



HG7™ HarmonicGuard® Series

Drive-Applied Filter

Performance and Protection for Drives





Reliable Harmonic Filtration Technology with the HarmonicGuard® Series Drive-Applied Filter

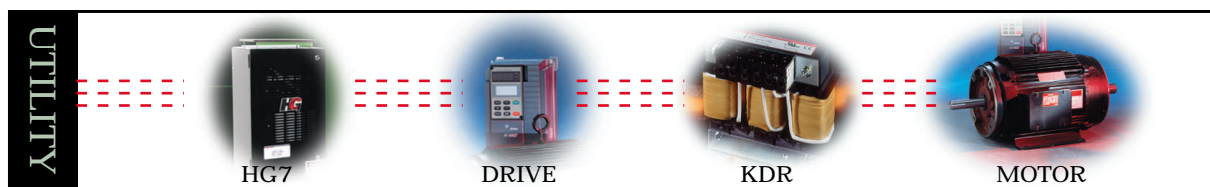
As power utilities continue to be pushed to the limits of supply capability, rising energy costs and decreasing power quality will continue to be an issue for consumers. Users continually search for ways to not only reduce energy costs, but also ensure their processes will continue to operate no matter 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. For over a decade, TCI has been building harmonic mitigation filters. From waste water treatment facilities, commercial buildings, and factory floors to harsh mountain environments, reliable TCI filters have been installed to the satisfaction of thousands of customers. The next generation of the HarmonicGuard® Series filter has arrived. TCI's considerable experience with harmonic mitigation technology has led to the development of the HG7; a filter design based on proven technology with significantly improved performance.

Manufacturer's Warranty

HG7 HarmonicGuard Series Drive-Applied Filters are warranted against Manufacturer's defect for three years from the date of original shipment. For complete warranty details, please refer to TCI's Limited Warranty Policy.

Drawings/Specifications

Autocad compatible *.dxf drawings and Acrobat Reader compatible *.pdf drawings of all HG7 HarmonicGuard Series Drive-Applied Filters are available at www.transcoil.com or by contacting TCI at (800) 824-8282. The Installation, Operation, and Maintenance Manual is also available for download.



Typical Problems, Superior Solutions with HG7 Filters

Non-linear Loads and the Impure Sine Wave

Non-linear loads are products that draw non-sinusoidal current from the distribution line. This non-sinusoidal current is derived from waveforms that combine the fundamental frequency with integral multiples of that frequency. The resulting harmonic distortion is a basic result of the operation of non-linear loads. When these types of loads are a significant portion of an electrical system, harmonic distortion may begin to cause problems throughout the entire system. These problems range from 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 utility's ability to efficiently supply power to all of its customers. As a result, in the search for more efficient power use, other costly issues have been created.

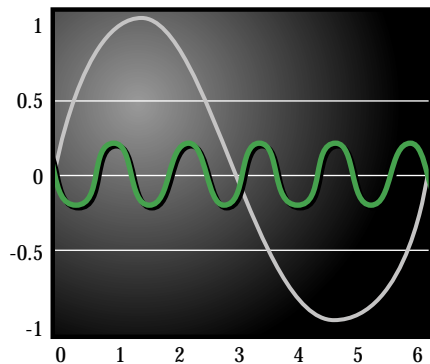
Superior HG7 Performance

The HG7 not only limits current distortion to less than 7% TDD, it also improves true power factor. Multiple package options will allow TCI customers to choose the right filter configuration for the application. Since every power system is different, harmonic mitigation requirements will differ, and even IEEE limits change based on the system loading characteristics. The HG7 product returns the power of choice to the customer, allowing for different configurations to achieve different performance and monitoring results. It is TCI's intention to provide the maximum value to our customers by offering the package and performance necessary for the application.

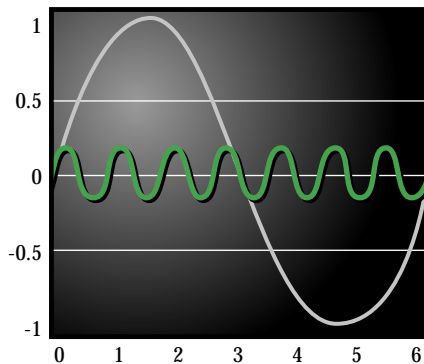
True Power Factor Correction

"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.

