



*“ All Over the World ”*

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**RoHS**  
COMPLIANT





# Low Voltage Protection, Control and Measurement Devices

## 4000 KINDS OF LOW-VOLTAGE PRODUCTS AT “FEDERAL”

Federal Elektrik has become one of the world's leader Low-Voltage Switchgear Equipment manufacturer.

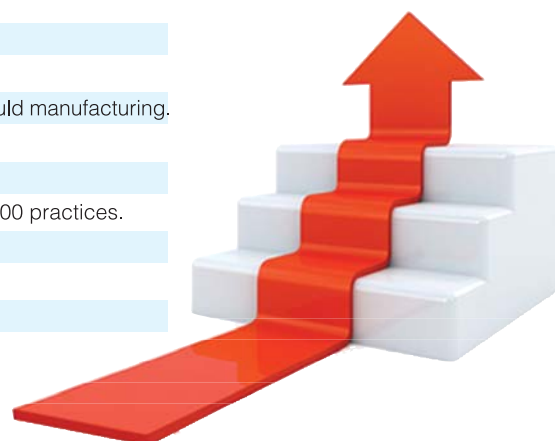
4000 kinds of products is being manufactured at the factory; within the frame of globally approved ISO 9001:2015 quality management system.

Quality of its products certified by number of world's most famous laboratories such as ASTA, IPH, KERI, IHP, BÜSTYAL, ANAB, NSF, INTERTEK, TSE, ROHS, CE certificates.



## HISTORY

- 2018 Government approved and supported R & D Centre established.
- 2017 Federal Academy established for entry-level youngsters.
- 2016 4,000 types of products have been reached in the Low Voltage range.
- 2015 Distribution network reached to 50 countries.
- 2014 İstanbul Foreign Trade Office was established.
- 2011 3,250 types of products have been reach in the Low Voltage range.
- 2010 Type Test Laboratory for Gas Meter established.
- 2008 Mass production of G4 type Natura Gas Meter have begun after being designed in the company.
- 2008 Accepted as a "Recognized Brand" world-wide.
- 2007 1100 people have been employed throughout the group.
- 2006 Low Voltage product line have been completed by the Federal R&D team.
- 2005 Federal Group have invested in sockets, electronic ballasts, automotive and ornamental plants.
- 2004 "Federal Electric Egypt" factory have started production in Egypt.
- 2002 İstanbul Sales Office for domestic market established.
- 1999 Federal Electric established a new 25,000sqm factory.
- 1999 International Low Voltage Type Test laboratory was established.
- 1998 Marble factory investment completed.
- 1996 Unigraphics 3D solid modeling have begun to be used in product design and mould manufacturing.
- 1996 FEDERAL ERP software launched.
- 1994 Distribution in the International Market launched.
- 1994 Federal Electric received the Quality Award in Belgium for having the best ISO9000 practices.
- 1992 Mass production have begun.
- 1990 The first domestic design compact type circuit breaker was produced.
- 1990 Federal Electric Investment & Trade Co. was established.



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# MOLDED CASE CIRCUIT BREAKERS



IEC / EN 60947-2  
CE

**Mounting Position** : Free  
**Altitude** : 2000 m (max)  
**Relative Humidity** : %90 (55°C)  
**Ambient Temperature** : between -25°C and +60°C<sup>①</sup>  
**Pollution Degree** : III  
**Protection Degree** : IP40 (at assembly lever area)

## Circuit Breakers (Thermal-Magnetic) MCCB



**F01 / F02** (16A ... 225A)



**F12** (16A ... 160A)  
**F12N** (16A ... 160A)



**F12R (ELCB)** (16A ... 160A)



**F31 / F32 / F33** (16A ... 250A)  
**F31N / F32N / F33N** (16A ... 250A)



**F31R** (80A ... 250A)



**F51 / F52 / F53** (125A ... 400A)  
**F51N / F52N / F53N** (125A ... 400A)



**F61 / F62** (300A ... 400A)



**F71 / F72** (300A ... 800A)



**F82 / F83** (300A ... 800A)  
**F82N / F83N** (300A ... 800A)

## Circuit Breakers (Electronic) MCCB



**F82E / F83E** (300A ... 800A)  
**F82EN / F83EN** (300A ... 800A)



**F91E / F92E** (800A ... 1250A)  
**F91EN / F92EN** (800A ... 1250A)



**F101E / F102E** (1000A ... 1600A)



**F111E / F112E** (1250A ... 2500A)












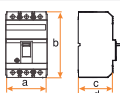
①: In given current load capacities for Circuit breakers on catalogue are valid for according to defined temperature conditions on norms. Current load capacities of products shall decrease in case of the Indoor conditions (non-ventilated)



**FEDERAL**












# MOLDED CASE CIRCUIT BREAKERS

## Thermal-Magnetic Circuit Breakers

															
Type			F01		F02		F12/N			F12R (ELCB)		F31/N	F32/N	F33/N	
Rated current - In			A		16 - 225		16 - 160			16 - 160		16 - 250			
Number of poles			1		3 / 4 ⑤		4⑤			3 / 4 ⑤		3 / 4 ⑤			
Rated insulation voltage - Ui 50-60 Hz			V		800		800			800		800			
Rated impulse withstand voltage - Uimp			kV		8		8			8		8			
Rated ultimate short - circuit breaking capacity - Icu ①															
(a.c.) 50-60 Hz 220/240 V (kA rms)			35	65	21	25	35	35		65	85	100			
(a.c.) 50-60 Hz 380/415 V (kA rms)			12	14	15	18	25	25		35	50	70			
(a.c.) 50-60 Hz 440 V (kA rms)			-	-	12	14	20	20		25	32	40			
(a.c.) 50-60 Hz 500 V (kA rms)			-	-	7	9	12	12		18	22	25			
(a.c.) 50-60 Hz 690 V (kA rms)			-	-	5	6	8	8		12	13	14			
DC (2p) 250 V② (kA rms)			10	10	8	10	15	15		22	22	22			
Rated short circuit breaking capacity - Ics 415V- (kA rms)			%100		%75	%75	%100	%75		%100					
Breaking duration (in short circuit)			ms		<7		<10			<10		<7			
Category (EN / IEC 60947-2)			A		A		A			A		A			
③ Trip Mechanism & Protection Characteristics	Thermal - Magnetic	Thermal Fixed	In		□			□		□		□			
		Thermal Adjusted	-		(0,8-1)In			(0,8-1)In		(0,7-1)In					
		Magnetic Fixed	≤63A:10In (min 300A) >63A: 8In (min 1000 A)		8In (min 600A) ⑦			8In (min 600A) ⑦		≤63A:10In (min 300A) >63A: 8In (min 1000A)					
		Magnetic Adjusted	-		-			-		□ ≥80A: (5-10) In ④					
	Electronic	Long time delay	-		-			-		-					
		Short time delay	-		-			-		-					
		Instantaneous	-		-			-		-					
Residual current threshold (only for F12R-F31R) mA			-		-			30 - 100 - 300		-		-			
Residual current time delay (only for F12R-F31R) ms			-		-			50 - 150 - 300		-		-			
Current limiting 															
Mechanical life Operation			15.000		15.000			15.000		15.000		15.000			
Electrical life Operation			3.000		5.000			3.000		5.000		5.000			
Weight kg			0,85		1 / 1,5			1,7		2,3 / 3,1					
Min - Max connection sections mm²			2,5 - 95		2,5 - 70			2,5 - 70		2,5 - 120					
Minimum - maximum tightening torque Nm			7 - 10		4 - 6			4 - 6		7 - 10					
Undervoltage release			-		-			□		□		□			
Shunt trip release			-		□			□		□		□			
Auxiliary contact block			-		□			□		□		□			
Motor control mechanism			-		-			-		□		□			
Extended rotary handle			-		-			-		□		□			
Lock Mechanism with key			-		□			-		□		□			
Extension bar			□		□			□		□		□			
Terminal cover			-		□			□		□		□			
Trip Contact			-		□			□		□		□			
Inverser (mechanical) lock			-		-			-		□		□			
Phase Barrier			-		□			□		□		□			
Extension handle			-		-			-		-		-			
			a (mm)		40			90 / 120		120		106 / 140			
			b (mm)		169			130 / 157			157		165 / 204		
			c (mm)		90			71			71		91		
			d (mm)		109			92			92		126		

-  standard,  upon request.
- ① Icu: O-t-CO test (O: Open maneuver, CO: Close - Open maneuver, t: Waiting duration)
- ② For serial connected two poles of the breaker.
- ③ See technical characteristic tables on our web site, for products with value.
- ④ Only for 3 pole (optional) circuit breakers.
- ⑤ Models with N refers to 4 pole.
- ⑥ For 300 and 400A: 121.5 for 3 poles; 156.5mm for 4 poles.
- ⑦ 10xIn can be made optional.
- ⑧ Manufactured up to 50kA for 400A.

# MOLDED CASE CIRCUIT BREAKERS

									
F31R (ELCB)	F51/N	F52/N	F53/N	F61	F62	F71	F72	F82/N	F83/N
80 - 250	125 - 400 ⑧			300 - 400		300 - 800		300 - 800	
4 ⑤	3 / 4 ⑤			3		3		3 / 4 ⑤	
800	800			800		800		800	
8	8			8		8		8	
65	65	85	100	50	65	52	70	75	100
35	35	50	70	25	35	35	50	50	70
25	25	35	50	20	25	30	40	40	50
18	20	25	40	12	18	25	35	30	42
12	14	16	18	8	12	20	25	20	25
22	22	22	22	15	22	20	20	20	20
%75	%100	%100	%100	%100	%75	%100	%75	%100	%75
<7	<10			<10		<20		<10	
A	A			A		A		A	
□	□			□		□		□	
(0,7-1)In	(0,7-1)In			(0,7-1) In		(0,7-1) In		300-630A: (0,7-1) In 800A: (0,6-1) In	
8In (min 1000A) ⑦	□			□		□		□	
-	≤320A: (5-10)In >320A: (4-8)In			(5-10)In		(5-10)In		(5-8)In	
-	-			-		-		-	
-	-			-		-		-	
-	-			-		-		-	
300-500-1000-1500	-			-		-		-	
50-150-300	-			-		-		-	
						-			
15.000	15.000			15.000		15.000		15.000	
3.000	3.000			3.000		3.000		3.000	
3,1	5 / 6,5			5,8		8		10 / 15	
16 - 120	35 - 240			120 - 240		120 - (2x240)		120 - (2x240)	
7 - 10	18 - 25			18 - 25		30 - 40		30 - 40	
-	□			□		□		□	
□	□			□		□		□	
-	□			□		□		□	
-	-			-		□		□	
-	□			-		□		□	
-	□			□		□		□	
□	□			□		□		□	
□	□			□		□		□	
□	□			□		□		□	
-	-			-		□		□	
□	□			□		□		□	
-	-			-		□		□	
140	105 / 140 ⑥			140		210		210 / 280	
204	255			257		270		280	
91	105,5			103		111		111	
126	145			156		159		159	

# MOLDED CASE CIRCUIT BREAKERS

## ELECTRONIC CIRCUIT BREAKERS

• As an additional protection against short circuit currents in Federal electronic circuit breakers, mechanical opening mechanism operating with magnetic field of the short circuit current has been placed on each phase. In this way, mechanical opening unit is tripping in over currents such as short circuit and risk of not tripping in case of electronic card failure has been eliminated. This is a great advantage of Federal circuit breakers.



Type	F82E/N	F83E/N	F91E/N	F92E/N	F101E	F102E	F111E	F112E
Rated current - In A	300 - 800		800 - 1250		800 - 1600		1250 - 2500	
Number of poles	3 / 4 ⑤		3 / 4 ⑤		3		3	
Rated insulation voltage - Ui 50-60 Hz V	800		800		800		800	
Rated impulse withstand voltage - Uimp kV	8		8		8		8	
Rated ultimate short - circuit breaking capacity - Icu ①								
(a.c.) 50-60 Hz 220/240 V (kA rms)	75	100	80	100	80	100	85	125
(a.c.) 50-60 Hz 380/415 V (kA rms)	50	70	50	65	50	70	50	70
(a.c.) 50-60 Hz 440 V (kA rms)	40	50	35	45	40	45	35	50
(a.c.) 50-60 Hz 500 V (kA rms)	30	42	25	35	25	35	30	42
(a.c.) 50-60 Hz 690 V (kA rms)	20	25	18	25	20	25	20	25

Rated short circuit breaking capacity - Ics 415V- (kA rms)			%100	%75	%50	%50	%100	%50	%100	%50	
Breaking duration (in short circuit) ms			<10		<20		<20		<20		
Category (EN / IEC 60947-2)			A-B		A-B		A-B		A-B		
③ Trip Mechanism & Protection Characteristics	Thermal - Magnetic	Thermal Fixed	-		-		-		-		
		Thermal Adjusted	-		-		-		-		
		Magnetic Fixed	-		-		-		-		
		Magnetic Adjusted	-		-		-		-		
	Electronic	Long time delay	I1=(0,4-1)In		I1=(0,4-1)In		I1=(0,4-1)In		I1=(0,4-1)In		
		Short time delay	□I2=(2-10)I1		□I2=(2-10)I1		□I2=(2-10)I1		□I2=(2-10)I1		
Instantaneous ④		I3=(2-10)I1		I3=(2-10)I1		I3=(2-10)I1		I3=(2-10)I1			
Residual current threshold (only for F12R-F31R) mA			-		-		-		-		
Residual current time delay (only for F12R-F31R) ms			-		-		-		-		
Current limiting					-						
Mechanical life Operation			15.000		10.000		10.000		10.000		
Electrical life Operation			3.000		3.000		3.000		3.000		
Weight kg			10 / 15		18 / 37		27		54		
Min - Max connection sections mm²			120 - (2x240)		(2x240)-2x(40x15)		2x(40x10)-2x(40x15)		(80x15)-2x(80x15)		
Minimum - maximum tightening torque Nm			30 - 40		35 - 50		35 - 50		35 - 50		
Undervoltage release			<input type="checkbox"/>		<input type="checkbox"/>		<input type="checkbox"/>		<input type="checkbox"/>		
Shunt trip release			<input type="checkbox"/>		<input type="checkbox"/>		<input type="checkbox"/>		<input type="checkbox"/>		
Auxiliary contact block			<input type="checkbox"/>		<input type="checkbox"/>		<input type="checkbox"/>		<input type="checkbox"/>		
Motor control mechanism			<input type="checkbox"/>		<input type="checkbox"/>		<input type="checkbox"/>		<input type="checkbox"/>		
Extended rotary handle			<input type="checkbox"/>		<input type="checkbox"/>		-		-		
Lock Mechanism with key			<input type="checkbox"/>		<input type="checkbox"/>		<input type="checkbox"/>		<input type="checkbox"/>		
Extension bar			<input type="checkbox"/>		<input type="checkbox"/>		<input type="checkbox"/>		<input type="checkbox"/>		
Terminal cover			<input type="checkbox"/>		<input type="checkbox"/>		<input type="checkbox"/>		<input type="checkbox"/>		
Trip Contact			<input type="checkbox"/>		<input type="checkbox"/>		<input type="checkbox"/>		<input type="checkbox"/>		
Inverser (mechanical) lock			<input type="checkbox"/>		<input type="checkbox"/>		<input type="checkbox"/>		<input type="checkbox"/>		
Phase Barrier			<input type="checkbox"/>		<input type="checkbox"/>		<input type="checkbox"/>		<input type="checkbox"/>		
Extension handle			<input type="checkbox"/>		<input type="checkbox"/>		<input type="checkbox"/>		<input type="checkbox"/>		
<div>Dimensions</div> <div></div>			a (mm)	210 / 280		210 / 280		210		392	
			b (mm)	280		370		370		412	
			c (mm)	111		124		155		250	
			d (mm)	162		180		203		320	

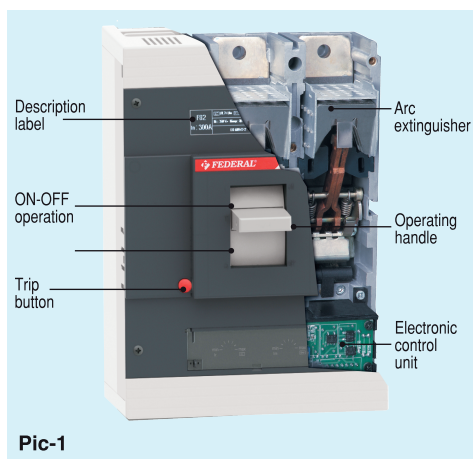
- ☒ standard, ☐ upon request.
- ① Icu: O-t-CO test (O: Open maneuver, CO : Close - Open maneuver, t : Waiting duration)
- ② For serial connected two poles of the breaker.
- ③ See technical characteristic tables on our web site, for products with value.

- ④ As an additional protection against short circuit currents in federal electronic circuit breakers, mechanical opening mechanism operating with magnetic field of the short circuit current has been placed on each phase. In this way, mechanical opening unit is open in over currents such as short circuit and risk of not opening in case of electronic card failure has been eliminated. This is a great advantage of Federal circuit breakers.
- ⑤ Models with N refers to 4 pole.

\*Electronic circuit breakers are manufactured as a Standard with adjustable overload and adjustable short circuit protection. Adjustable overload time delay, adjustable short-circuit protection and short-circuit time delay can be added according to the customer's request.



# MOLDED CASE CIRCUIT BREAKERS



Pic-1

The circuit breaker is a mechanical opening-closing device, which is used for closing, breaking, separating circuit and carrying current of that circuit under ordinary conditions and for automatically breaking the circuit under extraordinary conditions like short circuit and over current.

## Operating Principle of the Circuit Breaker:

The most important function of the circuit breaker, in addition to opening-closing the circuit, is to protect the circuit under extraordinary conditions.

There are some units inside the device to let the breaker fulfill its protection functions. Opening units of LV circuit breakers are described as release mechanism in TS EN 60947-2 standard.

## Releases :

- Over current releases (Over current opening unit)
- Under voltage releases (Low voltage opening unit)
- Shunt Trip releases (Remote release unit)

All the circuit breakers are equipped with over current releases. However, under voltage and shunt trip-release coil is not a standard accessory and added to the circuit breaker as per requirement.

## Over Current Option:

All the values exceeding rated current value are called over current.

## Formation of Over Current:

Over currents in electrical circuits result from increase of power expended or a short circuit. Both over currents are very dangerous for electrical devices. Over currents lead to thermal and dynamic forcing in electrical circuit.

- Although over currents, which are a result of increase in power expended, are not usually too high, they can go up to (2-3) time more than the rated current.

- Currents resulting from short circuit depend on characteristic of the electrical circuit. For example, they can go up to 3,2 kA in a transformer of 100 kVA; or 60kA in a transformer of 2500 kVA. Electrical devices such as transformer, generator, motor, cable etc. have a thermal forcing value  $I^2t$  to resist without damage due to the heat caused by over current. As it can be seen in the formula, both current value and current delay time is very important. In order to keep  $I^2t$  value under a particular value, flow duration of the current should decrease as the current increases. LV circuit breakers open the circuit below  $I^2t$  value of the protected device to provide safe protection (Figure-1).

## Over Current Release are divided into two:

1. Releases opened under over load conditions,
2. Releases opened under short circuit conditions.

## Releases opened under over load conditions:

These are the releases that operate when the current expended in the circuit exceeds the rated current value of the breaker. They operate on reverse time delay basis. As current value increases, opening duration decreases.

## Releases opened under short circuit conditions:

These are the releases that open the circuit in a very short time when the short circuit current exceeds the adjustment value of the release.

## Undervoltage Releases:

Voltage going below a particular value in electrical circuits or failure of any phase in tri-phase circuits may result in failure of devices. For example, failure of any phase in tri-phase motor shall overload other phases and result in failure of the motor. When required, low voltage coil can be assembled to the breaker to prevent occurrence of such failures. As under voltage coil is usually supplied by two phases, control of other phase is performed by a contactor (Figure-2).

## Shunt Trip Releases

They are used for remote-release of the circuit breaker. When a voltage is applied to a shunt trip release, opening should be made up to 70% and %110 of the supply voltage.

## TYPES OF CIRCUIT BREAKERS:

LV circuit breakers are manufactured in two different types depending on the release type. These are thermal-magnetic and electronic circuit breakers.

## Thermal - Magnetic Circuit Breakers:

Thermal protection function,  $(1,1-3) \times I_n$ : (For protection under over load conditions)

Bimetal, which provides thermal protection, consists of combination of two metals with different extension coefficients under heat. When bimetal is heated, it bends towards the metal with less extension. In this way, a notch that assists opening of the breaker mechanism is released to disable the breaker. Bending speed of bimetal is in direct proportion with size of the current passing through the breaker. Because, increase of current means increase of heat. In this way, over current protection function of the breaker is fulfilled by bimetal at load currents higher than the rated current.

Magnetic protection function,  $>3 \times I_n$ : (For protection under short circuit conditions)

Another function of the breaker is to protect the connected circuit against short circuits. Short circuit may occur as a result of contact of phases with each other or contact of phase-ground. Since a very high current shall pass through the cables in case of short circuit, system energy should be broken in a shorter

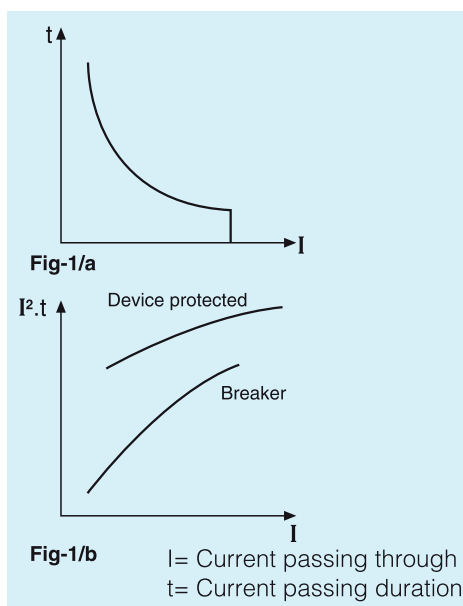


Fig-1/a

Fig-1/b

$I$  = Current passing through  
 $t$  = Current passing duration

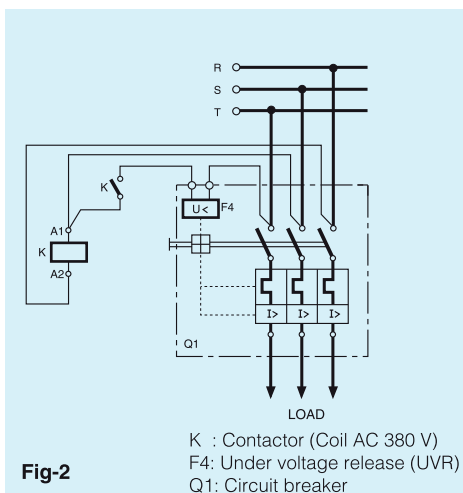


Fig-2

K : Contactor (Coil AC 380 V)  
F4: Under voltage release (UVR)  
Q1: Circuit breaker

# MOLDED CASE CIRCUIT BREAKERS

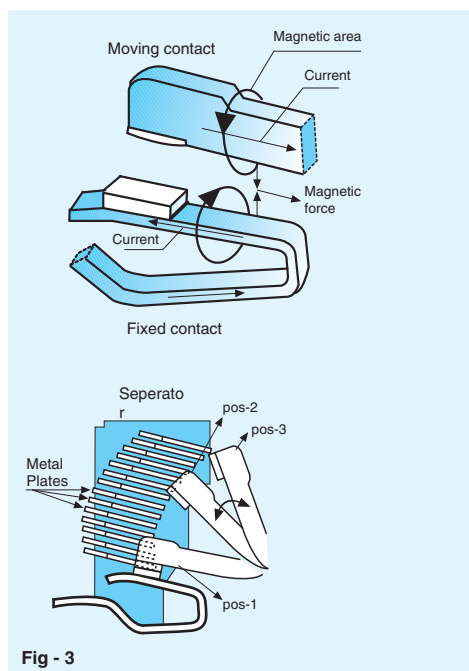


Fig - 3

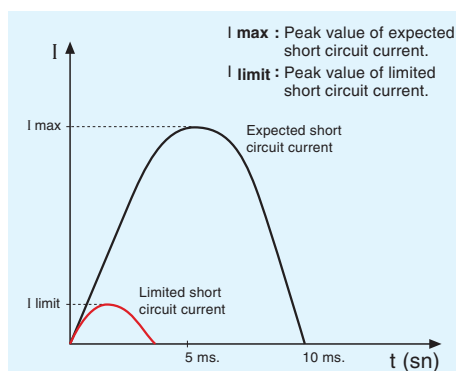
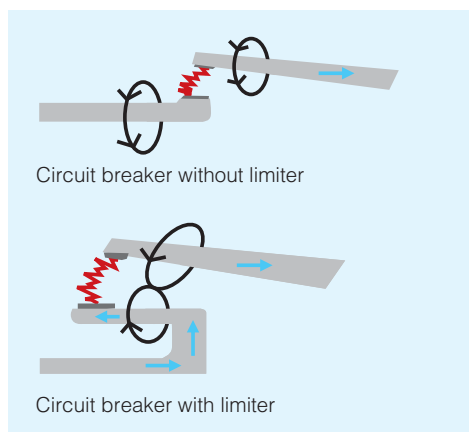


Fig - 4



The difference between circuit breakers with and without limiters is in the construction of fixed contacts. Fixed contacts of circuit breakers with limiters are in the structure to reverse the direction of current and form reverse magnetic force to push the moving contact.

time due to thermal protection. Breaker should perform instant opening to protect load it is connected to. The part fulfilling this function is a mechanical opening mechanism that operates with magnetization caused by the magnetic area formed by the short circuit current.

## Circuit Breakers with Electronic Over Current Release:

The feature discriminating electronic circuit breakers from thermal-magnetic breakers is to control the over current releases with electronic circuit. Electronic control is performed via microprocessor. During design of the electronic circuit, worst possibilities to encounter in operation have been taken into consideration. In high circuit currents, direct opening has been ensured without operating electronic circuit. In this way, possibility of failure in the electronic circuit has been eliminated.

- Computer memory can be used instead of current recording devices.
- Maximum, minimum, average etc. values of the drawn current at various time intervals (day-night) can be taken.
- Statistical information can be accessed any time.
- Opening period of the breaker can be adjusted in case of over current formation.
- Rated current and instant opening current of the breaker can be changed on computer.
- External opening control can be provided.

Rated and instant opening current adjustment areas of electronic circuit breakers are quite wide. This feature allows wide use opportunity to the breaker. Furthermore, electronic circuit breakers are not affected from ambient temperatures.

## Operating principle of limiter circuit breaker:

While breaker is opened and closed with lever, moving contact should be in ON position in pos-1, in OFF position in pos-3 (Figure - 3). The short circuit current that comes into existence when there is a short circuit in a breaking current without limiter opens the breaker by enabling the breaking mechanism via releases and takes breaking lever to trip position. Opening duration varies between 10-20 ms. In Federal limiter breakers, reverse magnetic area where short circuit occurs takes moving contact from pos-1 to pos-2 and contact remains in this position. That is, contact does not come to ON position again. Opening of the moving contact starts with the first millisecond of the short circuit. The contact arrives pos-2 in the first two milliseconds and complete cut-off of the arc lasts in 3-5 milliseconds maximum. Magnetic releases, which get into operation with start of the short circuit, take the breaking mechanism to OFF position; the mechanism takes the moving contact in pos-2 to pos-3 and the breaking lever remains in trip position. The current, which takes the

moving contact from pos-1 to pos-2, is a lower current than the expected short circuit current. Limited current is at one-eighth and even one-tenth of the expected current (Figure- 4). The expected short circuit current would flow in a shorter time than the current if there was no limiter circuit breaker.

## Advantages of Federal limiter circuit breaker:

- They protect transformers, cables and other devices in circuit by limiting the current up to 90% depending on the breaker type.
- As explosions and arcs remain at a very low level, critical safety is guaranteed in order not to give damage to other devices in the panel.

## PARTS OF CIRCUIT BREAKERS

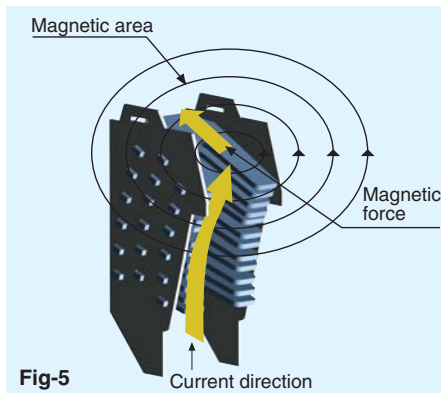
**Body and Cover:** Fiber-glass polyester resin has been used as the body and cover material in accordance with EN 60512-20-2 standard. This material, which is called BMC (Bulk Molding Compound) in the literature, is preferred due to high electrical and mechanical values and can resist to a temperature of 160°C continuously. BMC material does not burn when in contact with wire at a temperature of 960°C in accordance with IEC 695-2-1.

**Bimetal:** Bimetal is a material consisting of combination of two plate metals with different extension coefficients against heat. The current passing through the breaker heats up bimetal. Due to effect of this heat, bimetal bends towards the less-extending plate. Since heat increases as the current passing through the breaker increases, bimetal is heated more and bends more. In this way, it controls the opening mechanism to open the breaker.

**Contacts:** Contact alloy is determined for breakers by considering broken and carried current values and construction. Usually silver, graphite, nickel, wolfram alloy contacts are used in breakers. Contacts, which are made of silver-graphite alloys with a smoothers structure, are used in fixed (bottom) contacts, silver - wolfram contacts, which are harder, are used in moving (top) contacts. A swaged structure has been ensured in moving contacts. In this way, swaged and hard alloy contacts have a place on soft fixed contacts in each opening-closing. In this way, the lowest resistance is ensured. Moving contact should touch the fixed contact very well in order to have low contact resistance. However, excessive contact pressure force results in damage of contacts in a shorter period than normal. Contact alloys are very important for a healthy opening-closing.

**Arc Extinguisher Cell (Separator):** Separators are used to extinct the arc which is formed during operation of the breaker operating under energy. While moving

# MOLDED CASE CIRCUIT BREAKERS



contact is separated from fixed contact, current continues to flow between contacts for a while and this is called arc. This arc should be extinct in a very short time.

## Extinction of Arc:

Arc is pushed towards separators due to magnetic field formed around the arc. In this way, arc is extended and becomes slim and broken off between separator plates (Figure-5). Due to characteristic of the material used on side walls of the separators, a gas comes out due to high temperature caused by the arc. This gas has an important effect on extinction of the arc.

## Utilization Type of the Circuit Breaker:

There are 3 positions indicating position of the breaker. These positions are shown in Figure-6.

**ON/I Position:** It indicates that contacts of the breaker are closed. In this position, the breaker lever is in the top position.

**TRIP Position:** It indicates that the breaker is opened due to any failure (over load or short circuit). In this case, breaker lever is in the middle position between ON and OFF positions. In order to take the breaker, which is in trip position, to ON position; push the breaker lever downwards as shown by the OFF sign. Breaker shall be set with "click" sound. After that, pull the lever as shown by ON sign to close the breaker.

**OFF/O Position:** It indicates that contacts of the breaker are open. In this way, the breaker lever is in the bottom position.

**Assembly:** Important considerations during assembly are listed below.

- The place to assemble the breaker should be free of dust and moisture.
- Breaker should be assembled in a way not to be subject to gas and vapor.
- If the environment is dusty and moist, the breaker must be assembled in a housing with appropriate protection degree.
- While the breaker is in operation, it should not be exposed to vibration and sudden impacts.

- Minimum distances between two breakers assembled one on another should be as shown in Figure-7.

- Minimum distances between grounded or insulated wall and the breaker should be as shown in Figure-8.

- Assembly method of the connectors (for F31 and F51 type switches) vary according to connection at the front or at the back. Connector may be demounted, reversed

and mounted again if required.

- Cable connections of measurement devices should be made through busbars, no connection should be made through terminals of the breaker (Please request extension busbars from factory for connections to be made with cable shoes.)
- End insert should be used in connections of multi-wire cables to breaker connector and no brazing should be made at cable ends.

- In connection is made to the breaker via copper busbars, busbars should be painted and feather edges should be rounded to minimize the risk of jumping.

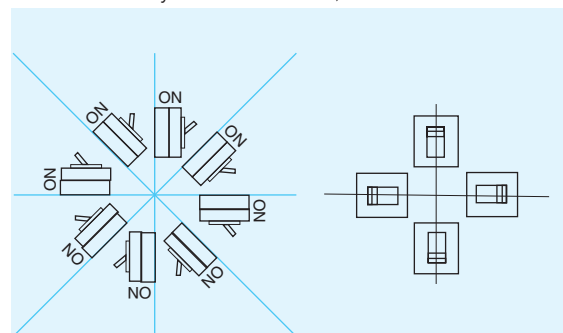
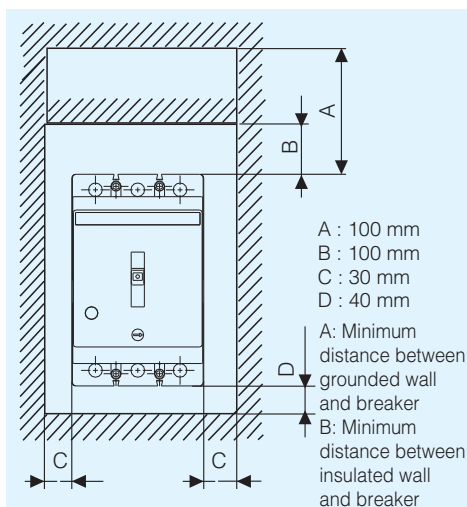
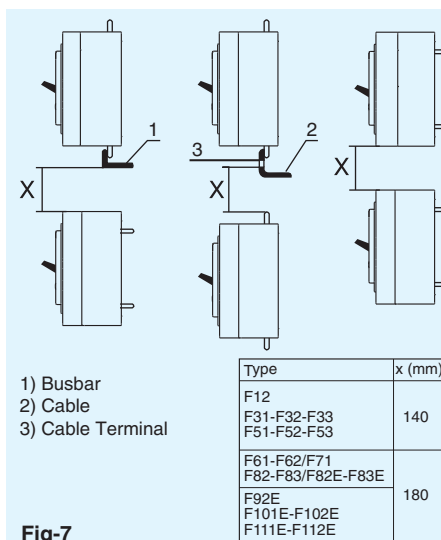
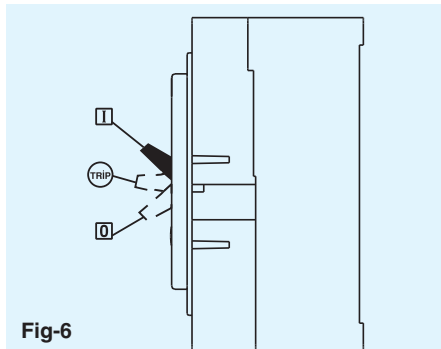
- Phase curtains must be placed in the conduit between two busbars in the breaker body.

- Grounding should be made in accordance with the regulations.

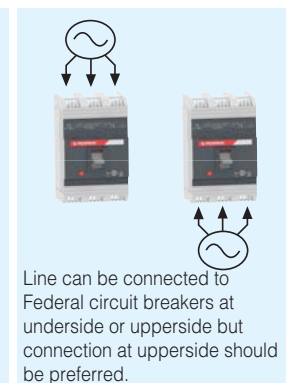
Against earth leakage currents resulting from the low voltage circuits, with combination of fault current sensor relay and toroidal transformer are detected and the protection can be achieved by controlling of shunt trip coil or under voltage release coil on the mounted circuit breakers, such as protection can be achieved by residual current protected type circuit breakers.

Toroidal transformer, sensors relay and shunt trip are placed into circuit breakers. Without the need any external accessory connector can be installed only by connecting the input and output terminals. For leakage current protection selectivity, the leakage current threshold and leakage current time delay can be set by user. There is test button for leakage current protection function as separately from trip test button. In this way, the earth leakage protection function can also be tested. Earth - leakage circuit breakers have also high thermal-magnetic protection like as our other compact type circuit breakers.

- Led indicating neutral is connected.
- Thermal and magnetic protection on 4th pole(neutral). (optional)
- Available for auxiliary contact connection



Assembly can be made in any angle.





# MOLDED CASE CIRCUIT BREAKERS

## EARTH - LEAKAGE CIRCUIT BREAKER (ELCB)



Against earth leakage currents resulting from the low voltage circuits, with combination of fault current sensor relay and toroidal transformer are detected and the protection can be achieved by controlling of shunt trip coil or under voltage release coil on the mounted circuit breakers, such as protection can be achieved by residual current protected type circuit breakers.

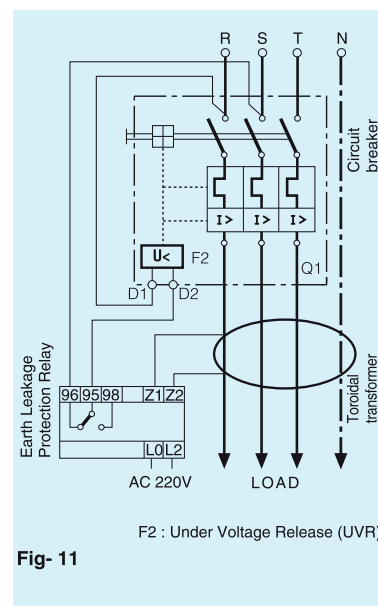
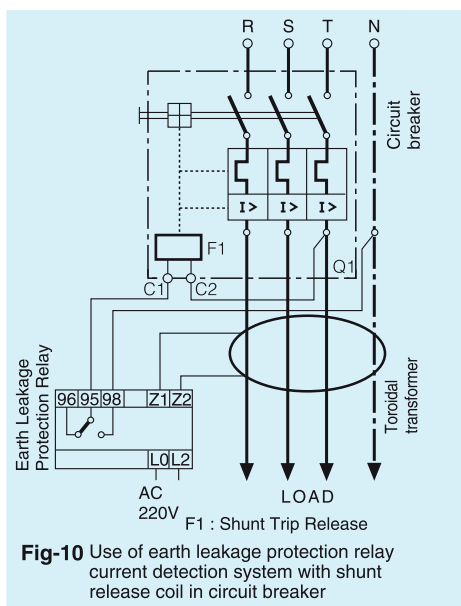
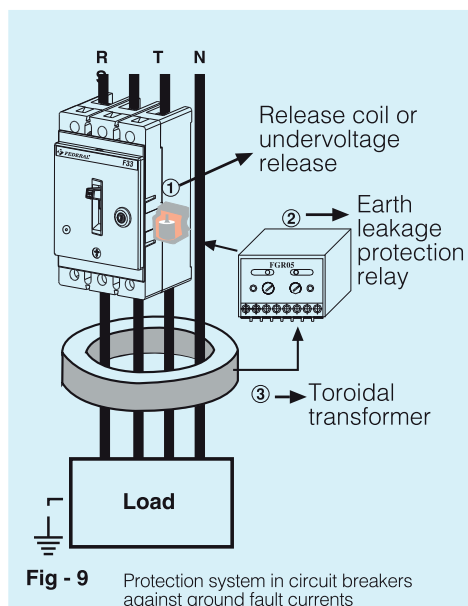
Federal leakage current protected switches are produced up to 40A - 250A. Toroidal transformer, sensors relay and shunt trip are placed into circuit breakers. Without the need any external accessory connector can be installed only by connecting the input and output terminals. For leakage current protection selectivity, the leakage current threshold and leakage current time delay can be set by user. There is test button for leakage current protection function as separately from trip test button. In this way, the earth leakage protection function can also be tested. Earth - leakage circuit breakers have also high thermal-magnetic protection like as our other compact type circuit breakers.

Type	In (A)	Residual Current Threshold (mA)	Thermal Setting Range (A) (40°C)	E x B x D (mm)	Nominal Operating Short Circuit Breaking Capacity (kA) (at 380V)		Magnetic Tripping Current (A)
					Icu	Ics	
F12R Series	40	30-100-300	(0.8-1)xIn	120x155x76	25	20	600
	50	30-100-300	(0.8-1)xIn	120x155x76	25	20	600
	63	30-100-300	(0.8-1)xIn	120x155x76	25	20	600
	80	30-100-300	(0.8-1)xIn	120x155x76	25	20	640
	100	30-100-300	(0.8-1)xIn	120x155x76	25	20	800
	125	30-100-300	(0.8-1)xIn	120x155x76	25	20	1000
	160	30-100-300	(0.8-1)xIn	120x155x76	25	20	1280
F31R Series	80	300-500-1000-1500	(0.8-1)xIn	140x210x112	35	35	800
	100	300-500-1000-1500	(0.8-1)xIn	140x210x112	35	35	800
	125	300-500-1000-1500	(0.8-1)xIn	140x210x112	35	35	1000
	160	300-500-1000-1500	(0.8-1)xIn	140x210x112	35	35	1280
	200	300-500-1000-1500	(0.8-1)xIn	140x210x112	35	35	1600
	225	300-500-1000-1500	(0.8-1)xIn	140x210x112	35	35	1800
	250	300-500-1000-1500	(0.8-1)xIn	140x210x112	35	35	2000

\* Different values can be made for the residual current threshold when desired. Please contact with our company.

### Protection System Against Earth Leakage Currents With Circuit Breakers:

Even small values (>30mA) of ground fault currents to occur in electrical circuits are quite dangerous in terms of safety of life and fire. As normal breakers cannot detect such small earth leakage protection relay, no additional protection is provided against ground leakages. Earth leakage protection relay can be added to electronic breakers without an additional mechanism. With this system, protection at (0,1-1)xIn sensitivity can be provided. Protection against earth leakage in non-electronic breakers and electronic breakers needing protection against leakage currents lower than the value mentioned above is provided with combination of toroidal transformer and leakage current detection relays.



# MOLDED CASE CIRCUIT BREAKERS

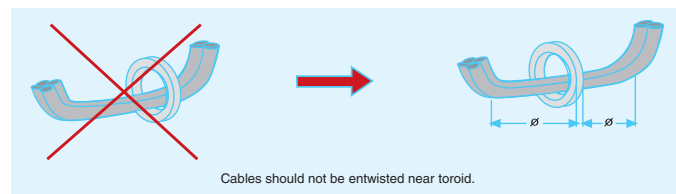
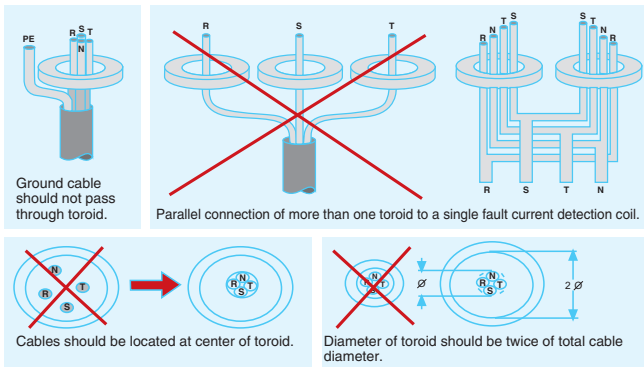
However, in this system, in order to let the circuit breaker open in ground leakage currents, remote-release coil or low voltage coil should have already been mounted to the breaker (Figure-9). Fault current of the fault current detection relay should be adjusted according to protection type and appropriate values to ensure selectivity among other detection relays. According to the standards, this values has been determined as 30mA for life protection and (300-500)mA for fire protection.

## Assembly:

All the phases and neutral cable, if any, shall pass through the toroidal transformer. Ground cable should not pass through the toroidal. Secondary cables of toroidal shall be connected to ground leakage detection relay (Z1-Z2) terminals and appropriate voltage written on the relay is supplied to energy input terminals of the relay. Remote-release coil or low voltage coil must have been connected to the breaker in order to open the circuit breaker due to ground fault. If remote-release coil has been connected to the circuit breaker, energy supplied to opening coil should be supplied through open contact of the ground leakage detection coil normally (Figure-10). If low voltage coil has been connected to the circuit breaker, energy supplied to the low voltage coil should be supplied through upper part of the energy breaker and normally closed contact of the ground leakage detection relay (Figure-11).

## Important considerations in assembly:

- Cables should pass through center of the toroidal transformer to the extent possible.
- Toroids with appropriate diameters should be utilized. Utilization of toroids with higher diameters shall reduce sensitivity.



- If cables cannot pass through a toroid with high diameter, several toroids can be connected parallel to the same ground detection relay. However, this transaction reduces sensitivity of the device and increases opening threshold.
- If it is not possible to place the toroid around primary busbars, it can be placed on neutral-ground connection of the transformer for balanced loads.

## Earth Leakage Protection Relays



When a fault current is detected in the system according to the sign coming from toroidal transformer, the circuit breaker controls the shunt trip or the undervoltage release to open the circuit breaker. Fault current value and time to operate the relay can be adjusted on the relay.

Type	FGR05
Fault current adjustment	0,03-30A
Order code	8AT-N0000-0500
Opening time adjustment	0,05-3sn
Supply	110V / 220-240V AC (50/60 Hz)
Output relay	3A, 250 V AC
Reset	Manuel / Electrical (Remote)
Current tolerance	(0,5-1)-I <sub>Δn</sub>
Time Tolerance	± %15
Time characteristic	Fixed
Temperature	Storage -30 / 70°C
	Working -20 / 60°C
Humidity	%40-85 RH without liquefaction
Installation	Pano / 35 mm DIN - RAY

## Toroidal Transformer



Ground fault relay and toroidal transformer are used with circuit breakers to detect even small ground leakages and open the circuit breaker.

Toroidal Transformer Diameter (mm) Ø	If the switch output is cable	If the switch output is a bara	Order Code
60 mm	F12-F31-F32-F33	F12	8AT-R0000-0060
110 mm	F51-F52-F53	F31-F32-F33-F51-F52-F53	8AT-R0000-0110
160 mm	F71-F82-F83-F82E-F83E	F61-F62	8AT-R0000-0160
210 mm		F71-F82-F83-F82E-F83E-F91E-F92E-F101E-F102E	8AT-R0000-0220

The cables for F111E-F112E-F121E-F123E-F131E-F133E-F141E-F143E-F151E-F152E-F153E can be used by connecting multiple tides parallel to the same ground detection relay if the diameter can not be crossed by a large trouser. However, this reduces the sensitivity of the device and thus raises the opening threshold.

# MOLDED CASE CIRCUIT BREAKERS

**Network Protection Breakers:** Big powerful motor, load with starting resistance don't exist in main networks and lines are quite long. LV circuit breaker should open in short circuit currents to occur by the end of these lines. Therefore, magnetic adjustments of the circuit breakers utilized in main lines should be between  $(4 - 8) \times I_n$ .

**Three-phase thermal-magnetic circuit breakers** / For protection of main networks:

Nominal current $I_n$ (A)	Rated current adjustment area $I_1$ (A)	Short circuit opening current $I_2$ (A)	Type	Order Code	Type	Order Code	Type	Order Code
16 - 75 80 - 160	$(0,8-1)I_n$ $(0,8-1)I_n$	600A 8 $I_n$	F12 25kA	9AR-TSS43-0□□□	F12R 25kA	9AR-TSS43-0□□□		
160	Sabit	8 $I_n$	F12S 25kA	9AR-TDS43-0160				
16 - 25 32-100 125 - 250 160 - 250	$(0,7-1)I_n$ $(0,7-1)I_n$ $(0,7-1)I_n$ $(0,7-1)I_n$	200A 10 $I_n$ 8 $I_n$ (5-10) $I_n$	F31 35kA F31R 35kA	9AB-TSS43-0□□□ 9AB-TSS#3-D	F32 50kA	9AB-TMS43-0□□□	F33 70kA	9AB-THS43-0□□□
100 - 250	Sabit	8 $I_n$	F31S 35kA	9AB-TSS43-0□□□				
125 - 175 200 - 320 400	$(0,7-1)I_n$ $(0,7-1)I_n$ $(0,7-1)I_n$	(5-10) $I_n$ (4-10) $I_n$ (3-8) $I_n$	F51 35kA	9AD-TSS43-0□□□	F52 50kA	9AD-TMS43-0□□□	F53 70kA	9AD-THS43-0□□□
300 - 400	$(0,7-1)I_n$ $(0,7-1)I_n$	(5-10) $I_n$	F61 25kA	9AP-TSS43-0□□□	F62 35kA	9AP-TMS43-0□□□		
300 - 800	$(0,7-1)I_n$	(5-10) $I_n$	F71 35kA	9AF-TSS43-0□□□	F72 50kA	9AF-TSH43-0□□□		
300 - 630 800	$(0,7-1)I_n$ $(0,6-1)I_n$	(5-8) $I_n$ (5-8) $I_n$	F82 50kA	9AG-TMS43-0□□□	F83 70kA	9AG-THS43-0□□□		

□□□: Enter amper value

**Generator Circuit Protection Breakers:** As the short circuit current to occur in the generators is at very low values, magnetic adjustments of the circuit breaker to be used for protection of generators should be  $(3 - 5) \times I_n$

**Three-phase thermal-magnetic circuit breakers** / For protection of generator circuits :

Nominal current $I_n$ (A)	Rated current adjustment area $I_1$ (A)	Short circuit opening current $I_2$ (A)	Type	Order Code	Type	Order Code	Type	Order Code
200 - 250	$(0,7-1)I_n$	1000 A	F31 35kA	9AB-TSJ43-0□□□	F32 50kA	9AB-TMJ43-0□□□	F33 70kA	9AB-THJ43-0□□□

□□□: Enter amper value D: Enter 0 for domestic market, D for foreign market #: Enter 4 for ambient operational temperature 40°C, 5 for 50°C

## Short circuit current of a generator

$S_{rg}$  : Rated power (kVA)

$U_r$  : Rated voltage (V)

$I_{kg}$  : Short circuit current (A)

$I_{rg}$  : Rated current (A)

$X''_d$  : Temporary reactance (%)

(Reactance observed around 5-20% of the impedance value for 5-30 ms)

$I_{sc}$  is calculated with the following formula.

$$I_{kg} = \frac{I_{rg} \cdot 100}{X''_d \%} \quad I_{rg} = \frac{S_{rg}}{\sqrt{3} \cdot U_r}$$

Circuit breakers should be selected according to the following formula in order to protect the generator circuits.

For single generator  $I_{cu} \geq I_{kg}$

For n pieces of identical generator connected parallel,  $I_{cu} \geq I_{kg} \times (n-1)$

For generator connected to network parallel,  $I_{cu} \geq I_{knet}$ .

Generator			Breaker
kVA	kW	A	A
9.4	7.5	13.6	16
12.5	10	18.2	20
18.7	15	27.3	32
25	20	36.4	40
31.3	25	45.5	50
37.5	30	54.6	63
50	40	73	80
62.5	50	91	100
75	60	109	125
100	80	146	160
125	100	182	200
156	125	228	250
187	150	273	300
250	200	364	400
312	250	455	500
375	300	546	630
500	400	730	800
625	500	910	1000
750	600	1090	1250
1000	800	1460	1600
1250	1000	1820	2000
1563	1250	2280	2500



# MOLDED CASE CIRCUIT BREAKERS

**Motor Circuit Protection Breakers:** Motors draw very high current for a short time during first start-up. In order to ensure operating continuity and to protect the system, magnetic adjustment area of the breaker to be selected should be  $(8 - 12) \times I_n$ .

**Three-phase thermal-magnetic circuit breakers** / For protection of motor circuits:

Nominal current $I_n$ (A)	Rated current adjustment area $I_1$ (A)	Short circuit opening current $I_2$ (A)	Type	Order code	Type	Order code	Type	Order code
125 - 250	$(0,7-1)I_n$	10 $I_n$	F31 35kA	9AA-TSM43-0□□□	F32 50kA	9AB-TMM43-0□□□	F33 70kA	9AB-THM43-0□□□

□□□: Enter amper value D: Enter 0 for domestic market, D for foreign market #: Enter 4 for ambient operational temperature 40°C, 5 for 50°C

Motor Power		Motor Rated Current	Breaker Rated Current	Motor Power		Motor Rated Current	Breaker Rated Current
(kW)	(Hp)	(A)	(A)	(kW)	(Hp)	(A)	(A)
5,5	7,5	11,5	16	59	80	112	125
9	12	18,5	20	80	110	147	160
11	15	22,5	25	100	136	188	200
15	20	30	32	132	175	243	250
18,5	25	36	40	140	190	260	300
22	30	43	50	160	220	292	300
30	40	58	63	200	270	368	400
37	50	72	80	250	340	465	500
40	54	79	100	315	430	580	630
51	70	98	100				

**Note:** These circuit breakers provide short circuit protection. Overload protection should be provided via thermal relays connected to the contactors.

## Three-phase electronic circuit breakers :

Nominal current $I_n$ (A)	Rated current adjustment area $I_1$ (A)	Short circuit opening current $I_2$ (A)	Type	Order code	Type	Order code
300 - 800	$(0,4-1)I_n$	$(2-10) \times I_1$	F82E 50kA	9AG-EMS43-0□□□	F83E 70kA	9AG-EHS43-0□□□
1000 - 1250			F91E 50kA	9AG-EMS43-0□□□	F92E 65kA	9AG-EHS43-0□□□
1000 - 1600			F101E 50kA	9AI-EMS43-0□□□	F102E 70kA	9AI-EHS43-0□□□
1600 - 2500			F111E 50kA	9AG-EMS43-0□□□	F112E 70kA	9AG-EHS43-0□□□

Delay time of the short circuit opening current (when required) can be adjusted as  $t_2$  : 50-100-200-300 ms..

□□□: Enter amper value D: Enter 0 for domestic market, D for foreign market #: Enter 4 for ambient operational temperature 40°C, 5 for 50°C

## Mono-phase thermal-magnetic circuit breakers:

Nominal current $I_n$ (A)	Rated current adjustment area $I_1$ (A)	Short circuit opening current $I_2$ (A)	Type	Order code	Type	Order Code
16 20 - 63 80 100 - 225	$I_n$	10 $I_n$ 8 $I_n$ 10 $I_n$ 8 $I_n$	F01 35kA	9AB-TSS41-0□□□	F02 65kA	9AB-THS43-0□□□

## Reasons For Over Voltages Occurring at L.V. Facilities And The Measures That Must Be Taken:

As known, over voltages may develop at power plants from time to time. These over voltages develop as a sudden impact for a very short time during the engagement and disengagement of equipment such as transformers, condensers, coils, etc., and this is also called lightning stroke or switching. During these temporary incidents that occur from time to time, by a jump between phases or phase-earth, they may turn into short circuits. Dirt, dust and moisture on the insulating material increase the probability of occurrence.

During the closing of the circuit when L.V. transformers are taken into operation, very short-period high magnetization currents occur. The initial peak value of these currents may go up to 16-35- fold of the nominal current in transformers between 50kVA and 1500 kVA, and 10-16-fold in power transformers over 1500kVA. Temporary magnetization currents fade away within a very short period of time (several milliseconds). When selecting switching devices for transformers, these magnetization currents have to be taken into

consideration. Additionally, some electronic devices, at starting (engines running in idle, transformers running in idler, industrial welding devices, fluorescent lights with electronic ballasts and electronic equipment) from harmonic currents and voltages in multiples of the basic mains frequency. For the protection of facilities from such harmonic currents and voltages, Harmonic Filter Reactors must be installed at the input of the low voltage panels and thus measures should be taken against damages on equipment

# MOLDED CASE CIRCUIT BREAKERS

by harmonic currents and voltages. In order to prevent the high voltage, described in the adjacent text and may occur due to many other reasons in addition to these, reaching dangerous levels, primarily suitable (approved quality) surge arrests must be installed at the M.V. and L.V. side of the transformer and the system earthing has to be made very well.

As an example, let us assume that the total resistance of the earthing network surrounding transformer center for protective earthing is represented by RE

and the earthing resistance is  $RE=5$ . When a phase-earth short circuit occurs on the medium voltage side of the transformer center, the short circuit current that will be developed will run into the ground and form a potential in the ground.

If the short circuit current is 6,000 amperes, a voltage of  $5 \times 6000 = 30,000$  volts will be distributed within the transformer center earthing networks. If the L.V. facility earthing has been connected to the M.V. protective earthing by mistake, the low voltage equipment

connected to the facility earthing will be affected by the developed 30,000 volt potential and this will cause serious damages in the low voltage equipment. The value of the over voltage developed by the phase-earth short circuit current on the medium voltage side diminishes considerably at 20m distance from the transformer center and becomes affectless. Therefore, the operating earthing at the transformer center must be installed at least 20m way from the protective earthing.

## Temperature effect on circuit breakers:

Thermal overload protection characteristics change due to the effect of temperature in thermo-magnetic circuit breakers. Circuit breaker trips earlier than its nominal value if it operates in a warmer environment than the calibrated temperature, and if it works in a cooler environment it trip later than it norm.

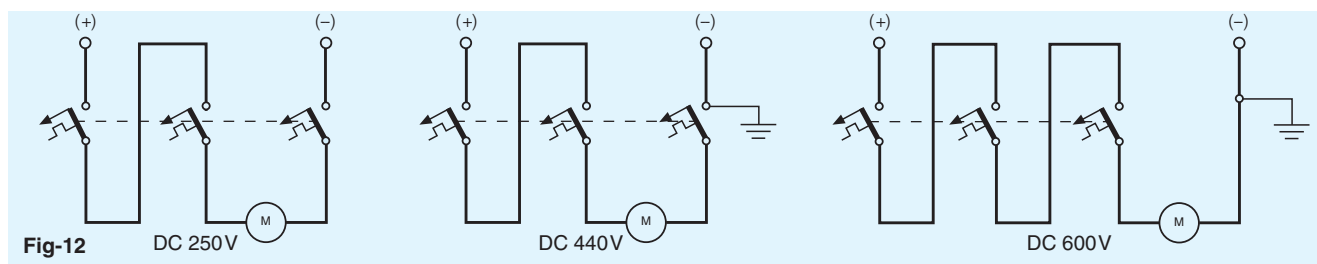
Federal thermo-magnetic circuit breakers are calibrated at 40°C as it's Standard. When requested, according to other different ambient temperature can be calibrated. The table below clarifies the operating currents for different ambient temperatures calibrated to 55°C. The working current at 40°C of the 100A circuit breaker calibrated to ambient temperature of 55°C can be found in the table as 106.8A.

In (A)	Operating Currents According to Ambient Temperature (Calibration Temperature 55°C)						
	10°C	20°C	30°C	40°C	50°C	55°C	60°C
16	19,2	18,5	17,8	17,1	16,4	16,0	15,6
20	24,1	23,2	22,3	21,4	20,5	20,2	19,6
25	30,1	28,9	27,8	26,7	25,6	25,0	24,4
30	36,1	34,7	33,4	32,0	30,7	30,0	29,3
32	38,5	37,0	35,6	34,2	32,7	32,0	31,3
40	48,1	46,3	44,5	42,7	40,9	40,0	39,1
50	60,1	57,9	55,6	53,4	51,1	50,0	48,9
60	72,2	69,5	66,8	64,1	61,4	60,0	58,7
63	75,8	72,9	70,1	67,3	64,4	63,0	61,6
80	96,2	92,6	89,0	85,4	81,8	80,0	78,2
100	120,3	115,8	111,3	106,8	102,3	100,0	97,8
125	150,3	144,7	139,1	133,4	127,8	125,0	122,2
150	180,4	173,6	166,9	160,1	153,4	150,0	146,6
160	192,4	185,2	178,0	170,8	163,6	160,0	156,4
200	240,5	231,5	222,5	213,5	204,5	200,0	195,5
225	270,6	260,4	250,3	240,2	230,1	225,0	219,9
250	300,6	289,4	278,1	266,9	255,6	250,0	244,4
300	360,8	347,3	333,8	320,3	306,8	300,0	293,3
400	481,0	463,0	445,0	427,0	409,0	400,0	391,0
500	601,3	578,8	556,3	533,8	511,3	500,0	488,8
630	757,6	729,2	700,9	672,5	644,2	630,0	615,8
800	962,0	926,0	890,0	854,0	818,0	800,0	782,0

## Utilization of Circuit Breakers in Direct Current Circuits:

Non-electronic thermal-magnetic circuit breakers can be safely used in switching of DC currents.

As it is seen in Figure-12, 2 or 3 poles are connected serially for voltages higher than 250V and voltage per pole is reduced.



# MOLDED CASE CIRCUIT BREAKERS

**Breaker Selection Table Used for Protection of 3-Phase Capacitor Circuits:**  
(400 V, for Ambient Temperature 40°C)

Capacitor		Breaker
Power (kVAr)	Rated Current (A)	Rated Current In (A)
5	7.6	16
10	15.2	25
15	22	40
20	29	63
25	36	80
30	43	100
40	58	100
50	72	125
60	87	125
80	115	160
100	144	200
150	216	300
200	288	400
250	361	500
300	433	630
350	505	800
400	577	800
500	722	1000
550	793	1250
600	866	1250

## Circuit breakers protecting capacitor circuits :

They should resist temporary currents during enablement and disablement of the capacitors.

They should resist currents at 15% more than capacity value and periodical and permanent over currents arising due to voltage harmonics.

They should have high mechanical and electrical life.

They should be selected to protect contactors after them.

They should break short circuit currents to occur in capacitor connectors.

According to IEC 60831-1 standard

Capacitors can operate continuously at currents 1.3 times more than rated currents and capacity value can be 15% more.

Accordingly, the highest current to pass through the circuit can reach  $1,5 \times I_{rc}$ .

$$I_{cmax} = 1.3 \times 1.15 \times I_{rc}$$

$I_{cmax}$  : Maximum current to pass through the capacitor

$I_{rc}$  : Capacitor rated current

Therefore

Rated current of the circuit breaker to be selected should be higher than  $1.5 \times I_{rc}$ .

Thermal adjustment should be at  $1.5 \times I_{rc}$  value.

Magnetic adjustment should not be lower than  $15 \times I_{rc}$ .

**Breakers Used in LV Main Distribution Panels of Distribution Transformers:**  
(up to 36kV voltage)

Transformer power Sn (kVA)	Nominal current In (A)	Breaker rated current In (A)	Short circuit current Usc (%)	3-phase short circuit current Isc (rms) (A)
40	58	63	4,5	1283
50	72	80	4,5	1603
63	91	100	4,5	2020
80	115	125	4,5	2566
100	144	160	4,5	3207
125	180	200	4,5	4009
160	231	250	4,5	5132
200	289	300	4,5	6415
250	361	400	4,5	8019
315	455	500	4,5	10103
400	578	630	4,5	12830
500	723	800	4,5	16038
630	910	1000	4,5	20207
800	1156	1250	6	19245
1000	1445	1600	6	24057
1250	1805	2000	6	30071
1600	2312	2500	6	38491
2000	2900	3000	6	48113
2500	3600	4000	6	60142

**Example:** Rated current of the primary circuit breaker to be connected to the main distribution panel of a 1600 kVA transformer should be 2500A; short circuit breaking capacitor should be at least 50 kA. Short circuit breaking capacities of breakers at secondary outputs should be selected to be at least 50 kA.

## Highest short circuit current of a distribution transformer on load side:

Tri-phase short circuit current of a transformer, with 36kV medium voltage side and 0.4kV output side, between low voltage ends is found with the following formula.

$S_n$  : Nominal power of the transformer (kVA)

$I_n$  : Rated current of the transformer (A)

$U_n$  : Output voltage between phases when transformer is unloaded (V)

$U_{sc}$  : Short circuit voltage of the transformer (%)

$I_{sc}$  : 3-phase maximum short circuit current at secondary side of the transformer (rms) (A)

$$I_{sc(rms)} = \frac{S \times 100}{1,73 \times U_n \times U_{sc}}$$

## Example:

What would be the continuous short circuit current when ( $U_n$ : 400 V,  $U_{sc}$ : %4,5) secondary of 630 kVA transformer is subject to short circuit?

$$I_{sc(rms)} = \frac{630 \times 100}{1,73 \times 400 \times 4,5} = 20207 \text{ A}$$

# MOLDED CASE CIRCUIT BREAKERS

## Calculation of short circuit at any point of the line:

$$I_{sc} = \frac{U_n}{\sqrt{3 \cdot \sqrt{R_t^2 + X_t^2}}} \quad (\text{kA})$$

R<sub>t</sub>: Total resistance (mW)  
X<sub>t</sub>: Total reactance (mW)

**Note:** Rms value is an expression used in alternative voltage and current measurement and this value is the AC (alternative current) value equivalent to effective or DC (direct current) value. For example, AC voltage giving light amount of a lamp, on which 12V DC voltage is applied, is called 12V ACrms voltage. AC rms value = AC peak value / 1.41

## Detailed calculation of short circuit at any point of the facility :

Facility zone	Resistance (mW)	Reactance (mW)	<div>Single line diagram</div>	Facility zone	Resistance (mW)	Reactance (mW)	
At network side	$R_1 = Z_1 \times \cos\phi \times 10^{-3}$ $\cos\phi = 0.15$ $Z_1 = \frac{U^2}{P_1}$ (Network impedance of the interconnected system)	$X_1 = Z_1 \times \sin\phi \times 10^{-3}$ $\sin\phi = 0.98$		network side P1=500 MVA	$R_1 = \frac{400^2}{500} \times 0.15 \times 10^{-3}$  $R_1 = 0.05 \text{ mW}$	$X_1 = \frac{400^2}{500} \times 0.98 \times 10^{-3}$  $X_1 = 0.31 \text{ mW}$	
Transformer	$R_2 = \frac{P_c \times U^2}{S^2} \times 10^{-3}$ Pc=cupper loss (W) S=apparent power of transformer (kVA)	$X_2 = \sqrt{Z_2^2 - R_2^2}$ $Z_2 = \frac{U_{sc}}{100} \times \frac{U^2}{S}$ Z2= impedance of transformer		Transformer S=800 kVA Usc=%6 U=400 V Pc=9700 W	$R_2 = \frac{9700 \times 40^2 \times 10^{-3}}{800^2}$  $R_2 = 2.42 \text{ mW}$	$X_2 = \sqrt{\left(\frac{6}{100} \times \frac{400^2}{800}\right)^2 - (2.42)^2}$  $X_2 = 11.75 \text{ mW}$	
Cables (1)	$R_3 = \frac{L}{k \cdot S} \times 10^3$ k=56 (Cu) or 36 (Al) k=self-conductivity $\left(\frac{\text{m}}{\text{Wmm}^2}\right)$	$X_3 = 0.07L$ (tri-phase cables) $X_3 = 0.15L$ (mono-phase cables) L : cable length (m) S : cable section (mm <sup>2</sup> )		Connection cables From transformer to Circuit breaker 2 ( 3x240 ) mm2 Copper per phase L=4 m	$R_3 = \frac{4 \times 10^3}{56 \times 240 \times 2}$  $R_3 = 0.14 \text{ mW}$	$X_3 = 0.07 \times \frac{4}{2}$  $X_3 = 0.14 \text{ mW}$	
Busbars	$R_3 = \frac{L}{k \cdot S} \times 10^3$ k=56 (Cu) or 36 (Al) k=self-conductivity $\left(\frac{\text{m}}{\text{Wmm}^2}\right)$	$X_3 = 0.15L$ L : busbar length (m) S : busbar section (mm <sup>2</sup> )					
Circuit breaker	R4 negligible	X4 negligible					
<b>Calculation of short circuit currents (kA)</b>							
	<b>Resistance (mW)</b>	<b>Reactance (mW)</b>		<b>Short circuit current (kA)</b>			
M1	$R_{t1} = R_1 + R_2 + R_3$ Rt1=2.61	$X_{t1} = X_1 + X_2 + X_3$ Xt1=12.2		$\frac{400}{\sqrt{3} \times \sqrt{(2.6^2 + 12.2^2)}} = 18.52 \text{ kA}$			
M2	$R_{t2} = R_{t1} + R_4 + R_5$ Rt2=2.71	$X_{t2} = X_{t1} + X_4 + X_5$ Xt2=12.65		$\frac{400}{\sqrt{3} \times \sqrt{(2.7^2 + 12.65^2)}} = 17.86 \text{ kA}$			
M3	$R_{t3} = R_{t2} + R_6 + R_7$ Rt3=9.46	$X_{t3} = X_{t2} + X_6 + X_7$ Xt3=17.55	$\frac{400}{\sqrt{3} \times \sqrt{(9.46^2 + 17.55^2)}} = 11.58 \text{ kA}$				
(1) If there are more than one parallel cable per phase, divide resistance and reactance of one cable into number of cables.							



# MOLDED CASE CIRCUIT BREAKERS

## Calculation of short circuit at any point of the network:

The following tables allow fast calculation of the short circuit current at any point in the network, if short circuit current at network side, cable section, type and length are known.

380 V										
Cable (mm <sup>2</sup> ) Cu	Al	Cable length (m)								
1,5	2,5	—	—	—	1	—	—	2	—	3
2,5	4	—	—	1	—	—	2	3	4	5
4	6	—	1	—	—	2	3	4	6	8
6	10	1	—	—	2	3	4	6	9	12
10	16	1	2	—	3	5	7	10	15	20
16	25	2	—	3	5	8	11	16	24	32
25	35	3	4	5	8	13	18	25	38	50
35	50	4	5	7	11	18	25	35	53	70
50	70	5	8	10	15	25	35	50	75	100
70	120	7	11	14	21	35	49	70	105	140
95	150	10	14	19	29	48	67	95	143	190
120	185	12	18	24	36	60	84	120	180	240
150	240	13	20	26	39	65	91	130	195	260
185	300	15	23	30	46	77	108	154	231	308
240		19	28	38	57	96	136	192	283	284
300		24	36	48	72	120	168	240	360	480
Isc network (kA)	Isc Short circuit current at Isc load side (kA)									
100	65	51	42	30	19	14	10	7	5	
90	62	49	41	29	19	14	10	7	5	
80	58	47	39	29	18	13	10	7	5	
70	52	44	37	28	18	13	10	6	5	
60	47	40	35	27	18	13	9	6	5	
50	41	36	32	25	17	13	9	6	5	
45	38	34	30	24	17	13	9	6	5	
40	35	32	28	23	16	13	9	6	5	
35	31	28	26	21	16	12	9	6	5	
30	27	25	23	20	15	12	9	6	5	
25	23	22	20	18	14	11	9	6	5	
22	21	20	19	18	13	11	9	6	5	
15	14	14	13	12	11	9	7	6	4	
10	10	10	9	9	8	7	6	5	4	
7	7	7	7	6	6	5	5	4	3	
5	5	5	5	5	5	4	4	3	3	
4	4	4	4	4	4	3	3	3	2	

## Example:

A value (67m) lower than 70 m cable length is selected on the row corresponding to 95 mm<sup>2</sup> cable (Cu) section in 380V panel. Short circuit current is found as 11 kA by intersection this column with the row giving a higher value (Isc: 22 kA) of the 20 kA short circuit current at network direction. Short circuit breaking capacity of the circuit breaker to be used at this point should be higher than (Icu) 11 kA.

## Reading of diagram:

Cable section and short circuit current on network side is marked in the table. Cable length is found on the cable section row. Cable length and short circuit current at network side are intersected and marked. This value gives the short circuit current to occur at the end of the cable.

415 V										
Cable (mm <sup>2</sup> ) Cu	Al	Cable length (m)								
1,5	2,5	—	—	—	—	1	—	2	3	5
2,5	4	—	—	—	1	2	3	4	5	8
4	6	—	—	1	2	3	4	6	8	12
6	10	—	1	2	3	4	6	9	13	19
10	16	—	2	3	5	7	10	15	20	30
16	25	2	3	5	8	11	16	24	32	48
25	35	4	5	8	13	17	25	38	50	75
35	50	5	7	11	18	24	35	53	70	105
50	70	9	12	18	30	42	60	89	120	179
70	120	11	15	23	38	53	75	113	151	226
95	150	14	19	29	48	66	95	143	190	285
120	185	18	24	36	60	84	120	180	240	360
150	240	19	26	39	65	91	130	195	260	391
185	300	23	30	46	77	107	154	231	308	462
240		28	38	57	96	134	192	288	384	576
300		36	48	72	120	168	240	360	480	720
Isc network (kA)	Isc Short circuit current at Isc load side (kA)									
100	45	40	25	20	12	8	5	4	3	
90	45	35	25	20	12	8	5	4	3	
80	45	35	25	15	12	8	5	4	3	
70	40	35	25	15	12	8	5	4	3	
60	40	35	25	15	12	8	5	4	3	
50	35	30	25	15	12	8	5	4	3	
45	35	30	25	15	12	8	5	4	3	
40	30	30	25	15	12	8	5	4	3	
35	30	25	20	15	10	8	5	4	3	
30	25	25	20	15	10	7	5	4	3	
25	25	20	20	12	10	7	5	4	3	
22	22	20	17	12	10	7	5	4	3	
15	15	15	12	10	8	6	5	4	3	
10	10	10	10	8	7	6	4	3	2	
7	7	6	6	6	5	4	4	3	2	
5	5	5	4	4	4	3	3	2	2	
4	4	4	4	3	3	3	2	2	2	

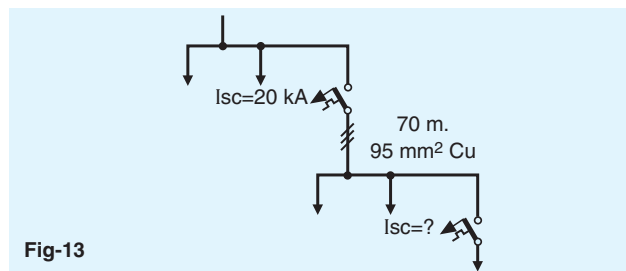


Fig-13

# MOLDED CASE CIRCUIT BREAKERS

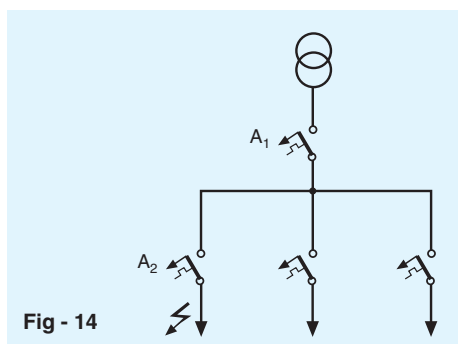


Fig - 14

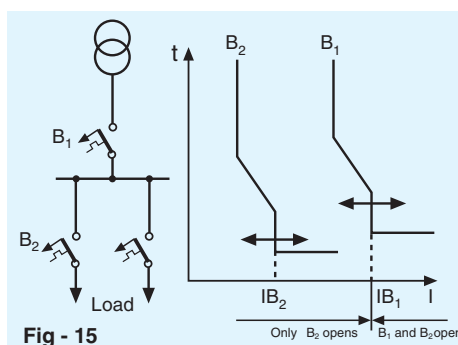


Fig - 15

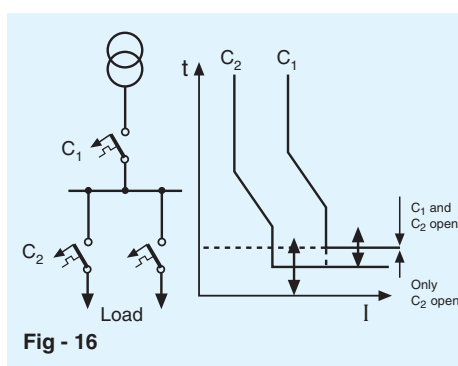
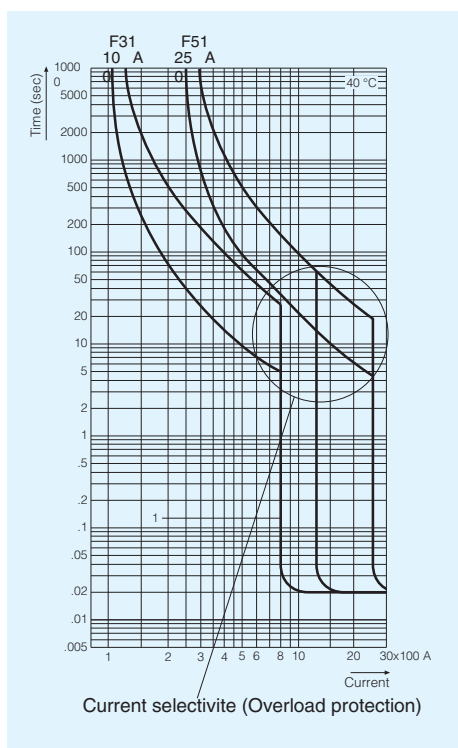


Fig - 16



Current selectivity (Overload protection)

## Selectivity:

When there is a fault at any point within the network, coordination of the automatic protection elements, which eliminates the fault only via the protection device located on the top or near the fault, is called selectivity. For example, when there is a fault in the load side controlled by A2 circuit breaker due to any reason such as over load or short circuit, if A2 is opened first and A1 remains closed, there is full selectivity for this system (Figure-14). If the above-mentioned condition cannot be met to the nominal short circuit current, there is partial selectivity. Selectivity ensures operating continuity, which is mandatory at many industrial, commercial or similar facilities. Selectivity is ensured with opening current ( $I_1$ ) and opening time ( $t$ ) parameters of the circuit breaker. These are;

## Current Selectivity:

Let suppose that  $IB_1$  rated current of B1 circuit breaker is higher than  $IB_2$  rated current of B2 circuit breaker in Figure-15. B2 circuit breaker opens the circuit in fault currents lower than  $IB_1$  current to provide current selectivity. This selectivity may be upgraded to full selectivity by using a circuit breaker with current limiter in B2. Because, limiter breakers limit the short circuit current and open the circuit in a very short time (less than 10 ms). That is, selectivity should be provided both in over loads and in short circuits.

## Time Selectivity:

Thanks to short-time delay adjustment of the circuit breaker, selectivity is provided by comparing opening times with other breakers in the system. As it is seen in Figure-16, operating curves of C1 and C2 breakers are intersected and delay time adjustment of C1 breaker is increased according to C2 breaker to provide selectivity. Here, C1 circuit breaker should have an electrodynamic resistance in compliance with the resistance current during short-time delay. It should be like delay (at transformer side) > delay (load side).

## Selectivity Chart:

Selectivity chart shows the current values at which the circuit breaker closest to the load shall open. Combinations providing selectivity are shown in dark areas. Within these areas, thermal and magnetic opening curves of the circuit breakers at transformer and load sides have been designed to avoid intersections. That is, selectivity tables have been arranged to have the maximum instant opening current of the breaker at the network side at 1.5 times

or more than the instant opening current of the breaker at the load side.

$I_2$  = Short circuit tripping current of circuit breaker (A)

$$\frac{I_2 \text{ (On transformer side)}}{I_2 \text{ (On load side)}} \geq 1.5$$

## Selectivity Limit:

This is the current value at which both protection elements shall open at the same time when selectivity limit is exceeded. Selectivity limit currents in the tables have been given as the top limit of the short circuit opening current of the circuit breaker at the network side.

## Current Time Curve of 400A NH Fuse with 400A Circuit Breaker:

A circuit breaker, in accordance with EN 60947-2 standard:

Should operate without opening for 2 hours at  $1.05 \times I_n$ ,

Should open within 2 hours at  $1.3 \times I_n$ . In practice, this time is adjusted as, 5-10 minutes.

However a NH fuse, in accordance with EN 60269-1 standard:

Should operate without opening for 3 hours at  $1.25 \times I_n$ .

Should open within 3 hours at  $1.6 \times I_n$ . Accordingly, a circuit breaker opens earlier than NH Fuses in over currents and provides better protection especially in over currents.

(Figure - 17)

NH fuses are protection devices which mainly provide protection against short circuit.

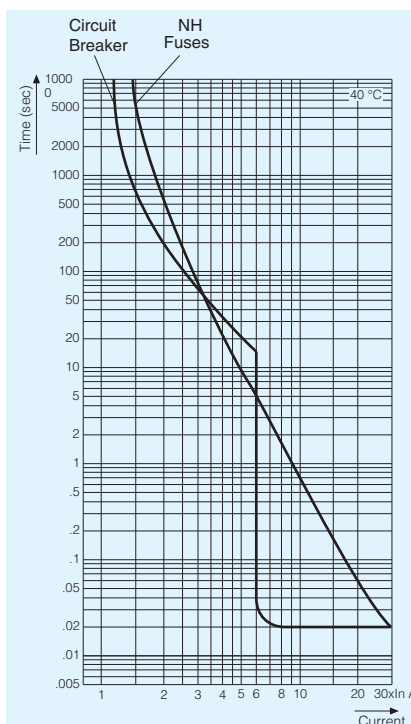


Fig-17

Current Time Curve of 400A NH Fuse with 400A Circuit Breaker

# MOLDED CASE CIRCUIT BREAKERS

		Network protection circuit breaker																							
Load side I <sub>1</sub> (A) ↓	Transformer side I <sub>n</sub> →	F31-F32-F33												F51-F52-F53						F61-F62/F71/F82-F83/F82E-F83E					
		16	25	32	40	50	63	80	100	125	160	200	160	200	225	250	300	400	300	400	500	630	800		
		Selectivity limit (A)	160	200	250	300	400	500	640	800	1000	1280	1600	1600	2000	2250	2500	3000	4000	2400	3200	4000	5040	6400	
Network protection circuit breaker  F12 F31-F32-F33	16																								
	25																								
	32																								
	40																								
	50																								
	63																								
	80																								
	100																								
	125																								
	160																								
	200																								
Motor protection circuit breaker  F12 F31-F32-F33	16																								
	25																								
	32																								
	40																								
	50																								
	63																								
	80																								
	100																								
	125																								
	160																								
	200																								
Generator protection circuit breaker  F12 F31-F32-F33	16																								
	25																								
	32																								
	40																								
	50																								
	63																								
	80																								
	100																								
	125																								
	160																								
	200																								

## Example :

If there is a network protection circuit breaker with 100 A nominal current at the transformer side, the following circuit breakers should be utilized at the secondary outputs (load side) right below the breaker to provide full selectivity;

Network protection : maximum 63 A

Motor protection : maximum 40 A

Generator protection: maximum 80 A

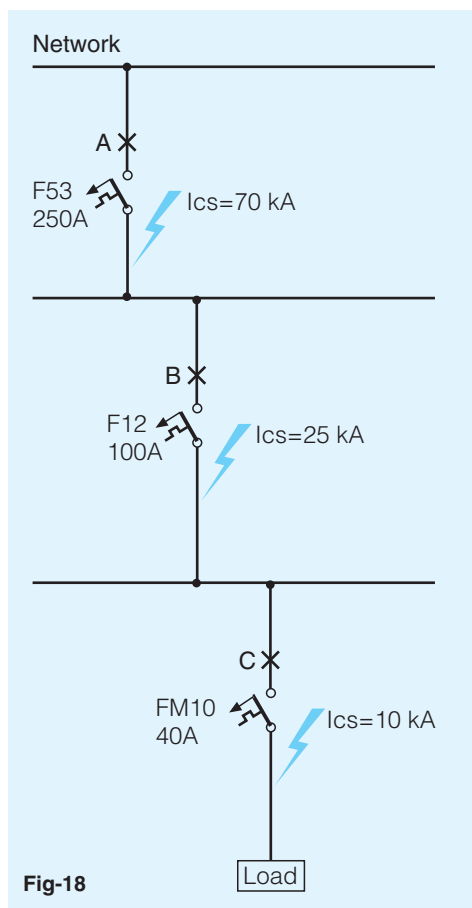
# MOLDED CASE CIRCUIT BREAKERS

		Network protection circuit breaker																
Load side I <sub>1</sub> (A)  ↓	Transformer side In (A) →	F51-F52-F53						F61-F62/F71/F82-F83/F82E-F83E					F91E-F92E F101E-F102E		F111E-F112E			
		160	200	225	250	300	400	300	400	500	630	800	1000	1250	1600	2000	2500	
	Selectivity limit (A)	1600	2000	2250	2500	3000	4000	2400	3200	4000	5040	6400	10000	12500	16000	20000	25000	
Network protection circuit breaker F51-F52-F53 F61-F62 F71-F72 F82-F83	200																	
	250																	
	300																	
	400																	
	500																	
	630																	
	800																	
Motor protection circuit breaker F51-F52-F53 F61-F62 F71-F72 F82-F83	200																	
	250																	
	300																	
	400																	
	500																	
	630																	
	800																	
Generator protection circuit breaker F51-F52-F53 F61-F62 F71-F72 F82-F83	200																	
	250																	
	300																	
	400																	
	500																	
	630																	
	800																	

		Motor protection circuit breaker															
Load side I <sub>1</sub> (A)  ↓	Transformer side I <sub>n</sub> (A) →	F51-F52-F53						F61-F62/F71/F82-F83/F82E-F83					F91E-F92E F101E-F102E		F111E-F112E		
		160	200	225	250	300	400	300	400	500	630	800	1000	1250	1600	2000	2500
	Selectivity limit (A)	1920	2400	2700	3000	3600	4800	3600	4800	6000	7560	9600	10000	12500	16000	20000	25000
Network protection circuit breaker F51-F52-F53 F61-F62 F71-F72 F82-F83 F82E-F83E	200																
	250																
	300																
	400																
	500																
	630																
	800																
Motor protection circuit breaker F51-F52-F53 F61-F62 F71-F72 F82-F83 F82E-F83E	200																
	250																
	300																
	400																
	500																
	630																
	800																
Generator protection circuit breaker F51-F52-F53 F61-F62 F71-F72 F82-F83 F82E-F83E	200																
	250																
	300																
	400																
	500																
	630																
	800																



# MOLDED CASE CIRCUIT BREAKERS



## Sequential Connection:

Sequential connection is a utilization type which allows use of lower-cost circuit breakers at the load side by using the current limiting feature of circuit breakers. Compact circuit breakers at the network side provide protection against over load and short circuit currents. These elements allow circuit breakers with a breaking capability lower than the short circuit current to operate within rated breaking capability limit. As the current is kept under control of the limiter circuit breaker in the whole circuit, sequential connection is useful for all the switching devices at load side of the circuit breaker.

## Utilization of Sequential Connection:

In sequential connections, circuit breaker elements can be placed in different panels. In this way, sequential connection makes it possible to use circuit breakers with lower capacity than the possible  $I_{cs}$  operating short circuit current to occur in the area of the device. Important point is that a circuit breaker at the capacity to break this short circuit current should be connected at the network side.

## Coordination Among Circuit Breakers:

Utilization of a circuit breaker, which has a breaking capacity lower than the short circuit current, is allowed only when another circuit breaker with the required breaking capacity is placed at the network side. In this case, characteristics of both elements should be coordinated with each other in a way not to give any damage to the element at the load side and cables protected by these elements.

## 3-Step Sequential Connection:

Criteria about sequential connection of serially connected A, B and C circuit breakers are fulfilled in two conditions. A breaker placed at the network side is used for both B and C breakers for sequential connection. Here, it should be checked whether (A+B and A+C) and (A+B and B+C) combinations have the required breaking capacity or not. (Figure - 18)

Short Circuit Breaking Capacity kA																						
		F12	F61	F31	F51	F62	F71	F32	F52	F72	F82	F91E	F101E	F111E	F92E	F33	F53	F83	F102E	F112E		
		25		35					50								65	70				
F12	25		25	35	35	35	35	50	50	40	50	25	25	-	25	70	70	60	25	-		
F61		-	-		35	35	35	-	50	40	50	25	25	-	25	-	70	60	25	-		
F31	35	-	-	-	35	35	35	50	50	50	50	35	35	35	35	70	70	70	30	35		
F51		-	-	-		35	35	-	50	50	50	35	35	35	35	-	70	70	30	35		
F62		-	-	-	-		35	-	50	50	50	35	35	35	35	-	70	70	30	35		
F71		-	-	-	-	-		-	-	50	50	35	35	35	35	-	70	70	30	35		
F32	50	-	-	-	-	-	-		50	50	50	50	50	50	65	70	70	70	50	50		
F52		-	-	-	-	-	-	-		50	50	50	50	50	65	-	70	70	50	50		
F72		-	-	-	-	-	-	-	-		50	50	50	50	65	-	-	70	50	50		
F82		-	-	-	-	-	-	-	-	50		50	50	50	65	-	-	70	50	50		
F91E		-	-	-	-	-	-	-	-	-	-		50	50	65	-	-	-	50	50		
F101E		-	-	-	-	-	-	-	-	-	-	-	-		50	-	-	-	-	50	50	
F111E		-	-	-	-	-	-	-	-	-	-	-	-	-		-	-	-	-	50		
F92E	65	-	-	-	-	-	-	-	-	-	-	-	-	-		-	-	-	70	70		
F33	70	-	-	-	-	-	-	-	-	-	-	-	-	-	-		70	70	70	70		
F53		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-		70	70	70		
F83		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-		70	70		
F102E		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-		70		
F112E		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-			

**NOTE:** The sequential connection option allows the switch on the load side to take advantage of the current limiting capability of the switch on the network side. It allows the switch to be connected to a point with a higher short-circuit power than the capacity. The values ??written to the switches are determined by the switch indicates the point with the highest short circuit power that can be installed when used.

# MOLDED CASE CIRCUIT BREAKERS



F71 Undervoltage Release

## Undervoltage Release :

It is used for opening the circuit breaker when energy is cut off or voltage goes below 70% of the operating voltage. In order to close the breaker, the voltage should be equal to or higher than 85% of the operating voltage. When no energy is supplied to the low voltage coil, the circuit breaker does not open.

Type	Ampere Ranges	Order Code
F12	16A - 160A	8AR-CA000-0□□□
F31 - F32 - F33	16A - 250A	#AB-CA000-0□□□
F51 - F52 - F53	125A-400A	#AD-CA000-0□□□
F61 - F62	300A-400A	#AE-CA000-0□□□
F71 - F72	300A-800A	#AF-CA000-0□□□
F82 - F83	400A - 800A	8AG-CA001-0□□□
F82E - F83E	300A - 800A	8AG-CA001-0□□□
F91E - F92E	1000A-1250A	#AH-CA000-0□□□
F101E - F102E	1000A-1600A	#AI-CA000-0□□□
F111E - F112E	1250A-2500A	#AK-CA000-0□□□

Not : Where seen □□□ please write the feeding voltage (230-400). # For plug-in 9, attached to product please write 8. The undervoltage coils supply voltage is AC. Low voltage bobbin does not set up circuit breaker without power. In 3-phase systems, 400V supply voltage should be preferred for control of all phases.

“—” DC, “~” AC, “” DC-AC



F31-F32-F33  
Extended Rotary Handle

## Extended Rotary Handle:

It is used for opening - closing the circuit breaker. It is used for rotating the circuit breaker, not pushing-pulling it upwards-downwards.

Type	Ampere Ranges	Order Code
F31 - F32 - F33	160A - 250A	8AB-G000-0000
F51 - F52 - F53	125A - 400A	8AD-G000-0000
F71 - F72	300A - 800A	8AF-G000-0000
F82 - F83 / F82E - F83E	300A - 800A	8AG-G000-000□
F91E - F92E	1000A - 1250A	8AH-G00△-0000

Note : It's not plug-in. □: 0 for F82-F83, 1 for F82E-F83E.

△: 1 for F91E, 0 for F92E.



Operating Handle Extention

## Operating Handle Extention:

Type	Ampere Ranges	Order Code
F71-F72-F82-F83	300A - 800A	8AG-UK000-0000
F82E - F83E - F91E - F92E - F101E - F102E	300A - 1600A	8AG-UK100-0000
F111E - F112E	1250A - 2500A	8AG-UK000-0000



Lock Mechanism with key



F71

## Lock Mechanism with key:

Lock mechanism mechanically locks the circuit breaker, which is on (trip) position due to service, and avoids ON and OFF positions.

Type	Ampere Ranges	Order Code
F12	16A - 160A	8AL-E0000-0000
F31-F32-F33	160A - 250A	8AB-E0000-0000
F51-F52-F53	125A - 400A	8AD-E0000-0000
F61-F62	300A - 400A	8AE-E0000-0000
F71-F72	300A - 800A	8AF-E0000-0000
F82-F83/F82E-F83E	300A - 800A	8AG-E0000-0000
F91E-F92E	1000A - 1250A	8AH-E0000-0000
F101E-F102E	1000A - 1600A	Standard
F111E-F112E	1250A - 2500A	Standard

Note : It's not plug-in

## Shunt Trip Release :

It is used for opening the circuit breaker remotely. When the breaker is in closed (ON) position, when voltage is supplied to the opening relay the breaker is opened and got Trip position. Opening relay may be manufactured at different voltages set out in the table in order to operate in AC and DC voltages. Operation of opening coil is guaranteed between 70% and 110% of the nominal voltage according to standards.



Shunt Trip Release

# MOLDED CASE CIRCUIT BREAKERS

Operating voltages	F12	F31-F32-F33	F51-F52-F53	F61-F62	F71-F72	F82-F83 F82E-F83E	F91E-F92E	F101E F102E	F11E-F112E
110 V ~	8AM-BA000-0110	8AB-BA000-0110	8AD-BA000-0110	8AP-BA000-0110	8AF-BA000-0110	8AG-BA000-0110	8AH-BA000-0110	8AI-BA000-0110	8AK-BA000-0110
220 V ~	8AM-BA000-0220	8AB-BA000-0220	8AD-BA000-0220	8AP-BA000-0220	8AF-BA000-0220	8AG-BA000-0220	8AH-BA000-0220	8AI-BA000-0220	8AK-BA000-0220
380 V ~	8AM-BA000-0380	8AB-BA000-0380	8AD-BA000-0380	8AP-BA000-0380	8AF-BA000-0380	8AG-BA000-0380	8AH-BA000-0380	8AI-BA000-0380	8AK-BA000-0380
24 V -	8AM-BD000-0024	8AB-BD000-0024	8AD-BD000-0024	8AP-BD000-0024	8AF-BD000-0024	8AG-BD000-0024	8AH-BD000-0024	8AI-BD000-0024	8AK-BD000-0024
48 V -	8AM-BD000-0048	8AB-BD000-0048	8AD-BD000-0048	8AP-BD000-0048	8AF-BD000-0048	8AG-BD000-0048	8AH-BD000-0048	8AI-BD000-0048	8AK-BD000-0048
110 V -	8AM-BD000-0110	8AB-BD000-0110	8AD-BD000-0110	8AP-BD000-0110	8AF-BD000-0110	8AG-BD000-0110	8AH-BD000-0110	8AI-BD000-0110	8AK-BD000-0110
220 V -	8AM-BD000-0220	8AB-BD000-0220	8AD-BD000-0220	8AP-BD000-0220	8AF-BD000-0220	8AG-BD000-0220	8AH-BD000-0220	8AI-BD000-0220	8AK-BD000-0220

**F31-F32-F33 / F51-F52-F53**

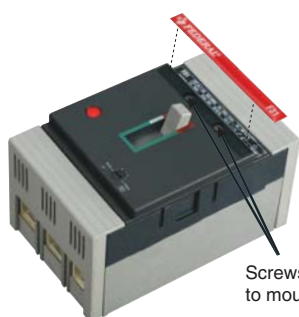


**F92E**

**F71**



Auxiliary Contact Block



Screws should be removed to mount accessories


## Auxiliary Contact Block:

It is used for supplying electrical signaling of the circuit breaker according to the operating position. Auxiliary contacts are opened and closed with primary contacts to fulfill warning and locking functions.

NO : Normally open contact

NC : Normally closed contact

Type	Ampere Ranges	Contact Equipment NO NC	Operating Voltage	Rated Current	Order Code
F12	16A - 160A	1 1	250 V~	2 A	8AL-A0011-0000
F31-F32-F33	16A - 250A	1 1	250 V~	2 A	8AB-A0011-0000
		2 2	250 V~	2 A	8AB-A0022-0000
F51-F52-F53	125A - 400A	1 1	250 V~	2 A	8AD-A0011-0000
		2 2	250 V~	2 A	8AD-A0022-0000
F61-F62	300A - 400A	1 1	400 V~	4 A	8AE-A0011-0000
F71-F72	300A - 800A	1 1	400 V~	4 A	8AF-A0011-0000
		2 2	400 V~	4 A	8AF-A0022-0000
F82-F83 F82E-F83E	300A - 800A	1 1	400 V~	4 A	8AG-A0011-0000
		2 2	400 V~	4 A	8AG-A0022-0000
		4 4	400 V~	4 A	8AG-A0044-0000
F92E	1000A - 1250A	1 1	400 V~	4 A	8AH-A0011-0000
		2 2	400 V~	4 A	8AH-A0022-0000
F101E-F102E	1000A - 1600A	1 1	400 V~	4 A	8AJ-A0011-0000
		2 2	400 V~	4 A	8AJ-A0022-0000
		4 4	400 V~	4 A	8AJ-A0044-0000
F111E-F112E	1250A - 2500A	1 1	400 V~	4 A	8AK-A0011-0000
		2 2	400 V~	4 A	8AK-A0022-0000

“-” DC, “~” AC, “” DC-AC

## Terminal cover:

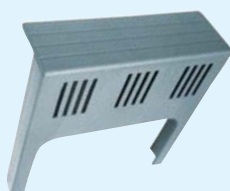
It provides a safe insulation by preventing contact of the terminal (busbar or cable) sections of the circuit breaker. Furthermore, terminal protective cover also insulates terminals from each other by passing through channels between poles. It is available in all our circuit breakers as a standard.

Type	Ampere Ranges	Order Code
F12	16A - 160A	8AR-F0000-0000
F31-F32-F33	160A - 250A	8AB-F0000-0000
F51-F52-F53	125A - 400A	8AD-F0000-0000
F61-F62	300A - 400A	8AP-F0000-0000
F71-F72	300A - 800A	8AF-F0000-0000
F82-F83/F82E-F83E	300A - 800A	8AG-F0000-0000
F91E-F92E	1000A - 1250A	8AH-F0000-0000
F101E-F102E	1000A - 1600A	8AI-F0000-0000
F111E-F112E	1250A - 2500A	8AK-F0000-0000

□ : It is 1 for the long terminal cover and 0 for the short terminal cover.

△: 0 for 3 poles, 4 for 4 poles.

Terminal cover



# MOLDED CASE CIRCUIT BREAKERS

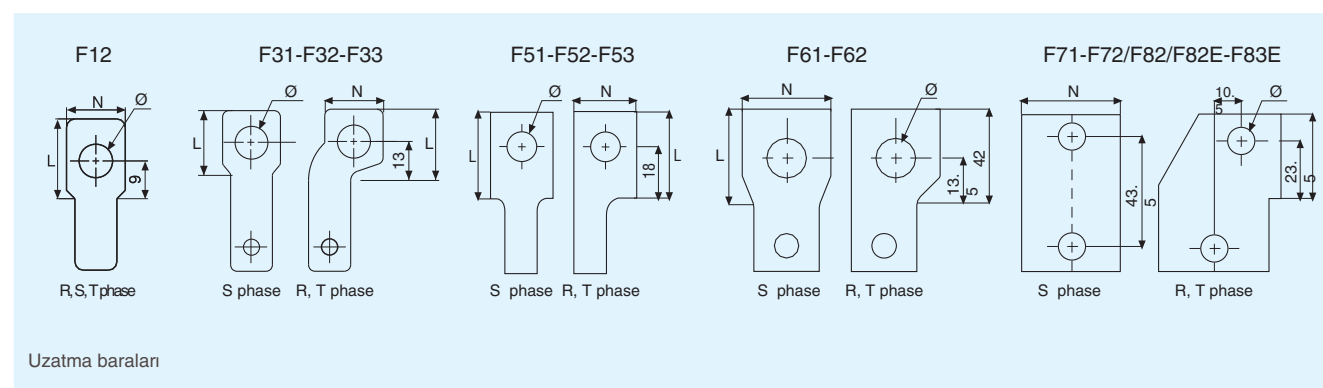
## Extension Bars :

Extension busbars allow easy and healthy cable or busbar connections to the terminals of the breaker. Busbars are manufactured of electrolytic copper material with silver coating.

Type	Lenght L (mm)	Width N (mm)	Thickness P (mm)	Hole Diameter Ø	Tightening Torque (Nm)	Nominal Current (A)	Quantity (Pieces)	Order Code
F12	36	14	3	M8	10	16 A - 160 A	6	8AM-H3000-0125
F31-F32-F33	35	18	5	M8	10	125 - 250 A	6	8AB-H5000-0125
F51-F52-F53	35	25	5	M12	25	125 A - 400 A	6	8AD-H5001-0250
F61-F62	42	38	8	M10	25	300 A - 400 A	6	8AE-H5000-0300
F71-F72 F82-F83 F82E-F83E	31	40	5	M10	40	300 A	6	8AF-H△△△00-0□□□
	31	40	6	M10	40	400 A - 500 A	6	
	31	40	8	M10	40	630 A	6	8AG-H△△△00-0□□□
	31	40	12	M10	40	800 A	6	

□□□: Write ampere value.

△△△: Write busbar thickness. (Enter 5 for 300A , 6 for 400A - 500A, 8 for 630A and 12 for 800A .)



**Connection Terminals:** They are dispatched with screwdriver or allen screw head.

Type	Cable Number	Cable Section (mm <sup>2</sup> )	Cable Diameter Ø (mm)	Tightening Torque (Nm)	Bolt Type	Quantity (pieces)
F12	1	2.5...70	6	6	Screwdriver	3
F31-F32-F33	1	2.5...120	12	10	Allen	3
F31-F32-F33	1	2.5...95	12	6	Screwdriver	3
F31-F32-F33	1	10...120	13	12	Allen	3
F51-F52-F53	1	95...120	13	25	Allen	3

**Note:** Connection terminal of F31-F32-F33 type circuit breaker can be manufactured as allen or screw head upon request.

Without fixing extention bars cable locks have 95 mm<sup>2</sup> cable section can be directly mounted to body of F31-F32-F33 / F51- F52 - F53 Type Circuit Breakers





# MOLDED CASE CIRCUIT BREAKERS



F31-F32-F33/F51

## Motor Control Mechanisms:

They are used for opening - closing the circuit breaker remotely. Moreover, thanks to the notch on it, manual opening-closing can be made. Motor control mechanism is assembled on top cover of the circuit breaker. It has mechanical locking feature.

## F31-F32-F33 Motor Control Mechanisms:

Technical Specification:

Order Code	8AB-DA000-0220 (From 16A to 250A)
Operating voltage	220 V AC
Power	100 W
Opening time	1 s
Closing time	1 s



F71-F72/F82-F83/F82E-F83E  
F92E/F101E-F102E

## F71/F82-F83/F82E-F83E/F91E-F92E/F101E-F102E

### Motor Control Mechanisms:

Type	Ampere Ranges	Order Code
F71-F72	300A ... 800A	8AF-DA000-0220
F82-F83	400A ... 800A	8AG-DA001-0220
F82E-F83E	300A ... 800A	8AG-DA000-0220
F91E-F92E	1000A ... 1250A	8AH-DA000-0220
F101E-F102E	1000A ... 1600A	8AN-DA000-0220

Technical Specification:

Operating voltage	220 V AC
Power	100 W
Opening time	4 s
Closing time	3.5 s



F111E-F112E

## F111E-F112E Motor Control Mechanisms:

Technical Specification:

F111E-F112E	8AK-DA000-0220 (from 1250A to 2500A)
Operating voltage	220 V AC
Power	500 W
Opening time	1.5 s
Closing time	1.5 s



## Mechanical Lock

It is very easy and important to make the network-generator automation also known for automatic inverter system; because an error to be made will cause the network and the generator to remain active at the same time, thus causing a short circuit, as opposed to phase coincidence.

A mechanical lock is used to eliminate this possibility of error and provide operational safety.

Since the locking is made mechanically and not electrically, it is absolutely prevented that both circuit breakers in the ON or OFF position are in error in the control system.

Mechanical Lock Order Codes:

Type	Ampere Ranges	Order Code
F31	160A - 250A	8AB-V0000-0000
F71-F72	300A - 800A	8AF-V0000-0000
F82-F83	300A - 800A	8AG-V0000-0000
F82E-F83E	300A - 800A	8AG-V1000-0000
F82EN-F83EN	300A - 800A	8AG-V0000-0001
F91E-F92E	1000A - 1250A	8AH-V0000-0000
F101E-F102E	1000A - 1600A	8AI-V0000-0000
F111E-F112E	1250A - 2500A	8AK-V0000-0000

# MOULDED CASE CIRCUIT BREAKERS



## Network - Generator Changeover Relay FER96 (For Circuit Breaker):

It is used to ensure automatic transition between network and generator at places where the circuit breaker is used for inverter purposes. Line, supply, switch statuses can be monitored on the relay. Fault contact and alarm and opening coil connection can be made.

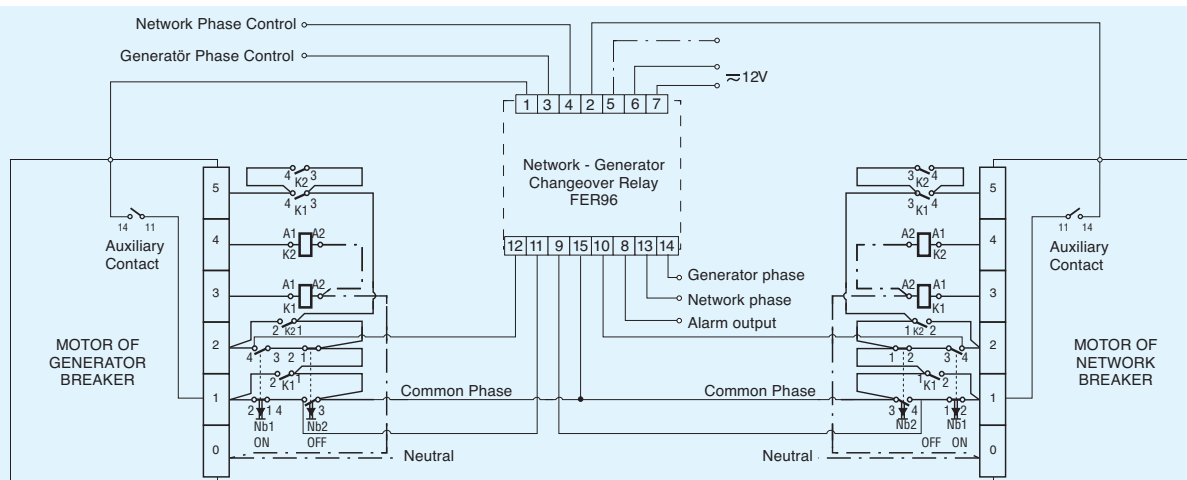
Output contacts	: 250V AC, 10A
Supply voltage	: 12V DC
Input voltage	: 220 V AC
Dimensions	: 96x96 mm
Order Code	: 9HK-DF000-0000



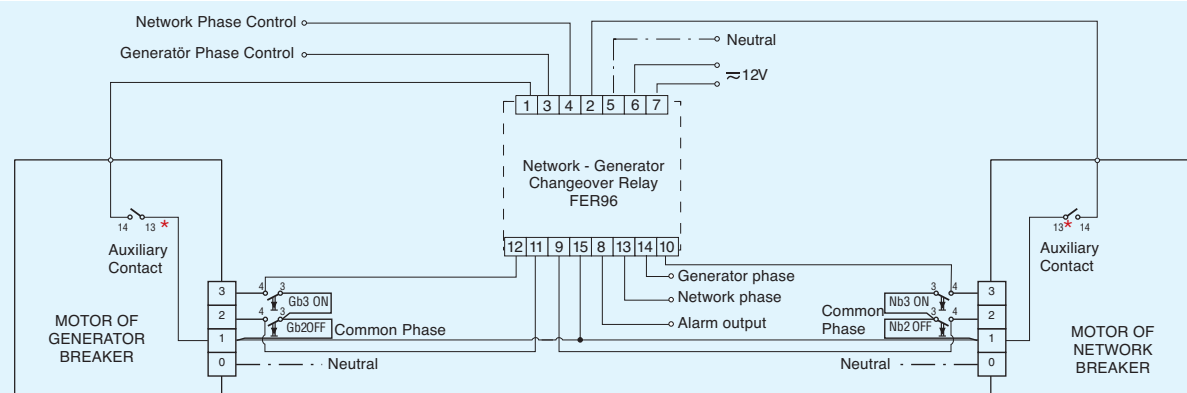
## Transfer Control Unit FER72 (For Contactors):

Low cost, microprocessor-controlled device that sends a remote start signal that monitors the three-phase mains voltage and transfers the load between the network and the generator.

Alternator Voltage	: 300V AC max
Mains Voltage	: 300V AC max (phase-neutral)
Network Contactor Time	: 0,75 seconds
Dimensions	: 72x72 mm
Order Code	: 9HK-DF000-0001



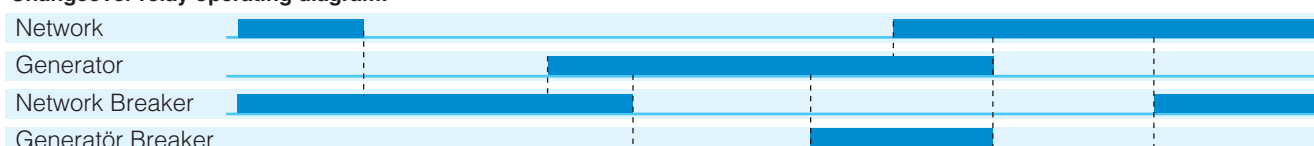
Connection diagram of F31-F32-F33 type circuit breaker with motor mechanism for changeover automation system.



\* F71 / F82 / F82E / F83 / F83E / F91E / F92E for 11, F101E / F102E / F111E / F112E for 13

Connection diagram of F71/F82-F83/F83E-F91E-F92E-F101E-F102E/F111E-F112E type circuit breaker with motor mechanism for changeover automation system.

## Changeover relay operating diagram:



# AUTOMATIC TRANSFER SWITCHES

## Automatic Transfer Switches

In the enterprises where power cuts are frequent, where uninterrupted power is needed and where interruption can cause huge damages (such in hospitals, shopping centers, banks , factories etc...), these can be securely used in order to realize the load transfer.

- In the system that is made by using Federal Automatic Transfer Switch there are manual and automatic control choices.
- Transfer time adjustment and jenerator start-stop delay time adjustment can be made in Federal Automatic Transfer Switch.
- In the system that has easy and secure assembly opportunity, in the situations that both grid and the generator run, there is a smart controlling unit where results can be observed.

### ATS with Circuit Breaker



#### Technical Features:

Standard	TS EN 60947-6-1
Circuit Breaker Rated Current (In)	16A ~ 1600A
Pole number	3, 4
Control Voltage	140 - 270V
Auxiliary Control Voltage	10 - 15V DC
Jenerator Start-Stop Time Adjusment	0,5 - 90 seconds (adjustable)
System Voltage	415V
Mechanical Life	10.000
Operating Temperature	-20 ~ +60°C
Protection Class	IP20
Pollution Level	III / 3

#### Product Types and Amps

F12/F12N	16A ... 160A
F31/F32/F33	16A ... 250A
F51/F52/F53/F51N/F52N/F53N	125A ... 400A
F71/F72	300A ... 800A
F82/F83/F82E/F833/F82N/F83N	400A ... 800A
F91E/F92E/F91EN/F92EN	1000A ... 1250A
F101E/F102E	1000A ... 1600A

### ATS with MCB



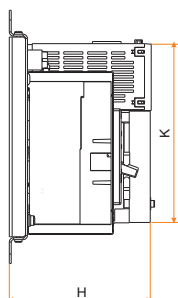
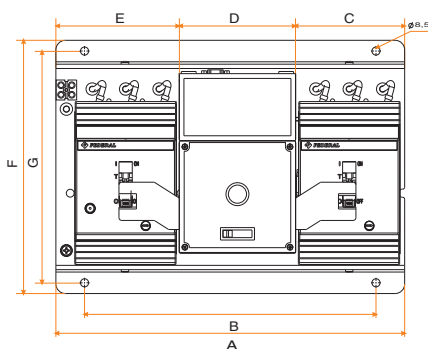
#### Technical Features:

Standard	TS EN 60947-6-1
Circuit Breaker Rated Current (In)	0,5A ~ 63A
Pole number	3, 4
Control Voltage	140 - 270V
Auxiliary Control Voltage	10 - 15V DC
Jenerator Start-Stop Time Adjusment	0,5 - 90 seconds (adjustable)
System Voltage	415V
Mechanical Life	10.000
Operating Temperature	-20 ~ +60°C
Protection Class	IP20
Pollution Level	III / 2

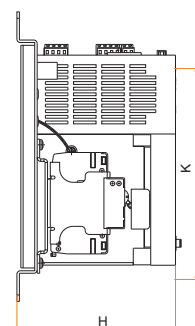
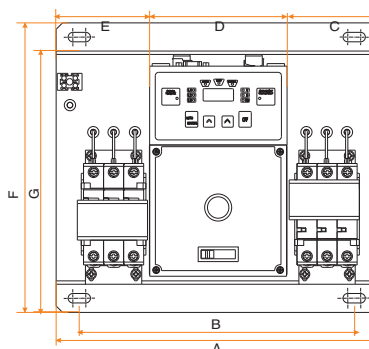
#### Product Types and Amps

FM6 / 6kA	0,5A ... 63A
FM10 / 10kA	0,5A ... 63A
FM10L / 10kA	80A ... 125A

### Compact Circuit Breakers



### Miniature Circuit Breakers



# AUTOMATIC TRANSFER SWITCHES

## Compact and Miniature Circuit Breaker Measurements

Type	Dimensions									Ampere Ranges	Order Code
	A	B	C	D	E	F	G	H	K		
FATS-F1	365	293	106,4	122	136,6	274,4	224,9	151,5	186,5	16A ... 160A	8AR-ATS00-0000
FATS-F1N	425	353	136,4	122	166,6	259,2	236,7	151,5	186,5	16A ... 160A	8AR-ATS01-0000
FATS-F3	380	340	114	122	145	265	242	147	247	16A ... 250A	8AB-ATS00-0000
FATS-F5	460	419	151	122	187	342	311	206	247	125A ... 400A	8AD-ATS00-0000
FATS-F5N (4 Pole)	495	454	151	122	221	342	311	206	247	125A ... 400A	8AD-ATS04-0000
FATS-F7	600	550	219	122	259	346	315	216	247	300A ... 800A	8AF-ATS00-0000
FATS-F8	600	550	219	122	259	346	315	216	247	400A ... 800A	8AG-ATS00-0000
FATS-F8N (4 Pole)	740	689	296	122	321	346	315	216	247	300A ... 800A	8AG-ATS04-0000
FATS-F9	600	550	219	122	259	436	405	235	247	1000A...1250A	8AH-ATS00-0000
FATS-F9N (4 Pole)	740	689	289	122	329	436	405	235	247	1000A...1250A	8AH-ATS04-0000
FATS-F10	600	550	219	122	259	436	405	260	247	1000A...1600A	8AI-ATS00-0000
FM6	286	244	80	122	83	257	232	141	187	1A ... 63A	8AL-ATS00-0000
FM10	286	244	80	122	83	257	232	141	187	1A ... 63A	
FM10L	390	324	119	122	149	265	242	142	187	80A ... 125A	

(\*) Note: If it is desired to check the first movement time while ATS is in the generator position, 10-15V DC supply must be done. If there is no DC supply, the generator start time delay will be "0" seconds. There is no need to supply external DC if this time delay is not requested by the generator.

## Alternative Changeover

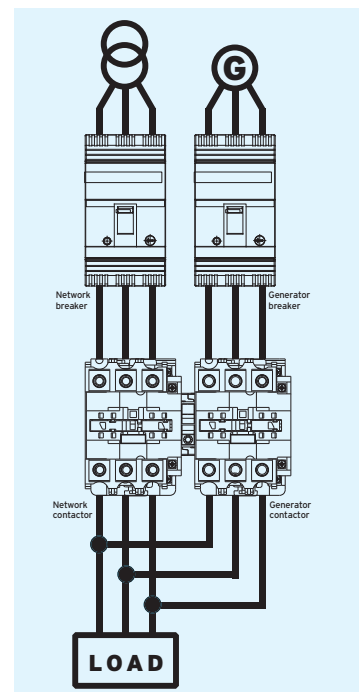
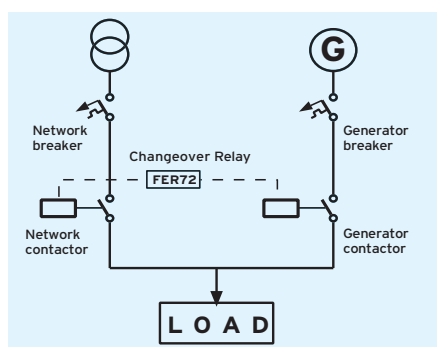
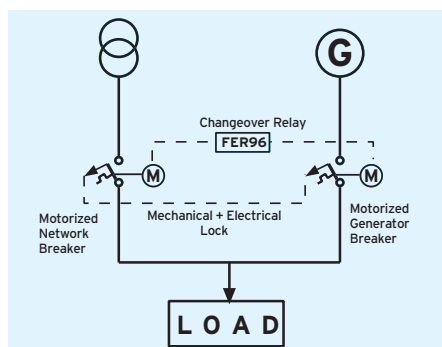


Network - generator systems can be made with compact type circuit breakers with motor mechanism or combination of compact type circuit breaker and contactor either.

As seen on right diagram, compact type circuit breakers are used for overload and short circuit protection while contactors are used for switching.

Changeover system can be made with mechanical and also electrical locking for contactors up to FC95D and with electrical locking only for contactors FC115D to FC750D

Changeover system 300A to 2500A can be made with mechanical and also electrical locking by using high current contactors.



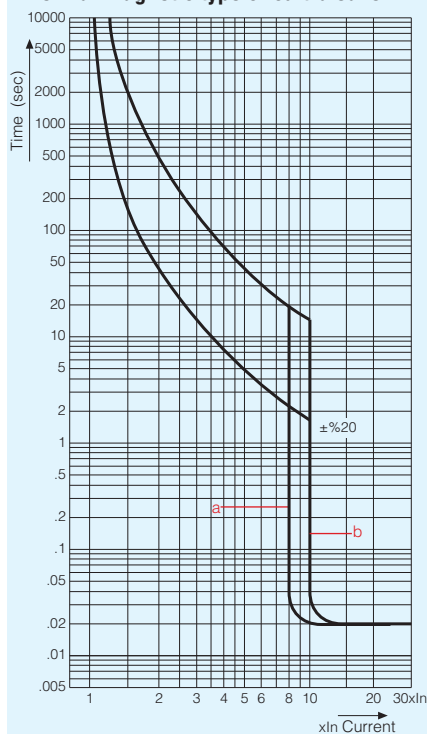
## Changeover system with motorized MCCB + mechanical lock

F31	16 ... 250	8AB-V2000-0000
F71-F72	300 ... 800	8AF-V2000-0000
F82-F83	400 ... 800	8AG-V2000-0000
F82E-F83E	300 ... 800	8AG-V2100-0000
F82EN-F83EN	300 ... 800	8AG-V2001-0000
F91E-F92E	1000 ... 1250	8AH-V2000-0000
F101E-F102E	1000 ... 1600	8AI-V2000-0000
F111E-F112E	1250 ... 2500	8AK-V2000-0000



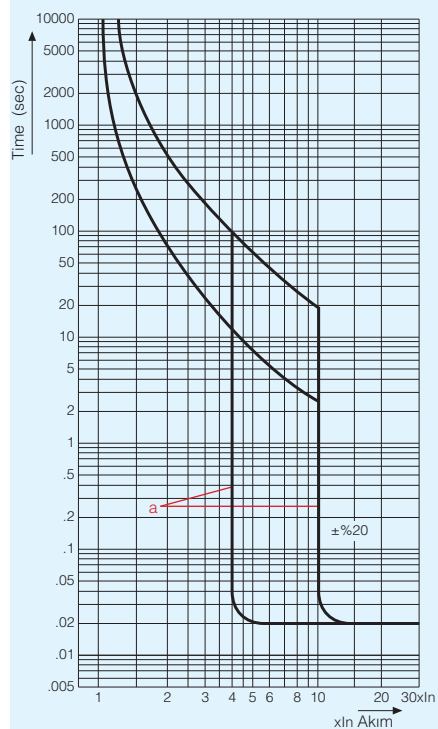
# MOLDED CASE CIRCUIT BREAKERS

**F01-F02-F12  
F31-F32-F33**  
Thermal magnetic type circuit breaker



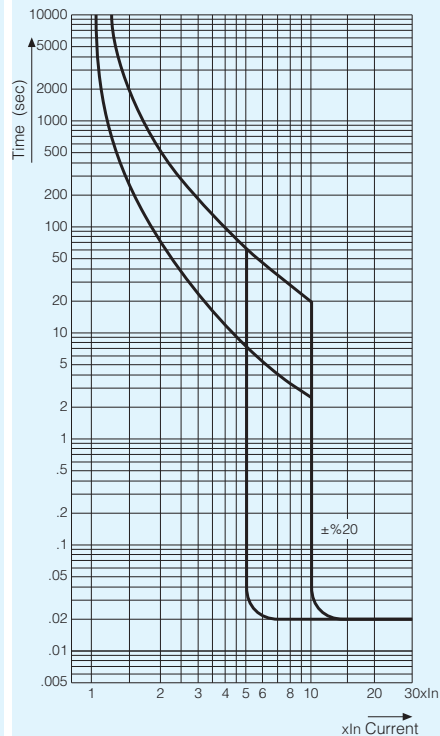
a: Standard Type (min. 600A)  
b: Motor Protection Type (min. 600A)

**F51-F52-F53**  
Thermal magnetic type circuit breaker

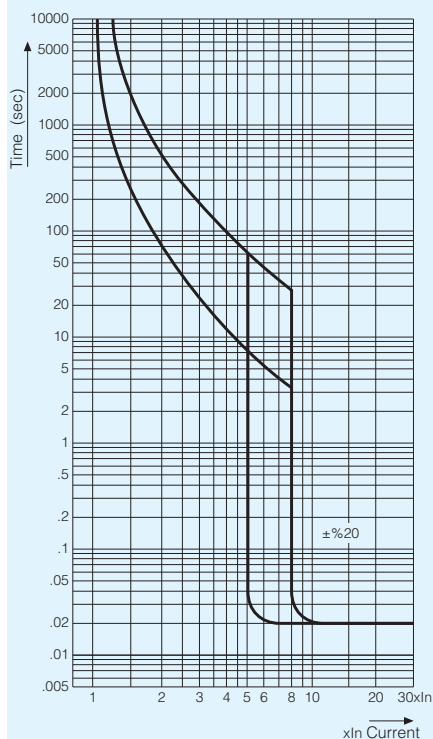


a: 125-160A=5-10In  
200-300A=4-10In  
400A 3-8In

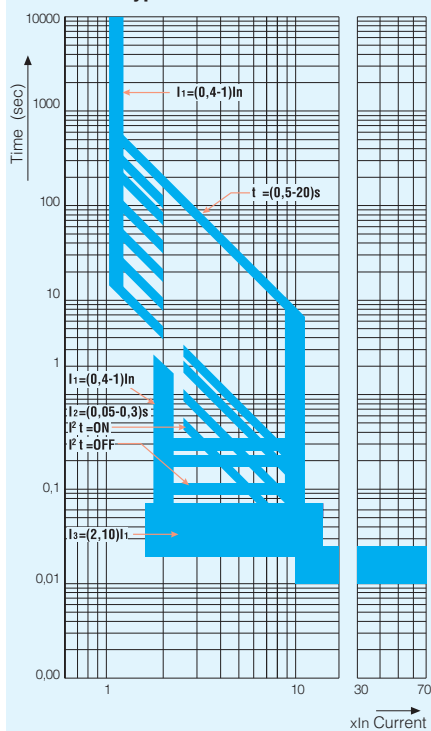
**F61-F62/F71-F72**  
Thermal magnetic type circuit breaker



**F82-F83**  
Thermal magnetic type circuit breaker



**F82E-F83E/F91E-F92E  
F101E-F102E/F111E-F112E**  
Electronic type circuit breaker



# MOLDED CASE CIRCUIT BREAKERS

Power losses for per pole (W)																								
Rated Current (A)																								
	16	20	25	32	40	50	63	80	100	125	160	200	225	250	300	400	500	630	800	1000	1250	1600	2000	2500
F12	6.5	6.5	7	5	5	6.5	10	8.5	12.5	13	13													
F31	4	4	4	4.5	5.5	7	9.5	8	10.5	12	15	21	25	28										
F32	4	4	4	4.5	5.5	7	9.5	8	10.5	12	15	21	25	28										
F33	4	4	4	4.5	5.5	7	9.5	8	10.5	12	15	21	25	28										
F51										23	20.5	28	23	25.5	36.5	45								
F52										23	20.5	28	23	25.5	36.5									
F53										23	20.5	28	23	25.5	36.5									
F61															26	40								
F62															26	40								
F71															31	30	39	53	54					
F72															31	30	39	53	54					
F82															32	38	38	53	54					
F83															32	38	38	53	54					
F82E															10	17	26	42	54					
F83E															10	17	26	42	54					
F91E																				55	85			
F92E																				55	85			
F101E																				40	60	100		
F102E																				40	60	100		
F111E																						54	84	132
F112E																						54	84	132

Molded Case Circuit Breakers Selection Table																											
Breaking Capacity	kA	70											F53									F102E					
			F33															F83 / F83E							F112E		
		65																				F92E					
			F02										F52									F101E					
		50															F82 / F82E					F91E		F111E			
			F32															F71-F72									
		35	F01																								
													F51														
25	F31										F62																
	F12														F61												
Molded Case Circuit Breakers			16	20	25	32	40	50	63	80	100	125	160	200	225	250	300	400	500	630	800	1000	1250	1600	2000	2500	
			A																								
			Rated Current																								

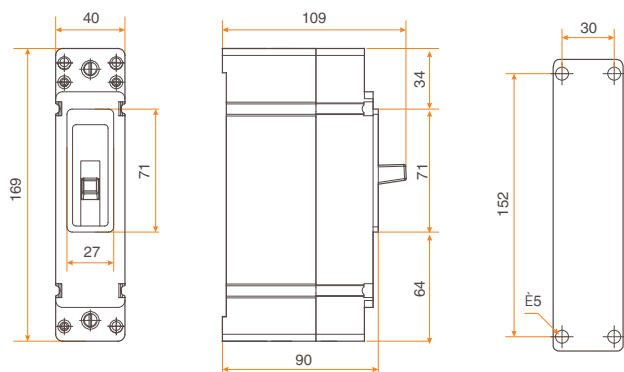
## ELECTRICAL SPECIFICATION OF CONDUCTOR MATERIALS:

Material		Self-conductivity (K) m/Ω.mm <sup>2</sup>
Silver	Ag	63
Copper	Cu	58
Gold	Au	45
Aluminium	Al	36
Magnesium	Mg	23
Molybdenum	Mo	18
Wolfram	W	17
Zinc	Zn	16
Cadmium	Cd	13
Brass	Cu (%86)+Zn (%35)	12
Nickel	Ni	11

Material		Self-conductivity (K) m/Ω.mm <sup>2</sup>
Iron	Fe	10
Platinum	Pt	9
Tin	Sn	8
Bronze	Cu (%88)+Sn (%12)	6
Lead	Pb	4.8
Manganin	Cu (%86)+Mn (%12)+Ni (%2)	2.3
Constantan	Cu (%55)+Ni (%45)	2
Bismuth	Bi	0.9
Graphite	C	0.125
Carbon	C	0.025

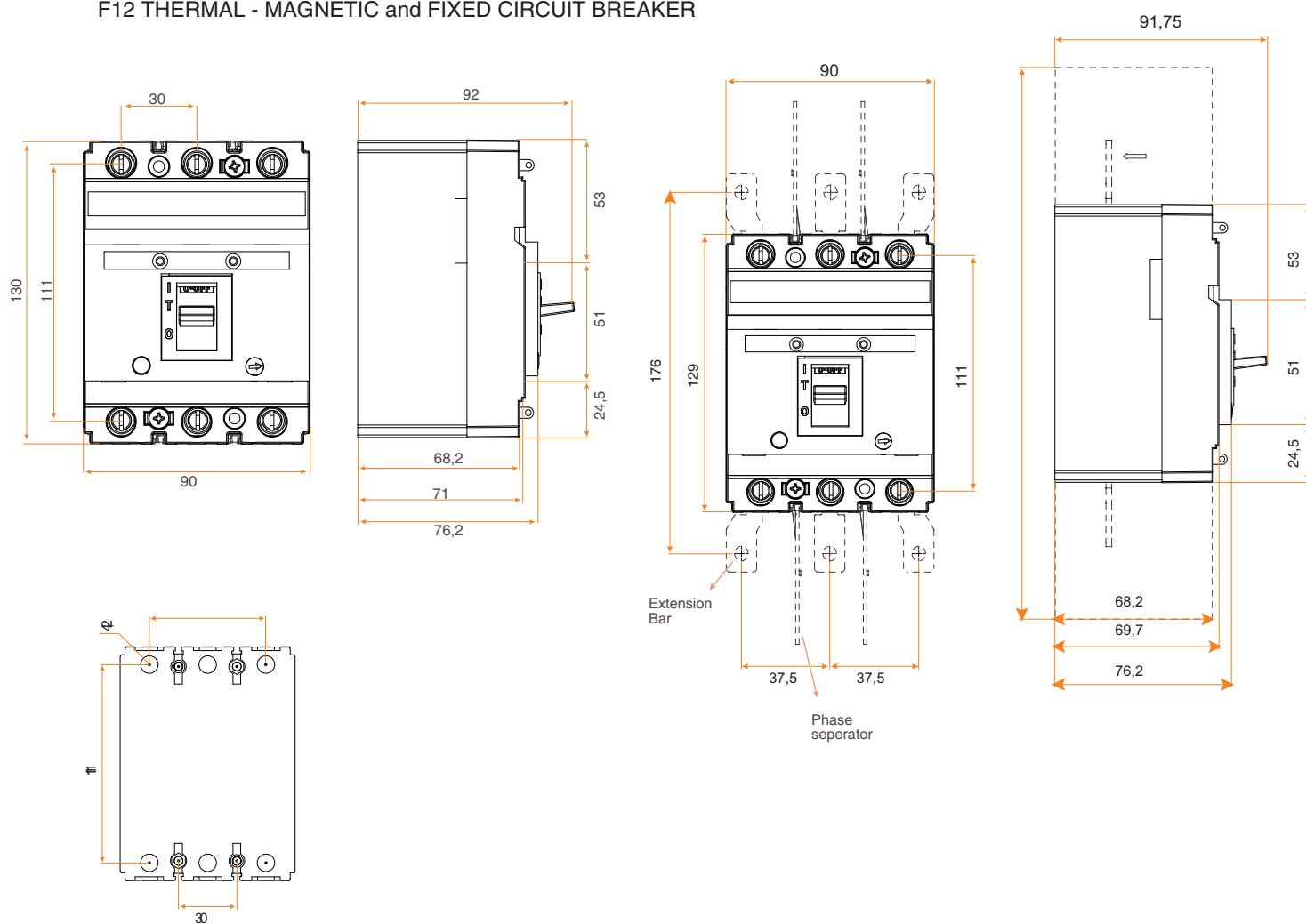
# MOLDED CASE CIRCUIT BREAKERS

F01 - F02



Assembling Gauge

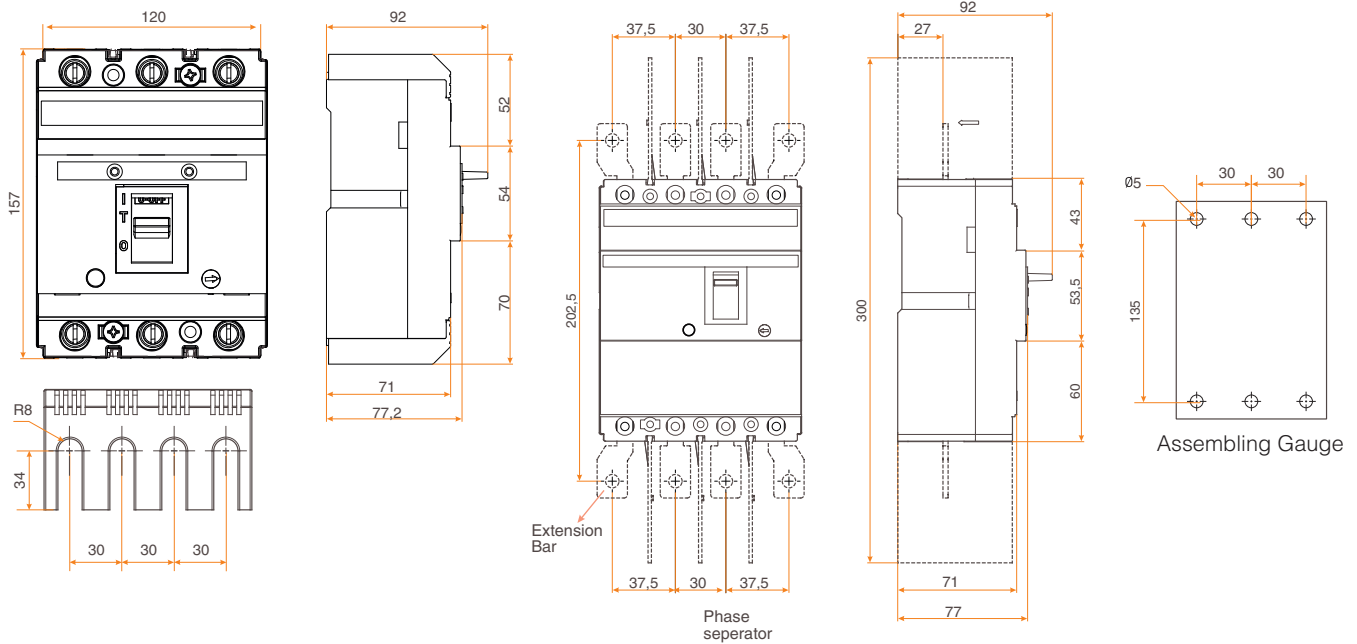
F12 THERMAL - MAGNETIC and FIXED CIRCUIT BREAKER



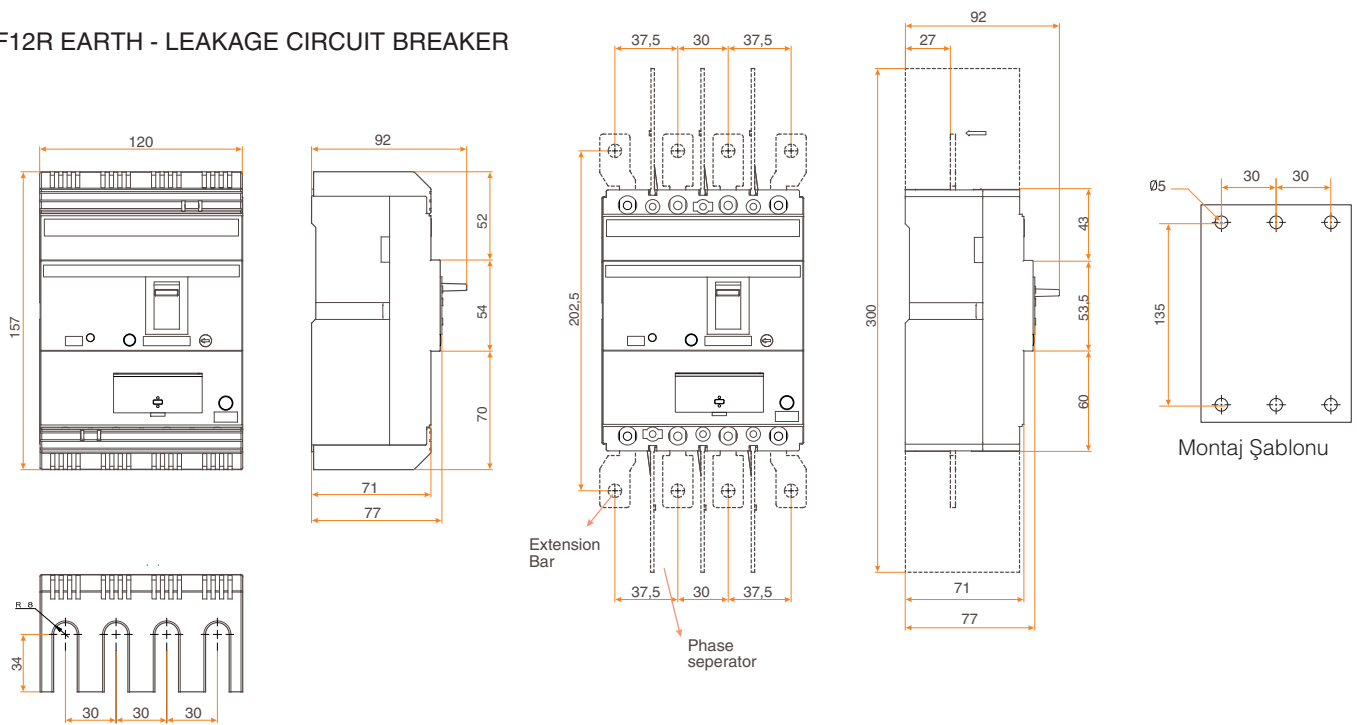
Assembling Gauge

# MOLDED CASE CIRCUIT BREAKERS

### F12N THERMAL ADJUSTABLE (4 Poles)



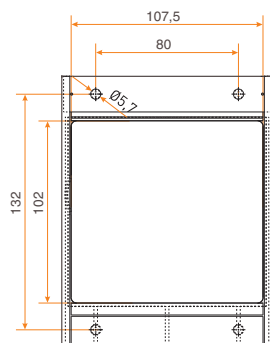
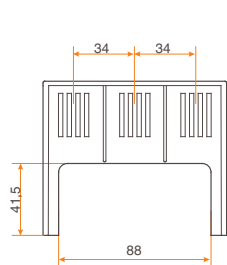
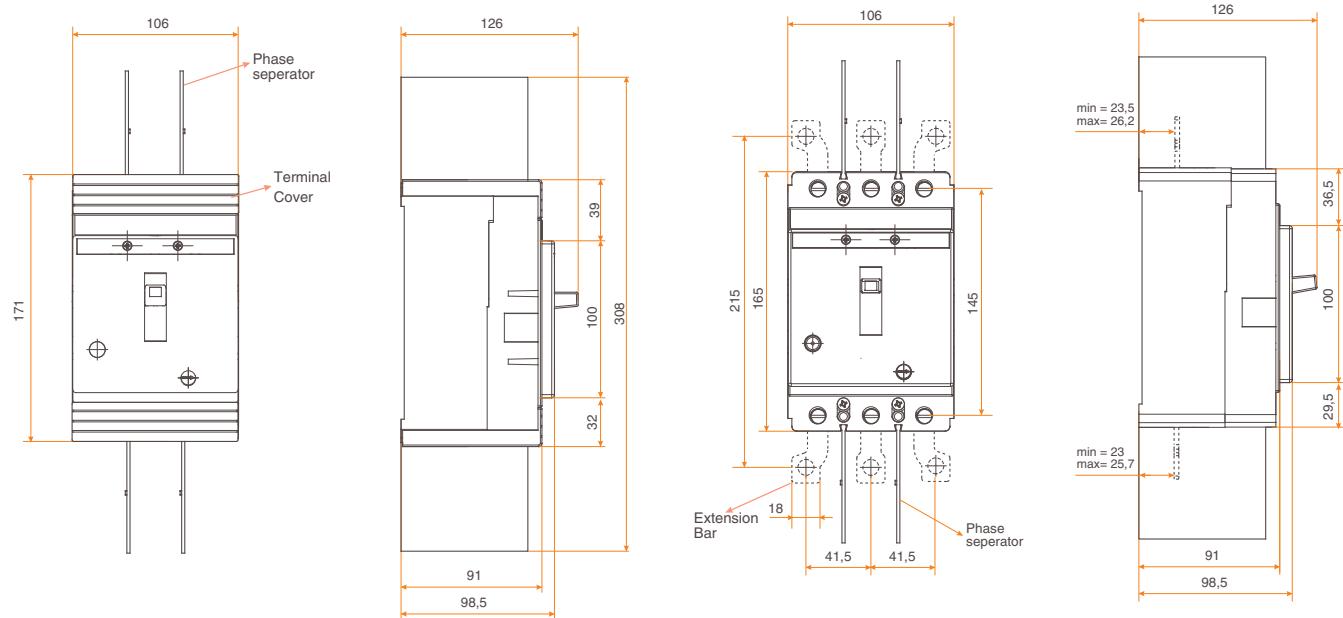
## F12R EARTH - LEAKAGE CIRCUIT BREAKER



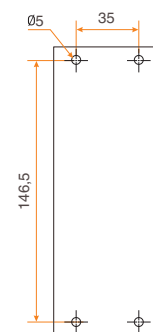
- - - - Shown parts with discrete lines are manufactured as per customer request.

# MOLDED CASE CIRCUIT BREAKERS

## F31 - F32 - F33 - F31S

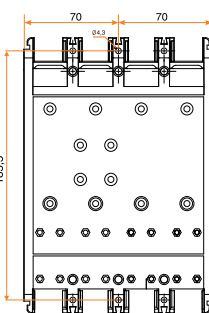
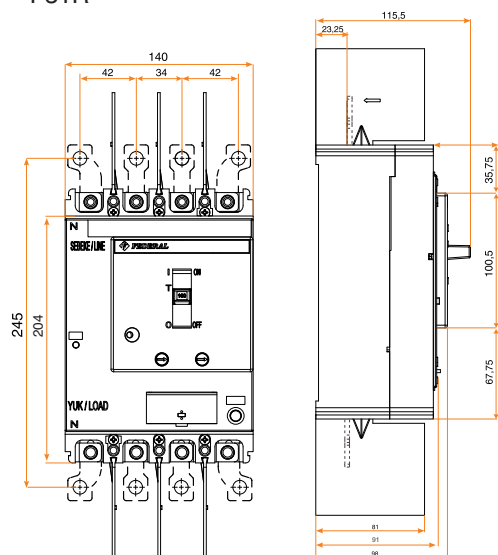


Panel Frame



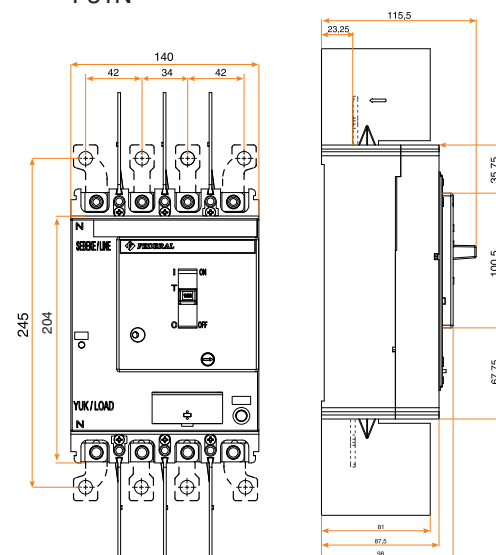
Assembling Gauge

## F31R



Assembling Gauge

## F31N

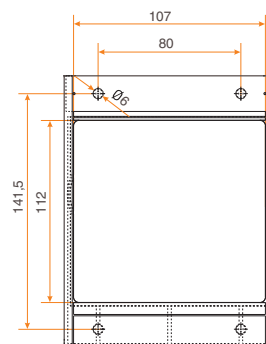
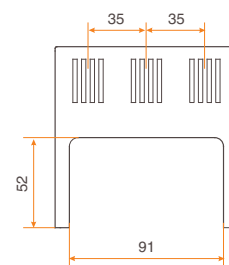
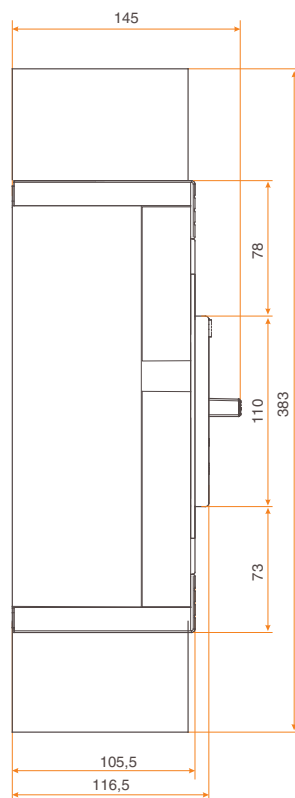
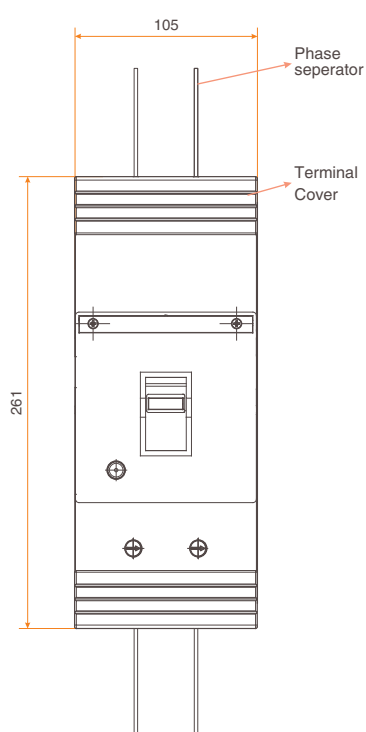


--- Shown parts with discrete lines are manufactured as per customer request.

