



"All Over the World"

CATALOGUE 2015 - 2016

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ASTA



KERI



ISO 9001:2008 REGISTERED COMPANY

Low Voltage Protection, Control and Measurement Devices

Design

To maintain the high level of technology and improve the product image, our R&D dept. utilizes the program UNIGRAPHICS. This is one the most advanced programs in CAD-CAM and aids this department to meet the demands of further development.



Production

At Federal Electric semi-automatic lines carry out assembly. Items come to the line as components are assembled and leave the line ready for testing. %95 of the raw material, which are used, at manufacturing, procured from domestic market, silver alloyed contacts and bimetals are procured from the international market. Most of its production capacity is being exported to more than 40 countries; in Europe, Middle East and USA.

Quality Assurance

Federal Electric, which is known to the world market, has been working according to ISO 9001:2000 standards. Our working principles are based on continuous development and satisfaction of the customer. All of this period is followed by static technique from design to purchasing, from process control to storage and logistics, from training and development to after sale services through the ERP software system.



Local and Foreign Market

Federal Electric continuous its marketing and sales activities through international trade organizations to meet the needs of local and international customers. Federal Electric's export activity has grown successfully every year. Federal Electric is currently exporting its products to more than 40 countries which the main ones are France, Germany, England, Sweden, Italy, Saudi Arabia, Egypt, Syria, Jordan, Iraq, Russia, Sri Lanka.

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MOLDED CASE CIRCUIT BREAKERS



Circuit Breakers (Thermal-Magnetic) MCCB



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

F11M (16A ... 125A)



F10 / F11 (16A ... 125A)



F12 (16A ... 160A)

F12S (160A)



F12N (16A ... 160A)

F12R (ELCB) (50A ... 160A)



F21 (16A ... 160A)



F31 / F32 / F33 (16A ... 250A)

F31S (160A ... 250A)



F51 / F52 / F53 (125A ... 400A)

F51N / F52N / F53N (125A ... 400A)



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

F61S (300A ... 400A)



F71 (300A ... 800A)



F82 / F83 (400A ... 800A)

F82N / F83N (400A ... 800A)

Circuit Breakers (Electronic) MCCB



F82E / F83E (300A ... 800A)

F82EN / F83EN (300A ... 800A)



F91E / F92E (1000A ... 1250A)

F91EN / F92EN (1000A ... 1250A)



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



F111E / F112E (1600A ... 2500A)

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IEC / EN 60947-2

CE






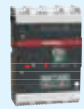




















































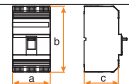
Mounting Position	: Free
Altitude	: 2000 m (max)
Relative Humidity	: %90 (55°C)
Ambient Temperature	: between -25°C and +60°C ^①
Pollution Degree	: III
Protection Degree	: IP40 (at assembly lever area)



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)

MOLDED CASE CIRCUIT BREAKERS

Thermal-Magnetic Circuit Breakers

										
Type			F01	F02	F11M	F10	F11	F12	F12S	F12R (ELCB)
Rated current - I _n	A		16,20,25,32,40,50,63,80,100,125,160,200,225		16,20,25,32,40,50,63,80,100,125	16,20,25,32,40,50,63,80,100,125		16,20,25,32,40,50,63,80,100,125,160	160	50,63,80,100,125,160
Number of poles			1		1	3		3,4	3	4
Rated operating voltage - U _e (a.c.) 50-60 Hz	V		240		240	415		415	415	415
Rated insulation voltage - U _i (a.c.) 50-60 Hz	V		750		750	750		750	750	750
Rated impulse withstand voltage - U _{imp}	kV		8		8	8		8	8	8
Test voltage (1 min) (a.c.) 50-60 Hz	V		3.000		3.000	3.000		3.000	3.000	3.000
Rated current adjustment - I ₁	A		Fixed		Fixed	Fixed		(0,8-1)I _n	Fixed	(0,8-1)I _n
Instant opening current adjustment - I ₂	① A		① 8xI _n		① 10xI _n ⑦	① 10xI _n ⑦		① 10xI _n ⑦	① 10xI _n ⑦	① 10xI _n ⑦
Highest nominal short circuit breaking capacity - I _{cu}	②									
(a.c.) 50-60 Hz 220/240 V (kA rms)			35	65	25	25	35	35	35	35
(a.c.) 50-60 Hz 380/415 V (kA rms)			12	14	6	20	25	25	25	25
(a.c.) 50-60 Hz 440 V (kA rms)			-	-	-	12	16	20	20	20
(a.c.) 50-60 Hz 500 V (kA rms)			-	-	-	8	10	12	12	12
(a.c.) 50-60 Hz 690 V (kA rms)			-	-	-	6	6	8	8	8
(d.c.) 250 V③ (kA rms)			10	10	8	15	15	15	15	15
Nominal operating short circuit breaking capacity - I _{cs} 415V-④ (kA rms)			%100 (240V-)		%75	%75	%75	%100	%100	%75
Rated short circuit making capacity-I _{cm} 415 V-kA peak			74	143①	52	32	52	52	52	52
Breaking duration (in short circuit)	ms		<7		<10	<10		<10	<10	<10
Category (EN 60947-2 / IEC 60947-2)			A		A	A		A	A	A
Thermal fixed - magnetic fixed										
Thermal adjusted - magnetic fixed										
Thermal adjusted - magnetic adjusted			—		—	—		—	—	—
Thermal fixed - magnetic adjusted			—		—	—		—	—	—
Microprocessor unit (Electronic)			—		—	—		—	—	—
Residual current threshold (only for F12R)	mA		—		—	—		—	—	30-100-300
Residual Current time delay (only for F12R)	ms		—		—	—		—	—	50-150-300
Current limiting										
Mechanical life	Operation		>15.000		>15.000	>15.000		>15.000	>15.000	>15.000
Electrical life	Operation		3000		3000	3000		3000	3000	3000
Weight	kg		0,85		0,40	0,95		1 / 1,5	1	1,7
Minimum connection sections⑤	mm ²		2,5,2,5,4,6,10,10,16,25,35,50,70,95,95		2,5,2,5,4,6,10,10,16,25,35,50	2,5,2,5,4,6,10,10,16,25,35,50		2,5,2,5,4,6,10,10,16,25,35,50,70	2,5,2,5,4,6,10,10,16,25,35,50,70	2,5,2,5,4,6,10,10,16,25,35,50,70
MCCB line / load terminal width	mm		20,5 / 19,7		12,6 / 12,6	12,6 / 12,6		14,6 / 14,6	14,6 / 14,6	14,6 / 14,6
Minimum - maximum tightening torque	Nm		7 - 10		4 - 6	4 - 6		4 - 6	4 - 6	4 - 6
Undervoltage release⑥			—						—	
Shunt trip release ⑥			—						—	
Auxiliary contact block⑥			—						—	
Motor control mechanism			—		—	—		—	—	—
Extended rotary handle			—		—	—		—	—	—
Lock Mechanism with key			—							
Extension bar										
Terminal cover			—							
Inverser (mechanical) lock			—		—	—		—	—	—
Phase separator			—							
Extension handle			—		—	—		—	—	—
Dimensions		a (mm)	40		30,4	76		90	90	120
		b (mm)	169		140,6	171		120,5	120,5	156,5
		c (mm)	90		76	75		77	77	77

■ standart, □ sipariş üzerine yapılan.

① Değeri için ürünlere ait teknik karakteristik tablolarına bakınız.

② I_{cu}: O-t-CO testi (O : Kesme manevrası,

CO : Kapama manevrası, t : Bekleme süresi)

③ Devre kesicinin iki kutbu seri bağlanmış durum için.

④ I_{cs} : O - t - CO - t - CO testi (O : kesme manevrası,










CO : kapama manevrası, t : bekleme süresi)

⑤ Bağlantı kesitleri TS EN 60947-1 standardına uygun olarak verilmiştir.

⑥ Devre kesicilerde aksesuarlar, ön kapak açılarak kullanıcı tarafından kolayca takılabilir.

⑦ 16,20,25,32,40A için ani açma akımı 600A'dır.

MOLDED CASE CIRCUIT BREAKERS

													
F21	F31	F32	F33	F31S	F51	F52	F53	F61	F62	F61S	F71	F82	F83
16,20,25,32,40,50,63,80,100,125,160	16,20,25,32,40,50,63,80,100,125,160,200,225,250			160,200,225,250	125,160,200,225,250,300,400			300,400		300,400	300,400,500,630,800	400,500,630,800	
3	3			3	3, 4			3		3	3	3, 4	
415	415			415	415			415		415	415	415	
750	750			750	750			750		750	750	750	
8	8			8	8			8		8	8	8	
3.000	3.000			3.000	3.000			3.000		3.000	3.000	3.000	
(0,7-1)In	(0,7-1)In			Fixed	(0,7-1)In			(0,7-1)In		Fixed	(0,7-1)In	(0,7-1)In	⑧
① 8xIn or (5-10)xIn	① 8xIn or (5-10)xIn			8xIn	(4-10)In			(5-10)xIn		10xIn	(5-10)xIn	(5-8)In	
50	65 85 100			65	65 85 100			35 65		35	42	75 100	
25	35 50 70			35	35 50 70			35 50		25	35	50 70	
20	25 32 40			25	25 35 50			20 25		20	30	30 50	
12	18 22 25			18	20 25 40			12 18		12	25	20 42	
8	12 13 14			12	14 16 18			8 12		8	20	20 25	
15	22 22 22			22	22 22 22			15 22		15	20	20 20	
%100	%100 %100 %100			%100	%100 %100 %75			%100 %75		%100	%75	%100 %75	
53	74 105 154			74	74 105 154			52 74		74	74	105 154	
<10	<7			<7	<7			<10		<10	<10	<10	
A	A			A	A			A		A	A	A	
□	□			■	□			□		□	□	□	
□	□			—	□			□		□	□	□	
□	□			—	■			■		■	■	■	
—	—			—	□			□		□	□	□	
—	—			—	—			—		—	—	—	
—	—			—	—			—		—	—	—	
—	—			—	—			—		—	—	—	
□	□			□	□			□		□	—	□	
>15.000	>15.000			>15.000	>15.000			> 15.000		> 15.000	> 15.000	> 15.000	
3000	3000			3000	3000			3000		3000	3000	3000	
1,1	2,3			2,3	5			5,8		5,8	8	10	
2,5,2,5,4,6,10,10,16,25,35,50,70	2,5,2,5,4,6,10,10,16,25,35,50,70,95,120			2,5,2,5,4,6,10,10,16,25,35,50,70,95,120	50,70,95,95,120,185,240			185,240		185,240	185,240,2(30x5),2(40x5),40x12	240,2(30x5),2(40x5),40x12	
17,9 / 17,9	23,5 / 25,5			23,5 / 23,5	25 / 25			31 / 30,7		31 / 30,7	52,8 / 52,5	52,4 / 52,4	
4 - 6	7 - 10			7 - 10	18 - 25			18 - 25		18 - 25	30 - 40	30 - 40	
□	□			—	□			□		□	□	□	
□	□			—	□			□		□	□	□	
□	□			—	□			□		□	□	□	
—	□			—	—			—		—	□	□	
—	□			—	□			—		—	□	□	
□	□			□	□			□		□	□	□	
□	□			□	□			□		□	□	□	
■	■			■	■			■		■	■	■	
—	□			—	—			—		—	□	□	
■	■			■	■			□		□	□	□	
—	—			—	—			□		□	■	■	
90	106				105			140			210	210	
155,7	166				255			257			270	286	
75	98,5				113			114			125	125	

• ⑥ Accessories can be easily mounted by the user by opening the front cover of circuit breakers. (Plug-In)

• ⑦ In 16A....50A, 600A magnetic opening limit is standard.

• ⑧ 800A de 500-800A thermal adjustment area is standard

• ⑨ Adjustment area for 160A is (0,8-1) In

• ⑩ Adjustment area for 125, 160A is (5-10) In - for 400A is (3-8) In

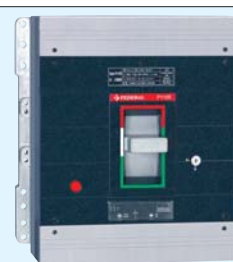
• ⑪ Value at 240V~ for F01 - F02 type breakers

Note: F21 and F31 type of circuit breakers are manufactured as with fixed thermal magnetic or adjustable thermal-magnetic ((5-10)In) depending on request.

MOLDED CASE CIRCUIT BREAKERS

Electronic Circuit Breakers

• ⑦ 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.

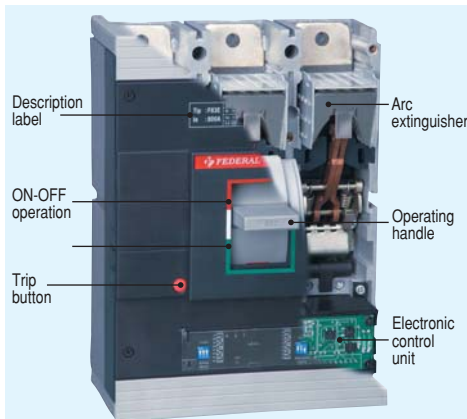


Type		F82E	F83E	F91E	F92E	F101E	F102E	F111E	F112E
Rated current - I _n	A	300,400,500,630,800		1000,1250		1000,1250,1600		1600,2000,2500	
Number of poles		3, 4		3, 4		3		3	
Rated operating voltage - U _e (a.c.) 50-60 Hz	V	415		415		415		415	
Rated insulation voltage - U _i (a.c.) 50-60 Hz	V	750		750		750		750	
Rated impulse withstand voltage - U _{imp}	kV	8		8		8		8	
Test voltage (1 min) (a.c.) 50-60 Hz	V	3.000		3.000		3.000		3.000	
Rated current adjustment area - I ₁	A	(0,4-1)I _n		(0,4-1)I _n		(0,4-1)I _n		(0,4-1)I _n	
Instant opening current adjustment area - I ₂	① A	(2-10)I ₁		(2-10)I ₁		(2-10)I ₁		(2-10)I ₁	
Highest nominal short circuit breaking capacity - I _{cu}	②								
(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)		35	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
(d.c.) 250 V ③ (kA rms)		—	—	—	—	—	—	—	—
Nominal operating short circuit breaking capacity - I _{cs}	~ ④ (kA rms)	%100	%75	%50	%50	%50	%50	%100	%50
Rated short circuit making capacity - I _{cm} 415 V 415 V-kA peak		105	154	105	143	105	143	105	143
Breaking duration (in short circuit)	ms	<10		<20		<20		<20	
Category (EN 60947-2 / IEC 60947-2)		A		A		A		A	
Thermal fixed - magnetic fixed		□		□		□		□	
Thermal adjusted - magnetic fixed		□		□		□		□	
Thermal adjusted - magnetic adjusted		■		■		■		■	
Thermal fixed - magnetic adjusted		□		□		□		□	
Microprocessor unit (Electronic)		■		■		■		■	
Current limiting	⚡	■ ⚡ ⑦		— ⑦		■ ⚡ ⑦		■ ⚡ ⑦	
Mechanical life	Operation	> 15.000		>15.000		>15.000		> 15.000	
Electrical life	Operation	3000		3000		3000		3000	
Weight	kg	10		18,5		27		54	
Minimum connection sections⑤	mm ²	185,240,2(30x5), 2(40x5),40x12		40x15 , 2(40x12)		2(40x10),2(40x15)		80x15 , 2(80x10), 2(80x15)	
MCCB input / output terminal weight	mm	52,4 / 52,4		45,7 / 45,7		46,5 / 46,5		85,5 / 85,5	
Minimum - maximum tightening torque	N	30 - 40		35 - 50		35 - 50		35 - 50	
Undervoltage release⑧	m	□		□		□		□	
Shunt trip release ⑧		□		□		□		□	
Auxiliary contact block⑧		□		□		□		□	
Motor control mechanism		□		□		□		□	
Extended rotary handle		□		□		—		—	
Lock Mechanism with key		□		□		■		■	
Extension bar		□		■ ⑥		■ ⑥		■ ⑥	
Terminal cover		■		■		■		■	
Inverser (mechanical) lock		□		□		—		□	
Phase separator		□		□		□		—	
Extension handle		■		■		■		■	
Dimensions		210		210		210		392	
		286		375		395		568	
		125		142,5		170		265	

- ■ standard, □ upon request.
- ① see technical characteristic tables for products with value.
- ② Icu: O-t-CO test (O: Open maneuver, CO: Close - Open maneuver, t: Waiting duration)
- ③ For serial connected two poles of the breaker.
- ④ Ics: O - t - CO - t - CO test (O: Open maneuver, CO: Close - Open maneuver, t: Waiting duration)
- ⑤ Connection sections are given in accordance with EN 60947-1 standard.

- ⑥ F91E,F92E,F101E,F102E,F111E and F112E type circuit breakers are manufactured with long busbar as the standard.
- ⑦ 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.
- ⑧ Accessories can be easily mounted by the user by opening the front cover of circuit breakers. (Plug-In)

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) x 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, $>3 \times I_n$:

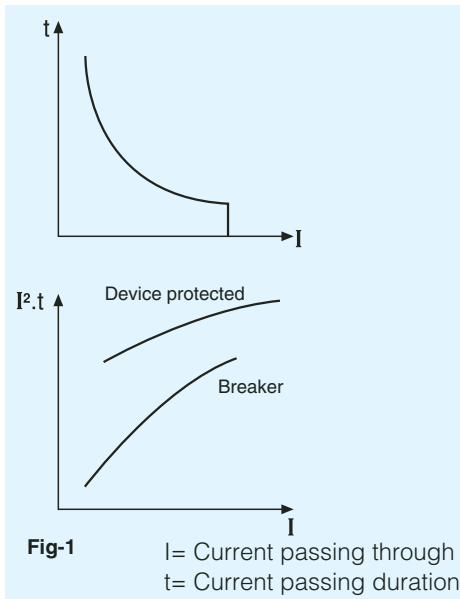


Fig-1

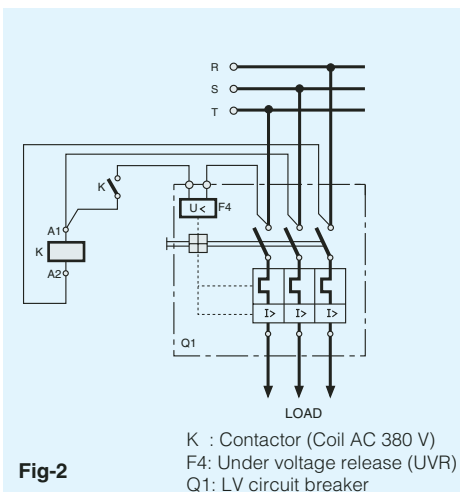


Fig-2

MOLDED CASE CIRCUIT BREAKERS

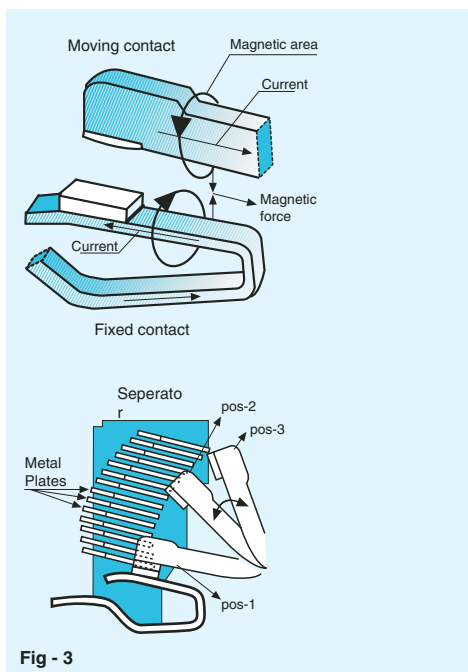


Fig - 3

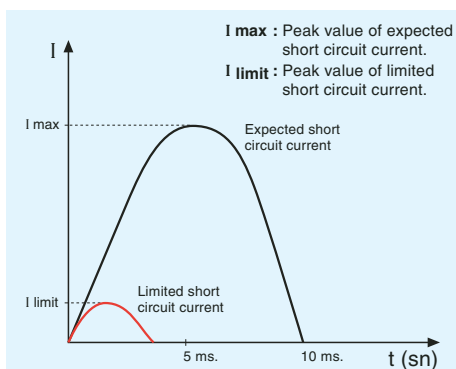
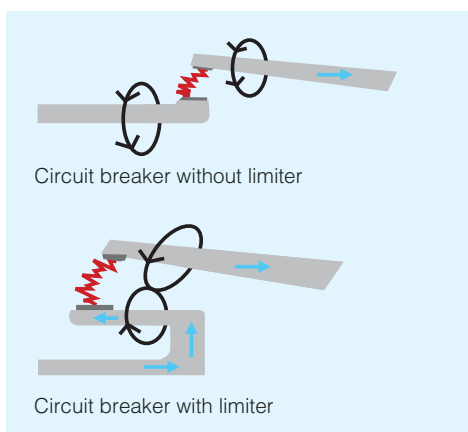


Fig - 4



The only 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.

(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 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. Federal electronic circuit breakers can be connected to computer through RS-232 protocol upon request. In this way;

- 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.

MOLDED CASE CIRCUIT BREAKERS

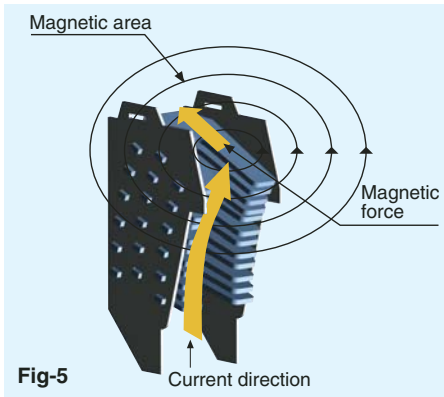


Fig-5

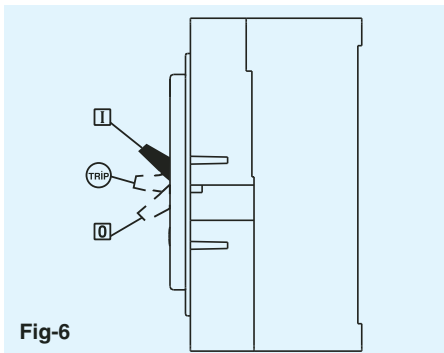


Fig-6

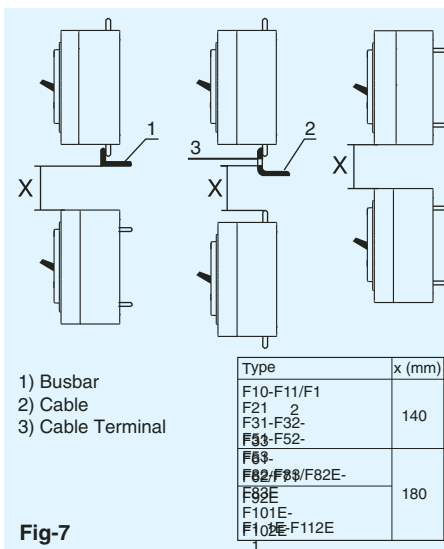


Fig-7

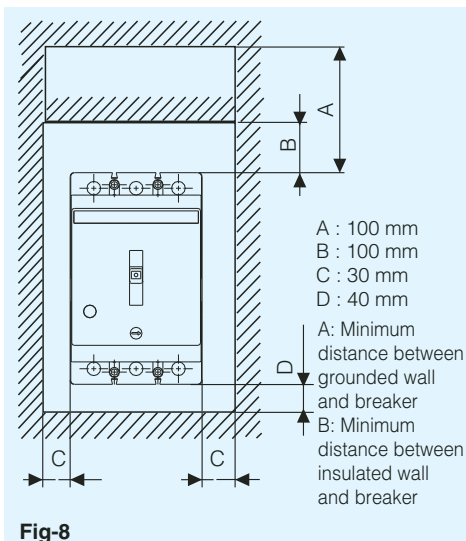


Fig-8

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 extinguish the arc which is formed during operation of the breaker operating under energy. While moving 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.

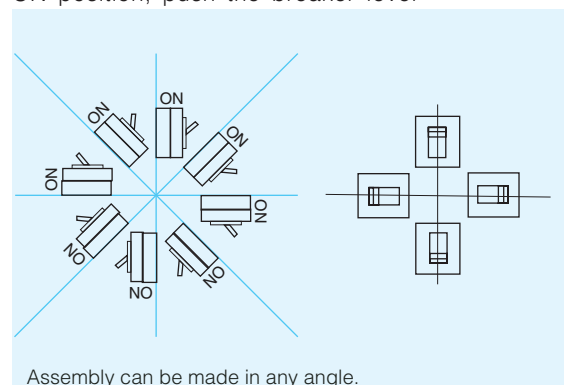
TRIP Position: It indicates that the breaker is opened due to any failure (over load or short circuit). In this case, breaker lever is in the middle position between ON and OFF positions. In order to take the breaker, which is in trip position, to ON position; push the breaker lever

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.

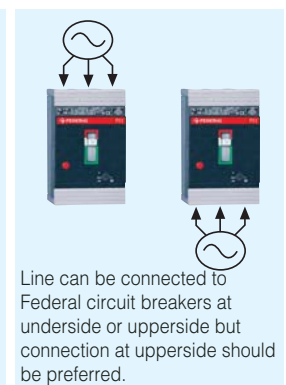
OFF/O Position: It indicates that contacts of the breaker are open. In this way, the breaker lever is in the bottom position.

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 factor 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.



Assembly can be made in any angle.



Line can be connected to Federal circuit breakers at underside or upperside but connection at upperside should be preferred.

MOLDED CASE CIRCUIT BREAKERS

EARTH - LEAKAGE CIRCUIT BREAKER (ELCB)



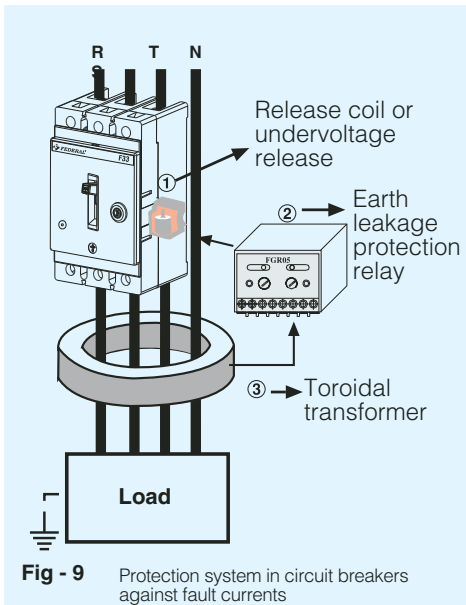
Against earth leakage currents resulting from the low voltage circuits, with combination of fault current sensor relay and toroidal transformer are detected and the protection can be achieved by controlling of shunt trip coil or under voltage release coil on the mounted circuit breakers, such as protection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

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

Protection System Against Earth Leakage Protection Relay

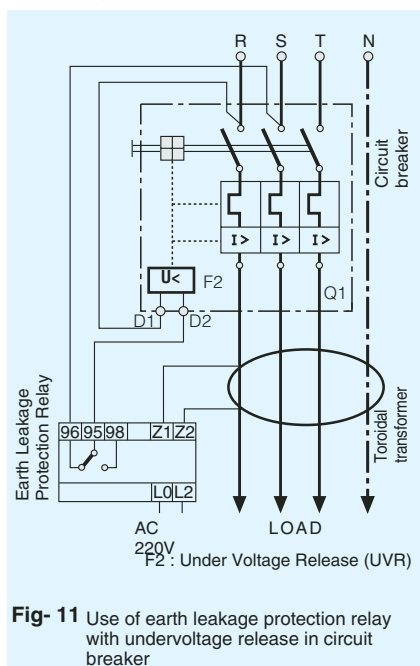
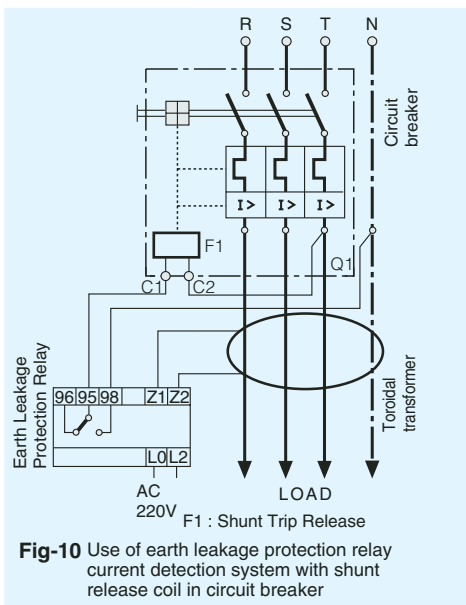


Even small values ($>30\text{mA}$) of ground fault currents to occur in electrical circuits are quite dangerous in terms of safety of life and fire. As normal breakers cannot detect such small earth leakage protection relay, no additional protection is provided against ground leakages. Earth leakage protection relay can be added to electronic breakers without an additional mechanism. With this system, protection at $(0,1-1)\times I_n$ 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. 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 $(300-500)\text{mA}$ 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).



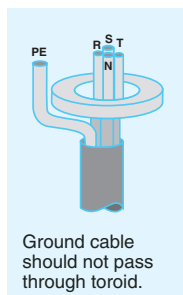
MOLDED CASE CIRCUIT BREAKERS

Important considerations in assembly:

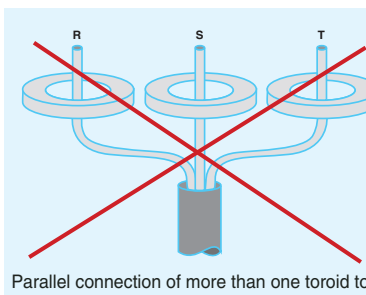
- Cables should pass through center of the toroidal transformer to the extent possible.
- Toroids with appropriate diameters should be utilized. Utilization of toroids with higher diameters shall reduce sensitivity.

Different Connections:

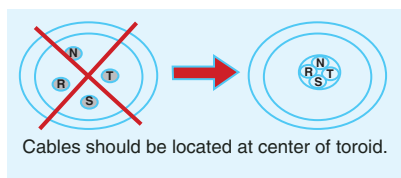
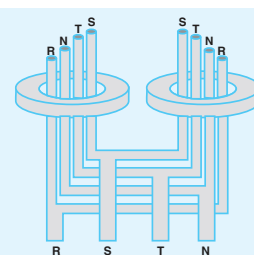
- If cables cannot pass through a toroid with high diameter, several toroids can be connected parallel to the same ground detection relay. However, this transaction reduces sensitivity of the device and increases opening threshold.
- If it is not possible to place the toroid around primary busbars, it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



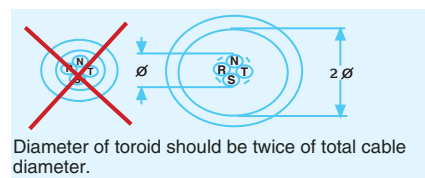
Ground cable should not pass through toroid.



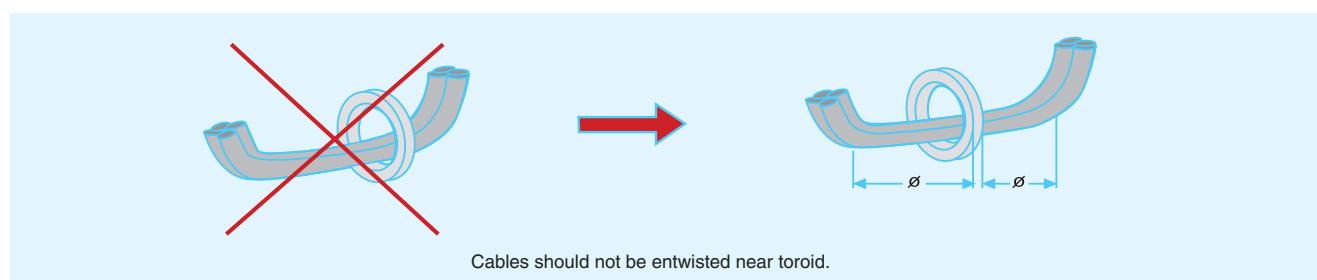
Parallel connection of more than one toroid to a single fault current detection coil.



Cables should be located at center of toroid.



Diameter of toroid should be twice of total cable diameter.



Cables should not be entwisted near toroid.

Earth Leakage Protection Relays



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	Manual / Electrical (Remote)
Current tolerance	0,5-1- $I_{\Delta n}$
Time tolerance	$\pm 15\%$
Time Characteristics	Fixed
Temperature	Storage -20 / 70°C
	Working -20 / 60°C
Humidity	Humidity / RH without liqu
Installation	Pano / 35 mm DIN - RAY

Toroidal Transformer



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	Order Code
60 mm	8AT-R0000-0060
110 mm	8AT-R0000-0110
160 mm	8AT-R0000-0160
210 mm	8AT-R0000-0220

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 In (A)	Rated current adjustment area I1 (A)	Short circuit opening current I2 (A)	Type	Order code	Type	Order code	Type	Order code
16 - 40 50 - 125	Fixed	600A 10 In	F10 20kA	9AM-TDS43-0□□□	F11 25kA	9AM-TSS43-0□□□		
16 - 40 50 - 160	(0,8-1)In (0,8-1)In	600A 10 In	F12 25kA	9AR-TSS43-0□□□	F12R 25kA	9AR-TSS43-0□□□		
16 - 25 32 - 125 160	(0,7-1)In (0,7-1)In (0,8-1)In	200A 8 In 8 In	F21 25kA	9AA-TSS43-0□□□				
16 - 25 32 - 250 160 - 250	(0,7-1)In (0,7-1)In (0,7-1)In	200A 8 In (5-10) In	F31 35kA	9AB-TSS43-0□□□	F32 50kA	9AB-TMS43-0□□□	F33 70kA	9AB-THS43-0□□□
125 - 200 225 - 400	(0,7-1)In (0,7-1)In	(5-10) In (4-10) In	F51 35kA	9AD-TSS43-0□□□	F52 50kA	9AD-TMS43-0□□□	F53 70kA	9AD-THS43-0□□□
300 - 400	(0,7-1)In (0,7-1)In	(5-10) In	F61 25kA	9AP-TSS43-0□□□	F62 35kA	9AP-TMS43-0□□□		
400 - 800	(0,7-1)In		F71 35kA	9AF-TSS43-0□□□				
	(0,7-1)In	(5-8) In	F82 50kA	9AG-TMS43-0□□□	F83 70kA	9AG-THS43-0□□□		

□□□: Please 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 In (A)	Rated current adjustment area I1 (A)	Short circuit opening current I2 (A)	Type	Order code	Type	Order code	Type	Order code
16 - 32 40 - 63 80 - 125 160	(0,7-1)In (0,7-1)In (0,7-1)In (0,8-1)In	160A 5 In 4 In 4 In	F21 25kA	9AA-TSJ43-0□□□				
16 - 32 40 - 63 80 - 250	(0,7-1)In (0,7-1)In (0,7-1)In	160A 5In 4 In	F31 35kA	9AB-TSJ43-0□□□	F32 50kA	9AB-TMJ43-0□□□	F33 70kA	9AB-THJ43-0□□□

•: Please enter amper value

Short circuit current of a generator

Srg rated power (kVA)
 Ur rated voltage (V)
 Ikg short circuit current (A)
 Irg rated current (A)
 Xd% temporary reactance (%)
 (Reactance observed around 5-20% of the impedance value for 5-30 ms)

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
16 - 20 32 - 125 160	(0,7-1) I_n (0,7-1) I_n (0,8-1) I_n	200A 10 I_n 10 I_n	F21 25kA	9AA-TSM43-0□□□				
16 - 20 32 - 250	(0,7-1) I_n	200A 10 I_n	F31 35kA	9AA-TSM43-0□□□	F32 50kA	9AB-TMM43-0□□□	F33 70kA	9AB-THM43-0□□□

□□□: Please enter amper value

Motor Power		Motor Rated Current	Breaker Rated Current
(kW)	(Hp)	(A)	(A)
5,5	7,5	11,5	16
9	12	18,5	20
11	15	22,5	25
15	20	30	32
18,5	25	36	40
22	30	43	50
30	40	58	63
37	50	72	80
40	54	79	100
51	70	98	100

Motor Power		Motor Rated Current	Breaker Rated Current
(kW)	(Hp)	(A)	(A)
59	80	112	125
80	110	147	160
100	136	188	200
132	175	243	250
140	190	260	300
160	220	292	300
200	270	368	400
250	340	465	500
315	430	580	630

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-□□□□	F83E 70kA	9AG-EHS43-□□□□
1000 - 1250			F91E 50kA	9AG-EMS43-□□□□	F92E 65kA	9AG-EHS43-□□□□
1000 - 1600			F101E 50kA	9AI-EMS43-□□□□	F102E 70kA	9AI-EHS43-□□□□
1600 - 2500			F111E 50kA	9AG-EMS43-□□□□	F112E 70kA	9AG-EHS43-□□□□

Delay time of the short circuit opening current (when required) can be adjusted as t_2 : 100-150-200-250-300-350-400 ms..

□□□: Please enter amper value

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□□□
16 - 40 50 - 125		500A 10 I_n	F11M 25kA	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 idler, 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.

MAX.CURRENT LOAD CAPACITY OF PRODUCTS IN DIFFERENT CONDITIONS:

Current load capacity of device decrease if the operating temperature is exceed to given value on indoor conditions. Standard Circuit breakers was calibrated for 40 °C. Values in the chart show the highest operating currents to be applied as a function of the ambient temperature. Increase in ambient temperature of the breaker shall result in decrease in allowed operating current of the breaker. Therefore, by considering the ambient temperature of the breaker, the rated current should be calibrated according to ambient temperature or the circuit breaker should be selected according to operating currents suitable for the value in the table. If the breaker is operated in an environment with a temperature higher than the calibrated ambient temperature, it opens earlier than the nominal values. If it is operated in a colder environment, it opens later than the nominal values.

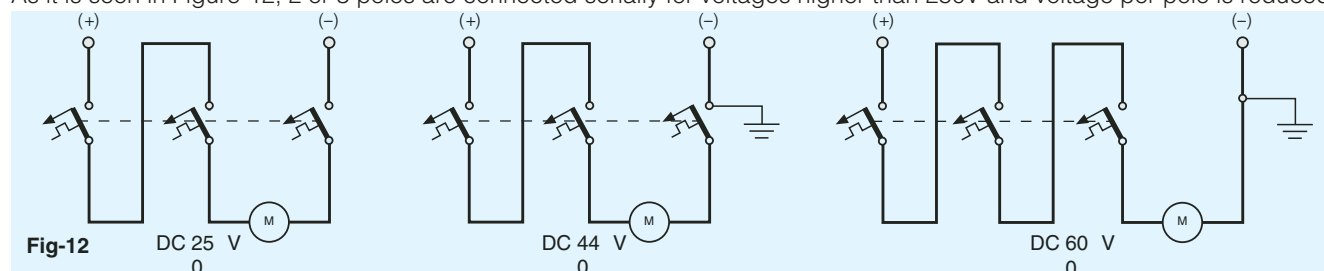
In(A)	20° C	30° C	40° C	50° C	60° C
Thermal-Magnetic Circuit Breakers					
16	17,1	16,6	16,0	15,2	14,6
20	21,4	20,8	20,0	19,0	18,2
25	26,7	26,0	25,0	23,8	22,8
32	34,2	33,3	32,0	30,4	29,1
40	42,8	41,6	40,0	38,0	36,4
50	53,5	52,0	50,0	47,5	45,5
63	67,4	65,5	63,0	59,9	57,3
80	85,6	83,2	80,0	76,0	72,8
100	107,0	104,0	100,0	95,0	91,0
125	133,8	130,0	125,0	118,8	113,8
160	171,2	166,4	160,0	152,0	145,6
200	214,0	208,0	200,0	190,0	182,0
200	240,8	234,0	225,0	213,8	204,8
250	267,5	260,0	250,0	237,5	227,5
300	321,0	312,0	300,0	285,0	273,0
400	428,0	416,0	400,0	380,0	364,0
500	535,0	520,0	500,0	475,0	455,0
630	674,1	655,2	630,0	598,5	573,3
800	856,0	832,0	800,0	760,0	728,0

Example: Highest operating current of an F31 type circuit breaker with 100 A rated current calibrated to 40°C would be 95 A in an environment of 50°C.

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

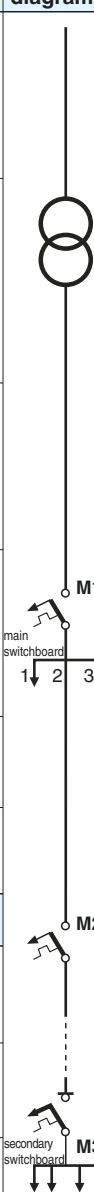
Calculation of short circuit at any point of the line:

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

R_t: Total resistance (mW)
X_t: 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)	Single line diagram	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	$R_1= \frac{400^2}{500} \times 0.15 \times 10^{-3}$ R1=0.05 mW	$X_1= \frac{400^2}{500} \times 0.98 \times 10^{-3}$ X1=0.31 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)	$X_2= \frac{Z_2^2-R_2^2}{2 \times R_2}$ $Z_2= \frac{U_{sc}}{100} \times \frac{U^2}{S}$ Z2= impedance of transformer		Transformer S=800 kVA Usc=% U=400 V Pc=9700 W	$R_2= \frac{9700 \times 400^2 \times 10^{-3}}{800^2}$ R2=2.42 mW	$X_2= \sqrt{\left(\frac{6}{100} \times \frac{400^2}{800}\right)^2 - (2.42)^2}$ X2=11.75 mW
Cables (1)	$R_3= \frac{L}{k \cdot S} \times 10^3$ k=56 (Cu) or 36 (Al) k=self-conductivity $\left(\frac{m}{Wmm^2}\right)$	$X_3=0.07L$ (tri-phase cables) $X_3=0.15L$ (mono-phase cables) L : cable length (m) S : cable section (mm ²)		Connection cables From transformer to Circuit breaker 2 (3x240) mm2 Copper per phase L=4 m	$R_3= \frac{4 \times 10^3}{56 \times 240 \times 2}$ R3=0.14 mW	$X_3= 0.07 \times \frac{4}{2}$ X3=0.14 mW
Busbars	$R_3= \frac{L}{k \cdot S} \times 10^3$ k=56 (Cu) or 36 (Al) k=self-conductivity $\left(\frac{m}{Wmm^2}\right)$	$X_3=0.15 L$ L : busbar length (m) S : busbar section (mm ²)		circuit breaker	R4=0	X4=0
Circuit breaker	R4 negligible	X4 negligible		output busbar no2 (Al) 10x80 mm2 Per phase L=3 m	$R_5= \frac{3 \times 10^3}{36 \times 800}$ R5=0.10 mW	$X_5=0.15 \times 3$ X5=0.45 mW
Calculation of short circuit currents (kA)					circuit breaker	R6=0
M1	Rt1=R1+R2+R3 Rt1=2.61	Xt1=X1+X2+X3 Xt1=12.2		Connection between secondary panel and primary low voltage panel (cables)(3x185 mm copper per phase L= 70 m	$R_7= \frac{70 \times 10^3}{56 \times 185}$ R7=6.75 mW	$X_7=0.07 \times 70$ X7=4.9 mW
M2	Rt2=Rt1+R4+R5 Rt2=2.71	Xt2=Xt1+X4+X5 Xt2=12.65				
M3	Rt3=Rt2+R6+R7 Rt3=9.46	Xt3=Xt2+X6+X7 Xt3=17.55				
(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 ²) 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	1	1	1	2	4	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	2	2	1	1	1	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	

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 ²) 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	

Example:

A value (67m) lower than 70 m cable length is selected on the row corresponding to 95 mm² cable (Cu) section in 380V panel. Short circuit current to occur 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.

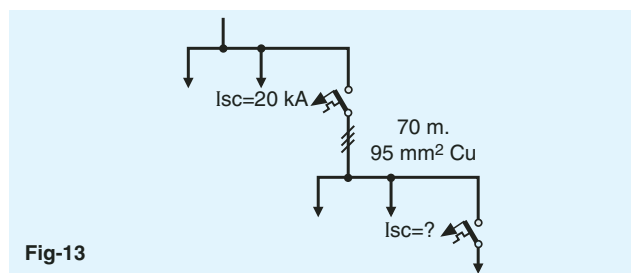


Fig-13

MOLDED CASE CIRCUIT BREAKERS

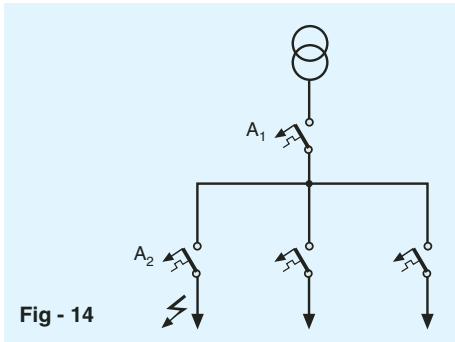


Fig - 14

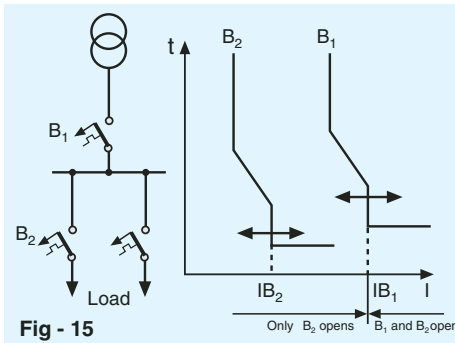


Fig - 15

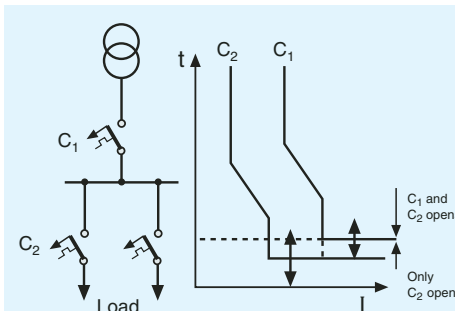
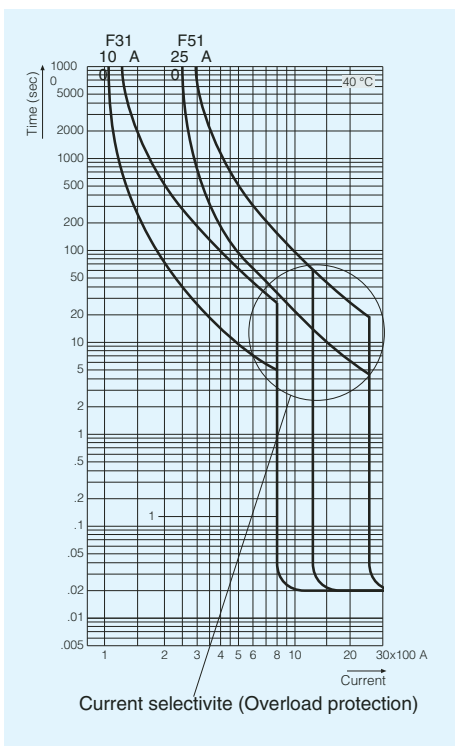


Fig - 16



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 $1.05I_n$,
Should open within 2 hours at $1.3I_n$.
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 $1.25I_n$.
Should open within 3 hours at $1.6I_n$.
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.

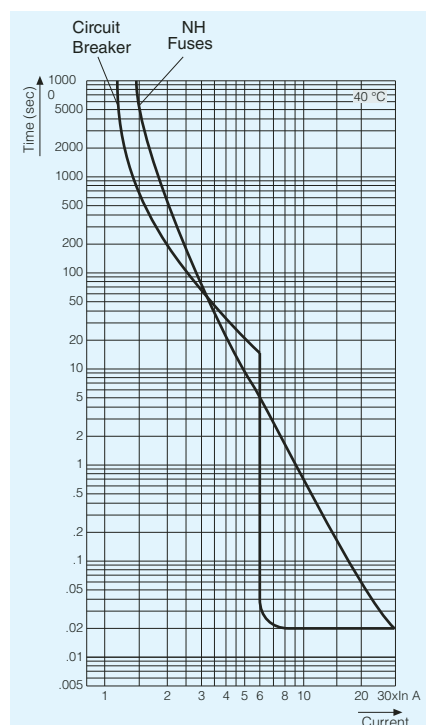


Fig-17

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

MOLDED CASE CIRCUIT BREAKERS

		Network protection circuit breaker																							
Load side I _l (A) ↓	Transformer side I _n →	F21-F22/ 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 F10-F11 F12 F21-F22 F31-F32-F33	16																								
	25																								
	32																								
	40																								
	50																								
	63																								
	80																								
	100																								
	125																								
	160																								
	200																								
Motor protection circuit breaker F10-F11 F12 F21-F22 F31-F32-F33	16																								
	25																								
	32																								
	40																								
	50																								
	63																								
	80																								
	100																								
	125																								
	160																								
	200																								
Generator protection circuit breaker F10-F11 F12 F21-F22 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 _l (A) ↓	Transformer side I _n (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
Network protection circuit breaker F51-F52-F53 F61-F62 F71 F82-F83	200																
	250																
	300																
	400																
	500																
	630																
	800																
Motor protection circuit breaker F51-F52-F53 F61-F62 F71 F82-F83	200																
	250																
	300																
	400																
	500																
	630																
	800																
Generator protection circuit breaker F51-F52-F53 F61-F62 F71 F82-F83	200																
	250																
	300																
	400																
	500																
	630																
	800																

		Motor protection circuit breaker															
Load side I _l (A) ↓	Transformer side I _n (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 F82-F83 F82E-F83E	200																
	250																
	300																
	400																
	500																
	630																
	800																
Motor protection circuit breaker F51-F52-F53 F61-F62 F71 F82-F83 F82E-F83E	200																
	250																
	300																
	400																
	500																
	630																
	800																
Generator protection circuit breaker F51-F52-F53 F61-F62 F71 F82-F83 F82E-F83E	200																
	250																
	300																
	400																
	500																
	630																
	800																

MOLDED CASE CIRCUIT BREAKERS

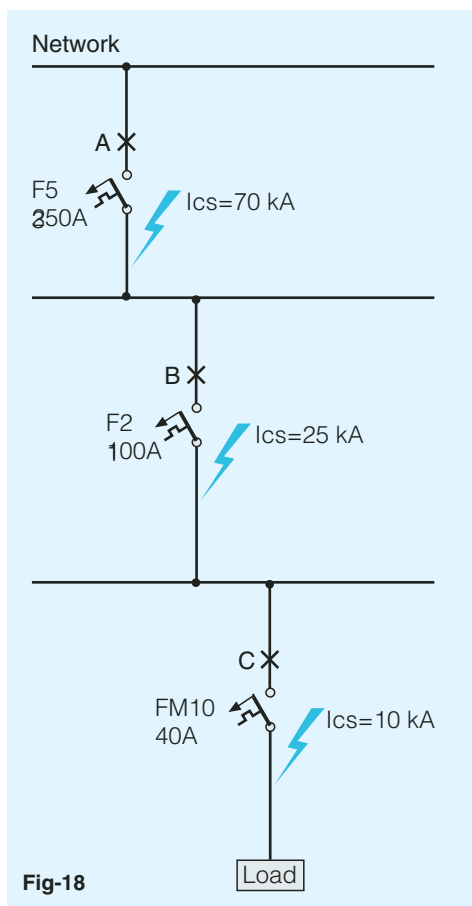


Fig-18

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)

Sequential Connection Table

		Network Side																					
		F10	F11	F21	F61	F12	F31	F51	F62	F71	F32	F52	F82	F91	F101	F111	F92	F102	F112	F33	F53	F83	
		kA	20	25				35				50				65				70			
Load Side	F10	20	-	25	25	20	25	35	25	20	-	45	25	20	-	-	-	-	-	45	25	20	
	F11	25	-	-	-	25	25	35	35	35	35	50	50	50	-	-	-	-	-	70	70	70	
	F21		-	-	-	25	25	35	35	35	35	50	50	50	-	-	-	-	-	70	70	70	
	F61		-	-	-	-	25	35	35	35	35	50	50	50	-	-	-	-	-	-	-	70	
	F12		-	-	-	-	-	35	35	35	35	50	50	50	-	-	-	-	-	70	70	70	
	F31	35	-	-	-	-	-	-	35	35	50	50	50	-	-	-	-	-	-	70	70	70	
	F51		-	-	-	-	-	-	-	35	50	50	50	-	-	-	-	-	-	70	70	70	
	F62		-	-	-	-	-	-	-	-	50	50	50	-	-	-	-	-	-	-	-	70	
	F71		-	-	-	-	-	-	-	-	-	50	50	50	-	-	-	-	-	-	-	-	70
	F32	50	-	-	-	-	-	-	-	-	-	-	-	50	50	50	50	65	70	70	70	70	70
	F52		-	-	-	-	-	-	-	-	-	-	-	-	50	50	50	65	70	70	70	70	70
	F82		-	-	-	-	-	-	-	-	-	-	-	-	50	50	50	65	70	70	-	-	70
F33	-		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	70	
F53	70	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
F83		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	

MOLDED CASE CIRCUIT BREAKERS

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.



F71 Undervoltage Release

Type	Operation Voltage	Working Voltage	Trip Voltage	Order Code
F21	220 V~	> 187 V~	< 154 V ≈	9AA-CA000-0220
	380 V~	> 323 V~	< 266 V ≈	9AA-CA000-0380
F31-F32-F33	220 V~	> 187 V~	< 154 V ≈	9AB-CA000-0220
	380 V~	> 323 V~	< 266 V ≈	9AB-CA000-0380
F51-F52-F53	220 V~	> 187 V~	< 154 V ≈	9AD-CA000-0220
	380 V~	> 323 V~	< 266 V ≈	9AD-CA000-0380
F61-F62	220 V~	> 187 V~	< 154 V ≈	9AE-CA000-0220
	380 V~	> 323 V~	< 275 V ≈	9AE-CA000-0380
F71	220 V~	> 187 V~	< 154 V ≈	9AF-CA000-0220
	380 V~	> 323 V~	< 275 V ≈	9AF-CA000-0380
F91E-F92E	220 V~	> 187 V~	< 154 V ≈	9AH-CA000-0220
	380 V~	> 323 V~	< 275 V ≈	9AH-CA000-0380
F101E-F102E	220 V~	> 187 V~	< 154 V ≈	9AI-CA000-0220
	380 V~	> 323 V~	< 275 V ≈	9AI-CA000-0380
F111E-F112E	220 V~	> 187 V~	< 154 V ≈	9AK-CA000-0220
	380 V~	> 323 V~	< 275 V ≈	9AK-CA000-0380

Note : Circuit breaker does not open when no energy is supplied to undervoltage release.

"—" DC, "≈" AC, "≈" DC-AC

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.



F31-F32-F33
Extended Rotary Handle

Type	Order Code
F31-F32-F33	8AB-G000-0000
F51-F52-F53	8AD-G000-0000
F71	8AF-G000-0000
F82-F83/F82E-F83E	8AG-G000-0000
F91E-F92E	8AH-G000-0000

Note : It's not plug-in

Operating Handle Extention:

F82E - F83E - F91E - F92E - F101E - F102E	8AG-UK100-0000
F111E - F112E	8AG-UK000-0000



Operating Handle Extention

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.



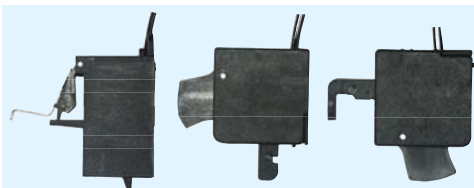
Lock Mechanism with key

Type	Order Code	Type	Order Code
F10-F11-F12	8AL-E0000-0000	F71	8AF-E0000-0000
F21	8AA-E0000-0000	F82-F83/F82E-F83E	8AG-E0000-0000
F31-F32-F33	8AB-E0000-0000	F91E-F92E	8AH-E0000-0000
F51-F52-F53	8AD-E0000-0000	F101E-F102E	Standard
F61-F62	8AE-E0000-0000	F111E-F112E	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 gets 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	F21	F31-F32-F33	F51-F52-F53	F61-F62	F71	F82-F83 F82E-F83E	F91E-F92E	F101E F102E	F111E-F112E
110 V ~	8AM-BA000-0110	8AA-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	8AA-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	8AA-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	8AA-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	8AA-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	8AA-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	8AA-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

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

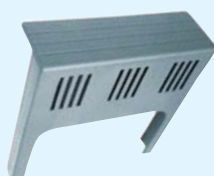
NC : Normally closed contact

Type	Contact equipment NO NC	Operating voltage	Rated current	Order Code
F10-F11-F12	1 1	250 V~	2 A	8AL-A0011-0000
F21	1 1	250 V~	2 A	8AA-A0011-0000
F31-F32-F33	1 1	250 V~	2 A	8AB-A0011-0000
	2 2	250 V~	2 A	8AB-A0022-0000
F51-F52-F53	1 1	250 V~	2 A	8AD-A0011-0000
	2 2	250 V~	2 A	8AD-A0022-0000
F61-F62	1 1	400 V~	4 A	8AE-A0011-0000
F71	1 1	400 V~	4 A	8AF-A0011-0000
	2 2	400 V~	4 A	8AF-A0022-0000
F82 F83/F82E-F83E	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	1 1	400 V~	4 A	8AH-A0011-0000
	2 2	400 V~	4 A	8AH-A0022-0000
F101E-F102E	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	1 1	400 V~	4 A	8AK-A0011-0000
	2 2	400 V~	4 A	8AK-A0022-0000

“—” DC, “~” AC, “” DC-AC



Screws should be removed to mount accessories



F10...F112E

Terminal cover

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	Order code
F10-F11	8AM-F0000-0000
F12	8AR-F0000-0000
F21	8AA-F0000-0000
F31-F32-F33	8AB-F0000-0000
F51-F52-F53	8AD-F0000-0000
F61-F62	8AP-F0000-0000

Type	Order code
F71	8AF-F0000-0000
F82-F83/F82E-F83E	8AG-F0000-0000
F91E-F92E	8AH-F0000-0000
F101E-F102E	8AI-F0000-0000
F111E-F112E	8AK-F0000-0000

MOLDED CASE CIRCUIT BREAKERS

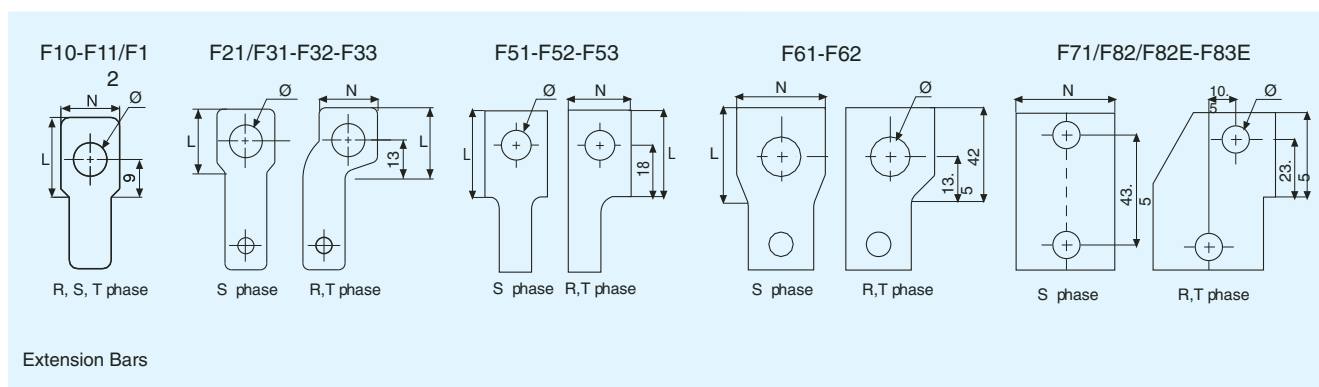
Extension Bars :

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
F10-F11	36	14	3	M8	10	16 A - 125 A	6	8AM-H3000-0125
F12	36	14	3	M8	10	16 A - 160 A	6	8AM-H3000-0125
F21	16	18	3	M8	10	16 A - 160 A	6	8AB-H5000-0125
F31-F32-F33	35	18	5	M8	10	125 - 250 A	6	8AB-H5000-0125
F51-F52-F53	35	25	5	M12	25	160 A - 400 A	6	8AD-H5001-0250
F61-F62	42	38	8	M10	25	300 A - 400 A	6	8AE-H5000-0300
F71 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 ²)	Cable Diameter Ø (mm)	Tightening Torque (Nm)	Bolt Type	Quantity (pieces)
F10-F11/F12	1	2.5...50	6	6	Screwdriver	3
F21/F31-F32-F33	1	2.5...120	12	10	Allen	3
F21/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 extension bars cable locks have 95 mm² 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

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
Operating voltage	220 V AC *
Power	100 W
Opening time	1 s
Closing time	1 s



F71/F82-F83/F82E-F83E/F92E/F101E-F102E Motor Control Mechanisms

F71/F82-F83/F82E-F83E/F92E/F101E-F102E Motor Control Mechanisms:

Technical Specification:

Order Code	
F71	8AF-DA000-0220
F82-F83 / F82E-F83E	8AG-DA000-0220
F91E-F92E	8AH-DA000-0220
F101E-F102E	8AN-DA000-0220
Operating voltage	220 V AC *
Power	100 W
Opening time	4 s
Closing time	3.5 s



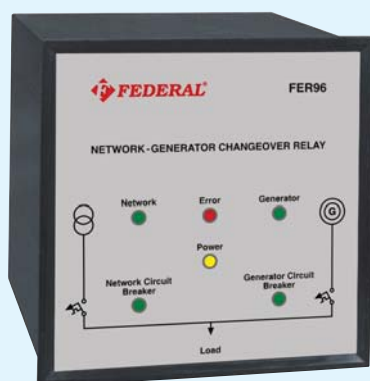
F111E-F112E Motor Control Mechanisms

F111E-F112E Motor Control Mechanisms:

Technical Specification:

Order Code	
F111E-F112E	8AK-DA000-0220
Operating voltage	220 V AC *
Power	500 W
Opening time	1.5 s
Closing time	1.5 s

MOLDED CASE CIRCUIT BREAKERS



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

Generators are very important for facilities, where electrical failures are quite frequent and likely to cause significant damages. Although generator is used, manual enablement of the generator by authorized personnel may last for minutes. Manually enabled generator should be disabled after energy failure ends and network switch is enabled to supply the system from the network. This fact results in both time and labor loss. Elimination of this issue is possible with network-generator automation.

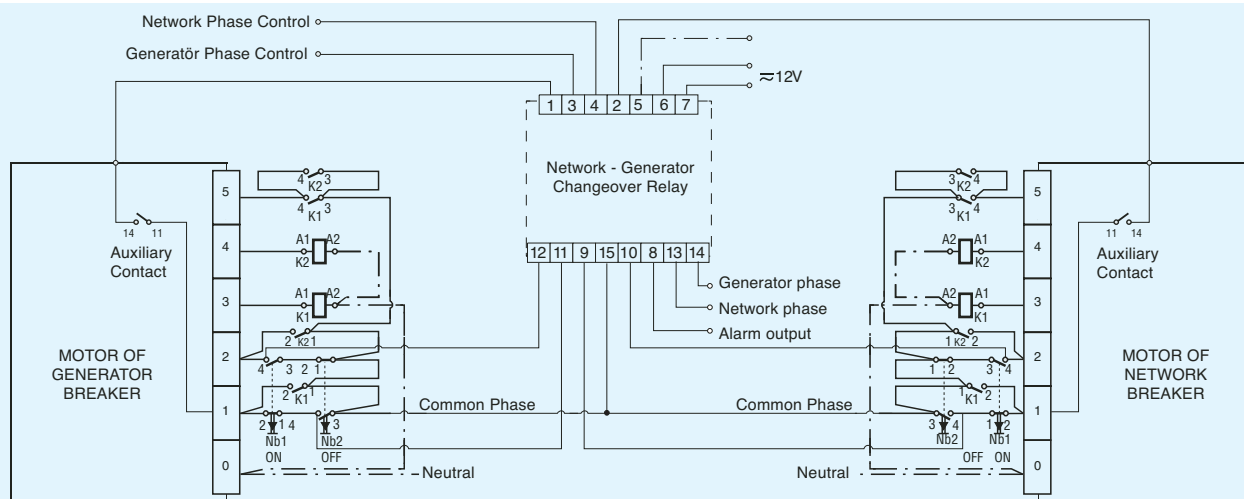
Network - Generator Changeover Relay:

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.

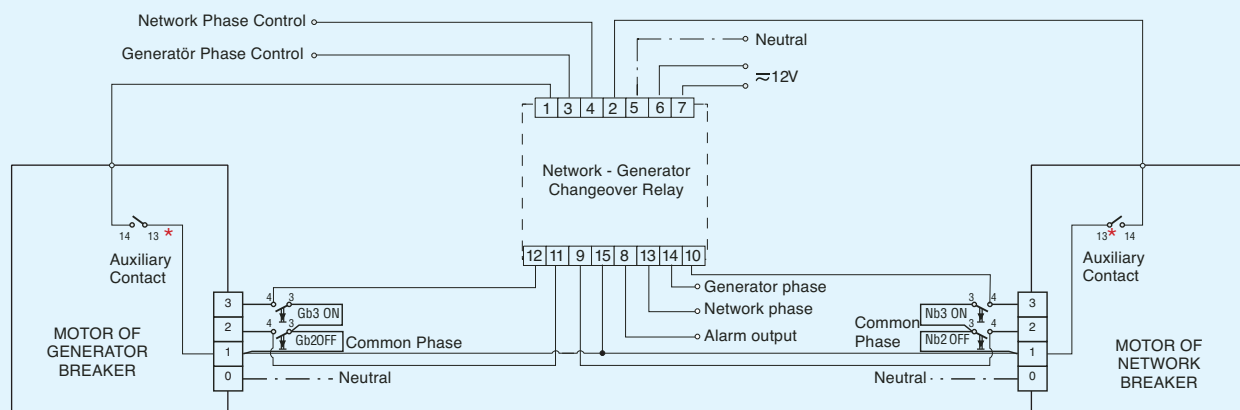
Establishment of network-generator automation, in other words automatic inverter system is both easy and important. Because a fault shall cause enablement of network and generator at the same time, therefore phase intersection and a short circuit. In order to eliminate this possibility of fault and to provide operating safety, mechanical lock is utilized. As locking is made mechanically, not electrically; possibility of ON or OFF position of both circuit breakers due to faults in the control system is totally prevented.

Mechanical Lock Order Codes:

F31	8AB-V0000-0000
F71	8AF-V0000-0000
F82-F83-F82E-F83E	8AG-V0000-0000
F91E-F92E	8AH-V0000-0000
F101E-F102E	8AI-V0000-0000
F111E-F112E	8AK-V0000-0000



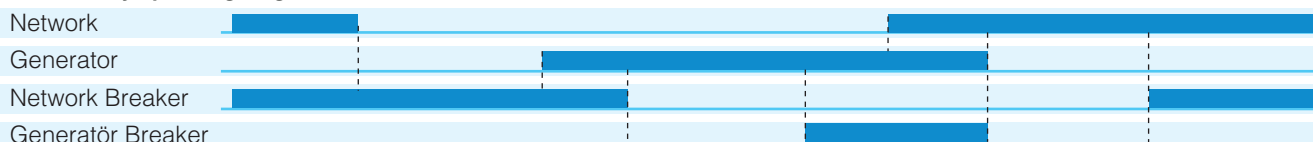
Connection diagram of F31-F32-F33 type circuit breaker with motor mechanism for inverter automation system.



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

Connection diagram of F71/F82-F83/F82E-F83E/F91E-F92E/F101E-F102E/F111E-F112E type circuit breaker with motor mechanism for inverter automation system.

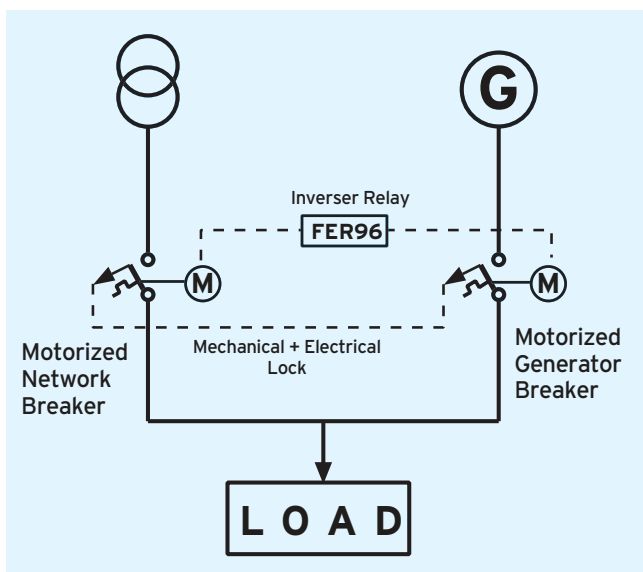
Inverter relay operating diagram:



MOLDED CASE CIRCUIT BREAKERS

Inverter system with motorized MCCB + mechanical lock

F31	8AB-V2000-0000
F71	8AF-V2000-0000
F82-F83-F82E-F83E	8AG-V2000-0000
F91E-F92E	8AH-V2000-0000
F101E-F102E	8AI-V2000-0000
F111E-F112E	8AK-V2000-0000



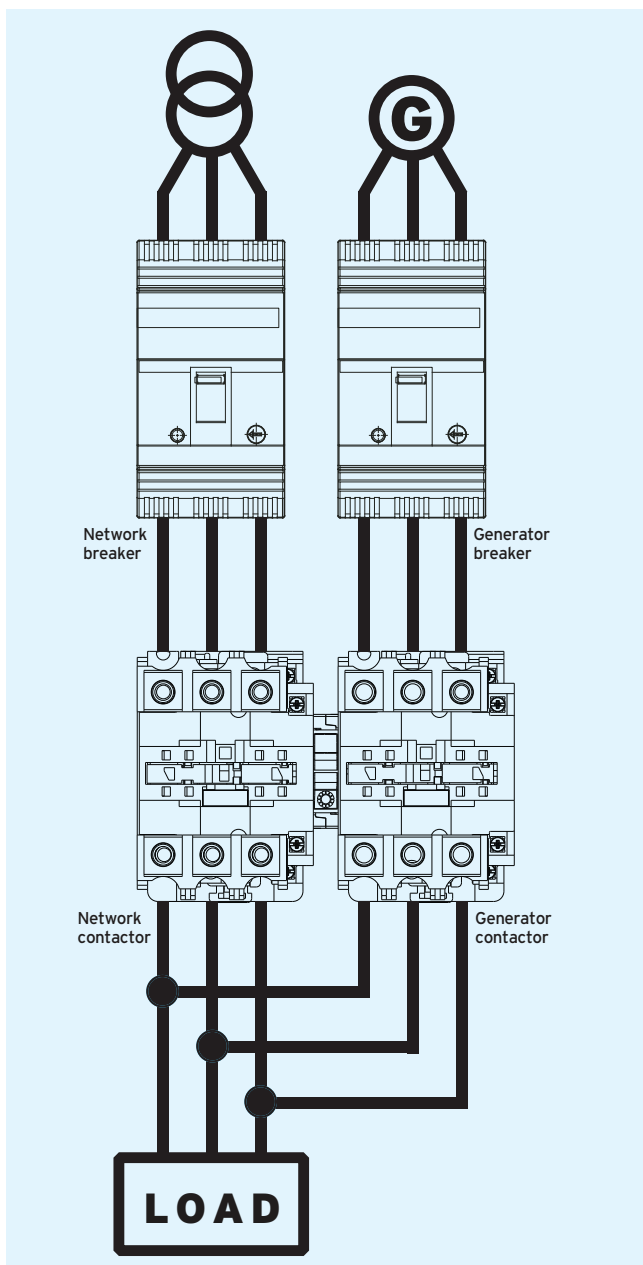
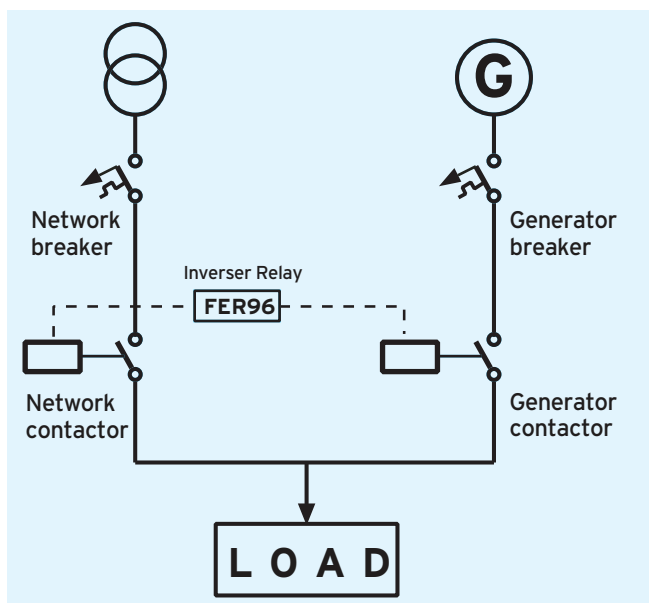
Alternative Inverser

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.

Inverser 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

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



MOLDED CASE CIRCUIT BREAKERS

Automatic Transfer Switches;

In the enterprises where electric 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.

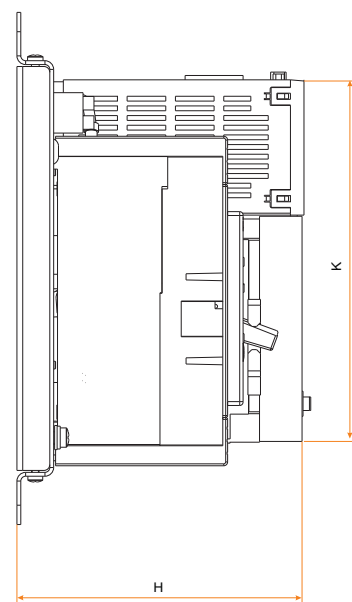
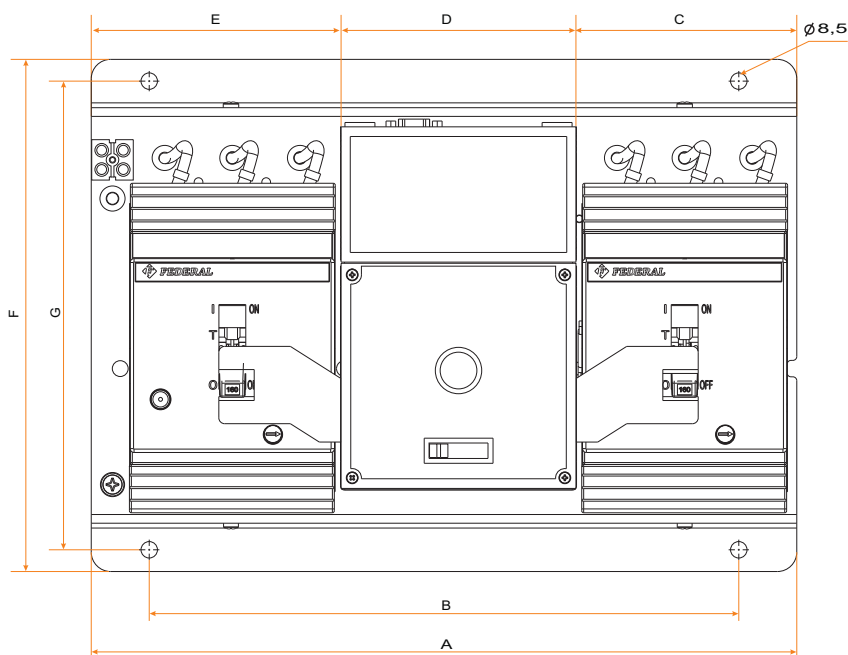
- It can be produced between 16A and 1600A
- In the system that is made by using Federal Automatic Transfer Switch there are manual and automatic control choices.
- Delay time adjustment and transfer time adjustment between 0,1-5 sec. can be made in Federal Automatic Transfer Switch
- In the system that 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.



Technical Features:

Standard	TS EN 60947-6-1
Circuit Breaker Rated Current (In)	16A ~ 1600A
Pole number	3, 4
Operating Voltage	140 - 270V
Transfer time delay	5 - 90 sn. (adjustable)
Rated Operating Voltage	415V
Mechanical Life	10.000
Operating Temperature	-20 ~ +60°C
Protection Class	IP20
Pollution Level	III / 3

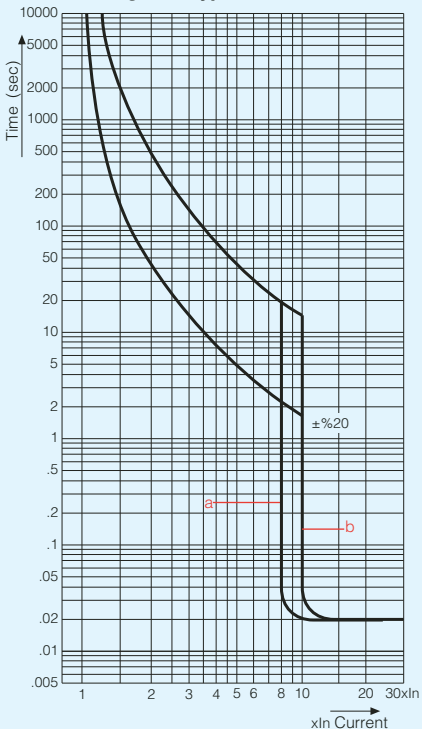
Technical Drawings and Their Ordering Codes



Type	Dimensions									Ordering Codes
	A	B	C	D	E	F	G	H	K	
FATS-F3	380	340	114	122	145	265	242	147	247	8AB-ATS00-0000
FATS-F5	460	419	151	122	187	342	311	206	247	8AD-ATS00-0000
FATS-F5N (4 Pole)	495	454	151	122	221	342	311	206	247	8AD-ATS04-0000
FATS-F7	600	550	219	122	259	346	315	216	247	8AF-ATS00-0000
FATS-F8	600	550	219	122	259	346	315	216	247	8AG-ATS00-0000
FATS-F8N (4 Pole)	740	689	296	122	321	346	315	216	247	8AG-ATS04-0000
FATS-F9	600	550	219	122	259	436	405	235	247	8AH-ATS00-0000
FATS-F9N (4 Pole)	740	689	289	122	329	436	405	235	247	8AH-ATS04-0000
FATS-F10	600	550	219	122	259	436	405	260	247	8AI-ATS00-0000

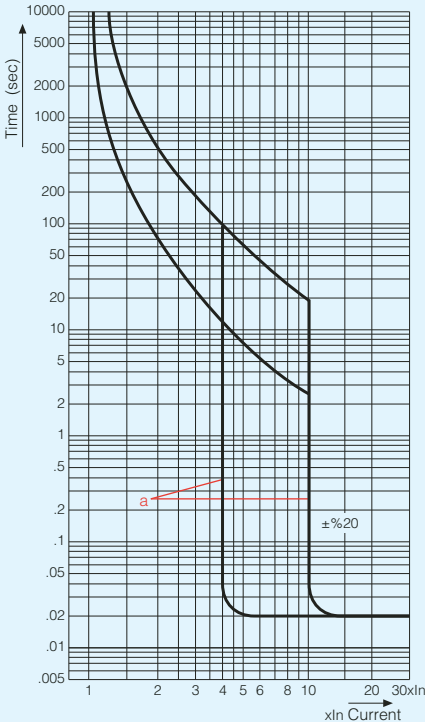
MOLDED CASE CIRCUIT BREAKERS

F01-F02/F10-F11-F12-F12S
F21/F31-F32-33-F31S
Thermal magnetic type circuit breaker



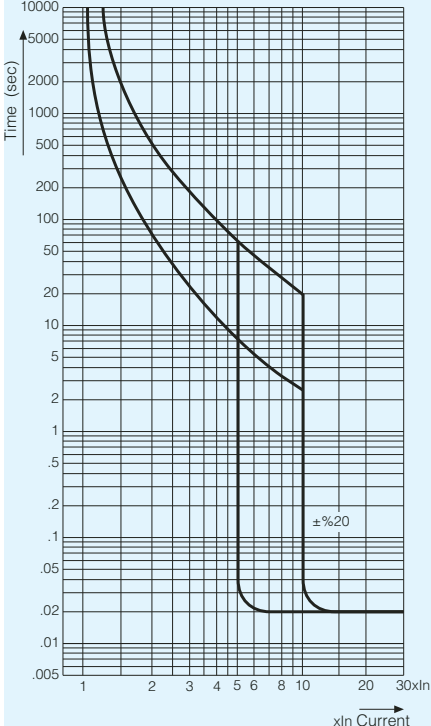
a: F01-F02 / F21-F22 / F31-F32-F33
b: F10-F11 / F12 (min. 600A)

F51-F52-F53
Thermal magnetic type circuit breaker

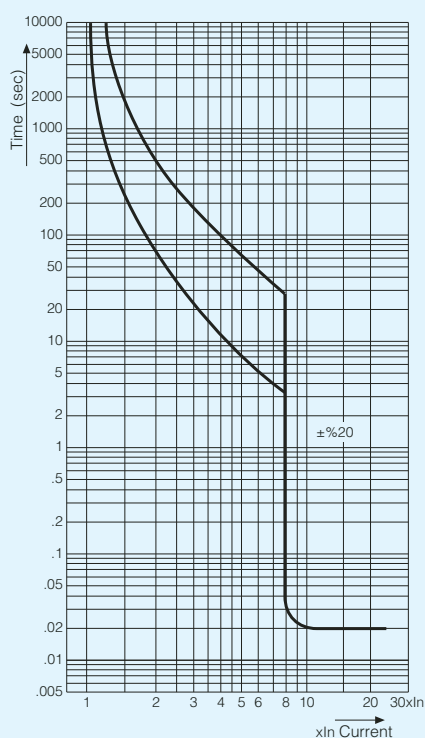


a: 125-160A=5-10ln
200-300A=4-10ln
400A 3-8ln

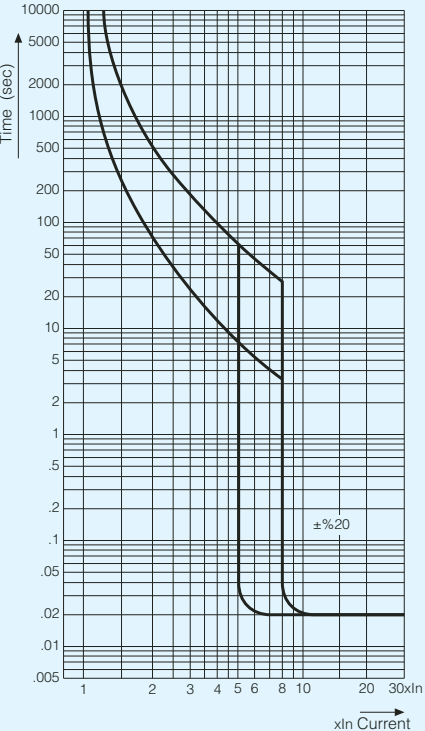
F61-F62/F71
Thermal magnetic type circuit breaker



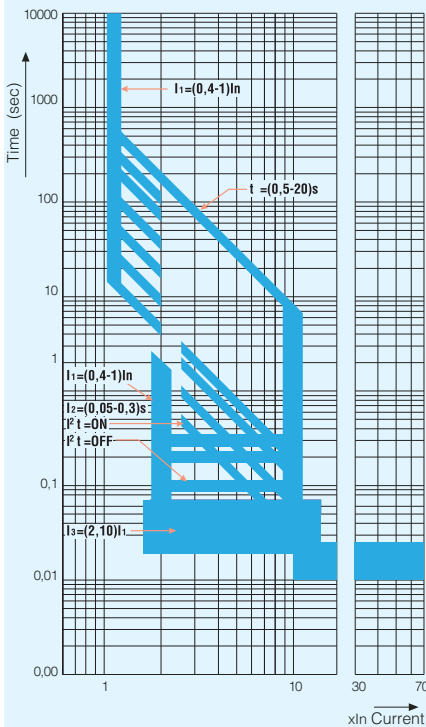
F61S / S400
Thermal magnetic type circuit breaker



F82-F83
Thermal magnetic type circuit breaker

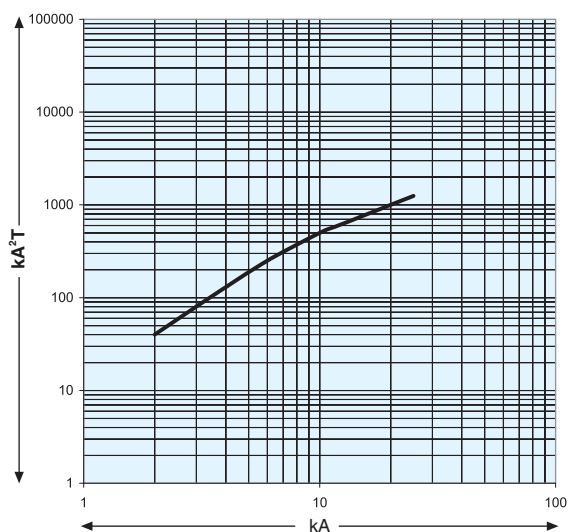


F82E-F83E/F91E-F92E
F101E-F102E/F111E-F112E
Electronic circuit breaker

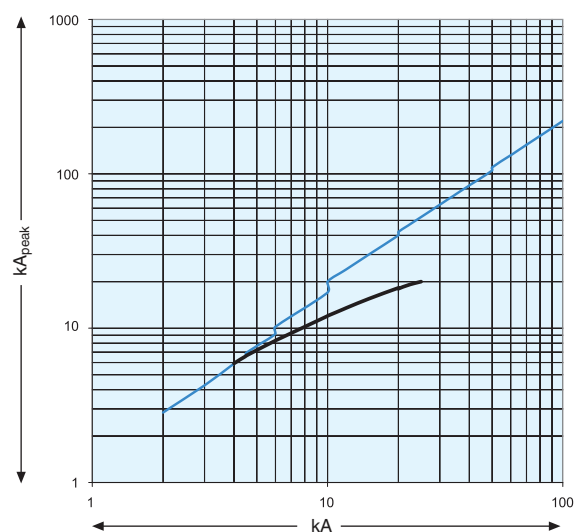


MOLDED CASE CIRCUIT BREAKERS

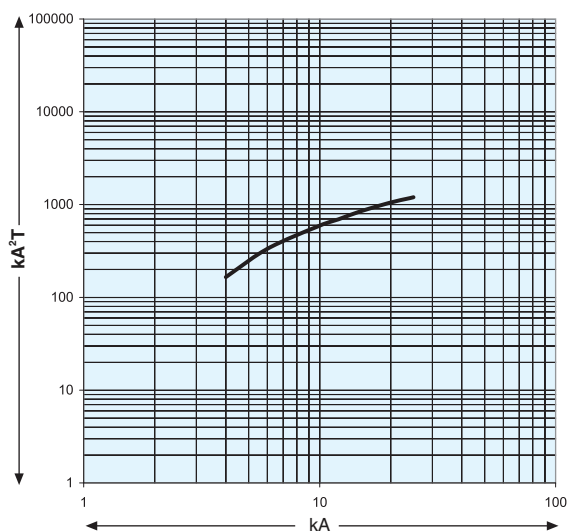
F10-F11-F12-F12S I^2T Curve



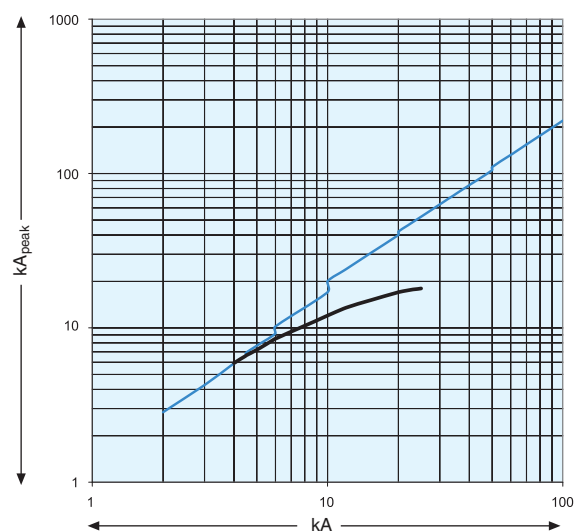
F10-F11-F12-F12S I_{peak} Curve



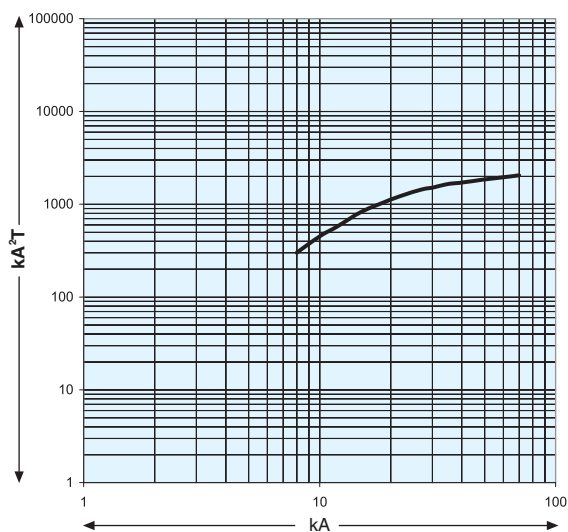
F21 I^2T Curve



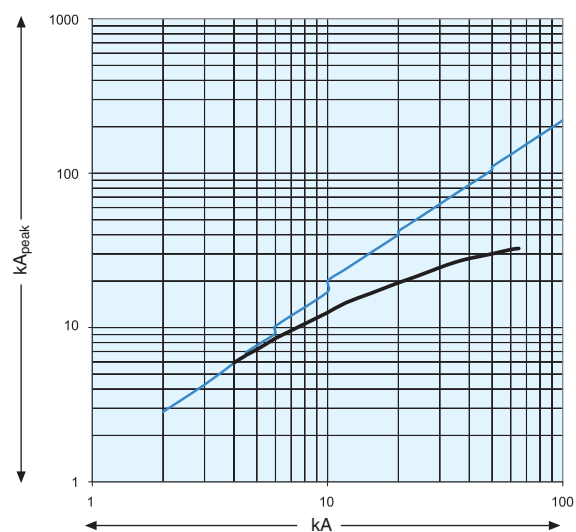
F21 I_{peak} Curve



F31-F32-F33-F31S I^2T Curve

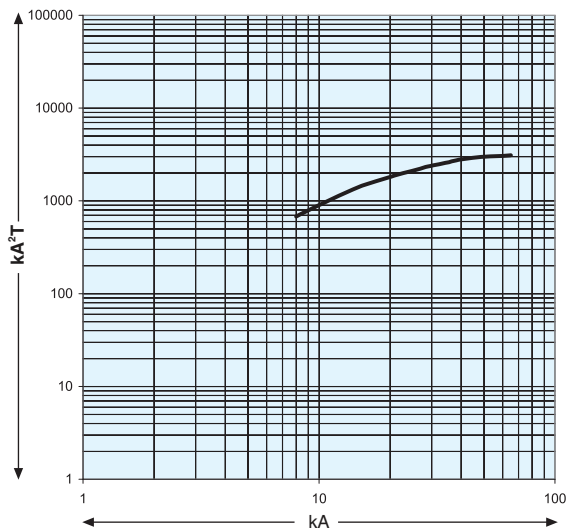


F31-F32-F33-F31S I_{peak} Curve

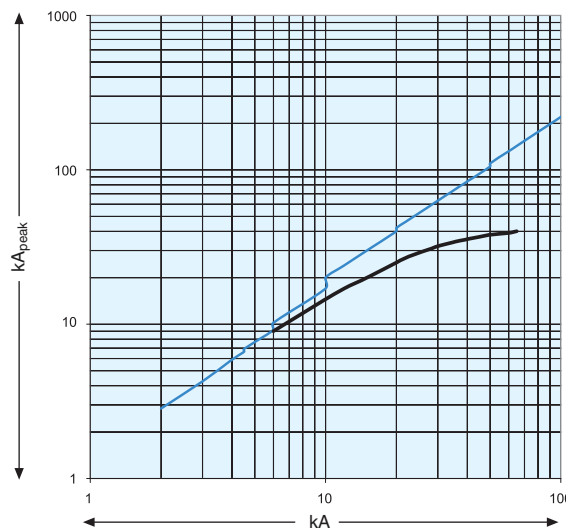


MOLDED CASE CIRCUIT BREAKERS

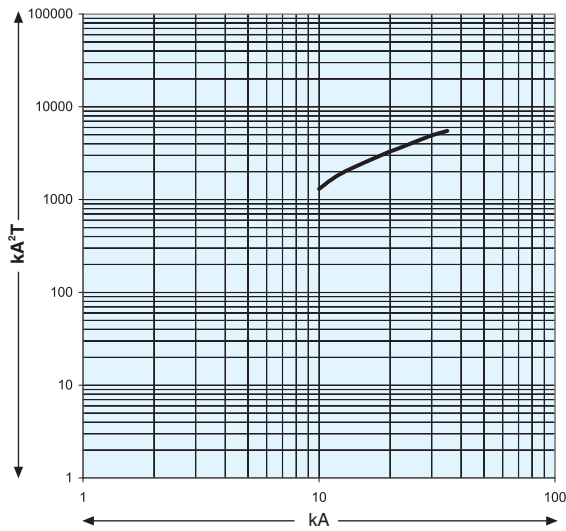
F51-F52-F53 I^2T Curve



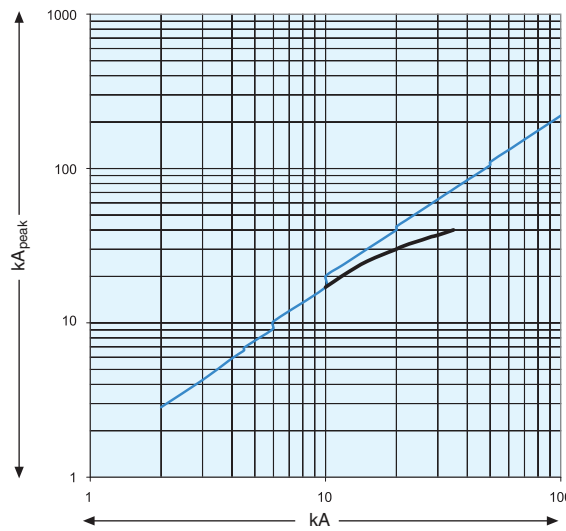
F51-F52-F53 I_{peak} Curve



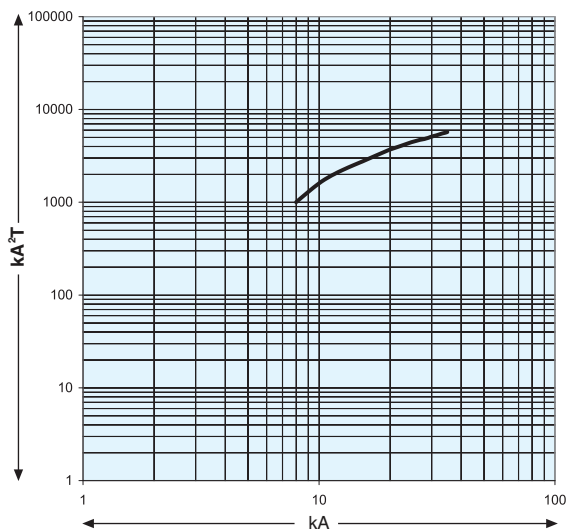
F61-F62-F61S I^2T Curve



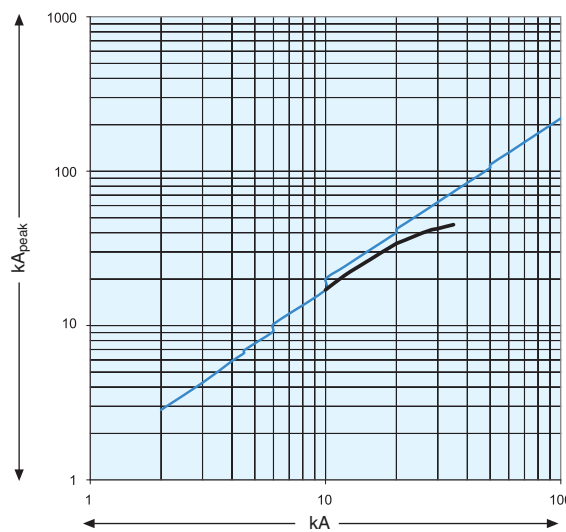
F61-F62-F61S I_{peak} Curve



F71 I^2T Curve

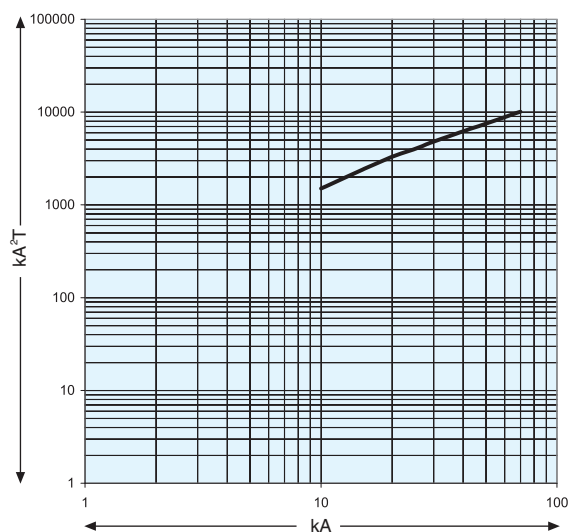


F71 I_{peak} Curve

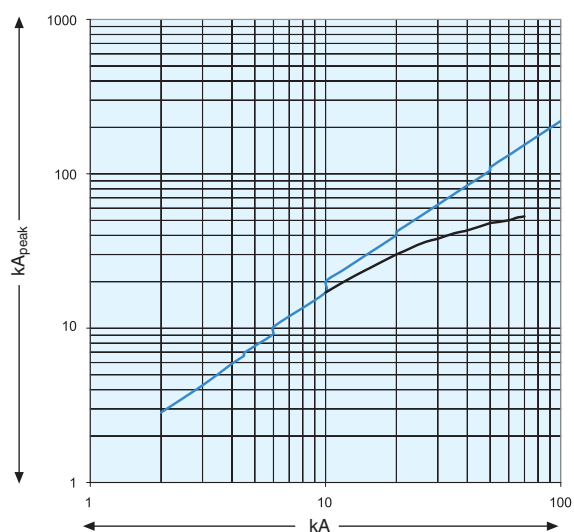


MOLDED CASE CIRCUIT BREAKERS

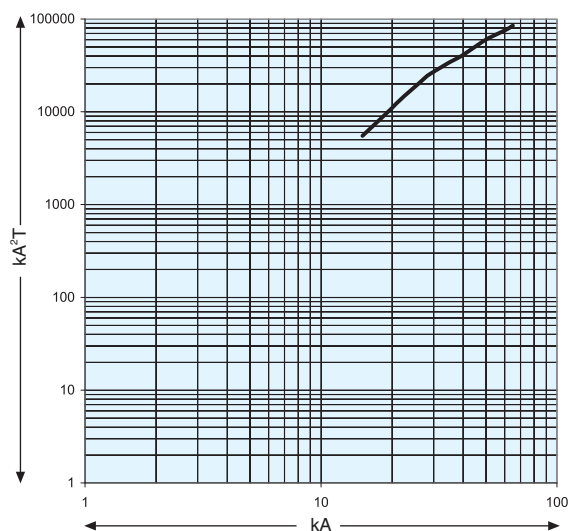
F82-F83-F82E-F83E I^2T Curve



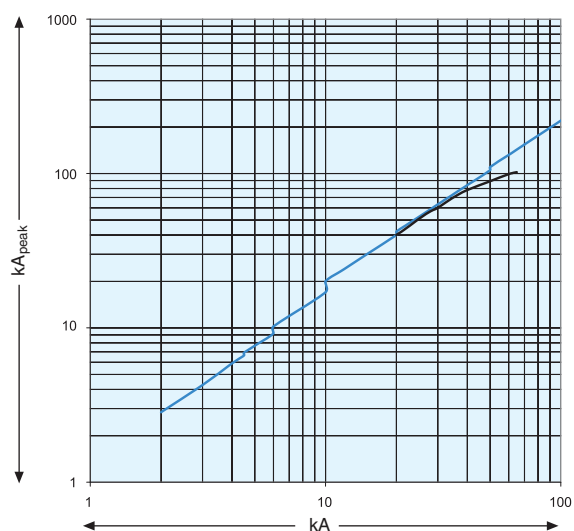
F82-F83-F82E-F83E I_{peak} Curve



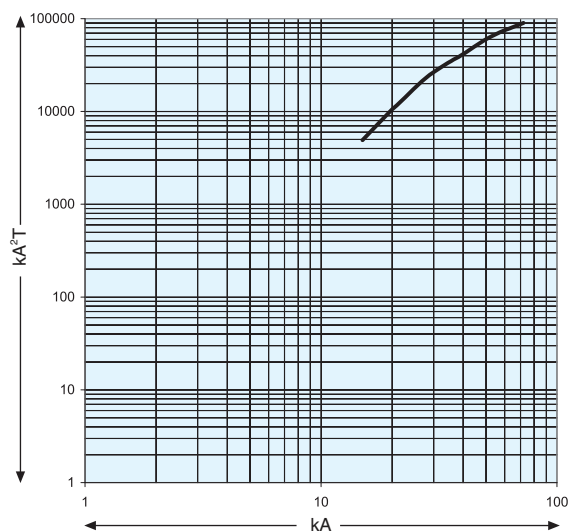
F91E-F92E I^2T Curve



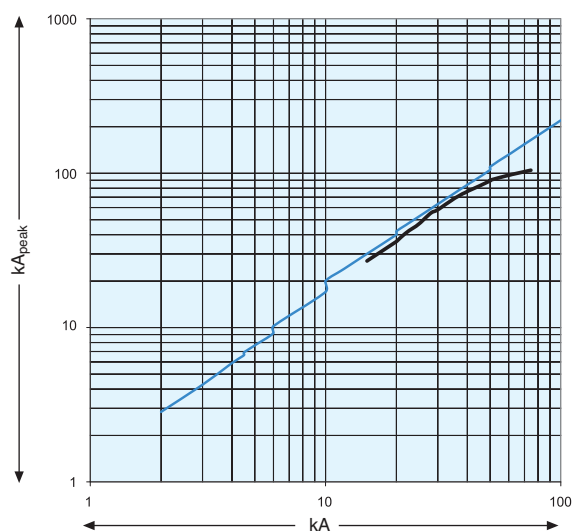
F91E-F92E I_{peak} Curve



F101E-F102E I^2T Curve

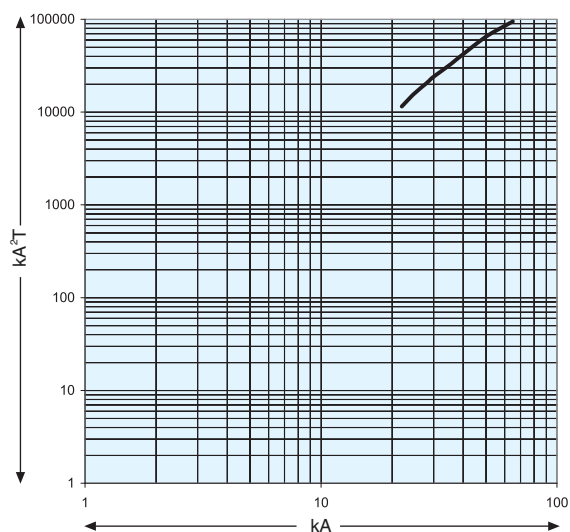


F101E-F102E I_{peak} Curve

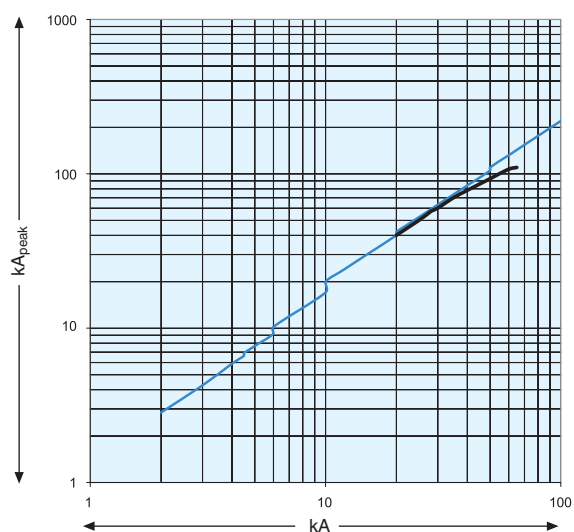


MOLDED CASE CIRCUIT BREAKERS

F111E-F112E I^2T Curve



F111E-F112E I_{peak} Curve



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
F10	6.5	6.5	7	5	5	6.5	10	8.5	12.5	13														
F11	6.5	6.5	7	5	5	6.5	10	8.5	12.5	13														
F12	6.5	6.5	7	5	5	6.5	10	8.5	12.5	13	13													
F21	3.5	4.5	5	5	5.5	6.5	6.5	11.5	12.5	13	20													
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					
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

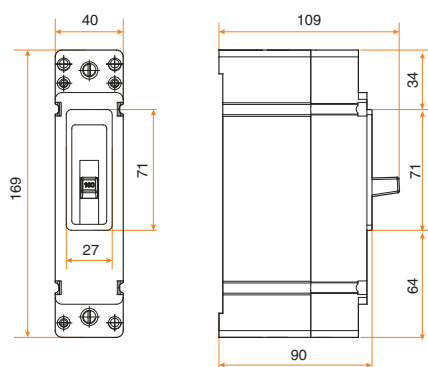
L.V. Circuit Breaker Selection Table (240V / 415V)																											
Breaking Capacity	kA	70	F33										F53					F83 / F83E					F102E		F112E		
		65	F02										F52					F82 / F82E					F92E				
																							F101E				
		50	F32										F51					F82 / F82E					F91E		F111E		
		35	F01										F51					F71									
			F31										F62														
		25	F12															F61									
		25	F21																								
		25	F11 / F11M																								
20	F10																										
L.V. 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 ²
Silver	Ag	63
Copper	Cu	58
Gold	Au	45
Aluminium	Al	36
Magnesium	Mg	23
Molybdenum	Mo	18
Wofram	W	17
Zinc	Zn	16
Cadmium	Cd	13
Brass	Cu (%86)+Zn (%35)	12
Nickel	Ni	11
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

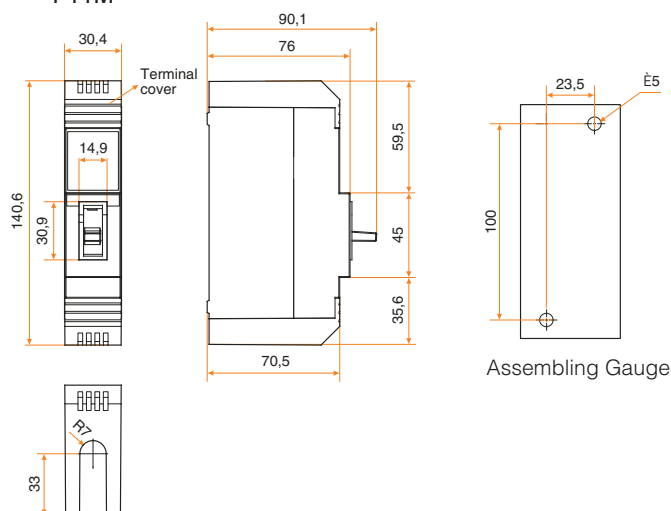
MOLDED CASE CIRCUIT BREAKERS

F01 - F02



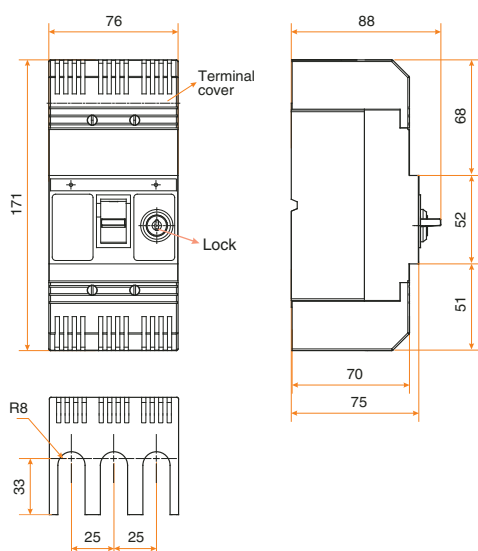
Assembling Gauge

F11M

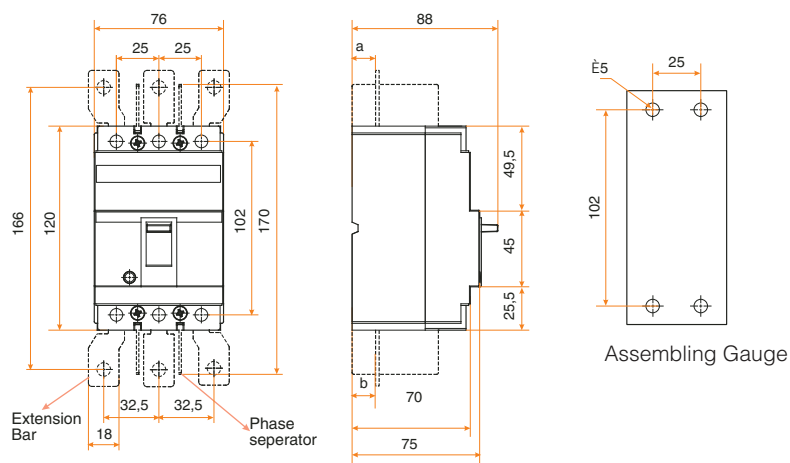
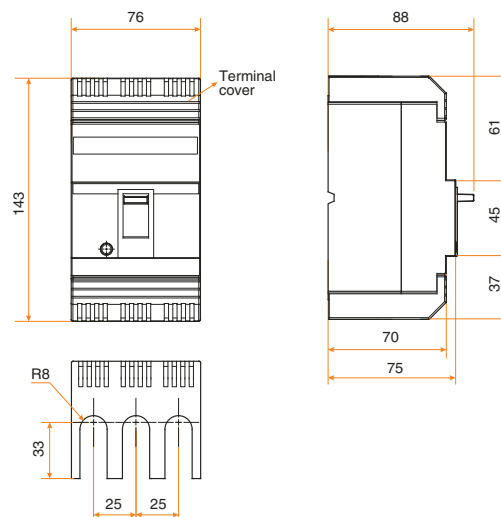


Assembling Gauge

F10 - F11 WITH LOCK (WITH LONG TERMINAL COVER)



F10 - F11 FIXED (WITH TERMINAL COVER)



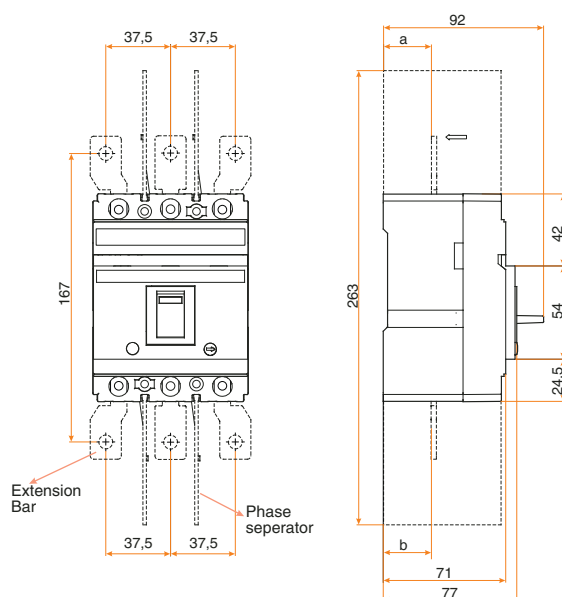
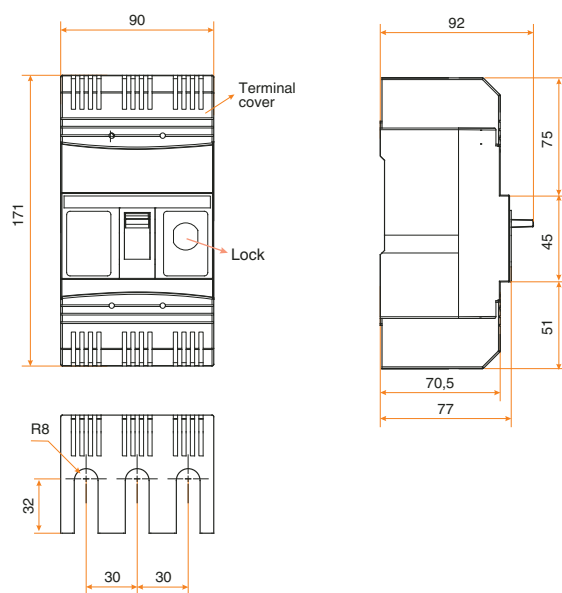
Assembling Gauge

Current (A)	Dimensions (mm)	
	a	b
16	24,2	22,2
20	24,2	22,2
25	24,2	22,2
32	24,2	23,7
40	24,2	23,7
50	24,2	23,7
63	24,2	23,7
80	24,2	23,7
100	24,2	23,7
125	24,2	23,7

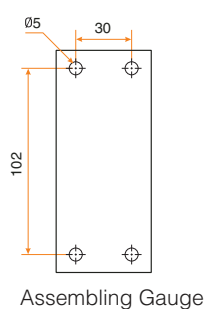
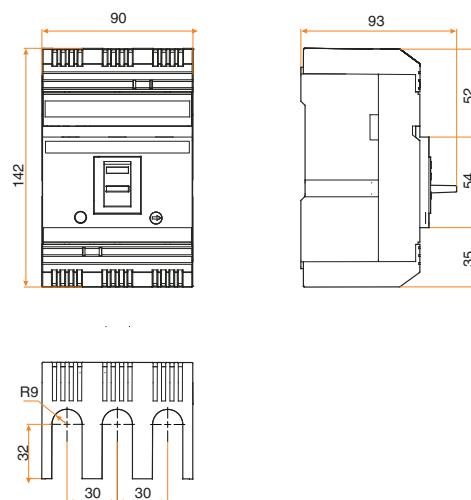
--- Shown parts with discrete lines are manufactured as per customer request.