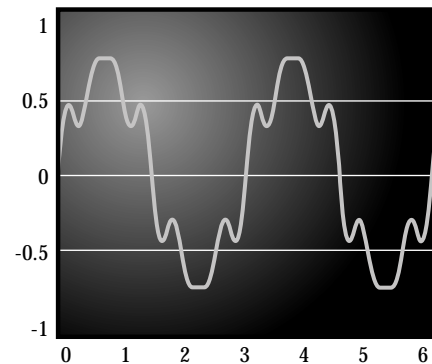
Sample 5th Harmonic



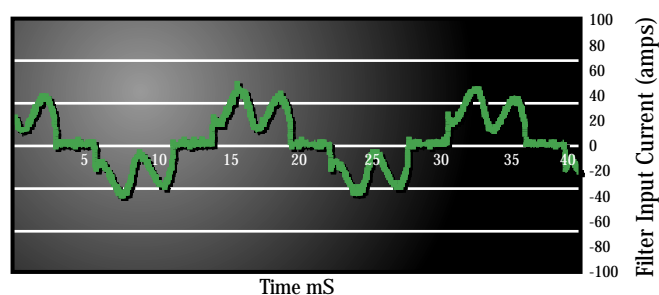
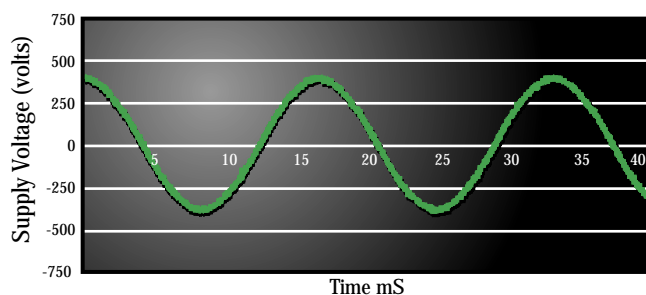
Sample 7th Harmonic



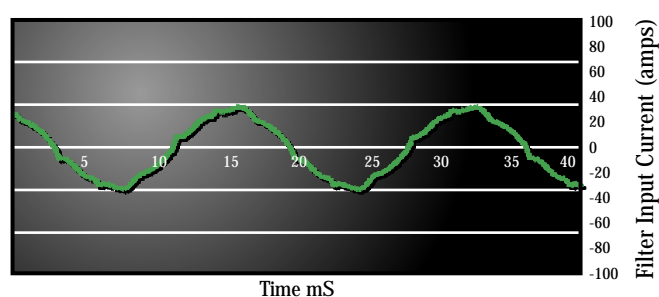
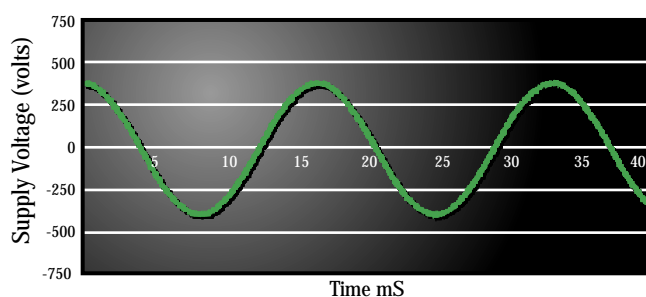
Fundamental Plus 5th and 7th



No Filter



HG7 Filter



IEEE-519 1992 Harmonic Distortion Limits

In 1981, "Recommended Practices and Requirements for Harmonic Control in Electric Power Systems" was published. This document was the first attempt at establishing acceptable standards for distortion, both voltage and current, within the distribution system. Unfortunately, the original document did not address the users' responsibility for contributing to the overall system distortion levels. Re-published in 1992, IEEE 519 set forth distortion limits for power users. These limits defined the maximum current and voltage distortion percentages allowable at the point of common coupling, commonly referred to as the PCC, under full load. These limits are on a sliding scale based on system loading parameters. Table 10-3 of IEEE Std 519-1992 "IEEE Recommended Practices and Requirements for Harmonic Control in Electrical Power Systems" can be found below.

