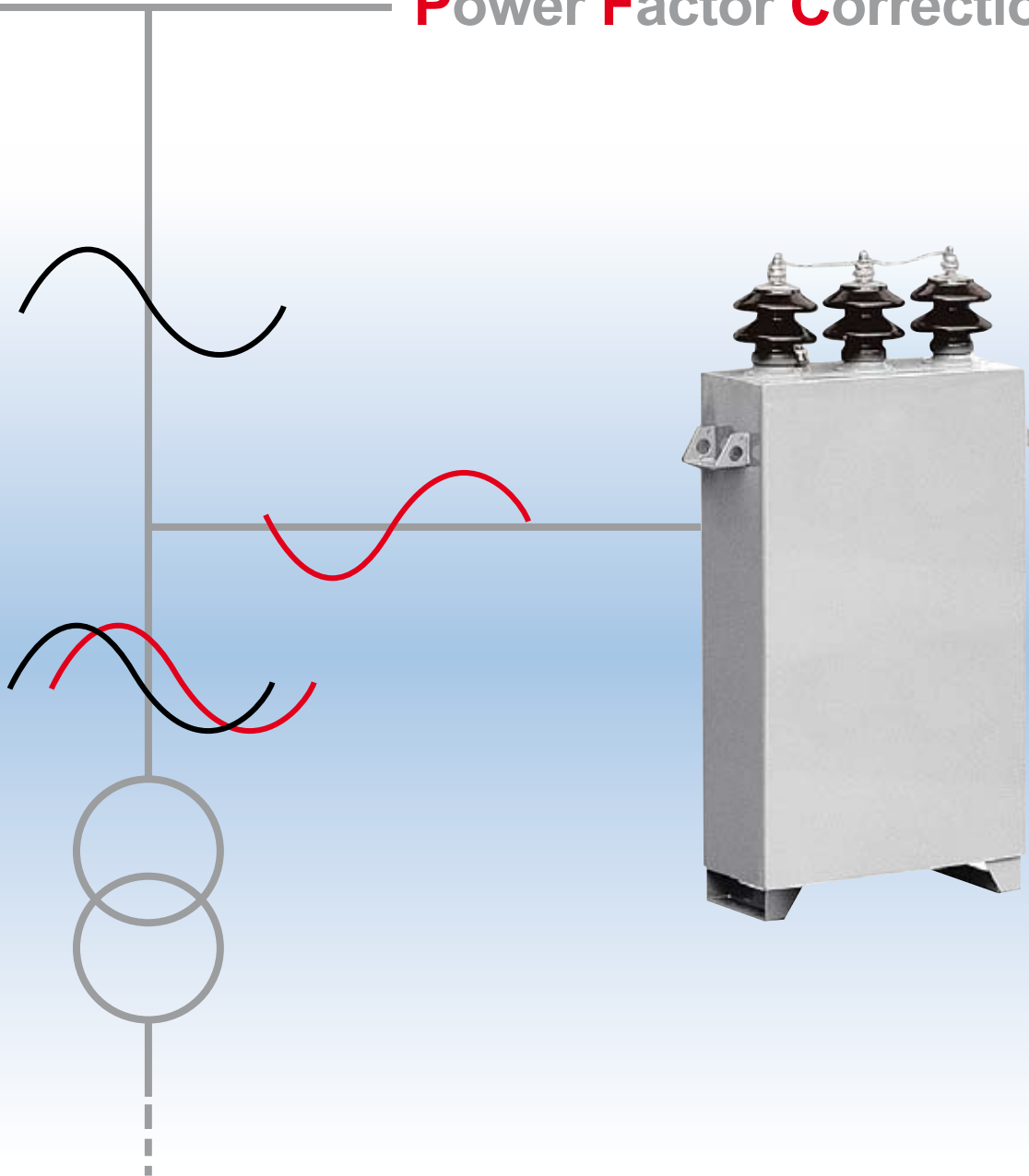




## Power Factor Correction



It's all about saving your money!

