Operation Manual

CPS100 Series – Rev 1.19   P/N 160953-10

CPS100 Series Programmable AC & DC Power Supplies

ADAPTIVE Power Systems

Worldwide Supplier of Power Equipment

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1 Contact Information

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2 Warranty, Service and Safety Information

2.1 Limited Warranty

Adaptive Power Systems, Inc. (APS) warrants each unit to be free from defects in material and workmanship. For the period of one (1) years from the date of shipment to the purchaser, APS will either repair or replace, at its sole discretion, any unit returned to the APS factory in Irvine, California or one of its designated service facilities. It does not cover damage arising from misuse of the unit or attempted field modifications or repairs. This warranty specifically excludes damage to other equipment connected to this unit.

Upon notice from the purchaser within (30) days of shipment of units found to be defective in material or workmanship, APS will pay all shipping charges for the repair or replacement. If notice is received more than thirty (30) days from shipment, all shipping charges shall be paid by the purchaser. Units returned on debit memos will not be accepted and will be returned without repair.

This warranty is exclusive of all other warranties, expressed or implied.

2.2 Service and Spare Parts Limited Warranty

APS warrants repair work to be free from defects in material and workmanship for the period of ninety (90) days from the invoice date. This Service and Spare Parts Limited Warranty applies to replacement parts or to subassemblies only. All shipping and packaging charges are the sole responsibility of the buyer. APS will not accept debit memos for returned power sources or for subassemblies. Debit memos will cause return of power sources or assemblies without repair.

This warranty is exclusive of all other warranties, expressed or implied.

2.3 Safety Information

This chapter contains important information you should read BEFORE attempting to install and power-up APS Equipment. The information in this chapter is provided for use by experienced operators. Experienced operators understand the necessity of becoming familiar with, and then observing, life-critical safety and installation issues. Topics in this chapter include:

- Safety Notices
- Warnings
- Cautions
- Preparation for Installation
- Installation Instructions

Make sure to familiarize yourself with the **SAFETY SYMBOLS** shown on the next page. These symbols are used throughout this manual and relate to important safety information and issues affecting the end user or operator.

SAFETY SYMBOLS

Symbol	Description
⎓	**Direct current (DC)**
∿	**Alternating current (AC)**
≂	**Both direct and alternating current**
3∿	**Three-phase alternating current**
⏚	**Protective Earth (ground) terminal**
│	**On (Supply)**
○	**Off (Supply)**
⊡	**Fuse**
⚠	**Caution: Refer to this manual before this using Product.**
⚡	**Caution, risk of electric shock**
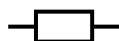
2.4   Safety Notices

SAFETY SUMMARY

The following general safety precautions must be observed during all phases of operation, service, and repair of this instrument. Failure to comply with these precautions or with specific warnings elsewhere in this manual violates safety standards of design, manufacture, and intended use of the instrument. Adaptive Power Systems assumes no liability for the customer's failure to comply with these requirements.

GENERAL

This product is a Safety Class 1 instrument (provided with a protective earth terminal). The protective features of this product may be impaired if it is used in a manner not specified in the operation instructions.

ENVIRONMENTAL CONDITIONS

This instrument is intended for indoor use in an installation category I, pollution degree 2 environments. It is designed to operate at a maximum relative humidity of 80% and at altitudes of up to 2000 meters / 6560 feet. Refer to the specifications tables for the ac mains voltage requirements and ambient operating temperature range.

BEFORE APPLYING POWER

Verify that the product is set to match the available line voltage and the correct fuse is installed.

GROUND THE INSTRUMENT

This product is a Safety Class 1 instrument (provided with a protective earth terminal). To minimize shock hazard, the instrument chassis and cabinet must be connected to an electrical ground. The instrument must be connected to the AC power source mains through a properly rated power cord, with the ground wire firmly connected to an electrical ground (safety ground) at the power outlet. Any interruption of the protective (grounding) conductor or disconnection of the protective earth terminal will cause a potential shock hazard that could result in personal injury.

FUSES

Only fuses with the required rated current, voltage, and specified type (normal blow, time delay, etc.) should be used. Do not use repaired Fuses or short circuit the fuse holder. To do so could cause a shock or fire hazard.

DO NOT OPERATE IN AN EXPLOSIVE ATMOSPHERE.

Do not operate the instrument in the presence of flammable gases or fumes.

KEEP AWAY FROM LIVE CIRCUITS.

Operating personnel must not remove instrument covers. Component replacement and internal adjustments must be made by qualified service personnel. Do not replace components with power cable connected. Under certain conditions, dangerous voltages may exist even with the power cable removed. To avoid injuries, always disconnect power, discharge circuits and remove external voltage sources before touching components.

DO NOT SERVICE OR ADJUST ALONE.

Do not attempt internal service or adjustment unless another person, capable of rendering first aid and resuscitation, is present.

DO NOT EXCEED INPUT RATINGS.

This instrument may be equipped with a line filter to reduce electromagnetic interference and must be connected to a properly grounded receptacle to minimize electric shock hazard. Operation at line voltages or frequencies in excess of those stated on the data plate may cause leakage currents in excess of 5.0 mA peak.

DO NOT SUBSTITUTE PARTS OR MODIFY INSTRUMENT.

Because of the danger of introducing additional hazards, do not install substitute parts or perform any unauthorized modification to the instrument. Return the instrument to an Adaptive Power Systems Sales and Service Office for service and repair to ensure that safety features are maintained.

Instruments that appear damaged or defective should be made inoperative and secured against unintended operation until they can be repaired by qualified service personnel.

3   Product Overview

This chapter provides an overview of the APS CPS100 Series programmable, AC and DC power sources. It introduces the reader to general operating characteristics of these power sources. Operational information and menu navigation details are provided in Section 6, "Front Panel Operation".

3.1   General Description

The APS CPS100 Series is available in seven different power levels and either Standard or Enhanced configurations, for a total of 14 unique models. Each model has similar electrical performance and operational characteristics except for maximum AC input currents, AC and DC output currents and AC input voltage requirements. Refer to Section 4, "Technical Specifications" for specific AC input specifications by model.

Note: Some functions and features described in this manual apply to the Enhanced version of the CPS100**E** Series models only. Where relevant, this will be indicated by this

ENHANCED VERSION ONLY   banner.

3.1.1   Models CPS106, CPS110 & CPS115

These are the smallest models offered at 600VA, 1000VA and 1500VA output respectively. Output voltage ranges are 150Vac and 300Vac in AC mode or 212Vdc and 424Vdc in DC mode. The models are the most compact having a height of 2U or 3.5"/ 89 mm only.

3.1.2   Model CPS120

The 2kVA/2KW CPS120 models offers the same features as the 2U units but supports 2000VA/W output power. Output voltage ranges are 150Vac and 320Vac in AC mode or 212Vdc and 424Vdc in DC mode. The CPS120 chassis has a height of 3U or 5.25"/ 133 mm.

3.1.3   Models CPS130, CPS140 & CPS150

These are the largest models offered at 3000VA, 4000VA and 5000VA output respectively. Output voltage ranges are 150Vac and 320Vac in AC mode or 212Vdc and 424Vdc in DC mode. The models have chassis height of 4U or 7"/ 178 mm.

3.2 Product Features

The following key characteristics apply to all CPS100 Series models:

- Fully programmable AC and DC output modes
- Frequency range in AC mode is 15 Hz to 1000 Hz (Standard "S"version) or 15 Hz to 1200 Hz (Enhanced "E" version)
- Dual voltage ranges in both modes
- AC voltage ranges are 0-150Vac and 0-300Vac RMS.
- CPS120, CPS130, CPS140 & CPS150 models support up to 320Vac RMS below 200Hz.
- DC voltage ranges are 0-212Vdc and 0-424Vdc.
- Programmable Current limit with Fold-Back (CC) and Shutoff Modes (CV)
- Full complement of output parameter metering:
  - Frequency
  - Volt AC or DC
  - Current AC or DC
  - AC Peak Current
  - Current Crest Factor
  - True Power
  - Apparent Power
  - Power Factor
- Over voltage, over current, over power and over temperature protection
- Fan Cooled
- RS232, RS488, USB, LAN and GPIB remote control interfaces
- Remote Interlock

3.3 Standard versus Enhanced Versions

The CPS100 Series is available in one of two versions, Standard (S Suffix) or Enhanced (E Suffix). The version is identified in the model number by either an S or an E at the end of the model. Standard versions cannot be upgraded to Enhanced versions due to hardware and firmware differences so desired version must be specified at time of order.

The table below highlights the differences between the two versions.

FEATURES VERSION:	STANDARD	ENHANCED
AC Mode	●	●
DC Mode	●	●
AC+DC Mode	●	●
Frequency Range	15-1000Hz	15-1200Hz
Dual AC Voltage Ranges 150/300 or 320Vac	●	●
Dual DC Voltage Ranges 212/425 Vdc	●	●
Harmonic Waveforms Library (fixed)	●	●
Waveform Synthesis from Front Panel	●	●
Transient List Mode	●	●
Measurements	●	●
Harmonic Waveform Synthesis		●
Harmonic Analysis & THD Measurements		●
Programmable Impedance		●
IEC411	●	●

FEATURES	VERSION:	STANDARD	ENHANCED
IEC413			●
IEC414			●
IEC428			●
Triac Function			●
LAN		option	●
USB		●	●
GPIB		option	option
RS232		●	●
RS485		●	●

3.4 Output Voltage Coupling Modes

The CPS100 Series offers three output coupling modes that are user selectable.

Mode	Description
AC MODE	CPS100 provides AC Voltage Output (AC Coupled)
DC MODE	CPS100 provides DC Voltage Output (DC Coupled)
AC+DC MODE	CPS100 provides combination of both AC and DC Voltage Output. (AC+DC Coupled) **Note:** The maximum peak voltage of any AC+DC combination cannot exceed 424Vpk in either positive or negative quadrant.

Table 3-1: CPS100 Series Output Coupling Modes

3.5 Voltage Ranges

Two voltage ranges are available, a 150V range (low) and a 300V or 320V range (high). Low range is always half the maximum available voltage on the HIGH range. Maximum current in the low range is two times that of the high range. The high range allows the maximum voltage to be programmed.

Range values are different for AC and DC modes as follows:

Mode	150V RANGE	300V RANGE
AC	0– 150 Vac RMS	CPS106 ~ CPS115: 0– 300 Vac RMS CPS120 ~ CPS150: 0 -320 Vac RMS < 200Hz 0 – 300Vac RMS > 200Hz
DC	0– 212 Vdc	0– 424 Vdc

Table 3-2: Available Voltage Ranges by Output Mode

An AUTO mode may be selected as well. In AUTO voltage range, the power source automatically switches between the low and high voltage ranges as determined by the voltage set point.

Note: AUTO mode switching causes momentary loss of output voltage as the output relay opens to allow the power source to re-configure its output. The no-output period is about 300 msecs long so the unit under test will power down until voltage is re-applied after the

range change operation. If this behavior is not desirable, select the 300V (high) range to prevent this from happening.

3.6 Current Protection Modes

Current protection is an important feature on programmable power sources as it allows protection of the unit under test against damage caused by over current conditions. The default setting for current limit is the maximum supported value for the voltage range selected. However, it should be set to a value appropriate for protecting the unit under test, before applying power. Current limit set values are in Aac RMS for AC current and Adc for DC mode.

Current protection mode is available using one of two modes of operation:

Current Fold-Back: In this mode, load current is limited to the set current limit value by reducing the output voltage. Thus, while in fold back mode, the output voltage will be less than the programmed (set) voltage. As the load impedance increases and thus the load current decreases, the voltage will go up until the load current is at or below the programmed current limit value and the voltage is at the set value.

Current Fault Mode: In this mode, the CPS100 Series will fault and open the output relay when the load current exceeds the set current limit value for some period. This period depends on the amount of load current. At current levels slightly above the set value, this time may be longer. At load currents significantly higher than the set current level – i.e. a short circuit condition - this period will be short.

3.7 Voltage & Current Output Profiles

The CPS100 Series provides higher load current at lower voltage as long as the total output power is within its power band. This results in a constant power voltage/current profile as shown in the following charts for each model by output mode (AC or DC), and voltage range (high (300Vac/424Vdc) or low (150Vac/212Vdc)).

This provides greater versatility compared to point-rated AC or DC power sources that provide maximum current and power **only** at full-scale output voltage.