Table 10-3

Current Distortion Limits for General Distribution Systems (120V through 69,000V)
Maximum Harmonic Current Distortion in Percent of IL
Individual Harmonic Order (Odd Harmonics)

ISC/IL	<11	11 ≤ h < 17	17 ≤ h < 23	23 ≤ h < 35	35 ≤ h	TDD
<20*	4.0	2.0	1.5	0.6	0.3	5.0
20 < 50	7.0	3.5	2.5	1.0	0.5	8.0
50 < 100	10.0	4.5	4.0	1.5	0.7	12.0
100 < 1000	12.0	5.5	5.0	2.0	1.0	15.0
>1000	15.0	7.0	6.0	2.5	1.4	20.0

Even harmonics are limited to 25% of the odd harmonic limits above. Current distortions that result in a dc offset, e.g., half-wave converters, are not allowed.

*All power generation equipment is limited to these values of current distortion, regardless of actual ISC/IL.

where

ISC = maximum short-circuit current at PCC.

IL = maximum demand load current (fundamental frequency component) at PCC.

HG7 480V AC Filters	PART NUMBER OPEN STYLE	HP	k-Var	WATTS LOSS	OPEN WEIGHT	PART NUMBER ENCLOSED	ENCLOSED DIMENSIONS (in.)			ENCLOSED WEIGHT	FIELD TERMINAL PHASE SIZE
							HEIGHT	WIDTH	DEPTH		
	HG8AW00ST	7.5	3	200	40	HG8AW01ST	19.75	17.50	12.14	66	#4 - #18
	HG10AW00ST	10	3	200	40	HG10AW01ST	19.75	17.50	12.14	66	#4 - #18
	HG15AW00ST	15	5	275	50	HG15AW01ST	19.75	17.50	12.14	75	#4 - #18
	HG20AW00ST	20	6	300	60	HG20AW01ST	19.75	17.50	12.14	85	#4 - #18
	HG25AW00ST	25	8	325	65	HG25AW01ST	19.75	17.50	12.14	90	#4 - #18
	HG30AW00ST	30	10	375	80	HG30AW01ST	31.38	17.50	12.14	130	#4 - #18
	HG40AW00ST	40	12	625	120	HG40AW01ST	31.38	17.50	12.14	170	#4 - #18
	HG50AW00ST	50	15	650	130	HG50AW01ST	31.38	17.50	12.14	180	#4 - #18
	HG60AW00ST	60	20	825	135	HG60AW01ST	31.38	17.50	12.14	90	#2 - #22
	HG75AW00ST	75	25	950	140	HG75AW01ST	31.38	17.50	12.14	195	#2/0 - #6
	HG100AW00ST	100	30	975	185	HG100AW01ST	31.38	17.50	12.14	235	#2/0 - #6
	HG125AW00ST	125	40	1150	220	HG125AW01ST	56.00	17.56	16.15	308	250MCM - #6
	HG150AW00ST	150	45	1450	260	HG150AW01ST	56.00	17.56	16.15	350	250MCM - #6
	HG200AW00ST	200	60	1775	350	HG200AW01ST	70.00	20.00	20.00	500	Two 250MCM - 1/0
	HG250AW00ST	250	75	2050	355	HG250AW01ST	70.00	20.00	20.00	505	Two 250MCM - 1/0
	HG300AW00ST	300	90	2500	450	HG300AW01ST	70.00	20.00	20.00	600	Two 350MCM - #4
	HG350AW00ST	350	105	2725	500	HG350AW01ST	70.00	20.00	20.00	650	Two 350MCM - #4
	HG400AW00ST	400	120	3100	680	HG400AW01ST	60.00	52.00	24.00	985	Two 350MCM - #4
	HG450AW00ST	450	150	3350	685	HG450AW01ST	60.00	52.00	24.00	990	Two 600MCM - #2
	HG500AW00ST	500	150	3500	715	HG500AW01ST	60.00	52.00	24.00	1020	Two 600MCM - #2
	HG600AW00ST	600	180	3500	950	HG600AW01ST	60.00	52.00	24.00	1235	Three 600MCM - #2
	HG700AW00ST	700	210	3600	1170	HG700AW01ST	60.00	52.00	24.00	1450	Three 600MCM - #2
	HG800AW00ST	800	240	3900	1175	HG800AW01ST	60.00	52.00	24.00	1460	Three 600MCM - #2
	HG900AW00ST	900	270	4200	1195	HG900AW01ST	60.00	52.00	24.00	1480	Three 800MCM - 350MCM

