

# CIRCUITO NACIONAL DO SETOR ELÉTRICO

## Ano 8



**CINASE**

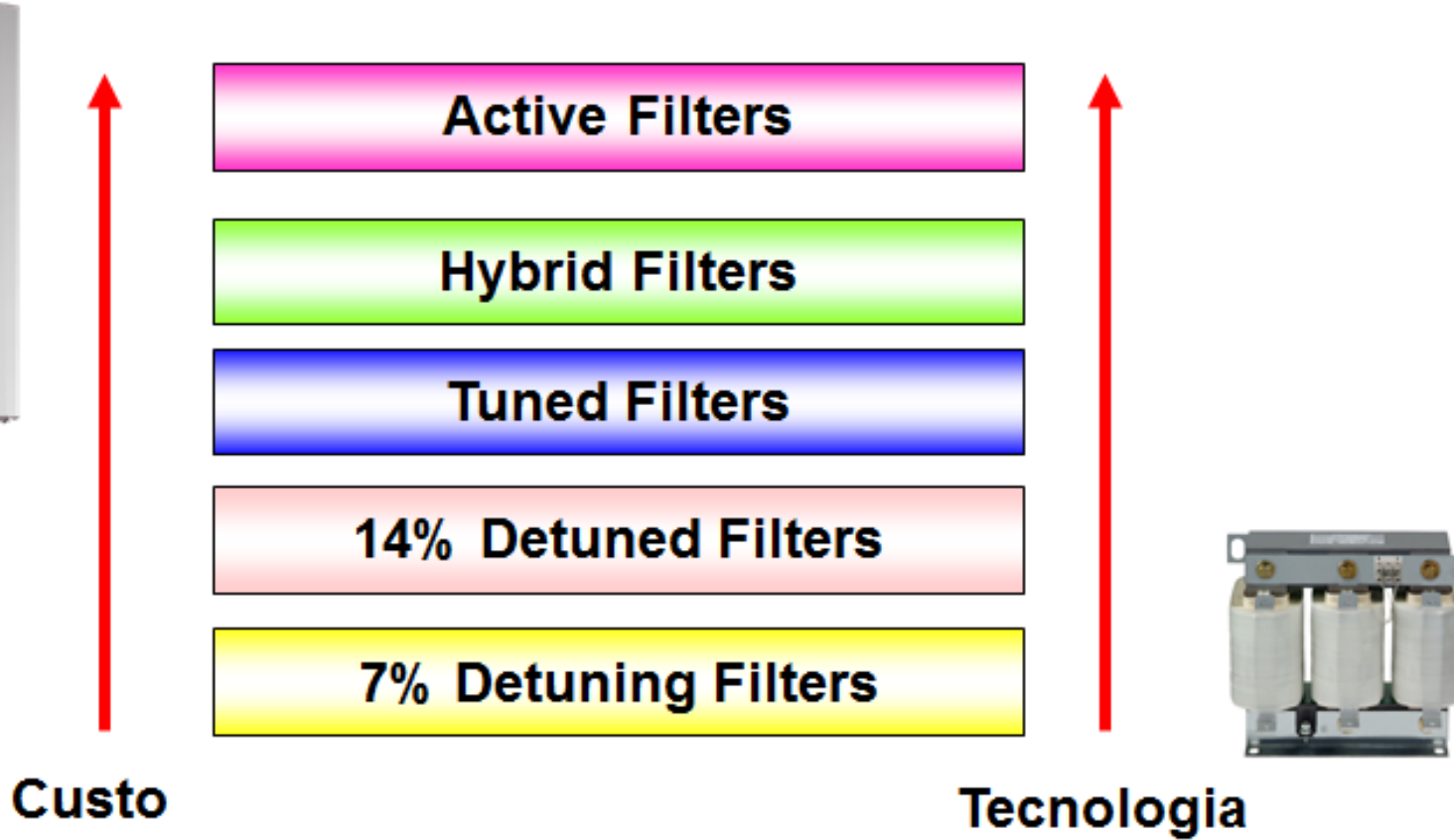
# Filtros Passivos e Ativos para Conteúdo Harmônico

