Electronic Trip Units

SMR range

Electronic trip units that offer sophisticated protective functions and wide setting bands are standard protection devices for the FG400, FG630, FK800, FK1250 and FK1600 frame sizes. The FE frame can be equipped with interchangeable trip units offering a choice of the electronic or the electro-mechanical device. Each electronic device has been designed with the abnormalities of a modern low voltage distribution circuits in mind and has been rigorously tested to cope with harmonic currents, electro-magnetic fields, inrush currents and spikes, thus preventing phenomanae as incorrect current measurement and nuisance tripping. The devices exist in a number of performance tiers, the SMR1 device for the FE and FG frame sizes, the SMR 2 for the FG frame size and the SMR1e, 1s and 1g types for the FK frame size.

SMR1

The SMR1 trip unit type is available for all FE and FG frame sizes. The device has two basic protective functions. The first is a Long Time or overload protection with two time bands designed to match motor or cable characteristics and a user defineable setting range. When set to motor protection mode a phase loss protection is initiated that will trip the breaker when the difference in current between one phase line and the average of all three phase drops below 20%.
The second device, the Short Time protection, offers protection against short-circuits and is settable from 2 to 13 x the adjusted LT protection.

This easy-to-adjust trip unit is equipped with a LT pre-alarm device made up of a LED indicator on the trip unit front face and an electronic contact. Before the breaker trip is initialized the LED will at first start to blink (at about 0.95 x Ir). When the Ir setting is reached It will stop blinking and remain on (breaker trip is imminent). An electronic contact will close, allowing the remote disconnection of a circuit. A so called LT module is available as a modular DIN-rail device. It transforms the electronic signal into a signal that allows the operation of an external relay or contactor before the main circuit is fully disconnected by the breaker.

All SMR 1 trip units have a built-in temperature sensor that trips the breaker at temperatures above 85°C. It thus prevents the breaker and electrical components in its immediate vicinity from overheating.

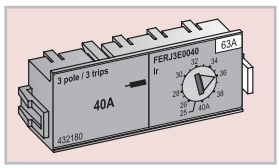
	Sensor color code
FE frame	25A
	63A
	125A
	160A
	250A
FG400	350A
	400A
FG630	400A
	500A
	630A

The SMR 1 uses rating plugs that allow the user flexibility to make a last minute choice in the required current rating, protected poles or protection band. These exist in two variants, adjustable and switchable. In order to prevent an insertion of a rating plug into the incorrect trip unit (number of poles and current rating) a mechanical interlock and color coding system are present.

Each SMR1 trip unit comes with a transparent, tamper-free (sealable) cover, this to prevent unauthorized manipulation of the breaker settings. They are supplied as a simple to mount, plug in electronic pouch (current sensors supplied with the breaker). The device is supplied with an electronic actuator coil that fits into a pocket in the breaker housing and is then connected to the trip unit. Without mounted and connected actuator coil the breaker will not function. In order to verify a correct operation of the combination a simple test device is available to test the assembly.
We strongly recommend the use of this test device.

Adjustable rating plug

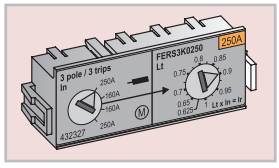
Specifically designed for line protection with a setting range of 0.64 to 1 x the plug rating over 16 setpoints. The settings on the devices are in current values and thus allow for ease of setting.



Each trip unit size can be equipped with one of two available adjustable rating plugs types. For 4 pole trip units the rating plugs exist in 3 and 4pole protected versions with a choice in neutral rating between 50 or 100% of the phase value.

Switchable rating plug

Allows for a choice of line or class 10 motor protection(1). The device has two setting knobs: one for the desired rating and band selection and one for the definite current setting.
The current setting is in multiples of the selected rating and has a range of 0.4 to 1 x the trip unit size over 32 set-points. Each trip unit size has one switch-able rating plug. For 4 pole trip units the rating plugs exist in 3 and 4pole protected versions with a choice in neutral rating between 50 or 100% of the phase value.



(1) according to IEC EN 60947-4.1

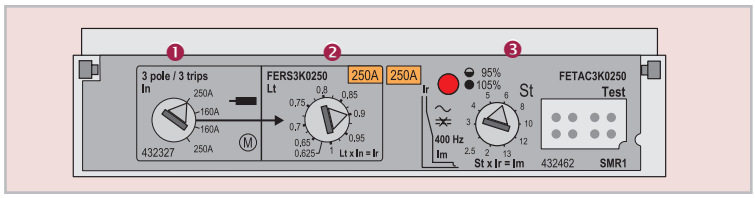
FE160 and FE250 breakers
SMR1 types

Trip units are available in 10 different versions depending on the frame rating and the network frequency.
FE 160 frame size 50/60 Hz 25, 63, 125 and 160A
FE250 frame size 50/60Hz 125, 160 and 250A
400 cycle variants (available on request)
FE160 - 125 and 160A, FE 250 - 250A
The trip units must be equipped with a rating plug that establishes the rated current of the protective device and its setting. A colour code and a mechanical interlock prevent incorrect combinations of electronic trip units and rating plugs. The 50/60Hz and 400Hz variants use the same rating plug.
For special applications a version with disabled LT or overload protection is available complete with a specific rating plug.

FE 160 & FE 250 Breakers - Electronic Trip Unit Overview

FE frame					Electronic trip unit overview							
					In	LT pick-up band 1.05÷1.3 Ir		ST pick-up band ± 20% Im			Neutral protection	
					[A]	Ir setting	max [A]	Im setting	fix [A]		4P4R	4P 3TN	4P3R
SMR1 + adjustable rating plug	N	H	L	FE160	16	0.625-1 In 16 steps line protection	16	2-13 Ir 10 steps	20	208	=Ir		not protected
					25		25		32	325	=Ir		
					40		40		50	520	=Ir		
					63		63		79	819	=Ir	=Ir/2	
					80		80		101	1040	=Ir	=Ir/2	
					100		100		126	1300	=Ir	=Ir/2	
					125		125		160	1625	=Ir	=Ir/2	
					160		160		200	2080	=Ir	=Ir/2	
				FE250	80		80		79	819	=Ir	=Ir/2	
					100		100		126	1300	=Ir	=Ir/2	
					125		125		160	1625	=Ir	=Ir/2	
					160		160		200	2080	=Ir	=Ir/2	
					250		250		320	3250	=Ir	=Ir/2	
SMR1 + switchable rating plug	N	H	L	FE160	25	❶ 0.4-1 In 32 steps line/mot. protection	25	❸ 2-13 Ir 10 steps	20	325	=Ir	=Ir/2	not protected
					63		63		50	819	=Ir	=Ir/2	
					125		125		100	1625	=Ir	=Ir/2	
					160		160		128	2080	=Ir	=Ir/2	
				FE250	125		125		100	1625	=Ir	=Ir/2	
					160		❷ 160		128	2080	=Ir	=Ir/2	
					250		250		200	3250	=Ir	=Ir/2	

Band timings	1.5 x Ir	7.2 x Ir
Line protection	65 - 95 sec	2.0 - 3.0 sec
Motor protection	200 - 300 sec	6.4 - 9.6 sec



How to set the device
The defined rating plug defines the long time (LT) setting range and the manner of its adjustment.