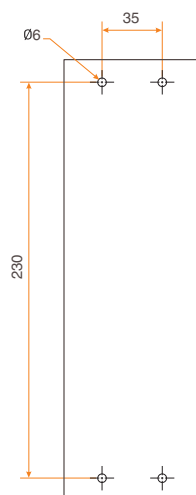
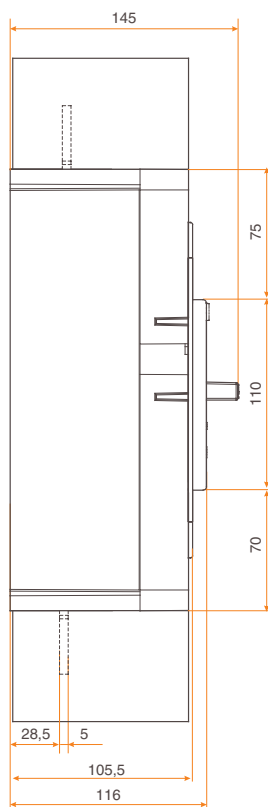
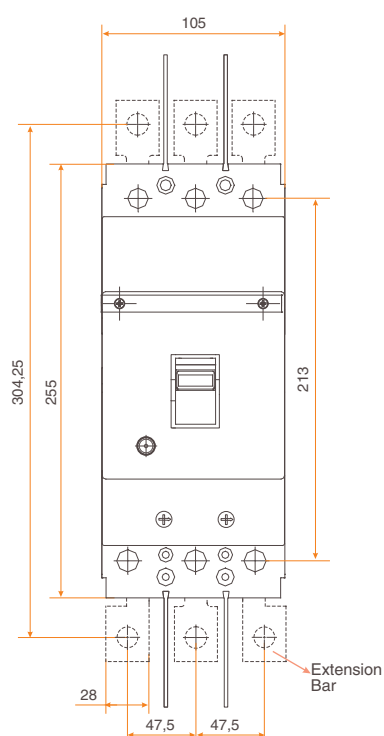


# MOLDED CASE CIRCUIT BREAKERS

F51 - F52 - F53



Panel Frame

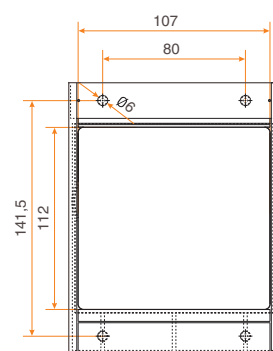
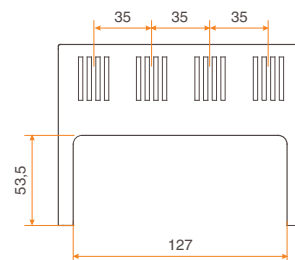
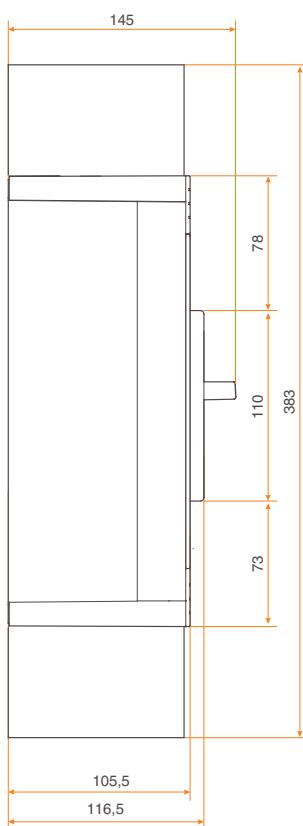
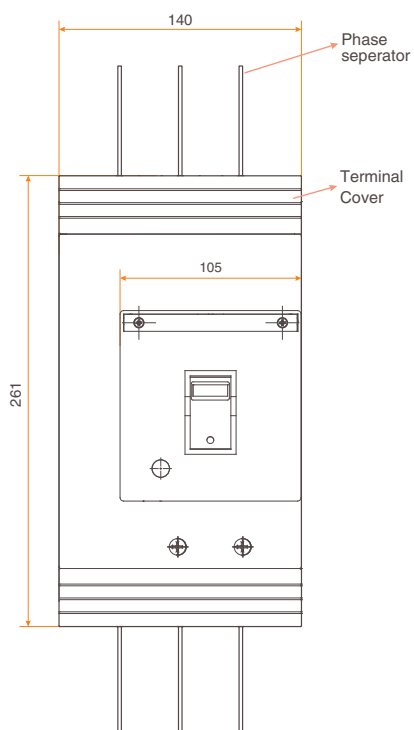


Assembling Gauge

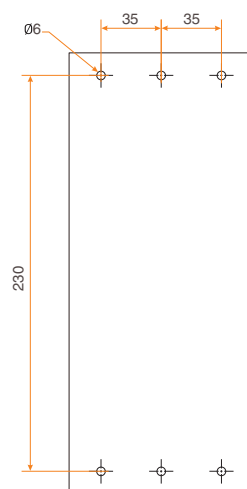
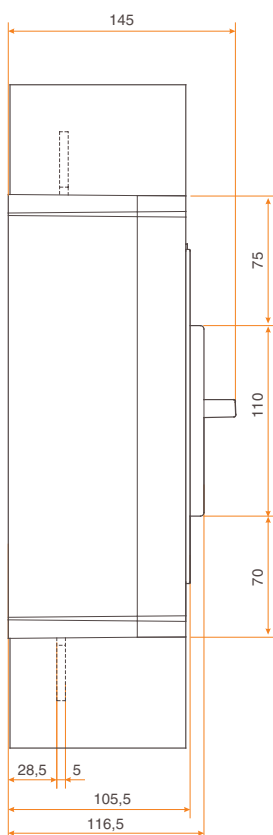
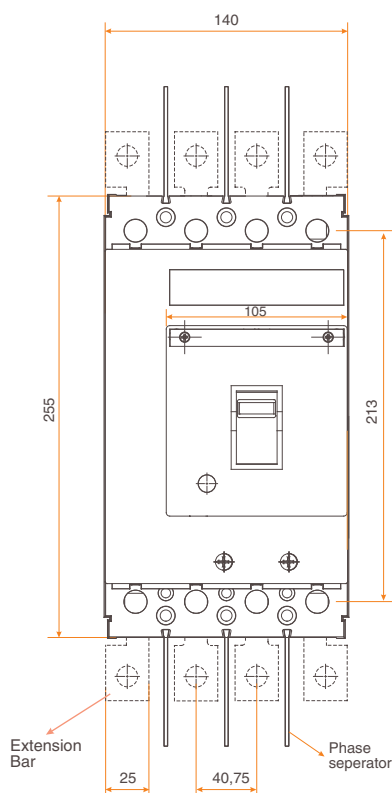
--- Shown parts with discrete lines are manufactured as per customer request, (only 300A-400A are produced with extension bar as a standard)

# MOLDED CASE CIRCUIT BREAKERS

F51N - F52N - F53N (4 Poles)



Panel Frame

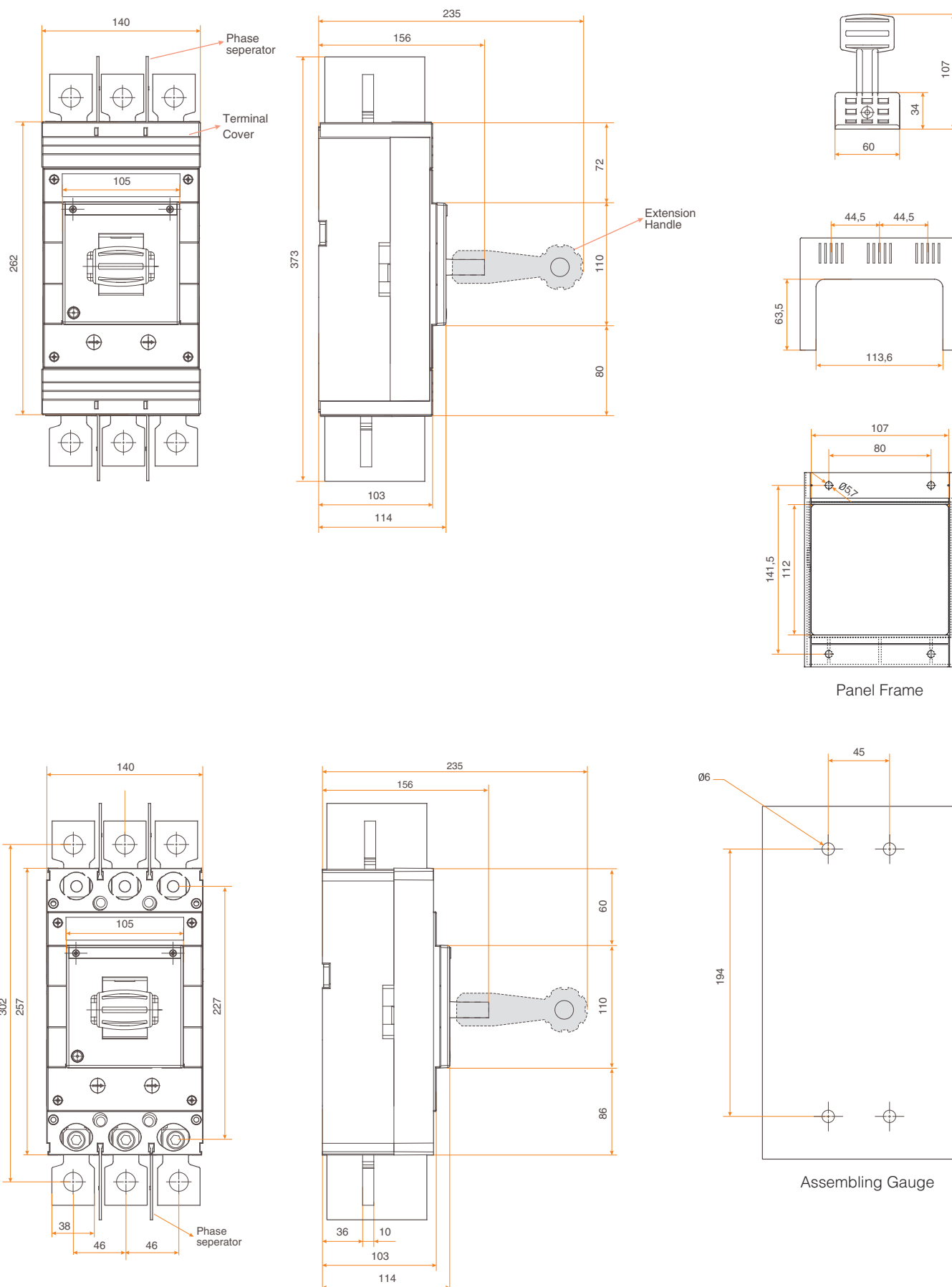


Assembling Gauge

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# MOLDED CASE CIRCUIT BREAKERS

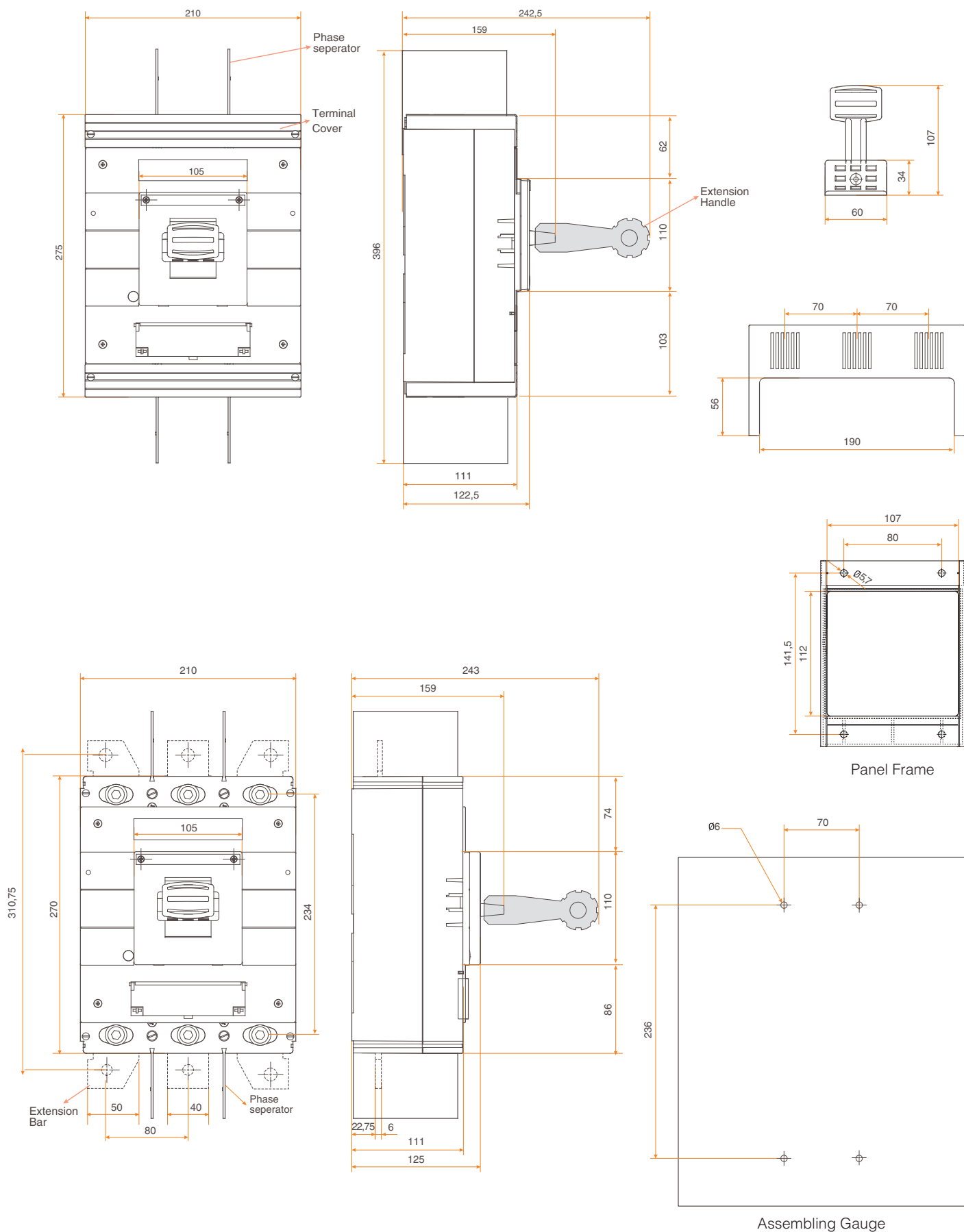
F61 - F62 - F61S



--- Shown parts with discrete lines are manufactured as per customer request.

# MOLDED CASE CIRCUIT BREAKERS

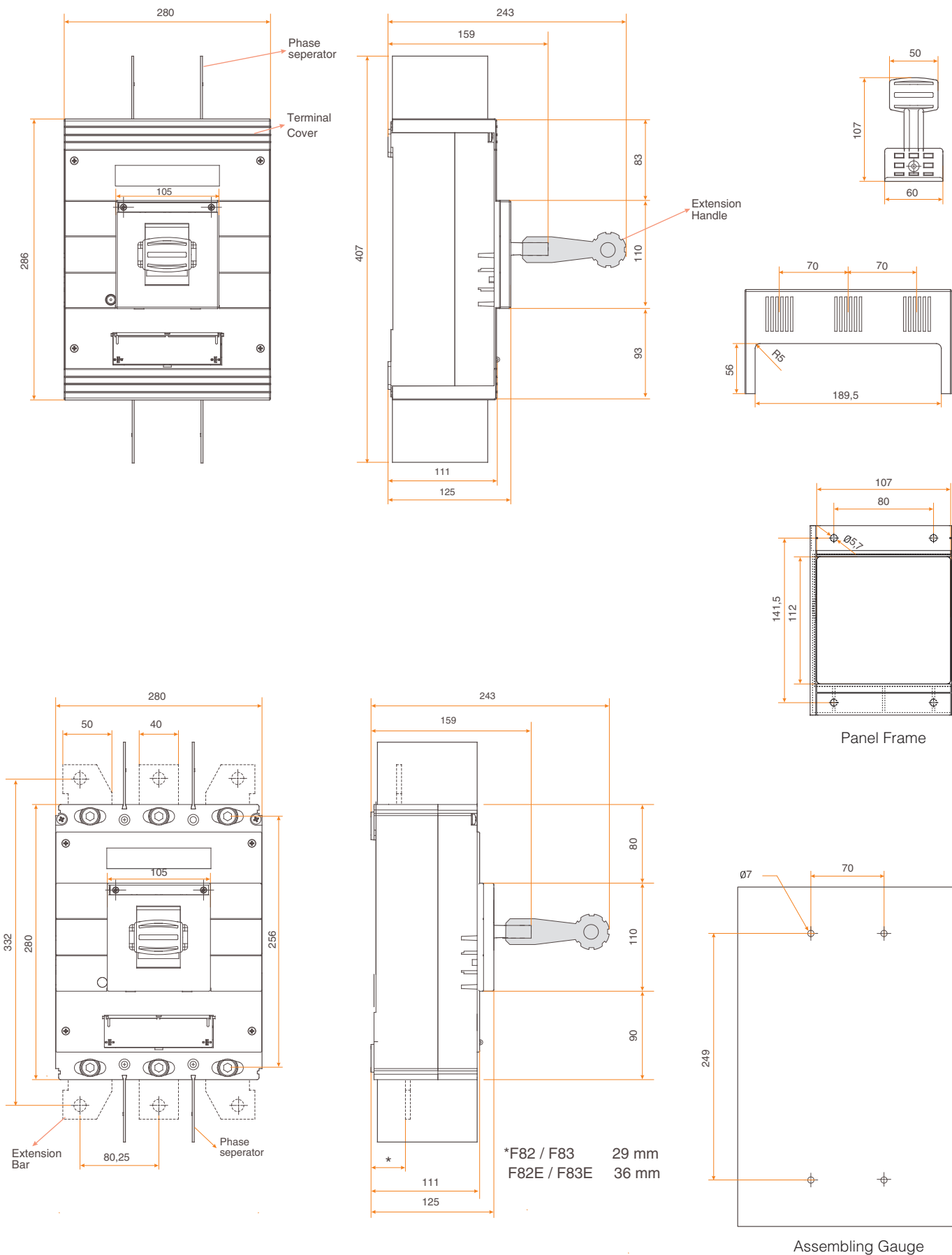
F71-F72



--- Shown parts with discrete lines are manufactured as per customer request.

# MOLDED CASE CIRCUIT BREAKERS

F82 - F83 - F82E - F83E

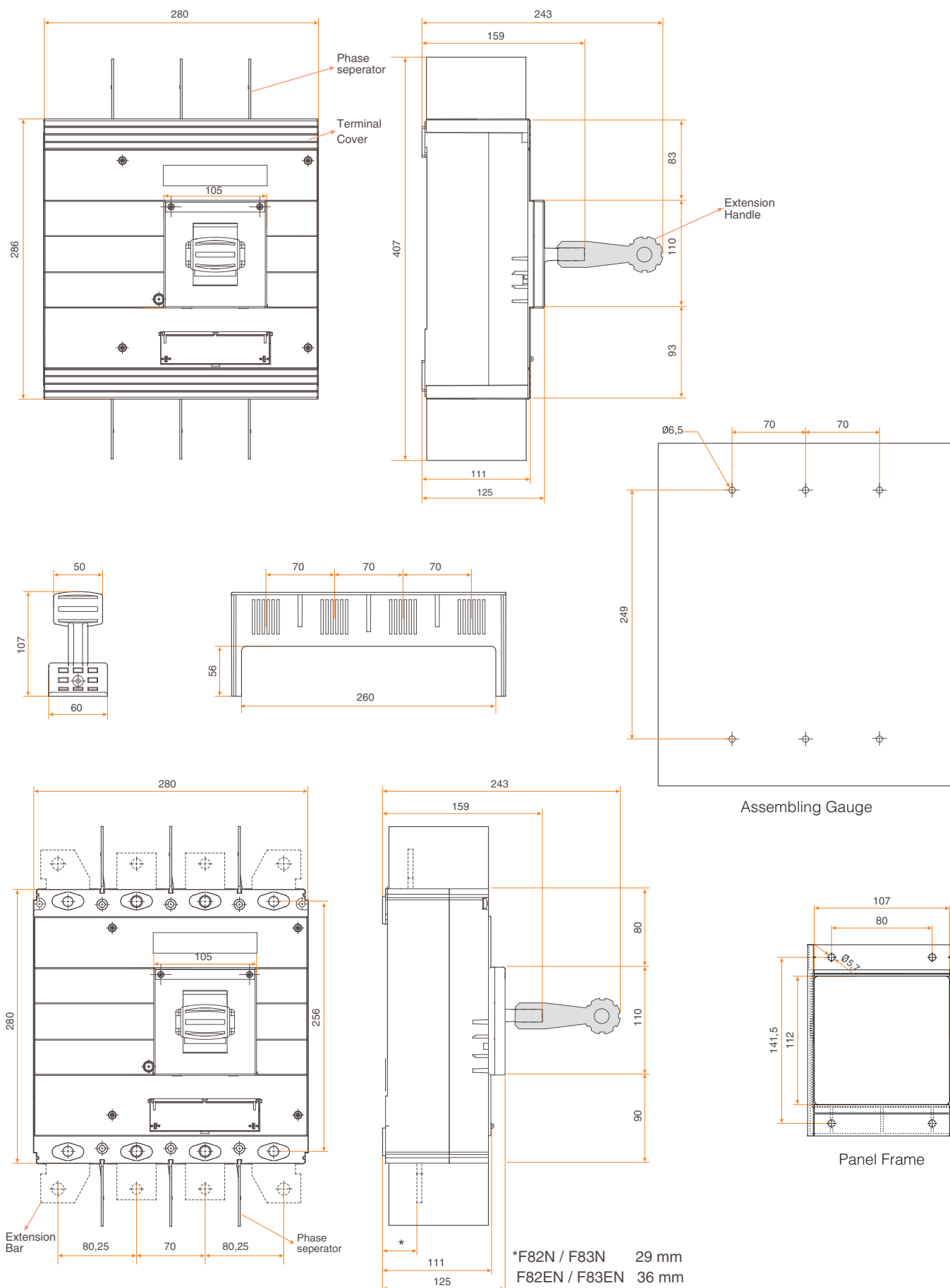


--- Shown parts with discrete lines are manufactured as per customer request.



# MOLDED CASE CIRCUIT BREAKERS

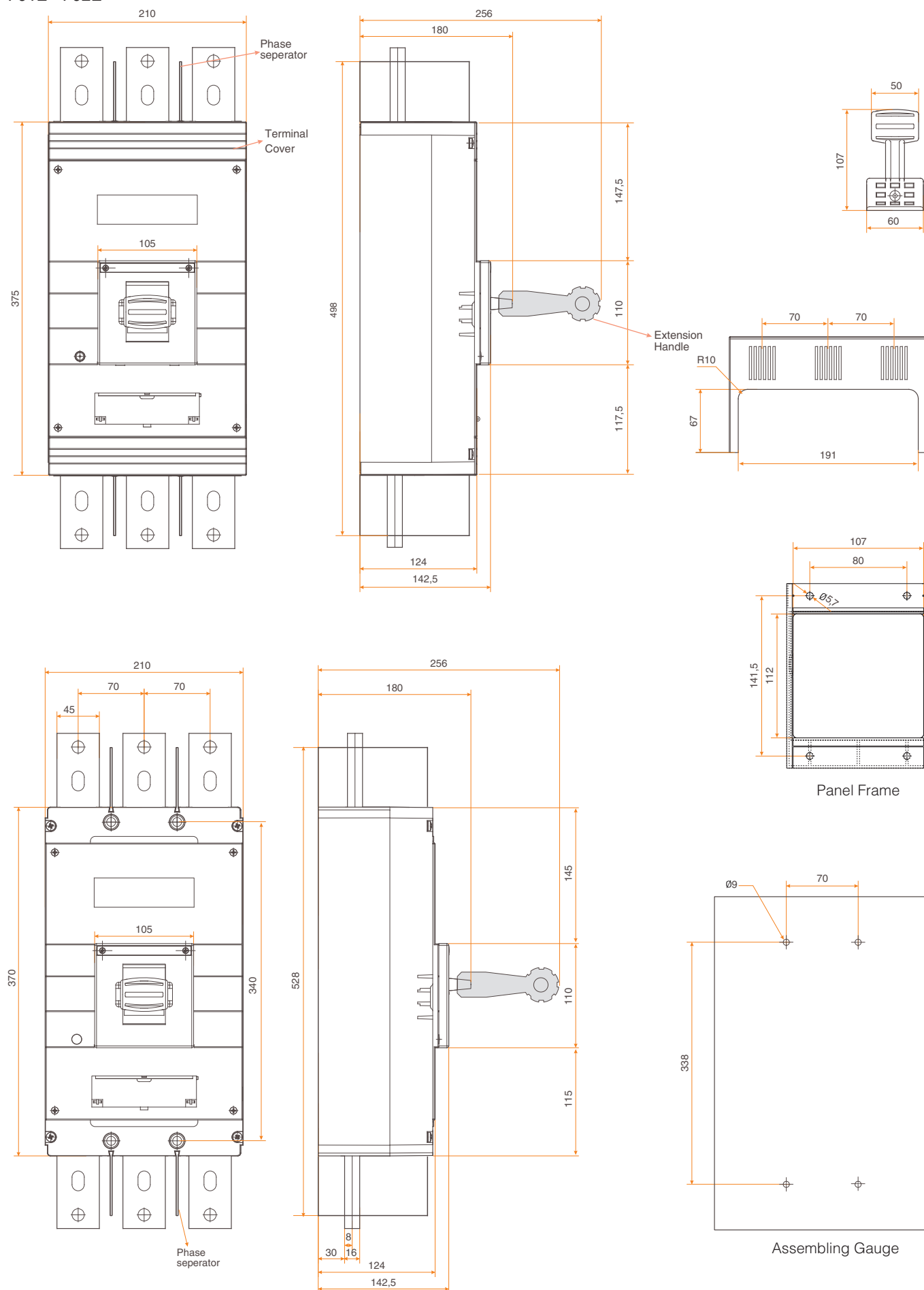
F82N - F83N - F82EN - F83EN



--- Shown parts with discrete lines are manufactured as per customer request.

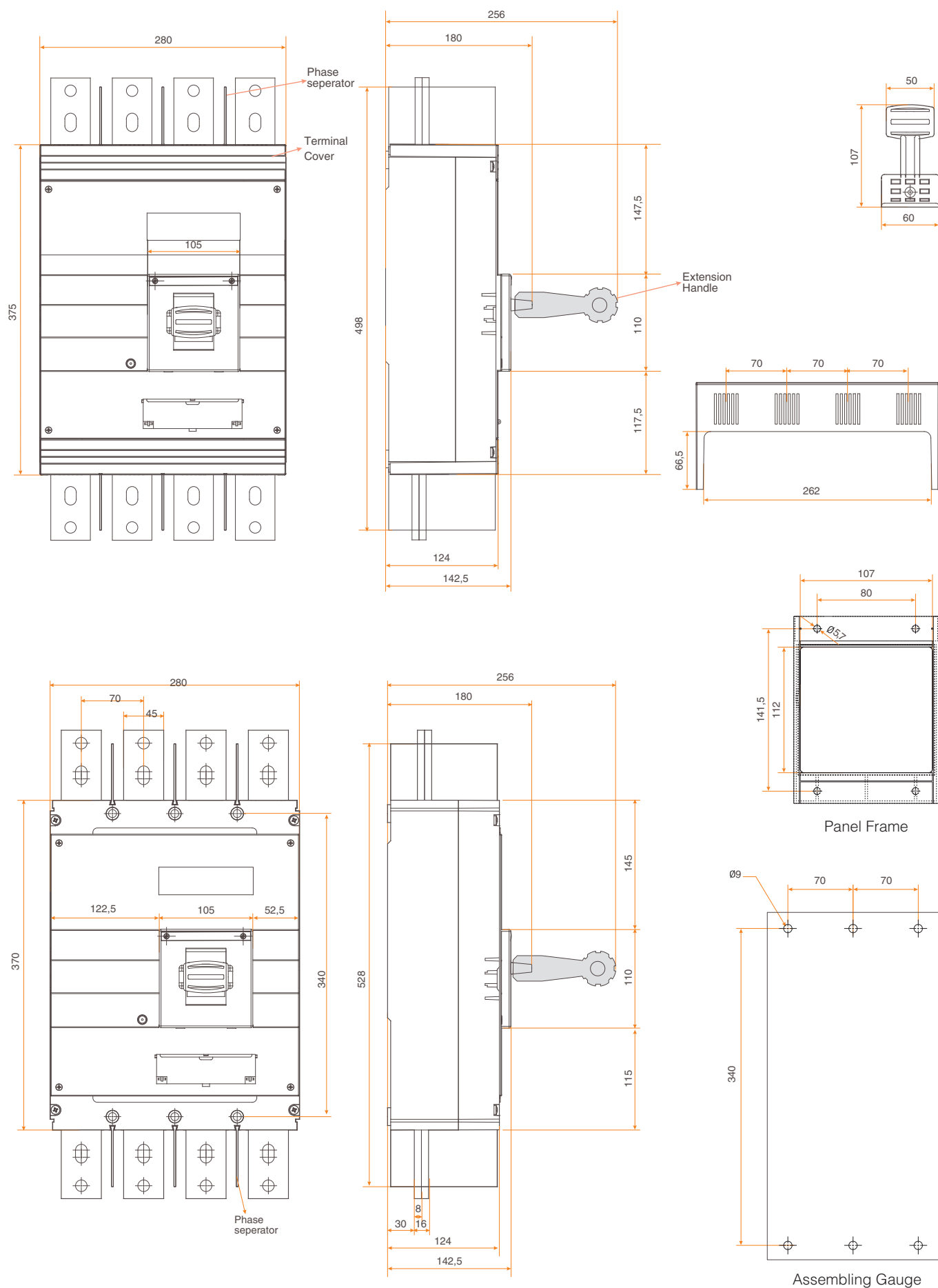
# MOLDED CASE CIRCUIT BREAKERS

F91E - F92E



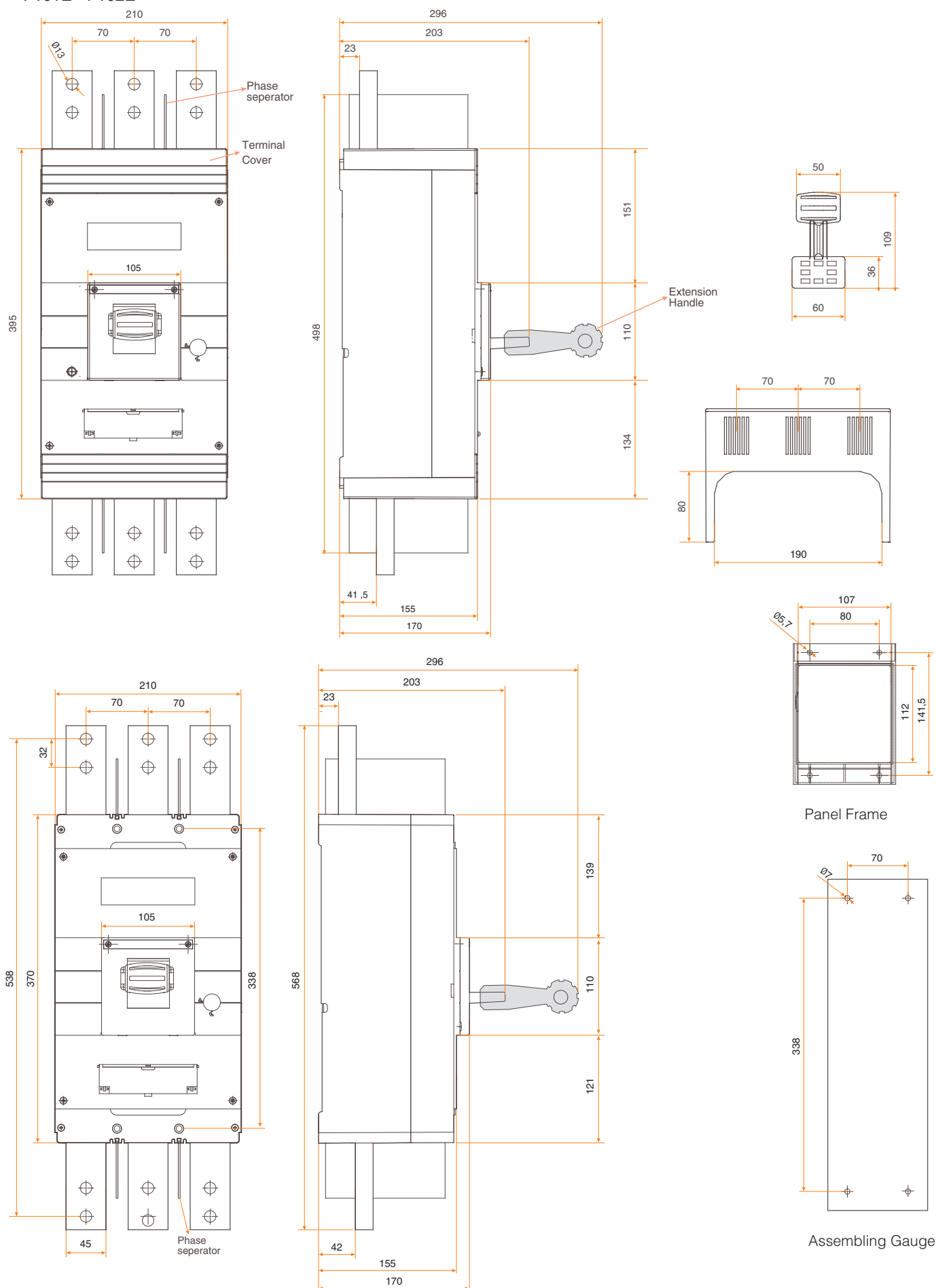
# MOLDED CASE CIRCUIT BREAKERS

F91EN -F92EN (4 Poles)



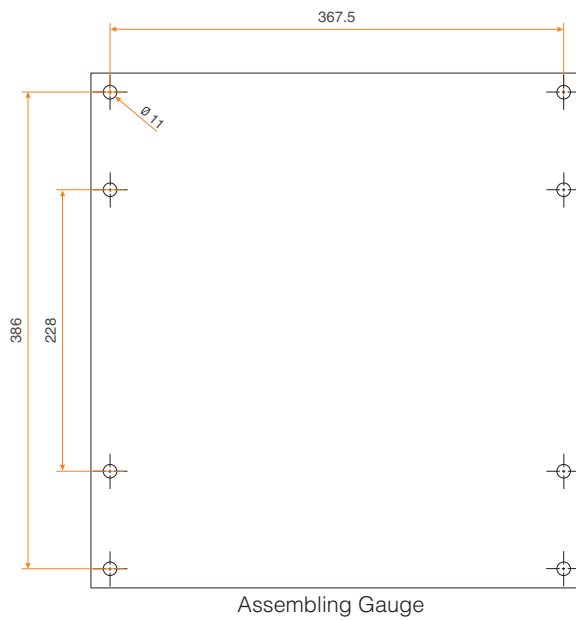
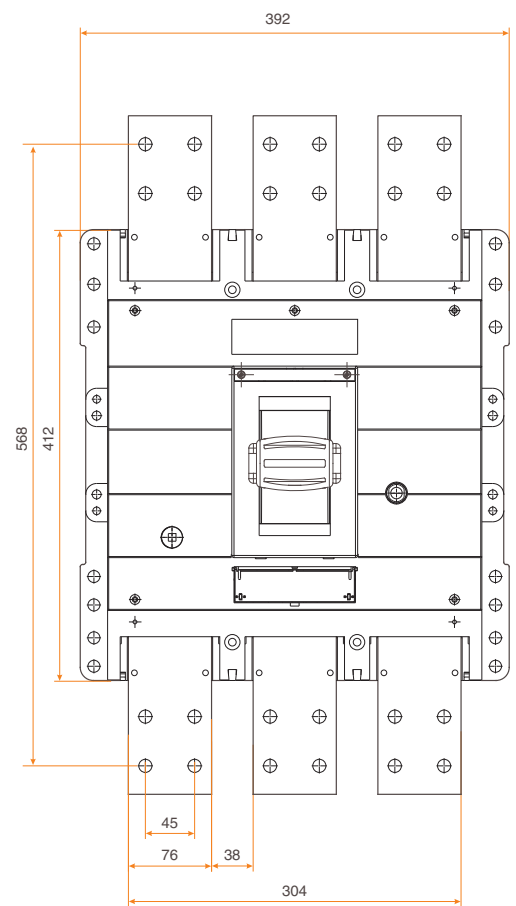
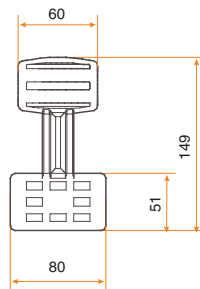
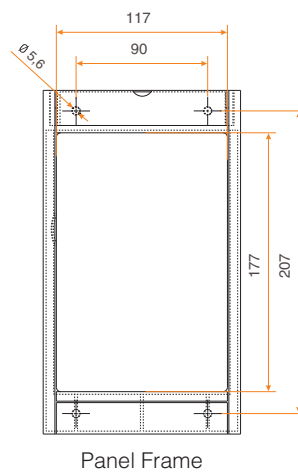
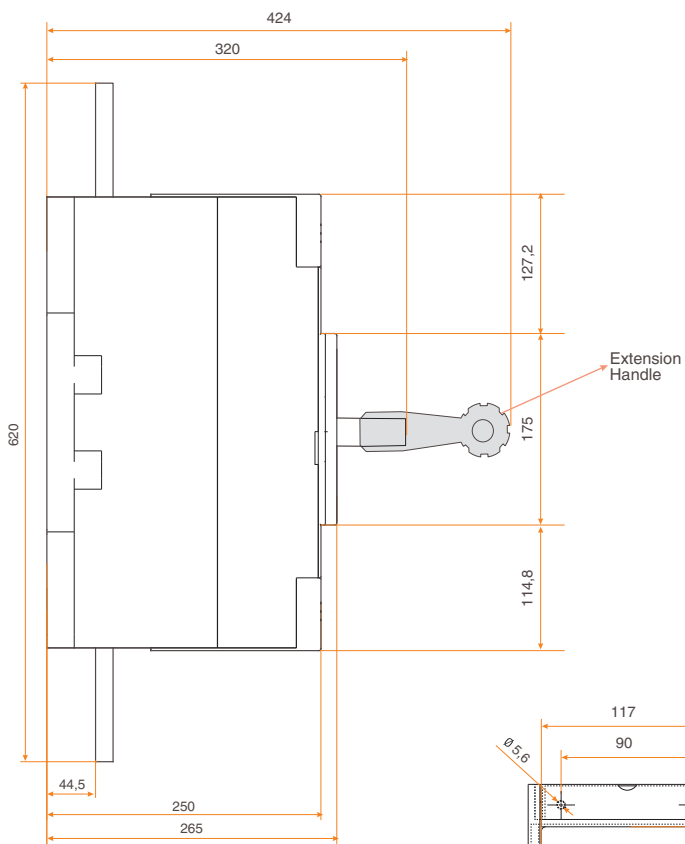
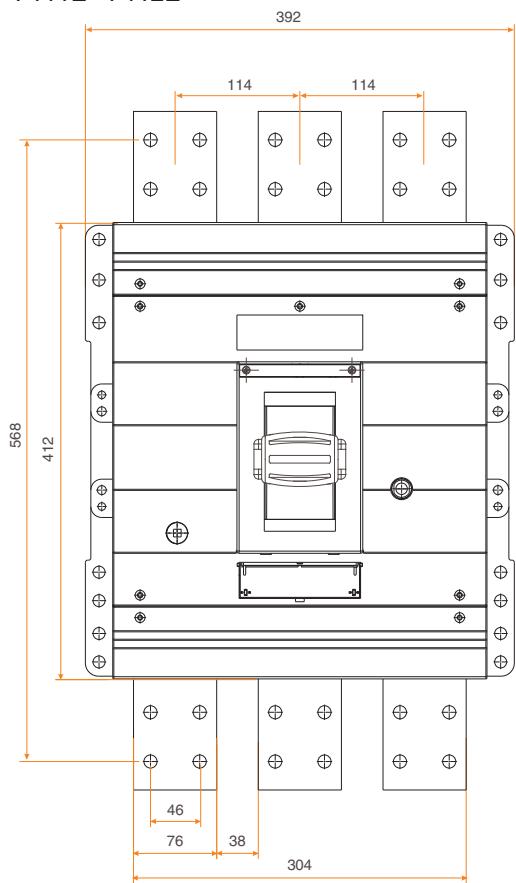
# MOLDED CASE CIRCUIT BREAKERS

F101E - F102E



# MOLDED CASE CIRCUIT BREAKERS

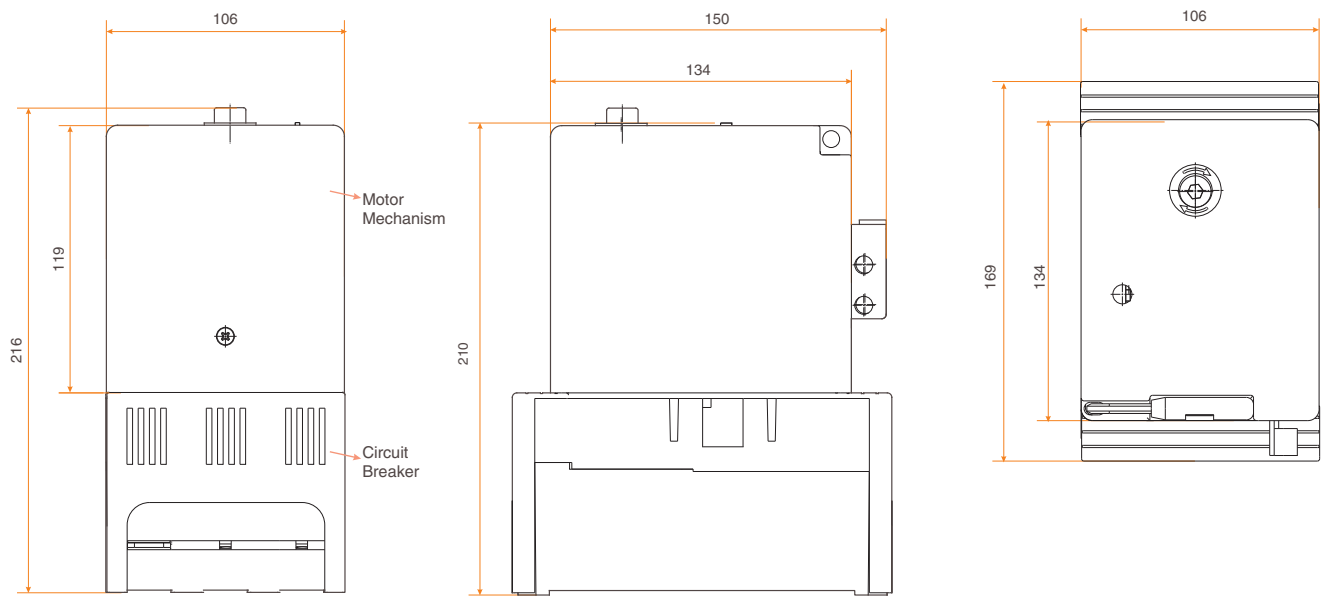
F111E - F112E



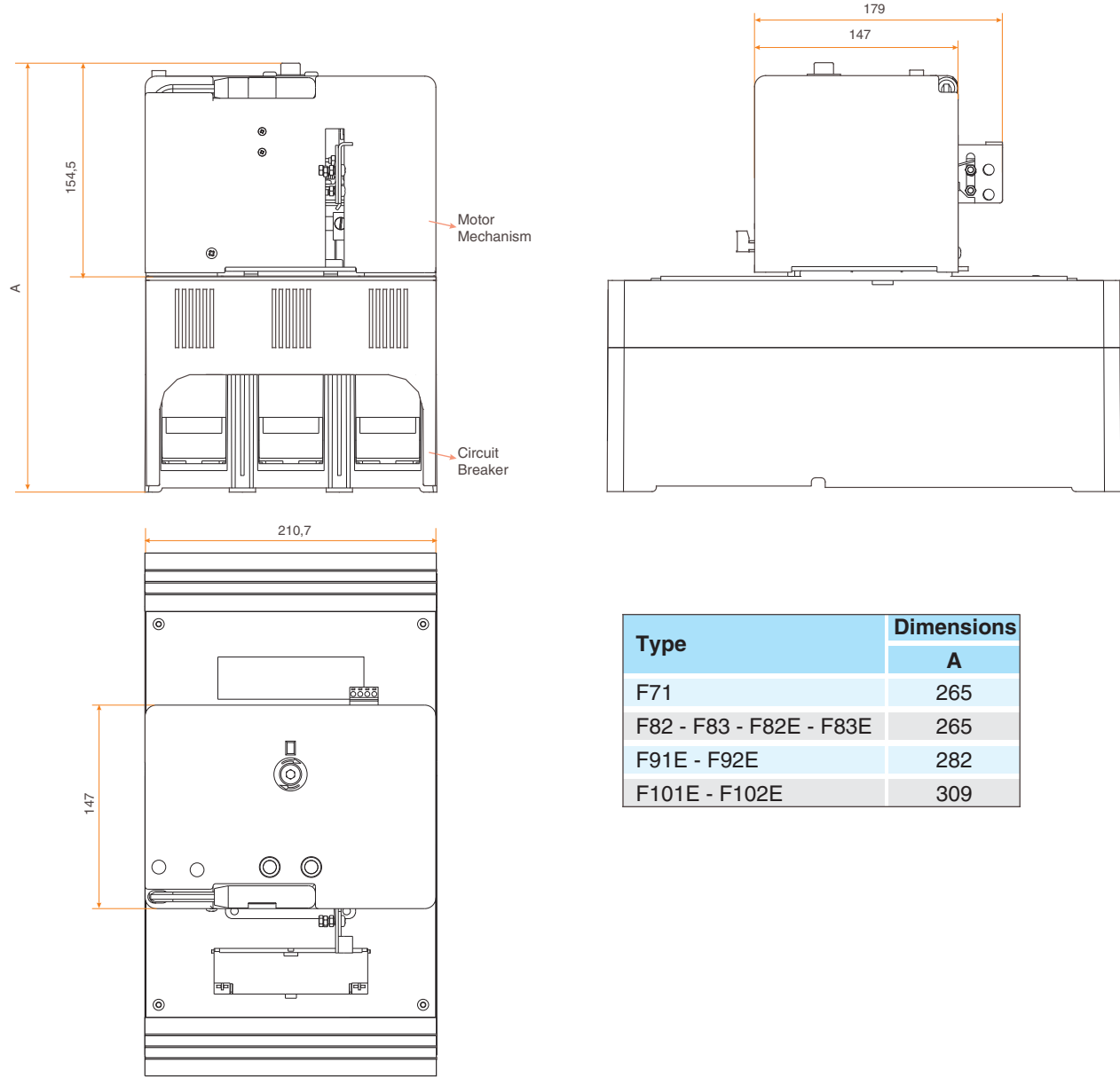


# MOLDED CASE CIRCUIT BREAKERS

## F31 - F32 - F33 - F31S MOTOR CONTROL MECHANISM



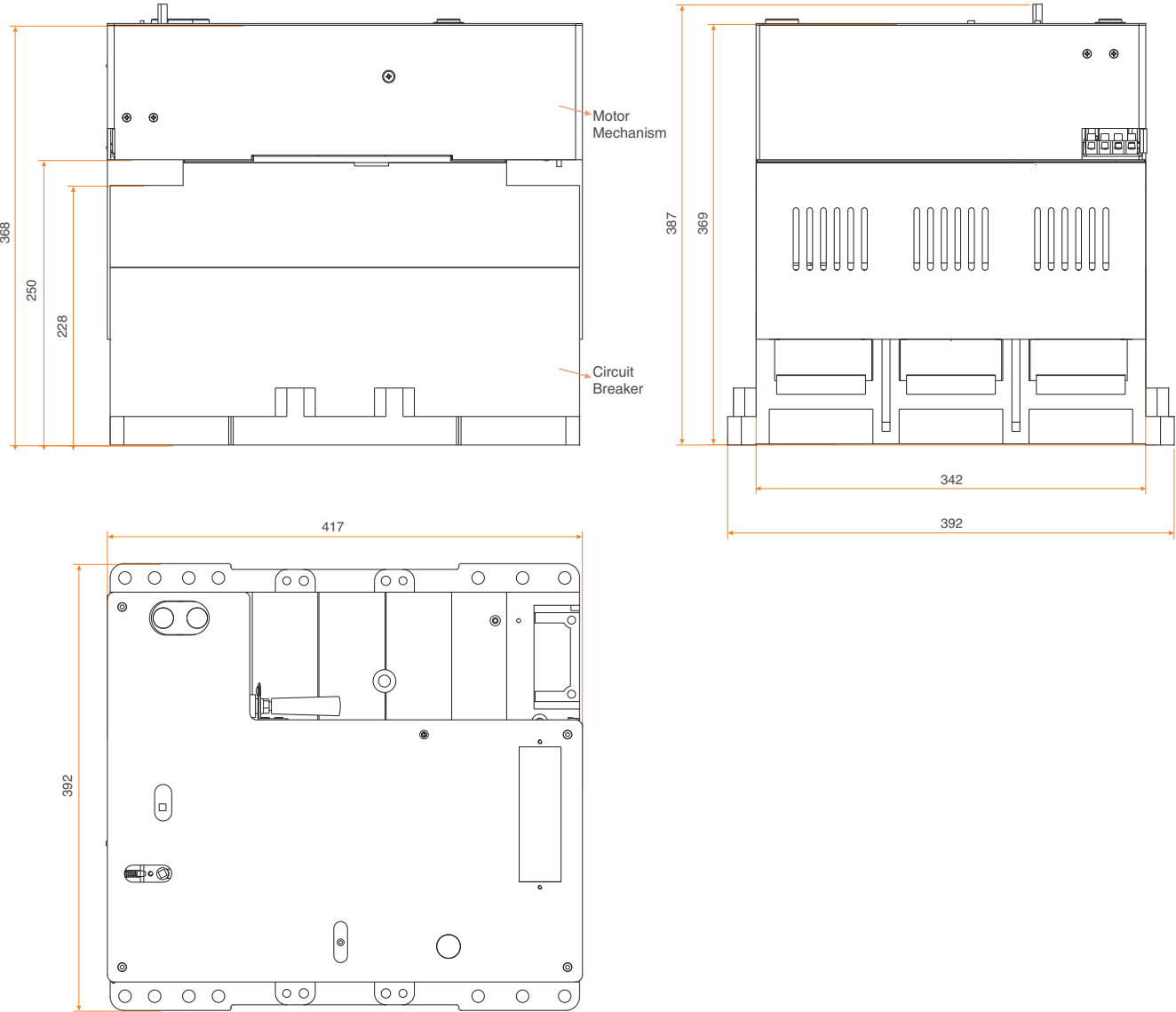
## F71 - F82 - F83 - F82E - F83E - F91E - F92E - F101E - F102E MOTOR CONTROL MECHANISM



Type	Dimensions
	A
F71	265
F82 - F83 - F82E - F83E	265
F91E - F92E	282
F101E - F102E	309

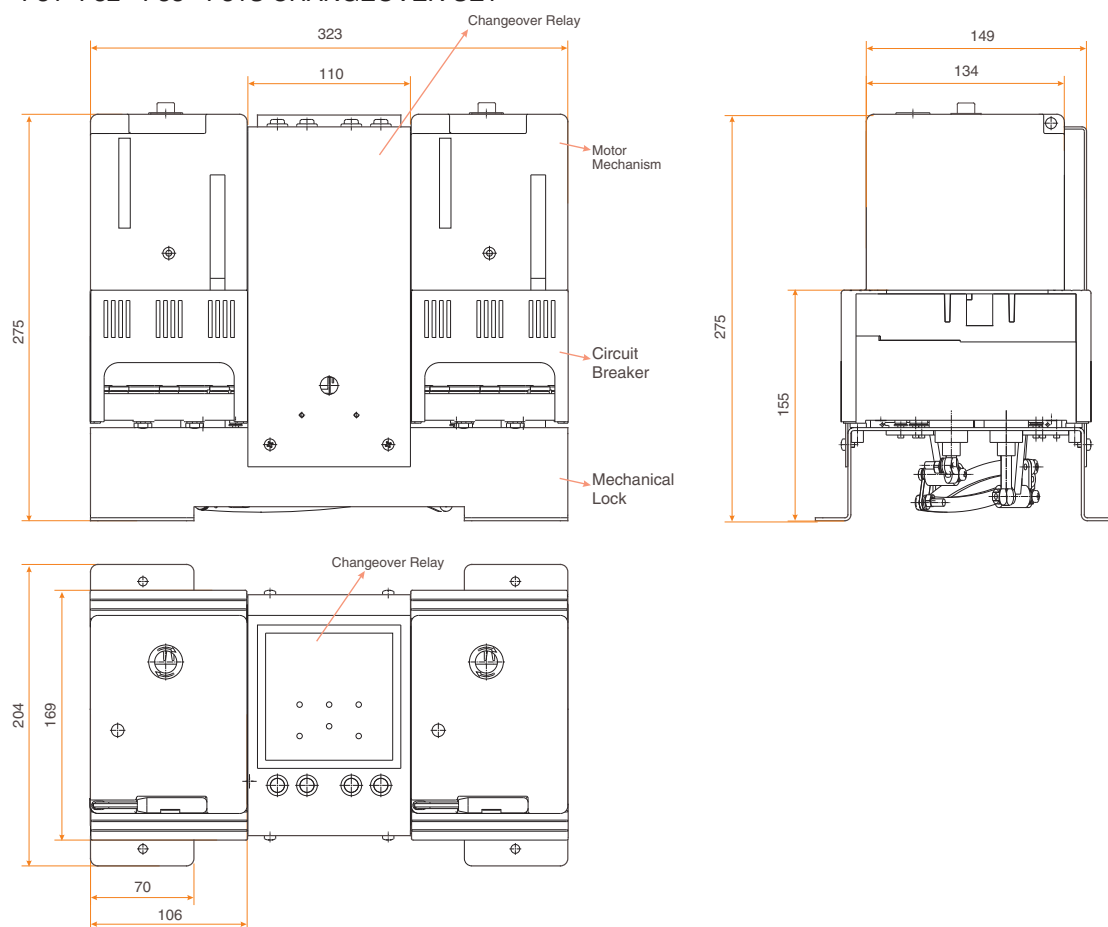
# MOLDED CASE CIRCUIT BREAKERS

## F111E - F112E MOTOR CONTROL MECHANISM

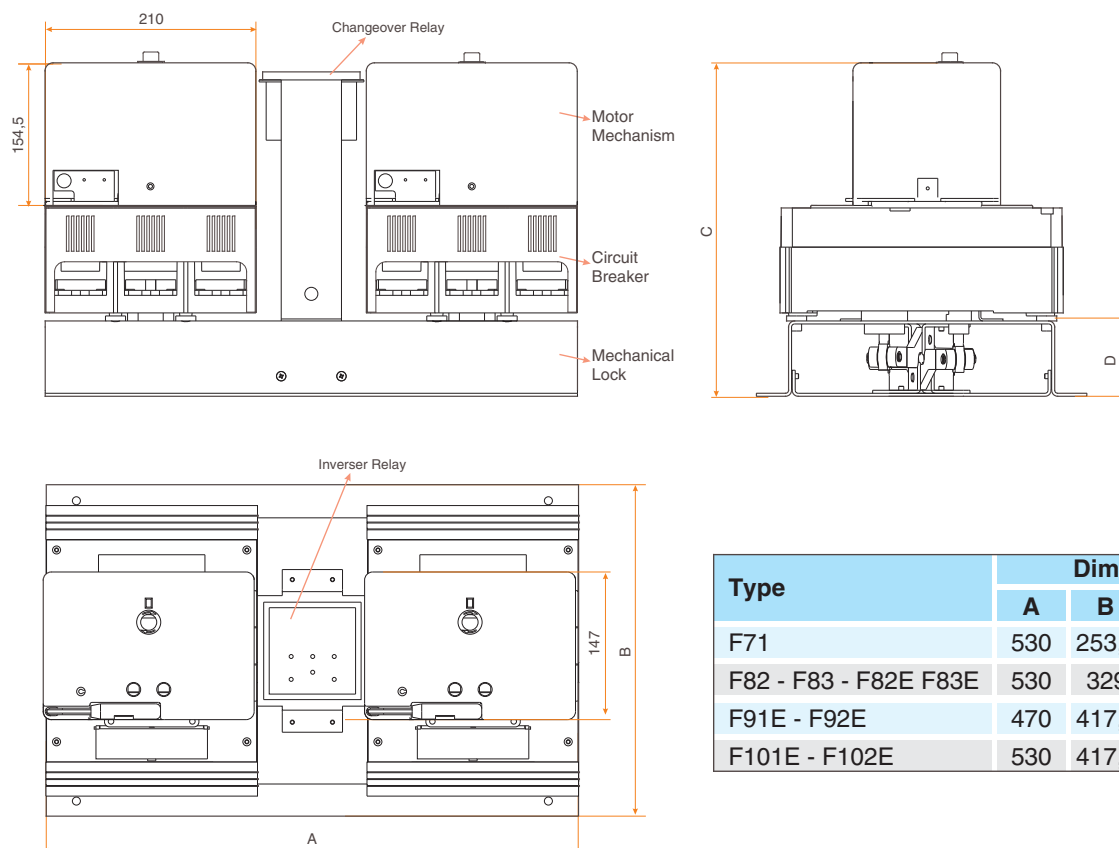


# MOLDED CASE CIRCUIT BREAKERS

## F31 - F32 - F33 - F31S CHANGEOVER SET



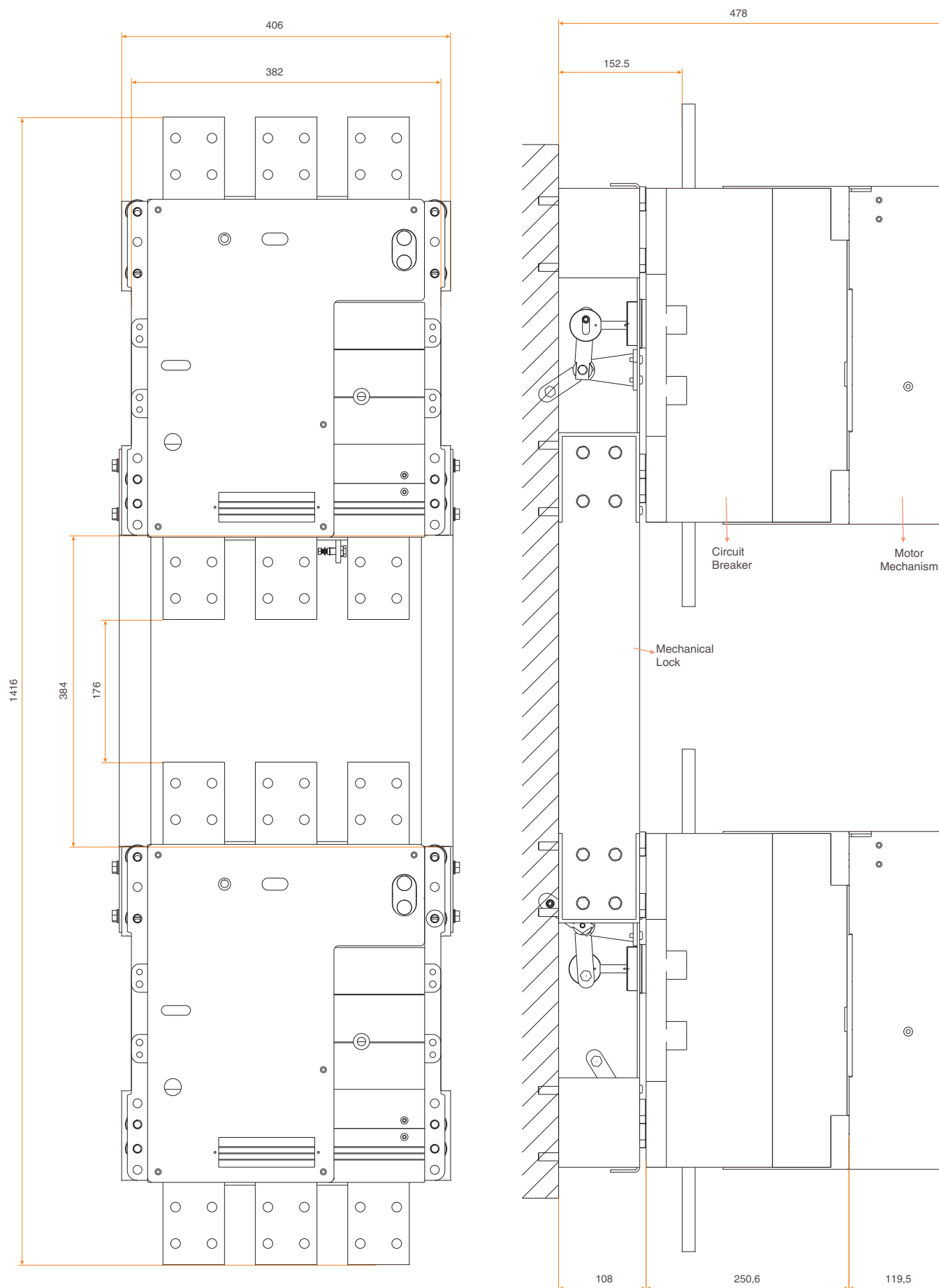
## F71 - F82 - F83 - F82E - F83E - F91E - F92E - F101E - F102E INVERSER SET



Type	Dimensions			
	A	B	C	D
F71	530	253,5	332	75
F82 - F83 - F82E F83E	530	329	340,5	75
F91E - F92E	470	417,5	363,5	75
F101E - F102E	530	417,5	395	75

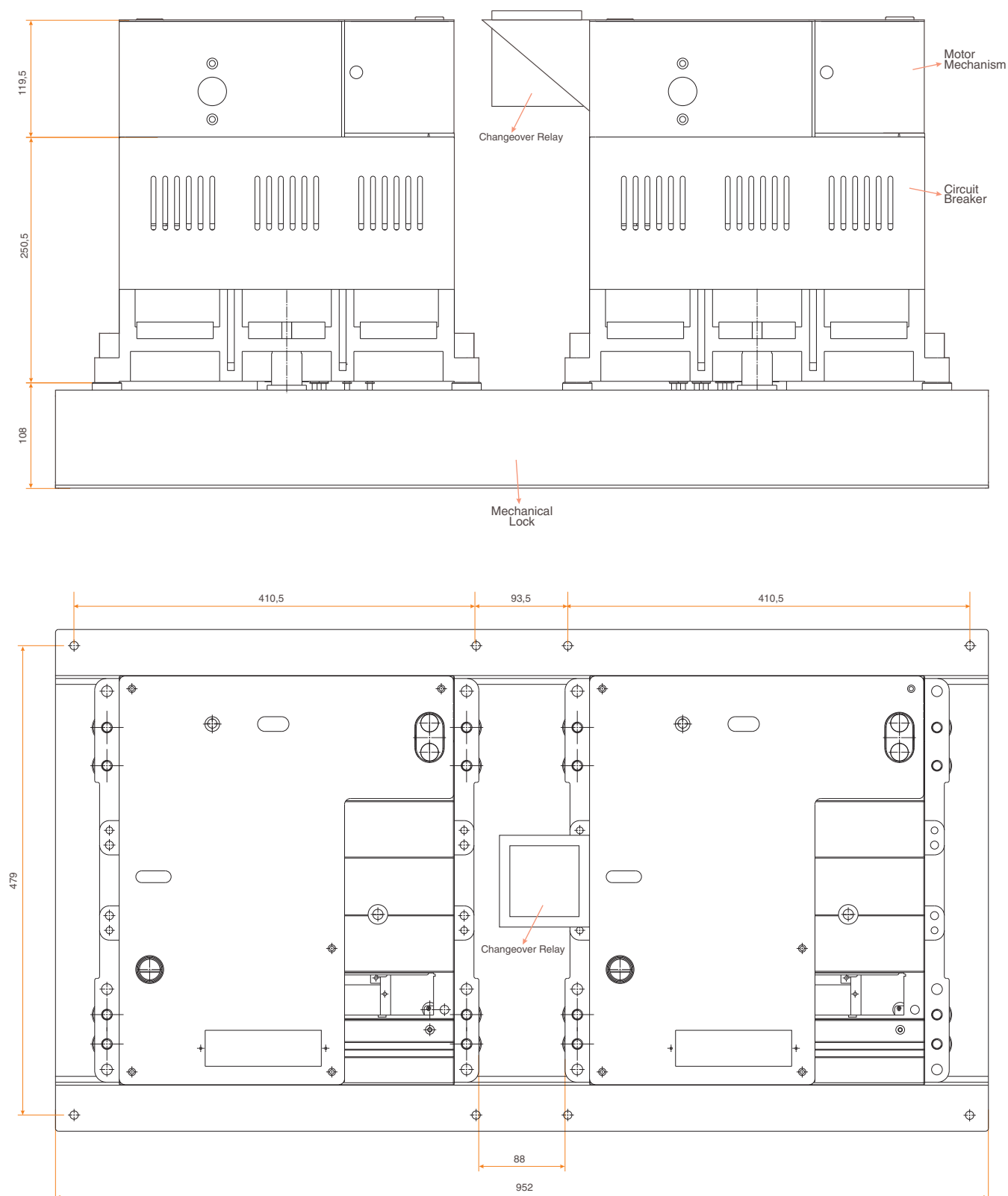
# MOLDED CASE CIRCUIT BREAKERS

F111E - F112E CHANGEOVER SET (VERTICAL)



# MOLDED CASE CIRCUIT BREAKERS

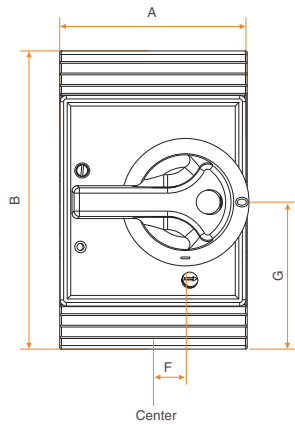
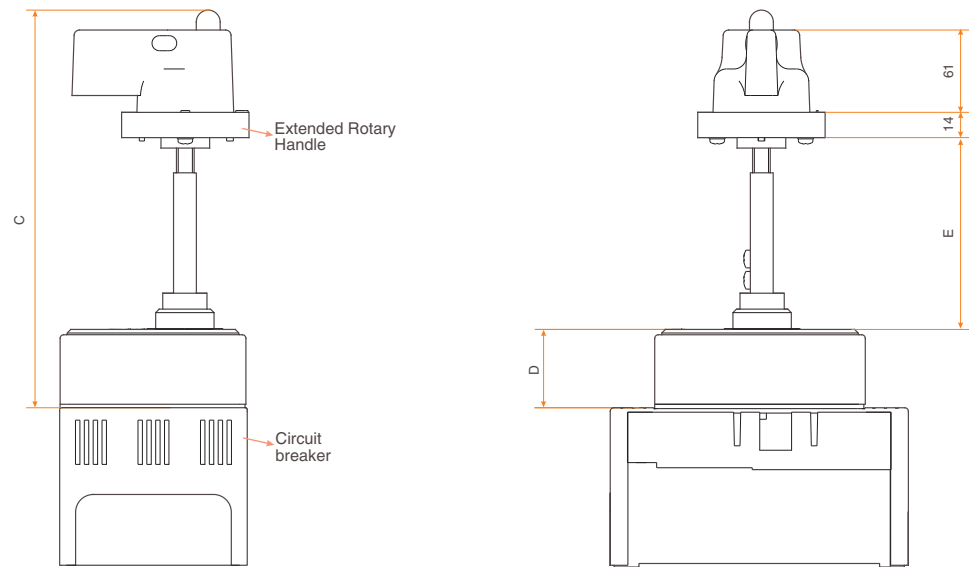
F111E - F112E CHANGEOVER SET (HORIZONTAL)



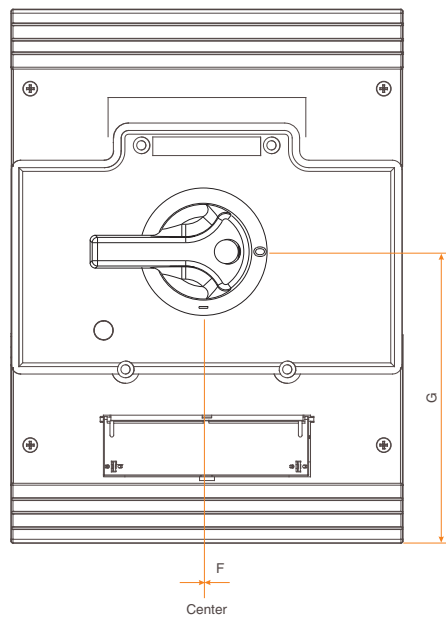


# MOLDED CASE CIRCUIT BREAKERS

## EXTENDED ROTARY HANDLE



Type	Dimensions							
	A	B	C	D	E		F	G
					min	max		
F31 - F32 - F33 - F31S	105	119,5	225	45	100	172	18	85
F51 - F52 - F53	105	119,5	225	45	100	172	18	125
F71 - F72	210	135	310	63,5	100	180	0	145
F82 - F83 - F82E - F83E	210	135	310	63,5	100	180	0	142
F91E - F92E	210	135	310	63,5	100	180	0	180



Please ask for special design dimensions CD, in case needed.

# AIR TYPE CIRCUIT BREAKERS



## Air Type Circuit Breakers (ACB)



**F121E / F122E / F123E**  
630A ... 2000A



**F131E / F132E / F133E**  
2500A ... 3200A



**F141E / F142E / F143E**  
4000A

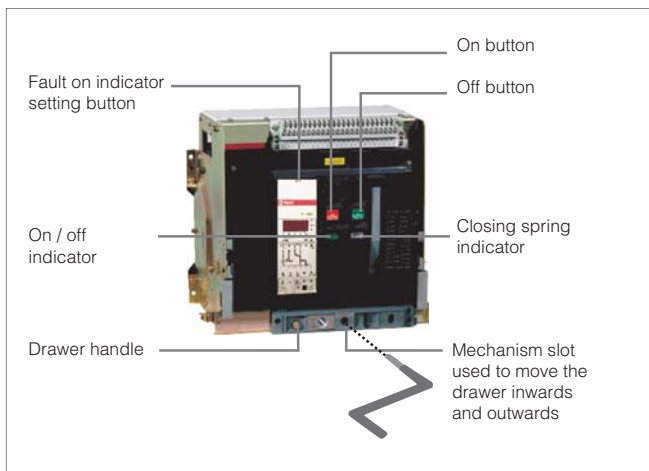


**F151E / F152E / F153E**  
5000A - 6300A

IEC / EN 60947-2  
CE

Mounting Position	: Vertical
Altitude	: 2000 m (max)
Relative Humidity	: %90 (55°C)
Ambient Temperature	: between -25°C and +60°C
Pollution Degree	: III
Protection Degree	: IP40 (at assembly lever area)

# AIR TYPE CIRCUIT BREAKERS



Air type circuit breakers are used for protection of generators with large powers, motor, capacitor groups and transformers, as well as general protection of factories, shopping malls, business centers.

## Drawout Type Circuit Breaker:

Circuit breakers are automatically turned on during pull and push of the drawer via lever. When drawer-type switches fail, they can be quickly replaced with the spare one.

## Features of Control Circuit

### Protection Functions:

Various functions such as overload, long reverse time delayed, short reverse time delayed, short time delayed, fixed time curves are available for users demanding various protection features.

### Indicator Function:

There is current adjustment indicator and operating current indicator.

### Ammeter Function:

It shows the current passing through the circuit.

### Alarm Feature:

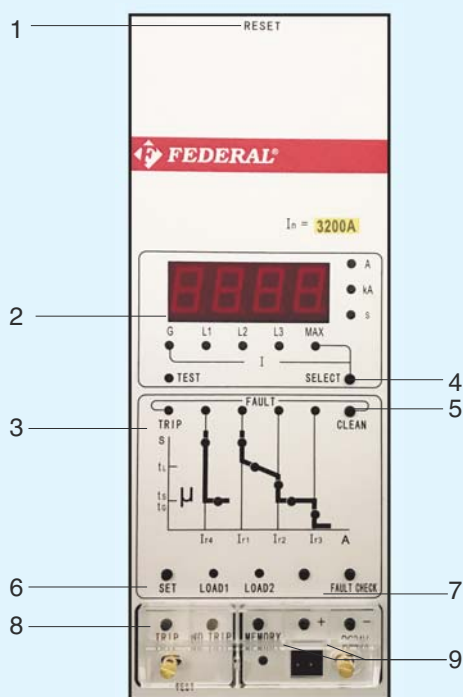
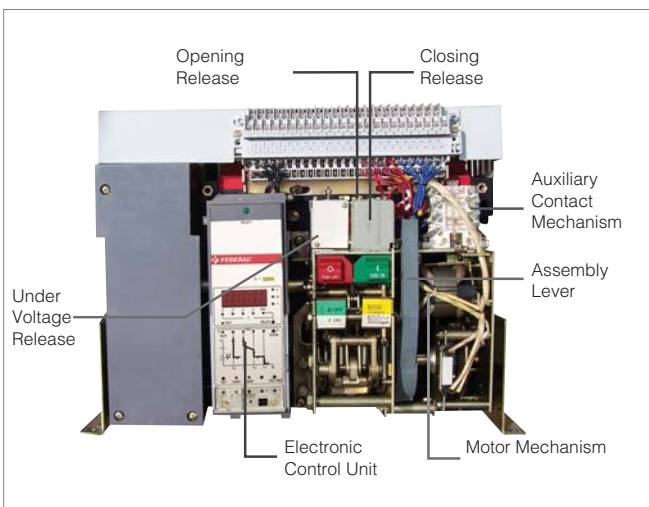
It shows overload status.

### Self-Control Feature:

It separates itself from the system with protection and control units against overheating.

### Test Feature:

It is used to test features of the breaker.



## Functions of buttons:

**1- RESET:** Press reset button after breaker trips, the breaker will get ready to close again.

**2- CURRENT-TIME indicator:** It shows the current and opening time.

**3- LED:** It shows status and features of the breaker.

**4- SELECT:** It shows maximum phase current under normal conditions. Current of each phase is displayed when you press this button.

**5- CLEAN:** Reset button must be pressed to close the breaker after adjusting operating current or opening breaker fault current.

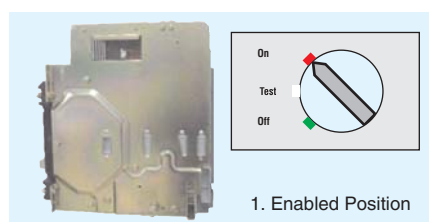
**6- SET:** You may press this button to adjust and check current and time characteristics and each status may be displayed in order.

**7- FAULT CHECK:** When you press this button, the last fault status, faulty current and time is displayed.

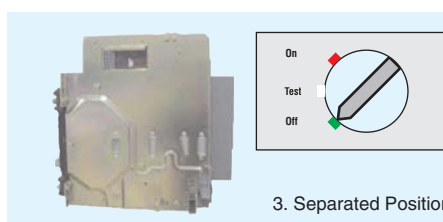
**8- TRIP and NON-TRIP:** Only for test.

**9- MEMORY:** Features adjusted with (+) and (-) buttons are saved.

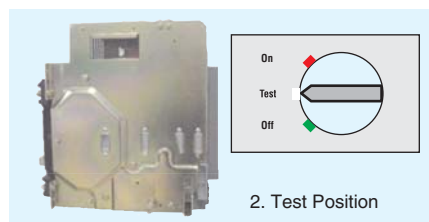
# AIR TYPE CIRCUIT BREAKERS



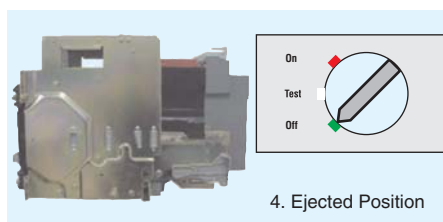
1. Enabled Position



3. Separated Position



2. Test Position



4. Ejected Position

**Air type circuit breaker may be in four positions on the drawer:**

**1. Enabled Position:** All the power circuits and auxiliary contacts are enabled.

**2. Test Position:** Power circuits are separated, but auxiliary contacts are enabled. This is the position of testing.

**3. Separated Position:** All the power circuits and auxiliary contacts are separated.

**4. Ejected Position:** All the power circuits and auxiliary contacts are separated. This is the position of ejecting the breaker from its drawer.

## Protection Features of Over Current Breaker:

Adjustment values of the breaker are given in the table below.

Long delay		Short delay		Instantaneous		Ground fault	
$I_{r1}$	Accuracy	$I_{r2}$	Accuracy	$I_{r3}$	Accuracy	$I_{r4}$	Accuracy
$(0.4-1) \times I_n$	$\pm 10\%$	$(0.4-15) \times I_n$	$\pm 10\%$	$1.0 \times I_n - 50kA$	$\pm 15\%$	$(0.2-0.8) \times I_n$	$\pm 10\%$

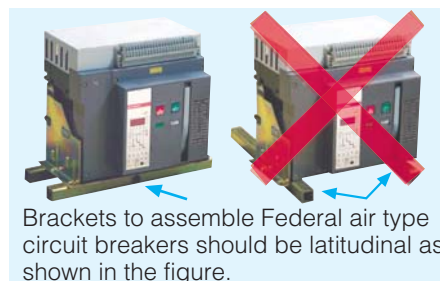
## Opening Time Features:

Over current protection, long time delay, reverse time opening features are given in the table below.

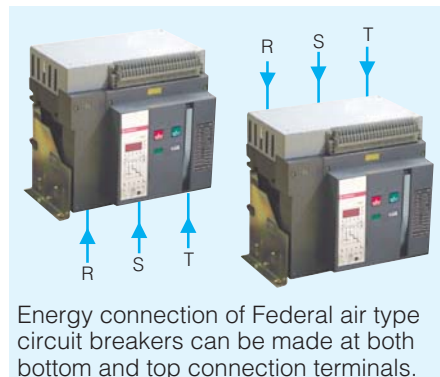
1,05xL	1,3xL	1.5xL time setting (s)	15	30	60	120	240	480
>2h non tripping	<1h tripping	2.0xL action time (s)	8.4	16.9	33.7	67.5	135	270



Assembly of Federal air type circuit breakers should be made in vertical position only.



Brackets to assemble Federal air type circuit breakers should be latitudinal as shown in the figure.



Energy connection of Federal air type circuit breakers can be made at both bottom and top connection terminals.

## Short time delay over current protection, opening features:

Reverse time (in short time delay current) protection feature of the breaker.

$$I^2 t = (8 \times I_{r1})^2 \times t_s$$

**T:** Opening time of the breaker

**I:** Fault current (Opening current)

**ts:** Adjusted short delay time

**Ir1:** If the adjusted long delay opening current is higher than over current  $8 I_{r1}$ , the opening time ( $t_s$ ) shall automatically turn into the adjusted delay time.

## Ammeter Feature:

The ammeter shows the main circuit current on display screen. When SELECT button is pressed, it shows current of the phase with LED on or maximum phase current. When the button is pressed again, current of the other phase is shown.

## Test Feature:

The breaker test be performed by pressing the test button. There are two kind of test buttons. One of them is non-trip test button and the other is trip test button. Non-trip test is performed when the breaker is connected to the network. Test is automatically broken when there is over current on the network.

## Adjustment Feature:

Current and delay times are adjusted by pressing "+/-" buttons according to user needs. When you see the required current or delay time on the display, save it by pressing Storage button. When over

current is present, this function is broken automatically.

































## Load-Dependent Features:

### Two values can be set:

Load 1 current ( $I_{c1}$ ) adjustment range  $(0.2-1) \times I_n$  and Load 2 current ( $I_{c2}$ ) adjustment range  $(0.2-1) \times I_n$ ,  $I_{c1}$  time delay is adjusted to half of long time delay.

$I_{c2}$  time delay has two features; first one is reverse time delay adjusted to \_ of long time delay and second one is fixed time delay set to 60 sec.  $I_{c1}$  and  $I_{c2}$  current values are used for disabling and enabling insignificant loads.

# AIR TYPE CIRCUIT BREAKERS

														
Type (LSIG)		F121E	F122E	F123E	F131E	F132E	F133E	F141E	F142E	F143E	F151E	F152E	F153E	
Rated current - In		A 630,800,1000 1250,1600,2000			2500, 3200			4000*			5000, 6300			
Number of poles		3 / 4			3 / 4			3 / 4			3 / 4			
Rated operating voltage - Ue (a.c.) 50-60 Hz		V	415			415			415			415		
Rated insulation voltage - Ui (a.c.) 50-60 Hz		V	1000 V			1000 V			1000 V			1000 V		
Rated impulse withstand voltage - Uimp		kV	8			8			8			8		
Test voltage (1 min) (a.c.) 50-60 Hz		kV	3			3			3			3		
Rated Current Adjustment field		In	(0,4-1)In			(0,4-1)In			(0,4-1)In			(0,4-1)In		
Rated ultimate short circuit breaking capacity - Icu 415V~		(kA rms)	70	80	100	70	80	100	70	80	100	70	80	120
Rated service short circuit breaking capacity - Ics 415V~		(kA rms)	35	50	65	35	65	80	35	65	80	35	65	100
Rated short time withstand capacity - Icw 1s 415 V~		(kA rms)	35	50	65	35	65	80	50	65	80	50	65	100
Category (EN 60947-2 / IEC 60947-2)		A, B			A, B			A, B			A, B			
Opening type		Electronic			Electronic			Electronic			Electronic			
Assembly method		Fixed / Drawout			Fixed / Drawout			Fixed / Drawout			Drawout			
Long time delay current (L)		Ir1	(0,4-1)In			(0,4-1)In			(0,4-1)In			(0,4-1)In		
Long time delay interval		tl s	15-500			15-500			15-500			15-500		
Short time delay current (Is)		Ir2	(0,4-15)In			(0,4-15)In			(0,4-15)In			(0,4-15)In		
Short time delay interval		ts s	0,1 - 1			0,1 - 1			0,1 - 1			0,1 - 1		
Instantaneous breaking current (Ii)		Ir3	In-50 kA			In-50 kA			In-50 kA			In-50 kA		
Ground fault current (Ic)		Ir4	(0,2-0,8)In			(0,2-0,8)In			(0,2-0,8)In			(0,2-0,8)In		
Mechanical life	With maintenance	10000			10000			10000			10000			
	Without maintenance	3000			3000			3000			3000			
Power losses per pole	Drawout	38, 47, 77, 110, 150, 160			210, 240			320			350, 420			
	Fixed	15, 21, 35, 50, 75, 85			90, 150			230			-			
Accessories														
Undervoltage release **														
Undervoltage release with time delay														
Shunt trip														
Closing coil														
Auxiliary contact block														
Motor control mechanism														
Inverser lock														

\* 4 pole 4000A switch is produced with drawer.

■ standards, ☐ optional

\*\* Opening time can be set as 1s, 3s, 5s, 7s, 9s, 10s.

Generator			Breaker
kVA	kW	A	A
375	300	546	630
438	350	637	800
500	400	730	800
625	500	910	1000
750	600	1090	1250
875	700	1274	1600
1000	800	1460	1600
1125	900	1640	2000
1250	1000	1820	2000
1563	1250	2280	2500
1875	1500	2730	3200
2188	1750	3180	3200
2500	2000	3640	4000

Motor		Breaker
kW	A	A
220	368	630
250	415	630
315	521	800
355	588	800
400	665	800
450	743	1000
500	819	1000
560	916	1250
630	1022	1250

Capacitor Power	Capacitor Current	Breaker Current
kVAr	A	A
578	834	1250
739	1067	1600
924	1334	2000
1155	1667	2500
1478	2134	3200

# AIR TYPE CIRCUIT BREAKERS

Order Codes:

Type	Rated Current(A)	Icu 415V	Fixed Type	Drawer Type
F121E	630A ... 2000A	70	9AL-ESS4□-△△△△	9AL-ESC4□-△△△△
F122E	630A ... 2000A	80	9AL-EMS4□-△△△△	9AL-EMC4□-△△△△
F123E	630A ... 2000A	100	9AL-EHS4□-△△△△	9AL-EHC4□-△△△△
F131E	2500A - 3200A	70	9AM-ESS4□-△△△△	9AM-ESC4□-△△△△
F132E	2500A - 3200A	80	9AM-EMS4□-△△△△	9AM-EMC4□-△△△△
F133E	2500A - 3200A	100	9AM-EHS4□-△△△△	9AM-EHC4□-△△△△
F141E	4000	70	9AN-ESS4□-△△△△	9AN-ESC4□-△△△△
F142E	4000	80	9AN-EMS4□-△△△△	9AN-EMC4□-△△△△
F143E	4000	100	9AN-EHS4□-△△△△	9AN-EHC4□-△△△△
F151E	5000A - 6300A	70	-	9AS-ESC4□-△△△△
F152E	5000A - 6300A	80	-	9AS-EMC4□-△△△△
F153E	5000A - 6300A	120	-	9AS-EHC4□-△△△△

□ : Number of poles (3,4)

△△△△:Enter ampere value.

## Selection of Air Type Circuit Breaker for Transformer

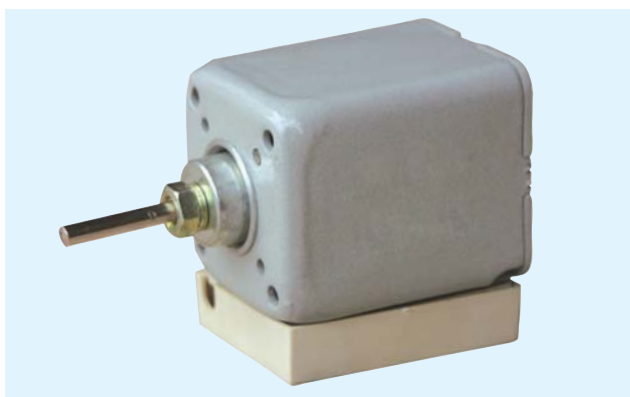
Transformer power and parallel connected number (kVA)	Transformer rated current In(A)	Short circuit current (kA)	Circuit breaker minimum breaking capacity (kA)	Circuit breaker type	Circuit breaker minimum breaking capacity (Branch Circuit)(kA)
1x800	1156	19,2	20	F121E - 1250	20
2x800	1156	19,2	20	F121E - 1250	40
3x800	1156	19,2	40	F121E - 1250	60
1x1000	1445	24	25	F121E - 1600	25
2x1000	1445	24	25	F121E - 1600	50
3x1000	1445	24	50	F121E - 1600	75
1x1250	1805	30	30	F121E - 2000	30
2x1250	1805	30	30	F121E - 2000	60
3x1250	1805	30	60	F121E - 2000	90
1x1600	2312	38,5	40	F131E - 2500	40
2x1600	2312	38,5	40	F131E - 2500	75
3x1600	2312	38,5	80	F132E - 2500	110
1x2000	2900	48,2	50	F131E - 3200	50
2x2000	2900	48,2	50	F131E - 3200	100
1x2500	3600	60	60	F141E - 4000	60
2x2500	3600	60	60	F141E - 4000	120
1x3150	4450	75,8	80	F152E - 5000	80

## Ambient Temperature Impact on Rated Operating Current of Circuit Breaker

Temperature (°C)	F121E (A)						F131E (A)		F141E (A)	F151E (A)	
40	630	800	1000	1250	1600	2000	2500	3200	4000	5000	6300
45	630	800	1000	1250	1600	1900	2400	3000	3800	5000	6300
50	630	800	1000	1250	1500	1900	2300	3000	3600	5000	6300
55	630	800	1000	1200	1500	1800	2200	2800	3400	4800	6100
60	610	800	1000	1150	1300	1700	2200	2800	3200	4800	6100
65	610	800	1000	1150	1300	1650	2200	2600	3200	4800	6100



# AIR TYPE CIRCUIT BREAKERS



**Undervoltage Release :** Undervoltage release is used in opening air type circuit breaker due to low voltage or phase disconnection. There are two types of low voltage releasers as instant opening and delayed opening types. Delayed type undervoltage release has 1 sec., 2 sec. and 5 sec. delayed models and accuracy class is 15%.

Characteristic

Rated control power voltage $U_s$ (V)	AC 230, 400
Actuation voltage (V)	$(0.85-1.1) U_e$
Release voltage	$(0.35-0.7) U_e$
Power consumption	48 W

Order Code	Delayed	8AM-CA000-0220
	Non-delayed	8AM-CA001-0220



**Closing Release:** After the motor mechanism completes energy storage, the closing coil promptly closes the breaker by releasing the spring in the mechanism.

Characteristic

Rated control power voltage $U_s$ (V)	AC 230, 400
Operating voltage	$(0.85-1.1) U_s$
Power consumption	40 W
Closing time	< 70 ms

Order Code	8AM-BD000-0222
------------	----------------

**Shunt Trip Release:** Air type circuit breakers, other than manual type, may be remote controlled with shunt trip coil.

Characteristic

Rated control power voltage $U_s$ (V)	AC 230, 400
Operating voltage	$(0.7-1.1) U_s$
Power consumption	40 W
Closing time	< 30 ms

Order Code	8AM-BD000-0221
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**Motor Mechanism:** Motor mechanism sets the mechanism springs (energy storage) and has the breaker ready for closing.

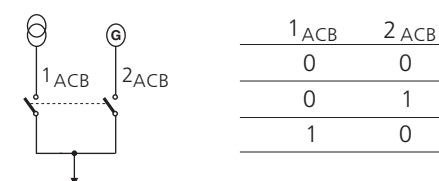
Characteristic

Rated control power voltage $U_s$ (V)	AC 230, 400
Operating voltage	$(0.85-1.1) U_s$
Power consumption	190 W
Setup period	4 sec

Order Code	
F121E/F123E	8AM-DA000-0220
F131E/F133E-F141/F143E	8AS-DA000-0220
F151E/F153E	

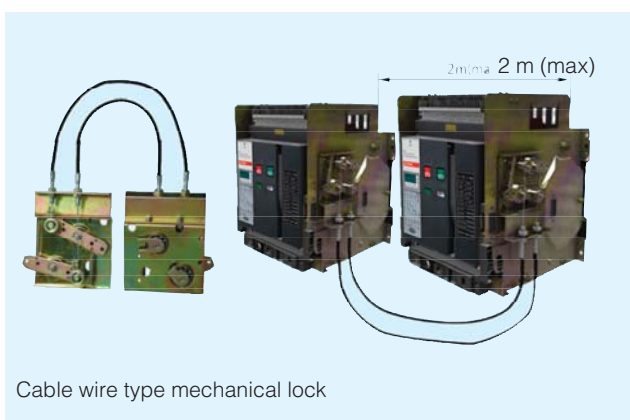
## Mechanical Lock:

One of 2 normal power supplies is active.

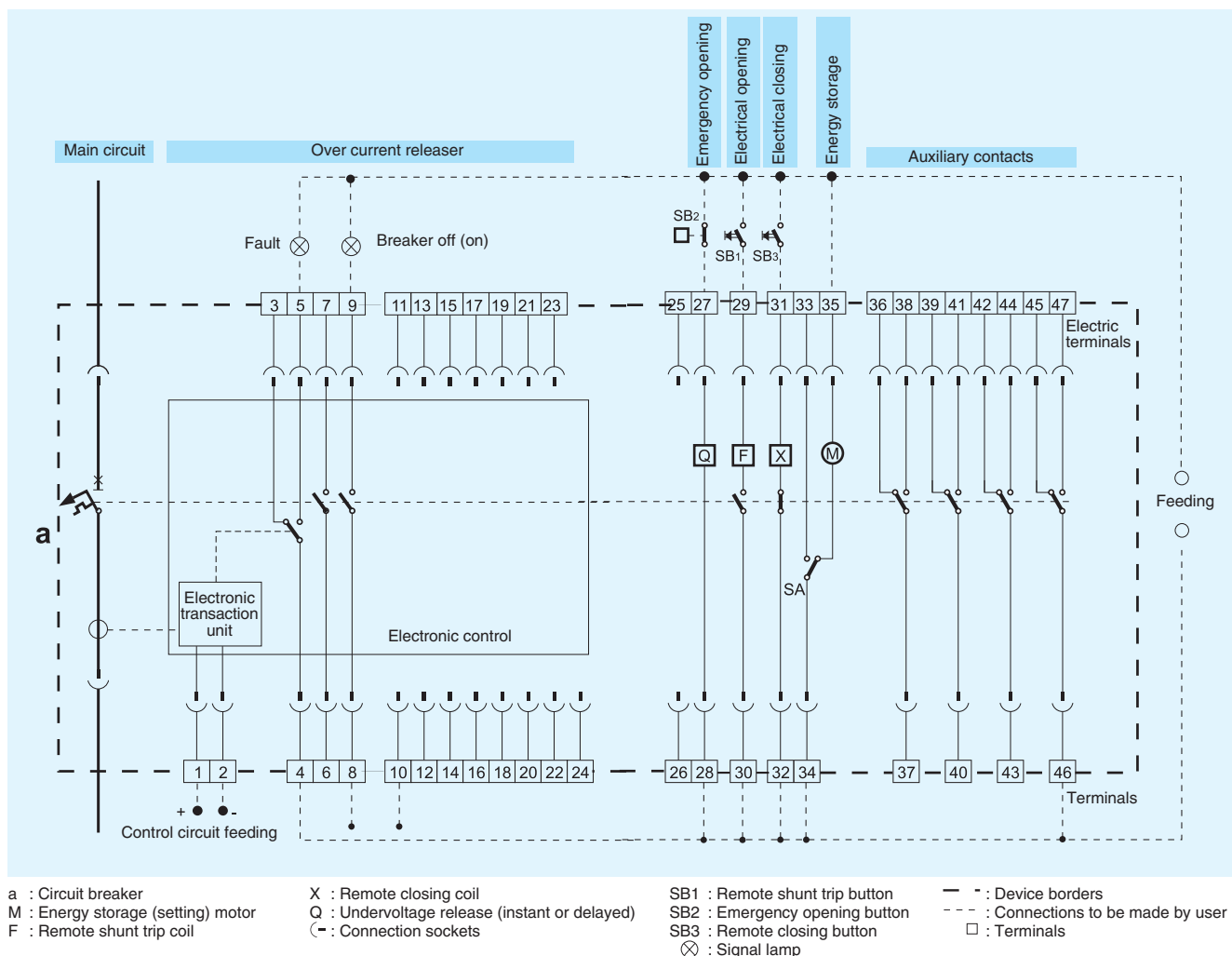


Cable wire type mechanical lock is used in cross locking of 2 circuit breakers in vertical or horizontal positions. The purpose of this application is to prevent accidental ON-1 position of one circuit breaker, while the other is in ON-1 position.

**Order Code:** 8AM-V0000-0000



# AIR TYPE CIRCUIT BREAKERS



**Note-1:** If Q, F, X and M control voltages are different from each other, these might be connected to different powers. Energy storage (setting) motor electric terminal (35) may be connected to the feeding directly or via a start button.

**Note-2:** Closing and opening coils burn if they are subject to energy continuously. Therefore, closing coils should be operated as serially connected to normally closed auxiliary contacts (e.g. 36-37); and opening coils should be operated as serially connected to normally open auxiliary contacts (e.g. 40-41).

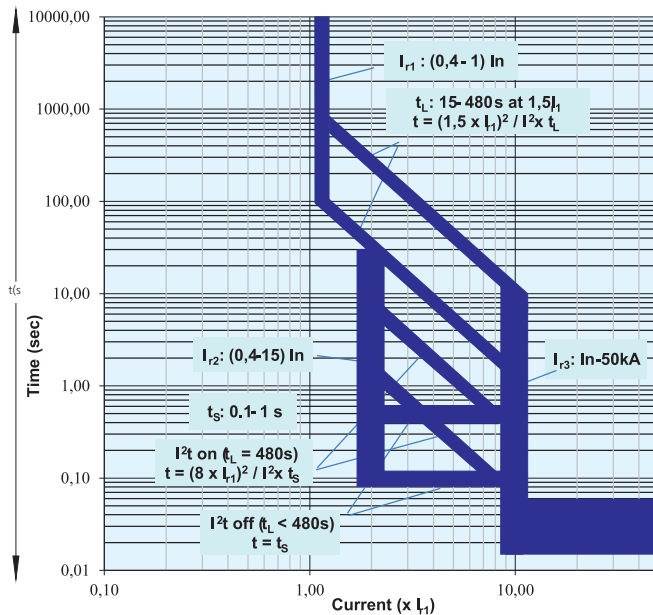


Federal air type circuit breaker control circuit electric terminals can be easily accessed without removing the front cover.

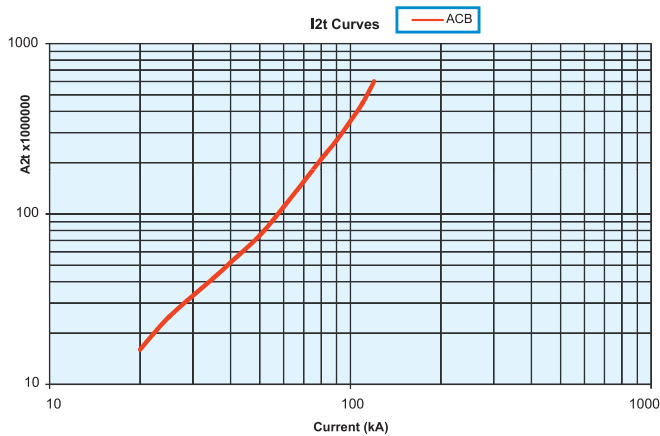
# AIR TYPE CIRCUIT BREAKERS

## Characteristic Curves:

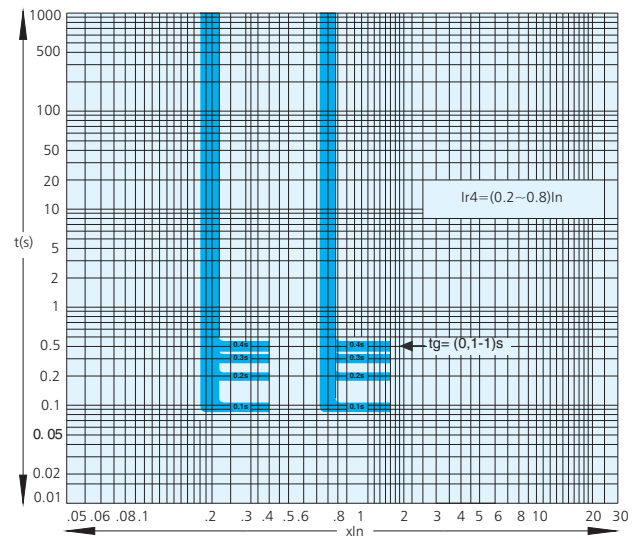
### Current-Time Curve:



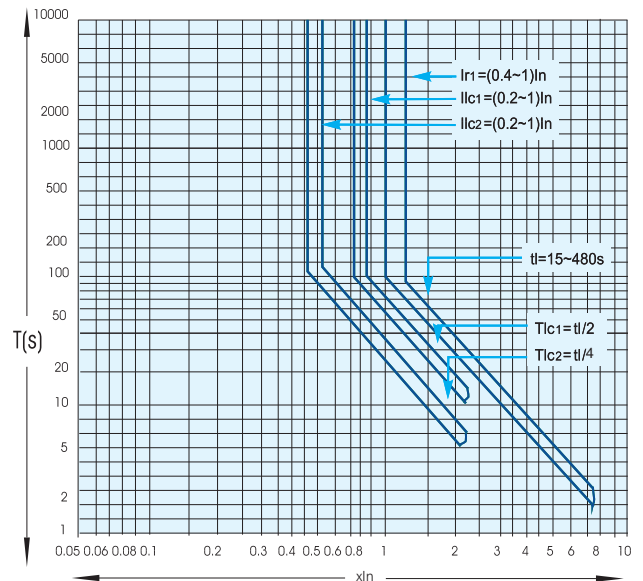
### I<sup>2</sup> T Curve:



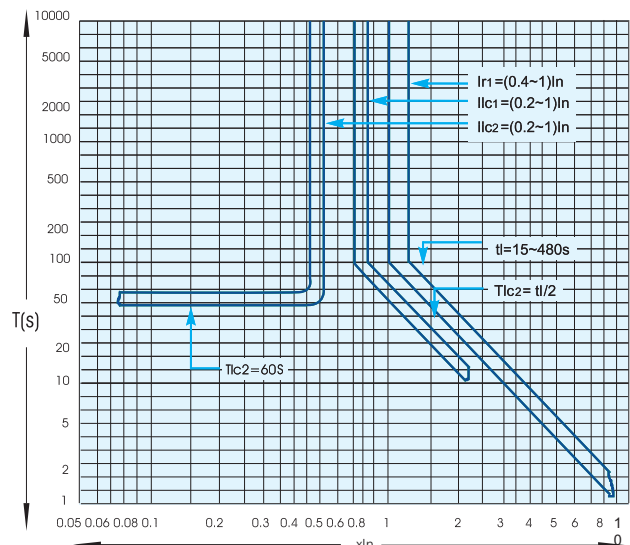
### Ground Fault Protection Current-Time Curve:



### Load-Dependent Values (1):

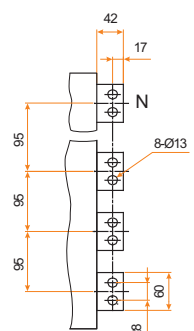
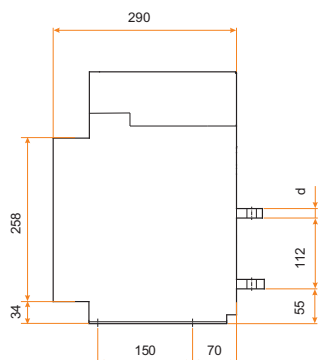


### Load-Dependent Values (2):

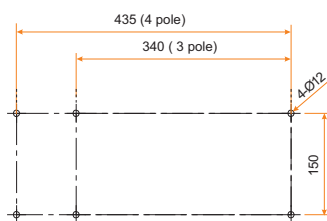
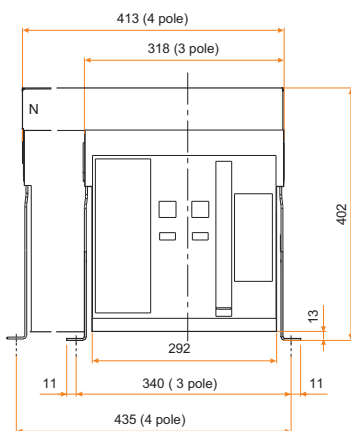


# AIR TYPE CIRCUIT BREAKERS

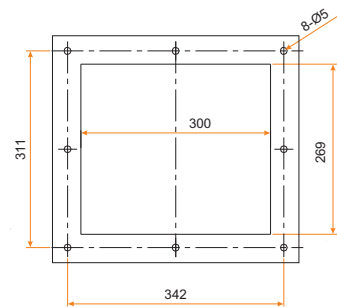
## F121E-F122E-F123E (Fixed Type)



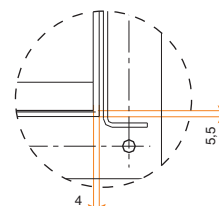
Busbar Connections



Assembling Gauge

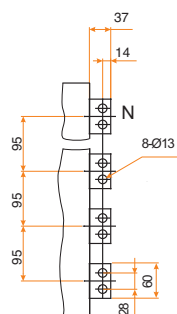
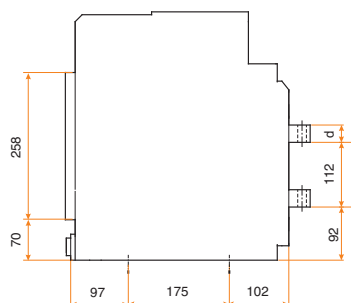


Panel Frame

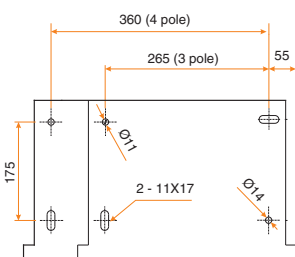
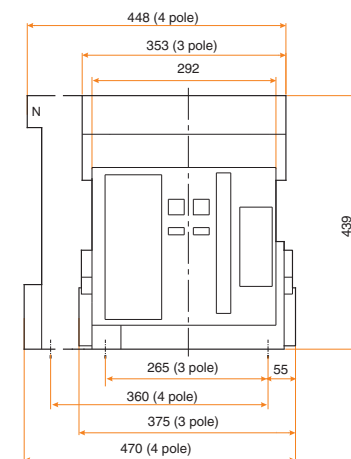


In A	busbar thickness d (mm)
630-800	10
1000-1600	15
2000	20

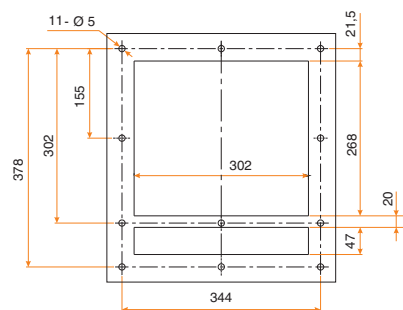
## F121E-F122E-F123E (Drawout Type)



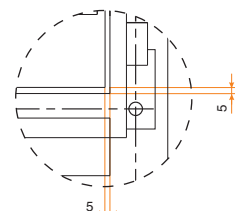
Busbar Connections



Assembling Gauge



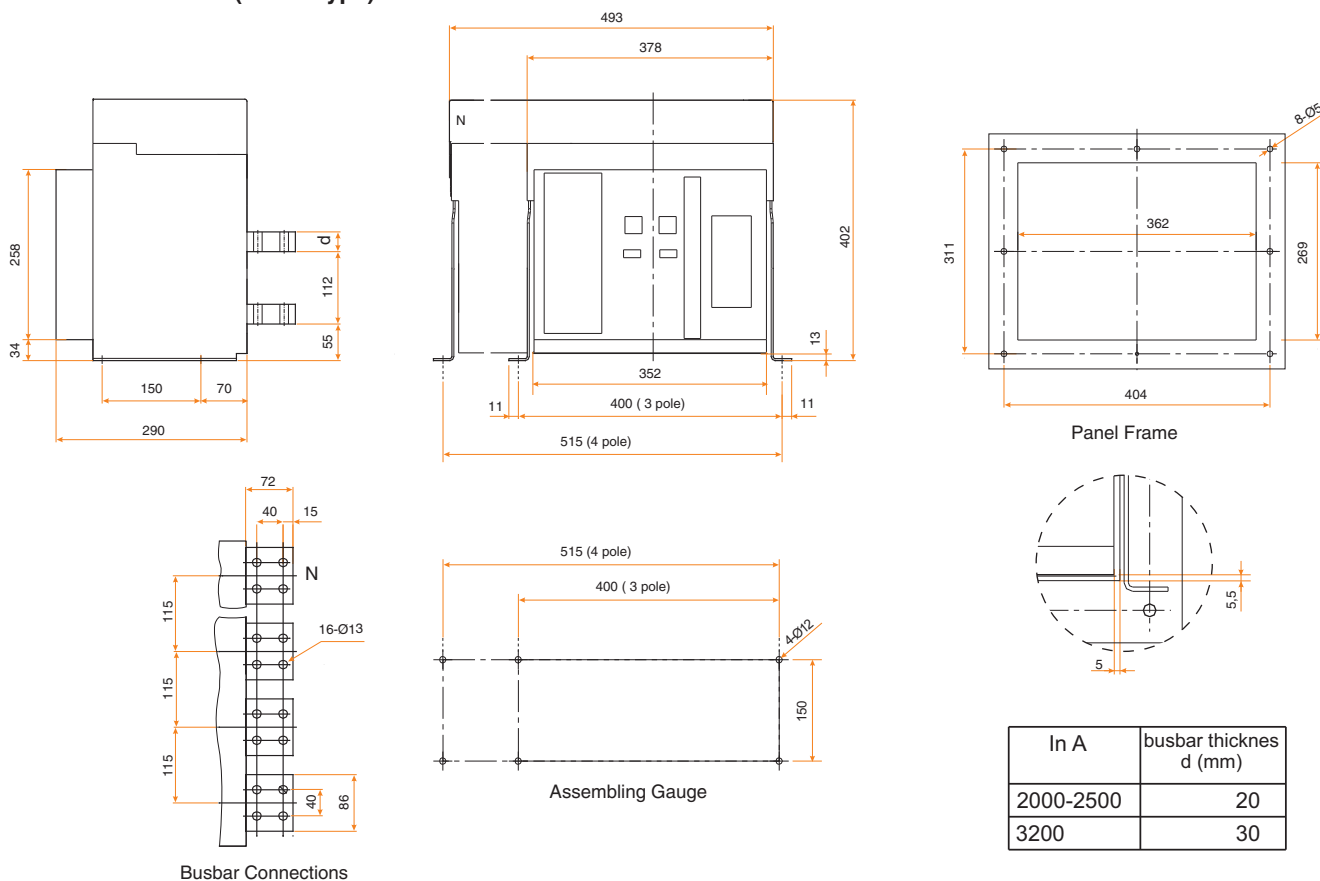
Panel Frame



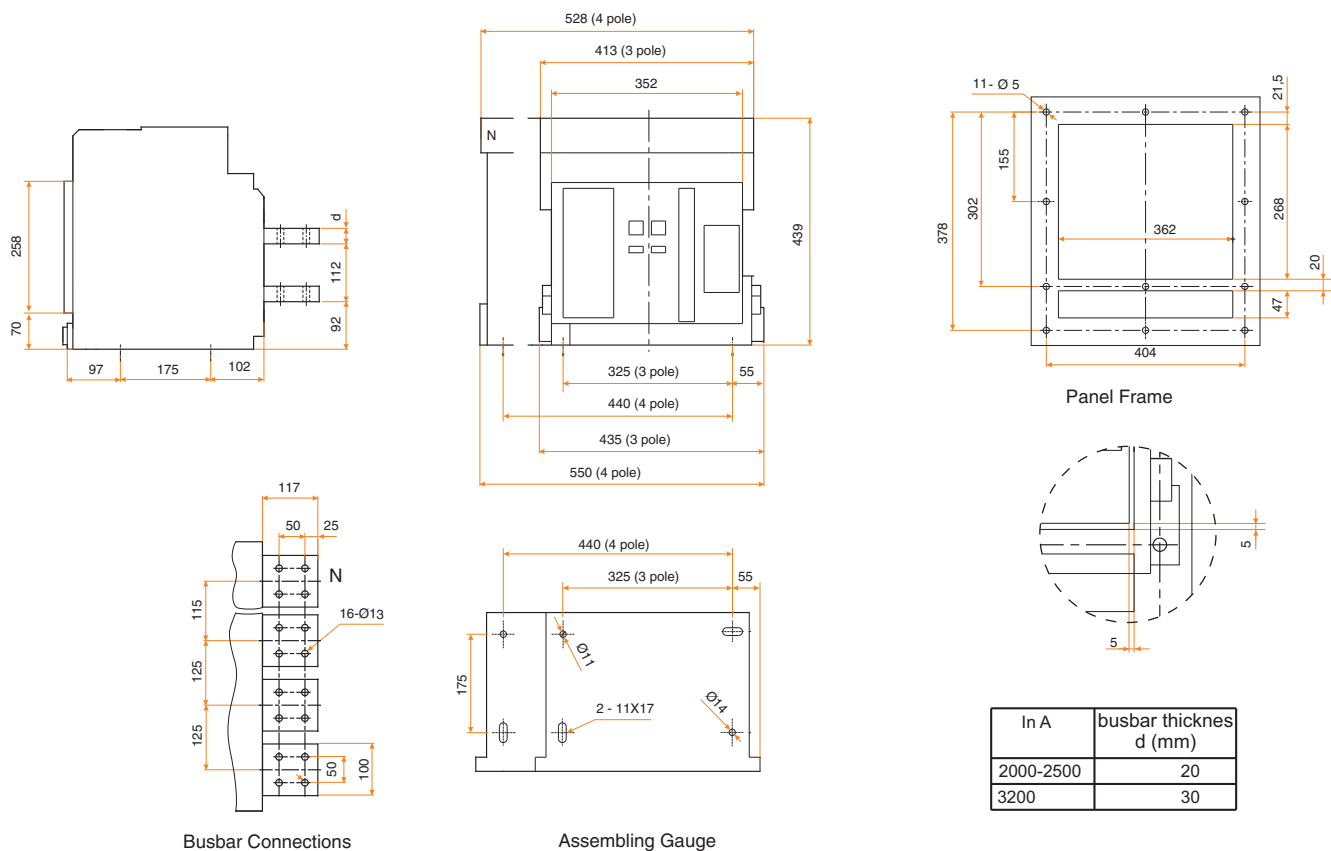
In A	busbar thickness d (mm)
630-800	10
1000-1600	15
2000	20

# AIR TYPE CIRCUIT BREAKERS

## F131E-F132E-F133E (Fixed Type)

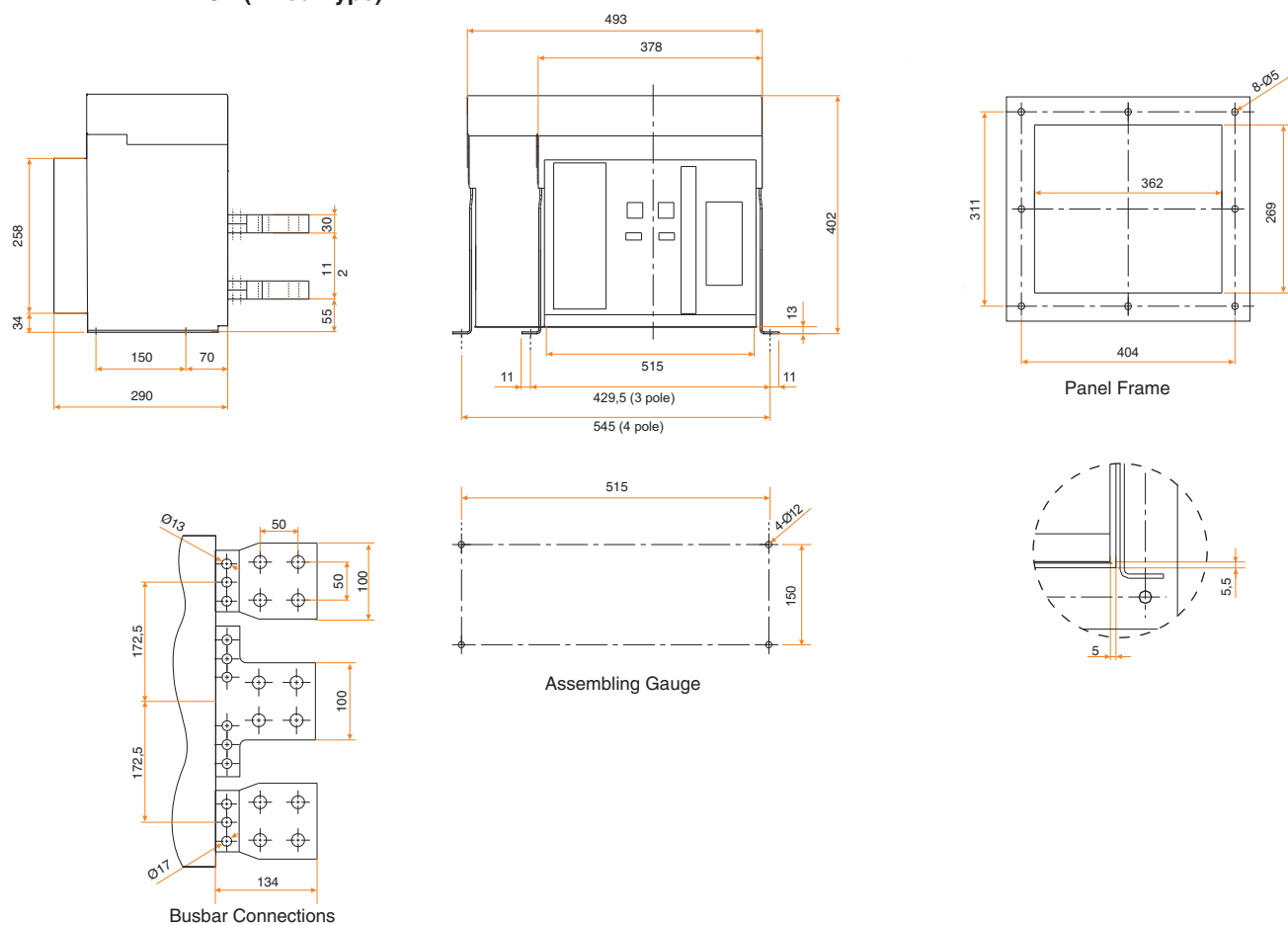


## F131E-F132E-F133E (Drawout Type)

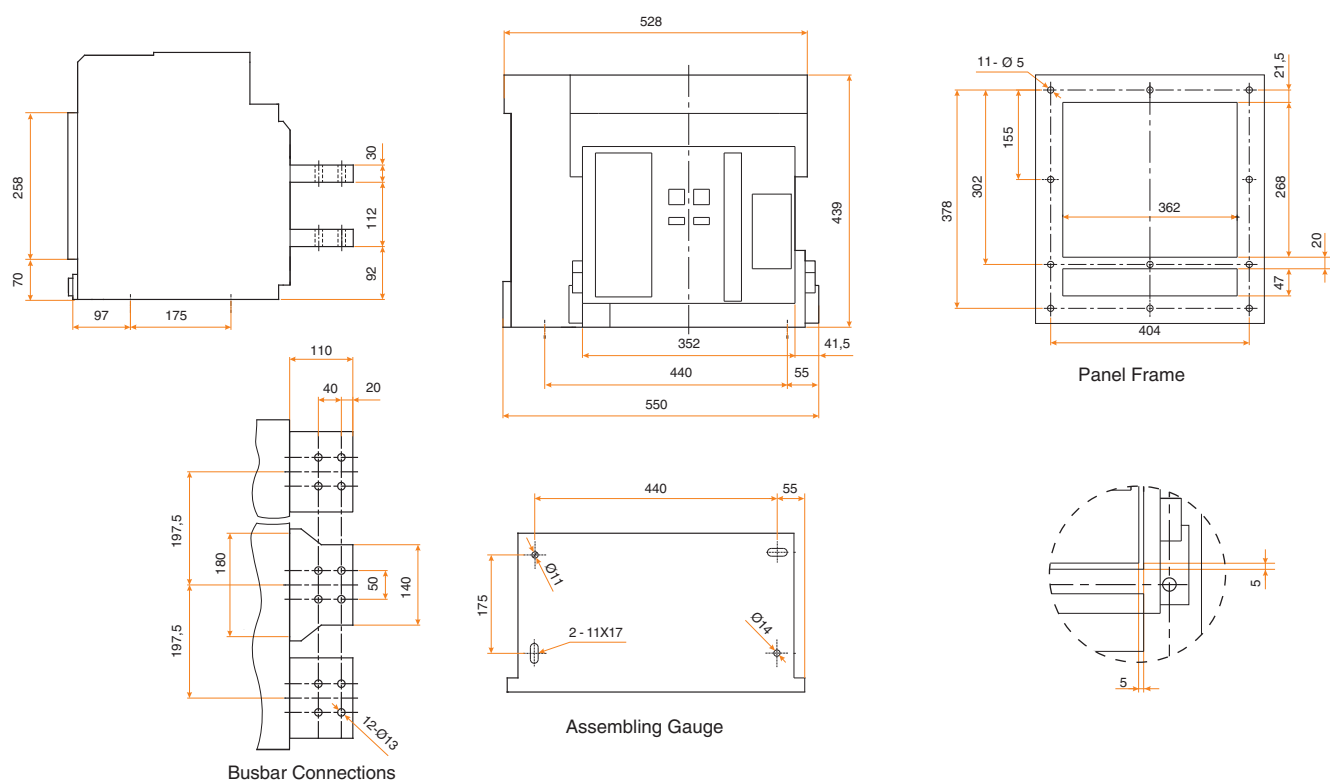


# AIR TYPE CIRCUIT BREAKERS

## F141E-F142E-F143E (Fixed Type)

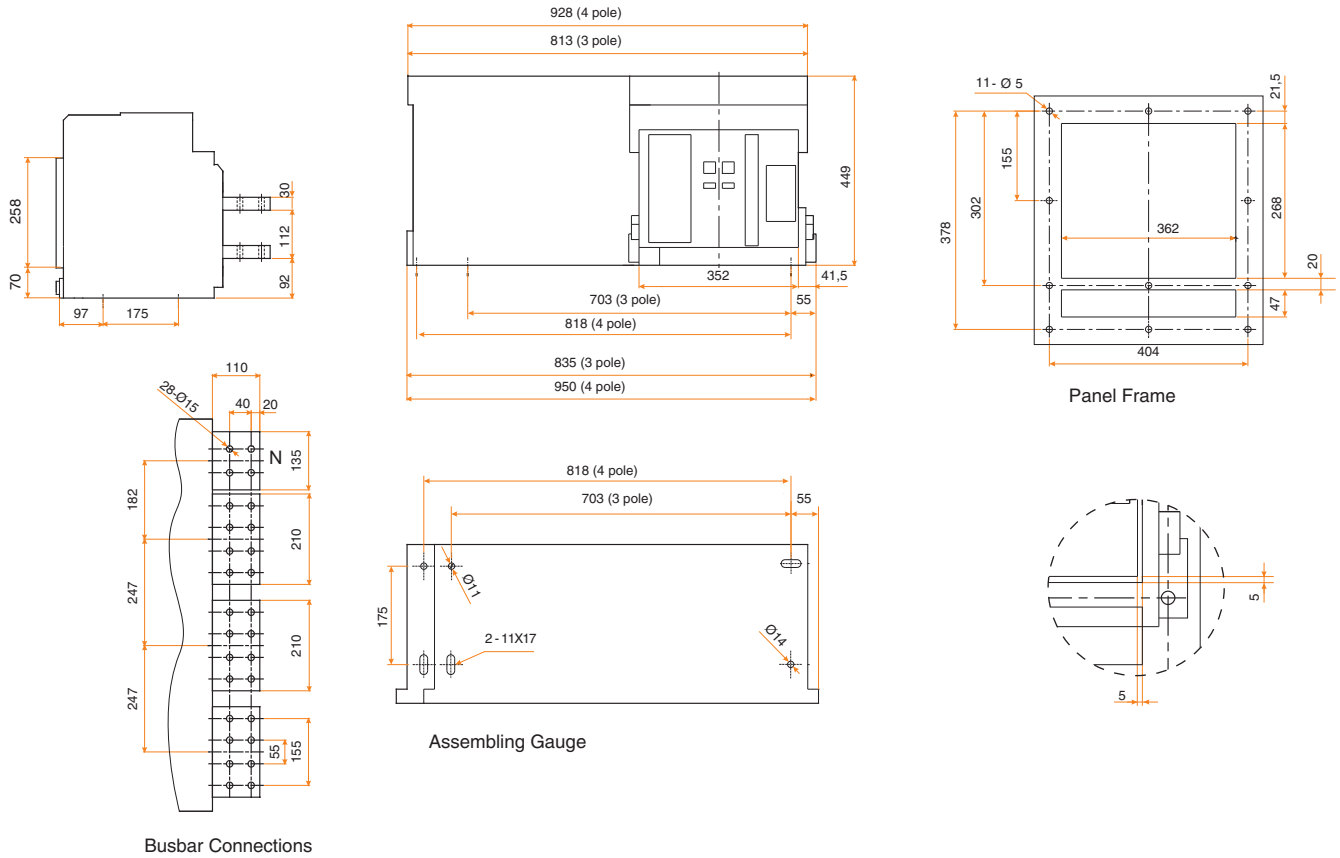


## F141E-F142E-F143E (Drawout Type)

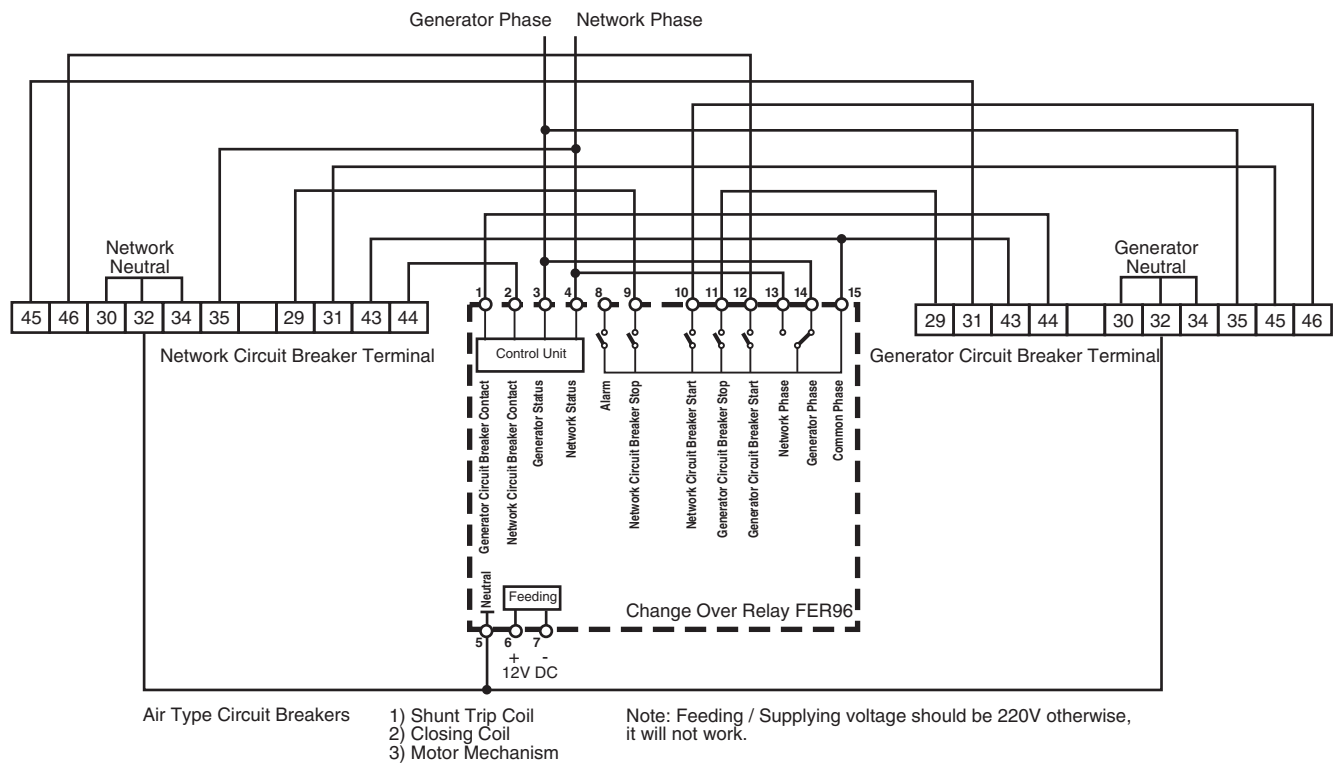


# AIR TYPE CIRCUIT BREAKERS

## F151E-F152E-F153E (Drawout Type)



## Wiring Diagram Of Change Over Systems For Air Circuit Breakers





# MINIATURE CIRCUIT BREAKERS



IEC / EN 60898-1

CE

Mounting Position : Free  
 Altitude : 2000m (max)  
 Relative Humidity : %50 (40°C), %90 (20°C)  
 Ambient Temperature : between -25°C and 60°C<sup>①</sup>  
 Pollution Degree : II  
 Protection Degree : IP20

IEC / EN 60947-2

CE

Mounting Position : Free  
 Altitude : 2000m (max)  
 Relative Humidity : %50 (40°C), %90 (20°C)  
 Ambient Temperature : between -25°C and 60°C<sup>①</sup>  
 Pollution Degree : II  
 Protection Degree : IP20

IEC / EN 60947-3

CE

Mounting Position : Free  
 Altitude : 2000m (max)  
 Relative Humidity : %50 (40°C), %90 (20°C)  
 Ambient Temperature : between -10°C and 60°C<sup>①</sup>  
 Pollution Degree : III  
 Protection Degree : IP20

IEC / EN 60947-4-1

CE

Mounting Position : Face Down  
 Altitude : 2000m (max)  
 Relative Humidity : %50 (40°C), %90 (55°C)  
 Ambient Temperature : between 25°C and 60°C<sup>①</sup>  
 Pollution Degree : III  
 Protection Degree : IP20

IEC / EN 61095

All these given information are general. We have always right to change them.

## Miniature Circuit Breakers

FM4E - FM6E - FM10  
 0,5A ... 63A



FM6L - FM10L  
 80A ... 125A



FM10 DC  
 0,5A ... 63A



FM10L DC  
 80A ... 125A



## Miniature Circuit Breakers Boxes



## ATS with MCB



FIR (Impulse Relay)  
 16A



FMS Disconnectors  
 40A ... 100A

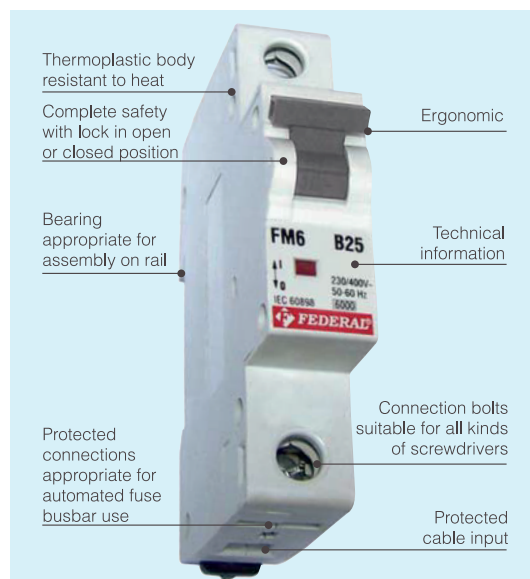


Installation Contactors  
 20A ... 63A



①: The rated operation currents of MCB is shown at temperatures mentioned in standards. Operation current of MCB lower than the nominal value in Closed (non-ventilated) enclosures and panels.

# MINIATURE CIRCUIT BREAKERS




Federal miniature circuit breakers protect the electrical circuit they are connected to against over current and short circuits. They allow easy open-close of the circuit. Miniature circuit breakers are manufactured with 1, 2, 3, 4 poles and 1 phase + neutral, 3 phase + neutral from 6A to 125A in accordance **CE**. There are two separate types as B, C and D. In case of a short circuit, B types open the circuit at 3 or 5 times more then nominal current, C types open the circuit at 5 or 10 times more then the nominal current and D types open the circuit at 10 or 20 times more than the nominal current. Miniature circuit breakers with 2, 3, 4 poles disable the device they are connected to, thanks to their mechanisms in case of a failure in any phase.

**B curve:** Used in illumination of houses, plugs and control circuit

**C / D curve:** Used in inductive loads like transformer, several fluorescent lamps etc.

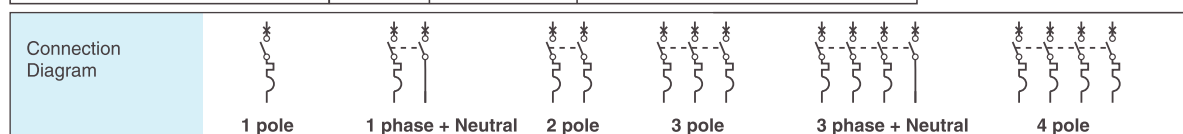
The device opening the current is enabled by lifting the lever in case of any failure. Lever-free opening mechanism shall open the current again as the failure continues. Federal miniature circuit breakers open the circuit in a very short time in case of a short circuit current are limited. It provides ease in assembly thanks to the desing of connection terminals, accidentally touches are eliminated. Federal miniature circuit breakers resist an ambient temperature of 55 °C and resist a relative humidity of 95%. 25mm cable can be connected to specially-designed cable inputs.

<div>PV</div>								
Type		FM4E	FM6E	FM10	FM6L	FM10L	FM10 DC	FM10L DC
Standard		IEC 60898-1			IEC 60947-2			
Rated Current - In	A	0,5-63	0,5-63	0,5-63	80-125	80-125	0,5-63	80-125
Number of Poles		1,2,3,4	1,2,3,4	1,2,3,4	1,2,3,4	1,2,3,4	1,2,3,4	1,2,3,4
Rated Insulation Voltage - Ui	V	630	630	630	630	630	630	630
Rated Impulse Withstand Voltage - Uimp	kV	6	6	6	6	6	6	6
Rated Operating Voltage	50-60 Hz (1p)	230/400	230/400	230/400	230	230	-	-
Ue	50-60 Hz (2p, 3p, 4p)	400	400	400	400	400	-	-
(V)	DC (1p)	60	60	60	60	60	250*	250*
Rated Short - Circuit Breaking Capacity	kA	4,5	6	10	6	10,15***	10	10
Protection Characteristics	Thermal	In	In	In	In	In	In	In
	Magnetic**	B,C,D	B,C,D	B,C,D	8In		10In	
Mechanical Life	Operation	>20000						
Electrical Life	Operation	> 4000						
Min-Max Connection Sections	mm <sup>2</sup>	1-25	1-25	1-25	1-50	1-50	1-25	1-50
Min-Max Tightening Torque	Nm	2-3	2-3	2-3	3-5	3-5	2-3	3-5
Shunt Trip Release		-	-	□230 V	-	□230 V	-	-
Auxiliary Contact Block		-	-	□1NO+1NC	-	□1NO+1NC		

□ : Upon request \* : 2P: 500V, 3P: 750V, 4P: 1000V \*\* : B: 3-5In, C: 5-10In, D: 10-20In \*\*\* : 15kA / 230V

	Rated current In (A)	Breaking capacity Ics (kA)	Order Codes
			Characteristic B / C / D
 FM3-FM6E-FM6-FM10E-FM10	2-63	3	9EC-△033□-0D##
	0,5-63	4,5	9ED-△043□-0D##
	0,5-63	6	9E☆-△063□-0D##
	0,5-63	10	9EE-△103□-0D##

△ : For type B (B), for type C (C), for type D (D)  
 □ : Number of poles (1,2,3,4)  
 ##: Fuse rated current (0,5...125)  
 ☆ : G for FM6E or FM10E, D for FM6 or FM10.



## \*At DC voltage

- Overload protection (thermal) characteristic is same as AC voltage.
  - Short circuit protection (magnetic) characteristic is %40 higher than AC voltage.
- Circuit Breakers produced for AC system, work at DC 60V voltage per pole.

# MINIATURE CIRCUIT BREAKERS

## Temperature Effect in Automatic Fuses:

The thermal overload protection characteristics change due to the temperature of the automatic fuses. From the calibrated temperature it will trip earlier than its nominal value if it operates in a warmer environment. If you work in a cooler environment it opens later. Federal automatic fuses are calibrated to 30 ° C as standard. Different on request calibration can also be performed for ambient temperatures. The table below shows the calibrated automatic fuse according to 30 ° C operating currents are given for different ambient temperatures. 40 A calibrated to ambient temperature of 30 ° C the operating current of the fuse at 50 ° C is found on the table 36A.

In (A)	Compensation Factor According to Ambient Temperature (k) (Calibration Temperature 30°C)						
	10°C	20°C	30°C	40°C	50°C	55°C	60°C
0,5	0,6	0,5	0,5	0,5	0,5	0,4	0,4
1	1,1	1,1	1,0	1,0	0,9	0,9	0,9
2	2,2	2,1	2,0	1,9	1,8	1,8	1,7
3	3,3	3,2	3,0	2,9	2,7	2,6	2,6
4	4,4	4,2	4,0	3,8	3,6	3,5	3,4
6	6,6	6,3	6,0	5,7	5,4	5,3	5,1
10	11,0	10,5	10,0	9,5	9,0	8,8	8,5
16	17,6	16,8	16,0	15,2	14,4	14,0	13,6
20	22,0	21,0	20,0	19,0	18,0	17,5	17,0
25	27,5	26,3	25,0	23,8	22,5	21,9	21,3
32	35,2	33,6	32,0	30,4	28,8	28,0	27,2
40	44,0	42,0	40,0	38,0	36,0	35,0	34,0
50	55,0	52,5	50,0	47,5	45,0	43,8	42,5
63	69,3	66,2	63,0	59,9	56,7	55,1	53,6
80	88,0	84,0	80,0	76,0	72,0	70,0	68,0
100	110,0	105,0	100,0	95,0	90,0	87,5	85,0
125	137,5	131,3	125,0	118,8	112,5	109,4	106,3

Since a large number of auto fuses running side by side in a box will affect each other, it will fall even further. In this case, the rated current of the auto-fuse is multiplied by 0.8 to obtain the new rated current. For example, if the 25A automatic fuse runs side-by-side with many fuses in a 40 ° C environment, the current is found to be  $23.8 \times 0.8 = 19 \text{ A}$ .

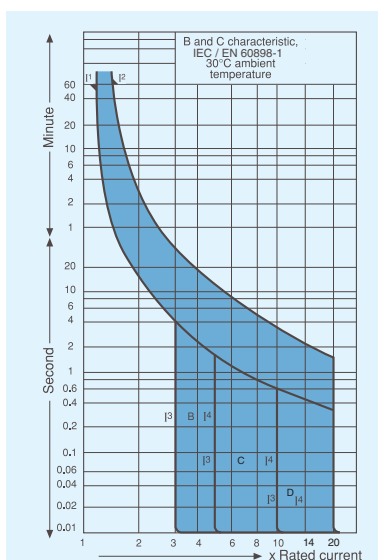


Fig-1 Current-Time Curve (FM3, FM6E In < 40A)

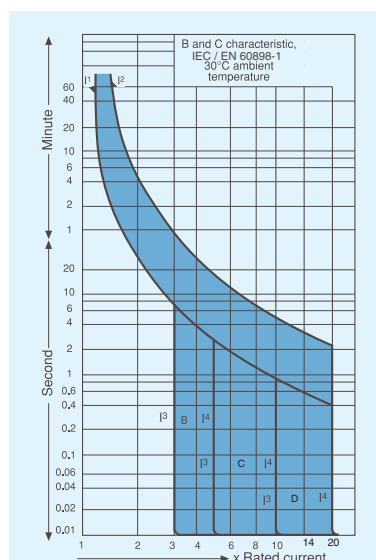


Fig-2 Current-Time Curve (FM3, FM6E In= 50A, 63A)

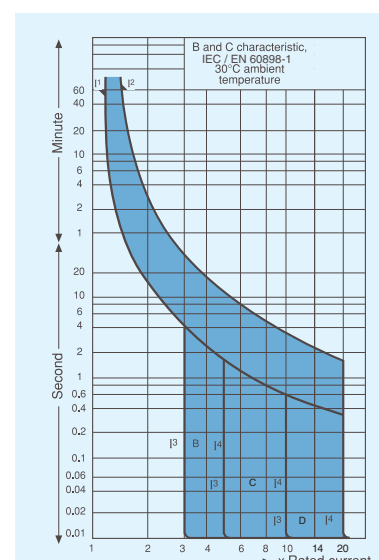


Fig-1 Current-Time Curve (FM6, FM10)

Characateristic	B	C	P
I1 ( t > 1h )	1,13 x In	1,13 x In	1,13 x In
I2 ( t < 1h )	1,45 x In	1,45 x In	1,45 x In
I3 ( t > 0,1s )	3 x In	5 x In	10 x In
I4 ( t < 0,1s )	5 x In	10 x In	20 x In

# MINIATURE CIRCUIT BREAKERS

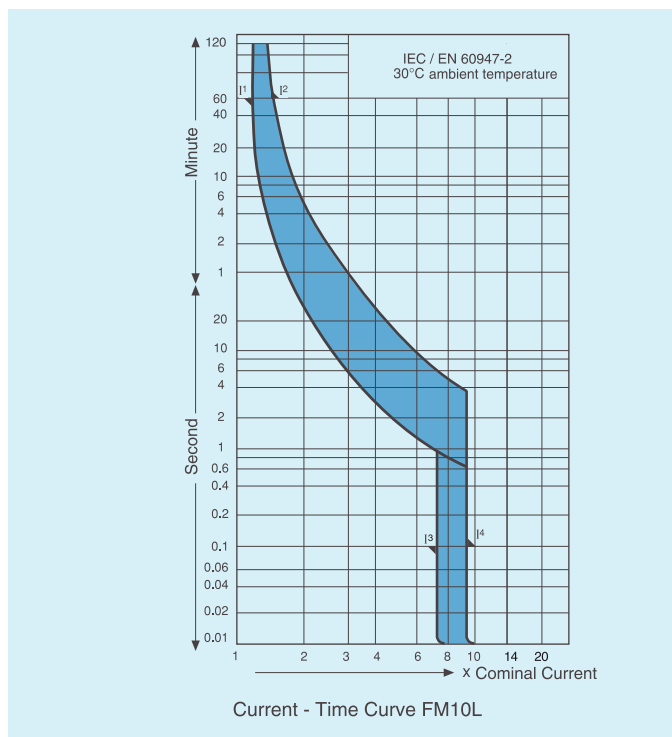






Miniature Circuit Breakers protect electrical circuits against overload and short-circuit current. They provide ON-OFF switching easily. 6,10 kA Federal Miniature Circuit Breaker is manufactured between the ranges 80A - 125A and 1, 2, 3, 4 poles. It is manufactured in accordance with IEC 60947-2 standard and CE norms. In the event of failure on any phase, 1, 2, 3, 4 poles circuit breakers obtain to not being put into use of device.

## Technical Specifications::

Type	FM6L / FM10L	
Breaking capacity $kA_{rms}$	FM6L	400V 6kA /
	FM10L	230V 15kA - 400V 10kA
Rated current	A	80,100,125
Rated operating voltage - $U_e$	V	230/400
Rated insulation voltage - $U_i$	V	630
Rated impulse withstand voltage - $U_{imp}$	kV	6
Number of poles		1,2,3,4
Frequency	Hz	50 - 60
Mechanical life	operation	>20.000
Electrical life	operation	>4.000
Min. - max. connection section	mm <sup>2</sup>	1 ... 50
Min. - max. clamping torque	Nm	3 - 5
Standard	IEC / EN 60947-2	

	Current
$I_1$ ( $t \geq 2h$ )	1,05 $I_n$
$I_2$ ( $t < 2h$ )	1,3 $I_n$
$I_3$ ( $t > 0,2s$ )	$8 \times 0,8 \times I_n$
$I_4$ ( $t < 0,2s$ )	$8 \times 1,2 \times I_n$



FM10L	Rated current $I_n$ (A)	Breaking capacity $I_{cs}$ (kA)	Order codes
	80	6	9EF-C033 □-0D80
	100	6	9EF-C033 □-D100
	125	6	9EF-C033 □-D125
	80	10	9EF-C103 □-0D80
	100	10	9EF-C103 □-D100
	125	10	9EF-C103 □-D125

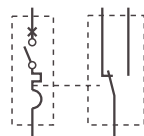
For FM6L-FM10L, desired number of poles is written in □ part (1,2,3,4)

## Accessories

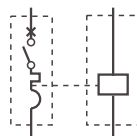


Type		Order Code
Shunt Trip - FM6 - FM10 - FM10L-AB	AC 230V	9EF-BA□00-D220
Auxiliary Contact - FM6 - FM10 - FM10L-YK	1NO / 1NC	9EF-AQ□11-D000

□ : 1 for FM6-FM10; 0 for FM10L.



Auxiliary Contact



Shunt Trip

# MINIATURE CIRCUIT BREAKERS BOXES - ATS with MCB

## ATS with MCB



### Technical Features:

Standard	TS EN 60947-6-1
Circuit Breaker Rated Current (In)	0,5A ~ 125A
Pole number	1, 2, 3, 4
Control Voltage	140 - 270V
Auxiliary Control Voltage	10 - 15V DC
Generator Start-Stop Time Adjustment	0,5 - 90 seconds (adjustable)
System Voltage	415V
Mechanical Life	10.000
Operating Temperature	-20 ~ +60°C
Protection Class	IP20
Pollution Level	III / 2

### Product Types and Amps

FM6 / 6kA	0,5A ... 63A
FM10 / 10kA	0,5A ... 63A
FM10L / 10kA	80A ... 125A

## MINIATURE CIRCUIT BREAKERS BOXES

### General Technical Specifications

- Material: Thermoplastic
- Standard color: White
- Recommended assembly temperature: before -15°C and + 60°C
- Field of use: Flush mounted and surface mounted installations

-Circuit labels, ground busbars, automated assembly rail are present.

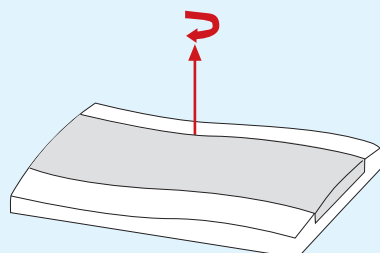
- Model of 1, 2, 3, 4, 6, 8, 9, 12, 18, 24
- Cover opening towards right or left.
- High-strength cover.
- Opening direction of covers may be reversed to right or left.



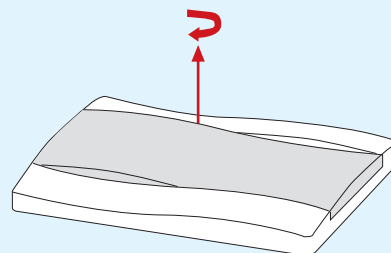
- 1, 2, 3, 4, 6, 8 ways
- Surface mounted
- Sealable cover



- 9, 12, 18, 24 ways
- Flush mounted and surface mounted



Symmetrical



Asymmetrical

Symmetrical and asymmetrical used cover



# IMPULSE RELAY - DISCONNECTORS

## IMPULSE RELAY



Impulse Current Breakers are used to control lightning from two or more points. Traditionally, the need for controlling lightning circuits in larger areas from various points was met by using vavien-key system. Limited number of keys, high material and installation costs creates a need for more economical and comfortable solutions. The product were developed to overcome this deficiency and presented to the end-users. According to the changing position principle of contacts when switched as the number of connection terminals will be the same regardless of the number of keys, 80% of the time during cable pulling and 50% savings in cable length is achieved.

### Specifications of Impulse Current Breaker:

- 24V-48V-230V coil voltage
- The modularity
- Rail mounting feature
- Auxiliary contacts can be added

### Connection Capacity:

- Rigid Conductor 10mm<sup>2</sup>
- Flexible Conductor 6mm<sup>2</sup>

### Description:

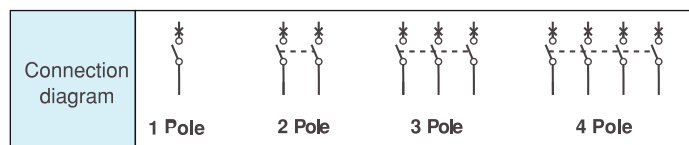
For control of lighting circuits in private buildings, small industry buildings. Latching relays operate when pulsed by a signal voltage. The pulse can be provided via a push button or switch. The first impulse sets the relay into its set (opposite) state, the next impulse returns it to its reset (original) state.

Type	Coil VAC 50 / 60 Hz	Coil VDC	Power Circuit AC1	Order Code
1NO	230	110	16A-250V	9DA-0001-0000
2NO	230	110	16A-250V	9DA-0022-0000
1NC+1NO	230	110	16A-250V	9DA-0011-0000

## DISCONNECTORS



On-off switches without thermal and magnetic protection feature are called disconnectors. Federal switches are manufactured in accordance with TS EN 60947-3 standard and **CE** norms from 40A to 100A with 1, 2, 3 and 4 poles. Thanks to their 2, 3 and 4-pole switch lever mechanisms, they break the system simultaneously. They can be used safely with distribution and control elements.



### Technical Characteristics:

Number of poles	1,2,3,4	Short-time withstand current	A/1s	12xIn	
Utilization class	AC-22A	Short circuit making capacity	A	20xIn	
Rated current In	A	40,63,80,100	Mechanical life	Operation	20.000
Rated insulation volage Ui	V	750 V	Electrical life	Operation	4.000
Rated impulse withstand voltage - Uimp Ith	kV	6	Min. - max. connection sections	mm <sup>2</sup>	6-35
Rated frequency	Hz	50/60	Min. - max. clamping torque	Nm	2-3
Standard	IEC / EN 60947-3				

### Order Codes :

Rated Current In (A)	1 Pole	2 Pole	3 Pole	4 Pole
40	9RA-00201-0040	9RA-00202-0040	9RA-00203-0040	9RA-00204-0040
63	9RA-00201-0063	9RA-00202-0063	9RA-00203-0063	9RA-00204-0063
80	9RA-00201-0080	9RA-00202-0080	9RA-00203-0080	9RA-00204-0080
100	9RB-00201-0100	9RB-00202-0100	9RB-00203-0100	9RB-00204-0100
Connection diagram				

# INSTALLATION CONTACTORS

## Installation Contactors

### Area of Usage

- Small engines
- At residential and office, at the power control of the last distribution circuit.
- Lighting
- Heating, pumps and furnaces
- Water heating for home using



Impact voltages and currents, which occur in illumination applications from time to time, may force the contactor.

It has been classified in terms of type behavior and closing-breaking operation for selection. While contactor is selected for illumination circuits, important factors are bulb type, connection, whether there is compensation or not, start-up and operating current and power factor. While the contactor is loaded up to 15 times of the lamp rated current during closing in filament lamps, breaking current is equal to rated current.

Compensation is very important in discharge and florescent lamps. In high pressure mercury vapor lamps, a current occurs at two times of the operating current during pre-heating period (approximately 5 minutes). This regime period is about 10 minutes in halogen lamps and sodium vapor lamps.