# Medium Voltage Capacitors



## Technology

**FRAKO** Medium Voltage (MV) Capacitors have been successfully manufactured for many years using all-film technology.

The dielectric material consists of high quality polypropylene film sandwiched between aluminium foil electrodes. A large number of capacitor elements are assembled to form a capacitor unit (see Fig. 1), also known as a winding pack. If desired by the customer, the elements can be provided with internal fuses. Each capacitor unit is permanently connected to a discharge resistor. The winding packs are housed in a sheet steel casing, which is filled with a high quality, environmentally sound impregnating oil.

Residual moisture and oxygen are removed from the winding pack in a drying and impregnation process taking place under vacuum at an increased temperature and lasting several days. The process is carried out very carefully by experienced personnel. This is crucial to producing a quality capacitor that is highly reliable and offers a long life expectancy.

Following this process, the capacitors are hermetically sealed by welding and are subjected to a routine test according to IEC 60871-1. They are then given a final finish with a high quality paint. The capacitors comply with the requirements of IEC 60871-1, IEC 60871-2 and IEC 60871-4. **FRAKO**'s wide range of manufacturing facilities makes it possible to produce capacitors in numerous dimensions with a variety of voltage and power ratings.

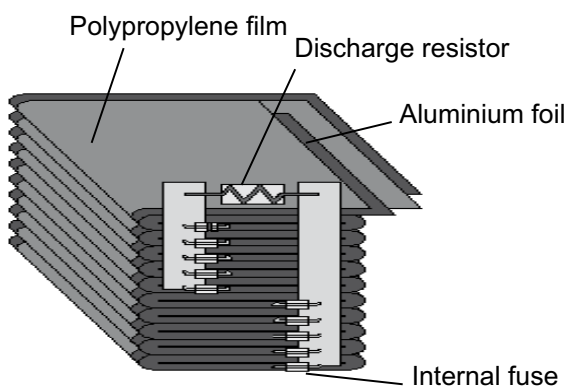


Fig. 1:  
Capacitor unit

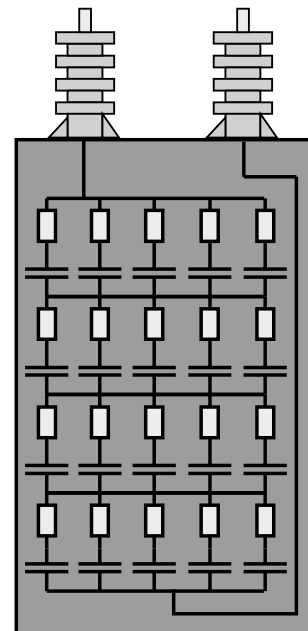


Fig. 2:  
Schematic of an MV  
capacitor with internal  
fuses

# Medium Voltage Capacitors



## // Safety

**FRAKO** Medium Voltage Capacitors are manufactured in two different versions: either for use with external fuses or already fitted with internal fuses.

## // External Fuses

Fig. 2 illustrates the internal arrangement in a capacitor. If it is overloaded, or another fault occurs, it is particularly important to prevent the capacitor casing rupturing. We therefore recommend the use of current-limiting HV HRC fuses to IEC 60549. As heavy transient currents and high voltages can occur when capacitors are switched in and out, the fuse rating should be at least twice the value of the capacitor current rating, and the voltage rating of the HV HRC fuse should be one level higher than the network nominal voltage (e. g. for a 12kV network voltage use a fuse with a 24 kV voltage rating). IEC 60549 must be complied with.

## // Internal fuses

Fig. 3 illustrates the internal configuration and the operating principle. Each capacitor element has its own internal fuse, which can isolate the element if it breaks down. The overloaded or damaged element is thus disconnected from the network. This means that the capacitor loses some of its capacitance, but is still able to operate safely. Switching out individual elements in this way has the consequence, however, that the voltage across the other elements generally rises. If many individual elements are disconnected, the voltage acting on the remaining elements can become too high. The capacitor must then be taken out of service and repaired. **FRAKO** internal fuses comply with the requirements of IEC 60871-4.