MOLDED CASE CIRCUIT BREAKERS

F12 WITH LOCK (WITH LONG TERMINAL COVER)



F12 THERMAL ADJUSTABLE (WITH TERMINAL COVER)

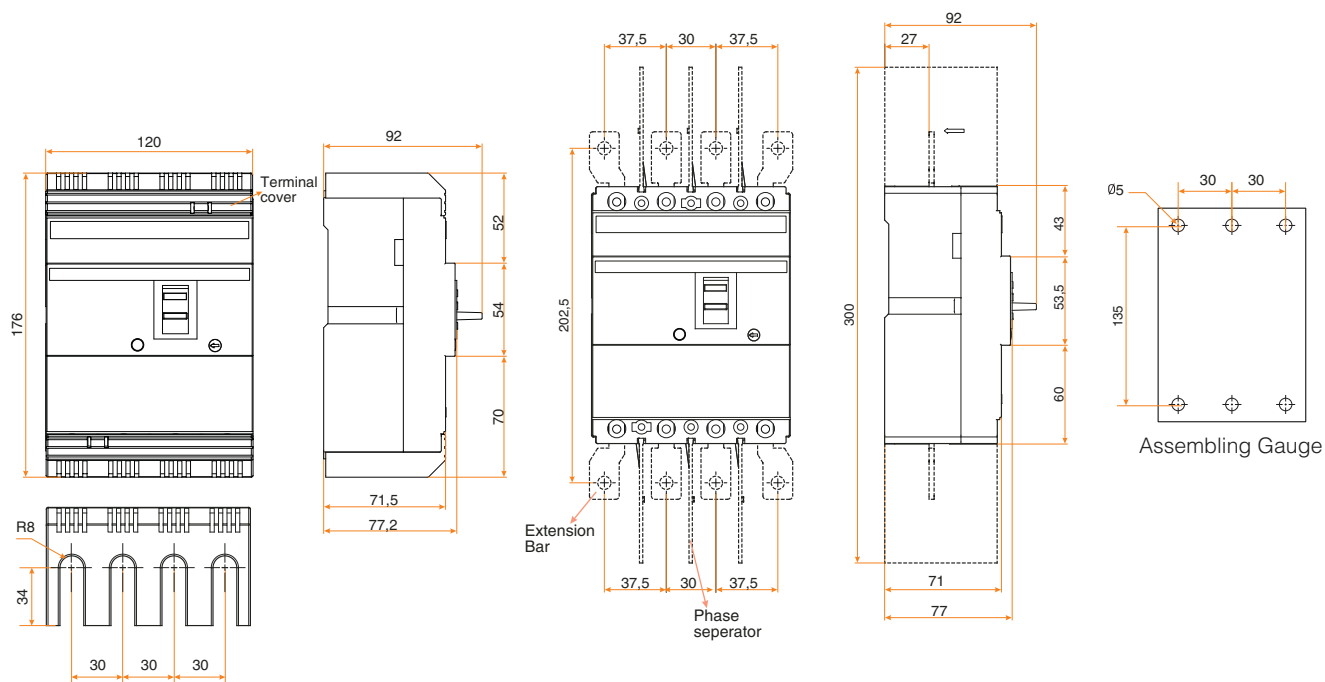


Current (A)	Dimensions (mm)	
	a	b
16	27,5	26
20	27,5	26
25	27,5	26
32	27,5	27
40	27,5	27
50	27,5	27
63	27,5	27
80	27,5	27
100	27,5	27
125	27,5	27
160	27,5	27

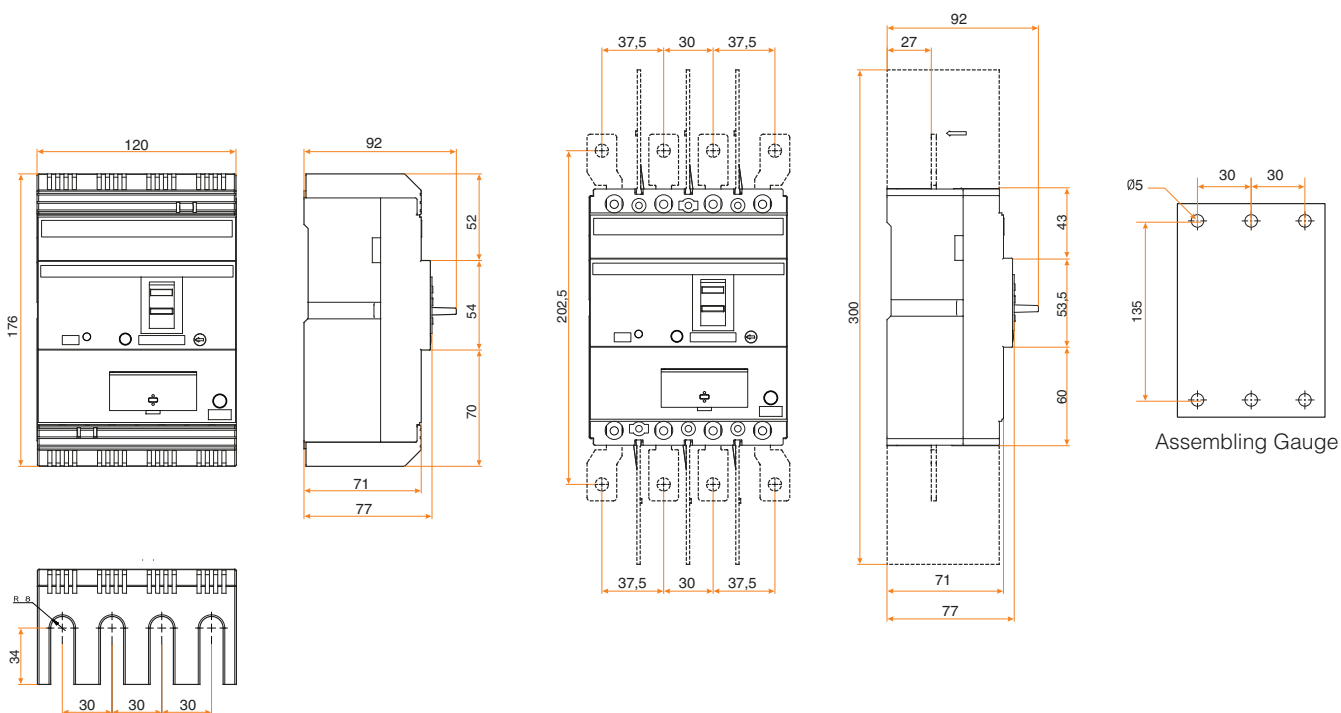
----- Shown parts with discrete lines are manufactured as per customer request.

MOLDED CASE CIRCUIT BREAKERS

F12N THERMAL ADJUSTABLE (4 Poles)



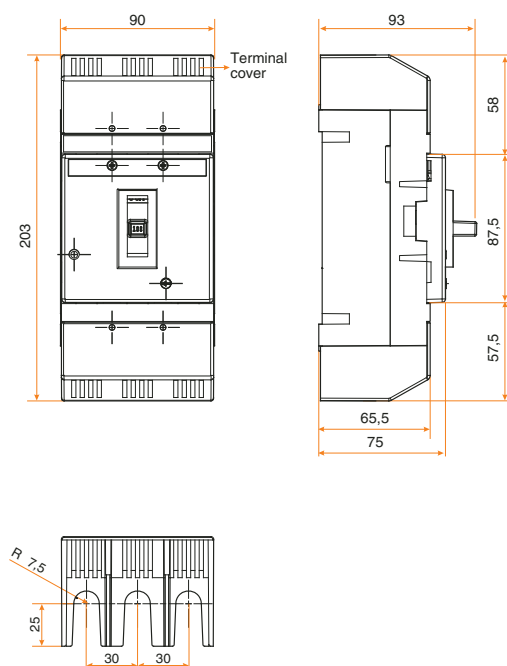
F12R EARTH - LEAKAGE CIRCUIT BREAKER



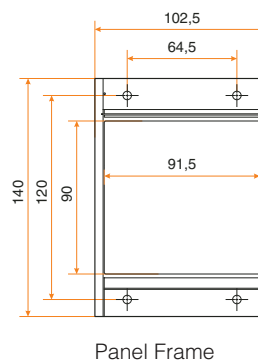
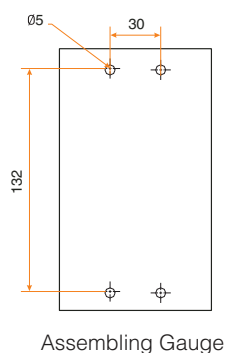
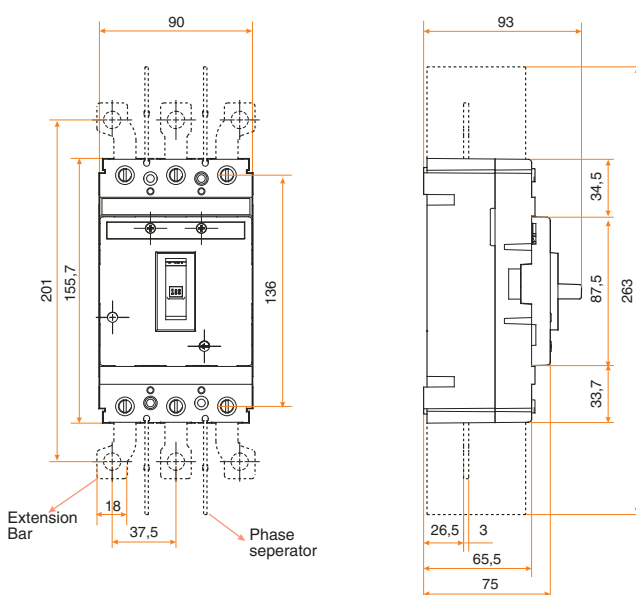
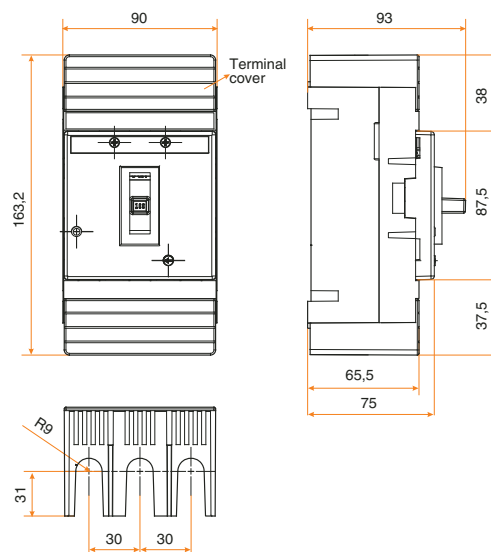
--- Shown parts with discrete lines are manufactured as per customer request.

MOLDED CASE CIRCUIT BREAKERS

F21 WITH LONG TERMINAL COVER



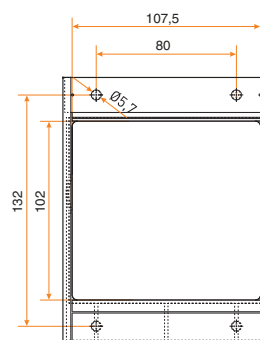
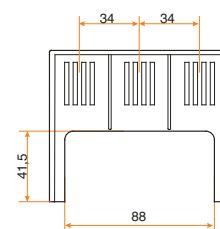
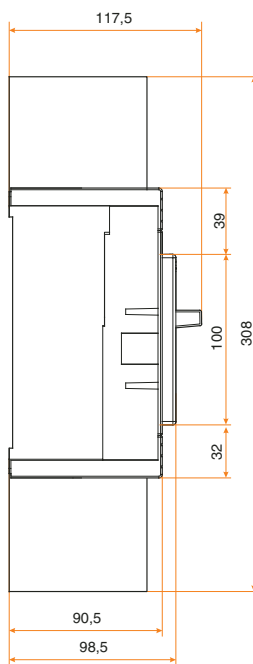
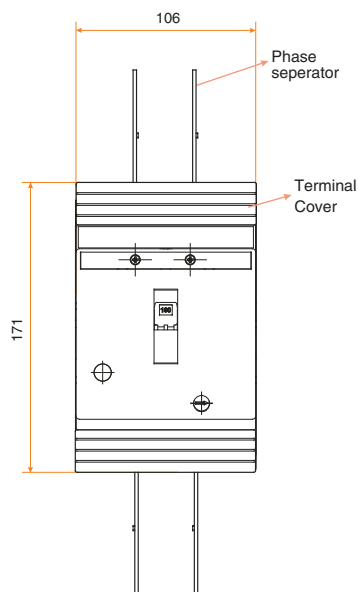
F21 WITH SHORT TERMINAL COVER



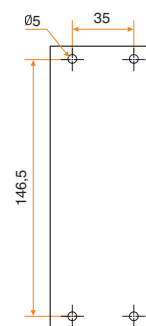
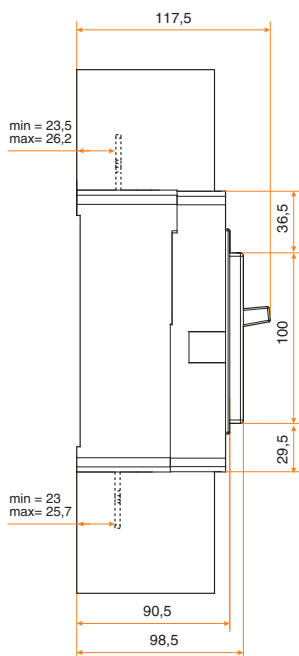
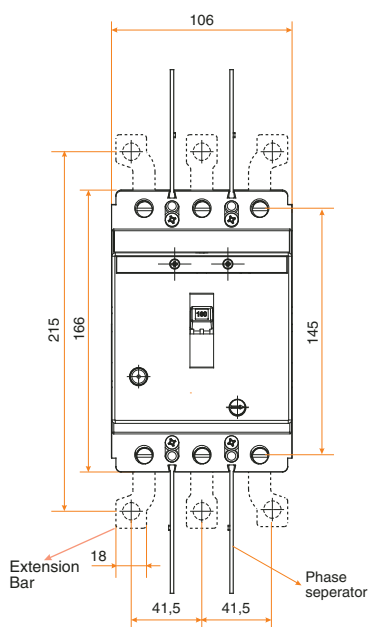
--- Shown parts with discrete lines are manufactured as per customer request.

MOLDED CASE CIRCUIT BREAKERS

F31 - F32 - F33 - F31S



Panel Frame

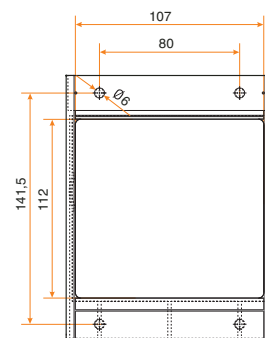
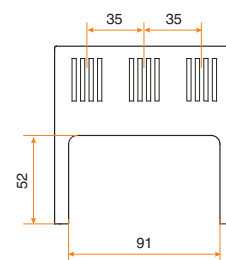
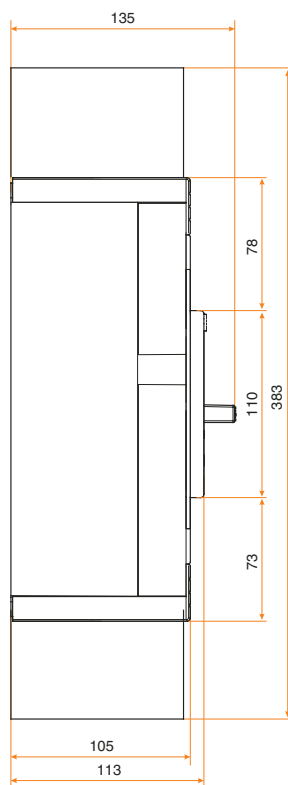
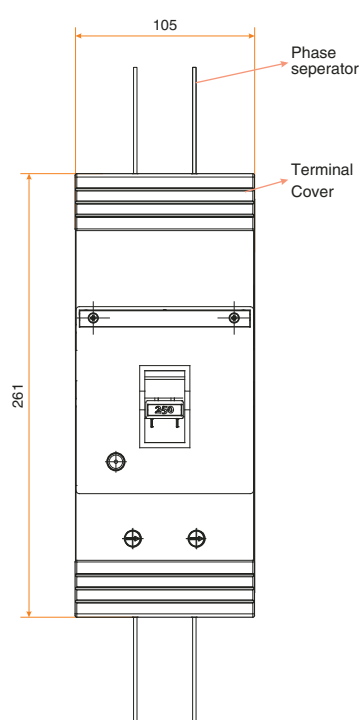


Assembling Gauge

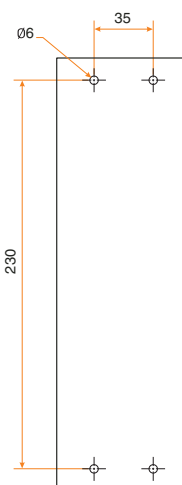
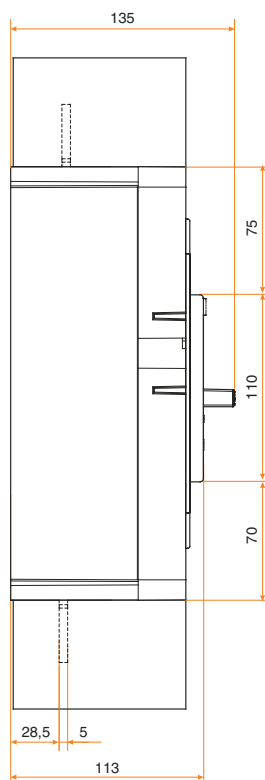
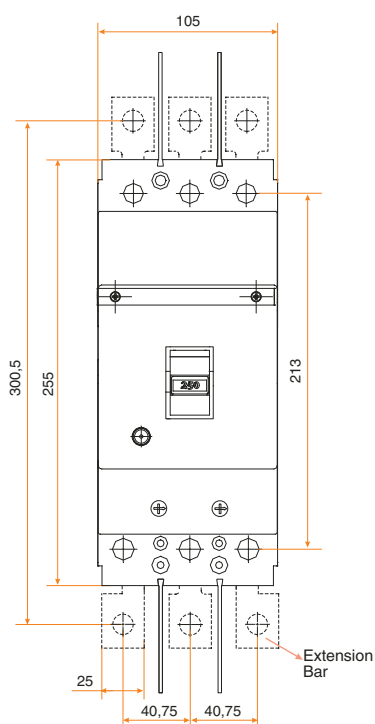
--- Shown parts with discrete lines are manufactured as per customer request.

MOLDED CASE CIRCUIT BREAKERS

F51 - F52 - F53



Panel Frame

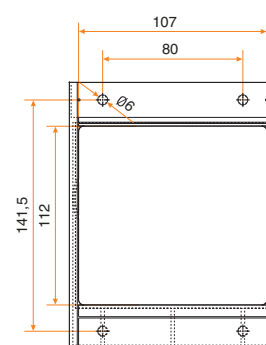
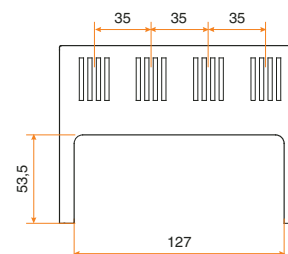
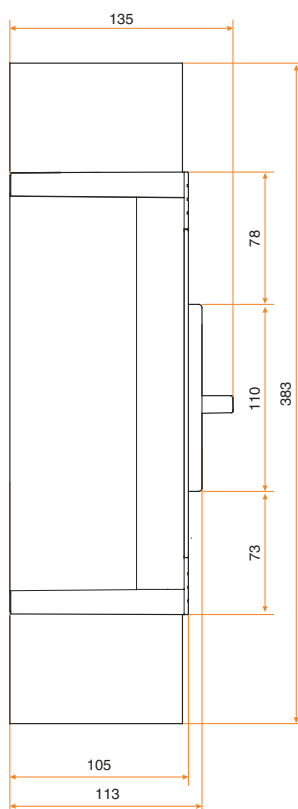
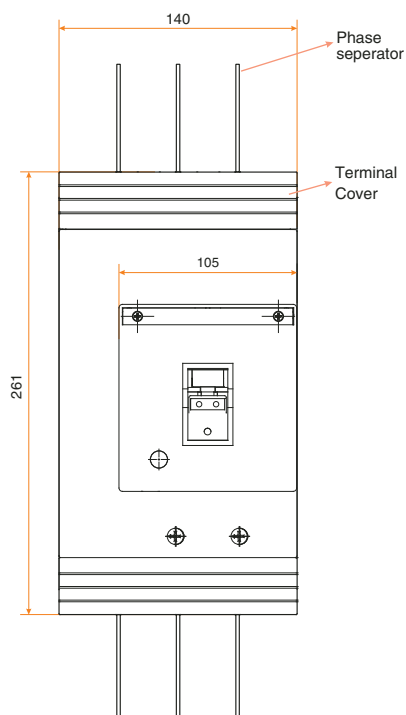


Assembling Gauge

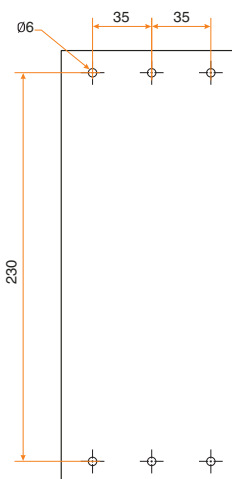
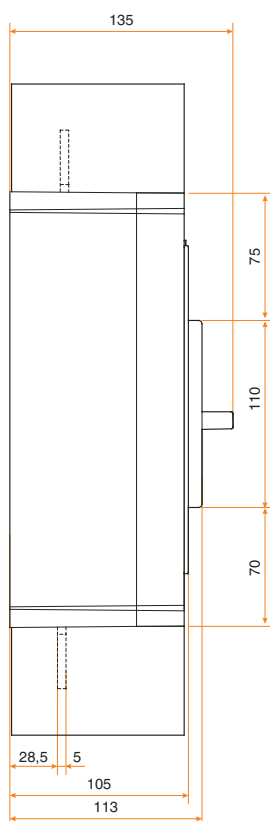
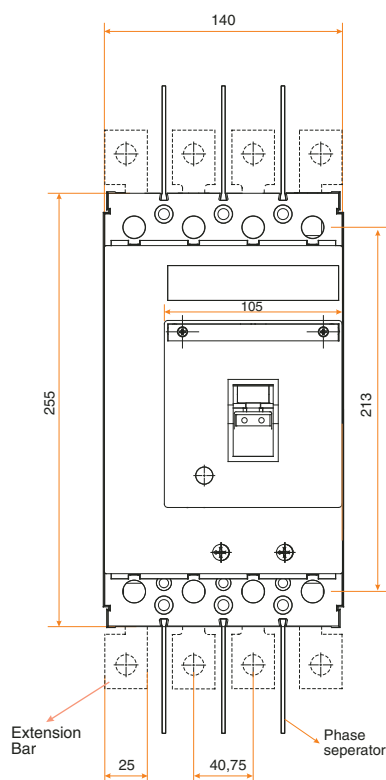
--- Shown parts with discrete lines are manufactured as per customer request, (only 300 A are produced with extension bar as a standard)

MOLDED CASE CIRCUIT BREAKERS

F51N - F52N - F53N (4 Poles)



Panel Frame

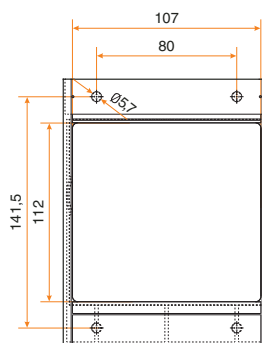
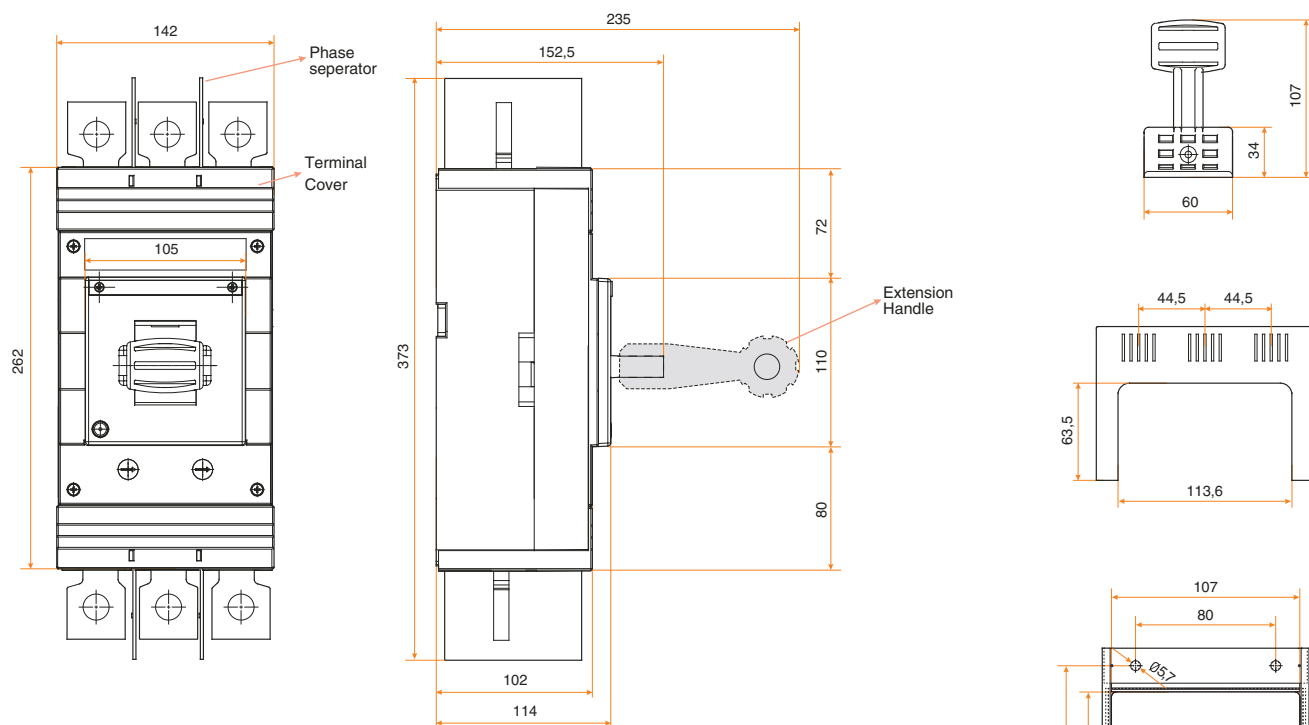


Assembling Gauge

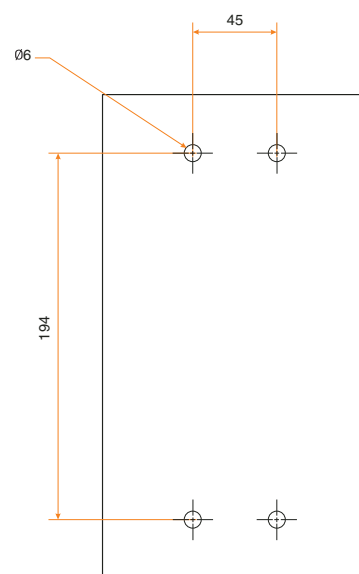
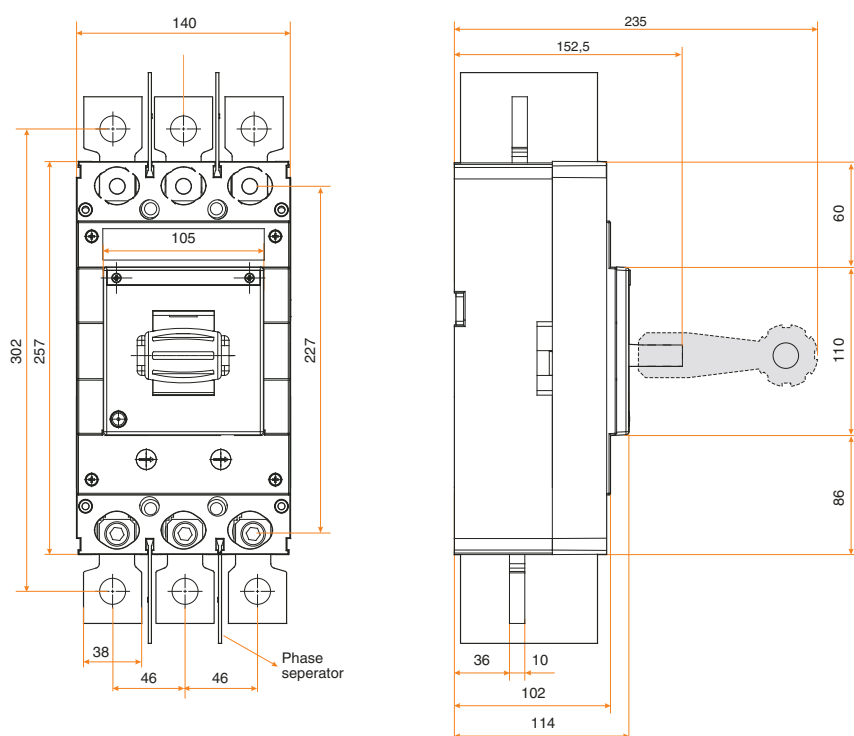
--- Shown parts with discrete lines are manufactured as per customer request, (only 300 A are produced with extension bar as a standard)

MOLDED CASE CIRCUIT BREAKERS

F61 - F62 - F61S



Panel Frame

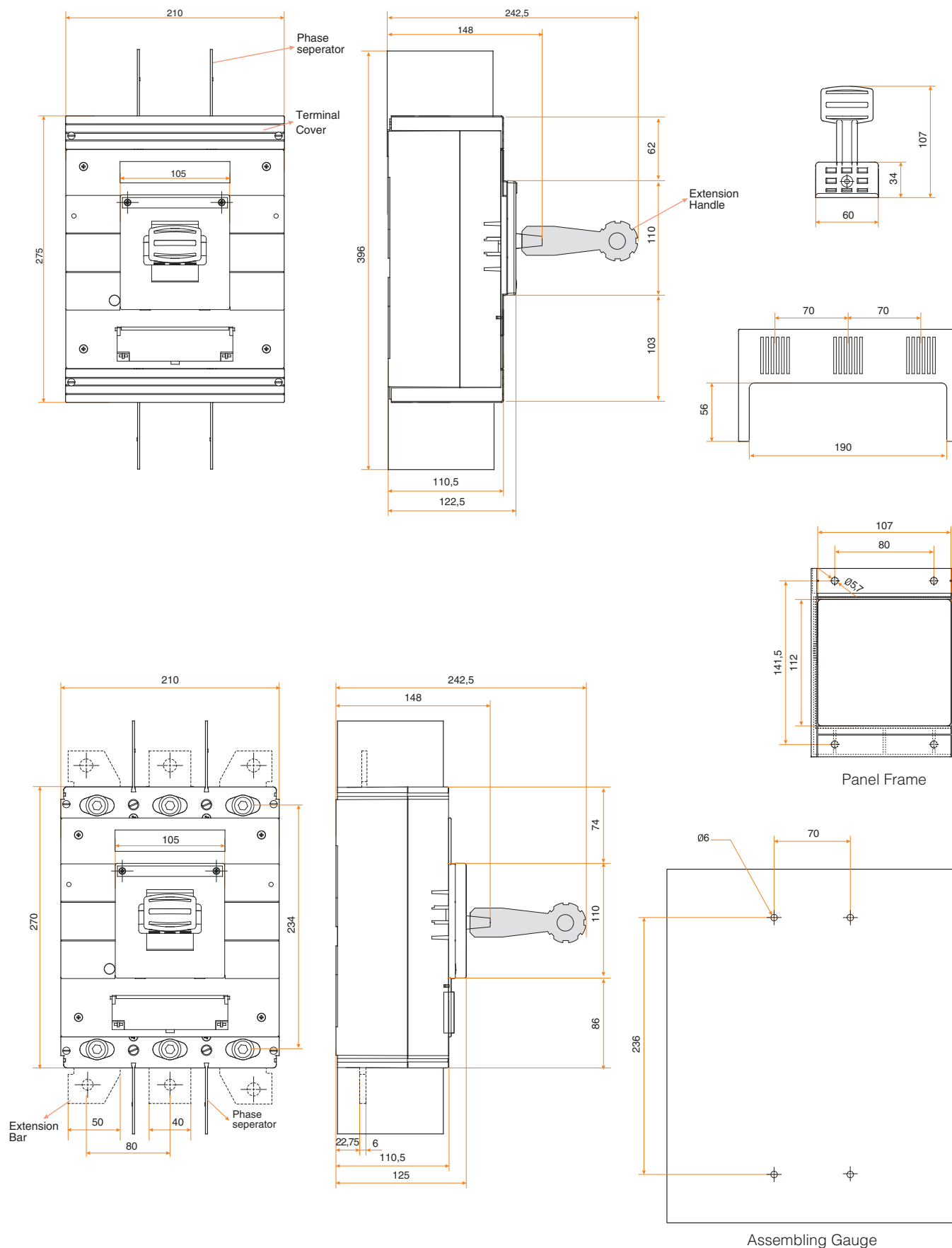


Assembling Gauge

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

MOLDED CASE CIRCUIT BREAKERS

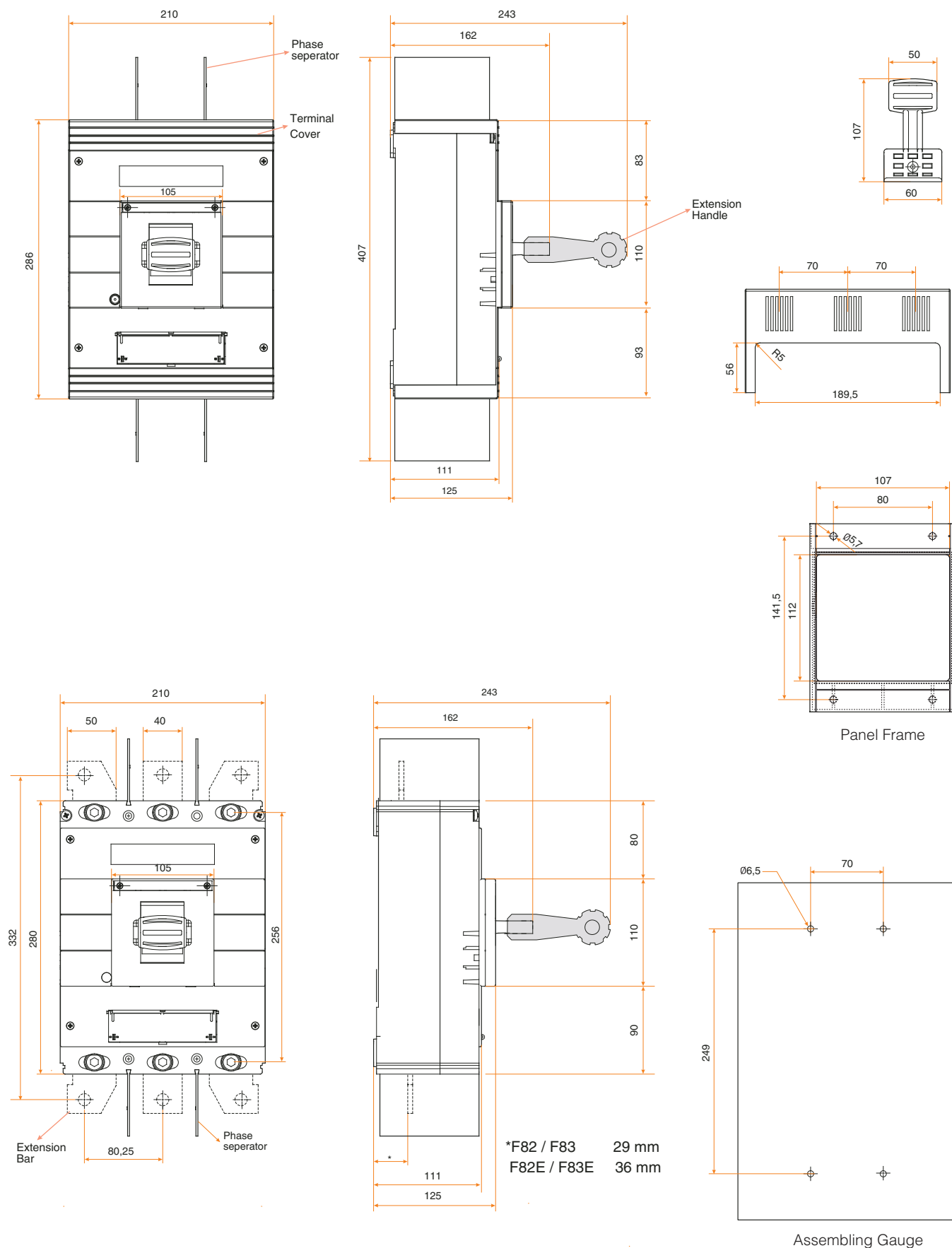
F71



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

MOLDED CASE CIRCUIT BREAKERS

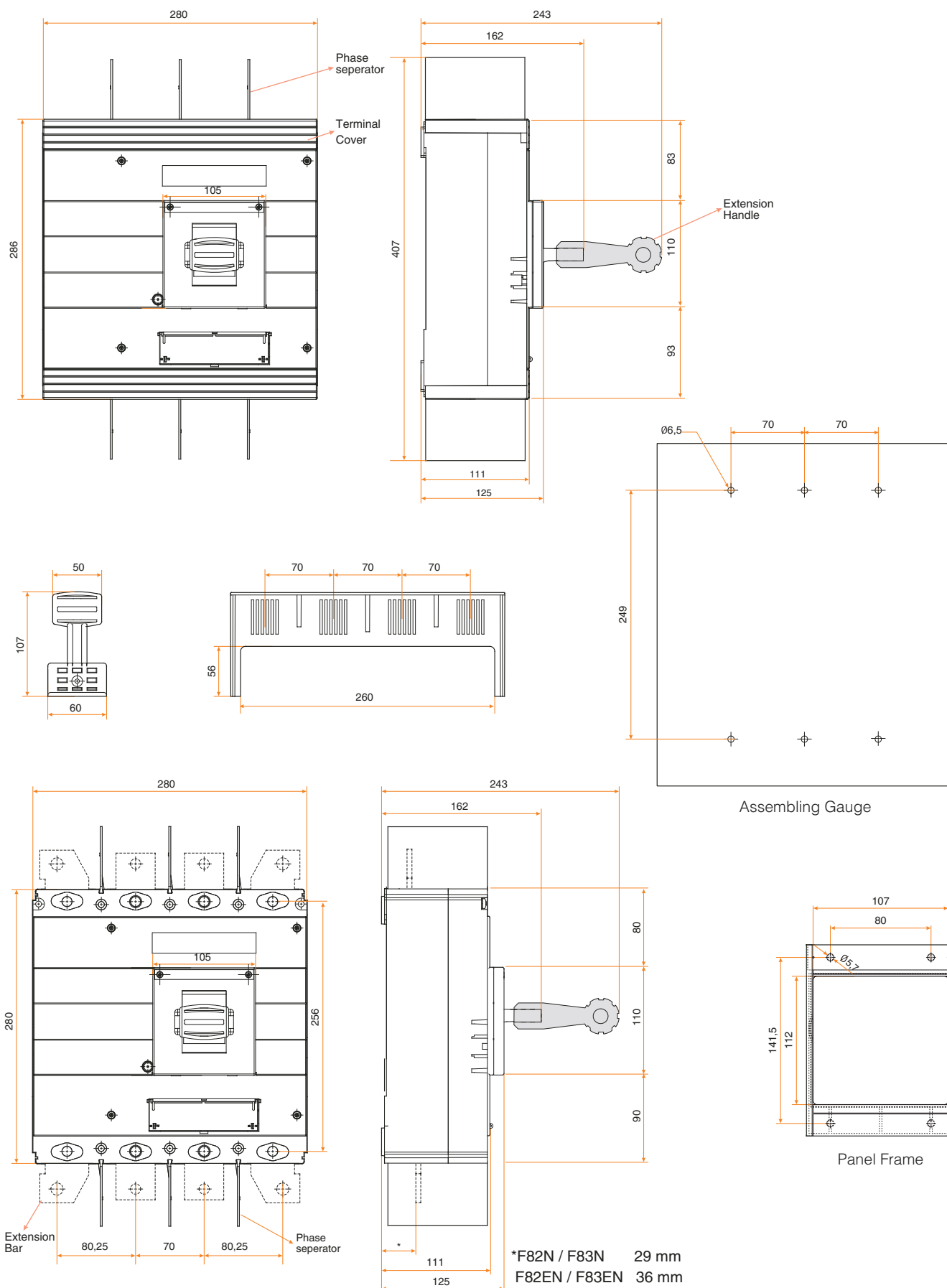
F82 - F83 - F82E - F83E



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

MOLDED CASE CIRCUIT BREAKERS

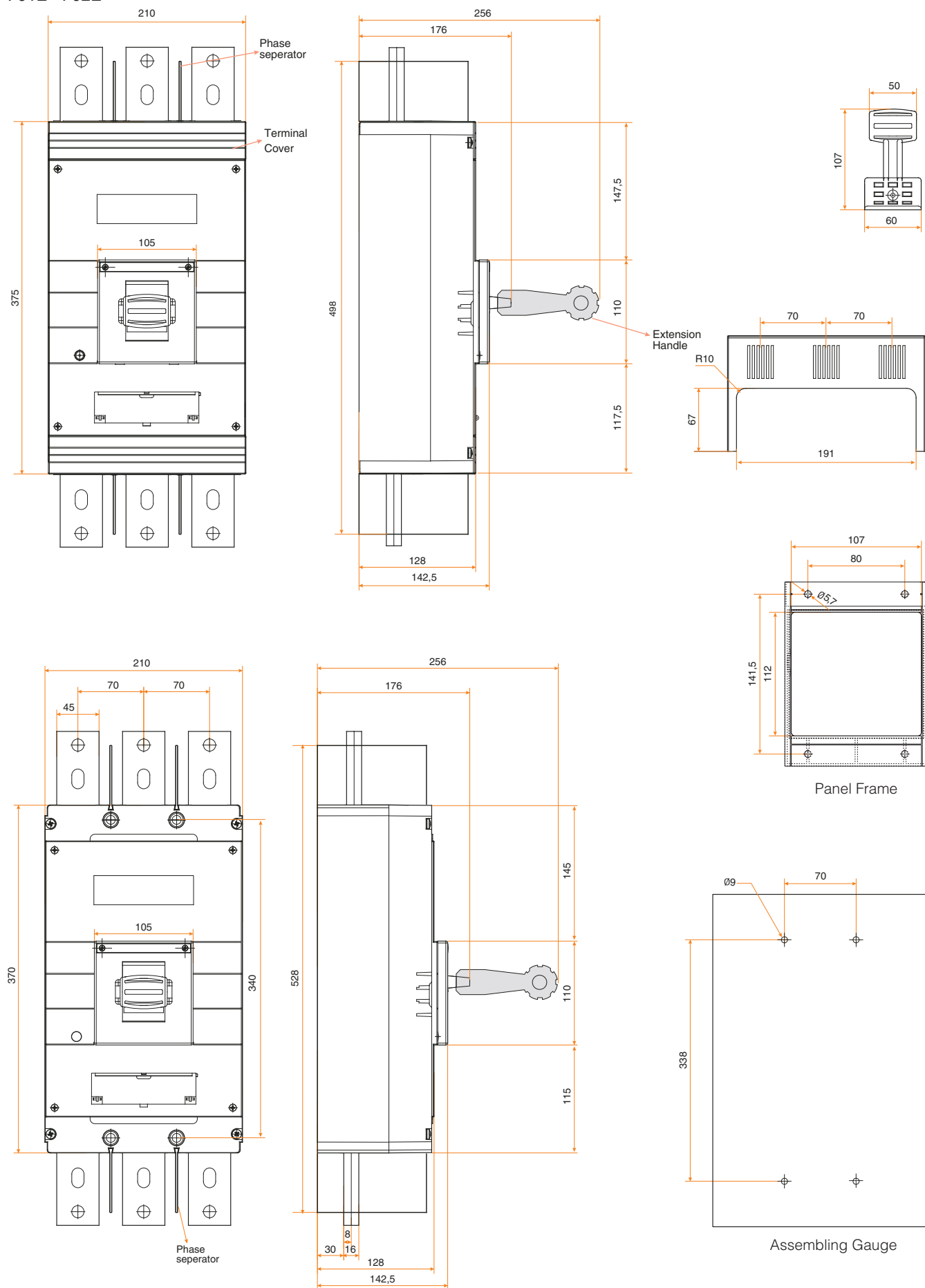
F82N - F83N - F82EN - F83EN



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

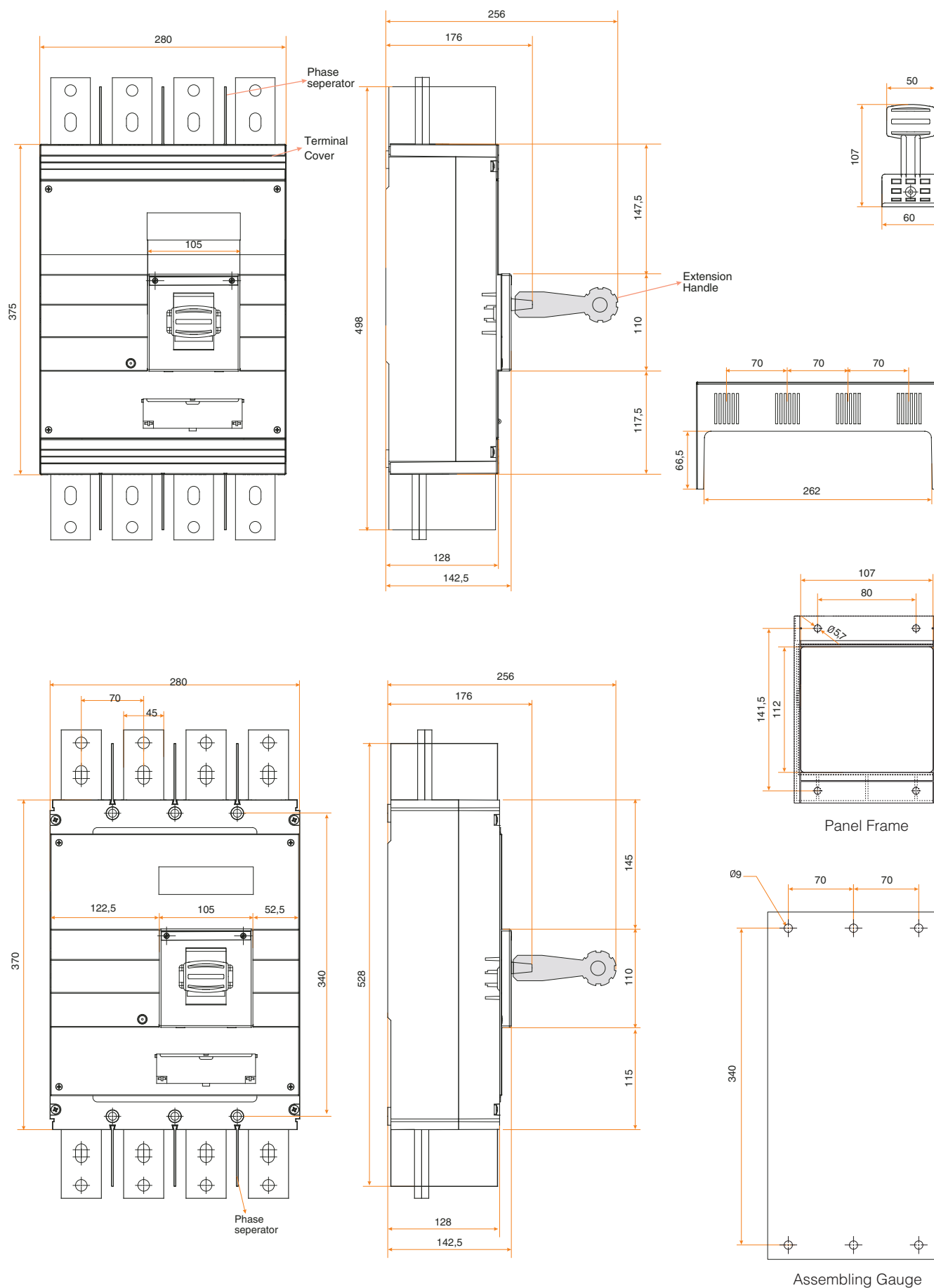
MOLDED CASE CIRCUIT BREAKERS

F91E - F92E



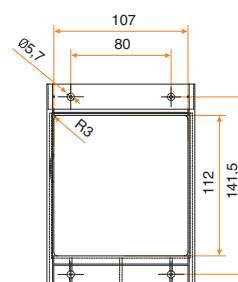
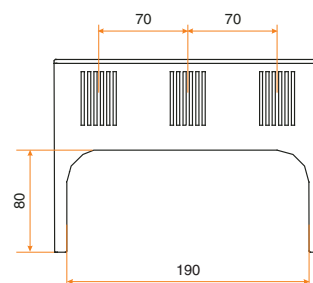
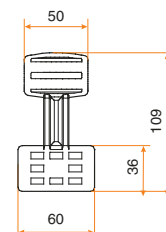
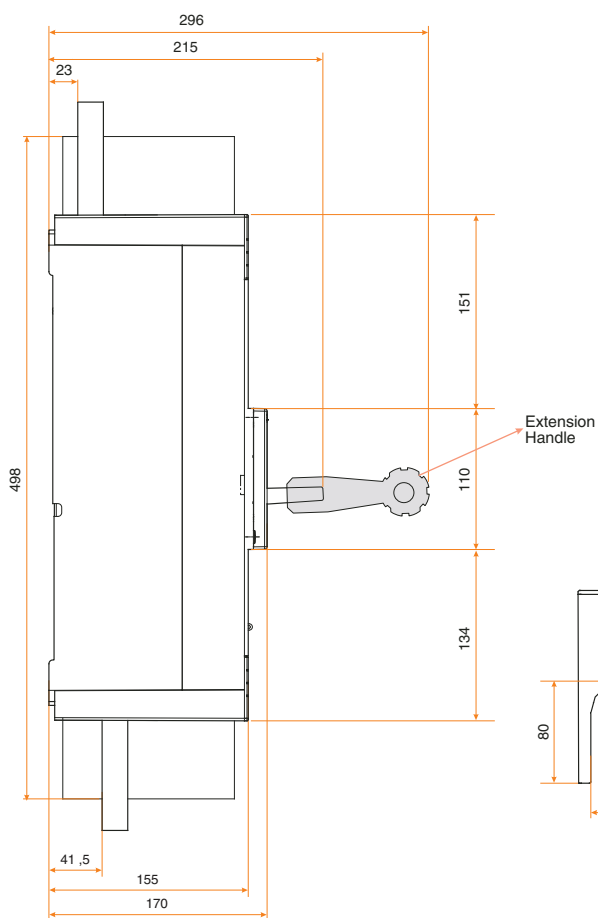
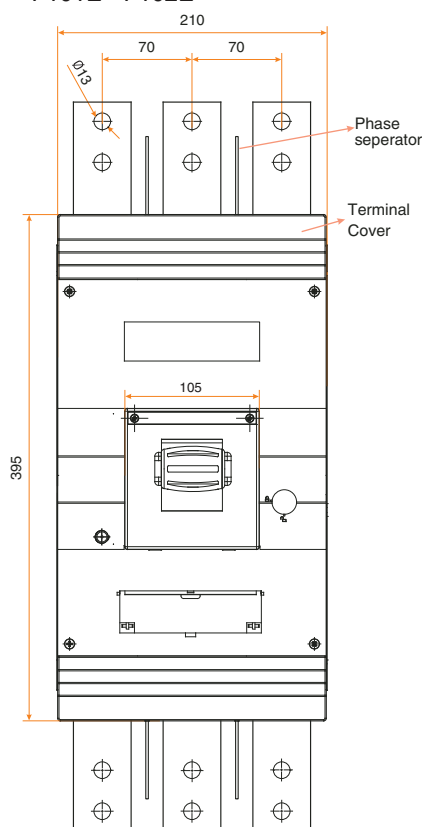
MOLDED CASE CIRCUIT BREAKERS

F91EN -F92EN (4 Poles)

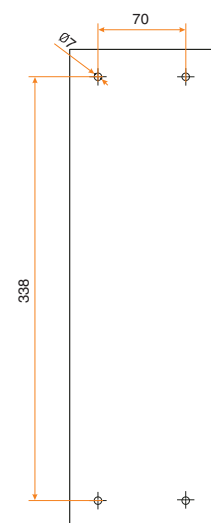
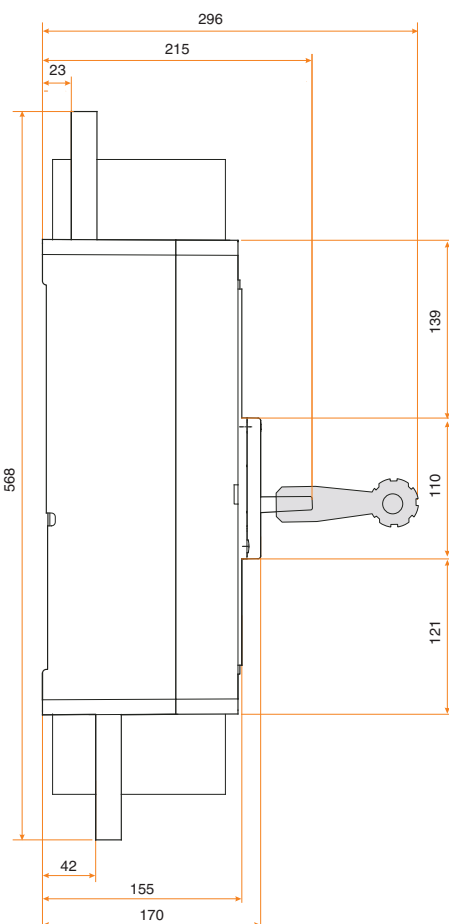
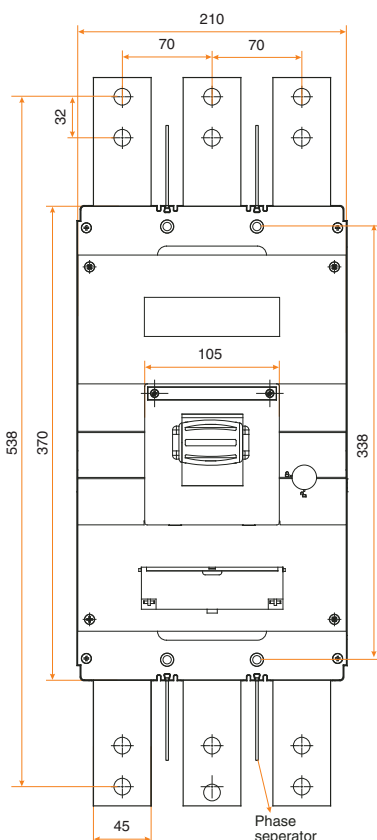


MOLDED CASE CIRCUIT BREAKERS

F101E - F102E



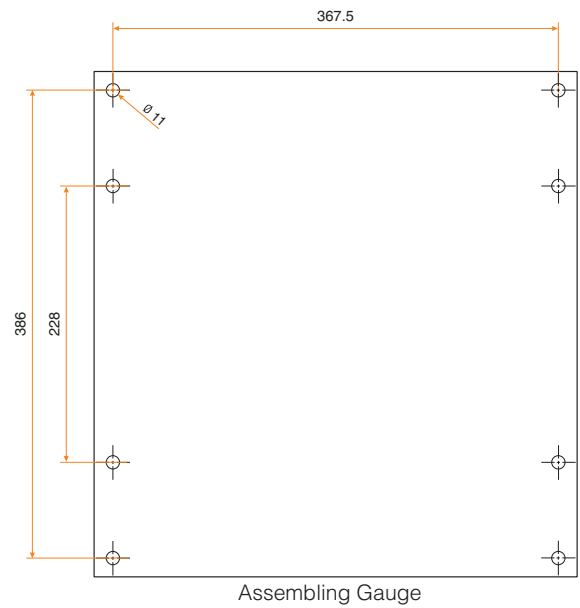
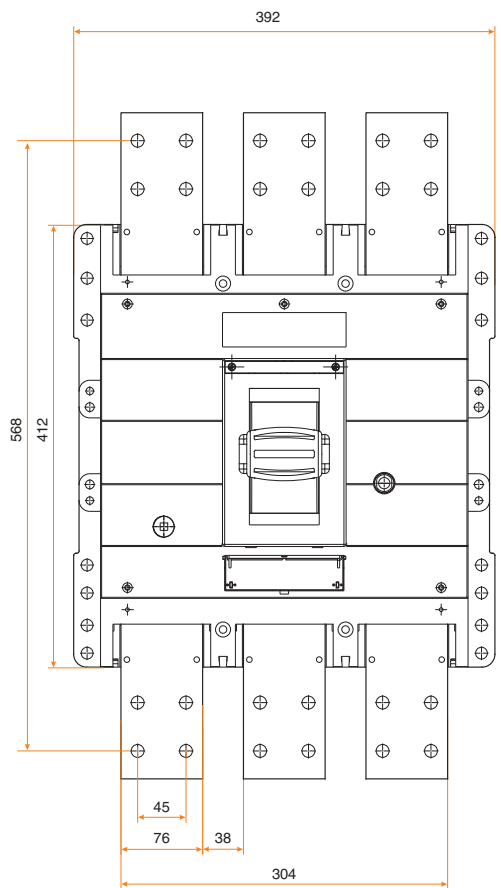
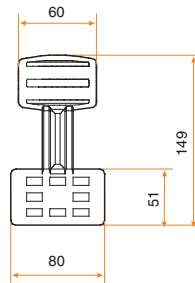
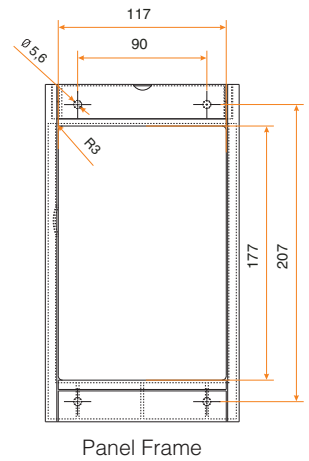
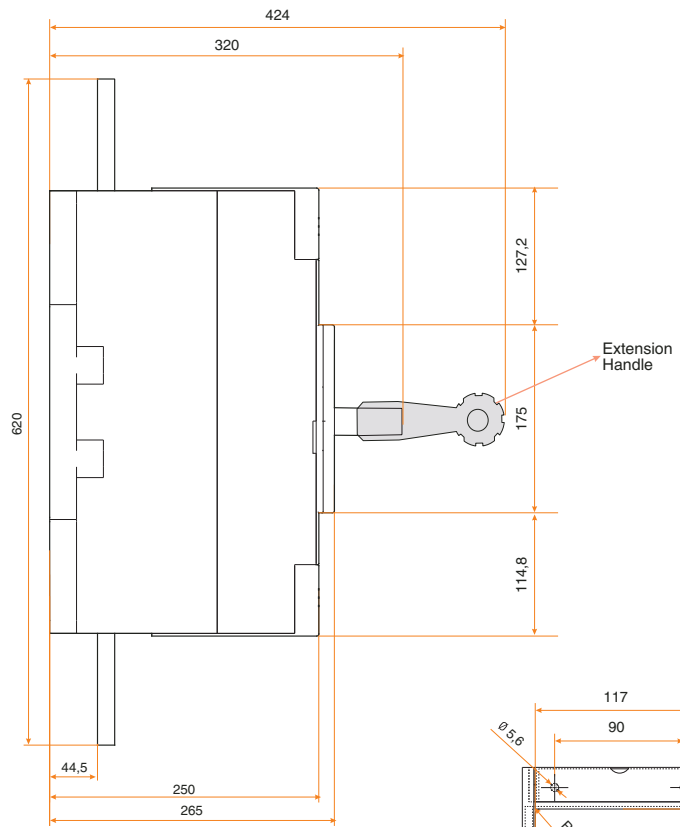
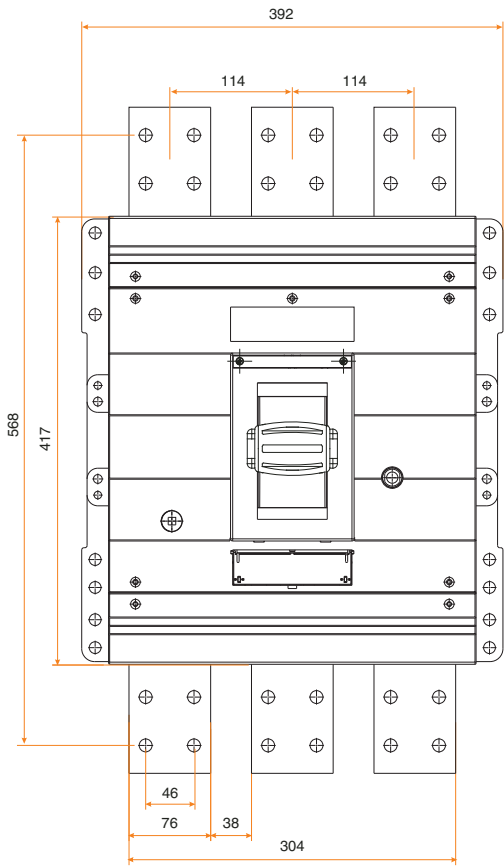
Panel Frame



Assembling Gauge

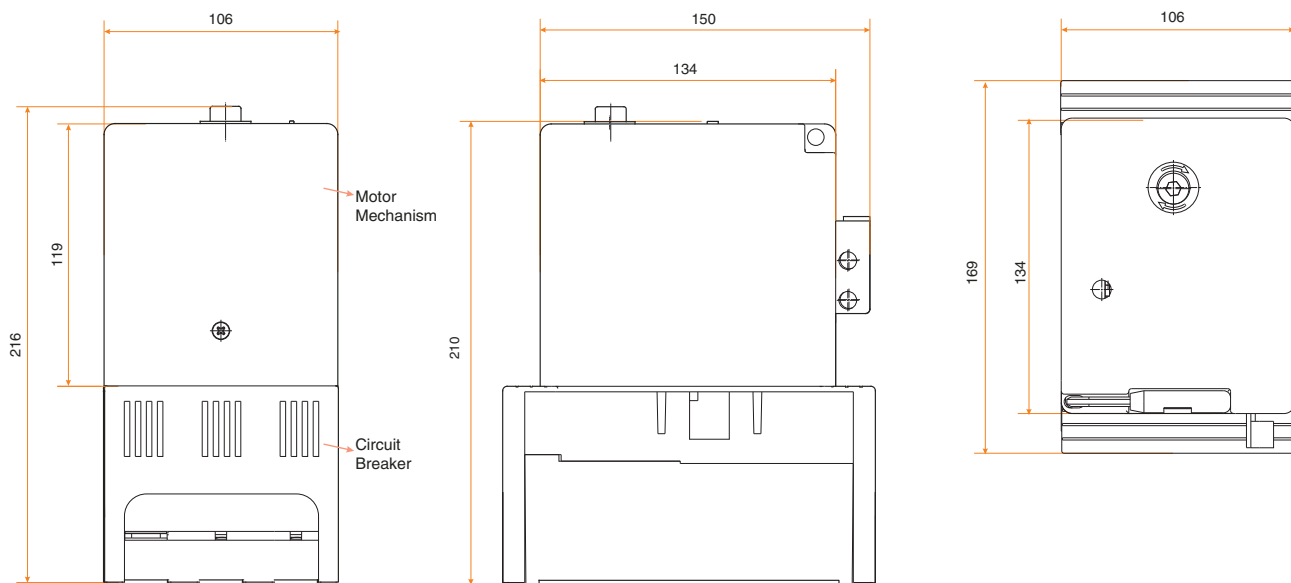
MOLDED CASE CIRCUIT BREAKERS

F111E - F112E

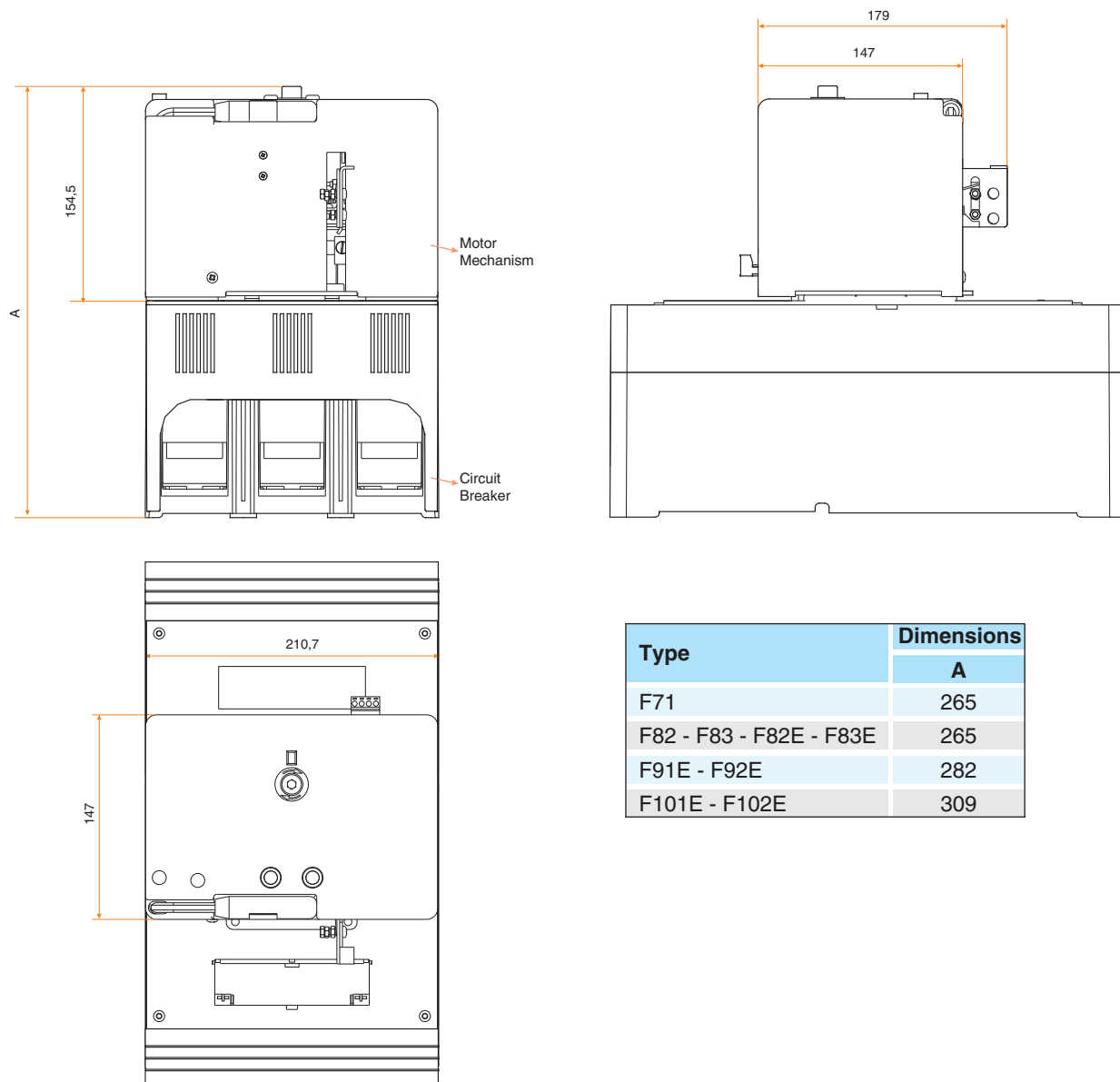


MOLDED CASE CIRCUIT BREAKERS

F31 - F32 - F33 - F31S MOTOR CONTROL MECHANISM



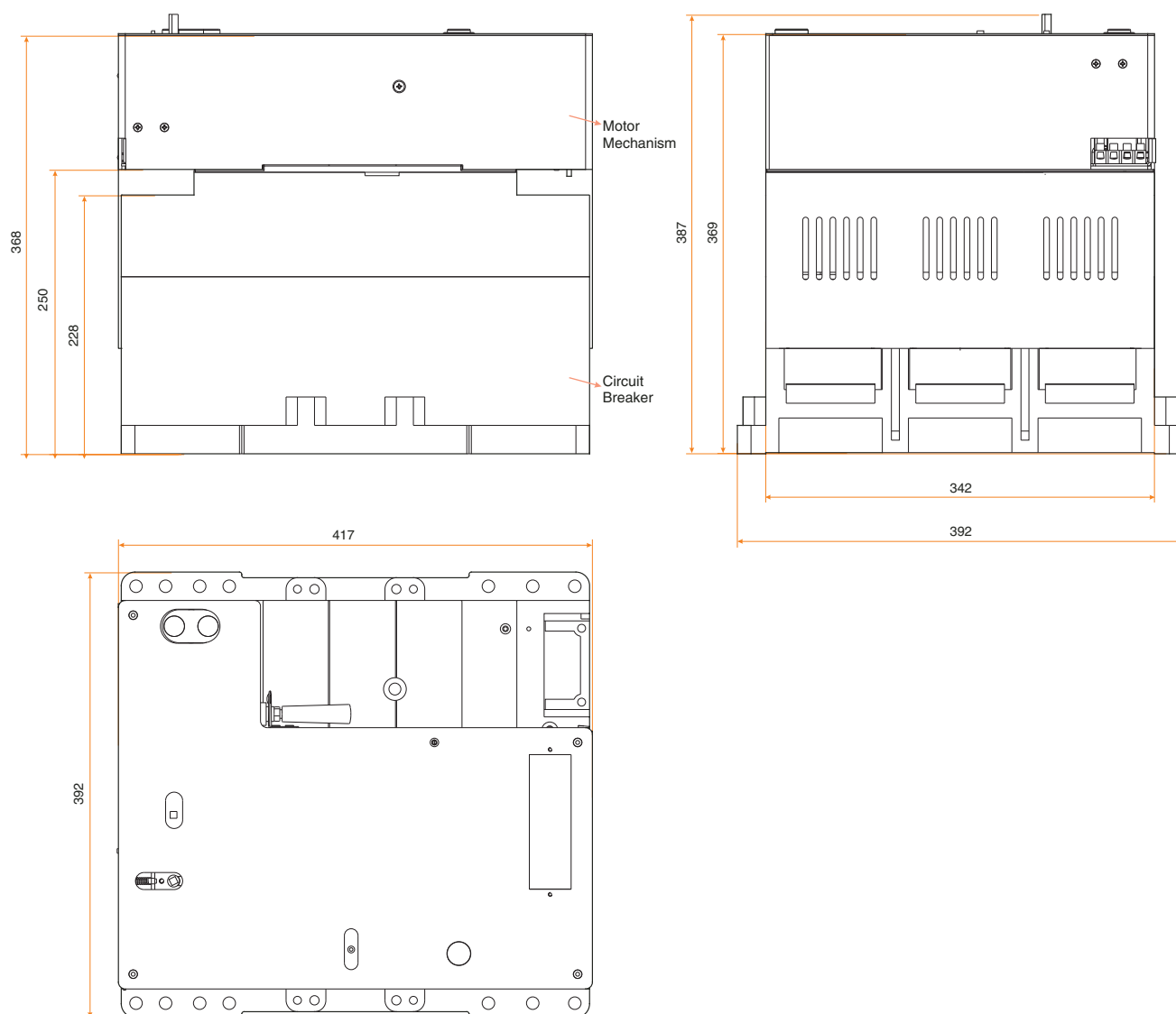
F71 - F82 - F83 - F82E - F83E - F91E - F92E - F101E - F102E MOTOR CONTROL MECHANISM



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

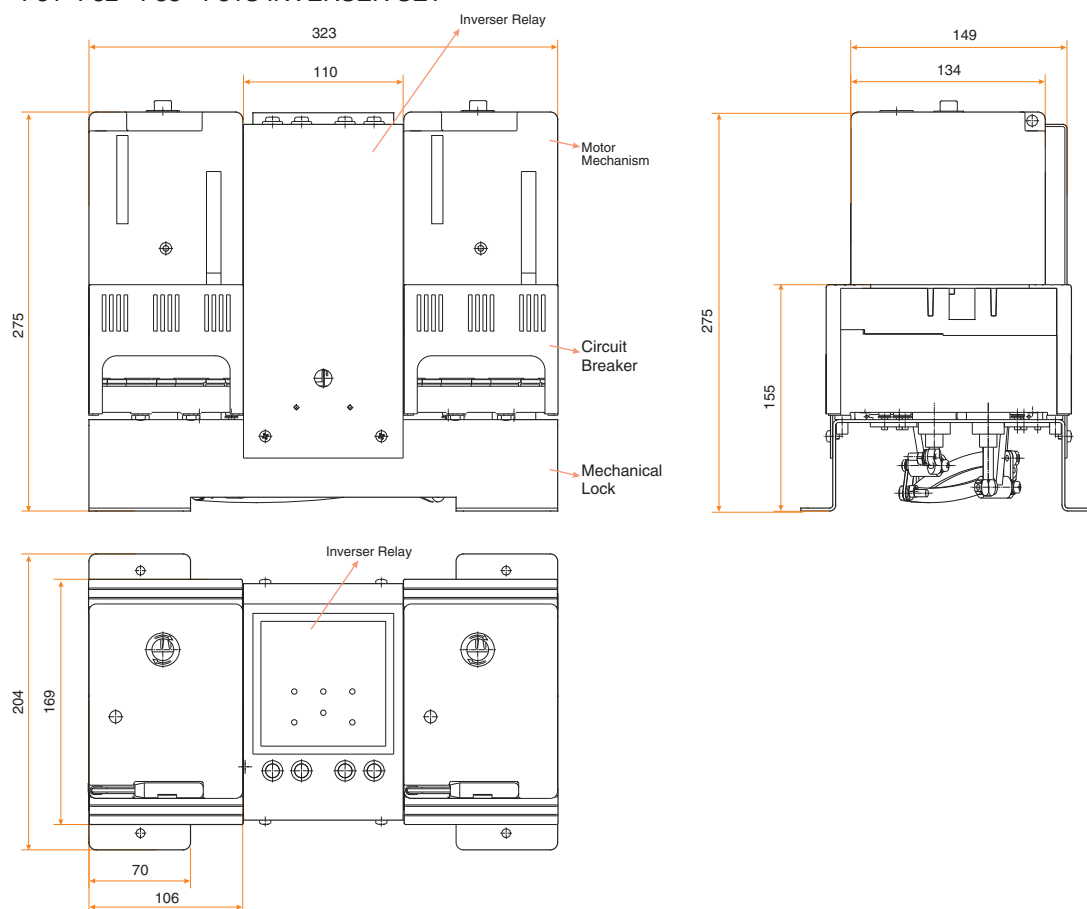
MOLDED CASE CIRCUIT BREAKERS

F111E - F112E MOTOR CONTROL MECHANISM

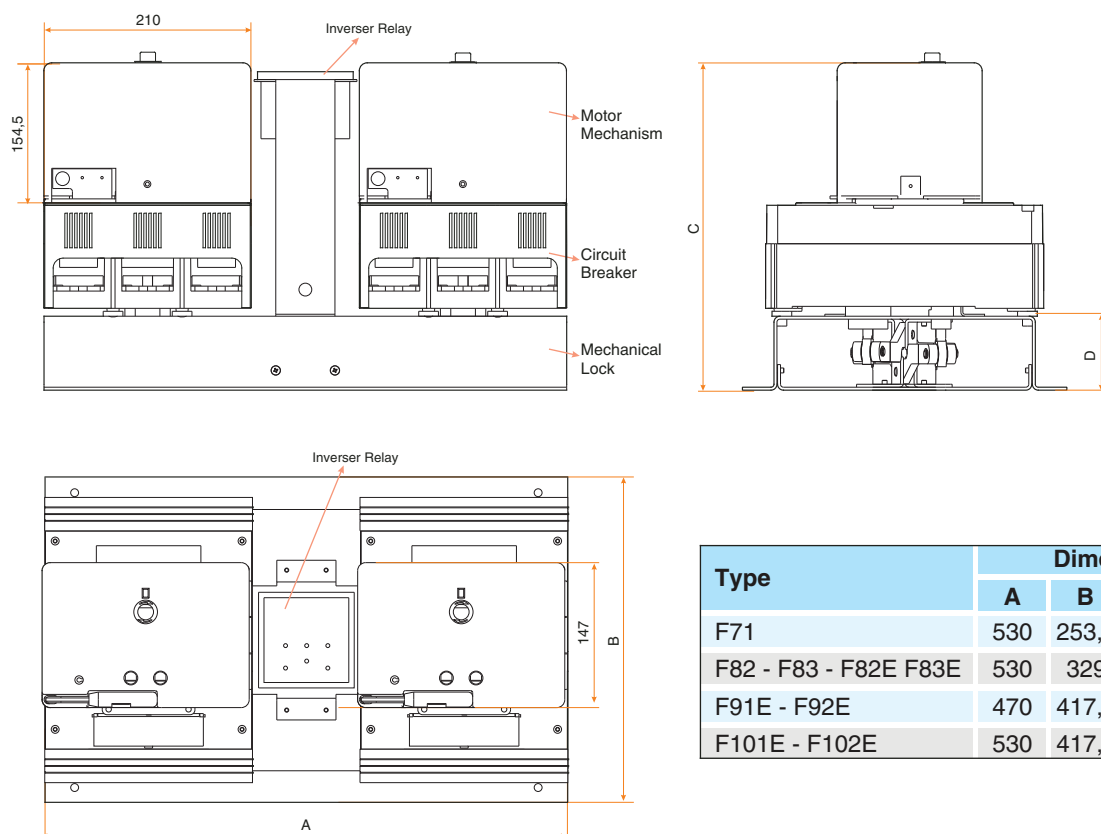


MOLDED CASE CIRCUIT BREAKERS

F31 - F32 - F33 - F31S INVERSER SET



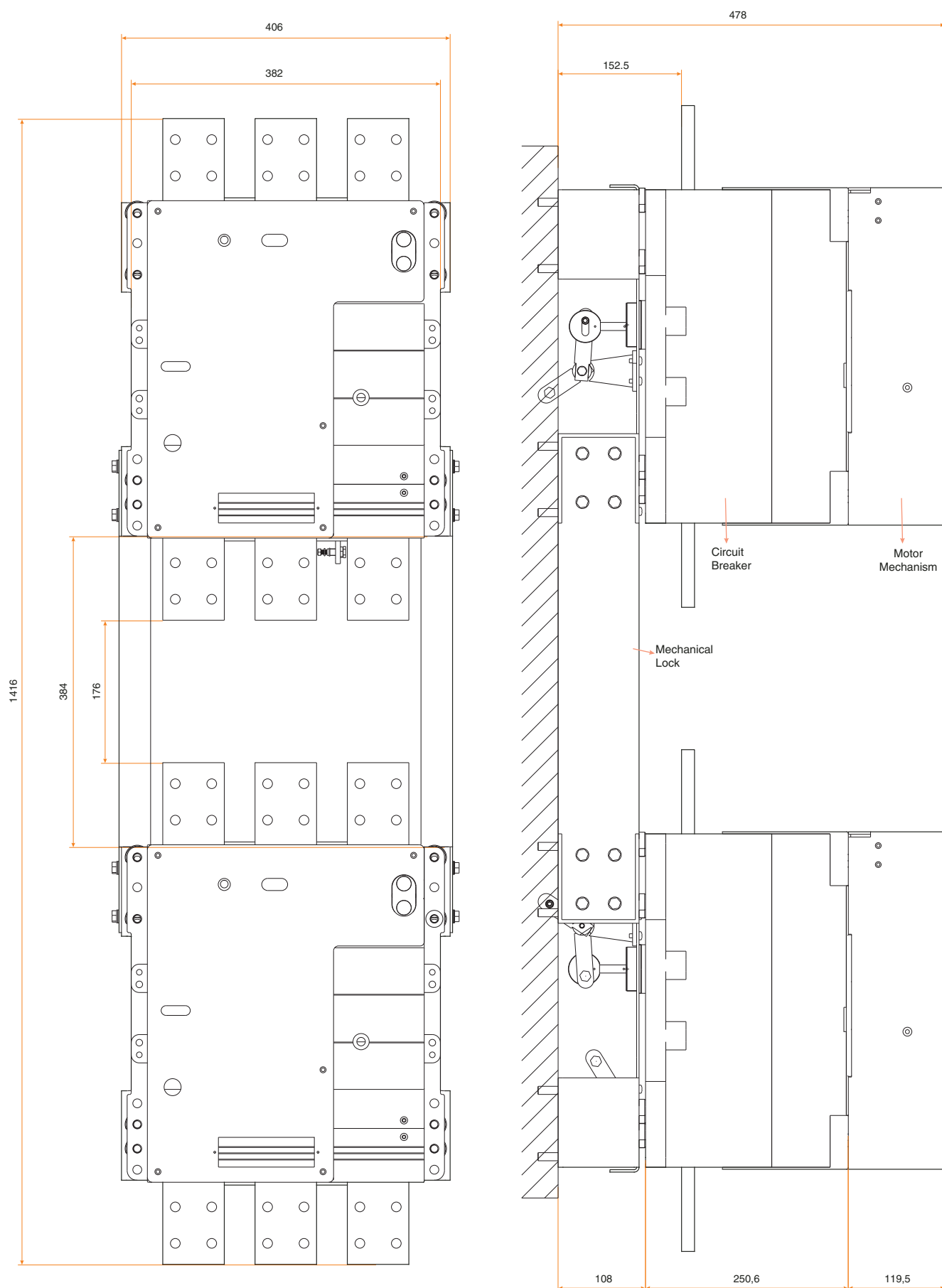
F71 - F82 - F83 - F82E - F83E - F91E - F92E - F101E - F102E INVERSER SET



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

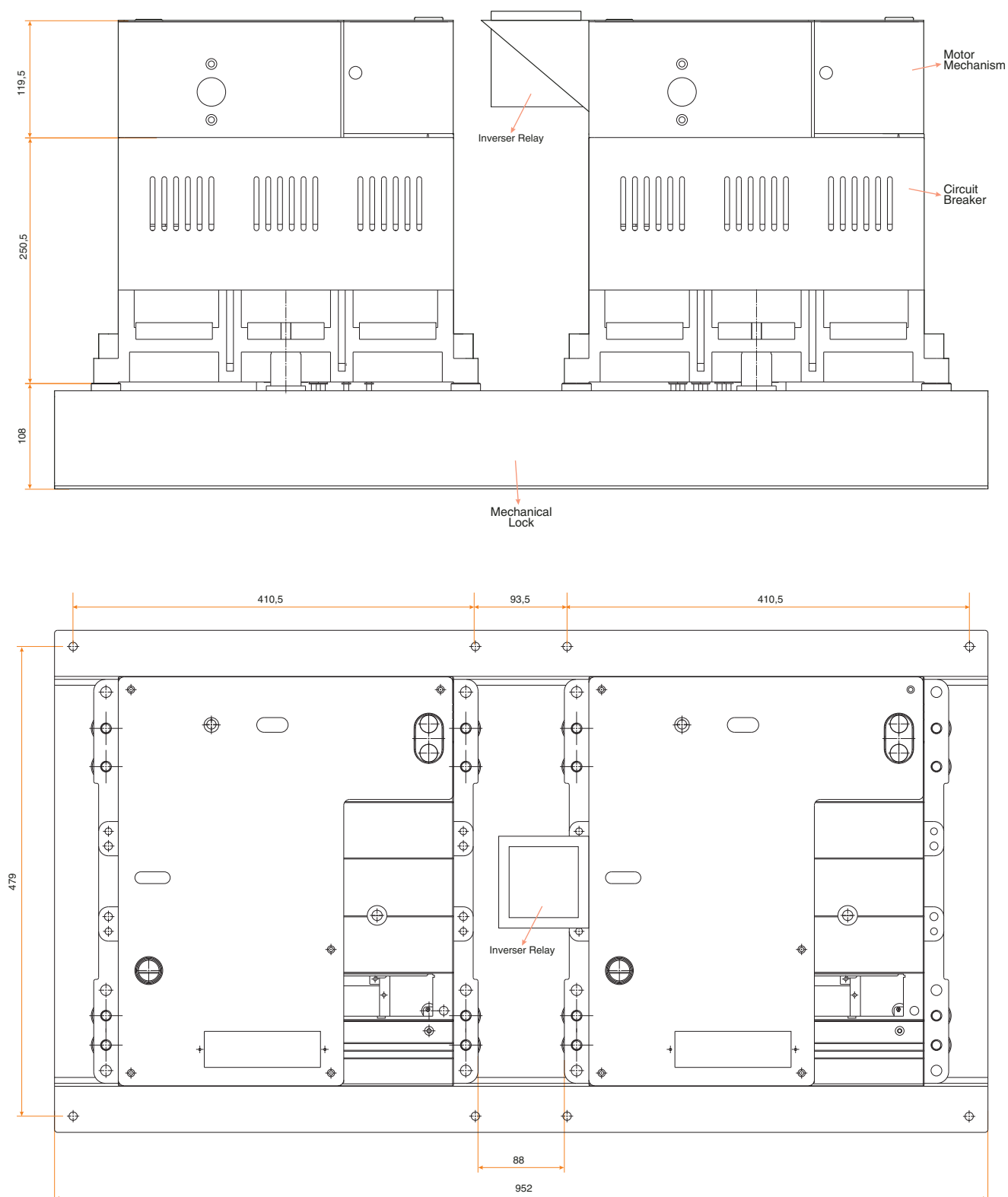
MOLDED CASE CIRCUIT BREAKERS

F111E - F112E INVERSER SET (VERTICAL)



MOLDED CASE CIRCUIT BREAKERS

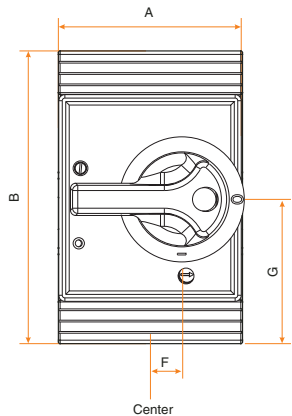
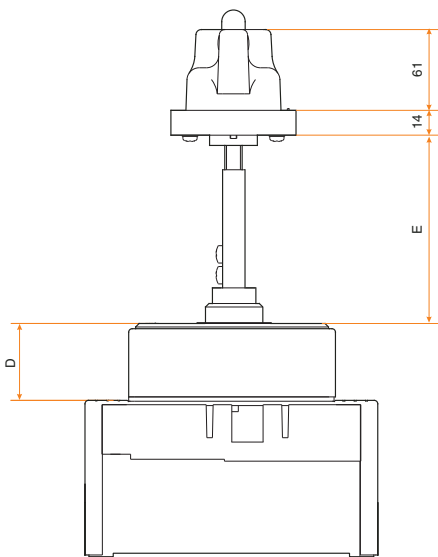
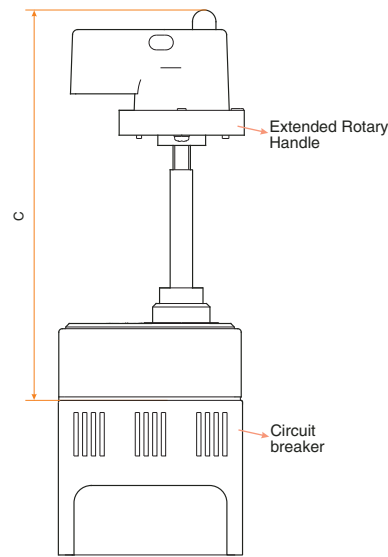
F111E - F112E INVERTER SET (HORIZONTAL)



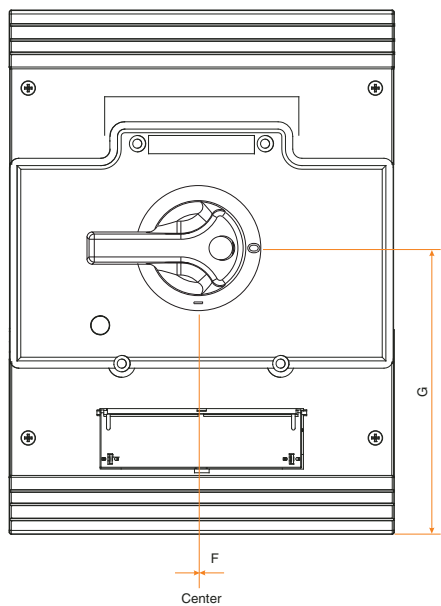
MOLDED CASE CIRCUIT BREAKERS

1

EXTENDED ROTARY HANDLE



Type	Dimensions							
	A	B	C	D	E		F	G
F31 - F32 - F33 - F31S	105	119,5	225	45	min	max	18	85
F51 - F52 - F53	105	119,5	225	45	100	172	18	125
F71	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 special design dimensions CD for panel builder.

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

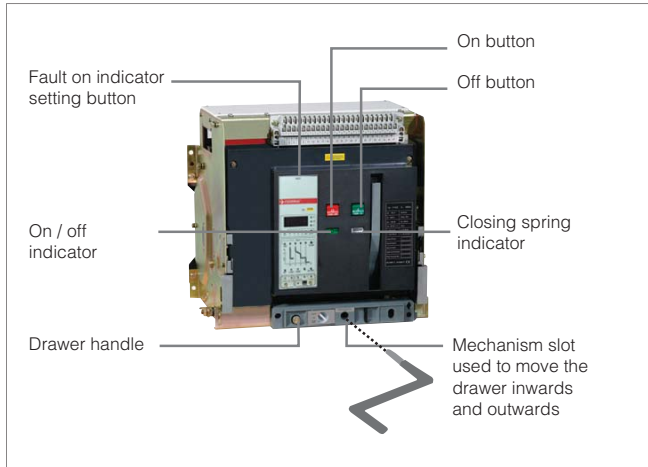
CONTENTS

Features of Control Circuits	1
Functions of Buttons	1
Functional Features of Breaker	2
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Ambient Temperature Impact on Rated Operating	5
Current of Circuit Breaker	5
Accessories	6
Undervoltage Coil	6
Closing Coil	6
Opening Coil	6
Motor Mechanism	6
Mechanical Lock	6
Connection Diagram	7
Characteristic Curves	8
Technical Drawings	9

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:

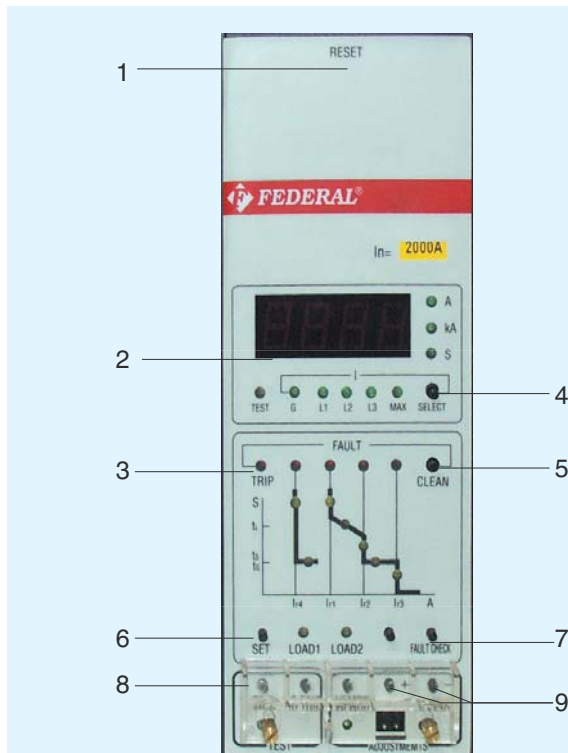
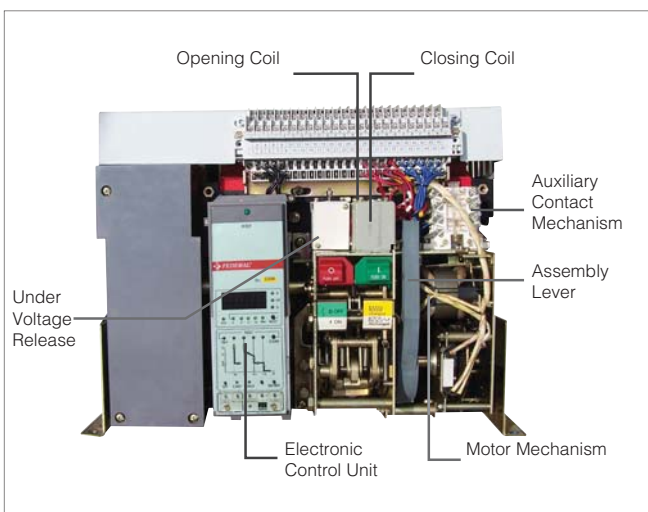
It shows overload status.

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.

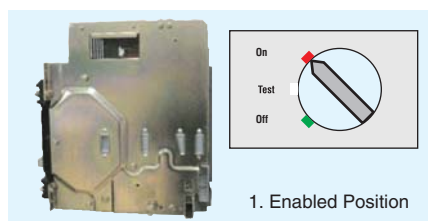
6- SET: You may press this button to adjust and check current and time characteristics and each status may be displayed in order.

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

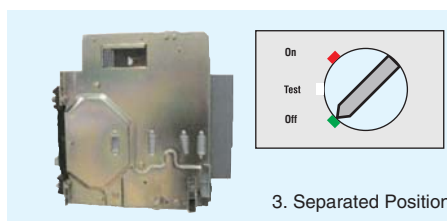
8- TRIP and NON-TRIP: Only for test.

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

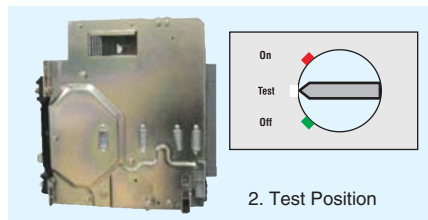
AIR TYPE CIRCUIT BREAKERS



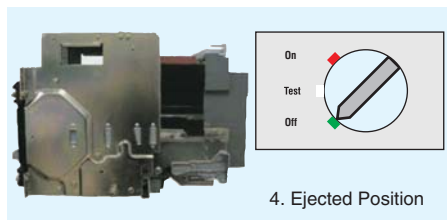
1. Enabled Position



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.

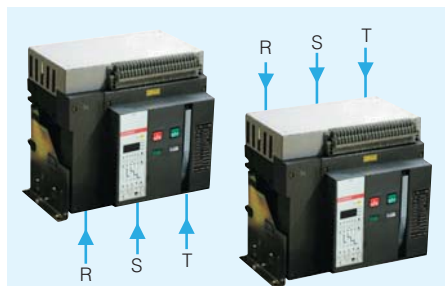
1,05xIL	1,3xIL	1.5xIL time setting (s)	15	30	60	120	240	480
>2h inaction	<1h action	2.0xIL action time (s)	8.4	16.9	33.7	67.5	135	270



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.

$$I^2T = (8I_{r1})^2 t_s$$

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 IL, the opening time (ts) 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 (Ic1) adjustment range $(0.2-1) \times I_n$ and Load 2 current (Ic2) adjustment range $(0.2-1) \times I_n$, Ic1 time delay is adjusted to half of long time delay.

Ic2 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. Ic1 and Ic2 current values are used for disabling and enabling insignificant loads.

AIR TYPE CIRCUIT BREAKERS

														
Type		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 ①		
Number of pole		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			Fixed / Drawout			
Long time delay current		Ir1	(0,4-1)In			(0,4-1)In			(0,4-1)In			(0,4-1)In		
Long time delay interval		sn	0-480			0-480			0-480			0-480		
Short time delay current		Ir2	(0,4-15)In			(0,4-15)In			(0,4-15)In			(0,4-15)In		
Short time delay interval		s	0,1 - 1			0,1 - 1			0,1 - 1			0,1 - 1		
Instantaneous breaking current		Ir3	In-50 kA			In-50 kA			In-50 kA			In-50 kA		
Ground fault current		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			8000			10000			
	Without maintenance	3000			3000			3000			2500			
Power losses per pole	Drawout	70,110,172,268,440,530			600,737			921			898			
	Fixed	34,50,78,122,200,262			312,307									
Accessories														
Undervoltage release *		<input type="checkbox"/>			<input type="checkbox"/>			<input type="checkbox"/>			<input type="checkbox"/>			
Undervoltage release with time delay		<input type="checkbox"/>			<input type="checkbox"/>			<input type="checkbox"/>			<input type="checkbox"/>			
Shunt trip		<input type="checkbox"/>			<input type="checkbox"/>			<input type="checkbox"/>			<input type="checkbox"/>			
Closing coil		<input type="checkbox"/>			<input type="checkbox"/>			<input type="checkbox"/>			<input type="checkbox"/>			
Auxiliary contact block		<input checked="" type="checkbox"/>			<input checked="" type="checkbox"/>			<input checked="" type="checkbox"/>			<input checked="" type="checkbox"/>			
Motor control mechanism		<input type="checkbox"/>			<input type="checkbox"/>			<input type="checkbox"/>			<input type="checkbox"/>			
Inverser lock		<input type="checkbox"/>			<input type="checkbox"/>			<input type="checkbox"/>			<input type="checkbox"/>			

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

☒ standards, ☐ optional

① 6300A is produced as 3 pole

AIR TYPE CIRCUIT BREAKERS

Order Codes:

Type	Rated Current(A)	Icu 415V	Fixed Type	Drawer Type
F121E	630	70	9AL-ESS43-0630	9AL-ESC43-0630
	800		9AL-ESS43-0800	9AL-ESC43-0800
	1000		9AL-ESS43-1000	9AL-ESC43-1000
	1250		9AL-ESS43-1250	9AL-ESC43-1250
	1600		9AL-ESS43-1600	9AL-ESC43-1600
	2000		9AL-ESS43-2000	9AL-ESC43-2000
F122E	630	80	9AL-EMS43-0630	9AL-EMC43-0630
	800		9AL-EMS43-0800	9AL-EMC43-0800
	1000		9AL-EMS43-1000	9AL-EMC43-1000
	1250		9AL-EMS43-1250	9AL-EMC43-1250
	1600		9AL-EMS43-1600	9AL-EMC43-1600
	2000		9AL-EMS43-2000	9AL-EMC43-2000
F123E	630	100	9AL-EHS43-0630	9AL-EHC43-0630
	800		9AL-EHS43-0800	9AL-EHC43-0800
	1000		9AL-EHS43-1000	9AL-EHC43-1000
	1250		9AL-EHS43-1250	9AL-EHC43-1250
	1600		9AL-EHS43-1600	9AL-EHC43-1600
	2000		9AL-EHS43-2000	9AL-EHC43-2000
F131E	2500 3200	70	9AM-ESS43-2500 9AM-ESS43-3200	9AM-ESC43-2500 9AM-ESC43-3200
F132E	2500 3200	80	9AM-EMS43-2500 9AM-EMS43-3200	9AM-EMC43-2500 9AM-EMC43-3200
F133E	2500 3200	100	9AM-EHS43-2500 9AM-EHS43-3200	9AM-EHC43-2500 9AM-EHC43-3200
F141E	4000	70	9AN-ESS43-4000	9AN-ESC43-4000
F142E	4000	80	9AN-EMS43-4000	9AN-EMC43-4000
F143E	4000	100	9AN-EHS43-4000	9AN-EHC43-4000
F151E	5000 6300	70	-	9AS-ESC43-5000 9AS-ESC43-6300
F152E	5000 6300	80	-	9AS-EMC43-5000 9AS-EMC43-6300
F153E	5000 6300	120	-	9AS-EHC43-5000 9AS-EHC43-6300

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

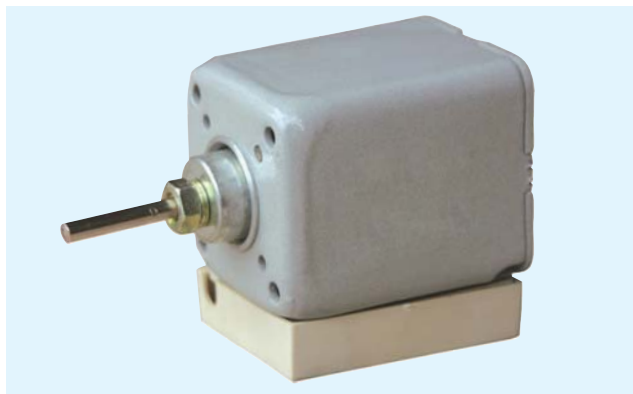
AIR TYPE CIRCUIT BREAKERS

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 (Brannoch 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



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 Coil: 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 Coil: 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
------------	----------------



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	

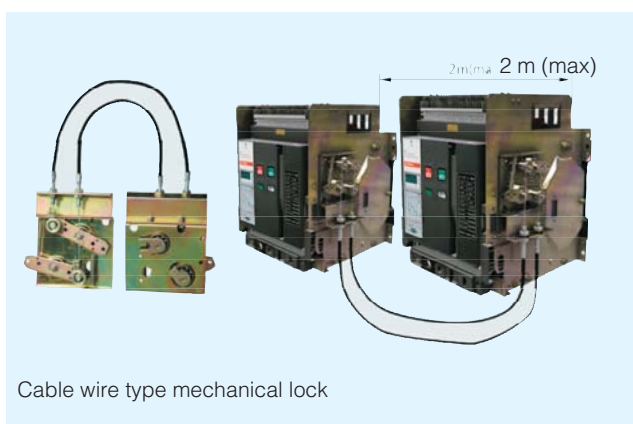
Mechanical Lock:

One of 2 normal power supplies is active.

	1 _{ACB}	2 _{ACB}
1 _{ACB}	0	0
2 _{ACB}	0	1
	1	0

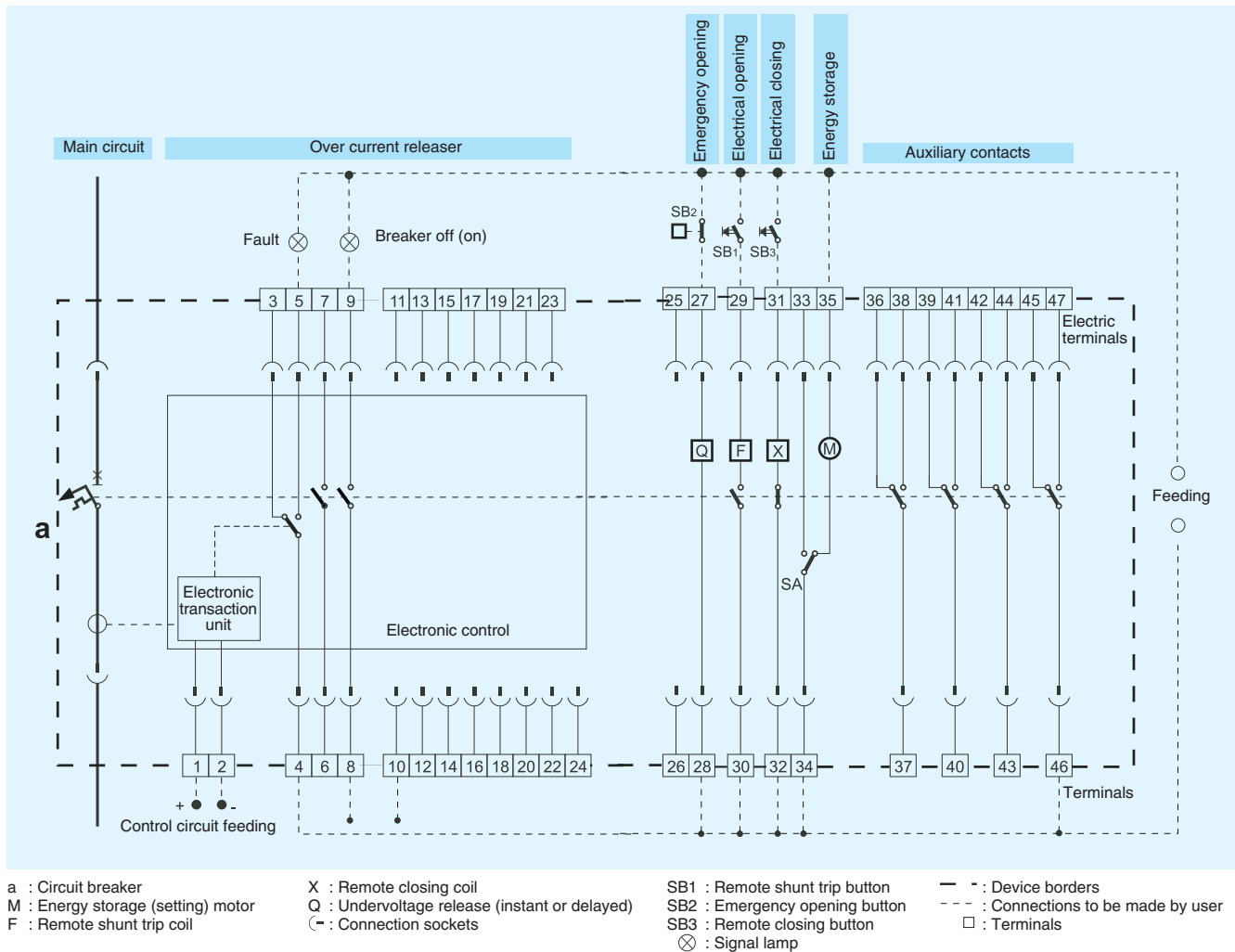
Cable wire type mechanical lock is used in cross locking of 2 circuit breakers in vertical or horizontal positions. The purpose of this application is to prevent accidental ON-1 position of one circuit breaker, while the other is in ON-1 position.

Order Code: 8AM-V0000-0000



Cable wire type mechanical lock

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).

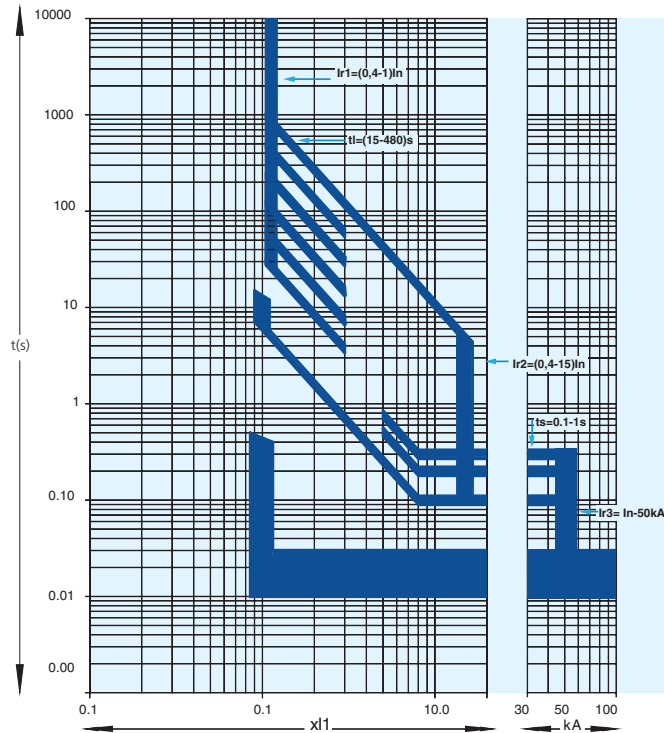


Federal open type circuit breaker control circuit electric terminals can be easily accessed without removing the front cover.

