HarmonicGuard® Series Bus-Applied Active Harmonic Filter

Installation, Operation, and Maintenance Manual

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Table of Contents

Revision	Description	Date
A	Release	10/29/13
B	--	03/03/14
C	Added 300A Added 150A 480 V Added 150A 600 V Updated Quick Start Guide Rev. B	09/10/14
D	Updated 300A Drawings	09/26/14
E	Added Floor Stand Added 600 V 220A Added Legacy QS Guide as Appx. E Updated Watts Loss on Standard Product Ratings and Dimension Tables	11/5/14
F	Updated Quick Start Added HGA-HMI Appendix F Updated Sections 4 and 5	12/11/15
G	Added 250/500A	05/16/16
H	Corrections to Standard Product Ratings and Dimension Tables	5/19/16
J	Added 200A Narrow	10/10/16
K	Updated Communications Product Numbering Updated Watts Loss on Standard Product Ratings and Dimension Tables Updated Unit Dimensions on 600 V	07/27/17
L	Updated information on Over Temperature Protection Added Fault Codes Update Drive Applied Connection Diagram Update Circuit Breaker Trip Rating Add Appendix H- BACnet Gateway Option	12/20/17
M	Updates to Part numbering system, general formatting	04/22/19
N	Updates to formatting and addition of 350A, 600A, and 700A	09/20/19
O	Add deratings curves and updates to Part numbering system	12/10/19
P	Updates to HMI information and Part Numbering	06/12/20
Q	Updates to circuit wiring tables; Update to HMI information,	12/01/2021
R	Updated Gateway EtherNet/IP Appendix and Part numbering system and added ALC 30- and 50-Amp Information.	03/10/2024

We strive to provide the most up to date and accurate documentation available at the time of printing. Please visit www.transcoil.com for the most recent revision of this manual.

1.0 HGA Quick Start Unit Software Setup for HMI Revision I

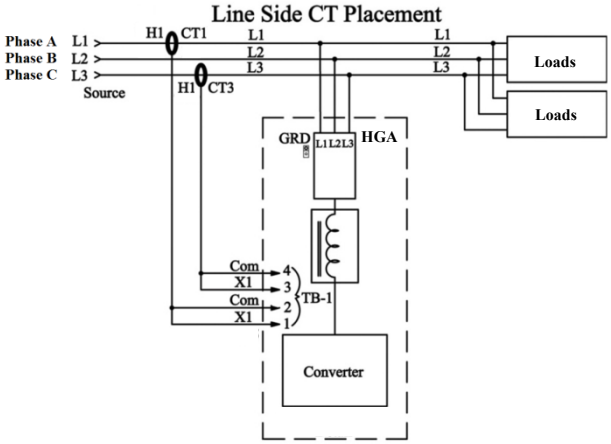
Warning 	Be sure to read, understand, and follow all safety instructions.
Warning 	Only qualified electricians should carry out all electrical installation and maintenance work on the HarmonicGuard Active (HGA) filter.
Warning 	All wiring must be in accordance with the National Electrical Code (NEC) and/or any other codes that apply to the installation site.
Warning 	Disconnect all power before working on the equipment. Do not attempt any work on a powered HGA filter.
Warning 	The HGA filter and other connected equipment must be properly grounded.
Warning 	The HGA filter may receive power from two or more sources. Three-phase power is connected to the main input terminals of the HGA filter. All of these sources of power must be disconnected before working on the HGA filter.
Warning 	After switching off the power, always allow 5 minutes for the capacitors in the HGA filter and connected equipment, if applicable, to discharge before working on the HGA filter, connected equipment, or the connecting wiring. It is good practice to check with a voltmeter to make sure that all sources of power have been disconnected and that all capacitors have discharged before beginning work.

1) Verify unit external connections.

Note: *If unit is configured for load side operation, reference the User Manual for Load Side CT Placement diagram.*

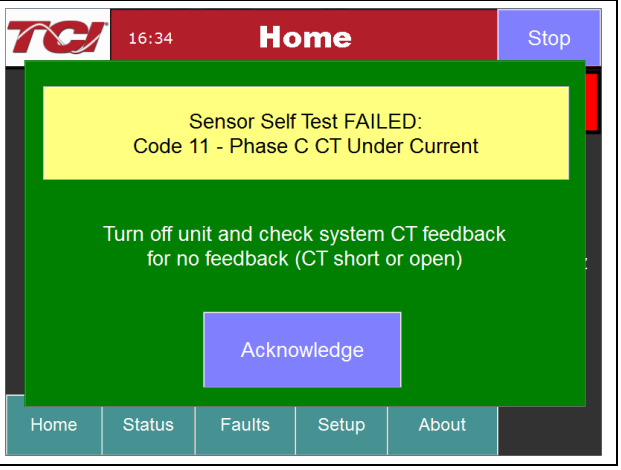
- Phase A, B, C power connection, with positive A-B-C phase rotation expected.
- CT H1 Terminal is pointing toward the source
- CT feedback on phases A & C to TB-1
- Leave CT shorting bars in place on TB-1
- TCI recommends a blank USB memory stick (500MB or larger) be inserted in the USB port located on the back of the HMI while the unit is powered off. This memory stick can be used to create a listing of all stored faults/alarms for troubleshooting purposes.
- With the HGA circuit breaker open, energize the source to the HGA.
- Close the HGA circuit breaker.
- Fans and HMI should come on in < 5 seconds
- HMI will start on Home screen.
- Load(s) have an integral 3% line reactance or equivalent DC bus choke.

Warning	Hazardous Voltages are present when unit is energized



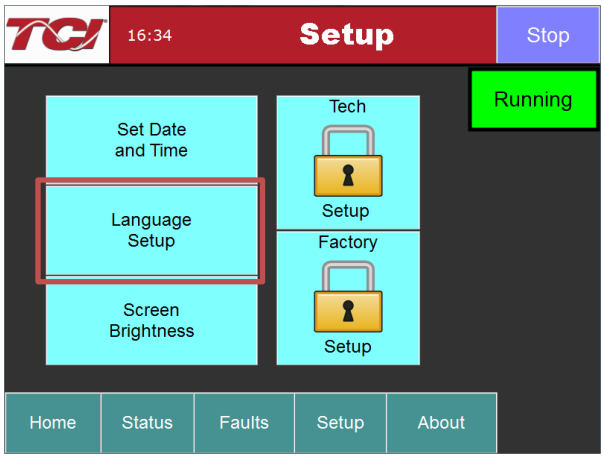
Note: Built-In Sensor Wiring Error Detection

- The active filter has an automatic sensor wiring error detection algorithm built into the controls.
- If a sensor wiring error is detected, please reference the Sensor Error Auto Detection section.



Note: Language Selection and Date / Time

- The active filter supports several languages including English, French and Spanish.
- Press “Setup” to navigate to Setup screen and press the “Language Setup” button.
- Select language setting from the language setup pop-up screen.
- Press the “Set Date and Time” button to change the configured system time.



2) Converter check – 1

- Press “Password Setup” to navigate to Setup screen
- Next, select “Tech Setup” and enter the password:

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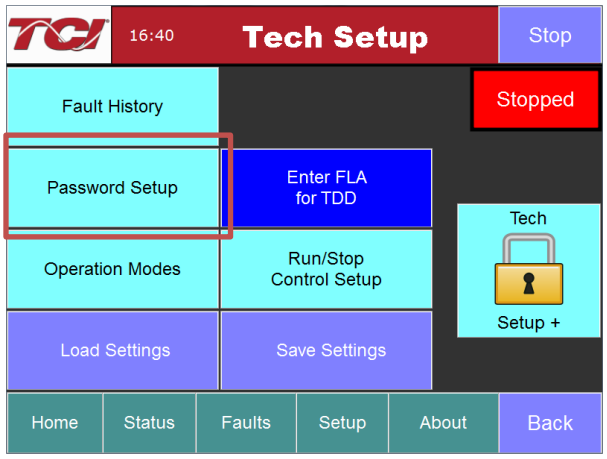
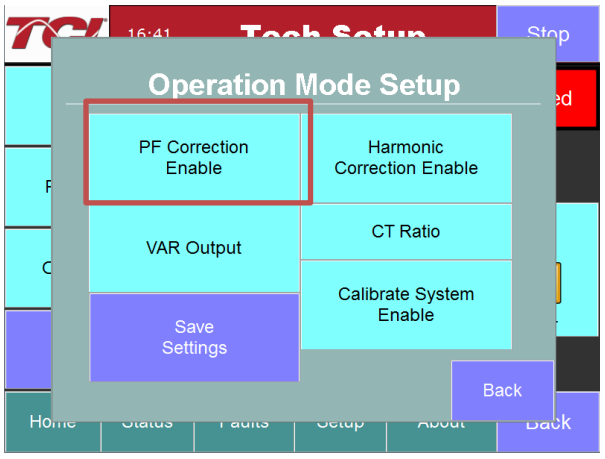
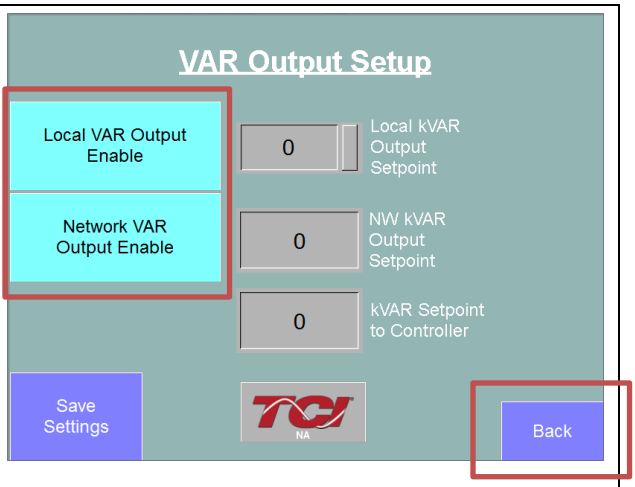
- Select the “Operation Modes” button



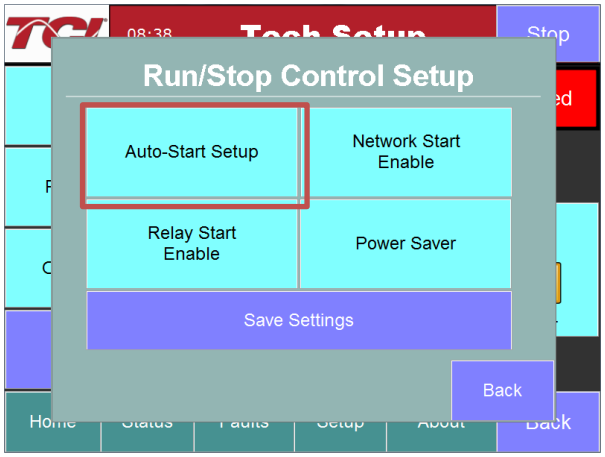
- On the “Operation Mode Setup” screen, ensure “PF Correction Enable” and “Harmonic Correction Enable” buttons are OFF (Blue). If buttons are green, press to toggle off
- Select the “CT Ratio” button and enter CT ratio to match the external current transformers wired to the unit. Select the “Back” button



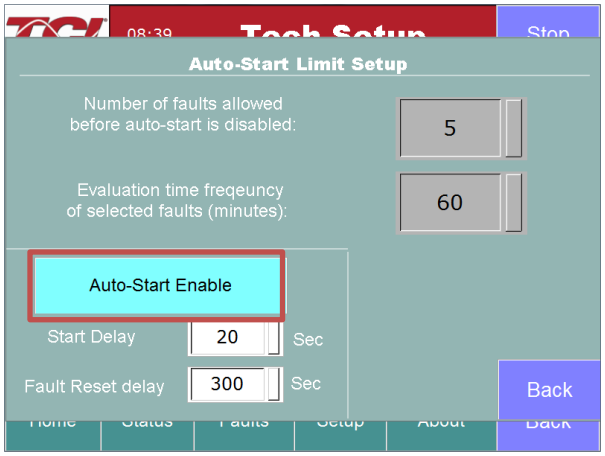
- Next, select the “VAR Output” button and ensure the “Local VAR Output Enable” and “Network VAR Output Enable” are OFF (Blue). If buttons are green, press to toggle off
- Select the “Back” buttons to return to the “Tech Setup” screen



- On the “Run/Stop Control Setup”, ensure the “Auto Start Setup” button is OFF (Blue). If button is ON (Green), press to toggle off.

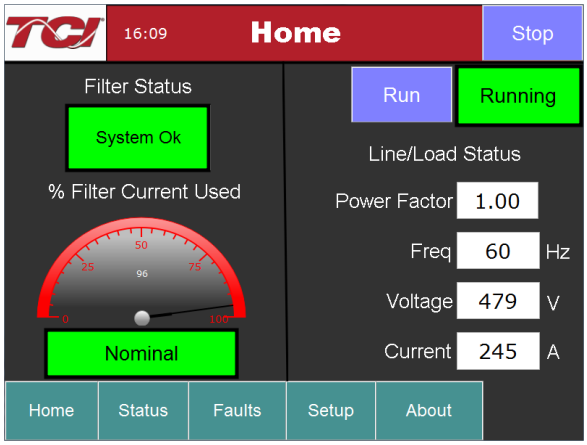


- Navigate back to “Tech Setup” screen
- Now select “Save Settings”
- Press “Home” to navigate to Home screen



3) Home screen check

- Compare “Freq” to expected line frequency
- Compare “Voltage” to expected line Voltage
- “Current” expected to be zero because unit is not running and CT inputs are shorted
- If status indicates a Fault, press “Stop” button to reset condition

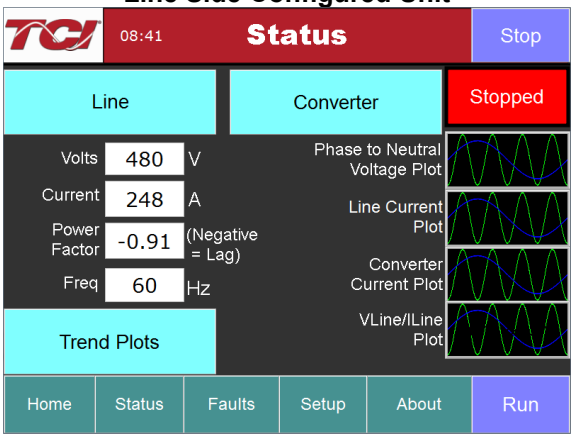


4) Status screen check

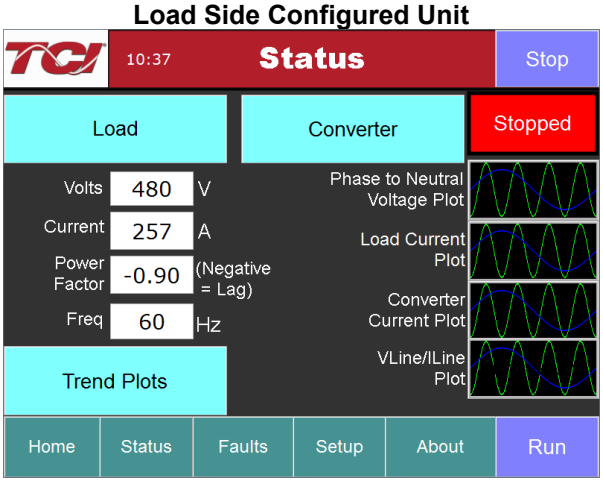
Note: *The Line/Load button and Line/Load Current Plot will say “Line” if a master/ line side unit.*

- Press “Status” to navigate to Status screen
- Compare “Volts” to expected line Voltage
- Compare “Freq” to expected line frequency
- “Current” expected to be zero if unit is not running and CT inputs are shorted

Line Side Configured Unit



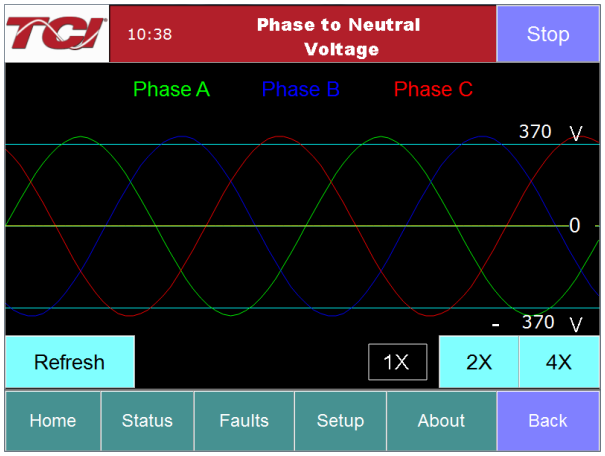
Load Side Configured Unit



5) Phase rotation check

- Press “Phase to Neutral Voltage Plot” button
- Check that the current peaks follow the following sequence from left to right: Phase A (Green), Phase B (Blue), Phase C (Red)
- Equipment is phase rotation sensitive, if phase rotation is incorrect, power down unit and rewire to adjust phase rotation by swapping two incoming phase connections

Warning	Improper operation will occur if input Voltage phase rotation is incorrect.



6) Running Converter

Press “Setup” to navigate to the setup screen
Select the “Tech Setup” button and enter the password:

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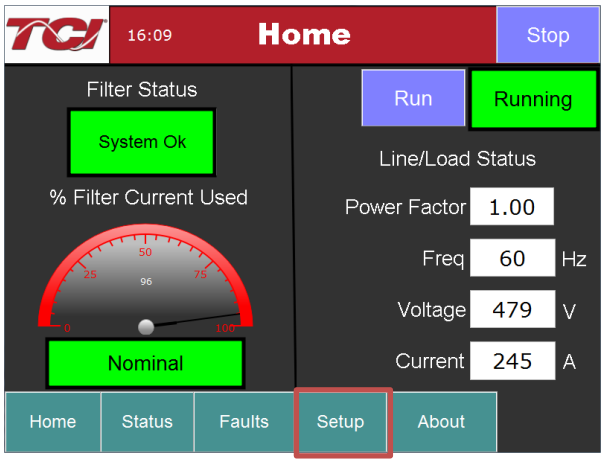
- Select the “Next” button from the splash screen
- Select the “Operation Modes” button
- On the “Operation Mode Setup” screen ensure “PF Correction Enable” and “Harmonic Correction Enable” buttons are OFF (Blue). If buttons are green, press to toggle off TODO and VAR output off.
- Select the “VAR Output” button and ensure the “Local VAR Output Enable” and “Network VAR Output Enable” are OFF (Blue). Select the “Back” buttons to go back to “Tech Setup” screen
- Select the “Home” button from navigation bar
- Select the “Run” button to start unit operation.



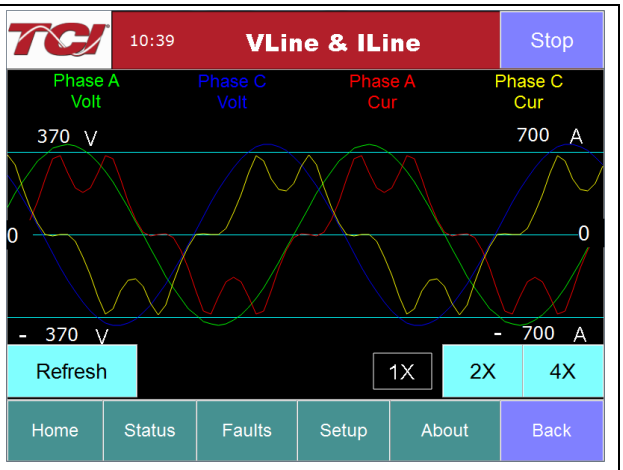
7) Remove CT shorting bars

- Press “Stop” to turn off unit
- Disconnect power from cabinet
- Turn off the built-in door breaker AND
- Turn off the upstream feeder breaker
- Open the cabinet door and remove shorting bars from CTs connected to TB-1

Warning	Lethal Voltages may be present. Wait 5 minutes for DC bus Voltage to drop to safe levels.
Warning	Check for Voltage in cabinet with a DMM before working inside cabinet.

8) Current polarity #1

- Power up unit
- From Home screen, press “Run” to turn on unit
- Press “Status” to navigate to Status screen
- Select “VLine/ILine” screen
- **Note**: Lightly loaded conditions (less than 20% CT rating) will not have enough current to show up on ILine plot
- Check that Phase A to Neutral Voltage peak lines up with Phase A current (use zoom if necessary)
- Check that Phase C to Neutral Voltage peak lines up with Phase C current
- Power system down and check CT installation location and orientation, if Phase A plots differ significantly from Phase C plots



Warning	Open circuit CT outputs can result in high Voltages and damage to equipment.

Warning	Wiring the CT incorrectly can lead to improper operation, which includes unit operating in limit and/or contributing to rather than correcting harmonics.

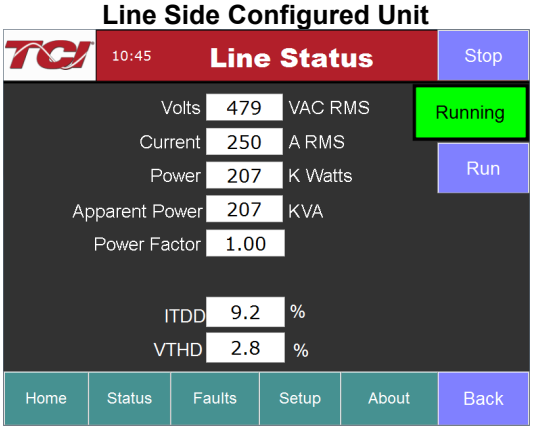
Note: *If using a Line Side (master) unit, the screen title will say “Line Status.”*
Also: *See notes under each screen.*

9) Current polarity #2

- Navigate to Status screen
- Depending on unit configuration, select either the “Line” or “Load” button
- Verify that the fields match expected values for the power system
- If they do not, verify correct CT installation

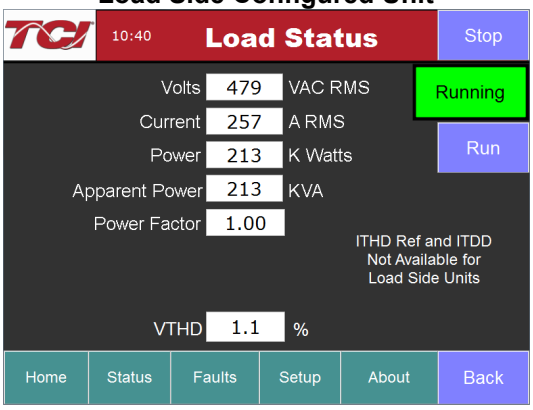
Note: *With the default parameter configuration, if secondary CT current is less than 1A, THID will be unavailable*

Line Side Configured Unit



Note: *If system Voltage is less than 480 V, the THVD value will be unavailable. If CT secondary feedback current less than 1 Amp, the THID and THID Ref values will be unavailable.*

Load Side Configured Unit



Note: *If system Voltage is less than 480 V, the THVD value will be unavailable. Load Side units do not report ITDD or THID Ref values. If CT secondary feedback current less than 1 Amp, the THID value will be unavailable.*

10) Final setup

- Press “Setup” to navigate to setup screen
- Select the “Tech Setup” button and enter the password:

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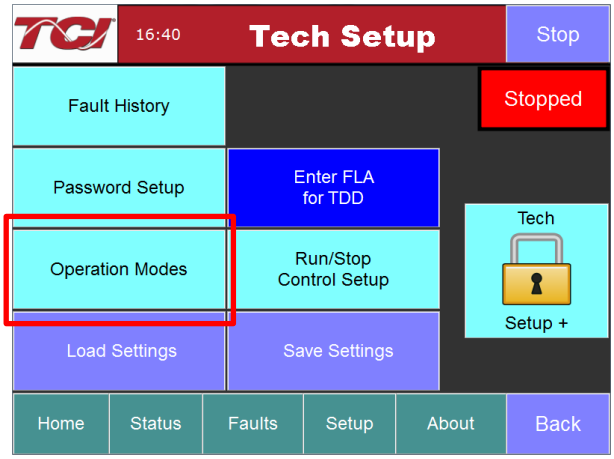
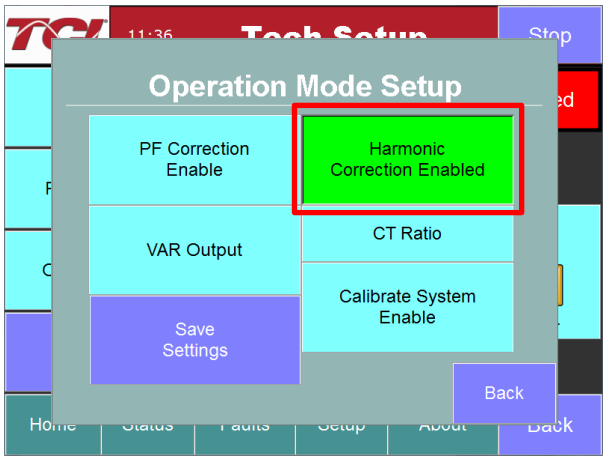
- Select the next button from the splash screen
- Select the “Operation Modes” button

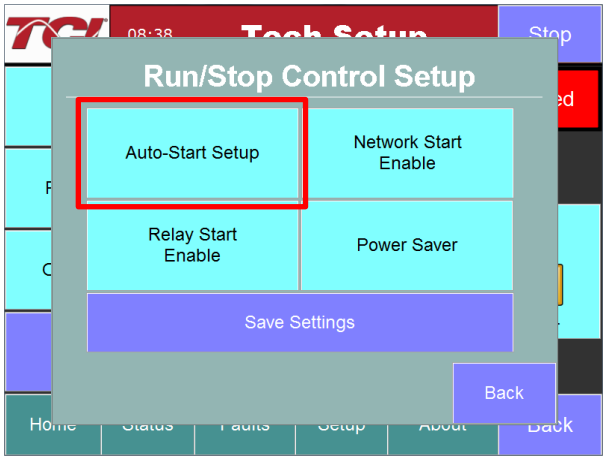


- On the “Operation Mode Setup” screen select the “Harmonic Correction Enable” button and ensure the button is ON (Green)

Note: *If unit is sized with sufficient capacity to provide power factor correction, select the “PF Correction Enable” button and ensure the button is ON (Green)*

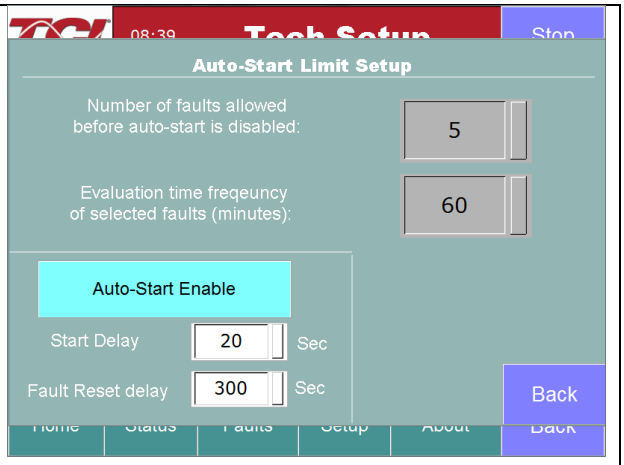


- Select the “CT Ratio” button and confirm the configured CT ratio matches the external current transformers that are wired to the unit
- Select the “Back” button and then from “Tech Setup” screen, select “Run/Stop Control Setup”



- Select “Auto-Start Setup”
- On this screen, select the “Auto-Start Enable” button and ensure the button is ON (Green)
- Navigate back to the “Tech Setup” screen and select the “Save Settings” button
- Navigate to the “Home” screen and press the Run button. The unit will start to operate. With the Auto-Start option enabled, the units will now automatically restart after future power on/off cycles of the unit or non-critical system faults

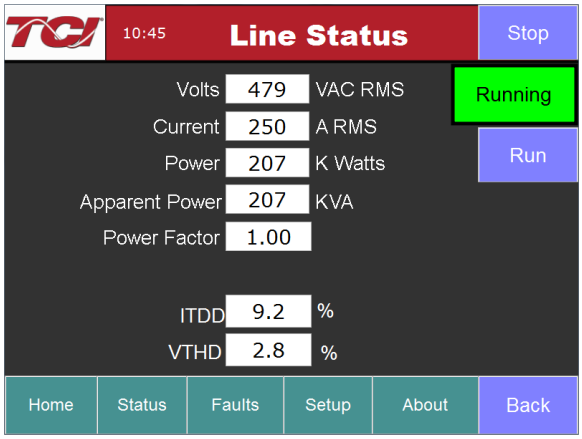
Warning	When Auto Start is enabled, unit may operate without operator input.



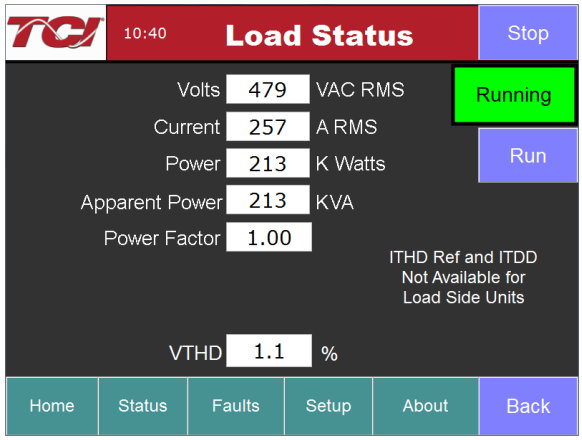
11) Final check

Note: *If unit is configured for load side operation, reference the User Manual for Load Side CT Placement diagram.*

- Navigate to the Status screen
- Navigate to Line/Load status
- Note the corrected Voltage, current, power and THD



Line Side



Load Side

2.0 Safety

Safety Instructions Overview

This section provides the safety instructions, which must be followed when installing, operating, and servicing the HarmonicGuard® Active (HGA) filter. If neglected, physical injury or death may follow, or damage may occur to the HGA filter or equipment connected to the HGA filter. The material in this chapter must be read and understood before attempting any work on or with the product.

The HGA filter is intended to be connected to the bus or power cables where one or more loads are connected. 3-phase power is connected to the input terminals of the unit and corrective current is supplied to the system through the HGA filter in response to the input signal being received from the CTs connected to the monitored bus. The instructions, and particularly the safety instructions for any other related equipment, must be read, understood, and followed when working on any of the equipment.

Warnings and Cautions

This manual provides two types of safety instructions. Warnings are used to call attention to instructions, which describe steps, which must be taken to avoid conditions, which can lead to a serious fault condition, physical injury, or death.

Cautions are used to call attention to instructions that describe steps that must be taken to avoid conditions that can lead to a malfunction and possible equipment damage.

Warnings

Readers are informed of situations that can result in serious physical injury and/or serious damage to equipment with warning statements marked with the following symbols:

Warning 	Dangerous Voltage Warning: warns of situations in which a high Voltage can cause physical injury and/or damage equipment. The text next to this symbol describes ways to avoid the danger.
Warning 	General Warning: warns of situations that can cause physical injury and/or damage equipment by means other than electrical. The text next to this symbol describes ways to avoid the danger.
Warning 	Many electronic components located within the filter are sensitive to static electricity. Voltages imperceptible to human touch can reduce the life, and affect performance, or destroy sensitive electronic devices. Use proper electrostatic discharge (ESD) procedures when servicing the filter and its circuit boards.

Cautions

Readers are informed of situations that can lead to a malfunction and possible equipment damage with caution statements:

Caution 	General Caution: Identifies situations that can lead to a malfunction and possible equipment damage. The text describes ways to avoid the situation.

General Safety Instructions

These safety instructions are intended for all work on the HGA filter. Additional safety instructions are provided at appropriate points in other sections of this manual.

Warning 	Be sure to read, understand, and follow all safety instructions.
Warning 	Only qualified electricians should carry out all electrical installation and maintenance work on the HGA filter.
Warning 	All wiring must be in accordance with the National Electrical Code (NEC) and/or any other codes that apply to the installation site.
Warning 	Disconnect all power before working on the equipment. Do not attempt any work on a powered HGA filter.
Warning 	The HGA filter and other connected equipment must be properly grounded.
Warning 	The HGA filter may receive power from two or more sources. 3-phase power is connected to the main input terminals of the HGA filter. All these sources of power must be disconnected before working on the HGA filter.
Warning 	After switching off the power, always allow 5 minutes for the capacitors in the HGA filter and connected equipment to discharge before working on the HGA filter, associated equipment, or the connecting wiring. It is good practice to check with a Voltmeter to make sure that all sources of power have been disconnected and that all capacitors have discharged before beginning work.

3.0 General Information

Thank you for selecting TCI's HarmonicGuard® Active filter. TCI has produced this filter for use in non-linear load applications that require input power line harmonic current reduction and power factor correction. This manual describes how to install, operate, and maintain the HarmonicGuard® Active filter. Please contact TCI Technical Support or visit TCI Support for additional information.

Intended Audience

This manual is intended for use by all personnel responsible for the installation, operation, and maintenance of the HarmonicGuard® Active filter. Such personnel are expected to have knowledge of electrical wiring practices, electronic components, and electrical schematic symbols.

General Terminology

Throughout this manual, many different terms are used. A list of some typical terms can be found below. These are provided to assist with the overall understanding of the manual. Please feel free to contact TCI directly if there are any questions regarding any portion of this manual.

HarmonicGuard® Active Filter (HGA) – TCI's brand name for a real time filter that mitigates harmonics while also maintaining near unity power factor. An Active Harmonic Filter is any piece of equipment that actively monitors and changes the incoming AC line current.

Active Harmonic Filter - An active harmonic filter is a piece of equipment that reads the incoming Voltage and current and injects current waveforms that cancel distortion. This term is commonly used in place of the entire brand name of HarmonicGuard® Active filter.

Bus-Applied Filter – A shunt device connected in parallel to the load. This is an active filter designed to mitigate the harmonics associated with multiple loads. The filter is directly connected to a main bus as can be found in a typical Motor Control Center. The filter is sized for corrective current needed to be injected to cancel the offending harmonics. A Digital Signal Processor (DSP) pulse width modulated controller is used for switching Insulated Gate Bipolar Transistor (IGBT) to cancel the harmonics.

Power Converter - The power converter is the digital filter module of the HarmonicGuard® Active filter.

Non-Linear Load Input Line Inductor – The 3-phase line reactor connected at the input of an adjustable frequency drive or other non-linear load.

Converter Inductor – The 3-phase inductor maintains a uniform air gap to give highly consistent and predictable inductance. These inductors are connected to the inverter, which buffers the inverter output from the analog portion of the filter, the source, and connected equipment.

Current Transformer (CT) – The device that monitors the incoming AC current waveform typically sized to handle the total connected load.

Receiving Inspection

The HarmonicGuard® Active filter has been thoroughly inspected and functionally tested at the factory and carefully packaged for shipment. When you receive the unit, you should immediately inspect the shipping container and report any damage to the carrier that delivered the unit. Verify that the part number of the unit you received is the same as the part number listed on your purchase order.

Storage Instructions

If the HarmonicGuard® Active filter is to be stored before use, be sure that it is in a location that conforms to published storage humidity and temperature specifications stated in the Table 1: HarmonicGuard® Active Filter Technical Specifications. Store the unit in its original packaging.

In the case of long-term storage, defined as any period greater than eighteen (18) months, TCI Technical Support must be contacted prior to applying power.

TCI Limited Warranty Policy

TCI, LLC ("TCI") warrants to the original purchaser only that its products will be free from defects in materials and workmanship under normal use and service for a period originating on the date of shipment from TCI and expiring at the end of the period described below:

Product Family	Warranty Period
KLR, KDR	For the life of the drive with which they are installed.
HGA, KMG, MSD, V1K	One (1) year of useful service, not to exceed 18 months from the date of shipment.
PF Guard, HGP, HGL, HSD, HSE, HSL, KRF	Three (3) years from the date of shipment.
KCAP, KTR	Five (5) years from the date of shipment.
All Other Products	One (1) year of useful service, not to exceed 18 months from the date of shipment.

The foregoing limited warranty is TCI's sole warranty with respect to its products and TCI makes no other warranty, representation, or promise as to the quality or performance of TCI's products. THIS EXPRESS LIMITED WARRANTY IS GIVEN IN LIEU OF AND EXCLUDES ANY AND ALL EXPRESS OR IMPLIED WARRANTIES INCLUDING, WITHOUT LIMITATION, ANY IMPLIED WARRANTY OF MERCHANTABILITY OR FITNESS FOR A PARTICULAR PURPOSE.

This warranty shall not apply if the product was:

a) Altered or repaired by anyone other than TCI.
b) Applied or used for situations other than those originally specified; or
c) Subjected to negligence, accident, or damage by circumstances beyond TCI's control, including but not limited to, improper storage, installation, operation, or maintenance.

If, within the warranty period, any product shall be found in TCI's reasonable judgment to be defective, TCI's liability and the Buyer's exclusive remedy under this warranty is expressly limited, at TCI's option, to (i) repair or replacement of that product, or (ii) return of the product and refund of the purchase price. Such remedy shall be Buyer's sole and exclusive remedy. TCI SHALL NOT, IN ANY EVENT, BE LIABLE FOR INCIDENTAL DAMAGES OR FOR CONSEQUENTIAL DAMAGES INCLUDING, BUT NOT LIMITED TO, LOSS OF INCOME, LOSS OF TIME, LOST SALES, INJURY TO PERSONAL PROPERTY, LIABILITY BUYER INCURS WITH RESPECT TO ANY OTHER PERSON, LOSS OF USE OF THE PRODUCT OR FOR ANY OTHER TYPE OR FORM OF CONSEQUENTIAL DAMAGE OR ECONOMIC LOSS.

The foregoing warranties do not cover reimbursement for removal, transportation, reinstallation, or any other expenses that may be incurred in connection with the repair or replacement of the TCI product.

The employees and sales agents of TCI are not authorized to make additional warranties about TCI's products. TCI's employees' and sales agents' oral statements do not constitute warranties; these shall not be relied upon by the Buyer and are not part of any contract for sale. All warranties of TCI are embodied in this writing and no other warranties are given beyond those set forth herein.

TCI will not accept the return of any product without its prior written approval. Please consult TCI Customer Service for instructions on the Return Authorization Procedure.

4.0 Pre-installation Planning

Verify the Application

Make sure that the HarmonicGuard® Active filter is correct for the application and sized for load. The voltage ratings of the HGA must match the input voltage rating of the connected AC bus.

Product Description

The HarmonicGuard® Active filter is an active harmonic filter designed and developed by TCI to relieve the power distribution system of the issues associated with harmonic currents that flow within the power distribution network caused by non-linear loads. The typical configuration can be found in Figure 1.

The topology of the bus-applied (3-phase, three wire) HGA consists of five major components:

- **Component 1** is made up of two current transformers (CTs) installed in phases A and C of the AC bus that are to be acted upon by the filter. The purpose of the CTs is to supply information to the HGA regarding the integrity of the composite AC bus current regarding the distortion (non-sinusoidal waveform) and displacement power factor relative to the AC bus Voltage. These signals will result in the HGA injecting currents that will return the AC line current to near sinusoidal shape and at unity power factor. Note that the CTs are located outside the HGA enclosure.
- **Component 2** is the HGA input protection (optional). This is provided to protect the HGA from destructive over current conditions if a malfunction occurs within the HGA circuitry. It also provides a convenient disconnect means and field wiring point for the installer of the filter equipment.
- **Components 3 and 4** are high frequency converter inductors. These inductors provide the proper inductance to the power converter.
- **Component 5** is a power electronic converter module. The Power converter module (PCM) is the heart of the HarmonicGuard® Active filter and is what differentiates the HGA from other types of harmonic mitigation. The PCM provides several highly complex electronic functions controlled by the on-board DSP controller. The PCM continuously senses the AC bus line Voltage and currents, processes the information at “nearly real time” by means of the instruction’s resident within the DSP program code, properly controls the six IGBT’s to operate in a safe manner that injects current into the AC bus grid that ensures the AC bus current is sinusoidal and near unity power factor. The power converter contains a pre-charge circuit, which consists of two SCRS and two pre-charging resistances, which control the inrush current.

Filter Configuration

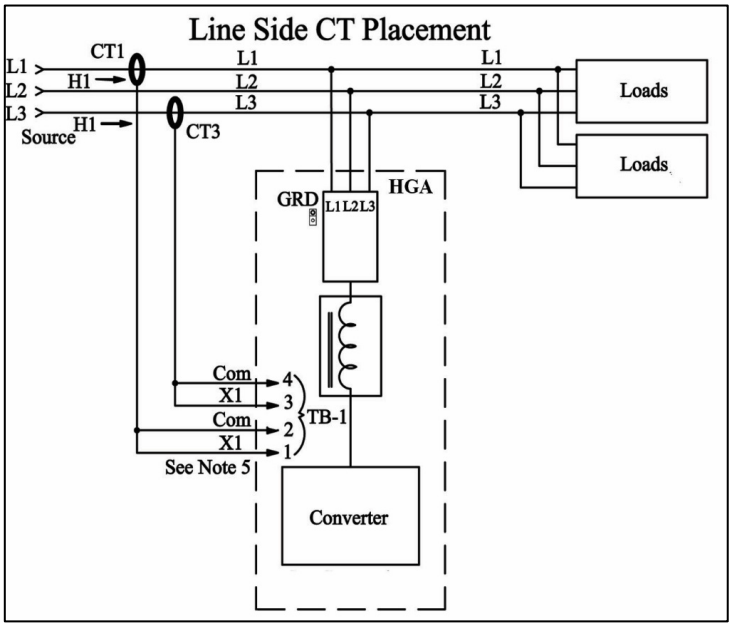


Figure 1: Typical Configuration of the HarmonicGuard® Active Filter

This drawing is for general reference only. Use the drawings supplied with the unit for installation.

Nameplate Data

Figure 2 shows a typical HarmonicGuard® Active filter nameplate. The following information is marked on the nameplate:

- Part number: Encoding is explained in the following pages.
- Corrective Current: The maximum amount of RMS Corrective Current the unit can deliver.
- System Voltage: The rated 3-phase line Voltage (RMS Volts)
- Hz: The rated frequency (60 Hz)
- Phase: 3, 3 Wire – The HGA is designed for use with only 3 wire systems with balanced 3-phase Voltage source.
- Drawing #: Outline and mounting dimension drawing number
- Schematic #: Schematic diagram drawing number
- Serial #: For unit tracking purposes
- Enclosure Type:
  UL508 - Open, UL Type 1
  UL508A – UL Type 3R (Gen 2 30A and 50A are UL508), and UL Type 12 Enclosures

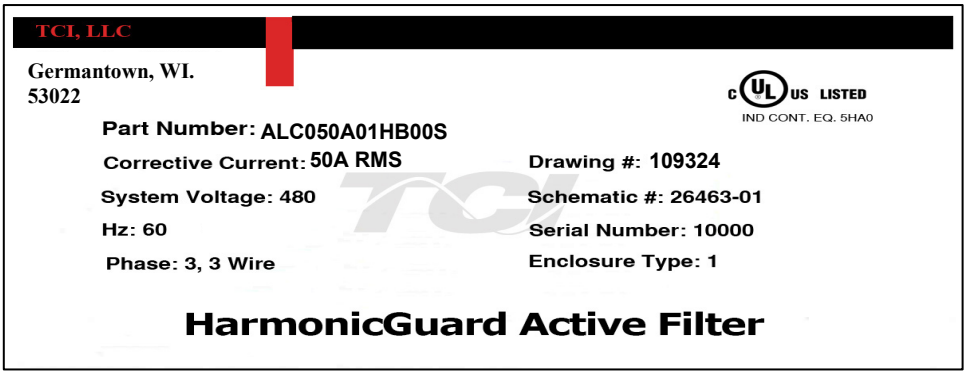


Figure 2: Typical HarmonicGuard® Nameplate

Table 1: HarmonicGuard® Active Filter Technical Specifications

Compensation Capacity (Parallel for Higher Capacity)	208 - 480 V: 30A – 700A, 3-phase, 50 or 60 Hz
	600 V: 24A – 520A; 3-phase; 50 or 60 Hz
Harmonic Cancellation Spectrum	To the 51st harmonic – auto-selecting, optional overall THD Setpoint Target available
Response Time	Less than 8 ms to step load changes
Power Factor Correction	Up to 0.98 lagging, optional Power Factor target setpoint available, optional VAR injection setpoint available.
RMS Current Attenuation	Less than 10:1
Parallel Configuration	Up to six active filters can be connected in parallel
Display	High quality touchscreen HMI with LED Backlight
Communications	Modbus RTU over RS485, Modbus TCP/IP, EtherNet/IP, BACnet;
Over Current Protection	Molded case 65 kAIC and 100 kAIC circuit breakers, 200kAIC Fuse Disconnect Switch, 200kAIC Fuse Block.
Environmental Conditions	
Ambient Temperature	Open, UL Type 1 & 12: 0°C to 40°C, Derating above 40°C UL Type 3R: -20°C to 40°C, Derating above 40°C All Generation 2 30A and 50A filters: 0 to 50°C, Derating above 50°C
Relative Humidity	95%, non-condensing
Operating Altitude	Up to 1000m (3,300 ft) without derating Up to 3000m (9,900 ft) with derating
Storage Temperature	Open Chassis, UL Type 1 & UL Type 12: -20°C (-4°F) to 60°C (140°F)
	UL Type 3R: -40°C (-40°F) to 60°C (140°F) UL Type 3R with HMI: 0°C (32°F) to 40°C (104°F)
Enclosure Options	Open Chassis, UL Type 1, UL Type 3R, UL Type 12
Reference Technical Standards	
Agency Approvals	cULus Listed
HMI Languages	English, French, Spanish
Surge Protection	ANSI C62.42

Ambient and Altitude Temperature Derating Curves

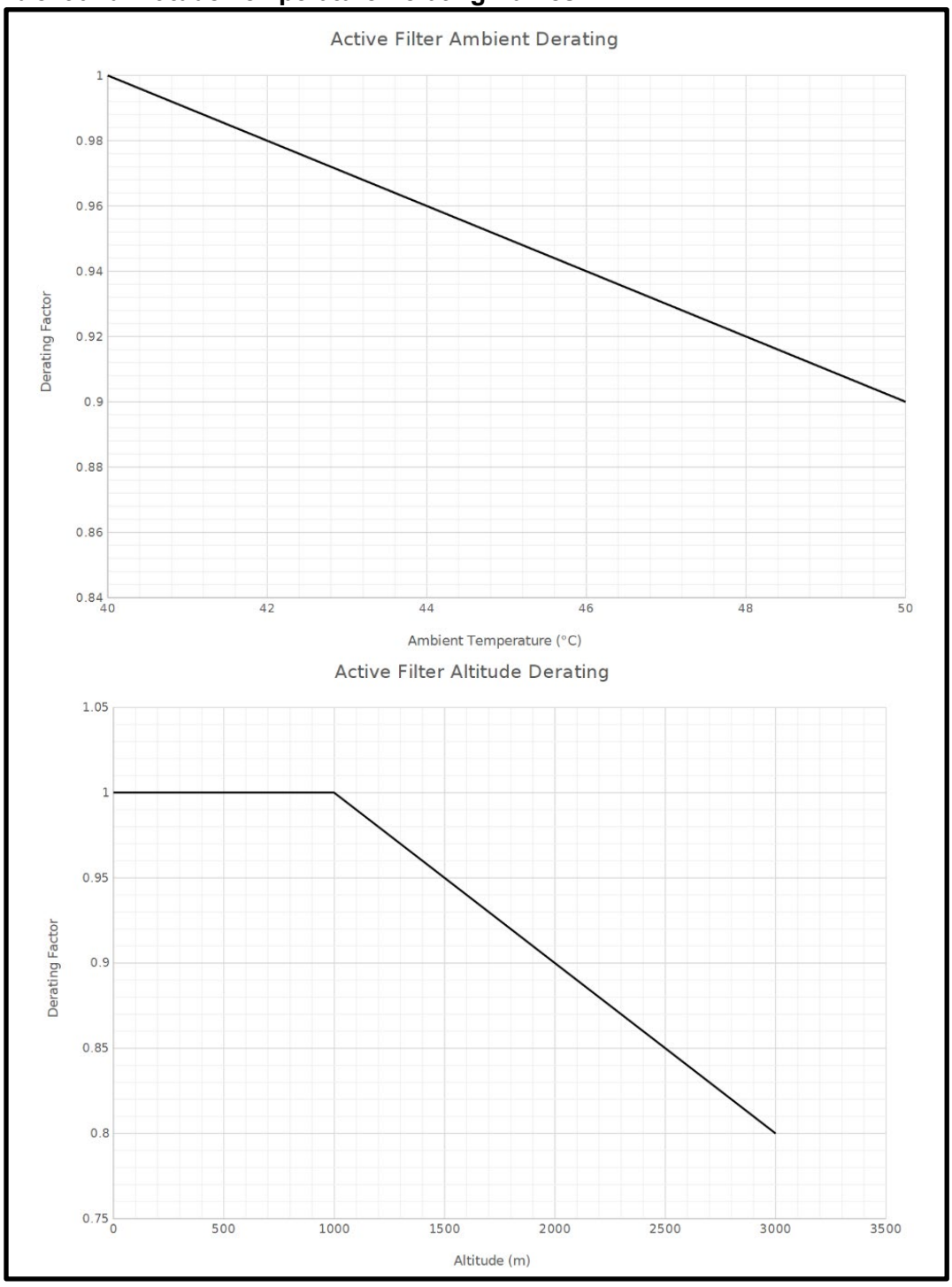


Figure 3: Ambient and Altitude Temperature Derating

HGA Part Numbering System

Figure 4 identifies the significance of each character in the HarmonicGuard® Active filter part number. An example of a completed part number would be ALC050A01HB00S. This designates an enclosed Type 1 HarmonicGuard® Active filter that is rated for 50 amps, 480 Volts, and has an HMI Interface Module Package module for 3-Level Topology (Gen 2). A HGA filter that utilizes 2-level power topology is denoted as Generation 1 in their part numbering scheme.

