

Harmonic Filters for Single Phase Equipment



Economical Solutions for:

- Agriculture
- Call Centers
- Casino Slot Machines
- Computer Centers
- Distributed Generation
- Electronic Power Converter
- Oil & Gas
- On-Line UPS
- Power Electronics Equipment
- Lighting
- Variable Speed Motor Drives
- Water Pumping
- Wind Turbines

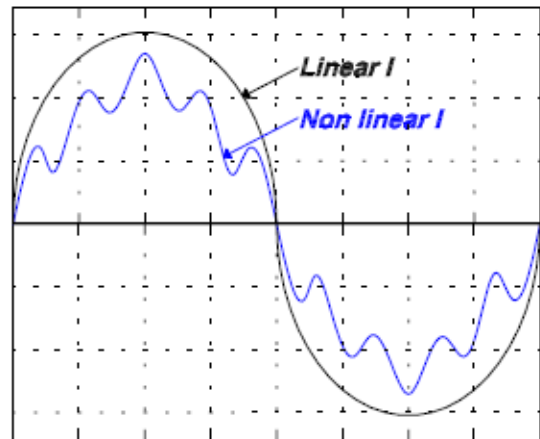
ARTECHE can solve your Harmonic Distortion and Power Factor problems!

What is Harmonic Distortion?

Harmonic distortion is the continuous deformation of the voltage or current waveforms and is generally caused by equipment that converts AC to DC, namely power electronics equipment. Harmonics are caused by common commercial and industrial loads such as:

- AC and DC motor drives,
- Motor soft starters,
- Welders,
- Computers,
- Slot machines
- UPS systems,
- Robotics, and
- Other power electronic loads.

AC to DC rectifiers do not draw current from the power source as a continuous sine wave, but rather in short, rapid bursts. These (non-linear) loads draw what appears to be a chopped up current waveform through the electrical system all the way back to the power source (transformer, utility system, generator). As more and more power electronics loads are added to the electrical system, the magnitude of harmonic distortion increases.



Because harmonics flow at frequencies higher than the normal 60hz, special harmonic analyzers are required to measure the magnitude of harmonic distortion. Total Harmonic Distortion (THD) is normally expressed as a percentage with respect to the value of fundamental current or voltage.

Why are harmonics a problem?

Harmonic distortion increases the total rms current that flows from a power source (transformer) to a load. Since the harmonic currents flow at frequencies which are higher than the supply frequency, they generate more heat and increase the possibility of equipment interference. Harmonics waste energy, contribute to premature equipment failure and can cause equipment malfunction. Problems caused by harmonics include:

- Increased heating of transformer and motors,
- Increased power losses,
- Failure of power factor capacitors,
- Distorted system voltage,
- Reduced transformer life,
- Increased motor heating,

Arteche solves harmonics problems!

Generally speaking, the best place to solve harmonics problems is as close to their point of generation as possible. The most common solutions for harmonic distortion tend to divert harmonic energy to an alternative path to keep it off the common power system and away from the power sources. By solving harmonics close to the load, all points upstream of the harmonic filter will benefit and experience a higher level of power quality. The electric utility system will benefit regardless where the filters are connected in a customer's facility, however, in order for the facility electrical system to benefit, harmonic filtering equipment must be applied close to the non-linear loads. Arteche offers a complete range of harmonic mitigating equipment. We can recommend the best solutions to meet your power quality goals.

Harmonics in Single Phase Systems

Harmonic distortion caused by 1-phase power electronics equipment is typically higher in magnitude than for 3-phase loads. Besides the higher total harmonic current distortion (THD-i), 1-phase systems also experience the cumulative effect of the 3rd, 9th and 15th harmonics on a shared neutral conductor (4-wire or 3-wire 120/240 systems). When harmonics flow on the neutral conductor;

- Neutral current increases
- Neutral to ground voltage increases at the load
- Fire hazard and liability increases
- NEC requires larger neutral conductors and K-factor transformers

The 3rd harmonic alone may be as high as 90% of the fundamental current. Since the neutral has no over current protection, this can lead to severe overheating and a dangerous situation. Excessive 3rd harmonic (180hz) current can cause equipment interference, reduction of useful equipment life and has been known to cause electrical fires.

