current limitation. This results in low peak current and energy values in the circuit and leads to lower electro-dynamic forces and thermal stress values in the protected electrical conductors, downstream protection devices and equipment.



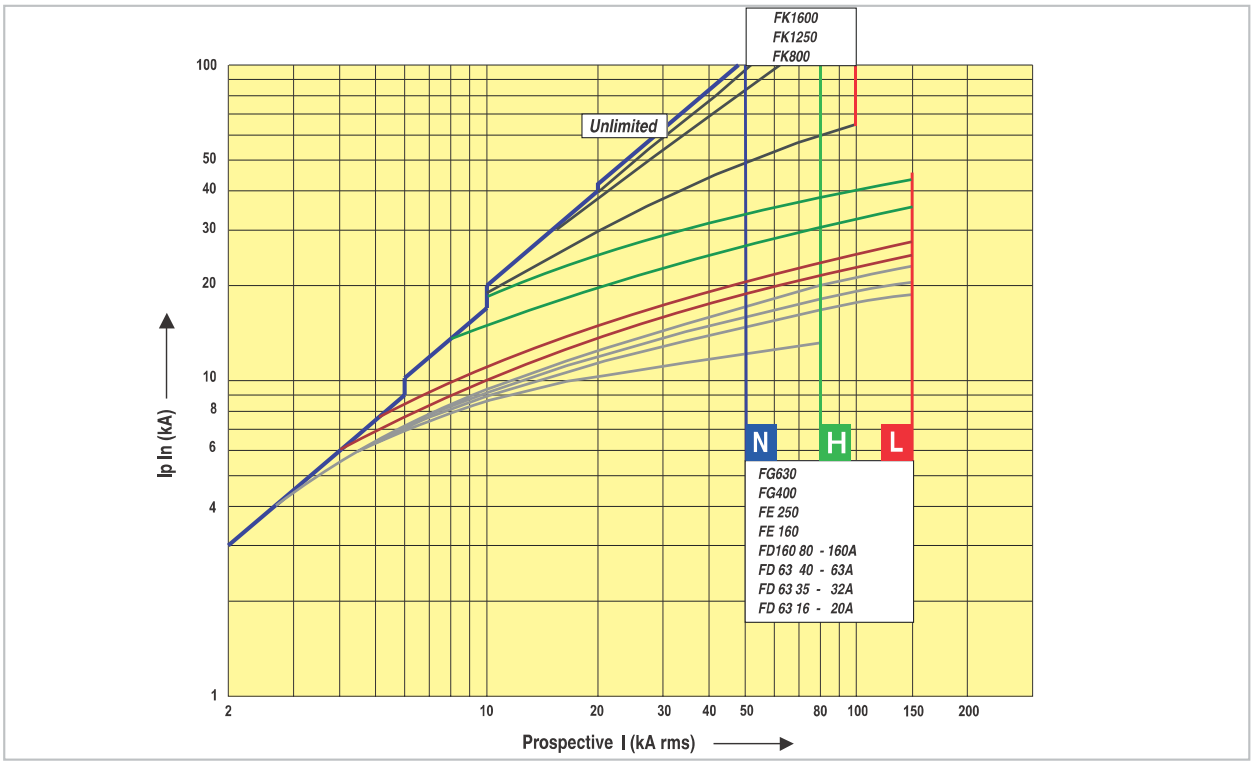
However, in some cases it is still necessary to check if the electrical conductors are protected correctly. This can be verified by taking the cable stress limits published on the previous page and comparing them with the let-through energy values found in the graphs. (page D.14 and D.15)

The limitation of electrodynamic forces and thermal stress by using back-up protection
Protection devices placed downstream from a protective device as a ***Record Plus*** breaker must be able to withstand the thermal and electrodynamic effects that occur at its point of installation. Placing current limiting devices upstream limits these values and can allow the use of smaller and more economical devices than is possible without the use of current limitation.

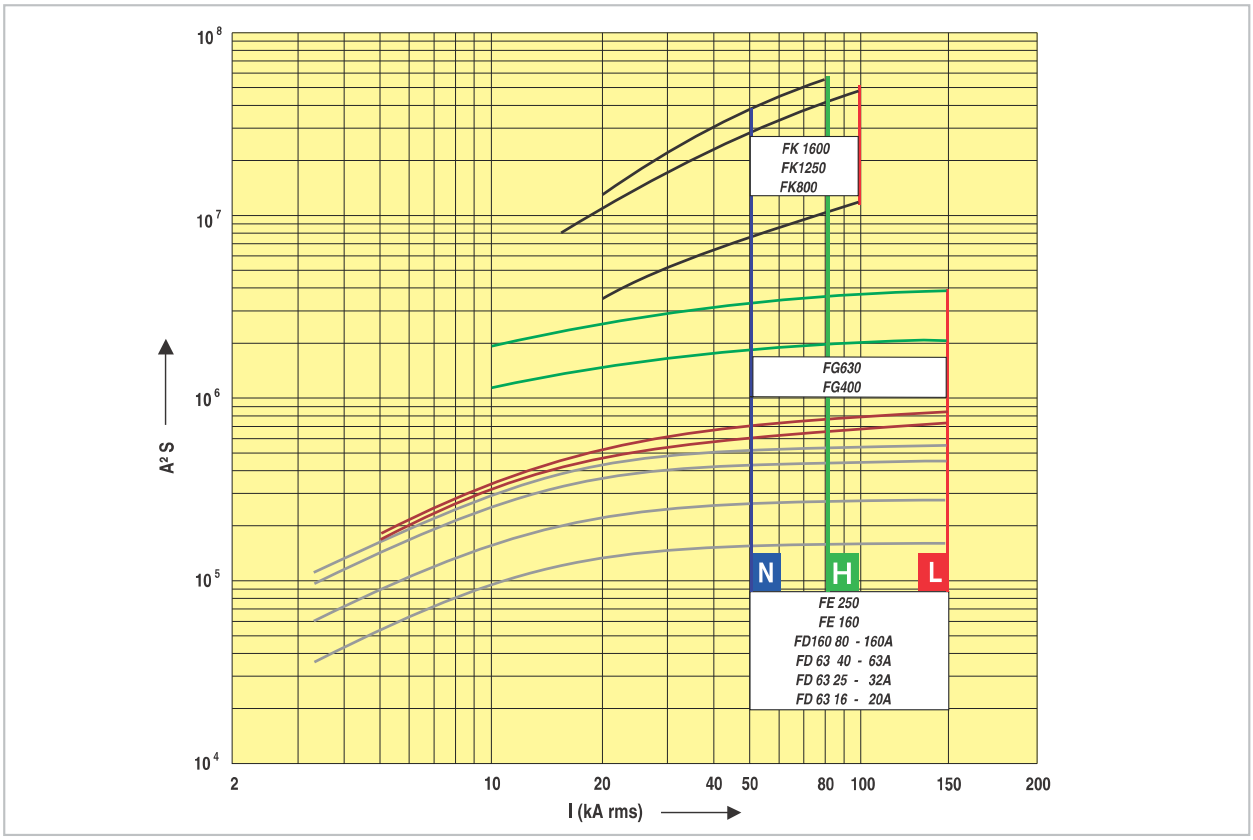
Back-up protection with ***Record Plus*** is described in the application data section of this catalogue. (page E.20)



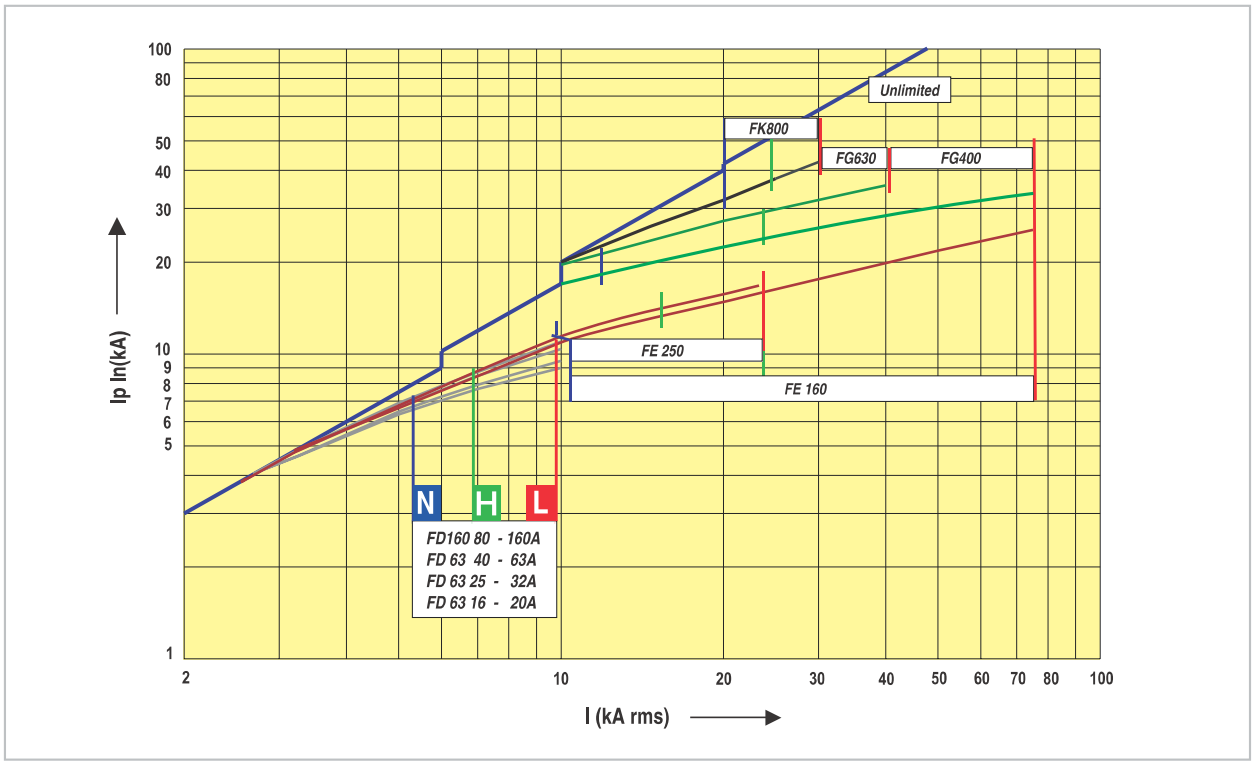
Current limitation data at 400/415V



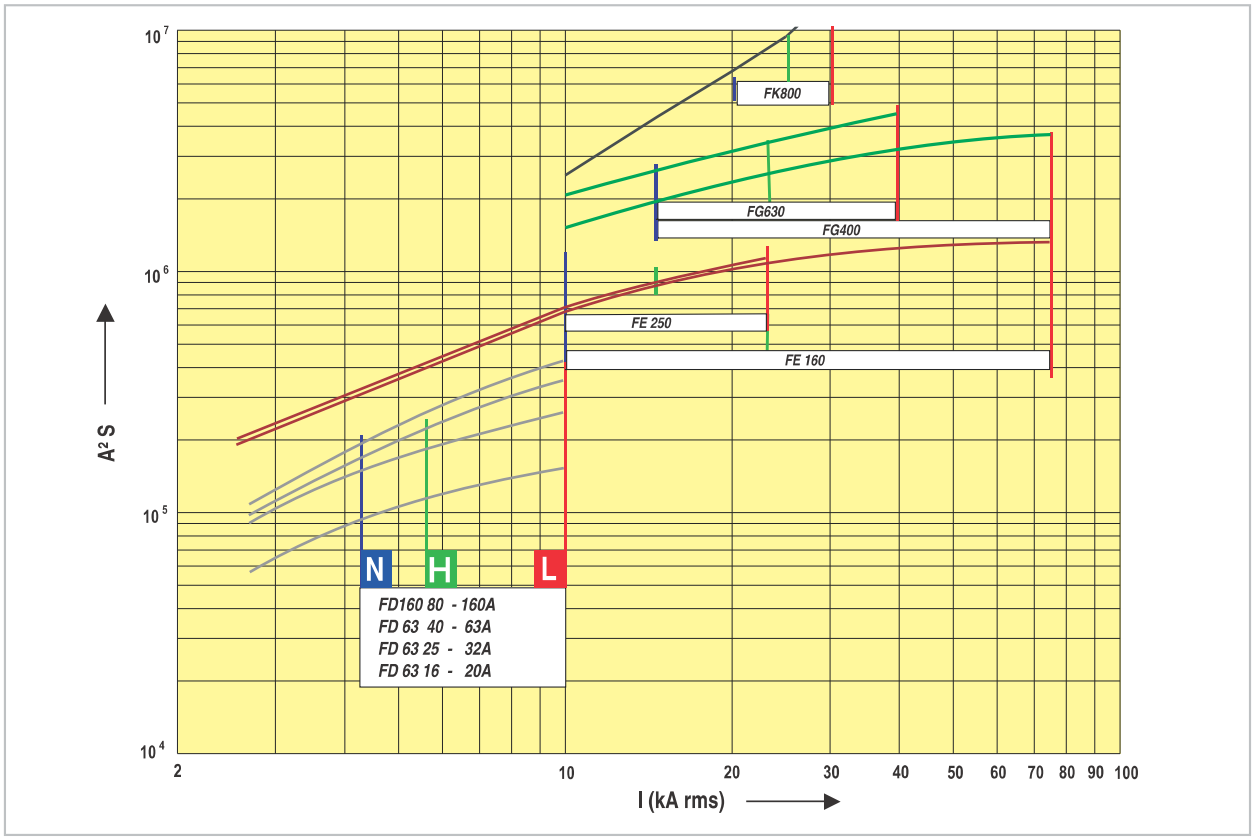
Thermal stress (Energy) Limitation data at 400/415V



Current limitation data at 690V



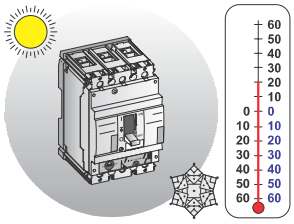
Thermal stress (Energy) Limitation data at 690V



Environmental considerations

Ambient temperature

Record Plus breakers are designed to operate normally at temperatures of -20 degrees to 70 C. Above 40 C derating factors must be applied for two basic reasons:
- To prevent the materials used to construct the device from reaching temperatures that have an adverse effect on their mechanical and/or electrical properties.
- When the breakers is equipped with a thermal magnetic protection device the bimetal in the device will react to the heat generated by the current flowing through the device.Typical for this kind of device is that its reaction time speeds up at higher ambient temperatures.

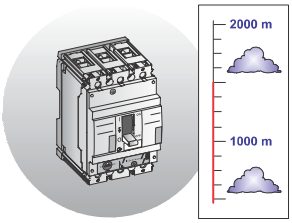


To achieve the same reaction time on a set current value it becomes necessary to derate.
The time current curves published in this catalogue are always valid for operating temperatures between 10 and 40 C.

Storage temperature

A ***Record Plus*** breaker is able to withstand non-operational storage temperature ranges of -40 to 85 C.

Influence of altitude

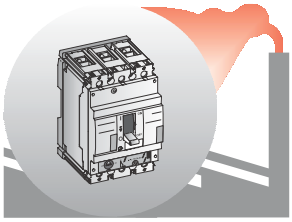


Up to altitudes of 2000 m above sea level no derating of breaker current or rated voltage is apllicable. For altitudes above 2000 m the following factors apply:

Altitude

Altitude (meters)	3000m	4000m	5000m
Ue max. (Volts)	550V	480V	420V
Max. Thermal current at 40 C	0.98 x In	0.93 x In	0.9 x In

Other atmospheric conditions



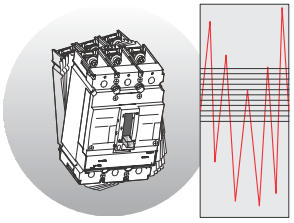
The breaker is designed to operate at the temperatures and relative humidities defined in the EN 60947 clause 6.1.3.1. It also meets the following standards:

IEC 68-2-1	Cold
IEC 68-2-2	Dry heat
IEC 68-2-11	Salt
IEC 68-2-14	Change of temperature
IEC 68-2-27	Shock test
IEC 68-2-29	Bump
IEC 68-2-30	Damp heat cyclic
IEC 68-2-31	Drop
MIL810F	Humidity

Shock & vibration

The ***Record Plus*** line has been designed to withstand shock and vibration to the following standards:
IEC 68-2-6
Lloyd s Register of Shippping
Bureau Veritas
IS 8370
More specifically: ***Record Plus*** passed the following electro-mechanical tests:

Functions normally while being subjected to 30 minutes of random vibration with a power spectral density of 0.29g^2/Hz in the range of 5Hz to 500Hz (3dB corner points, ±20dB/decade rolloff), this over three axes.



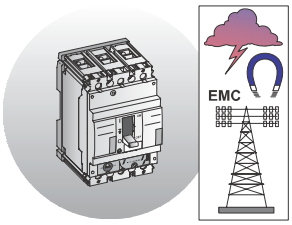
Functions normally while being subjected to sinusoidal vibration of 5g Peak from 10Hz to 500Hz using 30 minute sweeps with additional 30 minute dwells at the three greatest resonance points in this frequency range, this over three axes.

The product is shock resisitant and can withstand the following impacts in any possible orientation:
20g 6ms 10g 11ms

Electromagnetic compatibility

Meets the most stringent requirement of the EN 60947-2 and IEC 1000-4. The breaker and electronic trip unit have passed the following tests.

armonics, current dips, interruptions and power fre uency variations.
EN 60947-2 Annex F, Sub-clause F4.1 through 3
All requirements of non-sinusoidal currents resulting from harmonics are met i.e:



- Wave form consisting of a fundamental component 3rd harmonic component at 50 and 60Hz
- Wave form consisting of a fundamental component a 5th harmonic component at 50 and 60Hz
- Composite wave form with a fundumental component 3rd, 5th 7th and a harmonic at 50 and 60Hz
- All current dips and current interruptions are met.
- Frequency variation test from 45Hz to 65Hz in 1Hz steps (required 50Hz to 60Hz in 1Hz steps)

Electrostatic discharge
EN 70947 Annex F, Sub-clause F6 and the IEC 1000-4-2 (basic standard)
- Passed level 4 air discharge 15kV

Radiated radio fre uency electromagnetic field immunity test
EN 60947-2 Annex F, Sub-clause F7 and the IEC 1000-4-3 (basic standard)
- Passed higher than level 4.....field strength 30V/m

Electrical fast transient/burst
EN 60947-2 Annex F, Sub-clause F5 and the IEC 1000-4-4 (basic standard)
- Passed level 4 burst peak voltage 4kV

Surge immunity test
EN 60947-2 Annex F, Sub-clause F5 and the IEC 1000-4-5 (basic standard)
- Passed level 4 Voltage 1.2 s/50 s 6kV current 8 s/20 s 3kA

Dry heat test
EN 60947-2 Annex F, Sub-clause F8
- Passed all test requirements

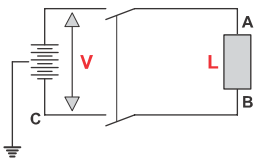
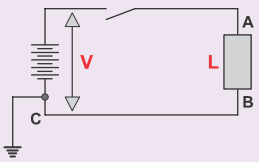
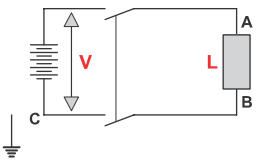
Thermal shock test
EN 60947-2 Annex F, Sub-clause F9
- No nuisance tripping within the 28-day temperature cycles

se in DC networks

In both AC and DC networks protective devices are required to interrupt the prospective short-circuit current at the point where the device is installed. For circuit breakers as the ***Record Plus*** this value is called the interuption or breaking capacity (Icu or Ics), a value dependent not only on the prospective fault current value but also on the system voltage rating. For DC networks the situation is basically the same as for AC networks.

However, the system voltage generally plays a greater role (is more difficult to interrupt) while the network defines how many poles need to participate in the interruption.
The drawing below indicates the three possible DC networks with the worst short-circuit for each of them, the number of poles that must particpate in the breaking operation and the voltage level that needs to be interrupted.

se in DC networks

Network Type	Center point connected to earth (A)	One pole connected to earth (B)	Insulated from earth (C)(1)
Electrical schemes			
Maximum short-circuit current (Icc max)	short-circuit A-B	short-circuit A-B or A-C	short-circuit A-B
Minimum poles needed	2 (one on each polarity)	1 (unearthed polarity)	2 (one on each pole)
Breaking capacity on each pole	Icc max at V/2	Icc max at V	Icc max at V

(1) When a pole is grounded due to a first fault nothing happens, on a second fault the network behaves like a system with one polarity connected to ground

Record Plus FD, FE, FG and FK line breakers can be used in DC networks with standard thermal magnetic trip units.
For ***Record Plus*** FG line breakers, please contact us.
The nominal current rating of the device does not vary in AC or DC applications. The setting of the short-circuit or magnetic device needs to be multiplied by 1.2 to determine its threshold in a DC network.
The table indicates the nominal current, the breaking capacity (Icu Ics) and the number of poles needed to participate in the interruption.

Example
Rated voltage 500V DC Rated current 200A Icc max 50kA
network A: center point connected to grond
FE250N 3x 250 - 1pole for each polarity
network B: one pole connected to ground
FE250N 3x 250 - 2poles on unearthed polarity.
network C: insulated network
FE250N 3 x 250 - 1 pole on each polarity

se in DC networks with standard thermal magnetic trip units

Breaker	Rated current	110V DC	250V DC	440V DC	500V DC	Thermal threshold	Magnetic threshold
FD160S	16 160	25 (1p)	25 (1p)	25 (3p)	-	AC	1.2
FD160N	16 160	40 (1p)	40 (1p)	40 (2p)	40 (2p)	AC	1.2
FD160H	16 160	65 (1p)	65 (1p)	65 (2p)	65 (3p)	AC	1.2
FD160L	16 160	100 (1p)	100 (1p)	100 (3p)	100 (3p)	AC	1.2
FE160N	25 160	50 (1p)	50 (1p)	50 (2p)	50 (2p)	AC	1.2
FE160H	25 160	85 (1p)	85 (1p)	85 (2p)	85 (3p)	AC	1.2
FE160L	25 160	100 (1p)	100 (1p)	100 (3p)	100 (3p)	AC	1.2
FE250V	125 250	25 (1p)	25 (1p)	25 (2p)	-	AC	1.2
FE250N	125 250	50 (1p)	50 (1p)	50 (2p)	50 (2p)	AC	1.2
FE250H	125 250	85 (1p)	85 (1p)	85 (2p)	85 (3p)	AC	1.2
FE250L	125 250	100 (1p)	100 (1p)	100 (3p)	100 (3p)	AC	1.2
FG400N							
FG400H							
FG400L							
FK800N	500 800	50 (1p)	50 (2p)	36 (3p)	36 (3p)	AC	1.2
FK800H	500 800	60 (1p)	60 (2p)	60 (3p)	60 (3p)	AC	1.2
FK800L	500 800	80 (1p)	80 (2p)	80 (3p)	80 (3p)	AC	1.2
FK1250N	640 1250	50 (1p)	50 (2p)	36 (3p)	36 (3p)	AC	1.2
FK1250N	640 1250	60 (1p)	60 (2p)	60 (3p)	60 (3p)	AC	1.2
FK1250L	640 1250	80 (1p)	80 (2p)	80 (3p)	80 (3p)	AC	1.2

se at fre uencies other than 50/60 cycles

Performance characteristics of protective devices used in electrical distribution networks or systems vary according to the network s rated frequency.
The ***Record Plus*** family of circuit breakers is designed to offer their best performance at 50/60 Hz network.

The breakers can be used at 16 2/3 (applications in rail transport) and 400hz (aviation) if the following is taken into account:
a The rated breaking capacity is decreased [1]
b The device trip unit settings are modified
Here the correct setting of the trip unit is vital to ensure that the circuit breaker performs well in the electrical distribution network.

Thermal magnetic trip units

Record Plus breakers and their trip units can be used at 16 2/3 Hz and 400 Hz provided that the trip units are set accordingly.The table indicates the coefficients to be applied for 16 2/3 Hz and 400 Hz applications.

Kt (for thermal)
Km (for magnetic)

The current values for each environment can be calculated by multiplying the values set on the breaker by the coefiicients mentioned in the tables.

Electronic (SMR1) trip units

The breakers and their trip units can be used at 400 Hz (aircraft) provided that the trip units are set accordingly.
The table indicates the coefficients to be applied for 16 2/3 Hz and 400 Hz applications.

Kt (for LT)
Km (for ST)

The current values for each environment can be calculated by multiplying the values set on the breaker by the coefiicients mentioned in the tables.

se in networks with a fre uency of 16 2/3 and 400 cycles

Breaker	Rated current	Trip Unit type	Thermal or LT settings		Magnetic or ST settings	
			Kt_{16} (16 2/3Hz)	Kt_{400} (400 Hz)	Km_{16} (16 2/3Hz)	Km_{400} (400 Hz)
FD160N H or L	3 160	LTMD GTM or MO	1	0.9	0.8	1.6
FE160N H or L	8 63	LTM LTMD GTM or MO	1	0.95	0.8	1.6
FE160N H or L	64 160	LTM LTMD GTM or MO	1	0.9	0.8	1.6
FE250N H or L	80 250	LTMD GTM or MO	1	0.9	0.8	1.6
FE160N H or L	10 125	SMR1	1	1	1	1
FE160N H or L	160	SMR1	1	0.9	1	1
FE250N H or L	40 125	SMR1	1	1	1	1
FE250N H or L	64 250	SMR1	1	0.9	1	1
FG400N H or L	100 400	SMR1	1	0.8	1	1
FG630N H or L	160 630	SMR1	1	0.8	1	1
FK800N H or L	320 800	LTM	1	0.6	1	1
FK1250N H or L	400 1250	LTM	1	0.6	1	1

Example
A FE160N with LTMD 160A trip unit in a 400 Hz network:
(from the table Kt_{400} 0.9 / Km_{400} 1.6)

If Ir is set at 160A and Im set at 1200A the real thermal threshold is 160 x 0.9 144A at 40
Thus the current in the circuit may not exceed this value
Im 1200
the real magnetic threshold is 1120 x 1.6 1920A

(1) Please consult us.

ntroduction

A protection device like the ***Record Plus*** circuit breaker is used in a wide variety of environments to protect conductors, equipment and devices in low voltage distribution circuits. To use this product to its full potential it is necessary to verify that it functions correctly in the environment in which it is used and that it meets the Electrotechnical requirements of the circuit it protects.

Environment

Record Plus breakers function well in almost any industrial environment. The IEC 60947 defines the main aspects of what is meant by industrial environment :

Temperature:
Relative humidity:
Altitude:
Pollution:
Network harmonic content:
Shock and vibration resistance:

For conditions other than the above mentioned please refer to page D.16 in which the effects of the environment are defined.

Maximum short-circuit current

Protective devices as the ***Record Plus*** circuit breaker must be able to interrupt the maximum short-circuit current at the point where they are installed.
The interruption ratings or breaking capacities of these breakers can be found in section D of this catalogue.
The short-circuit ratings at the point of installation of these devices can be determined by the use of software as Procera plus. A method to calculate these values conventionally is described on page E.4 and E.5 of this catalogue.

Design current of a circuit

The equipment and devices in an electrical circuit determines it s current load. The electrical conductor cross sections that can be used in the circuit are determined by a number of factors i.e.

- The design current of the circuit (I_B).
- Conductor type and it s insulation. (current capacity I_Z)
- Installation method.
- Temperature.
- Number of conductors mounted in each others vicinity.

The resulting combinations of current load and electrical conductor cross sections are beyond the scope of this catalogue, however a number of frequently used values are:

Conductor cross section	10mm²	25mm²	50mm²	70mm²	95mm²
I_B with Cu conductors in A	50	90	130	170	210
I_B with AL conductors in A	35	70	100	130	160

(1) In certain specific cases deviations are allowed.

Phase and Neutral conductors

Clause 431.1[(1)] of the IEC 60364 states that overcurrent detection and disconnection shall be provided for all live conductors.
In TN TT systems no neutral overcurrent protection is required if the neutral cross section is at least equivelant to that of the line conductors and the current is not expected to exceed that in the line conductors.
However, if this condition is not met a neutral current detection device is required that disconnects the line protection devices on the detection of a fault.
For IT systems where the neutral is distributed (NOT recommended) each circuit shall be provided with a line and neutral overcurrent protection and disconnection device.[(1)]

Harmonic currents

Clause 431.2.3 of the IEC 60364 requires that if the harmonic content of the line currents is such that a current in the neutral is expected that exceeds the neutrals current carrying capacity, overcurrent detection is required. The detection shall be compatible with the nature of the current in the neutral and shall cause disconnection of the line conductors.

Breaker parameters

Record Plus breakers are available equipped with 3 or 4 pole overload detection, protection and interruption devices. Multiple Neutral protection modes being available. In 4 pole devices the neutral pole always operates simultaneously with those present in the phases.

Each breaker has a minimum of two protection devices:
- Overload Protection Device.
  (In electronic devices - LT setting)
- Short Circuit Protection Device.
  (In electronic devices - ST or I setting)

Electronic Trip Units have extended protection features including:
- LT or Overload Protection device.
- ST or Time delayed Short Circuit Protection device.
- I or Instantaneous Short Circuit Protection device.

Optionally
- Gfsum. or Residual current operated protection device

All ***Record Plus*** breakers can be equipped with a externally linked Residual Current device.

Overload or LT setting

Referred to as Ir in the IEC 60364 the setting is determined by the use of two following formulae.

I_B Ir I_Z
It 1.45 x I_Z

Terminology

I_B Circuit design current
Ir Current set on breaker
I_Z Current carrying capacity of electrical conductor
I_t Tripping current of the protection device
(***Record Plus*** MCCB I_t 1.3 x Ir)

Use of the above mentioned formulae and the ***Record Plus*** characteristics give the following results:
Breaker setting Ir I_Z (I_t 1.3 x I_Z)
In practice Ir is generally set at a value equal to I_Z.

Magnetic setting (Im) or ST setting
Protected E uipment
The magnetic or ST setting of a breaker (Im) is primarily defined by the characteristics of the equipment and devices in the circuit.
The ***Record Plus*** device is equipped with trip units that react to fault currents when needed but are specifically designed not to react to most inrush-current profiles.
The details included in this section on devices as LV/LV transformers and the time current curves of the breaker published elsewhere in this catalogue allow a definition of the **Im** value.

Instantaneous setting (I) on Electronic breakers
All Electronic ***Record Plus*** breakers are equipped with this protection device that on detection of a short-circuit exceeding it s set value trip the breaker immediately.
The device has a fixed setting on all SMR1 devices and can be adjusted on all SMR2 trip unit types.
It is primarily used to limit the electrical energy level in the circuit (vs. the timed short-circuit setting ST).

Magnetic setting (Im) or ST setting
Protected Lines
On a short-circuit event the total circuit impedance determines the highest and the lowest current that can flow in the circuit. It is necessary not only to verify if the protective device can interrupt the maximum short-circuit value but also if the device protecting the circuit reacts and disconnects in time at the lowest possible short-circuit value.
Due to the fact that a major part of the circuit impedance is formed by electrical conductors like cables, busbar systems etc. within the circuit, this requirement has a limiting effect on the length of the conductors used in the circuit.

There are two conditions that have to be met:
a) The weakest short-circuit current must be disconnected before the electrical conductors exceed their temperature limits.
b) A current to earth (fault current) must be disconnected before inadvertent contact to normally non-conductive parts causes injury.
Please refer to the pages E.6 and E.13 for more details.

Ground Fault setting (GF) on Electronic breakers
All larger Electronic ***Record Plus*** breakers can be optionally equipped with a GF sum device that operates on a Residual Current principle.
It sums the values of the secondary circuits in the installed sensors in both the lines and Neutral pole and sends an alarm or trip signal when this value is to zero and exceeds the adjusted values.
This device allows the user to set a fault current value (Id) ranging from 02. to 1 times the breaker sensor rating and a trip time delay.
Where the standard breaker settings are insufficient a GFsum device allows the detection of low short-circuit values as the weakest short-circuit current and/or a current to earth (Fault Current).

IdN setting on Residual Current Devices
All ***Record Plus*** breakers can be optionally equipped with a Residual Current Device (RCD). The device sums the values of the primary circuits in both the lines and Neutral pole by using a summing CT place around all live conducors and the neutral (when present). If the sum differs from zero and exceeds a pre-defined current value and time span the device trips the associated breaker.
This device can be set at a current value (IdN) of 30, 300, 1000, 3000 or 10000 mA and a trip time delay.
Where the standard breaker settings are insufficient an RCD can be used to detect low short-circuit values as the weakest short-circuit current and/or a current to earth (Fault Current).

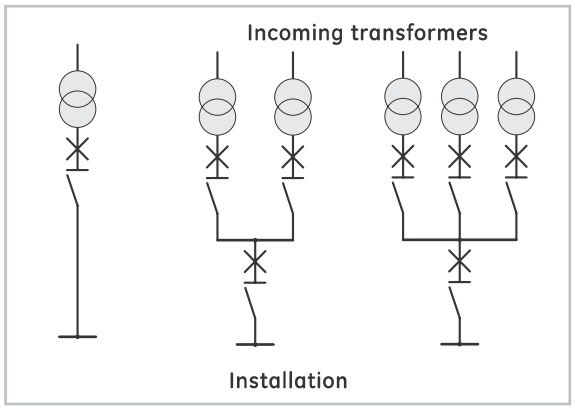
Protection against short-circuits

Maximum short-circuit ratings

Protective devices as the ***Record Plus*** circuit breaker must be able to interrupt the maximum short-circuit current at the point where they are installed.
The interruption ratings of these breakers (breaking capacity) can be found elsewhere in this catalogue.
For the calculation of the short-circuit current at the point where the breaker is installed a pan-European document is now available in the form of the R064-003.
The values published here are based on this document.

Power supply

The values mentioned in table indicate the effective values of the highest three phase short-circuit current that is available at the connection terminals of the incoming transformer(s).



Formulas

Medium voltage impedance

$$Z \quad \frac{(m \times Uo \times \sqrt{3})^2}{Sk} \quad m$$

MV/LV transformer impedance

$$Z_r \quad \frac{(m\ Uo\ s\ \ rt\ 3)^2}{S_rT} \times \frac{U_{kr}}{100} \quad m$$

Maximum short-circuit calculation

$$Ik_{3max} \quad \frac{(Cmax. \times m \times Uo \times \sqrt{3})^2}{\sqrt{R^2 + x^2}} \quad kA$$

Calculated maximum short-circuit values 3 phase 400 network

MV/LV Transformer(s)		Medium Voltage power SK in MvA					
S_rT kvA	U_{kr}	100	150	200	300	400	500
		Maximum short-circuit Values in kA (Ik_{3max})					
100	4	3.5	3.6	3.6	3.6	3.6	3.6
160	4	5.6	5.7	5.7	5.7	5.7	5.8
250	4	8.5	8.7	8.8	8.9	8.9	9.0
315	4	10.6	10.9	11.0	11.1	11.2	11.2
400	4	13.2	13.6	13.8	14.0	14.2	14.2
500	4	16.2	16.8	17.1	17.4	17.6	17.7
630	4	19.8	20.7	21.2	21.7	22.0	22.2
630	5	16.3	16.9	17.2	17.6	17.7	17.8
630	6	13.8	14.3	14.5	14.7	14.8	14.9
800	6	17.1	17.8	18.2	18.5	18.7	18.8
1000	6	20.8	21.8	22.3	22.9	23.2	23.4
1250	6	25.1	26.6	27.4	28.3	28.7	29.0
1600	6	30.6	32.9	34.2	35.6	36.3	36.8
2000	6	36.4	39.7	41.6	43.6	44.7	45.4
2500	6	42.9	47.5	50.2	53.2	54.8	55.9
2 x 400	4	24.2	25.7	26.4	27.2	27.7	27.9
2 x 500	4	29.1	31.2	32.3	33.5	34.2	34.6
2 x 630	4	34.9	37.9	39.6	41.4	42.4	43.0
2 x 630	5	29.3	31.4	32.5	33.8	34.4	34.8
2 x 630	6	25.3	26.8	27.6	28.5	29.0	29.3
2 x 800	6	30.6	32.9	34.2	35.6	36.3	36.8
2 x 1000	6	36.4	39.7	41.6	43.6	44.7	45.4
2 x 1250	6	42.9	47.5	50.2	53.2	54.8	55.9
2 x 1600	6	50.7	57.3	61.3	65.9	68.4	70.0
2 x 2000	6	58.3	67.3	72.8	79.4	83.1	85.5
2 x 2500	6	66.3	78.1	85.7	94.9	100.3	103.9
3 x 400	4	33.6	36.4	37.9	39.6	40.5	41.1
3 x 500	4	39.7	43.7	45.9	48.5	49.8	50.7
3 x 630	4	46.8	52.3	55.6	59.4	61.4	62.7
3 x 630	5	40.0	43.9	46.2	48.8	50.2	51.0
3 x 630	6	34.9	37.9	39.6	41.4	42.4	43.0
3 x 800	6	41.6	46.0	48.5	51.3	52.8	53.8
3 x 1000	6	48.6	54.6	58.2	62.3	64.6	66.0
3 x 1250	6	56.1	64.3	69.3	75.3	78.6	80.8
3 x 1600	6	64.8	76.1	83.3	91.9	97.0	100.3
3 x 2000	6	72.9	87.5	97.2	109.2	116.4	121.2
3 x 2500	6	81.0	99.4	112.1	128.6	138.7	145.6

Terminology

Sk	short-circuit power of the medium/high voltage network
S_{rT}	power rating of the MV/LV transformer
U_{kr}	short-circuit voltage in %, according to HD 398
m	no load factor 1.05 assumed
Cmax.	voltage factor 1.05 assumed
Uo	phase to neutral voltage
Ik_{3max}	maximum 3 phase short-circuit current
X	total reactance
X	0.995 x Z
X_T	0.95 x Z_T
R	total resistance
R	0.1 x X
R_T	0.31 x Z_T

Influence of cable runs

It is possible to calculate short-circuit values within circuits by determining the impedance, reactance and resistance of the power supply and by adding those of cable runs. These values are used here to calculate the maximum short-circuit levels at the end of a defined cable run.

Values used

Specific resistance of copper and aluminum at 20 C

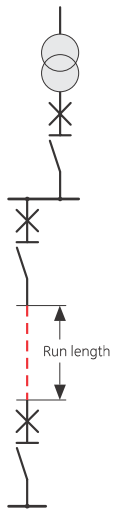
ρ_0 18.51 mΩ mm²/m. for copper cores
29.41 mΩ mm²/m. for aluminum cores

Reactance of multicore cables λ 0.08 mΩ /m.

Examples

$Ik_{3\ max.}$ at cable run start 50kA
54 meters of 185 mm² cable
$Ik_{3\ max.}$ at cable run end 22kA

$Ik_{3\ max.}$ at cable run start 120kA
12 meters of 185 mm² cable
$Ik_{3\ max.}$ at cable run end 80kA



Short-circuit values within circuits

$Ik_{3\ max.}$ without cable run	$IK_{3\ max}$ in kA at point where *Record Plus* MCCB is to be installed (This value must be Icu or Ics)									
145	80	65	50	30	25	22	20	15	10	6
140	80	65	50	30	25	22	20	15	10	6
130	80	65	50	30	25	22	20	15	10	6
120	80	65	50	30	25	22	20	15	10	6
110	80	65	50	30	25	22	20	15	10	6
100	65	65	50	30	25	22	20	15	10	6
90	65	65	50	30	25	22	20	15	10	6
80	65	50	50	30	22	20	20	15	10	6
70	65	50	50	25	22	20	20	15	10	6
60	50	50	50	25	22	20	20	15	10	6
50	50	36	36	22	20	20	20	15	10	6
45	50	36	30	22	20	20	20	15	10	6
40	36	36	30	20	20	20	15	15	10	6
35	30	30	25	20	20	15	15	15	10	6
30	30	25	22	20	20	15	15	15	10	6
25	22	22	20	15	15	15	15	10	10	6
20	-	-	-	15	15	15	15	10	10	6
15	-	-	-	-	-	10	10	10	10	6
10	-	-	-	-	-	-	-	-	6	6

Cable cross section Cu mm²	AL mm²	Re uired minimum length in meters of cable run of the mentioned cross section to achieve the $Ik_{3\ max}$ mentioned above									
1.5		0.5	0.5	0.5	1	1	1	1	1.5	2	3.5
2.5	4	0.5	0.5	0.5	1	1.5	1.5	1.5	2	3.5	5.5
4	6	0.5	0.5	1	1.5	2	2.5	2.5	4	5	9
6	10	1	1	1.5	2.5	3	3.5	3.5	5	8	13
10	16	1	2	2	4	5	5.5	6	8	13	21
16	25	1.5	2.5	3.5	6	8	9	10	13	20	35
25	35	2.5	4	5	9	12	13	15	20	32	55
35	50	3	4	7	13	16	18	20	28	42	70
50	70	4	6	9	18	22	25	29	39	60	100
70	95	6	8	12	24	30	35	40	55	85	135
2 x 35	2 x 50	6	8	13	25	32	36	40	55	85	140
95	150	7	11	16	32	39	46	51	70	110	180
2 x 50	2 x 70	8	12	18	35	44	52	58	80	120	200
120	185	9	13	19	38	48	55	62	85	130	220
150	240	10	15	23	46	58	66	75	100	155	255
2 x 70	2 x 95	11	16	24	50	60	70	80	110	170	270
185		12	18	27	54	65	76	84	116	180	300
240		14	21	32	32	78	88	98	135	210	340
2 x 95	2 x150	14	21	32	65	80	95	105	140	220	360
300		16	24	35	70	85	100	110	150	230	380
2 x120	2 x185	17	27	42	80	95	110	125	170	260	430
2 x150		20	30	48	91	115	135	150	200	310	510
3 x 95	3 x150	21	33	51	95	120	140	155	210	320	540
2 x185		23	35	53	105	130	155	170	235	360	590
3 x120		25	38	57	115	145	165	185	255	390	645
2 x240		28	41	62	125	155	180	200	270	410	675
3 x150	3 x240	30	45	68	140	170	200	220	300	460	765
3 x185		35	53	79	160	195	230	255	350	530	880
3 x240		41	80	125	185	230	265	295	410	620	

Protection against short-circuits

Weakest short-circuit current

It is necessary to verify that the permissible thermal stress in conductors is not exceeded at the maximum short-circuit level and at the weakest short-circuit level. Verification on the maximum short-circuit level is described on page E.4 of this catalogue. For the weakest short-circuit value it is necessary to verify that the protective devices as the ***Record Plus*** circuit breaker trips before the conductors reach the mentioned limits, this for operating times of 0.1 to 5 seconds.

Permissible thermal stress in conductors
Clause 434.5.2 of the IEC 60364 4d. 03 - 2008 defines that for interruption times between 0.1 and 5 seconds, the following formula applies:

$$t \quad (k^* S/I)^2 \quad \text{or it s equivelant} \quad k^2 S^2 \quad I^2t$$

Terminology

t	duration of the short-circuit in seconds
k	factor provided by the standard depending on the material the conductor is made of and it s insulation
S	cross section of the conductor
I	effective short-circuit current. (r.m.s value)

The tables included here indicates the factor k for conductors with different insulation materials and the calculated energy values ($K^2 S^2$ values in A^2S).

Record Plus Circuit breaker application
To meet this condition it is necessary to verify if the I^2t value of the protection device is lower than or equal to the $K^2 S^2$ value of the used conductors for interruption times between 0.1 and 5 seconds.

K factors in accordance with the EC 60364-4-43 ed.03

Insulation & maximum temperature	Copper (Cu)	Aluminium (Al)
PVC - 70 300 sq.mm	115	76
PVC - 70 300 sq.mm	103	68
PVC - 90 300 sq.mm	100	86
PVC - 90 300 sq.mm	86	57
XLPE EPR 90	143	94
Rubber 60	141	93
Mineral, bare unsheathed 105	135 or 115(1)	-

(1) The 115 value is be used for conductors exposed to touch.

Under normal conditions it is assumed that the current setting of the Magnetic or ST device and the associated tripping time is used to verify if this condition is met. This current value can be used to verify if the breaker trips on the weakest short-circuit current.
In certain cases (specifically with Electronic Trip Units) a lower current level with an interruption time of 5 seconds can be assummed.