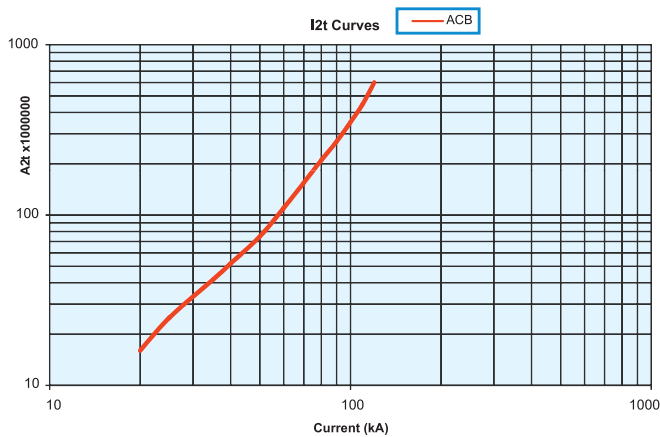
AIR TYPE CIRCUIT BREAKERS

Characteristic Curves:

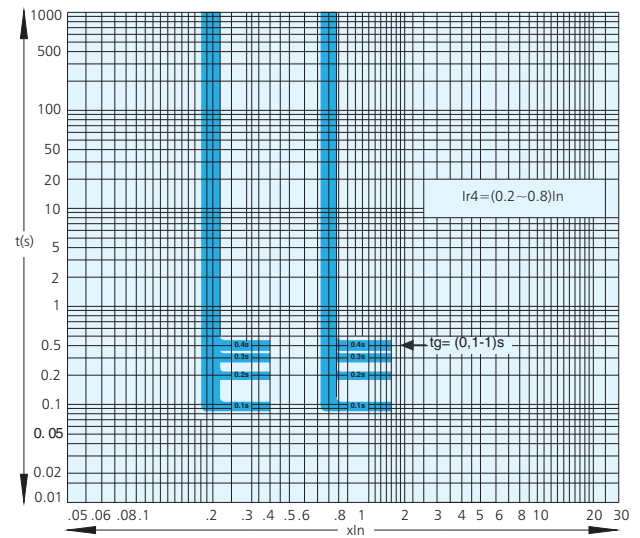
Current-Time Curve:



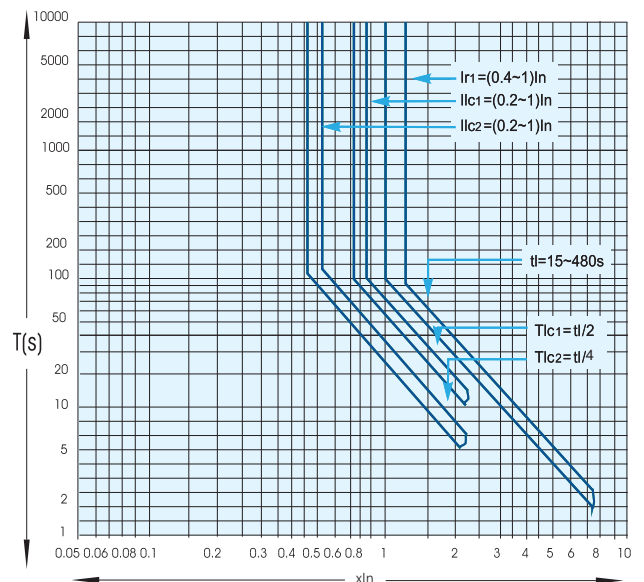
$I^2 T$ Curve:



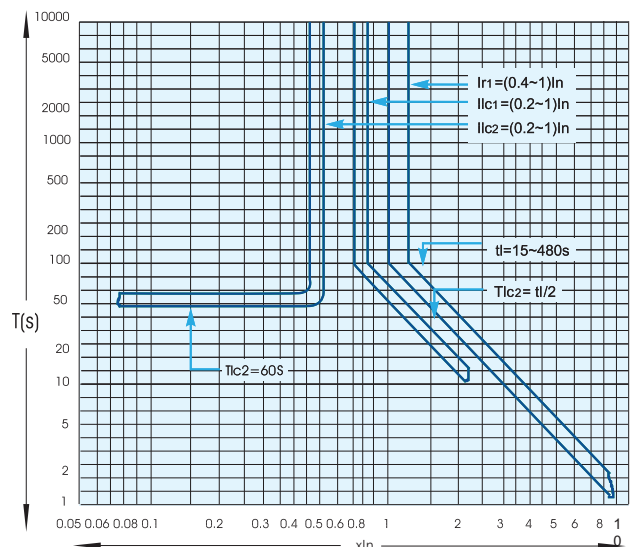
Ground Fault Protection Current-Time Curve:



Load-Dependent Values (1):

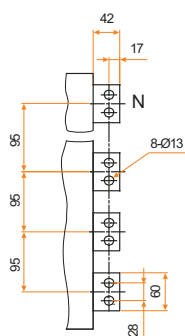
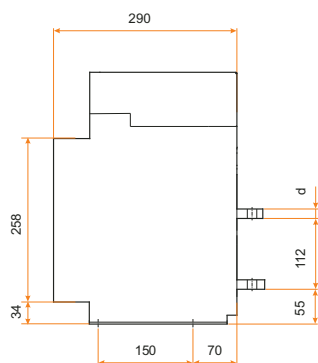


Load-Dependent Values (2):

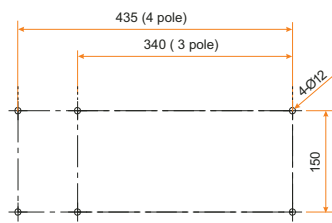
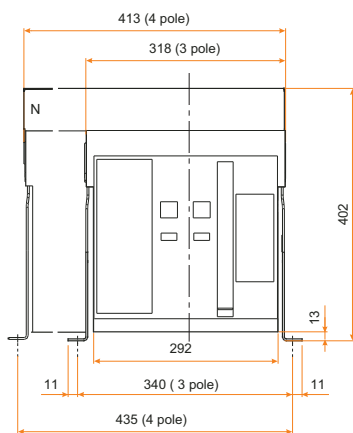


AIR TYPE CIRCUIT BREAKERS

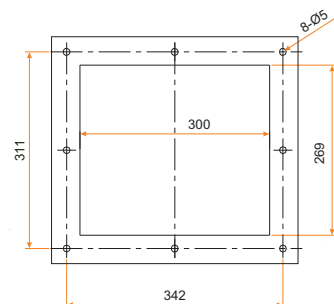
F121E-F122E-F123E (Fixed Type)



Busbar Connections



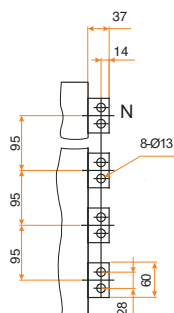
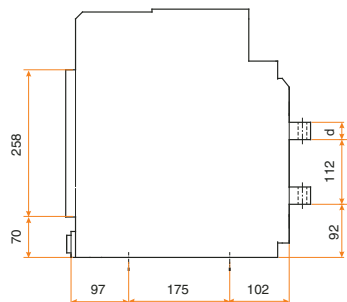
Assembling Gauge



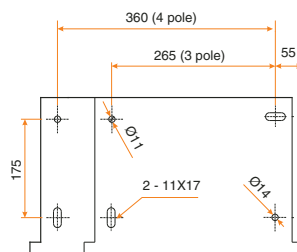
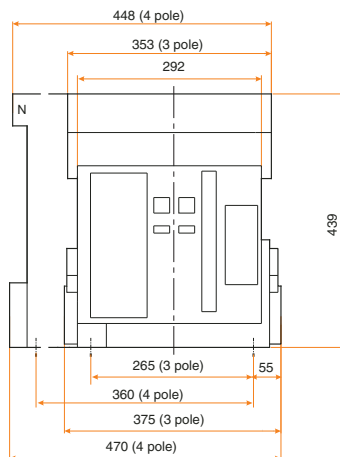
Panel Frame

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

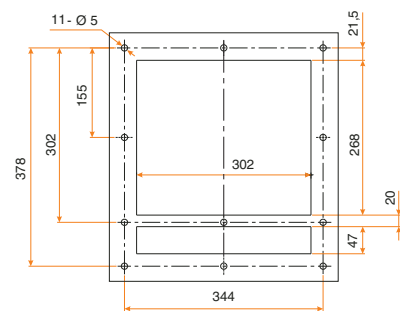
F121E-F122E-F123E (Drawout Type)



Busbar Connections



Assembling Gauge

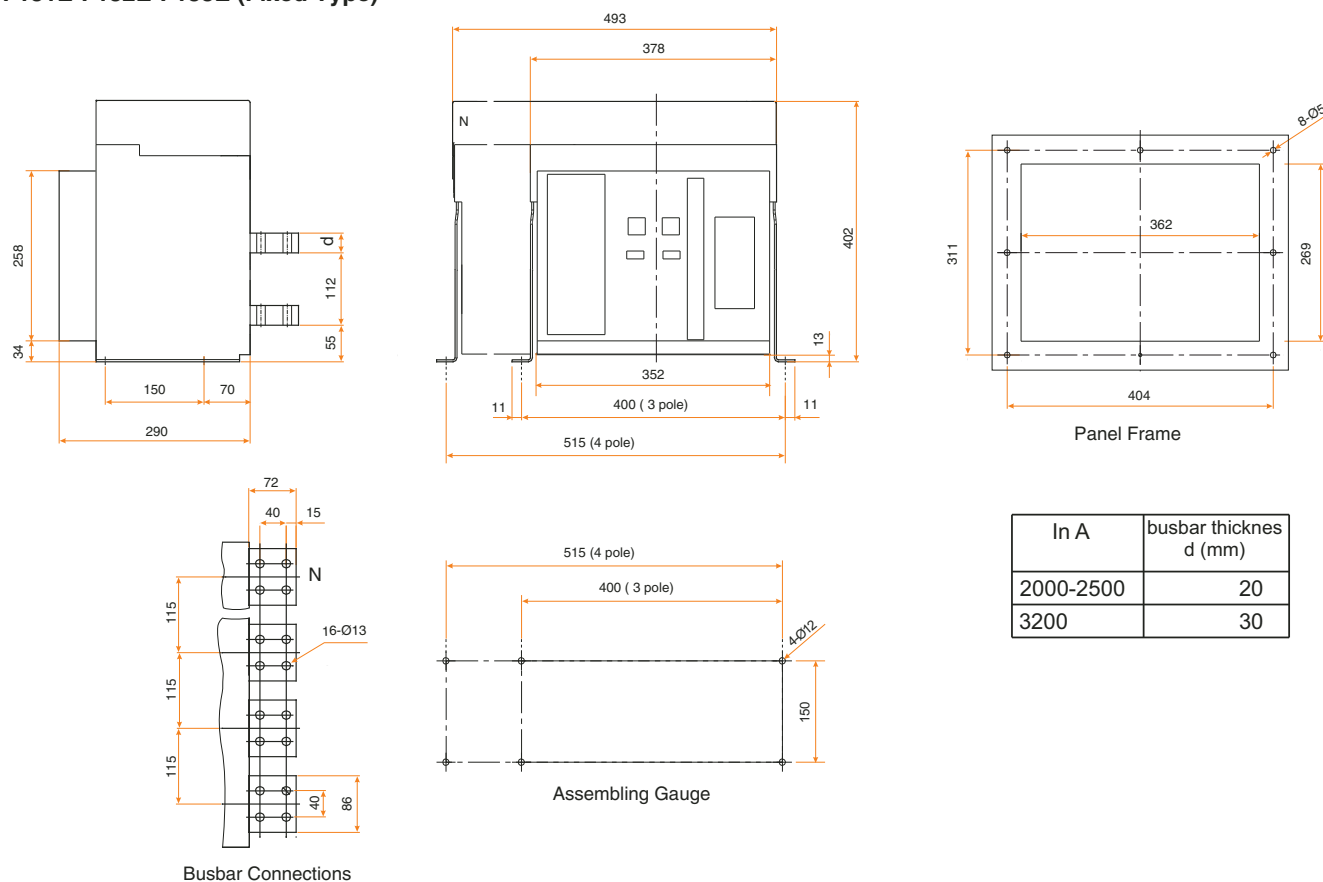


Panel Frame

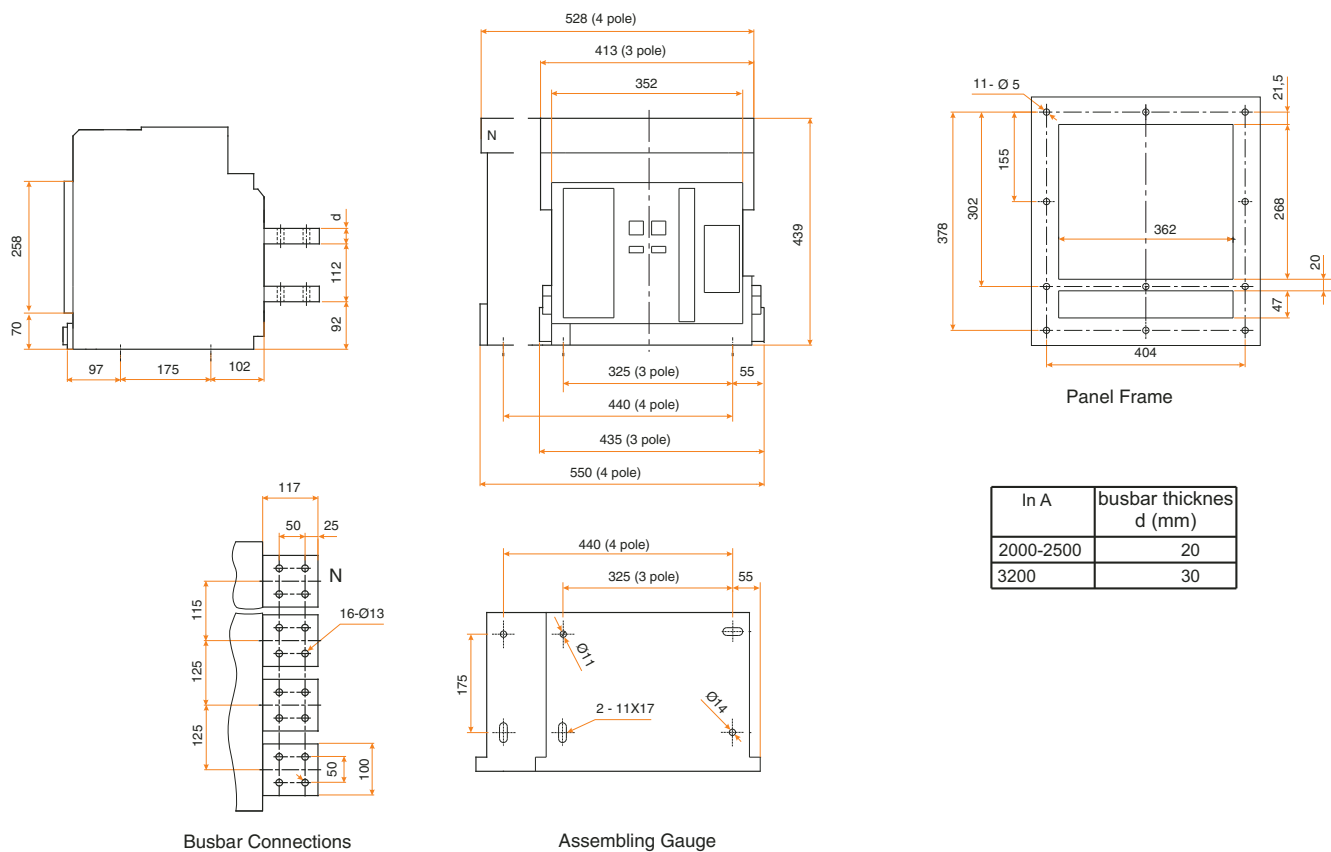
In A	busbar thickness d (mm)
630	10
800-1600	15
2000	20

AIR TYPE CIRCUIT BREAKERS

F131E-F132E-F133E (Fixed Type)

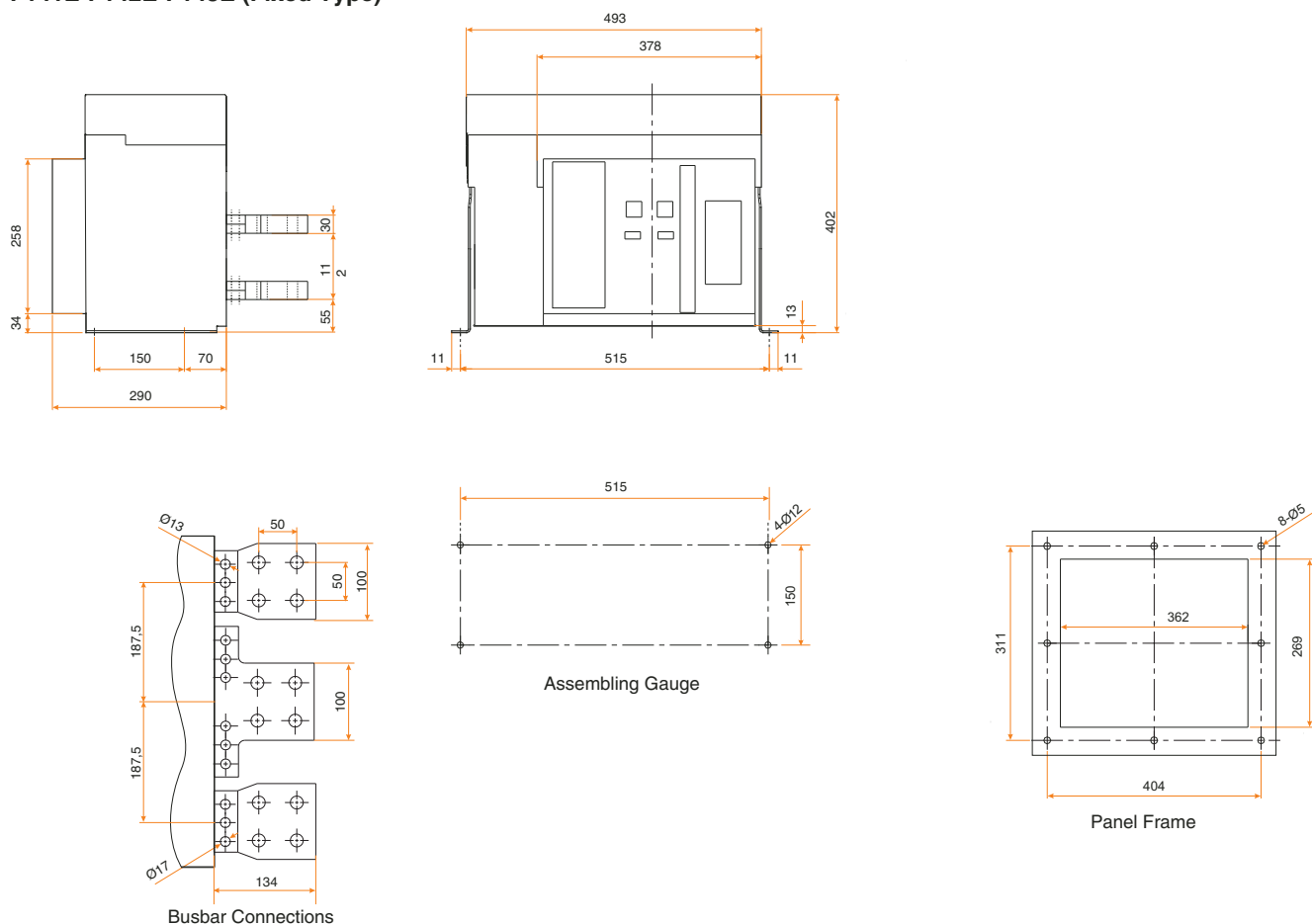


F131E-F132E-F133E (Drawout Type)

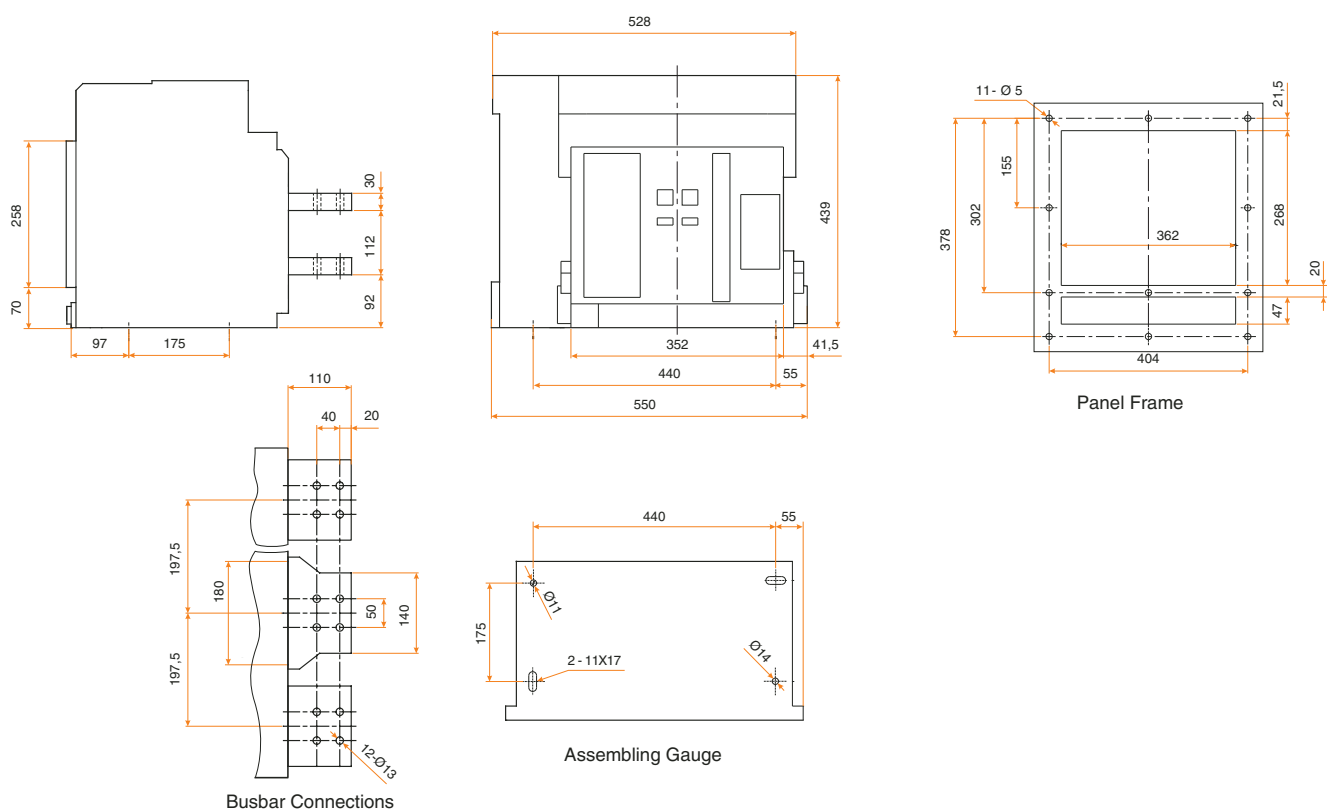


AIR TYPE CIRCUIT BREAKERS

F141E-F142E-F143E (Fixed Type)

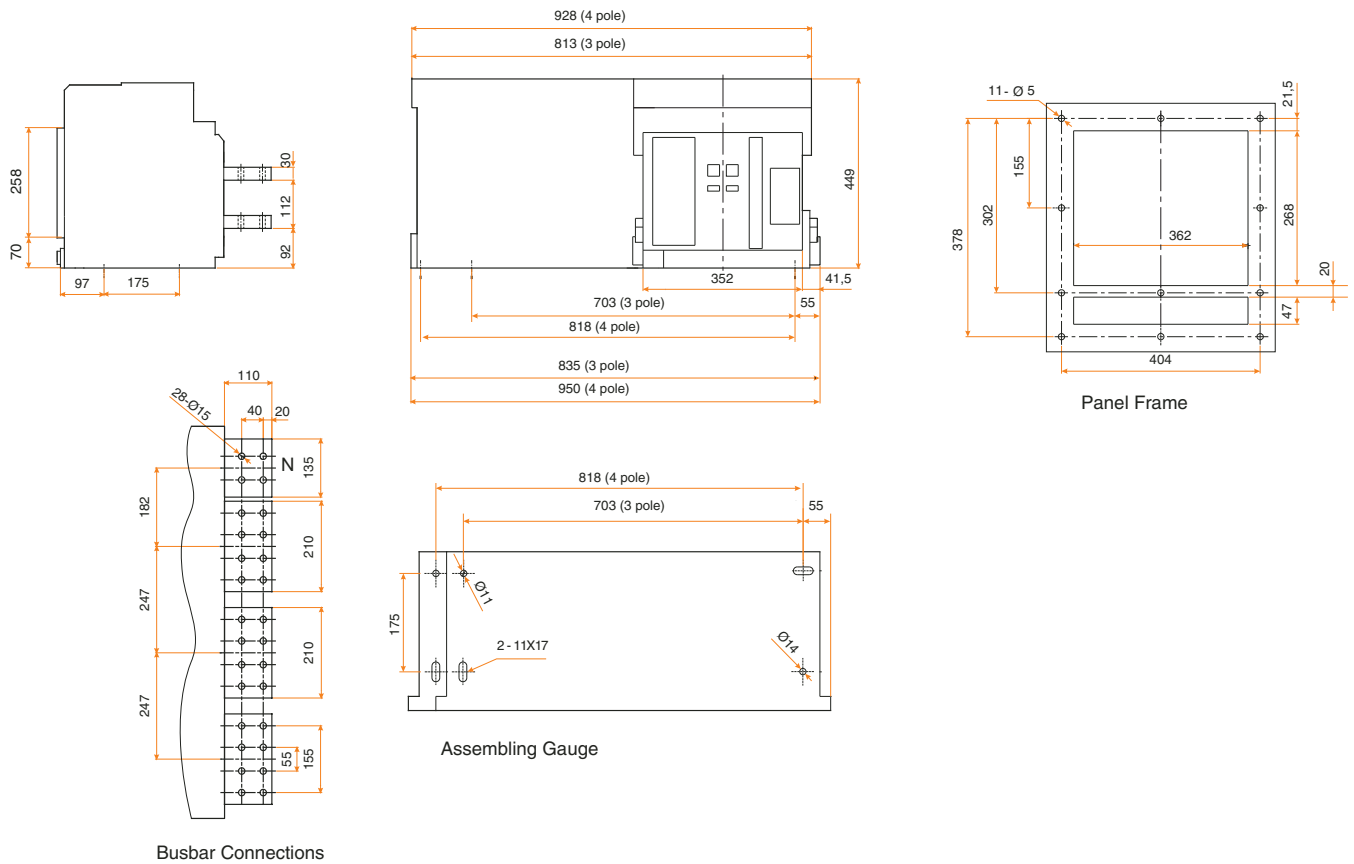


F141E-F142E-F143E (Drawout Type)



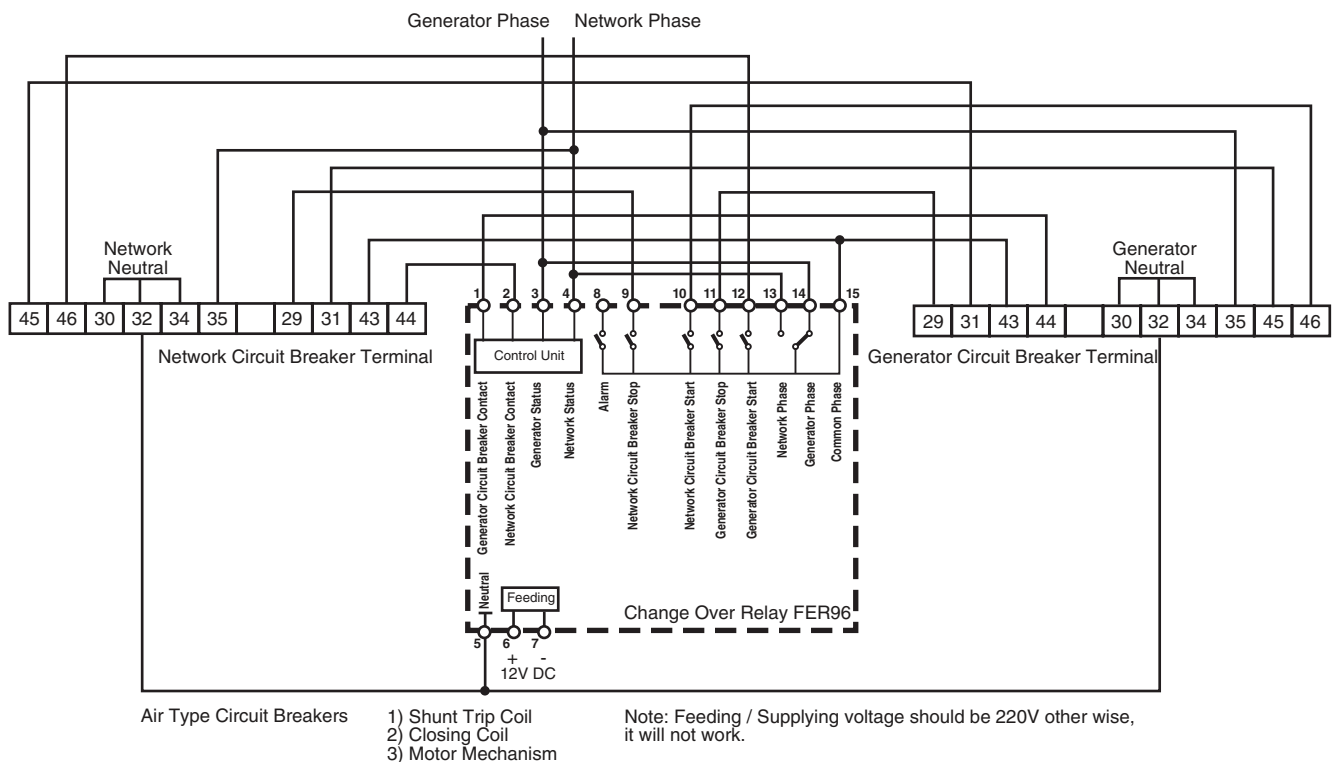
AIR TYPE CIRCUIT BREAKERS

F151E-F152E-F153E (Drawout Type)



2

Winning Diagram Of Change Over Systems For Air Circuit Breakers



MINIATURE CIRCUIT BREAKERS



Miniature Circuit Breakers (MCB)



FIR (Impulse Relay)

16A

FM3

2A ... 63A



FM6

2A ... 63A



FM10

2A ... 63A



FM10L

80A ... 125A



FMS Disconnectors

40A ... 100A

CONTENTS

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Technical Table	4
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IEC / EN 60898-1

CE

Mounting Position	: Free
Altitude	: 2000 m (max)
Relative Humidity	: 50% (40°C) , 90% (20°C)
Ambient Temperature	: between -5°C and + 40°C ^①
Pollution Degree	: II
Protection Degree	: IP20

IEC / EN 60947-2

CE

Mounting Position	: Free
Altitude	: 2000 m (max)
Relative Humidity	: 50% (40°C) , 90% (20°C)
Ambient Temperature	: between -5°C and + 40°C ^①
Pollution Degree	: II
Protection Degree	: IP20

IEC / EN 60947-3

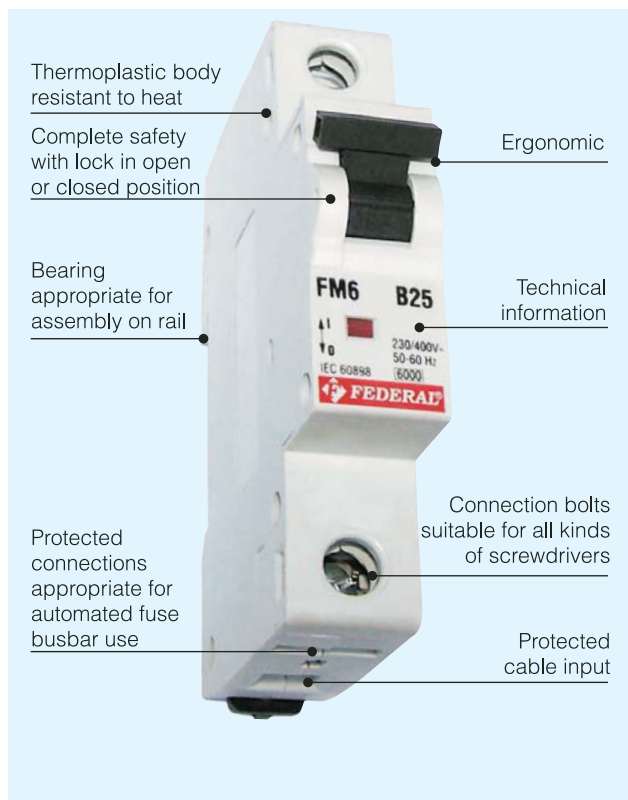
CE

Mounting Position	: Free
Altitude	: 2000 m (max)
Relative Humidity	: 50% (40°C) , 90% (20°C)
Ambient Temperature	: between -5°C and + 40°C ^①
Pollution Degree	: III
Protection Degree	: IP20

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

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 63A 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 than nominal current, C types open the circuit at 5 or 10 times more than 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 type: Used in illumination of houses, plugs and control circuits.

C / D type: 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. In this way, thermal and magnetic forced of the short circuit current are limited. It provides ease in assembly thanks to small dimensions and capability of mounting on rails. Thanks to the design of connection terminals, accidentally touches are eliminated. Federal miniature circuit breakers resist an impact voltage of 6kV, operate continuously under an ambient temperature of 55°C and resist a relative humidity of 95%. 25 mm² cable can be connected to specially-designed cable inputs.

Technical Specifications::

Type		FM3	FM6	FM10
Characteristic		B, C, D		
Breaking capacity	kA _{rms}	3	6	10
Rated current	A	0.5, 1, 2, 4, 6, 10, 16, 20, 25, 32, 40, 50, 63		
Rated operating voltage - U _e	V	DC 60V/pole - AC 220/400V 50-60 Hz		
Rated insulation voltage - U _i	V	500		
Rated impulse withstand voltage - U _{imp}	kV	4		
Number of poles		1, 1+1, 2, 3, 3+1, 4		
Electrical life	operation	>4.000		
Min. - max. connection section	mm ²	1 ... 16		
Min. - max. clamping torque	Nm	2 ... 3		
Standard		IEC / EN 60898-1		

Temperature effect on miniature circuit breakers:

Miniature circuit breakers are calibrated according to ambient temperature of 30°C unless it is specified as different. Overload protection characteristics change by temperature. Rated currents of miniature circuit breakers for different temperatures are given in below table.

I _n (A)	10 °C	20°C	30°C	40°C	50°C	55°C	60°C
2	2.2	2.1	2.0	1.9	1.8	1.7	1.7
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	5.2	5.1
10	11.0	10.5	10.0	9.5	9.0	8.7	8.4
16	17.7	16.8	16.0	15.2	14.3	13.9	13.5
20	22.1	21.0	20.0	19.0	17.9	17.4	16.9
25	27.6	26.3	25.0	23.7	22.4	21.8	21.1
32	35.3	33.7	32.0	30.3	28.7	27.8	27.0
40	44.2	42.1	40.0	37.9	35.8	34.8	33.8
50	55.2	52.6	50.0	47.4	44.8	43.5	42.2
63	69.6	66.3	63.0	59.7	56.4	54.8	53.2

Because a lot of miniature circuit breakers working alongside in a same box at the same time may effect each other, the rated current will decrease more. In this case the new rated current of miniature circuit breaker is found by multiplying by 0.8. For example it is found as 23.7A for a 25A circuit breaker working at 40°C. And the new rated current of the circuit breaker is 23.7x0.8 = 18.96 A.




*At DC voltage

- Overload protection (thermal) characteristic is same as AC voltage.

- Short circuit protection (magnetic) characteristic is %40 higher than AC voltage.

MINIATURE CIRCUIT BREAKERS




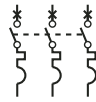
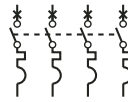
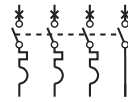
3

	Rated current In (A)	Breaking capacity Ics (kA)	Order codes
			Characteristic B / C / D
 <p>FM3</p>	2	3	9EC-Δ03☆□-0002
	4	3	9EC-Δ03☆□-0004
	6	3	9EC-Δ03☆□-0006
	10	3	9EC-Δ03☆□-0010
	16	3	9EC-Δ03☆□-0016
	20	3	9EC-Δ03☆□-0020
	25	3	9EC-Δ03☆□-0025
	32	3	9EC-Δ03☆□-0032
	40	3	9EC-Δ03☆□-0040
	50	3	9EC-Δ03☆□-0050
	63	3	9EC-Δ03☆□-0063
 <p>FM6</p>	2	6	9ED-Δ03☆□-0002
	4	6	9ED-Δ03☆□-0004
	6	6	9ED-Δ03☆□-0006
	10	6	9ED-Δ03☆□-0010
	16	6	9ED-Δ03☆□-0016
	20	6	9ED-Δ03☆□-0020
	25	6	9ED-Δ03☆□-0025
	32	6	9ED-Δ03☆□-0032
	40	6	9ED-Δ03☆□-0040
	50	6	9ED-Δ03☆□-0050
	63	6	9ED-Δ03☆□-0063
 <p>FM10</p>	2	10	9EE-Δ03☆□-0002
	4	10	9EE-Δ03☆□-0004
	6	10	9EE-Δ03☆□-0006
	10	10	9EE-Δ03☆□-0010
	16	10	9EE-Δ03☆□-0016
	20	10	9EE-Δ03☆□-0020
	25	10	9EE-Δ03☆□-0025
	32	10	9EE-Δ03☆□-0032
	40	10	9EE-Δ03☆□-0040
	50	10	9EE-Δ03☆□-0050
	63	10	9EE-Δ03☆□-0063

△ Please write (B) for B type, (C) for C type and (D) for D type

Please write ☆:(2) , □:(2) for 1 Phase + Neutral

Please write ☆:(4) , □:(4) for 1 Phase + Neutral

Connection diagram	1 pole	2 pole	1 phase + Neutral	3 pole	4 pole	3 phase + Neutral
						

MINIATURE CIRCUIT BREAKERS

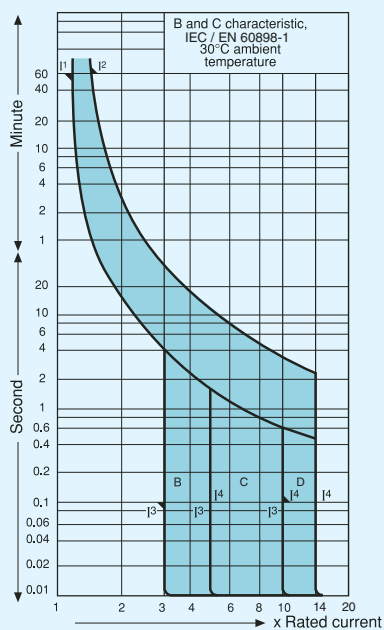


Fig-1 Current-Time Curve (FM3 $I_n < 40A$)

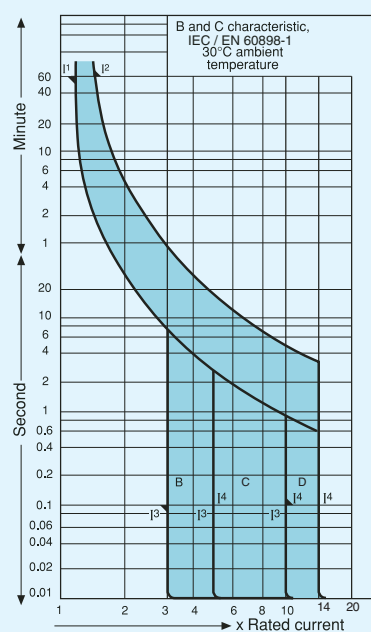


Fig-2 Current-Time Curve (FM3 $I_n = 50A, 63A$)

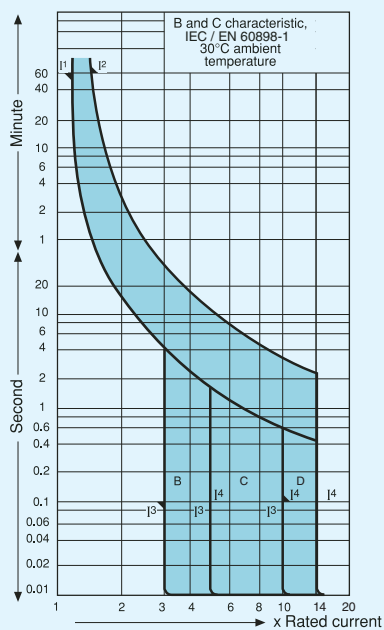


Fig-1 Current-Time Curve (FM6, FM10)

Characteristic	B	C	D
I_1 ($t \geq 1h$)	$1,13 \times I_n$	$1,13 \times I_n$	$1,13 \times I_n$
I_2 ($t < 1h$)	$1,45 \times I_n$	$1,45 \times I_n$	$1,45 \times I_n$
I_3 ($t \geq 0,1s$)	$3 \times I_n$	$5 \times I_n$	$10 \times I_n$
I_4 ($t < 0,1s$)	$5 \times I_n$	$10 \times I_n$	$14 \times I_n$

MINIATURE CIRCUIT BREAKERS



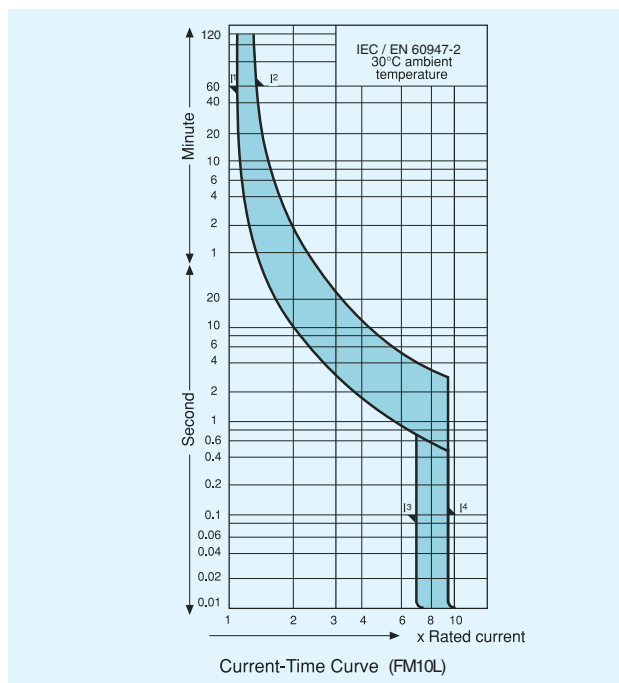
Miniature Circuit Breakers protect electrical circuits against overload and short-circuit current. They provide ON-OFF switching easily.

10 kA Federal Miniature Circuit Breaker is manufactured between the ranges 80A - 125A and 1, 2, 3, 4 poles. They comply with IEC 60947-2 standard and CE certificate. 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	FM10L
Breaking capacity	kA_{rms} 10
Rated current	A 80, 100, 125
Rated operating voltage - U_e	V 230/400
Rated insulation voltage - U_i	V 500
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^2 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 ($t < 0,2s$)	$8 \times 1,2 \times I_n$



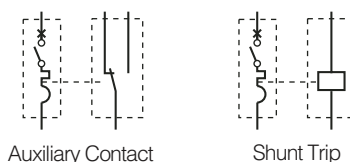
FM10L	Rated current I_n (A)	Breaking capacity I_{cs} (kA)	Order codes
 1 pole	80	10	9EF-C103□-0D80
 2 pole	100	10	9EF-C103□-D100
 3 pole	125	10	9EF-C103□-D125
 4 pole			

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

Accessories



Type	Order Code
Shunt Trip - FM10L-AB	9EF-BA000-D220
Auxiliary Contact - FM10L-YK	9EF-A0011-D000



Auxiliary Contact

Shunt Trip

MINIATURE CIRCUIT BREAKERS



DISCONNECTORS

On-off switches without thermal and magnetic feature are called disconnectors. Federal disconnectors are manufactured from 40A to 100A, with 1,2,3 and 4 poles, in accordance with TS EN 60947-3 standard and CE norms. 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 Characteristic :

Type	FMS
Number of poles	1,2,3,4
Utilization class	AC-22A
Rated current I_n	A 40,63,80,100
Rated operating voltage U_i	V 500 V
Rated impulse withstand voltage - U_{imp} lth	kV 6
Rated frequency	Hz 50/60
Short-time withstand current	A/1s $12 \times I_n$
Short circuit making capacity	A $20 \times I_n$
Mechanical life	Operation 10,000
Electrical life	Operation > 1500
Min. - max. connection sections	mm ² 6-35
Min. - max. clamping torque	Nm 2-3
Standard	IEC / EN 60947-3

Order Codes :

Rated Current I_n (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				

MINIATURE CIRCUIT BREAKERS

IMPULSE CURRENT BREAKER



Type	Coil VAC 50 / 60 Hz	Coil VDC	Power Circuit AC1	Width in 17,5 mm
1NO	230	110	16A-250V	1
2NO	230	110	16A-250V	1
1NC+1NO	230	110	16A-250V	1

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

Description:

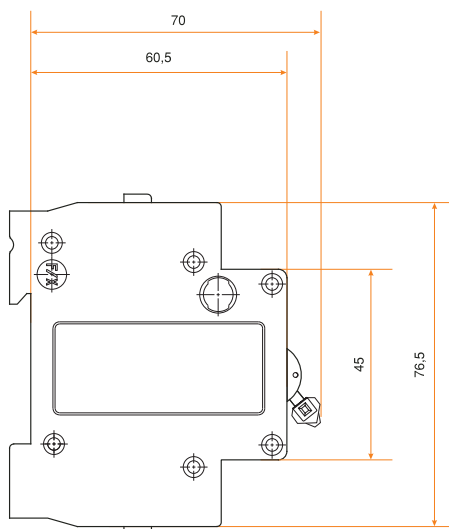
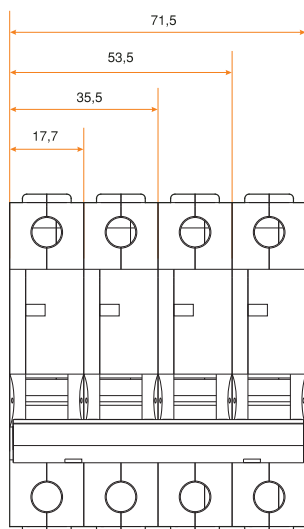
For control of lighting circuits in private buildings, small industry buildings. Latching relays operate when pulsed by a signal voltage. The pulse can be provided via a push button or switch. The first impulse sets the relay into its set (opposite) state, the next impulye returns it to its reset (original)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

Connection Capacity:

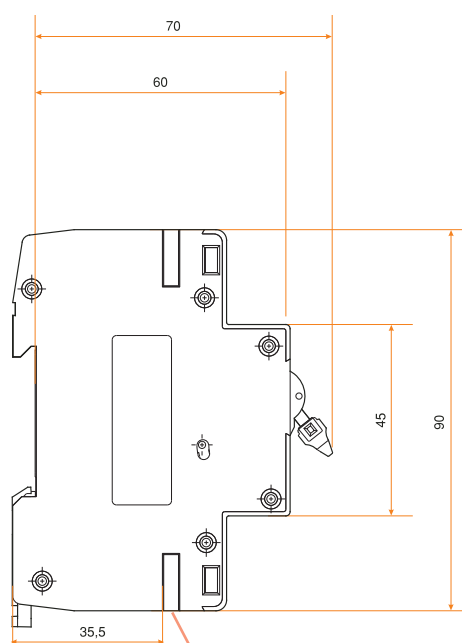
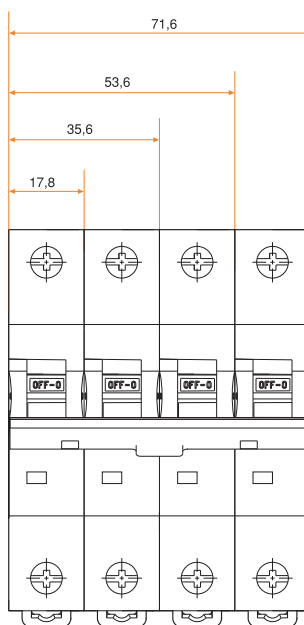
- 10 rigid cables
- 6 flexible cables

MINIATURE CIRCUIT BREAKERS

FM3



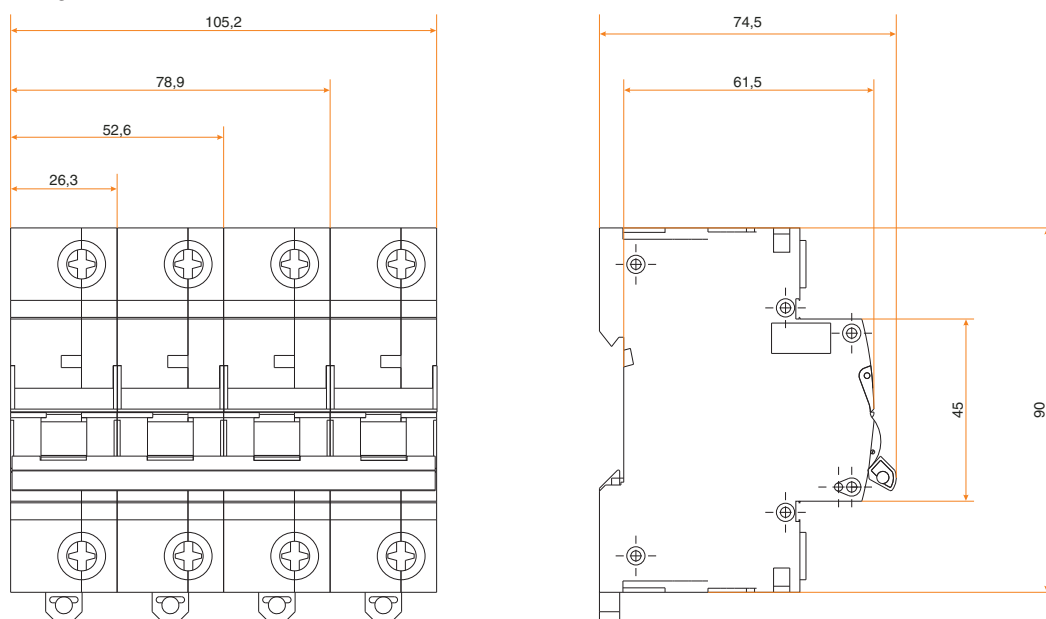
FM6 - FM10



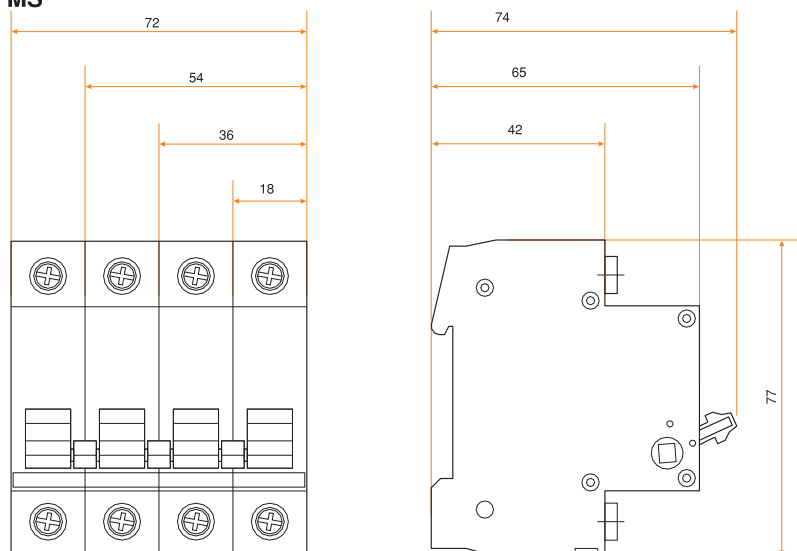
Federal Electric FM6, FM10 miniature circuit breakers may be used with FK2, FK4 residual current circuit breakers, thanks to automat busbar.

MINIATURE CIRCUIT BREAKERS

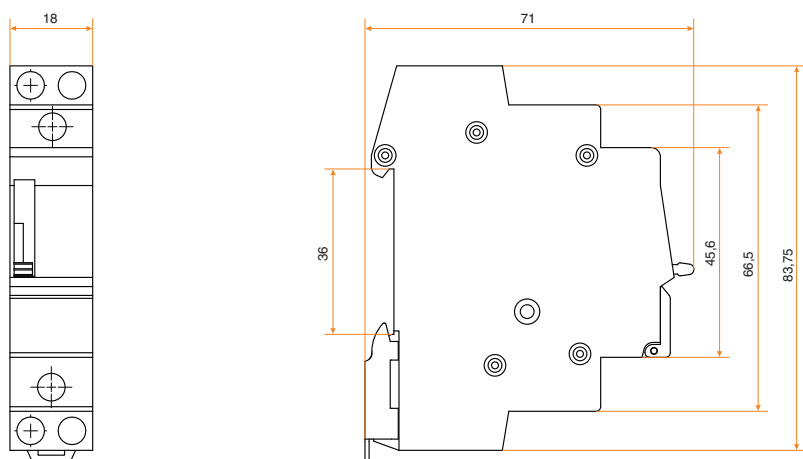
FM10L



FMS



FIR



INSTALLATION CONTACTORS



Installation Contactors



FCR2020



FCR4040



FCR6340

CONTENTS

Area of Application	1
Order Codes	1
Technical Table	1
Technical Drawings	1

IEC / EN 60947-4-1

IEC / EN 61095

CE

Mounting Position	: Front face downwards
Altitude	: 2000 m (max)
Relative Humidity	: %50 (40°C) , %90 (20°C)
Ambient Temperature	: between -5°C and +40°C
Pollution Degree	: 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

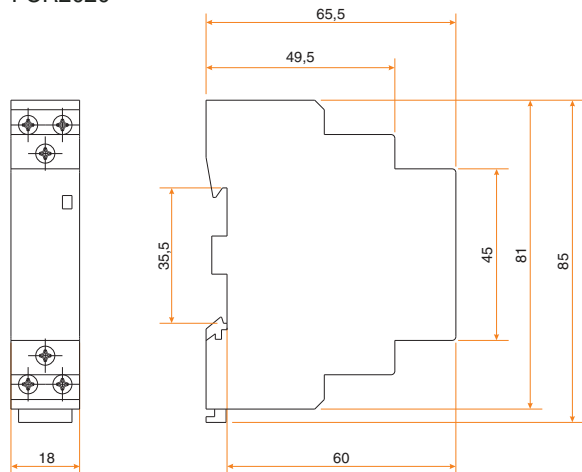
Effect of ambient temperature to rated operating current of installation contactors:

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

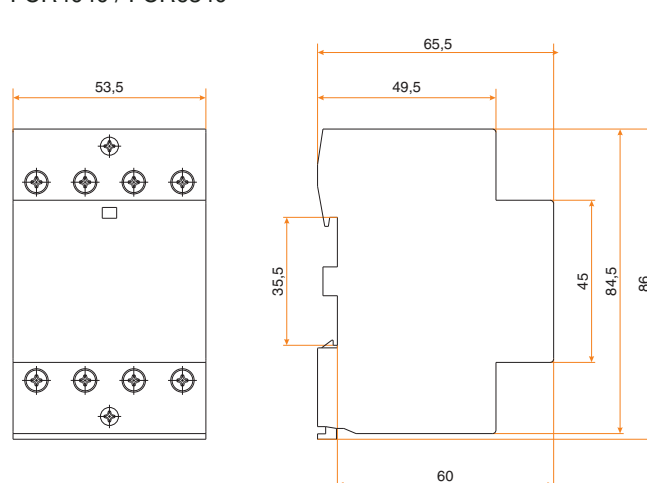
Number of Lamp which can be controlled by installation contactors:

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



RESIDUAL CURRENT CIRCUIT BREAKERS



Residual Current Circuit Breakers (RCCB)



FK2
25A - 40A - 63A



FK4
25A - 40A - 63A



FK4L
80A - 100A - 125A

Residual Current Circuit Breakers With Over-current Protection (RCBO)



FKM
6A ... 32A



FKM1
6A ... 32A

CONTENTS

Description of Residual Current	1
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Important Considerations	3
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Residual Current Circuit Breakers With Over-current Protection	7

IEC / EN 61008-1
IEC / EN 61008-2-1
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 : II
Protection Category : IP20

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

RESIDUAL CURRENT CIRCUIT BREAKERS

Every people from any profession and any cultural level are in close contact with electrical energy at any hour of the day and they may encounter residual currents. Under normal conditions, benefits from electrical energy are countless. However, damages arising from an insulation error are also really huge. Every year, many individuals become victim of electrical accidents and 40% of fires arise from faulty use of electrical energy. Therefore, use of residual current protection devices has been rendered mandatory in many countries and our country. Federal Residual Current Circuit breakers are manufactured in accordance with IEC / EN 61008-1 and CE directives. Effects of the electrical current and voltage on people and limit values are given below.

Impact of current size:

Electrical current pass through body of a person, who is in contact with an electrical device with any insulation fault or conductors under direct energy. Significance of hazard arising from

transition of the current through the body depends on many factors.

These are;

- Value of the current
- Transition duration of the current
- Path followed in the body.

Fibrillation is breakdown of the controlling system of the heart, when the residual current passes through it. In this case, heart cannot fulfill its duty to pump blood. As it is seen here, even a small current results in heart attack and accordingly death of the person.

Impact of contact voltage:

Safety curve of the contact voltage sets the border between life and death. Maximum value of this voltage, which does not give harm to human body, is calculated according to inner resistance that varies depending on the environment, by assuming threshold value of the residual current as 25 mA. Under normal conditions, inner resistance of an adult is 2 k Ω . This resistance goes down to 1 k Ω in humid environment and

to 480 Ω in wet environment. Voltage-time curves of contact voltages for normal, humid and wet environments are given in Figure-2. In Figure-2, it is seen that the maximum voltage value, which an adult can contact permanently without any risk of death under normal conditions, is 50 V. Under the same conditions, when the person is subject to a voltage of 100V, s/he can contact for only 0.3 seconds without any risk of death.

Description of contacts:

In general, two types of contacts are described. These are direct and indirect contact cases.

A- Direct contact:

It is direct contact of a human with parts bearing voltage subject to operation (Figure-3). In this case, residual current completes its circuit by flowing into ground through human body. Residual current passing through body at high values of contact voltage (for values higher than AC 50V) may cause a fatal accident.

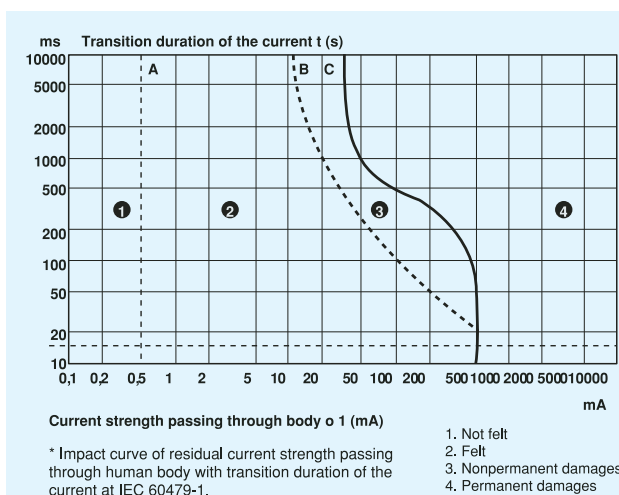


Fig-1

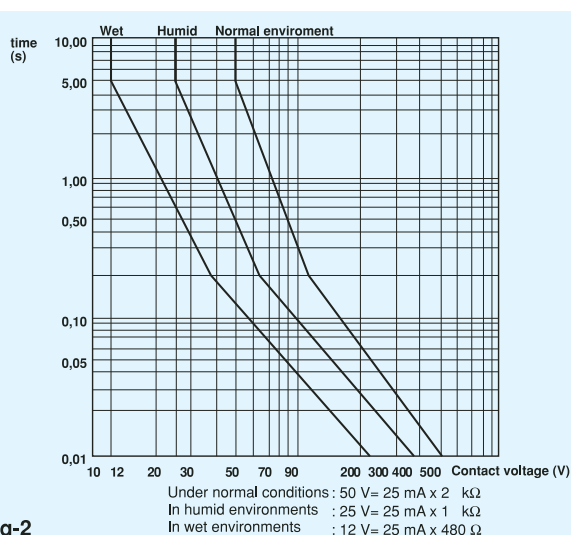


Fig-2

Impacts of alternative current passing through human body:

0,01 mA	Feeling limit of the current, tickling in hands.
1-5 mA	Slight anesthesia feeling in hands, moving hands and arms becomes difficult.
5-15 mA	Object in hand can be left, cramps start in hands and arms, blood pressure goes up.
15-25mA	It is not possible to leave the object in hand. Operation of heart is not affected.
25-80 mA	Bearable current strength, blood pressure goes up, heart begins operating irregularly, breathing becomes difficult, reversible hear attack occurs, generally people are conscious, some people faint after 50 mA.
80-100 mA	Fibrillation occurs in heart depending on impact duration of the current, conscious is lost. (Fibrillation does not occur in electrical shocks lasting for less than 0,3 seconds.)
>3-8A	Blood pressure goes up, heart attack occurs, lungs inflate, conscious is lost.

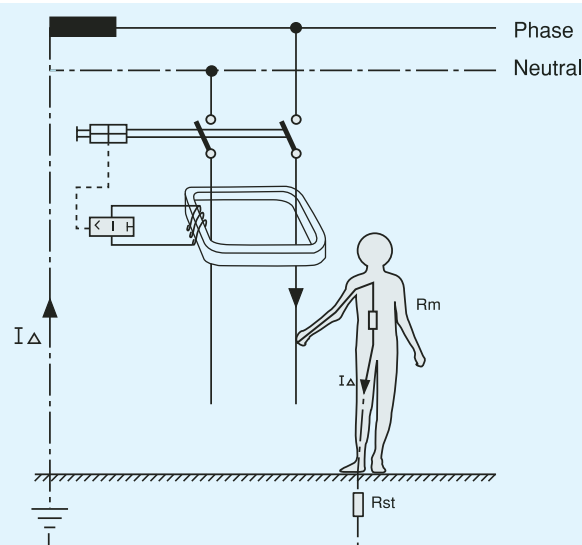


Fig-3 Direct contact case.

RESIDUAL CURRENT CIRCUIT BREAKERS

Protection against direct contact:

All the measures taken to protect people against hazards occurring when active parts of electrical operating devices are touched are called protection against direct contact. Active parts of non-faulty electrical devices under voltage are protected against direct contacts. Operating insulation in devices, appropriate composition and arrangement type or appropriate obstacles like grids, fences etc. provide adequate protection against direct contacts or accidental contacts. Furthermore, operating insulation made with lacquer, enamel, oxide layer or fiber does not provide adequate protection against direct contact. In such cases, additional protection is required. There is no harm in contacting passive parts, that is iron cores and outer metal coatings of non-faulty operating devices and electrical devices protected against direct contact. There is no need to establish protection against direct

contact in facilities with an operating voltage up to 42V. However, this facilitating provision is not valid for establishments and businesses with risk of fire and explosion. Separation of electrical facilities with grids or perforated sheets etc. can be accepted as a mean of protection against direct contact. Coatings, protection grids and sheet covers should be well secured and resistant in mechanical terms. Protection against direct contact at high voltage facilities is ensured by avoiding accidental contact with sections under voltage and avoiding approach to danger zones. In order to prevent foreign individuals, who are not related to high voltage facilities in terms of occupation and duty, from contacting facility sections under voltage by passing through the danger zone, it is essential to cover, close or hinder such areas. The particular distance around the facility elements under high voltage is considered to be the danger zone. According to various high voltage levels, smallest distances from areas under voltage are shown in the table according to indoor and outdoor conditions.

B- Indirect contact:

When there is a residual in a device operating under voltage due to insulation fault, the residual current completes its circuit through the grounding resistance. In this case, a person accidentally contacting the faulty device enters the residual current circuit in parallel form and some part of the residual current flows into ground through human body (Figure-4). Therefore, method of grounding is very important in cases of indirect contact.

Protection against indirect contact:

If outer metal parts in an operating device or electrical device remain under impact of a residual voltage due to insulation fault, indirect contact occurs. In this case, people contacting the faulty device get subject to contact voltage and encounter a life-threatening situation. Prevention of such a case is under responsibility of the manufacturer. Because application of an appropriate construction method, utilization of an appropriate insulation material and careful workmanship may avoid risks arising from indirect contact. On the other hand, it is essential to take additional protective measures at places, where a contact voltage more than 50V occurs.

Additional protective measures provide the following situations depending on their method of application and operation:

a) Dangerous situation is prevented:

- 1- Utilization of protective low voltage,
- 2- Application of protective insulation,

b) Dangerous situation is reduced:

- 3- Application of protective separation,
- 4- Additional protection, potential balancing,

c) Faulty part rapidly disabled by increasing residual current:

- 5- Appropriate network connections are made,
- 6- Start-up is made with residual voltage,
- 7- Start-up is made with residual current.

No separate protective conductor is needed in 1, 2 and 3 and there is no breaking mechanism in them. All the devices are grounded in 4. There, permanent insulation check is performed. Appropriate network connections are made and circuit is broken with over current protection devices in 5. Breaking of the circuit is ensured with special fault switch in 6 and 7. Federal residual current circuit breakers provides a safe protection by opening the circuit in case of any residual in the connected network. Residual current circuit breakers are manufactured in two types as life protection and fire protection.

1- Life protection:

According to IEC 60479-1, 30mA value of the residual current is the limit value in terms of human life. Residual current circuit breaker breaks energy of the circuit at 30mA (limit value) and higher values to provide safe protection.

Fields of Application:

1. Protection against direct contacts
2. Protection against indirect contacts
3. All areas open to risk (Worksites, pools, yacht ports etc.)

2- Fire protection:

When residual current value reaches 300mA, fire risk comes into existence due to heat formed by electrical arc. Residual current circuit breaker breaks energy of the circuit at 300mA threshold value and higher values in terms of safety of goods and lives to provide safe protection.

Fields of Application:

1. Areas with risk of fire
2. Protection against indirect contacts

Protection against accidental starts: Federal residual circuit breakers operate independently from voltage. In this way,

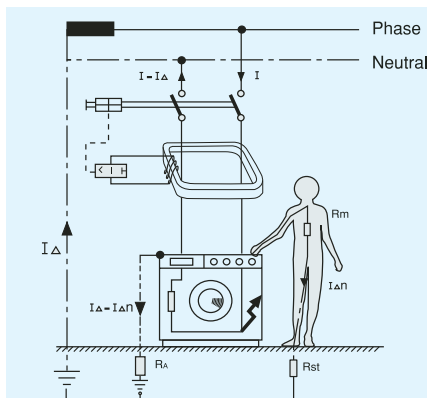


Fig-4 Indirect contact case

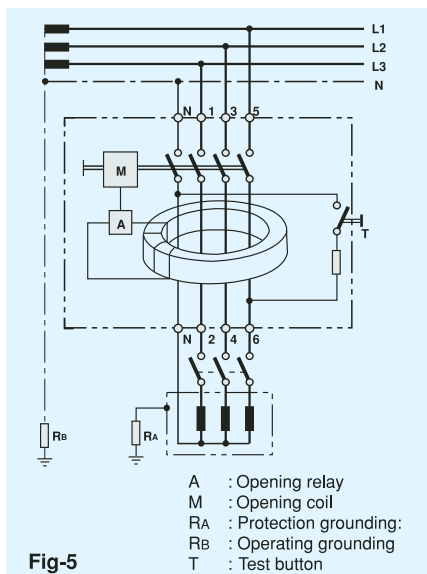


Fig-5

Approach Distances According to Voltage:

Normal Network Voltage (kV)	6	10	20	30	110	220	380
Inside building (mm)	90	120	220	320	1100	2200	2900
Outdoor (mm)	120	150					3400

RESIDUAL CURRENT CIRCUIT BREAKERS

residual current circuit breakers provides protection against over voltages formed due to lightning, over currents in case of switching and starts as a result of closing high capacitive circuits.

Principle of Operation: In residual current circuit breakers, phase or phases and neutral pass through a very sensitive toroidal nucleus as seen in Figure-5. As long as there is no difference between incoming current and returning current and magnetic flow of silence goes on the opening relay. When there is difference current, magnetic flow on the opening relay is corrupted due to induced voltage in secondary windings of current transformer. The latch connected to the natural magnet via a spring is released and mechanical opening signal is given to opening coil with the force of the spring. Opening coil breaks electricity by opening main contacts. This operation is fulfilled within less than 30ms. This mechanism, which seems to be simple, should be a high technology product, as the matter of question is human life and

it should be capable of performing the same operation for thousand times without any faults.

Important considerations in assembly:

Matters to be taken into consideration in assembly to allow the residual current circuit breakers to provide accurate and safe protection can be summarized as follows;

- Residual current circuit breakers with adequate ampere values should be used in cutout boxes with fire protection threshold and in meter column currents with life protection threshold.
- Neutral conductive should be laid down as insulated and should not be grounded anywhere (between residual current circuit breakers and load).
- In 2-pole residual current circuit breakers, phases and neutral conductive; in 4-pole residual current circuit breakers, all phases and neutral conductive should be connected to the residual current circuit breakers
- Current passing through residual current

circuit breaker should not exceed nominal current of the switch.

- Grounding resistance should be max 2160 Ω for 30mA residual current circuit breaker and max 216 Ω for 300 mA residual current circuit breaker.
- In order to check operation of the residual current circuit breaker to remain connected to the installation, press test "T" button. The device should open the circuit. Phase-neutral conductors should never be subject to short circuit to test the device.

Attention: The residual current circuit breaker must be independent from the supply voltage, that is it should not be electronic. Since electronic short circuit circuit breakers need supply voltage, they cannot operate and protect in case of a breakdown in the neutral line. Therefore, utilization of electronic type residual current circuit breakers in Turkey has been prohibited by the Ministry of Public Works and Settlement.



Type	FK2	FK2L	FK4	FK4L
Nominal residual current (mA)	30, 300	30, 300	30, 300	30, 300
Rated current (A)	25, 40, 63	80, 100, 125	25, 40, 63	80, 100, 125
Rated voltage (V)	240 / 415	240 / 415	240 / 415	240 / 415
Closing-breaking capacities ($I_m/I_{\Delta m}$), (A)	630	630	630	630
Fused short circuit current ($I_{nc}/I_{\Delta c}$), (A)	10000	10000	10000	10000
Frequency (Hz)	50-60	50-60	50-60	50-60
Number of poles	2	2	4	4
Weight (gr)	250	260	470	530

I_m : Rated making and breaking capacity

The r.m.s. value of the a.c. component of prospective current, assigned by the manufacturer, which an RCCB can make, carry and break under specified conditions.

$I_{\Delta m}$: Rated residual making and breaking capacity

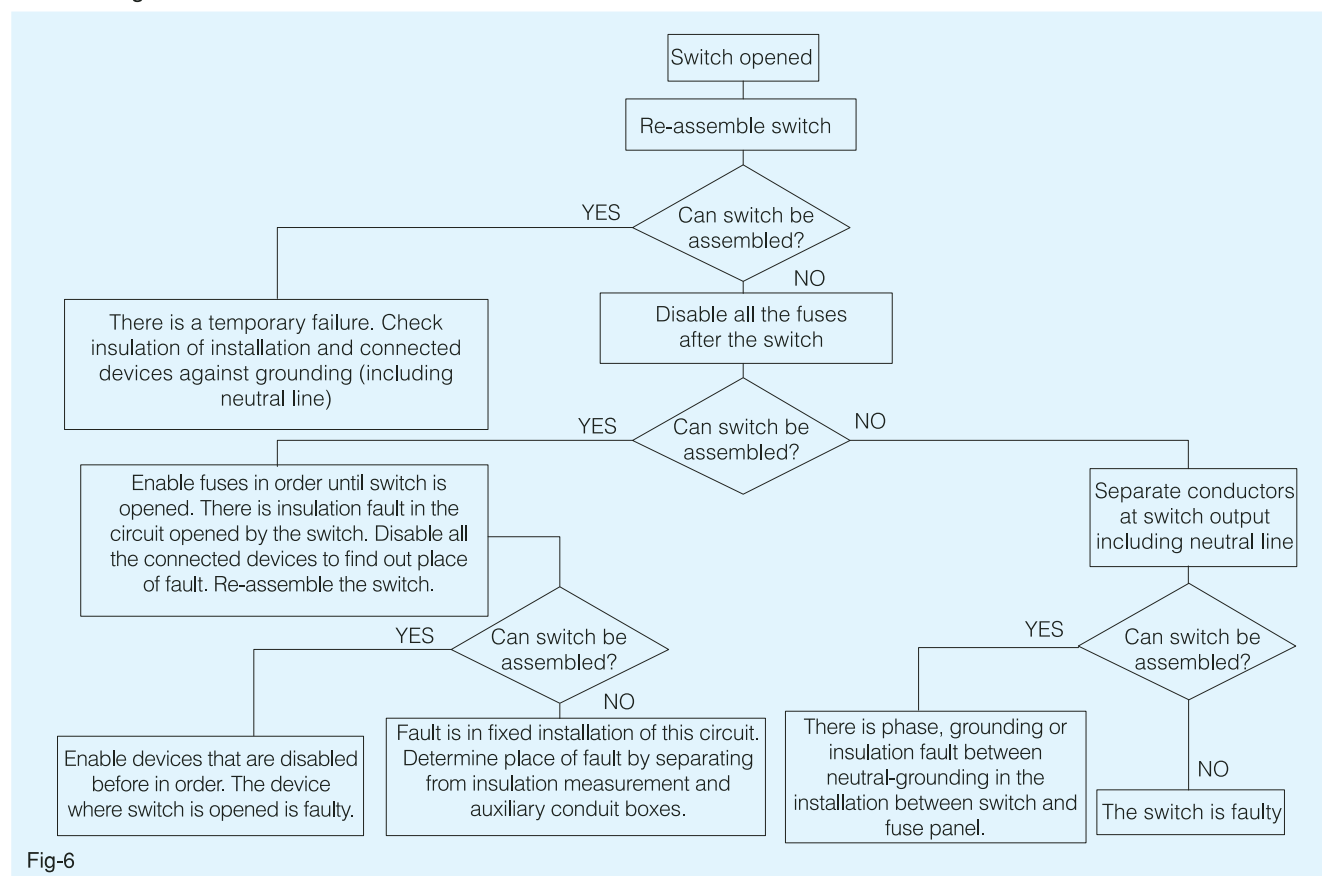
The r.m.s. value of the a.c. component of residual prospective current, assigned by the manufacturer, which an RCCB can make, carry and break under specified conditions.

Type	Number of pole	Nominal residual current (mA)	Rated Current	Order Code
 2 pole	2	30	25, 40, 63	9FA-H0002-0□□□
			80, 100, 125	9FA-H1002-0□□□
		300	25, 40, 63	9FA-Y0002-0□□□
			80, 100, 125	9FA-Y1002-0□□□
 4 pole	4	30	25, 40, 63	9FA-H0004-0□□□
			80, 100, 125	9FA-H1004-0□□□
		300	25, 40, 63	9FA-Y0004-0□□□
			80, 100, 125	9FA-Y1004-0□□□

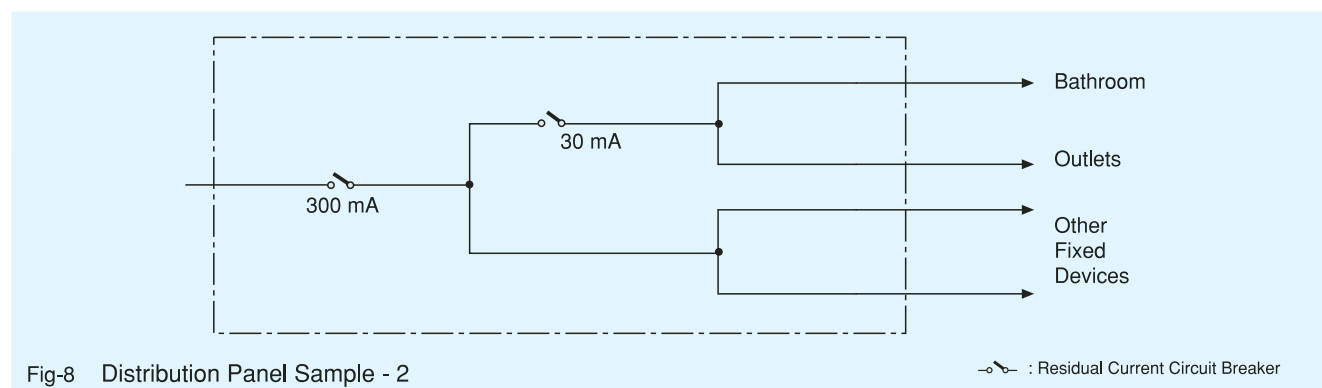
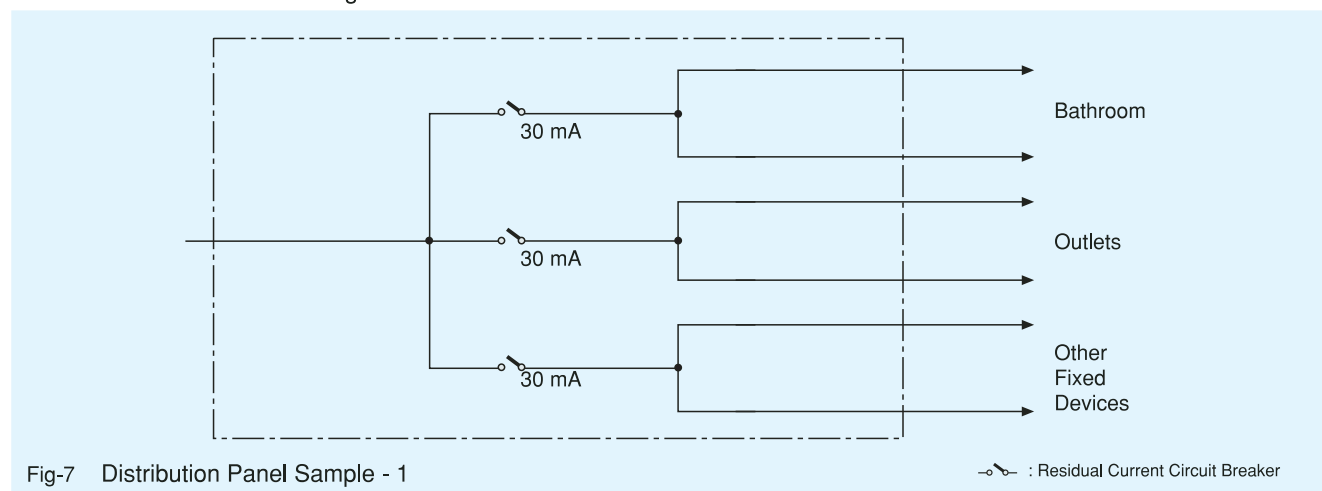
□□□ : Please enter amper value.

RESIDUAL CURRENT CIRCUIT BREAKERS

Control Diagram of Residual Current Circuit breaker:



Recommended Connection Diagrams for Inner Installation:



RESIDUAL CURRENT CIRCUIT BREAKERS

Utilization of Ground Residual Current Circuit Breaker in Residences:

According to the regulations, it is enough to provide life protection against direct and indirect contact with a single 30 mA threshold residual current circuit breaker. However, if many electrical devices and old devices with weak insulation are used in a wide residence, unnecessary electrical failures are caused due to frequent openings in normal conditions. When a full selectivity is required, distribution panel outputs can be

protected with 30mA threshold ground residual current circuit breaker separately or in groups as shown in Figure-7. In order to ensure an economic application and to provide life protection against direct and indirect contacts in the whole residence with partial selectivity, the main breaker is chosen with 300mA threshold and all the plugs with risk of contact, electrical installation in the bathroom and electrical devices used with water operations are supplied by residual current circuit breaker with 30mA

threshold. Other fixed devices are protected by 300mA devices located at the main input against indirect contact. Even in case of selectivity between 300mA protection threshold of the main input breaker and 30mA protection threshold at load side, as electrical failure shall occur in bathroom and plugs due to main input breaker in case of ground residual current fault, selectivity is ensured partially. (Figure- 8)

Test Mechanism of Residual Current Circuit breaker:

Residual current circuit breaker is manufactured in two types as electromechanical and electronic. Since there is no physical difference such as color, model, label info etc. between electronic and electromechanical type circuit breakers, consumers are misled consciously. We may understand whether a residual current circuit breaker is electromechanical type or electronic type with the help of the test mechanism.

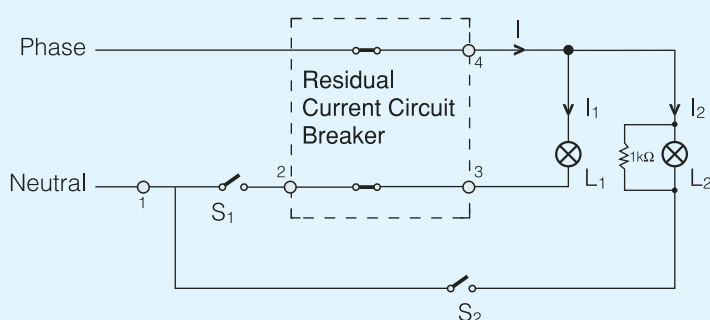


Fig-9 Test Mechanism

1- Electromechanical Type Residual Current Circuit breakers (Not Connected to Line Voltage) :

Observation No	Switch Positions		Observations				Results
	S1	S2	I ₁	I ₂	L ₁	L ₂	
1	Off	On	1	0	Flammable	Inflammable	No residual current, switch does not open the circuit.
2	Off	Off	I ₁	I ₂	Inflammable	Inflammable	Residual current, switch opens the circuit.
3	On	Off	0	1	Inflammable	Inflammable	Residual current, switch opens the circuit.

Not: If L2 lamp is off in 3rd condition, this indicates that the switch is an electromechanical type residual current circuit breaker operating with residual current and shall operate when neutral line is broken in case of residual current.

2- Electronic Type Residual Current Circuit breakers (Connected to Line Voltage) :

Observation No	Switch Positions		Observations				Results
	S1	S2	I ₁	I ₂	L ₁	L ₂	
1	Off	On	1	0	Flammable	Inflammable	No residual current, switch does not open the circuit.
2	Off	Off	I ₁	I ₂	Inflammable	Inflammable	Residual current, switch opens the circuit.
3	On	Off	0	1	Inflammable	Flammable	Residual current, switch does not open the circuit

Note: If L2 lamp is on in 3rd condition, this indicates that the switch is an electronic type residual current circuit breaker operating with residual current and shall not operate when neutral line is broken in case of residual current.

Superior features of electromechanical residual current circuit breakers

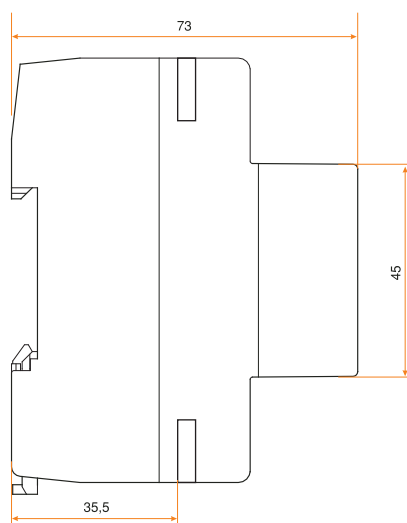
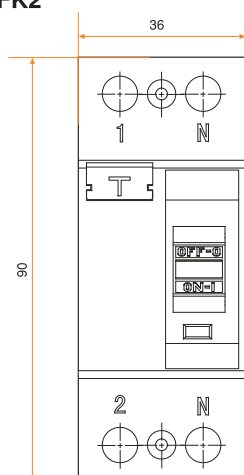
* As there is no electronic card, they are more resistant to impact voltages to occur in the system.

* As there is no electronic card, they are not affected from voltage fluctuations and they can operate without auxiliary voltage even in case of neutral line failure.

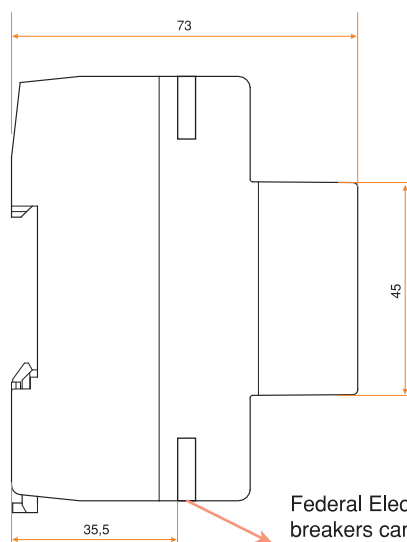
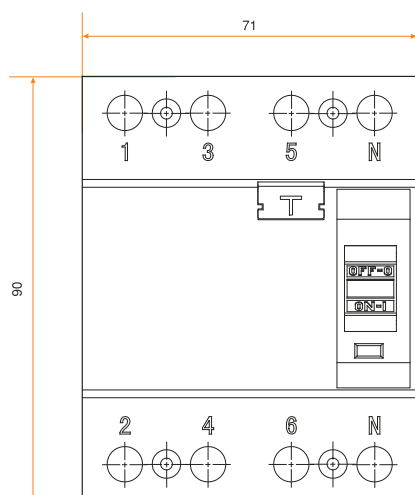
Utilization of electronic type residual current circuit breaker connected to line voltage has been prohibited in Turkey by the Ministry of Public Works and Settlement.

RESIDUAL CURRENT CIRCUIT BREAKERS

FK2

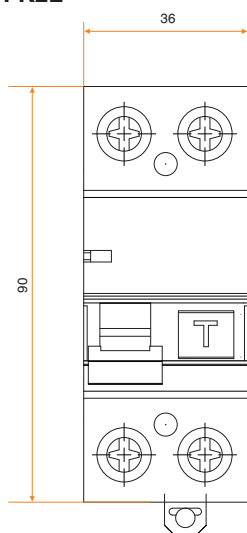


FK4

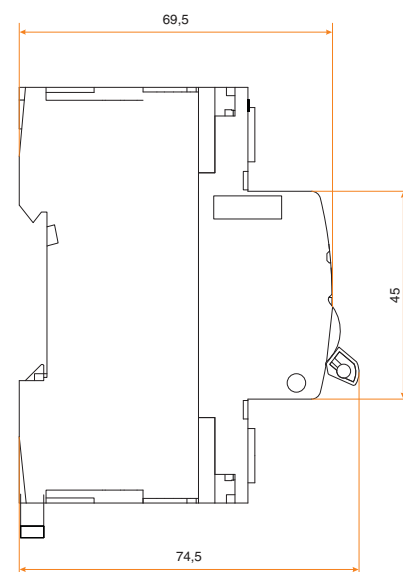
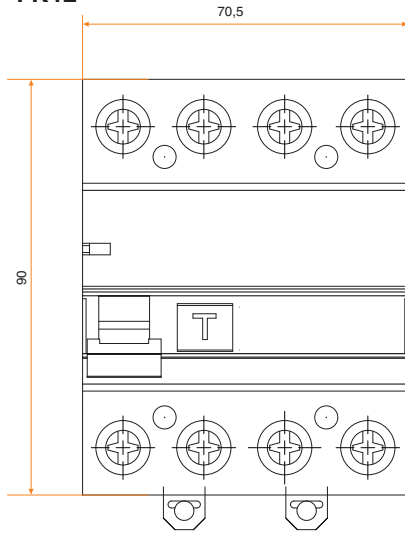


Federal Electric FK2, FK4 residual current circuit breakers can be used with FM6, FM10 automated fuses via automat busbar.

FK2L



FK4L



RESIDUAL CURRENT CIRCUIT BREAKERS OVER-CURRENT PROTECTION

Residual Current Circuit Breakers With Overcurrent Protection (RCBO):



Construction and Feature

- Provides protection against earth fault/leakage current, short-circuit and overload
- High short-circuit capacity
- Provides complementary protection against direct contact by human body
- Effectively protects electric equipment against insulating failure
- Contact position indication
- Provides protection against over-voltage
- Provides comprehensive protection to household and commercial distribution systems.
- The RCBO devices protect system against short-circuit and over loads by thermal and magnetic releasers.

Technical Data

- Residual current characteristics: AC
- Pole No: 1P+N
- Tripping curve: B,C
- Rated short- circuit capacity: 10000A
- Rated current (A): 6, 10, 16, 20, 25, 32
- Rated voltage: 230V AC
- Rated frequency: 50/60 Hz
- Rated residual operating current (A): 0.03, 0.3
- Tripping duration: instantaneous ≤ 0.1 s
- Electro-mechanical endurance: 4000 cycles
- Connection terminal: pillar terminal with clamp

Connection capacity:

- Flexible conductor 10mm²
- Rigid conductor 16mm²

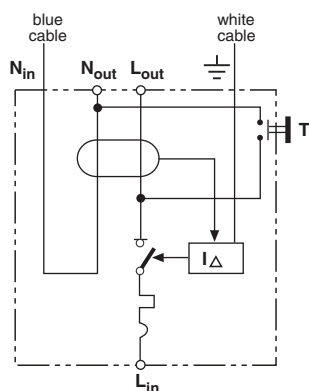
Installation:

- On symmetrical DIN rail 35
- Panel mounting

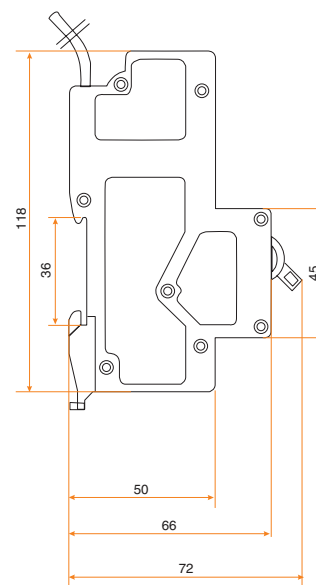
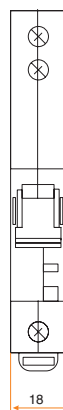
Number of pole	Nominal residual current (mA)	Rated Current	Order Code
1P + N	30	6	9SA-□H003-0006
		10	9SA-□H003-0010
		16	9SA-□H003-0016
		20	9SA-□H003-0020
		25	9SA-□H003-0025
		32	9SA-□H003-0032
	300	6	9SA-□H030-0006
		10	9SA-□H030-0010
		16	9SA-□H030-0016
		20	9SA-□H030-0020
		25	9SA-□H030-0025
		32	9SA-□H030-0032

□ : Please insert products type (B-C)

Wiring Diagram



Overall& installation Dimensions



RESIDUAL CURRENT CIRCUIT BREAKERS OVER-CURRENT PROTECTION



Construction and Feature

- Provides protection against earth fault/leakage current, short-circuit, overload and function os isolation.
- Contact position indication
- Provides protection against indirect contact by human body
- Provides complementary prodection against direct contact by human body
- Effectively protects electric equipment against insulating failure
- Equipped with switched neutral and phase pole
- Provides protection against over-voltage
- Provides comprehensive protection to hausehold and commercial distribution systems.

Tecnical Data

- Residual current characteristics: AC
- Pole No: 1P+N
- Tripping curve: B,C
- Rated short- circuit capacity: 6000A
- Rated current (A): 6, 10, 16, 20, 25, 32
- Rated voltage: 230V AC
- Rated frequency: 50/60 Hz
- Rated residual operating current (A): 0.03, 0.3
- Tripping duration: instantaneous ≤ 0.1 s
- Electro-mechanical endurance: 4000 cycles
- Connection terminal: pillar terminal with clamp

Connection capacity:

- Flexible conductor 10mm²
- Rigid conductor 16mm²

Installation:

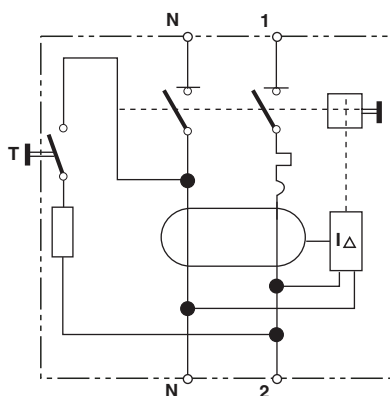
- On symmetrical DIN rail 35
- Panel mounting

5

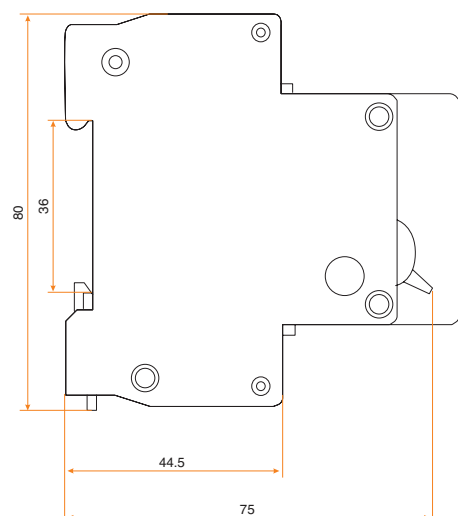
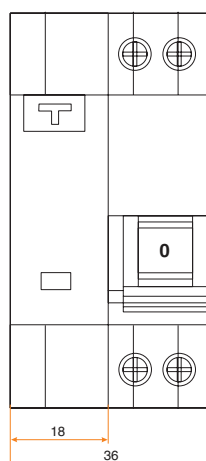
Number of pole	Nominal residual current (mA)	Rated Current	Order Code
1P + N	30	6	9SA-□04H2-0006
		10	9SA-□04H2-0010
		16	9SA-□04H2-0016
		20	9SA-□04H2-0020
		25	9SA-□04H2-0025
		32	9SA-□04H2-0032
	300	6	9SA-□04Y2-0006
		10	9SA-□04Y2-0010
		16	9SA-□04Y2-0016
		20	9SA-□04Y2-0020
		25	9SA-□04Y2-0025
		32	9SA-□04Y2-0032

□ : Please insert products type (B-C)

Wiring Diagram



Overall& Installation Dimensions



MINIATURE CIRCUIT BREAKERS BOXES



Flush Mounted Series



FVKS A2



FVKS A4



FVKS A6



FVKS A9



FVKS A12



FVKS A18



FVKS A24



FVKS A36

Surface Mounted Series



FEB 1 / FEB 2



FVKS U2



FVKS U4



FVKS U6



FVKS U9



FVKS U12



FVKS U18



FVKS U24



FVKS U36

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Technical Drawings	2

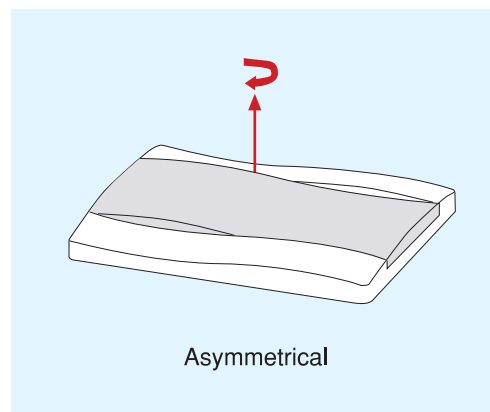
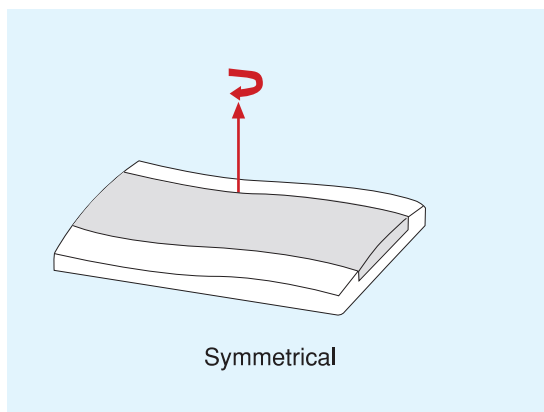
All these given information are general. We have always right to change them.

MINIATURE CIRCUIT BREAKERS BOXES

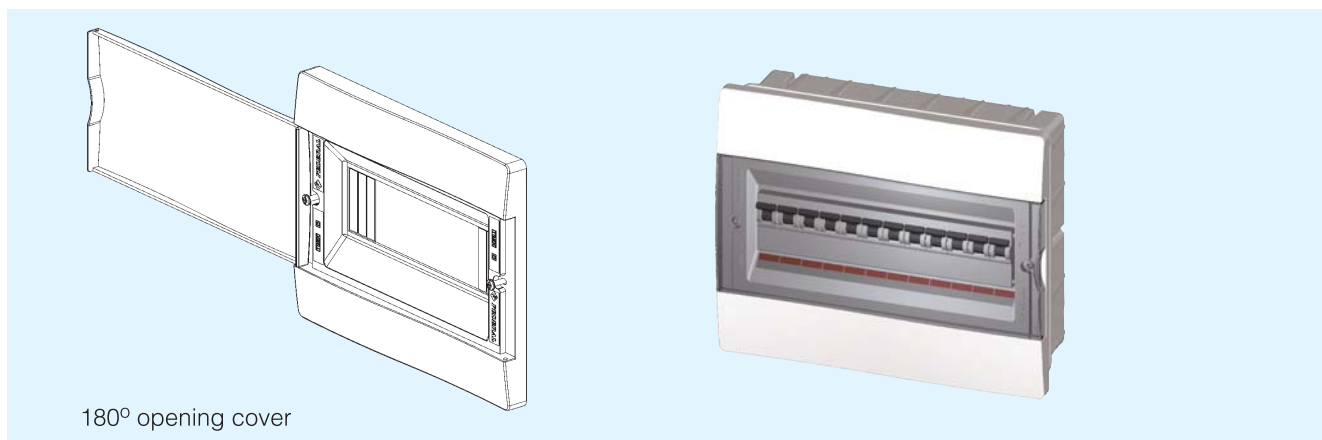
General Technical Specifications

- Material: Thermoplastic
- Protection class: IP40
- Standard color: White
- Recommended assembly temperature: before -15°C and $+60^{\circ}\text{C}$
- Field of use: Flush mounted and surface mounted installations
- Nonflammability Class: V0 / V1

- Circuit labels, ground busbars, automated assembly rail are present.
- Models of 2, 4, 6, 9, 12, 18, 24, 36
- Cover opening towards right or left.
- High-strength cover.
- Opening direction of covers may be reversed to right or left.



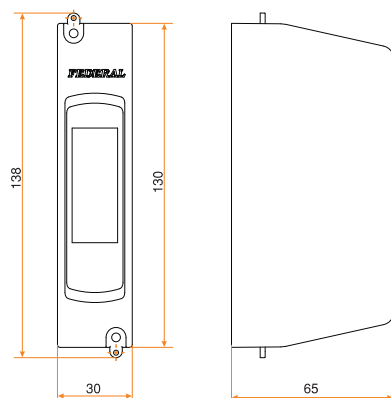
Symmetrical and Asymmetrical Used Cover



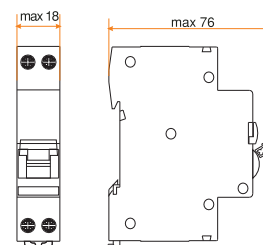
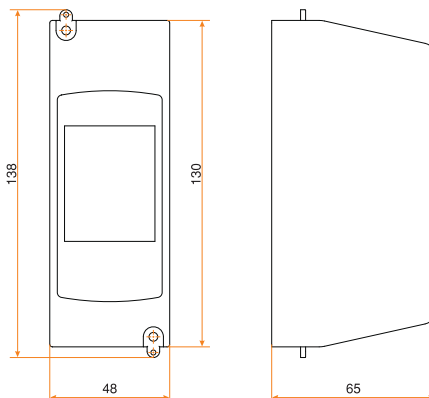
MINIATURE CIRCUIT BREAKERS BOXES

Surface Mounted Series

FEB1 (1p)

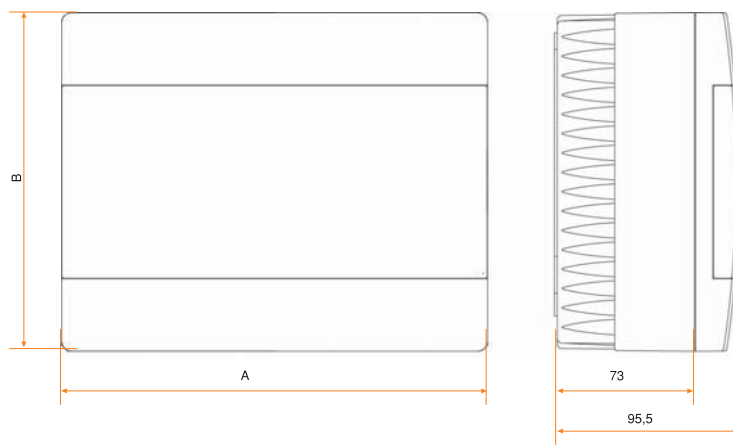


FEB2 (2p)

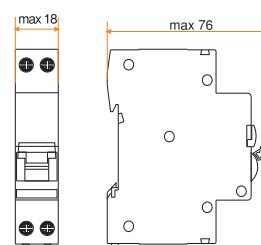


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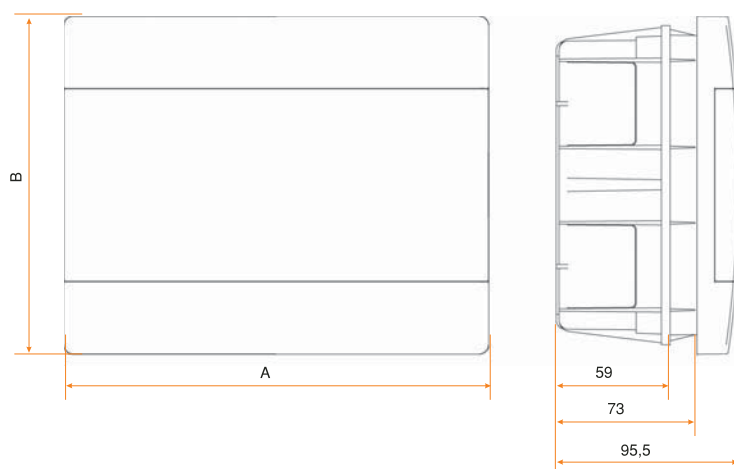
Flush Mounted Series



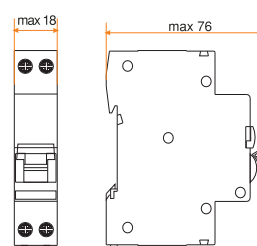
MODEL	A	B
FVK SA 2	94	141
FVK SA 4	140	141
FVK SA 6	166	141
FVK SA 9	220	175
FVK SA 12	274	210
FVK SA 18	220	290
FVK SA 24	274	335
FVK SA 36	274	460



Surface Mounted Series



MODEL	A	B
FVK SU 2	94	141
FVK SU 4	140	141
FVK SU 6	166	141
FVK SU 9	220	175
FVK SU 12	274	210
FVK SU 18	220	290
FVK SU 24	274	335
FVK SU 36	274	460



SURGE PROTECTIVE DEVICE



Surge Protective Device



FSPD-B100



FSPD-BC25



FSPD-C



FSPD-D

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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_{max}: 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.

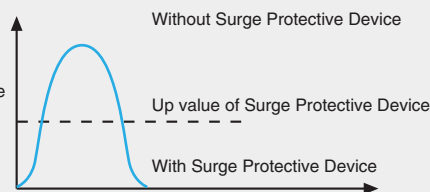
Uc: Sustained operating voltage. It is sustained maximum voltage rating which can be applied to surge protection device

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

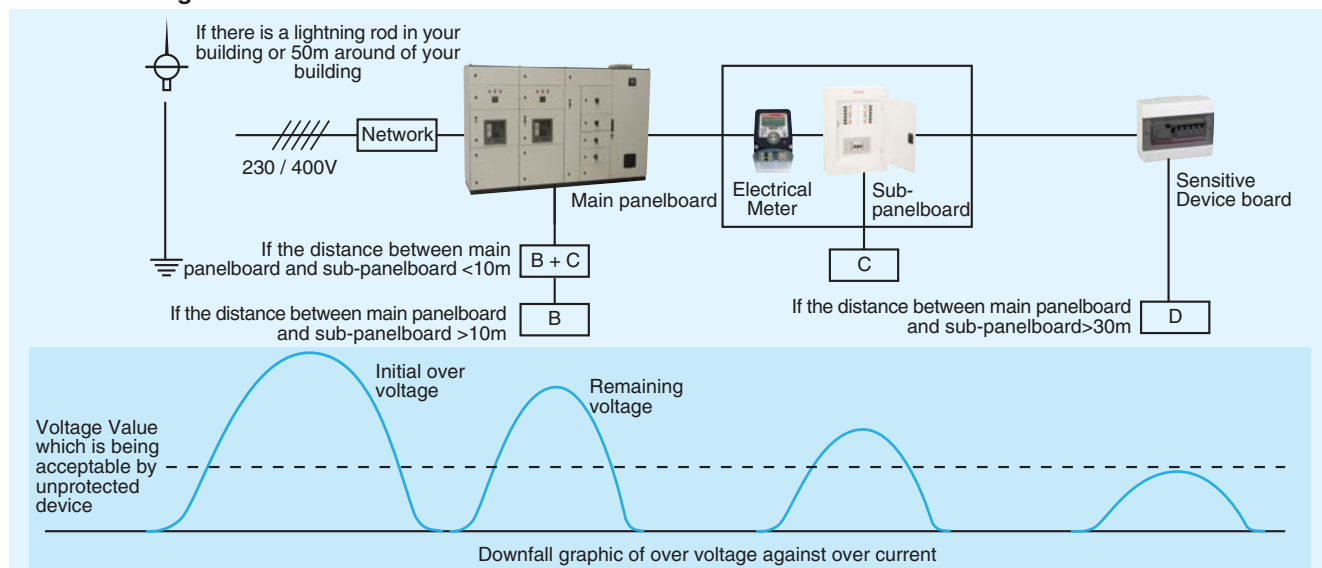


Fig 1:

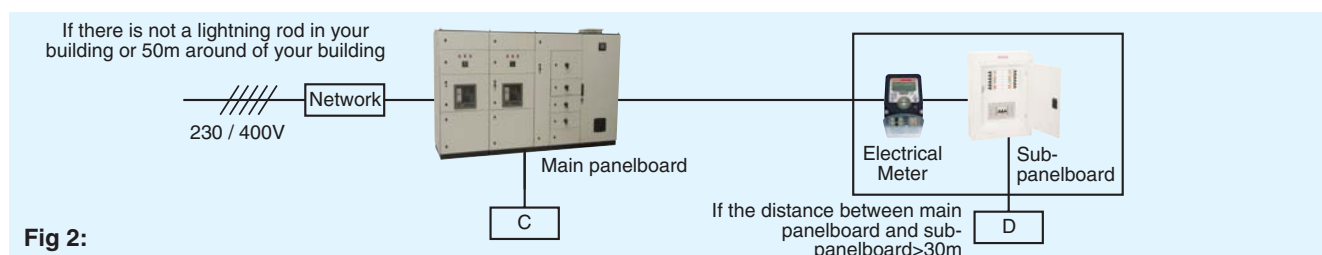


Fig 2:

SURGE PROTECTIVE DEVICE

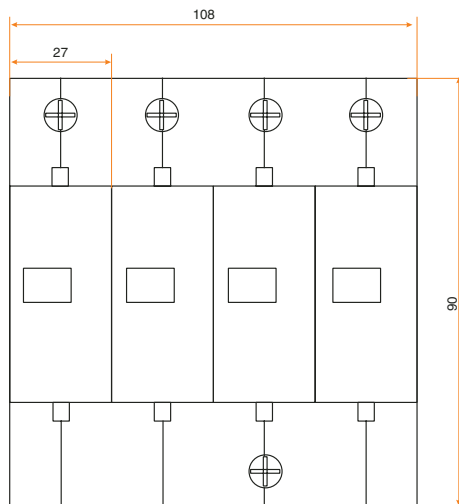
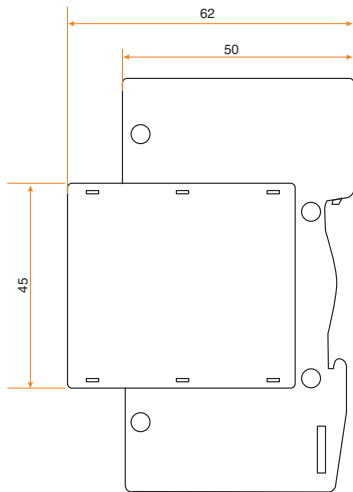


FSPD-B50 series surge protective device (in short :SPD, alias : surge protector, surge arrester) is suitable for TN-S,TN -C-S,TT.IT etc. power supply system of AC 50/60Hz=380V,installed on the joint of LPZ1and LPZ2 and LPZ3,it's designed according to IEC61643-1, it adopts 35mm standard rail, there is a failure release mounted on the module of surge protective device. When the SPD fails in breakdown for over-heat and over-current ,the failure release will help electric device separate from the power system and give the indication signal, green means normal ,red means abnormal, it's also could be replaced for the module when has operating voltage.