Two Types of Single Phase Harmonic Filters

Our Single Phase Harmonic Filters solve problems caused by 1-phase power electronics loads such as switch mode power supplies, motor drives and power converters. We offer two basic types of filters to solve a wide variety of applications:

- 3rd Harmonic Filters,
- Low Pass Harmonic Filters.

Rather than absorb the unwanted harmonics at the distribution panel, switchboard or upstream supply transformer, our single phase harmonic filters can be applied right at the loads (single load or group of loads). Solving for harmonics near to the culprit loads reduces the burden on your upstream electrical system and keeps your facility electrical system cleaner, more efficient, more reliable and safer.

3rd Harmonic Filters

Our 3rd Harmonic Filters are ideal for plug-in type electronic equipment such as personal computers, laptops, slot machines and other office equipment. To accommodate multiple loads, they can either be supplied with duplex receptacles, or field wiring terminals for direct wiring into the branch circuit. Not only does our 3rd Harmonic Filter reduce third harmonic current by as much as 80%, it also reduces the 5th, 7th and 9th harmonics. 3rd Harmonic Filters typically reduce the triplen (harmonics which are multiples of 3) harmonic currents flowing on the neutral to a fraction of the phase current. 3rd Harmonic Filters are designed for use where shared neutrals are common, and where many single phase power electronics loads are present. They focus on removing most of the 3rd harmonic, which is considered the most problematic for single phase systems. Our 3rd Harmonic filters allow fundamental (50hz or 60hz) current to flow easily from the supply to the load, but insert very high impedance at the 3rd harmonic frequency, effectively blocking most of the 3rd harmonic current. 3rd Harmonic Filters can reduce 3rd harmonic currents by as much as 80 percent, while reducing some higher order harmonics but by 25% to 50% .

Low Pass Harmonic Filters

Arteche's single phase Low Pass Harmonic Filter is generally considered the most effective of all passive harmonic filters. Often they are used in medium and high power applications such as:

- Electronic motor drives,
- Uninterruptible power supplies (UPS),
- Wind turbine inverters
- Photovoltaic power converters

Arteche Low Pass Harmonic Filters significantly reduce all frequencies of harmonic current, but allow the fundamental current to pass relatively unimpeded. While in 3-phase systems, our Low Pass Harmonic Filters achieve residual levels of total harmonic current distortion (THD-i) of 5% or less, the single phase version can achieve levels as low as 5% to 10% THD-i. The Low Pass Harmonic filter includes series impedance to protect the loads from transient over voltage, so no additional reactors are needed for motor drive applications.

3rd Harmonic Filters

Plug-In Style Filters

Typical Applications

- Office Buildings
- Computer Centers
- Schools & Universities
- Call centers
- Casinos



Photo depicts plug-in style filter with optional transient voltage protection.

The basic function of 3rd harmonic filters is to impede the flow of third harmonic current (180Hz for 60Hz systems) in a circuit with little to no attenuation of the fundamental frequency (60Hz) current. The filter combines inductors and capacitors in a way that offers nearly infinite impedance to the unwanted harmonic (3rd) frequency. Separate versions of the 3rd harmonic filters are available for either 60Hz or 50Hz systems.

Easy to Select

Plug-In style 3rd Harmonic Filters are supplied with one or more duplex receptacles, based on their maximum ampere rating. Select the correct filter based on the total connected load. The Plug-In style 3rd Harmonic Filter has internal over current protection.