LT setting with adjustable rating plug
One knob with 16 positions allows the user a current setting (Ir) between 0.625 and 1 times the chosen rating. (values in A)

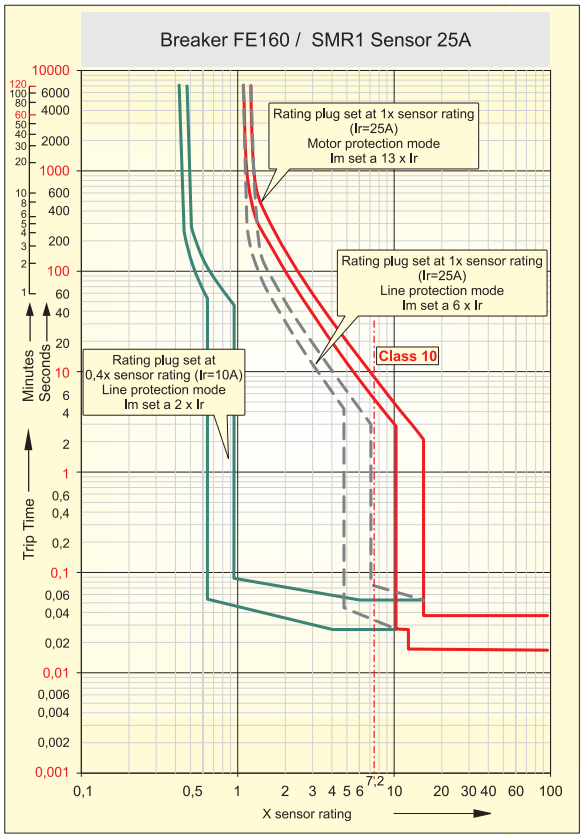
LT setting with switchable rating plug
One knob to set the protection band (line class 5 or motor class 10) and the rated current value (2 current value settings of 0.625 and 1 x the trip unit rating) - in sketch trip unit rating **250A** settings **160A or 250A**.
A second knob with 16 positions allows the user to set the current (Ir in multipliers of chosen rating). The combination of these two knobs allows a setting range of 0.4 to 1 x the trip unit rating with 32 setpoints.

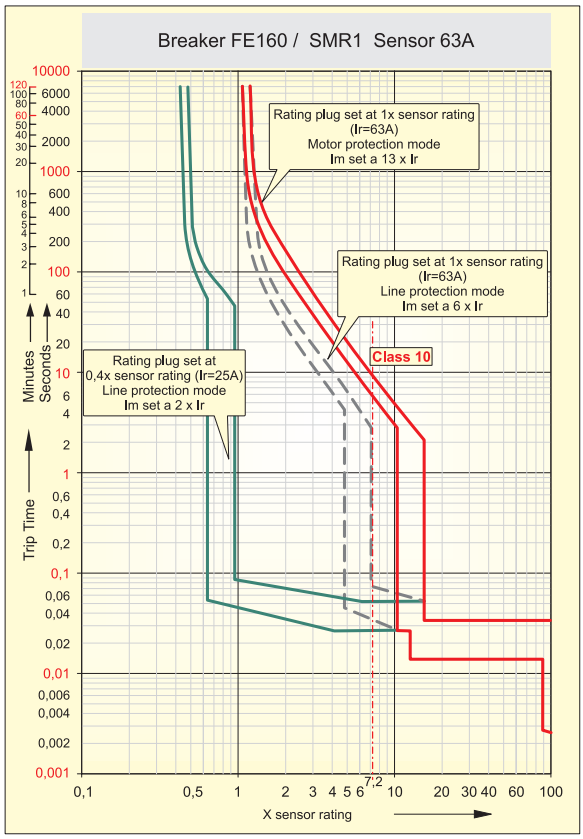
ST or Im setting
Is set in multiples of the LT current setting and has a setting of 2 to 13 x this value with 10 setpoints.

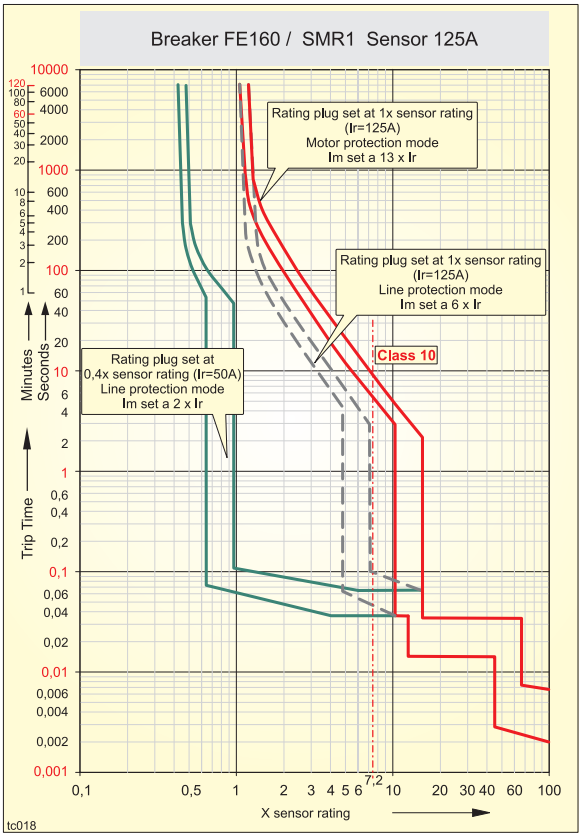
Example
A line protection device; required overload or **LT** setting 120A, short-circuit or **ST** setting 8 x the LT setting.
SMR1 of 250A + switchable rating plug of 250A.
LT setting .....knob 1 set to line and 160A
.....knob 2 set at 0.75 (0.75 x 160 = 120A)
ST setting.....knob 3 set a 8 x (= 8 x 120)
SMR1 of 250A + adjustable rating plug of 160A.
LT setting .....knob 2 set at 120 (value on scale)
ST setting.....knob 3 set at 8 x (= 8 x 120)

