

Medium Voltage



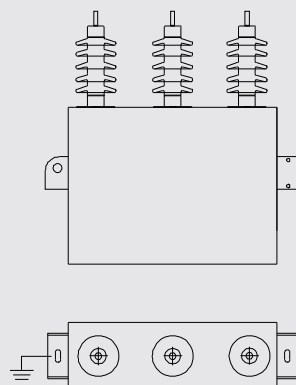
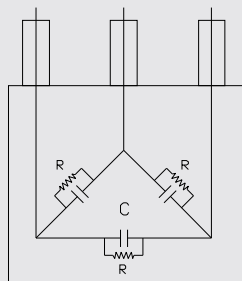
MEDIUM VOLTAGE

2. 3PH BO/R MT Series. Medium Voltage Three Phase Capacitors

Technical Characteristics	
Standard	IEC 871-1/2
Voltage	1-12 kV
Power	Until 500 kVAr
Frequency	50-60 Hz
Losses	<0.15 W/kVAr
Temperature	-50+55° C
Dielectric Liquid	MDBT Nonchlorinated (biodegradable)
Residual Voltage	10% Un later 5 min.
Dielectric	Hazy polypropylene film
Fuses	Optional
Use	Indoor-outdoor
Altitud	1000 m.s.n.m.
Maximun over voltage	1.1 x Un
Maximun over current	1.3 x In
Tolerance	-5+15%
Voltage test (Terminal-Terminal)	4.3 x Un (10 sec)



Drawing

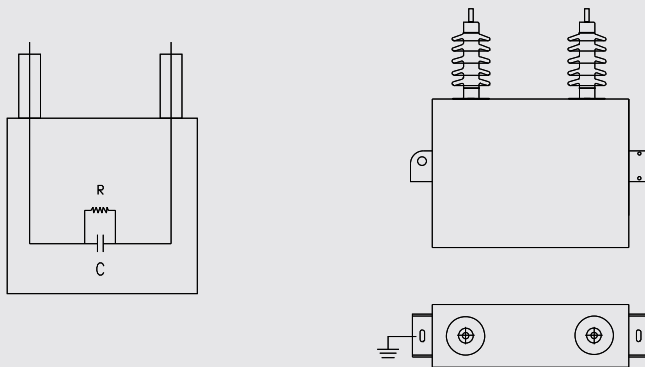


3. 1PH BO/R MT Series. Medium Voltage Single Phase Capacitors

Technical Characteristics	
Standard	IEC 871-1/2
Voltage	1-13.8 kV (with internal fuses) +13.8 kV (without internal fuses)
Power	Until 1000 kVAr
Frequency	50-60 Hz
Losses	<0.15 W/kVAr
Temperature	-50+55° C
Dielectric Liquid	MDBT Nonchlorinated (biodegradable)
Residual Voltage	10% un later 5 min.
Dielectric	Hazy polypropylene film
Fuses	Optional
Use	Indoor-outdoor
Altitud	1000 m.s.n.m.
Maximun over voltage	1.1 x Un
Maximun over current	1.3 x In
Tolerance	-5+15%
Voltage test (Terminal-Terminal)	4.3 x Un (10 sec)



Drawing



1. General information for MV capacitors

1.1 Total film dielectric

RTR Capacitors have a dielectric constituted in general by three polypropylene films "hazy", rough in both faces, of high purity. This construction, instead of which it uses only two layers of a rough film in a single one of his faces, common in other manufacturers, confers to RTR Capacitors greater security of operation and greater life utility. The rough of both faces of polypropylene is a condition indispensable for the complete impregnating of the film during the process and, therefore, for the stability of the capacitor in the long term.

1.2 Impregnating biodegradable

RTR Capacitors use exclusive impregnating the nonchlorinated MDBT, developed for the most demanding applications by Elf-Atochem(France). This it is characterized by his high flash point, great capacity of gas absorption derived from the internal electrical unloadings, and total environmental compatibility (biodegradable).

1.3 Construction with folio extended and wild fold

RTR Capacitors is constituted by elementary units, each one of them consisting of aluminum folio windings of high purity and polypropylene films. The aluminum laminae excel towards the ends of the coil, and their edges are folded forming a ring anticrown that confers to the condenser a tension of insepción ofpartial unloadings superior to 50% of the nominal value. The laminae are welded to each other and with the next coils by means of special alloys of great adhesion and low point of fusion. This way the use of "abatis", characteristic of the previous designs is avoided.