Weakest short-circuit current calculations
For the most commonly applied network configuration, 3 phase with neutral, the weakest short-circuit is the Phase to Neutral value.
The network configuration determines the value of this current. Cases where the Phase to Earth or two Phase value is the weakest are also commonplace.
Basically, the weakest short-circuit current is determined by the highest impedance loop in the circuit that the breaker is protecting.
The impedance of this loop is mainly determined by the conductors included in the circuit, thus their maximum length is limited. An approximation of the effect of the conductor or cable length on the weakest short-circuit is possible by using the following formula:

$$Ikmin \quad 0.8 \times \frac{Cmin \times Uo}{\sqrt{R^2 + x^2}} \times k1 \times k2 \times k3 \text{ Amp}$$

Terminology

Ikmin	Weakest short-circuit current
0.8	Assumed factor for the impedance of the upstream network
Cmin	Voltage factor 0.95 assumed
Uo	Phase to neutral voltage
X	Reactance of the conductors or cables in the circuit reactance of multi core cables X in mΩ/m 0.08
R	Resistance of the conductors or cables in the circuit based on the following basic data: (warm state) 22.069 mΩ mm^2/m. for copper cores(2) 37.178 mΩ mm^2/m. for aluminum cores(2)
k1 k2 k3	Correction factors, see next page

(2) 1.28 x 17.241 and 1.28 x 28.264 (see IEC 60364-4-43)

Maximum permissible thermal stress in Conductors for operating times from 0.1 to 5 seconds

Insulation	Core	Cross section in s . mm & maximum permissible thermal stress in A^2s															
		1.5	2.5	4	6	10	16	25	35	50	70	95	120	150	185	240	300
		x10⁴	x10⁴	x10⁴	x10⁴	x10⁶	x10⁶	x10⁶	x10⁶	x10⁶	x10⁸	x10⁸	x10⁸	x10⁸	x10⁸	x10⁸	x10⁸
PVC - 70	Cu	2.976	8.266	21.160	47.610	1.323	3.386	8.266	16.201	33.063	0.648	1.194	1.904	2.976	4.526	7.618	9.548
	Al	1.300	3.610	9.242	20.794	0.578	1.479	3.610	7.076	14.440	0.283	0.521	0.832	1.300	1.977	3.327	4.162
PVC - 90	Cu	2.250	6.250	16.000	36.000	1.000	2.560	6.250	12.250	25.000	0.490	0.903	1.440	2.250	3.423	5.760	6.656
	Al	1.664	4.623	11.834	26.626	0.740	1.893	4.623	9.060	18.490	0.362	0.667	1.065	1.664	2.531	4.260	2.924
XLPE & EPR 90	Cu	4.601	12.781	32.718	73.616	2.045	5.532	12.781	25.050	51.123	1.002	1.846	2.945	4.601	6.999	11.779	17.893
	Al	1.988	5.523	14.138	31.810	0.884	2.262	5.523	10.824	22.090	0.433	0.797	1.272	1.988	3.024	5.090	7.784
Rubber 60	Cu	4.473	12.426	31.810	71.572	1.988	5.090	12.426	24.354	49.703	0.974	1.794	2.863	4.473	6.804	11.451	17.893
	Al	1.946	5.406	13.838	31.136	0.865	2.214	5.406	10.595	21.623	0.424	0.781	1.245	1.946	2.960	4.982	7.784
Mineral bare 105 k 135	Cu	4.101	11.391	29.160	65.610	1.823	4.666	11.391	22.326	45.563	0.893	1.645	2.624	4.101	6.238	10.498	16.403
Mineral bare 105 k 115	Cu	2.976	8.266	21.160	47.610	1.323	3.386	8.266	16.201	33.063	0.648	1.194	1.904	2.976	4.526	7.618	11.903

Maximum conductor length

To meet the requirements the short-circuit device of the circuit breaker (Im) must react to the weakest short-circuit current. The table indicates the maximum cable length where this condition is still met.
The tolerances on the settings of the short-circuit device in the breaker are taken into account (factor included in calculations of 1.2).

Correction factors k

For a 3 phase circuit with no neutral and a voltage of 400V between phases:

k1 1.74

For a single phase circuit with neutral and a voltage of 230V between phase and neutral:

k1 1.00

For a 3 phase circuit with neutral, a voltage of 400V between phase and a neutral with 0.5 x the phase cross section:

k1 0.67

For a number of multi-core cables in parallel

k2 for 2 cores 2.00

k2 for 3 cores 2.65

For multicore cables with conductors made of aluminum:

Cu conductor Cross section S in mm²	k3
4 50	0.63
70	0.64
95	0.65
120	0.66
150	0.67
185	0.69
240	0.72
300	0.76

Maximum Cu conductor length in meters based on a Phase to eutral voltage o of 230 and valid for multicore conductors with stress calculations based on a k of 100
Areas in grey indiacte that stress re uirements are exceeded

Cross section S in mm²	Discon-nection time (s)	Record Plus™ Im or ST setting in Amps & conductor length in Meters										
		50	75	100	125	150	175	200	250	300	350	400
1,5	0,10	99	66	50	40	33	28	25	20	17	14	12
2,5	0,10	165	110	83	66	55	47	41	33	28	24	21
4	0,10	264	176	132	106	88	75	66	53	44	38	33
6	0,10	396	264	198	158	132	113	99	79	66	57	49
10	0,10	660	440	330	264	220	188	165	132	110	94	82
16	0,10	1054	703	527	422	351	301	264	211	176	151	132
25	0,50	1643	1096	822	657	548	470	411	329	274	235	205
35	0,50	2292	1528	1146	917	764	655	573	458	382	327	286
50	0,50	3247	2165	1624	1299	1082	928	812	649	541	464	406
70	0,50	4479	2986	2239	5516	1493	1280	1120	896	746	640	560
95	1,05	5929	3953	2964	5295	1976	1694	1482	1186	988	847	741
120	1,05	7263	4842	3632	4900	2421	2075	1816	1453	1211	1038	908

Cross section S in mm²	Discon-nection time (s)	Record Plus™ Im or ST setting in Amps & conductor length in Meters										
		450	500	600	700	800	900	1000	1250	1500	1750	2000
2,5	0,10	18	17	14	12							
4	0,10	29	26	22	19	16	15	13				
6	0,10	44	40	33	28	25	22	20	16	13	11	
10	0,10	73	66	55	47	41	37	33	26	22	19	16
16	0,10	117	105	88	75	66	59	53	42	35	30	26
25	0,10	183	164	137	117	103	91	82	66	55	47	41
35	0,10	255	229	191	164	143	127	115	92	76	65	57
50	0,10	361	325	271	232	203	180	162	130	108	93	81
70	0,50	498	448	373	320	280	249	224	179	149	128	112
95	1,05	659	593	494	423	371	329	296	237	198	169	148
120	1,05	807	726	605	519	454	404	363	291	242	208	182
150	1,05	966	870	725	621	544	483	435	348	290	249	217
185	1,05	1127	1014	845	724	634	563	507	406	338	290	254
240	1,05	1328	1195	996	854	747	664	598	478	398	341	299
300	1,05	1489	1340	1117	957	838	745	670	536	447	383	335

Cross section S in mm²	Discon-nection time (s)	Record Plus™ Im or ST setting in Amps & conductor length in Meters									
		2500	3000	3500	4000	4500	5000	5500	6000	6500	7000	7500
10	0,10	13	11	9								
16	0,10	21	18	15	13							
25	0,10	33	27	23	21	18	16	15	14	13	12	11
35	0,10	46	38	33	29	25	23	21	19	18	16	15
50	0,10	65	54	46	41	36	32	30	27	25	23	22
70	0,50	90	75	64	56	50	45	41	37	34	32	30
95	0,50	119	99	85	74	66	59	54	49	46	42	40
120	0,50	145	121	104	91	81	73	66	61	56	52	48
150	1,05	174	145	124	109	97	87	79	72	67	62	58
185	1,05	203	169	145	127	113	101	92	85	78	72	68
240	1,05	239	199	171	149	133	120	109	100	92	85	80
300	1,05	268	223	191	168	149	134	122	112	103	96	89

Cross section S in mm²	Discon-nection time (s)	Record Plus™ Im or ST setting in Amps & conductor length in Meters										
		8000	8500	9000	9500	10000	11000	12000	13000	14000	15000	16000
35	0,10	14	13	13	12	11	10					
50	0,10	20	19	18	17	16	15	14	12	12	11	
70	0,50	28	26	25	24	22	20	19	17	16	15	14
95	0,50	37	35	33	31	30	27	25	23	21	20	19
120	0,50	45	43	40	38	36	33	30	28	26	24	23
150	1,05	54	51	48	46	43	40	36	33	31	29	27
185	1,05	63	60	56	53	51	46	42	39	36	34	32
240	1,05	75	70	66	63	60	54	50	46	43	40	37
300	1,05	84	79	74	71	67	61	56	52	48	45	42

Notes
The disconnection time of 0.1 second is the lowest value defined in the standard and can be applied for the ***Record Plus*** FD160, FE 160 and FE250 breaker types.
The 0.5 second disconnection times can be used for all ***Record Plus*** breaker types FG400, FG630, FK800, FK1250 FK1600. (with and without time setting).
For cross sections 70 sq.mm the use of breakers with time a setting of 1 second as the EntelliGuard ACB is assummed. The resulting cable lengths also apply for Record Plus breakers.

Protection against Electric Shock

The 2001 edition of the IEC 60364-4-41 protection under normal conditions was referred to as direct contact and protection under fault conditions was referred to as Protection against indirect contact .
In the 2005 edition of the same standard the general terminology Protection against Electrical shock has been adapted whilst two new terms have been introduced:

1) Protection under normal conditions now designated: **Basic Protection**
2) Protection under fault conditions now designated: **Fault protection**

Basic protection being provided by basic insulation of live parts, barriers or enclosures whilst fault protection is provided by protective equipotential bonding and automatic disconnection in case of a fault in TN, TT and IT systems.
The Protective measure:
automatic disconnection of the power supply
being described in paragraph 411.
(Replacing paragraph 413 of the 2001 edition)

Generally, the required automatic disconnection time depends on the configuration of the system and the nominal voltage between line and earth (Uo). It is defined in clause 411.3.2.2 and table 41.1 of which an extract can be found on this page.
In addition to this table the following general requirements are put forward:

In TN systems, a disconnection time not exceeding 5 seconds is permitted for distribution circuits and circuits larger than 32A. (Not applicable in Belgium where table 41.1 applies generally)

In TT systems, a disconnection time not exceeding 1 second is permitted for distribution circuits and circuits larger than 32A.

In IT systems an automatic disconnection of the supply is generally not required on the first fault (Except in Norway). On a second fault, depending on the systems configuration, a disconnection time not exceeding **1 second or 5 seconds** is permitted for distribution circuits and circuits larger than 32A.

If the automatic disconnection times cannot be achieved in the required time supplementary protective equipotential bonding shall be provided.

In all network configurations it is necessary to ensure that the protective device will interrupt the circuit within the defined automatic disconnection times. Verification being necessary for the worst case scenario taking into account the Phase to Earth voltage the fault current and the characteristics of the protection device.

Record Plus Circuit breakers

As moulded case circuit breakers the Record Plus meet a number of the requirements of basic protection.
The double isolated casing offering a so called class II protection. The device when installed with cover plates and accessories as terminal shields offers a protection degree of up to IP40 or IP54.
When used for fault protection to automatically disconnect the supply Record Plus meet the required automatic disconnection times across a broad, adjustable current range. Where this current range does not suffice an RCD device can be added to breakers with ratings up to 630A whilst the GFsum option using a Residual Current Principle can be applied on larger breakers.

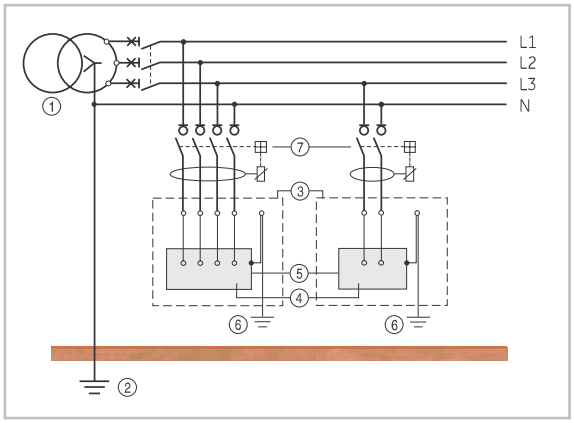
Maximum disconnection times for nal AC circuits not exceeding 32A

System	Maximum disconnection times in seconds										
	50V	Uo	120V AC	120V	Uo	230V AC	230V	Uo	400V AC	Uo	400V AC [3]
TN[1]	0,80			0,40			0,20			0,10	
TT[2]	0,30			0,20			0,07			0,04	

Notes to table
Where disconnection is provided by an RCD the above mentioned disconnection times relate to residual fault currents that are much higher than the rated residual operating current (typicaly 5 x Idn).
In Belgium, China and the Netherlands local regulations are more extensive.
(1) Also applies to IT systems with a distributed or non distributed neutral or mid point conductor
(2) Also applies to IT systems in which the exposed-conductive parts are earthed in groups or individually.
(3) In Belgium, above 400V the Belgian safety curves apply. (see local Wiring rules)

TT system characteristics

One point of the power supply is connected to earth whilst all conductive parts in the installation are connected to electrically independent earth electrodes.



① Power supply.
② Power supply earthing (R_N)
③ Low voltage installation, consumer portion.
④ Equipment present in installation.
⑤ Exposed conductive parts/surfaces.
⑥ Installation earthing. (R_A)
⑦ Recommended RCD device.

Under fault conditions disconnection of the supply may be assured by an overcurrent device as ***Record Plus*** provided a suitably low value of the fault circuit impedance Zs is reliably assured. The following condition shall then be fulfilled:

$$Z_s \times I_a \quad U_0$$

where:

Z_s the impedance in Ω of the fault loop compromising
- the Source
- the line conductor up to the point of the fault
- the protective conductor of the exposed parts
- the earthing conductor
- the earth electrode of the installation (RA)
- the earth electrode of the source (RN)

I_a the current in A causing the protection device to disconnect within the time as specified in table 41.1 (see excerpt on page E.8) or within 1 second depending on the stipulated requirements

U_0 the nominal a.c. or d.c. line to earth voltage

Generally under fault conditions the disconnection of the supply is assured by a residual current device (RCD). The device must disconnect within the time as specified in table 41.1 (see excerpt on page E.8) or within 1 second depending on the stipulated requirements and the following condition shall be fulfilled:

$$R_a \times I_n \quad 50V$$

where:

R_a the resistance in of the protective conductor of exposed parts and that of the earth electrode

I_n the rated residual operating current of the RCD in A

Notes

Where Ra is unknown it may be replaced by Zs.
The disconnection times mentioned in table 41.1 (see excerpt on page E.8) apply to residual fault currents that are much higher than the rated residual operating current (typicaly 5 x Idn).

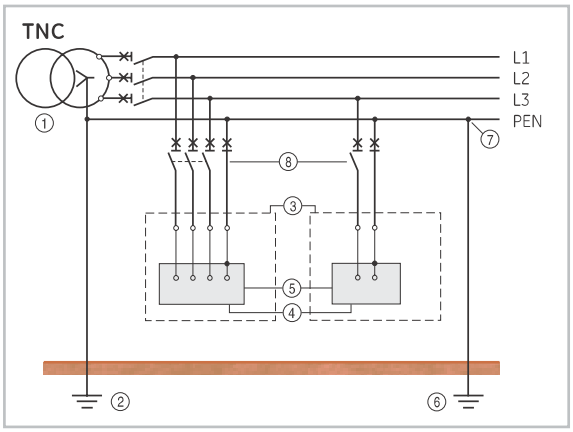
TN system characteristics

One or more points of the power supply are connected to earth whilst all conductive parts in the installation are electrically connected to this point by protective conductors. (PE or PEN conductors). The system exits in three main variants:

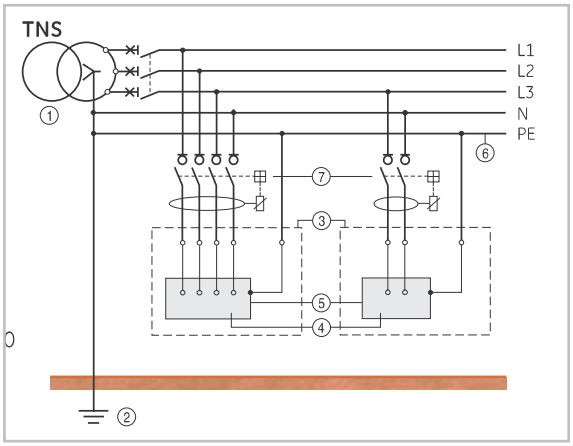
TNC The neutral and protective conductor are combined. (PEN)

TNS The neutral(N) and protective conductor (PE) are separate.

TNCS The supply is configured as a TNC, the system changes to a TNS system at a pre-defined point in the LV installation.



① Power supply.
② Power supply earthing.
③ Low voltage installation, consumer portion.
④ Equipment present in installation.
⑤ Exposed conductive parts/surfaces.
⑥ Additional supply earthing.
⑦ Protective conductor combined with the neutral.
⑧ Protective device.



① Power supply.
② Power supply earthing.
③ Low voltage installation, consumer portion.
④ Equipment present in installation.
⑤ Exposed conductive parts/surfaces.
⑥ Protective conductor.
⑦ Protective device.

Remark: a TNCS system is not depicted

T system Characteristics ct d

Under fault conditions disconnection of the supply may be assured by overcurrent devices as Record Plus or by residual current devices (RCDs). Where RCD s are used the circuit should also be protected by an overcurrent protection device.
In TN-C systems the use of RCDs is prohibited whilst in TN-CS systems a PEN conductor must be connected to the line or source side of the RCD.
The following condition shall then be fulfilled:

$$Z_s \times I_a \quad U_0$$

where:

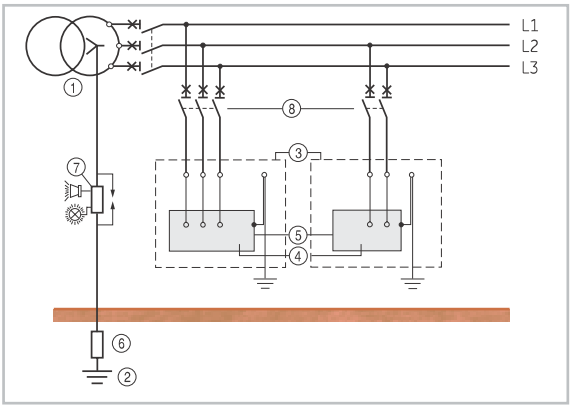
Z_s the impedance in Ω of the fault loop compromising
- the Source
- the line conductor up to the point of the fault
- the protective conductor of the exposed parts

I_a the current in A causing the protection device to disconnect within the time as specified in table 41.1 (see excerpt on page E.8) or within 5 seconds depending on the stipulated requirements.

U_0 the nominal a.c. or d.c. line to earth voltage.

IT system characteristics

The supply is isolated from earth or connected to earth by means of an impedance of a relatively high value. The conductive parts in the installation are connected to earth electrodes.



① Power supply.
② Power supply earthing.
③ Low voltage installation, consumer portion.
④ Equipment present in installation.
⑤ Exposed conductive parts/surfaces.
⑥ Impedance for insulation from earth.
⑦ Insulation monitoring device surge protection
⑧ Protective device.

On a first fault to earth is is not required that an automatic disconnection of the supply takes place provided that the exposed conductive parts are earthed meeting the following conditon:

$$R_A \times I_d \quad 50V$$

where:

R_A the resistance in of the protective conductor of exposed parts and that of the earth electrode.

I_d the fault current between line and exposed conductive parts in A of the first fault taking into account leakage currents and the total earthing impedance of the installation.

It is recommended that the first fault to earth is eliminated as soon as possible. To indicate the first fault between a live part to exposed conductors or earth insulation monitoring devices shall be provided.
If the supply of the first fault event is not interrupted by a protection device a residual current monitoring device or insulation fault location system can also be used. These devices produce a visible and/or audible signal persisting for as long as the fault exists.

After the ocurrence of a first fault a second fault on a different live conductor shall result in an automatic disconnection of the supply.
Where exposed conductive parts are interconnected by a protective conductor collectively linked to the same earthing system an IT is very similar to a TN system to which the following condtions apply.

Disconnection of the supply may be assured by overcurrent devices as Record Plus or by residual current devices (RCDs). Where RCD s are used the circuit should also be protected by an overcurrent protection device.

If the neutral or mid point conductor **is not** distributed the following condition must be fulfilled:

$$2 \times Z_s \times I_a \quad U$$

If the neutral or mid point conductor **is** distributed the following condition must be fulfilled:

$$2 \times Z_s \times I_a \quad U_0$$

where:

Z_s the impedance in of the fault loop compromising
- the line conductor and the protective conductor of the circuit.

Z_s the impedance in of the fault loop compromising
- the neutral conductor and the protective conductor of the circuit.

I_a the current in A causing the protection device to disconnect within the time as specified in table 41.1 for TN systems (see excerpt on page E.8) or within 5 seconds depending on the stipulated requirements.

U the nominal a.c. or d.c. line to line voltage.

U_0 the nominal a.c. or d.c. line to neutral or mid -point conductor voltage.

Where the exposed conductive parts are earthed in groups or individually the supply must be disconnected within the time as specified in table 41.1 for TT systems (see excerpt on page E.8) or within 1 second depending on the stipulated requirements and the following conditon shall be fulfilled:

$$R_A \times I_d \quad 50V$$

where:

R_A the sum of resistances in of the earth electrode and the protective conductor to the exposed conductive parts.

I_d the current in A causing the protection device to disconnect within the time as specified in table 41.1 for TT systems (see excerpt on page E.8) or within 1 second depending on the stipulated requirements.

Notes
When residual current devices (RCDs) are used the disconnection times mentioned in table 41.1 (see excerpt on page E.8) apply to residual fault currents much higher than the rated residual operating current (typicaly 5 x Idn).

Re uired Calculations

In order to meet the safety requirements under fault conditions where disconnection of the supply is required it is necessary to verify that the protective device will disconnect the supply within the defined connection times.

In all three systems, TT, TN IT, the use of a overcurrent protective device, a residual current device or a combination of both is required

A Record Plus moulded case circuit breaker is an over-current protection device in accordance with the IEC 60947. The product line includes Residual current devices that sum the residual current with one summing current transformer (RCD block) and a GFsum device using the secondary current transformers placed in the Phase and Neutral conductors in the same manner.

For all three devices the current at which the protective device interrupts the supply under fault conditions **(I_a)** at the interruption time required in table 41.1 and at 1 and 5 seconds is provided here. Also tabulated is the applicable **R_A** value in TT networks when RCDs are used. Using the most common line to earth voltage **U_0** the maximum allowable **Z_S** and **Z_S** values for a circuit protected by these devices have been calculated and indicated in a number of tables included here.

Tables

The table on this page can be used for Record Plus breakers with thermal magnetic trip units and the associated line of add on Residual current devices.
On pages E.12 and E.13 the tables indicate the values that can be used for Record Plus circuit breakers with electronic trip units whilst those on page E.14 contain the values for electronic devices with an integrated Gf sum protection.

Disconnection times, the associated current levels and calculated $_S$ & $_S$ values meeting EC 60364-4-41 clause 411
Record Plus Circuit breakers FD160, FE160, FE250, FK800 & FK1250 with TM & TMD type Trip nits

Magnetic setting Im (A)	I_a current (A)	Max. time (s)	Z_S value in at a U_0 in Volts a.c. of 127	220	230	250	400
63	75.6	0.06	1.680	2.910	3.042	3.307	5.291
160	192	0.06	0.661	1.146	1.198	1.302	2.083
200	240	0.06	0.529	0.917	0.958	1.042	1.667
250	300	0.06	0.423	0.733	0.767	0.833	1.333
320	384	0.06	0.331	0.573	0.599	0.651	1.042
400	480	0.06	0.265	0.458	0.479	0.521	0.833
500	600	0.06	0.212	0.367	0.383	0.417	0.667
600	720	0.06	0.176	0.306	0.319	0.347	0.556
630	756	0.06	0.168	0.291	0.304	0.331	0.529
650	780	0.06	0.163	0.282	0.295	0.321	0.513
700	840	0.06	0.151	0.262	0.274	0.298	0.476
750	900	0.06	0.141	0.244	0.256	0.278	0.444
800	960	0.06	0.132	0.229	0.240	0.260	0.417
900	1080	0.06	0.118	0.204	0.213	0.231	0.370
1000	1200	0.06	0.106	0.183	0.192	0.208	0.333
1250	1500	0.06	0.085	0.147	0.153	0.167	0.267
1500	1800	0.06	0.071	0.122	0.128	0.139	0.222
1750	2100	0.06	0.060	0.105	0.110	0.119	0.190
2000	2400	0.06	0.053	0.092	0.096	0.104	0.167
2250	2700	0.06	0.047	0.081	0.085	0.093	0.148
2500	3000	0.06	0.042	0.073	0.077	0.083	0.133
3000	3600	0.06	0.035	0.061	0.064	0.069	0.111
4000	4800	0.04	0.026	0.046	0.048	0.052	0.083
4500	5400	0.04	0.024	0.041	0.043	0.046	0.074
5000	6000	0.04	0.021	0.037	0.038	0.042	0.067
5500	6600	0.04	0.019	0.033	0.035	0.038	0.061
6000	7200	0.04	0.018	0.031	0.032	0.035	0.056
6500	7800	0.04	0.016	0.028	0.029	0.032	0.051
7000	8400	0.04	0.015	0.026	0.027	0.030	0.048
7500	9000	0.04	0.014	0.024	0.026	0.028	0.044
8000	9600	0.04	0.013	0.023	0.024	0.026	0.042
8500	10200	0.04	0.012	0.022	0.023	0.025	0.039
9000	10800	0.04	0.012	0.020	0.021	0.023	0.037
9500	11400	0.04	0.011	0.019	0.020	0.022	0.035
10000	12000	0.04	0.011	0.018	0.019	0.021	0.033
11000	13200	0.04	0.010	0.017	0.017	0.019	0.030
12000	14400	0.04	0.009	0.015	0.016	0.017	0.028
12500	15000	0.04	0.008	0.015	0.015	0.017	0.027

Record Plus with add on Residual Current devices type FD , FE & FG .
Values in grey background and red font do not meet the requirements of table 41.1. Values in grey background and orange font do not meet the requirements of table 41.1 in TT systems.

I n setting Im (A)	Time setting (ms)	I_a current (A)	Max. time (s)	ZS value in at a U0 in Volts a.c. of 220	230	250	400	
0.03	inst	0.15	0.04	847	1467	1533	1667	2667
0.3	inst	1.5	0.04	84.67	147	153	167	267
	60	1.5	0.1	84.67	147	153	167	267
	150	1.5	0.2	84.67	147	153	167	267
	300	1.5	0.4	84.67	147	153	167	267
	600	1.5	0.8	84.67	147	153	167	267
1	inst	5	0.04	25.40	44.00	46.00	50.00	80.00
	60	5	0.1	25.40	44.00	46.00	50.00	80.00
	150	5	0.2	25.40	44.00	46.00	50.00	80.00
	300	5	0.4	25.40	44.00	46.00	50.00	80.00
	600	5	0.8	25.40	44.00	46.00	50.00	80.00
3	inst	15	0.04	8.47	14.67	15.33	16.67	26.67
	60	15	0.1	8.47	14.67	15.33	16.67	26.67
	150	15	0.2	8.47	14.67	15.33	16.67	26.67
	300	15	0.4	8.47	14.67	15.33	16.67	26.67
	600	15	0.8	8.47	14.67	15.33	16.67	26.67
10	inst	50	0.04	2.54	4.40	4.60	5.00	8.00
	60	50	0.1	2.54	4.40	4.60	5.00	8.00
	150	50	0.2	2.54	4.40	4.60	5.00	8.00
	300	50	0.4	2.54	4.40	4.60	5.00	8.00
	600	50	0.8	2.54	4.40	4.60	5.00	8.00

RA values in TT & T networks with add on Residual current devices type FD , FE & FG meeting EC 60364-4-41 clause 411

I n	setting in A	0.03	0.30	1	3	10
R_A	values in	1667	166.67	50	16.67	5

Disconnection times, current levels and calculated Z_S & Z'_S values for Record Plus Circuit

Breaker FE160 with SMR1 Trip nit n 25A, r 25A[1] meeting table 41.1

Short time setting Ist (x Ir)	I_a current (A)	Max. time (s)	Z_S value in TT&TN 127	TT&TN 220	TT&TN 230	TN 250	TT[2] 250	TN 400	TT[2] 400
2	60	0.10	2.117	3.667	3.833	4.167	-	6.667	-
2.5	75	0.10	1.693	2.933	3.067	3.333	-	5.333	-
3	90	0.10	1.411	2.444	2.556	2.778	-	4.444	-
4	120	0.10	1.058	1.833	1.917	2.083	-	3.333	-
5	150	0.10	0.847	1.467	1.533	1.667	-	2.667	-
6	180	0.10	0.706	1.222	1.278	1.389	-	2.222	-
8	240	0.07	0.529	0.917	0.958	1.042	1.042	1.667	1.667
10	300	0.07	0.423	0.733	0.767	0.833	0.833	1.333	1.333
12	360	0.07	0.353	0.611	0.639	0.694	0.694	1.111	1.111
13	385	0.04	0.330	0.571	0.597	0.649	0.649	1.039	1.039

Breaker FE160 with SMR1 trip unit n 63A. r 32A[1] meeting table 41.1

Short time setting Ist (x Ir)	I_a current (A)	Max. time (s)	Z_S value in TT&TN 127	TT&TN 220	TT&TN 230	TN 250	TT[2] 250	TN 400	TT[2] 400
2	77	0.10	1.654	2.865	2.995	3.255	-	5.208	-
2.5	96	0.10	1.323	2.292	2.396	2.604	-	4.167	-
3	115	0.10	1.102	1.910	1.997	2.170	-	3.472	-
4	154	0.10	0.827	1.432	1.497	1.628	-	2.604	-
5	192	0.10	0.661	1.146	1.198	1.302	-	2.083	-
6	230	0.10	0.551	0.955	0.998	1.085	-	1.736	-
8	307	0.07	0.413	0.716	0.749	0.814	0.814	1.302	1.302
10	384	0.07	0.331	0.573	0.599	0.651	0.651	1.042	1.042
12	461	0.07	0.276	0.477	0.499	0.543	0.543	0.868	0.868
13	499	0.04	0.254	0.441	0.461	0.501	0.501	0.801	0.801

Breaker FE160 with SMR1 type trip unit n 63A, r 63A[1]
Disconnection time 1 sec. TT or 5 sec. T

Short time setting Ist (x Ir)	I_a current (A)	Max. time (s)	Z_S value in TT&TN 127	TT&TN 220	TT&TN 230	TT&TN 250	TT&TN 400	
2	151	0.10	0.840	1.455	1.521	1.653	2.646	
2.5	189	0.10	0.672	1.164	1.217	1.323	2.116	
3	227	0.10	0.560	0.970	1.014	1.102	1.764	
4	302	0.10	0.420	0.728	0.761	0.827	1.323	
			TT	TT	TT	TT	TT	
5	378	0.10	0.336	0.582	0.608	0.661	1.058	
6	454	0.10	0.280	0.485	0.507	0.551	0.882	
8	605	0.07	0.210	0.364	0.380	0.413	0.661	
10	756	0.07	0.168	0.291	0.304	0.331	0.529	
12	907	0.07	0.140	0.243	0.254	0.276	0.441	
			TN	TN	TN	TN	TN	Line
Ir 63A	378	5.000	0.336	0.582	0.608	0.661	1.058	mode

Breaker FE160 with SMR1 type trip unit n 125A, r 125A[1]
Disconnection time 1 sec. TT or 5 sec. T

Short time setting Ist (x Ir)	I_a current (A)	Max. time (s)	Z_S value in TT&TN 127	TT&TN 220	TT&TN 230	TT&TN 250	TT&TN 400	
2	300	0.20	0.423	0.733	0.767	0.833	1.333	
2.5	375	0.20	0.339	0.587	0.613	0.667	1.067	
3	450	0.20	0.282	0.489	0.511	0.556	0.889	
4	600	0.20	0.212	0.367	0.383	0.417	0.667	
			TT	TT	TT	TT	TT	
5	750	0.10	0.169	0.293	0.307	0.333	0.533	
6	900	0.10	0.141	0.244	0.256	0.278	0.444	
8	1200	0.10	0.106	0.183	0.192	0.208	0.333	
10	1500	0.10	0.085	0.147	0.153	0.167	0.267	
12	1800	0.07	0.071	0.122	0.128	0.139	0.222	
			TN	TN	TN	TN	TN	Line
Ir 125A	750	5.000	0.169	0.293	0.307	0.333	0.533	mode

Breaker FE160 with SMR1 type trip unit n 160A, r 160A[1]
Disconnection time 1 sec. TT or 5 sec. T

Short time setting Ist (x Ir)	I_a current (A)	Max. time (s)	Z_S value in TT&TN 127	TT&TN 220	TT&TN 230	TT&TN 250	TT&TN 400	
2	384	0.20	0.331	0.573	0.599	0.444	1.042	
2.5	480	0.20	0.265	0.458	0.479	0.444	0.833	
3	576	0.20	0.220	0.382	0.399	0.444	0.694	
4	768	0.20	0.165	0.286	0.299	0.444	0.521	
			TT	TT	TT	TT	TT	
5	960	0.10	0.132	0.229	0.240	0.444	0.417	
6	1152	0.10	0.110	0.191	0.200	0.444	0.347	
8	1536	0.10	0.083	0.143	0.150	0.444	0.260	
10	1920	0.10	0.066	0.115	0.120	0.444	0.208	
12	2304	0.07	0.055	0.095	0.100	0.444	0.174	
			TN	TN	TN	TN	TN	Line
Ir 160A	960	5.000	0.132	0.229	0.240	0.260	0.417	mode

(1) For other settings please refer to table:
Multiplication factors for Z_S values on page E.13

(2) In IT systems the lowest Z_S setting can also be used for Ist settings lower than 8 x Ir

Breaker FE250 with SMR1 type trip unit n 125A, r 125A[1]
Disconnection time 1 sec. TT or 5 sec. T

Short time setting Ist (x Ir)	I_a current (A)	Max. time (s)	Z_S value in TT&TN 127	TT&TN 220	TT&TN 230	TT&TN 250	TT&TN 400	
2	300	0.20	0.423	0.733	0.767	0.833	1.333	
2.5	375	0.20	0.339	0.587	0.613	0.667	1.067	
3	450	0.20	0.282	0.489	0.511	0.556	0.889	
4	600	0.20	0.212	0.367	0.383	0.417	0.667	
5	750	0.20	0.169	0.293	0.307	0.333	0.533	
			TT	TT	TT	TT	TT	
6	900	0.20	0.141	0.244	0.256	0.278	0.444	
8	1200	0.10	0.106	0.183	0.192	0.208	0.333	
10	1500	0.10	0.085	0.147	0.153	0.167	0.267	
12	1800	0.10	0.071	0.122	0.128	0.139	0.222	
			TN	TN	TN	TN	TN	Line
Ir 125A	750	5.000	0.169	0.293	0.307	0.333	0.533	mode

Breaker FE250 with SMR1 type trip unit n 160A, r 160A[1]
Disconnection time 1 sec. TT or 5 sec. T

Short time setting Ist (x Ir)	I_a current (A)	Max. time (s)	Z_S value in TT&TN 127	TT&TN 220	TT&TN 230	TT&TN 250	TT&TN 400	
2	384	0.13	0.331	0.573	0.599	0.651	1.042	
2.5	480	0.13	0.265	0.458	0.479	0.521	0.833	
3	576	0.13	0.220	0.382	0.399	0.434	0.694	
4	768	0.13	0.165	0.286	0.299	0.326	0.521	
			TT	TT	TT	TT	TT	
5	960	0.12	0.132	0.229	0.240	0.260	0.417	
6	1152	0.12	0.110	0.191	0.200	0.217	0.347	
8	1536	0.10	0.083	0.143	0.150	0.163	0.260	
10	1920	0.10	0.066	0.115	0.120	0.130	0.208	
12	2304	0.10	0.055	0.095	0.100	0.109	0.174	
			TN	TN	TN	TN	TN	Line
Ir 160A	960	5.000	0.132	0.229	0.240	0.260	0.417	mode

Breaker FE250 or FG400 with SMR1 type trip unit n 250A, r 250A[1]
Disconnection time 1 sec. TT or 5 sec. T

Short time setting Ist (x Ir)	I_a current (A)	Max. time (s)	Z_S value in TT&TN 127	TT&TN 220	TT&TN 230	TT&TN 250	TT&TN 400	
2	600	0.18	0.212	0.367	0.383	0.417	0.667	
2.5	750	0.18	0.169	0.293	0.307	0.333	0.533	
3	900	0.18	0.141	0.244	0.256	0.278	0.444	
4	1200	0.18	0.106	0.183	0.192	0.208	0.333	
			TT	TT	TT	TT	TT	
5	1500	0.15	0.085	0.147	0.153	0.167	0.267	
6	1800	0.15	0.071	0.122	0.128	0.139	0.222	
8	2400	0.13	0.053	0.092	0.096	0.104	0.167	
10	3000	0.13	0.042	0.073	0.077	0.083	0.133	
12	3600	0.13	0.035	0.061	0.064	0.069	0.111	
			TN	TN	TN	TN	TN	Line
Ir 250A	1500	5.000	0.085	0.147	0.153	0.167	0.267	mode

Breaker FG400 with SMR1 type trip unit n 400A, r 400A[1]
Disconnection time 1 sec. TT or 5 sec. T

Short time setting Ist (x Ir)	I_a current (A)	Max. time (s)	Z_S value in TT&TN 127	TT&TN 220	TT&TN 230	TT&TN 250	TT&TN 400	
2	960	0.18	0.132	0.229	0.240	0.260	0.417	
2.5	1200	0.18	0.106	0.183	0.192	0.208	0.333	
3	1440	0.18	0.088	0.153	0.160	0.174	0.278	
4	1920	0.18	0.066	0.115	0.120	0.130	0.208	
			TT	TT	TT	TT	TT	
5	2400	0.15	0.053	0.092	0.096	0.104	0.167	
6	2880	0.15	0.044	0.076	0.080	0.087	0.139	
8	3840	0.13	0.033	0.057	0.060	0.065	0.104	
10	4800	0.13	0.026	0.046	0.048	0.052	0.083	
12	5760	0.13	0.022	0.038	0.040	0.043	0.069	
			TN	TN	TN	TN	TN	Line
Ir 400A	2400	5.000	0.053	0.092	0.096	0.104	0.167	mode

Breaker FG630 with SMR1 type trip unit n 630A, r 630A[1]
Disconnection time 1 sec. TT or 5 sec. T

Short time setting Ist (x Ir)	I_a current (A)	Max. time (s)	Z_S value in TT&TN 127	TT&TN 220	TT&TN 230	TT&TN 250	TT&TN 400	
2	1512	0.20	0.084	0.146	0.152	0.165	0.265	
2.5	1890	0.20	0.067	0.116	0.122	0.132	0.212	
3	2268	0.20	0.056	0.097	0.101	0.110	0.176	
4	3024	0.20	0.042	0.073	0.076	0.083	0.132	
			TT	TT	TT	TT	TT	
5	3780	0.19	0.034	0.058	0.061	0.066	0.106	
6	4536	0.19	0.028	0.049	0.051	0.055	0.088	
8	6048	0.15	0.021	0.036	0.038	0.041	0.066	
10	7623	0.03	0.017	0.029	0.030	0.033	0.052	
			TN	TN	TN	TN	TN	Line
Ir 630A	3780	5.000	0.034	0.058	0.061	0.066	0.106	mode

Breakers meeting IEC 60364-4-41 clause 411 and table 41.1

Breaker FG400 with SMR2 type trip unit n 400A, r 250A [1]
Disconnection time 1 sec. TT or 5 sec. T

Short time setting Ist (x Ir)	I_a current (A)	Max. time (s)	Z_S value in at a U_0 in Volts a.c. of 127	220	230	250	400	
			TT&TN	TT&TN	TT&TN	TT&TN	TT&TN	
2	600	0.50	0.212	0.367	0.383	0.417	0.667	
2.5	750	0.50	0.169	0.293	0.307	0.333	0.533	
3	900	0.50	0.141	0.244	0.256	0.278	0.444	
			TT	TT	TT	TT	TT	
4	1200	0.50	0.106	0.183	0.192	0.208	0.333	
5	1500	0.50	0.085	0.147	0.153	0.167	0.267	
6	1800	0.50	0.071	0.122	0.128	0.139	0.222	
8	2400	0.50	0.053	0.092	0.096	0.104	0.167	
10	3000	0.50	0.042	0.073	0.077	0.083	0.133	
12	3600	0.50	0.035	0.061	0.064	0.069	0.111	
			TN	TN	TN	TN	TN	
Ir 250A	900	5.000	0.141	0.244	0.256	0.278	0.444	Class 1.25
	1350	5.000	0.094	0.163	0.170	0.185	0.296	Class 2.5
	1800	5.000	0.071	0.122	0.128	0.139	0.222	Class 5

Breaker FG400 with SMR2 type trip unit n 400A, r 400A [1]
Disconnection time 1 sec. TT or 5 sec. T

Short time setting Ist (x Ir)	I_a current (A)	Max. time (s)	Z_S value in at a U_0 in Volts a.c. of 127	220	230	250	400	
			TT&TN	TT&TN	TT&TN	TT&TN	TT&TN	
2	960	0.50	0.132	0.229	0.240	0.260	0.417	
2.5	1200	0.50	0.106	0.183	0.192	0.208	0.333	
3	1440	0.50	0.088	0.153	0.160	0.174	0.278	
			TT	TT	TT	TT	TT	
4	1920	0.50	0.066	0.115	0.120	0.130	0.208	
5	2400	0.50	0.053	0.092	0.096	0.104	0.167	
6	2880	0.50	0.044	0.076	0.080	0.087	0.139	
8	3840	0.50	0.033	0.057	0.060	0.065	0.104	
10	4800	0.50	0.026	0.046	0.048	0.052	0.083	
12	5760	0.50	0.022	0.038	0.040	0.043	0.069	
			TN	TN	TN	TN	TN	
Ir 400A	1440	5.000	0.088	0.153	0.160	0.174	0.278	Class 1.25
	2160	5.000	0.059	0.102	0.106	0.116	0.185	Class 2.5
	2880	5.000	0.044	0.076	0.080	0.087	0.139	Class 5

Breaker FG630 with SMR2 type trip unit n 630A, r 630A [1]
Disconnection time 1 sec. TT or 5 sec. T

Short time setting Ist (x Ir)	I_a current (A)	Max. time (s)	Z_S value in at a U_0 in Volts a.c. of 127	220	230	250	400	
			TT&TN	TT&TN	TT&TN	TT&TN	TT&TN	
2	1512	0.50	0.084	0.146	0.152	0.165	0.265	
2.5	1890	0.50	0.067	0.116	0.122	0.132	0.212	
3	2268	0.50	0.056	0.097	0.101	0.110	0.176	
			TT	TT	TT	TT	TT	
4	3024	0.50	0.042	0.073	0.076	0.083	0.132	
5	3780	0.50	0.034	0.058	0.061	0.066	0.106	
6	4536	0.50	0.028	0.049	0.051	0.055	0.088	
8	6048	0.50	0.021	0.036	0.038	0.041	0.066	
10	7560	0.50	0.017	0.029	0.030	0.033	0.053	
12	9072	0.50	0.014	0.024	0.025	0.028	0.044	
			TN	TN	TN	TN	TN	
Ir 630A	2268	5.000	0.056	0.097	0.101	0.110	0.176	Class 1.25
	3402	5.000	0.037	0.065	0.068	0.073	0.118	Class 2.5
	4536	5.000	0.028	0.049	0.051	0.055	0.088	Class 5

Breaker FK800 with SMR1e or 1s type trip unit n 800A, r 800A [1]
Disconnection time 1 sec. TT or 5 sec. T

Short time setting Ist (x Ir)	I_a current (A)	Max. time (s)	Z_S value in at a U_0 in Volts a.c. of 127	220	230	250	400	
			TT&TN	TT&TN	TT&TN	TT&TN	TT&TN	
1.5	1440	0.40	0.088	0.153	0.160	0.174	0.278	
2	1920	0.40	0.066	0.115	0.120	0.130	0.208	
2.5	2400	0.40	0.053	0.092	0.096	0.104	0.167	
3	2880	0.40	0.044	0.076	0.080	0.087	0.139	
4	3840	0.40	0.033	0.057	0.060	0.065	0.104	
5	4800	0.40	0.026	0.046	0.048	0.052	0.083	
6	5760	0.40	0.022	0.038	0.040	0.043	0.069	
			TT	TT	TT	TT	TT	
8	7680	0.40	0.017	0.029	0.030	0.033	0.052	
10	9600	0.40	0.013	0.023	0.024	0.026	0.042	
			TN	TN	TN	TN	TN	
Ir 800A	5760	5.000	0.022	0.038	0.040	0.043	0.069	SMR1e
	5760	5.000	0.022	0.038	0.040	0.043	0.069	SMR1s class 5

Breaker FK1250 with SMR1e or 1s type trip unit n 1000A, r 1000A [1]
Disconnection time 1 sec. TT or 5 sec. T

Short time setting Ist (x Ir)	I_a current (A)	Max. time (s)	Z_S value in at a U_0 in Volts a.c. of 127	220	230	250	400	
			TT&TN	TT&TN	TT&TN	TT&TN	TT&TN	
1.5	1800	0.40	0.071	0.122	0.128	0.139	0.222	
2	2400	0.40	0.053	0.092	0.096	0.104	0.167	
2.5	3000	0.40	0.042	0.073	0.077	0.083	0.133	
3	3600	0.40	0.035	0.061	0.064	0.069	0.111	
4	4800	0.40	0.026	0.046	0.048	0.052	0.083	
5	6000	0.40	0.021	0.037	0.038	0.042	0.067	
6	7200	0.40	0.018	0.031	0.032	0.035	0.056	
			TT	TT	TT	TT	TT	
8	9600	0.40	0.013	0.023	0.024	0.026	0.042	
10	12000	0.40	0.011	0.018	0.019	0.021	0.033	
			TN	TN	TN	TN	TN	
Ir 1000A	7200	5.000	0.018	0.031	0.032	0.035	0.056	SMR1e
	7200	5.000	0.018	0.031	0.032	0.035	0.056	SMR1s class 5

Breaker FK1250 with SMR1e or 1s type trip unit n 1000A, r 1000A [1]
Disconnection time 1 sec. TT or 5 sec. T

Short time setting Ist (x Ir)	I_a current (A)	Max. time (s)	Z_S value in at a U_0 in Volts a.c. of 127	220	230	250	400	
			TT&TN	TT&TN	TT&TN	TT&TN	TT&TN	
1.5	2250	0.40	0.056	0.098	0.102	0.111	0.178	
2	3000	0.40	0.042	0.073	0.077	0.083	0.133	
2.5	3750	0.40	0.034	0.059	0.061	0.067	0.107	
3	4500	0.40	0.028	0.049	0.051	0.056	0.089	
4	6000	0.40	0.021	0.037	0.038	0.042	0.067	
5	7500	0.40	0.017	0.029	0.031	0.033	0.053	
6	9000	0.40	0.014	0.024	0.026	0.028	0.044	
			TT	TT	TT	TT	TT	
8	12000	0.40	0.011	0.018	0.019	0.021	0.033	
10	15000	0.40	0.008	0.015	0.015	0.017	0.027	
			TN	TN	TN	TN	TN	
Ir 1250A	9000	5.000	0.014	0.024	0.026	0.028	0.044	SMR1e
	9000	5.000	0.014	0.024	0.026	0.028	0.044	SMR1s class 5

Breaker FK1600 with SMR1e or 1s type trip unit n 1600A, r 1600A [1]
Disconnection time 1 sec. TT or 5 sec. T

Short time setting Ist (x Ir)	I_a current (A)	Max. time (s)	Z_S value in at a U_0 in Volts a.c. of 127	220	230	250	400	
			TT&TN	TT&TN	TT&TN	TT&TN	TT&TN	
1.5	2880	0.40	0.044	0.076	0.080	0.087	0.139	
2	3840	0.40	0.033	0.057	0.060	0.065	0.104	
2.5	4800	0.40	0.026	0.046	0.048	0.052	0.083	
3	5760	0.40	0.022	0.038	0.040	0.043	0.069	
4	7680	0.40	0.017	0.029	0.030	0.033	0.052	
5	9600	0.40	0.013	0.023	0.024	0.026	0.042	
6	11520	0.40	0.011	0.019	0.020	0.022	0.035	
			TT	TT	TT	TT	TT	
8	15360	0.40	0.008	0.014	0.015	0.016	0.026	
10	19200	0.40	0.007	0.011	0.012	0.013	0.021	
			TN	TN	TN	TN	TN	
Ir 1600A	11520	5.000	0.011	0.019	0.020	0.022	0.035	SMR1e
	11520	5.000	0.011	0.019	0.020	0.022	0.035	SMR1s class 5

Multiplcation factors for $_S$ values applicable for T settings r.