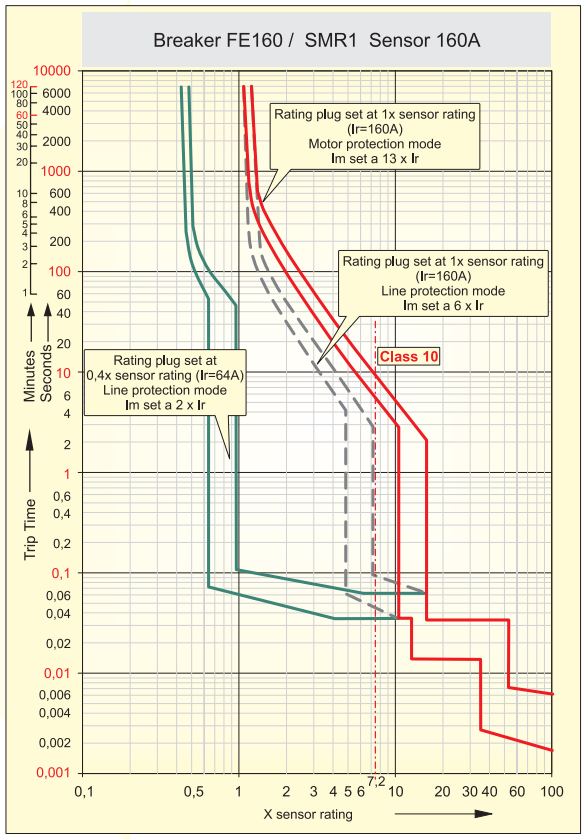
Time Current Curves

FE160 and FE250 breakers
SMR1 types

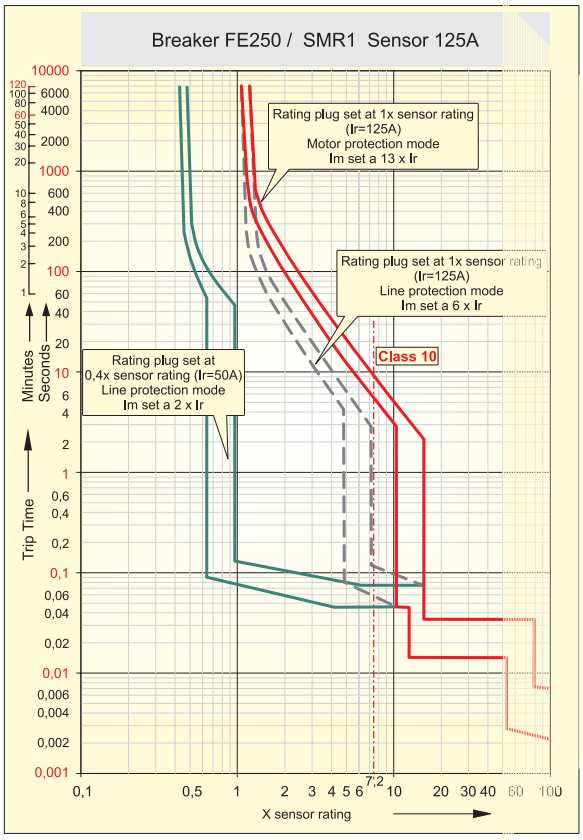


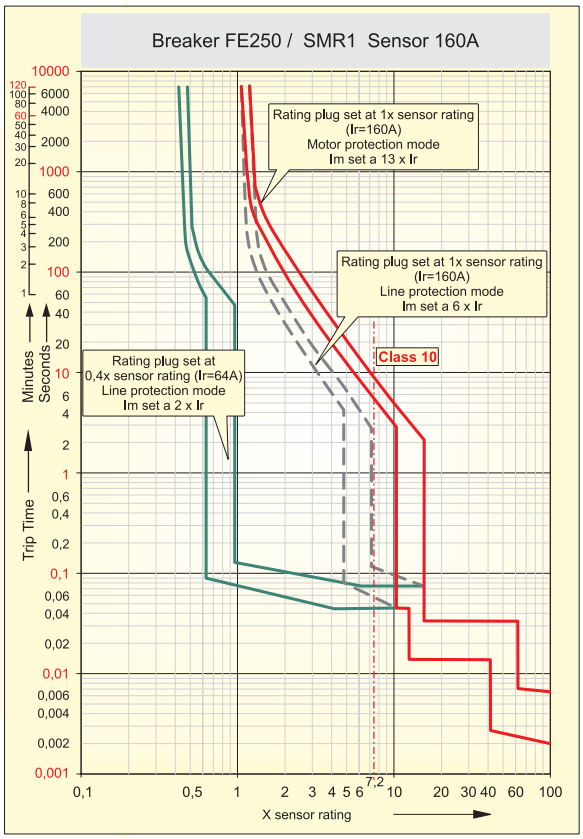


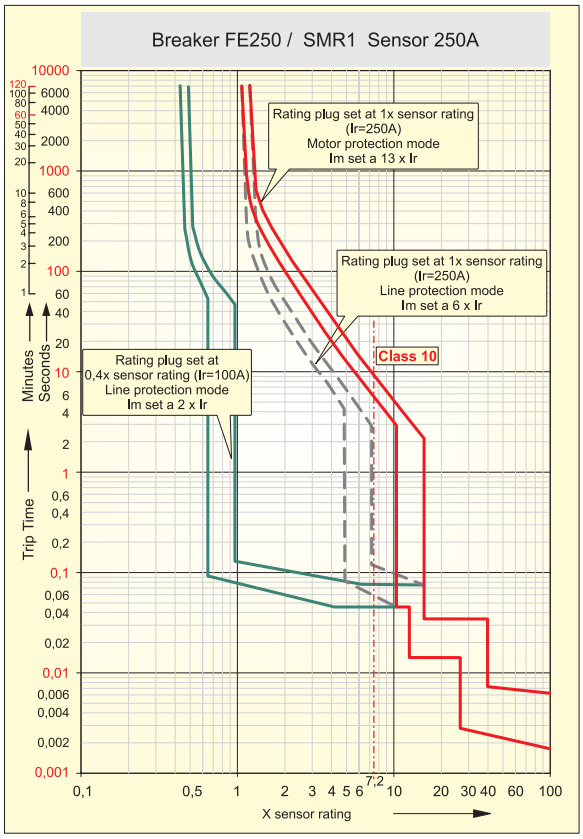




Time Current Curves



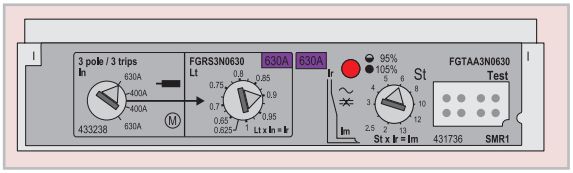




Electronic Trip Units

FG400 and FG630 breakers
SMR1 types

Trip units are available in 6 different versions depending on the frame rating and the network frequency.
FE400 frame size 50/60 Hz 250, 350 and 400A
FE630 frame size 50/60Hz 400, 500 and 630A
400 cycle variants (available on request)
FG400 - 400A, FG 630 - 630A
The trip units must be equipped with a rating plug that establishes the rated current of the protective device and its setting. A colour code and a mechanical interlock prevent incorrect combinations of electronic trip units and rating plugs. The 50/60Hz and 400Hz variants use the same rating plug.
For special applications a version with disabled LT or overload protection is available complete with a specific rating plug.



Band timings	1.5 x Ir	7.2 x Ir
Line protection	65 - 95 sec	2.0 - 3.0 sec
Motor protection	200 - 300 sec	6.4 - 9.6 sec

How to set the device
The rating plug defines the long time (LT) setting range and the manner of its adjustment.

LT setting with adjustable rating plug
One knob with 16 positions allows the user a current setting (Ir) between 0.625 and 1 times the chosen rating (values in A).

LT setting with switchable rating plug
One knob to set the protection band (line class 2.5 or motor class 10) and the rated current value (2 current value settings of 0.625 and 1 x the trip unit rating) - in sketch trip unit rating **400A** settings **250A or 400A**.
A second knob with 16 positions allows the user to set the current (Ir in multipliers of chosen rating). The combination of these two knobs allows a setting range of 0.4 to 1 x the trip unit rating with 32 setpoints.

ST or Im setting
Is set in multiples of the LT current setting and has a setting of 2 to 13x this values with 10 setpoints. The ST setting is limited to 10x on the FG00 400A trip unit and FG630 630Amp trip unit.