3.7.1 CPS106 Model VI Curves – 600W
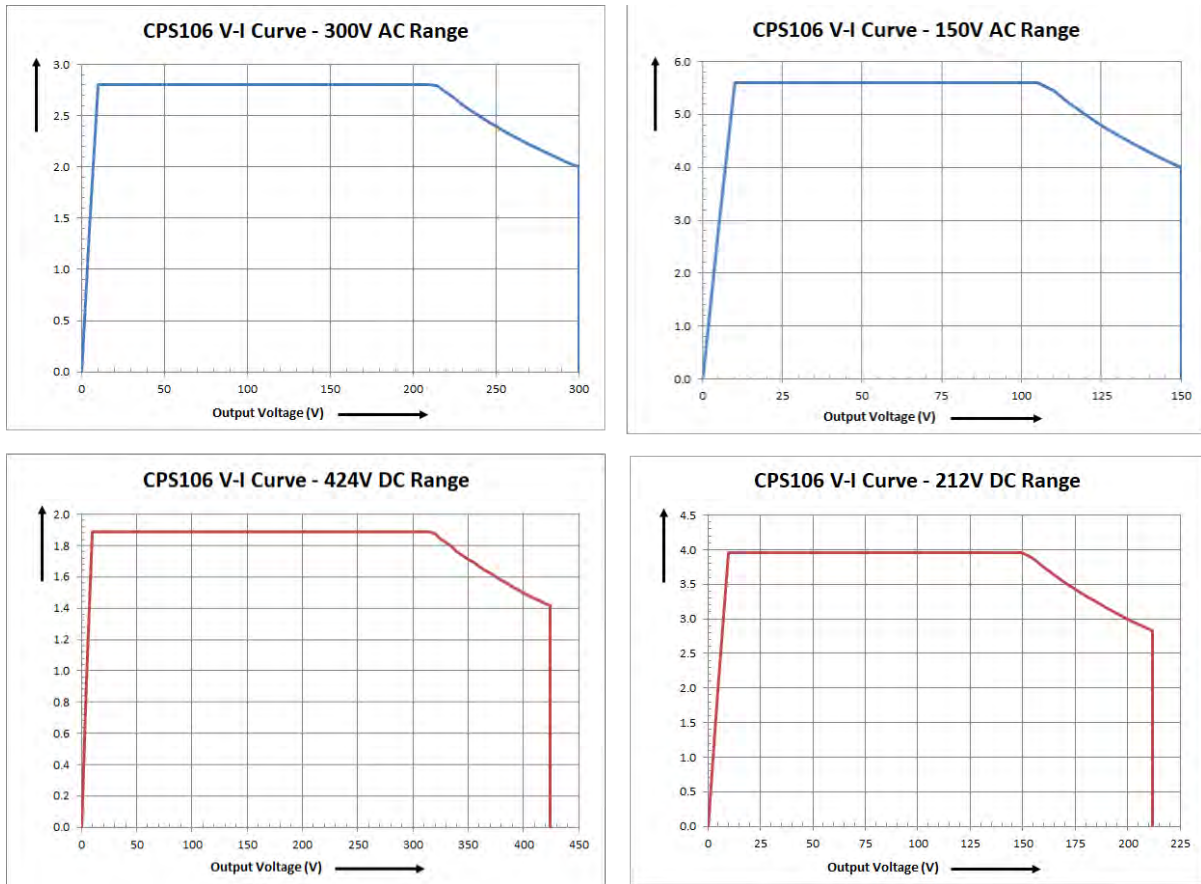
Figure 3-1: CPS106 Model VI Curves

3.7.2 CPS110 Model VI Curves – 1000W
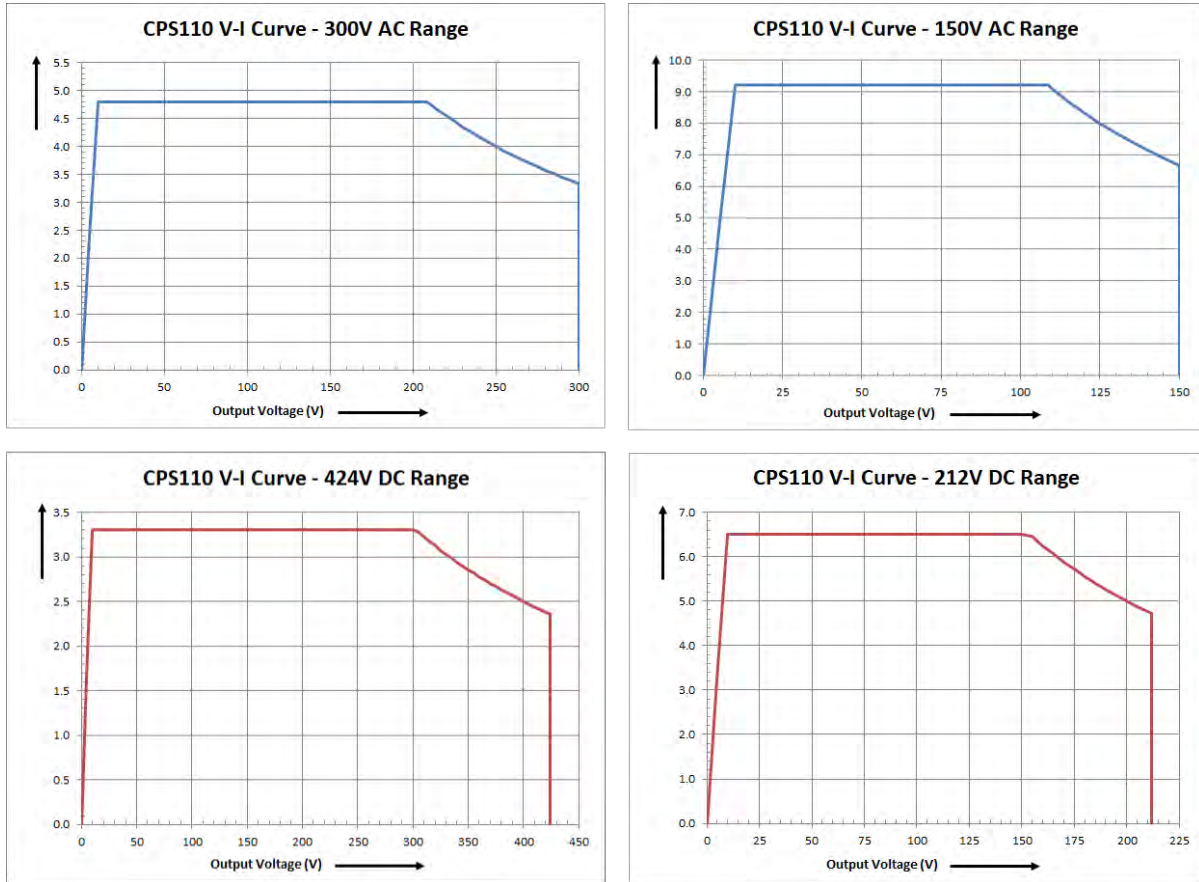
Figure 3-2: CPS110 Model VI Curves

3.7.3 CPS115 Model VI Curves – 1500W
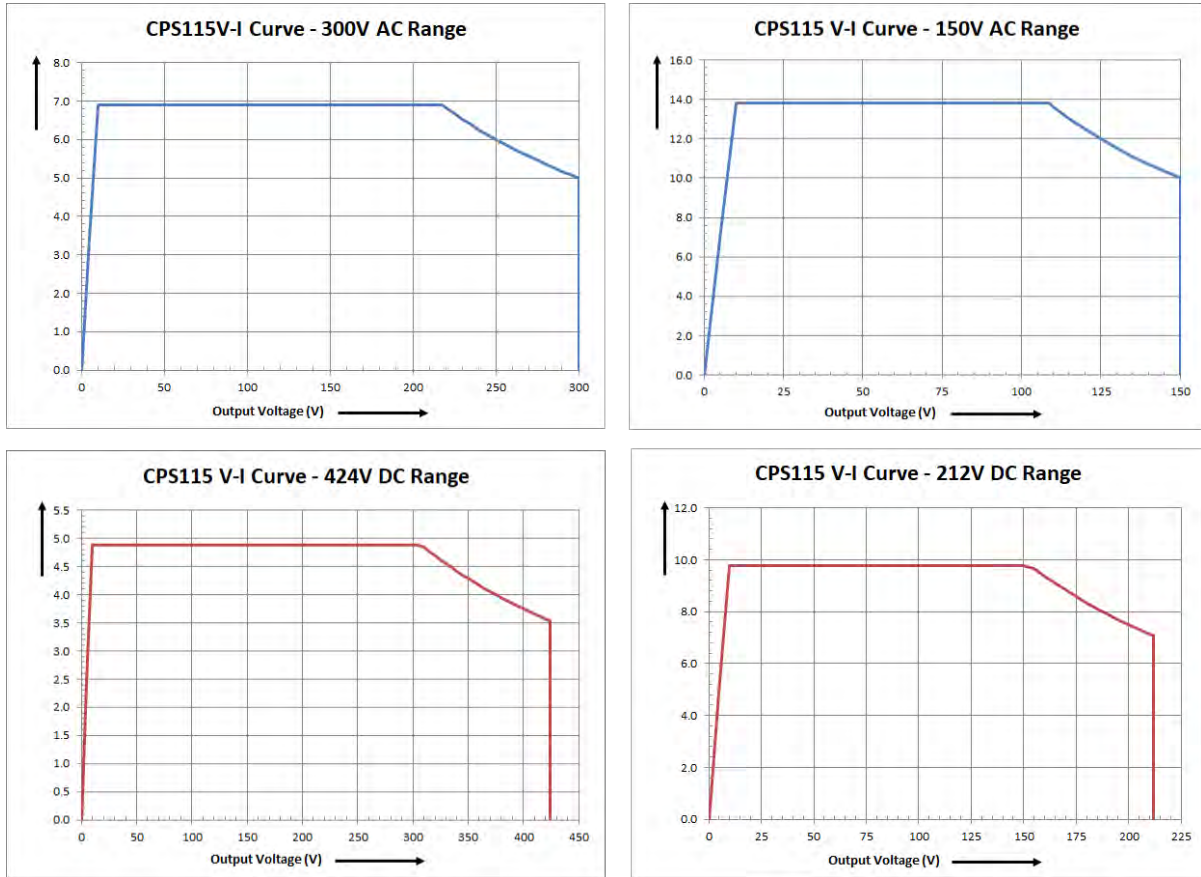
Figure 3-3: CPS115 Model VI Curves

3.7.4   CPS120 Model VI Curves – 2000W
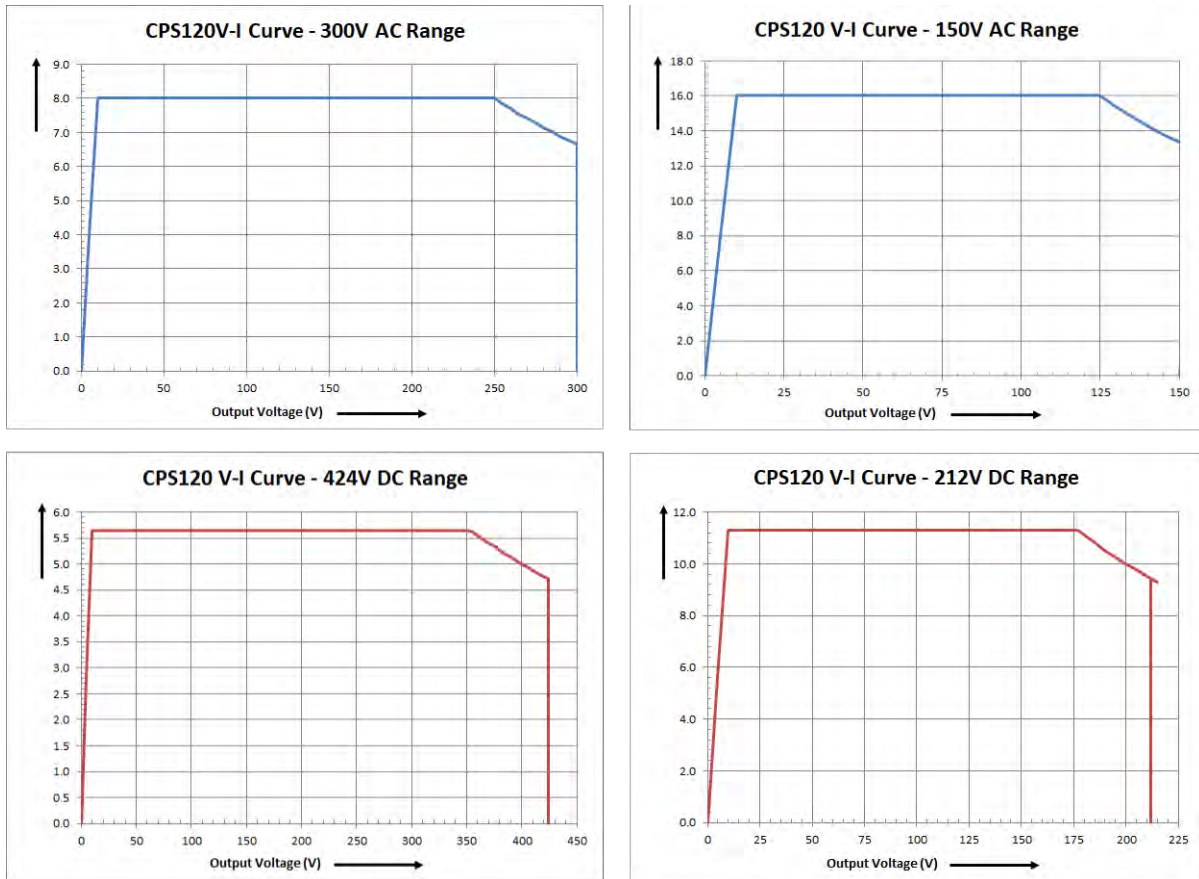
Figure 3-4: CPS120-Model VI Curves
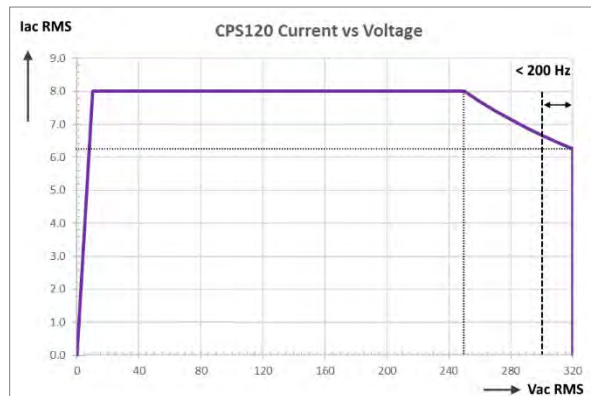
Figure 3-5: CPS120 High Voltage AC Range < 200Hz