	For Rating Plugs Ie 0.64 x breaker In							
Setting x Ie	0.625	0.650	0.675	0.700	0.725	0.750	0.775	0.800
Factor for Z_S	2.50	2.40	2.31	2.23	2.16	2.08	2.02	1.95
Setting x Ie	0.825	0.850	0.875	0.900	0.925	0.950	0.975	1.000
Factor for Z_S	1.89	1.84	1.79	1.74	1.69	1.64	1.60	1.56
	For Rating Plugs Ie 1 x breaker In							
Setting x In	0.625	0.650	0.675	0.700	0.725	0.750	0.775	0.800
Factor for Z_S	1.60	1.54	1.48	1.43	1.38	1.33	1.29	1.25
Setting x Ir	0.825	0.850	0.875	0.900	0.925	0.950	0.975	1.000
Factor for Z_S	1.21	1.18	1.14	1.11	1.08	1.05	1.03	1.00
	FK frame types with trip units types SMR1e s & g							
Setting x In	0.40	0.50	0.60	0.70	0.80	0.90	0.95	1.00
Factor for Z_S	2.50	2.00	1.67	1.43	1.25	1.11	1.05	1.00

Disconnection times, current levels and calculated Z_S & Z'_S values for Record Plus Circuit Breakers meeting IEC 60364-4-41 clause 411 and table 41.1

Breaker FG400 with SMR2 type trip unit n 250A with Groundfault sum. Disconnection time 1 sec. TT & T

GF sum setting (Id) (x In)	I_a current (A)	Max. time (s)	Z_S value in at a U_0 in Volts a.c. of				
			127	220	230	250	400
			TT&TN	TT&TN	TT&TN	TT&TN	TT&TN
0.2	60	0.50	2.117	3.667	3.833	4.167	6.667
0.25	75	0.50	1.693	2.933	3.067	3.333	5.333
0.3	90	0.50	1.411	2.444	2.556	2.778	4.444
0.4	120	0.50	1.058	1.833	1.917	2.083	3.333
0.5	150	0.50	0.847	1.467	1.533	1.667	2.667
0.6	180	0.50	0.706	1.222	1.278	1.389	2.222
0.7	210	0.50	0.605	1.048	1.095	1.190	1.905
0.8	240	0.50	0.529	0.917	0.958	1.042	1.667

Breaker FG400 & FG630 with SMR2 type trip unit n 400A with Groundfault sum. Disconnection time 1 sec. TT & T

GF sum setting (Id) (x In)	I_a current (A)	Max. time (s)	Z_S value in at a U_0 in Volts a.c. of				
			127	220	230	250	400
			TT&TN	TT&TN	TT&TN	TT&TN	TT&TN
0.2	96	0.50	1.323	2.292	2.396	2.604	4.167
0.25	120	0.50	1.058	1.833	1.917	2.083	3.333
0.3	144	0.50	0.882	1.528	1.597	1.736	2.778
0.4	192	0.50	0.661	1.146	1.198	1.302	2.083
0.5	240	0.50	0.529	0.917	0.958	1.042	1.667
0.6	288	0.50	0.441	0.764	0.799	0.868	1.389
0.7	336	0.50	0.378	0.655	0.685	0.744	1.190
0.8	384	0.50	0.331	0.573	0.599	0.651	1.042

Breaker FG630 with SMR2 type trip unit n 630A with Groundfault sum. Disconnection time 1 sec. TT & T

GF sum setting (Id) (x In)	I_a current (A)	Max. time (s)	Z_S value in at a U_0 in Volts a.c. of				
			127	220	230	250	400
			TT&TN	TT&TN	TT&TN	TT&TN	TT&TN
0.2	151	0.50	0.840	1.455	1.521	1.653	2.646
0.25	189	0.50	0.672	1.164	1.217	1.323	2.116
0.3	227	0.50	0.560	0.970	1.014	1.102	1.764
0.4	302	0.50	0.420	0.728	0.761	0.827	1.323
0.5	378	0.50	0.336	0.582	0.608	0.661	1.058
0.6	454	0.50	0.280	0.485	0.507	0.551	0.882
0.7	529	0.50	0.240	0.416	0.435	0.472	0.756
0.8	605	0.50	0.210	0.364	0.380	0.413	0.661

Breaker FG630 with SMR2 type trip unit n 630A with Groundfault sum. Disconnection time 1 sec. TT & T

GF sum setting (Id) (x In)	I_a current (A)	Max. time (s)	Z_S value in at a U_0 in Volts a.c. of				
			127	220	230	250	400
			TT&TN	TT&TN	TT&TN	TT&TN	TT&TN
0.2	96	0.50	1.323	2.292	2.396	2.604	4.167
0.25	120	0.50	1.058	1.833	1.917	2.083	3.333
0.3	144	0.50	0.882	1.528	1.597	1.736	2.778
0.4	192	0.50	0.661	1.146	1.198	1.302	2.083
0.5	240	0.50	0.529	0.917	0.958	1.042	1.667
0.6	288	0.50	0.441	0.764	0.799	0.868	1.389
0.7	336	0.50	0.378	0.655	0.685	0.744	1.190
0.8	384	0.50	0.331	0.573	0.599	0.651	1.042

Breaker FK800 with SMR2 type trip unit n 800A with Groundfault sum. Disconnection time 1 sec. TT & T

GF sum setting (Id) (x In)	I_a current (A)	Max. time (s)	Z_S value in at a U_0 in Volts a.c. of				
			127	220	230	250	400
			TT&TN	TT&TN	TT&TN	TT&TN	TT&TN
0.2	192	0.60	0.661	1.146	1.198	1.302	2.083
0.3	288	0.60	0.441	0.764	0.799	0.868	1.389
0.4	384	0.60	0.331	0.573	0.599	0.651	1.042
0.5	480	0.60	0.265	0.458	0.479	0.521	0.833
0.6	576	0.60	0.220	0.382	0.399	0.434	0.694
0.6	576	0.60	0.220	0.382	0.399	0.434	0.694
0.8	768	0.60	0.165	0.286	0.299	0.326	0.521
1.0	960	0.60	0.132	0.229	0.240	0.260	0.417

Breaker FK1250 with SMR2 type trip unit n 1000A with Groundfault sum. Disconnection time 1 sec. TT & T

GF sum setting (Id) (x In)	I_a current (A)	Max. time (s)	Z_S value in at a U_0 in Volts a.c. of				
			127	220	230	250	400
			TT&TN	TT&TN	TT&TN	TT&TN	TT&TN
0.2	240	0.60	0.529	0.917	0.958	1.042	1.667
0.3	360	0.60	0.353	0.611	0.639	0.694	1.111
0.4	480	0.60	0.265	0.458	0.479	0.521	0.833
0.5	600	0.60	0.212	0.367	0.383	0.417	0.667
0.6	720	0.60	0.176	0.306	0.319	0.347	0.556
0.6	720	0.60	0.176	0.306	0.319	0.347	0.556
0.8	960	0.60	0.132	0.229	0.240	0.260	0.417
1.0	1200	0.60	0.106	0.183	0.192	0.208	0.333

Breaker FK1250 with SMR2 type trip unit n 1250A with Groundfault sum. Disconnection time 1 sec. TT & T

GF sum setting (Id) (x In)	I_a current (A)	Max. time (s)	Z_S value in at a U_0 in Volts a.c. of				
			127	220	230	250	400
			TT&TN	TT&TN	TT&TN	TT&TN	TT&TN
0.2	300	0.60	0.423	0.733	0.767	0.833	1.333
0.3	450	0.60	0.282	0.489	0.511	0.556	0.889
0.4	600	0.60	0.212	0.367	0.383	0.417	0.667
0.5	750	0.60	0.169	0.293	0.307	0.333	0.533
0.6	900	0.60	0.141	0.244	0.256	0.278	0.444
0.6	900	0.60	0.141	0.244	0.256	0.278	0.444
0.8	1200	0.60	0.106	0.183	0.192	0.208	0.333
1.0	1500	0.60	0.085	0.147	0.153	0.167	0.267

Breaker Fk1600 with SMR2 type trip unit n 1600A with Groundfault sum. Disconnection time 1 sec. TT & T

GF sum setting (Id) (x In)	I_a current (A)	Max. time (s)	Z_S value in at a U_0 in Volts a.c. of				
			127	220	230	250	400
			TT&TN	TT&TN	TT&TN	TT&TN	TT&TN
0.2	384	0.60	0.331	0.573	0.599	0.651	1.042
0.3	576	0.60	0.220	0.382	0.399	0.434	0.694
0.4	768	0.60	0.165	0.286	0.299	0.326	0.521
0.5	960	0.60	0.132	0.229	0.240	0.260	0.417
0.6	1152	0.60	0.110	0.191	0.200	0.217	0.347
0.6	1152	0.60	0.110	0.191	0.200	0.217	0.347
0.8	1536	0.60	0.083	0.143	0.150	0.163	0.260
1.0	1920	0.60	0.066	0.115	0.120	0.130	0.208

otes

Selectivity/Discrimination

Fig. 1 depicts a typical distribution network. Here outgoing circuits are designed for the current load and the characteristics of the equipment within the circuit. Outgoing circuits that protect a certain area are placed together in panels or form groups within panels. Typically this group of circuits is protected by a second, similar device, the characteristics of which are determined in the same manner. This system can be extended to a multiple level distribution network.
In case of a fault it is necessary that the device nearest to the fault reacts while all others remain closed.
This capability is called discrimination (UK) or selectivity (USA and Europe). If this requirement is not met, a fault (F) in one arm of the distribution system will cause a number of upstream protection devices wired in series to trip. Thus a minor fault in a socket outlet of a circuit can cause whole floors, buildings or building complexes to be cut off from the power supply.

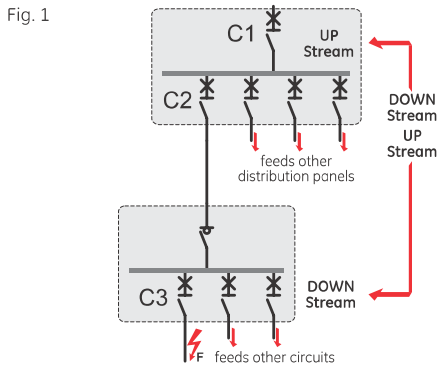
Record Plus breakers are specifically designed to discriminate. By introducing ***Record Plus*** . GE sets a new standard in circuit breakers by offering total selectivity for all normally proportioned distribution systems.

EN 60947-2 amendment 1, app. A defines under Coordination that discrimination/selectivity may be partial up to a pre-defined current limit (Is).
Discrimination is considered total when the current limit is equal to the rated short-circuit breaking capacity (Icu or Ics) of the downstream device.
Discrimination/Selectivity is determined by comparing the time it takes an upstream device to react at a specific current value and - again - comparing this to the time it takes a downstream device to clear the fault at the same current level. (see Fig. 2) The comparison of these two time spans can be used to define whether discrimination is present or not.
We have simplified this comparison by applying a multiplication factor between downstream and upstream devices. With the values indicated in the table we can guarantee discrimination.
(see page E.15)

Selectivity Plus

Record Plus circuit breakers limit the electrical energy and peak current of a short-circuit event extremely effectively and limit the time span involved to the utter minimum.
The downstream breaker limits the magnitude of the fault so effectivley that the upstream, time delayed, Record Plus breaker is only exposed to a relativley low level short-circuit current that does not trip the breaker.
Fig.3 depicts this three dimensional selectivity technique that allows for the selective interruption of a short-circuit event making use of all the events parameters **Current**, **Energy** and **Time**.

Fig. 1



ON fault F : C3 reacts only: 1 circuit without power
C2 C3 react: Multiple circuits without power
C1 C2 C3 react: Multiple panels containing Multiple circuits without power

Fig. 2

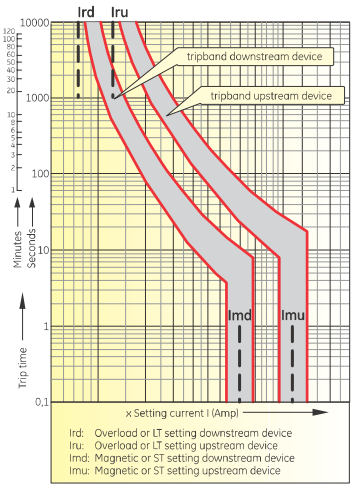
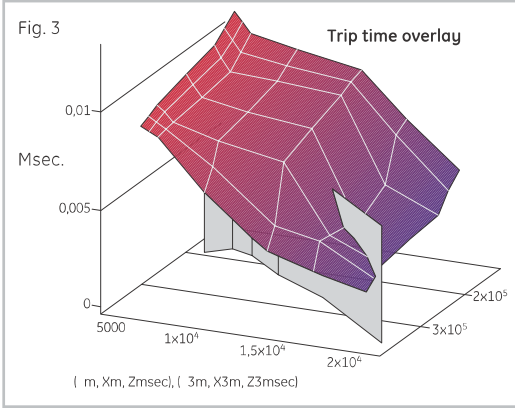


Fig. 3



How to determine discrimination/ selectivity with Record Plus™ (and associated devices)

Table D1 to D5 (page E.18 to E.21) indicate the discrimination levels that can be achieved with ***Record Plus*** and associated devices. Where discrimination is partial the selectivity limits in kA (Is) are mentioned in kA.
Where a T is found in the tables, this indicates total discrimination up to the highest breaking capacity of the devices at a voltage of 400/415V.
These discrimination/selectivity limits are only valid if the ratio between the current settings, ratings or time settings of the upstream and downstream breaker are equal or higher than the factor indicated here.

Selectivity/Discrimination

Downstream device		Upstream device		
		Record Plus MCCB		
		LTM or LTMD	SMR1 1e 1s or 1g	SMR2
Redline & Hti MCB	B, C D curve	**Ir** factor 1.6 **Im** factor 2	**Ir** factor 2 **Ist** factor 1.5	**Ir** factor 1.6 **Ist** factor 1.5
Surion Manual Motor Starter	Thermal mag or Mag. Only	**Ir** factor 3 **Im** factor 3	**Ir** factor 2 **Ist** factor 1.5	**Ir** factor 1.6 **Ist** factor 1.5
Record Plus **MCCB**	LTM or LTMD	**Ir** factor 1.6 **Im** factor 1.5	**Ir** factor 2 **Ist** factor 1.5	**Ir** factor 1.6 **Ist** factor 1.5
	SMR1	**Ir** factor 1.6 **Im** factor 1.5	**Ir** factor 1.6 **Ist** factor 1.5	**Ir** factor 1.6 **Ist** factor 1.5
			SMR1 1e 1s or 1g	**SMR2**
Record Plus **MCCB**	SMR1s SMR2		**Ir** factor 1.6 **LTD** set at one class higher **Ist** factor 1.5 **STD** Set at one band higher	**Ir** factor 1.6 **LTD** set at one class higher **IIst** factor 1.5 **STD** Set at one band higher Inst. factor 1.5 **A^2S** Set at one band higher
		EntelliGuard™ Power Circuit Breaker		
			GTU E S N or H I OFF	**GTU E S N or H I ON**
Record Plus **MCCB**	SMR1		**Ir** factor 1.5 **Ist** factor 1.4 **STD** timing 0.2	**Ir** factor 1.5 **LTD** Class 20 **Ist** factor 1.4 **STD** timing 0.2 **Iinst** set at (1)
Record Plus **MCCB**	SMR1s SMR2		**Ir** factor 1.5 **Ist** factor 1.4 **STD** Set at one band higher	**Ir** factor 1.5 **LTD** set at one class higher **Ist** factor 1.4 **STD** Set at one band higher **Iinst** set at (1)

LTD set at class 20

Terminology		
LTM	**Thermal magnetic Trip Unit**	
	Ir Overload setting	**Im** Magnetic setting
LTMD	**Selective Thermal magnetic Trip Unit**	
	Ir Overload setting	**Im** Magnetic setting
Mag. Break™	**Magnetic Only Trip Unit**	
	Im Magnetic setting	
SMR1 & SMR1e	**Selective Electronic Trip unit**	
	Ir Setting on **LT** device	**Ist** Setting on **ST** device
SMR1s g and SMR2 MPRO 17 20 30 & 40	**Enhanced Electronic Trip unit** **Mpact Electronic Trip Units**	
	Ir Setting on **LT** device	**Ist** Setting on **ST** device
	LTD class, time setting at 7.2 x Ir	**STD** Delay setting on ST device **A^2S** Cropped short time device delay setting **Inst.** Setting on I (**Instantaneous**) device

(1) 5kA - FD160
7kA - FE160
9kA - FE250
14kA - FG400
18kA - FG630

Table D1 - Selectivity/Discrimination

Upstream / Downstream	In(A)	Record Plus type																	
		FDC & FDE 160 LTM						FDS 160 LTMD						FDN H & L 160 LTMD					
		40	50	63	80	100	125 160	40	50	63	80	100	125 160	40	50	63	80	100	125 160
		Selectivity limit in kA*																	
Redline	**16**	0.6	2.5	T	T	T	T	T	T	T	T	T	T	T	T	T	T	T	T
EPC 30	**20**	0.6	2.5	3	T	T	T	T	T	T	T	T	T	T	T	T	T	T	T
G30	**25**	-	0.8	1.2	T	T	T	1.6	3.5	T	T	T	T	1.6	3.5	T	T	T	T
B/C curve	**32**	-	-	1.2	3	T	T	-	-	T	T	T	T	-	-	T	T	T	T
	40	-	-	-	3	T	T	-	-	T	T	T	T	-	-	T	T	T	T
Redline	**16**	0.6	2.5	T	T	T	T	T	T	T	T	T	T	T	T	T	T	T	T
EPC 45	**20**	0.6	2.5	3	T	T	T	3.5	T	T	T	T	T	3.5	T	T	T	T	T
G45	**25**	-	0.8	1.2	T	T	T	1.6	3.5	T	T	T	T	1.6	3.5	T	T	T	T
B/C curve	**32**	-	-	1.2	3	T	T	-	-	T	T	T	T	-	-	T	T	T	T
	40	-	-	-	3	4	T	-	-	-	T	T	T	-	-	-	T	T	T
Redline	**16**	0.6	2.5	6	6	T	T	T	T	T	T	T	T	T	T	T	T	T	T
EPC 60	**20**	0.6	2.5	3	6	T	T	3.5	T	T	T	T	T	3.5	T	T	T	T	T
DME60	**25**	-	0.8	1.2	6	6	T	1.6	3.5	T	T	T	T	1.6	3.5	T	T	T	T
B/C curve	**32**	-	-	1.2	3	6	T	-	-	T	T	T	T	-	-	T	T	T	T
	40	-	-	-	3	4	6	-	-	-	T	T	T	-	-	-	T	T	T
Redline	**16**	0.6	2.5	6	6	T	T	T	T	T	T	T	T	T	T	T	T	T	T
DM DMT60	**20**	0.6	2.5	3	6	8	T	3.5	T	T	T	T	T	3.5	T	T	T	T	T
DM DMT100	**25**	-	0.8	1.2	6	6	T	1.6	3.5	T	T	T	T	1.6	3.5	T	T	T	T
B/C curve	**32**	-	-	1.2	3	6	8	-	-	10	T	T	T	-	-	10	T	T	T
	40	-	-	-	3	4	6	-	-	-	T	T	T	-	-	-	T	T	T
	50	-	-	-	1.2	1.5	6	-	-	-	3.5	T	T	-	-	-	3.5	T	T
	63	-	-	-	-	1.5	2	-	-	-	-	8	T	-	-	-	-	8	T
Redline	**16**	0.6	2.5	6	6	10	T	10	10	T	T	T	T	10	10	T	T	T	T
G60	**20**	0.6	2.5	3	6	8	T	3.5	10	T	T	T	T	3.5	10	T	T	T	T
DME100	**25**	-	0.8	1.2	6	6	T	1.6	3.5	T	T	T	T	1.6	3.5	T	T	T	T
B/C curve	**32**	-	-	1.2	3	6	8	-	-	10	10	T	T	-	-	10	10	T	T
	40	-	-	-	3	4	6	-	-	-	10	T	T	-	-	-	10	T	T
	50	-	-	-	1.2	1.5	6	-	-	-	3.5	10	T	-	-	-	3.5	10	T
	63	-	-	-	-	1.5	2	-	-	-	-	8	T	-	-	-	-	8	T
Redline	**16**	0.6	2.5	6	6	10	T	10	10	T	T	T	T	10	10	T	T	T	T
G100 GT25	**20**	0.6	2.5	3	6	8	T	3.5	10	T	T	T	T	3.5	10	T	T	T	T
B/C curve	**25**	-	0.8	1.2	6	6	T	1.6	3.5	15	T	T	T	1.6	3.5	15	T	T	T
	32	-	-	1.2	3	6	8	-	-	10	10	T	T	-	-	10	10	T	T
	40	-	-	-	3	4	6	-	-	-	10	15	T	-	-	-	10	15	T
	50	-	-	-	1.2	1.5	6	-	-	-	3.5	10	T	-	-	-	3.5	10	T
	63	-	-	-	-	1.5	2	-	-	-	-	8	T	-	-	-	-	8	T
Redline	**80**	-	-	-	-	-	1.9	-	-	-	-	-	2.5	-	-	-	-	-	2.5
Series HTI C curve	**100**	-	-	-	-	-	1.9	-	-	-	-	-	2.5	-	-	-	-	-	2.5
Redline	**25**	-	0.8	0.9	1.2	1.5	1.9	-	1	1.2	15	15	15	-	1	1.2	15	15	15
Serie S90	**32**	-	-	0.9	1.2	1.5	1.9	-	-	1.2	15	15	15	-	-	1.2	15	15	15
	40	-	-	-	1.2	1.5	1.9	-	-	-	15	15	15	-	-	-	15	15	15
	50	-	-	-	1.2	1.5	1.9	-	-	-	15	15	15	-	-	-	15	15	15
	63	-	-	-	-	1.5	1.9	-	-	-	-	15	15	-	-	-	-	15	15
	80	-	-	-	-	-	1.9	-	-	-	-	-	15	-	-	-	-	-	15
	100	-	-	-	-	-	-	-	-	-	-	-	15	-	-	-	-	-	15
Surion	**20**	0.6	2.5	6	6	10	T	10	10	T	T	T	T	10	10	T	T	T	T
GPS1BS	**25**	-	1	1.2	6	6	T	-	3.5	15	15	T	T	-	3.5	15	15	T	T
GPS1MS	**32**	-	-	1.2	3	6	10	-	-	6	6	T	T	-	-	6	6	T	T
GPS2BS	**40**	-	-	-	3	4	6	-	-	-	6	T	T	-	-	-	6	T	T
GPS2MS	**50**	-	-	-	1.2	1.6	6	-	-	-	3.5	T	T	-	-	-	3.5	T	T
	63	-	-	-		1.6	2	-	-	-	-	8	T	-	-	-	-	8	T
Surion	**20**	T	T	T	T	T	T	T	T	T	T	T	T	T	T	T	T	T	T
GPS1BH	**25**	-	2.5	15	15	T	T	-	3.5	T	T	T	T	-	3.5	T	T	T	T
GPS1MH	**32**	-	-	6	6	8	T	-	-	T	T	T	T	-	-	T	T	T	T
GPS2BH	**40**	-	-	-	6	8	T	-	-	T	T	T	T	-	-	T	T	T	T
GPS2MH	**50**	-	-	-	-	6	T	-	-	-	3.5	T	T	-	-	-	3.5	T	T
	63	-	-	-	-	-	T	-	-	-	-	8	T	-	-	-	-	8	T
Record Plus	**25**	0.4	0.5	0.6	0.8	1	1.3	0.6	0.8	0.9	1.2	1.5	3.5	0.6	0.8	0.9	1.2	1.5	3.5
FD160E	**32**	-	0.5	0.6	0.8	1	1.3	-	0.8	0.9	1.2	1.5	3.5	-	0.8	0.9	1.2	1.5	3.5
LTM	**40**	-	-	-	0.8	1	1.3	-	-	-	1.2	1.5	3.5	-	-	-	1.2	1.5	3.5
	50	-	-	-	0.8	1	1.3	-	-	-	1.2	1.5	3.5	-	-	-	1.2	1.5	3.5
	63	-	-	-	-	1	1.3	-	-	-	-	1.5	3.5	-	-	-	-	1.5	3.5
	80	-	-	-	-	-	1.3	-	-	-	-	-	3.5	-	-	-	-	-	3.5

Where T is mentioned Selectivity is full up until the Icu of the downstream device
Remark For MCB s with D type Curve assume a C curve type with a one step higher rating.
E.G. Selectivity FD160 80Amp LTM with downstream C Curve 40A MCB 3kA, for D curve 40A, take the value mentioned for 50A C curve, here 1.2kA

Table D2 - Selectivity/Discrimination

Upstream / Downstream	In (A)	Record Plus type																				
		FE160N H & L - LTM					FE160N H & L - LTMD			FE160N H & L - SMR1			FE250V - LTM			FE250N H & L - LTMD				FE250N H & L - SMR1		
		63	80	100	125	160	100	125	160	63	125	160	160	200	250	125	160	200	250	125	160	250
		Selectivity limit in kA*																				
Redline	20	T	T	T	T	T	T	T	T	T	T	T	T	T	T	T	T	T	T	T	T	T
EPC 30 G30	25	1.2	T	T	T	T	T	T	T	T	T	T	T	T	T	T	T	T	T	T	T	T
B/C curve	25	1.2	T	T	T	T	T	T	T	T	T	T	T	T	T	T	T	T	T	T	T	T
	40	-	3	4	T	T	T	T	T	-	T	T	T	T	T	T	T	T	T	T	T	T
Redline	20	6	T	T	T	T	T	T	T	T	T	T	T	T	T	T	T	T	T	T	T	T
EPC 45 G45	25	1.2	T	T	T	T	T	T	T	T	T	T	T	T	T	T	T	T	T	T	T	T
B/C curve	32	1.2	3	6	T	T	T	T	T	T	T	T	T	T	T	T	T	T	T	T	T	T
	40	-	3	4	T	T	T	T	T	-	T	T	T	T	T	T	T	T	T	T	T	T
Redline	20	6	6	T	T	T	T	T	T	T	T	T	T	T	T	T	T	T	T	T	T	T
EPC 60 DME60	25	1.2	6	6	T	T	T	T	T	T	T	T	T	T	T	T	T	T	T	T	T	T
B/C curve	32	1.2	3	6	T	T	T	T	T	T	T	T	T	T	T	T	T	T	T	T	T	T
	40	-	3	4	6	6	T	T	T	-	T	T	T	T	T	T	T	T	T	T	T	T
Redline	20	6	6	8	T	T	T	T	T	T	T	T	T	T	T	T	T	T	T	T	T	T
DM60 DMT60	25	1.2	6	6	T	T	T	T	T	T	T	T	T	T	T	T	T	T	T	T	T	T
DM100 DMT100	32	1.2	3	6	8	T	T	T	T	T	T	T	T	T	T	T	T	T	T	T	T	T
B/C curve	40	-	3	4	6	6	T	T	T	T	T	T	T	T	T	T	T	T	T	T	T	T
	50	-	-	1.5	6	6	T	T	T	-	T	T	T	T	T	T	T	T	T	T	T	T
	63	-	-	1.5	2	2	T	T	T	-	T	T	T	T	T	T	T	T	T	T	T	T
Redline	20	6	6	8	T	T	T	T	T	T	T	T	T	T	T	T	T	T	T	T	T	T
G60	25	1.2	6	6	T	T	T	T	T	T	T	T	T	T	T	T	T	T	T	T	T	T
DME100	32	1.2	3	6	8	T	T	T	T	T	T	T	T	T	T	T	T	T	T	T	T	T
B/C curve	40	-	3	4	6	6	T	T	T	T	T	T	T	T	T	T	T	T	T	T	T	T
	50	-	1.2	1.5	6	6	T	T	T	-	T	T	T	T	T	T	T	T	T	T	T	T
	63	-	-	1.5	2	2	T	T	T	-	T	T	T	T	T	T	T	T	T	T	T	T
Redline	20	6	6	8	T	T	T	T	T	T	T	T	T	T	T	T	T	T	T	T	T	T
GT100 GT25	25	1.2	6	6	T	T	T	T	T	T	T	T	T	T	T	T	T	T	T	T	T	T
B/C curve	32	1.2	3	6	8	T	T	T	T	T	T	T	T	T	T	T	T	T	T	T	T	T
	40	-	3	4	6	6	T	T	T	T	T	T	T	T	T	T	T	T	T	T	T	T
	50	-	-	1.5	6	6	T	T	T	-	T	T	T	T	T	T	T	T	T	T	T	T
	63	-	-	1.5	2	2	T	T	T	-	T	T	T	T	T	T	T	T	T	T	T	T
Redline	80	-	-	1.5	2	2	-	T	T	-	T	T	1.9	2.5	3	T	T	T	T	T	T	T
Series HTI C curve	100	-	-	-	-	2	-	-	T	-	-	T	1.9	2.5	3	-	T	T	T	-	T	T
	125	-	-	-	-	-	-	-	-	-	-	-	-	-	3	-	T	T	T	-	T	T
Redline	40	-	1.2	1.5	1.9	1.9	T	T	T	T	T	T	1.9	2.5	3	T	T	T	T	T	T	T
Series S90	50	-	-	1.5	1.9	1.9	T	T	T	T	T	T	1.9	2.5	3	T	T	T	T	T	T	T
	63	-	-	-	1.9	1.9	-	T	T	-	T	T	1.9	2.5	3	T	T	T	T	T	T	T
	80	-	-	-	-	1.9	-	-	T	-	T	T	1.9	2.5	3	-	T	T	T	T	T	T
Surion	100	-	-	-	-	-	-	-	-	-	-	T	1.9	2.5	3	-	-	T	T	-	T	T
GPS1BS	20	6	6	10	T	T	T	T	T	T	T	T	T	T	T	T	T	T	T	T	T	T
GPS1MS	25	1.2	6	6	T	T	T	T	T	T	T	T	T	T	T	T	T	T	T	T	T	T
GPS2BS	32	1.2	3	6	10	10	T	T	T	T	T	T	10	T	T	T	T	T	T	T	T	T
GPS2MS	40	-	-	4	6	6	T	T	T	T	T	T	6	10	T	T	T	T	T	T	T	T
	50	-	-	1.6	6	6	T	T	T	-	T	T	6	6	10	T	T	T	T	T	T	T
Surion	63	-	-	-	2	2	-	T	T	-	T	T	2	6	6	T	T	T	T	T	T	T
GPS1BH	20	T	T	T	T	T	T	T	T	T	T	T	T	T	T	T	T	T	T	T	T	T
GPS1MH	25	15	15	T	T	T	T	T	T	T	T	T	T	T	T	T	T	T	T	T	T	T
GPS2BH	32	6	6	8	T	T	T	T	T	T	T	T	T	T	T	T	T	T	T	T	T	T
GPS2MH	40	-	6	8	T	T	T	T	T	T	T	T	T	T	T	T	T	T	T	T	T	T
	50	-	-	6	T	T	T	T	T	-	T	T	T	T	T	T	T	T	T	T	T	T
Record Plus	63	-	-	-	T	T	-	T	T	-	T	T	T	T	T	T	T	T	T	T	T	T
FFD160E	40	-	0.8	1	1.2	1.6	T	T	T	T	T	T	1.6	2	2.5	T	T	T	T	T	T	T
LTM	50	-	-	1	1.2	1.6	T	T	T	-	T	T	1.6	2	2.5	T	T	T	T	T	T	T
	63	-	-	-	1.2	1.6	T	T	T	-	T	T	1.6	2	2.5	T	T	T	T	T	T	T
	80	-	-	-	1.2	1.6	-	T	T	-	-	T	1.6	2	2.5	-	T	T	T	T	T	T
	100	-	-	-	-	1.6	-	-	T	-	-	T	1.6	2	2.5	-	-	T	T	-	T	T
	125	-	-	-	-	-	-	-	-	-	-	-	-	2	2.5	-	-	T	T	-	-	T
	160	-	-	-	-	-	-	-	-	-	-	-	-	-	2.5	-	-	-	T	-	-	T
Record Plus	40	0.6	0.8	1	1.2	1.6	30	30	30	36	36	36	1.6	2	2.5	42	42	42	42	50	50	50
FD160S, N	50	-	0.8	1	1.2	1.6	30	30	30	-	36	36	1.6	2	2.5	42	42	42	42	50	50	50
H L	63	-	-	1	1.2	1.6	30	30	30	-	36	36	1.6	2	2.5	42	42	42	42	50	50	50
LTMD	80	-	-	-	1.2	1.6	-	30	30	-	36	36	1.6	2	2.5	42	42	42	42	50	50	50
	100	-	-	-	-	1.6	-	-	30	-	-	36	1.6	2	2.5	-	42	42	42	-	50	50
	125	-	-	-	-	-	-	-	-	-	-	-	-	2	2.5	-	-	42	42	-	-	50
	160	-	-	-	-	-	-	-	-	-	-	-	-	-	2.5	-	-	-	42	-	-	50
Record Plus	40	0.6	0.8	1	1.2	1.6	30	30	30	36	36	36	1.6	2	2.5	42	42	42	42	50	50	50
FE160 N, H L	50	-	0.8	1	1.2	1.6	30	30	30	-	36	36	1.6	2	2.5	42	42	42	42	50	50	50
LTM/MO/GTM	63	-	-	1	1.2	1.6	30	30	30	-	36	36	1.6	2	2.5	42	42	42	42	50	50	50
	80	-	-	-	1.2	1.6	-	30	30	-	36	36	1.6	2	2.5	42	42	42	42	50	50	50
	100	-	-	-	-	1.6	-	-	30	-	-	36	1.6	2	2.5	-	42	42	42	-	50	50
	125	-	-	-	-	-	-	-	-	-	-	-	-	2	2.5	-	-	42	42	-	-	50
	160	-	-	-	-	-	-	-	-	-	-	-	-	-	2.5	-	-	-	42	-	-	50

Where T is mentioned Selectivity is full up until the Icu of the downstream device.

Table D3 - Selectivity/Discrimination

Upstream / Downstream	In (A)	Record Plus type															
		FE160N H&L - SMR1			FE250N H&L - LTMD				FE250N H&L - SMR1			FG400 H&L - SMR1 & SMR2			FG630N H&L - SMR1 & SMR2		
		63	125	160	125	160	200	250	125	160	250	250	350	400	400	500	630
		Selectivity limit in kA*															
Redline	**20**	T	T	T	T	T	T	T	T	T	T	T	T	T	T	T	T
EPC 30, 45 60N	**25**	T	T	T	T	T	T	T	T	T	T	T	T	T	T	T	T
G30, 45, 60 100	**32**	T	T	T	T	T	T	T	T	T	T	T	T	T	T	T	T
GT25, DME60	**40**	T	T	T	T	T	T	T	T	T	T	T	T	T	T	T	T
DM (T)60, 100	**50**	-	T	T	T	T	T	T	T	T	T	T	T	T	T	T	T
B/C curve	**63**	-	T	T	T	T	T	T	T	T	T	T	T	T	T	T	T
Redline	**80**	-	T	T	-	T	T	T	T	T	T	T	T	T	T	T	T
Series HTI C curve	**100**	-	-	T	-	T	T	T	-	T	T	T	T	T	T	T	T
	125	-	-	-	-	-	T	T	-	T	T	T	T	T	T	T	T
Redline	**40**	T	T	T	T	T	T	T	T	T	T	T	T	T	T	T	T
Series S90	**50**	-	T	T	T	T	T	T	T	T	T	T	T	T	T	T	T
	63	-	T	T	T	T	T	T	T	T	T	T	T	T	T	T	T
	80	-	T	T	-	T	T	T	T	T	T	T	T	T	T	T	T
	100	-	-	T	-	-	T	T	-	T	T	T	T	T	-	T	T
Surion	**40**	T	T	T	T	T	T	T	T	T	T	T	T	T	T	T	T
GPS1BS GPS1MS	**50**	-	T	T	T	T	T	T	T	T	T	T	T	T	T	T	T
GP2BS GPS2MS	**63**	-	T	T	T	T	T	T	T	T	T	T	T	T	T	T	T
Surion	**40**	T	T	T	T	T	T	T	T	T	T	T	T	T	T	T	T
GPS1BH GPS1MH	**50**	-	T	T	T	T	T	T	T	T	T	T	T	T	T	T	T
GP2BH GPS2MH	**63**	-	T	T	T	T	T	T	T	T	T	T	T	T	T	T	T
Record Plus	**40**	T	T	T	T	T	T	T	T	T	T	T	T	T	T	T	T
FD160 E	**50**	-	T	T	T	T	T	T	T	T	T	T	T	T	T	T	T
LTM	**63**	-	T	T	T	T	T	T	T	T	T	T	T	T	T	T	T
	80	-	-	T	-	T	T	T	T	T	T	T	T	T	T	T	T
	100	-	-	T	-	-	T	T	-	T	T	T	T	T	T	T	T
	125	-	-	-	-	-	T	T	-	-	T	T	T	T	T	T	T
	160	-	-	-	-	-	-	T	-	-	T	T	T	T	T	T	T
Record Plus	**40**	36	36	36	42	42	42	42	50	50	50	T	T	T	T	T	T
FD160 S, N, H L	**50**	-	36	36	42	42	42	42	50	50	50	T	T	T	T	T	T
LTMD/MO/GTM	**63**	-	36	36	42	42	42	42	50	50	50	T	T	T	T	T	T
	80	-	-	36	42	42	42	42	50	50	50	T	T	T	T	T	T
	100	-	-	36	-	42	42	42	-	50	50	T	T	T	T	T	T
	125	-	-	-	-	-	42	42	-	-	50	T	T	T	T	T	T
	160	-	-	-	-	-	-	42	-	-	50	T	T	T	T	T	T
Record Plus	**40**	36	36	36	42	42	42	42	50	50	50	T	T	T	T	T	T
FE160 N, H L	**50**	-	36	36	42	42	42	42	50	50	50	T	T	T	T	T	T
LTM/MO/GTM	**63**	-	36	36	42	42	42	42	50	50	50	T	T	T	T	T	T
	80	-	36	36	42	42	42	42	50	50	50	T	T	T	T	T	T
	100	-	-	36	-	42	42	42	-	50	50	T	T	T	T	T	T
	125	-	-	-	-	-	42	42	-	-	50	T	T	T	T	T	T
	160	-	-	-	-	-	-	42	-	-	50	T	T	T	T	T	T
Record Plus	**40**	0,8	1,8	2,2	1,3	1,6	2,5	2,5	1,8	2,2	3,5	T	T	T	T	T	T
FE160 N, H L	**63**	-	1,8	2,2	1,3	1,6	2,5	2,5	1,8	2,2	3,5	T	T	T	T	T	T
LTMD/SMR1	**80**	-	1,8	2,2	1,3	1,6	2,5	2,5	1,8	2,2	3,5	T	T	T	T	T	T
	100	-	-	2,2	-	1,6	2,5	2,5	-	2,2	3,5	T	T	T	T	T	T
	125	-	-	-	-	-	2,5	2,5	-	-	3,5	T	T	T	T	T	T
	160	-	-	-	-	-	-	2,5	-	-	3,5	T	T	T	T	T	T
Record Plus	**125**	-	-	-	-	-	-	-	-	-	-	3,5	10	15	T	T	T
FE250 N, H L	**160**	-	-	-	-	-	-	-	-	-	-	3,5	10	15	T	T	T
LTMD/SMR1	**200**	-	-	-	-	-	-	-	-	-	-	-	10	15	T	T	T
	250	-	-	-	-	-	-	-	-	-	-	-	10	15	T	T	T
Record Plus																	
FG400 N, H L	**250**	-	-	-	-	-	-	-	-	-	-	-	5	6	5	7	7
SMR1/SMR2	**400**	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	7

Table D4 - Selectivity/Discrimination

Downstream		Upstream In (A)	*Record Plus* type			
			FK800N H & L SMR1	FK1250N H & L SMR1		FK1600N H & L SMR1
			800	1000	1250	1600
			Selectivity limit in kA*			
Redline EPC 30, 45 60N / G30, 45, 60 100 / GT25 / DME60 DM(T)60, 100	B/C curve	All	T	T	T	T
Redline Series HTI S90	C curve	All	T	T	T	T
Surion GPS1BS, GPS1MS, GPS2BS, GPS2MS GPS1BH, GPS1MH, GPS2BH GPS2MH		All	T	T	T	T
Record Plus FD160E, S, N, H L types LTM/LTMD/MO/GTM		All	15	T	T	T
Record Plus FE160 N, H L types LTM/LTMD/MO/GTM/SMR1	Trip Units	All	T	T	T	T
Record Plus FE250 V, N, H L types LTM/LTMD/MO/GTM/SMR1	Trip Units	All	T	T	T	T
Record Plus FG400 N, H L types SMR1/SMR2	Trip Units	All	T	T	T	T
Record Plus FG630 N, H L types SMR1/SMR2	Trip Units	400A	15	T	T	T
		500A	15	T	T	T
		630A	15	T	T	T
Record Plus FK800 N, H L types LTM/MO/SMR1e, s g	Trip Units	All	-	15	15	25
Record Plus FK1250 N, H L types LTM/MO/SMR1e, s g	Trip Units	1000A	-	-	-	25
		1250A	-	-	-	25

Where T is mentioned Selectivity is full up until the Icu of the downstream device

Table D5 - Selectivity/Discrimination

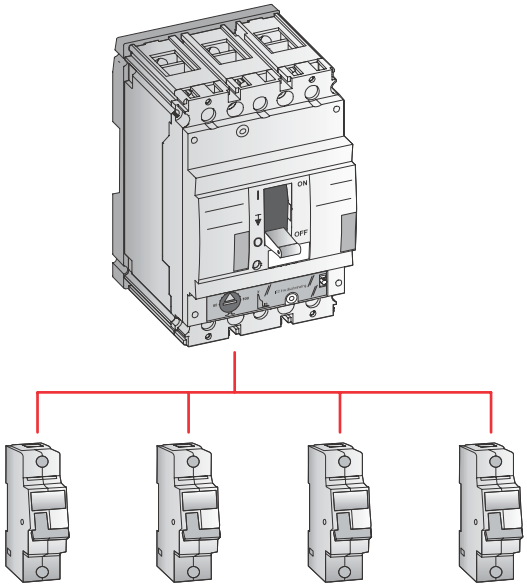
Downstream Device	Trip Unit	Upstream EntelliGuard™ G device and Selectivity limit Is [1]								
		GG04S to GG20S	GG04N to GG20N	GG25N to GG40N	GG04E to GG20E	GG(H)25H to GG(H)40H	GG(H)25M to GG(H)40M	GG32G to GG40G	GG40M to GG64M	GG40L to GG64L
Redline EPC 30, 45 60N / G30, 45, 60, 100 / GT25 / DME60 / DM(T)60, 100 B/C curve	All	T	T	T	T	T	T	T	T	T
Redline Series HTI S90 C curve	All	T	T	T	T	T	T	T	T	T
Surion Manual Motor starters GPS1BS GPS1MS GP2BS GPS2MS	All	T	T	T	T	T	T	T	T	T
Surion Manual Motor starters GPS1BH GPS1MH GP2BH GPS2MH	All	T	T	T	T	T	T	T	T	T
Record Plus										
FD FE frame C, E, V, S tiers	All	T	T	T	T	T	T	T	T	T
FD FE frame N tier	All	T	T	T	T	T	T	T	T	T
FD FE frame H tier	All	T	T	T	T	T	T	T	T	T
FD FE frame L tier	All	T	T	T	T	T	T	T	T	T
FG frame N tier	All	T	T	T	T	T	T	T	T	T
FG frame H tier	All	T	T	T	T	T	T	T	T	T
FG frame L tier	All	T	T	T	T	T	T	T	T	T
FK frame N tier	All	T	T	T	T	T	T	T	T	T
FK frame H tier	All	T	T	T	T	T	T	T	T	T
FK frame L tier	All	T	T	T	T	T	T	T	T	T
EntelliGuard										
GG04S to GG20S	All	50kA [2]	T	T	T	T	T	T	T	T
GG04N to GG20N	All	50kA [2]	65kA [2]	65kA [2]	T	T	T	T	T	T
GG04E to GG20E	All	50kA [2]	65kA [2]	65kA [2]	85kA [2]	85kA [2]	85kA [2]	T	T	T
GG(H)25H to GG(H)40H	All	-	-	65kA [2]	-	85kA [2]	85kA [2]	T	T	T
GG(H)25M to GG(H)40M	All	-	-	65kA [2]	-	85kA [2]	85kA [2]	T	T	T
GG(H)40M to GG(H)64M	All	-	-	-	-	-	-	-	100kA [2]	100kA [2]
GG(H)40L to GG(H)64L	All	-	-	-	-	-	-	-	100kA [2]	100kA [2]
Industrial fuses [3] GL/Gg type	-	T	T	T	T	T	T	T	T	T

(1) T Full selectivity until the Icu of the downstream or upstream device (the lowest of the two)
(2) Indicated values apply with I (Instantaneous) ON, If Off reduce by 10%
(3) Conditions for selectivity: Fuse rating Breaker LT rating /2,: Other minimum breaker settings: LTDB: F20, ST 8 x Ir, STDB band 5, Inst 12 x Ie.