Example
A line protection device; required overload or **LT** setting 280A, short-circuit or **ST** setting 6 x the LT setting.
SMR1 of 400A +switchable rating plug of 400A.
LT setting .....knob 1 set to line and 400A
.....knob 2 set at 0.7 (0.7 x 400 = 280A)
ST setting.....knob 3 set a 6 x (= 6 x 280)
SMR1 of 400A +adjustable rating plug of 400A.
LT setting .....knob 1 set at 280 (value on scale)
ST setting.....knob 3 set a 6 x (= 6 x 280)

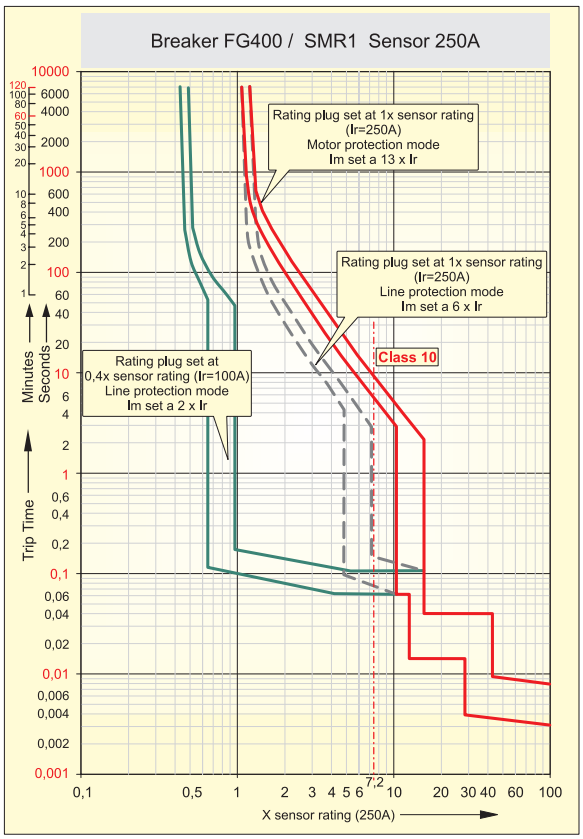
FG400 & FG630 Breakers - Electronic trip units type SMR1

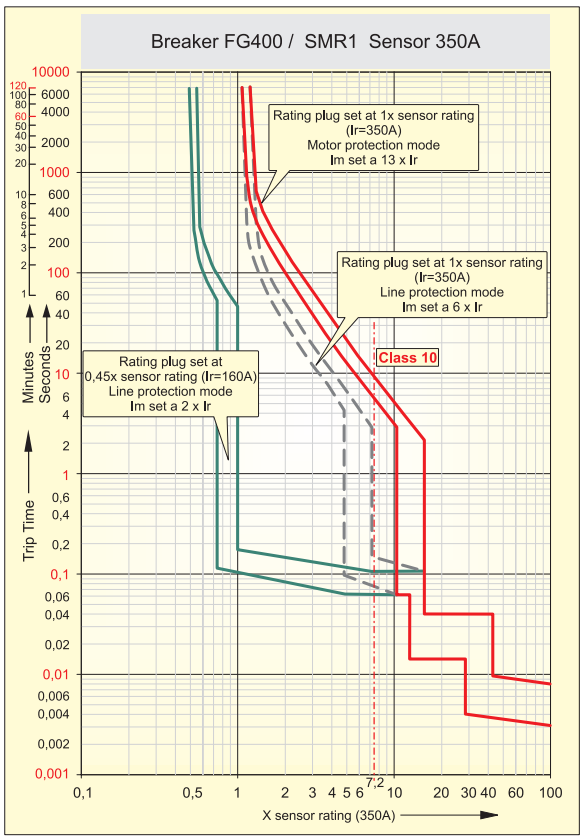
FG frame					Electronic trip unit overview								
					In	LT			ST			Neutral protection	
						pick-up band 1.05÷1.2 Ir			pick-up band ± 20% Im				
					[A]	Ir setting	min [A]	max [A]	Im setting	min [A]	max [A]	4P4T	4P 3TN	4P3T
SMR1 + adjustable rating plug	N	H	L	FG400	160	0.625-1 In 16 steps line prot.	100	160		200	2080	=Ir	=Ir/2	not protected
					250		160	250		320	3250	=Ir	=Ir/2	
					250		160	250	2-13 Ir 10 steps	320	3250	=Ir	=Ir/2	
					350		250	350		500	3500	=Ir	=Ir/2	
					400		250	400	2-10 Ir 10 steps	500	4000	=Ir	=Ir/2	
				FG630	400		250	400	2-13 Ir 10 steps	500	5200	=Ir	=Ir/2	
					500		400	500		800	6500	=Ir	=Ir/2	
					630		400	630	2-10 Ir 10 steps	800	6300	=Ir	=Ir/2	
SMR1 + switchable rating plug	N	H	L	FG400	250	0.4-1 In 32 steps line/mot. prot.	100	250		200	3250	=Ir	=Ir/2	not protected
					350		140	350	2-13 Ir 10 steps	280	4550	=Ir	=Ir/2	
				FG630	400		160	400		320	5200	=Ir	=Ir/2	
					500		400	500		800	6500	=Ir	=Ir/2	