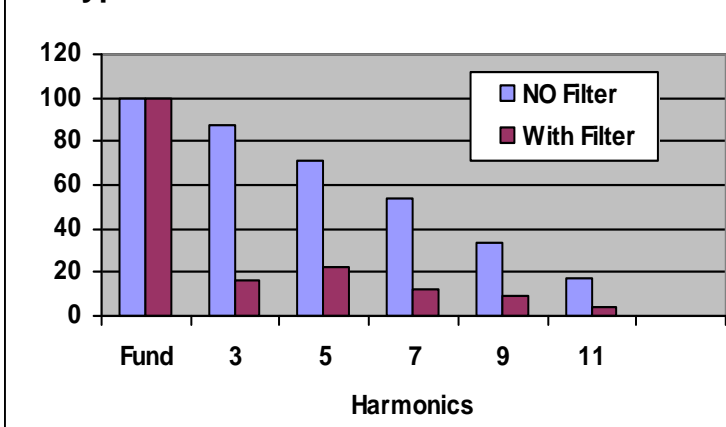
240V 60Hz - Selection Table		
Max. Load (Amps)	Number of Outlets	Catalog Number
5	4	THF 60 0005 240 4N1
10	6	THF 60 0010 240 6N1
15	8	THF 60 0015 240 8N1

120V 60Hz - Selection Table

Max. Load (Amps)	Number of Outlets	Catalog Number
5	4	THF 60 0005 120 4N1
10	6	THF 60 0010 120 6N1
15	8	THF 60 0015 120 8N1

Consult factory if you need other ratings.

Typical Performance - 3rd Harmonic Filters



The harmonic spectrum (left) illustrates the magnitudes of individual harmonic currents for single phase loads for two conditions - without a filter (often more than 100% THD-i) and with a 3rd harmonic filter (often $\leq 30\%$ THD-i).



3rd Harmonic Filters

Branch Circuit Rated Filters

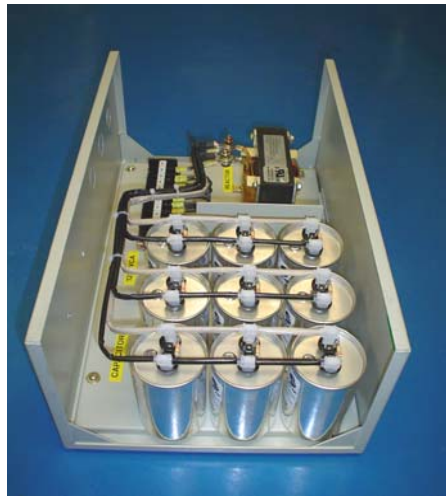


Photo (right) illustrates internal components for 20 amp branch circuit rated filter. Includes terminal block for easy in-circuit wiring. Filter is suitable for single or multiple loads up to its maximum current rating.

Typical Applications

- Office Buildings
- Computer Centers
- Schools & Universities
- Call centers
- Casino slot machines
- Lighting circuits

Easy to select

Branch Circuit Rated 3rd Harmonic Filters may be selected based on the current rating of the nearest upstream branch circuit protective device. This filter does not include internal fuses and therefore requires coordinated upstream over current protection.

120V 60Hz - Selection Table

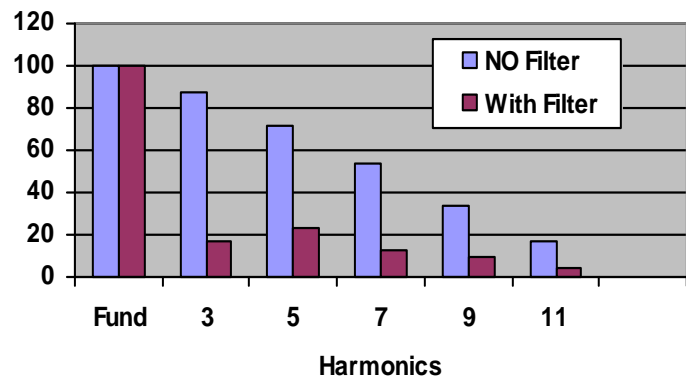
Max. Load (Amps)	Catalog Number
20	THF 60 0020 120 N1
30	THF 60 0030 120 N1
40	THF 60 0040 120 N1
50	THF 60 0050 120 N1
60	THF 60 0060 120 N1
100	THF 60 0100 120 N1

Consult factory if you need other ratings.