7

Technical Features

Type	FSPD-B50
Rated Operating Voltage Un (V~)	240-415V
Maximum Continuous Operating Voltage UC(V~)	275V
Voltage Protection Level Up (V~)kV	≤2
Nominal Discharge Current Iimp (10 / μ 350μ s)kA	50
Maximum Discharge Current Imax (8 / μ 20 μ s)kA	100
Response Time ns	<25
Pole	3P + NPE
Test Standard	IEC61643-1
L/N (mm) The Cross Section of L/N Line	16, 25
PE (mm) The Cross Section of PE Line	25, 35
Fuse or Switch (A)	100A
Operating Environment C°	-40C° ~ +85C°
Relative Humidity (25 C°)	≤95%
Installation	Standard Rail 35mm
Material of Outer Covering	Fiber glass reinforced plastic



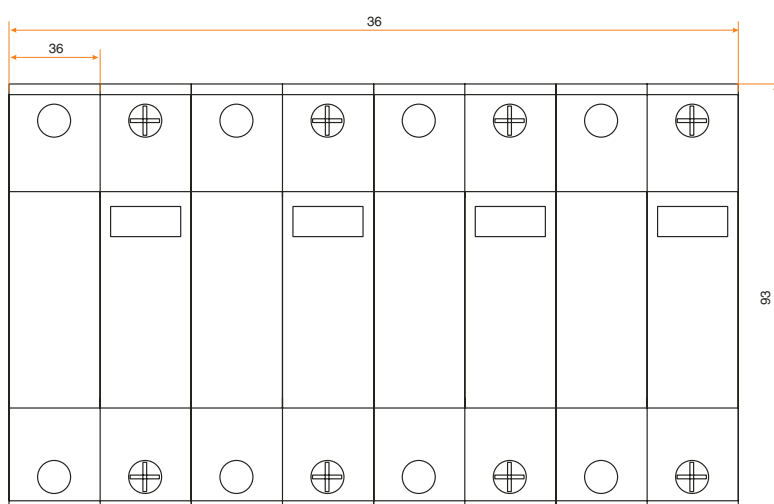
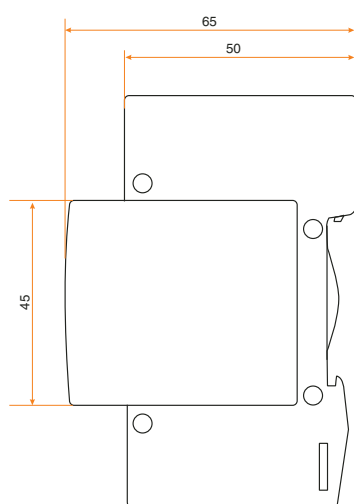
SURGE PROTECTIVE DEVICE



FSPD-BC25 series surge protective device (in short :SPD, alias : surge protector, surge arrester) is suitable for TN-S,TN -C-S,TT.IT etc. power supply system of AC 50/60Hz=380V, installed on the joint of LPZ1and LPZ2 and LPZ3,it's designed according to IEC61643-1, it adopts 35mm standard rail, there is a failure release mounted on the module of surge protective device. When the SPD fails in breakdown for over-heat and over-current, the failure release will help electric device separate from the power system and give the indication signal, green means normal, red means abnormal, it's also could be replaced for the module when has operating voltage.

Technical Features

Type	FSPD-BC25
Rated Operating Voltage Uc (V~)	240-415V
Maximum Continuous Operating Voltage UC(V~)	300V
Voltage Protection Level Up (V~)kV	≤1.2
Maximum Discharge Current I _{max} (10 / μ 350 μ s)kA	25
Response Time ns	<25
Pole	3P + NPE
Test Standard	IEC61643-1
L/N (mm) The Cross Section of L/N Line	2.5 ~ 30
PE (mm) The Cross Section of PE Line	35
Fuse or Switch (A)	125A
Operating Environment C°	-40C° ~ +85C°
Relative Humidity (25 C°)	≤95%
Istallation	Standard Rail 35mm
Material of Outer Covering	V0 PA66



SURGE PROTECTIVE DEVICE

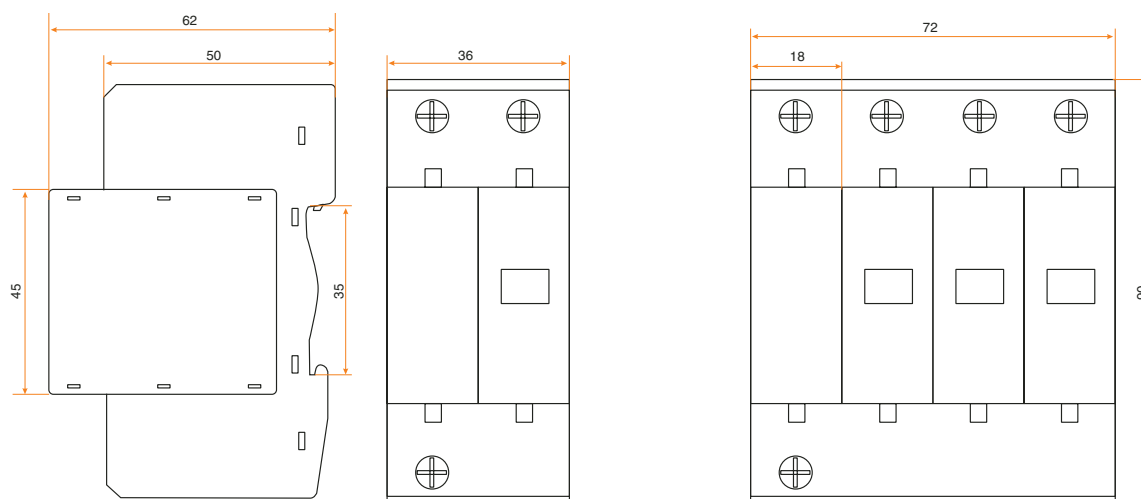


FSPD-C series surge protective device (in short :SPD, alias : surge protector, surge arrester) is suitable for TN-S,TN -C-S,TT.IT etc. power supply system of AC 50/60Hz=380V,installed on the joint of LPZ1and LPZ2 and LPZ3,it's designed according to IEC61643-1, it adopts 35mm standard rail, there is a failure release mounted on the module of surge protective device. When the SPD fails in breakdown for over-heat and over-current ,the failure release will help electric device separate from the power system and give the indication signal, green means normal ,red means abnormal, it's also could be replaced for the module when has operating voltage.

7

Technical Features

Type	FSPD-C
Rated Operating Voltage Uc (V~)	240-415V
Maximum Continuous Operating Voltage UC(V~)	440V
Voltage Protection Level Up (V~)kV	≤2
Nominal Discharge Current In (8 / μ 20 μ s)kA	20
Maximum Discharge Current Imax (8 / μ 20 μ s)kA	40
Response Time ns	<25
Pole	1P + N-PE, 3P + N-PE
Test Standard	IEC61643-1
L/N (mm) The Cross Section of L/N Line	10, 16
PE (mm) The Cross Section of PE Line	10, 25
Fuse or Switch (A)	32A
Operating Environment C°	-40C° ~ +85C°
Relative Humidity (25 C°)	≤95%
Istallation	Standard Rail 35mm
Material of Outer Covering	Fiber glass reinforced plastic



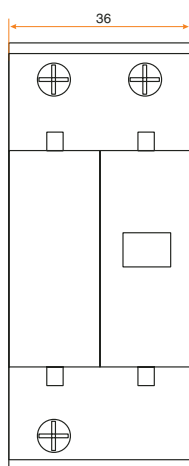
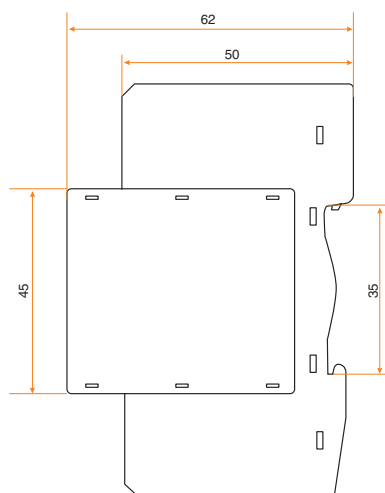
SURGE PROTECTIVE DEVICE



FSPD-D series surge protective device is suitable for TN-S, TN-C-S, TT, IT etc. power supply system of AC 50/60Hz=380V, installed on the joint of LPZ1 and LPZ2 and LPZ3, it's designed according to IEC61643-1, it adopts 35mm standard rail, there is a failure release mounted on the module of surge protective device. When the SPD fails in breakdown for over-heat and over-current, the failure release will help electric device separate from the power system and give the indication signal, green means normal, red means abnormal, it's also could be replaced for the module when has operating voltage.

Technical Features

Type	FSPD-D20
Rated Operating Voltage U_c (V~)	240-415V
Maximum Continuous Operating Voltage U_C (V~)	440V
Voltage Protection Level U_p (V~)kV	≤ 1.6
Nominal Discharge Current I_n (8 / μ 20 μ s)kA	10
Maximum Discharge Current I_{max} (8 / μ 20 μ s)kA	20
Response Time ns	< 25
Pole	1P + N-PE
Test Standard	IEC61643-1
L/N (mm) The Cross Section of L/N Line	6
PE (mm) The Cross Section of PE Line	10
Fuse or Switch (A)	16A, 25A
Operating Environment C°	$-40C^\circ \sim +85C^\circ$
Relative Humidity (25 C°)	$\leq 95\%$
Installation	Standard Rail 35mm
Material of Outer Covering	Fiber glass reinforced plastic



CURRENT TRANSFORMERS



Current Transformers (CT)



FAT - 30B



FAT - 30C



FAT - 30



FAT - 40



FAT - 40L



FAT - 60



FAT - 100



FAT - 100L



FAT - 130

CONTENTS

Features	1
Determination of Current Transformers' power	2
Technical Table	2
Chart of ratio error	3
Order Codes	4
Technical Drawings	5

IEC / EN 60044-1
CE

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

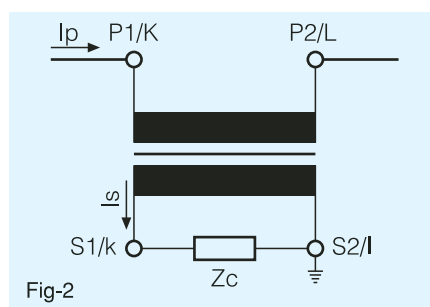
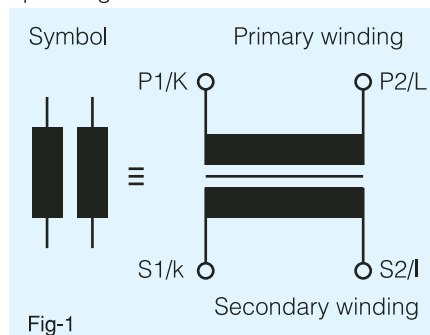
Explanations of technical terms used in current transformers:

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_{pn}):

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.



Secondary rated current (I_{sn}):

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_n):

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_{th}):

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_{dyn}):

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_s):

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

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

Here;

I_{ps} = Safety primary current
I_{pn} = 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_s 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_n = Rated transformation proportion
I_b = Effective value of the primary current
I_p = Instant value of the primary current
I_s = Instant value of the secondary current
T = Duration of a period

Current error (Transformation proportion error) (α₁) :

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_n = Rated transformation proportion
I_b = Primary current

I_s = This is the equivalent secondary current when I_p 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_c):

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.

8

Current error and phase shift limits (classes 0,1 - 0,2 - 0,5 - 1 according to IEC 385, IEC 60044-1):

Accuracy class	Current (proportion) error ± percentage for the rated currents given below				± phase shift for rated current percentages given below							
					Minutes				Centi-radians			
	% 5	% 20	% 100	% 120	% 5	% 20	% 100	% 120	% 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
0,2	0,75	0,35	0,2	0,2	30	15	10	10	0,9	0,45	0,3	0,3
0,5	1,5	0,75	0,5	0,5	90	45	30	30	2,7	1,35	0,9	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 ²	4,0 mm ²	6,0 mm ²	10,0 mm ²
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 (mm²)
 P = Power loss (VA)

For example; The load coming to the current transformer for an active, a reactive counter and 4 m 2,5 mm² 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
Nominal primary current	: 30A...4000A
Nominal secondary current	: 5 A
Operating frequency	: 50-60Hz
Operating temperature	: -25°C + 40°C
Thermal rated current	: Ith = 100xIn (Ith=60xIn for FAT-30B)
Dynamic rated current	: Idyn = 2,5xIth
Insulation Category	: e

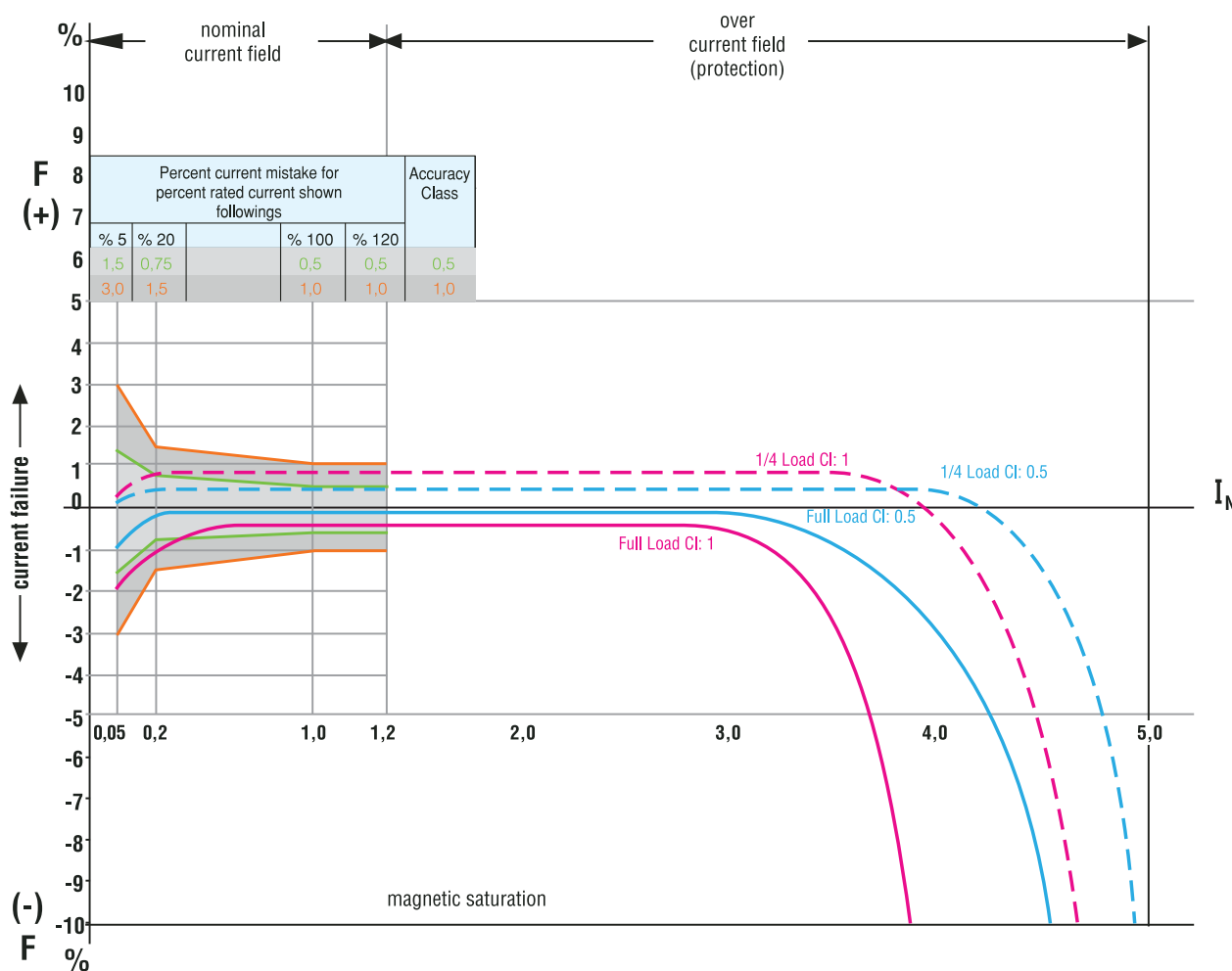
CURRENT TRANSFORMERS

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 $(1-1,2) \times I_N$.



CURRENT TRANSFORMERS

FAT - 30B



With Busbar

Type	Rated current (A)	Rated Power (VA) Class		Weight (kg)	Order Codes □ For Class 0,2 : C For Class 0,5 : A For Class 0,5s : D Δ For 5 VA : 2 For 10 VA : 4
		0,5	0,5s		
FAT-30B	30/5	10	5	0,60	9GA-□00Δ5-0030
FAT-30B	40/5	10	5	0,60	9GA-□00Δ5-0040
FAT-30B	50/5	10	5	0,60	9GA-□00Δ5-0050
FAT-30B	60/5	10	5	0,60	9GA-□00Δ5-0060
FAT-30B	75/5	10	5	0,60	9GA-□00Δ5-0075
FAT-30B	80/5	10	5	0,60	9GA-□00Δ5-0080
FAT-30B	100/5	10	5	0,60	9GA-□00Δ5-0100
FAT-30B	125/5	10	5	0,60	9GA-□00Δ5-0125
FAT-30B	150/5	10	5	0,60	9GA-□00Δ5-0150
FAT-30B	200/5	10	5	0,60	9GA-□00Δ5-0200
FAT-30B	250/5	10	10	0,60	9GA-□00Δ5-0250

FAT - 40



Without Busbar

Busbar: 40 x 10 mm.

Type	Rated current (A)	Rated Power (VA) Class			Weight (kg)	Cable (max) mm.	Order Codes □ For Class 0,2 : C For Class 0,5 : A For Class 0,5s : D Δ For 5 VA : 2 For 10 VA : 4
		0,2	0,5	0,5s			
FAT-40	200/5	-	5	-	0,38	Ø30	9GC-□00Δ5-0200
FAT-40	250/5	-	5	5	0,38	Ø30	9GC-□00Δ5-0250
FAT-40	300/5	-	10	5	0,38	Ø30	9GC-□00Δ5-0300
FAT-40	400/5	5	10	10	0,38	Ø30	9GC-□00Δ5-0400
FAT-40	500/5	10	10	10	0,38	Ø30	9GC-□00Δ5-0500
FAT-40	600/5	10	10	10	0,38	Ø30	9GC-□00Δ5-0600

FAT - 100



Without Busbar

Busbar: 80 x 30, 100 x 10 mm.

Type	Rated current (A)	Rated Power (VA) Class			Weight (kg)	Cable (max) mm.	Order Codes □ For Class 0,2 : C For Class 0,5 : A For Class 0,5s : D Δ For 15 VA : 5
		0,2	0,5	0,5s			
FAT-100	1000/5	15	15	15	0,69	Ø60	9GE-□00Δ5-1000
FAT-100	1200/5	15	15	15	0,70	Ø60	9GE-□00Δ5-1200
FAT-100	1250/5	15	15	15	0,72	Ø60	9GE-□00Δ5-1250
FAT-100	1500/5	15	15	15	0,80	Ø60	9GE-□00Δ5-1500
FAT-100	1600/5	15	15	15	0,83	Ø60	9GE-□00Δ5-1600
FAT-100	2000/5	15	15	15	0,94	Ø60	9GE-□00Δ5-2000

FAT - 30C



Without Busbar

Busbar: 30 x 10 mm.

Type	Rated current (A)	Rated Power (VA) Class			Weight (kg)	Cable (max) mm.	Order Codes □ For Class 0,2 : C For Class 0,5 : A For Class 0,5s : D Δ For 5 VA : 2 For 10 VA : 4
		0,2	0,5	0,5s			
FAT-30C	150/5	-	5	-	0,63	Ø30	9GB-□00Δ5-0151
FAT-30C	200/5	-	10	10	0,63	Ø30	9GB-□00Δ5-0201
FAT-30C	250/5	5	10	10	0,63	Ø30	9GB-□00Δ5-0251
FAT-30C	300/5	5	10	10	0,63	Ø30	9GB-□00Δ5-0301

FAT - 30



Without Busbar

Busbar: 30 x 10 mm.

Type	Rated current (A)	Rated Power (VA) Class			Weight (kg)	Cable (max) mm.	Order Codes □ For Class 0,2 : C For Class 0,5 : A For Class 0,5s : D Δ For 5 VA : 2 For 10 VA : 4
		0,2	0,5	0,5s			
FAT-30	150/5	-	5	-	0,60	Ø12	9GB-□00Δ5-0150
FAT-30	200/5	-	10	5	0,60	Ø12	9GB-□00Δ5-0200
FAT-30	250/5	5	10	10	0,60	Ø12	9GB-□00Δ5-0250
FAT-30	300/5	10	10	10	0,60	Ø12	9GB-□00Δ5-0300

FAT - 60



Without Busbar

Busbar: 60 x 20 mm.

Type	Rated current (A)	Rated Power (VA) Class			Weight (kg)	Cable (max) mm.	Order Codes □ For Class 0,2 : C For Class 0,5 : A For Class 0,5s : D Δ For 5 VA : 2 For 10 VA : 4
		0,2	0,5	0,5s			
FAT-60	500/5	-	10	5	0,60	Ø40	9GD-□00Δ5-0500
FAT-60	600/5	5	10	10	0,60	Ø40	9GD-□00Δ5-0600
FAT-60	750/5	10	10	10	0,60	Ø40	9GD-□00Δ5-0750
FAT-60	800/5	10	10	10	0,60	Ø40	9GD-□00Δ5-0800
FAT-60	1000/5	10	10	10	0,60	Ø40	9GD-□00Δ5-1000
FAT-60	1250/5	10	10	10	0,60	Ø40	9GD-□00Δ5-1250

FAT - 130



Without Busbar

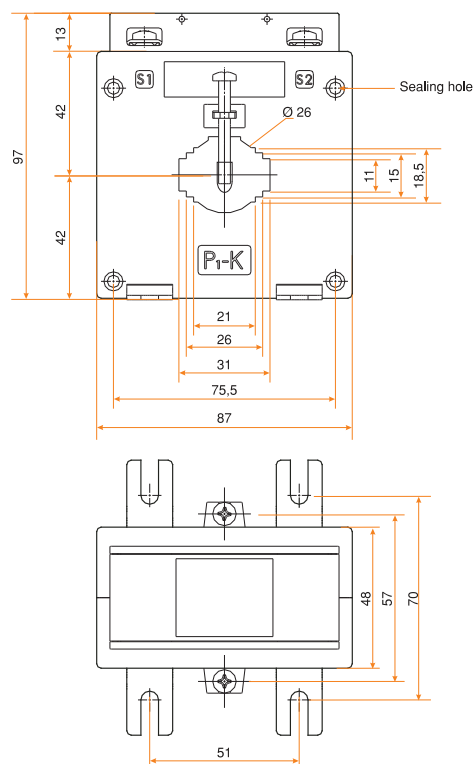
Busbar: 110 x 60 ; 2(110 x 20) mm.

Type	Rated current (A)	Rated Power (VA) Class			Weight (kg)	Cable (max) mm.	Order Codes □ For Class 0,2 : C For Class 0,5 : A For Class 0,5s : D Δ For 15 VA : 5 For 20 VA : 6 For 30 VA : 7 For 40 VA : 8
		0,2	0,5	0,5s			
FAT-130	1500/5	15	15	15	1,50	Ø105	9GN-□00Δ5-1500
FAT-130	1600/5	15	15	15	1,50	Ø105	9GN-□00Δ5-1600
FAT-130	2000/5	20	20	20	1,50	Ø105	9GN-□00Δ5-2000
FAT-130	2500/5	30	30	30	1,50	Ø105	9GN-□00Δ5-2500
FAT-130	3000/5	30	30	30	1,50	Ø135	9GN-□00Δ5-3000
FAT-130	3200/5	30	30	30	1,50	Ø135	9GN-□00Δ5-3200
FAT-130	4000/5	40	40	40	1,50	Ø135	9GN-□00Δ5-4000

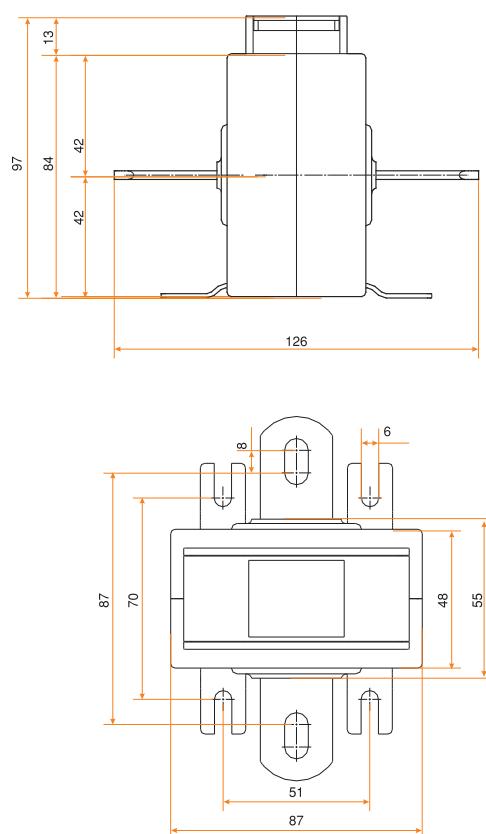
Note: Federal L.V current transformers possess sealing feature. Please call our company for current requests which are absent in the list.

CURRENT TRANSFORMERS

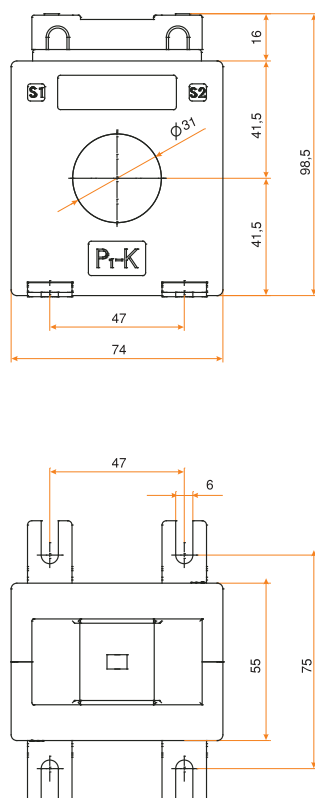
FAT - 30



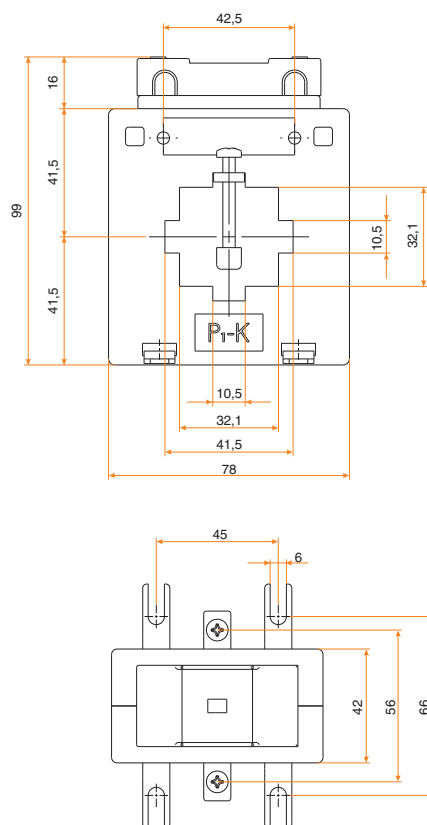
FAT - 30B



FAT - 30C

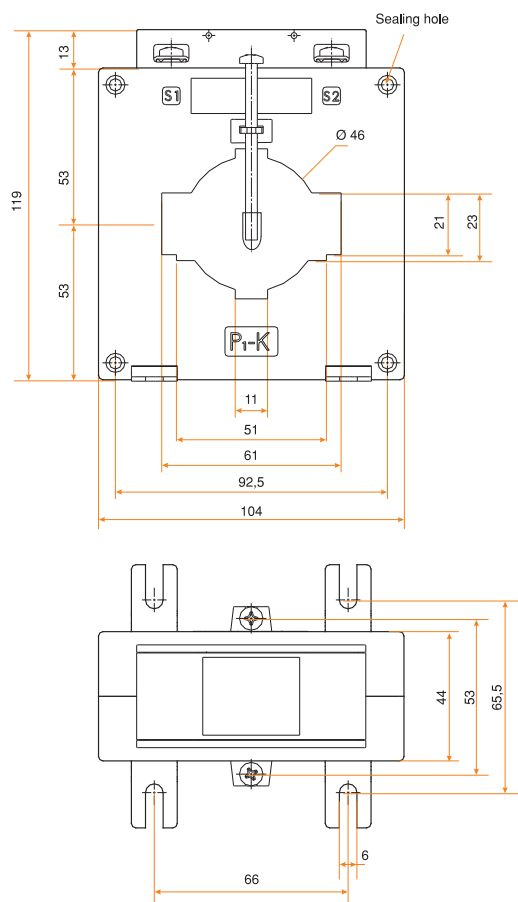


FAT - 40

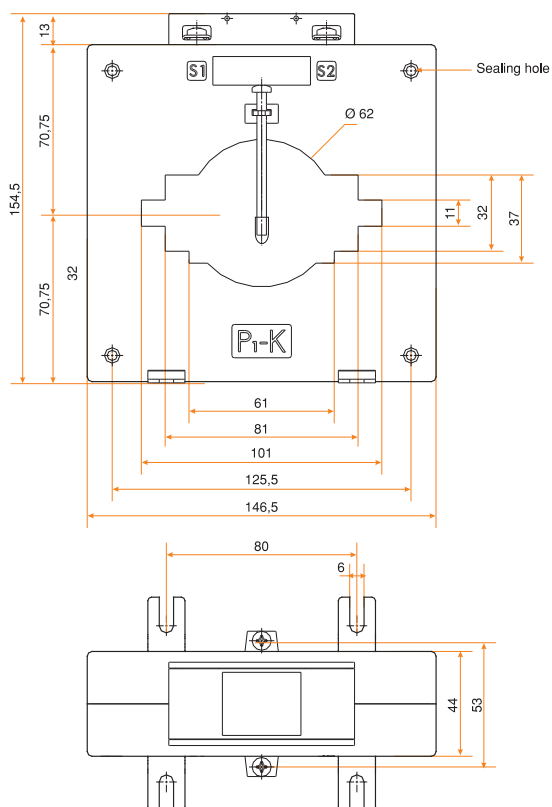


CURRENT TRANSFORMERS

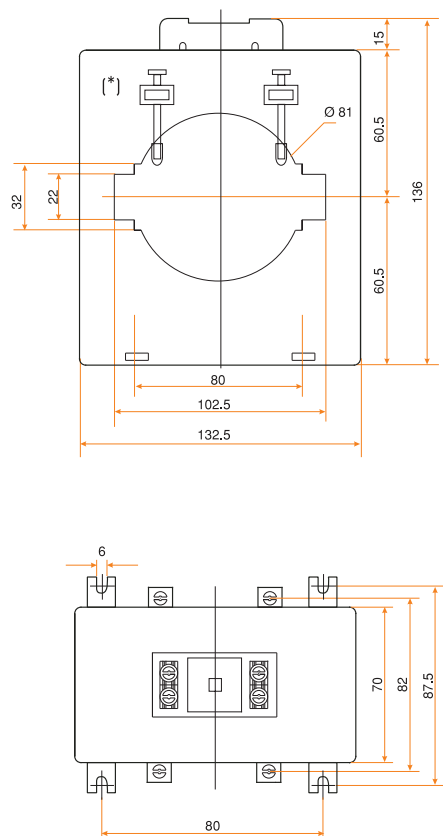
FAT - 60



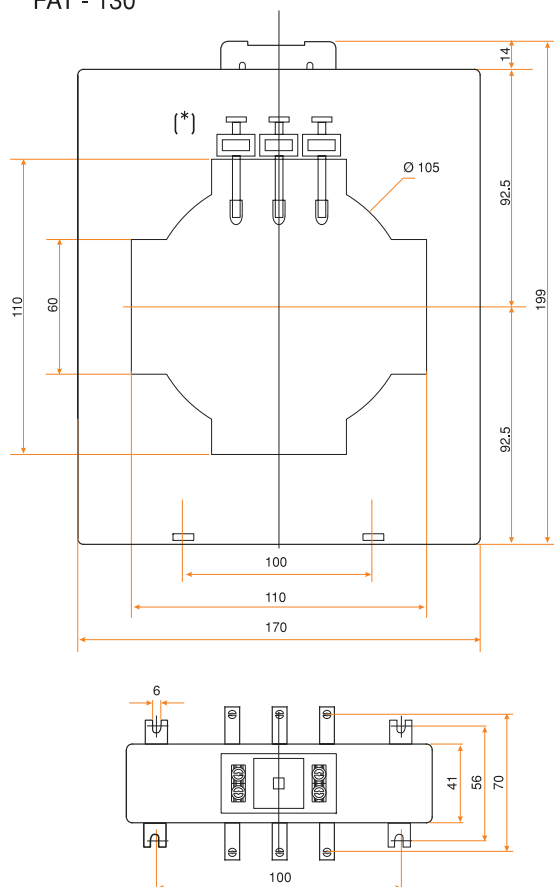
FAT - 100



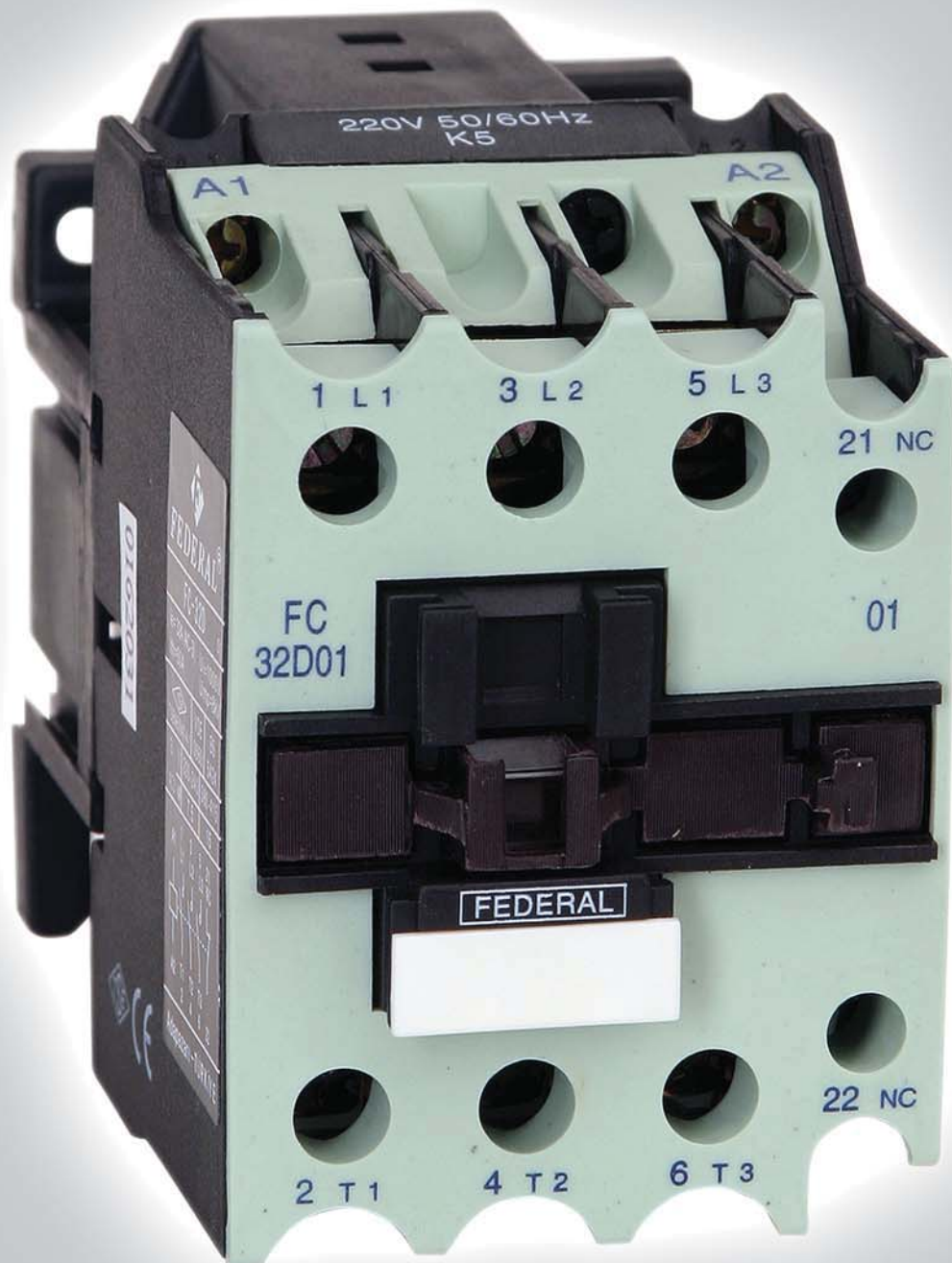
FAT - 100L



FAT - 130



CONTACTORS



Power Contactors



FC06M
FC09M



FC09D
FC12D
FC18D



FC25D
FC32D



FC40D
FC50D
FC65D



FC80D
FC95D



FC115D
FC150D



FC220D
FC260D
FC300D



FC400D
FC475D



FC580D
FC650D
FC750D

Contactors for Capacitor Switching



FC09DK
FC12DK



FC18DK



FC25DK



FC32DK



FC40DK
FC50DK
FC65DK



FC95DK



FC150DK

High Current Contactors



EC300 ... EC2500

CONTENT








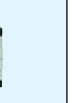
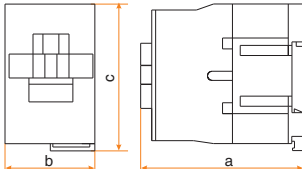








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IEC / EN 60947-4-1
CE

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.

CONTACTORS

										
Type		FC06M	FC09M	FC09D	FC12D	FC18D	FC25D	FC32D	FC40D	FC50D
Utilization class : AC3 I _e max U _e < 440 V	A	6	9	9	12	18	25	32	40	50
Number of pole		3	3	3 / 4	3 / 4	3	3 / 4	3	3 / 4	3 / 4
Utilization class : AC1 I _e max	40 °C	16	16	25	25	32	40	50	60	80
	55 °C A	12	12	20	20	26	32	44	55	70
Rated insulation voltage-U _i (a.c.) 50-60 Hz V		630	630	1000	750	750	750	750	750	750
Rated impulse withstand voltage - U _{imp} kV		8	8	8	8	8	8	8	8	8
Motor control 3 ~ AC3 Driving Stopping	220 / 230 V kW	1,5	2,2	2,2	3	4	5,5	7,5	11	15
	380 / 400 V kW	2,2	4	4	5,5	7,5	11	15	18,5	22
	415 V kW	2,2	4	4	5,5	9	11	15	22	25
	500 V kW	3	4	5,5	7,5	10	15	18,5	22	30
	660 / 690 V kW	3	4	5,5	7,5	10	15	18,5	30	33
Rated current AC 5A	A	9	12	12	16	25	35	45	55	70
Weight	3 pole kg.	0,16	0,16	0,33	0,33	0,345	0,52	0,55	1,14	1,14
	4 pole	-	-	0,33	0,33	3-4	-	3	1,29	1,29
Number of auxiliary contacts		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
Coil power consumption (at holding) W		1	1	1,5	1,5	1,5	1,5	2,5	2,5	2,5
Power loss per pole W		0,16	0,30	0,25	0,45	1,00	1,00	1,30	2,00	4,50
Max. - min. tightening torque Nm		1-1,5	1-1,5	1-1,5	1-1,5	1-1,5	1,2-2	1,2-2	3,5-4,5	3,5-4,5
Dimensions 	a (mm) AC	57	57	80	80	86	94	99	115	115
	a (mm) DC	-	-	114	114	120	130	130	172	172
	b (mm)	45,5	45,5	46	46	46	57	57	75	75
	c (mm)	58	58	74,5	74,5	74,5	84	84	128	128
Easily replaced coils		 FCC-D0	 FCC-D2		 FCC-D4					
Auxiliary contact blocks (Side assembly) 1. figure is number of NO contacts 2. figure is number of NC contacts								FCAB-F11 FCAB-F20 FCAB-F02		
Auxiliary contact blocks (Front assembly) 1. figure is number of NO contacts 2. 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

CONTACTORS

													
FC65D	FC80D	FC95D	FC115D	FC150D	FC220D	FC260D	FC300D	FC400D	FC475D	FC580D	FC650D	FC750D	
65	80	95	115	150	220	260	300	400	475	580	650	750	
3 / 4	3 / 4	3 / 4	3	3	3	3	3	3	3	3	3	3	
80	125	125	200	200	300	300	350	500	600	750	850	1000	
70	100	100	180	180	260	260	300	450	550	650	780	850	
750	750	750	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	116	140	160	200	250	315	355	400	
37	55	55	75	90	132	180	200	230	290	360	410	470	
37	45	45	80	100	160	200	250	300	375	470	530	650	
80	100	115	140	180	-	-	-	-	-	-	-	-	
1,14	1,38	1,38	2,1	2,1	4,7	4,7	8,5	15	15	17,4	17,4	22	
1,29	1,54	1,54	-	-	-	-	-	-	-	-	-	-	
1 NO + 1 NC	1 NO + 1 NC	1 NO + 1 NC	-	-	-	-	-	-	-	-	-	-	
2,5	3	3	3,5	3,5	3,5	3,5	8	20	20	22	22	24	
6,50	8,00	11,50	8	13	17	24	27	37	53	43	53	55	
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	
115	127	127	118	118	183	183	223	298,7	298,7	257	257	298	
172	183	183	-	-	-	-	-	-	-	-	-	-	
75	75	75	120	120	170	170	218	205,7	205,7	310	310	229	
128	128	128	154	154	175	175	210	185,5	185,5	304	304	210	
													
FCC-D6			FCC-D8		FCC-D10			FCC-D12					
 FCAB-F11 FCAB-F20 FCAB-F02													
													
FCB-F20 FCB-F02 FCB-F11				FCB-F40 FCB-F31 FCB-F22 FCB-F13 FCB-F04									

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 contactor 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 (ΔQ) 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 x 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 x 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: Ohmic loss,
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 x 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/o of the motor nominal power according to AC3 category. All the contactors are selected at 0.58 times more that is 1/o 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

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.

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	Utilization category	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

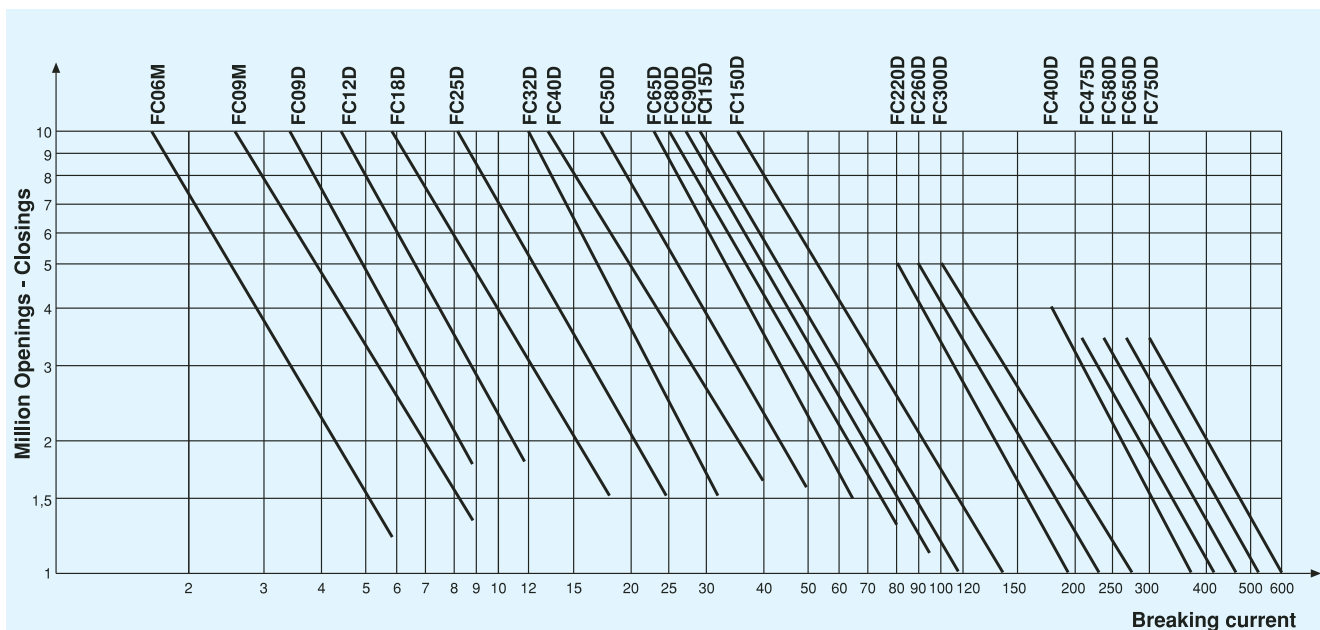


Fig-1 Electrical life values of contactors according to breaking current (Ue£440V, 50Hz for AC-3 class)

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.

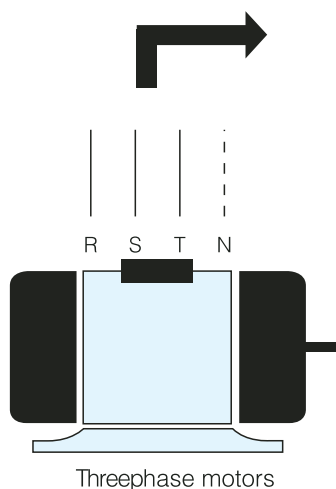
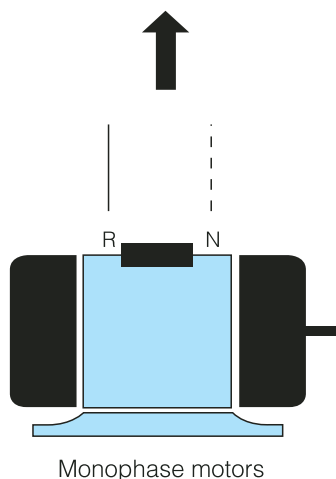
The most common area of utilization of the contactors is operation of motors. Different operating types of the motors are classified in IEC 60947-4-1.

Connection sections:

Min. and max. connection sections (mm ²)	Primary contact	Auxiliary contact	 mm ²	 mm ²	 mm ²	 mm ²	 mm
FC 09D			1...4	1...4 + 1...4	1...6	1...6 + 1...6	8
FC 12D			1...4	1...4 + 1...4	1...6	1...6 + 1...6	8
FC 18D			1...2,5	1...2,5 + 1...2,5	1...2,5	1...2,5 + 1...2,5	8
			2...6	1,5...6 + 1,5...6	1,5...6	1,5...6 + 1,5...6	10
FC 25D			2...10	1,5...6 + 1,5...6	1,5...6	1,5...6 + 1,5...6	10
FC 32D			1...2,5	1...2,5 + 1...2,5	1...2,5	1...2,5 + 1...2,5	8
			2...10	4...10 + 4...10	1,5...10	2,5...10 + 2,5...10	12
FC 40D FC 50D FC 65D			1...2,5	1...2,5 + 1...2,5	1...2,5	1...2,5 + 1...2,5	8
FC 80D FC 95D			2,5...25	2,5...16 + 2,5...16	2,5...25	4...16 + 4...16	—
			1...2,5	1...2,5 + 1...2,5	1...2,5	1...2,5 + 1...2,5	8
FC 115D FC 150D			4...50	4...35 + 4...35	4...50	16...35 + 16...35	—
			4...95	4...50 + 4...50	4...95	16...50 + 16...50	—
FC 220D FC 260D FC 300D			4...185	4...95 + 4...95	4...185	4...95 + 4...95	32
FC 400D			—	—	—	—	38
FC 475D FC 580D FC 650D FC 750D			—	—	—	—	44

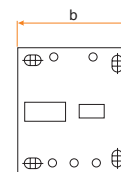
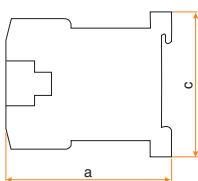
CONTACTORS

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



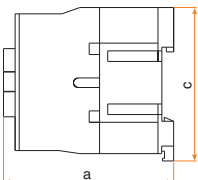
CONTACTORS

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

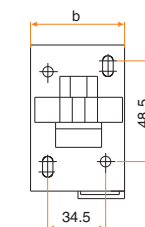
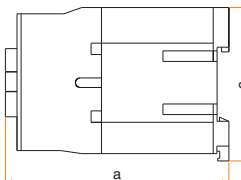


Type	a		b	c
	AC	DC		
FC 09D	80	114	46	74.5
FC12D	80	114	46	74.5
FC18D	86	120	46	74.5

AC

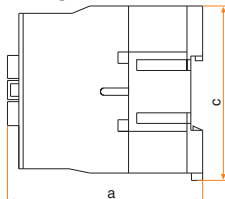


DC

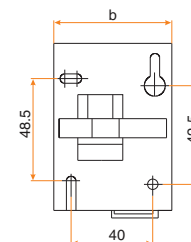
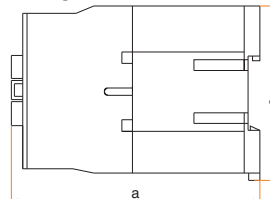


Type	a		b	c
	AC	DC		
FC25D	94	130	57	84
FC32D	99	130	57	84

AC

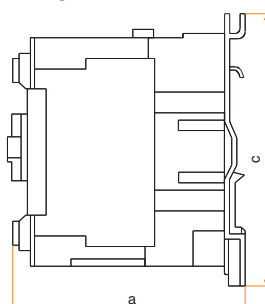


DC

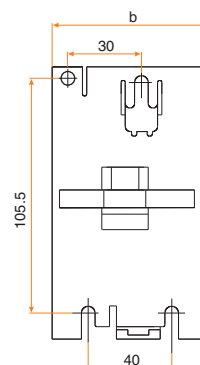
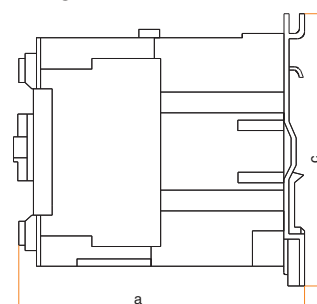


Type	a		b	c
	AC	DC		
FC40D	115	172	75	128
FC50D	115	172	75	128
FC65D	115	172	75	128
FC80D	127	183	75	128
FC95D	127	183	75	128

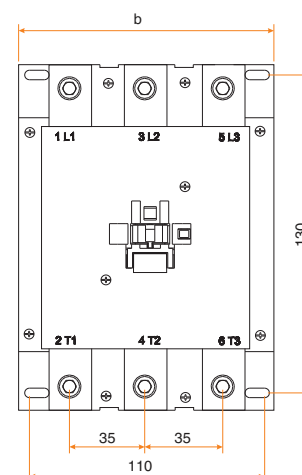
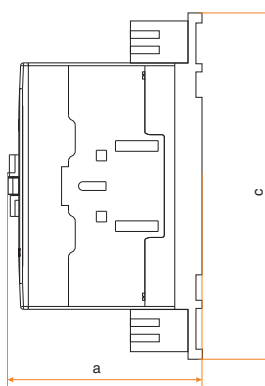
AC



DC

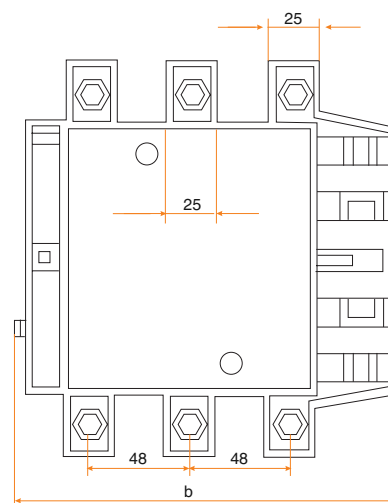
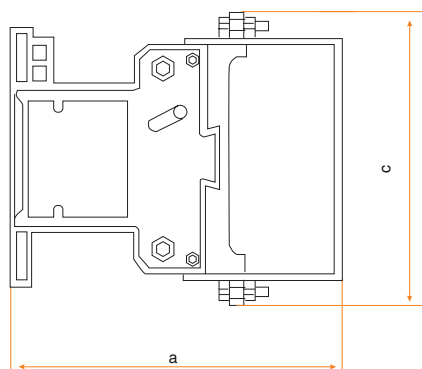


Type	a	b	c
FC115D	118	120	154
FC150D	118	120	154

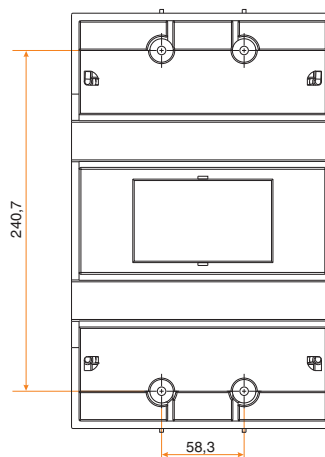
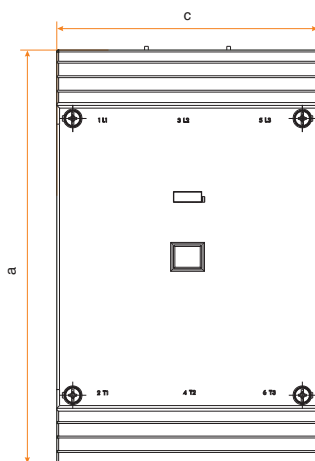
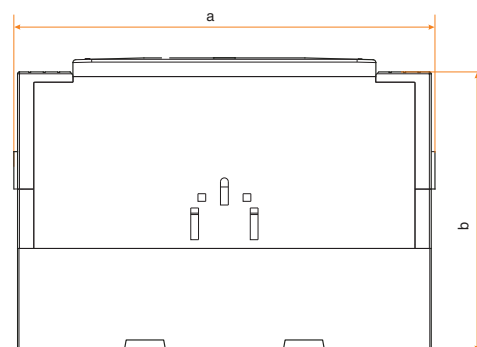
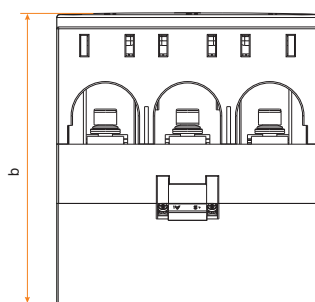


CONTACTORS

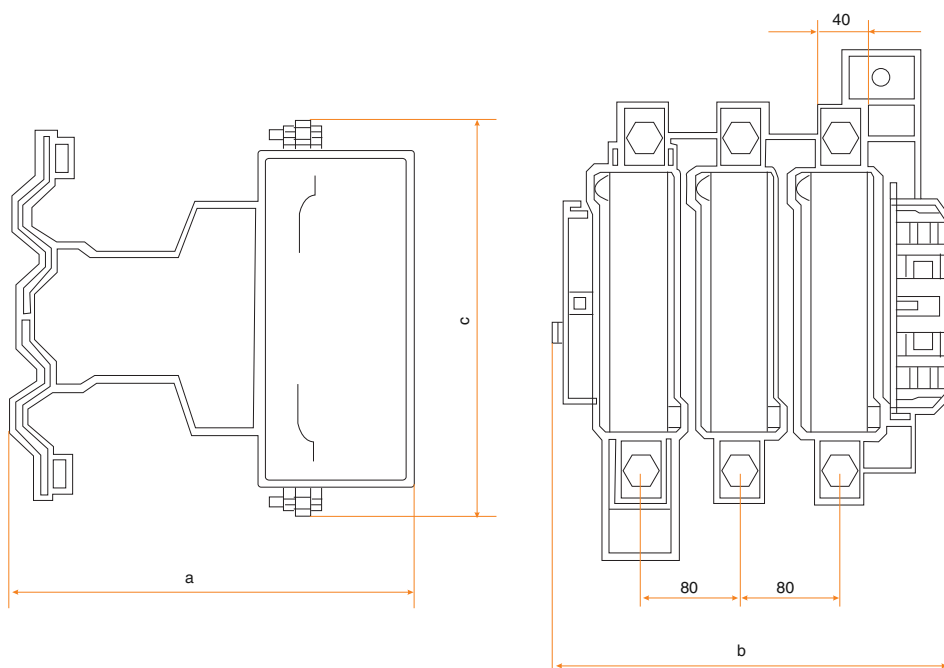
Type	a	b	c
FC220D	183	170	175
FC260D	183	170	175
FC300D	223	218	210



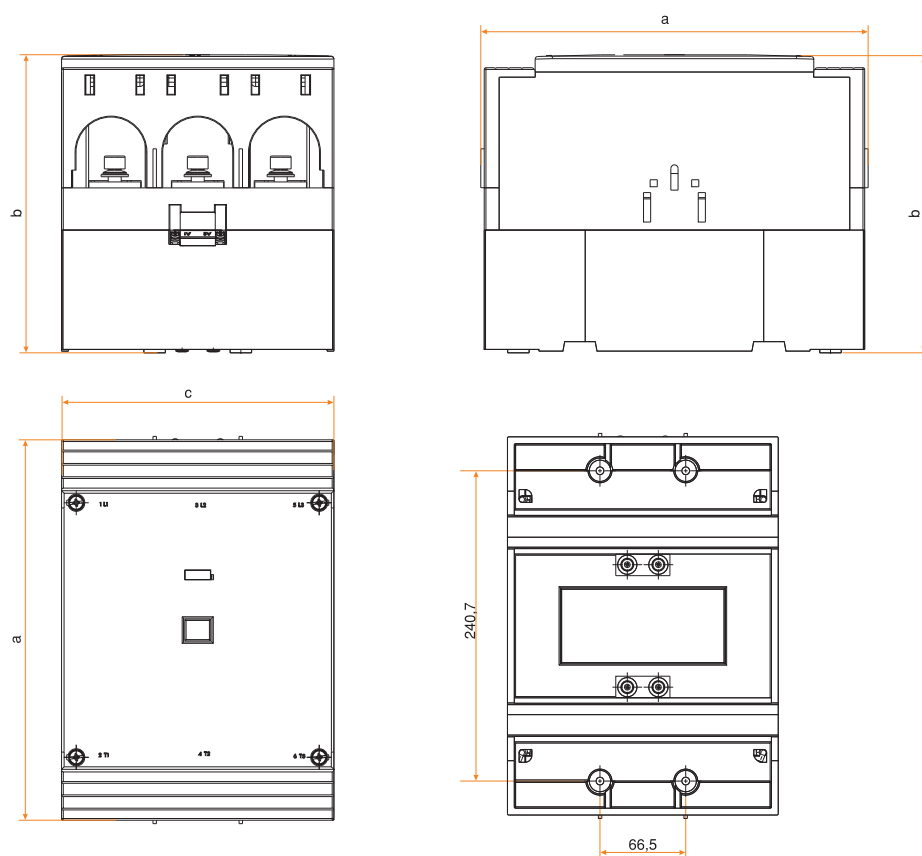
Type	a	b	c
FC400D	298.7	205.7	185.5
FC475D	298.7	205.7	185.5



Type	a	b	c
FC580D	257	310	304
FC650D	257	310	304

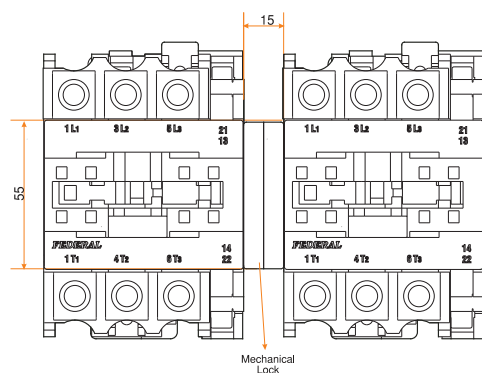


Type	a	b	c
FC750D	298	229	210

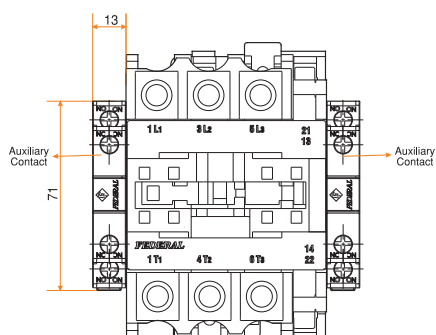


CONTACTORS

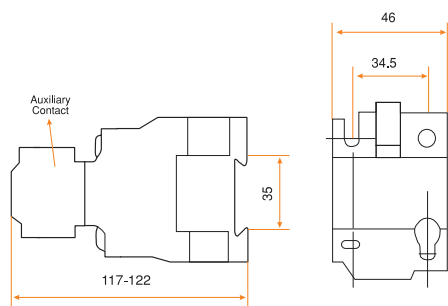
Mechanical lock



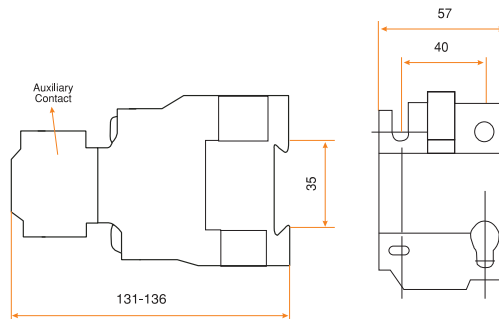
Side assembled contact block



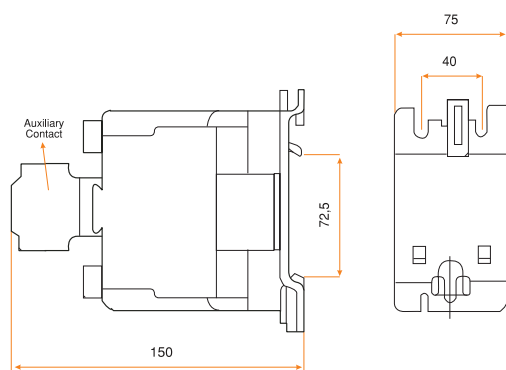
**FC12D / FC18D Front Assembling
One Assembly Auxiliary Contact Block :**



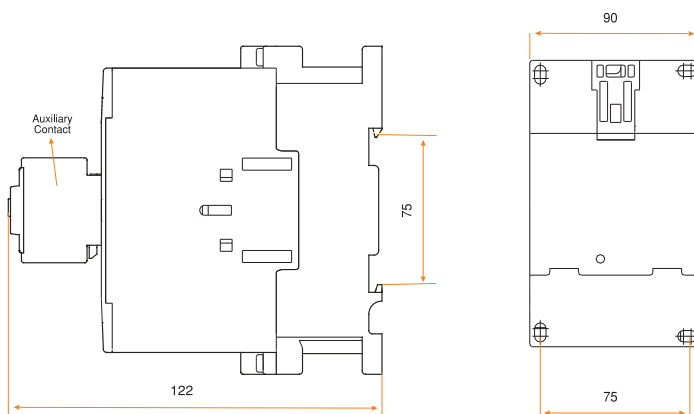
**FC25D / FC32D Front Assembling
One Assembly Auxiliary Contact Block :**



**FC40D / FC65D / FC95D Front Assembling
One Assembly Auxiliary Contact Block :**



**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

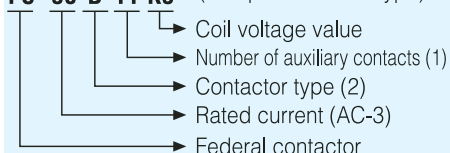
□□ Indicates coil operating voltage

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
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
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...FC32D	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 - 32D01 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.)

FC400 and FC750 Contactor Coil (with electronic control unit)

100-250V AC

Coils according to IEC standards

Coil can close contactors at 85% of coil voltage

Coil can open contactors between 30% - 70% of coil voltage.

While selecting coil voltage, voltage drops at working time and voltage rises at night should be taken into consideration.

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:

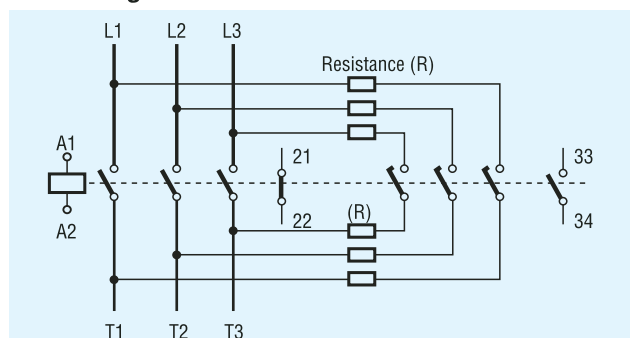


Fig-2 FC-12DK; FC-18DK; FC-25DK; FC-32DK

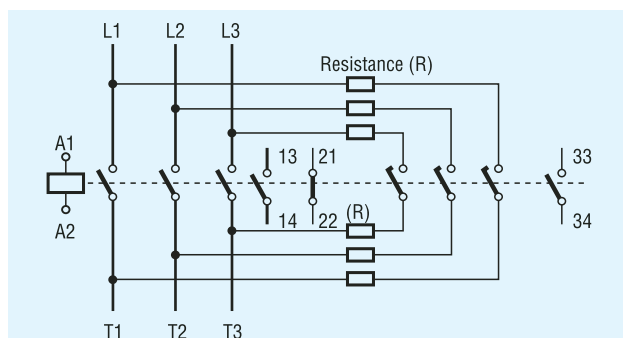


Fig-3 FC-65DK; FC-95DK

Contactor type		FC09DK	FC12DK	FC18DK	FC25DK	FC32DK	FC40DK	FC50DK	FC65DK	FC95DK	FC150DK
Utilization class AC-6b											
I _{max} U _e ≤ 415 V	A	7	11	15	23	29	36	43	58	72	101
Rated thermal current (I _{th})	A	25	25	32	40	50	80	80	80	125	200
Rated insulation voltage (kVAr) Q ≤ 40°C	220/240 V	3	4	6	9	11	14	17	22	30	40
	380/415 V	5	7,5	10	15	20	25	30	40	50	70
Rated insulation voltage	V	630	630	630	630	630	630	630	630	630	630
Rated impulse withstad voltage	kV	6	6	6	8	8	8	8	8	8	8
Electrical life (opening - closing)		200.000	200.000	200.000	200.000	200.000	200.000	200.000	200.000	200.000	200.000
Number of auxiliary contacts		1NO+1NC	1NO+1NC	1NO+1NC	1NO+1NC	1NO+1NC	1NO+1NC	1NO+1NC	2NO+1NC	2NO+1NC	1NO or 1NC
Weight	kg	0,39	0,39	0,40	0,58	0,60	1,36	1,36	1,36	1,58	2,65
Coil power consumption	W	1,5	1,5	1,5	1,5	2,5	2,5	2,5	2,5	3	3,5
Power loss per pole	W	0,16	0,38	0,65	1,00	1,44	2,00	2,64	4,16	5,50	8,00
Max. - min. tightening torque	Nm	1,1,5	1-1,5	1-1,5	1,2-2	1,2-2	3,5-4,5	3,5-4,5	3,5-4,5	6-10	6-10
Dimesions											
	a (mm)	3	130	140	140	150	3	3	200	210	230
	b (mm)	3	117	122	131	136	3	3	150	150	250
	c (mm)	3	46	46	57	57	3	3	75	75	90

Order codes of contactor for capacitor switching

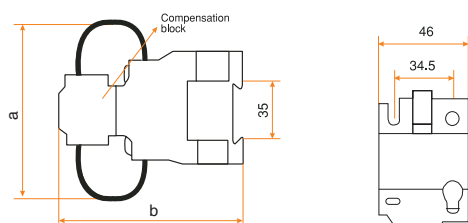
Type	AC-6b Ie (A)	kVAr 400 V	Standard auxiliary contact	Order code
FC09DK	7	5	1 NO + 1 NC	9DK-□□ 113-0009
FC12DK	11	7,5	1 NO + 1 NC	9DK-□□ 113-0012
FC18DK	15	10	1 NO + 1 NC	9DK-□□ 113-0018
FC25DK	23	15	1 NO + 1 NC	9DK-□□ 113-0025
FC32DK	29	20	1 NO + 1 NC	9DK-□□ 113-0032
FC65DK	36	25	2 NO + 1 NC	9DK-□□ 213-0065
FC40DK	43	30	1 NO + 1 NC	9DK-□□ 213-0040
FC50DK	58	40	2 NO + 1 NC	9DK-□□ 213-0050
FC95DK	72	50	2 NO + 1 NC	9DK-□□ 213-0095
FC-150DK	101	70	1 NO 1 NC	9DK-□□ 103-0150 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□□□

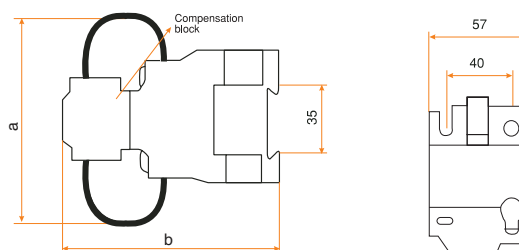
□□□□ Contactor type

FC09DK / FC12DK / FC18DK



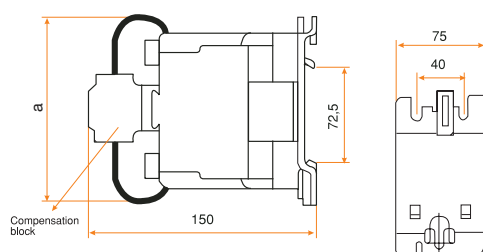
Type	a	b
FC09DK	130	117
FC12DK	130	117
FC18DK	140	122

FC25DK / FC32DK



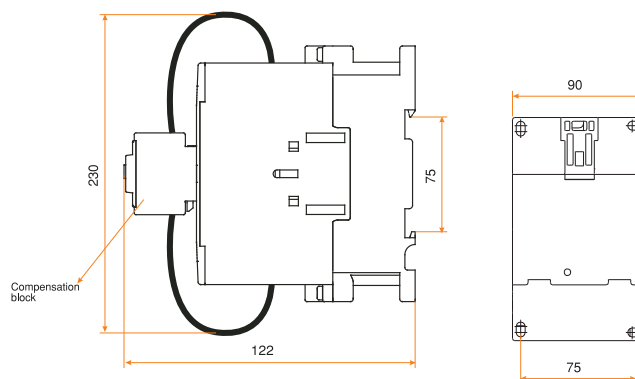
Type	a	b
FC25DK	140	131
FC32DK	150	136

FC40DK / FC50DK / FC65DK/ FC95DK



Type	a
FC40DK	200
FC50DK	200
FC65DK	200
FC95DK	210

FC150DK



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 now 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.

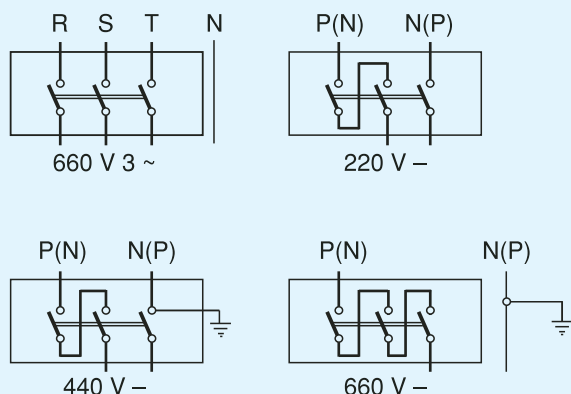
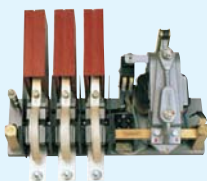
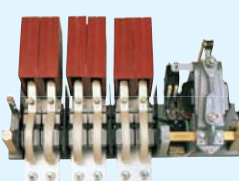
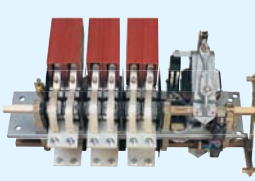


Fig-10

CONTACTORS

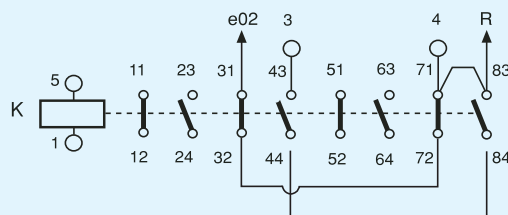
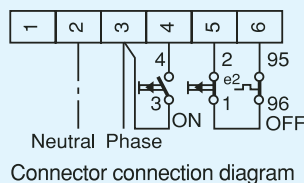
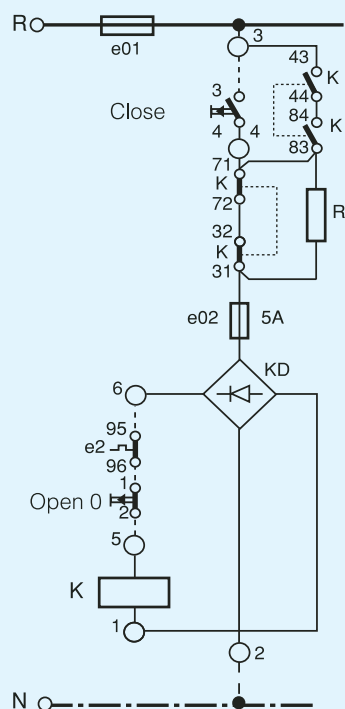
									
Type		EC 300	EC 400	EC 630	EC 800	EC 1250	EC 1600	EC 2000	EC 2500
Utilization class (lth) le max	AC1 ≤ 40°C A	300	400	630	800	1250	1600	2000	2500
Number of poles *		1,2,3,4	1,2,3,4	1,2,3,4	1,2,3,4	1,2,3	1,2,3	1,2,3	1,2,3
Rated impulse withstand voltage	kV	8	8	8	8	8	8	8	8
For motor control (Squirrel cage 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 :



Auxiliary contact block 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 Ω - 75 W)
 KD : Bridge diode
 K : Coil

Fig-11

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

Order codes of contactors :

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

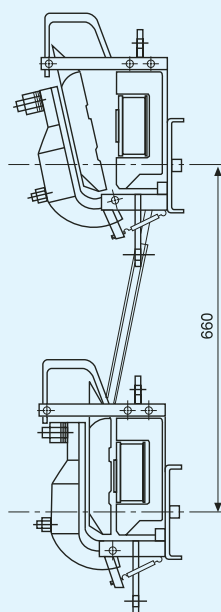
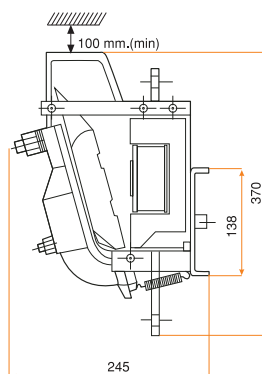
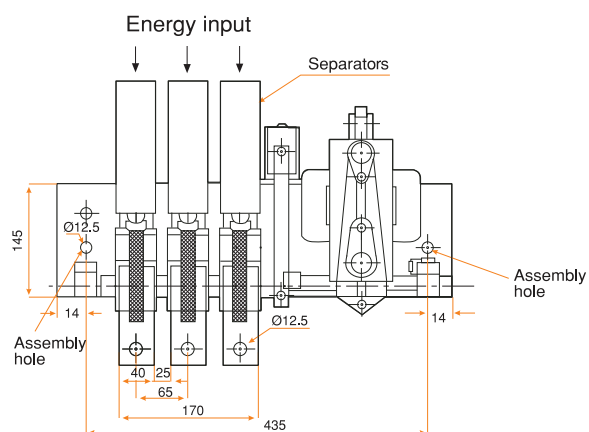


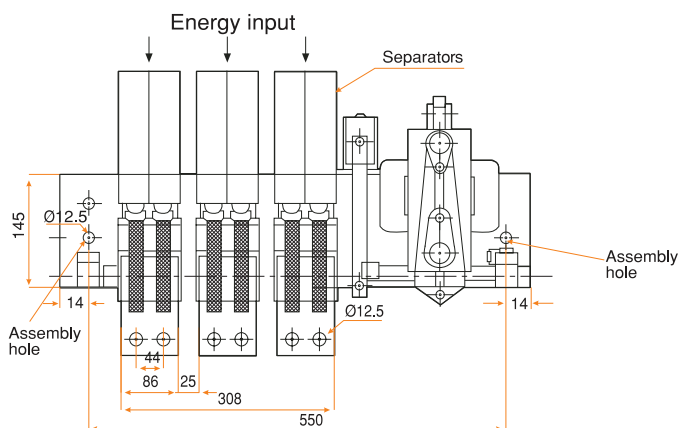
Fig-12

CONTACTORS

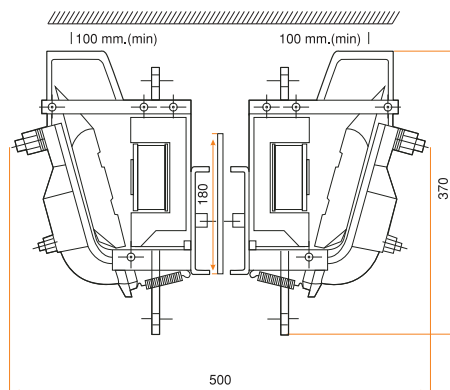
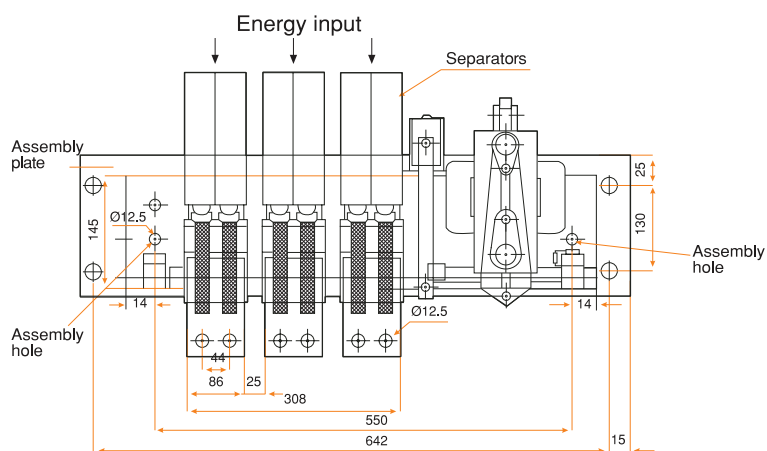
EC300-EC400-EC630-EC800:



EC1250 - EC1600:



EC2000 - EC2500:



THERMAL OVERLOAD RELAYS



Thermal Overload Relays



FTR25
0.1A ...32A



FTR95
30A - 93A

CONTENTS

Features	1
Characteristic Curves	1
Technical Table	1
Order Codes	2
Technical Drawings	3

IEC / EN 60947-4-1
CE

Altitude : 2000 m (max)
Relative Humidity : 50% (40°C), 90% (20°C)
Ambient Temperature : between -5°C and + 40°C
Pollution Degree : III

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

THERMAL OVERLOAD RELAYS

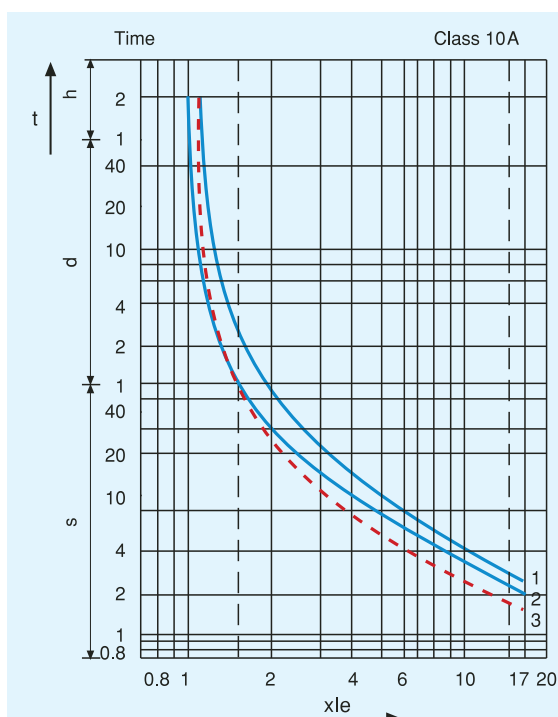


Fig-1: Current time graphic of thermal over current relay
 1: 3-phase balanced operation (cold condition)
 2: 2-phase balanced operation (cold condition)
 3: 3-phase balanced operation (hot condition)

Thermal relays disable 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 1.5xle. 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 le 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 $I_a = (1,05 - 1,2) \times I_{le}$. Furthermore, the relay is required to open in two minutes at 1.5xle over current value in hot condition and in 2 seconds or 5 seconds at 7.2xle over current value in cold condition, depending on the delay value.

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

Table 1. Thermal opening currents loaded in 20°C ambient temperature equal for each three current paths and delay times of over current relay.

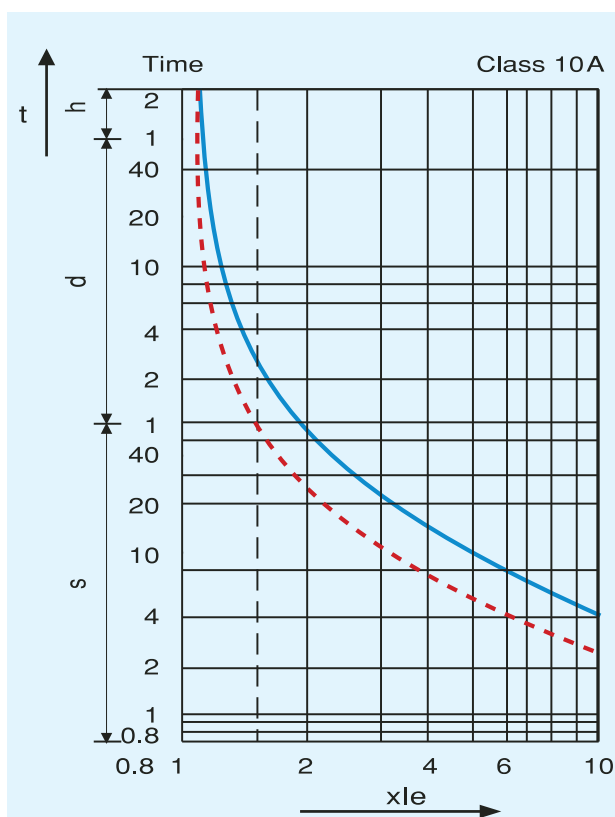


Fig-2: Opening characteristics for cold and hot operating conditions of thermal over current relay

THERMAL OVERLOAD RELAYS

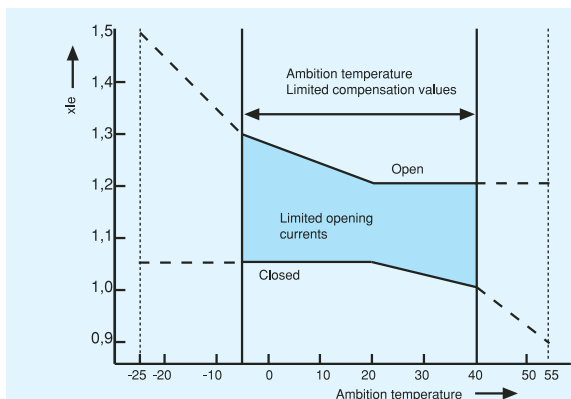
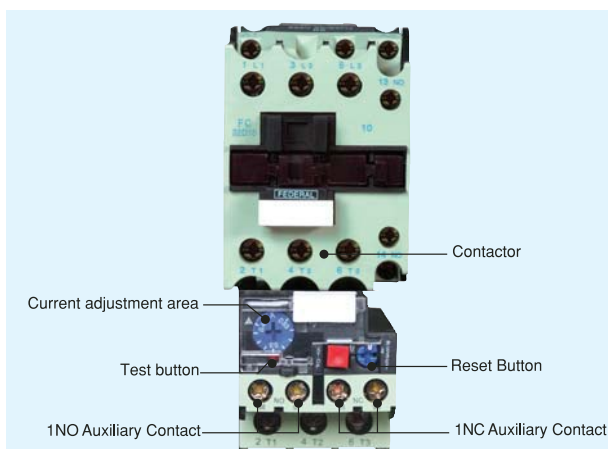


Fig-3: Temperature compensation



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 amper 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)xIe 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 Ie.

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.

Technical Specifications

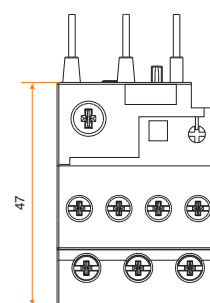
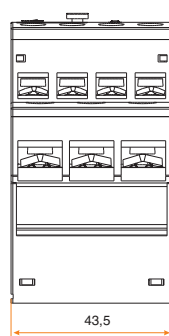
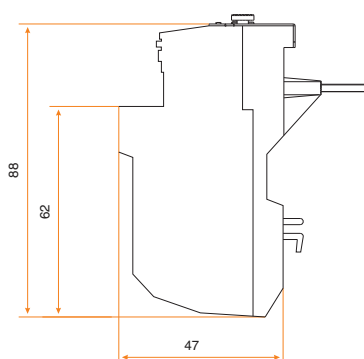
Type	FTR25	FTR95
Current Adjustment Area (A)	0.1 ... 32	30 - 93
Opening Class Class (A)	10	10
Rated Insulation Voltage (Ui) (V)	690	690
Rated Impulse Withstand Voltage (Uimp) kV	6	6
Operating Height m	2000	2000
Temperature Compensation C	-25...+55	-25...+55
Operating Frequency Hz	50/60	50/60
Auxiliary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

THERMAL OVERLOAD RELAYS

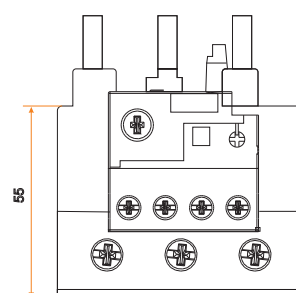
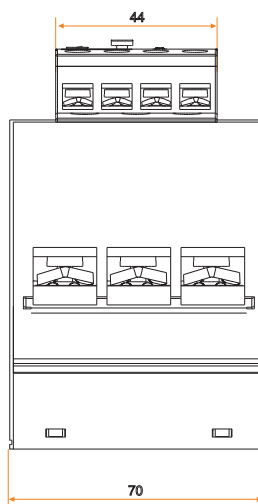
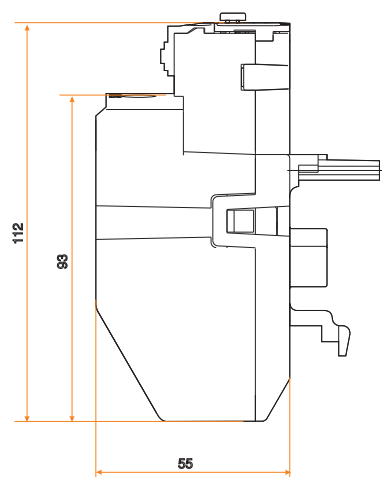
Accessories:

FTR25 mounting base	FTR95 mounting base
	
Assembled with FTR25 to form a complete set	Assembled with FTR25 to form a complete set

FTR25 :



FTR95 :



POWER CAPACITORS



K-Series Low Voltage Power Capacitors



FEK-13 (Three-Phase 400V)

5 kVAr ... 30 kVAr



FEK-13 (Three-Phase 450V)

10 kVAr ... 30 kVAr

M-Series Low Voltage Power Capacitors



FEKM (Mono-Phase 400V)

1,67 kVAr ... 5 kVAr

CONTENTS

Power Factor Compensation Methods	1
Advantages of MKP Technology	1
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Compensation of MV Transformers	3
Compensation of Tri-Phase Asynchronous Motors	3
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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.

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_ϕ , 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) (Şekil-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.

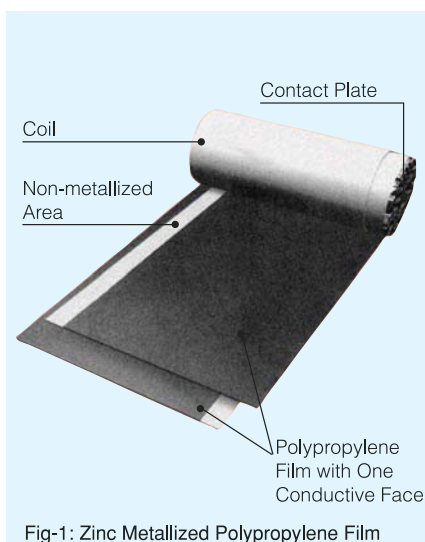


Fig-1: Zinc Metallized Polypropylene Film

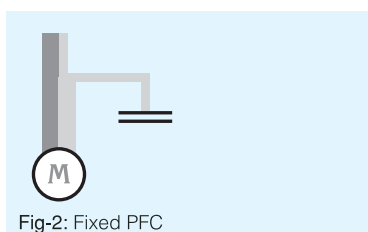


Fig-2: Fixed PFC

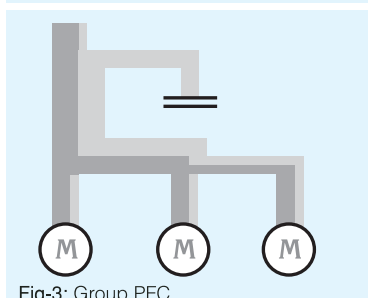


Fig-3: Group PFC

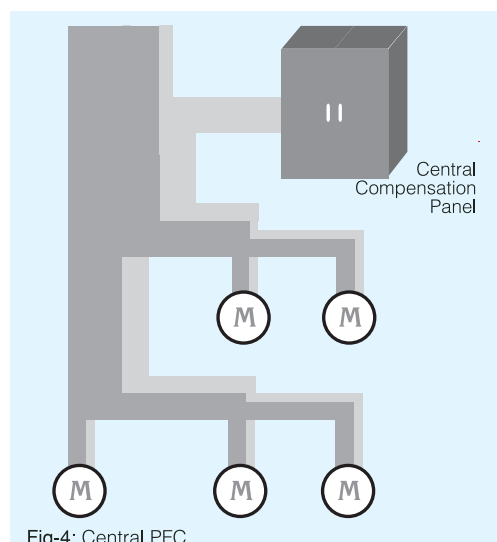


Fig-4: Central PFC

■ Active Energy ■ Reactive Energy

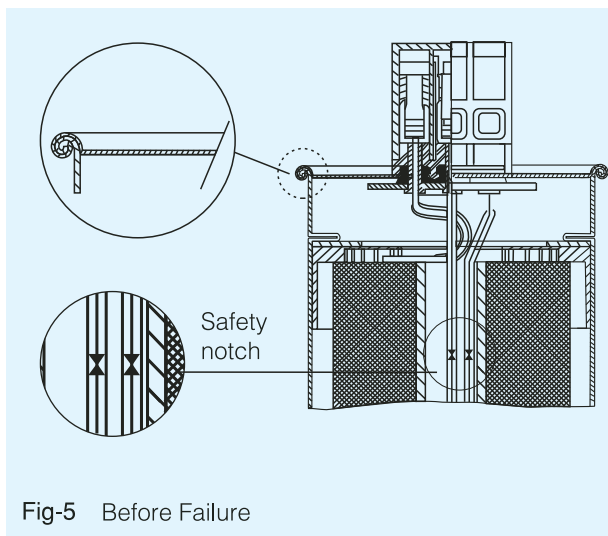


Fig-5 Before Failure

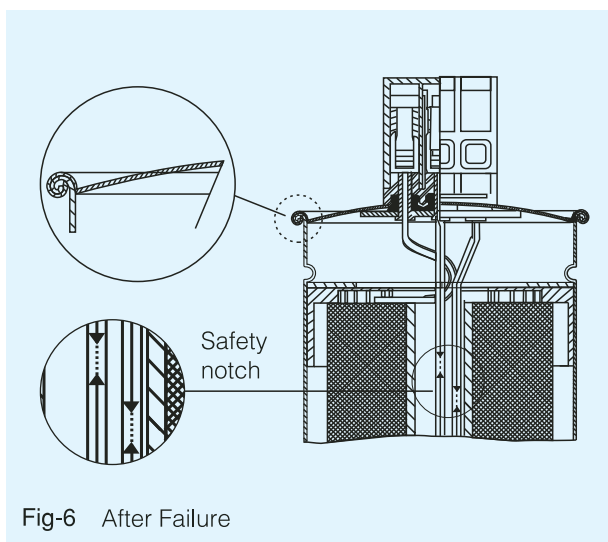


Fig-6 After Failure

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

Qc = Reactive power

Cosφ1 = Current power coefficient

Cosφ2 = Desired power coefficient

(tanφ1 - tanφ2) = 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
cosφ1=0,7 as cosφ2=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 cosφ1=0,7 and cosφ2=0,98 in the multiplier factor table, we find the multiplier factor as 0,817.

$$Q_c = 500 \times 0,817$$

$$Q_c = 408,5 \text{ kVar}$$

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 cosφ2					
	0,980	0,985	0,990	0,995	1,000	
Original cosφ1	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

Environmental

temperature category :

Symbol	Minimum	Maximum	Highest average value in periods	
			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.

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

I_o = 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.

Capacitor voltages are given in the table below according to total harmonic distortion.

THD < 12%
400V



THD < 20%
450V


THD < 27%
525V

POWER CAPACITORS


Technical Features:

Type	FEKM	FEK13
Rated Voltage	230/400 V	400/450 V
Frequency	50 Hz	50 Hz
Standards	TS EN 60831-1/2, IEC 831-1/2	TS EN 60831-1/2, IEC 831-1/2
Maximum over voltage	Un + 10% up to 8 hours a day	Un + 10% up to 8 hours a day
	Un + 15% up to 30 minutes a day	Un + 15% up to 30 minutes a day
	Un + 20% up to 5 minutes a day	Un + 20% up to 5 minutes a day
	Un + 30% up to 1 minute a day	Un + 30% up to 1 minute a day
	Voltages exceeding 15% should not be more than 200 times for the service life of capacitor.	Voltages exceeding 15% should not be more than 200 times for the service life of capacitor.
Over Current	4xIn	2xIn
Capacity tolerance	- 5%+10%	- 5%+10%
Test Voltage, terminal / terminal	2.15xUn AC 2 sec	2.15xUn AC 2 sec
Test Voltage, terminal / body	3 kV AC 10 sec	3 kV AC 10 sec
Sudden discharge current	Max. 200 x In	Max. 100 x In
Dielectric losses	0.2 W/kVAr	0.3 W/kVAr
Expected statistical life-time	130.000 hours (class -25/C)	100.000 hours.....(class -25/C)
	110.000 hours.....(class -25/D)	80.000 hours.....(class -25/D)
Protection Class	IP 00	With standard terminal protector : IP 30 With special protector : IP 54
Ambient temperature capacity	-25/D	-25/D
Cooling	Natural ventilated	Natural ventilated
Allowed relative humidity	Max 95%	Max % 95
Permitted max.Altitude	2000 m above sea level	2000 m above sea level
Assembly position	Any position possible	Any position possible
Assembly	Threaded M12 stud at the bottom of the case	Threaded M12 stud at the bottom of the case
Safety	Over pressure fear-off fuse	Over pressure fear-off fuse
Dielectric	MKP - metalizedpolypropylene film self heating	MKP - metalizedpolypropylene film self heating
Filling	Resin - without PCB	Resin - without PCB
Discharge resistances	-	- 75 V in 3 minutes

		Type	Power (kVAr)				Order Code
		M Series Mono-Phase					
		MKP technology	FEKM 0,4/1.67	230/400	0,55	1.67	9SF-AA000-0001
			FEKM 0,4/2.50	230/400	0,82	2.50	9SF-AA000-0002
			FEKM 0,4/3.33	230/400	1,10	3.33	9SF-AA000-0003
			FEKM 0,4/4.17	230/400	1,37	4.17	9SF-AA000-0004
			FEKM 0,4/5	230/400	1,65	5	9SF-AA000-0005

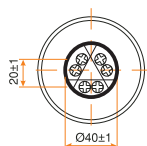
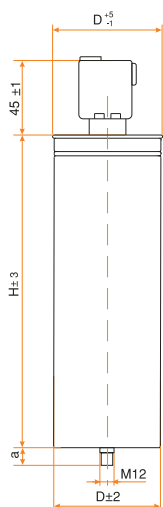
Type		Power (kVAr)		Order Code
K Series Three-Phase		400V	440V	
	MKP technology			
	FEK13	1	1,2	9SD-B□000-0100
	FEK13	1,5	1,8	9SD-B□000-0150
	FEK13	2,5	3,1	9SD-B□000-0250
	FEK13	5	6,1	9SD-B□000-0500
	FEK13	7,5	9,1	9SD-B□000-0750
	FEK13	10	12,1	9SD-B□000-1000
	FEK13	12,5	15,1	9SE-B□000-1250
	FEK13	15	18,2	9SE-B□000-1500
	FEK13	20	24,2	9SE-B□000-2000
	FEK13	25	30,3	9SE-B□000-2500
	FEK13	30	36,3	9SE-B□000-3000

□ = 400V for A, 440V for D enter value.

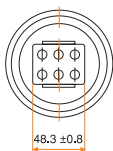
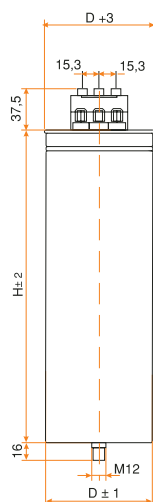
Type	Power (kVAr)				Order Code
		525V			
	FEK13	10			9SE-BC000-1000
	FEK13	15			9SE-BC000-1500
	FEK13	20			9SE-BC000-2000
	FEK13	25			9SE-BC000-2500

POWER CAPACITORS

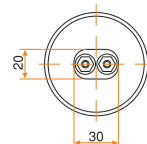
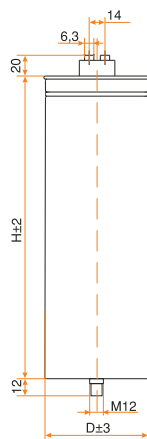
K Series:
400V, Q=5 ve 10 kVAr



K Series:
400V, $10 < Q \leq 30$ kVAr
450V, $10 \leq Q \leq 30$ kVAr



M Series:



Power (kVar)	a (mm)
5	12
10	16

HARMONIC FILTERS SHUNT REACTORS



Harmonic Filters



Shunt Reactors



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Harmonic Filters	2
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Description of Harmonic:

Ideal mains voltage and receiving current's sinusoidal form in electrical installation. But receiving current is non linear although mains voltage is sinusoidal according to electrical power has nonlinear characteristics (These electrical Powers are power electronic harmony, arc furnace etc.) so receiving voltage's wave form is not sinusoidal. Sinusoidal is exist in the system as voltage and current wave form's main frequency (50 Hz) multiples which is characterless 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 we call this HARMONIC.

Why Harmonic filters are needed?

Voltage harmonics which in different frequencies causes much current flow with increase frequency than capacitors in voltage distortions. These current flow causes further deterioration of the voltage. Thus, it creates a vicious circle in this system. Currents which has high harmonic are disrupt capacitor voltage much more so it causes decrease of power quality and receiving dangerous current.

To decrease of this effect, harmonic filter which has increased resistances when the frequency is increased are designing. These filters are serial fixing to capacitor in the system. Thus, filters which has increased resistances in increasing frequency causes raising of the difficulties to the reach of the capacitor against to high value frequency. Thus, it has barrier to the capacitor to receive high voltage.

Description of the Filter:

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

I) "Active Filters" which has controlled current of the filters or

voltage source.

II) "Passive Filters" are filter components's resistors, inductors and capacitors.

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

What should be careful 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 be 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 resonance. Filter frequencies which accepted and using in appliances are 134, 189, 210 Hz. Voltage increasing has occurred on capacitor because of inductance coil in filtration application. $U_c = U_n / (1 - p)$

U_n : Network Voltage

U_c : Voltage at the ends of capacitor

P : The factor 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 are reduce at the rate of square of reactive power voltage.

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

Therefore, active capacitor power in 400V networks can not change during the increasing of nominal voltage of capacitors so nominal power of compensation thus cost of system increases. 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 Terminal 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-) Manufacturing according to requested resonance frequency
- 8-) Saturation current (I_{lin}) suitable to request
- 9-) Protection degree IP 00
- 10-) F class isolation

HARMONIC FILTERS

	Power (kVAr)	Inductance (mH)	Width (mm)	Height (mm)	Depth (mm)	I system (A)	I Saturation (A)	Bus Voltage (V)	Capacitor Voltage (V)	Resonant Frequency (Hz)	P Factor	Order Code
Mono-phase 189 Hz Uk= 250V												
0.5	40.940	84	90	50	1.35	1.89	220	250	189	7%	9HF-BMA00-0050	
1	20.470	84	90	60	2.7	3.78	220	250	189	7%	9HF-BMA00-0100	
1.5	13.640	84	90	75	4.05	5.67	220	250	189	7%	9HF-BMA00-0150	
2	10.230	84	90	80	5.4	7.56	220	250	189	7%	9HF-BMA00-0200	
2.5	8.180	120	120	85	6.76	9.464	220	250	189	7%	9HF-BMA00-0250	
5	4.090	133	130	75	13.51	18.914	220	250	189	7%	9HF-BMA00-0500	
7.5	2.720	150	140	80	20.28	28.392	220	250	189	7%	9HF-BMA00-0750	
10	2.040	170	150	90	27.01	37.814	220	250	189	7%	9HF-BMA00-1000	
Mono-phase 189 Hz Uk= 280V												
0.5	34.220	84	90	50	1.62	2.268	220	280	189	7%	9HF-BMB00-0050	
1	17.110	84	90	60	3.23	4.522	220	280	189	7%	9HF-BMB00-0100	
1.5	11.410	84	90	75	4.85	6.79	220	280	189	7%	9HF-BMB00-0150	
2	8.550	84	90	80	6.47	9.058	220	280	189	7%	9HF-BMB00-0200	
2.5	6.840	120	120	85	8.08	11.312	220	280	189	7%	9HF-BMB00-0250	
5	3.410	133	130	75	13.47	18.858	220	280	189	7%	9HF-BMB00-0500	
7.5	2.870	150	140	80	24.26	33.964	220	280	189	7%	9HF-BMB00-0750	
10	1.700	170	150	90	32.36	45.304	220	280	189	7%	9HF-BMB00-1000	
Mono-phase 189 Hz Uk= 300V												
0.5	40.940	84	90	50	1.35	1.89	220	300	189	7%	9HF-BMC00-0050	
1	20.470	84	90	60	2.7	3.78	220	300	189	7%	9HF-BMC00-0100	
1.5	13.640	84	90	75	4.05	5.67	220	300	189	7%	9HF-BMC00-0150	
2	10.230	84	90	80	5.4	7.56	220	300	189	7%	9HF-BMC00-0200	
2.5	8.180	120	120	85	6.76	9.464	220	300	189	7%	9HF-BMC00-0250	
5	4.090	133	130	75	13.51	18.914	220	300	189	7%	9HF-BMC00-0500	
7.5	2.720	150	140	80	20.28	28.392	220	300	189	7%	9HF-BMC00-0750	
10	2.040	170	150	90	27.01	37.814	220	300	189	7%	9HF-BMC00-1000	
Three-phase 189Hz Uk=440V												
1	61.390	140	120	50	0.9	1.26	400	440	189	7%	9HF-BTD00-0100	
1.5	40.940	140	120	60	1.35	1.89	400	440	189	7%	9HF-BTD00-0150	
2	30.700	140	120	62	1.8	2.52	400	440	189	7%	9HF-BTD00-0200	
2.5	24.56	140	120	65	2.25	3.15	400	440	189	7%	9HF-BTD00-0250	
5	12.270	180	180	60	4.5	6.3	400	440	189	7%	9HF-BTD00-0500	
6.25	9.820	180	180	60	5.63	7.882	400	440	189	7%	9HF-BTD00-0625	
7.5	8.180	180	180	60	6.76	9.464	400	440	189	7%	9HF-BTD00-0750	
10	6.130	180	180	70	9.01	12.614	400	440	189	7%	9HF-BTD00-1000	
12.5	4.900	180	180	80	11.26	15.764	400	440	189	7%	9HF-BTD00-1250	
15	4.090	200	200	80	13.51	18.914	400	440	189	7%	9HF-BTD00-1500	
20	3.070	200	200	90	18.03	25.242	400	440	189	7%	9HF-BTD00-2000	
25	2.450	230	230	90	22.51	31.514	400	440	189	7%	9HF-BTD00-2500	
30	2.040	230	230	95	27.01	37.814	400	440	189	7%	9HF-BTD00-3000	
40	1.530	300	250	200	36.03	50.442	400	440	189	7%	9HF-BTD00-4000	
50	1.220	330	250	220	45.11	63.154	400	440	189	7%	9HF-BTD00-5000	
65	0.940	350	260	240	58.61	82.054	400	440	189	7%	9HF-BTD00-6500	
75	0.810	350	260	240	67.53	94.542	400	440	189	7%	9HF-BTD00-7500	
80	0.760	380	300	250	71.94	100.716	400	440	189	7%	9HF-BTD00-8000	
100	0.610	400	350	270	89.86	125.804	400	440	189	7%	9HF-BTD00-1100	

	Power (kVAr)	Inductance (mH)	Width (mm)	Height (mm)	Depth (mm)	I system (A)	I Saturation (A)	Bus Voltage (V)	Capacitor Voltage (V)	Resonant Frequency (Hz)	P Factor	Order Code
Three-phase 189Hz Uk=480V												
1	51.350	140	120	50	1.08	1.512	400	480	189	7%		9HF-BTE00-0100
1.5	34.220	140	120	60	1.62	2.268	400	480	189	7%		9HF-BTE00-0150
2	25.660	140	120	62	2.16	3.024	400	480	189	7%		9HF-BTE00-0200
2.5	20.530	140	120	65	2.69	3.766	400	480	189	7%		9HF-BTE00-0250
5	10.260	180	180	60	5.39	7.546	400	480	189	7%		9HF-BTE00-0500
6.25	8.210	180	180	60	6.74	9.436	400	480	189	7%		9HF-BTE00-0625
7.5	6.840	180	180	60	8.08	11.312	400	480	189	7%		9HF-BTE00-0750
10	5.130	180	180	70	10.78	15.092	400	480	189	7%		9HF-BTE00-1000
12.5	4.100	180	180	80	13.47	18.858	400	480	189	7%		9HF-BTE00-1250
15	3.410	200	200	80	16.16	22.624	400	480	189	7%		9HF-BTE00-1500
20	2.560	200	200	90	21.56	30.184	400	480	189	7%		9HF-BTE00-2000
25	2.050	230	230	90	26.95	37.73	400	480	189	7%		9HF-BTE00-2500
30	1.700	230	230	95	32.34	45.276	400	480	189	7%		9HF-BTE00-3000
40	1.270	300	250	200	43.09	60.326	400	480	189	7%		9HF-BTE00-4000
50	1.020	330	250	220	53.83	75.362	400	480	189	7%		9HF-BTE00-5000
65	0.790	350	260	240	70.19	98.266	400	480	189	7%		9HF-BTE00-6500
75	0.680	350	260	240	80.75	113.05	400	480	189	7%		9HF-BTE00-7500
80	0.630	380	300	250	86.17	120.638	400	480	189	7%		9HF-BTE00-8000
100	0.510	400	350	270	107.92	151.088	400	480	189	7%		9HF-BTE00-1100
Three-phase 189Hz Uk=525V												
1	61.390	140	120	50	0.9	1.26	400	525	189	7%		9HF-BTF00-0100
1.5	40.940	140	120	60	1.35	1.89	400	525	189	7%		9HF-BTF00-0150
2	30.700	140	120	62	1.8	2.52	400	525	189	7%		9HF-BTF00-0200
2.5	24.56	140	120	65	2.25	3.15	400	525	189	7%		9HF-BTF00-0250
5	12.270	180	180	60	4.5	6.3	400	525	189	7%		9HF-BTF00-0500
6.25	9.820	180	180	60	5.63	7.882	400	525	189	7%		9HF-BTF00-0625
7.5	8.180	180	180	60	6.76	9.464	400	525	189	7%		9HF-BTF00-0750
10	6.130	180	180	70	9.01	12.614	400	525	189	7%		9HF-BTF00-1000
12.5	4.900	180	180	80	11.26	15.764	400	525	189	7%		9HF-BTF00-1250
15	4.090	200	200	80	13.51	18.914	400	525	189	7%		9HF-BTF00-1500
20	3.070	200	200	90	18.03	25.242	400	525	189	7%		9HF-BTF00-2000
25	2.450	230	230	90	22.51	31.514	400	525	189	7%		9HF-BTF00-2500
30	2.040	230	230	95	27.01	37.814	400	525	189	7%		9HF-BTF00-3000
40	1.530	300	250	200	36.03	50.442	400	525	189	7%		9HF-BTF00-4000
50	1.220	330	250	220	45.11	63.154	400	525	189	7%		9HF-BTF00-5000
65	0.940	350	260	240	58.61	82.054	400	525	189	7%		9HF-BTF00-6500
75	0.810	350	260	240	67.53	94.542	400	525	189	7%		9HF-BTF00-7500
80	0.760	380	300	250	71.94	100.716	400	525	189	7%		9HF-BTF00-8000
100	0.610	400	350	270	89.86	125.804	400	525	189	7%		9HF-BTF00-1100

Note: Federal Electric Corp produces special Harmonic Filter by different Resonance Frequency such 134 Hz ve 210 Hz.