### Technical Features:

Type	Using Category	Insulation Voltage Ui (V)	Operating Voltage Ue (V~)	Rated of Heat Current (A)	Ie (A)	Control Power (kW)
FCR2020	AC-1,AC-7a	500	230	20	20	3,6
FCR4040	AC-1,AC-7a	500	400	40	40	22
FCR6340	AC-1,AC-7a	500	400	63	63	34

Type	Number of Poles	Ie (A) AC1 / AC7A	Operating Voltage (AC) V	Contact Type	Order Code
 2 poles	2	20	230	2NA	9DT-K3202-0020
 4 poles	4	40	400	4NA	9DT-K3404-0040
		63	400	4NA	9DT-K3404-0063

### Effect of ambient temperature to rated operating current of installation contactors:

Rated Current (A)	40°	50°	60°	70°
Ie=20	20A	18A	16A	14A
Ie=40	40A	38A	36A	32A
Ie=63	63A	57A	50A	46A

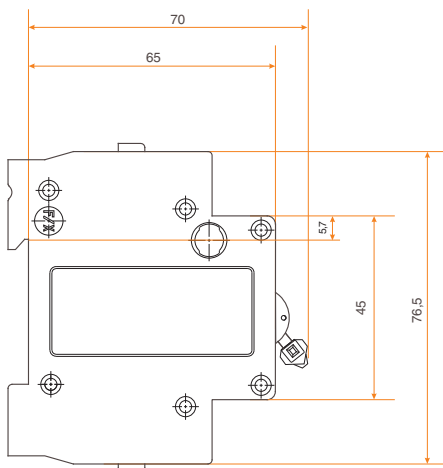
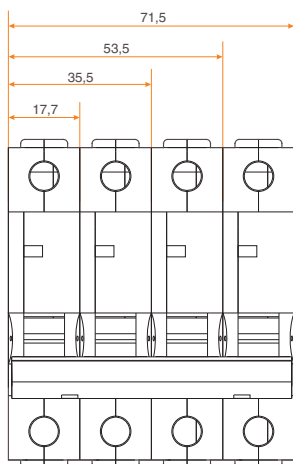
### Number of Lamp which can be controlled by installation contactors:

Tungsten Filamanlı ve Halojen Ampuller 230V									
Güç	40W	60W	75W	100W	150W	200W	300W	500W	1000W
20A	45	35	29	29	14	12	8	5	2
40A	118	87	72	72	36	26	18	11	7
63A	150	112	95	95	47	34	25	15	8

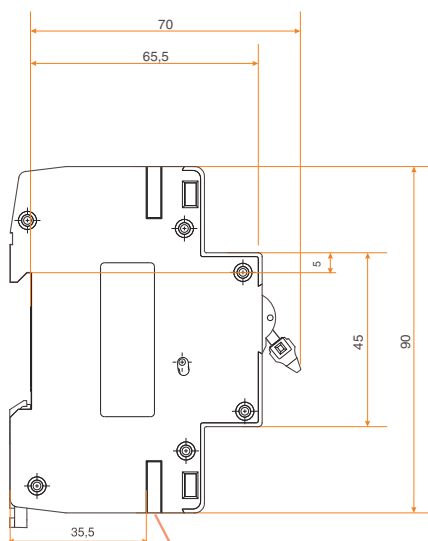
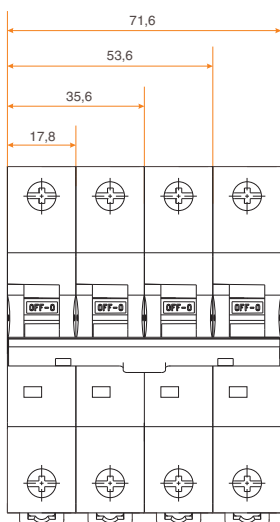


# MINIATURE CIRCUIT BREAKERS

## FM3

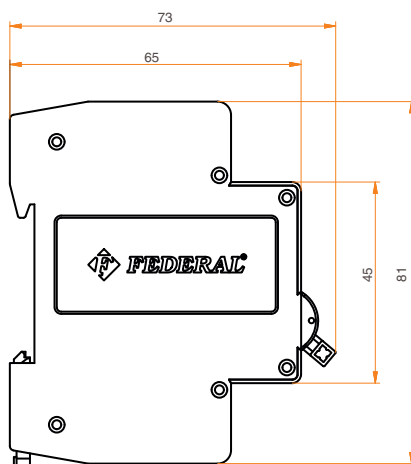
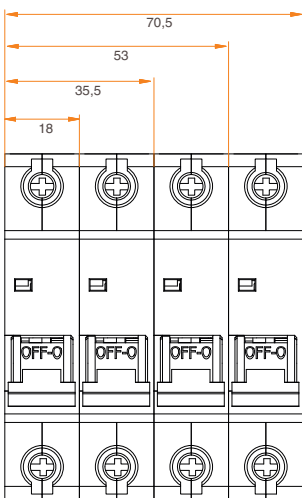


## FM6 - FM10



Federal Electric FM6, FM10 miniature circuit breakers may be used with FK2, FK4 residual current circuit breakers, thanks to automat busbar.

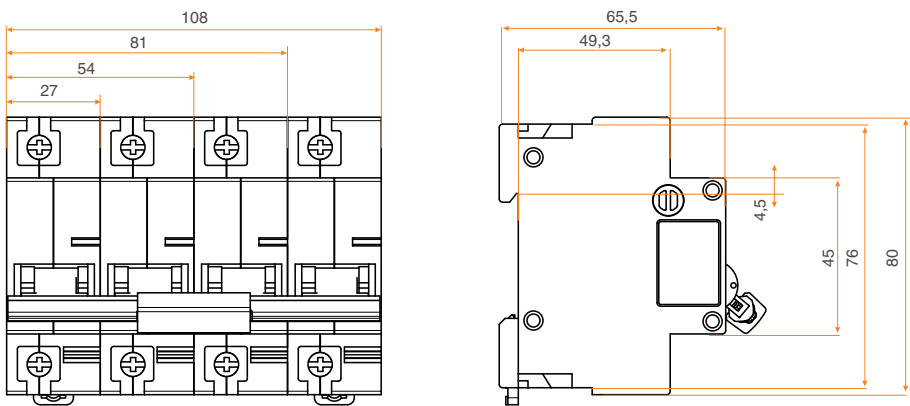
## FM6E - FM10E



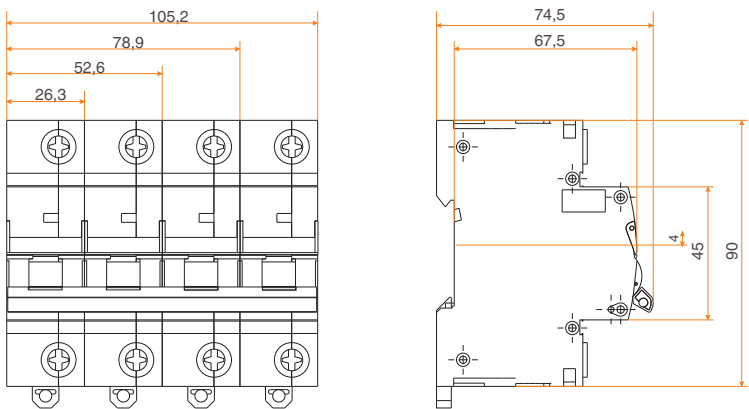
# MINIATURE CIRCUIT BREAKERS

## MINIATURE CIRCUIT BREAKERS BOXES

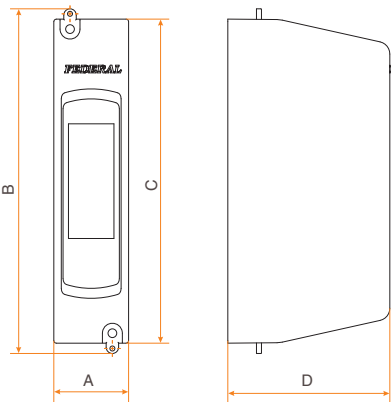
FM6L



FM10L

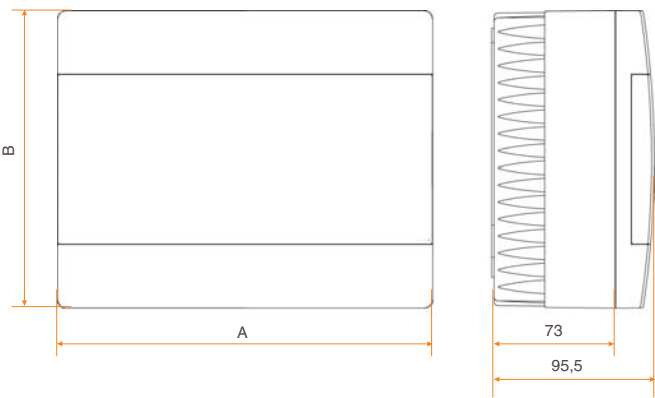


Surface Mounted Series



MODEL	A	B	C	D
FEB1 - FEB2	50,5	133	127	60,65
FEB3 - FEB4	86,60	133	127	60,65
FEB6 - FEB8	180	170	160	63

Surface Mounted Series

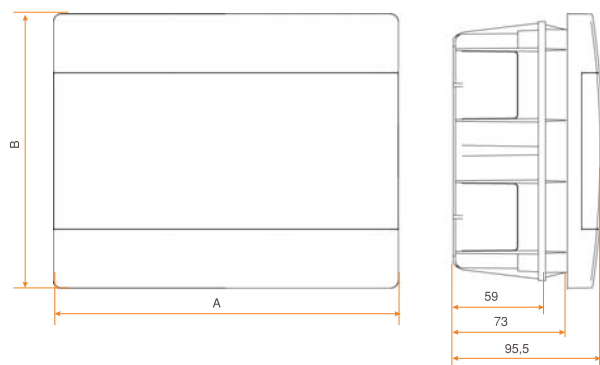


MODEL	A	B
FVK SA 9	220	175
FVK SA 12	274	210
FVK SA 18	220	290
FVK SA 24	274	335

# MINIATURE CIRCUIT BREAKERS BOXES

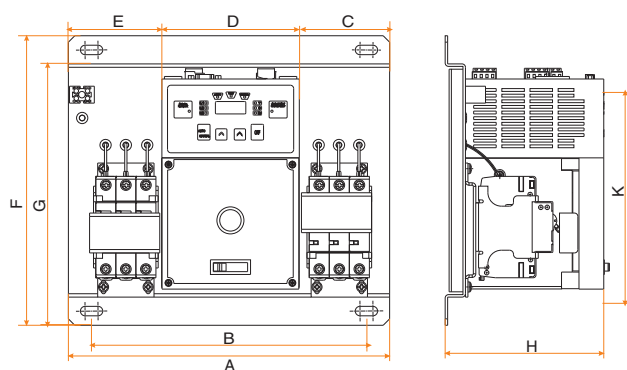
## MINIATURE CIRCUIT BREAKERS

### Flush Mounted Series



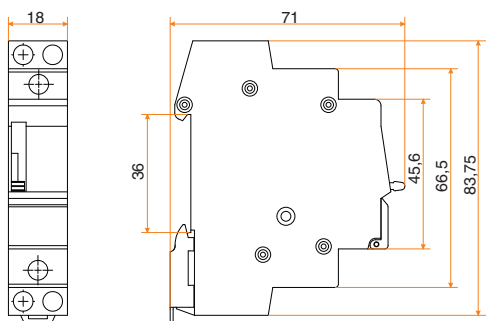
MODEL	A	B
FVK SU 9	220	175
FVK SU 12	274	210
FVK SU 18	220	290
FVK SU 24	274	335

### ATS With Miniature Circuit Breakers

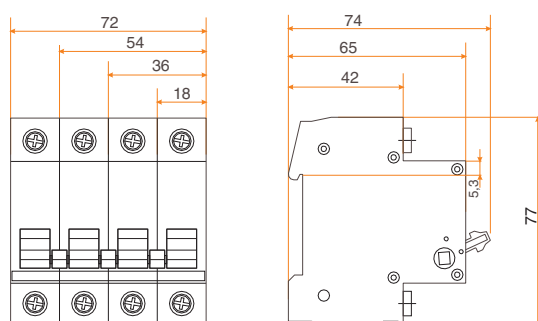


Type	Dimensions									Ampere Ranges
	A	B	C	D	E	F	G	H	K	
FM6	286	244	80	122	83	257	232	141	187	1A ... 63A
FM10	286	244	80	122	83	257	232	141	187	1A ... 63A
FM10L	390	324	119	122	149	265	242	142	187	80A ... 125A

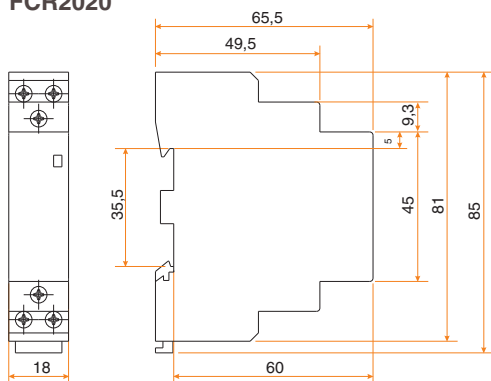
### FIR



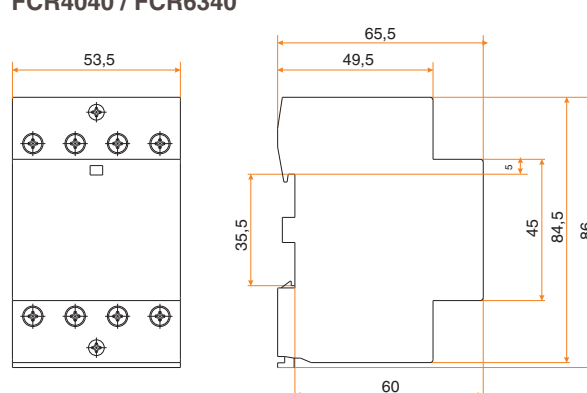
### FMS



### FCR2020



### FCR4040 / FCR6340



# INSTALLATION CONTACTORS



## Installation Contactors



**FCR2020**



**FCR4040**



**FCR6340**

IEC / EN 60947-4-1  
IEC / EN 61095  
CE

<b>Mounting Position</b>	: Front face downwards
<b>Altitude</b>	: 2000 m (max)
<b>Relative Humidity</b>	: %50 (40°C) , %90 (55°C)
<b>Ambient Temperature</b>	: between -25°C and +60°C
<b>Pollution Degree</b>	: III

All these given information are general. We have always right to change them.

# INSTALLATION CONTACTORS

## Area of Usage

- Small engines
- At residential and office, at the power control of the last distribution circuit.
- Lighting
- Heating, pumps and furnaces
- Water heating for home using



Impact voltages and currents, which occur in illumination applications from time to time, may force the contactor. It has been classified in terms of type

behavior and closing-breaking operation for selection. While contactor is selected for illumination circuits, important factors are bulb type, connection, whether there is compensation or not, start-up and operating current and power factor. While the contactor is loaded up to 15 times of the lamp rated current during closing in filament lamps, breaking current is equal to rated current. Compensation is very important in discharge and florescent

lamps. In high pressure mercury vapor lamps, a current occurs at two times of the operating current during pre-heating period (approximately 5 minutes). This regime period is about 10 minutes in halogen lamps and sodium vapor lamps.

## Technical Features:

Type	Using Category	Insulation Voltage Ui (V)	Operating Voltage Ue (V~)	Rated of Heat Current (A)	Ie (A)	Control Power (kW)
FCR2020	AC-1,AC-7a	500	230	20	20	3,6
FCR4040	AC-1,AC-7a	500	400	40	40	22
FCR6340	AC-1,AC-7a	500	400	63	63	34

Type	Number of Poles	Ie (A) AC1 / AC7A	Operating Voltage (AC) V	Contact Type	Order Code
 2 poles	2	20	230	2NO	9DT-K3202-0020
 4 poles	4	40	400	4NO	9DT-K3404-0040
		63	400	4NO	9DT-K3404-0063

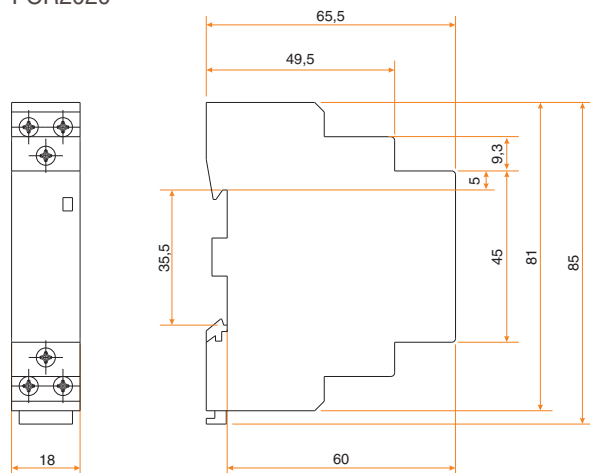
## Effect of ambient temperature to rated operating current of installation contactors:

Rated Current (A)	40°	50°	60°	70°
Ie=20	20A	18A	16A	14A
Ie=40	40A	38A	36A	32A
Ie=63	63A	57A	50A	46A

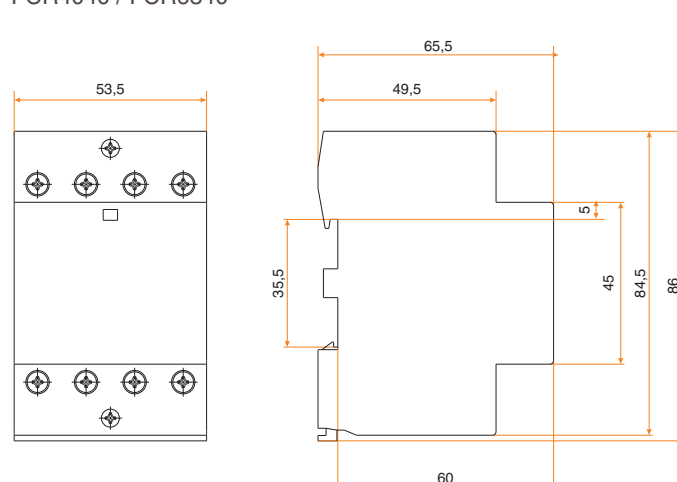
## Number of Lamp which can be controlled by installation contactors:

Tungsten Filament and Halogen Lamps 230V									
Power	40W	60W	75W	100W	150W	200W	300W	500W	1000W
20A	45	35	29	29	14	12	8	5	2
40A	118	87	72	72	36	26	18	11	7
63A	150	112	95	95	47	34	25	15	8

FCR2020



FCR4040 / FCR6340



# SURGE PROTECTIVE DEVICE



## Surge Protective Device



**FSPD-B100**



**FSPD-BC25**



**FSPD-C40  
FSPD-C40 DC**



**FSPD-D20**

# SURGE PROTECTIVE DEVICE

Devices which prevents effect of damage of high-voltage fluctuation which has result of the reasons as High-Voltage Line Faults, lightning and breaker open occur in power transmission lines or shortly surge protection device calls protection element which discharge over voltage into the ground which occur in power transmission lines. Surge protection device does not allow current passage into the ground in normal case. When over-voltage come the surge protection device discharge coming high-voltage to the ground as turning on swiftly. It returns normal operating again when effect of over-voltage is out. In normal operating surge protection device is a circuit element at open position.

## Types of surge protection device

**B class (Class 1- Type 1)** If there is a lightning rod application in your or 50m around of your building type 1 surge protection device selection should be done. Type 1 surge protection device is using in nearest enter point of power supply line in low voltage installation to the building. It's protection surge protection device class against to lightning for Low voltage facilities. It should be used before electrical meter.

**C class (Class 2- Type 2)** "Type 2" surge protection device should be additionally placed in each distribution board at wiring against internal sourced over voltages. This surge protection device is the limiter of over voltage at low voltage facilities. It uses after electrical meter.

**D class (Class 3- Type 3)** This surge protection device is the limiter of over voltage at low voltage facilities.. It's using for protection of electronic devices. Type 3 application should be made for sensitive electronic devices which we want to protect as Computer, copiers, television, telecommunication systems if these devices are over 30m far away from distribution board which contain type 2 surge protection device

**B+C class (Class 1+2 - Type 1+2)** It's a combination of Type 1 and Type 2 surge protection devices. It is advised to use in case of over

distance of 10 meter between main distribution panels and sub distribution panels.

As a summary, if there is lightning rod application in the building, Type 1 and Type 2 surge protection devices at the enter of the building, Type 2 surge protection device in sub distribution panels and if the distance is over than 30m between sensitive loads and distribution panel then type 3 surge protection device protection should make at the end-point of the distribution.

**Iimp:** Maximum impulse current for Type 1 surge protection devices.

**I<sub>max</sub>:** Maximum impulse current for Type 2 surge protection devices.

**In:** Nominal discharge current for Type 1 and Type 2 surge protection devices.

**Up:** Maximum protection voltage. Voltage rates between terminals of surge protection device at the moment of carrying nominal discharge current into the ground by surge protection device. It means If a protection voltage of surge protection device is lower the protection of it will be higher.

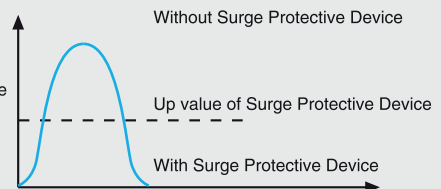
**Uc:** Sustained operating voltage. It is sustained maximum voltage rating which can be applied to surge protection device

## Varistor technology inside the Surge Protective Device

There are thousand of zinc oxide particles inside a Surge Protective Device. When there is no over voltage these particles provide a full resistance. ( No current flows except streak of lightning). In the event of over voltage these particles unite and compose lots of connection so that they provide a way for the current. The stronger the over voltage is, the lower resistance of particles gets. The name of " varistor" comes from this.

### Working principle of Varistor

Varistor inside the installation including surge protective device limits over voltage at Up value



## Selectin of Surge Protective Device

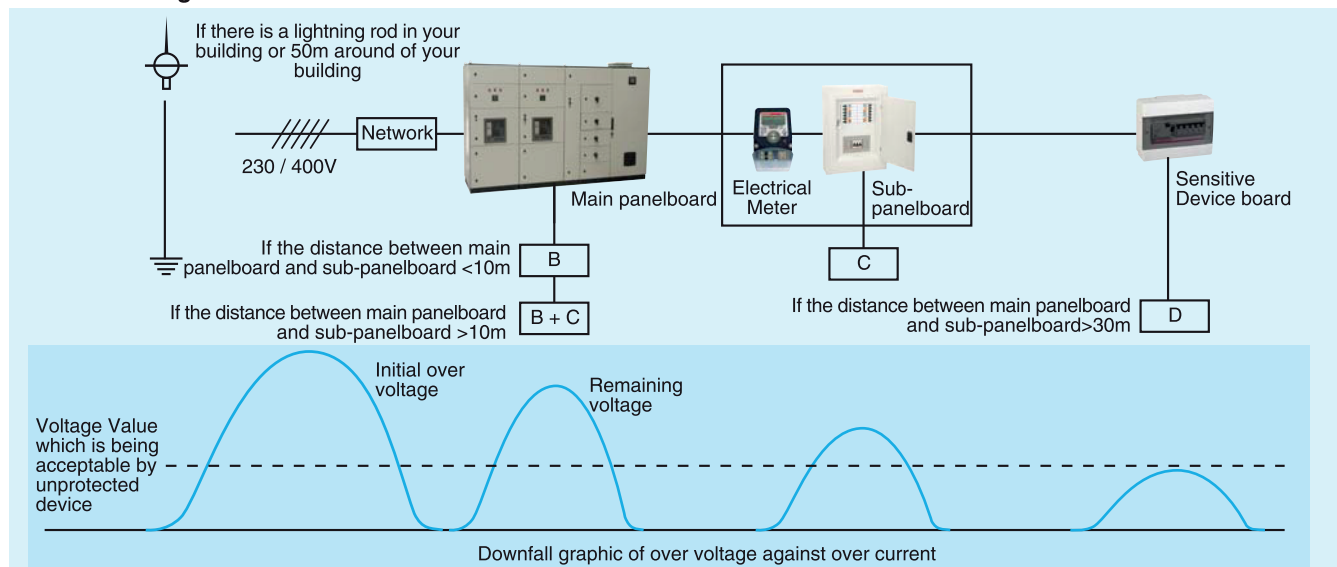


Fig 1:

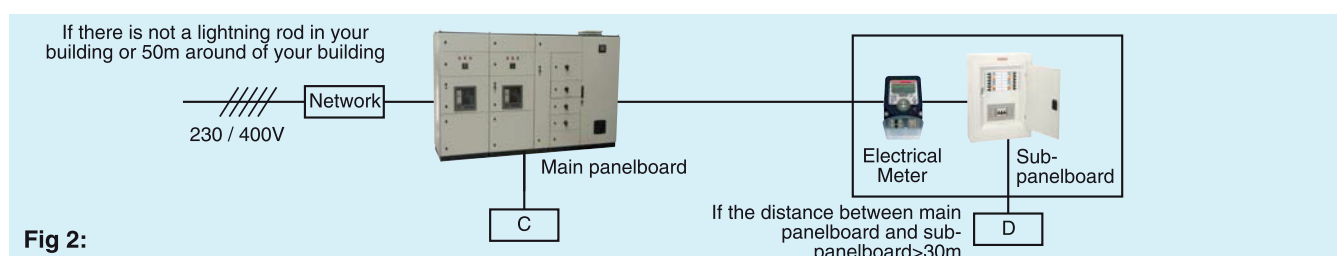


Fig 2:



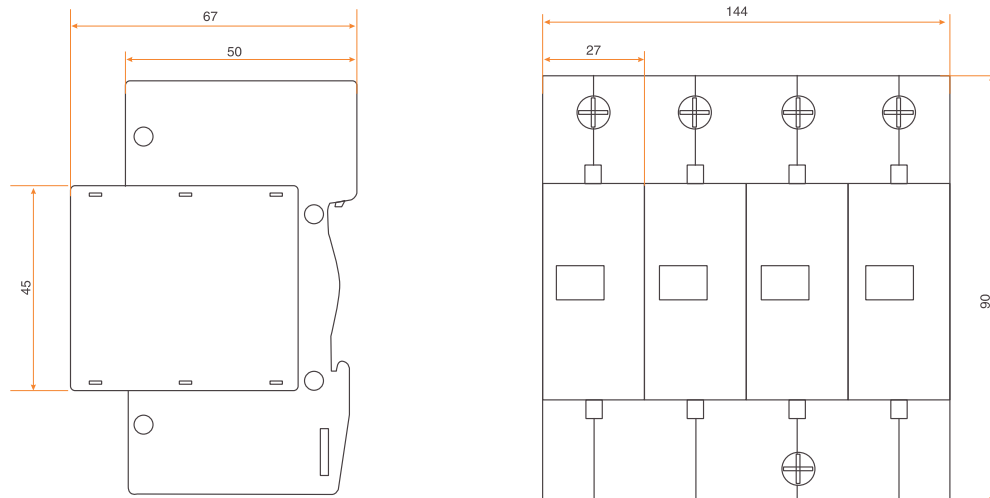
# SURGE PROTECTIVE DEVICE



Type	FSPD-B50	FSPD-BC25	FSPD-C40	FSPD-D20	FSPD-C40-DC
Maximum continuous operating voltage $U_c$ V	275 AC	300 AC	440AC	440 AC	500/800/1000 DC
Voltage protection level $U_p$ kV	2	1,2	2	1,6	1,8/2,6/3,8
Lighting impulse current (10/350 $\mu$ s) $I_{imp}$ kA	50	25	-	-	-
Charge Q As	25	12,5	-	-	-
Specific energy W/R kJ/ $\Omega$	625	156	-	-	-
Max. discharge current (8 / 20 $\mu$ s) $I_{max}$ kA	-	-	40	20	40
Nominal discharge current (8 / 20 $\mu$ s) $I_n$ kA	100	25	20	10	20
Response time $t_A$ ns	<100	<25	<25	<25	<25
Pole	3P+N	3P+N	1P+N, 3P+N	1P+N	1P+N
The cross section (L/N) mm <sup>2</sup>	16-25	16-25	10-16	6	10-16
The cross section (PE) mm <sup>2</sup>	25-35	25-35	10-25	10	10-25
Fuse or switch A	100	100	32	25	32
Operating environment	-40 ~ +85 °C				
Relative humidity (25 °C)	≤95%				
For mounting On	DIN rail 35mm				
Material of outer covering	Fiber glass reinforced plastic				
Test standard	IEC 61643-11				

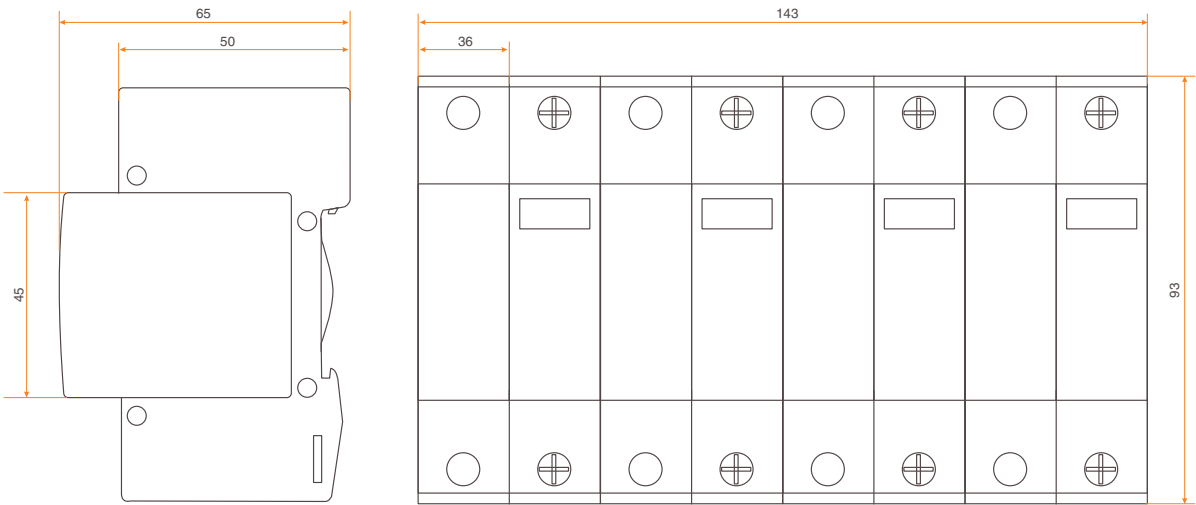
## Technical Drawings

### FSPD-B50

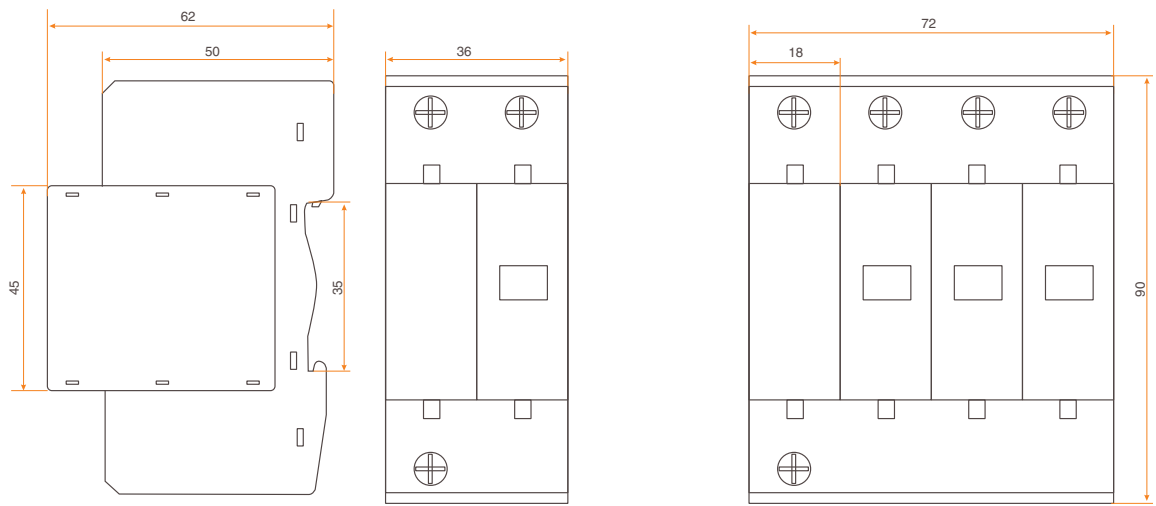


# SURGE PROTECTIVE DEVICE

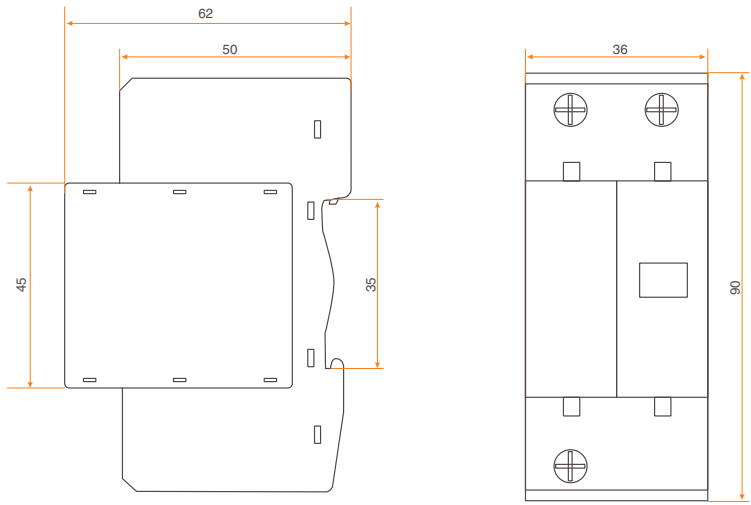
**FSPD-BC25**



**FSPD-C**



**FSPD-D20**



# CURRENT TRANSFORMERS



## Current Transformers (CT)



FAT - 30B



FAT - 30C



FAT - 30



FAT - 40



FAT - 40C



FAT - 60



FAT - 100



FAT - 130

TS EN 61869 - 1

TS EN 61869 - 2

CE

<b>Mounting Position</b>	: Free
<b>Altitude</b>	: 1000 m (max)
<b>Relative Humidity</b>	: 90% (max)
<b>Ambiance Temperature</b>	: Between -25°C and +60°C
<b>Protection Degree</b>	: IP20

All these given information are general. We have always right to change them.

# CURRENT TRANSFORMERS

**Low voltage current transformers;** consist of three parts as primary winding, secondary winding and magnetic core which those windings are wound on. There is no primary winding in current transformers without busbar in primary. Instead, primary winding is formed by passing busbar or cable through toroidal core of the transformer. Federal current transformers are manufactured in accordance with CE. Federal current transformers can be sealed.

**Measure current transformers:** Measure current transformers have been formed to feed measurement tools, counters, relays and other devices operating with similar techniques. These are the transformers which insulate such devices from high voltage networks and which reduce currents out of limits of measurement devices to measurable values.

## Explanations of technical terms used in current transformers:

**Primary winding (P1, P2):** This is the winding passing the current to be transformed.

**Secondary winding (S1, S2):** This is the winding feeding current circuits of current transformer, measurement tools, counters, relays and similar devices.

## Primary rated current (I<sub>pn</sub>):

This is the current which is taken as the basis in manufacture of the current transformer and which determines normal operating conditions of the transformer.

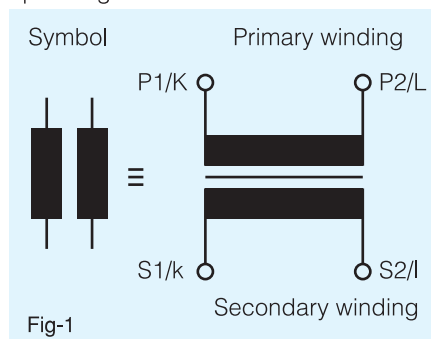


Fig-1

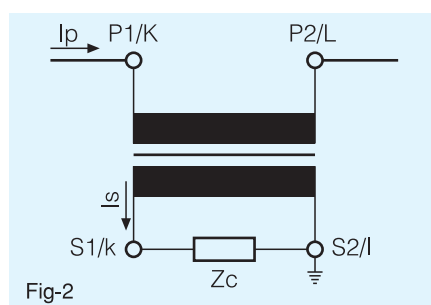


Fig-2

## Secondary rated current (I<sub>sn</sub>):

This is the current which is taken as the basis in manufacture of the current transformer and which determines normal operating conditions of the transformer.

**Rated transformation proportion (K<sub>n</sub>):** This is the proportion between the primary rated current and the secondary rated current.

$$K_n = \frac{I_{pn}}{I_{sn}}$$

**Short-term thermal rated current (I<sub>th</sub>):** This is the effective value of the primary current, which the secondary of the current transformer can resist for 1 second without any damage in short circuit condition.

## Dynamic rated current (I<sub>dyn</sub>):

This is the peak value of the primary current, which the secondary of the current transformer can resist without any electrical or magnetic damage due to electromagnetic forces in short circuit condition.

## Safety coefficient in measurement tools (F<sub>s</sub>):

Safety is expressed as the proportion of the primary current to the primary rated current.

$$F_s = \frac{I_{ps}}{I_{pn}}$$

Here;

I<sub>ps</sub> = Safety primary current

I<sub>pn</sub> = Primary rated current

In case of a short circuit in the network to which the primary winding is connected, safety of the tools fed by the current transformer is higher as the F<sub>s</sub> coefficient is lower.

## Compound error (oc) :

Provided that assumptions in marking of positive ends of primary and secondary currents are complied with, this is the effective value of the difference between rated transformation proportion and multiplication of instant values of the primary current and instant values of the secondary current in continuous operations. The compound error is generally given as % of the effective value of the primary current with the formula below.

$$\epsilon_c = \frac{100}{I_b} \sqrt{\frac{1}{T} \int (K_n \cdot I_s - I_p)^2 dt}$$

Here;

K<sub>n</sub>= Rated transformation proportion

I<sub>b</sub>= Effective value of the primary current

I<sub>p</sub>= Instant value of the primary current

I<sub>s</sub>= Instant value of the secondary current

T= Duration of a period

## Current error (Transformation proportion error) (α<sub>1</sub>) :

This is the error arising in measurement of the current due to inequality of the transformation proportion of the transformer to the rated transformation proportion. The current error is found with the following equality in percentage.

$$\epsilon_1 = \frac{K_n \times I_s - I_b}{I_b} \times 100 (\%)$$

Here;

K<sub>n</sub>= Rated transformation proportion

I<sub>b</sub>= Primary current

I<sub>s</sub>= This is the equivalent secondary current when I<sub>p</sub> passes through the primary winding during measurement.

## Phase shift (α) :

Provided that direction of the current vector is selected to have zero phase difference in an ideal transformer (with zero loss), this is the phase difference between vectors of primary and secondary currents in any current transformer. If phase of the secondary current vector is in front of phase of the primary current vector, the phase difference is positive; if it is behind, the phase difference is negative.

## Load (Z<sub>c</sub>):

Provided that power coefficient is stated, this is the impedance of the secondary current expressed in ohms (or in volt amperes in rated secondary current). Load is generally expressed with apparent power, which is taken at a particular power coefficient and secondary rated current and which is stated in volt ampere.

## Rated output power:

This is the apparent power, given by the current transformer to the secondary current at a particular power coefficient, secondary rated current and rated load and expressed in volt amperes.

$$P_c = Z_c \times I_{sn}^2 (VA)$$

## Accuracy class (CL):

This is a term used to describe that the error in current transformers remains within particular limits. Accuracy class of measurement current transformer is given with a number called "class index" in percentage which is equal to top limit of the current error in primary rated current and rated load. Standard value is 0,1 - 0,2 - 0,5 - 1 - 3 - 5. Accuracy class of the protection current transformer is given with a number called "class index" and a following "P" letter expressing the top level of the compound error in rated current and rated load. Standard value is 5P and 10P.

## Current error limits (for classes 3 and 5):

Accuracy class	±% current error for the current value expressed in percentage of the rated current	
	%50	%120
3	3	3
5	5	5

# CURRENT TRANSFORMERS

Highest network voltage (kV)	One-minute duration network resistance voltage (kV)	Impulse withstand voltage (kV)
0,6	3	-
1,2	6	-
2,4	11	-
3,6	16	45
7,2	22	60
12,0	28	75
17,5	38	95
24,0	50	125
36,0	70	170

Current error and phase shift limits (for classes 5P and 10P):

Accuracy class	Current error % in primary rated current	Phase shift in primary rated current		Compound error % in rated accuracy limit primary current
		Minutes	Centi-radians	
5P	±1	±60	±,18	5
10P	±3	—	—	10

## Rated insulation level:

This is the effective value of the large voltage in KV at any time and any point of the network between phase conductors of the network (except temporary voltage changes in case of instant cut-out of significant loads and failures).

## Impact voltage test :

This is the test carried out to determine impact voltage resistance of primary circuits of the current transformers employed in outside facilities.

## Network frequency voltage test:

This is the application of network frequency voltage value, which is the equivalent of the rated insulation level, to the transformer for 1 minute by connecting the primary winding and all the parts belonging to it. This is the application of a particular voltage value at high frequency (100 Hz - 200 Hz) for a duration calculated according to the frequency.

## Current error and phase shift limits (0,1 - 0,2 - 0,5 - 1 classes according to TS EN 61869-2):

Accuracy class	Current (proportion) error ± percentage for the rated currents given below					± phase shift for rated current percentages given below									
						Minutes					Centi-radians				
	% 1	% 5	% 20	% 100	% 120	% 1	% 5	% 20	% 100	% 120	% 1	% 5	% 20	% 100	% 120
0,1	-	0,4	0,2	0,1	0,1	-	15	8	5	5	-	0,45	0,24	0,15	0,15
0,2s	0,75	0,35	0,2	0,2	0,2	30	15	10	10	10	0,9	0,45	0,3	0,3	0,3
0,2	-	0,75	0,35	0,2	0,2	-	30	15	10	30	-	0,9	0,45	0,3	0,3
0,5s	1,75	0,75	0,5	0,5	0,5	90	45	30	30	60	2,7	1,35	0,9	0,9	0,9
0,5	-	1,5	0,75		0,5	-	90	45	30	60	-	2,7	1,35	1,35	0,9
1,0	-	3,0	1,5	1,0	1,0	-	180	90	60	60	-	5,4	2,7	1,8	1,8

When current fault and phase shift at rated frequency varies between 1/1 and 1/4 of the secondary load, rated load, the values in the table should not be exceeded.

## Powers of devices connected to current transformers:

Devices	Power VA)
Ammeter (soft iron)	0,7 ... 1,5
Watt meters	0,2 ... 5,0
Cosφ meters	2,0 ... 6,0
Counters (active and reactive)	0,4 ... 1,0
Reactive power control relays	0,5 ... 1,0
Over current relays	0,2 ... 6,0
Reverse current relay	1,0 ... 2,0
Secondary thermal relay	7,2 ... 9,0

## Additional loads arising from copper cables:

Power loss in cable with secondary current as 5 A (VA)

Cable (Cu)	2,5 mm <sup>2</sup>	4,0 mm <sup>2</sup>	6,0 mm <sup>2</sup>	10,0 mm <sup>2</sup>
1 m.	0,36	0,22	0,15	0,09
2 m.	0,71	0,45	0,30	0,18
3 m.	1,07	0,67	0,45	0,27
4 m.	1,43	0,89	0,60	0,36
5 m.	1,78	1,12	0,74	0,44
6 m.	2,14	1,34	0,89	0,54
7 m.	2,50	1,56	1,04	0,63
8 m.	2,86	1,79	1,19	0,71
9 m.	3,21	2,01	1,34	0,80
10 m.	3,57	2,24	1,49	0,89

## Power loss calculation of cable:

$$P = \frac{I_{sn}^2 \times 2L}{S \times 56} \text{ (VA)}$$

L = Length of the cable on secondary side (m)  
 Isn = Secondary rated current (A)  
 S = Section of copper cable (mm<sup>2</sup>)  
 P = Power loss (VA)

For example; The load coming to the current transformer for an active, a reactive counter and 4 m 2,5 mm<sup>2</sup> cable is 1+1+1,43 = 3,43 VA. Here, it would be suitable to use a current transformer of 5 VA.

## Technical Features :

Highest network voltage	: 720 V
Place of use	: Inside building
Continuous operating voltage	: 1,2xIn
One-minute duration test voltage	: 3 kV
Safety coefficient	: <5, <10
Nominal primary current	: 30A...4000A
Nominal secondary current	: 1A, 5 A
Operating frequency	: 50-60Hz
Operating temperature	: -25°C + 60°C
Thermal rated current	: 100xIn (FAT30,FAT30C) 60xIn (FAT30B) 50kA (FAT40, FAT40C, FAT60, FAT100, FAT130)
Dynamic rated current	: Idyn= 2,5xIth
Insulation Category	: E, F, H

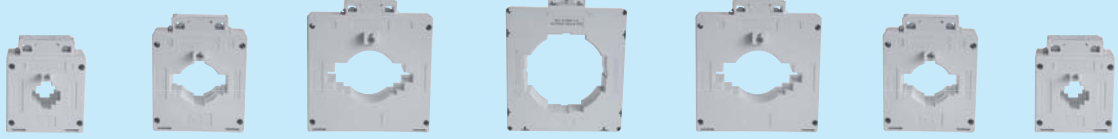
# CURRENT TRANSFORMERS

## Important considerations in assembly of current transformers:

- While current passes through the primary, the secondary circuit should not be opened.
- Primary ends of current transformers are shown with letters K-L, secondary ends are shown with letters k-l.
- Current transformers are made as one-phased.
- Current transformers are devices that usually operate in case of short circuit. (\*)

(\*) Current transformers must always be operated in case of short circuit. If the primary winding is under voltage, the secondary winding should be kept in short circuit. Otherwise, a fatal risk may occur for individuals carrying out measurement due to the excessive voltage to occur in the secondary winding.

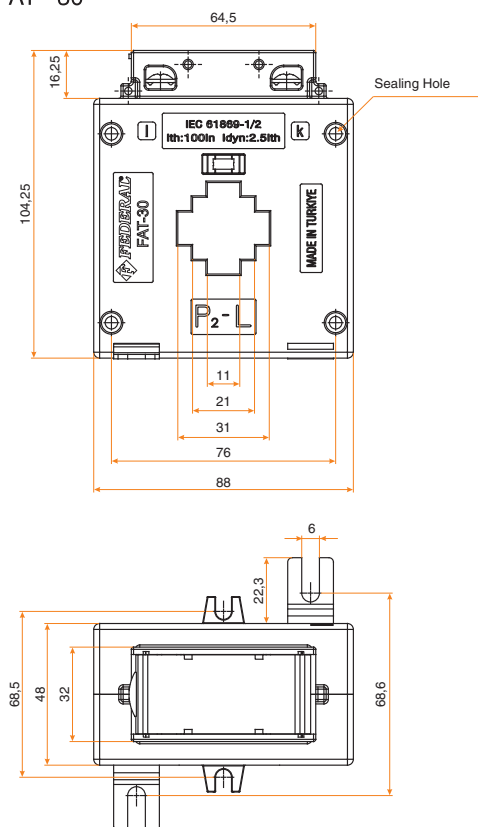
**Proportion error in current transformers** (as stated in the standards) guaranteed only between 100% and 120% of the nominal current. Error class might be 2-3 times more especially in currents below half of the nominal current. Attention should be paid to keep the load currents in application between  $(1-1,2) \times I_n$ .

												
Type	Ct mounting method	Rated current (A)	Rated Power (VA) Class				Weight (kg)	Cable (max) mm.	Busbar (max) mm.	Highest voltage for equipment (V)	Rated short-time thermal current (I <sub>th</sub> ) (1 sec.)	Rated continuous thermal current (I <sub>cth</sub> )
			0,2s	0,2	0,5s	0,5						
FAT-30B	with busbar	30	-	2,5	5	10	0,60	-	-	720	60 x I <sub>n</sub>	1,2 x I <sub>n</sub>
		40	-	2,5	5	10						
		50	-	2,5	5	10						
		60	-	2,5	5	10						
		75	-	2,5	5	10						
		80	-	2,5	5	10						
		100	-	2,5	5	10						
		125	-	2,5	5	10						
		150	-	2,5	5	10						
		200	-	2,5	7,5	10						
		250	2,5	2,5	10	10						
FAT-30C	without busbar	150	-	-	2,5	5	0,63	Ø31	30x10	720	100 x I <sub>n</sub>	1,2 x I <sub>n</sub>
		200	-	2,5	5	10						
		250	2,5	2,5	10	10						
		300	2,5	5	10	10						
FAT-30	without busbar	150	-	-	5	7,5	0,60	Ø24	30x10	720	100 x I <sub>n</sub>	1,2 x I <sub>n</sub>
		200	-	2,5	7,5	10						
		250	2,5	5	10	10						
		300	5	10	10	10						
FAT-40	without busbar	200	-	-	2,5	5	0,38	Ø33	40x10	720	50 kA	1,2 x I <sub>n</sub>
		250	-	-	5	10						
		300	-	2,5	7,5	10						
		400	2,5	5	10	10						
		500	5	10	10	10						
		600	7,5	10	10	10						
FAT-40C	without busbar	200	-	-	2,5	5	0,38	Ø41	40x10	720	50 kA	1,2 x I <sub>n</sub>
		250	-	-	5	10						
		300	-	2,5	7,5	10						
		400	2,5	5	10	10						
		500	5	10	10	10						
		600	7,5	10	10	10						
FAT-60	without busbar	500	-	2,5	7,5	10	0,60	Ø46	60x20	720	50 kA	1,2 x I <sub>n</sub>
		600	-	2,5	10	10						
		750	2,5	7,5	10	10						
		800	5	7,5	10	10						
		1000	7,5	10	10	10						
		1200	10	10	10	10						
		1250	10	10	10	10						
FAT-100	without busbar	1000	5	10	15	15	0,94	Ø62	80x30 100x10	720	50 kA	1,2 x I <sub>n</sub>
		1200	7,5	15	15	15						
		1250	7,5	15	15	15						
		1500	10	15	15	15						
		1600	10	15	15	15						
		2000	10	15	15	15						
FAT-130	without busbar	1500	15	15	15	15	1,50	Ø125	125x58	720	50 kA	1,2 x I <sub>n</sub>
		1600	15	15	15	15						
		2000	20	20	20	20						
		2500	30	30	30	30						
		3000	30	30	30	30						
		3200	30	30	30	30						
		4000	40	40	40	40						

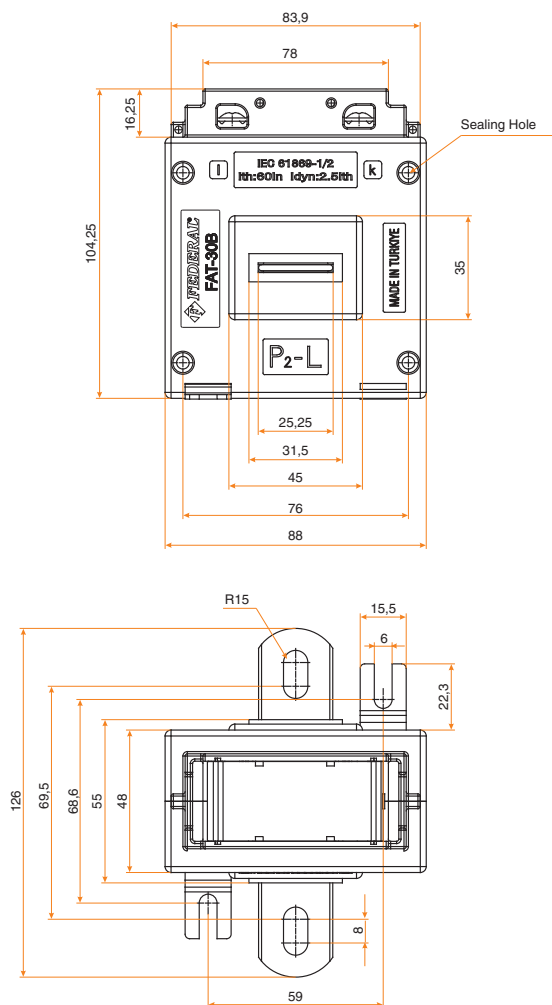
Note: Federal L.V current transformers possess sealing feature. Please call our company for current requests which are absent in the list.

# CURRENT TRANSFORMERS

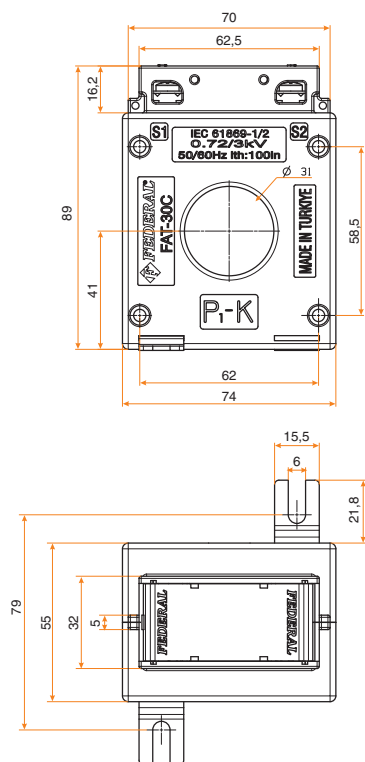
FAT - 30



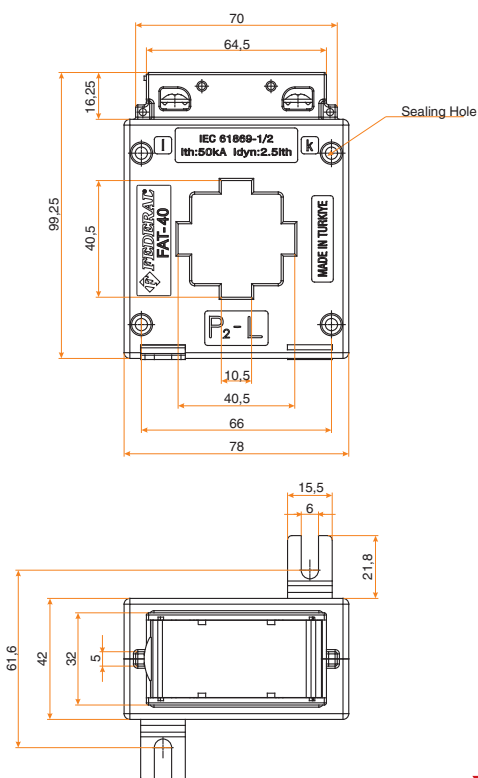
FAT - 30B



FAT - 30C



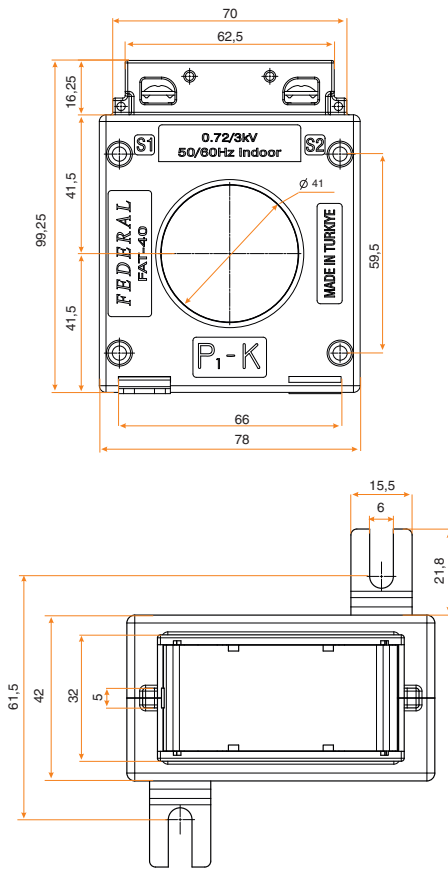
FAT - 40



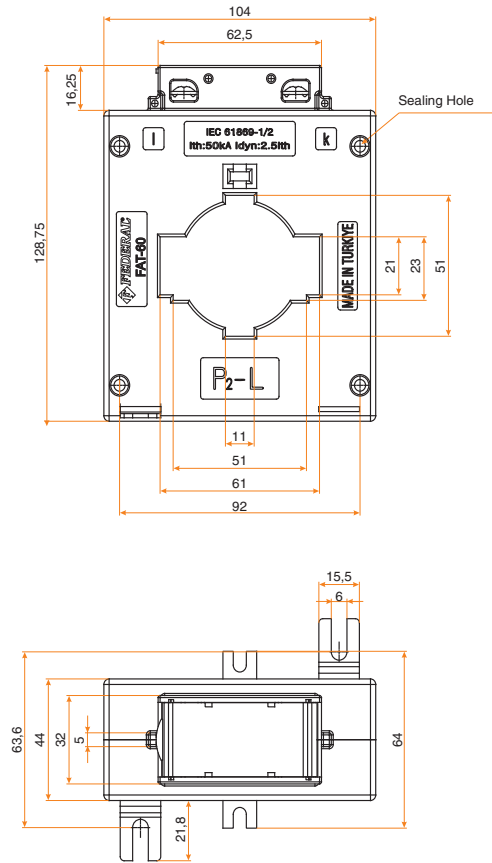


# CURRENT TRANSFORMERS

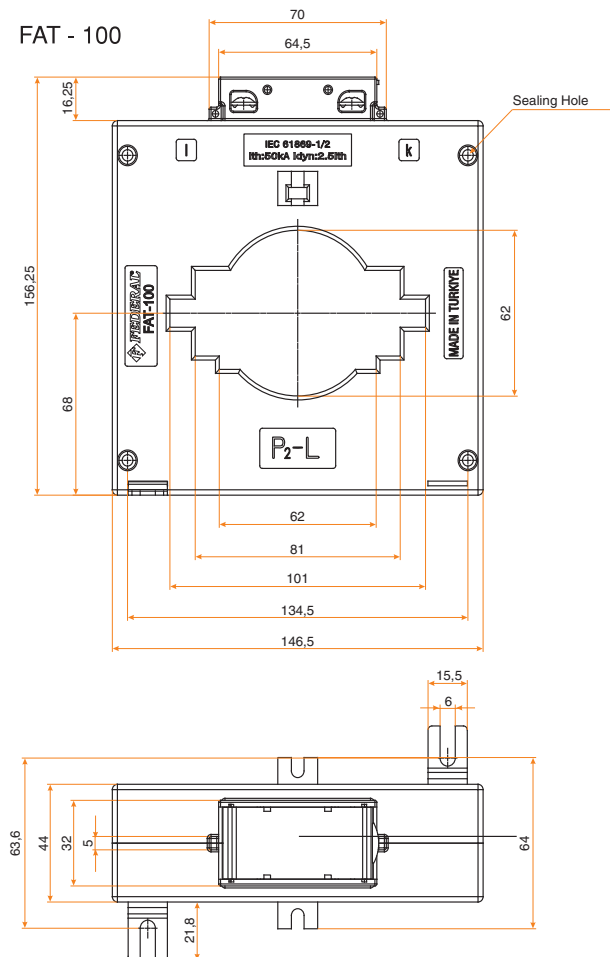
FAT - 40C



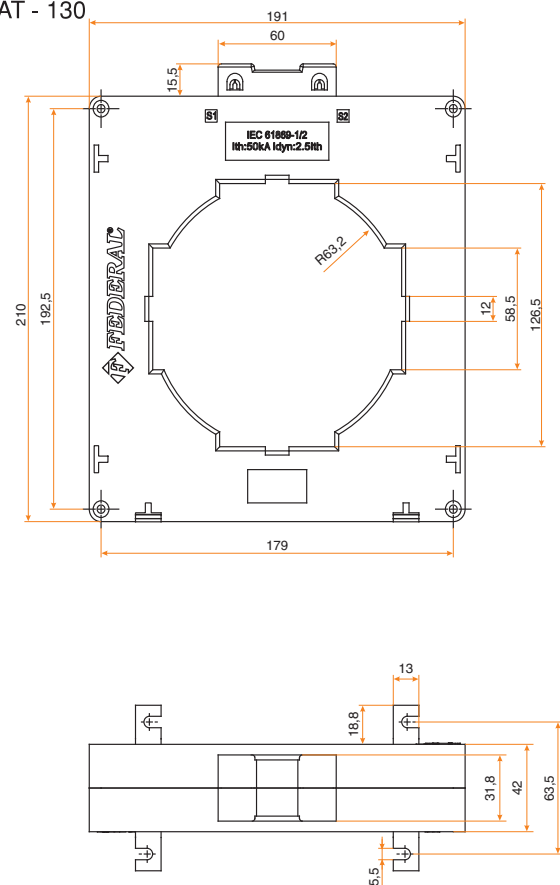
FAT - 60



FAT - 100



FAT - 130



# CONTACTORS



IEC / EN 60947-4-1  
CE

**Mounting Position** : Front face downwards  
**Altitude** : 2000 m (max)  
**Relative Humidity** : 90% (55°C)  
**Ambient Temperature** : between -25°C and +60°C  
**Pollution Degree** : III

All these given information are general. We have always right to change them.

## Power Contactors (AC - DC)



**FC06M**  
**FC09M**



**FC09D**  
**FC12D**  
**FC18D**



**FC25D**  
**FC32D**  
**FC38D**



**FC40D**  
**FC50D**  
**FC65D**



**FC80D**  
**FC95D**



**FC115D**  
**FC150D**



**FC220D**  
**FC260D**  
**FC300D**



**FC400D**  
**FC475D**



**FC580D**  
**FC650D**  
**FC750D**

## Contactors for Capacitor Switching



**FC09DK**  
**FC12DK**  
**FC18DK**



**FC25DK**



**FC32DK**



**FC38DK**



**FC40DK**  
**FC50DK**  
**FC65DK**



**FC80DK**  
**FC95DK**












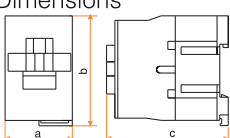









**FC115DK**  
**FC150DK**

## High Current Contactors



**EC300 ... EC2500**

# CONTACTORS


















											
Type		FC06M	FC09M	FC09D	FC12D	FC18D	FC25D	FC32D	FC38D	FC40D	FC50D
Number of Poles	A	3	3	3 - 4	3 - 4	3 - 4	3 - 4	3 - 4	3	3 - 4	3 - 4
Utilization Class - Ie (£440V) A	AC-3	6	9	9	12	18	25	32	38	40	50
	AC-5a	8	10	12	16	25	35	45	50	55	70
	AC-1	16	16	25	25	32	40	50	55	60	80
Rated Thermal Current - Ith £ 55°C	A	16	16	25	25	32	40	50	55	60	80
Rated Insulation Voltage-Ui 50-60Hz	V	800	800	800	800	800	800	800	800	800	800
Rated Impulse Withstand Voltage-Uimp	kV	8	8	8	8	8	8	8	8	8	8
Motor Control 3 ~ AC3 Driving Stopping kW	230 V	1,5	2,2	2,2	3	4	5,5	7,5	9	11	15
	400 V	2,2	4	4	5,5	7,5	11	15	18,5	18,5	22
	440 V	2,2	4	4	5,5	9	11	15	18,5	22	25
	500 V	3	4	5,5	7,5	10	15	18,5	18,5	22	30
	690 V	3	4	5,5	7,5	10	15	18,5	18,5	30	33
Weight	kg. 3 pole	0,16	0,16	0,33	0,33	0,33	0,345	0,52	0,55	1,14	1,14
	4 pole	-	-	0,33	0,33	0,33	0,59	0,59	-	1,29	1,29
Number of Auxiliary Contacts	3 pole	1 NO or 1 NC	1 NO or 1 NC	1 NO or 1 NC	1 NO or 1 NC	1 NO or 1 NC	1 NO or 1 NC	1 NO or 1 NC	1 NO or 1 NC	1 NO + 1 NC	1 NO + 1 NC
	4 pole	-	-	-	-	-	-	-	-	-	-
Coil Power Consumption (VA)	AC Coil Holding	7	7	9,5	9,5	9,5	9,5	11	11	30	30
	AC Coil Pull	50	50	75	75	75	75	110	110	225	225
	DC Coil	-	-	9	9	9	9	11	11	20	20
Power Loss Per Pole	(AC-3) W	0,15	0,33	0,30	0,50	1,2	2,1	2,3	2,9	2,8	4,1
Max. - min. Tightening Torque	Nm	1-1,5	1-1,5	1-1,5	1-1,5	1-1,5	1-1,5	1,2-2	1,5-2,5	3,5-4,5	3,5-4,5
<div>Dimensions</div> 	a (width) (mm)	45,5	45,5	47 / 47	47 / 47	47 / 47	47 / 57	57 / 57	57	77 / 85	77 / 85
	b (height) (mm)	58	58	76 / 76	76 / 76	76 / 76	76 / 86	86 / 86	86	129 / 129	129 / 129
	c (depth) (mm)	57	57	82 / 82	82 / 82	82 / 82	87 / 95	95 / 95	100	115 / 115	115 / 115
	DC Coiled c (depth) (mm)	-	-	116 / 116	116 / 116	116 / 116	120 / 130	130 / 130	135	175 / 174	175 / 174
Easily replaced coils											
Auxiliary contact blocks (Side assembly) 1st figure is number of NO contacts 2nd figure is number of NC contacts								FCBS-F11 FCBS-F20 FCBS-F02 			
Auxiliary contact blocks (Front assembly) 1st figure is number of NO contacts 2nd figure is number of NC contacts								FCB-F40 FCB-F31 FCB-F22 FCB-F13 FCB-F04			
Mechanical Lock											

**Note:** Auxiliary contact blocks are assembled on front face of the contactor

**NO** : Normally open contact

**NC** : Normally closed contact

# CONTACTORS

												
FC65D	FC80D	FC95D	FC115D	FC150D	FC220D	FC260D	FC300D	FC400D	FC475D	FC580D	FC650D	FC750D
3 - 4	3 - 4	3 - 4	3 - 4	3 - 4	3 - 4	3 - 4	3 - 4	3 - 4	3 - 4	3 - 4	3 - 4	3 - 4
65	80	95	115	150	220	260	300	400	475	580	650	750
80	100	115	140	180	260	300	350	470	560	680	760	880
80	125	125	200	200	300	315	400	600	650	750	850	1000
80	125	125	200	200	300	315	400	600	650	750	850	1000
800	800	800	1000	1000	1000	1000	1000	1000	1000	1000	1000	1000
8	8	8	8	8	8	8	8	8	8	8	8	8
18,5	22	25	30	40	60	80	90	110	140	180	200	220
30	37	45	55	75	110	140	160	200	250	315	355	400
37	45	45	59	80	129	150	160	220	250	315	355	450
37	55	55	75	90	132	180	200	257	290	360	410	470
37	45	45	80	100	160	200	250	280	375	470	530	650
1,14	1,38	1,38	2,1	2,1	4,7	4,7	8,5	8,5	10,8	17,4	17,5	19
1,29	1,54	1,54	4,3	4,5	5,7	5,7	10	10	12,9	20,5	20,5	22,4
1 NO + 1 NC	1 NO + 1 NC	1 NO + 1 NC	-	-	-	-	-	-	-	-	-	-
-	-	-	-	-	-	-	-	-	-	-	-	-
30	30	30	22/55	22/55	55	55	13	20	24	22	22	22
225	225	225	300	300	750	750	1100	1100	1250	1600	1600	1600
20	20	20	-	-	-	-	-	-	-	-	-	-
6	7,7	10,9	10	17	24	33	35	44	37	37	46	62
3,5-4,5	6-10	6-10	8-12	8-12	15-20	15-20	20-25	20-25	20-25	30-40	30-40	30-40
77/85	87/97	87/97	120/204	120/204	170/211	170/211	218/261	215/261	235/288	310/389	310/389	310/389
129/129	129/129	129/129	154/163	154/171	175/175	175/175	210/210	210/210	240/240	304/304	304/304	304/304
115/115	127/127	127/127	121/172	121/172	183/183	183/183	223/223	223/223	235/235	257/257	257/257	257/257
175/174	183/180	183/180	-	-	-	-	-	-	-	-	-	-
 FCC-D6			 FCC-D8		 FCC-D10				 FCC-D12			
 FCBS-F11 FCBS-F20 FCBS-F02												
					 FCB-F20 FCB-F02 FCB-F11  FCB-F40 FCB-F31 FCB-F22 FCB-F13 FCB-F04							
												

Give coil voltages of the contactors in accordance with the table below

	24V	42V	48V	110V	220V	230V	240V	380V	415V	440V	500V
AC	A	D	E	H	K	N	R	S	T	U	V
DC	A6		E6	H6	K6					U6	

Example: 9DD-A5013-0018 means 24V coil voltage 18A (AC3) 1NC contactors.

Contactors allow remote-control of electrical facilities such as compensation, heating etc. and in particular, electrical motors via a cable. When they are used with thermal relays, they protect devices and facilities against overload currents. Federal contactors are manufactured in accordance with international IEC 60947-4-1, TS EN60947-4-1 standards and CE. Coil and auxiliary contact blocks can be easily mounted and demounted with primary and auxiliary contacts. FC-type contacts have three-end coil. In this way, connection flexibility is provided. Coils of the contactors can be controlled safely between 0.8 and 1.1 times more of rated coil voltage. They operate with full efficiency between ambient temperatures of -5°C and +55°C. Contactors' capability of being assembled on rail provides great ease during installation. They can resist 1000V voltage in terms of their material composition.

## Major features of the contactor:

**1-** The contactor should bear high current values without being subject to any corrosion or boiling. This depends on quality of contactors (contact surface technology and resource technology). Contactor selection is very important especially in AC-3 class and capacitor control.

**2-** While the contractor is closed, the current flowing over the contacts causes heating. This heating is limited in standards. According to IEC 60947-4-1, when continuous thermal current ( $I_{th}$ ) passes through primary contacts for 8 hours, maximum heat increase in contactor terminals should not exceed 65K.

**3-** When the contactor breaks the current, it forms an electrical arc between separating contacts. The arc is the electron and ion current detaching from the contact material as a result of thermal impact. Arc temperature reaches thousands of degrees and this is higher than the temperature born by metals and conductors used in manufacture of breaking cells and contacts. Therefore, arc should be terminated as soon as possible. For this purpose, separators are used in contactors.

## Acceptable continuous thermal current $I_{th}$ :

Acceptable thermal current is the highest value of the test current to be used in heat increase test to be carried out in accordance with IEC 60947-4-1. This test is based on applying current to contact terminals through PVC-insulated copper conductors for 8 hours. In this case, heat change in contactor terminals should not exceed ( $\Delta Q$ ) 65 K.

## Closing capacity:

The closing capacity is the current value,

which the contactor can successfully close without any damage in contacts. Power factor and frequency of closing are factors affecting the closing capacity. In IEC60947-4-1, for AC3 utilization class; if  $I_e$  is the maximum motor operating current; the closing capacity should be  $10 \times I_e$ .

## Breaking capacity:

The breaking capacity is the current value, which the contactor can successfully break without any damage in contacts and arc extinction cells. As the voltage value increases, the breaking capacity decreases. In IEC60947-4-1, for AC3 utilization class; if  $I_e$  is the maximum motor operating current; the closing capacity should be  $8 \times I_e$ .

## Mechanical life:

Maximum number of openings + closings, which can be performed without any maintenance operation by supplying the coil only without passing any current through main poles of the contactor, determines mechanical resistance of the contactor.

## Electrical life:

Electrical resistance is the maximum number of openings + closings without any maintenance operation while load current passes through poles of the contactor. Electrical resistance is determined as a result of tests carried out on typical currents specified for various utilization classes.

AC1: Resistive load,

Closing current=breaking current= $I_e$

AC3: Squirrel cage asynchronous motors,

Closing current =  $6 I_e$  (drive)

Breaking current =  $I_e$  ( $I_e = I_n$ )

AC4: Discrete operation of squirrel cage or ring asynchronous motor and current breaking applications,

Closing current=breaking current= $6 I_e$ .

Contactor Selection According to Utilization Classes

One of the most important points in contactor selection is to understand the load well and to determine instant load characteristic sizes well.

## Important selection parameters:

Operating voltage ( $U_e$ ), operating current ( $I_e$ ), Coil voltage, current to be broken ( $I_c$ ), utilization class, operating type and contact life.

## Contactor selection for motors:

Important selection parameters in contactor selection for motors;

- Operating voltage ( $U_e$ ),
- Breaking current while motor is operating = Operating current ( $I_e$ ),
- Motor start-up current ( $I_c = m \times I_e$ ),

- Start-up frequency (K),
- Operation number.

## a. Cage asynchronous motors:

Motor rated power (kW), operating voltage and motor operating type (continuous, discrete, short-term etc.) are taken into consideration. While contactor is selected for motors operated at low power due to reasons such as high environmental temperature or increased safety, danger zone etc., motor operating current should be taken into consideration.

## b. Ring asynchronous motors:

Separate selections are made for stator and rotor circuits. Selection of stator contactor is made according to  $I_{th}$  thermal current. Important criteria for selection in rotor circuit are operating status (start-up, adjustment), insulation (there is grounding or not), application type (intermediate contactor or final contactor).

## c. Contactor selection in driving AC motors:

In direct driving; selection is made in AC3 utilization category according to motor nominal power. In unloaded star-triangle drives, since 1/3 of the motor nominal current shall pass through star contactor, the star contactor is selected at 1/3 of the nominal motor power according to AC3 utilization category. Since energy and triangle contactor is serially connected to motor coils, motor coil current passes through these contactors during operation. Therefore, these contactors are selected at 0.58 times more that is  $1/\sqrt{3}$  of the motor nominal power according to AC3 category. All the contactors are selected at 0.58 times more that is  $1/\sqrt{3}$  of the motor nominal power according to AC3 category in star-triangle drive of motors under load.

## d. Contactor selection for DC current:

Extinction of arc in direct current is more difficult than alternative current. In this selection, time constant L/R of the load is a size as important as load voltage and current. Load constant (L/R) is approximately 1 ms in non-inductive loads, 7.5 ms in shunt motors, 10 ms in serial motors and 300 ms in electromagnets. Important parameters in inductive DC load switching are voltage, load type (Ohmic or inductive) and switching frequency.

## e. Ohmic loads:

Ohmic loads are the most problem-free loads for enablement and disablement; because only rated current passes through the contactor. Closing current is equal to breaking current. It should be considered that the heat to be produced shall be higher as the switching



# CONTACTORS

Contactor selection in driving cage asynchronous motors	
Direct drive	Primary contactor current = $I_e$
Normal star-delta drive	Primary contactor : $0,58 I_e$ Delta contactor : $0,58 I_e$ Star contactor : $0,58 I_e$ Transition contactor : $0,30 I_e$
Impedance drive	Primary contactor : $I_e$ Start-up contactor : $0,7 I_e$
Auto transformer drive	Primary contactor : $I_e$ Transformer contactor : $I_e$ Star contactor : $0,5 I_e$

## Contactor selection in direct driving squirrel cage asynchronous motors:

Threephase 380/400V		Thermal relay adjustment area (A)	Suitable FEDERAL Contactor
kW	In (A)		
0,37	1,03	1 - 1,6	FC09D
0,55	1,6	1,25 - 2	FC09D
0,75	2	1,6 - 2,5	FC09D
1,1	2,6	2,5 - 4	FC09D
1,5	3,5	2,8 - 4	FC09D
2,2	5	4,5 - 6,3	FC09D
3	6,6	5,5 - 8	FC09D
4	8,5	7 - 10	FC09D
5,5	11,5	9 - 12,5	FC12D
7,5	15,5	14 - 20	FC18D
9	18,5	17 - 22	FC25D
11	22	20 - 25	FC25D
15	30	23 - 32	FC32D
18,5	37	30 - 40	FC40D
22	44	37 - 50	FC50D
30	60	55 - 70	FC65D
37	72	63 - 80	FC80D
45	85	75 - 105	FC95D
55	105	95 - 125	FC115D
75	138	100 - 160	FC150D
90	170	125 - 200	FC220D
110	205	200 - 315	FC260D
132	245	200 - 315	FC260D
160	300	250 - 400	FC300D

## Contactor selection in star-triangle driving squirrel cage asynchronous motors:

380/400V		Thermal relay adjustment area (A)	Suitable FEDERAL Contactor		
kW	In (A)		Line	Star	Delta
7,5	15,5	7-10	FC12D	FC12D	FC09D
9	18,5	9-12,5	FC12D	FC12D	FC09D
11	22	11-16	FC12D	FC12D	FC09D
15	30	14-20	FC18D	FC18D	FC09D
18,5	37	20-25	FC18D	FC18D	FC09D
22	44	23-32	FC32D	FC32D	FC18D
30	60	30-40	FC50D	FC40D	FC25D
37	72	38-50	FC50D	FC50D	FC32D
45	85	48-57	FC50D	FC50D	FC32D
55	105	57-66	FC65D	FC65D	FC50D
75	138	63-80	FC80D	FC80D	FC50D
90	170	75-105	FC150D	FC150D	FC80D
110	205	100-160	FC150D	FC150D	FC80D
132	245	100-160	FC220D	FC220D	FC150D
160	300	125-200	FC220D	FC220D	FC150D
200	370	200-315	FC260D	FC260D	FC220D
220	408	200-315	FC260D	FC260D	FC220D

frequency increases and calculation should be made by assuming lower rated current of the contactors selected according to AC1. 2 or 3 poles of 3-phase contactors, which are used for supplying heating circuits that are usually mono-phased, are connected serially. If two poles are serial, rated operating current should be calculated as  $1,6I_e$ ; if three poles are serial, it should be calculated as  $2I_e$ .

## f. Compensation applications:

Capacitors cause high frequency (1...5kHz) and high value temporary currents in the circuits they are connected to during start up. Switching of a single capacitor or a capacitor within a group of capacitors has different characteristics. Gradual start-up in group of capacitors is more difficult for the contactor. Because, while the capacitors in group of capacitors start up gradually, a circulating current is formed between parallel capacitor, in addition to drawing current of the battery and it forces the contactor. Therefore, special contactors and combinations have been developed for compensation applications. Where required, shock coil is used to limit the current. Contactors developed for controlling tri-phase capacitors have been developed with limit resistant transition contact blocks limiting the current value at start-up.

## g. Illumination facility applications:

Impact voltages and currents, which occur in illumination applications from time to time, may force the contactor. It has been classified in terms of type behavior and closing-breaking operation for selection. While contactor is selected for illumination circuits, important factors are bulb type, connection, whether there is compensation or not, start-up and operating current and power factor. While the contactor is loaded up to 15 times of the lamp rated current during closing in filament lamps, breaking current is equal to rated current. Compensation is very important in discharge and florescent lamps. In high pressure mercury vapor lamps, a current occurs at two times of the operating current during pre-heating period (approximately 5 minutes). This regime period is about 10 minutes in halogen lamps and sodium vapor lamps.

# CONTACTORS

## Utilization classes of contactor:

Accurate determination of the utilization class and selection in accordance with this class is the most important point for healthy operation of the contactor. The reason of many failures encountered in application is the failure to make the right selection according to utilization class of contactors.

### AC1 class:

It covers the alternative current loads with a power factor at least 0,95. The most common example of this is heating applications.

### AC3 class:

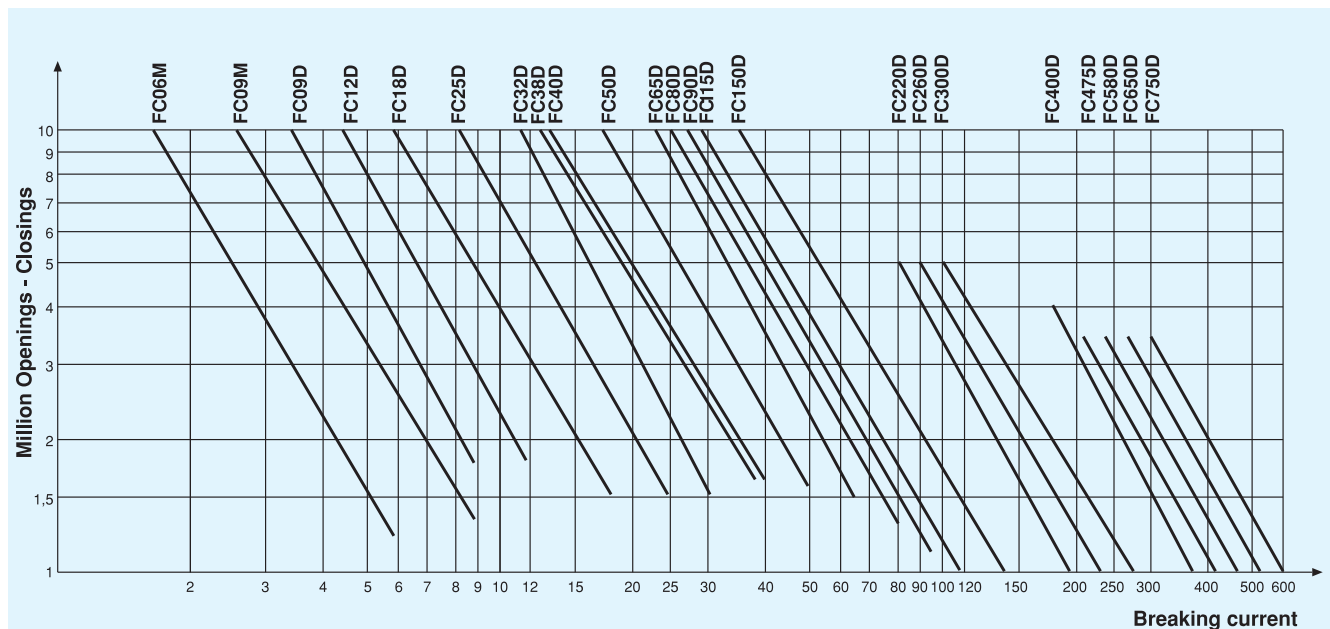
This is the most common application class. It covers cage asynchronous motors disabled while in operation after driving. At closing, motor start-up current, which is 5...7 times more than rated current of the motor, passes through the contactor contacts. At start-up, the contactor shall break the rated current drawn by the motor. At that time, the voltage between contactor poles is about 20% of the nominal voltage. This is an easy breaking situation. Examples of this class are stator and stator control of all standard squirrel cage motors and ring asynchronous motors, elevators, escalators, conveyors, pumps, ventilators, mixers, air-conditioning devices, coolers and valves.

### AC4 class:

This is related to discrete operation and reverse-current braking applications of cage or ring motors. Contactor opens and closes at driving current, which is 5...7 times more than rated current of the motor. Breaking is difficult at low speeds. Sample applications are pressing machines, wire and cable machines, discrete operating machine tools, metallurgy, lifting, electro valves, couplers etc.

## a.Contactor utilization classes according to IEC 60947-4-1:

Current type	Class	Area of utilization
Alternative current	AC - 1	Non-inductive or low-inductive loads, resistance furnaces
	AC - 3	Squirrel cage motors, driving, motor stop in operation
	AC - 4	Squirrel cage motors, driving, reversing operation, stepping operation
	AC - 5a	Electrical discharge lamp control mechanism switching
	AC - 6b	Switching of capacitor groups



**Fig-1** Electrical life values of contactors according to breaking current ( $U_e \leq 440V$ , 50Hz for AC-3 class)



# CONTACTORS

## Contactor failures and impacts:

If the contactors are not used in accordance with the technical data present in the catalogues or if there are failures in the supply network, failures may occur.

## Possible disablement reasons of contactors:

In general, contactors are actually devices which are not subject to failures quite easily. If selection has been made correct and if operating conditions are accurate, a contactor may perform millions of safe openings - closings. Below are the failures frequently encountered in contactors and reasons and solutions of these failures.

- Too long control (coil) circuit cables may cause some problems. Whereas significant voltage decrease throughout long cables makes closing difficult, too big section cable capacitance hinders opening. If control cable is longer than the recommended value, it is recommended to utilize a lower coil voltage or to connect a parallel resistance or inductive impedance to the coil.
- Existence of dust or foreign objects in

the contactor, severe atmosphere conditions and corrosion may hinder closing of the contactor especially with remote-control. When such a fault is encountered, the contactor should be cleaned with a strong clean air flow against dust and dirt, housing should be made more closed and protected, the circuit should be checked and any factor corrupting conductivity should be eliminated.

- The contactor coil may burn due to low or high voltage. Voltage regulator should be used in cases where network voltage fluctuates too much. Moreover, dust and foreign objects in air gap facilitate it. When coil is burnt, first voltage and frequency should be checked and a stable control voltage should be ensured.
- Another incident hindering opening other than the capacitive impact is adherence of the contacts. Reason of this adherence might be switching in high current, short circuit or fault in star-delta transition. If there is a short circuit, first of all reason of the short circuit should be found out.
- Incidents causing noisy operation of the contactor are presence of foreign

objects such as dust etc. in the air gap, failure of nucleus surface due to long-time operation and inappropriate voltage and frequency. In order to avoid them, nucleus surface should be kept clean and coil should be replaced according to voltage and frequency if required.

## Coil replacement:



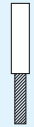





















Screws on both sides of the contactor are removed, top parts are separated, coil in the bottom is pulled out of its slot and new coil is mounted. Top part is placed and contactor is closed. However, attention should be paid to secure the spring during assembly.

## Contact life depending on opening current:

Contact melting loss at a particular switch device generally depends on opening current and contact lives are given in diagrams.

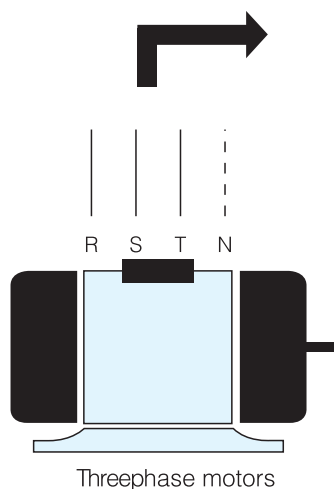
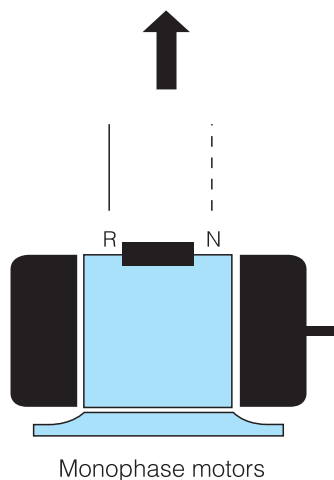
The most common area of utilization of the contactors is operation of motors. Different operating types of the motors are classified in IEC 60947-4-1.

## Connection sections:

Min. and max. connection sections (mm <sup>2</sup> )	 Primary contact	 Auxiliary contact	 mm <sup>2</sup>	 mm <sup>2</sup>	 mm <sup>2</sup>	 mm <sup>2</sup>	 mm
FC09D, FC12D, FC18D			1...4	1...4+1...4	1...6	1...6+1...6	8
FC25D			1...2,5	1...2,5+1...2,5	1...2,5	1...2,5+1...2,5	8
			1,5...6	1,5...6+1,5...6	1,5...6	1,5...6+1,5...6	10
FC32D			1,5...10	1,5...6+1,5...6	1,5...10	1,5...6+1,5...6	10
FC38D			1...2,5	1...2,5+1...2,5	1...2,5	1...2,5+1...2,5	8
			2,5...10	4...10+4...10	2,5...10	2,5...10+2,5...10	12
FC40D, FC50D, FC65D			1...2,5	1...2,5+1...2,5	1...2,5	1...2,5+1...2,5	8
			2,5...2,5	2,5...16+2,5...16	2,5...2,5	4...16+4...16	—
FC80D, FC95D			1...2,5	1...2,5+1...2,5	1...2,5	1...2,5+1...2,5	8
			4...50	4...35+4...35	4...50	6...35+6...35	—
FC115D, FC150D			—	—	—	—	20
FC220D, FC260D			—	—	—	—	25
FC300D, FC400D			—	—	—	—	25
FC475D			—	—	—	—	30
FC580D, FC630D, FC750D			—	—	—	—	40

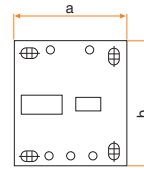
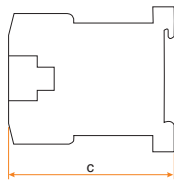
# CONTACTORS

Mono-phase motors				Threephase motors								
kW	HP	220 V A	240 V A	kW	HP	220-240 V A	380 V A	415 V A	440 V A	500 V A	660 V A	1000 V A
0,37	0,5	3,9	3,6	0,37	0,5	1,8	1,03	—	0,99	1	0,6	0,4
0,55	0,75	5,2	4,8	0,55	0,75	2,75	1,6	—	1,36	1,21	0,9	0,6
0,75	1	6,6	6,1	0,75	1	3,5	2	2	1,68	1,5	1,1	0,75
1,1	1,5	9,6	8,8	1,1	1,5	4,4	2,6	2,5	2,37	2	1,5	1
1,5	2	12,7	11,7	1,5	2	6,1	3,5	3,5	3,06	2,6	2	1,3
1,8	2,5	15,7	14,4	2,2	3	8,7	5	5	4,42	3,8	2,8	1,9
2,2	3	18,6	17,1	3	4	11,5	6,6	6,5	5,77	5	3,8	2,5
3	4	24,3	22,2	3,7	5	13,5	7,7	7,5	7,1	5,9	4,4	3
4	5	29,6	27,1	4	5,5	14,5	8,5	8,4	7,9	6,5	4,9	3,3
4,4	6	34,7	31,8	5,5	7,5	20	11,5	11	10,4	9	6,6	4,5
5,2	7	39,8	36,5	7,5	10	27	15,5	14	13,7	12	8,9	6
5,5	7,5	42,2	38,7	9	12	32	18,5	17	16,9	13,9	10,6	7
6	8	44,5	40,8	10	13,5	35	20	—	—	15	11,5	7,5
7	9	49,5	45,4	11	15	39	22	21	20,1	18,4	14	9
7,5	10	54,4	50	15	20	52	30	28	26,5	23	17,3	12
				18,5	25	64	37	35	32,8	28,5	21,3	14,5
				22	30	75	44	40	39	33	25,4	17
				25	35	85	52	47	45,3	39,4	30,3	20
				30	40	103	60	55	51,5	45	34,6	23
				33	45	113	68	60	58	50	39	25
				37	50	126	72	66	64	55	42	28
				40	54	134	79	71	67	60	44	30
				45	60	150	85	80	76	65	49	33
				51	70	170	98	90	83	75	57	38
				55	75	182	105	100	90	80	61	40
				59	80	195	112	105	97	85	66	43
				63	85	203	117	115	109	89	69	45
				75	100	240	138	135	125	105	82	53
				80	110	260	147	138	131	112	86	57
				90	125	295	170	165	146	129	98	65
				100	136	325	188	182	162	143	107	71
				110	150	356	205	200	178	156	118	78
				129	175	420	242	230	209	184	135	85
				132	180	425	245	240	215	187	140	90
				140	190	450	260	250	227	200	145	95
				147	200	472	273	260	236	207	152	100
				150	205	483	280	270	246	210	159	102
				160	220	520	300	280	256	220	170	115
				180	245	578	333	320	289	254	190	135
				185	250	595	342	325	295	263	200	138
				200	270	626	370	340	321	281	215	150
				220	300	700	408	385	353	310	235	160
				250	340	800	460	425	401	360	274	200
				257	350	826	475	450	412	365	280	203
				280	380	900	510	475	450	400	305	220
				295	400	948	546	500	473	416	320	227
				300	410	980	565	510	481	420	325	230
				315	430	990	584	535	505	445	337	239
				335	450	1100	620	550	518	472	355	250
				355	480	1150	636	580	549	500	370	262
				375	500	1180	670	610	575	527	395	273
				400	545	1250	710	650	611	540	410	288
				425	580	—	760	690	650	574	445	302
				445	600	—	790	730	680	595	455	317
				450	610	—	800	740	690	608	460	320
				175	645	—	850	780	730	645	485	335
				500	680	—	900	820	780	680	515	350

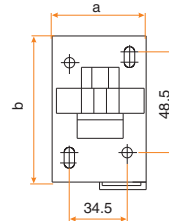
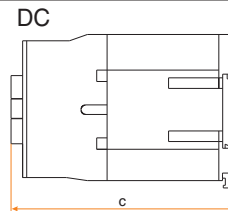
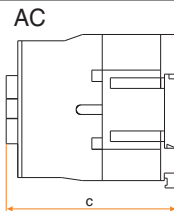


# CONTACTORS

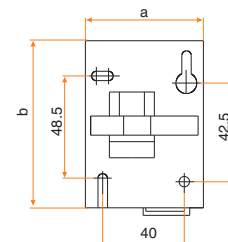
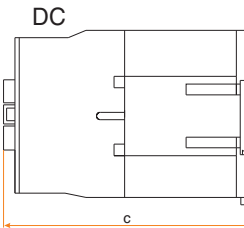
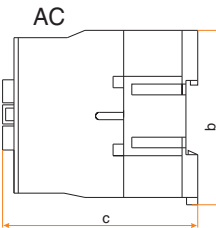
Type	a	b	c
FC06M	45.5	58	57
FC09M	45.5	58	57



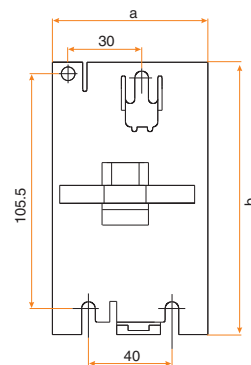
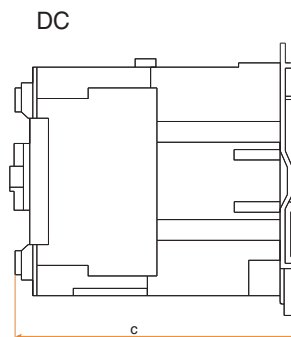
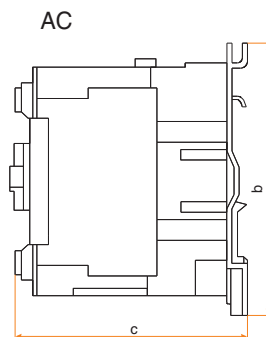
Type	Pole	a	b	c	
				AC	DC
FC09D	3	47	76	82	116
FC09D	4	47	76	82	116
FC12D	3	47	76	82	116
FC12D	4	47	76	82	116
FC18D	3	47	76	82	116
FC18D	4	47	76	82	116



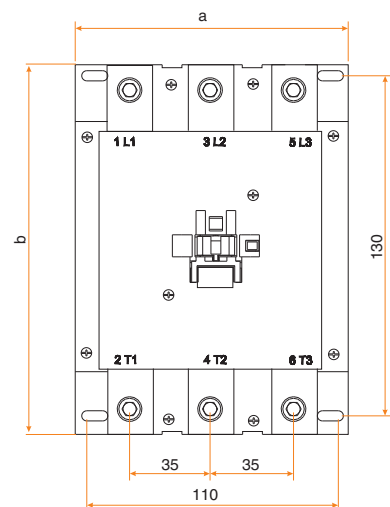
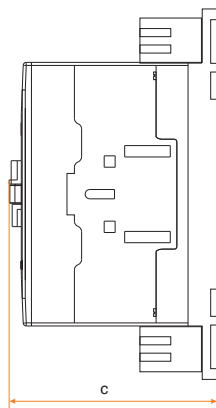
Type	Pole	a	b	c	
				AC	DC
FC25D	3	47	76	87	120
FC25D	4	57	86	95	130
FC32D	3	57	86	95	130
FC32D	4	57	86	95	130
FC38D	3	57	86	100	135



Type	Pole	a	b	c	
				AC	DC
FC40D	3	77	129	115	175
FC40D	4	85	129	115	174
FC50D	3	77	129	115	175
FC50D	4	85	129	115	174
FC65D	3	77	129	115	175
FC65D	4	85	129	115	174
FC80D	3	87	129	127	183
FC80D	4	97	129	127	180
FC95D	3	87	129	127	183
FC95D	4	97	129	127	180

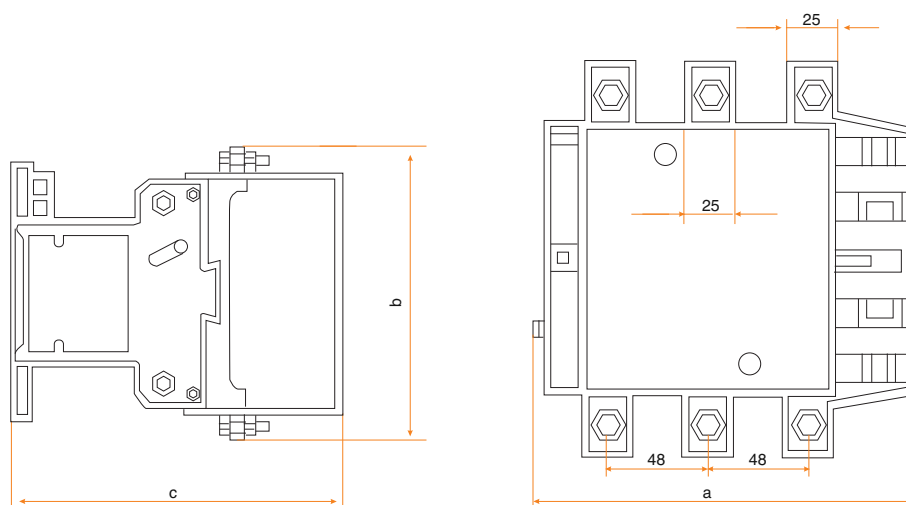


Type	Pole	a	b	c
FC115D	3	120	154	124
FC115D	4	204	163	172
FC150D	3	120	154	124
FC150D	4	204	171	172

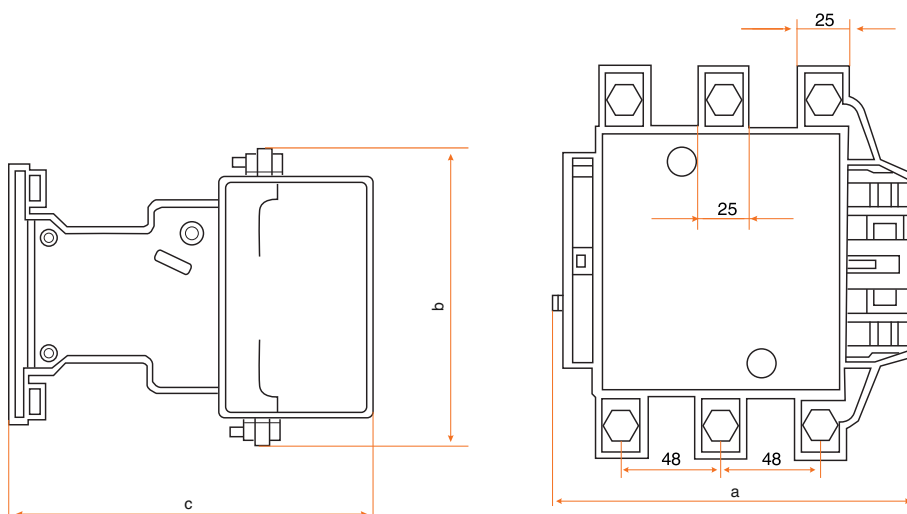


# CONTACTORS

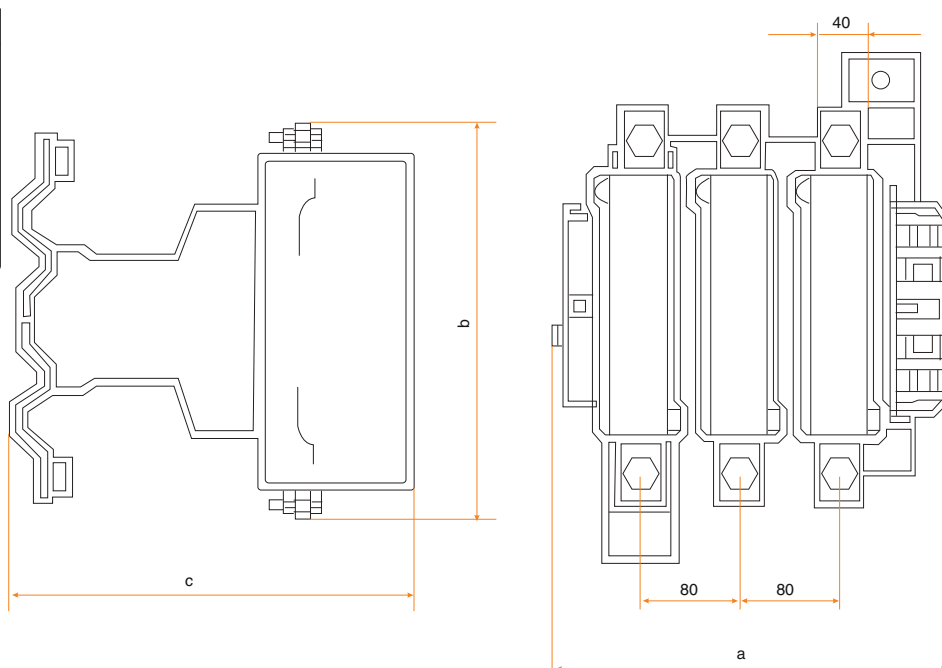
Type	Pole	a	b	c
FC220D	3	170	175	183
FC220D	4	211	175	183
FC260D	3	170	175	183
FC260D	4	211	175	183
FC300D	3	218	210	223
FC300D	4	261	210	223



Type	Pole	a	b	c
FC400D	3	218	210	223
FC400D	4	261	210	223
FC475D	3	235	240	235
FC475D	4	288	240	235

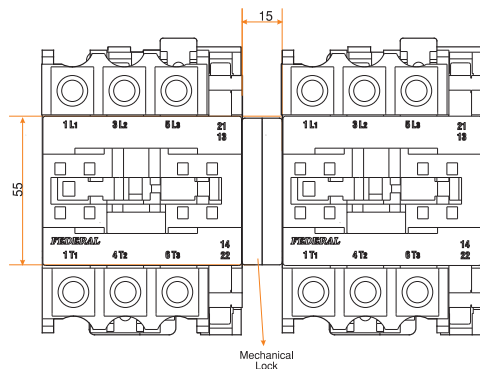


Type	Pole	a	b	c
FC580D	3	310	304	257
FC580D	4	389	304	257
FC650D	3	310	304	257
FC650D	4	389	304	257
FC750D	3	310	304	257
FC750D	4	389	304	257

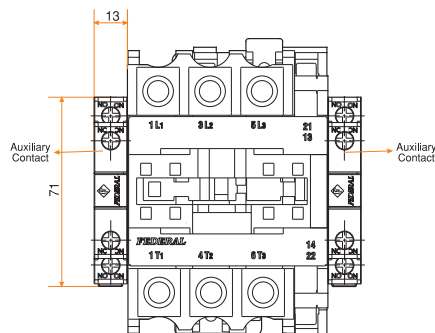


# CONTACTORS

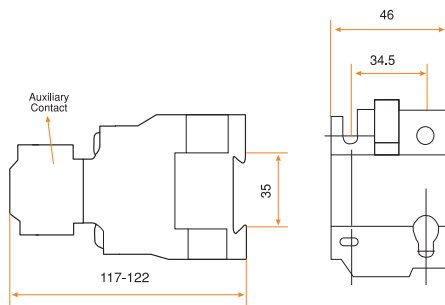
**Mechanical lock**



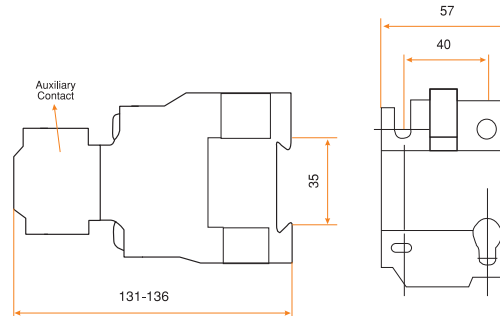
**Side assembled contact block**



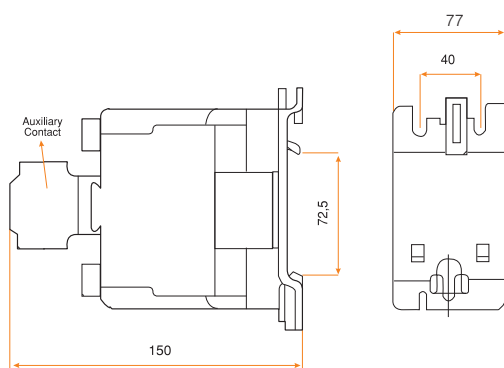
**FC12D / FC18D Front Assembling  
One Assembly Auxiliary Contact Block :**



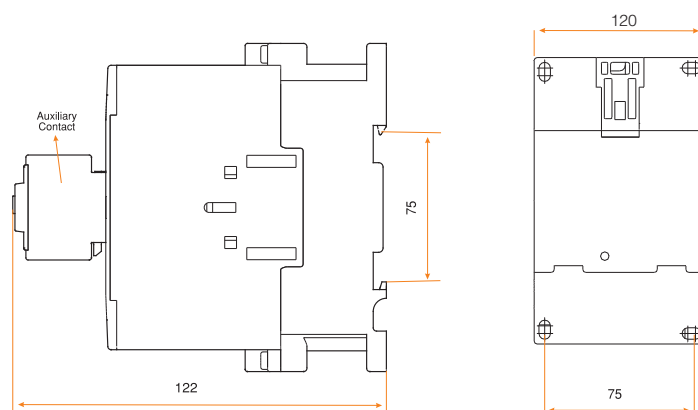
**FC25D / FC32D / FC38D Front Assembling  
One Assembly Auxiliary Contact Block :**



**FC40D / FC50D / FC65D / FC80D / FC95D  
Front Assembling One Assembly Auxiliary  
Contact Bloc:**



**FC115D / FC150D Front Assembling  
One Assembly Auxiliary Contact Block:**



## Order codes of auxiliary contact blocks

Top Assembly Type	Order code
FCB-F20	8DD-A0020-0000
FCB-F11	8DD-A0011-0000
FCB-F02	8DD-A0002-0000
FCB-F40	8DD-A0040-0000
FCB-F31	8DD-A0031-0000
FCB-F22	8DD-A0022-0000
FCB-F13	8DD-A0013-0000
FCB-F04	8DD-A0004-0000
Side Assembly Type	Order code
FCAB-F11	8DD-B0011-0000
FCAB-F20	8DD-B0020-0000
FCAB-F02	8DD-B0002-0000

## Order codes of spare coils:

Type	Order code
FCC-D2	8DD-C□□20-0000
FCC-D4	8DD-C□□30-0000
FCC-D6	8DD-C□□40-0000
FCC-D8	8DD-C□□50-0000
FCC-D10	8DD-C□□60-0000
FCC-D12	8DD-C□□70-0000

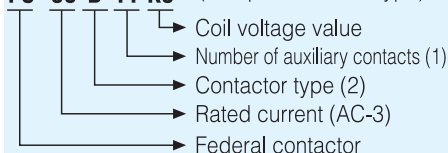
□□ Indicates coil operating voltage

## Order codes of spare primary contact sets:

Type	Order code
FC09 D	8DD-0000-0009
FC12 D	8DD-0000-0012
FC18 D	8DD-0000-0018
FC25 D	8DD-0000-0025
FC32 D	8DD-0000-0032
FC38 D	8DD-0000-0038
FC40 D	8DD-0000-0040
FC50 D	8DD-0000-0050
FC65 D	8DD-0000-0065
FC80 D	8DD-0000-0080
FC95 D	8DD-0000-0095
FC115 D	8DD-0000-0115
FC150 D	8DD-0000-0150
FC200 D	8DD-0000-0200
FC260 D	8DD-0000-0260
FC300 D	8DD-0000-0300
FC400 D	8DD-0000-0400
FC475 D	8DD-0000-0475
FC580 D	8DD-0000-0580
FC650 D	8DD-0000-0650
FC750 D	8DD-0000-0750

## Descriptions of contactor type codes:

**FC- 50 D 11 K5** (Sample contactor type)



(1) First figure indicates number of normally open (NO) contacts and second figure indicates number of normally closed (NC) contacts.

Sample

11=1NO + 1NC

(2) M: Mini contactor

D: Standard contactor

DK: Compensation contactor

## Order codes of contactors :

Type	AC-3 Ie (A)	kW 400 V	Standard auxiliary contact	Order code
FC06M22*	6	2.2	2 NO + 2 NC	9DM -K3 223-0006
FC06M	6	2.2	1 NO 1 NC	9DM -□□ 103-0006 9DM -□□ 013-0006
FC09M	9	4	1 NO 1 NC	9DM -□□ 103-0009 9DM -□□ 013-0009
FC09D	9	4	1 NO 1 NC	9DD -□□ 103-0009 9DD -□□ 013-0009
FC12D	12	5,5	1 NO 1 NC	9DD -□□ 103-0012 9DD -□□ 013-0012
FC18D	18	7,5	1 NO 1 NC	9DD -□□ 103-0018 9DD -□□ 013-0018
FC25D	25	11	1 NO 1 NC	9DD -□□ 103-0025 9DD -□□ 013-0025
FC32D	32	15	1 NO 1 NC	9DD -□□ 103-0032 9DD -□□ 013-0032
FC38D	38	18,5	1 NO 1 NC	9DD -□□ 103-0038 9DD -□□ 013-0038
FC40D	40	18,5	1 NO + 1 NC	9DD -□□ 113-0040
FC50D	50	22	1 NO + 1 NC	9DD -□□ 113-0050
FC65D	65	30	1 NO + 1 NC	9DD -□□ 113-0065
FC80D	80	37	1 NO + 1 NC	9DD -□□ 113-0080
FC95D	95	45	1 NO + 1 NC	9DD -□□ 113-0095
FC115D	115	55	-	9DD -□□ 003-0115
FC150D	150	75	-	9DD -□□ 003-0150
FC220D	220	110	-	9DD -□□ 003-0220
FC260D	260	140	-	9DD -□□ 003-0260
FC300D	300	160	-	9DD -□□ 003-0300
FC400D	400	200	-	9DD -□□ 003-0400
FC475D	475	250	-	9DD -□□ 003-0475
FC580D	580	315	-	9DD -□□ 003-0580
FC650D	650	355	-	9DD -□□ 003-0650
FC750D	750	400	-	9DD -□□ 003-0750

□□ Indicates coil operating voltage. \*Auxiliary contactor.

## Order codes of mechanical locks :

Type	Order code
FC09D...FC38D	8DD-MK000-0001
FC40D...FC95D	8DD-MK000-0002

## Coil voltages :

Give coil voltages of the contactors in accordance with the table below.

□□	24V	42V	48V	110V	220V	230V	240V	380V	415V	440V	500V
AC	A5	D5	E5	H5	K5	N5	R5	S5	T5	U5	V5
DC	A6		E6	H6	K6					U6	

Sample1: For 220 V, 50/60 Hz coil voltage; K5.

Sample2: For AC3 class 32 A, normally closed, coil voltage 48 V 50/60 Hz contactor: FC - 32DO1 E5.

Sample3: For AC3 class 95 A, normally 3 closed and 1 open auxiliary contacts, coil voltage 220 V 50/60 Hz contactor

FC - 95D11K5 + FCB-F02 (Contactor and 1 FCB - F02 contact block shall be adequate.)

# CONTACTORS

## Contactor for capacitor switching:

Contactor for capacitor switching have been designed to switch capacitors and can be safely utilized in compensation circuits thanks to their special design. Contactors limit start-up currents of the capacitors thanks to limiting contact blocks. In this way, life of either capacitors or circuit protective devices is extended. The only difference of FEDERAL contactor for capacitor switching from normal contactors is the transition block with current limiting resistances connected parallel to primary contacts on the contactor.

## Reasons for use of compensation contactor:

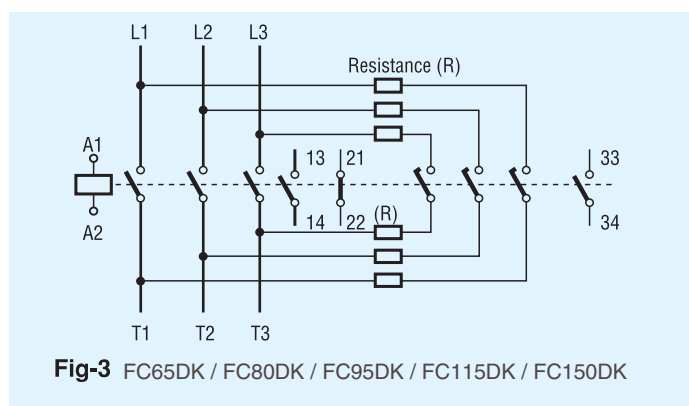
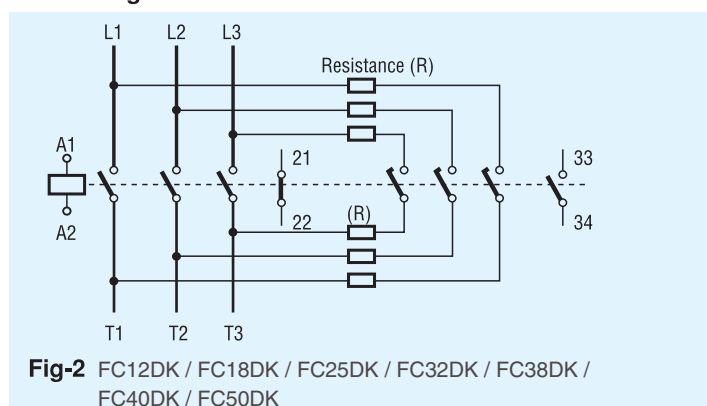
As it is known, capacitors cause high frequencies between 1 and 15 kHz and very short-time high currents that can be ten times more than the rated current during initial start-up. Inductance (shock coil) may be added to each three phases which the capacitor is connected to. However, as this transaction is difficult in practice, contactor for capacitor switching designed only for this purpose are utilized. In this way, life of the contactor shall extend by 100% when compared to normal contactors. To given an example, if electrical life of normal







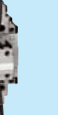
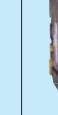





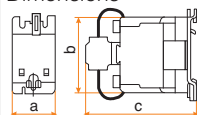
contactors at maximum load is 100,000, life of contactor for capacitor switching is 200,000.

## Principles of operation:

Contactor for capacitor switching' principle of operation is as follows. When contactor coil receives energy, first contacts of the transition block are closed. Approximately 3,5 ms after first start-up current of the capacitor passes through these contactors, contacts of the transition block are opened and nominal current of the capacitors are carried by primary contacts.

## Circuit diagram:



														
Contactor Type (DK)		FC09	FC12	FC18	FC25	FC32	FC38	FC40	FC50	FC65	FC80	FC95	FC115	FC150
Number of Poles		3	3	3	3	3	3	3	3	3	3	3	3	3
Utilization Class AC-6b Ie max 440V	A	13	16	20	22	26	33	44	52	59	79	85	92	105
Rated Thermal Current - Ith	A	25	25	32	40	50	55	60	80	80	125	125	200	200
Rated Insulation Voltage - Ui 50-60 Hz	V	630	630	630	630	630	630	630	630	630	630	630	630	630
Rated Impulse Withstand Voltage	kV	8	8	8	8	8	8	8	8	8	8	8	8	8
Rated Power	220/240 V	5	7	8	9	10	15	20	25	25	35	40	45	50
3 ~ AC-6b	400/440 V	10	12,5	15	16,7	20	25	33,3	40	45	60	65	70	80
55°C - kVAr	480/525 V	12,5	15	16,7	20	24	25	36	45	45	60	65	70	80
Weight	kg	0,39	0,39	0,39	0,4	0,58	0,6	1,2	1,2	1,2	1,5	1,5	2,2	2,2
Number of Auxiliary Contacts		1NO+1NC						2NO+1NC				1NO / 1NC		
Coil Power Consumption (holding)	VA	9,5	9,5	9,5	9,5	11	11	30	30	30	30	30	22	22
Power Loss Per Pole (AC-6b)	W	0,6	1	1,4	1,7	2,5	3,9	3,4	4,5	5	7,5	8,8	6,5	8,5
Min-Max Tightening Torque	Nm	1-1,5	1-1,5	1-1,5	1-1,5	1,2-2	1,5-2,5	3,5-4,5	3,5-4,5	3,5-4,5	6-10	6-10	8-12	8-12
 Dimensions	a (mm)	47	47	47	47	57	57	77	77	77	87	87	120	120
	b (mm)	76	76	76	76	86	86	129	129	129	129	129	154	154
	c (mm)	117	117	117	122	131	136	150	150	150	158	158	158	158



# CONTACTORS

## Order codes of contactor for capacitor switching

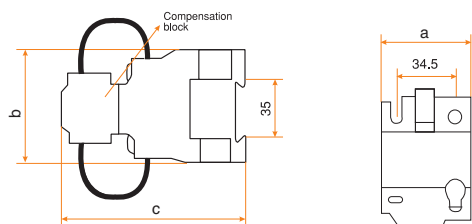
Type	AC-6b Ie (A)	kVAr 200/240 V	kVAr 400/440 V	Standard auxiliary contact	Order code
FC09DK	13	5	10	1 NO + 1 NC	9DK-□□ 113-0009
FC12DK	16	7	12,5	1 NO + 1 NC	9DK-□□ 113-0012
FC18DK	20	8	15	1 NO + 1 NC	9DK-□□ 113-0018
FC25DK	22	9	16,7	1 NO + 1 NC	9DK-□□ 113-0025
FC32DK	26	10	20	1 NO + 1 NC	9DK-□□ 113-0032
FC38DK	33	15	25	1 NO + 1 NC	9DK-□□ 113-0038
FC40DK	44	20	33,3	1 NO + 1 NC	9DK-□□ 213-0040
FC50DK	52	25	40	2 NO + 1 NC	9DK-□□ 213-0050
FC65DK	59	25	45	2 NO + 1 NC	9DK-□□ 213-0065
FC80DK	79	35	60	2 NO + 1 NC	9DK-□□ 213-0080
FC95DK	85	40	65	2 NO + 1 NC	9DK-□□ 213-0095
FC115DK	92	45	70	1 NO	9DK-□□ 103-0115
				1 NC	9DK-□□ 013-0115
FC-150DK	105	50	80	1 NO	9DK-□□ 103-0150
				1 NC	9DK-□□ 013-0150

## Order codes of contactor for capacitor switching accessories :

Type	Order code
Compensation resistance block	8DK-D21-0□□□
Compensation block	8DK-D21-1□□□

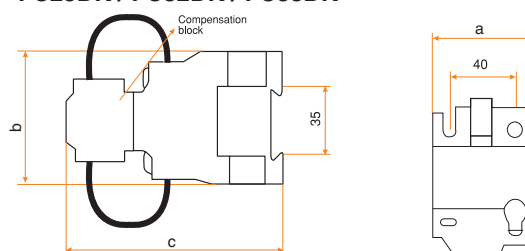
□□□□ Contactor type

### FC09DK / FC12DK / FC18DK



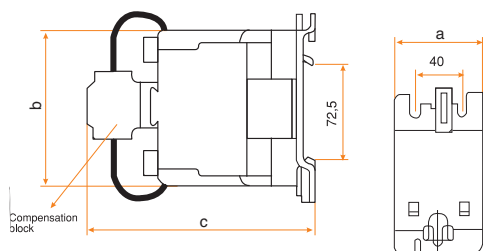
Type	a	b	c
FC09DK	47	76	117
FC12DK	47	76	117
FC18DK	47	76	117

### FC25DK / FC32DK / FC38DK



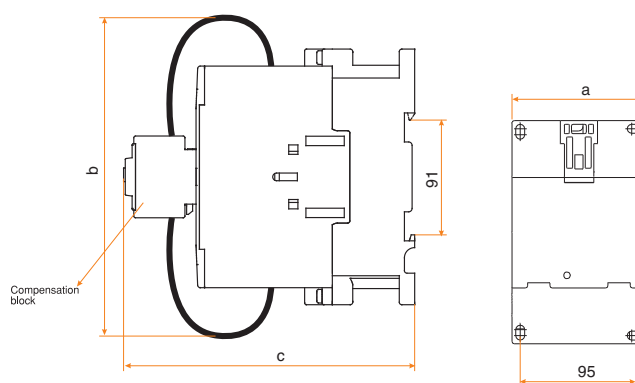
Type	a	b	c
FC25DK	47	76	122
FC32DK	57	86	131
FC38DK	57	86	136

### FC40DK / FC50DK / FC65DK/ FC80DK/ FC95DK



Type	a	b	c
FC40DK	77	129	150
FC50DK	77	129	150
FC65DK	77	129	150
FC80DK	87	129	158
FC95DK	87	129	158

### FC115DK / FC150DK



Type	a	b	c
FC115DK	120	154	158
FC150DK	120	154	158

# CONTACTORS

## Federal High Current Contactors:

They are used safely in Ohmic, inductive and capacitive, AC and DC circuits, network-transformer inverter systems. Contactors comply with EN 60947-4-1 standard. Contactors, which have 3 poles normally, are manufactured with 1, 2 and 4 poles upon order. Federal contactors are designed to break DC current. Since arc extinction is more difficult in DC than AC, Federal contactors can be utilized in AC circuits safely for a long time. Selection of contactors for various utilization classes and voltages is shown in the technical values table.

## Advantages:

- As there are arc contacts, primary contacts are not damaged in starting and breaking currents.
- Large arc separators can be safely used in severe conditions, to which compact contactors cannot resist, thanks to magnetic blow and special contact system.
- Heating of coil nucleus is avoided at high frequencies. Thanks to this feature, it is suitable for utilization in induction furnaces.
- There is no noise while contactor is in operation.
- Power consumption is very low.
- It is not affected from voltage fluctuations.
- There is adequate number of auxiliary contacts. (Number of auxiliary contacts may be increased if required.)
- There is no spare part problem.
- There is mechanical lock option as well as electrical lock.

- As well as these advantages, economic characteristic provides another advantage.

- It has long electrical life as they have double contacts..

## Coil circuit:

AC control supply voltage is converted into DC via a bridge diode and applied to contactor coil. As it can be seen in the connection diagram, starting button is placed on AC circuit; stopping button and thermal relay opening contact is placed on DC circuit. Contactor is not opened due to voltage fluctuations. For example, voltage should go below 55V ( $0.25 \times U_s$ ) for the contactor to open in a network with control supply voltage as ( $U_s$ ) 220V. When contactor is enabled initially, it draws a maximum current of 4A and while it is in operation, it draws maximum 180mA. As it can be understood here, power consumption of Federal contactors is very low. There is no noise problem in the contactor due to dirt or rust on nucleus plates in coil circuit.

## Contact system:

There are arc and primary contacts in main circuit of the contactor. First of all, arc contacts close the circuit in case of closing and instant driving currents on the nominal current are taken over by this contact. After that, primary contacts are closed to provide full contact. Thanks to this closing mechanism, damage of primary contacts due to crash and wearing

due to arcs is avoided. In case of opening, first primary contacts and then arc contacts are opened with spring force as soon as after coil voltage is broken. In this way, primary contacts are not damaged due to arc.

## Auxiliary contacts:

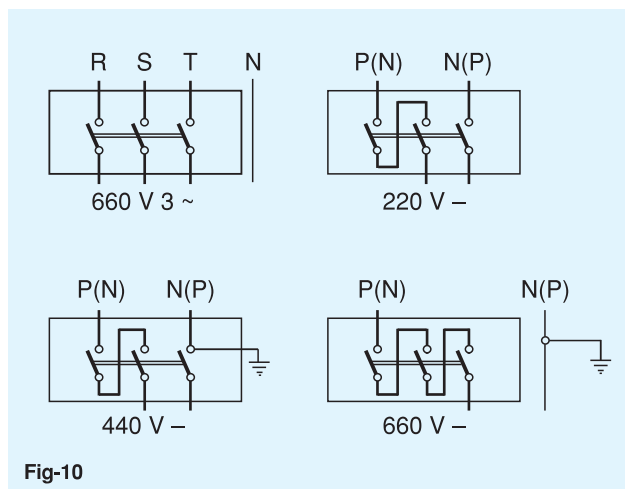
There are 4 open and 4 closed auxiliary contacts on the contactor. 2 open and 2 closed contacts of them have been used in coil circuit. Other 4 contacts (2 open and 2 closed) are kept as spares. 2 open and 2 closed contacts can be added to them if required.

## Arc Chamber:

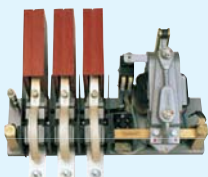
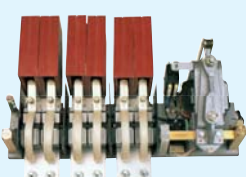
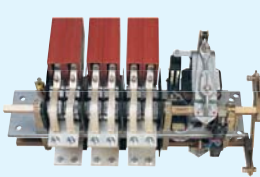
The arc formed during opening with the electromagnetic blow in the contactor is pushed into the arc chambers and arc chambers in the chamber separate the arc and extinct it. Therefore, contactors should not be opened and closed under voltage without assembling arc chambers.

## Connection types in AC and DC circuits:

Connection type of contactors for AC and various DC voltages is given in Figure-10. However, opening spring size and distance is different in AC and DC contactors. This fact should be taken into consideration in orders. In order to let electromagnetic blow push the arc into separators, energy to the contactor should be supplied through top terminals, where separators are present.



# CONTACTORS

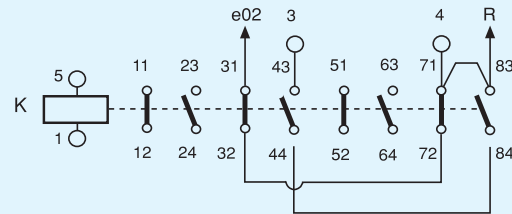
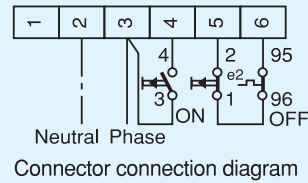
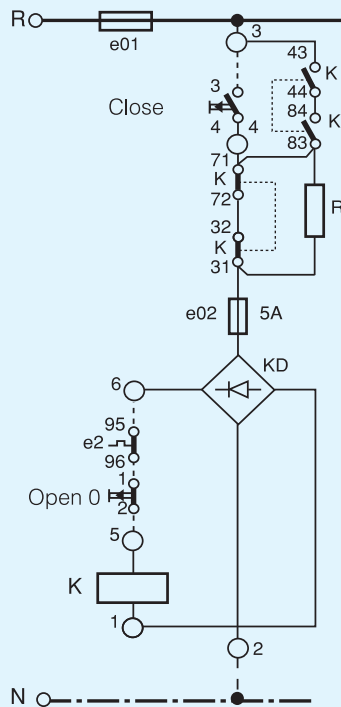
									
Type		EC 300	EC 400	EC 630	EC 800	EC 1250	EC 1600	EC 2000	EC 2500
Utilization class (Ith) le max	AC1 ≤ 40°C A	300	400	630	800	1250	1600	2000	2500
Number of poles *		1,2,3,4	1,2,3,4	1,2,3,4	1,2,3,4	1,2,3	1,2,3	1,2,3	1,2,3
Rated impulse withstand voltage	kV	8	8	8	8	8	8	8	8
For motor control (Squirrel cage motors) 3 ~ AC3	220 / 230 V kW	75	110	160	200	370	470	580	730
	380 / 400 V kW	132	200	280	335	630	790	980	1230
	500 V kW	180	257	355	450	740	960	1190	1490
In compensation circuits	380 / 400 V kVAr	150	200	250	300	450	525	655	820
Rated insulation voltage	Ui ~ V	690	690	690	690	690	690	690	690
Coil voltage	Us (AC) ~ V	24, 48, 110, 220, 240, 380, 415							
	Us (DC) – V	24, 48, 110, 220, 240, 380, 415							
Coil voltage operating interval	xUs ~ V	0,72 - 1,1							
Auxiliary contacts	NA (10A) Ad	2	2	2	2	2	2	4	4
	NK (10A) Ad	2	2	2	2	2	2	4	4
Coil power consumption	pulling W	800	800	800	800	880	880	1760	1760
	holding W	26	26	26	26	35	35	70	70
Mechanical life	Operation	50000	50000	50000	50000	50000	50000	50000	50000
Dimensions	depth mm	245	245	245	245	245	245	500	500
	wideness mm	462	462	462	462	577	577	710	710
	height mm	370	370	370	370	370	370	370	370
Weight	kg	28,6	29,2	29,8	30,4	44,2	44,8	88,4	89,6
Power loss per pole	W	6	11	26	42	52	85	80	125

**Us:**Control supply voltage.

\* High Current Contactors are manufactured with 3 poles as a standard.

# CONTACTORS

## Connection diagram :



e01 : 6A fuse  
e02 : 5A fuse  
e2 Thermal relay contact (Depends on user request)  
---- : Connections to be made by user (Stop mechanism)  
R : Voltage separator resistance (2200  $\Omega$  - 75 W)  
KD : Bridge diode  
K : Coil

Fig-11

-  $\bigcirc$  : Sequence connectors -  $V_{RN}=220\text{ V}$  for  $R1=(2200\pm\%5)\Omega-75\text{ W}$

- Place stop button in DC circuit as shown in the diagram, otherwise there shall be a delay in opening.

- Connectors no 5 and 6 are subject to short circuit for test. User should pay attention to this fact and make the connection according to the diagram.

## Mechanical lock connection diagram:

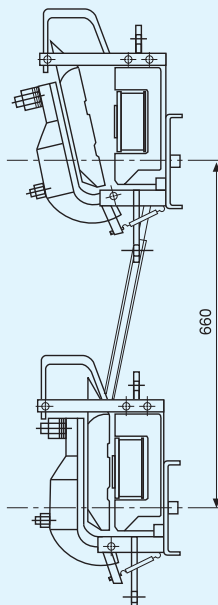


Fig-12

## Order codes of high current contactors :

Type	AC-3 I <sub>e</sub> (A)	kW 400 V	Standard Auxiliary Contact	Order code
EC 300	300	132	4 NO + 4 NC	9DY-□□ 22 Δ-0300
EC 400	400	200	4 NO + 4 NC	9DY-□□ 22 Δ-0400
EC 630	630	280	4 NO + 4 NC	9DY-□□ 22 Δ-0630
EC 800	800	325	4 NO + 4 NC	9DY-□□ 22 Δ-0800
EC 1250	1250	630	4 NO + 4 NC	9DY-□□ 22 Δ-1250
EC 1600	1600	790	4 NO + 4 NC	9DY-□□ 22 Δ-1600
EC 2000	2000	980	4 NO + 4 NC	9DY-□□ 22 Δ-2000
EC 2500	2500	1230	4 NO + 4 NC	9DY-□□ 22 Δ-2500

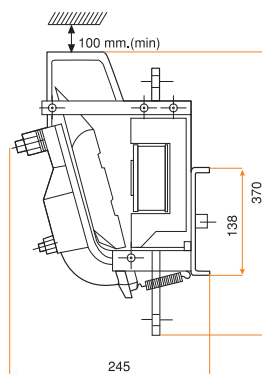
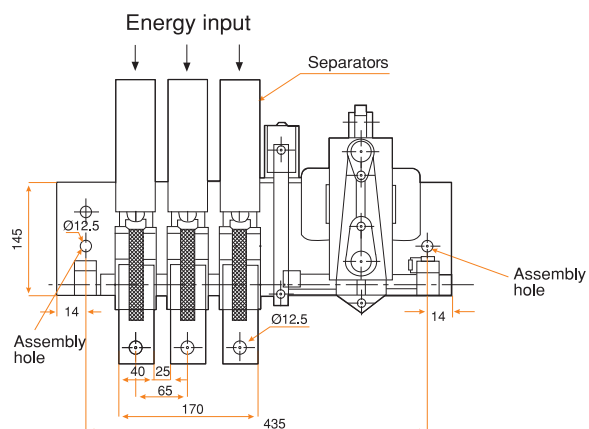
## Coil voltages :

□□	24 V	48 V	110 V	220 V	240 V	380 V	415 V
50/60 Hz	A5	E5	H5	K5	R5	S5	T5
DC	A6	E6	H6	K6	R6	S6	T6

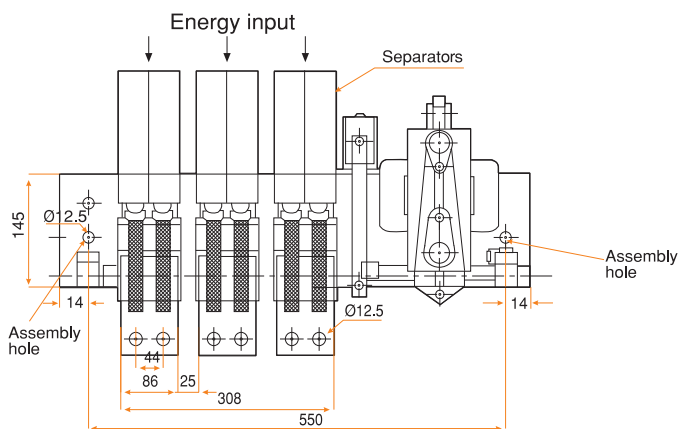
□□ : Coil operating voltages Δ : Number of poles ((1, 2, 3, 4))

# CONTACTORS

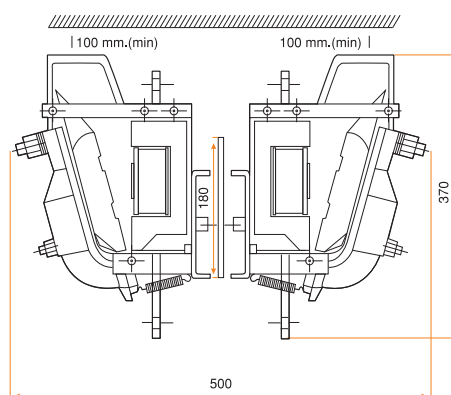
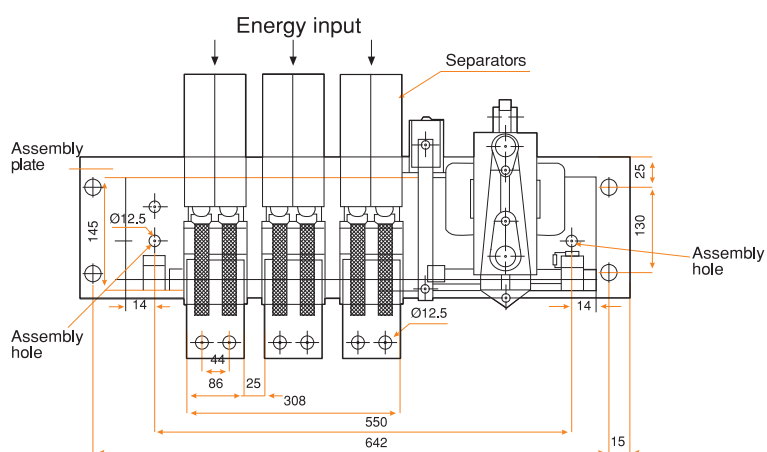
## EC300-EC400-EC630-EC800:



## EC1250 - EC1600:



## EC2000 - EC2500:



# THERMAL OVERLOAD RELAYS



## Thermal Overload Relays



**FTR25**  
0,1A - 32A



**FTR95**  
30A - 93A

**FTR150**  
80 - 150

**FTR200**  
80A - 200A

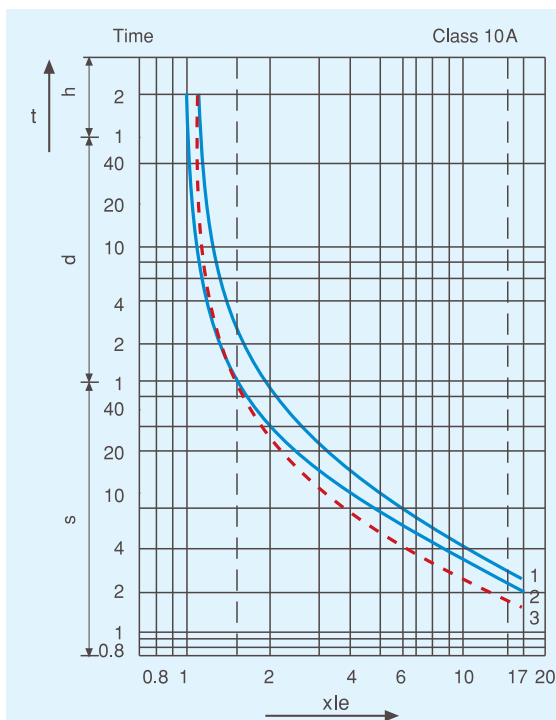
**FTR630**  
160A - 630A

IEC / EN 60947-4-1  
CE

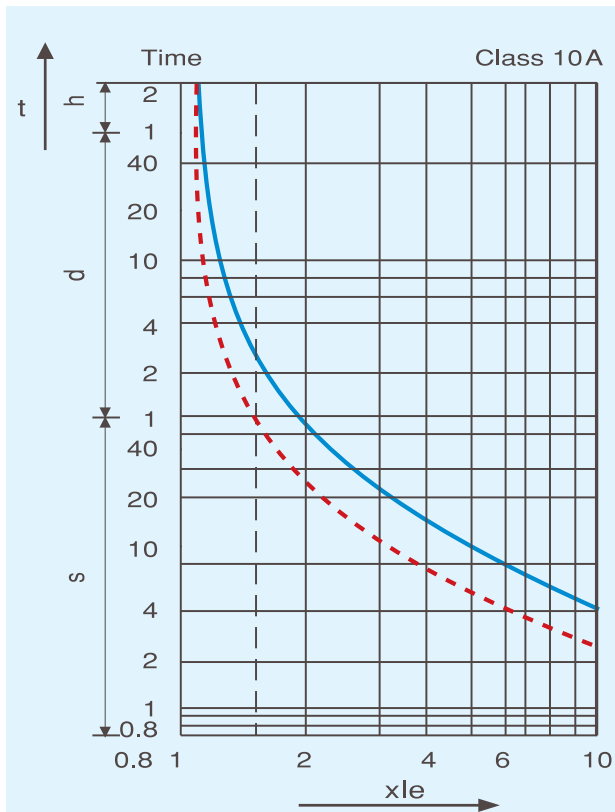
**Altitude** : 2000 m (max)  
**Relative Humidity** : 50% (40°C), 90% (55°C)  
**Ambient Temperature** : between -25°C and +60°C  
**Pollution Degree** : III

All these given information are general. We have always right to change them.

# THERMAL OVERLOAD RELAYS



**Fig-1:** Current time graphic of thermal over current relay  
 1: 3-phase balanced operation (cold condition)  
 2: 2- phase balanced operation (cold condition)  
 3: 3- phase balanced operation (hot condition)



**Fig-2:** Opening characteristics for cold and hot operating conditions of thermal over current relay

Thermal relays disables the motor via contactor in case of overload or phase cut-off; that is, a contactor equipped with thermal relay becomes a much more useful and advantageous device. Because, addition of a thermal relay to the contactor provides protection for both consumers against over current and for contactor against impacts of over heating due to over current. Federal Thermal Relays are manufactured up to 95A, as compensated against environmental temperature in accordance with EN 60947-4-1, IEC60947-4-1 standards and CE.

Each phase in thermal relay is connected to an over current opener. When bimetals heat up, they open the circuit by pushing the differential opening lever. In case of failure of any of the phases, only two of bimetals operate and over current opener gets into service faster than in case of overloading. Thermal relay mechanism compensates changes in environmental temperature and prevents relay from being affected by ambient temperature.

Average value of opening characteristic of thermal over current relay in hot operating condition is below the opening characteristic of the relay in cold operating condition. That is, cold relay at a particular opening current is opened approximately 1/4 later than relay in hot condition. This case is important in terms of safety of relay and device to be protected. According to IEC 60947-4-1, it is required for the relay to break the circuit in 2 minutes at the latest at 1.5 times loading in hot condition.

As it is seen in Figure-2, opening duration of a relay in hot condition is reduced from 3 minutes to about 2 minutes at 1,5xIe. Limit opening values according to IEC 947-4-1 have been stated in terms of opening current values of thermal relay. Accordingly, it is required that thermal relay, which is in 20°C ambient temperature and cold condition, should not open within two hours at 1.05 times of Ie adjustment current and should open in two hours at 1.2 times in hot condition. Accordingly, limit opening current of the relay is determined as  $I_a = (1,05 - 1,2) \times I_e$ . Furthermore, the relay is required to open in two minutes at 1.5xIe over current value in hot condition and in 2 seconds or 5 seconds at 7.2xIe over current value in cold condition, depending on the delay value.

Opening Current	Delay Time	Operating Condition	Explanation
1,05 Ie	> 2 hour	cold	Limit Opening Current
1,20 Ie	< 2 hour	hot	Limit Opening Current
1,50 Ie	< 2 minute	hot	-
7,2 Ie	> 2 second	cold	-

Table 1. Thermal opening currents loaded in 200C ambient temperature equal for each three current paths and delay times of over current relay.



# THERMAL OVERLOAD RELAYS

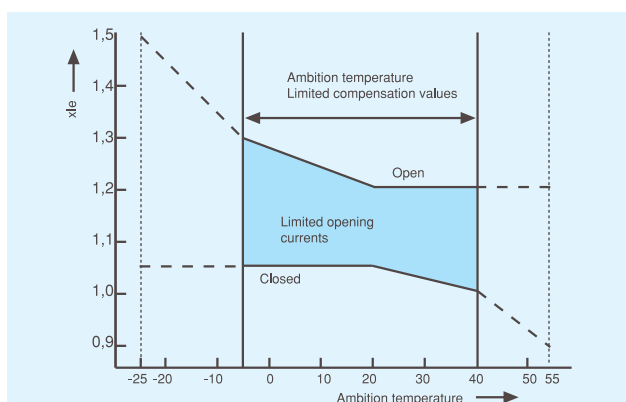
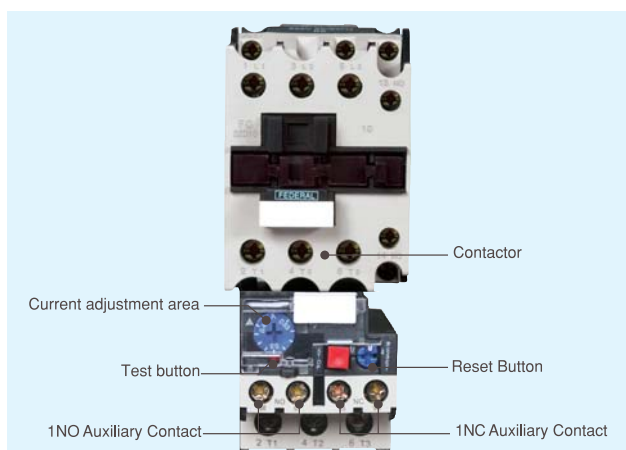


Fig-3: Temperature compensation



Pic-1

## Order Code

Type	Ampere Interval A	Contactor Type To Be Used	Order Code
FTR25	0.1-0.16	FC09D ... FC32D	9DD-TY001-0016
	0.16-0.25	FC09D ... FC32D	9DD-TY001-0025
	0.25-0.4	FC09D ... FC32D	9DD-TY001-0040
	0.4-0.63	FC09D ... FC32D	9DD-TY001-0063
	0.63-1	FC09D ... FC32D	9DD-TY001-0100
	1-1.6	FC09D ... FC32D	9DD-TY001-0160
	1.25-2	FC12D ... FC32D	9DD-TY001-0200
	1.6-2.5	FC12D ... FC32D	9DD-TY001-0250
	2.5-4	FC18D ... FC32D	9DD-TY001-0400
	4-6	FC25D ... FC32D	9DD-TY001-0600
	5.5-8	FC25D ... FC32D	9DD-TY001-0800
	7-10	FC25D ... FC32D	9DD-TY001-1000
	9-13	FC25D ... FC32D	9DD-TY001-1300
	12-18	FC25D ... FC32D	9DD-TY001-1800
FTR95	17-25	FC25D ... FC32D	9DD-TY001-2500
	23-32	FC32D	9DD-T0001-0032
	30-40	FC40D ... FC95D	9DD-T0001-0040
	37-50	FC40D ... FC95D	9DD-T0001-0050
	48-65	FC40D ... FC95D	9DD-T0001-0065
	55-70	FC40D ... FC95D	9DD-T0001-0070
	63-80	FC40D ... FC95D	9DD-T0001-0080
	80-93	FC40D ... FC95D	9DD-T0001-0093

For bigger ampere ranges, please contact with us.

If three-pole thermal relay is loaded as two-pole, opening time increases by 10%; if it is loaded as one-pole, it increases by 20%. Limit current values and opening characteristic have been determined according to 20°C ambient temperature. Opening time varies in different ambient temperatures. As a result, limit current value goes down and relay opens earlier. For example, limit current is 20% less in 50°C ambient temperature. On the contrary, the less ambient temperature is, the more current heat is needed for same opening type at 20°C. Under particular conditions, if relay and device to be protected, for example motor, operate in the same ambient temperature and if their heat is same, dependence of the relay's opening characteristic on ambient temperature would provide an advantage. However, it is not possible to always have these conditions especially in remote-controlled systems and relays in a closed housing. In such a case, the device to be protected and the relay may not be in the same ambient temperature. Moreover, it is not enough to have relay and motor in the same ambient temperature to provide a safe protection. Furthermore, opening limit heat of the relay should be equal to allowed heat of the motor. Usually, it is not possible to meet these two conditions at the same time. Therefore, parallel to temperature change, I adjustment current of the relay needs to be adjusted continuously. Thermal over current relays are equipped with a heating compensation due to temperature changes. In this way, limit opening current remains within (1.05-1.2) $\times$  $I_e$  limit values between -25°C and +55°C even in ambient temperature degrees other than 20°C. In this way, there is no need for a further adjustment in  $I_e$ .

While motors operate with tri-phase, motor draws more current than normal if any of the phase conductor cuts off or any of the fuses melts. In order not to have the motor encounter burning risk, phase fault protection feature of the thermal relay gets into service and disables the contactor.

## Auxiliary contacts:

Thermal opener enables two contacts, as one closing and one breaking. Breaking contact disables the motor contactor and breaks energy supplied to the motor. Closing contact may be used for different purposes.

## Reset button:

Reset button is used in automatic or manual position. In Automatic (A) position, thermal relay automatically enables the contactor after bimetals cool down. In Manual (M) position, reset button should be pressed to re-enable the contactor after bimetals cool down.

## Test button:

Operating status of the motor contactor is tested by pressing test button.

## Stop button:



It is used for disabling the motor contactor in case of emergency.

# THERMAL OVERLOAD RELAYS

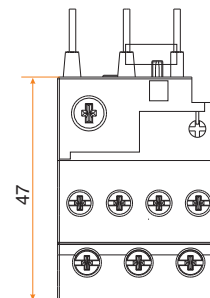
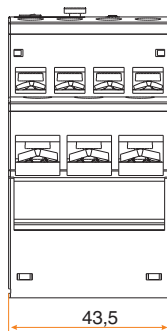
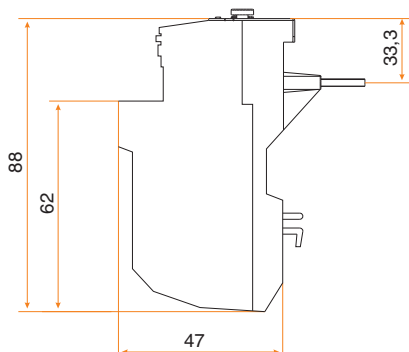
## Technical Specifications

Type		FTR25	FTR95	FTR150	FTR200	FTR630
Current Adjustment Area	(A)	0.1 ...32	30 - 93	80 - 150	80 - 200	160 - 630
Opening Class	Class (A)	10	10	10	10	10
Rated Insulation Voltage (Ui)	(V)	690	690	690	690	690
Rated Impulse Withstand Voltage (Uimp) kV		6	6	6	6	6
Operating Height	m	2000	2000	2000	2000	2000
Temperature Compensation	C	-25...+55	-25...+55	-25...+55	-25...+55	-25...+55
Operating Frequency	Hz	50 / 60	50 / 60	50 / 60	50 / 60	50 / 60
Auxiliary Contactor	Ie 220V	2.73	2.73	2.73	2.73	2.73
1NO+1NC	AC15 380V	1.58	1.58	1.58	1.58	1.58

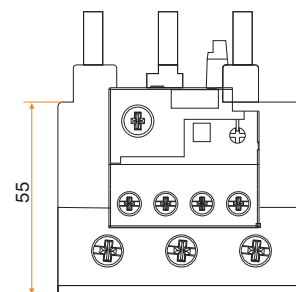
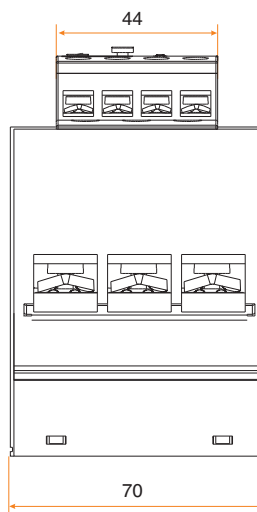
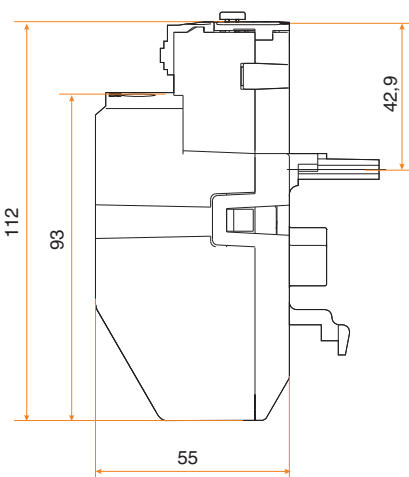
## Accessories:

FTR25 mounting base	FTR95 mounting base
 <p>Assembled with FTR25 to form a complete set</p>	 <p>Assembled with FTR95 to form a complete set</p>

## FTR25 :



## FTR95 :



# POWER CAPACITORS



## M-Series Low Voltage Power Capacitors



### FEKM (Mono-Phase 230V)

0,25 kVar ... 5 kVar

## K-Series Low Voltage Power Capacitors



### FEK-13 (Three-Phase 400V)

1 kVar ... 50 kVar



### FEK-13 (Three-Phase 440V)

1,21 kVar ... 60,50 kVar



### FEK-13 (Three-Phase 480V)

10 kVar ... 25 kVar

### FEK-13 (Three-Phase 525V)

11,97 kVar ... 29,91 kVar

IEC / EN 60831-1

IEC / EN 60831-2

CE

**Mounting Position** : Vertical (can be connected in horizontal position by supporting)

**Altitude** : 2000 m (max)

**Ambient Temperature** : between -25°C and +55°C

**Protection Degree** : IP00 (IP40 when plastic connector cover is used)

All these given information are general. We have always right to change them.

