

# Harmonic correction unit (HCU2) and electronic VAR injector (EVI2) active filters

## Operational manual



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## Contents

<b>SAFETY PRECAUTIONS</b> .....	<b>1</b>	Unit Settings .....	14
<b>INTRODUCTION</b> .....	<b>2</b>	Basic Setup .....	15
Harmonic Correction Unit .....	2	CT configuration .....	15
Electronic VAR Injector .....	2	Manual CT configuration .....	16
<b>OPERATION</b> .....	<b>3</b>	Automatic CT configuration .....	16
Home Screen .....	3	Brightness and Advanced HMI Settings .....	19
User Login .....	3	Input Configuration .....	19
System Status .....	3	Output Configuration .....	20
Overall Status Screen .....	4	External Interfaces .....	20
Unit Information .....	4	Modbus TCP/IP Address Setup .....	21
System Information .....	4	Set up users with the User Manager .....	21
Parallel Unit Status .....	4	Change a password .....	22
Unit Configuration Screen .....	4	Delete a user .....	22
Network Setup .....	5	<b>COMMISSIONING AND START-UP</b> .....	<b>23</b>
Unit Setup .....	5	Commissioning the unit .....	23
Voltages and Temperature .....	5	Adjust date and time .....	24
Voltages .....	5	Check fan .....	24
Temperatures .....	5	System Integrity Test .....	24
Unit Status .....	5	Parallel System Setup .....	26
Metering .....	6	External transformer .....	26
Currents .....	6	CT configuration .....	27
Fundamental Current .....	6	Manual CT configuration .....	27
Performance .....	7	Automatic CT Configuration .....	28
Power .....	7	System Mode Setup (HCU2 type) .....	30
Waveforms .....	7	System Mode Setup (EVI2 type) .....	30
Available Scope Data .....	8	Admin password setup .....	32
Phasor Diagram .....	9	Test Run .....	32
Event Log .....	9	Catalog Numbering System .....	34
System Settings .....	10	<b>TROUBLESHOOTING</b> .....	<b>34</b>
Compensation Mode Screen (HCU2 type) .....	10	<b>WARRANTY</b> .....	<b>36</b>
Compensation Mode Screen (EVI2 type) .....	11		
Miscellaneous Settings .....	12		
Voltages .....	13		
Parallel Configuration .....	14		
Harmonic Enable (HCU2 type) .....	14		

## Safety information

### Important information

Read these instructions carefully and look at the equipment to become familiar with the device before trying to install, operate, service or maintain it. The following special messages may appear throughout this bulletin or on the equipment to warn of potential hazards or to call attention to information that clarifies or simplifies a procedure.

The addition of either symbol to a “Danger” or “Warning” safety label indicates that an electrical hazard exists which will result in personal injury if the instructions are not followed.

This is the safety alert symbol. It is used to alert you to potential personal injury hazards. Obey all safety messages that follow this symbol to avoid possible injury or death.

---

 **DANGER**

---

**DANGER indicates a hazardous situation which, if not avoided, will result in death or serious injury.**

---

 **WARNING**

---

**WARNING indicates a hazardous situation which, if not avoided, could result in death or serious injury.**

---

 **CAUTION**

---

CAUTION indicates a hazardous situation which, if not avoided, could result in minor or moderate injury.

---

**NOTICE**

---

NOTICE is used to address practices not related to physical injury.

**Note:** Electrical equipment should be installed, operated, serviced and maintained only by qualified personnel. No responsibility is assumed by the manufacturer for any consequences arising out of the use of this material.

A qualified person is one who has skills and knowledge related to the construction, installation, and operation of electrical equipment and has received safety training to recognize and avoid the hazards involved.

As standards, specifications and designs change from time to time, please ask for confirmation of the information given in this publication.

## Safety precautions

Installation, wiring, testing and service must be performed in accordance with all local and national electrical codes.



### **DANGER**

---

#### **HAZARD OF ELECTRIC SHOCK, EXPLOSION, OR ARC FLASH**

- **Apply appropriate personal protective equipment (PPE) and follow safe electrical work practices. See NFPA 70E in the USA, CSA Z462, or applicable local standards**
- **This equipment must be installed and serviced only by qualified electrical personnel**
- **Do not exceed the device's ratings for maximum limits.**
- **Ground equipment using the ground connecting point provided before turning on any power supplying this device**
- **Turn off all power supplying this device and the equipment in which it is installed before working on the device or equipment**
- **After removing power, wait for 15 minutes to allow the capacitors to discharge prior to opening the doors or removing covers**
- **Always use a properly rated voltage sensing device to confirm power is off**
- **Replace all devices, doors, and covers before turning on power to this equipment**
- **Carefully inspect the interior for tools left behind before closing and sealing the door**

**Failure to follow these instructions will result in death or serious injury.**

### Introduction

The product can be provided in either of two types, an Harmonic Correction Unit (HCU2) or an Electronic VAR Injector (EVI2). Both types are to be installed as described in this manual. These products are both referred to as an active filter in this manual. For the most part, operation is the same for both types. Where there are differences, they are indicated by [HCU2] or [EVI2] in the topic heading. For example, the information in Harmonic Enable [HCU2 type] on **page 14** pertains to HCU2 type active filters.

### Harmonic correction unit

Active Harmonic Filters (HCU2) are static power electronic products that employ digital logic and IGBT semiconductors to synthesize a current waveform that is injected into the electrical network to cancel harmonic currents caused by nonlinear loads. HCU2 employ current transformers to measure the load current to determine the content of harmonic current present. By injecting the synthesized current, network harmonic currents are greatly mitigated, thus reducing the heating effects of harmonic current and reducing voltage distortion to permit other equipment to operate properly and enjoy a long product life span.

HCU2 also have the ability to correct for poor displacement power factor (DPF) and for mains current balancing. DPF correction can be provided for either leading (capacitive) or lagging (inductive) loads that cause poor DPF. Mains current balancing is achieved by measuring the negative sequence current present and injecting the inverse negative sequence current to balance the current for the upstream network.

### Electronic VAR injector

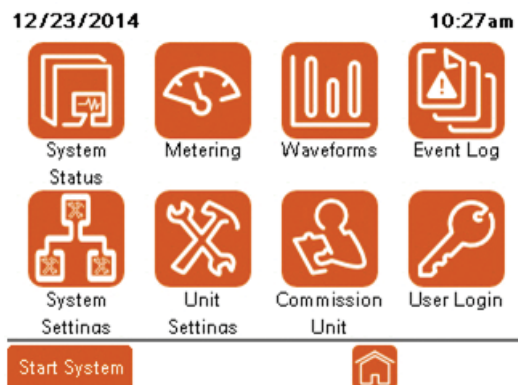
Electronic VAR injector (EVI2) are static power electronic products that employ digital logic and IGBT semiconductors to synthesize a current waveform that is injected into the electrical network to cancel load induced poor displacement power factor (DPF), phase current unbalance, and flicker. DPF correction can be provided for either leading (capacitive) or lagging (inductive) loads that cause poor DPF. Mains current balancing is achieved by measuring the negative sequence current present and injecting the inverse negative sequence currents to balance the current for the network. Flicker control is provided by rapid detection and injection of reactive current (VARs) to prevent the reactive current from over loading the network that causes rapid voltage deviations identified as flicker.

EVI2 also have the ability to monitor the network voltage on which they are connected and determine the proper amount of VARs to either raise the network voltage or lower it. EVI2 will inject leading VARs to raise the voltage and lagging VARs to lower the voltage. Entry of appropriate parameters will keep the network within its stated voltage tolerance level.

## Operation

This chapter provides information operation of the active filter. It covers additional settings that you can configure after commissioning. It includes descriptions of parameters and information available on the display as well as event logs.

### Home Screen



When first energized, the HMI displays the Home screen. To return to the Home screen, press the Home icon at the bottom on any of the screens. To change parameters, you must be logged in as an Admin level user. From the Home screen, you can access the following:

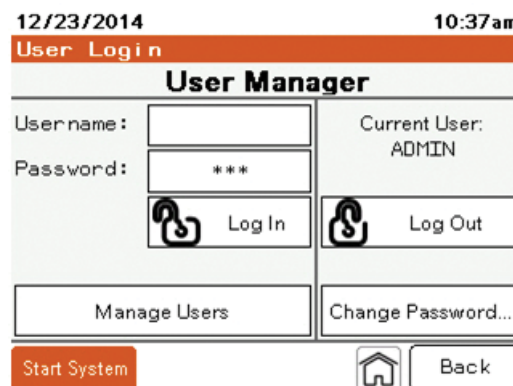
- **System Status:** Displays screens providing an overview of the system status
- **Metering:** Displays screens that provide measured values of the unit, system, and electrical distribution system
- **Waveforms:** Displays screens that graphically represent various values measured
- **Event Log:** Displays a list of all events that occurred with the unit
- **System Settings:** Allows changes to be made to the system parameters. When operating in parallel, all systems settings must match for each unit in the parallel system
- **Unit Settings:** Allows changes to the unit parameters
- **Commission Unit:** Provides a step-by-step procedure to commission the unit  
**Note:** Once the unit is commissioned, you do not need to perform this procedure again.
- **User Login:** This is where you log into the unit to change parameters
- **Start System/Stop System:** This icon toggles between Start System when inactive and Stop System when active. Start System activates the unit, or in parallel operation, it starts the entire system. Stop System stops the unit, or in parallel operation, it stops the entire system.

### User Login



For information on setting up users, refer to Set up users with the User Manager on **page 21**. To log in:

1. Press User Login.



2. Press the Username field. Type your user name on the keypad and press Enter.
3. Press the Password field and enter your password.
4. Press Log In.

### System Status



System Status screens display information on the unit's status. Also when installed as a parallel system, information for the entire active filter system is provided. To navigate through the screens, press the up or down arrow. To return to the Home screen, press the Home icon. An active filter operating as a standalone unit has four System Status screens. Active filters operating in a parallel system have five System Status screens.

## Operation

### Overall Status Screen

The Overall Status screen provides information on the status of the unit. When connected in parallel with other active filters, it provides information on the status of the entire parallel system.

04/21/2015		1/4		12:33pm	
Status		Overall Status			
<b>Unit Information:</b>			<b>System Information:</b>		
Unit Status	Stopped	System Status	OFF		
Unit Rating	300A	Available Cap.	0A		
Derating	0%	Active Cap.	0A		
Output		Output	0A		
Unit ID	1	Master ID	0		
Priority Group	1	Priority	1		
<b>Active Notifications</b>					
Start System					

#### Unit Information

**Unit Status:** Indicates whether the unit is in Run or Stopped condition.

**Unit Rating:** Indicates the amperage rating of the unit.

**Derating:** Indicates if the unit has been derated by a percentage.

**Output:** Indicates the total output current of the unit.

**Unit ID:** Indicates the unit unique identification number. Each unit in a parallel system must have a unique unit ID.

#### System Information

**System Status:** Indicates the status of the system.

**Available Cap:** Indicates the total capacity of units in the parallel system currently available, which includes all units currently running (actively compensating) and units in stand-by.

**Active Cap:** Indicates the total capacity of units in the parallel system currently running (actively compensating).

**Output:** Indicates the output current of the system in amperes.

**Master ID:** Indicates the unit ID of the unit that is currently acting as the Master.

**Priority:** Indicates the priority group that is operating.

### Parallel Unit Status

Parallel Unit Status displays when Network is selected in System Settings, Parallel Configuration.

04/21/2015		2/5		2:15pm	
Status		Parallel Unit Status			
Unit 1	Stopped	Unit 2	Offline	Unit 3	Offline
Unit 4	Offline	Unit 5	Offline	Unit 6	Offline
Unit 7	Offline	Unit 8	Offline	Unit 9	Offline
Unit 10	Offline	Unit 11	Offline	Unit 12	Offline
Unit 13	Offline	Unit 14	Offline	Unit 15	Offline
Unit 16	Offline	Unit 17	Offline	Unit 18	Offline
Unit 19	Offline	Unit 20	Offline	Unit 21	Offline
Unit 22	Offline	Unit 23	Offline	Unit 24	Offline
Unit 25	Offline	Synchronize System Settings...			
Start System		Display: Local Unit		Home, Up, Down	

The Parallel Unit Status provide general operating condition of each unit in the parallel system.

Selecting Synchronize System Settings synchronizes the System Status settings for all networked parallel units in the system.

### Unit Configuration Screen

The Unit Configuration screen provides the configuration information for the unit.

