



Frequently Asked Questions

HG7 Harmonic Filter

1. What is a harmonic?

A harmonic is a sinusoidal component of a periodic wave or quantity having a frequency that is an integral multiple of the fundamental frequency (IEEE Std 519-1992).

2. What causes harmonic distortion?

As power utilities continue to be pushed to the limits of supply capability, rising energy costs and decreasing power quality will continue to be an issue for consumers. Users continually search for ways to not only reduce energy costs, but also ensure their processes will continue to operate, no matter the quality of the incoming power. To accomplish this, more and more variable frequency drives, UPS systems, and other non-linear loads are being installed.

The usual waveform of an alternating current (AC) is generally that of a sine wave or a sinusoidal waveform. This is considered the fundamental waveform. Linear loads draw current in proportion to the sinusoidal voltage.

Non-linear loads, such as drives, change their impedance by conducting current only near the peak of the wave. Switching loads on and off during the waveform results in non-sinusoidal current pulses. These pulses introduce reflective currents (harmonics) back into the power distribution system. The non-sinusoidal waveforms have the fundamental wave plus integral multiples of that fundamental wave.

3. What is IEEE 519?

The IEEE is the Institute of Electrical and Electronics Engineers.

IEEE 519, "Recommended Practices and Requirements for Harmonic Control in Electric Power Systems," was published in 1981. The document established levels of voltage distortion acceptable to the distribution system. This document has been widely applied in establishing needed harmonic correction throughout the electrical power industry.

However with the increase in industrial usage of adjustable speed drives, rectifiers, and other non-linear loads, it became apparent that a rewrite of IEEE 519, treating the relationship of harmonic voltages to the harmonic currents flowing within industrial plants, was necessary to support control of harmonic voltages. The new IEEE 519, published in 1992, sets forth limits for both harmonic voltages on the utility transmission and distribution system and harmonic currents within the industrial distribution systems. Since harmonic voltages are generated by the passage of harmonic currents through distribution system impedances, by controlling the currents or system impedances within the industrial facility, one can control harmonic voltages on the utility distribution.

4. What kinds of problems are caused by harmonic distortion?

Harmonic distortion can cause poor power factor, transformer and distribution equipment overheating, random breaker tripping, or even sensitive equipment failure. Since harmonics affect the overall power distribution system, the power utility may even levy heavy fines when a facility is affecting the utilities' ability to efficiently supply power to all of its customers.

5. Which applications are best addressed by the HG7?

The HG7 is used where drives are a significant portion of the load. Prime candidates for filtering are installations of variable frequency drives or adjustable speed devices in facilities where those drives represent a significant portion of the load, or when specifications call for limited harmonics (like IEEE 519, 1992).

6. With the HG7 applied, will the power factor drop off as the load drops off?

No, the performance doesn't fall off with the load. HG7 performance is superior at 100% and 50% load.

7. What is included with the HG7 Standard Package Option?

The Standard Package includes everything necessary for an application to meet IEEE 519 standards. From the highest quality harmonic grade capacitors on the market to the extraordinary reactors, this filter will meet the majority of application requirements found today. This cost effective product is available as either an open panel version or in a UL Type 1 enclosure. The open panel is perfect for inclusion in a MCC section or easy installation into industry standard enclosures. The UL Type 1 enclosed units maintain the same vertical profile as the open panel design. This design is perfect for applications where floor space is at a premium.

8. What is included with the HG7 Power Monitor Option?

The Power Monitor package includes contactors and filter monitoring equipment. For units rated at 60 horsepower and below, the XM package utilizes indicator lights for filter operation and fuse failure. From 75 HP through 350 HP, the XM package uses the HG2™ Protection Monitor/Harmonic-Power Factor meter. The HG2™ Monitor Board displays operating information such as ITHD, VTHD, total filter amps, true power factor, and a series of fault and protection codes including over-current, over-voltage, and phase imbalance. It is also a programmable safety monitor, capable of bringing the filter off-line in a fault condition, or when the drive goes into a fault condition. For those applications that require the removal of capacitance for the start-up of stand-by generators, the contactors can remove the harmonic duty capacitors. Above 400 HP, the XM package includes a monitor board which has indicator lights to advise the mode of operation and when a fault should occur.

9. What exactly does the HG7 Component Package (CP) Option include?

This package consists of the series filter reactor, trap tuning reactor, capacitors, and cap brackets. A fundamental manual, along with a wiring diagram and layout drawing, is provided should a customer choose this package option. TCI recommends that only experienced drive integrators take advantage of this option.