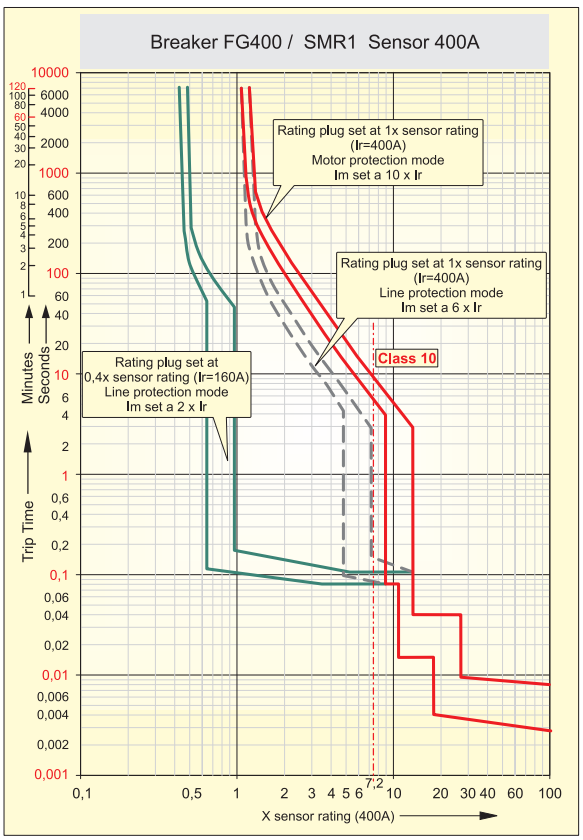
Notes

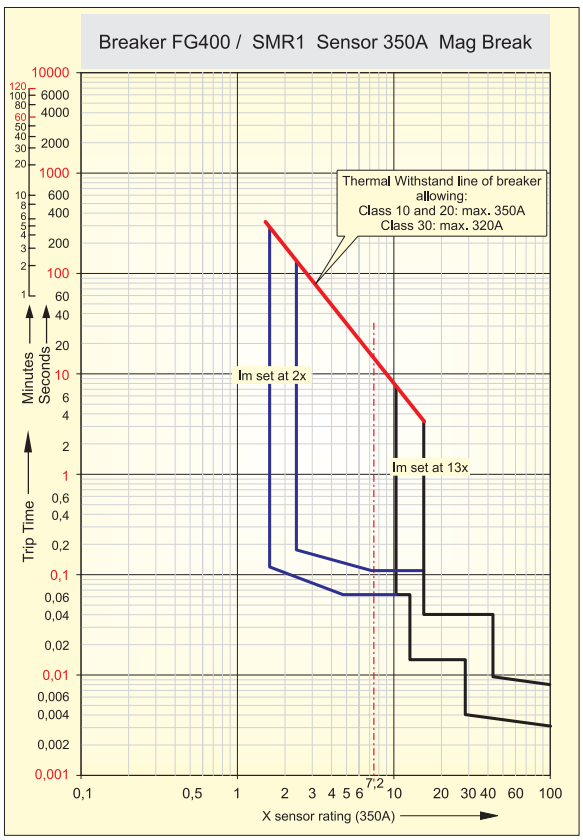
Time Current Curves

FG400 and FG630 breakers
SMR1 types

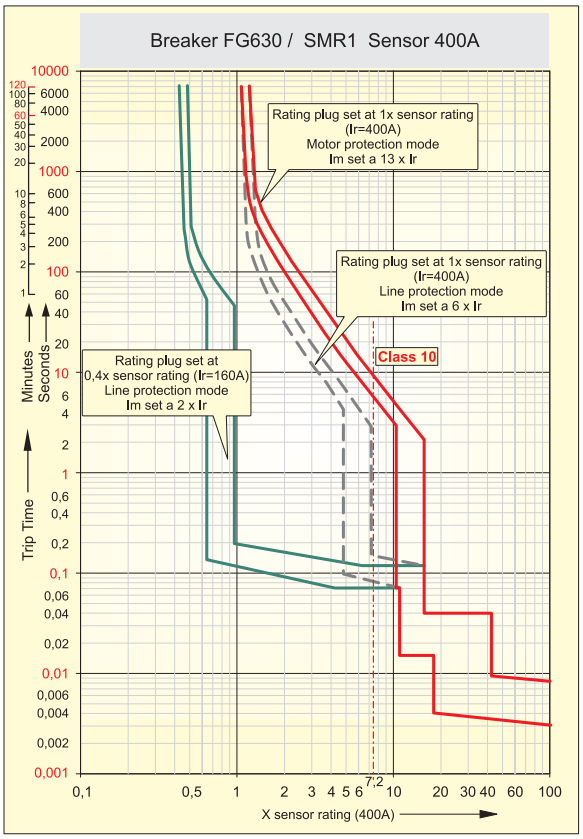


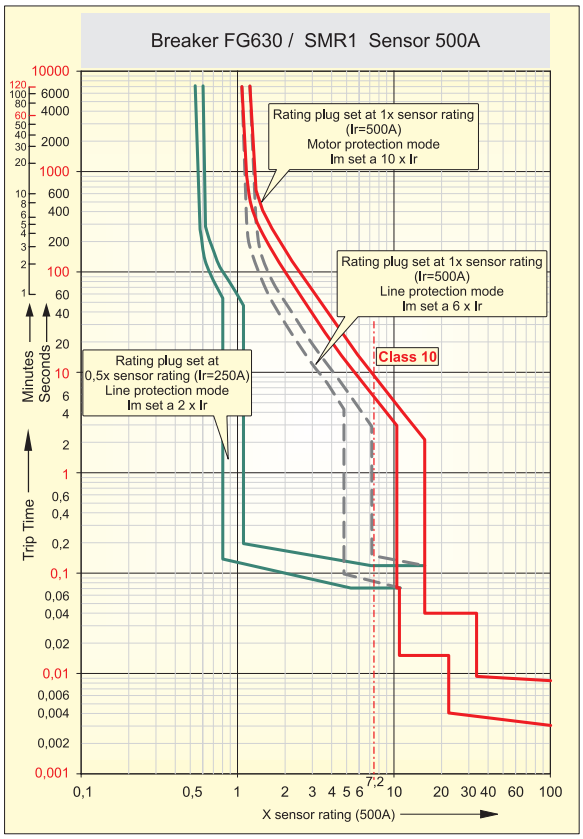


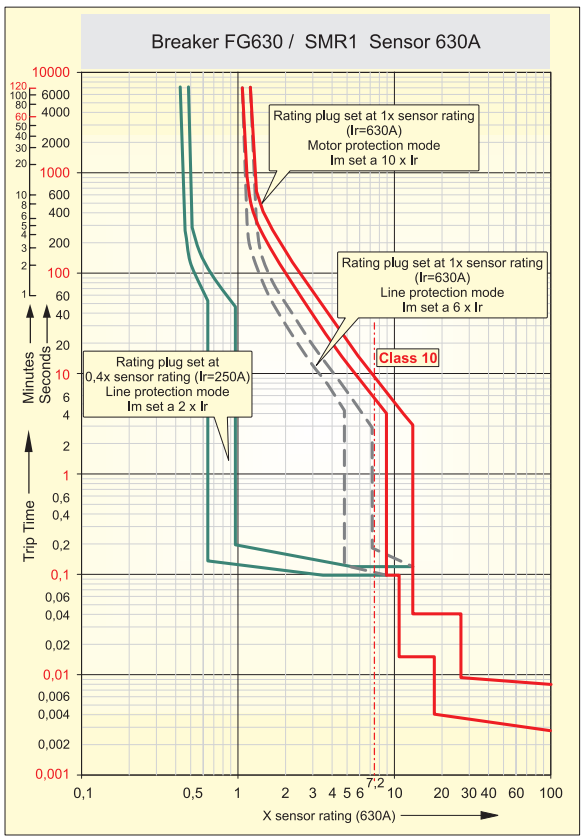


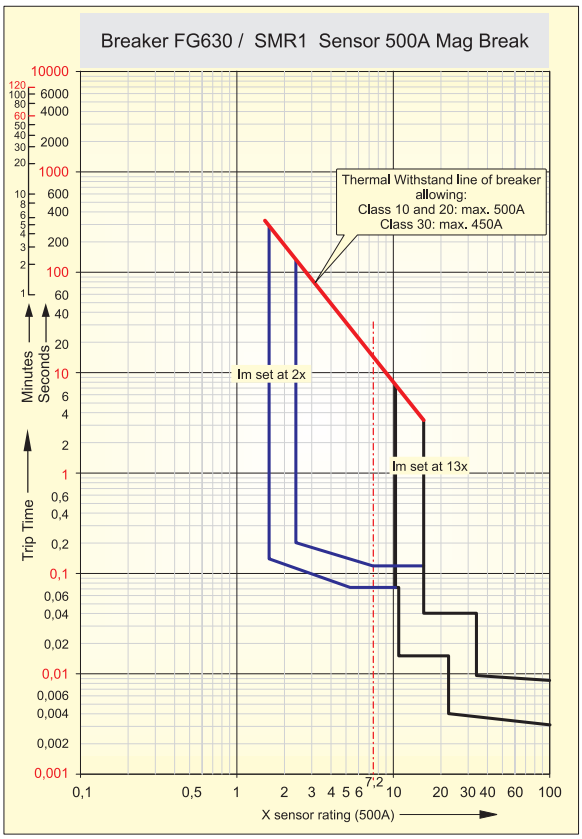


Time Current Curves









Electronic Trip Units

SMR2 range

The SMR2 is an electronic trip unit offering a fixed set of sophisticated protective functions that can be extended at will by the addition of seperately available modules. Designed for use with the FG400 and FG630 frame sizes the device has a fixed set of 3 protective functions allowing a selective and fully adjustable protection against Overloads (**LT**) and short-circuits (**ST** and **I**).
Both the **LT** and **ST** protection can be set to different time settings or bands (**LTD** and **STD**) whilst the ST device can be switched to a energy protection mode (I^2t).
The SMR2 uses rating plugs that give the user the flexibility to make a last minute choice in the required current rating, protected poles or protection band.