04/21/2015		3/5		3:05pm	
Status		Unit Configuration			
<b>HMI Version:</b>			<b>Unit Setup:</b>		
000.003.000.DEV			Unit Type	AF	
<b>Control DSP Version:</b>			Unit Size	300A	
DEMO 000.003.000-62-			480V	60Hz	
<b>Protection DSP Version:</b>			CT Conn.	2 CTs	
000.002.002			CT Ratio	3000:5	
<b>Network Setup</b>					
IP	10.172.132.204				
Subnet	255.255.0.0				
Start System		Display: Local Unit		Home, Up, Down	

**HMI Version:** Displays the HMI software version that is loaded on the HMI.

**Control DSP Version:** Displays the software version installed on the Control DSP.

**Protection DSP Version:** Displays the software version installed on the Protection DSP.



**Network Setup**

**IP:** Displays the IP address for the TCP/IP Ethernet connection.

**Subnet:** Displays the unit's subnet address.

See Unit Settings on **page 14** for instructions on changing the Network Setup values.

**Unit Setup**

**Unit Type:** Indicates whether the unit is an active filter or an electronic VAR compensator.

**Unit Size:** Displays the unit amperage rating.

**Nominal voltage and frequency:** Displays the system nominal voltage and frequency settings.

**CT Conn.:** Indicates the number of CT's connected to the unit.

**CT Ratio:** Displays the CT ratio used.

**CT Configuration:** Indicates whether the CT's are located on the Source or Load side of the active filter system.

**Voltages and Temperature**

04/21/2015 3/4 12:33pm  
 Status Voltage and Temperature

Voltages:			
Line Voltage	483V	DC Bus Top	334V
Line Frequency	59.99Hz	DC Bus Bot	334V

Temperatures:			
Inlet	26°C	IGBT L1	29°C
Unit Top	25°C	IGBT L2	27°C
Control Board	27°C	IGBT L3	26°C

Start System

**Voltages**

**Line Voltage:** Displays the three-phase average of the incoming line voltage to the unit.

**Line Frequency:** The measured source frequency.

**DC Bus Top:** The measured DC voltage of the top DC bus section.

**DC Bus Bot:** The measured DC voltage of the bottom DC bus section.

**Temperatures**

All temperatures are displayed in degrees Celsius.

**Inlet:** Unit's inlet air temperature.

**Unit Top:** Outlet air temperature of the electronic air section.

**Control Board:** Air temperature surrounding the Control Printed Circuit Board.

**IGBT L1:** Temperature of phase L1 inverter IGBT.

**IGBT L2:** Temperature of phase L2 inverter IGBT.

**IGBT L3:** Temperature of phase L3 inverter IGBT.

**Unit Status**

04/21/2015 4/4 12:33pm  
 Status Unit Status

Lifetime Unit Information:	
Uptime	100.43h
Total On Time	272.68h
Total Run Time	0.12h
Average Output L1	192.7A
Average Output L2	193.7A
Average Output L3	189.3A

Start System

**Uptime:** Elapsed time from the last energization.

**Total On Time:** Total time the unit has been energized.

**Total Run Time:** Total time the unit has been in Run condition.

**Average Output L1:** Average output current for L1 phase.

**Average Output L2:** Average output current for L2 phase.

**Average Output L3:** Average output current for L3 phase.

## Operation

### Metering



### Currents

04/21/2015 1/4 1:07pm  
Metering Currents

	L1	L2	L3
Total Load	214A	216A	142A
Load Harmonics	169A	171A	58A
Output Harmonics	0A	0A	0A
Output Fund.	0A	0A	0A
Total Output	0A	0A	0A
Source	520A	524A	523A

Start System

**Total Load:** Total load current in amperes RMS.

**Load Harmonics:** Total load harmonic current in amperes RMS.

**Output Harmonics:** Harmonic current output of the unit in amperes RMS for harmonic mitigation.

**Output Fund.:** Output current at the fundamental frequency for power factor correction and/or load balancing.

**Total Output:** Total output current of the unit in amperes RMS.

**Source:** Total source current in amperes RMS.

### Fundamental Currents

04/21/2015 2/4 1:07pm  
Metering Fundamental Current

	Load	Output
Reactive (PF)	0A	0A
Negative sequence	2A	0A

	L1	L2	L3
Fund Current Req	0A	0A	0A
Fund Current Out	0A	0A	0A
Load Balancing:	ON	PF Mode:	ON

Start System

**Reactive (PF):** Displays per phase average reactive current of the load and output in amperes RMS.

**Negative sequence:** Negative sequence current of the load and output in amperes RMS.

**Fund current Req:** Fundamental current required per phase to achieve set point.

**Fund Current Out:** Displays fundamental current produced per phase.

**Load Balancing:** Indicates whether the Load Balancing mode is ON or OFF.

**PF Mode:** Indicates that the Power Factor correction mode is ON or OFF.

**Performance**

04/24/2015 3/4 1:21pm

Metering Performance

	Source			Load		
	L1	L2	L3	L1	L2	L3
THDi	4.6%	4.7%	4.6%	34.4%	34.5%	34.2%
THDv	2.4%	2.1%	1.9%			
DPF	-1.000			0.981		
<b>Fundamental</b>						
	L1	L2	L3			
Load Current	492A	496A	496A			
Source Current	483A	480A	481A			
Voltage	479.9V	484.6V	482.0V			

Stop System

**THDi:** Total Harmonic Distortion of the current as a percentage of fundamental per phase at the Source and the Load.

**THDv:** Total Harmonic Distortion of the voltage as a percentage of fundamental per phase at the Source.

**DPF:** Displacement Power Factor of the Source and Load.

**Load Current:** Fundamental current of the Load per phase.

**Source Current:** Fundamental current of the source per phase

**Voltage:** Line-to-Line voltage per phase.

**Power**

12/23/2014 3/3 10:30am

Metering Power

Power at 60.0Hz

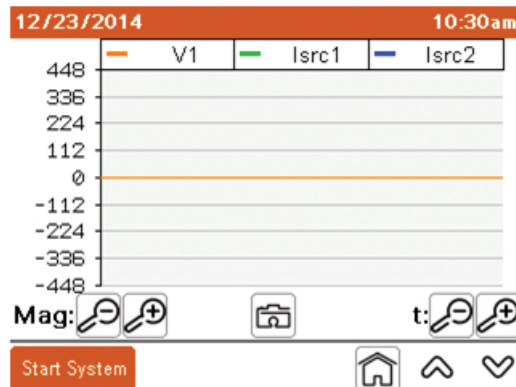
Source Apparent Power (S)	414.2 kVA
Source Real Power (P)	402.8 kW
Source Reactive Power (Q)	96.3 kVAR
Load Apparent Power (S)	414.2 kVA
Load Real Power (P)	402.9 kW
Load Reactive Power (Q)	96.2 kVAR
Output Reactive Power (Q)	0.0 kVAR

Start System

This screen displays three-phase values of the source, load, and output of the Harmonic Correction Unit.

**Waveforms**

The Waveforms screens display system information in three formats: Oscilloscope, Bar Graph, and Phasor diagram.



The oscilloscope screen can display up to three different values at the same time. You can touch one of the boxes at the top of the oscilloscope screen to display a table of the 16 different values available.

**Mag:** The magnifying glass icons next to Mag increase or decrease the amplitude scale.

**t:** The magnifying glass icons next to "t:" increases or decreases the time scale.

If you have a USB drive inserted into the USB port next to the HMI, you can click the camera icon to save the screen in a PDF format.

## Operation

### Available Scope Data

12/23/2014		10:31 am	
<b>Channel 1 Scope Data:</b>			
Vbus	Iref1	Iref2	Iref3
V1	Iout1	Iout2	Iout3
V2	Isrc1	Isrc2	Isrc3
V3	Iload1	Iload2	Iload3

OK

**Vbus:** Voltage of the total DC bus.

**V1:** Line to line voltage of L1 to L2

**V2:** Line-to-line voltage of L2 to L3

**V3:** Line-to-line voltage of L3 to L1

**Iref1:** Current reference L1

**Iref2:** Current reference L2

**Iref3:** Current reference L3

**Iout1:** Current output L1

**Iout2:** Current output L2

**Iout3:** Current output L3

**Isrc1:** Current source L1

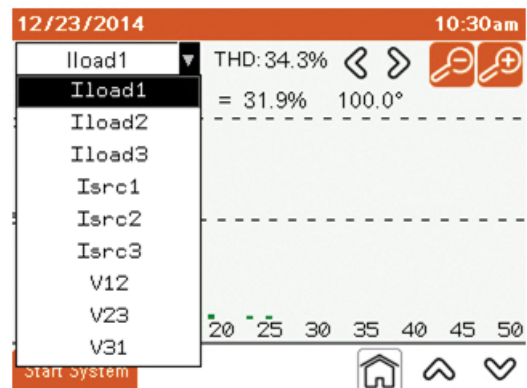
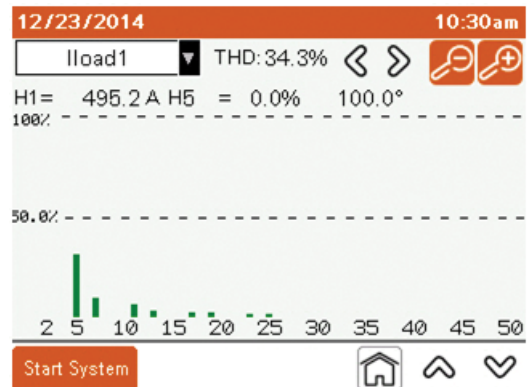
**Isrc2:** Current source L2

**Isrc3:** Current source L3

**Iload1:** Current load L1

**Iload2:** Current load L2

**Iload3:** Current load L3

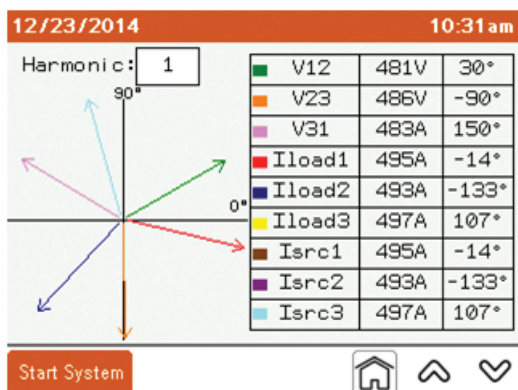


Use the top left drop-down to select the value to be analyzed.

H1, the fundamental value is constantly displayed. You can display a specific harmonic order value by pressing the left or right arrows at the top of the screen. You can adjust the amplitude scale with the magnifying glass icons. The values you can display are:

- **V12:** Bar graph harmonic analysis of the voltage of L1 to L2.
- **V23:** Bar graph harmonic analysis of the voltage of L2 to L3.
- **V31:** Bar graph harmonic analysis of the voltage of L3 to L1.
- **Isrc1:** Bar graph harmonic analysis of Current source L1.
- **Isrc2:** Bar graph harmonic analysis of Current source L2.
- **Isrc3:** Bar graph harmonic analysis of Current source L3.
- **Iload1:** Bar graph harmonic analysis of current load L1.
- **Iload2:** Bar graph harmonic analysis of current load L2.
- **Iload3:** Bar graph harmonic analysis of current load L3.

### Phasor Diagram



- V12:** Line-to-line voltage of L1 to L2.
- V23:** Line-to-line voltage of L2 to L3.
- V31:** Line-to-line voltage of L3 to L1.
- Iref1:** Current reference L1.
- Iref2:** Current reference L2.
- Iref3:** Current reference L3.
- Iout1:** Current output L1.
- Iout2:** Current output L2.
- Iout3:** Current output L3.
- Isrc1:** Current source L1.
- Isrc2:** Current source L2.
- Isrc3:** Current source L3.
- Iload1:** Current load L1.
- Iload2:** Current load L2.
- Iload3:** Current load L3.

### Event Log



04/21/2015 Event Log 12:18pm

Event	Time	Date
1 Unit Stopped	11:34:08	04/21/2015
2 System Stopped	11:34:08	04/21/2015
3 Unit Started	11:34:08	04/21/2015
4 System Started	11:34:07	04/21/2015
5 Parameter Changed	11:22:07	04/21/2015
6 Parameter Changed	11:22:07	04/21/2015
7 User Logged In	11:15:40	04/21/2015
8 User Logged Out	11:06:58	04/21/2015
9 Parameter Changed	11:03:16	04/21/2015
10 Parameter Changed	11:03:11	04/21/2015
11 Parameter Changed	11:03:06	04/21/2015
12 Parameter Changed	11:02:57	04/21/2015
13 Parameter Changed	10:55:56	04/21/2015

Start System

04/21/2015 Event Log 12:24pm

Event	Time	Date
<b>Event Details</b>		
Event:	Parameter Changed	
Event Date:	04/21/2015	Event Time: 11:22:07
Event Data 1:	00009	
Event Data 2:	31808	
Event Data 3:	32767	

Hide Event OK

The Event Log displays events that occurred. Touch an event to select it. Then, press the magnifying glass icon to display the details for that event.

