

INSTRUCTION MANUAL

Low Pass Harmonic Filters Low Voltage

For 480V, 60Hz Filters

**This instruction manual applies only to
OEM Kit versions
(Types “KB” and “KS”)**

This is a kit form version of the low pass filter consisting of components only.

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1.0 PRIOR TO INSTALLATION

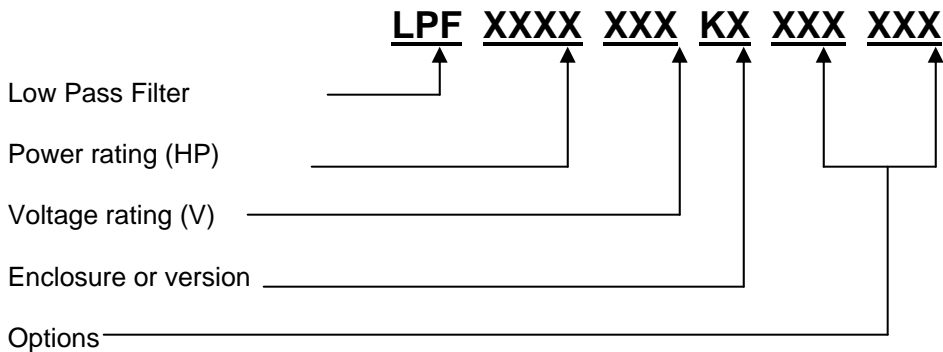
This manual is intended to serve the user as a general guide for the installation and maintenance of Low Pass Harmonic Filters.

The instruction manual must be read carefully before unpacking, installation and maintenance.

An outline drawing for each harmonic filter assembly is supplied to be used in conjunction with this instruction manual for installation purposes.

ARTECHE Low Pass Harmonic Filters are designed and intended for use with most six pulse rectifier units as found in variable frequency motor drives supplying variable torque loads such as fans and pumps. The customer is responsible for determining the filter suitability for their specific application and for installing, connecting, using and maintaining the filter in an appropriate manner and within its specifications.

1.1 Catalog Numbering System



Catalog No.Example:

A 250HP, 480V, Low Pass Harmonic Filter 2-stage filter Kit (L1, L3, C1 only) = **LPF 0250 480 KB**

A 50HP, 480V, Low Pass Harmonic Filter; 3-stage filter, Nema 1 (L1, L2, L3, C1) = **LPF 0050 480 KS N1**



SAFETY INSTRUCTIONS



!! CAUTION – High Voltage !!

WARNING - THE EQUIPMENT COVERED BY THIS PUBLICATION MUST BE SELECTED FOR A SPECIFIC APPLICATION AND MUST BE INSTALLED, OPERATED AND MAINTAINED BY QUALIFIED PERSONNEL WHO ARE THOROUGHLY TRAINED AND WHO UNDERSTAND ANY HAZARDS WHICH MAY BE INVOLVED. THIS MANUAL HAS BEEN WRITTEN FOR SUCH QUALIFIED PERSONNEL EXCLUSIVELY AND IS NOT INTENDED TO BE A SUBSTITUTE FOR ADEQUATE TRAINING IN SAFETY PROCEDURES FOR THIS TYPE OF EQUIPMENT.

WARNING – Only qualified electricians should handle the installation of this filter, otherwise electric shock or fire may occur.

CAUTION – Improper handling may cause mis-operation and reduce the life of the filter.

CAUTION – This manual should be given to the user of this product and should be kept in a safe place until the filter is removed from service.

WARNING – Disconnect all electrical power from the circuit into which the filter is being installed. Extreme caution must be taken to prevent contact with high voltage during installation, operation and service of this equipment. Accidental contact with high voltage can result in personal injury or death.

WARNING – This filter contains power capacitors which will store energy for a time period of up to five minutes. Using a voltmeter, confirm that the capacitor has entirely discharged as evidenced by zero voltage present between the capacitor terminals prior to performing installation, operation or service procedures. Accidental contact with energized parts may cause personal injury or death.

WARNING - There can be several live parts inside the filter while power is applied. Disconnect all electrical power to the circuit before installing or servicing the filter. Accidental contact with energized parts may cause personal injury or death.

WARNING – Observe torque requirements for all electrical connections. When making connection using crimp terminals, be sure to use the crimping tool recommended by the terminal manufacturer. Wire and cable connections having improper torque may cause fire.

WARNING – The ground terminal should always be connected to the ground using a conductor which is the same diameter (gauge) as the phase conductor. Lack of ground connection or improper grounding may result in electric shock or fire.

WARNING - Install filter in accordance with all applicable local electrical standards (NEC, etc). Failure to properly install filter in accordance with local electrical safety standards may cause electric shock, fire or service disruption.

WARNING – Install filter in an enclosure that will prevent accidental contact with live parts and by using proper wire sizes as dictated by local electrical safety standards. Accidental contact with energized parts may cause personal injury or death.

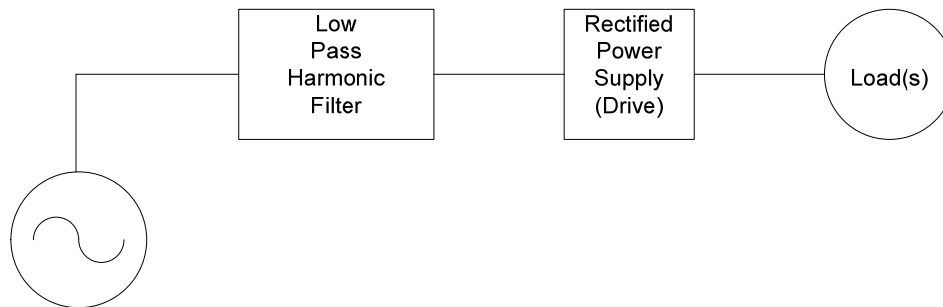
CAUTION – Install filter in an enclosure that will prevent foreign matter such as paper, lint, wood chips, metallic chips from contact with live parts, otherwise fire, personal injury or equipment mis-operation may occur.

We strongly recommend that the installation, operation and maintenance of this equipment be handled by an electrician engineer or technically qualified electrician with experience in electrical power equipment.

2.0 Theory of operation

ARTECHE Low Pass Harmonic Filters are designed and intended for use with most six pulse rectifier units as found in variable frequency motor drives supplying variable torque loads such as fans and pumps. The customer is responsible for determining the filter suitability for their specific application and for installing, connecting, using and maintaining the filter in an appropriate manner and within its specifications. Contact the factory for guidance in selection of filters for other types of loads (current source inverters, DC drives, variable voltage rectifiers, etc.).

The Low Pass Harmonic Filters are to be connected in series with and at the input to the non-linear load to be filtered. Only non-linear loads may be connected to the output terminals of the filter. Connection of linear loads to the filter output may cause mis-operation or premature failure of the load equipment. The low pass harmonic filter allows fundamental frequency current to flow easily to the load. This filter offers both sufficient impedance to minimize line current harmonics plus a tuned section to filter the 5th and 7th harmonics.



The KB version of the Low Pass Harmonic Filters offer filtering of all harmonic frequencies, similar to the standard Low Pass Harmonic Filter, except the number of reactors is reduced from three to two. This version is supplied without the output reactor (typically referred to as L2) and instead uses the internal inductance of a VFD, such as ac line reactor or dc bus choke to supply the near equivalent of the L2 inductor. Performance will vary depending on actual internal inductance value. The kit forms of the low pass filter are available for OEMs and are supplied as loose components for customer mounting and wiring in their own enclosure. Open panel or Nema enclosure construction are also available. The benefits of the KB version is fewer components to mount, lower cost and more compact space consumption.

| | | |
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| | INSTALLATION, OPERATION AND MAINTENANCE MANUAL FOR LOW VOLTAGE KIT Form Low Pass Harmonic Filters | Rev. 1 Sept. 30, 2007 Rev. 2: April 08, 2008 Rev. 3: Nov. 05, 2010 |
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All harmonic filters produced by ARTECHE are designed and assembled under quality standard ISO 9001, certified by UL (Underwriter's Laboratories). All harmonic filters produced by ARTECHE are suitable for field repair using original equipment replacement parts.

Application

Low Pass Harmonic Filters are always connected to the feeder line, and in series with one or more non-linear loads (only) which are within the maximum current rating of the filter.

The main objective of these devices is to minimize harmonic current and voltage distortion associated with power electronics equipment (motor drives, UPS, power supplies, etc) which are connected to an electrical power system.

All reactors and capacitors used in the Low Pass Harmonic Filters are UL and CUL approved.