# POWER CAPACITORS

Loads of large networks mainly have inductive characteristics. Since asynchronous motors, induction furnaces, ballast lamps draw inductive currents, they decrease power coefficients of the network they are connected to. The decrease in power coefficient results in voltage reductions and power losses in energy transmission and distribution lines. This case leads to decrease in efficiency. Loads with low power coefficient result in unnecessarily high capacities of alternators, transformer and circuit elements. In this case, it is not possible to utilize the system in an economical manner. Federal low voltage power capacitors utilized to compensate power coefficient are manufactured in accordance with CE.

## Power Factor :

Power factor of the load is described as proportion of active power to apparent power. The closer it is to  $\cos \phi$ , 1.00, the less power is drawn from the network. If  $\cos \phi = 1$ , transmission of 500 kW in 400 V tri-phase main lines requires a current of 722A. Transmission of the same effective power at  $\cos \phi = 0,6$  shall require a higher current, that is 1203A. Therefore, distribution and transmission equipments such as supply transformers should be sized for this high load.

- For systems with low power factor, transmission of electrical power appropriate with the current standards is more costly both for the consumers and the network distribution. Another reason of higher costs is the losses caused by the heat in conductors due to the entire current of the system, as well as transformer and power plant coils. Under general conditions, while power factor of a tri-phase system is going down, current goes up. Heat loss in the system increases proportional to square of current increase.

## As a result:

Decrease in electrical losses is ensured via compensation of power factor. The network shall be capable of supporting the additional load to be advantageous for an expanding system. Load in distribution shall decrease with compensation of the power factor and this case shall allow life extension of the devices in this system.

Power Factor Compensation Methods  
Counter-capacity reactive power supplied by the capacitor to the system may compensated the inductive reactive power needed by the electrical load. It ensures a decrease in reactive power drawn from the network and is called Power Factor Compensation (PFC). Most common methods of power-factor compensation;

## Single or fixed PFC:

Compensation of reactive power of each load or decrease of load at supply end (for fixed and/or large-power single receiver powers). (Figure-2)

## Group PFC:

Connection of the capacitor to a group of simultaneous-operating inductive load. (Example: Motor group, discharge lamps) (Figure-3)

## Central PFC:

It is used for wide electrical systems with variable load, where a particular number of capacitors are usually connected to a primary power distribution station or secondary station. Capacitors are controlled via microprocessor based reactive power control relay, which continuously monitors the reactive power demand in the network. (Figure-4)

Over-stimulus synchronous motors are also employed in compensation of

reactive power, as well as capacitors; however, employment of capacitors is more common than synchronous motors.

## MKP:

MKP type consists of low power loss dielectric shaped with pure polypropylene folio. Zinc metallized film is obtained by having polypropylene film subject to zinc steam under vacuum. This guarantees long service life of the capacitor. Capacitor elements are dried under vacuum. After the capacitor is placed in the housing, adhesive polyurethane resin or dried insulation gas is inserted.

## Advantages of MKP Technology:

As a result of the simple composition technology, MKP capacitors are manufactured with low costs by using less material; as a result, clients pay less. Although they have thicker dielectric, MKP capacitors are usually smaller than their equivalents. MKP capacitors have special high capacitance and high AC load capacity. As composition and high-quality material is used as mentioned below, reliability and long-term service life is guaranteed. Furthermore, Federal capacitors occupy a smaller space in compensation panels thanks to their small sizes.

## Self-Repair:

Federal capacitors self-repair punctures caused by sudden voltage in low voltage switch facilities. Arcs caused by punctures melt the metal plate and these arcs insulate the puncture part in the insulator. In this way, capacitor reaches full voltage strength and continues operating without any problem. Capacity loss arising from this is too less, so it can be neglected.

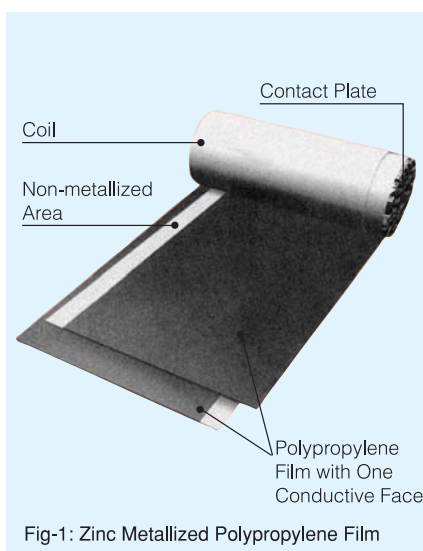


Fig-1: Zinc Metallized Polypropylene Film

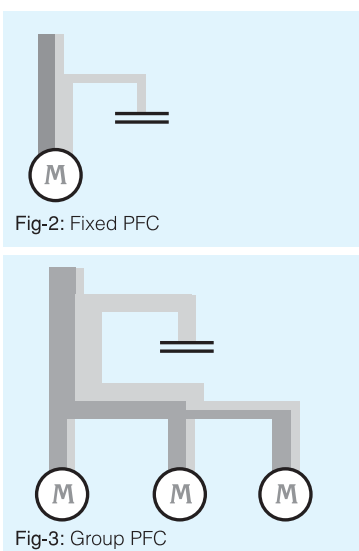


Fig-2: Fixed PFC

Fig-3: Group PFC

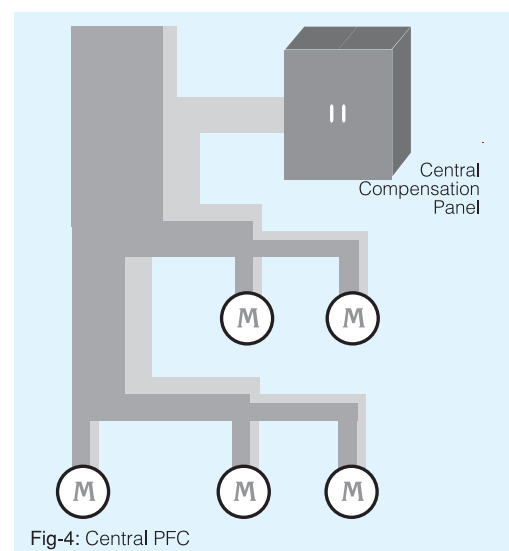


Fig-4: Central PFC



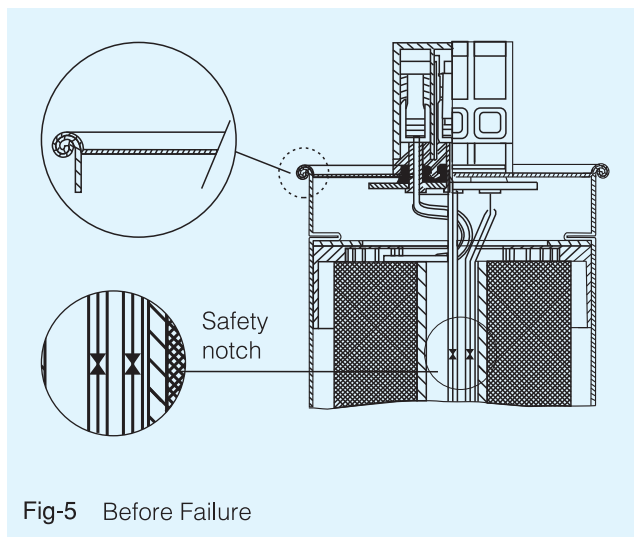


Fig-5 Before Failure

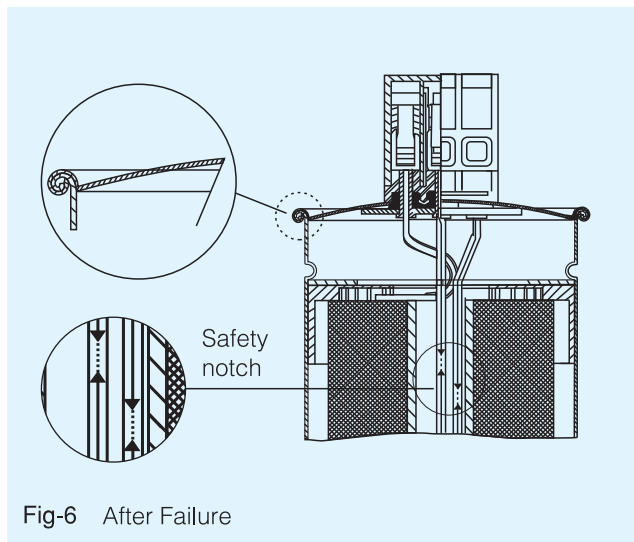


Fig-6 After Failure

## Protection Against Overloads:

Protection has been ensured against overloading with a separator fuse system integrated into Federal power capacitors. Gas arising from frequent self-repair causes high pressure in body of the device and as a result, cables between winding and connector break off from safety notch as the capacitor body bends lengthwise. In this way, capacitor is separated from the network. Protection against overload and failures for safety of the capacitor and the system is shown in Figure-5 and Figure-6.

## Calculation of Required Capacitor Capacity for Compensation of Power Coefficient:

Reactive power required to acquire the desired power factor is calculated as follows.

$$Q_c = P \times (\tan \phi_1 - \tan \phi_2)$$

P = Active power

S = Apparent power

Q<sub>c</sub> = Reactive power

Cos $\phi_1$  = Current power coefficient

Cos $\phi_2$  = Desired power coefficient

(tan $\phi_1$ -tan $\phi_2$ ) = Multiplier factor is shown in Table-1.

## Example :

Let's calculate the required capacitor power to have a system with active power : P=500 kW  
cos $\phi_1$ =0,7 as cos $\phi_2$ =0,98.

## Solution with use of the table:

In order to increase power factor from 0,7 to 0,98, when we cross rows and columns corresponding to cos $\phi_1$ =0,7 and cos $\phi_2$ =0,98 in the multiplier factor table, we find the multiplier factor as 0,817.  
Q<sub>c</sub>=500 x 0,817  
Q<sub>c</sub>=408,5 kVar

## Solution with use of formulas:

$$S_1 = \frac{P_1}{\cos \phi} = \frac{500}{0,7} = 714 \text{ kVA}$$

$$Q_1 = \sqrt{S_1^2 - P_1^2} = \sqrt{714^2 - 500^2} = 510 \text{ kVar}$$

$$S_2 = \frac{P_1}{\cos \phi} = \frac{500}{0,98} = 510,2 \text{ kVA}$$

$$Q_2 = \sqrt{S_2^2 - P_1^2} = \sqrt{510,2^2 - 500^2} = 101,5 \text{ kVar}$$

$$Q_c = Q_1 - Q_2 = 510 - 101,5 = 408,5 \text{ kVar}$$

**Note:**While facility materials of the compensation facilities are selected, effects of incidents occurring during opening and closing should be taken into consideration. While capacitors are enabled or connected parallel, they draw huge currents like short circuit current during temporary regime. Value and duration of these currents depend on capacitor power, inductive resistance and specific frequency of the subject network section. If switch is closed at the highest value of the voltage, current impacts reach the highest value. Effective period of this current is rarely longer than 1 or 2 periods.

In the meanwhile, in order to have the capacitors resist the connection over voltages, insulation against capacitor housing of the metal folio is anticipated to be 3.5 times more than maximum value of the nominal voltage. While capacitors are disabled, large arcs occur as it is more difficult to break the capacitive current. Therefore, these characteristics are taken into consideration in selection of connection elements such as switches, fuses and lines used in compensation facilities. Therefore, connection elements used in compensation facilities

Multiplier Factor		Target cos $\phi_2$				
		0,980	0,985	0,990	0,995	1,000
Original cos $\phi_1$	0,20	4,696	4,724	4,756	4,799	4,899
	0,25	3,670	3,698	3,730	3,773	3,873
	0,30	2,977	3,005	3,037	3,079	3,180
	0,35	2,473	2,501	2,534	2,576	2,676
	0,40	2,088	2,116	2,149	2,191	2,291
	0,45	1,781	1,809	1,842	1,884	1,985
	0,50	1,529	1,557	1,590	1,632	1,732
	0,55	1,315	1,343	1,376	1,418	1,518
	0,60	1,130	1,158	1,191	1,233	1,333
	0,65	0,966	0,994	1,027	1,069	1,169
	0,70	0,817	0,845	0,878	0,920	1,020
	0,75	0,679	0,707	0,739	0,782	0,882
	0,80	0,547	0,575	0,608	0,650	0,750
	0,85	0,417	0,445	0,477	0,519	0,620
	0,90	0,281	0,309	0,342	0,384	0,484
	0,95	0,126	0,154	0,186	0,228	0,329

Table-1

## Environmental

### temperature category :

Symbol	Minimum		Highest average value in periods	
	Minimum	Maximum	24 hours	1 year
25/C	25 °C	50 °C	40 °C	30 °C
25/D	25 °C	55 °C	45 °C	35 °C

# POWER CAPACITORS

are a bit different than the ones used in normal facilities and they are selected for higher currents than the nominal current corresponding to capacitor power.

It is recommended to use special compensation contactors, which are manufactured by our company, for the compensating switching systems. Contactors limit the start-up currents of the capacitors, thanks to their current-limiting contact blocks. In this way, service life of both capacitors and circuit protective devices is extended. Difference of Federal compensation contactors from normal contactors is that there is a transition block having a current limiting resistances connected parallel to main contacts on the contactor. In this way, service life of the contactor and the capacitor shall be doubled.

Transformer Power (kVA)	Capacitor Power for Oil Type Transformers (kVAr)	Capacitor Power for Dry Type Transformers (kVAr)
10	1	1,5
20	2	1,7
50	4	2
75	5	2,5
100	5	2,5
160	7	4
200	7,5	5
250	8	7,5
315	10	7,5
400	12,5	8
500	15	10
630	17,5	12,5
800	20	15
1000	25	17,5
1250	30	20
1600	35	22
2000	40	25
2500	50	35
3150	60	50

## Compensation of MV Transformers

MV transformers draw reactive energy from the network as long as they operate idle. This reactive energy is compensated by (fixed) capacitors permanently connected to the transformer. Powers of these capacitors are calculated with the formula below.

$$Q = I_0\% \times P_n / 100$$

$I_0$  = no load transformer current

$P_n$  = transformer power

Required capacitor value can easily be determined with used of the table above.

## Assembly Instructions :

Capacitors can be easily mounted by using M12 screws. Assembly screws are used as the grounding connection at the same time. Maximum tightening torque is 5 Nm. Connectors are connected with 5 mm screw and maximum 2Nm torque. Cable connections should be made in a way to allow the body length to bend for 20 mm minimum, in order to allow the capacitor to provide protection easily in case of over pressure.

**Attention!** Only copper cables should be utilized in connection of capacitors.

Capacitor Power for Tri-Phase Squirrel Cage Asynchronous Motors (kVAr)					
Motor Power		Motor Speed (s/m)			
(kW)	(Hp)	3000	1500	1000	750
22	30	6	8	9	10
30	40	7,5	10	11	12,5
37	50	9	11	12,5	16
45	60	11	13	14	17
55	75	13	17	18	21
75	100	17	22	25	28
80	125	20	25	27	30
110	150	24	29	33	37
132	180	31	36	38	43
160	218	35	41	44	52
200	274	43	47	53	61
250	340	52	57	63	71
280	385	57	63	70	79
355	482	67	76	86	98
400	544	78	82	97	106
450	610	87	93	107	117

## Compensation of Tri-Phase Asynchronous Motors:

The most common reactive power consumers are tri-phase motors. You may see the required capacitor powers for compensation of squirrel cage motors in the table above. Add 5 to values in the table for motors with winding rotor.

## Determination of Capacitor Voltage:

Voltages of the power capacitors to be used in compensation are determined according to harmonic currents in the network to be connected.

The capacitor voltages are given in the table below considering by total harmonic distortion at 230/400V network voltage.

THD < 12%	THD < 20%	THD < 27%
400V	440V	525V

# POWER CAPACITORS

## Technical Features

- Compact cylindrical body design
- 3 phase delta connection PHASE DELTA CONNECTION
- Easy installation
- PCB free
- Environmentally friendly
- Can withstand high temperatures
- Self-cooling
- Impact protected terminal
- Long lasting

## Protection Against Explosion

Condensers explode due to excessive voltage for a long time. But FEDERAL capacitors prevent explosion due to internal pressure adjustments as a result of expansion under increased pressure to avoid explosion.





## Design and Construction

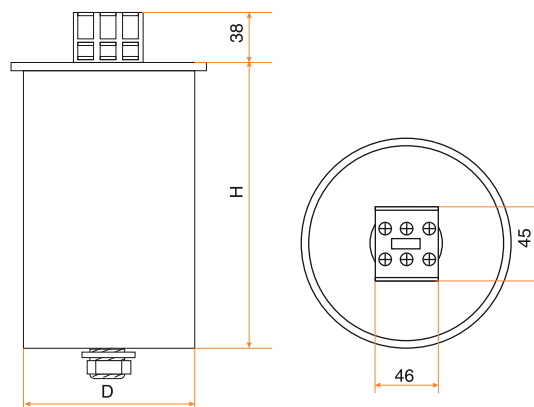
- Mkp film cylinder shaped aluminum case
- High power density resistant housing
- Low loss zinc part
- Self-repairing film design
- Long lasting and reliable.

Type	MKP Cylindrical Type
Rated Voltage	230, 400, 415, 440, 480, 525 V
Frequency	50/60 Hz
Standard	EN / IEC 60831-1/2
Maximum Overvoltage (Umax)	Un + 10% up to 8 hours a day Un + 15% up to 30 minutes per day Un + 30% 1 min per day
Overcurrent	2xIn
Capacitance Tolerance	-5% / +5%
Test Voltage, between terminals	2.15xUn, 10s
Test Voltage, between terminal body	3 kV AC, 10s
Power loss	≤0.5 W/kVAr
Lifetime	100.000 hours (for 55 oC)
Protection Class	IP20
Temperature Class	-25/D (max. +55°C)
Cooling	Natural Cooling
Maximum Humidity	Up to 95%
Maximum Height	2000 m
Mounting Position	Horizontal and vertical
Application	Internal and External
Safe	Aluminum case
terminals	16mm <sup>2</sup> cable cross-section - With arc protection - Bidirectional terminal
Mounting and Grounding	Under the case with M12 bolt connection
Protection	Dry type, Overpressure protected, Self-repairing
Internal Insulation Material	PCB-free, Resin-protected
Discharge Resistance	The built-in discharge resistor reduces the voltage below 50V within 1 min.



# POWER CAPACITORS

Type		Phase	Power (kVAr)		Ø(D)xH (mm)	
M Series Mono-Phase			230V	400V		
	FEKM 0,4/1.67	1	0,55	1,67	45x115	
	FEKM 0,4/2.50	1	0,83	2,50	50x115	
	FEKM 0,4/4.17	1	1,38	4,17	50x150	
M Series Mono-Phase Heavy-Duty			230V	415V	440V	
	FEKM 0,44/0.91	1	0,25	0,81	0,91	63,5x75
	FEKM 0,44/1.83	1	0,50	1,63	1,83	63,5x75
	FEKM 0,44/3.66	1	1,00	3,26	3,66	63,5x87
	FEKM 0,44/5.49	1	1,50	4,88	5,49	63,5x145
	FEKM 0,44/9.15	1	2,50	8,14	9,15	63,5x145
	FEKM 0,44/18.30	1	5,00	16,28	18,30	75x205
K Series Three-Phase Heavy-Duty			400V	415V	440V	
	FEK13 0,44/1.2	3	1,0	1,08	1,21	63,5X87
	FEK13 0,44/1.8	3	1,5	1,61	1,81	63,5X95
	FEK13 0,44/3.1	3	2,5	2,69	3,03	63,5X95
	FEK13 0,44/6.1	3	5,0	5,38	6,05	75x145
	FEK13 0,44/9.1	3	7,5	8,07	9,08	76x247
	FEK13 0,44/12.1	3	10,0	10,76	12,10	85x247
	FEK13 0,44/15.1	3	12,5	13,46	15,13	85x247
	FEK13 0,44/18.2	3	15,0	16,15	18,15	85x278
	FEK13 0,44/24.2	3	20,0	21,53	24,20	95x278
	FEK13 0,44/30.3	3	25,0	26,91	30,25	95x278
	FEK13 0,44/36.3	3	30,0	32,29	36,30	116x278
	FEK13 0,44/48.4	3	40,00	43,06	48,40	136x247
	FEK13 0,44/60.5	3	50,00	53,83	60,50	136x278
K Series Three-Phase			480V	525V		
	FEK13 0.52/11,97	3	10,0	11,96		75x210
	FEK13 0.52/17,94	3	15,0	17,94		85x210
	FEK13 0.52/23,93	3	20,0	23,93		95x247
	FEK13 0.52/29,91	3	25,0	29,91		116x247



# HARMONIC FILTERS SHUNT REACTORS



## Harmonic Filters



**Mono- Phase - Three-Phase**  
0,5 kVAr ... 100 kVAr

## Line Filters



**Mono- Phase - Three-Phase**  
0,37 kVAr ... 160 kVAr

## Shunt Reactors



**Mono- Phase - Three-Phase**  
0,1 kVAr ... 50 kVAr

All these given information are general. We have always right to change them.

# HARMONIC FILTERS



## Description of Harmonic:

Ideal mains voltage and receiving current's sinusoidal form in electrical installation. But receiving current is non line eralthought mains voltage is sinus oidal according to electrical power has nonlinear characteristics (These electrical Powers are power electronic harmony, arcfurnac etc.) soreceiving voltage's wiew form is not sinusoidal. Sinusoidal is exist in the system as voltage and current wiev form's main frequency (50 Hz) multiples which is characterles but renews against to the time. Current and voltage which are multiples of main frequencies resultant with main frequency's current and voltage and creates current and voltage of the system This resultant' system current and voltage are not in sinusoidal form any more and wecall this HARMONIC.

## Why Harmonic filters are needed?

Voltage harmonics which in different frequencies causes much current flow within crease frequency than capacitors in voltage distortions. These current flow causes further deterioration of the voltage. Thus, it creates a vicious circle in this system. Current which has high harmonic saredisrupt capacitor voltage much moreso it causes decrease of power quality and receiving dangerous current.

To decrease of this effect, harmonic filter swchich has in creased resistans when the frequency is in crease are designing. These filter sare serial fixing to capacitor in the system. Thus, filters which has in crease dresistans in in creasing frequency causes raising of the difficulties to there ach of the capacitor against to high value frequency. Thus, it has barrier to the capasitor to receive high voltage.

## Description of the Filter:

Current which is not sinsoidal in the system and / or circuit elements which has requested to destroy for the voltage is divided in to two parts.

I) "Actif Filters" which has controlled current of the filtersor voltage source.

II) "Pasive Filters" are filter components's resistans, enductans and capacitors.

Our manufactured product and subject is "Passive Filters" serial fixed enductans and resistance circuit element which has put between source and receiver and has requested destroy components except main frequency.

## What should be carefuled when selecting the Filter:

When the filter is selecting first of all harmonic current characteristics which system has received should analysis. Usually, 3,5,7th harmonics can seen in the system. It manufactures while selecting intermediate values which is not in These harmonic frequencies which main frequencies's multiples. Thus, system has blocked to enter resonans. Filter frequencies which accepted and using in appliance sare 134, 189, 210Hz. Voltage in creasing has occured on capacitor because of inductance coil in filtration application.

$U_c = U_n / (1-p)$

Un: Network Voltage

Uc: Voltage at the ends of capacitor

P : Thefactor of reactor

If the capacitor use in the network which has lower voltage than voltage rating which on the labels of the capacitors than reactive power which obtain from capacitor sare reduce at the rate of square of reactive power voltage.

P %	Resonance Frequencyfor 50 hz	Voltage at the ends of Capacitor
% 5,67	210 Hz	424 V
% 7	189 Hz	430 V
% 14	134 Hz	465 V

There fore, active capacitor power in 400V networks can not change during the increasing of nominal voltage of Capacitor so nominal power of compensation thus cost of system in creases. Because, 440V Capacitor can not give the label power to circuit at 420V and this cause in complete compensation.

## General Features:

- 1-) According to filter power Thermal clampor busbar connection in output
- 2-) Production with three or single phases
- 3-) Design with iron core, air gap
- 4-) Heat protection with thermo contact
- 5-) Copper or aluminum winding
- 6-) CE Certificate
- 7-) Manufacturing according to requested resonance frequency
- 8-) Saturation current (lin) suitable to request
- 9-) Protection degree IP 00
- 10-) F class izolation

# HARMONIC FILTERS

Power (kVAr)	Width (mm)	Height (mm)	Depth (mm)	Weight (kg)	Bus Voltage (V)	Terminal	Order Code
<b>Mono-phase (P:%7 189 Hz / P:5,67 210 Hz)</b>							
0.5	84	95	50	1,30	230	Klem. 2,5 mm <sup>2</sup>	9HF-BMA00-0050
1	84	95	60	1,40	230	Klem. 2,5 mm <sup>2</sup>	9HF-BMA00-0100
1.5	84	95	100	1,55	230	Klem. 2,5 mm <sup>2</sup>	9HF-BMA00-0150
2	120	120	90	2,50	230	Klem. 2,5 mm <sup>2</sup>	9HF-BMA00-0200
2.5	120	120	90	2,50	230	Klem. 2,5 mm <sup>2</sup>	9HF-BMA00-0250
5	133	130	75	3,80	230	Klem. 4 mm <sup>2</sup>	9HF-BMA00-0500
7.5	150	150	80	5	230	Klem. 6 mm <sup>2</sup>	9HF-BMA00-0750
10	170	150	90	5,50	230	Klem. 10 mm <sup>2</sup>	9HF-BMA00-1000
<b>Three-phase (P:%7 189 Hz / P:5,67 210 Hz)</b>							
1	150	145	95	4,50	400	Klem. 2,5 mm <sup>2</sup>	9HF-BTD00-0100
2	150	145	100	4,70	400	Klem. 2,5 mm <sup>2</sup>	9HF-BTD00-0200
2.5	150	145	100	5,00	400	Klem. 2,5 mm <sup>2</sup>	9HF-BTD00-0250
5	180	180	100	6,00	400	Klem. 4 mm <sup>2</sup>	9HF-BTD00-0500
6.25	180	180	100	7,00	400	Klem. 4 mm <sup>2</sup>	9HF-BTD00-0625
7.5	180	180	110	7,50	400	Klem. 4 mm <sup>2</sup>	9HF-BTD00-0750
10	180	180	120	9,00	400	Klem. 4 mm <sup>2</sup>	9HF-BTD00-1000
12.5	180	180	130	9,40	400	Klem. 10 mm <sup>2</sup>	9HF-BTD00-1250
15	180	180	130	9,75	400	Klem. 10 mm <sup>2</sup>	9HF-BTD00-1500
20	200	180	130	10,00	400	Klem. 10 mm <sup>2</sup>	9HF-BTD00-2000
25	230	220	170	14,00	400	Al. Papuç M6	9HF-BTD00-2500
30	250	220	170	16,00	400	Al. Papuç M6	9HF-BTD00-3000
40	260	220	180	17,00	400	Al. Papuç M8	9HF-BTD00-4000
50	300	250	180	23,00	400	Al. Papuç M10	9HF-BTD00-5000
65	300	260	200	28,00	400	Al. Papuç M10	9HF-BTD00-6500
75	320	260	240	39,00	400	Al. Papuç M10	9HF-BTD00-7500
80	380	300	250	41,00	400	Al. Papuç M10	9HF-BTD00-8000
100	400	350	270	45,00	400	Al. Papuç M12	9HF-BTD00-1100

□ 0 for 440V, 1 for 525V.

# LINE FILTERS

## DRIVE INPUT PROTECTION REACTORS (LINE FILTER) % 4 IMPEDANCE



Devices that operate with power electronic systems (Motor Drivers, UPS, Converters) are serialized to their inputs. As is known, these devices are they cause distortion in the sinus curvature, and these harmonics devices are adversely affected.

Line reactors, motor drivers, converters, etc. devices brought to the square harmonic currents, peak currents due to various causes, are used to limit the outgoing currents. These reactors are designed to provide 4% voltage drop across the fundamental frequency (Different voltage drops can be produced on request). At the end of the use of the reactors, the generated harmonic currents are reduced, peak currents are limited, Motor Drivers, inverters, warm-ups are prevented and their lifespan is extended. The system is protected by minimizing the harmonic current supplied to the mains. The high insurance choice used due to the demarcation goes away.

Motor Power KW	Voltage V	Current A	Inductance mH	Width mm	Height mm	Depth mm	Weight kg.	Terminal	Order Code
<b>Mono-phase</b>									
0,37	230	4,00	8	84	85	50	1,5	Klem. 2,5 mm <sup>2</sup>	9HF-HM000-0037
0,55	230	6,00	5	84	85	55	1,7	Klem. 2,5 mm <sup>2</sup>	9HF-HM000-0055
0,75	230	8,00	4	84	85	60	1,9	Klem. 2,5 mm <sup>2</sup>	9HF-HM000-0075
1,1	230	10,00	3	96	110	70	2,9	Klem. 2,5 mm <sup>2</sup>	9HF-HM000-0110
1,5	230	12,00	2,5	96	110	75	3	Klem. 2,5 mm <sup>2</sup>	9HF-HM000-0150
2,2	230	20,00	1,5	96	110	80	3,2	Klem. 2,5 mm <sup>2</sup>	9HF-HM000-0220
3	230	25,00	1,2	96	110	90	3,5	Klem. 4 mm <sup>2</sup>	9HF-HM000-0300
4	230	30,00	1	96	110	100	4	Klem. 4 mm <sup>2</sup>	9HF-HM000-0400
<b>Three-phase</b>									
0,37	400	1,5	20,00	145	150	90	2,00	Klem. 2,5 mm <sup>2</sup>	9HF-HT000-0037
0,55	400	2,0	15,00	145	150	90	2,20	Klem. 2,5 mm <sup>2</sup>	9HF-HT000-0055
0,75	400	2,5	12,00	145	150	90	2,20	Klem. 2,5 mm <sup>2</sup>	9HF-HT000-0075
1,1	400	3,0	10,00	145	150	90	2,20	Klem. 2,5 mm <sup>2</sup>	9HF-HT000-0110
1,5	400	4,0	7,50	145	150	100	3,05	Klem. 2,5 mm <sup>2</sup>	9HF-HT000-0150
2,2	400	6,0	4,90	145	150	100	3,20	Klem. 2,5 mm <sup>2</sup>	9HF-HT000-0220
3	400	8,0	3,80	145	150	110	3,40	Klem. 2,5 mm <sup>2</sup>	9HF-HT000-0300
4	400	10,0	3,00	180	180	110	5,00	Klem. 2,5 mm <sup>2</sup>	9HF-HT000-0400
5,5	400	12,0	2,50	180	180	115	5,50	Klem. 4 mm <sup>2</sup>	9HF-HT000-0550
7,5	400	16,0	1,85	180	180	115	5,70	Klem. 4 mm <sup>2</sup>	9HF-HT000-0750
11	400	25,0	1,20	200	180	115	7,00	Klem. 6 mm <sup>2</sup>	9HF-HT000-1100
15	400	35,0	0,85	200	180	120	7,30	Klem. 6 mm <sup>2</sup>	9HF-HT000-1500
18,5	400	40,0	0,74	200	180	125	7,80	Klem. 10 mm <sup>2</sup>	9HF-HT000-1850
22	400	50,0	0,60	200	180	130	8,00	Klem. 10 mm <sup>2</sup>	9HF-HT000-2200
30	400	63,0	0,48	240	230	125	11,00	Al. Papuç M10	9HF-HT000-3000
37	400	80,0	0,38	240	230	135	11,70	Al. Papuç M10	9HF-HT000-3700
45	400	100,0	0,30	240	230	145	12,00	Al. Papuç M10	9HF-HT000-4500
55	400	110,0	0,27	265	240	150	17,00	Al. Papuç M10	9HF-HT000-5500
75	400	160,0	0,19	265	240	165	17,00	Al. Papuç M10	9HF-HT000-7500
90	400	200,0	0,16	300	280	170	23,00	Al. Papuç M10	9HF-HT000-9000
110	400	220,0	0,13	300	280	195	24,00	Al. Papuç M10	9HF-HT000-1000
132	400	260,0	0,11	300	280	200	25,00	Al. Papuç M12	9HF-HT000-3200
160	400	320,0	0,09	360	320	205	30,00	Al. Papuç M12	9HF-HT000-6000

# SHUNT REACTORS



Characteristics of the energy which receives from network sarebegin change nowadays. A short time ago reactive power which has enductive caracteristic was receiving much from the network, but power electronic devices and electronic components have begin to use in facilities so feature of charge which is receiving from network has begin to change.

In this case using mandotary of there actor swchich receives enductive charge from the network has occured. Another mandotary of using These reactors is the aim of todestroy of capacitor effect of long transmission lines. Iron and copper losses will occur in Harmonic Filters and Reactors so its very important to take out the heat which consist with a correct ventilation inside of the panel.

Shunt reactors fix parallel to the busbar in the compensation systems.

## General Features:

- 1-) According to filter power Thermal clamp or busbar connection in output
- 2-) Production with three or single phases
- 3-) Design with iron core, air gap
- 4-) Heat protection with thermo contact
- 5-) Copper or aluminum winding
- 6-) CE Certificate
- 7-) Protection degree IP 00

	Power (kVAr)	Inductance (mH)	Current (A)	Width (mm)	Height (mm)	Depth (mm)	Order Code
<b>Mono-phase</b>							
	0.1	1697	0,43	85	90	80	9SR-BM000-0001
	0.25	679	1,09	85	90	100	9SR-BM000-0025
	0.5	339	2,17	110	120	110	9SR-BM000-0050
	0.75	226	3,26	120	120	125	9SR-BM000-0075
	1	169	4,35	150	150	125	9SR-BM000-0100
	1.5	113	6,52	150	150	145	9SR-BM000-0150
	2	84,89	8,70	150	150	160	9SR-BM000-0200
	2.5	67,91	10,87	170	170	160	9SR-BM000-0250
	3	56,59	13,04	170	170	170	9SR-BM000-0300
	4	42,44	17,39	200	200	180	9SR-BM000-0400
	5	33,95	21,74	200	200	200	9SR-BM000-0500
	7.5	22,64	32,61	250	250	210	9SR-BM000-0750
	10	16,98	43,68	250	250	230	9SR-BM000-1000
<b>Stage</b>							
	0,25-0,5-0,75	679-226	1,08-3,26	120	120	100	9SR-BK000-0075
	0,25-0,5-0,75-1	679-169	1,08-4,34	150	130	100	9SR-BK000-0100
	0,5-1-1,5	339-113	2,17-6,52	150	145	100	9SR-BK000-0150
<b>Three-phase</b>							
	0.5	1018	0,72	150	150	80	9SR-BT000-0050
	1	509	1,45	180	180	90	9SR-BT000-0100
	1.5	339	2,17	180	180	100	9SR-BT000-0150
	2	254	2,90	230	240	120	9SR-BT000-0200
	2.5	203	3,62	250	250	110	9SR-BT000-0250
	3	170	4,35	250	250	100	9SR-BT000-0300
	4	127	5,80	300	260	135	9SR-BT000-0400
	5	101	7,25	300	260	145	9SR-BT000-0500
	7.5	68	10,87	330	350	180	9SR-BT000-0750
	10	51	14,49	360	360	150	9SR-BT000-1000
	12.5	40,74	18,12	360	360	160	9SR-BT000-1250
	15	33,95	21,74	430	410	160	9SR-BT000-1500
	20	25,47	28,99	500	480	180	9SR-BT000-2000
	25	20,37	36,23	500	500	260	9SR-BT000-2500
	30	16,98	43,48	550	500	270	9SR-BT000-3000
	40	12,73	57,97	630	500	260	9SR-BT000-4000
	50	10,19	72,46	630	600	260	9SR-BT000-5000

## NOTLAR



# NH (H.R.C.) FUSES







IEC / EN 60269-1/ 2  
CE





Mounting Position : Vertical  
Altitude : 2000m (max)  
Relative Humidity : %50 (40°C), %90 (20°C)  
Ambient Temperature : between -25°C and +60°C

All these given information are general. We have always right to change them.

## NH (H.R.C) Fuses

	<b>NHC00-FB</b> 6A...100A		
	<b>NH00-FB</b> 6A...160A	<b>NH1-FB</b> 40A...250A	<b>NH3-FB</b> 125A...630A
	<b>NH0-FB</b> 25A...160A	<b>NHC2-FB</b> 40A...250A	<b>NH4-FB</b> 800A...1250A
	<b>NHC1-FB</b> 25A...160A	<b>NH2-FB</b> 63A...400A	

## NH Fuse Base

	<b>BMC</b> NH00-FA	<b>BMC</b> NH1-FA	<b>BMC</b> NH3-FA
	<b>BMC</b> NH0-FA	<b>BMC</b> NH2-FA	<b>BMC</b> NH4-FA
	<b>STEATIT</b> NH00-FA	<b>STEATIT</b> NH1-FA	<b>STEATIT</b> NH3-FA
	<b>STEATIT</b> NH0-FA	<b>STEATIT</b> NH2-FA	

## Solid Link

	<b>NH00</b>
	<b>NH1</b>
	<b>NH2</b>
	<b>NH3</b>



## J Type Fuses

	<b>FJF82030</b> 63A...200A
	<b>FJF82038</b> 250A...315A
	<b>FJF92040</b> 300A...400A

## HRC Fuse Base & Fuse Carrier



## Cylindrical Fuses

	<b>FCF10-38</b> 2A ... 25A	<b>FCF22-58</b> 10A ... 100A
	<b>FCF14-51</b> 2A ... 50A	

## Cylindrical Fuses Bases

	<b>FCFB</b> 32A ... 100A
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# NH (H.R.C.) FUSES

Fuse is a protective device and it breaks current when the wire inside melts and protects its circuit against over current risks. Federal NH fuse and fuse base are manufactured in accordance with **CE**.

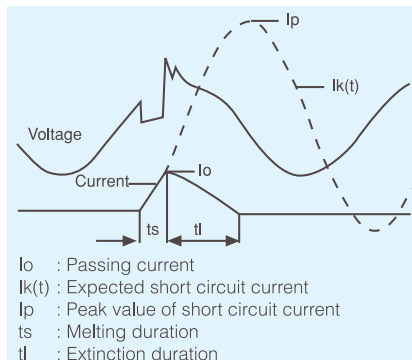
NH body is produced as steatite and glazed ceramic according to customer and specification expectations.

Glaze is protecting the surface of ceramic products and is used mostly in the field of fuses and insulators. Both spraying and immersion technologies are used.

Federal NH fuses are manufactured of steatite material and capable of breaking short circuit currents up to 120 kArms. Federal Electric NH fuses with rated voltages up to, 500V AC rated currents up to 1250A protect several devices and facilities such as transformer, cable, switch panel against overloading and short circuit safely.

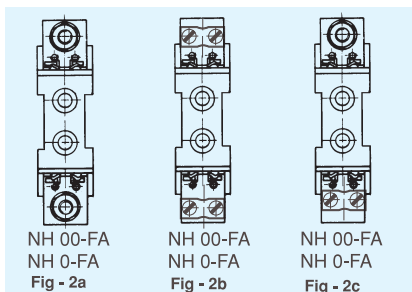
Current-time characteristics of fuses are seen in Figure-6. These curves indicate opening duration (t) of the fuse depending on the load current. As current increases, fuse's opening duration decreases. Federal NH fuse have delayed characteristics. They are resistant to progress currents of asynchronous motors. They provide good protection against short circuits and over currents and open the circuit without delay.

"gL/gG" mark means line protection and NH fuses in this class are especially used for protection of cables and conductors.



**Fig - 1** Current and Voltage Changes Graphic at Breaking of Leakage Current by Fuse.

Order code	Size	Pertinax dimensions (mm) (mm)		
		h	x	w
8CB-A0000-0000	1	116	x	227
8CB-A0000-0000	2	116	x	227
8CB-A0000-0000	3	116	x	227



As it can also be seen in the current-time curve, fuses operate at 1.6 times more of the nominal current and open the circuit within 5 seconds at a current of 5 x  $I_n$ . Melting wires used in NH fuses are manufactured in various types and forms depending on size of the fuse current. Same-sized cells (thin wires to melt) have been formed on melting wires. In case of overload and short circuit, melting partial arcs shall form at several points throughout the wire. Such a melting shall break the short circuit currents and temperature shall be dispersed throughout the whole fuse.

Outer body of the fuses should be resistant to high pressure and temperature caused by broken current. Because, the fuse wire needs to melt in order to break the current; that is, it should form a heat energy on resistance of the fuse wire of the current to be broken. In case of melting temperature sized by the fuse wire is exceeded with this heat energy produced by the current to be broken during its melting duration, current continues to flow through liquefied metal and metal steam. Current is in an arc form at this final stage of breaking operation (Figure-1). This arc causes increase in pressure and temperature in the fuse body during its extinction duration. The fuse body needs to resist these two impacts. Damage to the fuse by heat amounts produced by these currents on the fuse resistance, where it is not certain whether fuse wire shall melt or not or where they shall flow for a long time even in case of melting, may be avoided by manufacturing the fuse body of materials resistant to high temperatures.

Material used in Federal NH fuse is steatite material with high resistance to shock heats and dynamic forces. Contact knives of Federal fuses are made of special brass or copper material and coated with silver. Silver contacts with air and gets sulfured and dark in time. However, this is not important. Because, silver sulfur gets into conductive condition with the heat produced by the current passing through the circuit.

## Quartz Sand:

Quartz sand, which has high purity and cleanness, no humidity and grain size of which is controlled strictly, is used as the extinction environment for the arc to be formed during current breaking operation. It is tried to have the sand, which is placed in the body via vibration, surround the current line completely and to reduce the air in the inner structure to the largest extent possible. Quartz sand, which gets a uniform structure via partial melting, helps both extinction of the arc and insulation of broken fuse wires by placing between broken fuse wires.

## NH Fuse Base:

They are manufactured of steatite or

BMC materials, depending on the need, in five different sizes. Joints of base are manufactured as with connectors or bolts in 00 and 0 sizes, depending on customer request; and manufactured in a way to allow bolted connection in other sizes. Spring contacts of NH fuse base, which are made of electrolytic copper, are reinforced with special steel springs, as well as their own tightening and springiness features. Tightening power of the contacts is higher than other fuse base in the market; If the fuse base are assembled side by side, insulation among phases can be increased with Pertinax separators, which are provided as accessories upon request. While NH fuse are mounted to base, attention should be paid to secure the fuse knives on the base. Otherwise, poor contact resistance shall cause heat and power loss and accordingly failures. Another important issue is that conductors with sections in accordance with the standards should be connected to the NH base.

Three separate model connection types have been developed to easily connect busbars or cables to Federal 00 and 0 size NH base.

**Two-side bolted:** For cable shoe, thing, multi-wire cables or busbars (Figure-2a).

**Two-side bridge connector:** For single stranded cables (Figure-2b).

**One-side bolted, other side bridge connector:** For single stranded cables and busbars (Figure-2c).

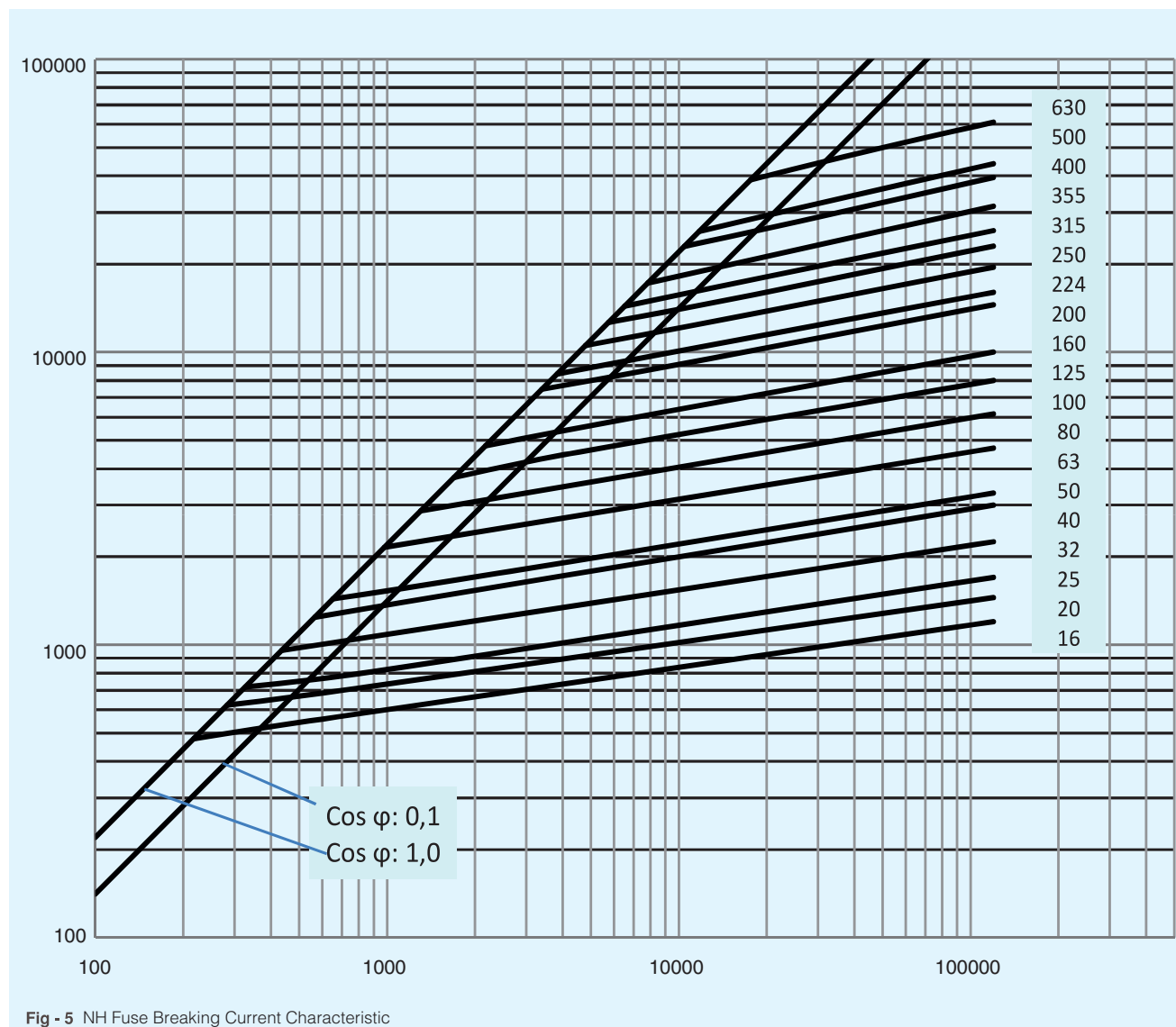
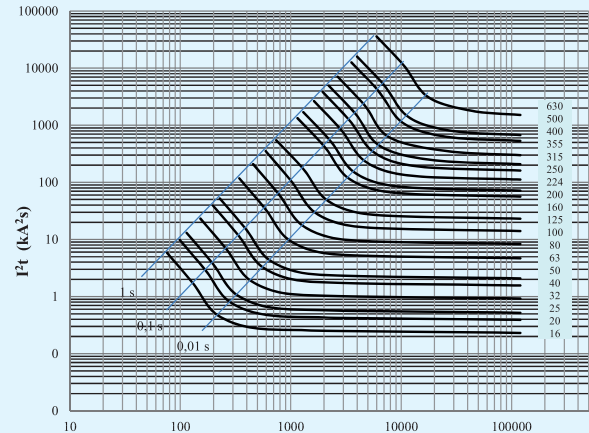
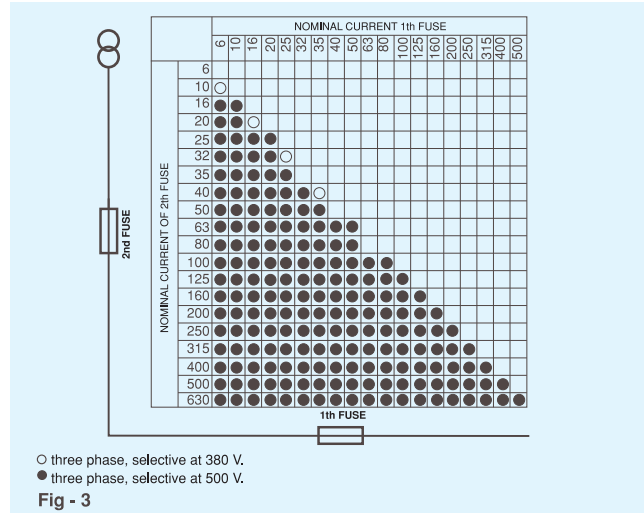
**Steatit:** It is used as NH fuse insulator in low voltage. It is a material resistant to high temperature. Steatit is a derivative of porcelain. With reflected of developing technology in quality of materials utilized in electrical industry, whereas normal porcelain materials are used in MV and LV bearers for insulating purposes; steatit materials are used in NH base, which has superior shock resistance and strength than porcelain materials.

**BMC (Bulk Molding Compound):** It is a polyester molding material, which looks like dough and which is reinforced with long fiber, and it is a composite material capable of being adjusted by changing rates of additives. BMC is in thermoset plastics class and bears similar characteristics with bakelite and melamine. However, it has significant superiorities when considered in terms of process conditions as an end product. It is resistant to dynamic forces and thermal shocks.

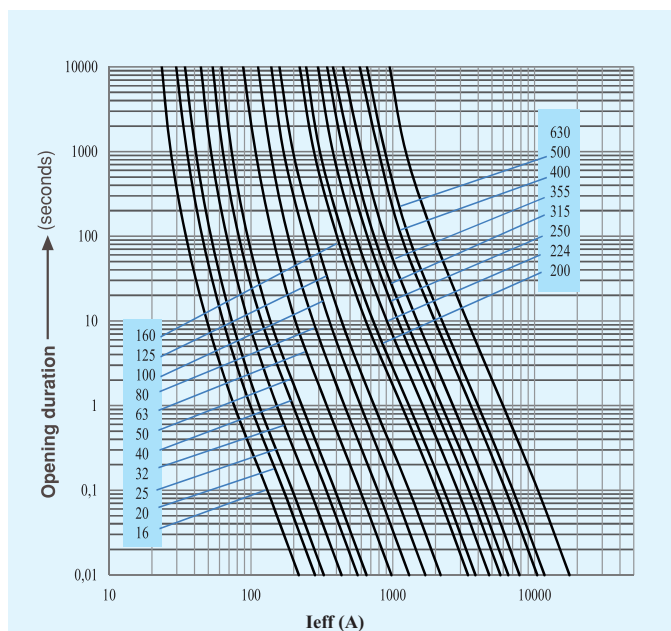
# NH (H.R.C.) FUSES

## Selective protection (selectivity):

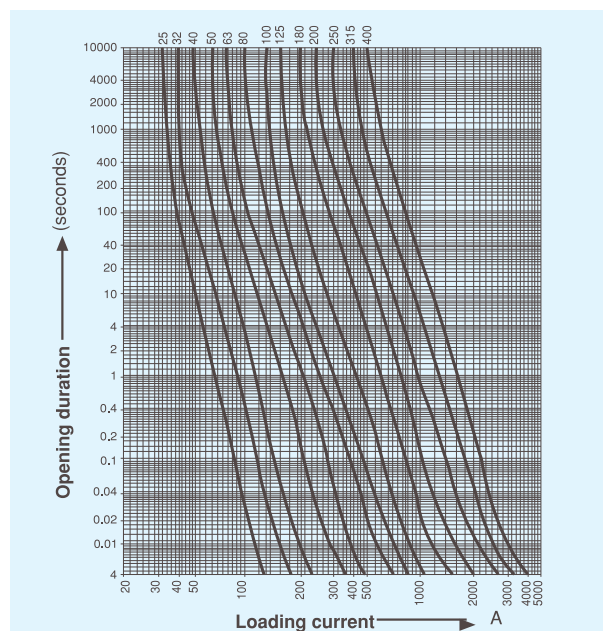
It is the method of design to ensure elimination of a failure (fault), which occurs at any point of the network, by the protection element on that faulty operating element and to allow other sections of the system to continue operation. NH fuse, which have a nominal current difference of 60% according to "gL/gG" operating class, should open the circuit selectively in high short circuit currents. NH fuses should be chosen according to the table in Figure-3 in order to ensure selectivity.



# NH (H.R.C.) FUSES



**Fig-6:**  
Current-time characteristic of NH fuses "gL/gG"



**Fig-7:**  
Current-time characteristic of super link NH fuses "gR"

## Super Flink NH Fuse:

These fuses are used in protection against over current and short circuits of AC and DC power circuits, where power electronic elements such as diode, thyristor are present. The most important feature discriminating super flink fuses from NH type fuses is the material type of the melting wire used inside the NH fuse. Pure silver material is used as the melting wire in super flink fuses. As it can be seen in current-time characteristic curves of super flink fuses, temperature increase is higher than protection devices with operating class "gL/gG" (Figure-7). In this way, sensitive protection is provided at rated current or values close to rated current via super flink fuses.

Operating characteristic : Super flink (fast)  
Rated voltage : AC 500 V  
Operating class : gR  
Breaking capacity : 120 kA (rms)

## Order Codes of Super Flink Fuses:

Type	Size	Rated current	I <sup>2</sup> T Total	I <sup>2</sup> T Melting	Order code
NHG00-FB	00	25 A	300	80	9CB-BH000-0025
NHG00-FB	00	32 A	450	130	9CB-BH000-0032
NHG00-FB	00	40 A	1000	260	9CB-BH000-0040
NHG00-FB	00	50 A	1500	400	9CB-BH000-0050
NHG00-FB	00	63 A	2300	620	9CB-BH000-0063
NHG00-FB	00	80 A	3400	900	9CB-BH000-0080
NHG00-FB	00	100 A	5700	1500	9CB-BH000-0100
NHG00-FB	00	125 A	10000	2700	9CB-BH000-0125
NHG00-FB	00	160 A	21000	6000	9CB-BH000-0160
NHG1-FB	1	100 A	6100	1600	9CD-BH000-0100
NHG1-FB	1	125 A	10000	2400	9CD-BH000-0125
NHG1-FB	1	160 A	20000	5100	9CD-BH000-0160
NHG1-FB	1	200 A	30000	7800	9CD-BH000-0200
NHG1-FB	1	250 A	52000	14000	9CD-BH000-0250
NHG2-FB	2	200 A	30000	7800	9CE-BH000-0200
NHG2-FB	2	250 A	52000	14000	9CE-BH000-0250
NHG2-FB	2	315 A	82000	20000	9CE-BH000-0315
NHG2-FB	2	400 A	160000	40000	9CE-BH000-0400
NHG3-FB	3	315 A	80000	20000	9CF-BH000-0315
NHG3-FB	3	400 A	160000	40000	9CF-BH000-0400
NHG3-FB	3	500 A	270000	70000	9CF-BH000-0500
NHG3-FB	3	630 A	360000	90000	9CF-BH000-0630

# NH (H.R.C.) FUSES

## Temperature effect on NH fuses:










The thermal overload protection characteristics change with the effect of the temperature of NH fuses. Fuses are manufactured according to ambient temperature of 20 ° C. If it operates in a warmer environment, it will trip earlier than the nominal value. If it works in a cooler environment, it will open later.

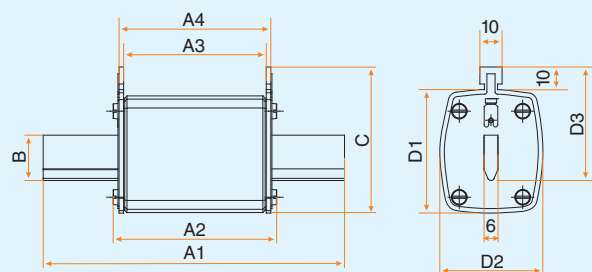
The table below shows the operating currents for different ambient temperatures. The operating current at 50 ° C of the 100A NH fuse is found on the table as 91A.

Calibration Temperature (°C)	In (A)	Compensation Factor According to Ambient Temperature (k)						
		10°C	20°C	30°C	40°C	50°C	55°C	60°C
20	6	6,2	6,0	5,8	5,6	5,5	5,4	5,3
20	10	10,3	10,6	9,7	9,4	9,1	9,0	8,8
20	16	16,5	16,0	15,5	15,0	14,6	14,3	14,1
20	20	20,6	20,0	19,4	18,8	18,2	17,9	17,6
20	25	25,8	25,0	24,3	23,5	22,8	22,4	22,0
20	32	33,0	32,0	31,0	30,1	29,1	28,6	28,2
20	40	41,2	40,0	38,8	37,6	36,4	35,8	35,2
20	50	51,5	50,0	48,5	47,0	45,5	44,8	44,0
20	63	64,9	63,0	61,1	59,2	57,3	56,4	55,4
20	80	82,4	80,0	77,6	75,2	72,8	71,6	70,4
20	100	103,0	100,0	97,0	94,0	91,0	89,5	88,0
20	125	128,8	125,0	121,3	117,5	113,8	111,9	110,0
20	160	164,8	160,0	155,2	150,4	145,6	143,2	140,8
20	200	206,0	200,0	194,0	188,0	182,0	179,0	176,0
20	250	257,5	250,0	242,5	235,0	227,5	223,8	220,0
20	315	324,5	315,0	305,6	296,1	286,7	281,9	277,0
20	400	412,0	400,0	388,0	376,0	364,0	358,0	352,0
20	500	515,0	500,0	485,0	470,0	455,0	447,5	440,0
20	630	648,9	630,0	611,1	592,2	573,3	563,9	554,4



# NH (H.R.C.) FUSES

	Order code	Size	Rated Current (A)	Pcs Box	kg. Box
 <b>NH00-FB</b>	9CB-BG☆00-0□□□	00	6 - 160	10	1.760
 <b>NHC00-FB</b>	9CA-BG☆00-0□□□	000	6 - 100	10	1.305
 <b>NH0-FB</b>	9CC-BG☆00-0□□□	0	25 - 160	5	1.225
 <b>NH1-FB</b>	9CD-BG☆00-0□□□	1	40 - 250	3	1.300
 <b>NHC1-FB</b>	9CI-BG☆00-0□□□	1/0	25 - 160	5	2.000
 <b>NH2-FB</b>	9CE-BG☆00-0□□□	2	63 - 400	3	2.005
 <b>NHC2-FB</b>	9CH-BG☆00-0□□□	2/1	40 - 250	3	1.440
 <b>NH3-FB</b>	9CF-BG☆00-0□□□	3	125 - 630	1	0.980
 <b>NH4-FB</b>	9CG-BG000-0□□□	4	800-1250	1	1.992











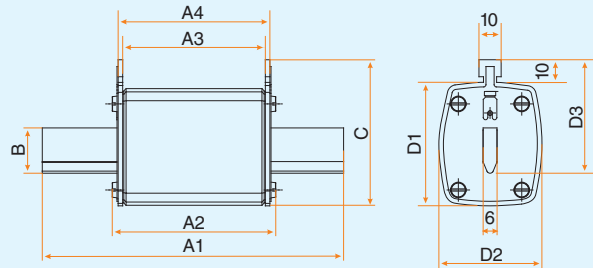
Type	Dimensions (mm)								
	A1	A2	A3	A4	B	C	D1	D2	D3
NH00-FB	78,5	54	45	50	15	58	48	29,5	45
NHC00-FB	78,5	54	45	49	15	47	36	21	45
NH0-FB	125	71	62	68	15	58	48	29,5	45
NH1-FB	135	72,5	62	68	20	64	52	46	50
NHC1-FB	135	71	62	68	15	58	48	29,5	45
NH2-FB	150	73,5	62	68	25	70	60	59	58
NHC2-FB	150	72,5	62	68	20	64	52	46	50
NH3-FB	150	73,5	62	68	32	85,5	75	69,5	70
NH4-FB	200	84,5	61,5	76	50	113	103	86	84

□: Please enter amper value.  
 ☆: 0 for unglazed nh, 1 for glazed nh.

# NH (H.R.C.) FUSES

Dual Indicator

	Order code	Size	Rated Current (A)	Pcs Box	kg. Box
 <b>NH00-FB</b>	9CB-BG☆10-0□□□	00	6 - 160	10	1.760
 <b>NH0-FB</b>	9CC-BG☆10-0□□□	0	25-160	5	1.225
 <b>NH1-FB</b>	9CD-BG☆10-0□□□	1	40-250	3	1.300
 <b>NHC1-FB</b>	9CI-BG☆10-0□□□	1/0	25-160	5	2.000
 <b>NH2-FB</b>	9CE-BG☆10-0□□□	2	63-400	3	2.005
 <b>NHC2-FB</b>	9CH-BG☆10-0□□□	2/1	40-250	3	1.440
 <b>NH3-FB</b>	9CF-BG☆10-0□□□	3	125-630	1	0.980
 <b>NH4-FB</b>	9CG-BG010-0□□□	4	800-1250	1	1.992

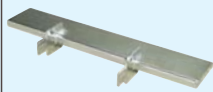
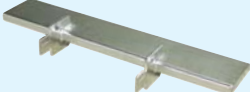

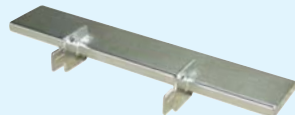


Type	Dimensions (mm)								
	A1	A2	A3	A4	B	C	D1	D2	D3
<b>NH00-FB</b>	78,5	54	45	50	15	58	48	29,5	45
<b>NHC00-FB</b>	78,5	54	45	49	15	47	36	21	45
<b>NH0-FB</b>	125	71	62	68	15	58	48	29,5	45
<b>NH1-FB</b>	135	72,5	62	68	20	64	52	46	50
<b>NHC1-FB</b>	135	71	62	68	15	58	48	29,5	45
<b>NH2-FB</b>	150	73,5	62	68	25	70	60	59	58
<b>NHC2-FB</b>	150	72,5	62	68	20	64	52	46	50
<b>NH3-FB</b>	150	73,5	62	68	32	85,5	75	69,5	70
<b>NH4-FB</b>	200	84,5	61,5	76	50	113	103	86	84

□: Please enter amper value.

☆: 0 for unglazed nh, 1 for glazed nh.



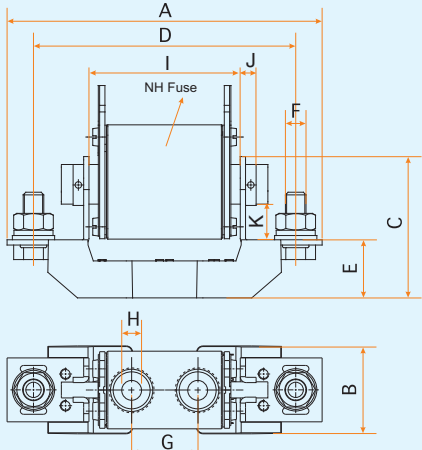



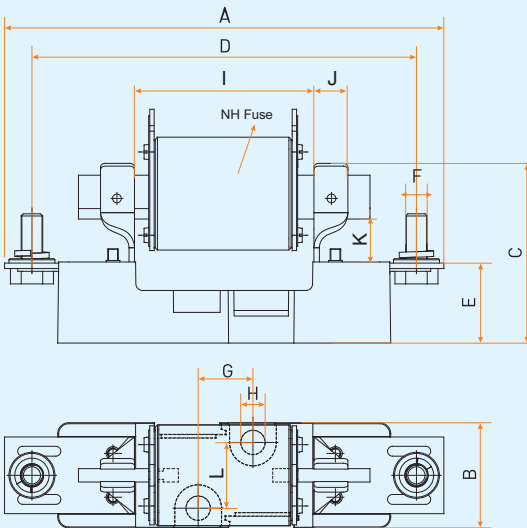


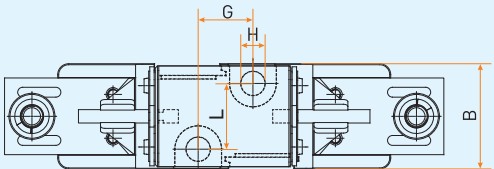



## SOLID LINK

				
<b>Type</b>	<b>NH00</b>	<b>NH1</b>	<b>NH2</b>	<b>NH3</b>
<b>Order Code</b>	9SL-C0000-0000	9SL-C0000-0001	9SL-C0000-0002	9SL-C0000-0003

Note: Solid Link is used by NH Fuses for direct connection of contacts without fuse link. It's non-isolated type.




# NH (H.R.C.) FUSES

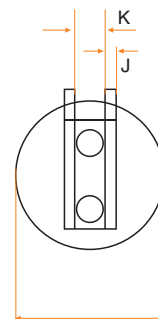
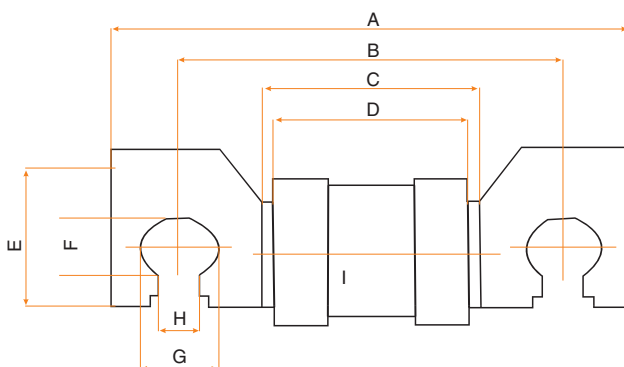
<div><p>BMC</p></div> <div><p>Steatit</p></div>	<p><b>NH00-FA</b></p> <p><b>Order code</b></p> <p>9CB-C0□00-0000 (BMC) 9CB-A0□00-0000 (Steatit)</p> <p><input type="checkbox"/> C- with screw <input type="checkbox"/> K- with clemens <input type="checkbox"/> X-with screw and clemens</p> <p>Size : 00 Rated current : 160 A Quantity / box : 5 Kg. / box : 0.795 (BMC) 1.060 (Steatit)</p>	<div></div> <table><tr><th rowspan="2">Type</th><th colspan="12">Dimensions (mm)</th></tr><tr><th>A</th><th>B</th><th>C</th><th>D</th><th>E</th><th>F</th><th>G</th><th>H</th><th>I</th><th>J</th><th>K</th></tr><tr><td>NH00</td><td>120</td><td>32,5</td><td>54</td><td>101</td><td>23,5</td><td>M8</td><td>25</td><td>7,5</td><td>57</td><td>2</td><td>13</td></tr><tr><td>NH0</td><td>170</td><td>32</td><td>64,5</td><td>150</td><td>30,5</td><td>M8</td><td>25</td><td>7,5</td><td>76</td><td>2</td><td>13</td></tr></table>	Type	Dimensions (mm)												A	B	C	D	E	F	G	H	I	J	K	NH00	120	32,5	54	101	23,5	M8	25	7,5	57	2	13	NH0	170	32	64,5	150	30,5	M8	25	7,5	76	2	13																														
Type	Dimensions (mm)																																																																															
	A	B	C	D	E	F	G	H	I	J	K																																																																					
NH00	120	32,5	54	101	23,5	M8	25	7,5	57	2	13																																																																					
NH0	170	32	64,5	150	30,5	M8	25	7,5	76	2	13																																																																					
<div><p>BMC</p></div>	<p><b>NH0-FA</b></p> <p><b>Order code</b></p> <p>9CC-C0□00-0000 (BMC)</p> <p><input type="checkbox"/> C- with screw <input type="checkbox"/> K- with clemens <input type="checkbox"/> X-with screw and clemens</p> <p>Size : 0 Rated current : 160 A Quantity / box : 5 Kg. / box : 1.020</p>																																																																															
<div><p>BMC</p></div> <div><p>Steatit</p></div>	<p><b>NH1-FA</b></p> <p><b>Order code</b></p> <p>9CD-C0C00-0000 (BMC) 9CD-A0C00-0000 (Steatit)</p> <p>Size : 1 Rated current : 250 A Quantity / box : 3 Kg. / box : 1.375 (BMC) 1.845 (Steatit)</p>	<div></div>																																																																														
<div><p>BMC</p></div> <div><p>Steatit</p></div>	<p><b>NH2-FA</b></p> <p><b>Order code</b></p> <p>9CE-C0C00-0000 (BMC) 9CE-A0C00-0000 (Steatit)</p> <p>Size : 2 Rated current : 400 A Quantity / box : 3 Kg. / box : 1.740 (BMC) 1.950 (Steatit)</p>	<div></div>																																																																														
<div><p>BMC</p></div> <div><p>Steatit</p></div>	<p><b>NH3-FA</b></p> <p><b>Order code</b></p> <p>9CF-C0C00-0000 (BMC) 9CF-A0C00-0000 (Steatit)</p> <p>Size : 3 Rated current : 630 A Quantity / box : 3 Kg. / box : 2.280 (BMC) 2.750 (Steatit)</p>	<table><tr><th rowspan="2">Type</th><th colspan="13">Dimensions (mm)</th></tr><tr><th>A</th><th>B</th><th>C</th><th>D</th><th>E</th><th>F</th><th>G</th><th>H</th><th>I</th><th>J</th><th>K</th><th>L</th></tr><tr><td>NH1</td><td>200</td><td>47,5</td><td>82</td><td>175</td><td>35</td><td>M10</td><td>25</td><td>10,5</td><td>80</td><td>15</td><td>20,5</td><td>30</td></tr><tr><td>NH2</td><td>225</td><td>47,5</td><td>88</td><td>200</td><td>35</td><td>M10</td><td>25</td><td>10,5</td><td>80</td><td>15</td><td>20</td><td>30</td></tr><tr><td>NH3</td><td>240</td><td>47,5</td><td>99</td><td>210</td><td>37</td><td>M12</td><td>25</td><td>10,5</td><td>80</td><td>15</td><td>19</td><td>30</td></tr><tr><td>NH4</td><td>309</td><td>87</td><td>134,5</td><td>268,5</td><td>48,5</td><td>M16</td><td>45</td><td>10,5</td><td>104</td><td>45</td><td>29</td><td>30</td></tr></table>	Type	Dimensions (mm)													A	B	C	D	E	F	G	H	I	J	K	L	NH1	200	47,5	82	175	35	M10	25	10,5	80	15	20,5	30	NH2	225	47,5	88	200	35	M10	25	10,5	80	15	20	30	NH3	240	47,5	99	210	37	M12	25	10,5	80	15	19	30	NH4	309	87	134,5	268,5	48,5	M16	45	10,5	104	45	29	30
Type	Dimensions (mm)																																																																															
	A	B	C	D	E	F	G	H	I	J	K	L																																																																				
NH1	200	47,5	82	175	35	M10	25	10,5	80	15	20,5	30																																																																				
NH2	225	47,5	88	200	35	M10	25	10,5	80	15	20	30																																																																				
NH3	240	47,5	99	210	37	M12	25	10,5	80	15	19	30																																																																				
NH4	309	87	134,5	268,5	48,5	M16	45	10,5	104	45	29	30																																																																				
<div><p>BMC</p></div>	<p><b>NH4-FA</b></p> <p><b>Order code</b></p> <p>9CG-A0C00-0000</p> <p>Size : 4 Rated current : 1250 A Quantity / box : 3 Kg. / box : 2.249</p>																																																																															

## J TYPE FUSE - LINKS

J type feeder pillar fuse links are designed to be used with wedge type fuse carriers. Type J fuse links are to be used in a.c. electricity supply networks. They are installed in distribution boards, feeder pillars, link boxes, pole mounted cut-outs and heavy duty service intakes, open type substation boards and underground connection boxes. They can also be fitted in pole or wall mounted outdoor service fuse links.

	Type	Current	A	B	C	D	E	F	G	H	I	J	K
	FJF82030	63A - 200A	110	82	45.2	40.5	30	14.5	17.5	9.8	30.9	2.4	6.45/6.53
	FJF82038	250A - 315A	110	82	45.2	40.5	30	14.5	17.5	9.8	38	2.4	6.45/6.53
	FJF92040	300A - 400A	131	92	46.7	40.3	38	14.5	20	10	40	3.1	8.05/8.75

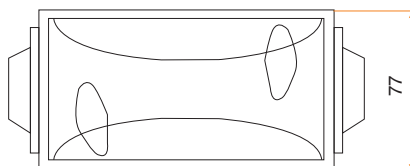
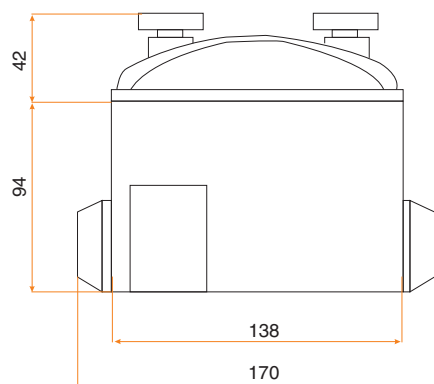
Rated Voltage	415V AC
Breaking Capacity	80kA
Function Level	gU
Cartridge	Ceramic
Connnection	Bolted
Standard	IEC60269



### HRC Fuse Base & Fuse Carrier



- Maximum rating 300A
- Fuse carrier with 83mm centers
- Moulded in white glass filled polyester thermoset material
- All contacts manufactured from solid brass
- Fuse Holder to use with J type fuse links
- Cable entry and exits through PVC grommet
- Maximum cable size 185mm<sup>2</sup>
- Refer to rage 14 for fuse bases, contacts and fuse handles



# CYLINDRICAL FUSES and BASES

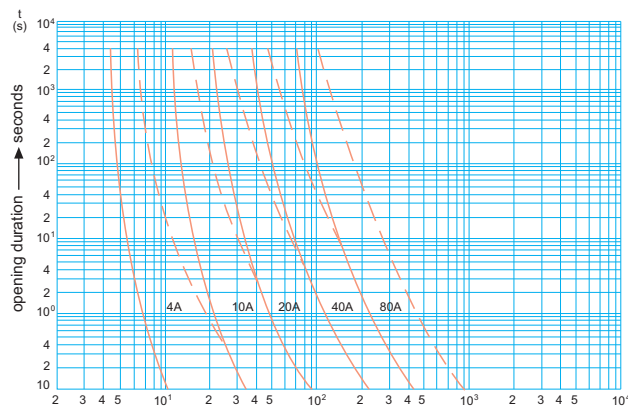
Cylindrical fuse link with cylindrical contact caps is designed for protecting electrical distribution in rated current up to 125A. Against damage due to overload and short circuit. Fuse link with the striker is supplied for the purpose of protecting against motor single phasing operation when fitted in fuse-isolators. This product conforms with IEC269 and CDE0636 standards.

Type	Dimensions mmxmm	Rated Voltage $U_n$ (V AC)	Rated Current $I_n$ (A)	Order Code
FCF10-38	10x38	500	2	9CF-1038-0002
FCF10-38	10x38	500	4	9CF-1038-0004
FCF10-38	10x38	500	6	9CF-1038-0006
FCF10-38	10x38	500	8	9CF-1038-0008
FCF10-38	10x38	500	10	9CF-1038-0010
FCF10-38	10x38	500	12	9CF-1038-0012
FCF10-38	10x38	500	16	9CF-1038-0016
FCF10-38	10x38	500	20	9CF-1038-0020
FCF10-38	10x38	500	25	9CF-1038-0025
FCF14-51	14x51	500	2	9CF-1451-0002
FCF14-51	14x51	500	4	9CF-1451-0004
FCF14-51	14x51	500	6	9CF-1451-0006
FCF14-51	14x51	500	8	9CF-1451-0008
FCF14-51	14x51	500	10	9CF-1451-0010
FCF14-51	14x51	500	16	9CF-1451-0016
FCF14-51	14x51	500	20	9CF-1451-0020
FCF14-51	14x51	500	25	9CF-1451-0025
FCF14-51	14x51	500	32	9CF-1451-0032
FCF14-51	14x51	500	40	9CF-1451-0040
FCF14-51	14x51	500	50	9CF-1451-0050
FCF22-58	22x58	500	10	9CF-2258-0010
FCF22-58	22x58	500	16	9CF-2258-0016
FCF22-58	22x58	500	20	9CF-2258-0020
FCF22-58	22x58	500	25	9CF-2258-0025
FCF22-58	22x58	500	32	9CF-2258-0032
FCF22-58	22x58	500	40	9CF-2258-0040
FCF22-58	22x58	500	50	9CF-2258-0050
FCF22-58	22x58	500	63	9CF-2258-0063
FCF22-58	22x58	500	80	9CF-2258-0080
FCF22-58	22x58	500	100	9CF-2258-0100

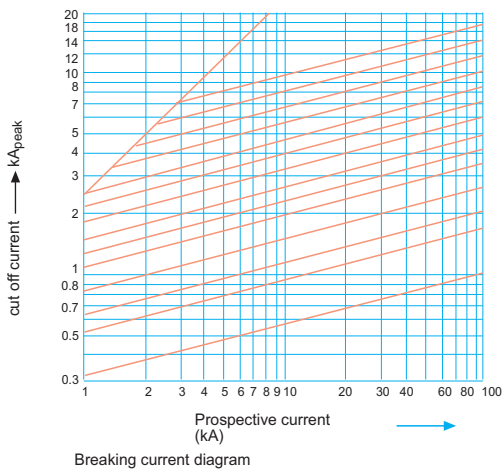
## Cylindrical Fuses Bases

Type	Dimensions mmxmm	Number of Pole	Rated Current $I_n$ (A)	Order Code
FCFB10-38	10x38	1	32	9CF-1038-A001
FCFB10-38	10x38	1+N	32	9CF-1038-A010
FCFB10-38	10x38	3	32	9CF-1038-A003
FCFB14-51	14x51	1	50	9CF-1451-A001
FCFB14-51	14x51	1+N	50	9CF-1451-A010
FCFB14-51	14x51	3	50	9CF-1451-A003
FCFB22-58	22x58	1	100	9CF-2258-A001
FCFB22-58	22x58	1+N	100	9CF-2258-A010
FCFB22-58	22x58	3	100	9CF-2258-A003
FCFB22-58	22x58	3+N	100	9CF-2258-A030

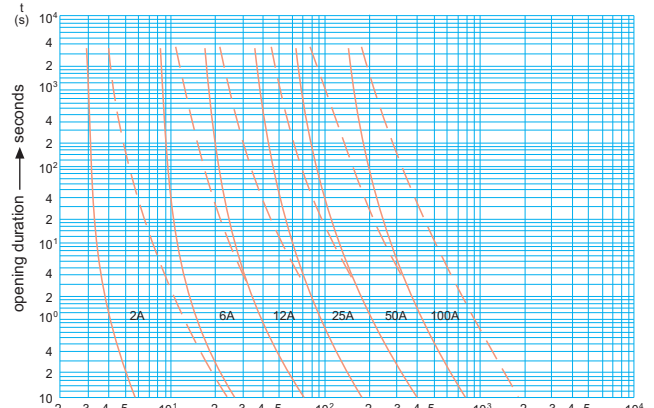
# CYLINDRICAL FUSES and BASES



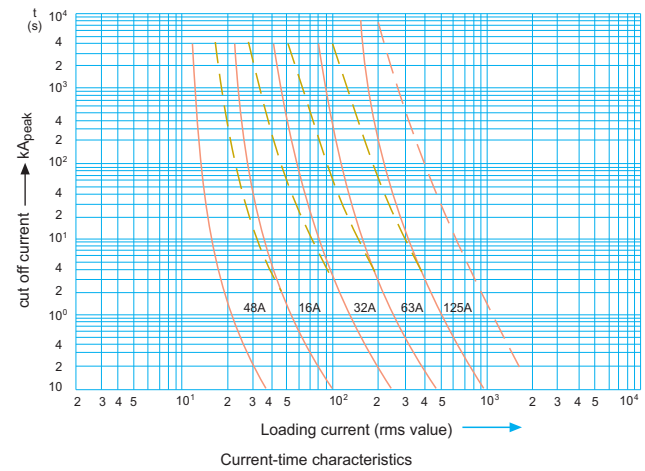
Current-time characteristics



Breaking current diagram

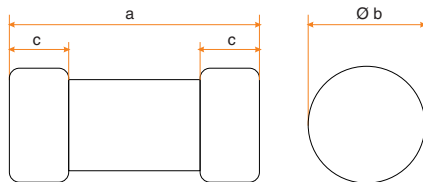


Current-time characteristics



Current-time characteristics

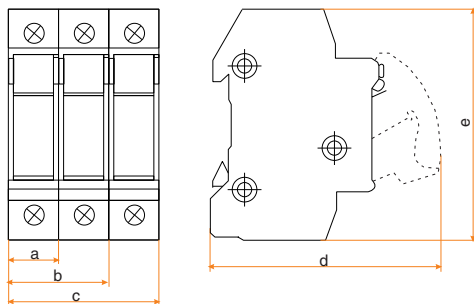
## Cylindrical Fuses



### Dimensions

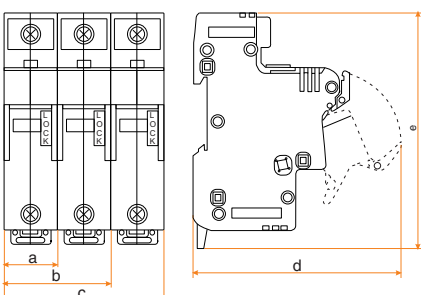
Type	FCF10	FCF14	FCF22
a (mm)	38	51	58
b (Ø)	10,3	14,3	22,2
c (mm)	10	12	14

## Cylindrical Fuses Bases



### Dimensions

Type	a	b	c	d	e
FCFB 10-38	17	34	51	79,5	78,3



### Dimensions

Type	a	b	c	d	e
FCFB 14-51	26,7	53,4	80,1	95	97
FCFB 22-58	34,7	69,4	104,1	104	127

## NOTLAR

# FUSE SWITCH DISCONNECTOR



## Vertical Type Fuse Switch Disconnecter

FVS160



FVS250  
FVS400  
FVS630



FVS800  
FVS1000  
FVS1250



VERTICAL TYPE FUSE  
RAIL



FUSE SWITCH  
DISCONNECTOR  
(1 Pole)



FUSE SWITCH  
DISCONNECTOR  
(3 Pole)



IEC / EN 60269-2  
CE

**Mounting Position** : Vertical  
**Altitude** : 2000 m (max)  
**Relative Humidity** : 90% (55°C)  
**Ambient Temperature** : between -25°C and +60°C  
**Pollution Degree** : III  
**Protection Degree** : IP20 - IP30  
**Over Voltage Class** : IV (IEC 60664)

# VERTICAL TYPE FUSE SWITCH DISCONNECTOR

Federal Electric vertical type switch fuses are manufactured in AC 22-B class in accordance with IEC 60947-3 standard according to CE. Federal FVS vertical type switch fuses are used in electricity distribution for protection against short circuit and overloads.

## Features:

- Each pole may open-close independently from other poles and all the poles can be opened-closed simultaneously with a single lever if required.

- It is designed to assemble in vertical position to horizontal busbars.

- Wear-out of contacts as a result of opening-closing under load is avoided thanks to use of arc separators.

- They have high short circuit breaking capacity.

- They are easy to assemble.

- They have high electrical and mechanical resistance.

- Modern technology and compact design.

- Low power loss.

- Melting of fuse wire can be seen with naked eye from outside.

- They are suitable for opening and closing load currents under normal circuit conditions and can be closed on short circuit.

- At open position, they fulfill the separation condition set out for the separators on both terminal sides of each pole.

- Insulating sections are insulated from voltage sections at rated insulation level.

- Fuse holders are made of an insulating material against extraordinary heat and flames and sections under voltage are

insulated at rated insulation level.

- Fuse holders can be easily mounted to and demounted from the housing. No auxiliary apparatus is needed for these works.

- Fuse holders are located on the housing on the front of the device and bear NH buttons.

- A single person can mount it by using insulated equipments on the front of the panel under voltage.

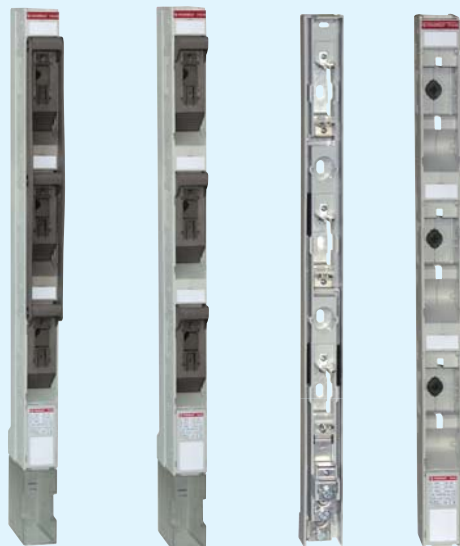
- All the plastic parts used in manufacture of the load separators are self-extinguishing and halogen-free and do not contain heavy metals.

- The case is made of an insulating material resistant against extraordinary heat and flames and insulated from voltage sections at rated insulation level.

- Contacts are made of electrolytic copper and coated with silver.

14

## FVS160



Three phase can open together

Three phase can open individual.

Body

Case



Fuse holder



Terminal cover

## FVS250 / FVS400 / FVS630



Three phase can open together

Three phase can open individual.

Body

Case



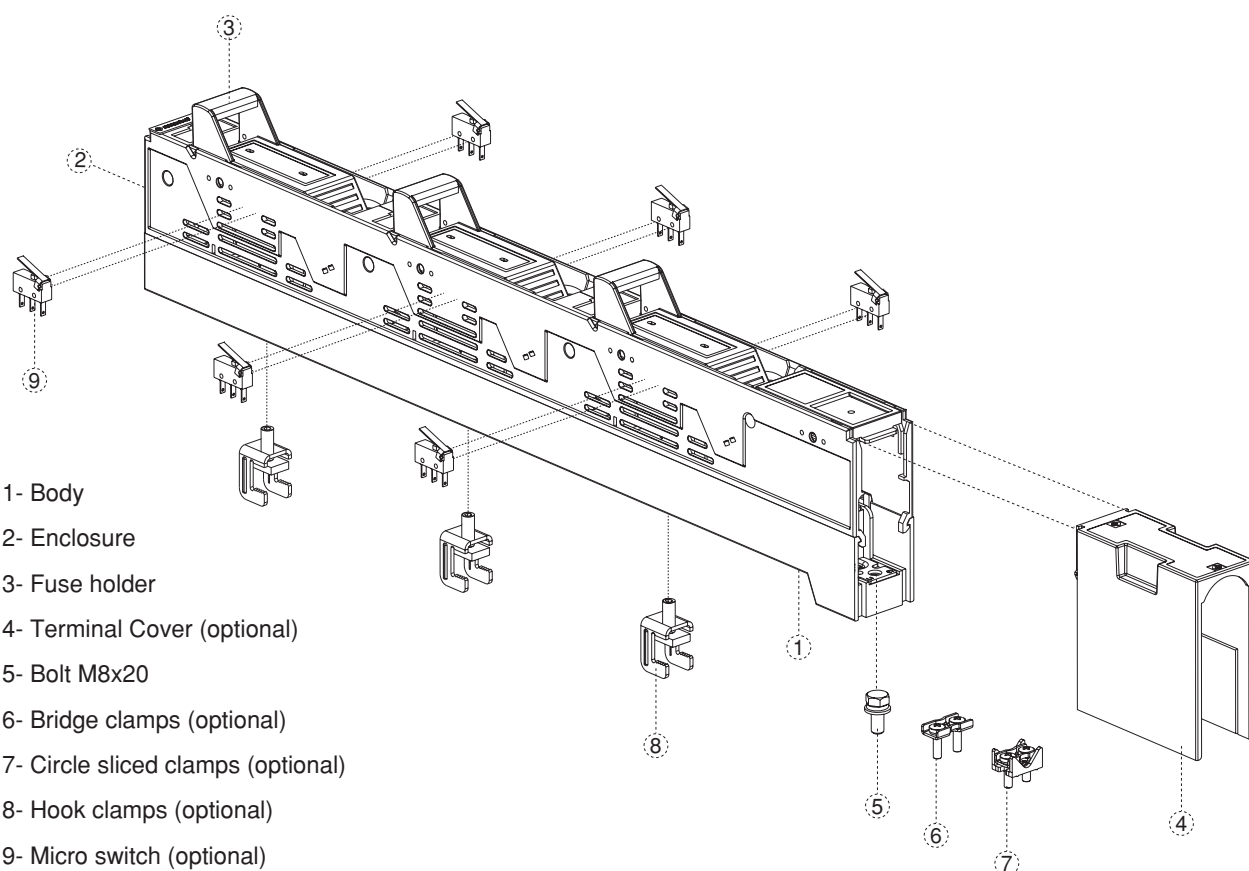
Fuse holder



Terminal cover



# VERTICAL TYPE FUSE SWITCH DISCONNECTOR



1- Body

2- Enclosure

3- Fuse holder

4- Terminal Cover (optional)

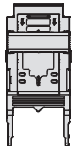
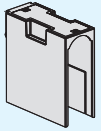



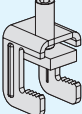

5- Bolt M8x20

6- Bridge clamps (optional)

7- Circle sliced clamps (optional)

8- Hook clamps (optional)

9- Micro switch (optional)

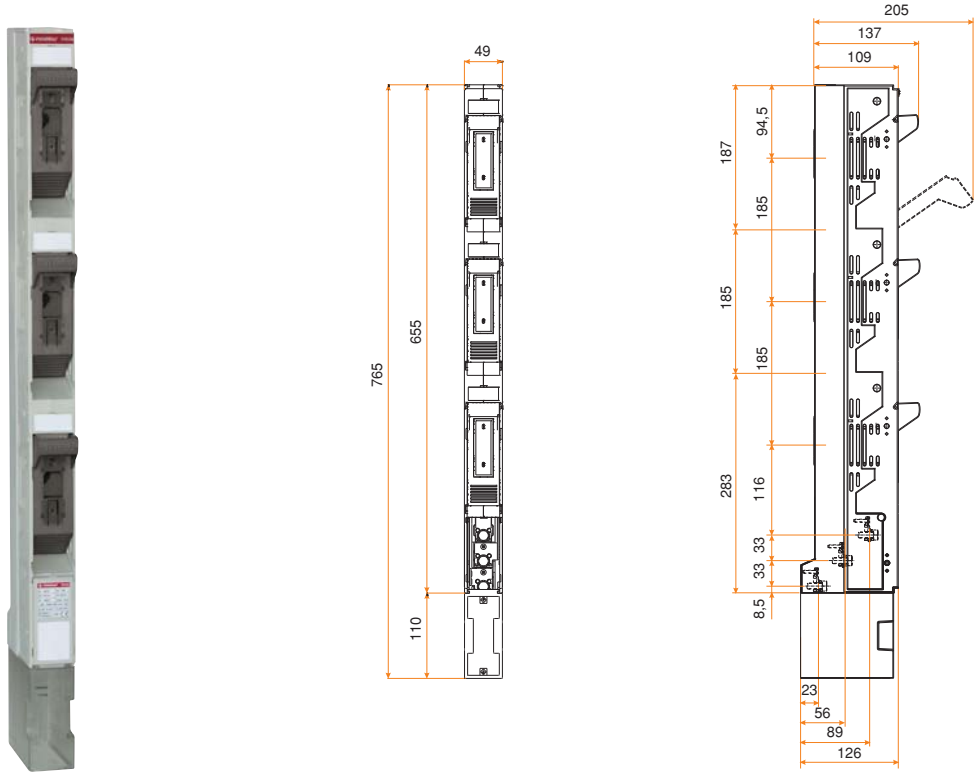
Accessories		Description	Type	Quantity (Pcs)	Order Code
Fuse holder		Insulates and cuts the contact with the base by inserting it inside the fuse.	FVS160 / 00	1	YP-069 (with three separate handle) YP-071 (with one handle)
			FVS250 / 1	1	YP-070 (separate opening) YP-073 (must open together)
			FVS400 / 2		
			FVS630 / 3		
Terminal cover		It is used to prevent touching through connection terminals.	FVS160 / 00	1	8BE-I0000-0000
			FVS250 / 1	1	8BE-J0000-0000
			FVS400 / 2		
			FVS630 / 3		
V clamps		It is used to connect bare-ended wires in the cross section of 35 - 240 mm <sup>2</sup> with one M16 bolt, V-shaped body and cable tightener.	FVS250 / 1 FVS400 / 2	1 1 1	YP-0096-Y
Bridge clamps		Used to connect wires with cross section between 4 to 70 mm <sup>2</sup> by two M5 bolts	FVS160 / 00	3	8BE-A0000-0000
Circle sliced clamps		Used to fix wire of sector shaped conductor with bore and cross-section 1,5 - 70 mm <sup>2</sup> by two M5 bolts.	FVS160 / 00	3	8BE-A0000-0001
Hook clamps		Used to assemble the body directly to the bar.	FVS160 / 00	3	8BE-A0000-0002
Micro switch		Used to control open and close position of fuse holder.	FVS160 / 00 FVS250 / 1 FVS400 / 2 FVS630 / 3	3 and 6	8BE-A0000-0003

# VERTICAL TYPE FUSE SWITCH DISCONNECTOR

## 160A Vertical Type Switch Fuses

Three phase can open individual.

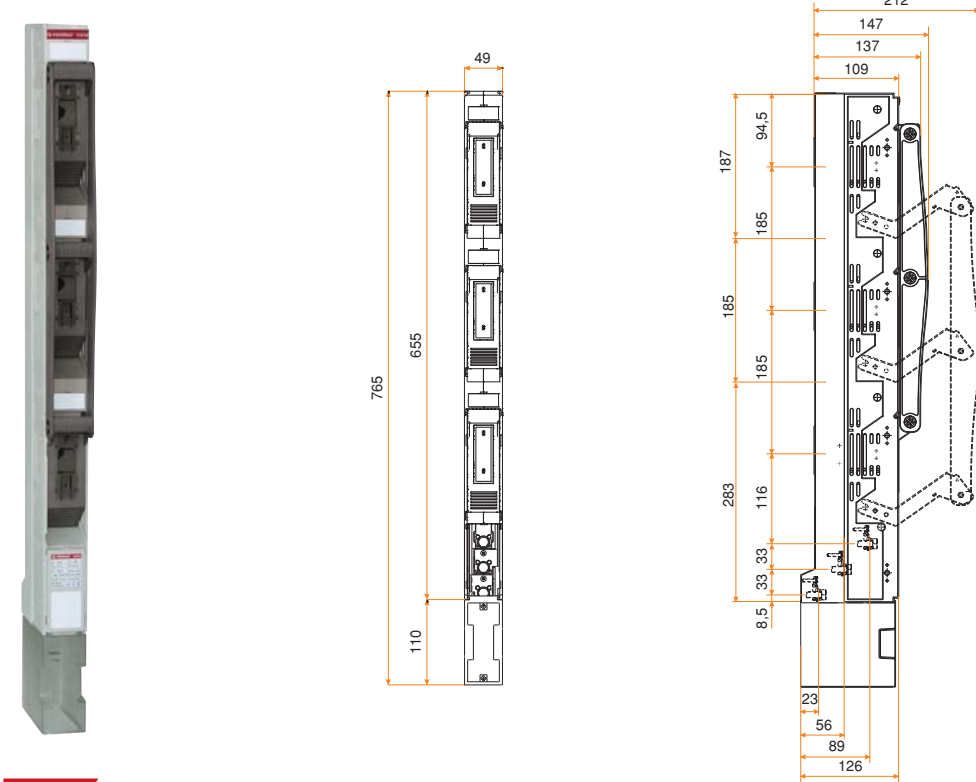
Type	Rated Current (A)	Product Structure	NH Fuse Type / Size	Order Code
FVS160	160A	Three phase can open individual.	NH00 / NH000	9BE-E1213-0160



## 160A Vertical Type Switch Fuses

Three phase can open together

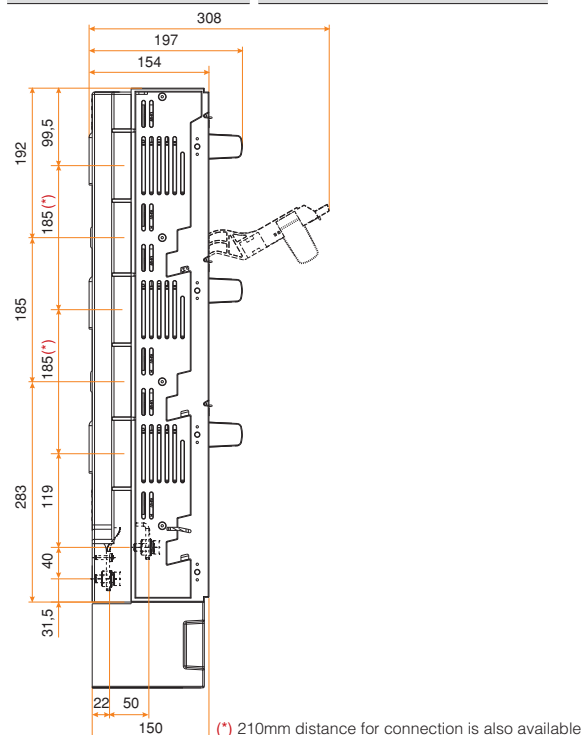
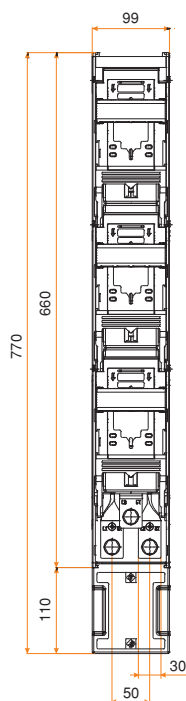
Type	Rated Current (A)	Product Structure	NH Fuse Type / Size	Order Code
FVS160	160A	Three phase can open together	NH00 / NH000	9BE-E1233-0160



# VERTICAL TYPE FUSE SWITCH DISCONNECTOR

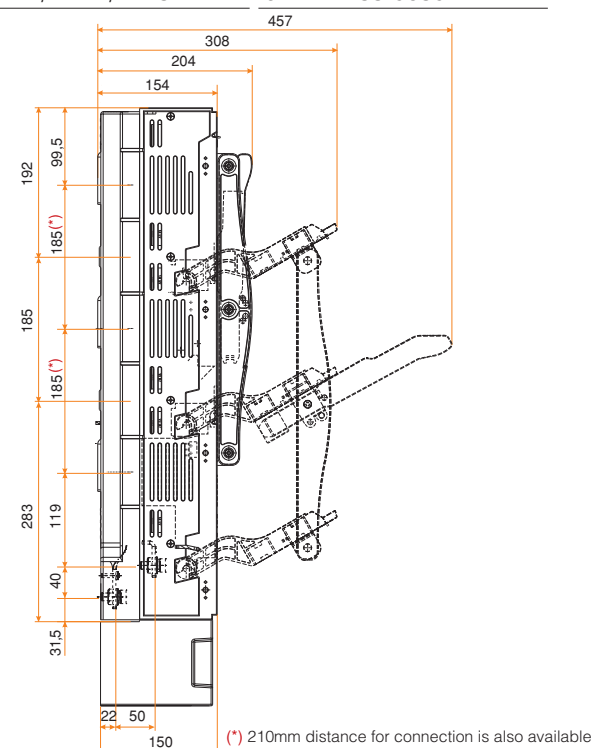
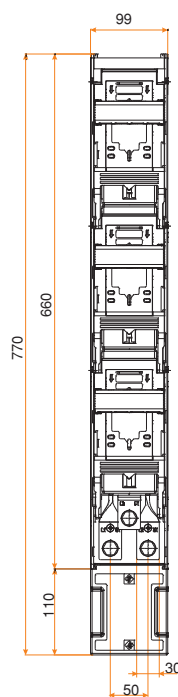
**250A - 400A - 630A Vertical Type Switch Fuses:** Three phase can open individual.

Type	Rated Current (A)	Product Structure	NH Fuse Type / Size	Order Code
FVS250	250	Three phase can open individual.	NH1 / NH2	9BE-E1213-0250
FVS400	400		NH1 / NH2 / NH3	9BE-E1213-0400
FVS630	630		NH1 / NH2 / NH3	9BE-E1213-0630
FVS800	800		NH1 / NH2 / NH3	9BE-E1213-0800
FVS1000	1000		NH1 / NH2 / NH3	9BE-E1213-1000
FVS1250	1250		NH1 / NH2 / NH3	9BE-E1213-1250



**250A - 400A - 630A Vertical Type Switch Fuses** Three phase can open together

Type	Rated Current (A)	Product Structure	NH Fuse Type / Size	Order Code
FVS250	250	Three phase can open together	NH1 / NH2	9BE-E1233-0250
FVS400	400		NH1 / NH2 / NH3	9BE-E1233-0400
FVS630	630		NH1 / NH2 / NH3	9BE-E1233-0630

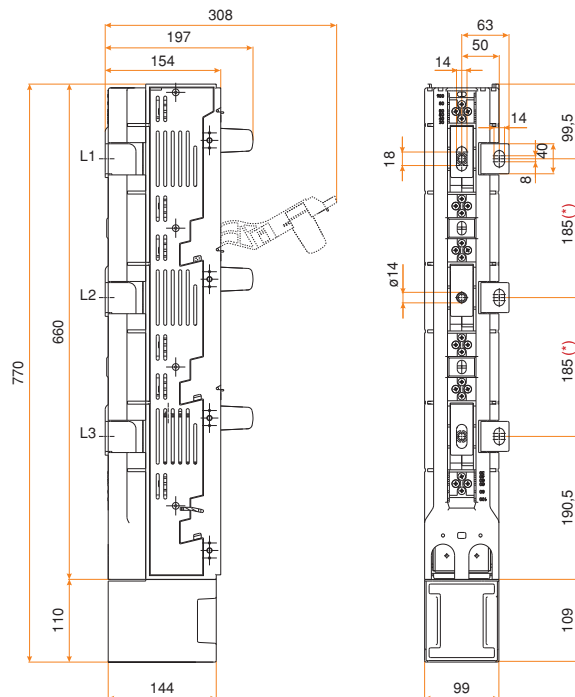


# VERTICAL TYPE FUSE SWITCH DISCONNECTOR

## 250A - 400A - 630A Vertical Type Switch Fuses

With left side output three phases can be opened separately

Type	Rated Current (A)	Product Structure	NH Fuse Type / Size	Order Code
FVS250-LS	250	With left side output three phases can be opened separately	NH1 / NH2	9BE-E4213-0250
FVS400-LS	400		NH1 / NH2 / NH3	9BE-E4213-0400
FVS630-LS	630		NH1 / NH2 / NH3	9BE-E4213-0630

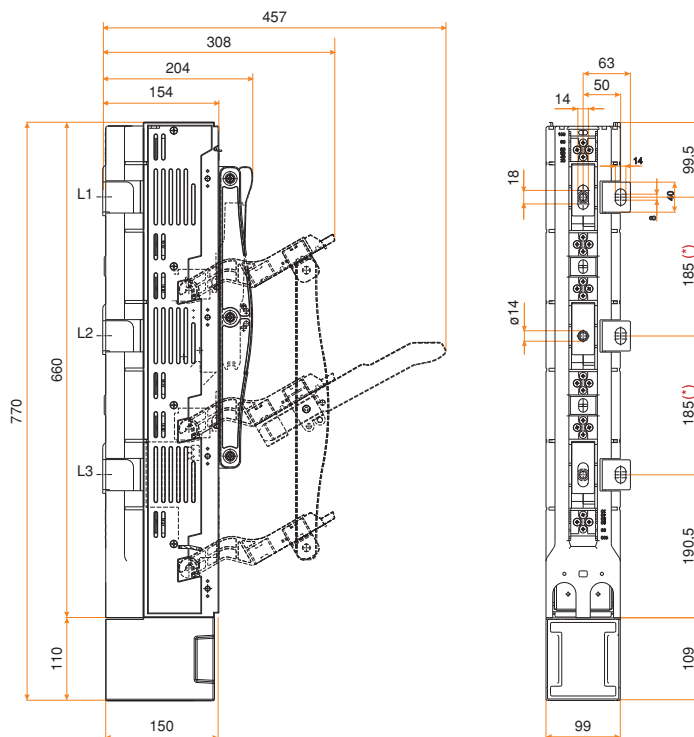


(\*) 210mm distance for connection is also available

## 250A - 400A - 630A Vertical Type Switch Fuses

With left side output three phases can be opened together

Type	Rated Current (A)	Product Structure	NH Fuse Type / Size	Order Code
FVS250-LS	250	With left side output three phases can be opened together	NH1 / NH2	9BE-E4233-0250
FVS400-LS	400		NH1 / NH2 / NH3	9BE-E4233-0400
FVS630-LS	630		NH1 / NH2 / NH3	9BE-E4233-0630



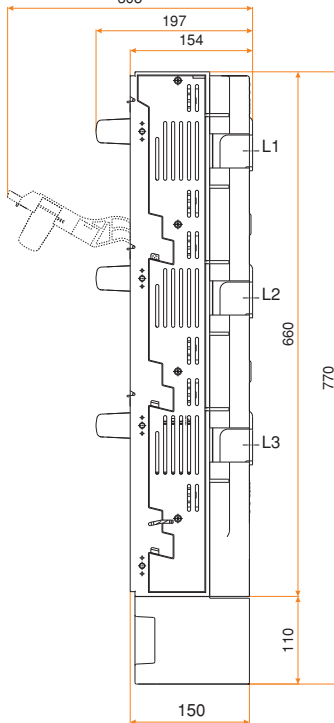
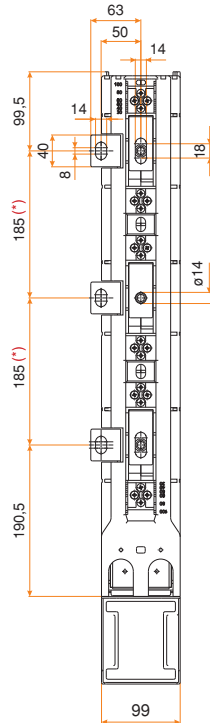
(\*) 210mm distance for connection is also available

# VERTICAL TYPE FUSE SWITCH DISCONNECTOR

## 250A - 400A - 630A Vertical Type Switch Fuses

With right side output single phase can be opened separately

Type	Rated Current (A)	Product Structure	NH Fuse Type / Size	Order Code
FVS250-RS	250	With right side output single phase can be opened separately	NH1 / NH2	9BE-E3213-0250
FVS400-RS	400		NH1 / NH2 / NH3	9BE-E3213-0400
FVS630-RS	630		NH1 / NH2 / NH3	9BE-E3213-0630

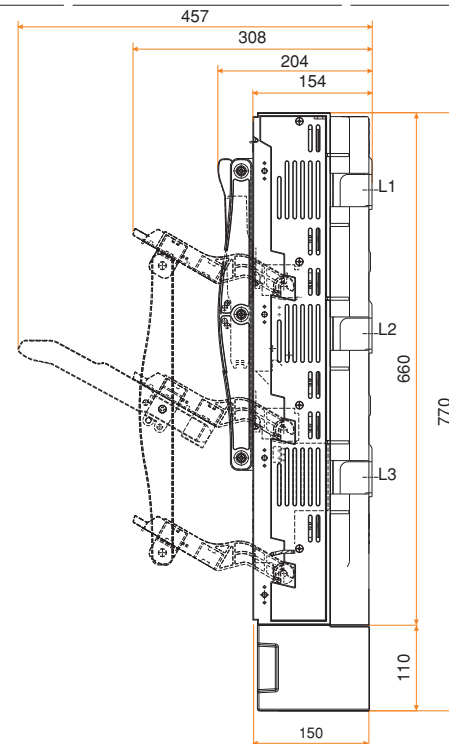
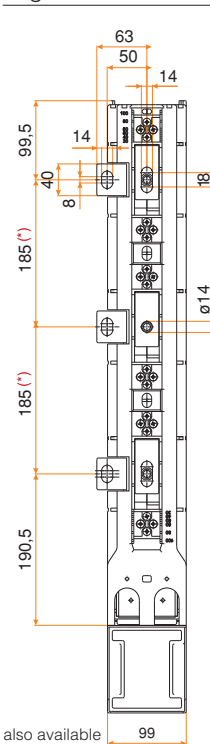


(\*) 210mm distance for connection is also available

## 250A - 400A - 630A Vertical Type Switch Fuses

With right side output single phase can be opened together

Type	Rated Current (A)	Product Structure	NH Fuse Type / Size	Order Code
FVS250-RS	250	With right side output single phase can be opened together	NH1 / NH2	9BE-E3233-0250
FVS400-RS	400		NH1 / NH2 / NH3	9BE-E3233-0400
FVS630-RS	630		NH1 / NH2 / NH3	9BE-E3233-0630

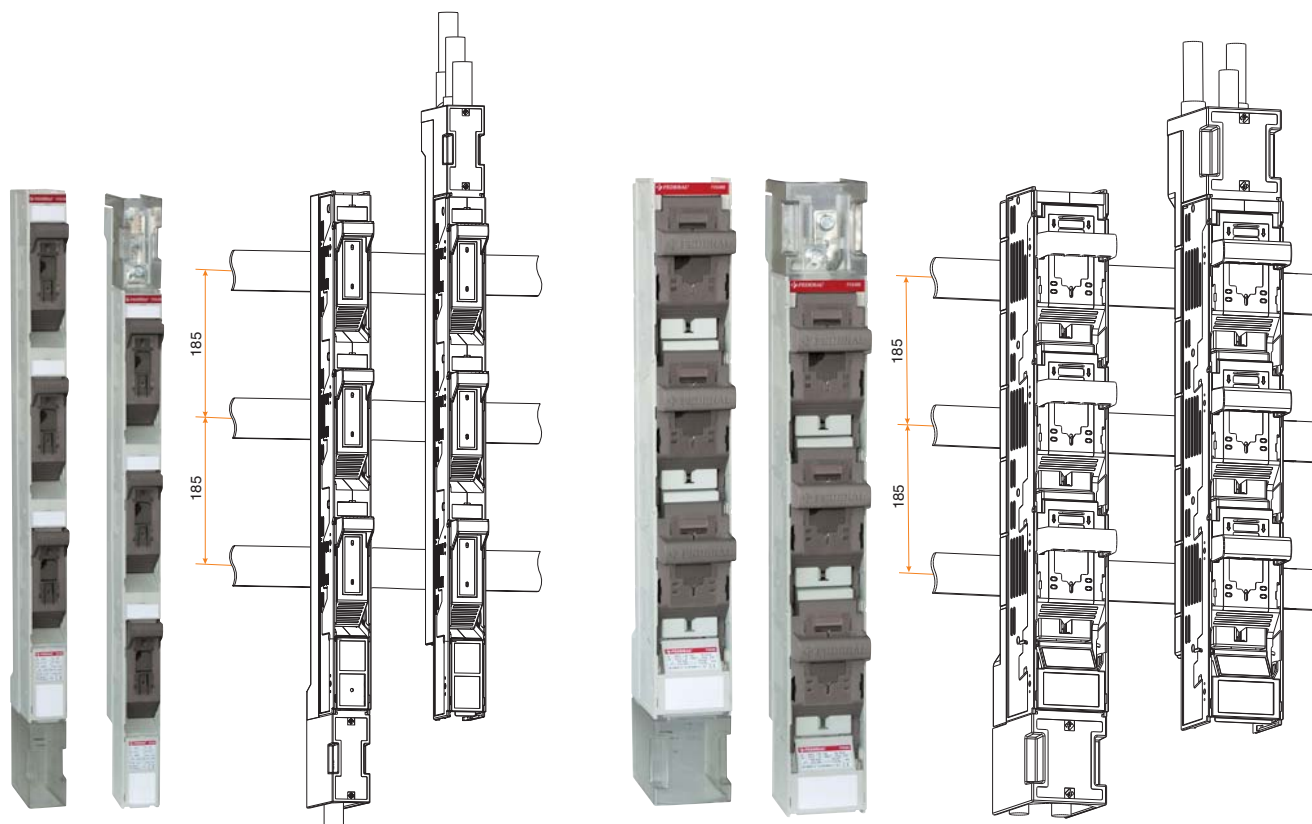


(\*) 210mm distance for connection is also available

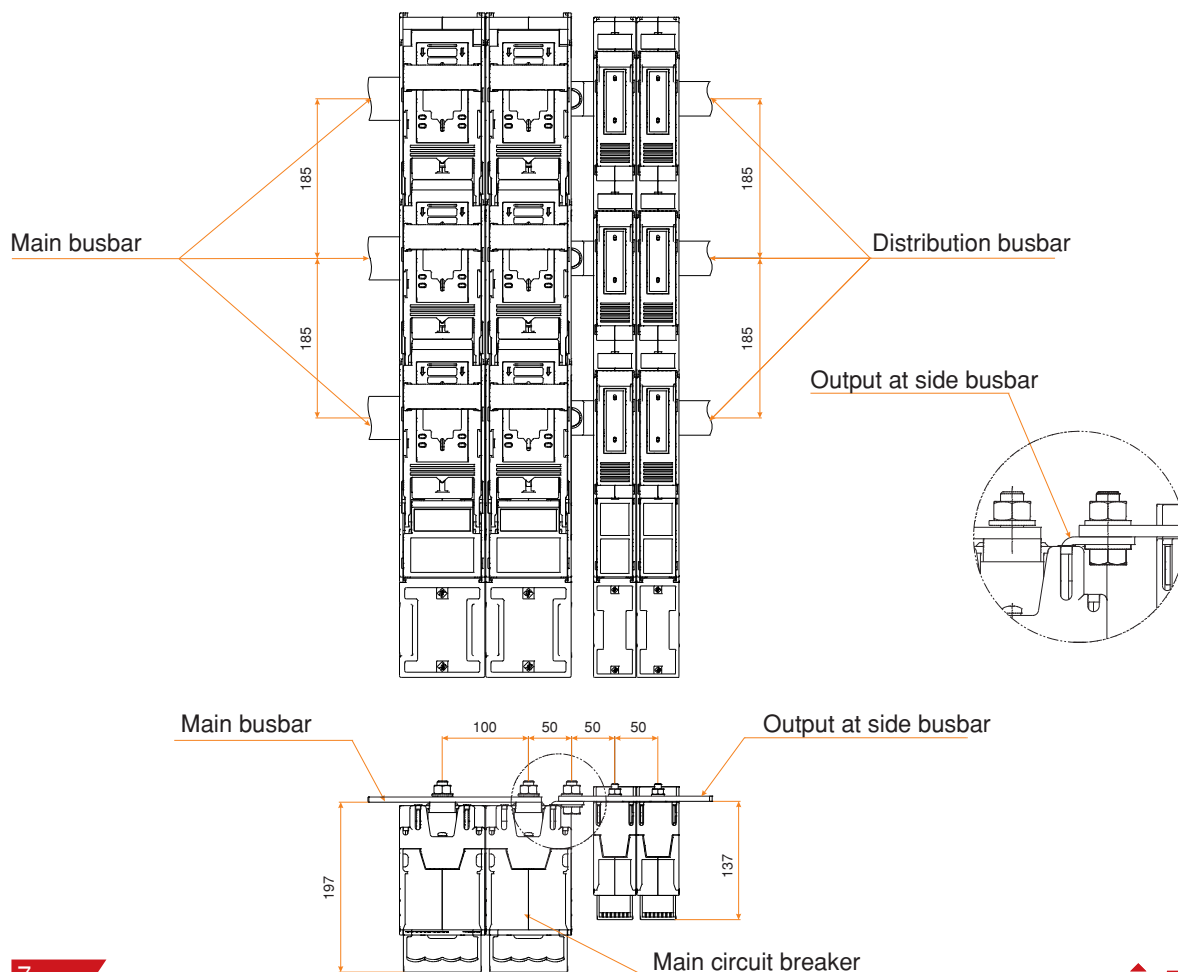
# VERTICAL TYPE FUSE SWITCH DISCONNECTOR

## Symmetrical Design

In case of cable input is from top side, Vertical Type Switch Fuse was design symmetrical as the body is suitable to turn 180°.



## Mounting Diagram for Vertical Type Switch Fuses With Outputs at Side





# VERTICAL TYPE FUSE SWITCH DISCONNECTOR

## Sealing Possibility

Sealing is possible in the aim of guarantee of fuse holder can not opened

## Additional Output Apparatus

Through the window capable to open and close placed on front of fuse holder, there is a possibility to get additional output as size 00 with optional additional output apparatus for necessary situation.

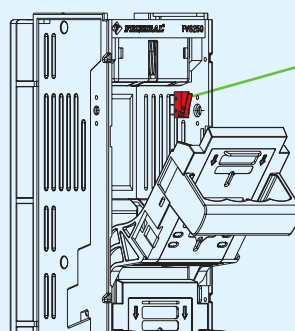
## Measurement under the voltage is possible.

Through the holes on the fuse holders, there is the possibility to measure under the voltage is possible.

## Sticker slot

Large sticker slot can be seen easily is placed on device when the device is mounted.

## Micro Switch



1 or 2 micro switch is available assembled to each phase is possible to control open and closed position of fuses holder.



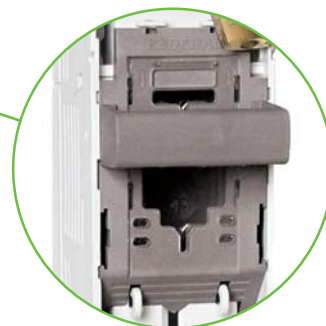
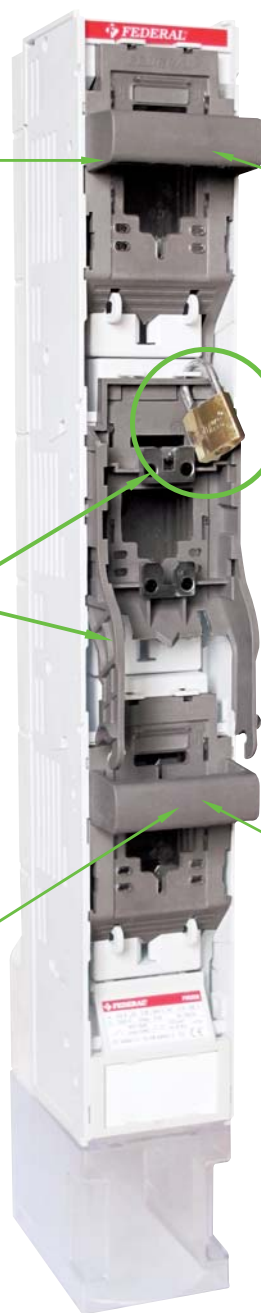


# VERTICAL TYPE FUSE SWITCH DISCONNECTOR

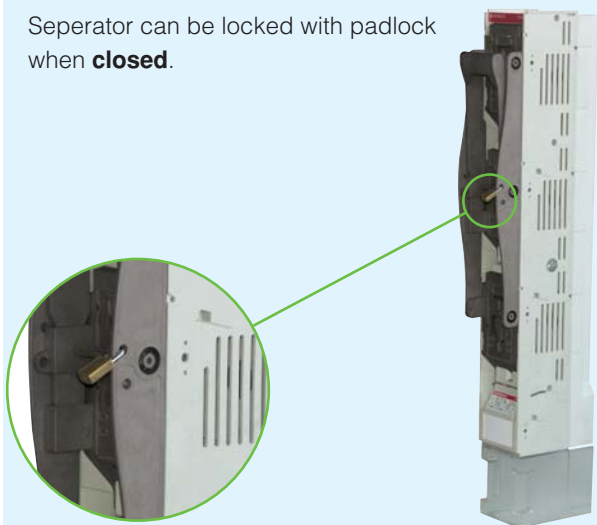
When the fuse holder arms are in closed position, they can be locked with the padlock.

The fuse holder arms can be locked with the padlock when parked (reverse).

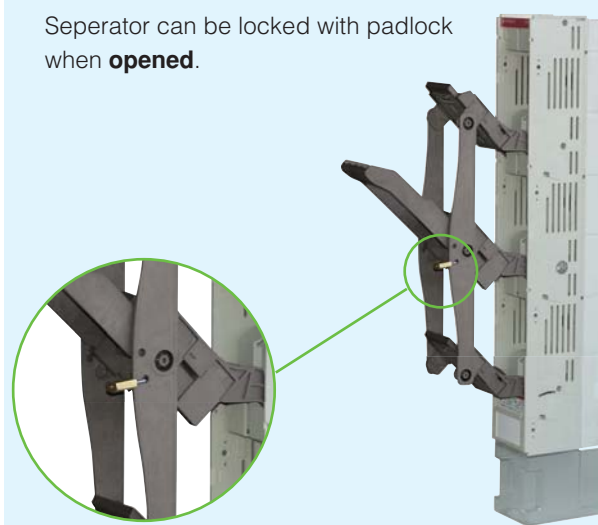
The fuse holder in the closed position is not affected by the fuse holder arm in the parking position when opening and closing the arm.



Seperator can be locked with padlock when **closed**.



Seperator can be locked with padlock when **opened**.



# VERTICAL TYPE FUSE SWITCH DISCONNECTOR



Type		FVS160	FVS250	FVS400	FVS630	FVS800	FVS1000	FVS1250
Conventional thermal current (Ith) 55 °C	A	160	250	400	630	800	1000	1250
Number of poles		3	3	3	3	3	3	3
Insulation voltage (Ui)	V	1000	1000	1000	1000	1000	1000	1000
Impulse withstand voltage (Uimp)	kV	12	12	12	12	12	12	12
Operational voltage (Ue) (50-60Hz) Utilization Category	400V	AC23B	AC23B	AC23B	AC22B	AC22B	AC22B	AC22B
	500V	AC22B	AC22B	AC22B	AC22B	AC22B	AC22B	AC22B
	690V	AC21B	AC21B	AC21B	AC21B	AC21B	AC21B	AC21B
Operational current (Ie)	A	160	250	400	630	800	1000	1250
Conditional short-circuit current (with NH Fuse) kA		85	85	85	70	85	70	70
Fuse type (dispatched without fuse)	NH	000,00	1,2	1,2	1,2,3	1,2	1,2,3	1,2,3
Mechanical durability	operation	> 30000	> 20000	> 20000	> 20000	> 20000	> 20000	> 20000
Electrical durability	operation	> 200	> 200	> 200	> 200	> 200	> 200	> 200
Connection conductor cross-section	mm <sup>2</sup>	70	120	240	2x185	2x240	4x150	4x185
Power loss per pole	W	9	11	19	36	40	46	75
Max- Min tightening torques	Nm	7..10	14..20	17..25	28..40	17..25	28..40	28..40
Hole diameter	Ø	M8	M10	M10	M12	M10	M12	M12
Distance between main busbar terminals	mm	185	185 - 210	185 - 210	185 - 210	185 - 210	185 - 210	185 - 210
Weight	kg	2,4	5,6	5,6	6,9	12	15	15
Protection Degree		IP20	IP20	IP20	IP20	IP20	IP20	IP20

**FVS 800A - 1000A - 1250A :** Vertical Switch fuses are parallel connected.

The designation of utilization categories is completed by the suffix A or B according to whether the intended applications require frequent or infrequent operations.

Utilization categories with suffix B are appropriate for devices which, due to design or application, are only intended for infrequent operation. This could apply, for example, to disconnectors normally only operated to provide isolation from maintenance work or switching devices where the fuse-link blade forms the moving contact.

Nature of current	Utilization Category		Typical Applications
	Category A	Category B	
Alternative Current	AC-20A <sup>a</sup>	AC-20B <sup>a</sup>	- Connecting and disconnecting under no-load conditions
	AC-21A	AC-21B	- Switching of resistive loads including moderate overload
	AC-22A	AC-22B	- Switching of mixed resistive and inductive loads, including moderate overloads.
	AC-23A	AC-23B	- Switching of motor loads or other highly inductive loads

<sup>a</sup> The use of these utilization categories is not permitted in the USA.

# VERTICAL TYPE FUSE SWITCH DISCONNECTOR

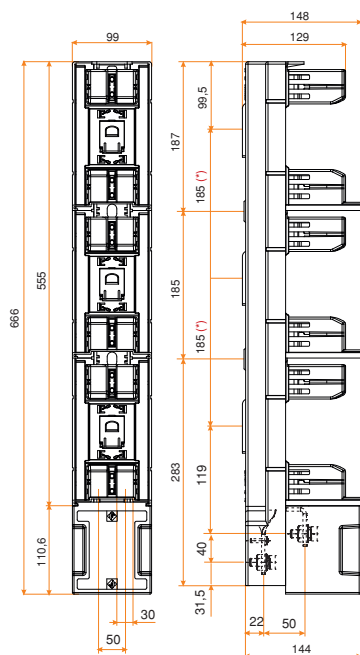
## VERTICAL TYPE FUSE RAIL

Federal Electric Vertical Type Fuse Rail have been designed in a manner that they can be easily and fast assembled vertically to the horizontal bus bars in 185 mm / 210 mm distances. The body material has been produced from fiberglass polyester resin (BMC) that belongs to thermoset material and its dielectric and mechanic features are very high. It is resistant to flame and heat. The contacts that are used in the fuse bases have been produced from electrolytic copper, and they have been covered with silver. The covers that take place in the front part and which prevents to contact to contacts, have been produced from polyamide material that is supported with fiberglass and whose exterior is resistant to heat and fire.



### Technical Features:

Tip		FVSB 200-250	FVSB 400	FVSB630
Conventional thermal current (Ith) 55 °C	A	250 / 200-250	400	630
Number of poles		3	3	3
Insulation voltage (Ui)	V	1000	1000	1000
Impulse withstand voltage (Uimp)	kV	12	12	12
Operational current (Ie)	A	200-250	400	630
Conditional short-circuit current (with NH Fuse)	kA	85	85	70
Fuse type (dispatched without fuse)	NH	1,2 / 1,2,3	1,2,3	1,2,3
Mechanical durability	operation	-	-	-
Electrical durability	operation	-	-	-
Connection conductor cross-section	mm <sup>2</sup>	95 -120	240	2x185
Power loss per pole	W	7- 11	19	36
Max- Min tightening torques	Nm	14..20	17..25	28..40
Hole diameter	Ø	M10	M10	M12
Distance between main busbar terminals	mm	185 - 210	185 - 210	185 - 210
Weight	kg	3	3,2	4,3
Protection Degree		IP20	IP20	IP20



# FUSE SWITCH DISCONNECTOR

## SINGLE POLE FUSE SWITCH DISCONNECTOR

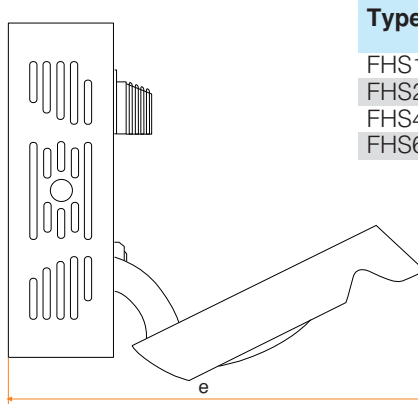
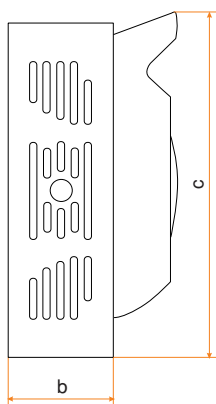
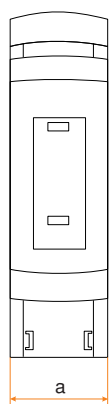


Single pole Fuse Switch Disconnectors are mainly used for disconnecting switch, emergency switching in inductive and capacitive characteristic AC system. They are very practical and safety products to sudden of and protect equipment & system, Single Pole Horizontal Disconnecting Switch is being produced according to IEC / EN60947-3 International Standard

Single Pole Horizontal Disconnecting Switch has feature by small design & dimensions, reliable and safety operation, convenient install/remove operation of fuse at small spaces. Single Pole Horizontal Disconnecting Switches provide high level protection for equipment and operators, have lowest power loss at each rated nominal current levels and high performance for energy efficiency.

Single Pole Horizontal Disconnecting Switches have half sealed structured body and cover. The Rated data, indicator status and fuse links can be observed from half transparent front cover. Single Pole Horizontal Disconnecting Switch products are produced for 160A-250A-400A and 630A series which are respectively compatible with NH00-NH1-NH2 and NH3 sizes fuse links.

Technical Features:		FHS1 160			FHS1 250			FHS1 400			FHS1 630		
Conventional thermal current (Ith)	A	160			250			400			630		
Number of poles		1			1			1			1		
Insulation voltage (Ui)	V	750			750			750			750		
Impulse withstand voltage (Uimp)	kV	8			8			8			8		
Frequency	Hz	50- 60			50- 60			50- 60			50- 60		
Operational voltage (Ue) (phase-neutral)	V	240	290	400	240	290	400	240	290	400	240	290	400
Utilization category		AC22B	AC22B	AC21B	AC22B	AC22B	AC21B	AC22B	AC22B	AC21B	AC22B	AC22B	AC21B
Operational current (Ie)	A	160			250			400			630		
Conditional short-circuit current (NH Fuse)kA		65			65			65			65		
Fuse type	NH	00 - 000			1			1 - 2			1 - 2 - 3		
Mechanical durability	operation	> 30000			> 20000			> 20000			> 20000		
Electrical durability	operation	200			200			200			200		
Connection conductor cross-section	mm <sup>2</sup>	70			120			240			2x185		
Power loss per pole	W	4			8			14			25		
Max- Min tightening torques	Nm	5..8			14..20			17..25			28..40		
Hole diameter	Ø	M6			M10			M10			M12		
Weight	kg	0,29			0,74			1,27			1,49		
Protection Degree		IP20			IP20			IP20			IP20		



Type	Dimensions (mm)			
	a	b	c	d
FHS160	40	47	175	205
FHS250	62	64	247	290
FHS400	90	87	280	340
FHS630	90	87	280	340

# FUSE SWITCH DISCONNECTOR



## FUSE SWITCH DISCONNECTOR:

Blade fused load cutters are produced in accordance with EN 60947-3 and in accordance with VDE and IEC from 160A to 630A. Blade fused load cutters Load cutters with fused fuses can be used both inside the panel and on the front face of the panel. It is possible to use the same switch in a versatile way because it allows circuit protection at the rated current or operation class by changing the fuse with a knife depending on the current and load change.

In order ensure a long durability lifespan, the Fuse Switch Disconnectors are manufactured with reinforced thermoplastic materials and flame retardant. Additionally, the feature contacts with silver coating, providing low power losses.

### General Features:

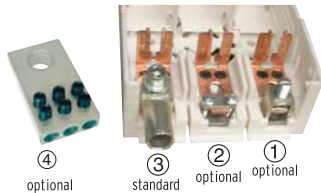
- IP20 protection degree
- Micro auxiliary switches. 1 or 2 pcs (accessory)
- Panelboard product labeling
- NH hole registered to overhead test
- Ergonomic and large holding surface
- Small volume
- Easy assembling
- Large safety distance between fuse links
- Modern and functional design
- Easy to operate
- Terminal cover according to different cable sector
- Suitable design for adding additional separator
- Protection of plastic to be deformed under overload condition.

① Clamp terminal (optional)

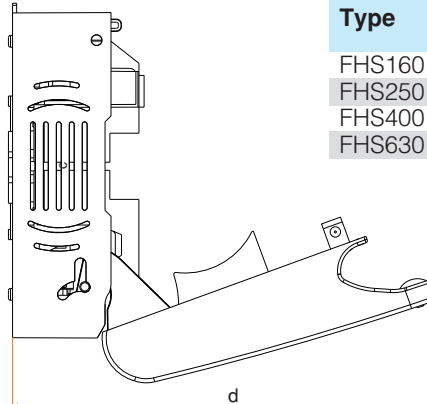
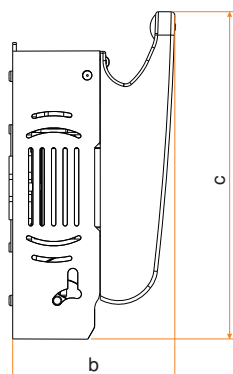
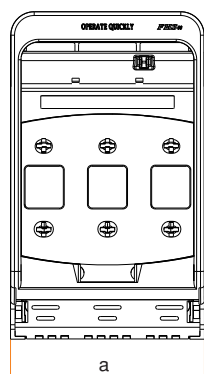
② Bridge Clamp (optional)

③ Available for cable lugs, screw and bolt connection (standard)

④ Braas clamp (optional)



		FHS 160			FHS 250			FHS 400			FHS 630		
Conventional thermal current (I <sub>th</sub> )	A	160			250			400			630		
Number of poles		3			3			3			3		
Insulation voltage (U <sub>i</sub> )	V	750			750			750			750		
Impulse withstand voltage (U <sub>imp</sub> )	kV	8			8			8			8		
Frequency	Hz	50- 60			50- 60			50- 60			50- 60		
Operational voltage (U <sub>e</sub> ) (phase-phase)	V	400	500	690	415	500	690	415	500	690	415	500	690
Utilization category		AC23B	AC22B	AC21B	AC22B	AC22B	AC21B	AC22B	AC22B	AC21B	AC22B	AC22B	AC21B
Operational current (I <sub>e</sub> )	A	160	160	125	250	250	200	400	400	315	630	630	500
Conditional short-circuit current (NH Fuse) kA		70	70	70	70	70	70	70	70	70	70	70	70
Fuse type	NH	00-000			1			1 - 2			1 - 2 - 3		
Mechanical durability	operation	>20000			> 20000			> 20000			> 20000		
Electrical durability	operation	200			200			200			200		
Connection conductor cross-section	mm <sup>2</sup>	70			120			240			2x185		
Power loss per pole	W	4			8			14			25		
Max- Min tightening torques	Nm	7..10			14..20			17..25			28..40		
Hole diameter	Ø	M8			M10			M10			M12		
Weight	kg	0,70			1,51			3,27			3,85		
Protection Degree		IP20			IP20			IP20			IP20		



Type	Dimensions (mm)			
	a	b	c	d
FHS160	106,5	89	180	205,7
FHS250	187	112	238	285
FHS400	250	137	275	340
FHS630	250	137	275	340

# LOAD BREAK SWITCHES WITH and WITHOUT FUSE



IEC / EN 60947-3

CE

**Mounting Position** : At any angle  
**Altitude** : 2000 m (max)  
**Relative Humidity** : 90% (55°C)  
**Ambient Temperature** : between -25°C and +60°C  
**Pollution Degree** : III  
**Protection Degree** : IP00  
**Utilization Category** : AC 23A (160...630), AC 22A (1000), AC 21A (2000)

All these given information are general. We have always right to change them.

## Load Break Switches With Fuse



**FSF 160**

NH00 / 160A



**FSF 250 - FSF 400**

NH1 / 250A  
NH2 / 400A



**FSF 630**

NH3 / 630A



## Load Break Switches Without Fuse



**FLS 160**

160A



**FLS 250 - FLS 400**

250A  
400A



**FLS 630**

630A



**FLS 800 - FLS 1000 - FLS 1250  
FLS 1600 - FLS 1800 FLS 2000**

800A 1800A  
1000A 2000A  
1250A  
1600A



**Changeover Isolation Switch**

160A 1800A  
250A 2000A  
400A  
630A  
800A  
1000A  
1250A  
1600A



# LOAD BREAK SWITCHES WITH and WITHOUT FUSE

Rotating contact system (for 250A, 400A, 630A)

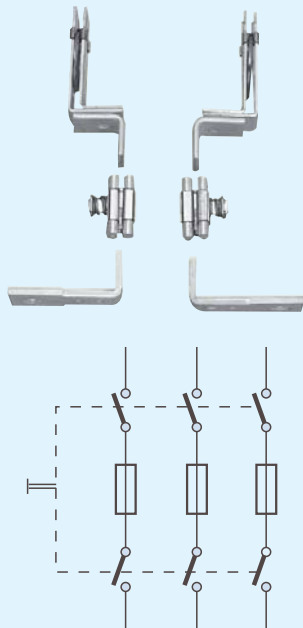


Fig - 1

Load break switches are manufactured in accordance with CE, according to EN 60947-3, IEC 60947-3 standards, in compliance with AC 23 class. They are safely used for switching purposes in motor circuits and AC-DC systems.

## Features:

- High breaking capacity
- High electrical and mechanical resistance
- Frictional and rotating contact system with self-repair capability
- Breaking at two separate points on each phase
- Modern technology and compact design
- Fast opening-closing operation independent from manual movements
- Small size
- Flame and heat resistant body made of thermoset material
- Assembly in panel at the back or on the front
- Control shaft length adjustable according to panel depth
- Locking feature

## Contacts:

Load separators consist of fixed contact knives, which are placed in the complete unit, and particular contact system. With this system, breaking energy is divided among contacts. Thanks to division of energy among contacts and arc extinction elements in load breaking cells, burning on contact surface has been minimized. Low burning extends contact life. There is frictional contact system in 160A separators and rotating contact system in other large-sized load break switches.

Frictional and rotating contact systems ensure a clean and healthy contact in each opening-closing. With the special spring system, transition resistance and energy losses in contacts have been minimized. Current is broken at four points in each phase in the separator. This feature both increases current breaking capacity of the separator and separates the plugs from the circuit at both ends. In this way, plugs separated from the circuit at both ends are replaced in a safe manner (Figure-1).

## Safety:

- Control lever is mechanically locked in "I" position. Therefore, panel cannot be opened when there is energy in the load break switches.
- When there is no energy in the load break switches, that is in "0" position, control lever can be locked with padlock and unauthorized energy supply can be prevented (Figure - 1).

- Heat and flame resistant, no-water absorbing materials are used in load break switch body and insulating parts. Body material is made of fiber-glass polyester resin and has high dielectric and mechanical features.

- Insulation distance between phases is quite wide against any possible jump. However, additional separators have been placed in types with fuse to provide better insulation and protection against possible contacts.

## Opening - closing mechanism and control lever:

Opening-closing mechanism allows simultaneous and fast operation of all poles. Opening-closing speed is independent from manual movement. Control lever is doweled type and its length can be adjusted to desired panel depth. Position of the separator can be easily seen thanks to indicator plate and control lever. Control lever changes 90° between open - closed positions of the load break switch.

- The current break at 4 different points in rotating contact system. In this way, both breaking capacity is increased and plugs are completely separated from the circuit while the load break switch is open.

- A fast opening-closing operation is ensured thanks to springs in the mechanism.

- There are arc extinction elements in load breaking cells.

## Body composition:

- Fiber-glass polyester resin has been used as the body and cover material in accordance with EN 60512-20-2 standard (BMC).

- Connection busbars are coated with silver. In this way, oxidation is avoided. In fact, silver is oxidized like other metals. However, when silver oxide is heated, it instantly becomes conductive.

- It occupies less space in panels, since it has fuse plugs on it and small sizes.

- There are separators made of heat resistant (polycarbonate or BMC) materials for insulation among phases.

The requirements for uninterruptable energy source in Industry is getting more important every passing day. Either Production loss caused by energy breaks or loss caused from barrier to use alternative energy source during any maintenance are very important. These kind of loss are more important at critical facilities such airport and hospitals. In any case of problem of main power supply or required maintenance, Change-over isolation switches safely provide taking alternative energy source on operation and without risk of short circuit.

Locking with padlock at "0" position



Pic - 1



Fig - 2

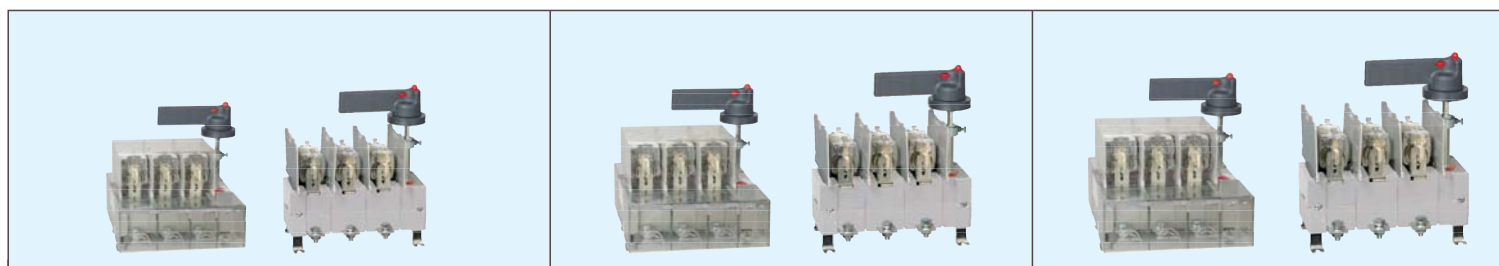
Terminal protective load break switch with fuse

Federal Electric load break switches are quite useful compact devices with capability of breaking at two separate points on the same phase with sudden opening-closing. They provide space economy in tables and panels they are used.



# LOAD BREAK SWITCHES WITH and WITHOUT FUSE



## LOAD BREAK SWITCH WITH FUSE



### Technical Specifications

TYPE		FSF 160			FSF 250			FSF 400			FSF 630		
Conventional Thermal Current (I <sub>th</sub> )	60°C A	160			250			400			630		
Number of Poles		3 - 4			3 - 4			3 - 4			3 - 4		
Insulation Voltage (U <sub>i</sub> )	V	1000			1000			1000			1000		
Impulse Withstand Voltage (U <sub>imp</sub> )	V	8			8			8			8		
Operational Voltage (U <sub>e</sub> ) (phase-phase)	kV	400	500	690	400	500	690	400	500	690	400	500	690
Utilization Category		AC23A	AC23A	AC23A	AC23A	AC23A	AC23A	AC23A	AC23A	AC23A	AC23A	AC23A	AC23A
Operational Current (I <sub>e</sub> )	A	160	160	125	250	250	200	400	400	315	630	630	500
Conditional Short - Circuit Current (with NH Fuse)	kA	65			65			65			65		
Short Time Withstand	kA	-			-			-			-		
Fuse Type (Dispatched Without Fuse)	NH	000, 00			1,2			1,2			1,2		
Mechanical Durability	Operation	>10.000			>10.000			>10.000			>8000		
Electrical Durability	Operation	>1000			>1000			>1000			>1000		
Connection Conductor Cross - Section	mm <sup>2</sup>	70			120			240			2x185		
Power Loss Per Pole	W	12			25			35			65		
Max - Min Tightening Torques	Nm	7-10			14-20			17-25			28-40		
Hole Diameter	Ø	M8			M10			M10			M12		
Distance Between Main Busbar Terminals	mm	-			-			-			-		
Weight	Kg	2,6 - 2,9			4,2 - 4,6			4,3 - 4,7			9,6 - 10,1		

### Order Codes

	Number of Poles	Type	Rated Current (A)	Order Code
	3,4	FSF 160	160	9BB-S110□-0160
		FSF 250	250	9BC-S110□-0250
		FSF 400	400	9BC-S110□-0400
		FSF 630	630	9BD-S110□-0630
Load Breakers with Terminal Cover				
	3,4	FSF 160	160	9BB-S111□-0160
		FSF 250	250	9BC-S111□-0250
		FSF 400	400	9BC-S111□-0400
		FSF 630	630	9BD-S111□-0630

□ field is for writing number of poles (3 or 4). Load break switch with fuse are dispatched without NH fuse.

# LOAD BREAK SWITCHES WITH and WITHOUT FUSE

## LOAD BREAK SWITCH WITHOUT FUSE




### Technical Specifications

TYPE		FLS 160			FLS 250			FLS 400			FLS 630		
Conventional Thermal Current (Ith)	60°C A	160			250			400			630		
Number of Poles		3 - 4			3 - 4			3 - 4			3 - 4		
Insulation Voltage (Ui)	V	1000			1000			1000			1000		
Impulse Withstand Voltage (Uimp)	kV	8			8			8			8		
Operational Voltage (Ue) (phase-phase)	V	400	500	690	400	500	690	400	500	690	400	500	690
Utilization Category		AC23A	AC23A	AC23A	AC23A	AC23A	AC23A	AC23A	AC23A	AC23A	AC23A	AC23A	AC23A
Operational Current (Ie)	A	160	160	125	250	250	200	400	400	315	630	630	500
Conditional Short - Circuit Current (with NH Fuse)	kA	65			65			65			65		
Short Time Withstand	kA	8			15			18			25		
Fuse Type (Dispatched Without Fuse)	NH	-			-			-			-		
Mechanical Durability	Operation	>10.000			>10.000			>10.000			>8000		
Electrical Durability	Operation	>1000			>1000			>1000			>1000		
Connection Conductor Cross - Section	mm <sup>2</sup>	70			120			240			2x185		
Power Loss Per Pole	W	12			25			35			65		
Max - Min Tightening Torques	Nm	7-10			14-20			17-25			28-40		
Hole Diameter	Ø	M8			M10			M10			M12		
Distance Between Main Busbar Terminals	mm	-			-			-			-		
Weight	Kg	2,4 - 2,7			3,8 - 4,2			3,9 - 4,3			9 - 9,5		

Rated Breaking Capacity : 8xle for AC23A, 3xle for AC22A, 1,5xle for AC21A, 1,5xle for AC21B.

Rated Closing Capacity : 10xle for AC23A, 3xle for AC22A, 1,5xle for AC21A, 1,5xle for AC21B.

### Order Code

	Number of Poles	Type	Rated Current (A)	Order Code
 <p>3 pole                      4 pole</p> <p>□ field is for writing number of poles (3 or 4).</p>	3,4	FLS 160	160	9BB-L110□-0160
		FLS 250	250	9BC-L110□-0250
		FLS 400	400	9BC-L110□-0400
		FLS 630	630	9BD-L110□-0630
		FLS 800	800	9BD-L1103-0800
		FLS 1000	1000	9BD-L1103-1000
	3	FLS 1250	1250	9BD-L1103-1250
		FLS 1600	1600	9BD-L1103-1600
		FLS 1800	1800	9BD-L1103-1800
		FLS 2000	2000	9BD-L1103-2000

# LOAD BREAK SWITCHES WITH and WITHOUT FUSE

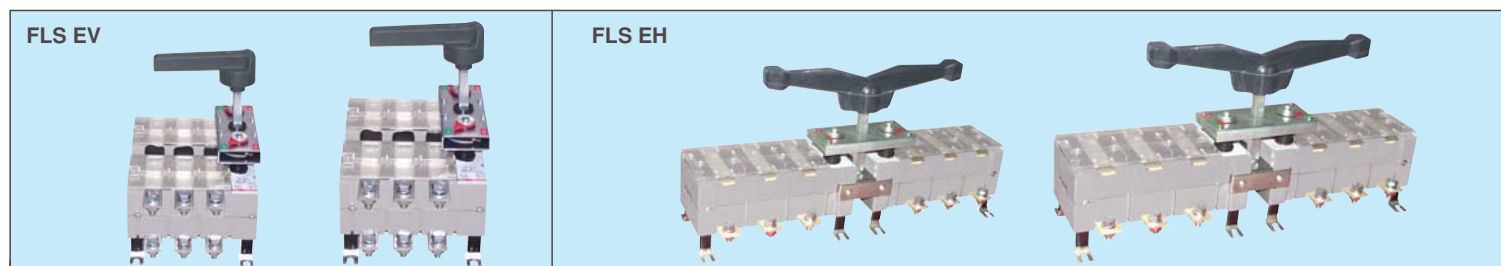
## LOAD BREAK SWITCH WITHOUT FUSE



FLS 800			FLS 1000			FLS 1250			FLS 1600			FLS 1800			FLS 2000		
800			1000			1250			1600			1800			2000		
3 - 4			3 - 4			3 - 4			3 - 4			3			3		
1000			1000			1000			1000			1000			1000		
8			8			8			8			8			8		
400	500	690	400	500	690	400	500	690	400	500	690	400	500	690	400	500	690
AC22A	AC22A	AC22A	AC22A	AC22A	AC22A	AC22A	AC21A	AC21A	AC21B	AC21B	AC21B	AC21B	AC21B	AC21B	AC21B	AC21B	AC21B
800	800	630	1000	1000	800	1250	1250	1000	1600	1600	1250	1800	1800	1600	2000	2000	1750
65			65			65			65			65			65		
35			35			35			35			35			35		
-			-			-			-			-			-		
>8000			>8000			>8000			>8000			>8000			>8000		
>500			>500			>500			>200			>150			>150		
2x240			40x15			2x(40x10)			2x(50x10)			3x(50x10)			3x(50x10)		
55			80			125			165			210			260		
28-40			28-40			28-40			28-40			28-40			28-40		
M12			M12			M12			M12			M12			M12		
-			-			-			-			-			-		
12,5 - 13			12,6 - 13,1			13 - 13,5			13,2 - 13,7			14			14		

# LOAD BREAK SWITCHES WITH and WITHOUT FUSE

## CHANGEOVER ISOLATION SWITCH (VERTICAL / HORIZONTAL INSTALLED)

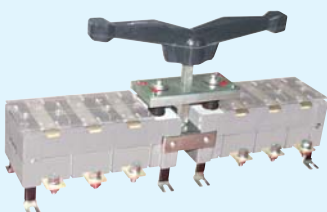


### Technical Specifications

TYPE		FLS 160EV / EH			FLS 250EV / EH			FLS 400EV / EH			FLS 630EV / EH		
Conventional Thermal Current (Ith)	60°C A	160			250			400			630		
Number of Poles		3 - 4			3 - 4			3 - 4			3 - 4		
Insulation Voltage (Ui)	V	1000			1000			1000			1000		
Impulse Withstand Voltage (Uimp)	kV	8			8			8			8		
Operational Voltage (Ue) (phase-phase)	V	400	500	690	400	500	690	400	500	690	400	500	690
Utilization Category	EV	AC22A	AC22A	AC22A	AC22A	AC22A	AC22A	AC22A	AC22A	AC22A	AC22A	AC22A	AC22A
	EH	AC23A	AC23A	AC23A	AC23A	AC23A	AC23A	AC23A	AC23A	AC23A	AC23A	AC23A	AC23A
Operational Current (Ie)	A	160	160	125	250	250	200	400	400	315	630	630	500
Conditional Short - Circuit Current (with NH Fuse)	kA	65			65			65			65		
Short Time Withstand	kA	8			8 / 15			15 / 18			15 / 25		
Fuse Type (Dispatched Without Fuse)	NH	-			-			-			-		
Mechanical Durability	Operation	>10.000			>10.000			>10.000			>10.000 / 8000		
Electrical Durability	Operation	>1000			>1000			>1000			>1000		
Connection Conductor Cross - Section	mm²	70			120			240			2x185		
Power Loss Per Pole	W	9 / 12			12 / 25			25 / 35			47 / 65		
Max - Min Tightening Torques	Nm	7-10			7-10 / 14-20			17-25			17-25 / 28-40		
Hole Diameter	Ø	M8			M8 / M10			M10			M10 / M12		
Distance Between Main Busbar Terminals	mm	-			-			-			-		
Weight	Kg	EV			5,8 - 6,4			6 - 6,8			9,2 - 10		
		EH			5,8 - 6,4			9 - 9,8			9,2 - 10		

Rated Breaking Capacity : 8xle for AC23A, 3xle for AC22A, 1,5xle for AC21A, 1,5xle for AC21B.  
 Rated Closing Capacity : 10xle for AC23A, 3xle for AC22A, 1,5xle for AC21A, 1,5xle for AC21B.