3.7.5   CPS130 Model VI Curves – 3000W
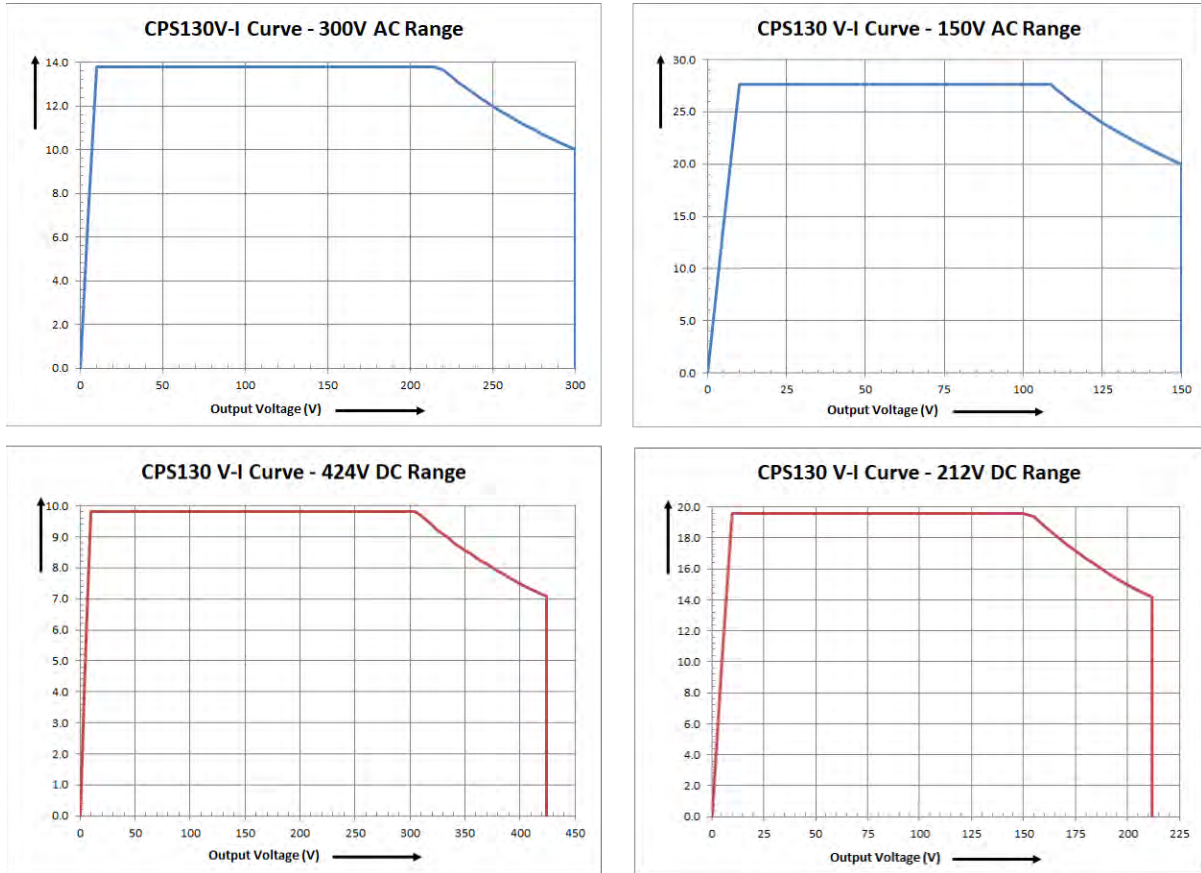
Figure 3-6: CPS130-Model VI Curves
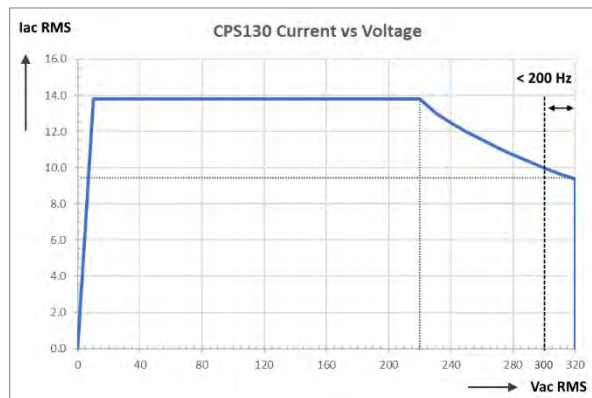
Figure 3-7: CPS130 High Voltage AC Range < 200Hz

3.7.6   CPS140 Model VI Curves – 4000W
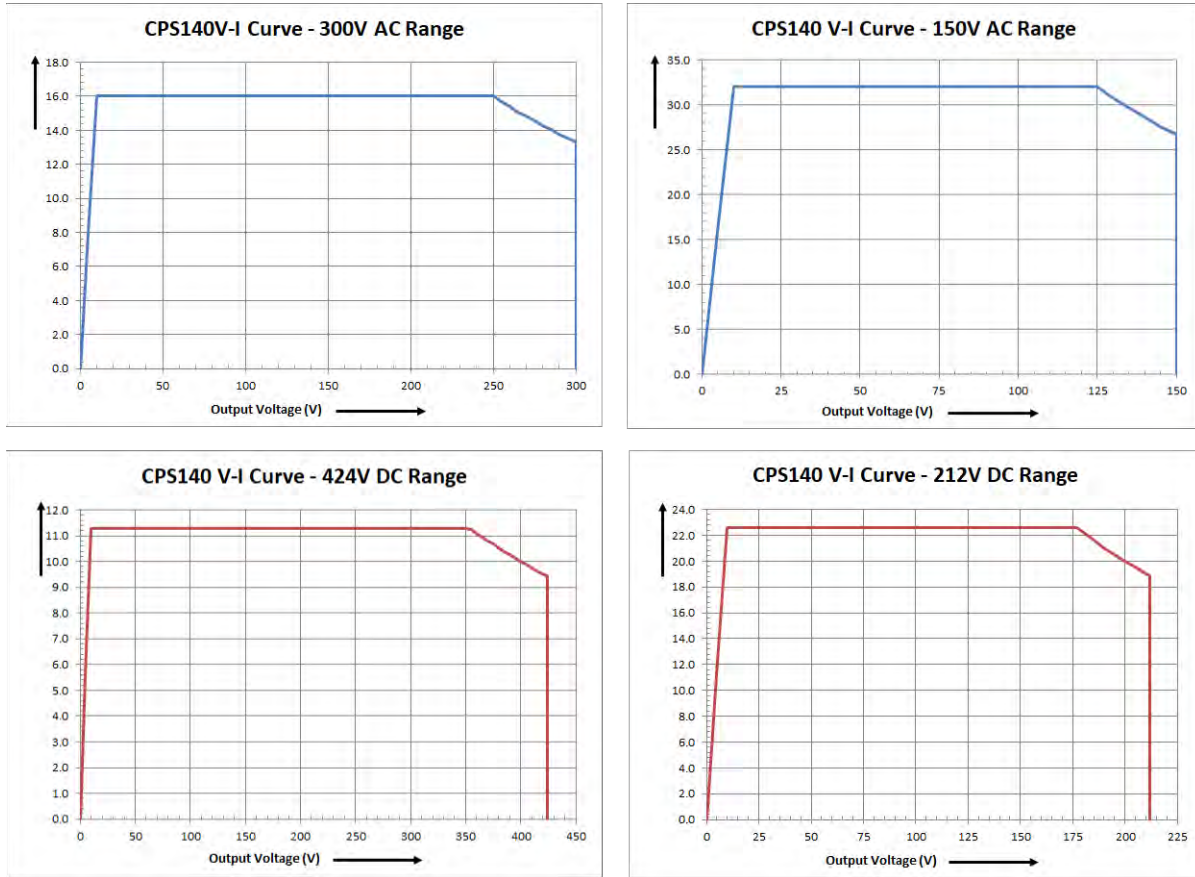
Figure 3-8: CPS140-Model VI Curves
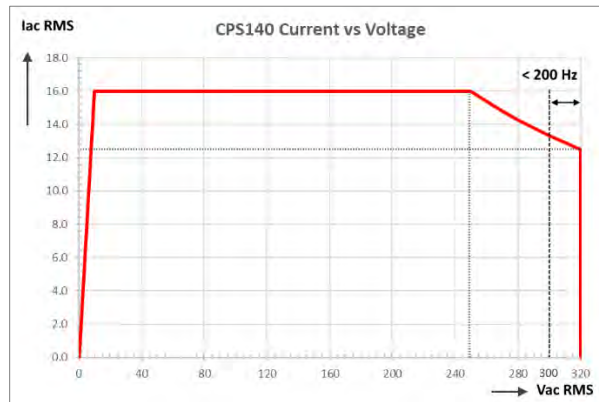
Figure 3-9: CPS140 High Voltage AC Range < 200Hz

3.7.7   CPS150 Model VI Curves – 5000W
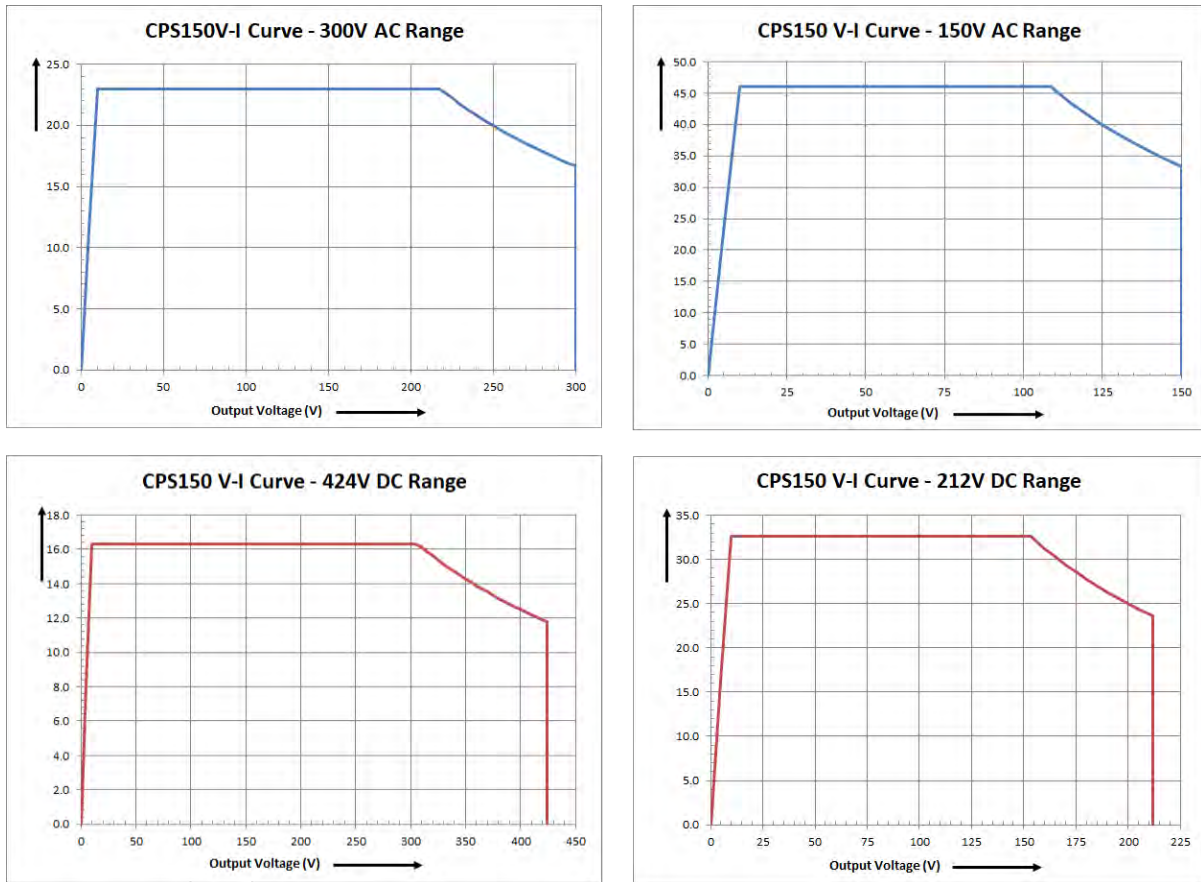
Figure 3-10: CPS150-Model VI Curves
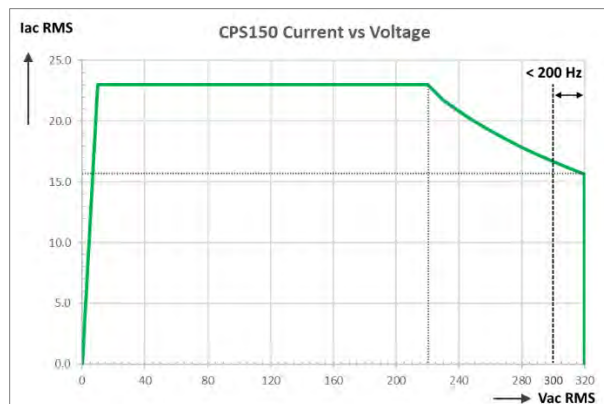
Figure 3-11: CPS150 High Voltage AC Range < 200Hz

4 Technical Specifications

Technical specifications shown here apply at an ambient temperature of 25° C ± 5° and after a 30 min warm-up time.