SHUNT REACTORS



Characteristics of the energy which receives from network are begin change now a days. A short time ago reactive power which has inductive characteristic 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 mandatory of these reactor which receives inductive charge from the network has occurred. Another mandatory of using these reactors is the aim of the destruction of capacitor effect of long transmission lines. Iron and copper losses will occur in Harmonic Filters and Reactors so it is very important to take out the heat which consists 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, airgap
- 4-) Heat protection with thermo contact
- 5-) Copper or aluminum winding
- 6-) CE Certificate
- 7-) Protection degree IP 00
- 8-) F class isolation

	Power (kVar)	Inductance (mH)	Width (mm)	Height (mm)	Depth (mm)	Order Code
Mono-phase						
	0.1	0.43	85	90	80	9SR-BM000-0010
	0.25	1.09	85	90	100	9SR-BM000-0025
	0.5	2.17	110	120	110	9SR-BM000-0050
	0.75	3.26	120	120	125	9SR-BM000-0075
	1	4.35	150	150	125	9SR-BM000-0100
	1.5	6.52	150	150	145	9SR-BM000-0150
	2	8.70	150	150	160	9SR-BM000-0200
	2.5	10.87	170	170	160	9SR-BM000-0250
	3	13.04	170	170	170	9SR-BM000-0300
	4	17.39	200	200	180	9SR-BM000-0400
	5	21.74	200	200	200	9SR-BM000-0500
	7.5	32.61	250	250	210	9SR-BM000-0750
	10	43.48	250	250	230	9SR-BM000-1000
Stage						
	0.25-0.5-0.75	1.08-3.26	120	120	100	9SR-BK000-0075
	0.25-0.5-0.75-1	1.08-4.34	150	130	100	9SR-BK000-0100
	0.5-1-1.5	2.17-6.52	150	145	100	9SR-BK000-0150
Three-phase						
	0.5	0.72	150	150	80	9SR-BT000-0050
	1	1.45	180	180	90	9SR-BT000-0100
	1.5	2.17	180	180	100	9SR-BT000-0150
	2	2.90	230	240	120	9SR-BT000-0200
	2.5	3.62	250	250	110	9SR-BT000-0250
	3	4.35	250	250	100	9SR-BT000-0300
	4	5.80	300	260	135	9SR-BT000-0400
	5	7.25	300	260	145	9SR-BT000-0500
	7.5	10.87	330	350	180	9SR-BT000-0750
	10	14.49	360	360	150	9SR-BT000-1000
	12.5	18.12	360	360	160	9SR-BT000-1250
	15	21.74	430	410	160	9SR-BT000-1500
	20	28.99	500	480	180	9SR-BT000-2000
	25	36.23	500	500	260	9SR-BT000-2500
	30	43.48	550	500	270	9SR-BT000-3000
	40	57.97	630	500	260	9SR-BT000-4000
	50	72.46	630	600	260	9SR-BT000-5000




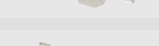
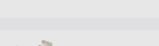




NH (H.R.C.) FUSES



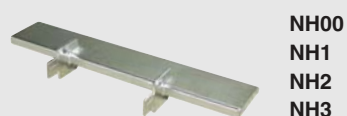
NH (H.R.C) Fuses

	NHC00-FB 6A...100A
	NHC2-FB 50A...250A
 	NH00-FB 6A...160A
	NH0-FB 25A...160A
 	NH1-FB 50A...250A
 	NH2-FB 80A...400A
 	NH3-FB 250A...630A

NH Fuse Base

	BMC NH00-FA		STEATIT NH00-FA
	BMC NH0-FA		
	BMC NH1-FA		STEATIT NH1-FA
	BMC NH2-FA		STEATIT NH2-FA
	BMC NH3-FA		STEATIT NH3-FA

Solid Link



CONTENTS

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NH Fuse Base	6
Order Codes	6
Technical Drawings	6

IEC / EN 60269-1
CE

Mounting Position	: Free
Altitude	: 2000 m (max)
Relative Humidity	: %50 (40°C) , %90 (20°C)
Ambient Temperature	: between -5°C and +40°C

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

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. 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 and 440V DC and rated currents up to 630A 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.

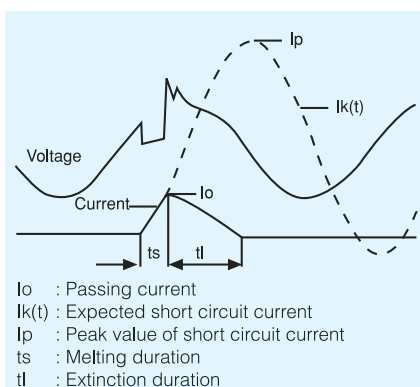
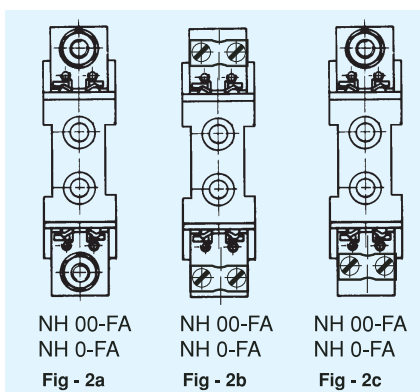


Fig - 1 Current and Voltage Changes Graphic at Breaking of Leakage Current by Fuse.

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 In. 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).

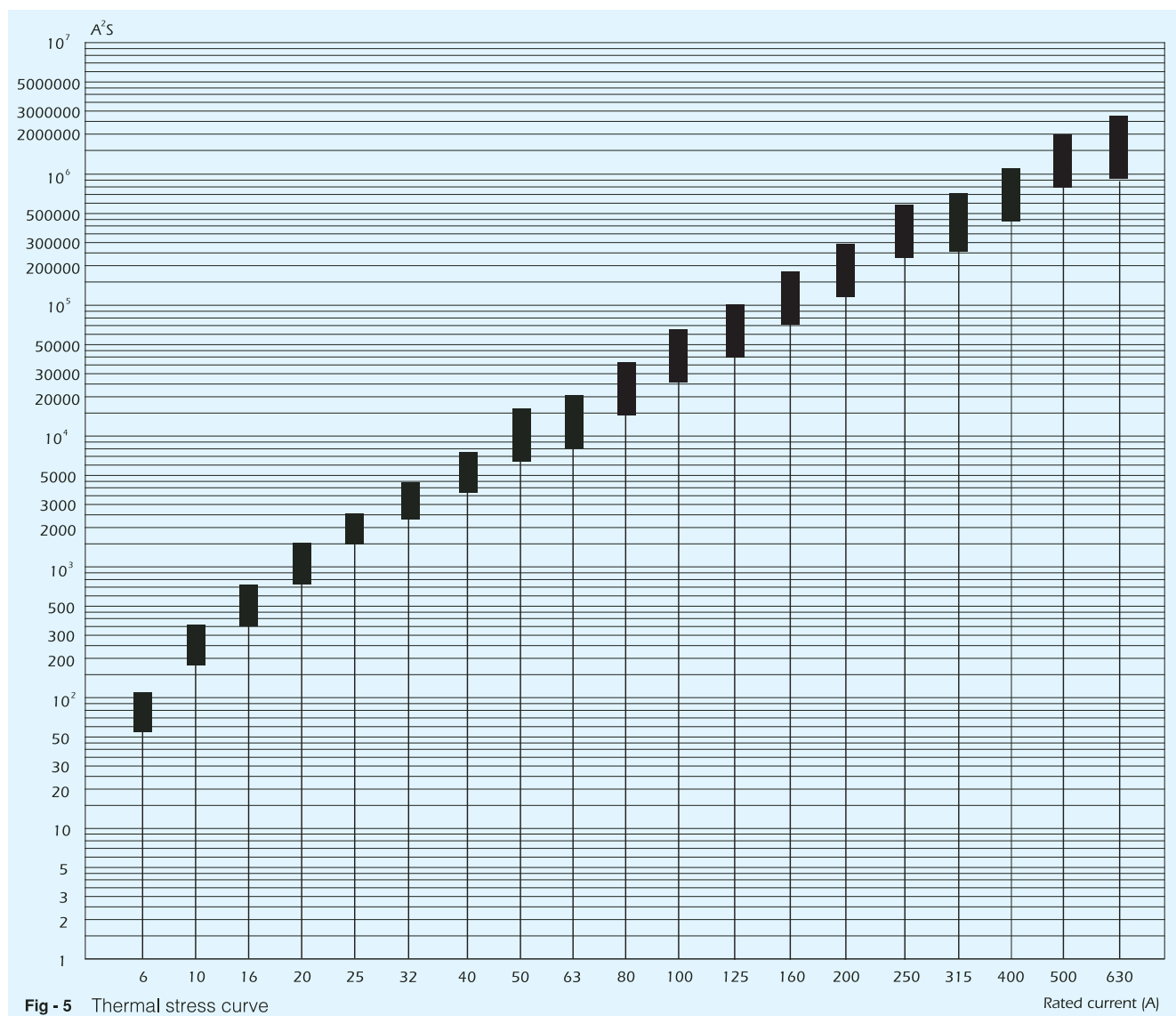
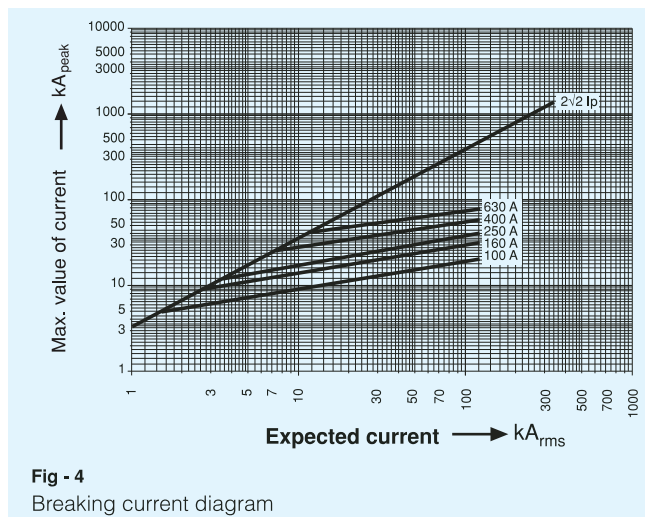
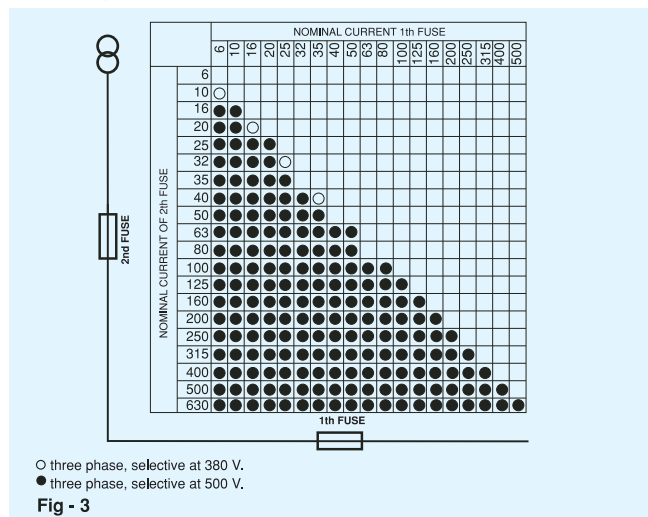
Steatit: It is used as NH fuse insulator in low voltage. It is a material resistant to high temperature. Steatit is a derivative of porcelain. With reflected of developing technology in quality of materials utilized in electrical industry, whereas normal porcelain materials are used in MV and LV bearers 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

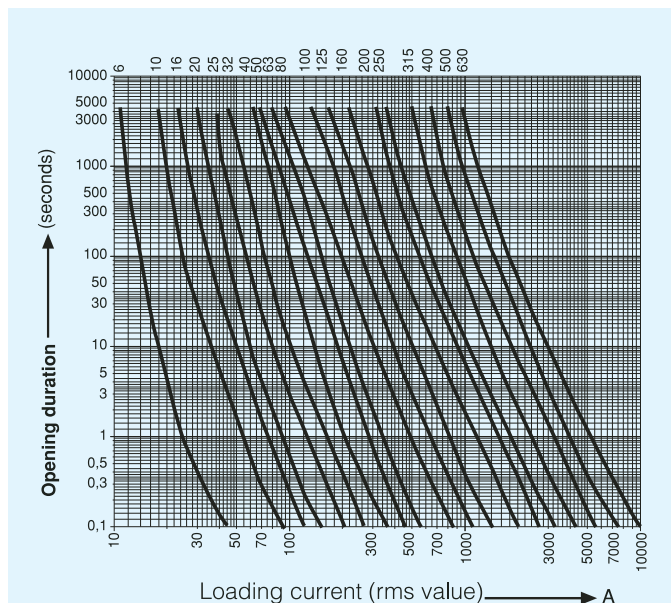


Fig-6:
Current-time characteristic of NH fuses "gL/gG"

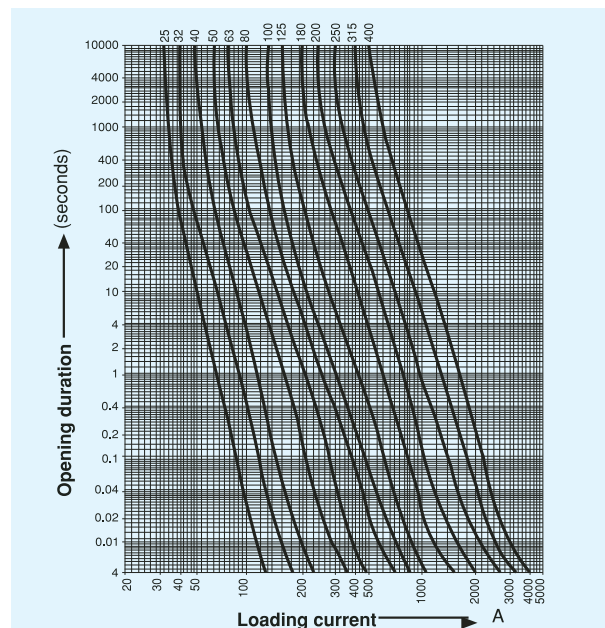


Fig-7:
Current-time characteristic of super flink NH fuses "gR"

Super Flink NH Fuse:









These are fuses 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.

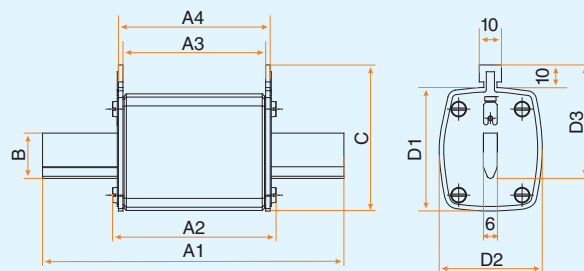
Operating characteristic : Super flink (fast)
Rated voltage : AC 500 V
Operating class : gR
Breaking capacity : 120 kA (rms)

Order Codes of Super Flink Fuses:

Type	Size	Rated current	I ² T Total	I ² 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


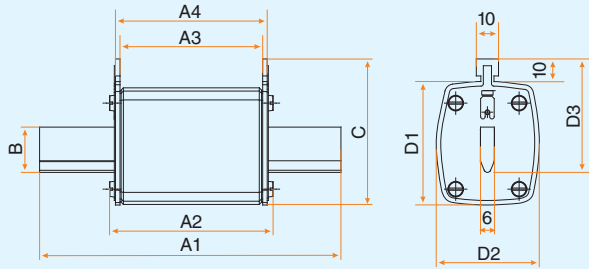







NH (H.R.C.) FUSES

	Order code	Size	Rated Current (A)	Pcs Box	kg. Box
 NH00-FB	9CB-BG000-0□□□ □: Please enter amper value	00	6 - 160	10	1.760
 NHC00-FB	9CA-BG000-0□□□ □: Please enter amper value	000	6 - 160	10	1.305
 NH0-FB	9CC-BG000-0□□□ □: Please enter amper value	0	25 - 160	5	1.225
 NH1-FB	9CD-BG000-0□□□ □: Please enter amper value	1	50 - 250	3	1.300
 NHC1-FB	9CI-BG000-0□□□ □: Please enter amper value	1/0	25 - 160	3	2.000
 NH2-FB	9CE-BG000-0□□□ □: Please enter amper value	2	80-400	3	2.005
 NHC2-FB	9CH-BG000-0□□□ □: Please enter amper value	2/1	40-250	3	1.440
 NH3-FB	9CF-BG000-0□□□ □: Please enter amper value	3	250-630	1	0.980



Type	Dimensions (mm)								
	A1	A2	A3	A4	B	C	D1	D2	D3
NH00-FB	78,5	54	45	49	15	58	48	29,5	44,5
NHC00-FB	78,5	54	45	49	15	47	36	21	44,5
NH0-FB	125	71	62	66	15	58	48	29,5	44,5
NH1-FB	135	71	62	68	20	64	54	45	51
NHC1-FB	135	71	62	68	15	64	48	29,5	51
NH2-FB	150	73,5	62	68	25	70	60	57	58
NHC2-FB	150	73,5	62	68	20	72,2	54	45	58
NH3-FB	150	73,5	62	68	32	85,5	75	69	70

NH (H.R.C.) FUSES

Dual Indicator	Order code	Size	Rated Current (A)	Pcs Box	kg. Box	
 NH00-FB	9CB-BG010-0□□□ □: Please enter amper value	00	6-160	10	1.760	
 NHC00-FB	9CA-BG010-0□□□ □: Please enter amper value	000	6-100	10	1.305	
 NH0-FB	9CC-BG010-0□□□ □: Please enter amper value	0	25-160	5	1.225	
 NH1-FB	9CD-BG010-0□□□ □: Please enter amper value	1	50-250	3	1.300	
 NHC1-FB	9CI-BG010-0□□□ □: Please enter amper value	1/0	25-160	3	2.000	
 NH2-FB	9CE-BG010-0□□□ □: Please enter amper value	2	80-400	3	2.005	
 NHC2-FB	9CH-BG010-0□□□ □: Please enter amper value	2/1	40-250	3	1.440	
 NH3-FB	9CF-BG010-0□□□ □: Please enter amper value	3	250-400	1	0.980	

Type	Dimensions (mm)								
	A1	A2	A3	A4	B	C	D1	D2	D3
NH00-FB	78,5	54	45	49	15	58	48	29,5	44,5
NHC00-FB	78,5	54	45	49	15	47	36	21	44,5
NH0-FB	125	71	62	66	15	58	48	29,5	44,5
NH1-FB	135	71	62	68	20	64	54	45	51
NHC1-FB	135	71	62	68	15	64	48	29,5	51
NH2-FB	150	73,5	62	68	25	70	60	57	58
NHC2-FB	150	73,5	62	68	20	72,2	54	45	58
NH3-FB	150	73,5	62	68	32	85,5	75	69	70

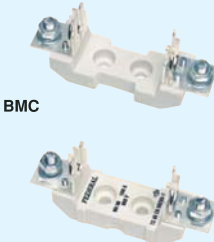
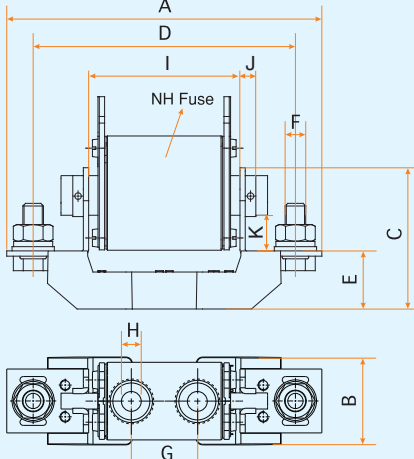

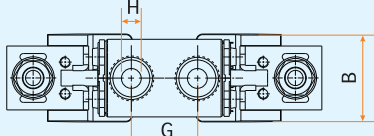

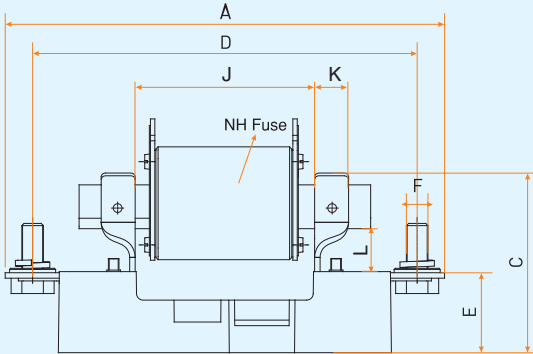
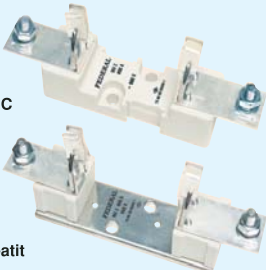
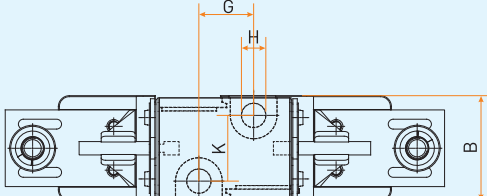
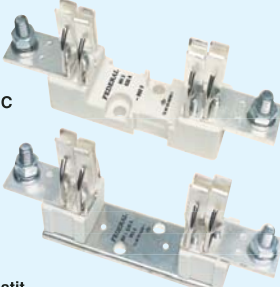
Temperature effect on NH fuses:

Thermal overload protection characteristics of NH fuses change by temperature. Fuses are manufactured according to ambient temperature of 20°C .When it works in an ambient having higher temperature it operates in shorter time than its nominal value.And if it works in an ambient having colder temperature it operates in longer time than its nominal value.. Coefficient factors for different ambient temperatures are given in below table.


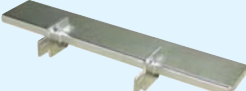

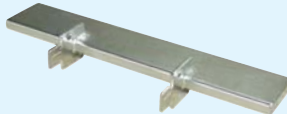
Trademark / Product	k / C	In (A)	Calibration temperature (°C)	Coefficient factor (k)							
				10 °C	20 °C	30 °C	40 °C	50 °C	55 °C	60 °C	70 °C
FEDERAL NH	0.00280	1	20	1,03	1,00	0,97	0,94	0,92	0,90	0,89	0,86

Example: Rated current of 100 A NH fuse at 50°C is found as $100 \times 0.92 = 92$ A according to table.

NH (H.R.C.) FUSES

 <p>BMC</p> <p>Steatit</p>	<p>NH00FA</p> <p>Order code 9CB-C0□00-0000 (BMC) 9CB-A0□00-0000 (Steatit) □ C- with screw □ K- with clemens □ X-with screw and clemens Size : 00 Rated current : 160 A Quantity / box : 5 Kg. / box : 0.795 (BMC) 1.060 (Steatit)</p>	 <table><tr><th>Type</th><th colspan="11">Dimension (mm)</th></tr><tr><th></th><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	Dimension (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	Dimension (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																																																								
 <p>BMC</p>	<p>NH0FA</p> <p>Order code 9CC-C0□00-0000 (BMC) □ C- with screw □ K- with clemens □ X-with screw and clemens Size : 0 Rated current : 160 A Quantity / box : 5 Kg. / box : 1.020</p>																																																																		
 <p>BMC</p> <p>Steatit</p>	<p>NH1FA</p> <p>Order code 9CD-C0C00-0000 (BMC) 9CD-A0C00-0000 (Steatit) Size : 1 Rated current : 250 A Quantity / box : 3 Kg. / box : 1.375 (BMC) 1.845 (Steatit)</p>																																																																		
 <p>BMC</p> <p>Steatit</p>	<p>NH2FA</p> <p>Order code 9CE-C0C00-0000 (BMC) 9CE-A0C00-0000 (Steatit) Size : 2 Rated current : 400 A Quantity / box : 3 Kg. / box : 1.740 (BMC) 1.950 (Steatit)</p>																																																																		
 <p>BMC</p> <p>Steatit</p>	<p>NH3FA</p> <p>Order code 9CF-C0C00-0000 (BMC) 9CF-A0C00-0000 (Steatit) Size : 3 Rated current : 630 A Quantity / box : 3 Kg. / box : 2.280 (BMC) 2.750 (Steatit)</p>	<table><tr><th>Type</th><th colspan="12">Dimension (mm)</th></tr><tr><th></th><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>30</td><td>80</td><td>15</td><td>20,5</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>30</td><td>83,5</td><td>15</td><td>20</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>30</td><td>81,5</td><td>15</td><td>19</td></tr></table>	Type	Dimension (mm)													A	B	C	D	E	F	G	H	I	J	K	L	Nh1	200	47,5	82	175	35	M10	25	10,5	30	80	15	20,5	Nh2	225	47,5	88	200	35	M10	25	10,5	30	83,5	15	20	Nh3	240	47,5	99	210	37	M12	25	10,5	30	81,5	15	19
Type	Dimension (mm)																																																																		
	A	B	C	D	E	F	G	H	I	J	K	L																																																							
Nh1	200	47,5	82	175	35	M10	25	10,5	30	80	15	20,5																																																							
Nh2	225	47,5	88	200	35	M10	25	10,5	30	83,5	15	20																																																							
Nh3	240	47,5	99	210	37	M12	25	10,5	30	81,5	15	19																																																							

SOLID LINK

				
Type	NH00	NH1	NH2	NH3
Order Code	9SL-C0000-0000	9SL-C0000-0001	9SL-C0000-0002	9SL-C0000-0003

Not: Solid Link, NH sigortaları buşonsuz olarak direkt köprüleme için kullanılır. İzolesiz tiptir.

CYLINDRICAL FUSES and BASES



Cylindrical Fuses



FCF08-32

2A ... 20A



FCF10-38

2A ... 25A



FCF14-51

2A ... 50A



FCF22-58

10A ... 100A

Cylindrical Fuses Bases



CONTENTS

Features	1
Technical Specifications	1

CYLINDRICAL FUSES and BASES

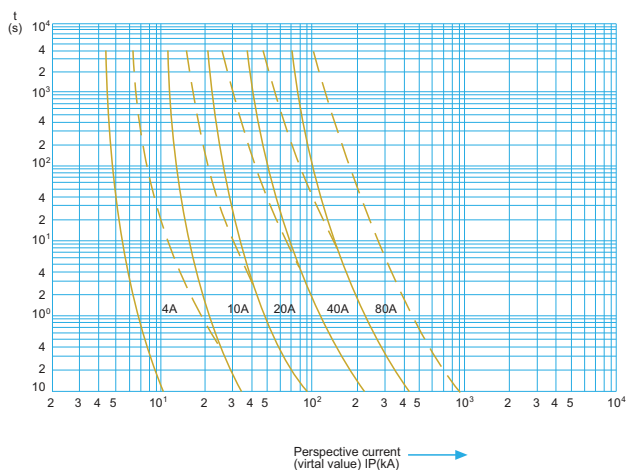
Cylindrical fuse link with cylindrical contact caps is designed for protecting electrical distributing in rated current up to 125A. Against damage due to overload and short circuit. Fuse link with the striker is supplied for the purpose of protecting against motor single phasing operation when fitted 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
FCF08-32	8x32	400	2	9CF-0832-0002
FCF08-32	8x32	400	4	9CF-0832-0004
FCF08-32	8x32	400	6	9CF-0832-0006
FCF08-32	8x32	400	10	9CF-0832-0010
FCF08-32	8x32	400	16	9CF-0832-0016
FCF08-32	8x32	400	20	9CF-0832-0020
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

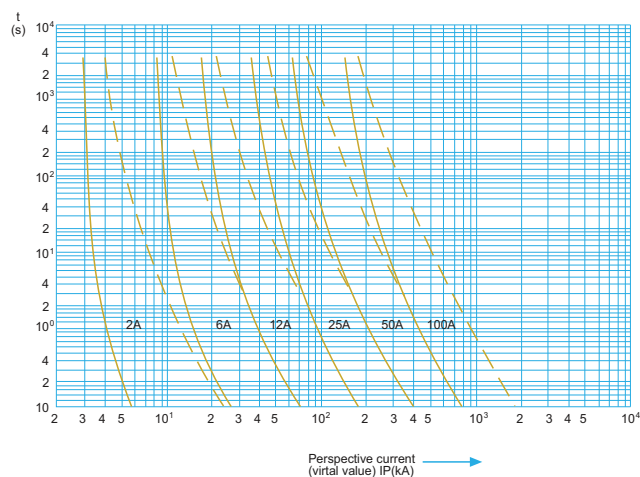
Cylindrical Fuses Bases

Type	Dimensions mmxmm	Number of Pole	Rated Current I_n (A)	Order Code
FCFB08-32	8x32	1	20	9CF-0832-A001
FCFB08-32	8x32	1+N	20	9CF-0832-A010
FCFB08-32	8x32	3	20	9CF-0832-A003
FCFB10-38	10x38	1	25	9CF-1038-A001
FCFB10-38	10x38	1+N	25	9CF-1038-A010
FCFB10-38	10x38	3	25	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

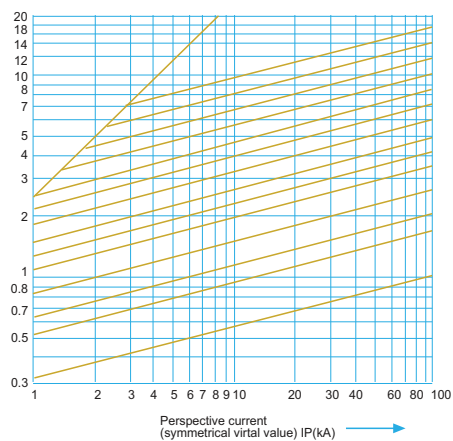
CYLINDRICAL FUSES and BASES



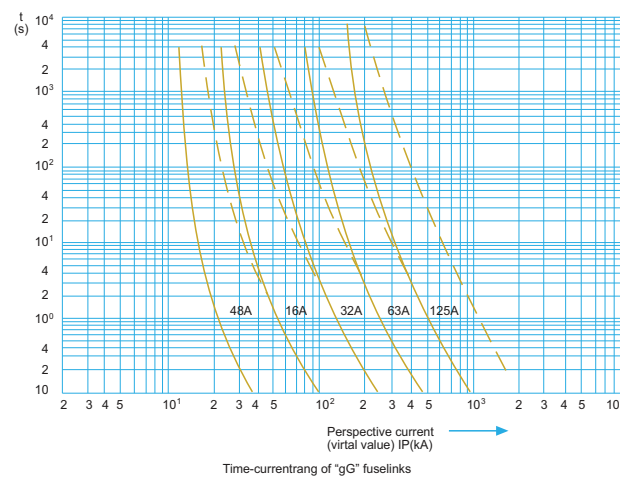
Time-currentrang of "gG" fuselinks



Time-currentrang of "gG" fuselinks



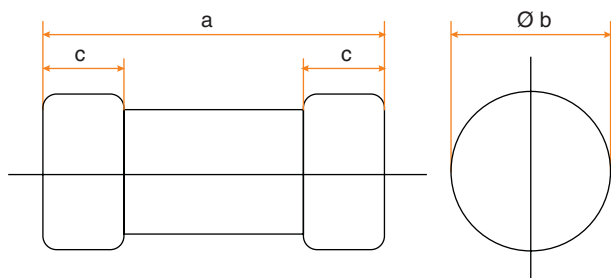
Breaking current characteristics curve of "gG" fuselinks



Time-currentrang of "gG" fuselinks

CYLINDRICAL FUSES and BASES

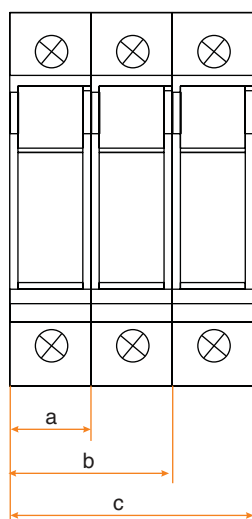
Cylindrical Fuses



Dimensions

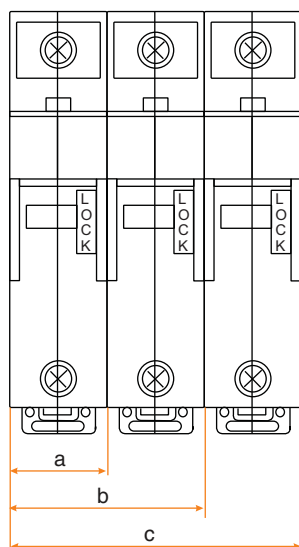
Type	FCF08	FCF10	FCF14	FCF22
a (mm)	31,5	38	51	58
b (Ø)	8,5	10,3	14,3	22,2
c (mm)	6,3	10	12	14

Cylindrical Fuses Bases



Dimensions

Type	a	b	c	d	e
FCFB 8-32					
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	100,5	111,5
FCFB 22-58	34,7	69,4	104,1	104	127

FUSE SWITCH DISCONNECTOR



Vertical Type Fuse Switch Disconnecter

FVS160

NH00 / 160A



FVS250

NH1 / 250A



FVS400

NH2 / 400A



FVS630

NH3 / 630A



VERTICAL TYPE FUSE BASES;



FUSE SWITCH DISCONNECTOR:



CONTENTS

Features	1
Accessories	2
Technical Drawings	3
Technical Table	9
Vertical Type Fuse Bases	10
Fuse Switch Disconnecter	11

IEC / EN 60947-3
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
Use Class	: AC22-B
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.

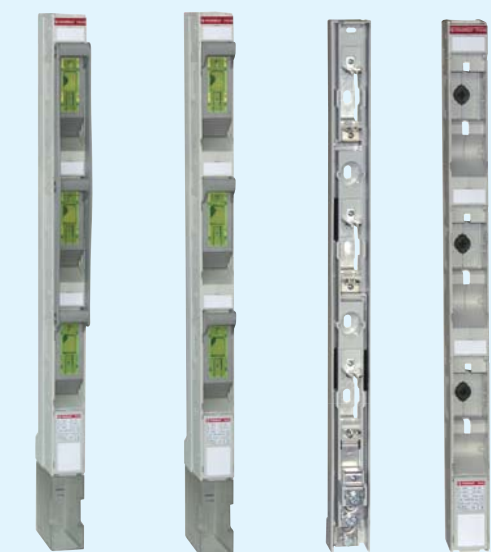
- A single personnel can mount it by using insulated equipments on the front of the panel under voltage.

- 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.

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

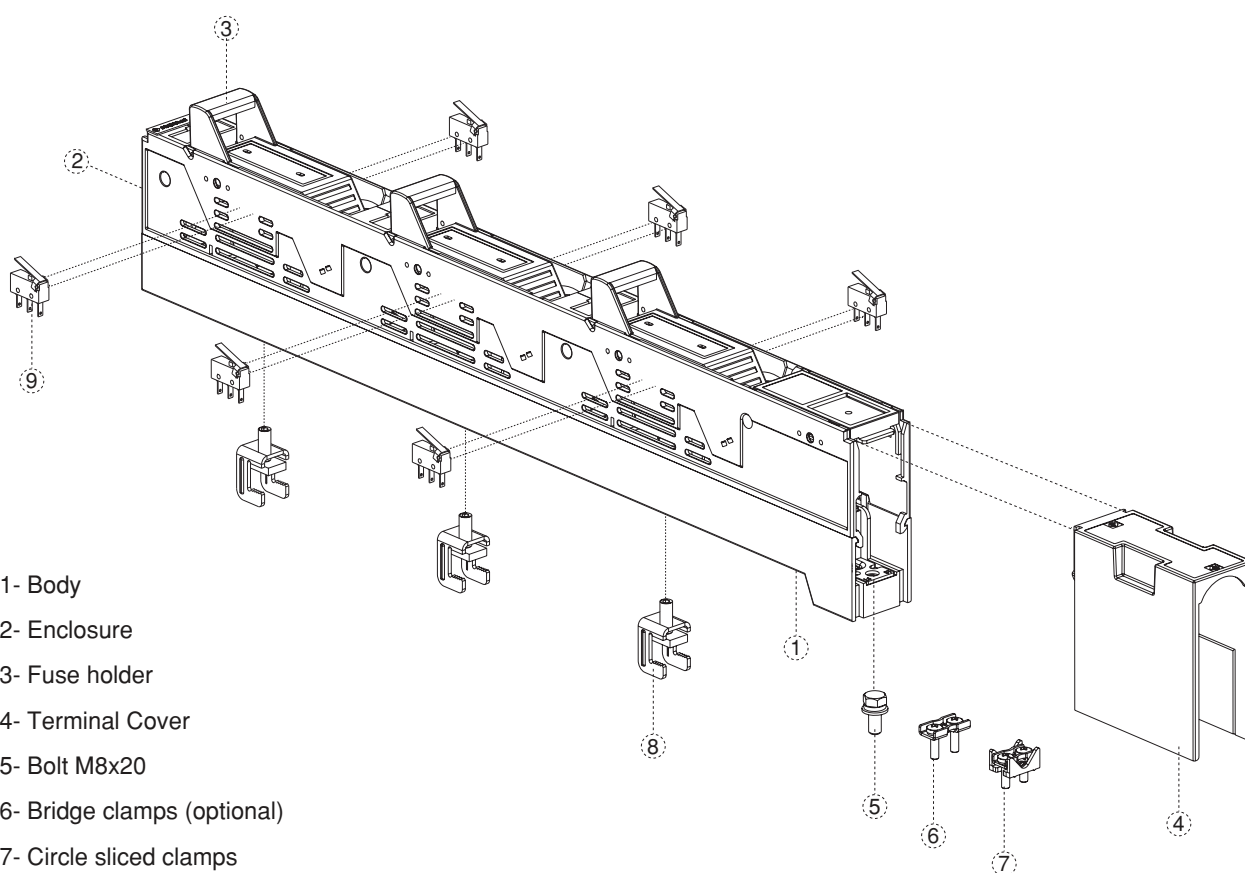


Fuse holder



Terminal cover

VERTICAL TYPE FUSE SWITCH DISCONNECTOR



- 1- Body
- 2- Enclosure
- 3- Fuse holder
- 4- Terminal Cover
- 5- Bolt M8x20
- 6- Bridge clamps (optional)
- 7- Circle sliced clamps
- 8- Hook clamps (optional)
- 9- Micro switch (optional)

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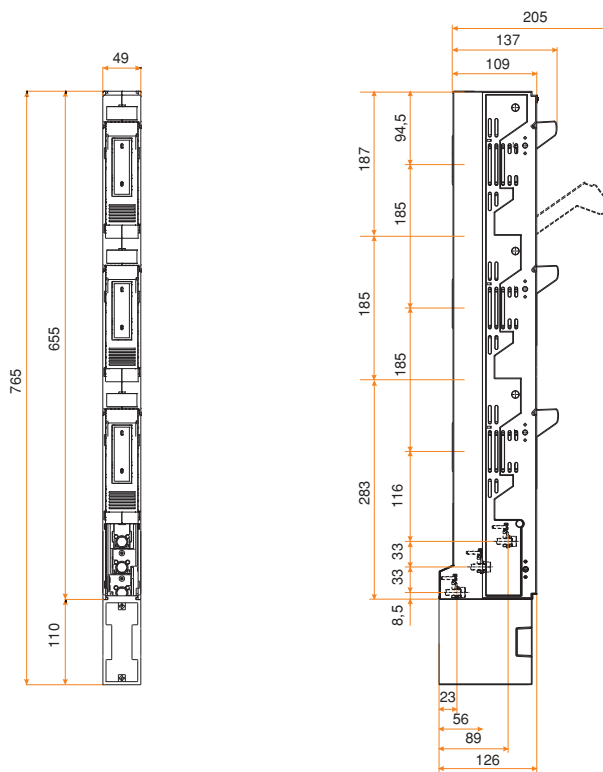
Accessories	Description	Type	Quantity (Pcs)	Order Code
Terminal cover	It is used to prevent touching thru connection terminals.	FVS160 / 00	1	8BE-I0000-0000
		FVS250 / 1		
		FVS400 / 2	1	8BE-J0000-0000
		FVS630 / 3		
Bridge clamps	Used to connect wires with cross section between 4 to 70 mm ² by two M5 bolts	FVS160 / 00	3	8BE-A0000-0000
Circle sliced clamps	Used to fixedwire of sector shoped condutor with bore and cross-section 1,5 - 70 mm ² 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.

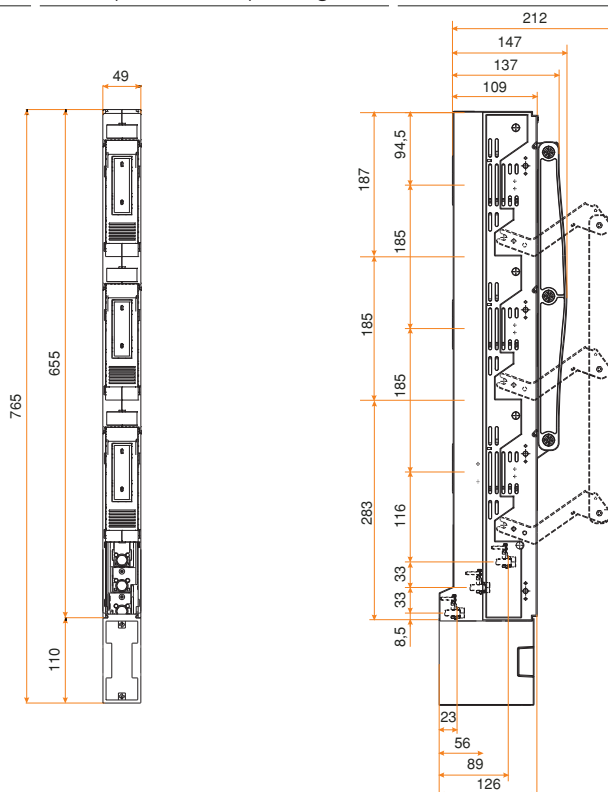
Type	Rated Current (A)	Product Structure	NH Fuse Type / Size	Order Code
FVS160	160A	Three phase can open individual.	NH-00 / 00	9BE-E1213-0160



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	NH-00 / 00	9BE-E1233-0160

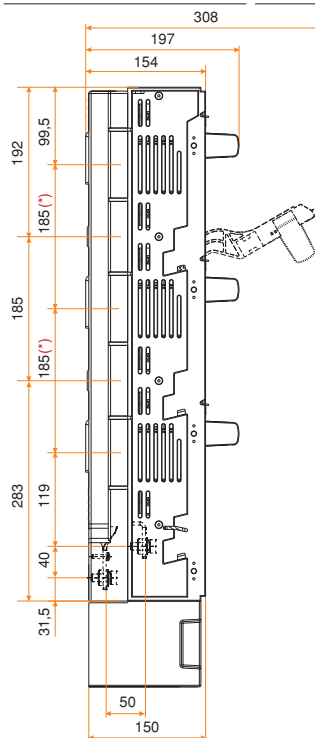
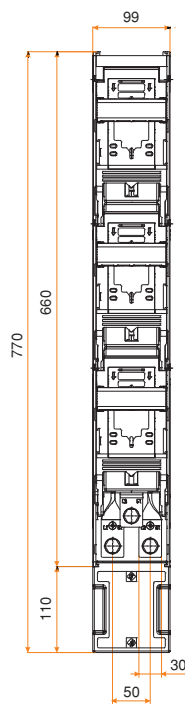


VERTICAL TYPE FUSE SWITCH DISCONNECTOR

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.	NH-1 / 1	9BE-E1213-0250
FVS400	400		NH-2 / 2	9BE-E1213-0400
FVS630	630		NH-3 / 3	9BE-E1213-0630



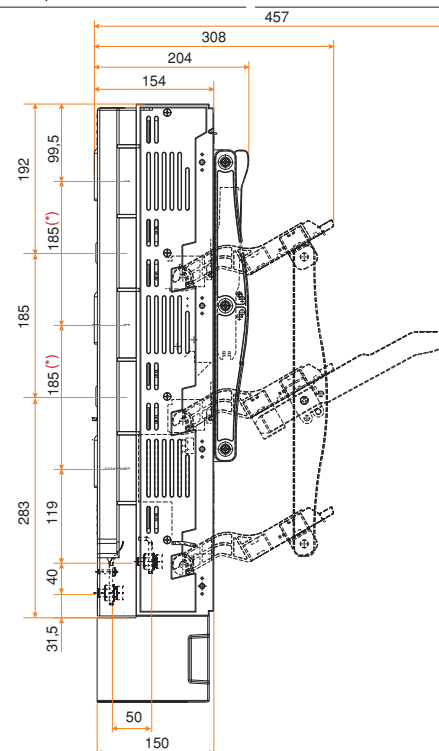
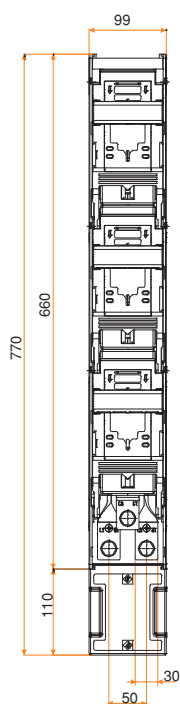
(*) 210mm distance for connection is also available

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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	NH-1 / 1	9BE-E1233-0250
FVS400	400		NH-2 / 2	9BE-E1233-0400
FVS630	630		NH-3 / 3	9BE-E1233-0630



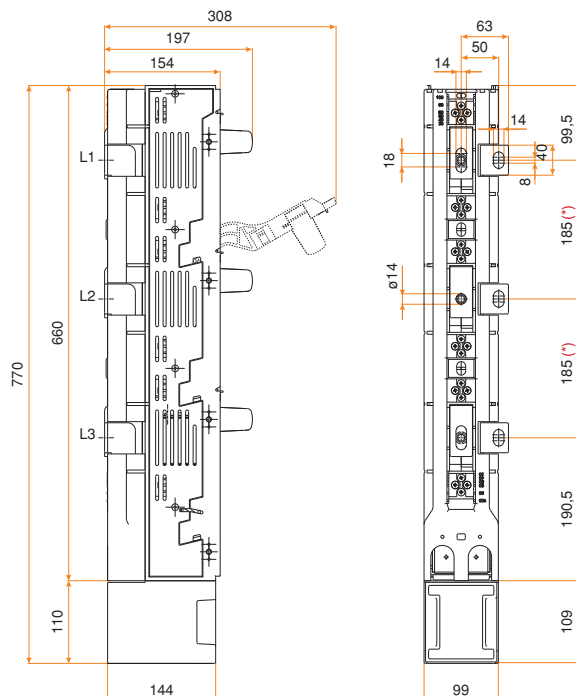
(*) 210mm distance for connection is also available

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	NH-1 / 1	9BE-E4213-0250
FVS400-LS	400		NH-2 / 2	9BE-E4213-0400
FVS630-LS	630		NH-3 / 3	9BE-E4213-0630

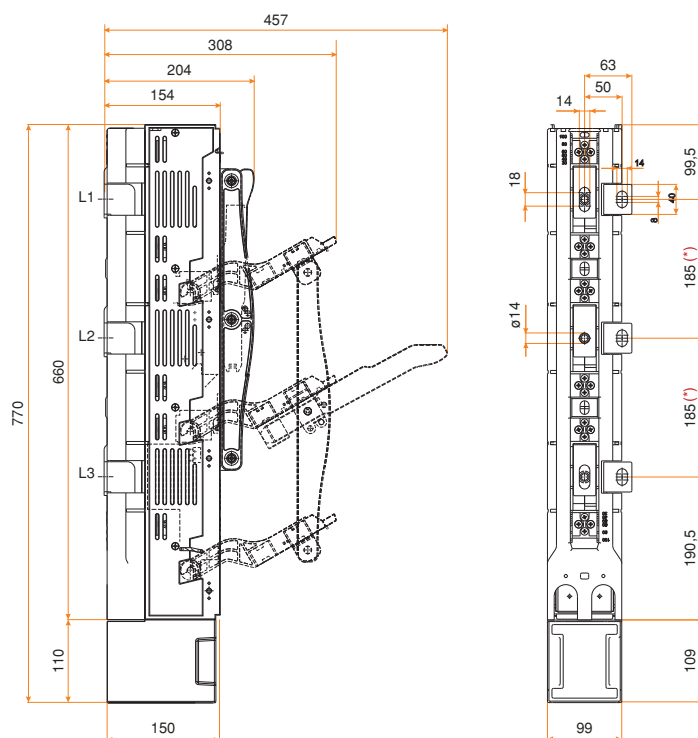


(*) 210mm distance for connection is also available

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	NH-1 / 1	9BE-E4233-0250
FVS400-LS	400		NH-2 / 2	9BE-E4233-0400
FVS630-LS	630		NH-3 / 3	9BE-E4233-0630



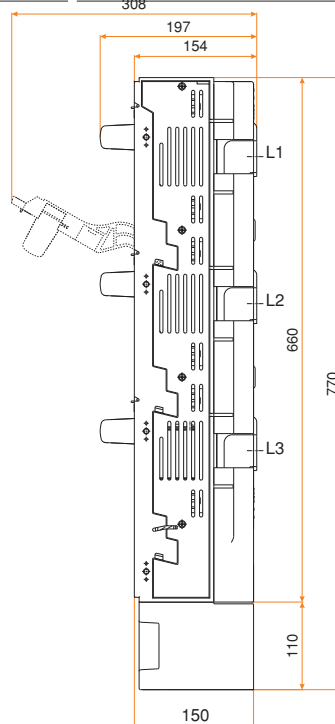
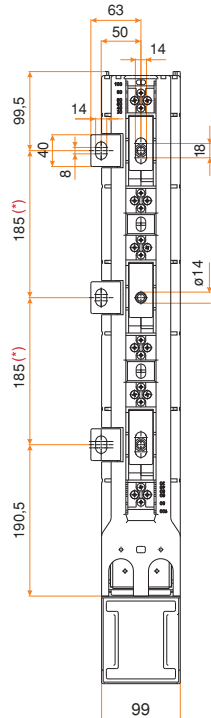
(*) 210mm distance for connection is also available

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	NH-1 / 1	9BE-E3213-0250
FVS400-RS	400		NH-2 / 2	9BE-E3213-0400
FVS630-RS	630		NH-3 / 3	9BE-E3213-0630



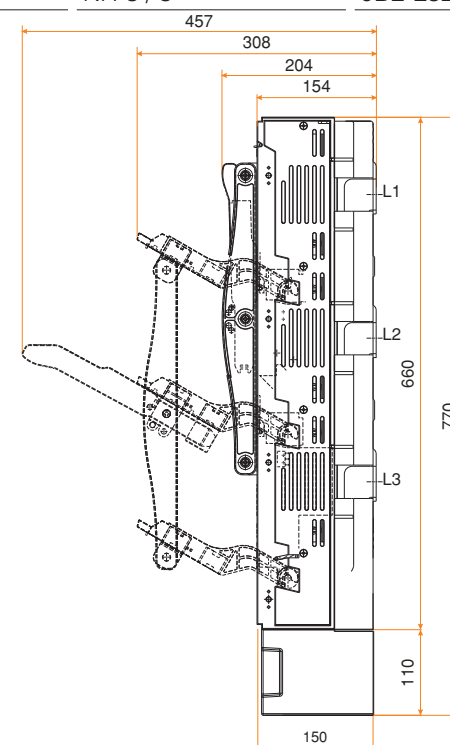
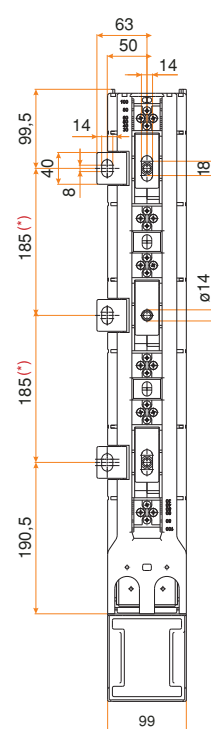
(*) 210mm distance for connection is also available

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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	NH-1 / 1	9BE-E3233-0250
FVS400-RS	400		NH-2 / 2	9BE-E3233-0400
FVS630-RS	630		NH-3 / 3	9BE-E3233-0630

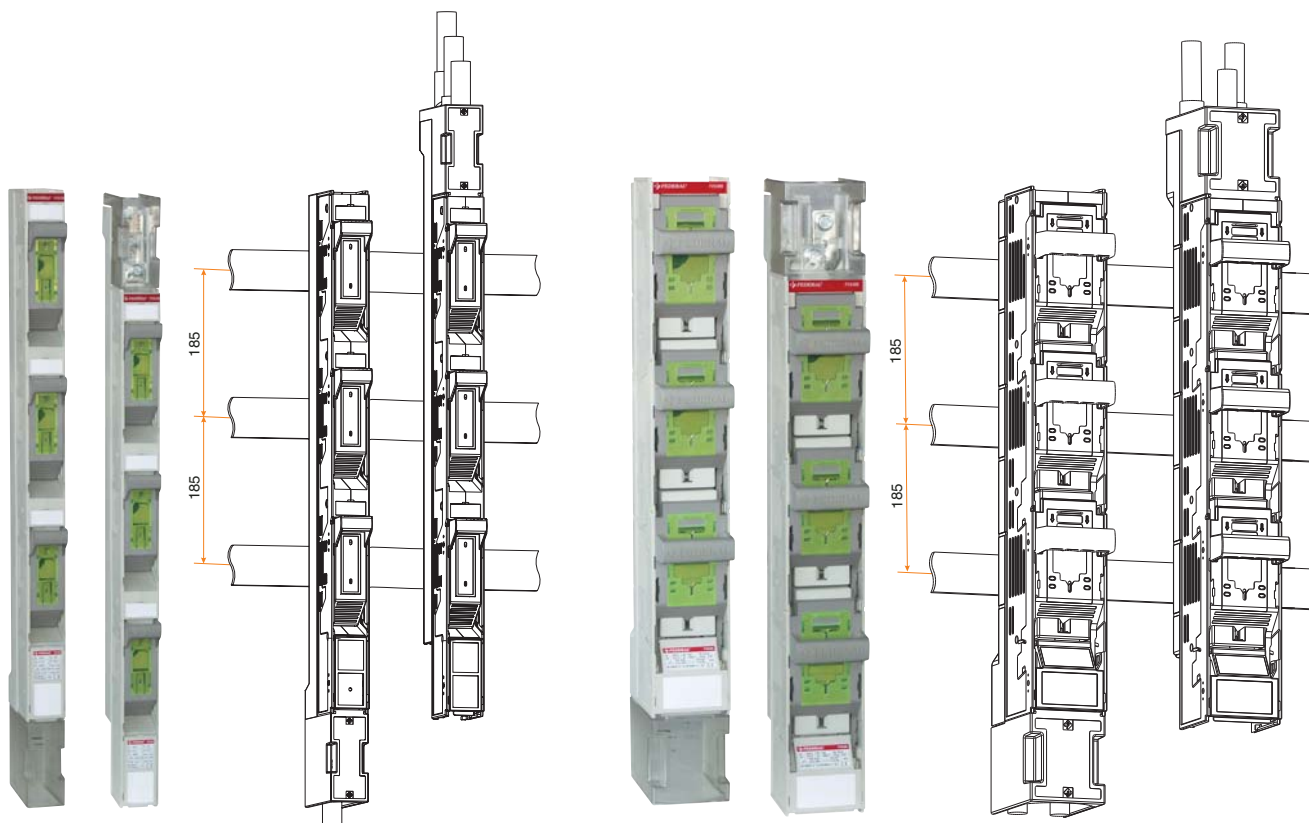


(*) 210mm distance for connection is also available

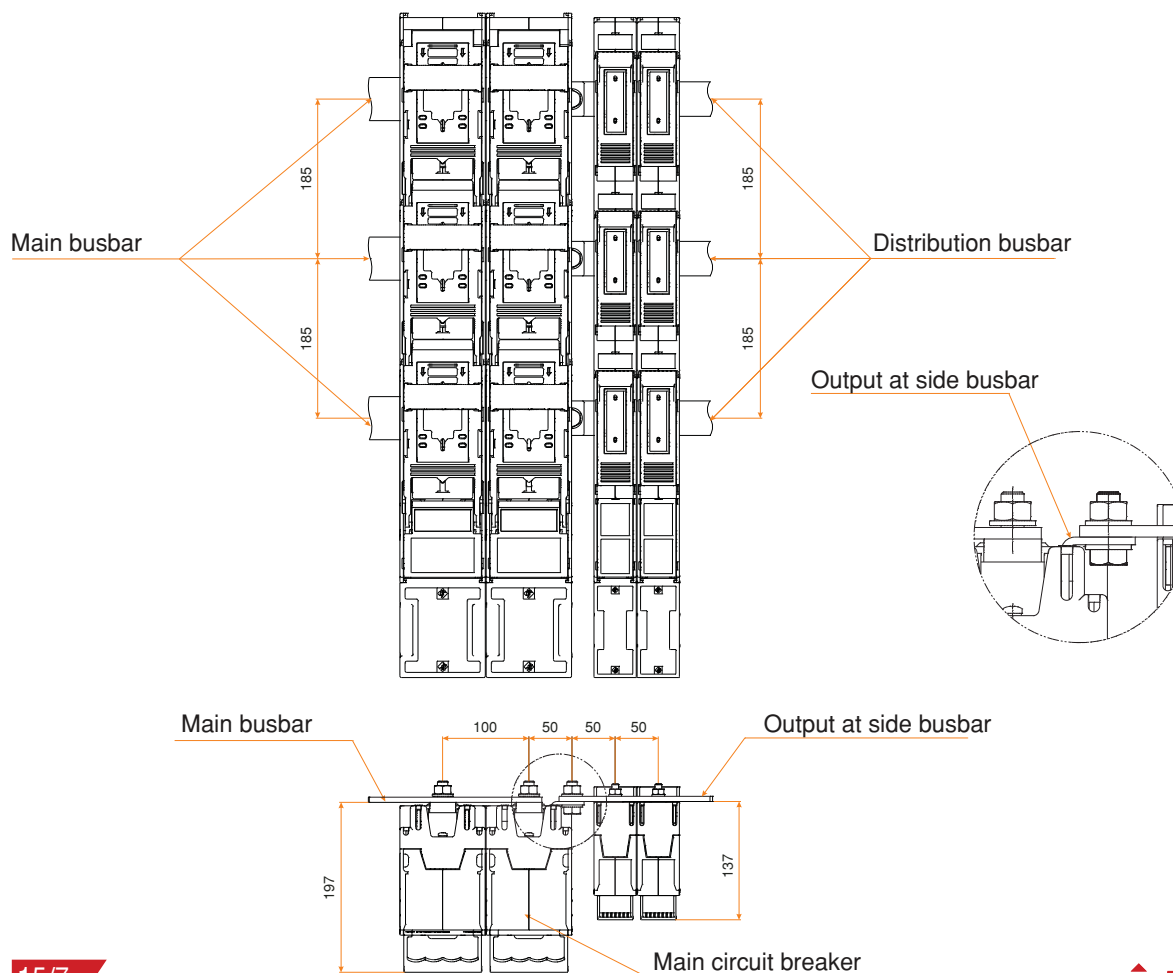
VERTICAL TYPE FUSE SWITCH DISCONNECTOR

Symmetrical Design

In case of cable input is from above, 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.

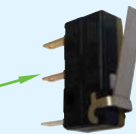
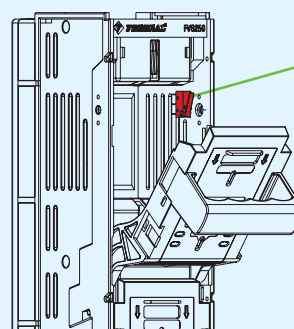
Measurement under the voltage is possible.

Through the holes on the fuse holders, there is the possibility to measure under the voltage is possible.

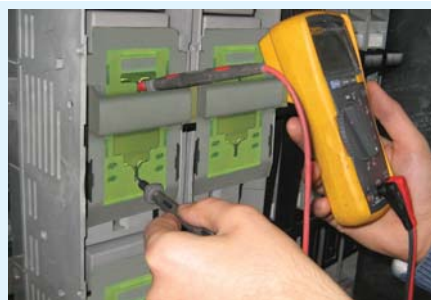
Sticker slot

Large sticker slot can be seen easily is placed on device when the device is mounted.

Micro Switch

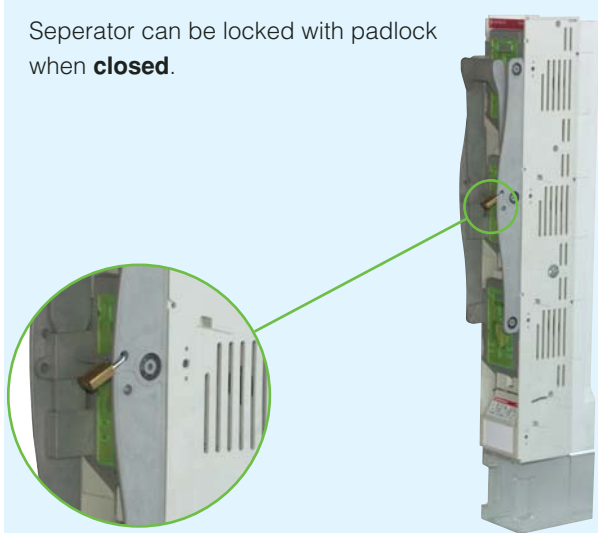


1 or 2 micro switch is available assembled to each phase is possible to control open and closed position of fuses holder.

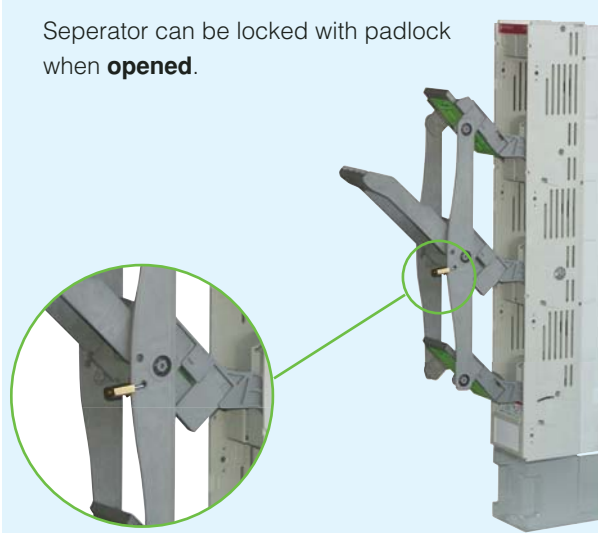


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Seperator can be locked with padlock when **closed**.



Seperator can be locked with padlock when **opened**.



VERTICAL TYPE FUSE SWITCH DISCONNECTOR



Technical Features:

Type		FVS160	FVS250	FVS400	FVS630
Conventional thermal current (Ith)	A	160	250	400	630
Number of poles		3	3	3	3
Insulation voltage (Ui)	V	1000	1000	1000	1000
Impulse withstand voltage (Uimp)	kV	8	8	8	8
Frequency	Hz	50- 60	50- 60	50- 60	50- 60
Operational voltage (Ue) (phase-phase)	V	415/500/690	415/500/690	415/500/690	415/500/690
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	85	85	85	70
Fuse type	NH	00	1	2	3
Mechanical durability	operation	> 30000	> 20000	> 20000	> 20000
Electrical durability	operation	200	200	200	200
Connection conductor cross-section	mm ²	70	120	240	2x185
Power loss per pole	W	9	11	19	36
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	185	185/210	185/210	185/210
Weight	kg	2,4	5,6	5,6	6,9

Circuit Type	Utilization Category		Typical Application
	A	B	
Alternative Current	AC-20A	AC-20B	- Connecting and disconnecting to un-loaded system - Switching of resistance and inductive loads combinations including medium overloads - Switching motor loads and other types of inductive loads.
	AC-21A	AC-21B	
	AC-22A	AC-22B	
	AC-23A	AC-23B	

VERTICAL TYPE FUSE SWITCH DISCONNECTOR

VERTICAL TYPE FUSE BASES;



Federal Electric Vertical Type Fuse Bases have been designed in a manner that they can be easily and fast assembled vertically to the horizontal bus bars in 185 mm distances. The body material has been produced from glass fiber 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 glass fiber and whose exterior is resistant to heat and fire.

Technical Features:

TYPE		FVS250	FVS400	FVS630
Conventional thermal current (I _{th})	A	250	400	630
Number of poles		3	3	3
Insulation voltage (U _i)	V	1000	1000	1000
Impulse withstand voltage (U _{imp})	kV	8	8	8
Frequency	Hz	50- 60	50- 60	50- 60
Rated voltage (U _n) (phase-phase)	V	415	415	415
Rated current (I _n)	A	250	400	630
Conditional short-circuit current (NH Fuse)	kA	70	70	70
Fuse type	NH	1	2	3
Connection conductor cross-section	mm ²	120	240	2x185
Power loss per pole	W	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	3,2	3,2	4,3
Order Codes		9BE-E0000-0250	9BE-E0000-0400	9BE-E0000-0630

FUSE SWITCH DISCONNECTOR

FUSE SWITCH DISCONNECTOR:



They are very safety and practical devices to protect system by sudden-off and equipment in box type. It is being provided by NH00 size. Fuse Switch Disconnectors are being produced IEC 60947-3 Standard and providing you to more practical working spaces over tables, panels and places, easy to use and protection for life and materials.

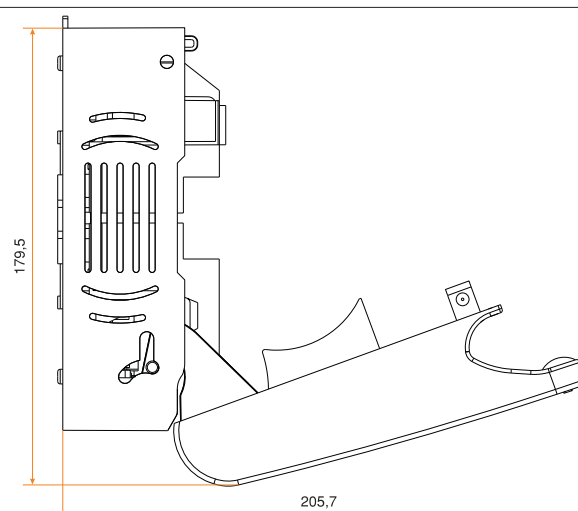
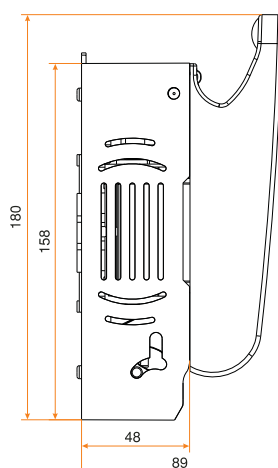
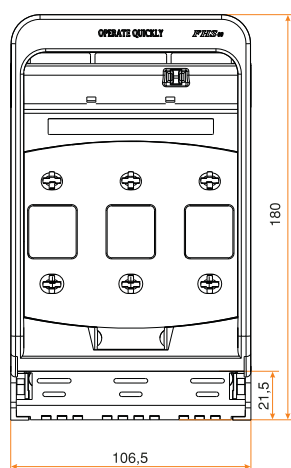
In order ensure a long durability lifespan, the Fuse Switch Disconnectors are manufactured with reinforced thermoplastic materials and flame retardant. Additionally, they feature contacts with silver coating, providing low power losses.

General Features:

- Unique design for NH00 fuses up to 160A (width=29,5mm)
- IP30 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
- Lange 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.

Technical Features:

Number of Poles		3
Rated Thermal Current (Ith)	A	160
Rated Insulation Voltage (Ui)	V	1000
Rated impulse withstand voltage (Uimp)	kV	8
Rated Frequency	Hz	50-60
Capacitor Power	380V kVAr	70
Rated Breaking Capacity	AC 22-B A	480
Rated Closing Capacity	AC 22-B A	480
Fused Short Circuit Breaking Capacity	kA _{rms}	70
Fuse Type (Dispatched without fuse)	NH	00
Mechanical Life	Operation	>20.000
Electrical Life	Operation	200
Connection Conductor cross-section	mm ²	70
Power Loss Per Pole	W	4
Distance Between Main Busbar Terminals	mm	34,75
Maximum - Minimum Squeeze Torque	Nm	7-10
Hole Diameter	Ø	m8x16
Operating Condition		Continuous Operation
Weight	gr.	675
Order Code		9BE-S1213-0160



FUSE SWITCH DISCONNECTOR

SINGLE POLE FUSE SWITCH DISCONNECTOR



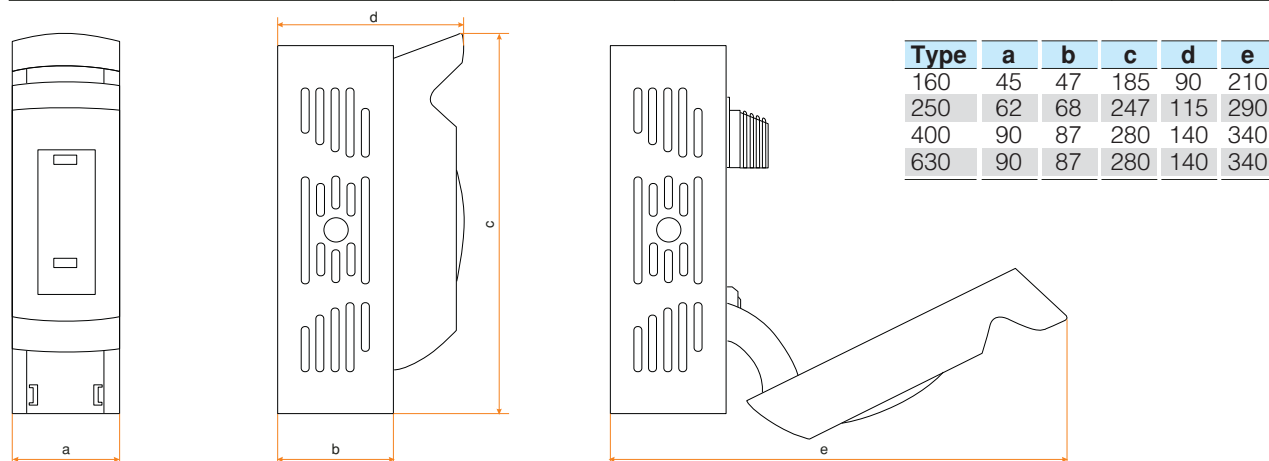
Single pole Fuse Switch Disconnectors are mainly used for disconnecting switch, emergency switching in inductive and capacitive characteristic AC system. They are very practical and safety products to sudden of and protect equipment & system, Single Pole Horizontal Disconnecting Switch is being produced 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:

Type		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	1	2	3
Mechanical durability	operation	> 30000	> 20000	> 20000	> 20000
Electrical durability	operation	200	200	200	200
Connection conductor cross-section	mm ²	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
Order Code		9BE-S1113-0160	9BE-S1113-0250	9BE-S1113-0400	9BE-S1113-0630



LOAD BREAK SWITCHES WITH and WITHOUT FUSE



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
800A
1000A
1250A
1600A



Change-over Isolation Switch
160A
250A
400A
630A
800A
1000A
1250A
1600A

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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 (1250)

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

LOAD BREAK SWITCHES WITH and WITHOUT FUSE

Rotating contact system (for 250A, 400A, 630A)

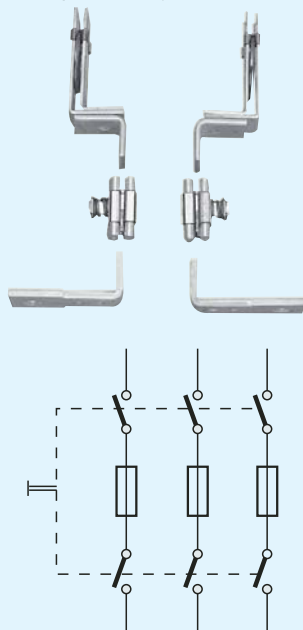


Fig - 1

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 as 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



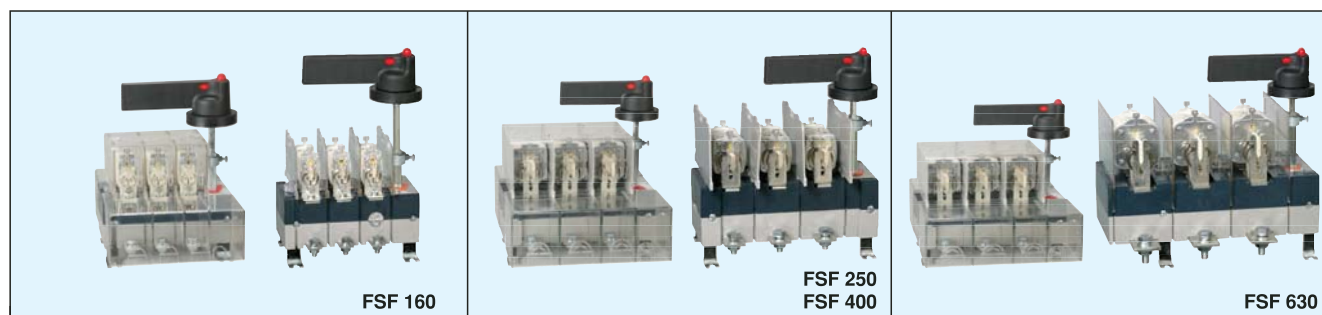
Fig - 2

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
Number of Poles		3 , 4	3 , 4	3 , 4	3 , 4
Utilization Category		AC 23A	AC 23A	AC 23A	AC 23A
Rated Thermal Current (I _{th})	A	160	250	400	630
Rated Insulation Voltage (U _i)	V	1000	1000	1000	1000
Rated Impulse Withstand Voltage (U _{imp})	kV	8	8	8	8
Rated Frequency	Hz	50-60	50-60	50-60	50-60
Rated Operating Power AC23	380V kW	75	132	200	320
	500V kW	100	160	280	340
	690V kW	120	220	360	400
Capacitor Power	380V kVAr	76	140	220	300
Rated Breaking Capacity	AC 23 A	8xI _n	8xI _n	8xI _n	8xI _n
Rated Closing Capacity	AC 23 A	10xI _n	10xI _n	10xI _n	10xI _n
Short Circuit Breaking Capacity with Fuse	kA _{rms}	65	65	65	65
Fuse Type (dispatched without fuse)	NH	00	1	2	3
Mechanical Life	Operation	10000	10000	10000	8000
Electrical Life	Operation	1000	1000	1000	1000
Weight	kg.	2.7	4.7	4.8	8.7
Maximum - Minimum Tightening Torque	Nm	8-10	19-25	19-25	30-40
Power Loss per Pole	W	10	13	27	50
Connection Conductive Section	mm ²	70	120	240	2x185

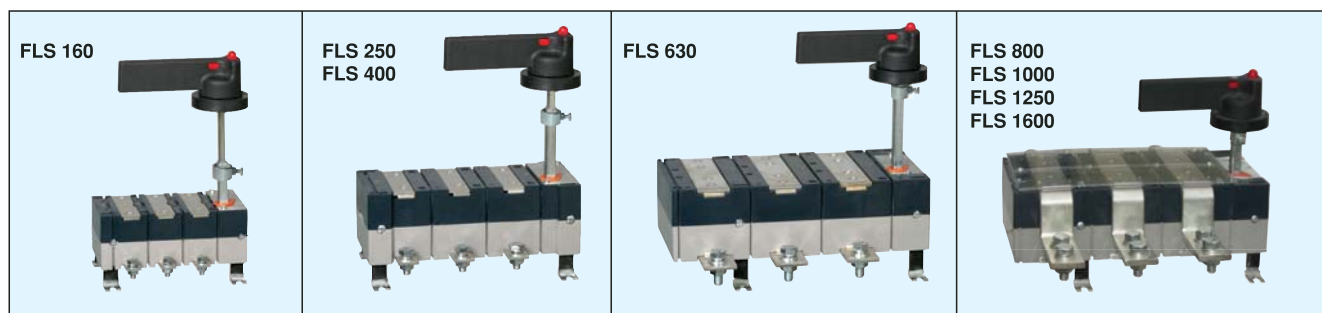
Order Codes:

	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	FLS 800	FLS 1000	FLS 1250	FLS 1600
Number of Poles	Ad.	3,4	3,4	3,4	3,4	3	3	3	3
Utilization Category		AC 23A	AC 23A	AC 23A	AC 23A	AC 22A	AC 22A	AC 21A	AC 21B
Rated Thermal Current (I _{th})	A	160	250	400	630	800	1000	1250	1600
Rated Insulation Voltage (U _i)	V	1000	1000	1000	1000	1000	1000	1000	1000
Rated Impulse Withstand Voltage (U _{imp})	kV	8	8	8	8	8	8	8	8
Rated Frequency	Hz	50-60	50-60	50-60	50-60	50-60	50-60	50-60	50-60
Rated Operating Power	380V kW	75	132	200	320	-	-	-	-
	500V kW	100	160	280	340	-	-	-	-
	690V kW	120	220	360	400	-	-	-	-
Capacitor Power	380V kVAr	76	140	220	300	-	-	-	-
Rated Breaking Capacity	A	8xI _n	8xI _n	8xI _n	5xI _n	3xI _n	3xI _n	1,5xI _n	1,5xI _n
Rated Closing Capacity	A	10xI _n	10xI _n	10xI _n	10xI _n	3xI _n	3xI _n	1,5xI _n	1,5xI _n
Short Circuit Breaking Capacity with Fuse	kA _{rms}	65	65	65	65	-	-	-	-
Short Time Withstand Current	kA/1s	8	15	15	25	35	35	35	35
Mechanical Life	Operation	10000	10000	10000	8000	8000	8000	8000	8000
Electrical Life	Operation	1000	1000	1000	1000	500	500	500	200
Weight	kg.	2.6	4.4	4.5	8.5	9	9	9	9
Maximum - Minimum Tightening Torque	Nm	8-10	19-25	19-25	30-40	30-40	30-40	30-40	30-40
Power Loss per Pole	W	9	12	25	47	54	70	100	145
Connection Conductive Section	mm ²	70	120	240	2x185	40x12	40x15	2x(40x10)	2x(50x10)

Order Code

	Number of Poles	Type	Rated Current (A)	Order Code
<p>3 pole 4 pole</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-L110□-0800
		FLS 1000	1000	9BD-L110□-1000
		FLS 1250	1250	9BD-L110□-1250
		FLS 1600	1600	9BD-L110□-1600

□ field is for writing number of poles (3 or 4).

LOAD BREAK SWITCHES WITH and WITHOUT FUSE

Change-over Isolation Switch (Vertical Installed):



Technical Specifications:

TYPE		FLS160EV	FLS250EV	FLS400EV	FLS630EV	FLS800EV	FLS1000EV	FLS1250EV	FLS1600EV
Number of Poles	Ad.	3,4	3,4	3,4	3,4	3	3	3	3
Utilization Category		AC 22A	AC 22A	AC 22A	AC 22A	AC 22A	AC 22A	AC 21A	AC 21B
Rated Thermal Class	A	160	250	400	630	800	1000	1250	1600
Rated Insulation Voltage (Ui)	V	1000	1000	1000	1000	1000	1000	1000	1000
Rated Impulse Withstand Voltage (Uimp)	kV	8	8	8	8	8	8	8	8
Rated Frequency	Hz	50-60	50-60	50-60	50-60	50-60	50-60	50-60	50-60
Rated Operating Power	380V kW	75	132	200	320	-	-	-	-
	500V kW	100	160	280	340	-	-	-	-
	690V kW	120	220	360	400	-	-	-	-
Capacitor Power	380V kVAr	76	140	220	300	-	-	-	-
Rated Breaking Capacity	A	8xIn	8xIn	8xIn	5xIn	3xIn	3xIn	1,5xIn	1,5xIn
Rated Closing Capacity	A	10xIn	10xIn	10xIn	10xIn	3xIn	3xIn	1,5xIn	1,5xIn
Short Circuit Breaking Capacity with Fuse	kA _{rms}	65	65	65	65	65	65	65	-
Short Time Withstand Current	kA/1s	8	15	15	25	35	35	35	35
Mechanical Life	Operation	10000	10000	10000	8000	8000	8000	8000	8000
Electrical Life	Operation	1000	1000	1000	1000	500	500	500	200
Weight	kg.	6	7	10	12	20	22	25	9
Minimum - Maximum Tightening Torque	Nm	8-10	19-25	19-25	30-40	30-40	30-40	30-40	30-40
Power Loss per Pole	W	9	12	25	47	54	70	100	145
Connection Conductive Section	mm ²	70	120	240	2x185	40x12	40x15	2x(40x10)	2x(50x10)

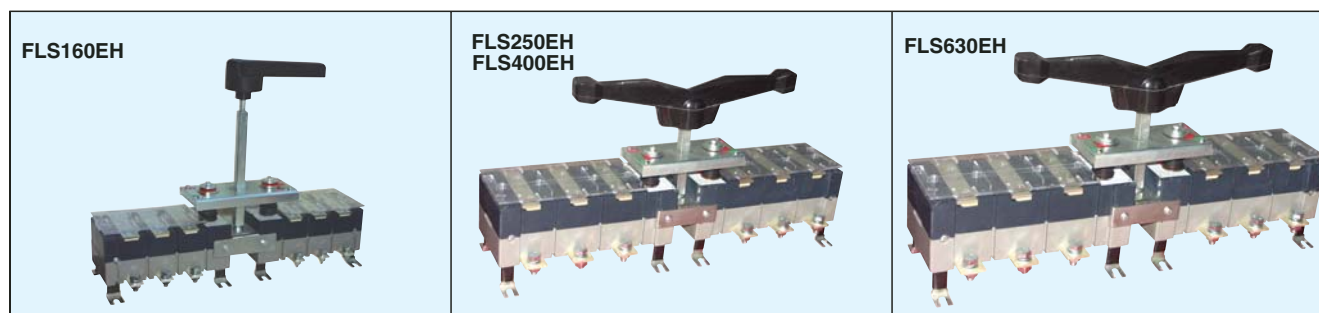
Change-over Isolation Switch Order Codes:

	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
		FLS 1250EV	1250	9BG-GS703-1250
		FLS 1600EV	1600	9BG-GS703-1600

□ field is for writing number of poles (3 or 4).

LOAD BREAK SWITCHES WITH and WITHOUT FUSE

Change-over Isolation Switch (Horizontal Installed):



Technical Specifications:

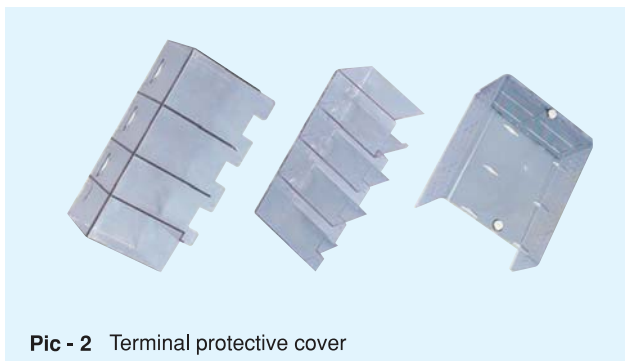
TYPE		FLS160EH	FLS250EH	FLS400EH	FLS630EH
Number of Poles	Ad.	3,4	3,4	3,4	3,4
Utilization Category		AC 22A	AC 22A	AC 22A	AC 22A
Rated Thermal Class	A	160	250	400	630
Rated Insulation Voltage (Ui)	V	1000	1000	1000	1000
Rated Impulse Withstand Voltage (Uimp)	kV	8	8	8	8
Rated Frequency	Hz	50-60	50-60	50-60	50-60
Rated Operating Power	380V kW	75	132	200	320
	500V kW	100	160	280	340
	690V kW	120	220	360	400
Capacitor Power	380V kVAr	76	140	220	300
Rated Breaking Capacity	A	8xIn	8xIn	8xIn	5xIn
Rated Closing Capacity	A	10xIn	10xIn	10xIn	10xIn
Short Circuit Breaking Capacity with Fuse	kA _{rms}	65	65	65	65
Short Time Withstand Current	kA/1s	8	15	15	25
Mechanical Life	Operation	10000	10000	10000	8000
Electrical Life	Operation	1000	1000	1000	1000
Weight	kg.	6	7	10	12
Minimum - Maximum Tightening Torque	Nm	8-10	19-25	19-25	30-40
Power Loss per Pole	W	9	12	25	47
Connection Conductive Section	mm ²	70	120	240	2x185

Change-over Isolation Switch 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



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	8BD-H0000-0000

Top coating plate order codes:

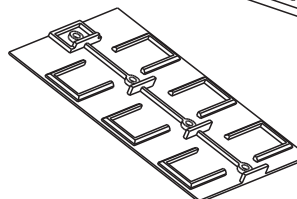
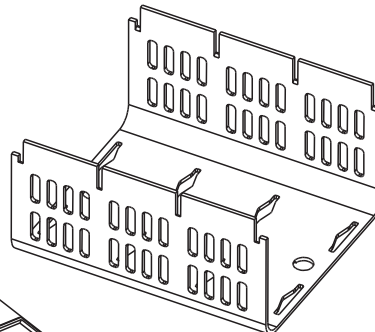
Type	Order Code
FLS160	8BA-D0000-0000
FLS250-400	8BB-D0000-0000
FLS630-800-1000-1250-1600	8BC-D0000-0000

Auxiliary Contact Block

Type	Order Code
1NA + 1NK	8BA-A0011-0000
2NA + 2NK	8BA-A0022-0000

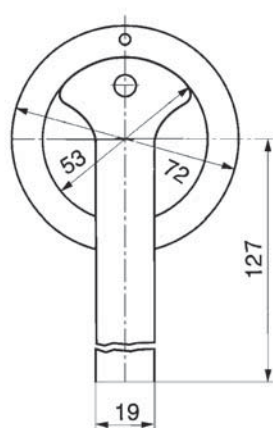
Top terminal protective cover:

For types with fuse

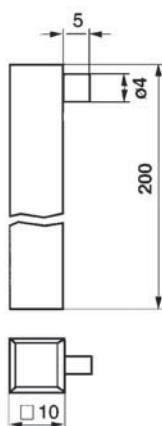


For types without fuse

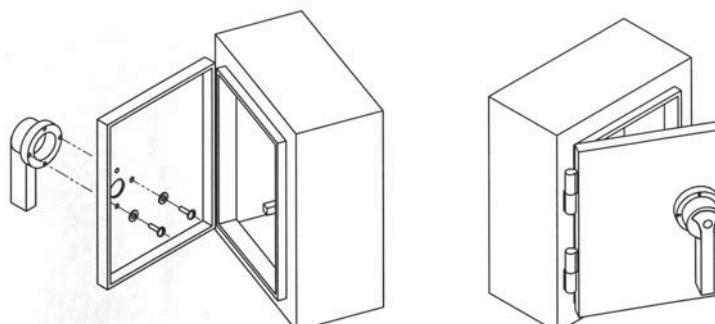
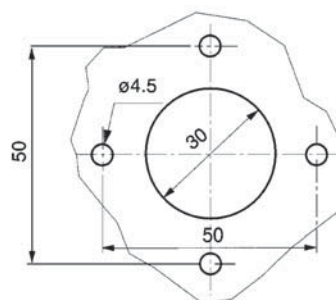
Control lever:



Control shaft:

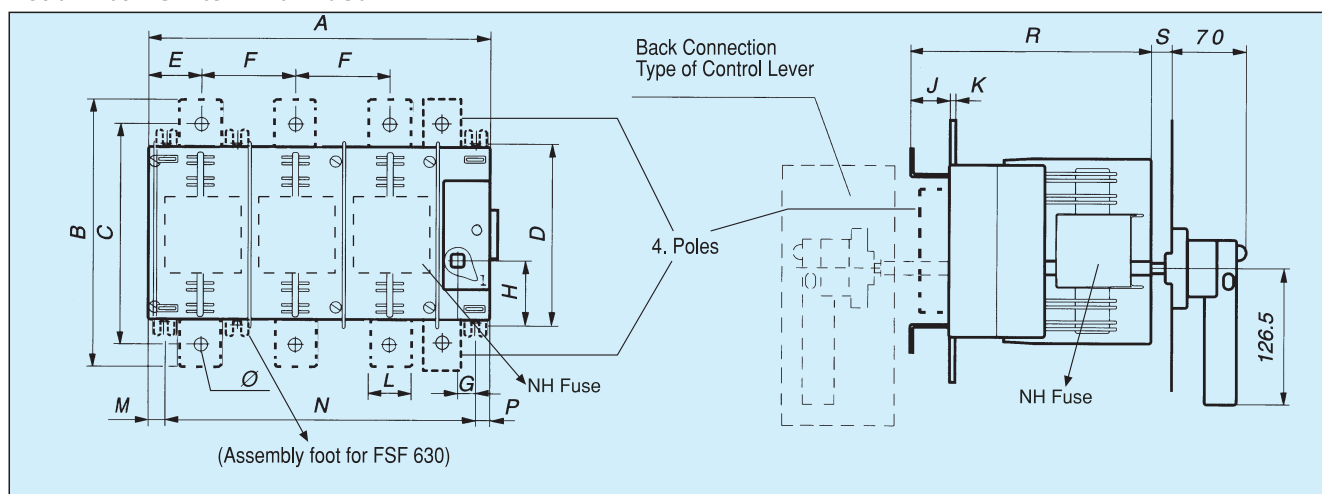


Panel connection hole dimensions:



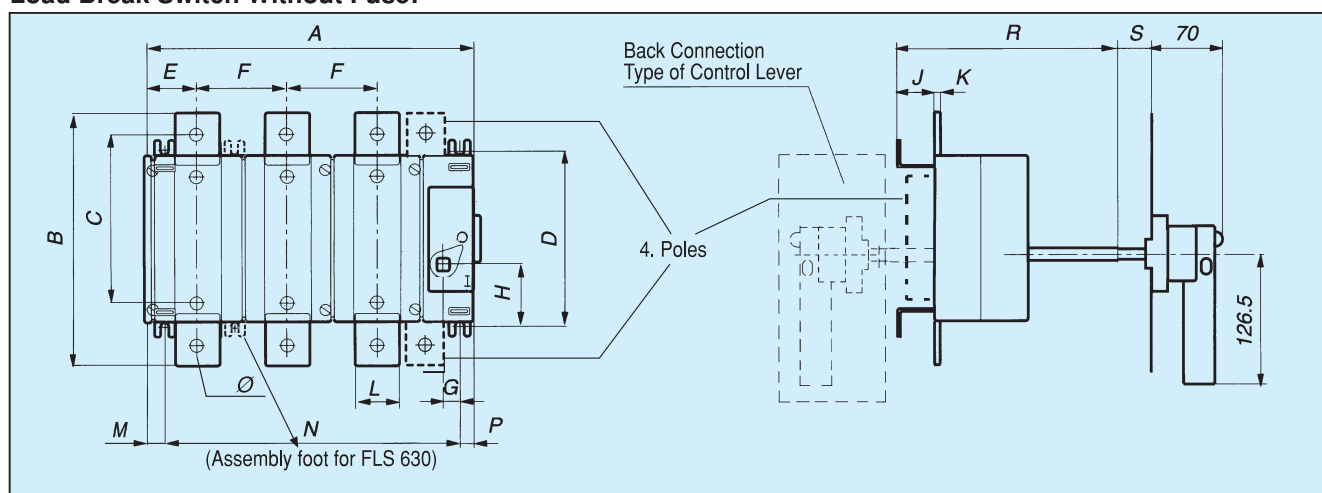
LOAD BREAK SWITCHES WITH and WITHOUT FUSE

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	105,5	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	89	16.5	54	37	6	40	83.5	224	14	222.5		13

Load Break Switch Without Fuse:

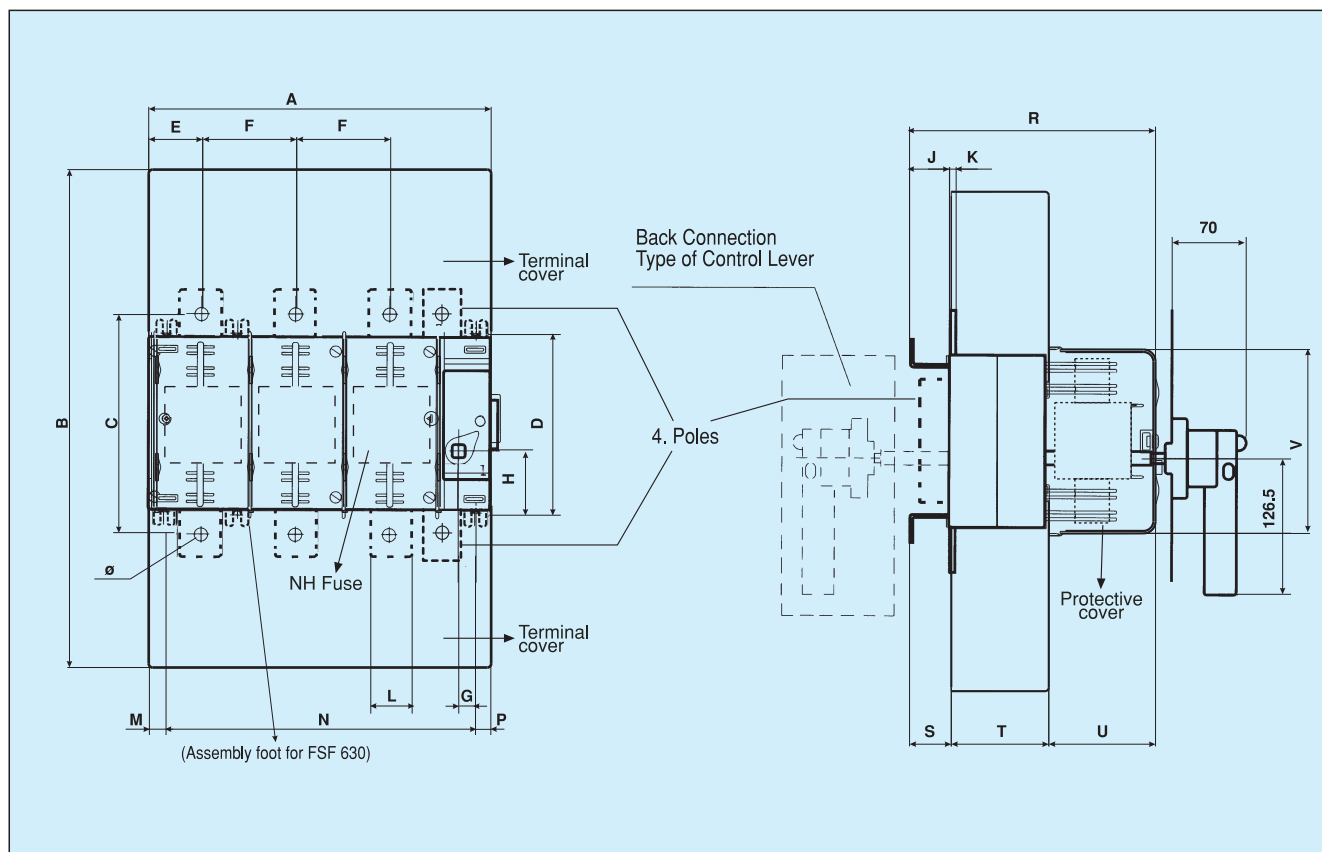


Tip	A	B	C	D	E	F	G	H	J	K	L	M	N	P	R	S	Ø
FLS 160	185	142	123	105,5	37	43.5	15	32	28	3	20	13	160	12	152	10-70	8
FLS 250	255.5	163	138.5	128	43.5	65	15.5	33	32	4	25	15	224	20.5	197		11
FLS 400											30						
FLS 630	317	243	202	168	50	89	16.5	54	37	6	40	83.5	224	14	222.5		13
FLS 800		355	315						35	8							
FLS1000									33	10							
FLS1250									31	12							
FLS1600																	

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

LOAD BREAK SWITCHES WITH and WITHOUT FUSE

Load Breakers With Terminal Cover:

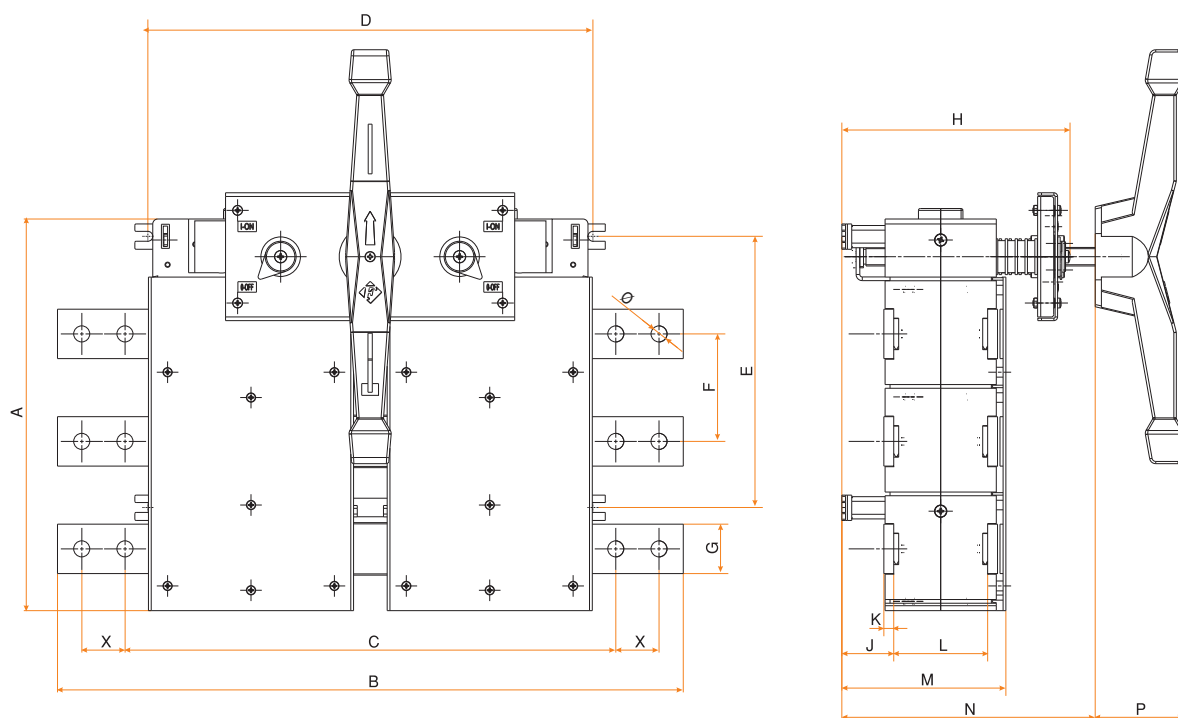


Type	A	B	C	D	E	F	G	H	J	K	L	M	N	P	R	S	T	U	V	Ø
FSF160	185	250	123	105,5	37	43.5	15	32	28	3	20	13	160	12	170	24	72,5	73,5	120	8
FSF250	254	327	138.5	128	43.5	65	15.5	33	32	4	25	15	224	20.5	200	25	88,5	91	165,5	11
FSF400											30									
FSF630	317	461	202	168	50	89	16.5	54	37	6	40	83.5	224	14	226	38	90	98	175	13

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

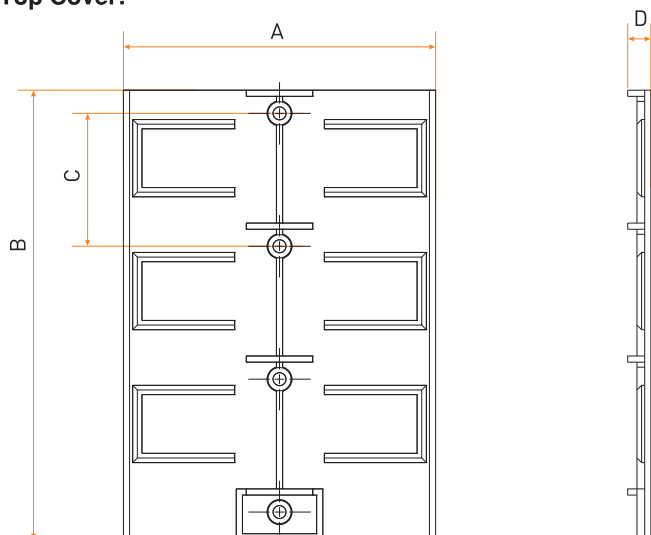
LOAD BREAK SWITCHES WITH and WITHOUT FUSE

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								10					35	
FLS1250EV																
FLS1600EV																

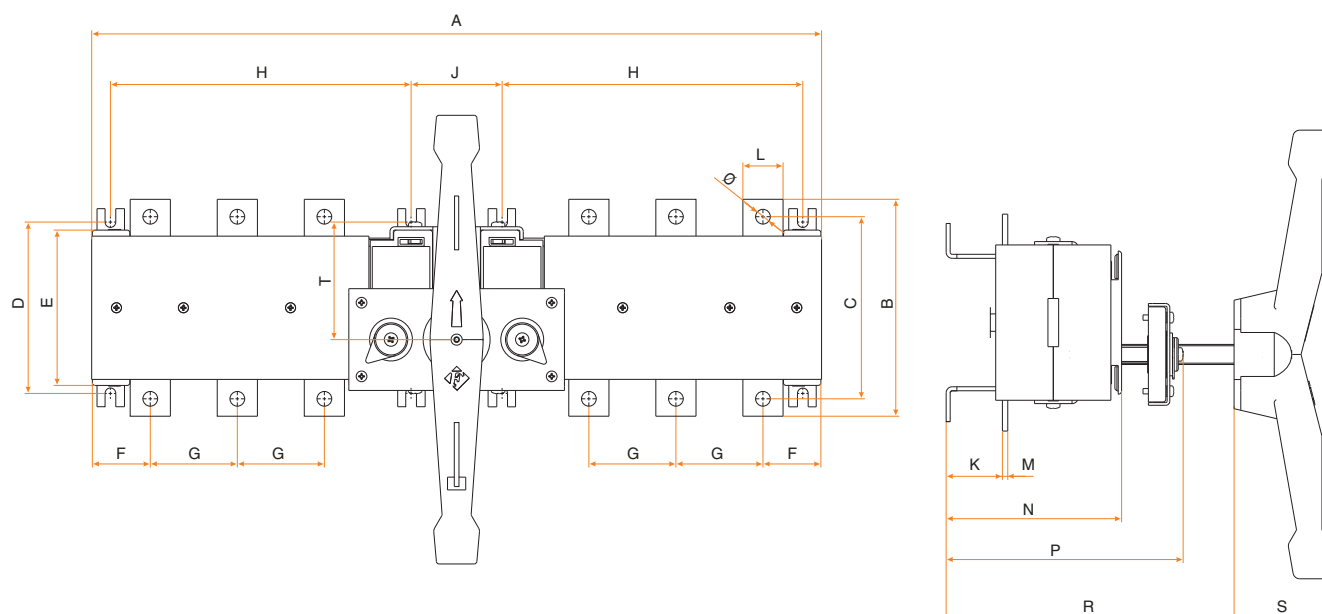
Top Cover:



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				

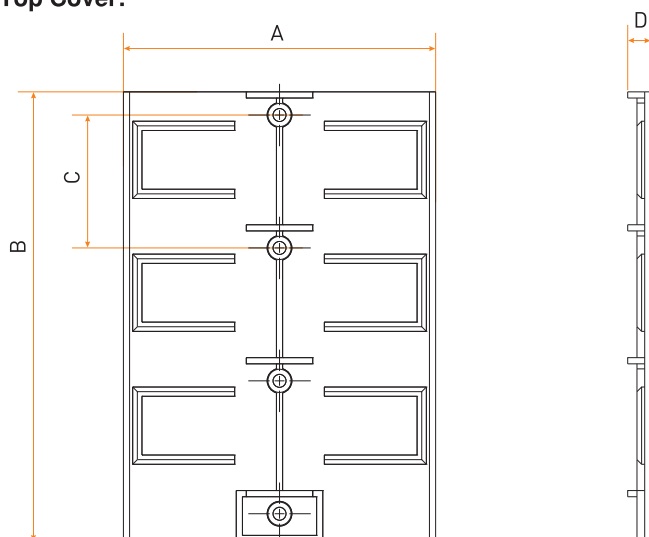
LOAD BREAK SWITCHES WITH and WITHOUT FUSE

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	13

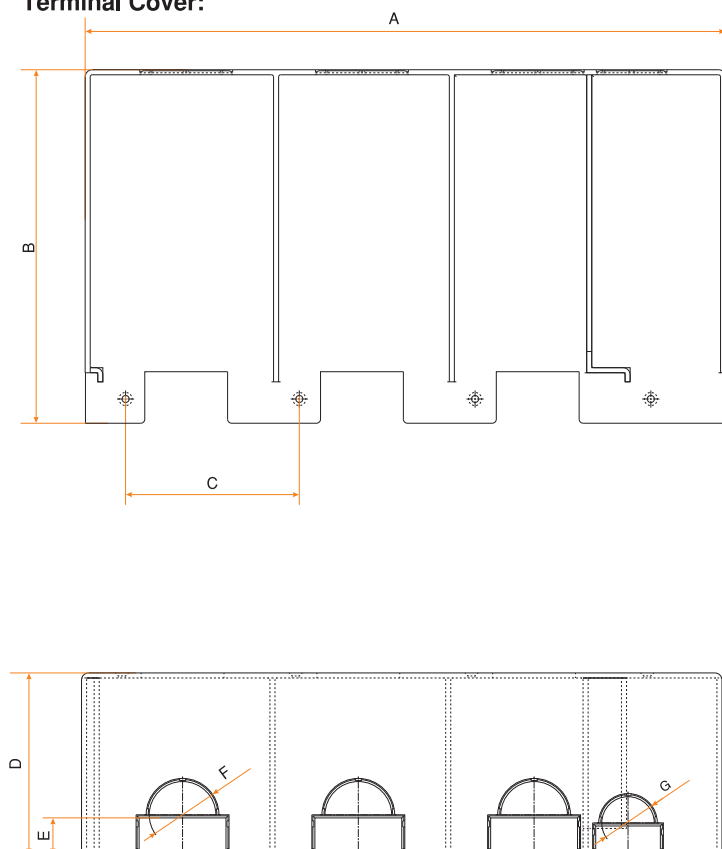
Top Cover:



Type	Dimension			
	A	B	C	D
FLS160EH	101	145,5	43	10,5
FLS250EH	107	207	50	10,5
FLS400EH				
FLS630EH	166	270	87	10,5
FLS800EH				
FLS1000EH				
FLS1250EH				
FLS1600EH				

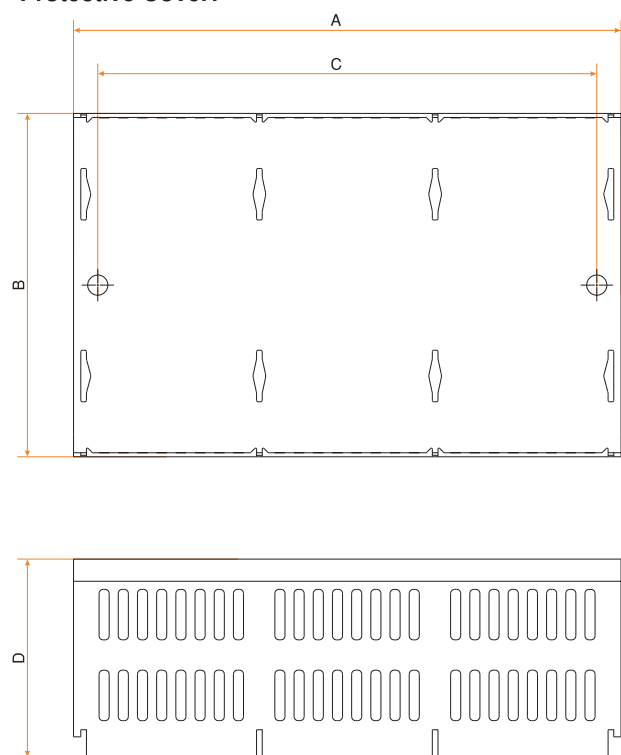
LOAD BREAK SWITCHES WITH and WITHOUT FUSE

Terminal Cover:



Type	Dimensions						
	A	B	C	D	E	F	G
FSF160 FLS160 FLS160EH FLS160EV	165	105,5	43	72,5	13	Ø19,5	Ø16
FSF250 FLS250EH FLS250EV							
FSF400 FLS400 FLS400EH FLS400EV	254	130	65	88,5	20,75	Ø30	Ø24,5
FSF630 FLS630 FLS630EH FLS630EV FLS800 FLS1000 FLS1250 FLS1600	317	175	87	90	18,25	Ø33	Ø26

Protective Cover:



Type	Dimensions			
	A	B	C	D
FSF160	139	120	115	73,5
FSF250 FSF400	203	165,5	181	91
FSF630	317	175	87	90

CAM SWITCHES



Cam switches



On-Off switches



Change Over Switches



Star Delta Starters



Motor Reversing Switches



Ammeter Switches



Voltmeter Switches



Safety switches

CONTENTS

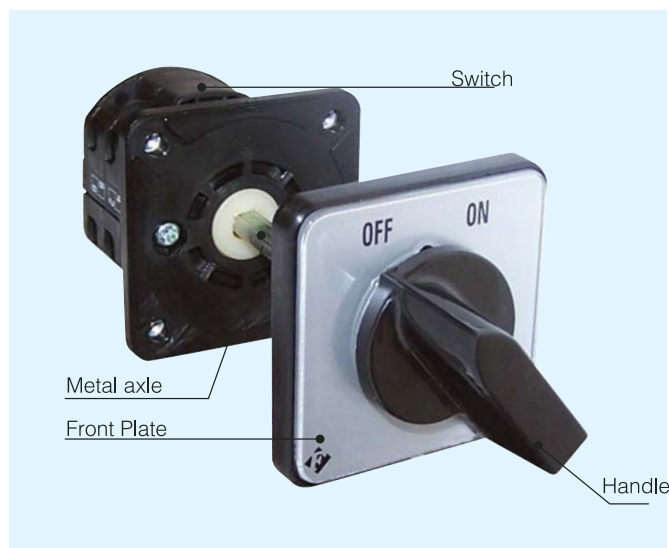
Features	1
Technical Table	1
Order Codes	2
Technical Drawings	3

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							
	AC15	220-240 V	5	5	5	7	12	14	16
		380-440 V	4	4	4	5	6	6	7
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)

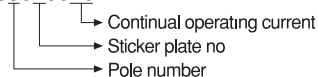
AC 23A :Control of low overloaded, resistive - inductive mixed loads (Switching of medium-degree overloads)

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□-0000 9TO-20Δ0□-0000
FCS2	32 63	4 Pole - 2 Stage			

Δ Pole number, □ Sticker plate, 00 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-10Δ04-0000 9TK-20Δ04-0000
FCS2	32 63	3 Pole - 3 Stage			

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-10Δ05-0000

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-10Δ06-0000

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

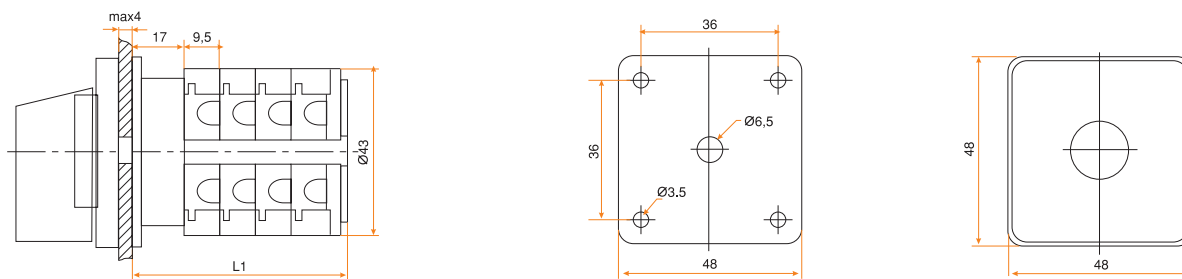
Type	Rated Thermal Current Ith (A)	Number of Pole - Stages	Label Plate	Connection Diagram	Order Code
FCS1	20	3 Pole - 4 Stage			9TA-103037-0020

Safety Switches

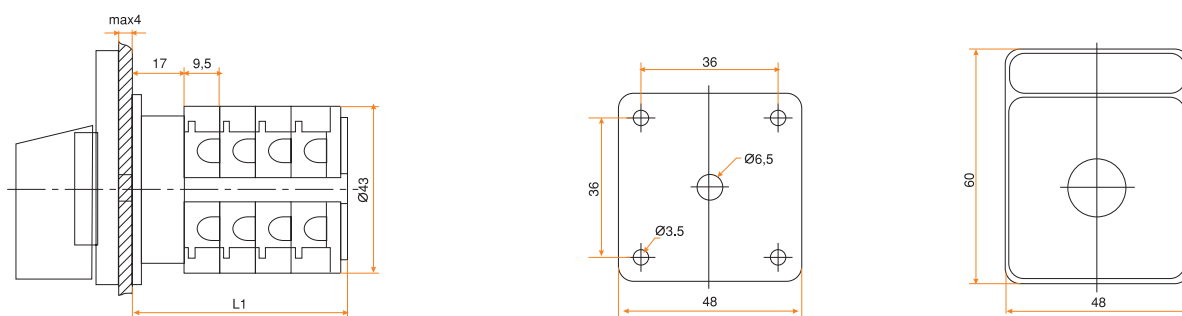
Type	Rated Thermal Current Ith (A)	Number of Pole - Stages	Label Plate	Connection Diagram	Order Code
FCS1	20	3 Pole - 2 Stage			9TP-10308-0020
FCS2	32				9TP-20308-0000
	40				
	63				

CAM SWITCHES

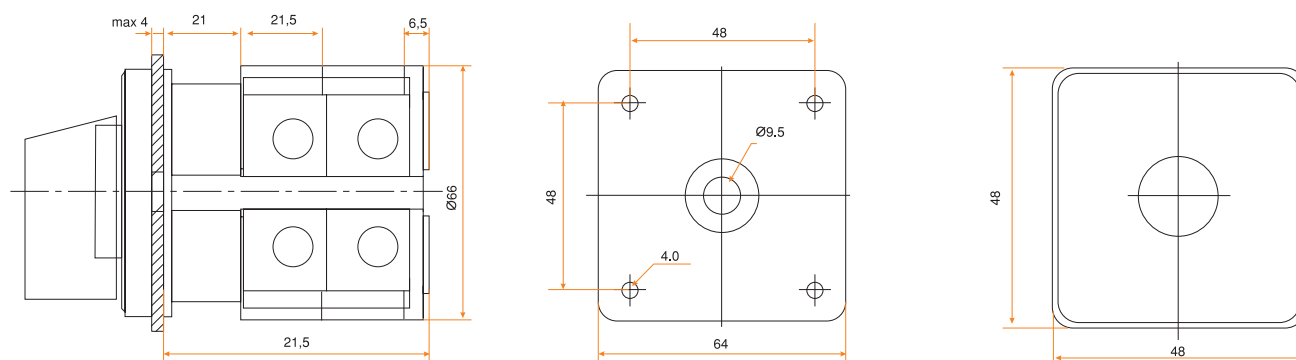
FCS1:



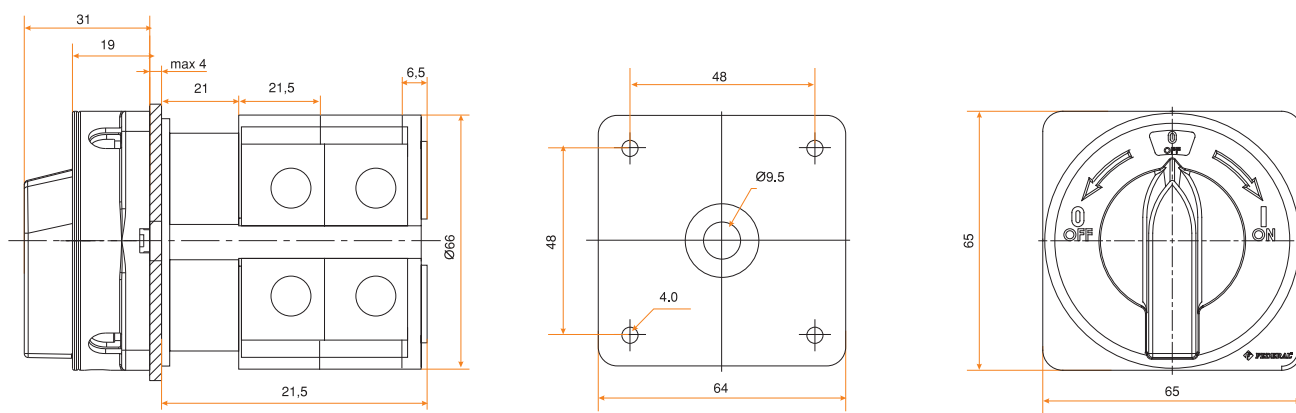
FCS1 Voltmeter - Ammeter Switches:



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
63A	9TP-20308-0063

MEASUREMENT DEVICE



Digital Measurement Devices



FYA72 / FYA 72 - 200
FYA96 / FYA 96 - 200



FYV72 / FYV96



FMM50

Analogue Measurement Devices



FA72 / FYA96



FMA72 / FMA96



FV72 / FYA96



FF72 / FYA96

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MEASUREMENT DEVICES

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
Measuring 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)		1 A, 5 A Direct (15 min.)		250 V ve 500 V		45 - 55 Hz ve 55 - 65 Hz	
	From 30/5A to 4000/5A (current trans)		X/5 A with current trans.(15 min)					
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	
Continously overload (2 hour)	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	
Standards	TS 5590 EN 60051-2		TS 5590 EN 60051-2		TS 5590 EN 60051-2		TS 5592 EN 60051-4	
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.