Back-up protection

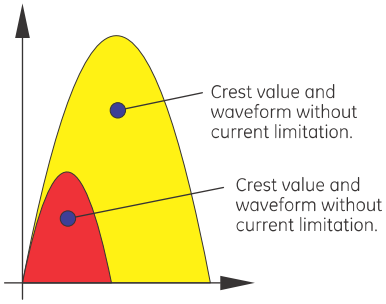
One of the operational requirements for a protective device is that its rated short-circuit breaking capacity Icu or Ics is either equal or greater than the prospective short-circuit current at the point where it is installed. EN 60384 defines one exception to this in clause 434:

The upstream device must posses the necessary rated short-circuit breaking capacity at its point of installation. The upstream device must coordinate with the downstream device in a manner that will limit the energy and short-circuit values to levels that the downstream device can handle.



Use of current limitation

Installing an upstream device that limits the prospective short-circuit values will enable the user to place a downstream device with a lower breaking capacity. The coordination between the two devices allows excellent breaking capacity at a low cost.



Effect of a current limiting device on a short-circuit in an AC network.

Record Plus

The ***Record Plus*** rotating dual contact configuration limits the energy and current values of prospective faults to extremely low values. This key design feature allows the use of cost-effective downstream devices while maintaining overall system protection.
Back-up protection is inherently unselective or non-discriminating . That means that the upstream device must react first in order to protect the downstream device. However, the ***Record Plus*** devices are so current limiting that the current and energy values present in the circuit do not trip the upstream breaker. Please refer to the details on Selectivity Plus for a description of this technique.

The tables B1 and B2 are in complete accordance with the EN 60947-2 requirements and have been verified through experiment where necessary. They provide data for the ***Record Plus*** breaker and the other GE Industrial Systems product lines.
The values are only applicable for the devices mentioned.

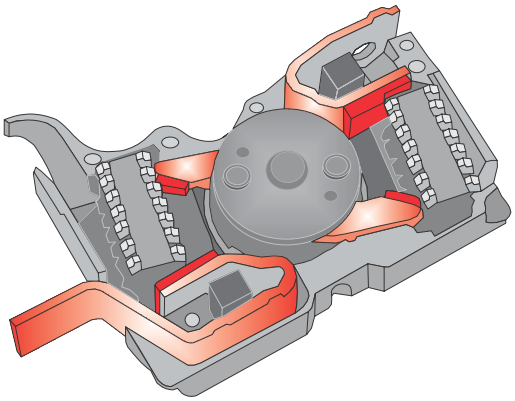


Table B1 - Back-up protection at 230/240

Upstream / Downstream	Icu (kA)	*Record Plus* type																											
		FD160C	FD160E	FD160S	FD160N	FD160H	FD160L	FD160N	FE160H	FE160L	FE250V	FE250N	FE250H	FE250L	FG400N	FG400H	FG400L	FG630N	FG630H	FG630L	FK800N	FK800H	FK800L	FK1250N	FK1250H	FK1250L	FK1600N	FK1600H
		25	40	50	85	100	200	85	100	200	65	85	100	200	85	100	200	85	100	200	80	100	170	80	100	170	80	100
		Icu of the combination in kA																										
Redline																												
EPC30	**3**	15	15	15	15	15	15	12	12	12	10	10	10	10	-	-	-	-	-	-	-	-	-	-	-	-	-	-
EPC451N / EPC45	**6**	15	18	18	18	18	18	15	15	15	12	12	12	12	-	-	-	-	-	-	-	-	-	-	-	-	-	-
DME60	**6**	15	18	22	22	22	22	18	18	18	15	15	15	15	-	-	-	-	-	-	-	-	-	-	-	-	-	-
EPC61N / EPC60	**7.5**	16	20	23	23	23	23	20	20	20	16	16	16	16	-	-	-	-	-	-	-	-	-	-	-	-	-	-
DM60 DMT60	**10**	22	25	30	36	85	85	36	85	85	30	36	65	65	16	16	16	14	14	14	-	-	-	-	-	-	-	-
DME100	**10**	18	22	25	25	25	25	22	22	22	18	18	18	18														
DM100 DMT100	**15**	25	36	42	50	100	100	42	100	100	30	36	65	65	18	18	18	16	16	16								
G30	**15**	25	36	42	50	100	100	42	100	100	30	36	65	65	18	18	18	16	16	16								
G45	**10**	22	25	30	36	85	85	36	85	85	30	36	65	65	16	16	16	14	14	14	-	-	-	-	-	-	-	-
G60	**20**	25	36	42	50	100	100	50	100	100	36	42	85	85	22	22	22	18	18	18	-	-	-	-	-	-	-	-
G100	**30**	-	42	50	65	100	100	65	100	100	42	50	85	85	-	-	-	-	-	-	-	-	-	-	-	-	-	-
GT25 25A	**50**	-	-	-	65	100	100	65	100	100	-	65	100	100	-	-	-	-	-	-	-	-	-	-	-	-	-	-
GT25 32 40A	**40**	-	-	50	65	100	100	65	100	100	42	50	85	85	-	-	-	-	-	-	-	-	-	-	-	-	-	-
GT25 50 63A	**30**	-	42	50	65	100	100	65	100	100	42	50	85	85	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Redline																												
Hti	**15**	22	36	42	50	100	100	50	100	100	36	42	80	80	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Redline																												
S90	**25**	-	36	42	85	100	100	85	100	100	36	50	85	85	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Surion																												
GPS1BS 16A	**100**	-	-	-	-	-	150	-	-	150	-	-	-	150	-	-	-	-	-	-	-	-	-	-	-	-	-	-
GPS1BS 16A	**50**	-	-	-	85	100	150	-	100	150	-	-	100	150	-	-	-	-	-	-	-	-	-	-	-	-	-	-
GPS1BH all	**100**	-	-	-	-	-	150	-	-	150	-	-	-	150	-	-	-	-	-	-	-	-	-	-	-	-	-	-
GPS2BS 16A	**100**	-	-	-	-	-	150	-	-	150	-	-	-	150	-	-	-	-	-	-	-	-	-	-	-	-	-	-
GPS2BS 16A	**50**	-	-	-	85	100	150	-	100	150	-	-	100	150	-	-	-	-	-	-	-	-	-	-	-	-	-	-
GPS2BH all	**100**	-	-	-	-	-	150	-	-	150	-	-	-	150	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Record Plus																												
FD160C	**18**	-	30	36	42	50	65	42	50	65	36	42	50	65	42	50	65	42	50	65	-	-	-	-	-	-	-	-
FD160E	**36**	-	-	50	65	85	100	65	85	100	50	65	85	100	65	85	100	65	85	100	-	-	-	-	-	-	-	-
FD160S	**50**	-	-	-	-	85	100	-	85	100	-	-	85	100	-	85	100	-	85	100	-	-	-	-	-	-	-	-
FD160N	**85**	-	-	-	-	100	200	-	100	200	-	-	100	200	-	100	200	-	100	200	80	100	150	80	100	150	80	100
FD160H	**100**	-	-	-	-	-	200	-	-	200	-	-	-	200	-	-	200	-	-	200	-	100	150	-	100	150	-	100
FE160N	**85**	-	-	-	-	-	-	-	100	200	-	-	100	200	-	100	200	-	100	200	80	100	150	80	100	150	80	100
FE160H	**100**	-	-	-	-	-	-	-	-	200	-	-	-	200	-	-	200	-	-	200	-	100	150	-	100	150	-	100
FE250N	**85**	-	-	-	-	-	-	-	-	-	-	-	100	200	-	100	200	-	100	200	80	100	150	80	100	150	80	100
FE250H	**100**	-	-	-	-	-	-	-	-	-	-	-	-	200	-	-	200	-	-	200	-	100	150	-	100	150	-	100
FG400N	**85**	-	-	-	-	-	-	-	-	-	-	-	-	-	-	100	200	-	100	200	80	100	150	80	100	150	80	100
FG400H	**100**	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	200	-	-	200	-	100	150	-	100	150	-	100
FG630N	**85**	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	100	200	80	100	150	80	100	150	80	100
FG630H	**100**	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	200	-	100	150	-	100	150	-	100
FK800N	**80**	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	80	100	150	80	100	150	80	100
FK800H	**100**	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	100	170	-	100	170	-	100
FK1250N	**80**	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	80	100	170	80	100	170	80	100
FK1250H	**100**	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	100	170	-	100	170	-	100

Table B2 - Back-up protection at 400/415

Upstream / Downstream	Icu (kA)	Record Plus type																											
		FD160C	FD160E	FD160S	FD160N	FD160H	FD160L	FD160N	FE160H	FE160L	FE250V	FE250N	FE250H	FE250L	FG400N	FG400H	FG400L	FG630N	FG630H	FG630L	FK800N	FK800H	FK800L	FK1250N	FK1250H	FK1250L	FK1600N	FK1600H
		18	25	36	50	80	150	50	80	150	36	50	80	150	50	80	150	50	80	150	50	80	100	50	80	100	50	80
		Icu of the combination in kA																										
Redline																												
EPC30	**5**	15	18	22	25	30	36	25	30	36	18	22	25	30	12	12	12	10	10	10	-	-	-	-	-	-	-	-
EPC452, 453 454	**6**	15	18	22	25	30	36	25	30	36	18	22	25	30	12	12	12	10	10	10	-	-	-	-	-	-	-	-
EPC62, 63 64	**7.5**	16	20	23	25	34	40	28	34	40	20	25	30	32	15	15	15	10	10	10	-	-	-	-	-	-	-	-
G32, 33 34	**3**	15	18	22	25	30	36	25	30	36	18	22	25	30	12	12	12	10	10	10	-	-	-	-	-	-	-	-
G452, 453 454	**5**	15	18	22	25	30	36	25	30	36	18	22	25	30	12	12	12	10	10	10	-	-	-	-	-	-	-	-
G60 GT10	**10**	18	22	25	30	36	42	30	36	42	22	30	36	36	16	16	16	12	12	12	-	-	-	-	-	-	-	-
GT100	**15**	18	25	30	36	42	50	36	42	50	25	30	36	36	22	22	22	16	16	16	-	-	-	-	-	-	-	-
GT25 25A	**25**	-	-	36	42	50	65	42	50	65	-	36	42	42	-	-	-	-	-	-	-	-	-	-	-	-	-	-
GT25 32 40A	**20**	-	-	30	36	42	50	36	42	50	-	36	42	42	-	-	-	-	-	-	-	-	-	-	-	-	-	-
GT25 50 63A	**15**	18	25	30	36	42	50	36	42	50	25	30	36	36	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Redline																												
Series Hti	**10**	15	18	25	30	36	42	30	36	42	18	30	36	36	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Redline																												
Series S90	**15**	18	25	30	36	42	50	36	42	50	25	36	42	42	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Surion																												
GPS1BS 10A	**100**	-	-	-	-	-	150	-	-	150	-	-	-	150	-	-	-	-	-	-	-	-	-	-	-	-	-	-
GPS1B/MS 12.5A	**50**	-	-	-	-	80	150	-	80	150	-	-	80	150	-	-	-	-	-	-	-	-	-	-	-	-	-	-
GPS1B/MS 16A	**25**	-	-	-	42	50	65	42	50	65	-	42	50	65	-	-	-	-	-	-	-	-	-	-	-	-	-	-
GPS1B/MH 12.5A	**100**	-	-	-	-	-	150	-	-	150	-	-	-	150	-	-	-	-	-	-	-	-	-	-	-	-	-	-
GPS1B/MH 12.5A	**50**	-	-	-	-	80	150	-	80	150	-	-	80	150	-	-	-	-	-	-	-	-	-	-	-	-	-	-
GPS2B/MS 10A	**100**	-	-	-	-	-	150	-	-	150	-	-	-	150	-	-	-	-	-	-	-	-	-	-	-	-	-	-
GPS2B/MS 10A	**25**	-	-	-	42	50	65	42	50	65	-	42	50	65	-	-	-	-	-	-	-	-	-	-	-	-	-	-
GPS2B/MH 10A	**100**	-	-	-	-	-	150	-	-	150	-	-	-	150	-	-	-	-	-	-	-	-	-	-	-	-	-	-
GPS2B/MH 10A	**50**	-	-	-	-	80	150	-	80	150	-	-	80	150	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Record Plus																												
FD160C	**18**	-	22	25	30	36	42	30	36	42	22	30	36	42	30	36	42	30	36	42	-	-	-	-	-	-	-	-
FD160E	**25**	-	-	30	36	42	50	36	42	50	-	36	42	50	36	42	50	36	42	50	-	-	-	-	-	-	-	-
FD160S	**36**	-	-	-	42	50	65	42	50	65	-	42	50	65	42	50	65	42	50	65	-	-	-	-	-	-	-	-
FD160N	**50**	-	-	-	-	80	150	-	80	150	-	-	80	150	-	80	150	-	80	150	-	80	100	-	80	100	-	80
FD160H	**80**	-	-	-	-	-	150	-	-	150	-	-	-	150	-	-	150	-	-	150	-	-	100	-	-	100	-	-
FE160N	**50**	-	-	-	-	-	-	-	80	150	-	-	80	150	-	80	150	-	80	150	-	80	100	-	80	100	-	80
FE160H	**80**	-	-	-	-	-	-	-	-	150	-	-	-	150	-	-	150	-	-	150	-	-	100	-	-	100	-	-
FE250N	**50**	-	-	-	-	-	-	-	-	-	-	-	80	150	-	80	150	-	80	150	-	80	100	-	80	100	-	80
FE250H	**80**	-	-	-	-	-	-	-	-	-	-	-	-	150	-	-	150	-	-	150	-	-	100	-	-	100	-	-
FG400N	**50**	-	-	-	-	-	-	-	-	-	-	-	-	-	-	80	150	-	80	150	-	80	100	-	80	100	-	80
FG400H	**80**	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	150	-	-	150	-	-	100	-	-	100	-	-
FG630N	**50**	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	80	150	-	80	100	-	80	100	-	80
FG630H	**80**	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	150	-	-	100	-	-	100	-	-
FK800N	**50**	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	80	100	-	80	100	-	80
FK800H	**80**	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	100	-	-	100	-	-
FK1250N	**50**	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	80	100	-	80	100	-	80
FK1250H	**80**	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	100	-	-	100	-	-

Application guide Selectivity Plus

Back-up protection requires an upstream device to open in order to protect the downstream device(s) before the downstream devices can be damaged. For continuity of service it is desirable that the upstream device remains closed and that only the downstream device closest to the fault reacts.
The ***Record Plus*** family of breakers resolves this paradox: the breakers are so current limiting that let-through energy and current are not sufficient to operate the upstream breaker. The result discrimination to current levels that are higher than the rated short-circuit breaking capacity of the downstream breaker.
Tables DB1 to DB5 provide the data for the ***Record Plus*** breaker line used in combination with the ElfaPlus, Surion and MPact protection devices. The values in the table are in kA and indicate the results of the Selectivity Plus technique.
Before the slash the discrimination limit in kA, after the slash the back-up protection value at 400V in kA (e.g. 50/80).

Table DB1 - Selectivity Plus

Upstream / Downstream	In (A)	*Record Plus* type																							
		FDC 63/160 LTM				FDE 63/160 LTM				FDS 63/160 LTMD				FDN 63/160 LTMD				FDH 63/160 LTMD				FDL 63/160 LTMD			
		63	80	100	125 160	63	80	100	125 160	63	80	100	125 160	63	80	100	125 160	63	80	100	125 160	63	80	100	125 160
		Selectivity limit in kA / Maximum Icu of combination at 400/415V AC																							
Redline G EPC30/45 B/C curve	16	6/15	6/15	10/15	15/15	6/18	6/18	10/18	18/18	22/22	22/22	22/22	22/22	25/25	25/25	25/25	25/25	30/30	30/30	30/30	30/30	36/36	36/36	36/36	36/36
	20	3/15	6/15	8/15	15/15	3/18	6/18	8/18	18/18	22/22	22/22	22/22	22/22	25/25	25/25	25/25	25/25	30/30	30/30	30/30	30/30	36/36	36/36	36/36	36/36
	25	-	6/15	6/15	15/15	-	6/18	6/18	18/18	15/22	15/22	22/22	22/22	15/25	15/25	25/25	25/25	15/30	15/30	30/30	30/30	15/36	15/36	30/36	30/36
	32	-	3/15	6/15	15/15	-	3/18	6/18	18/18	10/22	10/22	22/22	22/22	10/25	10/25	25/25	25/25	10/30	10/30	30/30	30/30	10/36	10/36	36/36	30/36
	40	-	3/15	4/15	15/15	-	3/18	4/18	18/18	3,5/22	10/22	15/22	22/22	3,5/25	10/25	15/25	25/25	3,5/30	10/30	15/30	25/30	3,5/36	10/36	15/36	25/36
Redline G60 B/C curve	16	6/18	6/18	10/18	18/18	6/22	6/22	10/22	22/22	25/25	25/25	25/25	25/25	30/30	30/30	30/30	30/30	36/36	36/36	36/36	36/36	36/42	36/42	36/42	36/42
	20	3/18	6/18	8/18	18/18	3/22	6/22	8/22	22/22	25/25	25/25	25/25	25/25	30/30	30/30	30/30	30/30	36/36	36/36	36/36	36/36	36/42	36/42	36/42	36/42
	25	-	6/18	6/18	18/18	-	6/22	6/22	22/22	15/25	15/25	25/25	25/25	15/30	15/30	30/30	30/30	15/36	15/36	30/36	30/36	15/42	15/42	30/42	30/42
	32	-	3/18	6/18	18/18	-	3/22	6/22	22/22	10/25	10/25	25/25	25/25	10/30	10/30	30/30	30/30	10/36	10/36	36/36	30/36	10/42	10/42	36/42	30/42
	40	-	3/18	4/18	18/18	-	3/22	4/22	22/22	3,5/25	10/25	15/25	25/25	3,5/30	10/30	15/30	25/30	3,5/36	10/36	15/36	25/36	3,5/42	10/42	15/42	25/42
	50	-	-	1,5/18	6/18	-	-	1,5/22	6/22	-	3,5/25	10/25	22/25	-	3,5/30	10/30	22/30	-	3,5/36	10/36	22/36	-	3,5/42	10/42	22/42
	63	-	-	-	-	-	-	-	-	-	-	8/25	22/25	-	-	8/30	22/30	-	-	8/36	22/36	-	-	8/42	22/42
Redline G100 B/C curve	16	6/18	6/18	10/18	18/18	6/25	6/25	10/25	25/25	30/30	30/30	30/30	30/30	36/36	36/36	36/36	36/36	36/42	36/42	36/42	36/42	36/50	36/50	36/50	36/50
	20	3/18	6/18	8/18	18/18	3/25	6/25	8/25	25/25	30/30	30/30	30/30	30/30	36/36	36/36	36/36	36/36	36/42	36/42	36/42	36/42	36/50	36/50	36/50	36/50
	25	-	6/18	6/18	18/18	-	6/25	6/25	25/25	15/30	30/30	30/30	30/30	15/36	36/36	30/36	30/36	15/42	36/42	30/42	30/42	15/50	15/50	30/50	30/50
	32	-	3/18	6/18	18/18	-	3/25	6/25	25/25	10/30	10/30	30/30	30/30	10/36	10/36	30/36	30/36	10/42	10/42	30/42	30/42	10/50	10/50	30/50	30/50
	40	-	3/18	4/18	18/18	-	3/25	4/25	25/25	3,5/30	10/30	15/30	25/30	3,5/36	10/36	15/36	25/36	3,5/42	10/42	15/42	25/42	3,5/50	10/50	15/50	25/50
	50	-	-	1,5/18	6/18	-	-	-	6/25	-	3,5/30	10/30	22/30	-	3,5/36	10/36	22/36	-	3,5/42	10/42	22/42	-	3,5/50	10/50	22/50
	63	-	-	-	2/18	-	-	-	2/25	-	-	8/30	22/30	-	-	8/36	22/36	-	-	8/42	22/42	-	-	8/50	22/50
Redline GT25 B/C curve	20	-	-	-	-	-	-	-	-	36/36	36/36	36/36	36/36	36/42	36/42	36/42	36/42	36/50	36/50	36/50	36/50	36/65	36/65	36/65	36/65
	25	-	-	-	-	-	-	-	-	15/36	15/36	30/36	30/36	15/42	15/42	30/42	30/42	15/50	15/50	30/50	30/50	15/65	15/65	30/65	30/65
	32	-	-	-	-	-	-	-	-	10/30	10/30	36/30	30/30	10/36	10/36	36/36	30/36	10/42	10/42	36/42	30/42	10/50	10/50	36/50	30/50
	40	-	-	-	-	-	-	-	-	3,5/30	10/30	15/30	25/30	3,5/36	10/36	15/36	25/36	3,5/42	10/42	15/42	25/42	3,5/50	10/50	15/50	25/50
	50	-	-	-	-	-	-	-	-	-	3,5/30	10/30	22/30	-	3,5/36	10/36	22/36	-	3,5/42	10/42	22/42	-	3,5/50	10/50	22/50
	63	-	-	-	-	-	-	-	-	-	-	8/30	22/30	-	-	8/36	22/36	-	-	8/42	22/42	-	-	8/50	22/50
Surion GPS1BS GPS1MS	10	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	150/150	150/150	150/150	150/150
	12.5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	80/80	80/80	80/80	80/80	150/150	150/150	150/150	150/150
	16/20	-	-	-	-	-	-	-	-	36/36	36/36	36/36	36/36	42/42	42/42	42/42	42/42	50/50	50/50	50/50	50/50	65/65	65/65	65/65	65/65
	25/32	-	-	-	-	-	-	-	-	36/36	36/36	36/36	36/36	42/42	42/42	42/42	42/42	50/50	50/50	50/50	50/50	65/65	65/65	65/65	65/65
	40	-	-	-	-	-	-	-	-	-	36/36	36/36	36/36	-	42/42	42/42	42/42	-	50/50	50/50	50/50	-	65/65	65/65	65/65
	50/63	-	-	-	-	-	-	-	-	-	-	36/36	36/36	-	-	42/42	42/42	-	-	50/50	50/50	-	-	65/65	65/65
Surion GPS2BS GPS2MS	10	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	150/150	150/150	150/150	150/150
	12.5	-	-	-	-	-	-	-	-	36/36	36/36	36/36	36/36	42/42	42/42	42/42	42/42	50/50	50/50	50/50	50/50	65/65	65/65	65/65	65/65
	16/20	-	-	-	-	-	-	-	-	36/36	36/36	36/36	36/36	42/42	42/42	42/42	42/42	50/50	50/50	50/50	50/50	65/65	65/65	65/65	65/65
	25/32	-	-	-	-	-	-	-	-	36/36	36/36	36/36	36/36	42/42	42/42	42/42	42/42	50/50	50/50	50/50	50/50	65/65	65/65	65/65	65/65
	40	-	-	-	-	-	-	-	-	-	36/36	36/36	36/36	-	42/42	42/42	42/42	-	50/50	50/50	50/50	-	65/65	65/65	65/65
	50/63	-	-	-	-	-	-	-	-	-	-	36/36	36/36	-	-	42/42	42/42	-	-	50/50	50/50	-	-	65/65	65/65
Surion GPS1BH GPS1MH GPS2BH GPS2MH	10	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	150/150	150/150	150/150	150/150
	12.5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	150/150	150/150	150/150	150/150
	16/20	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	80/80	80/80	80/80	80/80	150/150	150/150	150/150	150/150
	25/32	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	80/80	80/80	80/80	80/80	150/15	150/150	150/150	150/150
	40	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	80/80	80/80	80/80	-	150/150	150/150	150/150
	50/63	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	80/80	80/80	-	-	150/150	150/150

Table DB1a - Selectivity Plus

	In (A)	Selectivity limit in kA / Maximum Icu of combination at 230/240V AC																							
Redline EPC30 45 B/C curve	16	6/15	6/15	10/15	10/15	6/15	6/15	10/15	15/15	15/15	15/15	15/15	15/15	15/15	15/15	15/15	15/15	15/15	15/15	15/15	15/15	15/15	15/15	15/15	15/15
	20	3/15	6/15	8/15	10/15	3/15	6/15	8/15	10/15	15/15	15/15	15/15	15/15	15/15	15/15	15/15	15/15	15/15	15/15	15/15	15/15	15/15	15/15	15/15	15/15
	25	-	6/15	6/15	10/15	-	6/15	6/15	10/15	15/15	15/15	15/15	15/15	15/15	15/15	15/15	15/15	15/15	15/15	15/15	15/15	15/15	15/15	15/15	15/15
	32	-	3/15	6/15	10/15	-	3/15	6/15	10/15	10/15	10/15	15/15	15/15	10/15	10/15	15/15	15/15	10/15	10/15	15/15	15/15	10/15	10/15	15/15	15/15
	40	-	3/15	4/15	10/15	-	3/15	4/15	10/15	3,5/15	10/15	15/15	15/15	3,5/15	10/15	15/15	15/15	3,5/15	10/15	15/15	15/15	3,5/15	10/15	15/15	15/15
Redline DME60 EPC61N EPC60 B/C curve	16	6/15	6/15	10/15	10/15	6/18	6/18	10/18	10/18	22/22	22/22	22/22	22/22	22/22	22/22	22/22	22/22	22/22	22/22	22/22	22/22	22/22	22/22	22/22	22/22
	20	3/15	6/15	8/15	10/15	3/18	6/18	8/18	10/18	22/22	22/22	22/22	22/22	22/22	22/22	22/22	22/22	22/22	22/22	22/22	22/22	22/22	22/22	22/22	22/22
	25	-	6/15	6/15	10/15	-	6/18	6/18	10/18	15/22	22/22	22/22	22/22	15/22	22/22	22/22	22/22	15/22	22/22	22/22	22/22	15/22	22/22	22/22	22/22
	32	-	3/15	6/15	10/15	-	3/18	6/18	10/18	10/22	10/22	22/22	22/22	10/22	10/22	22/22	22/22	10/22	10/22	22/22	22/22	10/22	10/22	22/22	22/22
	40	-	3/15	4/15	10/15	-	3/18	4/18	10/18	3,5/22	10/22	15/22	25/22	3,5/22	10/22	15/22	25/22	3,5/22	10/22	15/22	25/22	3,5/22	10/22	15/22	25/22
Redline DME100 EPC101N B/C curve	16	6/18	6/18	10/18	18/18	6/22	6/22	10/22	10/22	25/25	25/25	25/25	25/25	25/25	25/25	25/25	25/25	25/25	25/25	25/25	25/25	25/25	25/25	25/25	25/25
	20	3/18	6/18	8/18	18/18	3/22	6/22	8/22	10/22	25/25	25/25	25/25	25/25	25/25	25/25	25/25	25/25	25/25	25/25	25/25	25/25	25/25	25/25	25/25	25/25
	25	-	6/18	6/18	18/18	-	6/22	6/22	10/22	15/25	25/25	25/25	25/25	15/25	25/25	25/25	25/25	15/25	25/25	25/25	25/25	15/25	25/25	25/25	25/25
	32	-	3/18	6/18	18/18	-	3/22	6/22	10/22	10/25	25/25	25/25	25/25	10/25	10/25	25/25	25/25	10/25	10/25	25/25	25/25	10/25	10/25	25/25	25/25
	40	-	3/18	4/18	18/18	-	3/22	4/22	10/22	3.5/25	10/25	15/25	25/25	3.5/25	10/25	15/25	25/25	3.5/25	10/25	10/25	25/25	3.5/25	10/25	10/25	25/25

Table DB2 - Selectivity Plus

Upstream / Downstream	In (A)	Record Plus type																							
		FE160N-LTMD/SMR1				FE160H-LTMD/SMR1				FE160L-LTMD/SMR1				FE250N-LTMD/SMR1				FE250H-LTMD/SMR1				FE250L-LTMD/SMR1			
		63	100	125	160	63	100	125	160	63	100	125	160	125	160	200	250	125	160	200	250	125	160	200	250
		Selectivity limit in kA / Maximum Icu of combination at 400/415V AC																							
Redline	25	25/25	25/25	25/25	25/25	30/30	30/30	30/30	30/30	36/36	36/36	36/36	36/36	22/22	22/22	22/22	22/22	25/25	25/25	25/25	25/25	30/30	30/30	30/30	30/30
G30 EPC30/45	32	25/25	25/25	25/25	25/25	30/30	30/30	30/30	30/30	36/36	36/36	36/36	36/36	22/22	22/22	22/22	22/22	25/25	25/25	25/25	25/25	30/30	30/30	30/30	30/30
B/C curve	40	-	25/25	25/25	25/25	-	30/30	30/30	30/30	-	36/36	36/36	36/36	22/22	22/22	22/22	22/22	25/25	25/25	25/25	25/25	30/30	30/30	30/30	30/30
Redline	25	30/30	30/30	30/30	30/30	36/36	36/36	36/36	36/36	42/42	42/42	42/42	42/42	30/30	30/30	30/30	30/30	36/36	36/36	36/36	36/36	36/36	36/36	36/36	36/36
G60	32	30/30	30/30	30/30	30/30	36/36	36/36	36/36	36/36	42/42	42/42	42/42	42/42	30/30	30/30	30/30	30/30	36/36	36/36	36/36	36/36	36/36	36/36	36/36	36/36
B/C curve	40	-	30/30	30/30	30/30	-	36/36	36/36	36/36	-	42/42	42/42	42/42	30/30	30/30	30/30	30/30	36/36	36/36	36/36	36/36	36/36	36/36	36/36	36/36
	50	-	30/30	30/30	30/30	-	36/36	36/36	36/36	-	42/42	42/42	42/42	30/30	30/30	30/30	30/30	36/36	36/36	36/36	36/36	36/36	36/36	36/36	36/36
	63	-	-	30/30	30/30	-	-	36/36	36/36	-	-	42/42	42/42	30/30	30/30	30/30	30/30	36/36	36/36	36/36	36/36	36/36	36/36	36/36	36/36
Redline	25	36/36	36/36	36/36	36/36	42/42	42/42	42/42	42/42	50/50	50/50	50/50	50/50	30/30	30/30	30/30	30/30	36/36	36/36	36/36	36/36	36/36	36/36	36/36	36/36
G100	32	36/36	36/36	36/36	36/36	42/42	42/42	42/42	42/42	50/50	50/50	50/50	50/50	30/30	30/30	30/30	30/30	36/36	36/36	36/36	36/36	36/36	36/36	36/36	36/36
B/C curve	40	-	36/36	36/36	36/36	-	42/42	42/42	42/42	-	50/50	50/50	50/50	30/30	30/30	30/30	30/30	36/36	36/36	36/36	36/36	36/36	36/36	36/36	36/36
	50	-	36/36	36/36	36/36	-	42/42	42/42	42/42	-	50/50	50/50	50/50	30/30	30/30	30/30	30/30	36/36	36/36	36/36	36/36	36/36	36/36	36/36	36/36
	63	-	-	36/36	36/36	-	-	42/42	42/42	-	-	50/50	50/50	30/30	30/30	30/30	30/30	36/36	36/36	36/36	36/36	36/36	36/36	36/36	36/36
Redline	25	42/42	42/42	42/42	42/42	50/50	50/50	50/50	50/50	65/65	65/65	65/65	65/65	36/36	36/36	36/36	36/36	42/42	42/42	42/42	42/42	42/42	42/42	42/42	42/42
GT25	32	36/36	36/36	36/36	36/36	42/42	42/42	42/42	42/42	50/50	50/50	50/50	50/50	36/36	36/36	36/36	36/36	42/42	42/42	42/42	42/42	42/42	42/42	42/42	42/42
B/C curve	40	-	36/36	36/36	36/36	-	42/42	42/42	42/42	-	50/50	50/50	50/50	36/36	36/36	36/36	36/36	42/42	42/42	42/42	42/42	42/42	42/42	42/42	42/42
	50	-	36/36	36/36	36/36	-	42/42	42/42	42/42	-	50/50	50/50	50/50	30/30	30/30	30/30	30/30	36/36	36/36	36/36	36/36	36/36	36/36	36/36	36/36
	63	-	-	36/36	36/36	-	-	42/42	42/42	-	-	50/50	50/50	30/30	30/30	30/30	30/30	36/36	36/36	36/36	36/36	36/36	36/36	36/36	36/36
Surion	10	-	-	-	-	-	-	-	-	150/150	150/150	150/150	150/150	-	-	-	-	-	-	-	-	150/150	150/150	150/150	150/150
GPS1BS GPS1MS	12.5	-	-	-	-	80/80	80/80	80/80	80/80	150/150	150/150	150/150	150/150	-	-	-	-	80/80	80/80	80/80	80/80	150/150	150/150	150/150	150/150
	16/20	42/42	42/42	42/42	42/42	50/50	50/50	50/50	50/50	65/65	65/65	65/65	65/65	42/42	42/42	42/42	42/42	50/50	50/50	50/50	50/50	65/65	65/65	65/65	65/65
	25/32	42/42	42/42	42/42	42/42	50/50	50/50	50/50	50/50	65/65	65/65	65/65	65/65	42/42	42/42	42/42	42/42	50/50	50/50	50/50	50/50	65/65	65/65	65/65	65/65
	40	-	42/42	42/42	42/42	-	50/50	50/50	50/50	-	65/65	65/65	65/65	42/42	42/42	42/42	42/42	50/50	50/50	50/50	50/50	65/65	65/65	65/65	65/65
	50/63	-	-	42/42	42/42	-	---	50/50	50/50	-	-	65/65	65/65	42/42	42/42	42/42	42/42	50/50	50/50	50/50	50/50	65/65	65/65	65/65	65/65
Surion	10	-	-	-	-	-	-	-	-	150/150	150/150	150/150	150/150	-	-	-	-	-	-	-	-	150/150	150/150	150/150	150/150
GPS2BS GPS2MS	12.5	42/42	42/42	42/42	42/42	50/50	50/50	50/50	50/50	65/65	65/65	65/65	65/65	42/42	42/42	42/42	42/42	50/50	50/50	50/50	50/50	65/65	65/65	65/65	65/65
	16/20	42/42	42/42	42/42	42/42	50/50	50/50	50/50	50/50	65/65	65/65	65/65	65/65	42/42	42/42	42/42	42/42	50/50	50/50	50/50	50/50	65/65	65/65	65/65	65/65
	25/32	42/42	42/42	42/42	42/42	50/50	50/50	50/50	50/50	65/65	65/65	65/65	65/65	42/42	42/42	42/42	42/42	50/50	50/50	50/50	50/50	65/65	65/65	65/65	65/65
	40	-	42/42	42/42	42/42	-	50/50	50/50	50/50	-	65/65	65/65	65/65	42/42	42/42	42/42	42/42	-	50/50	50/50	50/50	-	65/65	65/65	65/65
	50/63	-	-	42/42	42/42	-	-	50/50	50/50	-	-	65/65	65/65	42/42	42/42	42/42	42/42	-	-	50/50	50/50	-	-	65/65	65/65
Surion	10	-	-	-	-	-	-	-	-	150/150	150/150	150/150	150/150	-	-	-	-	-	-	-	-	150/150	150/150	150/150	150/150
GPS1BH GPS1MH	12.5	-	-	-	-	-	-	-	-	150/150	150/150	150/150	150/150	-	-	-	-	-	-	-	-	150/150	150/150	150/150	150/150
GPS2BH GPS2MH	16/20	-	-	-	-	80/80	80/80	80/80	80/80	150/150	150/150	150/150	150/150	-	-	-	-	80/80	80/80	80/80	80/80	150/150	150/150	150/150	150/150
	25/32	-	-	-	-	80/80	80/80	80/80	80/80	150/150	150/150	150/150	150/150	-	-	-	-	80/80	80/80	80/80	80/80	150/150	150/150	150/150	150/150
	40	-	-	-	-	--	80/80	80/80	80/80	-	150/150	150/150	150/150	-	-	-	-	80/80	80/80	80/80	80/80	150/150	150/150	150/150	150/150
	50/63	-	-	-	-	-	-	80/80	80/80	-	-	150/150	150/150	-	-	-	-	80/80	80/80	80/80	80/80	150/150	150/150	150/150	150/150

Table DB2a - Selectivity Plus

Upstream / Downstream	In (A)	Record Plus type																							
		FE160N-LTMD/SMR1				FE160H-LTMD/SMR1				FE160L-LTMD/SMR1				FE250N-LTMD/SMR1				FE250H-LTMD/SMR1				FE250L-LTMD/SMR1			
		63	100	125	160	63	100	125	160	63	100	125	160	125	160	200	250	125	160	200	250	125	160	200	250
		Selectivity limit in kA / Maximum Icu of combination at 230/240 AC																							
Redline	16	12/12	12/12	12/12	12/12	12/12	12/12	12/12	12/12	12/12	12/12	12/12	12/12	10/10	10/10	10/10	10/10	10/10	10/10	10/10	10/10	10/10	10/10	10/10	10/10
EPC30 45	20	12/12	12/12	12/12	12/12	12/12	12/12	12/12	12/12	12/12	12/12	12/12	12/12	10/10	10/10	10/10	10/10	10/10	10/10	10/10	10/10	10/10	10/10	10/10	10/10
B/C curve	25	12/12	12/12	12/12	12/12	12/12	12/12	12/12	12/12	12/12	12/12	12/12	12/12	10/10	10/10	10/10	10/10	10/10	10/10	10/10	10/10	10/10	10/10	10/10	10/10
	32	12/12	12/12	12/12	12/12	12/12	12/12	12/12	12/12	12/12	12/12	12/12	12/12	10/10	10/10	10/10	10/10	10/10	10/10	10/10	10/10	10/10	10/10	10/10	10/10
	40	-	12/12	12/12	12/12	-	12/12	12/12	12/12	-	12/12	12/12	12/12	10/10	10/10	10/10	10/10	10/10	10/10	10/10	10/10	10/10	10/10	10/10	10/10
Redline	16	18/18	18/18	18/18	18/18	18/18	18/18	18/18	18/18	18/18	18/18	18/18	18/18	15/15	15/15	15/15	15/15	15/15	15/15	15/15	15/15	15/15	15/15	15/15	15/15
DME60	20	18/18	18/18	18/18	18/18	18/18	18/18	18/18	18/18	18/18	18/18	18/18	18/18	15/15	15/15	15/15	15/15	15/15	15/15	15/15	15/15	15/15	15/15	15/15	15/15
C60	25	18/18	18/18	18/18	18/18	18/18	18/18	18/18	18/18	18/18	18/18	18/18	18/18	15/15	15/15	15/15	15/15	15/15	15/15	15/15	15/15	15/15	15/15	15/15	15/15
B/C curve	32	18/18	18/18	18/18	18/18	18/18	18/18	18/18	18/18	18/18	18/18	18/18	18/18	15/15	15/15	15/15	15/15	15/15	15/15	15/15	15/15	15/15	15/15	15/15	15/15
	40	-	18/18	18/18	18/18	-	18/18	18/18	18/18	-	18/18	18/18	18/18	15/15	15/15	15/15	15/15	15/15	15/15	15/15	15/15	15/15	15/15	15/15	15/15
Redline	16	22/22	22/22	22/22	22/22	22/22	22/22	22/22	22/22	22/22	22/22	22/22	22/22	18/18	18/18	18/18	18/18	18/18	18/18	18/18	18/18	18/18	18/18	18/18	18/18
DME100	20	22/22	22/22	22/22	22/22	22/22	22/22	22/22	22/22	22/22	22/22	22/22	22/22	18/18	18/18	18/18	18/18	18/18	18/18	18/18	18/18	18/18	18/18	18/18	18/18
B/C curve	25	22/22	22/22	22/22	22/22	22/22	22/22	22/22	22/22	22/22	22/22	22/22	22/22	18/18	18/18	18/18	18/18	18/18	18/18	18/18	18/18	18/18	18/18	18/18	18/18
	32	22/22	22/22	22/22	22/22	22/22	22/22	22/22	22/22	22/22	22/22	22/22	22/22	18/18	18/18	18/18	18/18	18/18	18/18	18/18	18/18	18/18	18/18	18/18	18/18
	40	-	22/22	22/22	22/22	-	22/22	22/22	22/22	-	22/22	22/22	22/22	18/18	18/18	18/18	18/18	18/18	18/18	18/18	18/18	18/18	18/18	18/18	18/18

Table DB3 - Selectivity Plus

Upstream / Downstream		Record Plus type																					
		FE160N-LTMD			FE160H-LTMD			FE160L-LTMD			FE250N-LTMD				FE250H-LTMD				FE250L-LTMD			
	In (A)	100	125	160	100	125	160	100	125	160	125	160	200	250	125	160	200	250	125	160	200	250
		Selectivity limit in kA / Maximum Icu of combination at 400/415V AC																					
Record Plus																							
LTM, LTMD, GTM MO																							
FD160C	63	30/30	30/30	30/30	30/36	30/36	30/36	30/42	30/42	30/42	30/30	30/30	30/30	30/30	36/36	36/36	36/36	36/36	42/42	42/42	42/42	42/42
FD160E	63	30/36	30/36	30/36	30/42	30/42	30/42	30/50	30/50	30/50	36/36	36/36	36/36	36/36	42/42	42/42	42/42	42/42	42/50	42/50	42/50	42/50
FD160S	63	30/42	30/42	30/42	30/50	30/50	30/50	30/65	30/65	30/65	42/42	42/42	42/42	42/42	42/50	42/50	42/50	42/50	42/65	42/65	42/65	42/65
FD160N	63	30/50	30/50	30/50	30/80	30/80	30/80	30/150	30/150	30/150	42/50	42/50	42/50	42/50	42/80	42/80	42/80	42/80	42/150	42/150	42/150	42/150
FD160H	63	-	-	-	30/80	30/80	30/80	30/150	30/150	30/150	-	-	-	-	42/80	42/80	42/80	42/80	42/150	42/150	42/150	42/150
LTM, LTMD, GTM MO																							
FDC160	100	-	-	30/30	-	-	30/36	-	-	30/42	-	30/30	30/30	30/30	-	36/36	36/36	36/36	-	42/42	42/42	42/42
FDE160	100	-	-	30/36	-	-	30/42	-	-	30/50	-	36/36	36/36	36/36	-	42/42	42/42	42/42	-	42/50	42/50	42/50
FDS160	100	-	-	30/42	-	-	30/50	-	-	30/65	-	42/42	42/42	42/42	-	42/50	42/50	42/50	-	42/65	42/65	42/65
FDN160	100	-	-	30/50	-	-	30/80	-	-	30/150	-	42/50	42/50	42/50	-	42/80	42/80	42/80	-	42/150	42/150	42/150
FDH160	100	-	-	-	-	-	30/80	-	-	30/150	-	-	-	-	-	42/80	42/80	42/80	-	42/150	42/150	42/150
LTM, LTMD GTM																							
FDC160	125	-	-	-	-	-	-	-	-	-	-	-	30/30	30/30	-	-	36/36	36/36	-	-	42/42	42/42
FDE160	125	-	-	-	-	-	-	-	-	-	-	-	36/36	36/36	-	-	42/42	42/42	-	-	42/50	42/50
FDS160	125	-	-	-	-	-	-	-	-	-	-	-	42/42	42/42	-	-	42/50	42/50	-	-	42/65	42/65
FDN160	125	-	-	-	-	-	-	-	-	-	-	-	42/50	42/50	-	-	42/80	42/80	-	-	42/150	42/150
FDH160	125	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	42/80	42/80	-	-	42/150	42/150
LTM, LTMD GTM																							
FDC160	160	-	-	-	-	-	-	-	-	-	-	-	-	30/30	-	-	-	36/36	-	-	-	42/42
FDE160	160	-	-	-	-	-	-	-	-	-	-	-	-	36/36	-	-	-	42/42	-	-	-	42/50
FDS160	160	-	-	-	-	-	-	-	-	-	-	-	-	42/42	-	-	-	42/50	-	-	-	42/65
FDN160	160	-	-	-	-	-	-	-	-	-	-	-	-	42/50	-	-	-	42/80	-	-	-	42/150
FDH160	160	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	42/80	-	-	-	42/150