You can save the Event Log to a USB storage device. Once it is connected, press this icon to save the log:



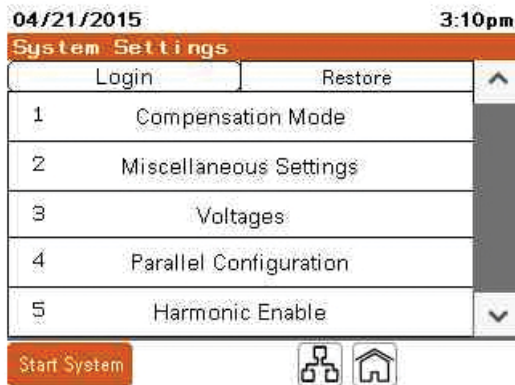
## Operation

### System Settings

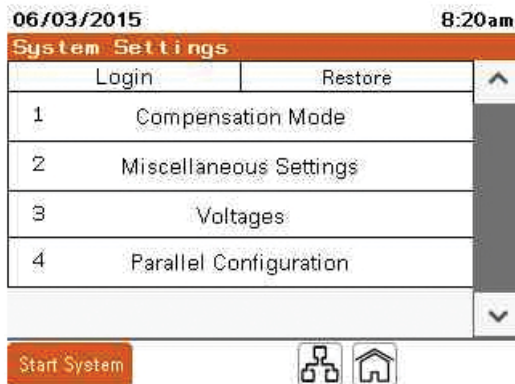


Within System Settings, you can change parameters for the system. When the unit is part of a parallel system, all of these settings for each unit must match.

#### System Settings screen (HCU2 type)



#### System Settings screen (EV12 type)

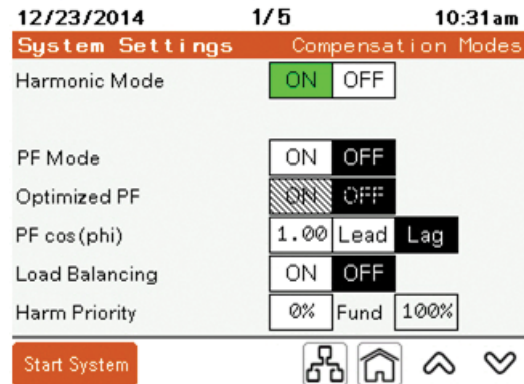


Press Login to display the Login screen.

Press Restore if you want to reset parameters to the default values.

Press the screen name to access a screen.

### Compensation Mode Screen (HCU2 type)



**Harmonic Mode:** Activates/Deactivates the harmonic correction mode.

**PF Mode:** Activates/Deactivates the Power Factor correction mode.

**Optimized PF:** When set to OFF, the unit maintains the PF cos (phi) setting. When set to ON and the load is less than the PF cos(phi) setting, the unit corrects the power factor to PF cos (phi). If the load PF is greater than the setting, the unit does not compensate unless the power factor is set to maintain a Lag power factor and the load becomes leading. Then, the unit corrects the power factor to a PF cos (phi) of 1.00. If the PF cos (phi) is set to Lead and the power factor of the load is lagging, the unit corrects to a PF cos (phi) of 1.00.

*Example:* With a PF cos (phi) set to 0.98 Lag, the unit maintains a Power Factor of 0.98 Lag when the corrected load is lagging. If the power factor improves to 0.99, no compensation is provided. If the connected load produces a leading power factor, the unit corrects the power factor to 1.00.

**PF cos (phi):** Target power factor setting.

**Load Balancing:** Activates/deactivates load balancing mode.

**Harmonic Priority:** Sets the percentage of the unit's output to harmonic mitigation when the system is at or over maximum capacity.

**Fund:** Displays the percentage of the unit's rating that is dedicated to correcting fundamental current as the result of the Harmonic Priority setting. This is mathematically calculated based on the Harmonic Priority setting.

Harmonic Priority only affects the HCU unit when harmonic mode and at least one other mode of operation is enabled. When the total current output of the active filter required exceeds the unit's rating, harmonic priority determines which mode has priority. With harmonic priority set to 100%, the unit outputs all current necessary to correct the harmonic content. Any output capacity left over is used for correcting PF and/or load balancing. Conversely, with harmonic priority set to 0%, the unit outputs the fundamental current required for correcting power factor and/or load balancing.

Any capacity left over is used for harmonic mitigation. When the unit is sized to correct both harmonic current and fundamental currents, PF, and/or load balancing, this parameter has no effect.

The total percentage of adding Harmonic priority to fundamental priority can be greater than 100%. The rated output current of the active filter is equal to the rms-sum of the harmonic and reactive current injected. The following table provides a representation of this relationship. All values are in percentage of rated output current.

	Dual mode output percentiles										
Harmonic current drawn by load	100%	90%	80%	70%	60%	50%	40%	30%	20%	10%	0%
Maximum reactive current available	0%	44%	60%	71%	80%	87%	92%	95%	98%	99%	100%

You can use the following formulas to calculate this current relationship:

$$I_{O/P}^2 = I_h^2 + I_r^2$$

or

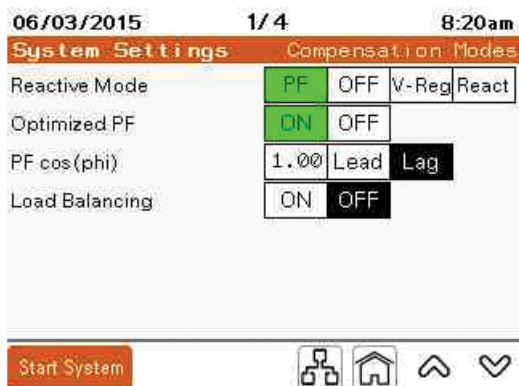
$$I_{O/P} = \text{SQRT}(I_h^2 + I_r^2)$$

Where

- $I_{O/P}$  is the total output current of active filter
- $I_h$  is the injected harmonic current of active filter
- $I_r$  is the injected reactive current of active filter

Use these percentages to determine the amount of current available for each function. Multiply the percentage by the active filter rated current to obtain the approximate amount of correction provided by the active filter for each function.

**Compensation Mode Screen (EVI2 type)**



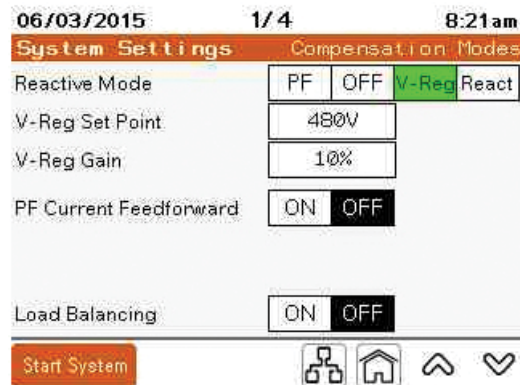
**Reactive Mode—PF:** Activates/Deactivates the Power Factor correction mode. With PF mode selected, additional parameters available for the PF mode are displayed.

**Optimized PF:** When set to OFF, the unit maintains the PF cos (phi) setting. When set to ON and the load is less than the PF cos (phi) setting, the unit corrects the power factor to PF cos (phi). If the load PF is greater than the setting, the unit does not compensate unless the power factor is set to maintain a Lag power factor and the load becomes leading. Then, the unit corrects the power factor to a PF cos (phi) of 1.00. If the PF cos (phi) is set to Lead and the power factor of the load is lagging, the unit corrects to a PF cos (phi) of 1.00.

*Example:* With a PF cos (phi) set to 0.98 Lag, the unit maintains a Power Factor of 0.98 Lag when the corrected load is lagging. If the power factor improves to 0.99, no compensation is provided. If the connected load produces a leading power factor, the unit corrects the power factor to 1.00.

**PF cos (phi):** Target power factor setting. The power factor can be set for either a leading or lagging cos(phi).

**Load Balancing:** When ON, the unit corrects for load imbalance (negative sequence current).



**Reactive Mode—V-Reg:** Voltage Regulation Mode. Voltage regulation mode monitors the voltage and adjusts the reactive current injected to maintain a voltage level.

**V-Reg Set Point:** Sets the desired voltage to be maintained.

## Operation

**V-Reg Gain:** Adjusts the response time of the voltage regulation. The higher the percentage of V-Reg Gain, the faster the response is. Faster response increases the potential for voltage instability of the electrical system.

06/03/2015		1/4		10:36am	
System Settings		Compensation Modes			
Reactive Mode	PF	OFF	V-Reg	React	
V-Reg Set Point	480V				
V-Reg Gain	10%				
PF Current Feedforward	ON	OFF			
PF cos(phi)	1.00	Lead	Lag		
Load Balancing	ON	OFF			
Start System					

**PF Current Feedforward:** When OFF, CTs are not required for this application. The unit maintains the V-Reg Set Point based on the unit's terminal voltage.

When ON, CTs are required for this application. The unit provides the reactive current required based on the PF cos(phi) set point resulting from rapid changes in the load. Adjustments to the reactive power are implemented to maintain the V-Reg Set Point.

PF cos(phi) is only displayed when PF current Feedforward is ON. PF cos(phi) is set to the appropriate value based on the source resistance.

Load Balancing can also be selected on this screen. Load Balancing requires the installation of CTs.

06/03/2015		1/4		8:21am	
System Settings		Compensation Modes			
Reactive Mode	PF	OFF	V-Reg	React	
Reactive Target	0	KVAR	Amps		
Load Balancing	ON	OFF			
Start System					

**Reactive Mode—React:** Reactive mode provides leading or lagging kVAR based on the Reactive Target. React Mode does not require the installation of CTs.

**Reactive Target** can be set either based on kVAR or amperes. Reactive Target can be set remotely through MODBUS.

Load Balancing can also be selected on this screen. Load Balancing requires the installation of CTs.

### Miscellaneous Settings

12/23/2014		2/5		10:31am	
System Settings		Misc Settings			
Auto Start	ON	OFF			
Auto Start Delay	30s				
Power Save ON	15%				
Power Save OFF	10%				
Start System					

**Auto Start:** The unit shuts down when the line voltage drops below 85% of nominal. With Auto Start ON, the unit automatically returns to RUN condition when the line voltage is within 85% of nominal. The unit must be in RUN condition during the event to return to RUN condition.

**Auto Start Delay:** Delay of Auto Start feature in seconds. The minimum is 10 seconds.

**Power Save ON:** Percentage of rated output current above which the unit starts up. The default value is 15%. It must be higher than the Power Save Off percentage.

**Power Save OFF:** Percentage of rated output current below which the unit shuts down. The default value is 10%. It must be lower than the Power Save On percentage.



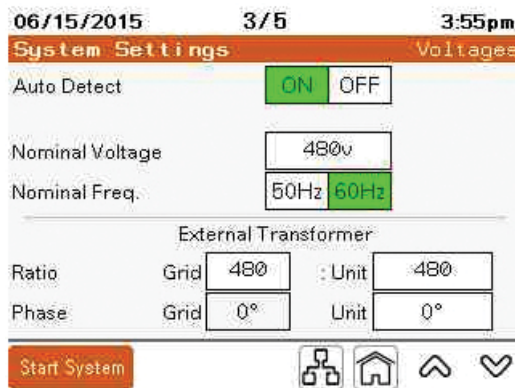
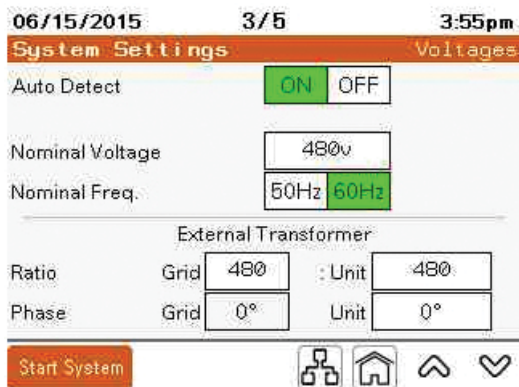
**Voltages**

**NOTICE**

**HAZARD OF UNINTENDED EQUIPMENT OPERATION**

Enter the External Transformer data according to the transformer specification.