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 (Amper)

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.

96X96 PANEL METER (VOLTMETER, AMMETER) INSTRUCTION MANUEL



FYV96 (Voltmeter) 96x96 Series voltmeters, measure -RMS AC Voltage value (potential difference) of receiver or circuit between 0-500V.

FYA96 (Ammeter) 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.

FYV96-2R, FYA96-2R, FYA96-200-2R (Voltmeter and Ammeter with 2 Relays) 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)
Type	FYA72 - FYA72 - 200 FYA96 - FYA96 - 200	FYA96 - 2R FYA96 - 2R 200	FYV72 - FYV96	FYV96 - 2R
Measurement wave form	AC (rms)	AC (rms)	AC (rms)	AC (rms)
Measuring 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 Gerilim Trafolu	
Accuracy class	1	1	1	1
Operating frequency	0 / 50 ... 60 Hz	0 / 50 ... 60 Hz	0 / 50 ... 60 Hz	0 / 50 ... 60 Hz
Operating temperature	-40°C ... +85°C	-40°C ... +85°C	-40°C ... +85°C	-40°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
Dimensions	72 x 72 / 96 x 96	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 In 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 Cos ϕ Section .

For each phase, the Cos ϕ 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 Cos ϕ 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 Cos ϕ Section.

In this section; LED 2 is constantly ON, LED3 flashes to show section position. For each phase, the Cos ϕ 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 Cos ϕ Section

In this section; LED 2 is constantly ON, LED4 flashes to show section position. For each phase, the Cos ϕ 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 Cos ϕ 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 1st relay,
R phase V (Voltage) HI is 2nd relay,
S phase V (Voltage) LO is 3rd relay,
S phase V (Voltage) HI is 4th relay,
T phase V (Voltage) LO is 5th relay,
T phase V (Voltage) HI is 6th 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 1st relay,
R phase I (Current) HI is 2nd relay,
S phase I (Current) LO is 3rd 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 1st 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 1st 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 Φ 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

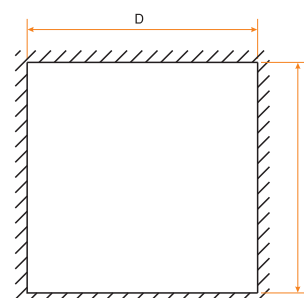
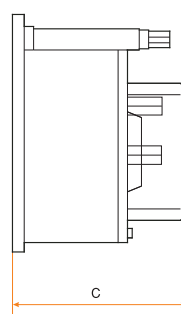
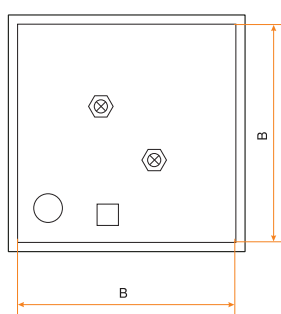
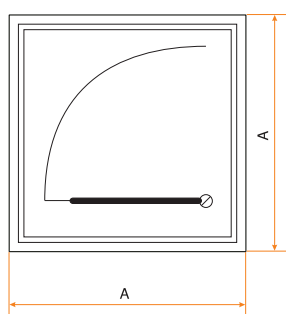
rL: Relay sealing feature. Adjustment interval is 0-1. Even desired conditions are completed, engaged relay is not released. Only operator can release relay by using "Up+Down" key combination. UnL signal is displayed. If Pulse (rP) feature is activated, sealing feature doesn't become active.

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

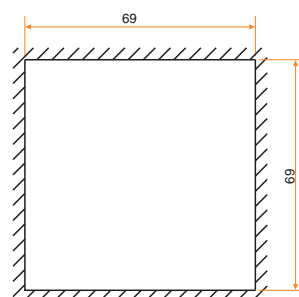
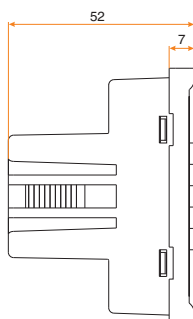
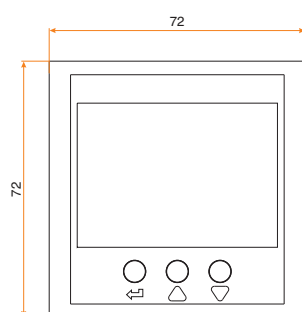
FA72 / FA96 / FMA72 / FMA96 / FV72 / FV96 / FF72 / FF96



Pano Assembling Dimensions

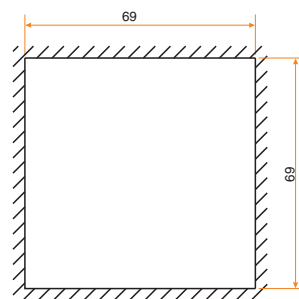
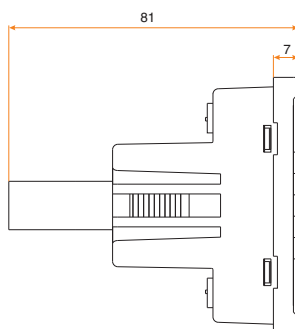
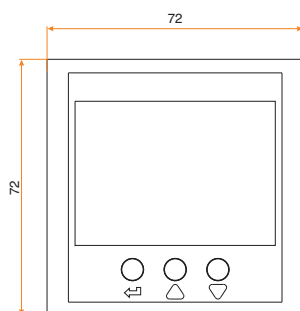
Dimensions (mm)	A	B	C	D
72 x 72	72	66	75	68 ± 0.5
96 x 96	96	90	75	92 ± 0.5

FYA72 / FYV72



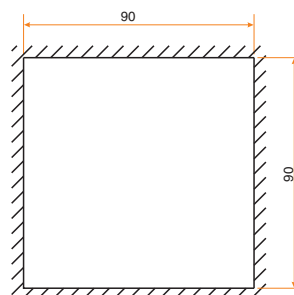
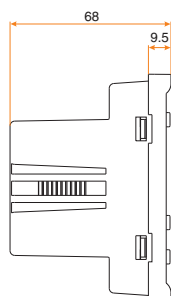
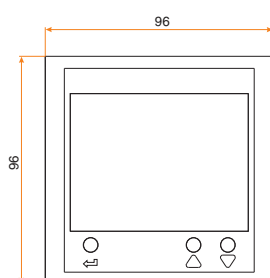
Pano Assembling Dimensions

FYA72 200



Pano Assembling Dimensions

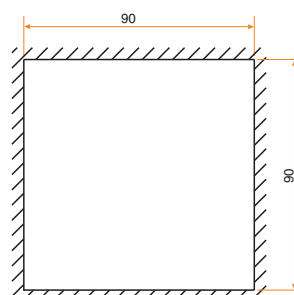
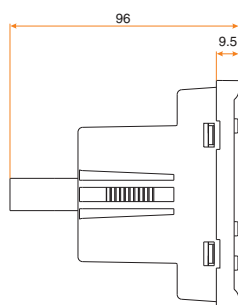
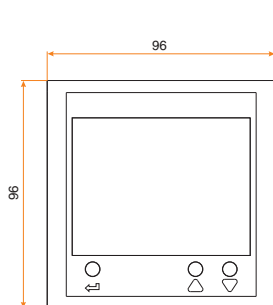
FYA96 / FYV96



Pano Assembling Dimensions

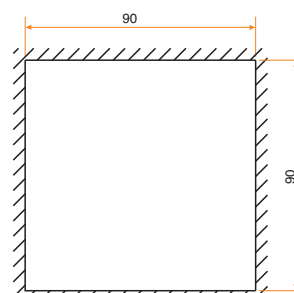
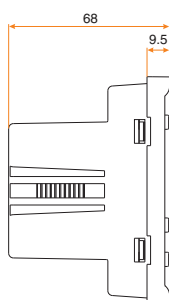
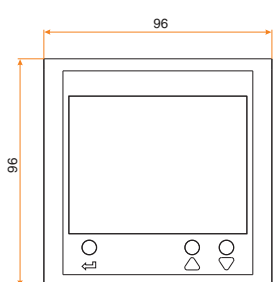
MEASUREMENT DEVICES

FYA96 - 200



Pano Assembling Dimensions

FMM50



Pano Assembling Dimensions

REACTIVE RELAYS



FX Series Reactive Power Control Relays



FX 5



FX 7



FX 12

EasyVAr Reactive Power Control Relays



EV96



EV144

FKR Series Reactive Power Control Relays



FKR240

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REACTIVE RELAYS



FX12 Reactive power control relay

FX series reactive power control relays, which are manufactured in accordance with CE, perceives the system current digitally and measures power factor of the facility sensitively. IN cases where estimated power factor is out of the desired values, capacitor is enabled or disabled. Capacitor contactors are driven by the relays in the device. These relays are resistant to temporary current regimes and opening-closing impact currents and arc has been minimized with filters used at contact ends.

Operating Characteristic :

- Front panel consists of easy to use, 3 multi-functional buttons.
- Functions are selected with SET button. Changes in the selected function are made with up and down buttons.
- The relay is not affected from harmonic currents.
- Breakdown of capacitor or contactors in time, increase in reactive power consumed by the facility may avoid reaching the desired power factor. In this case, alarm contact is enabled to give

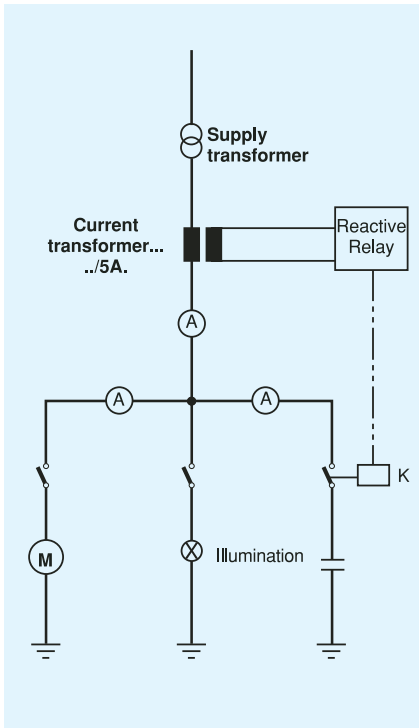
warning. All the warning statuses can be monitored by the leds on the front panel. It is recommended to connect a remarkable warning lamp or audible warning to the alarm circuit.

Factory Values of FX Series Reactive Power Control Relays:

- $\cos\phi$: 0.99
- Stepping duration : 8 sec
- Program : 3

It is recommended to keep low stepping duration in facilities that require phase compensation (gas stations, welding houses, plastic coating etc.)! Please check accuracy of set values and health operation of compensation with regular intervals.! Current transformer of reactive relay must be placed on the phase of supply. For example, if the relay is supplied from R phase; transformer should be placed on R phase before loads and after main switch.! Fixed capacitor should be used at places with little illumination load at the end of working hours or at nights.

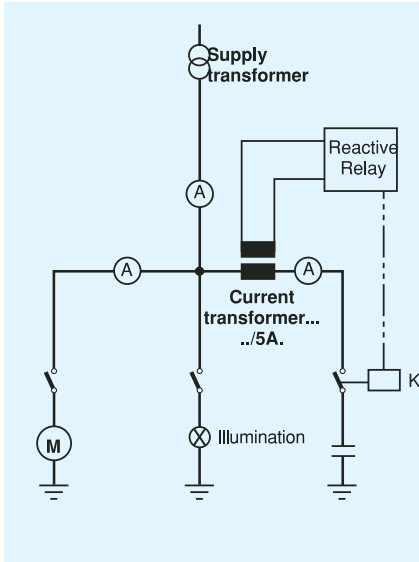
Right Connection Sample



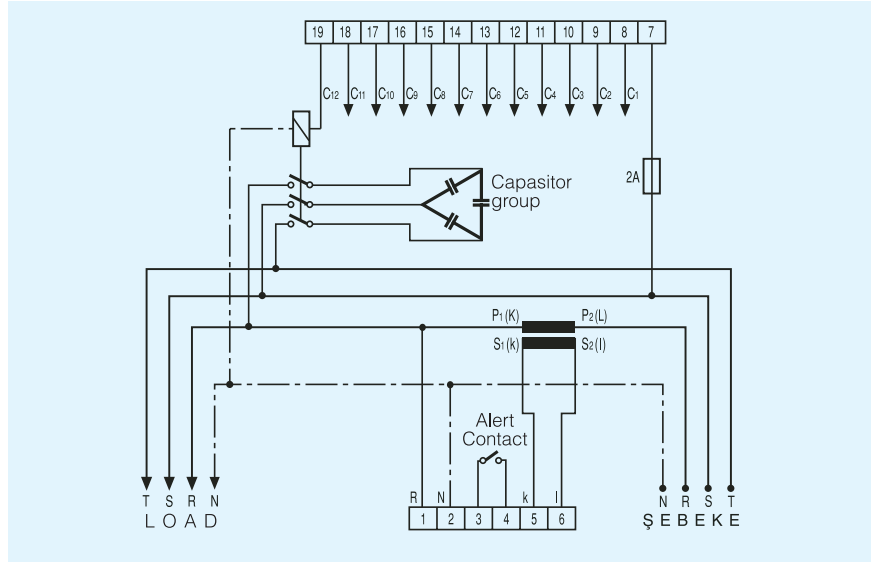
Technical Specifications:

Type	: FX5, FX7, FX12
Operating voltage	: 220 V (50/60Hz) $\pm 20\%$ (Other voltages are optional.)
Operating current	: 5A permanent
Operating method	: Can be selected from front panel as 1,2,2...; 1,2,4,4... or 1,2,4,8,8.. 2 and later capacities are operated in 1,2,2... system; 3 and later capacities are operated in 1,2,4,4.. system and 4 and later capacities are operated in 1,2,4,8,8.. system.
Output contact capacity	: 1,5 A; permanent 10A
$\cos\phi$ adjustment	: 0,95 - 1.00 inductive
c / k adjustment	: between 0,00-1,00, with 0,05 interval
Stepping duration	: Can be adjusted with 1 second sensitivity between 7-99 seconds.
Power consumption	: 6VA max.
Weight	: 800 gr
Operating temperature	: -10°C, + 70°C
Storage Temperature	: -20°C, + 80°C
Order Code	: FX5 : 9HA-1000-X005 FX7 : 9HA-1000-X007 FX12 : 9HA-1000-X012

Wrong Correction Sample:



Connection Diagram of FX series ve EasyVAR:



EasyVAR Reactive Power Control Relays



EV-96 and EV-144 LCD reactive relay measures voltage, current, active power and reactive power of the phase it is connected to and display it with $\cos\phi$. Current input is so sensitive to perceive a current of 10 mA and maximum input current value is 5.5 A. When a current transformer with a cycle ratio of 2000/5 is used, it can perceive a current of 4A on the phase it is connected to. As every value is displayed with units on wide LCD screen, it has a quite understandable and easy adjustable structure. Each value displayed out of inductive and capacitive $\cos\phi$ limit adjustments is shown with current $\cos\phi$ value. Moreover, operating capacities are also displayed on the screen.

Technical Specifications:

Type : EasyVAR
Operating modes : 1111-1222-1244-1248
Number of steps : (EV-144) 4 -12 steps
(EV-96) 4 - 6 steps
Operating voltage : 220 V (50 Hz) , $\pm\%20$
Operating current : 5A permanent
Output contact capacity: Permanent 1,5 A
Impact 10A

Stepping duration: Between 1 - 30 sec.
Power consumption : 6 VA max.

Weight : 800 gr.

$\cos\phi$ adjustment :

Inductive 0,95-0,96-0,97-0,98-0,99

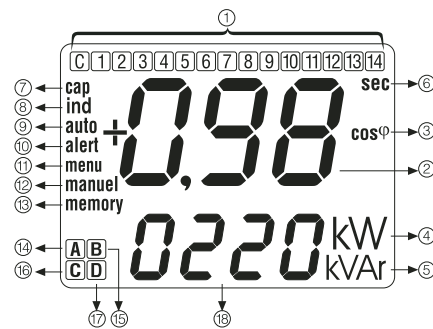
Capacitive f 0,98 - 0,99

Order Codes:

(EV-96) 9HA-DF000-C000

(EV-144) 9HA-DC000-B000

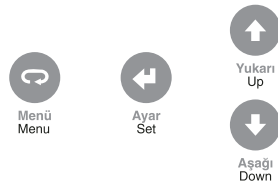
Screen Function :



1- Capacitor groups (*)
2- Power factor
3- $\cos\phi$ symbol
4- Active power symbol (W, kW)
5- V, A, VAR, kVAR symbols
6- Stepping duration symbol
7- Capacitive $\cos\phi$
8- Inductive $\cos\phi$
9- Automatic operation
10- Warning symbol
11- Menu adjustment symbol
12- Manual operation
13- Memory operation symbol
14- Capacity number adjustment symbol
15- Switching mechanism adjustment symbol
16- Minimum capacity value symbol (**)
17- Current transformer primary current value symbol (**)
18- Variable values (area of displaying all information except $\cos\phi$)
(*)9 step selections between EV-144, 4-12
3 step selections between EV-96, 4-6
(**)There is no need for individual c/k adjustment as minimum capacity value and current transformer primary current value is entered separately.

Programming:

Reactive Relay programming is made with four buttons on the front panel.



Menu button: It is possible to see current, voltage, active power and capacity values by pressing this button. Furthermore, this button should be used to make Reactive Relay adjustments.

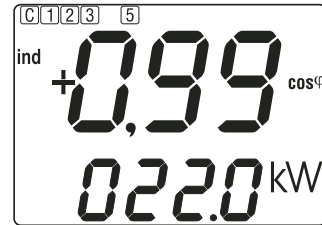
Adjustment button: You should press this button when you want to make a change in the values got by menu buttons.

Up - Down buttons: Are used to select the value to adjust.

Programming Samples:

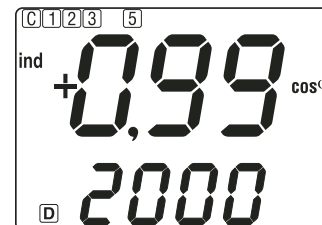
Active Power Display: On the screen where active power is displayed, active power amount passing through the phase

connected to the reactive relay is shown under \cos information with W or kW unit. If this value is shown as (-), this means ends of current transformer have been connected reverse. This case shall not affect compensation. In order to have correct values, primary current value of the current transformer should be entered correct.



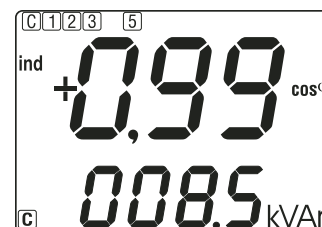
Current Transformer Primary Current Value Adjustment Display:

This is the primary current value of the current transformer connected to the reactive relay. For example, value should be entered as 2000 for 2000/5 current transformer. The value is shown with "D" icon. In order to make adjustment, adjustment button should be pressed and desired value should be obtained by pressing increase and decrease buttons after menu icon is displayed. At each time these buttons are pressed, values are changed by fives and if you press and hold the button, increase and decrease amounts shall increase. In this way, value can be adjusted to 5000 easily.



Minimum Capacity Power Adjustment Display:

Power of the capacitor connected to the circuit as the primary capacity should be notified to the reactive relay with kVar unit. Correct entry of this value is very important for an effective compensation operation. This value is displayed with C icon on LCD.



Note: EasyVAR Reactive Relay, as well as all these functions, allows us to see actual powers of the capacitors when we enable and disable capacitors one by one provided that manual position and capacity display is seen while system is in stable condition.

REACTIVE RELAYS

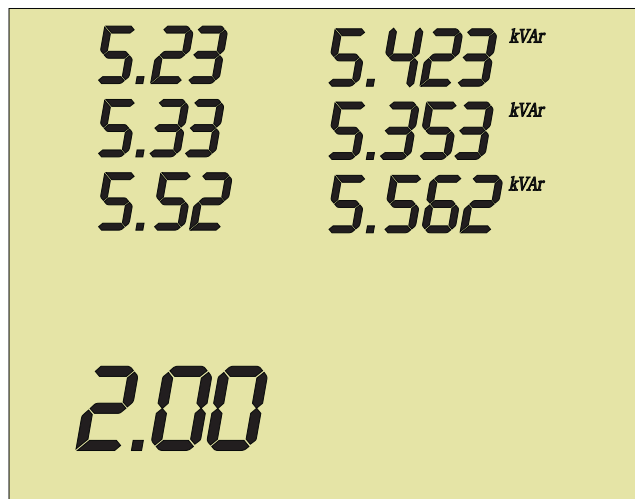
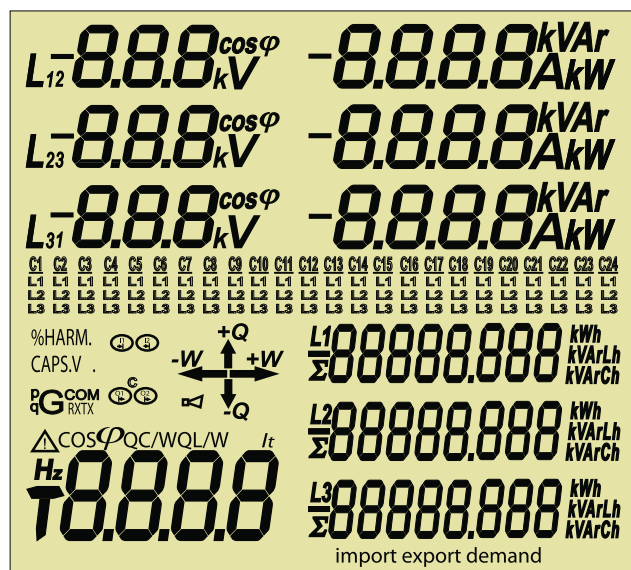
FKR Series Reactive Power Control Relays, which are manufactured with LCD display with 12, 18, 24 step options, have all the features of EA200 series Energy Analyzers and bear additional features to carry out compensation. LCD display showing electrical values is the same with the Analyzer. In addition, status of capacitors on all the phases can be seen with the special symbols on the display.

Ideal Solution for Imbalanced Loads:

Reactive energy consumed by each phase is recorded separated in systems utilizing electronic meters. Therefore, phase balancing gains more importance. In this case, it is very important to evaluate each phase individually and ensure compensation. FKR Series Reactive Power Control Relay has been developed for this purpose and has the capability of both mono-phase and tri-phase compensation. Users may connect desired number of mono-phase capacitors to the system depending on load balance or variability. The relay evaluates each phase separately and compensates mono-phase capacitors and phases separately.

Calculation of Power Values:

Last 6 reactive power values caused by each step when the relay is enabled are kept in the memory for each capacity. According to first in first out principle, new readings are added to this group of six and oldest readings are disabled. In this way, average of reactive power changes as a result of enablement and disablement of last 6 is taken to find the capacitor value.



Display of Power Values: Current six step is shown in bottom left. For example, power statuses of second six group, that is 7...12 capacities are shown here.

General Adjustments

1- Adjustment of Step Number: The relay may be adjusted to desired step number. Mainly mono-phase step should be utilized in places with dense imbalance. Total number of steps can be adjusted as required. Desired number of mono-phase capacitors allowed by the relay step can be connected.

That is, connection to 24-step relay can be as follows;
 3x1 mono-phase +21 tri-phase,
 3x2 mono-phase +18 tri-phase,
 3x3 mono-phase +15 tri-phase,

 3x8 mono-phase + 0 tri-phase.

2- COSφ operating intervals:

As it is known, reactive penalty rates reduced inductive rate is 0.20 and capacitive rate is 0.15.

If we calculate

For inductive:

If $\tan=0.20$ (q/w), angle = 11.31°

$\cos\phi$ (11.31) = 0.980.

That is, inductive penalty is 0.979.

For capacitive :

If $\tan=0.15$ (q/w), angle= 8.53°

$\cos\phi$ (8.53) = 0.989.

In normal conditions, we recommend 0.14 for inductive and 0.11 for capacitive.

In this case, recommended operating intervals

For inductive:

If $\tan=0.14$ (q/w), angle = 7.969°

$\cos\phi$ (7.969) = 0.990.

That is, inductive area adjustment should be entered as 0.990. (it is COS MIN in our relays.)

For capacitive:

If $\tan=0.11$ (q/w), angle = 6.277°

$\cos\phi$ (6.277) = 0.994.

That is, capacitive area adjustment should be entered as 0.994. (it is COS MAX in our relays.)

3- Initial capacitor power:

It determines sensitivity of the system. This capacitor power has an impact to decide operating compensation functions of the relay or not. If drawn reactive power is lower than 66% of this initial capacitor power, the relay does not enable the capacitor.

4- Operating modes:

0- 11111: The system where each capacitor is at the same power. The relay enables and disables all the capacitors in order according to first in first out principle.

1-12222: The system where only first capacitor is at the half power of others. The relay first takes 1st step to make adjustment. Other capacitors are operated according to first in first out principles.

2-12444: The system where first capacitor is at the half power of the second, and the second is at the half power of others. The relay first tries combinations according to statuses of 1st and 2nd steps. Other capacitors are operated according to first in first out principles.

3-124888: This is similar to Mode 2, but it operates more sensitively. The relay first tries combinations according to statuses of 1st, 2nd and 3rd steps. Other capacitors are operated according to first in first out principles.

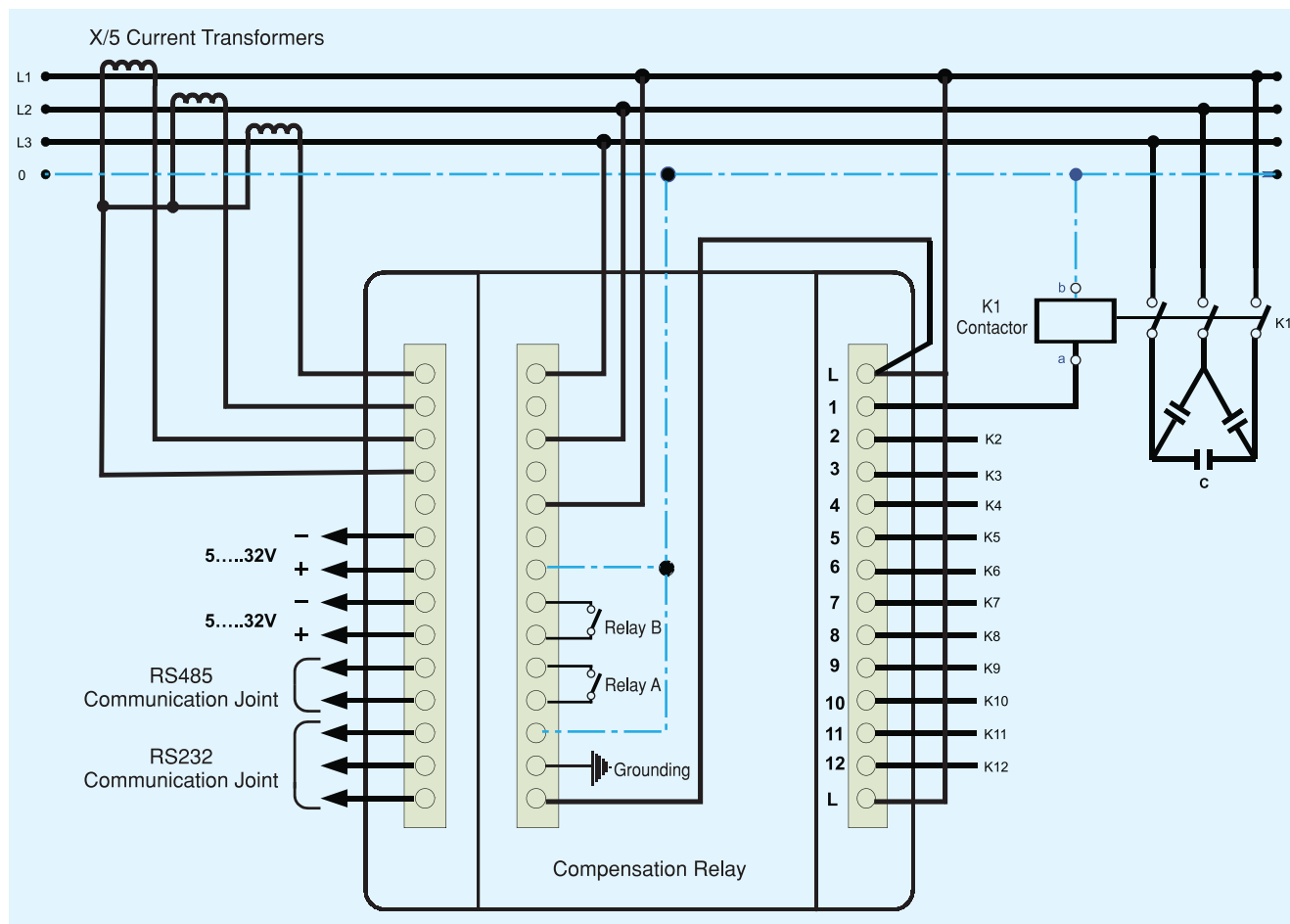
4-Automatic: Capacitor steps may be different in this mode. When the relay is enabled for the first time, all the capacitors are enabled and disabled to calculate their powers. In each enablement and disablement of these steps, control continues to refresh power data. The relay enables or disables the capacitor closest to reactive need of the system.

5- Enablement disablement durations:

Entering enablement disablement durations completely depend on changing speed of the system load. Each enablement disablement operation reduces the system life. Therefore, since discharge duration is not provided to the capacitors in 1-second applications, zero-passing relays should be utilized in order to avoid impact currents and have long service life for capacitor and thyristor switching contactors.

6- Number of banks:

A compensation system, which is made with 20 pieces of 25 kVAR capacitors, is more sensitive than a compensation system made with 10 pieces of 50 kVAR capacitor. When it is considered as a facility, high steps and low capacitor power in enablement and disablement of the capacitors result in less impact current and interference. Therefore, we recommend high step numbers.



Technical Values:

Supply Voltage	: 220V \pm 20%, 50 Hz
Measurement Voltage Input	: 3x300V Phase-Neutral, 50 Hz
Measurement Current Input	: 3x5A, 50 Hz
Power Consumption	: <10VA
Operating Temperature	: -25°C, +65°C
Class	: <1%
Order Code	12 steps : 9HF-DR00-0012
	18 steps : 9HF-DR00-0018
	24 steps : 9HF-DR00-0024

Gain Function:

Gain function may be used in system, where sensitive compensation is required for low loads in panels where big current transformers are utilized. In this way, system may be compensated even when 10A load is drawn at a facility using 2000/5 current transformer.

12 step capacitors total have been used, as 2 mono-phases to each phase and 6 tri-phases in the panel, gain connection diagram of which is given on the next page.

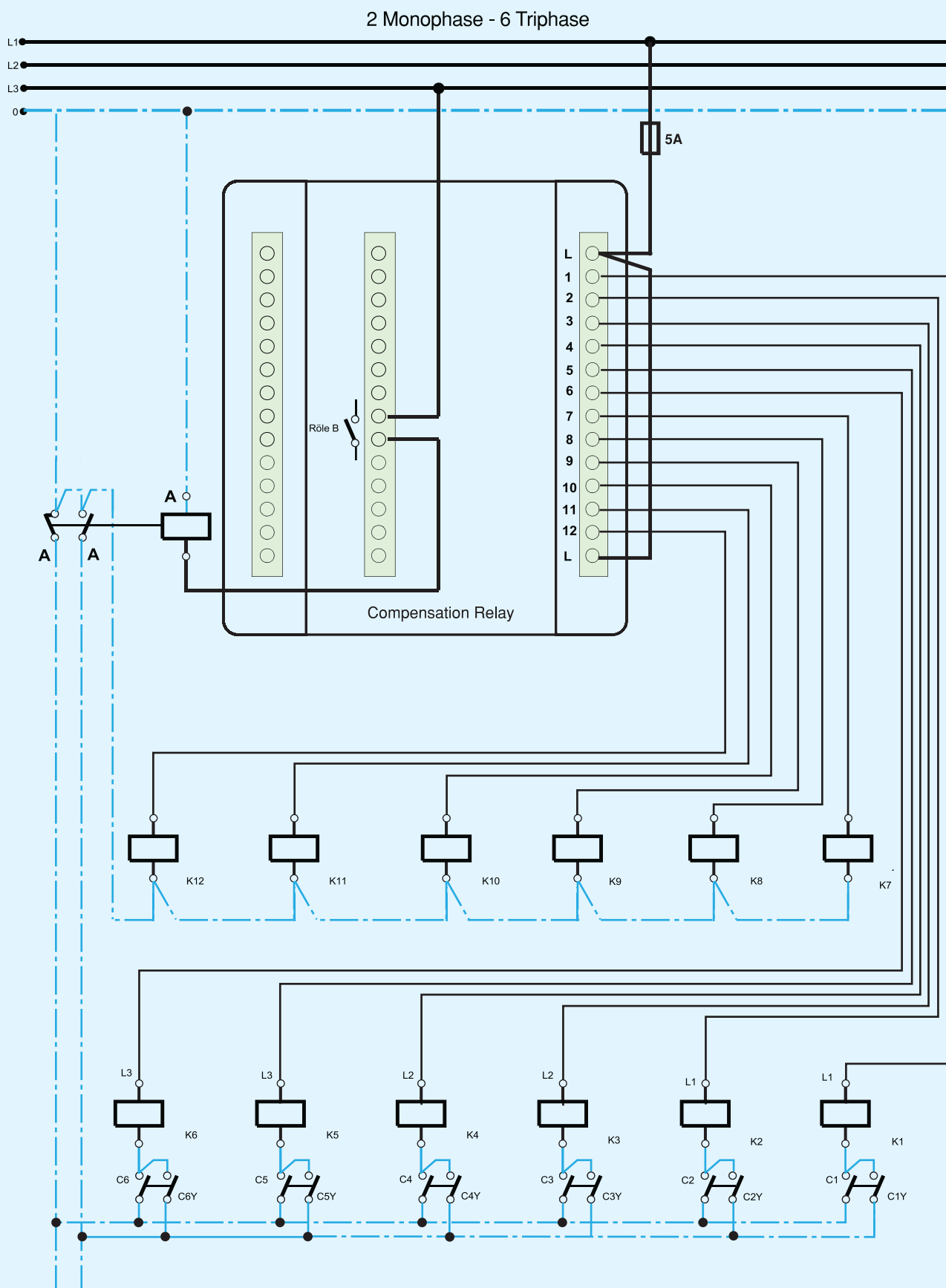
If the connection diagram is examined in detailed, it is seen that extra 6 mono-phase capacitors are used. Extra mono-phase capacitors have been selected at lower power when compared to first 6 capacitors. Now, let's explain what these additional capacitors are used for:

If the current passing through the system is in a measurement interval over 16% of the current transformer primary input (that is, if the current passing through the line in a system with 2000/5 current transformer is at 320 amperes and higher), the compensation relay shall enable and disable C1, C2, C3,, C7, C8,, C12 capacitors. If the current transformer is in a measurement interval below 16% of the current transformer primary input (that is, if the current passing through the line in a system with 2000/5 current transformer is below 320 amperes like 240 amperes), compensation relay shall enable and disable C1Y, C2Y, C3Y, and ... C7, C8,, C12 capacitors.

When the current passing through secondary of the current transformer goes below 16%, "Relay B" contact on FKR240 compensation relay shall be closed. When the relay B contact is closed, contactor A shall get energy. When contactor A gets energy, contacts shall be closed, neutral line of C1, C2,, C6 capacitors shall be broken and neutral line of C1Y, C2Y,, C6Y capacitors shall be connected to the circuit. In this way, when there is a current output below 16% at the current transformer secondary output, capacitors with lower power shall be exchanged with other capacitors until the current goes over 16% again.

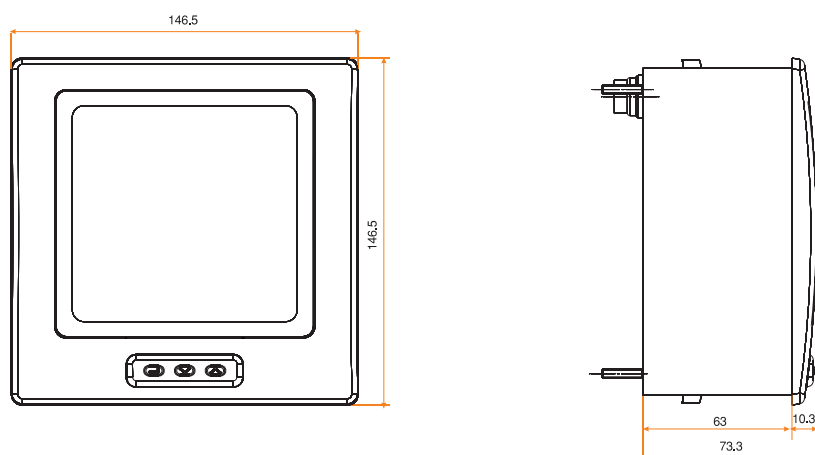
REACTIVE RELAYS

Gain Connection Diagram

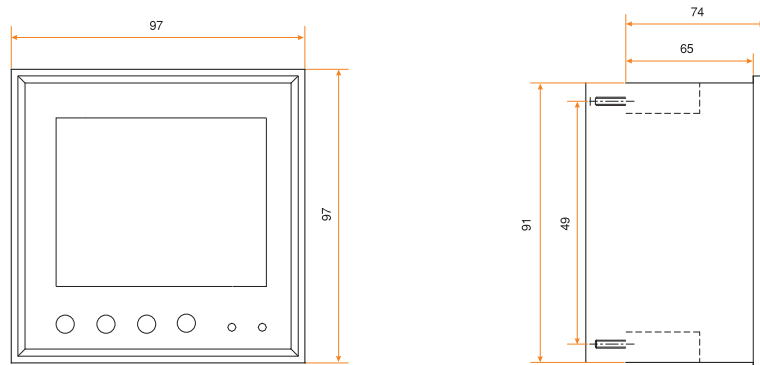


REACTIVE RELAYS

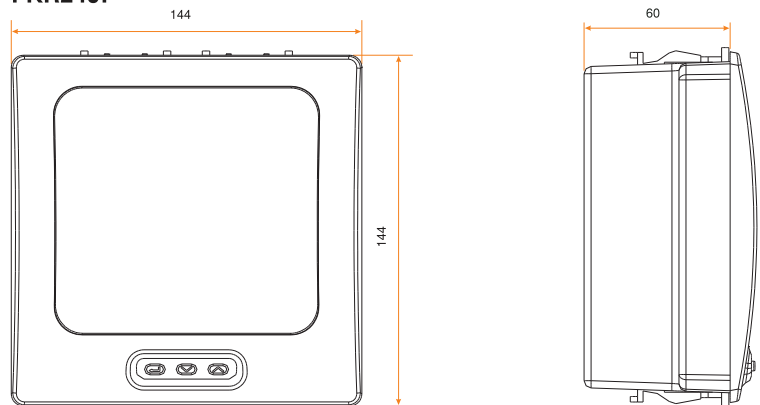
FX5 - FX7 - FX12 / EV144:



EV96:



FKR240:



REACTIVE RELAYS

Modbus Information for FPA50-FPA100-FPA120-FKR240 Devices:

The device is generally established on floating point register system. Therefore, each register is 4 bytes. Since Modbus is established on 2 byte word, a float register is described as two modbus registers. Number 3 and 16 modbus reading and multi-writing functions can be applied to the device; since floating point is 2 registers long, 16 multi-writing functions have been utilized.

Reading Format

Request

Device No	Function	Starting Address HI	Starting Address LO	Number of Registers HI	Number of Registers LO	CRC HI	CRC LO
-----------	----------	---------------------	---------------------	------------------------	------------------------	--------	--------

Response

Device No	Function	Number of Bytes	DATA HI	DATA LO	..	CRC HI	CRC LO
-----------	----------	-----------------	---------	---------	----	--------	--------

Sample: Read Phase 12 and Phase 23 voltages

Request

Device No	Function	Starting Address HI	Starting Address LO	Number of Registers HI	Number of Registers LO	CRC HI	CRC LO
1	3	0	3	0	4	180	9

Response

Device No	Function	Number of Bytes	U12 reg4				U23 reg5				CRC HI	CRC LO
			DATA HI2	DATA LO2	DATA HI1	DATA LO1	DATA HI2	DATA LO2	DATA HI1	DATA LO1		
1	3	8	0	0	0	0	0	0	0	0	149	215

Writing Format:

Request

Device No	Function	Starting Address HI	Starting Address LO	Number of Registers HI	Number of Registers LO	DATA HI	DATA LO	..	CRC HI	CRC LO
-----------	----------	---------------------	---------------------	------------------------	------------------------	---------	---------	----	--------	--------

Response

Device No	Function	Starting Address HI	Number of Registers HI	Number of Registers LO	CRC HI	CRC LO
-----------	----------	---------------------	------------------------	------------------------	--------	--------

Sample: Let's change voltage and current transformer rates

Request

Device No	Function	Starting Address HI	Starting Address LO	Number of Registers HI	Number of Registers LO	DATA HI2	DATA LO2	DATA HI1	DATA LO1	CRC HI	CRC LO
1	16	0	100	0	2	0	0	0	0	180	9

Response

Device No	Function	Starting Address HI	Starting Address LO	Number of Registers HI	Number of Registers LO	CRC HI	CRC LO
1	3	0	100	0	2	149	215

REACTIVE RELAYS

Register Map for FPA50-FPA100-FPA120-FKR240 Devices:

The device is designed in accordance with IEEE 754 standard, 32-bit floating, comma number standard. In this context, communication protocol has been arranged in compliance with 16-bit MODBUS structure. Curve information have different byte lengths and reading request should be made for bytes with similar lengths at the same time! Applicable MODBUS commands are 3 and 16. Orange areas are the registers used in compensation relay.

Reg. No.	Number of Bytes	Function	Description	W/R	Reg. No.	Number of Bytes	Function	Description	W/R
1	4	U1	Phase1 neutral voltage	R	53	4	BNK1	Hidden (compensation)	R
2	4	U2	Phase2 neutral voltage	R			BNK2	Hidden (compensation)	R
3	4	U3	Phase3 neutral voltage	R			BNK3	Hidden (compensation)	R
4	4	U12	Phase1, Phase2 voltage	R			BNK4	Hidden (compensation)	R
5	4	U23	Phase2, Phase3 voltage	R	54	4	KOND1	Hidden (compensation1 step power)	R
6	4	U31	Phase3, Phase1 voltage	R	55	4	KOND2	Hidden (compensation2 step power)	R
7	4	I1	Phase 1 Current	R	56	4	KOND3	Hidden (compensation3 step power)	R
8	4	I2	Phase 2 Current	R	57	4	KOND4	Hidden (compensation4 step power)	R
9	4	I3	Phase 3 Current	R	58	4	KOND5	Hidden (compensation5 step power)	R
10	4	kW1	Phase1 Active power	R	59	4	KOND6	Hidden (compensation6 step power)	R
11	4	kW2	Phase2 Active power	R	60	4	KOND7	Hidden (compensation7 step power)	R
12	4	kW3	Phase3 Active power	R	61	4	KOND8	Hidden (compensation8 step power)	R
13	4	kR1	Phase1 Reactive power	R	62	4	KOND9	Hidden (compensation9 step power)	R
14	4	kR2	Phase2 Reactive power	R	63	4	KOND10	Hidden (compensation10 step power)	R
15	4	kR3	Phase3 Reactive power	R	64	4	KOND11	Hidden (compensation11 step power)	R
16	4	cos 1	Phase1-1 skip	R	65	4	KOND12	Hidden (compensation12 step power)	R
17	4	cos 2	Phase1-2 skip	R	66	4	KOND13	Hidden (compensation13 step power)	R
18	4	cos 3	Phase1-3 skip	R	67	4	KOND14	Hidden (compensation14 step power)	R
19	4	PF 1	Phase1 power factor	R	68	4	KOND15	Hidden (compensation15 step power)	R
20	4	PF 2	Phase2 power factor	R	69	4	KOND16	Hidden (compensation16 step power)	R
21	4	PF 3	Phase3 power factor	R	70	4	KOND17	Hidden (compensation17 step power)	R
22	4	kVA1	Phase1 apparent power	R	71	4	KOND18	Hidden (compensation18 step power)	R
23	4	kVA2	Phase2 apparent power	R	72	4	KOND19	Hidden (compensation19 step power)	R
24	4	kVA3	Phase3 apparent power	R	73	4	KOND20	Hidden (compensation20 step power)	R
25	4	kW1e	Phase1 export power	R	74	4	KOND21	Hidden (compensation21 step power)	R
26	4	kW2e	Phase2 export power	R	75	4	KOND22	Hidden (compensation22 step power)	R
27	4	kW3e	Phase3 export power	R	76	4	KOND23	Hidden (compensation23 step power)	R
28	4	EW	Total power	R	77	4	KOND24	Hidden (compensation24 step power)	R
29	4	EWi	Total import power	R					R
30	4	EWe	Total export power	R					R
31	4	ERI	Total inductive power	R	91	128	U1,I1	U1,I1,...U127,I127 signed char	R
32	4	ERc	Total capacitive power	R	92	128	U2,I2	U1,I1,...U127,I127 signed char	R
33	4	Er	Total reactive power	R	93	128	U3,I3	U1,I1,...U127,I127 signed char	R
34	4	Ecos	Average phase skip	R					
35	4	EPF	Average power factor	R					
36	4	F + Inp.	2 byte FRK/10+1 byte:128 inp1,32 inp2,1 byte hidden	R					
37	4	kWhi1	Phase1 energy import	R	101	4	VT+CT	Integer voltage transformer rate , integer current transformer rate	W/R
38	4	kWhi2	Phase2 energy import	R	102	4	SURE	Hidden (enablement duration 1.disablement 1.enablement duration 3.disablement duration)	W/R
39	4	kWhi3	Phase3 energy import	R	103	4	B.AD,MODE	Hidden (bank number 1. Bank number 3, model1)	W/R
40	4	kWhe1	Phase1 energy import	R	104	4	ILK KVar	Hidden first capacitor power (Monophase)	W/R
41	4	kWhe2	Phase2 energy import	R	105	4	ILK KVar	Hidden first capacitor power (Threephase)	W/R
42	4	kWhe3	Phase3 energy import	R	106	4	Min Cos 1	Hidden min. mono-phase cos value shall be divided into long 1000	W/R
43	4	kRLh1	Phase1 inductive energy	R	107	4	Max Cos 1	Hidden max. mono-phase cos value shall be divided into long 1000	W/R
44	4	kRLh2	Phase2 inductive energy	R	108	4	Min Cos 3	Hidden min. triphase cos value shall be divided into long 1000	W/R
45	4	kRLh3	Phase3 inductive energy	R	109	4	Max Cos 3	Hidden max. triphase cos value shall be divided into long 1000	W/R
46	4	kRCh1	Phase1 capacitive energy	R	110	4	P+R+G	integer PORT + Restart (komp!) + GPRS mode	W/R
47	4	kRCh2	Phase2 capacitive energy	R	111	4	IP	IP1 + IP2 + IP3 + IP4	W/R
48	4	kRCh3	Phase3 capacitive energy	R	112	4	T+B+Cn	Integer Timeout (x10ms) + BAUD + Device no (1-250)	W/R
49	4	EWHi	Total import energy	R					
50	4	EWHe	Total export energy	R	121	4	BANK on/off	Hidden each byte right 6 bit x 4 capacitor ON/OFF	W/R
51	4	ELh	Total inductive energy	R	122	4	OUTPUT	1. byte 3=1. relay on 4=2.relay on 5=1. and 2. relay on	W/R
52	4	ECh	Total capacitive energy	R					

RELAYS



Phase Protection Relays



FMFK



MTPR1



FSMK

Time Relays



FT-30

Counters



FS72

Thermostats



FDT72



FDT96

Liquid Level Relay



FSSR

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Pic-1

Connection diagram:

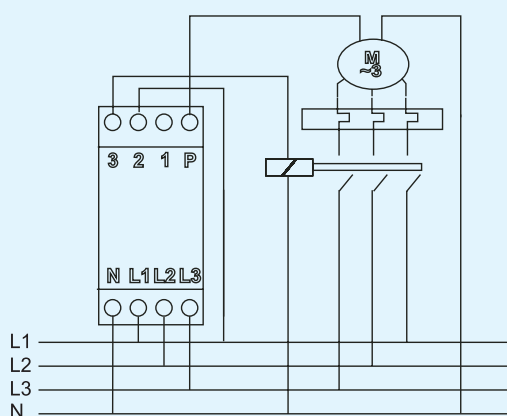


Fig-1

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 energise 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:

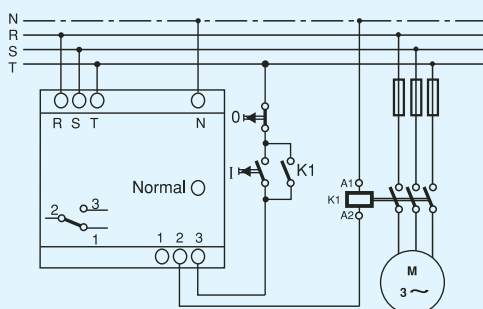


Fig-2

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



Pic-3

FSMK Phase Sequence and Motor Protection Relay

Connection Diagram:

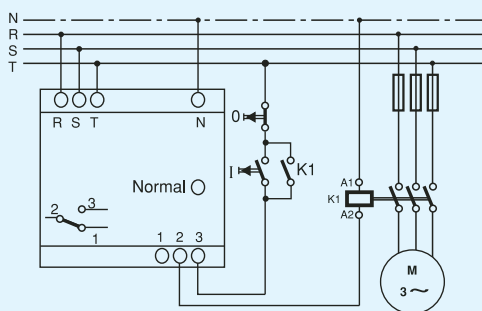


Fig-3

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.

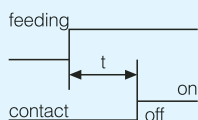
Technical Specifications:

Operating voltage	: 380 V AC
Operating interval	: (0,8-1,2) x Un
Operating frequency	: 50 - 60 Hz
Relay contacts	: 1 NA, 1 NK
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	: 0,15 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°C, + 60°C
Time adjustment	: 0-30 sec
Order code	: 9HD-A0001-0030



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

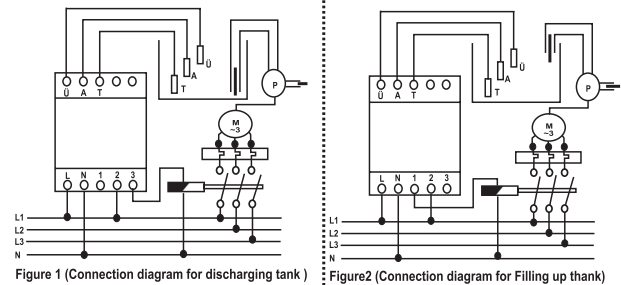
The freestanding electrodes which is made by stainless steel and covered by plastic are used in wells. In case which tank or frame are made by metal, this steel electrode can be mounted to metal body of tank. The boiler type of electrode should be used for controlling liquid levels under pressure in 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.

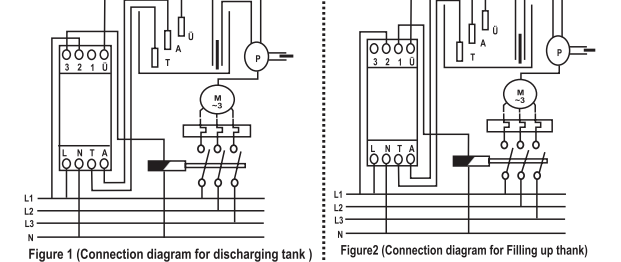
P.S.2 : In case of using 2 electrodes, Electrode 1 : Bottom, Electrode 2 : Upper. Upper and lower electrodes are shorted.

P.S. 3: LLR cannot be used in flammable liquids.

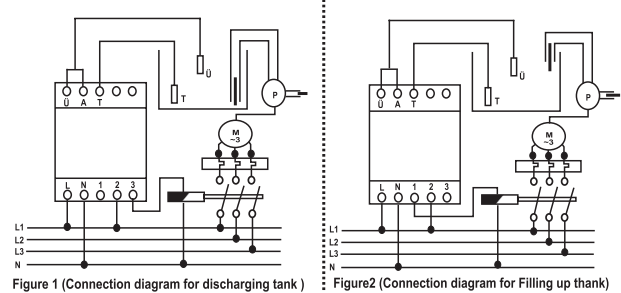
Connection Diagram (FSSR02 and FSSR03)



FSSR04



2 Using with electrode





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

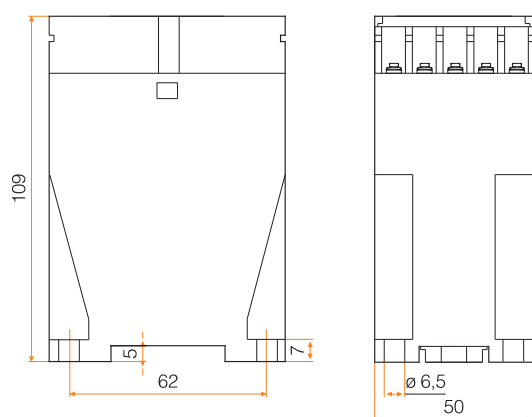
Federal Thermostats, which are manufactured in accordance with CE, operated in two manners as on-off and time-proportional control method. In On-off control method, when heat achieves the set value, thermostat relay is opened, when temperature value goes down to the set non-hysteria value, relay is closed 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:

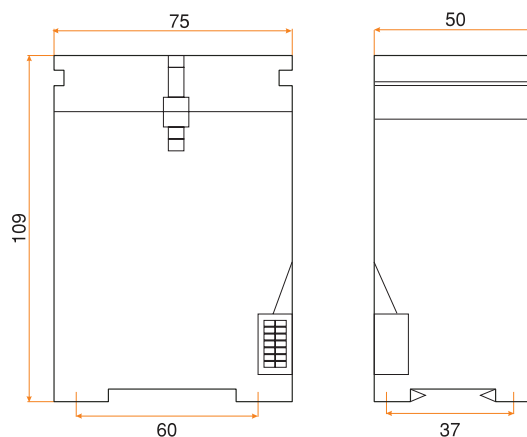
Operating voltage	: 220 V. AC. /50-60 Hz.
Measurement control interval	: 0-400°C
Power consumption	: ≤ 3 W
Ambient temperature	: -10°C, +60°C
Temperature compensation	: 0-50°C
Hys interval	: 2°C, - 20°C (While On-Off control method is employed)
Control Period	: 10 sec. - 200 sec.
Control Output	: Relay (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

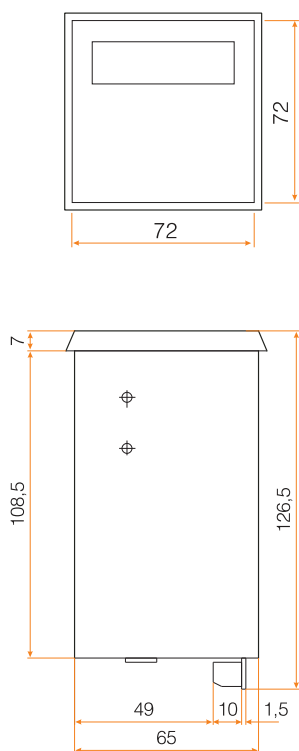
Motor Protection, Phase Sequence, Liquid Level Relay:



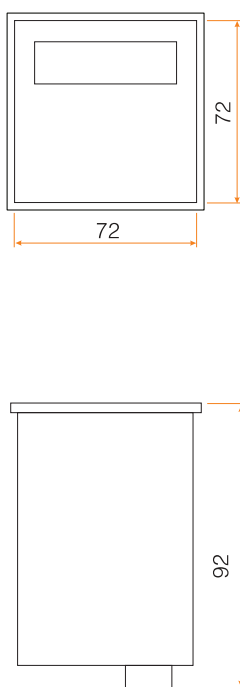
**Phase Sequence and Motor Protection Relay:
Motor Phase Protection Relay:
Time Relay:**



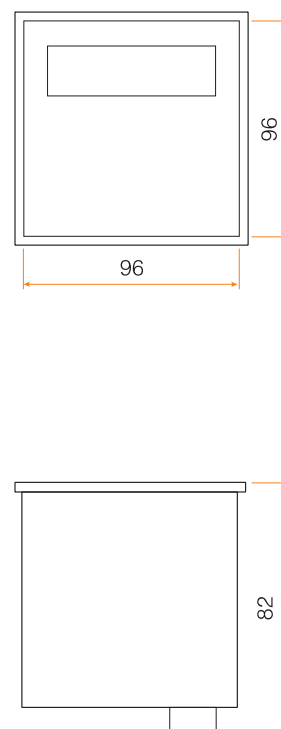
Counter



Thermostat (FDT72) :



Thermostat (FDT96) :



MOTOR PROTECTION SWITCHES



Motor Protection Switches



FMK25
0,16A / 32A

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Order Codes	2
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IEC / EN 60947-4-1
CE

Mounting Position : With box IP20 / without box IP55
Altitude : 2000 m (max)
Relative Humidity : %50 (40°C) , %90 (20°C)
Ambient Temperature : between -5°C and +40°C
Pollution Degree : III
Utilization Category : 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.

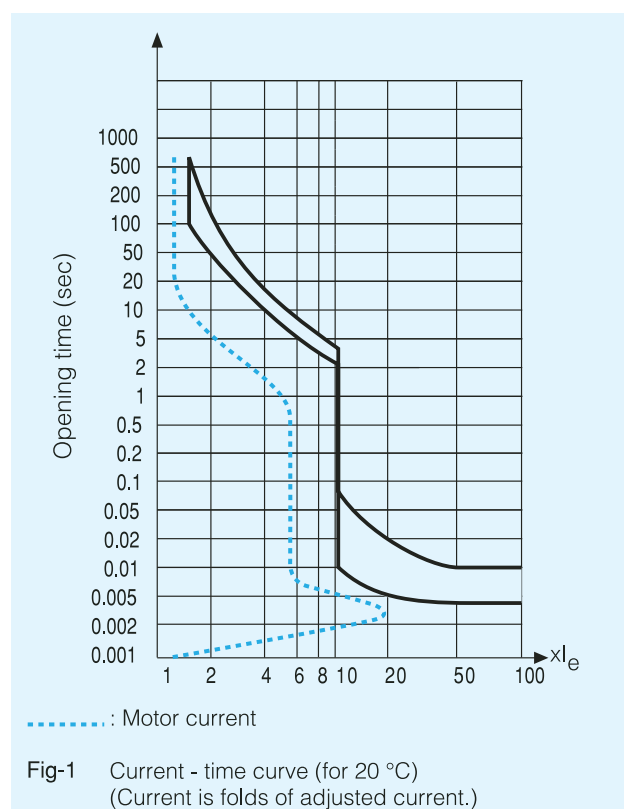
They can be simply and rapidly assembled on 35 mm assembly rail and fixed by using two screws with a special apparatus. FEDERAL FMK 25 type switches are used in protection of electrical motors up to 11 kW (380/400 V). They meet all the requirements of users thanks to wide variety of accessories.

Motor Protection Switches Selection Table:

Standard motor powers					Thermal adjustment area
1 phase	3 phase				
220 V 230 V	220 V 230 V	380 V 400 V	500 V	600 V 690 V	
kW					A
—	—	0,02	—	0,06	0,1...0,16
—	—	0,06	0,06	0,09	0,16...0,25
—	0,06	0,09	0,12	0,18	0,25...0,4
—	0,09	0,12	0,25	0,25	0,4...0,63
0,06...0,09	0,09...0,12	0,18...0,25	0,37	0,37...0,55	0,63...1
0,12	0,18...0,25	0,37...0,55	0,55...0,8	0,75...1,1	1...1,6
0,18...0,25	0,37	0,75...1,1	1,1	1,5	1,6...2,5
0,37	0,55...0,8	1,1...1,5	1,5...2,2	2,2...3	2,5...4
0,55...0,75	1,1...1,5	2,2...2,5	3	4	4..6,3
1,1...1,5	1,5...2,5	3...4	4...5,5	5,5...7,5	6,3...10
1,3...2	2...3,5	4...5,5	5,8...7,5	9...11	9...12
2,2	3...4	5...7,5	7,5...9	12	10...16
3,2	3...5	5...7,6	7,5...10	15	13...18
3	5,5	9	11...12,6	17	17...23
—	5,5...7,5	11...12,5	15	18,5	20...25
—	7,5...8,4	15	19	22,0	25...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	0,1...32A
Electrical life (according to AC3 class)		100.000
Min. max. tightening torque	Nm	1,5...2,5
Min. max. connection sections	mm ²	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 ²	0,75...2,5

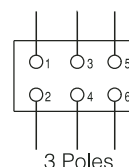
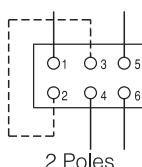
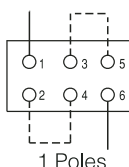


MOTOR PROTECTION SWITCHES






Type	Current setting range (A)	Mag. trip cur. (A)	Short-circuit breaking capacity $I_{cu} = I_{cs} = I_q$ (kA)				Max. front protection fuse gL, gG (A) (for $I > I_{cu}$)				Order Code
			220-240 V	380-415 V	500 V	660-690 V	230 V	400 V	500 V	690 V	
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	50	9LA-00000-1600
FMK 25-18	13...18	223	6	4	2,5	2	80	80	63	50	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

Note : Our products are being calibrated to 40 °C. On request of customer, this value can be changed.

Connection Diagram

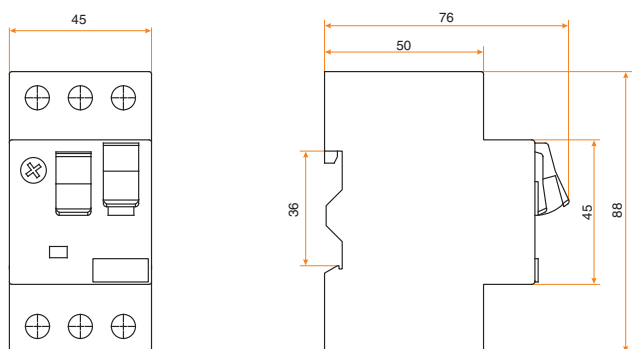


Accessories

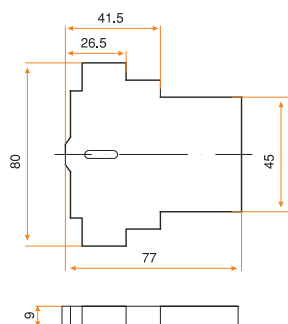
	Accessory name : Auxiliary switch Weight : 35 g		
	Type	Contact position	Order Code
	FMK F-20	2NO	8LA-A0020-0000
	FMK F-10	1NO	8LA-A0010-0000
	FMK F-01	1NC	8LA-A0001-0000
	FMK F-11	1NO+1NC	8LA-A0011-0000
	Accessory name : Under-voltage release Weight : 65 g		
	Type	Operating Voltage (50 Hz)	Order Code
	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
	FMK DGB-380	380 V	8LA-B0000-0380
	Accessory name : Shunt release Weight : 65 g		
	Type	Operating Voltage (50 Hz)	Order Code
	FMK A-24	24 V	8LA-C0000-0024
	FMK A-110	110 V	8LA-C0000-0110
	FMK A-220	220 V	8LA-C0000-0220
	FMK A-240	240 V	8LA-C0000-0240
	Accessory name : Emergency stop push-button		
	Weight : 35 g		
	Type : FMK NAT		
	Order code : 8LA-D0000-0000		
	Accessory name : Enclosure		
	Weight : 240 g		
	Type : FMK 55 ENC		
	Protection degree : IP 55		
	Order code : 8LA-E0000-0000		

MOTOR PROTECTION SWITCHES

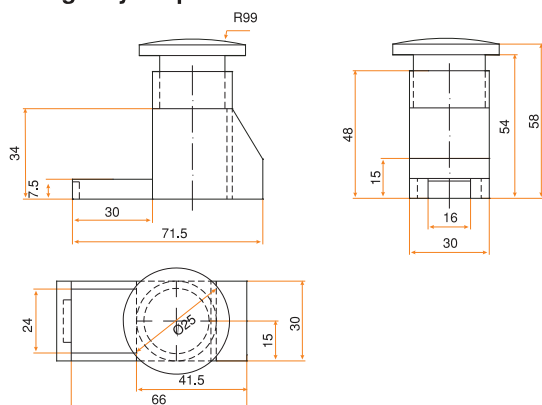
Motor Protection Switch:



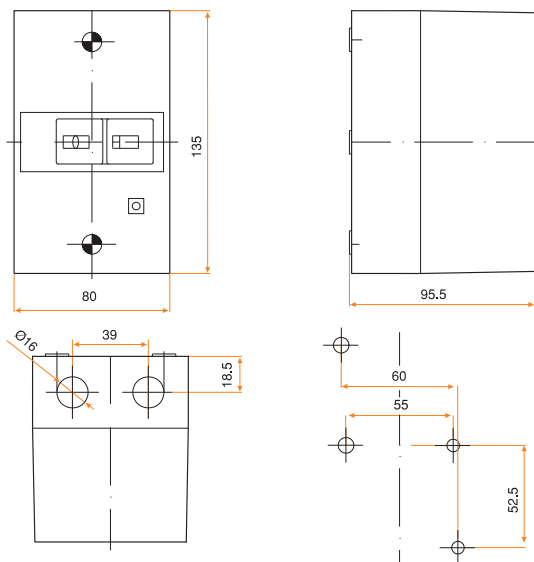
Auxiliary Contact:



Emergency Stop Button:



Protective Box:



FIBER GLASS REINFORCED POLYESTER CABINET



Fiber Glass Reinforced Polyester Cabinet



CONTENTS

Features	1
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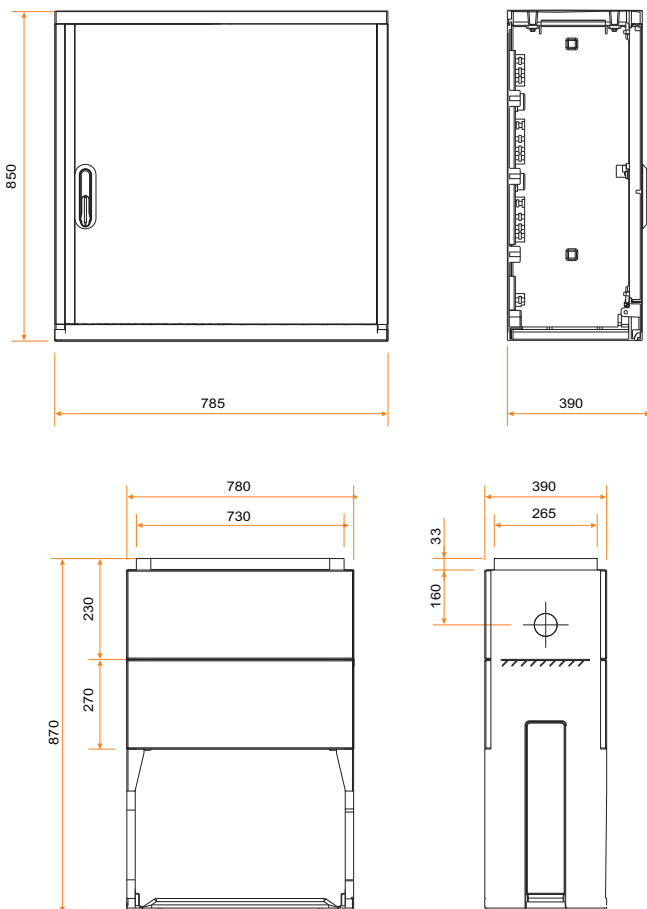
FIBER GLASS REINFORCED POLYESTER CABINET

When fibreglass 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

Width	: 785
Height	: 850
Depth	: 320
Base Length	: 900
IP Protection	: IP54
Thickness	: 3,5-4 mm.
Federal Thickness	: 5-5,5 mm.
Protection weight (kg)	: 25,6
Base weight (kg)	: 19,5
Total weight (kg)	: 42



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, FMS and RCCB are connected to the input of S type EasyPan Distribution Board

Ready Bus Systems



EasyPan with F11 Output

Main Busbar Current 250A-400A-630A



EasyPan with F31 Output

Main Busbar Current 250A-400A-630A

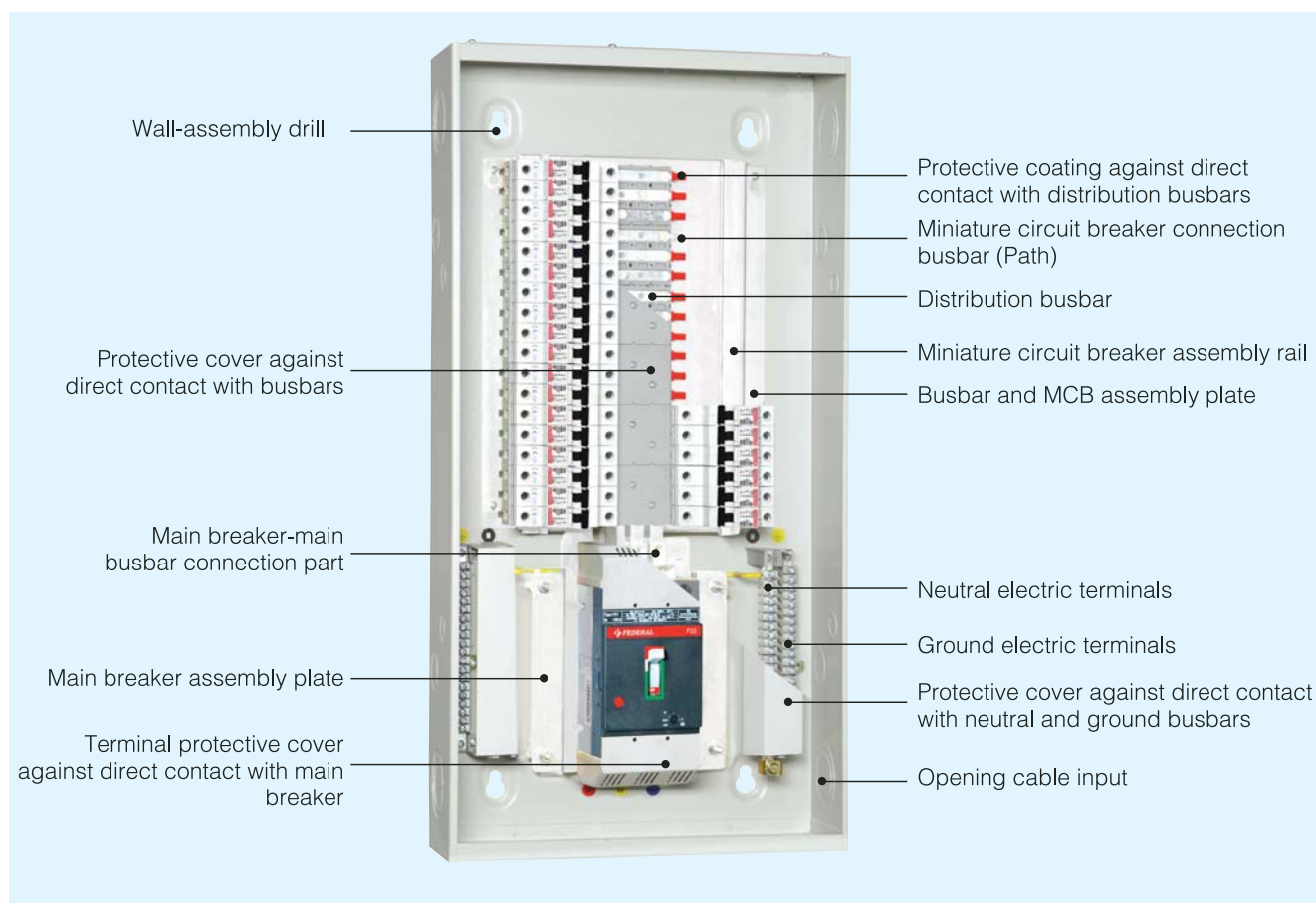
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All these given information are general. We have always right to change them.

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.

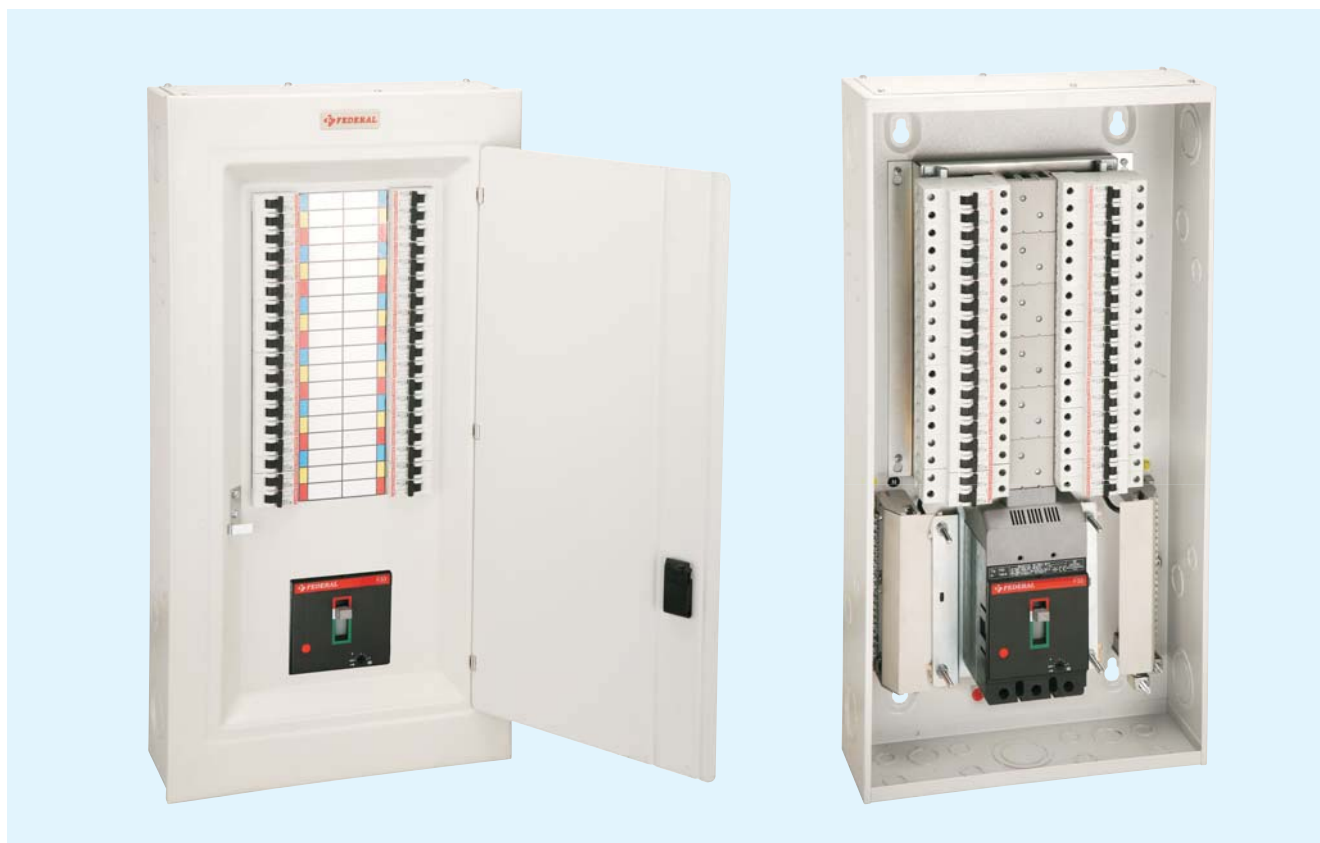


Features:




- 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 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			F10	F11	F12	F21	F31	F32	F33
Rated Current - In (40°C or 55°C) A			63 ...125		63 ...160	63 ...160	100 ...250		
Rated current adjustment range - I _I A			Fixed		(0,8-1) In	(0,7-1) In	(0,7-1) In		
Rated ultimate short-circuit breaking capacity - I _{cu}									
(a.c.) 50-60 Hz	3x380/415 V	(kA rms)	20	25	25	25	35	50	70
(a.c.) 50-60 Hz	3x220/240 V	(kA rms)	25	35	35	50	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 (F10 ... F33),
 □ : Ambiance temperature (20°C:1, 30°C:2, 40°C:3, 50°C:4, 55°C:5),
 ◇◇◇ : Rated current of circuit breaker (016 225).
 For example; Surface mounted, 30-way, F33 225A circuit breaker (Ambient temperature 40°C)
 EasyPan order code: 9VB-F33U1-3225
 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				
Type		FK2	FK4	FK4L
Number of poles		2	4	
Rated current	A	25, 40, 63		80, 100, 125
Nominal residual current	mA	30, 300		
Fused short circuit breaking capacity	kA _{rms}	10		

Order Codes

Assembly type			Flush Mounted	Surface Mounted
Type	Fused Short circuit breaking capacity (kA _{rms}) 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



Input Circuit: Miniature Circuit Breakers

TS 5018 TS EN 60898-1 / IEC 60898-1 CE		
Type	FM3 - FM6 - FM10	FM10L
Characteristics	B, C	C
Short circuit breaking capacity kA_{rms}	3 - 6 - 10	10
Rated current A	2 ... 63	80 ... 125
Number of poles	1, 2, 3, 4	1, 3, 4

Input Circuit: Switches:

TS EN 60947-3 / IEC 60947-3 CE	
Type	FMS
Rated Current (In)	A 63, 80, 100
Number of poles	2, 3
Short circuit breaking capacity kA_{rms}	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 kA_{rms}	3 kA	6 kA	10 kA
B Tipi	9EB-B03△□-00◇◇	9EB-B06△□-00◇◇	9EB-B10△□-00◇◇
C Tipi	9EB-C03△□-00◇◇	9EB-C06△□-00◇◇	9EB-C10△□-00◇◇

△ : Ambiance temperature (20°C:2, 30°C:3, 40°C:4, 50°C:5, 55°C:6)

□ : Number of poles (1, 2, 3, 4)

◇◇ : Rated current of MCB (06...63)

Example: Order code of 1 pole, B type 16A (10kA) miniature circuit breaker (ambient temperature 10°C): 9EB-B1041-0016

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














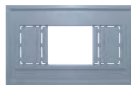

EasyPan Order Codes with direct connection

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
EP3S	36	9SB-DDDA1-0000	9SB-DDDU1-0000
	42	9SB-DDDA2-0000	9SB-DDDU2-0000

Power is supplied to panels by adding connection part to main busbars without using main breaker.

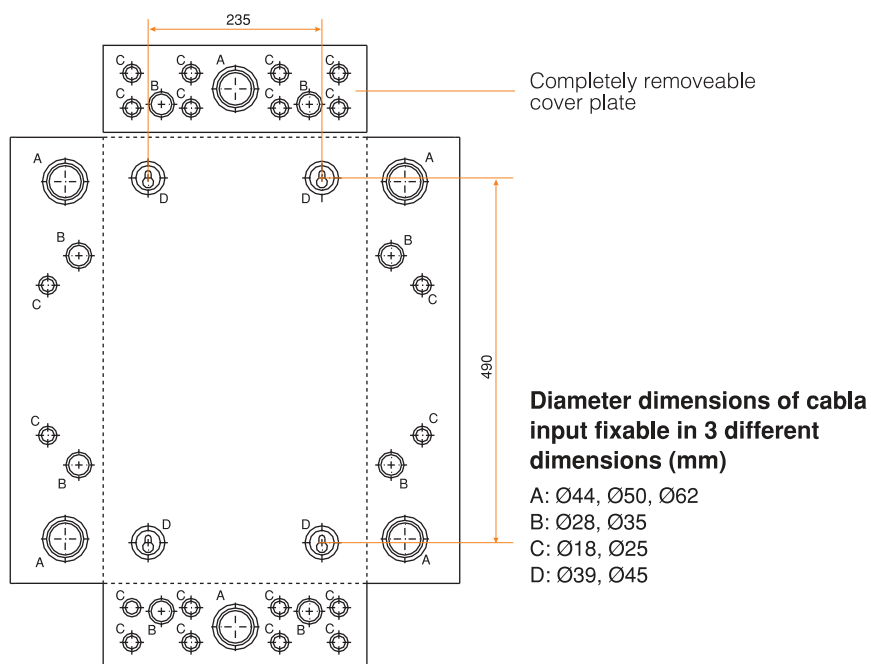
Please call our company for other combinations

- Short circuit breaking capacity of EasyPan distribution boards is equivalent to short circuit which main breaker used in boards can break.

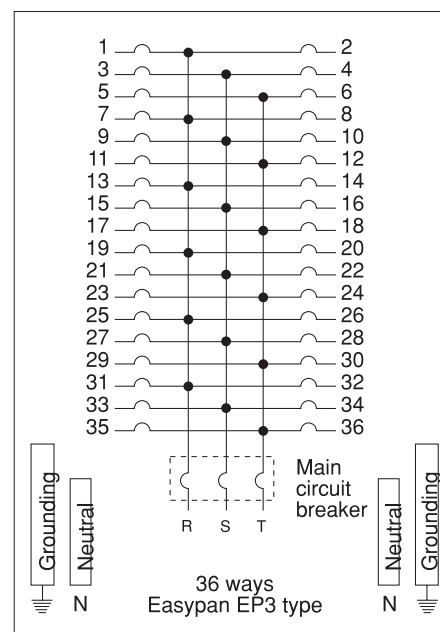
Accessories and order codes:				
MCB holding board with main busbar		Number of ways	Order codes	
		12	YP-0021	
		18	YP-0022	
		24	YP-0023	
		30	YP-0024	
		36	YP-0025	
Distribution busbar		Number of ways	Order codes	
			2 Bars	4 Bars
		12	YP-D212	YP-D412
		18	YP-D218	YP-D418
		24	YP-D224	YP-D424
		30	YP-D230	YP-D430
Neutral + ground terminals		Number of ways	Order codes	
		12	YP-0026	
		18	YP-0027	
		24	YP-0028	
		30	YP-0029	
		36	YP-0030	
Protective cover for upper terminal		Type of main circuit breaker	Order codes	
		F10, F11, F12	YP-0031	
		F21	YP-0032	
		F31, F32, F33	YP-0033	
		2 pole FK2 (30mA, 300mA)	YP-0034	
		4 pole FK4 (30mA - 300mA)	YP-0035	
Main breaker-main busbar connection parts		Type of main circuit breaker	Order codes	
		F10, F11, F12	YP-0039	
		F21	YP-0040	
		F31, F32, F33	YP-0041	
		2 pole FK2 (30mA, 300mA), FMS	YP-0042	
		4 pole FK4 (30mA - 300mA)	YP-0043	
MCB and RCCB assembly rail		Type	Order codes	
		FMS	YP-0045	
		FK3 - FK30	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

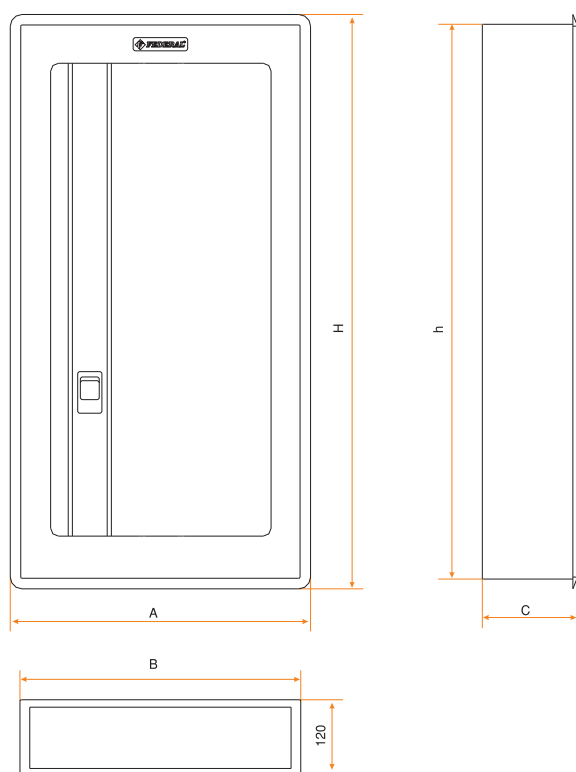


Sample Connection Diagram



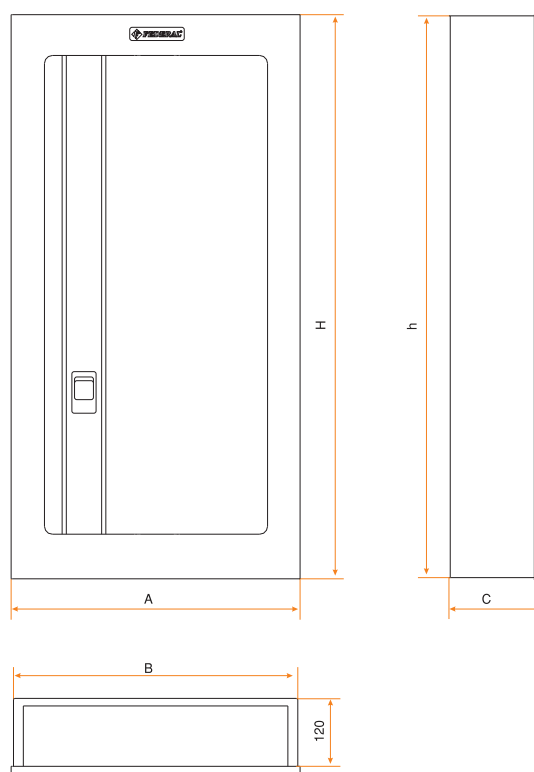
Technical Drawing

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

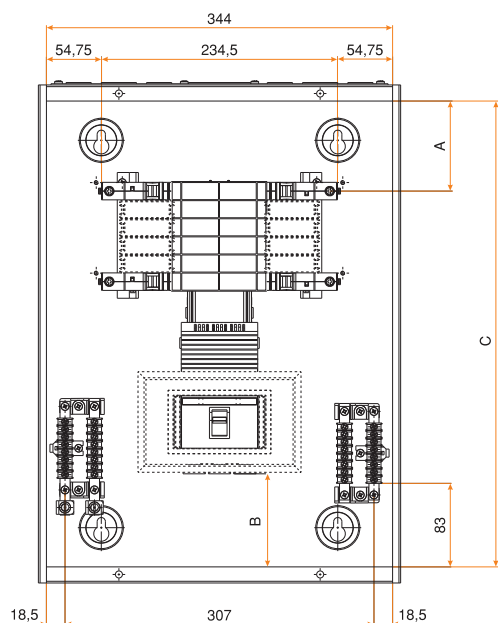


Surface Mounted	A	B	C	H	h
EP1	365	360	120	500	495
EP1S	335	310	110	415	410
EP2	365	360	120	610	605
EP2S	335	310	110	525	520
EP3	365	360	120	715	710
EP3S	335	310	110	635	630

EasyPan DISTRIBUTION BOARDS

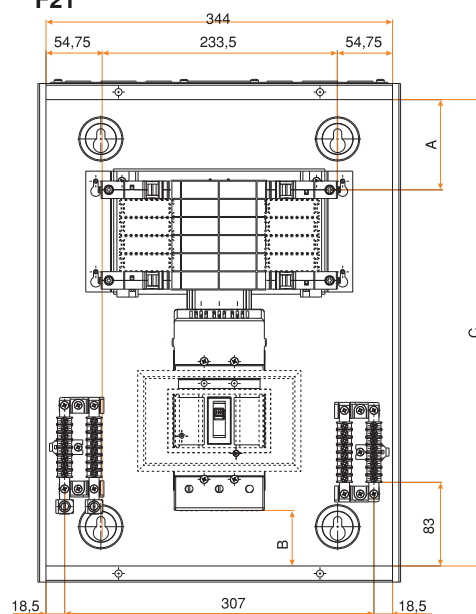
Calde space distances for different panel applications

F10 - F11



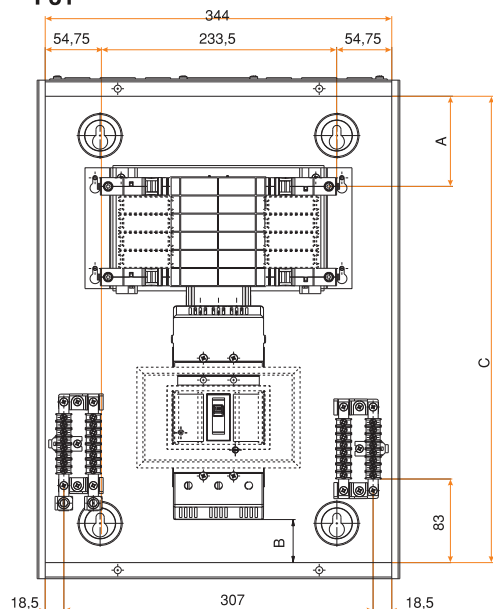
Type	A	B	C
EP1 12 ways	90	92	460
EP1 18 ways			
EP2 24 ways	90	92	570
EP2 30 ways			
EP3 36 ways	90	92	675
EP3 42 ways			

F21



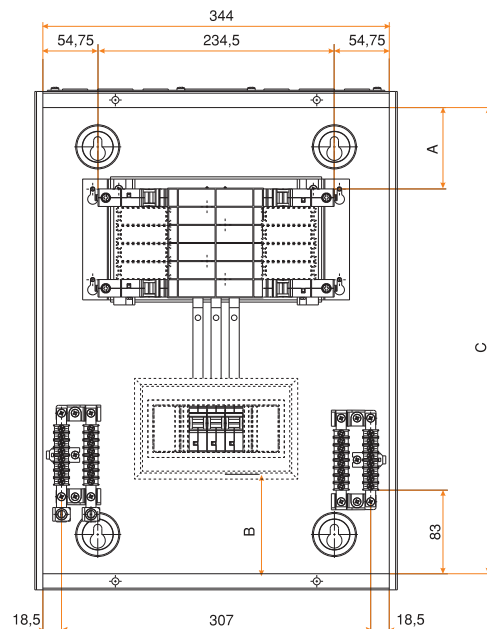
Type	A	B	C
EP1 12 ways	90	57	460
EP1 18 ways			
EP2 24 ways	90	57	570
EP2 30 ways			
EP3 36 ways	90	57	675
EP3 42 ways			

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			

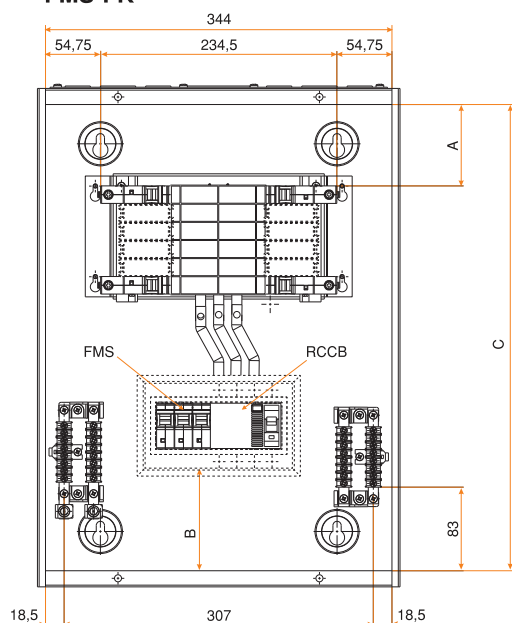
FMS



Type	A		B		C	
	EP	EPS	EP	EPS	EP	EPS
EP1	12 ways	90	87	100	85	460
	18 ways	90	33	100	85	460
EP2	24 ways	90	87	100	85	570
	30 ways	90	33	100	85	570
EP3	36 ways	90	87	100	85	675
	42 ways	90	33	100	85	675

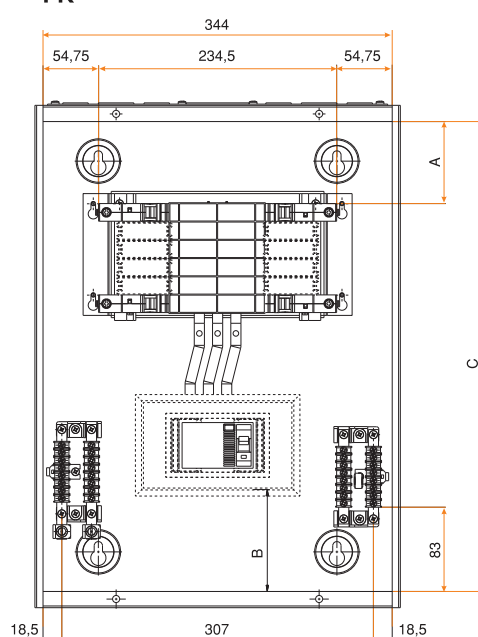
EasyPan DISTRIBUTION BOARDS

FMS-FK



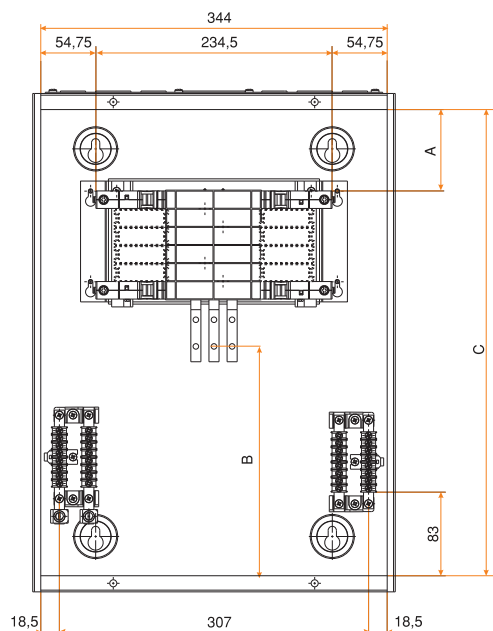
Type		A		B		C	
		EP	EPS	EP	EPS	EP	EPS
EP1	12 ways	90	87	100	85	460	375
	18 ways	90	33	100	85	460	375
EP2	24 ways	90	87	100	85	570	485
	30 ways	90	33	100	85	570	485
EP3	36 ways	90	87	100	85	675	595
	42 ways	90	33	100	85	675	595

FK



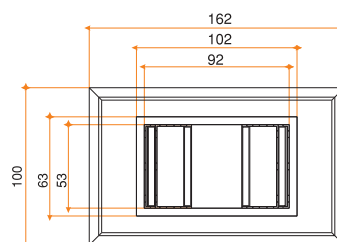
Type		A		B		C	
		EP	EPS	EP	EPS	EP	EPS
EP1	12 ways	90	87	100	85	460	375
	18 ways	90	33	100	85	460	375
EP2	24 ways	90	87	100	85	570	485
	30 ways	90	33	100	85	570	485
EP3	36 ways	90	87	100	85	675	595
	42 ways	90	33	100	85	675	595

Direct Connection

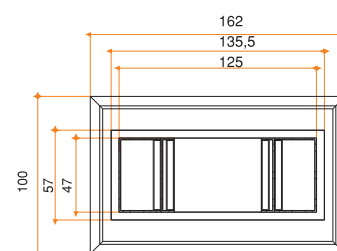


Type		A		B		C	
		EP	EPS	EP	EPS	EP	EPS
EP1	12 ways	90	87	200	170	460	375
	18 ways	90	33	200	170	460	375
EP2	24 ways	90	87	200	170	570	485
	30 ways	90	33	200	170	570	485
EP3	36 ways	90	87	200	170	675	595
	42 ways	90	33	200	170	675	595

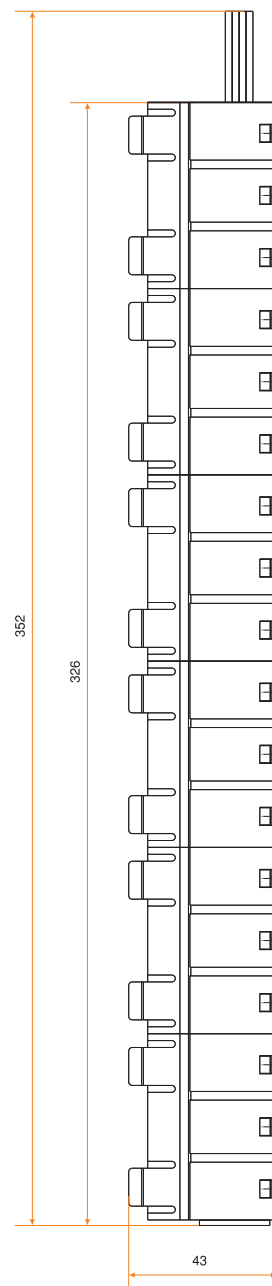
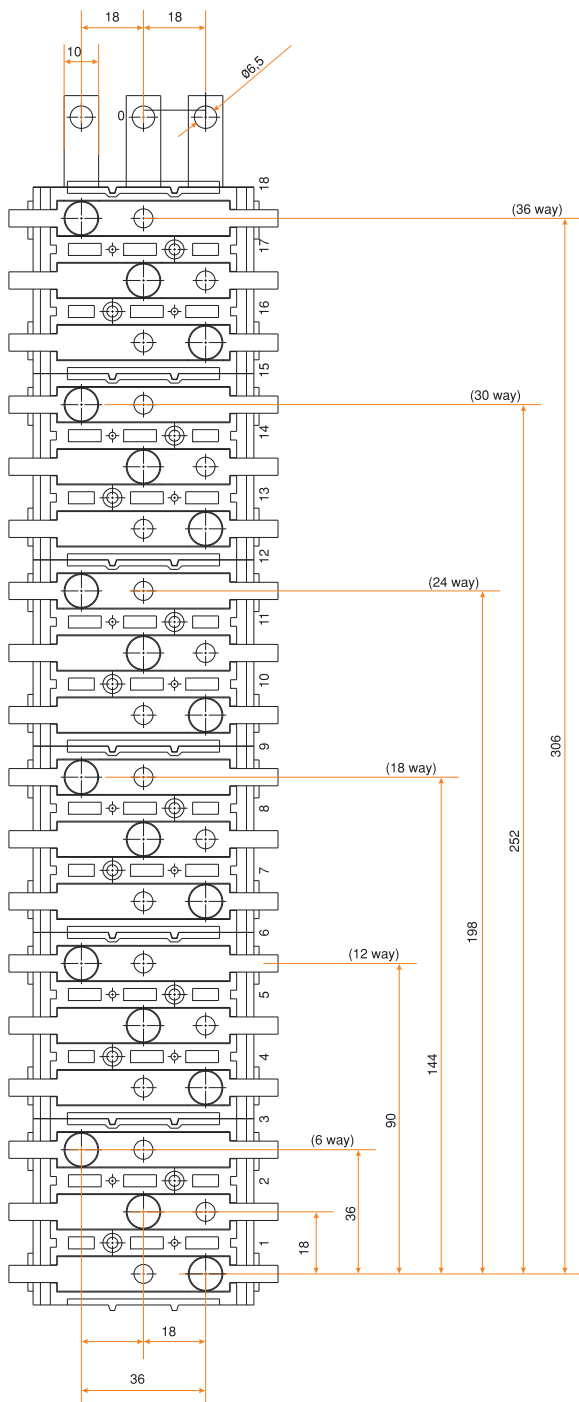
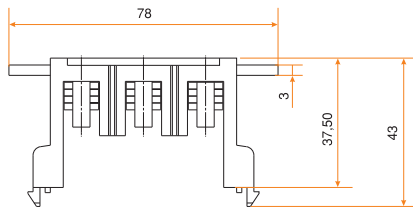
Panel Frame F11-F12-F11M



Panel Frame FK-FM3-FM6-FM10-FMS



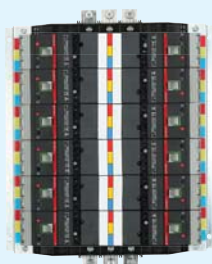
EasyPan DISTRIBUTION BOARDS



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 F10, F11, 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.

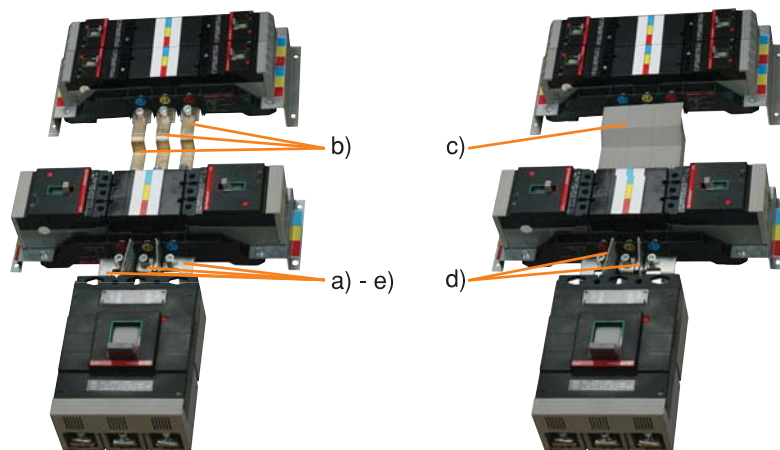
Anvantages :

- 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
F61 - F62		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

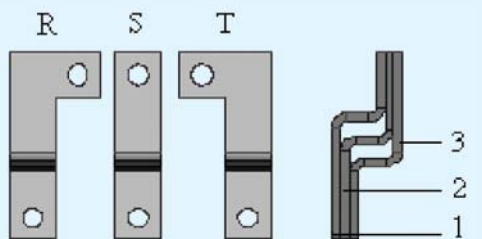
EasyPan READY BUS SYSTEMS

- 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 F11 or F31 bar system.



F11 Bar system accessories

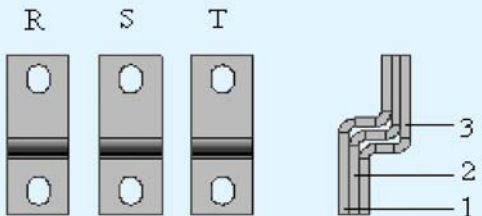
a) They are extension bus bars for connecting Mccb to distribution bus bar.



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	

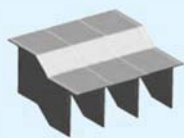
b) They are extension bus bars for connecting F11 distribution system to F31 distribution system.



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			250A R2	YP-D114
10 way			S2	
12 way			T2	
			R3	YP-D115
			S3	
			T3	

c)



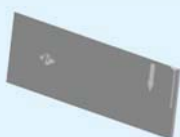
Terminal Cover

2,4,6,8,10, and 12 way

250A, 400A and 630A

YP-D116

d)



Terminal Separator

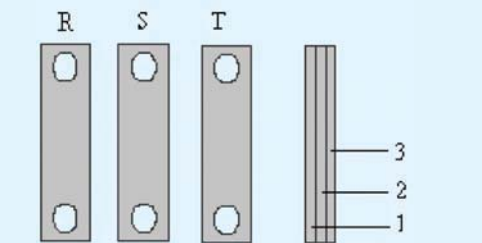
2,4,6,8,10, and 12 way

250A, 400A and 630A

YP-D117

F31 Bar system accessories

e) They are extension bus bars for connecting Mccb to distribution bus bar.