4.1 Output

OUTPUT POWER & CURRENT SPECIFICATIONS								
Model		CPS106	CPS110	CPS115	CPS120	CPS130	CPS140	CPS150
Power Rating (VA/W)		600	1000	1500	2000	3000	4000	5000
AC Current (Adc)	150V Range	5.6	9.2	13.8	16.0	27.6	32.0	46.0
	300V or 320 V Range	2.8	4.6	6.9	8.0	13.8	16.0	23.0
Crest Factor		5.8 to 1	6 to 1				5 to 1	4 to 1
DC Current (Adc)	212V Range	3.96	6.5	9.76	11.3	19.6	22.6	32.6
	424V Range	1.89	3.3	4.88	5.65	9.8	11.3	16.3

OUTPUT SPECIFICATIONS			
Model		CPS106 ~ CPS115	CPS120 ~ CPS150
Voltage Ranges	AC Low / High	0 - 150 Vac / 0 - 300 Vac	0 - 150 Vac / 0 - 320 Vac
	DC Low / High	0 - 212 Vdc / 0 - 424 Vdc	
	Resolution	0.1 V	
	Accuracy	± (0.3% setting + 0.3% F.S.)	
Waveforms		Sine, Square, Clipped Sine, Fixed (30), User (6)	
Frequency	Range	S Versions: 15 - 1000 Hz, E Versions: 15 - 1200 Hz	
	Resolution	0.1 Hz 15.0 - 99.9 Hz / 1 Hz 100 Hz - 1000 Hz / 5Hz 1001 Hz - 1200 Hz	
	Accuracy	± 0.1% of setting	± 0.03% of setting
Start/Stop Phase	Range	0 - 359.9°	
	Resolution	± 1° @ 45 - 65 Hz	
	Accuracy	±1%, 45- 65 Hz	
Load Regulation		± 0.1% F.S. RL, DC, 15-100 Hz	

OUTPUT SPECIFICATIONS	
	± 0.5% F.S. RL, 100.1-1200 Hz
External Voltage Sense	Remote sense, Max Vdrop 5.0V
Line Regulation	± 0.1 V
Harmonic Distortion (THD)(Full Resistive Load)	15-70Hz: < 0.3% @ 80-140Vac in Low Range, @ 160-280Vac in High Range
	70.1-500Hz: < 1% @ 80-140Vac in Low Range, @ 160-280Vac in High Range
	501-1000Hz: < 1% @ 100-140Vac in Low Range, @ 160-280Vac in High Range
	1001-1200Hz: < 2% @ 100-140Vac in Low Range, @ 160-280Vac in High Range
Ripple & Noise (rms)	L: < 700 mVrms @ 20Hz-1MHz BW
	H: < 1100 mVrms @ 20Hz-1MHz BW
Ripple & Noise (peak)	< 4000mVpp @ 20Hz-1MHz BW
Voltage Rise / Fall time	< 180 usec
Over Current Fold-back — Resolution	0.01 A
Over Current Fold-back — Accuracy	± (0.5% setting + 1.0% F.S.)
Over Current Fold-back — Response	< 1400 msec

4.2 Metering

CURRENT & POWER MEASUREMENTS								
Model		CPS106	CPS110	CPS115	CPS120	CPS130	CPS140	CPS150
Current RMS (Arms)	High Range	0.1-5.46	0.15-9.2	0.15-13.8	0.15-20.0	0.3-27.6	0.3-32	0.3-46
	Med. Range	-	-	-	-	0.2-20A	0.2-20	0.2-20
	Low Range	0.1-2.8	0.1-4.6	0.1-6.9	0.1-5	0.1-5	0.1-5	0.1-5
	mA Range	-	-	-	0.02-1.5	0.02-1.5	0.02-1.5	0.02-1.5
	Resolution	0.01 A						
	Accuracy	H/M: ± (0.4% setting + 1.0% F.S.) L/mA: ± (0.4% setting + 1.0% F.S.)			H/M: ± (0.4% setting + 1.5% F.S.) L/mA: ± (0.4% setting + 1.2% F.S.)		H/M: ± (0.4% setting + 1.0% F.S.) L/mA: ± (0.4% setting + 1.5% F.S.)	
Peak Curr. (A)	Range	0 - 32.4 A	0 - 81.5 A	0 - 81.5 A	0 - 81.5 A	0 - 168.6 A	0.05 - 163 A	0.05 - 188 A
	Resolution	0.01 A						

CURRENT & POWER MEASUREMENTS								
	Accuracy	H/M: ± (0.4% setting + 1.0% F.S.) L/mA: ± (0.4% setting + 1.0% F.S.)			H/M: ± (0.4% setting + 0.6% F.S.) L/mA: ± (0.4% setting + 1.0% F.S.)			
Power (Watts)	Range	0-612	0-1020	0-1530	0-2040	0-3060	0-4080	0-5100
	Resolution	0.1						
	Accuracy	± (0.4% setting + 1.0% F.S.) @ PF > 0.2 and Voltage > 5.0 V						
App. Power (VA)	Range	0-612	0-1020	0-1530	0-2040	0-3060	0-4080	0-5100
	Resolution	0.1						
	Accuracy	Calculated, Vrms * Irms						
Reactive Power (VAR)	Range	0-612	0-1020	0-1530	0-2040	0-3060	0-4080	0-5100
	Resolution	0.1						
	Accuracy	Calculated, $\sqrt{(VA^2 - W^2)}$						

VOLTAGE, FREQUENCY & POWER FACTOR MEASUREMENTS		
Voltage	AC Range	0 - 320 Vac
	DC Range	0 - 424 Vdc
	Resolution	0.1 V
	Accuracy	± (0.2% setting + 0.2% F.S.)
Frequency	Range	S Version: 15 - 1000 Hz, E Version: 15 - 1200 Hz
	Resolution	0.1 Hz 15.0 - 99.9 Hz 1 Hz 100 Hz - 1000 Hz 5 Hz 1001 Hz - 1200 Hz
	Accuracy	± 0.1% of setting
Power Factor	Range	0.00 - 1.00
	Resolution	0.01
	Accuracy	Calculated W/VA

4.3 System Parameters, Protections & Control Interfaces

SYSTEM PARAMETERS		
Model	CPS106~CPS115	CPS120~CPS150
Display	4.3" Color Touch LDC 640 x 480 pixels	5.6" Color Touch LCD 640 x 480 pixels
Data Entry Modes	Soft Keys, Numeric Keypad, Shuttle, USB stick	
Output Protection	OCP, OVP, OTP, RCP	
AC Input Protection	PRI-UVP, PRI_OTP, PRI_OCP	
Control Interfaces (std).	USB, RS232, RS485 (A/B)	USB, RS232 RS485 (A/B), LAN
Optional Interface	LAN + GPIB	GPIB

4.4 AC Input

INPUT VOLTAGE & CURRENT SPECIFICATIONS							
Model	CPS106	CPS110	CPS115	CPS120	CPS130	CPS140	CPS150
AC Input Voltage	90 - 265 Vac		100 - 265 Vac	190 - 265 Vac, Single Phase (L, N, G)			
Phases	1 Phase, 2W+G			1 Phase, 2W+G / 2 Phase L-L + G			
Line Frequency	47 - 63 Hz			47 - 63 Hz			
Max. AC Current	10 A	15 A	19 A	14 A	20 A	25 A	30 A
Input Power Factor @ F.L.	> 0.91	> 0.95	> 0.98	> 0.98	> 0.99	> 0.99	> 0.99
Efficiency @ Full Load	80 %	84 %	86 %	86 %	85 %	86 %	86 %

Note: AC input current values shown in the table above apply under full power output conditions. The actual AC input current will be a function of the output power and is shown at either 110Vac and 220Vac output voltage and 115Vac and 230Vac input voltage by model.

4.5   Programmable Functions

PROGRAMMABLE FUNCTIONS		
Transients (Available from 15-70Hz)	Modes	List, Pulse, Step
	Parameters	AC Voltage, Frequency, DC Voltage, Current, Start Phase, Stop Phase
	Timing	Transition Time: 0.0 - 66.5 ms @ 15Hz Resolution: 0.1 sec Transient Count: 0 - 9999
Test Mode		Pass/Fail based on Measurements

4.6   Test Functions

TEST MODE PARAMETERS	
Memories	1 through 50
Steps / Memory	1 through 9
Memory Cycling	0 - 9999, 0 = Cont., 1 = OFF
Test Limits	Frequency, Current Hi/Lo, Power Hi/Lo, App. Power Hi/Lo, PF Hi/Lo
Ramp Up or Down	0.0 - 999.9
Delay	0.5 - 999.9
Dwell	0.5 - 999.9
Step Cycles	0 - 9999, 0 = Cont., 1 = OFF
Connect	ON, OFF
Surge / Drop Voltage	ON: Start 0-20ms, Duration 0-20ms OFF: Start 0-99ms, Duration 0-99ms

4.7   Dimensions & Weight

MECHANICAL & ENVIRONMENTAL SPECIFICATIONS							
Model	CPS106	CPS110	CPS115	CPS120	CPS130	CPS140	CPS150
Dimensions (W x H x D)	432 x 87 x 520 mm			432 x 133 x 520 mm	432 x 177 x 520 mm		
	17" x 3.425" x 20.5"			17" x 5.24" x 20.5"	17" x 7" x 20.5"		
Shipping Size (W x H x D)	744 x 241 x 594 mm			597 x 276 x 694 mm	597 x 321 x 694 mm		
	29.3" x 9.5" x 23.4"			23.5"x10.9"x27.3"	23.5" x 12.6" x 27.3"		
Rack Mount	Width w/Handles & Rack Ear Kit = 483 mm / 19". Shelf or L-Bracket Support Required						
Weight Net	15.9 Kg/35 lbs			21Kg / 47.2 lbs	29 Kg / 63.9 lbs		
Shipping	19 Kg/42lbs			24.4 Kg / 53.8	32 Kg / 70.5 lbs		

Dimension drawings for each size model shown on next few pages.