1.4 Under stress

RTR Energía S.L. uses conservative criteria of design that imply the application of dielectric efforts (kV/ mm) relatively low on the materials. Like consequence, the capacitors are of dimensions somewhat greater than those of other marks, with an expectation of greater life utility.

1.5 Inner fuses

RTR Energía S.L. incorporates to a great part of their range of MV. capacitors (specially for the greater powers) with the option of individual inner fuses by coil, of new design. Such they allow to isolate the possible failure of anyone of the elements of the capacitor and other elements can still work in normal condition. The fuses are separated to each other, so that it is impossible that the performance of one of them causes the catuación of the fuse next to. In addition, the condensers with internal fuses allow simpler, light and economic constructions.

1.6 Dielectric low losses

The characteristics of their design, the rigorous selection of the manufacture materials and the artisan care put in their construction and process give like result capacitors of low losses, which is translated in smaller this form and operating temperatures, a greater life utility.

1.7 Insulators welded to Box

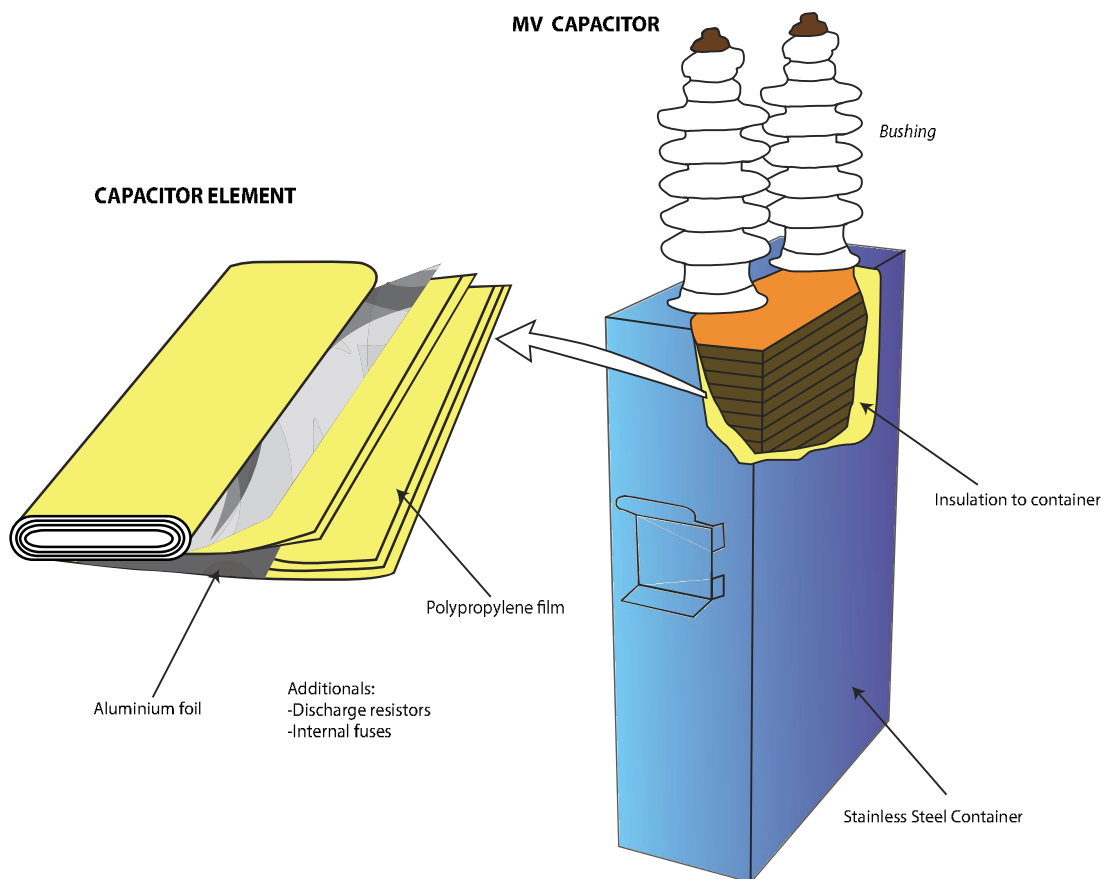
Glazed porcelain insulators for outdoor use, gray or brown color, welded to the metal box which offering guarantee of fixing, resistance to shock and improper, frequent efforts during handling units. The terminals are provided with a hollow threaded bolt M16x50mm, designed for setting a torque of at most 1.5 N tm.

