

HOW TO CHOOSE LV CAPACITORS FOLLOWING YOUR OPERATING CONDITIONS



The operating conditions are very important to the capacitors and can strongly influence the life expectancy. This is why, different categories of capacitors, with different levels of resistance, must be chosen according to operating conditions.

Capacitors must be selected in function of:

- Ambient temperature,
- Expected over-current related to voltage disturbances including maximum sustained over voltage,
- Requested life expectancy,
- Maximum number of switching during the year.



HARMONICS AND CAPACITORS

Capacitors are strongly sensitive to harmonics and particularly to harmonic currents. Harmonic currents are caused by non-linear loads connected to the distribution system. The presence of harmonics in electrical systems means that current and voltage are distorted and deviate from sinusoidal waveforms.

This phenomenon is particularly dangerous for capacitors since their impedance decreases proportionally to the order of the harmonics present with consequent capacitor overload and shortening steadily the life.

In some situations, resonance effect can occur as a result of amplification of harmonic currents and a very high voltage distortion.



NON-LINEAR LOADS

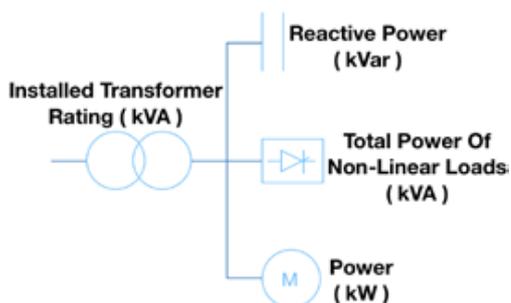
Considering what has been said before it is always necessary to keep in mind the level of harmonics in your network before choosing any kind of equipment especially Power Factor Correction one.

A significant parameter is the cumulated power of the non-linear loads generating harmonic currents.

Since the harmonics are caused by non-linear loads, an indicator for the magnitude of harmonics is the ratio of the total power of non-linear loads to the supply transformer rating.

$$N_{LL} = \frac{\text{Total Power of Non - Linear Loads}}{\text{Instaled Transformer Rating}}$$

EXAMPLE OF CALCULATIONS OF NON-LINEAR LOADS



Installed transformer rating: 500 kVA

Total power of non-linear loads: 115 kVA

$$N_{LL} = (115 / 500) \times 100 = 23\%$$



INTACT BASE RCM-INB-3: Capacitors designed to be used in standard conditions when there aren't any significant non-linear loads.

$N_{LL} < 10\%$

INTACT PLUS (Heavy Duty) RCM-INP-3: Capacitors for working in difficult conditions, resistant to voltage overloads or when the limited quantity of non-linear loads are installed.

Particularity – largely increased current resistance.

$N_{LL} < 20\%$

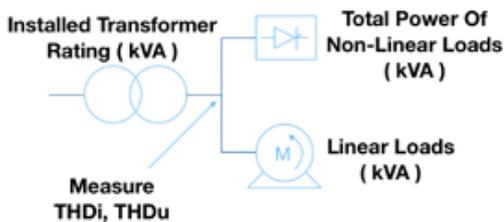
INTACT ALLPOWER (Extra Heavy Duty) RCM-INA-3: Highly reliable capacitors for operating in harsh environments or with a significant level of non-linear loads. Resistant to high overloads in current and voltage. Intact ALLPOWER is also resistant to high temperatures.

$N_{LL} < 25\%$

INTACT R-POWER RCM-INR-3: Capacitors to be used with detuned harmonic reactor. This is the optimal solution for reactive power compensation in networks where there is a significant quantity of non-linear loads, therefore the use of reactors is mandatory.

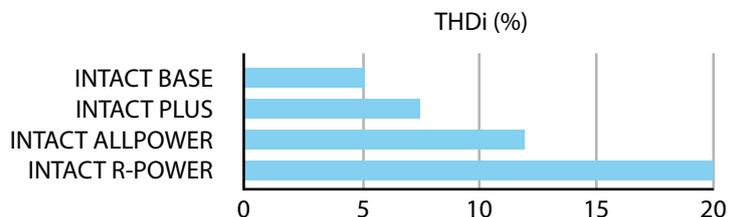
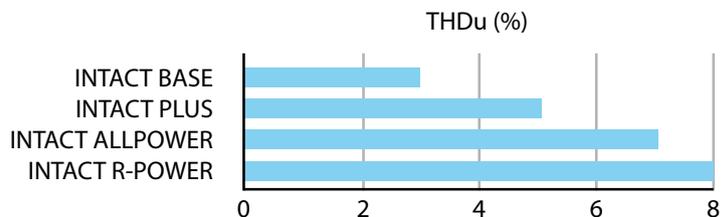
$N_{LL} < 30\%$

CAPACITORS SELECTION TAKING IN MIND LEVEL OF HARMONICS



As said before the percentage of non-linear loads N_{LL} is a very important indicator of magnitude of harmonics but a more detailed estimation of the magnitude of harmonics can be made with measurements.

Significant indicators are current harmonic distortion $THDi$ and voltage harmonic distortion $THDu$. Both values must be measured at the transformer secondary without connected capacitors. According to the measured distortion, different technologies of capacitors shall be selected.