### Order Codes:

	Number of Pole	Type	Rated Current (A)	Order Code
	3,4	FLS 160EH	160	9BG-GS71□-0160
		FLS 250EH	250	9BG-GS71□-0250
		FLS 400EH	400	9BG-GS71□-0400
		FLS 630EH	630	9BG-GS71□-0630

□ field is for writing number of poles (3 or 4).

# LOAD BREAK SWITCHES WITH and WITHOUT FUSE

## CHANGEOVER ISOLATION SWITCH (VERTICAL INSTALLED)



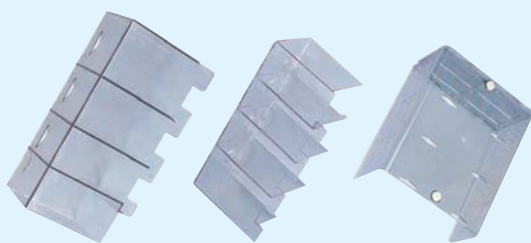
FLS 800EV			FLS 1000EV			FLS 1250EV			FLS 1600EV			FLS 1800EV			FLS 2000EV		
800			1000			1250			1600			1800			2000		
3 - 4			3 - 4			3 - 4			3 - 4			3			3		
1000			1000			1000			1000			1000			1000		
8			8			8			8			8			8		
400	500	690	400	500	690	400	500	690	400	500	690	400	500	690	400	500	690
AC22A	AC22A	AC22A	AC22A	AC22A	AC22A	AC22A	AC21A	AC21A	AC21B	AC21B	AC21B	AC21B	AC21B	AC21B	AC21B	AC21B	AC21B
-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
800	800	630	1000	1000	800	1250	1250	1000	1600	1600	1250	1800	1800	1600	2000	2000	1750
65			65			65			65			65			65		
35			35			35			35			35			35		
-			-			-			-			-			-		
>8000			>8000			>8000			>8000			>8000			>8000		
>500			>500			>500			>200			>150			>150		
2x240			40x15			2x(40x10)			2x(50x10)			3x(50x10)			3x(50x10)		
55			80			125			165			210			260		
28-40			28-40			28-40			28-40			28-40			28-40		
M12			M12			M12			M12			M12			M12		
-			-			-			-			-			-		
26 - 27			26,2 - 27,2			27 - 28			27,4 - 28,4			29			29		
-			-			-			-			-			-		

### Order Codes:

	Number of Pole	Type	Rated Current (A)	Order Code
	3,4	FLS 160EV	160	9BG-GS70□-0160
		FLS 250EV	250	9BG-GS70□-0250
		FLS 400EV	400	9BG-GS70□-0400
		FLS 630EV	630	9BG-GS70□-0630
		FLS 800EV	800	9BG-GS703-0800
		FLS 1000EV	1000	9BG-GS703-1000
	3	FLS 1250EV	1250	9BG-GS703-1250
		FLS 1600EV	1600	9BG-GS703-1600
		FLS 1800EV	1800	9BG-GS703-1800
		FLS 2000EV	2000	9BG-GS703-2000

□ field is for writing number of poles (3 or 4).

# LOAD BREAK SWITCHES WITH and WITHOUT FUSE



**Pic - 2** Terminal protective cover

## Accessories

- Auxiliary contact block: 1NO + 1NC, 2NO + 2 NC
- Terminal protective cover (Pic-2)
- Special lock and padlock system
- Cage type connector

**Note:** Terminal protective cover provides safe insulation in accordance with EN norms, by avoiding had contact of cable connection terminals and fuse connection sections of load separators.

## Terminal protective cover order codes:

Type	Order Code
FSF160	8BA-G0000-0000
FSF250-400	8BB-G0000-0000
FSF630	8BD-G0000-0000
FLS160	8BA-H0000-0000
FLS250-400	8BB-H0000-0000
FLS630-800-1000-1250-1600-1800-2000	8BD-H0000-0000

## Top coating plate order codes:

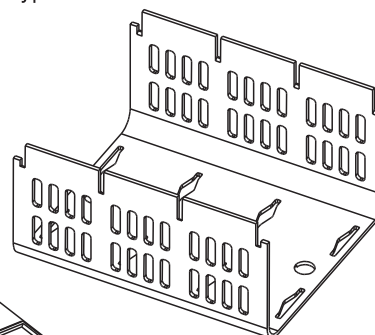
Type	Order Code
FLS160	8BA-D0000-0000
FLS250-400	8BB-D0000-0000
FLS630-800-1000-1250-1600-1800-2000	8BC-D0000-0000

## Auxiliary Contact Block

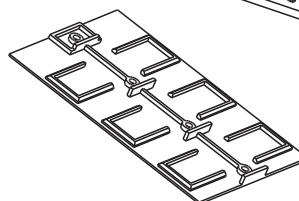
Type	Order Code
1NA + 1NK	8BA-A0011-0000
2NA + 2NK	8BA-A0022-0000

## Top terminal protective cover:

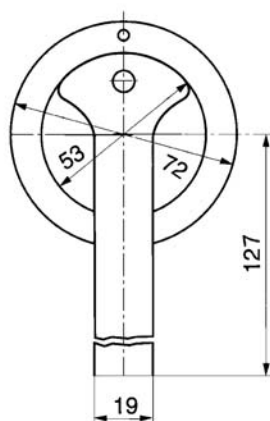
For types with fuse



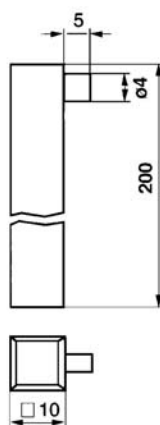
For types without fuse



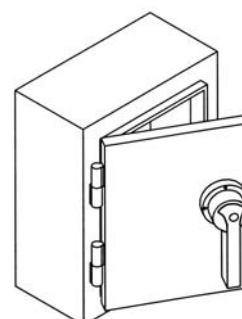
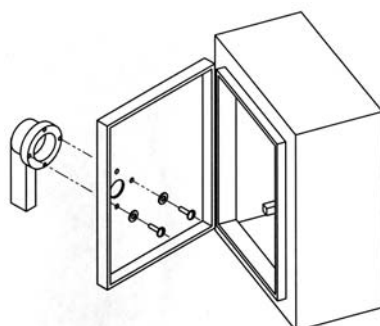
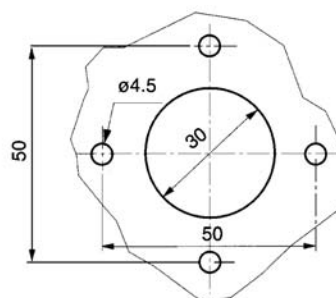
## Control lever:



## Control shaft:

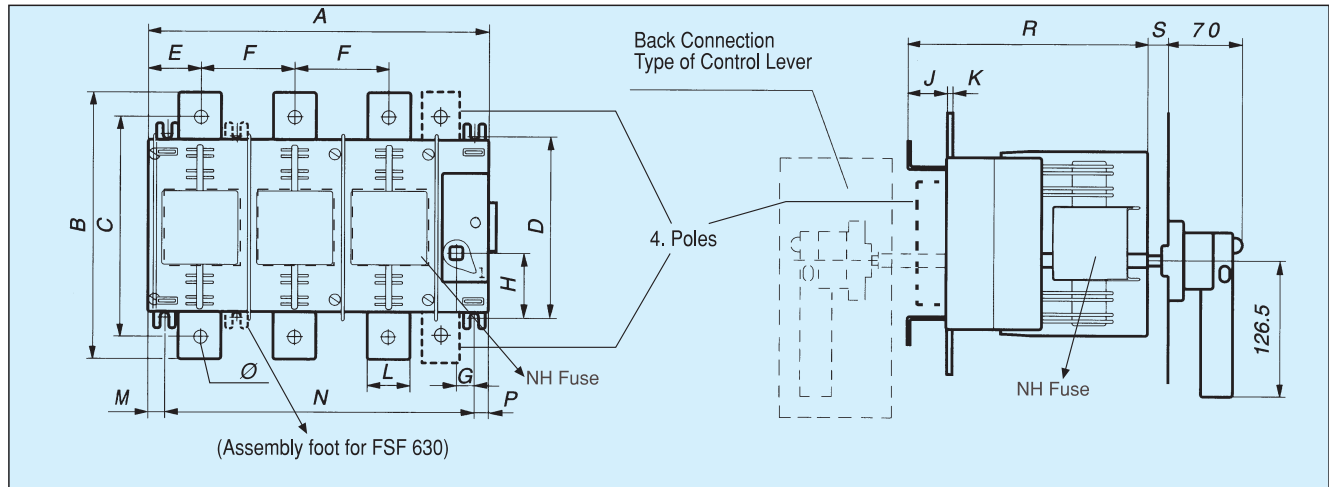


## Panel connection hole dimensions:



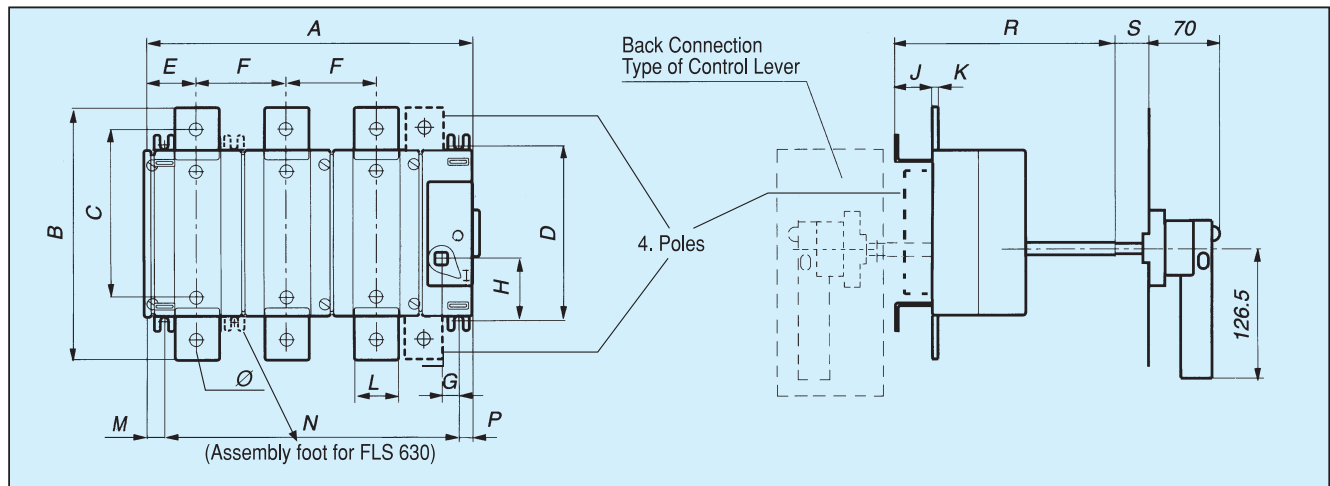
# LOAD BREAK SWITCHES WITH and WITHOUT FUSE

## Load Break Switch With Fuse:



Type	A	B	C	D	E	F	G	H	J	K	L	M	N	P	R	S	Ø
FSF 160	185	142	123	109	37	43.5	15	32	28	3	20	13	160	12	152	10-70	8
FSF 250	255.5	163	138.5	128	43.5	65	15.5	33	32	4	25	15	224	20.5	197		11
FSF 400											30						
FSF 630	317	243	202	168	50	8	16.5	54	37	6	40	83.5	224	14	222.5	13	

## Load Break Switch Without Fuse:



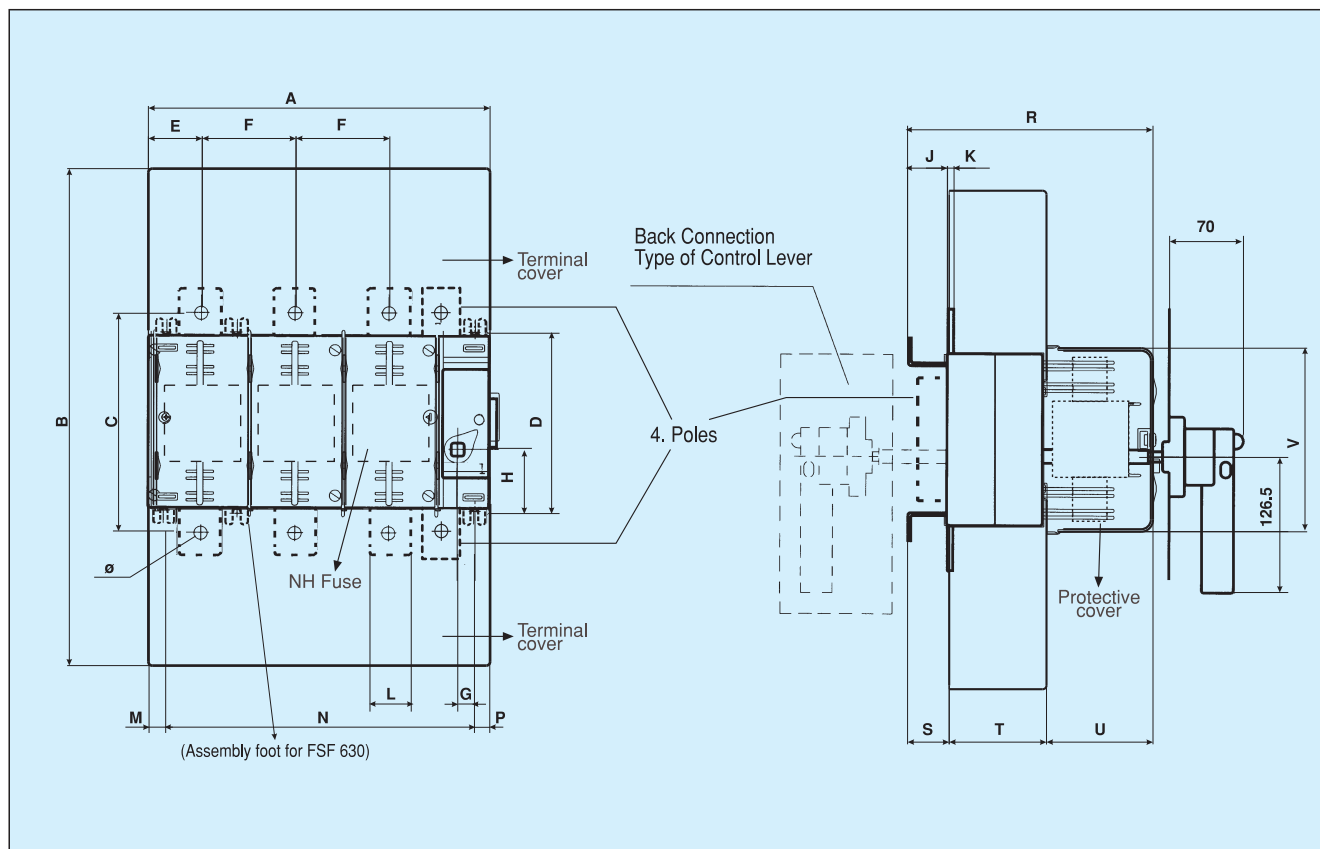
Tip	A	B	C	D	E	F	G	H	J	K	L	M	N	P	R	S	Ø	
FLS 160	185	142	123	105,5	37	43.5	15	32	28	3	20	13	160	12	152	10-70	8	
FLS 250	255.5	163	138.5	128	43.5	65	15.5	33	32	4	25	15	224	20.5	197		11	
FLS 400											30							
FLS 630	317	243	202	168	50	89	16.5	54	37	6	40	83.5	224	14	222.5	10-70	13	
FLS 800		355	315						35	8								
FLS1000									33	8								
FLS1250									31	10								
FLS1600																		
FLS1800																		
FLS2000																		

----- Shown parts with discrete lines are manufactured as per customer request.



# LOAD BREAK SWITCHES WITH and WITHOUT FUSE

## Load Breakers With Terminal Cover:

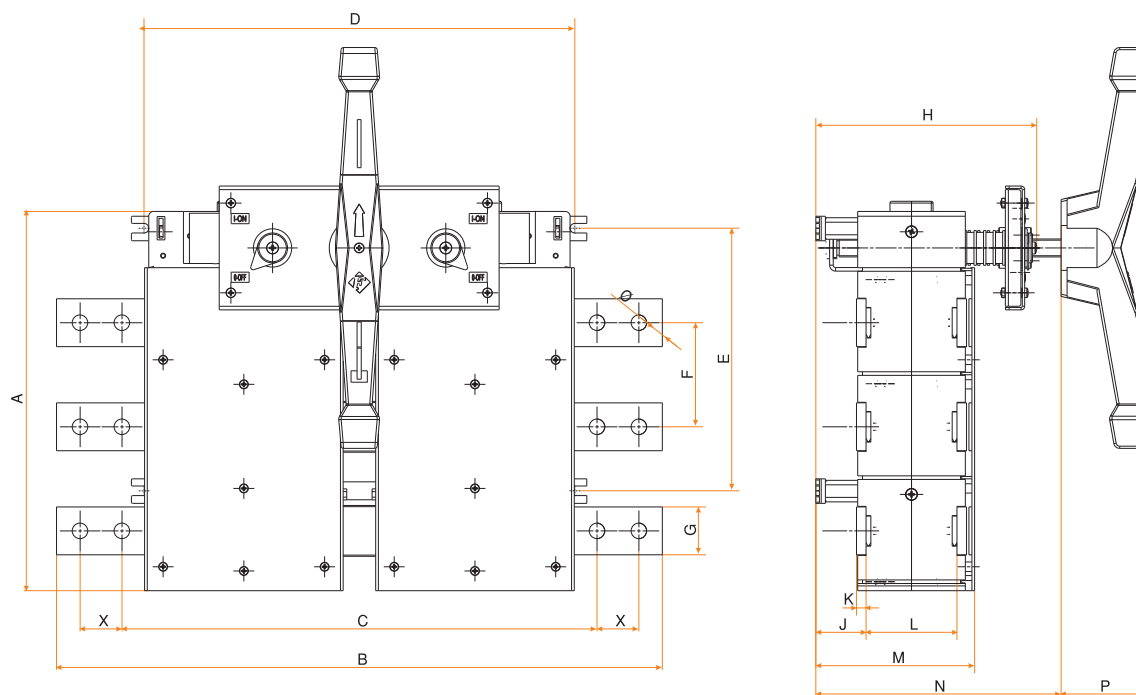


Type	A	B	C	D	E	F	G	H	J	K	L	M	N	P	R	S	T	U	V	Ø
FSF160	185	250	123	109	37	43.5	15	32	28	3	20	13	160	12	170	24	72,5	73,5	120	8
FSF250	254	327	138.5	128	43.5	65	15.5	33	32	4	25	15	224	20.5	200	25	88,5	91	165,5	11
FSF400											30									
FSF630	317	461	202	168	50	89	16.5	54	37	6	40	83.5	224	14	226	38	90	98	175	13

----- Shown parts with discrete lines are manufactured as per customer request.

# LOAD BREAK SWITCHES WITH and WITHOUT FUSE

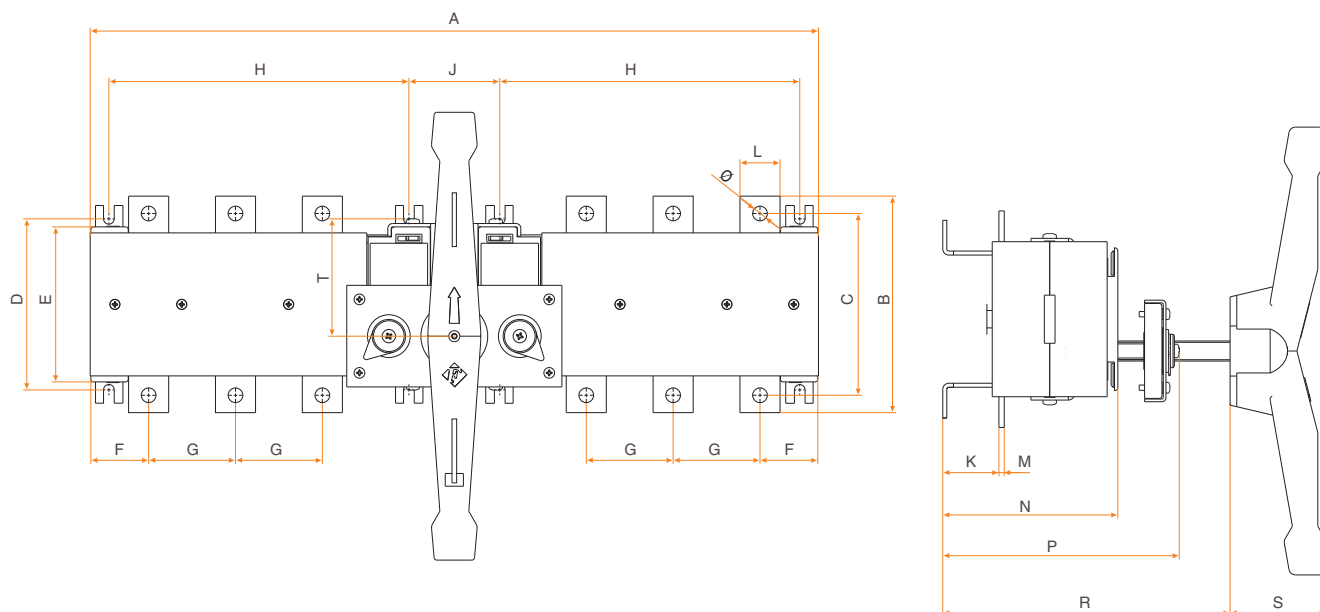
## Change-over Isolation Switch (Vertical Installed):



Type	Dimension															
	A	B	C	D	E	F	G	H	J	K	L	M	N	P	X	Ø
FLS160EV	185	280	260	242	160	43	20	160	41	3	56	110	205	41	-	8
FLS250EV		305	280				25		38	4	62					11
FLS400EV	254	307	282	272	220	65	30	178	46	4	68	128	203	72	-	11
FLS630EV									42	6	76					13
FLS800EV	317	436	397	360	220	87	40	185	42	8	76	133	203	72	-	13
FLS1000EV		506								35						
FLS1250EV																
FLS1600EV																
FLS1800EV																
FLS2000EV															12	

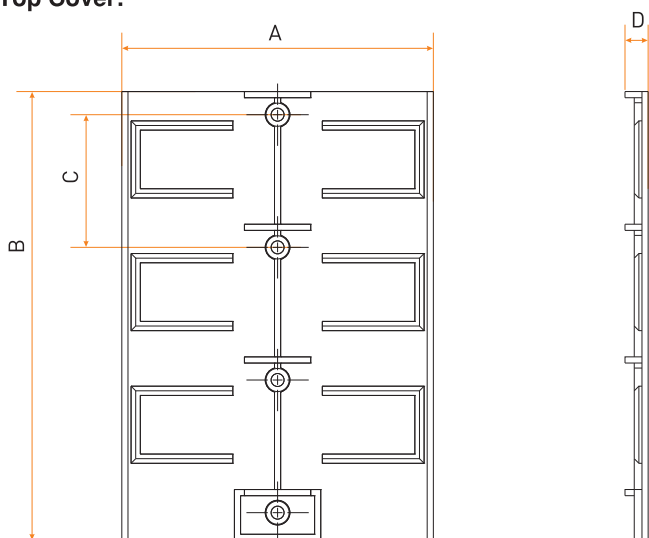
# LOAD BREAK SWITCHES WITH and WITHOUT FUSE

## Change-over Isolation Switch (Horizontal Installed):



Type	A	B	C	D	E	F	G	H	J	K	L	M	N	P	R	S	T	Ø
FLS 160EH	412	142	123	106	101	37	43	160	68	28	20	3	100	150	195	42		8
FLS 250EH	545	162	136	128	116	43	65	220		42	25	4	131	177	215	72	88	11
FLS 400EH											30							
FLS 630EH	671	243	202	168	166	50	87	65		36	40	6	133	186	217			108

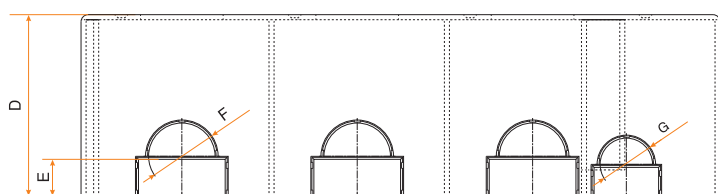
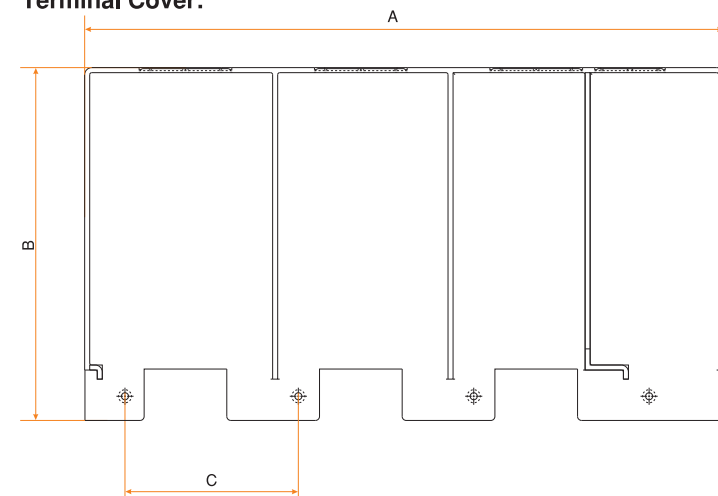
## Top Cover:



Type	Dimension			
	A	B	C	D
FLS160EV	101	145,5	43	10,5
FLS250EV	107	207	50	10,5
FLS400EV				
FLS630EV	166	270	87	10,5
FLS800EV				
FLS1000EV				
FLS1250EV				
FLS1600EV				
FLS1800EV				
FLS2000EV				

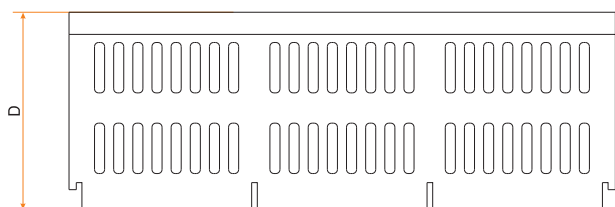
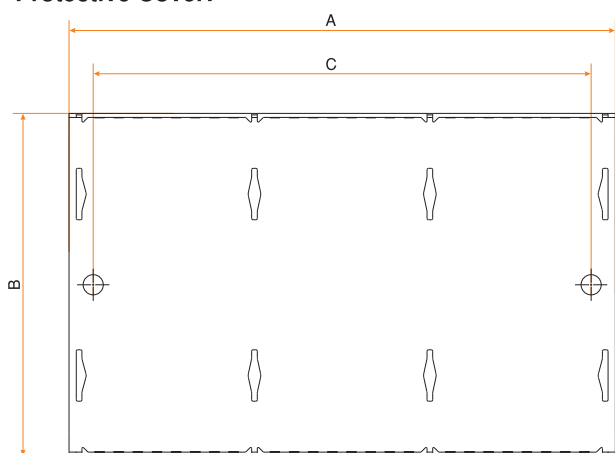
# LOAD BREAK SWITCHES WITH and WITHOUT FUSE

**Terminal Cover:**



Type	Dimensions						
	A	B	C	D	E	F	G
FSF160	165	105,5	43	72,5	13	Ø19,5	Ø16
FLS160							
FLS160EH							
FLS160EV							
FSF250	254	130	65	88,5	20,75	Ø30	Ø24,5
FLS250EH							
FLS250EV							
FSF400							
FLS400	317	175	87	90	18,25	Ø33	Ø26
FLS400EH							
FLS400EV							
FSF630							
FLS630	317	175	87	90	18,25	Ø33	Ø26
FLS630EH							
FLS630EV							
FLS800							
FLS1000	317	175	87	90	18,25	Ø33	Ø26
FLS1250							
FLS1600							
FLS1800							
FLS2000							

**Protective Cover:**



Type	Dimensions			
	A	B	C	D
FSF160	139	120	115	73,5
FSF250	203	165,5	181	91
FSF400				
FSF630	317	175	87	90

## NOTLAR

# CAM SWITCHES



## Cam switches

### On-Off switches



### Change Over Switches



### Star Delta Starters



### Motor Reversing Switches



### Ammeter Switches



### Voltmeter Switches



### Safety switches



IEC / EN 60947-3

CE

**Mounting Position** : Free  
**Altitude** : 2000 m (max)  
**Relative Humidity** : 50% (40°C) , 90% (20°C)  
**Ambient Temperature** : between -5°C and + 40°C  
**Pollution Degree** : III  
**Protection Degree** : IP40 (On front face)

All these given information are general. We have always right to change them.

# CAM SWITCHES



Manual switches, which consist of consecutive order of more than one same contact slots on a shaft and which can rotate around an axis; which are used in motor connection works, measurement device commutators and control and distribution panels, are called Cam (paco) switches. Medium and large-power motors are controlled with contactors and relays. However, as controlling of small-power motors are more economical and simple, they are controlled with Cam switches. Federal Cam switches are manufactured in accordance with IEC60947-3 / EN 60947-3 and CE. Cam switches, which have two, three or four silver-alloy contacts in each slice, are utilized in various controlling operations by increasing number of slices. Moving contact has a swaged surface, whereas fixed contact has a flat one. In this way, full contact and lowest resistance are ensured. Since contacts are opened and closed by pressing and cams on the shaft perform simultaneous opening-closing of contacts, it has been allowed to open and close all the controlling circuits or phases at the same time without any delay.

Cam switches		Type	FCS1				FCS2		
		Continuous operating current $I_{th}$ (A)	10	16	20	25	32	40	63
Operating currents (A)	AC21A	220-240 V	10	16	20	25	32	40	63
		380-440 V							
		660-690 V							
	AC1	220-240 V	10	16	20	25	32	40	63
		380-440 V							
		660-690 V							
Operating powers (kW)	AC23A	220-240 V 3p	3.0	3.7	4.0	5.5	7.5	11.0	15.0
		380-440 V 3p	4.0	5.5	7.5	11.0	15.0	18.5	30.0
		660-690 V 3p	4.0	5.5	7.5	11.0	15.0	18.5	30.0
	AC3	220-240 V 3p	2.2	3.0	3.7	4.0	5.5	7.5	11.0
		380-440 V 3p	3.0	4.0	5.5	7.5	11.0	15.0	18.5
		660-690 V 3p	3.0	4.0	5.5	7.5	11.0	15.0	18.5

## Usage Classes :

**AC 1** : Non-inductive or low-inductive loads (Resistance furnaces).

**AC 3** : Cage motor direct starting load shut-down, Star-Delta (Squirrel Cage motors; Starting; disablement in operation.)

**AC 15** : Enablement of motor and other high inductive loads with frequent intervals (Switching of motor loads or quite high inductive loads)

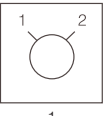

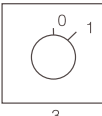

**AC 21A** : Magnetic drives, contactor, valves, magnetic coil control (Electromagnetic loads)

**AC 23A** : Control of low overloaded, resistive - inductive mixed loads (Switching of medium-degree overloads)

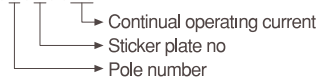


# CAM SWITCHES

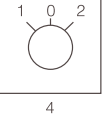
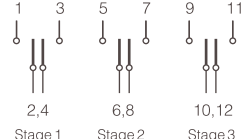

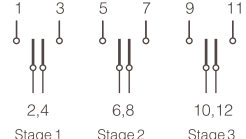
## On-Off switches

Type	Rated Thermal Current Ith (A)	Number of Pole - Stages	Label Plate	Connection Diagram	Order Code
FCS1	10 16 20 25	1 Pole - 1 Stage 2 Pole - 1 Stage 3 Pole - 2 Stage			9TO-10Δ0□-00◇◇
FCS2	32 63	4 Pole - 2 Stage			9TO-20Δ0□-00◇◇

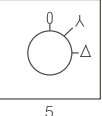
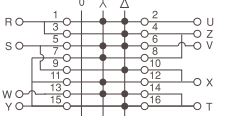
Δ Pole number, □ Sticker plate, ◇◇ Continual operating current. Descriptions of order codes: 9TO103020020



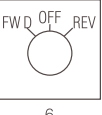
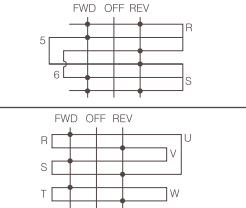
## Change Over Switches

Type	Rated Thermal Current Ith (A)	Number of Pole - Stages	Label Plate	Connection Diagram	Order Code
FCS1	10 16 20 25	1 Pole - 1 Stage			9TK-10Δ04-00◇◇
FCS2	32 63	3 Pole - 3 Stage			9TK-20Δ04-00◇◇

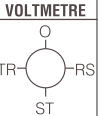
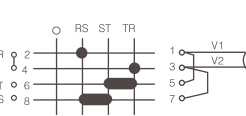
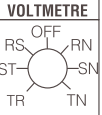
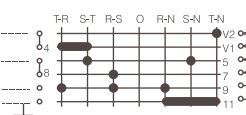
## Star Delta Starters

Type	Rated Thermal Current Ith (A)	Number of Pole - Stages	Label Plate	Connection Diagram	Order Code
FCS1	16 25	3 Pole - 4 Stage			9TS-10Δ05-00◇◇

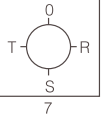
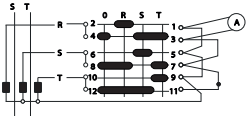
## Motor Reversing Switches

Type	Rated Thermal Current Ith (A)	Number of Pole - Stages	Label Plate	Connection Diagram	Order Code
FCS1	10 16 20 25	1 Pole - 2 Stage 3 Pole - 4 Stage			9TE-10Δ06-00◇◇

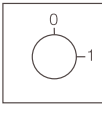
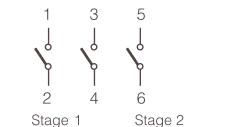
## Voltmeter Switches

Type	Rated Thermal Current Ith (A)	Function Number of Stages	Label Plate	Connection Diagram	Order Code
FCS1	20	4 Poz - 2 Stage			9TV-123V1-0020
		7 Poz - 3 Stage			9TV-143V2-0020

## Ammeter Switches

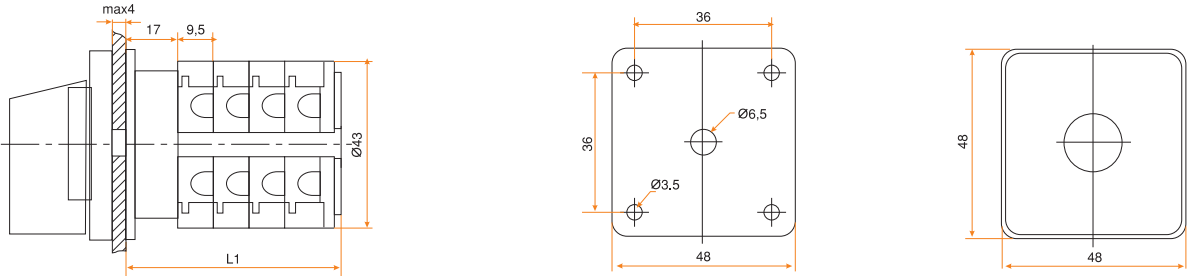
Type	Rated Thermal Current Ith (A)	Number of Pole - Stages	Label Plate	Connection Diagram	Order Code
FCS1	20	3 Pole - 4 Stage			9TA-103037-0020

## Safety Switches

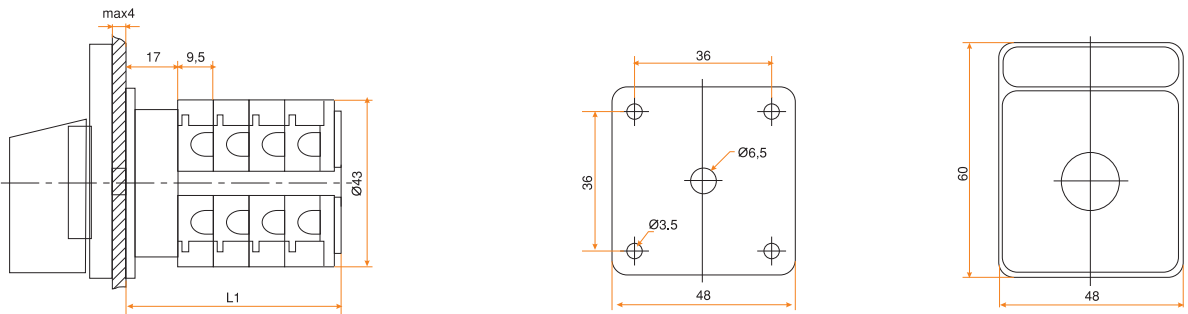
Type	Rated Thermal Current Ith (A)	Number of Pole - Stages	Label Plate	Connection Diagram	Order Code
FCS1	20	3 Pole - 2 Stage			9TP-10308-0020
FCS2	32				9TP-20308-00◇◇
	40				
	63				

# CAM SWITCHES

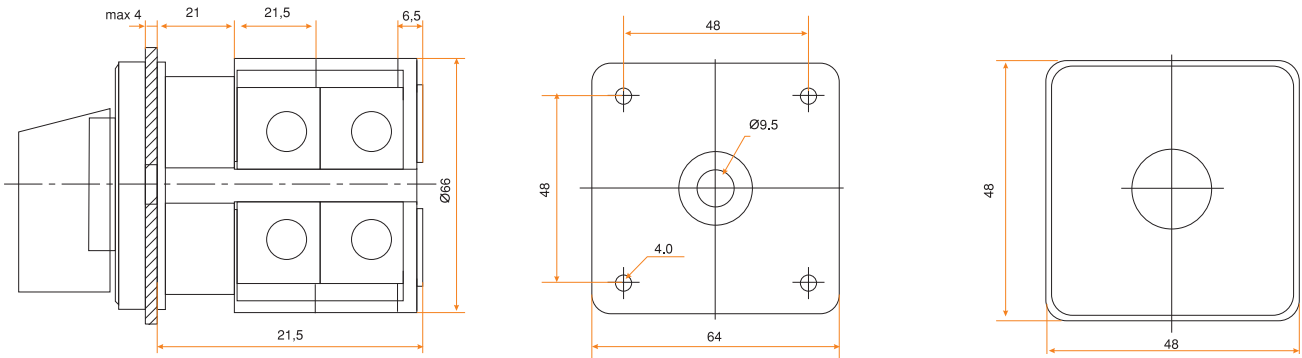
## FCS1:



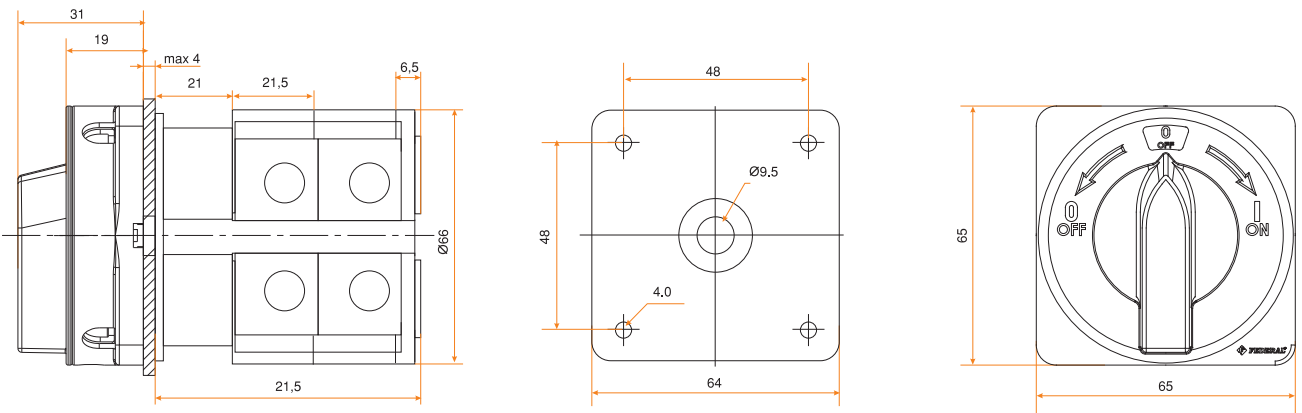
## FCS1 Voltmeter - Ammeter Switches:



## FCS2:



## FCS2 Safety switches:



## Body lengths:

Number of Slices	1	2	3	4
FCS1 Body Length (L1)	31.5	41	50.5	60
FCS2 Body Length (L2)	49	70.5	92	113.5

## Order Code:

20A	9TP-10308-0020
32A	9TP-20308-0032
40A	9TP-20308-0040
63A	9TP-20308-0063

# MEASUREMENT DEVICE



## Analogue Measurement Devices



**Ammeters**  
FA72 / FA96



**Demandmeters**  
FMA72 / FMA96



**Voltmeters**  
FV72 / FV96



**Frequencymeters**  
FF72 / FF96

## Digital Measurement Devices



**Ammeters**  
FYA72 / FYA96



**Voltmeters**  
FYV72 / FYV96



**Multimeters**  
FMM50

Comparison of a known size and an unknown size in the same kind is called measurement.

## Ammeter:

Ammeters are the devices measuring current strength (amount of current passing through conductive) of electrical current. They are serially connected to receiver in the electrical circuit. Current of the receiver should pass through the ammeter. However, the ammeter should measure this passing current but should not hinder it. For this purpose, inner resistance of the ammeter should be very low (0-1 Ohm). In order to have a low inner resistance of the ammeter, coil is wrapped with less spins than thick section conductive. The value measured by ammeters is shown with value L and expressed with letter A (such as  $I = 10A$ ). There are “-”, “~” and “≈” marks on the ammeter dial. “-” represents measurement in direct current, “~” represents measurement in alternative current and “o” represents measurement in both direct current and alternative current. In addition to ammeters measuring direct current (DC) and alternative current (AC); there are ammeters measuring both DC and AC.

**Ammeters with demand meter** can show the highest average current value drawn within a time period of 15 minutes. When it is required, ammeter with

demand meter can be made in 5 or 8-minute periods. In addition to dial ammeters, electronic (digital) ammeters are used and their areas of application increase day by day. There is no reading error in these ammeters and their features of use are same with the dial ammeters. Ammeters must be serially connected to the circuit. They fail when connected parallel.

## Voltmeter:

These are the tools measuring voltage (potential difference) of the receiver or the circuit in an electrical circuit. Voltmeters are connected parallel to the receiver, voltage of which shall be measured.

Since voltmeter is connected parallel to the receiver, a current pass through it. In order to have a low current, inner resistance should be high. In order to ensure this situation, which is contrary to ammeters, coils are wrapped with more spins than thin section conductive. The value measured by voltmeter is represented with letter U and expressed with letter V (such as  $U = 220 V$ ). Voltmeters have two kinds as DC voltmeter and AC voltmeter. Moreover, there are voltmeters capable of measuring both DC and AC. Attention should be paid prior to connecting voltmeter to the circuit. In addition to dial (analogue) voltmeters, digital voltmeters

are used. Just like digital ammeters, voltmeters become widespread every day. Because, there is no reading error in them and they occupy less space and reduce costs in time. Voltmeters are connected to the circuit parallel. No harm is caused in the device if they are connected serially to the receiver. However, since there shall be a big resistance in the circuit, the receiver shall not operate.

## Frequency meter:

Devices measuring frequency are called frequency meters. Frequency meters indicate number of cycles in 1 second and their unit is cycle/second or Hertz (Hz). Frequency meters are connected to the circuit, frequency of which shall be measured, parallel just like voltmeters. They are manufactured to be connected between phases or phase and neutral.

## Measurement Device Classes:

It is percentage expression of the error rate of the measurement device at the highest value to be measured.

**0,1 - 0,2 Class:** Measurement devices used in manufacture of measurement devices.

**0,5 - 1 Class:** Measurement devices usually used portable.

**1,5 - 2,5 Class:** Table-type measurement devices used in industrial measurements.





## Technical Specification

	Ammeters		Max. Demand Ammeters		Voltmeters		Frequencymeters	
Type	FA 72	FA 96	FMA 72	FMA 96	FV 72	FV 96	FF 72	FF 96
Measurement wave form	AC (r.m.s)		AC (r.m.s)		AC (r.m.s)		AC (r.m.s)	
Measuring range	From 10A to 100A (direct) From 30/5A to 4000/5A (current trans)		From 200/5A to 4000/5A with current trans. (15min)		250 V ve 500 V		45 - 65Hz 55 - 65Hz	45 - 55Hz 45 - 65Hz 55 - 65Hz
Accuracy class	1.5		3		1.5		1.5	
Operating method	Moving iron		Bimetal		Moving iron		Moving coil	
Operating frequency	45 - 65 Hz		45 - 65 Hz		45 - 65 Hz		45 - 55 Hz	
Continuously overload (2hour)	1.2 x In		1.2 x In		1.2 x Un		1,2 x Un, 1,2 x 55 Hz	
Short-time overload	10 x In		10 x In		2 x Un		2 x Un	
Consumption (max.)	1 VA		2.2 VA		3 VA		1 VA	
Insulation testing voltage	2000 V		2000 V		2000 V		2000 V	
Operating position	Scale vertical position		Scale vertical position		Scale vertical position		Scale vertical position	
Dimensions	72 X 72	96 X 96	72 X 72	96 X 96	72 X 72	96 X 96	72 X 72	96 X 96

Federal analogue meters are manufactured according to IEC 60051-2 / EN 60051-2 standards and CE certificate. There is no need to stock for ammeters due to inter changeable scale system. Only scale is sufficient to have in stock.

# MEASUREMENT DEVICES

## Order Code

	Type	Dimensions	Using Type	Order Code
	FA 72	72x72	Direct	9KA-AA120-□□□□
			With current transformer	9KA-AA121-□□□□
	FA 96	96x96	Direct	9KA-AA220-□□□□
			With current transformer	9KA-AA221-□□□□
	FMA 72	72x72	Direct	9KA-MA120-□□□□
			With current transformer	9KA-MA120-□□□□
	FMA 96	96x96	Direct	9KA-MA220-□□□□
			With current transformer	9KA-MA220-□□□□
	FV 72	72x72	Direct	9KV-AA120-ΔΔΔΔ
	FV 96	96x96	Direct	9KV-AA220-ΔΔΔΔ
	FF 72	72x72	Direct	9KF-A0120-0055
	FF 96	96x96	Direct	9KF-A0220-0055

□□□□: Measuring range of ammeter is written (Ampere)

Types for direct using: 0010, 0015, 0020, 0025, 0040, 0050, 0080, 0100.

Types used with current transformer: 0030, 0040, 0050, 0060, 0080, 0100, 0200, 0250, 0300, 0400, 0500, 0600, 0800, 1000, 1200, 1500, 2000, 2500, 3000, 4000.

ΔΔΔΔ : Measuring range of voltmeter is written like 0250, 0500.

## PANEL METER (VOLTMETER, AMMETER)




**FYV (Voltmeter)** 72x72 and 96x96 Series voltmeters, measure -RMS AC Voltage value (potential difference) of receiver or circuit between 0-500V.

**FYA (Ammeter)** 72x72 and 96x96 Series ammeters sensitively measure AC current between 0 - 5A from any circuit line without using current transformer by direct connection. In case of connected via current transformer, FY96 Ammeters measure current between 0 - 9999A by identified transforming rate of CT.

**FYA96-200 (Direct 200A. Ammeter)** This model of 96x96 Ammeter sensitively measures AC circuit between 0-200A by using installed current transformer.

**FYV-2R, FYA-2R, FYA96-200-2R (Voltmeter and Ammeter with 2 Relays)** 72x72 and 96x96 Series Ammeter and Voltmeter with relays models; the Lower (LO) and Higher (HI) limits will be measured are identified on devices. In case of measured values exceeds these defined limits, according to settings of rP relays is engaged than device allows either normal or pulse type signal out.

## Technical Features:

					
	Ammeter	Ammeter (with 2 relay)	Voltmeter	Voltmeter with 2 relay	Multimeter
Type	FYA72 - FYA96 FYA96 - 200	FYA72 - 2R / FYA96 - 2R FYA96 - 2R 200	FYV72 - FYV96	FYV72 - 2R FYV96 - 2R	FMM50 - FMM50R
Measurement wave form	AC (rms)	AC (rms)	AC (rms)	AC (rms)	AC ( rms)
Measurement Range	0-5A MAX.6A direct (FYA72, 96) 0-9999A with Current Transformers (FYA72, 96) 0-200A MAX.250A direct (FYA72, 96 - 200)		0-500V AC MAX.600V AC 0-36kV AC with voltage transformer		0-500V AC MAX.600V AC 0-36kV AC with voltage transformer 0-9999A with Current Transformers
Accuracy class	1	1	1	1	1
Operating frequency	0 / 50 ... 60 Hz	0 / 50 ... 60 Hz	0 / 50 ... 60 Hz	0 / 50 ... 60 Hz	0 / 50 ... 60 Hz
Operating temperature	-10°C ... +85°C	-10°C ... +85°C	-10°C ... +85°C	-10°C ... +85°C	-10°C ... +85°C
Feeding voltage	85 ... 265V AC 10 ... 300V DC	85 ... 265V AC 10 ... 300V DC	85 ... 265V AC 10 ... 300V DC	85 ... 265V AC 10 ... 300V DC	85 ... 265V AC 10 ... 350V DC
Dimensions	72 x 72 / 96 x 96	72 x 72 / 96 x 96	72 x 72 / 96 x 96	72 x 72 / 96 x 96	96 x 96

## KEY FUNCTIONS

### 1 Single Keys:

**1.1 Enter :** It makes go to next number or parameter when device is at menu section. ( All parameters settings are recorded step on by Enter key).

**1.2 Up:** When device shows main display ( normally working position, shows measuring values) press Up key, then the maximum measured value is shown during 3 sec.

**1.3 Up :** When device shows main display ( normally working position, shows measuring values) UP key provides to go sequentially upward on menu sections.

**1.4 Down :** When device shows main display ( normally working position, shows measuring values) press Up key, then the minimum measured value is shown during 3 sec.

**1.5 Down:** When device shows main display (normally working position, shows measuring values) Up key provides to go sequentially downward on menu sections and reduces the numeric input data.

### 2 Multi Function Keys:

**2.1 Enter & Down Keys:** these two keys combination provides to enter "SET" menu while device shows main display (normally working position, shows measuring values).

**2.2 Enter & Down Keys:** These two keys combination provides to go next parameters.

**2.3 Enter & Up Keys:** These two keys combination provides to go previous parameters

**2.4 UP & Down Keys:** While device is at Menu section, if these key combinations entered, devices goes to main display ( normally working position, shows measuring values) without saving any input data.

**2.5 UP & Down Keys:** While device is at main display ( normally working position, shows measuring values) if this key combination entered, device deletes measured maximum and minimum values from its memory and resets itself, after 3 seconds shows rSt on display.

### 3 Menu:

**3.1 Setting parameters on device;** The parameters can be set by two ways.

#### 3.1.1 Set up by using "Enter" :

Enter & Down key combination provides to enter to Set Menu. The Ut, Ct, St, HI, LO, dt, rP, rO, rL parameters are shown respectively according to device model. Numeric data are selected by using Down and/or Up keys. After input desired numeric data, goes to next step by Enter key. After all numeric data input into menu parameters, press "ENTER" key to complete setting up. All parameters are set by using "ENTER" key. Device displays each input parameters for 1 second and records the set. Device turn to main display after completed setting up.

#### 3.1.2 Setting parameters by using "ENTER & Up or Down:

This option provides to move on forward or rearward parameters. "ENTER" and Down keys combinations provides to enter SET menu. Numeric values are selected by using Down or Up keys. After last numeric data selected by "ENTER" key, next parameter is displayed. If there is no any desired adjustment, next parameter is directly called using by "ENTER" and Down key combination instead of moving all numeric data by "ENTER". "ENTER" and Down combination provides fast moving between parameters. When "ENTER" and Down combination is used after last parameter defined, all defined data (Ut, Ct, St, HI, LO, dt, rP, rO, rL) have been shown for 1 second and recorded. Devices shows main display after Setting completed.

**3.2 Recording of New Settings.** If there is no input for 30 seconds while at any section in Setting menu, Setting menu automatically closes itself and new identifies are not recorded.

**3.3 While Device is at normally working:** Device keeps functions over last settings during new data are being identified till new setting completed. (The relay controls of lower limit (LO) and higher limit (HI), measuring controls are kept working according to last defined settings)

### 4 Defining Parameters;

**4.1 Ut:** It is transforming ratio of voltage transformer. Data can be input between 1- 400.

**4.2 Ct:** It is transforming ratio of current transformer. It is "1" and cannot be changed at ammeters which directly connected. The Ct is between 1-20000 for X5 current transformers. For example: If device will be used by a current transformer 100/5A, the Ct value should be identified as "20" .

**4.3 St:** It is "Idle time" ( It is time period which LO and HI relays don't control from connected system) Time interval can be identified between 0-99 seconds.

**4.4 HI:** It is the highest limit value for measuring units at relay models. The setting interval can be identified between 0-999 for voltmeter 0-9999 for ammeter

**4.5 LO:** It is the lowest limit value for measuring units at relay models. The setting interval can be identified between 0-999 for voltmeter 0-9999 for ammeter.

**4.6 dt:** It is time period which relay makes delaying before engaged. Time period can be defined between 0-99 seconds.

**4.7 rP:** It is operating mode such Normal or Pulse types which is used at relay models.

**Normal operating:** When measured values exceed defined LO and HI values, relay is consistently engaged, NO contact of relay is closed. (Floating connection) Pulse type operating: When measured values exceed defined LO and HI values,

according to Relay Operating Type which defined at Item5. (Floating connection)

**5 Zero Value, Stable Feature - rO -:** It is used to accept situation of measured values (Zero value)

**5.1 rO=0:** Zero is accepted as lower value. , lower (LO) and higher (HI) limits are controlled by relay.

**5.2 rO=1:** Zero is NOT accepted as lower value. , lower (LO) and higher (HI) limits are NOT controlled by relay

### 6 Sealing Features -rL -,

t is used at relay models. If rP=0 it works.

**6.1 rL=0:** Normal operating, relay is engaged when defined HI and LO values are exceed and keep engaged till measured values turn to normal.

**6.2 rL=1:** Sealing is activated, relay is engaged when defined HI and LO values are exceed and keep engaged even measured values turn to normal. (The contacts are kept being floating connection). The Sealing is released by pressing "Up" and "Down" keys together. When device is "Reset" UnL is shown on display and relay is released. When device is reset while relay is sealed, maximum and minimum identified values are not reset.

### 7 Relay Operating Options;

**7.1 rP=0:** Normal operating, relay is engaged when defined HI and LO values are exceed and keep engaged till measured values turn to normal.

**7.2 rP=1:** Pulse time for 100 msec.

**7.3 rP=2:** Pulse time for 250 msec.

**7.4 rP=3:** Pulse time for 500 msec.

**7.5 rP=4:** Pulse time for 1 second.

**7.6 rP=5:** Pulse time for 2 second.

**7.7 rP=6:** Pulse time for 5 second.

### 8 Observing Measuring Values :

**8.1 Displaying Maximum Measured Values:** While device is on work by its set up, when press Up key, it shows the maximum measured value for 3 seconds. All other measuring operations and relay activities are go on.

**8.2 Displaying Minimum Measured Values:** While device is on work by its set up, when press "Down" key, it shows the maximum measured value for 3 seconds. All other measuring operations and relay activities are go on.

**8.3 Reset and Updating of Device Memory:** While device is on work by its set up, when press "Down+Up" keys together, device reset maximum and minimum values from its memory. Display shows rSt for 3 seconds, then continuously updates its memory by recording maximum and minimum measured values.



## MULTIMETER



### Technical Features:

Working Voltage	100 - 240 VAC
Frequency (Hz)	50 / 60 Hz
Class	1
Measuring interval for Voltage	0-500 VAC.Max.600 VAC
By Voltage Transformer	0 - 36 KVAC
Measuring interval for Current	0 - 9999 A
Ambient Temperature	- 40 °C / + 85 °C

FMM50 Series multimeter can directly be connected to system by 3 phases and neutral connections. It measures AC 0-500V (MAX. 0-600V AC) RMS value. When Voltage transformer is required, multimeter should be installed by 3 Phases and Neutral. The Star point of voltage transformer is used for Neutral connection. The maximum transformation rate is 800. When 100V RMS measurement transformer is used, up to 80KV RMS between phases and up to 46KV RMS values can be measured.

Because of current inputs are not isolated, Multimeter has to be connected to system via current transformers. When single phase measurement is required for test purpose, it can be directly connected to system without using current transformer. Nominal current is 5A, maximum current is 6A. There are two connection points for each phase. The ratio of current transforming can be adjusted between 1-2000.

### 1. DISPLAYING MEASURED VALUES: 1.1 Phase currents and Phase-Neutral voltage values section

In this section, measured values are displayed as 3 digits on the left for voltages and 4 digits on the right for currents. Phase sequence is shown as R, S and T respectively from top to bottom. LED1 on the left-bottom is ON to show this section..

When indicated voltage values don't have decimal, the measured value reading is Volt RMS, if there is decimal, reading value is KV RMS. Displayable measured voltage value is minimum 001 Volt, maximum 99,9 KV.

Current values are always "Amper". Displayable measured current value is minimum 0.001 Amper, maximum 9999 Amper.

Displaying decimal values is adjusted over Current and Voltage transformer ratio. Decimal value allocation is not changed when measured value is too small. The reason is having stationary value from measurement. In case of measured value excesses from display, the decimal value is re-adjusted and indicated measurement is displayed without round off..

When measured current value is bigger than 9999 kA, excess displaying is occurred. In this case, related section gives alert by flashing itself. Measured current value is shown as XX.XX form on display and referred to kA which is real and actual value.

When voltage value is over 99.9 kV excess displaying is occurred too and related section gives alert to excess measurement by flashing itself. Measured Voltage value is shown as XXXX form on display and referred to kV. Any acquired data is not missed on display.

### 1.2 Phase to Phase Voltage and Current values section.

In this section LED1 is constantly ON and LED2 is flashing. Measured values are displayed as 3 digits on the left for voltages and 4 digits on the right for currents. Features are same as section 1.1. Displaying sequence is shown as R-S, S-T, T-R respectively from top to bottom.

### 1.3 kW and CosΦ Section .

For each phase, the CosΦ values are shown as 3 digits on the left, the instantaneous consumption kW are shown as 4 digits on the right. Displaying phase sequence is same as section 1.1. LED2 is constantly ON to Show section position. Measured CosΦ value from system is displayed between 0.00 and 1.00. If system If the system is capacitive, related section gives alert by flashing itself. When measured kW value exceeds, indication value starts flashing and read as MW.

### 1.4 kVA and CosΦ Section.

In this section; LED 2 is constantly ON, LED3 flashes to show section position. For each phase, the CosΦ values are shown as 3 digits on the left, the instantaneous consumption kVA are shown as 4 digits on the right. Displaying phase sequence is same as section 1.1. When measured kVA value exceeds, indication value starts flashing and read as MVA.

### 1.5 kVAr and CosΦ Section

In this section; LED 2 is constantly ON, LED4 flashes to show section position. For each phase, the CosΦ values are shown as 3 digits on the left, the

instantaneous consumption kVAr are shown as 4 digits on the right. Displaying phase sequence is same as section 1.1. When measured kVAr value exceeds, indication value starts flashing and read as MVar.

### 1.6 Frequency and Period Section

In this section; LED3 is constantly "ON". For each phase, the Frequency values are shown as XX.X on the left referred to "Hz" and the Period values are shown as XX.XX referred to "ms"

### 1.7 Total Values Section.

In this section; LED4 (placed at the right side) is constantly "ON". The Mean Frequency Value of Three Phases is shown at top of left on display, the Mean Period of Three Phases is at middle-left and Total CosΦ of three phases is at bottom of left side. Right side of this section is reserved for Total Consumption of connected system. kW is at top right, kVA is in the middle and kVAr is at right-bottom side.

## 2. MULTIMETER KEYPAD CONTROLLING:

### 2.1 -Single Function Keys.

**"Enter" Key:** It provides navigation between sections of measuring menu (L1, L2, L3, L4). It also helps to go next number and parameter. (When last adjustment parameter is set up by using "ENTER" key, all parameter inputs are recorded).

**Up:** While device shows main display (normally working position, shows measuring values), UP key is used to display Maximum measured values which recorded by multimeter for 3 seconds. If it is used at Setting Menu, it increases the numeric data.

**Down:** When device shows main display (normally working position, shows measuring values), Down key is used to display Minimum measured values which recorded by multimeter for 3 seconds. If it is used at Setting Menu, it decreases the numeric data

### 2.2 Multi-Keys Combinations:..

Enter + Down Combination:

While device shows main display (normally working position, shows measuring values), "Enter+Down"



combination enters SET menu. If it is already in SET, it provides to go next stage in parameters.

## Enter + Up Combination:

While device shows main display (normally working position, shows measuring values), it provides to go previous stage in parameters.

## Up + Down Combination

While device is at Menu section, if these key combinations entered, devices goes to main display ( normally working position, shows measuring values) without saving any input data. While device shows main display (normally working position, shows measuring values), when Up+Down combination is activated, it reset all measured maximum & minimum values which recorded in memory. In this case "rSt" message is appeared on display for 3 seconds.

## 3. MULTIMETER SET MENU

When "Enter+Down" combination is pressed, All LEDs (L1, L2, L3, L4) are OFF and gone to SET Menu. SET menu is active. First section is to enter ratio of transformers and adjusting idle time of relays where St-Ut-Ct.

When there is no any new input or moving between sections during 60 seconds, device cancels all new adjustments and goes to main page.

When cancel key (UP+DOWN) empowered, all new adjustments are cancelled and gone to main page. New adjustment is recorded by empowering either "Enter" key or "Enter + Down" keys combination after last numeric data has input at last section when all new numeric values are entered. Device displays each input parameters for 1 second and records the set. Device turns to main display after completed setting up.

### 3.1 St-Ut-Ct Section:

**St** : is idle time of device after power supply connected or empowering after cut-off. Adjustment is between 1-30 seconds. It is highly recommended to adjust minimum 5 secs. The relay does not operate (HI and LO) during this time interval. However, device displays measuring values of connected system.

**Ut**: Voltage transformer ratio. Starting from 1, set interval 1-800

**Ct**: Current transformer ratio. Starting from 1, set interval 1-2.000

### 3.2 rLy-tyP-dt section:

**tyP**: It identifies relay features of device. Adjustment can be set between 0 and 4 interval.

**0**: Relays are OFF .

### 1. V: 3 phases Voltage measuring, phase-neutral (HI-LO, used 6 relays), : Current values of of 3 phases (HI-LO 2 relays)

R phase V (Voltage) LO is 1<sup>st</sup> relay,  
R phase V (Voltage) HI is 2<sup>nd</sup> relay,  
S phase V (Voltage) LO is 3<sup>rd</sup> relay,  
S phase V (Voltage) HI is 4<sup>th</sup> relay,  
T phase V (Voltage) LO is 5<sup>th</sup> relay,  
T phase V (Voltage) HI is 6<sup>th</sup> relay,  
I Current value for 3 phases (R,S,T)  
LO is 7. relay, HI is 8. relay,

### 2. I Current value for 3 phases (HI-LO 6 relays), 3 phases V (Voltage) measuring phase-neutral (HI-LO 2 relays)

R phase I (Current) LO is 1<sup>st</sup> relay,  
R phase I (Current) HI is 2<sup>nd</sup> relay,  
S phase I (Current) LO is 3<sup>rd</sup> relay,  
S phase I (Current) HI is 4. relay,  
T phase I (Current) LO is 5. relay, T phase I (Current) HI is 6. relay,  
V: FOR 3 phases Voltage measuring, phase-neutral LO 7. Relay, HI 8. relay

### 3. Each 3 phases V (Voltage) phase-neutral (HI-LO, 6 relays), Cos\_ of 3 phases (HI-LO, 2 relays)

R phase V (Voltage) LO is 1<sup>st</sup> relay,  
R phase V (Voltage) HI is 2. relay,  
S phase V (Voltage) LO is 3.. relay, S phase V (Voltage) HI is 4. relay,  
T phase V (Voltage) LO is 5. relay, T phase V (Voltage) HI is 6. relay,  
For Cos\_ of 3 phases (R,S,T) LO 7.relay, HI 8. Relay,

### 4 I Current value for 3 phases (HI-LO 6 relays), 3 phases Cos\_ (HI-LO 2 relays)

R phase I (Current) LO is 1<sup>st</sup> relay,  
R phase I (Current) HI is 2. relay,  
S phase I (Current) LO is 3.. relay, S phase I (Current) HI is 4. relay,  
T phase I (Current) LO is 5. relay, T phase I (Current) HI is 6. relay,  
For Cos\_ of 3 phases (R,S,T) LO 7.relay, HI 8. Relay,

When relay type is selected "0" (Zero) all other sections of adjustment are cancelled. If relay type is other than type "0", goes to Ut-HI-LO section.

**dt**: Delaying time interval of relay can be identified between 1-30 seconds and highly recommended to set min. 5 seconds.

### 3.3 Ut-HI-LO Section:

The fundamental RMS Voltage value of Phase-Neutral to be used by relay as base data is set in this section by HI and LO limits. Decimal partition is adjusted by device over Voltage transformer (UT) value. Adjustment interval is between 000-999.

### 3.4 Ct-HI-LO Section:

The fundamental RMS Current value of phases to be used by relay as base data is set in this section by HI and LO limits. Decimal partition is adjusted by device over Current transformer (CT) value. Adjustment interval is between 0000-9999.

### 3.5 PF-HI-LO Section:

The fundamental Cos $\phi$  value of system to be used by relay as base data is set in this section by HI and LO limits. Adjustment interval is between 0.00-1.00 Only inductive adjustment can be set. All capacitive values are accepted higher than 1.00 resistive value.

### 3.6 rP-r0-rL Section:

**rP**: If relay is engaged than released after particular time interval (Pulse feature), rP value is set different from "0". Adjustment interval is between 0-7. When Pulse is set different from "0" sealing feature of relay doesn't work.

**0**: Pulse feature is OFF

**1**: Pulse time 100 ms

**2**: Pulse time 250 ms

**3**: Pulse time 500 ms

**4**: Pulse time 750 ms

**5**: Pulse time 1 sec

**6**: Pulse time 2 sec

**7**: Pulse time 5 sec

**r0**: The feature for Checking Relay is "0" acceptable. Adjustment interval is 0-1

**0**: Zero "0" value is accepted as lower limit. Device operates of Relay Controls

**1**: Zero "0" value is NOT accepted as lower limit. Device DOES NOT operates of Relay Controls

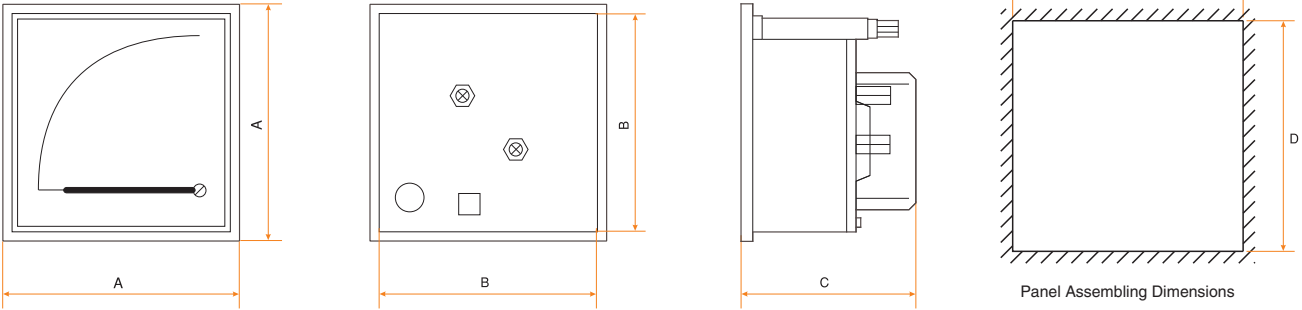
**rL**: Relay sealing feature. Adjustment interval is 0-1. Even desired conditions are completed, engaged relay is not released. Only operator can release relay by using "Up+Down" key combination. UnL signal is displayed. If Pulse (rP) feature is activated, sealing feature doesn't become active.

**0**: Sealing feature of relay doesn't work. Relays are engaged when LO and HI limits are exceeds, If the measured values become normal, relays turns to OFF.

**1**: Sealing feature of relay works. Relays are engaged when LO and HI limits are exceeds, relays keep engaged even measured values became normal. Relays can be released using by "Up+Down" key combination on device. UnL signal is displayed.

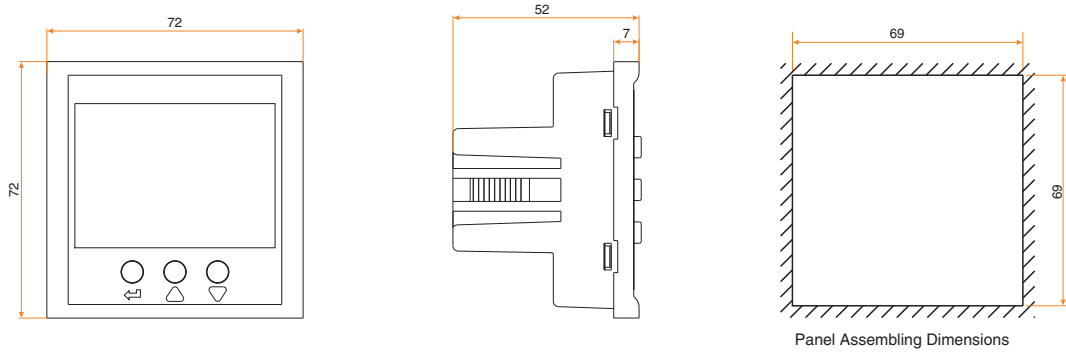
# MEASUREMENT DEVICES

## FA72 / FA96 / FMA72 / FMA96 / FV72 / FV96 / FF72 / FF96

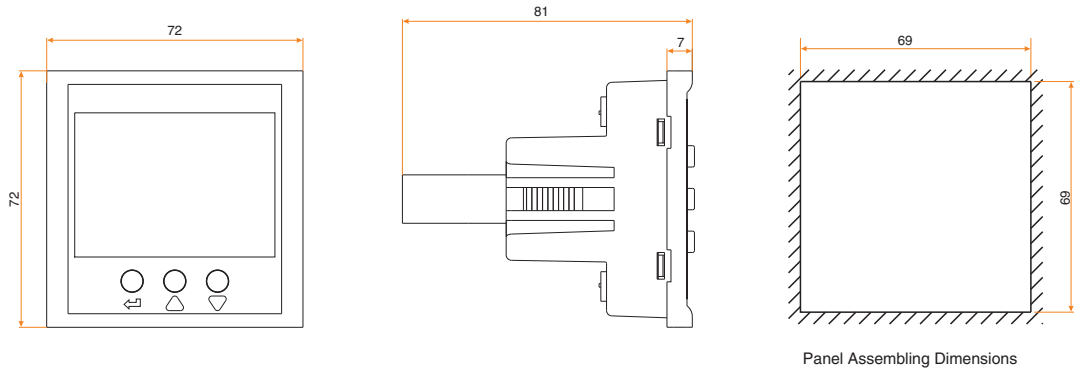


Dimensions (mm)	A	B	C	D
72 x 72	72	66	75	68 ± 0.5
96 x 96	96	90	75	92 ± 0.5

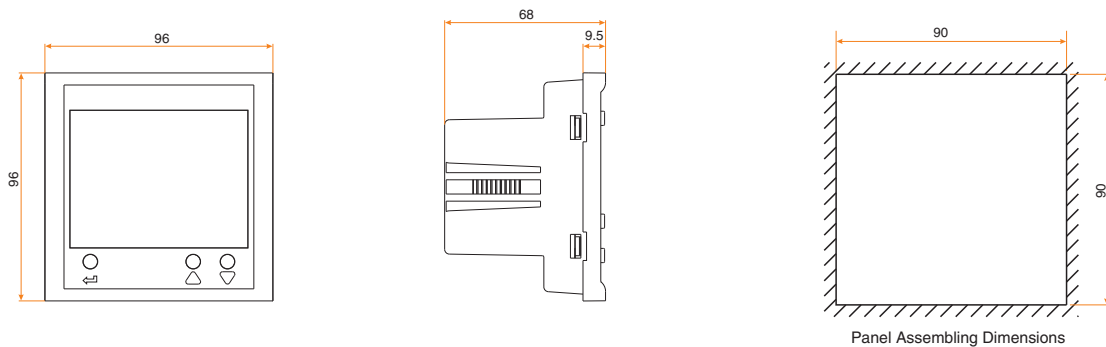
## FYA72 / FYV72



## FYA72 200

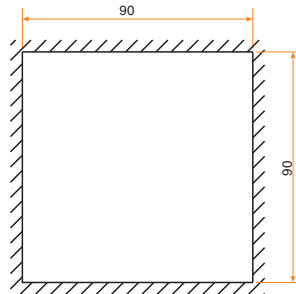
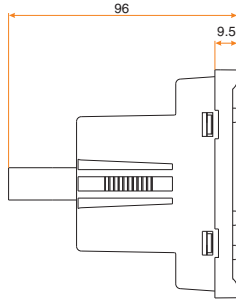
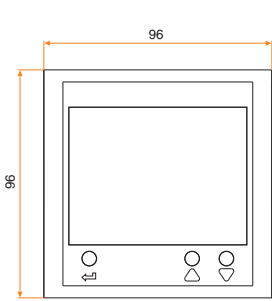


## FYA96 / FYV96



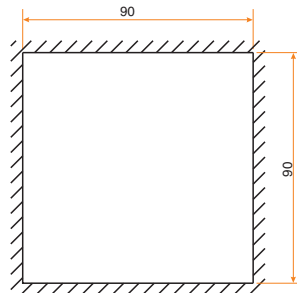
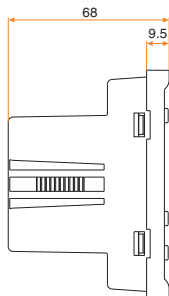
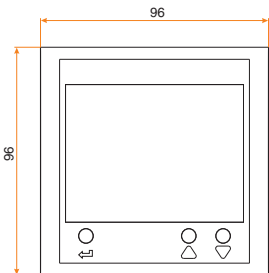
# MEASUREMENT DEVICES

## FYA96 - 200



Panel Assembling Dimensions

## FMM50



Panel Assembling Dimensions

# RELAYS



## Phase Protection Relays



**FMFK**



**MTPR1**



**FSMK**

## Time Relays



**FT-30**

## Counters



**FS72**

## Thermostats



**FDT72**



**FDT96**

## Liquid Level Relay



**FSSR**

All these given information are general. We have always right to change them.

# RELAYS



Pic-1

Connection diagram:

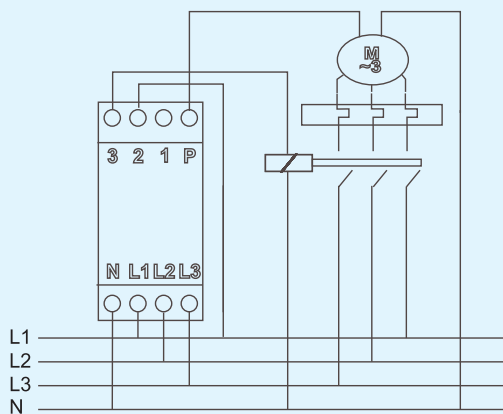


Fig-1

## Motor Phase Protection Relays

Motor Phase Protection Relays protects motor against lack of the phase, phase error, voltage unbalance and overheating at three phase systems.

### Protect Function:

**1) Phase error:** Phase error: If one or two of phases are absent before giving energy to the motor; relay blocks the energy flow to motor by deactivate the output.

**2) Temperature Protection:** If the winding temperature of the motor is exceed the temperature limit value of PTC regardless phase voltages motor deactivates.

**3) Voltage Unbalance:** If Phase-Neutral voltage unbalance exceeds determinated limits motor deactivates.

**4) Phase Sequence Error:** In case of wrong phase sequence, relay disallow the motor to work by deactivates the output

### Technical Specifications:

Supply Voltage	: 220 Vac , % 35 , 50 / 60 Hz
Un-Hysteris:	: Unbalance % 20
Control Output	: Relay, 1 Inverser, 10A / 250 Vac (Omron)
Power Consumption	: < 7 VA
PTC Resistance	: 2 k ohm
Working Temperature	: -5°C...+55°C
Electrical Life	: 50.000 Open / Close (Resistive Load)
Connection Type	: Vertical to the inside of the Panel or to the rail of Clamp.



Pic-2  
MTPR1 Motor phase protection relay

Connection diagram:

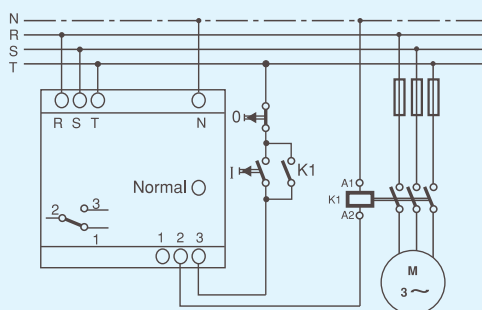


Fig-2

## MTPR1 Motor Phase Protection Relay:

Manufactured in accordance with CE. Protection functions fulfilled by the motor phase protection relay, which is intended to prevent failures in motors, are shown below.

### 1. Phase Cut-off:

Motor is disabled if it remains on 1 or 2 phases for any reason.

### 2. Voltage Imbalance:

Motor is disabled if neutral-phase voltage imbalance exceeds the level of 20% (optionally 40%).

### Technical Specifications:

Operating voltage	: 220 V AC
Operating interval	: (0,8 - 1,2) x Un
Operating frequency (Hz):	50 / 60 Hz
Relay contacts	: 1 NA, 1NK
Ambient temperature	: -5°C, + 50°C
Warning	: Normally on led, which is off in case of fault
Assembly type	: Vertical in the panel or on the terminal box rail
Weight	: 0,25 kg
Voltage imbalance	: Optional 20% or 40%
Order code	: 9HB-A0000-0000

# RELAYS



Pic-3

FSMK Phase Sequence and Motor Protection Relay

Connection Diagram:

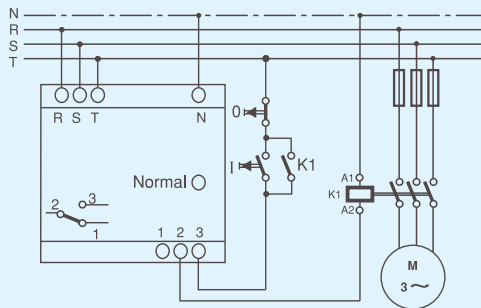


Fig-3

## FSMK Phase Sequence and Motor Protection Relay

Manufactured in accordance with CE. Protection functions fulfilled by the phase sequence and motor protection relay, which is intended to prevent failures in electrical motors widely used at industrial facilities, are shown below.

### 1. Phase Cut-off :

Motor is disabled if it remains on 1 or 2 phases for any reason.

### 2. Voltage Imbalance:

Motor is disabled if neutral-phase voltage imbalance exceeds the level of 20% (optionally 40%).

### 3. Phase Sequence:

When phase sequence is reverse (when time of R, S and T is reverse), motor is not enabled. If the phase sequence is changed due to any reason, motor is disabled.

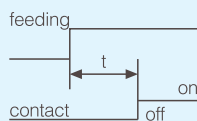
### Technical Specifications:

Operating voltage	: 380 V AC
Operating interval	: $(0,8-1,2) \times U_n$
Operating frequency	: 50 - 60 Hz
Relay contacts	: 1 NA, 1 NK
Ambient temperature	: $-5^{\circ}\text{C}$ , $+50^{\circ}\text{C}$
Warning	: Normally on led, which is off in case of fault
Assembly type	: Vertical in the panel or on the terminal box rail
Weight	: 0,15 kg
Voltage imbalance	: Optional 20% or 40%
Order code	: 9HG-A0000-0000



Pic-4

FT-30 time relay



FT-30 time relay operating way

## FT-30 Time Relay

Manufactured in accordance with CE. Time relays, which find a wide area of usage in industrial automation, are quite important for operation of automation mechanisms.

It operates delayed in drawing. After voltage application to relay, after waiting time delay (0-30 sec), auxiliary contact is shut down.

### Technical Specifications:

Operating voltage	: 220 V AC, 24 V AC/DC
Relay contacts	: 1 NA, 1 NK
Contact power	: 250 V / 5 A AC
Warning	: On led while relay is drawn
Assembly type	: Assembly on terminal box rail or vertical bolting in the panel.
Ambient temperature	: $-10^{\circ}\text{C}$ , $+60^{\circ}\text{C}$
Time adjustment	: 0-30 sec
Order code	: 9HD-A0001-0030



Pic-1

## Connection Diagram (FSSR02 and FSSR03)

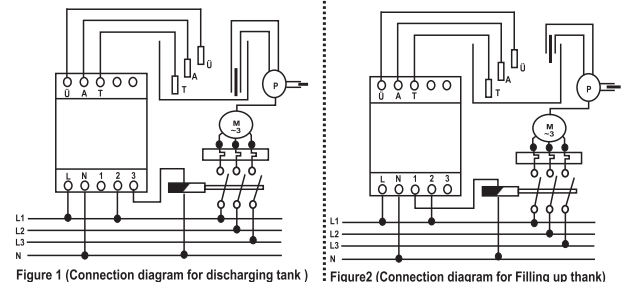


Figure 1 (Connection diagram for discharging tank)

Figure2 (Connection diagram for Filling up tank)

## FSSR04

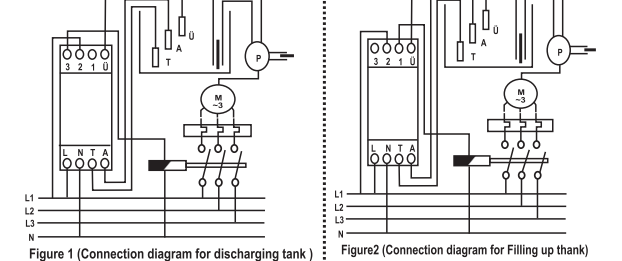


Figure 1 (Connection diagram for discharging tank)

Figure2 (Connection diagram for Filling up tank)

## 2. Using with electrode

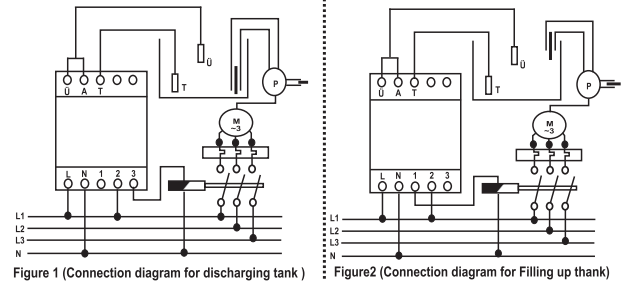


Figure 1 (Connection diagram for discharging tank)

Figure2 (Connection diagram for Filling up tank)

## Liquid Level Relay:

The pump motors where installed at Industrial tanks, water tanks, artesian well are controlled by Liquid Level Relays. Each relay has 3 electrodes which provide to fill up and discharge of tanks and well.

Operation and working procedures

Normally it is used 3 electrodes as bottom, lower and upper. When tank or frame is made by metal, it is not necessary for bottom electrode. In this case the relay output for bottom is directly connected to metal body of tank.

### A) Discharging of Tank.

The output of relay number 2 and 3 are connected to motor connection terminal as mentioned at Figure 1. When liquid level reaches to upper electrode, relay is engaged ( 2-3 contacts are shorted) and "RELAY" led is ON. In this position, water pump motor start to discharge tank. When water liquid level decreases till lower electrode, relay cuts off itself ( 1-2 contacts are shorted) and "RELAY" led is OFF. In this position, water pump motor stops. LLR waits to re-fill of liquid tank. If bottom and lower electrodes are closer each other's, liquid tank can be completely discharged. However, it is useful to install 10 cm distance between bottom and lower electrodes to prevent water pump motors in dry.

### B) Filling Up Tank:

The output of relay number 1 and 2 are connected to motor connection terminal as mentioned at Figure 2. In this position, when liquid level reaches to upper electrode level, water pump motor fills up the tank. LLR stand by and waits till liquid level decreases to lower electrode level, then starts to fill up tank when liquid level reaches lower electrode side.

When liquid conductivity are high or the resistance between two electrodes is lower, the sensitivity set should adjusted through max level. In the contrary case, When liquid conductivity are low or the resistance between two electrodes is much higher, the sensitivity set should be adjusted through min. Level. Thereby the wrong driving due to electrodes and wetness & humidity at their connection cables is prevented.

## Electrodes

The freestanding electrodes which is made by stainless steel and covered by plastic are used in wells. In case which tank or frame are made by metal, this steel electrode can be mounted to metal body of tank. The boiler type of electrode should be used for controlling liquid levels under pressure in such air pressure tank. It is recommended to use contact type buoy for type of liquids which electrical circuit is highly conducted or non-conducted.

**P.S. 1 :** The bottom electrode has to be used otherwise, relay cannot derive.

**P.S.2 :** In case of using 2 electrodes, Electrode 1 : Bottom, Electrode 2 : Upper. Upper and lower electrodes are shorted.

**P.S. 3:** LLR cannot be used in flammable liquids.





Pic-6 FS72 Counter

## FS72 Counter

Federal counter, which is manufactured in accordance with CE, counts depending on impulse input and multiplier factor. As the counting is performed under control of microprocessor, rate of errors is very low. FS 72 may keep program parameters and latest value for 10 years, even if there is an electricity failure. Pulse can be entered in FS 72 counter via encoder, proximity switch and contact. Input frequency is 130 Hz maximum.

### Technical Specifications::

Operating voltage	: 220 V AC 50 Hz
Relay contacts	: 1 NA , 1 NK
Contact power	: 250 V / 5 A AC
Warning	: On led while relay is drawn
Assembly type	: In front of the panel
Ambient temperature	: - 10°C, + 60°C
Input frequency	: Max. 130 Hz.
Counting interval	: 000000 - 999999
Multiplier coefficient	: 00.0001 - 99.9999
Reset duration	: 0.01-99.99 sec
Sensor supply output	: 12 V DC
Dimensions	: 72x72
Order code	: 9KS-D0100-0000



Pic-7  
FDT72 Thermostat

## FDT72 Thermostat

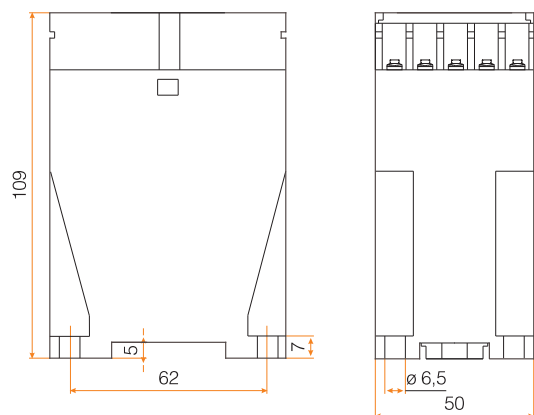
Federal Thermostats, which are manufactured in accordance with CE, operated in two manners as on-off and time-proportional control method. In On-off control method, when heat achieves the set value, thermostat relay is opened, when temperature value goes down to the set non-hysteria value, relay is closed again and continues operation in the desired area. When time-proportional control method is employed, device operates like in on-off control method 4°C below and above the set value. It is opened and closed in the selected control period at intermediate values.

### Technical Specifications:

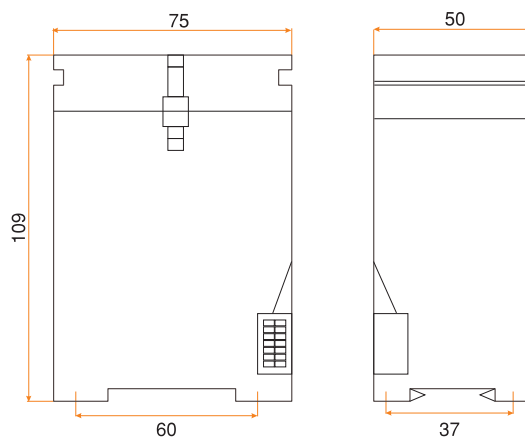
Operating voltage	: 220 V. AC. /50-60 Hz.
Measurement control interval:	0-400°C
Power consumption	: ≤ 3 W
Ambient temperature	: -10°C, +60°C
Temperature compensation	: 0-50°C
Hys interval	: 2°C, - 20°C (While On-Off control method is employed)
Control Period	: 10 sec. - 200 sec.
Control Output	: Relay (220 V. AC. 3A.)
Assembly type	: 1- On-Off control method 2- Time-proportional control method
Dimensions	: 72x72 (FDT 72) 96x96 (FDT 96)
Order code	: 9KT-D0110-0400 9KT-D0210-0400

# RELAYS

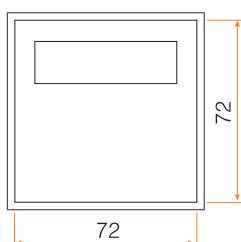
**Motor Protection, Phase Sequence, Liquid Level Relay:**



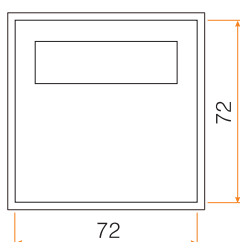
**Phase Sequence and Motor Protection Relay:  
Motor Phase Protection Relay:  
Time Relay:**



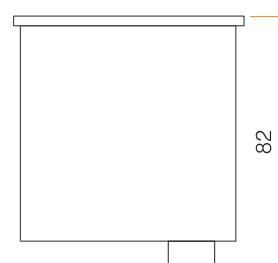
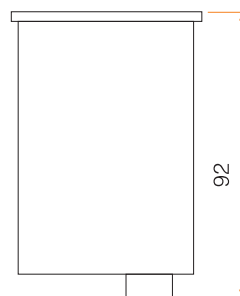
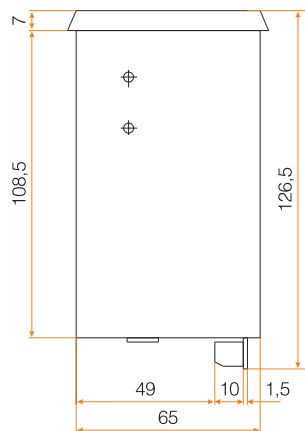
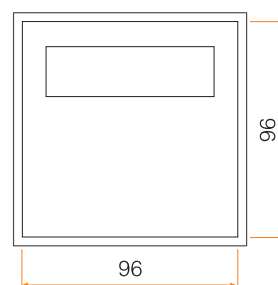
**Counter**



**Thermostat (FDT72) :**



**Thermostat (FDT96) :**



# MOTOR PROTECTION SWITCHES



## Motor Protection Switches



**FMK25**  
0,16A / 32A

IEC / EN 60947-4-1  
CE

<b>Mounting Position</b>	: With box IP20 / without box IP55
<b>Altitude</b>	: 2000 m (max)
<b>Relative Humidity</b>	: %50 (40°C) , %90 (20°C)
<b>Ambient Temperature</b>	: Between -25°C and +60°C
<b>Pollution Degree</b>	: III
<b>Utilization Category</b>	: AC3

All these given information are general. We have always right to change them.

# MOTOR PROTECTION SWITCHES

Federal FMK 25 type switches are designed specially for motor protection and they are ideal in terms of size, easy assembly and performance. They are manufactured in accordance with IEC / EN 60947-4-1 standards and **CE**. They provide excellent protection in overload and short circuit circumstances.

They can be simply and rapidly assembled on a 35 mm assembly rail and fixed by using two screws with a special apparatus. Federal FMK 25 type switches are used in protection of electrical motors up to 11 kW (380/400). They meet all the requirements of users thanks to wide variety of accessories.

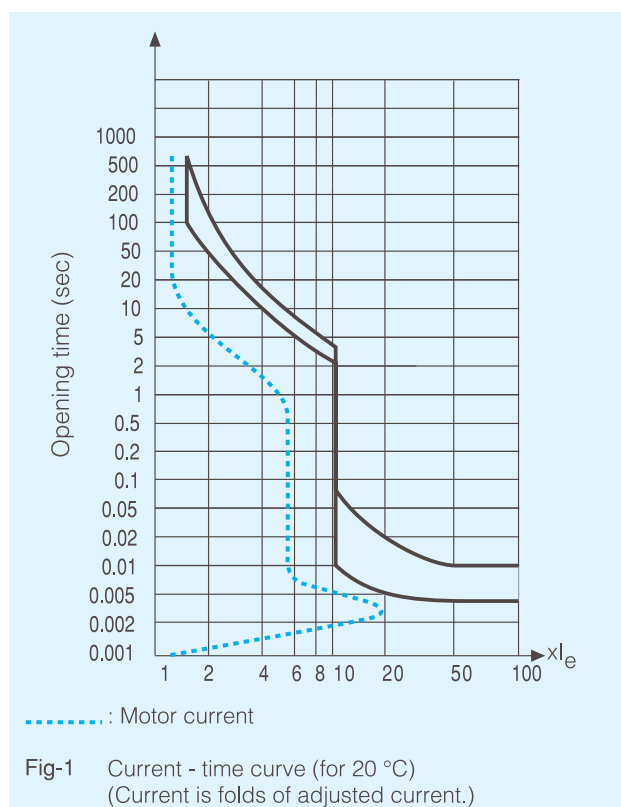
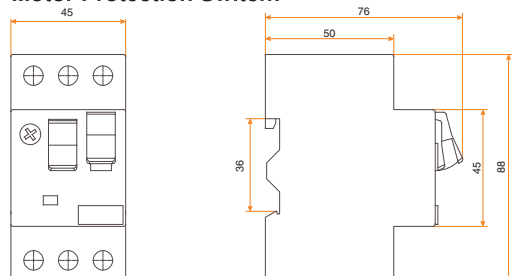
## Motor Protection Switches Selection Table:

Standard motor powers					Thermal adjustment area
1 phase	3 phase				
220V 240V	220V 240V	380V 415V	500V	660V 690V	
kW					A
0,03	-	0,03	-	-	0,1...0,16
0,06	0,03	0,06	0,09	0,12	0,16...0,25
0,06	0,06	0,09	0,12	0,09/0,12	0,25...0,4
0,9/0,12	0,6/0,09	0,18	0,18	0,25/0,37	0,04...0,63
0,18	0,09/0,18	0,25	0,25/0,37	0,55/0,75	0,63...1
0,25	0,25	0,37/0,55	0,55	0,75/1,1	1...1,6
0,37	0,37/0,55	0,55/0,75	1,1/1,5	1,5	1,6...2,5
0,55/0,75	0,55/1,1	1,1/1,5	1,5/2,2	2,2/3,7	2,5...4
1,1	1,1	2,2/3	3/4	3,7/5,5	4...6,3
1,5	2,2	3/4	4/5,5	5,5/7,5	6...10
2,2	3/3,7	5,5	7,5	7,5/11	9...14
3/3,7	3,7/4	7,5	11	15	13...18
3,7/4	5,5	11	15	11/15	17...23
-	5,5/7,5	11	15	18,5/22	20...25
-	7,5	15	15/18,5	22	24...32

## Technical Features

General		
Mechanical life	operation	100.000
Weight (~)	g	260
Main circuits		
Rated insulation voltage $U_i$	V	690
Rated impulse withstand voltage $U_{imp}$	kV	6
Thermal current $I_{th}=I_e$	A	0,1A...32A
Electrical life (according to AC3 class)		100.000
Min. max. tightening torque	Nm	1,5...2,5
Min. max. connection sections	mm <sup>2</sup>	0,75...6
Auxiliary contact block		
Rated insulation voltage $U_i$	V	690
Thermal current $I_{th}$	A	6
Rated operating current $I_e$	230 V	3,0
(according to AC 15)	400 V	2,0
	500 V	0,6
Short circuit protection - max	kA	6 (gL, gG)
Min. max connection sections	mm <sup>2</sup>	0,75...2,5

## Motor Protection Switch:

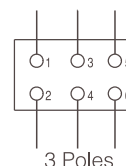
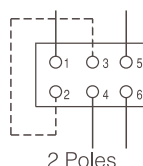
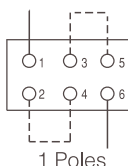


# MOTOR PROTECTION SWITCHES






Type	Thermal adjustment area (A)	Short circuit current (A)	Short circuit breaking capacity $I_{cu} = I_{cs} = I_g$ (kA)				Frontal protection insurance gL, gG (A) (for $I > I_{cu}$ )				Order Code
			220-240V	380-415V	500V	660-690V	230V	400V	500V	690V	
FMK 25-0,16	0,1...0,16	2	100	100	100	100	—	—	—	—	9LA-00000-0016
FMK 25-0,25	0,16...0,25	2,6	100	100	100	100	—	—	—	—	9LA-00000-0025
FMK 25-0,4	0,25...0,4	4,4	100	100	100	100	—	—	—	—	9LA-00000-0040
FMK 25-0,63	0,4...0,63	8	100	100	100	100	—	—	—	—	9LA-00000-0063
FMK 25-1	0,63...1	11	100	100	100	100	—	—	—	—	9LA-00000-0100
FMK 25-1,6	1...1,6	19	100	100	100	100	—	—	—	—	9LA-00000-0160
FMK 25-2,5	1,6...2,5	30	100	100	3	2,5	—	—	25	20	9LA-00000-0250
FMK 25-4	2,5...4	42	100	100	3	2,5	—	—	35	25	9LA-00000-0400
FMK 25-6,3	4...6,3	69	100	100	3	2,5	—	—	50	35	9LA-00000-0630
FMK 25-10	6...10	110	100	6	3	2,5	—	80	50	35	9LA-00000-1000
FMK 25-14	9...14	170	6	4	2,5	2	80	80	63	35	9LA-00000-1400
FMK 25-16	10...16	210	6	4	2,5	2	80	80	63	35	9LA-00000-1600
FMK 25-18	13...18	223	6	4	2,5	2	80	80	63	35	9LA-00000-1800
FMK 25-23	17...23	327	6	4	2,5	2	80	80	63	50	9LA-00000-2300
FMK 25-25	20...25	330	6	4	2,5	2	80	80	63	50	9LA-00000-2500
FMK 25-32	24...32	420	6	4	2,5	2	80	80	63	50	9LA-00000-3200
Dimension Lenght x width x depth: 88x45x75mm											

Note :Our products are calibrated to 40 °C. This value can be changed according to customer's request.

## Connection Diagram



## Accessories

	Accessory name: Auxiliary switch		
	Weight : 35g		
	Type	Contact Position	Order Code
	FMKF - 20	2NA	8LA-A0020-0000
	FMKF - 10	1NA	8LA-A0010-0000
	FMKF - 01	1NK	8LA-A0001-0000
	Accessory name: Under-voltage release		
	Weight : 65g		
	Tip	Operating Voltage (50 Hz)	Order Code
	FMK DGB-24	24 V	8LA-B0000-0024
	FMK DGB-48	48 V	8LA-B0000-0048
	FMK DGB-110	110 V	8LA-B0000-0110
	FMK DGB-220	220 V	8LA-B0000-0220
	FMK DGB-240	240 V	8LA-B0000-0240
	Accessory name: Opening Relay		
	Type	Operating Voltage (50 Hz)	Order Code
	FMK A-220	220 V	8LA-C0000-0220
	Accessory name: Emergency stop button with storage box		
	Type : FMK NAT		
	Order Code : 8LA-D0000-0000		
	Accessory name: Storage box		
	Type : FMK ENC		
	Protection Class : IP 55		
	Order Code : 8LA-E0000-0000		

## NOTLAR

# FIBER GLASS REINFORCED POLYESTER CABINET



Fiber Glass Reinforced Polyester Cabinet





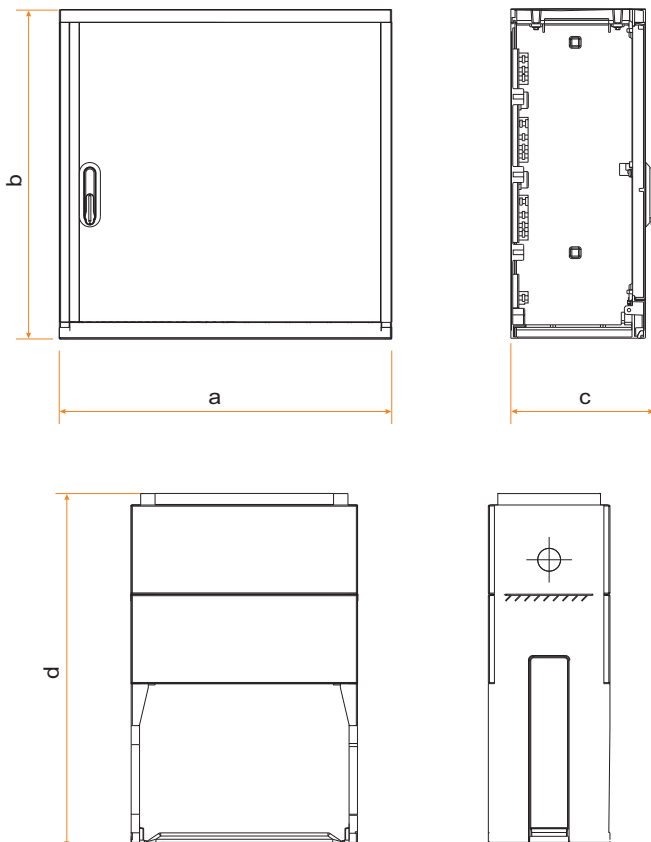
# FIBER GLASS REINFORCED POLYESTER CABINET

When fiber glass reinforced polyester cabinet compares with metal cabinets it prefers with the reason of much more low weight and life safety than other cabinets. Nowadays, many accidents occurs because of fires which caused by electrical leakage and electric shocks. Most of the accidents occur in short circuit and leakage into the cabinet and cables. Fiberglass reinforced polyester cabinet has undisputed importance in safety of life and property. During 2 minutes It doesn't have electric arc leakage which may occur. Fiberglass reinforced polyester cabinet which is using in production has capable of self-extinguishing. It has advantage in easy carry and mounted. These cabinets have function of water and humidity proof and it doesn't cause maintenance cost for the user. Cabinets which preferred because of stainless characteristics don't need paint.

## Features

- At least 25 years of service life
- Hot moulding method as SMC
- Fixing materials are stainless steel.
- Colour distribution is uniform.
- Self-Extinguishing
- During 2 minutes not have electric arc leakage
- Easy carry and mounted
- Water and humidity proof

## Technical Drawing



Technical Specifications	Type-1	Type-3
Width (a)	585	790
Height (b)	880	880
Depth (c)	320	320
Base Length (d)	900	900
IP Protection	IP54	IP54
Total weight (kg)	37	45
Color	7035	7035



# EasyPan DISTRIBUTION BOARDS



## EasyPan Distribution Boards



### EP1

12 ways  
18 ways

### EP1S

12 ways  
18 ways



### EP2

24 ways  
30 ways

### EP2S

24 ways  
30 ways



### EP3

36 ways  
42 ways

### EP3S

36 ways  
42 ways

Note: Only MCB, Isolator and RCCB are connected to the input of S type EasyPan Distribution Board

## Ready Bus Systems



### EasyPan with F12 Output

Main Busbar Current 250A-400A-630A



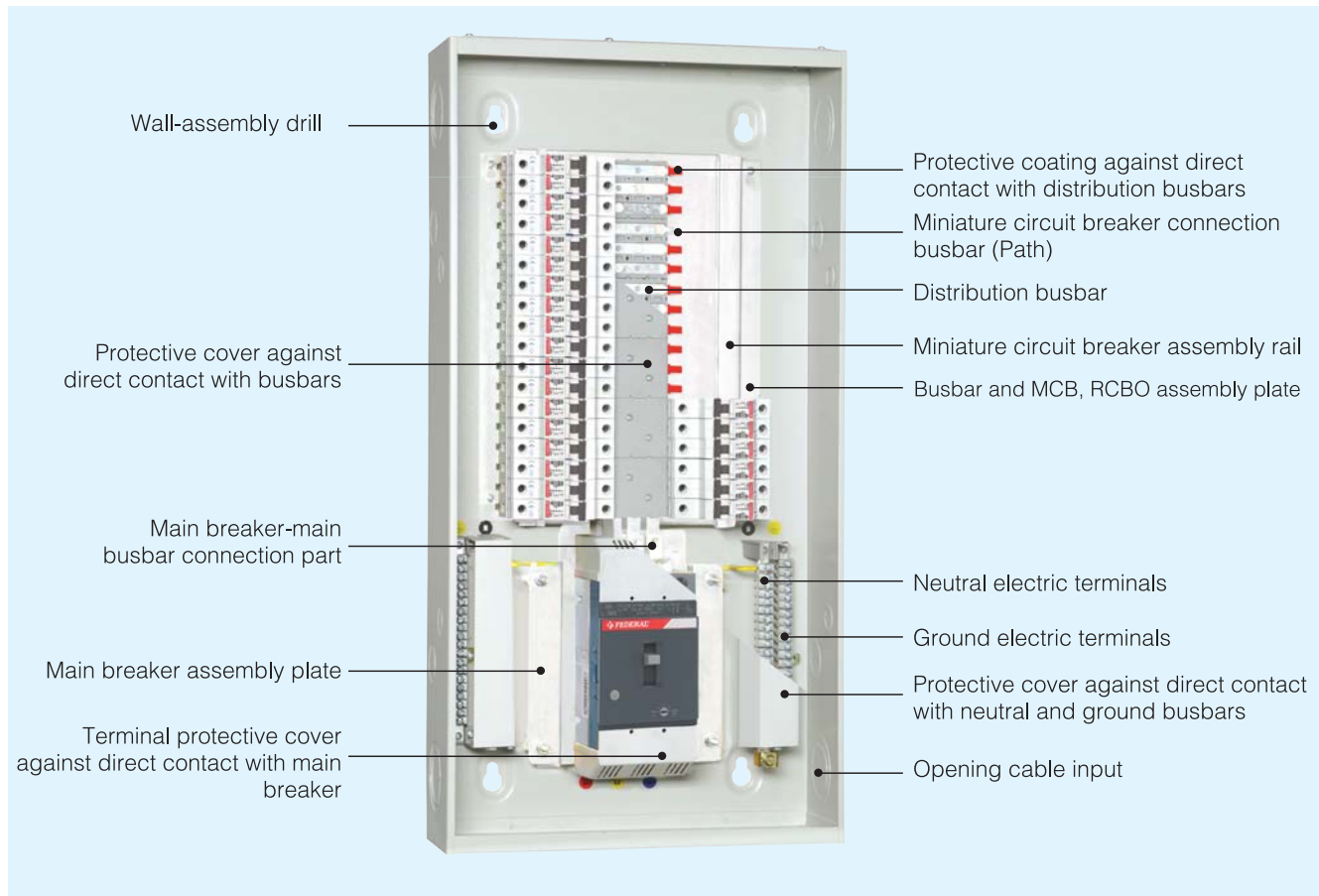
### EasyPan with F31 Output

Main Busbar Current 250A-400A-630A

All these given information are general. We have always right to change them.

# EasyPan DISTRIBUTION BOARDS

Federal EasyPan distribution boards, which are used for power distribution, illumination applications, installation control and protection against over current at residences and industrial facilities, are manufactured in accordance with IEC 60439-1 and “CE” norms as flush and surface mounted.



## Features:



- Easy assembly
- Easy and reliable maintenance
- Modern technology and modular structure
- Aesthetic appearance
- Suitable design for assembly of Federal products
- User-replaceable accessories
- Completely equipped or only dispatch with busbar system
- Selecting possibilities of circuit breaker, switch, residual current circuit breaker as a main breaker
- Direct connection possibility without usage of main breaker
- Cabling inside board
- Bottom, top and side opening cable inputs
- Light gray (RAL 9002) electrostatic powder paint 1,2 mm DKP plate  
(May be manufactured in different color or of galvanized plate upon customized order)
- IP40 and IPH54 protection class
- Displaying phases with colored labels: red (R phase), yellow (S phase), blue (T phase).

**Note:** In case of the place to EasyPan Distribution Board order, current breaking capacity rate (3kA-6kA-10kA) need to be informed.

# EasyPan DISTRIBUTION BOARDS



## Input Circuit: L.V. Circuit Breakers

TS EN 60947-2 / IEC 60947-2 CE						
Type			F12	F31	F32	F33
Rated Current - In (40°C or 55°C)		A	16 ...160	16 ...250		
Rated current adjustment range - I <sub>n</sub>		A	(0,8-1) In	(0,7-1) In		
Rated ultimate short-circuit breaking capacity - I <sub>cu</sub>						
(a.c.) 50-60 Hz	3x380/415 V	(kA rms)	25	35	50	70
(a.c.) 50-60 Hz	3x220/240 V	(kA rms)	35	65	85	100

Assembly type		Flush mounted	Surface mounted
Type	Number of ways	Order code	Order code
EP1	12	9VM-△△△A1-□◇◇◇	9VM-△△△U1-□◇◇◇
	18	9VM-△△△A2-□◇◇◇	9VM-△△△U2-□◇◇◇
EP2	24	9VK-△△△A1-□◇◇◇	9VK-△△△U1-□◇◇◇
	30	9VK-△△△A2-□◇◇◇	9VK-△△△U2-□◇◇◇
EP3	36	9VB-△△△A1-□◇◇◇	9VB-△△△U1-□◇◇◇
	42	9VB-△△△A2-□◇◇◇	9VB-△△△U2-□◇◇◇

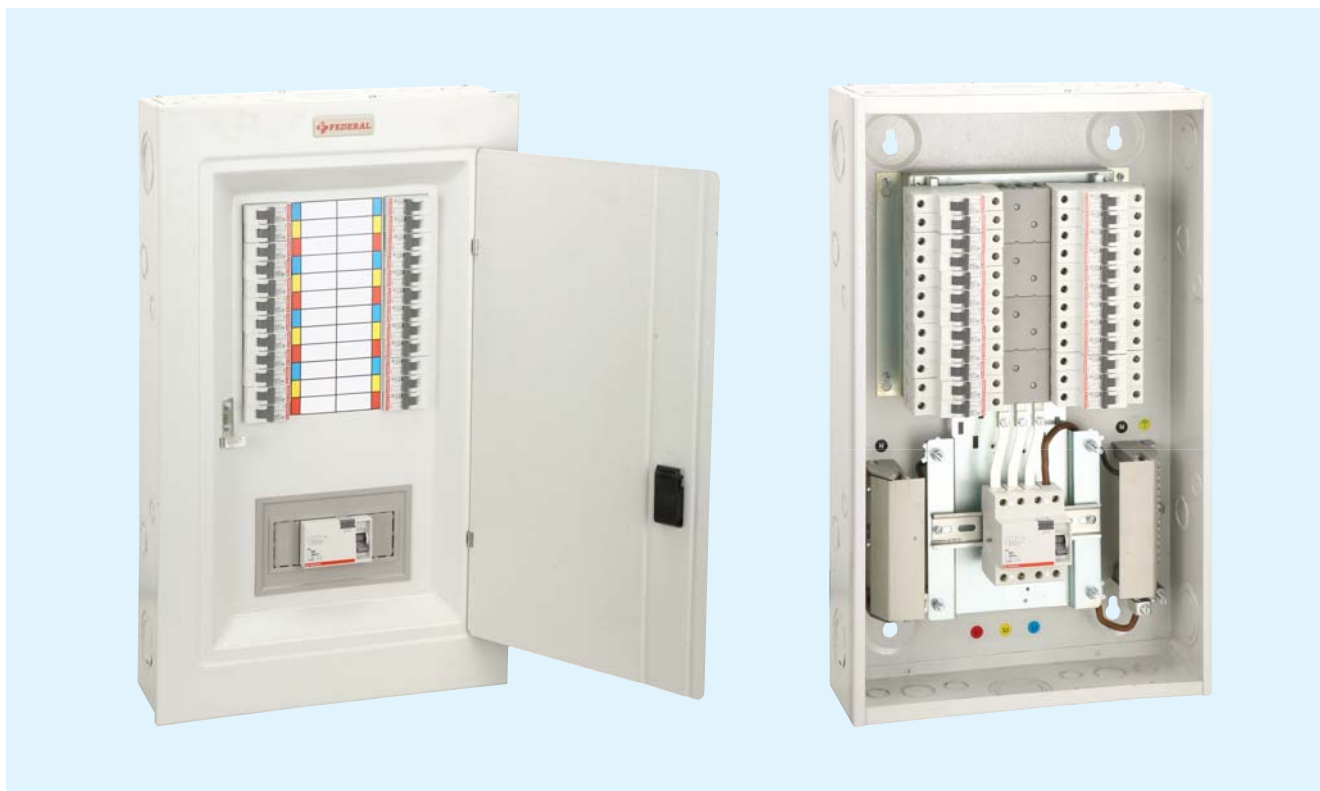
△△△ : Type of circuit breaker (F12 ... F33),  
□ : Ambiance temperature (20°C:1, 30°C:2, 40°C:3, 50°C:4, 55°C:5),  
◇◇◇ : Rated current of circuit breaker (016 .... 250).

For example; Surface mounted, 30-way, F33 2 0A circuit breaker (Ambient temperature 40°C)  
EasyPan order code: 9VB-F33U1-3200





Please indicate circuit breaker type in orders without circuit breaker and define order code as □: 0, ◇◇◇

For example; EasyPan order code without circuit breaker, suitable for assembly of surface mounted, 30-way, F3 type circuit breakers: 9VB-F3 △U1-0000

# EasyPan DISTRIBUTION BOARDS



## Input Circuit: Residual current circuit breakers

TS EN 61008-1 / IEC 61008-1 CE					
		<b>FK2 - FK2E</b>	<b>FK2L</b>	<b>FK4 - FK4E</b>	<b>FK4L</b>
Number of poles		2	2	4	4
Rated current	A	25, 40, 63	80, 100, 125	25, 40, 63	80, 100, 125
Nominal residual current	mA	30, 300			
Fused short circuit breaking capacity	kArms	10			

## Order Codes

Assembly type			Flush Mounted	Surface Mounted
Type	Fused Short circuit breaking capacity (kArms) 3x415 V / 3x240 V	Number of ways	Order Code	Order Code
EP1	3	12	9VM-△△△△A1-□◇◇◇	9VM-△△△△U1-□◇◇◇
		18	9VM-△△△△A2-□◇◇◇	9VM-△△△△U2-□◇◇◇
EP1S	3	12	9SM-△△△△A1-□◇◇◇	9SM-△△△△U1-□◇◇◇
		18	9SM-△△△△A2-□◇◇◇	9SM-△△△△U2-□◇◇◇
EP2	3	24	9VK-△△△△A1-□◇◇◇	9VK-△△△△U1-□◇◇◇
		30	9VK-△△△△A2-□◇◇◇	9VK-△△△△U2-□◇◇◇
EP2S	3	24	9SK-△△△△A1-□◇◇◇	9SK-△△△△U1-□◇◇◇
		30	9SK-△△△△A2-□◇◇◇	9SK-△△△△U2-□◇◇◇
EP3	3	36	9VB-△△△△A1-□◇◇◇	9VB-△△△△U1-□◇◇◇
		42	9VB-△△△△A2-□◇◇◇	9VB-△△△△U2-□◇◇◇

△△△ : Type of residual current circuit breaker (FK3,FK30)

□ : Number of pole (2,4)

◇◇◇ : Rated current of residual current circuit breaker (040,063).

For example; Surface mounted, 18-way, 30mA, 2P, 40A residual current circuit breaker EasyPan order code: 9VK-0FK3U1-2040

# EasyPan DISTRIBUTION BOARDS



## Input Circuit: Miniature Circuit Breakers

TS 5018 TS EN 60898-1 / IEC 60898-1 CE			
<b>Tip</b>		<b>FM4E-FM6E-FM10 FM6L-FM10L</b>	<b>FM6L - FM10L</b>
Characteristics		B, C, D	B, C
Short circuit breaking capacity kArms		3 - 6 - 10	10
Rated current	A	0,5 ... 63	80 ...125
Number of poles		1,1+1,2,3,3+1,4	1, 2, 3, 4

## Input Circuit: Isolator

TS EN 60947-3 / IEC 60947-3 CE			
<b>Type</b>		<b>FMS</b>	
Rated Current (In)	A	63, 80, 100	
Number of poles		1, 2, 3, 4	
Short circuit breaking capacity	kArms	12 In / 1sec	

Switch: Thermal and magnetic non-protective opening-closing breaker

## Miniature circuit breaker order codes: (Boards if miniature circuit breakers are requested assembled)

Short circuit breaking capacity kArms	3 kA	6 kA	10 kA
	9EC-△003□-0D##	9E☆-△0G3□-0D##	9EE-△103□-0D##

△ : For type B (B), for type C (C), for type D (D)

□ : Number of poles.(1,2,3,4)

##: Rated current (0,5...125)

☆ : G for FM6E or FM10E, O for FM6 or FM10.

O : 3 for FM3, 4 for FM4.

Example: 1 pole B type 16A (10kA) miniature circuit breaker (standard 40°C) order code: 9EE-B1031-0D16

## EasyPan Order Codes with switch:

Assembly type			Flush Mounted	Surface Mounted
Type	Short circuit breaking capacity	Number of ways	Order Code	Order Code
EP1	12 In / 1 sn	12	9VM-FMSA1-□◇◇◇	9VM-FMSU1-□◇◇◇
		18	9VM-FMSA2-□◇◇◇	9VM-FMSU2-□◇◇◇
EP1S	12 In / 1 sn	12	9SM-FMSA1-□◇◇◇	9SM-FMSU1-□◇◇◇
		18	9SM-FMSA2-□◇◇◇	9SM-FMSU2-□◇◇◇
EP2	12 In / 1 sn	24	9VK-FMSA1-□◇◇◇	9VK-FMSU1-□◇◇◇
		30	9VK-FMSA2-□◇◇◇	9VK-FMSU2-□◇◇◇
EP2S	12 In / 1 sn	24	9SK-FMSA1-□◇◇◇	9SK-FMSU1-□◇◇◇
		30	9SK-FMSA2-□◇◇◇	9SK-FMSU2-□◇◇◇
EP3	12 In / 1 sn	36	9VB-FMSA1-□◇◇◇	9VB-FMSU1-□◇◇◇
		42	9VB-FMSA2-□◇◇◇	9VB-FMSU2-□◇◇◇

□ : Number of pole (2,3)

◇◇◇ : Rated current of switch (063,080,100).

For example: Flush mounted, 36-way, 3P, 100A switch EasyPan order code: 9VB-FMSA2-3100



# EasyPan DISTRIBUTION BOARDS



## EasyPan Order Codes with direct connection

Assembly type		Flush mounted	Surface mounted
Type	Number of ways	Order code	Order code
EP1	12	9VM-DDDA1-0000	9VM-DDDU1-0000
	18	9VM-DDDA2-0000	9VM-DDDU2-0000
EP1S	12	9SM-DDDA1-0000	9SM-DDDU1-0000
	18	9SM-DDDA2-0000	9SM-DDDU2-0000
EP2	24	9VK-DDDA1-0000	9VK-DDDU1-0000
	30	9VK-DDDA2-0000	9VK-DDDU2-0000
EP2S	24	9SK-DDDA1-0000	9SK-DDDU1-0000
	30	9SK-DDDA2-0000	9SK-DDDU2-0000
EP3	36	9VB-DDDA1-0000	9VB-DDDU1-0000
	42	9VB-DDDA2-0000	9VB-DDDU2-0000













Power is supplied to panels by adding connection part to main busbars without using main breaker.

## Please call our company for other combinations

- Short circuit breaking capacity of EasyPan distribution boards is equivalent to short circuit which main breaker used in boards can break.

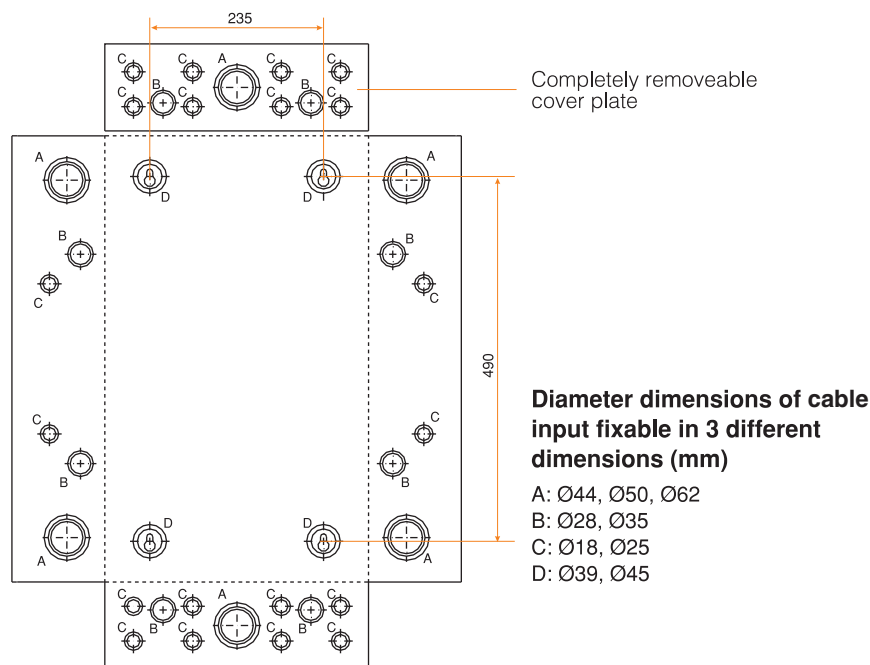


# EasyPan DISTRIBUTION BOARDS

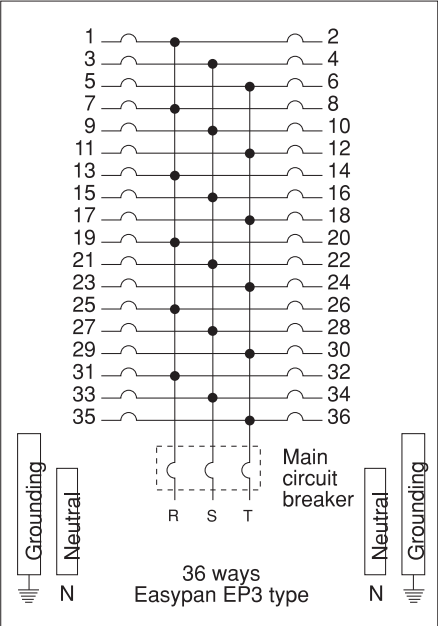
Accessories and order codes:				
MCB holding board with main busbar		Number of ways	Order codes	
		12 18 24 30 36	YP-0021 YP-0022 YP-0023 YP-0024 YP-0025	
Distribution busbar		Number of ways	Order codes	
		12 18 24 30 36	2 Bars YP-D212 YP-D218 YP-D224 YP-D230 YP-D236	4 Bars YP-D412 YP-D418 YP-D424 YP-D430 YP-D436
Neutral + ground terminals		Number of ways	Order codes	
		12 18 24 30 36	YP-0026 YP-0027 YP-0028 YP-0029 YP-0030	
Protective cover for upper terminal		Type of main circuit breaker	Order codes	
		F12 F31, F32, F33 2 pole FK2 (30mA, 300mA) 4 pole FK4 (30mA - 300mA) Direct connection	YP-0031 YP-0033 YP-0034 YP-0035 YP-0038	
Main breaker-main busbar connection parts		Type of main circuit breaker	Order codes	
		F12 F31, F32, F33 2 pole FK2-FK2E (30mA, 300mA), FMS 4 pole FK4-FK4E (30mA - 300mA) 3 pole FMS	YP-0039 YP-0041 YP-0042 YP-0043 YP-0044	
MCB and RCCB assembly rail		Type	Order codes	
		FMS FK3 - FK30	YP-0045 YP-0046	
Main busbar connection parts for direct connection		Type	Order codes	
		Standart part	YP-0047	
Height adjustable-main breaker assembly panel		Type	Order codes	
		Standart part	YP-0048	
MCB space plate (to cover unused MCB paths)		Type	Order codes	
		Standart part	YP-0049	
Automated locking mechanism		Type	Order codes	
		Standart part	YP-0050	
Terminal cover for distribution busbar		Type	Order codes	
		Standart part	YP-0051	
Panel Frame		Type	Order codes	
		Standart part	YP-0036	
		Type	Order codes	
		Standart part	YP-0037	

# EasyPan DISTRIBUTION BOARDS

Detailed Technical Drawing for Cable Inputs

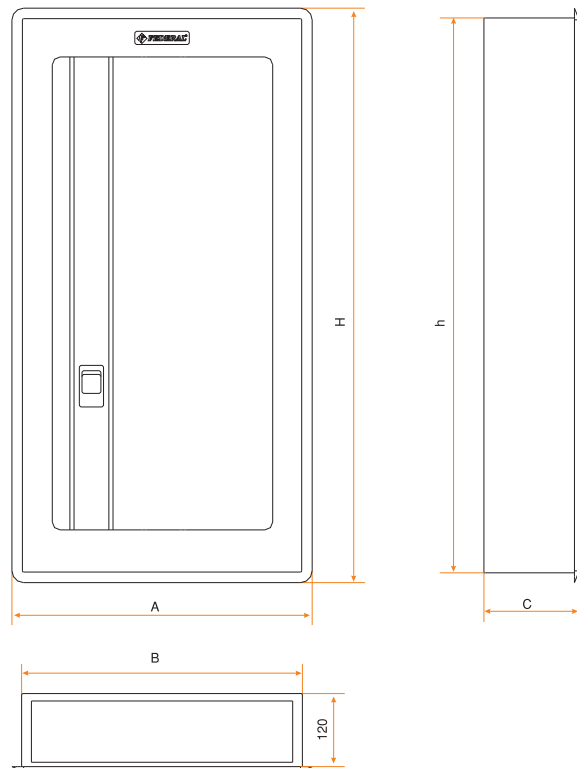


Sample Connection Diagram



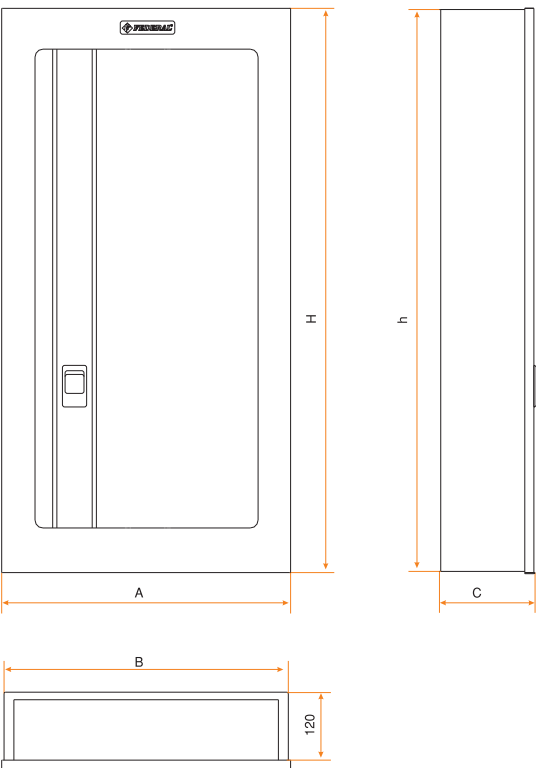
Technical Drawing

Flush Mounted



Flush Mounted	A	B	C	H	h
EP1	385	360	120	520	495
EP1S	355	330	110	435	410
EP2	385	360	120	630	605
EP2S	355	330	110	545	520
EP3	385	360	120	735	710
EP3S	355	330	110	655	630

Surface Mounted

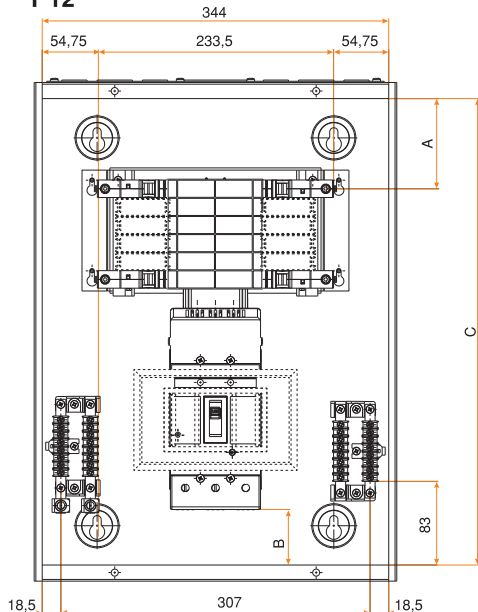


Surface Mounted	A	B	C	H	h
EP1	365	360	120	500	495
EP1S	335	310	110	415	410
EP2	365	360	120	610	605
EP2S	335	310	110	525	520
EP3	365	360	120	715	710
EP3S	335	310	110	635	630

# EasyPan READY BUS SYSTEMS

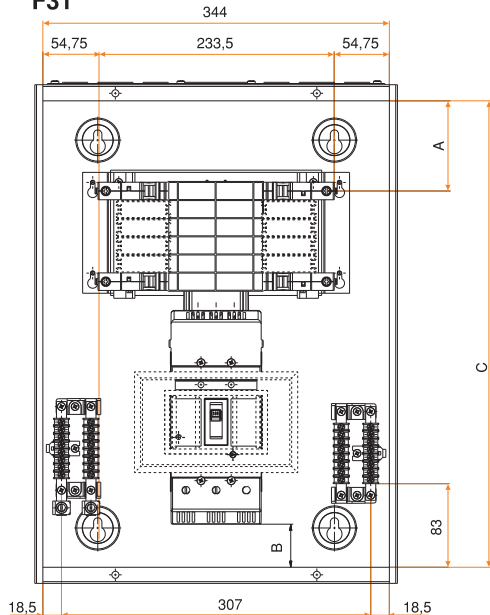
## Cable Gap Distances for Different Panel Applications:

### F12



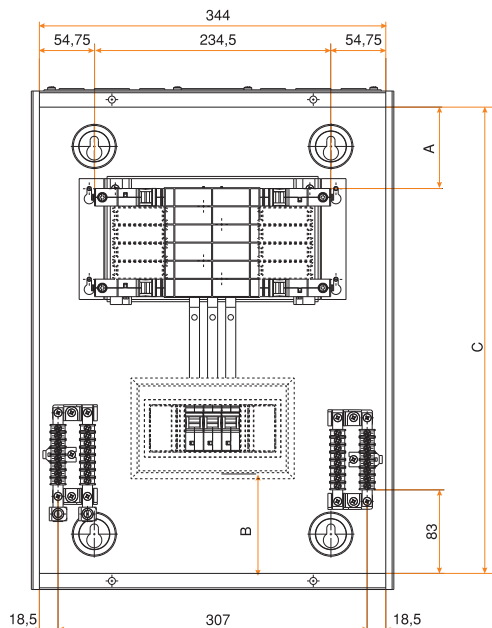
Type	A	B	C
EP1 12 Ways	90	57	460
EP1 18 Ways			
EP2 24 Ways	90	57	570
EP2 30 Ways			
EP3 36 Ways	90	57	675
EP3 42 Ways			

### F31



Type	A	B	C
EP1 12 Ways	90	42	460
EP1 18 Ways			
EP2 24 Ways	90	42	570
EP2 30 Ways			
EP3 36 Ways	90	42	675
EP3 42 Ways			

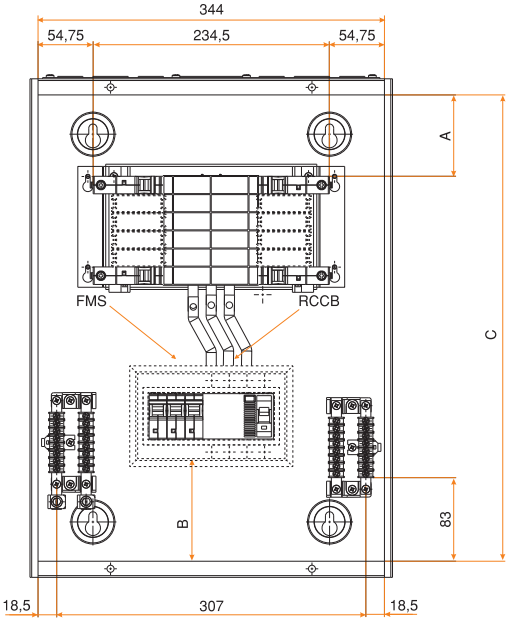
### FMS



Type		A		B		C	
		EP	EPS	EP	EPS	EP	EPS
EP1	12 Ways	90	87	100	85	460	375
	18 Ways	90	33	100	85	460	375
EP2	24 Ways	90	87	100	85	570	485
	30 Ways	90	33	100	85	570	485
EP3	36 Ways	90	87	100	85	675	595
	42 Ways	90	33	100	85	675	595

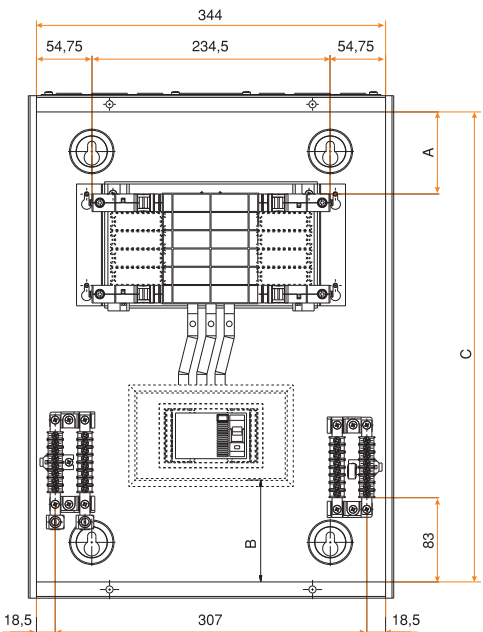
# EasyPan READY BUS SYSTEMS

FMS-FK



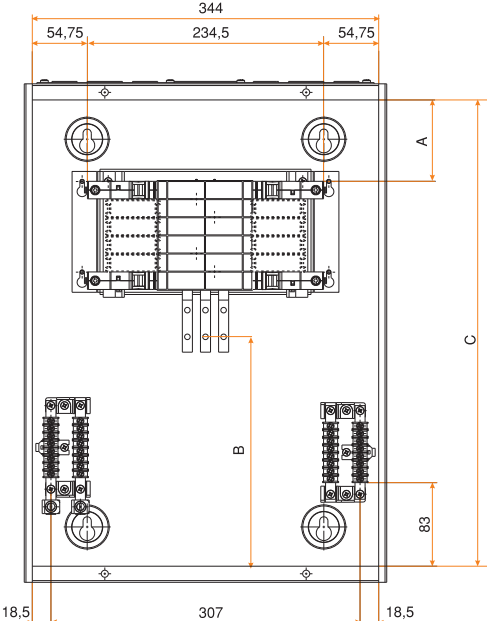
Type		A		B		C	
		EP	EPS	EP	EPS	EP	EPS
EP1	12 Ways	90	87	100	85	460	375
	18 Ways	90	33	100	85	460	375
EP2	24 Ways	90	87	100	85	570	485
	30 Ways	90	33	100	85	570	485
EP3	36 Ways	90	87	100	85	675	595
	42 Ways	90	33	100	85	675	595

FK



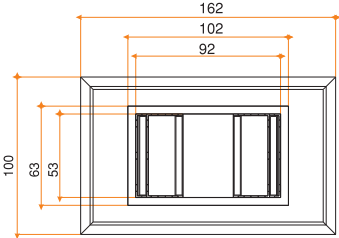
Type		A		B		C	
		EP	EPS	EP	EPS	EP	EPS
EP1	12 Ways	90	87	100	85	460	375
	18 Ways	90	33	100	85	460	375
EP2	24 Ways	90	87	100	85	570	485
	30 Ways	90	33	100	85	570	485
EP3	36 Ways	90	87	100	85	675	595
	42 Ways	90	33	100	85	675	595

Direct Connection

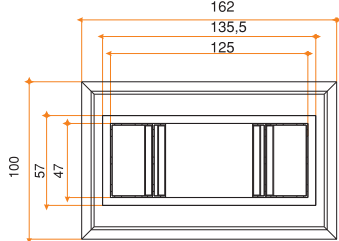


Type		A		B		C	
		EP	EPS	EP	EPS	EP	EPS
EP1	12 Ways	90	87	200	170	460	375
	18 Ways	90	33	200	170	460	375
EP2	24 Ways	90	87	200	170	570	485
	30 Ways	90	33	200	170	570	485
EP3	36 Ways	90	87	200	170	675	595
	42 Ways	90	33	200	170	675	595

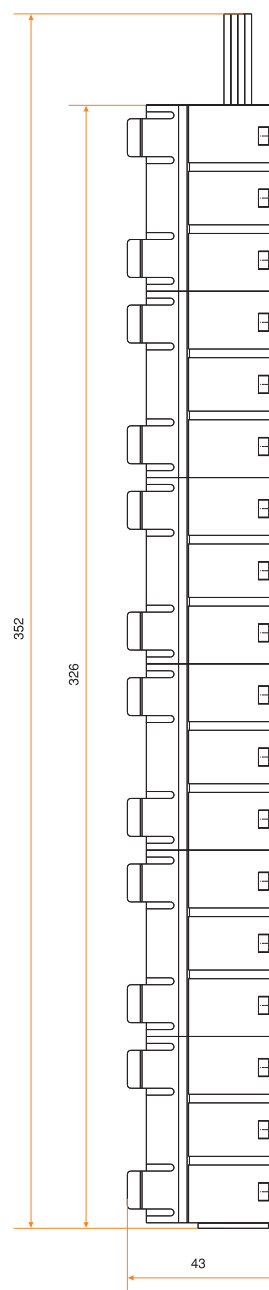
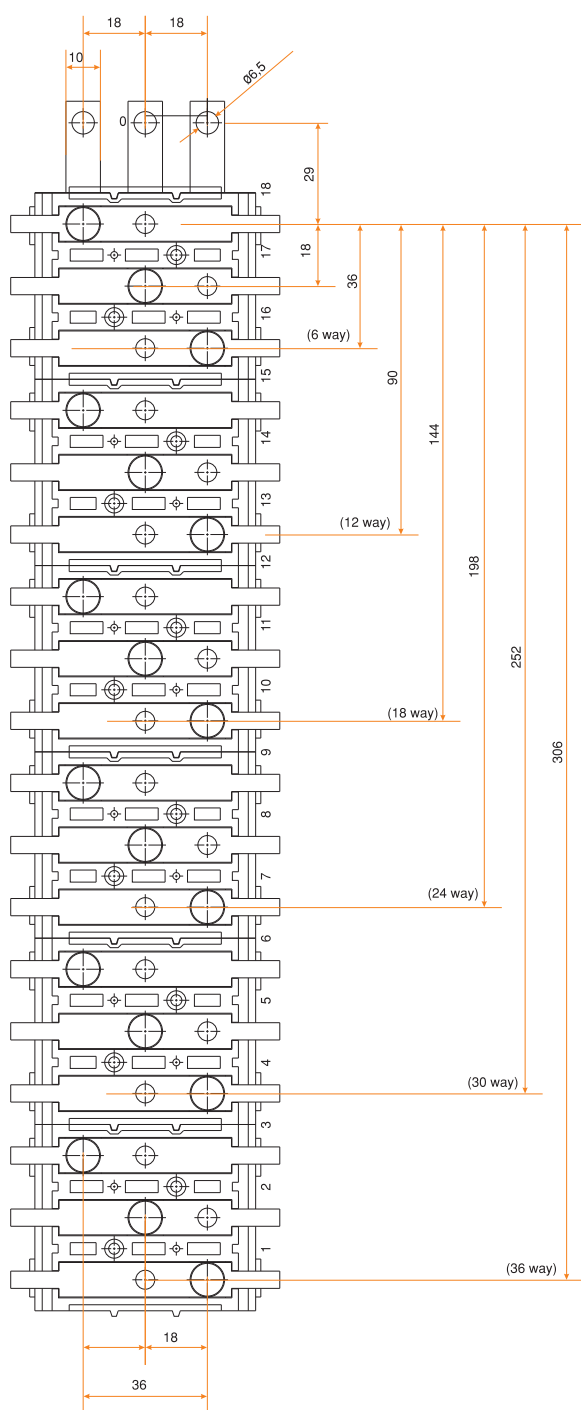
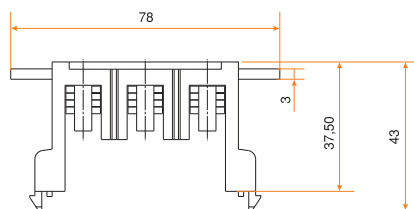
Panel Frame F12



Panel Frame FK-FM3-FM6E-FM6 FM10E-FM10-FMS



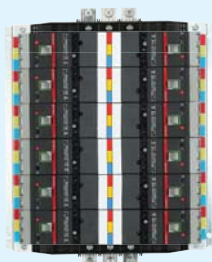
# EasyPan DISTRIBUTION BOARDS



# EasyPan READY BUS SYSTEMS

## Federal Busbar System

Federal busbar system is manufactured in accordance with IEC 60439-1 and CE norms to be used for power.



For F11 type



For F31 type

### Features:

- 250 A, 400A ve 630A main switch connection means
- 2, 4, 6, 10, 12 path (3 pole) Federal F 12, F31 type switch output means
- Conformity with IEC 60439-1 and CE norms
- Easy and reliable maintenance
- Aesthetic apperance
- Completely equipped
- Dispatch in optional panel
- Direct connection without main switch
- Phases shown with colored labels
- Barehand contact has been prevented in compliance with IP20 protection degree according to IEC standards and ensured complete life security.

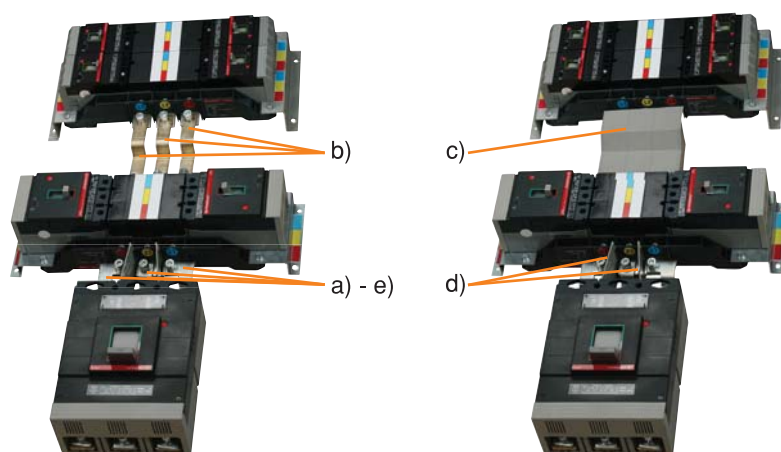
### Anvantages :

- Easy assembly;
- With easy installation and power distribution facilities
- Speedy;
- With simple fast assembly breaker can be changed quickly
- Flexibility;
- Can be increscd easily modular system that number of way
- Reliability;
- In the even of a shot circuit energy is switched on by main breaker. In the even of any failure main system continue to work because of only related breaker are changed.

Federal Busbar Systems		Number of ways	Order Code	
250A Main busbar current			For F11 type	For F31 type
		2	9ZA-F1131-0250	9ZA-F3131-0250
Recommended main circuit breaker		4	9ZA-F1132-0250	9ZA-F3132-0250
F31 - F32 - F33		6	9ZA-F1133-0250	9ZA-F3133-0250
F51 - F52 - F53		8	9ZA-F1134-0250	9ZA-F3134-0250
		10	9ZA-F1135-0250	9ZA-F3135-0250
		12	9ZA-F1136-0250	9ZA-F3136-0250
400A Main busbar current				
		2	9ZA-F1131-0400	9ZA-F3131-0400
Recommended main circuit breaker		4	9ZA-F1132-0400	9ZA-F3132-0400
		6	9ZA-F1133-0400	9ZA-F3133-0400
F71		8	9ZA-F1134-0400	9ZA-F3134-0400
F82 - F83		10	9ZA-F1135-0400	9ZA-F3135-0400
		12	9ZA-F1136-0400	9ZA-F3136-0400
630A Main busbar current				
		2	9ZA-F1131-0630	9ZA-F3131-0630
Recommended main circuit breaker		4	9ZA-F1132-0630	9ZA-F3132-0630
F71		6	9ZA-F1133-0630	9ZA-F3133-0630
F82 - F83		8	9ZA-F1134-0630	9ZA-F3134-0630
		10	9ZA-F1135-0630	9ZA-F3135-0630
		12	9ZA-F1136-0630	9ZA-F3136-0630

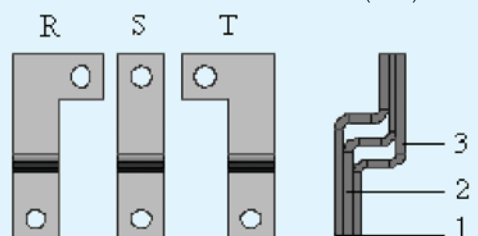
# EasyPan READY BUS SYSTEMS

- Terminal cover, terminal separator and interconnection parts are designed in F31bar distribution system.
- Form of extension bars and interconnection parts differ according to ampere group.
- a) - e) : It changes according to F12 or F31 bar system.



## F11 Bar system accessories

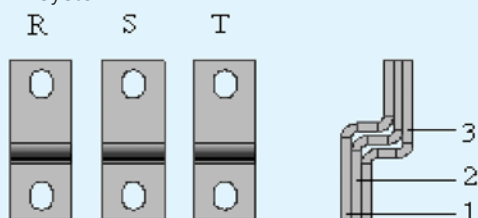
a) They are extension bus bars for connecting MCCB to distribution bus bar (F11) .



Entention bars use for main breaker F82E (800A)

Used system	Ampere Group			Order code
2 way	630A	400A	250A R1	YP-D110
4 way			S1	
6 way			T1	
8 way			250A R2	YP-D111
10 way			S2	
12 way			T2	
			R3	YP-D112
			S3	
			T3	

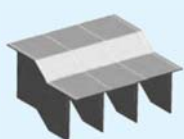
b) They are extension bus bars for connecting F11 distribution system to F31 distribution system.



Interconnection parts will be used when using F31 bar distribution system.