1.8 Metal Boxes

Stainless steel metal box, coated with anticorrosive primer and painted in color RAL 7040 and termination colorless polyurethane varnish. The covers are electrically welded to the boxes under inert gas atmosphere.

1.9 Testing

All capacitors units are checked and tested individually before packing and delivery, according to IEC 871-1 / 2



4. Capacitor Banks for Medium Voltage

RTR designed banks for medium or high voltage distribution networks are for installation with Transformers, Power Sub-Stations, Distribution Feeders and the users of MV network facilities, to provide reactive power compensation, system voltage regulation and avoiding penalties for low power factor in electrical bills.

The MV capacitors are composed of several series-parallel capacitive groups of "film-foil" type, impregnated with biodegradable oils free of chlorinated compounds (PCBs), very low loss, with internal discharge resistors and option internal fuses, suitable for mounting indoor /outdoors. The total power of the bank may be divided into progressive steps connection as different control schemes. Banks include all elements of isolation, control gears, switching, protection and communications appropriate for the required service.

4.1 Fixed banks for medium voltage overhead distribution lines

Fixed capacitor banks are most uses in medium voltage networks because of Low cost, low weight, easy installation on pole, maintenance free. Reducing power losses and voltage drops, improving the quality of service provided to users. Dimensioned to compensate minimum daily reactive demand, avoiding overvoltage and harmonics overcompensation.

Formed by 3 or 6 units capacitors connected in single or double star with isolated or grounded neutral star. Connected to the network by fuse disconnections and preferably equipped with overvoltage protectors.



4.2 Automatic capacitor banks for medium voltage overhead distribution lines.

They provide finer reactive control according to the load. Control strategies based either on time of day, voltage level, VAR demand, temperature or a combination of them. Microprocessor-based controls with metering, event recording, annual programming and remote supervision capacity.

Capacitor switching by means of economical oil switches or maintenance-free vacuum switches with dry, solid foam insulation.



Reactive Power Range:

- From 75 to 1500 kVAr (50Hz)
- From 90 to 1800 kVAr (60Hz)
- Voltage level from 3.6 to 36 kV

4.3 Fixed open type medium voltage capacitor banks for industrial installations and small power sub-stations.

When the capacitors are installed at the customer's installation, they provide low power factor penalty reduction or elimination. Floor-or platformmounted banks of reduced footprint. Capacitors connected in simple or double wye with unbalance protection. Various sectionalizing and protection schemes available.



Reactive Power Range:

- From 75 to 20 kVAr (50Hz)
- From 90 to 24 kVAr (60Hz)
- Voltage level from 3.6 to 36 kV

4.4 Automatic open type medium voltage capacitor banks for large industrial installations and power substations.

Control strategies based either on time of day, voltage level, VAR demand, temperature or combination of them. Single- or multistage banks, each stage provided with independent switching, protection and inrush current limiting reactors. Off-the-shelf or PLC-based, open-architecture controls. Special control options: Zero-Voltage-Crossing (ZVC) of switches, automatic tripping of bank upon loss of voltage, time-delayed bank reconnection after power restoring.



Reactive Power Range:

- From 75 to 1500 kVAr (50Hz)
- From 90 to 1800 kVAr (60Hz)
- Voltage level from 3.6 to 36 kV

4.5 High voltage capacitor banks for large power sub-stations.

They provide large amounts of reactive power to the system. All bank components are designed to withstand large short-circuit currents. Capacitors are connected in simple wye, double wye or bridge connection.



Reactive Power Range:

- From 1 to 100 MVAR (50Hz)
- From 1.2 to 120 MVAR (60Hz)
- Voltage level from 36 to 145 kV

4.6 Metal enclosed capacitor banks

Metal-enclosed capacitors modules, factory-assembled, ready to install in indoor or outdoor locations. Capacitor switching with vacuum contactors, vacuum switches or vacuum circuit breakers.



