Associated Power Technologies
A DIVISION OF IKONIX USA

5000 Series

Manual AC Power Source

Operation Manual for Models

5005
5010
5020
5040

Ver. 1.26
PART # 38913

28105 North Keith Drive, Lake Forest, IL 60045 USA
T. +1-847-367-4378 • F. +1-847-367-4658 • aptsources.com

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1. Introduction

1.1 Warranty

Associated Power Technologies, Inc. (APT), certifies that the instrument listed in this manual meets or exceeds published manufacturing specifications. This instrument was calibrated using standards that are traceable to the National Institute of Standards of Technology.

Your new instrument is warranted to be free from defects in workmanship and material for a period of 3 years from date of shipment. During the warranty period, you must return the instrument to Associated Power Technologies, Inc. or its branches for repair. Associated Power Technologies reserves the right to use its discretion on replacing the faulty parts or replacing the assembly or the whole unit.

APT will void your warranty under the following conditions:

- Operation of the instrumentation under non-normal conditions
- Any non-authorized modifications, tampering or physical damage
- Elimination of any connections in the earth grounding system or bypassing any safety systems
- Use of non-authorized parts in the repair of this instrument. Parts used must be parts that are recommended by APT as an acceptable specified part

This warranty does not cover accessories not of Associated Power Technologies, Inc. manufacture.

Except as provided herein, APT, makes no warranties to the purchaser of this instrument and all other warranties, expressed or implied (including, without limitation, merchantability or fitness for a particular purpose) are hereby excluded, disclaimed and waived.

APT recommends that your instrument be calibrated on a twelve month cycle. Instruments returned to APT annually for calibration fall under our extended warranty which can be extended up to five years. Each year the instrument is returned to APT in consecutive years the warranty is extended one additional year. This process can be repeated up to four years for a 5-Year Warranty.

Instruments returned for warranty repair within the first six months of the warranty period, will have the warranty extended for one year from the date of repair at no charge. Instruments received after the first six months can have the warranty

extended for 3 months after its original expiration date at no charge or the warranty can be extended for a full year at the cost of an annual calibration.

1.2 Glossary of Terms

Alternating Current (AC) - current that reverses direction on a regular basis (usually 60 times per second in the United States). Measured in amps.

AC Power Source - An instrument that takes one AC voltage and frequency level and converts it into another AC voltage and frequency level.

Amplifier - a circuit that boosts an input signal from one level to another.

Apparent Power - The total power generated or consumed by a device due to real and reactive circuit components. Measured in VA (volt-amps).

Crest Factor - The ratio of peak current (Apeak) to RMS current (Arms).

Complex Power – the vector sum of the real and reactive power components of a circuit. Measured in VA (volt-amps).

Direct Current (DC) - current that only flows in one direction. Direct current comes from a polarized source, meaning one terminal is always at a higher potential than the other. Measured in amps.

Frequency - The number of times a waveform completes a cycle in a period of time. Measured in hertz.

Inrush Current - A term used to describe the current needed to power a load upon start-up. Some loads require a large/inrush starting current in order to operate.

Linear Power Source – a power source that linearly amplifies the input signal using transistors to increase the voltage, current, and power output of the system.

OC Fold Back - Over current fold back is a technology used in power sources that keeps output current constant by reducing the voltage in order to power loads that may have a high inrush current.

Phase Angle – the degree of measurement that corresponds to an AC waveform's amplitude. Measured from 0 – 360 degrees.

PLC - Programmable Logic Control is an automation method using relay or digital technology.

Power - A generic term used to describe electrical work being done. There are many types of power, including real power, reactive power, apparent power, and complex power.

Power factor - The ratio of real power (watts) to apparent power (VA). Based on a scale from 0 to 1 to determine how reactive and resistive a load is.

Reactive Power – the power absorbed by capacitive or inductive elements in a circuit. This power does no work. Measured in VAR (volt-amps reactive).

Real Power – the power that performs work in a circuit. Measured in watts.

Response Time - The time that is needed to regulate the voltage, current, frequency, and power output when a load is added to the power source.

Safety Agency Listing - A safety mark given to a product that has met stringent benchmarks as classified by the authorized agency.

Steady State Current - A term used to describe the current when the load is running nominally after the inrush current.

Switching Power Source - A power source that uses switching technology (integrated circuits and components) in order to generate the AC voltage, current, frequency, and power.

Total Harmonic Distortion (THD) - A percentage that is used to identify the degree of the noise/unclean signal in a power source's output waveform.

Voltage - The amount of force that is needed to move current from point to point. Measured in volts.

1.3 Safety Precautions

- This product and its related documentation must be reviewed for familiarization with safety markings and instructions before operation.
- Before applying power verify that the instrument is set to the correct line voltage and the correct fuse is installed

To prevent accidental injury or death, these safety procedures must be strictly observed when handling and using the test instrument.

1.4 Service and Maintenance

User Service

To prevent electric shock do not remove the instrument cover. There are no user serviceable parts inside. Routine maintenance or cleaning of internal parts is not necessary. Any external cleaning should be done with a clean dry or slightly damp cloth. Avoid the use of cleaning agents or chemicals to prevent any foreign liquid from entering the cabinet through ventilation holes or damaging controls and switches. Some chemicals may also damage plastic parts or lettering. Any replacement cables and high voltage components should be acquired directly from APT or its distributors.

Service Interval

The instrument must be returned at least once a year to an APT authorized service center for calibration and inspection of safety related components. APT will not be held liable for injuries suffered if the instrument is not properly maintained and its safety checked annually.

User Modifications

Unauthorized user modifications will void your warranty. APT will not be responsible for any injuries sustained due to unauthorized equipment modifications or use of parts not specified by APT. Instruments returned to APT with unsafe modifications will be returned to their original operating condition at the customer's expense.

2. Getting Started

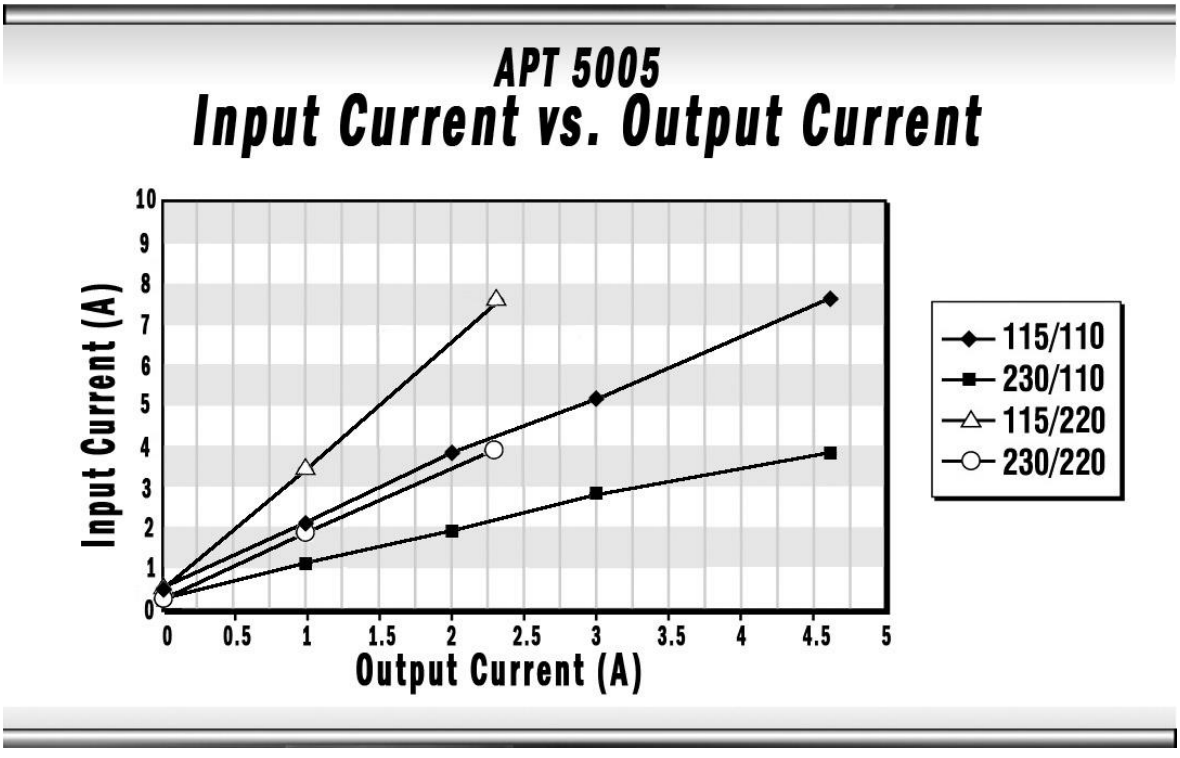
This section contains information for the unpacking, inspection, preparation for use and storage of your APT product.