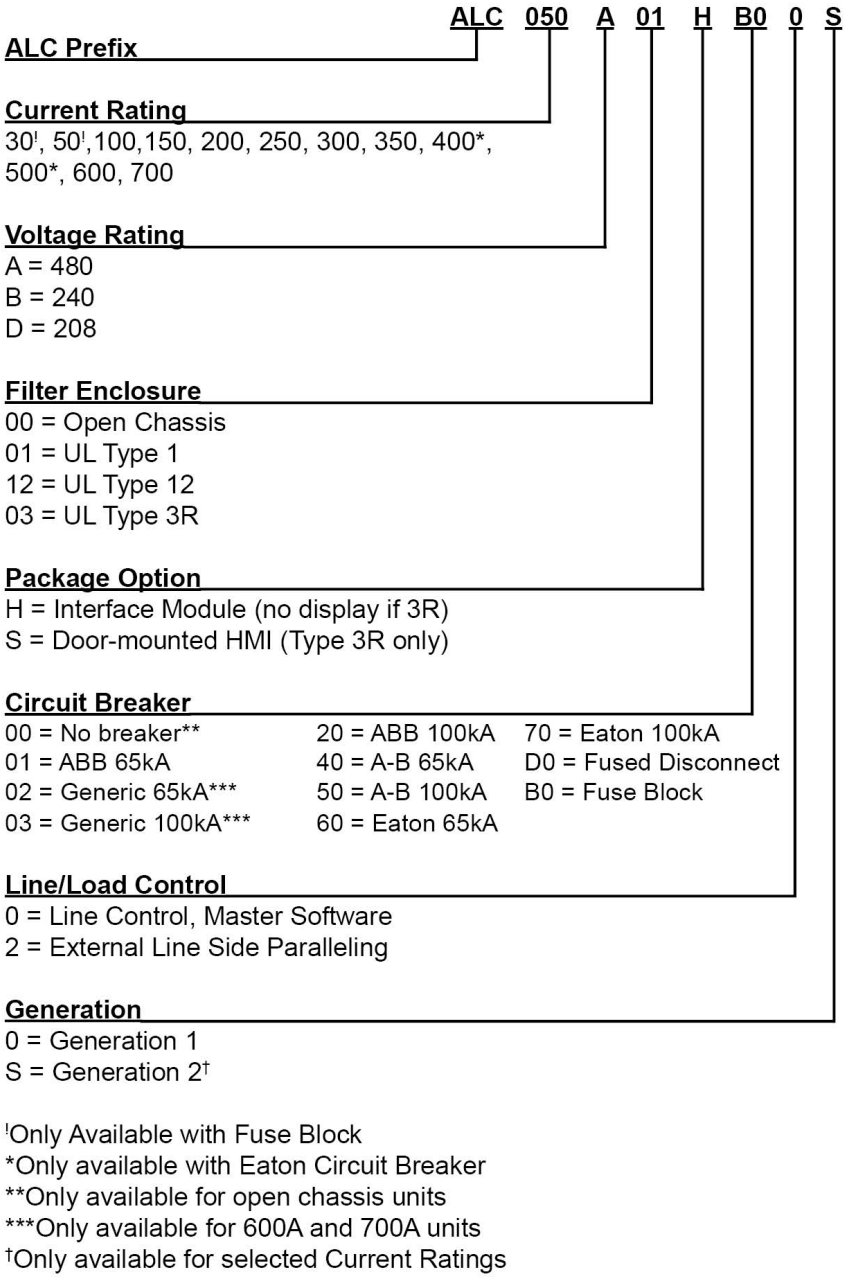


Figure 4: HarmonicGuard® Active Part Number Encoding

Note: *208 V and 240 V product versions are documented as 480 V in product description and data. To achieve a 600V filter, a 600V transformer will need to be paired in order to achieve correct amps at 600V w/ XFMR rating.*

Communications Part Numbering

Figure 5: Communication Part Number Scheme, below shows the Communications Module part numbering system. The base/standard communications unit is the CM050A00, which has the HMI with a Modbus RTU over RS485 network interface.

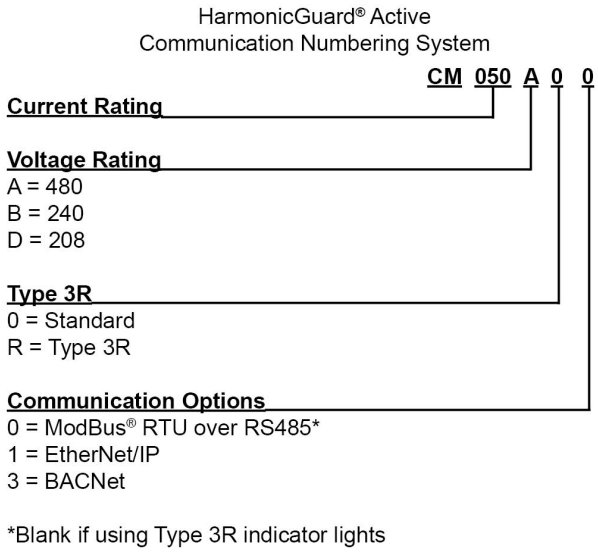


Figure 5: Communication Part Number Scheme

Floor Stand Options

Table 2 below shows the Floor Stand options. The floor stand is currently only available for use with Type 1 enclosures.

Note: *400A filters and above come with a floor stand installed already.*

Table 2: Floor Stand Options

Voltage	Floor Stand Part Number	Frame	Amp Rating
480 V	HGAF01D1A	D1	50A* & 100A
480 V	HGAF01E1	E1	150A
480 V	HGAF01F1	F1	200A & 250A
480 V	HGAF01E2	E2	300A
480 V	HGAF01G1	G1	300 Narrow/350

****For Generation 1 50A filters only, Generation 2 30A and 50A filters do not have a floor stand option.***

Note: *208 V and 240 V product versions are documented as 480 V in product description and data. To achieve a 600V filter, a 600V transformer will need to be paired in order to achieve correct amps at 600V w/ XFMR rating.*

Mounting an Open Chassis Unit

Open chassis models shall be mounted in an enclosure considered representative of the intended use. If you are mounting an open chassis unit in your own enclosure, you must provide an enclosure that is adequately sized and ventilated sufficiently to prevent overheating. Refer to the HGA Ratings Table for dimensions and heat loss that is dissipated by the HGA. The maximum ambient temperature should not exceed 40°C (104°F). The 30-amp and 50-amp generation 2 open chassis units have an ambient surrounding air temperature of 50ºC (122ºF).

Open chassis unit cooling notes

- Locate the air outlet in the top of enclosure or in the upper 5% of the sides, with the required vent open area specified in the cooling drawing.
- The air inlet should be in the bottom of enclosure or in the lower 5% of the sides, with the required vent open area specified in the cooling drawing.
- Minimum air flow per fan is specified in the cooling drawing.
- Depending on the efficiency of the bottom ventilation, the fans mounted on the bottom of the unit may not be necessary.
- Maximum side wall spacing is 2 inches.
- The chassis needs to be mounted vertically.
- The chassis is rated for 40° C ambient temperature.
- Additional ventilation may be needed, depending on air vent and enclosure configuration.
- Covers should remain in place to guarantee proper cooling.
- Contact TCI to deviate from the specifications defined in the cooling diagrams.
- Dimensions in the cooling diagrams are approximate and in inches.

Cooling Diagrams

Please reference TCI's website for a list of cooling diagram drawings for the HGA open chassis units. Paper copies of the cooling diagrams are in the literature kit that is included with all open chassis units.

UL Type 3R Unit Heating and Cooling Notes

The UL Type 3R Enclosed Active Filter is equipped with heating and cooling provisions to meet minimum ambient temperature requirements. Equipped are thermostat-controlled cooling fans and an enclosure heater. Under normal operating conditions, the Enclosure Thermostat is to be set to 90°F and the enclosure heater is to be set to 40°F. In humid environments, the enclosure heater is to be set to 100°F or MAX, whichever is lesser. (The Generation 2 30-amp and 50-amp filters do not have heaters.)

Working Space

Provide enough access and working space around the unit to permit ready and safe installation, operation, and maintenance. Make sure that the installation conforms to all working space and clearance requirements of the National Electrical Code (NEC) and/or any other applicable codes. Provide enough unobstructed space to allow cooling air to flow through the unit. Refer to the applicable installation drawing for clearances.

5.0 Installation Guidelines

Installation Checklist

The following are the key points to be followed for a successful installation. These points are explained, in detail, in the following sections of this manual.

- Make sure that the installation location will not be exposed to excessive vibration, corrosive or combustible airborne contaminants, excessive dirt, or liquids.
- Select a mounting area that will allow adequate cooling air flow and maintenance access.
- Make sure that all wiring conforms to the requirements of the National Electrical Code (NEC) and/or other applicable electrical codes.
- Connect the HGA filter equipment-grounding lug to the system ground of the premises wiring system. Use a properly sized grounding conductor.
- Connect 3-phase power to the input terminals of the HGA filter, L1; L2; L3.
- Ensure that the CTs are properly installed and connected to the proper terminals inside the HGA filter.
- Check everything thoroughly before applying.

Select a Suitable Location

Locating the HarmonicGuard® Active filter in a suitable environment will help ensure proper performance and a normal operating life. Refer to the environmental specifications listed in Table 1: HarmonicGuard® Active Filter Technical Specifications, marked on the unit's nameplate and/or noted on the drawings furnished with the unit.

Warning 	Unless specifically labeled as approved for such use, this equipment is not suitable for use in an explosive atmosphere or in a "Hazardous (Classified) Location" as defined in article 500 of the National Electrical Code (NEC).

UL Type 1 and open chassis units shall be installed in a pollution degree 2 environment (UL 508) where it will not be exposed to:

- Rain or dripping liquids.
- Corrosive liquids or gases.
- Explosive or combustible gases or dust.
- Excessive airborne dirt and dust.
- Excessive vibration. [0.152 mm (0.006 in.) displacement, 1G peak]
  Please note that custom enclosure options may vary by available installation areas.

Lifting And Mounting

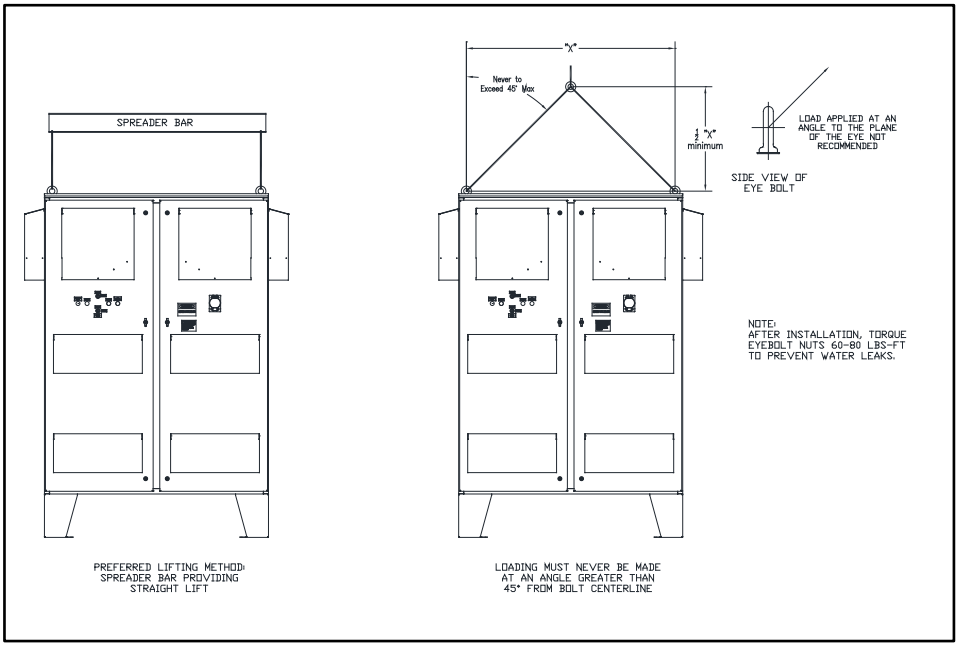


Figure 6: Lifting Diagram

The HGA must be mounted vertically on a smooth, solid surface, free from heat, dampness, and condensation. Refer to the applicable installation drawing for clearances.

Wiring

Cable Entry Locations

The enclosed HarmonicGuard® Active filters are not provided with enclosure wiring knockouts. However, a removable wire entry plate is provided. A selection can be made at the time of installation. Typical or recommended cable entry locations are shown in the drawings shipped with the unit.

Circuit Breaker

For HGA units with an internal circuit breaker, see the tables below for field wiring terminal wire size and tightening torque information. Please reference the Circuit Breaker Selection for circuit breaker selection recommendations on HGA units provided without a circuit breaker. The Circuit Breaker Selection contains tables of acceptable 65kAIC and 100kAIC circuit breakers from various manufacturers.

Field Wiring Connection Terminals

Compression type terminals are provided for all field wiring connections. The wire size (75° C copper) capacity ranges and tightening torque for the grounding and power terminals are listed in the following tables. Refer also to the drawings and other information shipped with the unit. A means to disconnect is the responsibility of the customer.

Table 3: Power Terminal Wire Size Capacity Range and Tightening Torque for Active Filter Ground Lug

Filter Size		Ground Lugs		
208-480 V	**600 V****	**Wire Size*****	**Torque In-Lbs. (Nm)**	**Wire Type**
30A to 50A*	24A to 39A	2 - 1/0 AWG	50 (5.7)	CU/AL
50A (Gen 1) to 100A	39A to 78A	6 - 2/0 AWG	50 (5.7)	CU/AL
150A	110A	6 - 2/0 AWG	50 (5.7)	CU/AL
200A	150A	6 AWG - 250 MCM	375 (42.4)	CU/AL
250A	185A	6 AWG - 250 MCM	375 (42.4)	CU/AL
300A	220A	(2) 4 AWG - 600 MCM	500 (57)	CU/AL
350A	260A	(2) 4 AWG - 600 MCM	500 (57)	CU/AL
400A	300A	(2) 4 AWG - 600 MCM	500 (57)	CU/AL
500A	370A	(2) 4 AWG - 600 MCM	500 (57)	CU/AL
600A	450A	(3) 2 AWG - 600 MCM	500 (57)	CU/AL
700A	520A	(3) 2 AWG - 600 MCM	500 (57)	CU/AL

**50A filter refers to Generation 2 Filter, Legacy Generation 1 Filter wire size is 6 AWG – 2/0.*

***To achieve a 600V filter, a 600V transformer will need to be paired to achieve correct amps at 600V w/ XFMR rating.*

******* Wire size range listed is for lug as per lug manufacturer. Follow NEC guidelines for sizing ampacity of power conductors.

Table 4: Power Terminal Wire Size Capacity Range and Tightening Torque for Active Filter Models with Eaton Circuit Breakers

Filter Size		Breaker IC	CB Power Terminals		
208-480 V	**600 V****		**Wire Size*****	**Torque In-Lbs. (Nm)**	**Wire Type**
50A*	39A	65/100 kA	14 - 3/0 AWG	45 (5.1)	CU/AL
100A	78A	65/100 kA	14 - 3/0 AWG	50 (5.7)	CU/AL
150A	110A	65/100 kA	4 - 4/0 AWG	120 (14)	CU/AL
200A	150A	65/100 kA	3 AWG - 350 MCM	275 (31)	CU/AL
250A	185A	65/100 kA	3 AWG - 350 MCM	275 (31)	CU/AL
300A	220A	65/100 kA	250-500 MCM	375 (42)	CU/AL
350A	260A	65/100 kA	(2) 2 AWG - 500 MCM	375 (42)	CU/AL
400A	300A	65/100 kA	(2) 2 AWG - 500 MCM	375 (42)	CU/AL
500A	370A	65/100 kA	(2) 2 AWG - 500 MCM	375 (42)	CU/AL

** 50A refers to Generation 1 Active Harmonic Filters, 30/50A Generation 2 Filters are only offered with Fuse Block Protection.*

***To achieve a 600V filter, a 600V transformer will need to be paired to achieve correct amps at 600V w/ XFMR rating.*

**** Wire size range listed is for lug as per lug manufacturer. Follow NEC guidelines for sizing ampacity of power conductors.*

Table 5: Power Terminal Wire Size Capacity Range and Tightening Torque for Active Filter Models with Rockwell Allen Bradley Circuit Breakers

Filter Size		Breaker IC	CB Power Terminals		
208-480 V	**600 V****		**Wire Size*****	**Torque In-Lbs. (Nm)**	**Wire Type**
50A* to 100A	39A to 78A	65/100 kA	14 - 1/0 AWG	62 (7.0)	CU Only
150A	110A	65/100 kA	4 AWG - 300 MCM	200 (23)	CU/AL
200A	150A	65/100 kA	4 AWG - 300 MCM	200 (23)	CU/AL
250A	185A	65/100 kA	(2) 2/0 AWG - 250 MCM	275 (31)	CU/AL
300A	220A	65/100 kA	(2) 2/0 AWG - 250 MCM	275 (31)	CU/AL
350A	260A	65/100 kA	(2) 2/0 AWG - 250 MCM	275 (31)	CU/AL

** 50A refers to Generation 1 Active Harmonic Filters, 30/50A Generation 2 Filters are only offered with Fuse Block Protection.*

***To achieve a 600V filter, a 600V transformer will need to be paired to achieve correct amps at 600V w/ XFMR rating.*

**** Wire size range listed is for lug as per lug manufacturer. Follow NEC guidelines for sizing ampacity of power conductors.*

Table 6: Power Terminal Wire Size Capacity Range and Tightening Torque for Active Filter Models with ABB Circuit Breakers

Filter Size		Breaker IC	CB Power Terminals		
208-480 V	**600 V****		**Wire Size*****	**Torque In-Lbs. (Nm)**	**Wire Type**
50A* to 100A	39A to 78A	65/100 kA	14 - 1/0 AWG	50 (5.7)	CU/AL
150A	110A	65/100 kA	4 AWG - 300 MCM	200 (22.6)	CU/AL
200A	150A	65/100 kA	4 AWG - 300 MCM	200 (22.6)	CU/AL
250A	185A	65/100 kA	(2) 2/0 AWG - 500 MCM	275 (31)	CU/AL
300A	220A	65/100 kA	(2) 2/0 AWG - 500 MCM	275 (31)	CU/AL
350A	260A	65/100 kA	(2) 2/0 AWG - 500 MCM	275 (31)	CU/AL

** 50A refers to Generation 1 Active Harmonic Filters, 30/50A Generation 2 Filters are only offered with Fuse Block Protection.*

***To achieve a 600V filter, a 600V transformer will need to be paired to achieve correct amps at 600V w/ XFMR rating.*

**** Wire size range listed is for lug as per lug manufacturer. Follow NEC guidelines for sizing ampacity of power conductors.*

Table 7: Power Terminal Wire Size Capacity Range and Tightening Torque for Active Filter Models with LSIS Circuit Breakers

Filter Size		LSIS MCCB Power Terminals			
208 - 480 V	**600 V***	**Breaker IC**	**Wire Size****	**Torque In-Lbs (Nm)**	**Wire Type**
600A	450A	65kA/100 kA	(3) 3/0 AWG - 400 MCM	400 (45)	CU/AL
700A	520A	65kA/100 kA	(3) 3/0 AWG - 400 MCM	400 (45)	CU/AL

**To achieve a 600V filter, a 600V transformer will need to be paired to achieve correct amps at 600V w/ XFMR rating.*

*** Wire size range listed is for lug as per lug manufacturer. Follow NEC guidelines for sizing ampacity of power conductors.*

Table 8: Power Terminal Wire Size Capacity Range and Tightening Torque for 600 V Active Filter Models with 480V/600V K-Rated AutoTransformer

Filter Size	Primary Power Terminals		Secondary Power Terminals		Ground Lug		
600 V*	**Wire Size***	**Torque In-Lbs. (Nm)**	**Wire Size***	**Torque In-Lbs. (Nm)**	**Wire Size***	**Torque In-Lbs. (Nm)**	**Wire Type**
39A to 78A	14 - 2/0 AWG	84 (9.5)	14 - 2 AWG	84 (9.5)	14 - 2 AWG	84 (9.5)	CU/AL
110A to 150A	300 MCM	240 (27)	6 AWG - 300 MCM	240 (27)	14 - 2 AWG	84 (9.5)	CU/AL
185A to 220A	600 MCM	360 (41)	600 MCM	360 (41)	14 - 2 AWG	84 (9.5)	CU/AL
370A	PADS	240 (27)	PADS	240 (27)	14 - 2 AWG	84 (9.5)	CU/AL

***To achieve a 600V filter, a 600V transformer will need to be paired to achieve correct amps at 600V w/ XFMR rating.*

****** Wire size range listed is for lug as per lug manufacturer. Follow NEC guidelines for sizing ampacity of power conductors.

Table 9: Power Terminal Wire Size Capacity Range and Tightening Torque for Open Chassis Active Filter Models with Power Terminal Block (without Circuit Breaker)

Filter Size	Filter Size	Power Terminal Block		
208-480 V	**600 V****	**Wire Size*****	**Torque In-Lbs. (Nm)**	**Wire Type**
50A* to 100A	39A - 78A	14 - 2/0 AWG	120 (13.6)	CU/AL
150A	110A	3/0 AWG - 350 MCM	275 (31)	CU/AL
200A	150A	3/0 AWG - 350 MCM	275 (31)	CU/AL
250A	185A	4 AWG - 500 MCM	375 (42.4)	CU/AL
300A	220A	(2) 6 AWG – 250 MCM	275 (31.1)	CU/AL
350A	260A	(2) 6 AWG – 250 MCM	275 (31.1)	CU/AL
400A	300A	(2) 4 AWG – 500 MCM	450 (51)	CU/AL
500A	370A	(2) 4 AWG – 500 MCM	450 (51)	CU/AL
600A	450A	(4) 6 AWG – 350 MCM	275 (31.1)	CU/AL
700A	520A	(4) 6 AWG – 350 MCM	275 (31.1)	CU/AL

** 50A refers to Generation 1 Active Harmonic Filters, 30/50A Generation 2 Filters are only offered with Fuse Block Protection.*

***To achieve a 600V filter, a 600V transformer will need to be paired to achieve correct amps at 600V w/ XFMR rating.*

**** Wire size range listed is for lug as per lug manufacturer. Follow NEC guidelines for sizing ampacity of power conductors.*

Table 10: Power Terminal Wire Size Capacity Range and Tightening Torque for Active Filter models with Fused Disconnect Switches

Filter Size	Filter Size	CB Power Terminals			
208 - 480 V	**600 V****	**MFG**	**Wire Size*****	**Torque In-Lbs. (Nm)**	**Wire Type**
50A*	39A	Socomec	10 - 2/0 AWG	40 (4.5)	CU
100A	78A	ABB	4 AWG - 300 MCM	200 (23)	CU/AL
150A	110A	ABB	4 AWG - 300 MCM	200 (23)	CU/AL
200A	150A	Socomec	2 AWG - 600 MCM	310 (35)	CU/AL
250A	185A	Socomec	2 AWG - 600 MCM	310 (35)	CU/AL
300A	220A	Socomec	(2) 2 AWG - 600 MCM	500 (57)	CU/AL
350A	260A	Socomec	(2) 2 AWG - 600 MCM	500 (57)	CU/AL
400A	300A	Eaton	(2) 2 AWG - 600 MCM	500 (57)	CU/AL
500A	370A	Socomec	(2) 2 AWG - 600 MCM	500 (57)	CU/AL

* 50A refers to Generation 1 Active Harmonic Filters, 30/50A Generation 2 Filters are only offered with Fuse Block Protection.
**To achieve a 600V filter, a 600V transformer will need to be paired to achieve correct amps at 600V w/ XFMR rating.
*** Wire size range listed is for lug as per lug manufacturer. Follow NEC guidelines for sizing ampacity of power conductors.

Table 11: Power Terminal Wire Size Capacity Range and Tightening Torque for Active Filter Models with Non-Fused Disconnect Switches

Filter Size		Control Connections			
208 - 480 V	**600 V***	**MFG**	**Wire Size****	**Torque In-Lbs (Nm)**	**Wire Type**
300A	220A	Socomec	(2) 6 AWG - 350 kcmil	500 (57)	CU/AL
350A	260A	Socomec	(2) 6 AWG - 350 kcmil	500 (57)	CU/AL
400A	300A	Eaton	(2) 2 AWG - 600 kcmil	500 (57)	CU/AL
500A	370A	Socomec	(2) 2 AWG - 600 kcmil	500 (57)	CU/AL

**To achieve a 600V filter, a 600V transformer will need to be paired to achieve correct amps at 600V w/ XFMR rating.*
*** Wire size range listed is for lug as per lug manufacturer. Follow NEC guidelines for sizing ampacity of power conductors.*

Table 12: Power Terminal Wire Size Capacity Range and Tightening Torque for Active Filter Models with Fuse Block

Filter Size		CB Power Terminals		
208-480 V	**600 V***	**Wire Size****	**Torque In-Lbs. (Nm)**	**Wire Type**
30A* to 50A*	24A to 39A	4 AWG – 2 AWG	50 (5.7)	CU/AL
90A to 100A	78A	6 AWG - 250 MCM	375 (42)	CU/AL
150A	110A	6 AWG - 250 MCM	375 (42)	CU/AL
200A	150A	4 AWG - 500 MCM	450 (51)	CU/AL
250A	185A	4 AWG - 500 MCM	450 (51)	CU/AL
300A	220A	(2) 4 AWG - 500 MCM	450 (51)	CU/AL
350A	250A	(2) 4 AWG - 500 MCM	450 (51)	CU/AL
400A	300A	(2) 4 AWG - 500 MCM	450 (51)	CU/AL
500A	370A	(2) 4 AWG - 500 MCM	450 (51)	CU/AL

** 30/50A refers to Generation 2 Active Harmonic Filters.*
***To achieve a 600V filter, a 600V transformer will need to be paired to achieve correct amps at 600V w/ XFMR rating.*
**** Wire size range listed is for lug as per lug manufacturer. Follow NEC guidelines for sizing ampacity of power conductors.*

Table 13: Control Terminal Wire Size Capacity Range and Tightening Torque for all Active Filter models

Control Connections		
Wire Size*	**Torque In-Lbs (Nm)**	**Wire Type**
28 to 14 AWG	4.4 (0.5)	CU/AL

*****Note**: Wire size range listed is for lug as per lug manufacturer. Follow NEC guidelines for sizing ampacity of power conductors.*

Caution 	Use copper wire that is appropriate for the Voltage and current rating of the equipment. The wire selection must conform to the requirements of the National Electrical Code (NEC) and/or other applicable electrical codes. Use wire with an insulation temperature rating of 75°C or higher.

Connection Diagram

The Figure 7: Load Connection Diagram below shows the typical wiring connections between the models of the HGA and the load. Refer to the drawings furnished with the unit for more specific information.

Connection diagram in this section is representative. For the latest connection diagram, please see the TCI website for the 25027-3 for 208-480 V connection diagram, 28425 drawing for 600 V connection diagram, the 28283-1 for HMI and network connection diagram, and 28282-1 for HMI plate connection & installation Diagram with HMI purchase. For the most current CT options and sizes please see TCI Current Transformer Drawing 26461.

The input 3-phase AC Voltage source must be connected in a positive ABC phase rotation from L1-L2-L3 for correct unit operation.

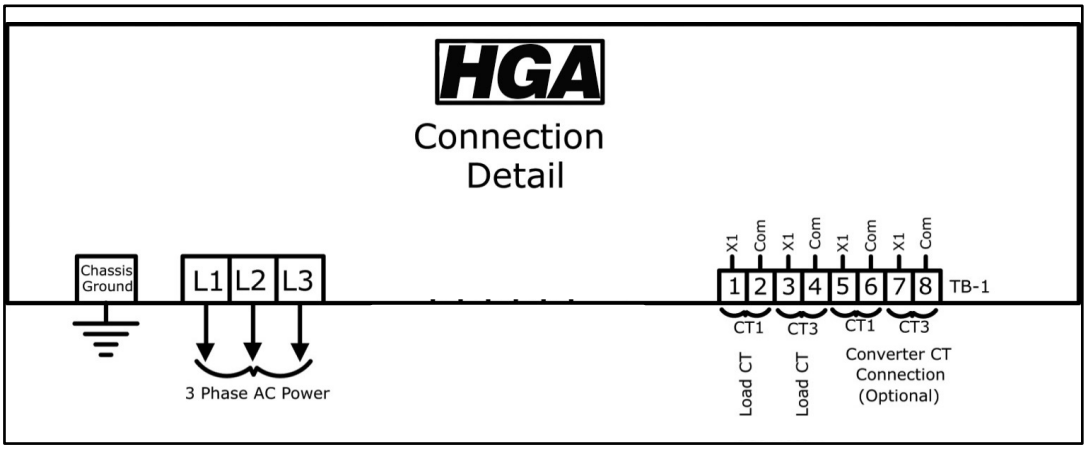


Figure 7: Load Connection Diagram

Notes:

- Wiring should be 75° C or higher insulated copper, with the appropriate Voltage and current rating.
- The chassis ground must be connected to the ground of the premises wiring system, in accordance with NEC and local codes. Connection must be made using a wire conductor.
- Terminal TB-I & J25 wire range is 30-12 AWG, tightening torque is 4.4 IN-LB (0.5 NM).
- Operating current transformers with the secondary winding open can result in a high Voltage across the secondary terminals, which may be dangerous to personnel or equipment.

Current Transformer Installation

For accurate sensing of the load, it is important that the load sensing current transformers are properly installed.

Warning	All electrical installation and maintenance work on the HGA should be carried out by qualified electricians only. Failure to follow standard safety procedures may result in death or serious injury. Do not attempt any work on a powered HGA. Disconnect all sources of power to the HGA and any connected equipment before working on the equipment. Check for zero Voltage between all phases of the input and output lines. **Operating current transformers with the secondary winding open can result in a high Voltage across the secondary terminals, which may be dangerous to personnel or equipment.**

It is necessary for the HGA to monitor the current in Phase “A” (L1) and Phase “C” (L3). Stand-alone HGA filters are designed for Line Side current transformer (CT) placement as shown in Figure 8. It is important that both CTs are on the same side of the HGA. The CTs should be centered around the conductor.

The polarity of the CT is important; the “H1” marking on the CT must face the source. The secondary windings of the CT around conductor L1 should connect to TB-1 terminals 1 & 2 and the CT around conductor L3 should connect to TB-1 terminals 3 & 4. The secondary wire of the CT identified as “X1” must connect to the “X1” terminal of TB-1 for both CTs. Failure to maintain the correct polarity and phasing will cause an over-current fault. If this should happen, refer to the troubleshooting section.

***Note**: Units with black “TB-1” terminal blocks are shipped with two position shorting jumpers installed between positions 1 & 2 and 3 & 4. This is done for safety and to prevent equipment damage. The jumpers are installed in the center of the block and can be identified by the gray top. After the load CTs are installed and wired, these jumpers must be removed for correct unit operation. They can be removed with a standard flat blade screwdriver.*

***Note:** CT operation can be verified via the HMI touchscreen feedback waveform plot screens. Reference the HMI VLine & ILine Waveform Plot Sub Screen for details.*

Table 14: CT Range by Model Size

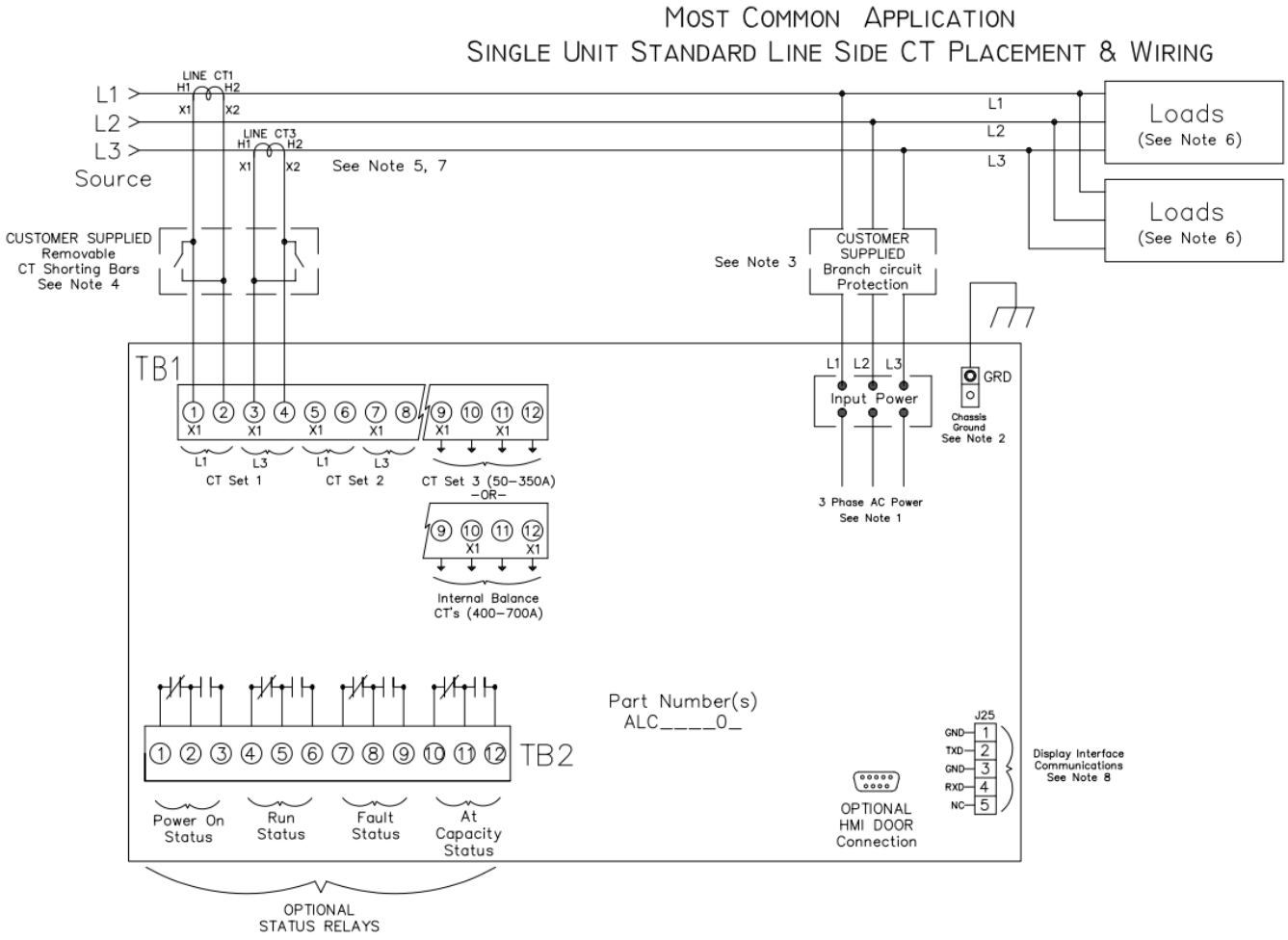
Amps	Voltage	CT Min Ratio	CT Max Ratio	Notes
30 & 50*	480 V	100:5	2000:5	***Factory Technician start up required to use CTs outside of the published range***
50 to 100	Up to 600 V	250:5	3000:5	
150	480 V	300:5	4000:5	
150	600 V	800:5	3000:5	
185	600 V	600:5	5000:5	
200	480 V	600:5	5000:5	
220	600 V	1000:5	4000:5	
250	480 V	600:5	5000:5	
300	480 V	800:5	6000:5	
350	480 V	800:5	6000:5	
370	600 V	1800:5	6000:5	
400	480 V	1800:5	6000:5	
500	480 V	1800:5	6000:5	
600	480 V	1200:5	6000:5	
700	480 V	1200:5	6000:5	

** 30A/50A refers to Generation 2 Active Harmonic Filters.*

Current Transformer Placement

The exact CT placement is dependent on the HGA's configuration and size. Please refer to the current transformer diagrams found on the TCI HGA webpage for the installation that applies to your configuration.

The HGA is factory configured for Line Applied/Master. A line side unit wired with load side CT feedback will not operate correctly.



Notes:

1.) Wiring should be 75°C or higher insulated copper, with the appropriate voltage and current rating.
2.) Chassis ground must be connected to the ground of the premises wiring system, in accordance with NEC and local codes. Connection must be made using a wire conductor.
3.) Customer is responsible for branch circuit protection.
4.) Operating current transformers with the secondary winding open can result in a high voltage across the secondary terminals which may be dangerous to personnel or equipment.
5.) Current transformers should be centered around conductor.
6.) Load(s) have an integral 3% line reactance or equivalent dc bus choke to optimize Active Filter utilization, consult TCI for Active Filter capacity with less than 3%.
7.) CT's are customer installed, and external to the Active Filter.
8.) Available network interface depends on CM Module HMI option or enclosure type. Reference the HGA IOM or HMI Schematic / Connection Diagram 28283–1

Figure 8: HGA 480 V Most Common Single Unit Line Side CT Placement and Wiring

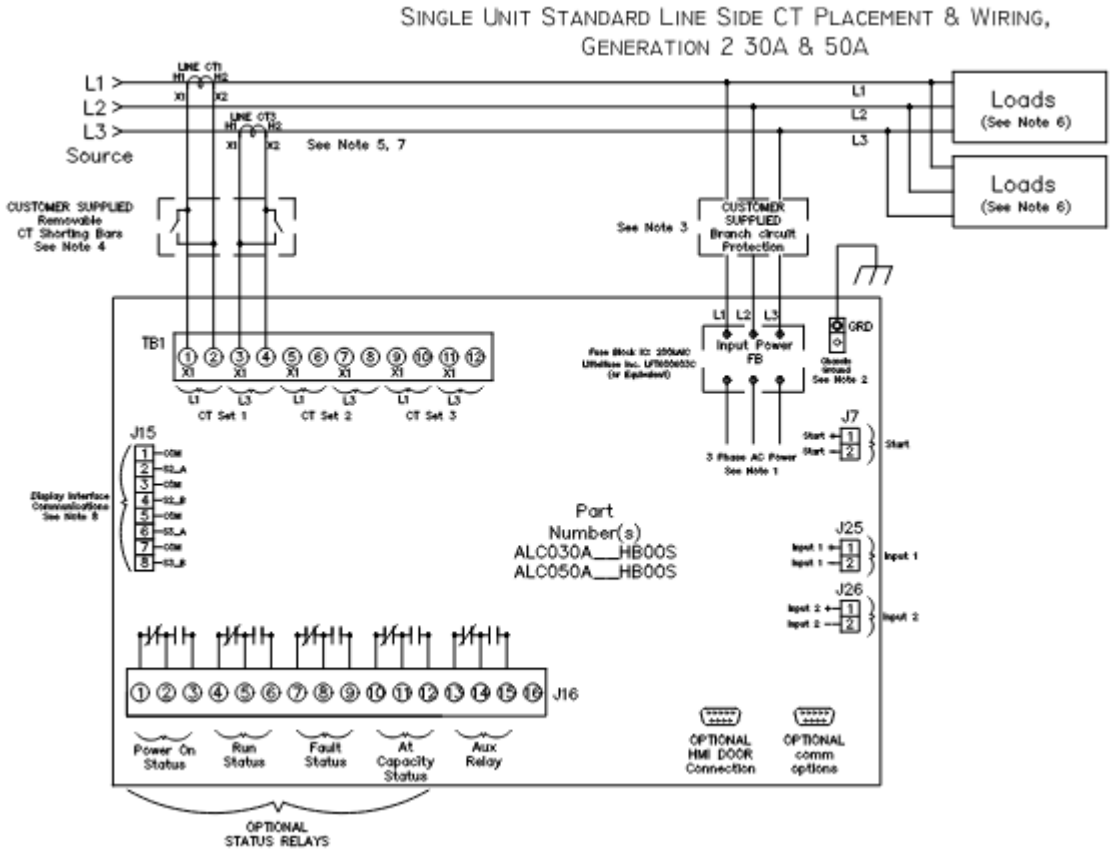


Figure 9: HGA 480 V Generation 2 30A or 50A Single Unit Line Side CT Placement and Wiring

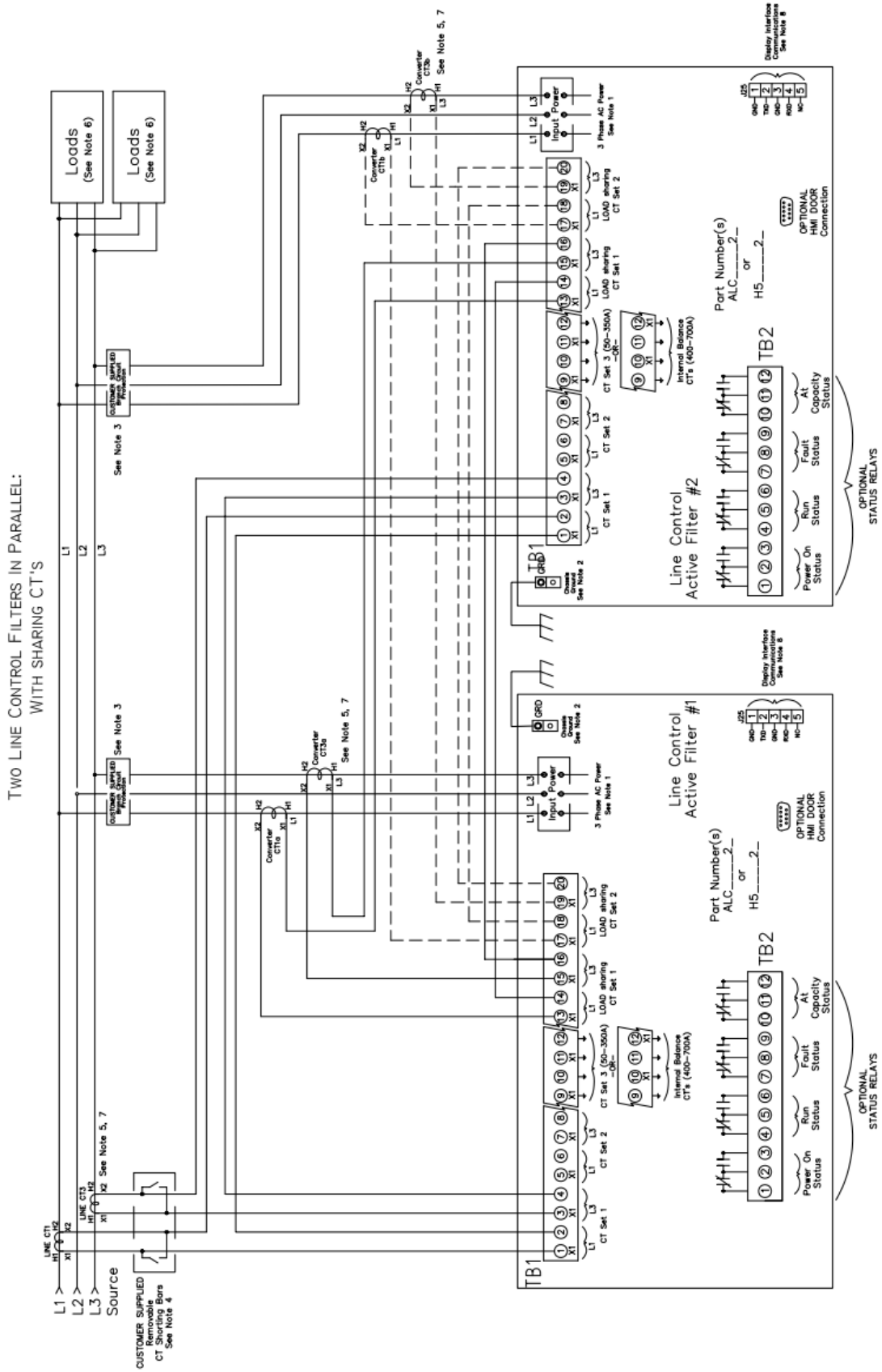


Figure 10: HGA 480 V Two Unit Line Control Filters in Parallel Connection Diagram

Notes:
1.) Wiring should be 75°C or higher insulated copper, with the appropriate voltage and current rating.
2.) Chassis ground must be connected to the ground of the premises wiring system, in accordance with NEC and local codes. Connection must be made using a wire conductor.
3.) Customer is responsible for branch circuit protection.
4.) Operating current transformers with the secondary winding open can result in a high voltage across the secondary terminals which may be dangerous to personnel or equipment.
5.) Current transformers should be centered around conductor.
6.) Load(s) have an integral 3% line reactance or equivalent dc bus choke to optimize Active Filter utilization, consult TCI for Active Filter capacity with less than 3%.
7.) CT's are customer installed, external to the Active Filter. Load sharing CT's are 1000:1 ratio.
8.) Active Filter #1 and #2 must be same current rating.
9.) Available network interface depends on CM Module HMI option or enclosure type. Reference the HGA IOM or HMI Schematic / Connection Diagram 28283–1

Figure 11: Notes for HGA 480V Two Unit Line Control Filters in Parallel

CT Wire Recommendations

If you want to extend your CT leads, there are four basic options:

- Twisted - Our standard CT leads are twisted. Twisting is important for noise immunity, especially at 50-60 Hz.
- Shielded and twisted - Adding a shield—in addition to the twisting—can offer some additional noise immunity, especially for long extensions. Note: for best immunity to crosstalk, the wires should be twisted in pairs.
- Non-shielded and non-twisted - Most cables are twisted, so this normally only arises if you use two single conductors. We recommend this for most applications because there is very little noise immunity. This can work if the conductors for each CT are kept in close contact to minimize loop area and if the CT conductors are kept away from line (mains) conductors and in their own conduit or metal raceway.
- Shielded but non-twisted - This is a bit unusual but does occur. There are two concerns with this type of cable. First, the shield primarily blocks high frequency interference, but not 60 Hz. 60 Hz is much better blocked by twisting the wires. 60 Hz interference is a big concern, because there is a lot of 60 Hz noise and it's the main frequency we are measuring. Second, because the wires are not twisted into pairs, there is a greater risk of crosstalk between CTs if you run more than one pair of CT wires in the same cable. If possible, use twisted pair cabling when extending CT wires.

