

FT100 series Detuned Filter Bank



Automatic Power Factor correction and Filter Banks

The Power Quality Solution



Power transmission and distribution systems are designed to operate with sinusoidal voltage and current having constant frequency. When nonlinear loads-such as thyristor drives and converters are connected to the system, harmonics are generated, which causes voltage and current distortion.

Capacitor capacitance and network inductance may form a parallel resonant circuit where harmonic currents may reach as high as 20 times the normal level. Should the tuned frequency of the resonant circuit match an existing harmonic frequency, the current distortion caused by resonance leads to further voltage distortion? This is why power factor correction can be affected by harmonic network content.



In systems where harmonics are present, power factor correction should be done by means of detuned filters. These consist of capacitors and reactors connected in series, and are capable of compensating reactive power at fundamental frequency without amplifying the harmonics.

TECHNICAL DATA - FT100 series

● Rated Voltage / Phase	208 TO 600 Volts / 3 phases
● Rated Frequency	50Hz or 60Hz
● Rated Power	20 to 1200 kVAR / unit
● Tuned Frequency	7% or 12.6% (other tune frequency on request)
● Power Factor Controller	N12 or NC12 12 steps
● Insulation level	5 kV
● Power losses	0.4 w/kVAR
● Continuous over-voltage	110 %
● Continuous over-current	135 %
● Mounting type	Floor mounting
● Enclosure type	Indoor , outdoor
● Temperature class	-40 °C to 55° C
○ Average 24h :	+ 45° C
● Color	ASA 61 (light grey)
● Construction Standard	UL, CSA, IEC

6 to 20 Unit Assemblies

- 20 to 1200 kVAR
- 208 to 600 Volts
- Nema-1, 12, 3R & 4X

POWER FACTOR CORRECTION IN THE PRESENCE OF HARMONICS

Gentec **FT100** Detuned filters are designed to be used for power factor correction in systems where harmonics are generated.

Each step of a detuned filter consists of a capacitor and a reactor connected in series. These components form a series resonant circuit tuned at a frequency below the lowest harmonic frequency present in the system, normally the 5th (300Hz).

Below the tuned frequency of the resonant circuit, for example at fundamental frequency (60Hz), the detuned filter is capacitive, generating reactive power. Above the tuned frequency the detuned filter is inductive, which means that it cannot amplify any common harmonics, including the 5th, 7th and 11th. A detuned filter also removes lower order harmonics from the system to some extent.

As in conventional capacitor banks, the steps are switched on and off by power factor controllers according to the demand of reactive power.



1. DSHI CAPACITORS
2. FILTER REACTOR
3. CONTROL DEVICES
4. SWITCHING DEVICES

P.Q. Manager



➤ Technical Data *FT100 series*

Standard Features and Options :	4 Units Ass.	6 Units Ass.	12 Units Ass.
Enclosure floor mounted c/w lifting ring (Type 1, 2, 3R, 4X)	1, 2, 3R, 12, 4X	1, 2, 3R, 12, 4X	1, 2, 3R, 12, 4X
Three points lockable door handle	▪	▪	▪
ASA 61 Grey (other color on request)	▪	▪	▪
Top Cable entry (Bottom entry on request)	▪	▪	▪
Capacitors space / KVAR max / Unit (Custom Staging Ratios)	4 / 100 kVAR	6 / 100 kVAR	12 / 100 kVAR
Incoming silver Flashed Copper Bus 30 kV BIL c/w mechanical lugs	▪	▪	▪
Power and Control wires	T90 / T105	T90 / T105	T90 / T105
DSHI Capacitor (Heavy Duty type on request)	▪	▪	▪
Current limiting fuses HRC type ____ Amp. 200 ka	▪	▪	▪
Magnetic Contactor c/w special switching devices	▪	▪	▪
Detuned reactor c/w thermal detection device	▪	▪	▪
Power Factor Controller (On / Off switches)	6 steps	6 & 12 steps	12 steps
Control & Potential Transformer c/w GFI breaker*, CT Shorting	▪	▪	▪
Thermostatic ventilation system	▪	▪	▪
Optional (s)			
Current Transformer (Split core type)	○	○	○
Main Breaker or Fuses Disconnect	○	○	○
Blown fuses indicating light c/w push bottom test	○	○	○
Main current metering c/w Ammeter and phase selector	○	○	○
Electric Door interlock	○	○	○
Kirk Key system interlock with the remote main breaker	○	○	○
Special Metering Arrangement	○	○	○
Ground switch interlocked with doors and main supply	○	○	○

▪ Standard ○ = Optional

➤ Technical Application

If harmonic filters are being considered only for the purpose of power factor correction, then a de-tuned filter bank is the best choice. This filter will do little for removing any harmonic distortion present on the system but will allow the installation of a large capacitor bank without any adverse system interactions. De-tuned filter banks are less costly and are more reliable than partially de-tuned and tuned filter banks. The anti-resonant frequency should be considered to assure that it does not fall near the 3rd harmonic.