4.7.1   Dimensions 2U Models CPS106, CPS110, CPS115
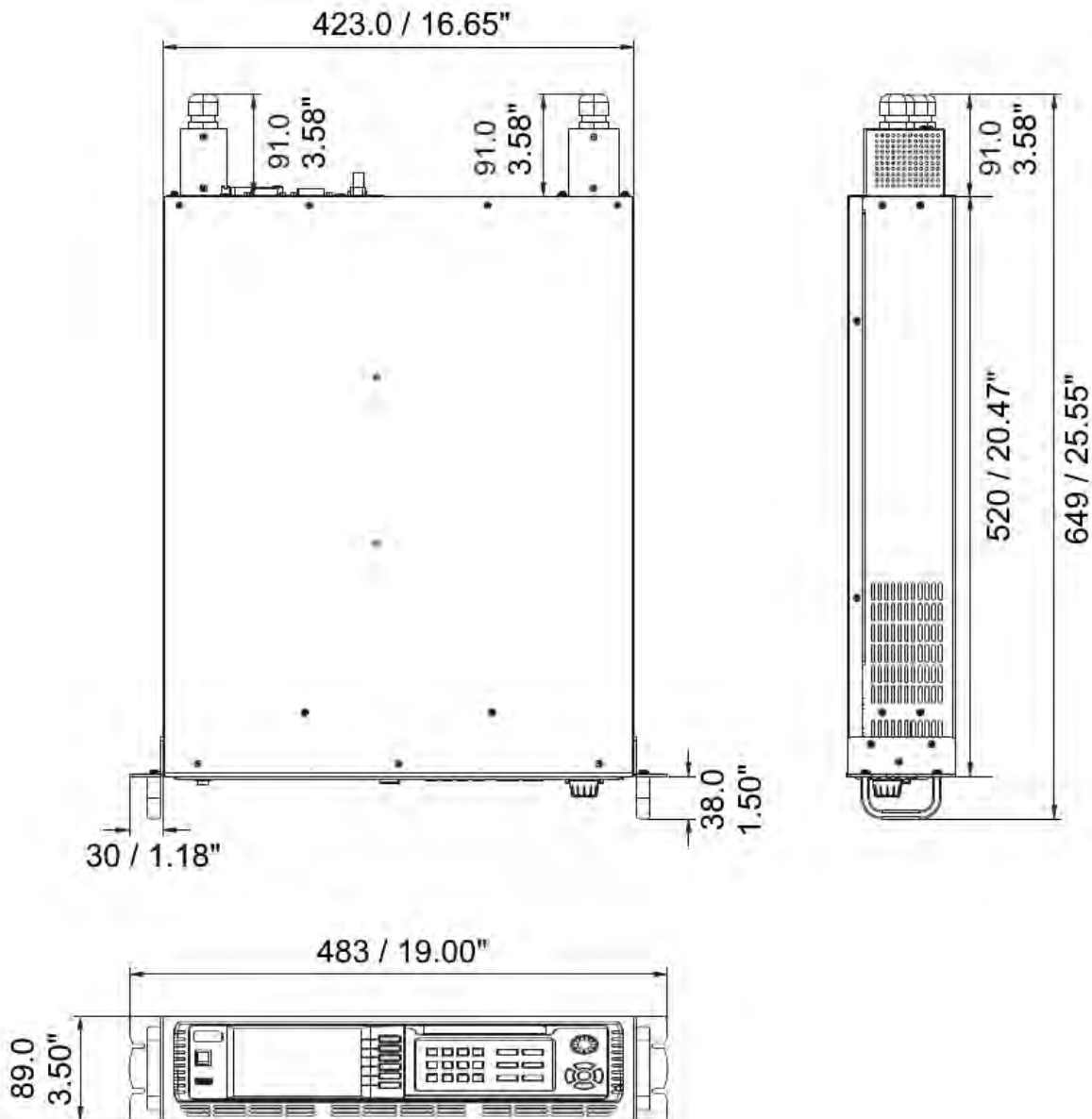
Figure 4-1: Dimension drawing 2U Models

4.7.1 Dimensions 3U Model CPS120
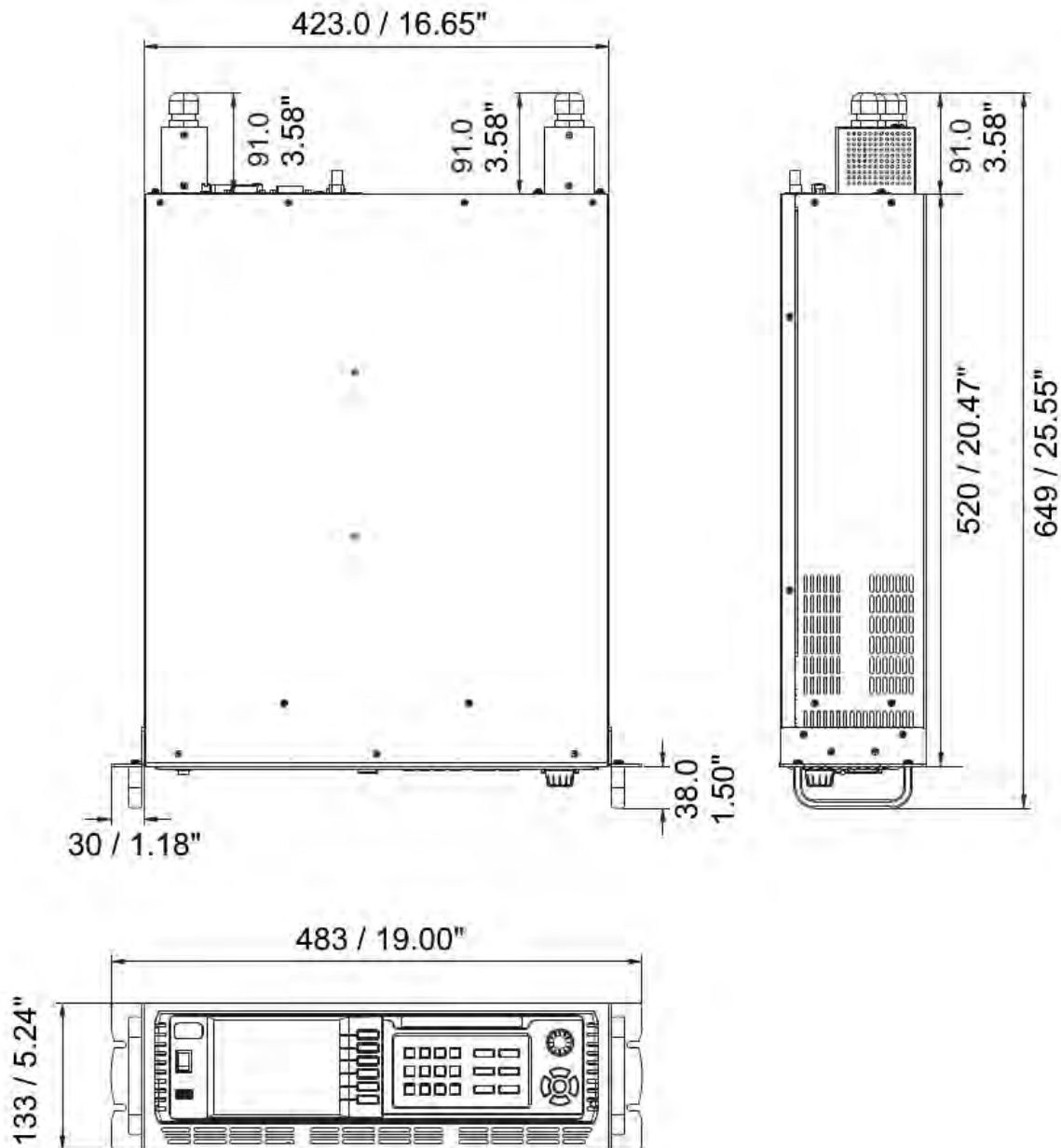
Figure 4-2: Dimension drawing 3U Model

4.7.1 Dimensions 4U Models CPS130, CPS140, CPS150
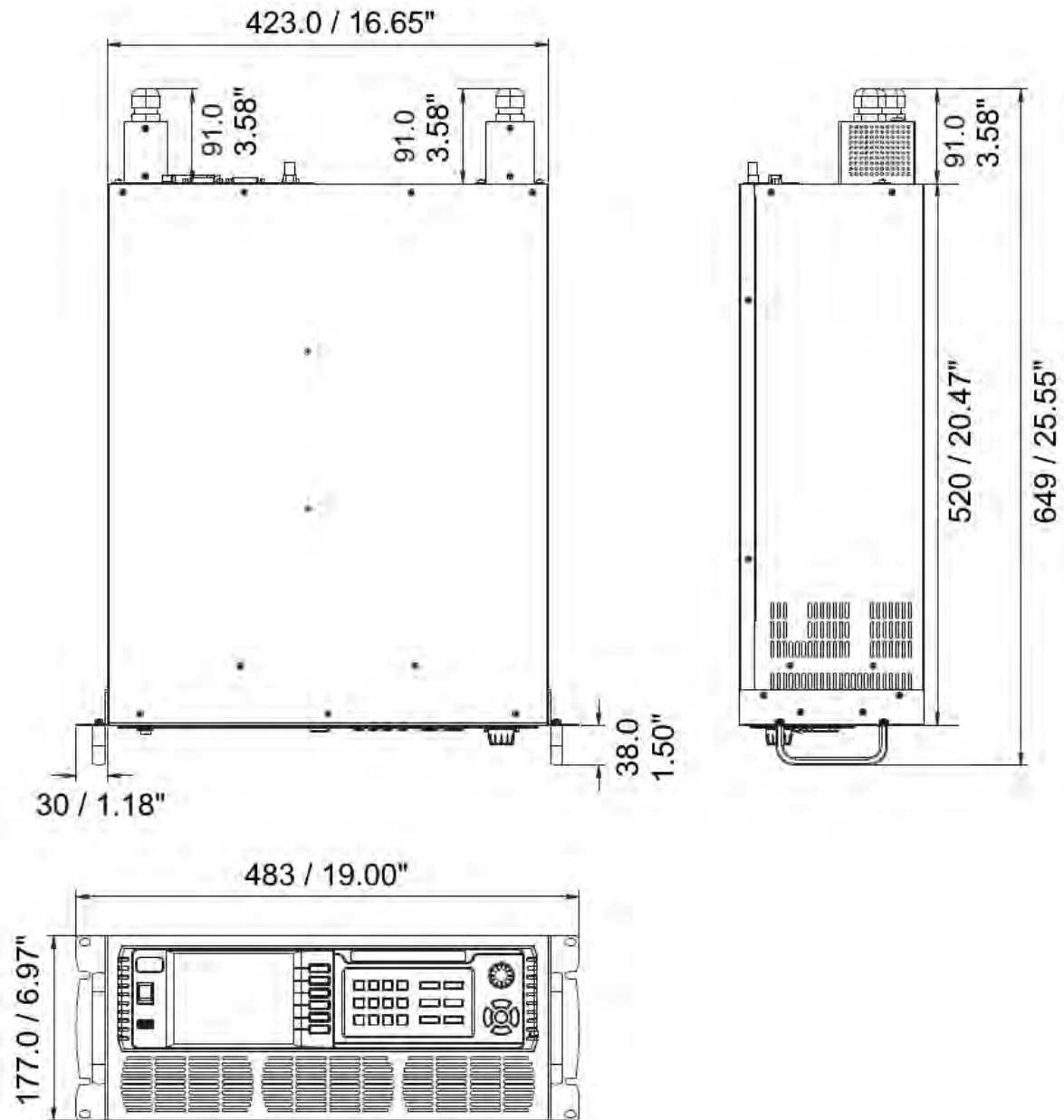
Figure 4-3: Dimension drawing 4U Models

4.8   Environmental

Operating Environment	
Temperature Operating	0° to 40° C / 32° to 104° F
Storage	-40° to 85° C / -40° to 185° F
Fan Cooled	Temperature controlled. Front intake rear exhaust. Fan noise 73 dBA at max. fan speed
Temperature Coefficient	Voltage: 100ppm/°C, Current: 300ppm/°C, Frequency: 100ppm/°C
Rel. Humidity	5% to 95% non-condensing
Altitude Operating	2000 m / 6560 feet

4.9   Safety & Regulatory

REGULATORY COMPLIANCE	
Emissions	CE marked per EMC Directive 2014/30/EU/EN61326-1:2013 Class A for emissions and immunity as required for CE Mark. FCC verification for conformity for CFR 74 Part 15 of FCC rules
Safety	CE marked per LVD Directive 2014/35/EU/EN61010-1, third edition as required for CE Mark
CE Mark	Installation Over voltage Category II, Pollution Degree 2, Class II Equipment, indoor use only
Isolation Voltage	3000Vac Input to Output, 1500Vac Input to Chassis
RoHS	Meets EU Directive 2011/65/EU for restriction of hazardous substances in Electrical and Electronic Equipment

Refer to Declaration of Conformity sheet in Section 14, "CE MARK Declaration of Conformity" at the end of this manual.

4.10 ENHANCED Versions - Additional Specifications

ENHANCED MODEL FUNCTIONS		ENHANCED VERSION ONLY
PROGRAMMABLE OUTPUT IMPEDANCE		
Range	Resistance	0 Ω - 1 Ω
	Inductance	0 µH - 1 mH
HARMONICS & INTER HARMONICS		
Range		0.01 Hz - 2400 Hz
Waveform Synthesis		2 - 40 Harmonics @ 50 Hz or 60 Hz
HARMONIC & THD MEASUREMENTS		
Parameters		Voltage, Current
Harmonic Measurements		2 - 40 Harmonics @ 50Hz or 60 Hz
THD %		Calculated
IEC 61000-4 TEST FUNCTIONS		
Supported Standards		IEC 61000-4-11, IEC 61000-4-13, IEC 61000-4-14, IEC 61000-4-28
Other Test Functions		Triac Waveform Test

4.11 Remote Control Interfaces

The CPS100 Series supports several standard digital control interfaces. Some of these may be optional on certain models.