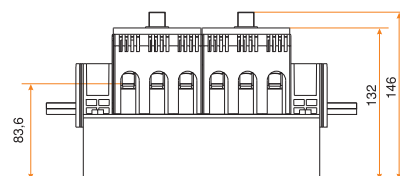
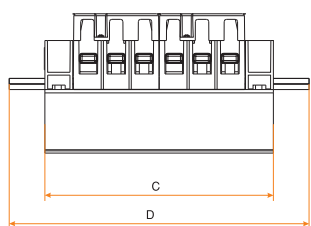
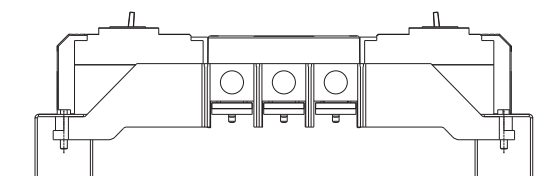
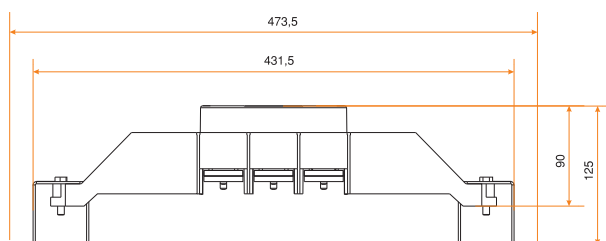
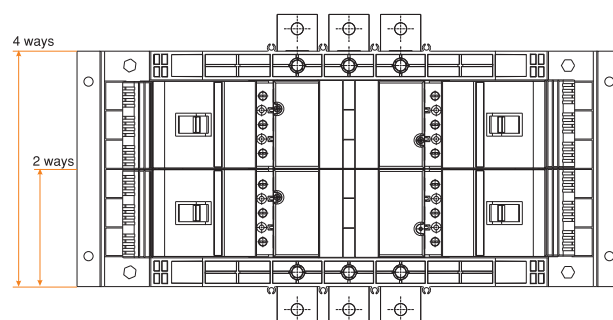
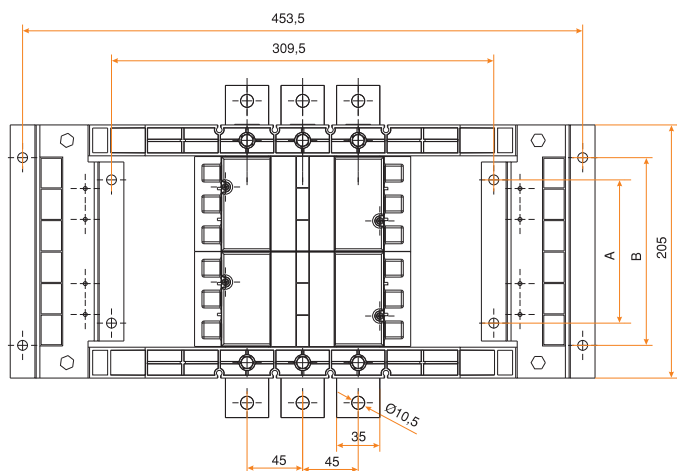


Extention bars use for main breaker F82E (800A)

Used system	Ampere Group			Order code
2 way	630A	400A	250A R1	YP-D0310
4 way			S1	
6 way			T1	
8 way			250A R2	YP-D0311
10 way			S2	
12 way			T2	
			R3	YP-D0312
			S3	
			T3	

EasyPan READY BUS SYSTEMS

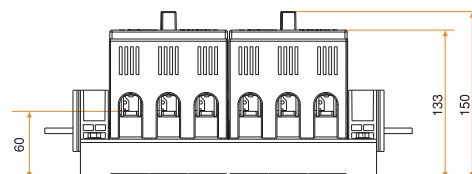
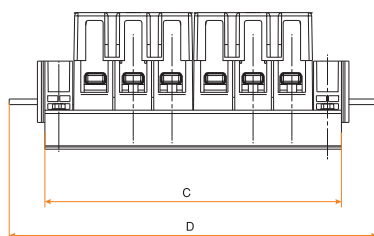
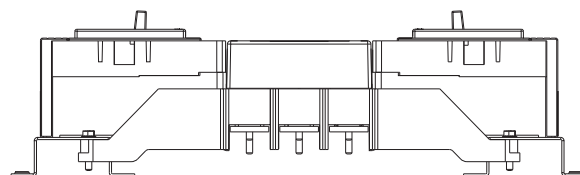
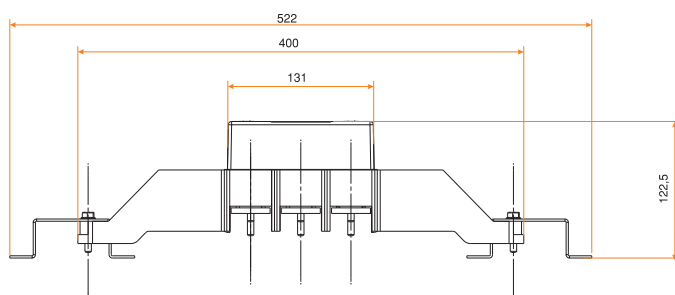
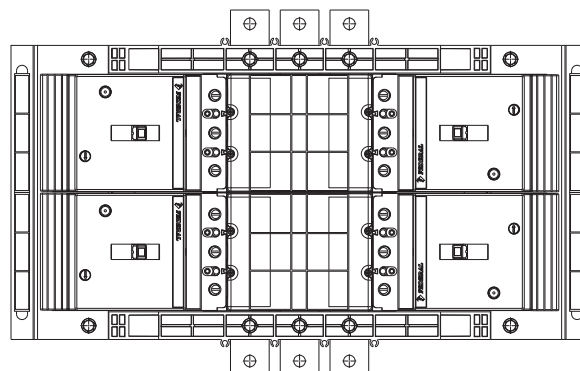
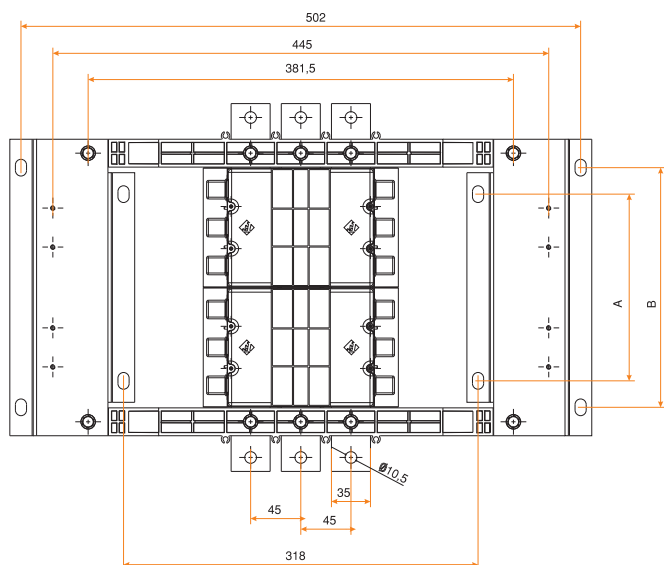
For F11 Type



	A	B	C	D
2 ways	40	76	128	192
4 ways	116	152	205	269
6 ways	192	228	282	346
8 ways	268	304	359	423
10 ways	344	380	436	500
12 ways	420	456	513	577

EasyPan READY BUS SYSTEMS

For F31 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 BOARD



Type Tested Panel



Modular Panel Systems

FMP1

FMP2



CONTENTS

Type Tested Panel	1
Features	4
Electrical - Mechanical Characteristics	4
FMP-1 Modular Panels	5
Panel Dimensions	5
Panel Components	5
FMP-2 Modular Panels	6
Panel Dimensions	6
Panel Components	6
Technical Drawings	7

Please ask for a panel catalogue for further information.

TYPE TESTED PANEL

Federal Electric 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	: Type1, Type2, Type3 Type4, Type5, Type6



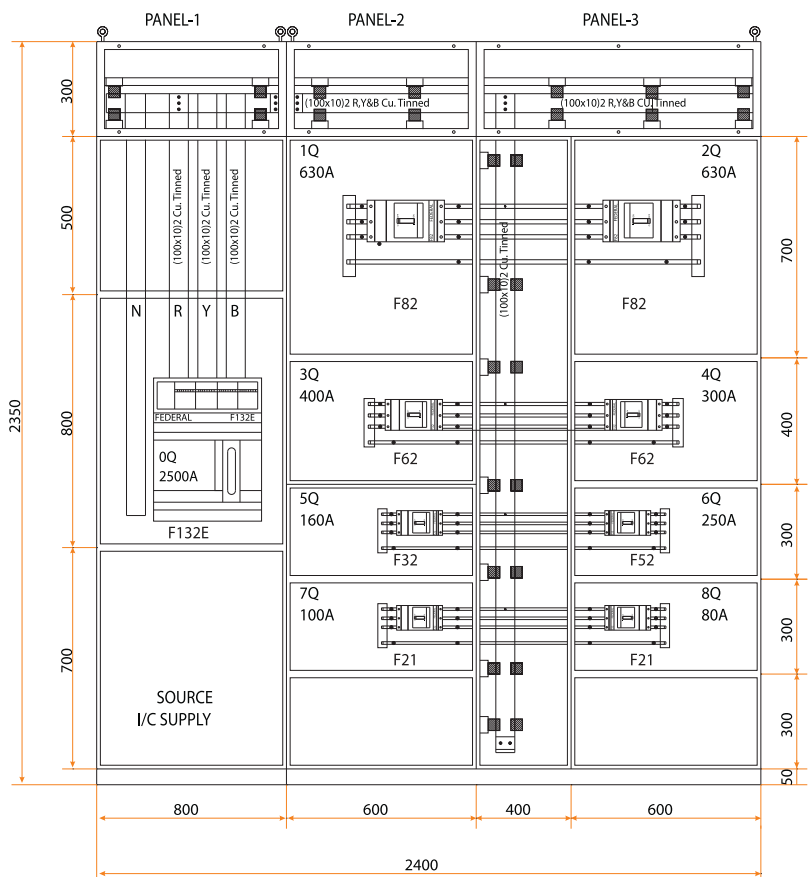
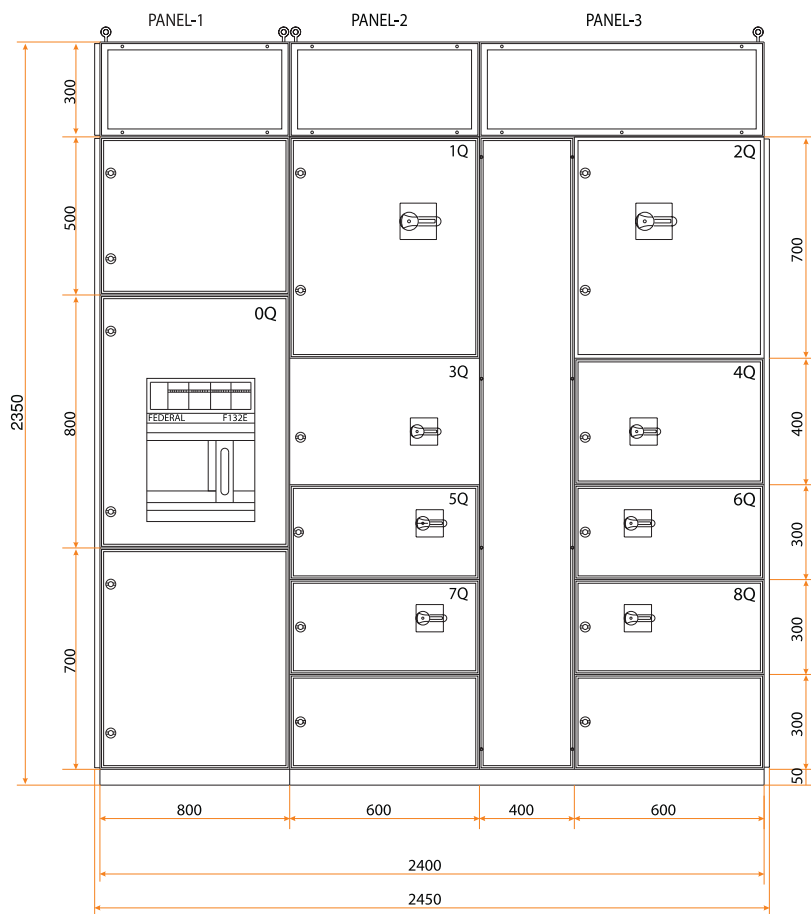
Please contact our factory for making panel partner application negotiations about low voltage panel systems.

TYPE TESTED PANEL

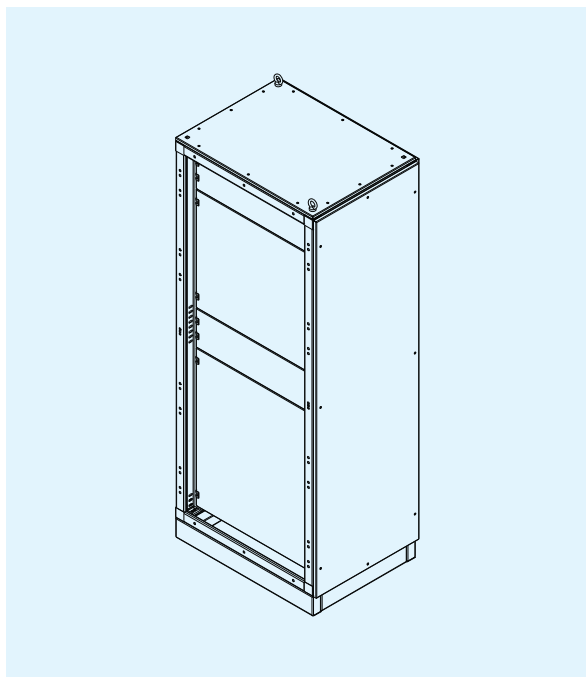


TYPE TESTED PANEL

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.

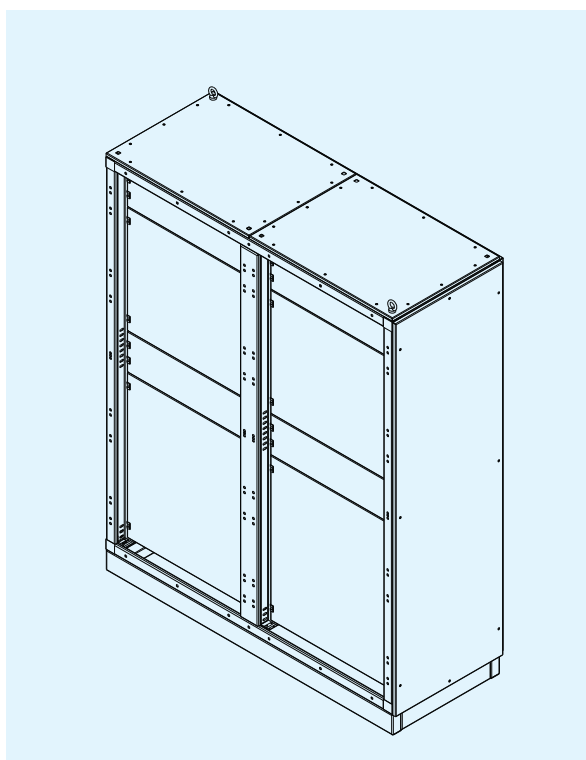
Thanks to low-temperature coefficient busbar design utilized in Federal Electric modular panels, in-panel equipments have a long service life.

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,

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).

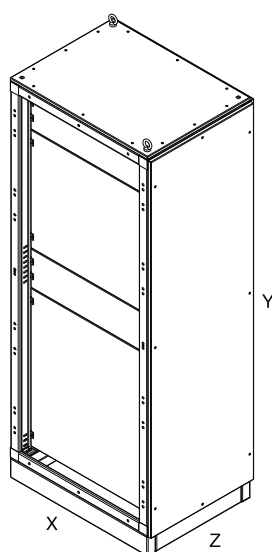
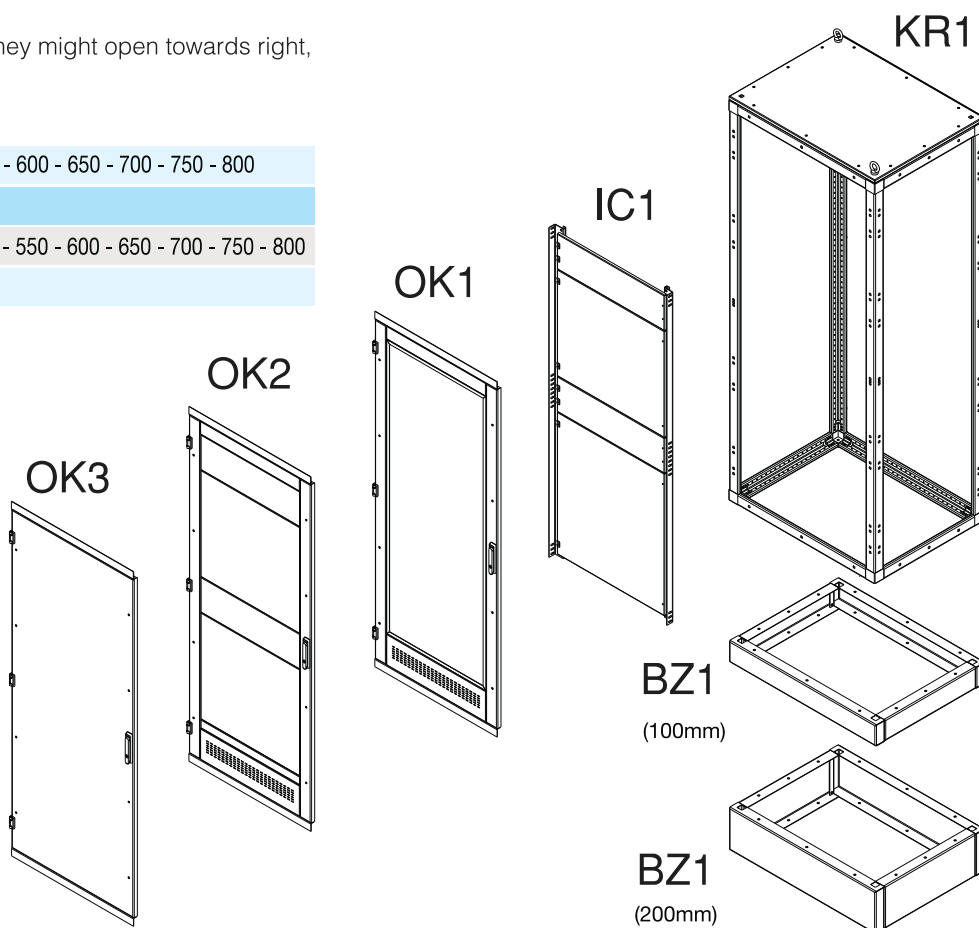
Panel Dimensions (mm)

X : 300 - 350 - 400 - 450 - 500 - 550 - 600 - 650 - 700 - 750 - 800

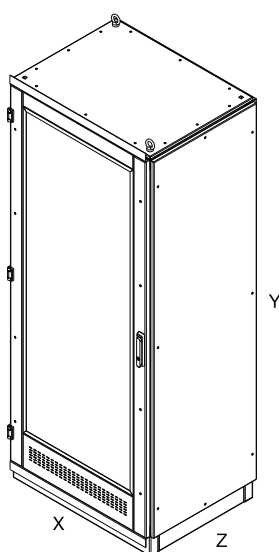
B : 100 - 200

Z : 250 - 300 - 350 - 400 - 450 - 500 - 550 - 600 - 650 - 700 - 750 - 800

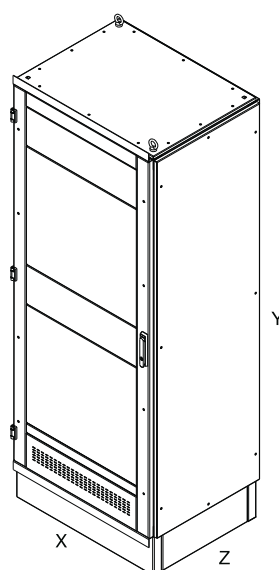
Y : 1900



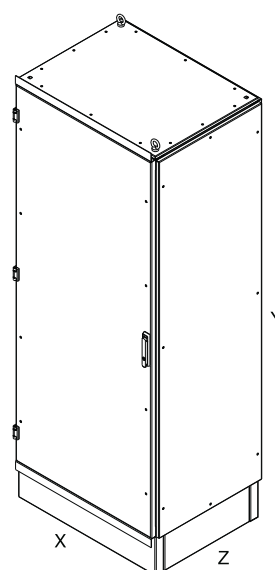
KR1+BZ1+IC1-A1 (A2)
Base Height: 100mm



KR1+BZ1+OK1+IC1-A1 (A2)
Base Height: 100mm



KR1+BZ1+OK2+IC1-A1 (A2)
Base Height: 200mm



KR1+BZ1+OK3+IC1-A1 (A2)
Base Height: 200mm

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).

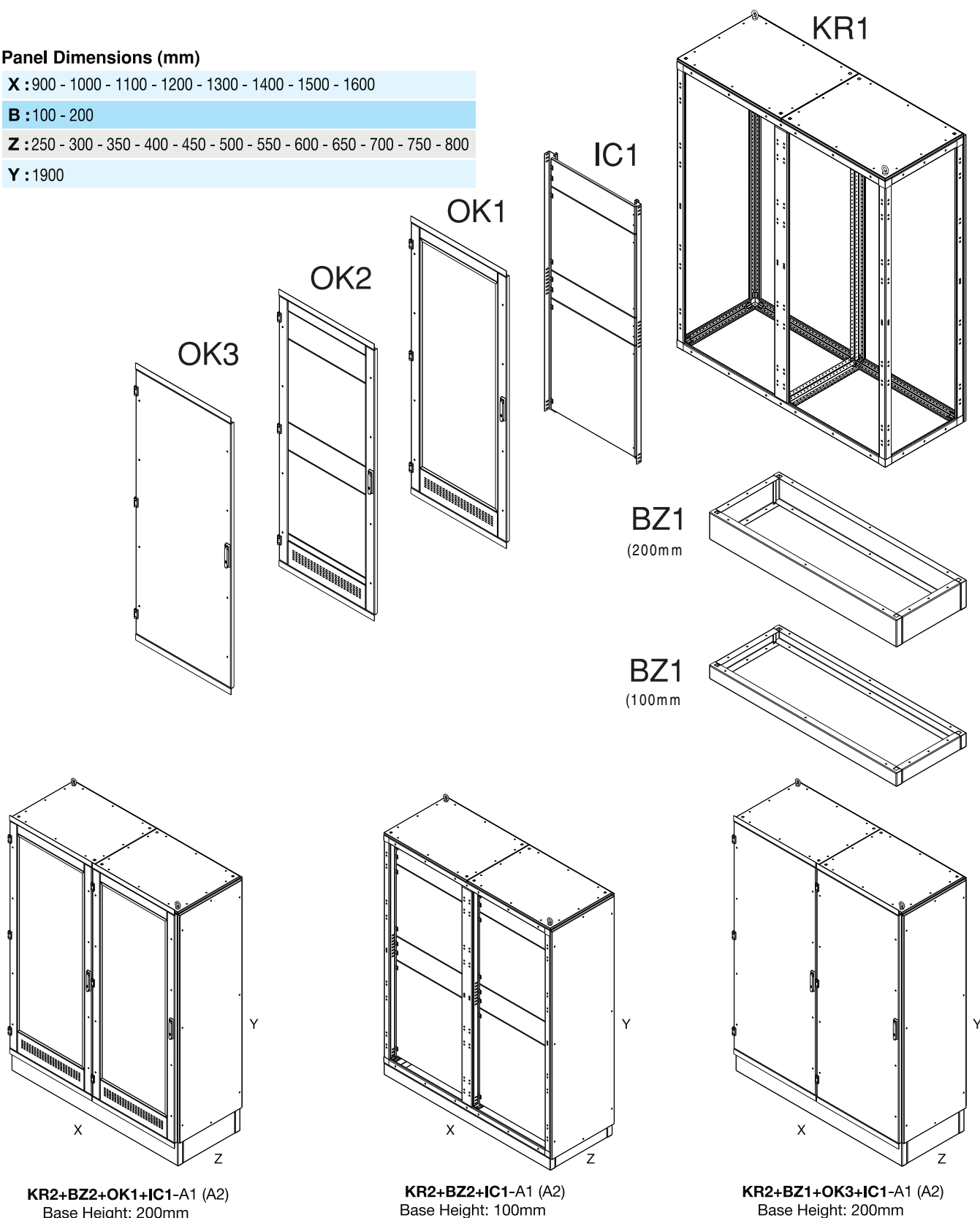
Panel Dimensions (mm)

X : 900 - 1000 - 1100 - 1200 - 1300 - 1400 - 1500 - 1600

B : 100 - 200

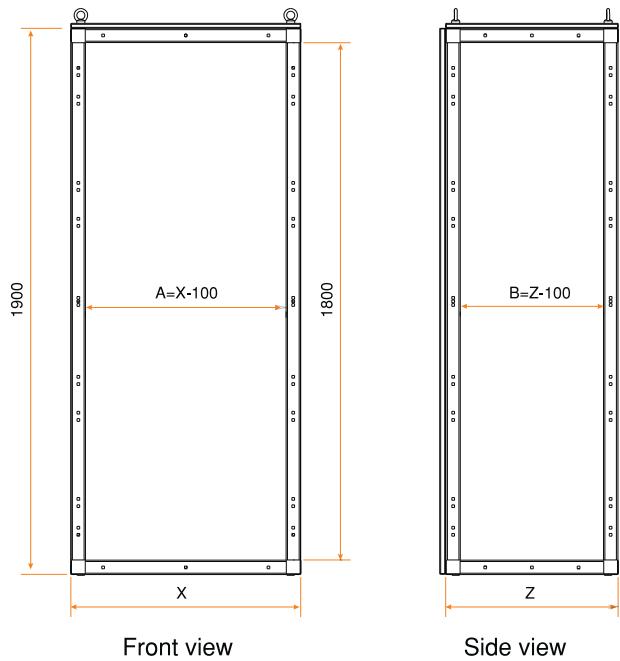
Z : 250 - 300 - 350 - 400 - 450 - 500 - 550 - 600 - 650 - 700 - 750 - 800

Y : 1900



MODULAR MAIN DISTRIBUTION PANEL BORD

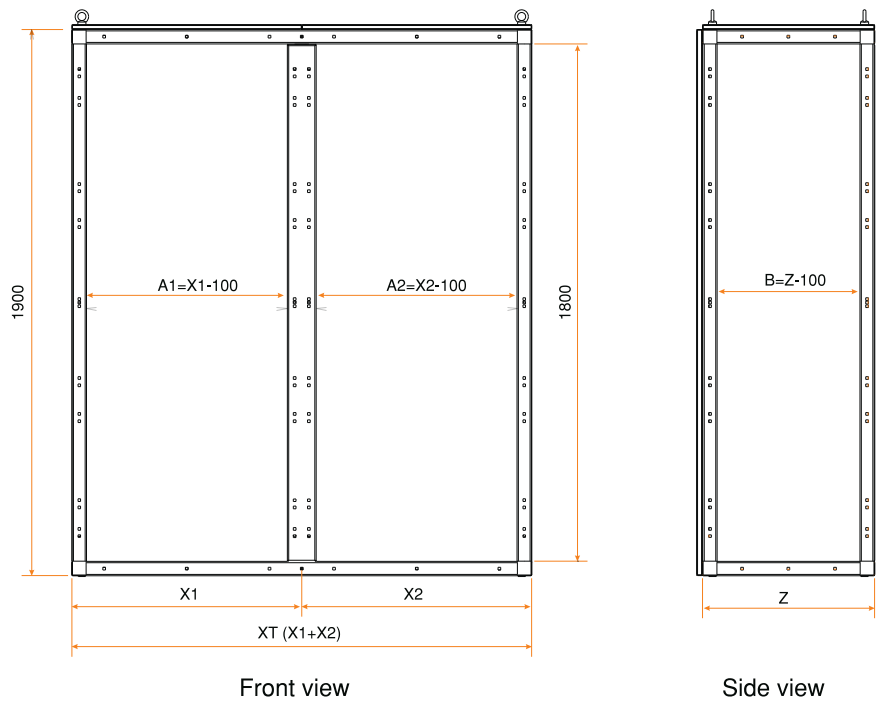
KR1: Single-division framework



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

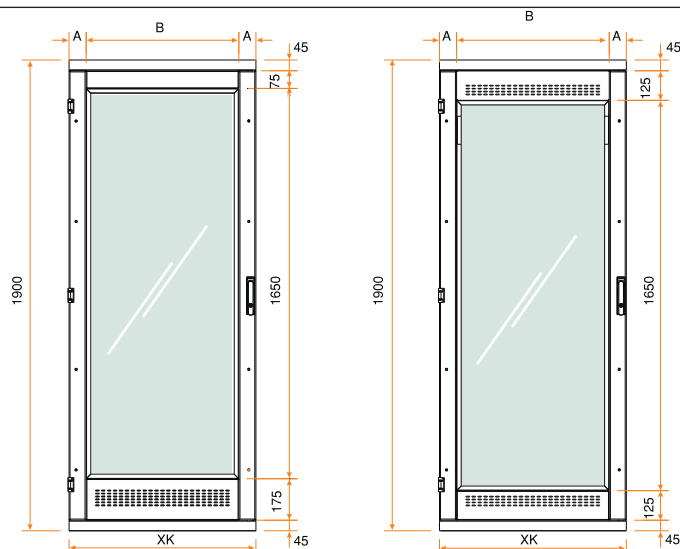
KR2: Double-division framework



Dimension mm

MODULAR MAIN DISTRIBUTION PANEL BORD

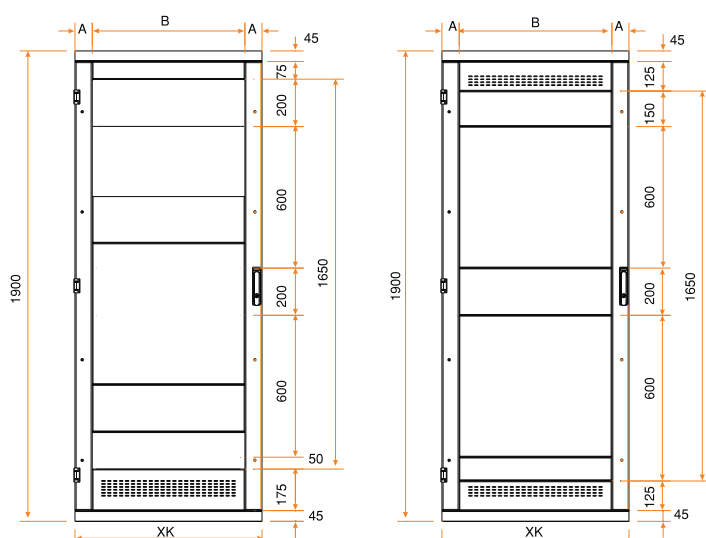
OK1: Front cover (with glass)



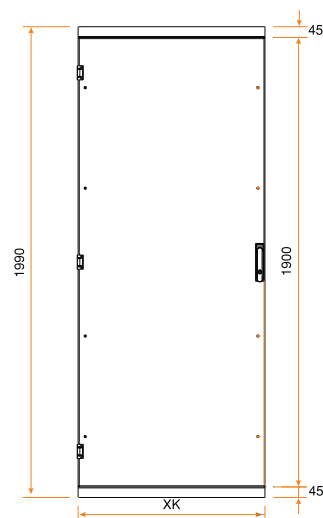
X	XK	A	B (XK-2A)
300	290	72,5	155
350	340	47,5	256
400	390	72,5	255
450	440	47,5	356
500	490	72,5	355
550	540	47,5	456
600	590	72,5	455
650	640	47,5	556
700	690	72,5	555
750	740	47,5	656
800	790	72,5	655

Dimension mm

OK2: Front cover

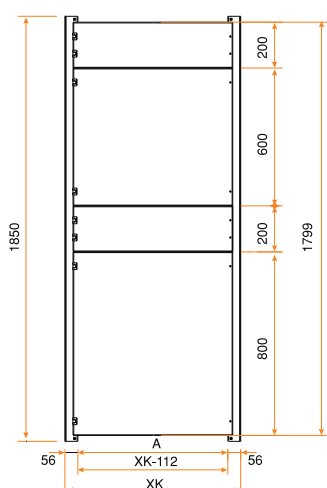


OK3: Front cover



Note: In piece covers in OK2, parts no (212 and 204) can be variable provided that the dimension 1650 mm remains fixed.

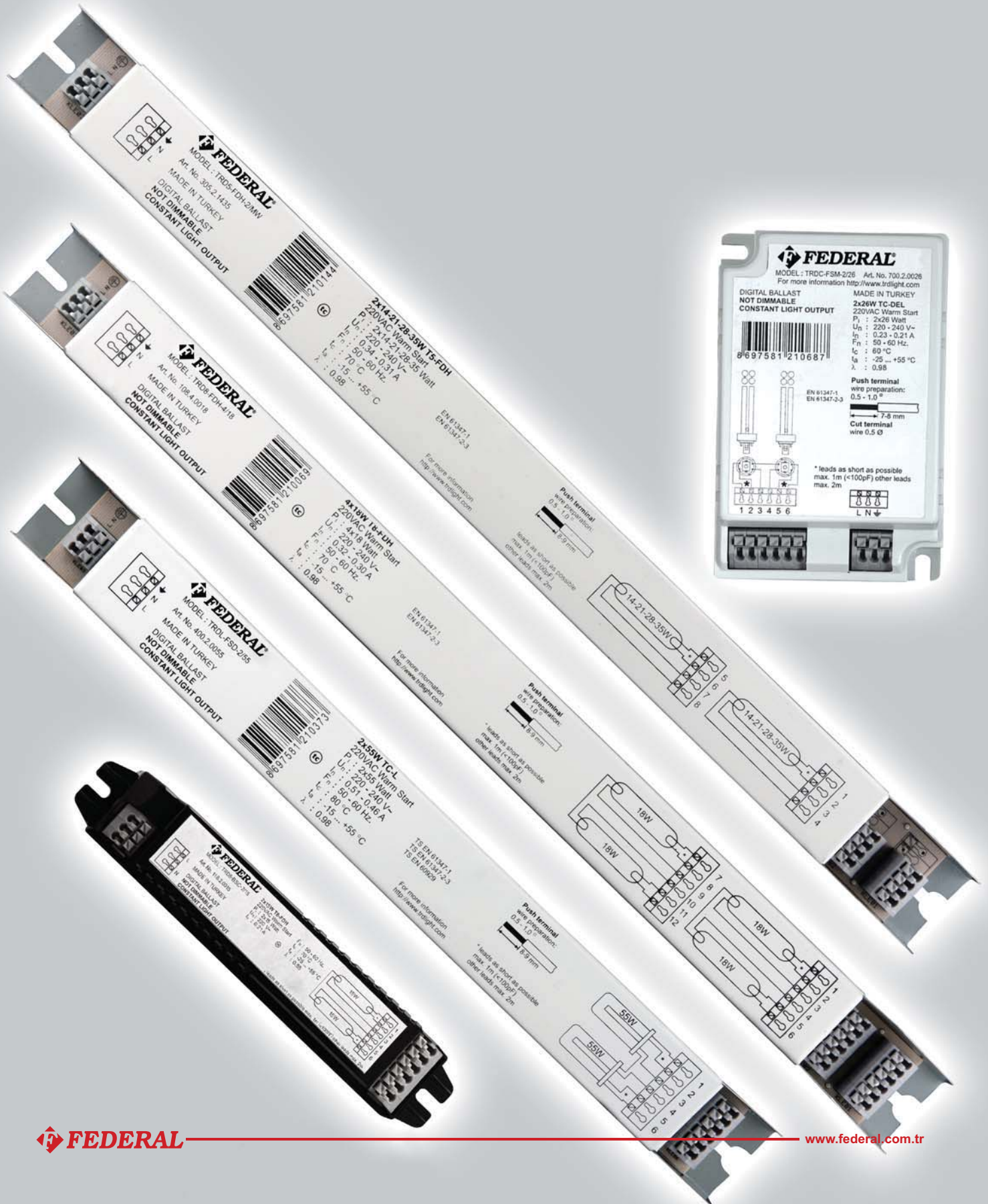
IC1: Inner cover



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

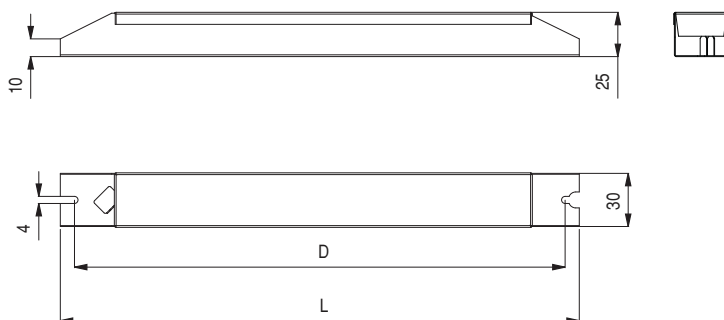


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PROFESSIONAL ELECTRONIC BALLASTS FOR T5 LINEAR LAMPS

14-54w 220-240 V 50/60/0 Hz. PROFESSIONAL SERIES T5



- 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 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)	λ (220V/50 Hz.) (A)	tc (°C)	ta (°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

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

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.)
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

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

Lamp operating characteristic

- Warm Start: Lamp cathodes are heated by 1.5s of pre-heating in the AC and DC supply voltages.

Emergency Lighting

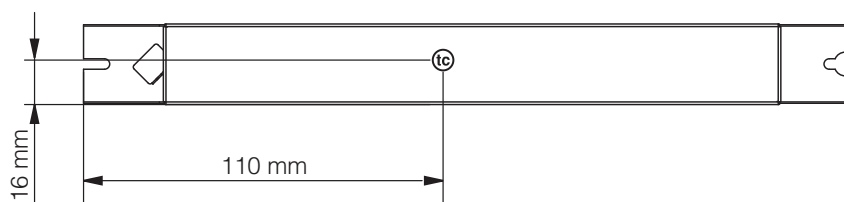
- It is compatible with the emergency lighting kits defined in the EN 60347-2-3 EK-J.
- In energy cuts the stepping in time is 0.5s.

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 ² (Piece)	C13 1.5 mm ² (Piece)	C16 1.5 mm ² (Piece)	C20 2.5 mm ² (Piece)	←Automatic Circuit Breaker→ ← Cable Section Ø →	B10 1.5 mm ² (Piece)	B13 1.5 mm ² (Piece)	B16 1.5 mm ² (Piece)	B20 1.5 mm ² (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 mm² 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.

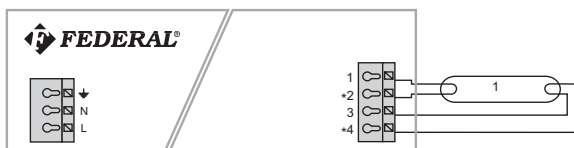
The habit of considering only power criteria in conventional

(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



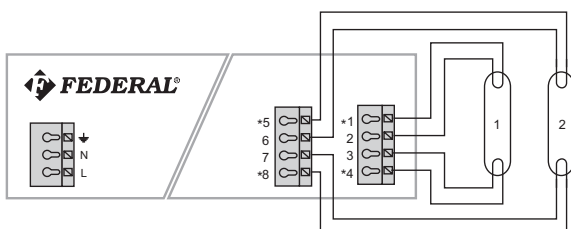
The lamp connection diagrams of the electronic ballasts in following models should be as given above. Cable lengths are provided in the table.

- TRD5-FDH-1/MW (1x14W)
- TRD5-FDH-1/MW (1x21W)
- TRD5-FDH-1/MW (1x28W)



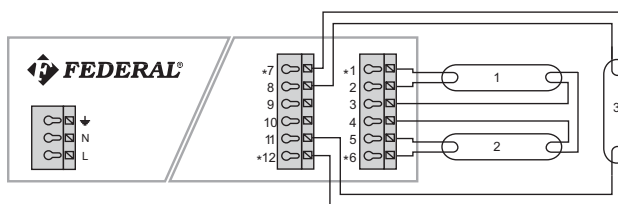
The lamp connection diagrams of the electronic ballasts in following models should be as given above. Cable lengths are provided in the table.

- TRD5-FDH-2/54 (2x54W)



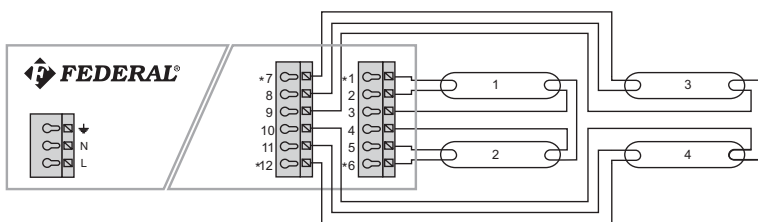
The lamp connection diagrams of the electronic ballasts in following models should be as given above. Cable lengths are provided in the table.

- TRD5-FDH-2/MW (2x14W)
- TRD5-FDH-2/MW (2x21W)
- TRD5-FDH-2/MW (2x28W)
- 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.

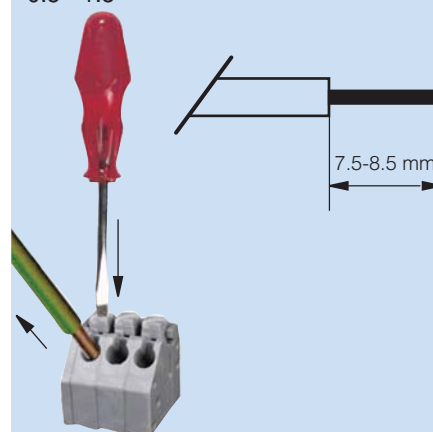
- TRD5-FDH-4/14

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 - 1.5²

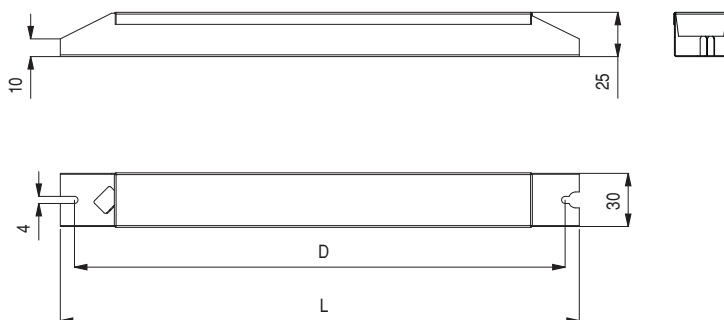


Simple installation brings simple removal. As shown in the picture, when button is pushed with the help of a screwdriver the connector shall release the cable and this shall provide the removal.

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)	λ (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

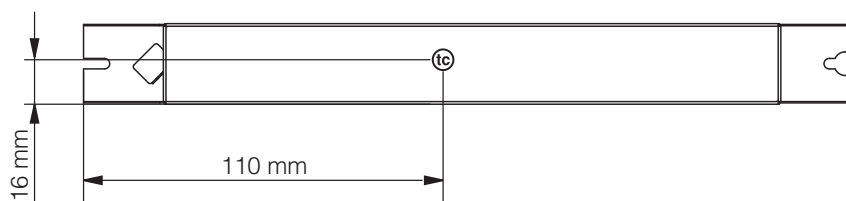
- It is compatible with the emergency lighting kits defined in the EN 60347-2-3 EK-J.
- In energy cuts the stepping in time is 0.5s.

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)	Automatic Circuit Breaker				Cable Section Ø			
		C10 1.5 mm ² (Piece)	C13 1.5 mm ² (Piece)	C16 1.5 mm ² (Piece)	C20 2.5 mm ² (Piece)	B10 1.5 mm ² (Piece)	B13 1.5 mm ² (Piece)	B16 1.5 mm ² (Piece)	B20 1.5 mm ² (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 mm² 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

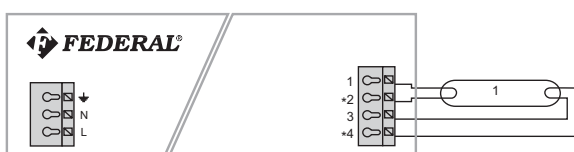
T8 linear lamps should be applied along with the T8 electronic ballasts; the power and length values of T8 linear lamps are provided below. The only way to achieve the maximum efficiency of the system is by using appropriate lamps. The habit of considering only power criteria in conventional (magnetic) 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	



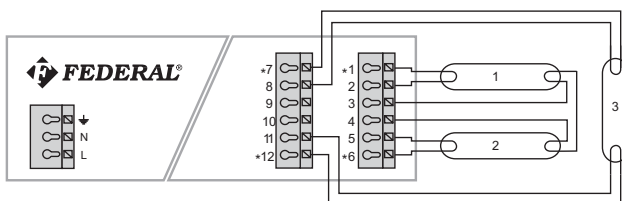
The lamp connection diagrams of the electronic ballasts in following models should be as given above. Cablelengths are provided in the table.

- TRD8-FDH-1/15
- TRD8-FDH-1/18
- TRD8-FDH-1/30
- TRD8-FDH-1/36
- TRD8-FDH-1/58



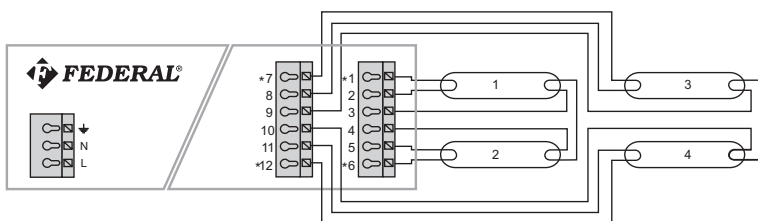
The lamp connection diagrams of the electronic ballasts in following models should be as given above. Cablelengths are provided in the table.

- 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)

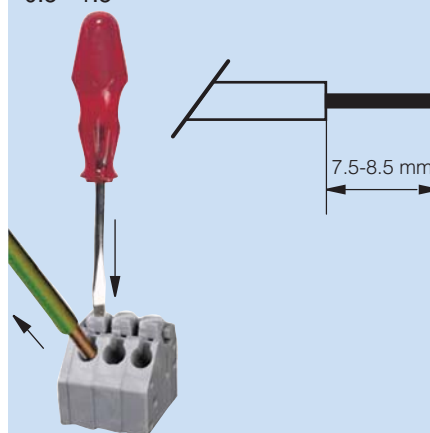


The lamp connection diagrams of the electronic ballasts in following models should be as given above.

- 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:

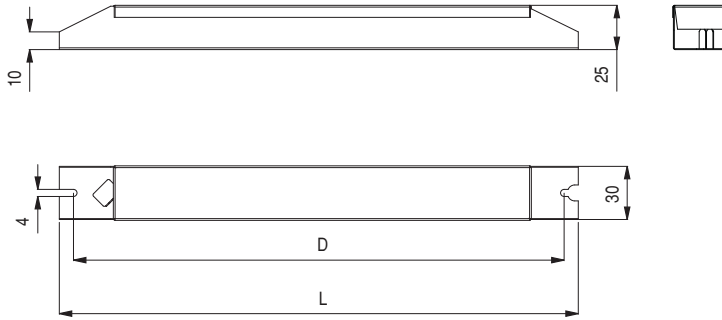
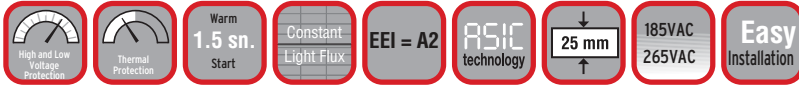


Simple installation brings simple removal. As shown in the picture, when button is pushed with the help of a screwdriver the connector shall release the cable and this shall provide the removal.

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 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)	λ (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.

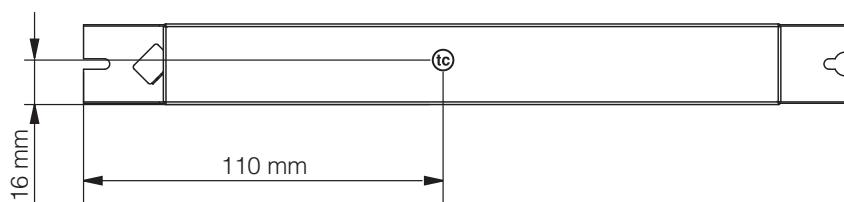
PROFESSIONAL ELECTRONIC BALLASTS FOR TC-L LINEAR LAMPS

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)	Automatic Circuit Breaker				Cable Section Ø			
		C10 1.5 mm ² (Piece)	C13 1.5 mm ² (Piece)	C16 1.5 mm ² (Piece)	C20 2.5 mm ² (Piece)	B10 1.5 mm ² (Piece)	B13 1.5 mm ² (Piece)	B16 1.5 mm ² (Piece)	B20 1.5 mm ² (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 mm² 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.

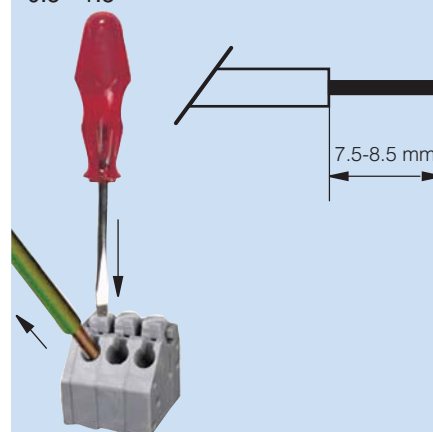
Applying thicker and/or thinner cables may damage the connectors. Appropriate cables should be used for the terms of warranty to be valid. Especially using multi wired, very thin, very thick cables or connecting more than one cable to a connector shall decrease the system performance and may cause physical 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.

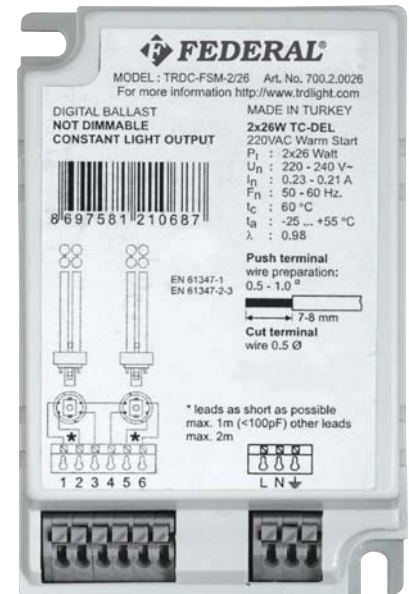
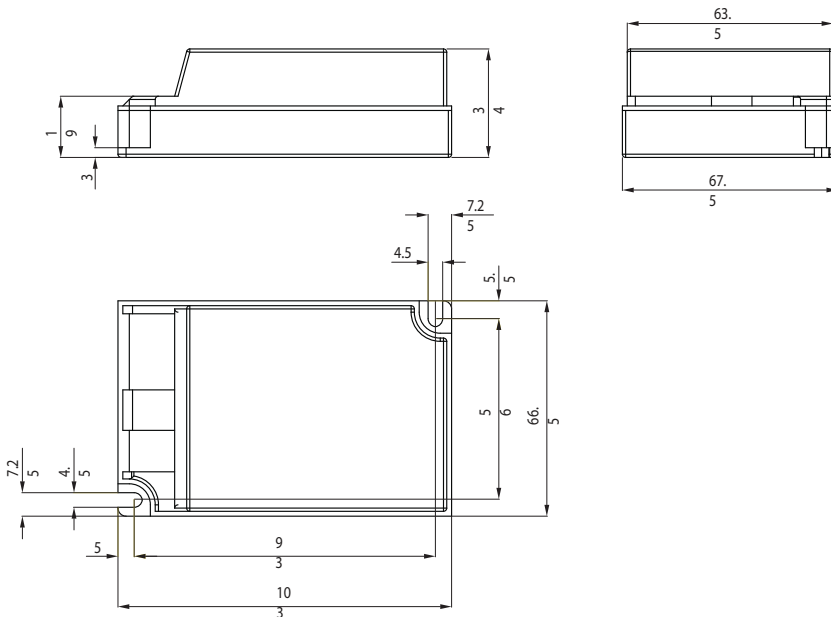
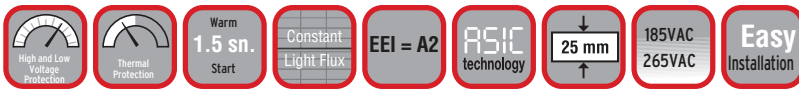
Cable Preparation:

0.5 - 1.5^{mm}



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

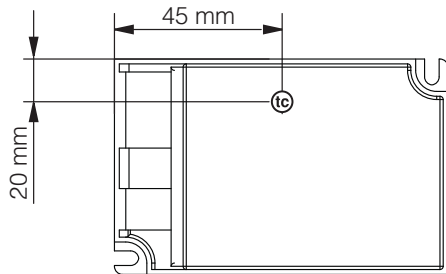
- It is compatible with the emergency lighting kits defined in the EN 60347-2-3 EK-J.
- In energy cuts the stepping in time is 0.5s.

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 ² (Piece)	C13 1.5 mm ² (Piece)	C16 1.5 mm ² (Piece)	C20 2.5 mm ² (Piece)	←Automatic Circuit Breaker→ ← Cable Section Ø →	B10 1.5 mm ² (Piece)	B13 1.5 mm ² (Piece)	B16 1.5 mm ² (Piece)	B20 1.5 mm ² (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 mm² 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.

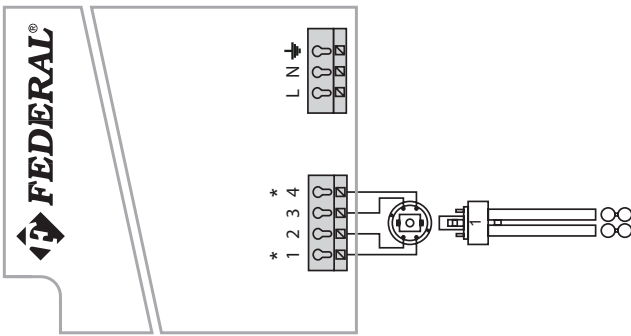
The habit of considering only power criteria in conventional

(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.

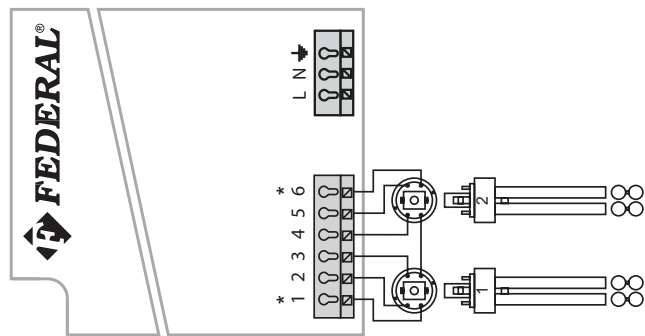
T8 Lamba Bilgisi

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/MW (1x26W)



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/MW (2x26W)

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.

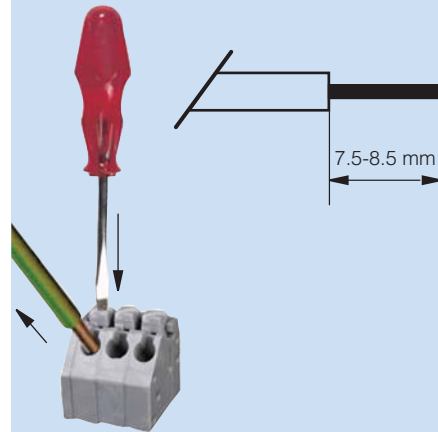
Applying thicker and/or thinner cables may damage the connectors. Appropriate cables should be used for the terms of warranty to be valid. Especially using multi wired, very thin, very thick cables or connecting more than one cable to a connector shall decrease the system performance and may cause physical 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.

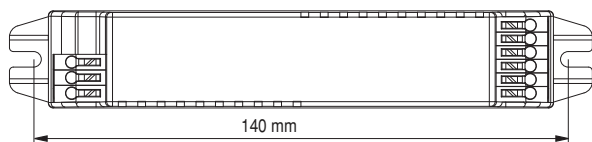
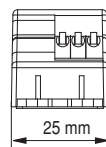
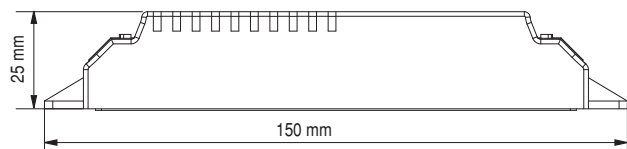
Cable Preparation:

0.5 - 1.5"



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)	λ (220V/50 Hz.) (A)	tc (°C)	ta (°C)	Celma Class (EEI)
T8 Class											
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
T5 Class											
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
T5C Class											
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)	λ (220V/50 Hz.) (A)	tc (°C)	ta (°C)	Celma Class (EEI)
TCL Class											
1x18	217	TRDL-BSC-1/MW	410.1.1824	54	16.00	19.00	0.16	0.54	70	-25...+55	A2
1x24	317	TRDL-BSC-1/MW	410.1.1824	54	22.00	24.50	0.20	0.57	70	-25...+55	A2
TC-DEL Class											
1x10	103	TRDC-BSC-1/MW	710.1.1018	54	9.50	11.00	0.10	0.50	70	-25...+55	A2
1x13	131	TRDC-BSC-1/MW	710.1.1018	54	12.50	15.00	0.13	0.52	70	-25...+55	A2
1x18	146	TRDC-BSC-1/MW	710.1.1018	54	16.50	19.00	0.16	0.54	70	-25...+55	A2
2x10	103	TRDC-BSC-2/MW	710.2.1013	56	19.00	22.50	0.18	0.56	70	-25...+55	A2
2x13	131	TRDC-BSC-2/MW	710.2.1013	56	22.00	25.00	0.20	0.58	70	-25...+55	A2
1x26	165	TRDC-BSC-1/26	710.1.0026	54	22.00	25.00	0.20	0.58	70	-25...+55	A2
TC-SEL Class											
1x5	85	TRDS-BSC-1/MW	720.1.0511	54	4.50	6.50	0.07	0.45	70	-25...+55	A2
1x7	114	TRDS-BSC-1/MW	720.1.0511	54	6.00	8.00	0.08	0.47	70	-25...+55	A2
1x9	144	TRDS-BSC-1/MW	720.1.0511	54	7.50	9.50	0.09	0.49	70	-25...+55	A2
1x11	214	TRDS-BSC-1/MW	720.1.0511	54	11.00	13.50	0.12	0.51	70	-25...+55	A2
2x5	85	TRDS-BSC-2/MW	720.2.0511	56	9.00	11.00	0.10	0.50	70	-25...+55	A2
2x7	114	TRDS-BSC-2/MW	720.2.0511	56	12.00	14.50	0.13	0.52	70	-25...+55	A2
2x9	144	TRDS-BSC-2/MW	720.2.0511	56	15.00	18.00	0.15	0.54	70	-25...+55	A2
2x11	214	TRDS-BSC-2/MW	720.2.0511	56	22.00	24.50	0.19	0.58	70	-25...+55	A2
TC-TEL Class											
1x26	126	TRDT-BSC-1/26	730.1.0026	54	22.00	25.00	0.20	0.58	70	-25...+55	A2
TC-F Class											
1x18	122	TRDF-BSC-1/MW	740.1.1824	54	16.00	19.00	0.16	0.55	70	-25...+55	A2
1x24	165	TRDF-BSC-1/MW	740.1.1824	54	22.00	25.00	0.19	0.59	70	-25...+55	A2
TC-DD Class											
1x10	94	TRDD-BSC-1/MW	750.1.1016	54	9.00	11.50	0.10	0.50	70	-25...+55	A2
1x16	141	TRDD-BSC-1/MW	750.1.1016	54	14.00	17.00	0.15	0.52	70	-25...+55	A2
2x10	94	TRDD-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

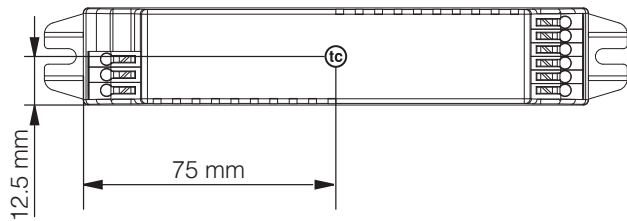
ta (Operating Temperature) and tc (Test Point)

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)	C10 1.5 mm ² (Piece)	C13 1.5 mm ² (Piece)	C16 1.5 mm ² (Piece)	C20 2.5 mm ² (Piece)	Automatic Circuit Breaker Cable Section Ø	B10 1.5 mm ² (Piece)	B13 1.5 mm ² (Piece)	B16 1.5 mm ² (Piece)	B20 1.5 mm ² (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

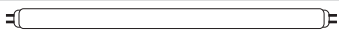



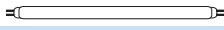
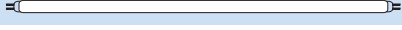

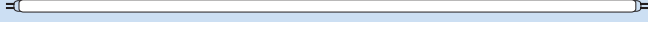


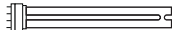






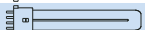

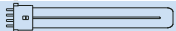
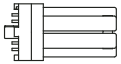

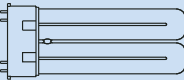
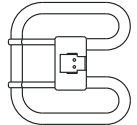
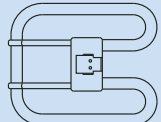
Model	Power (W)	Connector		Maximum Cable Length		Maximum Capacity	
		Cold	Hot	Cold	Hot	Cold	Hot
TRD8-BSC-1/15	1x15		1,2,3,4	1,5m	0,75m	150pF	75pF
TRD8-BSC-2/15	2x15	3,4	1,2,5,6	1,5m	0,75m	150pF	75pF
TRD8-BSC-1/18	1x18		1,2,3,4	1,5m	0,75m	150pF	75pF
TRD5-BSC-1/LW	1x4		1,2,3,4	1,5m	0,75m	150pF	75pF
TRD5-BSC-1/LW	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 mm² 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)	
T8 Class		
15	438	
18	590	
T5 Class		
4	136	
6	212	
8	288	
13	517	
14	549	
21	849	
24	549	
T5C Class		
22	225	
TCL Class		
18	217	
24	317	
TC-DEL Class		
10	103	
13	131	
18	146	
26	165	
TC-SEL Class		
5	85	
7	114	
9	144	
11	214	
TC-TEL Class		
26	126	
TC-F Class		
18	122	
24	165	
TC-DD Class		
10	94	
16	141	

BASIC ELECTRONIC BALLASTS FOR LINEAR LAMPS

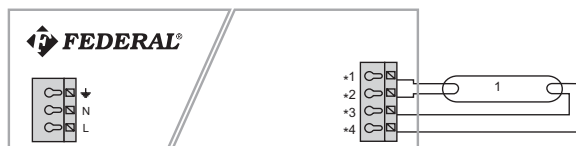
Fluorescent Lamps

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
- TRD8-BSC-1X18
- TRD5-BSC-1/LW (1x4W)
- TRD5-BSC-1/LW (1x6W)
- TRD5-BSC-1/LW (1x8W)
- TRD5-BSC-1/LW (1x13W)
- TRD5-BSC-1/MW (1x14W)
- TRD5-BSC-1/MW (1x21W)
- TRD5-BSC-1X24
- TRD5-BSC-1X22
- 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)
- TRDC-BSC-1X26
- TRDS-BSC-1/MW (1x5W)
- TRDS-BSC-1/MW (1x7W)
- TRDS-BSC-1/MW (1x9W)
- TRDS-BSC-1/MW (1x11W)
- TRDT-BSC-1X26
- TRDF-BSC-1/MW (1x18W)
- TRDF-BSC-1/MW (1x24W)
- TRDD-BSC-1/MW (1x10W)
- TRDD-BSC-1/MW (1x16W)



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.

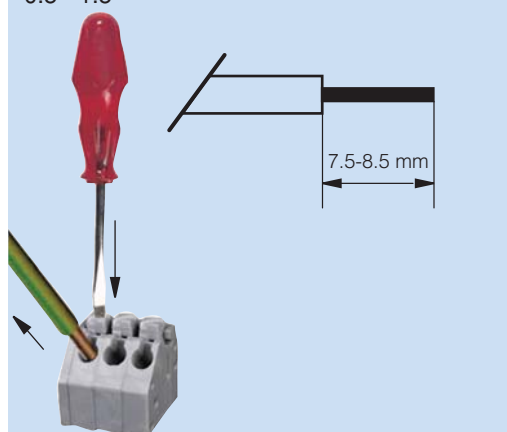
The cable sector should be in line with the values indicated both on the ballast and in the catalogue.

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"



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
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

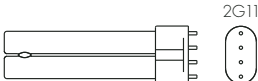
Lamp Type	Ballast		Lamp			Terminals for Installation												Cable Length		The Number Of Ballasts That Can Be Connected To Automatic Circuit Breakers							
	Order Code	Product Code	Number	Power	Lamp holder / Socket	1	2	3	4	5	6	7	8	9	10	11	12	* Hot (m/pF)	Cold (m/pF)	Type B				Type C			
																				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
	105.2.1435	TRD5-FDH-2/MW	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
	700.1.0026	TRDC-FSM-1/26	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
	700.2.0026	TRDC-FSM-2/26	2	26W	G24-q1 4-PIN	x*	x	x	x	x	x*	-	-	-	-	-	-	1m/100pF	2m/200pF	11	16	19	22	22	32	38	44

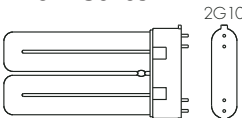
INSTALLATION INFORMATION FOR BASIC ELECTRONIC BALLASTS

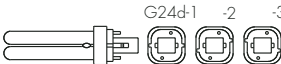
Lamp Type	Ballast		Lamp			Terminals for Installation												Cable Length		The Number Of Ballasts That Can Be Connected To Automatic Circuit Breakers							
	Order Code	Product Code	Number	Power	Lamp holder / Socket	1	2	3	4	5	6	7	8	9	10	11	12	* Hot (m/pF)	Cold (m/pF)	Type B				Type C			
																				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
			2	13W	G5	x*	x*	x	x	x*	x*	-	-	-	-	-	-	0,75m/75pF	1,5m/150pF	28	37	50	60	56	74	100	120
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
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
			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

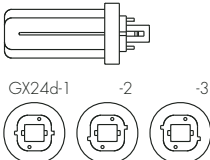
CELMA TABLE (2000/55/EC)

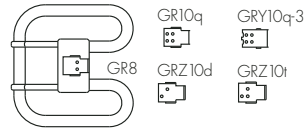
Lamp type	Ilcos code	Lamp power		Class						
		50Hz	HF	A1	A2	A3	B1	B2	C	D
T Series 	FD-15-E-G13-26/450	15W	13.5W	9W	16W	18W	21W	23W	25W	>25W
	FD-18-E-G13-26/600	18W	16W	10.5W	19W	21W	24W	26W	28W	>28W
	FD-30-E-G13-26/900	30W	24W	16.5W	31W	33W	36W	38W	40W	>40W
	FD-36-E-G13-26/1200	36W	32W	19W	36W	38W	41W	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
TC-L Series 	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

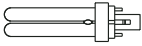
Lamp type	Ilcos code	Lamp power		Class						
		50Hz	HF	A1	A2	A3	B1	B2	C	D
TC-F Series 	FSS-18-E-2G10	18W	16W	10.5W	19W	21W	24W	26W	28W	>28W
	FSS-24-E-2G10	24W	22W	13.5W	25W	27W	30W	32W	34W	>34W
	FSS-36-E-2G10	36W	32W	19W	36W	38W	41W	43W	45W	>45W


Lamp type	Ilcos code	Lamp power		Class						
		50Hz	HF	A1	A2	A3	B1	B2	C	D
TC-D / TC-DE Series 	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

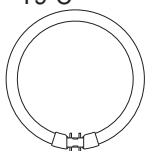
Lamp type	Ilcos code	Lamp power		Class						
		50Hz	HF	A1	A2	A3	B1	B2	C	D
TC-T / TC-TE Series 	FSM-13-I-GX24d=1	13W	12.5W	8W	14W	16W	17W	19W	21W	>21W
	FSM-13-E-GX24q=1	13W	12.5W	8W	14W	16W	17W	19W	21W	>21W
	FSM-18-I-GX24d=1	18W	16.5W	10.5W	19W	21W	24W	26W	28W	>28W
	FSM-18-E-GX24q=1	18W	16.5W	10.5W	19W	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
TC-DD / TC-DDE Series 	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

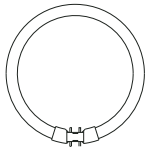
CELMA TABLE (2000/55/EC)

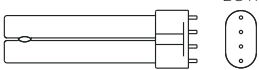
Lamp type	Ilcos code	Lamp power		Class						
		50Hz	HF	A1	A2	A3	B1	B2	C	D
	FSD-5-I-G23	5W	4.5W	4W	7W	8W	10W	12W	14W	>14W
	FSD-5-E-2G7	5W	4.5W	4W	7W	8W	10W	12W	14W	>14W
	FSD-7-I-G23	7W	6.5W	5W	9W	10W	12W	14W	16W	>16W
	FSD-7-E-2G7	7W	6.5W	5W	9W	10W	12W	14W	16W	>16W
	FSD-9-I-G23	9W	8W	6W	11W	12W	14W	16W	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

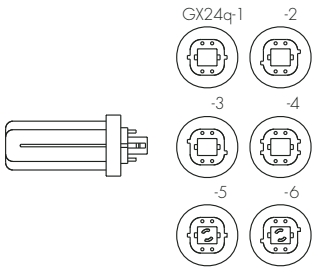
Lamp type	Ilcos code	Lamp power		Class						
		50Hz	HF	A1	A2	A3	B1	B2	C	D
	FC-22-E-G10q-29	22W	19W	12W	22W	24W	28W	30W	32W	32W
	FC-32-E-G10q-29	32W	30W	18.5W	35W	34W	38W	40W	42W	42W
	FC-40-E-G10q-29	40W	32W	19.5W	37W	39W	46W	48W	50W	50W

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					

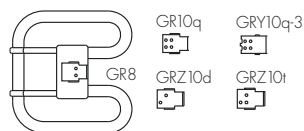
Lamp type	Ilcos code	Lamp power		Class						
		50Hz	HF	A1	A2	A3	B1	B2	C	D
	FCH-22-L/P-2GX13-16		22W	14W	26W	28W				
	FCH-40-L/P-2GX13-16		40W	24W	45W	48W				
	FCH-55-L/P-2GX13-16		55W	32.5W	61W	65W				
	FCH-60-L/P-2GX13-16		60W	35W	66W	70W				

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
TC-TE 	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
TC-DD	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-SEL	Single Tube Compact - Electronic
TC-D	Duo Tube Compact
TC-DEL	Duo Tube Compact - Electronic
TC-T	Triple Tube Compact
TC-TEL	Triple Tube Compact - Electronic
TC-Q	Quad Tube Compact
TC-QEL	Quad Tube Compact - Electronic
TC-DD	Duo Tube, D Shaped Compact
TC-L	Long Tube, U Shaped Compact
TC-F	Compact Tube - Flat
T2 (T7)	Tube Shaped $\varnothing 2/8"$ (7 mm)
T5 (T16)	Tube Shaped $\varnothing 5/8"$ (16 mm)
T8 (T26)	Tube Shaped $\varnothing 8/8"$ (26 mm)
T12 (T38)	Tube Shaped $\varnothing 12/8"$ (38 mm)
T-U	U Shaped Tube
T-R	Ring Shaped Tube
T-R5 (T-R16)	Ring Shaped Tube $\varnothing 5/8"$ (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).

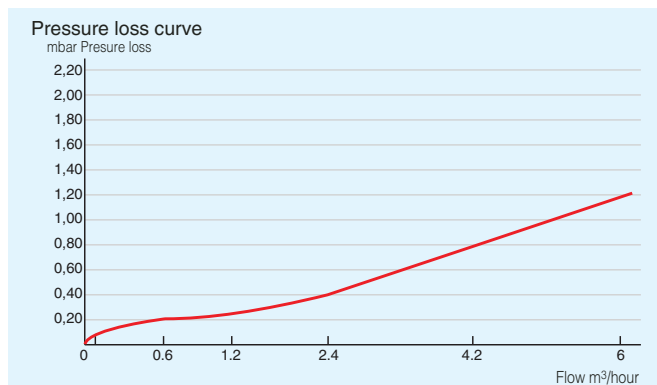
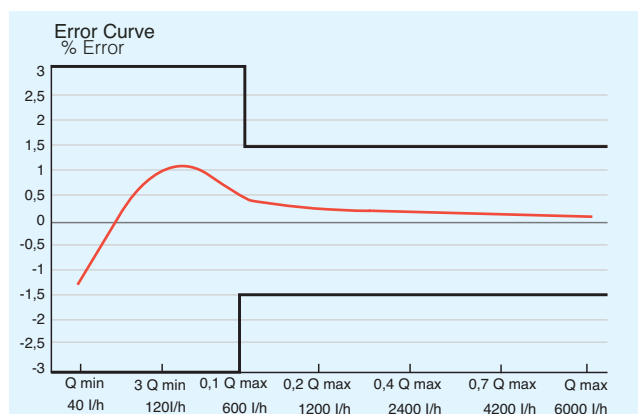
Assembly

- 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



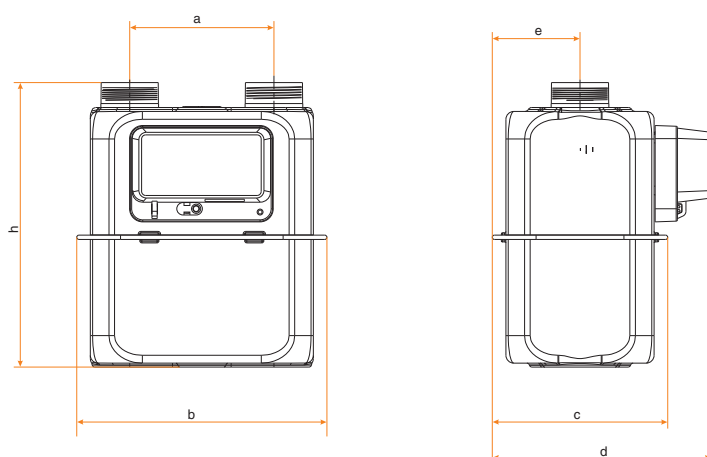
Points to be considered

- 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
	32	25	20	G1 1/4", G1", G 3/4", ISO 228-1:G7/8	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 ³ / h
Q Max	10m ³ / h
Measuring Interval	0.06m ³ /h - 10m ³ /h
Max. Operating Pressure	0.5 bar
Leakage Test Pressure Value	750 mbar
Measuring Volume	2.2 dm ³
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 dm³ 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 0,01m³)
- 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 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 0,01m³).

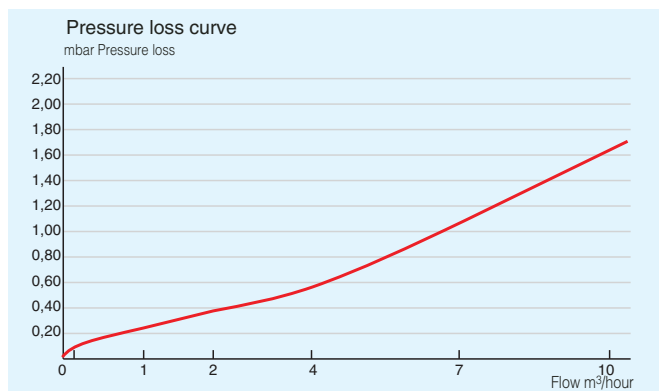
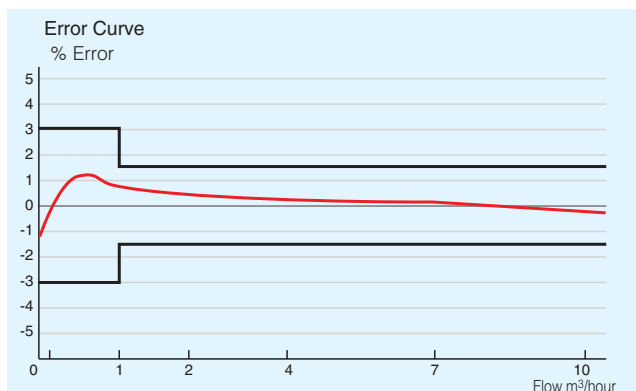
Assembly

- 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

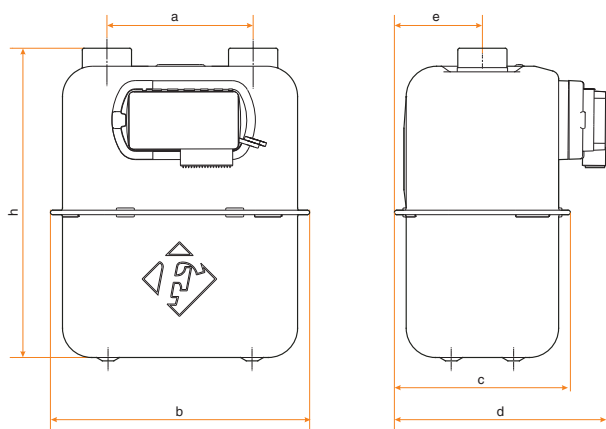


Points to be considered

- 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 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

NATURAL GAS METERS

FN G10



Technical Features

Type	FN G10
Gas Types	Natural Gas- Air Gas
Q Min	0.1m ³ / h
Q Max	16m ³ / h
Measuring Interval	0.1m ³ /h - 16m ³ /h
Max. Operating Pressure	0.5 bar
Leakage Test Pressure Value	750 mbar
Measuring Volume	5 dm ³
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 dm³ 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 0,01m³)
- 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
- 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 0,01m³).

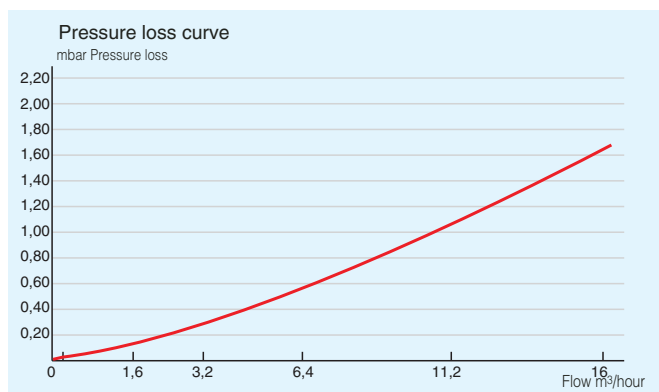
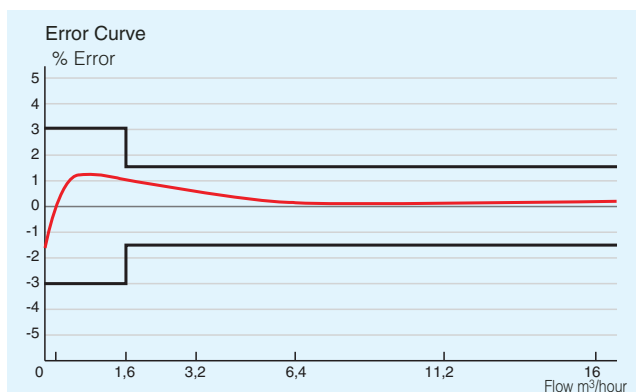
Assembly

- 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.

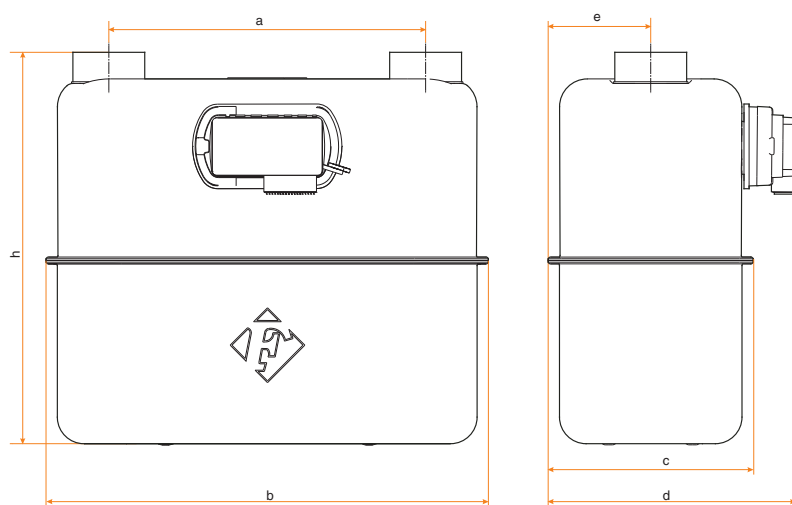
NATURAL GAS METERS



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 G10



Type	Connection		Dimensions					
	DN	Connection Size	h	a	b	c	d	e
FN G10	50	G2"	345	280	395	186	214	93

FN G4-CPPU V1



Technical Features

Gas Types	Natural Gas- Air Gas
Q min	0.04m ³ /h
Q max	6m ³ /h
Max. Operating Pressure	500mbar
Measuring Volume	1.2dm ³
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	0,001m ³
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	0,01m ³
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:

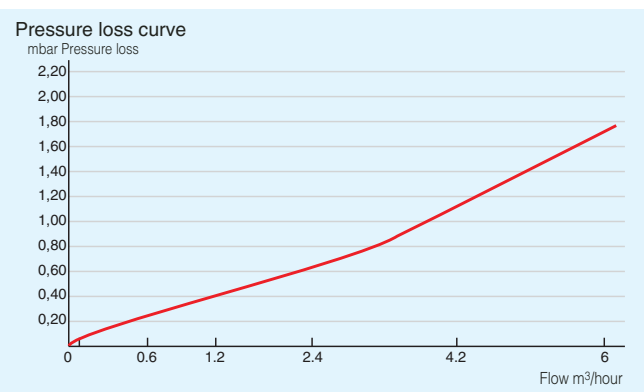
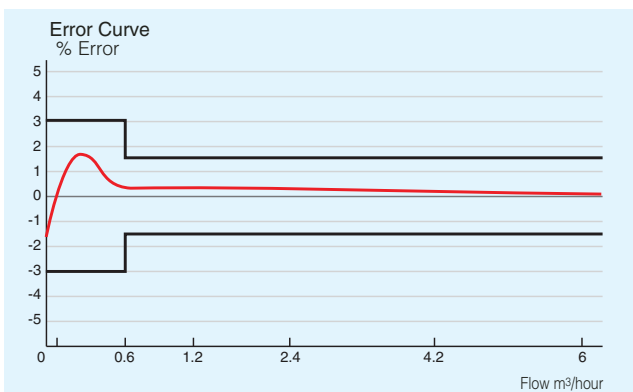
- Saves the companies from visiting subscribers each month for counter-reading processes.
- The consumed gas amount is received in advance.
- Subscribers are not affected from price changes based on the gas they have purchased.
- It supports a more conscious consumption.
- Saves subscribers from invoice 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.

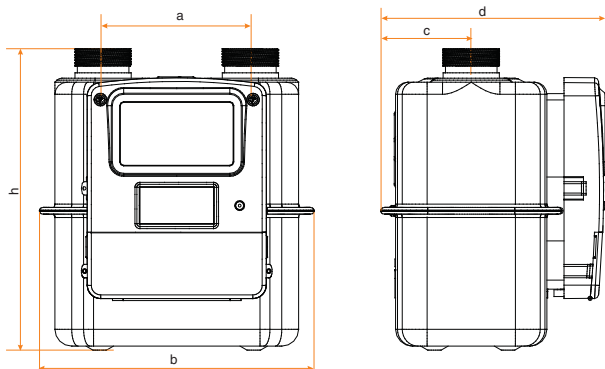


Points to be considered

- 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.

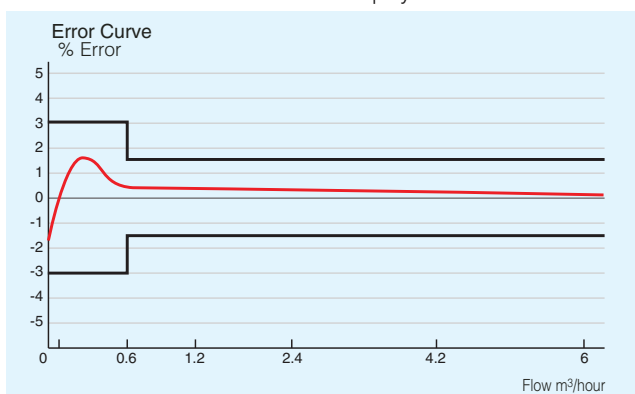
The valve closes instantly hindering further gas consumption. After The end of operations of authorized personnel such as battery replacement, the closed valve is opened again via an authorization card.

- 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:

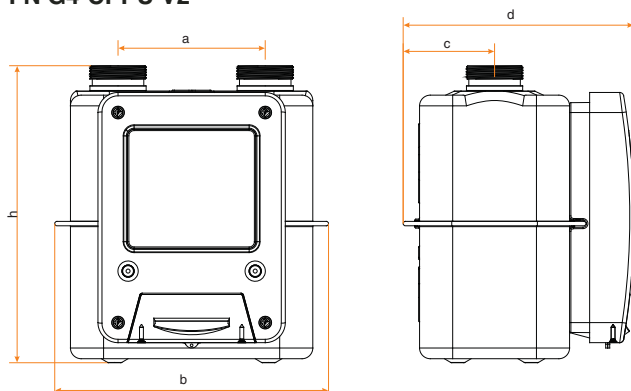
- Saves the companies from visiting subscribers each month for counter- reading processes.
- The consumed gas amount is received in advance.
- Subscribers are not affected from price changes based on the gas they have purchased.
- It supports a more conscious consumption.
- Saves subscribers from invoice 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.

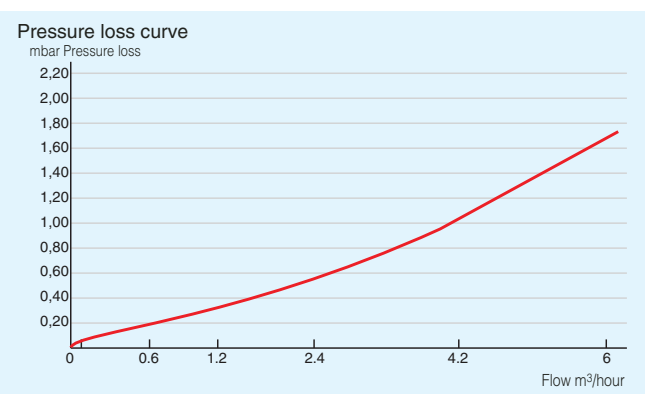
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The subscriber monitoring system or subscriber management system is a computer supported system where all type of processes related to subscribers are monitored and carried out. It is equipped with an advanced data base management system where all 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
	32	25	20	G1¼", G1", G¾" ISO 228-1:G7/8		226	110	206
							68,5	168

NATURAL GAS METERS

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.

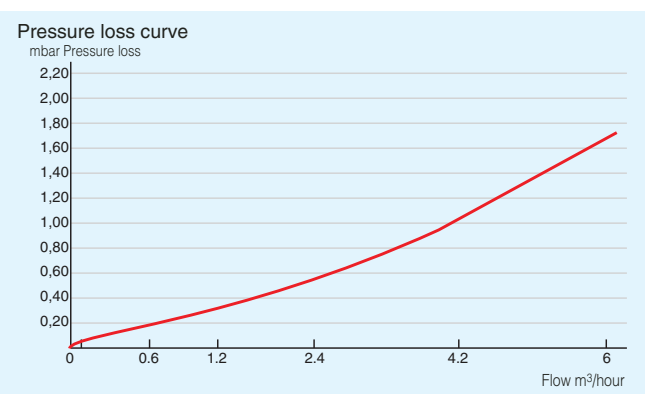
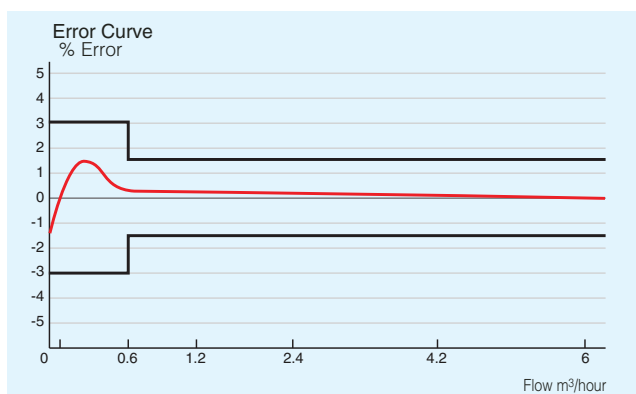
Components of Prepaid Gas Distribution System Can be summarized as;

- 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.

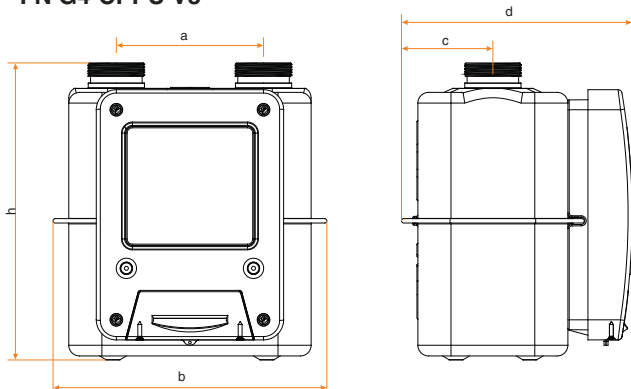
Federal Elektrik offers a complete solution and a continuous technicalsupport to entities based on the subscriber management system and the credit selling points.



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 ³ /h
Q max	10m ³ /h
Max. Operating Pressure	500mbar
Measuring Volume	2.2dm ³
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 ³
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 ³
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 0.001m³ 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:

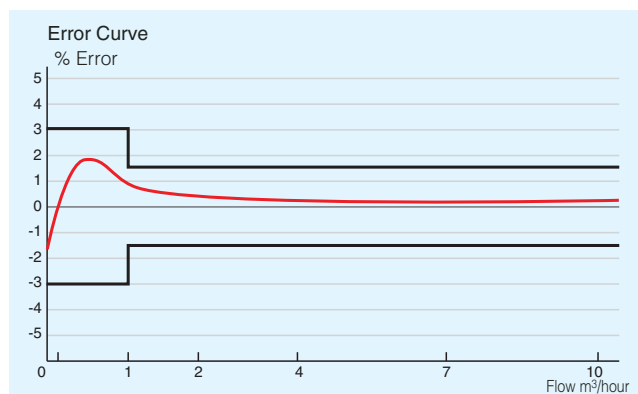
- The counter continuously monitors the credit status and operating conditions and hinders gas usage by closing the valf in the event that the credit is used up or upon any circumstances that may be harmful for the counter operation.
- In the event that the credit falls under specified limits the subscriber 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.
- 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:

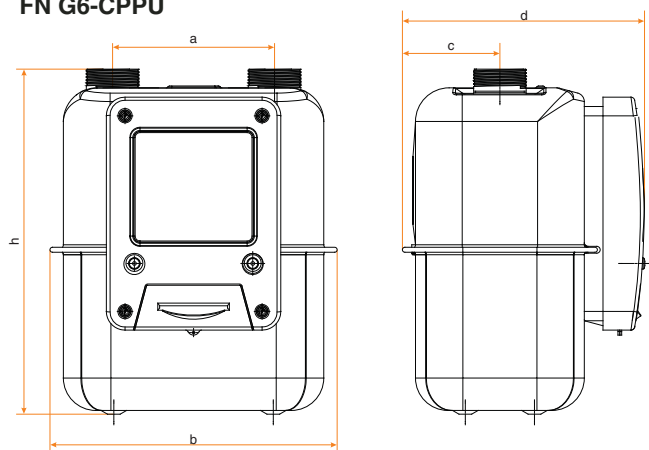
- Saves the companies from visiting subscribers each month for counter-reading processes.
- The consumed gas amount is received in advance.
- Subscribers are not affected from price changes based on the gas they have purchased.
- It supports a more conscious consumption.
- Saves subscribers from invoice 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.

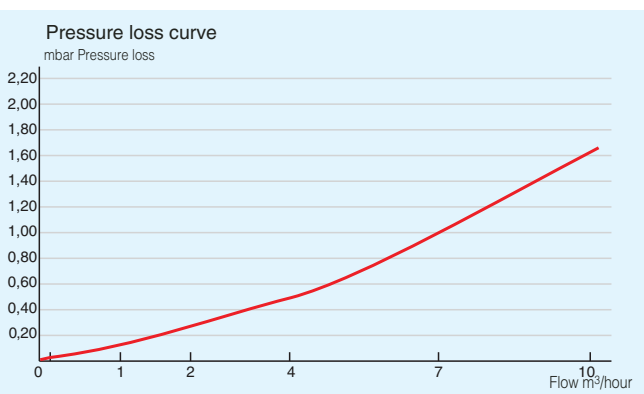
Components of Prepaid Gas Distribution System Can be summarized as;

- 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 markeets. 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.



- 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				
	DN	Connection Size	h	a	b	c	d
FN CPPU G6	32	G1¼"	276	130	231	78	195



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 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

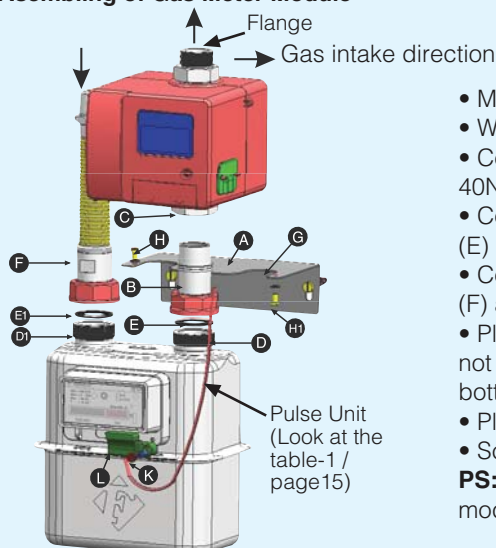
OIMLR 137-1 A.8 Performance Test (Battery powered instrument IEC 60068-2-

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

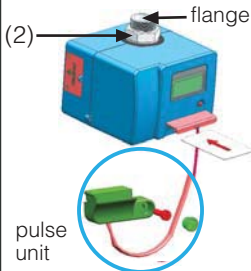
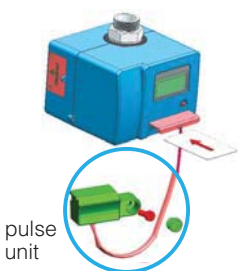
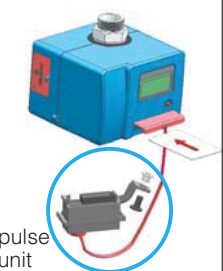
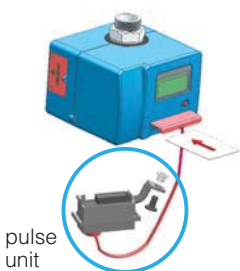
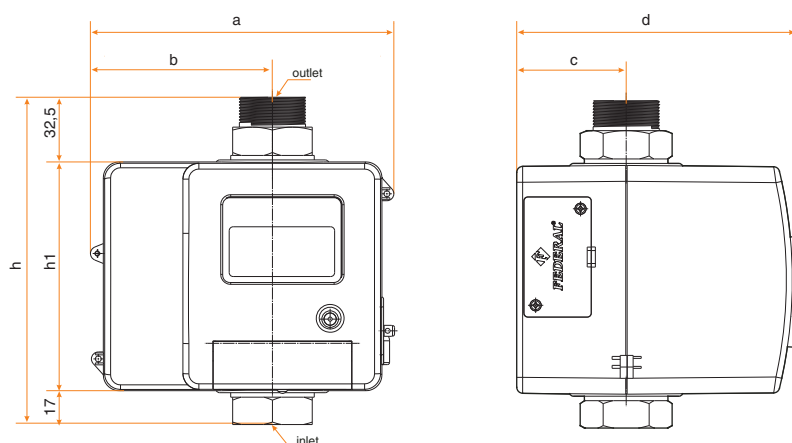
PREPAYMENT UNITS	PREPAYMENT UNIT VERSION	IMPULSE SOCKET OF PREPAYMENT UNITS			
		V1 (G4)	V2 (G4)	V2 (G6)	V2 (G10)
					
	Prepayment Unit Outer Dimensions (2)	1"	1"	1"	1 1/4"

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 ³ / h
Q Max	2,5m ³ / h
Measuring Interval	0,016m ³ /h - 2,5m ³ /h
Max. Operating Pressure	0,5 bar
Leakage Test Pressure Value	750 mbar
Measuring Volume	0,7 dm ³
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 ³
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 ³ / h
Q Max	4,0m ³ / h
Measuring Interval	0,025m ³ /h - 4,0m ³ /h
Max. Operating Pressure	0,5 bar
Leakage Test Pressure Value	750 mbar
Measuring Volume	1,2 dm ³
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 ³
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 ³ / h
Q Max	6,0m ³ / h
Measuring Interval	0,04m ³ /h - 6,0m ³ /h
Max. Operating Pressure	0,5 bar
Leakage Test Pressure Value	750 mbar
Measuring Volume	1,7 dm ³
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 ³
Union Pipe & Nut	3/4"
Flow Direction	Option (Left Type or Right Type)
Body	Aluminium Die Casting
Weight	3,3 kg.

NATURAL GAS METERS

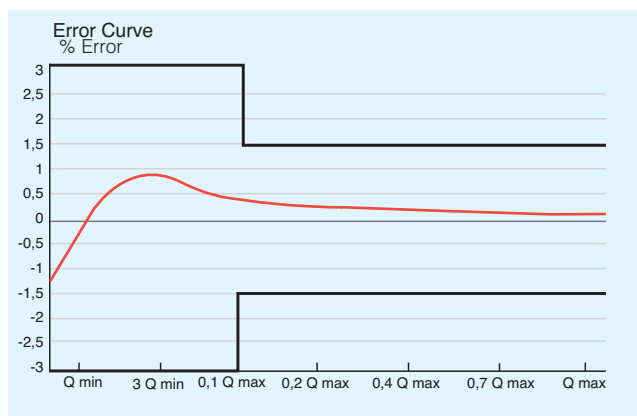
General Features

- 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 (1imp \pm 0,01m³).

Note: According to quantity of requested meter changes can be made on meter connection fitting spindles and fitting external dimensions.

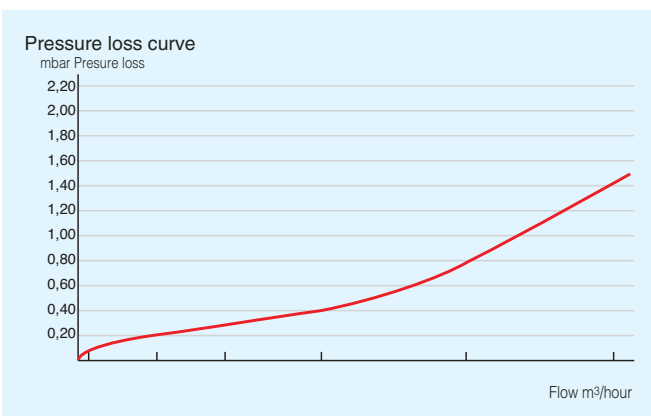


Assembly

- 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.

