FANOX

PROTECTION AND CONTROL

FANOX introduces its complete range of protection, control and measuring electronic devices for application in the Industry.

We are leaders in the electronic protection of industrial electric motors. Everyday our relays prevent the burnout of any number of motors, saving on repair costs and process downtimes.

Among the many technical advantages of these relays, we highlight the following:

- **Thermal memory,** which continuously creates a model of the heating and cooling of the motor during its start-up, running, overload and shutoff cycles.

- **Immediate detection** of phase failure, including at low motor loads, with a rapid shutdown of the motor which prevents costly breakdowns.

- **Display module,** of the size of a pushbutton of 22mm in diameter, which, mounted on the outside of the panel or of the motor control center, allows rapid detection of the cause of the motor shutdown.

This protection has become the most reliable and cost effective on the market, and far surpasses the functions offered by other conventional protection devices, such as thermal relays, thermal-electronic relays, manual motor starters or thermal magnetic circuit breakers.

Our relays are ideal for protecting pumps, compressors, fans and all types of industrial motors having to withstand multiple start-up/shutoff cycles, heavy start-ups or that work in high-temperature locations.

Models G and BG are approved by PTB (Physikalisch-Technische Bundesanstalt) of Germany for the protection of EEx e motors that run in explosive or hazardous areas.

Other products of interest include earth leakage relays, especially those which incorporate the toroidal transformer and relay in one single unit.

The range of generator control and protection devices, voltage monitors, phase and frequency relays, timers, manual motor starters and electrical multimeters complete a wide selection of products for application in the Industry.

A complete package of technical information, installation instructions, settings, applications and a selection guide comes included, and provides all the guidelines and instructions necessary for proper use.

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Motor protection relays

Protections

- $I>$ **Overload**
- $I<$ **Undercurrent**
- cos φ **Underload**
- **Phase imbalance or phase loss**
- **Overtemperature**
- **Phase sequence**

Basic motor protection

For motors of low and medium power in several applications as compressors, ventilators, surface mounted pumps, conveyor belts, machine tools, and in general to protect motors which need dependable and accurate protection relays for every type of start.

Its 3 trip classes cover any type of starting or working cycle.

Integral motor protection

For whatever power motors (1 to 630 A and over), in several applications as surface mounted pumps, compressors, mixers, ventilators, elevators, cranes, industrial refrigeration and in general for those motors requiring a complete protection where the overtemperature (by means of PTC sensor) and a wrong phase sequence protections are required.

Its 7 trip classes cover all type of starting or working cycle.

C

GL

Protections			$I>$			$I>$			
Models			**C 9**	**C 21**	**C 45**	**GL 16**	**GL 40**	**GL 90**
Adjustment range	I_B (A)		3 - 9,3	9 - 21,6	20 - 45,2	4 - 16,7	15 - 40,5	40 - 91
Motor 400 V	HP		2 - 5,5	7,5 - 12	15 - 30	3 - 10	10 - 25	30 - 60
50/60 Hz	kW		1,5 - 4	5,5 - 9	11 - 22	2,2 - 7,5	7,5 - 18,5	22 - 45
Code no. according to the relay voltage supply (+15% -10%) ac: 50/60 Hz	230 Vac	single phase	11203	11223	11243	11303	11323	11343
	115 Vac	single phase	11202	11222	11242	11302	11322	11342
	24 Vac, dc	single phase	11200	11220	11240	11300	11320	11340
	400/440 Vac	3-phase (motor)	-	-	-	-	-	-
	230 Vac	3-phase (motor)	-	-	-	-	-	-
For I_N of the motor below the minimum setting I_B			Pass the motor cables several times (n) through the corresponding holes in the relay I_B = n x I_N					
For I_N of the motor above the maximum setting I_B			Use 3 CT .../5 and the lowest range relay of each family					
External display module (optional)			ODC			ODGL		

Characteristics		
Thermal memory / Overload trip	Yes / From 1,1 x I_B	Yes / From 1,1 x I_B
Maximum motor nominal voltage	1000 Vac	1000 Vac
Trip classes (IEC 947-4-1)	10 - 20 - 30	5 - 10 - 15 - 20 - 25 - 30 - 35
Phase sequence protection	-	ON ■□ OFF It actuates during the motor start
Phase imbalance protection	Over 40%. Tripping time < 3s	Over 40%. Tripping time < 3s
Undercurrent protection adjustable/ Trip delay	-	-
Underload protection by cos φ / Trip delay	-	-
PTC Min/max cold resist.-Average trip / reset resist.	-	25Ω / 1500Ω - 3600Ω / 1800Ω
Reset mode	Manual and remote	Manual and remote
Signalling LED's	3 LED's: ON + one for each protection	4 LED's: ON + $I>$ + +
Output contacts	1 relay with 1 NO + 1 NC	1 relay with 1 NO + 1 NC
Switching power	I_{th}: 5A; AC15 - 250V - 2A; DC13 - 30V - 2A	I_{th}: 5A; AC15 - 250V - 2A; DC13 - 30V - 2A
Terminals: Max. section / screw torque	2,5 mm², No. 22 - 12AWG / 20Ncm, 1.8 LB - IN	2,5 mm², No. 22 - 12AWG / 20Ncm, 1.8 LB - IN
Power consumption	C9: 6,5VA, 230V; 3VA,115V / C21 - C45: 2,5 VA	2,5 VA
Protection degree / weight / mounting	IP20 / 0,3 kg / DIN rail	IP20 / 0,5 kg / DIN rail
Storage temperature	-30°C +70°C	-30°C +70°C
Operation temperature / max. altitude	-15° +60°C / 1000m ; -15° +50°C / 3000m	-15°C +60°C / 1000m; -15°C +50°C / 3000m
Standards	IEC 255, IEC 947, IEC 801, EN 50081-2	IEC 255, IEC 947, IEC 801, EN 50081-2
	CE c UL US LISTED	CE c UL US LISTED

For dimensions, installations, setting and curves, see page 18 and following.

- *For 3-phase motors up to 1000 Vac. Passing through wires*
- *Broad range of current adjustment (1 to 630 A and over)*
- *Precise motor heating and cooling memory, reproduces its thermal image*
- *Visual indication of tripping cause*

Pumps protection

Suitable where the undercurrent (running without load) is critical, as submersible pumps, surface pumps, etc. In these cases, when the equipments run without load (dry well) the relay trips by undercurrent.

Pumps protection

Underload protection by cos φ

For application in pumps and other systems where running without load is critical (dry well, transmission belt broken, etc). With the underload protection by cos φ it is ideal when the motor is over-sized, such as submersible pumps in gasoline stations where, at every pumping start-up operation, the motor can work even at the 20% of its nominal load.

External display module

By means of this plug-in optional accessory, the relay status can be seen and reset from the exterior of the electrical panel board.

Easy to install. Size of a Ø22 mm push button.

Suitable for motor control centres (MCC) and panel boards.

P

PF

OD

Relay with external display module

$I>$	$I<$			$I>$	cos φ		
P 19	**P 44**	**P 90**		**PF 16**	**PF 47**		
7 - 19,6	19 - 44,2	40 - 90,4		4 - 16,6	16 - 47,5		
4 - 10	12,5 -27,5	27,5 - 55		2 - 10	10 - 30		
3 - 7,5	9,2 - 20	20 - 40		1,5 - 7,5	7,5 - 22		
11403	11423	11443		-	-		
11402	11422	11442		-	-		
11400	11420	11440		-	-		
-	-	-		11374	11384		
-	-	-		11373	11383		
Pass the motor cables several times (n) through the corresponding holes in the relay I_B = n x I_N							
Use 3 CT .../5 and the lowest range relay of each family							
ODP				ODPF			

Models	Code no.	Relay type
ODC	12530	C
ODGL	12535	GL
ODP	12540	P
ODPF	12555	PF

Yes / From 1,1 x I_B	Yes / From 1,1 x I_B
1000 Vac	440 Vac
5 - 10 - 15	10 - 20 - 30
Yes. It actuates during the motor start	Yes
Over 40%. Tripping time < 3s	Over 40%. Tripping time < 3s
From 0,5 to 0,9 x I_B. Operative from 0,3 x I_B / Delay 3s	-
-	cos φ adjustable 0,1 to 0,9 / Adjustable 5 to 45s
-	-
Manual, remote and automatic (every 20 minutes)	Manual, remote and automatic (every 20 minutes)
4 LED's: ON + $I>$ + $I<$ +	4 LED's: ON + $I>$ + cos φ +
1 relay with 1 NO + 1 NC	1 relay with 1 NO + 1 NC
I_{th}: 5A; AC15 - 250V - 2A; DC13 - 30V - 2A	I_{th}: 5A; AC15 - 250V - 2A; DC13 - 30V - 2A
2,5 mm², No. 22 - 12AWG / 20Ncm, 1.8 LB - IN	2,5 mm², No. 22 - 12AWG / 20Ncm, 1.8 LB - IN
2,5 VA	1,5W - 12 VA (230 Vac) - 20 VA (400 Vac)
IP20 / 0,5 kg / DIN rail	IP20 / 0,5 kg / DIN rail
-30°C +70°C	-30°C +70°C
-15°C +60°C / 1000m; -15°C +50°C / 3000m	-15°C +60°C / 1000m; -15°C +50°C / 3000m
IEC 255, IEC 947, IEC 801, EN 50081-2	IEC 255, IEC 947, IEC 801, EN 50081-2
CE c UL us LISTED	CE

This optional display module is mounted externally, e.g. on the panel door or a draw-out unit in a motor control centre (MCC) and connected to the relay by a flat cable (length 2 meters).

The module has the appropriate LED's to signal the trip cause and a reset push-button.

Weight: 0,05 kg.

Protection degree: IP50

Relays for the protection of EEx e motors

- *Approved by PTB for EEx e motors*
- *For 3-phase motors up to 1000 Vac*
- *Currents from1,5 to 630 A and higher*
- *With thermal memory*
- *Visual indication of tripping cause*

Protections

I> **Overload**

Phase imbalance or phase loss

Overtemperature

Protection of motors in explosive or hazardous areas

For EEx e motors of any power rating, and currents up to 630A and higher, which work in explosive or hazardous areas such as the petrochemical industry, plastic factories, mines, etc. The relay is installed away from the explosive area.

The overload LED starts to blink from 1,1 x I_B.

In the event of a phase loss the relay trips in less than 3s, even when the motor is at low load.

Relay to be used with the external display module

With the same features and applications as the G17 relay, the BG17 relay incorporates an external display module which shows the status of the relay and allows it to be reset from outside of the panel or the motor control center (MCC).

As the BG17 is designed for use with the ODG display module, it does not include the LED signals on the front of the relay itself.