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| | <p style="text-align: center;">INSTALLATION, OPERATION AND MAINTENANCE MANUAL FOR LOW VOLTAGE KIT Form Low Pass Harmonic Filters</p> | <p style="text-align: right;">Rev. 1 Sept. 30, 2007 Rev. 2: April 08, 2008 Rev. 3: Nov. 05, 2010</p> |
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3.0 Advantages of the Low Pass Harmonic Filter

Harmonic filters are field repairable using factory original parts from ARTECHE.

20 year design life expectancy on reactors and capacitors, with continuous operation.

Harmonic filters are manufactured with high quality capacitor cells made in United States and are suitable for use in a continuous ambient temperature of 80°C. Capacitor cells are constructed in aluminum cases filled with high performance and biodegradable dielectric fluid which is free of PBCs. Capacitors used in low pass harmonic filters are self-healing and self-protecting. In the event of an internal insulation breakdown, due to exposure to excessive voltage or overcurrent, capacitors will heal themselves but lose capacity gradually. A UL approved internal pressure sensitive switch interrupts the internal electrical connections before the case can rupture. The self healing and self protecting features eliminate the necessity for filter fuses.

Reactors are specially constructed using an exclusive technique called PolyGap™ core structure. This method uses numerous tiny air gaps in order to achieve superior saturation characteristics and minimizing harmonic losses and stray flux. Reactors have all been factory qualified under real life harmonic current conditions. Reactors are constructed with +/- 3% tolerance for inductance between all three phases and the nominal inductance value.

Optional circuit breakers or fuses are available to provide general control of the harmonic filter.

Low pass harmonic filters are designed for natural convection cooling, therefore fans are only required if the customer determines it is necessary for heat removal. It is the customer's responsibility to install the filter in a suitable and well ventilated enclosure. Refer to the Technical Data section for filter watts losses.

Transient voltage surge suppressors are available as an option.

4.0 Application of the Low Pass Harmonic Filters

The Low Pass Harmonic Filters can achieve extremely low levels of harmonic current and voltage distortion. With the following qualities and benefits.

- No controller necessary
- Metalized Capacitors, self-healing, self protecting
- Magnetic Contactors are optional
- Copper cables
- Fuses and circuit breakers are optional
- Can meet IEEE-519 harmonic distortion limits

ARTECHE Low Pass Harmonic Filters typically perform better than competitive products due to three factors:

- 1) Design – technique which uses more inductance and capacitance.
- 2) Reactor - inductance balance between all three phases and PolyGap™ core structure
- 3) Capacitor – specially constructed for harmonic environments and it is the only capacitor capable of operation at up to 85C temperature. Normal operation will be at much lower temperatures and will result in extremely long capacitor life.

ARTECHE Low Pass Harmonic Filters are designed with adequate internal inductance and therefore do not require additional reactors or line impedance to achieve harmonic reduction objectives.

5.0 Transportation and Handling

Harmonic filters may be damaged by mishandling. Always handle with care in an upright position. Be certain that no metal or conductive objects fall into the filter components or enclosure.

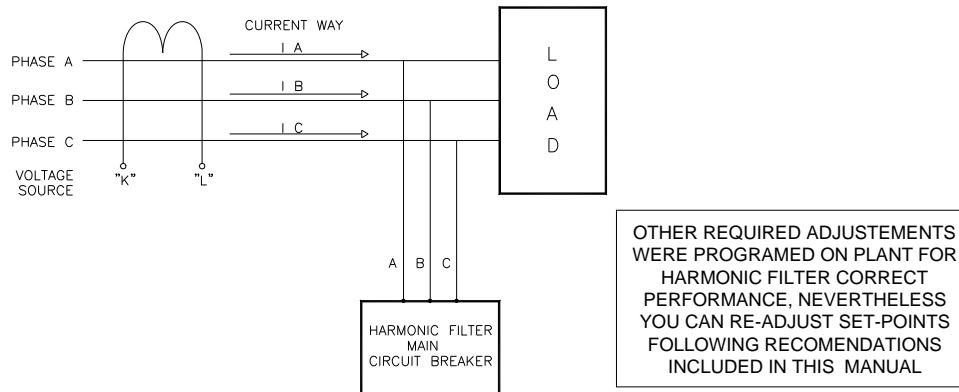
6.0 Installation

The place selected for the installation must have sufficient space around for a good air circulation. The filter enclosure is provided with perforations to be fixed on the floor. It is also provided with removable lifting eyes on the top for carrying and handling the filter with a crane.

- 6.1 Upon arrival, the packing list and shipment should be carefully checked for completeness. The crating must be examined for transit damage. In the event of visible transit damage, a claim must be filed immediately with the carrier.

In the event that the equipment is not installed immediately after arrival, it should be placed in intermediate storage without removing the packing. In this case, the crates are to be stored on a level area of sufficient strength to bear their weight and in a clean and non-corrosive atmosphere. If the intermediate storage is outdoors the period of storage must be limited to approximately 6 months, depending on the atmospheric conditions. This storage time will only affect the wooden packing and will not affect Capacitor cells.

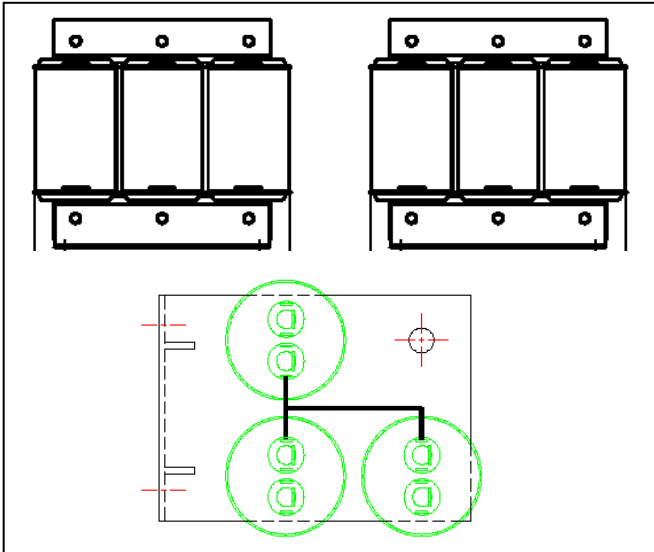
- 6.2 Capacitors should be located in a ventilated area; Nema enclosed filters are intended for either Indoor or Outdoor (in case NEMA 3R) use and must be installed according to level of enclosure protection as provided. It must be installed only for electrical trained and qualified personal. It is recommended to fix the equipment to the floor with adequate bolts.
- 6.3 Harmonic filters are provided with terminals or lugs to receive feeders and grounding conductors. To connect the filter is just necessary to introduce the conductors into the lugs and tighten fitting it. Always start grounding the detuned capacitor and after connecting feeder conductors.
- 6.4 Conduit sizes, tray sizes and cable's ampacity must be according National Electrical Code or applicable electrical codes in your area.
- 6.5 Capacitor enclosure is provided, for connection cables, with TOP (need to cut) and SIDE (need to cut) entry for conduit or tray. Next figure shows these connection entries in enclosures.
- 6.6 **Once the filter has been mechanically installed, verify the torques of all the electrical connections. Make sure the equipment is properly connected to ground using the grounding terminal provided. See Torque Table on Page 12.**
- 6.7 With the aid of a phase sequence indicator, verify the phase sequence of your electrical installation to identify a positive phases sequence A, B and C, or R, S and T or 1, 2 and 3.



- 6.8 Proceed to connect the feeder cables to the main switch, being assured of preserving the positive sequence during the connection (see Figure 1 for better comprehension). This operation will have to be accomplished with the equipment completely without energy.

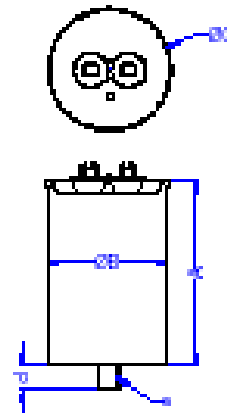
6.9 Component mounting:

Components should be mounted in such a manner that allows the capacitors to be located beneath the reactors so that reactor heat does not directly contribute to capacitor temperature. Reactors may be mounted on either a horizontal or vertical panel. If mounted on a vertical panel, the best heat dissipation and coil temperature control will be achieved when reactors are mounted in the horizontal plane so each coil is to the left or right of each other coil.



Suggested component layout

Capacitors are supplied as individual single phase capacitor cells.