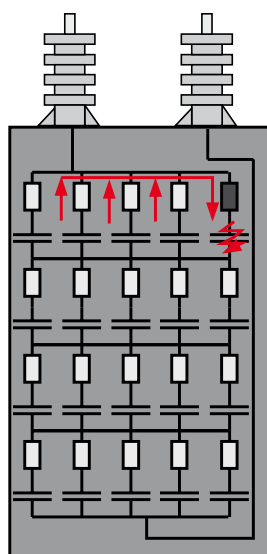


Fig. 3:  
Operating principle of  
the internal fuses

# Medium Voltage Capacitors

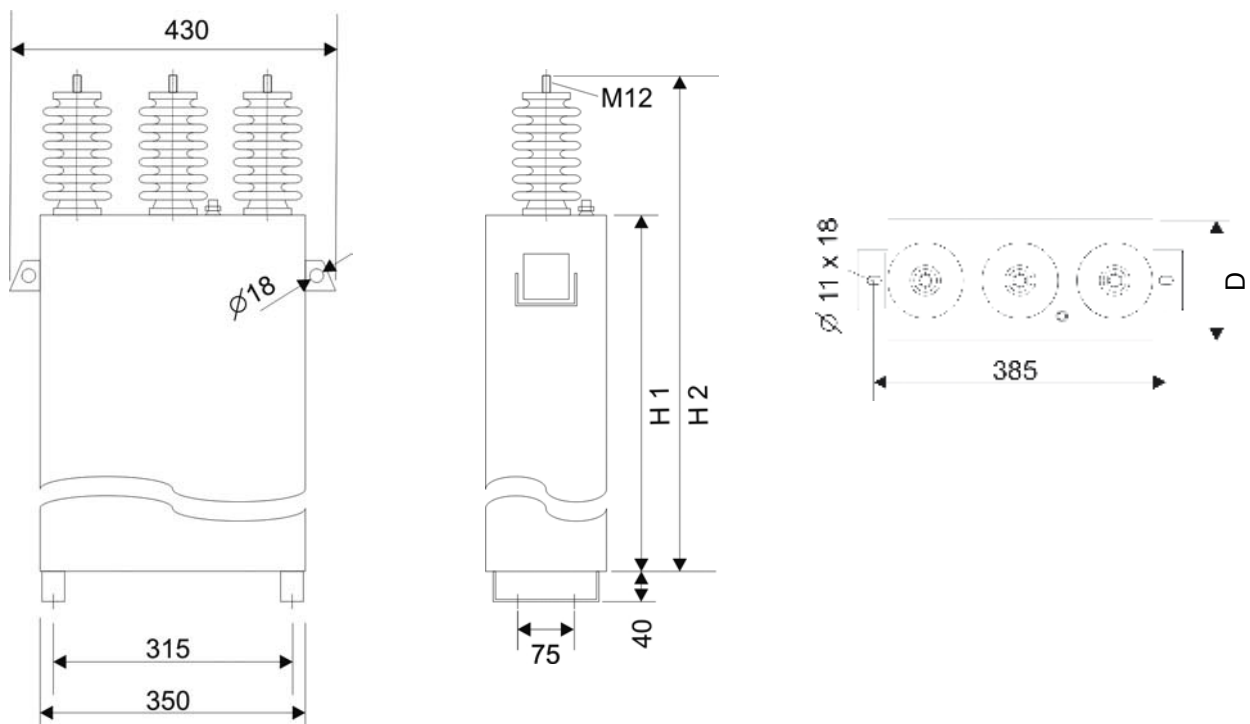


## Technical data

- Voltage ratings from 3 to 24 kV, 50 or 60 Hz
- Power rating 50 to 700 kvar per capacitor casing
- Single-phase and three-phase capacitors
- Available for indoor or outdoor installation
- Overpressure switch available on request
- Temperature class - 40°C to +50°C
- Power loss < 0.2W/kvar
- Discharge to less than 75V in <10 minutes
- IEC 60871-1, IEC 60871-2 and IEC 60871-4 compliance