**Failure to follow these instructions may result in damage to the active filter or other equipment on same electrical system.**



**Auto Detect:** Instructs the controller to determine nominal grid voltage and frequency when power is applied.

**Nominal Voltage:** With Auto Detect ON, the nominal voltage is automatically entered. With Auto Detect OFF the nominal voltage level applied at the input power connection must be entered. Nominal voltages at 480 V, 415 V, 400 V, and 380 V are automatically detected. For other nominal operating voltages, enter them manually.

**Nominal Freq.:** With Auto Detect ON, the nominal frequency is automatically entered. With Auto Detect OFF, the nominal frequency applied at the input power connection must be selected.

Ratio Grid	Enter the voltage rating of the transformer on the grid side.
(Ratio) Unit	Enter the voltage rating of the transformer on the active filter side.
Phase Grid	The is set to zero. It is not an adjustable parameter.
(Phase) Unit	Touching this data box displays the available phase shift options for the transformer.

The **External Transformer** section must be changed if there is an external transformer between the Harmonic Correction Unit and the voltage bus being corrected. This parameter is not used for the integrated transformer units. These units are identified by a rating of 600 or 690 V on the nameplate.

Active filters that are connected to the electrical distribution systems at voltage levels above the unit’s nameplate voltage rating require a transformer to step up the voltage to the desired level. Auto-transformers, Delta-Delta, and Wye-Wye transformers have no phase shift. Therefore the AF = parameter is set to 0 degrees. If transformers are used with a Delta to Wye configuration, the phase shift must be entered. Typically transformer manufacturers indicate this in clock face notation. The Grid side of the transformer is used as the reference and is set to zero or 12 o’clock. The high voltage side is indicated with a capital letter. “D” indicates the delta winding is on the high voltage side. A lower case letter indicates the winding type of the low voltage side; “y” indicates a wye wound low voltage side.

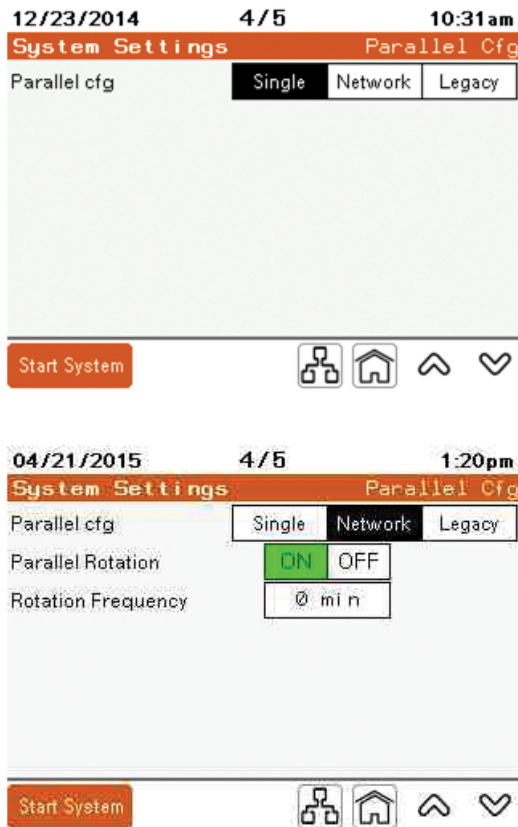
Refer to the following table for setting the AF = parameter based on common transformer nameplate information.

**Table 1. External Transformer AF = Settings**

Transformer Nameplate	Unit options AF =
Dy1	30 Lag
Dy2	60 Lag
Dy4	120 Lag
Dy5	150 Lag
Dy6	180
Dy7	150 Lead
Dy8	120 Lead
Dy10	60 Lead
Dy11	30 Lead

# Operation

## Parallel Configuration



**Single:** Select single for a standalone unit not operating in parallel with another active filter.

**Network:** Select if all units that are operating can be networked together for parallel operation.

**Legacy:** Select if the unit is being added to an existing active filter system that does not have parallel networking capability. When selected, the total capacity of the active filter system must be entered in the Total System Capacity text box.

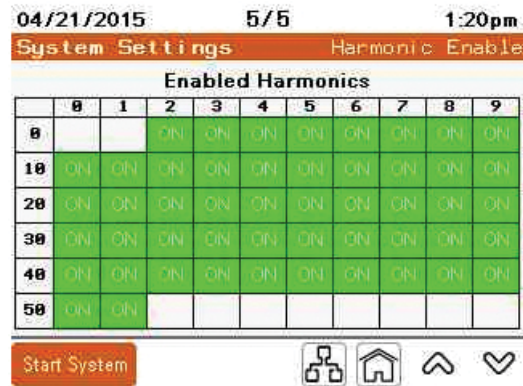
When **Network Parallel** is selected, two additional parameters are displayed. These parameters are used if the system is designed for redundant operation.

Select **Parallel Rotation OFF** if the system is designed with parallel for capacity only or if the units are to equally share the load at all times.

Select **Parallel Rotation ON** if the additional units should be cycled through with the minimum number operating to support the correction required. This is based on the Parallel Priority Group parameter located under Unit Settings, Basic Setup.

Set the **Rotation Frequency** to the time the lowest priority group is off until the next priority group is off. With this setting, the units that are on or off rotate based on the total capacity required by the load to achieve set point.

## Harmonic Enable (HCU2 type)



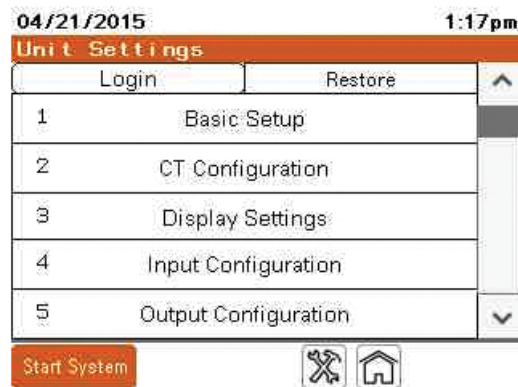
On this screen, you can select which individual harmonic orders are compensated.

When ON, the harmonic order compensation is enabled. Touching any harmonic order toggles it off or on.

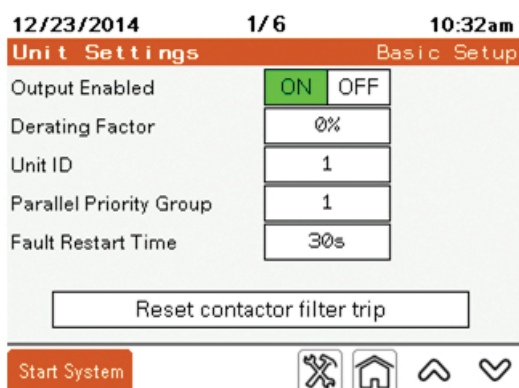
## Unit Settings



Unit settings are individual settings for the specific unit. This section covers the parameters you can configure.



**Basic Setup**



**Output Enabled:** When ON, the unit provides corrective current as necessary. When OFF, the unit does not provide corrective current. Output Enabled must be set to the ON condition after stopping the unit in parallel systems.

**Derating Factor:** Percentage of rated output current that is subtracted from maximum output to compensate for high altitude. The unit must be de-rated if the unit is installed at an elevation over 1,000 meters above sea level. Derate by 1% for every 100 meters over 1,000 meters above sea level.

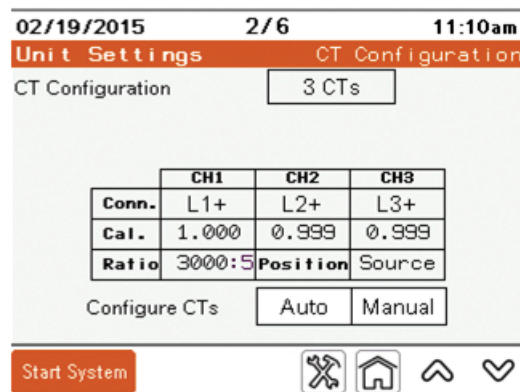
**Unit ID:** For parallel systems, each unit in the parallel system must have a unique unit identification number.

**Parallel Priority Group:** Identifies the parallel priority group to which the unit belongs.

**Fault Restart Time:** How long in seconds a restart of the active filter is delayed after the occurrence of a non-critical fault. The minimum is 10 seconds.

**Reset contactor filter trip:** Resets the contactor if a filter trip occurs while the unit is in STOP condition.

**CT configuration**



The CT Configuration screen provides information on how the unit is currently configured for the connected CTs. If needed, you can configure additional CTs manually or automatically.

**CT Configuration:** Displays the number of CTs used.

**CH1, CH2, and CH3** refer to which channels are used on the CT board.

**Conn.:** Indicates the setting for which phase and polarity the CT is connected for that channel.

**Cal:** When Automatic CT detection is used and the CTs are connected on the source side, the unit performs a CT calibration. The calibration value is indicated.

**Ratio:** Displays the parameter setting of the CTs installed.

**Position:** Displays the position of the CTs in relationship to the active filter.

**Configure CTs:** When selecting Auto, the unit detects the CT connection type for each input, CT ratio, and position. Refer to Automatic CT configuration on **page 16**. Selecting Manual displays a Modify CT Configuration screen to allow manual setting of these parameters. Refer to Manual CT configuration.

## Operation

### Manual CT configuration

#### NOTICE

#### HAZARD OF UNINTENDED EQUIPMENT OPERATION

Verify that the CT Configuration is entered exactly as the CTs are installed on the electrical distribution system.

**Failure to follow these instructions may result in damage to the active filter or other equipment on same electrical system.**

	Connection	CT Calibration
Channel 1:	L1+	1.001
Channel 2:	L2+	1.000
Channel 3:	None	

CT Ratio: 3000:5    Position: Load    Source

CT Secondary Rating: 1A    5A

Cancel    OK

**Channel** is the location where the CT secondary wiring is connected to the CT board.

When you touch the **Connection** data block, you scroll through the available options:

L1+, L1-, L2+, L2-, L3+, L3- or None.

L1, L2, L3 and None describe which phase the CT is connected.

The polarity of the CT connection is identified as "+" or "-".

- "+" indicates H1 of the CT is closest to the source,
- "-" indicates H1 of the CT is closest to the load.

**CT Calibration** allows for adjusting for errors.

**CT Ratio:** Touching the data box brings up a numerical keypad to enter the primary ratio of the CTs being used.

**Position:** Select Load if the CTs are measuring only the connected loads to be corrected. This option is not available for systems operating in parallel. Select Source if the CTs are measuring the current of all loads being corrected and the active filter current.

**CT Secondary Rating:** The rating of the CT secondary that is installed.

### Automatic CT configuration

An active filter that is connected to an electrical distribution system at a voltage above the unit's nameplate voltage rating must have the external transformer parameters properly set before performing the Automatic CT Configuration. Refer to External transformer on **page 26**.

#### NOTICE

#### HAZARD OF UNINTENDED EQUIPMENT OPERATION

Verify that the External Transformer parameters are correctly entered before performing the Automatic CT configuration procedure.

**Failure to follow these instructions may result in damage to the active filter or other equipment on same electrical system.**

Automatic CT Configuration

Enter CT Ratio below:  
CT Ratio: 3000:5

CT Secondary Rating: 1A    5A

Select channels CTs are connected to:  
CH1-CH2    CH2-CH3    CH1-CH3  
CH1-CH2-CH3

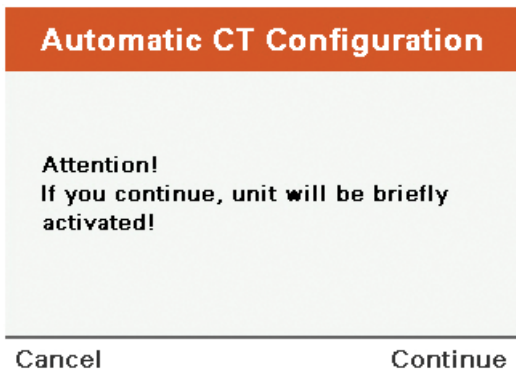
Continue

To perform Automatic CT Configuration, do the following:

1. In the **CT Ratio** field, enter the primary CT ratio.
2. In the **CT Secondary Rating** field, select either 1 A or 5 A based on the secondary rating of the CTs installed.
3. In the **Select channels CTs are connected to** field, select the channels used to connect the CT secondary wiring to the CT board of the unit. This information should be provided by the installer. See Installation Manual for CT installation details.