G

BG

Protections			I>	I>
Models			**G 17**	**BG 17**
Adjustment range	I_B (A)		5 - 17,7	5 - 17,7
Motor 400 V	HP		3 - 10	3 - 10
50/60 Hz	kW		2,2 - 7,5	2,2 - 7,5
Code no. according	230 Vac	single phase	10723	10733
to the relay	115 Vac	single phase	10722	10732
voltage supply	24 Vdc		10720	10730
For I_N of the motor below the minimum setting I_B			Pass the motor cables several times (n) through the corresponding holes in the relay I_B = n x I_N	
For I_N of the motor above the maximum setting I_B			Use 3 CT's .../5 and pass their secondary twice (n=2) through the relay holes	
External display module / Code no.			No	ODG / 12505

Characteristics	G 17 and BG 17
Thermal memory / Overload trip	Yes / From 1,1 x I_B
Maximum motor nominal voltage	1000 V
15 adjustable tripping curves	Cold tripping times at 6 x I_B from 2 to 30s
Phase imbalance protection	Over 40%. Tripping time < 3s
PTC min/max cold resist. / Average trip resistance	100 Ω / 1500 Ω - 2750 Ω
Reset mode	Manual and remote
Signalling LED's	4 LED's: ON + one for each protection
Single phase auxiliary power supply	
• Voltage Us	115 - 230 Vac (+15% -6%) / 24 Vdc (±10%)
• Frequency	50/60 Hz (from 49 to 61,2 Hz)
• Consumption	2,5 VA (115 - 230 Vac) / 1,5 W (24 Vdc)
• Protection fuse	GL 6 A
Output contacts	1 relay with 1 NO + 1 NC
• Switching capacity in abnormal conditions	I_{th}: 5A; AC15 - 250V - 2A; DC13 - 30V - 2A
• Short-circuit resistance	1000 A
Terminals max. section / Screw torque	2,5 mm², No. 22 - 12AWG / 20Ncm, 1.8 LB - IN
Protection degree / weight / mounting	IP20 / 0,5 Kg / DIN rail
Storage temperature	-30°C +70°C
Operation temperature	-15°C +60°C
Standards	IEC 255, IEC 947, IEC 801, EN 50081-2, VDE 0660
	PTB Ex 3.43 - 30004/00 CE c UL US LISTED

ODG display module

This module, which is the size of a pushbutton of Ø22 mm, is mounted outside on the panel door or on the front of the motor control center (MCC), and is connected to the relay by means of a 2 meters long flat cable.

To see the state of the relay or reset in the event of a tripping, it is not necessary to open the door or remove the MCC, since the module includes the corresponding identifying LED's and the reset button.

Weight: 0,05 Kg.

PTB approval:

G and BG relays have been approved by the **Physikalisch-Technische Bundesanstalt-PTB** for the protection of EEx e protected explosion motors (DIN EN 50019 / DIN VDE 0170 /DIN VDE 0171 part 6) according to the stipulations and requirements of PTB.

PTB report no. PTB Ex 3.43-30004/00

For dimensions, installation, adjustments and curves see pages 18 and following.

Generator protection relay

- *For generators up to 1000 Vac*
- *With themal memory*
- *Visual indication of tripping cause*
- *Fast tripping curves*

Protections

I> **Overload**

Phase imbalance / Phase loss

Generator protection

This relay is specially applicable for protecting low voltage generators up to 1000V, and current up to 2000A or higher. It offers a suitable protection since you can choose among 15 tripping curves in order to avoid the generator working over its damage curve.

External display module

By means of this plug-in optional accessory the relay status can be seen and reset from the exterior of the electrical panel board.

Easy to install. Size of Ø22 mm push button.

	GEN	OD
		

Protections	I>	
Models	**GEN 10**	
Adjustment range I_B (A)	4 - 10,3	
Auxiliary voltage supply (+15% -10%)	24 Vdc	
Code no.	11350	
For I_N of the generator above 10,3 A	Use 3 CT.../5	
External display module (optional)	ODGEN	

Characteristics	
Thermal memory / Overload trip	Yes / From 1,1 x I_B
Maximum generator nominal voltage	1000 Vac
Trip time $t_{6 \times I_B}$	15 adjustable curves from 0,2 to 3 s.
Phase imbalance protection	Over 20%. Tripping time < 3s
Reset mode	Manual and remote
Signalling LED's	3 LED's: ON + one for each protection
Output contacts	1 relay with 1 NO + 1 NC
Switching power	I_{th}: 5A; AC15 - 250V - 2A; DC13 - 30V - 2A
Terminals: Max.section / screw torque	2,5 mm², No. 22 - 12AWG / 20Ncm, 1.8 LB - IN
Power consumption	1,5 W
Protection degree / weight / mounting	IP20 / 0,5 kg / DIN rail
Storage temperature	-30°C +70 °C
Operation temperature / max. altitude	-15°C +60°C / 1000m; -15°C +50°C / 3000m
Standards	IEC 255, IEC 801, EN 50081-2
	CE c UL US LISTED

For dimensions, installation, adjustment and curves see pages 18 and following.

Models	Code no.	Relay type
ODGEN	12545	GEN

This optional display module is mounted externally e.g. on the panel door, and is connected to the relay by a flat cable of 2 meters.

The module has the appropriate LED's to signal the trip cause and a reset push-button.

Weight: 0,05 Kg.

Other relays for generators:

- **H:** Frequency relay. See page 9.
- **U3P:** 3-phase voltage relay (without neutral). See page 11.
- **U3N:** Three-phase voltage relay (with neutral). See page 11.

FANOX

Control relays

Protections

- Phase loss / phase imbalance
- Phase sequence
- Overtemperature
- Hz Frequency variation
- Temperature variation
- Thermistor short-circuit

Phase relay

- To protect 3-phase devices
- Suitable for air conditioning, elevators, cranes, hoists and similar installations.
- Sensitive to incorrect phase sequence.
- 22,5 mm wide.

Phase and temperature relay

- To protect 3-phase devices
- Suitable for motors with built-in PTC sensors in applications such as elevators, cranes, hoists and similar installations.
- Sensitive to incorrect phase sequence.
- Monitoring of short circuit and broken wire in PTC circuit.
- 22,5 mm wide.

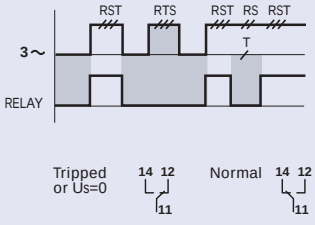
S

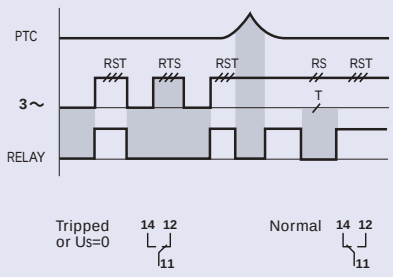
ST

Protections				
Models	**S2**	**S4**	**ST2**	**ST4**
Nominal voltage of the line to be monitored (±15%)	3 x 230 V	3 x 400 V	3 x 230 V	3 x 400 V
Voltage supply (±15%)	Self-powered (3-phase)		Self-powered (3-phase)	
Code no.	12033	12034	12001	12012

Characteristics		
Nominal frequency	50/60 Hz	50/60 Hz
Control range	Phase loss: with resistive loads it trips when a phase loss occurs. With three-phase motors it trips if the voltage regenerated by the motor is lower than 60% of the main voltage. Phase imbalance > 40%	
Hysteresis	-	-
PTC sensor: min/max cold resist - Trip resist	-	100Ω / 1500Ω - 2300Ω
Trip time delay	< 0,1 s	< 0,1 s
Reset mode	Automatic	Automatic
Signalling LED's	2 LED's: ON +	3 LED's: ON + +
Output contacts	1 relay with 1 change over NO - NC	1 relay with 1 change over NO - NC
Switching power	I_{th}: 5A; AC15 - 250V - 2A; DC13 - 30V - 2A	I_{th}: 5A; AC15 - 250V - 2A; DC13 - 30V - 2A
Maximum terminal section / screw torque	2,5 mm², No. 22 - 12AWG / 20Ncm, 1.8 LB - IN	2,5 mm², No. 22 - 12AWG / 20Ncm, 1.8 LB - IN
Power consumption	7,5 VA (230 Vac) - 11 VA (400 Vac)	7,5 VA (230 Vac) - 11 VA (400 Vac)
Protection degree / weight	IP20 / 0,12 kg	IP20 / 0,13 kg
Storage / operation temperature	-30°C +70°C / -15°C +60°C	-30°C +70°C / -15°C +60°C

CE





For dimensions: see page 23

- ***Self-powered by the voltage to be monitored (S, ST y H).***
- ***Visual indication of tripping cause***
- ***DIN rail mounting***

Frequency monitoring relay

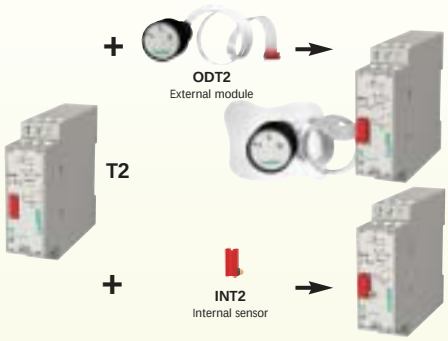
- Suitable for monitoring the frequency of a single phase or 3-phase system.
- Suitable for generators, alternators and electrical generator sets.
- Maximum and minimum thresholds can be adjusted separately.
- Two independent output relays.

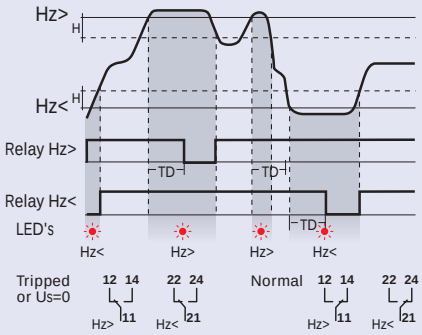
Lifts temperature control relay

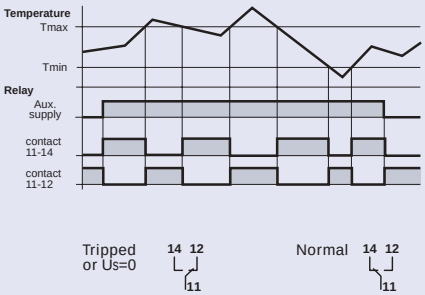
- It controls the temperature of the lift motor room (relay + external module ODT2) or the temperature inside of the switchboard for those lifts without motor room (relay + internal sensor INT2).
- Designed according to the EN 81-1 standard and complying with the European Union Directive for Lifts (95/16/CE).
- Two adjustable temperature thresholds.
- 22,5 mm wide.