Notes:

- Wiring should be 75° C or higher insulated copper, with the appropriate Voltage and current rating.
- The chassis ground must be connected to the ground of the premises wiring system, in accordance with NEC and local codes. Connection must be made using a wire conductor.
- The customer is responsible for branch circuit protection.
- Terminal TB-1 and J25 wire range is 30-12 AWG, tightening torque is 4.4 in-lb. (.5 Nm).
- Operating current transformers with the secondary winding open can result in a high Voltage across the secondary terminals, which may be dangerous to personnel or equipment.
- Current transformers should be centered around conductor.
- Load(s) have an integral 3%-line reactance or equivalent DC bus choke to optimize Active Filter utilization, consult TCI for Active filter capacity with less than 3%.
- Source CTs are customer installed and external to the active filter.
- Available network interface depends on CM Module HMI option or enclosure type. Reference the HGA IOM or HMI Schematic / Connection Diagram 28283-1.

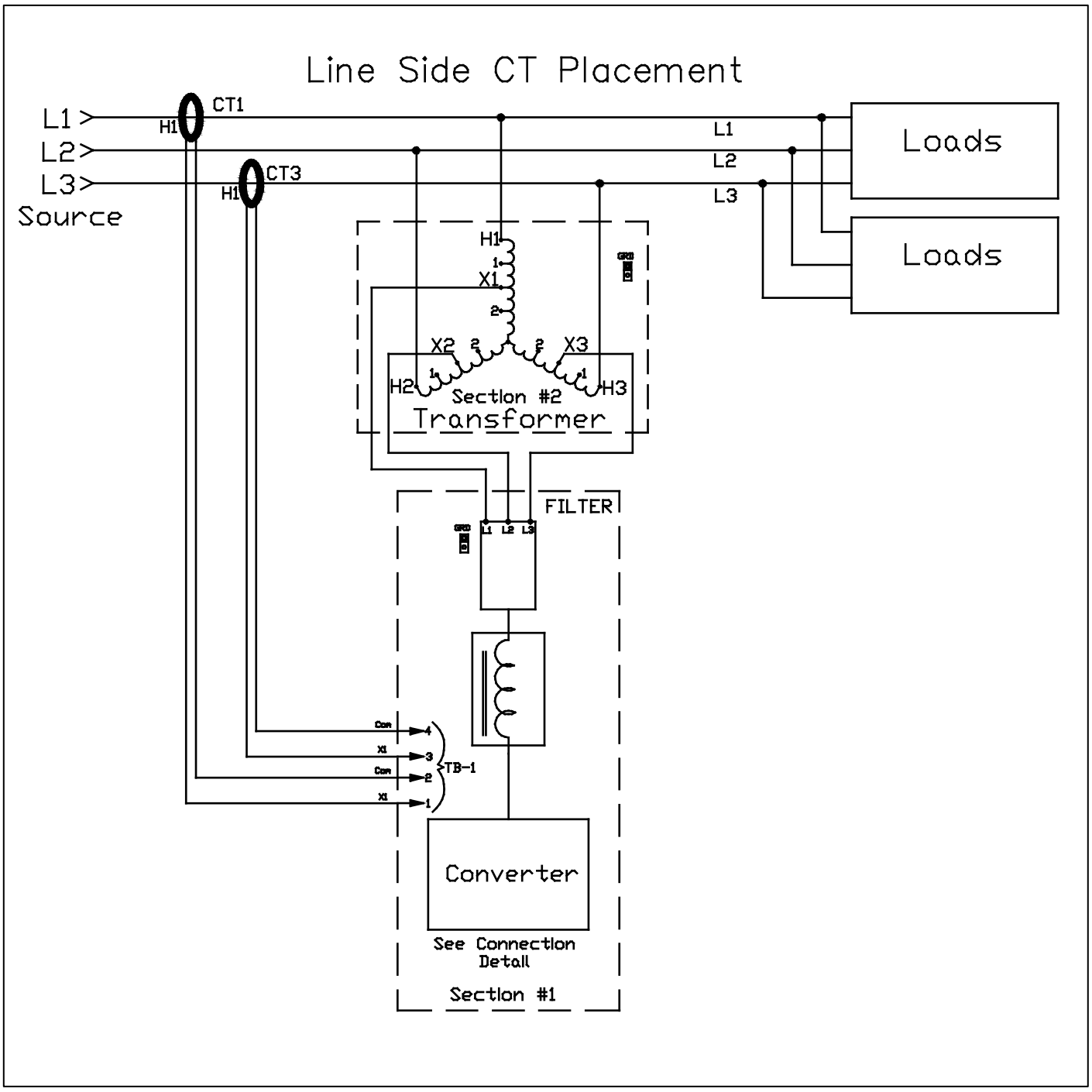


Figure 12: HGA 600 V Single Unit Line Side / Bus Applied Connection Diagram

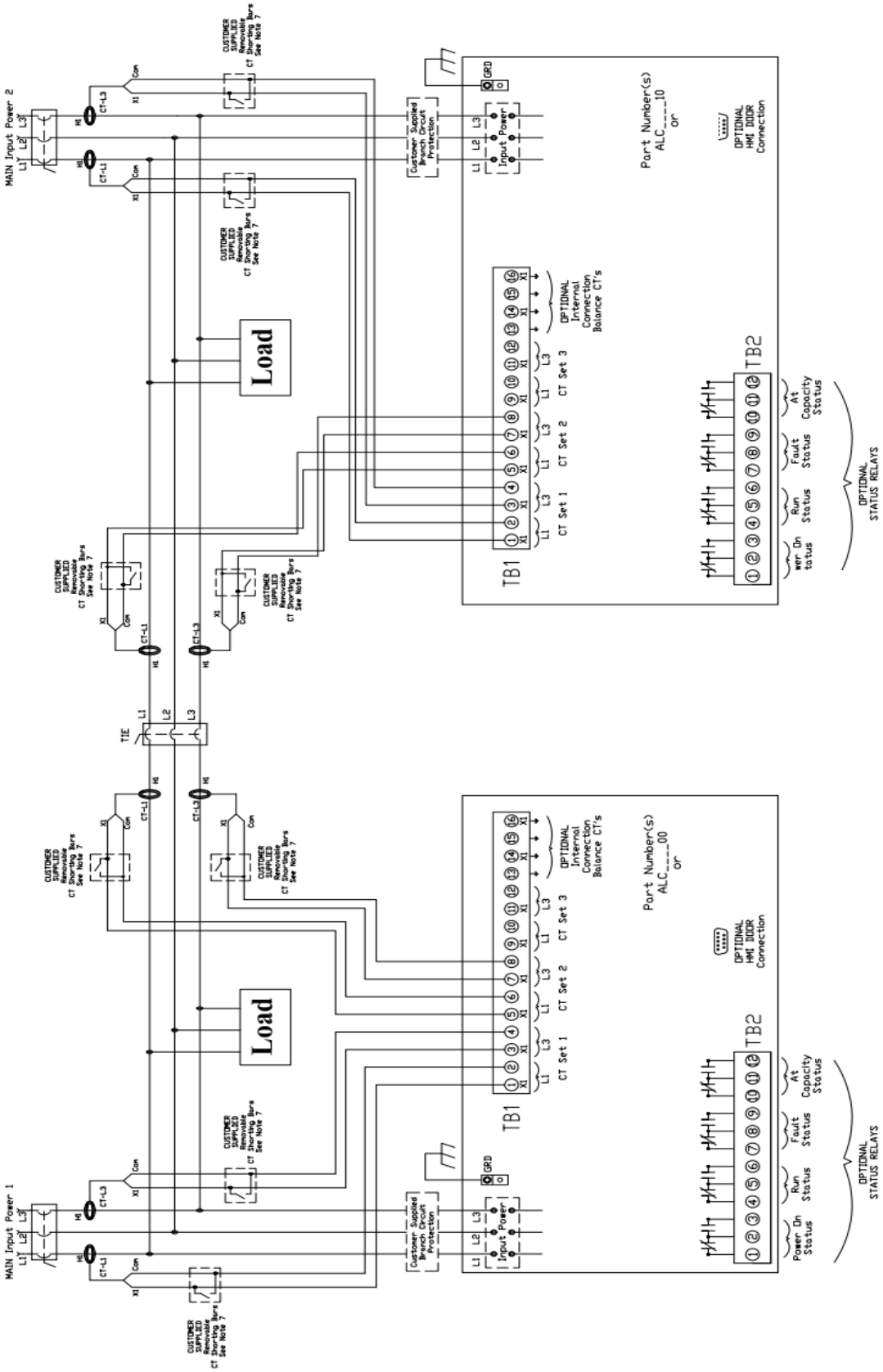


Figure 13: HGA 480 V Main-Tie-Main Connection Diagram

Grounding

The HarmonicGuard® Active filter panel equipment-grounding lug must be connected to the ground of the premises wiring system. The equipment grounding connection must conform to the requirements of the National Electrical Code (NEC) and/or any other codes that apply to the installation site. The ground connection must be made using a wire conductor. Metallic conduit is not a suitable grounding conductor. The integrity of all ground connections should be periodically checked.

CM Module Serial Cable Connection for Open Chassis Units

The HGA units the communications module (CM) is a separate assembly for the main HGA active filter chassis. The CM module assembly contains the HMI touchscreen, communications interface PCB, and any optional network interface communications gateway included with the unit. For fully enclosed HGA units, the CM module is mounted to the enclosure door. On open chassis HGA units, the CM module needs to be mounted in the end user's enclosure, MCC section, or Electrical House panel.

The CM module should be connected to the HGA power converter prior to applying power to the unit. The serial cable that connects the CM module to the power converter is packed with the CM module prior to shipment. One end of the serial cable is plugged into the communications interface PCB on the CM module. The other end of the communications cable is plugged into one or more power converters on the main active filter chassis.

The CM module is packed as a loose part in the shipping materials of the active filter open chassis panel along with the serial cable used to connect the CM module to the power converter. See the Figure 14: HGA CM Module with Chassis Communications Cable Serial Connector J2 for the location of the J2 Chassis Communication Cable connection on the CM module.

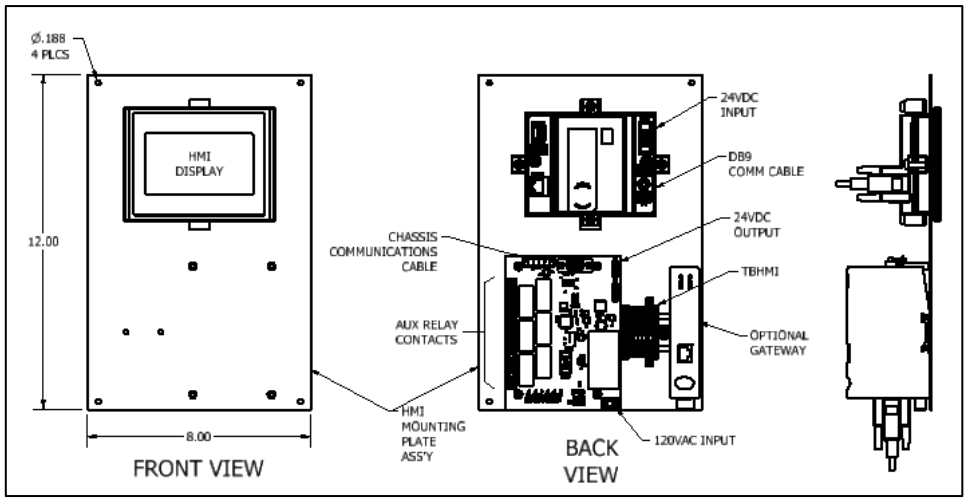
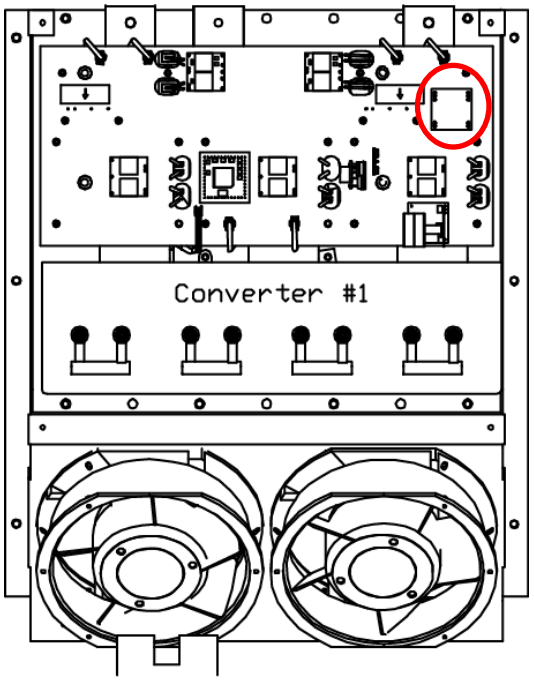


Figure 14: HGA CM Module with Chassis Communications Cable Serial Connector J2

Power Converter Serial Cable Connections

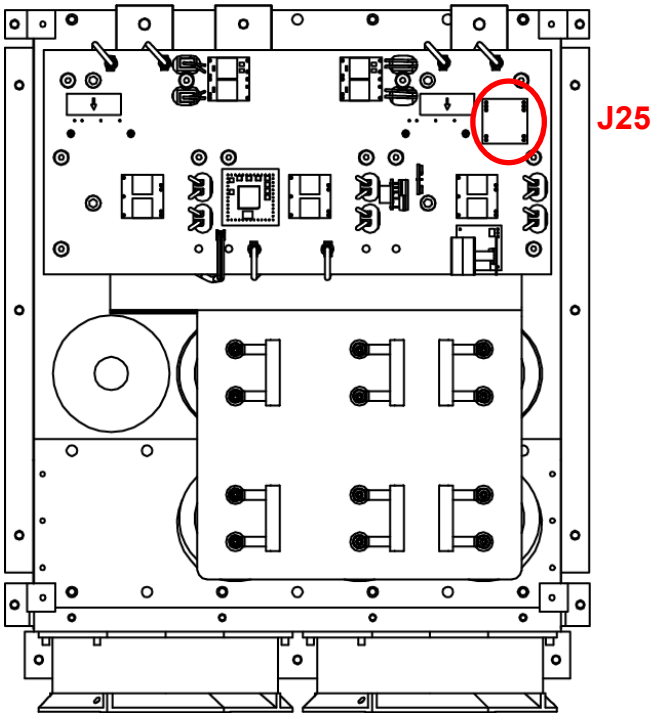
Note: *Do not connect the serial cable while the HGA unit is powered. Remove and lockout power prior to installing the serial cable.*

The power converter is located on the bottom half of the HGA panel. See the figure below for the location of the J25 connection on the power converter module. The J25 connection is below the power converter arch shield.



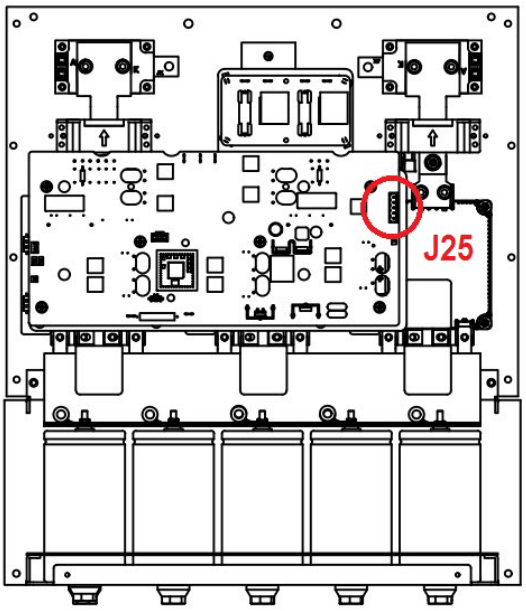
480 V - 50A / 100A

600 V - 39A / 78A



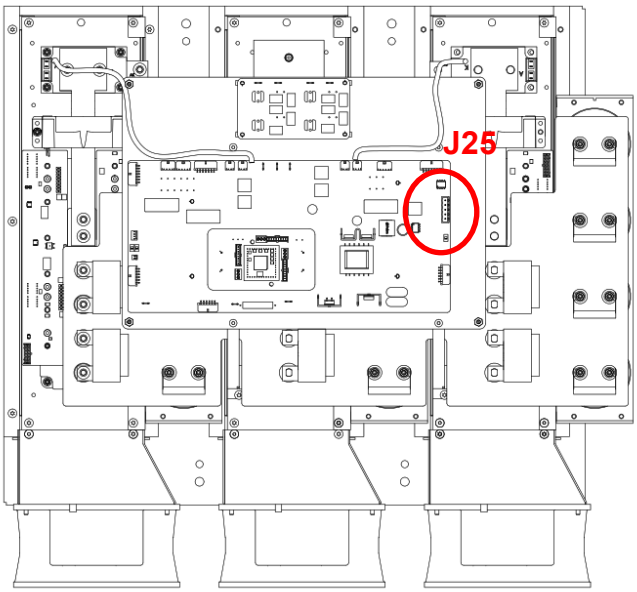
480 V - 150A

600 V - 220A



480 V - 200A / 250A

600 V - 150A / 185A / 370A



480 V - 300A / 350A

Figure 15: HGA Power Converter Module with Serial Connector J25 Highlighted in Red

Serial Cable Termination Setup

Note: *The serial cable termination configuration for the HGA units is setup during assembly and test of the unit. For new installations, the end user does not need to manually configure the serial cable termination DIP switches on the power converters. These instructions only need to be followed if a new power converter is being installed for repair.*

In the HGA Active Filter, the serial communications cable between the Communications Interface PCB and the Power Converters are implemented with RS-485 differential transceivers. These differential transceivers are very robust in noisy industrial environments if the serial communication bus is properly configured with a termination resistor at each end of the communications cable. The Communications Interface PCB is one end point of the serial communications bus and has a built-in bus termination resistor that is always in circuit.

The other end point of the serial communications cable will be at one of the active filter power converters. The power converter at the end of the communications cable should be configured with the bus termination resistor in circuit or ON. The bus termination resistor ON/OFF DIP switch is located near the J25 serial cable header. Note the Gen 2 30A and 50A do not have a serial cable termination resistor ON/OFF switch.

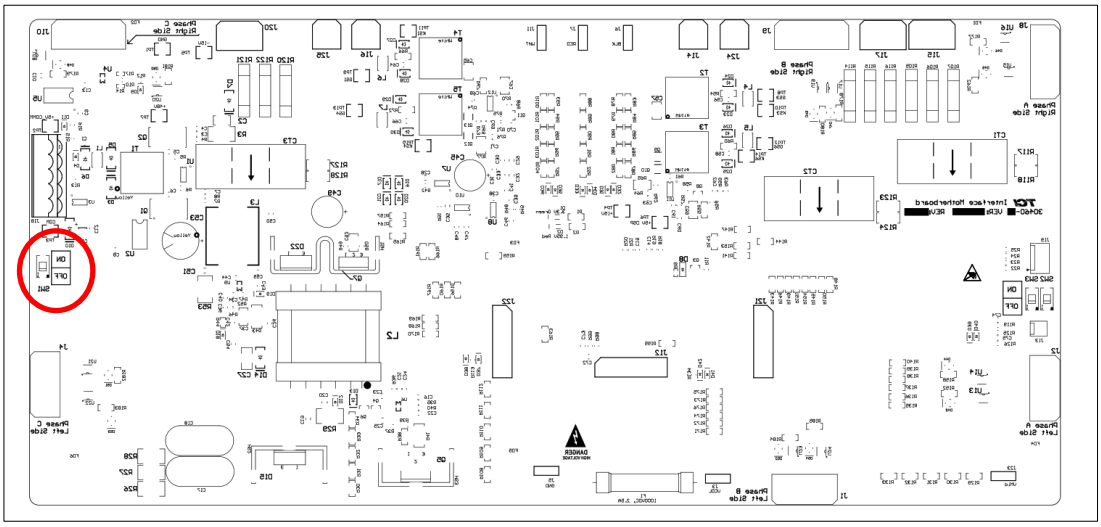


Figure 16: 300A, 350A, 600A, 700A Power Converter PCB Serial Cable Termination Resistor ON/OFF Switch.

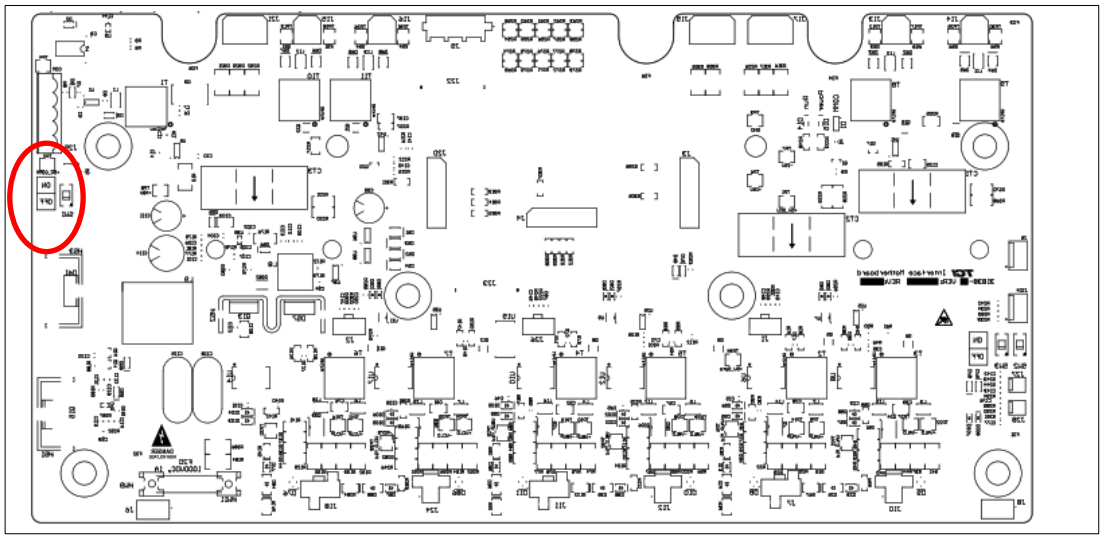


Figure 17: 50A (Gen 1), 100A, 150A, 250A, 400A, and 500A Power Converter PCB Serial Cable Termination Resistor ON/OFF Switch.

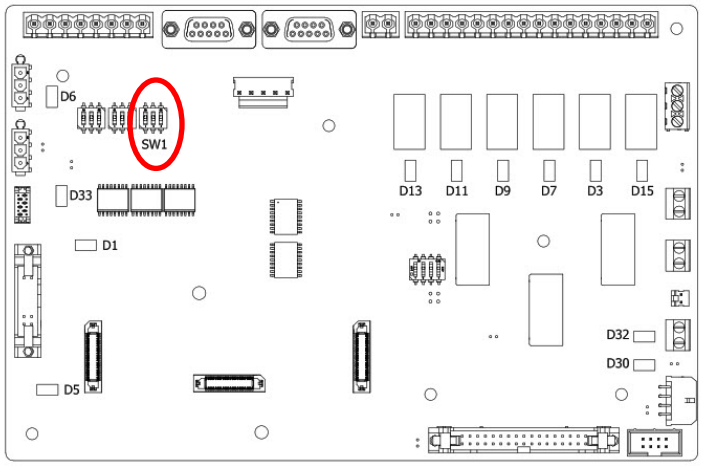


Figure 18: 30A and 50A (Gen 2) Power Converter PCB Serial Cable Termination Resistor ON/OFF Switch.

For single power converter systems (480 V 50A, 100A, 150A, 200A, 250A, 300A, 350A and 600 V 23A, 39A, 78A, 150A, 185A), the bus termination resistor DIP switch should always be set to on. For systems with two or more power converters (480 V 300A, 400A, 500A, 600A, 700A and 600 V 220A, 370A), only the bus termination resistor DIP switch of the power converter at the end of the serial cable should be set on. For multi power converter systems additional power converters located in the middle of the serial communication cable should have their bus termination resistors out of circuit or OFF (reference Figure 19).

A piece of thin adhesive tape will be covering the bus termination switch. This tape is used to keep the conformal PCB sealant out of the switch mechanism during PCB assembly. This covering will need to be removed to change the switch ON/OFF position.

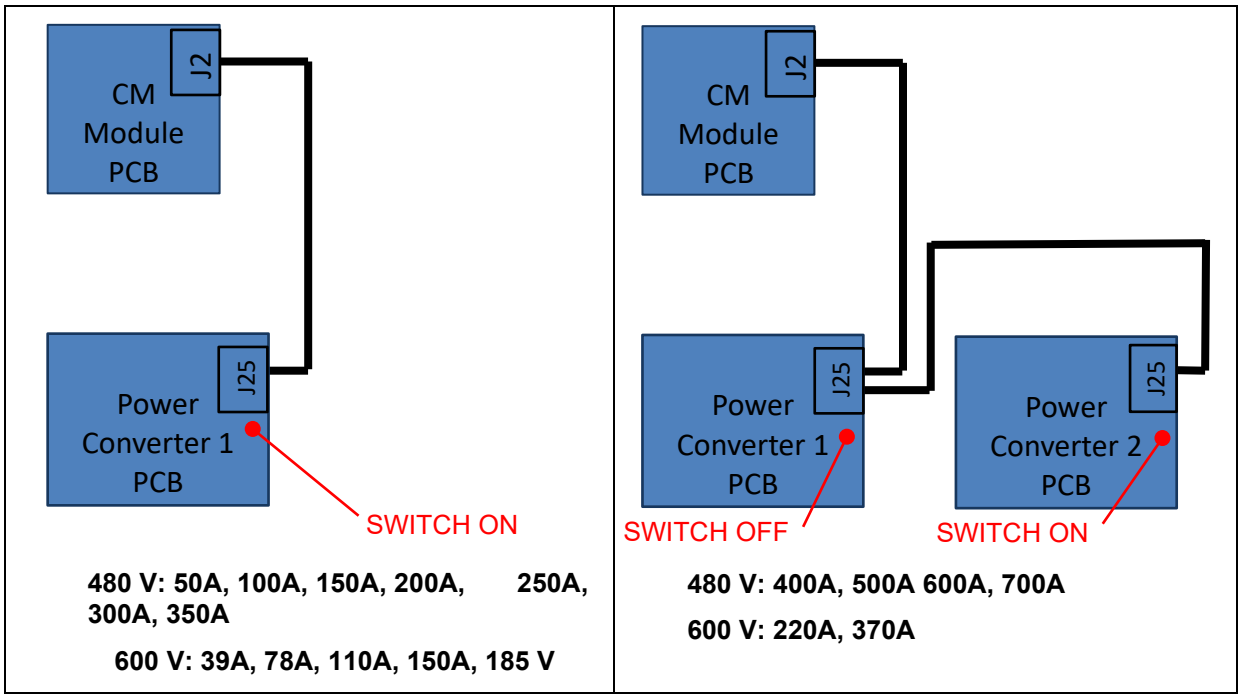


Figure 19: HGA Serial Cable Connection Diagram and Serial Bus Termination Switch Configuration

6.0 Filter Operation

Adjustments and Commissioning (Start Up)

The HGA has been factory calibrated and thoroughly tested. There is no need to make any adjustments.

Caution	
	Thoroughly check the installation before applying power and operating the equipment for the first time.

Before Applying Power for the First Time

Inspect the installation to make sure that all equipment has been completely and correctly installed in accordance with the Installation Guidelines Section of this manual.

- If it is a floor mount unit, check to see that it is securely anchored to the floor.
- Check the panel and the inside of the enclosure for any foreign objects, dirt, metal filings, wire whiskers, and loose hardware.
- Verify that any covers or guards that were removed during installation were reinstalled.
- Ensure that the unit is properly grounded.
- Check for properly tightened connections.

General Operation

Warning	
	Since the HGA is an active filter, it is always operating whenever the power is applied.

Warning	
	Only qualified electricians should carry out all electrical installation and maintenance work on the HarmonicGuard Active filter. Disconnect all sources of power to the HGA and connected equipment before working on the equipment. Do not attempt any work on a powered unit.

Warning	
	Be aware that everything ahead of the circuit breaker will still be energized. It is important to note that the lack of lit LEDs does not necessarily mean that the HGA is not receiving power from an external source.

Maintenance and Service

HGA Reliability and Service Life

The HGA has been designed and thoroughly tested at the factory to ensure that it will perform reliably from the time it is put into service. The following periodic maintenance is recommended to ensure that the HarmonicGuard Active filter will always perform reliably and provide the expected service life.

Periodic Maintenance

The following checks should be conducted monthly or more frequently when installed in harsh or dusty environments.

- Check to see that the installation environment remains free from excessive vibration, exposure to excessive dirt, moisture, and contaminants. Refer to Pre-installation Planning of this manual.
- Check to make sure that the enclosure ventilation openings are clean and unobstructed.
- Clean the air filter in units that have filtered air inlets. Clean as often as necessary to prevent dirt build-up from impeding air flow.
- Check for any dust or dirt build-up on the fans and heat sink fins.
- Check the operation of the cooling fans.
- Inspect the interior of the enclosure for signs of overheated components. Clean the interior of the enclosure whenever excess dirt has accumulated.
- Check the integrity of all power, ground, and control wiring connections.
- All electrical connections must be re-torqued annually.

Warning 	Many electronic components located within the filter are sensitive to static electricity. Voltages imperceptible to human touch can reduce life, and affect performance, or destroy sensitive electronic devices. Use proper electrostatic discharge (ESD) procedures when servicing the filter and its circuit boards.
Warning 	Only qualified electricians should carry out all electrical installation and maintenance work on the HGA. Disconnect all sources of power to the HGA and connected equipment before working on the equipment. Do not attempt any work on a powered HGA. This HGA unit contains high voltages capacitors. Wait at least five minutes after disconnecting power from the filter before you attempt to service the conditioner. Check for zero voltage between all terminals on the capacitors. Also, check for zero voltage between all phases of the input and output lines. All maintenance and troubleshooting must be done by a qualified electrician. Failure to follow standard safety procedures may result in death or serious injury. **Unless an external disconnect means has been provided everything ahead of the filter circuit breaker will still be energized.**

Application of Aprilaire 412 Filter Adhesive Coat for Type 3R Enclosures

An adhesive coating can be applied to the washable air filters used in the HGA Type 3R enclosures to increase the effectiveness of the filter. If the adhesive coating is used, the air filters should be periodically inspected and re-coated. To order the Air Filter Adhesive Spray Coating, contact TCI Technical Support and order TCI part number 29636.

Note: *These steps apply only to the Type 3R Enclosure Option.*

- Remove the air filter from the enclosure. The air filters are in the door, held in place with Torx screws. Rotate the door hinge to allow space to slide out the air filters.
- Verify that the air filter is clean. If the air filter is dirty, flush with water and allow it to dry before applying adhesive. Use room temperature water at low pressure.
- Choose a flat working surface large enough to lay down the air filter.
- Lay down some newspaper to protect the work area; the adhesive spray may stain the area that it is sprayed. Place the air filter on top of the newspaper.
- Use a 10 oz spray bottle "Aprilaire Super Filter Coat Adhesive" to spray the air filter using 2-4 pumps.
- Flip over the air filter and spray the other side using 2-4 pumps.
- Install the air filter into the enclosure. Take care to avoid exposure to dirt and dust before installation.

Reference Aprilaire Super Filter Coat Adhesive manufacturer data sheet for additional precautions and storage instructions.

Reference Drawings

There could be slight differences between your unit and the configurations shown in this manual. It is recommended that you refer to the drawings provided with your specific equipment when conducting troubleshooting operations. Reference schematics are also available online for download on the HGA active filter product page.

Overload / Over Current Protected

The filter has factory-set built-in electronic overload and over current protection. If the converter current exceeds the preset instantaneous peak, the converter will shut down to prevent permanent damage to the converter, and at which time, it will indicate a fault. Faults that do not automatically reset can be cleared by pressing the stop button on the HMI display.

An indication that the filter is going into overload will be observed by a gradual worsening of the total harmonic distortion (THD), or power factor, as the load increases. The HGA filter units can be paralleled to increase total corrective current capability if a unit is undersized for a particular application. Call TCI technical support for options to expand the installed system current capability.

Circuit Breaker Protection

The HGA Unit may come factory-equipped with a circuit breaker. This circuit breaker is used to protect the unit and the point of interconnection during a fault condition. The circuit breaker can also be used to disconnect the unit from its point of common coupling. The size and type of circuit breaker must not be altered without consulting TCI engineering.

Notes:

- Open chassis units can be provided without circuit breakers. The end user must protect the HGA with the following UL listed molded case circuit breaker.
- All circuit breakers referenced below are 480 V circuit breakers and the trip levels specified are at 480 V. For 600 V units that consist of a 600 V/480 V K-Rated autotransformer paired with a 480 V active filter, the unit circuit breaker is in the 480 V active filter connected to the 480 V secondary of the autotransformer.
- 45Amp to 50Amp 480 V (39A 600 V): A max peak let-through current of 26 kA in correspondence with a short circuit of 100 kA at 480 V, and a max peak let-through of 24kA for 65kA. The trip current setpoint for the 45A and 50A active filters must not exceed 100 Amps.
- 90Amp to 100Amp 480 V (78A 600 V): A max peak let-through current of 26 kA in correspondence with a short circuit of 100 kA at 480 V, , and a max peak let-through of 24kA for 65kA. The trip current setpoint for the 90Amp and 100A active filters must not exceed 125 Amps.
- 150Amp 480 V: A max peak let-through current of 40 kA in correspondence with a short circuit of 100 kA at 480 V, and a max peak let-through of 39kA for 65kA. The trip current setpoint for the 150A active filter must not exceed 175Amps.
- 200Amp 480 V (150A 600 V): A max peak let-through current of 55 kA in correspondence with a short circuit of 100 kA at 480 V, and a max peak let-through of 48kA for 65kA. The trip current setpoint for the 200A active filter must not exceed 225 Amps.
- 250Amp 480 V (185A 600 V): A max peak let-through current of 55 kA in correspondence with a short circuit of 100 kA at 480 V, and a max peak let-through of 52kA for 65kA. The trip current setpoint must not exceed 300 Amps.
- 300Amp 480 V (220A 600 V): A max peak let-through current of 75 kA in correspondence with a short circuit of 100 kA at 480 V, and a max peak let-through of 52kA for 65kA. The trip current setpoint for the 300A active filter must not exceed 375 Amps.
- 350Amp 480 V (270A 600 V): A max peak let-through current of 75 kA in correspondence with a short circuit of 100 kA at 480 V, and a max peak let-through of 52kA for 65kA. The trip current setpoint for the 350A active filter must not exceed 550 Amps.
- 400Amp 480 V (300A to 370A 600 V): A max peak let-through current of 63 kA in correspondence with a short circuit of 100 kA at 480 V, and a max peak let-through of 52kA for 65kA. The trip current setpoint for the 400Amp active filter must not exceed 600 Amps.
- 500Amp 480 V (270A 600 V): A max peak let-through current of 75 kA in correspondence with a short circuit of 100 kA at 480 V, and a max peak let-through of 52kA for 65kA. The trip current setpoint for the 500A active filter must not exceed 600 Amps.
- 600Amp 480 V (270A 600 V): A max peak let-through current of 75 kA in correspondence with a short circuit of 100 kA at 480 V, and a max peak let-through of 67kA for 65kA. The trip current setpoint for the 600A active filter must not exceed 700 Amps.
- 700Amp 480 V (270A 600 V): A max peak let-through current of 75 kA in correspondence with a short circuit of 100 kA at 480 V, and a max peak let-through of 67kA for 65kA. The trip current setpoint for the 700A active filter must not exceed 800 Amps.

Table 15: Active Filter 65kAIC Circuit Breaker Manufacturer Part Number and Trip Ratings.

HGA Unit Rating*		ABB - Option 0100		Allen Bradley - Option 4000		Eaton - Option 6000		LSIS - 0200	
480VAC	600VAC***	Amps**	MFG P/N	Amps**	MFG P/N	Amps**	MFG P/N	Amps**	MFG P/N
50A	39A	80A	XT2HQ3080BFF000XXX	100A	140G-G6C3-D10	100A	PDG13M0100TFFJ	100A	UTS150H FTU 100A 3P LL UL
100A	78A	125A	XT2HU3125BFF000XXX	125A	140G-H6F3-D12	125A	PDG13M0125TFFJ	125A	UTS150H FTU 125A 3P LL UL
150A	110A	175A	XT4HQ3175BFF000XXX	175A	140G-J6F3-D17	200A	PDG23M0200TFFJ	200A	UTS250H FTU 200A 3P LL UL
200A	150A	250A	XT4HQ3250BFF000XXX	225A	140G-J6F3-D22	250A	PDG33M0250TFAJ	250A	UTS250H FTU 250A 3P LL UL
250A	185A	300A	XT5HU340ABFF000XXX	300A	140G-K6F3-D30	300A	PDG33M0300TFAJ	350A	UTS400H FTU 350A 3P LL UL
300A	220A	600A	XT5HU360BBFF000XXX	400A	140G-K6H3-D40	400A	PDG33M0400TFAJ	400A	UTS400HT ATU 400A 3P LL UL
350A	260A	600A	XT5HU360BBFF000XXX	400A	140G-K6H3-D40	500A	PDG33M0500TFAJ	400A	UTS400HT ATU 400A 3P LL UL
400A	300A					600A	PDG33M0600TFAJ	500A	UTS600HT ATU 500A 3P LL UL
500A	370A					600A	PDG33M0600TFAJ	600A	UTS600HT ATU 600A 3P LL UL
600A	450A							630A	UTS800HT NG0 630A 3P LL UL
700A	520A							800A	UTS800HT NG0 800A 3P LL UL

*The HGA Active Filter controls have a current limit that limits the filter output current to the amp rating of the active filter.
**Amps listed are maximum values for the circuit breaker. Actual trip setpoints may vary.
***For 600 V units the breaker is located on the 480 V secondary of the included 600 V/480 V K-Rated Autotransformer.
****Trip setpoints should be set following manufacturer instructions.

Table 16: Active Filter 100kAIC Circuit Breaker Manufacturer Part Number and Trip Ratings.

HGA Unit Rating*		ABB - Option 2000		Allen Bradley - Option 5000		Eaton - Option 7000		LSIS - 0300	
480VAC Units	600VAC Units***	Amps**	MFG P/N	Amps**	MFG P/N	Amps**	MFG P/N	Amps**	MFG P/N
50A	39A	100A	XT2LU3100BFF000XXX	100A	140G-H0F3-D10	100A	PDG13P0100TFFJ	100A	UTS150L FTU 100A 3P LL UL
100A	78A	125A	XT2LU3125BFF000XXX	125A	140G-H0F3-D12	125A	PDG13P0125TFFJ	125A	UTS150L FTU 125A 3P LL UL
150A	110A	175A	XT4LQ3175BFF000XXX	175A	140G-J0F3-D17	200A	PDG23P0200TFFJ	200A	UTS250L FTU 200A 3P LL UL
200A	150A	250A	XT4LQ3250BFF000XXX	225A	140G-J0F3-D22	250A	PDG33P0250TFAJ	250A	UTS250L FTU 250A 3P LL UL
250A	185A	300A	XT5LU340ABFF000XXX	300A	140G-K0F3-D30	300A	PDG33P0300TFAJ	350A	UTS250L FTU 250A 3P LL UL
300A	220A	600A	XT5LU360BBFF000XXX	400A	140G-K0H3-D40	400A	PDG33P0400TFAJ	400A	UTS400LT ATU 400A 3P LL UL
350A	260A	600A	XT5LU360BBFF000XXX	400A	140G-K0H3-D40	500A	PDG33P0500TFAJ	400A	UTS400LT ATU 400A 3P LL UL
400A	300A					600A	PDG33P0600TFAJ	500A	UTS600LT ATU 500A 3P LL UL
500A	370A					600A	PDG33P0600TFAJ	600A	UTS600LT ATU 600A 3P LL UL
600A	450A							630A	UTS800LT NG0 630A 3P LL UL
700A	520A							800A	UTS800LT NG0 800A 3P LL UL

*The HGA Active Filter controls have a current limit that limits the filter output current to the amp rating of the active filter.
**Amps listed are maximum values for the circuit breaker. Actual trip setpoints may vary.
***For 600 V units the breaker is located on the 480 V secondary of the included 600 V/480 V K-Rated Autotransformer.
****Trip setpoints should be set following manufacturer instructions.

Warning	If the system breaker has tripped, do not attempt to re-energize the HGA unit until the cause of the trip has been determined.

Pre-Charge Circuit Over Current Protection

Pre-Charge circuitry is used to limit the in-rush current to a safe level upon powerup. When started, the Pre-Charge circuitry will be switched out of circuit. If for some reason this circuitry should malfunction, class CC fuses are utilized to limit the current to not exceed the ratings of the components.

Over Temperature Protection

The converter has a thermal fold back mechanism that will automatically reduce unit output current as the converter temperature approaches its shutdown threshold. Additionally, the converter has an internal heat sink over temperature protection, which will shut down the converter if its threshold is exceeded. The fans will continue to run and once the heat sink cools down the converter will automatically restart if the auto restart feature is enabled.

There is a secondary overtemperature circuit, which monitors the temperature of the power resistors and inductors located on the chassis of the HGA. The sensor is a snap action switch activated when the over temperature threshold is reached. The fans will continue to run and once the thermal switch resets the converter will automatically restart if the auto restart feature is enabled.

Note that if the unit faults continuously, this likely indicates something more serious with the operation of the unit. The unit will shut down on an Auto Restart Limit fault if the set number of faults has occurred in a set time frame, as configured on the HMI. In this case, the fault will remain latched until the fault is reset manually via the local HMI installed in the unit.

The HMI display can be used to diagnose which fault has occurred, using the Active Faults and Fault History screens. Reference Table 32: Fault CodesTable 32: Fault Codes for fault nomenclature.