2.1 Unpacking and Inspection

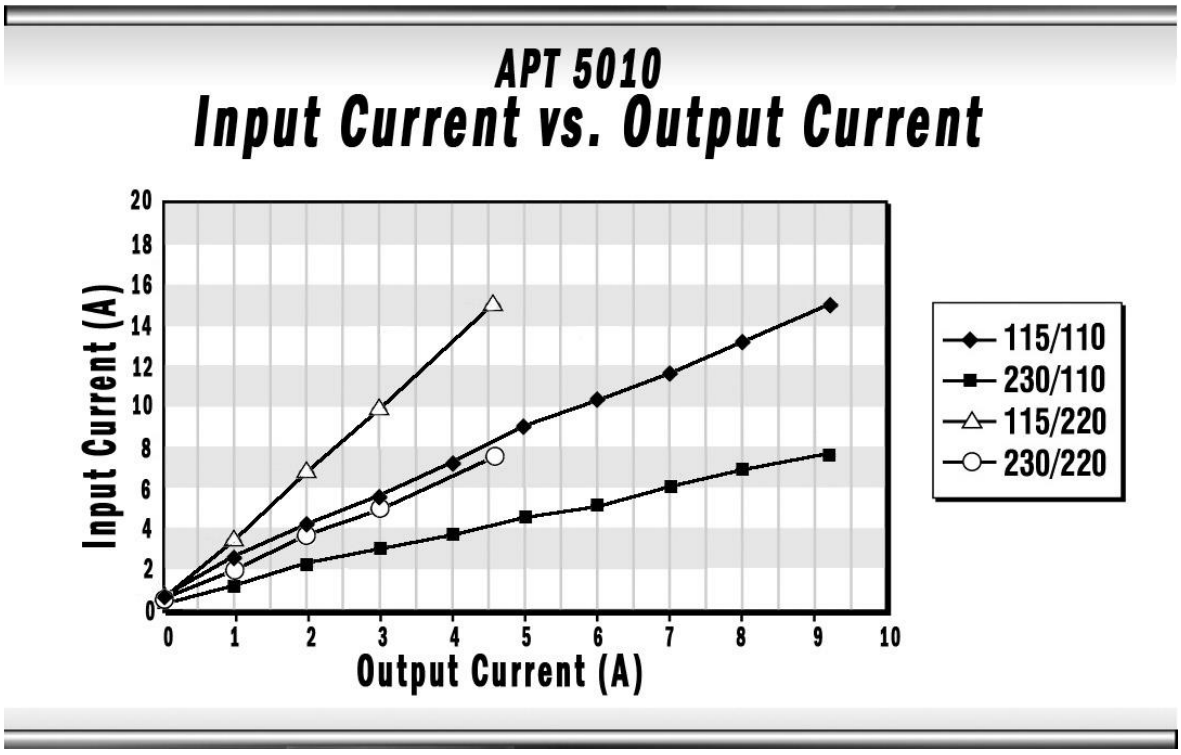
Your instrument was shipped in a protective shipping carton designed to protect the instrument through the shipping process. If the shipping carton is damaged, inspect the contents for visible damage such as dents, scratches, or broken display. If the instrument is damaged, notify the carrier and APT's customer support department. Please save the shipping carton and packing material for the carrier's inspection. Our customer support department will assist you in the repair or replacement of your instrument. Please do not return your product without first notifying us.

2.2 Input/Output Current Considerations

Refer to the following diagrams for input/output current considerations for the 5000 series.

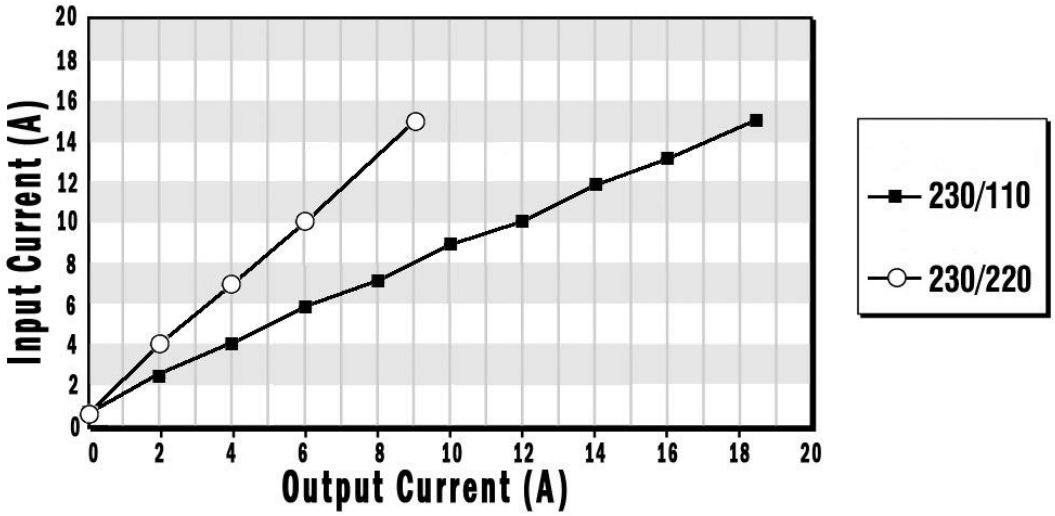


5005


APT 5010
Input Current vs. Output Current
Input Current (A)
Output Current (A)
0
2
4
6
8
10
12
14
16
18
20
0
1
2
3
4
5
6
7
8
9
10
115/110
230/110
115/220
230/220

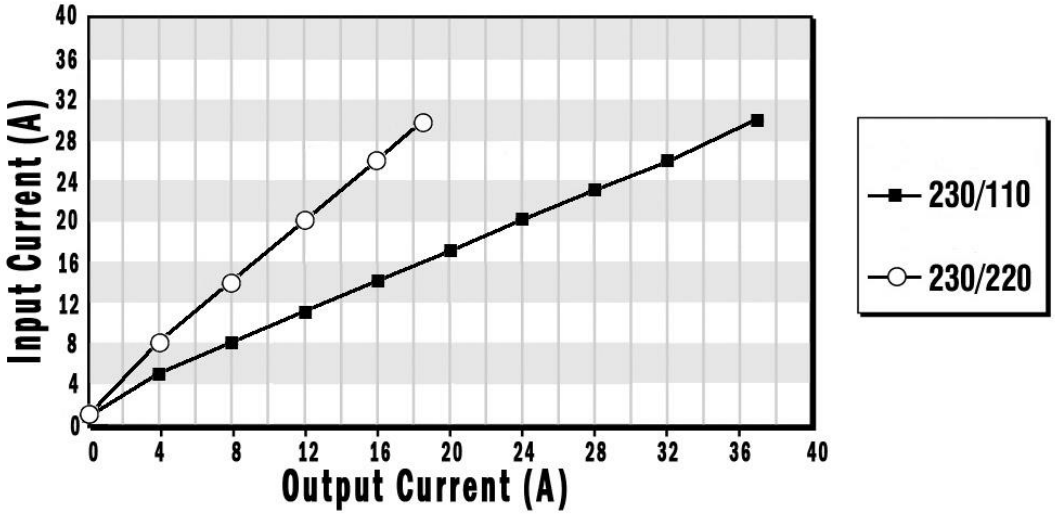
5010

APT 5020
Input Current vs. Output Current



5020

APT 5040
Input Current vs. Output Current



2.3 Preparation For Use

Models 5005 & 5010 require an input line voltage of 115/230 volts AC ± 10%, 47 – 500 Hz single phase. The 5020 & 5040 models require an input line voltage of 208 volts ± 10%, 47 - 500 Hz single phase. A 230 volts AC ± 10%, 47 - 500 Hz single phase option is available for the 5020 & 5040 models. Please check the rear panel to be sure the proper switch setting is selected for your line voltage requirements before turning your instrument on for the 5005 and 5010 models. The 5020 and 5040 models do not provide a switching setting for input line voltage since a terminal block style connect is needed for input power.