The basic function of 3rd harmonic filters is to impede the flow of third harmonic current (180Hz for 60Hz systems) in a circuit with little to no attenuation of the fundamental frequency (60Hz) current. The filter combines inductors and capacitors in a way that offers nearly infinite impedance to the unwanted harmonic (3rd) frequency. Separate versions of the 3rd harmonic filters are available for either 60Hz or 50Hz systems.

The harmonic spectrum at the illustrates the typical magnitudes of individual harmonic currents for single phase loads for two conditions - without a filter (often more than 100% THD-i) and with a 3rd harmonic filter (often \leq 30% THD-i).

Typical Performance - 3rd Harmonic Filters



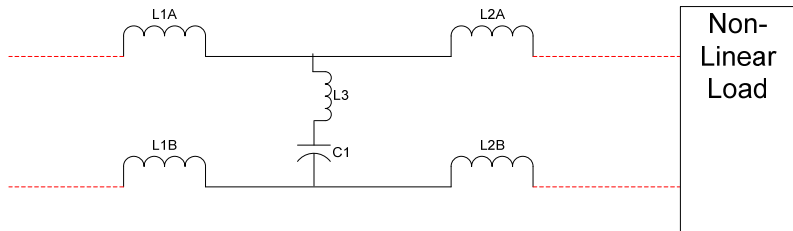
Low Pass Harmonic Filters

For Single-Phase Motor Drives



Arteche Low Pass Harmonic Filters reduce harmonic current distortion to the lowest possible levels and return input current to a near sine wave. They have proven to be a reliable means of achieving compliance with IEEE-519 and other international power quality standards and where ever harmonics need to be reduced to very low levels.

Circuit Diagram: Our Single Phase type LPF filters utilize the same proven technology as our popular three phase low pass harmonic filters by combining three stages of filtering to achieve the very lowest levels of residual harmonic current distortion.

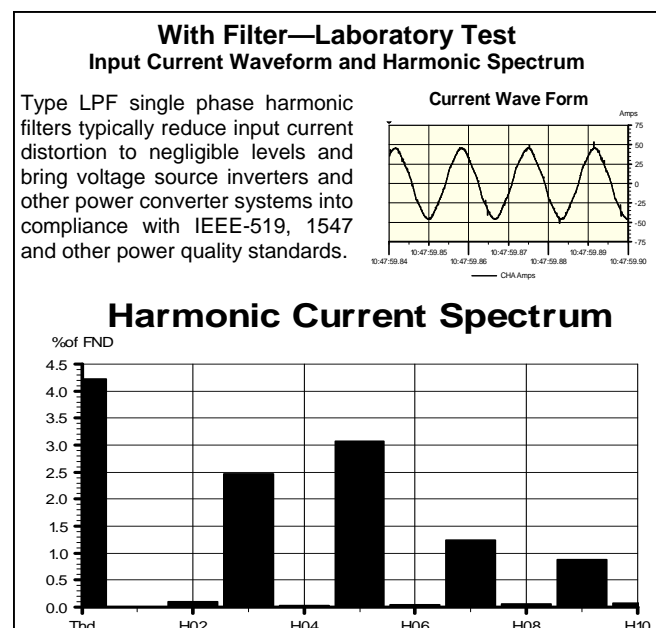
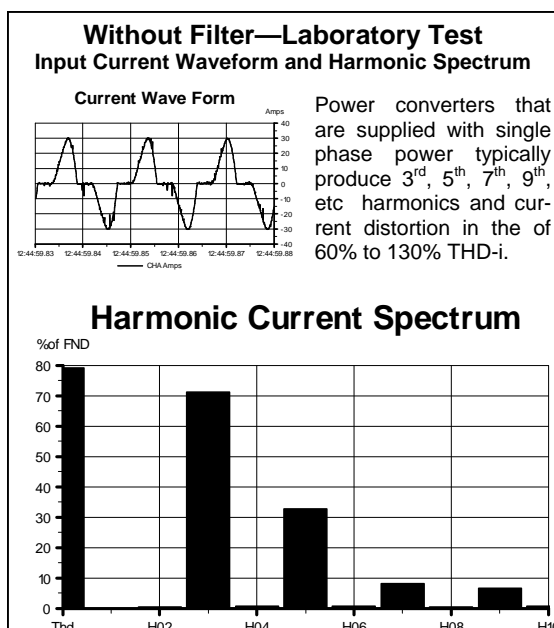