Troubleshooting

Failure to maintain the correct polarity of the current transformers (CTs) will cause an overcurrent fault on power up. The converter will not run and will stay in a stopped condition. If it is suspected that the CTs are installed backwards or the secondary wiring is incorrect, refer to the steps below to isolate the error.

Note: *CT operation can be verified via the HMI touchscreen feedback waveform plot screens. Reference the HMI VLine & ILine Waveform Plot Sub Screen for details.*

Warning 	Only qualified electricians should carry out all electrical installation and maintenance work on the HGA. Failure to follow standard safety procedures may result in death or serious injury. Disconnect all sources of power to the HGA and connected equipment before working on the equipment. Do not attempt any work on a powered HGA. Also, check for zero Voltage between all phases of the input and output lines. **Operating current transformers with the secondary winding open can result in a high Voltage across the secondary terminals, which may be dangerous to personnel or equipment.**

1. If the CTs and wiring are easily accessible, double check the CT orientation for proper direction, and trace the secondary wiring against the applicable diagrams in CT Wire Recommendations for polarity, phasing, and connection to terminal TB-1. Correct any errors and apply power for proper power-up if it doesn't clear the fault or if accessibility is too difficult proceed to step #2.
2. There is a possibility that the CTs markings are different from the diagrams provided. This could affect the polarity, to verify this try reversing the two leads on TB-1 positions 1 & 2, do the same with wires in positions 3 & 4. Apply power for proper power-up; if it doesn't proceed to #3.

3. Reverse just one set of CT leads at a time, first 1 & 2; verify power-up. If it doesn't work put wires 1 & 2 back and try the same with wires 3 & 4. Apply power for proper power-up; if it doesn't, replace all wiring to its original positions, and proceed to #4.
4. There is a possibility that the phasing of the CT L1 and L3 are incorrect. To test this theory, swap the two wires on TB-1 positions 1 & 2 with the two wires in positions 3 & 4. Apply power for proper power-up if it doesn't repeat steps 2 and 3.
5. If the HGA doesn't indicate a run status after completion of steps 1 through 4, contact TCI technical support for further assistance.

System Failure

The Digital Signal Processor is continually monitoring the performance and fault status of the filter. It will shut down the converter section if the processor should sense a fault. The filter is also equipped with a circuit breaker providing a second layer of overcurrent protection for the converter section. The circuit breaker can also serve as a means of electrical isolation from the system power grid. It is recommended by TCI that all power to the HarmonicGuard Active filter be disconnected. If you elect to service the HGA by using the circuit breaker to isolate the converter section, please take special note of the following warnings:

Warning 	Only qualified electricians should carry out all electrical installation and maintenance work on the HGA. Disconnect all sources of power to the HGA and connected equipment before working on the equipment. Do not attempt any work on a powered HGA. This HGA unit contains high Voltages and capacitors. Wait at least five minutes after disconnecting power from the filter before you attempt to service the conditioner. Check for zero Voltage between all terminals on the capacitors. Also, check for zero Voltage between all phases of the input and output lines. All maintenance and troubleshooting must be done by a qualified electrician. Failure to follow standard safety procedures may result in death or serious injury. **Unless an external disconnect means has been provided everything ahead of the filter circuit breaker, including the reactors, will still be energized.**

Required Equipment

- AC Voltmeter and ammeter/multimeter designed for true RMS measurements for a harmonic rich circuit and rated for the voltage and current marketed on the filter's nameplate. The multimeter must have 1,000 Volt minimum isolation.
- Clamp-on current probe suitable for the rated current and voltage of the filter.
- Clip-on Voltage probes are suitable for the rated voltage marked on the nameplate. Select probes that can be securely clipped on to the test points without shorting between points or falling off.

***Note**: When disconnecting wires from components and terminations, mark the wires to correspond to their component and terminal connection. Extreme care should be taken when removing the fast-on terminals from the circuit board. Excessive force will result in damaging the interface board and require the converter to be repaired by TCI authorized personnel only.*

Converter Inspection

- Verify that power has been removed from converter and 10 minutes has passed before inspection.
- Remove plastic cover from the filter's converter section.
- Visually check the circuit boards for debris, contamination, overheated traces, burnt circuit board, overheated, cracked, or broken components, corrosion, and poor solder joints.
- Check all wires and terminals connected to the circuit boards. Conduct a snug test on all terminals connected to other circuit boards.
- Check the four electrolytic capacitors for bulges, ruptures, popped vent plugs, discoloration, or leakage.
- Check the power semiconductors mounted to heat-sink for cracked cases, ruptures, debris, arcing, and burning.
- Check for any loose connections if no apparent damage is found to the power semiconductors.
- Measure resistance of power semiconductors using a multi-meter set on the diode check setting, see Figure 20 for semiconductors locations. Look for opens, ∞, or dead short readings. With the red lead of your meter connected to the far-right negative terminal of the capacitor bank, measure with the black lead of the meter to each of the three output terminals (bus bars), the reading should be approximately 0.35Ω. Reverse the meter leads and repeat measuring to each terminal. This time a low reading will be present, which will continue to increase; this is an indication of a capacitor charging. Next, connect the black meter led to the "positive capacitor terminal" and again measure to each of the output terminals with the other lead; the reading should be approximately 0.35Ω. Reverse the meter leads and repeat measuring to each terminal. Again, it will be a low reading, which will continue to increase. If the readings are as described, it is likely the power semiconductors are good. If any readings are open or dead shorts, it will be an indication that something is bad in the power section. Do not reapply power if you are not sure the IGBTs are good.

Troubleshooting Flow Chart

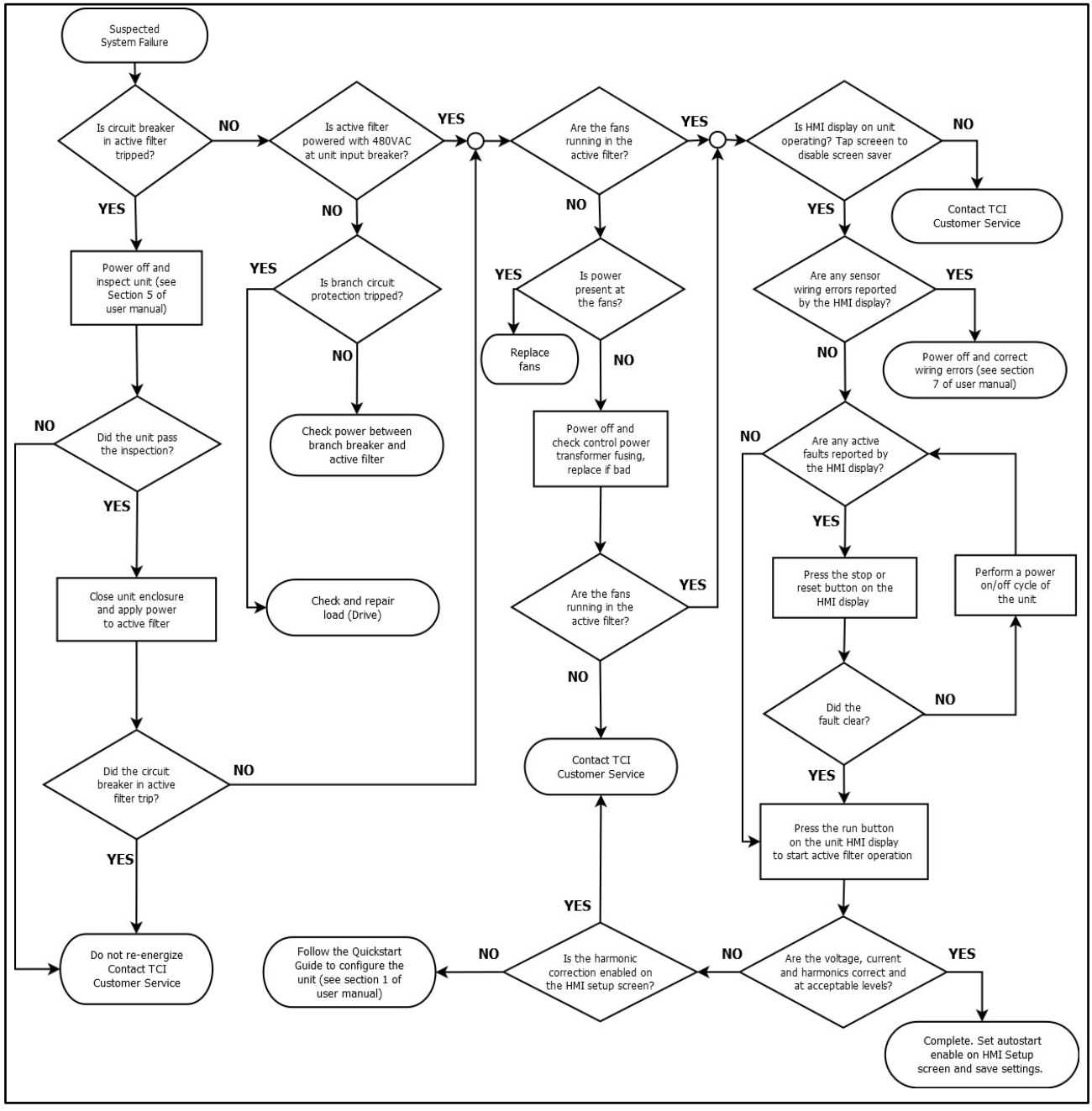


Figure 20: HGA System Troubleshooting Flowchart

Power Component Layout

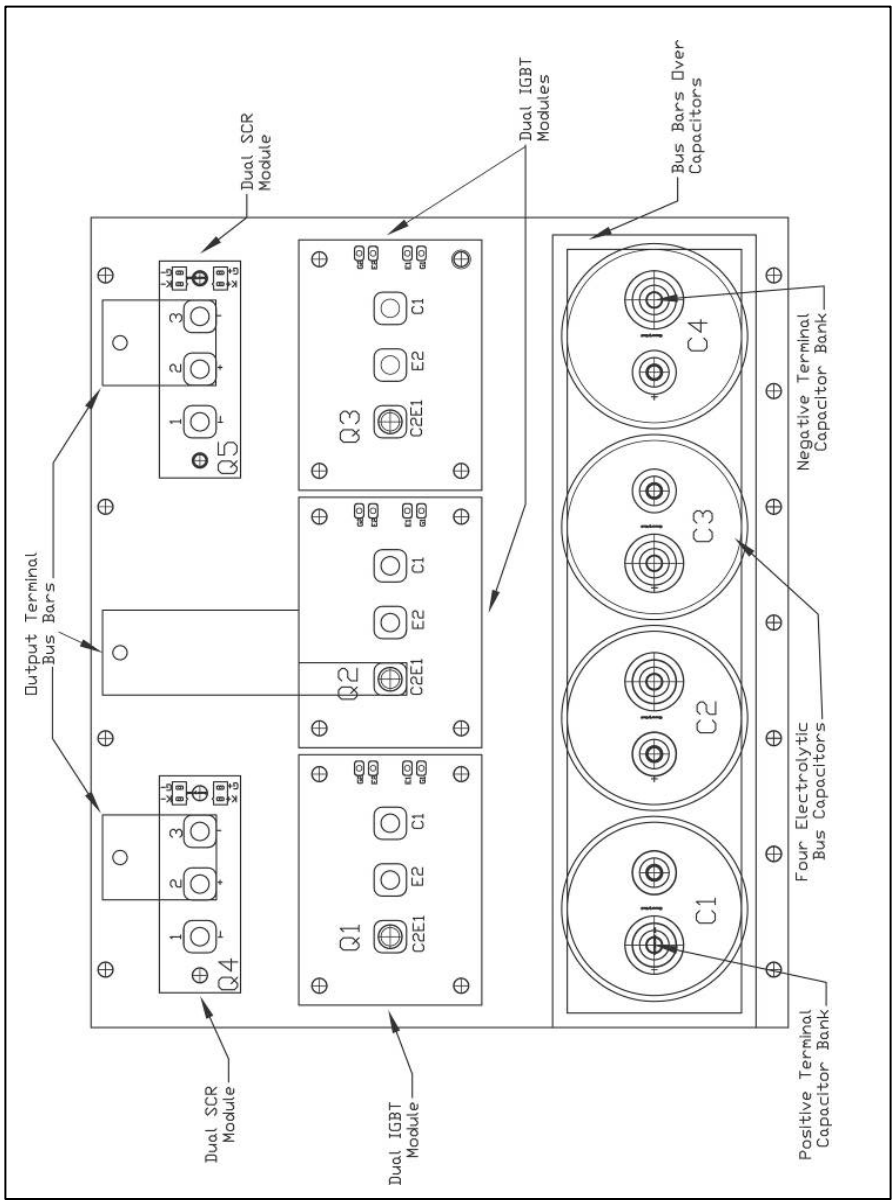


Figure 21: (600 V) 39, 78 Amp & (480 V) 50, 100 Amp Power Component Layout

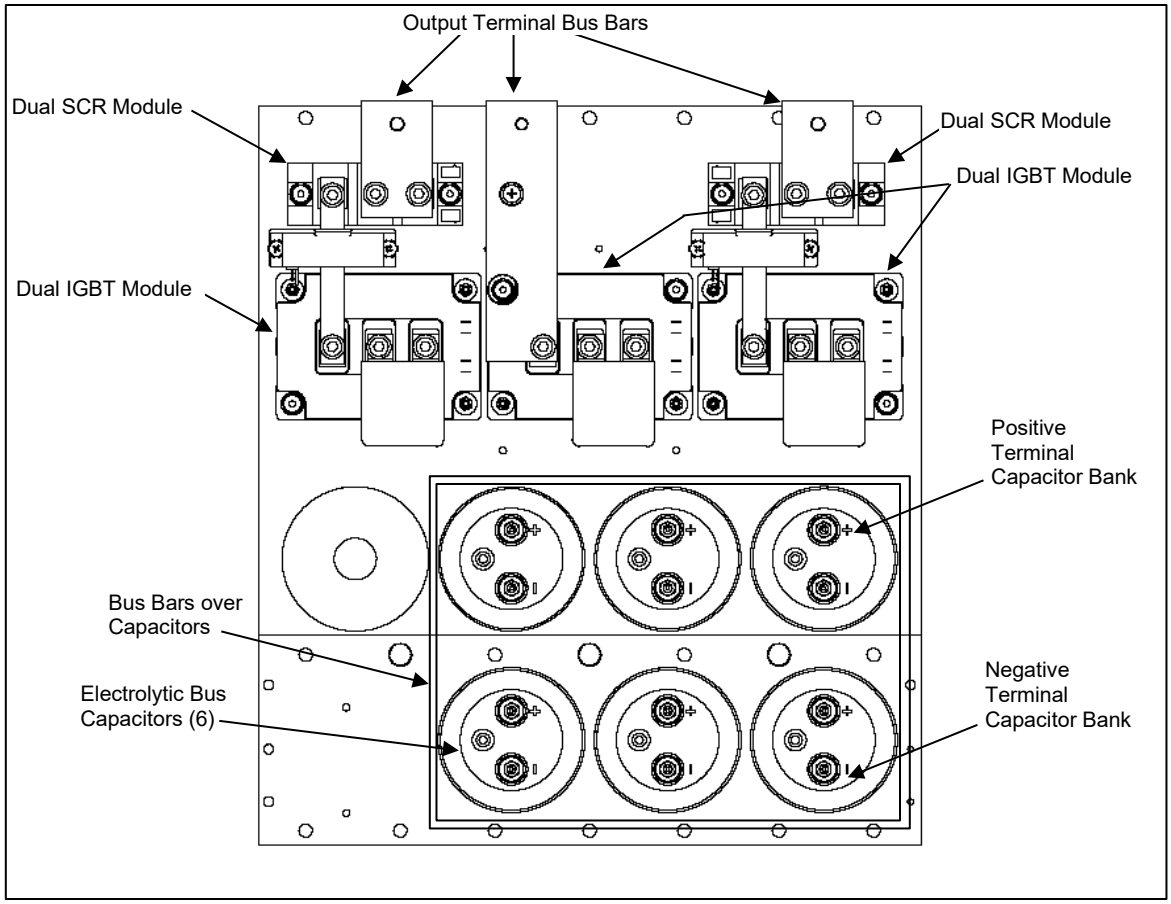


Figure 22: (480 V) 150 Amp & (600 V) 110 Amp Power Component Layout

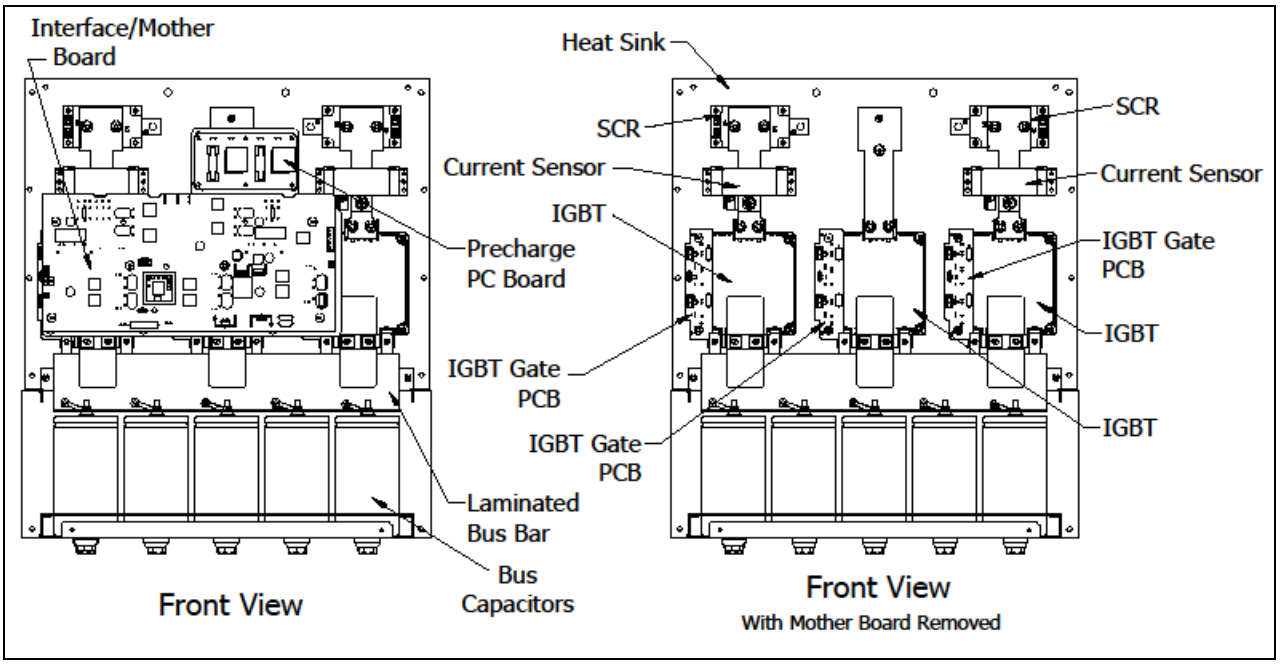


Figure 23: (480 V) 200, 250, 400, 500 Amp & (600 V) 150, 185, 300, 370 Amp Power Component Layout

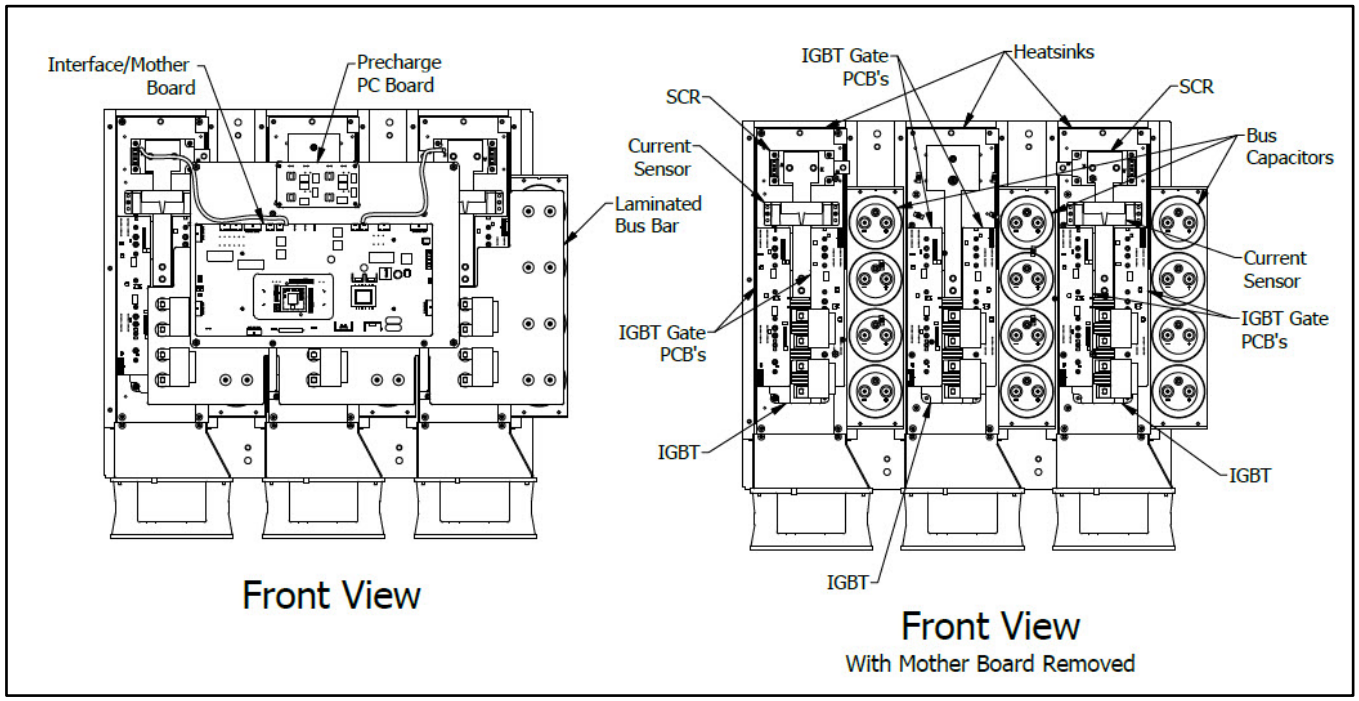


Figure 24: (480 V) 300, 350, 600, 700 Amp Power Component Layout

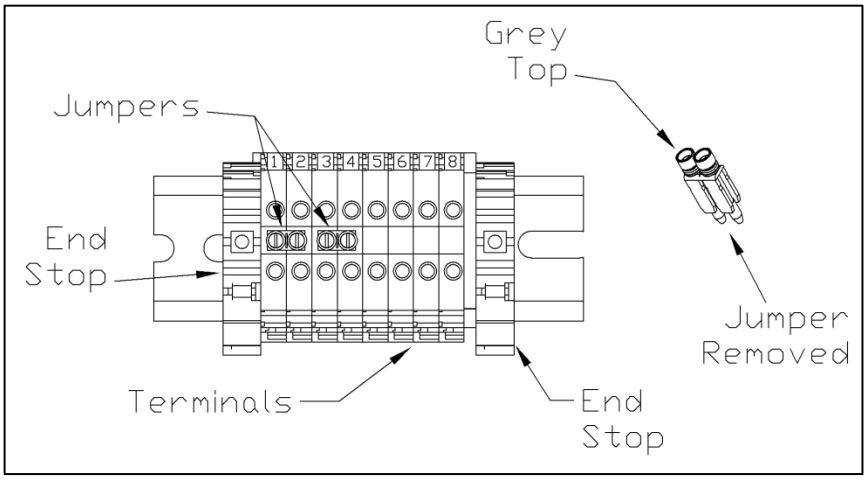


Figure 25: TB-1 Terminal Block

Warning	Only qualified personnel should operate the HarmonicGuard® Active filter with the door open. Failure to follow standard safety procedures may result in death or serious injury. Do not attempt any work on a powered filter converter. The HGA contains high Voltages and capacitors. Wait at least five minutes after disconnecting power from the converter before you attempt servicing. Check for zero Voltage between all terminals to the converter. **Be aware everything ahead of the circuit breaker will still be energized.**

Replacement Parts

If replacement parts are needed, please contact your TCI representative. To ensure that the HarmonicGuard® Active filter continues to perform to its original specifications, replacement parts should conform to TCI specifications. Use of non-TCI approved components will void all warranties.

Factory Contacts and Technical Support

For technical support, contact your local TCI distributor or sales representative. You can contact TCI directly at **1-800-824-8282**. Select "Customer Service" or "Technical Support" and have your HarmonicGuard® Active filter nameplate information and any drawings available.

Outline and Mounting Dimension Drawings

Installation drawings are available online for download at HGA 5% Active Harmonic Filter - TCI, LLC (transcoil.com) or Catalog - TCI, LLC (transcoil.com). The installation diagrams show the overall enclosure dimensions, the conduit access areas, and the wiring connection points. The installation diagrams also show the major internal components pictorially. A paper copy of the installation diagram is included in the literature kit shipped with all units.

7.0 HMI Introduction

The Interface Module provides the user with a convenient way to monitor the operation of TCI's HarmonicGuard® Active filter and allows for the ability to adjust run-time set points under password control. This section describes how to install, operate, and maintain the Interface Module.

Overview

The Interface Module has three major components; the Interface PCB, the HMI Display, and an optional network Communications Gateway (Figure 25: Interface Module Components).

The interface PCB contains a Chassis Communications Port that connects to the power converter of the HarmonicGuard® Active filter. The interface PCB translates status and commands data between the power converter controls and the HMI Display. The interface PCB also contains the 24V Relay I/O for basic status monitoring and run/stop control of the HarmonicGuard® Active filter.

The HMI Display is a color Touchscreen display containing a series of status screens that provide the user with a convenient way to monitor the operation of the HarmonicGuard® Active filter. The HMI display also contains an integrated ModbusRTU network connection for remote monitoring of the HarmonicGuard® Active filter.

The optional network Communications Gateway can be connected to the integrated ModbusRTU network connection in the HMI Display to translate the ModbusRTU protocol to an alternate Fieldbus or Industrial protocol such as Ethernet/IP.

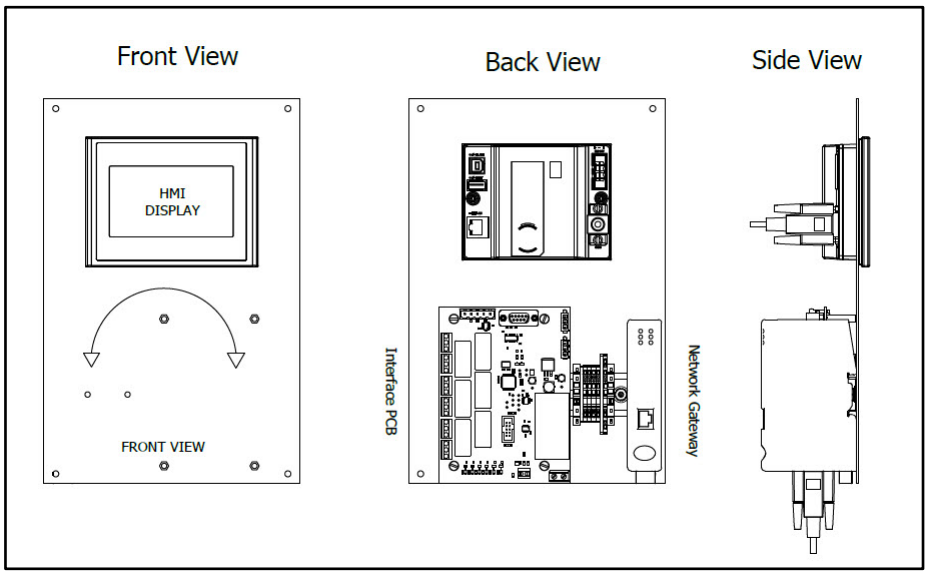


Figure 26: Interface Module Components

Caution	This section provides general information describing the Interface Module. Be sure to carefully review the more specific information provided by the drawings shipped with the module. Information from the drawings takes precedence over the information provided in this section. The information and ratings given in this manual are approximate and should not be used for any purpose requiring exact data. Contact the factory in situations where certified data is required. All data is subject to change without notice.

Installation Guidelines

Checklist

The following are the key points to be followed for a successful installation. These points are explained in detail in the following sections.

- Make sure the installation location will not be exposed to excessive vibration, corrosive or combustible airborne contaminants, excessive dirt, or liquids.
- Select a mounting area that will allow adequate cooling air.
- Make sure that all wiring conforms to the requirements of the National Electrical Code (NEC) and/or other applicable electrical codes.
- Ground the HMI display by using the grounding terminal. Not only does this act as a safety, but it also filters out electrical noise.
- Check all connections and components thoroughly before applying power to the equipment.
- Check the panel and the inside of the enclosure for any foreign objects, dirt and/or loose hardware.

Location

The location of the Interface Module should be placed in a suitable environment in order to ensure proper performance and a normal operating life.

Warning	Unless specifically labeled as approved for such use, this equipment is not suitable for use in an explosive atmosphere or in a "Hazardous (Classified) Location" as defined in article 500 of the National Electrical Code (NEC).

- Avoid corrosive liquids or gases.
- Avoid explosive or combustible gases or dust.
- Avoid excessive airborne dirt and dust (Pollution Degree 2, according to EN50178 and UL508C)
- Avoid excessive vibration (0.152 mm (0.006 in.) displacement, 1G peak)

Mounting

Mounting requires at least a depth of 4” (102 mm). The Interface Module will mount in a panel with a thickness of 0.02 to 0.35 inch (0.5-9.0 mm) with an opening 6.79” by 5.21” (173 by 133 mm). Fit the Interface Module assembly into the opening carefully pressing on all four corners. Use the mounting hardware (4 sets) to secure the assembly on the corners.

Warning: To avoid damaging the case, do not exceed a tightening torque of 3.47 to 4.34 lbs.-in (0.39-0.49 Nm). Care should be taken not to mount the Interface Module too close to a heat source (such as power resistors), which could be located behind the Interface Module.

Caution	The display panel is waterproof. But care should be taken to prevent grease, corrosive liquids, and sharp objects from contacting the front panel.

Warning	Many electronic components located within the Interface Module and HMI are sensitive to static electricity. Voltages imperceptible to human touch can reduce life, and affect performance, or destroy sensitive electronic devices. Use proper electrostatic discharge (ESD) procedures when servicing the Interface Module and HMI.

Wiring

***Note**: Some of the following sections only apply if the Interface Module is not factory installed and may be different for some harmonic active filters, refer to your filter specific schematic.*

A wiring block diagram of the Interface Module components is available in Figure 26. When selecting a mounting location for the unit, plan for the routing of commutation and power cable. Keep the wiring away from power wires where electrical noise could be induced. All wiring should conform to the requirements of the National Electrical Code (NEC) and/or other applicable electrical codes. The length of the communication cable between the Interface module chassis communication port and the HarmonicGuard® Active filter power converter module should not exceed 25 feet (7.6 meters).

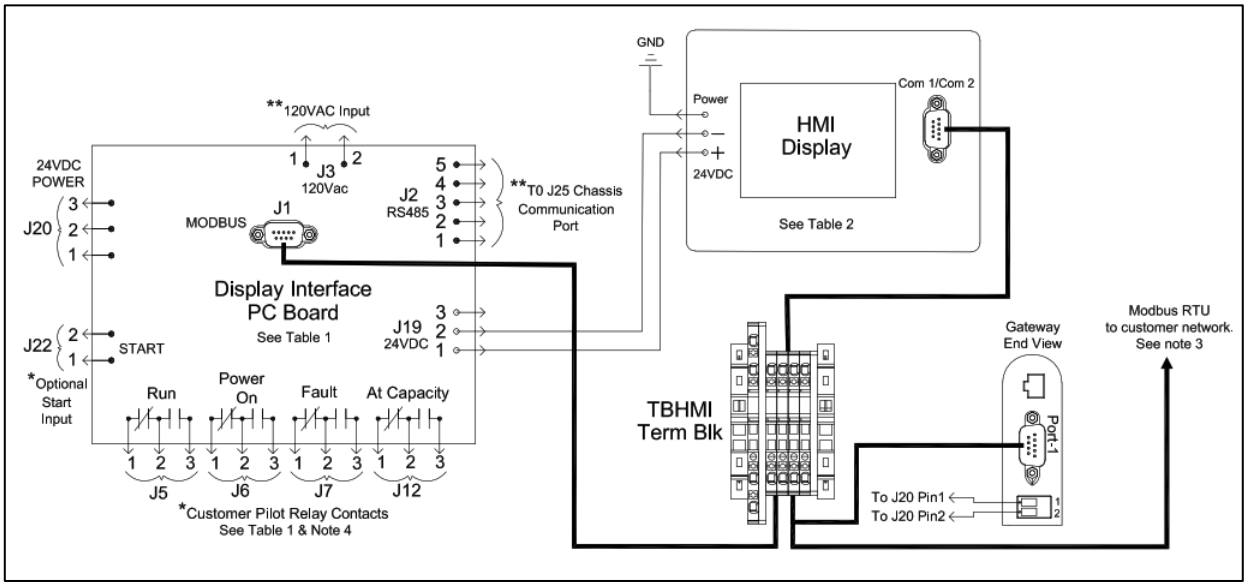


Figure 27: Interface Module Connections

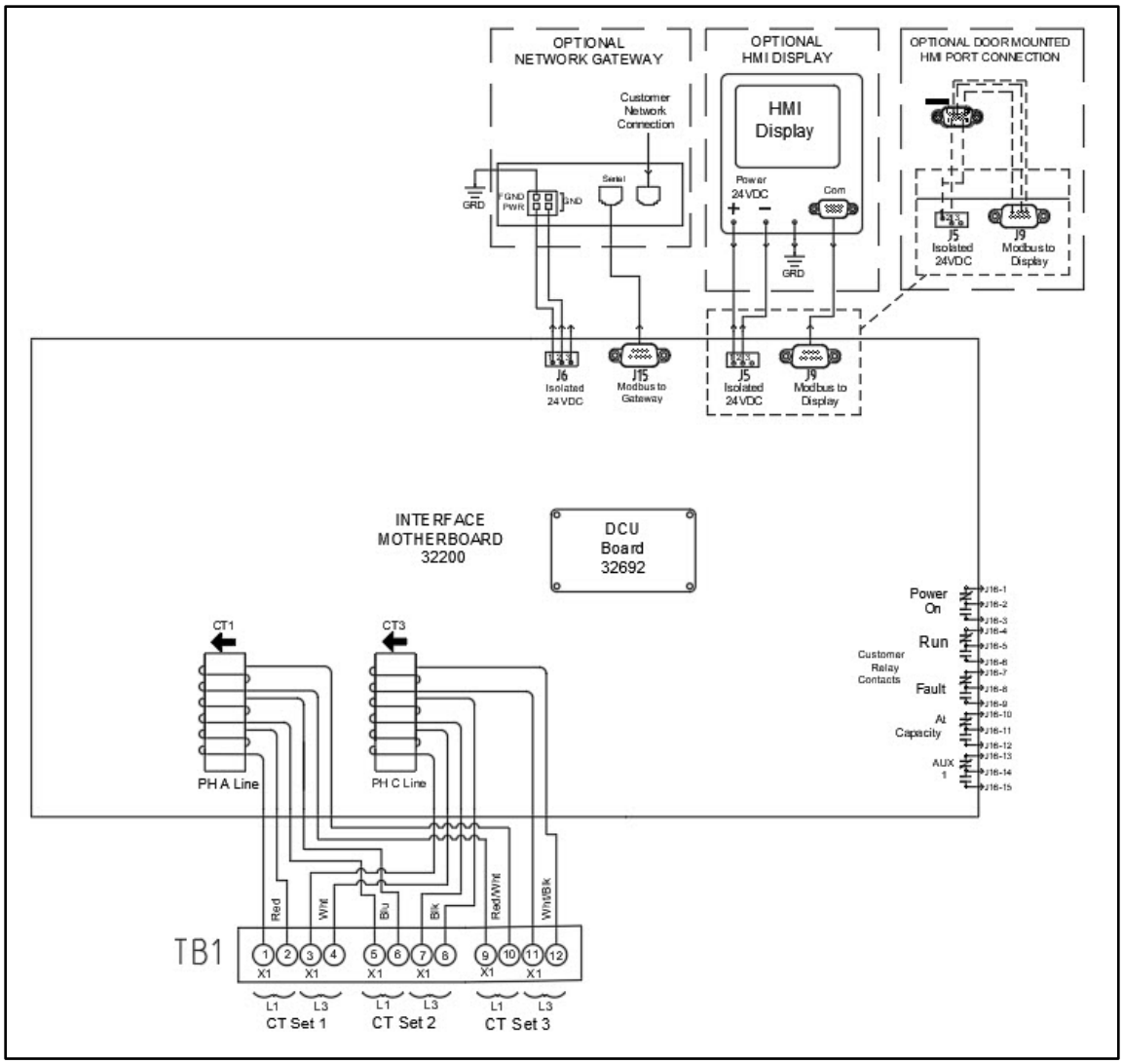


Figure 28: Interface Module Connections for Gen 2

Interface PCB Connections

Most customer connections to the Interface module will be made on the Interface PCB. Refer to connection diagrams in Figure 29. The details of the power and communications terminals are shown in Table 17.

Form C relays are available on the Interface PCB, these connections are shown in Table 18. Four outputs are available on the Interface PCB.

The relay start command input connection on J22 of the interface PCB allows a contact closure to send a run command to the HarmonicGuard Active filter. The relay start command input will only be acknowledged if the Relay Run/Stop Enable is set to Enabled on the HMI Display setup screen. Pressing stop locally via the HMI Display will set the enable for the relay start command to DISABLED.

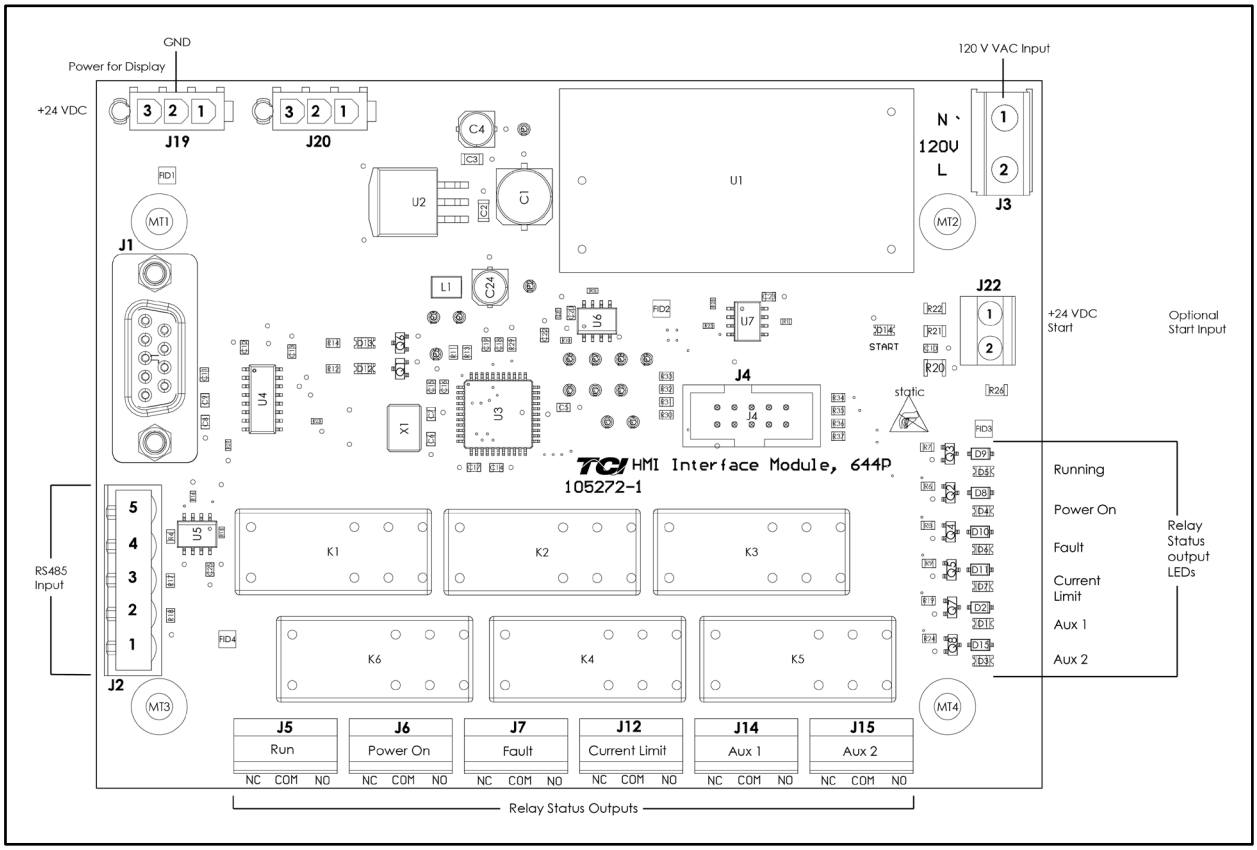


Figure 29: Interface PCB connections

Table 17: Power & Communications Terminals

Terminal	Pin	Description	Label	Rating
J1	1	HMI Display	For factory use	N/A
J2	1	RS485	Not Connected	N/A
	2		B	
	3		Ground	
	4		A	
	5		Not connected	
J3	1	Input Power	Neutral	120 VAC
	2		Line	
J4	1-14	Micro Programming	For factory use	N/A
J19	1	HMI Power Supply	24 VDC	24 VDC
	2		Common	
	3		Not Connected	
J22	1	Start Command	24 VDC	Contact Closure
	2		Start	

***Note**: The power terminal on the back of the HMI display accepts 28 to 14 AWG stranded wire, with a tightening torque of 4.4 in-lb. (0.5 Nm).*

Table 18: Form C Relay Contacts

Terminal	Pin	Description	Label	Tightening Torque	Wire Range
J5	1	Run	Normally Closed	4.4 lbs.-in (0.5 Nm)	28-14 Awg
	2		Common		
	3		Normally Open		
J6	1	Power On	Normally Closed	4.4 lbs.-in (0.5 Nm)	28-14 Awg
	2		Common		
	3		Normally Open		
J7	1	Fault	Normally Closed	4.4 lbs.-in (0.5 Nm)	28-14 Awg
	2		Common		
	3		Normally Open		
J12	1	Current Limit	Normally Closed	4.4 lbs.-in (0.5 Nm)	28-14 Awg
	2		Common		
	3		Normally Open		
J16	1	Power On	Normally Closed	4.4 lbs.-in (0.5Nm)	24-14 Awg
	2		Common		
	3		Normally Open		
	4	Run	Normally Closed		
	5		Common		
	6		Normally Open		
	7	Fault	Normally Closed		
	8		Common		
	9		Normally Open		
	10	At Capacity	Normally Closed		
	11		Common		
	12		Normally Open		
	13	Aux 1	Normally Closed		
	14		Common		
	15		Normally Open		
	16	N/C	N/A		

***Note**: Form-C relay contacts are gold plated with a load rating of 2.0A @ 250VAC.*

HMI Display Connections

***Note**: The following section describes the default ModbusRTU network connection option. If an optional advanced network Communications Gateway is included in the Interface Module, see the appendix A through F for the specific Communications Gateway configuration.*

The HMI display implements a ModbusRTU slave device over RS-485. This network connection is available on the COM2/3 DB9 connector on the back of the HMI Display, refer to Figure 29.

The output registers from the HarmonicGuard® Active filter are mapped to Modbus register address 40500. The input registers to the HarmonicGuard® Active filter are mapped to Modbus register address 40564. For definitions of the input and output data available via the network connection see tables below.

If the optional network Communications Gateway is present, the integrated ModbusRTU interface on the HMI Display will not be available. When configured, the Communications Gateway will be wired and terminated to the communications terminal block TBHMI.

Table 19: Modbus Connector Pin Definitions

TBHMI Pin Number	Signal Name	Signal Type
1	no connect	-
2	no connect	-
3	D+	RS-485 (non-inverting)
4	D-	RS-485 (inverting)
5	GND	RS-485 (signal/common ground)
6	no connect	-
7	no connect	-
8	no connect	-
9	no connect	-

Table 20: ModbusRTU Protocol Settings

Parameter	Default Value	Units
Baud Rate	19200	Bps
Data Bits	8	Bits
Stop Bits	1	Bits
Parity	Even	-
Slave ID	113	-

Communications Gateway Connections (Optional)

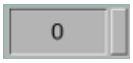
If an optional advanced network Communications Gateway is included in the Interface Module, see the specific appendix for that Communications Gateway wiring details.

If the optional network Communications Gateway is present, the integrated ModbusRTU interface on the HMI Display will not be available. When configured, the Communications Gateway will occupy the ModbusRTU COM2/3 DB9 connector on the back of the HMI Display.

HMI Screen Elements

This section focuses on the operation of the HMI Display. The HMI Display contains several screens that allow the user to monitor the status of the line/load and the HarmonicGuard® Active filter. Additionally, the HMI display can be used for local run/stop control and basic setup of the HarmonicGuard® Active filter.

Table 21: General HMI Screen Elements

HMI Graphic Element	Example	Description
Buttons		Buttons will appear raised or depressed, depending on set point and command conditions.
Indicators		Indicator status fields will appear flat and are read only.
Numerical Displays		Display fields will appear flat. Numerical displays are read only.
Numerical Entry Fields		Numerical Entry fields appear indented. Selecting them will open a keypad for numerical entry.
Navigation Bar		The Navigation Bar allows for easy navigation between the five major HMI screens. The Navigation Bar appears on all HMI screens.
Title Bar		The Title Bar contains the current system time, screen selection, and a stop button to turn off the system. Also, small “Configuration Change Pending” text will appear above the screen name if any parameter changes are pending but not saved. The Title Bar appears on all HMI screens.