4.11.1 RS232 Interface

RS232 Interface	
Connector Type	DB9
Connector Location	Rear Panel
Baud Rates	9600, 19022, 38400, 57600, 115200
Parity Bits	NONE, ODD, EVEN
Stop Bits	1 or 2

4.11.2   RS485 Interface

RS485 Interface	
Connector Type	Header - MSTB 2,5/ 5-GF-5,08 – 1776537 Pin assignments: Gnd, A, A, B, B Mating removable screw compression connector installed on unit.
Connector Location	Rear Panel
Baud Rates	9600, 19022, 38400, 57600, 115200
Parity Bits	NONE, ODD, EVEN
Stop Bits	1 or 2
Address Range	1 ~ 254
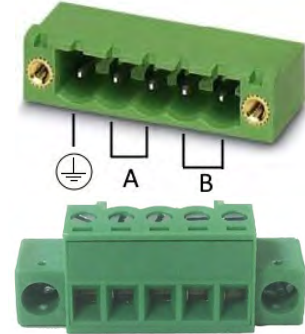
4.11.3   USB Interface

USB Interface	
Connector Type	USB Type B, Device Connection
Connector Location	Rear Panel
Baud Rates	9600, 19022, 38400, 57600, 115200
Device Driver	Virtual COM Windows Driver

4.11.4   LAN Interface (Option)

LAN Interface	
Connector Type	RJ45
Connector Location	Rear Panel
Ethernet	100BASE-TX
ETH Setting	Auto or Manual
Available Settings	IP Address, Net Mask, Gateway
Note: The LAN/GPIB interface option on CPS106, CPS110 & CPS115 replaces the USB/RS232/RS485 interface card. Only one or the other can be installed at any time. On higher power models, the LAN option is added when ordered.	

4.11.5 GPIB Interface (Option)

GPIB Interface	
Connector Type	24-pin Amphenol micro ribbon connector
Connector Location	Rear Panel
Address Range	1 ~ 30

4.12 Options for CPS106, CPS110, CPS115

Model	CPS106, CPS110, CPS115
Option –EXT: External I/O	
DIGITAL I/O	
TTL Inputs	Output ON/OFF, KEEP OFF, RESET, RECALL SETUP 1-7 (3 bits)
Relay Contacts	3 sets, PASS, FAIL (contact closure)
Connector Type	20 Position dual row compression
ANALOG	
Voltage Input	Modes: SYNC or ANALOG, RMS. SET
Connector Type	BNC
Option -MSB: Master/Slave Bus	
System Interface Bus	
Modes Parallel	4 units max. for higher power
Series	2 units max. for 600V output
Three Phase	3 units in Delta or Wye Configuration

Note: Options –EXT and -MSB are mutually exclusive, i.e. only one can be installed at any time.

4.13 Options for CPS120, CPS130, CPS140, CPS150

Model	CPS120, CPS130, CPS140, CPS150
Option –AUX: Auxiliary I/O and Master/Slave Bus	
Same as for CPS106 ~ CPS115 and adds:	
Relay Contacts	Adds 1 set
System Interface Bus	
Modes Parallel	4 units max. for higher power
Series	2 units max. for 600V output
Three Phase	3 units in Delta or Wye Configuration

5   Unpacking and Installation

5.1   Inspection

The CPS100 Series of power sources are inspected before shipment. If instrument damage has occurred during transport, please inform Adaptive Power Systems' nearest sales and service office or representative.

5.2   Proper Lifting and Handling Guidelines

Lifting properly is important. While there are some general lifting guidelines, a different approach may be needed for each load to be lifted. Generally, it is best to lift with your legs, not your back. Lifting techniques depend on the size and shape of the load, and the frequency of lifting that is required.

The higher power CPS Series units (2kVA and higher) are considered heavy; proper lifting and handling techniques must be used at all times.

Removing CPS units from their packaging should be done with ergonomics in mind. Items to be planned include determining routes between staging areas and work spaces and soliciting assistance from other members of your team.

The power zone for lifting is close to the body, between mid-thigh and mid-chest height. Comparable to the strike zone in baseball, this zone is where arms and back can lift the most with the least amount of effort.
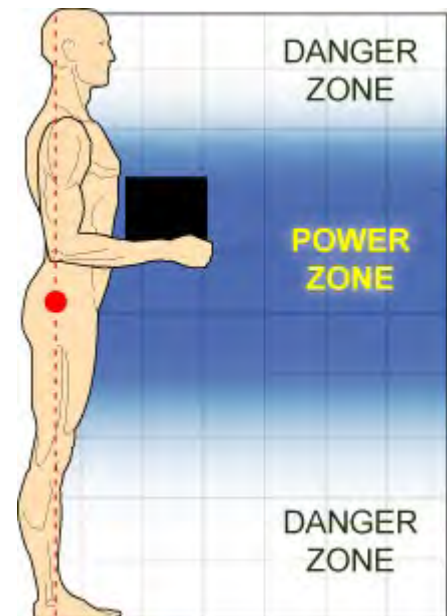
Refer to the "LIFTING DO'S & DON'TS" chart below before removing any CPS units from its packaging or re-locating it to a different work area.

Figure 5-2: Lifting Do's and Don'ts Chart

5.2.1   Unpacking CPS106, CPS110, CPS115 and CPS120 Models

The CPS106 through CPS115 are shipped in a cardboard box with protective foam inserts. To remove these units, one or two persons may be used.

Removal Steps:

1. Position the carton on a stable flat surface with sufficient clearance.

2. Make sure the carton is right side up. Top is clearly marked on the side of the carton.

3. Know where the unit will be placed before proceeding. Make sure the path between the carton and the staging area is short and clear of any obstacles.

4. Use a box cutter to cut the tape that holds the top flaps together. Also, cut the side tape on the top flaps.

5. Open all four flaps completely and fold them down along the side of the carton so they do not interfere with access to the inside of the carton.

6. Remove the ship kit items from the box and put in a safe place.

7. Remove the top foam insert piece and retain for future use if desired.

8. Removal:

    a. Stand as close to the back of the box (where the rear panel of the unit is) and bend with your knees.

    b. Get a firm handhold underneath the units by placing your hands on each side of the unit near the middle. This will help even the weight when lifting.

    c. While keeping your back straight, lift the unit out of the box by straightening your legs.

    d. Place the unit on the intended staging surface, usually a bench or table.

5.2.2   Unpacking CPS130, CPS140 and CPS150 Models

⚠ **WARNING**

**THESE CPS MODELS WEIGH 29 Kg / 63.9 lbs. OR MORE.
AT LEAST TWO PEOPLE ARE REQUIRED TO LIFT AND HANDLE**

All 4U tall CPS100 Series models are shipped in a cardboard box with protective foam inserts. To remove these units, two persons are required due to weight.

Removal Steps:

1. Position the carton on a stable flat surface with sufficient clearance.

2. Know where the unit will be placed before proceeding. Make sure the path between the carton and the staging area is short and clear of any obstacles.

3. Use a box cutter to cut the tape that holds the top flaps together. Also cut the side tape on the top flaps.

4. Open all four flaps completely and fold them down along the side of the carton so they do not interfere with access to the inside of the carton.

5. Remove the ship kit items from the box and put in a safe place.

6. Remove the top foam insert piece and retain for future use if desired.

7. Removal:

    a. Two people are required depending no model/weight.

    b. Have each person stand as close to the front and the back of the pallet and bend with your knees.

c.   Each should get a firm handhold underneath the unit by placing their hands on each side of the unit near the front and back of the unit respectively. This will help divide the weight between both persons when lifting.

d.   While keeping their backs straight, lift the unit out of the bottom foam insert and off the pallet simultaneously by straightening legs.

e.   Place the unit on the intended staging surface, usually a bench or table.

5.3   Ship Kits

All units are shipped with a ship kit that may contain several items. Ship kits can vary by model so check the contents of the ship kit you received against the relevant table below. If any items appear to be missing, contact Adaptive Power Systems customer service. (support@adaptivepower.com).

5.3.1   CPS Series Ship Kit Contents

The following accessories are included or available as an option with each CPS model power source. Optional items must be ordered. See image below for reference.

Item #	ITEMS INCLUDED	QTY
A	Rack mount Handles (removable)[1]	2
B	Input Terminals Safety Cover	1
C	Output Terminals Safety Cover	1
D	Screws to install Rack mount Handles	12
E	RS232 Serial Cable, 1 meter	1
Item #	**OPTIONAL ITEMS – NOT INCLUDED**	**OPTION**
F	LAN Cat-5 Cable, 1 meter (Ref	1
G	USB Cable, 1 meter	1
H	GPIB Communication Cable (Not shown)	1
I	System Bus Comm DVI Cable (Option -AUX or -MSB)	1
J	BNC Cable (Option -AUX or -EXT)	1

Table 5-1: CPS Series Included Accessories Ship Kit

Figure 5-3: CPS100 Series Ship Kit Items

Note 1: *Rack handle height varies by model (2U, 3U or 4U)*

5.4   AC Input Connections

All CPS100 Series units operate on single-phase AC input through an AC input terminal block on the rear panel. Before making any connections, read the following warnings.

⚠️ **WARNINGS**

Always disconnect the Mains before accessing AC input or AC/DC output compartment or connections.

Make sure to connect a green/yellow safety GROUND cable to the earth terminal ⏚ of the AC Power input terminal block connected to earth ground. If not, risk of electrical shock exits!

There is certain danger if the connection of the AC power source is not made correctly. Please assure that the AC power cable used is installed by a qualified electrician or otherwise authorized personnel. If the AC input will be hard wired to the mains, make sure this is only done by a qualified electrician and a suitable disconnect and branch protection is installed.
OR

It is strongly recommended to use an external circuit breaker, which protects and is used to disconnect all the current carrying conductors of the AC input Cable.

DO NOT position the equipment so that is difficult to operate the Mains disconnect device or switch.

Safety approved flexible power cords with double insulation, suitable wire size and minimum of 60° C temperature rating must be used per the table below must be used to connect the AC input.

For CPS150 models, the maximum AC input is 30A rms. If the current exceeds this limit, output power is reduced.

5.4.1 AC Input Wire Sizes by Model

Model	Wire Size	Input Breaker	Model	Wire Size	Input Breaker
CPS106	2.0 mm^2 / 16 AWG	12 A	**CPS130**	3.5 mm^2 / 12 AWG	25 A
CPS110	2.5 mm^2 / 14 AWG	16 A	**CPS140**	5.6 mm^2 / 10 AWG	30 A
CPS150	3.5 mm^2 / 12 AWG	20 A	**CPS150**	8.5 mm^2 / 8 AWG	40 A
CPS120	3.5 mm^2 / 12 AWG	20 A			

Table 5-2: AC Input Wire Sizes by Model

Note: Breaker ratings shown for CPS106 through CPS115 are for 115V~. Breaker ratings shown for CPS120 through CPS150 are for 230V~.

5.4.2 AC Input Terminal as Safety Cover

The AC input connections are made at the rear of the CPS100 units. The AC input terminal is located on the right hand side when facing the back panel of the power source.

A safety cover is provided for both AC input and AC/DC Output terminal blocks.

⚠️ **CAUTION**

The included AC Input and Output safety covers must be properly installed when using this equipment

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5.4.3   Input Power Cord Installation

To install a power cord to the AC input terminal block, proceed as follows:

1. Strip the outside installation of the AC power cord approximately 25 mm or 1 inch. Then strip 7 mm or 1/3 inch of insulation from each of the wires (L, N, G) of the power cord.

2. Loosen the plastic nut of the provided input safety cover's stain relief.

3. Pass the cable end including the line, neutral and ground wire through the cable strain relief as illustrated in the adjacent drawing.

4. Insert each lead in its corresponding input terminal position as shown.

5. Using a suitable size flat blade screwdriver, tighten the terminal block screws assuring all wires are held tightly.

6. Replace and faster the safety cover and tighten the plastic nut of the strain relief clamp.
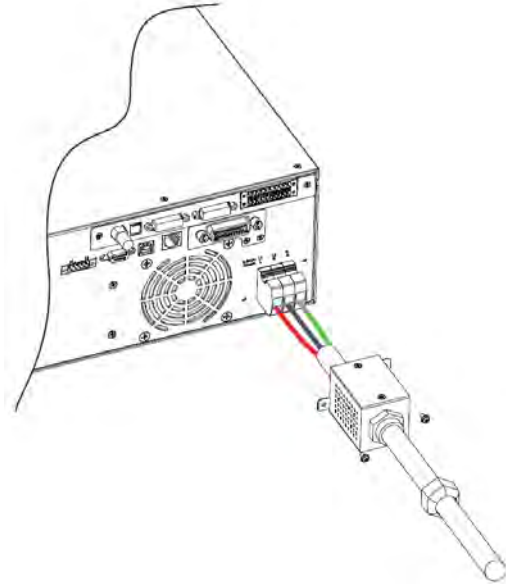
5.4.4   Grounding Requirements

⚠ ⚠ **WARNING**

SHOCK HAZARD

EQUIPMENT MUST BE GROUNDED

The chassis must be grounded. A proper Earth Ground connection must be used at all times. Correct grounding of your electrical system infrastructure according to applicable national standards must be observed.