CAUTION Do not switch the line voltage selector switch located on the rear panel while the instrument is on or operating. This may cause internal damage and represents a safety risk to the operator.

2.4 Power Cable

WARNING Before connecting power to this instrument, the protective ground (earth) terminals of this instrument must be connected to the protective conductor of the line (mains) power cord. The main plug shall only be inserted in a socket outlet (receptacle) provided with a protective ground (earth) contact. This protective ground (earth) must not be defeated by the use of an extension cord without a protective conductor (grounding).

2.5 Environmental Conditions

Operating Environment
Temperatures: 0º - 40º C (32º - 104º F)
Relative humidity: 20% - 80%
Altitude: 2,000 meters (6,562 feet)

The instrument should also be protected against temperature extremes which may cause condensation within the instrument.

Storage and Shipping Environment
This instrument may be stored or shipped in environments with the following limits:
Temperature……..-40º to +55º C (-40 to 131º F)

Altitude…….7,620 meters (25,000 feet)

2.6 Packaging

Please enclose the instrument with all options, accessories and test leads. Also, please mark the container “FRAGILE” to ensure proper handling. All returns must be accompanied by a return material authorization (RMA) number which is provided by the customer support department. All instruments shipped without a RMA number will result in additional fees for handling and storage.

APT will not be responsible for any repair costs associated with shipping damage as a result of improper packaging. The customer is responsible for providing adequate shipping insurance coverage while shipping an instrument in the event of loss or damage while in transit.

3. Specifications and Controls

3.1 Specifications

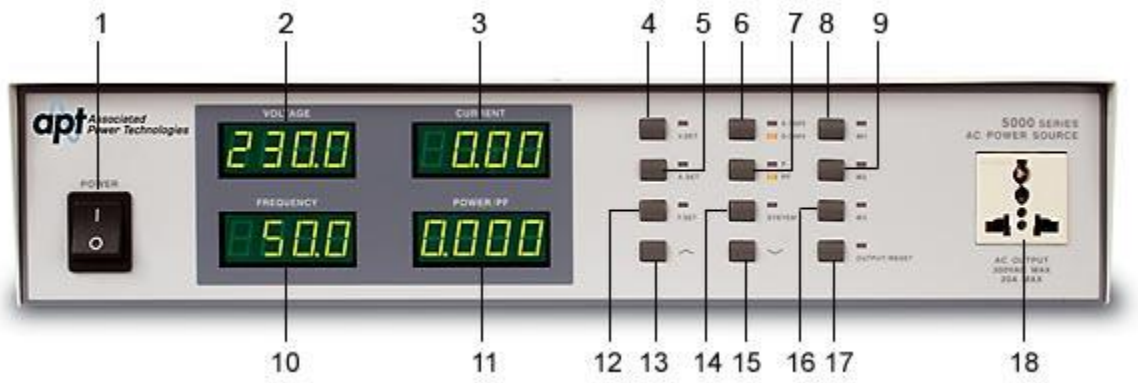
MODEL		5005	5010	5020	5040
INPUT					
Phase		1Ø			
Voltage		115/230 VAC ±10%		208 VAC ± 10%	
Frequency		47 – 500 Hz			
OUTPUT					
Max. Power		500 VA	1 KVA	2 KVA	4 KVA
Max. Current (r.m.s)	0 – 150 V	4.6 A @ 110 V	9.2 A @ 110 V	18.4 A @ 110 V	36.8 A @ 110 V
	0 – 300 V	2.3 A @ 220 V	4.6 A @ 220 V	9.2 A @ 220 V	18.4 A @ 220 V
Voltage		0.0 – 300.0 Volts			
Frequency		40.0 – 450.0 Hz			
Phase		1Ø2W			
Total Harmonic Distortion (THD)		< 1% (Resistive Load) for low range voltage 80V – 140V and high range voltage 160V – 280V			
Crest Factor		≥ 3			
Line Regulation		± 0.1 V			
Load Regulation		± (0.5% of output + 0.5 V) at Resistive Load			
Response Time		< 400 µsec			
SETTINGS					
Voltage	Low Range	0 – 150 V		5 – 150 V	
	High Range	0 – 300 V		5 – 300 V	
	Resolution	0.1 V			
	Accuracy	± (1% of setting + 2 counts)		± (1% of setting + 5 counts) > 5V	
Frequency	Range	40 – 450 Hz Full Range Adjust			
	Resolution	0.1 Hz at 40.0 – 99.9 Hz, 1 Hz at 100 – 450 Hz			
	Accuracy	± 0.03% of setting			
Current Hi Limit	High Range	0.01 – 4.60 A	0.01 – 9.20 A	0.01 – 18.40 A	0.10 – 36.80 A
	Low Range	0.01 – 2.30 A	0.01 – 4.60 A	0.01 – 9.20 A	0.10 – 18.40 A
	Resolution	0.01 A			
	Accuracy	± (2% of reading + 2 counts)			

Why use the term "Counts"?
Associated Power Technologies publishes some specifications using COUNTS which allows us to provide a better indication of the tester's capabilities across measurement ranges. A COUNT refers to the lowest resolution of the display for a given measurement range. For example, if the resolution for voltage is 1V then 2 counts = 2V.

MODEL		5005	5010	5020	5040
MEASUREMENT					
Voltage	Range	0.0 – 400.0 V			
	Resolution	0.1 V			
	Accuracy	± (1% of reading + 2 counts)		± (1% of setting + 5 counts) > 5V	
Frequency	Range	0.0 – 500.0 Hz			
	Resolution	0.1 Hz			
	Accuracy	± 0.1 Hz			
Current	Range	0.00 – 6.50 A	0.00 – 13.00 A	0.00 -26.00 A	0.05 – 52.00A
	Resolution	0.01A			
	Accuracy	± (1% of reading + 5 counts)			
Power	Range	0 - 650 W	0 – 1300 W	0 - 2600 W	0 – 5200 W
	Resolution	1 W			
	Accuracy	± (2% of reading + 10 counts) at PF >=0.2			± (2% of reading + 10 counts) at PF >=0.2, Current >0.05A
Power Factor	Range	0 – 1.000			
	Resolution	0.001			
	Accuracy	W/VA, Calculated and displayed to three significant digits			
SYSTEM SETTINGS					
Power Up Settings	P-UP	On, Last, Off			
Voltage Limits	Hi/Lo Volt	0.0 – 300.0 V		5.0 – 300.0 V	
Frequency Limits	Hi/Lo Freq	40.0 – 450.0 Hz			
Over Current Foldback	Fold OC	On, Off, Response time < 1400 ms			
Lock	LocH	On, Off			
GENERAL					
Inrush Current		4 times of rating current			
Enhanced Over Load Capacity		4 times of rating current, Over Current 110% can hold for 1000 ms w/o Protection			
Operation Key Feature		Up / Down Arrow Key			
Memory		3 Memories (M1, M2, M3)			
Fan		Temp. Control Two Fan Speed			Temp. Control Linear Fan Speed
Front Output		Universal Receptacle			
Rear Output		-	-	Universal Receptacle	Terminal Block L, N, G
Displays		LED			
Efficiency		≥ 80% (at full load)			
Protection Circuits		OCP, OVP, OPP, OTP (Over Current, Over Voltage, Over Power, Over Temp.)			
Calibration		Front Panel Calibration			
Dimensions (W x H x D) in.		17 x 3.5 x 12 (432 x 89 x 305mm)	17 x 3.5 x 16 (432 x 89 x 406mm)	17 x 3.5 x 20 (432 x 89 x 508mm)	17 x 8.75 x 20 (432 x 222 x 508mm)
Net Weight		28 lbs (11.3kgs)	40 lbs (18.1kgs)	66 lbs (29.2kgs)	143 lbs (64.8kgs)
OPTIONS					
230 VAC ± 10% Input	Opt. 01	-	-	Yes	Yes
Grounded Return	Opt. 02	Yes	Yes	Yes	Yes