HG7 600V AC Filters	PART NUMBER OPEN STYLE	HP	k-Var	WATTS LOSS	OPEN WEIGHT	PART NUMBER ENCLOSED	ENCLOSED DIMENSIONS (in.)			ENCLOSED WEIGHT	FIELD TERMINAL PHASE SIZE
							HEIGHT	WIDTH	DEPTH		
	HG15CW00ST	15	5	300	40	HG15CW01ST	19.75	17.50	12.14	40	#4 - #18
	HG30CW00ST	30	10	425	80	HG30CW01ST	31.38	17.50	12.14	130	#4 - #18
	HG40CW00ST	40	12	675	120	HG40CW01ST	31.38	17.50	12.14	170	#4 - #18
	HG50CW00ST	50	15	700	130	HG50CW01ST	31.38	17.50	12.14	180	#4 - #18
	HG60CW00ST	60	20	900	135	HG60CW01ST	31.38	17.50	12.14	190	#4 - #18
	HG75CW00ST	75	25	1000	140	HG75CW01ST	31.38	17.50	12.14	195	2/0 - #6
	HG100CW00ST	100	30	1050	185	HG100CW01ST	31.38	17.50	12.14	235	2/0 - #6
	HG125CW00ST	125	40	1200	220	HG125CW01ST	56.00	17.56	16.15	308	2/0 - #6
	HG150CW00ST	150	45	1500	260	HG150CW01ST	56.00	17.56	16.15	350	250MCM - #6
	HG200CW00ST	200	60	1850	350	HG200CW01ST	70.00	20.00	20.00	500	250MCM - #6
	HG250CW00ST	250	75	2000	355	HG250CW01ST	70.00	20.00	20.00	505	Two 250MCM - 1/0
	HG300CW00ST	300	90	2500	520	HG300CW01ST	70.00	20.00	20.00	675	Two 250MCM - 1/0
	HG350CW00ST	350	105	2800	500	HG350CW01ST	70.00	20.00	20.00	725	Two 350MCM - #4
	HG400CW00ST	400	120	2700	600	HG400CW01ST	60.00	52.00	24.00	990	Two 350MCM - #4
	HG450CW00ST	450	150	3050	725	HG450CW01ST	60.00	52.00	24.00	1200	Two 350MCM - #4
	HG500CW00ST	500	150	3000	930	HG500CW01ST	60.00	52.00	24.00	1300	Two 350MCM - #4
	HG600CW00ST	600	180	3200	950	HG600CW01ST	60.00	52.00	24.00	1400	Two 600MCM - #2
	HG700CW00ST	700	210	3600	1065	HG700CW01ST	60.00	52.00	24.00	1500	Two 600MCM - #2
	HG800CW00ST	800	240	3900	1240	HG800CW01ST	60.00	52.00	24.00	1600	Three 600MCM - #2
	HG900CW00ST	900	270	3800	1325	HG900CW01ST	60.00	52.00	24.00	1750	Three 600MCM - #2

HG7 240V AC Filters	PART NUMBER OPEN STYLE	HP	k-Var	WATTS LOSS	OPEN WEIGHT	PART NUMBER ENCLOSED	ENCLOSED DIMENSIONS (in.)			ENCLOSED WEIGHT	FIELD TERMINAL PHASE SIZE
							HEIGHT	WIDTH	DEPTH		
	HG8BW00ST	7.5	3	200	50	HG8BW01ST	19.75	17.50	12.14	75	#4 - #18
	HG10BW00ST	10	3	225	55	HG10BW01ST	19.75	17.50	12.14	80	#4 - #18
	HG15BW00ST	15	5	300	60	HG15BW01ST	19.75	17.50	12.14	85	#4 - #18
	HG20BW00ST	20	6	350	80	HG20BW01ST	30.75	17.50	12.14	130	#4 - #18
	HG25BW00ST	25	8	375	90	HG25BW01ST	30.75	17.50	12.14	140	2/0 - #6
	HG30BW00ST	30	10	450	100	HG30BW01ST	30.75	17.50	12.14	150	2/0 - #6
	HG40BW00ST	40	15	675	120	HG40BW01ST	30.75	17.50	12.14	170	2/0 - #6
	HG50BW00ST	50	15	700	130	HG50BW01ST	30.75	17.50	12.14	180	250MCM - #6
	HG60BW00ST	60	20	800	150	HG60BW01ST	30.75	17.50	12.14	200	250MCM - #6
	HG75BW00ST	75	25	900	180	HG75BW01ST	56.00	17.56	16.15	265	Two 250MCM - 1/0
	HG100BW00ST	100	30	1100	195	HG100BW01ST	56.00	17.56	16.15	285	Two 250MCM - 1/0