Used system	Ampere Group			Order code
2 way	630A	400A	250A R1	YP-D113
4 way			S1	
6 way			T1	
8 way			R2	YP-D114
10 way			S2	
12 way			T2	
			R3	YP-D115
			S3	
			T3	

c)



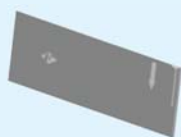
Terminal Cover

2,4,6,8,10, and 12 way

250A, 400A and 630A

YP-D116

d)



Terminal Separator

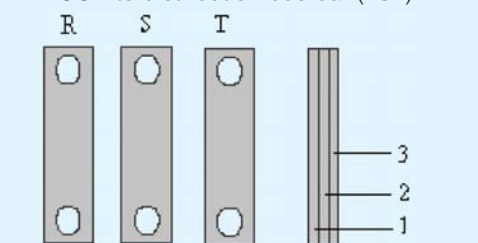
2,4,6,8,10, and 12 way

250A, 400A and 630A

YP-D117

## F31 Bar system accessories

e) They are extension bus bars for connecting MCCB to distribution bus bar (F31)



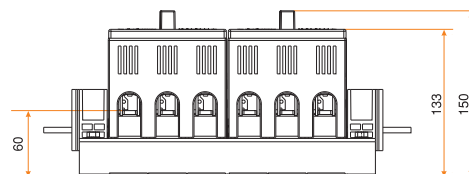
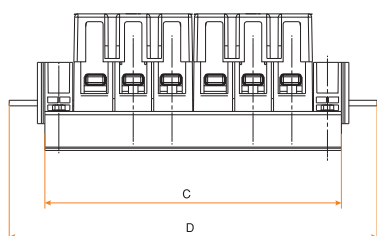
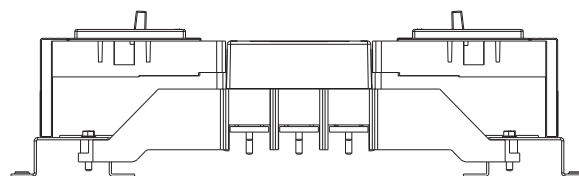
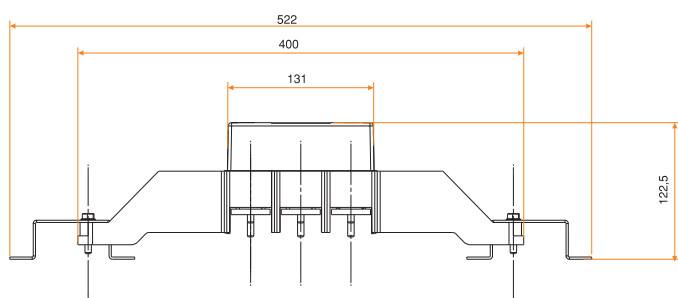
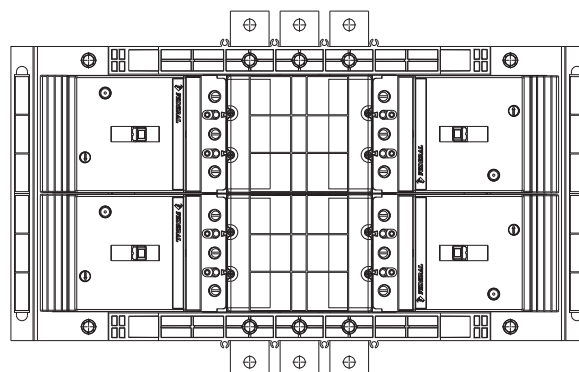
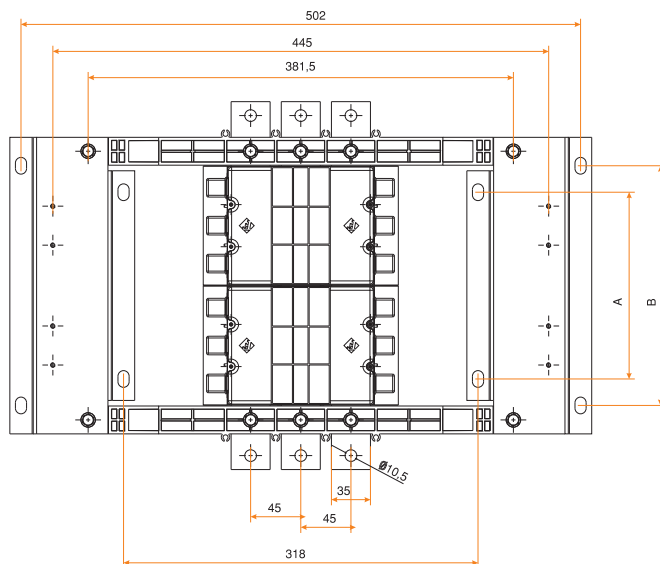
Extention bars use for main breaker F82E (800A)

Used system	Ampere Group			Order code
2 way	630A	400A	250A R1	YP-D0310
4 way			S1	
6 way			T1	
8 way			R2	YP-D0311
10 way			S2	
12 way			T2	
			R3	YP-D0312
			S3	
			T3	



# EasyPan READY BUS SYSTEMS

For F31 Type



Type	A	B	C	D
2 ways	65	114,5	158,5	222,5
4 ways	162,5	215	266	330
6 ways	275	322,5	373,5	437,5
8 ways	315	355	481	545
10 ways	490	537,5	588,5	652,5
12 ways	597,5	645	696	760

# MODULAR MAIN DISTRIBUTION PANEL BOARDS



## Type Tested Panels



## Modular Panel Systems

FMP1



FMP2



Please ask for a panel catalogue for further information.

## TYPE TESTED PANELS

Federal Elektrik has taken type tests for the panels that it has produced. The experiments have been made in IHP Laboratories and Boğaziçi University high current laboratories by the English Certification Institute ASTA observers.

While the inputs and the outputs in the Federal Type Tested Panel can be made over or under the panel according to the needs of the system, it provides the opportunity of making the cable or the bus bar connections from front or rear of the panel. As the panels have been completely designed in modular structure by means of their screw combinations changes can be made and/or new modules can be added and structure can be enlarged. With their sound structures, they are resistant to the dynamic forces that occur during the opening and closing maneuvers of the cutters having high cutting capacities. Through the bus bar design having low temperature increment coefficient that is used in panels, it is provided the interior panel equipments to have long lives. In order to ensure life and property security the contact with energy loaded parts directly or indirectly have been prevented.

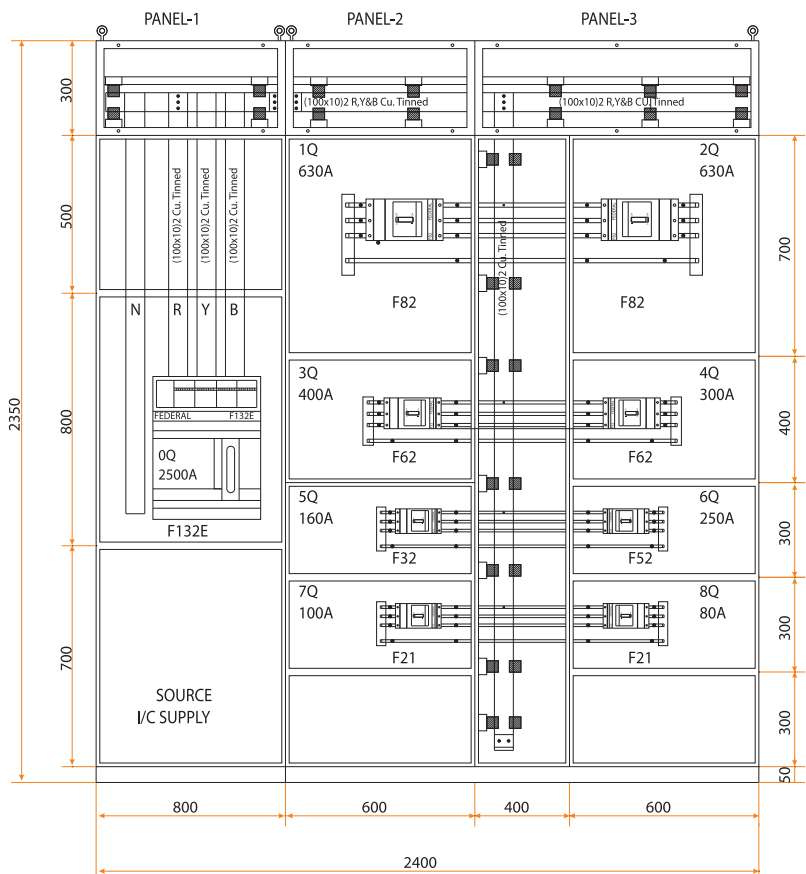
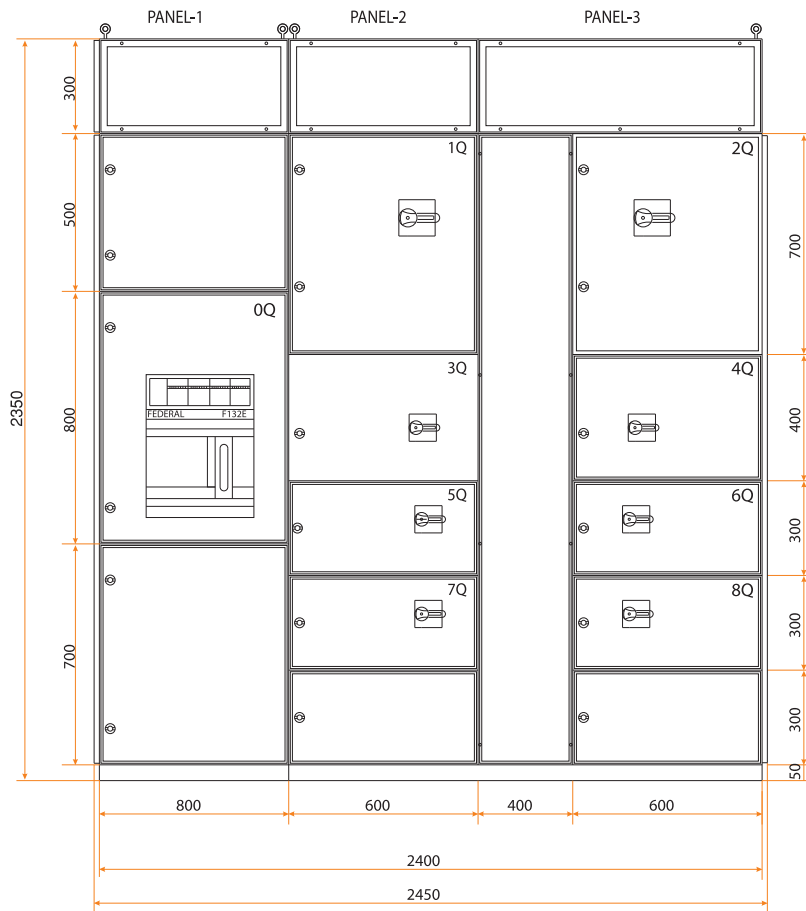
### Electrical characteristics of federal panel

Current Capacity	: 2500 A
Rated Voltage	: 415 V
Isolated Voltage	: 1000 V
Impact Resistance Voltage	: 8kV
Peak Resistance Voltage	: 143kApk
Short Period Resistance Current	: 65kArms
Usage Factor	: 1
Protection Degree	: IP54
Formatting	: Form 4b
Standard	: IEC 61439-1 and IEC 61439-2

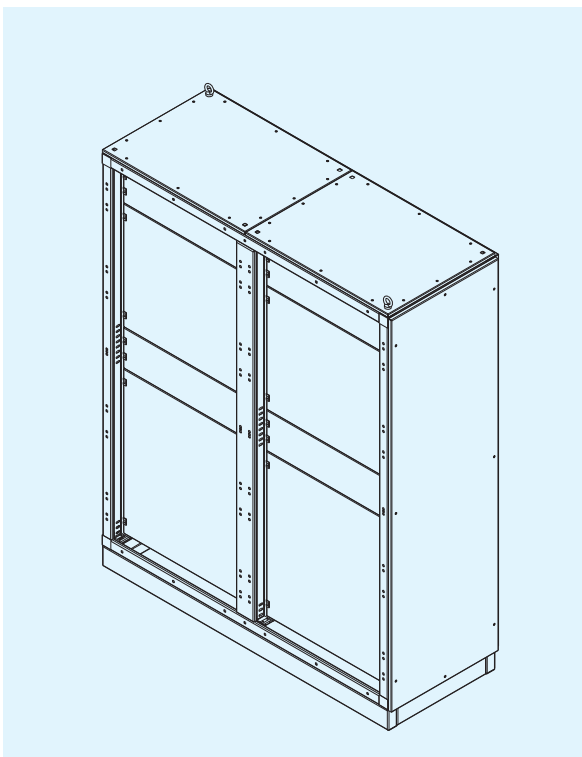
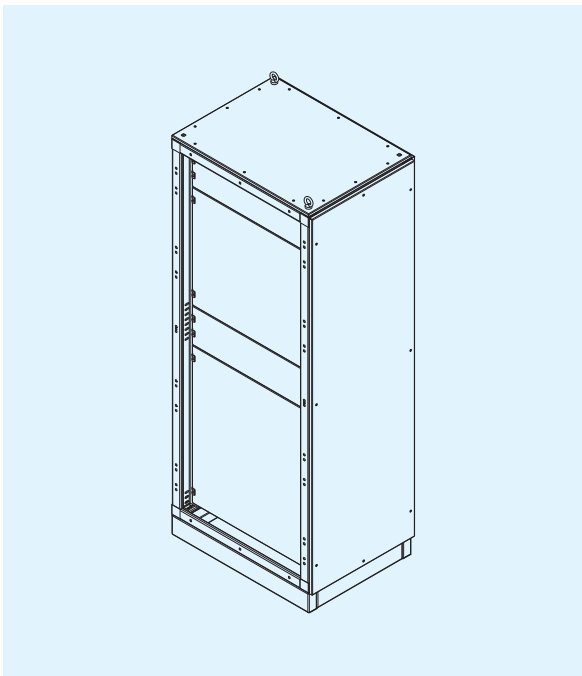


# TYPE TESTED PANEL

## Sample type tasted panel board



# MODULAR MAIN DISTRIBUTION PANEL BORD



Federal Electric modular panels are designed and manufactured in accordance with energy distributing, controlling and monitoring purposes.

As they are designed completely modular, you may make amendments and / or expand them by adding modules thanks to their screwed joints.

They allow easy equipment assembly thanks to wide variety of accessories.

They are dispatched as assembled to Federal Electric products depending on your projects.

They are resistant to dynamic forces formed during opening-closing maneuvers of breakers with high breaking capacity thanks to their solid composition.

Thanks to low-temperature coefficient busbar design utilized in Federal Electric modular panels, in-panel equipments have a long service life.

They are manufactured in standard parts at CNC machines using high-quality raw materials and assembled with completely screwed joints.

Inner assembly parts are manufactured as galvanized coated, sheet materials are manufactured as electrostatic powder painted on DKP sheet or electrostatic powder painted on galvanized coating.

Front cover and framework is manufactured of sheet with 2 mm thickness and other parts are manufactured of sheet with 1.5 mm thickness.

In Federal Electric modular panels, maximum operating and maintenance safety has been ensured with Form-1, Form-2, Form-4 manufacturing options in accordance with IEC 439 standard.

## Electrical Characteristics

Rated Current	Up to 4000A
Rated Operating Voltage	380 - 415V (up to 690V)
Rated Insulation Voltage	1000V
Rated Resistance Voltage	8 kV
Rated Short Term Resistance Voltage	65 kA
Rated Peak Resistance Voltage	143 kA
Rated Operating Frequency	50 - 60 Hz
Over Voltage Class	III
Pollution Degree	3

## Mechanical Characteristics

Panel Protection Class	IP 31 ..., IP54
Panel Inner Segmentation Form	1, 2, 4
Colour	RAL 7035 (Other colours are optional)

# MODULAR MAIN DISTRIBUTION PANEL BORD

**FMP-1** panels have two kinds of assembly elements as aluminum casting corner (A1) and sheet corner (A2). It is completely bolted and in modular form. Panel depth can be used as width and width can be used as depth in the framework. Opening door can be used as well as cover on the side edge.

Our doors open towards left. They might open towards right,

## Panel Dimensions (mm)

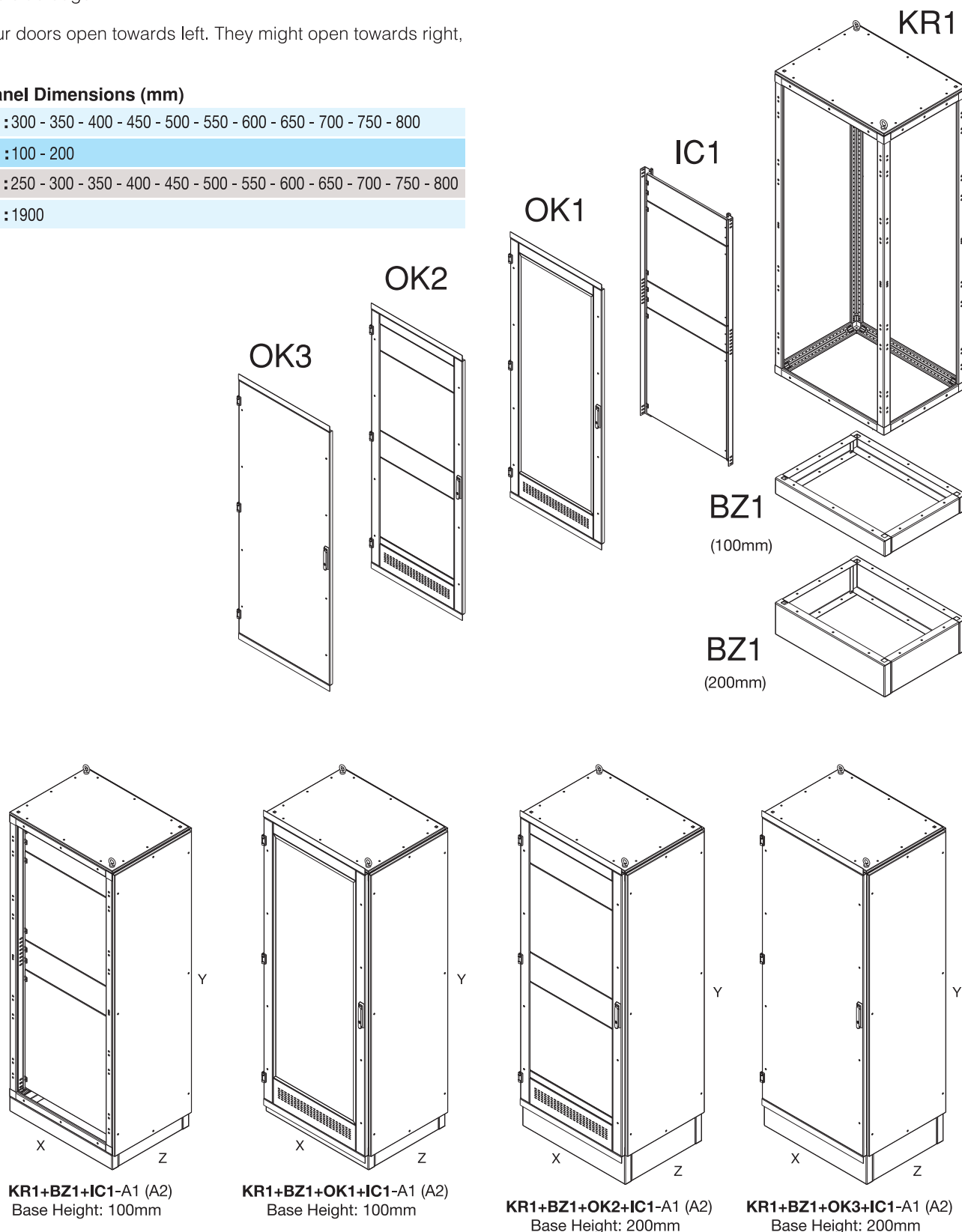
**X** : 300 - 350 - 400 - 450 - 500 - 550 - 600 - 650 - 700 - 750 - 800

**B** : 100 - 200

**Z** : 250 - 300 - 350 - 400 - 450 - 500 - 550 - 600 - 650 - 700 - 750 - 800

**Y** : 1900

if required. Door directions may be reversed without any problem in piece covers when you instruct so, however, door direction should be instructed at ordering stage for single piece door (OK3).



# MODULAR MAIN DISTRIBUTION PANEL BORD

**FMP-2** panels have two kinds of assembly elements as aluminum casting corner (A1) and sheet corner (A2). It is completely bolted and in modular form. Panel depth can be used as width and width can be used as depth in the framework. Opening door can be used as well as cover on the side edge.

Our doors open towards left. They might open towards right, if required. Door directions may be reversed without any problem in piece covers when you instruct so, however, door direction should be instructed at ordering stage for single piece door (OK3).

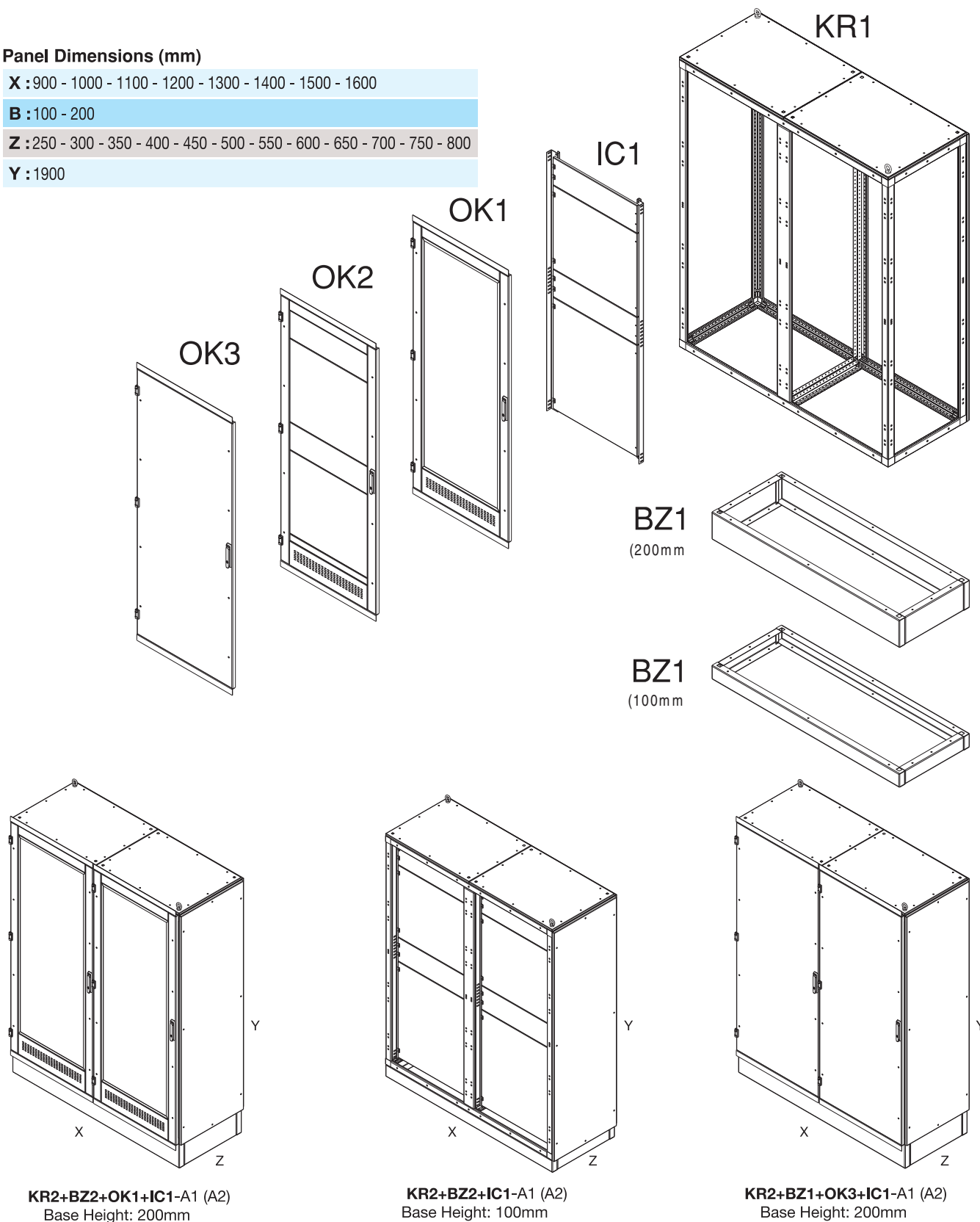
## Panel Dimensions (mm)

**X** : 900 - 1000 - 1100 - 1200 - 1300 - 1400 - 1500 - 1600

**B** : 100 - 200

**Z** : 250 - 300 - 350 - 400 - 450 - 500 - 550 - 600 - 650 - 700 - 750 - 800

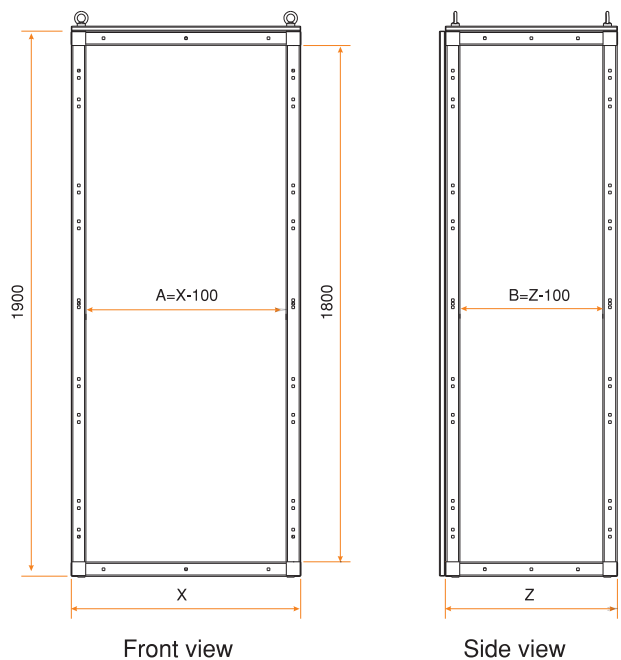
**Y** : 1900





# MODULAR MAIN DISTRIBUTION PANEL BORD

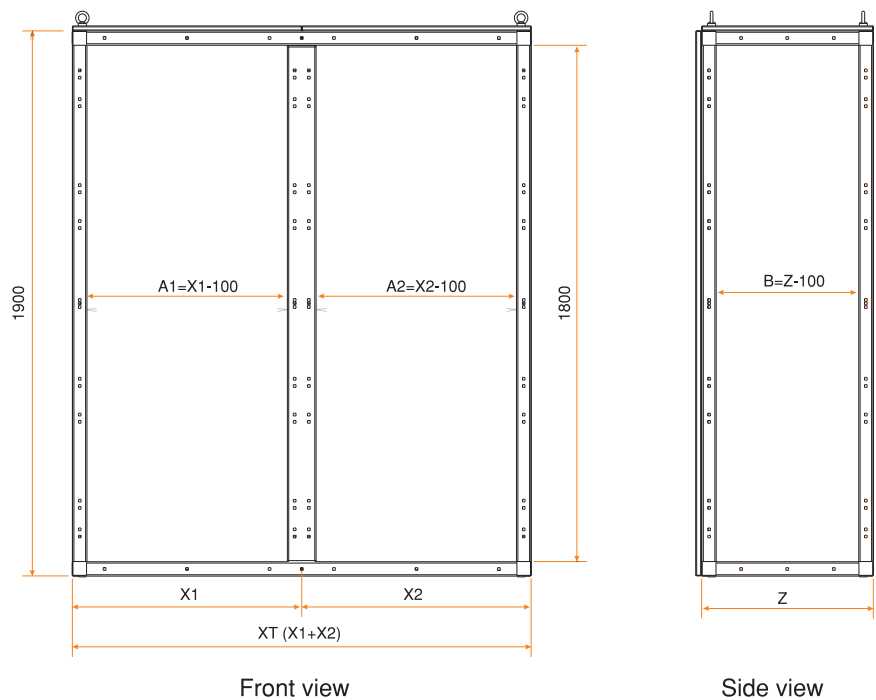
## KR1: Single-division framework



X	A	Z	B
300	200	250	150
350	250	300	200
400	300	350	250
450	350	400	300
500	400	450	350
550	450	500	400
600	500	550	450
650	550	600	500
700	600	650	550
750	650	700	600
800	700	750	650
		800	700

X1	X2	XT	A1	A2
300	600	900	200	500
350	550		250	450
400	500		300	400
450	450		350	350
300	700	1000	200	600
350	650		250	550
400	600		300	500
450	550		350	450
500	500		400	400
300	800	1100	200	700
350	750		250	650
400	700		300	600
450	650		350	550
500	600		400	500
550	550		450	450
300	900	1200	200	800
400	800		300	700
450	750		350	650
500	700		400	600
550	650		450	550
600	600		500	500
300	1000	1300	200	900
400	900		300	800
500	800		400	700
550	750		450	650
600	700		500	600
650	650		550	550
300	1100	1400	200	1000
400	1000		300	900
500	900		400	800
600	800		500	700
650	750		550	650
700	700		600	600
300	1200	1500	200	1100
400	1100		300	1000
500	1000		400	900
600	900		500	800
700	800		600	700
750	750		650	650
300	1300	1600	200	1200
400	1200		300	1100
500	1100		400	1000
600	1000		500	900
700	900		600	800
800	800		700	700

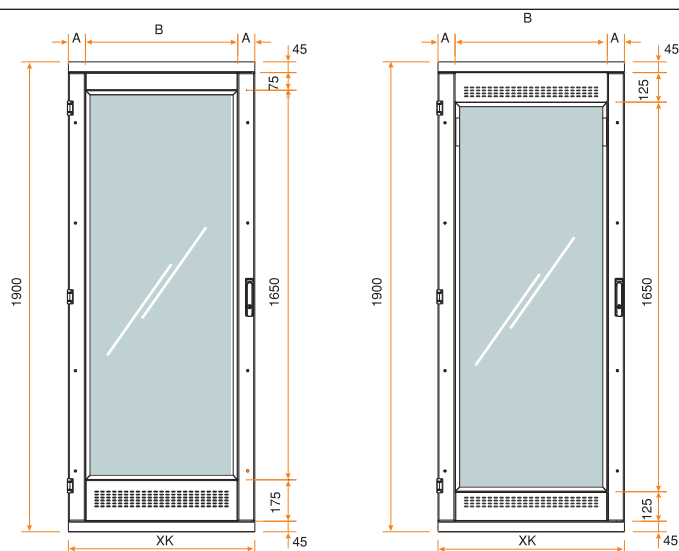
## KR2: Double-division framework



Dimension mm

# MODULAR MAIN DISTRIBUTION PANEL BORD

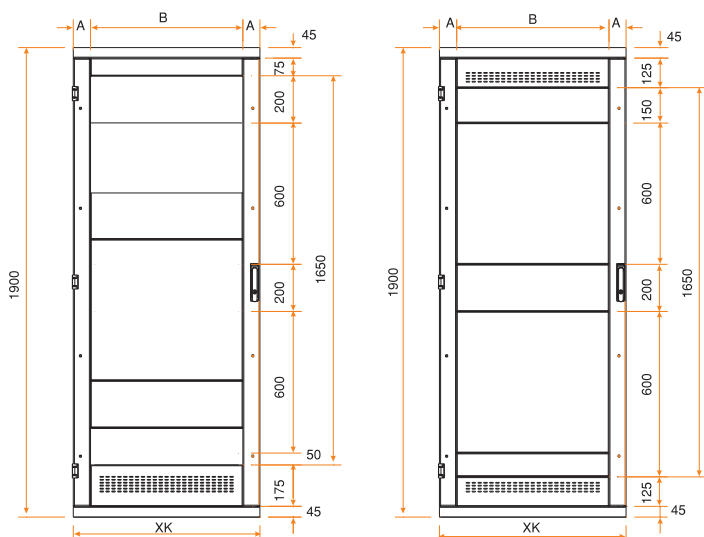
OK1: Front cover (with glass)



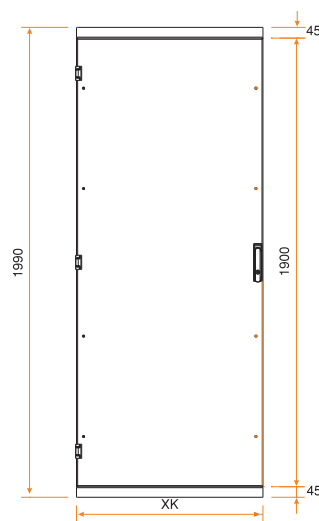
X	XK	A	B (XK-2A)
300	290	72,5	155
350	340	47,5	256
400	390	72,5	255
450	440	47,5	356
500	490	72,5	355
550	540	47,5	456
600	590	72,5	455
650	640	47,5	556
700	690	72,5	555
750	740	47,5	656
800	790	72,5	655

Dimension mm

OK2: Front cover

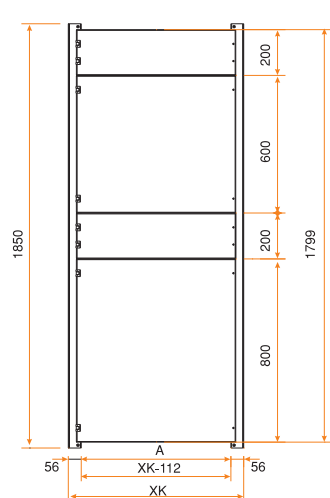


OK3: Front cover



**Note:** In piece covers in OK2, parts no (212 and 204) can be variable provided that the dimension 1650 mm remains fixed.

IC1: Inner cover



X	XK	A (XK-112)
300	265	153
350	315	203
400	365	253
450	415	303
500	465	353
550	515	403
600	565	453
650	615	503
700	665	553
750	715	603
800	765	653

Dimension mm

# ELECTRONIC BALLASTS



## Professional Electronic Ballasts

### T5 Series



### T8 Series



### TC-L Series



### TC-DEL Series



## Basic Electronic Ballasts

### T8 Series

### T5 Series

### T5C Series

### TC-DD Series

### TC-F Series

### TC-TEL Series

### TC-SEL Series

### TCL Series

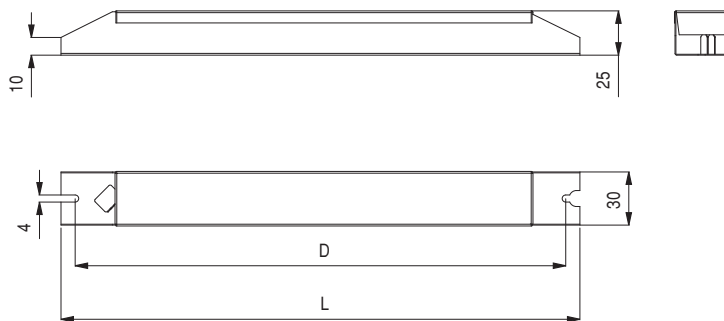
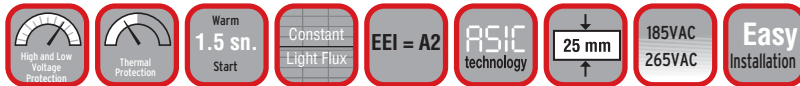
### TC-DEL Series

### TR-DEL UV Series



# PROFESSIONAL ELECTRONIC BALLASTS FOR T5 LINEAR LAMPS

14-54w 220-240 V 50/60/0 Hz. PROFESSIONAL SERIES T5



24

- AC operating voltage 185 – 265V, ignition voltage > 170V
- DC operating voltage 196 – 330V, ignition voltage > 240V
- High voltage protection > 315 VAC
- Low voltage protection < 150 VAC
- Operation frequency > 40 kHz.
- Average service life 50.000h (failure frequency at maximum  $t_a$  temperature < %0.2 / 1.000h)
- Has protection for lamp instant failures.
- Lamp life protection < 0.7s
- It automatically restarts on lamp changes.
- Lamp capacitive mode protection > 2.5s
- Lamp asymmetric voltage protection > 2.5s
- It performs lamp filament control initially and during operation.
- It performs warm start in 1.5s.
- It has large operating temperature range (-25 °C ... +55 °C).
- It conforms to the emergency lighting kits.
- Thermal protection > 110 °C
- CELMA energy efficiency index EEI = A2
- It provides constant light flux regardless of the fluctuations in the mains voltage.

- Operation without pre-heating in instant energy cuts (< 0.8s)
- It has soft start feature.
- Low harmonic current distortion < 10%
- It provides long filament and lamp life with its smart pre-heating control.
- Enhanced ignition voltage and current control
- Suitable for automatic and manual cabling, provides easy installation with the self-tightening connectors.

## Package Features

- 25 Pieces / Box
- 100 Pieces / Parcel
- 27 Parcels / Pallet
- 2700 Pieces / Pallet

## Quality Certificates

- EN 61347-2-3

LAMP		BALLAST											
Power (W)	Length (mm)	Model	Order Code	L (mm)	D (mm)	Weight (kg)	Lamp Power (W)	Circuit Power (W)	Current (220V/50 Hz.) (A)	$\lambda$ (220V/50 Hz.) (A)	$t_c$ (°C)	$t_a$ (°C)	Celma Class (EEI)
1x14	549	TRD5-FDH-1/MW	105.1.1435	296	280	0.21	14.00	16.00	0.08	0.94	65	-25...+55	A2
1x21	849	TRD5-FDH-1/MW	105.1.1435	296	280	0.21	21.00	23.00	0.11	0.95	65	-25...+55	A2
1x28	1149	TRD5-FDH-1/MW	105.1.1435	296	280	0.21	28.00	30.00	0.14	0.97	65	-25...+55	A2
1x35	1449	TRD5-FDH-1/MW	105.1.1435	296	280	0.21	35.00	38.50	0.18	0.98	65	-25...+55	A2
1x54	1149	TRD5-FDH-1/54	105.1.0054	296	280	0.25	54.00	58.00	0.27	0.99	65	-25...+55	A2
2x14	549	TRD5-FDH-2/MW	105.2.1435	381	365	0.31	28.00	32.00	0.15	0.97	65	-25...+55	A2
2x21	849	TRD5-FDH-2/MW	105.2.1435	381	365	0.31	42.00	45.00	0.21	0.98	65	-25...+55	A2
2x28	1149	TRD5-FDH-2/MW	105.2.1435	381	365	0.31	56.00	61.00	0.28	0.99	65	-25...+55	A2
2x35	1449	TRD5-FDH-2/MW	105.2.1435	381	365	0.31	70.00	76.00	0.35	0.99	70	-25...+55	A2
2x54	1149	TRD5-FDH-2/54	105.2.0054	296	280	0.25	108.00	113.50	0.52	0.99	70	-25...+55	A2
3x14	549	TRD5-FDH-3/14	105.3.0014	381	365	0.31	42.00	50.00	0.23	0.98	65	-25...+55	A2
4x14	549	TRD5-FDH-4/14	105.4.0014	381	365	0.31	56.00	61.00	0.28	0.99	65	-25...+55	A2

# PROFESSIONAL ELECTRONIC BALLASTS FOR T5 LINEAR LAMPS

## DC Operating Currents

Model	Lamp Type	Power (W)	Current (Un=240VDC)(A)
TRD5-FDH-1/MW	T5	1x14	0.07
TRD5-FDH-1/MW	T5	1x21	0.10
TRD5-FDH-1/MW	T5	1x28	0.13
TRD5-FDH-1/MW	T5	1x35	0.16
TRD5-FDH-1/54	T5	1x54	0.24
TRD5-FDH-2/MW	T5	2x14	0.13
TRD5-FDH-2/MW	T5	2x21	0.19
TRD5-FDH-2/MW	T5	2x28	0.25
TRD5-FDH-2/MW	T5	2x35	0.32
TRD5-FDH-2/54	T5	2x54	0.47
TRD5-FDH-3/14	T5	3x14	0.21
TRD5-FDH-4/14	T5	4x14	0.25

## Harmonic Distortion

Model	Lamp Type	Power (W)	THD (220V / 50 Hz.)
TRD5-FDH-1/MW	T5	1x14	< %10
TRD5-FDH-1/MW	T5	1x21	< %10
TRD5-FDH-1/MW	T5	1x28	< %10
TRD5-FDH-1/MW	T5	1x35	< %10
TRD5-FDH-1/54	T5	1x54	< %10
TRD5-FDH-2/MW	T5	2x14	< %10
TRD5-FDH-2/MW	T5	2x21	< %10
TRD5-FDH-2/MW	T5	2x28	< %10
TRD5-FDH-2/MW	T5	2x35	< %10
TRD5-FDH-2/54	T5	2x54	< %10
TRD5-FDH-3/14	T5	3x14	< %10
TRD5-FDH-4/14	T5	4x14	< %10

## Operating Voltage

Model	Lamp Type	Power (W)	Uout
TRD5-FDH-1/MW	T5	1x14	380VDC
TRD5-FDH-1/MW	T5	1x21	380VDC
TRD5-FDH-1/MW	T5	1x28	380VDC
TRD5-FDH-1/MW	T5	1x35	380VDC
TRD5-FDH-1/54	T5	1x54	380VDC
TRD5-FDH-2/MW	T5	2x14	380VDC
TRD5-FDH-2/MW	T5	2x21	380VDC
TRD5-FDH-2/MW	T5	2x28	380VDC
TRD5-FDH-2/MW	T5	2x35	380VDC
TRD5-FDH-2/54	T5	2x54	380VDC
TRD5-FDH-3/14	T5	3x14	380VDC
TRD5-FDH-4/14	T5	4x14	380VDC

## Ballast Lumen Factor (EN 60929 8.1)

Model	Lamp Type	Power (W)	AC / DC - BLF U= 185- 265V, 25 °C
TRD5-FDH-1/MW	T5	1x14	1.00
TRD5-FDH-1/MW	T5	1x21	1.00
TRD5-FDH-1/MW	T5	1x28	1.00
TRD5-FDH-1/MW	T5	1x35	1.00
TRD5-FDH-1/54	T5	1x54	1.00
TRD5-FDH-2/MW	T5	2x14	1.00
TRD5-FDH-2/MW	T5	2x21	1.00
TRD5-FDH-2/MW	T5	2x28	1.00
TRD5-FDH-2/MW	T5	2x35	1.00
TRD5-FDH-2/54	T5	2x54	1.00
TRD5-FDH-3/14	T5	3x14	1.00
TRD5-FDH-4/14	T5	4x14	1.00

## AC Operating

Supply Voltage

- 220 – 240V 50/60Hz.
- 185 – 265V 50/60Hz. Safe operating tolerance ( $\pm 15\%$ )
- 207 – 253V 50/60Hz. Performance tolerance ( $\pm 10\%$ )

## DC Operating

Supply Voltage

- 220 – 240V 0Hz.
- 240 – 390V 0Hz. Lamp Ignition Voltage
- 130 – 390V 0Hz. Operating Voltage

## Lamp operating characteristic

- Warm Start: Lamp cathodes are heated by 1.5s of pre-heating in the AC and DC supply voltages.

## Emergency Lighting

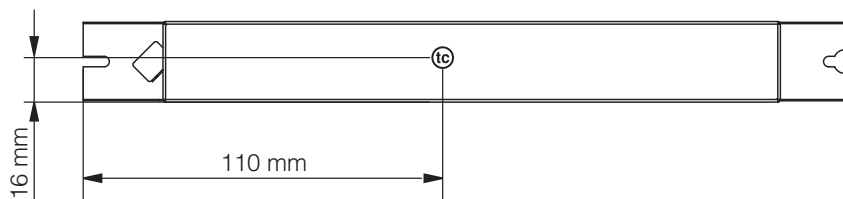
- It is compatible with the emergency lighting kits defined in the EN 60347-2-3 EK-J.
- In energy cuts the stepping in time is 0.5s.

# PROFESSIONAL ELECTRONIC BALLASTS FOR T5 LINEAR LAMPS

## ta (Operating Temperature) and tc (Test Point)

ta and tc points are directly related to the life of ballast. tc value depends on the temperatures that are defined in the ta range. The value of ta is significant for the critical components used in the ballast (For example, electrolytic capacitors).

ta and tc values are indicated on the ballast covers. For long operating life, these values should be followed. In addition, the terms of warranty are valid for the declared ta and tc values.



## The Number of Ballasts that Can Be Connected to the Automatic Circuit Breakers

Model	Power (W)	C10 1.5 mm <sup>2</sup> (Piece)	C13 1.5 mm <sup>2</sup> (Piece)	C16 1.5 mm <sup>2</sup> (Piece)	C20 2.5 mm <sup>2</sup> (Piece)	←Automatic Circuit Breaker→ ←Cable Section Ø→	B10 1.5 mm <sup>2</sup> (Piece)	B13 1.5 mm <sup>2</sup> (Piece)	B16 1.5 mm <sup>2</sup> (Piece)	B20 1.5 mm <sup>2</sup> (Piece)
TRD5-FDH-1/MW	1x14	32	42	50	64		16	21	25	32
TRD5-FDH-1/MW	1x21	32	42	50	64		16	21	25	32
TRD5-FDH-1/MW	1x28	32	42	50	64		16	21	25	32
TRD5-FDH-1/MW	1x35	32	42	50	64		16	21	25	32
TRD5-FDH-1/54	1x54	28	40	44	58		14	20	22	29
TRD5-FDH-2/MW	2x14	18	24	28	34		9	12	14	17
TRD5-FDH-2/MW	2x21	18	24	28	34		9	12	14	17
TRD5-FDH-2/MW	2x28	18	24	28	34		9	12	14	17
TRD5-FDH-2/MW	2x35	18	24	28	34		9	12	14	17
TRD5-FDH-2/54	2x54	14	20	24	30		7	10	12	15
TRD5-FDH-3/14	3x14	26	32	36	42		13	16	18	21
TRD5-FDH-4/14	4x14	18	24	28	34		9	12	14	17

## Installation rules

Electronic ballasts should be installed inside the lighting armatures in accordance with the established standards. Any inappropriate applications shall affect the ballast life adversely. Especially during the aesthetical designs of the armatures, the contact of ballast with the lamp, or placing the ballast between two lamps exceeds the defined operating ambient temperature (ta) and shortens the ballast life. Moreover, this

condition shall make ballast shut down the circuit by activating its thermal protection. For a healthy operating system, it is important to design the armatures without preventing the air circulation and with keeping the inside of the armature below high temperatures. Especially fluorescent lamps do not perform well in high temperatures and this shortens the operating life.

## Connector and Cable Features for Installation

Model	Power (W)	Connector		Maximum Cable Length		Maximum Capacity	
		Cold	Hot	Cold	Hot	Cold	Hot
TRD5-FDH-1/MW	1x14	1,2	2,4	2m	1m	200 pF	100 pF
TRD5-FDH-1/MW	1x21	1,2	2,4	2m	1m	200 pF	100 pF
TRD5-FDH-1/MW	1x28	1,2	2,4	2m	1m	200 pF	100 pF
TRD5-FDH-1/MW	1x35	1,2	2,4	2m	1m	200 pF	100 pF
TRD5-FDH-1/54	1x54	1,2	2,4	2m	1m	200 pF	100 pF
TRD5-FDH-2/MW	2x14	2,3,6,7	1,4,5,8	2m	1m	200 pF	100 pF
TRD5-FDH-2/MW	2x21	2,3,6,7	1,4,5,8	2m	1m	200 pF	100 pF
TRD5-FDH-2/MW	2x28	2,3,6,7	1,4,5,8	2m	1m	200 pF	100 pF
TRD5-FDH-2/MW	2x35	2,3,6,7	1,4,5,8	2m	1m	200 pF	100 pF
TRD5-FDH-2/54	2x54	2,3,4,5	1,6	2m	1m	200 pF	100 pF
TRD5-FDH-3/14	3x14	2,3,4,5,8,11	1,6,7,12	2m	1m	200 pF	100 pF
TRD5-FDH-4/14	4x14	2,3,4,5,8,9,10,11	1,6,7,12	2m	1m	200 pF	100 pF

The ballast – lamp connection cables to be used in armatures shall be performed in accordance with the lamp connection diagrams indicated on the ballasts.

Different connection types shall lead to a breakdown of the ballast and/or lamp and invalidate the terms of warranty. It shall increase the efficiency of the system if the installation cable is between 0.5 – 1.5 mm<sup>2</sup> section range, one veined,

and soft copper cable. The cable lengths should be in accordance with the values given in the table. Since longer cables shall have higher resistance capacity, it would decrease the ballast performance.

In order to provide the maximum efficiency from the system, the given values in the table should be followed.



# PROFESSIONAL ELECTRONIC BALLASTS FOR T5 LINEAR LAMPS

## T5 Linear Lamps

T5 linear lamps should be applied along with the TRDLIGHT T5 electronic ballasts; the power and length values of T5 linear lamps are provided below. The only way to achieve the maximum efficiency of the system is by using appropriate lamps.

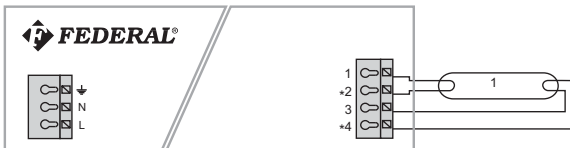
The habit of considering only power criteria in conventional

(magnetic) ballasts is not applicable for the electronic ballasts. Different electronic ballasts should be used for each different power and type of fluorescent lamps.

Considering that our products operate at 40 kHz. and above, the lamps to be applied in the system should be suitable for operating at high frequency. Using old type lamps with electronic ballasts not only shortens the lamp life but also decreases the ballast performance.

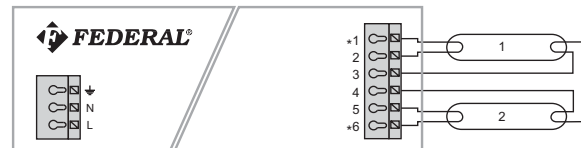
## T5 Lamp Information

Power (W)	Length (mm)
14	549
21	849
28	1149
35	1449
54	1149



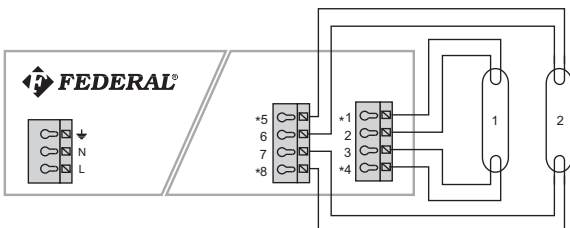
The lamp connection diagrams of the electronic ballasts in following models should be as given above. Cable lengths are provided in the table.

- TRD5-FDH-1/MW (1x14W)
- TRD5-FDH-1/MW (1x35W)
- TRD5-FDH-1/MW (1x21W)
- TRD5-FDH-1/54 (1x54W)
- TRD5-FDH-1/MW (1x28W)



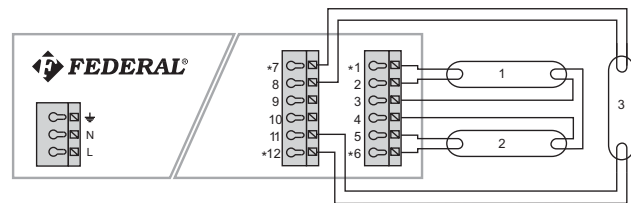
The lamp connection diagrams of the electronic ballasts in following models should be as given above. Cable lengths are provided in the table.

- TRD5-FDH-2/54 (2x54W)



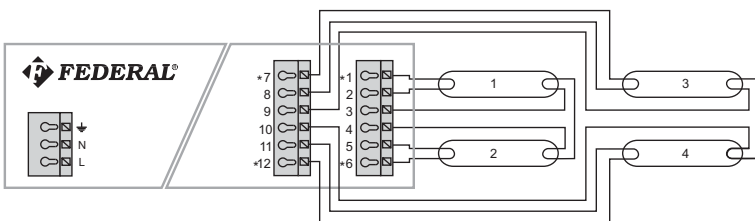
The lamp connection diagrams of the electronic ballasts in following models should be as given above. Cable lengths are provided in the table.

- TRD5-FDH-2/MW (2x14W)
- TRD5-FDH-2/MW (2x28W)
- TRD5-FDH-2/MW (2x21W)
- TRD5-FDH-2/MW (2x35W)



The lamp connection diagrams of the electronic ballasts in following models should be as given above. Cable lengths are provided in the table.

- TRD5-FDH-4/14 (To connect Model 4/14 electronic ballast as 3/14)



The lamp connection diagrams of the electronic ballasts in following models should be as given above. Cable lengths are provided in the table.

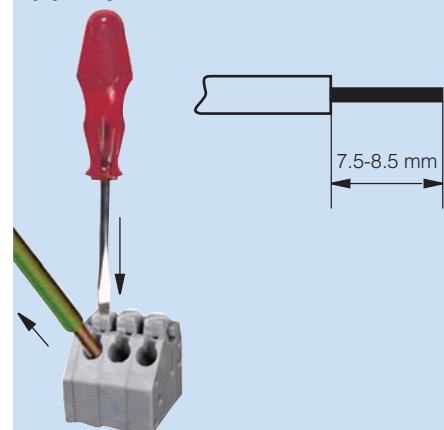
- TRD5-FDH-4/14

Self-tightening automatic connectors are used in electronic ballasts. These connectors provide a simple installation. The cable sector should be in line with the values indicated both on the ballast and in the catalogue.

Applying thicker and/or thinner cables may damage the connectors. Appropriate cables should be used for the terms of warranty to be valid. Especially using multi wired, very thin, very thick cables or connecting more than one cable to a connector shall decrease the system performance and may cause physical damages.

## Cable Preparation:

0.5 - 1.5<sup>2</sup>



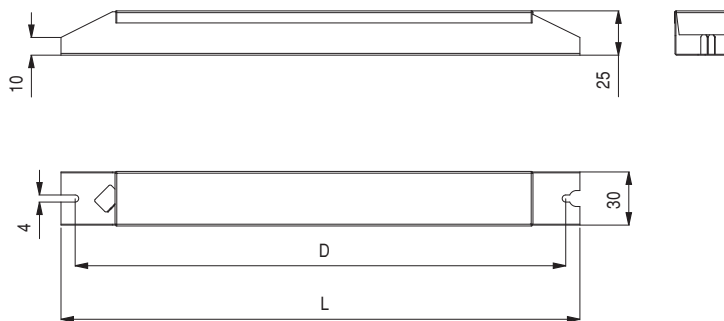
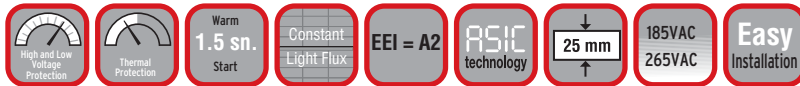
Simple installation brings simple removal. As shown in the picture, when button is pushed with the help of a screwdriver the connector shall release the cable and this shall provide the removal.

For all of our products we highly recommend a ground connection both for the health of the users and system.



# PROFESSIONAL ELECTRONIC BALLASTS FOR T8 LINEAR LAMPS

15-58W 220-240V 50/60/0 Hz. PROFESSIONAL SERIES T8



- AC operating voltage 185 – 265V, ignition voltage > 170V
- DC operating voltage 196 – 330V, ignition voltage > 240V
- High voltage protection > 315 VAC
- Low voltage protection < 150 VAC
- Operation frequency > 40 kHz.
- Average service life 50.000h (failure frequency at maximum temperature < %0.2 / 1.000h)
- Has protection for lamp instant failures.
- Lamp life protection < 0.7s
- It automatically restarts on lamp changes.
- Lamp capacitive mode protection > 2.5s
- Lamp asymmetric voltage protection > 2.5s
- It performs lamp filament control initially and during operation.
- It performs warm start in 1.5s.
- It has large operating temperature range ( -25 °C ... +55 °C)
- It conforms to the emergency lighting kits.
- Thermal protection > 110 °C
- CELMA energy efficiency index EEI = A2
- It provides constant light flux regardless of the fluctuations in the mains voltage.

- Operation without pre-heating in instant energy cuts (< 0.8s)
- It has soft start feature.
- Low harmonic current distortion < 10%
- It provides long filament and lamp life with its smart pre-heating control.
- Enhanced ignition voltage and current control
- Suitable for automatic and manual cabling, provides easy installation with the self-tightening

## Package Features

- 25 Pieces / Box
- 100 Pieces / Parcel
- 27 Parcels / Pallet
- 2700 Pieces / Pallet

## Quality Certificates

- EN 61347-2-3
- EN 60929

LAMP		BALLAST											
Power (W)	Length (mm)	Model	Order Code	L (mm)	D (mm)	Weight (kg)	Lamp Power (W)	Circuit Power (W)	Current (220V/50 Hz.) (A)	$\lambda$ (220V/50 Hz.) (A)	tc (°C)	ta (°C)	Celma Class (EEI)
1x15	438	TRD8-FDH-1/15	108.1.0015	298	282	0.215	13.50	16.00	0.080	0.93	65	-25...+55	A2
1x18	590	TRD8-FDH-1/18	108.1.0018	298	282	0.215	16.00	18.00	0.090	0.96	65	-25...+55	A2
1x30	895	TRD8-FDH-1/30	108.1.0030	298	282	0.215	24.00	28.00	0.130	0.98	65	-25...+55	A2
1x36	1200	TRD8-FDH-1/36	108.1.0036	298	282	0.215	32.00	34.50	0.160	0.98	65	-25...+55	A2
1x58	1500	TRD8-FDH-1/58	108.1.0058	298	282	0.215	50.00	52.50	0.230	0.99	65	-25...+55	A2
2x15	438	TRD8-FDH-2/15	108.2.0015	298	282	0.215	27.00	30.00	0.140	0.98	65	-25...+55	A2
2x18	590	TRD8-FDH-2/18	108.2.0018	298	282	0.215	32.00	36.50	0.170	0.98	65	-25...+55	A2
2x30	895	TRD8-FDH-2/30	108.2.0030	298	282	0.215	48.00	52.00	0.240	0.99	65	-25...+55	A2
2x36	1200	TRD8-FDH-2/36	108.2.0036	298	282	0.215	64.00	69.50	0.320	0.99	70	-25...+55	A2
3x36	1200	TRD8-FDH-3/36	108.3.0036	298	282	0.215	100.00	110.00	0.520	0.99	70	-25...+55	A2
2x58	1500	TRD8-FDH-2/58	108.2.0058	298	282	0.215	108.00	107.00	0.490	0.99	70	-25...+55	A2
3x18	490	TRD8-FDH-3/18	108.3.0018	383	367	0.285	48.00	58.00	0.270	0.98	70	-25...+55	A2
4x18	490	TRD8-FDH-4/18	108.4.0018	383	367	0.285	64.00	69.50	0.320	0.99	70	-25...+55	A2

# PROFESSIONAL ELECTRONIC BALLASTS FOR T8 LINEAR LAMPS

## DC Operating Currents

Model	Lamp Type	Power (W)	Current (Un=240VDC)(A)
TRD8-FDH-1/15	T8	1x15	0.070
TRD8-FDH-1/18	T8	1x18	0.080
TRD8-FDH-1/30	T8	1x30	0.120
TRD8-FDH-1/36	T8	1x36	0.140
TRD8-FDH-1/58	T8	1x58	0.220
TRD8-FDH-2/15	T8	2x15	0.130
TRD8-FDH-2/18	T8	2x18	0.150
TRD8-FDH-2/30	T8	2x30	0.220
TRD8-FDH-2/36	T8	2x36	0.290
TRD8-FDH-3/36	T8	3x36	0.290
TRD8-FDH-2/58	T8	2x58	0.450
TRD8-FDH-3/18	T8	3x18	0.240
TRD8-FDH-4/18	T8	4x18	0.290

## Operating Voltage

Model	Lamp Type	Power (W)	Uout
TRD8-FDH-1/15	T8	1x15	380VDC
TRD8-FDH-1/18	T8	1x18	380VDC
TRD8-FDH-1/30	T8	1x30	380VDC
TRD8-FDH-1/36	T8	1x36	380VDC
TRD8-FDH-1/58	T8	1x58	380VDC
TRD8-FDH-2/15	T8	2x15	380VDC
TRD8-FDH-2/18	T8	2x18	380VDC
TRD8-FDH-2/30	T8	2x30	380VDC
TRD8-FDH-2/36	T8	2x36	380VDC
TRD8-FDH-3/36	T8	3x36	380VDC
TRD8-FDH-2/58	T8	2x58	380VDC
TRD8-FDH-3/18	T8	3x18	380VDC
TRD8-FDH-4/18	T8	4x18	380VDC

## AC Operating

Supply Voltage

- 220 – 240V 50/60Hz.
- 185 – 265V 50/60Hz. Safe operating tolerance ( $\pm 15\%$ )
- 207 – 253V 50/60Hz. Performance tolerance ( $\pm 10\%$ )

## DC Operating

Supply Voltage

- 220 – 240V 0Hz.
- 240 – 390V 0Hz. Lamp Ignition Voltage
- 130 – 390V 0Hz. Operating Voltage

## Harmonic Distortion

Model	Lamp Type	Power (W)	THD (220V / 50 Hz.)
TRD8-FDH-1/15	T8	1x15	< %10
TRD8-FDH-1/18	T8	1x18	< %10
TRD8-FDH-1/30	T8	1x30	< %10
TRD8-FDH-1/36	T8	1x36	< %10
TRD8-FDH-1/58	T8	1x58	< %10
TRD8-FDH-2/15	T8	2x15	< %10
TRD8-FDH-2/18	T8	2x18	< %10
TRD8-FDH-2/30	T8	2x30	< %10
TRD8-FDH-2/36	T8	2x36	< %10
TRD8-FDH-3/36	T8	3x36	< %10
TRD8-FDH-2/58	T8	2x58	< %10
TRD8-FDH-3/18	T8	3x18	< %10
TRD8-FDH-4/18	T8	4x18	< %10

## Ballast Lumen Factor (EN 60929 8.1)

Model	Lamp Type	Power (W)	AC / DC - BLF U= 185- 265V, 25 °C
TRD8-FDH-1/15	T8	1x15	1.00
TRD8-FDH-1/18	T8	1x18	1.00
TRD8-FDH-1/30	T8	1x30	1.00
TRD8-FDH-1/36	T8	1x36	1.00
TRD8-FDH-1/58	T8	1x58	1.00
TRD8-FDH-2/15	T8	2x15	1.00
TRD8-FDH-2/18	T8	2x18	1.00
TRD8-FDH-2/30	T8	2x30	1.00
TRD8-FDH-2/36	T8	2x36	1.00
TRD8-FDH-3/36	T8	3x36	1.00
TRD8-FDH-2/58	T8	2x58	1.00
TRD8-FDH-3/18	T8	3x18	1.00
TRD8-FDH-4/18	T8	4x18	1.00

## Lamp operating characteristic

- Warm Start: Lamp cathodes are heated by 1.5s of pre-heating in the AC and DC supply voltages.

## Emergency Lighting

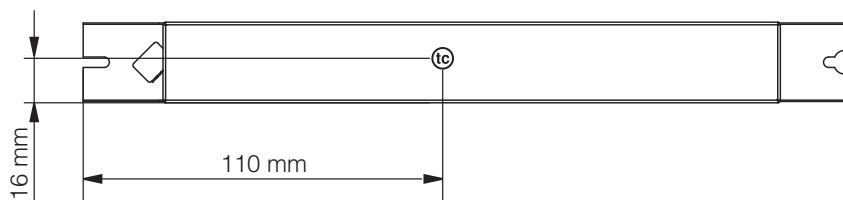
- It is compatible with the emergency lighting kits defined in the EN 60347-2-3 EK-J.
- In energy cuts the stepping in time is 0.5s.

# PROFESSIONAL ELECTRONIC BALLASTS FOR T8 LINEAR LAMPS

## ta (Operating Temperature) and tc (Test Point)

ta and tc points are directly related to the life of ballast. tc value depends on the temperatures that are defined in the ta range. The value of ta is significant for the critical components used in the ballast (For example, electrolytic capacitors).

ta and tc values are indicated on the ballast covers. For long operating life, these values should be followed. In addition, the terms of warranty are valid for the declared ta and tc values.



## The Number of Ballasts that Can Be Connected to the Automatic Circuit Breakers

Model	Power (W)	C10 1.5 mm <sup>2</sup> (Piece)	C13 1.5 mm <sup>2</sup> (Piece)	C16 1.5 mm <sup>2</sup> (Piece)	C20 2.5 mm <sup>2</sup> (Piece)	Automatic Circuit Breaker Cable Section Ø	B10 1.5 mm <sup>2</sup> (Piece)	B13 1.5 mm <sup>2</sup> (Piece)	B16 1.5 mm <sup>2</sup> (Piece)	B20 1.5 mm <sup>2</sup> (Piece)
TRD8-FDH-1/15	1x15	44	62	74	104		22	31	37	52
TRD8-FDH-1/18	1x18	44	62	74	104		22	31	37	52
TRD8-FDH-1/30	1x30	40	52	60	72		19	26	30	36
TRD8-FDH-1/36	1x36	38	52	60	72		19	26	30	36
TRD8-FDH-1/58	1x58	36	50	60	70		18	25	30	35
TRD8-FDH-2/15	2x15	40	54	64	76		20	27	32	38
TRD8-FDH-2/18	2x18	36	50	60	72		18	25	30	36
TRD8-FDH-2/30	2x30	22	30	38	42		11	15	19	21
TRD8-FDH-2/36	2x36	24	32	38	44		12	16	19	22
TRD8-FDH-3/36	3x36	16	22	26	30		8	11	13	15
TRD8-FDH-2/58	2x58	30	40	52	64		15	20	26	32
TRD8-FDH-3/18	3x18	30	40	52	64		15	20	26	32
TRD8-FDH-4/18	4x18	30	40	52	64		15	20	26	32

## Installation rules

Electronic ballasts should be installed inside the lighting armatures in accordance with the established standards. Any inappropriate applications shall affect the ballast life adversely. Especially during the aesthetical designs of the armatures, the contact of ballast with the lamp, or placing the ballast between two lamps exceeds the defined operating ambient temperature (ta) and shortens the ballast life.

Moreover, this condition shall make ballast shut down the circuit by activating its thermal protection. For a healthy operating system, it is important to design the armatures without preventing the air circulation and with keeping the inside of the armature below high temperatures. Especially fluorescent lamps do not perform well in high temperatures and this shortens the operating life.

## Connector and Cable Features for Installation

Model	Power (W)	Connector		Maximum Cable Length		Maximum Capacity	
		Cold	Hot	Cold	Hot	Cold	Hot
TRD8-FDH-1/15	1x15	1,3	2,4	2m	1m	200 pF	100 pF
TRD8-FDH-1/18	1x18	1,3	2,4	2m	1m	200 pF	100 pF
TRD8-FDH-1/30	1x30	1,3	2,4	2m	1m	200 pF	100 pF
TRD8-FDH-1/36	1x36	1,3	2,4	2m	1m	200 pF	100 pF
TRD8-FDH-1/58	1x58	1,3	2,4	2m	1m	200 pF	100 pF
TRD8-FDH-2/15	2x15	2,3,4,5	1,6	2m	1m	200 pF	100 pF
TRD8-FDH-2/18	2x18	2,3,4,5	1,6	2m	1m	200 pF	100 pF
TRD8-FDH-2/30	2x30	2,3,4,5	1,6	2m	1m	200 pF	100 pF
TRD8-FDH-2/36	2x36	2,3,4,5	1,6	2m	1m	200 pF	100 pF
TRD8-FDH-3/36	3x36	2,3,4,5,8,11	1,6,7,12	2m	1m	200 pF	100 pF
TRD8-FDH-2/58	2x58	2,3,4,5	1,6	2m	1m	200 pF	100 pF
TRD8-FDH-3/18	3x18	2,3,4,5,8,11	1,6,7,12	2m	1m	200 pF	100 pF
TRD8-FDH-4/18	4x18	2,3,4,5,8,9,10,11	1,6,7,12	2m	1m	200 pF	100 pF

The ballast – lamp connection cables to be used in armatures shall be performed in accordance with the lamp connection diagrams indicated on the ballasts.

Different connection types shall lead to a breakdown of the ballast and/or lamp and invalidate the terms of warranty.

It shall increase the efficiency of the system if the installation cable is between 0.5 – 1.5 mm<sup>2</sup> section range, one veined, and soft copper cable.

The cable lengths should be in accordance with the values given in the table. Since longer cables shall have higher resistance capacity, it would decrease the ballast performance. In order to provide the maximum efficiency from the system, the given values in the table should be followed.

# PROFESSIONAL ELECTRONIC BALLASTS FOR T8 LINEAR LAMPS

## T8 Linear Lamps

T8 linear lamps should be applied along with the T8 electronic ballasts; the power and length values of T8 linear lamps are provided below. The only way to achieve the maximum efficiency of the system is by using appropriate lamps. The habit of considering only power criteria in conventional (magnetic) ballasts is not applicable for the electronic ballasts. Different electronic ballasts should be used for each different

power and type of fluorescent lamps.

Considering that our products operate at 40 kHz. and above, the lamps to be applied in the system should be suitable for operating at high frequency. Using old type lamps with electronic ballasts not only shortens the lamp life but also decreases the ballast performance.

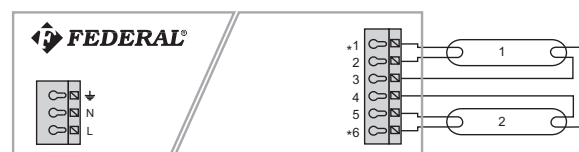
## T8 Lamp Information

Power (W)	Length (mm)	
15	438	
18	590	
30	895	
36	1200	
58	1500	



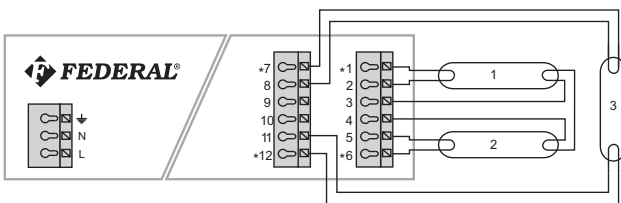
The lamp connection diagrams of the electronic ballasts in following models should be as given above. Cablelengths are provided in the table.

- TRD8-FDH-1/15
- TRD8-FDH-1/18
- TRD8-FDH-1/30
- TRD8-FDH-1/36
- TRD8-FDH-1/58



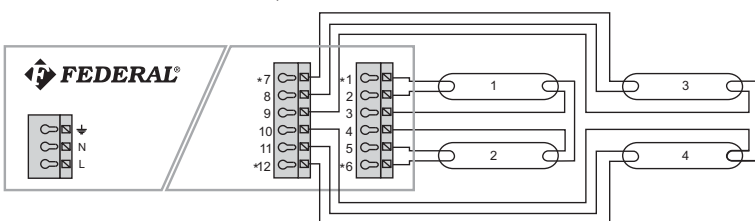
The lamp connection diagrams of the electronic ballasts in following models should be as given above. Cablelengths are provided in the table.

- TRD8-FDH-2/15
- TRD8-FDH-2/18
- TRD8-FDH-2/30
- TRD8-FDH-2/36
- TRD8-FDH-2/58



The lamp connection diagrams of the electronic ballasts in following models should be as given above. Cablelengths are provided in the table.

- TRD8 – FDH -4/18 (To connect Model 4/18 electronic ballast as 3/18)



The lamp connection diagrams of the electronic ballasts in following models should be as given above. Cablelengths are provided in the table.

- TRD8-FDH-4/18

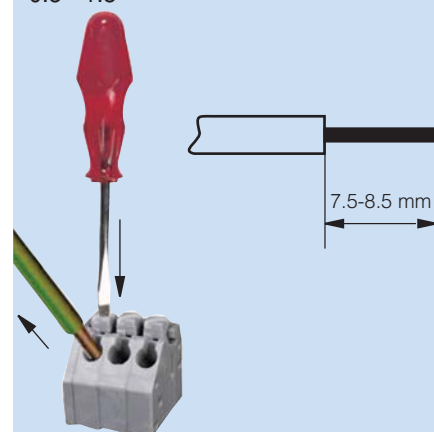
Self-tightening automatic connectors are used in electronic ballasts. These connectors provide a simple installation.

The cable sector should be in line with the values indicated both on the ballast and in the catalogue.

Applying thicker and/or thinner cables may damage the connectors. Appropriate cables should be used for the terms of warranty to be valid. Especially using multi wired, very thin, very thick cables or connecting more than one cable to a connector shall decrease the system performance and may cause physical damages. Easy installation brings easy removal.

## Cable Preparation:

0.5 - 1.5<sup>2</sup>

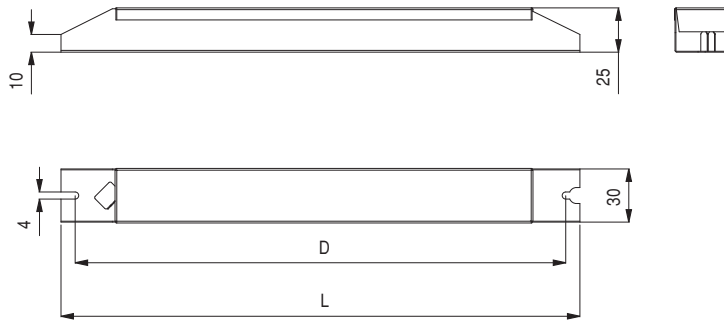
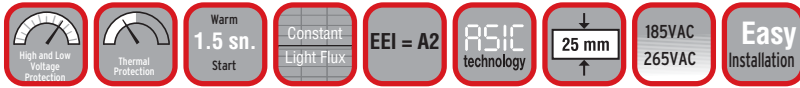


Simple installation brings simple removal. As shown in the picture, when button is pushed with the help of a screwdriver the connector shall release the cable and this shall provide the removal.

For all of our products we highly recommend a ground connection both for the health of the users and system.

# PROFESSIONAL ELECTRONIC BALLASTS FOR TC-L LINEAR LAMPS

## 15-58W 220-240V 50/60/0 Hz. PROFESSIONAL SERIES TC-L



- AC operating voltage 185 – 265V, ignition voltage > 170V
- DC operating voltage 196 – 330V, ignition voltage > 240V
- High voltage protection > 315 VAC
- Low voltage protection < 150 VAC
- Operation frequency > 40 kHz.
- Average service life 50.000h (failure frequency at maximum ta temperature < %0.2 / 1.000h)
- Has protection for lamp instant failures.
- Lamp life protection < 0.7s
- It automatically restarts on lamp changes.
- Lamp capacitive mode protection > 2.5s
- Lamp asymmetric voltage protection > 2.5s
- It performs lamp filament control at start and during operation.
- It performs warm start in 1.5s.
- It has large operating temperature range ( -25 °C... +55 °C)
- It conforms to the emergency lighting kits.
- Thermal protection > 110 °C
- CELMA energy efficiency index EEI = A2
- It provides constant light flux regardless of the fluctuations in the mains voltage.

- Operation without pre-heating in instant energy cuts (< 0.8s)
- It has soft start feature.
- Low harmonic current distortion < 10%
- It provides long filament and lamp life with its smart pre-heating control.
- Enhanced ignition voltage and current control
- Suitable for automatic and manual cabling, provides easy installation with the self-tightening

### Package Features

- 25 Pieces / Box
- 100 Pieces / Parcel
- 27 Parcels / Pallet
- 2700 Pieces / Pallet

### Quality Certificates

- EN 61347-2-3

LAMP		BALLAST											
Power (W)	Length (mm)	Model	Order Code	L (mm)	D (mm)	Weight (kg)	Lamp Gücü (W)	Circuit Power (W)	Current (220V/50 Hz.) (A)	$\lambda$ (220V/50 Hz.) (A)	tc (°C)	ta (°C)	Celma Class (EEI)
1x18	217	TRDL-FSD-1/MW	400.1.1824	296	280	0.21	16.00	18.00	0.09	0.92	65	-25...+55	A2
1x24	317	TRDL-FSD-1/MW	400.1.1824	296	280	0.21	22.00	24.00	0.12	0.95	65	-25...+55	A2
1x36	411	TRDL-FSD-1/36	400.1.0036	296	280	0.21	32.00	35.00	0.16	0.98	65	-25...+55	A2
1x40	533	TRDL-FSD-1/40	400.1.0040	296	280	0.21	40.00	43.00	0.20	0.99	65	-25...+55	A2
1x55	533	TRDL-FSD-1/55	400.1.0055	296	280	0.21	55.00	59.00	0.27	0.99	65	-25...+55	A2
2x18	217	TRDL-FSD-2/MW	400.2.1824	296	280	0.21	32.00	34.50	0.16	0.98	65	-25...+55	A2
2x24	317	TRDL-FSD-2/MW	400.2.1824	296	280	0.21	44.00	48.00	0.22	0.99	65	-25...+55	A2
2x36	411	TRDL-FSD-2/36	400.2.0036	296	280	0.21	64.00	69.00	0.32	0.99	65	-25...+55	A2
2x40	533	TRDL-FSD-2/40	400.2.0040	296	280	0.21	80.00	86.00	0.39	0.99	70	-25...+55	A2
2x55	533	TRDL-FSD-2/55	400.2.0055	296	280	0.21	110.00	117.50	0.54	0.99	70	-25...+55	A2

# PROFESSIONAL ELECTRONIC BALLASTS FOR TC-L LINEAR LAMPS

## DC Operating Currents

Model	Lamp Type	Power (W)	Current (Un=240VDC)(A)
TRDL-FSD-1/MW	TC-L	1x18	0.08
TRDL-FSD-1/MW	TC-L	1x24	0.15
TRDL-FSD-1/36	TC-L	1x36	0.15
TRDL-FSD-1/40	TC-L	1x40	0.18
TRDL-FSD-1/55	TC-L	1x55	0.25
TRDL-FSD-2/MW	TC-L	2x18	0.14
TRDL-FSD-2/MW	TC-L	2x24	0.20
TRDL-FSD-2/36	TC-L	2x36	0.29
TRDL-FSD-2/40	TC-L	2x40	0.36
TRDL-FSD-2/55	TC-L	2x55	0.49

## Harmonic Distortion

Model	Lamp Type	Power (W)	THD (220V / 50 Hz.)
TRDL-FSD-1/MW	TC-L	1x18	< %10
TRDL-FSD-1/MW	TC-L	1x24	< %10
TRDL-FSD-1/36	TC-L	1x36	< %10
TRDL-FSD-1/40	TC-L	1x40	< %10
TRDL-FSD-1/55	TC-L	1x55	< %10
TRDL-FSD-2/MW	TC-L	2x18	< %10
TRDL-FSD-2/MW	TC-L	2x24	< %10
TRDL-FSD-2/36	TC-L	2x36	< %10
TRDL-FSD-2/40	TC-L	2x40	< %10
TRDL-FSD-2/55	TC-L	2x55	< %10

## Operating Voltage

Model	Lamp Type	Power (W)	Uout
TRDL-FSD-1/MW	TC-L	1x18	380VDC
TRDL-FSD-1/MW	TC-L	1x24	380VDC
TRDL-FSD-1/36	TC-L	1x36	380VDC
TRDL-FSD-1/40	TC-L	1x40	380VDC
TRDL-FSD-1/55	TC-L	1x55	380VDC
TRDL-FSD-2/MW	TC-L	2x18	380VDC
TRDL-FSD-2/MW	TC-L	2x24	380VDC
TRDL-FSD-2/36	TC-L	2x36	380VDC
TRDL-FSD-2/40	TC-L	2x40	380VDC
TRDL-FSD-2/55	TC-L	2x55	380VDC

## Ballast Lumen Factor (EN 60929 8.1)

Model	Lamp Type	Power (W)	AC / DC - BLF U= 185- 265V, 25 °C
TRDL-FSD-1/MW	TC-L	1x18	1.00
TRDL-FSD-1/MW	TC-L	1x24	1.00
TRDL-FSD-1/36	TC-L	1x36	1.00
TRDL-FSD-1/40	TC-L	1x40	1.00
TRDL-FSD-1/55	TC-L	1x55	1.00
TRDL-FSD-2/MW	TC-L	2x18	1.00
TRDL-FSD-2/MW	TC-L	2x24	1.00
TRDL-FSD-2/36	TC-L	2x36	1.00
TRDL-FSD-2/40	TC-L	2x40	1.00
TRDL-FSD-2/55	TC-L	2x55	1.00

## AC Operating

Supply Voltage

- 220 – 240V 50/60Hz.
- 185 – 265V 50/60Hz. Safe operating tolerance ( $\pm 15\%$ )
- 207 – 253V 50/60Hz. Performance tolerance ( $\pm 10\%$ )

## DC Operating

Supply Voltage

- 220 – 240V 0Hz.
- 240 – 390V 0Hz. Lamp Ignition Voltage
- 130 – 390V 0Hz. Operating Voltage

## Lamp operating characteristic

- Warm Start: Lamp cathodes are heated by 1.5s of pre-heating in the AC and DC supply voltages.

## Emergency Lighting

- It is compatible with the emergency lighting kits defined in the EN 60347-2-3 EK-J.
- In energy cuts the stepping in time is 0.5s.



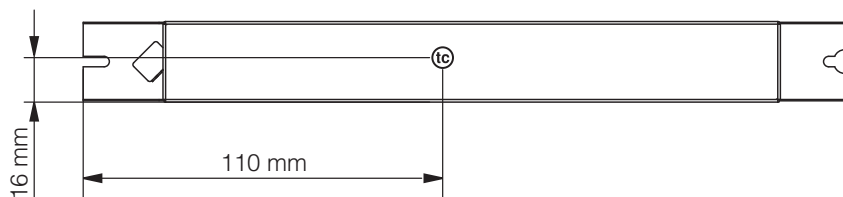
# PROFESSIONAL ELECTRONIC BALLASTS FOR TC-L LINEAR LAMPS

## ta (Operating Temperature) and tc (Test Point)

ta and tc points are directly related to the life of ballast. tc value depends on the temperatures that are defined in the ta range. The value of ta is significant for the critical components used

in the ballast (For example, electronic capacitors).

ta and tc values are indicated on the ballast covers. For long operating life, these values should be followed. In addition, the terms of warranty are valid for the declared ta and tc values.



## The Number of Ballasts that Can Be Connected to the Automatic Circuit Breakers

Model	Power (W)	C10 1.5 mm <sup>2</sup> (Piece)	C13 1.5 mm <sup>2</sup> (Piece)	C16 1.5 mm <sup>2</sup> (Piece)	C20 2.5 mm <sup>2</sup> (Piece)	Automatic Circuit Breaker Cable Section Ø	B10 1.5 mm <sup>2</sup> (Piece)	B13 1.5 mm <sup>2</sup> (Piece)	B16 1.5 mm <sup>2</sup> (Piece)	B20 1.5 mm <sup>2</sup> (Piece)
TRDL-FSD-1/MW	1x18	38	46	58	74		19	23	29	37
TRDL-FSD-1/MW	1x24	38	46	58	74		19	23	29	37
TRDL-FSD-1/36	1x36	34	48	54	68		17	24	27	34
TRDL-FSD-1/40	1x40	32	46	52	62		16	23	26	31
TRDL-FSD-1/55	1x55	28	38	50	60		14	19	25	30
TRDL-FSD-2/MW	2x18	30	40	52	64		15	20	26	32
TRDL-FSD-2/MW	2x24	30	40	52	64		15	20	26	32
TRDL-FSD-2/36	2x36	24	34	44	50		12	17	22	25
TRDL-FSD-2/40	2x40	16	24	28	32		8	12	14	16
TRDL-FSD-2/55	2x55	8	14	18	20		4	7	9	10

## Installation rules

Electronic ballasts should be installed inside the lighting armatures in accordance with the established standards. Any inappropriate applications shall affect the ballast life adversely. Especially during the aesthetical designs of the armatures, the contact of ballast with the lamp, or placing the ballast between two lamps exceeds the defined operating ambient temperature (ta) and shortens the ballast life.

Moreover, this condition shall make ballast shut down the circuit by activating its thermal protection. For a healthy operating system, it is important to design the armatures without preventing the air circulation and with keeping the inside of the armature below high temperatures. Especially fluorescent lamps do not perform well in high temperatures and this shortens the operating life.

## Connector and Cable Features for Installation

Model	Power (W)	Connector		Maximum Cable Length		Maximum Capacity	
		Cold	Hot	Cold	Hot	Cold	Hot
TRDL-FSD-1/MW	1x18	1,3	2,4	2m	1m	200 pF	100 pF
TRDL-FSD-1/MW	1x24	1,3	2,4	2m	1m	200 pF	100 pF
TRDL-FSD-1/36	1x36	1,3	2,4	2m	1m	200 pF	100 pF
TRDL-FSD-1/40	1x40	1,3	2,4	2m	1m	200 pF	100 pF
TRDL-FSD-1/55	1x55	1,3	2,4	2m	1m	200 pF	100 pF
TRDL-FSD-2/MW	2x18	2,3,4,5	1,6	2m	1m	200 pF	100 pF
TRDL-FSD-2/MW	2x24	2,3,4,5	1,6	2m	1m	200 pF	100 pF
TRDL-FSD-2/36	2x36	2,3,4,5	1,6	2m	1m	200 pF	100 pF
TRDL-FSD-2/40	2x40	2,3,4,5	1,6	2m	1m	200 pF	100 pF
TRDL-FSD-2/55	2x55	2,3,4,5	1,6	2m	1m	200 pF	100 pF

The ballast – lamp connection cables to be used in armatures shall be performed in accordance with the lamp connection diagrams indicated on the ballasts.

Different connection types shall lead to a breakdown of the ballast and/or lamp and invalidate the terms of warranty. It shall increase the efficiency of the system if the installation cable is between 0.5 – 1.5 mm<sup>2</sup> section range, one veined, and soft copper cable.

The cable lengths should be in accordance with the values given in the table. Since longer cables shall have higher resistance capacity, it would decrease the ballast performance. In order to provide the maximum efficiency from the system, the given values in the table should be followed.



# PROFESSIONAL ELECTRONIC BALLASTS FOR TC-L LINEAR LAMPS

## TC-L Linear Lamps

TC-L linear lamps should be applied along with the TC-L electronic ballasts; the power and length values of TC-L linear lamps are provided below. The only way to achieve the maximum efficiency of the system is by using appropriate lamps.

The habit of considering only power criteria in conventional (magnetic) ballasts is not applicable for the electronic ballasts. Different electronic ballasts should be used for each

different power and type of fluorescent lamps.

Considering that our products operate at 40 kHz. and above, the lamps to be applied in the system should be suitable for operating at high frequency. Using old type lamps with electronic ballasts not only shortens the lamp life but also decreases the ballast performance.

## TC-L Lamp Information

Power (W)	Length (mm)	
18	217	
24	317	
36	411	
40	533	
55	533	



The lamp connection diagrams of the electronic ballasts in following models should be as given above. Cable lengths are provided in the table.

- TRDL-FSD-1/MW (1x18W)
- TRDL-FSD-1/MW (1x24W)
- TRDL-FSD-1/36
- TRDL-FSD-1/40
- TRDL-FSD-1/55



The lamp connection diagrams of the electronic ballasts in following models should be as given above. Cable lengths are provided in the table.

- TRDL-FSD-2/MW (2x18W)
- TRDL-FSD-2/MW (2x24W)
- TRDL-FSD-2/36
- TRDL-FSD-2/40
- TRDL-FSD-2/55

Self-tightening automatic connectors are used in electronic ballasts. These connectors provide a simple installation.

The cable sector should be in line with the values indicated both on the ballast and in the catalogue.

Applying thicker and/or thinner cables may damage the connectors.

Appropriate cables should be used for the terms of warranty to be valid.

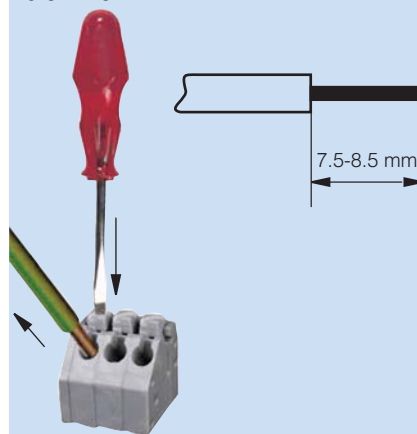
Especially using multi wired, very thin, very thick cables or connecting more than one cable to a connector shall decrease the system performance and may cause physical damages.

Simple installation brings simple removal. As shown in the picture, when button is pushed with the help of a screwdriver the connector shall release the cable and this shall provide the removal.

For all of our products we highly recommend a ground connection both for the health of the users and system.

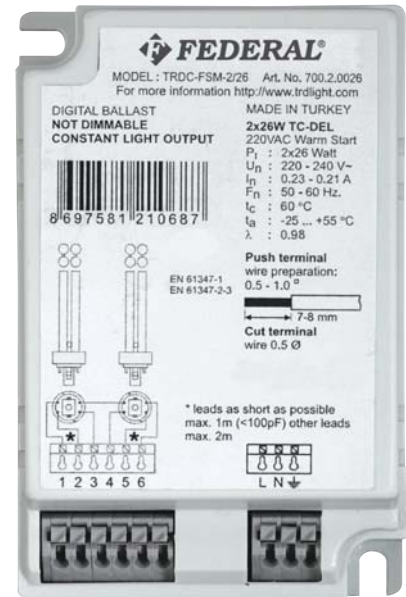
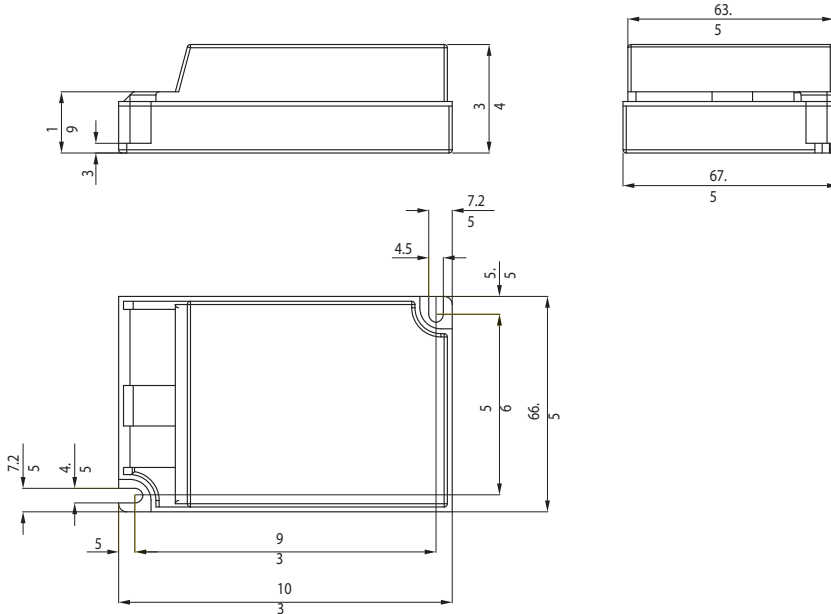
## Cable Preparation:

0.5 - 1.5<sup>2</sup>



# PROFESSIONAL ELECTRONIC BALLASTS FOR TC-DEL LINEAR LAMPS

## 10-26W 220-240V 50/60/0 Hz. PROFESSIONAL SERIES TC-DEL



- AC operating voltage 185 – 265V, ignition voltage > 170V
- DC operating voltage 196 – 330V, ignition voltage > 240V
- High voltage protection > 315 VAC
- Low voltage protection < 150 VAC
- Operation frequency > 40 kHz.
- Average service life 50.000h (failure frequency at maximum ta temperature < %0.2 / 1.000h)
- Has protection for lamp instant failures
- Lamp life protection < 0.7s
- It automatically restarts on lamp changes.
- Lamp capacitive mode protection > 2.5s
- Lamp asymmetric voltage protection > 2.5s
- It performs lamp filament control at start and during operation.
- It performs warm start in 1.5s.
- It has large operating temperature range (-25 °C ... +55 °C).
- It conforms to the emergency lighting kits.
- Thermal protection > 110 °C
- CELMA energy efficiency index EEI = A2
- It provides constant light flux regardless of the fluctuations in the mains voltage.

- Operation without pre-heating in instant energy cuts (< 0.8s)
- It has soft start feature.
- Low harmonic current distortion < 10%
- It provides long filament and lamp life with its smart pre-heating control.
- Enhanced ignition voltage and current control
- Suitable for automatic and manual cabling, provides easy installation with the self-tightening connectors.

### Package Features

- 25 Pieces / Box
- 100 Pieces / Parcel
- 27 Parcels / Pallet
- 2700 Pieces / Pallet

### Quality Certificates

- EN 61347-2-3
- EN 60929

LAMP		BALLAST									
Power (W)	Length (mm)	Model	Order Code	Weight (kg)	Lamp Power (W)	Circuit Power (W)	Current (220V/50 Hz.) (A)	λ (220V/50 Hz.) (A)	tc (°C)	ta (°C)	Celma Class (EEI)
1x10	103	TRDC-FSM-1/MW	700.1.1018	0.14	9.50	10.50	0.06	0.88	60	-25...+55	A2
1x13	131	TRDC-FSM-1/MW	700.1.1018	0.14	12.50	13.50	0.07	0.90	60	-25...+55	A2
1x18	146	TRDC-FSM-1/MW	700.1.1018	0.14	16.50	18.00	0.09	0.94	60	-25...+55	A2
1x26	165	TRDC-FSM-1/26	700.1.0026	0.14	24.00	25.50	0.12	0.96	60	-25...+55	A2
2x10	103	TRDC-FSM-2/MW	700.2.1018	0.14	19.00	21.00	0.10	0.96	60	-25...+55	A2
2x13	131	TRDC-FSM-2/MW	700.2.1018	0.14	25.00	27.50	0.13	0.97	60	-25...+55	A2
2x18	146	TRDC-FSM-2/MW	700.2.1018	0.14	33.00	35.50	0.16	0.98	60	-25...+55	A2
2x26	165	TRDC-FSM-2/26	700.2.0026	0.14	48.00	52.00	0.24	0.99	60	-25...+55	A2

# PROFESSIONAL ELECTRONIC BALLASTS FOR TC-DEL LINEAR LAMPS

## DC Operating Currents

Model	Lamp Type	Power (W)	Current (Un=240VDC)(A)
TRDC-FSM-1/MW	TC-DEL	1x10	0.04
TRDC-FSM-1/MW	TC-DEL	1x13	0.06
TRDC-FSM-1/MW	TC-DEL	1x18	0.08
TRDC-FSM-1/26	TC-DEL	1x26	0.11
TRDC-FSM-2/MW	TC-DEL	2x10	0.09
TRDC-FSM-2/MW	TC-DEL	2x13	0.11
TRDC-FSM-2/MW	TC-DEL	2x18	0.15
TRDC-FSM-2/26	TC-DEL	2x26	0.22

## Operating Voltage

Model	Lamp Type	Power (W)	Uout
TRDC-FSM-1/MW	TC-DEL	1x10	380VDC
TRDC-FSM-1/MW	TC-DEL	1x13	380VDC
TRDC-FSM-1/MW	TC-DEL	1x18	380VDC
TRDC-FSM-1/26	TC-DEL	1x26	380VDC
TRDC-FSM-2/MW	TC-DEL	2x10	380VDC
TRDC-FSM-2/MW	TC-DEL	2x13	380VDC
TRDC-FSM-2/MW	TC-DEL	2x18	380VDC
TRDC-FSM-2/26	TC-DEL	2x26	380VDC

## AC Operating

Supply Voltage

- 220 – 240V 50/60Hz.
- 185 – 265V 50/60Hz. Safe operating tolerance ( $\pm 15\%$ )
- 207 – 253V 50/60Hz. Performance tolerance ( $\pm 10\%$ )

## DC Operating

Supply Voltage

- 220 – 240V 0Hz.
- 240 – 390V 0Hz. Lamp Ignition Voltage
- 130 – 390V 0Hz. Operating Voltage

## Harmonic Distortion

Model	Lamp Type	Power (W)	THD (220V / 50 Hz.)
TRDC-FSM-1/MW	TC-DEL	1x10	< %10
TRDC-FSM-1/MW	TC-DEL	1x13	< %10
TRDC-FSM-1/MW	TC-DEL	1x18	< %10
TRDC-FSM-1/26	TC-DEL	1x26	< %10
TRDC-FSM-2/MW	TC-DEL	2x10	< %10
TRDC-FSM-2/MW	TC-DEL	2x13	< %10
TRDC-FSM-2/MW	TC-DEL	2x18	< %10
TRDC-FSM-2/26	TC-DEL	2x26	< %10

## Ballast Lumen Factor (EN 60929 8.1)

Model	Lamp Type	Power (W)	AC / DC - BLF U= 185- 265V, 25 °C
TRDC-FSM-1/MW	TC-DEL	1x10	1.00
TRDC-FSM-1/MW	TC-DEL	1x13	1.00
TRDC-FSM-1/MW	TC-DEL	1x18	1.00
TRDC-FSM-1/26	TC-DEL	1x26	1.00
TRDC-FSM-2/MW	TC-DEL	2x10	1.00
TRDC-FSM-2/MW	TC-DEL	2x13	1.00
TRDC-FSM-2/MW	TC-DEL	2x18	1.00
TRDC-FSM-2/26	TC-DEL	2x26	1.00

## Lamp operating characteristic

- Warm Start: Lamp cathodes are heated by 1.5s of pre-heating in the AC and DC supply voltages.

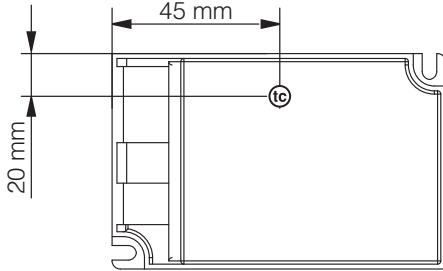
## Emergency Lighting

- It is compatible with the emergency lighting kits defined in the EN 60347-2-3 EK-J.
- In energy cuts the stepping in time is 0.5s.

# PROFESSIONAL ELECTRONIC BALLASTS FOR TC-DEL LINEAR LAMPS

## ta (Operating Temperature) and tc (Test Point)

ta and tc points are directly related to the life of ballast. tc value depends on the temperatures that are defined in the ta range. The value of ta is significant for the critical components used in the ballast (For example, electrolytic capacitors).



ta and tc values are indicated on the ballast covers. For long operating life, these values should be followed. In addition, the terms of warranty are valid for the declared ta and tc values.

## The Number of Ballasts that Can Be Connected to the Automatic Circuit Breakers

Model	Güç (W)	C10 1.5 mm <sup>2</sup> (Piece)	C13 1.5 mm <sup>2</sup> (Piece)	C16 1.5 mm <sup>2</sup> (Piece)	C20 2.5 mm <sup>2</sup> (Piece)	←Automatic Circuit Breaker→ ← Cable Section Ø →	B10 1.5 mm <sup>2</sup> (Piece)	B13 1.5 mm <sup>2</sup> (Piece)	B16 1.5 mm <sup>2</sup> (Piece)	B20 1.5 mm <sup>2</sup> (Piece)
TRDC-FSM-1/MW	1x10	46	70	78	98		23	35	39	49
TRDC-FSM-1/MW	1x13	46	70	78	98		23	35	39	49
TRDC-FSM-1/MW	1x18	46	70	78	98		23	35	39	49
TRDC-FSM-1/26	1x26	34	46	74	84		17	23	37	42
TRDC-FSM-2/MW	2x10	32	44	52	60		16	22	26	30
TRDC-FSM-2/MW	2x13	32	44	52	60		16	22	26	30
TRDC-FSM-2/MW	2x18	32	44	52	60		16	22	26	30
TRDC-FSM-2/26	2x26	22	32	38	44		11	16	19	22

## Installation rules

Electronic ballasts should be installed inside the lighting armatures in accordance with the established standards. Any inappropriate applications shall affect the ballast life adversely. Especially during the aesthetical designs of the armatures, the contact of ballast with the lamp, or placing the ballast between two lamps exceeds the defined operating ambient temperature (ta) and shortens the ballast life.

Moreover, this condition shall make ballast shut down the circuit by activating its thermal protection. For a healthy operating system, it is important to design the armatures without preventing the air circulation and with keeping the inside of the armature below high temperatures. Especially fluorescent lamps do not perform well in high temperatures and this shortens the operating life.

## Connector and Cable Features for Installation

Model	Power (W)	Connector		Maximum Cable Length		Maximum Capacity	
		Cold	Hot	Cold	Hot	Cold	Hot
TRDC-FSM-1/MW	1x10	2,3	1,4	2m	1m	200 pF	100 pF
TRDC-FSM-1/MW	1x13	2,3	1,4	2m	1m	200 pF	100 pF
TRDC-FSM-1/MW	1x18	2,3	1,4	2m	1m	200 pF	100 pF
TRDC-FSM-1/26	1x26	2,3	1,4	2m	1m	200 pF	100 pF
TRDC-FSM-2/MW	2x10	2,3,4,5	1,6	2m	1m	200 pF	100 pF
TRDC-FSM-2/MW	2x13	2,3,4,5	1,6	2m	1m	200 pF	100 pF
TRDC-FSM-2/MW	2x18	2,3,4,5	1,6	2m	1m	200 pF	100 pF
TRDC-FSM-2/26	2x26	2,3,4,5	1,6	2m	1m	200 pF	100 pF

The ballast – lamp connection cables to be used in armatures shall be performed in accordance with the lamp connection diagrams indicated on the ballasts. Different connection types shall lead to a breakdown of the ballast and/or lamp and invalidate the terms of warranty. It shall increase the efficiency of the system if the installation cable is between 0.5 – 1.5 mm<sup>2</sup> section range, one veined, and soft copper cable.

The cable lengths should be in accordance with the values given in the table. Since longer cables shall have higher resistance capacity, it would decrease the ballast performance. In order to provide the maximum efficiency from the system, the given values in the table should be followed.

# PROFESSIONAL ELECTRONIC BALLASTS FOR TC-DEL LINEAR LAMPS

## TC-DEL Linear Lamps





TC-DEL linear lamps should be applied along with the TC-DEL electronic ballasts; the power and length values of TC-DEL linear lamps are provided below. The only way to achieve the maximum efficiency of the system is by using appropriate lamps.

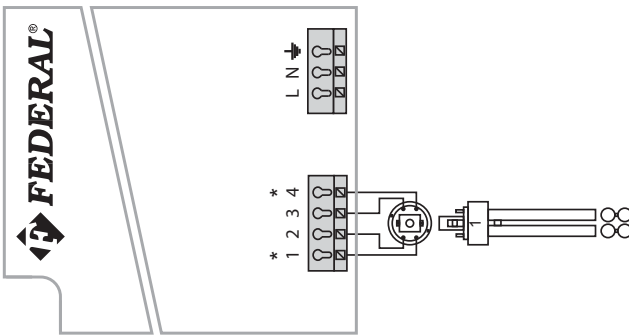
The habit of considering only power criteria in conventional

(magnetic) ballasts is not applicable for the electronic ballasts. Different electronic ballasts should be used for each different power and type of fluorescent lamps.

Considering that our products operate at 40 kHz. and above, the lamps to be applied in the system should be suitable for operating at high frequency. Using old type lamps with electronic ballasts not only shortens the lamp life but also decreases the ballast performance.

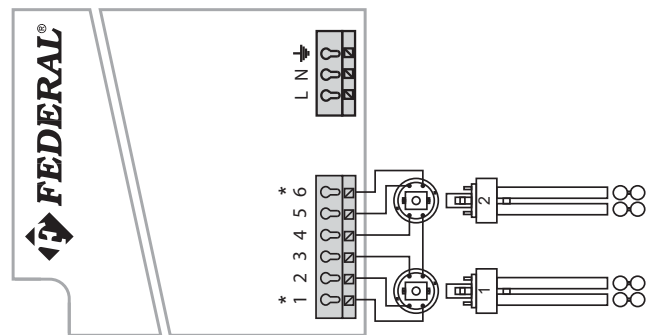
## T8 Lamba Bilgisi

Power (W)	Length (mm)	
10	103	
13	131	
18	146	
26	165	



The lamp connection diagrams of the electronic ballasts in following models should be as given above. Cable lengths are provided in the table.

- TRDC-FSM-1/MW (1x10W)
- TRDC-FSM-1/MW (1x13W)
- TRDC-FSM-1/MW (1x18W)
- TRDC-FSM-1/26



The lamp connection diagrams of the electronic ballasts in following models should be as given above. Cable lengths are provided in the table.

- TRDC-FSM-2/MW (2x10W)
- TRDC-FSM-2/MW (2x13W)
- TRDC-FSM-2/MW (2x18W)
- TRDC-FSM-2/26

Self-tightening automatic connectors are used in electronic ballasts. These connectors provide a simple installation.

The cable sector should be in line with the values indicated both on the ballast and in the catalogue.

Applying thicker and/or thinner cables may damage the connectors.

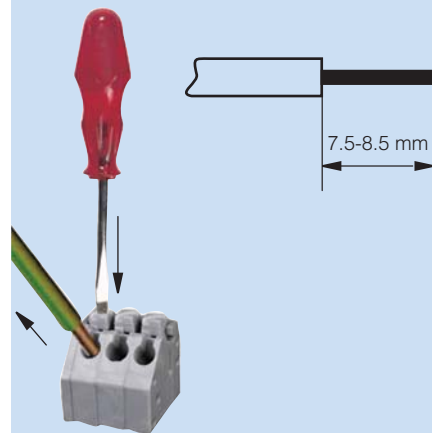
Appropriate cables should be used for the terms of warranty to be valid. Especially using multi wired, very thin, very thick cables or connecting more than one cable to a connector shall decrease the system performance and may cause physical damages.

Simple installation brings simple removal. As shown in the picture, when button is pushed with the help of a screwdriver the connector shall release the cable and this shall provide the removal.

For all of our products we highly recommend a ground connection both for the health of the users and system.

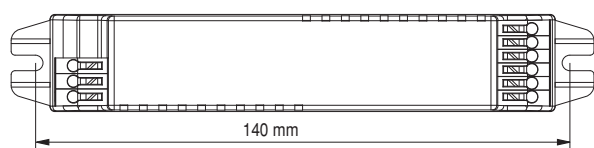
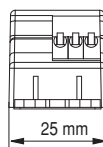
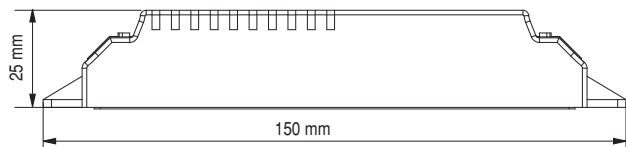
## Cable Preparation:

0.5 - 1.5<sup>2</sup>



# BASIC ELECTRONIC BALLASTS FOR LINEAR LAMPS

## 4-26W 220-240V 50/60/0 Hz. BASIC SERIES



- AC/DC operating voltage 220V  $\pm$ 10%
- Operation frequency > 40 kHz.
- Average service life 50.000h (failure frequency at maximum  $t_a$  temperature < %0.2 / 1.000h)
- Has protection for lamp instant failures.
- It automatically restarts on lamp changes.
- It performs lamp filament control at start.
- It performs warm start in 1.5s.
- It has large operating temperature range (-25 °C ... +55 °C).
- Suitable for automatic and manual cabling, provides easy installation with the self-tightening connectors.
- CELMA energy efficiency index EEI = A2

### Package Features

- 50 Pieces / Box
- 200 Pieces / Parcel
- 27 Parcels / Pallet
- 5400 Pieces / Pallet

LAMP		BALLAST									
Power (W)	Length (mm)	Model	Order Code	Weight (kg)	Lamp Power (W)	Circuit Power (W)	Current (220V/50 Hz.) (A)	$\lambda$ (220V/50 Hz.) (A)	$t_c$ (°C)	$t_a$ (°C)	Celma Class (EEI)
<b>T8 Class</b>											
1x15	438	TRD8-BSC-1/15	118.1.0015	54	13.50	15.00	0.14	0.49	70	-25...+55	A2
2x15	438	TRD8-BSC-2/15	118.2.0015	56	11.50	25.00	0.21	0.55	70	-25...+55	A2
1x18	590	TRD8-BSC-1/18	118.1.0018	54	16.00	18.00	0.16	0.51	70	-25...+55	A2
<b>T5 Class</b>											
1x4	136	TRD5-BSC-1/LW	115.1.0413	54	3.40	5.00	0.05	0.44	70	-25...+55	A2
1x6	212	TRD5-BSC-1/LW	115.1.0413	54	5.10	7.00	0.07	0.46	70	-25...+55	A2
1x8	288	TRD5-BSC-1/LW	115.1.0413	54	6.70	9.00	0.08	0.49	70	-25...+55	A2
1x13	517	TRD5-BSC-1/LW	115.1.0413	54	11.80	14.50	0.13	0.52	70	-25...+55	A2
2x4	136	TRD5-BSC-2/LW	115.2.0413	56	6.80	8.50	0.08	0.48	70	-25...+55	A2
2x6	212	TRD5-BSC-2/LW	115.2.0413	56	10.20	12.50	0.11	0.50	70	-25...+55	A2
2x8	288	TRD5-BSC-2/LW	115.2.0413	56	13.40	16.00	0.14	0.51	70	-25...+55	A2
2x13	517	TRD5-BSC-2/LW	115.2.0413	56	22.00	24.50	0.19	0.58	70	-25...+55	A2
1x14	549	TRD5-BSC-1/MW	115.1.1421	54	14.00	16.50	0.15	0.51	70	-25...+55	A2
1x21	849	TRD5-BSC-1/MW	115.1.1421	54	21.00	24.00	0.19	0.56	70	-25...+55	A2
1x24	549	TRD5-BSC-1/24	115.1.0021	54	22.00	25.00	0.20	0.58	70	-25...+55	A2
<b>T5C Class</b>											
1x22	225	TRD5-BSC-1/22	125.1.0022	54	22.00	25.00	0.20	0.58	70	-25...+55	A2

# BASIC ELECTRONIC BALLASTS FOR LINEAR LAMPS

LAMP		BALLAST									
Power (W)	Length (mm)	Model	Order Code	Weight (kg)	Lamp Power (W)	Circuit Power (W)	Current (220V/50 Hz.) (A)	$\lambda$ (220V/50 Hz.) (A)	tc (°C)	ta (°C)	Celma Class (EEI)
<b>TCL Sınıfı</b>											
1x18	217	FDRL-BSC-1/MW	410.1.1824	54	16.00	19.00	0.16	0.54	70	-25...+55	A2
1x24	317	FDRL-BSC-1/MW	410.1.1824	54	22.00	24.50	0.20	0.57	70	-25...+55	A2
<b>TC-DEL Sınıfı</b>											
1x10	103	FDRC-BSC-1/MW	710.1.1018	54	9.50	11.00	0.10	0.50	70	-25...+55	A2
1x13	131	FDRC-BSC-1/MW	710.1.1018	54	12.50	15.00	0.13	0.52	70	-25...+55	A2
1x18	146	FDRC-BSC-1/MW	710.1.1018	54	16.50	19.00	0.16	0.54	70	-25...+55	A2
2x10	103	FDRC-BSC-2/MW	710.2.1013	56	19.00	22.50	0.18	0.56	70	-25...+55	A2
2x13	131	FDRC-BSC-2/MW	710.2.1013	56	22.00	25.00	0.20	0.58	70	-25...+55	A2
2x18											
1x26	165	FDRC-BSC-1/26	710.1.0026	54	22.00	25.00	0.20	0.58	70	-25...+55	A2
<b>TC-SEL Sınıfı</b>											
1x5	85	FDRS-BSC-1/MW	720.1.0511	54	4.50	6.50	0.07	0.45	70	-25...+55	A2
1x7	114	FDRS-BSC-1/MW	720.1.0511	54	6.00	8.00	0.08	0.47	70	-25...+55	A2
1x9	144	FDRS-BSC-1/MW	720.1.0511	54	7.50	9.50	0.09	0.49	70	-25...+55	A2
1x11	214	FDRS-BSC-1/MW	720.1.0511	54	11.00	13.50	0.12	0.51	70	-25...+55	A2
2x5	85	FDRS-BSC-2/MW	720.2.0511	56	9.00	11.00	0.10	0.50	70	-25...+55	A2
2x7	114	FDRS-BSC-2/MW	720.2.0511	56	12.00	14.50	0.13	0.52	70	-25...+55	A2
2x9	144	FDRS-BSC-2/MW	720.2.0511	56	15.00	18.00	0.15	0.54	70	-25...+55	A2
2x11	214	FDRS-BSC-2/MW	720.2.0511	56	22.00	24.50	0.19	0.58	70	-25...+55	A2
<b>TC-TEL Sınıfı</b>											
1x26	126	FDRT-BSC-1/26	730.1.0026	54	22.00	25.00	0.20	0.58	70	-25...+55	A2
<b>TC-F Sınıfı</b>											
1x18	122	FDRF-BSC-1/MW	740.1.1824	54	16.00	19.00	0.16	0.55	70	-25...+55	A2
1x24	165	FDRF-BSC-1/MW	740.1.1824	54	22.00	25.00	0.19	0.59	70	-25...+55	A2
<b>TC-DD Sınıfı</b>											
1x10	94	FDRD-BSC-1/MW	750.1.1016	54	9.00	11.50	0.10	0.50	70	-25...+55	A2
1x16	141	FDRD-BSC-1/MW	750.1.1016	54	14.00	17.00	0.15	0.52	70	-25...+55	A2
2x10	94	FDRD-BSC-2/10	750.2.0010	56	18.00	21.00	0.17	0.55	70	-25...+55	A2



# BASIC ELECTRONIC BALLASTS FOR LINEAR LAMPS

## DC Operating Currents

Model	Lamp Type	Power (W)	Current (Un=240VDC)(A)
TRD8-BSC-1/15	T8	1x15	0.06
TRD8-BSC-2/15	T8	2x15	0.10
TRD8-BSC-1/18	T8	1x18	0.08
TRD5-BSC-1/LW	T5	1x4	0.02
TRD5-BSC-1/LW	T5	1x6	0.03
TRD5-BSC-1/LW	T5	1x8	0.04
TRD5-BSC-1/LW	T5	1x13	0.06
TRD5-BSC-2/LW	T5	2x4	0.04
TRD5-BSC-2/LW	T5	2x6	0.05
TRD5-BSC-2/LW	T5	2x8	0.07
TRD5-BSC-2/LW	T5	2x13	0.10
TRD5-BSC-1/MW	T5	1x14	0.07
TRD5-BSC-1/MW	T5	1x21	0.10
TRD5-BSC-1/24	T5	1x24	0.10
TRD5-BSC-1/22	T5C	1x22	0.10
TRDL-BSC-1/MW	TCL	1x18	0.08
TRDL-BSC-1/MW	TCL	1x24	0.10
TRDC-BSC-1/MW	TC-DEL	1x10	0.05
TRDC-BSC-1/MW	TC-DEL	1x13	0.06
TRDC-BSC-1/MW	TC-DEL	1x18	0.08
TRDC-BSC-2/MW	TC-DEL	2x10	0.09
TRDC-BSC-2/MW	TC-DEL	2x13	0.10
TRDC-BSC-1/26	TC-DEL	1x26	0.10
TRDS-BSC-1/MW	TC-SEL	1x5	0.03
TRDS-BSC-1/MW	TC-SEL	1x7	0.03
TRDS-BSC-1/MW	TC-SEL	1x9	0.04
TRDS-BSC-1/MW	TC-SEL	1x11	0.06
TRDS-BSC-2/MW	TC-SEL	2x5	0.05
TRDS-BSC-2/MW	TC-SEL	2x7	0.06
TRDS-BSC-2/MW	TC-SEL	2x9	0.08
TRDS-BSC-2/MW	TC-SEL	2x11	0.10
TRDT-BSC-1/26	TC-TEL	1x26	0.10
TRDF-BSC-1/MW	TC-F	1x18	0.08
TRDF-BSC-1/MW	TC-F	1x24	0.10
TRDD-BSC-1/MW	TC-DD	1x10	0.05
TRDD-BSC-1/MW	TC-DD	1x16	0.07
TRDD-BSC-2/10	TC-DD	2x10	0.09

## Ballast Lumen Factor (TS EN 60929 8.1)

Model	Lamp Type	Power (W)	AC / DC - BLF U= 185- 265V, 25 °C
TRD8-BSC-1/15	T8	1x15	0.96
TRD8-BSC-2/15	T8	2x15	0.95
TRD8-BSC-1/18	T8	1x18	0.97
TRD5-BSC-1/LW	T5	1x4	1.00
TRD5-BSC-1/LW	T5	1x6	1.00
TRD5-BSC-1/LW	T5	1x8	1.00
TRD5-BSC-1/LW	T5	1x13	0.95
TRD5-BSC-2/LW	T5	2x4	0.96
TRD5-BSC-2/LW	T5	2x6	0.96
TRD5-BSC-2/LW	T5	2x8	0.96
TRD5-BSC-2/LW	T5	2x13	0.97
TRD5-BSC-1/MW	T5	1x14	1.00
TRD5-BSC-1/MW	T5	1x21	0.97
TRD5-BSC-1/24	T5	1x24	1.00
TRD5-BSC-1/22	T5C	1x22	1.00
TRDL-BSC-1/MW	TCL	1x18	0.97
TRDL-BSC-1/MW	TCL	1x24	0.95
TRDC-BSC-1/MW	TC-DEL	1x10	1.00
TRDC-BSC-1/MW	TC-DEL	1x13	1.00
TRDC-BSC-1/MW	TC-DEL	1x18	0.97
TRDC-BSC-2/MW	TC-DEL	2x10	0.98
TRDC-BSC-2/MW	TC-DEL	2x13	0.96
TRDC-BSC-1/26	TC-DEL	1x26	0.96
TRDS-BSC-1/MW	TC-SEL	1x5	0.95
TRDS-BSC-1/MW	TC-SEL	1x7	0.95
TRDS-BSC-1/MW	TC-SEL	1x9	0.95
TRDS-BSC-1/MW	TC-SEL	1x11	0.97
TRDS-BSC-2/MW	TC-SEL	2x5	0.98
TRDS-BSC-2/MW	TC-SEL	2x7	0.98
TRDS-BSC-2/MW	TC-SEL	2x9	0.98
TRDS-BSC-2/MW	TC-SEL	2x11	0.98
TRDT-BSC-1/26	TC-TEL	1x26	0.95
TRDF-BSC-1/MW	TC-F	1x18	0.90
TRDF-BSC-1/MW	TC-F	1x24	0.90
TRDD-BSC-1/MW	TC-DD	1x10	0.95
TRDD-BSC-1/MW	TC-DD	1x16	0.95
TRDD-BSC-2/10	TC-DD	2x10	0.95

# BASIC ELECTRONIC BALLASTS FOR LINEAR LAMPS

## Operating Voltage

Model	Lamp Type	Power (W)	Uout
TRD8-BSC-1/15	T8	1x15	380VDC
TRD8-BSC-2/15	T8	2x15	380VDC
TRD8-BSC-1/18	T8	1x18	380VDC
TRD5-BSC-1/LW	T5	1x4	380VDC
TRD5-BSC-1/LW	T5	1x6	380VDC
TRD5-BSC-1/LW	T5	1x8	380VDC
TRD5-BSC-1/LW	T5	1x13	380VDC
TRD5-BSC-2/LW	T5	2x4	380VDC
TRD5-BSC-2/LW	T5	2x6	380VDC
TRD5-BSC-2/LW	T5	2x8	380VDC
TRD5-BSC-2/LW	T5	2x13	380VDC
TRD5-BSC-1/MW	T5	1x14	380VDC
TRD5-BSC-1/MW	T5	1x21	380VDC
TRD5-BSC-1/24	T5	1x24	380VDC
TRD5-BSC-1/22	T5C	1x22	380VDC
TRDL-BSC-1/MW	TCL	1x18	380VDC
TRDL-BSC-1/MW	TCL	1x24	380VDC
TRDC-BSC-1/MW	TC-DEL	1x10	380VDC
TRDC-BSC-1/MW	TC-DEL	1x13	380VDC
TRDC-BSC-1/MW	TC-DEL	1x18	380VDC
TRDC-BSC-2/MW	TC-DEL	2x10	380VDC
TRDC-BSC-2/MW	TC-DEL	2x13	380VDC
TRDC-BSC-1/26	TC-DEL	1x26	380VDC
TRDS-BSC-1/MW	TC-SEL	1x5	380VDC
TRDS-BSC-1/MW	TC-SEL	1x7	380VDC
TRDS-BSC-1/MW	TC-SEL	1x9	380VDC
TRDS-BSC-1/MW	TC-SEL	1x11	380VDC
TRDS-BSC-2/MW	TC-SEL	2x5	380VDC
TRDS-BSC-2/MW	TC-SEL	2x7	380VDC
TRDS-BSC-2/MW	TC-SEL	2x9	380VDC
TRDS-BSC-2/MW	TC-SEL	2x11	380VDC
TRDT-BSC-1/26	TC-TEL	1x26	380VDC
TRDF-BSC-1/MW	TC-F	1x18	380VDC
TRDF-BSC-1/MW	TC-F	1x24	380VDC
TRDD-BSC-1/MW	TC-DD	1x10	380VDC
TRDD-BSC-1/MW	TC-DD	1x16	380VDC
TRDD-BSC-2/10	TC-DD	2x10	380VDC

## AC Operating

Supply Voltage

- 220 – 240V 50/60Hz.
- 185 – 265V 50/60Hz. Safe operating tolerance ( $\pm 15\%$ )
- 207 – 253V 50/60Hz. Performance tolerance ( $\pm 10\%$ )

## DC Operating

Supply Voltage

- 220 – 240V 0Hz.
- 240 – 390V 0Hz. Lamp Ignition Voltage
- 130 – 390V 0Hz. Operating Voltage

## Lamp operating characteristic

- Warm Start: Lamp cathodes are heated by 1.5s of pre-heating in the AC and DC supply voltages.

# BASIC ELECTRONIC BALLASTS FOR LINEAR LAMPS

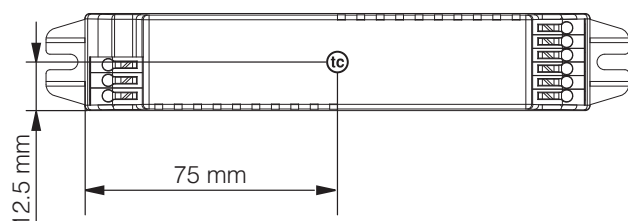
## ta (Operating Temperature) and tc (Test Point)

ta and tc points are directly related to the life of ballast. tc value depends on the temperatures that are defined in the ta range.

The value of ta is significant for the critical components used

in the ballast (For example, electrolytic capacitors).

ta and tc values are indicated on the ballast covers. For long operating life, these values should be followed. In addition, the terms of warranty are valid for the declared ta and tc values.



## The Number of Ballasts that Can Be Connected to the Automatic Circuit Breakers

Model	Lamp Type	Power (W)	Automatic Circuit Breaker				Cable Section Ø			
			C10 1.5 mm <sup>2</sup> (Piece)	C13 1.5 mm <sup>2</sup> (Piece)	C16 1.5 mm <sup>2</sup> (Piece)	C20 2.5 mm <sup>2</sup> (Piece)	B10 1.5 mm <sup>2</sup> (Piece)	B13 1.5 mm <sup>2</sup> (Piece)	B16 1.5 mm <sup>2</sup> (Piece)	B20 1.5 mm <sup>2</sup> (Piece)
TRD8-BSC-1/15	T8	1x15	56	74	100	120	28	37	50	60
TRD8-BSC-2/15	T8	2x15	50	64	80	100	25	32	40	50
TRD8-BSC-1/18	T8	1x18	56	74	100	120	28	37	50	60
TRD5-BSC-1/LW	T5	1x4	80	108	130	164	40	54	65	82
TRD5-BSC-1/LW	T5	1x6	80	108	130	164	40	54	65	82
TRD5-BSC-1/LW	T5	1x8	80	108	130	164	40	54	65	82
TRD5-BSC-1/LW	T5	1x13	80	108	130	164	40	54	65	82
TRD5-BSC-2/LW	T5	2x4	80	108	130	164	40	54	65	82
TRD5-BSC-2/LW	T5	2x6	80	108	130	164	40	54	65	82
TRD5-BSC-2/LW	T5	2x8	80	108	130	164	40	54	65	82
TRD5-BSC-2/LW	T5	2x13	56	74	100	120	28	37	50	60
TRD5-BSC-1/MW	T5	1x14	50	64	80	100	25	32	40	50
TRD5-BSC-1/MW	T5	1x21	50	64	80	100	25	32	40	50
TRD5-BSC-1/24	T5	1x24	50	64	80	100	25	32	40	50
TRD5-BSC-1/22	T5C	1x22	50	64	80	100	25	32	40	50
TRDL-BSC-1/MW	TCL	1x18	56	74	100	120	28	37	50	60
TRDL-BSC-1/MW	TCL	1x24	50	64	80	100	25	32	40	50
TRDC-BSC-1/MW	TC-DEL	1x10	80	108	130	164	40	54	65	82
TRDC-BSC-1/MW	TC-DEL	1x13	80	108	130	164	40	54	65	82
TRDC-BSC-1/MW	TC-DEL	1x18	56	74	100	120	28	37	50	60
TRDC-BSC-2/MW	TC-DEL	2x10	50	64	80	100	25	32	40	50
TRDC-BSC-2/MW	TC-DEL	2x13	50	64	80	100	25	32	40	50
TRDC-BSC-1/26	TC-DEL	1x26	50	64	80	100	25	32	40	50
TRDS-BSC-1/MW	TC-SEL	1x5	70	90	116	140	35	45	58	70
TRDS-BSC-1/MW	TC-SEL	1x7	70	90	116	140	35	45	58	70
TRDS-BSC-1/MW	TC-SEL	1x9	70	90	116	140	35	45	58	70
TRDS-BSC-1/MW	TC-SEL	1x11	70	90	116	140	35	45	58	70
TRDS-BSC-2/MW	TC-SEL	2x5	70	90	116	140	35	45	58	70
TRDS-BSC-2/MW	TC-SEL	2x7	70	90	116	140	35	45	58	70
TRDS-BSC-2/MW	TC-SEL	2x9	60	80	106	130	30	40	54	65
TRDS-BSC-2/MW	TC-SEL	2x11	50	74	100	120	25	37	50	60
TRDT-BSC-1/26	TC-TEL	1x26	50	64	80	100	25	37	40	50
TRDF-BSC-1/MW	TC-F	1x18	50	64	80	100	25	37	40	50
TRDF-BSC-1/MW	TC-F	1x24	50	64	80	100	25	37	40	50
TRDD-BSC-1/MW	TC-DD	1x10	80	108	130	164	40	54	65	82
TRDD-BSC-1/MW	TC-DD	1x16	60	80	106	130	30	40	54	65
TRDD-BSC-2/10	TC-DD	2x10	60	80	106	130	30	40	54	65

# BASIC ELECTRONIC BALLASTS FOR LINEAR LAMPS

## Installation rules

Electronic ballasts should be installed inside the lighting armatures in accordance with the established standards. Any inappropriate applications shall affect the ballast life adversely. Especially during the aesthetical designs of the armatures, the contact of ballast with the lamp, or placing the ballast between two lamps exceeds the defined operating ambient temperature (ta) and shortens the ballast life.

Moreover, this condition shall make ballast shut down the circuit by activating its thermal protection. For a healthy operating system, it is important to design the armatures without preventing the air circulation and with keeping the inside of the armature below high temperatures. Especially fluorescent lamps do not perform well in high temperatures and this shortens the operating life.

## Connector and Cable Features for Installation



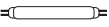


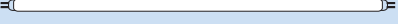

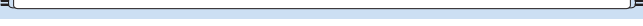








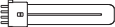



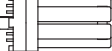
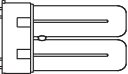

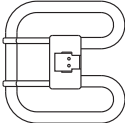
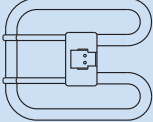
Model	Power (W)	Connector		Maximum Cable Length		Maximum Capacity	
		Cold	Hot	Cold	Hot	Cold	Hot
TRD8-BSC-1/15	1x15		1,2,3,4	1,5m	0,75m	150pF	75pF
TRD8-BSC-2/15	2x15	3,4	1,2,5,6	1,5m	0,75m	150pF	75pF
TRD8-BSC-1/18	1x18		1,2,3,4	1,5m	0,75m	150pF	75pF
TRD5-BSC-1/LW	1x4		1,2,3,4	1,5m	0,75m	150pF	75pF
TRD5-BSC-1/LW	1x6		1,2,3,4	1,5m	0,75m	150pF	75pF
TRD5-BSC-1/LW	1x8		1,2,3,4	1,5m	0,75m	150pF	75pF
TRD5-BSC-1/LW	1x13		1,2,3,4	1,5m	0,75m	150pF	75pF
TRD5-BSC-2/LW	2x4	3,4	1,2,5,6	1,5m	0,75m	150pF	75pF
TRD5-BSC-2/LW	2x6	3,4	1,2,5,6	1,5m	0,75m	150pF	75pF
TRD5-BSC-2/LW	2x8	3,4	1,2,5,6	1,5m	0,75m	150pF	75pF
TRD5-BSC-2/LW	2x13	3,4	1,2,5,6	1,5m	0,75m	150pF	75pF
TRD5-BSC-1/MW	1x14		1,2,3,4	1,5m	0,75m	150pF	75pF
TRD5-BSC-1/MW	1x21		1,2,3,4	1,5m	0,75m	150pF	75pF
TRD5-BSC-1/24	1x24		1,2,3,4	1,5m	0,75m	150pF	75pF
TRD5-BSC-1/22	1x22		1,2,3,4	1,5m	0,75m	150pF	75pF
TRDL-BSC-1/MW	1x18		1,2,3,4	1,5m	0,75m	150pF	75pF
TRDL-BSC-1/MW	1x24		1,2,3,4	1,5m	0,75m	150pF	75pF
TRDC-BSC-1/MW	1x10		1,2,3,4	1,5m	0,75m	150pF	75pF
TRDC-BSC-1/MW	1x13		1,2,3,4	1,5m	0,75m	150pF	75pF
TRDC-BSC-1/MW	1x18		1,2,3,4	1,5m	0,75m	150pF	75pF
TRDC-BSC-2/MW	2x10	3,4	1,2,5,6	1,5m	0,75m	150pF	75pF
TRDC-BSC-2/MW	2x13	3,4	1,2,5,6	1,5m	0,75m	150pF	75pF
TRDC-BSC-1/26	1x26		1,2,3,4	1,5m	0,75m	150pF	75pF
TRDS-BSC-1/MW	1x5		1,2,3,4	1,5m	0,75m	150pF	75pF
TRDS-BSC-1/MW	1x7		1,2,3,4	1,5m	0,75m	150pF	75pF
TRDS-BSC-1/MW	1x9		1,2,3,4	1,5m	0,75m	150pF	75pF
TRDS-BSC-1/MW	1x11		1,2,3,4	1,5m	0,75m	150pF	75pF
TRDS-BSC-2/MW	2x5	3,4	1,2,5,6	1,5m	0,75m	150pF	75pF
TRDS-BSC-2/MW	2x7	3,4	1,2,5,6	1,5m	0,75m	150pF	75pF
TRDS-BSC-2/MW	2x9	3,4	1,2,5,6	1,5m	0,75m	150pF	75pF
TRDS-BSC-2/MW	2x11	3,4	1,2,5,6	1,5m	0,75m	150pF	75pF
TRDT-BSC-1/26	1x26		1,2,3,4	1,5m	0,75m	150pF	75pF
TRDF-BSC-1/MW	1x18		1,2,3,4	1,5m	0,75m	150pF	75pF
TRDF-BSC-1/MW	1x24		1,2,3,4	1,5m	0,75m	150pF	75pF
TRDD-BSC-1/MW	1x10		1,2,3,4	1,5m	0,75m	150pF	75pF
TRDD-BSC-1/MW	1x16		1,2,3,4	1,5m	0,75m	150pF	75pF
TRDD-BSC-2/10	2x10	3,4	1,2,5,6	1,5m	0,75m	150pF	75pF

The ballast – lamp connection cables to be used in armatures shall be performed in accordance with the lamp connection diagrams indicated on the ballasts. Different connection types shall lead to a breakdown of the ballast and/or lamp and invalidate the terms of warranty. It shall increase the efficiency of the system if the installation cable is between 0.5 – 1.5 mm<sup>2</sup> section range, one veined, and soft copper cable.

The cable lengths should be in accordance with the values given in the table. Since longer cables shall have higher resistance capacity, it would decrease the ballast performance. In order to provide the maximum efficiency from the system, the given values in the table should be followed.

# BASIC ELECTRONIC BALLASTS FOR LINEAR LAMPS

## Lamp Information

Power (W)	Length (mm)	
<b>T8 Class</b>		
15	438	
18	590	
<b>T5 Class</b>		
4	136	
6	212	
8	288	
13	517	
14	549	
21	849	
24	549	
<b>T5C Class</b>		
22	225	
<b>TCL Class</b>		
18	217	
24	317	
<b>TC-DEL Class</b>		
10	103	
13	131	
18	146	
26	165	
<b>TC-SEL Class</b>		
5	85	
7	114	
9	144	
11	214	
<b>TC-TEL Class</b>		
26	126	
<b>TC-F Class</b>		
18	122	
24	165	
<b>TC-DD Class</b>		
10	94	
16	141	

# BASIC ELECTRONIC BALLASTS FOR LINEAR LAMPS

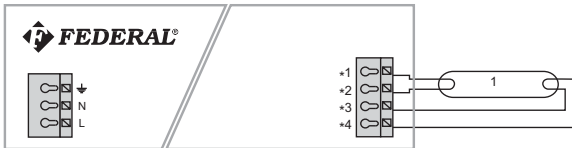
## Fluorescent Lamps

The fluorescent lamps should be applied along with the BASIC series electronic ballasts; the power and length values of the fluorescent lamps are provided below. The only way to achieve the maximum efficiency of the system is by using appropriate lamps.

The habit of considering only power criteria in conventional (magnetic) ballasts is not applicable for the electronic

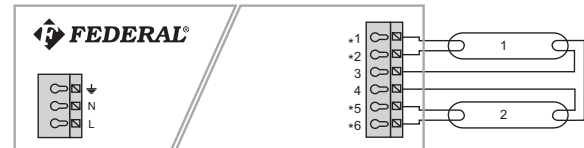
ballasts. Different electronic ballasts should be used for each different power and type of fluorescent lamps.

Considering that our products operate at 40 kHz. and above, the lamps to be applied in the system should be suitable for operating at high frequency. Using old type lamps with electronic ballasts not only shortens the lamp life but also decreases the ballast performance.



The lamp connection diagrams of the electronic ballasts in following models should be as given above. Cable lengths are provided in the table.

- |                         |                         |
|-------------------------|-------------------------|
| • TRD8-BSC-1X15         | • TRDC-BSC-1X26         |
| • TRD8-BSC-1X18         | • TRDS-BSC-1/MW (1x5W)  |
| • TRD5-BSC-1/LW (1x4W)  | • TRDS-BSC-1/MW (1x7W)  |
| • TRD5-BSC-1/LW (1x6W)  | • TRDS-BSC-1/MW (1x9W)  |
| • TRD5-BSC-1/LW (1x8W)  | • TRDS-BSC-1/MW (1x11W) |
| • TRD5-BSC-1/LW (1x13W) | • TRDT-BSC-1X26         |
| • TRD5-BSC-1/MW (1x14W) | • TRDF-BSC-1/MW (1x18W) |
| • TRD5-BSC-1/MW (1x21W) | • TRDF-BSC-1/MW (1x24W) |
| • TRD5-BSC-1X24         | • TRDD-BSC-1/MW (1x10W) |
| • TRD5-BSC-1X22         | • TRDD-BSC-1/MW (1x16W) |
| • TRDL-BSC-1/MW (1x18W) |                         |
| • TRDL-BSC-1/MW (1x24W) |                         |
| • TRDC-BSC-1/MW (1x10W) |                         |
| • TRDC-BSC-1/MW (1x13W) |                         |
| • TRDC-BSC-1/MW (1x18W) |                         |



The lamp connection diagrams of the electronic ballasts in following models should be as given above. Cable lengths are provided in the table.

- TRD8-BSC-2X16
- TRD5-BSC-2/LW (2x4W)
- TRD5-BSC-2/LW (2x6W)
- TRD5-BSC-2/LW (2x8W)
- TRD5-BSC-2/LW (2x13W)
- TRDC-BSC-2/MW (2x10W)
- TRDC-BSC-2/MW (2x13W)
- TRDS-BSC-2/MW (2x5W)
- TRDS-BSC-2/MW (2x7W)
- TRDS-BSC-2/MW (2x9W)
- TRDS-BSC-2/MW (2x11W)
- TRDD-BSC-2X10

Self-tightening automatic connectors are used in electronic ballasts. These connectors provide a simple installation.

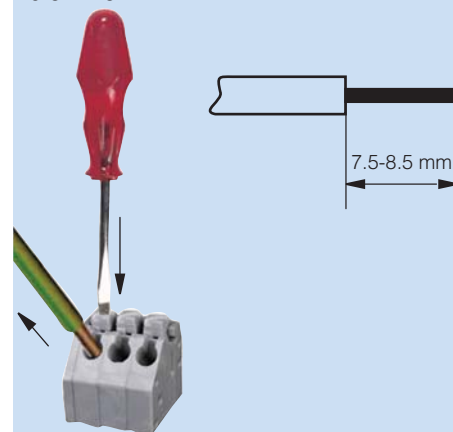
The cable sector should be in line with the values indicated both on the ballast and in the catalogue.

Applying thicker and/or thinner cables may damage the connectors. Appropriate cables should be used for the terms of warranty to be valid. Especially using multi wired, very thin, very thick cables or connecting more than one cable to a connector shall decrease the system performance and may cause physical damages.

Simple installation brings simple removal.

As shown in the picture, when button is pushed with the help of a screwdriver the connector shall release the cable and this shall provide the removal. For all of our products we highly recommend a ground connection both for the health of the users and system.

