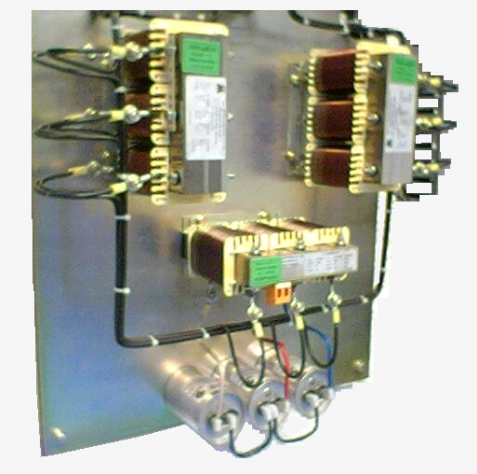
ARTECHE
POWER QUALITY

General Data Sheet

Low Pass Harmonic Filters

Three Phase



200V thru 690V

50Hz or 60Hz

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POPULAR OPTIONS

Enclosures : **Nema 1, Nema 3R, Nema 4, Nema 12**

Mounting Configurations : **Open Panel, OEM Kit (Reactors + Capacitors)**

Phases : **1-phase, 3-phase**

Customized Assemblies : **Filter with capacitor cut-out**
: **Filter with bypass**
: **Other custom assemblies available on request**

Harmonic Analysis : **Available on request**

For a review of our technical application bulletins, visit our website: www.artechepq.com

For a comprehensive review of Arteche products and capabilities, visit www.arteche.com

Harmonics Tutorial

Harmonics are repetitive disturbances of a moderate frequency nature, typically in the range of 120Hz to 3000Hz, caused when an electronic load draws current in a non-sine wave manner. Harmonics are common where ever power electronics equipment is operated. Harmonics are a wasteful by-product of the AC to DC power conversion process which is so very common in consumer, commercial and industrial equipment such as adjustable speed drives, computers, compact fluorescent lamps, welders, battery chargers, heating controls, uninterruptible power supplies and nearly every piece of electronic equipment.

AC to DC Conversion Produces Harmonics

During the process of converting AC to DC, current is drawn in pulses rather than the normal smooth sinusoidal waveform. In essence, current flows at multiple frequencies including the fundamental system frequency (60Hz or 50Hz) and specific higher frequencies. For three phase power supplies using six rectifiers, the harmonics include 5^{th}, 7^{th}, 11^{th},13^{th}, etc., where the harmonic number indicates the waveform frequency as a multiple of the fundamental frequency (5^{th} harmonic = 5 x 60Hz = 300Hz).

Harmonics Can Interfere With Other Equipment

Individually, the multiple frequencies of currents flow as sine waves, but they sum together in the phases to produce a distorted composite waveform. The peak current increases when harmonics are present, the rms current increases when harmonics are present and the current and voltage waveforms become distorted when harmonics flow in a system. Depending on the severity of the harmonics, true rms current can increase by as much as 40% above the fundamental frequency current. As true rms current increases, power losses increase, KVA demand increases, motors and transformers can overheat, equipment life decreases and total power factor decreases. Thus, harmonics has a negative impact on a facilities bottom line. Harmonics degrade the quality of system electrical power and can cause interference with other equipment along with equipment malfunctions.

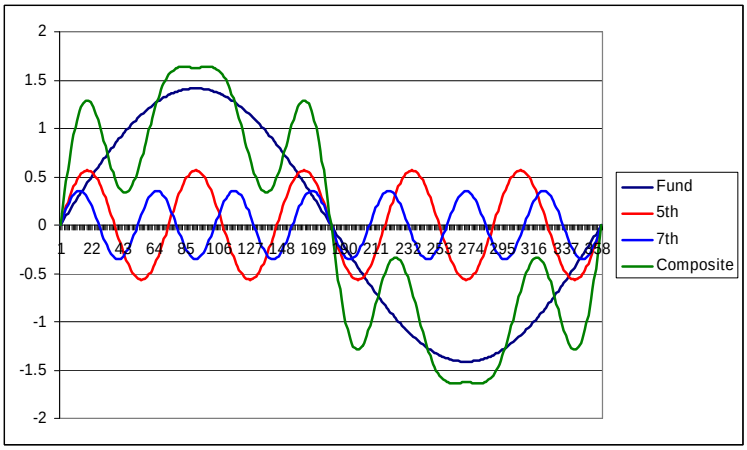


Fig. 1 - Distorted Waveform comprised of sine waves at several harmonic frequencies