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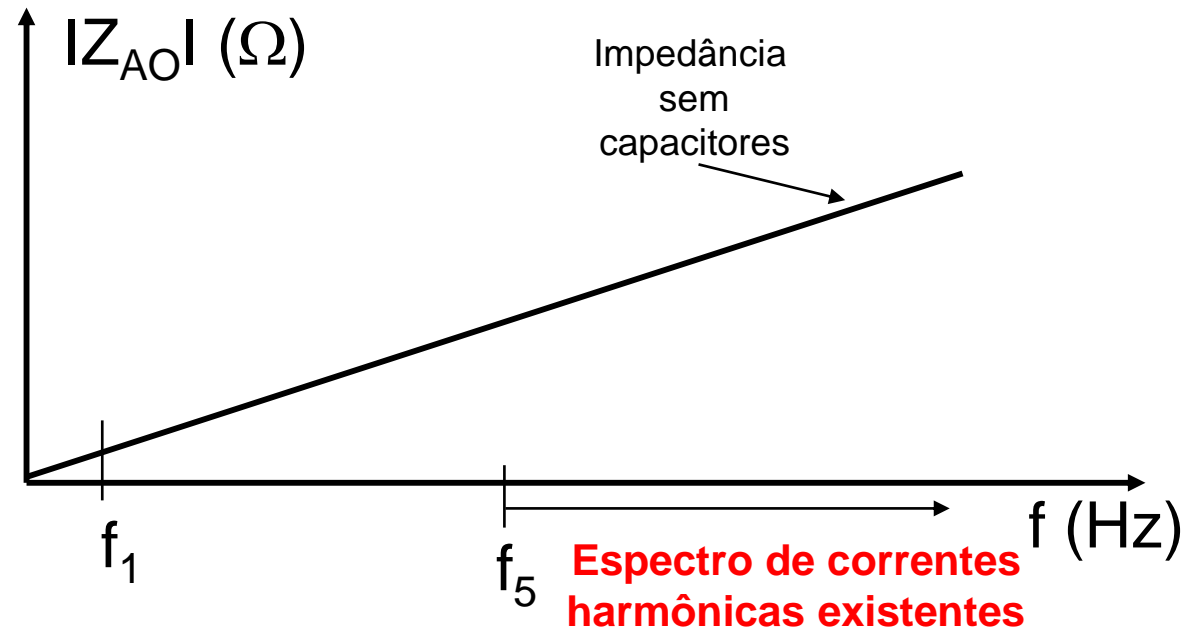
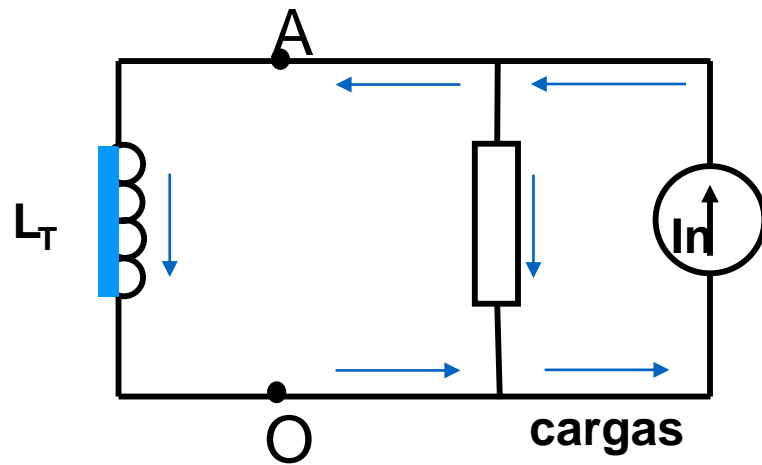