Overload protection LT (long time)
The **L**ong **T**ime or overload protection is adjustable from 0.4 (0.64)(1) to 1 x the chosen sensor ratings in 16 (32)(1) steps. The user can also define one of 8 time bands (**LTD**) each designed to match specific loads, motor or cable characteristics. Of these 8 time band settings, 5 have time bands for line applications and 3 are dedicated to motor protection (for time band classes see EN 60947-4.1). When set to motor protection mode, a phase loss protection is initiated that will trip the breaker when the difference in current between one phase line and the average of all three phases drops below 20%.

This easy-to-adjust trip unit is equipped with a LT load indicator device that operates by means of two LED indicators located on the trip unit front face. If the load reaches a 60% of the set Ir value, a **green LED** will start to blink (3 flashes a second). When the load reaches 75% of Ir it will stop blinking and remain on. The second **orange LED** will start to blink at 95% of the Ir value. It will remain on when the load reaches 105% of Ir and a trip is imminent.

(1) Normally supplied with two ratng plugs each 0.64 -1 in 16 steps.
(2) Some types limited to 10 x
(3) Some types limited to 12 x

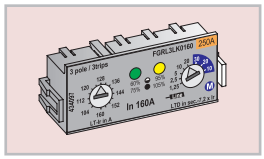
All SMR2 trip units have a built-in temperature sensor that trips the breaker at temperatures above 85°C. It thus prevents the breaker and electrical components in its immediate vicinity from over-heating. The SMR2 is also equipped with a so called thermal memory device. This memory tracks overheating even after the device has tripped and prevents the breaker from being switched whilst its environment is still at a too high temperature.

Short-circuit Protection ST (short time)
Offering a selective protection against low value short-circuits the Short Time protection is settable from 2 to 13(2) x the adjusted LT protection (Ir). The device can be set to five time setting bands (**STD**), this allowing selectivity between different breaker sizes. The **STD** device can be set to an 'energy curve mode'. This mode changes the fixed delay and reaction time value of the device, when the set current level is reached, into a reaction time that depends on the energy flowing in the circuit.

Short-circuit Protection I (instantaneous)
Offerering a protection against short-circuits the Instantaneous protection is settable from 2 to 14(3) x the chosen sensor rating. The I device has no time delay band so that the breaker immediately trips when the set threshold is reached.

Each SMR2 trip unit comes with a transparent, tamper-free (sealable) cover, this to prevent unauthorized manipulation of the breaker settings. They are supplied as a simple to mount, plug-in electronic pouch (current sensors supplied with the breaker). The device is supplied with an actuator with flux shifter that fits into a pocket in the breaker housing and is then connected to the trip unit. Without a mounted and connected actuator coil the breaker will not function. In order to verify a correct operation of the combination a simple device is available to test the assembly.
We strongly recommend the use of this test device.

Adjustable rating plug
An SMR2 rating plug has two setting knobs. The first is used for the setting of the overload current device (LT) and has a setting range of 0.64 to 1 x the chosen rating over 16 setpoints. The settings on the devices are in current values thus avoiding the use of complicated multipliers. The second knob is used to set the time delay band of the overload protection (LTD) and has 8 possible time settings.



Each trip unit size can be equipped with one of two available adjustable rating plug types.
There is a version of the trip unit without rating plug and one in which the two rating plug types are included. For 4pole trip units the rating plugs exist in 3 and 4pole protected versions with a choice in neutral rating between 50 or 100% of the phase value.

FG400 and FG630 breakers
SMR2 types

Each SMR2 device has three plug-in elements of which two are needed to allow the device to work properly. A rating plug is needed and is plugged into the jack at the top left of the device. Without a rating plug the SMR2 device will still provide circuit protection but only at a level of 15% of its chosen sensor rating. A battery needs to be placed in the appropiate module, this to power the thermal memory within the trip unit when the breaker has tripped. If the latter is not installed, this function will be disabled.
The third plug-in element is the extension module jack that allows for extra functionality and/or features.
A standard SMR2 is supplied with a blank non function module. Most of these modules will only function when a battery is present.
A 24V DC auxiliary supply can be connected to the trip unit. This enables all modules to be used to their full capacity.

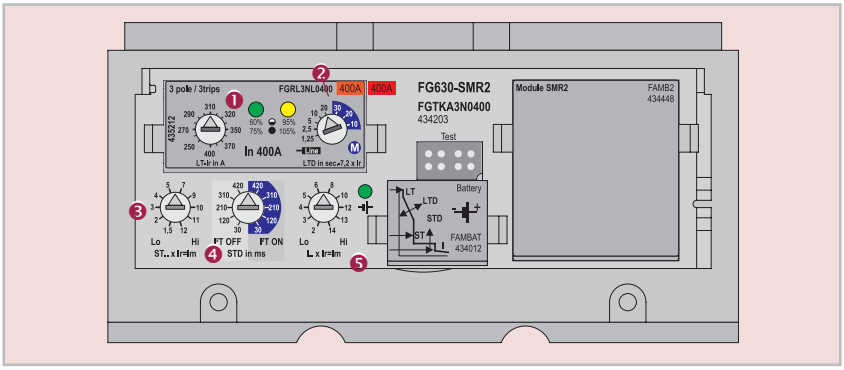
FG400 & FG 630 Breakers - Electronic trip units type SMR2

FG frame					Electronic trip unit overview											
					In	LT			ST			I			Neutral protection		
						pick-up band 1.05÷1.2 Ir			pick-up band ± 20% Ist			pick-up band ± 10% In					
					[A]	Ir setting	min [A]	max [A]	Ist setting	min [A]	max [A]	Im setting	min [A]	max [A]	4P4T	4P 3TN	4P3T
SMR2 + adjustable rating plug	N	H	L	FG400	160	0.4-1 In 32 steps utlising two rating plugs	100	160	3 2-13 Ir 10 steps	200	2080	5 2-14 Is 10 steps	500	3500	=Ir	=Ir/2	not protected
					250		160	250		320	3250				=Ir	=Ir/2	
					250		160	250		320	3250		700	4900	=Ir	=Ir/2	
					350		250	350		500	3500				=Ir	=Ir/2	
					400		250	400	2-10 Ir 10 steps	500	4000	2-11 Is 10 steps	1000	4400	=Ir	=Ir/2	
				FG630	400		250	400	2-13 Ir 10 steps	500	5200	2-13 Is 10 steps	1000	7000	=Ir	=Ir/2	
					500		400	500		800	6500				=Ir	=Ir/2	
					630		400 1	630	2-10 Ir 10 steps	800	6300	2-11 Is 10 steps	1260	6930	=Ir	=Ir/2	

LTD, Line no phase loss			STD Standard		
Setting	min [sec.]	max [sec.]	Setting	min [msec.]	max [msec.]
1.25	1	1.5	0.03	0.015	0.05
2.5	2	3	0.12	0.095	0.17
5	4	6	0.21	0.175	0.29
10	6.4 2	9.6	0.31	0.255	0.41
20	12.8	19.2	0.42	0.335	0.53
30	19.2	28.8		-OR- I^2T	
LTD, Motor with phase loss protection(1)			0.03	4	
			0.12		
10	6.4	9.6	0.21		
20	12.8 2	19.2	0.31		
30	19.2	28.8	0.42		

(1) Timing applies at 7.2 x the set current value. (I.)