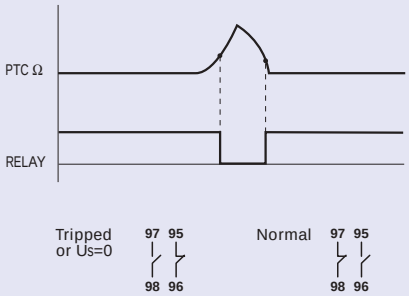
Thermistor protection relay

- Controls the temperature with the use of thermistors (PTC sensors)
- Detects short-circuits and breakage in the circuit of sensors.
- Protects the motors against overtemperature caused by excess surrounding temperature, insufficient ventilation or cooling, etc.
- Applicable in transformers and other machines.
- 22,5 mm wide.

H	T			MT
				
				
Hz> Hz<				
H	**T2**	**ODT2**	**INT2**	**MT2**
-	–	–	–	–
115 Vac Self-powered single phase 230 Vac	230 Vac (Aux) 24 Vac, dc	–	–	230 Vac (Aux.supply)
12100 12101	12051 12052	12037	12036	12039
50/60 Hz selectable by a dipswitch	50/60 Hz			50/60 Hz
Hz> From +0,5 to +3,5 Hz. Steps of 0,5 Hz (±0,1%)	Maximum temperature setting from 40°C to 55°C			According to the PTC installed
Hz< From -0,5 to -3,5 Hz. Steps of 0,5 Hz (±0,1%)	Minimum temperature setting from -5°C to 5°C			
≤ 0,5%	2°C			-
-	-			25Ω / 1500Ω - 3600Ω. Reset1800Ω
Adjustable from 0,2 to 30 s ±5%	-			< 0,1s
Automatic	Automatic			Automatic
3 LED's: ON + **Hz>** + **Hz<**	2 LED's: ON +			3 LED's: ON + +
2 relays, 1 per limit, with 1 change over NO - NC	1 relay with 1 change over NO - NC			1 relay with 1 NO + 1 NC
I_{th}: 5A; AC15 - 250V - 2A; DC13 - 30V - 2A	I_{th}: 5A; AC15 - 250V - 2A; DC13 - 30V - 2A			I_{th}: 5A; AC15 - 250V - 2A; DC13 - 30V - 2A
2,5 mm², No. 22 - 12AWG / 20Ncm, 1.8 LB - IN	2,5 mm², No. 22 - 12AWG / 20Ncm, 1.8 LB - IN			2,5 mm², No. 22 - 12AWG / 20Ncm, 1.8 LB - IN
3,7 VA (230 Vac)	5 VA (230 Vac) - 0,5 W (24 Vdc)			6 VA (230 Vac)
IP20 / 0,3 kg	IP20 / 0,11 kg			IP20 / 0,12 kg
-30°C +70°C / -15°C +60°C	-30°C +70°C / -15°C +60°C			-30°C +70°C / -15°C +60°C







Voltage monitoring relays

Protections

- Phase loss
- Phase sequence
- U> Overvoltage
- U< Undervoltage
- Loss of neutral

Single phase voltage relay

- Suitable for single phase installations such as air conditioning, electronic equipments, etc.
- Suitable for AC/DC.
- Minimum and maximum thresholds can be adjusted separately.
- Reset time delay adjustable.

Three-phase voltage relay

- Protects equipment such as digital instruments or electrical equipment from voltage variations in the network.
- Suitable for AC/DC.
- Minimum and maximum thresholds adjustables (two potentiometers).
- Tripping time delay adjustable (two potentiometers).
- 22,5 mm wide.

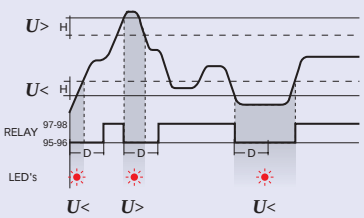
U1

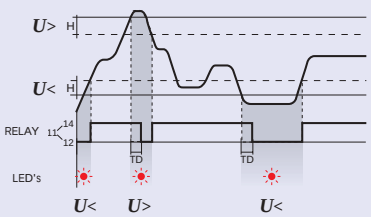
U1D

Protections	U> U<			U> U<		
Models	**U1-24 D**	**U1-115**	**U1-230**	**U1D-24D**	**U1D-115**	**U1D-230**
Frequency	Direct c.	50/60 Hz	50/60 Hz	DC	50/60 Hz	50/60 Hz
Maximum threshold V	24-27	115-130	230-260	23-28	105-135	215-275
Minimum threshold V	21-24	100-115	200-230	19-25	90-120	160-230
Code no.	12023	12020	12021	12028	12026	12027

Characteristics		
Type of current to be monitored	Single phase	Single phase
Auxiliary supply ±10%	Self-powered	Self-powered
Accuracy	U> +4% -1%; U< +1% -4%	U> +4% -1%; U< +1% -4%
Trip time delay	-	-
Reset time delay	0,05 to 306 s (±20%)	0,1 to 6s (±20%) for U> U<
Reset mode	Automatic	Automatic
Hysteresis	4% of the nominal voltage	4% of the nominal voltage
Signalling LED's	3 LED's: ON + U> + U<	3 LED's: ON + U> + U<
Output contacts	1 relay with 1 NO + 1 NC	1 relay with 1 change-over NO + 1 NC
Switching power	I_{th}: 5A; AC15 - 250V - 2A; DC13 - 30V - 2A	I_{th}: 5A; AC15 - 250V - 2A; DC13 - 30V - 2A
Terminals: Max. section / Screw torque	2,5 mm², No. 22 - 12AWG / 20Ncm, 1.8 LB - IN	2,5 mm², No. 22 - 12AWG / 20Ncm, 1.8 LB - IN
Power consumption	4 VA (115Vac) - 7,5VA (230Vac) - 0,7W (24 Vdc)	3 VA (115Vac) - 5VA (230Vac) - 0,7W (24 Vdc)
Protection degree / weight	IP20 / 0,2 kg	IP20 / 0,11 kg
Storage / operation temperature	-30°C +70 °C / -15°C +60°C	-30°C +70 °C / -15°C +60°C

CE





For dimensions see page 23

- ***Self-powered by the voltage to be monitored***
- ***Visual indication of tripping cause***
- ***DIN rail mounting***

Three-phase voltage relay

- Protects three-phase installations against voltage variations between phases, incorrect sequence of phases and phase loss.
- Minimum and maximum thresholds adjustables (two potentiometers).
- Tripping time delay adjustable (two potentiometers).
- Model U3S-420 is valid for 400 and 440 nominal V.
- 22,5 mm wide.

Three-phase voltage relay

- Suitable to protect three-phase installations against variations in main voltage. Sensitive to incorrect phase sequence.
- Applicable in generators, automatic transfer setups, etc.
- Maximum and minimum thresholds can be adjusted separately.
- Two independent output relays.

Three-phase voltage relay

- Suitable to protect three-phase with neutral installations against variations in main voltage and loss of neutral. Sensitive to incorrect phase sequence.
- Applicable in generators, automatic transfer setups, etc.
- Maximum and minimum thresholds can be adjusted separately.
- Two independent output relays.

U3 S

U3 P

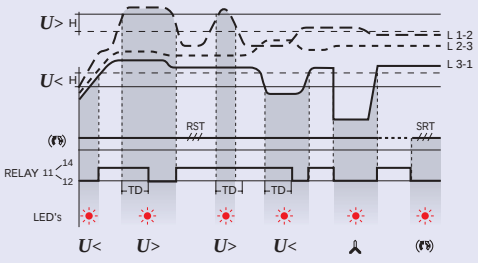
U3 N

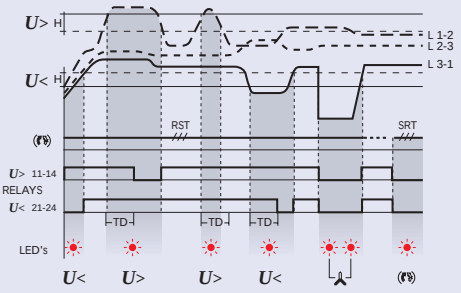
U> U<		
U3S-230	**U3S-420**	
50/60 Hz	50/60 Hz	
210-290	380-500	
185-230	350-430	
12071	12070	

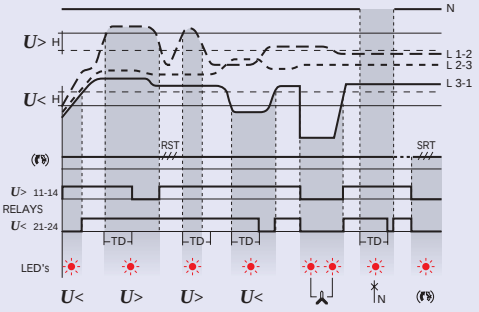
U> U<		
U3P-230	**U3P-400**	**U3P-440**
50/60 Hz	50/60 Hz	50/60 Hz
230-260	400-460	440-500
200-230	340-400	380-440
12066	12065	12067

U> U<		I_N
U3N-230	**U3N-400**	**U3N-440**
50/60 Hz	50/60 Hz	50/60 Hz
230-260	400-460	440-500
200-230	340-400	380-440
12056	12055	12057

Three phase	Three-phase	Three-phase with neutral
Self-powered	Self-powered	Self-powered
U>+4% -1%; U<+1% -4%	U>+4% -1%; U<+1% -4%	U>+4% -1%; U<+1% -4%
-	0,1 to 3,7s (±20%) for U> U<	0,1 to 3,7s (±20%) for U> U< I_N
0,1 to 6s (±20%) for U> U<	-	-
Automatic	Automatic	Automatic
4% of the nominal voltage	4% of the nominal voltage	4% of the nominal voltage
4 LED's: ON + U> + U< +	4 LED's: ON + U> + + U<	4 LED's: ON + U> + + U< I_N
1 relay with 1 change-over NO + 1 NC	2 relays with 1 NO	2 relays with 1 NO
I_{th}: 5A; AC15 - 250V - 2A; DC13 - 30V - 2A	I_{th}: 5A; AC15 - 250V - 2A; DC13 - 30V - 2A	I_{th}: 5A; AC15 - 250V - 2A; DC13 - 30V - 2A
2,5 mm², No. 22 - 12AWG / 20Ncm, 1.8 LB - IN	2,5 mm², No. 22 - 12AWG / 20Ncm, 1.8 LB - IN	2,5 mm², No. 22 - 12AWG / 20Ncm, 1.8 LB - IN
7,5 VA (230 Vac) - 11 VA (400 Vac)	12 VA (230 Vac) - 20 VA (400 Vac)	12 VA (230 Vac) - 20 VA (400 Vac)
IP20 / 0,12 kg	IP20 / 0,35 kg	IP20 / 0,35 kg
-30°C +70 °C / -15°C +60°C	-30°C +70 °C / -15°C +60°C	-30°C +70 °C / -15°C +60°C







Earth leakage relays

Multirange relay with built-in toroidal transformer

- Sensitivity from 0,025 to 25A.
- Trip time delay from 0,02 to 5s.
- Modular size. DIN rail mounting.
- Protection front cover.