Table DB4 - Selectivity Plus

Upstream / Downstream		Record Plus type																					
		FE160N-SMR1			FE160H-SMR1			FE160L-SMR1			FE250N-SMR1				FE250H-SMR1				FE250L-SMR1			
	In (A)	100	125	160	100	125	160	100	125	160	125	160	200	250	125	160	200	250	125	160	200	250
		Selectivity limit in kA / Maximum Icu of combination at 400/415V AC																					
Record Plus																							
LTM, LTMD, GTM MO																							
FD160C	63	-	30/30	30/30	-	30/36	30/36	-	36/42	36/42	30/30	30/30	30/30	30/30	36/36	36/36	36/36	36/36	42/42	42/42	42/42	42/42
FD160E	63	-	36/36	36/36	-	30/42	30/42	-	36/50	36/50	36/36	36/36	36/36	36/36	42/42	42/42	42/42	42/42	50/50	50/50	50/50	50/50
FD160S	63	-	36/42	36/42	-	30/50	30/50	-	36/65	36/65	42/42	42/42	42/42	42/42	50/50	50/50	50/50	50/50	50/65	50/65	50/65	50/65
FD160N	63	-	36/50	36/50	-	30/80	30/80	-	36/150	36/150	50/50	50/50	50/50	50/50	50/80	50/80	50/80	50/80	50/150	50/150	50/150	50/150
FD160H	63	-	-	-	-	30/80	30/80	-	36/150	36/150	-	-	-	-	50/80	50/80	50/80	50/80	50/150	50/150	50/150	50/150
LTM, LTMD, GTM MO																							
FDC160	100	-	-	30/30	-	-	30/36	-	-	36/42	-	30/30	30/30	30/30	-	36/36	36/36	36/36	-	42/42	42/42	42/42
FDE160	100	-	-	36/36	-	-	30/42	-	-	36/50	-	36/36	36/36	36/36	-	42/42	42/42	42/42	-	50/50	50/50	50/50
FDS160	100	-	-	36/42	-	-	30/50	-	-	36/65	-	42/42	42/42	42/42	-	50/50	50/50	50/50	-	50/65	50/65	50/65
FDN160	100	-	-	36/50	-	-	30/80	-	-	36/150	-	50/50	50/50	50/50	-	50/80	50/80	50/80	-	50/150	50/150	50/150
FDH160	100	-	-	-	-	-	30/80	-	-	36/150	-	-	-	-	-	50/80	50/80	50/80	-	50/150	50/150	50/150
LTM, LTMD GTM																							
FDC160	125	-	-	-	-	-	-	-	-	-	-	-	30/30	30/30	-	-	36/36	36/36	-	-	42/42	42/42
FDE160	125	-	-	-	-	-	-	-	-	-	-	-	36/36	36/36	-	-	42/42	42/42	-	-	50/50	50/50
FDS160	125	-	-	-	-	-	-	-	-	-	-	-	42/42	42/42	-	-	50/50	50/50	-	-	50/65	50/65
FDN160	125	-	-	-	-	-	-	-	-	-	-	-	50/50	50/50	-	-	50/80	50/80	-	-	50/150	50/150
FDH160	125	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	50/150	50/150
LTM, LTMD GTM																							
FDC160	160	-	-	-	-	-	-	-	-	-	-	-	-	30/30	-	-	-	36/36	-	-	-	42/42
FDE160	160	-	-	-	-	-	-	-	-	-	-	-	-	36/36	-	-	-	42/42	-	-	-	50/50
FDS160	160	-	-	-	-	-	-	-	-	-	-	-	-	42/42	-	-	-	50/50	-	-	-	50/65
FDN160	160	-	-	-	-	-	-	-	-	-	-	-	-	50/50	-	-	-	50/80	-	-	-	50/150
FDH160	160	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	50/80	-	-	-	50/150

Table DB5 - Selectivity Plus

Upstream / Downstream	*Record Plus* type											
	FG400N-SMR1		FG400H-SMR1		FG400L-SMR1		FG630N-SMR1		FG630H-SMR1		FG630L-SMR1	
In (A)	250	400	250	400	250	400	400	500 - 630	400	500 - 630	400	500 - 630
	Selectivity limit in kA / Maximum Icu of combination at 400/415V AC											
Record Plus												
LTM, LTMD, GTM MO												
FDC160	30/30	30/30	36/36	36/36	42/42	42/42	30/30	30/30	36/36	36/36	42/42	42/42
FDE160	36/36	36/36	42/42	42/42	50/50	50/50	36/36	36/36	42/42	42/42	50/50	50/50
FDS160	42/42	42/42	50/50	50/50	65/65	65/65	42/42	42/42	50/50	50/50	65/65	65/65
FDN160	50/50	50/50	80/80	80/80	150/150	150/150	50/50	50/50	80/80	80/80	150/150	150/150
FDH160	-	-	80/80	80/80	150/150	150/150	-	-	80/80	80/80	150/150	150/150
LTM, LTMD, GTM, MO SMR1												
FEN160	50/50	50/50	80/80	80/80	150/150	150/150	50/50	50/50	80/80	80/80	150/150	150/150
FEH160	-	-	80/80	80/80	150/150	150/150	-	-	80/80	80/80	150/150	150/150
FEN250	-	-	80/80	80/80	150/150	150/150	50/50	50/50	80/80	80/80	150/150	150/150
FEH250	-	-	80/80	80/80	150/150	150/150	-	-	80/80	80/80	150/150	150/150

Table DB6 - Selectivity Plus

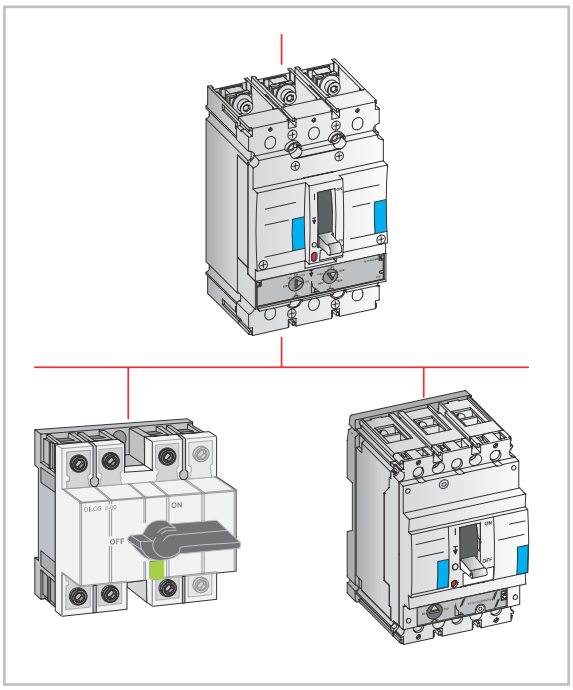
Upstream / Downstream	*Record Plus* type										
	FK800N-SMR	FK800H-SMR	FK800L-SMR	FK1250N-SMR		FK1250H-SMR		FK1250L-SMR		FK1600N-SMR	FK1600H-SMR
In (A)	800	800	800	1000	1250	1000	1250	1000	1250	1600	1600
	Selectivity limit in kA / Maximum Icu of combination at 400/415V AC										
Record Plus											
LTM, LTMD, GTM MO											
FDN160	50/50	80/80	100/100	50/50	50/50	80/80	80/80	100/100	100/100	50/50	80/80
FDH160	50/50	80/80	100/100	50/50	50/50	80/80	80/80	100/100	100/100	50/50	80/80
LTM, LTMD, GTM, MO SMR1											
FEN160	50/50	80/80	100/100	50/50	50/50	80/80	80/80	100/100	100/100	50/50	80/80
FEH160	50/50	80/80	100/100	50/50	50/50	80/80	80/80	100/100	100/100	50/50	80/80
FEN250	50/50	80/80	100/100	50/50	50/50	80/80	80/80	100/100	100/100	50/50	80/80
FEH250	-	80/80	100/100	50/50	50/50	80/80	80/80	100/100	100/100	50/50	80/80
SMR1 SMR2											
FGN400	50/50	80/80	100/100	50/50	50/50	80/80	80/80	100/100	100/100	50/50	80/80
FGH400	50/50	80/80	100/100	50/50	50/50	80/80	80/80	100/100	100/100	50/50	80/80
FGN630	15/50	15/80	15100	50/50	50/50	80/80	80/80	100/100	100/100	50/50	80/80
FGH630	-	15/80	15/100	-	-	80/80	80/80	100/100	100/100	50/50	80/80
SMR1											
FKN800	-	-	-	15/50	15/50	15/80	15/80	15/100	15/100	25/50	25/80
FKH800	-	-	-	-	-	15/80	15/80	15/100	15/100	25/50	25/80
FKN1250	-	-	-	-	-	-	-	-	-	25/50	25/80

Coordination with loadbreak disconnect switches

Record Plus circuit breakers excel in their characteristics as current and energy limiting devices. This allows one to use lighter and more economical downstream busbar systems and switchgear.

A frequently used combination is that of a ***Record Plus*** breaker, used as a protection and switching device in the mains switchboard, and a Dilos loadbreak switch, as an incomer, in a downstream, secondary switchboard. In this application the Dilos needs to be able to withstand the current and energy values on a short-circuit event, this taking the limiting effects of the upstream breaker into account.

The table indicates the maximum prospective short-circuit that the combination of an upstream ***Record Plus*** and a downstream Dilos or ***Record Plus*** in its switch disconnect variant (type **Y**) can withstand.



Protection of Switch Disconnectors Dilos or Record Plus with Record Plus circuit breakers - alid for 400/415 AC

Upstream *Record Plus* circuit breaker	Breaking capacity Icu Ics (kA eff.)	Downstream Dilos switch	Maximum allowable short-circuit (kA eff.) of combination	Downstream *Record Plus* switch	Maximum allowable short-circuit (kA eff.) of combination
FD160S	36	Dilos 1 1H	18	FD63	36
		Dilos 2	18	FD160	36
FD160N	50	Dilos 1 1H	25	FD63	50
		Dilos 2	25	FD160	50
FD160H	80	Dilos 1 1H	30	FD63	80
		Dilos 2	30	FD160	80
FD160L	150	Dilos 1 1H	36	FD63	150
		Dilos 2	36	FD160	150
FE160N	50	Dilos 1 1H	25	FD63	50
		Dilos 2	25	FD160	50
FE160H	80	Dilos 1 1H	30	FD63	80
		Dilos 2	30	FD160	80
FE160L	150	Dilos 1 1H	36	FD63	150
		Dilos 2	36	FD160	150
FE250N	50	Dilos 3	50	FE250	50
FE250H	80	Dilos 3	80	FE250	80
FE250L	150	Dilos 3	150	FE250	150
FG400N	50	Dilos 4	50	FG400	50
FG400H	80	Dilos 4	80	FG400	80
FG400L	150	Dilos 4	150	FG400	150
FG630N	50	Dilos 4	50	FG630	50
FG630H	80	Dilos 4	80	FG630	80
FG630L	150	Dilos 4	150	FG630	150
FK800N	50	Dilos 6	50	FK800	50
FK800H	80	Dilos 6	80	FK800	80
FK1250N	50	Dilos 6	50	FK1250	50
FK1250H	80	Dilos 6	80	FK1250	80
FK1600N	50	Dilos 7	50	FK1600	50
FK1600H	80	Dilos 7	80	FK1600	80

Protection of motor circuits

General
In a circuit that provides power to a motor a number of protective and control devices are normally present. The combination of these devices must be coordinated to ensure the efficiency and an optimal protection of the motor. Here, the protection of such circuits strongly depends on the operational requirements, as the application for which the motor is used, the required starting frequency, the required service level and the applicable safety standards.

Protection of the electrical circuit
The motor circuit must provide the following functionality:

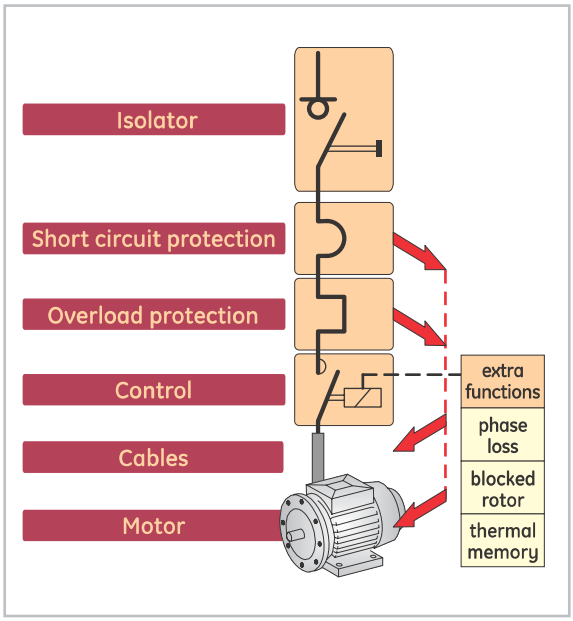
- Isolate the circuit from the network for maintenance.
- Protect against short-circuits in the equipment, the starter and the cables within the circuit.
- Protect against overloads in the equipment, the starter and the cables within the circuit.
- Protect against faults specific to the motor within it s application.

Control of the motor in question, this covering starting, stopping, speed control etc.

Standards
The requirements for circuits supplying a motor, in general called motor starters , can be found in the IEC 60947-4-1. To define the components for isolation, overload and short-circuit protection the following elements must be defined:

- Depending on the type of electrical motor and it's operational requirements, four motor utilization categories have been defined. These have an impact on the characteristics of the control element within the circuit. These so called AC classes are depicted in the table on the right.
- The required trip curve class of the overload protection, this depending on the motor application, the classes 10A, 10, 20 and 30 are normally used, the requirements for which are indicated in the table.

Isolation and safety during maintenance. Use of the ***Record Plus*** breaker here provides an enhancement of the present standard requirement for **POSITIVE OFF** adding in a **POSITIVE ON** indication.



Category	Load type	Contactor usage
AC1	Non Inductive motors	Energization
AC2	Slip ring motors	Starting Switching off whilst running Regenerative breaking Inching
AC3	Squirrel-cage motors	Energization Switching off whilst running
AC4	Squirrel-cage motors (cos phi 0.45 100A) (cos phi 0.35 100A)	Starting Switching off whilst running Regenerative breaking Plugging Inching

	Re uired tripping times at		
Trip class	1.2 x In	1.5 x In	7.2 x In
10A	t 2 hours	t 2 min.	2 t 10 sec.
10	t 2 hours	t 4 min.	4 t 10 sec.
20	t 2 hours	t 8 min.	6 t 20 sec.
30	t 2 hours	t 12 min.	9 t 30 sec.

Coordination
The standards require tests to define the coordination between the devices within the motor starter. Depending on the state of the components after the test two coordination classes 1 and 2 have been defined.

The unique properties of the ***Record Plus*** breaker allow GE to offer solutions meeting the highest standards. For this reason all tables published here only refer to **coordination type 2**.

This entails that the GE e uipment meets the following standards

No or minor weldings of the contactors after testing contact separation is simple and easy
The switchgear and controlgear are fully operational after the tests indicated here.

Solutions with the *Record Plus* breaker
Motor starters are compiled with a number of GE components. This is to offer the required functionality of the motor starter circuit and to allow a choice in the execution thereof.

Coordination type 2 test se uence

Motor current Ie (AC3)	Test with current r
Ie 16A	1 kA
16 Ie 63A	3 kA
63 Ie 125A	5 kA
125 Ie 315A	10 kA
315 Ie 630A	18 kA
After this test the original characterstics of the contactor and thermal relay MUST remain unchanged.	
After this test the short-circuit protection must trip within 10 ms at a fault current 15 x In.	

Short-circuit test

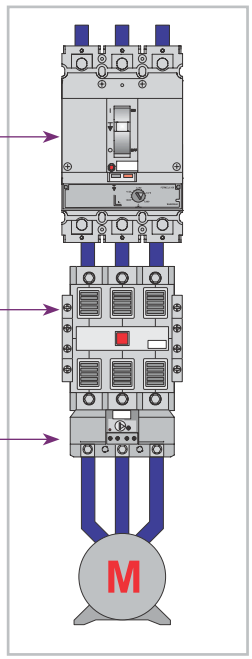
This value which is generally 50kA is used to check the coordination of the devices used in the motor starter circuit. For each combination with ***Record Plus*** breakers this value is mentioned in the tables on pages E.31, E.32, E.33, E.34 and E.35.
After a test with this current the following conditions must be met:
No or minor weldings of the contactors after testing contact separation is simple and easy
The switchgear and controlgear are fully operational after the test.

Option 1

Magnetic only circuit breaker as the short-circuit protection device.

Contactor for control purposes.

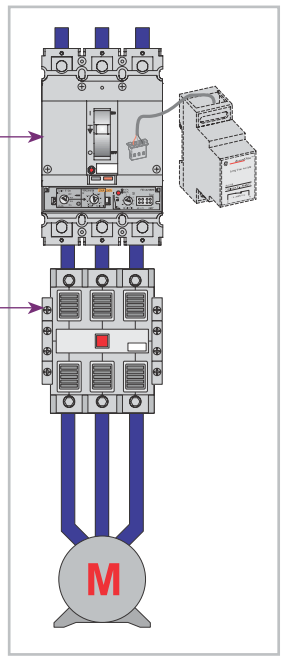
Separate thermal relay for class 10 or class 30 as overload protection.



Option 2

Electronic circuit breaker as the short-circuit and Overload protection device.

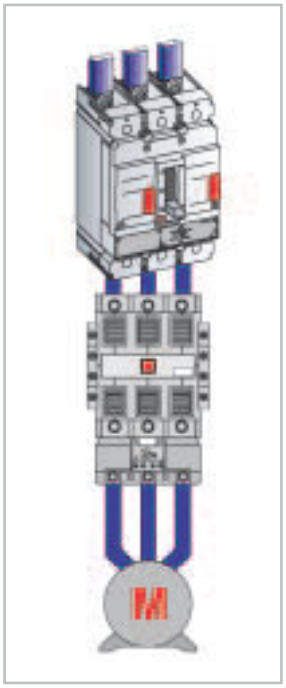
Contactor for control purposes.



After power is disconnected (circuit interruption after a fault) the breaker has no thermal memory function. This implies that after an overload, immediate breaker reset and re-energization of the circuit is possible.
In order to prevent this a Long time module can be utilized that closes a contact on an overload just before the breaker trips. This allowing the contactor in the circuit to be de-energized and a external thermal memory to be initialized, before the breaker trips.

The sketch here depicts the long time module as an optional add on in the circuit diagram. Here the breaker is the short-circuit protection device **AND** a backup overload protection. If the contactor fails to open on a long time module signal the breaker will trip.

Coordination type - E 60 4 -4 - Class 10 protection



Short-circuit Protection by means of Magnetic Only MCCB.

Overload Protection by means of a direct heated electromechanical thermal relay

Phase Loss protection (Thermal relay feature)

Control by GE contactor

Upstream *Record Plus* Breaker selection							
Type	N	H	L	Type	N	H	L
	Icc values in kA Ue 230V AC				Icc values in kA Ue 400/415V AC		
FD160	85	100	130	FD160	50	80	130
FE160/250	85	100	130	FE160/250	50	80	130
FG 400/630	85	100	130	FG 400/630	50	80	130
FK 800/1250	85	100	130	FK 800/1250	50	80	100

Selection of associated components[1]											
Motor		Breaker details			Contactor	Motor		Breaker details			Contactor
P(kw)	In	Type	Ie	Im	Type+O.R.	P(kw)	In	Type	Ie	Im	Type
0.37	2.0	FD/FE160	3[2]	30	CL25+RT1						
0.55	2.8	FD/FE160	3[2]	36	CL25+RT1K						
0.75	3.5	FD/FE160	3[2]	70	CL25+RT1K	0.75	2.0	FD/FE160	3[2]	30	CL25+RT1
1.1	5.0	FD/FE160	7	70	CL03+RT12L	1.1	2.6	FD/FE160	3[2]	33	CL25+RT1K
1.5	6.1	FD/FE160	7	80	CL03+RT1M	1.5	3.6	FD/FE160	7	70	CL03+RT1K
2.2	8.7	FD/FE160	12.5[3]	125	CL06+RT2AN	2.2	5.0	FD/FE160	7	80	CL03+RT12L
3	11.5	FD/FE160	12.5[3]	150	CL06+RT2AN	3	6.6	FD/FE160	7	86	CL03+RT1M
4	14.5	FD/FE160	20[3]	200	CL06+RT2B	4	8.3	FD/FE160	12.5[3]	125	CL06+RT2AN
5.5	20.0	FD/FE160	20[3]	260	CL06-RT2C	5.5	11.5	FD/FE160	12.5[3]	150	CL06+RT2AN
7.5	28	FD/FE160	30[4]	364	CL06-RT2D	7.5	16.1	FD/FE160	20[3]	200	CL06+RT2B
10	36	FD/FE160	50	500	CL06+RT2E	10	21	FD/FE160	30[4]	300	CL06-RT2C
11	39	FD/FE160	50	507	CL06+RT2E	11	22	FD/FE160	30[4]	300	CL06-RT2C
15	50	FD/FE160	50	650	CL06+RT2G	15	30	FD/FE160	30[4]	390	CL06-RT2D
18.5	64	FD/FE160	80[5]	832	CL09+RT2	18.5	37	FD/FE160	50	478	CL06+RT2E
22	75	FD/FE160	80[5]	975	CL09+RT2	22	43	FD/FE160	50	561	CL06+RT2G
25	85	FD/FE160	100	1020	CL09+RT2L	25	49	FD/FE160	50	635	CL06+RT2G
30	100	FD160	100	1300	CL09+RT2M	30	58	FD/FE160	80[5]	800	CL09+RT2H
30	100	FE160	100	1300	CK75C+RT2M	37	72	FD/FE160	80[5]	934	CL09+RT2
37	125	FE160	125	1625	CK85B+RT3E	45	86	FD160	100	1121	CL09+RT2L
45	150	FE160	160	1950	CK85B+RT3F	45	86	FE160	100	1121	CK75C+RT2L
55	180	FE250	250	2500	CK95B+RT3F	55	104	FE160	125	1346	CK85B+RT3E
75	250	FG400	250	3250	CK10B+RT4P	75	144	FE160	160	1869	CK85B+RT3F
90	312	FG400	400	4056	CK10B+RT5C	90	179	FE250	250	2500	CK95B+RT4N
110	360	FG400	400	4680	CK12B+RT5C	110	207	FE250	250	2691	CK10B+RT4P
132	430	FG630	500	5590	CK12B+RT5D	132	247	FG400	250	3214	CK10B+RT4R
160	520	FK800	800	6760	CK13B+RT5E	160	300	FG400	400	3900	CK10B+RT5C
200	630	FK800	800	6930	CK13B+RT5E	200	360	FG400	400	4680	CK12B+RT5C
-	-	-	-	-	-	220	400	FG630	500	5200	CK12B+RT5D
-	-	-	-	-	-	250	462	FG630	500	6004	CK12B+RT5D
-	-	-	-	-	-	300	560	FK800	800	6720	CK13B+RT5E
-	-	-	-	-	-	315	582	FK800	800	6985	CK13B+RT5C
-	-	-	-	-	-	335	619	FK800	800	6810	CK13B+RT5C

(1) The contactor has a breaking capacity that is sufficient to operate the specified motor up to the specified magnetic setting of the breaker
(2) The 3Amp device is designed to operate at a current level up to 3.5Amps
(3) FD160 type contactor size can be reduced to CL04
(4) FD160 type contactor size can be reduced to CL45
(5) FD160 type contactor size can be reduced to CL08

Coordination type - E 60 4 -4 - Class 10 protection

Upstream *Record Plus* Breaker selection

Type	N	H	L
	Icc values in kA Ue 440V AC		
FD160	30	50	80
FE160/250	42	65	130
FG 400/630	42	65	130
FK 800/1250	42	65	80

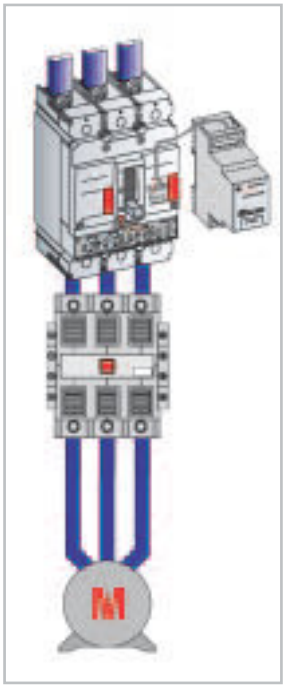
Type	N	H	L
	Icc values in kA Ue 500/525V AC		
FD160	-	36	50
FE160/250	-	50	80
FG 400/630	-	50	80
FK 800/1250	-	36	50

Type	N	H	L
	Icc values in kA Ue 690V AC		
FD160	-	6	Tests pending
FE160/250	-	22	
FG 400/630	-	22	
FK 800/1250	-	22	

Selection of associated components[1]

Motor		Breaker details			Contactor	Motor		Breaker details			Contactor	Motor		Breaker details			Contactor
P(kw)	In	Type	Ie	Im	Type+O.R.	P(kw)	In	Type	Ie	Im	Type+O.R.	P(kw)	In	Type	Ie	Im	Type+O.R.
0.8	1.9	FD/FE160	3[2]	30	CL25+RT1	0.8	1.5	FD/FE160	3[2]	30	CL25+RT1H						
1.1	2.5	FD/FE160	3[2]	30	CL25+RT1K	1.1	2.0	FD/FE160	3[2]	30	CL25+RT1	1.5	2.0	FD/FE160	3[2]	30	CL25+RT1
1.5	3.4	FD/FE160	3[2]	70	CL25+RT1K	1.5	2.6	FD/FE160	3[2]	40	CL25+RT1K	2.2	2.9	FD/FE160	3[2]	38	CL25+RT1K
2.2	4.6	FD/FE160	7	70	CL03+RT12L	2.2	3.8	FD/FE160	7	70	CL03+RT12L	3	3.5	FD/FE160	3[2]	70	CL25+RT1K
3	6.0	FD/FE160	7	78	CL03+RT1M	3	5.0	FD/FE160	7	70	CL03+RT1M	3.7	4.6	FD/FE160	7	70	CL03+RT12L
4	7.6	FD/FE160	12.5[3]	100	CL06+RT2AN	4	6.5	FD/FE160	7	85	CL03+RT1M	4	5.0	FD/FE160	7	70	CL03+RT12L
5.5	10.5	FD/FE160	12.5[3]	136	CL03+RT2AN	5.5	9.0	FD/FE160	12.5[3]	125	CL06+RT2AN	5.5	7.0	FD/FE160	7	91	CL03+RT12M
7.5	14.6	FD/FE160	20[3]	200	CL06+RT2B	7.5	12.0	FD/FE160	12.5[3]	156	CL06+RT2BP	7.5	9.0	FD/FE160	12.5[3]	125	CL07+RT2AN
10	18.8	FD/FE160	20[3]	245	CL06+RT2B	10	15.0	FD/FE160	20[3]	200	CL06+RT2B	11	12.5	FD/FE160	12.5[3]	163	CL07+RT2BP
11	20	FD/FE160	30[4]	300	CL06-RT2C	11	18.4	FD/FE160	20[3]	300	CL06-RT2B	13	16.0	FD/FE160	20[3]	208	CL07+RT2B
15	27	FD/FE160	30[4]	355	CL06-RT2D	15	23	FD/FE160	30[4]	300	CL06-RT2C	15	18.0	FD/FE160	20[3]	234	CL07+RT2B
18.5	33	FD/FE160	50	500	CL06+RT2E	18.5	29	FD/FE160	30[4]	371	CL06-RT2D	18.5	23	FD/FE160	30[4]	300	CL09+RT2C
22	39	FD/FE160	50	510	CL06+RT2E	22	33	FD/FE160	50	500	CL06+RT2E	22	25	FD/FE160	30[4]	325	CL09+RT2D
25	44	FD/FE160	50	578	CL06+RT2G	-	-	-	-	-	-	-	-	-	-	-	-
30	52	FD/FE160	80	680	CL09+RT2H	30	45	FD/FE160	50	585	CL06+RT2G	30	35	FD/FE160	50	500	CL09+RT2E
37	65	FD/FE160	80	849	CL09+RT2	37	55	FD/FE160	80[5]	800	CL09+RT2	37	42	FD/FE160	50	546	CL09+RT2E
45	78	FD/FE160	80	1019	CL09+RT2	45	65	FD/FE160	100	1000	CL09+RT2	45	49	FD/FE160	50	637	CL09+RT2G
55	86	FD160	100	1223	CL09+RT2L	55	80	FD160	100	1100	CL09+RT2S	55	60	FD/FE160	80[5]	800	CL09+RT2
55	94	FE160	100	1223	CK75C+RT2L	55	80	FE160	100	1100	CK75C+RT2	75	80	FD/FE160	80[5]	1040	CL09+R2TL
75	131	FE160	160	1699	CK85B+RT3E	75	110	FE160	125	1430	CK85B+RT3D	90	100	FD160	100	1300	CL09+R2TL
90	163	FE250	250	2500	CK95B+RT3F	90	130	FE160	160	1690	CK95B+RT3E	90	100	FE160	100	1300	CK85B+RT2M
110	188	FE250	250	2500	CK95B+RT4P	110	156	FE160	160	2028	CK95B+RT3F	110	120	FE160	125	1560	CK85B+RT3E
132	225	FE250	250	2922	CK95B+RT4R	132	190	FE250	250	2500	CK95B+RT4P	132	140	FE160	160	1820	CK95B+RT3F
160	300	FG400	400	3900	CK10B+RT5C	160	228	FE250	250	2964	CK95B+RT4R	160	175	FE250	250	2100	CK95B+RT4N
200	360	FG400	400	4680	CK12B+RT5C	200	281	FG400	400	3653	CK10B+RT5C	200	220	FE250	250	2860	CK10B+RT4R
220	400	FG630	500	5200	CK12B+RT5D	220	310	FG400	400	4030	CK10B+RT5C	220	240	FG400	250	3120	CK10B+RT4R
250	462	FG630	500	6004	CK12B+RT5D	-	-	-	-	-	-	250	270	FG400	400	3510	CK10B+RT5C
300	509	FK800	800	6619	CK13B+RT5E	-	-	-	-	-	-	-	-	-	-	-	-
315	529	FK800	800	6880	CK13B+RT5E	315	445	FG630	500	5785	CK12B+RT5D	-	-	-	-	-	-
335	563	FK800	800	6754	CK13B+RT5E	335	460	FG630	500	5980	CK12B+RT5D	335	335	FG400	400	4355	CK10B+RT5C
355	596	FK800	800	6560	CK13B+RT5E	355	500	FK800	800	6500	CK13B+RT5E	-	-	-	-	-	-
375	630	FK800	800	6930	CK13B+RT6A	375	530	FK800	800	6890	CK13B+RT5E	375	400	FG630	500	5200	CK12B+RT5D
-	-	-	-	-	-	400	570	FK800	800	6840	CK13B+RT5E	-	-	-	-	-	-
-	-	-	-	-	-	450	630	FK800	800	7560	CK13B+RT6A	450	480	FG630	500	6240	CK12B+RT5D
-	-	-	-	-	-	-	-	-	-	-	-	500	530	FK800	800	6360	CK13B+RT5E
-	-	-	-	-	-	-	-	-	-	-	-	560	580	FK800	800	6380	CK13B+RT5E

Coordination type - E 60 4 -4 - Class 10 protection with SMR2 other classes possible



Short-circuit and Overload protection by means of Electronic MCCB.
Phase Loss protection (in MCCB)

Overload backup protection and overload alarm on use of LT module.
Control by GE contactor

Upstream *Record Plus* Breaker selection

Type	N	H	L	Type	N	H	L
	Icc values in kA Ue 230V AC				Icc values in kA Ue 400/415V AC		
FE160/250	85	100	130	FE160/250	50	80	130
FG 400/630	85	100	130	FG 400/630	50	80	130

Selection of associated components[1]

Motor		Breaker details			Contactor	Motor		Breaker details			Contactor
P(kw)	In	Type	Ie	Ist	Type	P(kw)	In	Type	Ie	Im	Type
3	11.5	FE160	25	150	CL08	-	-	-	-	-	-
4	14.5	FE160	25	189	CL08	-	-	-	-	-	-
5.5	20	FE160	25	260	CL08	5.5	11.5	FE160	25	150	CL08
7.5	28	FE160	63	364	CL09	7.5	16.1	FE160	25	200	CL08
10	36	FE160	63	468	CL09	10	21	FE160	25	300	CL08
11	39	FE160	63	507	CL09	11	22	FE160	25	300	CL08
15	50	FE160	63	650	CL09	15	30	FE160	63	390	CL09
18.5	64	FE160	125	832	CK85B	18.5	37	FE160	63	478	CL09
22	75	FE160	125	975	CK85B	22	43	FE160	63	561	CL09
25	85	FE160	125	1105	CK85B	25	49	FE160	63	635	CL09
30	100	FE160	125	1300	CK85B	30	58	FE160	63	800	CL09
37	125	FE160	160	1625	CK95B	37	72	FE160	125	934	CK85B
45	150	FE160	160	1950	CK95B	45	86	FE160	125	1121	CK85B
55	180	FE250	250	2340	CK95B	55	104	FE160	125	1346	CK85B
75	250	FG400	250	3000	CK95B	75	144	FE160	160	1869	CK85B
90	312	FG400	400	4056	CK10C	90	179	FE250	250	2500	CK95B
110	360	FG400	400	4680	CK12B	110	207	FE250	250	2691	CK95B
132	430	FG630	500	5590	CK12B	132	247	FG400	250	2967	CK95B
-	-	-	-	-	-	160	300	FG400	400	3900	CK10C
-	-	-	-	-	-	200	360	FG400	400	4680	CK12B
-	-	-	-	-	-	220	400	FG630	500	5200	CK12B
-	-	-	-	-	-	250	462	FG630	500	6004	CK12B

(1) The contactor has a breaking capacity that is sufficient to operate the specified motor up to the specified magnetic setting of the breaker

Coordination type - E 60 4 -4 - Class 10 protection with SMR2 other classes possible

Upstream *Record Plus* Breaker selection

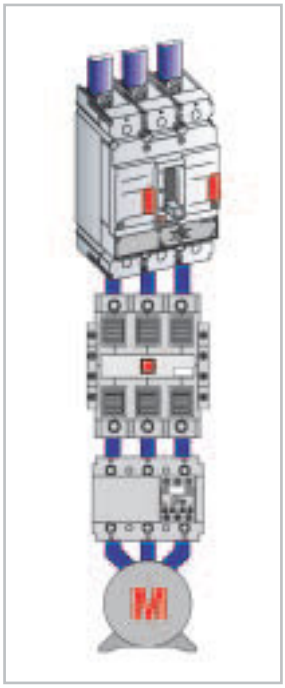
Type	N	H	L	Type	N	H	L	Type	N	H	L
	Icc values in kA Ue 440V AC								Icc values in kA Ue 690V AC		
FE160/250	42	65	130	FE160/250	-	50	80	FE160/250	-	22	50
FG 400/630	50	65	130	FG 400/630	-	50	80	FG 400/630	-	22	50

Selection of associated components[1]

Motor		Breaker details			Contactor	Motor		Breaker details			Contactor	Motor		Breaker details			Contactor
P(kw)	In	Type	Ie	Im	Type	P(kw)	In	Type	Ie	Im	Type	P(kw)	In	Type	Ie	Im	Type
-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
5.5	10.5	FE160	25	136	CL08	-	-	-	-	-	-	-	-	-	-	-	-
7.5	14.6	FE160	25	200	CL08	7.5	12.0	FE160	25	156	CL09	-	-	-	-	-	-
10	18.8	FE160	25	245	CL08	10	15.0	FE160	25	200	CL09	10	11.5	FE160	25	150	CK85B
11	20	FE160	25	265	CL08	11	18.4	FE160	25	300	CL09	-	-	-	-	-	-
15	27	FE160	63	355	CL09	15	23	FE160	25	300	CL09	15	17.1	FE160	25	223	CK85B
18.5	33	FE160	63	500	CL09	18.5	29	FE160	63	371	CL10	18.5	20	FE160	25	260	CK85B
22	39	FE160	63	510	CL09	22	33	FE160	63	423	CL10	-	-	-	-	-	-
25	44	FE160	63	578	CL09	-	-	-	-	-		-	-	-	-	-	-
30	52	FE160	63	680	CL09	30	45	FE160	63	585	CL10	30	35	FE160	63	500	CK85B
37	65	FE160	125	849	CK85B	37	55	FE160	63	800	CL10	37	42	FE160	63	546	CK85B
45	78	FE160	125	1019	CK85B	-	-	-	-	-	-	45	49	FE160	63	637	CK85B
55	94	FE160	125	1223	CK85B	55	80	FE160	125	1040		55	60	FE160	63	800	CK85B
75	131	FE160	160	1699	CK85B	75	110	FE160	125	1430	CK85B	75	80	FE160	125	1040	CK85B
90	163	FE250	250	2500	CK95B	90	130	FE160	160	1690	CK85B	90	100	FE160	125	1300	CK85B
110	188	FE250	250	2500	CK95B	110	156	FE160	160	2028	CK85B	110	120	FE160	125	1560	CK85B
132	225	FE250	250	2922	CK95B	132	190	FE250	250	2500	CK95B	132	140	FE160	160	1820	CK85B
160	300	FG400	400	3900	CK10C	160	228	FE250	250	2964	CK95B	160	175	FE250	250	2275	CK10C
200	360	FG400	400	4680	CK12B	200	281	FG400	400	3653	CK10C	200	220	FE250	250	2860	CK10C
220	400	FG630	500	5200	CK12B	220	310	FG400	400	4030	CK10C	220	240	FG400	250	3120	CK10C
250	462	FG630	500	6004	CK12B	-	-	-	-	-	-	250	270	FG400	400	3510	CK10C
-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
-	-	-	-	-	-	315	445	FG630	500	5785	CK12B	-	-	-	-	-	-
-	-	-	-	-	-	335	460	FG630	500	5980	CK12B	335	335	FG400	400	4355	CK10C
-	-	-	-	-	-	355	500	FG630	500	6500	CK12B	-	-	-	-	-	-
-	-	-	-	-	-	-	-	-	-	-	-	375	400	FG630	500	5200	CK12B
-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
-	-	-	-	-	-	-	-	-	-	-	-	450	480	FG630	500	6240	CK12B

(1) The contactor has a breaking capacity that is sufficient to operate the specified motor up to the specified magnetic setting of the breaker

Coordination type - E 60 4 -4 - Class 20 [3] protection



Short-circuit Protection by means of Magnetic Only MCCB.
Overload Protection by means of a electromechanical thermal relay.

Phase Loss protection (Thermal relay feature)

Control by GE contactor

Upstream *Record Plus* Breaker selection							
Type	N	H	L	Type	N	H	L
	Icc values in kA Ue 230V AC				Icc values in kA Ue 400/415V AC		
FD160	85	100	130	FD160	50	80	130
FE160/250	85	100	130	FE160/250	50	80	130
FG 400/630	85	100	130	FG 400/630	50	80	130
FK 800/1250	85	100	130	FK 800/1250	50	80	100

Selection of associated components[1]											
Motor		Breaker details			Contactor	Motor		Breaker details			Contactor
P(kw)	In	Type	Ie	Im	Type+O.R.	P(kw)	In	Type	Ie	Im	Type+O.R.
0.37	2.0	FD/FE160	3[2]	35	CL25+RT12						
0.55	2.8	FD/FE160	3[2]	35	CL25+RT12K						
0.75	3.5	FD/FE160	3[2]	46	CL25+RT12K	0.75	2.0	FD/FE160	3[2]	35	CL25+RT12
1.1	5.0	FD/FE160	7	70	CL03+RT12L	1.1	2.6	FD/FE160	3[2]	35	CL25+RT12K
1.5	6.1	FD/FE160	7	80	CL03+RT12M	1.5	3.6	FD/FE160	7	70	CL03+RT12K
2.2	8.7	FD/FE160	12.5[4]	125	CL06+RT2AN	2.2	5.0	FD/FE160	7	80	CL03+RT12L
3	11.5	FD/FE160	12.5[4]	150	CL06+RT2AN	3	6.6	FD/FE160	7	86	CL03+RT12M
4	14.5	FD/FE160	20[4]	200	CL06+RT2B	4	8.3	FD/FE160	12.5[4]	125	CL06+RT2AN
5.5	20.0	FD/FE160	20[4]	260	CL06-RT2C	5.5	11.5	FD/FE160	12.5[4]	150	CL06+RT2AN
7.5	28	FD/FE160	30[5]	364	CL06-RT22D	7.5	16.1	FD/FE160	20[4]	200	CL06+RT2B
10	36	FD/FE160	50	500	CL06+RT22E	10	21	FD/FE160	30[5]	300	CL06-RT2C
11	39	FD/FE160	50	507	CL06+RT22E	11	22	FD/FE160	30[5]	300	CL06-RT2C
15	50	FD/FE160	50	650	CL06+RT22G	15	30	FD/FE160	30[5]	390	CL06-RT22D
18.5	64	FD/FE160	80[6]	832	CL09+RT22	18.5	37	FD/FE160	50	478	CL06+RT22E
22	75	FD/FE160	80[6]	975	CL09+RT22	22	43	FD/FE160	50	561	CL06+RT22G
25	85	FD/FE160	100	1020	CL09+RT22L	25	49	FD/FE160	50	635	CL06+RT22G
30	100	FD160	100	1300	CL09+RT22M	30	58	FD/FE160	80[6]	800	CL09+RT22H
30	100	FE160	100	1300	CK75C+RT22M	37	72	FD/FE160	80[6]	934	CL09+RT22
37	125	FE160	125	1625	CK85B+RT32E	45	86	FD160	100	1121	CL09+RT22L
45	150	FE160	160	1950	CK85B+RT32F	45	86	FE160	100	1121	CK75C+RT22L
55	180	FE250	250	2500	CK95B+RT32F	55	104	FE160	125	1346	CK85B+RT32E
75	250	FG400	250	3250	CK10B+RT5LB	75	144	FE160	160	1869	CK85B+RT32F
90	312	FG400	400	4056	CK10B+RT5LB	90	179	FE250	250	2500	CK95B+RT32F
110	360	FG400	400	4680	CK12B+RT5LC	110	207	FE250	250	2691	CK10B+RT5LB
132	430	FG630	500	5590	CK12B+RT5LD	132	247	FG400	250	3214	CK10B+RT5LB
160	520	FK800	800	6760	CK13B+RT5LE	160	300	FG400	400	3900	CK10B+RT5LB
200	630	FK800	800	6930	CK13B+RT5LE	200	360	FG400	400	4680	CK12B+RT52LC
-	-	-	-	-	-	220	400	FG630	500	5200	CK12B+RT52LD
-	-	-	-	-	-	250	462	FG630	500	6004	CK12B+RT52LD
-	-	-	-	-	-	300	560	FK800	800	6720	CK13B+RT5LE
-	-	-	-	-	-	315	582	FK800	800	6985	CK13B+RT5LE
-	-	-	-	-	-	335	619	FK800	800	6810	CK13B+RT5LE

(1) The contactor has a breaking capacity that is sufficient to operate the specified motor up to the specified magnetic setting of the breaker.
(2) The 3Amp device is designed to operate at a current level up to 3.5Amps.
(3) Class 30 on request.
(4) FD160 type contactor size can be reduced to CL04
(5) FD160 type contactor size can be reduced to CL45
(6) FD160 type contactor size can be reduced to CL08

Coordination type - E 60 4 -4 - Class 20 [3] protection

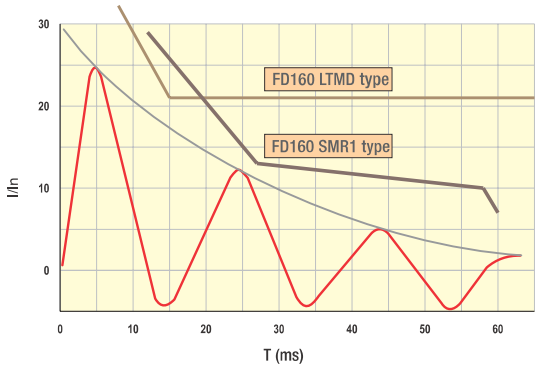
Upstream *Record Plus* Breaker selection												
Type	N	H	L	Type	N	H	L	Type	N	H	L
	Icc values in kA Ue 440V AC				Icc values in kA Ue 500/525V AC				Icc values in kA Ue 690V AC		
FD160	30	50	80	FD160	-	36	50	FD160	-	6	10
FE160/250	42	65	130	FE160/250	-	50	80	FE160/250	-	22	50
FG 400/630	42	65	130	FG 400/630	-	50	80	FG 400/630	-	22	50
FK 800/1250	42	65	80	FK 800/1250	-	36	50	FK 800/1250	-	22	30

Selection of associated components[1]																	
Motor		Breaker details			Contactor	Motor		Breaker details			Contactor	Motor		Breaker details			Contactor
P(kw)	In	Type	Ie	Im	Type+O.R.	P(kw)	In	Type	Ie	Im	Type+O.R.	P(kw)	In	Type	Ie	Im	Type+O.R.
0.75	1.9	FD/FE160	3[2]	30	CL25+RT12	0.75	1.5	FD/FE160	3[2]	30	CL25+RT12H						
1.1	2.5	FD/FE160	3[2]	30	CL25+RT12K	1.1	2.0	FD/FE160	3[2]	30	CL25+RT12						
1.5	3.4	FD/FE160	3[2]	70	CL25+RT12K	1.5	2.6	FD/FE160	3[2]	40	CL25+RT12K	1.5	2.0	FD/FE160	3[2]	30	CL25+RT12
2.2	4.6	FD/FE160	7	70	CL03+RT12L	2.2	3.8	FD/FE160	7	70	CL03+RT12L	2.2	2.9	FD/FE160	3[2]	38	CL25+RT12K
3	6.0	FD/FE160	7	78	CL03+RT12M	3	5.0	FD/FE160	7	70	CL03+RT12M	3	3.5	FD/FE160	3[2]	46	CL25+RT12K
4	7.6	FD/FE160	12.5[4]	100	CL06+RT2AN	4	6.5	FD/FE160	7	85	CL03+RT12M	3.7	4.6	FD/FE160	7	70	CL03+RT12L
5.5	10.5	FD/FE160	12.5[4]	136	CL06+RT2AN	5.5	9.0	FD/FE160	12.5[4]	125	CL06+RT2AN	4	5.0	FD/FE160	7	70	CL03+RT12L
7.5	14.6	FD/FE160	20[4]	200	CL06+RT2B	7.5	12.0	FD/FE160	12.5[4]	156	CL06+RT2BP	5.5	7.0	FD/FE160	7	91	CL03+RT12M
10	18.8	FD/FE160	20[4]	245	CL06+RT2B	10	15.0	FD/FE160	20[4]	200	CL06+RT2B	7.5	9.0	FD/FE160	12.5[4]	125	CL07+RT2AN
11	20	FD/FE160	30[5]	300	CL06-RT2C	11	18.4	FD/FE160	20[4]	300	CL06-RT2B	11	12.5	FD/FE160	12.5[4]	163	CL07+RT2BP
15	27	FD/FE160	30[5]	355	CL06-RT22D	15	23	FD/FE160	30[5]	300	CL06-RT2C	13	16.0	FD/FE160	20[4]	208	CL07+RT2B
18.5	33	FD/FE160	50	500	CL06+RT22E	18.5	29	FD/FE160	30[5]	371	CL06-RT22D	15	18.0	FD/FE160	20[4]	234	CL07+RT2B
22	39	FD/FE160	50	510	CL06+RT22E	22	33	FD/FE160	50	500	CL06+RT22E	18.5	23	FD/FE160	30[5]	300	CL09+RT2C
25	44	FD/FE160	50	578	CL06+RT22G	-	-	-	-	-	-	22	25	FD/FE160	30[5]	325	CL09+RT22D
30	52	FD/FE160	80[6]	680	CL09+RT22H	30	45	FD/FE160	50	585	CL06+RT22G	-	-	-	-	-	-
37	65	FD/FE160	80[6]	849	CL09+RT22	37	55	FD/FE160	80[6]	800	CL09+RT22	30	35	FD/FE160	50	500	CL09+RT22E
45	78	FD/FE160	80	1019	CL09+RT22	45	65	FD/FE160	100	1000	CL09+RT22	37	42	FD/FE160	50	546	CL09+RT22F
55	94	FD160	100	1223	CL09+RT22L	55	80	FD160	100	1000	CL09+RT22	45	49	FD/FE160	50	637	CL09+RT22G
55	94	FE160	100	1223	CK75C+RT22L	55	80	FE160	100	1100	CK75C+RT22	55	60	FD/FE160	80[6]	800	CL09+RT22
75	131	FE160	160	1699	CK85B+RT32E	75	110	FE160	125	1430	CK85B+RT32D	75	80	FD/FE160	80[6]	1040	CL09+R2T2L
90	163	FE250	250	2500	CK95B+RT32F	90	130	FE160	160	1690	CK95B+RT32E	90	100	FD/FE160	100	1300	CK85B+RT22M
110	188	FE250	250	2500	CK95B+RT5LB	110	156	FE160	160	2028	CK95B+RT32F	110	120	FE160	125	1560	CK85B+RT32E
132	225	FE250	250	2922	CK95B+RT5LB	132	190	FE250	250	2500	CK95B+RT5LB	132	140	FE160	160	1820	CK95B+RT32F
160	300	FG400	400	3900	CK10B+RT5LC	160	228	FE250	250	2964	CK95B+RT5LB	160	175	FE250	250	2100	CK95B+RT32F
200	360	FG400	400	4680	CK12B+RT5LD	200	281	FG400	400	3653	CK10B+RT5LC	200	220	FE250	250	2860	CK10B+RT5LB
220	400	FG630	500	5200	CK12B+RT5LD	220	310	FG400	400	4030	CK10B+RT5LC	220	240	FG400	250	3120	CK10B+RT5LB
250	462	FG630	500	6004	CK12B+RT5LD	-	-	-	-	-	-	250	270	FG400	400	3510	CK10B+RT5LC
300	509	FK800	800	6619	CK13B+RT5LE	-	-	-	-	-	-	-	-	-	-	-	-
315	529	FK800	800	6880	CK13B+RT5LE	315	445	FG630	500	5785	CK12B+RT5LD	-	-	-	-	-	-
335	563	FK800	800	6754	CK13B+RT5LE	335	460	FG630	500	5980	CK12B+RT5LD	335	335	FG400	400	4355	CK10B+RT5LC
355	596	FK800	800	6560	CK13B+RT5LE	355	500	FK800	800	6500	CK13B+RT5LE	-	-	-	-	-	-
375	630	FK800	800	6930	CK13B+RT5LE	375	530	FK800	800	6890	CK13B+RT5LE	375	400	FG630	500	5200	CK12B+RT5LD
-	-	-	-	-	-	400	570	FK800	800	6840	CK13B+RT5LE	-	-	-	-	-	-
-	-	-	-	-	-	450	630	FK800	800	7560	CK13B+RT5LE	450	480	FG630	500	6240	CK12B+RT5LD
-	-	-	-	-	-	-	-	-	-	-	-	500	530	FK800	800	6360	CK13B+RT5LE
-	-	-	-	-	-	-	-	-	-	-	-	560	580	FK800	800	6380	CK13B+RT5LE

Protection of / transformers

Transformers generally produce a very high inrush current. The crest value of the first half cycle may reach values of 15 to 25 times the effective rated current.
For a protective device capable of protecting these units this must be taken into account. Manufacturers data and tests have indicated that a protective device feeding a transformer must be capable of carrying the following current values without tripping (see graph insert).