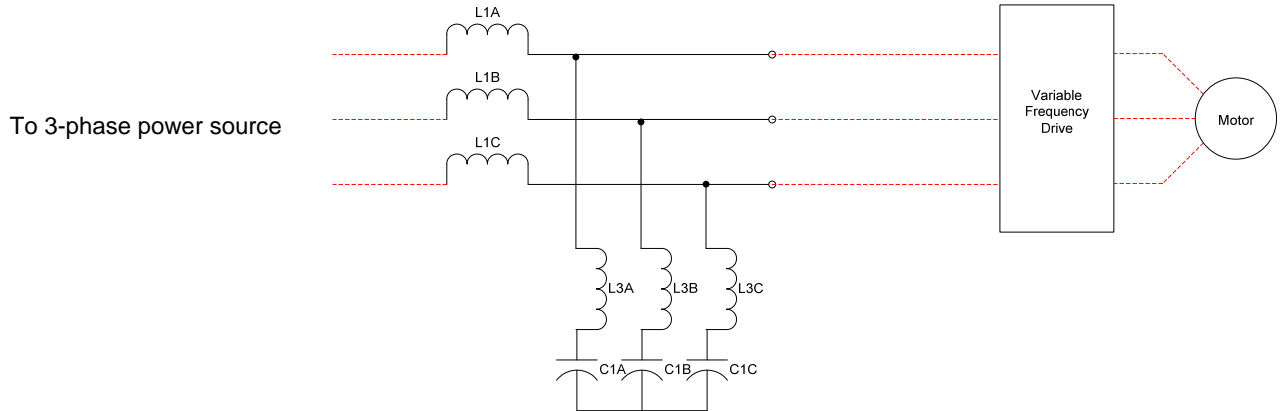


!! Never energize the circuit while installing the Current Transformer if the leads of the secondary are not connected to its terminals or adequately shorted circuit !!

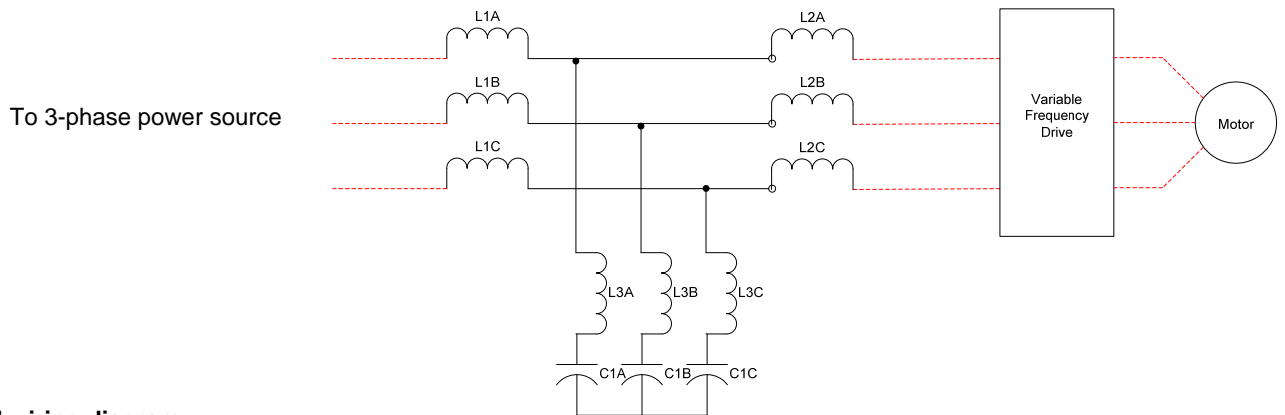


7.0 Connection:

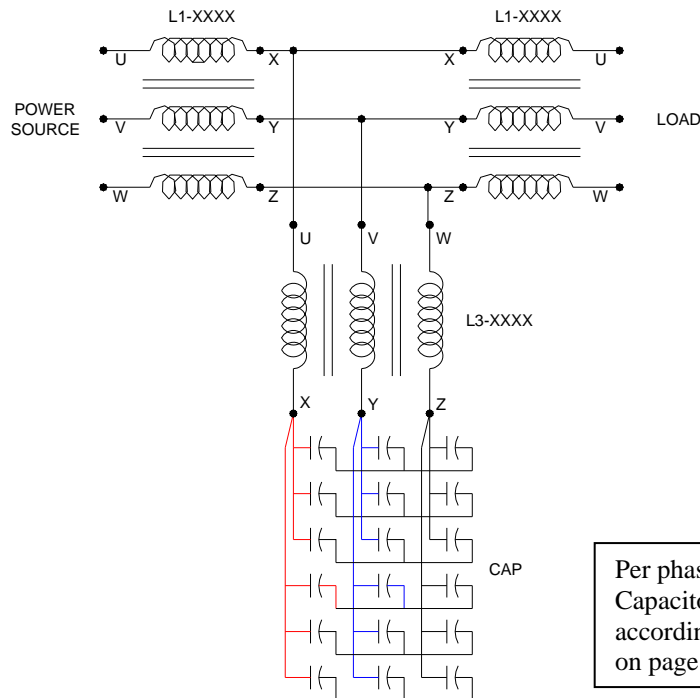
Version KB



Version KS



General wiring diagram



Per phase
 Capacitors
 according to chart
 on page 16.

ii Never energize the circuit while installing the Current Transformer if the leads of the secondary are not connected to its terminals or adequately shorted circuit !!



7.1 Verify torque it of all the terminals (reactors, fuses, contactors, etc..), they could have loosened during transportation. See table.

| Bolt Diameter | TPI | <i>ASTM A193 GR B7, B8, B16, B8M bolting & K-500 monel</i> with a bolt stress of 60,000 PSI |
|---------------|-----|--|
| 1/4 | 20 | 14 |
| 5/16 | 18 | 21 |
| 3/8 | 16 | 30 |
| 7/16 | 14 | 45 |
| 1/2 | 13 | 65 |
| 9/16 | 12 | 95 |
| 5/8 | 11 | 135 |
| 3/4 | 10 | 230 |
| 7/8 | 9 | 360 |
| 1 | 8 | 535 |
| 1 1/8 | 8 | 815 |
| 1 1/4 | 8 | 1,125 |
| 1 3/8 | 8 | 1525 |
| 1 1/2 | 8 | 1900 |
| 1 5/8 | 8 | 2540 |
| 1 3/4 | 8 | 3240 |
| 1 7/8 | 8 | 4075 |
| 2 | 8 | 4990 |
| 2 1/4 | 8 | 6665 |
| 2 1/2 | 8 | 8525 |
| 2 5/8 | 8 | 9525 |
| 2 3/4 | 8 | 10525 |
| 3 | 8 | 13760 |

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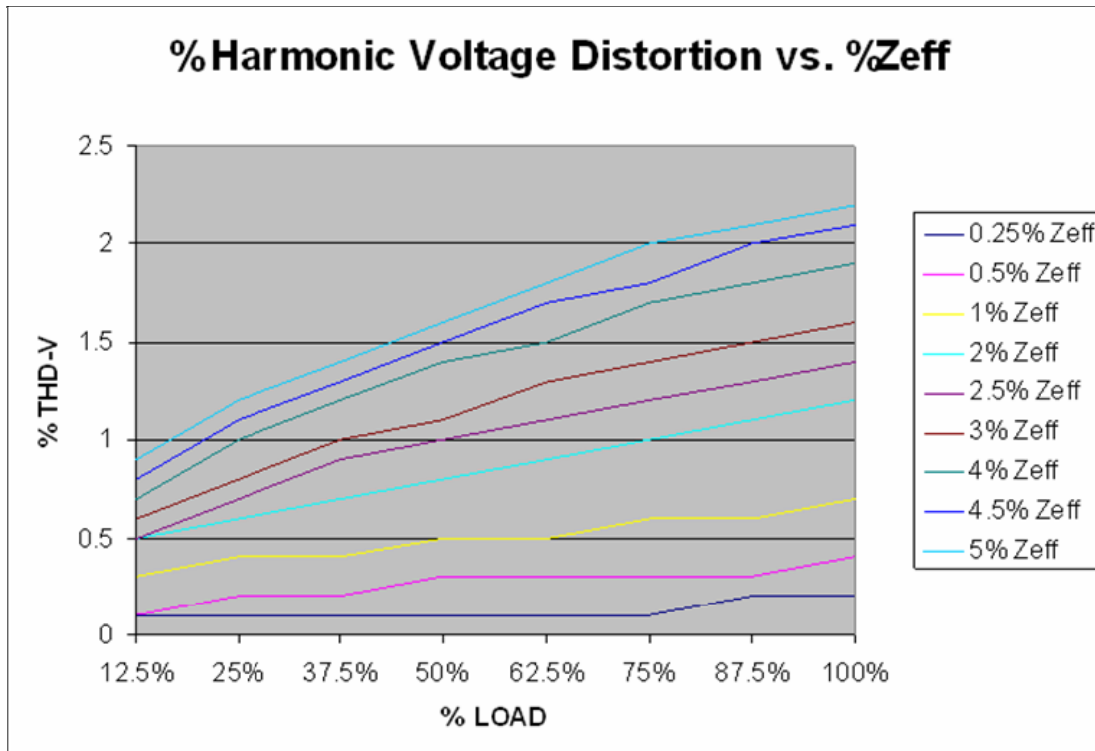
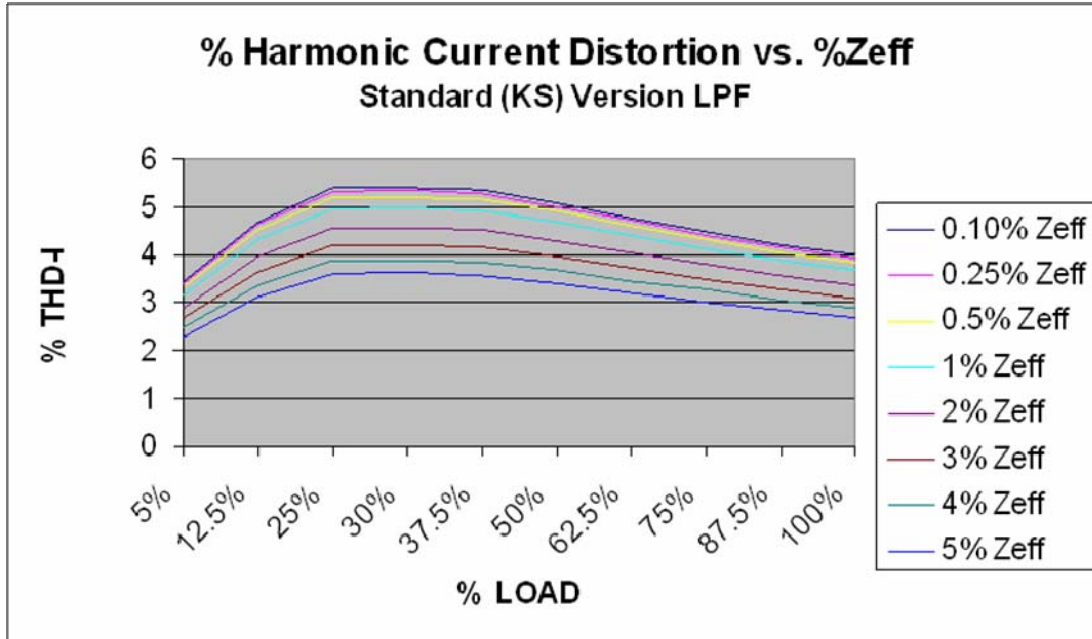
8.0 Specifications:

| | |
|---|--|
| System Voltage: | 480 Volts rms (L-L), 3-phase. Also available in 200, 208, 220, 240, 380, 400, 415, 440, 480, 600, 660, 690. |
| System Voltage tolerance: | + / - 5% |
| System Voltage unbalance: | up to 3% line voltage unbalance (note: THD-I will increase above normal levels when line voltage is unbalanced) |
| Frequency: | 50HZ +/- 1Hz or 60hz, +/- 1hz available as separate kits |
| Effective source impedance: | |
| Utility - 0.1% to 6% | => 3.5% to 5% voltage boost at output terminals |
| Generator - 10% to 15% | => 6% to 8% voltage boost at output terminals |
| Loads: | Non-linear loads only, ratings per selection table |
| Service Factor: | |
| Voltage source inverters | 1.0 x maximum ampere rating |
| Current source inverters | 0.7 x maximum ampere rating |
| Power losses: | 1% typical |
| Altitude: | 1000 meters maximum |
| Relative Humidity: | 95% maximum |
| Harmonics attenuated: | 3 rd – 50 th |
| Residual harmonic current distortion: KS version | Typical contribution of harmonic current distortion at full load is 5%THD-i. |
| Residual harmonic distortion: KB version when VFD has internal AC or DC reactor. | Typical contribution of harmonic current distortion at full load is 5%THD-I, but varies depending on the electrical parameters of the internal reactor in the VFD. |
| Residual harmonic distortion: KB Version without any AC or DC reactor | Typical contribution of harmonic current distortion at full load is 8%THD-i to 10% THD-I,. |
| IEEE – 519 Compliance: | Guaranteed for all I_{sc}/I_L ratios when using “KS” version filter. |

* Guarantee applies for complete filter (L1, L2, L3 and C1 components) with voltage unbalance up to 0.5% and voltage distortion (by other loads) up to 0.5%.

8.1 Performance of Harmonic Filter at various system conditions and loads.

Residual current distortion is a function of system impedance, load current and pre-existing voltage distortion on electrical supply. The contribution of harmonic distortion by VFD(s) outfitted with the Low Pass Harmonic Filter is depicted in the following to graphs.



9.0 Technical Data: Component Selection and Capacitor Data

| 480 60 HP | Reactors | | Capacitor Cells per Phase | | | | | | Total Capacitor Cells | Capacitor Data | | | |
|-----------------|----------|---------|---------------------------|---------|---------|---------|---------|---------|-----------------------------|----------------|--------|--------|--------|
| | L1/L2 | L3 | C1-3001 | C1-3002 | C1-2001 | C1-3004 | C1-2003 | C1-2004 | | Total | Xc | Ic | Max |
| | series | shunt | 480 | 480 | 346 | 480 | 346 | 346 | | uF | (ohms) | (amps) | (amps) |
| HP | ID | ID | 11.9uF | 19.9uF | 38.5uF | 49.9uF | 57.0uF | 72.1uF | | | | | |
| 2 | L1-1003 | L3-3002 | 1 | | | | | | 3 | 11.9 | 222.9 | 1.2 | 1.7 |
| 4 | L1-1006 | L3-3005 | | 1 | | | | | 3 | 19.9 | 133.3 | 2.1 | 2.8 |
| 5 | L1-1007 | L3-3006 | 2 | | | | | | 6 | 23.8 | 111.5 | 2.5 | 3.4 |
| 7.5 | L1-1008 | L3-3008 | | | 1 | | | | 3 | 38.5 | 68.9 | 4.0 | 5.4 |
| 10 | L1-1010 | L3-3010 | | | | | 1 | | 3 | 57.0 | 46.5 | 6.0 | 8.0 |
| 15 | L1-1011 | L3-3011 | | | | | | 1 | 3 | 72.1 | 36.8 | 7.5 | 10.2 |
| 20 | L1-1012 | L3-3013 | | 1 | | | | 1 | 6 | 92.0 | 28.8 | 9.6 | 13.0 |
| 25 | L1-1013 | L3-3015 | | | | | 2 | | 6 | 114.0 | 23.3 | 11.9 | 16.1 |
| 30 | L1-1014 | L3-3018 | | | | | | 2 | 6 | 144.2 | 18.4 | 15.1 | 20.3 |
| 40 | L1-1016 | L3-3021 | | 2 | | | | 2 | 12 | 184.0 | 14.4 | 19.2 | 26.0 |
| 50 | L1-1018 | L3-3022 | | | | | | 3 | 9 | 216.3 | 12.3 | 22.6 | 30.5 |
| 60 | L1-1019 | L3-3025 | | | 1 | | | 3 | 12 | 254.8 | 10.4 | 26.6 | 35.9 |
| 75 | L1-1020 | L3-3027 | | 1 | | | | 4 | 15 | 308.3 | 8.60 | 32.2 | 43.5 |
| 100 | L1-1021 | L3-3029 | | | | | | 1 | 5 | 417.5 | 6.35 | 43.6 | 58.9 |
| 125 | L1-1022 | L3-3030 | 2 | | | | | 7 | 27 | 528.5 | 5.02 | 55.2 | 74.5 |
| 150 | L1-1023 | L3-3032 | | | | | 1 | 8 | 27 | 633.8 | 4.19 | 66.2 | 89.4 |
| 200 | L1-1025 | L3-3034 | | | | | | 12 | 36 | 865.2 | 3.07 | 90.4 | 122.0 |
| 250 | L1-1026 | L3-3035 | | | | | | 14 | 42 | 1009.4 | 2.63 | 105.5 | 142.4 |
| 300 | L1-1027 | L3-3036 | | | | | | 17 | 51 | 1225.7 | 2.16 | 128.1 | 172.9 |
| 350 | L1-1028 | L3-3038 | | | | | | 20 | 60 | 1442.0 | 1.84 | 150.7 | 203.4 |
| 400 | L1-1029 | L3-3039 | | | | | | 23 | 69 | 1658.3 | 1.60 | 173.3 | 233.9 |
| 450 | L1-1030 | L3-3040 | | | | | | 26 | 78 | 1874.6 | 1.42 | 195.9 | 264.4 |
| 500 | L1-1031 | L3-3042 | | | | | | 28 | 84 | 2018.8 | 1.31 | 210.9 | 284.7 |
| 600 | L1-1032 | L3-3045 | | | | | | 34 | 102 | 2451.4 | 1.08 | 256.1 | 345.8 |
| 700 | L1-1033 | L3-3047 | | | | | | 40 | 120 | 2884 | 0.92 | 301.3 | 406.8 |
| 800 | L1-1034 | L3-3048 | | | | | | 45 | 135 | 3244.5 | 0.82 | 339.0 | 457.6 |
| 900 | L1-1035 | L3-3049 | | | | | | 51 | 153 | 3677.1 | 0.72 | 384.2 | 518.6 |
| 1000 | L1-1036 | L3-3050 | | | | | | 57 | 171 | 4109.7 | 0.65 | 429.4 | 579.7 |