Multirange relay with built-in toroidal transformer

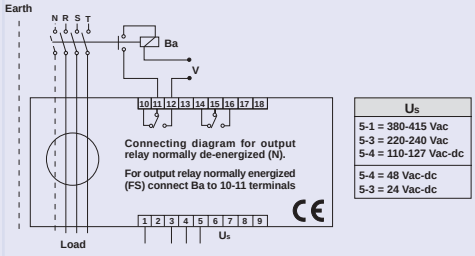
- Sensitivity from 0,025 to 25A.
- Trip time delay from 0,02 to 5s.
- Compact device. Suitable for motor control centers (MCC).

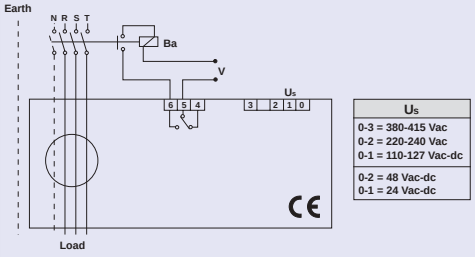
ELR-A

ELR-T

Models	ELR-A		ELR-T60		ELR-T110	
Sensitivity	Adjustable from 0,025 A to 25 A		Adjustable from 0,025A to 25 A			
Trip time delay	Adjustable from 0,02 s to 5 s		Adjustable from 0,02 s to 5 s			
Aux. voltage supply 50/60 Hz	24-48 Vdc, ac	115 Vdc, ac 230-400 Vac	4-48 Vdc, ac	115 Vdc, ac 230-400 Vac	24-48 Vdc, ac	115 Vdc, ac 230-400 Vac
Code no.	41017	41015	41107	41105	41102	41100

Characteristics		
Toroidal transformer	Built-in Ø28 mm	Built-in Ø60 mm and Ø110 mm
Max. length between relay and transformer	-	-
Reset mode	Automatic, manual and remote (in manual mode disconnect the aux. supply during 1s)	Automatic, manual and remote (in manual mode disconnect the aux.supply during1s)
Signalling LED's	2 LED's: ON + Trip	2 LED's: ON + Trip
Output contacts mode	Selectable: normally de-energized or energized	Normally de-energized
Output contacts	2 change over NO-NC	1 change over NO-NC
Switching power (resistive load)	5A - 250V	5A - 250V
Maximum terminal section	2,5 mm^2	2,5 mm^2
Maximum consumption	3 VA	3 VA
Modular size	6 modules x 17,5 mm = 105 mm	No
Frequency	50/60 Hz	50/60 Hz
Protection degree / weight	IP20 / 0,4 kg	IP20 / 0,4 y 0,6 kg
Storage / operation temperature	-10°C +60°C	-10°C +60°C
Standards	IEC 41-1, IEC 255, VDE 0664, EN 50081-1, EN 50082-2	IEC 41-1, IEC 255, VDE 0664, EN 50081-1, EN 50082-2





For dimensions see page 23

- ***Electronic relays with adjustable delay time and sensitivity.***
- ***Suitable for direct pulse current.***
- ***Practically immune to external disturbances.***

Relay with adjustable delay time and sensitivity

- Selectable sensitivity 0,3 or 0,5A.
- Selectable tripping time delay 0,02 or 0,5s.
- To be used with CT-1 transformers.
- Modular size. DIN rail mounting .
- Sealable front cover.

Multirange relay

- Sensitivity from 0,025 to 25A.
- Trip time delay from 0,02 to 5s.
- To be used with CT-1 transformers.
- Modular size. DIN rail mounting.
- Sealable front cover.

Toroidal transformers

- To be used with ELR-B and ELR-3C relays.
- The transformer and relay assembly sensitivity is fixed by the relay.

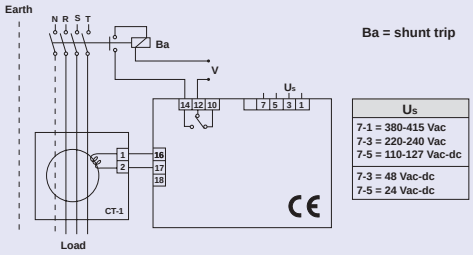
ELR-B

ELR-3C

CT-1

ELR-B		ELR-3C	
0,3A or 0,5A		Adjustable from 0,025A to 25 A	
0,02 s or 0,5 s		Adjustable from 0,02s to 5s	
24-48 Vdc, ac	115 Vdc, ac 230-400 Vac	24-48 Vdc, ac	115 Vdc, ac 230-400 Vac
41012	41010	41005	41000

In combination with CT-1	In combination with CT-1
20 m with cables twisted	20 m with cables twisted
Automatic, manual and remote (in manual mode disconnect the aux. supply during 1s)	Automatic, manual and remote (in manual mode disconnect the aux. supply during 1s)
2 LED's: ON + Trip	2 LED's: ON + Trip
Normally de-energized	Normally de-energized
1 change over NO-NC	1 change over NO-NC
5A - 250V	5A - 250V
2,5 mm^2	2,5 mm^2
3 VA	3 VA
3 modules x 17,5 mm = 52,5 mm	3 modules x 17,5 mm = 52,5 mm
50/60 Hz	50/60 Hz
IP-20 / 0,2 kg	IP-20 / 0,2 kg
-10°C +60°C	-10°C +60°C
IEC 41-1, IEC 255, VDE 0664, EN 50081-1, EN 50082-2	IEC 41-1, IEC 255, VDE 0664, EN 50081-1, EN 50082-2



Type	Inner Ø	Code no.	Weight (kg)
CT-1/35	35 mm	41025	0,2
CT-1/60	60 mm	41030	0,3
CT-1/80	80 mm	41035	0,5
CT-1/110	110 mm	41040	0,5
CT-1/160	160 mm	41045	1,4
CT-1/210	210 mm	41050	1,5

Working principles: The toroidal transformer is installed between the source and the load. The system works on the current balance principle. In a correct installation the vector sum of the currents is zero and the relay will not trip.

In case of an insulation fault on the circuit a leakage current flows to earth. Now the vector sum of the current passing through the transformer is not zero, this imbalance is detected by the transformer that induces a current in the secondary winding which is connected to the relay.

If the fault level is higher than the selected sensitivity and when the trip time delay has elapsed, the relay trips and actuates on the shunt trip of a circuit breaker or on the coil of a contactor interrupting therefore the supply to the load.

The dimensioning of the toroidal transformer depends on the diameter of all active wires (not earth conductors) put through the transformers.

Electrical multimeters

- ***Measure and display up to 30 parameters of a three phase line with or without neutral. True RMS values.***
- ***All the values can be read without making program changes.***
- ***Reduced size 96x96 mm. Flush mounting in panel***

V	**Voltage**
A	**Current**
Cosφ	**Power factor (PF)**
W	**Active power (P)**
VAr	**Reactive power (Q)**
VA	**Apparent power (S)**
kWh	**Active energy counter**
kVArh	**Reactive energy counter**
Hz	**Frequency**
°C	**Temperature**
Max	**Maximum values**

- Calculates the current demand.
- 4 displays with red LED´s of 3 digits with 7 segments for easy reading.
- 3 membrane push-buttons.
- Automatic scale of units.
- Suitable for all electrical switchboards used in the industrial field for instruments, motors, generators, etc.

- With active and reactive energy meter.
- 4 displays with red LED´s of 3 digits with 7 segments for easy reading.
- 3 membrane push-buttons.
- Automatic scale of units.
- Suitable for all electrical switchboards used in the industrial field for instruments, motors, generators, etc.

EMM

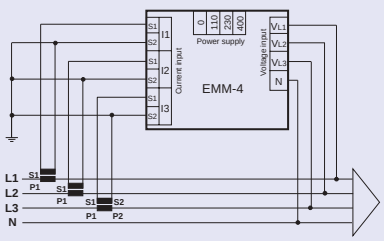
Models	**EMM 4**	**EMM 6**
Measured and displayed values	V A PF W VAr VA Hz °C Max	V A PF W VAr VA kWh kVArh Hz Max
Auxiliary supply ±10% 50/60 Hz	100-125 / 220-240 / 380-415 V	100-125 / 220-240 / 380-415 V
Code no.	41200	41205

Characteristics		
Voltage input	4 wires imput. For both 4 and 3 wires systems (in this case don't connect N)	
• Input impedance	1 MΩ	1 MΩ
• Continuous overload	+20%	+20%
Current input	From 0,02 to 5 A. Use always 3 CT.../5. Multimeter self-consumption < 5VA	
• CT primary I_N current	Range between 5 and 10.000 A. This value has to be programmed by the user in the multimeter	
• Continuous overload	+30%	+30%
Maximum terminal section	2,5 mm²	2,5 mm²
Front protection degree / weight	IP 52 / 0,5 kg	IP 52 / 0,5 kg
Storage / operation temperature; humidity	-25°C to 80°C / -10°C to 60°C; < 90%	-25°C to 80°C / -10°C to 60°C; < 90%
Standards	IEC EN 50081-2, IEC EN 50082-1, IEC EN 61010-1	IEC EN 50081-2, IEC EN 50082-1, IEC EN 61010-1

CE

Wiring diagram

4 wires system.
In 3-phase applications (without or with neutral not distributed) don't connect the terminal N.



EMM 4	EMM 6	Parameters	Measured parameters				Range	Accuracy % ±digits
•	•	V_{L-N} Voltage	V_{L1-N}	V_{L2-N}	V_{L3-N}	ΣV_{L-N}	20 - 290 Vrms	±0,5 ±1
•	•	V_{L-L} Voltage	V_{L1-2}	V_{L2-3}	V_{L3-1}	ΣV_{L-L}	20 - 500 Vrms	±0,5 ±1
•	•	A Current	I_{L1}	I_{L2}	I_{L3}	ΣI_L	0,02 - 9990 Arms	±0,5 ±1
•	•	PF Power factor cosφ	PF_{L1}	PF_{L2}	PF_{L3}	ΣPF_L	0,1 a 1 (+ind.,-cap.)	±1 ±1
•	•	W Active power	P_{L1}	P_{L2}	P_{L3}	ΣP_L	0,01 - 9990 kW	±1 ±1
•	•	VAr Reactive power	Q_{L1}	Q_{L2}	Q_{L3}	ΣQ_L	0,01 - 9990 kVAr	±1 ±1
•	•	VA Apparent power	S_{L1}	S_{L2}	S_{L3}	ΣS_L	0,01 - 9990 kVA	±1 ±1
	•	kWh Act. en. count	ΣkWh				0 - 10^8 kWh	Clase 2
	•	kVArh React. en. count	ΣkVArh				0 - 10^8 kVArh	Clase 2
•	•	Hz Frecuency	F_{L1}				40 - 500 Hz	±0,5 ±1
•		°C Temperature	T	Measured with internal sensor			0 - 60°C	±2°C
•	•	Max. (instantaneous)	$\Sigma P_{L\,max}$	Values every second				
	•	Integrated active power	$\Sigma P_{L\,max}$	Average of max. values over last 15 minutes				
•		Max. (instantaneous)	$I_{L1\,max}$	$I_{L2\,max}$	$I_{L3\,max}$	Values every second		
•		Integrated current	$I_{L1\,max}$	$I_{L2\,max}$	$I_{L3\,max}$	Average of max. values over last 15 minutes		

For dimensions see page 23

Timers

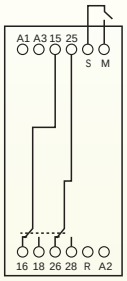
- ***Multifunction digital timer***
- ***Possibility of programming up to 9 different times. Each time can be set from 0,1 seconds to 99 hours***
- ***With built-in battery which allows timer to be programmed without connecting to auxiliary voltage. Complete battery discharge does not affect operation or adjustment settings.***

- For control and automation systems in industry.
- Command contact with 5 programmable functions.
- 2 digit, 7 segment LED displays and push-buttons provide programming, and during operation allow for monitoring of the time period and review the programmed settings.
- 45 mm module size, 35 mm wide. DIN EN 50022-35 rail mounting.