10. Who should consider buying the HG7 CP Option filter?

The "CP" version of the HG7 is designed and developed for the systems integrator and experienced filter panel designer and builder. By buying the CP Option, customers can build the high performance harmonic filter into their existing packages. While fundamental schematic diagrams and layout documents are provided should the customer opt to use TCI's proven schematic, the use of these filter components is intended for the experienced, highly technical panel builders and system integrators. The customer is responsible for all phases of design and fabrication of the filter. Included in the package are the series line reactor, the tuning reactor, the capacitors, and the cap mounting brackets.

11. If the new standard HG7 filter does not include a circuit contactor, will this cause a problem with my drive or power system?

In earlier drive configurations, it was important to keep undesired capacitance off-line until the system required it. The contactor controlled the circuit such that the filter only came on-line when the drive had started and come up to a speed where there was a presence of harmonic currents on the line. The filter circuit was then initiated and the harmonic current was contained by the filter. In earlier series drives, excessive capacitance on the line side of the drive could have resulted in drive tripping and even drive damage. With the advent of modern drive topology, control and protection circuits are typically incorporated to prevent damage and nuisance tripping. Today, drives can operate with the filter on-line during drive startup and operation. From the filter standpoint, this eliminates the need for the contactor and other supporting devices such as the control power transformer and its associated wiring and fuse protection.

12. What does the Power Monitor Package Option, “XM”, add to the standard HG7 filter?

The “XM” Option is essentially adding to the HG7 standard product the features found on the full feature HarmonicGuard filter. This includes the contactor, control circuit power transformer, control circuit fusing, and the monitor board with its alarm annunciation and filter control functions. The HG2 monitor board and the full features of the earlier series HarmonicGuard have become a standard for many filter users and TCI wants to ensure this mainstay product option is available on the HG7.

13. Is the physical size of the Standard HG7 and Power Monitor Package Option, “XM” different?

The physical size of the “XM” Option is larger than the standard HG7 because of the features added to the product. In both the open style and enclosed version, the filters will be larger when the “XM” Option is specified.

14. When should I consider buying the “XM” Option over the standard HG7 filter?

The HG7 standard product is a high performance filter that will perform the function of mitigating excessive harmonics related to the drive system. The “XM” Option goes beyond that to allow additional control, alarm, and monitor features. The “XM” Option would be the desired version to specify if the customer is looking for alarm features should a filter fault occur or be able to turn off the filter circuit without shutting down the drive.

15. I have a 208 volt power system; do you have a 208 volt version of the HG7?

HG7 filters are designed and available for 240, 480, and 600 volt systems. The 208 volt product design is not available at this time. TCI does have many 208 volt designs available in the earlier KH series of HarmonicGuard. This design has proven itself in thousands of commercial and industrial applications. Please contact TCI Technical Support to find out if a 208 volt design is available for your application.

16. Why are high endurance capacitors in the HG7 filters so important?

High endurance capacitors are critical in the service life of any harmonic related device. The harmonic current that flows through any harmonic filter is extremely harsh and hard on electrical components. Early in the development life of the first harmonic filters, TCI found that a high endurance or harmonic rated capacitor was critical to ensure long service life. Standard power factor correction caps or motor starting caps are a poor way to protect the service of your filter and your drive system. While the high endurance capacitor is considerably more expensive, TCI has found this to be an important component that can be a great cost savings to the customer down the road.

17. Will the HG7 filter work on any drive?

The HG7 filter is designed to work with any standard, 6 pulse, and PWM drive on a standard NEMA design motor. Contact TCI Technical Support if the intention is to use the HG7 on a drive system incorporating braking resistors or regenerative drive circuitry to ensure compatibility.

18. Does the drive require special adjustments in order to use the HG7 filter?

TCI has studied the standard drive product offerings used in industry today. Standard, 6 pulse, PWM drives and standard NEMA design motors are compatible packages. The drives typically need no special adjustment when using the HG7 harmonic filter. If your drive application is utilizing unique drive components, contact your drive manufacturer's technical support staff for clarification on limitations to harmonic mitigation equipment.

19. Is the performance of the HG7 notably better than earlier filters?

The performance is truly better with the HG7 than with earlier filter designs. TCI can match performance with any filter design over a broad load range of operation. Very few filter designs can match that performance along with long filter service life and ease of installation and drive compatibility.

20. What do I do if I need a NEMA 12, 4, or 3R enclosure for the HG7?

These enclosures are presently not available from TCI as a standard product offering. A qualified customer can purchase the "CP" Option that will allow them to build their own filter using TCI components or a special product may be available from TCI. Contact TCI Technical Support for discussion on the enclosure options available and methods to handle special applications.