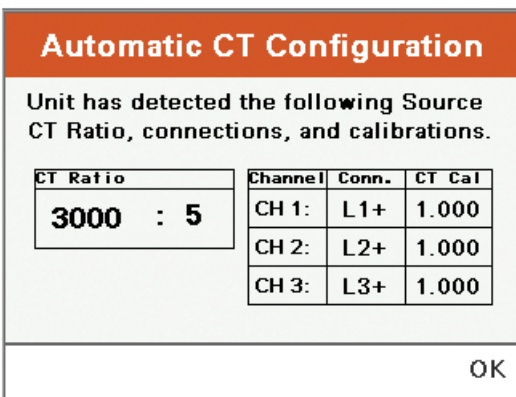
An information screen is displayed indicating that the unit is ready to perform the automatic CT detection.

4. Touch Continue to continue the test.



The unit runs for a short period of time to detect how the CTs are installed.

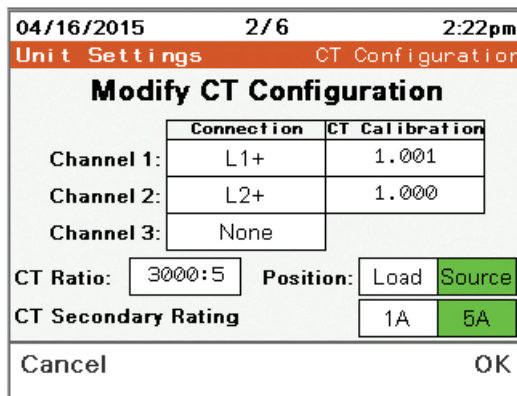
5. Once the test is complete and the detected CT configuration is displayed, touch OK.



**Source Position Detected**

With CTs installed on the source side of the active filter, the unit displays the configuration of the CTs as connected to the lines and CT ratio.

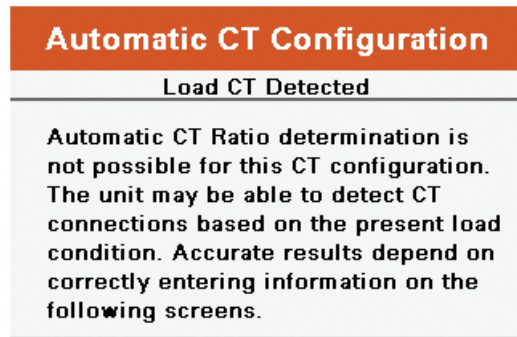
1. Press OK to proceed to Modify CT Configuration.



2. Once the unit is properly configured for the CTs that are installed, press OK to continue.

**Load CT Detected**

If a Load CT is detected, the following screen displays.



OK

## Operation

### Parallel Systems

If this is a parallel system, the CTs cannot be installed on the load side of the active filter. Either the CTs are improperly installed, the CTs are not functioning, or the CT secondary wiring is not properly installed.

### Single Unit

If you intend to install a single unit and the CTs on the source side of the active filter, verify CT installation, operation, or secondary wiring.

If you intend to install a single unit and the CT on the load side of the active filter:

1. Touch OK.
  - The unit asks if the load is regenerating.
    - If so, the auto CT detection does not accurately determine the CT configuration. Manually enter the CT configuration.
    - If the loads are not regenerative, touch NO and Continue.

**Automatic CT Configuration**

**Load Identification**

**Is the load continuously regenerating power to the source?**

Note: Most loads do not continuously regenerate power to the source unless they contain energy sources like generators, PV, wind or other distributed energy sources.

**Continue**

The unit asks if the displacement power factor of the load operating at the time of the test was extremely low, less than 0.5.

**Automatic CT Configuration**

**Load Identification**

**Is the load currently operating at extremely low displacement PF (|DPF| < 0.5 or current-to-voltage phase angle > 60 degree)?**

Note: Unless the system is very lightly loaded, most loads operate at |DPF| > 0.5.

**Back**
**Continue**

2. Touch Yes or No as applicable for the connected loads and then touch Continue.

The unit asks if the connected load at the time of the CT detection was capacitive (having a leading power factor) or inductive (having a lagging power factor).

**Automatic CT Configuration**

**Load Identification**

**Is the load capacitive (LEADING PF) or inductive (LAGGING PF)?**

Note: AC motors and drives, induction heaters typically have lagging PF (inductive), while computer power supplies, lighting ballasts/UV have leading PF (capacitive).

**Back**
**Continue**

3. Select the appropriate load type and touch Continue.
  - The CT configuration is displayed based on parameters selected. The DPF value and Leading or Lagging can be compared to an external meter to verify accuracy of the results.

**Automatic CT Configuration**

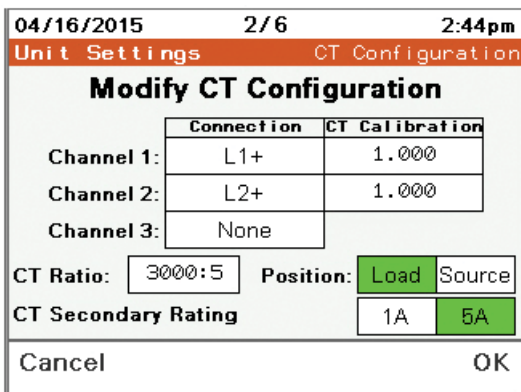
**Load Identification**

**Based on the information you provided, below are the detected CT connections and associated DPF.**

	Connection	DPF	Type
CH 1:	L1+	0.983	LAG
CH 2:	L2+	0.984	LAG

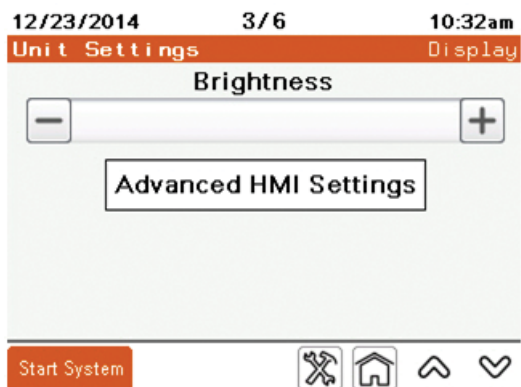
**OK**

4. Press OK.  
The HMI returns to the CT Configuration screen.



5. When the CTs are properly configured touch OK.

### Brightness and Advanced HMI Settings



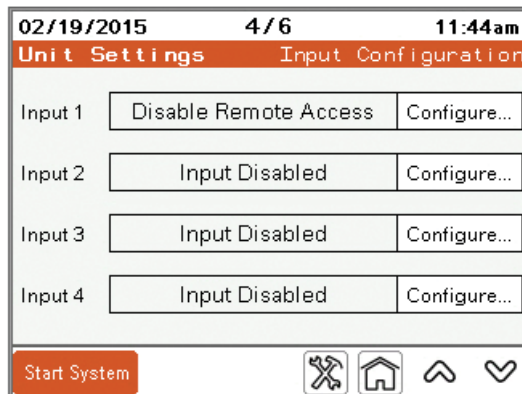
**Brightness:** Press “-” or “+” to adjust the brightness of the HMI display.

**Advanced HMI Settings** accesses the options for adjusting TCP/IP Address, Subnet, and default gateway as well as DHCP settings. Refer to “Modbus TCP/IP Address Setup” on **page 21** for more information.

### Input Configuration

Four input controls are available at J2 of the Control Board: one Ground and four inputs labeled I1 to I4. The inputs are at 5 V DC and are grounded to activate. See the Installation Manual for details and requirements for wiring input controls.

On the Input Configuration screen, press “Configure...” to display the options and set the parameters.



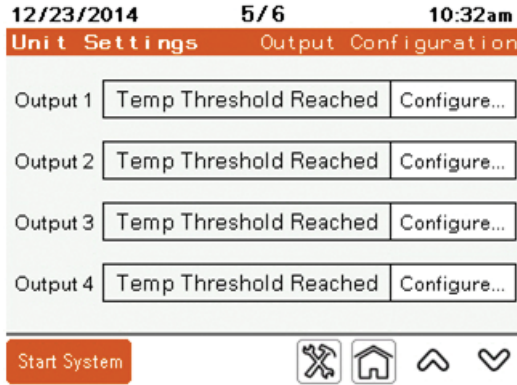
The choices for an input command are:

- **Input Disabled:** The input is not used.
- **Run System:** Causes the system to go into RUN condition.
- **Stop System:** Causes the system to STOP (no output).
- **Unit Pause:** Stops the output current until input changes states.
- **Disable Remote Access:** When enabled, this prevents remote access to the unit.
- **Disable Auto-Start:** When enabled, the unit does not auto-start after power has been reapplied.
- **Active when:** You can set the condition to be active when the input is either Not Grounded or Grounded.
- **Current State:** Indicates the current condition of the input.

# Harmonic correction unit (HCU2) and electronic VAR injector (EVI2) active filters

## Output Configuration

Four configurable outputs or dry contacts are provided on the Control board labeled Q1 to Q4. The four outputs can be programmed to change states based on different conditions set on the HMI.



Touch **Configure...** to access the User Output Configuration screen.

Each Output Function can be active when the switch is either Open or Closed.

Available output functions are:

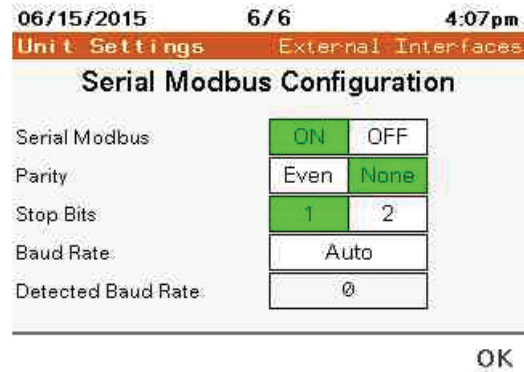
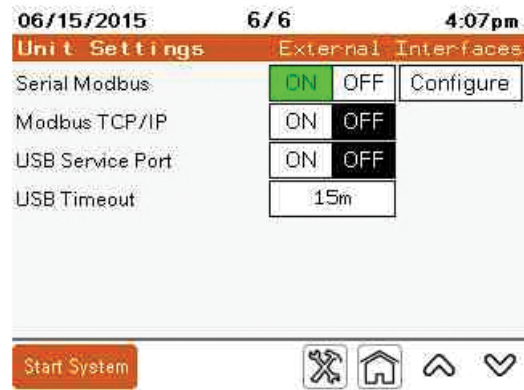
- **Output Disabled:** Indicates when the output of the active filter is disabled.
- **Unit Running:** Switched when the unit is Running.
- **Event Active:** Switched when an event is activated.
- **Power On:** Indicates that power is applied to the unit.
- **Max Capacity Reached:** Indicates that the unit is operating at maximum current capacity.
- **Defined Capacity Reached:** Indicates when a user set capacity is reached.
- **Temperature Threshold Reached:** Indicates when a user defined temperature is reached on either, IGBT, CB Temp (Control Board Temperature), Unit Top (Exhaust air temperature), or Inlet (intake air temperature).
- **KVAR Threshold Reached:** Indicates that a user-set kVAR threshold is reached.

## External Interfaces

On the External Interfaces screen, you can turn the external interfaces on or off for the following:

- Serial Modbus. When Serial Modbus is ON, press Configure to enter the communication variables for the Modbus system being utilized.
- Modbus TCP/IP
- USB Service Port

You can also set the USB timeout.





### Modbus TCP/IP Address Setup

To set up the Modbus TCP/IP address, do the following:

1. Press Unit Settings.
2. Press Display Settings.
3. Press Advanced HMI Settings.
4. Press the OFFLINE tab.
5. Press Network.
 

The HMI shuts down and restarts for entering network settings.
6. Press the DHCP Tab and ensure the DHCP check box is not selected.
 

The DHCP must be disabled to enter a Static IP.
7. Press Static IP.
8. Enter the IP Address, Subnet Mask, and Default Gateway provided by the facility's network administrator.
9. Press OK.
10. Press To Run Mode.
11. Press OK to shut down and restart the HMI.

### Set up users with the User Manager



You must have ADMIN level access to set up users.

#### NOTICE

#### RISK OF EQUIPMENT DAMAGE

Only allow qualified electrical personnel access to the AdminUser or QualifiedUser level user name and password.

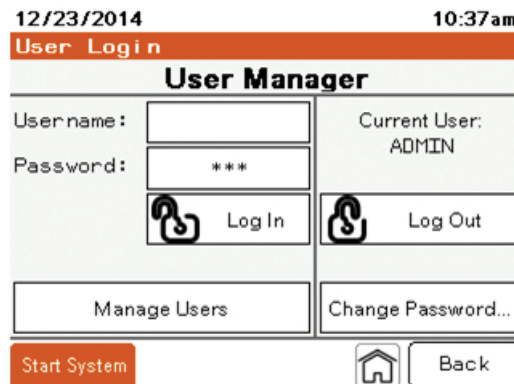
#### Failure to follow these instructions can result in equipment damage.