Programmable parameters

- Initial state of outpout relays: energized (1H) or de-energized (1L).
- Working mode: cycle (C1) or non-cycle (C0).
- Number of different times per program: up to 8 in cycle mode and up to 9 in non-cycle.
- Time setting range: from 0,1 seconds to 99 hours.
- Command contact.

MTR-10



Auxiliary voltage
A1-A2: 230 Vac
A2-A3: 24 Vac, dc

Model	**MTR-10**
Auxiliary power supply (+15 -10%)	230 V 50/60 Hz, 24 Vdc, ac
Code no.	12110

Characteristics	
Time setting range	From 0,1 seconds to 99 hours
Accuracy	1% ±10 ms
Repeat accuracy	0,5%
Number of different times per program	Up to 8 in cycle mode and 9 in no-cycle
Output contacts	1 relay with 2 timed change over contacts NO-NC
Switching power	I_{th}: 5A; AC15 - 250V - 2A; DC13 - 30V - 2A
Terminals: max section / screw torque	2,5 mm², No. 22 - 12AWG / 20Ncm, 1.8 LB - IN
Mechanical / electrical life	>20 x 10^6 operations / >10^5 operations
Consumption	8 VA (230 Vac) - 1W (24 Vdc)
Protection degree / weight	IP 40 front / 0,15 kg
Storage / operation temperature	-30°C +70°C / -20°C +55°C
Standards	IEC 255

CE

Function example diagrams

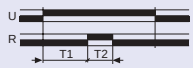
U: power supply **R**: relay output
Output relay at start: **1L** de-energized; **1H** energized.
Work mode: **CO** non-cycle; **C1** cycle.
Command contact: **cu**, **cr**, **cl**, **ci**, **co**.

Delay on
1L - CO - cu

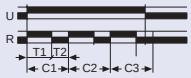
Timing on
1H - CO - cu

Delay off
With command contact
1H - CO - co

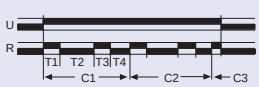
Double timing
1L - CO - cu



Double timing
Cycle work mode
1H - C1 - cu



Four timings
Cycle work mode
1H - C1 - cu



Timing with partial shutdown by command contact
1L - CO - cl

Command contact Can be switched on in two ways:

- By closing an external voltage free contact between M and S
- By connecting 5-35 Vac,dc between M(+) and R(-)

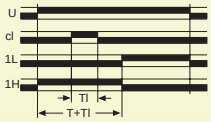
One of the following arrangements can be programmed:

Each diagram represents the effect of the command contact for the two initial states of the output relay: de-energized (1L) and energized (1H).

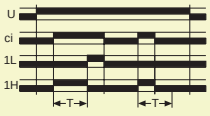
cu **Switched off contact**
Its function is blocked

cr **Reset contact**
When connected the output relay is de-energized; upon disconnecting, the programmed timing starts.

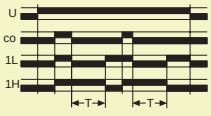
cl **Lock contact**
A partial shutdown of the timing takes place during its operation.



ci **Delay on contact**
When disconnected the output relay is de-energized; when connected the programmed timing starts.



co **Delay off contact**
When disconnected the output relay is de-energized. When connected, the relay is energized. When disconnected again, the programmed timing starts.



For dimensions see page 23

FANOX

Accessories

Current transformers

- Up to 1000 A of primary current.
- Transformers ratio .../5.
- Sealable connection terminal box, metal brackets for fitting and bus-bar holders included.

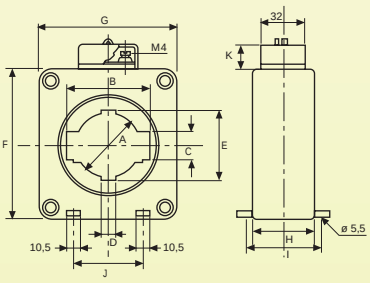
Thermistor sensors

- Connected to GL, G, BG or ST relays protect motors against overtemperature.
- PTC. Positive temperature coeficient
- PTC 120, for internal mounting. Temperature threshold 120°C.
- PTCEX 70, for external mounting. Temperature threshold 70°C.

CT

Primary .../ 5A	Model	Code	VA class 1
60	CT20	41402	2,5
100	CT20	41404	2,5
150	CT20	41406	5
200	CT30	41412	5
250	CT30	41414	5
300	CT30	41416	5
400	CT30	41418	5
500	CT50	41422	5
600	CT50	41424	5
800	CT50	41426	10
1000	CT50	41428	15

Characteristics	
Overload	1,2 I_N
Max. line voltage bus-bars / cable1000V	660V / 1000V
Max. size: bus-bars / Ø cable (mm) CT 20	30 x 10 / Ø 20
Max. size: bus-bars / Ø cable (mm) CT 30	40 x 10 / Ø 30
Max. size: bus-bars / Ø cable (mm) CT 50	60 x 20 / Ø 40



mm	CT 20	CT 30	CT 50
A Ø	23	31	46
B	30	42	61
C	11	11,5	21
D	11	11,5	11
E	25	42	51
F	67	82	111
G	60	75	101
H	32,5	42	44
I	58	59	60
J	32	45	45
K	12	17	17

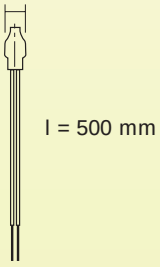
CE

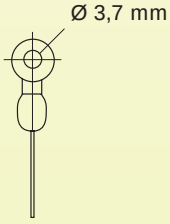
PTC

PTCEX 70

PTC 120

Models	PTC 120	PTCEX 70
Code	41700	41705
Threshold temperature	120°C	70°C
Threshold resistance	≥ 1330 Ω	≥ 1330 Ω
Mounting	internal	external





Manual motor starters

- ***Overload and short-circuit protection***
- ***Overload range adjustable from 0,1 to 25A.***
- ***Broad range of accessories***

- Suitable for small size motors in machine-tools, conveyor systems, etc.
- Modular size 45 mm. DIN rail mounting (EN 50022-35).
- Isolating and main switch function (IEC 204-1).
- Current limiter M-SB (I_N=32A), increases the short circuit capacity up to 50kA/400V. Assembly: under the manual motor starter or remoted from it.
- Undervoltage trip and remote trip.
- Enclosures, auxiliary contacts, emergency push-button and indicator lights.

M

Accessories

Characteristics

Rated operational voltage Ue	690 V
Rated impulse withstand voltage Vimp	6 kV
Frequency	40/60 Hz
Mechanical or electrical operations	100.000
Max. operating frequency	30 oper/h
Current heat losses (3-phases)	5,8 W
Opening time	7 ms
Terminal section	2 x 6 mm²
Screw torque	1,2 Nm
Protection degree	IP20
Fix magnetic tripping (A)	12 x I ±20%

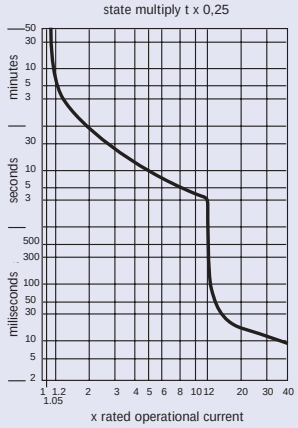
Auxiliary contacts

Rated operational voltage	500 V
Rated impulse withstand voltage	4 kV
Maximum current I_{th}	6 A
Rated current AC-15:230/400 V	3,5 / 2 A
Terminal section	2 x 2,5 mm²
Screw torque	1 Nm

Code no.	Model	Range A	Motor 3F, AC3 kW - 400 V
35016	**M-0,16**	0,1 - 0,16	–
35000	**M-0,25**	0,16 - 0,25	0,06
35001	**M-0,4**	0,25 - 0,4	0,09
35002	**M-0,63**	0,4 - 0,63	0,12
35003	**M-1**	0,63 - 1	0,25
35004	**M-1,6**	1 - 1,6	0,55
35005	**M-2,5**	1,6 - 2,5	0,75
35006	**M-4**	2,5 - 4	1,5
35007	**M-6,3**	4 - 6,3	2,2
35008	**M-10**	6,3 - 10	4
35009	**M-16**	10 - 16	7,5
35010	**M-20**	16 - 20	9
35011	**M-25**	20 - 25	12,5

Rated short circuit breaking capacity I_{cu} (DIN VDE 0660 part 101; IEC 947-2)							Back-up fuse			
Manual motor starter models	Switching capacity I_{cu} [kA]				With limiter M-SB		Fuses gL, aM (A)			
V	230	400	500	690	230	400	230	400	500	690
M-0,16 a M-1,6	Not required		3	2,5	Not required		Not required		25	20
M - 2,5			3	2,5					35	25
M - 4			3	2,5					50	35
M - 6,3		6	3	2,5		50		80	50	35
M - 10	10	6	2,5	2	100	50	80	80	63	35
M - 16	10	6	2,5	2	100	50	80	80	63	50
M-20 a M-25										

Cold state curve. For warm state multiply t x 0,25



Description / Model / Code no.