5.4.5   Check Line Voltage

Before connecting the power source to the mains, check the input voltage rating on the model type label located on the top cover. Make sure the mains voltage at the location the product will be connected is within the stated input voltage range.

Consult a local electrician as needed to make sure the mains connection meets local safety standards.

5.5   Cleaning

To clean this product, use a soft or slightly damp cloth.

⚠ CAUTION

BEFORE you clean the unit, switch the mains power off and disconnect the input line cord.
・Please do NOT use any organic solvent capable of changing the nature of the plastic such as benzene or acetone.
・Please ensure that no liquid is allowed to penetrate this product.

5.6   Powering Up

The following procedure should be followed before applying mains power:

1. Check that the POWER switch is in the OFF (O) position.
2. Verify that the model nameplate AC input specification match the local utility power.
3. Make sure that nothing is connected to any of the output terminals on the rear panel.
4. Turn ON (I) the front panel POWER switch.
5. If the instrument does not turn ON for some reason, turn OFF the POWER switch and verify the presence of the correct AC line input voltage using appropriate safety measures.

5.7   In Case of Malfunction

In the unlikely event of an instrument malfunction or if the instrument does not turn ON despite the presence of the correct AC line voltage, please attach a warning tag to the instrument to identify the owner and indicate that service or repair is required. Contact Adaptive Power Systems or its authorized representative to arrange for service.

5.8   Output Terminals

The location and size of the AC or DC output terminals is model dependent. The rear panels for each model are shown here for reference.

Note: Always refer to Section 2.3 "Safety Information" and Section 2.4 "Safety Notices" before making any load connections.

5.8.1   Rear Panel Models CPS106, CPS110, CPS115

The AC or DC output terminal is located on the **left** hand side when facing the back panel of the power source.

Figure 5-4: Output Terminal Locations - 2U Models

5.8.2   Rear Panel Model CPS120

The AC or DC output terminal is located on the **left** hand side when facing the back panel of the power source.
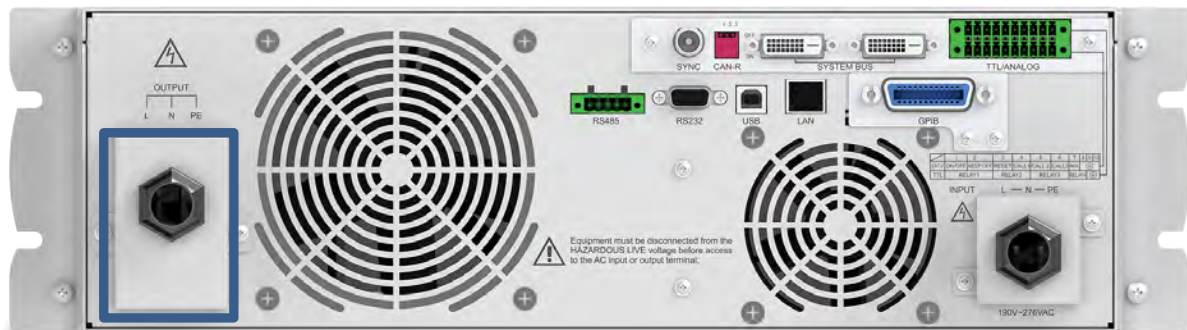
Figure 5-5: Output Terminal Locations - 3U Models

5.8.3   Rear Panel Models CPS130, CPS140, CPS150

The AC or DC output terminal is located on the **left** hand side when facing the back panel of the power source.
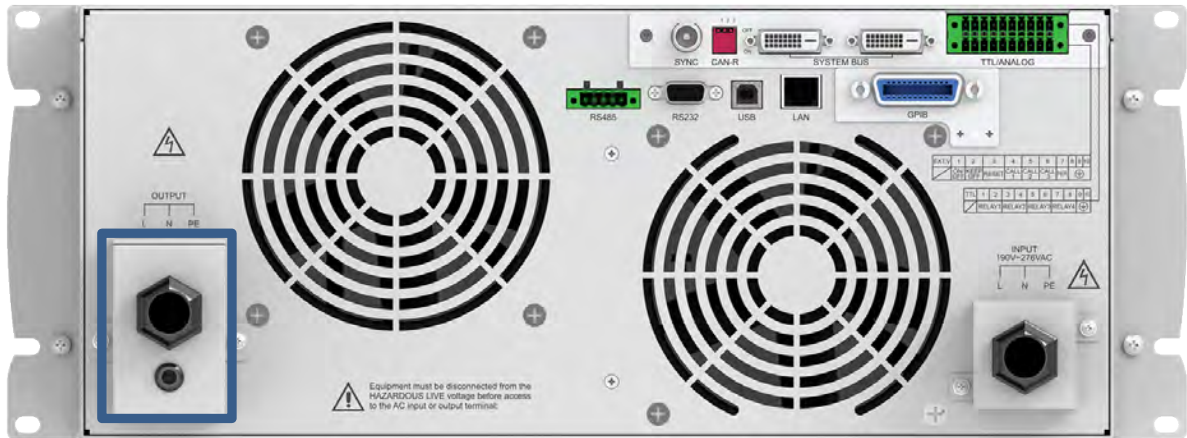
Figure 5-6: Output Terminal Locations - 4U Models

5.8.4   Output Terminal Connections

Before making any connections, read the following warnings.

> ## ⚠ WARNINGS
>
> Always disconnect the Mains before accessing AC input or AC/DC output compartment or connections.
>
> Safety approved flexible power cords with double insulation, suitable wire size and minimum of 60° C temperature rating must be used per the table below must be used to connect the output.
>
> Use certified type double insulation or cord with 18-25 mm diameter.

5.8.5   Recommended Output Wire Size

A major consideration in making load connections is the wire size. The minimum wire size is required to prevent overheating and to maintain good regulation. It is recommended that the wires are sized large enough to limit the voltage drop at the maximum current rating of the power source to no more than 0.25V per lead when external sense mode is used.

Recommended wire gauges for copper wire are shown in the table below for highest current rating by model, which occurs in AC mode and low voltage range. Aluminum wire is not recommended. Keep the distance between the power source and load as short as possible for best results.

Model	US/Canada	Europe / Asia
CPS106	16 AWG, Copper / 2.58 kcmil, 1.31 mm^2	2.0 mm^2
CPS110	16 AWG, Copper / 2.58 kcmil, 1.31 mm^2	2.0 mm^2
CPS115	14 AWG, Copper / 4.11 kcmil, 2.08 mm^2	2.5 mm^2
CPS120	12 AWG, Copper / 6.53 kcmil, 3.31 mm^2	3.5 mm^2
CPS130	10 AWG, Copper / 10.4 kcmil, 5.26 mm^2	5.5 mm^2
CPS140	8 AWG, Copper / 16.5 kcmil, 8.37 mm^2	8.5 mm^2
CPS150	6 AWG, Copper / 26.3 kcmil, 13.3 mm^2	13.5 mm^2

Table 5-3: Recommend Output Wire Sizes by model

5.8.6   Output Power Cord Connection

To install a power cord to the output terminal block, proceed as follows:

1. Strip the outside installation of the AC power cord approximately 25 mm or 1 inch. Then strip 7 mm or 1/3 inch of insulation from each of the wires (L, N, G) of the power cord.

2. Loosen the plastic nut of the provided output safety cover's stain relief.

3. Pass the cable end including the line, neutral and ground wire through the cable strain relief as illustrated in the adjacent drawing.

4. Insert each lead in its corresponding output terminal position as shown.
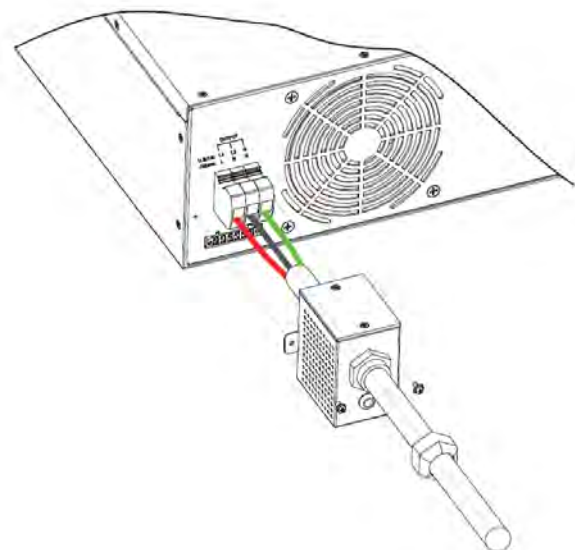
5. Using a suitable size flat blade screwdriver, tighten the terminal block screws assuring all wires are held tightly.

6. Replace and faster the safety cover and tighten the plastic nut of the strain relief clamp.

5.8.7 Floating Output Neutral - Grounding

The output line and neutral terminals are floating with respect to Ground. The chassis of the CPS100 unit must be connected to Protective Earth (see Section 2.4, "Safety Notices" on page 14.
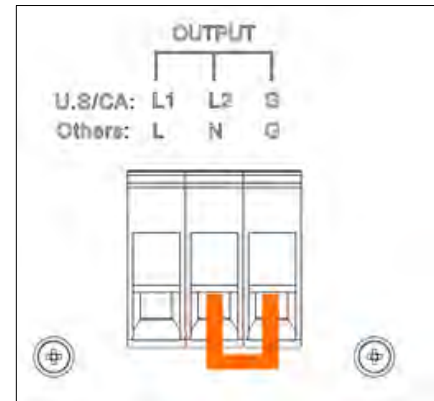
As needed, the output Neutral (L2 / N) terminal can be grounded by connecting it to the Ground terminal position provided on the output terminal (source side) or it can be grounded at the load side. See illustration to the right. Note that some EUT's already have their neutral input grounded internally so a grounding jumper may not be needed.

5.8.8 Connecting a UUT

When setting up for a new test and connecting any equipment to the power source, proceed as follows:

1. Always make sure the power source is turned OFF at the POWER switch when making any output connections.
2. Check that the output of the equipment under test is **OFF** and that the load is not still energized. This applies in particular to DC Mode when driving a load with input capacitance or batteries.
3. Connect the power cord leads to the unit under test.
4. Check the polarity of the connections and connect the other end of the load wires to the input terminals of the equipment under test.

5.8.9   Remote Voltage Sense

The power source senses its own output voltage and adjusts as needed to maintain the set voltage regardless of load changes. Voltage sense is supported in two ways:

Local (internal):   Voltage sense is done at the output terminals of the power source by looping a sense wire jumper from the external sense input to a set of output terminals on the same connector that are internally connected to the output terminals.

Remote (external):   Remote voltage sensing allows the power source to compensate for any voltage drop between the source's output terminal and the load connection point caused by the wire impedance of the load wires. This voltage drop can be significant if the length of the load wires is long and/or the wire gauge is marginal. This voltage drop will also increase with the amount of load current.

To overcome this, the power source can sense at the load terminals using the external voltage sense connector. The sense wires will not carry any load current as the Vsense input is high impedance to normal 24AWG wire can be used for the external sense connection.
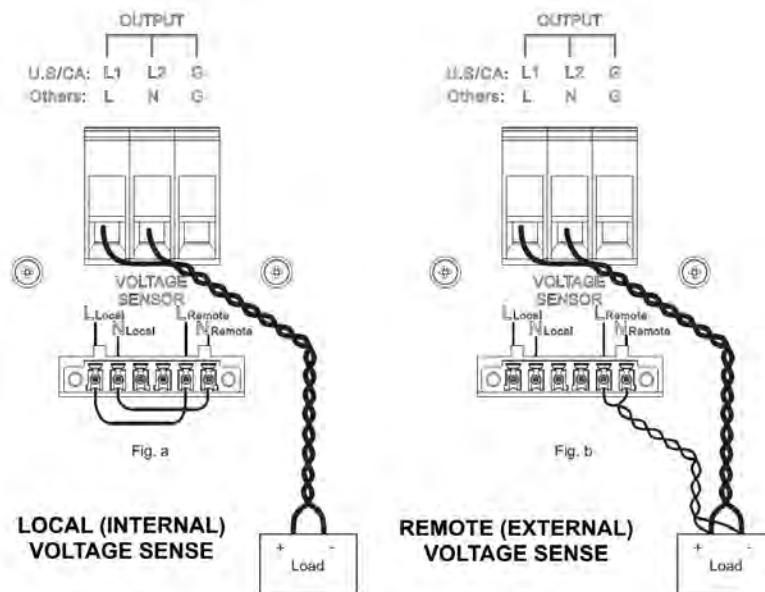
Figure 5-7: Voltage Sense Connections

For internal voltage sense, jumper the VOLTAGE SENSOR connector as shown in Figure 5-7 a. This will connect the output of the power source to the sense inputs. Make sure the sense wire jumpers are NOT crossed. L to L and N to N.

For external voltage sense, remove the jumper from the VOLTAGE SENSOR connector and connect a twisted pair of wire long enough to reach the point of load connection as shown in Figure 5-7 b. This will voltage present at the load to the sense inputs. Make sure the sense wire jumpers are NOT crossed. L to L and N to N.