Reactive Power Range:

- From 1 to 100 MVAR (50Hz)
- From 1.2 to 120 MVAR (60Hz)
- Voltage level from 36 to 145 kV

4.7 Fixed capacitor Banks for the mining and oil industries

They are used to supply reactive power to internal power distribution systems in mining and oil fields, and also to provide VARs to well pumps, oil-pumping stations, etc. Sturdy design to withstand the harshest environmental conditions without maintenance. No floor preparation works or protective fences required.



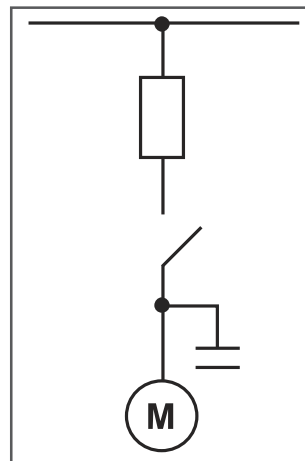
Reactive Power Range:

- From 50 to 6 MVAR (50Hz)
- From 60 to 7.2 MVAR (60Hz)
- Voltage level from 2.3 to 15 kV

5. Selection chart of MV capacitors for motors and transformers

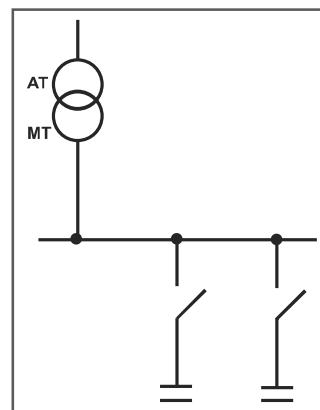
5.1 Charts for MV motors

Power		Reactive power (kVAr)	
KW	H.P.	3000 r.p.m	1500 r.p.m.
150	204	30	37
180	245	40	45
200	272	42	50
250	340	53	63
300	408	63	75
400	543	80	100
500	680	100	125
750	1019	150	187
1000	1359	200	250
1300	1766	260	325
1600	2174	320	400
2000	2717	400	500
2500	3397	500	625
3000	4076	590	750
4000	5435	800	1000
5000	6793	1000	1250



5.2 Charts to transformers

Aparent Power	Primary Voltage	Secondary Voltage	Reactive power
MVA	kV	kV	kVAr
2,5	≤20	≤16	190
3,15	≤20	≤16	240
4	≤20	≤16	300
5	≤20	≤16	375
6,3	≤36	≤20	475
8	≤36	≤20	600
10	≤36	≤20	750
12,5	≤36	≤20	940
16	≤66	≤20	1200
20	≤66	≤20	1500
25	≤66	≤20	1875
31,5	≤66	≤20	2360
40	≤66	≤20	3000



6. Unbalance protection in neutral current

6.1 Simple star connection

This type of protection is based on impedance variation in the phases to happen a failure in one of the capacitors. It consists a current transformer connected between two electrically balanced points and combined with a current relay.

When that happens, an unbalance current flows from the connection between the neutral and earth in the bank in which the primary of a current transformer is connected to a single core measurement and secondary turn feeds to an overcurrent relay (with rejection of harmonic currents). This type of protection is used in powerful banks in high voltage.

In this case, the impedance increases in the phase of the units which is out of service in the same proportion to the same quantity. The banks made with capacitors with internal fuses in elements, their action also results in an increase in impedance in this branch, but in this case the variation is much smaller, because the other internal elements of capacitor continue working.