A distorted waveform can be analyzed by transforming the complex (distorted) waveform into individual waveforms that are sine waves at frequencies higher than the fundamental (60Hz) frequency. The harmonic frequencies are typically odd numbers greater than 1 multiplied by the fundamental frequency (for 60Hz: 180hz, 300hz, etc). The multiple frequencies of sine waves can be directly added together to reconstruct the complex waveform. This is demonstrated by Fig. 1 above.

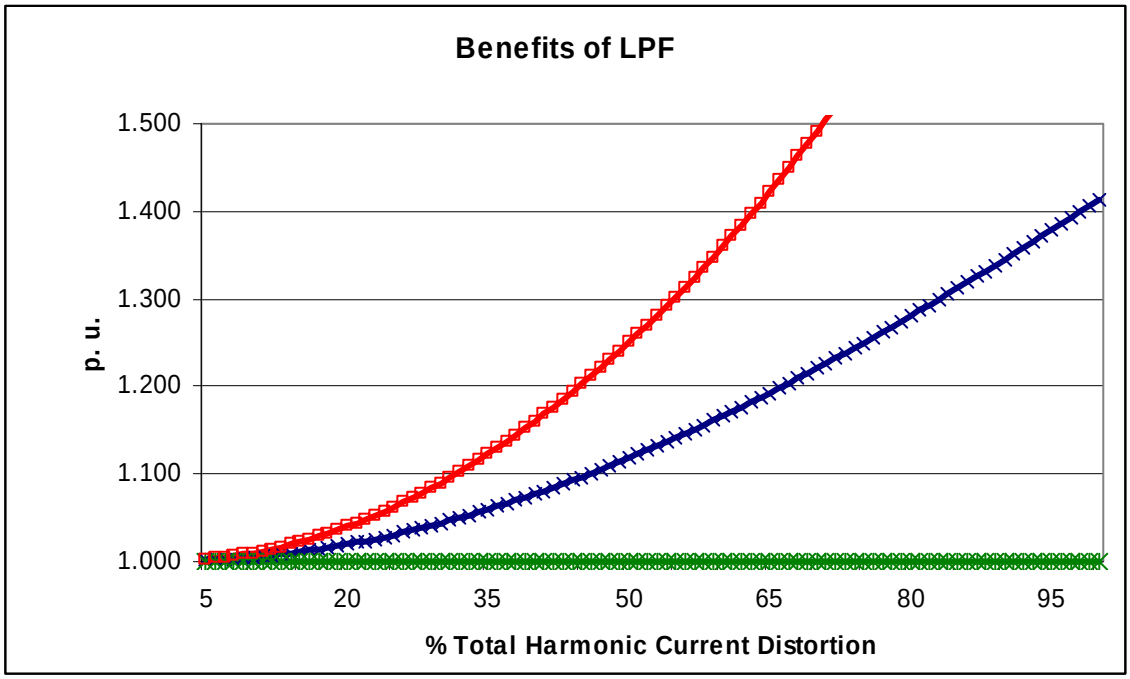
Harmonic Distortion Wastes Energy

One can easily see that when harmonics are present, there is more current flowing in the system. Every amp of current flowing through conductors, transformers and switchgear, contributes to increased system power losses. System power loses can increase by as much as 1-4% due to harmonics. By eliminating harmonic distortion, you will also reduce power system losses.