Transformer value	Maximum crest inrush values		
	1st period 5 ms	2nd period 25 ms.	after 3 periods 45 ms.
50 kvA	25 x In	12 x In	5 x In
50 kvA	15 x In	8 x In	3.5 x In



Record Plus circuit breakers have been designed to cope with this kind of phenomenae. The adjacent table indicates the types to select, based on the breaker characteristics, the transformer ratings and the above mentioned inrush current prognoses.

Protection of / transformers with Record Plus circuit breakers

Transformer ratings						Record Plus breaker choice		
1ph 230V		3ph 230V 1ph 400V		3ph 400V		Type	Trip unit type & rating	Ist *
kVA	In	kVA	In	kVA	In			
2.5	10	4	10	6.3	9	FD160N FD160H or L	LTMD-25	250
4	11	5	12	8	12	FD160N FD160H or L	LTMD-25	250
5	17	6.3	16	10	14	FD160N FD160H or L	LTMD-32	320
		8	20	12.5	18	FD160N FD160H or L	LTMD-32	320
6.3	27	10	24	16	23	FD160N FD160H or L	LTMD-40	400
8	34	12.5	30	20	28	FD160N FD160H or L	LTMD-50	500
10	42	16	39	25	35	FD160N FD160H or L	LTMD-63	630
12.5	53	20	49	31.5	44	FD160N FD160H or L	LTMD-80	800
		25	61	40	56	FD160N FD160H or L	LTMD-100	1000
16	68			50	70	FD160N FD160H or L	LTMD-125	1250
20	84	31.5	77			FD160N FD160H or L	LTMD-125	1250
		40	98	63	89	FE160N H or L	SMR1-125	
25	105	50	122	80	113	FE160N H or L	SMR1-125	
31.5	133	63	154	100	141	FE160N H or L	SMR1-160	
40	169	80	195	125	176	FE250N H or L	SMR1-250	
50	211	100	244	160	225	FE250N H or L	SMR1-250	
63	266	125	305	200	287	FG400N H or L	SMR1-350	
80	338	160	390	250	352	FG400N H or L	SMR1-350	
100	422			315	444	FG630N H or L	SMR1-500	
125	528			400	563	FG630N H or L	SMR1-630	
160	675			500	704	FK800N or H	SMR- 800	
				630	887	FK1250N or H	SMR-1000	
				800	1126	FK1250N or H	SMR-1250	
				1000	1408	FK1600N or H	SMR-1600	

Magnetic threshold of breaker

Protection of capacitor banks
(power factor improvement units)

For circuit breakers and particularly for the ***Record Plus*** device, designed to offer high making and breaking capacities under adverse conditions, the switching of capacitor banks has little to no effect on the breaker, its characteristics as a protective device, or on its lifespan.

However, the current flowing in the circuit can trip a circuit breaker and a capacitor load displays certain anomalies. In a circuit with capacitors the maximum current flow in the circuit cannot be assumed to be the calculated capacitor current only. The effective value must be increased due to harmonic content (a factor normally taken as 30%) and an allowance for the tolerances in the capacitance of the unit itself.
(10% assumed).

In order to protect these devices without running into regular nuisance tripping due to overloads please refer to the adjacent table in which the correct ***Record Plus*** breaker is specified to protect and switch the indicated capacitor banks at several different voltages.

n 230 phase to phase voltage

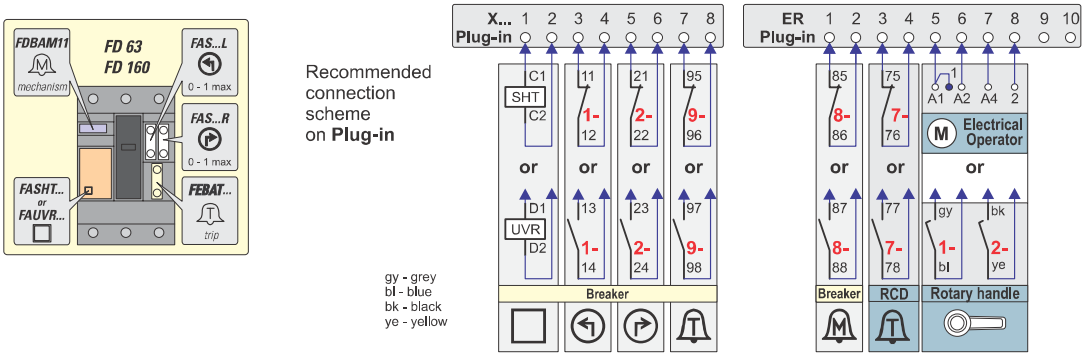
Capacitor rating (kVAr)	*Record Plus* breaker	Ir setting (min)
5	FD160N FD160H or L	18 A
7.5	FD160N FD160H or L	27 A
10	FD160N FD160H or L	36 A
12.5	FD160N FD160H or L	45 A
15	FD160N FD160H or L	54 A
20	FD160N FD160H or L	72 A
25	FD160N FD160H or L	90 A
30	FD160N FD160H or L	108 A
35	FD160N or FE160N H or L	126 A
40	FE160N H or L	144 A
45	FE250N H or L	162 A
50	FE250N H or L	179 A
60	FE250N H or L	215 A
75	FG400N H or L	269 A
90	FG400N H or L	323 A
100	FG400N H or L	359 A
120	FG630N H or L	431 A
150	FG630N H or L	538 A
180	FK800N or H	646 A

n 400 phase to phase voltage

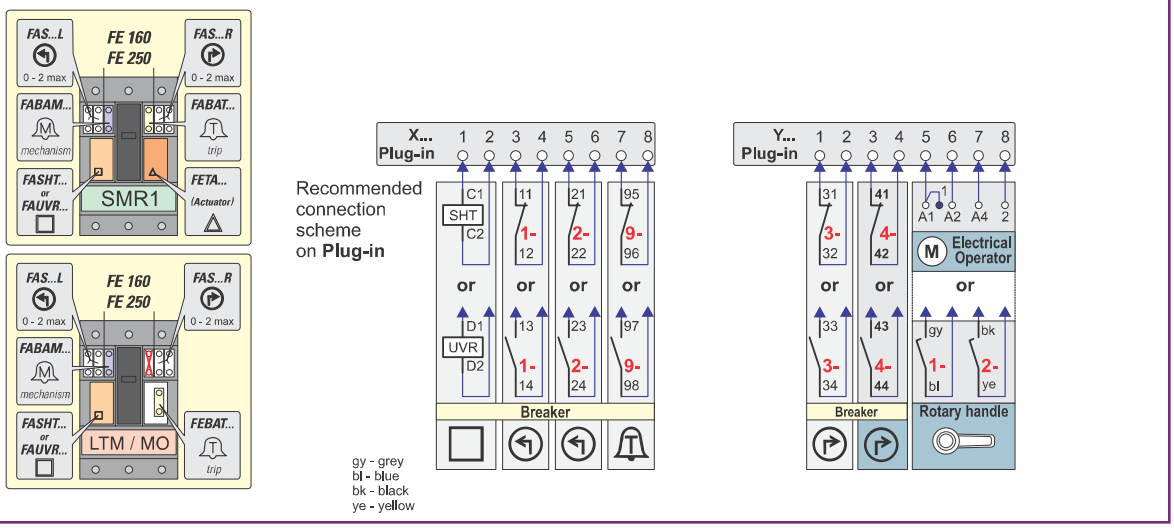
Capacitor rating (kVAr)	*Record Plus* breaker	Ir setting (min)
10	FD160N FD160H or L	21 A
15	FD160N FD160H or L	31 A
20	FD160N FD160H or L	41 A
25	FD160N FD160H or L	52 A
30	FD160N FD160H or L	62 A
35	FD160N FD160H or L	72 A
40	FD160N FD160H or L	83 A
45	FD160N FD160H or L	93 A
50	FD160N FD160H or L	103 A
60	FD160N FD160H or L	124 A
70	FD160N or FE160N H or L	144 A
80	FE250 N H or L	165 A
90	FE250N H or L	186 A
100	FE250N H or L	206 A
120	FE250N H or L	248 A
140	FG400N H or L	289 A
160	FG400N H or L	330 A
180	FG400N H or L	372 A
200	FG630N H or L	413 A
250	FG630N H or L	516 A
300	FG630N H or L	619 A
350	FK800N or H	722 A

Recommended wiring diagrams

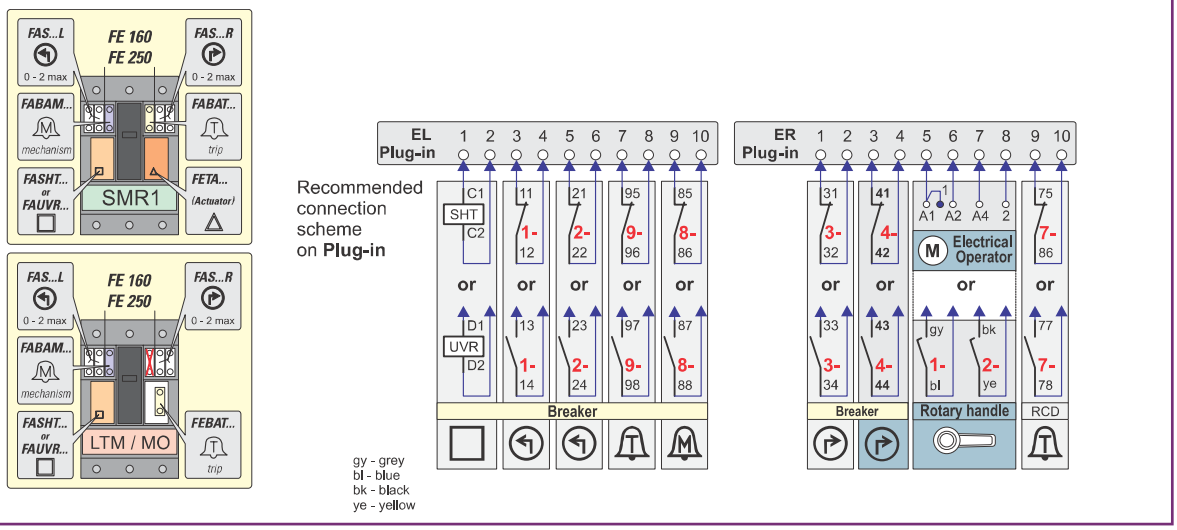
FD frame, plug in device 8 & 10 pole connectors



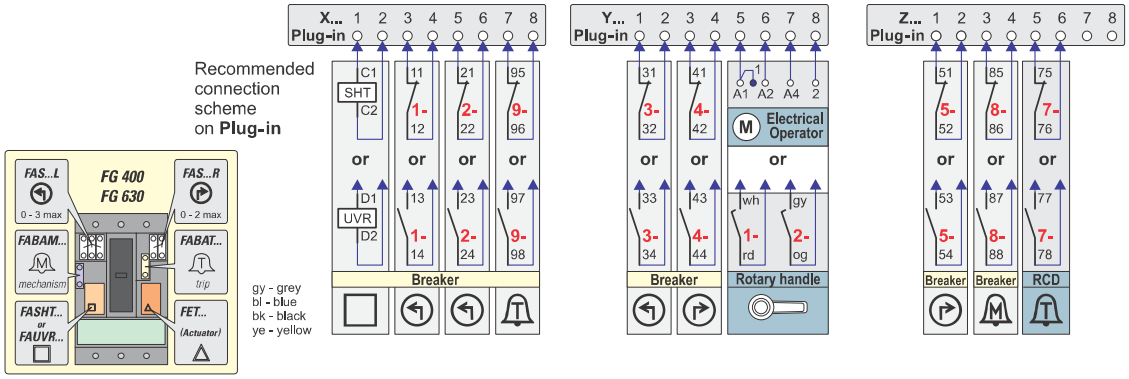
FE frame, plug-in & draw-out device 8 pole connectors



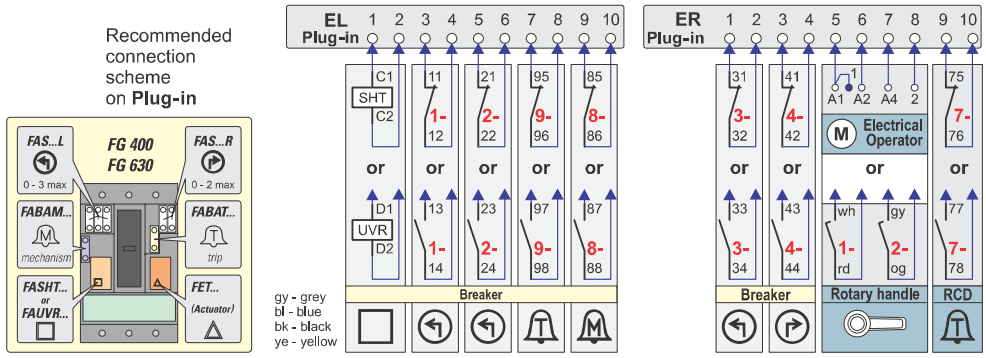
FE frame, plug-in & draw-out device 10 pole connectors



FG frame, plug-in & draw-out device 8 pole connectors



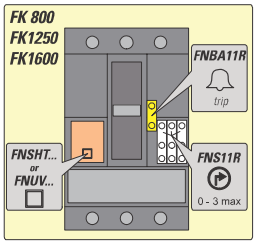
FG frame, plug-in & draw-out device 10 pole connectors

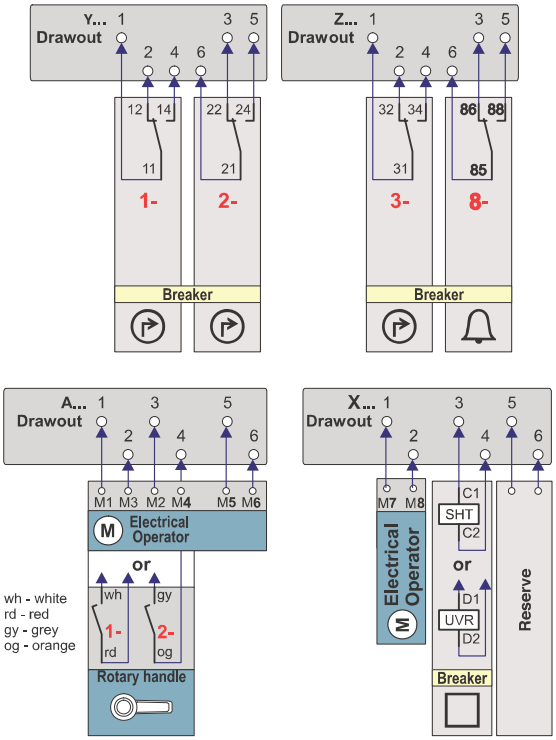


Recommended iring diagrams

FK frame 3 pole, draw out device 6 pole connectors

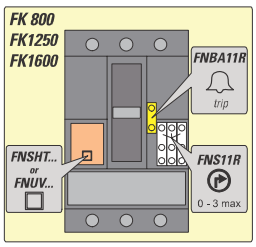
Recommended connection scheme on **Drawout**

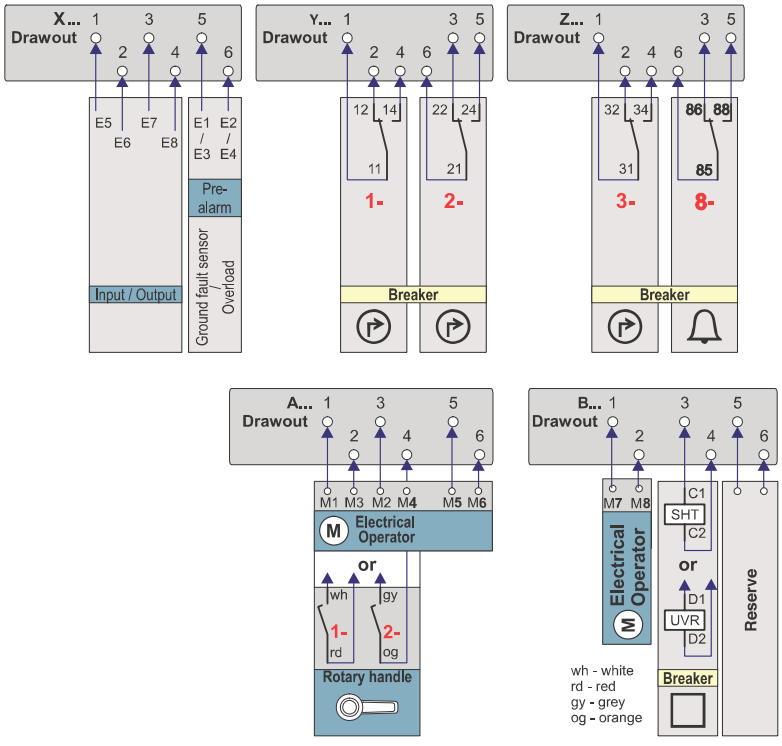




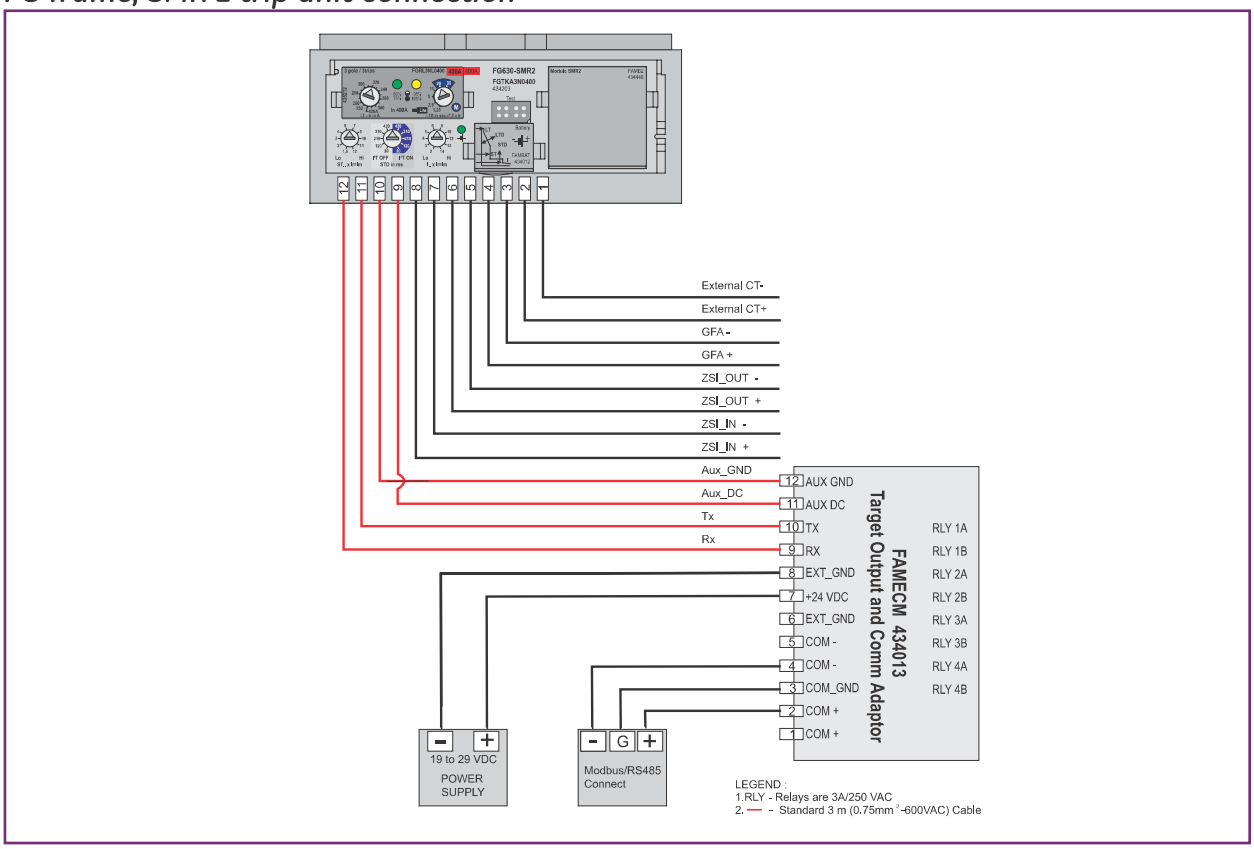
FK frame 4 pole, draw out device 6 pole connectors

Recommended connection scheme on **Drawout**



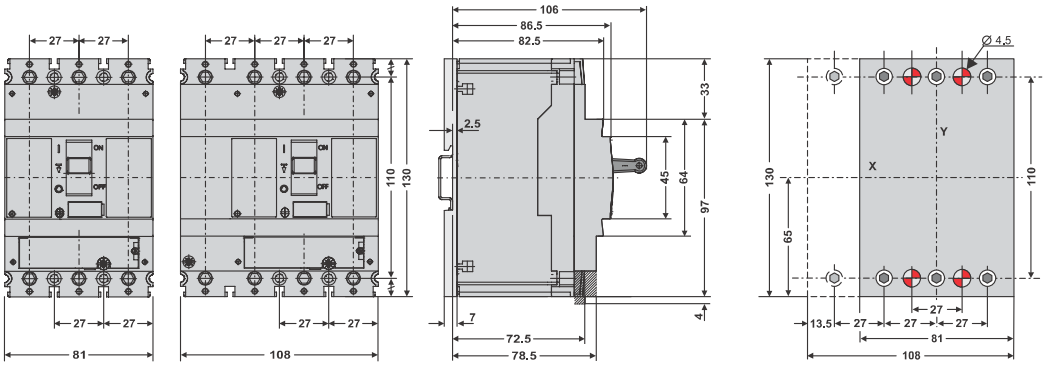


FG frame, SMR 2 trip unit connection

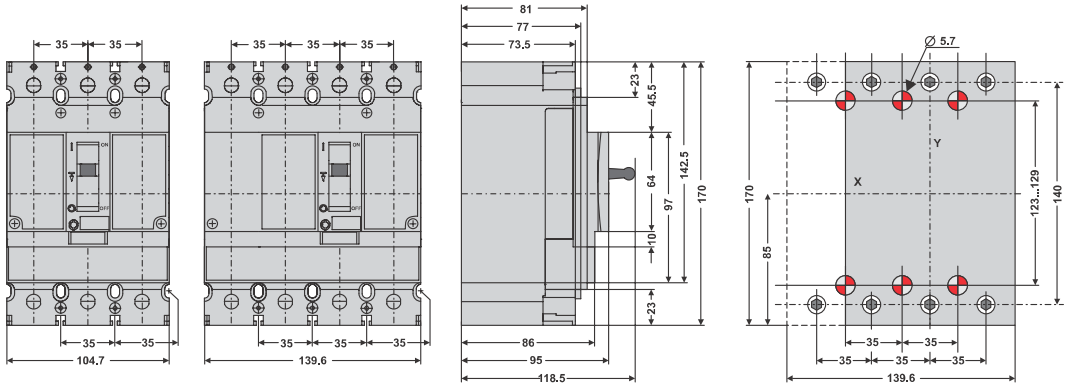


Dimensional Drawings

Breakers - FD160 fixed, front connected

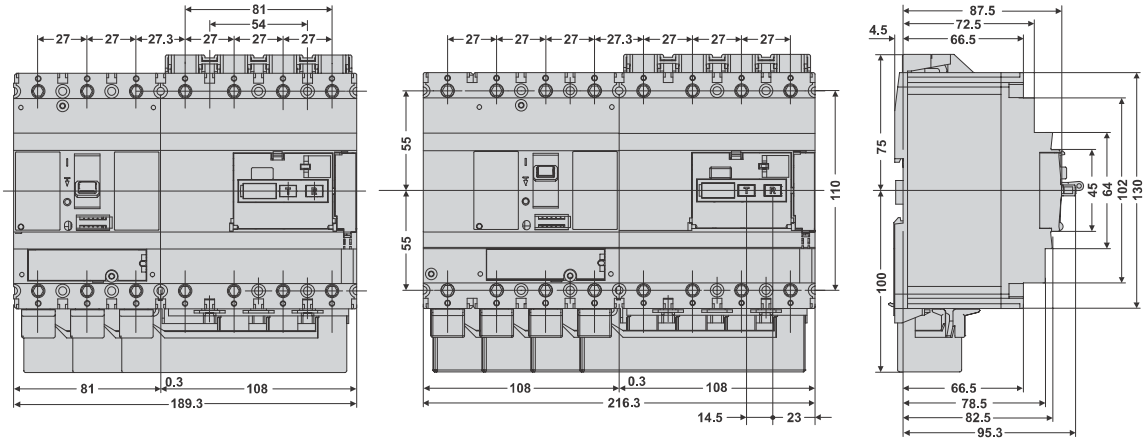


Breakers - FE160 and FE250 fixed, front connected

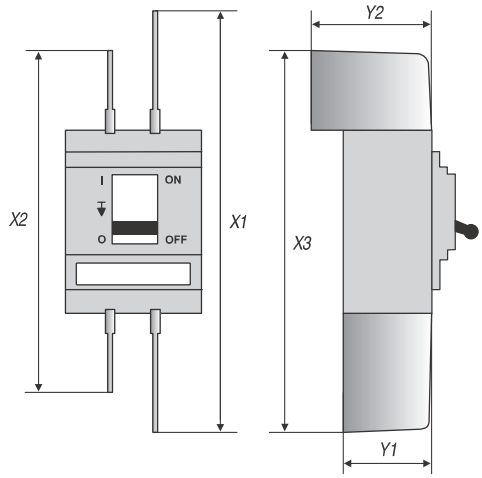


Dimensional Drawings

RCD side mounted - FD160



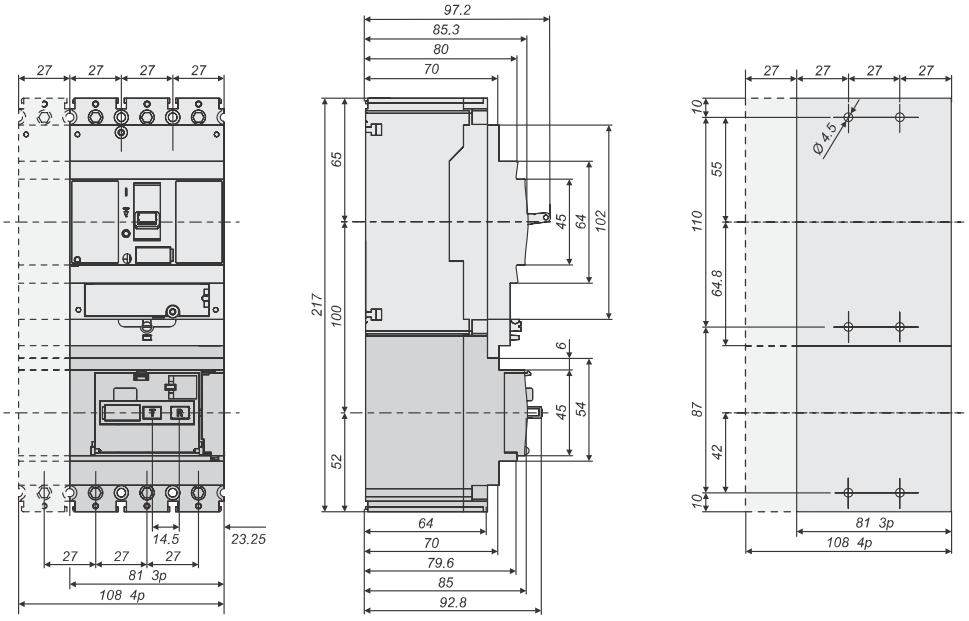
Breakers with phase separator - FD and FE frames



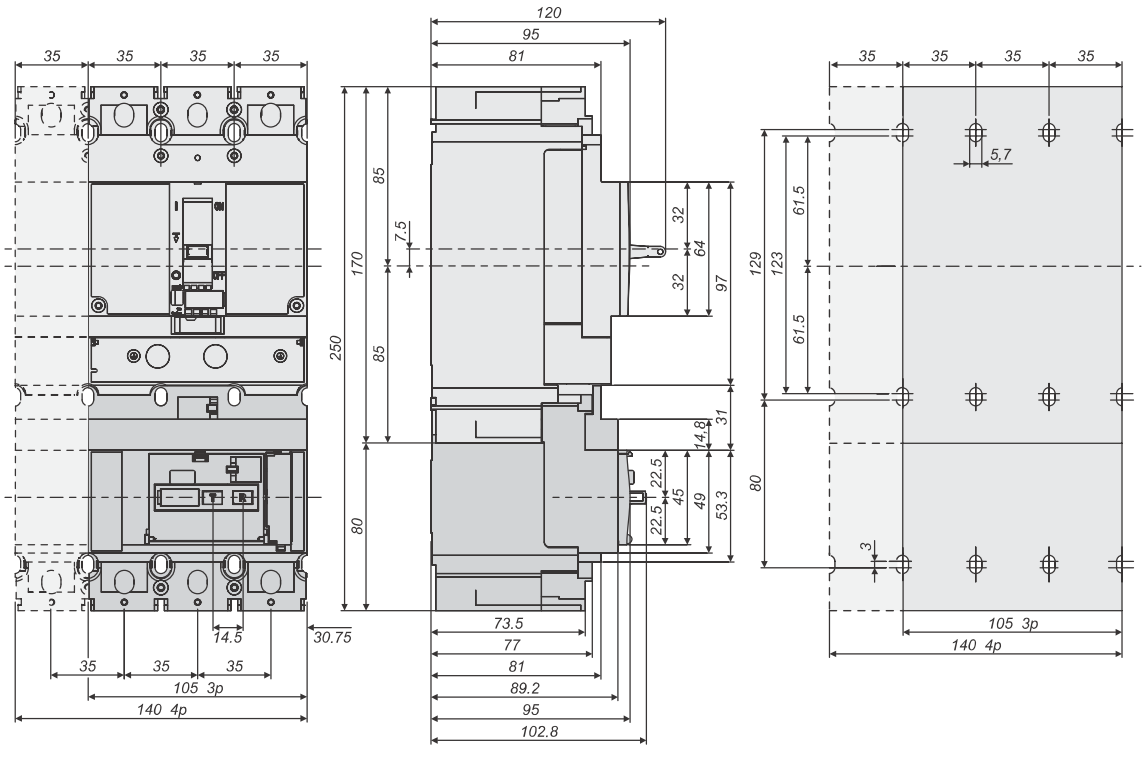
Dimensions	FD63 FD160	FE160 FE250
X1	330	410
X2	245	304
X3	287.5	357
Y1	63	72,5
Y2	105.5	126

Dimensional Drawings

RCD bottom mounted - FD160

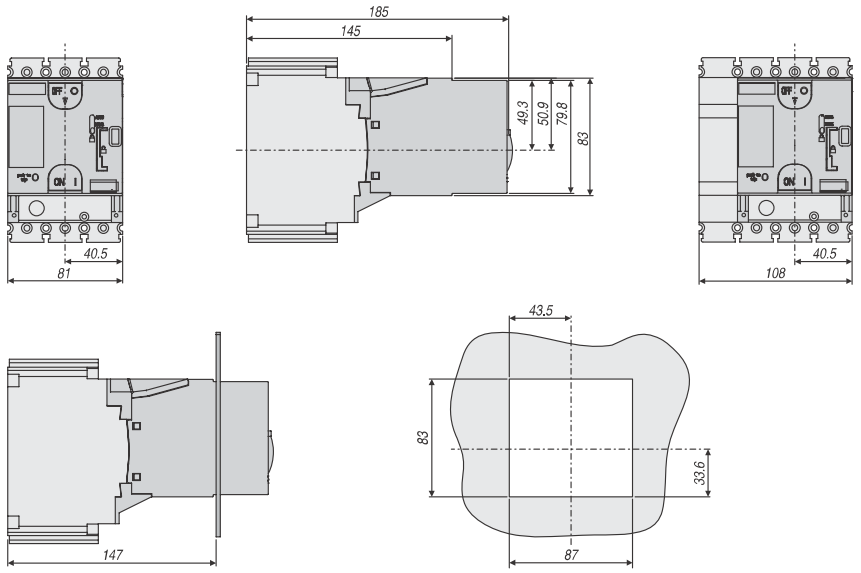


RCD bottom mounted - FE160 and FE250

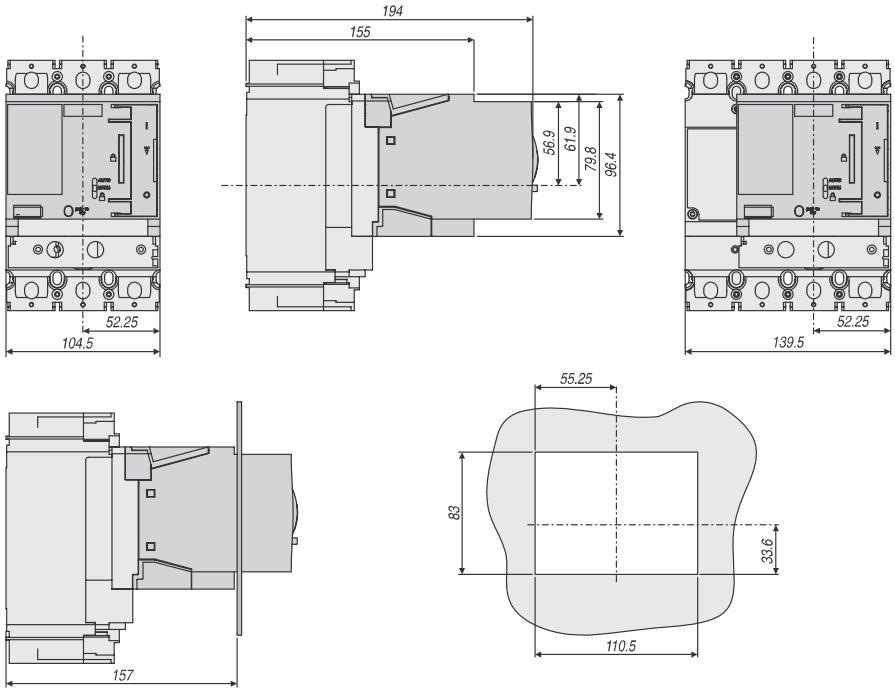


Dimensional Drawings

Breaker with electrical operator - FD160

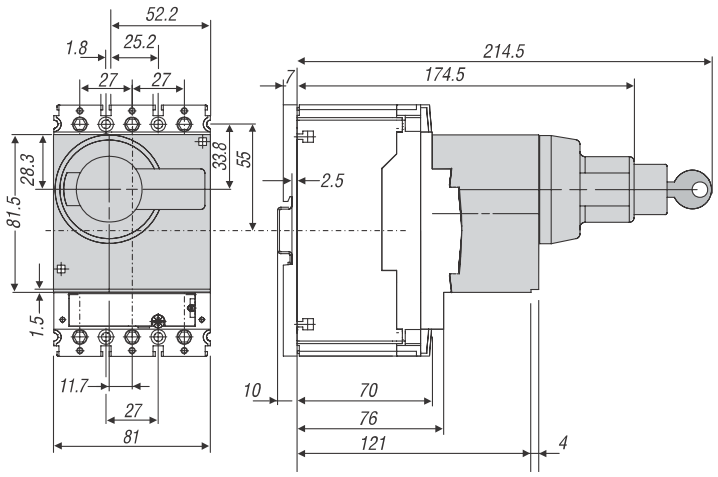


Breaker with electrical operator - FE160 and FE250

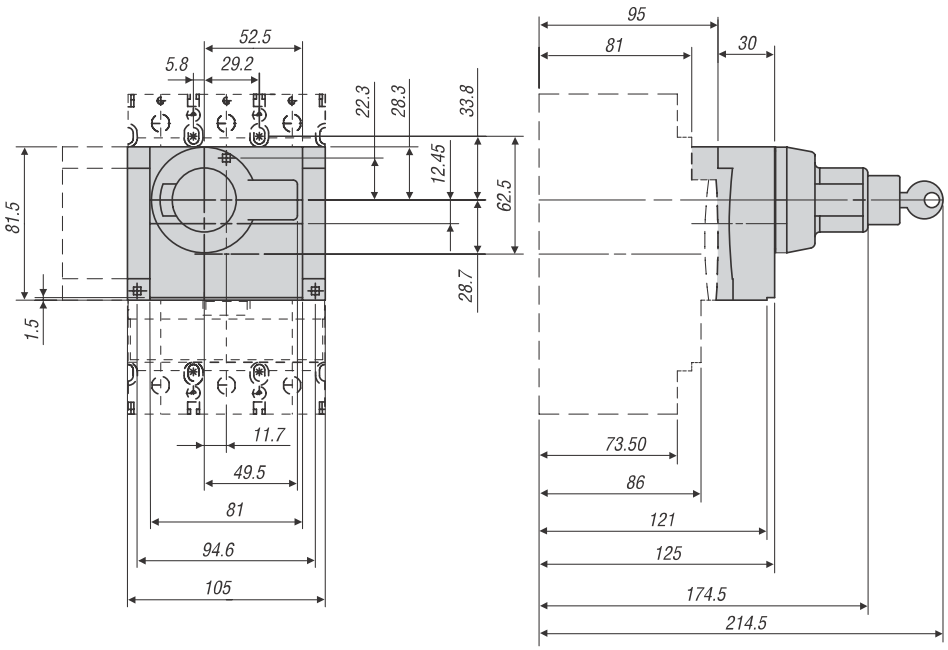


Dimensional Drawings

Rotary handle - Breaker and through panel mounted - FD160

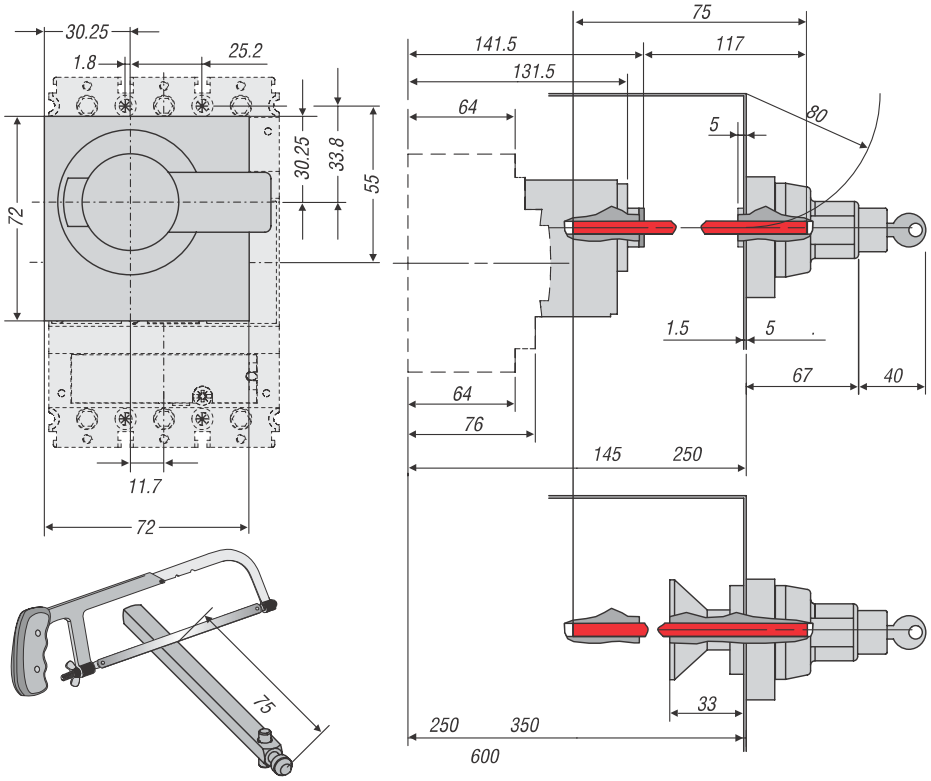


Rotary handle - Breaker and through panel mounted - FE160 and FE250

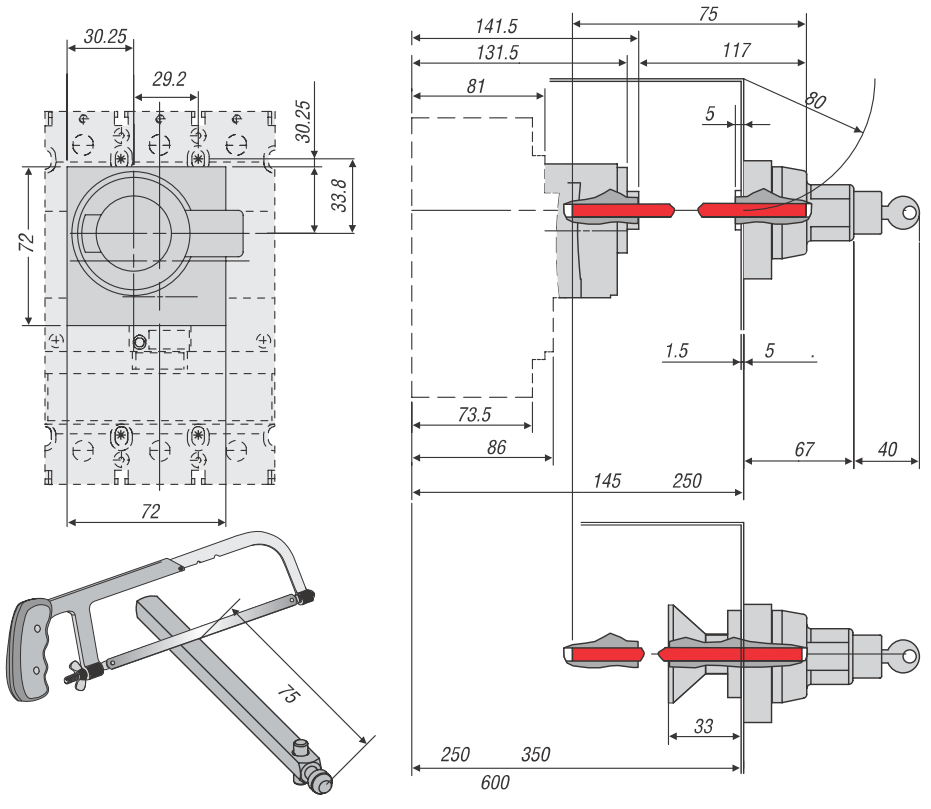


Dimensional Drawings

Rotary handle - Door mounted FD160

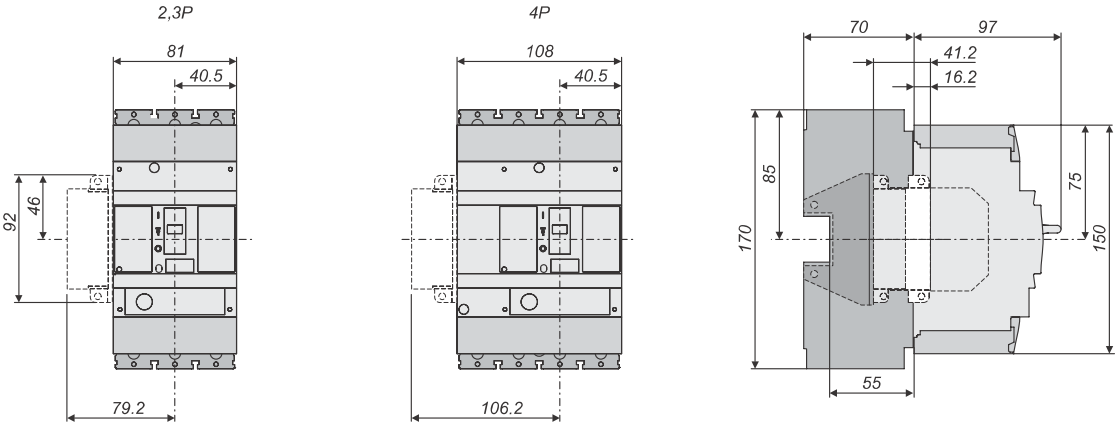


Rotary handle - Door mounted - FE 160 and FE250

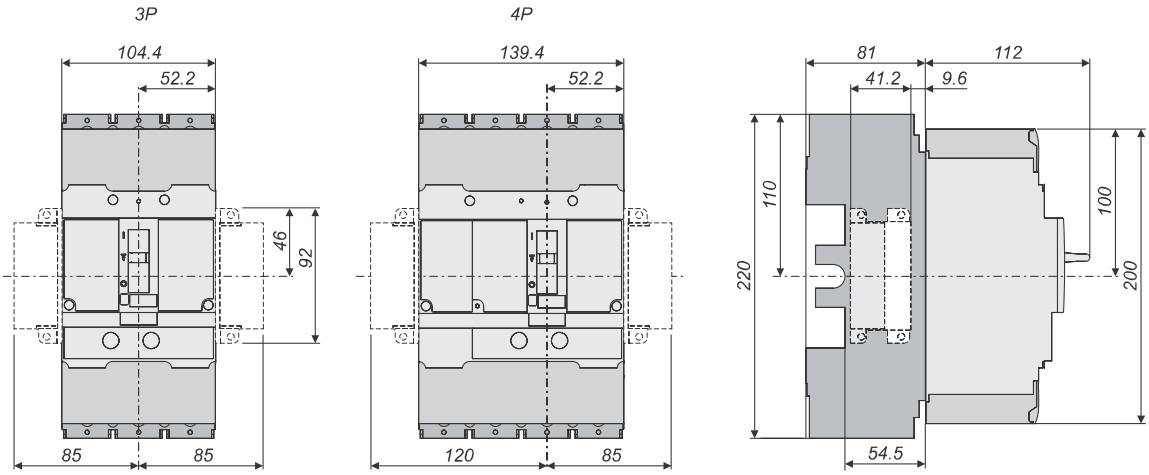


Dimensional Drawings

Plug-in version - FD160

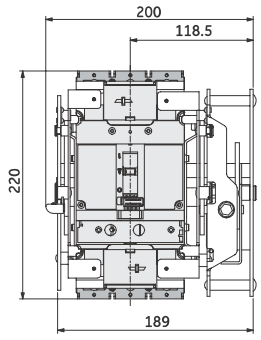


Plug-in version - FE160 and FE250

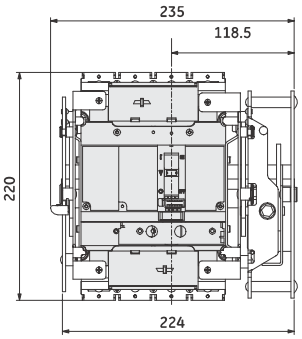


Dimensional Drawings

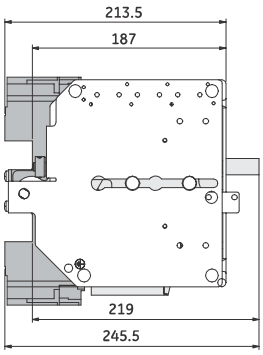
Draw-out version - FE160 & FE250



3 pole front view

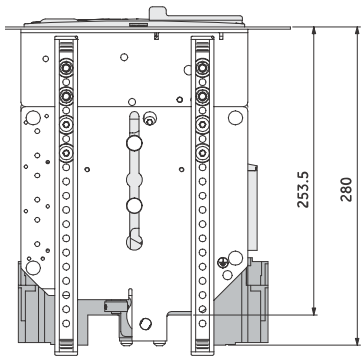


4 pole front view

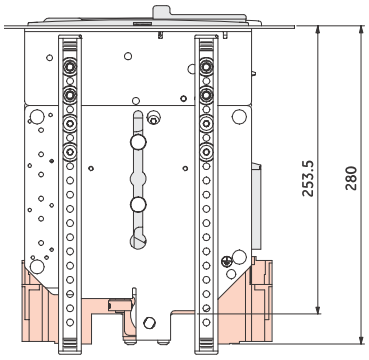


Side view

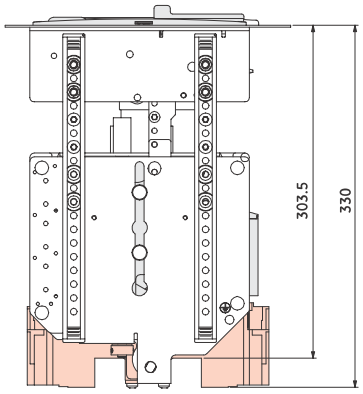
Draw-out version - FE160 & FE250 - Through door execution side views