Consequently, adjusting the protection must discriminate unbalance current variations much lower. In some cases it is desirable to have an ampere meter which always measure unbalance current variations base, so that we can see variations that may give premature

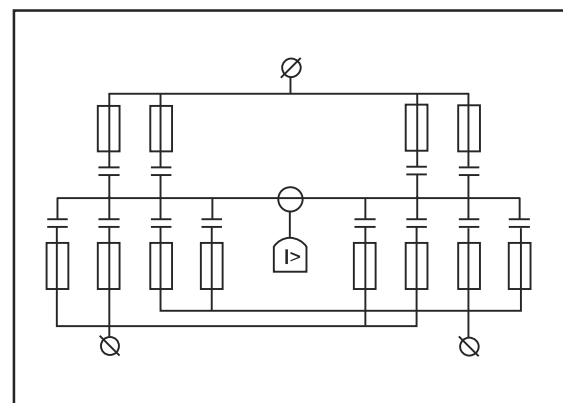
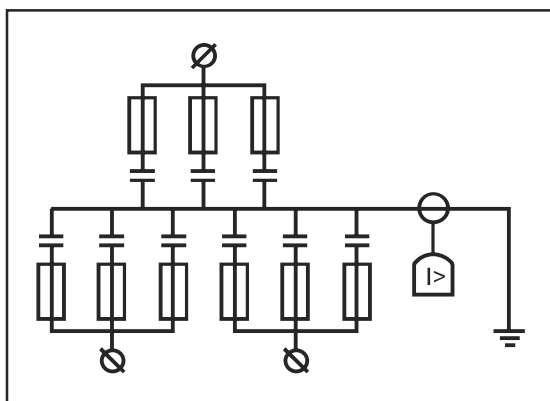
signs of any inconvenience at the bank. In other cases you can choose one protection with a first alarm step and a second step of disconnection. In all these cases it is advisable to contact our technical department to determine the adjustment calculation protections, specifying the total number of units, the characteristics of each capacitor, the CT and relay available.

6.2 Double star with isolated neutral connection

This type of protection is bases on the impedance variation of the one phase of one of the stars of the bank to a fault happen in one of the capacitors.

When that happens, an unbalance current flows through the connection between the neutral of the star, on which the primary of a current transformer is connected to a single measurement core, whose secondary turn feeds an overcurrent relay. This type of protection is used by almost all banks in MT medium and large power, particularly those installed in sub-stations.

The variation in impedance capacitor banks without internal fuses is produced by the action of an external fuses. In this case the impedance increases in the phase out of service units, in proportion to the quantity of the same. In banks made capacitors with internal fuses, the performance of one of

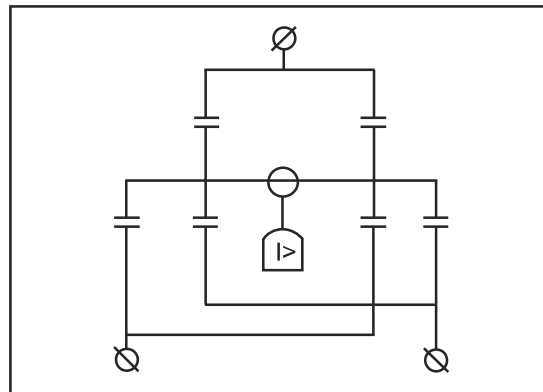


MEDIUM VOLTAGE

these also causes an increase in impedance in this branch, but in this case this variation is much lower, as the other elements of that capacitor continue working. Consequently adjustment protection should discriminate unbalance current variations much smaller.

In some cases it is convenient to have an ampere meter which always measures current unbalance, so that we can see variations that may give premature signs of any problems at the bank. In other cases, you can choose one protection with an alarm first step and a second step of disconnection.

In all these cases it is advisable to contact our technical department to determine the adjustment calculation protections, specifying the total number of units, the characteristics of each capacitor, the CT and relay available.



7. Medium Voltage harmonic filters

They provide reactive compensation and filtering of harmonic distortion produced by electric furnaces, electrolytic processes, soft-starters, variable drives and other non-linear loads. Heavyduty capacitors specially designed to operate under permanent overvoltage and high currents.



Reactive Power Range:

- From 250 to 6 MVar (50Hz)
- From 250 to 7.2 MVar (60Hz)
- Voltage level from 1 to 36 kV

8. Current limiting reactors for MV Capacitors (*)



Power	Voltage	Electric current
KVAr	kV	A
25	6.6	2,75
50	6.6	5,5
75	6.6	8,25
100	6.6	11
150	6.6	16,5
200	6.6	22
250	6.6	27,5
300	6.6	33

(*) For any further information please contact to our Technical Dept

9. Three-phase contactor for MV capacitors (*)



Voltage	Electric current
kV	A
6.6	400

(*) For any further information please contact to our Technical Dept