SMR2 front view
Indicating the location of the settings, the battery, rating plug and extension modules. The in/out put terminals are located within the trip unit pouch just below the battery modules and can be accessed by removing a break away cover.



FG400 and FG630 breakers
SMR2 types *(continued)*

Modules
Each SMR2 device can be equipped with two plug-in elements, a rating plug and an extension module. The extension modules are simple plug-in devices that allow the user to enhance the SMR2 as a protective device or to add in extra functional features. There is a single function module available with Amp meter and a range of functional modules each adding two functions to the device. this allows an SMR 2 to be equipped with:

Ground fault Protection
Ground fault alarm
Load shedding across two channels
Trip Reason indicators
Communication (modbus RTu)
Infrared reader
Each module has a low level electronic output that can be channeled through the communication bus (when present) or be used to trigger 1A/250 Volt change over contacts placed in one or more external contact modules. Each contact module contains four contacts.

Ground fault protection
Designed for protection against indirect contact, the ground fault device measures the vectorial sum of the three phase currents and, if present, that of the neutral conductor. If the sum of these values exceeds the set current thresholds for a period of time greater than the set time delay, the breaker is tripped.
The **G**round **F**ault protection option is adjustable from 0.2 to 0.8 x the chosen sensor ratings in 12 steps. The user can also define one of 5 delay time bands (**GFD**) designed to allow selectivity between different sensor ratings.
The **GFD** device can be set to an 'energy curve mode'. This mode changes the fixed delay and reaction time value of the device, when the set current level is reached, into a reaction time that depends on the energy flowing in the circuit.
A breaker trip due to a ground fault event can be channeled through the communication output (when present) or be wired out to the contact module. (type ECM)

Ground fault alarm
The **G**round **F**ault Alarm option offers the same functionality as the Ground Fault protection, here however **ONLY** an alarm signal is given and the breaker is **NOT TRIPPED**. It is adjustable from 0.2 to 0.8 x the chosen sensor ratings in 12 steps. The user can also define one of 5 delay time bands (**GFD**).
The **GFD** device can be set to an 'energy curve mode'. This changes the fixed delay and reaction time value of the device, when the set current level is reached, into a reaction time that depends on the energy flowing in the circuit.
An alarm due to a ground fault event can be channeled through the communication output (when present) or be wired out to the contact module. (type ECM)

Load shedding device
The Load Shefding device (**R**) allows the user to switch off non priority loads before the **LT** function trips the breaker due to an overload. It measures the current within the circuit and provides a signal if the current measured in the three phases exceeds the set current values. The device has two channels, both adjustable from 0.6 to 1 x the set LT protection value (Ir).
Each channel is equipped with a time delay directly proportional to that of the **LTD** setting. Chanel 1 is set to a time delay equal to **LTD**/2 and channel two is set to a time delay of **LTD**/4. If the current drops below the set thresholds for a period longer than 10 seconds, the signal is reset.
A signal due to a load shedding event can be channeled through the communication output (when present) or be wired out to the contact module. (type ECM)

Trip Reason Indicators
In order to indicate the reason of a breaker trip a set of three LED's are provided on the trip unit front face, one indicating a trip due to the **LT** device, one indicating a trip due to the **ST** device and one for the **I** device.
Without an auxiliary power, the trip reason button must be used to light up the appropiate **LED**. With an auxilliary power the trip reason push button is not needed.
The three trip signals can be channeled through the communication output (when present) or be wired out to the contact module. (type ECM)

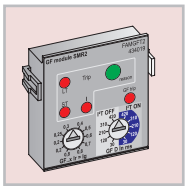
Communication
When the communication option is added to the SMR2 trip unit the following data can be viewed:
- The set current values and time delays of all installed protection devices.
- The current flowing in the circuit (3 phase and neutral conductors)
- Signals indicating on which of the installed protection devices the breaker has tripped.
- Load shedding orders.
- Zone selective interlock occurrences.
- A temperature pre-alarm that provides a signal at 80 degrees (this is 5 degrees before the temperature alarm is activated).

The communication option requires a 24V DC auxiliary supply.

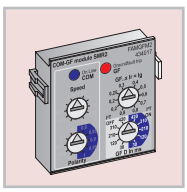
Zone Selective Interlock
A device that allows the user to achieve selectivity combined with the fastest possible fault reaction time. When **ZSI** is set to 'ON', the SMR2 trip unit will always trip the breaker as quickly as possible, ignoring the time delays set by means of the **STD** or **GFD** devices. However, when a **ZSI** signal is received from a downstream breaker equipped with an SMR2, the **STD** or **GFD** of the upstream SMR2 device revert to wherever the adjustment is set. The Ground Fault and Short Time Zone Selective Interlock signals are shared on one in/out put.
The device is normally set to its “OFF” position and can be activated by means of a Dip switch.
When the breaker is equipped with a "COM" option these signals are also passed on through the communication output. Up to a distance of 10 meters between the breakers no auxiliary supply is required. When an auxiliary supply is present and a shielded cable is used, the distance between breakers can be increased to 1 km. A maximum of five SMR2 trip units can be linked in this manner.

Ampmeter
Provides the user with the current running in one of the breaker phases. The device has an accuracy of 10% and normally indicates the current in the highest loaded phase. The push buttons on the module front allow the user to select an indication of the current in one of the other phases or neutral (if present). After a set delay of 30 seconds the device reverts to its standard indication setting.

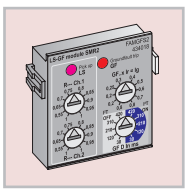
The SMR 2 trip unit is normally supplied with a non functional or filler module. This can be removed and replaced by one of the following functional modules.



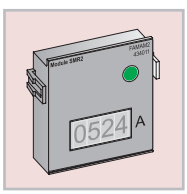
Module FAMGFT2
A combination of the Ground Fault protection and the Trip Reason indicators.



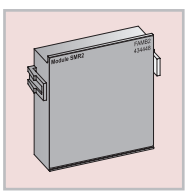
Module FAMGFM2
A combination of the Ground Fault protection and the communication option.



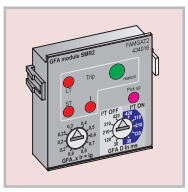
Module FAMGFS2
A combination of the Ground Fault protection and the load shedding device.



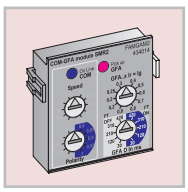
Module FAMAM2
An Amp-meter.



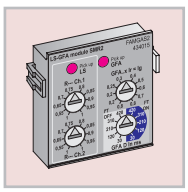
Module FAMB2
Spare filler module.