- Current limiter **M-SB** 03990
- Auxiliary contacts (*NO early make)

Contact	Side mounting		Inside mounting	
2 NO	**M-HS20**	03901		
NO + NC	**M-HS11**	03900	**M-EHS11**	03908
NO	**M-HS10**	39011	**M-SHS10**	03906
2 NC	**M-HS02**	03903		
NC	**M-HS01**	39031	**M-SHS01**	03907
NO*+ NC	**M-VHS11**	03902		

- Remote trip and undervoltage trip (Inside mounting)

V / Hz	Remote		Undervoltage	
24 / 50-60	**M-AS-05**	03923	**M-UN-05**	03913
110 / 50 120 / 60	**M-AS-15**	03920	**M-UN-15**	03910
220-240 / 50 240 / 60	**M-AS-25**	03921	**M-UN-25**	03911
380-415 / 50 440 / 60	**M-AS-45**	03922	**M-UN-45**	03912
500 / 50			**M-UN-55**	03915

- Enclosures

Surface mounting IP41	**M-GE**	03950
Flush mounting IP41	**M-FP**	03940
Kit IP55 (M-GE and M-FP)	**M-BS**	03948
Enclosure IP54, 5 poles CEE-17	**M-GC**	04055
Idem with phase inverter	**M-GC1**	04056

- Emergency stop-operation for M-GE and M-FP

Push-button type IP55	**M-PT**	03980
Self-locking type IP55	**M-PV**	03981
Self-locking with key IP55	**M-PS**	39822

- Others for enclosures M-GE and M-FP

Padlocking feature (max. 3)	**M-VSL**	03988
N-terminal	**M-N**	03949
Indicator lights white, red or green		

For dimensions see page 23

Motor and generator protection relays. Installation and setup

The motor protection

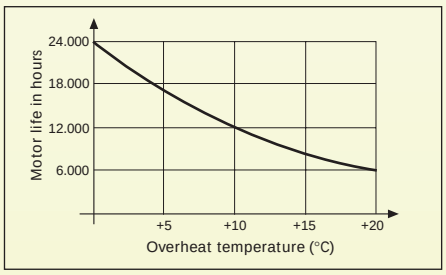
The electric motor is one of the most important operating devices in industry. Many times the shutdown of an industrial process is caused by a simple motor. High-cost production runs and valuable machinery can become paralysed at great cost, even more than the cost of rewinding the motor.

Experience shows us that motor protection continues to be a problem, based on the number of breakdowns occuring every day.

Over 60% of failures are due to causes produced by overheating of the motor winding. These can be detected, and prevented, by measuring and analysing the current being absorbed by the motor, or by controlling temperature limits of the winding. The major causes are as follows:

- Overloads
- Locked rotor
- Over and undervoltage
- Phase imbalance or phase loss
- Long and heavy start-ups
- Excessive operating cycling
- Heating from non-electric causes
- Inadequate motor ventilation
- High room temperature
- Insulation failure

The following diagram shows the dramatic decrease suffered in the electric life of a motor due to the excessive heat of the motor windings (Montsinger's rule).



As one can see, a 10ºC increase in temperature reduces the useful life of the motor by half.

The most reliable protection option, which is becoming more commonly used, is the one consisting on:

- Fuses or circuit breakers for short-circuit protection.
- Electronic motor protection relays with thermal memory.
- Contactors for motor control.

FANOX relays

Our R+D Division has allowed FANOX to develop a wide range of easy-to-install and operate electronic relays, at truly competitive prices, which will save downtime and money.

FANOX motor protection relays work with the current measured at every moment. These currents, which are read by three current transformers built into the relays, are electronically processed and used to modelize the thermal image of the motor, and to compare them with the values set in the relay.

The three power supply connections to the motor are not directly connected to the relay, but pass through its corresponding holes.

This provides motor protection against:

- Overloads: since the relay creates a model of the thermal image of the motor during its heating and cooling cycles. In this way, in overload conditions, the relay will take into consideration previous operating conditions of the motor, and will trip faster if the relay has detected other previous overloads. This thermal memory is independent of the auxiliary voltage supply of the relay so that it remains active even when this voltage is cut off or disconnected. The different tripping curves available for selection in the relays allow for precise adjustment to any kind of motor start-up or work cycle.
- Underloads: protects motors against no-load working, which is very important for pumps (dry running).
- Phase imbalance and phase loss: even if the motor is running below its full load current.
- The incorrect phase sequence detection is highly important when the correct phase sequence is critical as in compressors, pumps, fans and other applications.

For protection against no-load operation when the motor is oversized, underload protection by cos φ has been incorporated so that the relay differentiates precisely between very low load and no-load operations, and drops out in the latter case.

In addition, when the relay is connected to thermistor sensors (PTC), it protects the motor against electrical and non-electrical overheating.

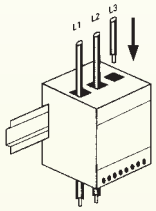
A visual display of the tripping reason allows maintenance personnel to identify and immediately act on the underlying causes. The use of the OD display makes this operation much easier.

All of this make FANOX relays the ideal protection for your motors (pumps, compressors, fans, etc).

1. Installation

1.1. General

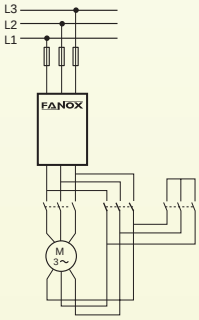
For correct installation and operation of the relays, please bear on mind the following considerations:



- After being fixed to the DIN rail, the cables for the three phases should be passed through the holes in the relay.

  The maximum section of 700V insulated wires that can pass through the holes are:

C	16 mm²
GL, P, PF, G, BG, GEN	35 mm²



- In star-delta starting, the relay or the current transformers must be installed between the fuses or circuit breaker and the contactor.

- Relays used in combination with frequency inverters:

a) GL relays with the selector for phase sequence in "ON" and P and PF relays: don't use in combination with inverters.

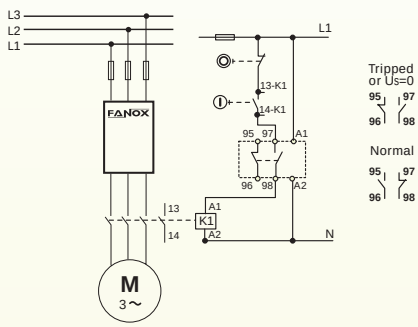
b) GL relays with the selector for phase sequence in "OFF" and C, G and BG: the relay or current transformers and the relay's auxiliary supply shouldn't be connected at the inverter output.

- Connection between the PTC sensors and the relay (GL, G and BG). For PTC connection lengths over 100 m or when the influence of high frequency transient voltages is expected, it is adviseable to use screened cable and connect the screen to terminal T1.

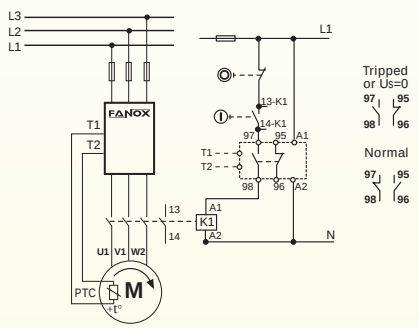
Note: every relay comes with its instruction manual providing information on its correct installation and setup.

1.2. Wiring diagrams

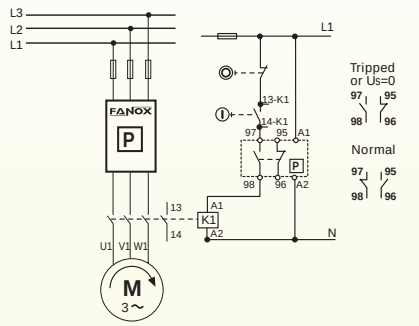
C



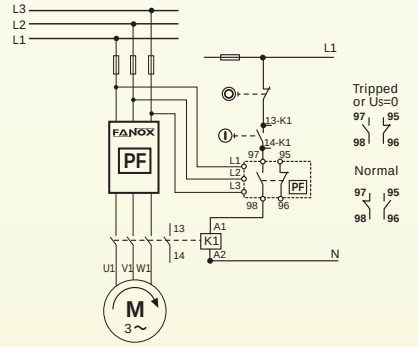
GL-G-BG



P

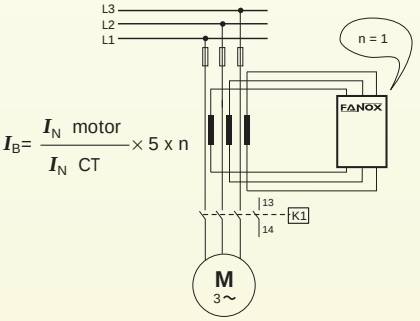


PF



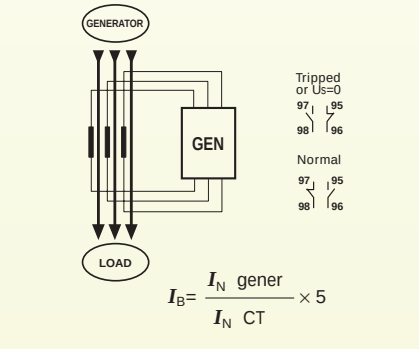
C-GL-P-PF-G-BG

With current transformers



$$I_B = \frac{I_N \text{ motor}}{I_N \text{ CT}} \times 5 \times n$$

GEN 10



$$I_B = \frac{I_N \text{ gener}}{I_N \text{ CT}} \times 5$$

2. Setup procedure. C, GL, P, PF, G, BG and GEN

Basically the main steps to follow are described below:

- Adjust the I_B current of the relay (C, GL, P, PF, G, BG and GEN). See 2.1.
- Select and adjust the trip class (C, GL, P and PF) or the tripping time (G, BG and GEN). See 2.2. and 2.3.
- Select and adjust the underload tripping level by cos φ and the trip delay (PF). See 2.4.
- Select and adjust the undercurrent tripping level (P). See 2.5.
- Select (ON-OFF) the protection against incorrect phase sequence (GL). See 2.6.
- Select the reset mode to manual or automatic (P and PF). See 2.7.

After installation and setup and before starting up the motor, make sure the motor is in a cold state. This will ensure that both, the relay and motor start to operate with the same thermal memory (cold condition).

2.1. Current setting I_B. C, GL, P, PF, G, BG and GEN

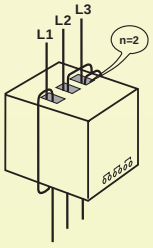
Adjust the current I_B on the corresponding dipswitches (full load current). When setting the current take into account that the base current of the relay always remain added to the current selected with the dipswitches in "ON" position (to the right). The total addition is the set current I_B.

Overload tripping current from 1,1 x I_B.

a) For motor or generator rated currents (I_N) within the range of the relay, the setting I_B must be equal to the I_N of the motor or generator.

$$I_B = I_N$$

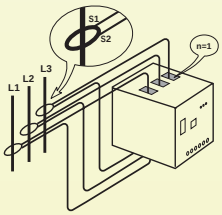
b) For motor rated currents below the range of the relay, the setting I_B must be equal to the rated current of the motor I_N multiplied by the number of times that the conductors have been passed through the relay holes.



$$I_B = I_N \times n$$

c) For motor or generator rated currents (I_N) above the range of the relay, use three current transformers .../5 in combination with the corresponding relay.

$$I_B = \frac{I_N \text{ mot/gen}}{I_N \text{ CT}} \times 5 \times n$$



2.2. Tripping times GEN

Select the tripping curve suitable for the good performance of the generator on the 4 positions dipswitch (trip time setting).