3.2 Instrument Controls

3.2.1 Front Panel Controls



1. Power Switch: Rocker style power switch with international ON (|) and OFF (0).

2. Voltage Display: When the output is OFF the display shows the output voltage setting. When the output is ON the display shows the output voltage measurement.

3. Current Display: When the output is OFF the display shows the output current setting. When the output is ON the display shows the output current measurement.

4. V. Set Key: Voltage set key. Press to change the voltage output.

5. A. Set Key: Current set key. Press to change the current maximum limit.

6. Range Key: Used to select the output voltage range. When the 0-150V indicator LED is illuminated the output is set to the low range. When the 0-300V indicator LED is illuminated the output is set to the high range.

7. Wattmeter/Power Factor Key: Used to select the wattage or power factor measurement on the Power P/PF display. When the P indicator LED is illuminated the wattage will be displayed. When the PF indicator LED is illuminated the power factor will be displayed.

8. M1 Key: Used to recall or store parameter settings in memory one. When LED indicator is on the memory is active.

9. M2 Key: Used to recall or store parameter settings in memory two. When the LED indicator is on the memory is active.

10. Frequency Display: When the output is OFF the display shows the output frequency setting. When the output is ON the display shows the output frequency measurement.

11. Power/PF Display: Displays the value of the output wattage or power factor.

12. F. Set Key: Frequency set key. Press to change the frequency output.

13. Up Arrow Key: Used to change parameters.

14. System Key: Used to change the instruments system settings such as power up state, voltage high and low limits, frequency high and low limits, over current fold back, and locking.

15. Down Arrow Key: Used to change parameters

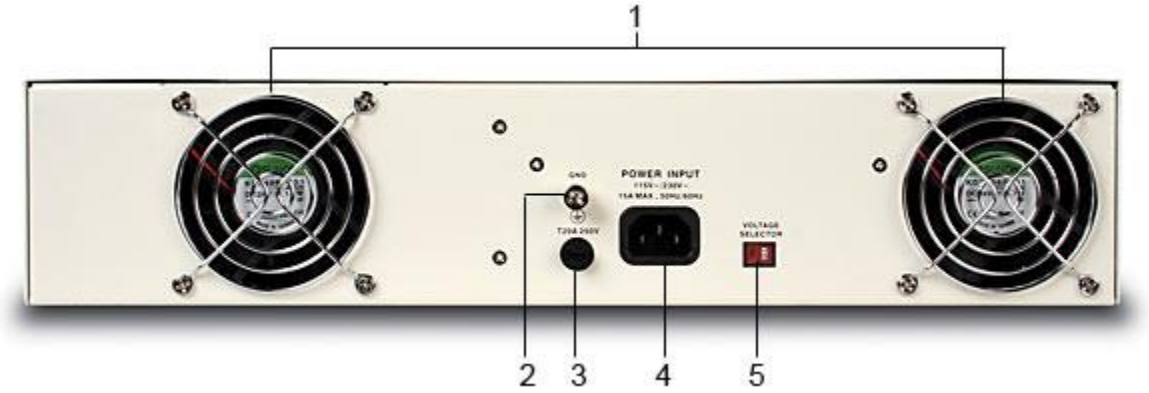
16. M3 Key: Used to recall or store parameter settings in memory three. When the LED indicator is on the memory is active.

17. Output/Reset Key: Used to turn ON/OFF output voltage, or used to reset the instrument in the event of a failure condition. When the LED indicator is ON voltage is being output. When the LED indicator is blinking the instrument is in a failure condition.

18. Universal AC Output Socket: 300 VAC max voltage & 20 A max current

19. Reset Switch: Used to reset the unit if 20 A max current is reached on the universal AC output socket. (Only available on 5040 Series shown below).

3.2.2 Rear Panel Controls



1. **Thermal Fans:** Used to cool the instrument.

2. **Ground Lug:** Additional ground connector in addition to power cord ground.

3. **Fuse Receptacle**: To change the fuse unplug the power (mains) cord and turn the fuse cap counter clockwise to remove fuse.

4. Input Power Receptacle: Standard IEC 320 connector for connection to a standard NEMA style line power (mains) cord.

5. **Input Power Switch**: Line voltage input selection is set by the position of the switch 115/230V.

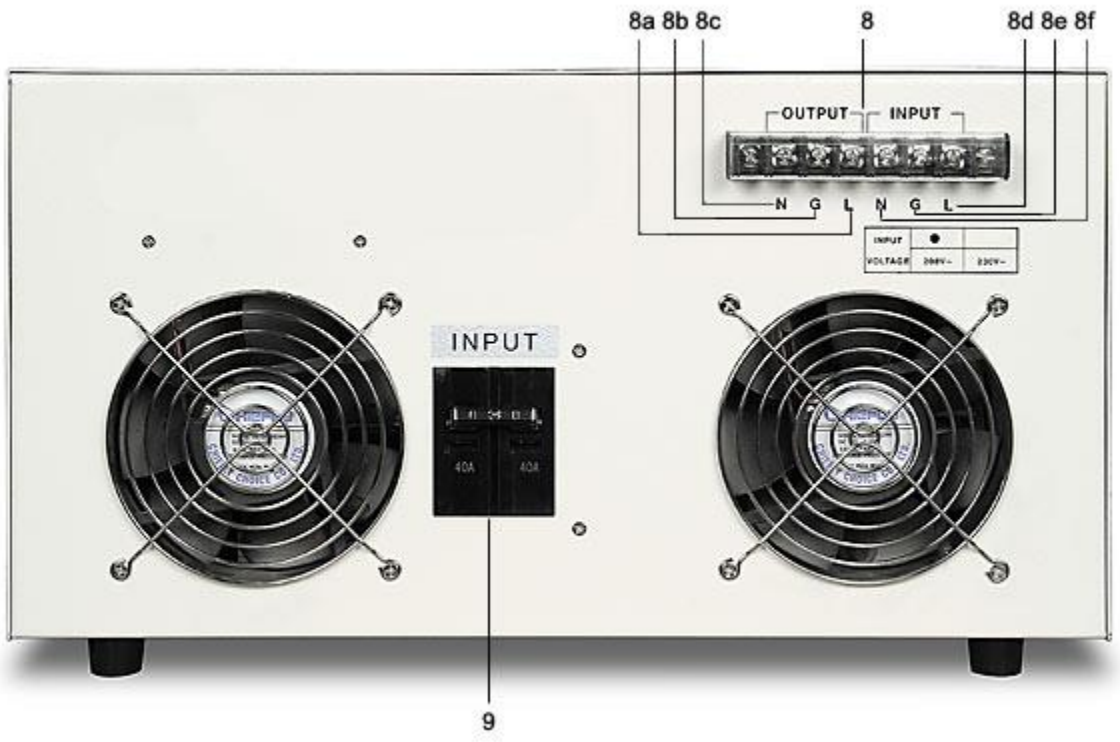
6. **Universal AC Output Socket**: 300 VAC max voltage & 20 A max current. Only available on the 5020.