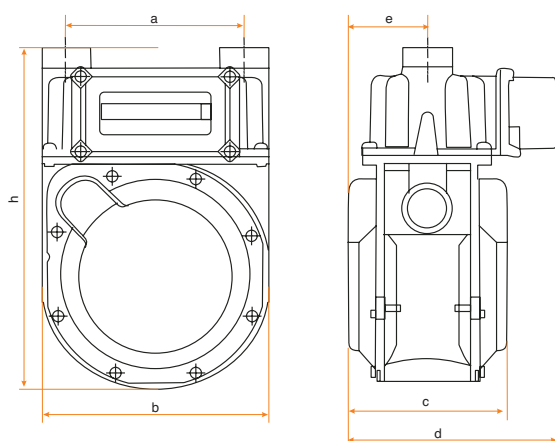


NATURAL GAS METERS

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 pasal
0,5 bar	=	500 mbar	=	50 kpasal	=	50.000 pasal

PLUGS & SOCKETS

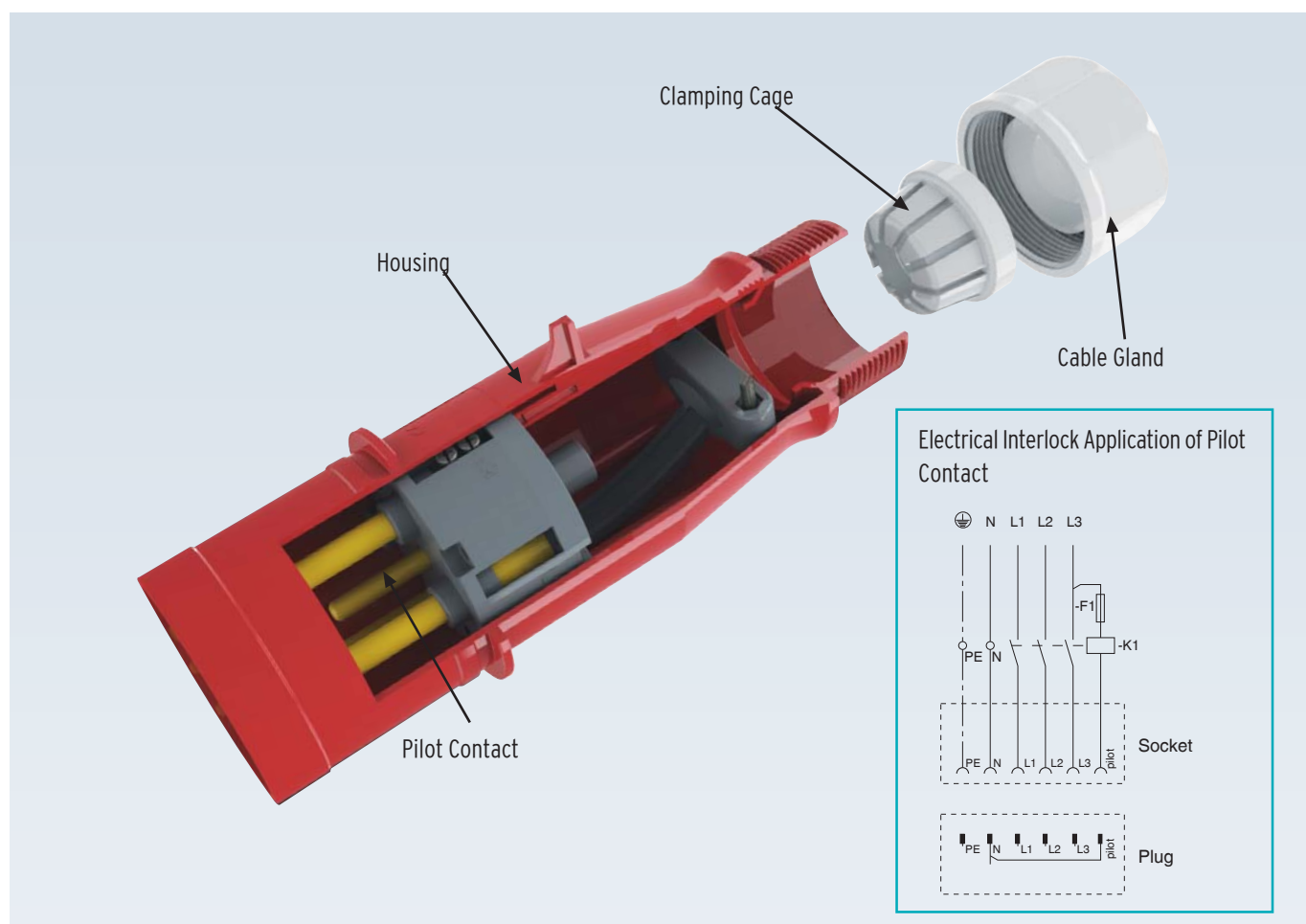


Plugs & Sockets



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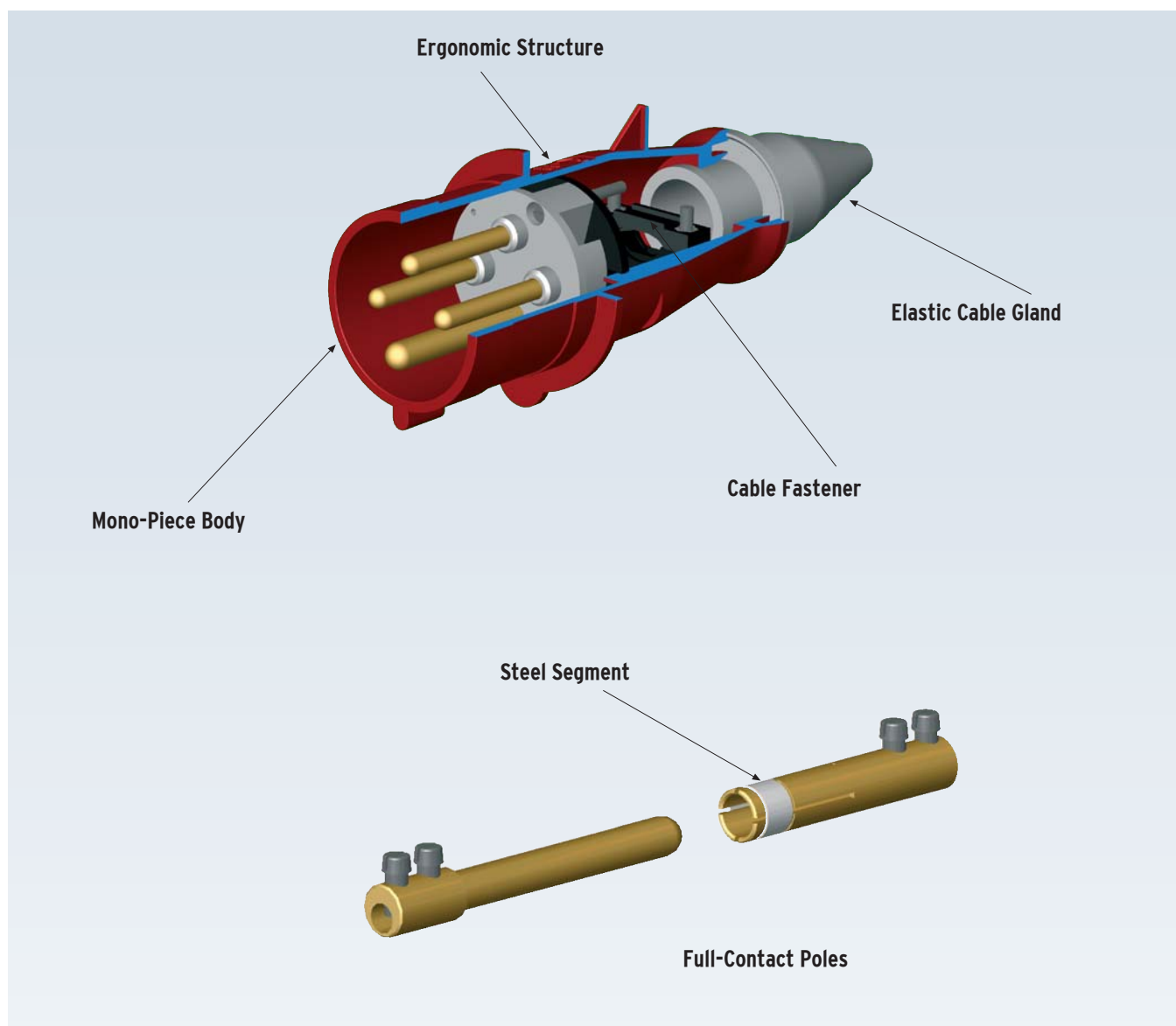
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Standards	Nominal Voltage Un (V)	Poles	Color	Nominal Current In (A)	h	IP	Hz.	Installation Temperature	
EN 60309-1-2 TS 7205-7206	110	3		16	4	44	50-60	-25°C	+60°C
	220	3		16	6	44			
	380	4				44-67			
	380	5		32		44-67			
	220	3				44-67			
	380	4		63		44-67			
	380	5				44-67			
	380	4				44-67			

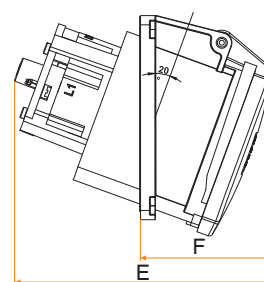
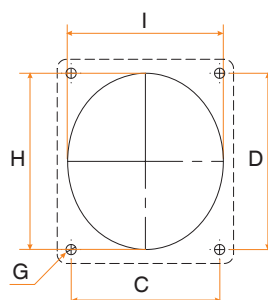
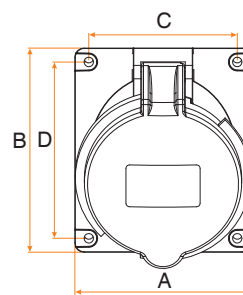
Nominal Current in (A)	Terminal	Terminal Cable Capacity mm2 NYA	
A	mm2	min.	max.
16	20	1,5	4
32	50	2,5	10
63	113	6	25

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



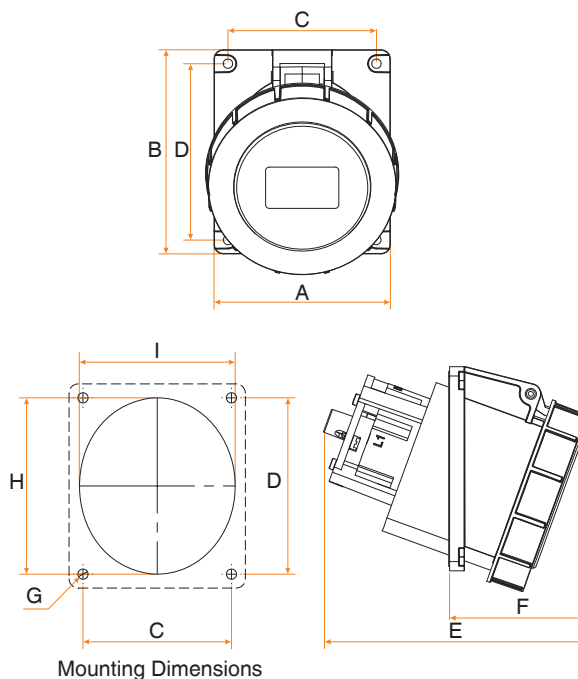
Mounting Dimensions

	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
2P+E							
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
3P+E							
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
3P+N+E							
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

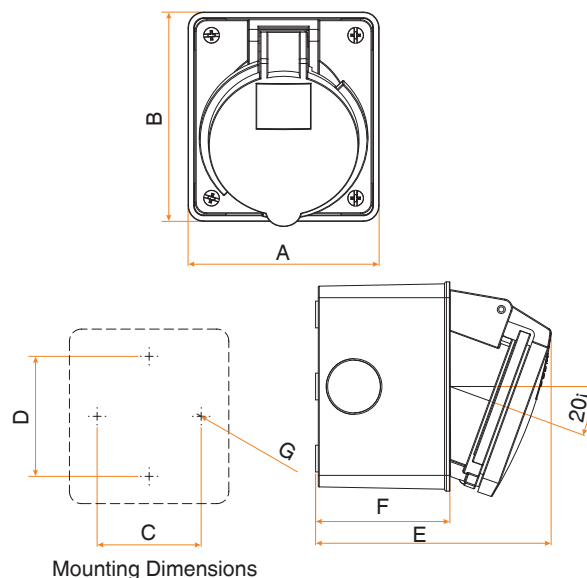


	Amper (A)	Dimensions (mm)								
		A	B	C	D	E	F	G	H	I
2P+E	32	92	101	75	85	108	60	6	84	84
	16	79.5	79.5	57.5	57.5	87	57	5	70	70
3P+E	32	92	102	75	85	100.5	60	6	84	84
	63	95	110	80	95	142	74	5	95	84
3P+N+E	16	79.5	79.5	60	60	72.5	50	4.5	57	57
	32	92	101	75	85	103	60	6	84	84
	63	92	110	80	95	142	74	5	95	84



	Amper (A)	(V)	(h)	Color	Weight (gr.)	Min. Order Quantity	Order Code
2P+E							
IP 67	32	200 - 250	6	●	264	12	9SL-66332-0250
3P+E							
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
3P+N+E							
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

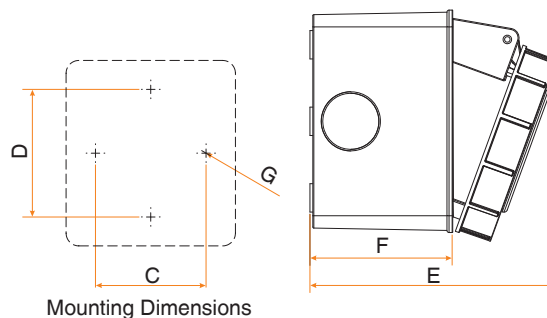
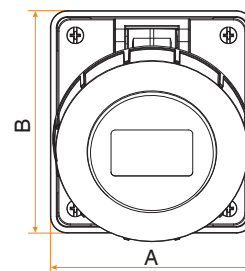


	Amper (A)	Dimensions (mm)						
		A	B	C	D	E	F	G
2P+E	16	86	86	55	55	94	45	6
	16	86	86	55	55	94	45	6
	32	99.5	109	64	75	122.5	70	6
3P+E	16	86	86	55	55	99	45	6
	32	99.5	109	65	75	121	70	6
3P+N+E	16	86	86	55	55	90.5	45	6
	32	99.5	109	65	75	122.5	70	6



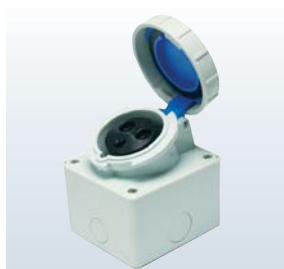
	Amper (A)	(V)	(h)	Color	Weight (gr.)	Min. Order Quantity	Order Code
2P+E							
IP 44	16	110 - 130	4	●	184	12	9WS-44316-S130
	16	200 - 250	6	●	181	12	9WS-46316-S250
	32	200 - 250	6	●	347	6	9WS-46332-S250
3P+E							
IP 44	16	380 - 415	6	●	226	12	9WS-46416-S415
	32	380 - 415	6	●	357	6	9WS-46432-S415
3P+N+E							
IP 44	16	380 - 415	6	●	218	12	9WS-46516-S415
	32	380 - 415	6	●	369	6	9WS-46532-S415

WALL MOUNTING SOCKET WITH STRAIGHT BOX AND LOCKED COVER



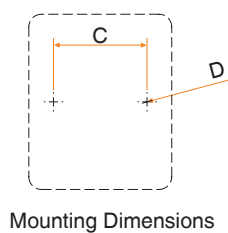
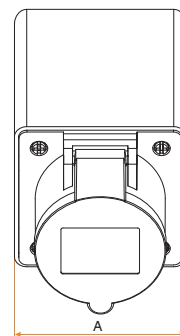
Mounting Dimensions

	Amper (A)	Dimensions (mm)						
		A	B	C	D	E	F	G
2P+E	32	99.5	109	64	75	122	70	6
	16	86	86	55	55	120	45	6
3P+E	32	99.5	109	65	75	122	70	6
	16	86	86	55	55	92.5	45	6
3P+N+E	32	99.5	109	65	75	120	70	6
	16	86	86	55	55	92.5	45	6

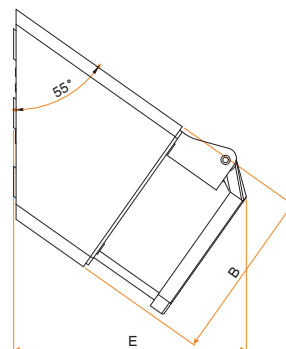


	Amper (A)	(V)	(h)	Color	Weight (gr.)	Min. Order Quantity	Order Code
2P+E							
IP 67	32	200 - 250	6	●	378	6	9WL-66332-S250
3P+E							
IP 67	16	380 - 415	6	●	324	6	9WL-66416-S415
	32	380 - 415	6	●	381	6	9WL-66432-S415
3P+N+E							
IP 67	16	380 - 415	6	●	248	12	9WL-66516-S415
	32	380 - 415	6	●	410	6	9WL-66532-S415

WALL MOUNTING SOCKET WITH ANGLED BOX



Mounting Dimensions

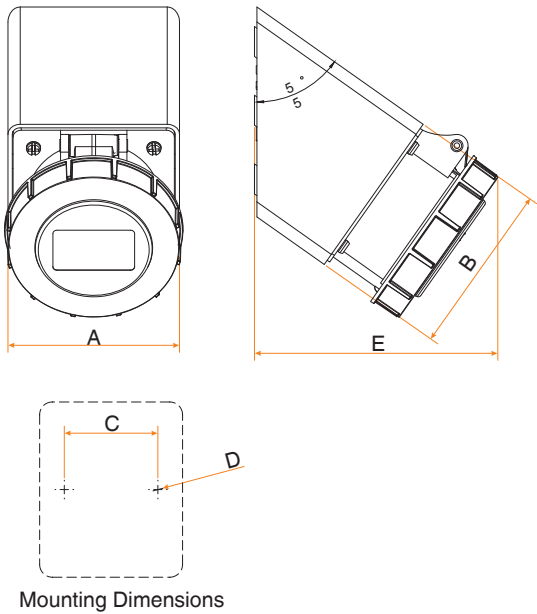


	Amper (A)	Dimensions (mm)				
		A	B	C	D	E
2P+E	16	84	84	55	6	120
	16	84	84	55	6	120
3P+E	16	84	84	55	6	125
3P+N+E	16	84	84	55	6	114



	Amper (A)	(V)	(h)	Color	Weight (gr.)	Min. Order Quantity	Order Code
2P+E							
IP 44	16	110 - 130	4	Yellow	243	12	9WS-44316-A130
	16	200 - 250	6	Blue	240	12	9WS-46316-A250
3P+E							
IP 44	16	380 - 415	6	Red	285	12	9WS-46416-A415
3P+N+E							
IP 44	16	380 - 415	6	Red	276	12	9WS-46516-A415

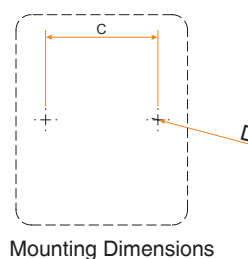
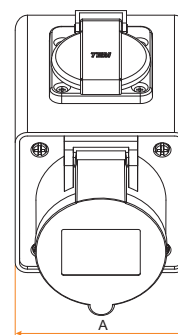
WALL MOUNTING SOCKET WITH ANGLED BOX AND LOCKED COVER



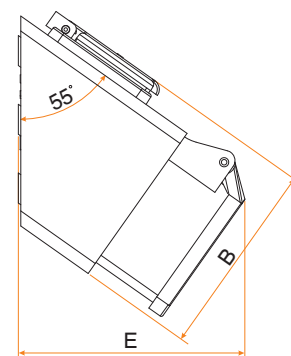
	Amper (A)	Dimensions (mm)				
		A	B	C	D	E
3P+N+E	16	84	84	55	6	120

	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

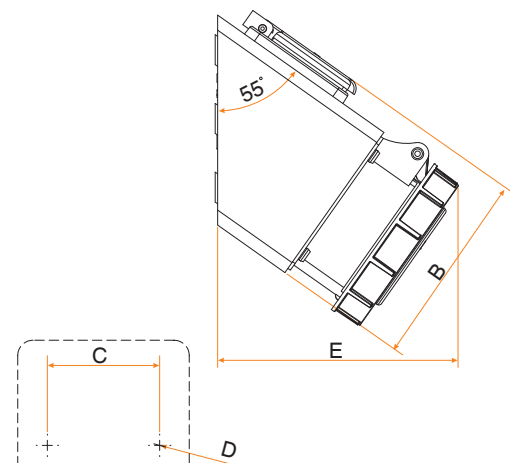
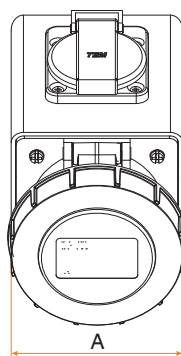


	Amper (A)	Dimensions (mm)				
		A	B	C	D	E
2P+E	16	84	96	55	6	120
3P+E	16	84	96	55	6	125
3P+N+E	16	84	96	55	6	114



	Amper (A)	(V)	(h)	Color	Weight (gr.)	Min. Order Quantity	Order Code
2P+E							
IP 44	16	200 - 250	6	●	278	12	9WS-46316-C250
3P+E							
IP 44	16	380 - 415	6	●	323	12	9WS-46416-C415
3P+N+E							
IP 44	16	380 - 415	6	●	314	12	9WS-46516-0415

WALL MOUNTING SOCKET WITH ANGLED BOX AND LOCKED COVER + SCHUKO

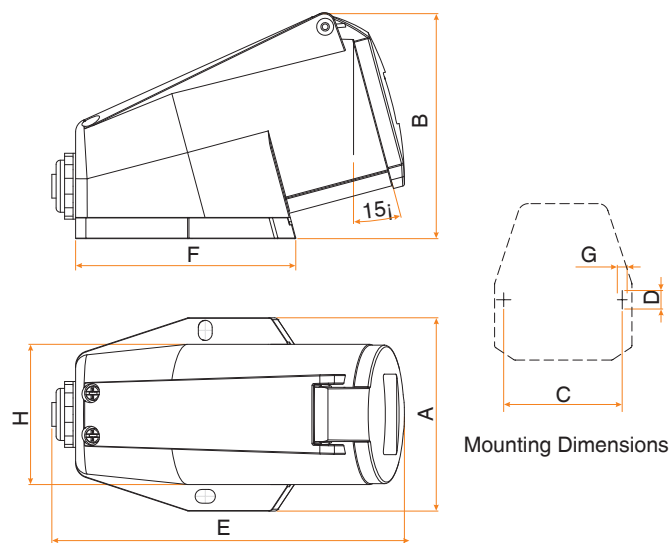


Mounting Dimensions

	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

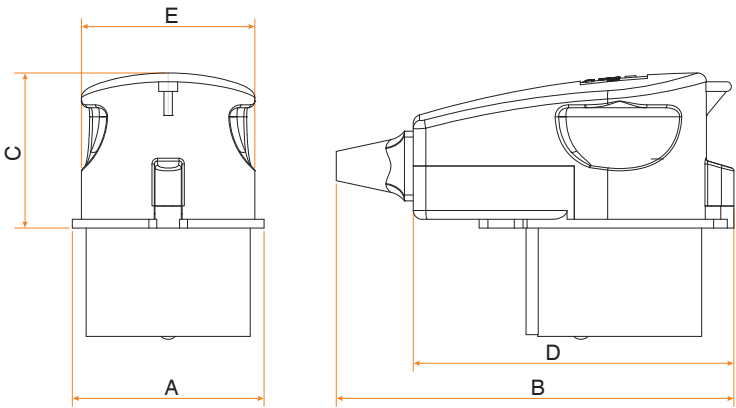


	Amper (A)	Dimensions (mm)							
		A	B	C	D	E	F	G	H
2P+E	32	91	106	78	12	166	103	7	66
3P+E	32	91	106	78	12	166	103	7	66
3P+N+E	16	88	87	72	6	132	114	6	62



	Amper (A)	(V)	(h)	Color	Weight (gr.)	Min. Order Quantity	Order Code
2P+E							
IP 44	16	200 - 250	6	●	299	12	9AS-46316-0250
3P+E							
IP 44	16	380 - 415	6	●	307	12	9AS-46416-0415
3P+N+E							
IP 44	16	380 - 415	6	●	214	12	9AS-46516-0415

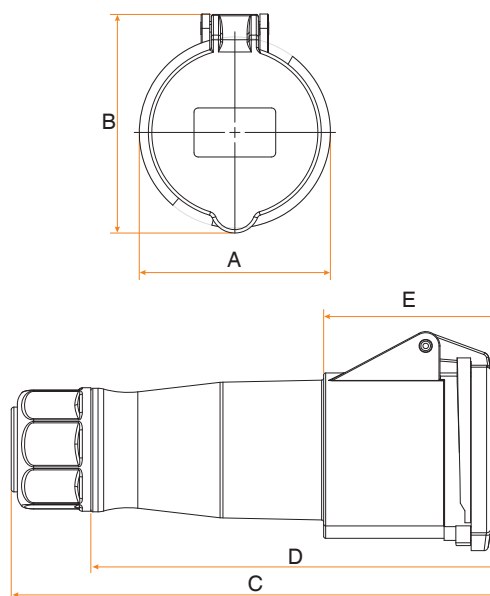
ANGLED PLUG



	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

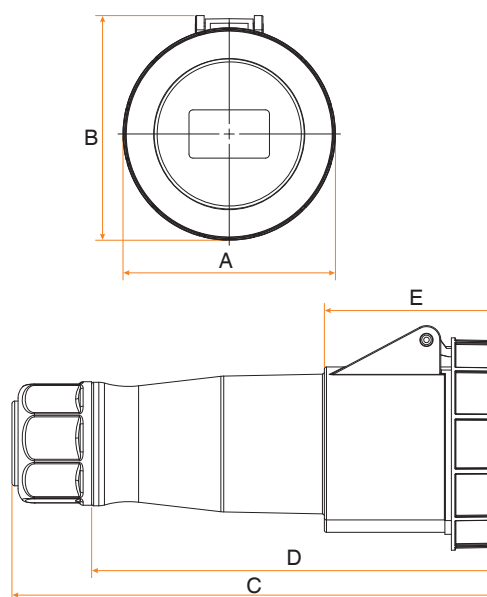


	Amper (A)	Dimensions (mm)				
		A	B	C	D	E
3P+E	16	52	69	152.5	116	51
	16	52	69	152.5	116	51
	32	65	88	233	159	64
3P+E	16	69	85.5	167	128	53
	32	65	88	233	159	64
	63	94	107	238	200	85
3P+N+E	16	65	82.5	166.5	127	48
	32	73	97	230	154	64
	63	94	107	238	200	85



	Amper (A)	(V)	(h)	Color	Weight (gr.)	Min. Order Quantity	Order Code
2P+E							
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
3P+E							
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
3P+N+E							
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

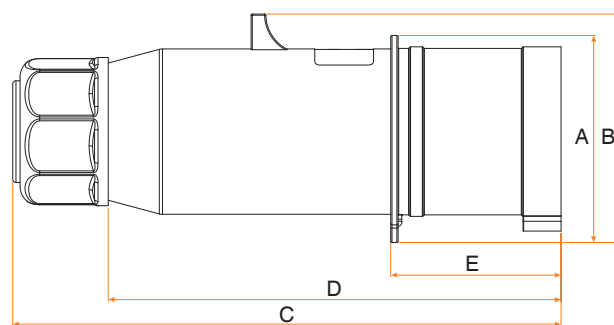


	Amper (A)	Dimensions (mm)				
		A	B	C	D	E
3P+E	16	80	88.5	164	125	50
3P+N+E	63	104	110	237	198	84
	63	104	110	237	198	84



	Amper (A)	(V)	(h)	Color	Weight (gr.)	Min. Order Quantity	Order Code
3P+E							
IP 44	16	380 - 415	6	●	195	12	9CL-46416-0415
3P+E							
IP 67	63	380 - 415	6	●	665	6	9CL-66463-0415
3P+N+E							
IP 67	63	380 - 415	6	●	714	6	9CL-66563-0415

PLUG

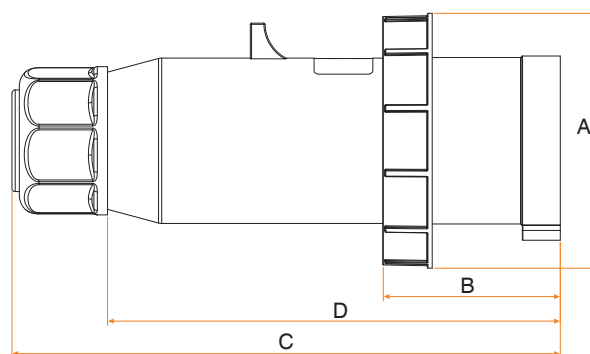


	Amper (A)	Dimensions (mm)				
		A	B	C	D	E
2P+E	16	50	57.5	143.5	107	39
	16	50	57.5	143.5	107	39
	32	70.5	79	215	141	49
3P+E	16	58.5	65	158.5	119	39
	32	70.5	79	215	141	52
	63	78.5	93	224	185	69.5
3P+N+E	16	63	71	156.5	117	39
	32	76.5	82.5	217	141	50
	63	78.5	93	224	185	69.5



	Amper (A)	(V)	(h)	Color	Weight (gr.)	Min. Order Quantity	Order Code
2P+E							
IP 44	16	110 - 130	4	●	106	12	9PF-44316-0130
	16	200 - 250	6	●	106	12	9PF-46316-0250
	32	200 - 250	6	●	208	12	9PF-46332-0250
3P+E							
IP 44	16	380 - 415	6	●	141	12	9PF-46416-0415
	32	380 - 415	6	●	227	12	9PF-46432-0415
	63	380 - 415	6	●	495	6	9PF-46463-0415
3P+N+E							
IP 44	16	380 - 415	6	●	155	12	9PF-46516-0415
	32	380 - 415	6	●	250	12	9PF-46532-0415
	63	380 - 415	6	●	537	6	9PF-46563-0415

PLUG WITH LOCK

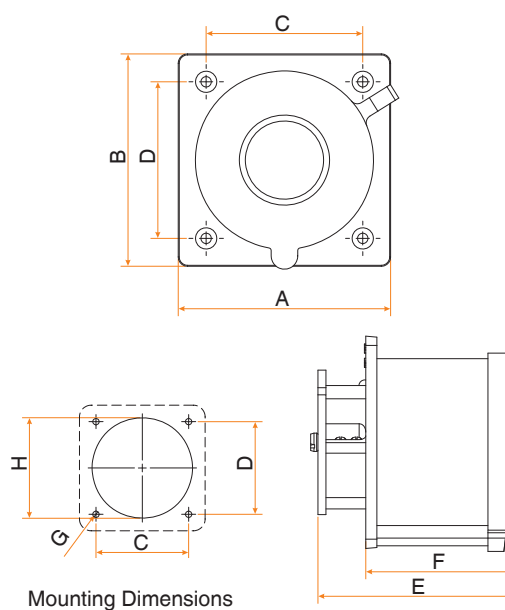


	Amper (A)	Dimensions (mm)			
		A	B	C	D
2P+E	32	90.5	51.5	215	141
	16	80	42.5	158.5	119
3P+E	32	90.5	54.5	215	141
	63	104	72	224	185
	16	87.5	41.5	156.5	117
3P+N+E	32	97	53	218	141
	63	104	72	224	185
	16	87.5	41.5	156.5	117



	Amper (A)	(V)	(h)	Color	Weight (gr.)	Min. Order Quantity	Order Code
2P+E							
IP 44	32	200-250	6	●	237	12	9PL-46332-0250
3P+E							
IP 44	16	380 - 415	6	●	161	12	9PL-46416-0415
	32	380 - 415	6	●	256	12	9PL-46432-0415
3P+N+E							
IP 44	16	380 - 415	6	●	158	12	9PL-46516-0415
	32	380 - 415	6	●	280	12	9PL-46532-0415
3P+E							
IP 67	63	380 - 415	6	●	530	6	9PL-66463-0415
3P+N+E							
IP 67	63	380 - 415	6	●	573	6	9PL-66563-0415

WALL MOUNTING INLET

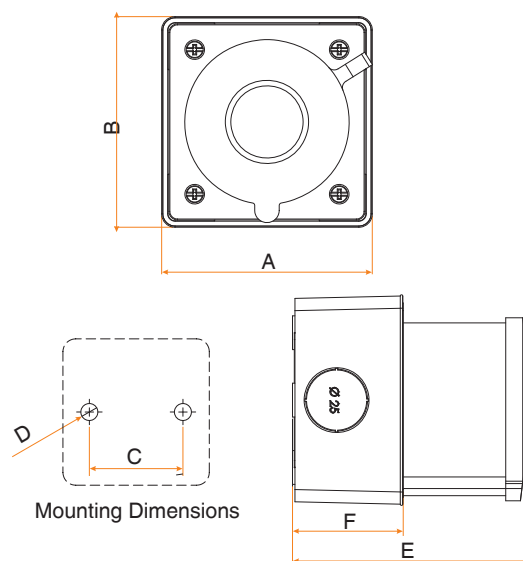


	Amper (A)	Dimensions (mm)							
		A	B	C	D	E	F	G	H
3P+E	32	80	80	59	59	71,5	53,5	4	64
3P+N+E	16	80	80	59	59	57,5	40	4	64
	32	80	80	59	59	74	56	4	64



	Amper (A)	(V)	(h)	Color	Weight (gr.)	Min. Order Quantity	Order Code
3P+E							
IP 44	32	380 - 415	6	●	149	12	9WI-46416-0415
3P+N+E							
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

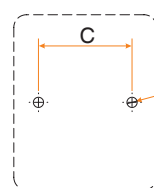
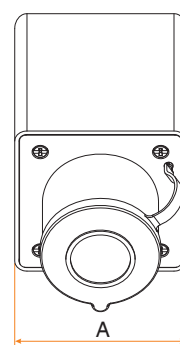


	Amper (A)	Dimensions (mm)					
		A	B	C	D	E	F
3P+E	32	86	86	55	10	94,5	45
3P+N+E	16	86	86	55	10	85	45
	32	86	86	55	10	97	45

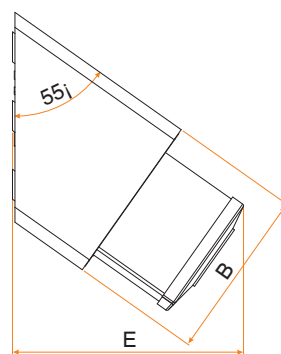


	Amper (A)	(V)	(h)	Color	Weight (gr.)	Min. Order Quantity	Order Code
3P+E							
IP 44	32	380 - 415	6	●	212	12	9WI-46432-S415
3P+N+E							
IP 44	16	380 - 415	6	●	178	12	9WI-46516-S415
	32	380 - 415	6	●	235	12	9WI-46532-S415

WALL MOUNTING INLET WITH ANGLED BOX



DUVAR MONTALAMA 2xL, 1xLERÜ

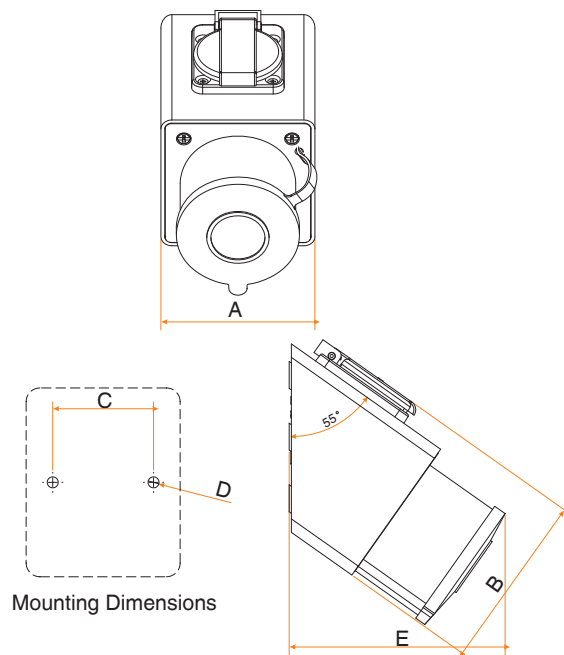


	Amper (A)	Dimensions (mm)				
		A	B	C	D	E
3P+E	32	84	84	55	6	113
3P+N+E	16	84	84	55	6	105,5
	32	84	84	55	6	118



	Amper (A)	(V)	(h)	Color	Weight (gr.)	Min. Order Quantity	Order Code
3P+E							
IP 44	32	380 - 415	6	●	270	12	9WI-46432-A415
3P+N+E							
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

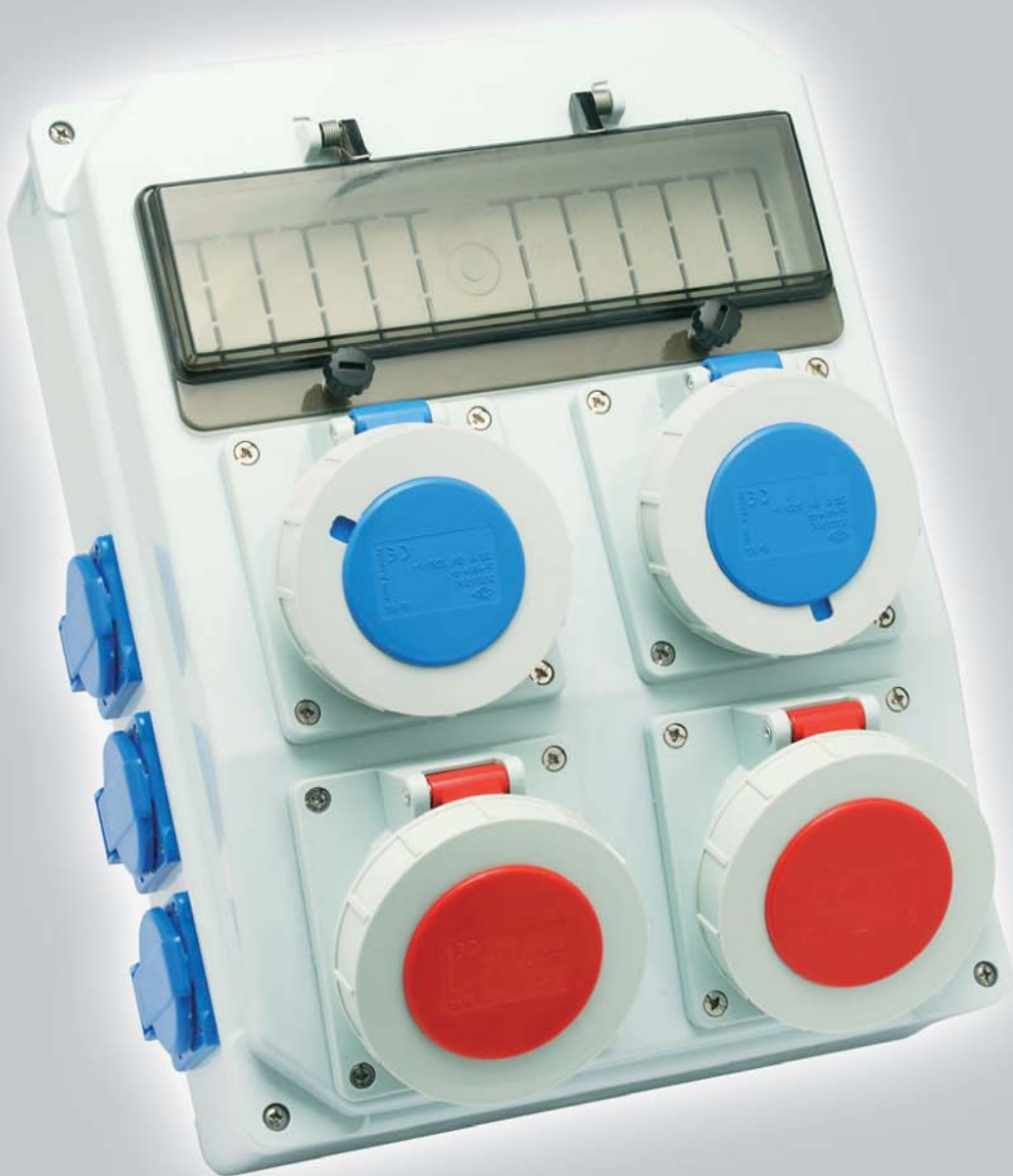


	Amper (A)	Dimensions (mm)				
		A	B	C	D	E
3P+E	32	84	96	55	6	113
3P+N+E	16	84	96	55	6	105,5
	32	84	96	55	6	118



	Amper (A)	(V)	(h)	Color	Weight (gr.)	Min. Order Quantity	Order Code
3P+E							
IP 44	32	380 - 415	6	●	309	12	9WI-46432-S415
3P+N+E							
IP 44	16	380 - 415	6	●	275	12	9WI-46516-S415
	32	380 - 415	6	●	334	12	9WI-46532-S415

COMBINATION BOXES



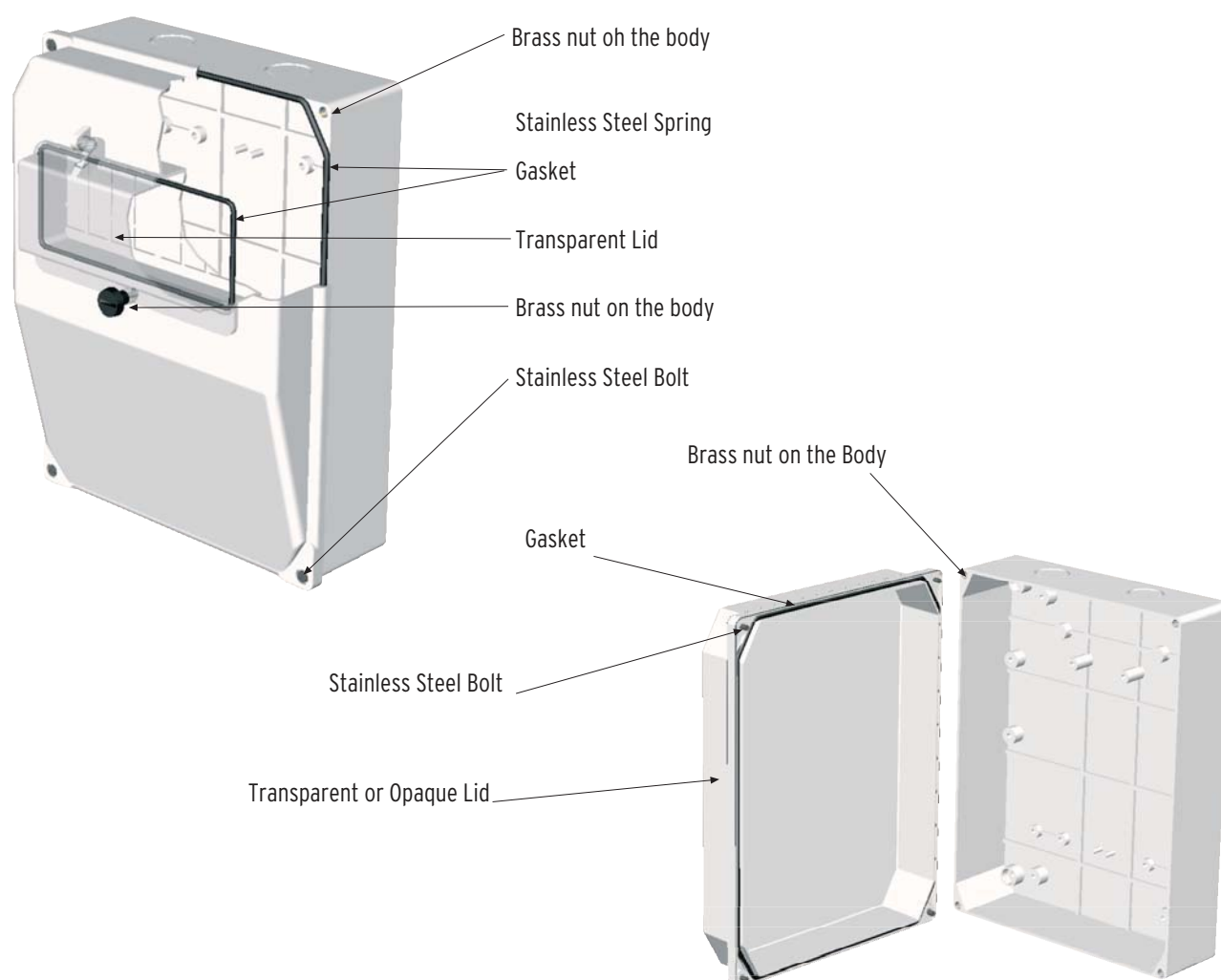
Combination Boxes



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MOLDED CASE CIRCUIT BREAKERS



	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 chasis 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.

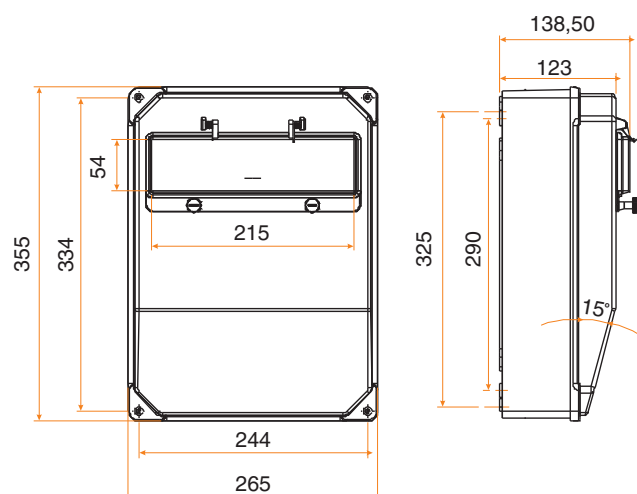
MOLDED CASE CIRCUIT BREAKERS



9CB-C2635-0115

260 x 350 x 115 mm

IP 67



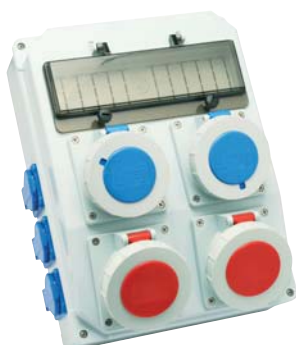
4(4x16A) CEE IP44
2(1x16A) Schuko IP44



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

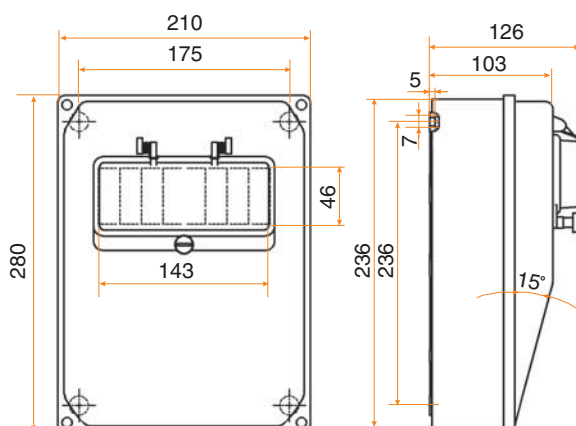
MOLDED CASE CIRCUIT BREAKERS



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

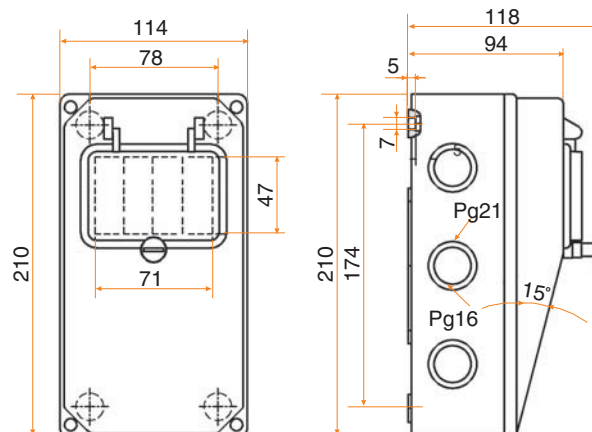
MOLDED CASE CIRCUIT BREAKERS



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



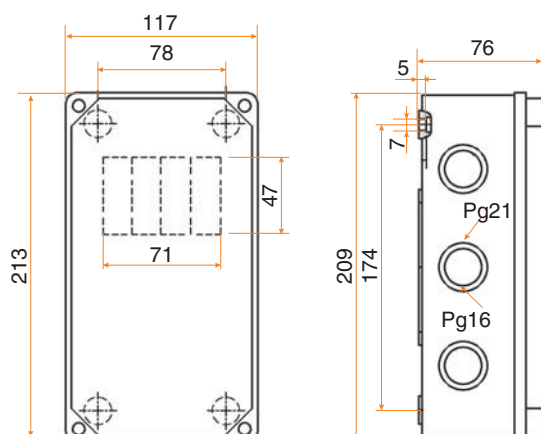
1(5x32A) CEE IP44
2(1x16A) Schuko IP44



1 x Switch

MOLDED CASE CIRCUIT BREAKERS

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

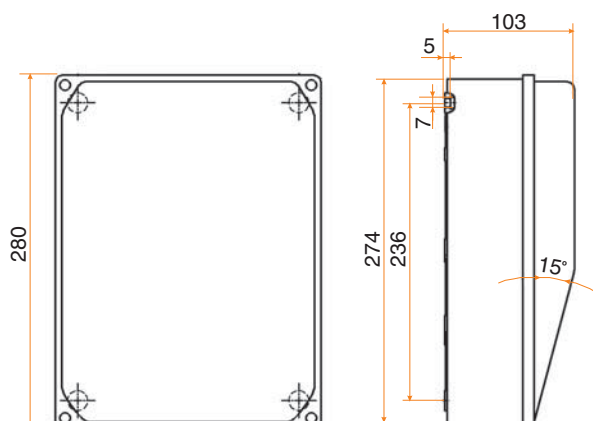


1 x Switch

MOLDED CASE CIRCUIT BREAKERS



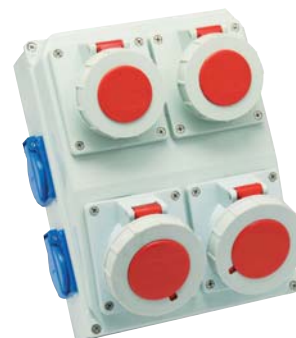
9CB-02128-0100
210 x 280 x 100 mm
IP 67



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**

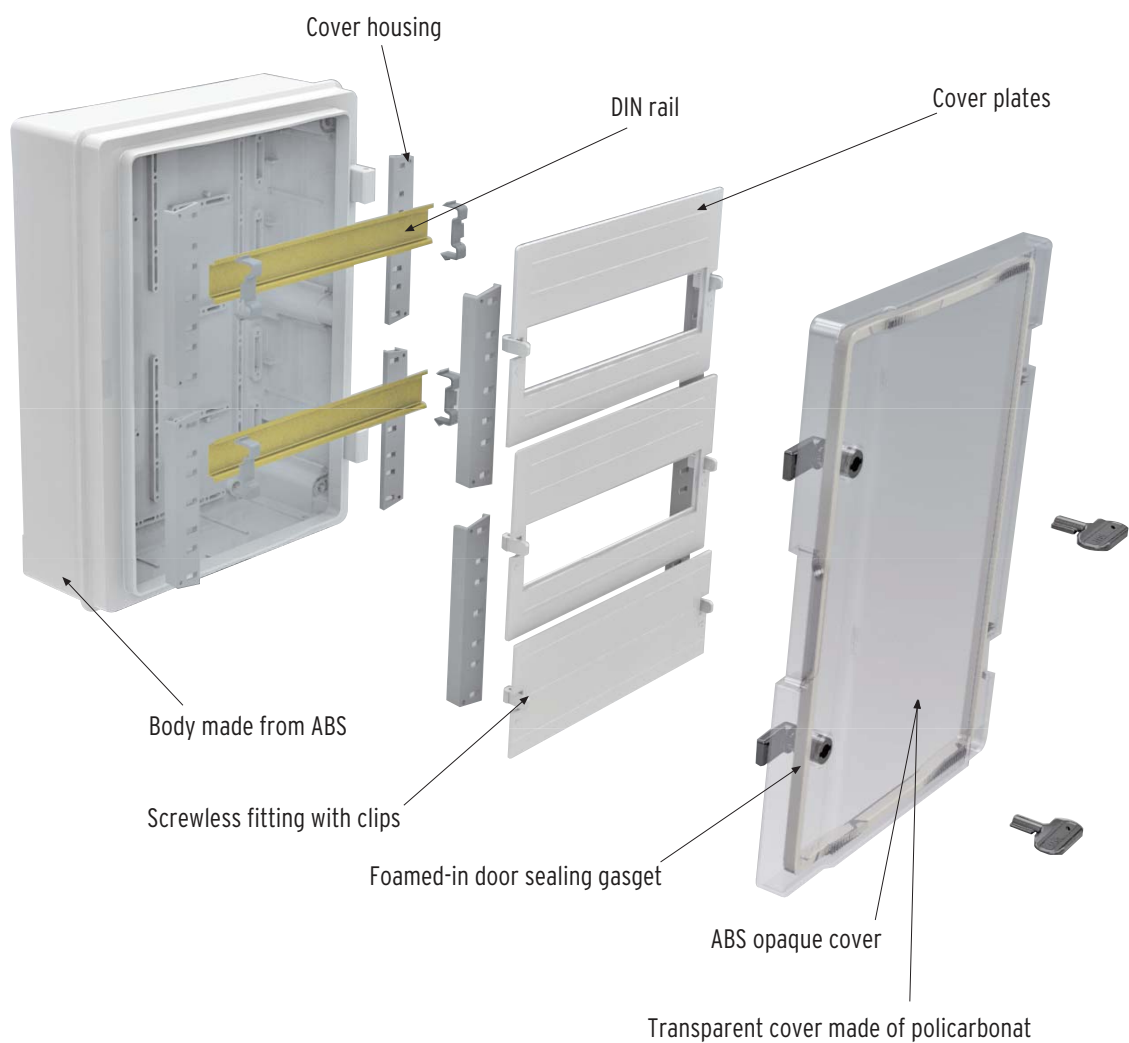


**2(4x32A) CEE IP44
2(5x16A) CEE IP44**



**2 x Switch
2(5x32A) CEE IP67**

MOLDED CASE CIRCUIT BREAKERS



MOLDED CASE CIRCUIT BREAKERS



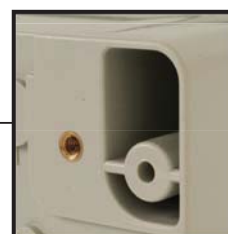
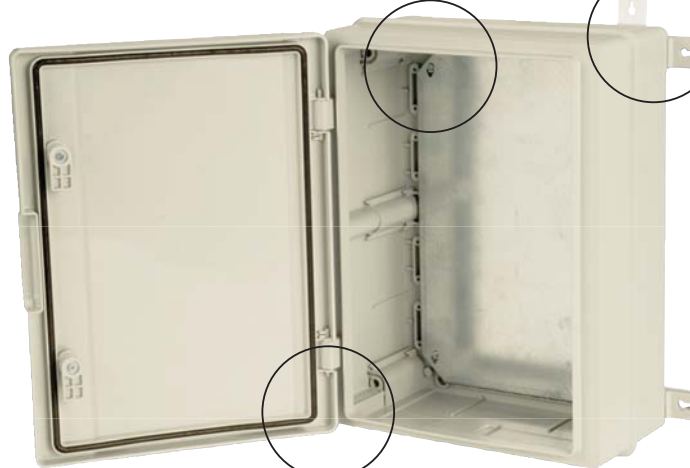
easiness of mounting
plate fitting



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

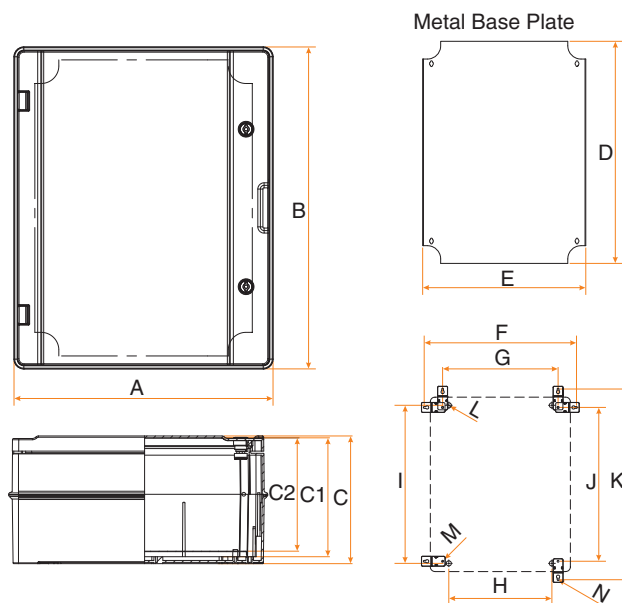
Sizes

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

MOLDED CASE CIRCUIT BREAKERS



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

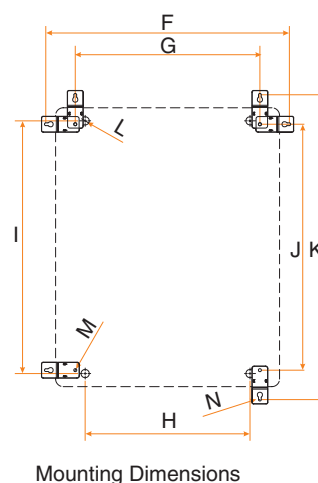
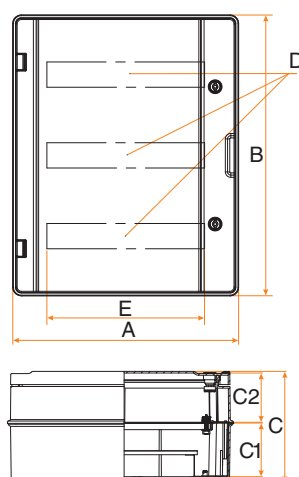


IP65																		
Dimensions	Opaque cover	Transparent cover	A	B	C	C1	C2	D	E	F	G	H	I	J	K	L	M	N
21x30x13 cm	9DB-02130-M013	9DB-T2130-M013	221	311	137	124.5	123.5	270	174.5	253.5	146	118	261	248.5	355.5	15	M5	2.5
26x35x15 cm	9DB-02635-M015	9DB-T2635-M015	265	355	152	138.5	130	315	227	305	198	198	318	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

MOLDED CASE CIRCUIT BREAKERS



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



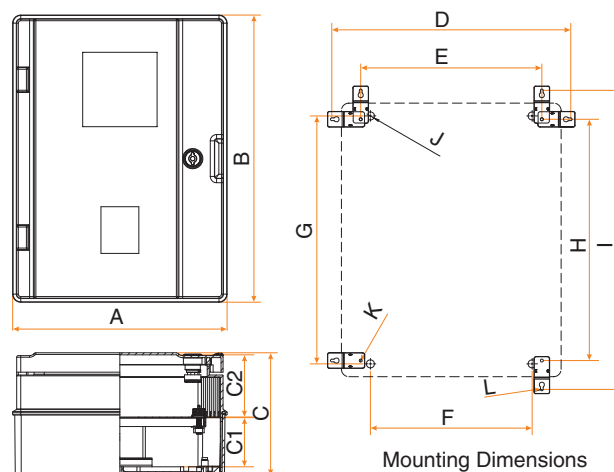
Mounting Dimensions

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

MOLDED CASE CIRCUIT BREAKERS



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

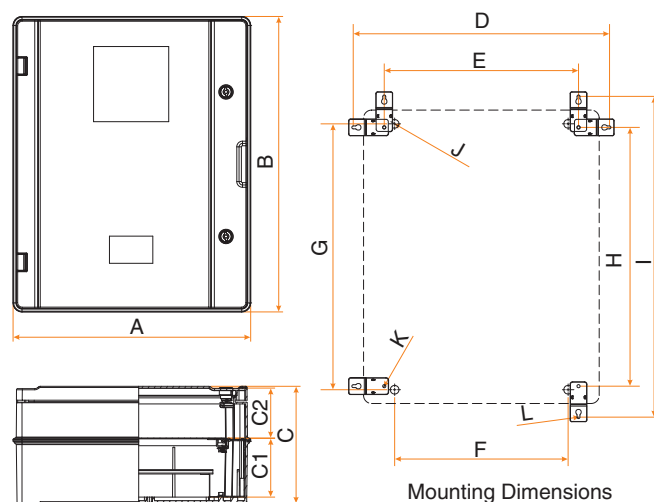


IP65																	
Dimensions	Opaque cover	Transparent cover	A	B	C	C1	C2	D	E	F	G	H	I	J	K	L	M
21x30x13 cm	9DB-02130-1013	9DB-T2130-1013	221	311	137	72	51.5	253.5	146	118	261	248.5	355.5	15	M5	2.5	3
26x35x15 cm	9DB-02635-1015	9DB-T2635-1015	265	355	152	61	77	305	198	198	318	291	398	15	M5	2.5	4
30x40x13 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

MOLDED CASE CIRCUIT BREAKERS



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

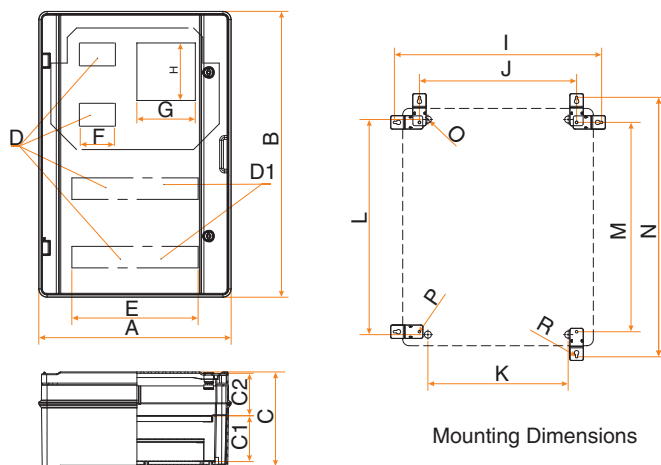


IP65																	
Dimensions	Opaque cover	Transparent cover	A	B	C	C1	C2	D	E	F	G	H	I	J	K	L	M
30x40x13 cm	9DB-03040-3013	9DB-T3040-3013	310	410	132	70	43	343	236	200	360	348	456	15	M5	2.5	8
30x40x17 cm	9DB-03040-3017	9DB-T3040-3017	310	410	170	70	66	343	236	200	360	348	456	15	M5	2.5	8
40x50x20 cm	9DB-03050-3020	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

MOLDED CASE CIRCUIT BREAKERS



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

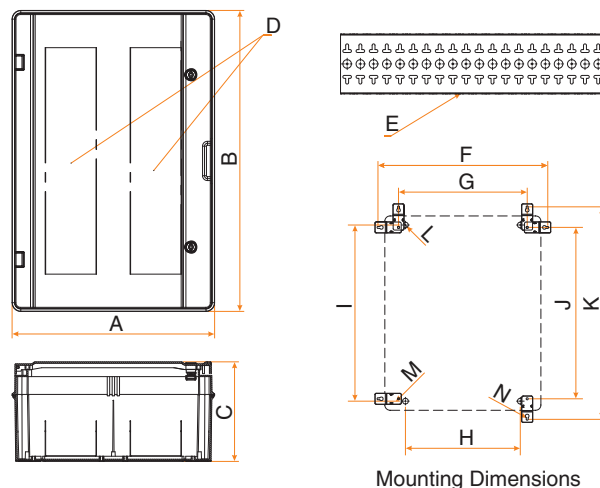


IP65																								
Dimensions	Opaque cover	Transparent cover	A	B	C	C1	C2	D	D1	E	F	G	H	I	J	K	L	M	N	O	P	R	S	
40x50x20 cm	9DB-04050-M120	9DB-T4050-M120	410	510	202	98	90	3	1	16	4	125	123	442	336	300	460	447.5	555	15	M5	2.5	24	
40x60x20 cm	9DB-04060-M120	9DB-T4060-M120	410	610	202	98	90	4	2	16	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	

MOLDED CASE CIRCUIT BREAKERS



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



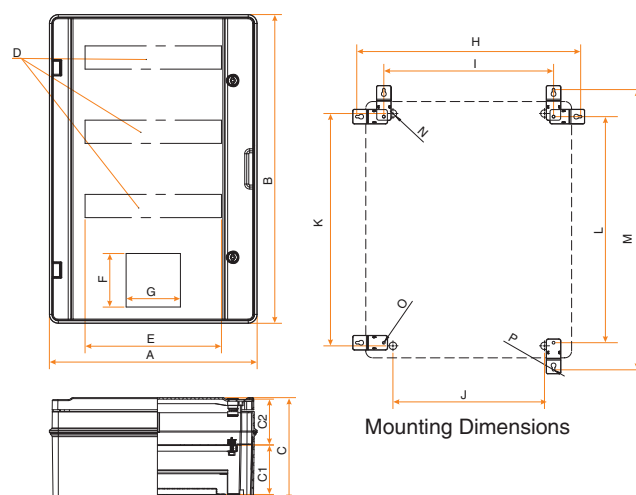
IP65																
Dimensions	Opaque cover	Transparent cover	A	B	C	D	E	F	G	H	I	J	K	L	M	N
21x30x13 cm	9D□-02130-B013	9D□-T2130-B013	221	311	137	3	30	253.5	146	118	261	248.5	355.5	15	M5	2.5
26x35x15 cm	9D□-02635-B015	9D□-T2635-B015	265	355	152	5	50	305	198	198	318	291	398	15	M5	2.5
30x40x13 cm	9D□-03040-B013	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

MOLDED CASE CIRCUIT BREAKERS



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

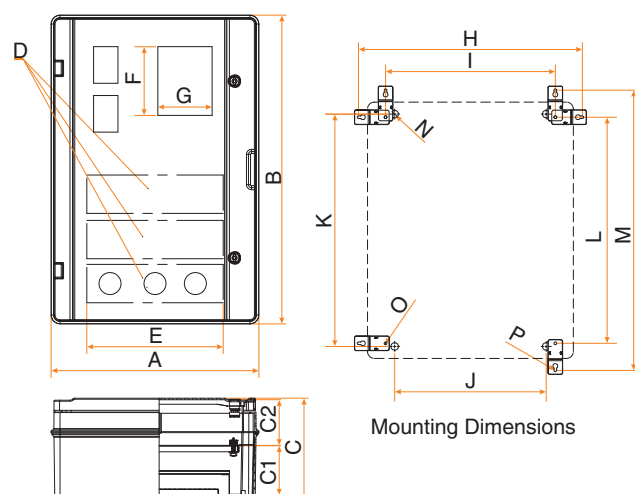


IP65																						
dimension	Opaque cover	Transparent cover	A	B	C	C1	C2	D	E	F	G	H	I	J	K	L	M	N	O	P	R	
40x50x20 cm	9DB-04050-C020	9DB-T4050-C020	410	510	202	98	90	2	16	105	105	444	336	300	460	448	555	12	M5	2.5	32	
40x60x20 cm	9DB-04060-C020	9DB-T4060-C020	410	610	202	98	90	3	16	105	105	442	336	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	

MOLDED CASE CIRCUIT BREAKERS



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

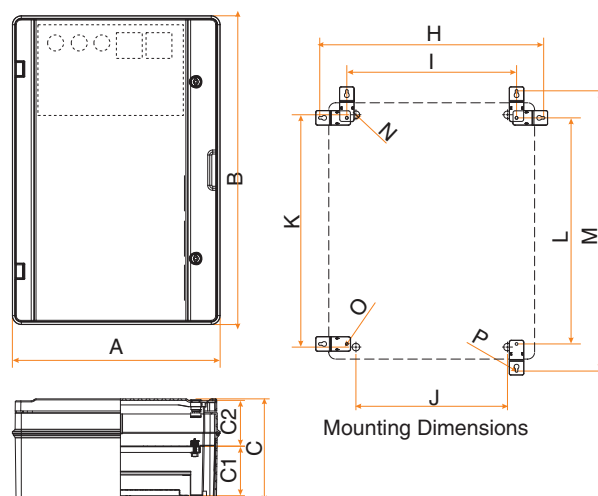


IP65																				
Dimensions	Opaque cover	Transparent cover	A	B	C	C1	C2	D	E	F	G	H	I	J	K	L	M	N	O	P
40x60x20 cm	9DB-04060-S020	9DB-T4060-S020	410	610	202	98	90	1	16	123	125	442	336	336	560	550	657	15	M5	2.5
50x70x25 cm	9DB-05070-S025	9DB-T5070-S025	511	711	254	98	140	2	40	123	125	547	440	440	660	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

MOLDED CASE CIRCUIT BREAKERS



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

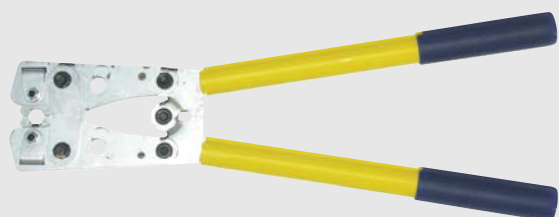


Dimensions	Opaque cover	Transparent cover	A	B	C	C1	C2	H	I	J	K	L	M	N	O	P
40x50x20 cm	9DB-04050-P120	9DB-T4050-P120	410	510	202	98	90	444	336	300	460	448	555	12	M5	2.5
40x60x20 cm	9DB-04060-P120	9DB-T4060-P120	410	610	202	98	90	442	336	300	460	560	657	12	M5	2.5
50x70x25 cm	9DB-05070-P125	9DB-T5070-P125	511	711	254	98	140	547	440	410	660	650	757	15	M5	2.5

CABLE LUGS and TOOLS



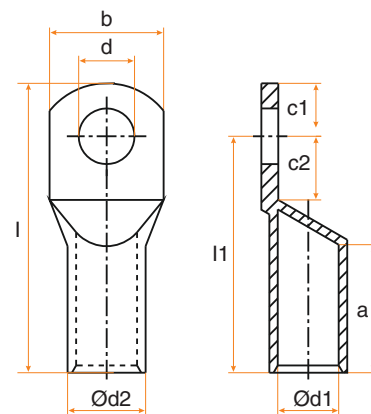
Cable Lugs and Tools



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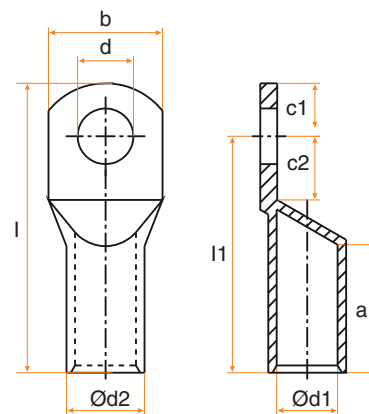
CABLE LUGS (FCL0)



Cross-Section mm ²	Bolt Ø	Dimensions (mm)									Package Weight (~kg)	Package Amount	Order Code
		d	d1	d2	l	l1	a	b	c1	c2			
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.

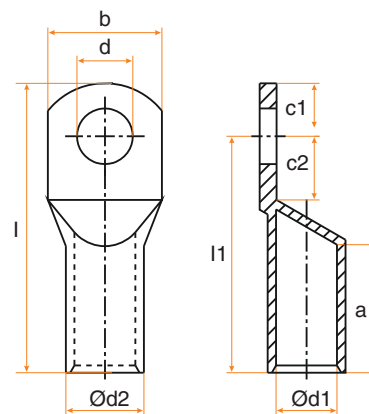
CABLE LUGS (FCL0)



Cross-Section mm²	Bolt Ø	Dimensions (mm)										Package Weight (~kg)	Package Amount	Order Code
		d	d1	d2	l	l1	a	b	c1	c2				
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.

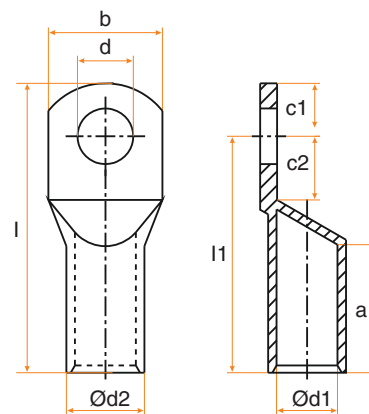
CABLE LUGS (FCL1)



Cross-Section mm²	Bolt Ø	Dimensions (mm)										Package Weight (~kg)	Package Amount	Order Code
		d	d1	d2	l	l1	a	b	c1	c2				
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.

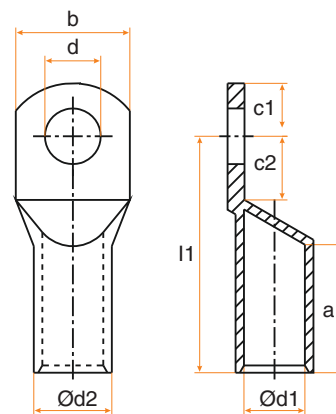
CABLE LUGS (FCL1)



Cross-Section mm²	Bolt Ø	Dimensions (mm)									Package Weight (~kg)	Package Amount	Order Code
		d	d1	d2	l	l1	a	b	c1	c2			
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.

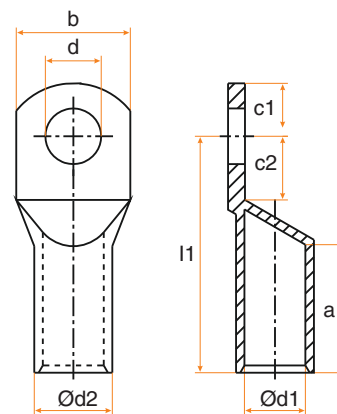
DIN 46235 TYPE SKP COMPRESSION TYPE CABLE LUGS



Cross-Section mm ²	Bolt Ø	Dimensions (mm)								Package Weight (~kg)	Package Amount	Order Code
		d	d1	d2	l1	a	b	c1	c2			
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.

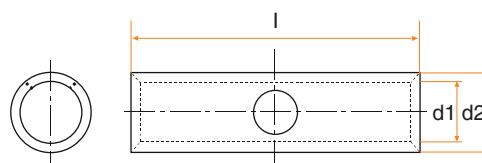
DIN 46235 TYPE SKP COMPRESSION TYPE CABLE LUGS



Cross-Section mm ²	Bolt Ø	Dimensions (mm)									Package Weight (~kg)	Package Amount	Order Code
		d	d1	d2	l1	a	b	c1	c2				
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

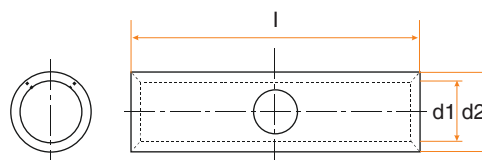
* The cable lugs for which the cross sections are written with bold letters are standard production. Please ask the stock quantity for the other cross sections.

STANDARD TYPE BUTT-CONNECTOR





Cross-Section mm ²	Dimensions (mm)			Package Weight (~kg)	Package Amount	Order Code
	d1	d2	L			
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 ²	Dimensions (mm)			Package Weight (~kg)	Package Amount	Order Code
	d1	d2	L			
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



SKP CRIMPING TOOLS - MECHANICAL CRIMPERS

	Crimping Form	Crimping Range (mm ²)	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 ²)	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 ²)	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 ² - Makes hexagonal crimping and with revolving Dies - Grips are plastic insulated			

	Crimping Form	Crimping Range (mm ²)	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 ²)	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 ²)	Crimping Force (kN)	Stroke (mm)	Length (mm)	Weight (kg.)	Order Code
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10,00 - 240,00	60	13	365	2,950	9CT-00240-0000
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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 mm²


	Crimping Range (mm ²)	Crimping Force (kN)	Stroke (mm)	Length (mm)	Weight (kg.)	Order Code
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16,00 - 400,00	130	38	545	5,360	9CT-00400-0000
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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 mm²

COPPER CABLE CUTTERS - MECHANIC CUTTERS


	Max. Cross Section (mm ²)	Length (mm)	Weight (kg.)	Order Code
	95 or 4x16	410	0,750	9MC-95000-0000
	<ul style="list-style-type: none"> - Cuts NYA-NYY and NYM copper and aluminum cables - Handles are of steel pipes. - Grips are plastic insulated. 			

	Max. Cross Section (mm ²)	Length (mm)	Weight (kg.)	Order Code
	240 or 3x35+10	650	2,000	9MC-24000-0000
	<ul style="list-style-type: none"> - Cuts NYA-NYY and NYM copper and aluminum cables - Handles are of steel pipes. - Grips are plastic insulated. 			

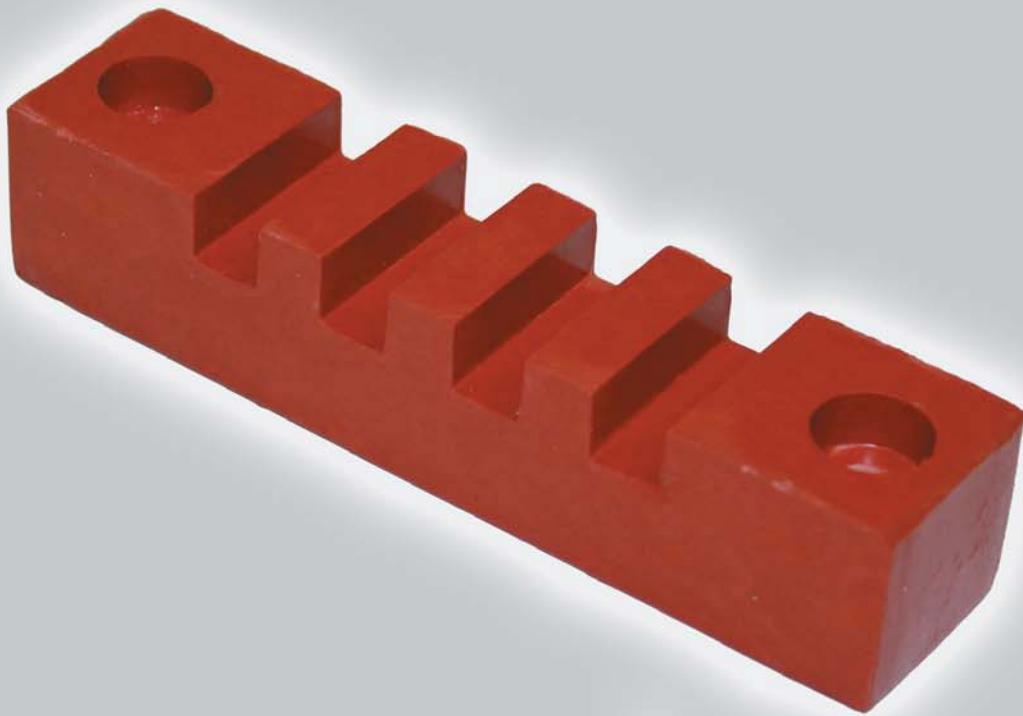
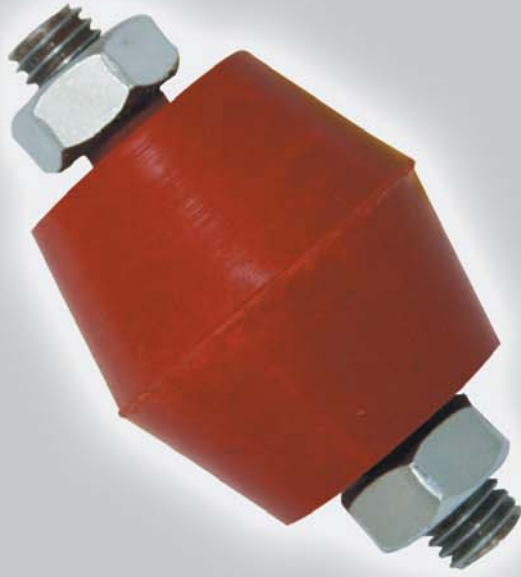
	Max. Cross Section (mm ²)	Length (mm)	Weight (kg.)	Order Code
	325 or 3x70+35	650	2,000	9MC-32500-0000
	<ul style="list-style-type: none"> - Cuts NYA-NYY and NYM copper and aluminum cables - Aluminum tattoo sleeves. - Grips are plastic insulated. 			

	Max. Cross Section (mm ²)	Length (mm)	Weight (kg.)	Order Code
	500 or 3x120+70	800	2,930	9MC-50000-0000
	<ul style="list-style-type: none"> * Cuts NYA-NYY and NYM copper and aluminum cables * Aluminum tattoo sleeves. * Grips are plastic insulated. 			

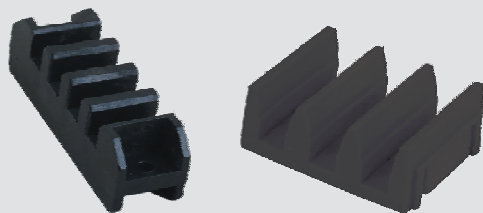
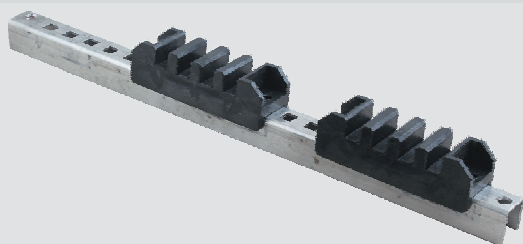
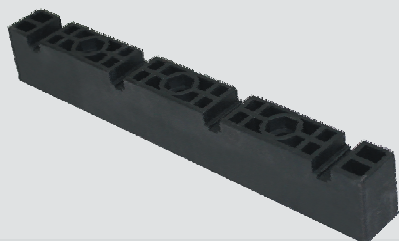
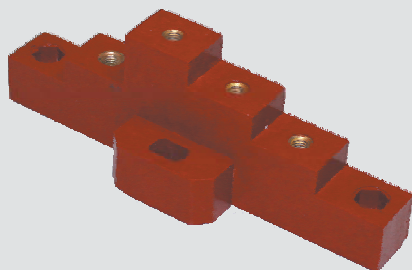
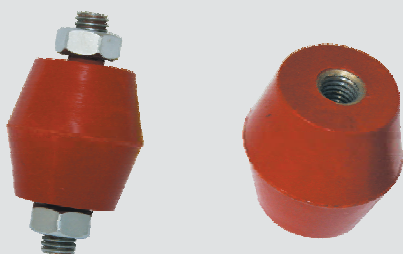
Cable Cutters - Mechanic Cutters (Cuts steel reinforced aluminum conductors)

	Maksimum Diameter (Ø)	Length (mm)	Weight (kg.)	Order Code
	20	590	2,000	9MC-16000-A000
	<ul style="list-style-type: none"> * Cuts steel reinforced aluminum conductors up to a maximum diameter of 20mm. * Blades are hardened steel. * Aluminum tattoo sleeves. * Grips are plastic insulated. 			

INSULATORS



Insulators



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INDOOR TYPE INSULATOR LV

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:

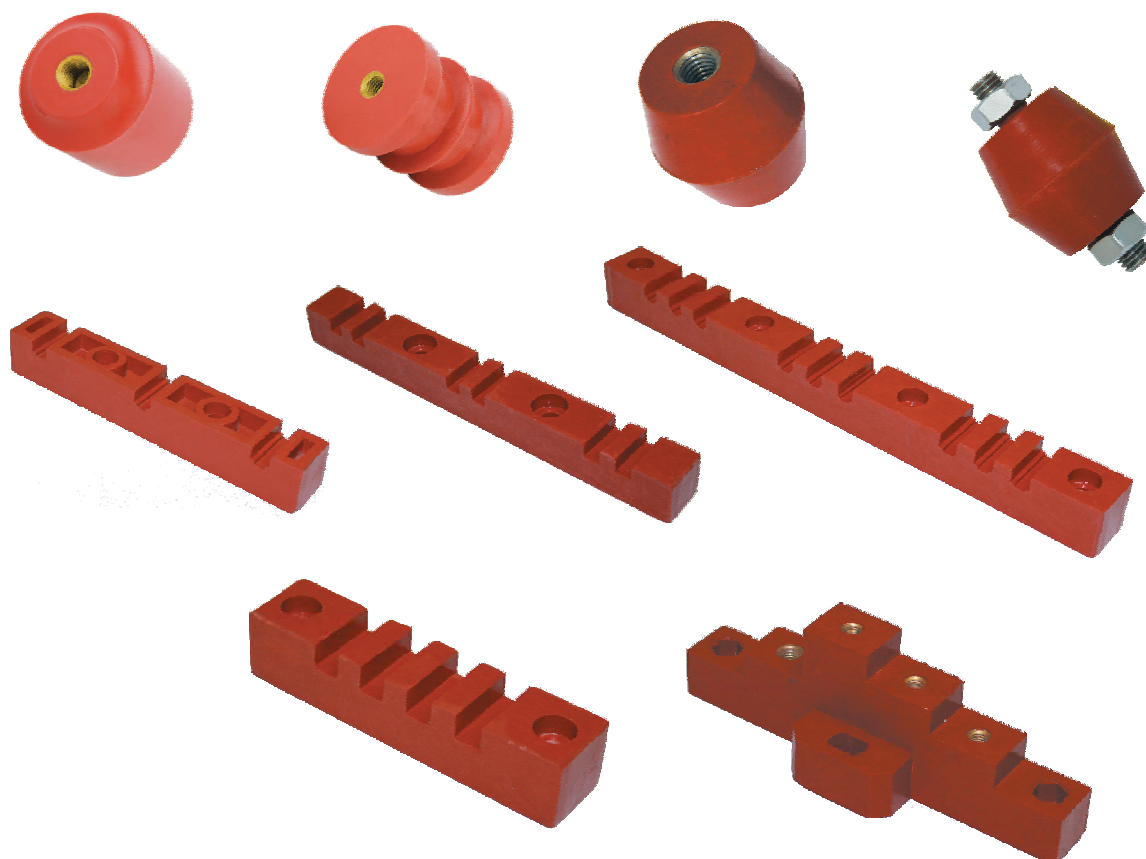
Fiber glass reinforced polyester, has 18% of fibers. Standard color, Irox red 130. (another color can be used if needed)

Nuts: steel-zinc lined. (brass material can be used if needed)

Bolt: Cr3 8.8 steel bolt

Specific Weight	DIN 53479	1,75 g/cm ³
Martens Degree	DIN 53462	> 200°C
Flexural Strength		90 N/mm ²
Impact Strength	DIN EN ISO 179	25-30 kJ/m ²
Flammability	UL 94	V0
Glow-Wire Flammability	DIN EN 60695	960 °C
Temperature Range		-40°C +130°C
Surface Resistivity	DIN IEC 60093	10 ¹⁴ Ω cm
Volume Resistivity	DIN IEC 60093	10 ¹⁴ Ω cm
Water Absorption	DIN EN ISO 62	<0,2% (<25mg)

Information for informational purposes only and are not binding.



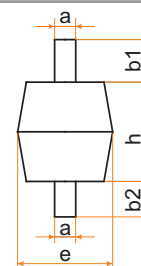
INDOOR TYPE INSULATOR LV

STAND-OFF INSULATORS

Double Sided Bolt



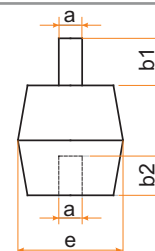
Service Voltage kV	Test Voltage kV	Tensile Strength kN	Weight kg / 1 box	Box Qty.	Order Code	Dimensions (mm)				
						a	b1	b2	e	h
0,6	3	0,75	11,00	500	9FI-05000-0000	5	8	10	22	24
0,6	3	1,00	12,00	300	9FI-06000-0000	6	10	10	27	28
1	3	4,00	10,50	100	9FI-08000-0000	8	12	15	40	40
1	3	4,00	14,00	100	9FI-10000-0000	10	12	15	40	40



One Side Bolt



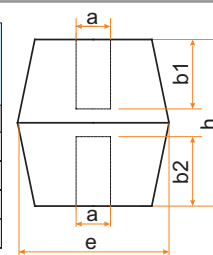
Service Voltage kV	Test Voltage kV	Tensile Strength kN	Weight kg / 1 box	Box Qty.	Order Code	Dimensions (mm)				
						a	b1	b2	e	h
0,6	3	0,75	10,50	500	9FI-05000-0001	5	8	10	22	24
0,6	3	1,00	10,80	300	9FI-06000-0001	6	10	10	27	28
1	3	4,00	9,80	100	9FI-08000-0001	8	15	12	40	40
1	3	4,00	11,40	100	9FI-10000-0001	10	15	15	40	40



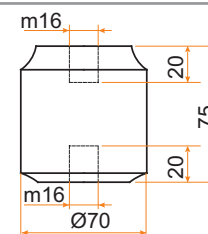
Double Side Support



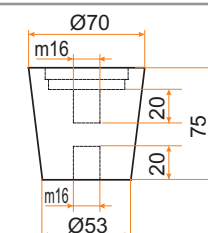
Service Voltage kV	Test Voltage kV	Tensile Strength kN	Weight kg / 1 box	Box Qty.	Order Code	Dimensions (mm)				
						a	b1	b2	e	h
0,6	3	0,75	10,00	500	9FI-05000-0002	5	9	9	22	24
0,6	3	1,00	9,90	300	9FI-06000-0002	6	10	10	27	28
1	3	4,00	8,80	100	9FI-08000-0002	8	15	15	40	40
1	3	4,00	8,90	100	9FI-10000-0002	10	15	15	40	40



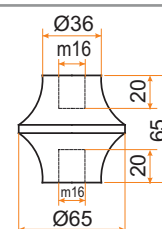
Service Voltage kV	Test Voltage kV	Tensile Strength kN	Weight kg / 1 box	Box Qty.	Order Code	Dimensions (mm)				
						a	b1	b2	e	h
3	20	8,00	9,00	18	9FI-16000-0001	16	20	20	70	75



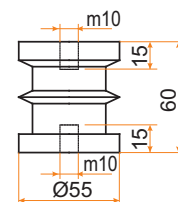
Service Voltage kV	Test Voltage kV	Tensile Strength kN	Weight kg / 1 box	Box Qty.	Order Code	Dimensions (mm)				
						a	b1	b2	e	h
3	15	5,50	6,65	18	9FI-16000-0002	16	20	20	70	75



Service Voltage kV	Test Voltage kV	Tensile Strength kN	Weight kg / 1 box	Box Qty.	Order Code	Dimensions (mm)				
						a	b1	b2	e	h
3	15	5,00	4,60	18	9FI-16000-0003	16	20	20	70	75



Service Voltage kV	Test Voltage kV	Tensile Strength kN	Weight kg / 1 box	Box Qty.	Order Code	Dimensions (mm)				
						a	b1	b2	e	h
3	15	5,00	7,00	32	9FI-16000-0004	16	20	20	70	75

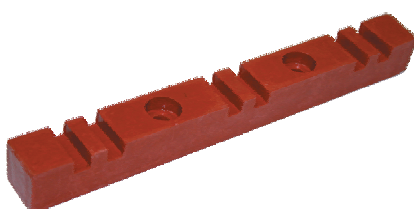
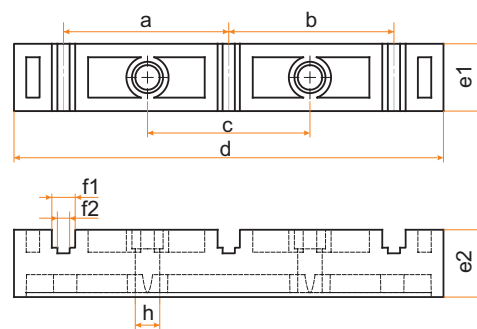


INDOOR TYPE INSULATOR LV

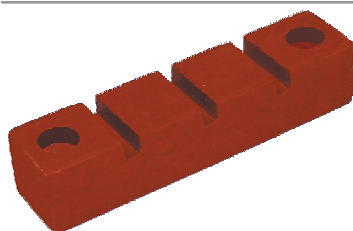
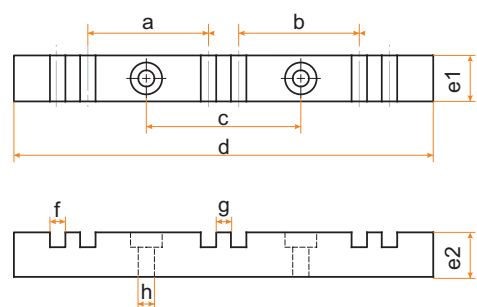
FIBER GLASS BUSBAR SUPPORT INSULATORS



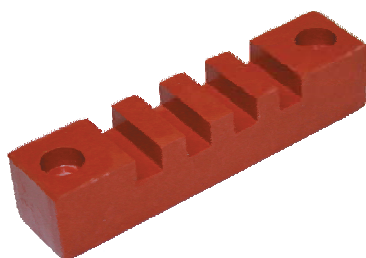
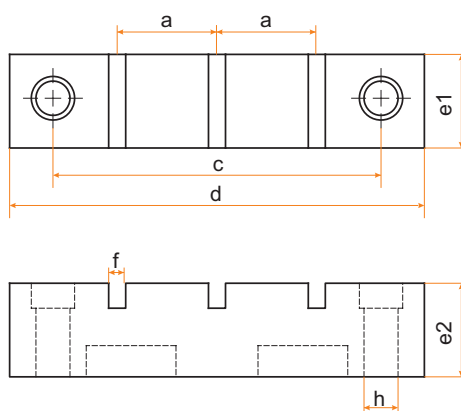
Min. Strenght kN	Box Qty.	Order Code	Dimensions (mm)									
			a	b	c	d	e1	e2	f1	f2	h	
5	30	9FI-74500-0000	74,5	74,5	73	193	30	30	10,5	5,5	Ø11	



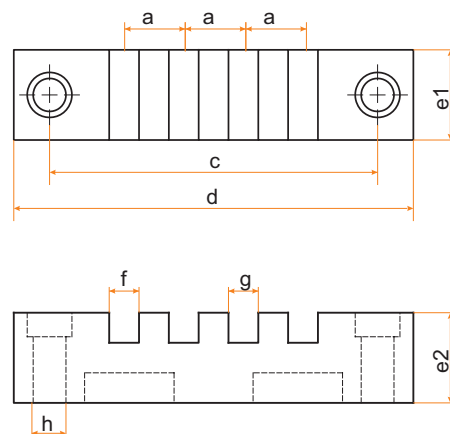
Min. Strenght kN	Box Qty.	Order Code	Dimensions (mm)									
			a	b	c	d	e1	e2	f1	f2	h	
5	50	9FI-82000-0000	82	82	105	285	31	30	10,5	10	Ø11	
5	50	9FI-91500-0000	91,5	91,5	105	285	31	30	5,5	5	Ø11	



Min. Strenght 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	

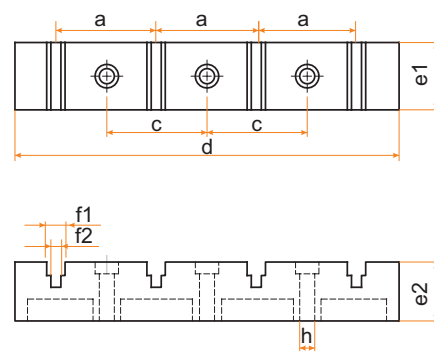
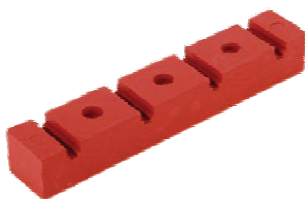


Min. Strenght kN	Box Qty.	Order Code	Dimensions (mm)								
			a	c	d	e1	e2	f	g	h	
5	50	9FI-22000-0000	22	110	134	31	29	5,5	10,5	Ø9	
5	50	9FI-22000-0001	22	110	134	31	29	10,5	10,5	Ø9	

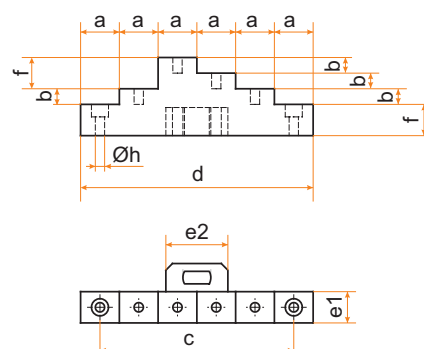
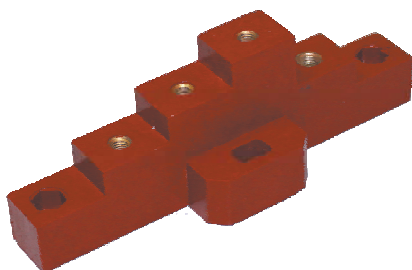


INDOOR TYPE INSULATOR LV

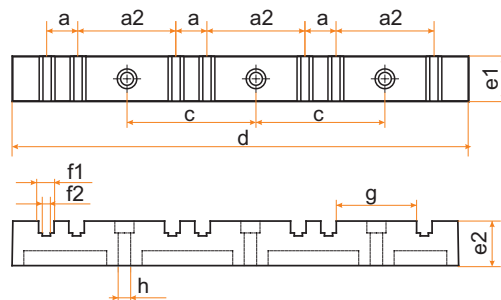
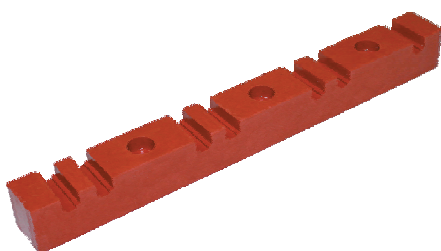
FIBER GLASS BUSBAR SUPPORT INSULATORS



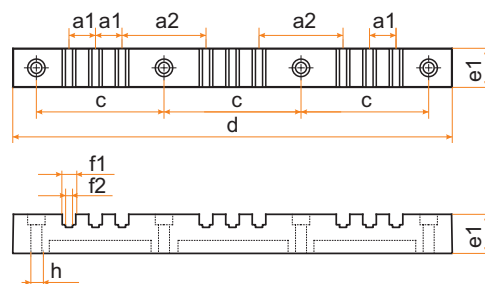
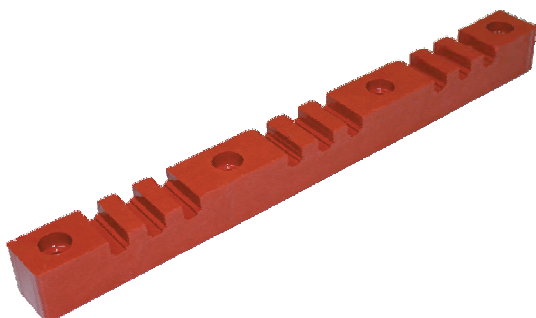
Min. Strenght kN	Box Qty.	Order Code	Dimensions (mm)							
			a	c	d	e1	e2	f1	f2	h
5	32	9FI-60100-0000	60	60	230	40	34,5	10,5	5,5	Ø9



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	6



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



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 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.

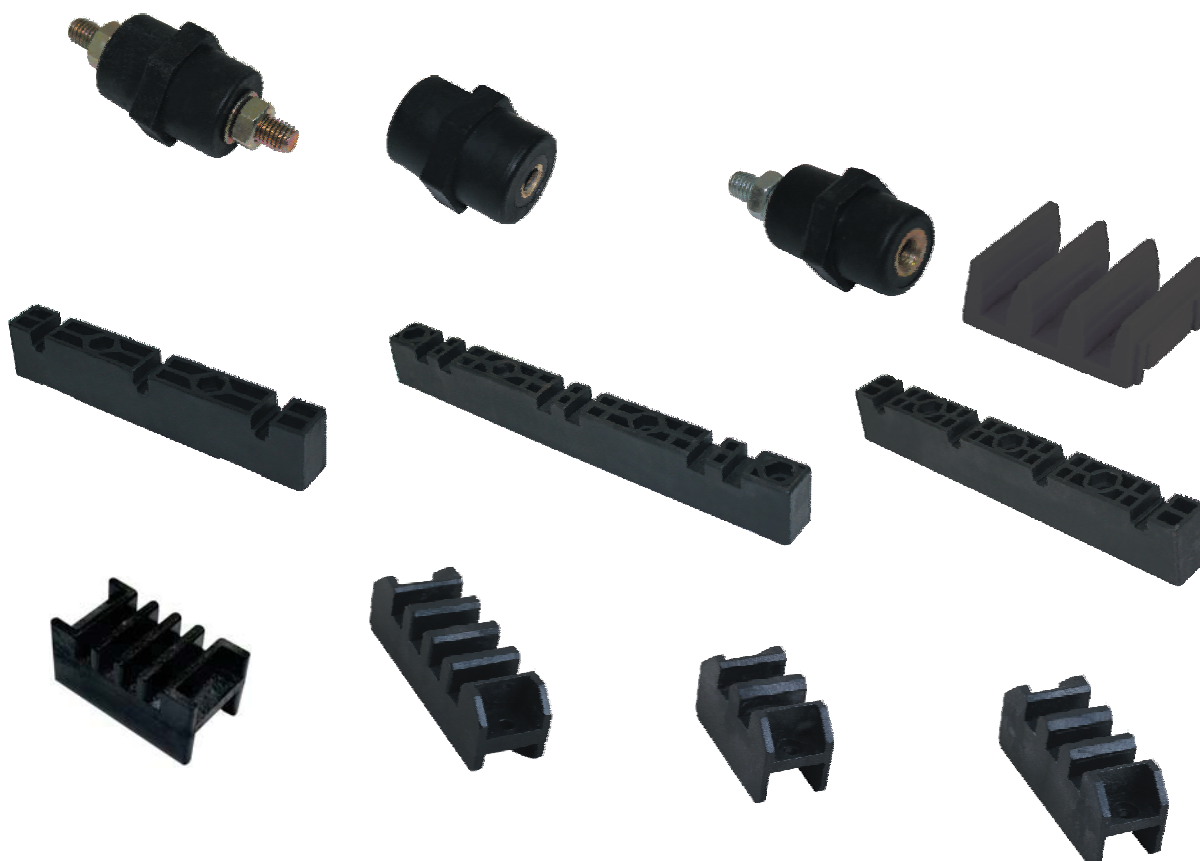
Standard color: Black

Nuts: Steel-zinc lined. (brass material can used if needed)

Bolt: Cr3 8.8 steel bolt

Specific Weight		1,56 g/cm ³
Martens Degree	DIN 53462	> 200°C
Flexural Strenght	ISO 178	205 N/mm ²
Impact Strenght	ISO 180/1A	14 kJ/m ²
Flammabiliy	UL 94	V0
Temperatre Range		-40°C + 130°C
Surface Reisistivity	IEC 93	10 ¹³ 0cm
Volume Resistivity	IEC 93	10 ¹³ 0cm
Water Absorption	DIN EN ISO 62	<0,2% (<25mg)

Information for informational purposes only and are not binding.



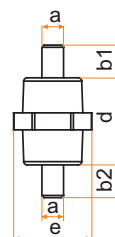
INDOOR TYPE INSULATOR LV

STAND-OFF INSULATOR (VO)

Double Sided Bolt



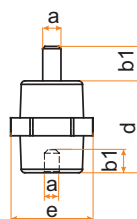
Service Voltage kV	Test Voltage kV	Tensile Strength kN	Weight kg / 1 box	Box Qty.	Order Code	Dimensions (mm)				
						a	b1	b2	e	h
0,6	3	1,00	8,50	500	9FI-05000-V000	5	12	12	18	25,5
0,6	3	1,00	8,70	300	9FI-06000-V000	6	16	16	21	29,5
1	3	4,00	7,10	100	9FI-08000-V000	8	15	15	31,5	40
1	3	4,00	9,50	100	9FI-10000-V000	10	15	15	31,5	40



One Side Bolt



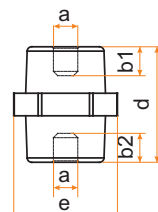
Service Voltage kV	Test Voltage kV	Tensile Strength kN	Weight kg / 1 box	Box Qty.	Order Code	Dimensions (mm)				
						a	b1	b2	e	h
0,6	3	1,00	8,00	500	9FI-05000-V001	5	12	10	18	25,5
0,6	3	1,00	7,50	300	9FI-06000-V001	6	16	12	21	29,5
1	3	4,00	5,80	100	9FI-08000-V001	8	15,5	15	31,5	40
1	3	4,00	7,70	100	9FI-10000-V001	10	15	15	31,5	40



Double Side Support



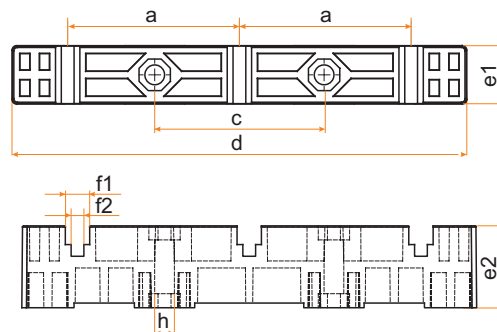
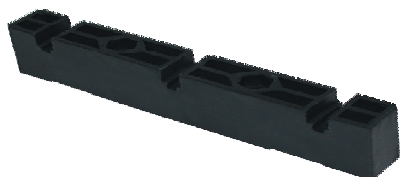
Service Voltage kV	Test Voltage kV	Tensile Strength kN	Weight kg / 1 box	Box Qty.	Order Code	Dimensions (mm)				
						a	b1	b2	e	h
0,6	3	1,00	7,50	500	9FI-05000-V002	5	7	10	18	25,5
0,6	3	1,00	6,30	300	9FI-06000-V002	6	10	10	21	29,5
1	3	4,00	4,60	100	9FI-08000-V002	8	15	15	31,5	40
1	3	4,00	5,00	100	9FI-10000-V002	10	15	15	31,5	40



INDOOR TYPE INSULATOR LV

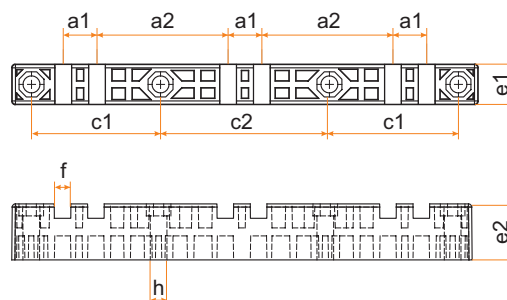
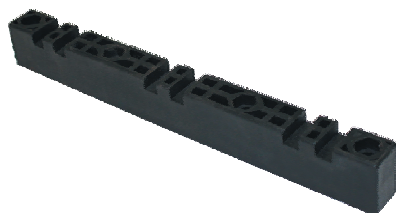
STAND-OFF INSULATOR (V0)

3x1F Support Insulator



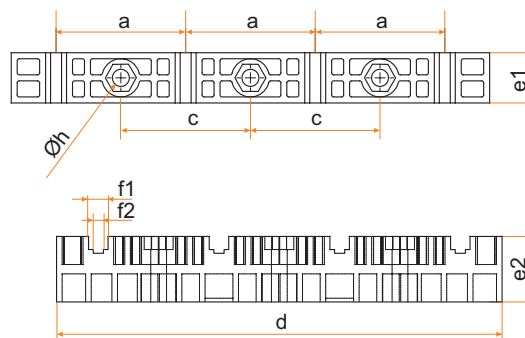
Min. Strenght kN	Box Qty.	Order Code	Dimensions (mm)							
			a	c	d	e1	e2	f1	f2	h
5	30	9FI-74000-V000	74	73	196	25	34,5	10,5	5,5	Ø8,5

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	81.5	80	105	290	25.0	34.5	10.5	Ø8.5

3x1F + N Support Insulator

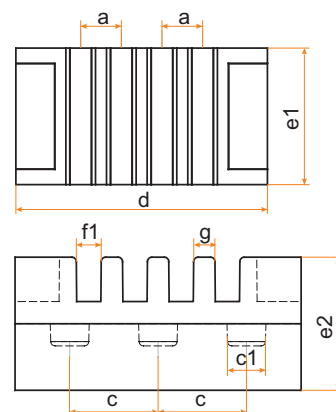
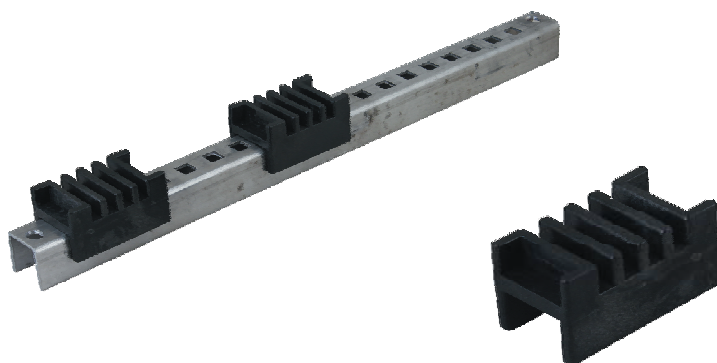


Min. Strenght kN	Box Qty.	Order Code	Dimensions (mm)							
			a	c	d	e1	e2	f1	f2	h
5	50	9FI-65000-V000	65	65	240	25,5	35,0	10,5	5,5	Ø9

INDOOR TYPE INSULATOR LV

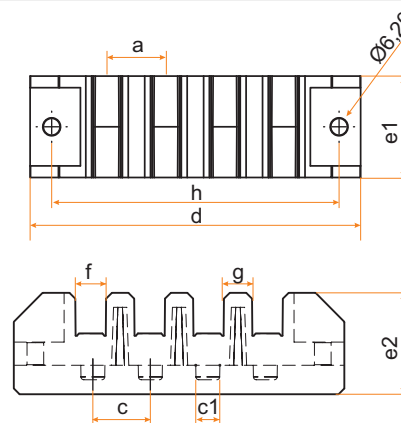
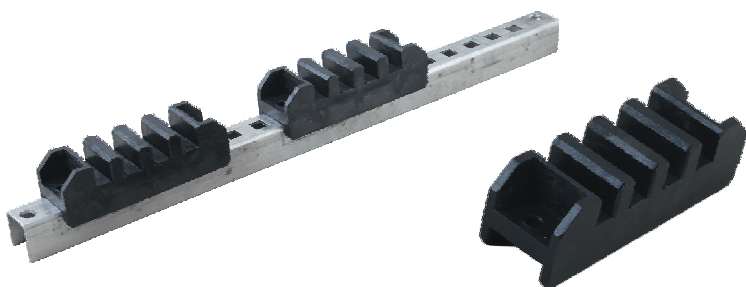
STAND-OFF INSULATOR (V0)

1x4F 5mm Support Insulator



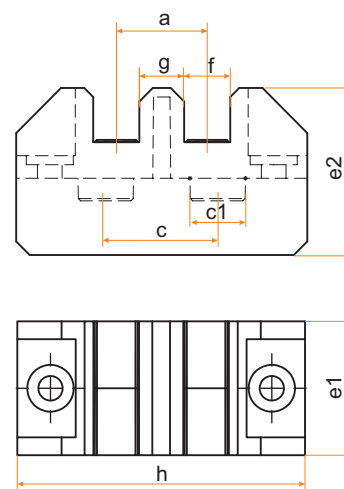
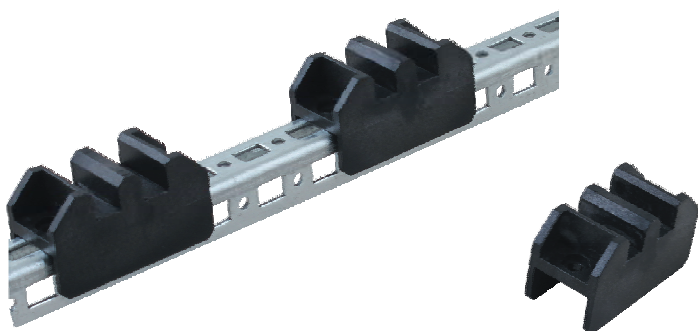
Min. Strenght kN	Box Qty.	Order Code	Dimensions (mm)							
			a	c	c1	d	f1	e1	e2	g
5	100	9FI-10500-V001	10,5	20	8	65	5,5	35,5	30	5

1x4F 10mm Support Insulator



Min. Strenght kN	Box Qty.	Order Code	Dimensions (mm)								
			a	c	c1	d	f	h	e1	e2	g
5	30	9FI-20500-V001	20,5	20	8,4x8,4	115	10,5	100	35	35	10

1x2F 10mm Support Insulator

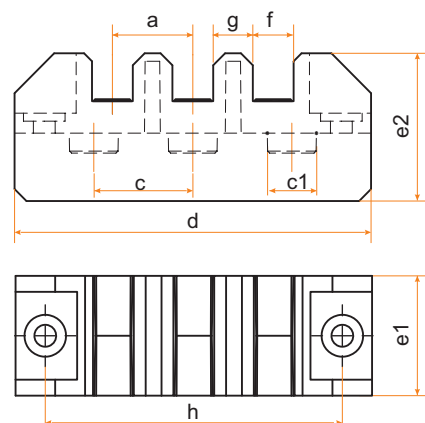
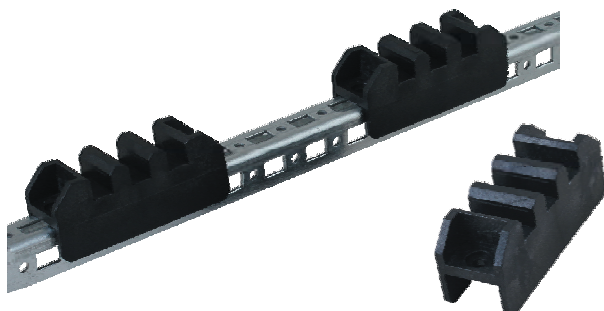


Min. Strenght kN	Box Qty.	Order Code	Dimensions (mm)								
			a	c	c1	d	f	h	e1	e2	g
5	30	9FI-20500-V002	20.5	20	8x12.4	65	10.5	50	30	37	10

INDOOR TYPE INSULATOR LV

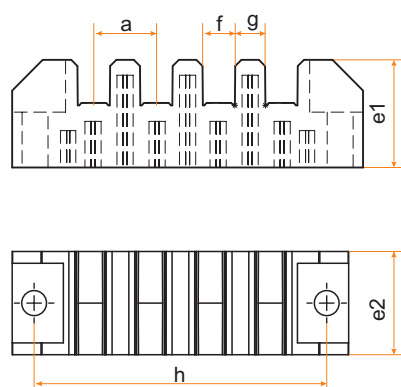
STAND-OFF INSULATOR (V0)

1x3F 10mm Support Insulator



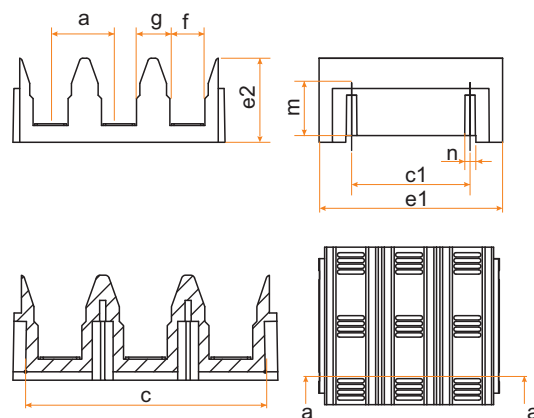
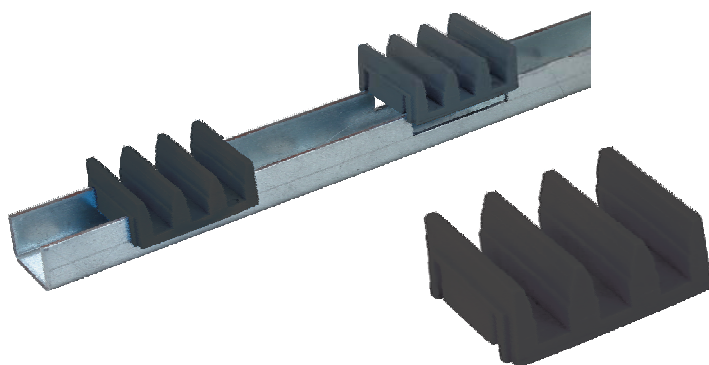
Min. Strenght kN	Box Qty.	Order Code	Dimensions (mm)								
			a	c	c1	d	f	h	e1	e2	g
5	100	9FI-20500-V003	20,5	20	8x12,4	90	10,5	75	30	37	10

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

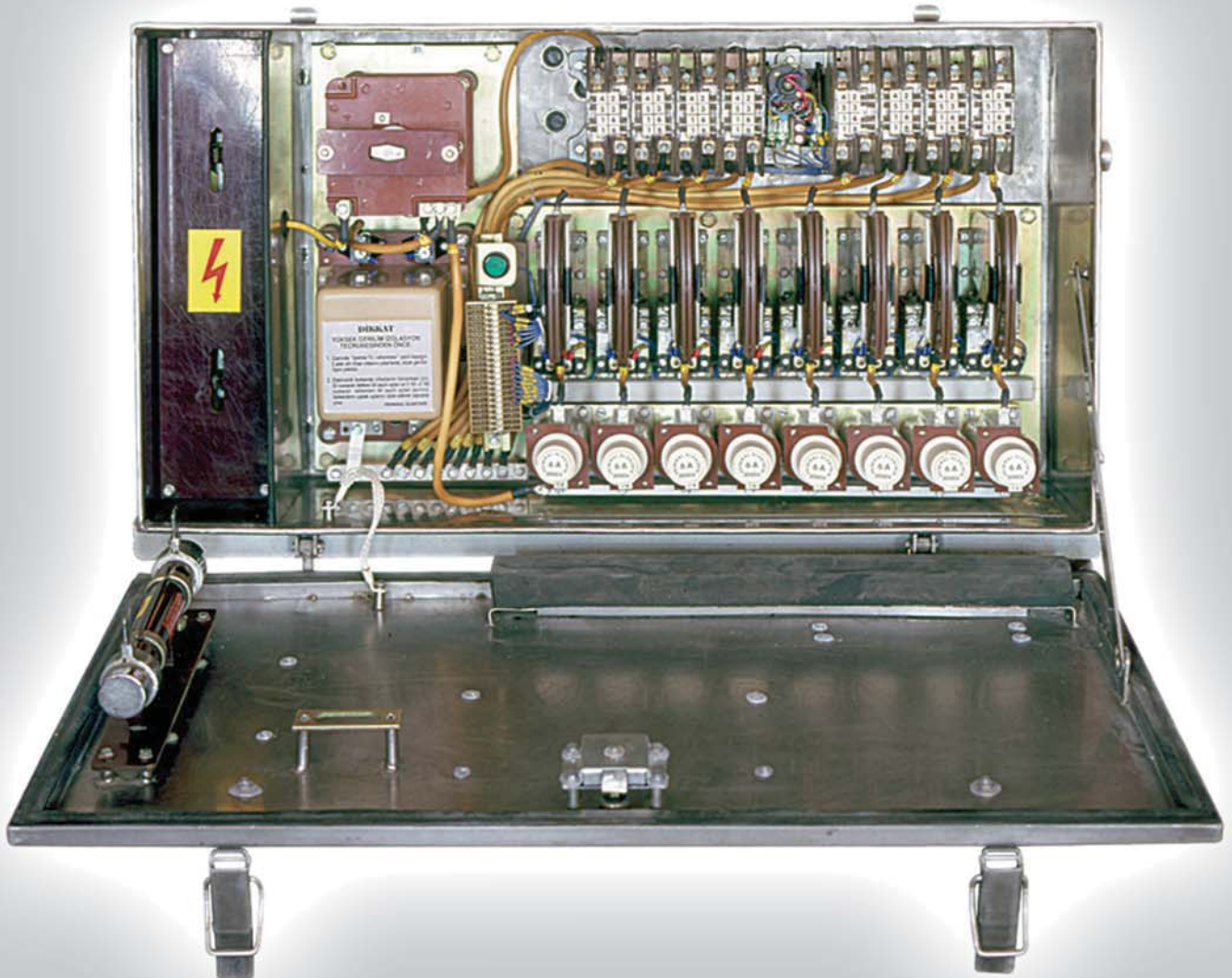
FIBER GLASS PLATE

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
Fiber Glass Plate	30x800x1200	9FG-30800-1200
	03x30x1200	9FG-03300-1200
	03x40x1200	9FG-03400-1200
	03x50x1200	9FG-03500-1200
	03x60x1200	9FG-03600-1200
	03x70x1200	9FG-03700-1200
Fiber Glass Plate	03x80x1200	9FG-03800-1200
	03x90x1200	9FG-03900-1200
	05x30x1200	9FG-05300-1200
	05x40x1200	9FG-05400-1200
	05x50x1200	9FG-05500-1200
	05x60x1200	9FG-05600-1200
Fiber Glass Plate	05x70x1200	9FG-05700-1200
	05x80x1200	9FG-05800-1200
	05x90x1200	9FG-05900-1200
	10x30x1200	9FG-10300-1200
	10x40x1200	9FG-10400-1200
	10x50x1200	9FG-10500-1200
Fiber Glass Plate	10x60x1200	9FG-10600-1200
	10x70x1200	9FG-10700-1200
	10x80x1000	9FG-10800-1000
	10x90x1200	9FG-10900-1200
	15x30x1200	9FG-15300-1200
	15x40x1200	9FG-15400-1200
Fiber Glass Plate	15x50x1200	9FG-15500-1200
	15x60x1200	9FG-15600-1200
	15x70x1200	9FG-15700-1200
	15x80x1200	9FG-15800-1200
	15x90x1200	9FG-15900-1200
	20x30x1200	9FG-20300-1200
Fiber Glass Plate	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
Fiber Glass Plate	25x90x1200	9FG-25900-1200
	30x30x1200	9FG-30300-1200
	30x40x1200	9FG-30400-1200
	30x50x1200	9FG-30500-1200
	30x60x1200	9FG-30600-1200
	30x70x1200	9FG-30700-1200
Fiber Glass Plate	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)

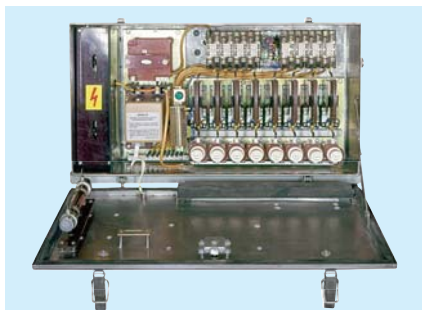
It consists of following parts.

- 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
Distribrution 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 diot 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 to 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

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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/cm² 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 ³	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 ²	≥ 6,0
Notched stoke strength		≥ 3,5
Elasticity resistance	Mpa	≥ 70
Insulation resistance	Ω	≥ 10 ¹¹
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

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FEDERAL SUBSCRIBER INFORMATION MANAGEMENT SYSTEM

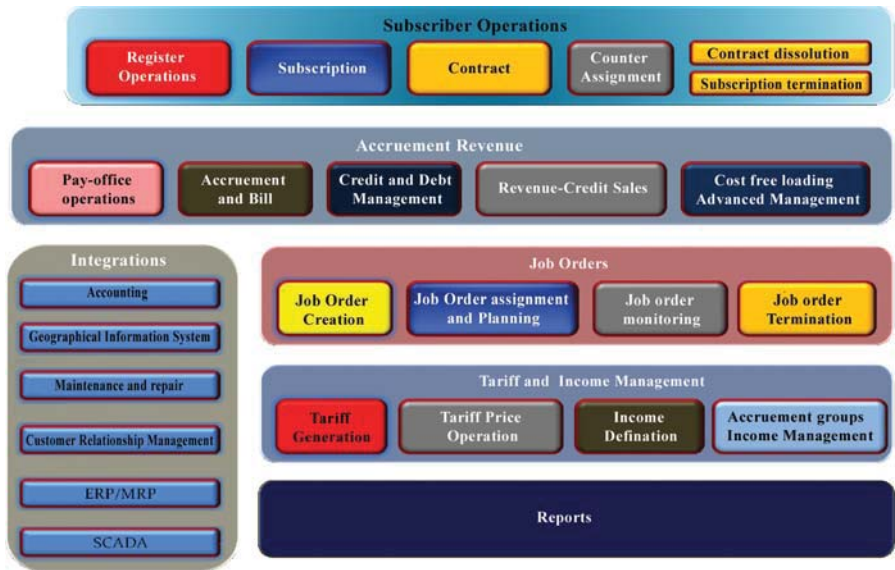
The Subscriber Information Management System (SIMS) is a system that administrates, follows, the operations of gas, electric and water counters of the energy distribution enterprises, and provides all the subscribing processes of the subscribers who use these counters, and specifies the needs by analyzing 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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