To add users, do the following:

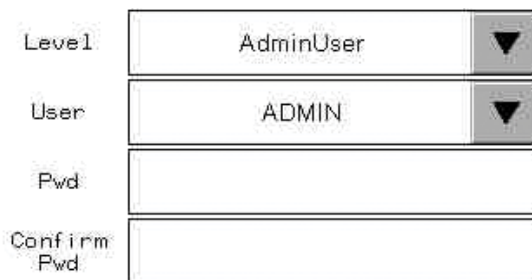
1. Press the Username field. Type ADMIN on the keypad and press Enter.
2. Press the Password field and enter the ADMIN password.

The default password for the ADMIN user is ADMIN. If the password has already been changed, use the new password.

3. Press Log In.
4. Press Manage Users.



5. Press the drop-down arrow for Level.




Three choices are available for Level:

- **AdminUser:** Has complete access to all parameters described in this manual. The AdminUser level is the only level with permission to add or remove users. The AdminUser name must be ADMIN. There can only be one AdminUser level user.
- **QualifiedUsers:** Have access to all parameters except adding new users to the system.
- **RegularUsers:** Have access to change parameters on the Unit Setting, Compensation Mode screen only.

## Operation

6. Select the appropriate user level for the person being added.

Level	QualifiedUsers	▼
User	AdminUser	
	QualifiedUsers	
Pwd	RegularUsers	
	WebGateUsers	
Confirm Pwd		



7. Press the User field. Type the new Username on the keypad and press Enter.
8. Press Pwd and let the user type the password. Or, you can create a temporary password for the user to change when first logging in.  
The password must be between 6 and 32 characters with any combination of letters or numbers. Passwords are case sensitive.
9. Press Confirm Pwd and re-enter the password.
10. Press the Add User icon.



### Change a password

To change passwords:

1. Log in with the user name and password.
2. Press Change Password.
3. Enter the new password.  
The password must be between 6 and 32 characters with any combination of letters or numbers. Passwords are case sensitive.
4. Enter it again in the Confirm field.
5. Press Change Password.
6. Press Back to return to the log in screen.

### Delete a user

To delete a user, do the following:

1. From the Level drop-down, choose the level the user is in.

Level	AdminUser	▼
User	ADMIN	▼
Pwd		
Confirm Pwd		



2. From the User drop-down, choose the user.
3. Press the Delete User icon.



4. Confirm that the user is to be deleted.

## Commissioning and start-up

This chapter provides information for commissioning the active filter. Before applying power, read and understand this information thoroughly.

### DANGER

#### HAZARD OF ELECTRIC SHOCK, EXPLOSION, OR ARC FLASH

- **Apply appropriate personal protective equipment (PPE) and follow safe electrical work practices. See NFPA 70E in the USA, CSA Z462, or applicable local standards**
- **This equipment must be installed and serviced only by qualified electrical personnel**
- **Do not exceed the device's ratings for maximum limits.**
- **Ground equipment using the ground connecting point provided before turning on any power supplying this device**
- **Turn off all power supplying this device and the equipment in which it is installed before working on the device or equipment**
- **After removing power, wait for 15 minutes to allow the capacitors to discharge prior to opening the doors or removing covers**
- **Always use a properly rated voltage sensing device to confirm power is off**
- **Replace all devices, doors, and covers before turning on power to this equipment**
- **Carefully inspect the interior for tools left behind before closing and sealing the door**

**Failure to follow these instructions will result in death or serious injury.**

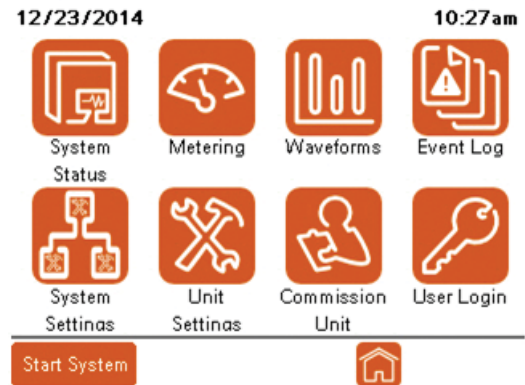
Once the unit is commissioned, you do not have to perform this procedure again.

The following is a summary of the steps for commissioning and starting up the active filter:

1. Ensure that the unit has been installed according to procedures in the installation guide.
2. Complete the inspection and checklist covered in the Pre-commissioning chapter of the installation guide.
3. Follow the procedure covered in Commissioning the unit on **page 23**.
4. Start up the unit.
5. Set up users in the User Manager and configure the network, system, and unit settings. Refer to Operation on **page 3**.

## Commissioning the unit

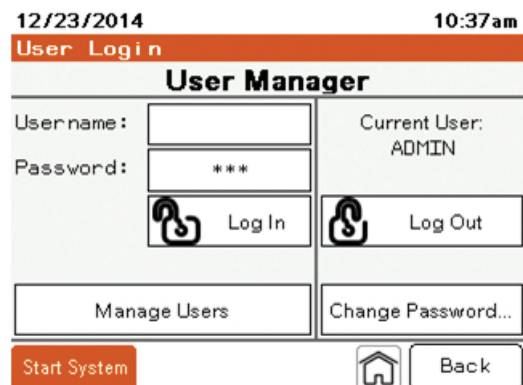
When the active filter is first energized, the HMI displays the Home screen.



1. Press User Login.



2. To log in for the first time, enter ADMIN for both user name and password and press Log In.



3. Press Back to begin the commissioning procedure.

## Commissioning and start-up

### Adjust date and time

Set the date time for the active filter as follows:

Commissioning

**Step 1: Adjust Date & Time**

Date: 04/17/2015

Time: 9:42am

Cancel Next

1. Touch the screen to open an editable screen.

Commissioning

Set Date and Time

9 : 56 : 26

April 23 2015

Cancel OK

2. Touch the hour, minutes, seconds, date, and year to open a numeric keypad to enter the date and time. Touch the month to display arrows, scroll to the appropriate month and press Enter.
3. Press OK.

### Check fan

Test each fan individually as follows.

04/17/2015 Commissioning 9:43am

**Step 2: Check Fan**

Start fans to verify correct

Fan Enable:

Enclosure Heatsink OFF

Prev Cancel Next

1. Press Enclosure and listen for any unusual sounds.
2. Press Heatsink and listen for any unusual sounds. If you hear no sound at all or if you hear mechanical rubbing, contact Technical Support.
3. Press Next if both fans are operating normally.

### System Integrity Test

This test verifies that the unit can generate current and provide current correction.

04/17/2015 Commissioning 9:44am

**Step 3: System Integrity Test**

The unit will run for 15 minutes to check the integrity of the system.

Mode:

Capacitive Inductive

Duration 15min

Skip Test

Prev Cancel Begin Test

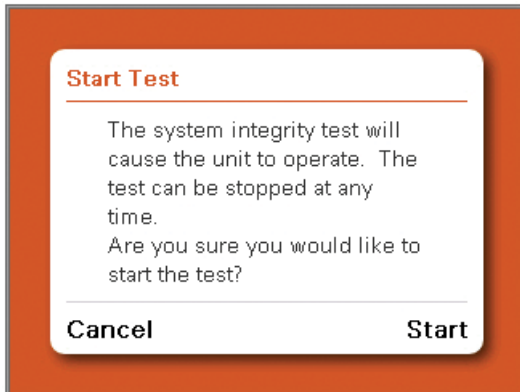
The unit can either operate in Capacitive or Inductive modes for this test. The loads operating on the system determine which mode is best for the application.

- **Capacitive:** This mode is typically the correct mode for operating the unit for most applications. If the loads are mostly inductive, motors, or VFDs, the system has a lagging power factor. Operating in Capacitive mode improves the power factor and reduces the total kVA of the system during the test
- **Inductive:** This mode is for applications with a leading power factor. Operating in Inductive mode corrects for a leading power factor facility.

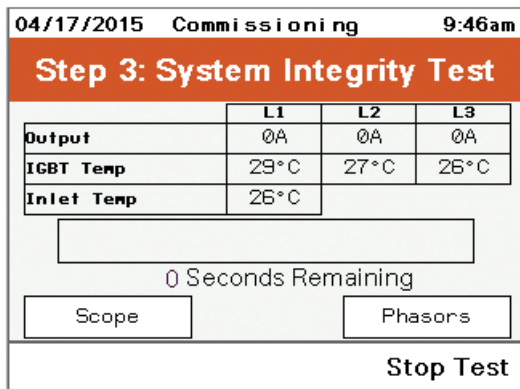
During this test, the unit output is at full capacity. Ensure that there is sufficient ampacity on the system to support this additional current. Otherwise, it could trip an upstream circuit breaker.

To run the System Integrity Test, do the following:

1. Select the appropriate mode for the application and press Begin Test.
2. Press Start.



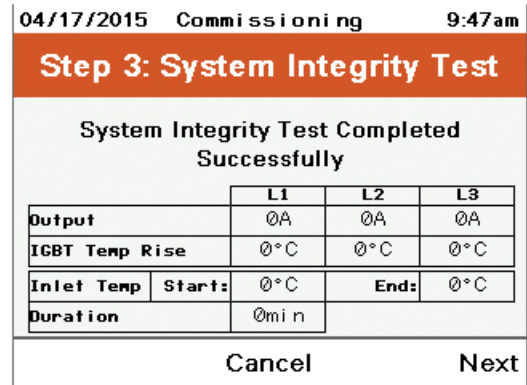
During the System Integrity Test the unit displays output current, IGBT temperature, and Inlet temperature. A status bar indicates the time remaining for the test.



When the System Integrity Test is complete, the values displayed indicate:

- Output current
- IGBT temperature rise
- Inlet temperature at the start of the test
- Inlet temperature at the end of the test
- Duration of the test

If any of these values are outside acceptable limits, the unit does not pass the System Integrity Test.



3. Based on test results, do one of the following:
  - If the IGBT temperature rise is above the acceptable range, the unit display indicates that the test failed. Verify that there is nothing obstructing the intake or exhaust airflow. If there are no obstructions, contact technical support for assistance.
  - If there is an unqualified output current, the unit display indicates that the test failed. Contact technical support for assistance.
  - If any other alarms are displayed during this test, contact technical support for assistance.
  - If no issues are detected, click Next.

## Commissioning and start-up

### Parallel System Setup

Choose one of the following:

- **Single:** Select this option if the unit is operating alone without parallel units connected
- **Network:** Select this option if all parallel units have networking capability and a CAT5 cable connected to each unit for parallel communications
- **Legacy:** Select this option if the unit is being added to a legacy system that does not have parallel communications capability

### External transformer

1. For external transformer setup, choose either Yes or No based on the following:
  - Press Yes if there is a transformer added to the output of the active filter for connection to a voltage level that is different from the nominal voltage rating of the unit.
  - Press No if the output voltage rating of the unit matches the voltage rating of the loads being corrected.

2. If you chose No in the preceding step, skip this step. If you chose Yes, make the following settings:
  - **Ratio Grid:** Enter the Grid side voltage of the transformer.
  - **Unit:** Enter the transformer voltage rating at the active filter side.
  - **Phase Grid:** This value is set to 0 degrees. It is not an adjustable parameter.
  - **Unit:** Touching this field opens the External Transformer screen. Select the appropriate phase shift of the transformer based on the transformer design.

3. Change the settings on the External Transformer screen if there is an external transformer between the Harmonic Correction Unit and the voltage bus being corrected.

**Note:** This parameter does not apply to the integrated transformer units that are rated at 600 V or 690 V on the nameplate.

0°	30° lag	60° lag	120° lag	150° lag
180°	150° lead	120° lead	60° lead	30° lead

Refer to the following for making the settings:

- Active filters that are connected to the electrical distribution systems at voltage levels above the unit's nameplate voltage rating require a transformer to step up the voltage to the desired level.
- Auto-transformers, Delta-Delta and Wye-Wye transformers have no phase shift. Therefore, set the AF= parameter to 0 degrees.
- If transformers are used with a Delta to Wye configuration, enter the phase shift.
- Typically transformer manufacturers will indicate the phase shift using a clock face notation. The Grid side of the transformer is used as the reference and is set to zero or 12 o'clock.
- The high voltage side is indicated with a capital letter. For example, "D" indicates the delta winding is on the high voltage side. A lower case letter indicates the winding type of the low voltage side. For example, "y" indicates a wye wound low voltage side.