7. Terminal Power Block: 208 VAC ± 10% max input voltage or 230 VAC ± 10% (option) for input voltage. Output voltage 300 VAC max & 18.4 A max current. Terminal power block only available on the 5020.

7a. Neutral Input Terminal: Neutral (return) screw terminal. Line voltage may be applied at this terminal for balanced input voltage conditions.

7b. Ground Input Terminal: Earth ground (chassis) connection for line cord.

7c. Line Input Terminal: High voltage input screw terminal.



8. **Terminal Power Block**: 208 VAC ± 10% max input voltage or 230 VAC ± 10% (option) for input voltage. Output voltage 300 VAC max & 36.8 A max current. Terminal power block only available on the 5040.

8a. Line Output Terminal: High voltage output screw terminal.

8b. Ground Output Terminal: Earth ground (chassis) connection.

8c. Neutral Output Terminal: Neutral (return) screw terminal.

8d. Line Input Terminal: High voltage input screw terminal for line cord.

8e. Ground Input Terminal: Earth ground (chassis) screw terminal for line cord.

8f. Neutral Input Terminal: Neutral (return) screw terminal for line cord. Line voltage may be applied at this terminal for balanced input voltage conditions.

9. Input Breaker: Protection breaker for input current protection set at 40 amps. Only available on 5040 model.

4. Programming Instructions

4.1 Instrument Operation

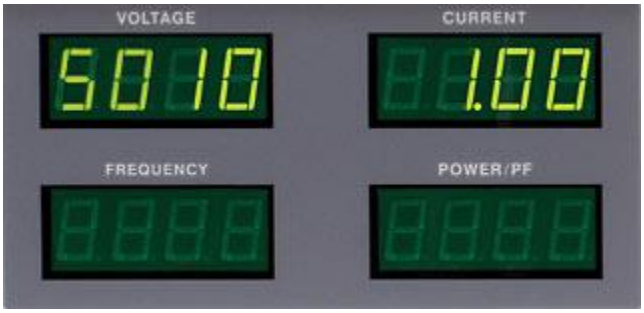
4.1.1 Powering on Instrument

Toggle on the power switch in the lower left hand corner of the instrument.

4.1.2 Power On Condition

On every power up cycle the instrument will provide you with the model number and current firmware version of the instrument in the voltage and current display.

Display On Power Up



(5010 Display Shown)

4.1.3 Setting the Output Voltage Range

Press the Range key to change the LED indicator to select either the low voltage output range of 0-150V, or to select the high voltage range 0-300V.

4.1.4 Setting the Output Voltage

Press the V. Set key and the Voltage display will begin flashing indicating that the voltage is ready for setting. If you don't change the voltage setting within 15 seconds the display will stop flashing and you will have to repress the V. Set key to change the voltage setting. Then press the up or down arrow keys in order to change the voltage. Press the V. Set key again to accept the parameter.

4.1.5 Setting the Current Limit

Press the A. Set key and the Current display will begin flashing indicating that the current is ready for setting. If you don't change the current setting within 15 seconds the display will stop flashing and you will have to repress the A. Set key to change the current setting. Then press the up or down arrow keys in order to change the current. Press the A. Set key again to accept the parameter. The current that you are setting is the high limit current. Therefore if the load draws more than the high limit current setting the instrument will give you a failure (HI-A).

If the system parameter setting for OC Fold back is ON and the current high limit is set, the output voltage will fold back to maintain the output current. If the high limit is OFF, the output will terminate once the current exceeds the current output of the instrument and a failure will be given (OCP).

4.1.6 Setting the Frequency

Press the F. Set key and the Frequency display will begin flashing indicating the frequency is ready for setting. If you don't change the frequency setting within 15 seconds the display will stop flashing and you will have to repress the F. Set key to change the frequency setting. Then press the up or down arrow keys in order to change the frequency. Press the F. Set key again to accept the parameter.

4.1.7 Setting the Power/Power Factor

Press the Wattage/Power Factor key to select whether the Power P/F display will show wattage or power factor. If the LED indicator for P is lit the wattage will be displayed. If the LED indicator for PF is lit the power factor will be displayed.

4.1.8 Setting the Memories

Three memories are available via the M1, M2, and M3 keys. Press the memory key to which you would like to store your parameters. If the LED indicator is lit next to the memory key that memory is active. Program the settings you would like for voltage, current, frequency, voltage output range, wattage and power factor. Then press and hold the memory key in for several seconds. The LED indicator will begin flashing for several seconds and return to a solid state. Once the LED is in a solid state the memory has been stored.

4.1.9 Setting the Output & Reset

Press the Output/Reset key to set the output. If the LED indicator is lit the decimal points in the displays of voltage, current, frequency, and power/PF will blink

continuously notifying the operator that output is ON. If the LED indicator is not lit and the decimal points in the displays of voltage, current, frequency, and power/PF are lit steadily this indicates that the output will be OFF. When the output is OFF the displays will show their present settings.

If the Output/Reset LED indicator is flashing this is a notification that a limit threshold has been exceeded, a failure has occurred, or an instrument protection circuit has been activated. Press the Output/Reset key to reset the instrument to a normal state.

4.2 System Setup

Press the System key to change the system parameters. The LED indicator will be on when the System key is activated. The System key is only available if the output is off or the LED indicator is off on the Output/Reset key. The system parameters that can be set are power up state, high voltage limit, low voltage limit, high frequency limit, low frequency limit, over current fold back, and lock out. To set the parameters use the up or down arrow keys to change the parameter. To scroll through each of these system parameter settings you must press the System key.

4.2.1 System Parameters

Display				
Voltage	Current	Frequency	Power/PF	Explanation
P-UP	LASt			Output is on/off for power up based on last setting prior to power off
P-UP	OFF			Output is off on power up
P-UP	On			Output is on for power up
HI	300.0	Volt		High voltage limit setting (0.0 – 300.0 V)
LO	0.0	Volt		Low voltage limit setting (0.0 – 300.0 V)
HI	450.0	FrEq		High frequency limit setting (40.0 – 450.0 Hz)
LO	0.0	FrEq		Low Frequency limit setting (40.0 – 450.0 Hz)
Fold	OFF	OC		Over current fold back is off
Fold	On	OC		Over current fold back is on
LocH	OFF			Lockout is off
LocH	On			Lockout is on

4.2.2 Setting the Power Up

Press the System key until the voltage display reads P-UP. Press the up / down arrow key to toggle the following parameters:

LAST

OFF

ON

Press the System key again to accept the setting and move to the next parameter setting, high voltage limit.

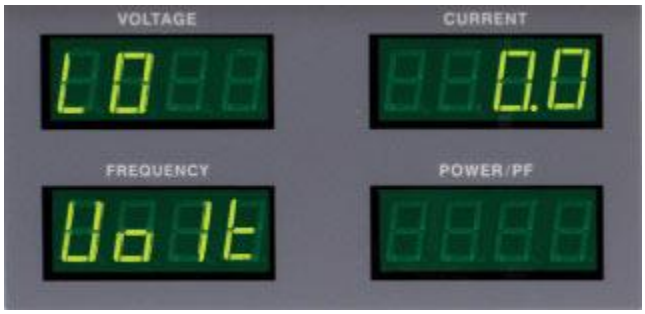
4.2.3 Setting the Voltage HI Limit

Press the System key until the voltage display reads HI and the frequency display reads Volt as shown below:

Press the up / down arrow key to select the high limit voltage (0.0 – 300.0 V). Press the System key again to accept the setting and move to the next parameter setting, low voltage limit.