21. How can a harmonic filter improve my system power factor?

"Real" or True power is used to perform real work. Inductive loads require Real and Reactive power. Utilities provide apparent power. Apparent power is a geometric combination of Real and Reactive (or imaginary) power. Reactive power performs no work. However, the flow of reactive current, a component of reactive power, does consume energy as it passes through resistive elements of the power system, thus reducing overall system efficiency. This reactive power is used to generate magnetic fields within motors, transformers, and other magnetic devices. Reactive power, combined with harmonic currents, contribute to poor power factor in electrical systems. The capacitors inherent in the HG7 design supply the necessary reactive power so the utility doesn't have to. The reduction in harmonic currents further improves the ratio of active power to apparent power. This overall improvement to true power factor assists in the efficient operation of facilities and the avoidance of possible fines due to poor power factor.

22. How can I find out if the filter will bring my power system into compliance with IEEE-519?

The best way for true power system evaluation is to have an actual power measurement taken at the facility. For the sake of an informal, computer assisted power system review, the Analyzer Program can be found on the TCI website. Contact TCI Technical Support for assistance on this and other thoughts on compliance with IEEE-519 standards.

23. I typically use a line reactor on my drive applications. If I use an HG7 filter, do I still need a separate line reactor?

The HG7 harmonic filter comes complete with a series line reactor designed for use in the HG7 filter. A separate line reactor is not required.

24. I have a 2.5% impedance line reactor built into my drive. Will this create a voltage problem if I install the HG7 filter?

As long as the incoming power is strong and does not already reflect depressions or downward swings in line voltage, adding a standard HG7 filter to a drive system that already has a built-in 2.5% line reactor will not be a problem. It is very important to have the series line reactor in the filter circuit. If the 2.5% added voltage drop at full load is a concern, TCI recommends the drive customer to remove the drives internal 2.5% line reactor. The series inductor designed into the HG7 filter provides an inductance value that is important to the level of harmonic mitigation performed by the filter.

25. Can I use the HG7 on drive bypass applications?

Yes, an independent third party test was conducted to evaluate the use of the HG7 on bypass systems. The concern is to ensure the series inductor does not provide too excessive of a line voltage drop to prevent proper operation of the bypass control contactors. A 75 HP NEMA design A motor and drive package with a bypass option was tested. Extensive testing showed that the voltage drop across the 480/120 volt control power transformer being caused by the series reactor was approximately 10% at full load which was well within the contactor coils dropout rating. The bypass circuit worked very well and the results concluded the HG7 can be used with a standard drive/bypass configuration without any special system modifications.

26. Is the HG7 filter available in a bus-applied version?

The HG7 was designed to be used in drive-applied applications.

27. Can I use the HG7 on multiple motors?

The HG7 was designed to focus on drive-applied applications but can be sized for multiple motor systems as well. Caution must be taken to size the unit properly as well as to take all of the power system variables into consideration. Contact TCI Technical Support to fully discuss your multiple motor applications.

28. If I have a non-standard specialty motor, can I use the standard HG7 filter?

The HG7 filter is sized based on HP when using standard NEMA design B, 2 and 4 pole motors. The filter can be safely used on special motors if the nameplate information is discussed and the filter is sized properly. Contact TCI Technical Support for special motor applications.

29. The filters are all rated in HP. What are the current limits of the HG7 filters?

TCI has a complete listing of filter current limits. Contact TCI Technical Support for information and technical details.

30. Can I get design assistance if I purchase the HG7 Component Package “CP” filter?

The “CP” Option is designed for the very experienced panel builder and systems integrator. TCI can provide technical guidance but reserves the right of filter design to the experienced shop. Contact your TCI Territory or Regional Sales Manager for the required qualifications. If you are not familiar with your Territory or Regional Sales Manager, contact TCI Customer Service for a complete listing.

31. I have a harmonic limit requirement for my facility. What filter do I use?

The best way to address specification and harmonic limits is to do a proper analysis of your power system to establish a base line value of the harmonics presently on the power system at the point of common coupling, (PCC). Once that value is found, a proper solution can be formulated for your facility. For specifications that state a specific value at the drive or filter terminals, TCI can typically provide an HG7 that will meet the limits of most power quality specifications. Most industry power quality people today rely on the committee studies and findings of IEEE. The guideline that IEEE established is their standard 519-1992. TCI complies with this standard on the HG7 drive-applied harmonic filter when the customer evaluates the harmonic content at the point of the drive or filter terminals. This standard has reached an industry wide level of acceptance, and most power quality Engineers will reference this standard and openly accept the performance of the TCI HG7 filter for drive applied applications. For additional information of IEEE-519 requirements and how the TCI HG7 filter complies, contact the TCI Technical Support staff or you local TCI Territory Manager.