Initialization

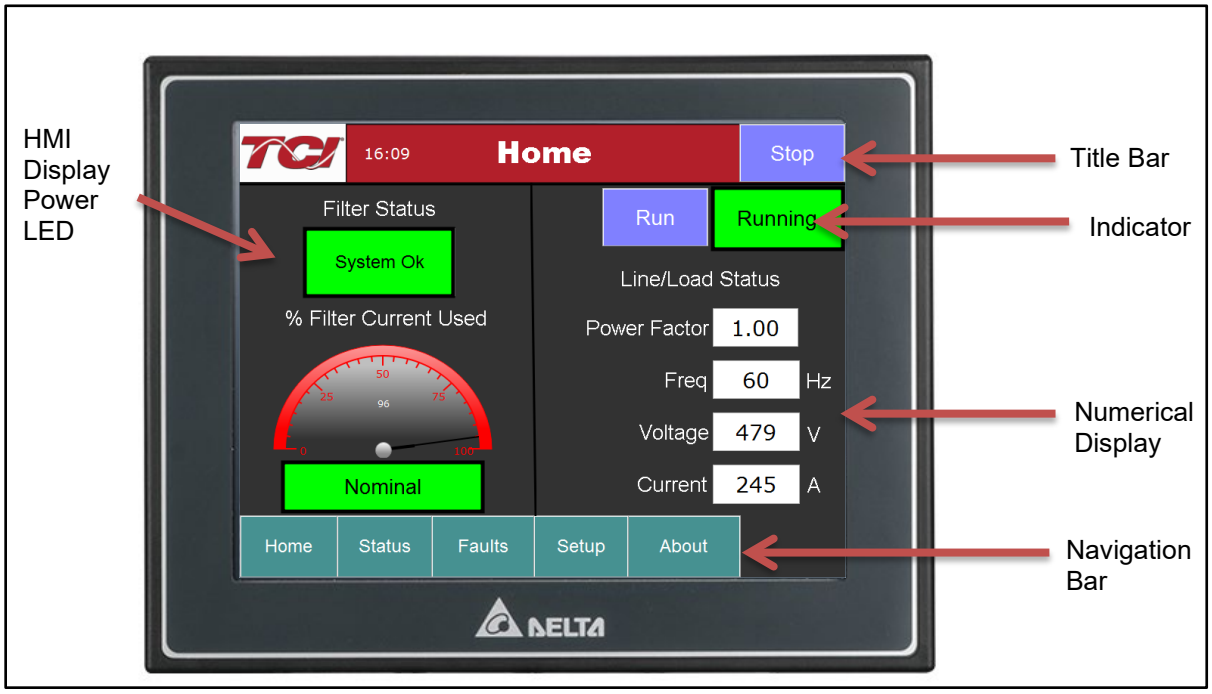


Figure 30: HMI Display

When first powered, the green LED (Power) on the HMI Display will light, refer to Figure 30. After a five second boot up sequence, the Home Screen will be displayed. If the home screen is not displayed and power is available to the HMI Display, see 9.0 HMI Troubleshooting for diagnosing common problems.

HMI Installation Diagram

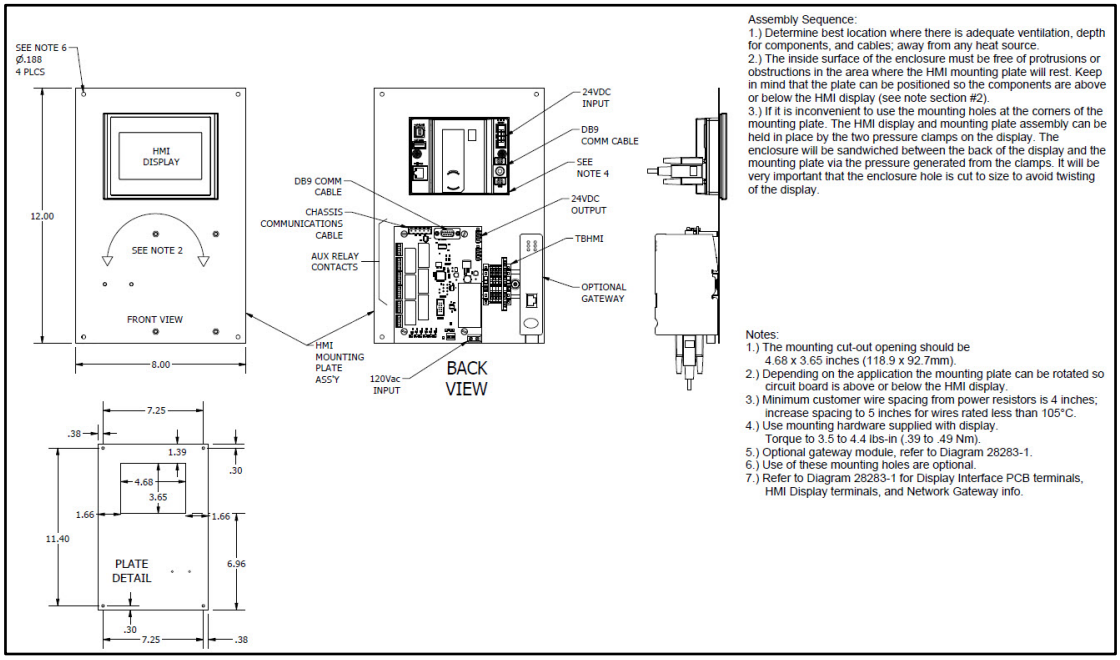


Figure 31: HMI Installation Diagram

HMI Screens

Home Screen

The Home screen displays a dashboard of overall filter status information and allows the user to run and stop the HarmonicGuard® Active filter.

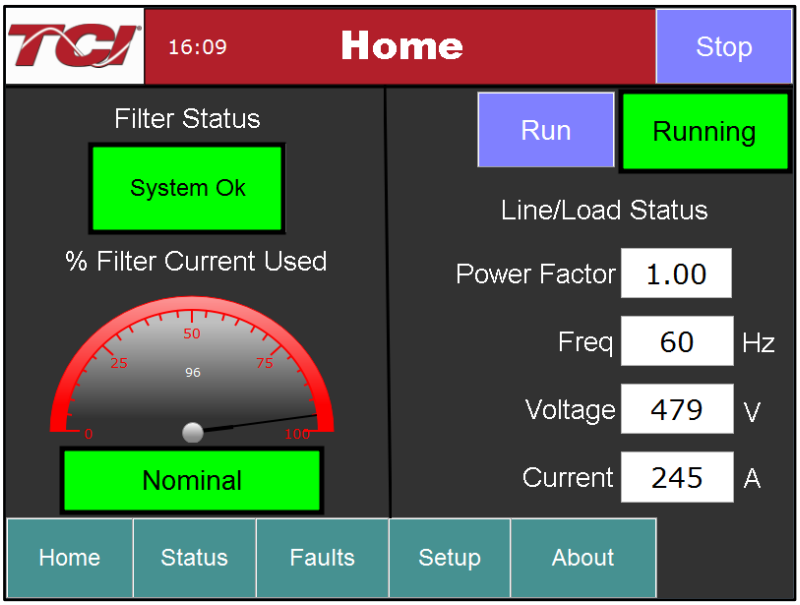


Figure 32: Home Screen

Table 22: Home Screen Elements

Screen Element	Description
Filter Status Display	Indicates if a converter fault is active and preventing the HarmonicGuard® Active filter from running. If a fault occurs, the indicator will flash red and display “Fault”. Specific Fault codes can be viewed on the “Fault” Screen.
% Filter Current Used Display	This gauge displays the current filter capacity as a percentage of total available capacity. In normal operation, the display will read “Nominal”. If the unit output corrective current is above 95% of maximum capacity, the indicator light will turn red and display “At Capacity”. When the converter is at capacity, the Relay K4 (J12 Connector), and J11 Contacts used for a remote indicator will also be energized. If the monitor continually displays “At Capacity”, a second filter may be required to handle the load. Please contact TCI for assistance.
Run/Stop Button	Runs and stops the HarmonicGuard® Active filter.
System State Indicator (located immediately below stop button)	When the HarmonicGuard® Active filter is in a stop mode, the “Status” light will turn red and display “Stopped”. When the converter is running, the status light will be green and will display “Running”. The status light will also show if the HarmonicGuard® Active filter is in Input line Sync mode, Reset mode, Pre-charge mode, Calibrate mode, Power Save mode or Faulted. When the HarmonicGuard® Active filter is faulted, it will shut down automatically.
Power Factor Display	Displays current line/load power factor. 1.00 indicates unity power factor. A negative power factor indicates lagging power factor.
Line Frequency Display	Displays the current utility line frequency in Hz.
Supply Voltage	Displays the supply Voltage coming into the HarmonicGuard® Active filter.
Line/Load Current Display	Displays the current line/load phase current in Amps RMS. ***Note:*** *The displayed current is affected by the CT Ratio configuration on the “Tech Setup” page.*

Status Screen

The Status screen shows more specific information on the performance of the system, such as current and Voltage waveforms, Power Factor, and information specific to the Line/Load screen and Converter screen.

Note: *The Status Screen will indicate if unit is Line Side/Load Side. The "Line/Load" button and the "Line/Load Current Plot" text changes to show Line or Load status.*

The figure below explains the main "Status" screen.

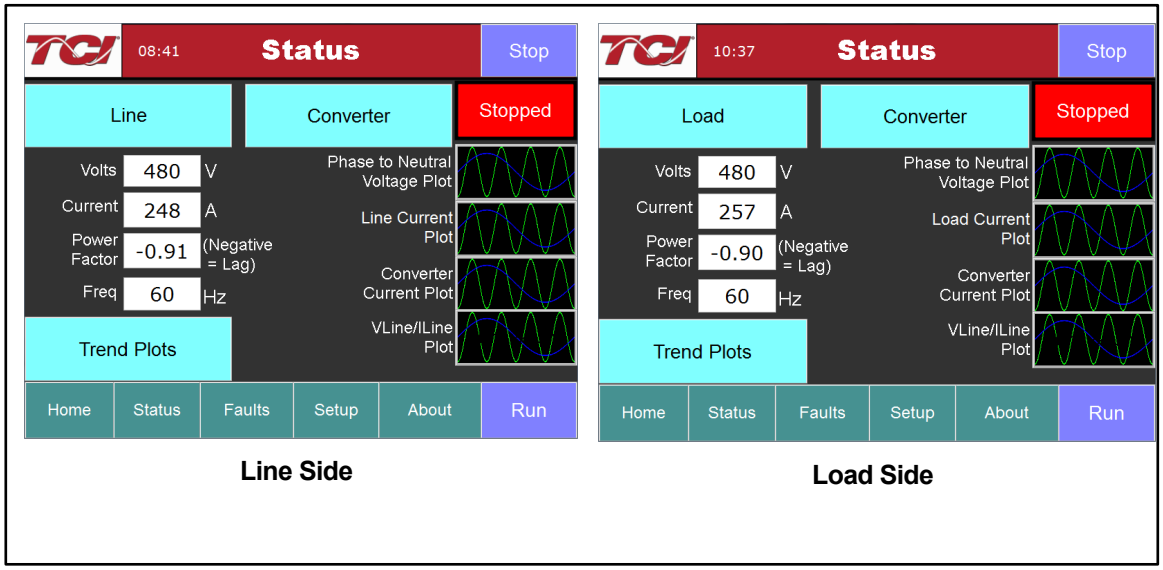


Figure 33: Status Screen

Table 23: Status Screen Elements

Screen Element	Description
Line/Load Button	Use this button to get to the "Line/Load Status" Sub Screen
Volts Display	Displays the current utility phase to phase line Voltage in Volts RMS.
Current Display	Displays the current line/load phase current in Amps RMS.
Power Factor Display	Displays current line/load power factor. A value of 1.00 indicates unity power factor. A negative power factor indicates lagging power factor.
Frequency Display	Displays the current utility line frequency in Hz.
Run/Stop Button	Runs and stops the HarmonicGuard® Active filter.
Converter Button	This button will take the user to the "Converter Status" Sub Screen.
Phase to Neutral Voltage, Line Voltage, Line/Load Current, Converter Current, and VLine/ILine Waveform Screens	The "Waveform" screen buttons will take the user to one of the four real-time waveform capture screens: Line Voltage (Phase to Neutral), Line Current, Converter current, or VLine/ILine plot.
Trend Plots Screen	When the user presses the "Trend Plots" button, the Historical Trend screen menu is displayed.

Converter Status Screen

The converter status sub screen shows the present status of the HarmonicGuard® Active filter power converter module.

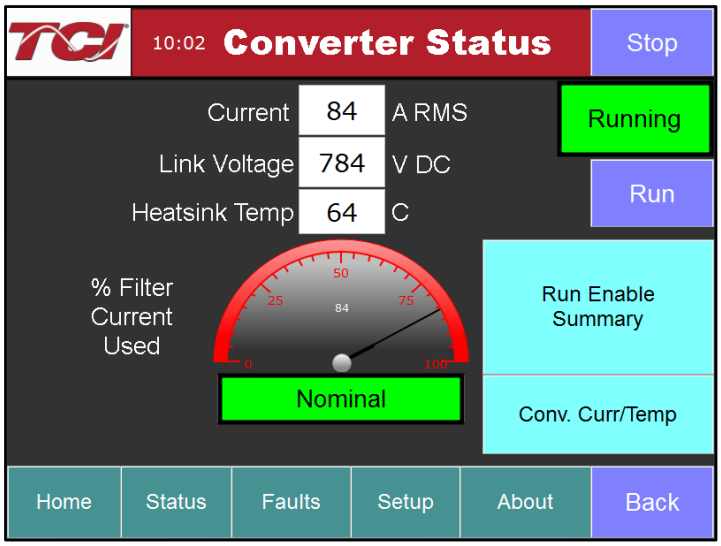


Figure 34: Converter Status Sub Screen

Table 24: Converter Status Screen Elements

Screen Element	Description
Run/Stop Button	Runs and stops the HarmonicGuard® Active filter.
Current Display	Displays the present HarmonicGuard® Active filter output corrective current in Amps RMS for each phase
Link Voltage Display	Displays the internal DC Link Bus Voltage of the HarmonicGuard® Active filter in Volts DC for the total DC Bus and the lower half of the DC Bus
Heatsink Temp Display	Displays the present HarmonicGuard® Active filter power converter heat sink temperature in Degrees Celsius for all three phases. Note the 50A, 100A, and 150A models have one heatsink temperature located in the center of the power converter so the three phase values will be the same.
% Filter Current Used Display	This gauge displays the current filter capacity as a percentage of total available capacity. In normal operation, the display will read “Nominal”. If the unit output corrective current is above 95% of maximum capacity, the indicator light will turn red and display “At Capacity”. When the converter is at capacity the Relay K4 (J12 Connector), and J11 Contacts used for a remote indicator will also be energized. If the monitor continually displays “At Capacity”, a second filter may be required to handle the load. Please contact TCI for assistance. If the unit is in thermal limit “THERMAL LIMIT” text will be displayed below the gauge. If an individual harmonic regulator is at its correction capability maximum, then “E-Gain Active” text will be displayed to the bottom left of the gauge.
Run Enable Summary	Displays the current state of all enables that affect the running of the HarmonicGuard® Active filter. If a button is red, that option is disabled and if it is green, that option is enabled. If the “Auto Start” is enabled, a countdown timer will run to the right of the button, when the count reaches 0 the converter will start.
Conv. Curr/Temp Button	Displays current and temperature levels for each individual converter in the unit.
Back Button	Returns user to the main status screen.

Run Enable Summary Screen

The Run Enable Summary sub screen shows the state of all the enables that affect the running of the HarmonicGuard® Active filter.

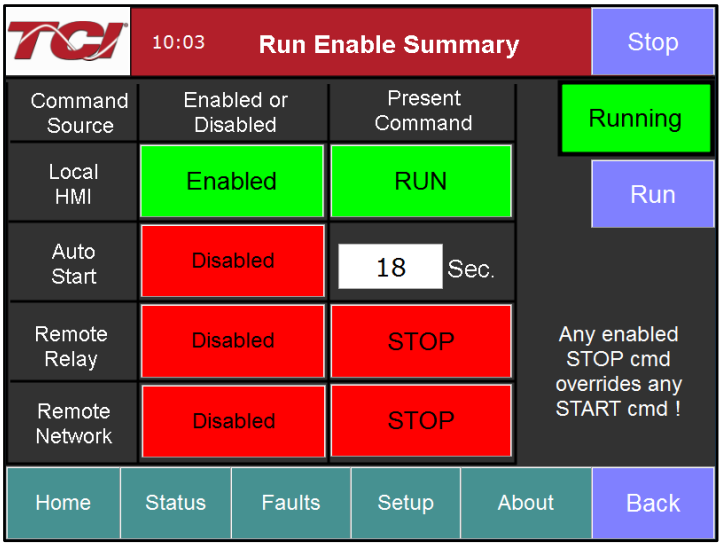


Figure 35: Run Enable Summary Screen (RUN)

When the HMI Stop button is pressed locally on the HMI, the unit enters a Run Inhibit state and will show a “Run Inhibit Active” message on the Run Enable Summary Screen center right. When the Run Inhibit is Active, the unit will not be allowed to start remotely via a Network start, Remote relay start, or Auto-start command. The Run Inhibit is cleared by pressing the HMI Run button locally on the HMI display.

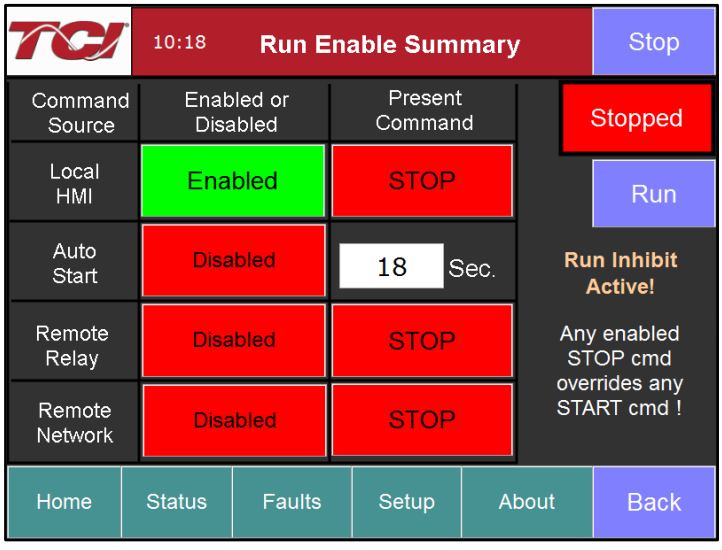


Figure 36: Run Enable Summary Screen (STOP)

Table 25: Run Enable Summary Sub Screen Elements

Screen Element	Description
Run/Stop Button	Runs and stops the HarmonicGuard® Active filter.
Local HMI	This option is always enabled. The “Present Command” field will be green and say RUN, if the local HMI run button has been pressed and the unit is operational. It will be red and say STOP, if the unit is stopped locally or in the Run Inhibit state.
Auto Start	Changes to green, if enabled and the countdown timer (to the right of the button) will start. When it reaches 0, the HarmonicGuard® Active filter will start.
Remote Relay	Changes to green, if enabled. If enabled the HarmonicGuard® Active filter can be remotely turned on with a contact closure.
Remote Network	Changes to green, if enabled. If enabled, the HarmonicGuard® Active filter can be remotely stopped/started with a contact closure. When the contact is closed, the unit will run and when opened the unit will stop. When enabled and the option is active, the field to the right will be green and read “RUN”.
Back	This button will take you back to the converter status screen.

Converter Current/Temperature Screen

The Converter Current/Temperature screen displays the current and temperature levels for each individual converter that is present in the unit. These values are represented as “Converter Current” and “Converter Temperature” throughout the HMI.

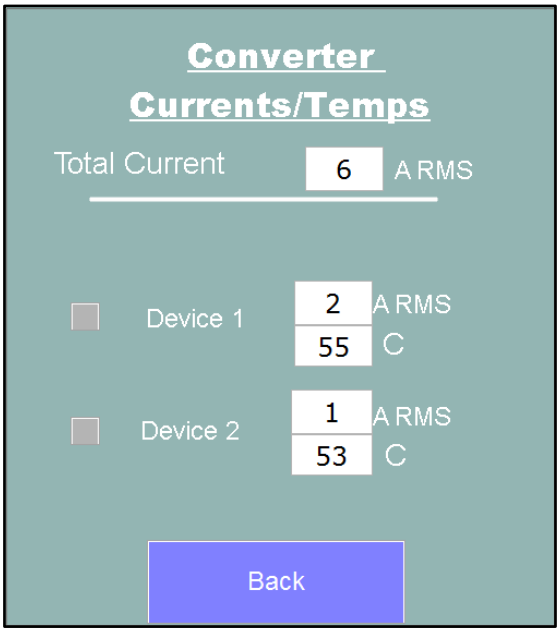


Figure 37: Converter Current/Temperature Screen

Line/Load Status Screen

The Line/Load Status Sub Screen shows more specific information regarding the source or Load Voltage, Current, Power, Power Factor and THD measurements.

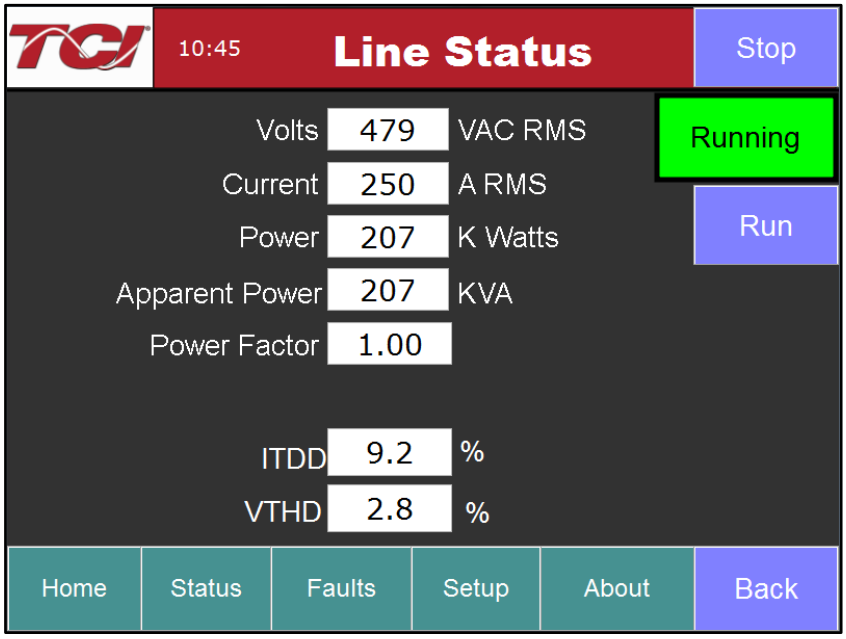


Figure 38: Line Status Sub Screen

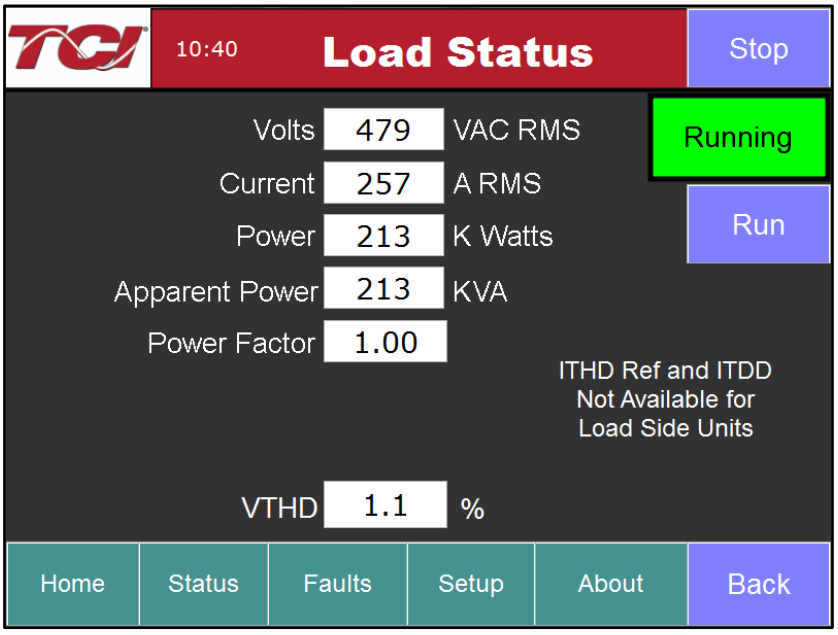


Figure 39: Load Status Sub Screen

Table 26: Line/Load Status Screen Elements

Screen Element	Description
Volts Display	Displays the current utility phase to phase line Voltage in Volts RMS.
Current Display	Displays the current line/load phase current in Amps RMS. ***Note:*** *The displayed current is affected by the CT Ratio configuration on the "Setup" page.*
Power Display	The 3-phase real power (P) of the line/load in kW.
Apparent Power Display	The 3-phase apparent power (S) of the line/load in kVA.
Power Factor Display	Displays current line/load power factor. 1.00 indicates unity power factor. A negative power factor indicates lagging power factor.
I THD Display	Displays the Total Harmonic Distortion of the utility Line/Load current as a percentage. ***Note****: If secondary CT current is less than 1A, THID and THID Ref will be unavailable*
V THD Display	Displays the Total Harmonic Distortion of the utility line Voltage as a percentage.
I THD Ref Display	Displays the reference Total Harmonic Distortion of the utility Line current in a percentage. This THD display is the uncorrected THD of the Line taken when the HarmonicGuard® Active filter was not running. ***Note:*** *For load side configured units, I THD Reference and I TDD displays are not available* ***Note:*** *If secondary CT current is less than 1A, THID and THID Ref will be unavailable*
I TDD Display	Displays the Total Demand Distortion of the utility. By default, this is calculated based on CT Ratio, but can be adjusted by entering the system Full Load Amps (FLA) on the "Tech Setup" screen. See the "Tech Setup Screen" section below
Run/Stop Button	Runs and stops the HarmonicGuard® Active filter.
Back Button	Returns user to the main Status Screen.

Waveform Plot Sub-Screens

The HMI display supports capture and display of real time system Voltage and current data. 3-phase waveform data can be viewed for Line Voltage, Line/Load Current, and Converter Corrective Current.

The waveform screens contain a zoom feature, which supports three magnitude scales: 1X, 2X and 4X (Figure 40). The Refresh button on the waveform screens will update the plot with new data from the HarmonicGuard® Active filter converter.

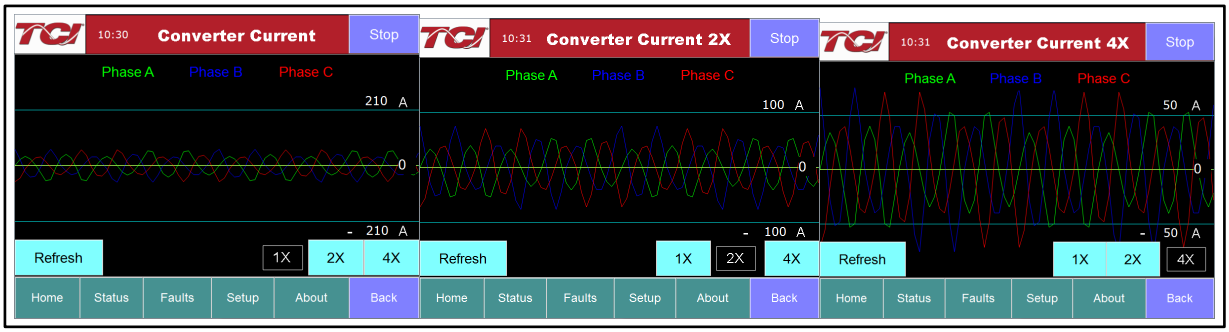


Figure 40: Example Waveform Plot Screens (Converter Corrective Current) at 1x, 2x, 4x Zoom

Table 27: Waveform Plot Sub Screen Elements

Screen Element	Description
Refresh Button	The "Refresh" button will reload the data from the HarmonicGuard® Active filter power converter controller and redraw the waveform plot. When the waveform plot is being refreshed a loading bar will be shown instead of the refresh button along with "Loading…" text.
1X, 2X, and 4X Buttons	Waveform zoom buttons will redraw the present data at a different scale.

VLine & ILine Waveform Plot Sub-Screen

The VLine & ILine Waveform Plot Sub Screen is available to verify the proper installation of the HarmonicGuard® Active filter power connections and system current CT feedback. The waveform plot shows Voltage and current feedback for both Phase A and C on the same plot. When the HarmonicGuard® Active filter is powered, but in the stopped state this plot can be used to check for the following:

- Proper Line Voltage phase rotation.
- Proper Line/Load Current phase rotation.
- Proper Line Voltage and Line/Load Current relative polarity and phase.
- Missing/Open Circuit System Current CT Feedback.

If the HarmonicGuard® Active filter performance is degraded, the VLine & ILine waveform plot should be examined to determine if any system connection errors are present. Prior to examining the VLine & ILine waveform plot, the HarmonicGuard® Active filter should be put in the stopped state by pressing the stop button in the upper right corner of the HMI screen. Figure 40 shows the VLine & ILine waveform plot sub screen for a properly connected, but non-running HarmonicGuard® Active filter when connected to a typical non-linear, rectifier load. Note the following characteristics:

- Phase C Voltage (Blue) leads Phase A Voltage (Green).
- Phase C current (Yellow) leads Phase A current (Red).
- Phase A Voltage (Green) and Phase A current (Red) are in phase and the same polarity.
- Phase C Voltage (Blue) and Phase C current (Yellow) are in phase and the same polarity.

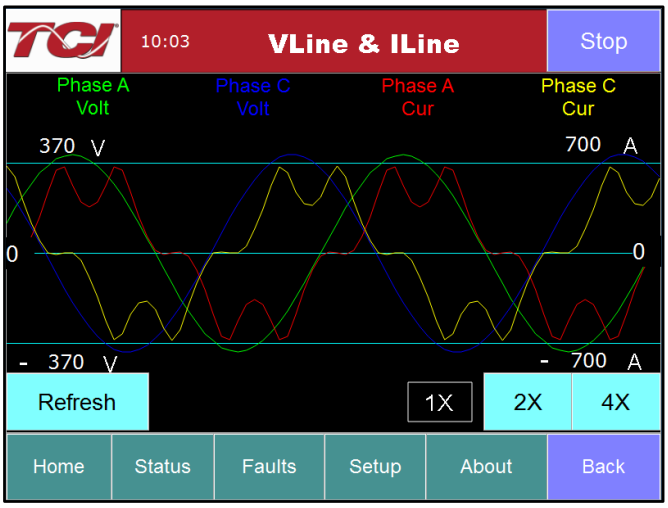
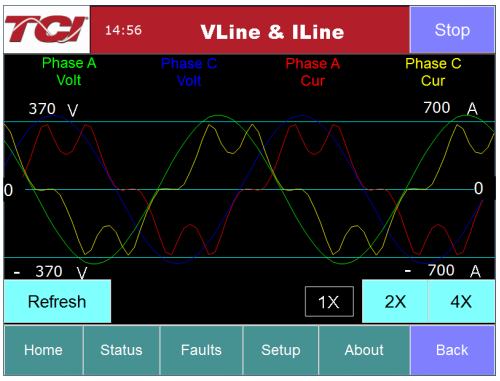
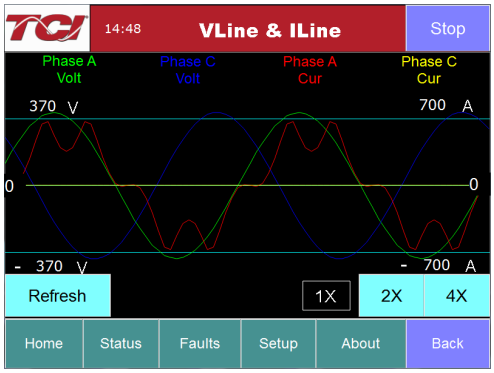
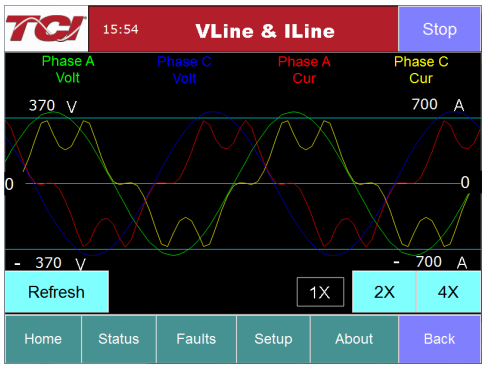
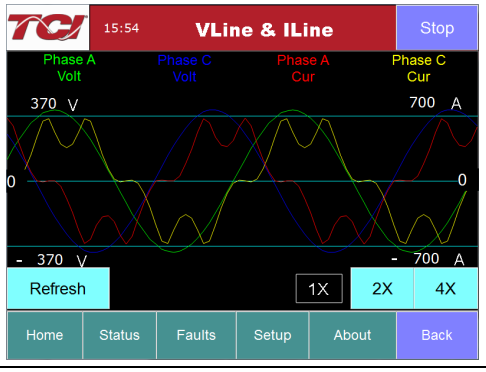


Figure 41: VLine & ILine Waveform Plot of a Properly Connected HarmonicGuard® Active filter (unit in stopped state)

Note: *The example VLine & ILine Waveform Plot screens apply to rectifier loads only. For low power factor loads, the VLine & ILine waveform screen will appear different.*

The table below shows what the VLine & ILine Waveform Plot Sub Screen would look like with various connection errors present in the system.

Table 28: VLine & ILine Waveform Plot Screen Examples when Typical Connection Errors Present in System

VLine & ILine Waveform Plot Sub Screen with Rectifier Load	Connection Error Description	Connection Error Resolution
	Phase rotation is Incorrect: Phase A leads Phase C instead of Phase C leading Phase A.	To correct, swap Phase A and Phase C HarmonicGuard® Active filter power connections AND swap Phase A and Phase C system CT current feedback then recheck plot.
	Phase C system CT current feedback missing: Phase C current is zero while Phase A current is present.	Check Phase C CT for open circuit or loose connection.
	Phase A and Phase C CT current feedback swapped: Phase A current (red) in phase with Phase C Voltage (blue), instead of Phase A Voltage (green).	To correct, swap Phase A and Phase C system CT current feedback and recheck plot.
	Phase A current (red) is opposite polarity of Phase A Voltage (green) and Phase C current (yellow) is opposite polarity of Phase C Voltage (blue).	To correct, re-install both Phase A and Phase C system CTs with polarity arrow in opposite direction OR swap positive and negative connections of each CT at HGA filter terminal block then recheck plot.

Historical Trend Plot Menu Sub-Screen

From the historical trend plot menu sub screen, the trend graphs of various HarmonicGuard® Active filter system signals can be viewed.

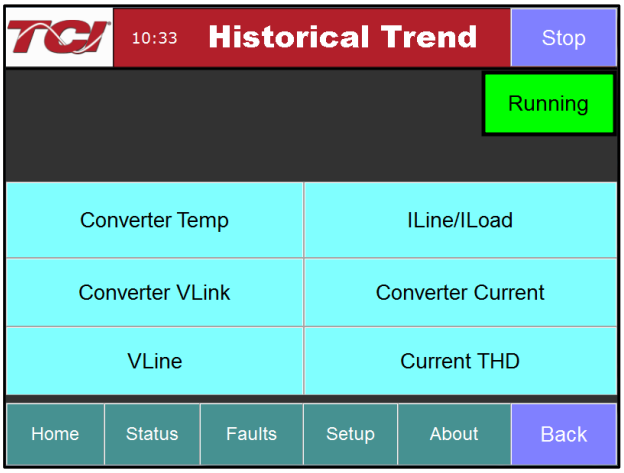


Figure 42: Historical Trend Plot Menu Sub Screen

Table 29: Historical Trend Plot Menu Sub Screen Elements

Screen Element	Description
Converter Temp Button	Opens the HarmonicGuard® Active filter heatsink temperature historical trend graph screen. This signal is sampled every 15 seconds and historical data is maintained for 10 hours.
Converter VLink Button	Opens the HarmonicGuard® Active filter DC Link Voltage historical trend graph screen. This signal is sampled every 3 seconds and 2 hours of historical data is maintained.
VLine Button	Opens the utility input RMS Voltage historical trend graph screen. This signal is sampled every 3 seconds and 2 hours of historical data is maintained.
ILine/ILoad Button	Opens the line/load RMS current historical trend graph screen. This signal is sampled every 3 seconds and historical data is maintained for 2 hours.
Converter Current Button	Opens the HarmonicGuard® Active filter RMS current historical trend graph screen. This signal is sampled every 3 seconds and 2 hours of historical data is maintained.
Current THD Button	Opens the line/load Total Harmonic Distortion historical trend graph screen. This signal is sampled every 3 seconds and 2 hours of historical data is maintained.

Historical Trend Plot Sub Screens

The historical trend plot screens graph time-stamped feedback data over an extended period. Once the trend plot display data buffer is full, the oldest data is overwritten. Historical data can be viewed using the integrated scroll bars of the trend plot. All trend plot data is maintained between power on/off cycles of the HarmonicGuard® Active filter. See figure below for an example of a typical trend graph (trend plot example is for the HarmonicGuard® Active filter power converter heatsink temperature measurement).

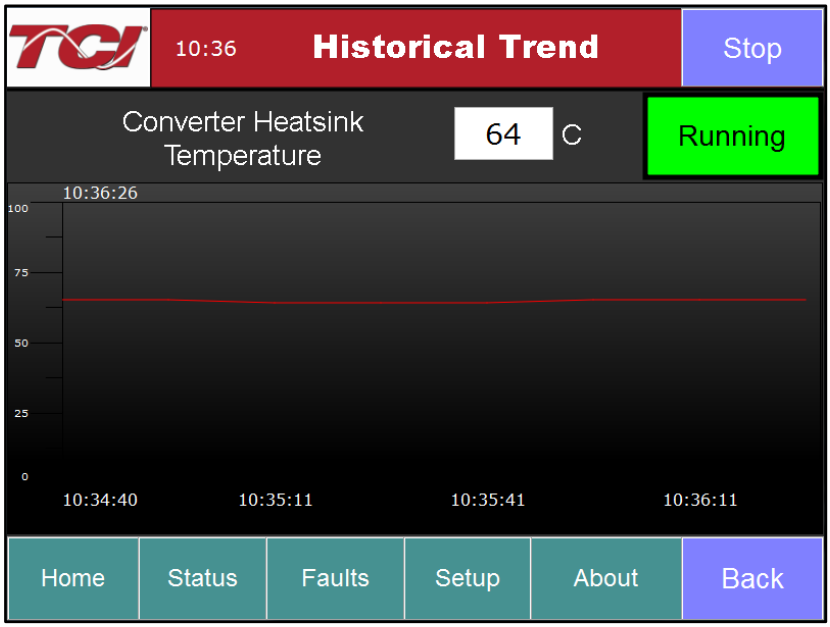


Figure 43: Example Historical Trend Plot Sub Screen

Table 30: Trend Plot Screen Elements

Screen Element	Description
Run/Stop Button	Runs and stops the HarmonicGuard® Active filter.
Plot Scale Display (located on the left side of the graph)	Indicates the magnitude of the samples of the trend plot. The scale varies with each of the trend plots.
Right Timestamp	Indicates the date and time the right-most sample displayed on the screen was taken.
Left Timestamp	Indicates the date and time the left-most sample displayed on the screen was taken.
Scroll Bar	Allows the user to scroll through all sample points available in the trend plot data buffer.
Trend Plot Display	The historical graph of the value being sampled over time.
Zoom In, Out, Reset	The zoom buttons will decrease or increase the horizontal time span of the displayed trend plot. The middle zoom reset button will reset the time span of the trend plot back to the original value.

Fault Screen

This button takes the user to the “Active Fault” screen. See figure below, which lists all the active faults. The faults will stay in this list until the “Reset”, or “Stop” button is pressed or the fault self clears. The “Fault History” screen can also be viewed here.

Figure 44: Fault Screen

Table 31: Fault Screen Elements

Screen Element	Description
Stop Button	Turns off the HarmonicGuard® Active filter.
Reset Button	This button will remove all faults from the list if the fault conditions have cleared. Once cleared, a fault will still be viewable in the fault history log available from the “Tech Setup” screen.
Fault Trip Entry Display	When a fault occurs, the fault screen will display information about the fault including the (from left to right across the screen): Fault bit mask number Fault timestamp Fault code Fault description
Up, Down, Page Up, Page Down Buttons	The up, down, page up, and page down buttons will move through the list of faults if not all faults fit on one screen.

Table 32: Fault Codes

Fault Code	Critical or Non-critical Fault	Auto or Manual Reset	Fault Description
10	Critical	Manual*	Desaturation - Hardware Phase A
11	Critical	Manual*	Desaturation - Hardware Phase B
12	Critical	Manual*	Desaturation - Hardware Phase C
920	Non-critical	Auto	Internal CPU Fault 1 (CPU Cycle Time)
921	Non-critical	Auto	Internal CPU Fault 2 (CPU Clock Failure)
922	Non-critical	Auto	Internal CPU Fault 3 (CPU Stop)
923	Non-critical	Auto	Internal CPU Fault 4 (CPU Hardware)
950	Non-critical	Auto	Invalid Setpoint Configuration
951	Non-critical	Auto	Internal CPU Fault 5 (CPU Memory)
980	Non-critical	Auto	Test Fault 1 (Run)
981	Non-critical	Auto	Test Fault 2 (PCB)
1000	Non-critical	Auto	DC Bus Overvoltage - Overall
1001	Non-critical	Auto	DC Bus Overvoltage - Lower
1250	Non-critical	Auto	DC Bus Undervoltage - Overall
1251	Non-critical	Auto	DC Bus Overvoltage - Lower
3000	Non-critical	Auto	Overcurrent - Phase A
3010	Non-critical	Auto	Overcurrent - Phase B
3020	Non-critical	Auto	Overcurrent - Phase C
4000	Non-critical	Auto	Over Temperature - Phase A
4010	Non-critical	Auto	Over Temperature - Phase B
4020	Non-critical	Auto	Over Temperature - Phase C
4250	Non-critical	Auto	Under temperature - Phase A
4260	Non-critical	Auto	Under temperature - Phase B
4270	Non-critical	Auto	Under temperature - Phase C
4500	Non-critical	Auto	Exhaust Over Temperature
7000	Non-critical	Auto	Calibration Fault
7010	Non-critical	Auto	Communications Fault
7050	Critical	Manual*	Auto-start Restart Limit Exceeded
Unit N Faulted	Non-critical	Auto	Fault location indication. Fault originated in Unit N where N is in the range 1 to 8. For factory configured parallel systems, the unit numbers are sequential ordered from left to right when looking at the front of the system. Unit 1 is the left most unit in the system.

*Critical faults flagged with a manual reset require an HMI stop button or run/stop switch stop command at the unit to clear.

Setup Screen

Note: *Some set-up screens are password protected to prevent changes that could damage the filter.* When the user presses the "Setup" button, a screen will appear where the Date, Time, Language, and Screen Brightness can be selected.

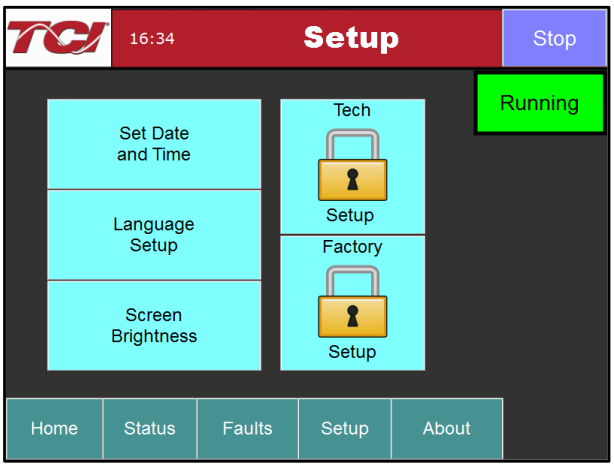
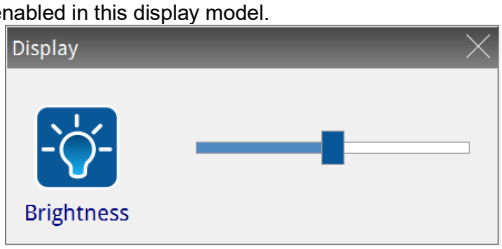


Figure 45: Setup screen

Table 33: Setup Screen Elements

Screen Element	Description
Set Date and Time	Presents a sub screen, which allows the user to change the date and time displayed on the screen. The date and time are also used for time stamps in the fault history and historical trend plots.
Language Setup	Allows user to select Language (English, Spanish, French)
Screen Brightness	This option allows the user to change the brightness of the display. The contrast control is not enabled in this display model.  ***Note:*** *Screen is designed to be viewed at chest level.*
Tech Setup	This button is password protected. Takes user to "Tech Setup" screen. Outline to follow. The HMI has an auto password bypass feature. After successful entry of the Tech Setup password the Tech Setup button will change to yellow and indicate that the bypass is active. The password bypass will auto clear after 30 minutes or when the Clear Password Bypass button is pressed.
Factory Setup	This button is password protected and used during the factory and TCI technician setup only.
Clear Password Bypass	The HMI has an auto password bypass feature. After successful entry of either a Tech Setup or Tech Setup Plus password the Tech Setup buttons will change to yellow and indicate that the password bypass is active. The password bypass will auto clear after 30 minutes or when the Clear Password Bypass button is pressed.

Tech Setup Screen

To continue to the Tech Setup page, select the “Tech Setup” button and enter the Tech Password: **08252014.** Next, a splash screen will appear saying “The Filter is about to stop” Choosing “Next” will stop the filter and take the user to the “Tech Setup” screen. Pressing the “Back” button returns the user to the “Home” screen and does not turn off the filter. If the filter is off, this splash screen will not appear.