9.1 Technical Data

Load and power loss data

| HP | Catalog Number | Max. Load (Amperes) | Power Loss (Watts) "KB" | Power Loss (Watts) "KS" | Capacitor Amps (60Hz) | Capacitor kVAr |
|------|-----------------|------------------------|----------------------------------|----------------------------------|-----------------------------|-------------------|
| 2 | LPF 0002 480 KB | 4 | 51 | 81 | 1.2 | 1 |
| 4 | LPF 0004 480 KB | 5.8 | 81 | 131 | 2.1 | 1.7 |
| 5 | LPF 0005 480 KB | 6.6 | 81 | 131 | 2.5 | 2 |
| 7.5 | LPF 0007 480 KB | 8 | 122 | 192 | 4.0 | 3.3 |
| 10 | LPF 0010 480 KB | 12.8 | 163 | 253 | 6.0 | 5 |
| 15 | LPF 0015 480 KB | 19 | 183 | 283 | 7.5 | 6.3 |
| 20 | LPF 0020 480 KB | 24 | 204 | 314 | 9.6 | 8 |
| 25 | LPF 0025 480 KB | 31 | 224 | 344 | 12 | 10 |
| 30 | LPF 0030 480 KB | 48 | 265 | 415 | 15 | 12.5 |
| 40 | LPF 0040 480 KB | 61 | 297 | 457 | 19 | 16 |
| 50 | LPF 0050 480 KB | 72 | 318 | 498 | 23 | 19 |
| 60 | LPF 0060 480 KB | 84 | 367 | 567 | 27 | 22 |
| 75 | LPF 0075 480 KB | 102 | 411 | 641 | 32 | 27 |
| 100 | LPF 0100 480 KB | 138 | 515 | 805 | 44 | 36 |
| 125 | LPF 0125 480 KB | 175 | 639 | 999 | 55 | 46 |
| 150 | LPF 0150 480 KB | 210 | 742 | 1182 | 66 | 55 |
| 200 | LPF 0200 480 KB | 286 | 900 | 1400 | 90 | 75 |
| 250 | LPF 0250 480 KB | 334 | 956 | 1506 | 106 | 88 |
| 300 | LPF 0300 480 KB | 406 | 1153 | 1813 | 128 | 107 |
| 350 | LPF 0350 480 KB | 478 | 1320 | 2030 | 151 | 125 |
| 400 | LPF 0400 480 KB | 550 | 1498 | 2358 | 173 | 144 |
| 450 | LPF 0450 480 KB | 623 | 1773 | 2723 | 196 | 163 |
| 500 | LPF 0500 480 KB | 670 | 1820 | 2870 | 211 | 175 |
| 600 | LPF 0600 480 KB | 809 | 2115 | 3365 | 256 | 213 |
| 700 | LPF 0700 480 KB | 952 | 2430 | 3693 | 301 | 250 |
| 800 | LPF 0800 480 KB | 1070 | 2693 | 4393 | 339 | 282 |
| 900 | LPF 0900 480 KB | 1213 | 3488 | 5688 | 384 | 320 |
| 1000 | LPF 1000 480 KB | 1356 | 4214 | 6914 | 430 | 358 |

9.2 Technical Data Component Dimensions:

The components supplied in the **KB filter** configuration include inductor L1, inductor L3 and capacitor cells C1.

The components supplied in the **KS filter** configuration include inductors L1 and L2, inductor L3 and capacitor cells C1.

L1 and L2 are the exact same reactors and have identical part numbers and ratings.

L1 (L2) Inductor
L3 Inductor

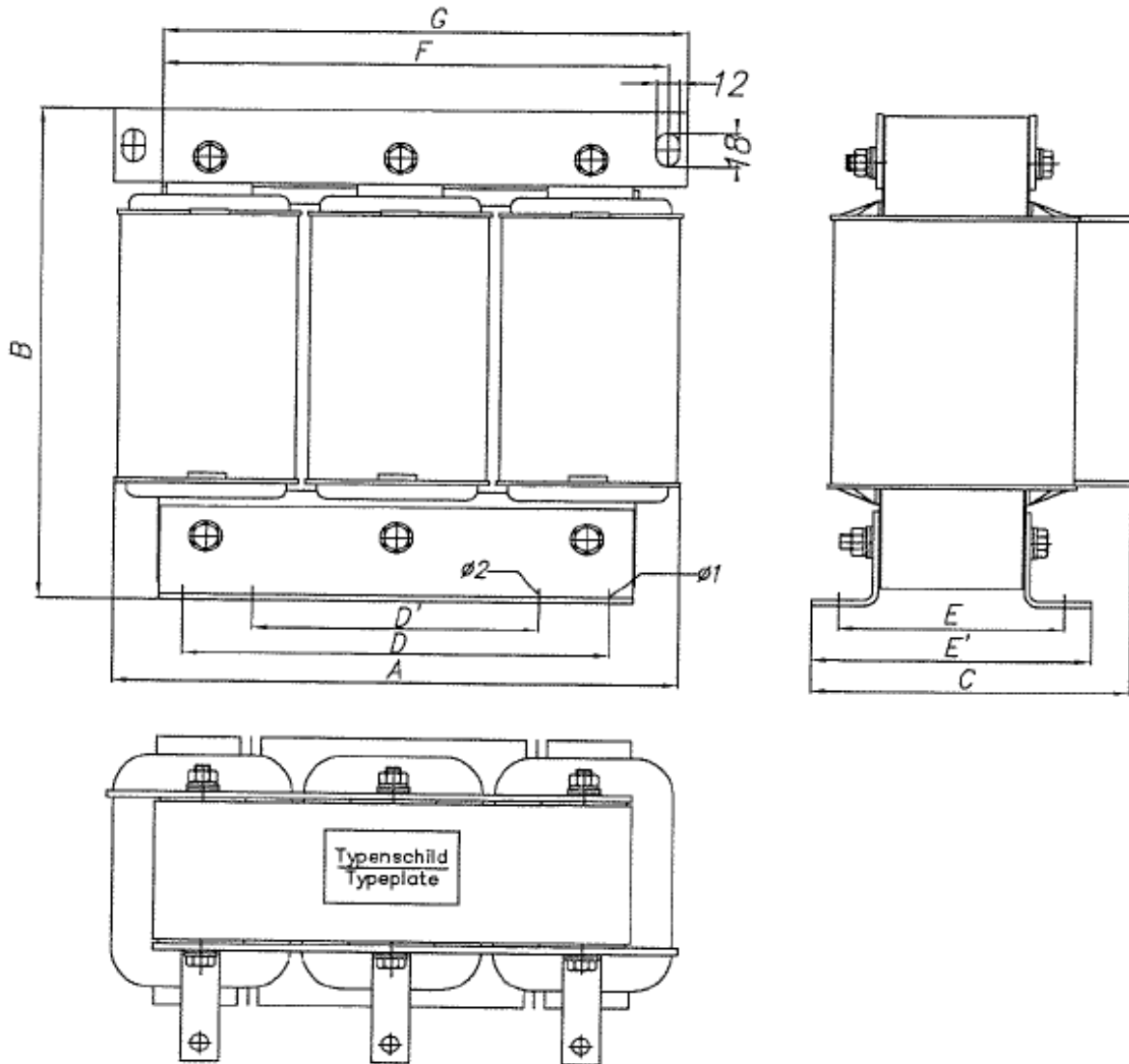


Fig. 1

Reactor dimensions:

L1 and L2 (Series) Reactor dimensions (inches) – Refer to Fig. 1

| KW | Catalog Number | Reactor Part No. | A | B | C | D | D' | E | E' | Ø1 | Ø2 | Weight (LB) |
|------|-----------------|------------------|-------|-------|-------|-------|------|------|-------|----|----|-------------|
| 2 | LPF 0002 480 KB | L1-1003 | 9.06 | 8.07 | 4.53 | 6.93 | 5.91 | 2.80 | 3.54 | | | 24 |
| 4 | LPF 0004 480 KB | L1-1006 | 9.06 | 8.07 | 4.53 | 6.93 | 5.91 | 2.80 | 3.54 | | | 24 |
| 5 | LPF 0005 480 KB | L1-1007 | 9.06 | 8.07 | 4.53 | 6.93 | 5.91 | 2.80 | 3.54 | | | 24 |
| 7.5 | LPF 0007 480 KB | L1-1008 | 9.06 | 8.07 | 4.53 | 6.93 | 5.91 | 2.80 | 3.54 | | | 26 |
| 10 | LPF 0010 480 KB | L1-1010 | 9.06 | 8.07 | 4.53 | 6.93 | 5.91 | 2.80 | 3.54 | | | 26 |
| 15 | LPF 0015 480 KB | L1-1011 | 9.06 | 8.07 | 4.53 | 6.93 | 5.91 | 2.80 | 3.54 | | | 31 |
| 20 | LPF 0020 480 KB | L1-1012 | 9.06 | 8.07 | 5.51 | 6.93 | 5.91 | 3.74 | 4.49 | | | 40 |
| 25 | LPF 0025 480 KB | L1-1013 | 9.45 | 8.27 | 5.51 | 7.28 | 5.91 | 3.66 | 4.45 | | | 44 |
| 30 | LPF 0030 480 KB | L1-1014 | 10.43 | 9.45 | 6.10 | 7.87 | 5.91 | 4.02 | 5.20 | | | 57 |
| 40 | LPF 0040 480 KB | L1-1016 | 10.43 | 9.45 | 6.10 | 7.87 | 5.91 | 4.02 | 5.20 | | | 62 |
| 50 | LPF 0050 480 KB | L1-1018 | 11.81 | 9.45 | 6.69 | 8.82 | 5.91 | 4.69 | 5.79 | | | 75 |
| 60 | LPF 0060 480 KB | L1-1019 | 11.81 | 10.63 | 6.69 | 8.82 | 5.91 | 4.69 | 5.79 | | | 84 |
| 75 | LPF 0075 480 KB | L1-1020 | 11.81 | 10.63 | 7.28 | 8.82 | 5.91 | 5.28 | 6.38 | | | 97 |
| 100 | LPF 0100 480 KB | L1-1021 | 11.81 | 11.81 | 7.28 | 8.82 | 5.91 | 5.28 | 6.38 | | | 110 |
| 125 | LPF 0125 480 KB | L1-1022 | 14.17 | 13.98 | 8.27 | 10.39 | - | 6.10 | 7.20 | | | 152 |
| 150 | LPF 0150 480 KB | L1-1023 | 16.54 | 14.96 | 9.45 | 12.44 | - | 6.93 | 8.11 | | | 198 |
| 200 | LPF 0200 480 KB | L1-1025 | 16.54 | 16.14 | 9.06 | 12.44 | - | 6.93 | 8.11 | | | 229 |
| 250 | LPF 0250 480 KB | L1-1026 | 16.54 | 18.50 | 10.63 | 12.44 | - | 8.11 | 9.29 | | | 293 |
| 300 | LPF 0300 480 KB | L1-1027 | 16.54 | 18.50 | 9.84 | 12.44 | - | 6.93 | 8.11 | | | 271 |
| 350 | LPF 0350 480 KB | L1-1028 | 16.54 | 25.59 | 11.02 | 12.44 | - | 8.11 | 9.29 | | | 345 |
| 400 | LPF 0400 480 KB | L1-1029 | 18.90 | 25.59 | 12.20 | 13.98 | - | 8.39 | 9.84 | | | 407 |
| 450 | LPF 0450 480 KB | L1-1030 | 18.90 | 25.59 | 12.20 | 13.98 | - | 8.39 | 9.84 | | | 515 |
| 500 | LPF 0500 480 KB | L1-1031 | 18.90 | 25.59 | 12.20 | 13.98 | - | 8.39 | 9.84 | | | 521 |
| 600 | LPF 0600 480 KB | L1-1032 | 16.54 | 25.20 | 11.02 | 12.44 | - | 8.11 | 9.29 | | | 442 |
| 700 | LPF 0700 480 KB | L1-1033 | 16.54 | 25.20 | 11.02 | 12.44 | - | 8.11 | 9.29 | | | 475 |
| 800 | LPF 0800 480 KB | L1-1034 | 18.90 | 25.59 | 12.20 | 13.98 | - | 8.39 | 9.84 | | | 557 |
| 900 | LPF 0900 480 KB | L1-1035 | 18.90 | 25.59 | 13.78 | 13.98 | - | 8.39 | 11.14 | | | 680 |
| 1000 | LPF 1000 480 KB | L1-1036 | 18.90 | 25.98 | 17.72 | 13.98 | - | 9.69 | 11.14 | | | 682 |

L3 (Shunt) Reactor dimensions (inches) – Refer to Fig. 1

| KW | Catalog Number | Reactor Part No. | A | B | C | D | D' | E | E' | Ø1 | Ø2 | Weight (LB) |
|------|-----------------|------------------|-------|-------|-------|-------|------|------|-------|----|----|-------------|
| 2 | LPF 0002 480 KB | L3-3002 | 9.06 | 8.07 | 4.53 | 6.93 | 5.91 | 2.80 | 3.54 | | | 24 |
| 4 | LPF 0004 480 KB | L3-3005 | 9.06 | 8.07 | 4.53 | 6.93 | 5.91 | 2.80 | 3.54 | | | 24 |
| 5 | LPF 0005 480 KB | L3-3006 | 9.06 | 8.07 | 4.53 | 6.93 | 5.91 | 2.80 | 3.54 | | | 24 |
| 7.5 | LPF 0007 480 KB | L3-3008 | 9.06 | 8.07 | 4.53 | 6.93 | 5.91 | 2.80 | 3.54 | | | 24 |
| 10 | LPF 0010 480 KB | L3-3010 | 9.06 | 8.07 | 4.53 | 6.93 | 5.91 | 2.80 | 3.54 | | | 24 |
| 15 | LPF 0015 480 KB | L3-3011 | 9.06 | 8.07 | 4.53 | 6.93 | 5.91 | 2.80 | 3.54 | | | 24 |
| 20 | LPF 0020 480 KB | L3-3013 | 9.06 | 8.07 | 4.53 | 6.93 | 5.91 | 2.80 | 3.54 | | | 27 |
| 25 | LPF 0025 480 KB | L3-3015 | 9.06 | 8.07 | 4.53 | 6.93 | 5.91 | 2.80 | 3.54 | | | 27 |
| 30 | LPF 0030 480 KB | L3-3018 | 9.06 | 8.07 | 4.53 | 6.93 | 5.91 | 2.80 | 3.54 | | | 29 |
| 40 | LPF 0040 480 KB | L3-3021 | 9.06 | 8.07 | 5.51 | 6.93 | 5.91 | 3.74 | 4.49 | | | 40 |
| 50 | LPF 0050 480 KB | L3-3022 | 9.06 | 8.07 | 5.51 | 6.93 | 5.91 | 3.74 | 4.49 | | | 40 |
| 60 | LPF 0060 480 KB | L3-3025 | 9.45 | 8.27 | 5.51 | 7.28 | 5.91 | 3.66 | 4.54 | | | 42 |
| 75 | LPF 0075 480 KB | L3-3027 | 9.45 | 8.27 | 5.91 | 7.28 | 5.91 | 4.06 | 4.84 | | | 49 |
| 100 | LPF 0100 480 KB | L3-3029 | 10.43 | 9.45 | 6.10 | 7.87 | 5.91 | 4.02 | 5.20 | | | 60 |
| 125 | LPF 0125 480 KB | L3-3030 | 11.81 | 10.63 | 6.69 | 8.82 | 5.91 | 4.68 | 5.79 | | | 82 |
| 150 | LPF 0150 480 KB | L3-3032 | 11.81 | 10.63 | 7.28 | 8.82 | 5.91 | 5.28 | 6.38 | | | 95 |
| 200 | LPF 0200 480 KB | L3-3034 | 11.81 | 12.99 | 7.28 | 8.82 | 5.91 | 5.28 | 6.38 | | | 115 |
| 250 | LPF 0250 480 KB | L3-3035 | 11.81 | 12.99 | 7.28 | 8.82 | 5.91 | 5.28 | 6.38 | | | 121 |
| 300 | LPF 0300 480 KB | L3-3036 | 14.17 | 13.98 | 8.27 | 10.39 | - | 6.10 | 7.20 | | | 152 |
| 350 | LPF 0350 480 KB | L3-3038 | 16.54 | 16.14 | 9.06 | 12.44 | - | 6.93 | 8.11 | | | 211 |
| 400 | LPF 0400 480 KB | L3-3039 | 16.54 | 16.14 | 9.45 | 12.44 | - | 6.93 | 8.11 | | | 220 |
| 450 | LPF 0450 480 KB | L3-3040 | 16.54 | 14.96 | 10.63 | 12.44 | - | 8.11 | 9.29 | | | 264 |
| 500 | LPF 0500 480 KB | L3-3042 | 16.54 | 16.14 | 10.24 | 12.44 | - | 8.11 | 9.29 | | | 284 |
| 600 | LPF 0600 480 KB | L3-3045 | 18.89 | 16.93 | 10.04 | 14.02 | - | 7.09 | 9.29 | | | 293 |
| 700 | LPF 0700 480 KB | L3-3047 | 16.54 | 25.2 | 11.2 | 12.44 | - | 8.11 | 9.29 | | | 330 |
| 800 | LPF 0800 480 KB | L3-3048 | 16.54 | 25.2 | 11.2 | 12.44 | - | 8.11 | 9.29 | | | 341 |
| 900 | LPF 0900 480 KB | L3-3049 | 18.89 | 25.6 | 12.2 | 13.78 | - | 9.84 | 11.14 | | | 497 |
| 1000 | LPF 1000 480 KB | L3-3050 | 18.89 | 25.6 | 12.2 | 13.78 | - | 9.84 | 11.14 | | | 541 |