Benefits of Using ARTECHE Low Pass Harmonic Filters

ARTECHE LPF Reduces THD-I, True RMS Current, KVA Demand and I^2R Losses

When electronic loads distort the current waveform and cause harmonic currents to flow, the true rms current increases as does the KVA demanded from the power sources also increases. A standard adjustable speed motor drive can cause input harmonic current distortion from 30% to over 100%, depending on the power rating and system impedance. The following demonstrates that when harmonic current distortion is reduced to 5% THD-I or less, by using Arteche's Low Pass Harmonic Filters, the True RMS current is reduced significantly. This also reduces both the KVA demanded from the power source and the I^2R power losses of the upstream conductors and transformers. Transformer iron losses also reduce when Arteche's Low Pass Harmonic Filter is used.



Itrms, KVA, I^2R Losses (With LPF); Itrms & KVA (NO Filter); I^2R Losses (No Filter)

Carbon Footprint

The carbon imprint associated with electrical equipment is a function of the total KVA that must be generated to sustain and power this load. By reducing total harmonic current distortion to 5% or less, Arteche's Low Pass Harmonic Filter can substantially reduce the CO_2 footprint of your facility.

LPF CO_2 Footprint Example*

Condition	100HP VFD at 2080 hrs	500HP VFD at 2080 hrs
Without LPF	203 Tons CO_2	756 Tons CO_2
With LPF	143 Tons CO_2	684 Tons CO_2
CO_2 Reduction with LPF	**60 Tons CO_2**	**72 Tons CO_2**

* Based on 1MVA transformer rated 5% impedance. Using 124FLA (100HP) and 590FLA (500HP).

Product Technical Specifications

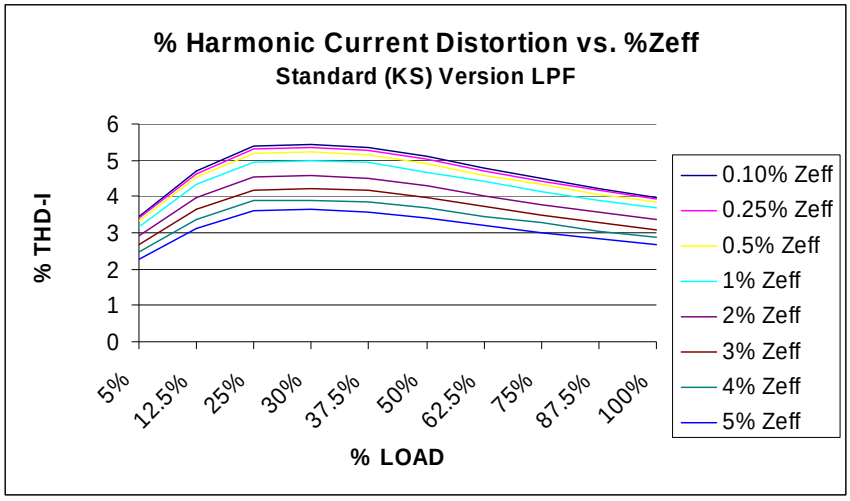
ELECTRICAL	
System Voltage	208-240, 380-415, 480, 600 and 690 volts
Voltage Tolerance	+/- 10%
Frequency	60Hz or 50Hz available
Phases	3-phase and 1-phase available
Input Current Ratings	3 to 3000 amps
Input power ratings	1.1kW to 2500kW (1.5HP to 3000HP)
Total Harmonic Current Distortion	≤ 5% THD-I (Type KS) 5% to 8% THD-i (Type KB when VFD has internal AC or DC reactor) 8% to 12% THD-i (Type KB when VFD has NO internal reactor)
Total Demand Distortion	Meets IEEE-519, Table 10.3
Total Harmonic Voltage Distortion	VFD at load typically contributes less than 2% THD-v to background voltage distortion
Voltage Regulation	+/- 5% (Output voltage from No Load to Full Load)
Efficiency	99% at rated load
Dielectric Strength	Reactors: 3000 volts (1min) Capacitors: 2 x rated + 1000 volts (1min)
Overload Capability	1.5 x rated current (1 minute, 1 time per hour)
Damping	Self damping reactors (no power resistors required)
Life Expectancy	> 480,000 hours at 50C, rated power
ENVIRONMENTAL	
Ventilation	Natural convection (No fans required)
Enclosures Available	Indoors, Industrial, Outdoors, Open Panels, Kits
Ambient Temperature	-30C to + 50C
Reduced kVA Demand	As much as 30% (when THD-i is reduced from 100% to 5%)
Reduced Current Demand	As much as 30% (when THD-i is reduced from 100% to 5%)
Potential Energy Savings	Typically by 1% to 4% (depending on transformer and conductors)
STANDARDS	
Underwriters Laboratories (UL)	Assemblies are UL-508A approved (600V and less) Components offered in kits are UL component recognized Complies with UL1531
IEC / EN	Complies with EN60289, EN60076-3
CE (Low Voltage Directive)	LVD certificate available
Harmonic Standards	Meets IEEE-519, AN-2279, EN 61000-3-2, EN-61000-3-12, G5/4