Typical Applications

- Printers
- Extruders
- Machining
- Pulp & Paper
- Waste Water Treatment
- Down Hole Pumping
- HVAC
- Uninterruptible Power Supplies
- AC Variable Frequency Drives
- 6-pulse rectifiers
- Fans
- Other Mission Critical Applications

Package Options

The HG7 has been designed with the customer in mind. From the Standard Package to the Power Monitor Package, TCI has the right solution for the application.

Standard Package

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.

Sample Part Number: HG100AW00ST

Power Monitor Package 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.

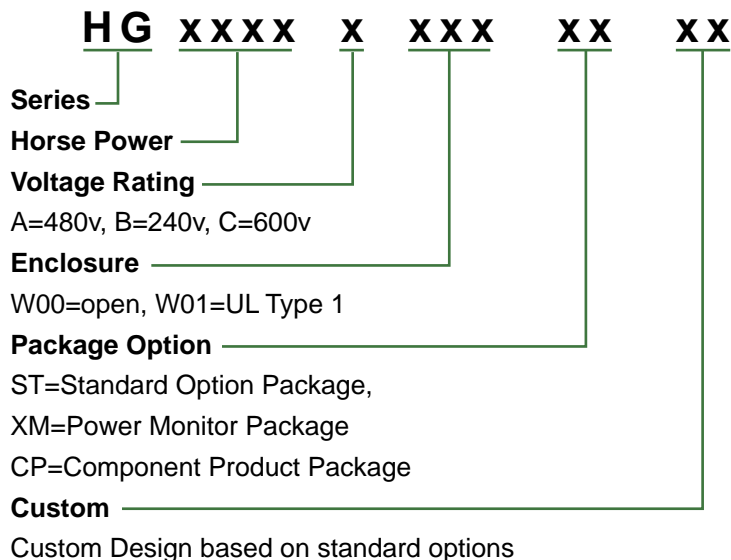
Sample Part Number: HG100AW00XM

Component Package Option

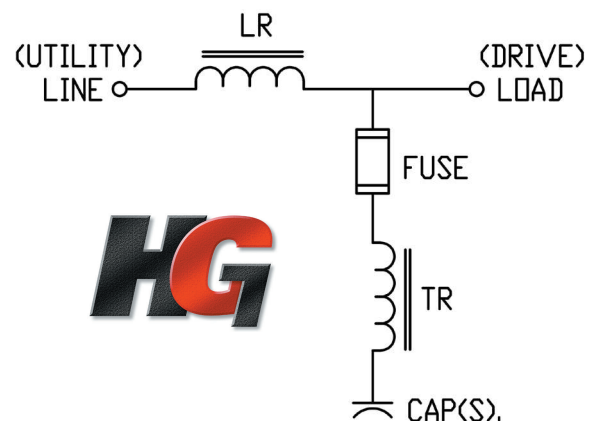
This package includes all of the major components that are found in the Standard Package. Ideal for integration into drive sections or other end-products, this option is ideal for the experienced drive integrator. This option does not include panels, enclosures, heating or cooling devices, wire, or lugs. It is also important to note that the inclusions of the Power Monitor package are also not available as a component set.