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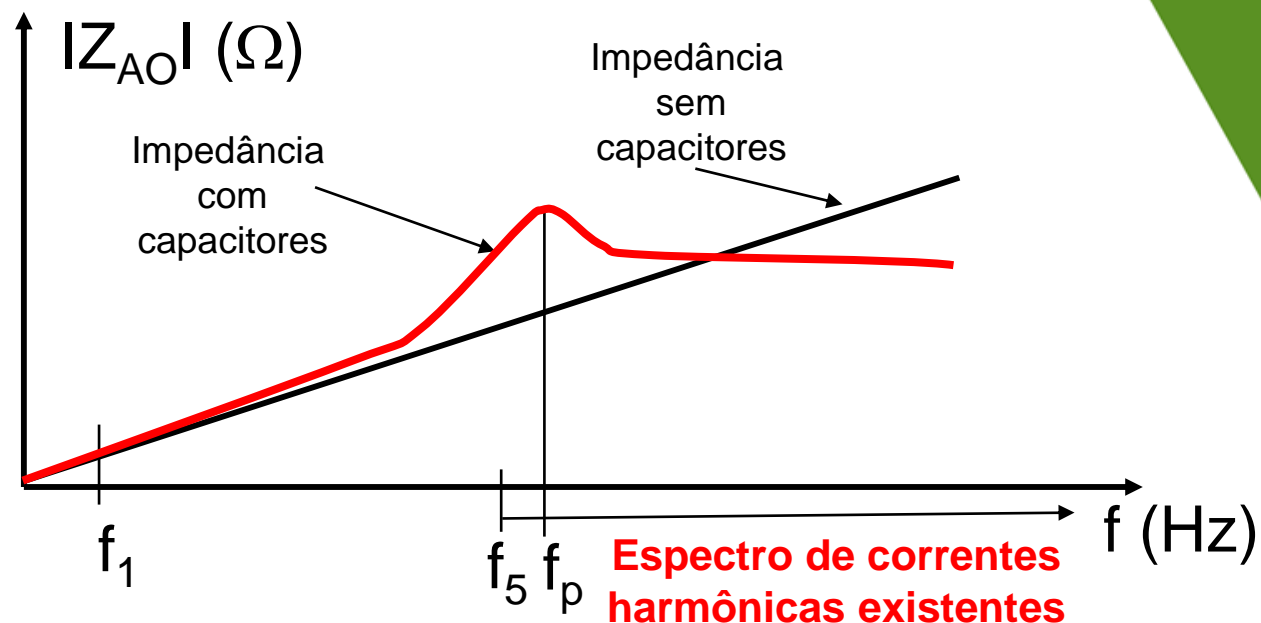
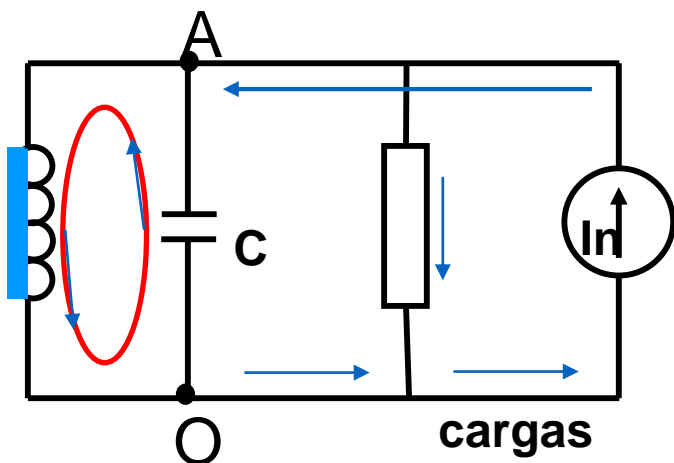
## Tipos de Filtros