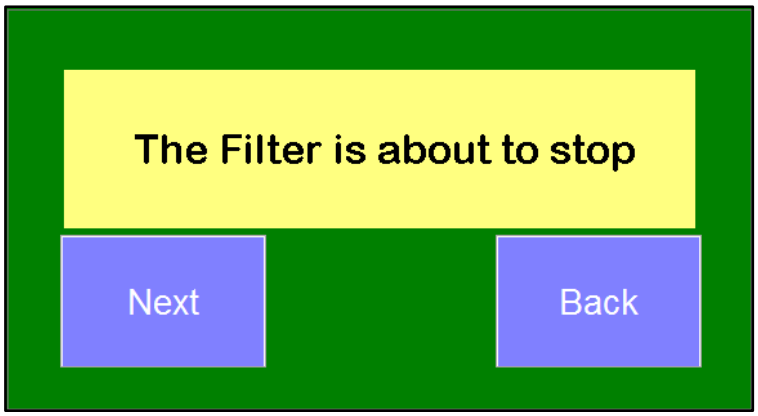


Figure 46: Setup Transition Sub Screen

The Tech Setup Screen allows basic configuration of the HarmonicGuard® Active filter operation.

Note: *It is recommended that the new settings are saved when changes are made. See the description of the “Save Settings” button in Table 34.*

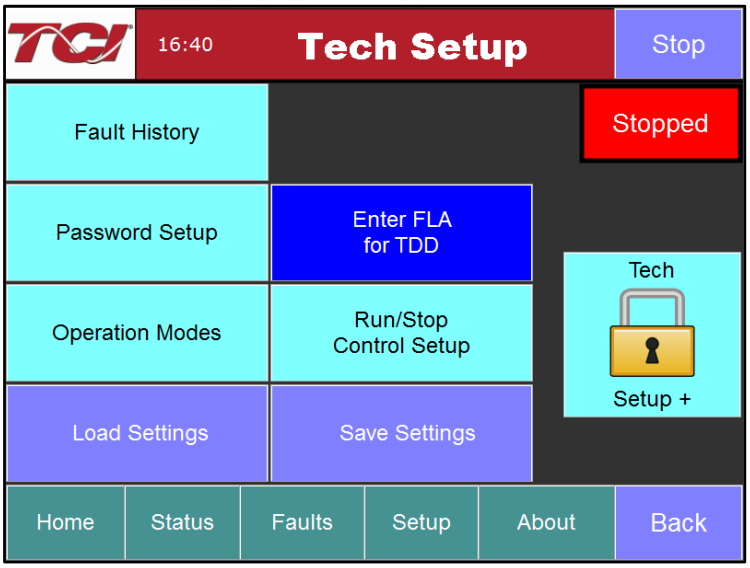
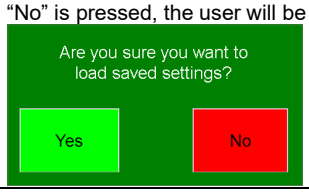
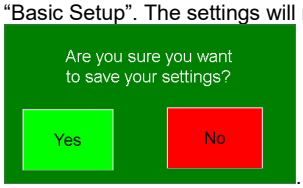


Figure 47: Tech Setup Screen

Table 34: Tech Setup Screen Elements

Screen Element	Description
Operation Modes	Takes user to “Operation Mode Setup” screen. This screen is outlined below.
Password Setup	This button is password protected. Takes user to pop-up screen where passwords can be re-configured.
Fault History	Takes user to the “Fault History” screen. This screen is outlined below.
Run/Stop Control Setup	Takes user to “Run/Stop Control Setup” sub screen. Outline to follow.
Load Settings	This button will restore the user saved settings from non-volatile persistent memory. A confirmation screen will pop up asking “Are you sure you want to load saved settings”. If “Yes” is chosen, any temporary changes made to the working set point parameters will be lost and the user saved settings will be restored. If “No” is pressed, the user will be sent back at the “Basic Setup” screen. 
Save Settings	This button will save the current working settings to non-volatile memory that persist when power is removed from the unit. To save the current settings, choose “Yes” on the confirmation screen, or choose “No” to cancel and go back to the “Basic Setup”. The settings will not be saved if “No” is chosen.  .
Tech Setup +	The password protected Tech Setup + button opens application specific setup screens for advanced configuration of the active filter. Access to this HMI screen is not needed for basic system installation and commissioning. If a specialized setup feature is required for your application, an authorized TCI field service representative will provide instruction on those features.
Tech Setup ++	The password protected Tech Setup ++ button opens application specific setup screens for advanced configuration of the active filter and utility functions used during power converter replacement. Access to this HMI screen is not needed for basic system installation and commissioning. If a specialized setup feature is required for your application, an authorized TCI field service representative will provide instruction on those features.
Full Load Amps Entry	This button allows user to enter in the system full load amps rating and is used to calculate the ITDD display shown on the “Line Status” screen ***Note:*** *ITDD Display is not available for load side configured units*

Fault History Sub Screen

The “Fault History” sub screen contains up to 120 entries that mark the onset and clearing of system faults. At the onset of a fault condition, a row entry will be generated in the fault history. This entry will have a timestamp for the onset of the condition logged in the “Trigger” column on the left side of the entry. When a fault clears, a time stamp entry will be logged in the “Recovery” column on the right side of the fault entry.

The Fault History persists through power on/off cycles. In the event the fault history log exceeds the max number of 120 entries, the oldest entry will be overwritten by new entries.

The up, down, page up, and page down buttons located on the top left side of the screen will move through the list of faults if not all faults fit on one screen.

The “Save All to USB Storage” button will create an archive of the alarm fault history and historical trend data then save that archive to a USB memory stick installed in the USB port located on the back of the HMI. If a valid USB storage device is available when the save button is pressed the HMI will display an “Exporting Data…” message for up to 10 seconds. If no USB storage device is installed or available, the HMI will display a “Disk Not Ready” message.

The “Remove USB Storage” button will prepare any installed USB storage device to be removed. The USB device should not be removed from the HMI unless the “Remove USB Storage” button was pressed first or unless the HMI has been powered off. If the HMI is installed in the same enclosure as the high voltage line connections to the unit the unit should be completely de-energized before removing the USB memory device.

The Fault History Sub Screen is available from the Tech Setup screen.

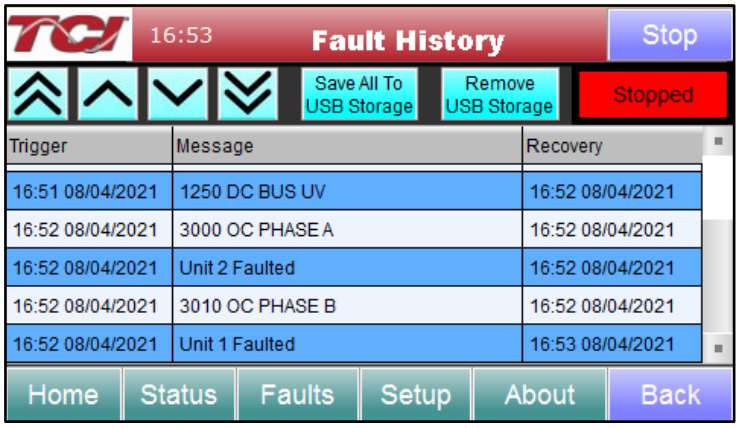


Figure 48: Fault History Sub Screen

Table 35: Fault History

Column (from left to right)	Format	Description
Onset/Clear Marker	O = Fault Onset X = Fault Cleared	Marks the start and end of a fault in the fault history.
Timestamp	HH:MM MM/DD/YYYY	Time and date the fault entry was logged.
Fault Code	Four-digit code	Fault code (See Table 32)
Fault Description	Text	A short text description of the fault.

Operation Mode Setup Sub-Screen

Allows for selection of operation modes, CT Ratio, and unit calibration enable.

Note: *If button is GREEN, the option is ENABLED. If button is BLUE, option is DISABLED.*

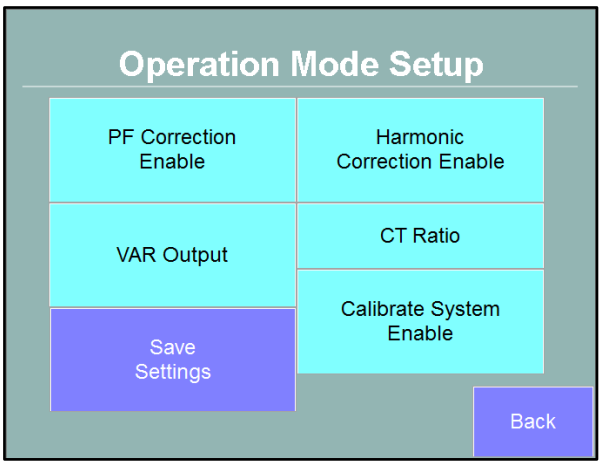
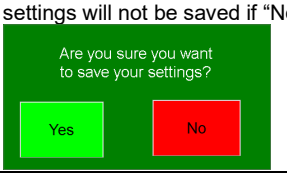


Figure 49: Operation Mode Setup Sub-Screen

Table 36: Harmonic/PF Correction Setup Screen Elements

Screen Element	Description
Harmonic Correction Enable	This option turns the Automatic Harmonic Correction on or off. This option is on by default. If both harmonic correction and power factor correction are enabled and the HarmonicGuard® Active filter is at its maximum capacity, the power factor correction will automatically be phased back to allow the system to continue correcting harmonics.
PF Correction Enable	This option turns the Automatic Power Correction on or off. This option is on by default. If both harmonic correction and power factor correction are enabled and the HarmonicGuard® Active filter is at its maximum capacity, the power factor correction will automatically be phased back to allow the system to continue correcting harmonics.
CT Ratio	The CT ratio button opens a pop-up sub screen that allows selection of the turns ratio of the system line or load current transducers (CTs). The CT ratio is expected to be in terms of primary current to 5A of secondary current. For example, a 1000:5 CT means that for 1000A of primary current there are 5A of current in the CT secondary winding connected to the active filter. See user manual **Table 4.4** for the allowable CT range for an active filter unit type.
VAR Output	The "VAR Output" button opens a sub screen that allows enabling the VAR output operation mode. User can enable either local or network mode and can manually enter in the desired output KVAR via keypad entry. The max leading/lagging KVAR output is unit amp rating specific ***Note:*** *Enabling this option will automatically disable PF correction, if enabled* ***Note:*** *Only network or local VAR Output can be enabled at any given time*
Calibrate System Enable	This button initiates the active filter sensor calibration procedure. There is no need to calibrate the unit unless instructed by authorized TCI field service personnel. The active filter ships from the factory with all sensors fully calibrated so calibration is not required at the time of unit startup. This button is available for recalibration of the unit during field service trips. The calibration process will only run if the unit is in the nominal stopped state. Calibration should be done when the system bus is at no-load.
Save Settings	This button will save the current working settings to non-volatile memory that persist when power is removed from the unit. To save the current settings choose "Yes" on the confirmation screen or choose "No" to cancel and go back to the "Basic Setup". The settings will not be saved if "No" is chosen. 
Back	Takes user back to the Tech Setup screen

Run/Stop Control Setup Sub-Screen

Allows user to configure control settings.

Note: *If button is GREEN, the option is ENABLED. If button is BLUE, option is DISABLED.*

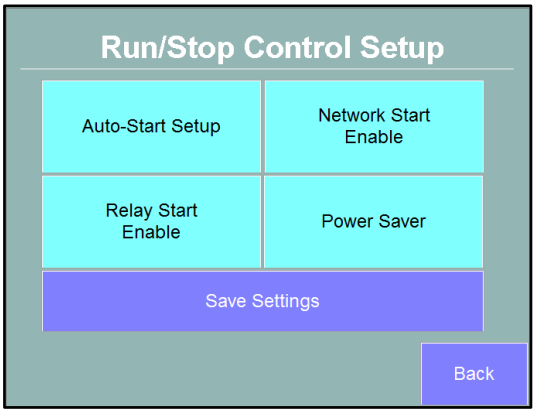
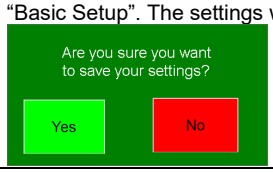


Figure 50: Tech Setup Screen

Table 37: Run/Stop Control Setup Screen Elements

Screen Element	Description
Auto-Start Setup	Takes user to Auto-Start Setup sub screen.
Relay Start Enable	This option allows the Active Line Conditioner to be remotely turned on or off via an external relay. J2 on the interface requires a switch closure to turn on the converter. If the stop button is pressed locally on the HMI Display, the unit will be put into an inhibit state and not respond to relay run commands until either the run button is pressed on the HMI display or the unit is power cycled. Once the run button is pressed, the relay start/stop command will again control the unit.
Network Start Enable	This option allows the Active Line Conditioner to be remotely turned on or off across a network connection. If the stop button is pressed locally on the HMI Display, the unit will be put into an inhibit state and not respond to network run commands until either the run button is pressed on the HMI display or the unit is power cycled. Once the run button is pressed, the network start/stop command will again control the unit.
Power Saver	This button opens the power save feature sub screen. The power save feature allows the unit to turn off its internal power converter, if the system line current, THID and/or Power factor drops below a set threshold. The line current Amp threshold depends on the system CTs installed with the active filter. For example, a power save threshold set to 10% with 1000:5 CTs installed would result in the filter turning off if less than 100A of current is measured via the line/load CTs. Both the line current threshold amps and percentage are displayed on the power save sub screen. The THID% and Power Factor turn on threshold level can also be set on the power save sub screen. In order to go into power-save mode the RMS, current level must be below the threshold. To come out of power save mode, first the RMS current level must be above the set RMS current threshold then either the THID must be above the set THID threshold or the power factor must be below the power factor threshold. The power save feature has a five second on/off delay and threshold hysteresis built in to prevent limit cycling of the active filter when the system current level is near the power save feature threshold.
Save Settings	This button will save the current working settings to non-volatile memory that persist when power is removed from the unit. To save the current settings, choose “Yes” on the confirmation screen, or choose “No” to cancel and go back to the “Basic Setup”. The settings will not be saved if “No” is chosen. 
Back	Takes user back to the Tech Setup screen

Auto Start Setup Sub-Screen

Allows user to configure the parameters necessary to use the Auto-Start option.

Note: *If button is GREEN, the option is ENABLED. If button is BLUE, option is DISABLED.*

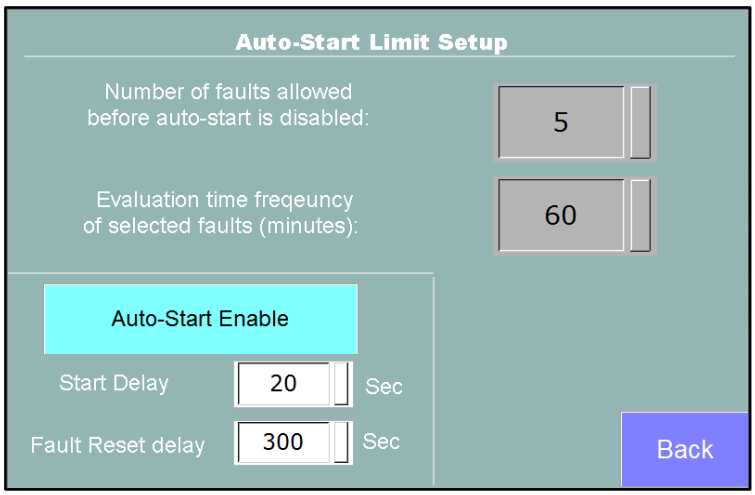


Figure 51: Auto Start Setup Screen

Table 38: Auto-Start Setup Screen Elements

Screen Element	Description
Auto-Start Enable	This option will set the converter to start automatically after a programmed delay after power is applied or after a fault occurs. This option is on by default.
Select number of faults	Allows user to select number of faults allowed to occur before auto start option is disabled.
Select time frequency	Allows user to select the time allowed between faults before auto start option is disabled.
Disable Auto-Start Limit	The disable auto start limit button will disable the frequency limit or the number of allowed unit auto-starts after a fault is detected.
Start Delay	The start delay is the time in seconds the active filter will wait after a power up or after a fault before auto starting the harmonic and/or power factor correction, if the auto start feature is enabled.
Fault Reset Delay	The fault reset delay is the time in seconds the active filter will wait after a fault is detected prior to attempting to auto-clear the fault and restart harmonic and/or power factor correction if the auto-start feature is enabled.
Back	Takes user back to the Tech Setup screen.

Tech Plus Setup Screen

The password protected Tech Setup Plus screens contain application specific setup screens for advanced configuration of the active filter. Access to this HMI screen is not needed for basic system installation and commissioning. If a specialized setup feature is required for your application, an authorized TCI field service representative will provide instruction on those features.

Features available in the Tech Plus Setup Screen include.

- Wiring Setup – Set input voltage phase order, set CT locations, set CT polarity, used to correct unit wiring errors via software instead of physically rewiring the unit.
- THID Setpoint – Set the target minimum current THD for the harmonic correction to minimize injection current, lower unit operating temperature, and extend unit lifetime.
- Power Factor Setpoint – Set the maximum power factor for the power factor correction to minimize injection current, reserve injection current for harmonic correction, lower unit operation temperature, and extend unit lifetime.
- Logging Configuration– Serial and SD memory card based fault/event logging enable/disable and log severity level setting.
- Series Transformer Setup – Set series transformer ratio and transformer tap for units that include a K-Rated auto transformer for applications greater than 480V.
- Sensor Error Setup – Enable, disable, and configure automatic sensor wiring error detection.
- Network Setup – Enable and disable the network Run/Stop and VAR commands.
- Regulator Setup – Enable and disable individual harmonic regulators.
- Calibrate System Enable – Re-initiate the unit auto calibration routine.
- Test Var – Command a variable number of inductive amps to the grid to confirm unit operation.
- Clear Fault History – Clear the alarm fault history log.
- HMI Settings – HMI hardware and communications settings and touchscreen calibration.
- HMI Password – Allows viewing and changes to the Tech Setup password.
- Various Parameter Tuning – Configure application specific parameter tuning values for specialized unit commissioning or field service support.

Wiring Setup Screen

The wiring selection screen is used to configure the feedback and connections of the CT's and power wiring. This screen is available from the Tech Setup Plus screen.

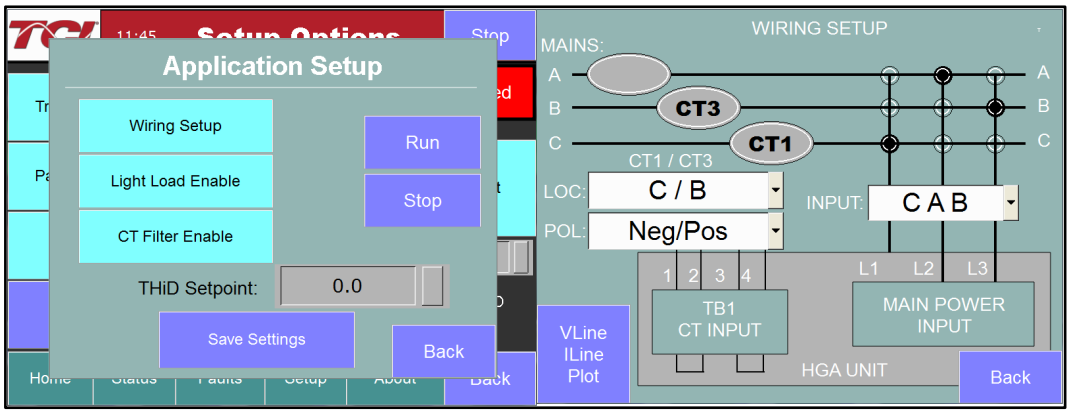


Figure 52: Wiring Setup screen

This screen is used to compensate for reversed CT's, CTs on wrong phases, and power wiring discrepancies that occur during installation.

The main benefit of it is to avoid making a hardware change such as moving/replacing a CT or a power wire that requires a shutdown.

Note: The software-based wiring setup correction only works on single panel/single converter units including the 30A, 50A, 100A, 150A, 250A, 300A, and 350A frame size's

About Screen

The About Screen displays model number, serial number, and software/firmware version information regarding the filter, as well as the CT ratio.

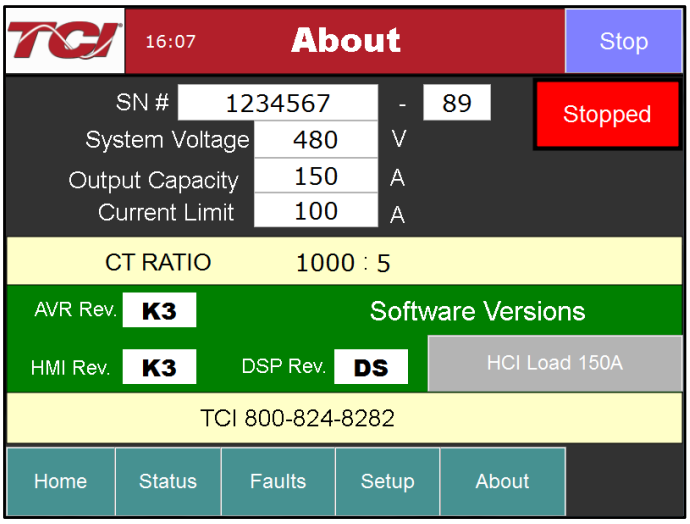


Figure 53: About Screen

Table 39: About Screen Elements

Screen Element	Description
Stop Button	Turns off the HarmonicGuard® Active filter.
Serial # Display	Displays the pre-programmed factory serial number of the HarmonicGuard® Active filter.
Total Output Current Display	Displays the total corrective current capacity in Amps RMS of the HarmonicGuard® Active filter.
System Voltage Display	Displays the line Voltage the HarmonicGuard® Active filter is set to run on.
CT Ratio Display	Displays the CT ratio the HarmonicGuard® Active filter is set to run on.
DSP Type Display	Displays the Digital Signal Processor type used in the HarmonicGuard® Active filter power converter controller.
DSP Revision Display	Displays the software revision of the installed Digital Signal Processor used in the HarmonicGuard® Active filter power converter controller.
AVR Revision Display	Displays the software revision of the installed microcontroller in the Interface PCB.
HMI Revision Display	Displays the software revision of the HMI Display application code.
Current Limit	Displays the configured corrective current limit in Amps RMS for the unit. The current limit will typically match the unit capacity, unless the unit has been derated for a specific application, such as high altitude or elevated ambient temperature.

Sensor Wiring Error Auto Detection Sub Screen

Some HarmonicGuard® Active filter models are equipped with Voltage and current feedback sensor wiring error detection algorithms. The detection algorithms run briefly on unit power up and check the unit sensors for signatures of common wiring errors, such as incorrect ACB phase rotation (instead of the required ABC rotation) and inverted system CT polarity.

The Sensor Wiring Error Sub Screen is a pop-up screen, which is not accessible from any of the main navigation screens. The screen is only displayed if a wiring error is detected. If no sensor wiring errors are detected, the pop-up screen will remain hidden.

If a Sensor Wiring Error is detected, the HGA will be inhibited from running until system power is removed from the unit and the error is corrected.

The Sensor Wiring Error Detection feature is comprised of several independent detection algorithms. The two main categories of algorithms are Voltage based detections and current based detections. The Voltage based detection algorithms monitor the 3-phase line Voltage input for proper ABC phase rotation, polarity, balance and nominal magnitude. The current based detection algorithms monitor the system Current Transformer (CT) sensor feedback for proper phase rotation, polarity, balance, and CT open or shorted conditions. The current base detections are only engaged if a minimum level of load current is present during power up. Both the Voltage and current detection algorithms can be globally or individually configured by TCI qualified personnel via the password protected Technician level Setup Screen.

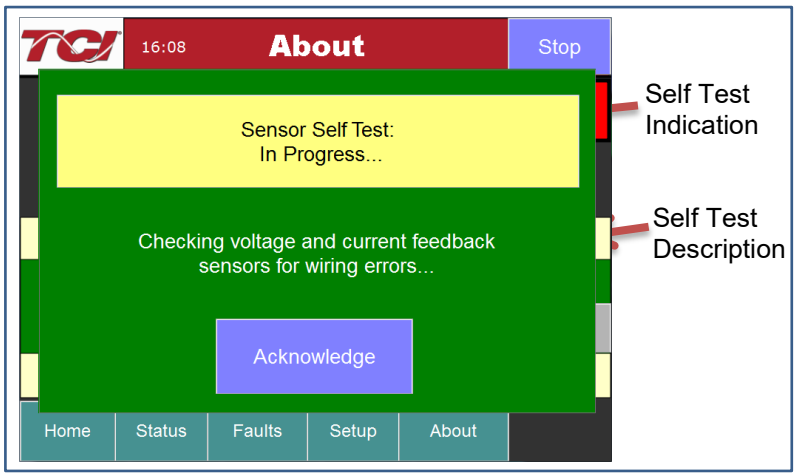


Figure 54: Sensor Wiring Error Self Test Sub Screen

Table 40: Sensor Wiring Error Self Test Sub Screen Elements

Screen Element	Description
Self Test Result Indication	Displays the current Pass/Fail/In-Progress State of the Sensor Wiring Error Auto Detection feature. When a sensor wiring error is detected the specific fault code will be shown.
Self Test Result Description	When a sensor wiring error is detected, one or more corrective actions will be displayed here. See Table 41 for a list of suggested resolutions.
Acknowledge Button	Pressing the Acknowledge Button will hide the Sensor Wiring Error Self Test Sub Screen so other screens can be examined in order to trouble shoot the wiring error. If a user attempts to operate the unit while a sensor wiring error is still present by pressing the Run or Stop buttons, the screen will reappear.

Table 41: Sensor Wiring Error Code Table

Error Code	Error	Suggested Corrective Action
0	No Error	No corrective action required.
1	Self Test In Progress	No correction action required. Typically, the self-test will complete and auto clear in less than 10 seconds after power up.
2	Line Voltage Synch	Turn off unit and check 3 phase AC input Voltage wiring for missing phase connection or low line Voltage.
3	Input Over Voltage	Turn off unit and check 3 phase AC input Voltage wiring for high line Voltage
4	Reverse Voltage Phase Rotation	Turn off unit and check 3 phase AC input Voltage wiring for A, B, C phase rotation or missing phase connection.
5	Phase A Input Under Voltage	Turn off unit and check 3 phase AC input Voltage wiring for missing phase or low line Voltage.
6	Phase B Input Under Voltage	Turn off unit and check 3 phase AC input Voltage wiring for missing phase or low line Voltage.
7	Phase C Input Under Voltage	Turn off unit and check 3 phase AC input Voltage wiring for missing phase or low line Voltage.
8	Reverse CT Current Rotation	Turn off unit and check system CT feedback for A, B, C phase rotation, inverted CT polarity, or CT short/open.
9	Phase A CT Under Current	Turn off unit and check system CT feedback for no feedback (CT short or open).
10	CT Under Current	Turn off unit and check system CT feedback for no feedback (CT short or open).
11	Phase C CT Under Current	Turn off unit and check system CT feedback for no feedback (CT short or open).
12	Phase A CT Polarity	Turn off unit and check system CT phase A feedback for incorrect polarity or reverse phase rotation.
13	CT Polarity	Turn off unit and check system CT phase A and C feedback for incorrect polarity or reverse phase rotation.
14	Phase C CT Polarity	Turn off unit and check system CT feedback phase C for incorrect polarity or reverse phase rotation.
15	Phase Power Imbalance	Turn off unit and check CT feedback and 3 phase AC input Voltage for incorrect polarity or reverse phase rotation.

Network Interface

The network interface on the Interface Module allows basic Run/Stop commands and internal status data and can be communicated to and from the HarmonicGuard® Active filter. The HMI display implements an integrated ModbusRTU slave device for the network interface (see the HMI Display Connection section) or an optional network communications gateway can be used such as Ethernet/IP to implement other protocols (see 10.0 Appendix A: Ethernet/IP Gateway Option).

The input/output register maps of the data available from the network interface are available in Table 42 and Table 43. All input and output registers are two bytes in size and formatted as 16-bit signed integers. For the base address of the input and output data sections, please reference the connection sections in this manual specific to the configured protocol. For the integrated ModbusRTU network interface, reference the HMI Display Connection section. If an option Communications Gateway is configured, reference the appendix.

Table 42: Network Interface OUTPUT Register Map

Parameter Name	I/O Reg Address Offset	Direction	Data Values and Examples	Description
SYS_RUNNING	0	Output	0 = Idle 1 = Running	Indicates if the HGA filter is currently running or in the idle state
SYS_POWER_ON	1	Output	0 = Power Off 1 = Power On	Indicates if the HGA filter has input power available
SYS_FAULTED	2	Output	0 = Not faulted 1 = Faulted	Indicates if the HGA filter is faulted
SYS_IN_I_LIMIT	3	Output	0 = Nominal 1 = At Capacity	Indicates if the HGA filter is running at its maximum capacity
V_LINE_LL_RMS	4	Output	Volts RMS 480 = 480 VRMSLL Range: 0 to 1,000	Source Utility Line Phase to Phase Voltage
I_LINE_RMS	5	Output	Amps RMS 1,000 = 1,000 ARMS Range: 0 to 10,000	Line/Load Phase Current
I_LINE_PF	6	Output	100 = 1.00 Unity PF -95 = 0.95 Lagging PF 95 = 0.95 Leading PF Range = -99 to 100	Line/Load Displacement Power Factor - Negative values indicate lagging power factor
SYS_NW_START_EN	7	Output	0 = Network Run Disabled 1 = Network Run Enabled	Network Run/Stop command enable setpoint
SYS_STATE	8	Output	0,1 = Initialization 2 = Fault inhibit 3 = Input inhibit 4 = Fault reset 5 = Stop 6,7 = Pre-Charge 8 = Run 9 = Fault 10 = Calibration 11 = Power Save 13 = Communication Configuration 14 = Calibration Self Check	Present control state of power converter
I_CONV_RMS	9	Output	Amps RMS 100=100Amps Range: 0 to current rating of unit	Active filter correction injection current
FAULT_ACTIVE_A	10	Output	16 position bit-mapped value: Bit - Fault 0 - IGBT Gate A 1 - Exhaust OT 2 - Internal CPU Cycle 3 - DC Bus OV 4 - DC Bus UV 5 - Phase A OC 6 - Phase B OC 7 - Phase C OC 8 - HW Phase A OC 9 - HW Phase B OC 10 - HW Phase C OC 11 - Power Conv OT A 12 - Power Conv UT A 13 - Unit Cal 14 - Com Fault 15 - Restart Limit	Each bit represents whether the assigned fault was detected. A value of binary 1 indicate the assigned fault was detected and a value of zero indicates the assigned value was not detected.
FAULT_ACTIVE_B	11	Output	16 position bit-mapped value: Bit - Fault 0 - IGBT Gate B	Each bit represents whether the assigned fault was detected. A value of binary 1 indicate the assigned fault was detected

			<table><tr><td>1</td><td>- IGBT Gate C</td></tr><tr><td>2</td><td>- DC Bus OV Lower</td></tr><tr><td>3</td><td>- DC Bus UV Lower</td></tr><tr><td>4</td><td>- Power Conv OT B</td></tr><tr><td>5</td><td>- Power Conv OT C</td></tr><tr><td>6</td><td>- Power Conv UT B</td></tr><tr><td>7</td><td>- Power Conv UT C</td></tr><tr><td>8</td><td>- Internal CPU Clk</td></tr><tr><td>9</td><td>- Internal CPU Stop</td></tr><tr><td>10</td><td>- Internal CPU HW</td></tr><tr><td>11</td><td>- Setpoint Config</td></tr><tr><td>12</td><td>- Internal CPU Mem</td></tr><tr><td>13</td><td>- Test Run</td></tr><tr><td>14</td><td>- Test PCB</td></tr><tr><td>15</td><td>- Not Defined</td></tr></table>	and a value of zero indicates the assigned value was not detected.
FAULT_LOCATION	12	Output	16 position bit-mapped value bit0 = Power Converter 1 Fault (leftmost position) Bit1 = Power Converter 2 Fault Bit3= Power Converter 3 Fault	System fault location indicator bits. Each bit represents wither a fault was detected in a power converter. A value of binary 1 indicates the assigned power converter detected a fault and a value of 0 indicates the assigned power converter did not detect a fault.
MB_INHIBIT_ACTIVE	13	Output		System wiring error unit inhibit code. Please reference Table 41: Sensor Wiring Error Code Table for a list of error codes and their definitions. For units equipped with an HMI touchscreen the error code definitions are also displayed on the unit's local HMI.
T_CONV	14	Output	Degrees C 25=25C	Primary power converter heatsink temperature
SYS_INT_HB	15	Output	Range 0 to 65535	Processor internal heartbeat. Internal counter that counts up and rolls over to zero used to verify processor clock operation.
SW_DSP	16	Output	Two 8bit ASCCI Characters 0x3144 = ASCCI for "D1"	Software revision code for power converter processor.
AVR_SW_VER	17	Output	Two 8bit ASCCI Characters 0x3144 = ASCCI for "D1"	Software revision code for communications interface processor
ID_HMI_SW_VER	18	Output	Two 8bit ASCCI Characters 0x3144 = ASCCI for "D1"	Software revision code for HMI touchscreen processor.
SYS_MODEL_NUM	19	Output	8,9,16=Line Side Control 12,13,18=Load Side Control	Active filter Line or Load controls configuration.
SYS_SERIAL_NUM_2	20	Output	Parameter contains UUUU in the UUUULLLL-NN serial number format.	Unit serial number section - upper 16 bits of 32-bit unit job number
SYS_SERIAL_NUM_1	21	Output	Parameter contains LLLL in the UUUULLLL-NN serial number format.	Unit serial number section - lower 16 bits of 32-bit unit job number
SYS_SERIAL_NUM_0	22	Output	Parameter contains NN in the UUUULLLL- NN serial number format.	Unit serial number section - two-digit unit number
MB_ID_SYS_CURRENT_LIMIT	23	Output	Amps RMS100=100AmpsRange: 0 to current rating of unit	Active filter current limit setpoint. Sometime the current limit of the unit is set lower than max capacity of the model to derate for altitude or ambient temperature.
SYS_CAPACITY	24	Output	Percent injection current used 100=100% Range: 0 to 100	Present injection current capacity of active filter in units of percent of max capacity.

CT_RATIO	25	Output	XXXX:5 where XXXX is the primary turns count of the CT. 1000 = 1000:5 CT Range: 100 to 10000	Line or Load Current Transformer (CT) turns ratio.
SYS_IN_T_LIMIT	26	Output	0 = Unit not in thermal limit 1 = Unit in thermal limit	Indicator that unit is in thermal limit current foldback. Active filter correction current reduced due to power converter heatsink temperature approaching trip level.
SYS_PWR_SV	27	Output	0 = Unit not in power save mode 1 = Unit in power save mode.	Indicator for unit in power save mode where a run command is present but correction demand below turn on threshold.
I_LINE_THD	28	Output	% THD 50=5.0% THD Range: 0 to 100	THID for line current feedback (for units configured for line side/bus applied control) or THID for load current feedback (for units configured for load side control).
I_LINE_THD_REF	29	Output	% THD 50=5.0% THD Range: 0 to 100	THID of line current feedback BEFORE active filter turn on. In cases of low signal feedback, this value will be zeroed out.
V_LINE_THD	30	Output	% THD 50=5.0% THD Range: 0 to 100	THVD of line Voltage at injection point. In cases of low signal feedback, this value will be zeroed out.
NW_VAR_OUTPUT_EN	31	Output	0 = Network VAR Output Disabled 1 = Network VAR Output Enabled	Network VAR Output control mode enable command

Table 43: Network Interface INPUT Register Map

Parameter Name	I/O Reg Address Offset	Direction	Format	Description
SYS_NW_START_IN	0	Input	0 = Network Command Stop 1 = Network Command Run	Remote Network Run/Stop command to the HGA
NW_VAR_OUTPUT_SET POINT	1	Input	Enter in desired leading/lagging kVAR output ***Note:*** *Software bounds to be unit amp rating appropriate* ***Note:*** *A negative setpoint value results in lagging kVAR output.*	Commanded KVAR value for controller while in VAR Output mode
Unused	1	Input	-	-
Unused	2	Input	-	-
Unused	3	Input	-	-
Unused	4	Input	-	-
Unused	5	Input	-	-
Unused	6	Input	-	-
Unused	7	Input	-	-

The network Run/Stop command allows a remote network to send a run command to the HarmonicGuard® Active filter. The network command input will only be acknowledged if the Network Run/Stop Enable is set to ENABLED on the HMI Display setup screen. If the stop button is pressed locally on the HMI Display, the unit will be put into an inhibit state and not respond to network run commands until either the run button is pressed on the HMI display, or the unit is power cycled. Once the run button is pressed, the network start/stop command will again control the unit.

8.0 HMI Maintenance

Software Field Upgrades

In the event the HMI Display application software needs to be upgraded, the USB host port on the back panel of the HMI Display can be used for field upgrades. Software upgrade instructions will be sent with any software updates provided by TCI.

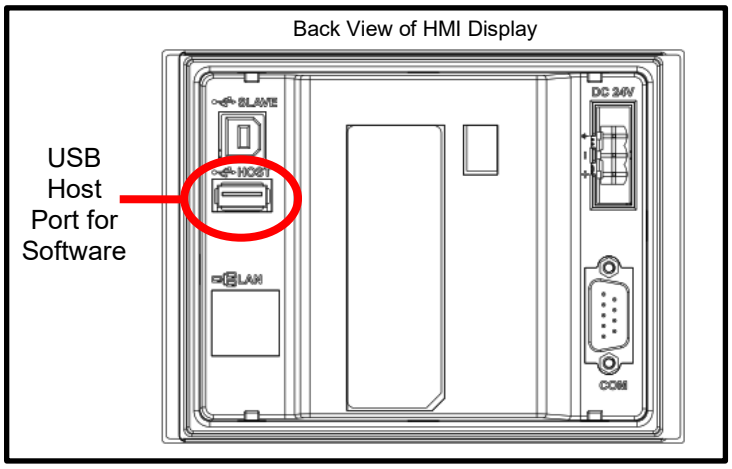


Figure 55: HMI Display USB Host Location

9.0 HMI Troubleshooting

HarmonicGuard® Active Filter Fault

If the display indicates a fault has occurred, proceed to the fault screen by choosing the “Fault” menu screen button. To see if this is a recurring fault, hit the “History” button from inside the “Fault” screen. To clear a fault, press the “Reset” button from inside the “Fault” Screen or the “Stop” button from any screen.

Warning 	Only qualified electricians should carry out all electrical installation & maintenance work on the HGA. Disconnect all sources of power to the HGA and connected equipment before working on the equipment. Do not attempt any work on a powered HGA. This HGA unit contains high Voltages and capacitors. Wait at least five minutes after disconnecting power from the filter before attempting to service the conditioner. Check for zero Voltage between all terminals on the capacitors. Also, check for zero Voltage between all phases of the input and output lines. All maintenance and troubleshooting must be done by a qualified electrician. Failure to follow standard safety procedures may result in death or serious injury. **Unless an external disconnect means has been provided everything ahead of the filter circuit breaker, including the reactors, will still be energized.**

Interface Module Problem

The Interface Module is comprised of four major components; the HMI display, the Interface PCB, the cabling and an optional Gateway. The Interface PCB contains diagnostic LEDs. The locations of the LEDs are shown in Figure 55 and their functions are listed in Table 44.

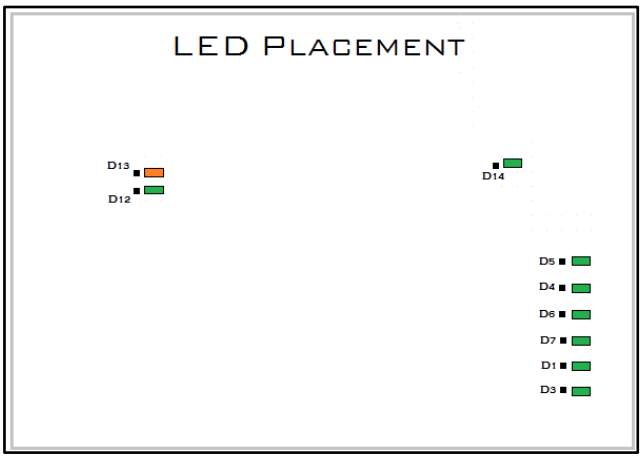


Figure 56: Communications Board LED placement (50A Gen 1, 100A-700A)

Table 44: LED Functions

LED	LED Color	Description (LED Color)
D1	Green	AUX 1
D3	Green	AUX 2
D4	Green	Running Relay Energized
D5	Green	Power-On Relay Energized
D6	Green	Fault Relay Energized
D7	Green	Current Limit Relay Energized
D12	Green	RS485 Communication is active from converter
D13	Orange	RS485 Communication is active to converter
D14	Green	Input Run Command Present

Figure 57: Communications Board LED placement 30A and 50A Gen 2

Table 45: LED Functions

LED	LED Color	Description (LED Color)
D1	Green	+5V DCU
D3	Green	Power On
D5	Green	+15V
D6	Green	+24 Viso
D7	Green	Run
D9	Green	Fault
D11	Green	At Capacity
D13	Green	AUX 1
D15	Green	Fan AUX
D30	Green	+24V
D32	Green	+48V
D33	Green	+5 Viso

Fault Troubleshooting Notes

- To reboot the system, remove power to the filter and Interface Module, wait a few minutes then reapply. If this does not work, check all the cable and connections, and try again. If the problem is still not resolved, replace the Interface Module assembly.
- If no buttons are pressed for 5 minutes, the screen will turn off. To reactivate, touch anywhere on the screen.
- If the HMI Display shows a “COM 1 Station 1: Communication Error” across the bottom of the screen, check the serial cable between HMI Display COM1 and Interface PCB J1.
- If the HMI Display shows a “NO COM” indication on the system state indicator or a 7010 Communications Fault in the fault screen, check the serial cable between Interface PCB J2 and the HarmonicGuard® Active filter power converter module J25 (100A/50A units) or J7 (200A units).
- For technical support, contact TCI directly at 1-800-824-8282. Select "Customer Service" or "Technical Support".

10.0 Appendix A: Ethernet/IP Gateway Option

Introduction

The Ethernet/IP network communications gateway option allows an upstream Ethernet/IP network to access the command and status data in the HGA unit via the HGA HMI display's integrated communications interface. The gateway translates from the ModbusRTU protocol used by the HMI to Ethernet/IP. The Ethernet/IP Communications Gateway is implemented using an industry leading Ethernet/IP solution from Allient Spectrum Controls: The Universal Industrial Gateway WP-G-222-P1. Note that the same gateway is used for Ethernet/IP and Modbus TCP communication options.

Table 46: EtherNet/IP Communications Gateway Key Features

Feature	Description
Protocol Support	Pre-configured with Ethernet/IP CIP over IP Server and Modbus TCP Server. Other supported protocols include EtherNet/IP-PCCC, Direct NET, CCM, and Hotlink but these protocols require alternate gateway configuration not supported in standard HGA products.
Connection	10/100 Mbps full-duplex, 8-pin RJ45
Isolation	Ethernet ports: 1500 VAC, 50 to 60 Hz for sixty seconds and 250 VAC working voltage. DC power and serial ports: 707 VDC for 60 seconds and 120 VAC working voltage.
TCP/IP Settings	Web Browser Based Configuration. Google Chrome recommended. Default IP address: 192.168.1.100. Default logins use **admin** and password **AllientTCIHGA**
Reset (pinhole on front of Gateway).	Reset Options: • Retain its current configuration. To do so, insert a paper clip into the **RESET** switch on the Gateway and press gently and briefly (less than 15 seconds). As soon as you release the button, the Gateway reboots. Status LED blinks red (0.5 seconds on/0.5 seconds off). • Reset to factory defaults. Insert the paper clip and press gently for more than 15 seconds. Status LED blinks red (0.5 seconds on, 0.5 seconds off). • If the software does not respond to a reset or reset-to-defaults request via reset switch, the display will blink the horizontal segments until the unit is power cycled. This period may be brief enough that the segments only blink once.
Display button	Press to wake up the display. If you press the display button again while the display is on, the button press is ignored, and the 90-second countdown continues.
LED (128 × 32-pixel OLED display)	Press to wake up the display. If you press the display button again while the display is on, the button press is ignored, and the 90-second countdown continues.
Status button	At initial power-on, Status LED is solid green under hardware control. During initial boot-up, the Status LED blinks green when under software control. Once the network interface is fully available, the LED changes to solid green.

Note: *The optional network Communications Gateway part number and hardware is identical for the Ethernet/IP interface and the Modbus TCP/IP interface. Verify you are referencing the appropriate Appendix section for the network protocol you have selected.*

Wiring

Connection of the HarmonicGuard® Active filter Interface Module to the end user's upstream Ethernet/IP network occurs at the RJ45 connection on the Communications Gateway. The Communication Gateway is mounted on the back panel of the Interface Module.

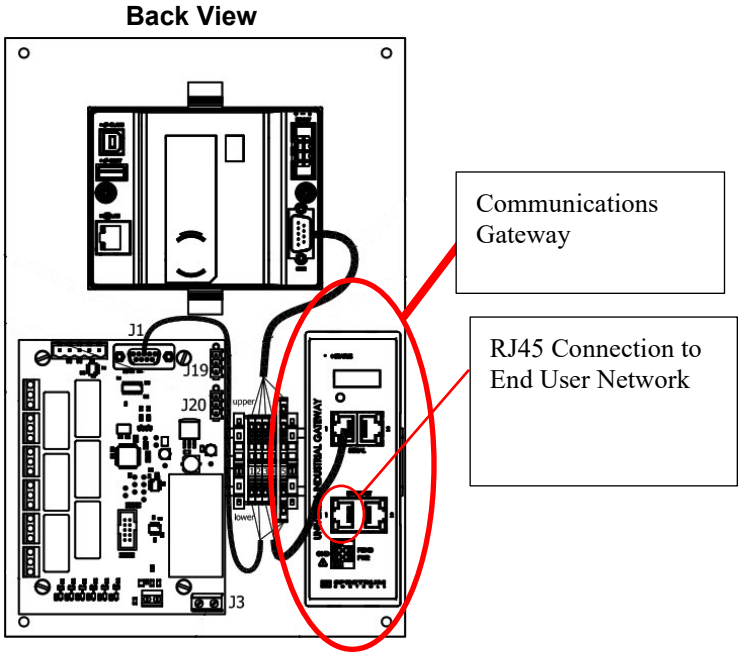
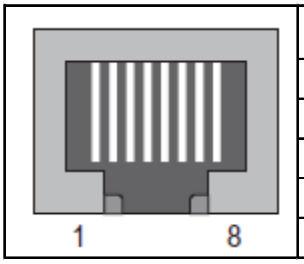


Figure 58: EtherNet/IP Communications Gateway Location



Pin Number	Description
1	TD+
2	TD-
3	RD+
6	RD-
4, 5, 7, 8	Termination

Table 47: EtherNet/IP Connector Pinout

Configuration

To configure the IP address of the Ethernet/IP communications gateway, connect the gateway to the Ethernet network then open a web browser window (Google Chrome recommended) and type in the default IP address of the gateway (see Table 47: Gateway Default Settings below) and press enter. The PC/laptop being used to connect to the gateway needs to be on the same sub net as the gateway. The Communications Gateway configuration login page should load. For the gateway login use the following credentials (case sensitive):

- Username: **admin**
- Password: **AllientTCIHGA**

The recommended web browser to use for gateway configuration is the Google Chrome web browser.