Sample Part Number: HG100AW00CP

Part Numbering System

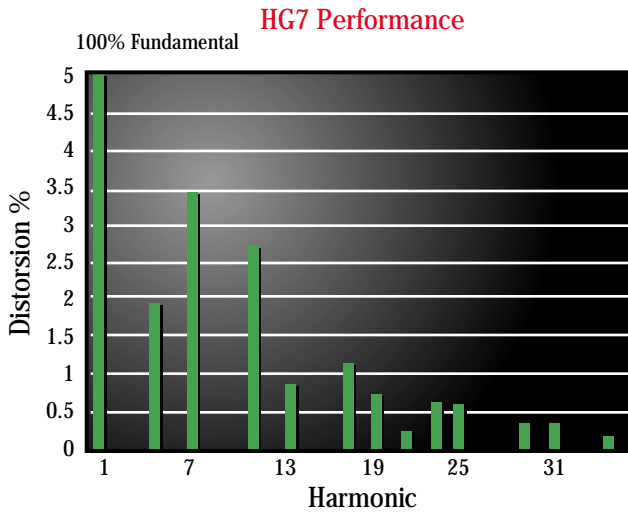


Standard Configuration One Line Diagram



Technological Highlights

With over a decade of experience in the manufacture and application of harmonic mitigation filters, TCI can provide the right filter for the job. With so many mitigation techniques available, from multi-pulse configurations to active harmonic cancellation filters, choosing the right form of harmonic reduction can be a difficult task. The HG7 is not only guaranteed to perform, its performance matches all but the most expensive mitigation technologies currently available on the market. The HG7 is easy to install and is shipped with all necessary components including an Installation, Operation, and Maintenance manual. Each unit contains high quality capacitors certified for harmonic rich environments. It is also important to note that critical applications will continue to operate even if the HG7 shuts down.



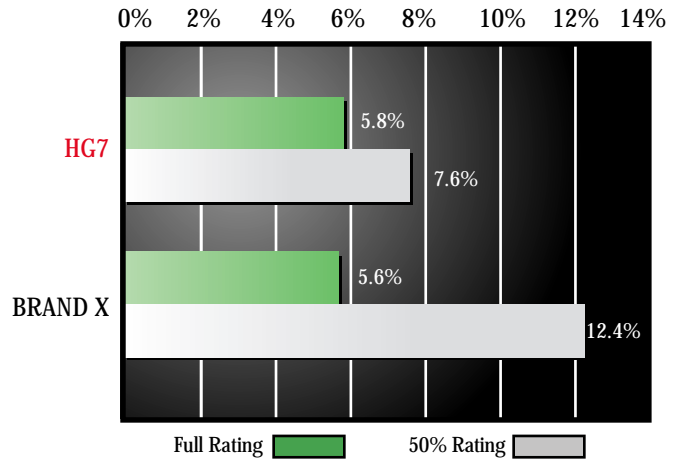
Distortion Comparison

Performance of the HG7 Harmonic Filter has been compared to other offerings currently available on the market. As noted in the waveforms displayed to the right, the differences in performance are subtle and hard to detect in a visual inspection. Between the 5% and 9% distortion range, performance may be less of a concern than other factors, including price, delivery, or support. In this particular example, the HG7 performs at the mid-point but carries a price tag that is less than the 8.5% filter. Although the differences between 20% distortion and 5% distortion are clear, determining the overall value between 8.5% and 5.3% distortion may be extremely difficult in each unique application.

Independent Third Party Testing

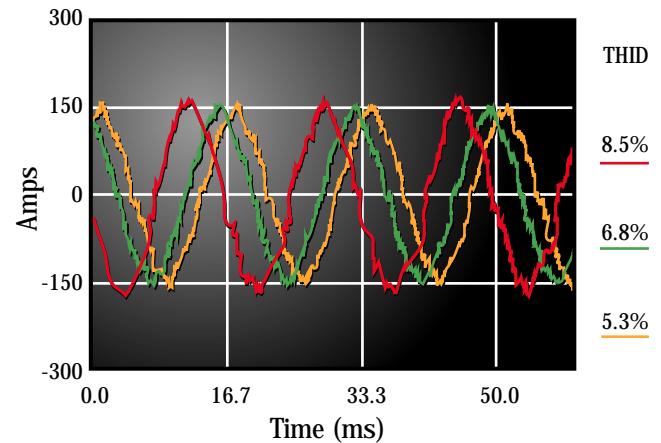
In independent third party tests, the HG7 filter performed extremely well. Test one applied a 75 HP HG7 to a 75 HP variable frequency drive connected to a 75 HP NEMA Design A motor at full load. The specified drive came with a bypass option. The concern was the operation of the bypass circuit as it relates to the voltage drop from the filter and the ability to pull in the 120 volt coils on the bypass contactors. Extensive testing showed that the voltage drop across the 480/120 Volt control power transformer was approximately 10%, well within the coil's dropout rating. The results show that the HG7 can be used with a standard drive/bypass configuration without any special system modifications.