## Cargas não lineares com baixo $f_p$



## Ressonância paralela entre trafo e capacitores

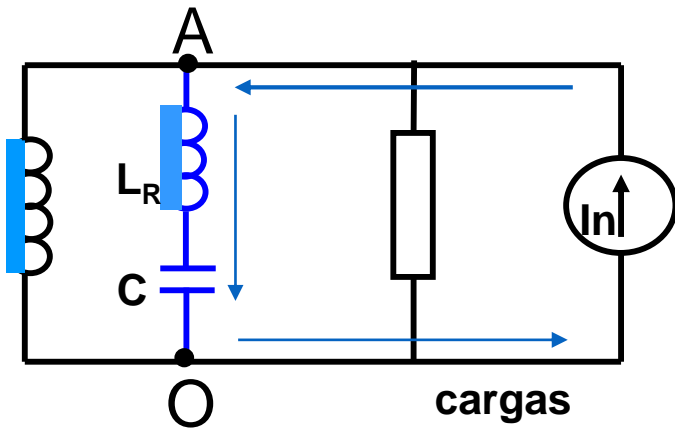


$$V_n = Z_{AO_n} I_n$$

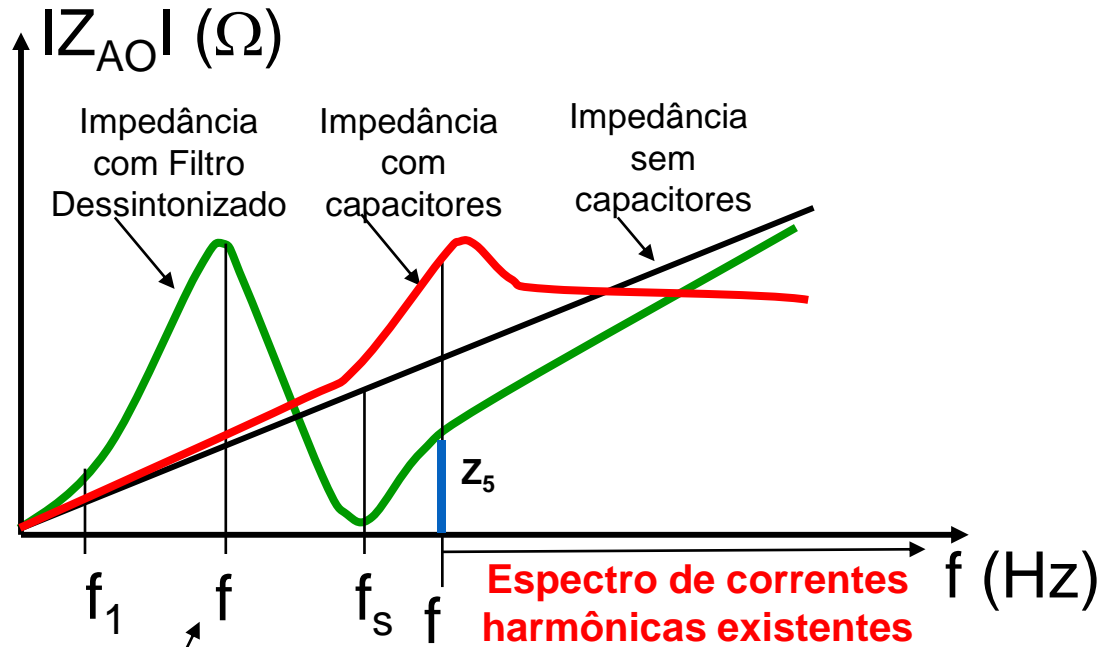
$$f_p = \frac{1}{2\pi\sqrt{L_T C}}$$



# Filtro Dessintonizado



$$V_n = Z_{AO_n} \cdot I_n$$



Nova  $f_p = \frac{1}{2\pi\sqrt{(L_T+L_R)C}}$

Nova  $f_s = \frac{1}{2\pi\sqrt{L_R \cdot C}}$



## Precauções

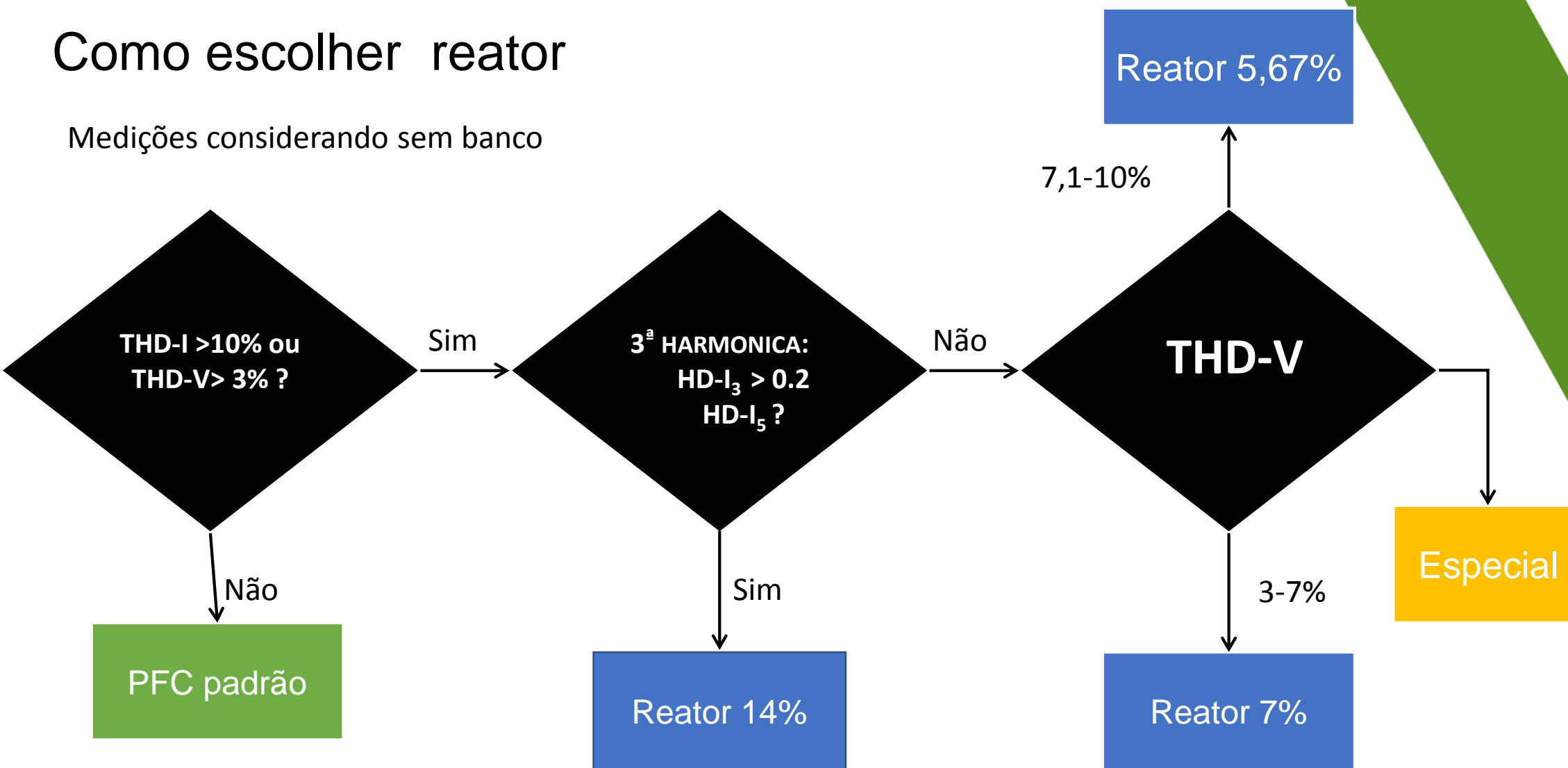
### Technical Data

Filtering factor p [%]:	7
Effective filter output Qc [kvar]:	25
Rated voltage [V]: <sup>1)</sup>	400
Rated frequency [Hz]:	50
Ambient temperature / Insulation class:	40°C/B
Capacitance C delta (tot.) [µF]:	462 (= 3 x C delta )
Induktivity L [mH]:	1,53
Linear up to :	1,73 x I1
Effective current I rms [A]: <sup>2)</sup>	41
Rated current EN61558 I <sub>Ln</sub> [A]	36,9
Rated harmonic voltages (3 <sup>rd</sup> /5 <sup>th</sup> /7 <sup>th</sup> /11 <sup>th</sup> /13 <sup>th</sup> ) [%]:	0,5 / 6 / 5 / 3,5 / 3