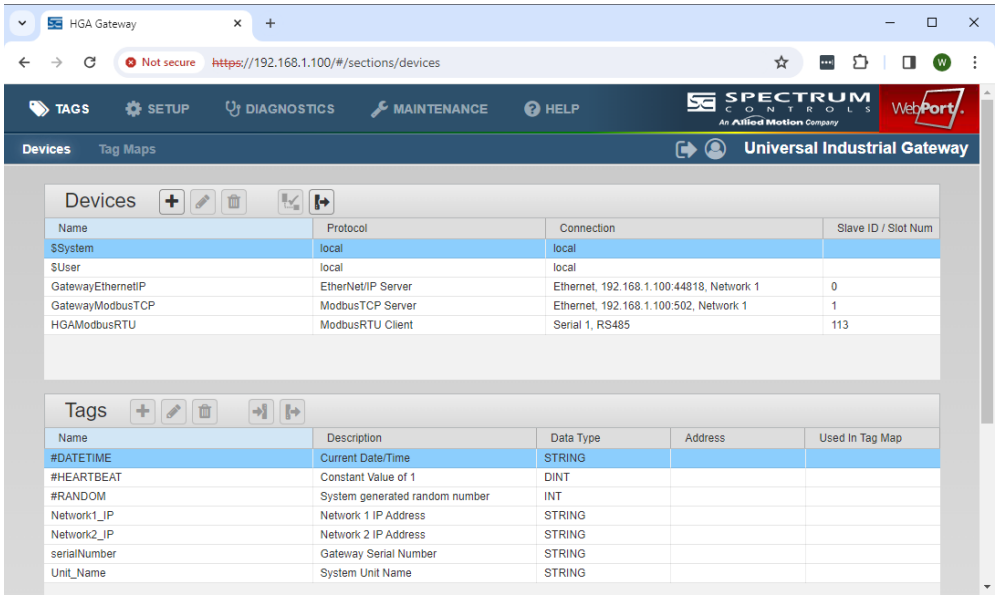


Figure 59: EtherNet/IP Gateway Configuration Page

Table 48: Gateway Default Settings

Setting	Default Value
IP Address	192.168.1.100
Subnet	255.255.255.0
Gateway	192.168.1.1
DHCP	Off (Static IP enabled)

To update the IP address switch to the **Setup** tab then select **Networks:**

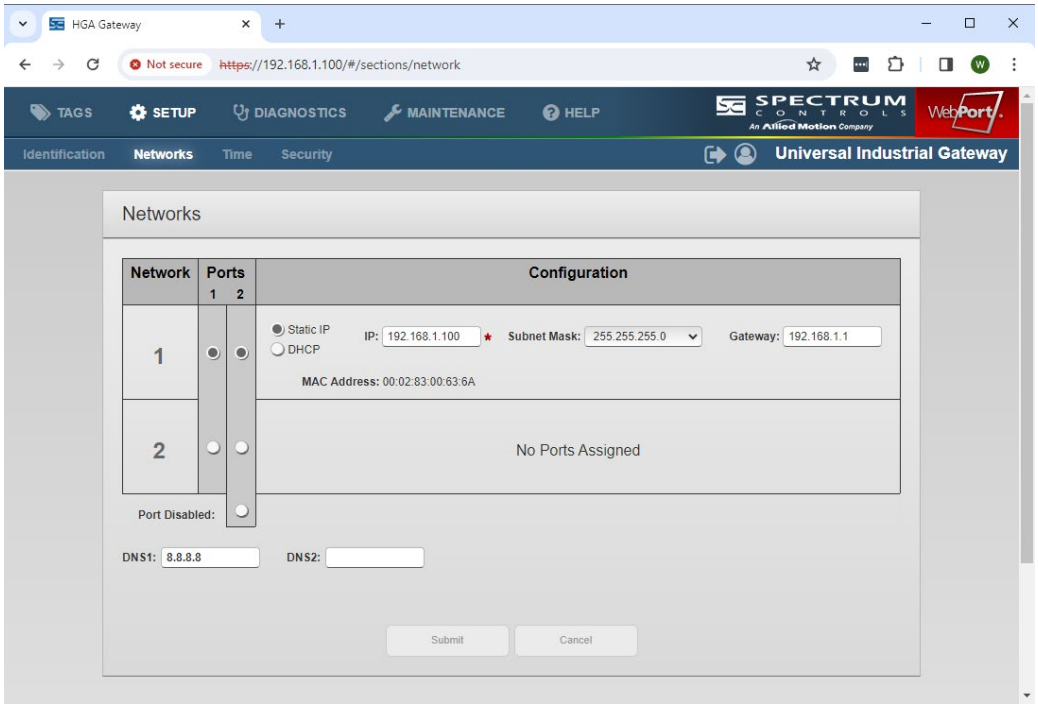


Figure 60: Gateway IP Address Configuration Screen

To change the gateway IP address type in a new IP address on the configuration page, then click on the **Submit** button. After the new IP address is stored, cycle power to the Communication Gateway to load the new IP address.

The Ethernet/IP Communications Gateway supports two options for data exchange.

- Explicit Ethernet/IP CIP Message commands (via PLC MSG blocks)
- PLC Ethernet/IP Client tag maps

The EDS file for the Ethernet/IP Communications Gateway can be uploaded directly from the gateway using a network configuration tool such as Rockwell Automation's RSlinx Classic.

For advanced configuration options, such as MAC Address blacklist/whitelist, reference the Spectrum Controls Universal Industrial Gateway User Manual, available on the Spectrum Controls website (https://www.spectrumcontrols.com)

Register Map

The gateway implements a 16-bit integer data array for all the feedbacks from the HGA and a 16 bit integer data array for all the setpoints that can be written to the HGA.

For a description of the input/setpoint and output/feedback data available over the network interface, reference Table 42: Network Interface OUTPUT Register Map and Table 43: Network Interface INPUT Register Map in section 0 7.0 HMI Introduction.

Gateway Tag Maps

The gateway implements several tag maps that can be used to access the HGA setpoints and feedback.

Table 49: Gateway Tagmaps and Descriptions

Tag Map Name	Description
FeedbacksToEthernetIPClient	Feedback data from the HGA unit mapped to the Ethernet/IP client device. The client device would typically be a PLC. The client/PLC needs to have an array tag named HGAFeedbacksClientTag (sized to match the number of data elements in the Network Interface OUTPUT Register Map). The preconfigured IP address for the client is 192.168.1.15. If your PLC has a different IP address update the Ethernet/IP Client device using the gateway web browser Tags - Devices screen.
FeedbacksToEthernetIPFromHGA	Feedback data from the HGA unit mapped on an Ethernet/IP server. A client device, such as a PLC, can use MSG commands to explicitly read feedback data via this tag map. The MSG block will need to be configured for a CIP Data Table Read of source array tag HGAFeedbacks[0] with the number of elements sized to match the number of data elements in the Network Interface OUTPUT Register Map.
FeedbacksToModbusTCPFromHGA	Feedback data from the HGA unit mapped to a Modbus TCP server in address space 30000, function code 4. See at the end of this appendix for a ModbusTCP example.
SetpointsFromEthernetIPToHGA	Setpoint data to the HGA unit mapped on an Ethernet/IP server. A client device, such as a PLC, can use MSG commands to explicitly write setpoint data via this tag map. The MSG block will need to be configured for a CIP Data Table Write with destination array tag HGASetpoints[0] with the number of elements sized to match the number of data elements in the Network Interface INPUT Register Map.
SetpointsFromModbusTCPToHGA	Setpoint data to the HGA unit mapped to a Modbus TCP server in address space 400000, function code 6. See appendix at the end of this document for a ModbusTCP example.
SetpointsToEthernetIPClient	Setpoint data to the HGA unit mapped to the Ethernet/IP client device. The client device would typically be a PLC. The client needs to have an array tag named HGASetpointsClientTag (sized to match the number of data elements in the Network Interface INPUT Register Map). The preconfigured IP address for the client is 192.168.1.15. If your PLC has a different IP address update the Ethernet/IP Client device using the gateway web browser Tags -> Devices screen.

Feedback Tag Maps Note:

The HGA unit Ethernet gateway is pre-configured to have all three feedback tag maps activated by default (Ethernet/IP Server, Ethernet/IP Client, Modbus TCP Server)

This means the feedback data from the HGA will be mirrored to the Ethernet/IP Server, Ethernet/IP Client, and Modbus TCP Server devices concurrently.

Setpoint Tag Maps Note:

Only ONE setpoint tag map should be running in the gateway at any time.

If multiple setpoint tag maps are running then there will be multiple sources writing to the same HGA setpoint values. This will cause competing values to be sent to the HGA unit which may result in unexpected or unwanted behavior if the multiple data sources are not all writing identical setpoint values.

The HGA unit Ethernet gateway is pre-configured to have the Ethernet/IP Server setpoint tag map running (MSG command option) and the Ethernet/IP client and Modbus TCP setpoint tag maps stopped/turned off.

If a different setpoint tag map needs to be turned on than the default use the web browser gateway configuration tap map screens to activate the desired setpoint tag map and deactivate the other two tag maps.

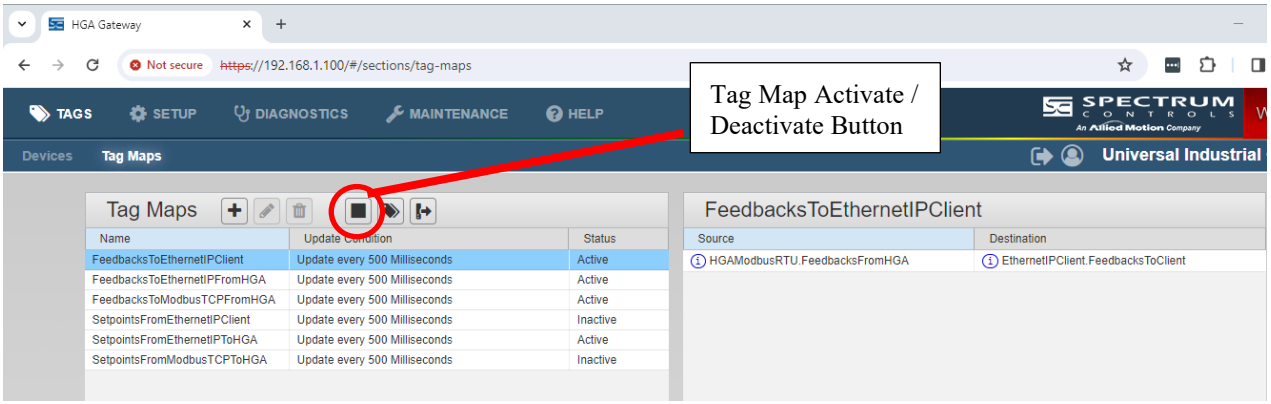


Figure 61: Location of Tag Map Activate\Deactivate Button

Operation

The Communication Gateway has LED indicators that show the status of the Ethernet/IP and sub-network communications. The meanings of the LED indicators are described below.

Table 50: EtherNet/IP Gateway LED Diagram

	LED	Indication
Gateway Front View 	Ethernet Port LEDs:	**Green LED**: • ON when receiving data at 100 Mbytes/second. Each byte of traffic turns on the LED for 200 ms (±50 ms) **Yellow LED**: • ON: when linked; blinking when traffic is transmitting on the line. Each byte of traffic turns on the LED for 200 ms (±50 ms) **EtherNet/IP Ether link Status**: • ON: Link • OFF: No link **EtherNet/IP Ether link Activity Status**: • Flashing: Port Activity • OFF: No activity
	Serial Port LEDs:	**Green LED:** • ON: Linked • Blinking when receiving traffic online. Each byte of data turns on the LED for 200 ms (±50 ms) **Yellow LED:** • ON: Linked • Blinking when transmitting traffic online. Each byte of data turns on the LED for 200 ms (±50 ms) **Status LED:** • ON: Green; Power OK • Blink: Green; booting • ON: Red; Error • Blink: Red; Reset

HGA Gateway to PLC Examples Setup

Two example Ethernet/IP communication methods are shown below.

- The first example uses explicit MSG commands to read and write data to the HGA gateway. This example requires use of a basic ladder logic program in the PLC to implement and sequence the MSG commands.
- The second example uses an Ethernet/IP Client device defined in the gateway and uses tag maps to map data between the PLC and the gateway. With this method no ladder logic is required.

Required Equipment

- Spectrum Universal Industrial Gateway programmed with TCI HGA configuration.
- HGA HMI display connected to Spectrum gateway.
- Local Area Network (LAN) Ethernet switch.
- Rockwell PLC and associated development tools.
- Ethernet RJ45 cables.

Setup

- Connect the RJ45 cable to the Ethernet Port on the Spectrum gateway to the Ethernet Switch (LAN).
- Connect the PLC to the Ethernet Switch (LAN) via RJ45 cable.
- The network setup is displayed below.

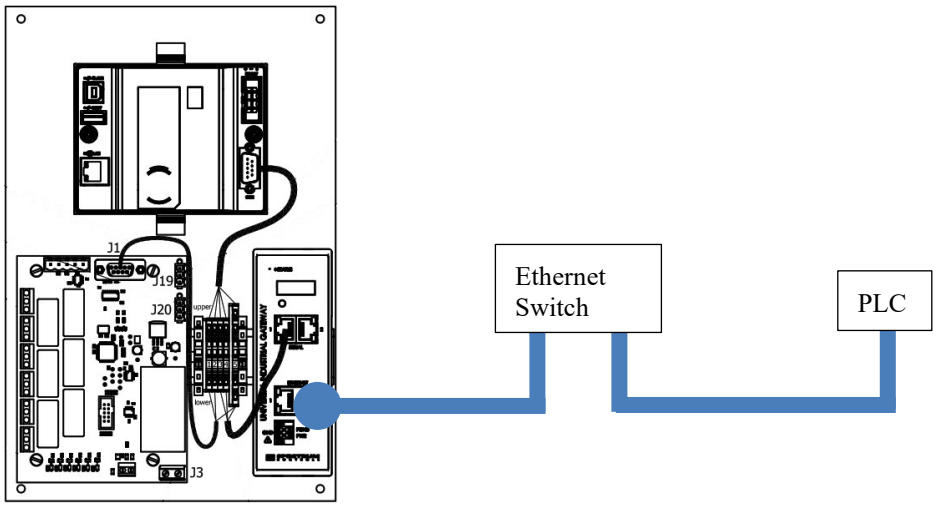


Figure 62: Gateway Network Setup with PLC Example

PLC Programming Example

Rockwell Automation Studio 5000 can be used to create tags and a ladder logic program to run on the PLC. This example assumes familiarity with Rockwell Automation PLC and PLC design tools.

EDS File Installation

Prior to creation of the example PLC gateway communications program the Gateway EDS file should be installed. The Gateway EDS file can be uploaded directly from the gateway using Rockwell Automation RSLinx program.

Creation of Gateway Module in PLC Program

Once the EDS file is installed the module can be added to the PLC program I/O Configuration by right clicking on the Ethernet group and selecting New Module… In the search filter search for Spectrum and then select the WP-G-222 Universal Industrial Gateway.

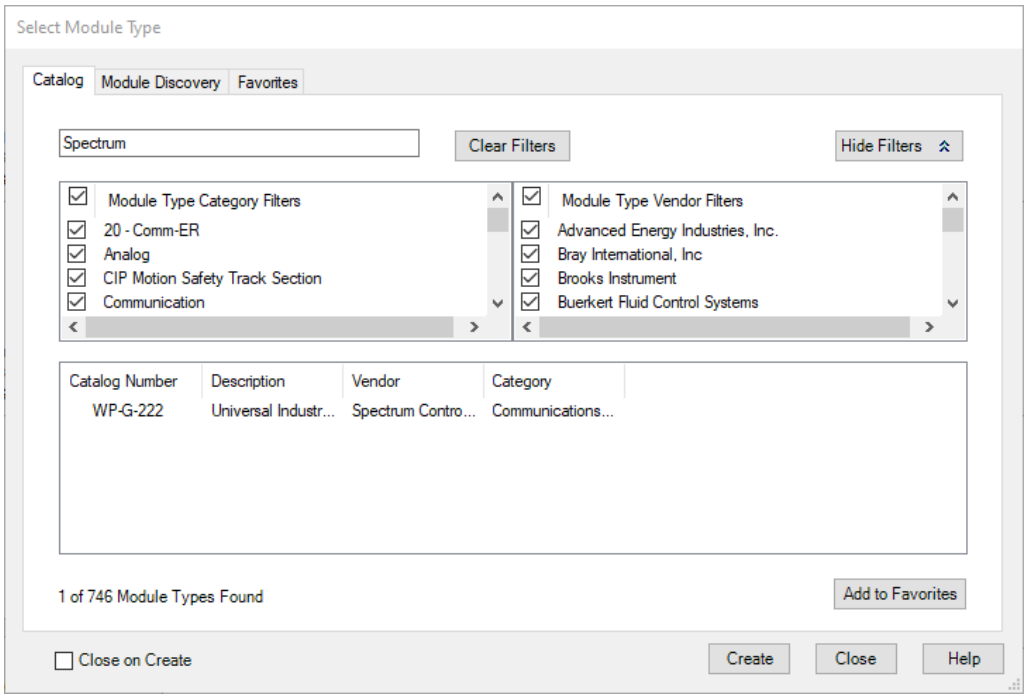


Figure 63: Spectrum Universal Gateway during New Module Creation in PLC Program

In the new module dialog box use HGAGateway for the module name and assign the gateway the IP address of 192.168.1.100

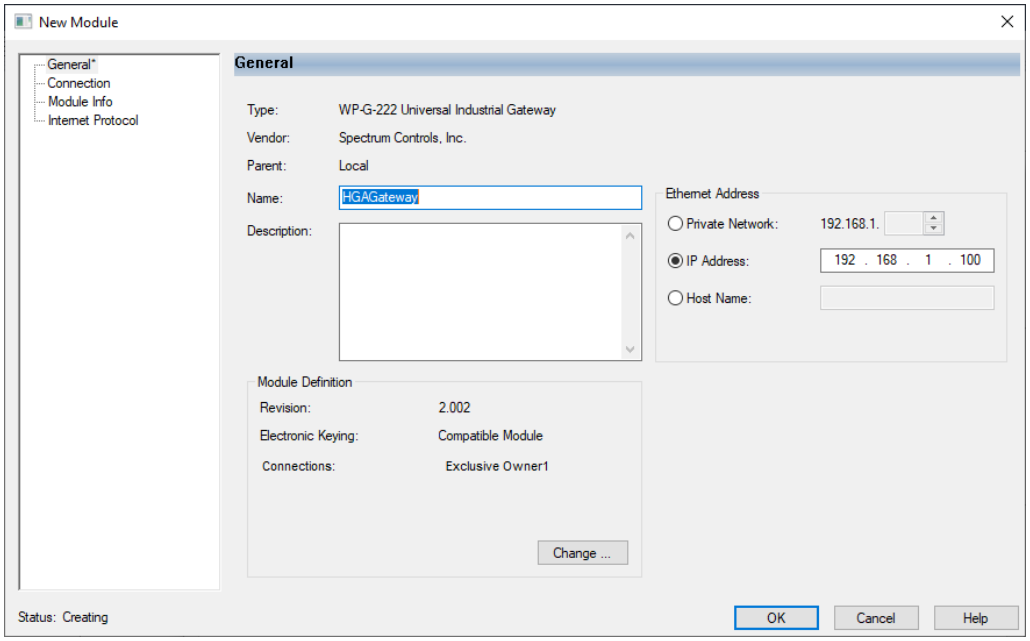


Figure 64: New Module Creation for HGA Gateway in PLC Program

Controller Tag Creation

In the controller tags section of the PLC project create the following tags.

- Tag COUNTER_MSG type COUNTER – a counter used to sequence the explicit MSG blocks. The counter starts at zero. The read data MSG block will run when the counter is equal to 1 and the write data MSG block will run when the counter is equal to 2. When the counter is equal to 3 the counter gets reset to zero to start the MSG block sequence over.
- Tag TIMER_MSG type TIMER – a timer set to increment counter COUNTER_MSG every 200 milliseconds.
- Tag HGA_FEEDBACKS type INT[32] – an array used as a destination by the read feedback MSG block for the explicit MSG command communication example.
- Tag HGA_SETPOINTS type INT[2] – an array used as a source by the write setpoints MSG block for the explicit MSG command communication example.
- Tag MSG01 type MESSAGE – The MSG data structure used to read feedbacks for the explicit MSG command communication example.
- Tag MSG02 type MESSAGE – The MSG data structure used to write setpoints for the explicit MSG command communication example.
- Tag HGAFeedbacksClientTag type INT[32] – An array for the feedback values used in the client tag map example.
- Tag HGASetpointsClientTag type INT[2] – An array for the setpoint values used in the client tag map example
- Other tags
  - Tag HGAGateway:I1 – This tag is not used in the communications examples. This tag is auto generated when the gateway module is added to the PLC project. The first data value in this assembly is HGAGateway:I1.ConnectionFaulted which can be used to determine if the connection to the HGA gateway is faulted or not (0=not faulted, 1 = faulted).
  - Tag HGAGateway:O1 – This tag is not used in the communications examples. This tag is auto generated when the gateway module is added to the PLC project.

When all the controller tags are created the tag monitor view should look as follows in the controller tags section of the PLC project:

Name	Value	Force Mask	Style	Data Type	Description
COUNT	{...}	{...}		COUNTER[5]	Diagnostic counters for MSG blocks
COUNTER_MSG	{...}	{...}		COUNTER	Counter to sequence MSG blocks
HGA_FEEDBACKS	{...}	{...}	Decimal	INT[32]	INT array used as destination by read feedbac
HGA_SETPOINTS	{...}	{...}	Decimal	INT[2]	INT array used as source for write setpoints M
HGAGateway:I1	{...}	{...}		_003A:000C_012A_4D9A70CC:I:0	
HGAGateway:O1	{...}	{...}		_003A:000C_012A_472039DA:O:0	
MSG01	{...}	{...}		MESSAGE	MSG data for reading feedbacks
MSG02	{...}	{...}		MESSAGE	MSG data for writting setpoints
TIMER_MSG	{...}	{...}		TIMER	Timer used to sequence MSG blocks
HGAFeedbacksClientTag	{...}	{...}	Decimal	INT[32]	
HGASetpointsClientTag	{...}	{...}	Decimal	INT[2]	

Figure 65: Completed Controller Tag List in PLC Example Program

Example 1 – Ethernet/IP MSG Commands

Create the following ladder logic diagram in the PLC design tool.

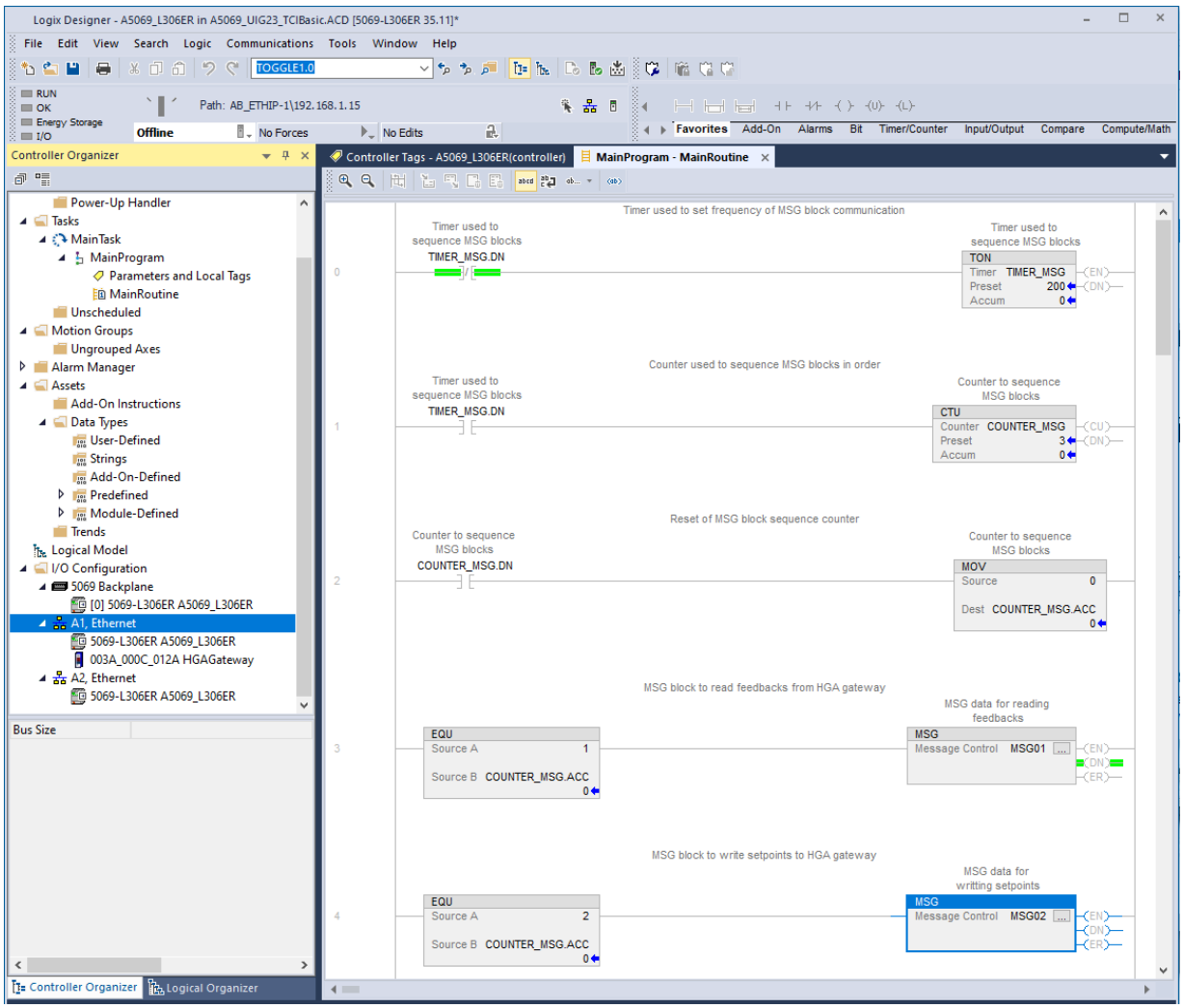


Figure 66: Studio 5000 Ladder Logic Diagram using explicit MSG blocks.

In the ladder logic program shown above the write MSG command block should use the MSG02 tag for message control, Message Type should be set to CIP Data Table Write, Source Element set to PLC tag HGA_SETPOINTS[0], size 2, with Destination Element set to gateway tag HGASetpoints[0]:

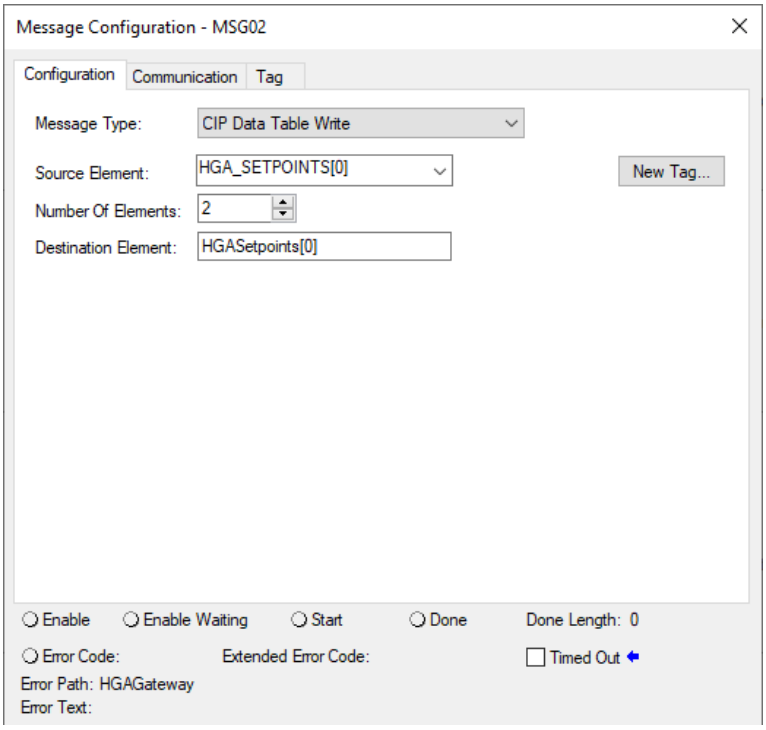


Figure 67: Message Structure (Write Command) Settings

In the ladder logic program shown above the read MSG command block should use the MSG01 tag for message control, Message Type should be set to CIP Data Table Read, Source Element set to gateway tag HGAFeedbacks[0] size 32, with Destination Element set to PLC tag HGA_FEEDBACKS[0]:

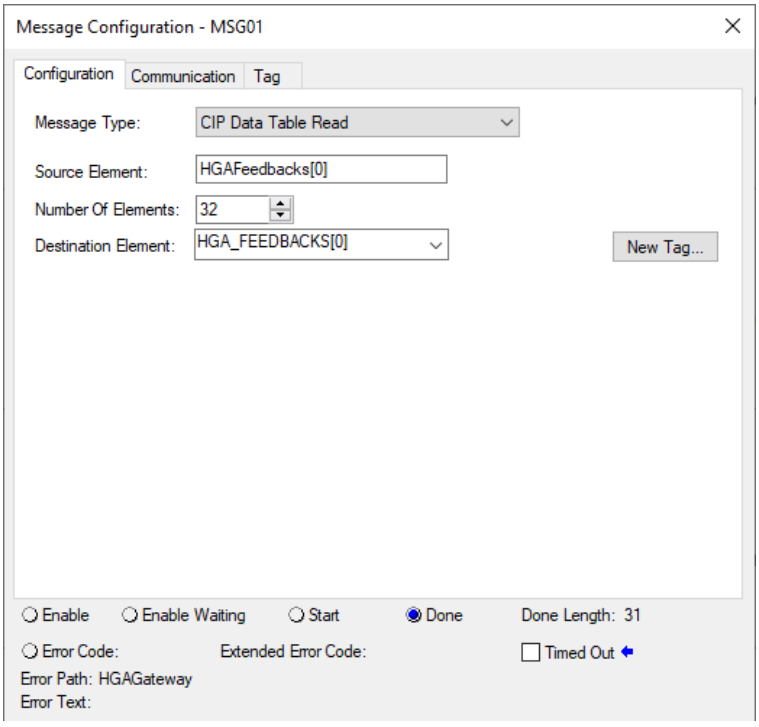


Figure 68: Message Structure (Read Command) Settings

Once the PLC program is downloaded on to the PLC and set to run the tag values read from the gateway can be viewed in the tag monitor of the PLC project:

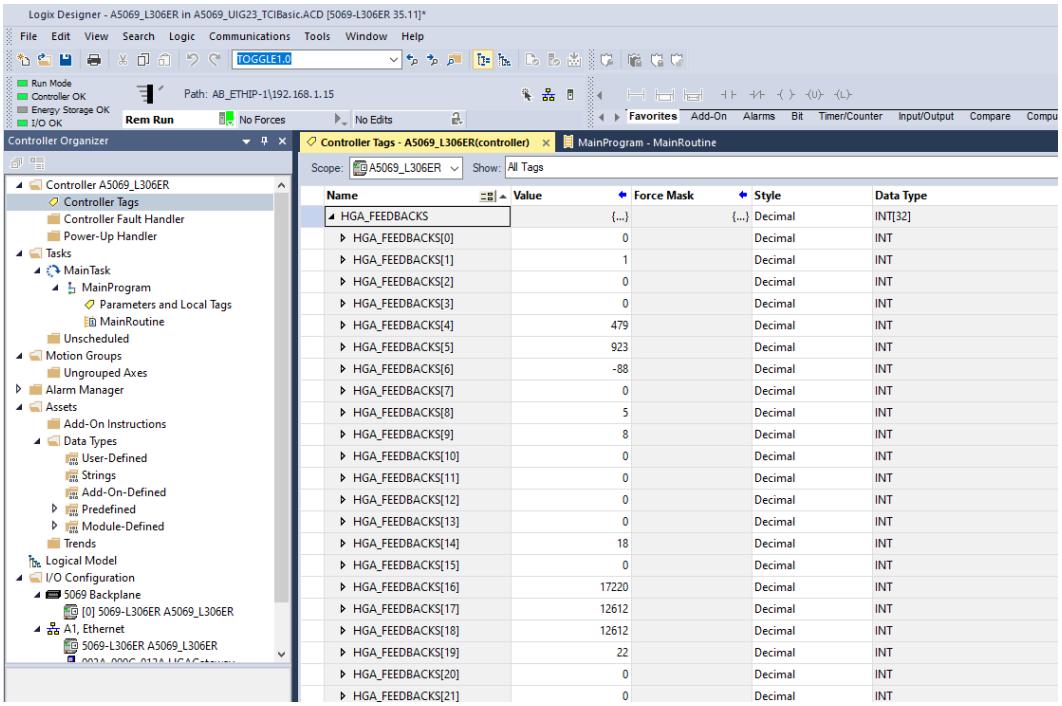


Figure 69: PLC Controller Tag Monitor view of HGA Explicit MSG Feedback

In the controller tag monitor view the individual feedback values read from the HGA can be viewed. For example, Feedback value 0 is the run/stop status indication of the HGA unit. Feedback 4 is the Line Voltage feedback value, and Feedback value 5 is the Line Current feedback value. For the full list of feed backs and setpoints see interface, reference Table 42: Network Interface OUTPUT Register Map and Table 43: Network Interface INPUT Register Map.

Example 2 – Ethernet/IP Client Tag Map

A second method of reading and writing data to the HGA gateway via Ethernet/IP is via a client device and tag maps defined in the gateway. Unlike the explicit MSG block command example above, this method does not require a ladder logic program.

First the Ethernet/IP client device that is pre-defined in the gateway configuration will need to be updated so the IP address and network settings of the client device in the gateway configuration matches the PLC the gateway is connected to.

Figure 70: Gateway Ethernet/IP Client Device Settings Web Browser Settings Screen

Once the EtherNET/IP Client device is configured for the connected PLC turn on the Ethernet IP Client tag maps via the Gateway web browser Tag Map screen.

- Note: For the feedback tag maps all three feedback tag maps can be active at the same time (Multiple readers of one data source is ok).
- Note: for the setpoint tag maps only one of the three setpoint tag maps should be active at any time. Otherwise, the multiple active setpoint tag maps will overwrite each other causing unintended behavior (Multiple writers to one data source causes data contention).

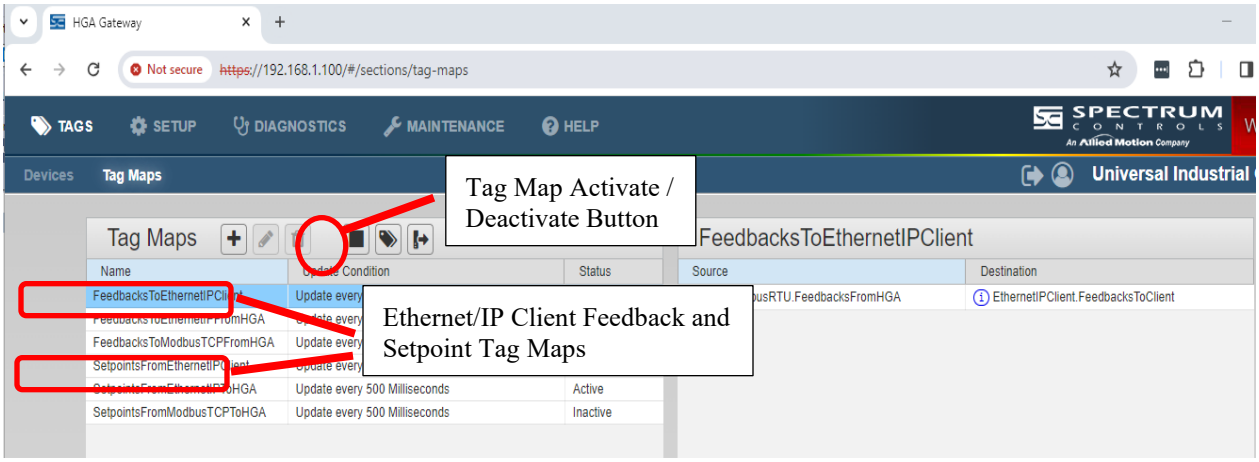


Figure 71: Gateway Ethernet/IP Client Tag Map Settings and Activation Web Browser Screen

With the Ethernet/IP Client tag maps active the HGA gateway data can be viewed via the controller tag monitor in the PLC design software. As in the previous example Feedback value 0 is the run/stop status indication of the HGA unit. Feedback 4 is the Line Voltage feedback value, and Feedback value 5 is the Line Current feedback value. For the full list of feed backs and setpoints see interface, reference Table 42: Network Interface OUTPUT Register Map and Table 43: Network Interface INPUT Register Map.

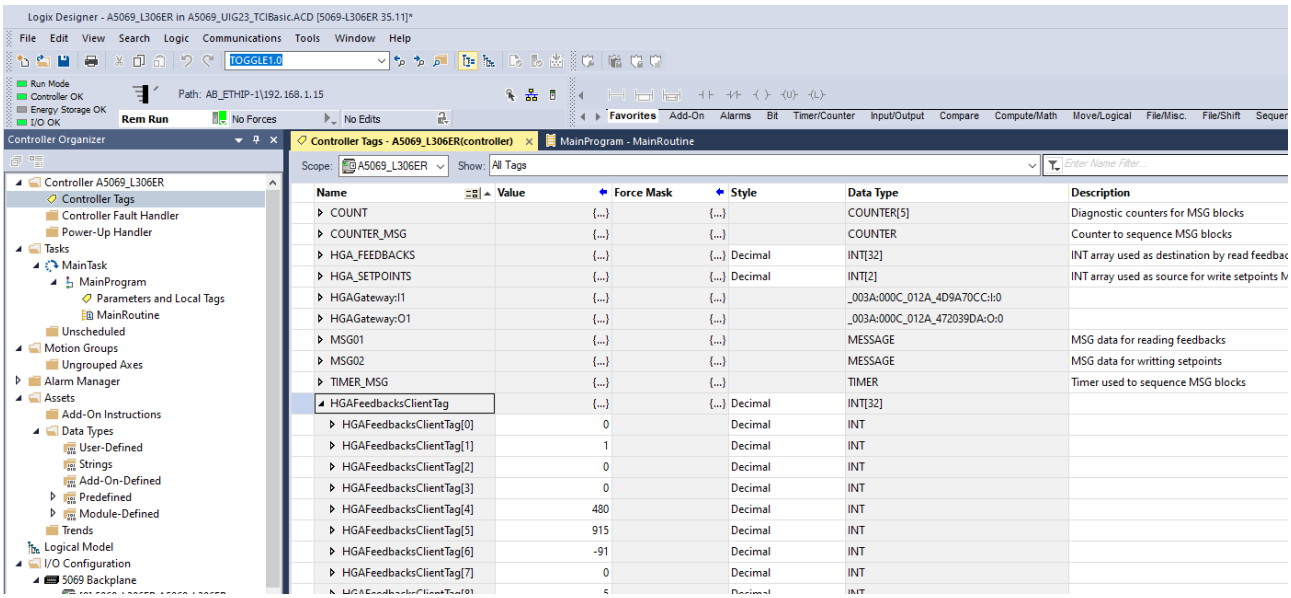


Figure 72: PLC Controller Tag Monitor view of HGA Ethernet/IP Client Tag Map Feedback Values

11.0 Appendix B: Modbus TCP/IP Gateway Option

Introduction

The Modbus TCP/IP network Communications Gateway translates command and status data to and from the HMI Display's integrated network interface from the Modbus RTU protocol to Modbus TCP/IP. Modbus TCP/IP (also Modbus-TCP) is simply the Modbus-RTU protocol with a TCP interface that runs on Ethernet. The Modbus TCP/IP Communications Gateway is implemented using an industry leading Ethernet/IP solution from Allient Spectrum Controls: The Universal Industrial Gateway WP-G-222-P1. Note that the same gateway and gateway configuration is used for both Modbus TCP and Ethernet/IP,

Table 51: Modbus TCP/IP Communications Gateway Key Features

Feature	Description
Protocol Support	Modbus TCP Server Functionality
Connection	10/100 Mbps full-duplex, 8-pin RJ45
Isolation	Ethernet ports: 1500 VAC, 50 to 60 Hz for sixty seconds and 250 VAC working voltage. DC power and serial ports: 707 VDC for 60 seconds and 120 VAC working voltage.
TCP/IP Settings	Web Browser Based Configuration. Google Chrome recommended. Default IP address: **192.168.1.100.** Default logins use **admin** and password **AllientTCIHGA**
Reset (pinhole on front of Gateway).	Reset Options: • Retain its current configuration. To do so, insert a paper clip into the **RESET** switch on the Gateway and press gently and briefly (less than 15 seconds). As soon as you release the button, the Gateway reboots. Status LED blinks red (0.5 seconds on/0.5 seconds off). • Reset to factory defaults. Insert the paper clip and press gently for more than 15 seconds. Status LED blinks red (0.5 seconds on, 0.5 seconds off). • If the software does not respond to a reset or reset-to-defaults request via reset switch, the display will blink the horizontal segments until the unit is power cycled. This period may be brief enough that the segments only blink once.
Display button	Press to wake up the display. If you press the display button again while the display is on, the button press is ignored, and the 90-second countdown continues.
LED (128 × 32-pixel OLED display)	Press to wake up the display. If you press the display button again while the display is on, the button press is ignored, and the 90-second countdown continues.
Status button	At initial power-on, Status LED is solid green under hardware control. During initial boot-up, the Status LED blinks green when under software control. Once the network interface is fully available, the LED changes to solid green.

Note: *The optional network Communications Gateway part number and hardware is identical for the Ethernet/IP interface and the Modbus TCP/IP interface. Verify you are referencing the appropriate Appendix section for the network protocol you have selected.*

Wiring

Connection of the HarmonicGuard® Active filter Interface Module to the end user's upstream Modbus TCP/IP network occurs at the RJ45 connection on the Communications Gateway. The Communication Gateway is mounted on the back panel of the Interface Module.

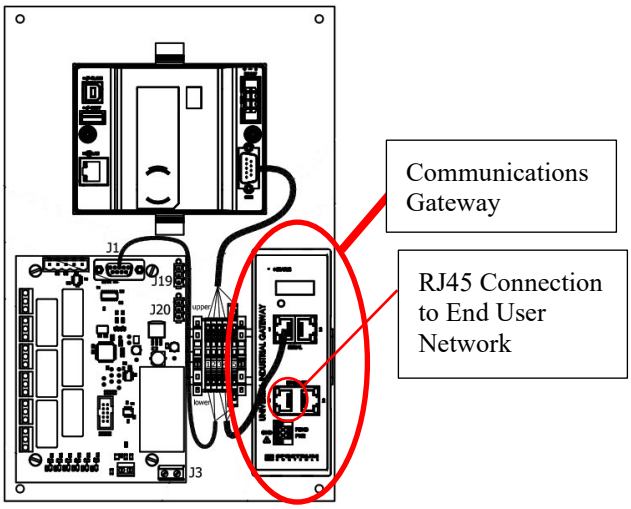
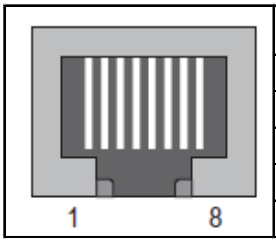


Figure 73: Modbus TCP/IP Communications Gateway Location

Table 52: Modbus TCP/IP Connector Pinout



Pin Number	Description
1	TD+
2	TD-
3	RD+
6	RD-
4, 5, 7, 8	Termination

Configuration

To configure the IP address of the Modbus TCP/IP communications gateway, connect the gateway to the TCP network then open a web browser window and type in the default IP address of the gateway (see Table 47: Gateway Default Settings below) and press enter. The Communications Gateway configuration login page should load. For the gateway login use the following credentials (case sensitive):

- Username: **admin**
- Password: **AllientTCIHGA**

The recommended web browser to use for gateway configuration is the Google Chrome web browser.