4.2.4 Setting the Voltage LO Limit

Press the System key until the voltage display reads LO and the frequency display reads Volt as shown below:



Press the up / down arrow key to select the low limit voltage (0.0 – 300.0 V). Press the System key again to accept the setting and move to the next parameter setting, high frequency limit.

4.2.5 Setting the Frequency HI Limit

Press the System key until the voltage display reads HI and the frequency display reads FrEq as shown below:

Press the up / down arrow key to select the high limit frequency (40.0 – 450.0 Hz). Press the System key again to accept the setting and move to the next parameter setting, low frequency limit.

4.2.6 Setting the Frequency LO Limit

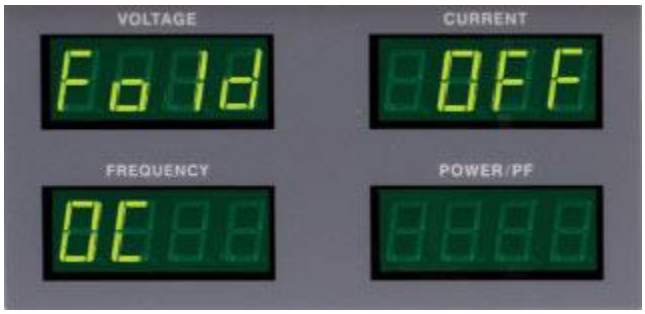
Press the System key until the voltage display reads LO and the frequency display reads FrEq as shown below:

Press the up / down arrow key to select the low limit frequency (40.0 – 450.0 Hz). Press the System key again to accept the setting and move to the next parameter setting, over current fold back.

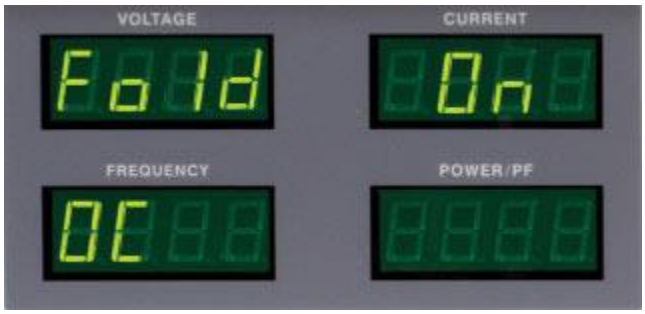
4.2.7 Setting the Over Current Fold back

Press the System key until the voltage display reads Fold and the frequency display reads OC. Press the up / down arrow key to select the over current fold back setting OFF or On the displays are shown below:

OFF



ON

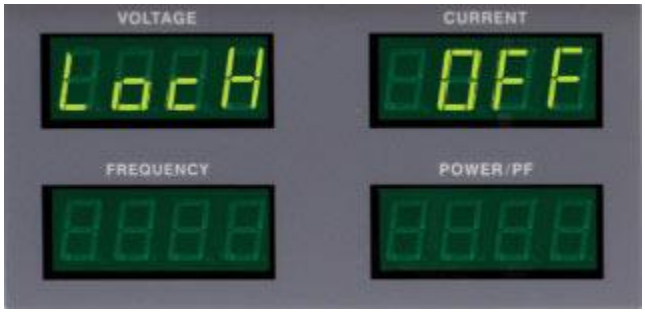


Press the System key again to accept the setting and move to the next parameter setting, lockout.

4.2.8 Setting the Lockout

Press the System Key until the voltage display reads LocH. Press the up / down arrow key to select the lockout state of OFF or On. The displays are shown below:

OFF



ON

Press the System key again to accept the setting. Since the lockout setting is the last parameter when the System key is pressed here you will exit the system parameter setup.

4.3 Error Messages

If an abnormal condition occurs, there are several error messages that could be indicated in the frequency display. When an abnormal condition occurs, the output will be disabled and the alarm will sound. The Output/Reset LED indicator will also begin flashing. Pressing the Output/Reset key will reset the audible alarm and the abnormal condition will be displayed.

WARNING All error messages occur in abnormal conditions and therefore must be recorded. Check the cause of the error to ensure the problem is eliminated before restarting the operation, or contact Associated Power Technologies, Inc., or our official distributors for further assistance.

4.3.1 Error Message Definition

Frequency Display	Definition
OtP	Over Temperature Protection
OCP	Over Current Protection
OPP	Over Power Protection
HI-A	High Limit Current Exceeded
OVP	Over Voltage Protection
A-SH	Amplifier Shutdown Protection
LVP	Low Voltage Protection

4.3.2 OtP – Over Temperature Protection

Displayed if the heat sink of the instrument has exceeded 130º C. The voltage and current displays will show the overloaded voltage or current respectively. The LED indicator for the Output/Reset key will be blinking.

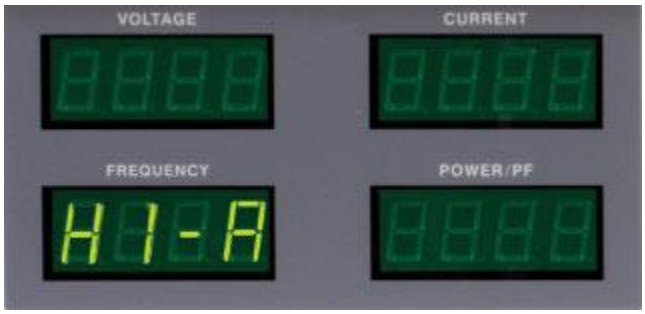
4.3.3 OCP – Over Current Protection

Displayed if the output current has exceeded 110% of maximum current rating for 1 second or there is a short circuit for 6 seconds. The LED indicator for the Output/Reset key will be blinking.

4.3.4 OPP – Over Power Protection

Displayed if the output power has exceeded 110% of maximum power rating for 1 second. The LED indicator for the Output/Reset key will be blinking.

4.3.5 HI-A – High Limit Current Exceed



Displayed if the output current has exceeded the setting of current. The LED indicator for the Output/Reset key will be blinking.

4.3.6 OVP – Over Voltage Protection

Displayed if the output voltage has exceeded 5 V of the setting voltage in the 0-150V range, or has exceeded 10 V of the setting voltage in the 0-300V range.

The LED indicator for the Output/Reset key will be blinking. If an OVP error occurs on the next power up cycle the displays will show
Volt Err.

4.3.7 A-SH – Amplifier Shutdown Protection

Displayed if the amplifier is in an abnormal condition. The LED indicator for the Output/Reset key will be blinking.

4.3.8 LVP – Low Voltage Protection

Displayed if the power source detects a discrepancy between the output voltage and the voltage setting of 10V or greater for more than 1sec. The LED indicator the Test/Reset key will be blinking.

5. Calibration Procedures

All Associated Power Technologies, Inc. instruments have been calibrated at the factory prior to delivery. The recommended calibration cycle for all APT instruments is every 12 months.

5.1 Hardware Verification

The hardware verification is required to be performed prior to the standard software calibration. This verification should be used to determine if a hardware calibration should be performed. All tests should be performed at 60 Hz. If the hardware verification requires adjustment proceed to **5.4 Hardware Calibration**. If the hardware verification does not require adjustment proceed to **5.7 Software Calibration**.