Distributed Generation: Our single phase Low Pass Harmonic Filters (LPF) can also be applied on distributed power generation sources. The filter not only serves as a buffer between the power source and the utility grid or between the power source and connected loads, but also reduces the RMS and peak current that non-linear loads demand from the power source. The 1-phase LPF will typically enable the D-G equipment to comply with electric utility interconnect standards such as IEEE-1547. An optional Interconnect relay is available for those applications where demanded by the local electric utility.

Test Results:

Laboratory - the single phase version of our low pass harmonic filter has been evaluated in conjunction with a single phase input variable frequency drive. Measurements have consistently shown that THD-I levels of 5% to 10% are possible. Results will vary based on application variables such as pre-existing system voltage distortion and source impedance.

Field - Customer reports have consistently indicated compliance with IEEE-519 when our single phase low pass harmonic filter was applied to the input of a variable frequency drive.



Typical Applications

- Irrigation pumps
- Recreational water
- Dairy farm
- Residential water pumps
- Methane wells
- Oil- jack pumps
- Motor drives/inverters
- Online UPS
- Wind turbine inverters
- Photovoltaic inverters
- Micro turbines
- Generators supplying VFDs



Photo: 20HP single phase low pass harmonic filter

Selection is easy!

Determine the power system single phase line to line voltage and select the proper filter based on the maximum rating (HP) of the total connected load(s). Our single phase low pass harmonic filters are only intended for non-linear type loads (ie: power electronics equipment).

240V 60Hz - Selection Table Nema 3R version	
Max. Load (HP)	Catalog Number
5	LPF 0005 216 N3R
7.5	LPF 0008 216 N3R
10	LPF 0010 216 N3R
15	LPF 0015 216 N3R
20	LPF 0020 216 N3R
25	LPF 0025 216 N3R
30	LPF 0030 216 N3R

480V 60Hz - Selection Table Nema 3R version	
Max. Load (HP)	Catalog Number
5	LPF 0005 416 N3R
7.5	LPF 0008 416 N3R
10	LPF 0010 416 N3R
15	LPF 0015 416 N3R
20	LPF 0020 416 N3R
25	LPF 0025 416 N3R
30	LPF 0030 416 N3R

Consult factory for other ratings and enclosures.



ARTECHE can solve your Harmonic Distortion and Power Factor problems!

Analysis—Engineering—Solutions

Low Voltage—Medium Voltage—High Voltage

Type of Solution	Harmonic Mitigating Reactor	Tuned 5th Harmonic Filter	Low Pass (Wide Band) Harmonic Filter	Dynamic Harmonic Filter	12 or 18 Pulse Rectifier Conversion Kit	Active Harmonic Filter
Configuration						
Current Waveform						
Harmonic Current Distortion	35% to 45% THD-I	15% to 25% THD-I	5% or 10% THD-I	15% to 25% THD-I	5% to 10% THD-I	5% THD-I
Basic Product Photo						

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