Toggle operator

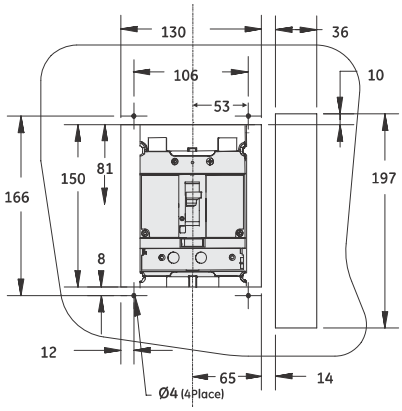


Through door rotary handle



Motor operator

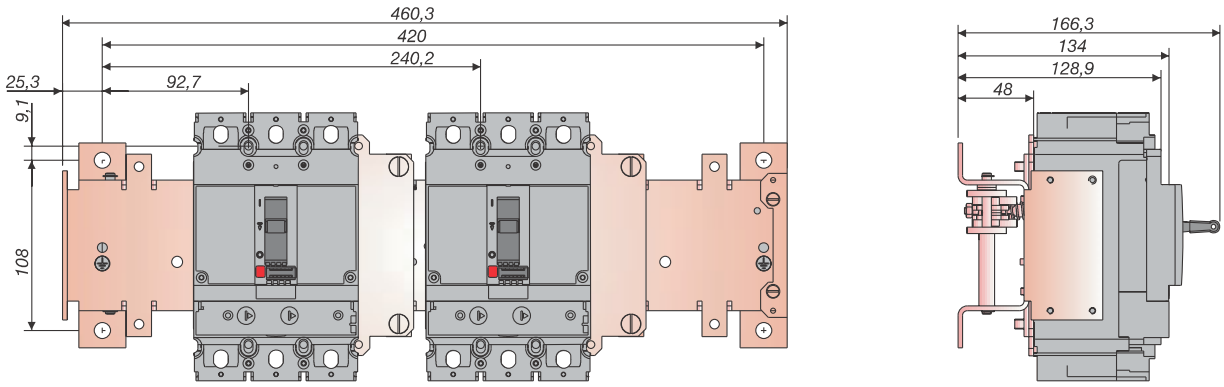
Draw-out version - FE160 & FE250 - Through door execution, door cut-outs



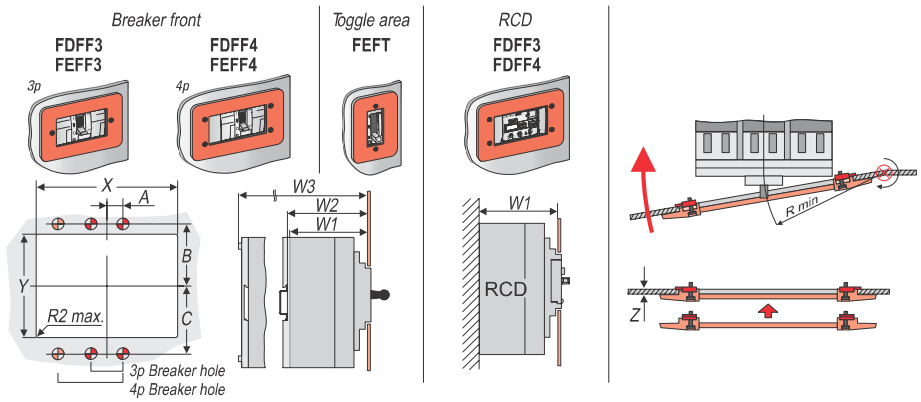
All through door variants

Dimensional Drawings

FE Frame, 2 pieces mechanically interlocked



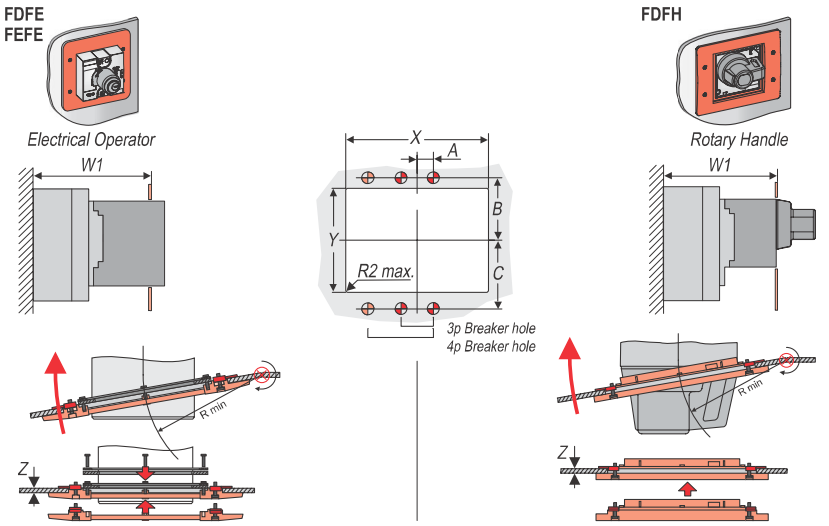
Door flanges - FD160, FE160 and FE250



Dimensions												
			A	B	C	Rmin	W1(max)	W2(max)	W3(max)	X	Y	Z
FDFF3	FD 63/160	3p	13.5	55	55	80	83.2	85.8	93.2	114	78	1...4
FDFF4	FD 63/160	4p	13.5	55	55	93.5	83.2	85.8	93.2	146	78	1...4
FEFF3	FE160/250	3p	17.5	55.5	70.5	91.75	89.2	-	-	138	97	1...4
FEFF4	FE160/250	4p	17.5	55.5	70.5	102.5	89.2	-	-	173	97	1...4
FEFT	FE 160/250	3p/4p	17.5	55.5	70.5	93,5	93.2	-	-	60	97	1...4
FDFF3 (RCD*)	FD63/160	3p	13.5	155	42	80	83.2	85.8	93.2	114	78	1...4
FDFF4 (RCD*)	FD63/160	4p	13.5	155	42	93.5	83.2	85.8	93.2	146	78	1...4
FDFF3 (RCD*)	FE160/250	3p/4p	18	182.1	42	80	89.2	-	-	114	78	1...4

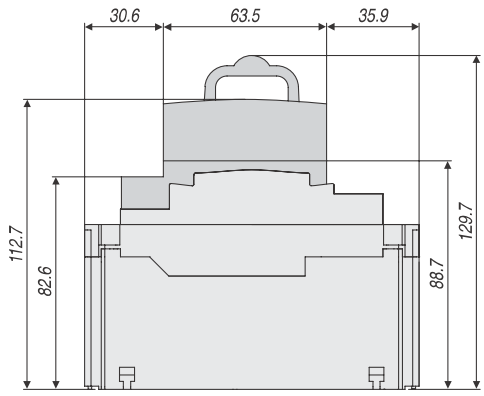
Dimensional Drawings

Door flanges - FD160, FE160 and FE250

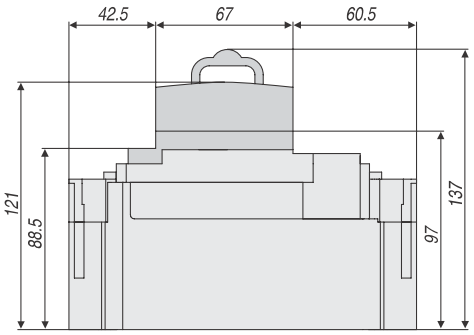


Dimensions									
3+4 pole versions		A	B	C	Rmin	W1(max)	X	Y	Z
FDFE	FD 63/160 Electr. Operator	13.5	49.5	64.5	80	141	148.5	124.5	1...4
FEFE	FE 160/250 Electr. Operator	17.5	46	80	100	170	172	124.5	1...4
FDFH	FD63/160 Rotary Handle	13.5	46,25	63.75	100	125	120	120	1...4
FEFH	FE 160/250 Rotary Handle	17.5	46.25	81.75	100	125	120	120	1...4

Padlocking device fixed on breaker



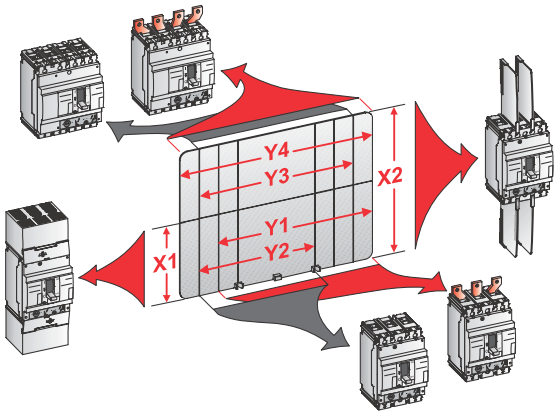
FD160

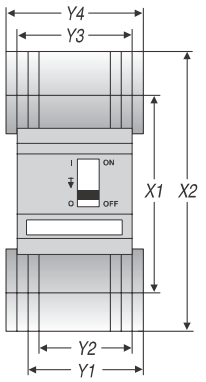


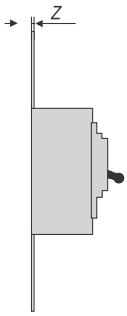
FE160 and FE250

Dimensional Drawings

Backplate - FD160

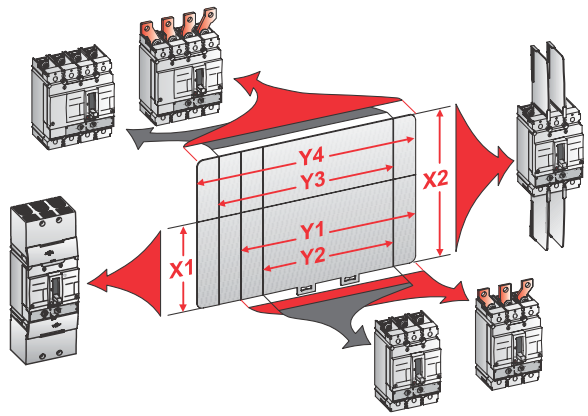


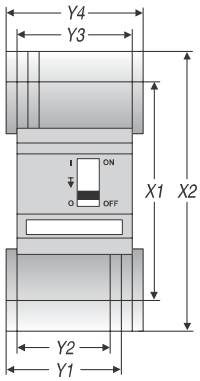


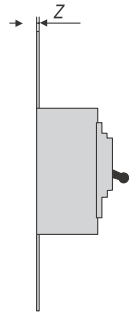


Dimensions	FD 63 FD 160
X1	230
X2	330
Y1	108
Y2	81
Y3	108
Y4	135
Z	1

Backplate - FE160 and FE250



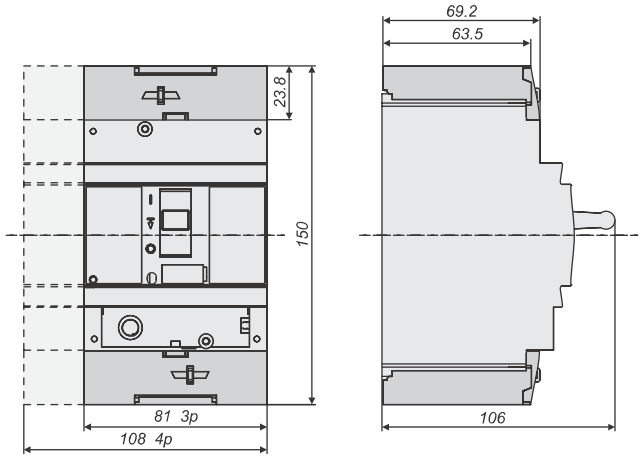




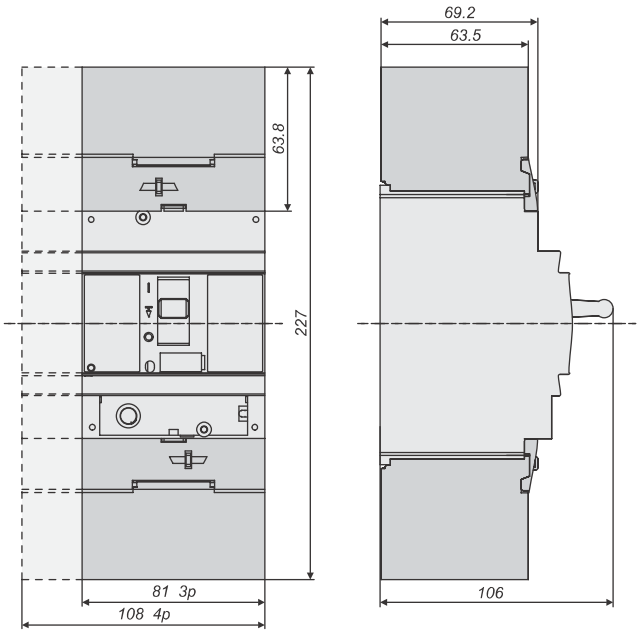
Dimensions	FE160 FE250
X1	310
X2	410
Y1	139.5
Y2	104.5
Y3	139.5
Y4	175
Z	1

Dimensional Drawings

Breaker with short terminal shields - FD160

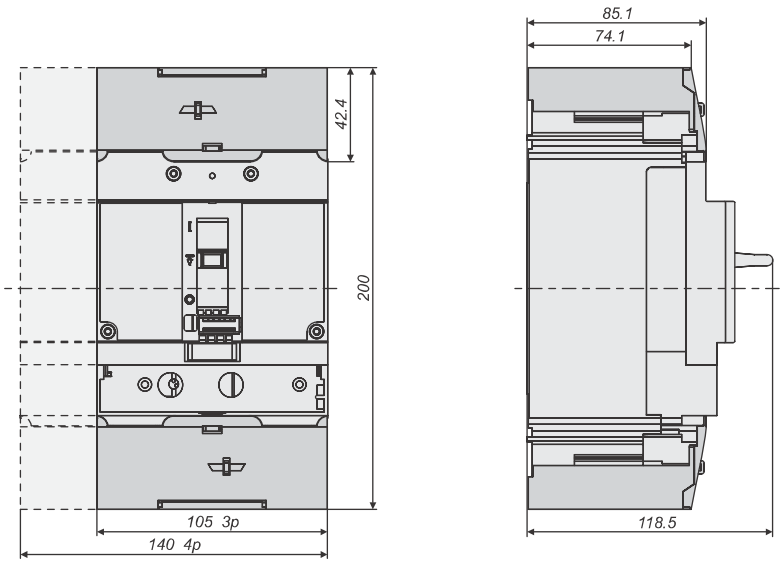


Breaker with long terminal shields - FD160

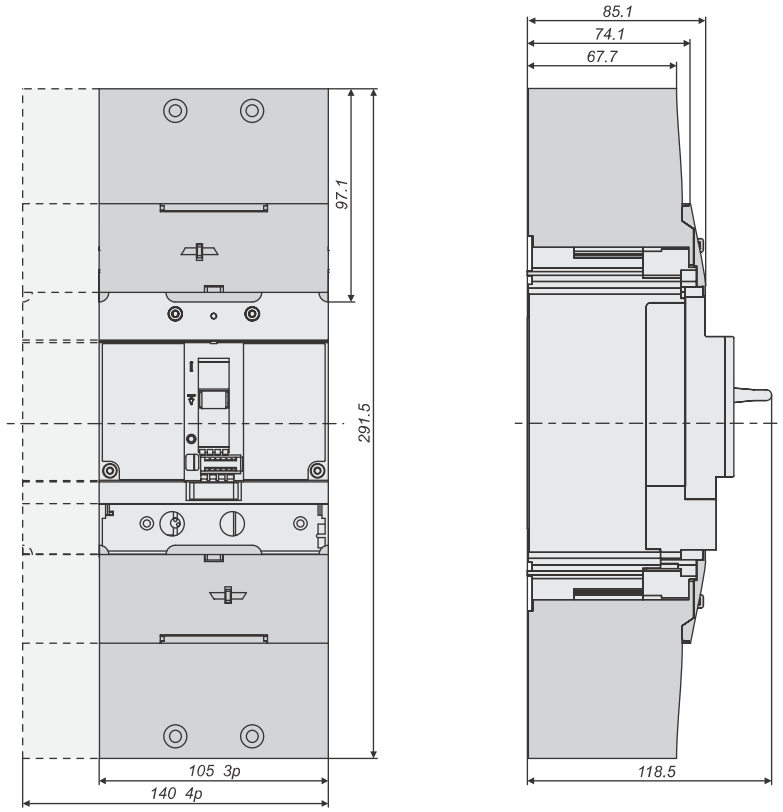


Dimensional Drawings

Breaker with short terminal shields - FE160 and FE250

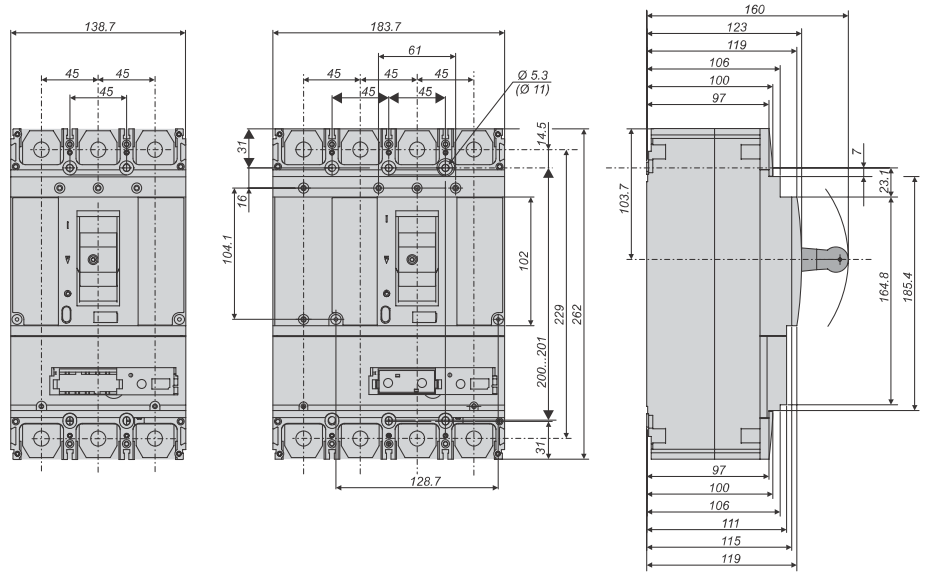


Breaker with long terminal shields - FE160 and FE250

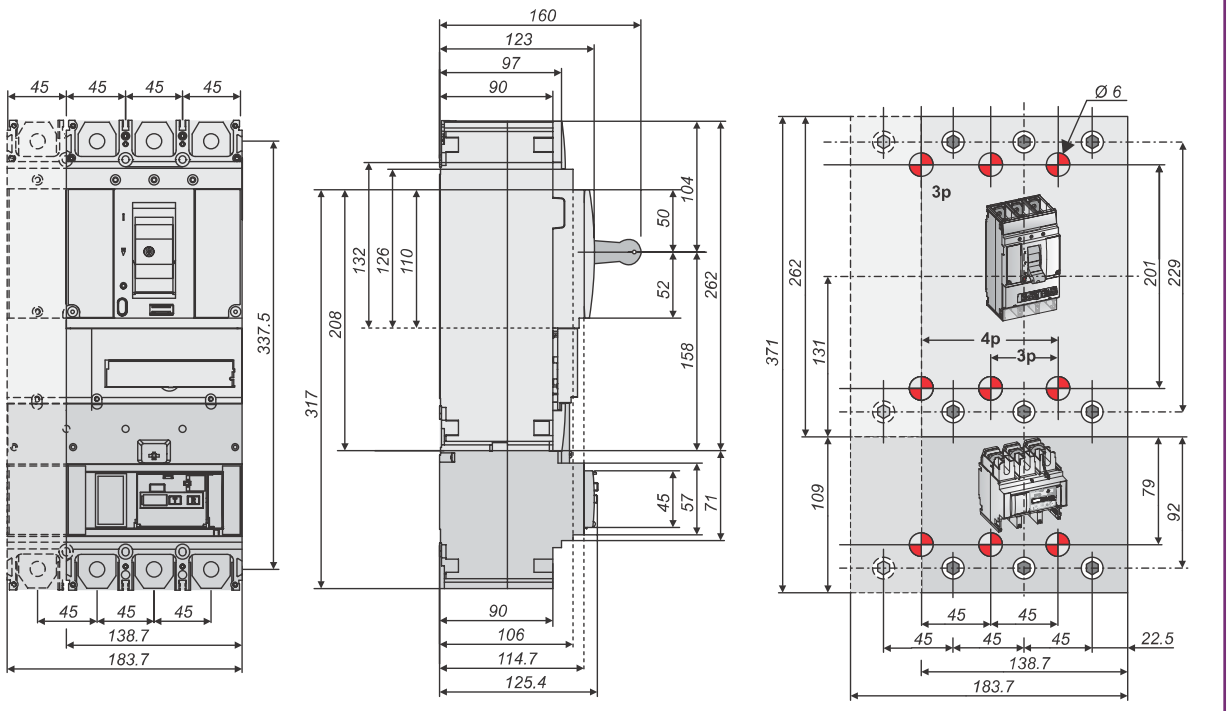


Dimensional Drawings

Breakers - FG400/630 fixed, front connected

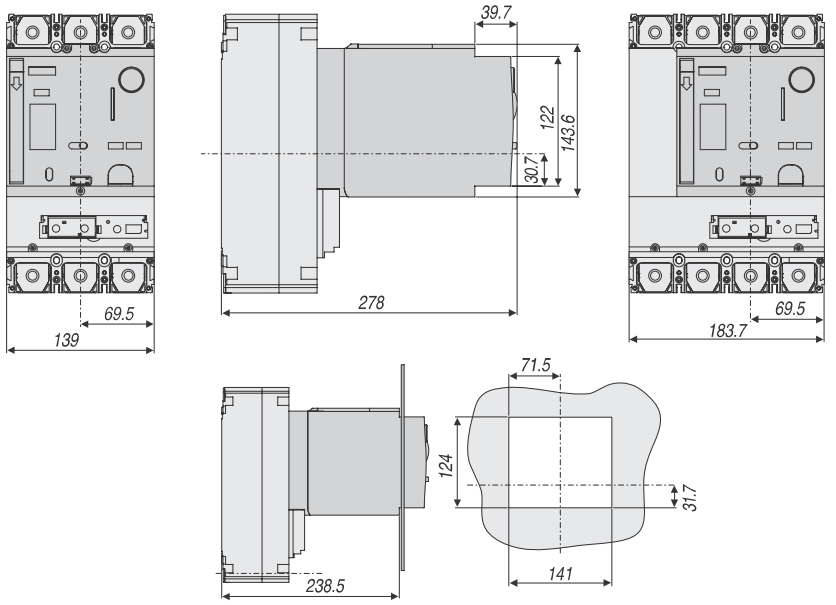


RCD bottom mounted - FG 400/630

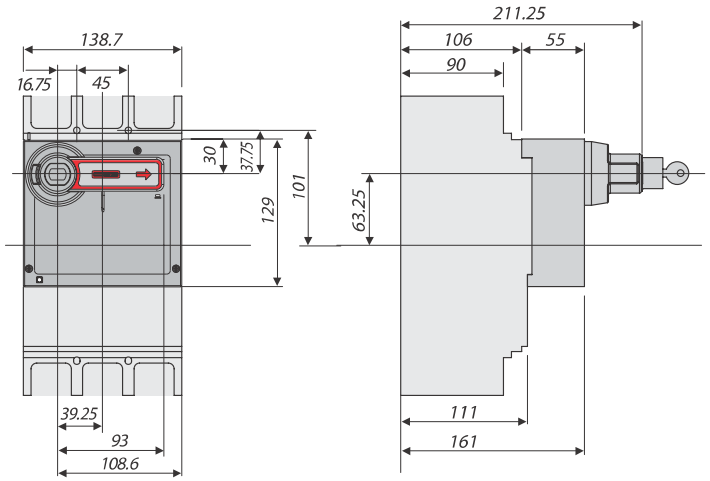


Dimensional Drawings

Breaker with electrical operator - FG400/630

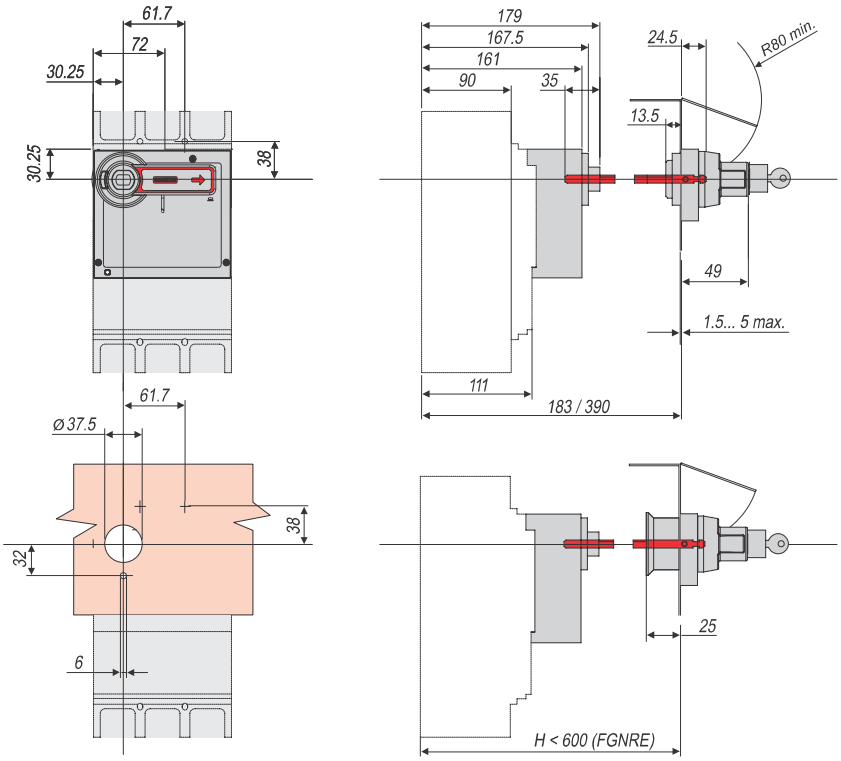


Rotary handle, breaker and through panel mounted - FG400/630

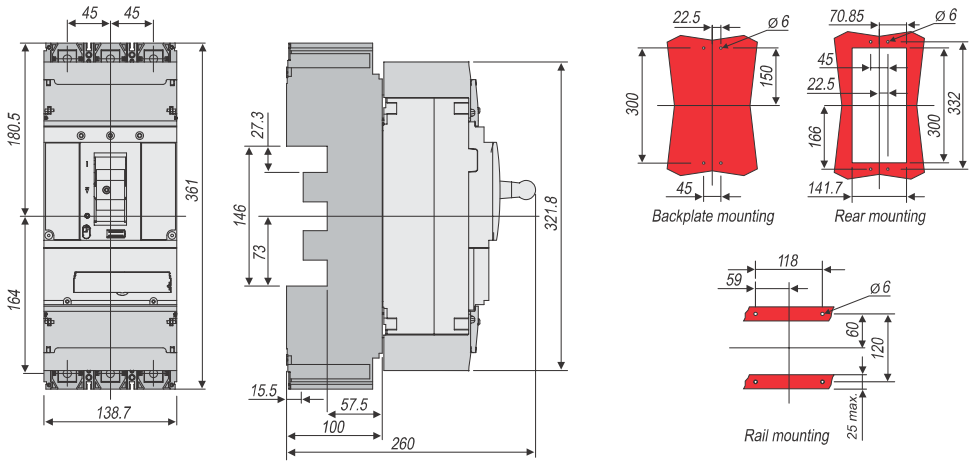


Dimensional Drawings

Rotary handle, door mounted - FG400/630

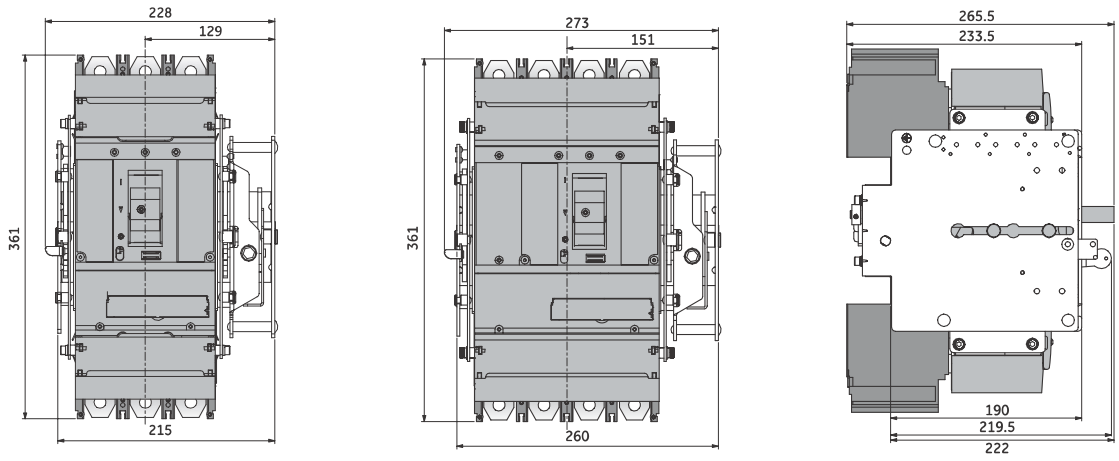


Plug-in version - FG400/630



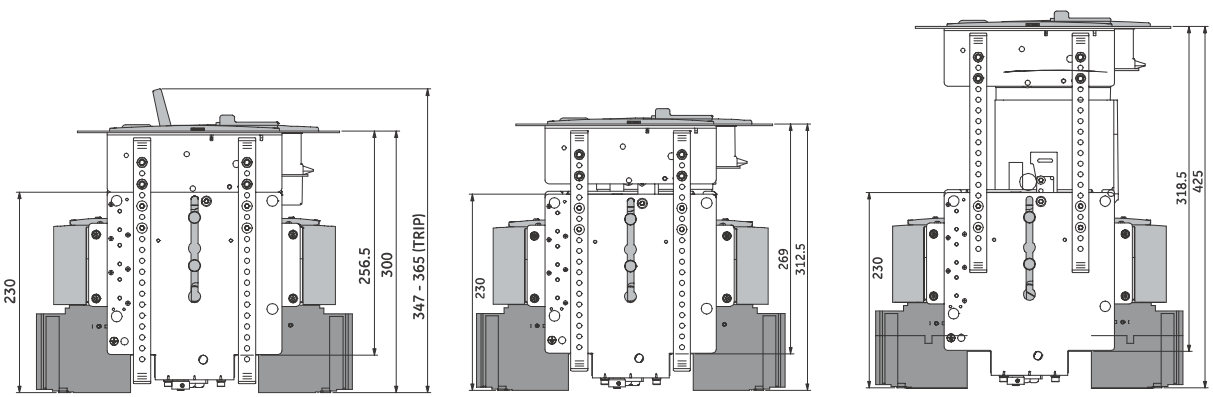
Dimensional Drawings

Draw-out version - FG400 & FG630



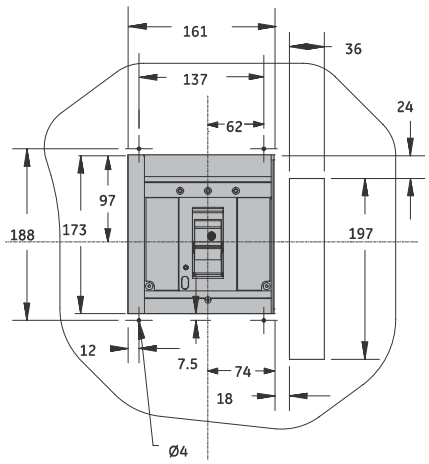
4 pole front view

Draw-out version - FG400 & FG630 - Through door execution side views



Toggle operator | Through door rotary handle | Motor operator

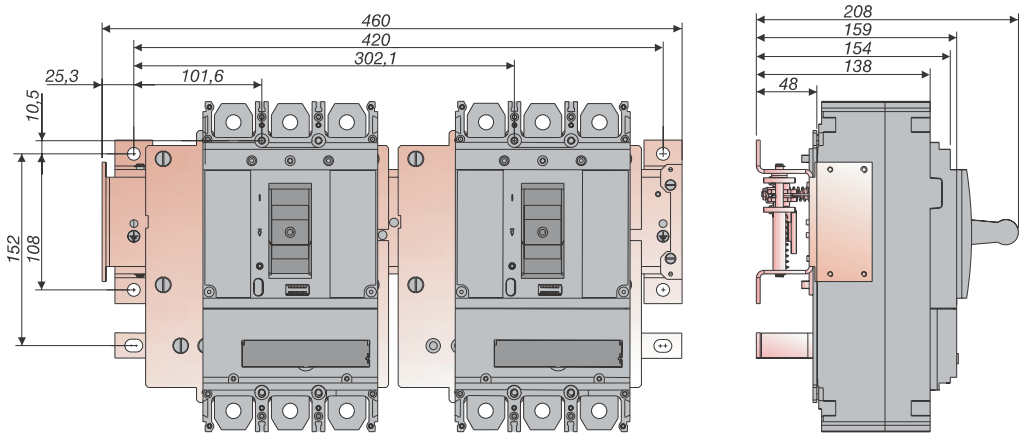
Draw-out version - FG400 & FG630 - Through door execution, door cut-outs



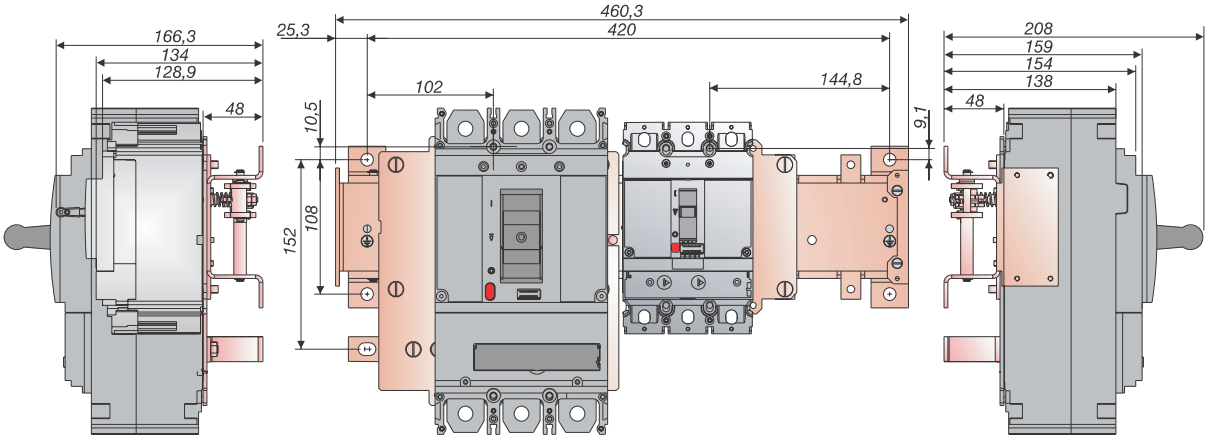
All through door variants

Dimensional Drawings

FG frame, 2 pieces mechanically interlocked

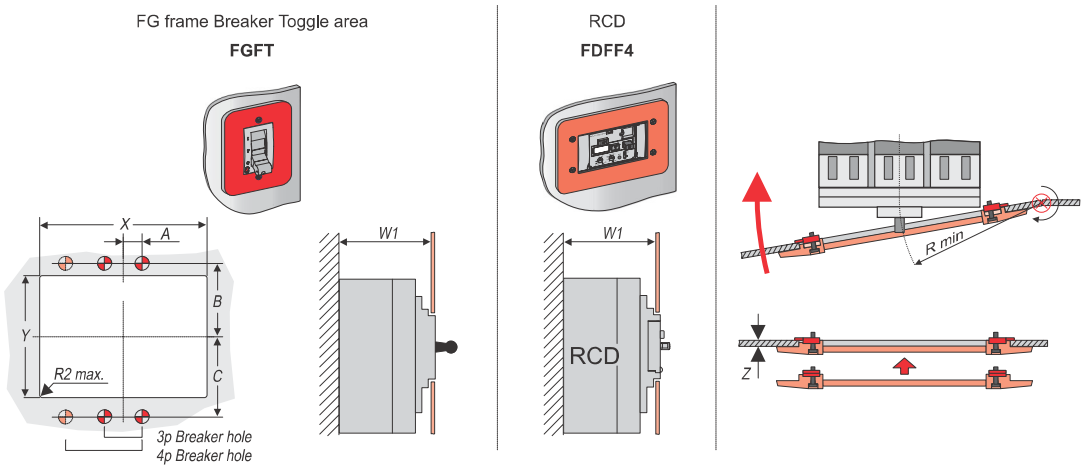


FG frame and FE frame mechanically interlocked



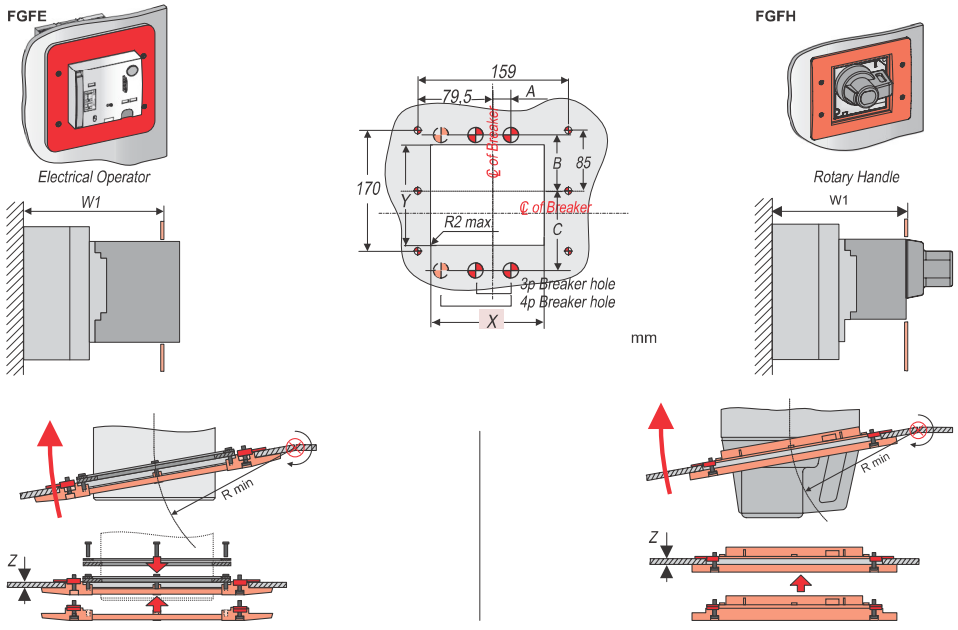
Dimensional Drawings

Door flanges - FG400/630



Dimensions										
			A	B	C	Rmin	W1(max)	X	Y	Z
FGFT	FG 400/630 Toggle	3p/4p	22.5	73	127	100	115	95	135	1...4
FDFF4	FG 400/630 RCD	3p/4p	22.5	297.5	68.5	93.5	115	146	78	1...4