5.2 Hardware Verification Requirements

5.2.1 Required Measurement Standard

High Band DVM > 50 kHz capable of measuring millivolts DC and 110 VAC

5.2.2 Required Measurement Equipment.

- 475 kΩ, ¼ watt resistor
- 10 µF, 110 volt non-polarized capacitor
- 10 kΩ, 10 watt resistor

5.3 Hardware Verification Procedure

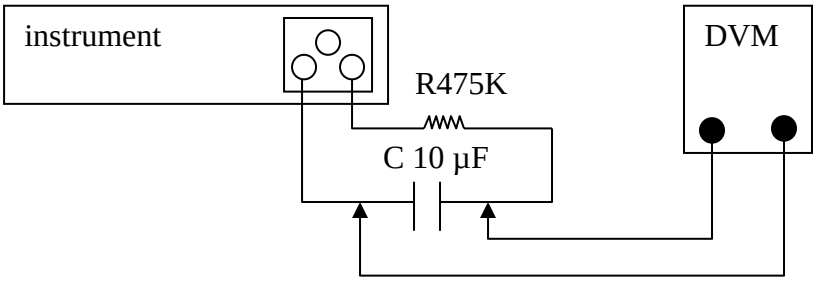
5.3.1 Activate Non-Calibration Mode

Press the V. Set key while simultaneously powering the instrument on.

5.3.2 Verify the High Frequency Noise

1. Connect the output of the instrument to the DVM
2. Set the DVM to measure to AC mV.
3. Set the output voltage to “0” volts in the low voltage range and activate the output of the instrument.

4. Verify that the reading on the DVM is <= 200 mV.



5.3.3 Verify the "110" Volts DC Offset

1. Connect the 475 kΩ resistor in series with the 10µf capacitor and connect the DVM and load to the instrument as illustrated in the following diagram:
2. Set the DVM to read DC millivolts.
3. Set the output voltage to "110 volts in the low voltage range and activate the output of the instrument.
4. Wait twenty seconds and take a measurement.
5. Verify that the DVM measures "0" volts +\- 100 mV.
6. Disconnect the load and the DVM.

5.3.4 Exit Non-Calibration Mode

Exit non-calibration mode for normal operation. Reset the unit by powering it off and then back on for standard operation mode.

5.4 Hardware Calibration

The hardware verification is required to be performed prior to the standard software calibration only if adjustments were necessary for the hardware verification of section 5.1. All tests should be performed at 60 Hz.

5.5 Hardware Calibration Requirements

5.5.1 Required Measurement Standard

- DVM capable of measuring millivolts DC and 110 VAC
- Potentiometer adjustment tool
- Oscilloscope
- Plastic inductor adjustment tool.
- 3 Ω, 3333 Watt (minimum) resistor for 5040
- 6 Ω, 1666 Watt (minimum) resistor for 5020
- 12 Ω, 833 Watt (minimum) resistor for 5010
- 24 Ω, 416 Watt (minimum) resistor for 5005

5.5.2 Required Measurement Equipment

- 475 kΩ, ¼ watt resistor.
- 10 µF, 110 volt non-polarized capacitor

5.6 Hardware Calibration Procedures

5.6.1 Activate Non-Calibration Mode

Press the V.Set key while simultaneously powering the instrument on.

5.6.2 Clear the High Frequency Noise

1. Connect the output of the instrument to the Oscilloscope.
2. Adjust the Oscilloscope to approximately 100mV/10µs. This will allow viewing of the high frequency noise.
3. Set the output voltage to “0” volts in the low voltage range and activate the output of the instrument.
4. Adjust the variable inductor, located either on the amplifier board or the output board, so that the high frequency waveform displayed on the Oscilloscope matches the numbers below. Refer to the service manual schematics for the designator and location of the variable inductor. There may also be some glue on top of the inductor, please remove this glue using the plastic inductor adjustment tool first.

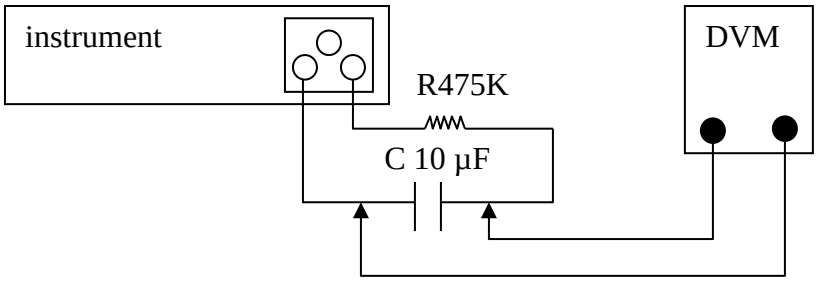
   Model 5005 <= 150mV P-P
   Model 5010 <= 200mV P-P
   Model 5020 <= 600mV P-P
   Model 5040 <= 900mV P-P

When doing this adjustment you may see some high frequency spikes and anomalies on the screen which are not critical or applicable to this adjustment.

5. Disconnect the Oscilloscope.

5.6.3 Adjust the "110" Volts DC Offset

1. Plug in the jumper to JP1 on the PWM6900C.
2. Connect the 475kΩ resistor in series with the 10 µF capacitor and connect the DVM and load to the instrument as illustrated in the following diagram:



3. Set the DVM to read DC millivolts.
4. Set the output voltage to 0V in the low voltage mode and activate the output of the instrument. Record the DVM value.
5. Set the output voltage to "115" volts in the low voltage (0 – 150 V) range and activate the output of the instrument.
6. Adjust VR1 on the CON6900 board so that the DVM measures the value which was recorded ±20mV
7. Reset the output and power the instrument off.
8. Remove the jumper from JP1 on the PWM6900C. Disconnect the load and the DVM.

5.6.4 OCP Set Point

1. Connect the necessary resistor for the corresponding model number to the output of the instrument:

Model	Resistor
5005	24 Ω, 416 watt resistor

5010	12 Ω, 833 watt resistor
5020	6 Ω, 1666 watt resistor
5040	3 Ω, 3333 watt resistor

2. Rotate VR2 of the CON6900 clockwise to the end of its travel.
3. Set the output voltage to “105” volts in the low voltage range and activate the output of the instrument.
4. Using the arrow keys, adjust the voltage up until the specified current is displayed on the current meter for each model:

Model	Current Meter Setting
5005	4.88 ± 0.05 Amps
5010	9.75 ± 0.10 Amps
5020	19.50 ± 0.20 Amps
5040	39.00 ± 0.40 Amps

5. Wait 15 seconds
6. Rotate VR2 counter clockwise until the frequency meter displays OCP.

5.6.5 Exit Non-Calibration Mode

Exit non-calibration mode for normal operation. Reset the unit by powering it off and then back on for standard operation mode.

5.7 Software Calibration

The software calibration is recommended to be performed after the hardware verification and hardware calibration have been completed.

5.8 Software Calibration Requirements

5.8.1 Required Measurement Standard

- 0-60 Amp AC True RMS Ammeter
- 0-300 VAC True RMS Meter
- 4000 W Watt Meter

5.8.2 Required Measurement Equipment

- 3 Ω / 3333 W Resistor for 5040 Model
- 6 Ω / 1666 W Resistor for 5020 Model

- 12 Ω / 833 W Resistor for 5010 Model
- 24 Ω / 416 W Resistor for 5005 Model

5.8.3 Activate Software Calibration Mode

To enter the calibration mode you must power on the instrument while pressing the A. Set key. The displays will read as follows based on the calibration mode. The System key is used to toggle between the different calibration modes. To exit the calibration mode turn OFF the instrument via the power switch.

Display				
Voltage	Current	Frequency	Power/PF	Explanation
150.0	150.0	U-LO	CAL	Calibration mode for the volt low setting
300.0	300.0	U-HI	CAL	Calibration mode for the volt high setting
100.0	10.00	A-HI	CAL	Calibration mode for the current high setting
100.0	1000	P-HI	CAL	Calibration mode for the power meter setting

5.8.4 Low Range Voltage Calibration

Press the System key until the Frequency display reads U-LO. Connect a calibrated true RMS voltmeter on one of the output sockets of the universal receptacle and press the Output/Reset key in order to activate the CPU to read a low range offset voltage and send a 150 VAC output voltage. The accurate RMS voltmeter will indicate an actual voltage while the current display on the instrument will indicate a necessary value needed to be calibrated. Using the voltage value from the RMS voltmeter press the up and down arrow keys to select the appropriate voltage level, which will be displayed in the Current display. Press the System key to save the new value.