32. The utility has issued a harmonic limit specification for my facility. How can I find out what to use?

Power quality specifications can be difficult to interpret and often times confusing. For accurate definitions of the standards and a discussion involving easy-to-understand information, contact the TCI Technical Support staff.

33. Is the HG7 CE compliant?

The HG7 family of harmonic filters is not CE compliant at this time. It is UL and cUL listed.

34. I am building a system in the US and then installing it in a foreign country. Their line voltage is 380 volts 50 Hz. Can I build and test my system here on a 480 volt 60 Hz line and then use the 480 volt version of the HG7 on a 380 volt, 50 Hz application?

The HG7 filter is designed for a specific voltage and frequency. Because both components are integrated to the filter design, it is important to use both voltage and frequency when designing both the “L” and “C” components of the filter. By using the standard filter on a 380/3/50 power system, the tuning frequency would be slightly off and the performance of the filter would be impaired. For that reason, TCI does not recommend the random use of the 480 volt product on a 380 volt 3 phase, 50 Hz system unless the specific size and rating is verified with TCI Engineering first. Technical Support at TCI can review the rating and application requirements upon request.

35. My line voltage is 575 volts. Can I use the 600 volt HG7 filter?

For the sake of the harmonic filter, the 600 volt product was designed with an understanding that 575 volt power systems typically have a target supply voltage of 600 with a nominal applied voltage of around 575 volts. With that in mind, the 600 volt designation can be used on both 575 and 600 volts.

36. How can I estimate or calculate how much my system will improve with the use of the HG7 filter?

This can be done with the TCI “Analyzer” program or reviewed and analyzed by the TCI Technical Support staff. For the sake of general evaluations, you may estimate the drive input terminal point to be at approximately 7% TDD. The system, as a whole, would need further review and program work.

37. Can I use the HG7 on a generator power source or is this strictly for use on utility power?

You can use the HG7 on generator power; however it is more critical to size the device properly. If the non-linear load represents a great portion of the total generator load and the drive is very lightly loaded, the filter capacitance may cause the generator to experience voltage regulation issues. Contact TCI Technical Support for a system evaluation. You may also contact the generator provider for their guidelines on the use of harmonic mitigation and capacitive equipment on their systems.

38. The previous HarmonicGuard filter had a separate rating for use on either an AC or DC drive application. Has this changed with the new HG7 filter?

The HG7 filter was designed to primarily address the continually expanding AC drive market. This filter technology can be easily employed on DC drives but should be sized for DC drive topology. Standard “K” series HarmonicGuard DC Drive filters will still be available upon request. Contact TCI Technical Support for more information on DC drive filter options.

39. Does the standard HG7 require a special set up or calibration procedure for system startup?

The standard HG7 product is truly a plug-n-play product. It merely requires line power connections from the incoming power line and then connected to the drive. Unlike the “K” Series HarmonicGuard filter, the HG7 product does not require control circuit or drive control connections.

40. I will be using the HG7 filter in Canada. Is the HG7 CSA approved?

The HG7 is not CSA approved or tested but it is UL and cUL for Canadian applications.

41. Where can I find the field terminal size information so I can have them available to install the HG7 filter when it is delivered?

Connection information is readily available on the outline drawings provided by TCI.

42. How can the dimensions for the HG7 open panel design be the same as the enclosed version?

Similar to the “K” Series Harmonic Guard filter, the HG7 utilizes an integral enclosure system such that, the back panel of the filter is actually the back side of the enclosure when an enclosed version is selected. Please see the outline drawings on the TCI website for a closer look at this configuration.

43. Can I order an HG7 with custom features not listed in the brochure such as a disconnect switch or special cabinet color to match my drive system?

TCI builds custom equipment for many customers and OEMs. It is in the best interest of everyone that a standard product be selected if possible. Often times, a small, seemingly simple modification can require added Engineering design time, drawings, and a list of special parts to be added. This results in added cost and lead time to acquire the equipment. TCI is sensitive to the needs of the application and suggests the solution product that is the most readily available and cost effective for the customer. If the standard product is not suited for the application or the customer requires special modifications, the TCI Technical Support staff can make suggestions and present ideas for the best solution available. TCI is interested in hearing the needs and requirements of our customers. Contact TCI at (414) 357-4480 or (800) TCI-8282 for more information on power quality and harmonic mitigation equipment.