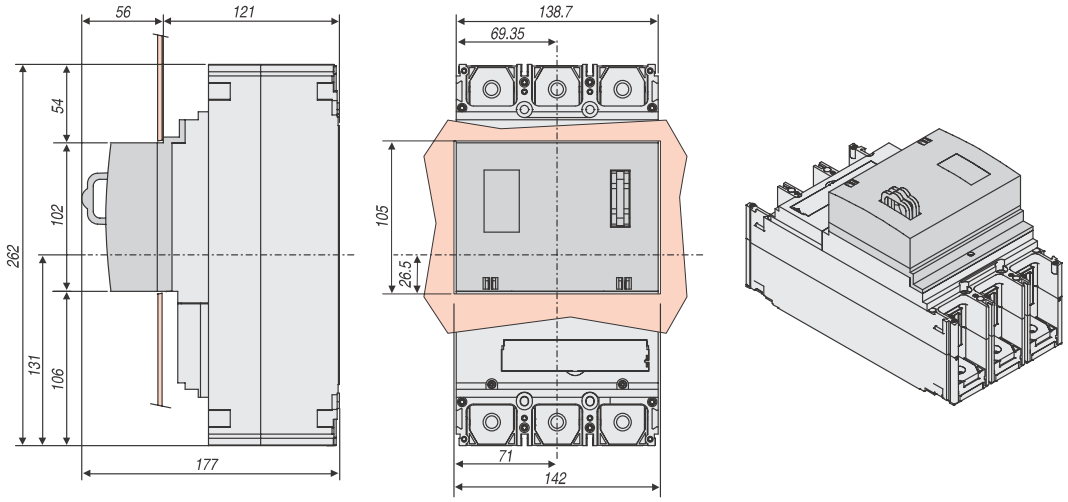
Door flanges - FG400/630



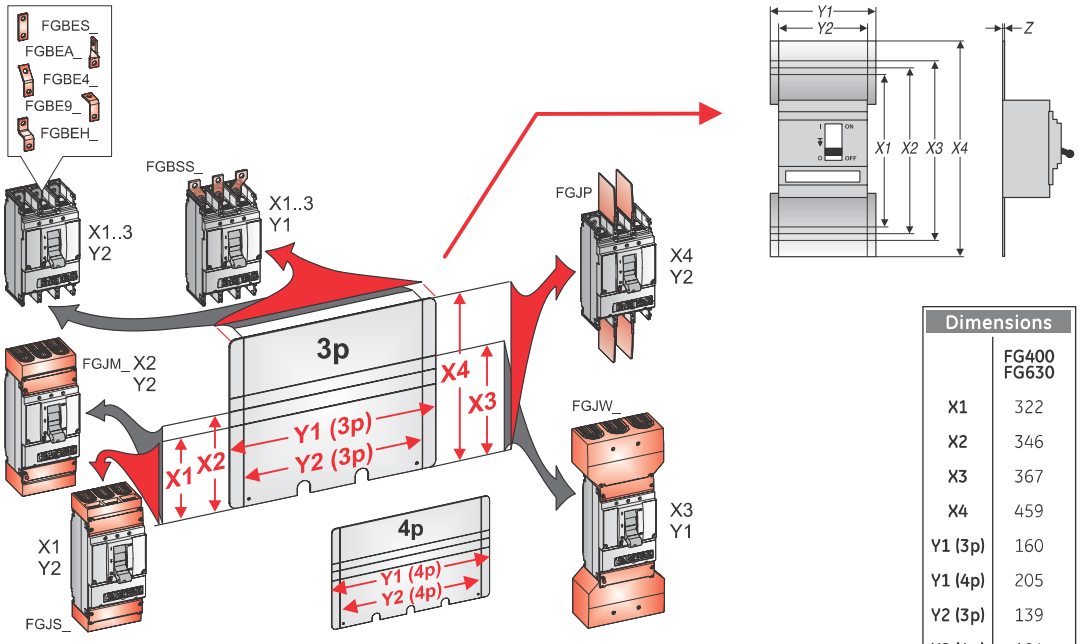
Dimensions									
3+4 pole versions		A	B	C	Rmin	W1(max)	X	Y	Z
FGFE	FG 400/630 Motor Operator	22.5	70	130.8	100	238.5	143	125	1...4
FGFH	FG 400/630 Rotary Handle	22.5	71.5	129	115	161	143	133	1...4

Dimensional Drawings

Padlock fixed - FG400/630



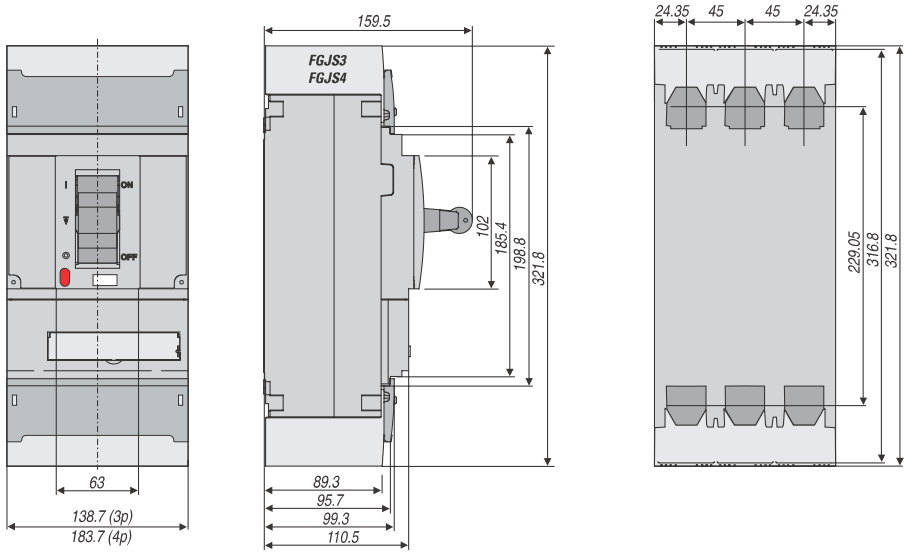
Backplate - FG400/630



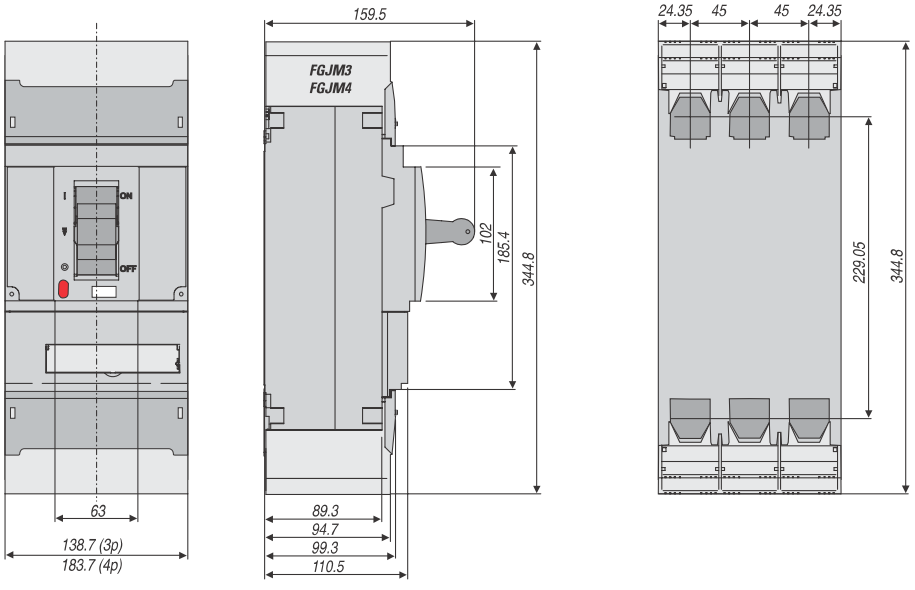
Dimensions	
	FG400 FG630
X1	322
X2	346
X3	367
X4	459
Y1 (3p)	160
Y1 (4p)	205
Y2 (3p)	139
Y2 (4p)	184
Z	1.5

Dimensional Drawings

Breaker with short terminal shields - FG400/630

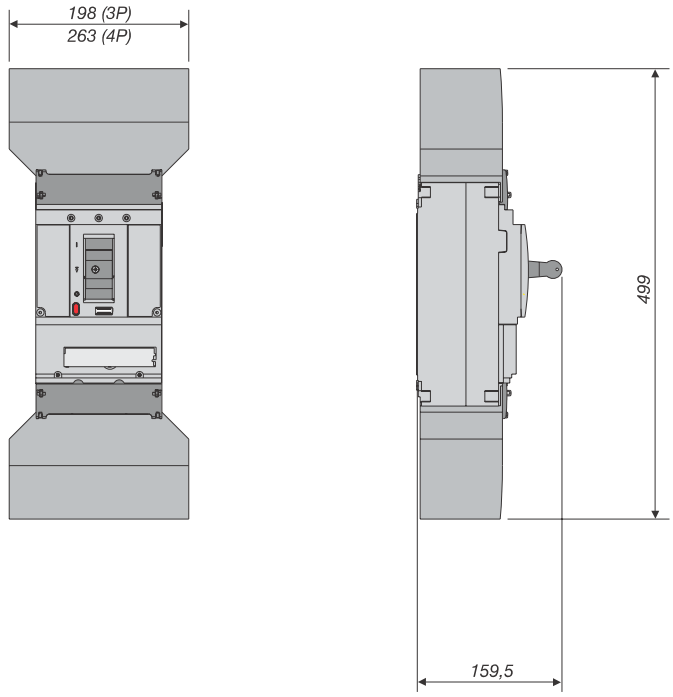


Breaker with medium terminal shields - FG400/630



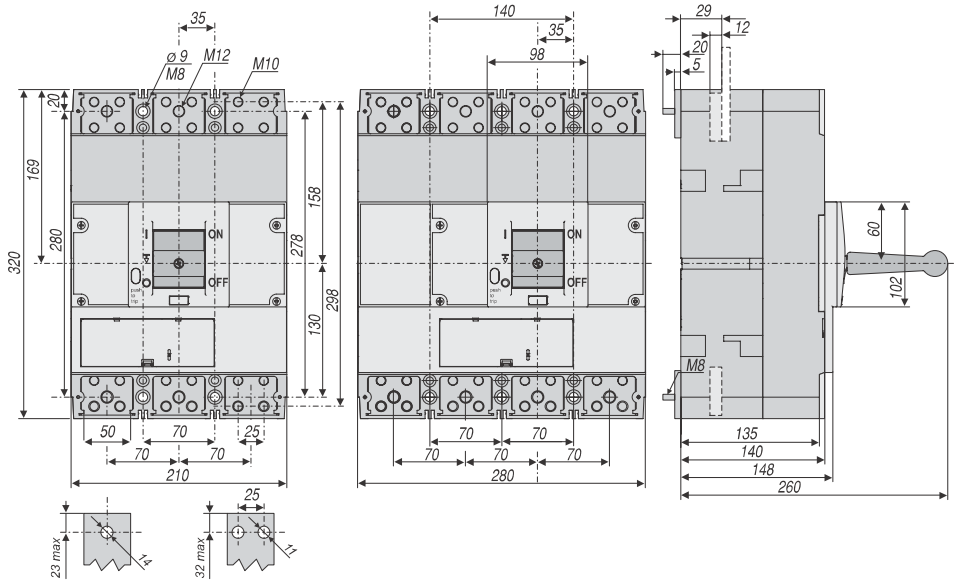
Dimensional Drawings

Breaker with long and wide terminal shields - FG400/630

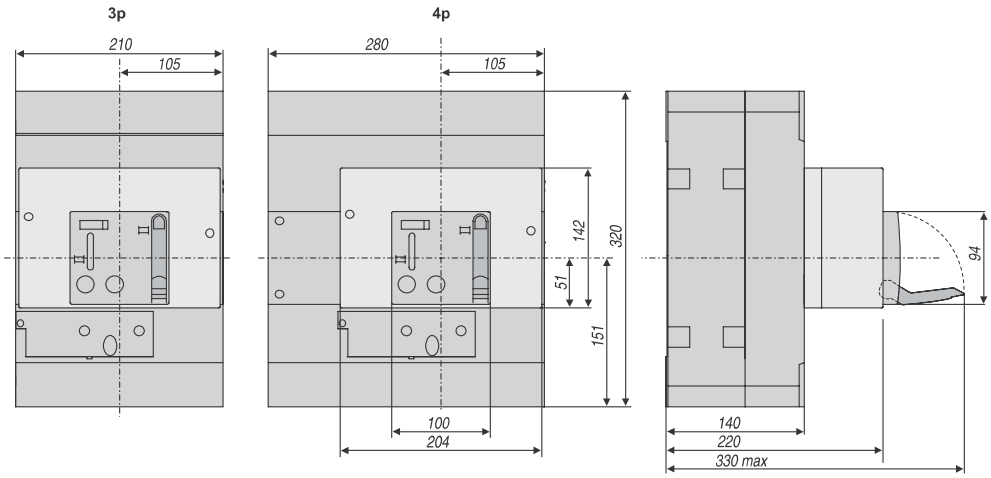


Dimensional Drawings

Breakers - FK800/1250/1600 fixed, front connected

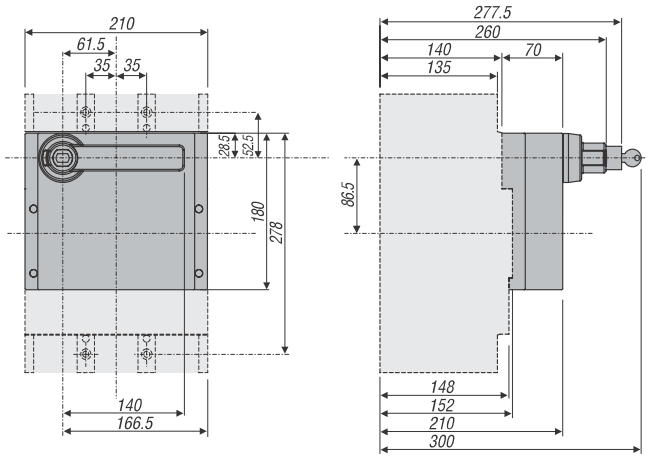


Breaker with electrical operator - FK800/1250/1600

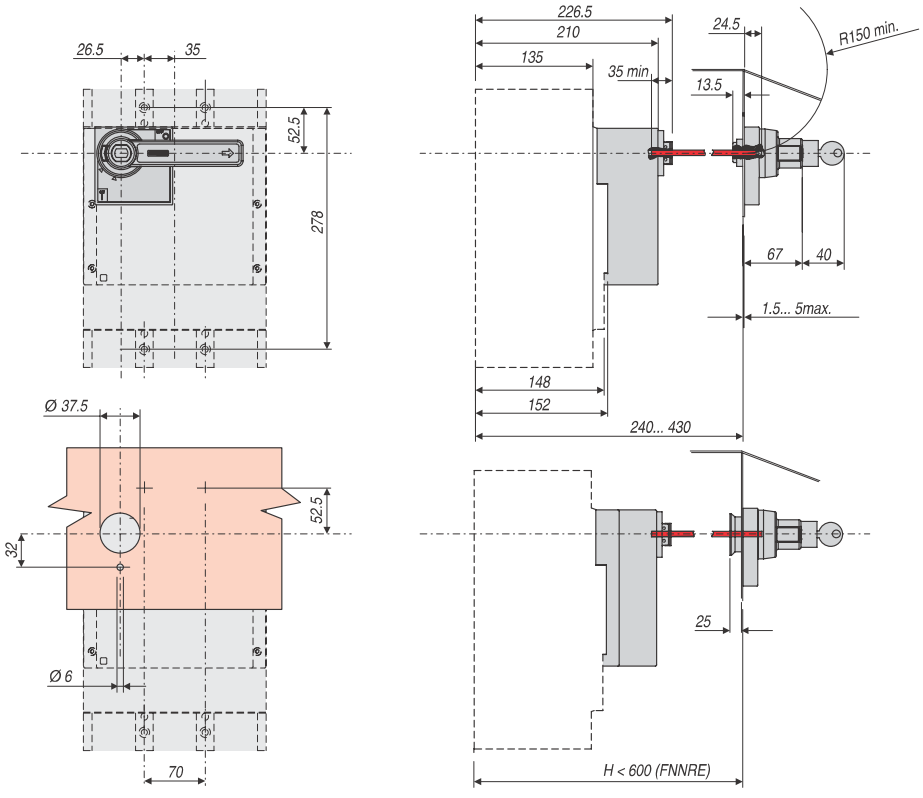


Dimensional Drawings

Rotary handle, door mounted - FK800/1250/1600

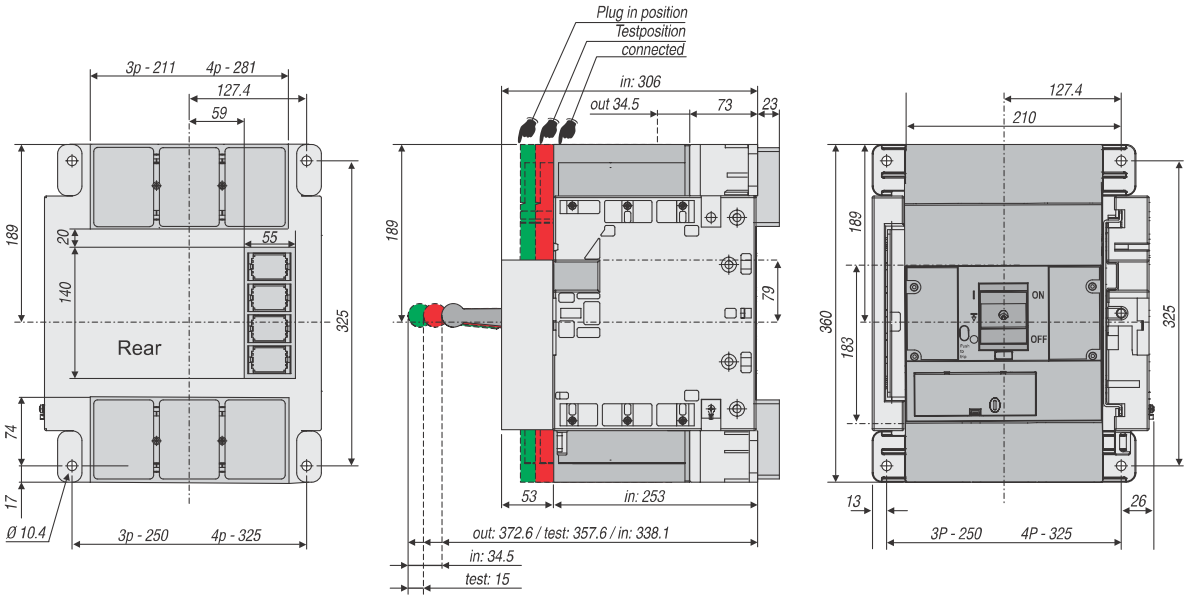


Rotary handle, breaker and through panel mounted - FK800/1250/1600

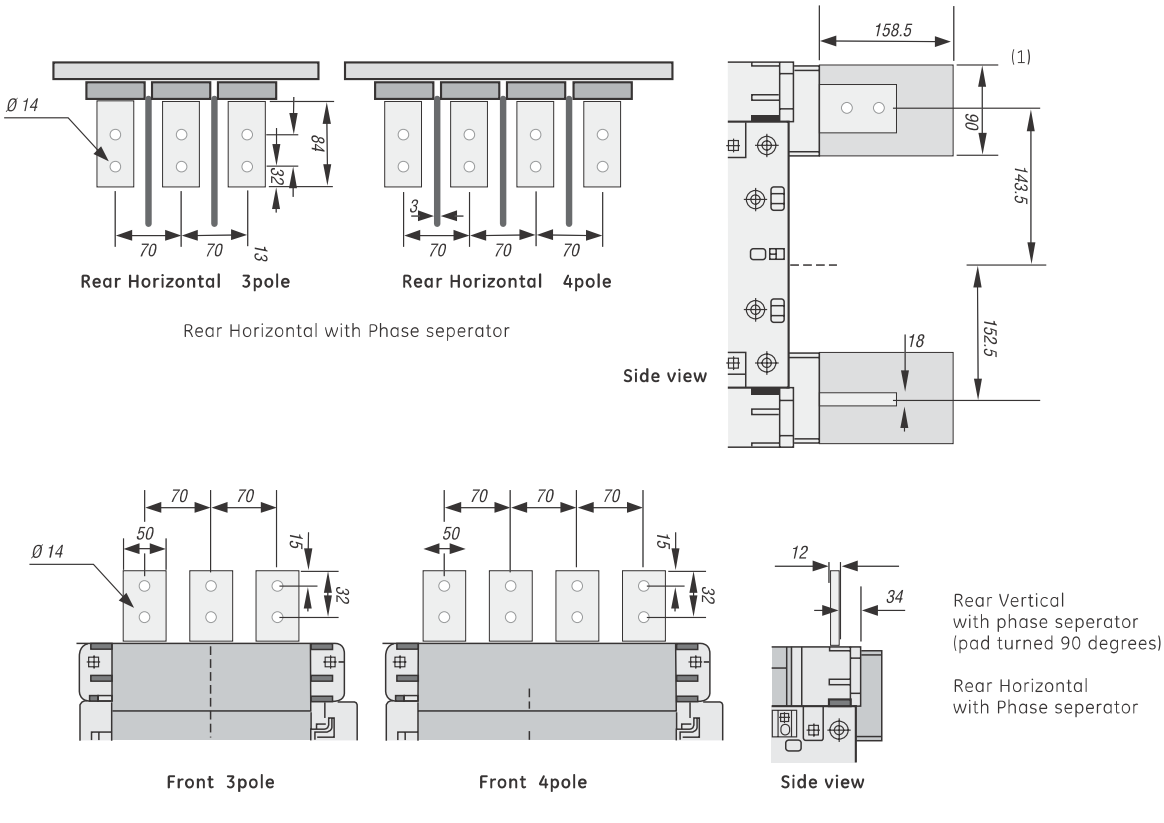


Dimensional Drawings

Draw-out version - FK800/1250/1600



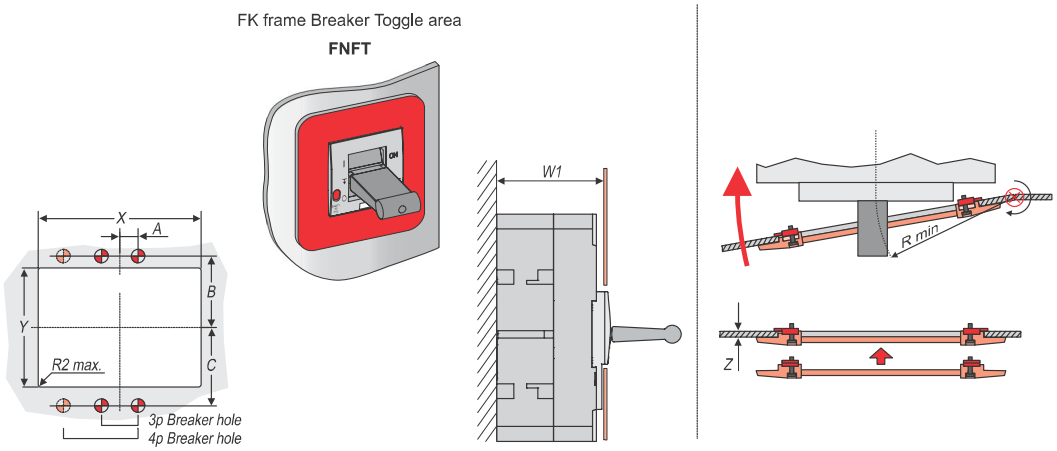
Draw-out version FK800/1250/1600 connection options



(1) Pad can be turned 90 degrees to indicated Rear Vertical connection mode.

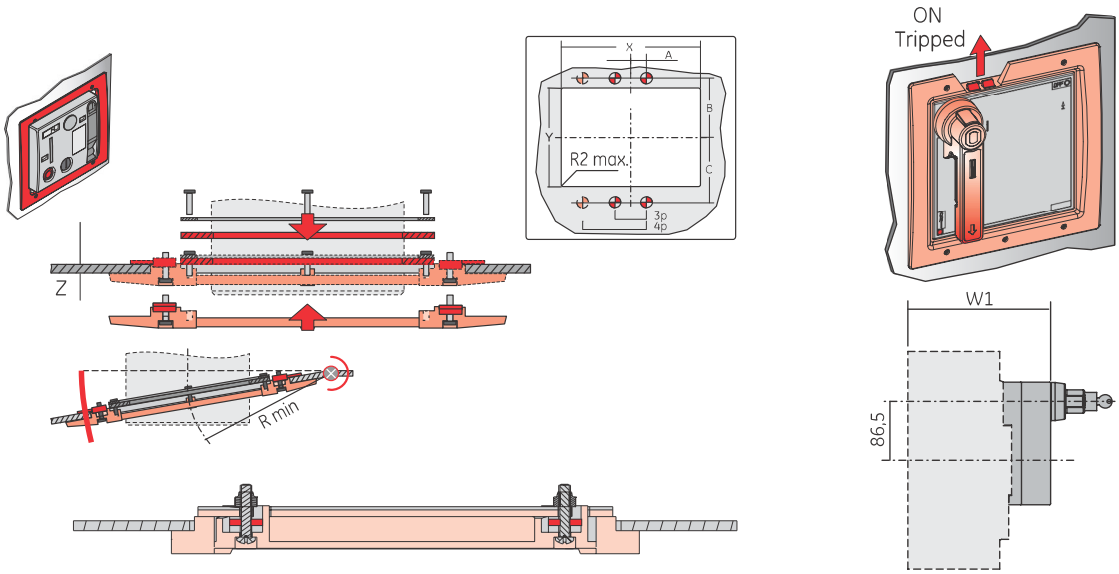
Dimensional Drawings

Door flanges - FK800/1250/1600



Dimensions										
			A	B	C	Rmin	W1(max)	X	Y	Z
FNFT	FK 800/1250/1600	3p/4p	35	130	150	120	153	101	104	1...4

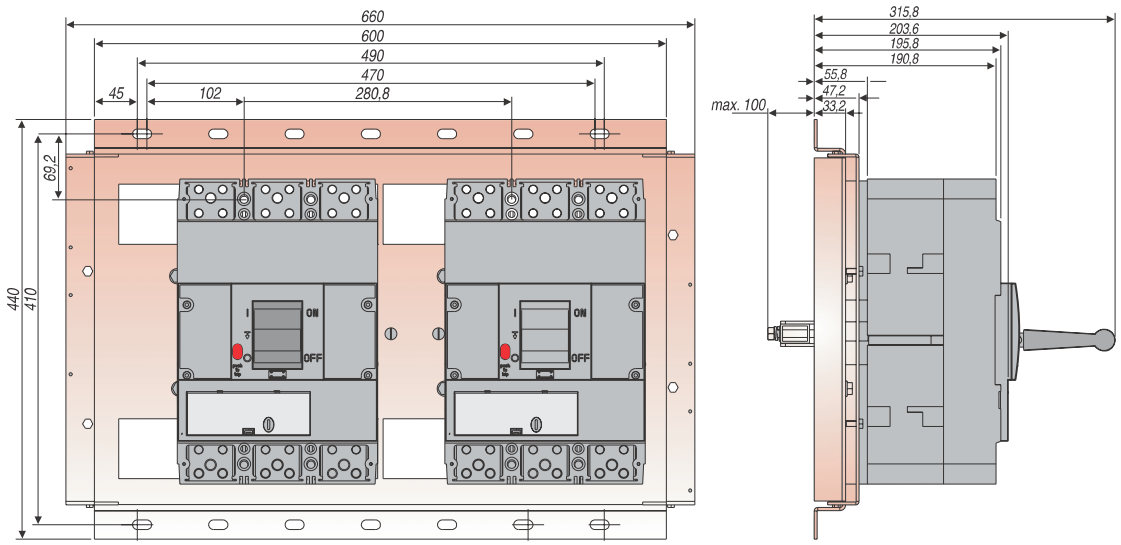
Door flanges - FK800/1250/1600



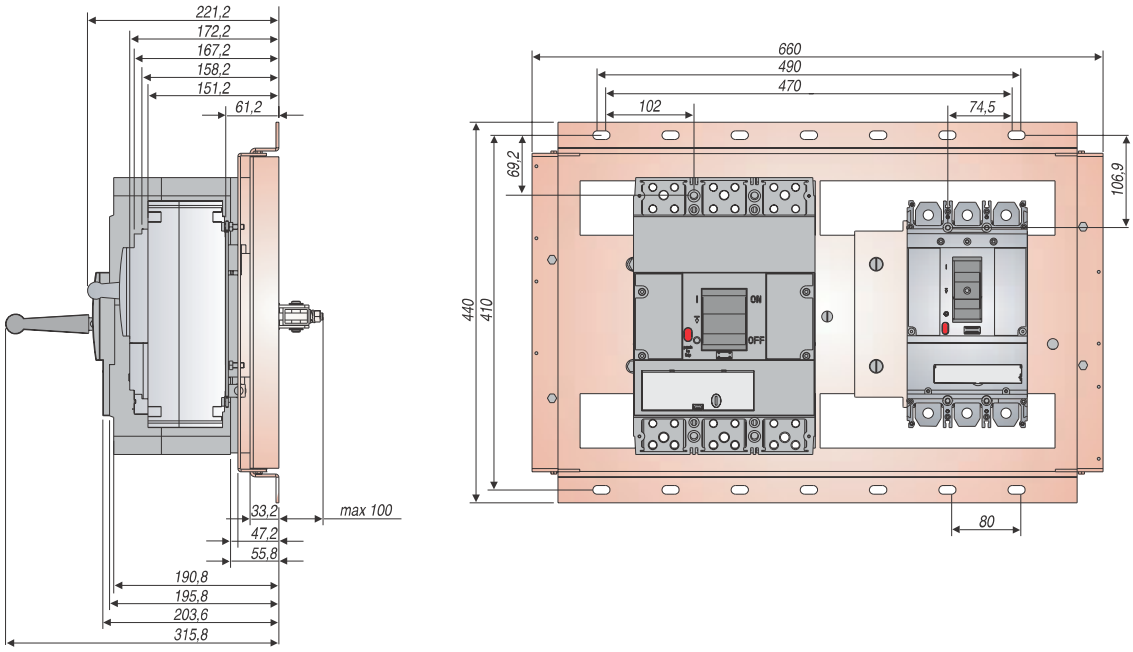
Dimensions									
3 + 4 pole versions		A	B	C	Rmin	W1(max)	X	Y	Z
FNFE	FK 800/1250/1600 Electr. operator	35	129	151	120	220	142	125	1...4
FNFH	FK 800/1250/1600 Rotary handle	35	114	163	190	210	232.5	232.5	1...4

Dimensional Drawings

FK frame, 2 pieces mechanically interlocked

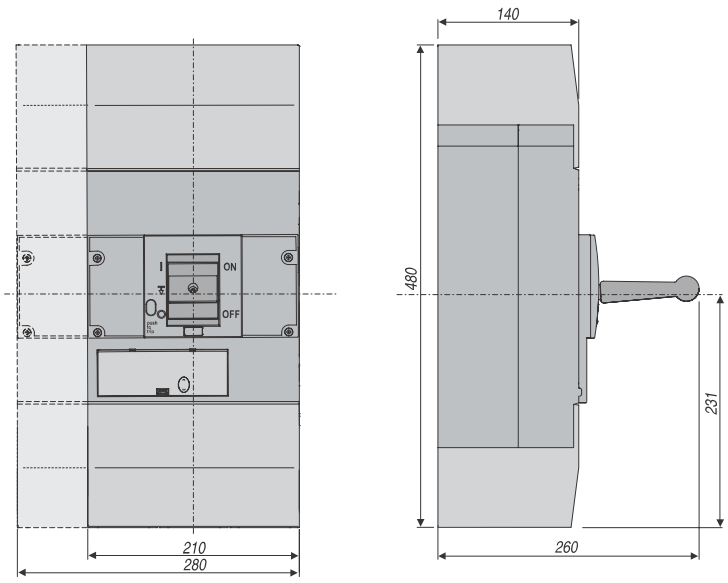


FK frame and FG frame. mechanically interlocked



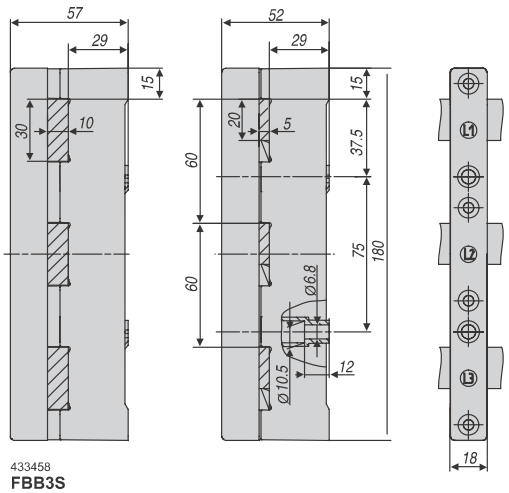
Dimensional Drawings

Breaker with long terminal shields - FK800/1250/1600

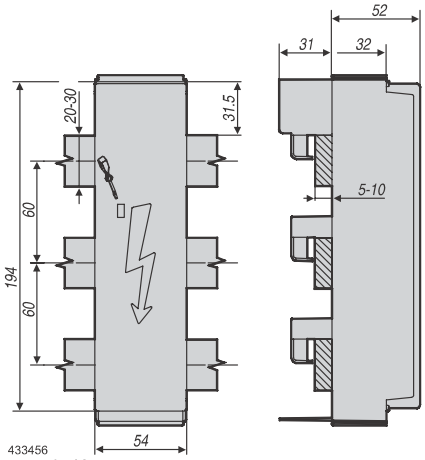


Dimensional Drawings

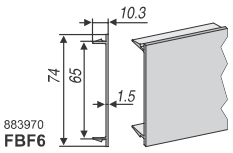
Connectivity 60 mm system - FD and FE frame 3 pole



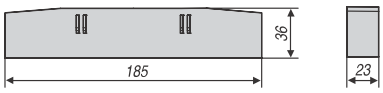
433458
FBB3S



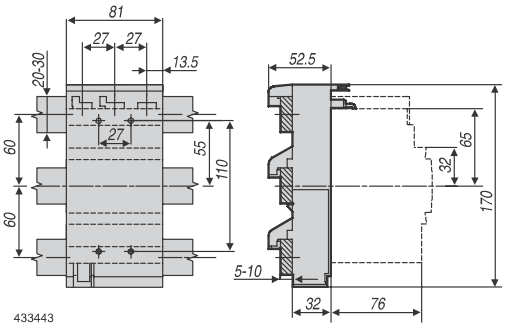
433456
FBTF3L12



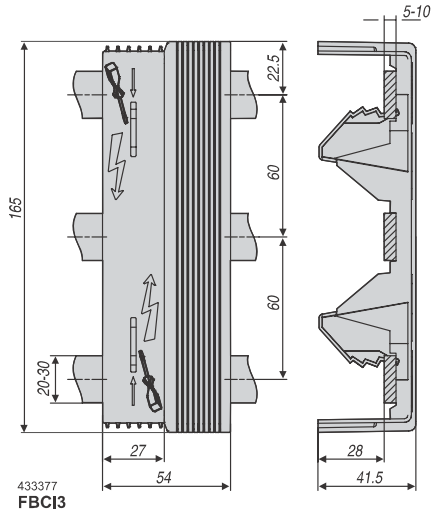
883970
FBF6



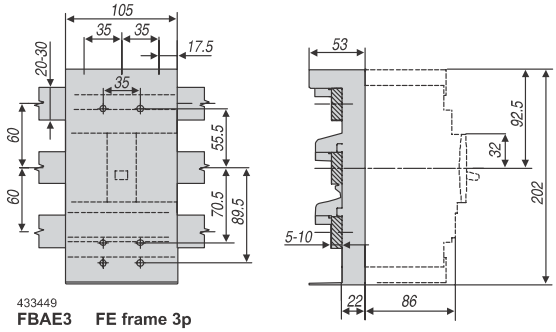
433455
FBB3E



433443
FBAD3 **FD frame 3p**



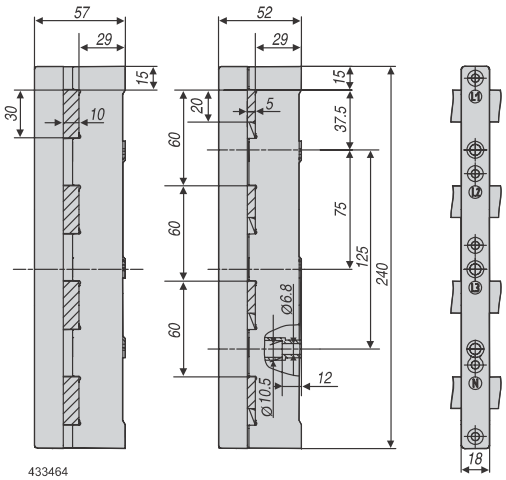
433377
FBCI3

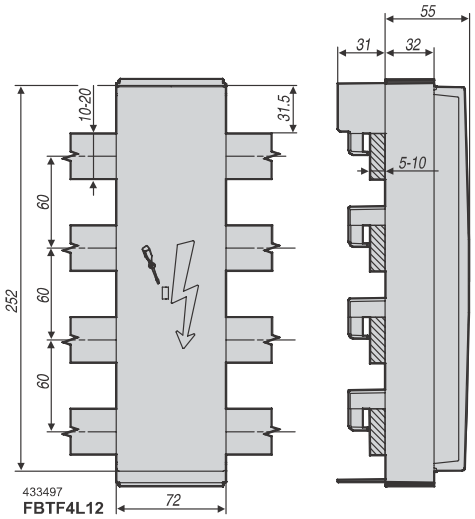


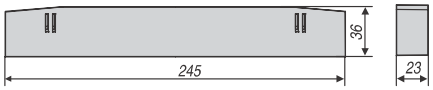
433449
FBAE3 **FE frame 3p**

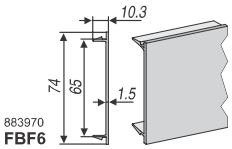
Dimensional Drawings

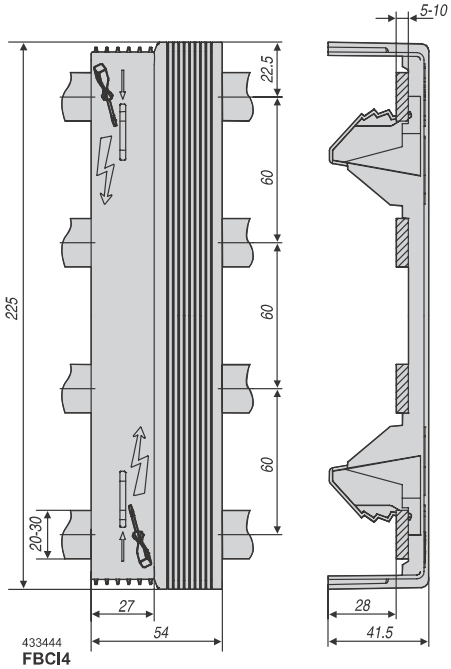
Connectivity 60 mm system - FD and FE frame 4 pole

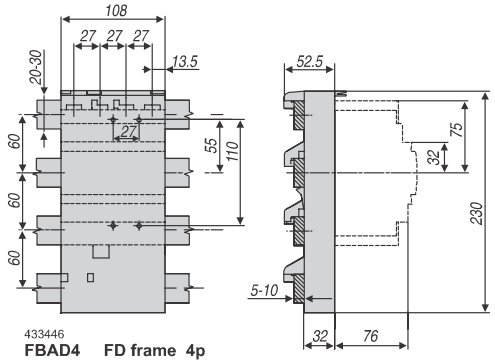


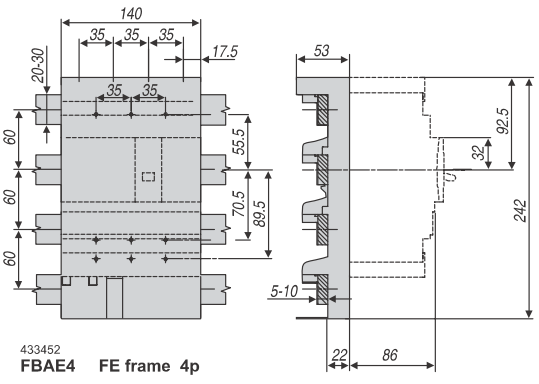








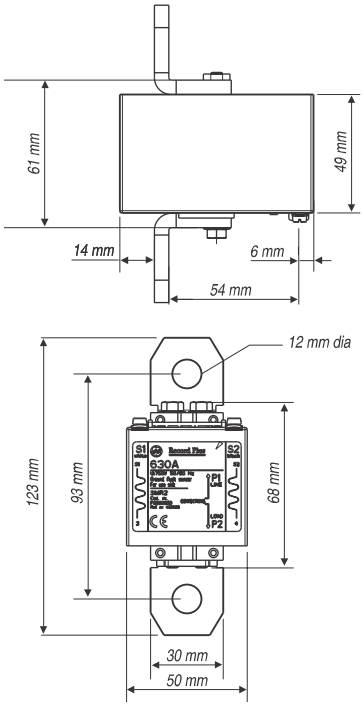




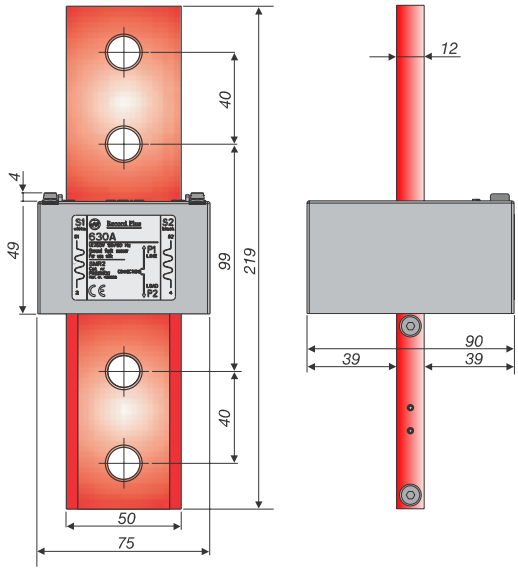
Dimensional Drawings

FG & FK frame, external groundfault sensors

FG type

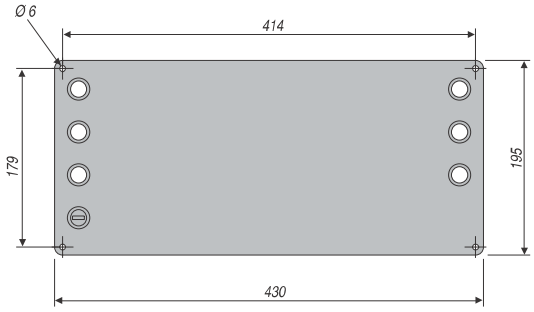


FK type

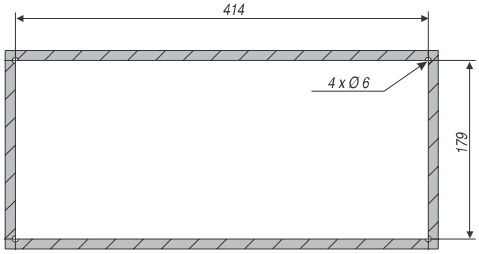


FE, FG & FK frame, controller for changeover device

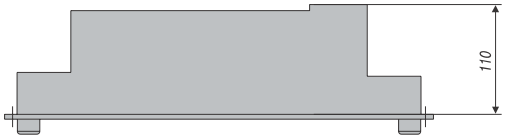
Controller type E and E Plus, front view



Cut-out for panel or door mounting



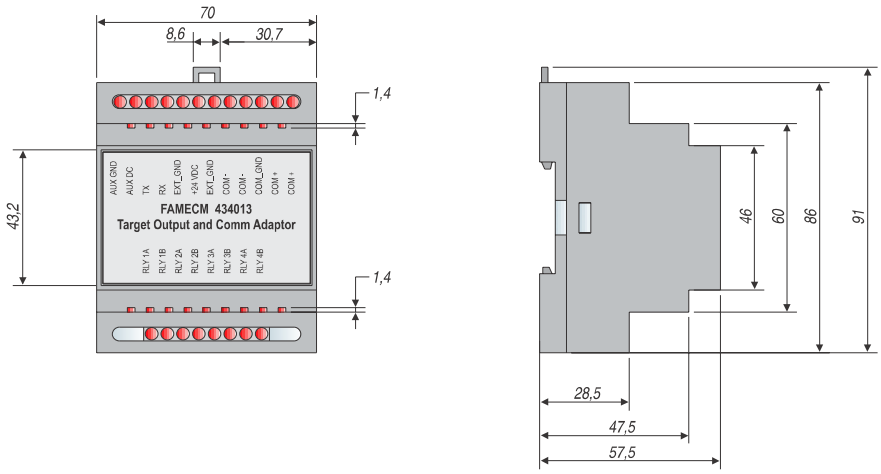
Controller type E, top view



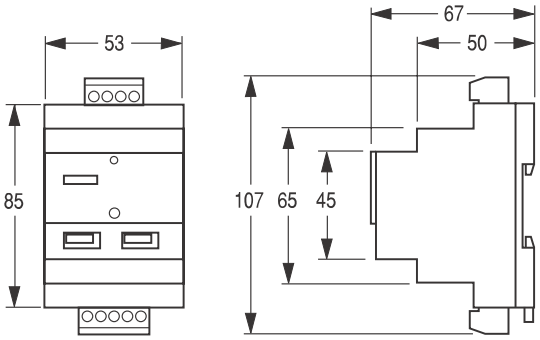
Controller type E Plus, top view

Dimensional Drawings

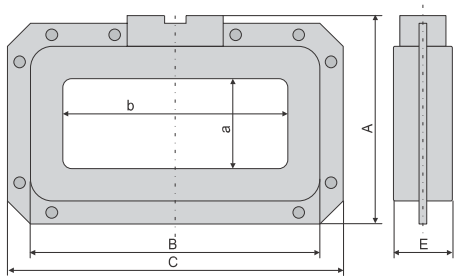
FG frame SMR2 trip unit accessory; FACM module



Relay RD5 and RD6

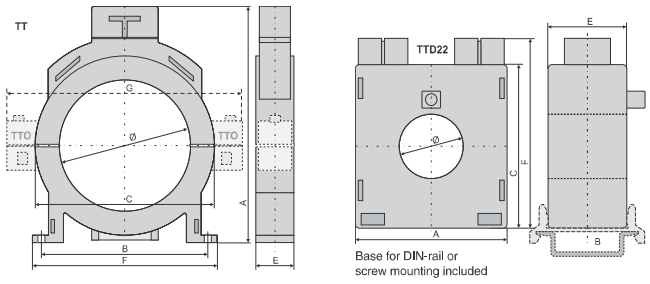


Rectangular sensor



Dimensions					
	a x b	A	B	C	E
BTR 175	70x175	162	225	261	46
BTR 305	115x305	226	360	402	55
BTR 350	130x350	271	415	460	55

Circular sensor



Dimensions							
	Ø	A	B	C	E	F	G
TTD22	22	52	21	56	27	65	-
TT35	35	118	90	78.5	27	104	-
TT60	60	143	102	94.5	27	117	-
TT80	80	163	110	114.5	27	125	-
TT110	110	198	140	150.5	32	155	-
TT160	160	248	181	200.5	32	197	-
TT210	210	298	210	250.5	32	227	-
TT0110	110	198	140	150.5	32	155	198
TT0210	210	298	210	250.5	32	227	296