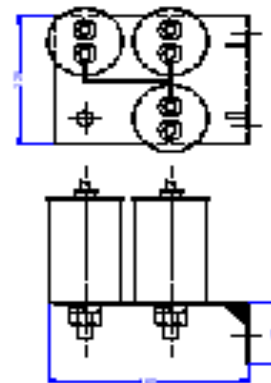
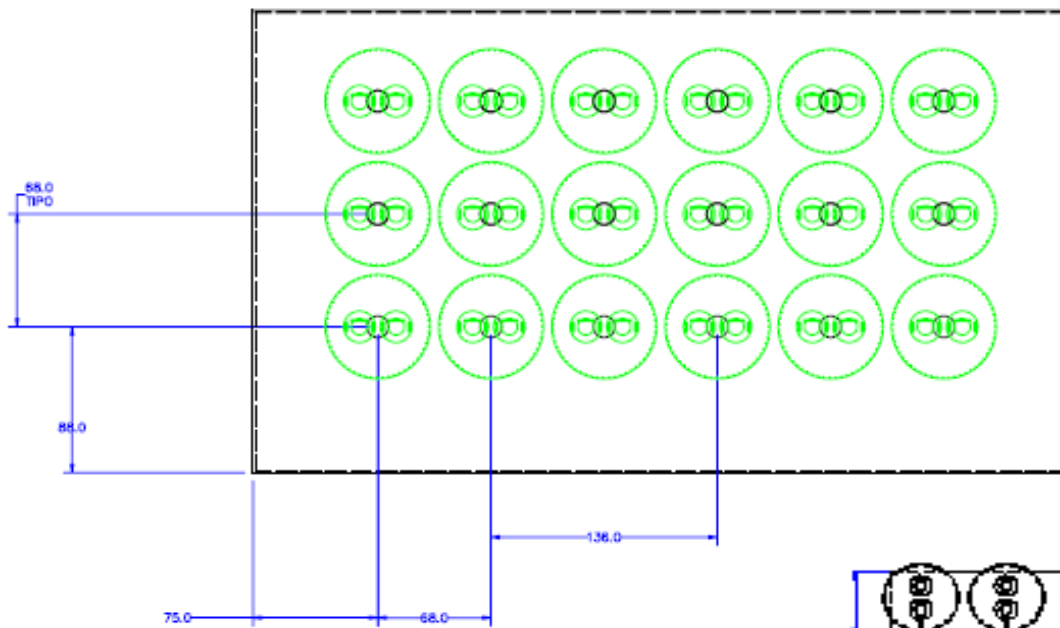
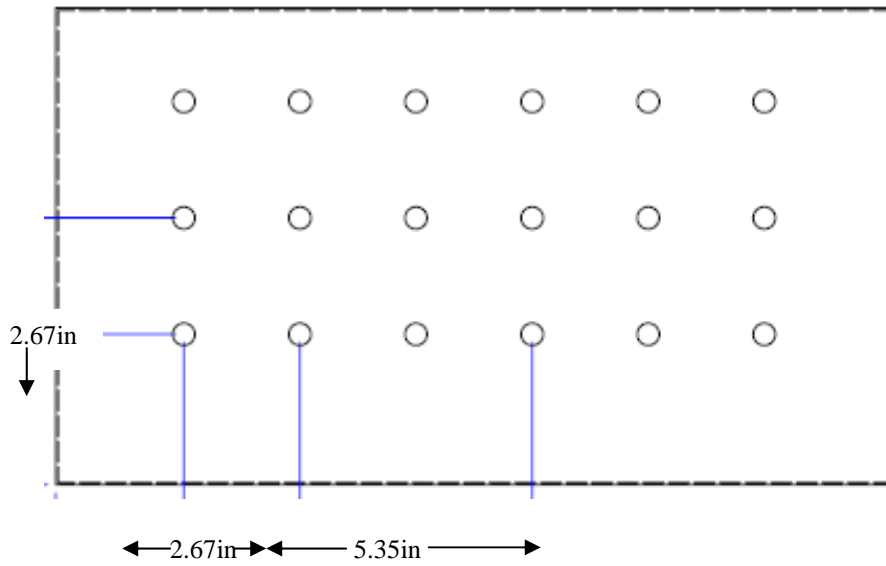
Capacitor Dimensions and Data:

C1 Capacitor Selection

(Chart indicates number of capacitor cells (by uF rating) to be connected PER PHASE in WYE configuration).

| KW | Part Number | Capacitors Total Cells (All Phases) | 11.9 uF | 19.9 uF | 38.5 uF | 49.9 uF | 57.0 uF | 72.1 uF |
|-----------|--------------------|--|--------------------|--------------------|--------------------|--------------------|--------------------|--------------------|
| 2 | LPF 0002 480 KB | 3 | 1 | | | | | |
| 4 | LPF 0004 480 KB | 3 | | 1 | | | | |
| 5 | LPF 0005 480 KB | 6 | 2 | | | | | |
| 7.5 | LPF 0007 480 KB | 3 | | | 1 | | | |
| 10 | LPF 0010 480 KB | 3 | | | | | 1 | |
| 15 | LPF 0015 480 KB | 3 | | | | | | 1 |
| 20 | LPF 0020 480 KB | 6 | | 1 | | | | 1 |
| 25 | LPF 0025 480 KB | 6 | | | | | 2 | |
| 30 | LPF 0030 480 KB | 6 | | | | | | 2 |
| 40 | LPF 0040 480 KB | 12 | | 2 | | | | 2 |
| 50 | LPF 0050 480 KB | 9 | | | | | | 3 |
| 60 | LPF 0060 480 KB | 12 | | | 1 | | | 3 |
| 75 | LPF 0075 480 KB | 15 | | 1 | | | | 4 |
| 100 | LPF 0100 480 KB | 18 | | | | | 1 | 5 |
| 125 | LPF 0125 480 KB | 27 | 2 | | | | | 7 |
| 150 | LPF 0150 480 KB | 27 | | | | | 1 | 8 |
| 200 | LPF 0200 480 KB | 36 | | | | | | 12 |
| 250 | LPF 0250 480 KB | 42 | | | | | | 14 |
| 300 | LPF 0300 480 KB | 51 | | | | | | 17 |
| 350 | LPF 0350 480 KB | 60 | | | | | | 20 |
| 400 | LPF 0400 480 KB | 69 | | | | | | 23 |
| 450 | LPF 0450 480 KB | 78 | | | | | | 26 |
| 500 | LPF 0500 480 KB | 84 | | | | | | 28 |
| 600 | LPF 0600 480 KB | 102 | | | | | | 34 |
| 700 | LPF 0700 480 KB | 120 | | | | | | 40 |
| 800 | LPF 0800 480 KB | 135 | | | | | | 45 |
| 900 | LPF 0900 480 KB | 153 | | | | | | 51 |
| 1000 | LPF 1000 480 KB | 171 | | | | | | 57 |

Suggested layout for capacitor cell mounting hole



Optional Capacitor "L" Bracket (Holds maximum of four (4) individual cells).

C1 Capacitor cell dimensions.