## Dimensions



# Medium Voltage Capacitors



## Technical Data

Power kvar	Voltage rating kV (bei 50Hz)	H 1 mm	H 2 mm	D mm	Configuration	Type	Weight kg
200	6	580	760	160	Δ	MSCD 200-6	34
300	6	670	850	160	Δ	MSCD 300-6	46
400	6	870	1050	160	Δ	MSCD 400-6	57
500	6	810	990	175	Δ	MSCD 500-6	68
100	12	410	590	160	Δ	MSCD 100-12	22
200	12	580	760	160	Δ	MSCD 200-12	34
300	12	670	850	160	Δ	MSCD 300-12	46
400	12	870	1050	160	Δ	MSCD 400-12	57
500	12	810	990	175	Δ	MSCD 500-12	68
150	12	410	631	160	I	MSCE 150-12	31
250	12	670	891	160	I	MSCE 250-12	43
500	12	780	1001	175	I	MSCE 500-12	70

Other power and voltage ratings on request.  
We reserve the right to change the technical data and dimensions.

## Inquiry form for Medium Voltage Capacitors

Customer						Date				
Project										
Fixed PF correction		<input type="checkbox"/>	with filter reactor		<input type="checkbox"/>	Series resonance frequency		<input type="text" value=""/>	Hz	
Variable PF correction		<input type="checkbox"/>	without filter reactor		<input type="checkbox"/>					
Network nominal voltage					kV					
Network nominal frequency					Hz					
Single-phase capacitor		units	Power rating		kvar	Voltage rating		kV	Nominal frequency	Hz
Three-phase capacitor		units	Power rating		kvar	Voltage rating		kV	Nominal frequency	Hz
Bank of single-phase capacitors in double star configuration		units	Power rating		kvar	Voltage rating		kV	Nominal frequency	Hz
Outdoor version, IP 00		<input type="checkbox"/>	Overpressure switch per capacitor		<input type="checkbox"/>					
Outdoor version, IP 55		<input type="checkbox"/>	Unbalance protection		<input type="checkbox"/>					
Indoor version, IP 00		<input type="checkbox"/>			<input type="checkbox"/>					
Indoor version, IP 54		<input type="checkbox"/>			<input type="checkbox"/>					
Circuit diagram										

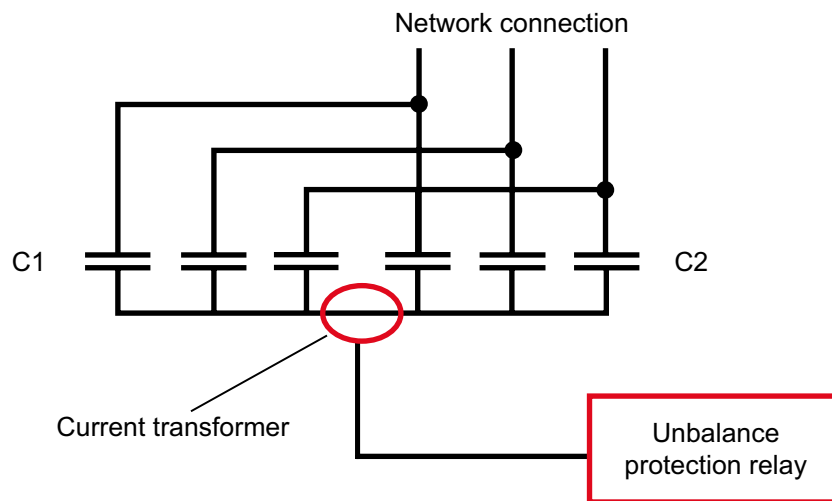
# Medium Voltage Capacitors



## // Operating reliability of Medium Voltage Capacitors

Single-phase Medium Voltage Capacitors are frequently connected in a double star configuration in order to be used at higher network voltages. In these applications the operating reliability of the capacitors can be significantly increased by electronically monitoring the conductor between the star points of two capacitor groups, a current transformer being used to measure the current flowing between them. If a breakdown occurs in an element in one of the capacitors, an unbalanced current will start to flow through the current transformer. An electronic relay monitors this current and sends an alarm signal to the appropriate control system if the current reaches an adjustable set point. The control system then switches this capacitor bank out.

If the capacitor bank is tripped out in this way, it must be isolated and then inspected by appropriately qualified electricians, any necessary repairs being carried out.



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