5.8.5 High Range Voltage Calibration

Press the System key until the Frequency display reads U-HI. Connect a calibrated true RMS voltmeter on one of the output sockets of the universal receptacle and press the Output/Reset key in order to activate the CPU to read a low range offset voltage and send a 300 VAC output voltage. The accurate RMS voltmeter will indicate an actual voltage while the current display on the instrument will indicate a necessary value needed to be calibrated. Using the voltage value from the RMS voltmeter press the up and down arrow keys to select the appropriate voltage level, which will be displayed in the Current display. Press the System key to save the new value.

5.8.6 High Range Current Calibration

Press the System key until the Frequency display reads A-HI. Connect a variable resistor as the load and a calibrated true RMS ammeter on one of the output sockets of the universal receptacle and press the Output/Reset key in order to activate the CPU to read a high range offset current and send a 100 VAC output voltage. The accurate RMS ammeter will indicate an actual current while the current display on the instrument will indicate a necessary value needed to be calibrated. Adjust the load or voltage to get the reading from the ammeter to the following suggested values: (500VA ≤ 4.5A, 1KVA ≤ 9A, 2 KVA ≤ 18 A, 4 KVA ≤ 36 A). Using the current value from the RMS ammeter press the up / down arrow keys to select the appropriate current level, which will be displayed in the Current display. Press the System key to save the new value.

5.8.7 High Range Power Calibration

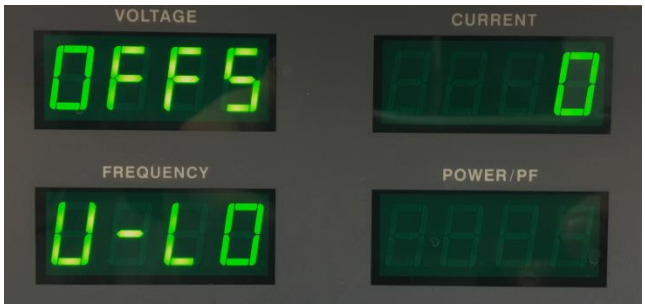
Press the System key until the Frequency display reads P-HI. Connect a variable resistor as the load and a calibrated true RMS power meter on one of the output sockets of the universal receptacle and press the Output/Reset key in order to activate the CPU to read a high range offset power and send a 100 VAC output voltage. The accurate RMS power meter will indicate an actual power while the current display on the instrument will indicate a necessary value needed to be calibrated. Adjust the load or voltage to get the reading from the power meter to the following suggested values (500VA ≤ 500W, 1KVA ≤ 1000W, 2 KVA ≤ 2000W, 4 KVA ≤ 4000W). Using the power value from the RMS power meter press the up / down arrow keys to select the appropriate power level, which will be displayed in the Current display. Press the System key to save the new value.

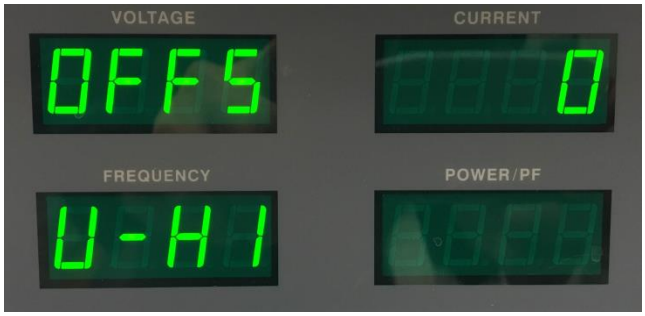
5.9 Additional Calibration Steps After Calibration:

Connect the instrument's output to an external True RMS Volt meter. Set the output on APT source to 10V and record the voltage on standard meter in both the 0 - 150V and 0 - 300V range. To change between the two ranges press the key Range key described in section 3.2.1 Front Panel Control of this manual. When the 0-150V indicator LED is illuminated the output is set to the low range. When the 0-300V indicator LED is illuminated the output is set to the high range. These recorded data will be used for the steps below.

Power on the instrument while pressing the System key. The displays will read as follows based on the calibration mode. The System key is used to toggle between

the different calibration modes. To exit the calibration mode turn OFF the instrument via the power switch.





Use the ∧, ∨ soft keys to enter the 10V reading's decimal value in hundreds of millivolts. Example: if the standard meter reads 10.4V, then use the ∧ key to set "4".

Exit the calibration mode by turning OFF the instrument via the power switch. Power up the instrument normally and check the standard reading 10V.

6. Options

6.1 Option 01 – 230 VAC ± 10%

This option allows an input voltage of 230 VAC. This option is available for the 5020 & 5040 models.

6.2 Opt. 02 – Grounded Neutral

This option will ground the neutral output. It is ideal for customers looking to reduce overall leakage current that can result from the instrument itself in normal operation. This option is ideal for the medical industry. This option is available for all models (5005, 5010, 5020, & 5040).

7. Service & Maintenance

7.1 User Protection

To avoid electrical shock do not dismantle the cover of the instrument. When any abnormal symptom happens with the instrument, please contact Associated Power Technologies, Inc. or the authorized distributor for assistance.

7.2 Consistency of Service

The instrument's internal circuits and all related parts are required to be checked and calibrated at least once every year. This is to protect the user in terms of safety and to ensure a high accuracy of operation and measurement of this instrument at all times.

7.3 User Modification

Modification by the user of the instrument's internal circuits and all related parts is not recommended. All warranties will be void if any modifications have been conducted by the user. Associated Power Technologies, Inc. reserves the right to convert the original circuitry to its original state if any modifications have been made to the instrument. The customer will be responsible for any charges associated with bring the instrument to its original state.

8. Replacement Parts List

Rev: E 02/04/2015 ECO 5736

Part Number	Qty.	Ref. Designator	Description
Supplied Accessories			
38503	1	-(5005)	Fuse 10A 250V Slow-Blow 20mm
38896	1	-(5010 and 5020)	Fuse 20A 250V Slow-Blow 20mm
33189	1	-	Cable Input Cordset USA
Panel Components			
38882	1	-	Universal Receptacle 3kV
38109	1	-	Power Switch 2P 10A/250V
38274	12	-	Button Keypad Rect. 9.8 x 8.0mm
38947	1	(5040)	40A Circuit Breaker
38952	1	(5040)	15A Circuit Breaker
38960	1	(5040)	40A Terminal Block
38021	12	-	Diode LED Red Square
38895	4	-	Tapered Plastic Feet
39427	1	(5020)	Input Terminal Cover Kit
39428	1	(5040)	I/O Terminal Cover Kit
PCB Assemblies			
38890	1	DSP6900	Display Board
38891	1	PWM6900	PWM Control Board
38924	1	AMP6905	Amplifier Board (5005)
38888	1	AMP6910	Amplifier Board (5010)
38925	1	AMP6920	Amplifier Board (5020)
38934	1	AMP6600	Amplifier Board (5040)
38935	1	DCB6940	DC Power Board (5040)
38936	1	OPT6660	Output Control Board (5040)
38994	1	PWR6920	Input Power Board (5020)
38953	1	PWR6940	Input Power Board (5040)
38889	1	CON6900	Main Control Board
38892	1	PWR6910	Input Voltage Select Board (5005 and 5010)
Internal Components			
38262	1	IC 9	IC W78E516B
38930	1	T1	Input Transformer for 5005
38900	1	T1	Input Transformer for 5010
38956	1	T2	Input Transformer (Control Board) for 5020

Part Number	Qty.	Ref. Designator	Description
39041	1	T1	Input Transformer 208/230VAC Tappable for 5040
39517	2	T1, T2	INPUT TRANSFORMER 208/230VAC TAPPABLE FOR 5020