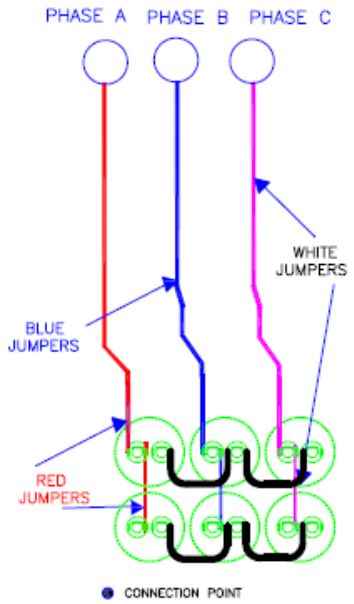


Fig. 2

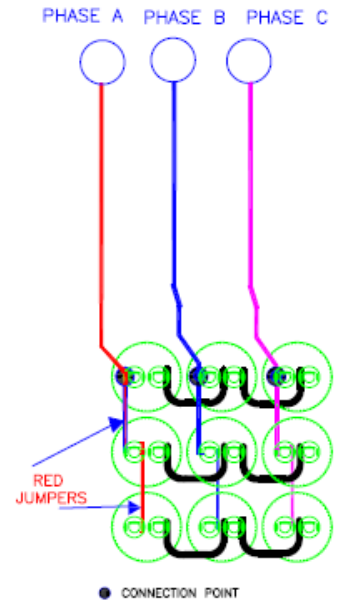
Above dimensions in mm.

| I.D. No. | uF | Volts | Dimensions (inches) | | |
|----------|------|-------|---------------------|--------|----------|
| | | | Dia. | Height | Mtg Stud |
| C1-1001 | 48 | 240 | 2.00 | 4.37 | .433 |
| C1-1002 | 80 | 240 | 2.50 | 4.37 | .433 |
| C1-2001 | 38.5 | 346 | 2.50 | 4.37 | .433 |
| C1-2002 | 46 | 346 | 2.50 | 4.37 | .433 |
| C1-2003 | 57 | 346 | 2.50 | 4.37 | .433 |
| C1-2004 | 72 | 346 | 2.50 | 4.37 | .433 |
| C1-3001 | 12 | 480 | 2.00 | 3.37 | .433 |
| C1-3002 | 20 | 480 | 2.00 | 3.37 | .433 |
| C1-3003 | 40 | 480 | 2.50 | 4.37 | .433 |
| C1-3004 | 50 | 480 | 2.50 | 4.37 | .433 |

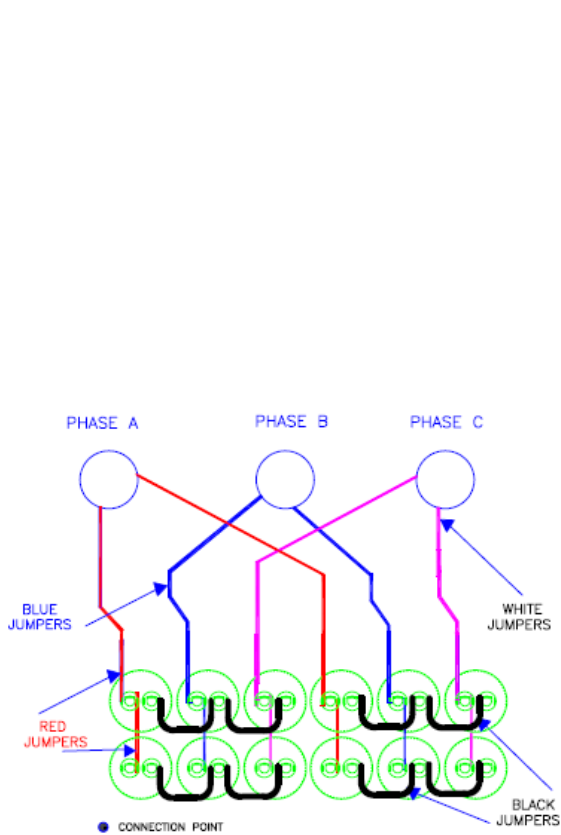
Recommended Capacitor Wiring Techniques. (Capacitor wiring harnesses are available as an option.)



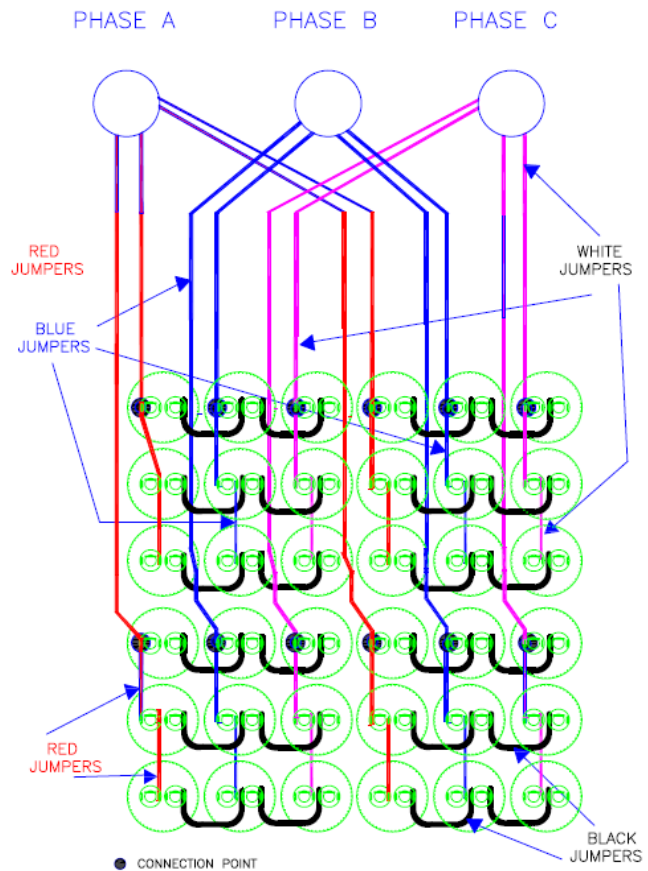
CONNECTION FOR SIX CELLS



CONNECTION FOR NINE CELLS



CONNECTION FOR TWELVE CELLS



Connection for thirty six cells

10.0 Maintenance

Generally, the low pass harmonic filter is considered to be maintenance free. During the course of normal operation, the capacitor cells will experience minute levels of expansion and contraction due to fluctuations in operating and ambient temperatures.

The following inspections should be made during regular station maintenance intervals.

- Periodically inspect the individual capacitor cells for bulging. If the top (terminal area) is bulging, then it is likely that the pressure switch has opened and the capacitor is no longer operational. Any failed capacitor cells should be replaced with direct factory replacements.
- Remove any dust that may have accumulated within your filter cabinet.
- To verify the general condition of the capacitors, take a current measurement in each capacitor phase. A discrepancy in current between phases may indicate a failed capacitor cell.
- Routinely check torque on all terminations. Verify they are in compliance with the torque table on Page 12.

11.0 Troubleshooting Guide

| Symptom | Problem | Solution |
|--|--|---|
| Input Harmonic Current Distortion (THD-I) exceeds 5% | Power system voltage distortion is excessive | Identify the source of voltage distortion and apply appropriate harmonic filter to that individual load or consult factory for recommendation. |
| | Unbalanced source voltage | Identify single phase loads contributing to voltage unbalance. Re-distribute loads to cause proper balancing or supply voltage. See application section for more details. |
| | Light load or NO load connected | At very light loads the magnitude of harmonic current may be very small, yet a THD-I percentage above 5%. This is usually acceptable under the guidelines of IEEE-519 because IEEE-519 is based on Total Demand Distortion (TDD), not an instantaneous THD measurement. See application section for more details. |
| | Improper connection | Check the component connection and confirm that L1, L3 and the capacitor assemblies are wired correctly. |
| | Failed capacitor(s) | Check each capacitor for a bulge on the top (terminal end) of capacitor. If bulge is present, capacitor pressure switch activated and capacitor can no longer be used. Replace only with proper ARTECHE capacitor cell. |
| Output voltage is low | Capacitors not connected or failed | Verify that the proper ratings and quantity of capacitors are in use and that all capacitors are properly connected. |
| | Reactors switched | Confirm that L1 is being used as the input series reactor and that L3 is being used in series with the shunt connected capacitor network. |
| Output voltage is high | Filter is too large for load | Verify correct rating of filter based on actual load rating. |
| | Generator power source is too small | Verify that the generator is at least as large as the full load filter rating. |
| Phase currents are not balanced | Failed capacitor | Identify failed capacitor (look for bulge at top) or fuse and replace using exact replacement. |

| | | |
|--|--|--|
| | INSTALLATION, OPERATION AND MAINTENANCE MANUAL FOR LOW VOLTAGE KIT Form Low Pass Harmonic Filters | Rev. 1 Sept. 30, 2007 Rev. 2: April 08, 2008 Rev. 3: Nov. 05, 2010 |
|--|--|--|

Notes:

| | | |
|--|--|---|
| | INSTALLATION, OPERATION AND MAINTENANCE MANUAL FOR LOW VOLTAGE KIT Form Low Pass Harmonic Filters | Rev. 1 Sept. 30, 2007 Rev. 2: April 08, 2008 Rev. 3: Nov. 05, 2010 |
|--|--|---|

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