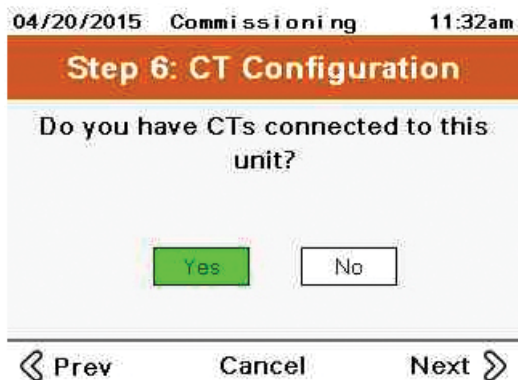
Refer to the following table for setting the "AF=" parameter based on common transformer nameplate information.

**Table 2. External Transformer AF = Settings**

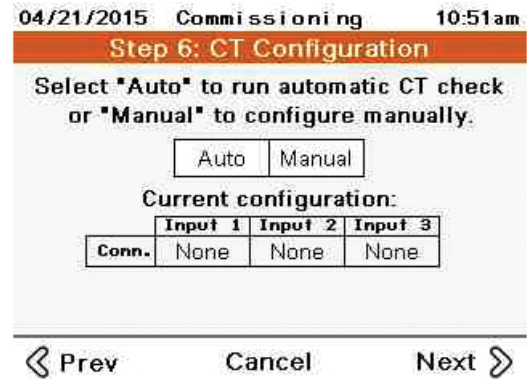
Transformer nameplate	Unit options AF =
Dy1	30 Lag
Dy2	60 Lag
Dy4	120 Lag
Dy5	150 Lag
Dy6	180
Dy7	150 Lead
Dy8	120 Lead
Dy10	60 Lead
Dy11	30 Lead

**CT configuration**

1. For CT Configuration, choose either Yes or No based on the following:
  - Press Yes to perform CT configuration if CT wiring is connected to the unit.
  - Press No if the unit is intended to operate as a Slave in a parallel system.

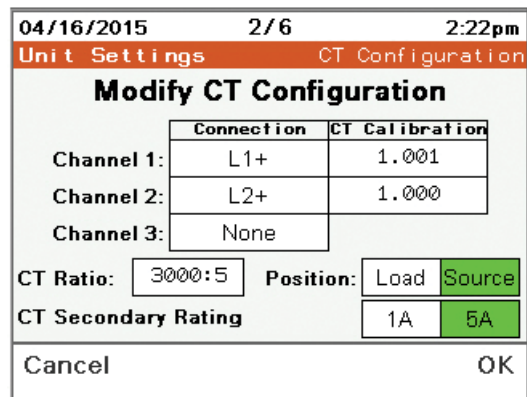


2. If you chose Yes in the preceding step, do one of the following:
  - Press Auto to have the unit automatically detect CT configuration.
  - Press Manual to manually enter the CT configuration.



**Manual CT configuration**

If you chose Manual for CT configuration, refer to the following for making the settings on this screen:



## Commissioning and start-up

**Channel** is the location where the CT secondary wiring is connected to the CT board.

When you tap the **Connection** data block, you can scroll through the available options:

- L1+
  - L1-
  - L2+
  - L2-
  - L3+
  - L3
  - None
- L1, L2, L3 and None describe which phase the CT is connected to. The polarity of the CT connection is identified as "+" or "-":
- "+" indicates H1 of the CT is closest to the source,
  - "-" indicates H1 of the CT is closest to the load.

**CT Calibration** allows for adjusting for CT variation.

**CT Ratio:** Touching the data box opens a numerical keypad to enter the primary ratio of the CTs being used.

**Position:** Select Load if the CTs are measuring only the connected loads to be corrected. This option is not allowed for systems operating in parallel. Select Source if the CTs are measuring the current of all loads being corrected and the active filter current.

**CT Secondary Rating:** Select the secondary rating of the CT installed.

### Automatic CT Configuration

If you chose Auto for CT configuration, do the following:

Automatic CT Configuration

Enter CT Ratio below:

CT Ratio:

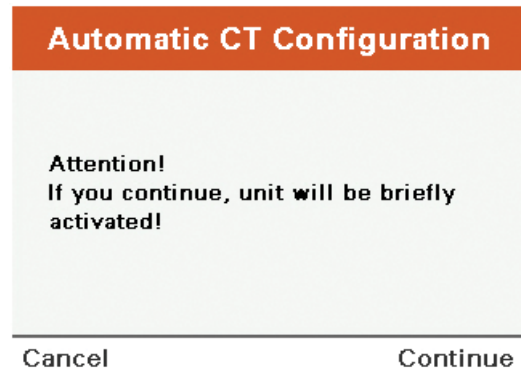
CT Secondary Rating

Select channels CTs are connected to:

Continue

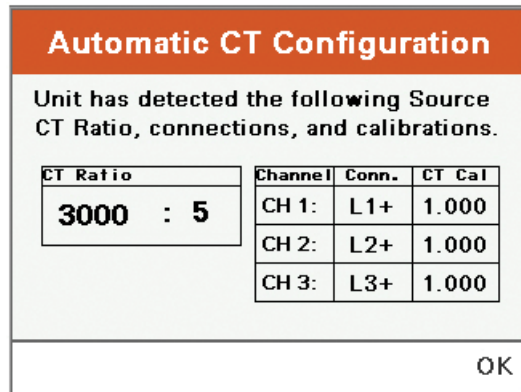
1. In the **CT Ratio** field, enter the primary CT ratio.
2. In the **CT Secondary Rating** field, select either 1 A or 5 A based on the secondary rating of the CTs installed.
3. In the **Select channels CTs are connected** field, select the channels used to connect the CT secondary wiring to the CT board of the unit. This information should be provided by the installer. See Installation Manual for CT installation details.
 

An information screen is displayed indicating that the unit is ready to perform the automatic CT detection.
4. Touch Continue to continue the test.



The unit runs for a short period of time to detect how the CTs are installed.

5. Touch OK when the test is complete and the detected CT configuration is displayed.





**Source Position Detected**

With CTs installed on the source side of the active filter, the unit displays the configuration of the CTs as they are connected to the lines and the CT ratio.

Press OK to modify the CT configuration.

04/16/2015		2/6		2:22pm	
Unit Settings			CT Configuration		
<b>Modify CT Configuration</b>					
	<b>Connection</b>	<b>CT Calibration</b>			
Channel 1:	L1+	1.001			
Channel 2:	L2+	1.000			
Channel 3:	None				
CT Ratio:	3000:5	Position:	Load	Source	
CT Secondary Rating		1A	5A		
Cancel			OK		

Once the unit is configured for the CTs that are installed, press OK to continue.

**Load CT Detected**

If a Load CT is detected, the following screen displays.

**Automatic CT Configuration**

**Load CT Detected**

Automatic CT Ratio determination is not possible for this CT configuration. The unit may be able to detect CT connections based on the present load condition. Accurate results depend on correctly entering information on the following screens.

OK

**Parallel Systems**

If this is a parallel system, the CTs cannot be installed on the load side of the active filter. Either the CTs are improperly installed, the CTs are not functioning, or the CT secondary wiring is not properly installed.

**Single Unit**

If you intend to install a single unit and the CTs on the source side of the active filter, verify CT installation, operation, or secondary wiring.

If you intend to install a single unit and the CT on the load side of the active filter, do the following:

1. Press OK.

**Automatic CT Configuration**

**Load Identification**

**Is the load continuously regenerating power to the source?**

Note: Most loads do not continuously regenerate power to the source unless they contain energy sources like generators, PV, wind or other distributed energy sources.

Continue

The unit asks if the load is regenerating.

- If so, the auto CT detection does not accurately determine the CT configuration. Manually enter the CT configuration.
- If the loads are not regenerative, touch NO and Continue.

**Automatic CT Configuration**

**Load Identification**

**Is the load currently operating at extremely low displacement PF (|DPF| < 0.5 or current-to-voltage phase angle > 60 degree)?**

Note: Unless the system is very lightly loaded, most loads operate at |DPF| > 0.5.

Back

Continue

The unit asks if the displacement power factor of the load operating at the time of the test was extremely low, less than 0.5.

## Commissioning and start-up

- Touch Yes or No as applicable for the connected loads and then touch Continue.

The unit asks if the connected load at the time of the CT detection was capacitive (having a leading power factor) or inductive (having a lagging power factor).

**Automatic CT Configuration**

**Load Identification**

**Is the load capacitive (LEADING PF) or inductive (LAGGING PF)?**

Note: AC motors and drives, induction heaters typically have lagging PF (inductive), while computer power supplies, lighting ballasts/LUV have leading PF (capacitive).

Back
Continue

- Select the appropriate load type and touch Continue. The CT configuration is displayed based on the answers entered. The DPF value and Leading or Lagging can be compared to an external meter to verify accuracy of the results.

**Automatic CT Configuration**

**Load Identification**

**Based on the information you provided, below are the detected CT connections and associated DPF.**

	Connection	DPF	Type
CH 1:	L1+	0.983	LAG
CH 2:	L2+	0.984	LAG

OK

- Press OK.

04/16/2015
2/6
2:44pm

Unit Settings
CT Configuration

**Modify CT Configuration**

	Connection	CT Calibration
Channel 1:	L1+	1.000
Channel 2:	L2+	1.000
Channel 3:	None	

CT Ratio:

Position:

CT Secondary Rating

Cancel
OK

- The HMI returns to the CT Configuration screen.
- When the CTs are properly configured, touch OK.

### System Mode Setup (HCU2 type)

Make the System Mode settings as follows:

04/21/2015
Commissioning
8:59am

**Step 7: System Mode Setup**

**Choose operating modes for the system.**

Harmonic Mode

Target THD:

PF Mode

Load Balancing

⏪ Prev
Cancel
Next ⏩

**Harmonic Mode:** When ON, the unit corrects harmonic current.

**Target THD:** Set the target value to either THDi or THDv based on application requirements.

**PF Mode:** When ON, the unit corrects displacement power factor. The default is set to a PF of 1.0.

**Load Balancing:** When ON, the three-phase currents at the source have equal current on each phase.

### System Mode Setup (EV12 type)

06/04/2015
Commissioning
8:42am

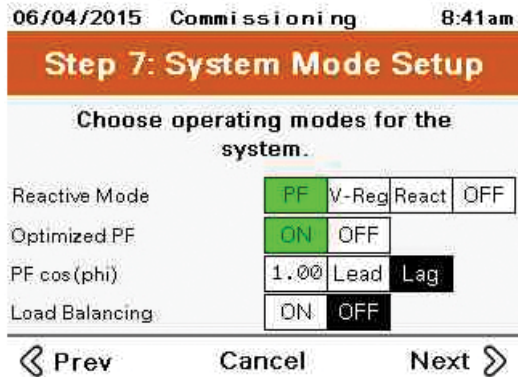
**Step 7: System Mode Setup**

**Choose operating modes for the system.**

Reactive Mode

⏪ Prev
Cancel
Next ⏩

When **Reactive Mode** is off, no compensation is selected.



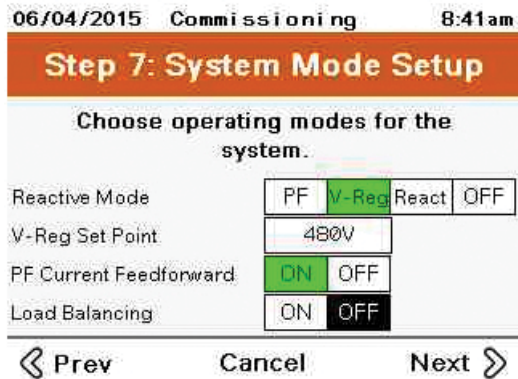
**Reactive Mode—PF:** With PF mode selected, additional parameters available for the PF mode are displayed.

**Optimized PF:** When set to OFF, the unit maintains the PF cos (phi) setting. When set to ON and the load is less than the PF cos (phi) setting, the unit corrects the power factor to PF cos (phi). If the load PF is greater than the setting, the unit does not compensate unless the power factor is set to maintain a Lag power factor and the load becomes leading. Then, the unit corrects the power factor to a PF cos (phi) of 1.00. If the PF cos (phi) is set to Lead and the power factor of the load is lagging, the unit corrects to a PF cos (phi) of 1.00.