Note: There is no minimum source impedance requirement for Arteche Type LPF filters.

Product Performance Characteristics

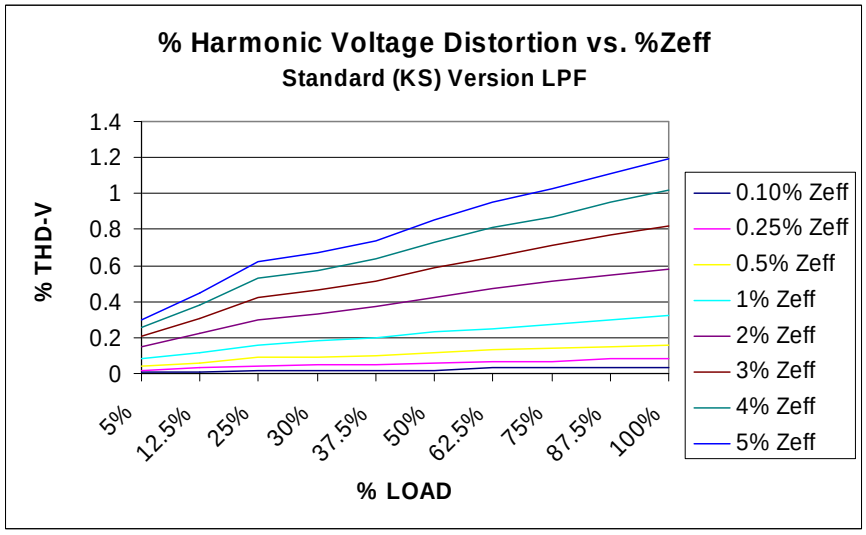
Harmonic Current Distortion

Arteche LPF filters offer the industry lowest THD-I and THD-v for any operating load condition (0% to 100% load). The contribution of THD-i for a given load, when filtered by our LPF will vary slightly depending on the effective source impedance. Standard (Type KS) filters are capable of maintaining 5% THD-I across the entire operating range from 0% to100% load. Distortion may be slightly higher for low impedance power sources.



Harmonic Voltage Distortion

VFDs equipped with Arteche standard (Type KS) LPF filters will typically add about 1% THD-v to the power system. The contribution of THD-v for a given load, when filtered by our LPF will vary slightly depending on the effective source impedance. Distortion may be slightly higher for high impedance power sources.



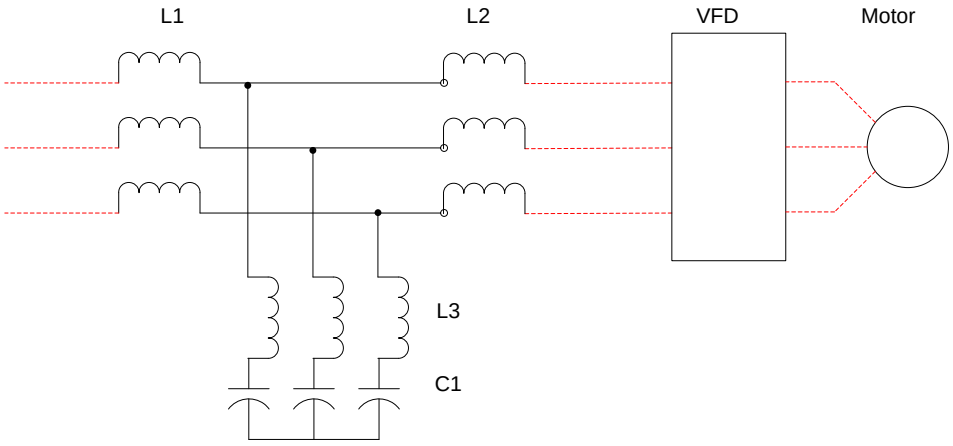
Voltage Regulation

Type LPF control the filter output voltage between +5% at No Load and -5% at full load.