The selected curve will correspond to the result of the addition of the dipswitches in "ON" position (to the right).

2.3. Trip class / tripping time (IEC 947-4-1). C, GL, P and PF / G and BG

The different trip classes enable the user to select the overload protection according to the various motor applications in either short or long start-ups.

The class number or the tripping time refers to the maximum approximate time in seconds allowed for the direct start of the motor from a cold condition.

To select the trip class or tripping time (t_{6xI_B}) use the corresponding dipswitches. The recommended values are listed in the following tables.

Motor with direct start-up

Start time (s) RPM t_s	Trip classes											Trip time t_{6xI_B}	
	Models											Models	
	C9	C21	C45	GL16	GL40	GL90	P19	P44	P90	PF16	PF47	G17	BG17
1	10	10	10	10	10	10	5	5	5	10	10	4	4
2	10	10	10	10	10	10	10	10	10	10	10	6	6
3	10	20	20	15	15	15	10	10	10	20	20	10	10
4	20	20	20	20	20	20	15	15	15	20	20	12	12
5	20	30	30	20	20	25	15	15	15	20	20	16	16
6	20	30	30	25	25	25				30	30	18	18
7	30	30	30	30	30	30				30	30	22	22
8	30	30	30	30	30	35				30	30	24	24
9	30	30	30	35	35	35				30	30	28	28
10	30	30	30	35	35	35				30	30	30	30

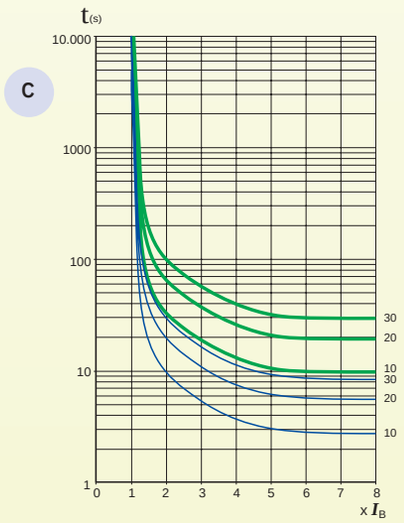
Motor with star-delta start

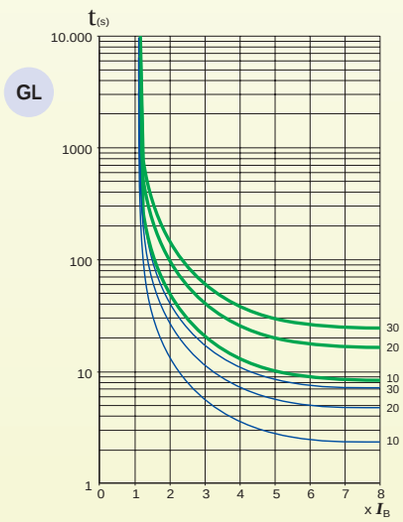
Y-Δ Start time (s) RPM t_s	Trip classes											Trip time t_{6xI_B}	
	Models											Models	
	C9	C21	C45	GL16	GL40	GL90	P19	P44	P90	PF16	PF47	G17	BG17
5	10	10	10	10	10	10	5	5	5	10	10	4	4
10	10	10	10	10	10	10	10	10	10	10	10	6	6
15	20	20	20	10	15	15	10	10	10	10	20	8	8
20	20	20	30	20	20	20	15	15	15	20	20	10	10
25	30	30	30	20	20	25	15	15	15	20	20	14	14
30	30	30	30	20	25	30				20	30	16	16
35	30	30	30	20	30	35				20	30	18	18
40	30	30	30	25	30	35				30	30	20	20

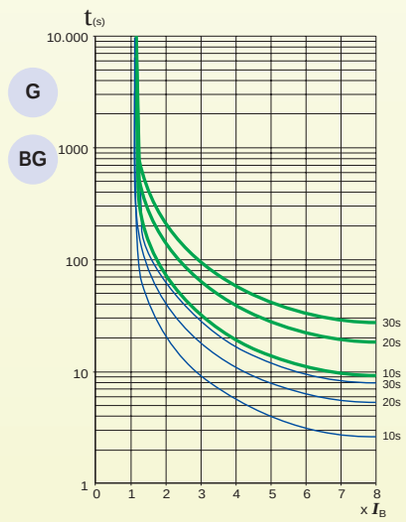
Average trip curves (IEC 947-4-1)

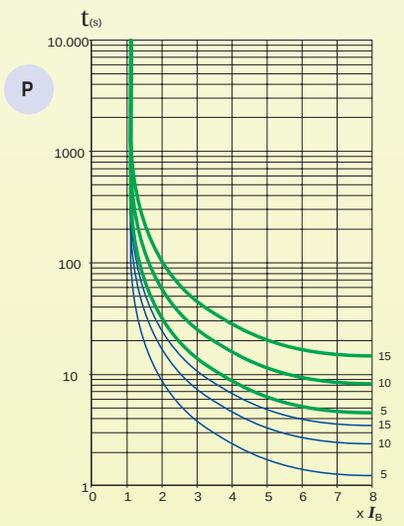
Cold curve: it represents the performance of the relay without any previous current flow, first start.

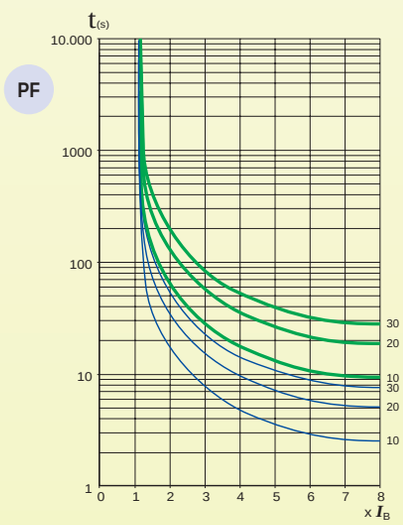
Warm curve: the tripping times decrease as the current flows, and are adapted to the motor heating condition based on the thermal memory, the warm condition (IEC-255) is reached after a current of 0.9 x I_N (motor rated current) flows during 2 hours approximately.

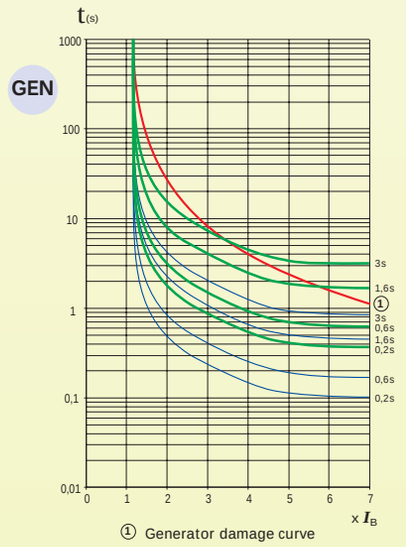












① Generator damage curve

2.4. Underload by cos φ. PF

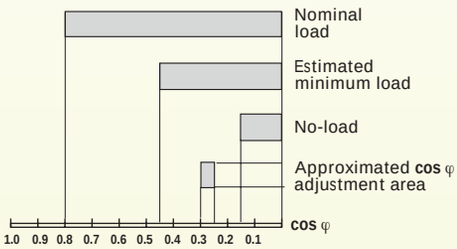
The cos φ underload trip level is set by means of a potentiometer from 0,1 to 0,9.

Select this value taking into consideration the no-load motor cos φ and that corresponding to the estimated minimum operating load. Choose an intermediate value between these two cos φ levels and set it in the relay.

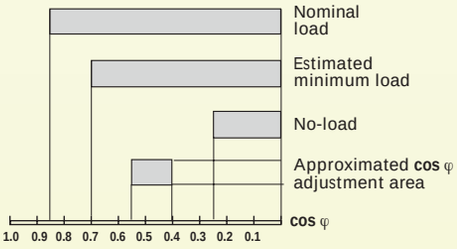
Select the underload trip delay from 5 to 45 seconds and set it with the 3 corresponding dipswitches (trip delay).

For your guidance you can find below two practical examples.

a) A very oversized motor for its application. The cos φ of the motor is 0,15 when working without load.



b) A slightly oversized motor for its application. The cos φ of the motor is 0,25 when working without load.



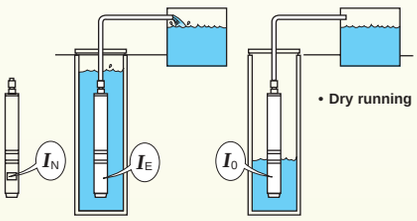
If the above mentioned cos φ values are unknown, the underload trip setting can be made in the following way:

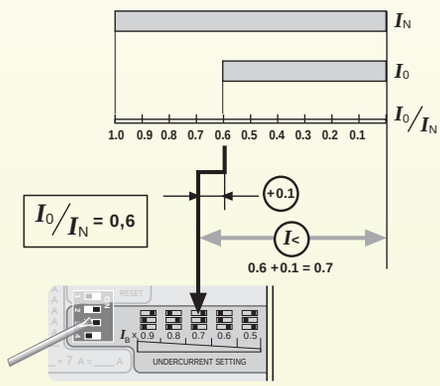
1. Set the underload trip delay to zero by moving the three dipswitches to the left (trip delay).
2. Using the potentiometer (cos φ setting), set the cos φ value to the minimum 0,1.
3. Start up the motor and run it with the minimum estimated load.
4. Slowly turn the cos φ potentiometer clockwise until the relay trips and the cos φ LED lights up.
5. Turn the cos φ potentiometer anticlockwise until the cos φ is set at approximately 30% less than the previous value (point 4).
6. Set the underload trip delay using the 3 corresponding dip switches.

2.5. Undercurrent. P

The undercurrent trip level in P relays is set using three dipswitches. To avoid nuisance trips, set this level to approximately 10% above the no-load motor current.

Example:





2.6. Incorrect phase sequence

Monitoring the current. GL and P

An incorrect phase sequence is detected by current sensing and it is only operative during the motor start-up, for correct detection the starting time must be longer than 0.2 s.

In GL relays the user can activate or desactivate this protection by a dipswitch. Should the right phase sequence be critical, move the dipswitch to the "ON" position. If this protection is not required leave it always in the "OFF" position.

As this function is not compatible with the use of frequency inverters, where it is necessary to protect phase sequence in these installations, move the dipswitch to "OFF" and install an "S" type relay.

Monitoring the voltage. PF

An incorrect phase sequence is detected by voltage monitoring.

In the event that an incorrect phase sequence has been detected, the motor will not start-up since the relay is tripped because it has previously detected the wrong phase sequence.

2.7. Reset

Relays	manual	remote	autom.
C, GL, G, BG, GEN	•	•	
P, PF	man	man	auto

Manual reset

Push the "RESET" button.

After tripping due to phase imbalance, phase loss, undercurrent or incorrect phase sequence, the relay could be reset after 2 seconds have elapsed.