*Example:* With a PF cos (phi) set to 0.98 Lag, the unit maintains a Power Factor of 0.98 Lag when the corrected load is lagging. If the power factor improves to 0.99, no compensation is provided. If the connected load produces a leading power factor, the unit corrects the power factor to 1.00.

**PF cos (phi):** Target power factor setting. The power factor can be set for either a leading or lagging cos (phi).

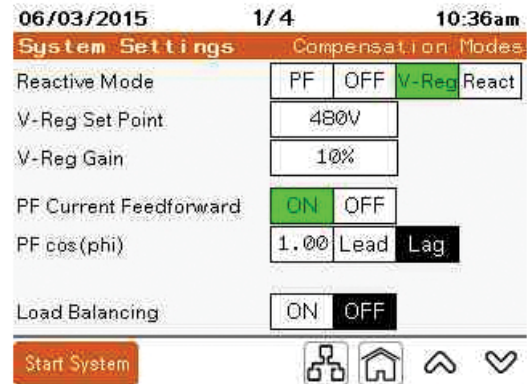
**Load Balancing:** When ON, the unit corrects for load imbalance (negative sequence current).



**Reactive Mode—V-Reg:** Voltage Regulation Mode. Voltage regulation mode monitors the voltage and adjusts the reactive current injected to maintain a voltage level.

**V-Reg Set Point:** Set the desired voltage to be maintained.

**V-Reg Gain:** Adjusts the response time of the voltage regulation. The higher the percentage of V-Reg Gain, the faster the response is. Faster response increases the potential for voltage instability of the electrical system.



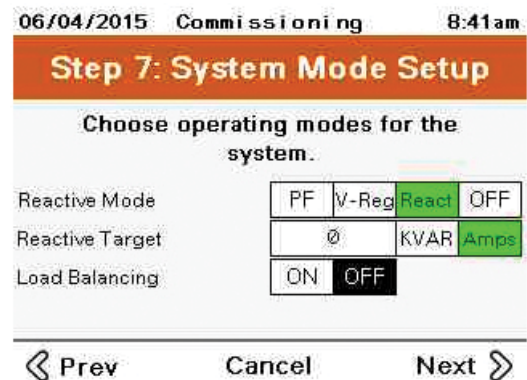
**PF Current Feedforward:** When OFF, CTs are not required for this application. The unit maintains the V-Reg Set Point based on the unit's terminal voltage.

When ON, CTs are required for this application. The unit provides the reactive current required based on the PF cos (phi) set point resulting from rapid changes in the load.

Adjustments to the reactive power are implemented to maintain the V-Reg Set Point.

The **PF cos (phi)** is set to 1.0 by default. Go to System Settings/Compensation Modes to change the target PF cos (phi) set point.

**Load Balancing:** When ON, the unit corrects for load imbalance (negative sequence current).



## Commissioning and start-up

**Reactive Mode—React:** Reactive mode provides leading or lagging kVAR based on the Reactive Target. React Mode does not require the installation of CTs.

**Reactive Target** can be set either based on kVAR or amperes. Reactive Target can be set remotely through MODBUS

**Load Balancing:** When ON, the unit corrects for load imbalance (negative sequence current). CTs are required when Load Balancing is selected.

### Admin password setup

For security purposes, we recommend changing the Admin password from the default password. To change the password:

1. Touch the Password field to open an alpha keypad.
2. Enter a new password for the Admin User.  
The password must be between 6 and 32 characters with any combination of letters or numbers. Passwords are case sensitive.
3. Enter it again in the Confirm field.
4. Press Change Password. Or, if you prefer to keep the default password, just press Next.

Commissioning

### Step 8: Password Setup

**Please choose a new password for the Admin User.**

Additional users can be configured from the login panel.

Password:

Confirm:

Current User: ADMIN

### Test Run

When you initiate the Test Run, the unit operates briefly providing data on the unit or system performance.

**Note:** If this is a parallel system, perform this step after all other units in the system have been properly commissioned and are ready to run or you might see a reduction in performance.

To perform the Test Run, do the following:

1. Press Yes.

04/20/2015 Commissioning 11:33am

### Step 9: Test Run

**Would you like to test run the system to evaluate system performance?**

If this is a parallel system, perform this step after all other units in the system have been properly commissioned and ready to run.

2. Press Start.

### Test Run

**Attention!**

If you continue, system will be run to capture performance!

	L1	L2	L3
<b>Total Load</b>	641A	647A	638A
<b>Load Harmonics</b>	169A	171A	169A
<b>THDi</b>	34.4%	34.5%	34.2%
<b>DPF</b>	0.972		

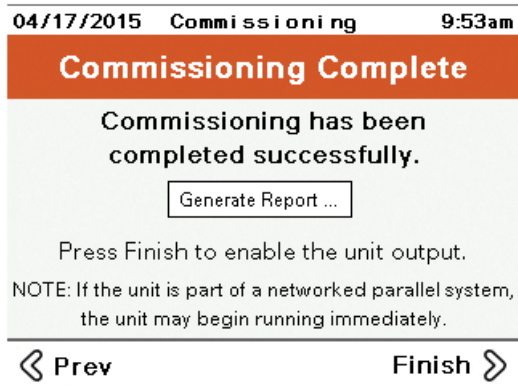
When the test run has completed, the unit or system performance results are displayed. You should see a significant reduction in THDi between Unit On versus Unit Off.

### Test Run Completed

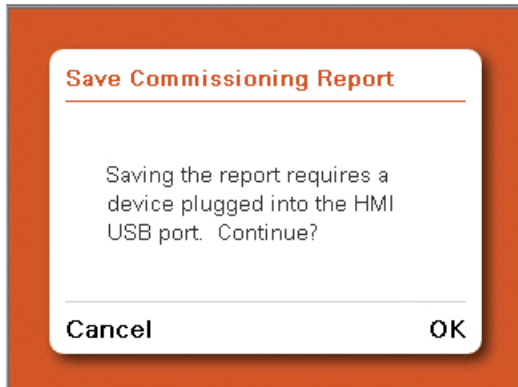
	Unit On			Unit Off		
	L1	L2	L3	L1	L2	L3
<b>THDi</b>	5.0%	5.0%	5.0%	34.4%	34.5%	34.2%
<b>THDv</b>	2.4%	2.1%	1.9%	6.0%	5.9%	5.9%
<b>DPF</b>	0.981			0.972		
<b>Unbal</b>	1%	0%	0%	1%	0%	0%
<b>Fund Current Change</b>	L1			L2		
	0.0%	-0.9%	-0.8%			
<b>Load Harmonic Rise</b>	L1			L2		
	0%	-1%	-0%			
<b>Output Harmonics</b>	L1			L2		
	49%	50%	49%			
<b>Total Output</b>	L1			L2		
	49%	50%	49%			

OK

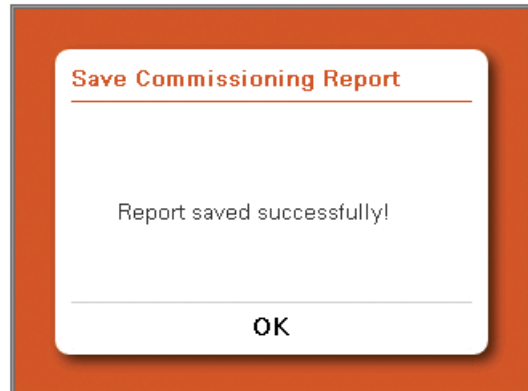
3. Press Generate Report if you want to produce a report of the test results.



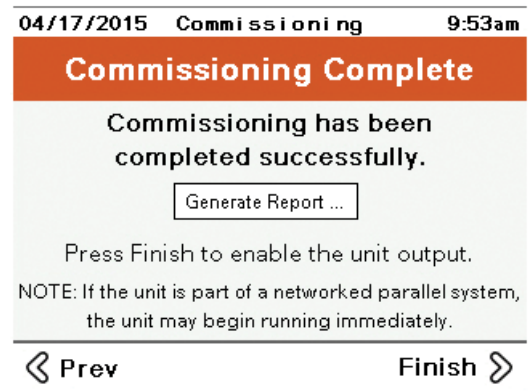
A screen displays indicating that a USB storage device is required.



4. Press OK when USB storage device is installed.

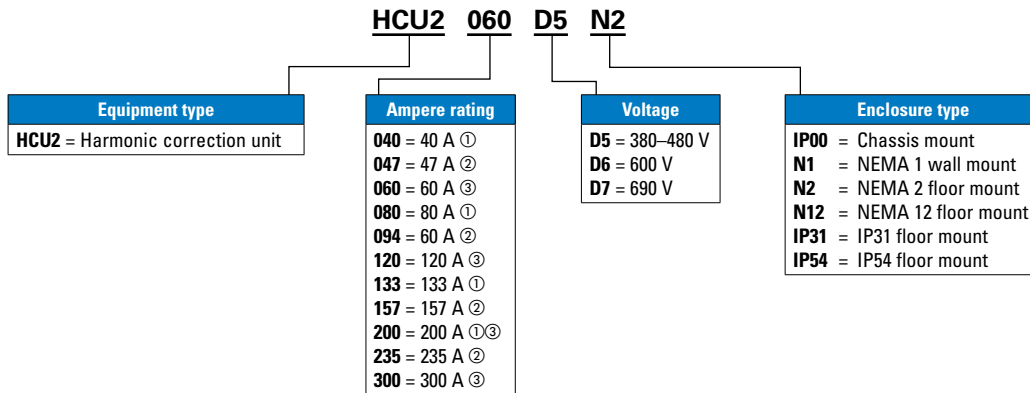


5. Press OK.  
The report is saved as a csv file on the USB storage device at:  
\*:\PUBLIC\PROJECTS\ACTIVEFILTER\DATA\ALARM\COMMISSIONINGREPORT
6. Press Finish to complete the commissioning procedure.



# Troubleshooting

## Catalog numbering system



- ① 690 V units only.
- ① 600 V units only.
- ② 380–480 V units only.

## Troubleshooting

Refer to this table for troubleshooting.

Event	Explanation	Action
AC Line Not Qualified	Frequency Not Qualified	Verify Line Frequency is within $\pm 3$ Hz.
	Three-Phase Loss	Verify AC Line is present.
	Single-Phase Loss	Verify all three line voltages are present.
	Over Voltage	Verify Line voltage is within +10%.
	Voltage Imbalance	Verify voltage imbalance is less than 8%.
	Fast Under Voltage	Verify voltage is within 50% of nominal (1/4 cycle).
	Fast Over Voltage	Verify voltage is within +10% of nominal (1/4 cycle).
Auto Detection Out of Range	Unit was unable to Auto Detect voltage or frequency	Disable Auto Detect. Manually enter nominal voltage and frequency of the electrical system.
Low Order Harmonics OFF (HCU2 type only)	5th and/or 7th order harmonic disabled	Typically caused by harmonic loads without the minimum 3% impedance or un-isolated power factor correction capacitors on the load side of the main CTs.
Fan Failure Detected	Power section fan inoperable	Call your local service center.
Filter Trip	Inverter Filter inoperable	Call your local service center.
Gate Drive Trip	Power supply issue on Gate Driver	Call your local service center.
HMI Communication Loss	HMI communication to Control Board loss	Verify Proper connection of HMI RJ45 Com jack. Call your local service center.
IGBT Trip	IGBT issue detected	Call your local service center.
MOV Requires Service	MOV issue detected	Call your local service center.
Over Current Condition Detected		Call your local service center.
Over Temperature	Over Temperature detected	Verify air temperatures to the air intake of the unit are within specification. Verify intake and exhaust air vents are not obstructed.
Parallel Power Wiring Mismatch	L1, L2 and L3 are not powered by the same phase for each parallel unit	Ensure L1, L2 and L3 of all parallel units are power by the same phase.
Protection Firmware Trip	Firmware issue detected	Call your local service center.
Power Supply Out of Range	Power Supply issue detected	Call your local service center.
Current Sensor Inoperable	Internal Current Sensor issue detected	Call your local service center.
Transformer Over Temperature	Transformer Over Temperature detected (600 and 690 V units only)	Verify air temperatures to the air intake of the unit are within specification. Verify intake and exhaust air vents are not obstructed.
High Frequency Voltage Distortion Condition	Excessive inverter switching frequency detected on line voltage	Call your local service center.

## Warranty

Standard warranty is 1 year, parts only, against manufacturing defects.

### Disclaimer of warranties and limitations of liability

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For product support, please contact Eaton's Technical Resource Center (TRC) power quality application engineers at **1-800-809-2772**, choose option #4, then option #2.  
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