Circuit Diagrams

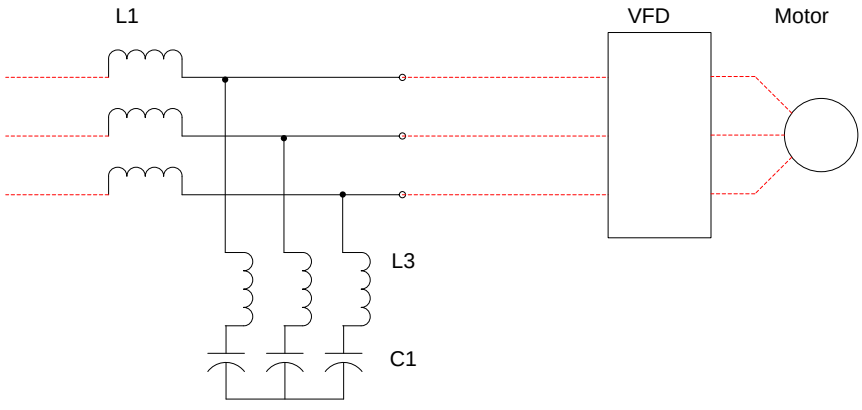
Circuit Diagram – Type KS

Use this filter to achieve ≤ 5% THD-I regardless of whether VFD has ac line reactor or dc choke. If VFD has internal inductance, you may only need to use KB style filter.



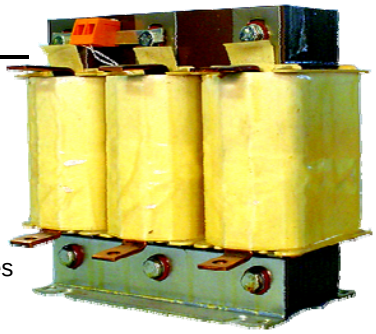
Circuit Diagram – Type KB

Use this filter for the following situations:
1) To achieve 5% - 8% THD-I when VFD has AC line reactor or DC link choke (minimum 3% impedance).
2) To achieve 8% -12% THD-1 when VFD does not have AC line reactor or DC link choke.



Major Component Specifications

Reactor Specifications



Inductance Tolerance:	+3% / -3% (balanced in all three phases)
Maximum Voltage:	600V (Except 690V filters)
Maximum Current:	125% of rated AC current, one minute
Power Loss:	0.4 watts per kVAr
Dielectric Strength	
Coil to coil:	3000V AC for one second
Coil to core:	3000V AC for one second
Core construction:	PolyGap™, Low audible noise, low harmonic losses
Impregnation:	Vacuum, overpressure varnish impregnation
Operating Temperature:	-40 degrees C to +50 degrees C
Over temperature Protection:	Temperature switch included in shunt reactor (center leg)
Life Expectancy:	Over 20 years at 40 degrees C operation
Terminals:	Copper
Agency Approval:	UL Component Recognized (File # E173113)

Capacitor Specifications

Capacitance Tolerance:	+4% / -4%
Maximum Voltage:	110% of rated AC voltage
Maximum Current:	135% of rated AC current
Power Loss:	0.4 watts per kVAr
Dielectric Strength	
Terminal to case:	2 x rated AC voltage + 1000 volts, for one second
Terminal to terminal:	1.75 x rated AC voltage for one second
Construction:	Impregnated Metalized Polypropylene (MPP)
Operating Temperature:	-40 degrees C to +80 degrees C
Life Expectancy:	Over 1,000,000 hours at 40 degrees C operation
Terminals:	Brass
Agency Approval:	UL Component Recognized (File # E71645)

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