When a trip is caused by an overload, the waiting time could be as much as 8 minutes for C, GL, G and GB relays, 5 minutes in P and PF relays, and 1 minute in GEN relays, depending on the severity of the fault.

Remote reset

After the required waiting time, disconnect the relay's auxiliary power supply and then reconnect it after 3 seconds.

In P and PF relays the reset position dipswitch should be set at "man".

Automatic reset

Only available in P and PF relays.

Choose this mode by moving the dipswitch to the "auto" position.

After any kind of trip, resetting will take place in approximately 15 minutes time, continuously for unlimited starts.

3. Operating test. TEST

To perform the trip test for phase loss, the current which passes through the relay must be higher than 0.7 the set current I_B. Under these conditions, push and hold the TEST button for three seconds, the relay will trip due to phase loss and the corresponding LED will light up.

Motor and generator protection relays. Applications and selection guide

Industries

FANOX protection relays for motors and generators have been installed in the most important areas of industry, including:

- OEM (Original Equipment Manufacturers)
- Chemical and petrochemical
- Quarries, gravel pits and cement factories
- Steelworks, iron and steel industry
- Automotive
- Utilities
- Water treatment and distribution
- Mining
- Food industry
- Marine and shipbuilding
- Sugar industry
- Timber industry
- Elevation industry
- Electric generation and cogeneration
- HVAC (Heat Ventilation Air Condition)

Installations

The following is an informative list of the most important applications using FANOX relays:

- Motor Control Centers (MCC)
- EEx e motors in explosive or hazardous environments
- Submergible pumps, in service stations and water pumping, surface pumps and other types.
- Compressors
- Fans, blowers and ventilators
- Industrial refrigeration and air conditioning
- Centrifuges
- Presses
- Cranes, elevators and escalators
- Lifting machinery in general
- Machine tool
- Conveyor belts
- Mills and mixers
- Generators, alternators and electrical generator sets

Selection guide for protection relays in motors and generators

MODELS	Adjustment range I_B (A)	Trip classes / Trip times	I>	I<	cos φ			
C 9	3 - 9,3	10 - 20 - 30	•			•		
C 21	9 - 21,6	10 - 20 - 30	•			•		
C 45	20 - 45,2	10 - 20 - 30	•			•		
GL 16	4 - 16,7	5 - 10 - 15 - 20 - 25 - 30 - 35	•			•	ON •	•
GL 40	15 - 40,5	5 - 10 - 15 - 20 - 25 - 30 - 35	•			•	ON •	•
GL 90	40 - 91	5 - 10 - 15 - 20 - 25 - 30 - 35	•			•	ON •	•
P 19	7 - 19,6	5 - 10 - 15	•	•		•	•	
P 44	19 - 44,2	5 - 10 - 15	•	•		•	•	
P 90	40 - 90,4	5 - 10 - 15	•	•		•	•	
PF 16	4 - 16,6	10 - 20 - 30	•		•	•	•	
PF 47	16 - 47,5	10 - 20 - 30	•		•	•	•	
G 17 - BG 17	5 - 17,7	De 2 a 30s	•			•		•
GEN 10	4 - 10,3	De 0,2 a 3s	•			•		

I> Overload — I< Undercurrent — cos φ Underload — Phase loss, Phase imbalance — Phase sequence — Overtemperature

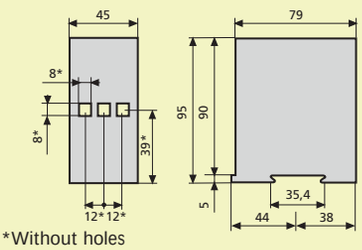
Nominal current rating of asynchronous three-phase motors

The current values listed in the following table correspond to the average ratings given by various manufacturers. In some cases, these may not coincide exactly with the ratings listed on the motor characteristics plates

kW			0,75	1,1	1,5	2,2	3	3,7	4	5,5	7,5	11	15	18,5	22	30	37	45	55	75	90	110
HP			1	1,5	2	3	4	5	5,5	7,5	10	15	20	25	30	40	50	60	75	100	125	150
I_N (A) Average values	MOTOR 4P	230 V 50Hz	3,5	5	6,5	9,5	11	–	15	22	28	42	54	68	80	104	130	154	192	248	312	360
		400 V 50Hz	2	2,5	3,5	5	6,5	–	8,5	11	15	22	29	35	42	57	69	81	100	131	162	195
		440 V 50Hz	1,7	2,4	3,2	4,5	6	–	8	10,5	14	20	27	33	39	52	64	76	91	120	147	178
		220/240 V 60Hz	3,2	4,4	6,2	8,5	10,5	–	14	20	26	38	50	63	74	98	122	146	180	233	290	345
		440/460 V 60Hz	1,5	2,2	3	4,3	5,5	–	7,5	10	13	19	25	31	37	49	61	73	90	116	144	173
	MOTOR 2P	400 V 50Hz	2,0	2,8	3,8	5,5	7	–	9,5	13	16,5	24	32	40	47	64	79	92	113	149	183	220
		440/460 V 60Hz	1,9	2,5	3,4	4,8	6	7,5	–	11	15	21	27	33	39	53	65	79	95	120	153	183

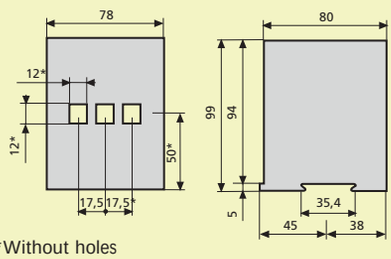
Dimensions (mm)

C
H*, U1*



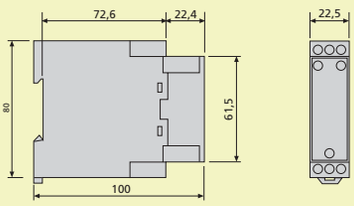
*Without holes

GL, P, PF, G, BG, GEN
U3P*, U3N*

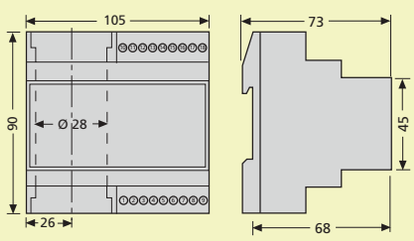


*Without holes

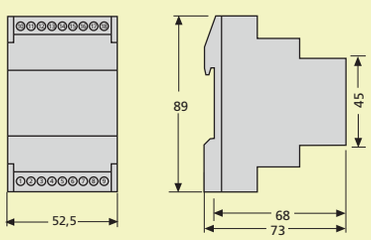
S, ST, T2, MT2, U1D, U3S



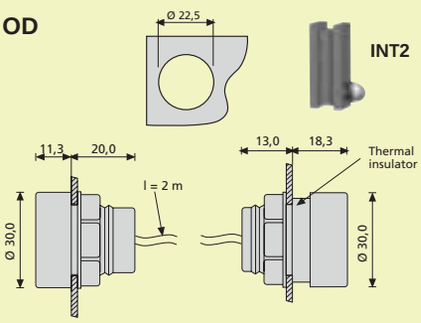
ELR-A



ELR-B, ELR-C

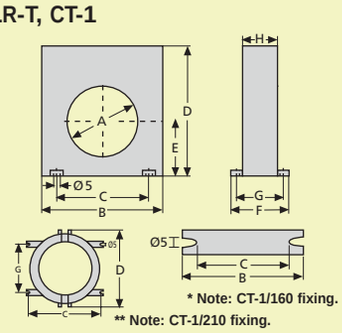


OD



C, GL, P, PF, BG, GEN ODT2

ELR-T, CT-1

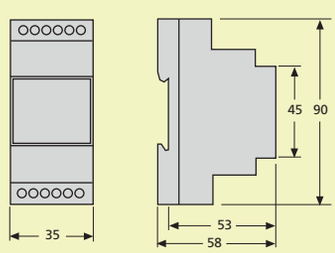


* Note: CT-1/160 fixing.

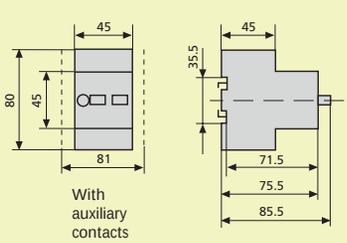
** Note: CT-1/210 fixing.

	A	B	C	D	E	F	G	H
ELR-T60	60	100	60	110	47	70	60	50
ELR-T110	110	150	110	160	70	70	60	50
CT-1/35	35	100	60	110	47	50	43	30
CT-1/60	60	100	60	110	47	50	43	30
CT-1/80	80	150	110	160	70	50	43	30
CT-1/110	110	150	110	160	70	50	43	30
CT-1/160	160	280*	260*	280	140	–	–	50
CT-1/210	210	–	280**	311**	–	–	240**	35

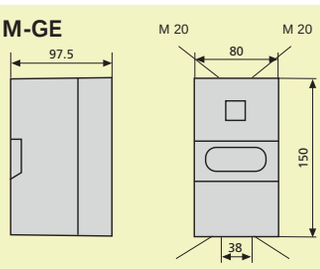
MTR-10



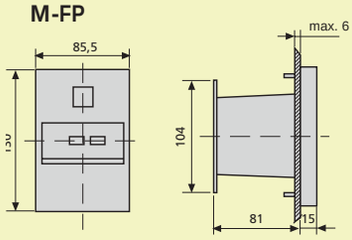
M



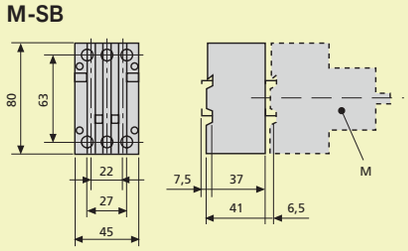
M-GE



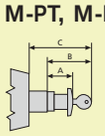
M-FP



M-SB

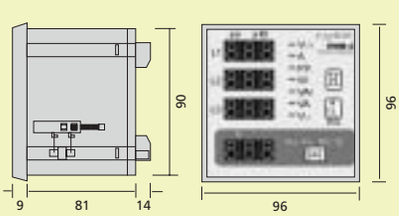


M-PT, M-PV, M-PS



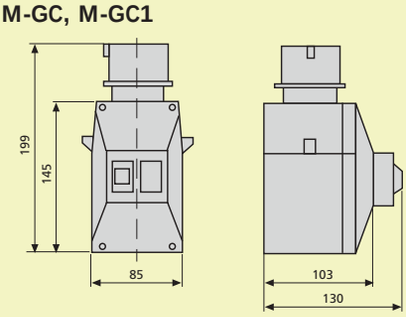
	A	B	C
M-PT	27	54	–
M-PV	28,5	55,5	–
M-PS	37	64	91

EMM



Panel cut out 92x92
Panel flush mounting according to DIN 43700

M-GC, M-GC1



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