In a second test, a 10 HP filter was applied to a 10 HP drive at 460 volts. In this particular application, 100% of the system was non-linear load. Under full load conditions, operating on an extremely stiff source, TDD was equivalent to 8%.



Superior Filter Performance

In general, the HG7 performs as well as, if not better than, any filter technology currently available on the market today. Harmonic distortion at the input terminals is typically between 5 and 7% TDD. With the HG7, voltage drop on the dc bus of a variable frequency drive is less than 2%. Since the filter uses TCI's reactor technology, nuisance tripping is eliminated and drive uptime is dramatically increased. While attenuating harmonic distortion, the filter also dramatically improves true power factor.



Total Demand Distortion (TDD) Guarantee

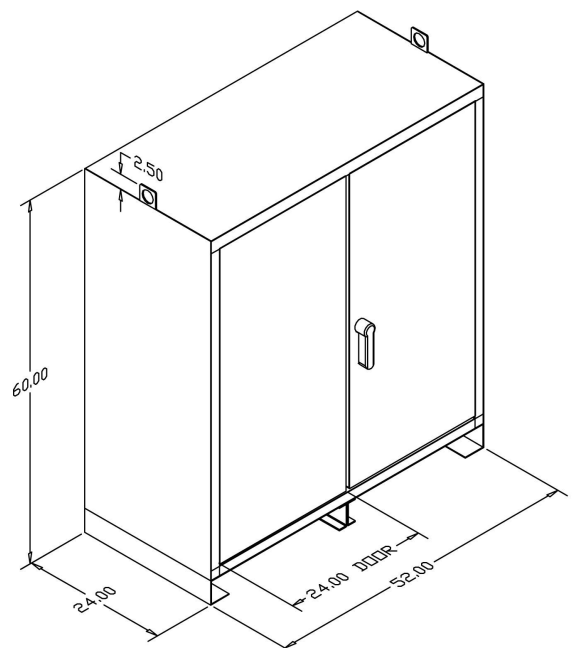
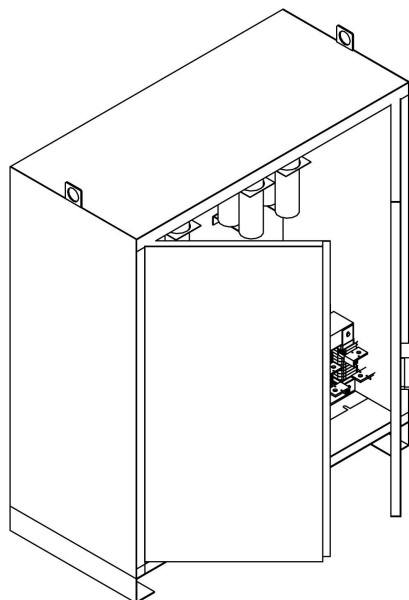
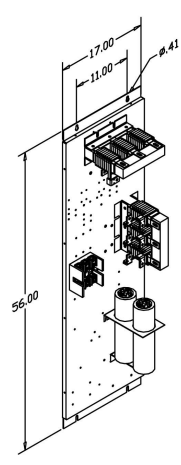
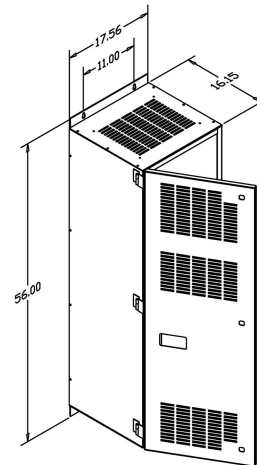
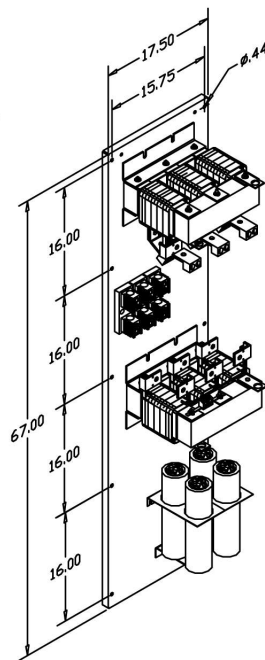
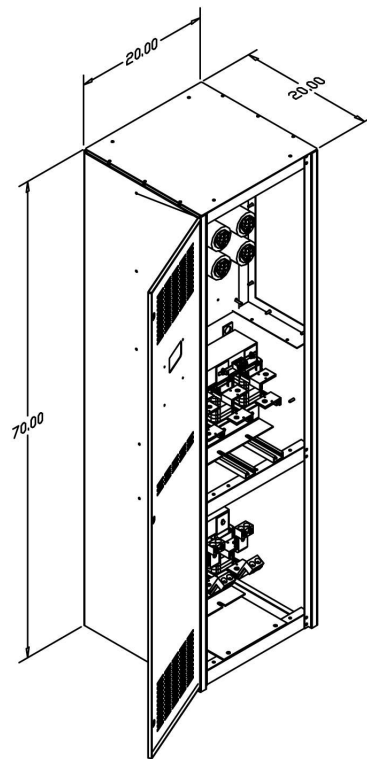
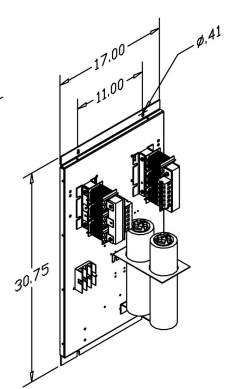
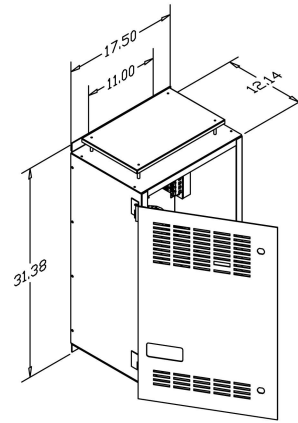
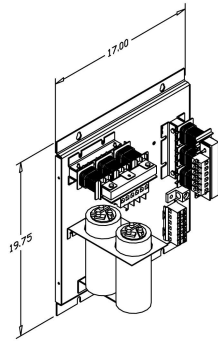
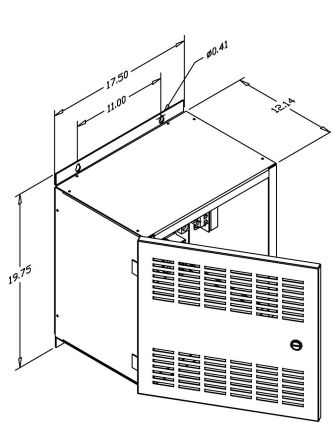