## Como escolher reator

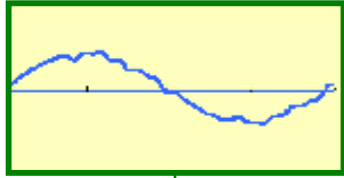
Medições considerando sem banco



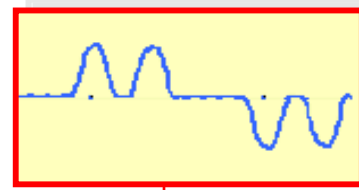


## Princípio de Funcionamento

Resultado: Forma de onda de corrente senoidal



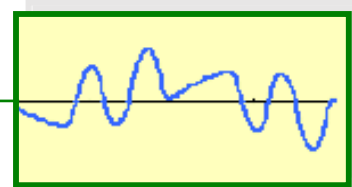
Corrente não senoidal



Mains



Tranformador de corrente



Corrente compensatória

Filtro Ativo Ligado



Fonte Harmônica

(Por exemplo, motor com inversor de frequência)

## Filtro Ativo

### Características principais

- Correção de fp ultra-rápido;
- Eliminação do conteúdo harmônico(até 50<sup>a</sup>);
- Balanceamento de carga entre fases e neutro;
- Compensação Flicker.





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## Filtros Passivo e Ativos para conteúdo Harmônico

### Como escolher um filtro ativo

Filter Current Rated capacity	60A-600A (AHF Module of 60A)	25A-600A (AHF modules of 25/35/50/60/75/90/100/150 A)
Rated input line voltage	3P3W device: 200 V ... 480 V (±10%) 3P4W device: 200 V ... 415 V (±10%)	380V(-40% ~ +20%) 480V, 600V 690V
Power grid frequency	47Hz - 63 Hz	45Hz~62Hz
Parallel operation	Unlimited	Unlimited
Overall efficiency	Up to 99%	> 97%
Power grid structure	3P4W;3P3W	3P4W;3P3W
Specifications CT	Source or load side selectable, 100/1 A ... 3,500/1 A, 3 CT devices for 3P3W and 3P4W	Source or load side selectable, 150/5 ... 10,000/5, 2 CT devices for 3P3W and 2 CT devices for 3P4W
Circuit topology	3-level NPC Topology, IGBT	3-level NPC Topology, IGBT
Harmonic compensation	YES	YES
Unbalance / Reactive power compensation	YES	YES
Filtering range	2 to 50 orders (adjustable)	2 to 50 orders (adjustable)
Response time	<21µs	50µs / 100 µs
Overall response time	< 300 µs	< 5ms / < 20ms
Module mains connection	"Plug and play" fork plug spring connector	Screw terminal connection
MTTR	< 3 minutes	<10 minutes
Switching / Control frequency	24kHz/48kHz	20kHz/20kHz 18kHz/18kHz
Display touchscreen	7" or 12.1" - Linux OS	7" - Android OS
Operating temperature	-10 to +40°C, up to +55 °C with derating	-10 to +40°C up to 50°C with derating

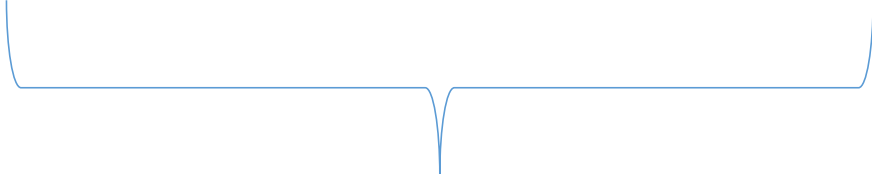


## Filtro Ativo

### Cálculo da corrente de compensação

$$I_H = \frac{I_{RMS}}{\sqrt{\frac{1}{THDi^2} + 1}}$$

$$I_R = \frac{Q_c}{\sqrt{3} \cdot V_{L-L}}$$


$$I_{Filtro} = \sqrt{(I_H)^2 + (I_R)^2}$$

# OBRIGADO

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