**Cable Preparation:**  
0.5 - 1.5<sup>2</sup>



# RECOMMENDED LAMP BRANDS / MODELS FOR PROFESSIONAL ELECTRONIC BALLASTS

Lamp	Ballast		Lamp					
	Order Code	Product Code	Power	Lamp Holder/Socket	GE	Osram	Philips	Sylvania
T8	108.1.0015	TRD8-FDH-1/15	15W	G13	POLYLUX XLR F15W	LUMILUX L 15W	TL-D 15W	LUXLINE PLUS F15W
	108.2.0015	TRD8-FDH-2/15	15W	G13	POLYLUX XLR F15W	LUMILUX L 15W	TL-D 15W	LUXLINE PLUS F15W
	108.1.0018	TRD8-FDH-1/18	18W	G13	POLYLUX XLR F18W	LUMILUX L 18W	TL-D 18W	LUXLINE PRO F18W
	108.2.0018	TRD8-FDH-2/18	18W	G13	POLYLUX XLR F18W	LUMILUX L 18W	TL-D 18W	LUXLINE PRO F18W
	108.4.0018	TRD8-FDH-4/18	18W	G13	POLYLUX XLR F18W	LUMILUX L 18W	TL-D 18W	LUXLINE PRO F18W
	108.1.0030	TRD8-FDH-1/30	30W	G13	POLYLUX XLR F30W	LUMILUX L 30W	TL-D 30W	LUXLINE PLUS F30W
	108.1.0036	TRD8-FDH-1/36	36W	G13	POLYLUX XLR F36W	LUMILUX L 36W	TL-D 36W	LUXLINE PRO F36W
	108.2.0030	TRD8-FDH-2/30	30W	G13	POLYLUX XLR F30W	LUMILUX L 30W	TL-D 30W	LUXLINE PLUS F30W
	108.2.0036	TRD8-FDH-2/36	36W	G13	POLYLUX XLR F36W	LUMILUX L 36W	TL-D 36W	LUXLINE PRO F36W
	108.1.0058	TRD8-FDH-1/58	58W	G13	POLYLUX XLR F58W	LUMILUX L 58W	TL-D 58W	LUXLINE PRO F58W
	108.2.0058	TRD8-FDH-2/58	58W	G13	POLYLUX XLR F58W	LUMILUX L 58W	TL-D 58W	LUXLINE PRO F58W
T5	105.1.1435	TRD5-FDH-1/MW	14W	G5	STARCOAT T5 HE F14W	LUMILUX FH 14W	TL5 HE 14W	FHE 14W
			21W	G5	STARCOAT T5 HE F21W	LUMILUX FH 21W	TL5 HE 21W	FHE 21W
			28W	G5	STARCOAT T5 HE F28W	LUMILUX FH 28W	TL5 HE 28W	FHE 28W
			35W	G5	STARCOAT T5 HE F35W	LUMILUX FH 35W	TL5 HE 35W	FHE 35W
	105.2.1435	TRD5-FDH-2/MW	14W	G5	STARCOAT T5 HE F14W	LUMILUX FH 14W	TL5 HE 14W	FHE 14W
			21W	G5	STARCOAT T5 HE F21W	LUMILUX FH 21W	TL5 HE 21W	FHE 21W
			28W	G5	STARCOAT T5 HE F28W	LUMILUX FH 28W	TL5 HE 28W	FHE 28W
			35W	G5	STARCOAT T5 HE F35W	LUMILUX FH 35W	TL5 HE 35W	FHE 35W
	105.4.0014	TRD5-FDH-4/14	14W	G5	STARCOAT T5 HE F14W	LUMILUX FQ 14W	TL5 HE 14W	FHE 14W
	105.1.0054	TRD5-FDH-1/54	54W	G5	STARCOAT T5 HO F54W	LUMILUX FQ 54W	TL5 HO 54W	FHO 54W
	105.2.0054	TRD5-FDH-2/54	54W	G5	STARCOAT T5 HO F54W	LUMILUX FQ 54W	TL5 HO 54W	FHO 54W
TC-L	400.1.1824	TRDL-FSD-1/MW	18W	2G11 4-PIN	BIAX L-18W	DULUX L-18W	PL-L 18W	LYNX CF LE-18W
			24W	2G11 4-PIN	BIAX L-24W	DULUX L-24W	PL-L 24W	LYNX CF LE-24W
	400.2.1824	TRDL-FSD-2/MW	18W	2G11 4-PIN	BIAX L-18W	DULUX L-18W	PL-L 18W	LYNX CF LE-18W
			24W	2G11 4-PIN	BIAX L-24W	DULUX L-24W	PL-L 24W	LYNX CF LE-24W
	400.1.0036	TRDL-FSD-1/36	36W	2G11 4-PIN	BIAX L-36W	DULUX L-36W	PL-L 36W	LYNX CF LE-36W
	400.2.0036	TRDL-FSD-2/36	36W	2G11 4-PIN	BIAX L-36W	DULUX L-36W	PL-L 36W	LYNX CF LE-36W
	400.1.0040	TRDL-FSD-1/40	40W	2G11 4-PIN	BIAX L-40W	DULUX L-40W	PL-L 40W(HF)	LYNX CF LE-40W
	400.1.0040	TRDL-FSD-2/40	40W	2G11 4-PIN	BIAX L-40W	DULUX L-40W	PL-L 40W(HF)	LYNX CF LE-40W
	400.1.0055	TRDL-FSD-1/55	55W	2G11 4-PIN	BIAX 6-55W	DULUX L-55W	PL-L 55W (HF)	LYNX CF LE-55W
	400.2.0055	TRDL-FSD-2/55	55W	2G11 4-PIN	BIAX 6-55W	DULUX L-55W	PL-L 55W (HF)	LYNX CF LE-55W
TC-DEL	700.1.1018	TRDC-FSM-1/MW	10W	G24-q1 4-PIN	BIAX D/E-10W	DULUX D/E-10W	PL-C/4p 10W	LYNX CF DE-10W
			13W	G24-q1 4-PIN	BIAX D/E-13W	DULUX D/E-13W	PL-C/4p 13W	LYNX CF DE-13W
			18W	G24-q2 4-PIN	BIAX D/E-18W	DULUX D/E-18W	PL-C/4p 18W	LYNX CF DE-18W
	700.2.1018	TRDC-FSM-2/MW	10W	G24-q1 4-PIN	BIAX D/E-10W	DULUX D/E-10W	PL-C/4p 10W	LYNX CF DE-10W
			13W	G24-q1 4-PIN	BIAX D/E-13W	DULUX D/E-13W	PL-C/4p 13W	LYNX CF DE-13W
			18W	G24-q2 4-PIN	BIAX D/E-18W	DULUX D/E-18W	PL-C/4p 18W	LYNX CF DE-18W
	700.1.0026	TRDC-FSM-1/26	26W	G24-q3 4-PIN	BIAX D/E-26W	DULUX D/E-26W	PL-C/4p 26W	LYNX CF DE-26W
	700.2.0026	TRDC-FSM-2/26	26W	G24-q3 4-PIN	BIAX D/E-26W	DULUX D/E-26W	PL-C/4p 26W	LYNX CF DE-26W



# RECOMMENDED LAMP BRANDS / MODELS FOR BASIC ELECTRONIC BALLASTS

Lamp	Ballast		Lamp					
	Order Code	Product Code	Power	Lamp Holder/Socket	GE	Osram	Philips	Sylvania
T8	118.1.0015	TRD8-BSC-1/15	15W	G13	POLYLUX XLR F15W	LUMILUX L 15W	TL-D 15W	LUXLINE PLUS F15W
	118.2.0015	TRD8-BSC-2/15	15W	G13	POLYLUX XLR F15W	LUMILUX L 15W	TL-D 15W	LUXLINE PLUS F15W
	118.1.0018	TRD8-BSC-1/18	18W	G13	POLYLUX XLR F18W	LUMILUX L 18W	TL-D 18W	LUXLINE PRO F18W
T5	115.1.0413	TRD5-BSC-1/LW	4W	G5	T5 MINI STD HALO F4W	BASIC L 4W	TL MINI 4W	F4W
			6W	G5	T5 MINI STD HALO F6W	BASIC L 6W	TL MINI 6W	F6W
			8W	G5	T5 MINI STD HALO F8W	BASIC L 8W	TL MINI 8W	F8W
			13W	G5	T5 MINI STD HALO F13W	BASIC L 13W	TL MINI 13W	F13W
	115.2.0413	TRD5-BSC-2/LW	4W	G5	T5 MINI STD HALO F4W	BASIC L 4W	TL MINI 4W	F4W
			6W	G5	T5 MINI STD HALO F6W	BASIC L 6W	TL MINI 6W	F6W
			8W	G5	T5 MINI STD HALO F8W	BASIC L 8W	TL MINI 8W	F8W
			13W	G5	T5 MINI STD HALO F13W	BASIC L 13W	TL MINI 13W	F13W
	115.1.1421	TRD5-BSC-1/MW	14W	G5	STARCOAT T5 HE F14W	LUMILUX FH 14W	TL5 HE 14W	FHE 14W
			21W	G5	STARCOAT T5 HE F21W	LUMILUX FH 21W	TL5 HE 21W	FHE 21W
	115.1.0024	TRD5-BSC-1/24	24W	G5	STARCOAT T5 HO F24W	LUMILUX FH 24W	TL5 HO 24W	FHO 24W
			24W	G5	STARCOAT T5 HO F24W	LUMILUX FH 24W	TL5 HO 24W	FHO 24W
T5-C	125.1.0022	TRD5-BSC-1/22	22W	2GX13		LUMILUX FC 22W	22W C-T5 1CT	
TC-L	410.1.1824	TRDL-BSC-1/MW	18W	2G11 4-PIN	BIAX L-18W	DULUX L-18W	PL-L 18W	LYNX CF LE-18W
			24W	2G11 4-PIN	BIAX L-24W	DULUX L-24W	PL-L 24W	LYNX CF LE-24W
TC-DEL	710.1.1018	TRDC-BSC-1/MW	10W	G24-q1 4-PIN	BIAX D/E-10W	DULUX D/E-10W	PL-C/4p 10W	LYNX CF DE-10W
			18W	G24-q2 4-PIN	BIAX D/E-18W	DULUX D/E-18W	PL-C/4p 18W	LYNX CF DE-18W
	710.2.1013	TRDC-BSC-2/MW	10W	G24-q1 4-PIN	BIAX D/E-10W	DULUX D/E-10W	PL-C/4p 10W	LYNX CF DE-10W
			13W	G24-q1 4-PIN	BIAX D/E-13W	DULUX D/E-13W	PL-C/4p 13W	LYNX CF DE-13W
	710.1.0026	TRDC-BSC-1/26	26W	G24-q3 4-PIN	BIAX D/E-26W	DULUX D/E-26W	PL-C/4p 26W	LYNX CF DE-26W
TC-SEL	720.1.0511	TRDS-BSC-1/MW	5W	2G7 4-PIN	BIAX S/E-5W	DULUX S/E-5W	PL-S/4p 5W	LYNX CF SE-5W
			7W	2G7 4-PIN	BIAX S/E-7W	DULUX S/E-7W	PL-S/4p 7W	LYNX CF SE-7W
			9W	2G7 4-PIN	BIAX S/E-9W	DULUX S/E-9W	PL-S/4p 9W	LYNX CF SE-9W
			11W	2G7 4-PIN	BIAX S/E-11W	DULUX S/E-11W	PL-S/4p 11W	LYNX CF SE-11W
	720.2.0511	TRDS-BSC-2/MW	5W	2G7 4-PIN	BIAX S/E-5W	DULUX S/E-5W	PL-S/4p 5W	LYNX CF SE-5W
			7W	2G7 4-PIN	BIAX S/E-7W	DULUX S/E-7W	PL-S/4p 7W	LYNX CF SE-7W
			9W	2G7 4-PIN	BIAX S/E-9W	DULUX S/E-9W	PL-S/4p 9W	LYNX CF SE-9W
			11W	2G7 4-PIN	BIAX S/E-11W	DULUX S/E-11W	PL-S/4p 11W	LYNX CF SE-11W
TC-TEL	730.1.0026	TRDT-BSC-1/26	26W	GX24-q3 4-PIN	BIAX T/E-26W	DULUX T/E-26W	PL-T/4p 26W	LYNX CF TE-26W
TC-F	740.1.1824	TRDF-BSC-1/MW	18W	2G10 4-PIN		DULUX F-18W		LYNX CF F-18W
			24W	2G10 4-PIN		DULUX F-24W		LYNX CF F-24W
TC-DD	750.1.1016	TRDD-BSC-1/MW	10W	GR10q 4-PIN	BIAX 2D/E—10W			
			16W	GR10q 4-PIN	BIAX 2D/E—16W		PL-Q Pro/4P 16W	
	750.2.0010	TRDD-BSC-2/10	10W	GR10q 4-PIN	BIAX 2D/E—10W			

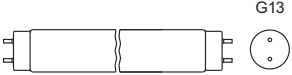
# INSTALLATION INFORMATION FOR PROFESSIONAL ELECTRONIC BALLASTS

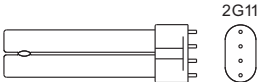
Lamp Type	Ballast		Lamp			Terminals for Installation												Cable Length		The Number Of Ballasts That Can Be Connected To Automatic Circuit Breakers							
	Order Code	Product Code	Number	Power	Lamp holder / Socket	1	2	3	4	5	6	7	8	9	10	11	12	*Hot (m/pF)	Cold (m/pF)	Type B				Type C			
																				10A	13A	16A	20A	10A	13A	16A	20A
T8	108.1.0015	TRD8-FDH-1/15	1	15W	G13	x	x*	x	x*	-	-	-	-	-	-	-	-	1m/100pF	2m/200pF	22	31	37	52	44	62	74	104
	108.1.0018	TRD8-FDH-1/18	1	18W	G13	x	x*	x	x*	-	-	-	-	-	-	-	-	1m/100pF	2m/200pF	22	31	37	52	44	62	74	104
	108.1.0030	TRD8-FDH-1/30	1	30W	G13	x	x*	x	x*	-	-	-	-	-	-	-	-	1m/100pF	2m/200pF	19	26	30	36	40	52	60	72
	108.1.0036	TRD8-FDH-1/36	1	36W	G13	x	x*	x	x*	-	-	-	-	-	-	-	-	1m/100pF	2m/200pF	19	26	30	36	38	52	60	72
	108.1.0058	TRD8-FDH-1/58	1	58W	G13	x	x*	x	x*	-	-	-	-	-	-	-	-	1m/100pF	2m/200pF	18	25	30	35	36	50	60	70
	108.2.0015	TRD8-FDH-2/15	2	15W	G13	x*	x	x	x	x	x*	-	-	-	-	-	-	1m/100pF	2m/200pF	20	27	32	38	40	54	64	76
	108.2.0018	TRD8-FDH-2/18	2	18W	G13	x*	x	x	x	x	x*	-	-	-	-	-	-	1m/100pF	2m/200pF	18	25	30	36	36	50	60	72
	108.2.0030	TRD8-FDH-2/30	2	30W	G13	x*	x	x	x	x	x*	-	-	-	-	-	-	1m/100pF	2m/200pF	11	15	19	21	22	30	38	42
	108.2.0036	TRD8-FDH-2/36	2	36W	G13	x*	x	x	x	x	x*	-	-	-	-	-	-	1m/100pF	2m/200pF	12	16	19	22	24	32	38	44
	108.2.0058	TRD8-FDH-2/58	2	58W	G13	x*	x	x	x	x	x*	-	-	-	-	-	-	1m/100pF	2m/200pF	8	11	13	15	16	22	26	30
	108.3.0018	TRD8-FDH-3/18	3	18W	G13	x*	x	x	x	x	x*	x*	x	-	-	x	x*	1m/100pF	2m/200pF	15	20	26	32	30	40	52	64
	108.4.0018	TRD8-FDH-4/18	4	18W	G13	x*	x	x	x	x	x*	x*	x	x	x	x	x*	1m/100pF	2m/200pF	15	20	26	32	30	40	52	64
T5	105.1.1435	TRD5-FDH-1/MW	1	14W	G5	x	x*	x	x*	-	-	-	-	-	-	-	-	1m/100pF	2m/200pF	16	21	25	32	32	42	50	64
			1	21W	G5	x	x*	x	x*	-	-	-	-	-	-	-	-	1m/100pF	2m/200pF	16	21	25	32	32	42	50	64
			1	28W	G5	x	x*	x	x*	-	-	-	-	-	-	-	-	1m/100pF	2m/200pF	16	21	25	32	32	42	50	64
			1	35W	G5	x	x*	x	x*	-	-	-	-	-	-	-	-	1m/100pF	2m/200pF	16	21	25	32	32	42	50	64
	105.1.0054	TRD5-FDH-1/54	1	54W	G5	x	x*	x	x*	-	-	-	-	-	-	-	-	1m/100pF	2m/200pF	14	20	22	29	28	40	44	58
			2	14W	G5	x*	x	x	x*	x*	x	x	x*	-	-	-	-	1m/100pF	2m/200pF	9	12	14	17	18	24	28	34
			2	21W	G5	x*	x	x	x*	x*	x	x	x*	-	-	-	-	1m/100pF	2m/200pF	9	12	14	17	18	24	28	34
			2	28W	G5	x*	x	x	x*	x*	x	x	x*	-	-	-	-	1m/100pF	2m/200pF	9	12	14	17	18	24	28	34
			2	35W	G5	x*	x	x	x*	x*	x	x	x*	-	-	-	-	1m/100pF	2m/200pF	9	12	14	17	18	24	28	34
	105.2.0054	TRD5-FDH-2/54	2	54W	G5	x*	x	x	x	x	x*	-	-	-	-	-	-	1m/100pF	2m/200pF	7	10	12	15	14	20	24	30
	105.3.0014	TRD5-FDH-3/14	3	14W	G5	x*	x	x	x	x	x*	x*	x	-	-	x	x*	1m/100pF	2m/200pF	9	12	14	17	18	24	28	34
	105.4.0014	TRD5-FDH-4/14	4	14W	G5	x*	x	x	x	x	x*	x*	x	x	x	x	x*	1m/100pF	2m/200pF	9	12	14	17	18	24	28	34
TC-L	400.1.1824	TRDL-FSD-1/MW	1	18W	2G11 4-PIN	x*	x	x	x*	-	-	-	-	-	-	-	-	1m/100pF	2m/200pF	19	23	29	37	38	46	58	74
			1	24W	2G11 4-PIN	x*	x	x	x*	-	-	-	-	-	-	-	-	1m/100pF	2m/200pF	19	23	29	37	38	46	58	74
	400.1.0036	TRDL-FSD-1/36	1	36W	2G11 4-PIN	x*	x	x	x*	-	-	-	-	-	-	-	-	1m/100pF	2m/200pF	17	24	27	34	34	48	54	68
	400.1.0040	TRDL-FSD-1/40	1	40W	2G11 4-PIN	x*	x	x	x*	-	-	-	-	-	-	-	-	1m/100pF	2m/200pF	16	23	26	31	32	46	52	62
	400.1.0055	TRDL-FSD-1/55	1	55W	2G11 4-PIN	x*	x	x	x*	-	-	-	-	-	-	-	-	1m/100pF	2m/200pF	14	19	25	30	28	38	50	60
	400.2.1824	TRDL-FSD-2/MW	2	18W	2G11 4-PIN	x*	x	x	x	x	x*	-	-	-	-	-	-	1m/100pF	2m/200pF	15	20	26	32	30	40	52	64
			2	24W	2G11 4-PIN	x*	x	x	x	x	x*	-	-	-	-	-	-	1m/100pF	2m/200pF	15	20	26	32	30	40	52	64
	400.2.0036	TRDL-FSD-2/36	2	36W	2G11 4-PIN	x*	x	x	x	x	x*	-	-	-	-	-	-	1m/100pF	2m/200pF	12	17	22	25	24	34	44	50
	400.2.0040	TRDL-FSD-2/40	2	40W	2G11 4-PIN	x*	x	x	x	x	x*	-	-	-	-	-	-	1m/100pF	2m/200pF	8	12	14	16	16	24	28	32
	400.2.0055	TRDL-FSD-2/55	2	55W	2G11 4-PIN	x*	x	x	x	x	x*	-	-	-	-	-	-	1m/100pF	2m/200pF	4	7	9	10	8	14	18	20
TC-DEL	700.1.1018	TRDC-FSM-1/MW	1	10W	G24-q1 4-PIN	x*	x	x	x*	-	-	-	-	-	-	-	-	1m/100pF	2m/200pF	23	35	39	49	46	70	78	98
			1	13W	G24-q1 4-PIN	x*	x	x	x*	-	-	-	-	-	-	-	-	1m/100pF	2m/200pF	23	35	39	49	46	70	78	98
			1	18W	G24-q1 4-PIN	x*	x	x	x*	-	-	-	-	-	-	-	-	1m/100pF	2m/200pF	23	35	39	49	46	70	78	98
			1	26W	G24-q1 4-PIN	x*	x	x	x*	-	-	-	-	-	-	-	-	1m/100pF	2m/200pF	17	23	37	42	34	46	74	84
	700.2.1018	TRDC-FSM-2/MW	2	10W	G24-q1 4-PIN	x*	x	x	x	x	x*	-	-	-	-	-	-	1m/100pF	2m/200pF	16	22	26	30	32	44	52	60
			2	13W	G24-q1 4-PIN	x*	x	x	x	x	x*	-	-	-	-	-	-	1m/100pF	2m/200pF	16	22	26	30	32	44	52	60
			2	18W	G24-q1 4-PIN	x*	x	x	x	x	x*	-	-	-	-	-	-	1m/100pF	2m/200pF	16	22	26	30	32	44	52	60
			2	26W	G24-q1 4-PIN	x*	x	x	x	x	x*	-	-	-	-	-	-	1m/100pF	2m/200pF	11	16	19	22	22	32	38	44

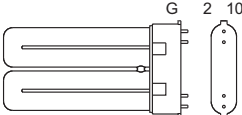
# INSTALLATION INFORMATION FOR BASIC ELECTRONIC BALLASTS

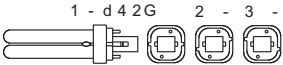
Lamp Type	Ballast		Lamp			Terminals for Installation												Cable Length		The Number Of Ballasts That Can Be Connected To Automatic Circuit Breakers							
	Order Code	Product Code	Number	Power	Lamp holder / Socket	1	2	3	4	5	6	7	8	9	10	11	12	*Hot (m/pF)	Cold (m/pF)	Type B				Type C			
						x*	x*	x*	x*	-	-	-	-	-	-	-	-			10A	13A	16A	20A	10A	13A	16A	20A
T8	118.1.0015	TRD8-BSC-1/15	1	15W	G13	x*	x*	x*	x*	-	-	-	-	-	-	-	-	0,75m/75pF	1,5m/150pF	28	37	50	60	56	74	100	120
	118.1.0018	TRD8-BSC-1/18	1	18W	G13	x*	x*	x*	x*	-	-	-	-	-	-	-	-	0,75m/75pF	1,5m/150pF	28	37	50	60	56	74	100	120
	118.2.0015	TRD8-BSC-2/15	2	15W	G13	x*	x*	x	x	x*	x*	-	-	-	-	-	-	0,75m/75pF	1,5m/150pF	25	32	40	50	50	64	80	100
T5	115.1.0413	TRD5-BSC-1/LW	1	4W	G5	x*	x*	x*	x*	-	-	-	-	-	-	-	-	0,75m/75pF	1,5m/150pF	40	54	65	82	80	108	130	164
			1	6W	G5	x*	x*	x*	x*	-	-	-	-	-	-	-	-	0,75m/75pF	1,5m/150pF	40	54	65	82	80	108	130	164
			1	8W	G5	x*	x*	x*	x*	-	-	-	-	-	-	-	-	0,75m/75pF	1,5m/150pF	40	54	65	82	80	108	130	164
			1	13W	G5	x*	x*	x*	x*	-	-	-	-	-	-	-	-	0,75m/75pF	1,5m/150pF	40	54	65	82	80	108	130	164
	115.1.1421	TRD5-BSC-1/MW	1	14W	G5	x*	x*	x*	x*	-	-	-	-	-	-	-	-	0,75m/75pF	1,5m/150pF	25	32	40	50	50	64	80	100
			1	21W	G5	x*	x*	x*	x*	-	-	-	-	-	-	-	-	0,75m/75pF	1,5m/150pF	25	32	40	50	50	64	80	100
	115.1.0024	TRD5-BSC-1/24	1	24W	G5	x*	x*	x*	x*	-	-	-	-	-	-	-	-	0,75m/75pF	1,5m/150pF	25	32	40	50	50	64	80	100
			2	4W	G5	x*	x*	x	x	x*	x*	-	-	-	-	-	-	0,75m/75pF	1,5m/150pF	40	54	65	82	80	108	130	164
	115.2.0413	TRD5-BSC-2/LW	2	6W	G5	x*	x*	x	x	x*	x*	-	-	-	-	-	-	0,75m/75pF	1,5m/150pF	40	54	65	82	80	108	130	164
			2	8W	G5	x*	x*	x	x	x*	x*	-	-	-	-	-	-	0,75m/75pF	1,5m/150pF	40	54	65	82	80	108	130	164
			2	13W	G5	x*	x*	x	x	x*	x*	-	-	-	-	-	-	0,75m/75pF	1,5m/150pF	28	37	50	60	56	74	100	120
			1	22W	2GX13	x*	x*	x*	x*	-	-	-	-	-	-	-	-	0,75m/75pF	1,5m/150pF	25	32	40	50	50	64	80	100
T5-C	125.1.0022	TRD5-BSC-1/22	1	22W	2GX13	x*	x*	x*	x*	-	-	-	-	-	-	-	-	0,75m/75pF	1,5m/150pF	25	32	40	50	50	64	80	100
			1	22W	2GX13	x*	x*	x*	x*	-	-	-	-	-	-	-	-	0,75m/75pF	1,5m/150pF	25	32	40	50	50	64	80	100
TC-L	410.1.1824	TRDL-BSC-1/MW	1	18W	2G11 4-PIN	x*	x*	x*	x*	-	-	-	-	-	-	-	-	0,75m/75pF	1,5m/150pF	28	37	50	60	56	74	100	120
			1	24W	2G11 4-PIN	x*	x*	x*	x*	-	-	-	-	-	-	-	-	0,75m/75pF	1,5m/150pF	25	32	40	50	50	64	80	100
TC-DEL	710.1.1018	TRDC-BSC-1/MW	1	10W	G24-q1 4-PIN	x*	x*	x*	x*	-	-	-	-	-	-	-	-	0,75m/75pF	1,5m/150pF	40	54	65	82	80	108	130	164
			1	13W	G24-q1 4-PIN	x*	x*	x*	x*	-	-	-	-	-	-	-	-	0,75m/75pF	1,5m/150pF	40	54	65	82	80	108	130	164
	710.1.0026	TRDC-BSC-1/26	1	18W	G24-q2 4-PIN	x*	x*	x*	x*	-	-	-	-	-	-	-	-	0,75m/75pF	1,5m/150pF	28	37	50	60	56	74	100	120
			1	26W	G24-q3 4-PIN	x*	x*	x*	x*	-	-	-	-	-	-	-	-	0,75m/75pF	1,5m/150pF	25	32	40	50	50	64	80	100
	710.2.1013	TRDC-BSC-2/MW	2	10W	G24-q1 4-PIN	x*	x*	x	x	x*	x*	-	-	-	-	-	-	0,75m/75pF	1,5m/150pF	25	32	40	50	50	64	80	100
			2	13W	G24-q1 4-PIN	x*	x*	x	x	x*	x*	-	-	-	-	-	-	0,75m/75pF	1,5m/150pF	25	32	40	50	50	64	80	100
TC-SEL	720.1.0511	TRDS-BSC-1/MW	1	5W	2G7 4-PIN	x*	x*	x*	x*	-	-	-	-	-	-	-	-	0,75m/75pF	1,5m/150pF	35	45	58	70	70	90	116	140
			1	7W	2G7 4-PIN	x*	x*	x*	x*	-	-	-	-	-	-	-	-	0,75m/75pF	1,5m/150pF	35	45	58	70	70	90	116	140
			1	9W	2G7 4-PIN	x*	x*	x*	x*	-	-	-	-	-	-	-	-	0,75m/75pF	1,5m/150pF	35	45	58	70	70	90	116	140
			1	11W	2G7 4-PIN	x*	x*	x*	x*	-	-	-	-	-	-	-	-	0,75m/75pF	1,5m/150pF	35	45	58	70	70	90	116	140
	720.2.0511	TRDS-BSC-2/MW	2	5W	2G7 4-PIN	x*	x*	x	x	x*	x*	-	-	-	-	-	-	0,75m/75pF	1,5m/150pF	35	45	58	70	70	90	116	140
			2	7W	2G7 4-PIN	x*	x*	x	x	x*	x*	-	-	-	-	-	-	0,75m/75pF	1,5m/150pF	35	45	58	70	70	90	116	140
			2	9W	2G7 4-PIN	x*	x*	x	x	x*	x*	-	-	-	-	-	-	0,75m/75pF	1,5m/150pF	30	40	54	65	60	80	106	130
			2	11W	2G7 4-PIN	x*	x*	x	x	x*	x*	-	-	-	-	-	-	0,75m/75pF	1,5m/150pF	25	37	50	60	50	74	100	120
TC-TEL	730.1.0026	TRDT-BSC-1/26	1	26W	GX24-q3 4-PIN	x*	x*	x*	x*	-	-	-	-	-	-	-	-	0,75m/75pF	1,5m/150pF	25	37	40	50	50	64	80	100
TC-F	740.1.1824	TRDF-BSC-1/MW	1	18W	2G10 4-PIN	x*	x*	x*	x*	-	-	-	-	-	-	-	-	0,75m/75pF	1,5m/150pF	25	37	40	50	50	64	80	100
			1	24W	2G10 4-PIN	x*	x*	x*	x*	-	-	-	-	-	-	-	-	0,75m/75pF	1,5m/150pF	25	37	40	50	50	64	80	100
TC-DD	750.1.1016	TRDD-BSC-1/MW	1	10W	GR10q 4-PIN	x*	x*	x*	x*	-	-	-	-	-	-	-	-	0,75m/75pF	1,5m/150pF	40	54	65	82	80	108	130	164
			1	16W	GR10q 4-PIN	x*	x*	x*	x*	-	-	-	-	-	-	-	-	0,75m/75pF	1,5m/150pF	30	40	54	65	60	80	106	130
	750.2.0010	TRDD-BSC-2/10	2	10W	GR10q 4-PIN	x*	x*	x	x	x*	x*	-	-	-	-	-	-	0,75m/75pF	1,5m/150pF	30	40	54	65	60	80	106	130


# CELMA TABLE (2000/55/EC)

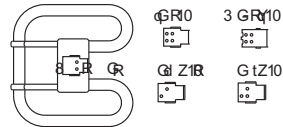
Lamp type	Ilcos code	Lamp power		Class						
		50Hz	HF	A1	A2	A3	B1	B2	C	D
<b>T Series</b> 	FD-15-E-G13-26/450	15W	13.5W	9W	16W	18W	21W	23W	25W	>25W
	FD-18-E-G13-26/600	18W	16W	10.5W	19W	21W	24W	26W	28W	>28W
	FD-30-E-G13-26/900	30W	24W	16.5W	31W	33W	36W	38W	40W	>40W
	FD-36-E-G13-26/1200	36W	32W	19W	36W	38W	41W	43W	45W	>45W
	FD-38-E-G13-26/1047	38W	32W	20W	38W	40W	43W	45W	47W	>47W
	FD-58-E-G13-26/1500	58W	50W	29.5W	55W	59W	64W	67W	70W	>70W
	FD-70-E-G13-26/1800	70W	60W	36W	68W	72W	77W	80W	83W	>83W

Lamp type	Ilcos code	Lamp power		Class						
		50Hz	HF	A1	A2	A3	B1	B2	C	D
<b>TC-L Series</b> 	FSD-18-E-2G11	18W	16W	10.5W	19W	21W	24W	26W	28W	>28W
	FSD-24-E-2G11	24W	22W	13.5W	25W	27W	30W	32W	34W	>34W
	FSD-36-E-2G11	36W	32W	19W	36W	38W	41W	43W	45W	>45W

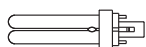
Lamp type	Ilcos code	Lamp power		Class						
		50Hz	HF	A1	A2	A3	B1	B2	C	D
<b>TC-F Series</b> 	FSS-18-E-2G10	18W	16W	10.5W	19W	21W	24W	26W	28W	>28W
	FSS-24-E-2G10	24W	22W	13.5W	25W	27W	30W	32W	34W	>34W
	FSS-36-E-2G10	36W	32W	19W	36W	38W	41W	43W	45W	>45W


Lamp type	Ilcos code	Lamp power		Class						
		50Hz	HF	A1	A2	A3	B1	B2	C	D
<b>TC-D / TC-DE Series</b> 	FSQ-10-E-G24q=1	10W	9.5W	6.5W	11W	13W	14W	16W	18W	>18W
	FSQ-10-I-G24d=1	10W	9.5W	6.5W	11W	13W	14W	16W	18W	>18W
	FSQ-13-E-G24q=1	13W	12.5W	8W	14W	16W	17W	19W	21W	>21W
	FSQ-13-I-G24d=1	13W	12.5W	8W	14W	16W	17W	19W	21W	>21W
	FSQ-18-E-G24q=2	18W	16.5W	10.5W	19W	21W	24W	26W	28W	>28W
	FSQ-18-I-G24d=2	18W	16.5W	10.5W	19W	21W	24W	26W	28W	>28W
	FSQ-26-E-G24q=3	26W	24W	14.5W	27W	29W	32W	34W	36W	>36W
	FSQ-26-I-G24d=3	26W	24W	14.5W	27W	29W	32W	34W	36W	>36W

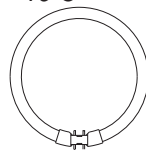
Lamp type	Ilcos code	Lamp power		Class						
		50Hz	HF	A1	A2	A3	B1	B2	C	D
<b>TC-T / TC-TE Series</b> 	FSM-13-I-GX24d=1	13W	12.5W	8W	14W	16W	17W	19W	21W	>21W
	FSM-13-E-GX24q=1	13W	12.5W	8W	14W	16W	17W	19W	21W	>21W
	FSM-18-I-GX24d=1	18W	16.5W	10.5W	19W	21W	24W	26W	28W	>28W
	FSM-18-E-GX24q=1	18W	16.5W	10.5W	19W	21W	24W	26W	28W	>28W
	FSM-26-I-GX24d=1	26W	24W	14.5W	27W	29W	32W	34W	36W	>36W
	FSM-26-E-GX24q=1	26W	24W	14.5W	27W	29W	32W	34W	36W	>36W


Lamp type	Ilcos code	Lamp power		Class						
		50Hz	HF	A1	A2	A3	B1	B2	C	D
<b>TC-DD / TC-DDE Series</b> 	FSS-10-E-GR10q	10W	9W	6.5W	11W	13W	14W	16W	18W	>18W
	FSS-L/P/H-GR10q	10W	9W	6.5W	11W	13W	14W	16W	18W	>18W
	FSS-16-I-GR8	16W	14W	8.5W	17W	19W	21W	23W	25W	>25W
	FSS-16-E-GR10q	16W	14W	8.5W	17W	19W	21W	23W	25W	>25W
	FSS-16-L/P/H-GR10q	16W	14W	8.5W	17W	19W	21W	23W	25W	>25W
	FSS-21-E-GR10q	21W	19W	12W	22W	24W	27W	29W	31W	>31W
	FSS-21-L/P/H-GR10q	21W	19W	12W	22W	24W	27W	29W	31W	>31W
	FSS-28-I-GR8	21W	25W	15.5W	29W	31W	34W	36W	38W	>38W
	FSS-28-E-GR10q	28W	25W	15.5W	29W	31W	34W	36W	38W	>38W
	FSS-28-L/P/L-GR10q	28W	25W	15.5W	29W	31W	34W	36W	38W	>38W
	FSS-38-E-GR10q	38W	34W	20W	38W	40W	43W	45W	47W	>47W
	FSS-38-L/P/L-GR10q	38W	34W	20W	38W	40W	43W	45W	47W	>47W

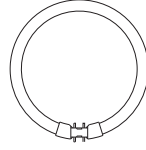
# CELMA TABLE (2000/55/EC)

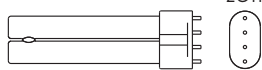
Lamp type	Ilcos code	Lamp power		Class						
		50Hz	HF	A1	A2	A3	B1	B2	C	D
	FSD-5-I-G23	5W	4.5W	4W	7W	8W	10W	12W	14W	>14W
	FSD-5-E-2G7	5W	4.5W	4W	7W	8W	10W	12W	14W	>14W
	FSD-7-I-G23	7W	6.5W	5W	9W	10W	12W	14W	16W	>16W
	FSD-7-E-2G7	7W	6.5W	5W	9W	10W	12W	14W	16W	>16W
	FSD-9-I-G23	9W	8W	6W	11W	12W	14W	16W	18W	>18W
	FSD-9-E-2G7	9W	8W	6W	11W	12W	14W	16W	18W	>18W
	FSD-11-I-G23	11W	11W	7.5W	14W	15W	16W	18W	20W	>20W
	FSD-11-E-2G7	11W	11W	7.5W	14W	15W	16W	18W	20W	>20W

Lamp type	Ilcos code	Lamp power		Class						
		50Hz	HF	A1	A2	A3	B1	B2	C	D
	FD-4-E-G5-16/150	4W	3.4W	3.5W	6W	7W	9W	11W	13W	>13W
	FD-6-E-G5-16/225	6W	5.1W	4W	8W	9W	11W	13W	15W	>15W
	FD-8-E-G5-16/300	8W	6.7W	5W	11W	12W	13W	15W	17W	>17W
	FD-13-E-G5-16-525	13W	11.8W	8W	15W	16W	17W	19W	21W	>21W

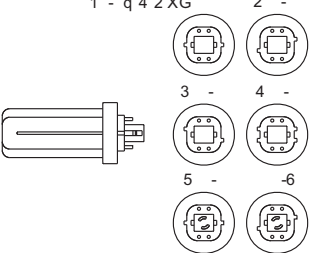
Lamp type	Ilcos code	Lamp power		Class						
		50Hz	HF	A1	A2	A3	B1	B2	C	D
	FC-22-E-G10q-29	22W	19W	12W	22W	24W	28W	30W	32W	32W
	FC-32-E-G10q-29	32W	30W	18.5W	35W	34W	38W	40W	42W	42W
	FC-40-E-G10q-29	40W	32W	19.5W	37W	39W	46W	48W	50W	50W

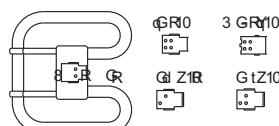
Lamp type	Ilcos code	Lamp power		Class						
		50Hz	HF	A1	A2	A3	B1	B2	C	D
	FDH-14-G5-L/P-16/550	14W	9.5W	17W	19W					
	FDH-21-G5-L/P-16/850	21W	13W	24W	26W					
	FDH-24-G5-L/P-16/550	24W	14W	26W	28W					
	FDH-28-G5-L/P-16/1150	28W	17W	32W	34W					
	FDH-35-G5-L/P-16/1450	35W	21W	39W	42W					
	FDH-39-G5-L/P-16/850	39W	23W	43W	46W					
	FDH-49-G5-L/P-16/1450	49W	29W	55W	58W					
	FDH-54-G5-L/P-16/1150	54W	31.5W	60W	63W					
	FDH-80-G5-L/P-16/1150	80W	47.5W	88W	92W					

Lamp type	Ilcos code	Lamp power		Class						
		50Hz	HF	A1	A2	A3	B1	B2	C	D
	FCH-22-L/P-2GX13-16		22W	14W	26W	28W				
	FCH-40-L/P-2GX13-16		40W	24W	45W	48W				
	FCH-55-L/P-2GX13-16		55W	32.5W	61W	65W				
	FCH-60-L/P-2GX13-16		60W	35W	66W	70W				

Lamp type	Ilcos code	Lamp power		Class						
		50Hz	HF	A1	A2	A3	B1	B2	C	D
	FSDH-40-L/P-2G11		40W	24W	45W	48W				
	FSDH-55-L/P-2G11		55W	32.5W	61W	65W				
	FSDH-80-L/P-2G11		80W	47.5W	88W	92W				

# CELMA TABLE (2000/55/EC)

Lamp type	Ilcos code	Lamp power		Class						
		50Hz	HF	A1	A2	A3	B1	B2	C	D
<b>TC-TE</b> 1 - q 4 2 XG 	FSMH-32-L/P-2GX24q=3		32W	19.5W	36W	39W				
	FSMH-42-L/P-2GX24q=4		42W	25W	47W	50W				
	FSM6H-57-L/P-2GX24q=5		57W	33.5W	63W	67W				
	FSM8H-57-L/P-2GX24q=5		57W	33.5W	63W	67W				
	FSM6H-70-L/P-2GX24q=6		70W	41W	77W	82W				
	FSM8H-70-L/P-2GX24q=6		70W	41W	77W	82W				
	FSM6H-60-L/P-2G8=1		63W	37.5W	70W	75W				
	FSM6H-85-L/P-2G8=1		87W	51.5W	96W	103W				
	FSM6H-120-L/P-2G8=1		122W	72W	135W	144W				
	FSM8H-120-L/P-2G8=1		122W	72W	135W	144W				

Lamp type	Ilcos code	Lamp power		Class						
		50Hz	HF	A1	A2	A3	B1	B2	C	D
<b>TC-DD</b> 	FSSH-55-L/P-GR10q		55W	32.5W	61W	65W				

## SYMBOLS AND ABBREVIATIONS



This symbol represents that the product shall protect itself and shut down the system outside the minimum and maximum operating voltages defined in this catalogue. By this way, the system security is ensured.



Thermal protection symbol represents that the product shall operate between the minimum and maximum temperatures defined in this catalogue, and outside these limits it shall ensure the security by shutting down the system.



This symbol represents that ballasts shall ignite the florescent lamps with a pre-heating of 1.5s. Pre-heating provides a longer ballast life and a more efficient lamp operation in cold ambient.



It symbolizes that lamp light flux is not affected by the fluctuations in the mains. Products carrying this symbol have Power Factor Correction (PFC) which does not reflect the fluctuations to the lamp and provides constant light flux continuously.



This symbol represents that the product is categorised in the CELMA Energy Efficiency Index (EEI) as the highest level, A2 class, of the electronic ballasts which provide constant light flux and are designed for the florescent lamps. The products in this class indicate maximum energy saving with the most efficient performance.



This symbol represents that the product includes a special chip designed for the electronic ballasts. By means of this chip, electronic ballasts are controlled and the efficiency is increased.



It symbolizes that the ballast height is 25mm. Provides a simple installation especially considering the confined spaces inside the armature.



It symbolizes that the product shall operate between 185-265VAC constant light flux. It is not guaranteed that the product shall operate at supply voltages outside this limit.



Products carrying this symbol may easily be installed in armatures. The holes and channels on the product make it possible to install in different forms.

TC-S : Single Tube Compact	TC-Q : Quad Tube Compact	T5 (T16) : Tube Shaped ø5/8" (16 mm)
TC-SEL : Single Tube Compact - Electronic	TC-QEL : Quad Tube Compact - Electronic	T8 (T26) : Tube Shaped ø8/8" (26 mm)
TC-D : Duo Tube Compact	TC-DD : Duo Tube, D Shaped Compact	T12 (T38) : Tube Shaped ø12/8" (38 mm)
TC-DEL : Duo Tube Compact - Electronic	TC-L : Long Tube, U Shaped Compact	T-U : U Shaped Tube
TC-T : Triple Tube Compact	TC-F : Compact Tube - Flat	T-R : Ring Shaped Tube
TC-TEL : Triple Tube Compact - Electronic	T2 (T7) : Tube Shaped ø2/8" (7 mm)	T-R5 (T-R16) : Ring Shaped Tube ø5/8" (16 mm)



# NATURAL GAS METERS





## Natural Gas Meter



FN G2,5  
FN G4  
FN G2,5-HT  
FN G4-HT



FN G6



FN G10



FN G1.6-AB  
FN G2.5-AB  
FN G4-AB

## Prepaid Compact Type Natural Gas Meters



FN G4-CPPU V1



FN G4-CPPU V2  
FN G4-CPPU V3



FN G6-CPPU

## Prepaid Module



FNG-PPU G4-G25

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# NATURAL GAS METERS

## FN G2.5 / FN G4 FN G2.5-HT / FN G4-HT



### Technical Features

Type	FN G2.5 FN G2.5-HT	FN G4 FN G4-HT
Gas Types	Natural Gas - Air Gas	
Q Min	0.025m³ / h	0.04m³ / h
Q Max	4m³ / h	6m³ / h
Measuring Interval	0.025m³/h - 4m³/h	0.040m³/h - 6m³/h
Max. Operating Pressure	0.5 bar	
Leakage Test Pressure Value	750 mbar	
Measuring Volume	1.2 dm³	
Operating Temperature	-25 C°, +55 C°	
Storage Temperature	-30 C°, +70 C°	
Body	Deep Drawing Sheet Iron	
Weight	2 kg.	

- Connection points; manufactured as two outlet fittings
- As inner volume of 1.2 dm³ suits best to operating conditions, it can operate in optimal rates during high haulage.



EN 1359



1432

SK 08-004 MI-002

0407

MID-112 (IG-273-2011)



### General Features

- Outer frame is made of deep drawing sheet and is dyed with electrostatic powder paint.
- Gas input and output fitting spindles are of 110 mm, G1 1/4", G1", G3/4" (DN32, DN25, DN20) outer measurement.
- In the case of reverse connect of gas meter (giving gas flow from gas exit side); numarator doesn't turn and gas meter doesn't make record will be corrected as mentioned.
- Minimum pieces of engineering plastics are used on gas meter body
- The gas meter has a special magnetic transfer system (stainless magnetic coupling)
- There is an long 360° rotary type operating mechanism used in inner mechanism for sensitive measuring.
- Counter structure is suitable for signalling regarding prepaid systems (1imp±0,01m³).
- In virtue of above standard discs a comfortable counter reading is provided.
- Counter materials are selected among high resistant materials in terms of unfavorable conditions.
- Special fitting locking console sheet that is resistant to turning moments is delivered as standard piece together with the counter for assembly and commissioning.
- In virtue of its executed design and materials used it has a lower pressure loss than indicated in EN 1359 Standards.
- Measuring failure rate at 0,1 Qmax - Qmax interval is lower than ±1,5
- The meter is suitable for natural gas, air gas and LPG gas.
- HT series gas meter products has Pressure Measuring Points which described at EN 1359 clause 6.5.1.
- HT series gas meter products are conformed to Resistance to High Ambient Temperatures which described at EN 1359 clause 6.5.5
- The Color of Gas Meter is RAL 7035.

Optionally(\*);

- The color of gas meter can be changed upon request
- Pulser type counter body cover can be produced upon request (1imp±0,01m³).

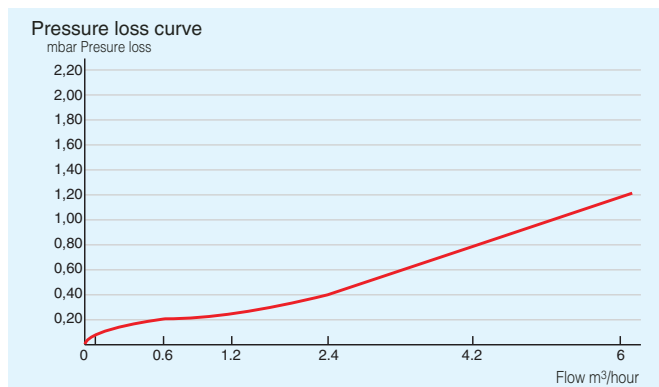
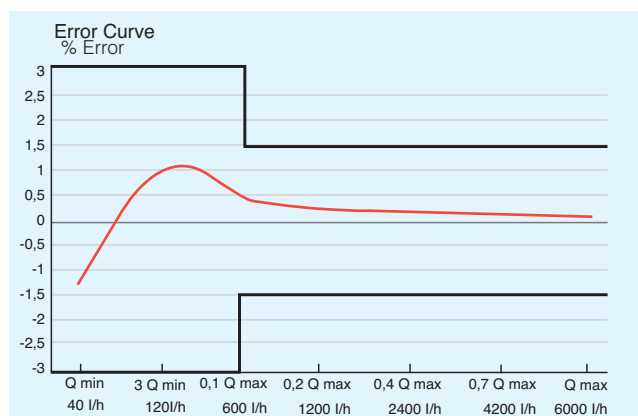
### Assembly

- Counter; assembled to stairwells inside buildings via a console or if out of the building inside an aired, sheeted lightened sheet panel.
- The home type counter display (numarator) must be of minimum 1,80m or maximum 2.0 m height.
- The counter should be assembled by means of a connection console in horizontal position taking into consideration the flow direction.
- The out-of-building applications (external) of the counter Should be certainly executed by proper panels.
- The size of the counter panel should enable easy mounting, repair and dismantling for maintenance.
- There must be always a check valve on counter inlet.
- The counter inlet connection must be assembled with a flexible hose made of stainless material (PVC covered or without cover)
- The counter outlet connection should be connected to the house inlet installation via a fitting.
- Gaskets appropriate for natural gas (according to (TS 9808) should be used on counter--installation connection fittings.

### Maintenance

- The device owner may clean the dirt on the counter with a wet cloth. External washing is not recommended.
- As counters are mesuring devices, maintenance, repair and providing spare sparts are only carried out by the manufacturing company based on the test results executed.
- Due to its structure the device does not require any maintenance. Using manufacturer-approved filters on the inlets and outlets of the natural gas meter will prolong the life of the device.

# NATURAL GAS METERS



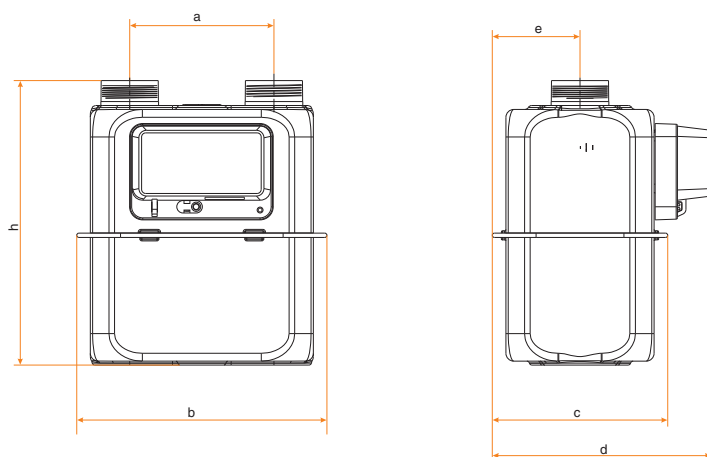
## Points to be considered

- The counter should be protected by an appropriate protective panel from weather conditions, damages that may arise from accidents or from actions that could harm its operation (impacts, vibrations, corrosion, very low or high temperatures, humidity, etc).
- Electric switches, counters, junction boxes, instruments and devices that operate with electricity such as bells should not be placed close to the device. In obligatory circumstances this distance should be minimum 1.5 meters.
- It should not be forgotten that a direct or indirect interference by unauthorized people during using phase will lead to penalty provisions.

- Federal is not responsible for any damages arising from impacts or falling during carrying after delivery and for any deformations that may arise as a result of not deactivating the device during the leakage test of the installation.
- The assembly of the device should be carried out when spatters and similar particles are removed and cleaned from the inside of the pipe
- It is recommended to place filters in counter's inlets and outlets in order to avoid the entrance of installation spatters and dust that may originate on lines. (A material available in Federal Electric DGS Accessories. Delivered upon demand).

## FN G2.5 / FN G4

## FN G2.5-HT / FN G4-HT



Type	Connection				Dimensions					
FN G2,5 G4 G2,5-HT G4-HT	DN			Connection Size	h	a	b	c	d	e
	32	25	20	G1 <sup>1</sup> / <sub>4</sub> " , G1" , G <sup>3</sup> / <sub>4</sub> " , ISO 228-1:G <sup>7</sup> / <sub>8</sub>	219.5	110	193.2	133.8	135.7	67.8

## FN G6



### Technical Features

Type	FN G6
Gas Types	Natural Gas- Air Gas
Q Min	0.06m <sup>3</sup> / h
Q Max	10m <sup>3</sup> / h
Measuring Interval	0.06m <sup>3</sup> /h - 10m <sup>3</sup> /h
Max. Operating Pressure	0.5 bar
Leakage Test Pressure Value	750 mbar
Measuring Volume	2.2 dm <sup>3</sup>
Operating Temperature	-25 C°, +55 C°
Storing Temperature	-30 C°, +70 C°
Body	Deep Drawing Sheet Iron
Weight	3 kg.

- Connection points; manufactured as two outlet fittings.
- As inner volume of 2.2 dm<sup>3</sup> suits best to operating conditions, it can operate in optimal rates during high haulage.



PL-06  
ZT-E4  
AT TYPE APPROVED

### General Features

- Outer frame is made of deep drawing sheet and is dyed with electrostatic powder paint.
- Gas input and output fitting spindles are of 110 mm.
- In case that the gas meter is inverse connected (inflicting gas flow in gas output direction), the gas inner mechanism does not allow gas transition and the numarator does not spin.
- Minimum pieces of engineering plastics are used on gas meter body
- The gas meter has a special magnetic transfer system (stainless magnetic coupling)
- There is an long-lasting ellipse diaphragm in inner mechanism compatible and approved by standards
- Lateral operating seperators with adjustable joints for sensitive measuring.
- Counter structure is suitable for signalling regarding prepaid systems (1imp $\pm$ 0,01m<sup>3</sup>)
- In virtue of above standard discs a comfortable counter reading is provided
- Counter materials are selected among high resistant materials in terms of unfavorable conditions.
- Special fitting locking console sheet that is resistant to turning moments is delivered as standard piece together with the counter for assembly and commissioning.
- In virtue of its executed design and materials used it has a lower pressure loss than indicated in TS 5910 EN 1359 Standards.
- Measuring failure rate at 0,1 Qmax - Qmax interval is lower than  $\pm 1,5$
- The counter is suitable for natural gas, air gas and LPG gas

Optionally(\*);

- The color of gas meter can be changed upon request
- Pulser type counter body cover can be produced upon request (1imp $\pm$ 0,01m<sup>3</sup>).

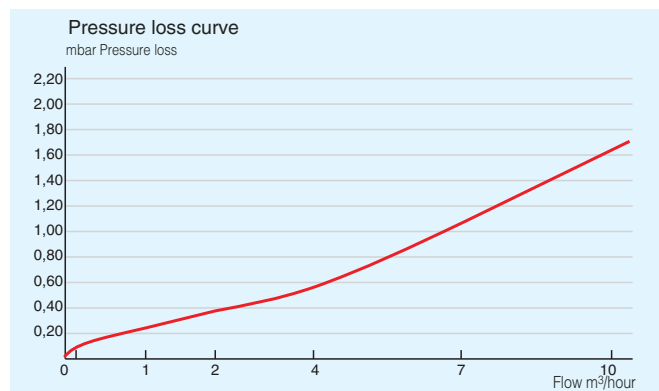
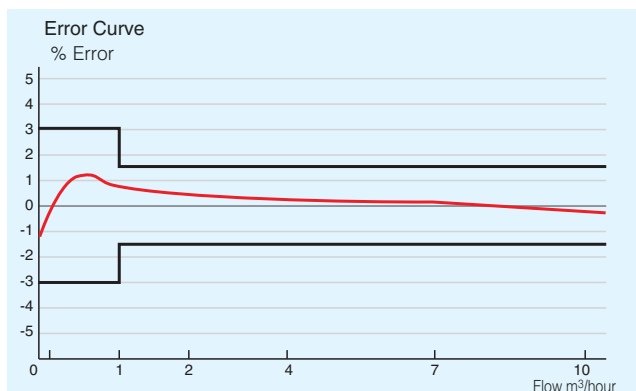
### Assembly

- Counter; assembled to stairwells inside buildings via a console or if out of the building inside an aired, sheeted lightened sheet panel.
- The home type counter display (numarator) must be of minimum 1,80m or maximum 2.0 m height.
- The counter should be assembled by means of a connection console in horizontal position taking into consideration the flow direction.
- The out-of-building applications (external) of the counter Should be certainly executed by proper panels.
- The size of the counter panel should enable easy mounting, repair and dismantling for maintenance.
- There must be always a check valve on counter inlet.
- The counter inlet connection must be assembled with a flexible hose made of stainless material (PVC covered or without cover)
- The counter outlet connection should be connected to the house inlet installation via a fitting.
- Gaskets appropriate for natural gas (according to (TS 9808) should be used on counter--installation connection fittings.

### Maintenance

- The device owner may clean the dirt on the counter with a wet cloth. External washing is not recommended.
- As counters are mesuring devices, maintenance, repair and providing spare sparts are only carried out by the manufacturing company based on the test results executed.
- Due to its structure the device does not require any maintenance. Using manufacturer-approved filters on the inlets and outlets of the natural gas meter will prolong the life of the device.

# NATURAL GAS METERS

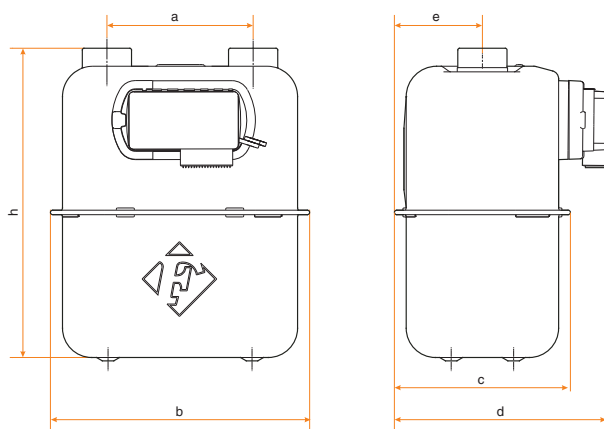


## Points to be considered

- The counter should be protected by an appropriate protective panel from weather conditions, damages that may arise from accidents or from actions that could harm its operation (impacts, vibrations, corrosion, very low or high temperatures, humidity, etc).
- Electric switches, counters, junction boxes, instruments and devices that operate with electricity such as bells should not be placed close to the device. In obligatory circumstances this distance should be minimum 1.5 meters.
- It should not be forgotten that a direct or indirect interference by unauthorized people during using phase will lead to penalty provisions.

- Federal is not responsible for any damages arising from impacts or falling during carrying after delivery and for any deformations that may arise as a result of not deactivating the device during the leakage test of the installation.
- The assembly of the device should be carried out when spatters and similar particles are removed and cleaned from the inside of the pipe
- It is recommended to place filters in counter's inlets and outlets in order to avoid the entrance of installation spatters and dust that may originate on lines. (A material available in Federal Electric DGS Accessories. Delivered upon demand).

## FN G6



Type	Connection		Dimensions					
	DN	Connection Size	h	a	b	c	d	e
FN G6	32	G1 1/4"	276	130	231	157	187	78.5

## FN G10



### Technical Features

Type	FN G10
Gas Types	Natural Gas- Air Gas
Q Min	0.1m <sup>3</sup> / h
Q Max	16m <sup>3</sup> / h
Measuring Interval	0.1m <sup>3</sup> /h - 16m <sup>3</sup> /h
Max. Operating Pressure	0.5 bar
Leakage Test Pressure Value	750 mbar
Measuring Volume	5 dm <sup>3</sup>
Operating Temperature	-25 C°, +55 C°
Storing Temperature	-30 C°, +70 C°
Body	Deep Drawing Sheet Iron
Weight	6.8 kg.

- Connection points; manufactured as two outlet fittings.
- As inner volume of 5 dm<sup>3</sup> suits best to operating conditions, it can operate in optimal rates during high haulage.



D06  
07.122.62  
AT TYPE APPROVED

### General Features

- Outer frame is made of deep drawing sheet and is dyed with electrostatic powder paint.
- Gas input and output fitting spindles are of 280 mm.
- In case that the gas meter is inverse connected (inflicting gas flow in gas output direction), the gas inner mechanism does not allow gas transition and the numarator does not spin.
- Minimum pieces of engineering plastics are used on gas meter body.
- The gas meter has a special magnetic transfer system (stainless magnetic coupling)
- There is an long-lasting ellipse diaphragm in inner mechanism compatible and approved by standards
- Minimum horizontal friction lift and force mechanism is used.
- Counter structure is suitable for signalling regarding prepaid systems (1imp $\pm$ 0,01m<sup>3</sup>)
- In virtue of above standard discs a comfortable counter reading is Provided.
- Counter materials are selected among high resistant materials in terms of unfavorable conditions
- In virtue of its executed design and materials used it has a lower pressure loss than indicated in TS 5910 EN 1359 Standards
- Measuring failure rate at 0,1 Qmax - Qmax interval is lower than  $\pm 1,5$
- The counter is suitable for natural gas, air gas and LPG gas

Optionally(\*);

- The color of gas meter can be changed upon request
- Pulser type counter body cover can be produced upon request (1imp $\pm$ 0,01m<sup>3</sup>).

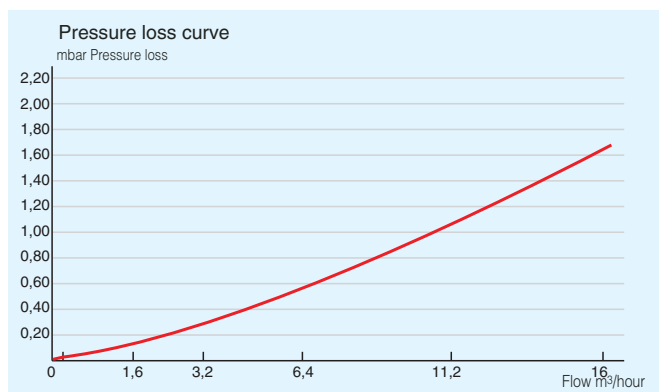
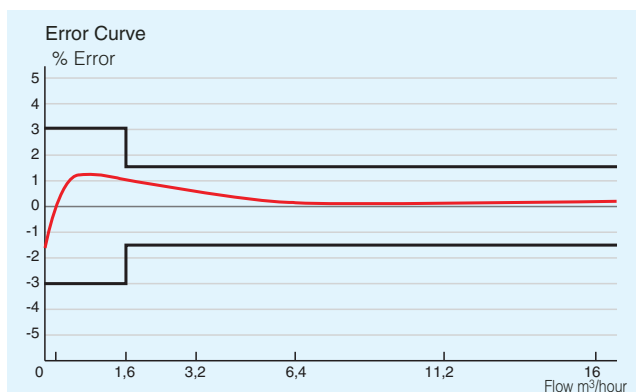
### Assembly

- Counter; assembled to stairwells inside buildings via a console or if out of the building inside an aired, sheeted lightened sheet panel.
- The home type counter display (numarator) must be of minimum 1,80m or maximum 2.0 m height.
- The counter should be assembled by means of a connection console in horizontal position taking into consideration the flow direction.
- The out-of-building applications (external) of the counter Should be certainly executed by proper panels.
- The size of the counter panel should enable easy mounting, repair and dismantling for maintenance.
- There must be always a check valve on counter inlet.
- The counter inlet connection must be assembled with a flexible hose made of stainless material (PVC covered or without cover)
- The counter outlet connection should be connected to the house inlet installation via a fitting.
- Gaskets appropriate for natural gas (according to (TS 9808) should be used on counter--installation connection fittings.

### Maintenance

- The device owner may clean the dirt on the counter with a wet cloth. External washing is not recommended.
- As counters are mesuring devices, maintenance, repair and providing spare sparts are only carried out by the manufacturing company based on the test results executed.
- Due to its structure the device does not require any maintenance. Using manufacturer-approved filters on the inlets and outlets of the natural gas meter will prolong the life of the device.

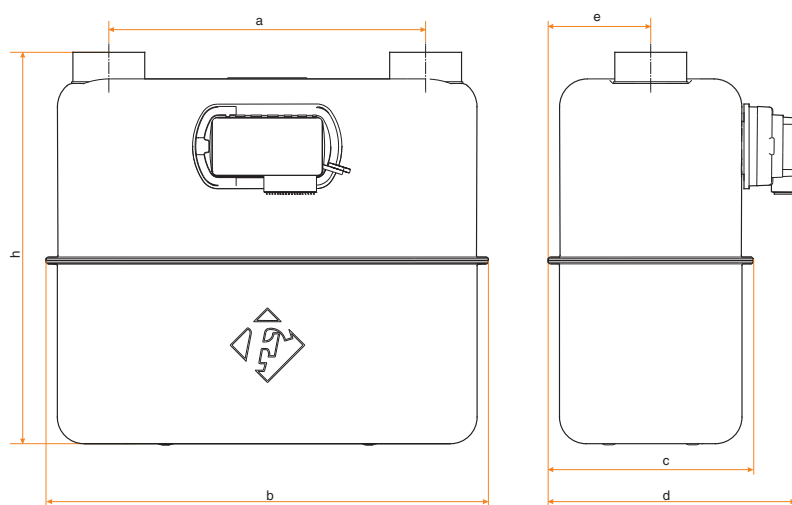
# NATURAL GAS METERS



## Points to be considered

- The counter should be protected by an appropriate protective panel from weather conditions, damages that may arise from accidents or from actions that could harm its operation (impacts, vibrations, corrosion, very low or high temperatures, humidity, etc).
- Electric switches, counters, junction boxes, instruments and devices that operate with electricity such as bells should not be placed close to the device. In obligatory circumstances this distance should be minimum 1.5 meters.
- It should not be forgotten that a direct or indirect interference by unauthorized people during using phase will lead to penalty provisions.
- Federal is not responsible for any damages arising from impacts or falling during carrying after delivery and for any deformations that may arise as a result of not deactivating the device during the leakage test of the installation.
- The assembly of the device should be carried out when spatters and similar particles are removed and cleaned from the inside of the pipe
- It is recommended to place filters in counter's inlets and outlets in order to avoid the entrance of installation spatters and dust that may originate on lines. (A material available in Federal Electric DGS Accessories. Delivered upon demand).

## FN G10



Type	Connection		Dimensions					
FN G10	DN	Connection Size	h	a	b	c	d	e
	50	G2"	345	280	395	186	214	93



## FN G4-CPPU V1



### Technical Features

Gas Types	Natural Gas- Air Gas
Q min	0.04m³/h
Q max	6m³/h
Max. Operating Pressure	500mbar
Measuring Volume	1.2dm³
Operating Temperature	-25°C , +55°C
Body	Deep Drawing Sheet Iron
Weight	2.2kg
Verification Qmin	±%3 (max)
Verification Qmax	±%1,5 (max)
Displayable Max. Value	99999,999
Resolution	0,001m³
Pressure Loss (for Q max)	<2mbar
P valf	50mbar
Circuit	Procesor based special design manufactured via SMD Technology
Power feeding	8,5 Ah long-lasting lithium main battery 1,2 Ah long-lasting lithium spare battery 1,5 F super capacitor
Display	Special design advanced LCD,
Safety	Flow consumption detection
Measuring Method	Magnetic reading
Position Class	IP54
Card Reader	Smart card reader ISO7816 compatible
Data Safety	Permanent memory unaffected from interruptions (EEPROM)
Resolution	0,01m³
Counter Safety	Perception of cover and battery opening Magnetic external impact detection

### Prepaid Compact Natural Gas Meter:

The design, R&D studies and manufacturing of FN G4-CPPU V1 gas meters have been carried out in Federal Elektrik facilities. They are long-lasting devices executing sensitive and safe measurements.

### Area of Use:

FN G4-CPPU V1 gas meters are used for measuring the gas delivered to home type subscribers with low natural gas and air gas consumption. They are developed according to needs of distribution companies that perform sales on prepaid basis.

### General Features:

- The prepaid Compact Gas Meters consist of a mechanic gas meter, special gas cutting valf that is placed into the mechanic body and of the electronic prepay circuit.
- The mechanic counter is the unit that is measuring the consumed gas measuring the gas consumption at 0.001m³ resolution.
- The electronic circuit magnetically reads the counter and performs a credit facility.
- The gas cutting valve embedded into the mechanic counter body cuts or releases the gas under the control of the electronic circuit.
- The electronic circuit is a smart circuit that operates with a battery, enables credited gas consumption, processor based, and that is operating with a software, equipped with a LCD display and a smart card reader.
- The credit purchased via the smart card (subscription card) is loaded on the counter and the consumption is credited by regularly deducting the gas consumption accordingly. If credit is used up, the system automatically cuts the gas by closing the valf.
- Each counter has an individual subscription card.
- The system is of integrated structure with mechanical body and electronic components.
- The counter battery is able to feed the system for minimum 10 years without interruption and can be replaced if necessary. Furthermore, it is equipped with another spare battery in order to ensure an uninterrupted operation of the counter. A super

capacitor has been added into the system in order to keep batteries working for many long years.

### Using Features:

- The counter continuously monitors the credit status and operating conditions and hinders gas usage by closing the valf in the event that the credit is used up or upon any circumstances that may be harmful for the counter operation.
- In the event that the credit falls under specified limits the subscriber is alerted as the LCD display turns on and off accordingly.
- A small portion (determined by the company) of the gas purchased is stored by the company as spare on the subscription card. In the event that the subscriber has not purchased any new gas upon use up, he/she continues using gas by loading the spare credit. This feature is important as it prevents the subscriber, who might have forgotten to buy new gas, from being left without gas during hours where gas purchasing is not available.

### Safety Precautions:

- All connections of mechanic counter and valf of the prepaid system are hidden within the body. There is no possibility to reach these components without opening the cover.
- The body cover is sealed which needs to be broken in order to be able to open the cover. There is a separate seal for the battery cover that enables battery replaced by authorized personnel without the need of opening the body cover.
- Opening of body cover and battery cover is electronically detected. The valf closes instantly hindering further gas consumption. After The end of operations of authorized personnel such as battery replacement, the closed valf is opened again via an authorization card.
- If counter failures are deleted via authorization cards, the valf does not open instantly. The subscription card must be inserted into the counter as well to open the valf. This feature is important for avoiding gas leakage which also ensures that the subscriber is at home when the valf is opened.
- It detects extreme gas consumption. If a failure is detected it cuts the gas end ensures the safety of the subscriber.

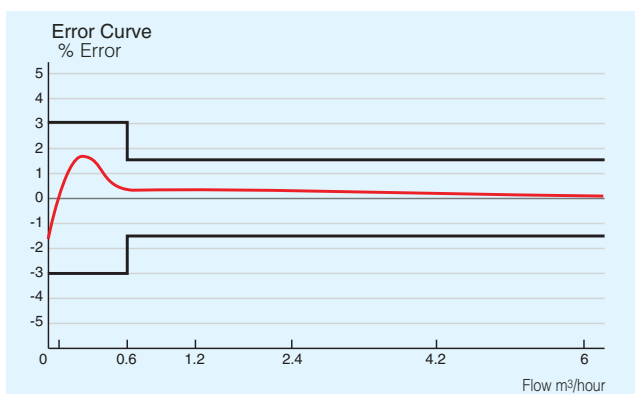
# NATURAL GAS METERS

## The Advantages of the Prepaid System:

- Saves the companies from visiting subscribers each month for counter-reading processes.
- The consumed gas amount is received in advance.
- Subscribers are not affected from price changes based on the gas they have purchased.
- It supports a more conscious consumption.
- Saves subscribers from invoice payments and from inconveniences like chasing the last payable day of invoice.
- Saves entities from gas cutting-opening processes due to payment problems.

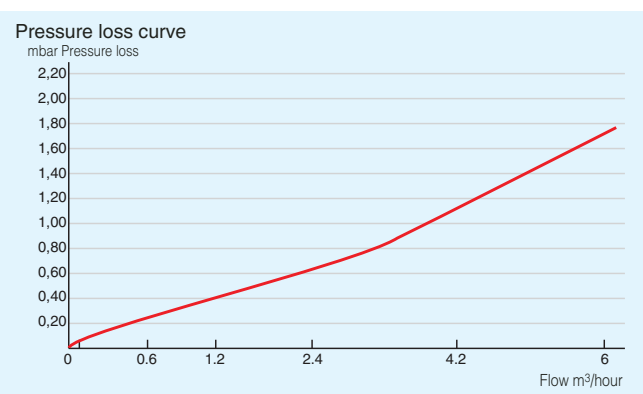
## Components of Prepaid Gas Distribution System Can be summarized as;

- Prepaid counter and credit loading card (subscriber card),
- Credit selling points,
- Subscriber monitoring system.



Credit selling points may be special selling desks of the entity, contractual banks, contractual marketes. It is very important subscribers will purchase their credit without standing in a queue and without being limited with working ours.

The subscriber monitoring system or subscriber management system is a computer supported system where all type of processes related to subscribers are monitored and carried out. It is equipped with an advanced data base management system where all past processes are recorded accordingly. Federal Elektrik offers a complete solution and a continuous technical support to entities based on the subscriber management system and the credit selling points.

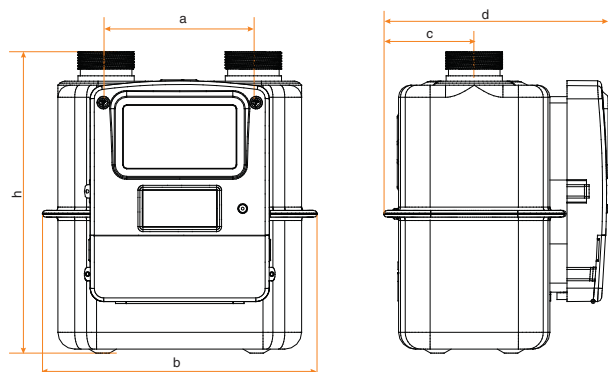


## Points to be considered

- The counter should be protected by an appropriate protective panel from weather conditions, damages that may arise from accidents or from actions that could harm its operation (impacts, vibrations, corrosion, very low or high temperatures, humidity, etc).
- Electric switches, counters, junction boxes, instruments and devices that operate with electricity such as bells should not be placed close to the device. In obligatory circumstances this distance should be minimum 1.5 meters
- It should not be forgotten that a direct or indirect interference by unauthorized people during using phase will lead to penalty provisions.

- Federal is not responsible for any damages arising from impacts or falling during carrying after delivery and for any deformations that may arise as a result of not deactivating the device during the leakage test of the installation.
- The assembly of the device should be carried out when spatters and similar particles are removed and cleaned from the inside of the pipe
- It is recommended to place filters in counter's inlets and outlets in order to avoid the entrance of installation spatters and dust that may originate on lines. (A material available in Federal Electric DGS Accessories. Delivered upon demand).

## FN G4-CPPU V1



Type	Connection			Dimensions					
	DN			Connection Size	h	a	b	c	d
FN CPPU G4 V1	32	25	20	G1 1/4", G1", G3/4" ISO 228-1:G7/8	226	110	206	68,5	168

# NATURAL GAS METERS

## FN G4-CPPU V2



### Technical Features

Gas Types	Natural Gas - Air Gas
Q min	0.04m³/h
Q max	6m³/h
Max. Operating Pressure	500mbar
Measuring Volume	1.2dm³
Operating Temperature	-25°C , +55°C
Body	Deep Drawing Sheet Iron
Weight	2.2kg
Verification Qmin	±%3 (max)
Verification Qmax	±%1,5 (max)
Max. Displayable Value	99999,999
Resolution	0,001m³
Pressure Loss(for Q max)	<2mbar
P valf	500mbar
Circuit	Procesor based special design manufactured via SMD Technology
Power feeding	8,5 Ah long-lasting lithium main battery 1,2 Ah long-lasting lithium spare battery 1,5 F super capacitor
Display	Special design advanced LCD, Display illuminating feature at dark
Safety	Detection of extreme consumption and gas leakage
Measuring Method	Optical reading
Position Class	IP54
Card Reader	ISO7816 compatible smart card reader
Data Safety	Permanent memory unaffected from interruptions (EEPROM, DATA FLASH)
Resolution	0,001m3
Counter Safety	Detection of cover and battery cover opening Perception of optical reading failures
Optionel Features	Wireless M-BUS remote reading and management Remote software updating Reading gas temperature, correction process according to gas temperature

### Prepaid Compact Natural Gas Meter:

The design, R&D studies and manufacturing of FN G4-CPPU V2 gas meters have been carried out in Federal Elektrik facilities. They are long-lasting devices executing sensitive and safe measurements.

### Area of Use:

FN G4-CPPU V2 gas meters are used for measuring the gas delivered to home type subscribers with low natural gas and air gas consumption. They are developed according to needs of distribution entities that perform sales on prepaid basis.

### General Features:

- The prepaid Compact Gas Meters consist of a mechanic gas meter, special gas cutting valf that is placed into the mechanic body and of the electronic prepaid circuit.
- The mechanic counter is the unit that is measuring the consumed gas measuring the gas consumption at 0.001m3 resolution.
- The electronic circuit magnetically reads the counter and performs a credit facility.
- The gas cutting valve embedded into the mechanic counter body cuts or releases the gas under the control of the electronic circuit.
- The electronic circuit is a smart circuit that operates with a battery, enables credited gas consumption, processor based, and that is operating with a software, equipped with a LCD display and a smart card reader.
- The credit purchased via the smart card (subscription card) is loaded on the counter and the consumption is credited by regularly deducting the gas consumption accordingly. If credit is used up, the system automatically cuts the gas by closing the valf.
- Each counter has an individual subscription card.
- The system is of integrated structure with mechanical body and electronic components.

- The counter battery is able to feed the system for minimum 10 years without interruption and can be replaced if necessary. Furthermore, it is equipped with another spare battery in order to ensure an uninterrupted operation of the counter. A super capacitor has been added into the system in order to keep batteries working for many long years.

### Optionel Features:

- Optionel gas temperature measuring and correcting process according to Temperature.
- Wireless M-BUS remote reading and remote management,
- Wireless M-BUS remote software updating.

### Using Features:

- The counter continuously monitors the credit status and operating conditions and hinders gas usage by closing the valf in the event that the credit is used up or upon any circumstances that may be harmful for the counter operation.
- In the event that the credit falls under specified limits the subscriber is alerted as the LCD display turns on and off accordingly.
- A small portion (determined by the company) of the gas purchased is stored by the company as spare on the subscription card. In the event that the subscriber has not purchased any new gas upon use up, he/she continues using gas by loading the spare credit. This feature is important as it prevents the subscriber, who might have forgotten to buy new gas, from being left without gas during hours where gas purchasing is not available.

### Safety Precautions:

- All connections of mechanic counter and valf of the prepaid system are hidden within the body. There is no possibility to reach these components without opening the cover.
- The body cover is sealed which needs to be broken in order to

# NATURAL GAS METERS

be able to open the cover. There is a separate seal for the battery cover that enables battery replaced by authorized personnel without the need of opening the body cover.

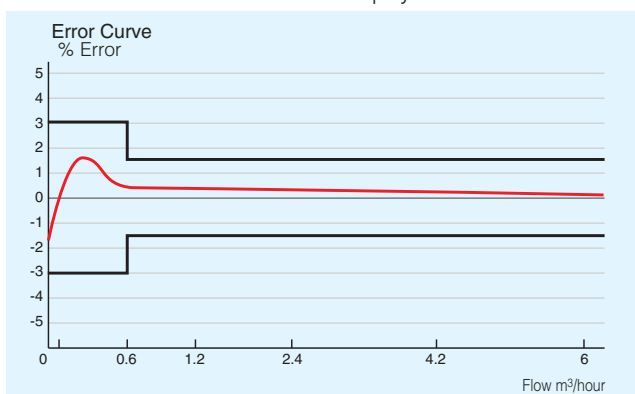
- Opening of body cover and battery cover is electronically detected.

The valve closes instantly hindering further gas consumption. After The end of operations of authorized personnel such as battery replacement, the closed valve is opened again via an authorization card.

- If counter failures are deleted via authorization cards, the valve does not open instantly. The subscription card must be inserted into the counter as well to open the valve. This feature is important for avoiding gas leakage which also ensures that the subscriber is at home when the valve is opened.
- It detects extreme gas consumption. If a failure is detected it cuts the gas end ensures the safety of the subscriber.

## The Advantages of the Prepaid System:

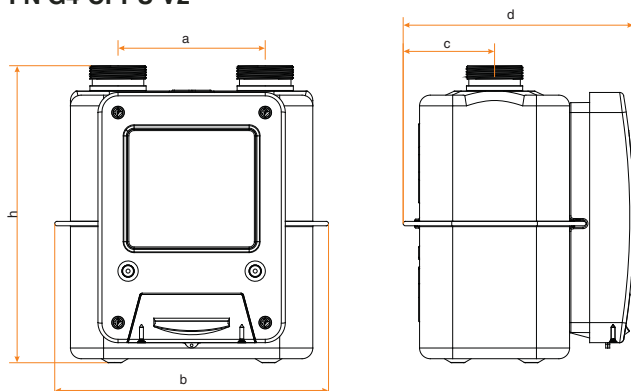
- Saves the companies from visiting subscribers each month for counter- reading processes.
- The consumed gas amount is received in advance.
- Subscribers are not affected from price changes based on the gas they have purchased.
- It supports a more conscious consumption.
- Saves subscribers from invoice payments and from



## Points to be considered

- The counter should be protected by an appropriate protective panel from weather conditions, damages that may arise from accidents or from actions that could harm its operation (impacts, vibrations, corrosion, very low or high temperatures, humidity, etc).
- Electric switches, counters, junction boxes, instruments and devices that operate with electricity such as bells should not be placed close to the device. In obligatory circumstances this distance should be minimum 1.5 meters
- It should not be forgotten that a direct or indirect interference by unauthorized people during using phase will lead to penalty provisions.

## FN G4-CPPU V2



inconveniences like chasing the last payable day of invoice.

- Saves entities from gas cutting-openig processes due to payment problems.

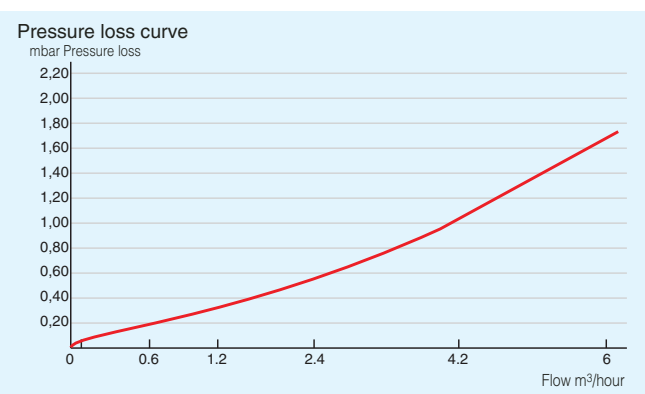
## Components of Prepaid Gas Distribution System Can be summarized as;

- Prepaid counter and credit loading card (subscriber card),
- Credit selling points,
- Subscriber monitoring system.

Credit selling points may be special selling desks of the entity, contractual banks, contractual marketes. It is very important subscribers will purchase their credit without standing in a queue and without being limited with working ours.

The subscriber monitoring system or subscriber management system is a computer supported system where all type of processes related to subscribers are monitored and carried out. It is equipped with an advanced data base management system where all past processes are recorded accordingly.

Federal Elektrik offers a complete solution and a continuous technicalsupport to entities based on the subscriber management system and the credit selling points.



- Federal is not responsible for any damages arising from impacts or falling during carrying after delivery and for any deformations that may arise as a result of not deactivating the device during the leakage test of the installation.
- The assembly of the device should be carried out when spatters and similar particles are removed and cleaned from the inside of the pipe
- It is recommended to place filters in counter's inlets and outlets in order to avoid the entrance of installation spatters and dust that may originate on lines. (A material available in Federal Electric DGS Accessories. Delivered upon demand).

Type	Connection			Dimensions						
FN CPPU G4 V2	DN			Connection Size		h	a	b	c	d
	32	25	20	G1¼", G1", G¾" ISO 228-1:G7/8		226	110	206	68,5	168

## FN G4-CPPU V3



### Technical Features

Gas Types	Natural Gas - Air Gas
Q min	0.04m³/h
Q max	6m³/h
Max. Operating Pressure	500mbar
Measuring Volume	1.2dm³
Operating Temperature	-25°C , +55°C
Body	Deep Drawing Sheet Iron
Weight	2.2kg
Verification Qmin	±%3 (max)
Verification Qmax	±%1,5 (max)
Max. Displayable Value	99999,999
Resolution	0,001m³
Pressure Loss(for Q max)	<2mbar
P valf	500mbar
Circuit	Procesor based special design manufactured via SMD Technology
Power feeding	8,5 Ah long-lasting lithium main battery 1,2 Ah long-lasting lithium spare battery 1,5 F super capacitor
Display	Special design advanced LCD, Display illuminating feature at dark
Safety	Detection of extreme consumption and gas leakage
Measuring Method	Optical reading
Position Class	IP54
Card Reader	ISO7816 compatible smart card reader
Data Safety	Permanent memory unaffected from interruptions (EEPROM, DATA FLASH)
Resolution	0,001m3
Counter Safety	Detection of cover and battery cover opening Perception of optical reading failures
Optionel Features	Wireless M-BUS remote reading and management Reading gas temperature, correction process according to gas temperature

### Prepaid Compact Natural Gas Meter:

The design, R&D studies and manufacturing of FN G4-CPPU V3 gas meters have been carried out in Federal Elektrik facilities. They are long-lasting devices executing sensitive and safe measurements.

### Area of Use:

FN G4-CPPU V3 gas meters are used for measuring the gas delivered to home type subscribers with low natural gas and air gas consumption. They are developed according to needs of distribution entities that perform sales on prepaid basis.

### General Features:

- The prepaid Compact Gas Meters consist of a mechanic gas meter, special gas cutting valf that is placed into the mechanic body and of the electronic prepaid circuit.
- The mechanic counter is the unit that is measuring the consumed gas measuring the gas consumption at 0.001m3 resolution.
- The electronic circuit magnetically reads the counter and performs a credit facility.
- The gas cutting valve embedded into the mechanic counter body cuts or releases the gas under the control of the electronic circuit.
- The electronic circuit is a smart circuit that operates with a battery, enables credited gas consumption, processor based, and that is operating with a software, equipped with a LCD display and a smart card reader.
- The credit purchased via the smart card (subscription card) is loaded on the counter and the consumption is credited by regularly deducting the gas consumption accordingly. If credit is used up, the system automatically cuts the gas by closing the valf.
- Each counter has an individual subscription card.
- The system is of integrated structure with mechanical body and electronic components.

- The counter battery is able to feed the system for minimum 10 years without interruption and can be replaced if necessary. Furthermore, it is equipped with another spare battery in order to ensure an uninterrupted operation of the counter. A super capacitor has been added into the system in order to keep batteries working for many long years.

### Optionel Features:

- Optionel gas temperature measuring and correcting process according to Temperature.
- Wireless M-BUS remote reading and remote management,

### Using Features:

- The counter continuously monitors the credit status and operating conditions and hinders gas usage by closing the valf in the event that the credit is used up or upon any circumstances that may be harmful for the counter operation.
- In the event that the credit falls under specified limits the subscriber is alerted as the LCD display turns on and off accordingly.
- A small portion (determined by the company) of the gas purchased is stored by the company as spare on the subscription card. In the event that the subscriber has not purchased any new gas upon use up, he/she continues using gas by loading the spare credit. This feature is important as it prevents the subscriber, who might have forgotten to buy new gas, from being left without gas during hours where gas purchasing is not available.

### Safety Precautions:

- All connections of mechanic counter and valf of the prepaid system are hidden within the body. There is no possibility to reach these components without opening the cover.
- The body cover is sealed which needs to be broken in order to be able to open the cover. There is a separate seal for the battery



# NATURAL GAS METERS

cover that enables battery replaced by authorized personnel without the need of opening the body cover.

- Opening of body cover and battery cover is electronically detected.

The valve closes instantly hindering further gas consumption. After The end of operations of authorized personnel such as battery replacement, the closed valve is opened again via an authorization card.

- If counter failures are deleted via authorization cards, the valve does not open instantly. The subscription card must be inserted into the counter as well to open the valve. This feature is important for avoiding gas leakage which also ensures that the subscriber is at home when the valve is opened.

- It detects extreme gas consumption. If a failure is detected it cuts the gas end ensures the safety of the subscriber.

## The Advantages of the Prepaid System:

- Saves the companies from visiting subscribers each month for counter- reading processes.
- The consumed gas amount is received in advance.
- Subscribers are not affected from price changes based on the gas they have purchased.
- It supports a more conscious consumption.
- Saves subscribers from invoice payments and from

inconveniences like chasing the last payable day of invoice.

- Saves entities from gas cutting-openig processes due to payment problems.

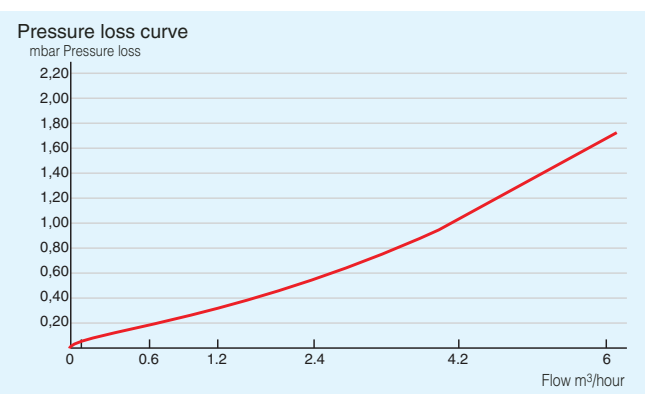
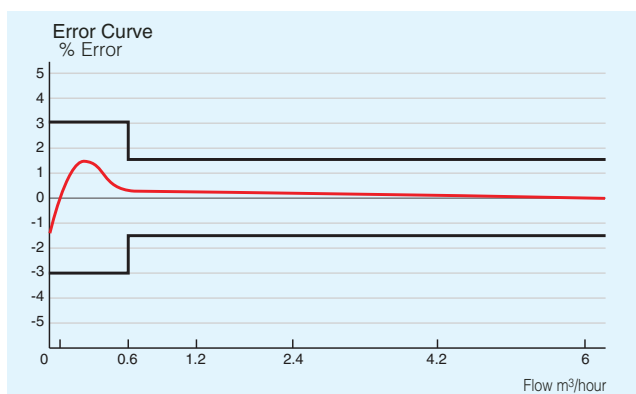
## Components of Prepaid Gas Distribution System Can be summarized as;

- Prepaid counter and credit loading card (subscriber card),
- Credit selling points,
- Subscriber monitoring system.

Credit selling points may be special selling desks of the entity, contractual banks, contractual marketes. It is very important subscribers will purchase their credit without standing in a queue and without being limited with working ours.

The subscriber monitoring system or subscriber management system is a computer supported system where all type of processes related to subscribers are monitored and carried out. It is equipped with an advanced data base management system where all past processes are recorded accordingly.

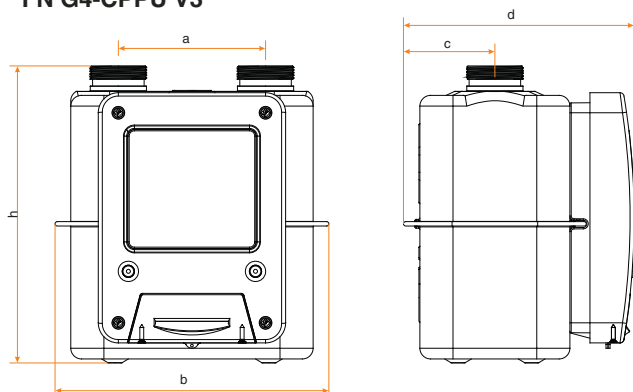
Federal Elektrik offers a complete solution and a continuous technicalsupport to entities based on the subscriber management system and the credit selling points.



## Points to be considered

- The counter should be protected by an appropriate protective panel from weather conditions, damages that may arise from accidents or from actions that could harm its operation (impacts, vibrations, corrosion, very low or high temperatures, humidity, etc).
- Electric switches, counters, junction boxes, instruments and devices that operate with electricity such as bells should not be placed close to the device. In obligatory circumstances this distance should be minimum 1.5 meters
- It should not be forgotten that a direct or indirect interference by unauthorized people during using phase will lead to penalty provisions.

## FN G4-CPPU V3



- Federal is not responsible for any damages arising from impacts or falling during carrying after delivery and for any deformations that may arise as a result of not deactivating the device during the leakage test of the installation.

- The assembly of the device should be carried out when spatters and similar particles are removed and cleaned from the inside of the pipe

- It is recommended to place filters in counter's inlets and outlets in order to avoid the entrance of installation spatters and dust that may originate on lines. (A material available in Federal Electric DGS Accessories. Delivered upon demand).

Type	Connection			Dimensions				
FN CPPU G4 V3	DN		Connection Size	h	a	b	c	d
	32	25	20 G1 1/4", G1", G 3/4" ISO 228 ÷ 1: G 7/8	226	110	206	68,5	168

# NATURAL GAS METERS

## FN G6-CPPU V2



### Technical Features

Gas Types	Natural Gas - Air Gas
Q min	0.06m <sup>3</sup> /h
Q max	10m <sup>3</sup> /h
Max. Operating Pressure	500mbar
Measuring Volume	2.2dm <sup>3</sup>
Operating Temperature	-25°C, +55°C
Body	Deep Drawing Sheet Iron
Weight	3.2kg
Verification Qmin	±%3 (max)
Verification Qmax	±%1,5 (max)
Max. Displayable Value	99999,999
Resolution	0,001m <sup>3</sup>
Pressure Loss (for Q max)	<2mbar
P Valf	500mbar
Circuit	Processor based special design manufactured via SMD Technology
Power Feeding	8,5 Ah long-lasting lithium main battery 1,2 Ah long-lasting lithium spare battery 1,5 F super capacitor
Display	Special design advanced LCD, Display illuminating feature at dark
Safety	Detection of extreme consumption and gas leakage
Measuring Method	Optical reading
Position Class	IP54
Card Reader	ISO7816 compatible smart card reader
Data Safety	Permanent memory unaffected from interruptions (EEPROM, DATA FLASH)
Resolution	0,001m <sup>3</sup>
Counter Safety	Detection of cover and battery cover opening Perception of optical reading failures
Optionel Features	Wireless M-BUS remote reading and management Remote software updating Reading gas temperature, correction process according to gas temperature

### Prepaid Compact Natural Gas Meter:

The design, R&D studies and manufacturing of FN G6-CPPU gas meters have been carried out in Federal Elektrik facilities. They are long-lasting devices executing sensitive and safe measurements.

### Area of Use:

FN G6-CPPU gas meters are designed according to large Residences and small entities and is used for the measuring of natural gas and air gas delivered to subscribers. They are developed according to needs of distribution entities that perform sales on prepaid basis.

### General Features:

- The prepaid Compact Gas Meters consist of a mechanic gas meter, special gas cutting valf that is placed into the mechanic body and of the electronic prepay circuit.
- The mechanic counter is the unit that is measuring the consumed gas measuring the gas consumption at 0.001m<sup>3</sup> resolution.
- The electronic circuit magnetically reads the counter and performs a credit facility.
- The gas cutting valve embedded into the mechanic counter body cuts or releases the gas under the control of the electronic circuit.
- The electronic circuit is a smart circuit that operates with a battery, enables credited gas consumption, processor based, and that is operating with a software, equipped with a LCD display and a smart card reader.
- The credit purchased via the smart card (subscription card) is loaded on the counter and the consumption is credited by regularly deducting the gas consumption accordingly. If credit is used up, the system automatically cuts the gas by closing the valf.
- Each counter has an individual subscription card.
- The system is of integrated structure with mechanical body and electronic components.

- The counter battery is able to feed the system for minimum 10 years without interruption and can be replaced if necessary. Furthermore, it is equipped with another spare battery in order to ensure an uninterrupted operation of the counter. A super capacitor has been added into the system in order to keep batteries working for many long years.

### Optionel Features:

- Optionel gas temperature measuring and correcting process according to Temperature.
- Wireless M-BUS remote reading and remote management,
- Wireless M-BUS remote software updating.

### Using Features:

- The counter continuously monitors the credit status and operating conditions and hinders gas usage by closing the valf in the event that the credit is used up or upon any circumstances that may be harmful for the counter operation.
- In the event that the credit falls under specified limits the subscriber is alerted as the LCD display turns on and off accordingly.
- A small portion (determined by the company) of the gas purchased is stored by the company as spare on the subscription card. In the event that the subscriber has not purchased any new gas upon use up, he/she continues using gas by loading the spare credit. This feature is important as it prevents the subscriber, who might have forgotten to buy new gas, from being left without gas during hours where gas purchasing is not available.
- All connections of mechanic counter and valf of the prepaid system are hidden within the body. There is no possibility to reach these components without opening the cover.
- The body cover is sealed which needs to be broken in order to be able to open the cover. There is a separate seal for the battery cover that enables battery replaced by authorized personnel without the need of opening the body cover.

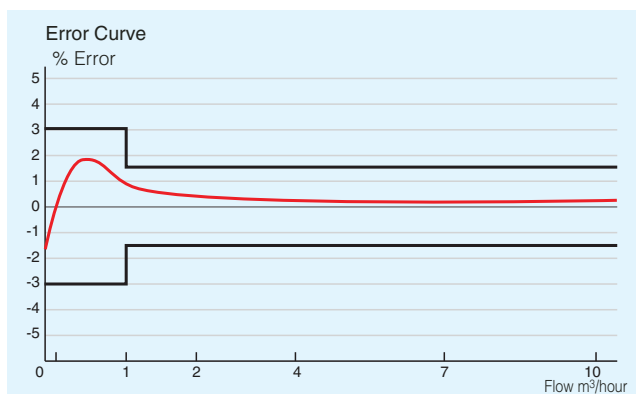


# NATURAL GAS METERS

- Opening of body cover and battery cover is electronically detected. The valve closes instantly hindering further gas consumption. After the end of operations of authorized personnel such as battery replacement, the closed valve is opened again via an authorization card.
- If counter failures are deleted via authorization cards, the valve does not open instantly. The subscription card must be inserted into the counter as well to open the valve. This feature is important for avoiding gas leakage which also ensures that the subscriber is at home when the valve is opened.
- It detects extreme gas consumption. If a failure is detected it cuts the gas and ensures the safety of the subscriber.

## The Advantages of the Prepaid System:

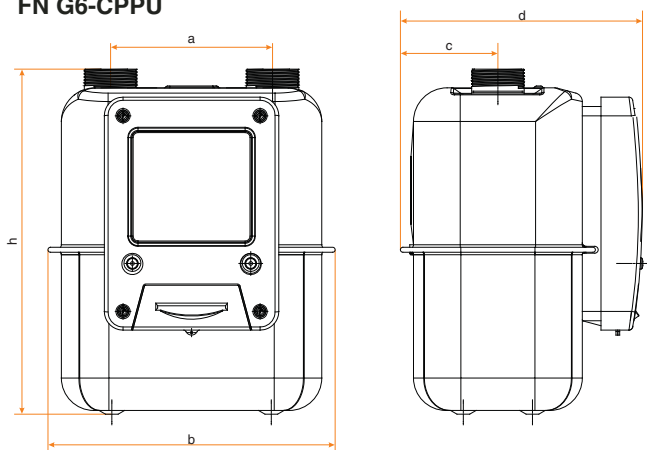
- Saves the companies from visiting subscribers each month for counter-reading processes.
- The consumed gas amount is received in advance.
- Subscribers are not affected from price changes based on the gas they have purchased.
- It supports a more conscious consumption.
- Saves subscribers from invoice payments and from inconveniences like chasing the last payable day of invoice.



## Points to be considered

- The counter should be protected by an appropriate protective panel from weather conditions, damages that may arise from accidents or from actions that could harm its operation (impacts, vibrations, corrosion, very low or high temperatures, humidity, etc).
- Electric switches, counters, junction boxes, instruments and devices that operate with electricity such as bells should not be placed close to the device. In obligatory circumstances this distance should be minimum 1.5 meters
- It should not be forgotten that a direct or indirect interference by unauthorized people during using phase will lead to penalty provisions.

## FN G6-CPPU



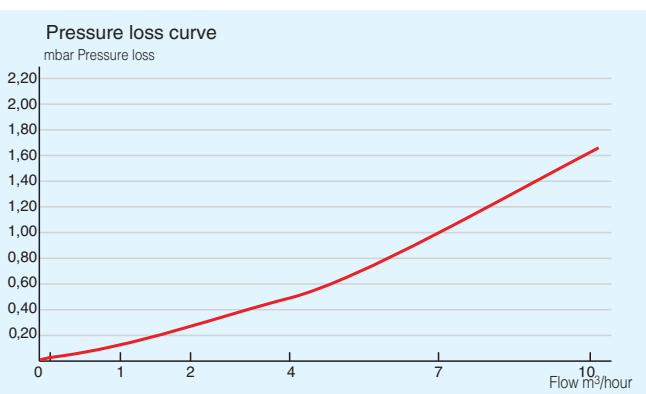
- Saves entities from gas cutting-opening processes due to payment problems.

## Components of Prepaid Gas Distribution System Can be summarized as;

- Prepaid counter and credit loading card (subscriber card),
- Credit selling points,
- Subscriber monitoring system.

Credit selling points may be special selling desks of the entity, contractual banks, contractual markets. It is very important subscribers will purchase their credit without standing in a queue and without being limited with working hours.

The subscriber monitoring system or subscriber management system is a computer supported system where all type of processes related to subscribers are monitored and carried out. It is equipped with an advanced data base management system where all past processes are recorded accordingly. Federal Elektrik offers a complete solution and a continuous technical support to entities based on the subscriber management system and the credit selling points.



- Federal is not responsible for any damages arising from impacts or falling during carrying after delivery and for any deformations that may arise as a result of not deactivating the device during the leakage test of the installation.
- The assembly of the device should be carried out when spatters and similar particles are removed and cleaned from the inside of the pipe
- It is recommended to place filters in counter's inlets and outlets in order to avoid the entrance of installation spatters and dust that may originate on lines. (A material available in Federal Elektrik DGS Accessories. Delivered upon demand).

Type	Connection	Dimensions					
FN CPPU G6	DN	Connection Size	h	a	b	c	d
	32	G1¼"	276	130	231	78	195

# NATURAL GAS METERS



FNG PPU

## Prepayment Module,

Federal prepayment module provides conscious gas consumption and thus the most efficient use of energy resources by sensitive, accurate and reliable measurement.

This module has been designed using the latest technology and manufactured in accordance with international standards

Prepayment module works on the basis of consumer consumption from the credit which was purchased and loaded to module and decreased during the gas consumption and broke the gas when credit is finished.

Consumer goes to Credit Loading Centers and is loaded the credits to his consumer card. When the consumer card is inserted in the prepayment unit the credits is transferred to the device.

## User of Prepayment Unit,

- Is freed from following of bills and last payment date
- Contribute to his budget and country by more reliable and sensitive measure
- Is not affected by price increases because of advance payment.

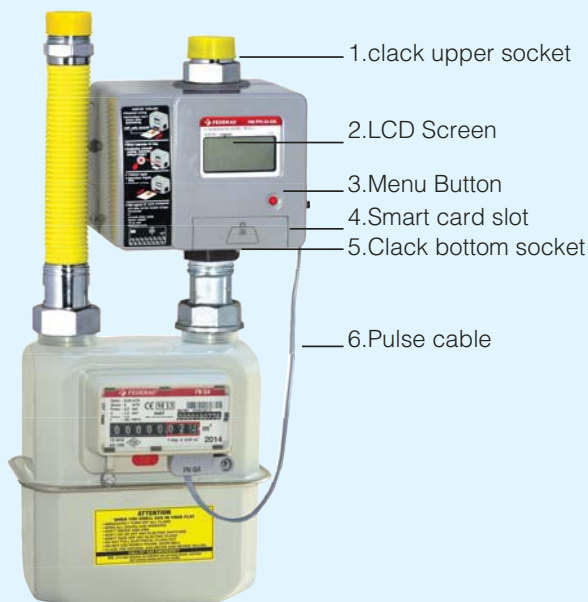
## General Features:

- Lifetime of the device is ten years
- Displays real time-hour; features minimum deviation in date time
- Has a permanent memory for storage of information
- The position of the valve is shown on the LCD by an icon indicating that the valve is on or off
- The status of the battery is shown on the LCD screen in three stages
- The remaining credits are shown on the LCD screen in six digits
- The information on credit loading and device is retrieved via a button on the device
- Any error or warning is communicated by ! sign. This remains on until maintenance or care by a service team. The device is able to keep consumption statistics for 6 months.

- It can hold all care and interventions on its memory in details. In such cases, it prevents gas passage by shutting down the device valve. The device operates on a lithium battery (3.6V 8.5 Ah). A reserve battery is provided in case of battery malfunctions or replacements in order to keep the device operating. In case of weak battery, the device warns the user via a statement that appears on the screen. It shuts down the valve when the battery is to be out and disallows gas use.

- In case of disconnection or malfunction with the cable between the mechanical meter and the prepayment module, the device valve is shut down and the relevant warnings are displayed.

- When the amount of credit on the device falls below a certain limit, the screen displays a warning accordingly.



**1- Clack upper socket:** Outlet end

**2- LCD:** The screen that displays information including the amount of consumption in terms of cubic meter, credits and date

**3- Menu button:** Ensures sequential display of information on total amount of consumption, remaining credits and date; credit is loaded by pressing this button after insertion of the smart card

**4- Smart card slot:** the section where the smart card is inserted

**5- Clack bottom socket:** Outset end (depends on the size of the meter)

**6- Pulse cable:** The cable that carries the gas consumption signal from the mechanical meter to the prepayment module.

Type	: FNG PPU G4-G25		
Operating bar	: $P_{max} = 0,5 \text{ Bar}$		
Accuracy	: $0.01 \text{ m}^3$		
Measurement type	: Pulse		
Screen	: Special design LCD		
Relative humidity	: $\leq \%93$		
Room Temperature	: $-20^\circ\text{C} \dots +55^\circ\text{C}$		
Storage temp	: $-30^\circ\text{C} \dots +70^\circ\text{C}$		
Material	: ABS, UV-V0		
Communication	: RS232 (For factory adjustment)		
Data protection	: EEPROM, reserve battery		
Card type	: Encrypted smart card 7816 1-2-3 compatible		
Metering interval	: $Q_{min} : 0,040 \text{ m}^3 / \text{hour}$ $Q_{max} : 40 \text{ m}^3 / \text{hour}$		
Battery	: 3.6V, 8.5 Ah lithium battery >10 Years		
Protection class	: IP54		
Weight	: G4-G6	: G10-G16	: G25
	1,8 kg	2,1 kg	2,2 kg

## Loading Credit On Prepayment Unit



The card is inserted on the smart card slot on the prepayment module in a way that the chip stays up and front.



A few seconds pass after the insertion of the card to ensure that the meter loads credits.



The card is taken off the device.

Four different situations may be encountered when the card is inserted on the device.;

**1. Loading main credit on the module** When the main credit is loaded on the meter, the amount of credit is displayed on the screen subsequent to the appearance of the statement "credit has been loaded." The total credit on the device increases in the amount of the loaded credit. Subsequently, the total amount of credit is displayed on the screen..

**2. Loading the reserve credit on the module** The amount of loaded credit is displayed on the screen when the reserve credit is loaded in the aftermath of the statement "reserve credit has been loaded. The total credit on the device increases in the amount of the loaded credit. Subsequently, the total amount of credit is displayed on the screen. Reserve credit may be loaded when the credit on the device falls below the critical level and the device screen blinks for warning.

**3. Failure to load credit** If no credit available on the card, the screen displays "subscriber." In this case, no credit could be loaded on the device. No credit can be loaded on the device if the amount of credit on the device is not below the critical level despite that the card is able to load reserve credit. Subsequently, the total amount of credit is displayed on the screen.

**4. Error** An error message appears on the screen in case of malfunction with the card or its early withdrawal. This error is expressed with XATO and an error number. For instance, XATO 01.

If the device valve is shut down because of non-availability of credit, the valve will reopen and gas will be passed through when credit is loaded. The valve left shut down after technical service will reopen when the card is inserted provided that there is no preventing problem.

## Use of prepayment module

There are two types of credits on the card.

### Main credit

There is no special condition to load this type of credit. If the card has this type of credit, it is activated when the card is inserted on the device.

### Reserve credit

To load this credit, the amount of the credit on the device should fall below a certain limit. The subscriber keeps the amount of credit allocated by the relevant office and seller as reserve credit on his or her card. This is for emergency use.

### For example:

Let us assume that no credit is left on the card and that the reserve credit limit set by the seller is 5 cubic meters. A 15 cubic meter credit purchased by the subscriber is loaded on the card to meet the main and reserve credits (5 cubic meters is reserve and 10 cubic meters is main). Unless the reserve credit is used, the subsequent loads are added to the main credits. The reserve credit saves the subscribers in case of emergencies. In general, it provides enough credit sufficient for a few days of use.

## Modular unit testing information

For the sake of user and device safety, the following standards have been complied with and the relevant tests have been run in the laboratories.

### Climate tests

IEC 60068-2-2 (15) Dry heat

IEC 60068-2-1 (14) Cold

IEC 60068-2-78 (20) Damphead, steady-state.

IEC 60068-2-30 (16) Damphead, cyclic. (condensing)

### Performance tests

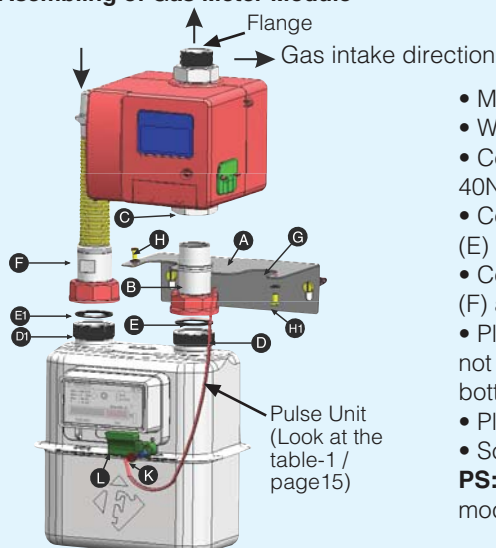
OIMLR 137-1 A.8 Performance Test (Battery powered instrument IEC 60068-2-

31 Mechanical Shock IEC 60068-2-64 Vibration Random EMU Tests

IEC 61000-4-3 (24) Radiated, radio frequency, electromagnetic fields.

IEC 61000-4-2 (23) Electrostatic discharge, disturbance test

## Assembly of Gas Meter Module



- Mount the hanger sheet (A) to the wall (\*)
- Wrap the socket (B) notch with Teflon band for leakage-proof
- Combine module socket (C) with the socket (B) and tighten (max 40Nm torque)
- Connection sleeve (B) module to the meter socket (D) by placing a gasket (E) and tighten it (max 110Nm torque)
- Connect the meter phase inlet socket (D1) via gasket (E1) and flex pipe (F) and tighten (max 110Nm torque)
- Place the meter on the hanger slot (G). To make sure that the meter does not come out, tighten the screw (H) from above and the other (H1) from the bottom.
- Place the cabled socket (L) on the numerator (Look at the table-1 / page 15)
- Screw the socket and cover it with its fuze (K).

**PS:** This installation and assembly applies to G4-G6 models (\*) There is no console hanger in G10 model.

# NATURAL GAS METERS

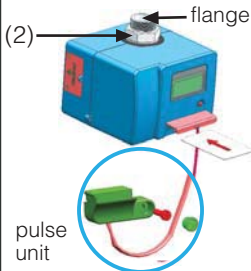
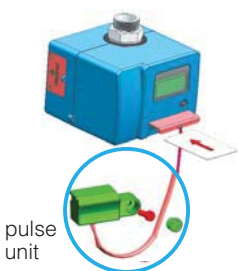
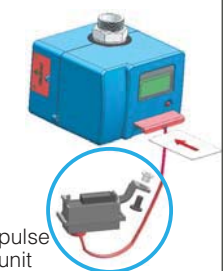
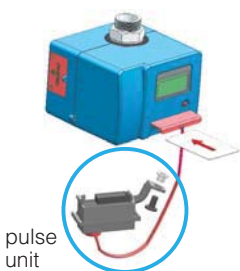
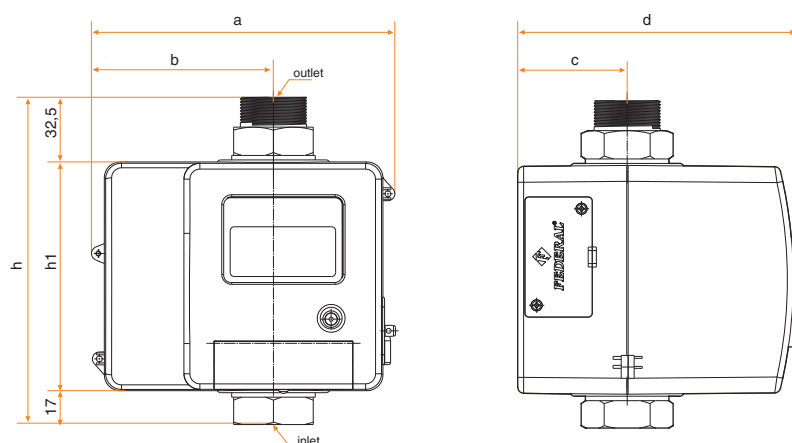
PREPAYMENT UNITS	PREPAYMENT UNIT VERSION	IMPULSE SOCKET OF PREPAYMENT UNITS			
		V1 (G4)	V2 (G4)	V2 (G6)	V2 (G10)
					
	Prepayment Unit Outer Dimensions (2)	1"	1"	1"	1 1/4"

Table1:

## Problems that may be encountered during use and methods to resolve these problems

Problem	Reason	Solution
No display on screen	Press menu buton; If still no display Battery may be dead	Call tech service
Battery sign displays No battery	Battery may be out	Call tech service
No gas flow, though Credit available	No gas on network or the device on Service status	Call tech service
⚠ sign appears On the screen	Servis uyarısı. Herhangi bir arıza meydana gelmiştir. SRVC koduna bakarak arıza nedeni bulunabilir.	Call tech service
Screen blinks	Credit below critical level	Load the credit
⚠ sign on Screen and no gas flow	Out of credit if no other service warning	Load the credit
A XATO warning Along with a number Appears on the screen When the card inserted	The card may be inserted wrong; Card may be broken	Try again after inserting the card correctly; if the error persists, call the office To replace your card



Type	Connection Size			Dimensions					
	DN	inlet	outlet	h	h1	a	b	c	d
FNG-PPU G4-G6	25	1"	1"	164.5	115	140	85	55	140
FNG-PPU G10-G16	40	1 1/2"	1 1/2"	164.5	115	140	85	55	140
FNG-PPU G25	50	2"	2"	164.5	115	140	85	55	140

# NATURAL GAS METERS

**FN G1.6-AB**



## Technical Features

Type	FN G1.6-AB
Gas Types	Natural Gas- Air Gas
Q Min	0,016m <sup>3</sup> / h
Q Max	2,5m <sup>3</sup> / h
Measuring Interval	0,016m <sup>3</sup> /h - 2,5m <sup>3</sup> /h
Max. Operating Pressure	0,5 bar
Leakage Test Pressure Value	750 mbar
Measuring Volume	0,7 dm <sup>3</sup>
Qmin ≤ Q < 0.1 Qmax	± 3%
0.1 Qmax ≤ Q ≤ Qmax	± 1,5%
Operating Temperature	-25 C°, +60 C°
Storing Temperature	-30 C°, +70 C°
Maximum Totalizer Capacity	99999,999m <sup>3</sup>
Union Pipe & Nut	3/4"
Flow Direction	Option (Left Type or Right Type)
Body	Aluminium Die Casting
Weight	1,5 kg.

**FN G2.5-AB**



## Technical Features

Type	FN G2.5-AB
Gas Types	Natural Gas- Air Gas
Q Min	0,025m <sup>3</sup> / h
Q Max	4,0m <sup>3</sup> / h
Measuring Interval	0,025m <sup>3</sup> /h - 4,0m <sup>3</sup> /h
Max. Operating Pressure	0,5 bar
Leakage Test Pressure Value	750 mbar
Measuring Volume	1,2 dm <sup>3</sup>
Qmin ≤ Q < 0.1 Qmax	± 3%
0.1 Qmax ≤ Q ≤ Qmax	± 1,5%
Operating Temperature	-25 C°, +60 C°
Storing Temperature	-30 C°, +70 C°
Maximum Totalizer Capacity	99999,999m <sup>3</sup>
Union Pipe & Nut	3/4"
Flow Direction	Option (Left Type or Right Type)
Body	Aluminium Die Casting
Weight	1,8 kg.

**FN G4-AB**



## Technical Features

Type	FN G4-AB
Gas Types	Natural Gas- Air Gas
Q Min	0,04m <sup>3</sup> / h
Q Max	6,0m <sup>3</sup> / h
Measuring Interval	0,04m <sup>3</sup> /h - 6,0m <sup>3</sup> /h
Max. Operating Pressure	0,5 bar
Leakage Test Pressure Value	750 mbar
Measuring Volume	1,7 dm <sup>3</sup>
Qmin ≤ Q < 0.1 Qmax	± 3%
0.1 Qmax ≤ Q ≤ Qmax	± 1,5%
Operating Temperature	-25 C°, +60 C°
Storing Temperature	-30 C°, +70 C°
Maximum Totalizer Capacity	99999,999m <sup>3</sup>
Union Pipe & Nut	3/4"
Flow Direction	Option (Left Type or Right Type)
Body	Aluminium Die Casting
Weight	3,3 kg.



# NATURAL GAS METERS

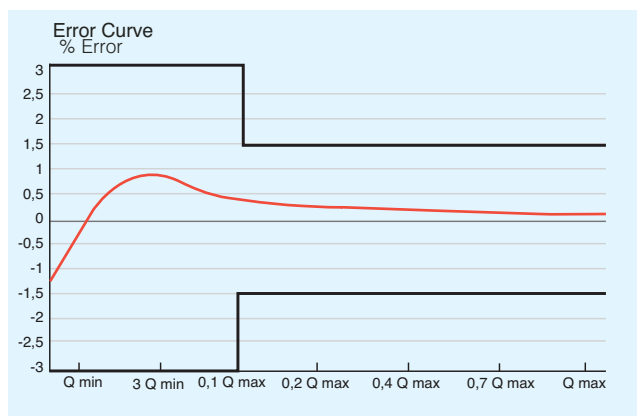
## General Features

- Outer body is made of special aluminum material with injection method and painted with ovened electrostatic powder paint.
- Gas input and outgoing fitting axes can produce 130 / 100 mm and fitting external measurement can produce G.-3/4".
- Meter structure does not allowed reverse connection or manipulation by manual intervention
- Minimum pieces of engineering plastics are used on gas meter internal body.
- The gas meter has a special magnetic transfer system (stainless magnetic coupling)
- There is approved and durable circular diaphragm which is suitable with standards in internal mechanism.
- There is an long 360° rotary type operating mechanism used in inner mechanism for sensitive measuring.
- Easy reading of the meter have been provided with big counter discs which are above-standards.
- Meter materials are selected among high resistant materials in terms of unfavorable conditions.
- Special fitting locking console sheet that is resistant to turning moments is delivered as standard piece together with the meter for assembly and commissioning.
- In virtue of its executed design and materials used it has a lower pressure loss than indicated in TS 5910 EN 1359 Standards.
- Measuring failure percentage at 0,1 Qmax - Qmax interval is lower than  $\pm 1,5$
- The meter is suitable for natural gas, air gas and LPG gas.

Optionally(\*);

- The color of gas meter can be changed upon request
- Pulser type counter body cover can be produced upon request ( $1 \text{ imp} \pm 0,01 \text{ m}^3$ ).

**Note:** According to quantity of requested meter changes can be made on meter connection fitting spindles and fitting external dimensions.

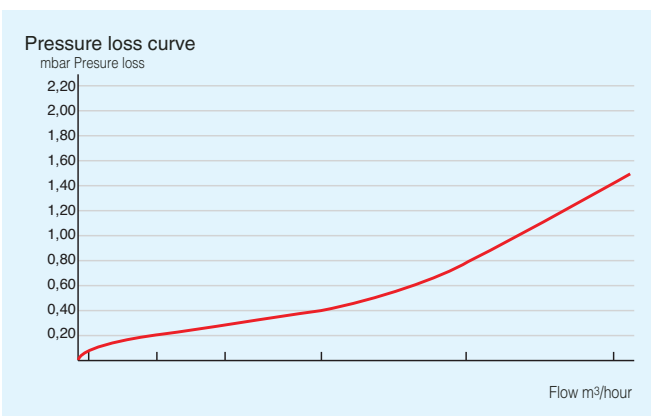


## Assembly

- Meter is assembling with console in stairwells which is inside of the building or if it is outside of the building then it can be assembled in the place which ventilation is provided and lightened inside of sheet panel.
- The home type meter indicator (numarator) should be minimum 1,80m or maximum 2.0 m height.
- The meter should be assembled with connection console in consider of horizontal position and through to the flow.
- The out-of-building applications (external) of the meter should exactly made with suitable panels.
- The size of the counter panel should enable easy mounting, repair and dismantling for maintenance.
- Everytime, there should be control valve input of the meter.
- The meter input connection should made with stainless material (PVC covered or without cover) and assembled with flexible hose.
- Meter outgoing connection should connect with fitting to input installation of the house.
- Gasket which is suitable to natural gas should be use in fittings on the connection of the meter and installation.

## Maintenance

- The device owner can clean any pollution with wet pack on the meter. Excluding washing is not advise.
- As meters are mesuring devices, maintenance, repair and providing spare sparts are only carried out by the manufacturing company based on the test results executed.
- Due to its structure the device does not require any maintenance. Meter life will be extended in case of Using manufacturer-approved filters input and outgoing of the natural gas meter.

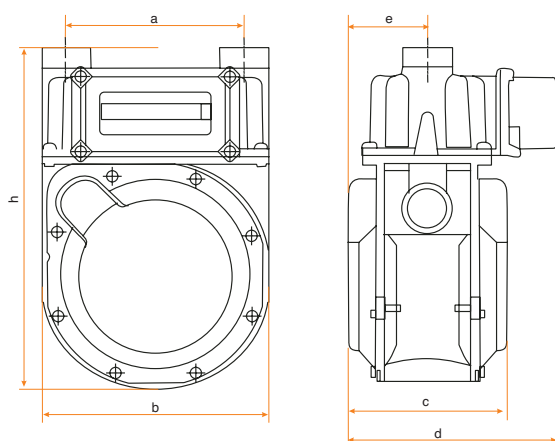


# NATURAL GAS METERS

## Points to be considered

- The counter should be protected by an appropriate protective panel from weather conditions, damages that may arise from accidents or from actions that could harm its operation (impacts, vibrations, corrosion, very low or high temperatures, humidity, etc).
- Electric switches, counters, junction boxes, instruments and devices that operate with electricity such as bells should not be placed close to the device. In obligatory circumstances this distance should be minimum 1.5 meters.
- It should not be forgotten that a direct or indirect interference by unauthorized people during using phase will lead to penalty provisions.

- Federal is not responsible for any damages arising from impacts or falling during carrying after delivery and for any deformations that may arise as a result of not deactivating the device during the leakage test of the installation.
- The assembly of the device should be carried out when spatters and similar particles are removed and cleaned from the inside of the pipe
- It is recommended to place filters in counter's inlets and outlets in order to avoid the entrance of installation spatters and dust that may originate on lines. (A material available in Federal Electric DGS Accessories. Delivered upon demand).



Type	Connection	Dimensions (mm)					
	Connection Size	h	a	b	c	d	e
FN G1.6-AB	3/4"	226 ±2	100	168 ±2	100 ±2	138 ±2	50 ±2
FN G2.5-AB	3/4"	226 ±2	100	168 ±2	100 ±2	138 ±2	50 ±2
FN G4-AB	G1 1/4" - 3/4"	226 ±2	130/100	168 ±2	100 ±2	138 ±2	50 ±2

## Pressure Conversion Table

1 bar	=	1000 mbar	=	100 kpasal	=	100.000 pascal
0,5 bar	=	500 mbar	=	50 kpasal	=	50.000 pascal

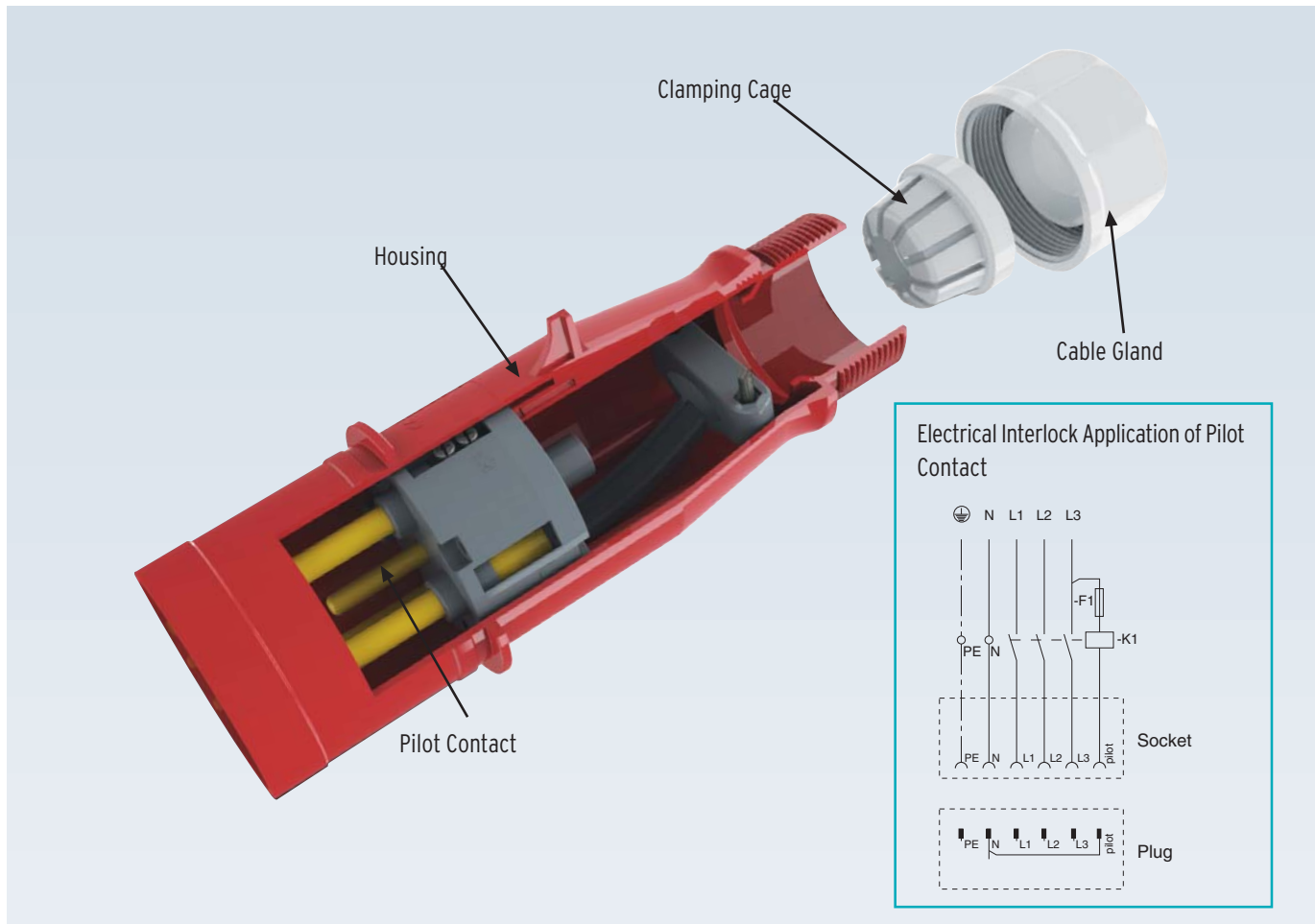


# PLUGS & SOCKETS



## Plugs & Sockets

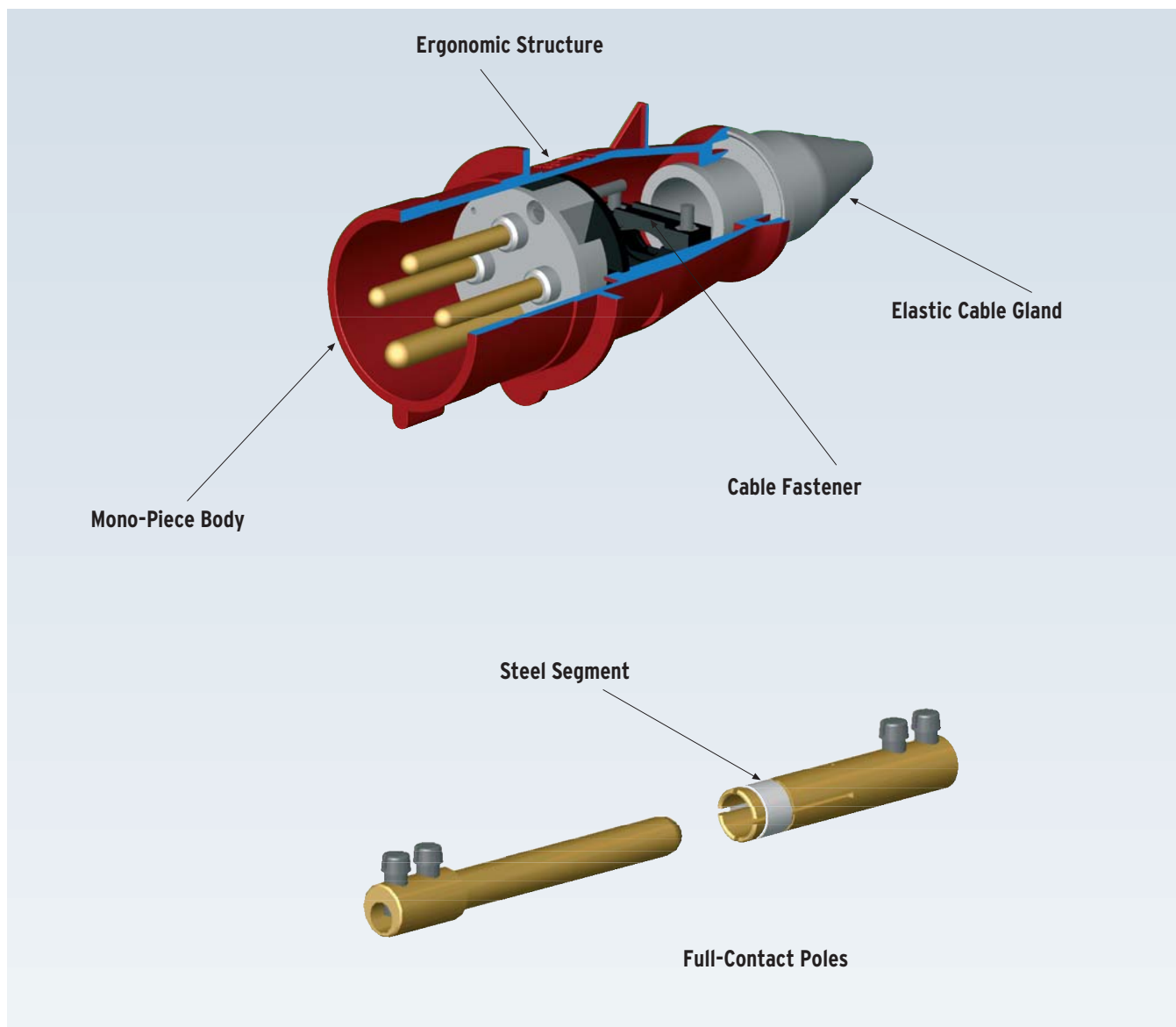




Standards	Nominal Voltage Un (V)	Poles	Color	Nominal Current In (A)	h	IP	Hz.	Installation Temperature	
EN 60309-1-2 TS 7205-7206	110	3		16	4	44	50-60	-25°C	+60°C
	220	3		16	6	44			
	380	4				44-67			
	380	5		44-67					
	220	3		44-67					
	380	4		44-67					
	380	5		44-67					
	380	4		63		44-67			

Nominal Current in (A)	Terminal	Terminal Cable Capacity mm2 NYA	
		min.	max.
A	mm2		
16	20	1,5	4
32	50	2,5	10
63	113	6	25

Material	Installation Temperature	Heat Resistance Level
PA	-25°C +60°C	V2

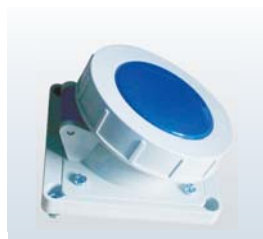


FEDERAL CEE plugs and sockets, with their number of poles (2P+E; 3P+E; 3P+N+E) connecting to almost any electric circuit, meet appropriately the requirements. They are adapted to operate at low voltage (110V, 220V, 380V, 450V) and colored according to their feeding. Different execution styles (wall mounting, panel mounting, angled, straight, with box) are available like high protection degrees (IP 44 and IP 67) and different nominal currents (16A, 32A, 63A).

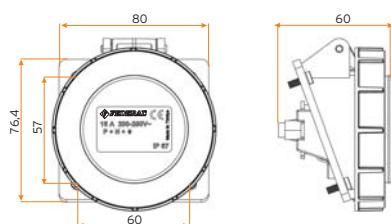
# PANEL MOUNTING SOCKET

**Panel Mounting Socket Angled With Locking Cover**

12 180 gr.



200 - 250V  
16A  
P+N+  
IP 67

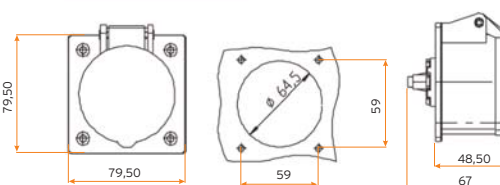


**Panel Mounting socket**

12 160 gr.



200 - 250V  
16A  
2P+  
IP 44

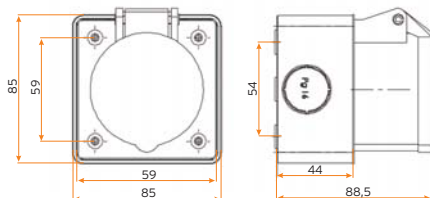


**Wall Mounting Socket With Straight Box**

12 170 gr.



200 - 250V  
16A  
2P+  
IP 44

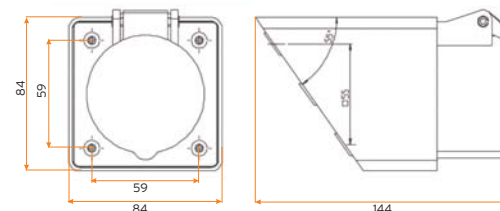


**Wall Mounting Socket With Angled Box**

12 230 gr.



200 - 250V  
16A  
2P+  
IP 44

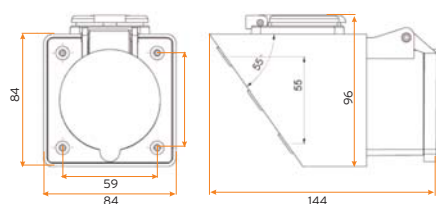


**Wall Mounting Socket With Angled Box + Schuko**

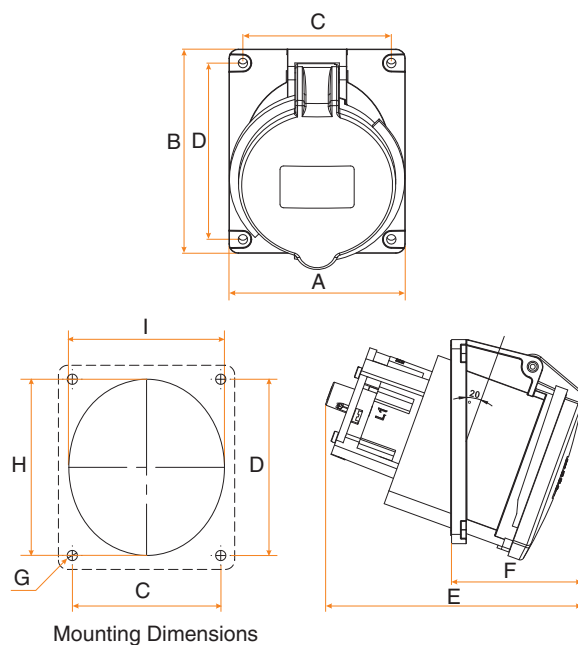
12 268 gr.



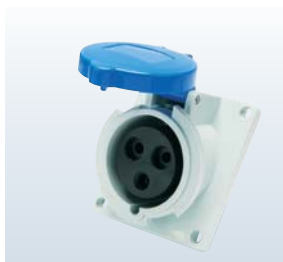
200 - 250V  
16A  
2P+  
IP 44



# PANEL MOUNTING SOCKET

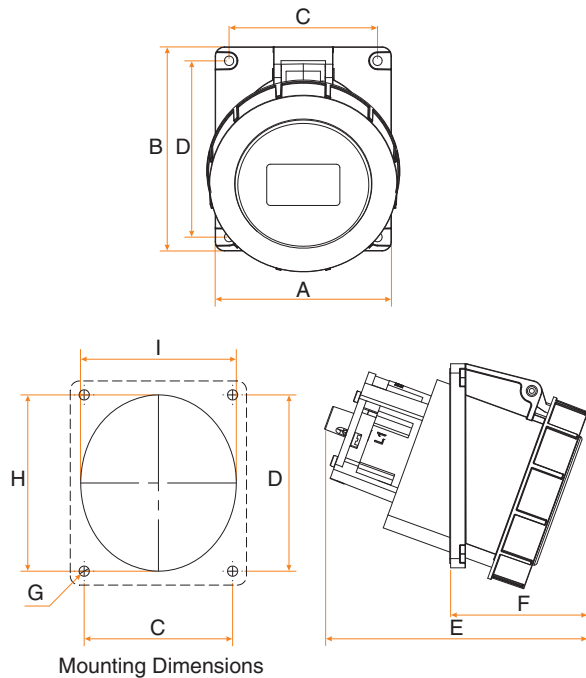


	Amper (A)	Dimensions (mm)								
		A	B	C	D	E	F	G	H	I
2P+E	16	79.5	79.5	60	60	72	52.5	4.5	65	65
	16	79.5	79.5	60	60	72	52.5	4.5	65	65
	32	92	100.5	75	85	109	61	6	84	84
3P+E	16	79.5	79.5	57.5	57.5	90	58	5	70	70
	16	92	102	75	85	99.5	58	6	84	84
	32	92	102	75	85	99.5	58	6	84	84
	63	95	110	80	95	139	71	5	95	84
3P+N+E	16	79.5	79.5	60	60	70.5	48	4.5	57	57
	32	92	101	75	85	105	61	6	84	84
	63	92	110	80	95	139	71	5	95	84



	Amper (A)	(V)	(h)	Color	Weight (gr.)	Min. Order Quantity	Order Code
<b>2P+E</b>							
IP 44	16	110-130	4	Yellow	120	12	95S-44316-0130
	16	200-250	6	Blue	118.5	12	95S-46316-0250
	32	200-250	6	Blue	235	12	95S-46332-0250
<b>3P+E</b>							
IP 44	16	380 - 415	6	Red	163	12	95S-46416-0415
	16	380 - 415	6	Red	180	12	95S-46416-0416
	32	380 - 415	6	Red	242	12	95S-46432-0415
	63	380 - 415	6	Red	569	6	95S-46463-0415
<b>3P+N+E</b>							
IP 44	16	380 - 415	6	Red	155	12	95S-46516-0415
	32	380 - 415	6	Red	225	12	95S-46532-0415
	63	380 - 415	6	Red	588	6	95S-46563-0415

# PANEL MOUNTING SOCKET WITH LOCKED COVER

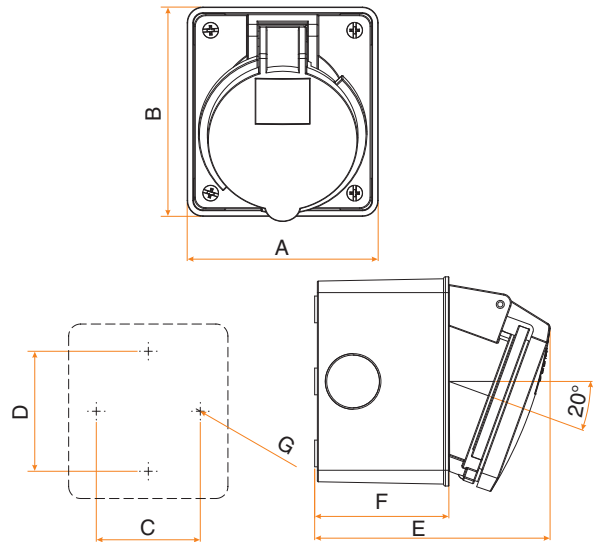


	Amper (A)	Dimensions (mm)								
		A	B	C	D	E	F	G	H	I
<b>2P+E</b>	32	92	101	75	85	108	60	6	84	84
<b>3P+E</b>	16	79.5	79.5	57.5	57.5	87	57	5	70	70
	32	92	102	75	85	100.5	60	6	84	84
	63	95	110	80	95	142	74	5	95	84
<b>3P+N+E</b>	16	79.5	79.5	60	60	72.5	50	4.5	57	57
	32	92	101	75	85	103	60	6	84	84
	63	92	110	80	95	142	74	5	95	84



	Amper (A)	(V)	(h)	Color	Weight (gr.)	Min. Order Quantity	Order Code
<b>2P+E</b>							
IP 67	32	200 - 250	6	●	264	12	9SL-66332-0250
<b>3P+E</b>							
IP 67	16	380 - 415	6	●	210	12	9SL-66416-0415
	32	380 - 415	6	●	267	12	9SL-66432-0415
	63	380 - 415	6	●	586	6	9SL-66463-0415
<b>3P+N+E</b>							
IP 67	16	380 - 415	6	●	185	12	9SL-66516-0415
	32	380 - 415	6	●	295	12	9SL-66532-0415
	63	380 - 415	6	●	629	6	9SL-66563-0415

# WALL MOUNTING SOCKET WITH STRAIGHT BOX



Mounting Dimensions

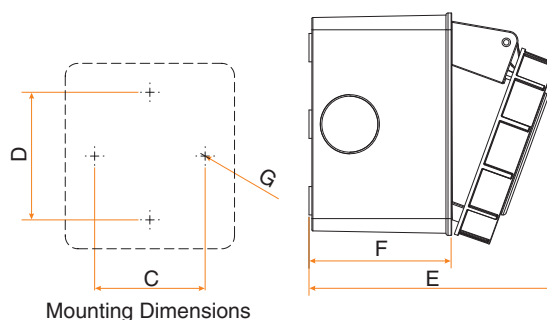
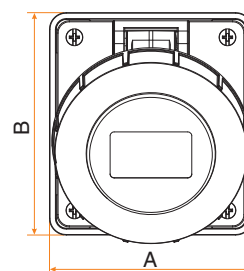
	Amper (A)	Dimensions (mm)						
		A	B	C	D	E	F	G
2P+E	16	86	86	55	55	94	45	6
	16	86	86	55	55	94	45	6
	32	99.5	109	64	75	122.5	70	6
3P+E	16	86	86	55	55	99	45	6
	32	99.5	109	65	75	121	70	6
3P+N+E	16	86	86	55	55	90.5	45	6
	32	99.5	109	65	75	122.5	70	6



	Amper (A)	(V)	(h)	Color	Weight (gr.)	Min. Order Quantity	Order Code
<b>2P+E</b>							
IP 44	16	110 - 130	4	Yellow	184	12	9WS-44316-S130
	16	200 - 250	6	Blue	181	12	9WS-46316-S250
	32	200 - 250	6	Blue	347	6	9WS-46332-S250
<b>3P+E</b>							
IP 44	16	380 - 415	6	Red	226	12	9WS-46416-S415
	32	380 - 415	6	Red	357	6	9WS-46432-S415
<b>3P+N+E</b>							
IP 44	16	380 - 415	6	Red	218	12	9WS-46516-S415
	32	380 - 415	6	Red	369	6	9WS-46532-S415



# WALL MOUNTING SOCKET WITH STRAIGHT BOX AND LOCKED COVER

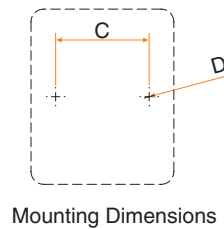
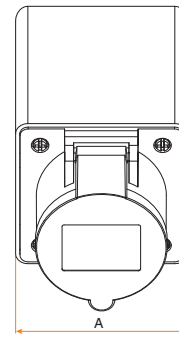


	Amper (A)	Dimensions (mm)						
		A	B	C	D	E	F	G
<b>2P+E</b>	32	99.5	109	64	75	122	70	6
	16	86	86	55	55	120	45	6
<b>3P+E</b>	32	99.5	109	65	75	122	70	6
	16	86	86	55	55	92,5	45	6
<b>3P+N+E</b>	32	99.5	109	65	75	120	70	6
	16	86	86	55	55	120	70	6

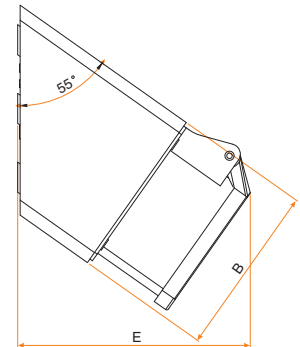


	Amper (A)	(V)	(h)	Color	Weight (gr.)	Min. Order Quantity	Order Code
<b>2P+E</b>							
IP 67	32	200 - 250	6	●	378	6	9WL-66332-S250
<b>3P+E</b>							
IP 67	16	380 - 415	6	●	324	6	9WL-66416-S415
	32	380 - 415	6	●	381	6	9WL-66432-S415
<b>3P+N+E</b>							
IP 67	16	380 - 415	6	●	248	12	9WL-66516-S415
	32	380 - 415	6	●	410	6	9WL-66532-S415

# WALL MOUNTING SOCKET WITH ANGLED BOX



Mounting Dimensions

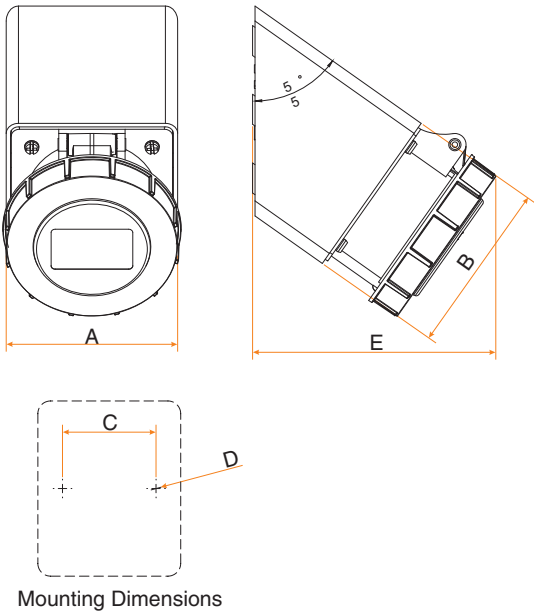


	Amper (A)	Dimensions (mm)				
		A	B	C	D	E
<b>2P+E</b>	16	84	84	55	6	120
	16	84	84	55	6	120
<b>3P+E</b>	16	84	84	55	6	125
<b>3P+N+E</b>	16	84	84	55	6	114



	Amper (A)	(V)	(h)	Color	Weight (gr.)	Min. Order Quantity	Order Code
<b>2P+E</b>							
IP 44	16	110 - 130	4	Yellow	243	12	9WS-44316-A130
	16	200 - 250	6	Blue	240	12	9WS-46316-A250
<b>3P+E</b>							
IP 44	16	380 - 415	6	Red	285	12	9WS-46416-A415
<b>3P+N+E</b>							
IP 44	16	380 - 415	6	Red	276	12	9WS-46516-A415

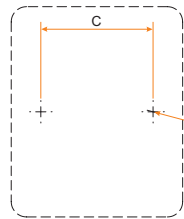
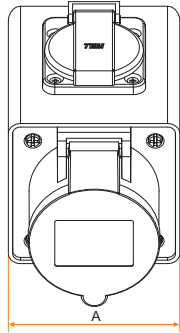
# WALL MOUNTING SOCKET WITH ANGLED BOX AND LOCKED COVER



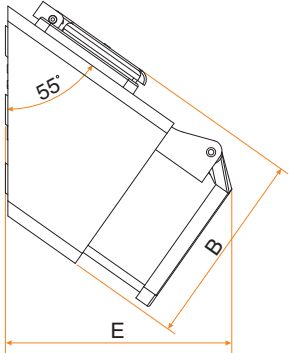
	Amper (A)	Dimensions (mm)				
		A	B	C	D	E
3P+N+E	16	84	84	55	6	120

	Amper (A)	(V)	(h)	Color	Weight (gr.)	Min. Order Quantity	Order Code
3P+N+E							
IP 67	16	380 - 415	6	●	307	12	9WL-66516-A415

# WALL MOUNTING SOCKET WITH ANGLED BOX + SCHUKO



Mounting Dimensions

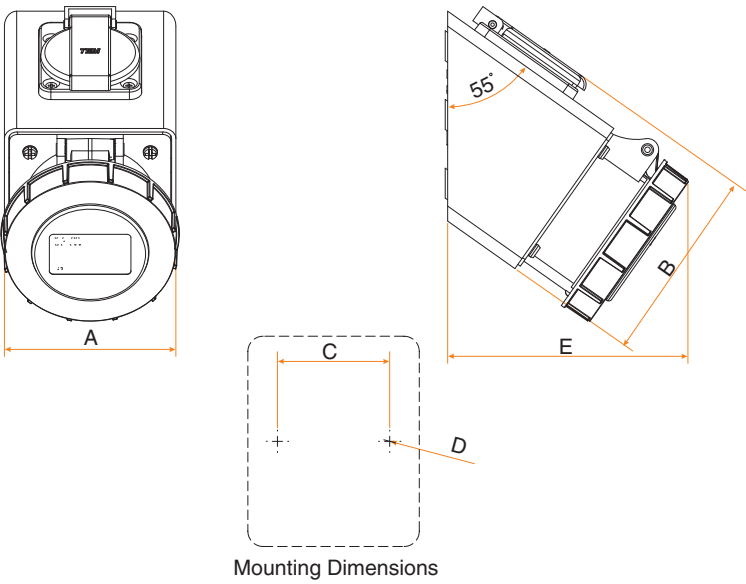


	Amper (A)	Dimensions (mm)				
		A	B	C	D	E
2P+E	16	84	96	55	6	120
3P+E	16	84	96	55	6	125
3P+N+E	16	84	96	55	6	114



	Amper (A)	(V)	(h)	Color	Weight (gr.)	Min. Order Quantity	Order Code
<b>2P+E</b>							
IP 44	16	200 - 250	6	●	278	12	9WS-46316-C250
<b>3P+E</b>							
IP 44	16	380 - 415	6	●	323	12	9WS-46416-C415
<b>3P+N+E</b>							
IP 44	16	380 - 415	6	●	314	12	9WS-46516-0415

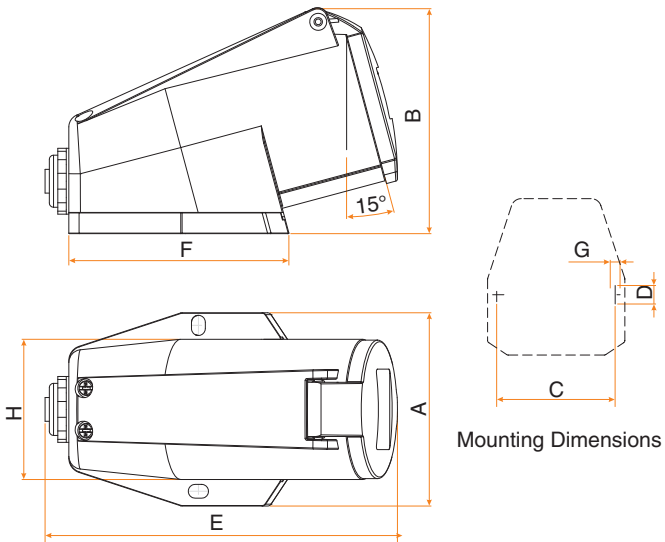
# WALL MOUNTING SOCKET WITH ANGLED BOX AND LOCKED COVER + SCHUKO



	Amper (A)	Dimensions (mm)				
		A	B	C	D	E
3P+N+E	16	84	96	65	6	114

	Amper (A)	(V)	(h)	Color	Weight (gr.)	Min. Order Quantity	Order Code
3P+N+E							
IP 67	16	380 - 415	6	●	346	12	9WL-66516-0415

# ANGLED WALL MOUNTING SOCKET

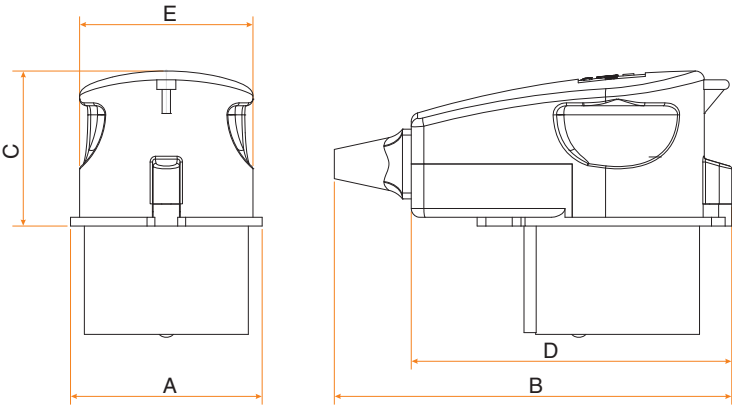


	Amper (A)	Dimensions (mm)							
		A	B	C	D	E	F	G	H
2P+E	32	91	106	78	12	166	103	7	66
3P+E	32	91	106	78	12	166	103	7	66
3P+N+E	16	88	87	72	6	132	114	6	62



	Amper (A)	(V)	(h)	Color	Weight (gr.)	Min. Order Quantity	Order Code
<b>2P+E</b>							
IP 44	16	200 - 250	6	●	299	12	9AS-46316-0250
<b>3P+E</b>							
IP 44	16	380 - 415	6	●	307	12	9AS-46416-0415
<b>3P+N+E</b>							
IP 44	16	380 - 415	6	●	214	12	9AS-46516-0415

# ANGLED PLUG

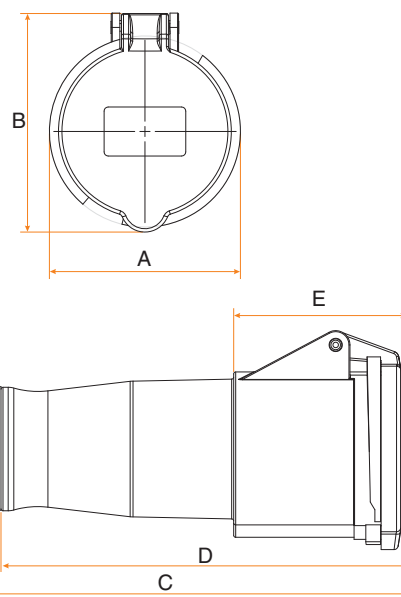


	Amper (A)	Dimensions (mm)				
		A	B	C	D	E
3P+N+E	16	65,5	136	53	109,5	59

	Amper (A)	(V)	(h)	Color	Weight (gr.)	Min. Order Quantity	Order Code
3P+N+E							
IP 44	16	380 - 415	6	●	185	12	9AP-46516-0415



# CONNECTOR

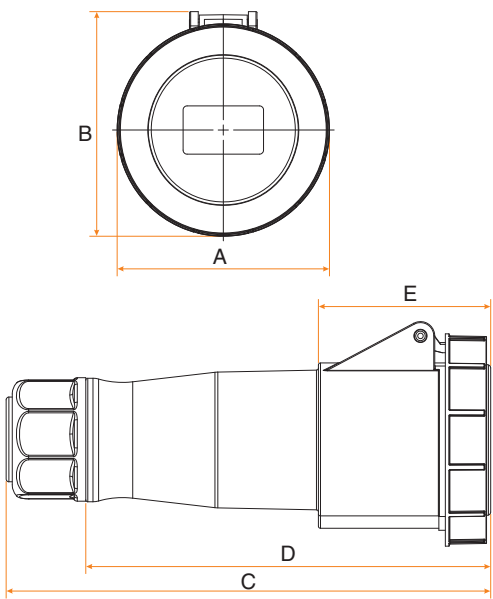


	Amper (A)	Dimensions (mm)				
		A	B	C	D	E
3P+E	16	52	69	152.5	116	51
	16	52	69	152.5	116	51
	32	65	88	233	159	64
3P+E	16	69	85.5	167	128	53
	32	65	88	233	159	64
	63	94	107	238	200	85
3P+N+E	16	65	82.5	166.5	127	48
	32	73	97	230	154	64
	63	94	107	238	200	85



	Amper (A)	(V)	(h)	Color	Weight (gr.)	Min. Order Quantity	Order Code
<b>2P+E</b>							
IP 44	16	110 - 130	4	●	124	12	9CC-44316-0130
	16	200 - 250	6	●	127	12	9CC-46316-0250
	32	200 - 250	6	●	244	12	9CC-46332-0250
<b>3P+E</b>							
IP 44	16	380 - 415	6	●	181	12	9CC-46416-0415
	32	380 - 415	6	●	256	12	9CC-46432-0415
	63	380 - 415	6	●	625	6	9CC-46463-0415
<b>3P+N+E</b>							
IP 44	16	380 - 415	6	●	192	12	9CC-46516-0415
	32	380 - 415	6	●	300	12	9CC-46532-0415
	63	380 - 415	6	●	671	6	9CC-46563-0415

# CONNECTOR WITH LOCKED COVER

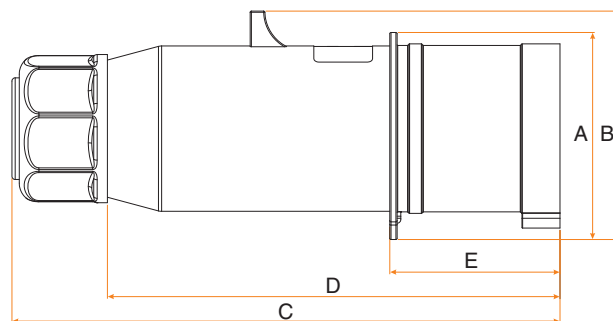


	Amper (A)	Dimensions (mm)				
		A	B	C	D	E
<b>3P+E</b>	16	80	88.5	164	125	50
<b>3P+N+E</b>	63	104	110	237	198	84
	63	104	110	237	198	84



	Amper (A)	(V)	(h)	Color	Weight (gr.)	Min. Order Quantity	Order Code
<b>3P+E</b>							
IP 44	16	380 - 415	6	●	195	12	9CL-46416-0415
<b>3P+E</b>							
IP 67	63	380 - 415	6	●	665	6	9CL-66463-0415
<b>3P+N+E</b>							
IP 67	63	380 - 415	6	●	714	6	9CL-66563-0415

# PLUG

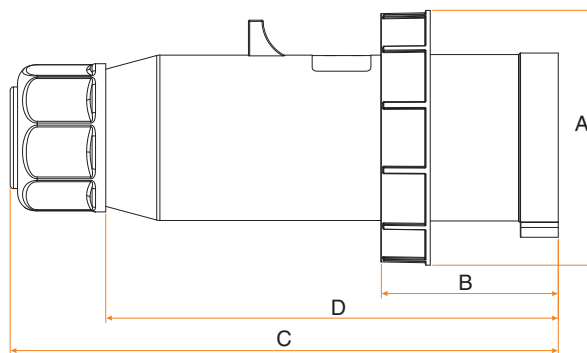


	Amper (A)	Dimensions (mm)				
		A	B	C	D	E
2P+E	16	50	57.5	143.5	107	39
	16	50	57.5	143.5	107	39
	32	70.5	79	215	141	49
3P+E	16	58.5	65	158.5	119	39
	32	70.5	79	215	141	52
	63	78.5	93	224	185	69.5
3P+N+E	16	63	71	156.5	117	39
	32	76.5	82.5	217	141	50
	63	78.5	93	224	185	69.5



	Amper (A)	(V)	(h)	Color	Weight (gr.)	Min. Order Quantity	Order Code
<b>2P+E</b>							
IP 44	16	110 - 130	4	Yellow	106	12	9PF-44316-0130
	16	200 - 250	6	Blue	106	12	9PF-46316-0250
	32	200 - 250	6	Blue	208	12	9PF-46332-0250
<b>3P+E</b>							
IP 44	16	380 - 415	6	Red	141	12	9PF-46416-0415
	32	380 - 415	6	Red	227	12	9PF-46432-0415
	63	380 - 415	6	Red	495	6	9PF-46463-0415
<b>3P+N+E</b>							
IP 44	16	380 - 415	6	Red	155	12	9PF-46516-0415
	32	380 - 415	6	Red	250	12	9PF-46532-0415
	63	380 - 415	6	Red	537	6	9PF-46563-0415

# PLUG WITH LOCK

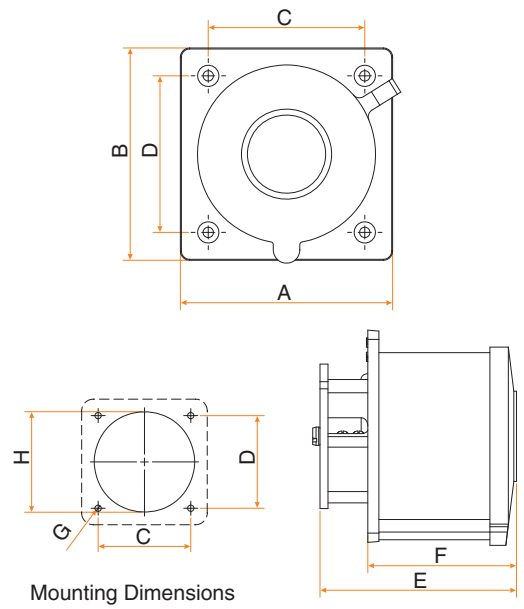


	Amper (A)	Dimensions (mm)			
		A	B	C	D
2P+E	32	90.5	51.5	215	141
	16	80	42.5	158.5	119
3P+E	32	90.5	54.5	215	141
	63	104	72	224	185
	16	87.5	41.5	156.5	117
3P+N+E	32	97	53	218	141
	63	104	72	224	185
	16	87.5	41.5	156.5	117



	Amper (A)	(V)	(h)	Color	Weight (gr.)	Min. Order Quantity	Order Code
<b>2P+E</b>							
IP 44	32	200-250	6	●	237	12	9PL-46332-0250
<b>3P+E</b>							
IP 44	16	380 - 415	6	●	161	12	9PL-46416-0415
	32	380 - 415	6	●	256	12	9PL-46432-0415
<b>3P+N+E</b>							
IP 44	16	380 - 415	6	●	158	12	9PL-46516-0415
	32	380 - 415	6	●	280	12	9PL-46532-0415
<b>3P+E</b>							
IP 67	63	380 - 415	6	●	530	6	9PL-66463-0415
<b>3P+N+E</b>							
IP 67	63	380 - 415	6	●	573	6	9PL-66563-0415

# WALL MOUNTING INLET

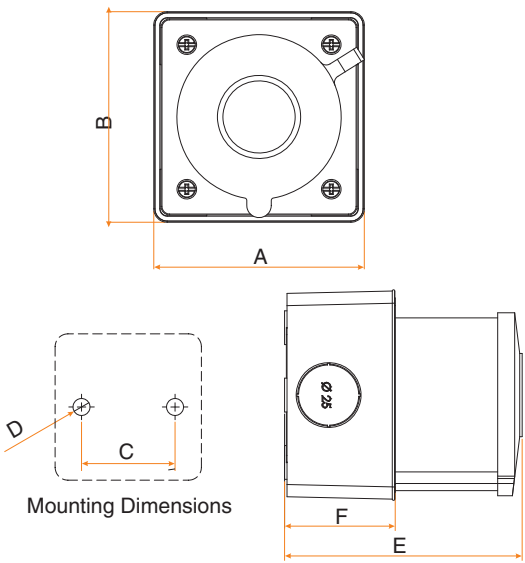


	Amper (A)	Dimensions (mm)							
		A	B	C	D	E	F	G	H
<b>3P+E</b>	32	80	80	59	59	71,5	53,5	4	64
<b>3P+N+E</b>	16	80	80	59	59	57,5	40	4	64
	32	80	80	59	59	74	56	4	64



	Amper (A)	(V)	(h)	Color	Weight (gr.)	Min. Order Quantity	Order Code
<b>3P+E</b>							
IP 44	32	380 - 415	6	●	149	12	9WI-46416-0415
<b>3P+N+E</b>							
IP 44	16	380 - 415	6	●	115	12	9WI-46516-0415
	32	380 - 415	6	●	174	12	9WI-46532-0415

# WALL MOUNTING INLET WITH STRAIGHT BOX

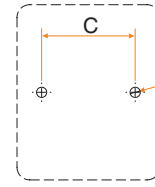
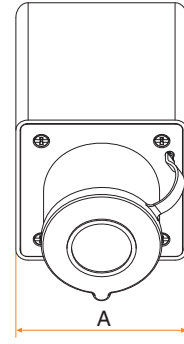


	Amper (A)	Dimensions (mm)					
		A	B	C	D	E	F
3P+E	32	86	86	55	10	94,5	45
3P+N+E	16	86	86	55	10	85	45
	32	86	86	55	10	97	45

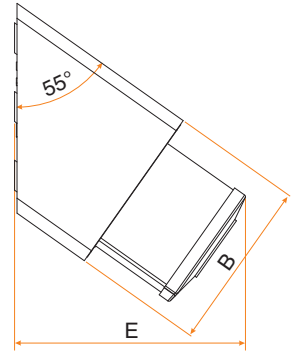


	Amper (A)	(V)	(h)	Color	Weight (gr.)	Min. Order Quantity	Order Code
<b>3P+E</b>							
IP 44	32	380 - 415	6	●	212	12	9WI-46432-S415
<b>3P+N+E</b>							
IP 44	16	380 - 415	6	●	178	12	9WI-46516-S415
	32	380 - 415	6	●	235	12	9WI-46532-S415

# WALL MOUNTING INLET WITH ANGLED BOX



DUVAR MONTALAMA ÖLÇÜLERİ



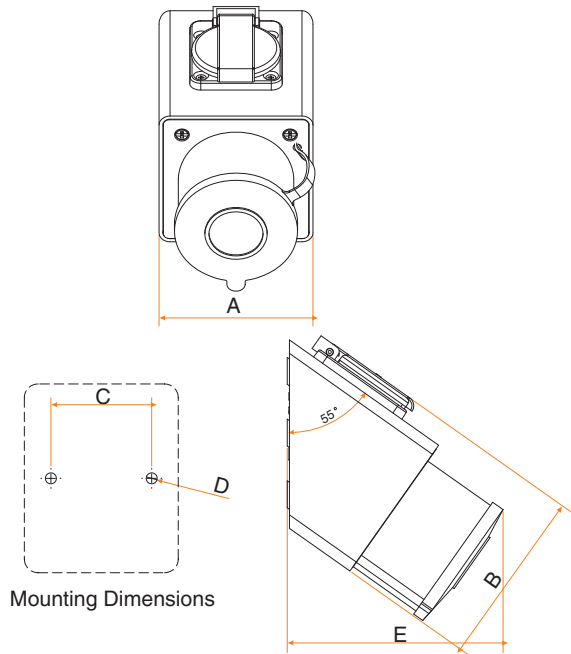
	Amper (A)	Dimensions (mm)				
		A	B	C	D	E
<b>3P+E</b>	32	84	84	55	6	113
<b>3P+N+E</b>	16	84	84	55	6	105,5
	32	84	84	55	6	118



	Amper (A)	(V)	(h)	Color	Weight (gr.)	Min. Order Quantity	Order Code
<b>3P+E</b>							
IP 44	32	380 - 415	6	●	270	12	9WI-46432-A415
<b>3P+N+E</b>							
IP 44	16	380 - 415	6	●	237	12	9WI-46516-A415
	32	380 - 415	6	●	295	12	9WI-46532-A415



# WALL MOUNTING INLET WITH ANGLED BOX + SCHUKO

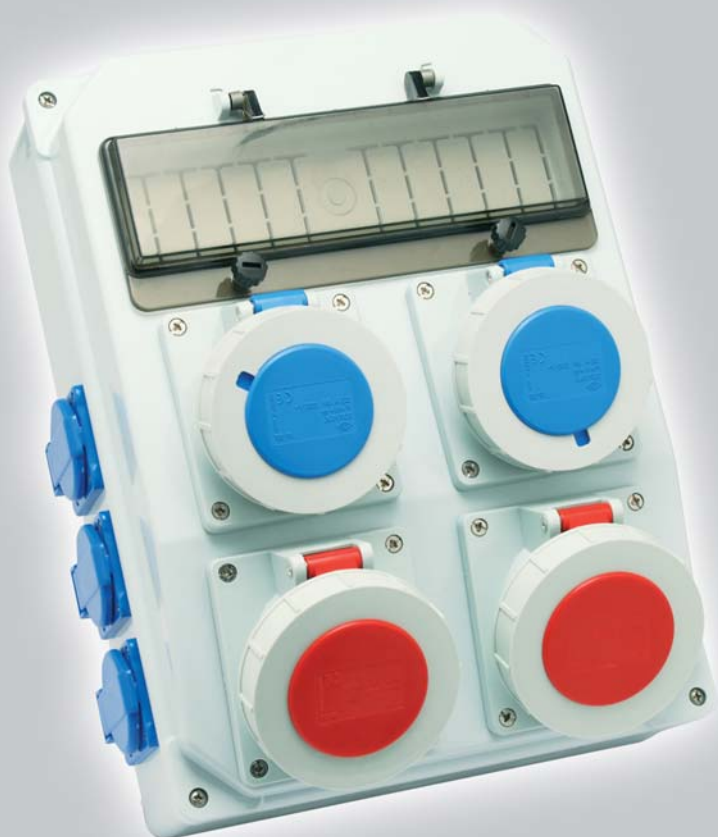


	Amper (A)	Dimensions (mm)				
		A	B	C	D	E
<b>3P+E</b>	32	84	96	55	6	113
<b>3P+N+E</b>	16	84	96	55	6	105,5
	32	84	96	55	6	118



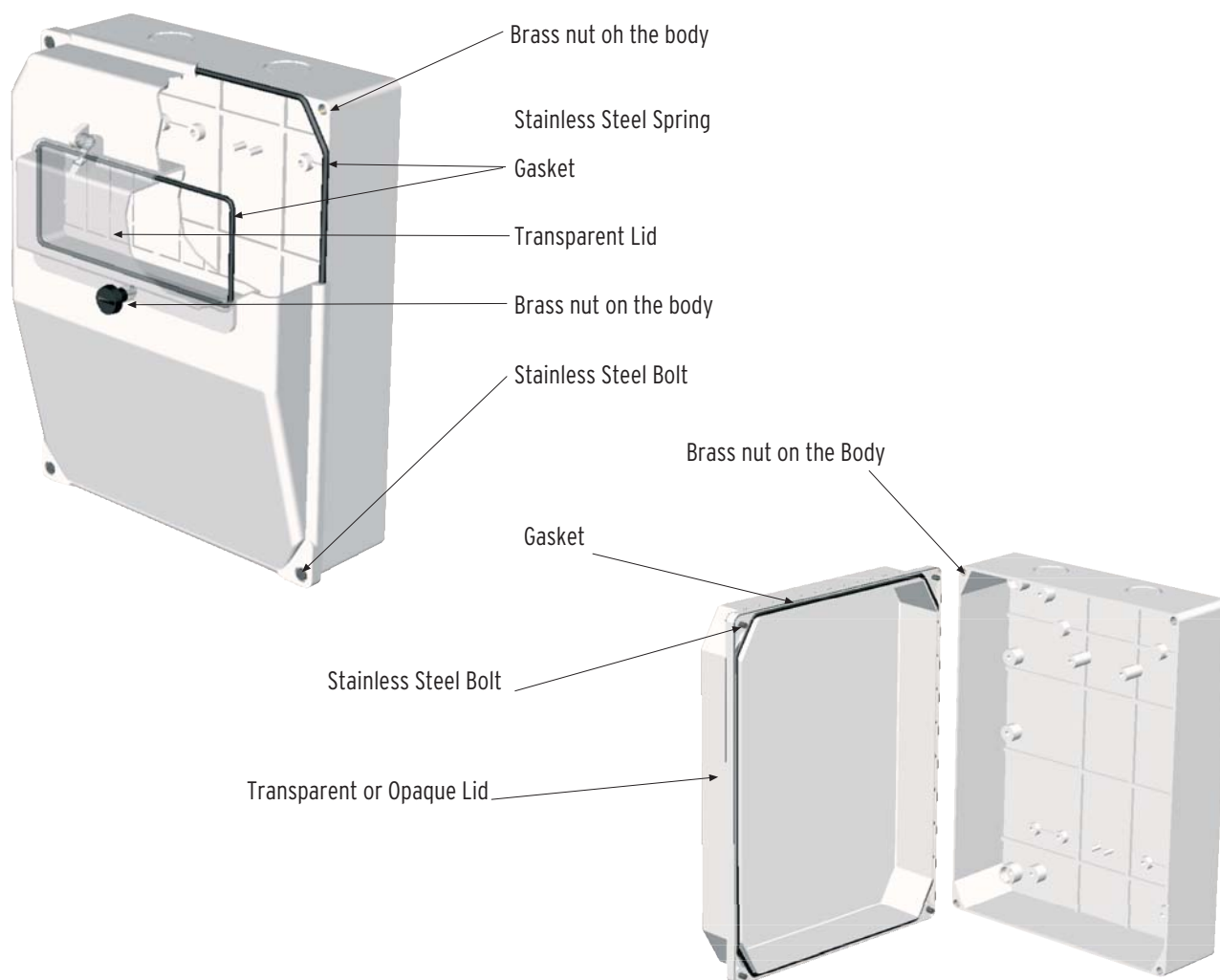
	Amper (A)	(V)	(h)	Color	Weight (gr.)	Min. Order Quantity	Order Code
<b>3P+E</b>							
IP 44	32	380 - 415	6	●	309	12	9WI-46432-S415
<b>3P+N+E</b>							
IP 44	16	380 - 415	6	●	275	12	9WI-46516-S415
	32	380 - 415	6	●	334	12	9WI-46532-S415

# COMBINATION BOXES



Combination Boxes





	Dimension			Thickness	Min. Order Quantity	Width	IP	Installation temperature		Heat resistance level	Standards
	mm			mm		gr.		max	min		
	260	350	115	2 - 3	1	1275	67	-25 °C	+60 °C	V2	IEC 60309-1 IEC 60695-2-1
	210	280	100	2,5 - 3	1	840	67				
	113	210	90	2 - 2,5	3	340	64				
	113	210	70	2 - 2,5	6	305	44				
	210	280	100	2 - 3	1	670	67				

Five different series of combination box chassis is available for several CEE Norm and Schuko sockets. IP protection according to the models. The cover for the MCB part is transparent ve it's spring is from stainless steel. Brass nut on the body and stainless bold is the specialities that protect it's quality. Customizing is available on request.