Properly applied and sized for the application, TCI guarantees that the HG7 will deliver typical results of 5 – 6 % TDD, but no more than 8%, at the filter input terminals. If a properly selected, installed, and loaded HG7 filter fails to meet the guaranteed performance levels, TCI will provide the necessary components or replacement filter at no additional charge. TCI does not take responsibility for additional installation or removal costs, to include, but not limited to, replacement of third party equipment.

Minimum System Requirements:

In order to achieve the performance levels as stated in this guarantee, the electrical system must adhere to the following:

Line Voltages must be balanced to within $\pm 1\%$; Voltage at the filter input terminals is 100% ($\pm 5\%$) of filter rating; Source Impedance is at least 3%; Filter loading is 100% ($\pm 5\%$) of filter rating; Load is at least 10% of source rating. TCI cannot guarantee individual results when harmonic distortion exists on the system prior to HG7 installation. TCI does not take responsibility for incorrect installation of the component package option.

ENCLOSURES



HG7 Product Specifications

- Available in 240V, 480V, and 600V designs
- UL-Listed (Industrial Control Panel)
- 3 Year Warranty
- Available in Standard 7.5 through 900 HP (100 HP Max at 240V)
- Open Panel and UL Type 1 Enclosed options available
- Convenient Component Package available
- Robust Power Monitor Package available
- High Quality Harmonic Grade Capacitors



Performance and Protection For Drives

7878 North 86th Street, Milwaukee, WI 53224

PHONE 1-800-824-8282 **FAX** (414) 357-4484

WEB www.transcoil.com