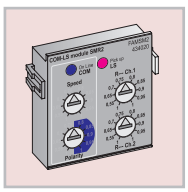
Module FAMGAT2
A combination of the Ground Fault Alarm function and the Trip Reason Indicators.



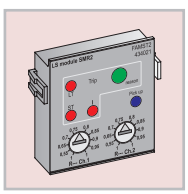
Module FAMGAM2
A combination of the Ground Fault alarm function and the communication option.



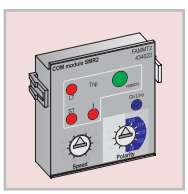
Module FAMGAS2
A combination of the Ground Fault alarm option and the load shedding device.



Module FAMSM2
A combination of the load shedding device and the communiaction option.



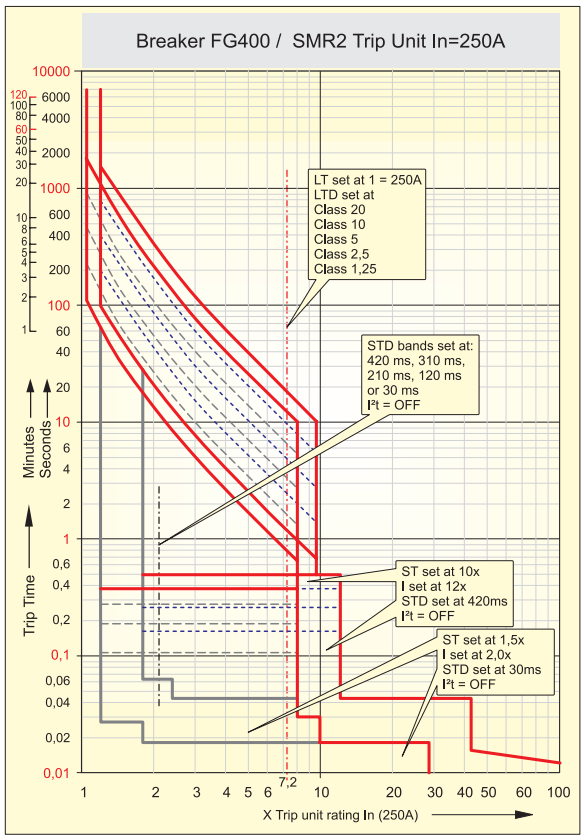
Module FAMST2
A combination of the load shedding device and the Trip Reason Indicators.

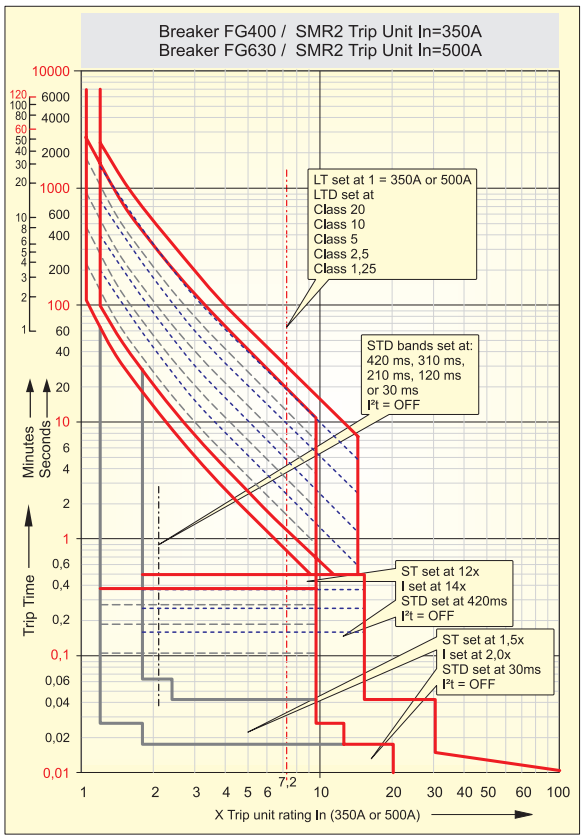


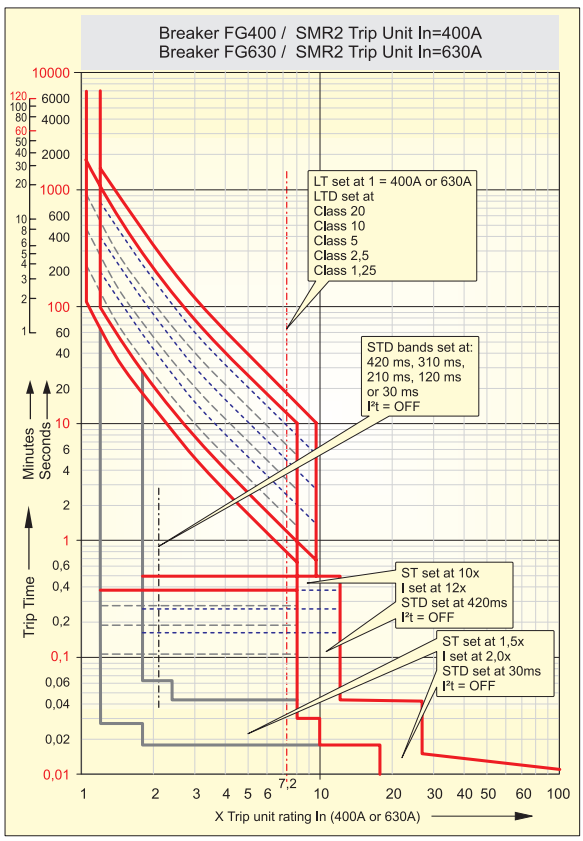
Module FAMMT2
A combination of the comunication option and the Trip Reason Indicators.

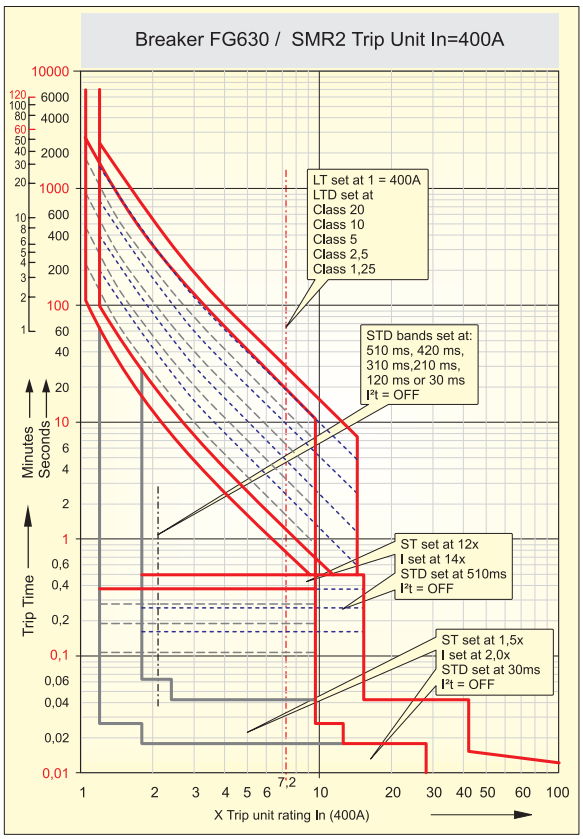
Time Current Curves

FG400 and FG630 breakers
SMR2 types









Time Current Curves