Note:

The capacitor type should be selected according to the most restrictive measurement. For Example, a measurement is giving the following results:

- $THDi = 14,0\%$
- $THDu = 4,0\%$

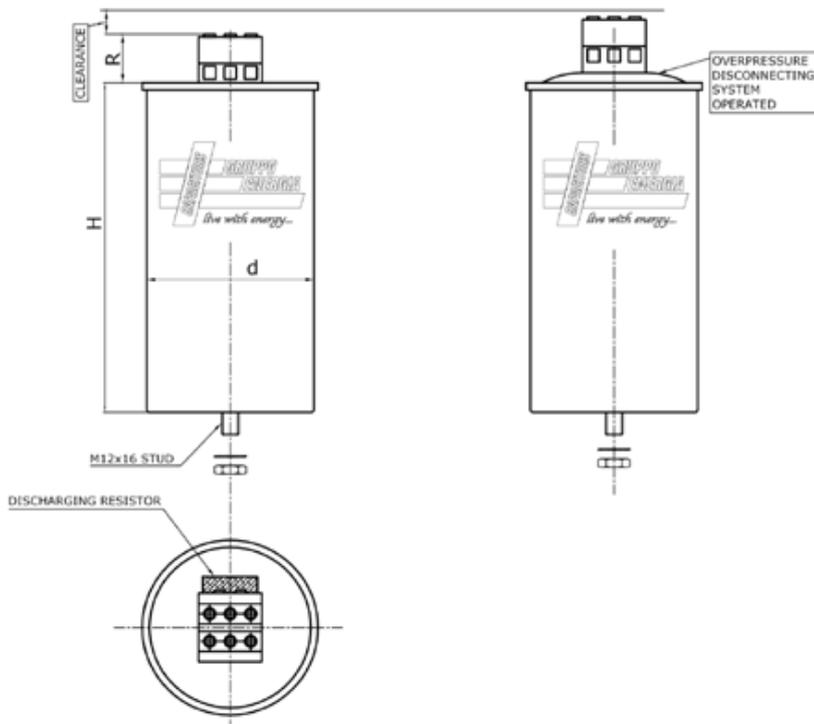
INTACT R-POWER with Detuned Reactor has to be selected.

Capacitor Family	Type	Applications	Max. Conditions
Intact Base RCM - INB - 3	Standard Capacitor	<ul style="list-style-type: none"> • Networks with non significant non-linear loads • Standard over-current • Standard operating temperature • Normal switching frequency • Standard life expectancy 	<ul style="list-style-type: none"> • NLL < 10% • 1,5 In • 55 °C • 5000 / year • Up to 100000 h*
Intact Plus RCM - INP - 3	Heavy Duty Capacitor	<ul style="list-style-type: none"> • Few non-linear loads • Significant over-current • High operating temperature • Significant switching frequency • Long life expectancy 	<ul style="list-style-type: none"> • NLL < 20% • 1,8 In • 60 °C • 7000 / year • Up to 160000 h*
Intact AllPower RCM - INA - 3	Extra Heavy Duty Capacitor	<ul style="list-style-type: none"> • Significant number of non-linear loads (up to 25%) • Significant over-current • Extreme temperature conditions • Frequent switching frequency • Extra long life expectancy 	<ul style="list-style-type: none"> • NLL < 25% • 2,5 In • 60 °C • 10000 / year • Up to 180000 h*
Intact R-Power + Detuned Harmonic Reactor RCM - INR - 3	Capacitor For Critical Applications	<ul style="list-style-type: none"> • High level of non-linear loads (up to 30%) • Significant over-current • Standard operating temperature • Significant switching frequency • Long life expectancy 	<ul style="list-style-type: none"> • NLL < 30% • 1,5 In • 55 °C • 7000 / year • Up to 160000 h*

Advise For You:

It is highly recommended to do harmonic study and detailed load study before selecting the capacitor family. For more informations don't hesitate to contact Gruppo Energia team.

CONSTRUCTION DIAGRAM



CASE

- Expansion: Maximum 12 mm.
- Clearance: Minimum 15 mm.

MOUNTING

- M12 threaded bolt
- Tightening torque: T= 10 Nm.
- Toothed washer: DIN 6789.
- Hexagonal nut: DIN 439.

TERMINALS

- Finger-proof terminal: Yes.
- **MT 16**
 - For 16 mmq cable.
 - M4 terminal screw.
 - Tightening torque: T= 1,3 Nm
 - R = 33 ±2
- **MT 25**
 - For 25 mmq cable.
 - M5 terminal screw.
 - Tightening torque: T= 2,5 Nm
 - R = 33 ±2
- **MT 35**
 - For 35 mmq cable.
 - M5 terminal screw.
 - Tightening torque: T= 3,0 Nm
 - R = 43 ±2

* The maximum life expectancy is given considering standard operating conditions as rated voltage (Un), rated current (In), 35 °C ambient temperature.

* Attention: The life expectancy will be reduced if capacitors are used at maximum working conditions.