- Detuned filters

When the resonant frequency of the series resonant filter circuit is tuned to a frequency lower than the harmonic occurring in the system, the filter circuit is termed as detuned filter. The philosophy of the detuned filters would be clear from the following example.

The harmonics that would be generated are 5th, 7th, 11th and 13th and so on. The lowest harmonic frequency which would occur in the system is the fifth harmonic i.e. 300 Hz. If the series resonant circuit is tuned to a frequency of 245 Hz, then at all the harmonic frequencies the filter acts as an inductive component and the possibility of resonance at the fifth harmonic is eliminated.

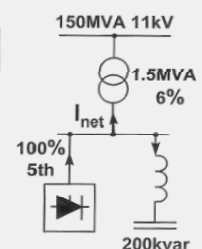
The impedance offered to the 5th harmonic signal is less than the capacitor alone. This means that the series resonant filter will absorb the 5th harmonic to a certain extent.

The reactor to capacitance ratio $p(\%)$ reflects the ratio of reactor reactance to capacitor reactance at fundamental frequency. The resonant frequency of the series resonant filter circuit is indicated indirectly by p . The following table shows a comparison for various reactor/ capacitor combinations at fundamental frequency of 60 Hz.

Resonance Frequency F_r	Relative Resonance	Reactor/Capacitor Factor : p
227	3.8	7.0
245	4.1	6.0
252	4.2	5.67
282	4.7	4.52
288	4.8	4.33
300	5.0	4.0

Percentage of the 5th harmonic current to the network with different tuning frequencies

Tuning frequency Hz	Reactor percentage %	I_{net} %
227	7.00	77
245	6.00	69
252	5.67	65
270	4.94	52
282	4.53	24



Reactive FT100 series			Options								
Power	Basic Part. #	System Voltage	Reactive kvar	No step	Step / Kvar	Type 1, 12, 3R	Protection Device	3 F Ind. Light	Tuned Freq.	DWG	Fig
Kvar	+ -->	Suffix	Suffix	Suffix	Suffix	Suffix	Suffix	Suffix	# TH	SK - #	#
50	FT100	480	50	5	10	1	B	BFI	4.5	6093A	1
75	FT100	480	75	5	15	1	B	BFI	4.5	6039A	1
100	FT100	480	100	5	20	1	B	BFI	4.5	6093A	1
120	FT100	480	120	4	30	1	B	BFI	4.5	6039A	1
125	FT100	480	125	5	25	1	B	BFI	4.5	6093A	1
150	FT100	480	140	7	20	1	B	BFI	4.5	6039A	1
160	FT100	480	150	5	30	1	B	BFI	4.5	6039A	1
175	FT100	480	175	7	25	1	B	BFI	4.5	6093A	1
200	FT100	480	200	4	50	1	B	BFI	4.5	6039A	1
225	FT100	480	210	7	30	1	B	BFI	4.5	6039A	1
240	FT100	480	240	4	60	1	B	BFI	4.5	6093A	1
250	FT100	480	250	5	50	1	B	BFI	4.5	6039A	1
360	FT100	480	360	6	60	1	B	BFI	4.5	6126A	2
600	FT100	480	600	6	100	1	B	BFI	4.5	6126A	2
800	FT100	480	800	8	100	1	B	BFI	4.5	6008A	1+2
1000	FT100	480	1000	10	100	1	B	BFI	4.5	6168A	2+2
1200	FT100	480	1200	12	100	1	B	BFI	4.5	6168A	2+2
***	FT100										***
Model	1	2	3	4	5	6	7	8			
No ...	FT100	480	1200	12	100	1	B	BFI			

1	FT100 Series for Standard Automatic Detuned Filter FT200 Series for Standard Automatic Tuned Filter
2	System Voltage applied 204, 480, 600 Volts
3	Total Reactive Power = ___ Kvar
4	Number of step increment switching
5	Increment of ___ Kvar / step
6	Type Enclosure = 1, 12, 3R, 4X
7	Option : B : Breaker D : Disconnect Switch FD : Fuses Disconnect Switch
8	Option : Blown Fuses indicating lights = BFI

P.Q. Manager
NC12 Model