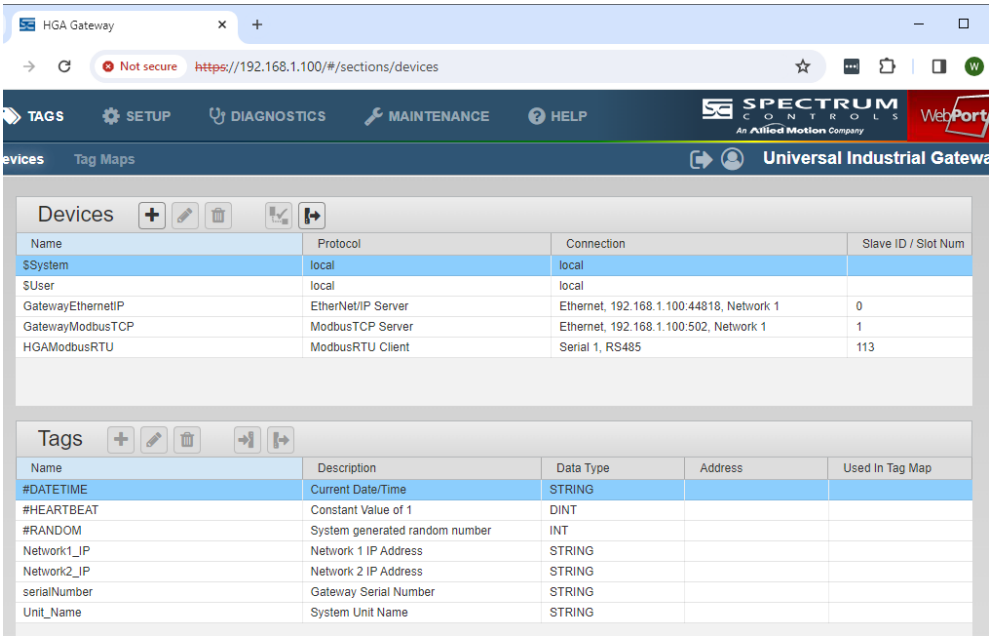


Figure 74: Modbus TCP/IP Gateway Configuration Page

Table 53: Gateway Default Settings

Setting	Default Value
IP Address	192.168.1.100
Subnet	255.255.255.0
Gateway	192.168.1.1
DHCP	Off (Static IP enabled)

To update the IP address switch to the **Setup** tab then select **Networks:**

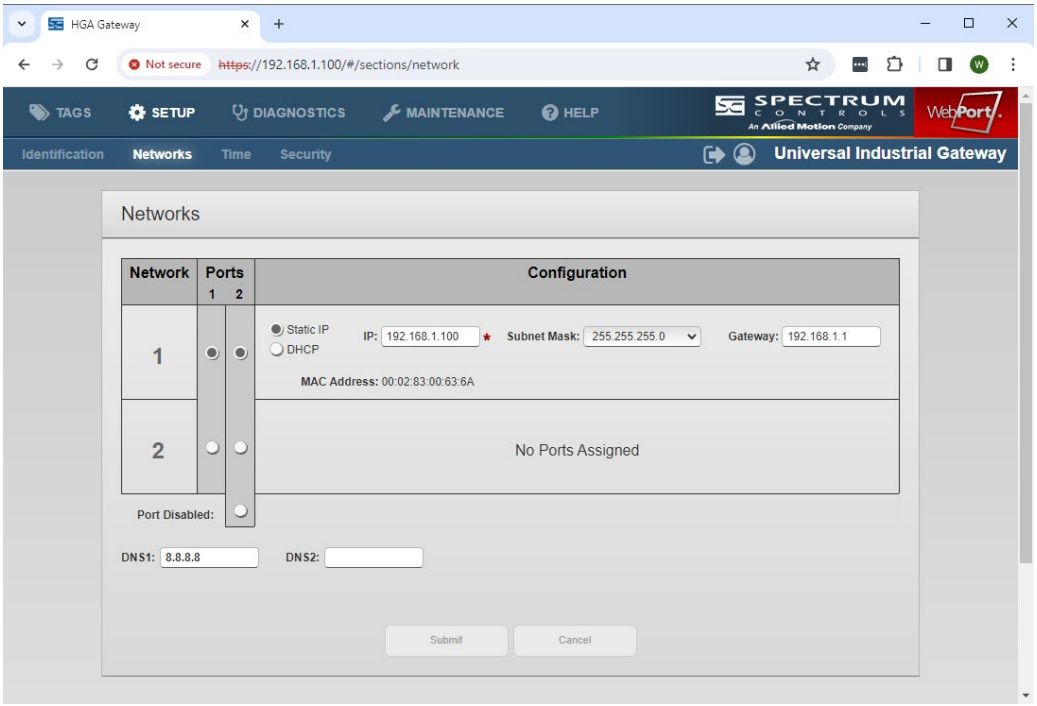


Figure 75: Gateway IP Address Configuration Screen

To change the gateway IP address type in a new IP address on the configuration page, then click on the **Submit** button. After the new IP address is stored, cycle power to the Communication Gateway to load the new IP address.

For advanced configuration options, such as MAC Address blacklist/whitelist, reference the Spectrum Controls Universal Industrial Gateway User Manual, available on the Spectrum Controls website (https://www.spectrumcontrols.com)

Register Map and Address Offsets

The gateway implements a data array for all the feedback from the HGA and a data array for all the setpoints that can be written to the HGA.

For a description of the input/setpoint and output/feedback data available over the network interface, reference Table 42: Network Interface OUTPUT Register Map and Table 43: Network Interface INPUT Register Map.

For the Modbus TCP interface the **HGA output status data** registers from the HGA, which contain unit status, Voltage, current, etc. are in **Modbus register space 30000 (3x Input Registers)**. This register space should be access via **Modbus Function Code 04 Read Input Registers**.

For the Modbus TCP interface the **HGA input command data** register to the HGA, which contains the unit run stop command are in Modbus register space **40000 (4x Holding Registers).** This register space should be access via **Modbus Function code 06 Write Single Register**.

Gateway Tag Maps

The gateway implements several tag maps that can be used to access the HGA setpoints and feedback.

Table 54: Description of Gateway Data Tag Maps

Tag Map Name	Description
FeedbacksToEthernetIPClient	Feedback data from the HGA unit mapped to the Modbus TCP/IP client device. The client device would typically be a PLC. The client needs to have an array tag named HGAFeedbacksClientTag (sized to match the number of data elements in the Network Interface OUTPUT Register Map). The preconfigured IP address for the client is 192.168.1.15. If your PLC has a different IP address update the Modbus TCP/IP Client device using the gateway web browser Tags -> Devices screen.
FeedbacksToEthernetIPFromHGA	Feedback data from the HGA unit mapped on a Modbus TCP/IP server. A client device, such as a PLC, can use MSG commands to explicitly read feedback data via this tag map. The MSG block will need to be configured for a CIP Data Table Read of source array tag HGAFeedbacks[0] with the number of elements sized to match the number of data elements in the Network Interface OUTPUT Register Map.
FeedbacksToModbusTCPFromHGA	Feedback data from the HGA unit mapped to a Modbus TCP server in address space 300000, function code 4.
SetpointsFromEthernetIPToHGA	Setpoint data to the HGA unit mapped on an Modbus TCP/IP server. A client device, such as a PLC, can use MSG commands to explicitly write setpoint data via this tag map. The MSG block will need to be configured for a CIP Data Table Write with destination array tag HGASetpoints[0] with the number of elements sized to match the number of data elements in the Network Interface INPUT Register Map.
SetpointsFromModbusTCPToHGA	Setpoint data to the HGA unit mapped to a Modbus TCP server in address space 400000, function code 6.
SetpointsToEthernetIPClient	Setpoint data to the HGA unit mapped to the Modbus TCP/IP client device. The client device would typically be a PLC. The client needs to have an array tag named HGASetpointsClientTag (sized to match the number of data elements in the Network Interface INPUT Register Map). The preconfigured IP address for the client is 192.168.1.15 If your PLC has a different IP address update the Modbus TCP/IP Client device using the gateway web browser Tags -> Devices screen.

Feedback Tag Maps Notes:

- The HGA unit Ethernet gateway is pre-configured to have all three feedback tag maps activated by default (Modbus TCP/IP Server, Modbus TCP/IP Client, Modbus TCP Server)
- This means the feedback data from the HGA will be mirrored to the Modbus TCP/IP Server, Modbus TCP/IP Client, and Modbus TCP Server devices.

Setpoint Tag Maps Notes:

Only One setpoint tag map should be running in the gateway at any time.

- If multiple setpoint tag maps are running then there will be multiple sources writing to the same HGA setpoint values. This will cause competing values to be sent to the HGA unit which may result in unexpected or unwanted behavior if the multiple data sources are not all writing identical setpoint values.

- The HGA unit Ethernet gateway is pre-configured to have the Modbus TCP/IP Server setpoint tag map running (MSG command option) and the Modbus TCP/IP client and Modbus TCP setpoint tag maps stopped/turned off.
- If a different setpoint tag map needs to be turned on than the default use the web browser gateway configuration tap map screens to activate the desired setpoint tag map and deactivate the other two tag maps.

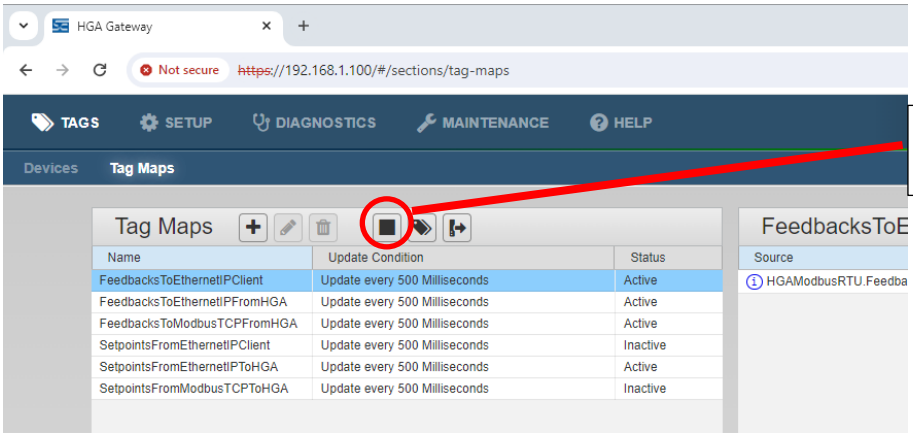


Figure 76: Location of Tag Map Activate\Deactivate

Operation

The Communication Gateway has LED indicators that show the status of the ethernet and sub-network communications. The meanings of the LED indicators are described below.

Table 55: Modbus TCP/IP/Modbus TCP Gateway LED Diagram

Gateway Front View	LED	Indication
	Ethernet Port LEDs:	**Green LED:** • ON when receiving data at 100 Mbytes/second. Each byte of traffic turns on the LED for 200 ms (±50 ms) **Yellow LED:** • ON: ON when linked; blinking when traffic is transmitting on the line. Each byte of traffic turns on the LED for 200 ms (±50 ms) **Modbus TCP/IP Etherlink Status:** • ON: Link • OFF: No link **Modbus TCP/IP Etherlink Activity Status:** • Flashing: Port Activity • OFF: No activity
	Serial Port LEDs:	**Green LED:** • ON: Linked • Blinking when receiving traffic online. Each byte of data turns on the LED for 200 ms (±50 ms) **Yellow LED:** • ON: Linked • Blinking when transmitting traffic online. Each byte of data turns on the LED for 200 ms (±50 ms). **Status LED:** • ON: Green; Power OK • Blink: Green; booting • ON: Red; Error • Blink: Red; Reset

Required Equipment

- Spectrum Universal Industrial Gateway programmed with TCI HGA configuration.
- HGA HMI display connected to Spectrum gateway.
- Local Area Network (LAN) Ethernet switch.
- Rockwell PLC and associated development tools.
- Ethernet RJ45 cables.
- Simply Modbus Master Software

Setup

- Connect the RJ45 cable to the Ethernet Port on the Spectrum gateway to the Ethernet Switch (LAN).
- Connect the PLC to the Ethernet Switch (LAN) via RJ45 cable.
- The network setup is displayed below.

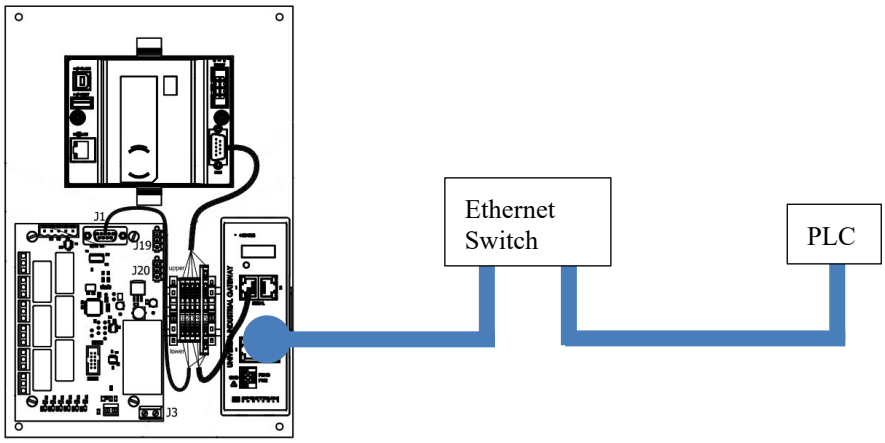


Figure 77: Network Setup with PC Example

Read HGA Feedback Data

- Open Simply Modbus and type in the IP address set for the Modbus TCP/IP gateway **(1)**.
- Select mode as TCP and then hit CONNECT **(2)**. Once connected, a disconnect option will appear in place of NOT CONNECTED.
- Set the register size as 16 bits **(3)**.
- Select the first register as "0" and No. of Regs to 8 **(4)**.
- Set the minus offset at "0" **(5).**
- Set the function code to 4 **(6).**
- Uncheck the High Byte / Low Byte Check box **(7).**
- Click SEND **(8)**. The HMI data will appear on the table in the upper right side of the Simple Modbus application. For register map definitions, please reference Table 42: Network Interface OUTPUT Register Map and Table 43: Network Interface INPUT Register Map.
- To receive data continuously, decrease the pause between sends to 0.0 and check send continuously **(9)**.

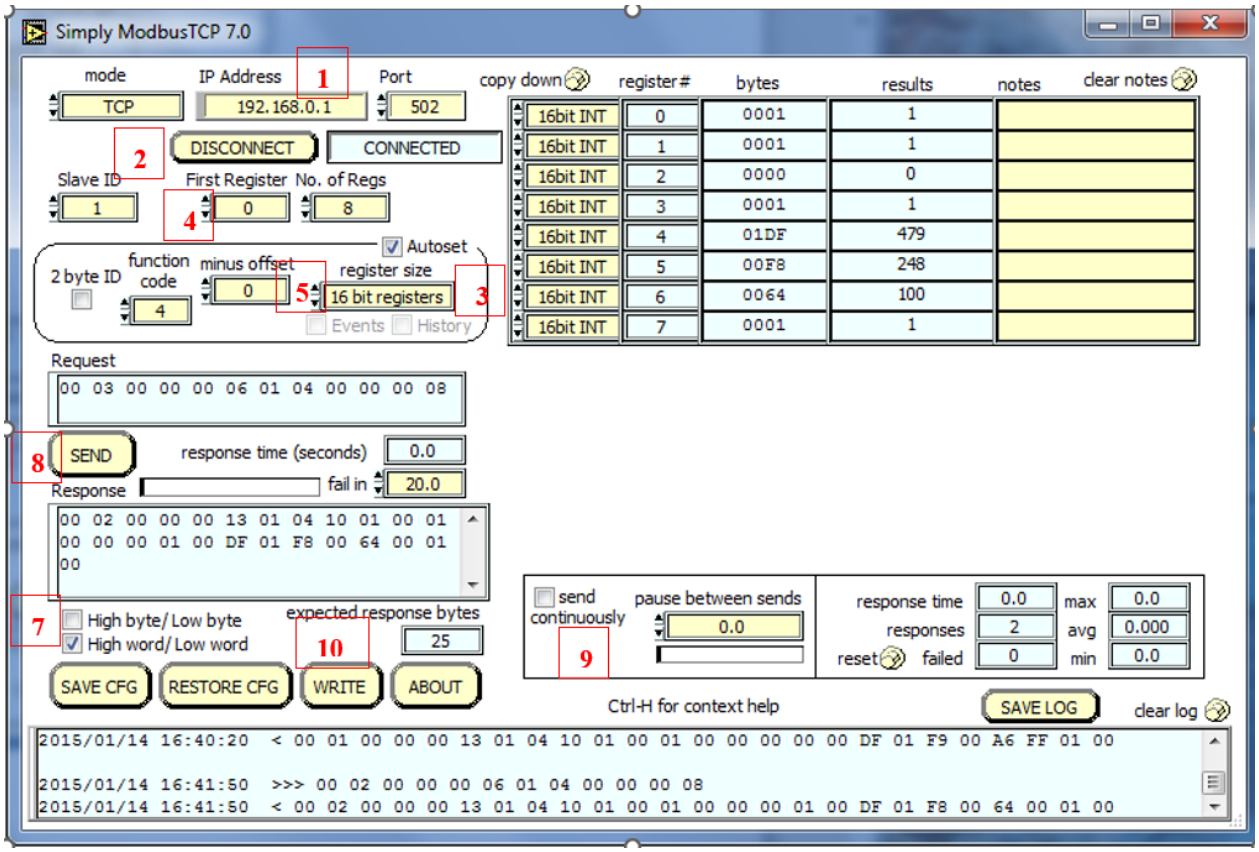


Figure 78: Simply Modbus Example

Write HGA Setpoint Data

- Reference figure above and click the write command in the Simply Modbus main window.
- Select the first register value as “0” **(1)**.
- Select the data type as 16-bit INT **(2)**.
- Set the minus offset to “0” **(3).**
- Write the value as “1” in register number “0” **(4)** and hit SEND **(5)**. The unit will begin to run if the network run command enable is enabled. If the network run command enable is off/disabled, the network run command will be ignored.
- Sending “0” in the same command will stop the unit.
- The changes can be observed in the main window.

***Note**: HGA unit will only respond to network run command if the network run command enabled is enabled via the HGA unit’s HMI setup screen.*

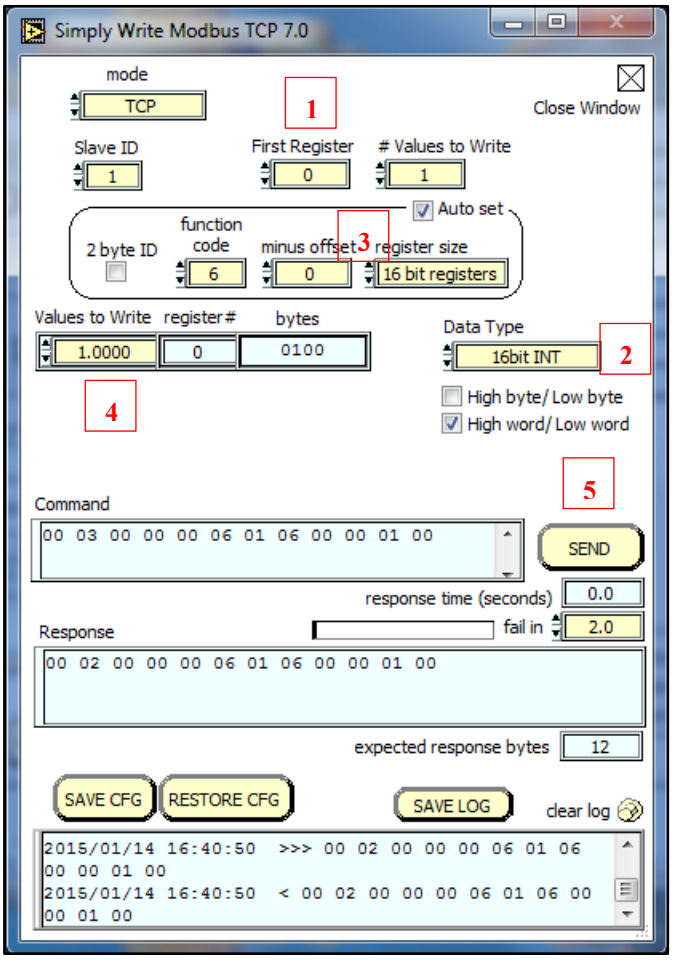


Figure 79: Simply Write Modbus Screen

12.0 Appendix C: BACnet/IP Gateway Option

Introduction

The BACnet/IP-to-Modbus Communication Gateway translates command/status data to/from the HMI Display's integrated network interface from the Modbus RTU protocol to BACnet/IP. The BACnet/IP Communication Gateway is implemented using a third party, industry leading solution from Contemporary Controls BASGLX-M1.

Table 56: BACnet Communications Gateway Key Features

Feature	Description
Connection	10/100 MBit twisted pair RJ45 Connection
Galvanic Isolation	Transformer isolated Ethernet interface
TCP/IP Settings	Web Browser Based Configuration
Baud Rate	10/100 MBit auto detect
Protocol Conformance	Conforms to ASHARE 125-2004, Annex J, B-ASC Profile

Wiring

Connection of the HarmonicGuard® Active filter Interface Module to the end user's upstream BACnet network occurs at the RJ45 connection on the Communications Gateway. The Communication Gateway is mounted on the pack panel of the HMI Interface Module.

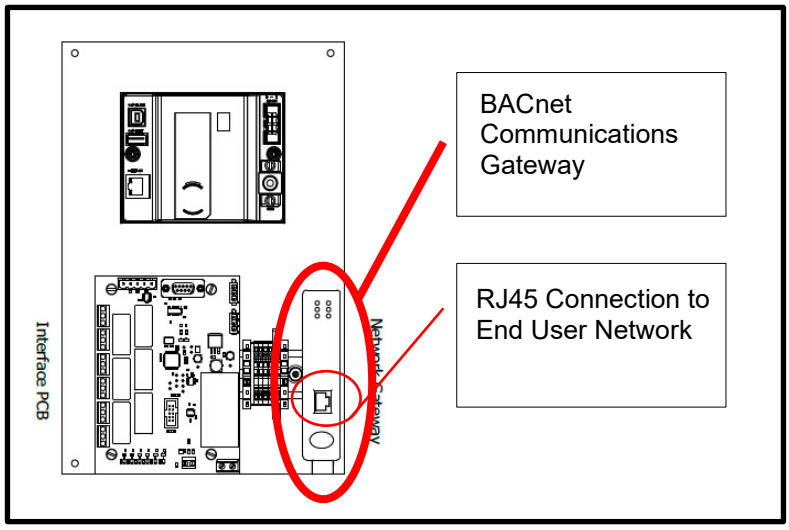


Figure 80: BACnet Communications Gateway Location

Configuration

To configure the IP address of the BACnet communications gateway, connect gateway to the BACnet/IP network. Then, open a web browser window and type in the default IP address of the gateway and press enter. The Communications Gateway configuration page should load. Open the Configure tab.

Table 57: Gateway Default Settings

Setting	Default Value
IP Address	192.168.92.68
Gateway	0.0.0.0
Subnet	255.255.255.0

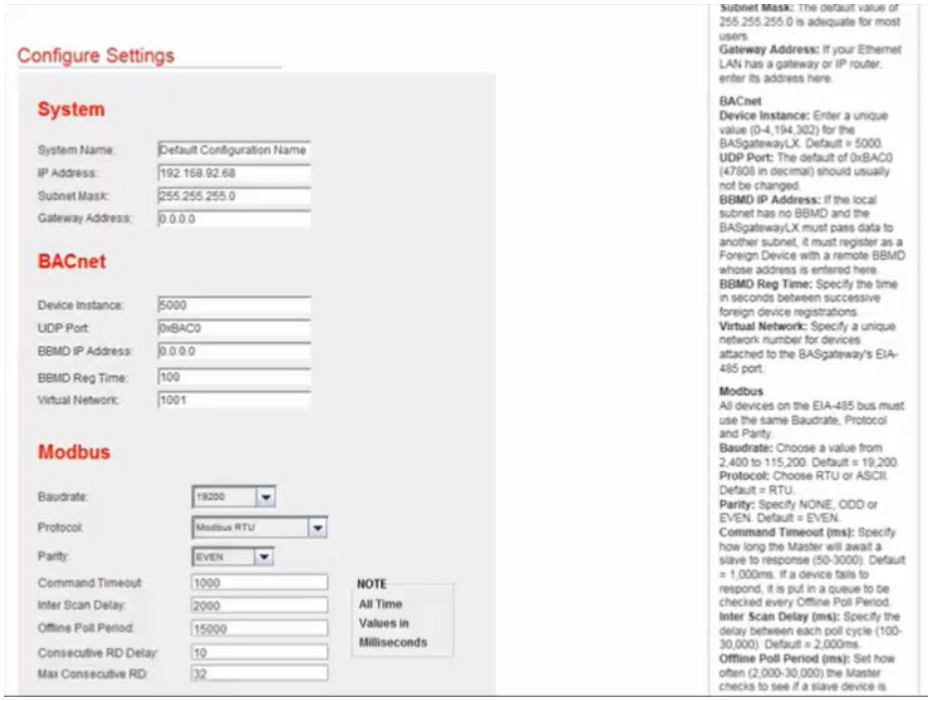


Figure 81: BACnet Gateway Configuration Page

- If Java is not installed, follow the link at the bottom of the “Configure Page” to install it.
- The default username and password are both “admin”.
- The IP Address can now be modified and saved.
- Reboot the gateway to finalize the change.
- The IP Address can be reset to the BACnet Gateway’s default of 192.168.92.68 using the recessed reset button on the gateway.

Register Map

For a description of the input and output data available over the network interface, please reference Table 42: Network Interface OUTPUT Register Map and Table 43: Network Interface INPUT Register Map.

BACNet/IP Gateway Example

Gateway to BACnet Master Example

HMI ModbusRTU server connected through gateway to BACnet Master:

Required Equipment:

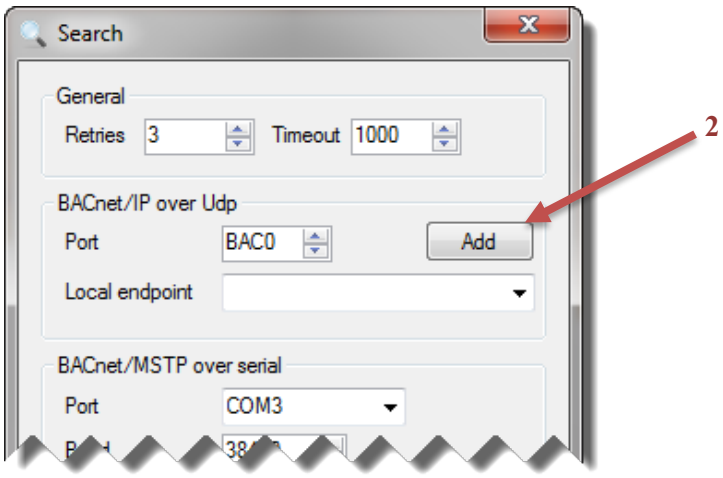
- BASGLX-M1 gateway programmed with TCI HGA configuration.
- HMI display connected to BACnet/IP gateway.
- Ethernet RJ45 cable.
- **Y**et **A**nother **B**ACnet **E**xplorer (Yabe) software.

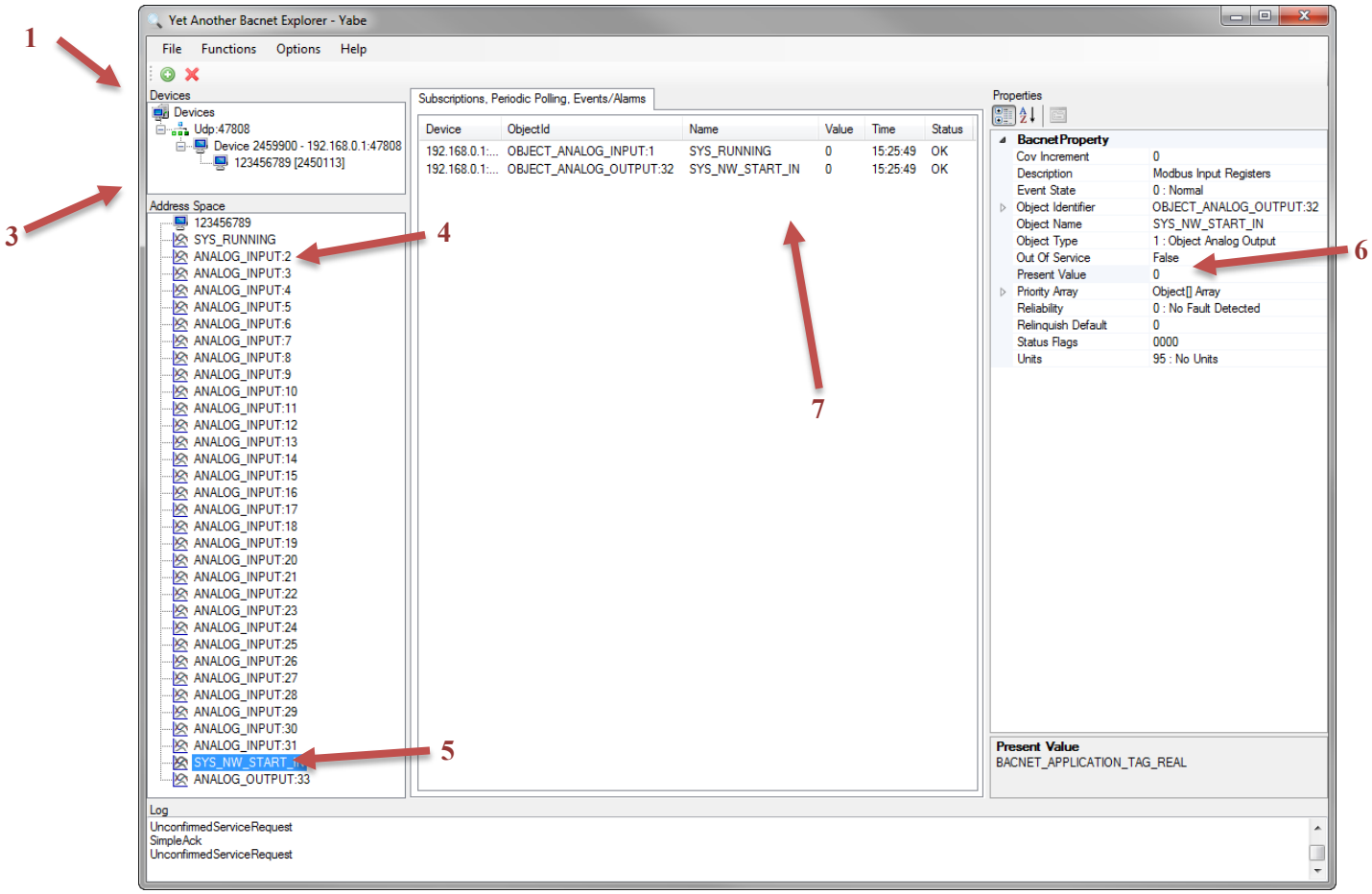
Set-Up:

- Connect PC to BACnet/IP port on gateway using RJ45 cable.
- Ensure PC is on the same subnet as the gateway.

Programming:

- In our example, the BACnet master is Yabe.
- Click “Add Device” (search). This is the green plus. (**1**)
- In the new window, click “Add” in the BACnet/IP over “UDP” section. The gateway will appear as the serial number of the HGA unit. (**2**)
- Select the gateway to display the available properties. (**3**)
- Right click on ANALOG_INPUT:1 and click “Subscribe.” Note that the name of the property changes to SYS_RUNNING. (**4**)
- Subscribe to ANALOG_OUTPUT:32 (SYS_NW_START_IN). (**5**)
- While keeping SYS_NW_START_IN selected under “Address Space,” the “Present Value” can be changed in “Properties.” Change the value to “1” and press enter. The unit will begin to run if the network run command enable is enabled. If the network run command enable is off/disabled, the network run command will be ignored. (**6**)
- Changing the same value to “0” will stop the unit.
- The changes will appear in the “Subscriptions” window. SYS_RUNNING will have a value of “1” while the unit is running and “0” while the unit is not running.





Note: *HGA unit will only respond to network run command if the network run command enabled is enabled via the HGA unit's HMI setup screen. For information on how to enable the network run command. The network run command enable can only be enabled via the HMI on the HGA unit*

13.0 Appendix D: ModbusRTU Master

Introduction

The HGA Modbus RTU network communication interface transmits and receives command and status data from the HGA HMI display to a connected Modbus master over a RS-485 serial link. ModbusRTU is a simple serial communications protocol originally developed by Modicon for use with Programmable Logic Controllers (PLCs) in control of industrial devices. ModbusRTU is commonly supported by most PLCs and is an open, royalty-free communications standard.

Wiring and Configuration

The HGA implements a ModbusRTU slave device, which can be accessed by a connected ModbusRTU master that supports two wire RS-485 signal levels. The HGA HMI communication port used for the Modbus RTU interface is COM2. The COM3 serial connection header is shared with the COM2 port. The COM2 port is located on the back of the HMI display.

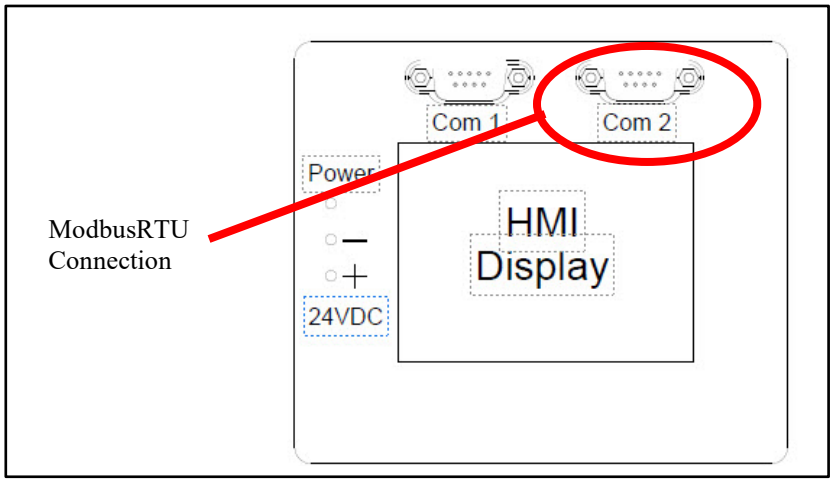


Figure 82: Modbus RTU Connection

The hardware pinout for the HMI COM3 port and the default settings are shown below.

Table 58: HMI COM3 Port Pinout and Default Settings

TBHMI Pin Number	Signal Name	Signal Type
1	no connect	-
2	no connect	-
3	D+	RS-485(non-inverting)
4	D-	RS-485 (inverting)
5	GND	RS-485 (Signal Common/Ground)
6	no connect	-
7	no connect	-
8	no connect	-
9	no connect	-

The default protocol settings for the RS-485 ModbusRTU interface on COM3 are show below.

Table 59: RS-485 ModbusRTU interface on COM3 Default Settings

Parameter	Default Value	Units
Baud Rate	19200	bps
Data Bits	8	bits
Stop Bits	1	bits
Parity	Even	-
Slave ID	113	-

The default settings can be modified via the HMI system menu. Please reference *the HMI Modbus RTU COM Change Instructions* at the end of this document to change the default protocol settings.

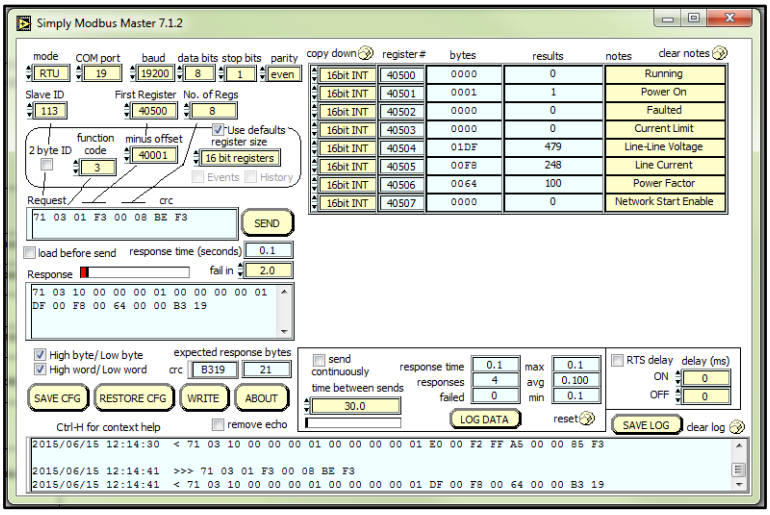
Example Application Using "Simply Modbus Master 7.2.1"

The ModbusRTU network interface COM3 port is configured for RS-485 signal levels. The following example uses an RS-485 to USB converter to connect the HGA HMI to a laptop PC running the ModbusRTU master application. The picture below shows an example "B&B SmartWorx, Inc" Model, USPTL4 model RS-422/485 to USB converter.

Figure 83: B&B SmartWorx, Inc Model: USPTL4 model RS-422/485 converter

Example Setup Instructions to Read Data from the HGA Unit

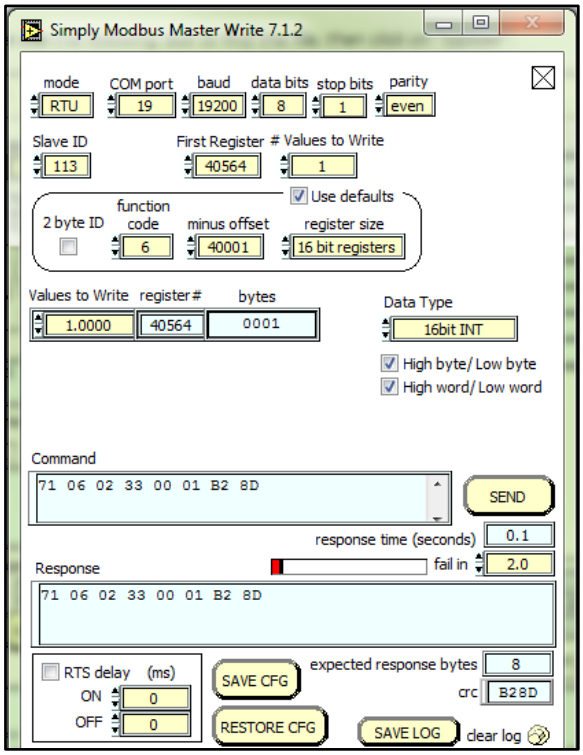
- Connect the cable to COM2/3 on back of HMI.
- Connect the USB end to the computer.
  - Determine the assigned COM port number for the RS-485 to USB converter using the computer device manager control panel.
  - The converter used in this example typically enumerates between the range of COM5 to COM20 on a standard laptop computer running the Microsoft windows operating system.
- Configure the computer COM port settings to match the default settings used by the HGA HMI COM3 port listed above (baud, parity, stop bit(s), slave ID, etc...)
- Open the Simple Modbus Master software.
  - Can be downloaded from the link below:
  - http://www.simplymodbus.ca/manual.htm
  - The trial version of the software is free and fully functional for this task hence no License key is necessary.
- Next, configure the fields in the screen as shown below. These are again the default settings of the HMI COM3 port.
  - ***Note:*** *The "notes" sections of the display data registers are filled in manually*



- Select the "SEND" button and the data available on the network will be displayed.
  - Start and stop the unit using the HMI to see the changes in the fields.

Example Setup Instructions to Write Data to the HGA Unit

- To start/stop the unit, first the “Network Start Enable” parameter must be enabled on the HMI manually.
  - Navigate to the Tech Setup page and then select the “Run/Stop Control Setup” button.
  - Select the “Network Start En” button. It will turn green and say, “Network Start”.
- Next, select the “WRITE” button on the screen shown above.
- The screen below will be shown. Configure the fields as shown in the picture.



- Select “1” in the field “Values to Write” to turn the unit ON or “0” to turn the unit OFF.
- Verify via the HMI that the unit is receiving commands by going to the screen shown below.

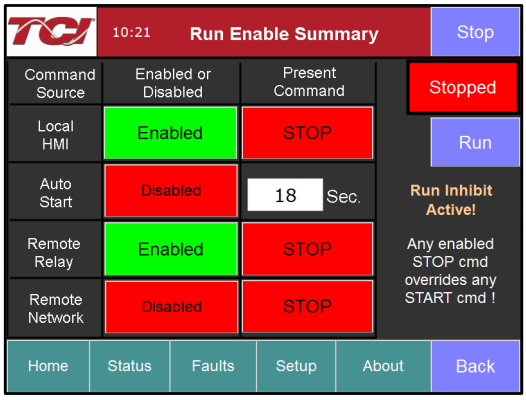


Figure 84: HGA with Remote Network Enabled

- This can be accomplished by selecting the “Status” page on the bottom of the screen, choosing the blue “Converter” button, and selecting “Run Enable Summary”.
- The figure above displays the unit with the Remote Network enabled and the converter in the Off state. The status indicator of the “Remote Network” in the “Present Command” column will echo the start/stop command from the Simple Modbus ModbusRTU master

14.0 Appendix E: HMI Modbus RTU COM Instructions

This document will outline to the user how to change the communication settings for the Modbus RTU protocol enabled via COM3 on the HMI.

NOTE: On the HMI, COM2 and COM3 share the same physical port, which is labeled COM2.

On the 'Network' page (Setup -> Tech Setup -> Tech Setup+ -> Network Setup) you can see the current settings of the port. When selecting 'HMI Settings' and attempting to change these, you will be prompted to call TCI. This document is intended to explain the process for changing those settings once TCI has been contacted.

NOTE: The text displayed on the 'Network' screen will not change as it is static.

1. Go back to the 'Tech Setup+' screen and select 'HMI System Menu'.
2. Select 'System Settings' in the top left corner. Using the arrows scroll to the 'COM Port' tab.
3. Tap the screen and it will turn blue and a new set up command will show up on the bottom. Using the left/right keys, Select COM Port: 3.
4. Now using the arrow keys, you have access to all the settings for the Modbus RTU protocol. Change them to your preferred settings. The Comm. HMI Station is the slave ID of the device. It is defaulted from TCI to be '113'

15.0 Appendix F: Operating the HGA in 3R Enclosure.

Warning 	Be sure to read, understand, and follow all safety instructions.
Warning 	Only qualified electricians should carry out all electrical installation and maintenance work on the HarmonicGuard® Active (HGA) filter.
Warning 	All wiring must be in accordance with the National Electrical Code (NEC) and/or any other codes that apply to the installation site.
Warning 	Disconnect all power before working on the equipment. Do not attempt any work on a powered HGA filter. The HGA filter and other connected equipment must be properly grounded.
Warning 	The HGA filter may receive power from two or more sources. 3-phase power is connected to the main input terminals of the HGA filter. All these sources of power must be disconnected before working on the HGA filter.
Warning 	After switching off the power, always allow 5 minutes for the capacitors in the HGA filter and connected equipment, if applicable, to discharge before working on the HGA filter, associated equipment, or the connecting wiring. It is good practice to check with a Voltmeter to make sure that all sources of power have been disconnected and that all capacitors have discharged before beginning work.

Introduction

The HGA is available in a rugged 3R enclosure that makes it suitable for use in demanding environmental conditions. Standard status indicator lights have been placed on the exterior of the enclosure to accommodate the physical characteristics and requirements of a 3R enclosure. Refer to the table below for a legend of the indicator lights and their function. Our 3R enclosures are also provided with an exterior diagnostic port to connect to an optional portable HMI.

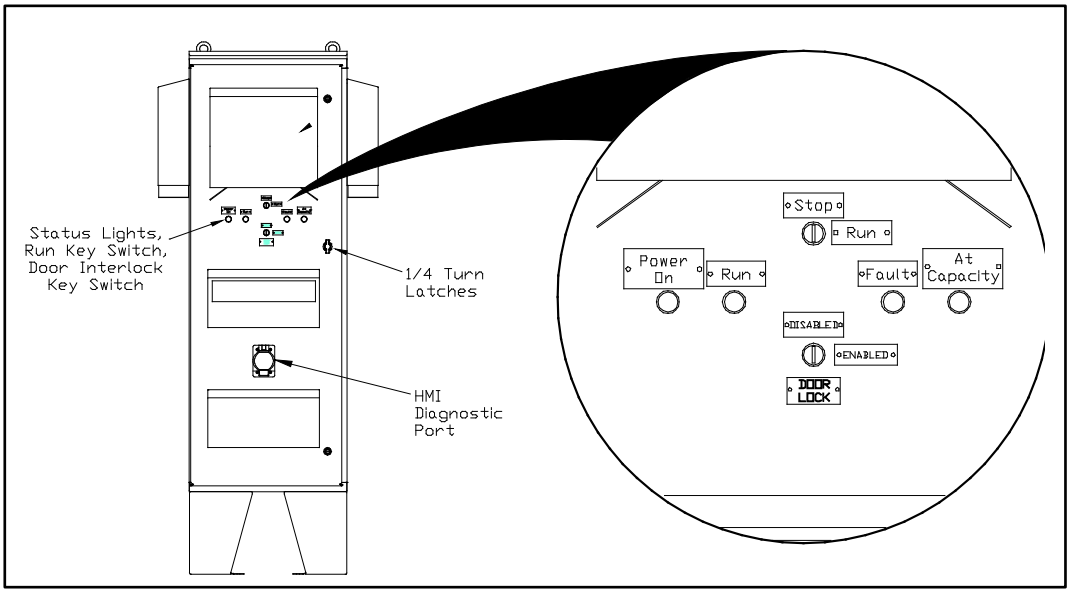


Figure 85: 3R Indicator Lights

Table 60: HGA-3R Indicator Lights

HGA 3R Indicator Light	Description
Power On	Indicates if the HGA filter has input power available.
Run	Indicates if the HGA filter is currently running or in the idle state.
Stop	Turn the key to the stop position to turn off the HGA unit power converter. If the HGA unit is faulted, turning the key to the stop position also resets the unit fault.
Run	Turn the key to the run position to enable HGA unit power converter.
Fault	Indicates if the HGA filter is faulted.
At Capacity	Indicates if the HGA filter is running at its maximum capacity.
Door Lock	Locks Cabinet Door.

HGA-HMI Operation

Connect the HGA-HMI connection port to the HMI diagnostic port using the 9-pin serial cable provided. When the HGA-HMI unit boots up follow the Quick Start guide appropriate for your HGA model.

Figure 86: HGA HMI and Connection Cord

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