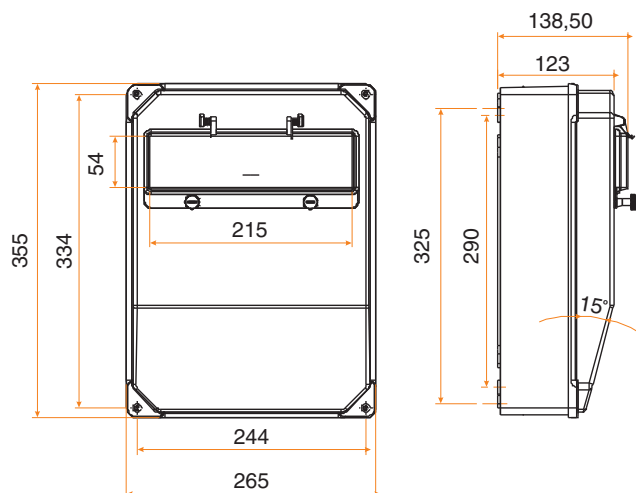
# 26X35 COMBINATION BOXES



## 9CB-C2635-0115

260 x 350 x 115 mm

IP 67



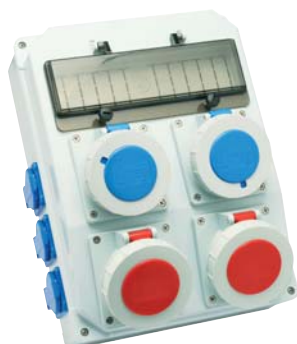
4(4x16A) CEE IP44  
2(1x16A) Schuko IP44



4(4x16A) CEE IP67  
6(1x16A) Schuko IP44



2(5x16A) CEE IP44  
2(5x32A) CEE IP44  
2(1x16A) Schuko IP44



2(3x32A) CEE IP67  
2(5x32A) CEE IP67  
6(1x16A) Schuko IP44



4(5x32A) CEE IP67  
4(1x16A) Schuko IP44



2 x Switch  
2(5x16A) CEE IP67  
6(1x16A) Schuko IP44

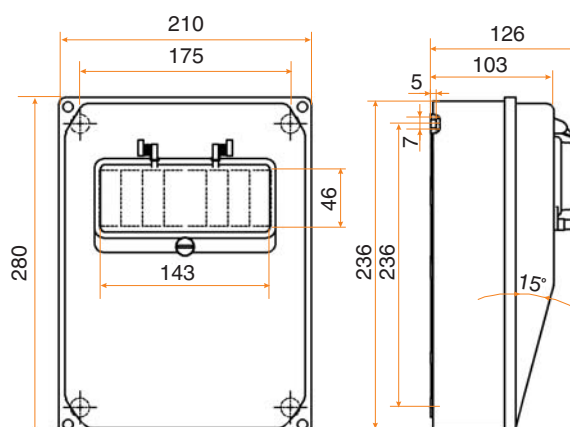
# 21X28 COMBINATION BOXES



**9CB-C2128-0100**

210 x 280 x 100 mm

IP 67



1(4x16A) CEE IP44  
2(1x16A) Schuko IP44



1(5x32A) CEE IP67  
1(4x32A) CEE IP67



1(5x32A) CEE IP67  
4(1x16A) Schuko IP44



2(5x16A) CEE IP44  
2(1x16A) Schuko IP44



2(4x32A) CEE IP44  
2(1x16A) Schuko IP44



2 x Switch

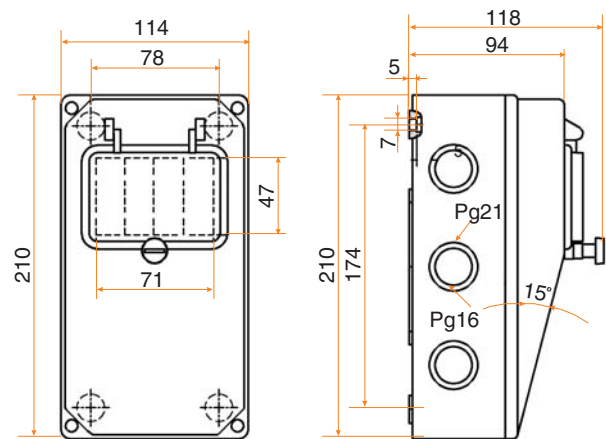
# 11X21 COMBINATION BOXES



**9CB-C1121-0090**

113 x 210 x 90 mm

IP64



2(1x16A) Schuko IP44



1(5x16A) CEE IP44  
1(1x16A) Schuko IP44



1(4x16A) CEE IP67  
1(1x16A) Schuko IP44



1(4x32A) CEE IP44  
2(1x16A) Schuko IP44



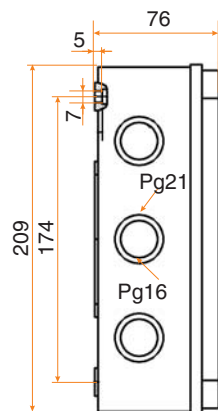
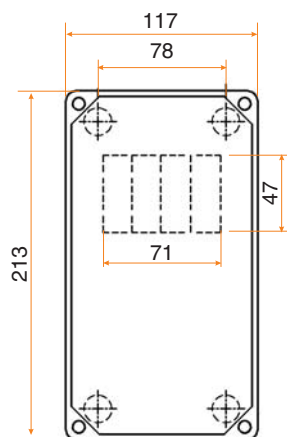
1(5x32A) CEE IP44  
2(1x16A) Schuko IP44



1 x Switch



# 11X21 COVERLESS COMBINATION BOXES



**9CB-01121-0070**  
113 x 210 x 70 mm



**1(3x32A) CEE IP44**  
**2(1x16A) Schuko IP44**



**1(4x16A) CEE IP44**  
**2(1x16A) Schuko IP44**



**1(4x32A) CEE IP44**  
**1(1x16A) Schuko IP44**



**1(5x16A) CEE IP44**



**1(5x32A) CEE IP44**  
**2(1x16A) Schuko IP44**



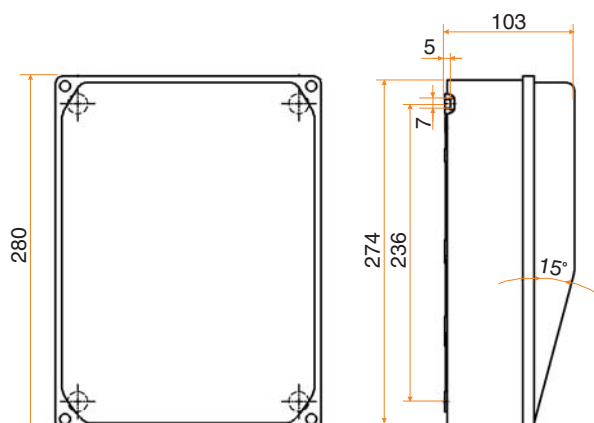
**1 x Switch**



## 21X28 COMBINATION BOXES WITHOUT MCB



**9CB-02128-0100**  
210 x 280 x 100 mm  
IP 67



**4(4x32A) CEE IP67**



**4(5x16A) CEE IP67**



**2(4x16A) CEE IP67  
2(4x32A) CEE IP67  
4(1x16A) Schuko IP44**



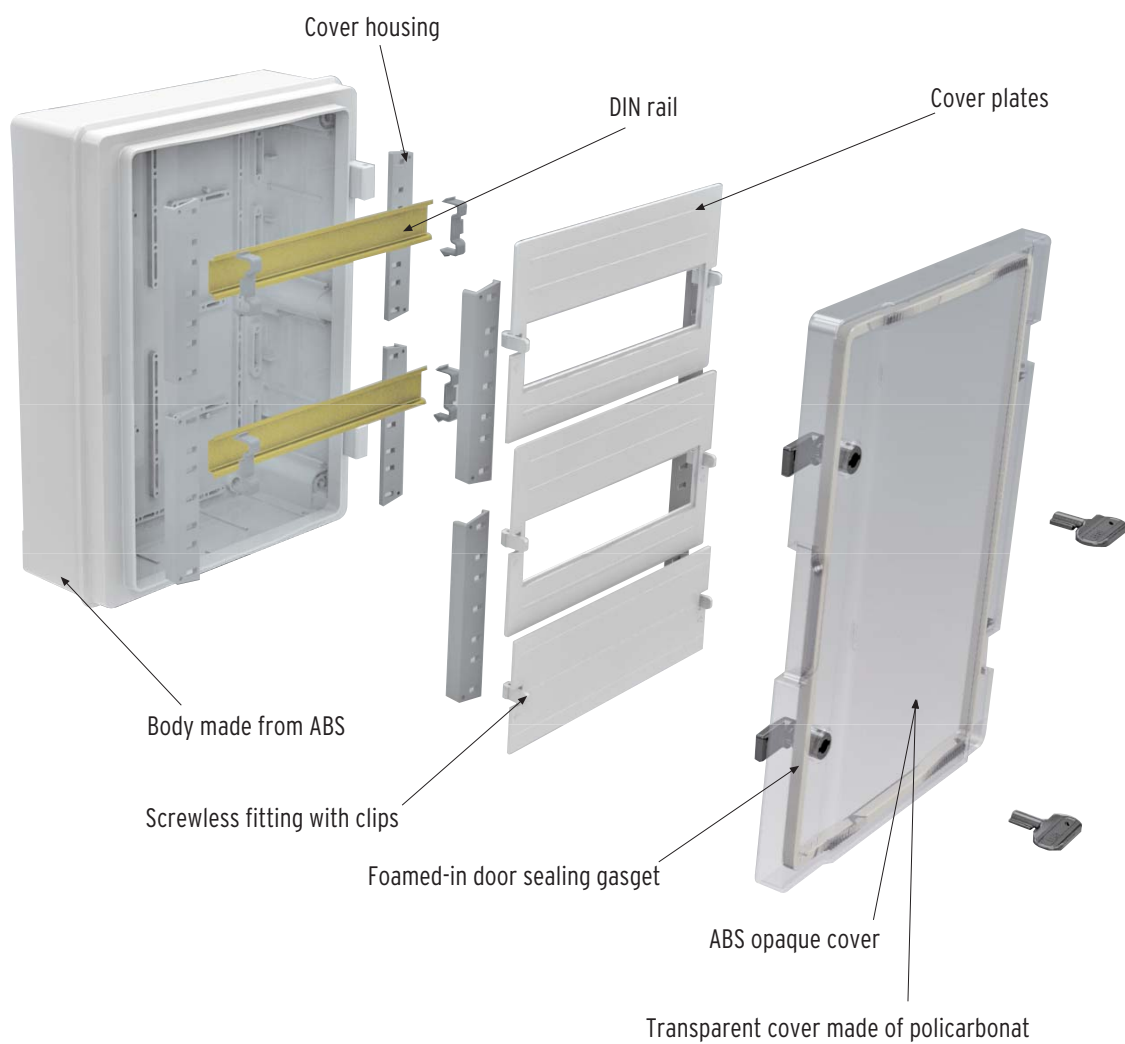
**2(4x16A) CEE IP67  
2(5x32A) CEE IP67  
2(1x16A) Schuko IP44**



**2(4x32A) CEE IP44  
2(5x16A) CEE IP44**



**2 x Switch  
2(5x32A) CEE IP67**



## TECHNICAL DETAILS



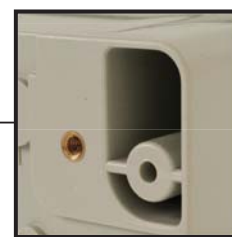
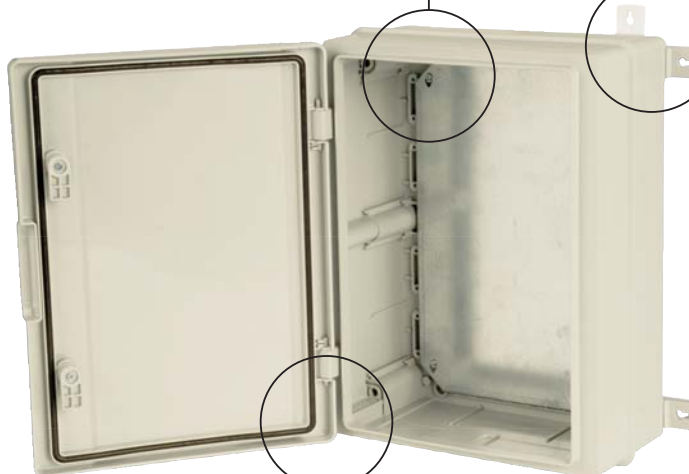
easiness of mounting  
plate fitting



hanger with horizontal  
and vertical options



foamed-in door  
sealing gasket



brass nut on the body

### Specifications

- Ease of carrying and fitting due to his lightness comparing to metal enclosures
- Cover can be opened 210° to left and right
- Wide mouth opening
- Temperature of use: -25 +60°C
- Can be easily cleaned
- Compared to Metal Enclosures it is easier to drill. Once drilled, paint is not damaged and corrosion does not occur.
- Naturally insulated against electric leakage
- IP65

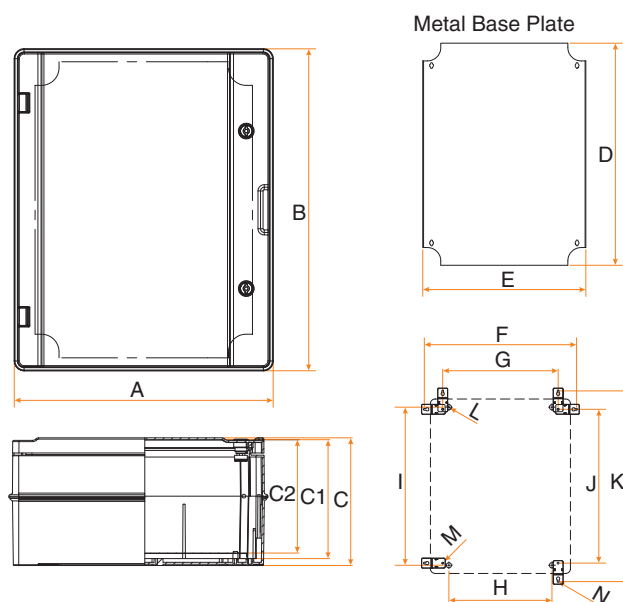
### Sizes

21 x 30 x 13 cm
26 x 35 x 15 cm
30 x 40 x 13 cm
30 x 40 x 17 cm
40 x 50 x 20 cm
40 x 60 x 20 cm
50 x 70 x 25 cm

# DISTRIBUTION BOARD WITH METAL MOUNTING PLATE



C1	Distance between the mounting grills and the metal plate
C2	Distance between the cover and the metal plate
Dimensions to be considered during the mounting	
Vertical mounting with hangers	G - K - N
Horizontal mounting with hangers	F - J - N
Mounting with nuts on the body	G - J - M
Mounting from the inside to the wall	H - I - L

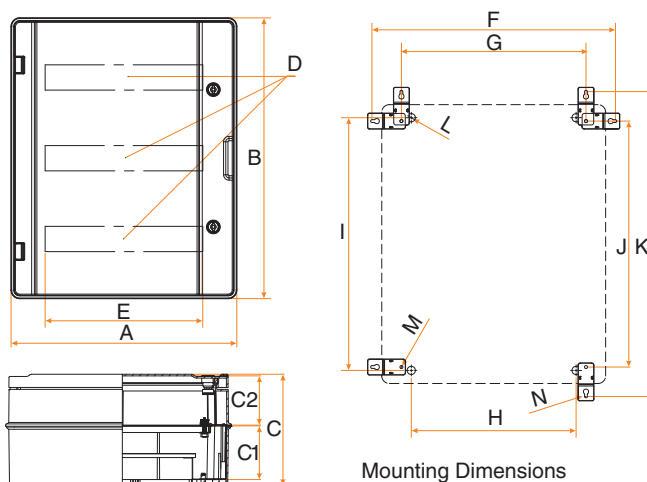


IP65																		
Dimensions	Opaque cover	Transparent cover	A	B	C	C1	C2	D	E	F	G	H	I	J	K	L	M	N
21x30x13 cm	9DB-02130-M013	9DB-T2130-M013	221	311	137	124.5	123.5	270	174.5	253.5	146	118	261	248.5	355.5	15	M5	2.5
26x35x15 cm	9DB-02635-M015	9DB-T2635-M015	265	355	152	138.5	130	315	227	305	198	198	318	291	398	15	M5	2.5
30x40x13 cm	9DB-03040-M013	9DB-T3040-M013	310	410	132	118	116.5	360	245	343	236	200	360	347.5	456	15	M5	2.5
30x40x17 cm	9DB-03040-M017	9DB-T3040-M017	310	410	170	157	150.5	360	245	343	236	200	360	347.5	456	15	M5	2.5
40x50x20 cm	9DB-04050-M020	9DB-T4050-M020	410	510	202	188.5	180	470	345	442	336	300	460	447.5	555	15	M5	2.5
40x60x20 cm	9DB-04060-M020	9DB-T4060-M020	410	610	202	189	179	564	375	442	336	300	560	550	657	15	M5	2.5
50x70x25 cm	9DB-05070-M025	9DB-T5070-M025	511	711	253.5	239.5	230.5	660	472	547	440	410	660	650	757	15	M5	2.5

# DISTRIBUTION BOARD WITH PLATE FOR MCB



C1	Distance between the mounting grills and the cover plate
C2	Distance between the cover and the cover plate
D	Number of line for MCBs
E	Capacity of MCBs per line
O	Total capacity for MCBs
Dimensions to be considered during the mounting	
Vertical mounting with hangers	G - K - N
Horizontal mounting with hangers	F - J - N
Mounting with nuts on the body	G - J - M
Mounting from the inside to the wall	H - I - L

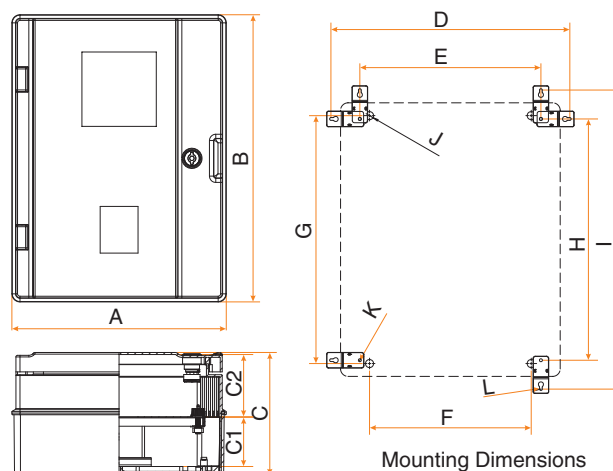


IP65																			
Dimensions	Opaque cover	Transparent cover	A	B	C	C1	C2	D	E	F	G	H	I	J	K	L	M	N	O
21x30x13 cm	9DB-02130-P013	9DB-T2130-P013	221	311	137	72	51.5	2	8	253.5	146	118	261	248.5	355.5	15	M5	2.5	16
26x35x15 cm	9DB-02635-P015	9DB-T2635-P015	265	355	152	47	86	2	9	305	198	198	318	291	398	15	M5	2.5	18
30x40x13 cm	9DB-03040-P013	9DB-T3040-P013	310	410	132	70	44	2	12	343	236	200	360	347.5	456	15	M5	2.5	24
30x40x17 cm	9DB-03040-P017	9DB-T3040-P017	310	410	170	70	83	2	12	343	236	200	360	347.5	456	15	M5	2.5	24
40x50x20 cm	9DB-04050-P020	9DB-T4050-P020	410	510	202	98	90	3	16	442	336	300	460	447.5	555	15	M5	2.5	48
40x60x20 cm	9DB-04060-P020	9DB-T4060-P020	410	610	202	98	90	4	16	442	336	300	560	550	657	15	M5	2.5	64
50x70x25 cm	9DB-05070-P025	9DB-T5070-P025	511	711	254	98	141	5	20	547	440	410	660	650	757	15	M5	2.5	100

# DISTRIBUTION BOARD WITH PLATE FOR SINGLE PHASE ENERGY METER



C1	Distance between the mounting grills and the cover plate
C2	Distance between the cover and the cover plate
M	Total capacity for MCBs
Dimensions to be considered during the mounting	
Vertical mounting with hangers	E - I - L
Horizontal mounting with hangers	D - H - L
Mounting with nuts on the body	E - H - K
Mounting from the inside to the wall	G - F - J

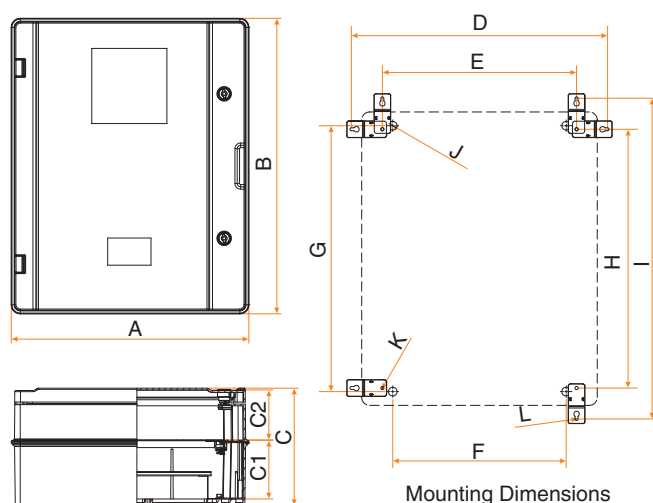


IP65																	
Dimensions	Opaque cover	Transparent cover	A	B	C	C1	C2	D	E	F	G	H	I	J	K	L	M
21x30x13 cm	9DB-02130-1013	9DB-T2130-1013	221	311	137	72	51.5	253.5	146	118	261	248.5	355.5	15	M5	2.5	3
26x35x15 cm	9DB-02635-1015	9DB-T2635-1015	265	355	152	61	77	305	198	198	318	291	398	15	M5	2.5	4
30x40x13 cm	9DB-03040-1013	9DB-T3040-1013	310	410	132	70	44	343	236	200	360	347.5	456	15	M5	2.5	15
30x40x17 cm	9DB-03040-1017	9DB-T3040-1017	310	410	170	70	66	343	236	200	360	347.5	456	15	M5	2.5	15

# DISTRIBUTION BOARD WITH PLATE FOR THREE PHASE ENERGY METER



C1	Distance between the mounting grills and the metal plate
C2	Distance between the cover and the metal plate
M	Total capacity for MCBs
Dimensions to be considered during the mounting	
Vertical mounting with hangers	E - I - L
Horizontal mounting with hangers	D - H - L
Mounting with nuts on the body	E - H - K
Mounting from the inside to the wall	G - F - J



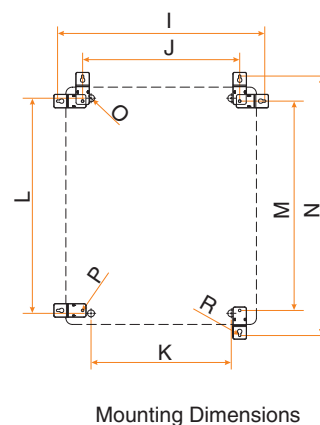
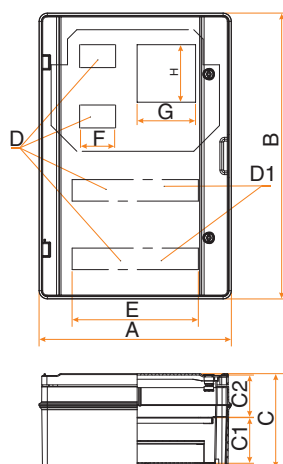
IP65																	
Dimensions	Opaque cover	Transparent cover	A	B	C	C1	C2	D	E	F	G	H	I	J	K	L	M
30x40x13 cm	9DB-03040-3013	9DB-T3040-3013	310	410	132	70	43	343	236	200	360	348	456	15	M5	2.5	8
30x40x17 cm	9DB-03040-3017	9DB-T3040-3017	310	410	170	70	66	343	236	200	360	348	456	15	M5	2.5	8
40x50x20 cm	9DB-03050-3020	9DB-T3050-3020	410	510	202	98	90	442	336	300	460	448	555	15	M5	2.5	8
40x60x20 cm	9DB-03060-3020	9DB-T3060-3020	410	610	202	98	90	442	336	300	560	550	657	15	M5	2.5	8
50x70x25 cm	9DB-05070-3025	9DB-T5070-3025	511	711	253.5	98	140	547	440	410	660	650	757	15	M5	2.5	8



# DISTRIBUTION BOARD WITH PLATE FOR THREE PHASE ENERGY METER and MCB



D	Number of lines for MCB - 1
D1	Number of lines for MCB - 2
E	MCB capacity of the line
F	MCB capacity of the line
C1	Distance between the mounting grills and the cover plate
C2	Distance between the cover and the cover plate
S	Total capacity for MCBs
Dimensions to be considered during the mounting	
Vertical mounting with hangers	J - N - R
Horizontal mounting with hangers	I - M - R
Mounting with nuts on the body	J - M - P
Mounting from the inside to the wall	K - L - O



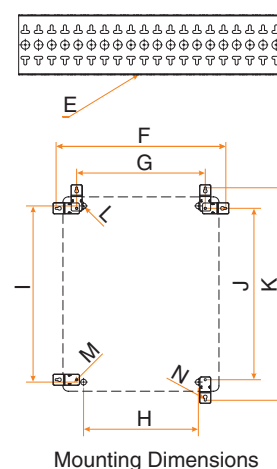
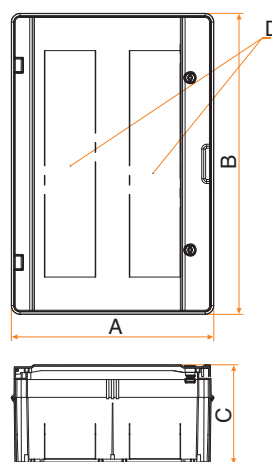
Mounting Dimensions

IP65			A	B	C	C1	C2	D	D1	E	F	G	H	I	J	K	L	M	N	O	P	R	S
Dimensions	Opaque cover	Transparent cover																					
40x50x20 cm	9DB-04050-M120	9DB-T4050-M120	410	510	202	98	90	3	1	16	4	125	123	442	336	300	460	447.5	555	15	M5	2.5	24
40x60x20 cm	9DB-04060-M120	9DB-T4060-M120	410	610	202	98	90	4	2	16	4	125	123	442	336	300	560	550	657	15	M5	2.5	40
50x70x25 cm	9DB-05070-M125	9DB-T5070-M125	511	711	254	98	140	5	3	20	4	125	123	547	440	410	660	650	757	15	M5	2.5	68

# OUTDOOR DISTRIBUTION BOARD FOR TELEPHONE MODULES



C1	Distance between the mounting grills and the cover plate
C2	Distance between the cover and the cover plate
D	Number of chasis for reglet
E	Total capacity of reglets
Dimensions to be considered during the mounting	
Vertical mounting with hangers	G - K - N
Horizontal mounting with hangers	F - J - N
Mounting with nuts on the body	G - J - M
Mounting from the inside to the wall	H - I - L



Mounting Dimensions

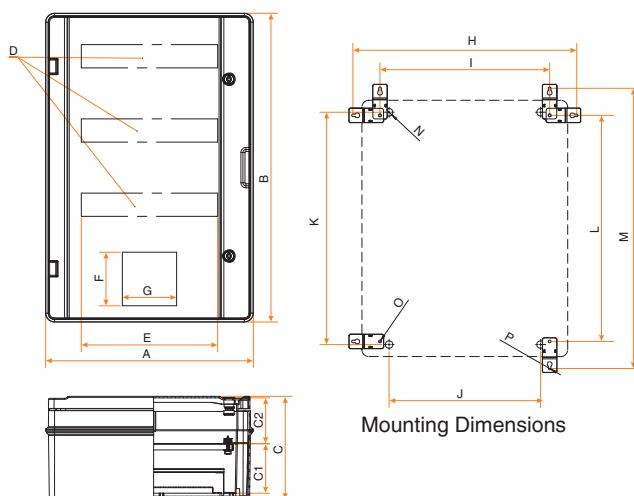
IP65																
Dimensions	Opaque cover	Transparent cover	A	B	C	D	E	F	G	H	I	J	K	L	M	N
21x30x13 cm	9D□-02130-B013	9D□-T2130-B013	221	311	137	3	30	253.5	146	118	261	248.5	355.5	15	M5	2.5
26x35x15 cm	9D□-02635-B015	9D□-T2635-B015	265	355	152	5	50	305	198	198	318	291	398	15	M5	2.5
30x40x13 cm	9D□-03040-B013	9D□-T3040-B013	310	410	132	10	100	343	236	200	360	347.5	456	15	M5	2.5
30x40x17 cm	9D□-03040-B017	9D□-T3040-B017	310	410	170	10	100	343	236	200	360	347.5	456	15	M5	2.5
40x50x20 cm	9D□-02130-B020	9D□-T2130-B020	410	510	202	30	150	442	336	300	460	447.5	555	15	M5	2.5
40x50x20 cm	9D□-04050-B020	9D□-T4050-B020	410	510	202	30	200	442	336	300	460	447.5	555	15	M5	2.5
40x50x20 cm	9D□-04050-B020	9D□-T4050-B020	410	510	202	30	300	442	336	300	460	447.5	555	15	M5	2.5
40x60x20 cm	9D□-04060-B020	9D□-T4060-B020	410	610	202	40	400	442	336	300	560	550	657	15	M5	2.5
50x70x25 cm	9D□-05070-B025	9D□-T5070-B025	511	711	253.5	50	500	547	440	410	660	650	757	15	M5	2.5

□ = 1 empty  
 2 with chasis  
 3 with chasis + reglet

## DISTRIBUTION BOARD WITH PLATE FOR COMPACT SWITCH



C1	Distance between the mounting grills and the cover plate
C2	Distance between the cover and the cover plate
D	Number of line
E	MCB capacity of the line
F	Hole of switch height
G	Hole of switch width
R	Total capacity for MCBs
Dimensions to be considered during the mounting	
Vertical mounting with hangers	I - M - P
Horizontal mounting with hangers	H - L - P
Mounting with nuts on the body	I - L - O
Mounting from the inside to the wall	K - J - N

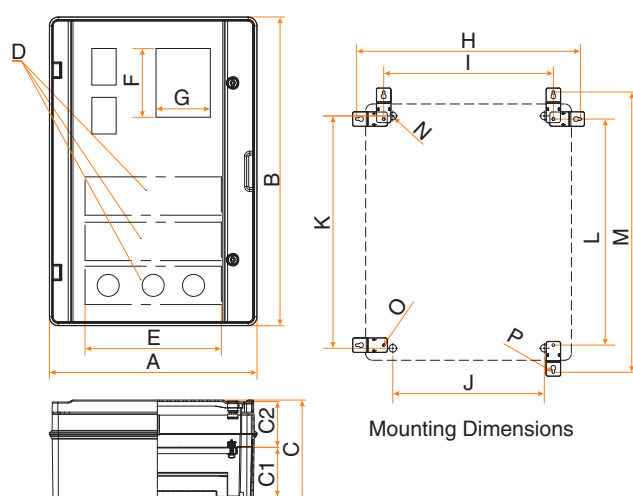


IP65																						
dimension	Opaque cover	Transparent cover	A	B	C	C1	C2	D	E	F	G	H	I	J	K	L	M	N	O	P	R	
40x50x20 cm	9DB-04050-C020	9DB-T4050-C020	410	510	202	98	90	2	16	105	105	444	336	300	460	448	555	12	M5	2.5	32	
40x60x20 cm	9DB-04060-C020	9DB-T4060-C020	410	610	202	98	90	3	16	105	105	442	336	300	560	550	657	15	M5	2.5	48	
50x70x25 cm	9DB-05070-C025	9DB-T5070-C025	511	711	253.5	98	141	4	20	105	105	547	440	410	660	650	757	15	M5	2.5	80	

# DISTRIBUTION BOARD FOR CONSTRUCTION SITE



C1	Distance between the mounting grills and the cover plate
C2	Distance between the cover and the cover plate
D	Number of line
E	MCB capacity of the line
F	Hole of meter height
G	Hole of meter width
Dimensions to be considered during the mounting	
Vertical mounting with hangers	I - M - P
Horizontal mounting with hangers	H - L - P
Mounting with nuts on the body	I - L - O
Mounting from the inside to the wall	K - J - N

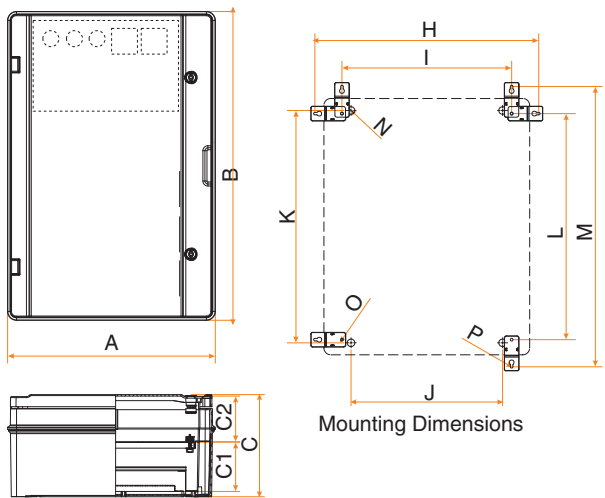


IP65																				
Dimensions	Opaque cover	Transparent cover	A	B	C	C1	C2	D	E	F	G	H	I	J	K	L	M	N	O	P
40x60x20 cm	9DB-04060-S020	9DB-T4060-S020	410	610	202	98	90	1	16	123	125	442	336	336	560	550	657	15	M5	2.5
50x70x25 cm	9DB-05070-S025	9DB-T5070-S025	511	711	254	98	140	2	40	123	125	547	440	440	660	650	757	15	M5	2.5
50x70x25 cm	9DB-05070-S125	9DB-T5070-S125	511	711	254	98	140	1	20	123	125	547	440	440	660	650	757	15	M5	2.5

# DISTRIBUTION BOARD FOR WATER PUMP



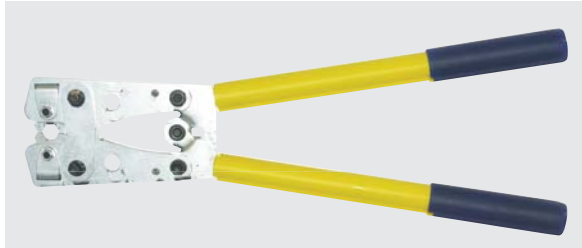
C1	Distance between the mounting grills and the cover plate
C2	Distance between the cover and the cover plate
Dimensions to be considered during the mounting	
Vertical mounting with hangers	I - M - P
Horizontal mounting with hangers	H - L - P
Mounting with nuts on the body	I - L - O
Mounting from the inside to the wall	K - J - N



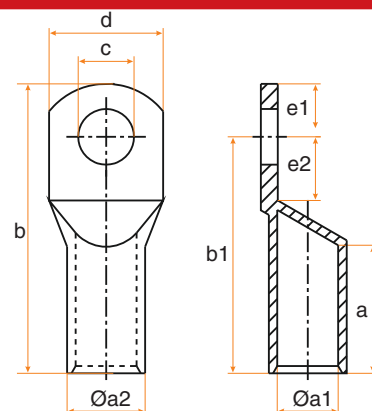
Dimensions	Opaque cover	Transparent cover	A	B	C	C1	C2	H	I	J	K	L	M	N	O	P
40x50x20 cm	9DB-04050-P120	9DB-T4050-P120	410	510	202	98	90	444	336	300	460	448	555	12	M5	2.5
40x60x20 cm	9DB-04060-P120	9DB-T4060-P120	410	610	202	98	90	442	336	300	460	560	657	12	M5	2.5
50x70x25 cm	9DB-05070-P125	9DB-T5070-P125	511	711	254	98	140	547	440	410	660	650	757	15	M5	2.5

# CABLE LUGS and TOOLS

## Cable Lugs and Tools



# Cable Lugs (FCL0)



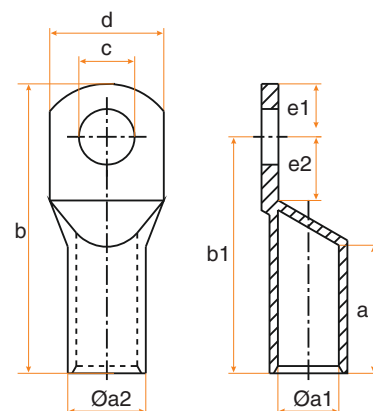
28

Cross-Section mm <sup>2</sup>	Bolt Ø	Dimensions (mm)									Package Weight (~kg)	Package Amount	Order Code
		a	a1	a2	b	b1	c	d	e1	e2			
10	M5	5,5	4,7	6,6	27,5	22,0	10,0	10,3	5,5	7,0	2,8	800	9CL-01005-S000
10	M6	6,5	4,7	6,6	27,5	22,0	10,0	10,3	5,5	7,0	2,6	800	9CL-01006-S000
10	M8	8,5	4,7	6,6	30,5	23,7	10,0	13,5	6,8	8,7	2,8	800	9CL-01008-S000
16	M5	5,5	5,6	7,8	29,5	24,0	12,0	11,2	5,5	6,5	2,6	500	9CL-01605-S000
16	M6	6,5	5,6	7,8	29,5	24,0	12,0	11,2	5,5	6,5	2,7	500	9CL-01606-S000
16	M8	8,5	5,6	7,8	33,0	26,2	12,0	13,5	6,8	8,7	2,9	500	9CL-01608-S000
16	M10	10,5	5,6	7,8	33,5	26,0	12,0	16,0	7,5	8,5	2,9	500	9CL-01610-S000
25	M6	6,5	7,1	9,5	39,0	32,2	16,0	13,7	6,8	9,2	3,0	300	9CL-02506-S000
25	M8	8,5	7,1	9,5	39,0	32,2	16,0	13,7	6,8	9,2	2,7	300	9CL-02508-S000
25	M10	10,5	7,1	9,5	42,0	34,0	16,0	16,0	8,0	11,0	2,9	300	9CL-02510-S000
25	M12	13,0	7,1	9,5	45,0	35,0	16,0	18,0	10,0	12,0	2,9	300	9CL-02512-S000
35	M6	6,5	8,2	10,8	44,0	35,7	19,0	15,3	8,3	9,7	2,8	200	9CL-03506-S000
35	M8	8,5	8,2	10,8	44,0	35,7	19,0	15,3	8,3	9,7	2,8	200	9CL-03508-S000
35	M10	10,5	8,2	10,8	48,0	38,0	19,0	15,7	10,0	12,0	2,8	200	9CL-03510-S000
35	M12	13,0	8,2	10,8	48,0	38,0	19,0	18,0	10,0	12,0	2,8	200	9CL-03512-S000
50	M6	6,5	10,1	13,0	47,5	39,2	21,0	18,9	8,3	9,7	3,0	150	9CL-05006-S000
50	M8	8,5	10,1	13,0	47,5	39,2	21,0	18,9	8,3	9,7	3,1	150	9CL-05008-S000
50	M10	10,5	10,1	13,0	51,5	41,5	21,0	18,9	10,0	12,0	3,3	150	9CL-05010-S000
50	M12	13,0	10,1	13,0	51,5	41,5	21,0	18,9	10,0	12,0	3,1	150	9CL-05012-S000
50	M14	15,0	10,1	13,0	56,5	44,5	21,0	22,0	12,0	15,0	3,3	150	9CL-05014-S000
70	M8	8,5	11,5	14,7	50,6	42,3	23,0	21,1	8,3	9,7	2,8	100	9CL-07008-S000
70	M10	10,5	11,5	14,7	54,6	44,6	23,0	21,1	10,0	12,0	3,0	100	9CL-07010-S000
70	M12	13,0	11,5	14,7	54,6	44,6	23,0	21,1	10,0	12,0	2,8	100	9CL-07012-S000
70	M14	15,0	11,5	14,7	62,6	47,6	23,0	21,5	15,0	15,0	3,4	100	9CL-07014-S000
70	M16	17,0	11,5	14,7	62,6	47,6	23,0	21,5	15,0	15,0	3,2	100	9CL-07016-S000
95	M8	8,5	13,5	16,7	58,8	48,8	26,0	24,7	10,0	12,0	3,0	80	9CL-09508-S000
95	M10	10,5	13,5	16,7	58,8	48,8	26,0	24,7	10,0	12,0	3,0	80	9CL-09510-S000
95	M12	13,0	13,5	16,7	58,8	48,8	26,0	24,7	10,0	12,0	2,9	80	9CL-09512-S000
95	M14	15,0	13,5	16,7	66,8	51,8	26,0	24,7	15,0	15,0	3,2	80	9CL-09514-S000
95	M16	17,0	13,5	16,7	66,8	51,8	26,0	24,7	15,0	15,0	3,1	80	9CL-09516-S000
120	M10	10,5	15,6	19,0	69,0	56,0	29,0	27,7	13,0	14,5	2,7	50	9CL-01210-S000
120	M12	13,0	15,6	19,0	69,0	56,0	29,0	27,7	13,0	14,5	2,6	50	9CL-01212-S000
120	M14	15,0	15,6	19,0	69,0	56,0	29,0	27,7	13,0	14,5	2,5	50	9CL-01214-S000
120	M16	17,0	15,6	19,0	69,0	56,0	29,0	27,7	13,0	14,5	2,4	50	9CL-01216-S000
120	M20	21,0	15,6	19,0	69,0	56,0	29,0	27,7	13,0	14,5	2,1	50	9CL-01220-S000

\* The cable lugs for which the cross sections are written with bold letters are standard production. Please ask the stock quantity for the other cross sections.



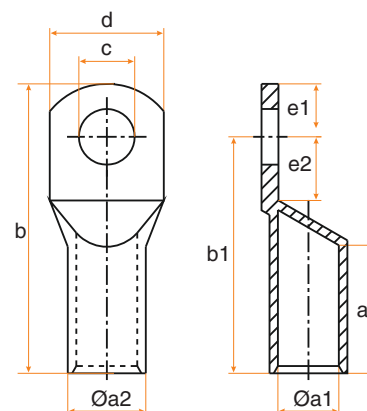
# Cable Lugs (FCL0)



Cross-Section mm²	Bolt Ø	Dimensions (mm)										Package Weight (~kg)	Package Amount	Order Code
		a	a1	a2	b	b1	c	d	e1	e2				
150	M10	10,5	16,5	21,0	76,5	60,0	30,0	30,4	16,5	16,5	2,6	30	9CL-01510-S000	
150	M12	13,0	16,5	21,0	76,5	60,0	30,0	30,4	16,5	16,5	2,5	30	9CL-01512-S000	
150	M14	15,0	16,5	21,0	76,5	60,0	30,0	30,4	16,5	16,5	2,4	30	9CL-01514-S000	
150	M16	17,0	16,5	21,0	76,5	60,0	30,0	30,4	16,5	16,5	2,4	30	9CL-01516-S000	
185	M10	10,5	18,4	23,0	82,5	65,5	33,0	34,2	17,0	18,0	3,0	30	9CL-01810-S000	
185	M12	13,0	18,4	23,0	82,5	65,5	33,0	34,2	17,0	18,0	3,0	30	9CL-01812-S000	
185	M14	15,0	18,4	23,0	82,5	65,5	33,0	34,2	17,0	18,0	2,9	30	9CL-01814-S000	
185	M16	17,0	18,4	23,0	82,5	65,5	33,0	34,2	17,0	18,0	2,9	30	9CL-01816-S000	
240	M10	10,5	21,0	26,0	89,0	72,0	38,0	38,7	17,0	18,0	3,7	25	9CL-02410-S000	
240	M12	13,0	21,0	26,0	89,0	72,0	38,0	38,7	17,0	18,0	3,7	25	9CL-02412-S000	
240	M14	15,0	21,0	26,0	89,0	72,0	38,0	38,7	17,0	18,0	3,7	25	9CL-02414-S000	
240	M16	17,0	21,0	26,0	89,0	72,0	38,0	38,7	17,0	18,0	3,6	25	9CL-02416-S000	
300	M12	13,0	23,4	28,6	95,0	77,0	41,0	42,6	18,0	18,0	3,5	20	9CL-02412-S000	
300	M14	15,0	23,4	28,6	95,0	77,0	41,0	42,6	18,0	18,0	3,4	20	9CL-02414-S000	
300	M16	17,0	23,4	28,6	95,0	77,0	41,0	42,6	18,0	18,0	3,2	20	9CL-02416-S000	
400	M12	13,0	26,8	32,8	108,2	88,2	48,0	48,3	20,0	20,0	3,4	12	9CL-04012-S000	
400	M16	17,0	26,8	32,8	108,2	88,2	48,0	48,3	20,0	20,0	3,4	12	9CL-04014-S000	
400	M20	21,0	26,8	32,8	108,2	88,2	48,0	48,3	20,0	20,0	3,4	12	9CL-04016-S000	
500	M16	17,0	29,8	38,4	115,5	93,0	48,0	54,9	22,5	22,5	3,4	8	9CL-05016-S000	
500	M20	21,0	29,8	38,4	115,5	93,0	48,0	54,9	22,5	22,5	3,4	8	9CL-05020-S000	
600	M20	21,0	34,5	44,0	133,1	110,1	61,0	63,0	23,0	23,0	4,2	6	9CL-06020-S000	

\* The cable lugs for which the cross sections are written with bold letters are standard production. Please ask the stock quantity for the other cross sections.

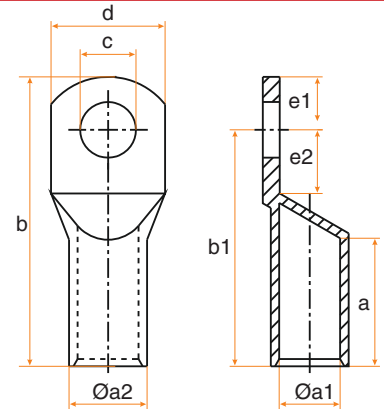
# Cable Lugs (FCL1)



Cross-Section mm²	Bolt Ø	Dimensions (mm)										Package Weight (~kg)	Package Amount	Order Code
		a	a1	a2	b	b1	c	d	e1	e2				
10	M5	5,5	4,5	7,0	28,5	22,0	10,0	12,0	6,5	7,5	3,0	600	9CL-01005-S100	
10	M6	6,5	4,5	7,0	28,5	22,0	10,0	12,0	6,5	7,5	3,0	600	9CL-01006-S100	
10	M8	8,5	4,5	7,0	35,0	25,0	10,0	15,0	10,0	10,0	3,6	600	9CL-01008-S100	
10	M10	10,5	4,5	7,0	39,0	27,0	10,0	17,0	12,0	12,0	3,8	600	9CL-01010-S100	
16	M6	6,5	5,5	8,5	33,25	27,0	13,0	12,0	6,25	7,5	3,5	400	9CL-01606-S100	
16	M8	8,5	5,5	8,5	37,5	29,0	13,0	15,0	8,5	9,5	3,9	400	9CL-01608-S100	
16	M10	10,5	5,5	8,5	41,5	31,0	13,0	17,0	10,5	11,5	3,9	400	9CL-01610-S100	
25	M5	5,5	7,0	10,0	37,5	30,0	15,0	14,0	7,5	7,5	3,3	250	9CL-02505-S100	
25	M6	6,5	7,0	10,0	37,5	30,0	15,0	14,0	7,5	7,5	3,3	250	9CL-02506-S100	
25	M8	8,5	7,0	10,0	42,0	32,0	15,0	16,0	10,0	10,0	3,3	250	9CL-02508-S100	
25	M10	10,5	7,0	10,0	46,0	34,0	15,0	18,0	12,0	12,0	3,5	250	9CL-02510-S100	
25	M12	13,0	7,0	10,0	48,0	35,0	15,0	19,0	13,0	13,0	3,6	250	9CL-02512-S100	
35	M6	6,5	8,5	12,0	39,5	32,0	17,0	17,0	7,5	7,5	2,9	150	9CL-03506-S100	
35	M8	8,5	8,5	12,0	44,0	34,0	17,0	17,0	10,0	10,0	2,9	150	9CL-03508-S100	
35	M10	10,5	8,5	12,0	49,0	37,0	17,0	19,0	12,0	12,0	3,2	150	9CL-03510-S100	
35	M12	13,0	8,5	12,0	51,0	38,0	17,0	21,0	13,0	13,0	3,0	150	9CL-03512-S100	
50	M6	6,5	10,0	14,0	47,0	37,0	19,0	20,0	10,0	10,0	3,8	120	9CL-05006-S100	
50	M8	8,5	10,0	14,0	47,0	37,0	19,0	20,0	10,0	10,0	3,8	120	9CL-05008-S100	
50	M10	10,5	10,0	14,0	51,0	39,0	19,0	20,0	12,0	12,0	3,7	120	9CL-05010-S100	
50	M12	13,0	10,0	14,0	56,0	43,0	19,0	23,0	13,0	13,0	3,6	120	9CL-05012-S100	
50	M14	15,0	10,0	14,0	59,5	45,0	19,0	23,0	14,5	14,5	3,6	120	9CL-05014-S100	
50	M16	17,0	10,0	14,0	62,0	46,0	19,0	28,0	16,0	16,0	3,5	120	9CL-05016-S100	
70	M8	8,5	12,0	16,5	53,0	43,0	21,0	23,0	10,0	10,0	3,5	80	9CL-07008-S100	
70	M10	10,5	12,0	16,5	56,0	44,0	21,0	23,0	12,0	12,0	3,4	80	9CL-07010-S100	
70	M12	13,0	12,0	16,5	59,0	46,0	21,0	23,0	13,0	13,0	3,8	80	9CL-07012-S100	
70	M14	15,0	12,0	16,5	62,5	48,0	21,0	23,0	14,5	14,5	3,8	80	9CL-07014-S100	
95	M8	8,5	13,5	18,0	60,0	48,0	25,0	26,0	12,0	12,0	3,5	60	9CL-09508-S100	
95	M10	10,5	13,5	18,0	60,0	48,0	25,0	26,0	12,0	12,0	3,4	60	9CL-09510-S100	
95	M12	13,0	13,5	18,0	62,0	49,0	25,0	26,0	13,0	13,0	3,2	60	9CL-09512-S100	
95	M14	15,0	13,5	18,0	65,5	51,0	25,0	26,0	14,5	14,5	3,3	60	9CL-09514-S100	
95	M16	17,0	13,5	18,0	70,0	54,0	25,0	28,0	16,0	16,0	3,2	60	9CL-09516-S100	
120	M8	8,5	15,0	19,5	65,0	51,0	26,0	28,0	14,0	14,0	3,1	50	9CL-01208-S100	
120	M10	10,5	15,0	19,5	65,0	51,0	26,0	28,0	14,0	14,0	3,1	50	9CL-01210-S100	
120	M12	13,0	15,0	19,5	65,0	51,0	26,0	28,0	14,0	14,0	3,1	50	9CL-01212-S100	
120	M14	15,0	15,0	19,5	67,0	52,0	26,0	28,0	15,0	15,0	3,0	50	9CL-01214-S100	
120	M16	17,0	15,0	19,5	70,0	54,0	26,0	30,0	16,0	16,0	3,0	50	9CL-01216-S100	

\* The cable lugs for which the cross sections are written with bold letters are standard production. Please ask the stock quantity for the other cross sections.

# Cable Lugs (FCL1)

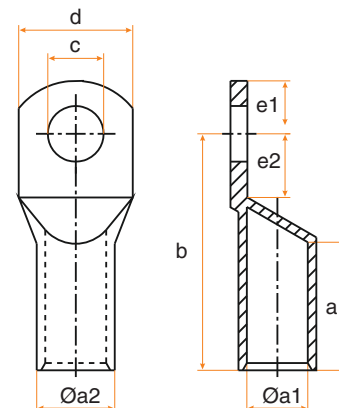


Cross-Section mm²	Bolt Ø	Dimensions (mm)										Package Weight (~kg)	Package Amount	Order Code
		a	a1	a2	b	b1	c	d	e1	e2				
150	M8	8,5	16,5	21,0	70,0	56,0	30,0	31,0	14,0	14,0	2,4	30	9CL-01508-S100	
150	M10	10,5	16,5	21,0	70,0	56,0	30,0	31,0	14,0	14,0	2,4	30	9CL-01510-S100	
150	M12	13,0	16,5	21,0	72,0	57,0	30,0	31,0	15,0	15,0	2,3	30	9CL-01512-S100	
150	M14	15,0	16,5	21,0	72,0	57,0	30,0	31,0	15,0	15,0	2,3	30	9CL-01514-S100	
150	M16	17,0	16,5	21,0	74,0	58,0	30,0	31,0	16,0	16,0	2,4	30	9CL-01516-S100	
185	M10	10,5	19,0	24,0	83,0	65,0	30,0	35,0	18,0	18,0	2,9	25	9CL-01810-S100	
185	M12	13,0	19,0	24,0	83,0	65,0	30,0	35,0	18,0	18,0	2,9	25	9CL-01812-S100	
185	M14	15,0	19,0	24,0	83,0	65,0	30,0	35,0	18,0	18,0	2,9	25	9CL-01814-S100	
185	M16	17,0	19,0	24,0	83,0	65,0	30,0	35,0	18,0	18,0	2,9	25	9CL-01816-S100	
240	M10	10,5	21,0	26,0	93,5	72,0	35,0	39,0	21,5	19,0	3,7	25	9CL-02410-S100	
240	M12	13,0	21,0	26,0	93,5	72,0	35,0	39,0	21,5	19,0	3,7	25	9CL-02412-S100	
240	M14	15,0	21,0	26,0	93,5	72,0	35,0	39,0	21,5	19,0	3,7	25	9CL-02414-S100	
240	M16	17,0	21,0	26,0	93,5	72,0	35,0	39,0	21,5	19,0	3,6	25	9CL-02416-S100	
240	M20	21,0	21,0	26,0	93,5	72,0	35,0	39,0	21,5	19,0	3,4	25	9CL-02420-S100	

\* The cable lugs for which the cross sections are written with bold letters are standard production. Please ask the stock quantity for the other cross sections.

Note: The 45°C  and 90°C  angle cable lugs are available P.S. you welcome to send inquiries.

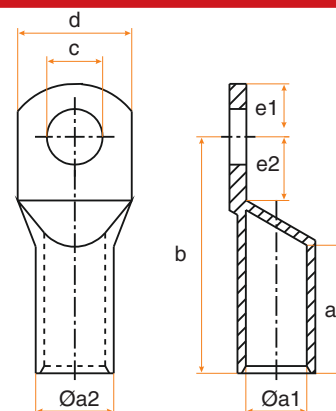
# DIN 46235 Type Compression Type Cable Lugs



Cross-Section mm <sup>2</sup>	Bolt Ø	Dimensions (mm)								Package Weight (~kg)	Package Amount	Order Code
		a	a1	a2	b1	c	d	e1	e2			
10	M5	5,3	4,5	6,0	27,0	10,0	9,0	7,0	8,5	1,6	500	9CL-01005-D100
10	M6	6,4	4,5	6,0	27,0	10,0	9,0	7,5	8,5	1,6	500	9CL-01006-D100
16	M6	6,4	5,5	8,5	36,0	20,0	13,0	7,5	8,0	3,0	250	9CL-01606-D100
16	M8	8,4	5,5	8,5	36,0	20,0	13,0	10,0	10,0	3,3	250	9CL-01608-D100
16	M10	10,5	5,5	8,5	36,0	20,0	17,0	12,0	12,0	3,2	250	9CL-01610-D100
25	M6	6,4	7,0	10,0	38,0	20,0	14,0	7,5	8,0	2,9	200	9CL-02506-D100
25	M8	8,4	7,0	10,0	38,0	20,0	16,0	10,0	10,0	3,0	200	9CL-02508-D100
25	M10	10,5	7,0	10,0	38,0	20,0	17,0	12,0	12,0	3,2	200	9CL-02510-D100
25	M12	13,0	7,0	10,0	38,0	20,0	19,0	13,0	13,0	3,2	200	9CL-02512-D100
35	M8	8,4	8,2	12,5	42,0	20,0	17,0	10,0	10,0	3,5	120	9CL-03508-D100
35	M10	10,5	8,2	12,5	42,0	20,0	19,0	12,0	12,0	3,5	120	9CL-03510-D100
35	M12	13,0	8,2	12,5	42,0	20,0	21,0	13,0	13,0	3,6	120	9CL-03512-D100
50	M8	8,4	10,0	14,5	52,0	28,0	20,0	10,0	10,0	2,9	65	9CL-05008-D100
50	M10	10,5	10,0	14,5	52,0	28,0	22,0	12,0	12,0	3,0	65	9CL-05010-D100
50	M12	13,0	10,0	14,5	52,0	28,0	24,0	13,0	13,0	2,9	65	9CL-05012-D100
50	M16	17,0	10,0	14,5	52,0	28,0	28,0	16,0	16,0	2,9	65	9CL-05016-D100
70	M8	8,4	11,5	16,5	55,0	28,0	24,0	10,0	10,0	2,9	50	9CL-07008-D100
70	M10	10,5	11,5	16,5	55,0	28,0	24,0	12,0	12,0	3,0	50	9CL-07010-D100
70	M12	13,0	11,5	16,5	55,0	28,0	24,0	13,0	13,0	3,0	50	9CL-07012-D100
70	M16	17,0	11,5	16,5	55,0	28,0	30,0	16,0	16,0	3,2	50	9CL-07016-D100
95	M10	10,5	13,5	19,0	65,0	35,0	28,0	12,0	12,0	2,7	30	9CL-09510-D100
95	M12	13,0	13,5	19,0	65,0	35,0	28,0	13,0	13,0	2,7	30	9CL-09512-D100
95	M16	17,0	13,5	19,0	65,0	35,0	32,0	16,0	16,0	2,8	30	9CL-09516-D100
120	M10	10,5	15,5	21,0	70,0	35,0	32,0	15,0	16,0	2,9	25	9CL-01210-D100
120	M12	13,0	15,5	21,0	70,0	35,0	32,0	16,0	17,0	2,9	25	9CL-01212-D100
120	M16	17,0	15,5	21,0	70,0	35,0	32,0	19,0	20,0	2,9	25	9CL-01216-D100
120	M20	21,0	15,5	21,0	70,0	35,0	38,0	21,0	22,0	2,9	25	9CL-01220-D100
150	M10	10,5	17,0	23,5	78,0	35,0	34,0	15,0	16,0	3,2	20	9CL-01510-D100
150	M12	13,0	17,0	23,5	78,0	35,0	34,0	16,0	17,0	3,1	20	9CL-01512-D100
150	M16	17,0	17,0	23,5	78,0	35,0	34,0	19,0	20,0	3,4	20	9CL-01516-D100
150	M20	21,0	17,0	23,5	78,0	35,0	40,0	21,0	22,0	3,4	20	9CL-01520-D100
185	M10	10,5	19,0	25,5	82,0	40,0	37,0	15,0	16,0	2,9	15	9CL-01810-D100
185	M12	13,0	19,0	25,5	82,0	40,0	37,0	16,0	17,0	2,8	15	9CL-01812-D100
185	M16	17,0	19,0	25,5	82,0	40,0	37,0	19,0	20,0	3,0	15	9CL-01816-D100
185	M20	21,0	19,0	25,5	82,0	40,0	40,0	21,0	22,0	3,1	15	9CL-01820-D100

\* The cable lugs for which the cross sections are written with bold letters are standard production. Please ask the stock quantity for the other cross sections.

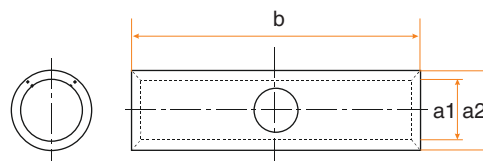
# DIN 46235 Type Compression Type Cable Lugs



Cross-Section mm <sup>2</sup>	Bolt Ø	Dimensions (mm)								Package Weight (~kg)	Package Amount	Order Code
		a	a1	a2	b	c	d	e1	e2			
240	M12	13,0	21,5	29,0	92,0	40,0	42,0	16,0	17,0	2,7	10	9CL-02412-D100
240	M16	17,0	21,5	29,0	92,0	40,0	42,0	19,0	20,0	2,8	10	9CL-02416-D100
240	M20	21,0	21,5	29,0	92,0	40,0	45,0	21,0	22,0	2,9	10	9CL-02420-D100
300	M16	17,0	24,5	32,0	100,0	50,0	48,0	19,0	22,0	3,4	10	9CL-03016-D100
300	M20	21,0	24,5	32,0	100,0	50,0	48,0	22,0	22,0	3,4	10	9CL-03020-D100
400	M16	17,0	27,5	38,5	115,0	70,0	55,0	25,0	25,0	5,3	8	9CL-04016-D100
400	M20	21,0	27,5	38,5	115,0	70,0	55,0	25,0	25,0	5,4	8	9CL-04020-D100
500	M20	21,0	31,0	42,0	125,0	70,0	60,0	25,0	25,0	-	4	9CL-05020-D100
625	M20	21,0	34,5	44,0	135,0	80,0	60,0	25,0	25,0	-	4	9CL-06220-D100

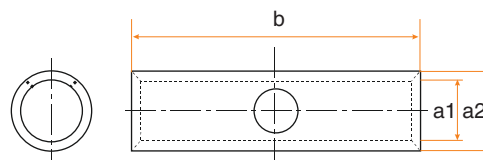
\* The cable lugs for which the cross sections are written with bold letters are standard production. Please ask the stock quantity for the other cross sections.

## Standard Type Butt-connector



Cross-Section mm <sup>2</sup>	Dimensions (mm)			Package Weight (~kg)	Package Amount	Order Code
	a1	a2	b			
6	3,8	5,5	27,0	2,3	800	9BC-00006-S000
10	4,7	6,6	27,5	2,5	600	9BC-00010-S000
16	5,6	7,8	29,5	2,5	400	9BC-00016-S000
25	7,1	9,5	39,0	2,8	250	9BC-00025-S000
35	8,2	10,8	44,0	2,3	150	9BC-00035-S000
50	10,1	13,0	51,5	2,3	90	9BC-00050-S000
70	11,5	14,7	54,6	2,2	65	9BC-00070-S000
95	13,5	16,7	58,8	2,1	50	9BC-00095-S000
120	15,6	19,0	69,0	2,4	40	9BC-00120-S000
150	16,5	21,0	76,5	2,3	25	9BC-00150-S000
185	18,4	23,0	82,5	2,5	22	9BC-00185-S000
240	21,0	26,0	89,0	2,9	18	9BC-00240-S000
300	23,4	28,6	95,0	2,0	10	9BC-00300-S000
400	26,8	32,8	108,2	-	-	9BC-00400-S000
500	29,8	38,4	115,5	-	-	9BC-00500-S000
600	34,5	44,0	133,1	-	-	9BC-00600-S000


## DIN 46267 Type Butt-connector




Cross-Section mm <sup>2</sup>	Dimensions (mm)			Package Weight (~kg)	Package Amount	Order Code
	a1	a2	b			
10	4,5	6,0	34,0	0,60	300	9BC-00010-D000
16	5,5	8,5	43,5	2,80	200	9BC-00016-D000
25	7,0	10,0	48,0	2,70	150	9BC-00025-D000
35	8,2	12,5	54,0	3,00	100	9BC-00035-D000
50	10,0	14,5	64,0	2,60	60	9BC-00050-D000
70	11,5	16,5	67,0	2,69	50	9BC-00070-D000
95	13,5	19,0	78,0	2,64	30	9BC-00095-D000
120	15,5	21,0	86,0	2,44	25	9BC-00120-D000
150	17,0	23,5	78,0	2,80	20	9BC-00150-D000
185	19,0	25,5	101,0	2,52	15	9BC-00185-D000
240	21,5	29,0	108,0	2,40	10	9BC-00240-D000
300	24,5	32,0	119,0	-	-	9BC-00300-D000
400	27,5	38,5	140,0	-	-	9BC-00400-D000
500	31,0	42,0	150,0	-	-	9BC-00500-D000
625	34,5	44,0	160,0	-	-	9BC-00625-D000

## Crimping Tools - Mechanical Crimpers




Crimping Form	Crimping Range (mm <sup>2</sup> )	Length (mm)	Weight (kg.)	Order Code
	10,00 - 120,00	400	4,600	9CT-00120-0000
* 10/120 - 16/95 - 25/70 and 35/50 in the form of back and front. Makes a star-shaped crimping. * Handles are of steel pipes. * Grips are plastic insulated * Supplied with plastic carrying case.				




Crimping Form	Crimping Range (mm <sup>2</sup> )	Length (mm)	Weight (kg.)	Order Code
	10,00 - 300,00	600	7,400	9CT-00300-0000
* 10/300 - 16/240 - 25/185 - 35/150 - 50/120 and 70/95 in the form of back and front. * Custom design aluminum arms can be extended and are adjustable. * Makes a star-shaped crimping. - Grips are plastic insulated. * Supplied with plastic carrying case.				




Crimping Form	Crimping Range (mm <sup>2</sup> )	Length (mm)	Weight (kg.)	Order Code
	6,00 - 50,00	390	1,100	9CT-00500-0000
- Presses STANDARD cable lugs from 6,00-50,00 mm <sup>2</sup> - Makes hexagonal crimping and with revolving Dies - Grips are plastic insulated				



Crimping Form	Crimping Range (mm <sup>2</sup> )	Length (mm)	Weight (kg.)	Order Code
	10,00 - 120,00	650	2,900	9CT-01120 -0000
* Presses STANDARD cable lugs from 10,00 - 120,00 mm . * Makes hexagonal crimping and with revolving Dies. * Grips are plastic insulated.				



Crimping Form	Crimping Range (mm <sup>2</sup> )	Length (mm)	Weight (kg.)	Order Code
	25,00 - 150,00	650	2,900	9CT-00150-0000
* Presses STANDARD cable lugs from 25,00 - 150,00 mm . * Makes hexagonal crimping and with revolving Dies. * Grips are plastic insulated.				

## Hydraulic Crimping Tools and Heads - Hydraulic Tools



Crimping Range (mm <sup>2</sup> )	Crimping Force (kN)	Stroke (mm)	Length (mm)	Weight (kg.)	Order Code
10,00 - 240,00	60	13	365	2,950	9CT-00240-0000
Crimper, Plastic carrying case, full die set Hydraulic Tools (Body) HEXAGONAL VERTICAL CRIMPING DIE SET 10/185, 16/150, 25/120, 35/95, 50/70, 240 mm <sup>2</sup>					



Crimping Range (mm <sup>2</sup> )	Crimping Force (kN)	Stroke (mm)	Length (mm)	Weight (kg.)	Order Code
16,00 - 400,00	130	38	545	5,360	9CT-00400-0000
Crimper, Plastic carrying case, full die set Hydraulic Tools (Body) HEXAGONAL BIG CRIMPING DIE SET 16, 25, 35, 50, 70, 95, 120, 150, 185, 240, 300, 400 mm <sup>2</sup>					



## Copper Cable Cutters - Mechanic Cutters



Max. Cross Section (mm <sup>2</sup> )	Length (mm)	Weight (kg.)	Order Code
95 or 4x16	410	0,750	9MC-95000-0000

- Cuts NYA-NYY and NYM copper and aluminum cables
- Handles are of steel pipes.
- Grips are plastic insulated.



Max. Cross Section (mm <sup>2</sup> )	Length (mm)	Weight (kg.)	Order Code
240 or 3x35+10	650	2,000	9MC-24000-0000

- Cuts NYA-NYY and NYM copper and aluminum cables
- Handles are of steel pipes.
- Grips are plastic insulated.



Max. Cross Section (mm <sup>2</sup> )	Length (mm)	Weight (kg.)	Order Code
325 or 3x70+35	650	2,000	9MC-32500-0000

- Cuts NYA-NYY and NYM copper and aluminum cables
- Aluminum tattoo sleeves.
- Grips are plastic insulated.



Max. Cross Section (mm <sup>2</sup> )	Length (mm)	Weight (kg.)	Order Code
500 or 3x120+70	800	2,930	9MC-50000-0000

- \* Cuts NYA-NYY and NYM copper and aluminum cables
- \* Aluminum tattoo sleeves.
- \* Grips are plastic insulated.

## Cable Cutters - Mechanic Cutters (Cuts steel reinforced aluminum conductors)



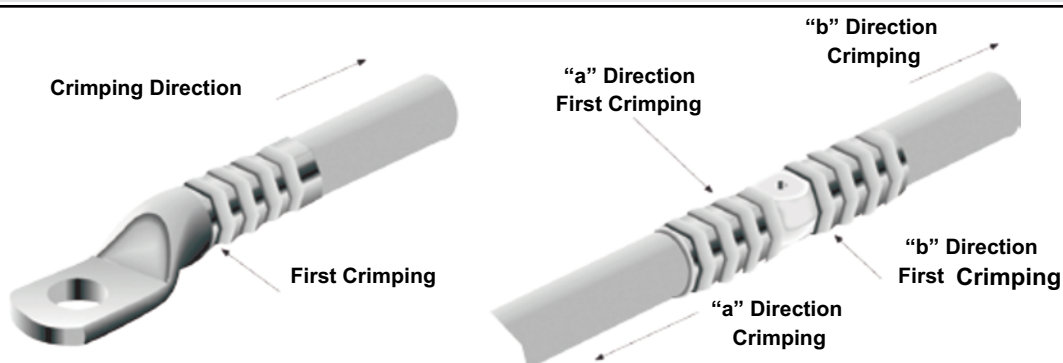
Maksimum Diameter (Ø)	Length (mm)	Weight (kg.)	Order Code
20	590	2,000	9MC-16000-A000

- \* Cuts steel reinforced aluminum conductors up to a maximum diameter of 20mm.
- \* Blades are hardened steel.
- \* Aluminum tattoo sleeves.
- \* Grips are plastic insulated.

## Characteristics

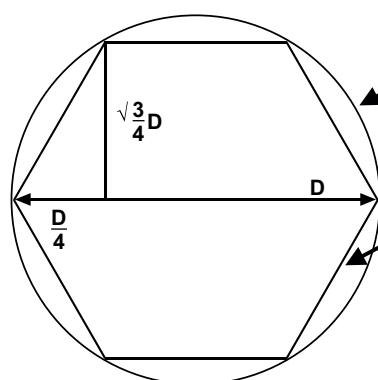
Canada Standard Code Name	TS Code AL / Steel	AWG Size CIRC. / MILS	Diameters and Wire Numbers					Cross-Section			Nomina Breakin Load	Theoretical Weight
			Total Ø	Aluminum		Steel		Total	Aluminum	Steel		
	Number			Diameter Ø	Number	Diameter Ø	mm²					
	mm²		mm	No	mm	No	mm					
Swan	21/4	4	6,36	6	2,12	1	2,12	24,71	21,18	3,53	830	85
Swallow	27/4	3	7,14	6	2,38	1	2,38	31,14	26,69	4,45	1025	108
Sparrow	34/6	2	8,01	6	2,67	1	2,67	39,19	33,59	5,6	1265	136
Robin	45/7	88,22	9,24	6	3,08	1	3,08	52,15	44,7	7,45	1575	179
Raven	54/9	1/0	10,11	6	3,37	1	3,37	62,44	53,52	8,92	1925	216
Pigeon	85/14	3/0	12,75	6	4,25	1	4,25	99,3	85,12	14,18	3035	344
Partridge	135/22	266,8	16,28	26	2,57	7	2	156,86	134,87	21,99	5100	549
Ostrich	152/25	300	17,28	26	2,73	7	2,12	176,9	152,19	24,71	5730	619
Hawk	242/39	477	21,8	26	3,44	7	2,67	280,84	241,65	39,19	8800	985
Drake	403/65	795	28,11	26	4,44	7	3,45	468	402,56	65,44	14100	1638
Condor	402/52	795	27,72	54	3,08	7	3,08	454,48	402,33	52,15	12900	1520
Rail	483/34	954	29,58	45	3,7	7	2,47	517	483,4	33,6	12200	1605
Cardinal	485/63	954	30,42	54	3,38	7	3,38	547	484,2	62,8	15500	1830
Pheasant	645/82	1.272.000	35,1	54	3,9	19	2,34	726,79	645,08	81,71	19700	2425

## Crimping Cable Lugs and Connectors



- 1- Entering the conductor wires to the bare tip of the clear according to the depth.
- 2- Fully insert the conductor into cable lug or connector.
- 3- Crimp with the appropriate tool and the directions given above.

## Rate Reduction



**Before Crimping** D : Lug or connector outside diameter = Distance of the dies vertex

$$\text{Area before crimping} = \frac{\pi}{4} D^2$$











$$\text{Area after crimping} = \frac{3}{8} \sqrt{3} D^2$$

$$\text{Crimping rate} = \frac{\frac{3}{8} \sqrt{3} D^2}{\frac{\pi}{4} D^2} = 0,827$$

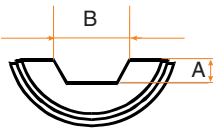
## Recommended Number of Crimping

		6	10	16	25	35	50	70	95	120	150	185	240	300	400	500
Standard	Narrow Die	1	1	1	2	2	2	2	2	2	2	2	4	4	4	-
	Width Die	-	-	1	1	1	1	1	1	1	1	1	2	2	2	-
DIN 46 235	Narrow Die	2	2	2	2	2	3	3	4	4	4	4	5	-	-	-
	Width Die	-	-	1	1	1	1	1	2	2	2	2	2	2	3	3

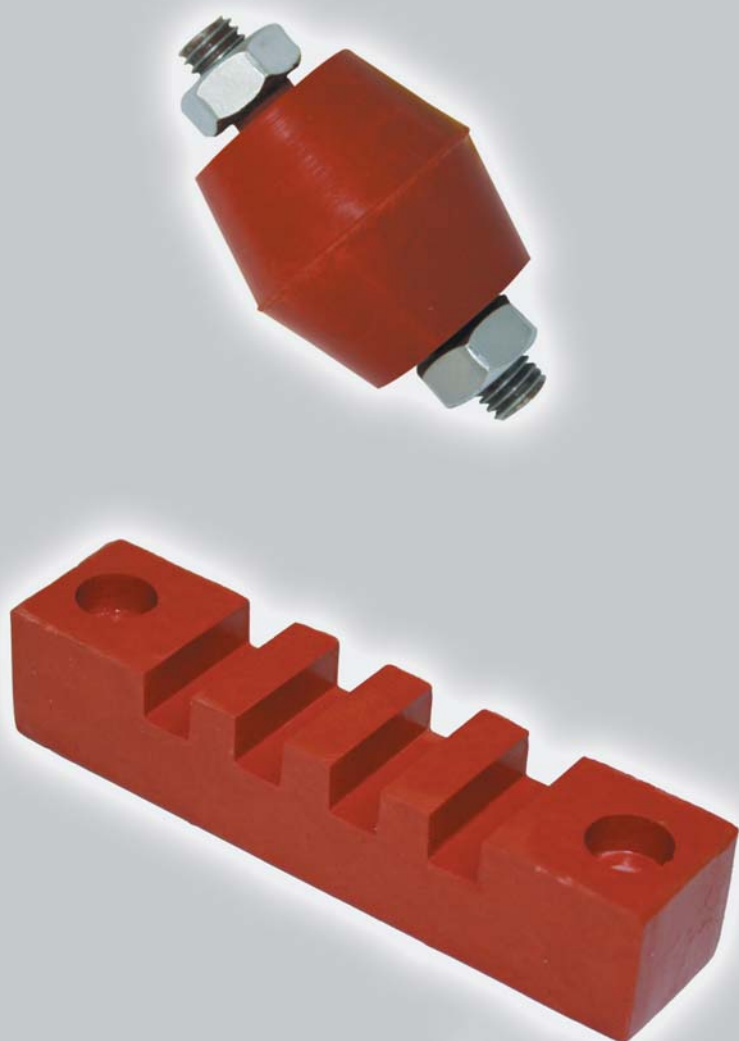
## Crimping Type

	<b>Hexagonal Crimping</b> standard SKP and connectors, DIN 46 235 cable lugs appropriate, suitable 4 6 267 Butt Connectors, Butt Connectors and aluminum cable lugs. Application Range : 6...1000mm <sup>2</sup>
	<b>Point Crimping</b> standard cable lug and connectors, cable ends according to DIN 46 234 norm and needle-type cable ends (DIN 46 230), insulated cable ends nickel cable lugs and connectors. Application Range : 0.75...400mm <sup>2</sup>
	<b>Oval Crimping</b> Insulated cable terminals, ICI fittings, clamp-type insulated cable lugs and connectors, pin type insulated cable ends and Butt connectors according to DIN 48217, crimping terminations, insulated cable connectors. Application Range: 0.1...185mm <sup>2</sup>
	<b>Point Crimping</b> standard cable lugs and connectors, thin and multi-core cable lugs. Application Range : 6...400mm <sup>2</sup>
	<b>Dual-Point Crimping</b> standard cable lugs and connectors, nickel cable lugs and connectors. Application Range : 4...95mm <sup>2</sup>
	<b>Trapezoid Crimping</b> insulated, non-insulated and double-entry cord-end sleeves. Application Range: 0,14...185mm <sup>2</sup>
	<b>Point Crimping</b> insulated, non-insulated and double-entry cord-end sleeves. Application Range: 0.5...35mm <sup>2</sup>
	<b>Square Crimping</b> insulated, non-insulated and double-entry cord-end sleeves. Application Range: 0.14...6mm <sup>2</sup>
	<b>Roll Crimping</b> non-insulated, terminals and 46 228 - Chapter 2 compliant cord-end sleeves. Application Range: 0.1...6mm <sup>2</sup>
	<b>Rounding to 90°</b> ve 120° sector-shaped conductors Application Range: 10...300mm <sup>2</sup> - multi core 35...300mm <sup>2</sup> - single conductor

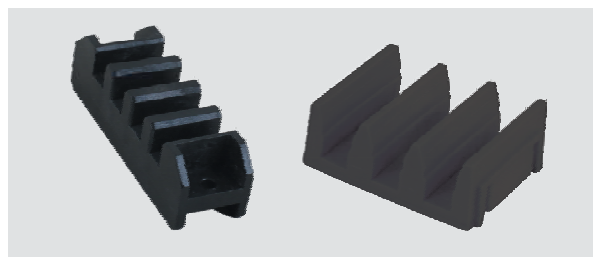
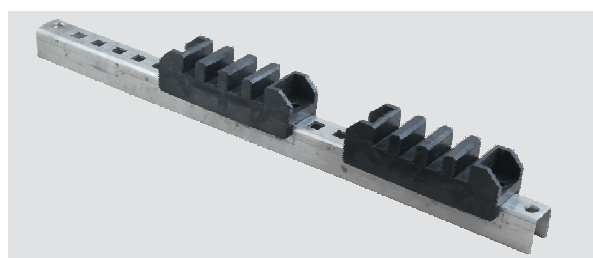
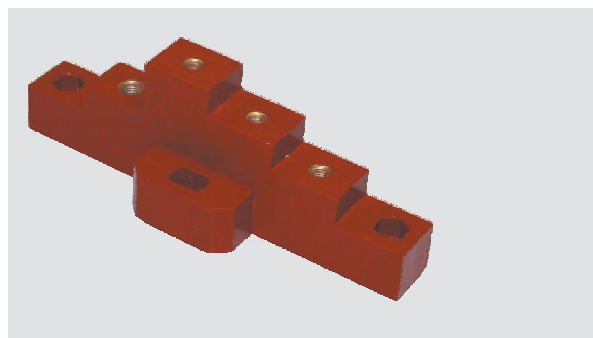
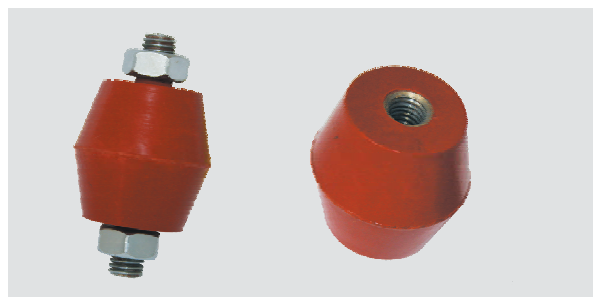
Insulation Classes			Degrees of enclosure protection		
Symbol	Continuous Operating Temperature C°	Insulation Material	Symbol	First Digit Protection Against Dust	Second Digit Protection Against Water
B	130 C°	Glass fibers, mica products, special synthetic sheets, compressed mineral-filled materials	IP 54	Amount of protection against ingress of damaging dust	Protection against splashing water from any angle
F	155 C°	Glass fibers, mica products, aromatic polyamides, varnishes (polyester) impregnated glass fiber	IP 55 IP 56		Protection against water sprayed from any direction. Protection against water sprayed from a storm or pressure on the deck of the ship.
H	180 C°	Glass fibers, mica products, aromatic polyamides, silicone rubber, telon	IP 65 IP 66	Complete protection against the ingress of dust	Protection against water sprayed from any direction. Protection against water sprayed from a storm or pressure on the deck of the ship.
C	>180 C°	Mica, porcelain, glass, quartz, telon	IP 67 IP 68		Protection against immersion and specific period of time in water under pressure. With the provisions of the manufacturer protection against keeping constant under water

DIN 48 083	Length mm		Cross-Section	
	A (mm)	B (mm)	Al (mm <sup>2</sup> )	Cu (mm <sup>2</sup> )
	1,5	3,9	-	4
	1,9	5,0	-	6
	2,1	5,5	-	10
	3,2	8,0	-	16
	3,8	9,4	-	25
	4,7	11,5	25	35
	5,5	13,5	35	50
	6,0	15,5	50	70
	7,3	18,0	70	95
	8,0	19,8	-	120
	9,1	22,2	95/120	150
	10,2	24,8	150	185
	12,0	27,8	185	240
	13,6	31,7	240	300
	14,5	33,7	300	400

# INSULATORS



## Insulators



# INDOOR TYPE INSULATOR LV

29

## FIBER GLASS SUPPORT INSULATORS

Low tension post insulators, whose rated voltage can go up to 100V, are used to join a copper bar to a base in indoor. Post insulators are one the vital points in the placed they are used.

They are manufactured from BMC material, which has a high specific resistance and thermal features, elasticity, lightness, perfect dielectric features, flexibility in molding and designing, is also made from combining fiber glass which is resistant to the indoor conditions, flexible and highly mechanic resistance.

It's chemical characters are listed below:

Fiber glass reinforced polyester, has 18% of fibers. Standard color, Irox red 130. (another color can used in needed)

Nuts: steel-zinc lined. (brass material can used if needed)

Bolt: Cr3 8.8 steel bolt

Specific Weight	DIN 53479	1,75 g/cm <sup>3</sup>
Martens Degree	DIN 53462	> 200°C
Flexural Strenght		90 N/mm <sup>2</sup>
Impact Strenght	DIN EN ISO 179	25-30 kJ/m <sup>2</sup>
Flammabiliy	UL 94	V0
Glow-Wire Flammability	DIN EN 60695	960 °C
Temperatre Range		-40°C + 130°C
Surface Reisistivity	DIN IEC 60093	10 <sup>14</sup> 0 cm
Volume Resistivity	DIN IEC 60093	10 <sup>14</sup> 0 cm
Water Absorption	DIN EN ISO 62	<0,2% (<25mg)

Information for informational purposes only and are not binding.

## PLASTIC BUSBAR SUPPORT INSULATOR (V0)

Low tension post insulators is made of non-flammable (V0) material. It is used for the same purpose as BMC insulators. It is more flexible than BMC insulators due to refraction rate is low. It's chemical characters are listed below:

Fiber glass reinforced poliamid (PA6) nonflamable, has 30% of fibers.

Standard color: Black

Nuts: Steel-zinc lined. (brass material can used if needed)

Bolt: Cr3 8.8 steel bolt

Specific Weight		1,56 g/cm <sup>3</sup>
Martens Degree	DIN 53462	> 200°C
Flexural Strenght	ISO 178	205 N/mm <sup>2</sup>
Impact Strenght	ISO 180/1A	14 kJ/m <sup>2</sup>
Flammabiliy	UL 94	V0
Temperatre Range		-40°C + 130°C
Surface Reisistivity	IEC 93	10 <sup>13</sup> 0cm
Volume Resistivity	IEC 93	10 <sup>13</sup> 0cm
Water Absorption	DIN EN ISO 62	<0,2% (<25mg)

Information for informational purposes only and are not binding.

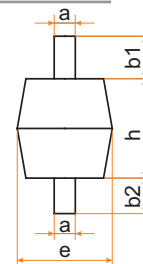
# INDOOR TYPE INSULATOR LV

## FIBER GLASS STAND-OFF INSULATORS

### Double Sided Bolt



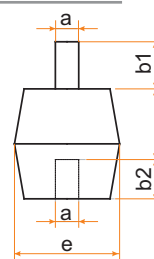
Service Voltage kV	Test Voltage kV	Tensile Strenght kN	Weight kg / 1 box	Box Qty.	Order Code	Type	Dimensions (mm)				
							a	b1	b2	e	h
0,6	3	0,75	11,00	500	9FI-05000-0000	1NO - S/m5	5	12	12	22	24
0,6	3	1,00	12,00	300	9FI-06000-0000	1N1 - S/m6	6	15	15	27	28
1	3	2,5	10,50	100	9FI-08000-0000	1NMS - 1/m8	8	16	19	40	40
1	3	2,7	14,00	100	9FI-10000-0000	1NMS - 2/m10	10	12	15	40	40



### One Side Bolt



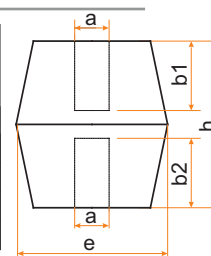
Service Voltage kV	Test Voltage kV	Tensile Strenght kN	Weight kg / 1 box	Box Qty.	Order Code	Type	Dimensions (mm)				
							a	b1	b2	e	h
0,6	3	0,75	10,50	500	9FI-05000-0001	1NO - K/m5	5	12	12	22	24
0,6	3	1,00	10,80	300	9FI-06000-0001	1N1 - K/m6	6	15	15	27	28
1	3	2,5	9,80	100	9FI-08000-0001	1NMK - 3/m8	8	16	15	40	40
1	3	2,7	11,40	100	9FI-10000-0001	1NMK - 2/m10	10	15	15	40	40



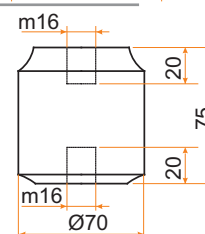
### Double Side Support



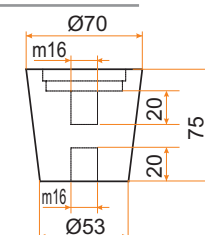
Service Voltage kV	Test Voltage kV	Tensile Strenght kN	Weight kg / 1 box	Box Qty.	Order Code	Type	Dimensions (mm)				
							a	b1	b2	e	h
0,6	3	0,75	10,00	500	9FI-05000-0002	1NO - KK/m5	5	9	9	22	24
0,6	3	1,00	9,90	300	9FI-06000-0002	1N1 - KK/m6	6	12	12	27	28
1	3	2,5	8,80	100	9FI-08000-0002	1NMK - 4/m8	8	15	15	40	40
1	3	2,7	8,90	100	9FI-10000-0002	1NMK - 1/m10	10	15	15	40	40



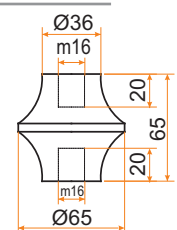
Service Voltage kV	Test Voltage kV	Tensile Strenght kN	Weight kg / 1 box	Box Qty.	Order Code	Type	Dimensions (mm)				
							a	b1	b2	e	h
3	20	6,00	9,00	18	9FI-16000-0001	1NMD - 1	16	20	20	70	75



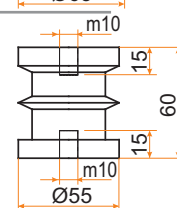
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							a	b1	b2	e	h
3	15	5,50	6,65	18	9FI-16000-0002	1NMA - 2	16	20	20	70	75



Service Voltage kV	Test Voltage kV	Tensile Strenght kN	Weight kg / 1 box	Box Qty.	Order Code	Type	Dimensions (mm)				
							a	b1	b2	e	h
3	15	5,00	4,60	18	9FI-16000-0003	1NMC - 3	16	20	20	65	65



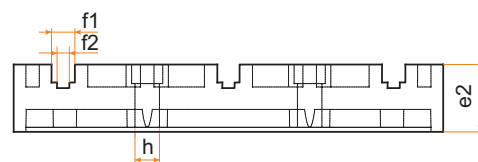
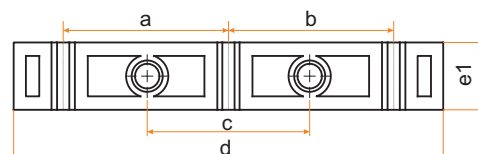
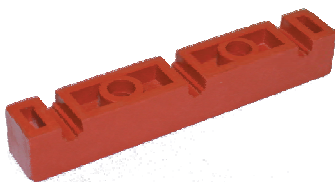
Service Voltage kV	Test Voltage kV	Tensile Strenght kN	Weight kg / 1 box	Box Qty.	Order Code	Type	Dimensions (mm)				
							a	b1	b2	e	h
3	15	5,00	7,00	32	9FI-16000-0004	1N 500	10	15	15	55	60



# INDOOR TYPE INSULATOR LV

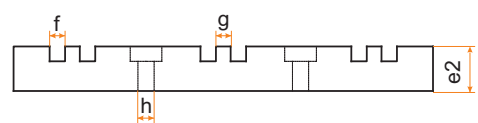
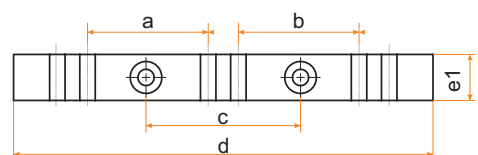
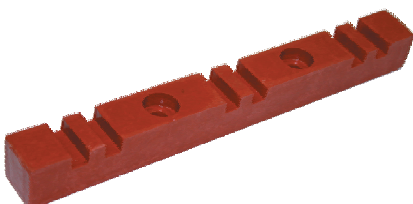
## FIBER GLASS POLYESTER BUSBAR SUPPORT INSULATORS

### 3x1F Support Insulator



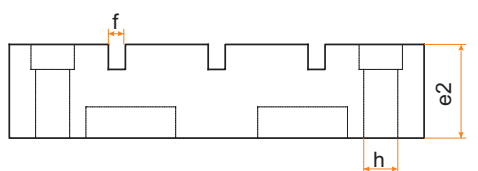
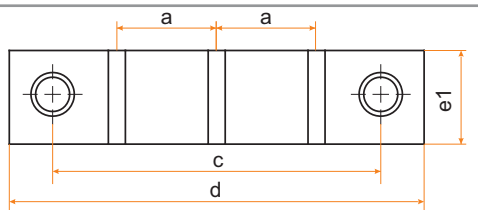
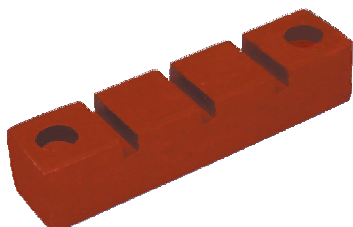
Min. Strength kN	Box Qty.	Order Code	Dimensions (mm)								
			a	b	c	d	e1	e2	f1	f2	h
5	40	9FI-74500-0000	74,5	74,5	73	193	30	30	10,5	5,5	Ø11

### 3x2F Support Insulator



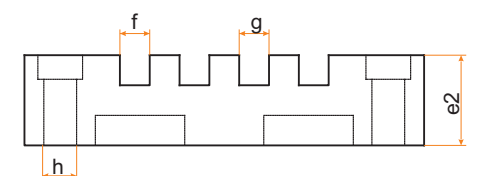
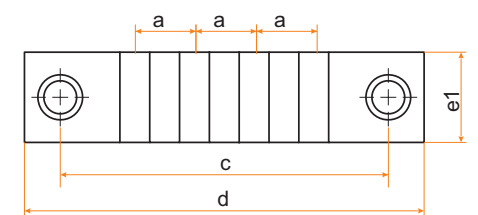
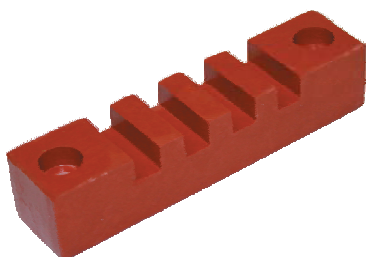
Min. Strength kN	Box Qty.	Order Code	Dimensions (mm)								
			a	b	c	d	e1	e2	f1	f2	h
5	50	9FI-82000-0000	82	82	105	285	31	30	10,5	10	Ø11
5	50	9FI-91500-0000	91,5	91,5	105	285	31	30	5,5	5	Ø11

### 3x1FK Support Insulator



Min. Strength kN	Box Qty.	Order Code	Dimensions (mm)							
			a	c	d	e1	e2	f	g	h
5	50	9FI-33000-0000	33	110	134	31	29	5,5	27	Ø9

### 1x4F Support Insulator



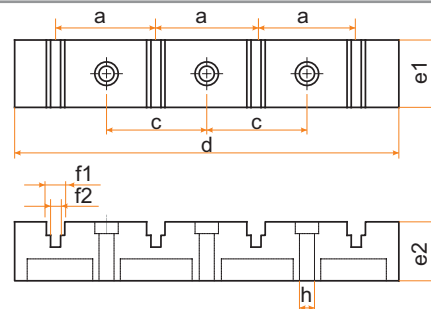
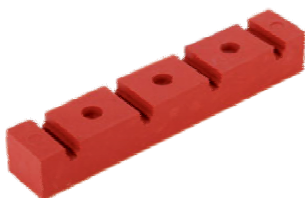
Min. Strength kN	Box Qty.	Order Code	Dimensions (mm)							
			a	c	d	e1	e2	f	g	h
5	50	9FI-22000-0000	22	110	134	31	29	5,5	10,5	Ø9
5	50	9FI-22000-0001	22	110	134	31	29	10,5	10,5	Ø9



# INDOOR TYPE INSULATOR LV

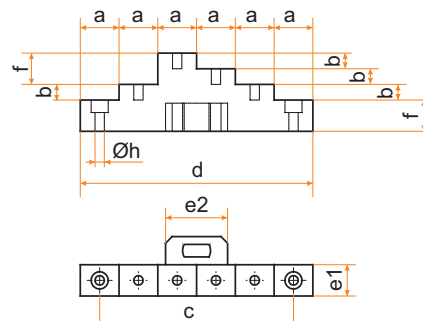
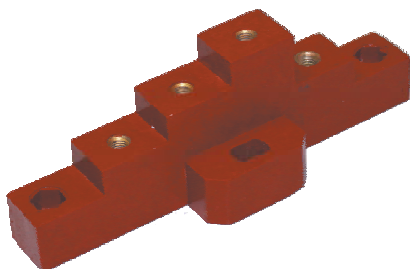
## POLYESTER BUSBAR SUPPORT INSULATORS

### 3x1F+N Support Insulator



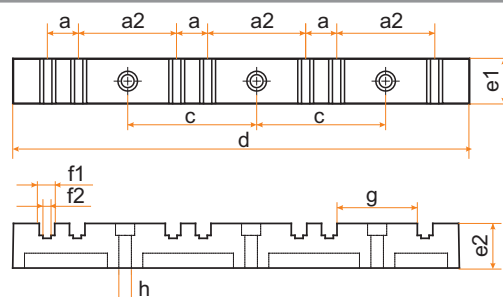
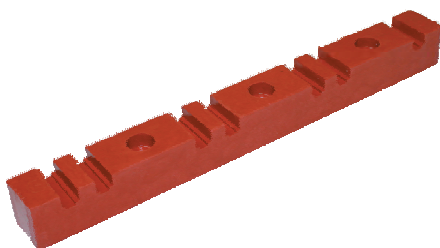
Min. Strenght kN	Box Qty.	Order Code	Dimensions (mm)							
			a	c	d	e1	e2	f1	f2	h
5	32	9FI-60100-0000	60	60	230	40	34,5	10,5	5,5	Ø9

### 3x1FY+N Support Insulator



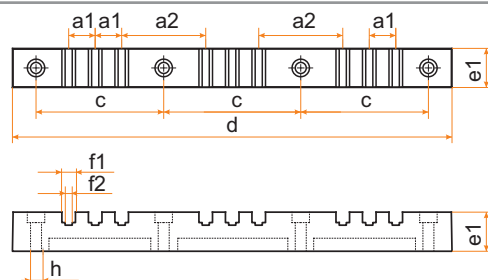
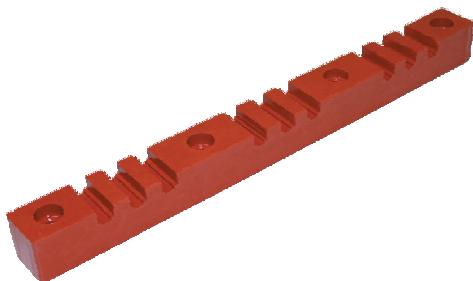
Min. Strenght kN	Box Qty.	Order Code	Dimensions (mm)							
			a	b	c	d	e1	e2	f	h
5	26	9FI-25000-0000	25	10	125	150	38	40	20	Ø6

### 3x2F+N Support Insulator



Min. Strenght kN	Box Qty.	Order Code	Dimensions (mm)									
			a1	a2	c	d	e1	e2	f1	f2	g	h
5	20	9FI-20500-0000	20,5	65	85,5	303	31	30	10,5	5,5	54,5	Ø8,5

### 3x3F Support Insulator



Min. Strenght kN	Box Qty.	Order Code	Dimensions (mm)										
			a1	a2	c1	c2	d	e1	e2	f1	f2	g	h
5	20	9FI-20500-0001	20.5	65	98.75	106	340	30	30	10.5	5.5	10	Ø8.5

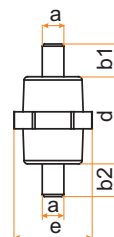
# INDOOR TYPE INSULATOR LV

## PLASTIC STAND-OFF INSULATOR (VO)

### Double Sided Bolt



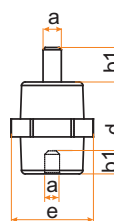
Service Voltage kV	Test Voltage kV	Tensile Strenght kN	Weight kg / 1 box	Box Qty.	Order Code	Type	Dimensions (mm)				
							a	b1	b2	e	h
0,6	3	1,00	8,50	500	9FI-05000-V000	1NO - S/m5	5	12	12	18	25,5
0,6	3	1,00	8,70	300	9FI-06000-V000	1N1 - S/m6	6	16	16	21	29,5
1	3	4,00	7,10	100	9FI-08000-V000	1NMS - 1/m8	8	15	15	31,5	40
1	3	4,00	9,50	100	9FI-10000-V000	1NMS - 2/m10	10	15	15	31,5	40



### One Side Bolt



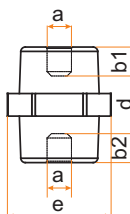
Service Voltage kV	Test Voltage kV	Tensile Strenght kN	Weight kg / 1 box	Box Qty.	Order Code	Type	Dimensions (mm)				
							a	b1	b2	e	h
0,6	3	1,00	8,00	500	9FI-05000-V001	1NO - K/m5	5	12	9	18	25,5
0,6	3	1,00	7,50	300	9FI-06000-V001	1N1 - K/m6	6	16	12	21	29,5
1	3	4,00	5,80	100	9FI-08000-V001	1NMK - 3/m8	8	15,5	15	31,5	40
1	3	4,00	7,70	100	9FI-10000-V001	1NMK - 2/m10	10	15	15	31,5	40



### Double Side Support



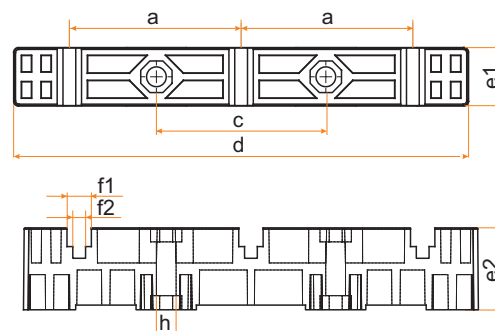
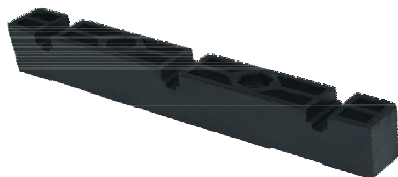
Service Voltage kV	Test Voltage kV	Tensile Strenght kN	Weight kg / 1 box	Box Qty.	Order Code	Type	Dimensions (mm)				
							a	b1	b2	e	h
0,6	3	1,00	7,50	500	9FI-05000-V002	1NO - KK/m5	5	9	9	18	25,5
0,6	3	1,00	6,30	300	9FI-06000-V002	1N1 - KK/m6	6	12	12	21	29,5
1	3	4,00	4,60	100	9FI-08000-V002	1NMK - 4/m8	8	15	15	31,5	40
1	3	4,00	5,00	100	9FI-10000-V002	1NMK - 1/m10	10	15	15	31,5	40



# INDOOR TYPE INSULATOR LV

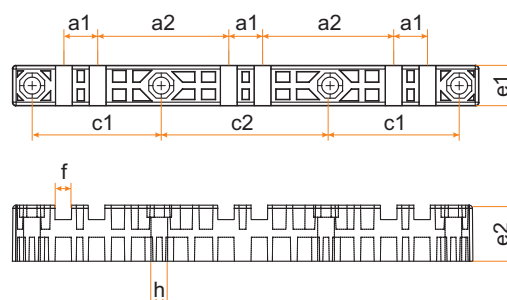
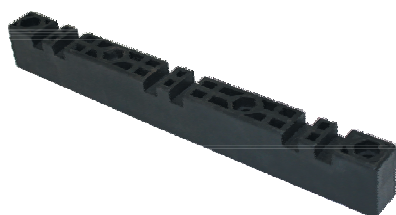
## PLASTIC STAND-OFF INSULATOR (V0)

### 3x1F Support Insulator



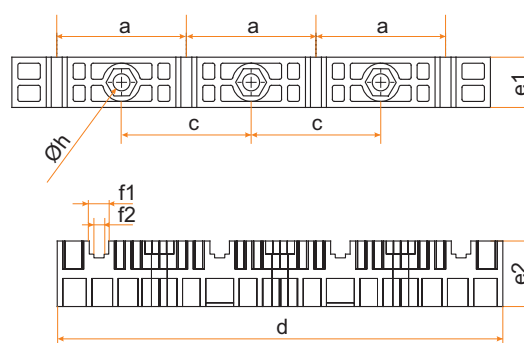
Min. Strenght kN	Box Qty.	Order Code	Dimensions (mm)							
			a	c	d	e1	e2	f1	f2	h
5	50	9FI-74000-V000	74	73	196	25	34,5	10,5	5,5	Ø8,5

### 3x2F Support Insulator



Min. Strenght kN	Box Qty.	Order Code	Dimensions (mm)							
			a	c	d	e1	e2	f1	f2	h
5	50	9FI-20500-V000	20,5	81,3	80	105	290	25,0	34,5	10,5

### 3x1F + N Support Insulator

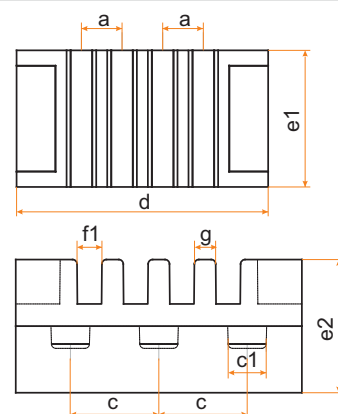
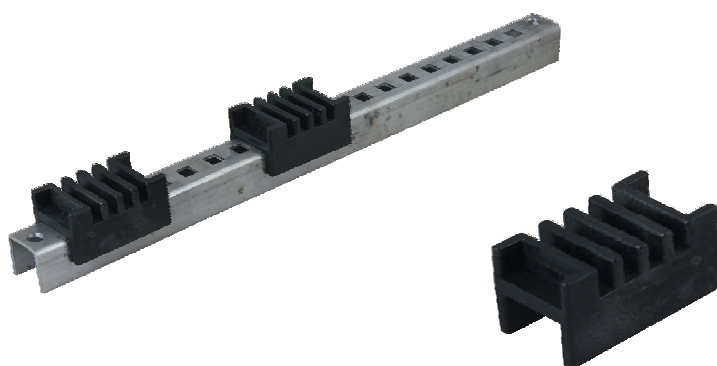


Min. Strenght kN	Box Qty.	Order Code	Dimensions (mm)							
			a	c	d	e1	e2	f1	f2	h
5	50	9FI-65000-V000	65	65	240	25,5	35,0	10,5	5,5	Ø9

# INDOOR TYPE INSULATOR LV

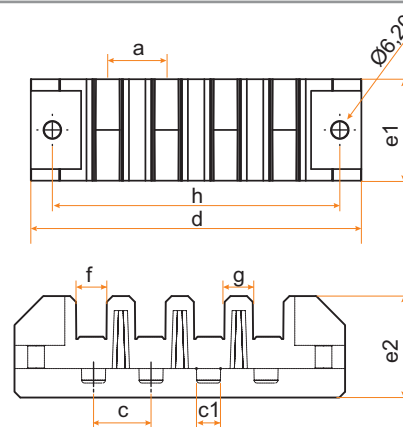
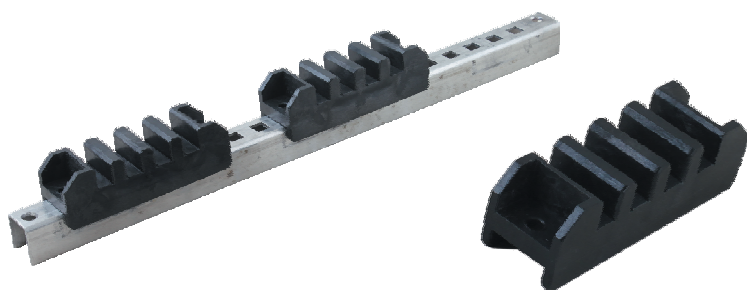
## PLASTIC STAND-OFF INSULATOR (V0)

### 1x4F 5mm Support Insulator



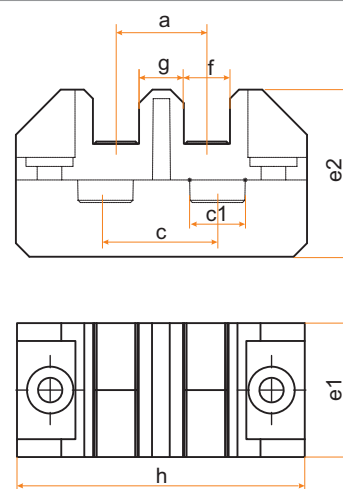
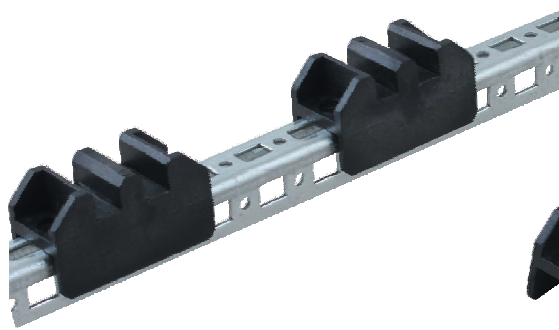
Min. Strength kN	Box Qty.	Order Code	Dimensions (mm)							
			a	c	c1	d	f1	e1	e2	g
5	100	9FI-10500-V001	10,5	20	8	65	5,5	35,5	30	5

### 1x4F 10mm Support Insulator



Min. Strength kN	Box Qty.	Order Code	Dimensions (mm)								
			a	c	c1	d	f	h	e1	e2	g
5	100	9FI-20500-V001	20,5	20	8,4x8,4	115	10,5	100	35	35	10

### 1x2F 10mm Support Insulator

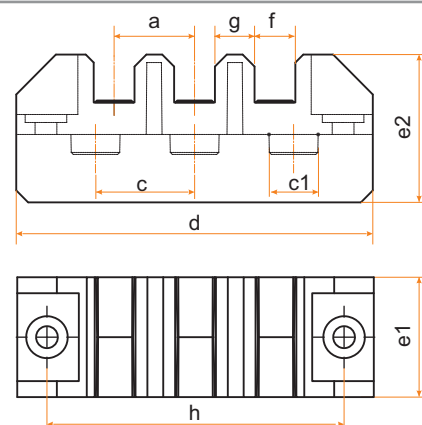
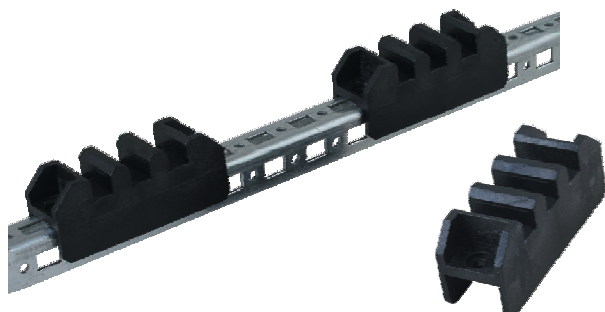


Min. Strength kN	Box Qty.	Order Code	Dimensions (mm)								
			a	c	c1	d	f	h	e1	e2	g
5	100	9FI-20500-V002	20,5	20	8x12,4	65	10,5	50	30	37	10

# INDOOR TYPE INSULATOR LV

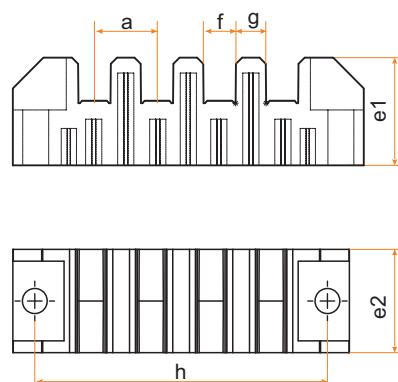
## PLASTIC STAND-OFF INSULATOR (V0)

### 1x3F 10mm Support Insulator



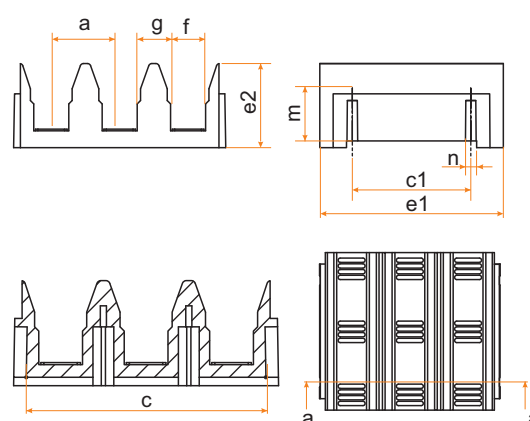
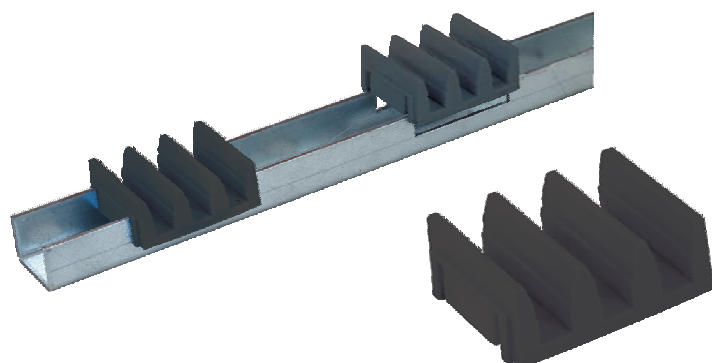
Min. Strenght kN	Box Qty.	Order Code	Dimensions (mm)								
			a	c	c1	d	f	h	e1	e2	g
5	100	9FI-20500-V003	20,5	20	8x12,4	90	10,5	75	30	37	10

### 1x4F 10mm Support Insulator



Min. Strenght kN	Box Qty.	Order Code	Dimensions (mm)						
			a	d	f	h	e1	e2	g
5	100	9FI-20500-V004	20,5	115	10,5	100	35	35	10

### 1x3F 10mm Support Insulator



Min. Strenght kN	Box Qty.	Order Code	Dimensions (mm)										
			a	d	f	h	e1	e2	g	c	c1	n	m
5	100	9FI-21000-V005	21	69.6	10.5	51.5	55	25	10	63	35.5	35.5	15.7

# INDOOR TYPE INSULATOR LV

## FIBER GLASS PLATE

These products are made hand-made in the form of plate. It's used to carry and support copper busbar in the panel. Products have more mechanical strenght than BMC products. It can be made between 3mm - 30mm thickness. The application methods are as follows. Standart color RAL 7035

Product Name	Dimensions (mm)	Order Code
Fiber Glass Plate	03x800x1200	9FG-03800-1200
	05x800x1200	9FG-05800-1200
	10x800x1200	9FG-10800-1200
	15x800x1200	9FG-15800-1200
	20x800x1200	9FG-20800-1200
	25x800x1200	9FG-25800-1200
	30x800x1200	9FG-30800-1200
Fiber Glass Plate	03x30x1200	9FG-03300-1200
	03x40x1200	9FG-03400-1200
	03x50x1200	9FG-03500-1200
	03x60x1200	9FG-03600-1200
	03x70x1200	9FG-03700-1200
	03x80x1200	9FG-03800-1200
	03x90x1200	9FG-03900-1200
Fiber Glass Plate	05x30x1200	9FG-05300-1200
	05x40x1200	9FG-05400-1200
	05x50x1200	9FG-05500-1200
	05x60x1200	9FG-05600-1200
	05x70x1200	9FG-05700-1200
	05x80x1200	9FG-05800-1200
	05x90x1200	9FG-05900-1200
Fiber Glass Plate	10x30x1200	9FG-10300-1200
	10x40x1200	9FG-10400-1200
	10x50x1200	9FG-10500-1200
	10x60x1200	9FG-10600-1200
	10x70x1200	9FG-10700-1200
	10x80x1000	9FG-10800-1000
	10x90x1200	9FG-10900-1200
Fiber Glass Plate	15x30x1200	9FG-15300-1200
	15x40x1200	9FG-15400-1200
	15x50x1200	9FG-15500-1200
	15x60x1200	9FG-15600-1200
	15x70x1200	9FG-15700-1200
	15x80x1200	9FG-15800-1200
	15x90x1200	9FG-15900-1200
Fiber Glass Plate	20x30x1200	9FG-20300-1200
	20x40x1200	9FG-20400-1200
	20x50x1200	9FG-20500-1200
	20x60x1200	9FG-20600-1200
	20x70x1200	9FG-20700-1200
	20x80x1200	9FG-20800-1200
	20x90x1200	9FG-20900-1200
Fiber Glass Plate	25x30x1200	9FG-25300-1200
	25x40x1200	9FG-25400-1200
	25x50x1200	9FG-25500-1200
	25x60x1200	9FG-25600-1200
	25x70x1200	9FG-25700-1200
	25x80x1200	9FG-25800-1200
	25x90x1200	9FG-25900-1200
Fiber Glass Plate	30x30x1200	9FG-30300-1200
	30x40x1200	9FG-30400-1200
	30x50x1200	9FG-30500-1200
	30x60x1200	9FG-30600-1200
	30x70x1200	9FG-30700-1200
	30x80x1200	9FG-30800-1200
	30x90x1200	9FG-30900-1200





# AUTOMATIC CONTROL UNIT of HEATING SYSTEMS for PASSENGER COACH





## Automatic Control Unit Of Heating Systems For Passenger Coach



## CONTENTS

Features	1
Technical Table	1

# AUTOMATIC CONTROL UNIT of HEATING SYSTEMS for PASSENGER COACH

Electrical Automatical Heating system is generally used for passenger railway cars.

## 1-Heating System (1000 V)

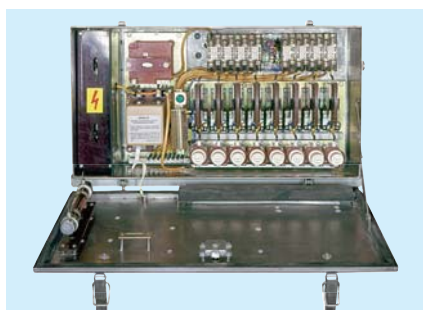
It consists of following parts.

- Equipment panel
- Main switch
- Power contactor
- Main fuse
- Low voltage relay
- Distribution fuse

## 2. Heating System (1000-1500-3000V):

It consists of following parts.

- Equipment panel
- Main switch
- Power contactor
- Main fuse
- Electronic voltage selection relay
- Distribution fuse
- Level changing motor circuit breaker



Pic-1 Automatical Heating System for Passenger Railway Car



Pic- 2 Power Contactor



Pic- 3 Main fuse



Pic- 4 Distribution fuse

## Equipment Panel :

Main and Auxiliary Equipment panels are assembled under the passenger railway car. They have 4mm length and include stainless steel material. Protection class IP54 has a security system for touching, dust and water input. Main and auxiliary equipment panels are given to the railway car with cable connections made and ready to assembly. Opening of equipment panel's cover, under voltage is prevented with mechanic locking mechanism.

## Main Switch :

These switches are manufactured for 50kW heating power.  
For 1000 V AC, DC, 50 A  
For 3000 V DC, 16.7 A  
Main switch mechanism is a cam switch with spring that has a 90° moment breaking.  
This mechanism locks the system when the cover is opened. Switching on is prevented by this way.

## Power Contactor :

Power Contactor is used at every electric circuit for commanding heaters. This contactor is a magnetic polarized contactor.  
Coil operating voltage is DC. Contactor is manufactured as C insulating class according to VDE 0110, and as D device group according to VDE 0660 standards. Operating coil is bridged with a diode and serial connected resistance to have protection from over voltage.

## Technical Specification :

Type	: FEC
Using Class	: AC1 / DC1
Nominal Power	: 16 kW 3000V AC/DC
Number of Contacts (Ad)	: 1
Auxiliary Contact	: 1 NA / 1 NK < 10A
Coil Voltage	: 24, 72, 120V DC
Weight	: 3,2 kg
Insulation	: C group for VDE 0110

There are 8 contactors at equipment panel and there are 6 contactors at auxiliary equipment panel. Auxiliary equipment panel is manufactured according to orders.

## Main Fuse :

Insulated body is manufactured with high ceramic dough, which has a mechanic resistance of main fuse. Cylindrical shaped ceramic body is equipped with covers and contact knives at both ends. Melting wire is pure silver. (it doesn't depend on corrosion) Fuses have a normally delaying characteristic. Quartz sand is used as arc extinguishing material.

Fuses limit the short circuit current with a high measurement in a short circuit position and so, they protect the system against thermal and dynamical forces. Main fuses are manufactured as knife fuses and fixed to equipment panel. Therefore, maintenance operations of this product are made without voltage applied. When the cover is opened, fuses prevent the contact of the cover plate and human.

Operating Voltage : 3000 V AC/DC  
Operating Current : 6 A

## 1000 V Under Voltage Relay :

Low voltage relay is operating between 450 V AC (600 V DC) and 1000 V AC (1200 V DC) ( $\pm 10\%$ ). It directly gives contact output. This contact and high voltage is insulated from each other. This relay is towards to voltage at heating system. If the voltage is higher than 450V AC (600 V DC), operating command is issued and heaters switch on. If this voltage is lower than 300V AC (360 V DC) heaters are switch off.

Operating Field : 450-1000 V AC  
600-1200 V DC  
Open-Close Capacity : 1 A at 24 V DC

## Distribution Fuse :

Cylindrical fiberglass not flaming thermostet body is used at distribution fuses. There are connection terminals on the body and pure silver melting wire and quartz sand as arc extinguisher are inside of the product.

Operating Voltage : 3000 V AC/DC  
Operating Current : 6 A

## Electronic Voltage Selectivity Relay : Operating Way :

High Voltage is divided on resistances and sent to four-measurement step. These are  
at AC 1000V, 1500V  
at DC 1500V, 3000V the steps.  
Also, there are two overload measurement levels instead of these four measurement levels (one AC, the other DC). If an overload is determined higher than 1850 V AC, 3750 V DC at both measurement levels, 3000 V position is selected and heaters are switch off. With the sign which is obtained from measurement rank, signal is given to the related transistor, and relay with having a time delay.

Operating Field : 650V AC - 1875V AC  
1000V DC - 4000V DC  
Operating Levels: 1000, 1500V AC  
1500, 3000V DC  
Battery Voltage : 24V DC (18-32V DC)

## Level Changing Motor Circuit Breaker:

Level Changing Motor Circuit is manufactured for equipment panel with group of 8 and for auxiliary equipment panel with group of 6. Groups that are assembled on to the chassis are manufactured with transparent and not flaming material and contacts are seen easily. Level changing motor circuit breaker has the contacts 1000, 1500 and 3000V positions with the assistance of servomotors by receiving the signal from the electronic voltage selecting relay and transmit the electrical energy to the power contact.

# BMC (Bulk Moulding Compaund)



## BMC



## CONTENTS

Features	1
Technical Drawings	1

## BMC (Bulk Moulding Compound):

It is a polyester moulding material that resembles dough and which has been supported with appropriate glass fiber. It can be adjusted by changing the additive materials according to the required feature. It is in the thermoset plastics group because of its main characteristics and it can be produced with hot press (straight, transfer, injection) moulding method.

## BMC Characteristic Features:

- Having high mechanical forces not only under static loads but also under dynamic loads
- Having well adjustment in measurements with its low tensile properties
- High thermo stability
- Having low rated dehumidification feature
- High electrical features (insulation)
- Feature of flame delaying formulate preparation
- Low cost

The temperature in BMC coating is averagely between 140 - 180 °C.

The pressure is between 100 - 140 kg/cm<sup>2</sup> bar.

An ideal coating material must have the following features:

- Low melting temperature
- High fluidity
- Remaining in fluid form for a long time
- Hardening in high speed

Federal has been realizing the thermoset material production, in composite plastic area, by BMC (Bulk Moulding Compound) as moulding dough for 15 years in its structure. All the needed machinery and the equipments for the productions are found in its facilities. By using special formulations, BMC productions having required colors and properties can be made.



The glass fiber that is found in the structure of the BMC material provides it high and superior insulation feature, high stroke resistance and many similar important features by combining its superior mechanical feature with polyester resin and other components.

In the moulds that have been designed and produced from raw material production, the parts are shaped under heat and pressure in press shops, and the produced semi products turn into final products.

Many requests are being made to our firm about our BMC productions from our country and foreign countries, and these requests are met by us in shortest times.

Please contact our firm for your BMC requests having the colors that you want.

Features	Unit	Value
Density	gr/cm <sup>3</sup>	1,75 - 1,85
Fluidity	mm	120 - 180
Mould drawing	%	0,2 - 0,5
Hardness	barcoll	50 - 60
Resistance against heat	°C	≥ 200
Unnotched stoke strength	ISO 180/A Kj / m <sup>2</sup>	≥ 6,0
Notched stoke strength		≥ 3,5
Elasticity resistance	Mpa	≥ 70
Insulation resistance	Ω	≥ 10 <sup>11</sup>
Dielectric resistance	(90 °C)MV/m	≥ 3,5
Superficial leakage way index	(UL746A)CTI	≥ 600
Environment waste factor	(1 MHz) tgδ	≤ 0,1
Combustion resistance	UL-94 yanmazlık sınıfı	V - 0
Water absorption	mg	≤ 10



# FEDERAL SUBSCRIBER INFORMATION MANAGEMENT SYSTEM



**Federal Subscriber Information  
Management System**

ABYS

**CONTENTS**

Advantages For The Enterprise	1
General Features	1
Technical Features	1
Functional Features	1



# FEDERAL SUBSCRIBER INFORMATION MANAGEMENT SYSTEM

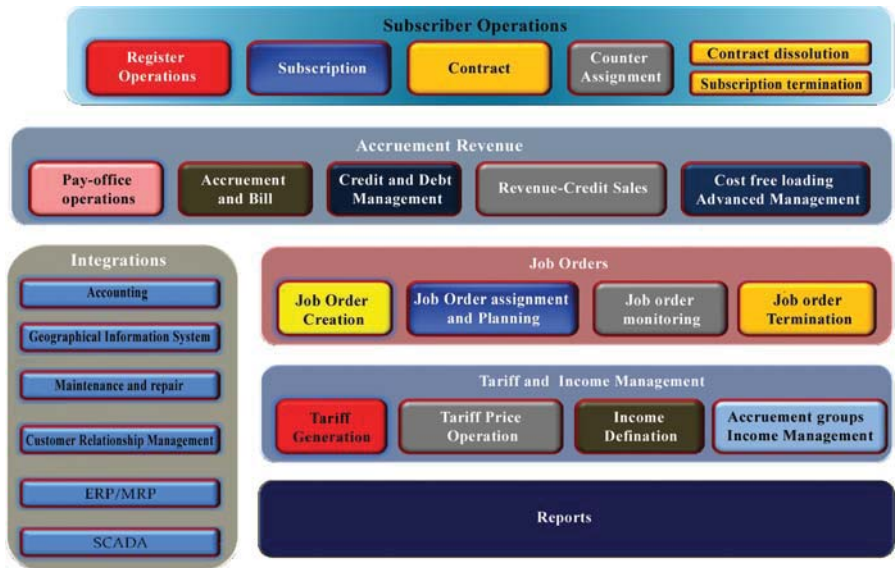
The Subscriber Information Management System (SIMS) is a system that administrates, follows, the operations of gas, electric and water counters of the energy distribution enterprises, and provides all the subscribing processes of the subscribers who use these counters, and specifies the needs by analyzing the data that it has collected from other systems mainly from scada, and the data in its database, and increases the enterprise profitability to the maximum level.

## Advantages for the Enterprise:

- It plans the counter and service operations and it provides obeying these plans, administrating the system regularly and efficiently and ensures the services continue without any interruption.
- It provides supervision on the enterprise and the subscriber. It provides the personnel and the subscriber to obey the required formation, gives the opportunity of accessing the targets in an easiest and fastest way.
- By using the enterprise sources in a correct and effective way, it increases the profitability and service quality.
- By estimating the likely problems previously, it provides contribution for taking required precautions.
- By evaluating the requirements and the complaints of the customers, it renews the system and working periods.

## GENERAL FEATURES

- Making the accrue ment and collection without any interruption and in a correct way.
- Assessing the information that come from prepaid counters, and providing the security.
- By evaluating the customer requirements, increasing the customer satisfaction.
- By taking the subscriber consumption under control, providing the usage of the energy in an efficient and right way.
- Planning the counter demounting, assembling, controlling and maintenance activities and monitoring these.
- Management of the first subscription and service giving periods.
- Making all the operations in compatible to the related legislations
- By being integrated to the required systems, being able to transfer information to these systems
- In order not to hamper the service that is given, providing making the related supervisions and controls.



## TECHNICAL FEATURES

- Design that is Appropriate to the Technologic Substructure and Scattered Architecture

The system client/server can be used over web scanner as it works on the architecture. It provides usage over web technology (browser) in the regions where internet substructure is weak, and in the regions where there is no problem such as this; it provides usage over Windows displays, which are more user friendly systems.

It uses oracle database. It provides this system work in the most secure way without any interruption. The data are always under security and the backing up operation is made online. In the situations of disaster, there is an opportunity of flashback and no data loss is experienced.

- Easy Usage and Parametric Structure

Usage is easy and it has been designed in a way that prevents making mistakes. The user is directed by teaching the work flows to the system.

- Secure Substructure

It provides a large authorization. Each user takes the authorities and menu structures of the groups that he/she has been involved. It provides table based access and detailed authorization. Each operation recording is realized. The system entering and exiting times of the user, the changes that he/she has realized, and their times can be reported in details. The data integrity is provided in maximum level.

- Integration

It can work integrated with many systems. Due to its structure it can realize the integration in an easiest and fastest way. It can comply with the online bank and pos systems easily. It can be integrated to the accountancy and finance systems in any required way.

- Reporting

The user can design his/her reports independently. He or she can share these reports with other users whenever he/she wants and also publish these on the internet environment.

- Different Language Choices

SIMS takes all the warning messages and information on the user interface from xml file. By changing this xml file, an adaptation the required language can be provided in a very short time. The Turkish, English, Russian and Uzbek xml files have already been defined.

## FUNCTIONAL FEATURES

- Flexibility, Modular and Parametric Structure

SIMS has been developed completely on parametric structure. It can be applied to the enterprises having different structures. It can comply with the developing conditions. It can meet the different requirements that can develop as time goes on. By means of its modular structure making changes is easy.

- Supervision and Control

Each operation that has been realized can be supervised and reported. Specified phases can be subjected to

# FEDERAL SUBSCRIBER INFORMATION MANAGEMENT SYSTEM

supervisor supervision. For example: in order to make subscriber card operation one-off allowances can be given in subscriber base and the users can make operations according to these allowances.

- Wizards

Many operations are made by wizards. This can both prevent the user originated mistakes and provide easy usage.

- Large Scope

SIMS has been designed in a manner that will meet the needs of the gas, electric and water enterprises. As it has met all the needs of the enterprise in practice, there is no need to use other software or systems.

- Process and the Work Orders

The enterprise structure is modeled into the system. The commands, such as "Which operations will be realized in which phase", "What should be the next operation" are introduced to the system by means of work orders and it is provided the users follow this way. So the order of the operations such as "which operation is in which step", and "what has to be done in the next step" can be easily seen.

The area work orders are transferred to the area by mobile terminals. In how much time the personal in the area has made this work order and what is its result can be monitored. The results of each operation are introduced to the system separately. For example the intervention place and the results of the work order that has been opened due to a gas odor and which has been conveyed to the area, is chosen by means of the multi menu that founds on the mobile terminal and it is transferred to the system. The work orders that have not been completed in their periods are monitored and the needed warnings are made to the related persons.

- Data Integrity and Consistency

In order provide the system to reach its targets and it to be used efficiently, data integrity and consistency should be ensured. For this reason the data should be entered to the system correctly,

regularly and in an unrepeatable manner. The data entry to SIMS is made according to rules and in a controlled manner. No allowance is given for entering the next data before entering the data before it. Specified data are entered to the system by using a multiple choice and pre-defined format. If the information that has been entered to the system does not comply with each other the operator is warned and he/she is obliged to make correct entrance.

- Supporting the Different Counter Technologies

The counters that SIMS support are the counters of Federal Group. So that all the functions of the electronic and prepaid counters can be controlled by SIMS and no compliance problem is experienced. On the other hand it can support different brand and model counters too.

System can support;

- Mechanical
  - Electronic
  - Prepaid
  - Remote Reading
- water, gas and electric counters.

The tariff structure and the parameters in the counters having tariff, are defined by SIMS. The consumption and the period tariffs can be supported according to the structure of the counter. There are different advantages of developing the counter and the SIMS by one firm.

These advantages are:

- SIMS is designed to support all the features of the counter.
  - All the information on the counter are transferred to the system without any default and correct interpretations are made.
  - There is 100% sovereignty on the smartcard. Applying interventions to its all regions and information is possible.
  - Development according to the requirements on the counter can be realized and this is reflected to SIMS software at the same moment.
  - The card operations are fast as there is no any interface among them.
- The readings of the mechanical and non prepaid electronic counters' readings can be made by using hand terminal. According to the consumption values

that are read from the hand terminal, the accrue can be realized.

- Searching Function According To Entered Information

Interrogation can be made according to every kind of information that is entered from the used display. The interrogation is made from the same displays that data entrances are made. This provides to reach the required data in a very practical way.

- Sectional Collection and Payment By Installments

The revenues under collection groups can be accrued to the subscribers in advance or by installments. In the payments made by installments delay interest can be applied. One accrue can be sectional collected even if it is a tally trade.

- Debiting By Energy Unit

The debit can be accrued to the subscribers in m3 or Kw-h units. These debts can be divided into installments. The debts are collected from their tariffs on due dates.

- Doubtful Operation and Subscriber Follow

By using developed methods with SIMS, the consumption and doubtful situations of the subscribers can be followed and controlled.

The average monthly consumption of the subscribers is followed by the program. If a determination of very over or under the average the system automatically arranges a work order and provides the control of the counter and the installment that belongs to that subscriber.

In the prepaid counters, the credits on the counter and the loading data on the system are controlled. If there is any difference the cashier is warned and the sale on account can be prevented. The automatic work orders can be arranged and these can be oriented to the related team.

By means of the warning mechanisms on the counter the subscriber is followed. By calculating the system entrance date of the subscriber, automatic work orders are arranged for the subscribers who do



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