5.9 Rear Panel Controls and Connectors

All CPS100 Series have several controls and connectors on the rear panel in addition to the AC input and AC output terminals covered in the previous sections. Other connectors and features are detailed in this section by model number.

5.9.1 CPS106, CPS110, CPS115 Rear Panel Overview

The callouts for the controls and connectors located on the rear panel of the 2U CPS Models are identified in the table below.

Figure 5-8: Rear Panel Callouts – 2U Models

5.9.2 CPS120 Rear Panel Overview

The callouts for the controls and connectors located on the rear panel of the 3U CPS Model is identified in the table below.
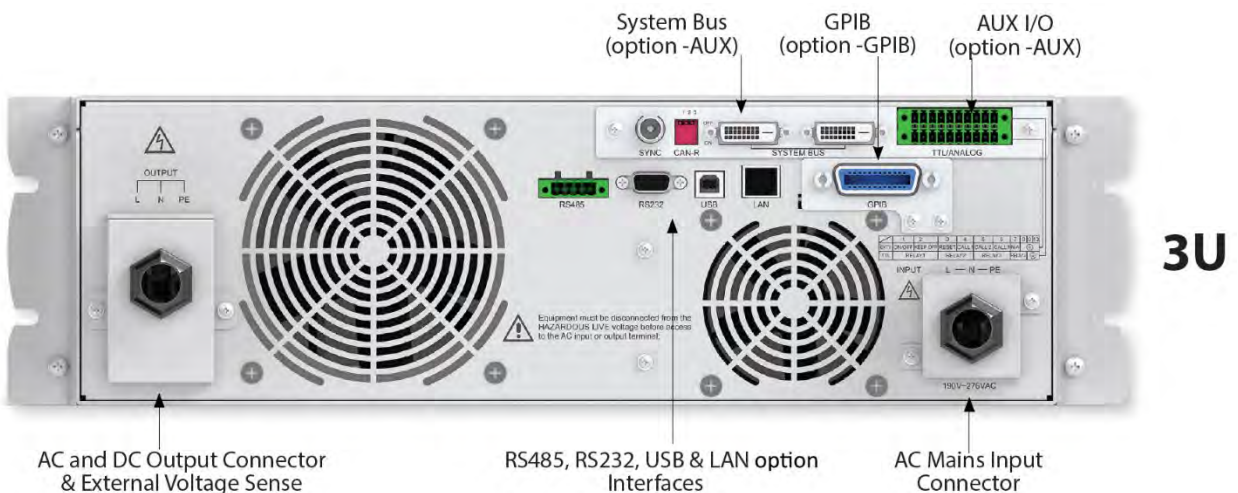

Figure 5-9: Rear Panel Callouts – 3U Model

5.9.3 CPS130, CPS140, CPS150 Rear Panel Overview

The callouts for the controls and connectors located on the rear panel of the 4U CPS Models are identified in the table below.
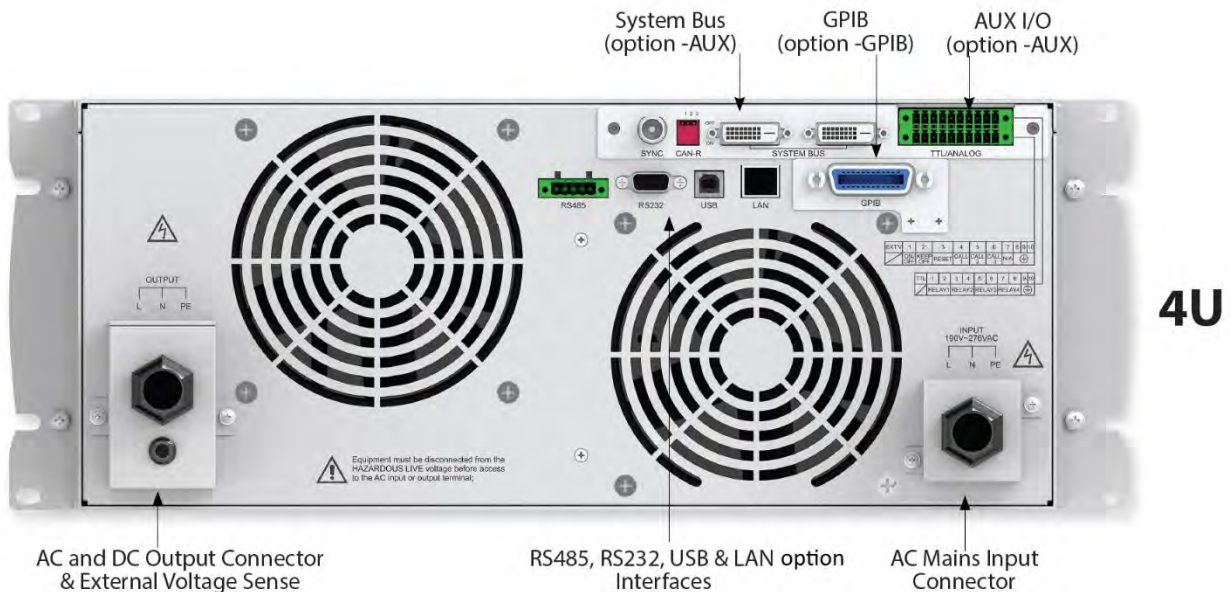

Figure 5-10: Rear Panel Callouts – 4U Models

5.9.4   AUX I/O Card Connectors (CPS120 ~ CPS150 Models)

All CPS100 Series models with either a 3U or 4U height chassis support the optional AUX I/O card.

This card contains the following connectors:

Interface	Description
SYNC	Sync Input BNC connector for external analog signal to control waveform amplitude.
CAN-R	Parallel Operation mode interconnect bus.
SYSTEM BUS	System interface bus for communication between master and slaves in serial, parallel or three phase configurations.
TTL / ANALOG	TTL Relay Contacts / Analog

Figure 5-11: AUX I/O Option Card Connections

Note the two rows of connections on the AUX I/O Connector and the orientation of TTL vs EXT.V rows as illustrated on the silk screen on the back panel of the power source.

1. TTL is Top Row

2. EXT.V is Bottom Row

Pin 1 for each row is on the left when facing the back of the unit and pin 10 is on the right.
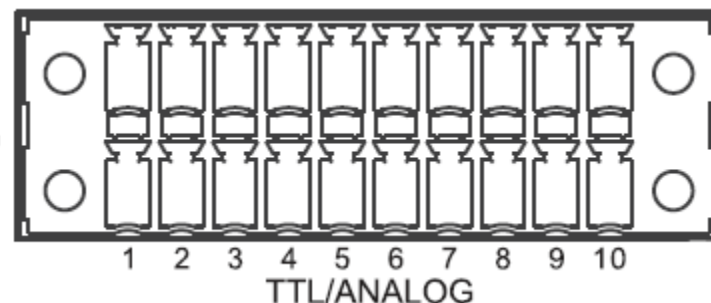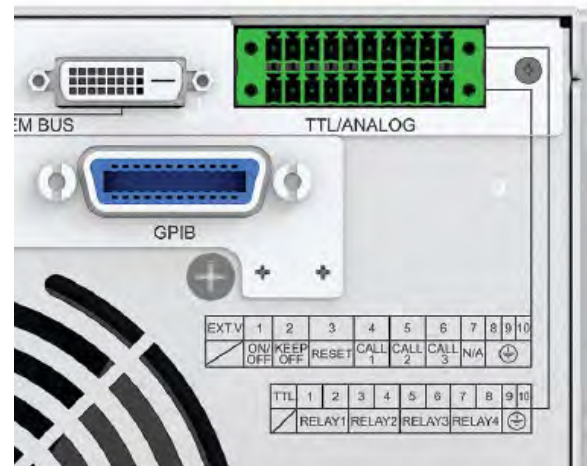
The following pins are available on the TTL/ANALOG Connector of the AUX I/O Option card.

EXT V I/O –- RELAY CONTACTS

TTL	1	2	3	4	5	6	7	8	9	10
╱	RELAY 1 (PASS)		RELAY 2 (FAIL)		RELAY 3 (RUN)		RELAY 4 (N/A)		⏚	

DIGITAL I/O – TTL INPUTS

EXT. V	1	2	3	4	5	6	7	8	9	10
╱	ON/ OFF	KEEP OFF	RESET	CALL 1	CALL 2	CALL 3	N/A		⏚	

Note: Pins 4~6 binary input to recall setup 1 through 7.

5.9.5   EXT I/O Card Connectors (CPS106, CPS110 & CPS115 Models)

The –EXT option card on 2U CPS models uses the same connectors and pinouts as the AUX I/O option card for 3U and 4U models. Refer to previous section for pin configurations,

5.9.6   AUX I/O Card Pin Assignments

Analog I/O Relay Contacts

Pin #	Signal	Description
1, 2	RELAY 1, PASS	These two pins will be shorted internally when a test mode has a PASS result.
3, 4	RELAY 2, FAIL	These two pins will be shorted internally when a test mode has a FAIL result.
5, 6	RELAY 3, RUN	These two pins will be shorted internally when a test is running.
7, 8	RELAY 4	Not Used
9, 10	⏚	Chassis Ground

Table 5-4: AUX I/O Analog Pin Functions

TTL Digital Inputs

For all TTL inputs, logic voltage levels are:

- Logic Low = 0V ~ 0.5V
- Logic High = 4.5 ~ 5.5V

Pin #	Signal	Description
1	ON/OFF	Output control input. Low = Output OFF High = Output ON
2	KEEP OFF	OUTPUT lockout input. Low = Output Control Disabled High = Output Control Enabled
3	RESET	Unit Reset input. Low = Reset Active High = Reset Inactive
4	RECALL 1	These inputs allow recall of output settings from Setup[1] to Setup[7]:
5	RECALL 2	
6	RECALL 3	

Pin 6	Pin 5	Pin 4	Channel #
0	0	1	Setup [1]
0	1	0	Setup [2]
0	1	1	Setup [3]
1	0	0	Setup [4]
1	0	1	Setup [5]
1	1	0	Setup [6]
1	1	1	Setup [7]

		It is possible to use this function to recall the output between AC and DC outputs.
7	N/A	Not Used
8, 9, 10	⏚	Chassis Ground

Table 5-5: AUX I/O Digital Input Pin Functions

5.10 Remote Control Programming Interfaces

The CPS100 Series offers standard RS232, RS485 and USB interfaces for remote control operation. CPS100 models of 2000VA and higher also offer standard Ethernet (LAN).

Other interfaces may be specified at the time of order as they are installed at the factory prior to shipment. It is possible to add interface options in the field. Available interface options are:

For CPS106, CPS110 and CPS115 models:

- Ethernet / LAN + GPIB   (Option –LAN+GPIB)
  Note: This interface option installs in place of the standard RS232, RS484 and USB interfaces. (Occupies the same physical slot).

Figure 5-12: CPS106, CPS110 or CPS115 rear panel with optional LAN+GPIB Interfaces

For CPS120, CPS130, CPS140 and CP150 models:

- GPIB / IEEE-488   (Option –GPIB)
- LAN   (Option -LAN)

5.10.1 RS232 Serial Interface

Figure 5-13 shows the RS232 connector (Male) on the rear panel. This connects the power source to an RS232 port of a computer.
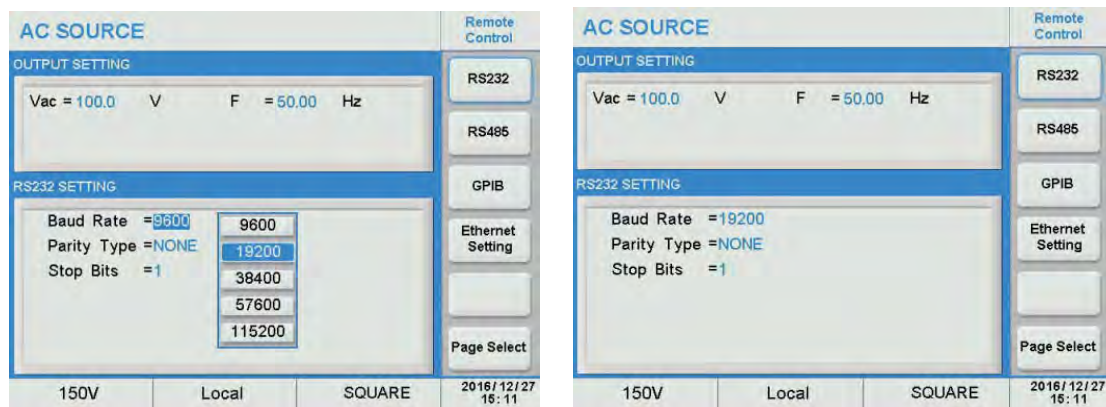
Signal Pin Assignments:

Figure 5-13: RS232 Connector

PIN	Abbreviation	Description
Pin2	RXD	Receive Data
Pin3	TXD	Transmit Data
Pin5	GND	Ground
Pins 1, 4, 6, 7, 8, 9	N.C.	Not connected

Table 5-6: RS232 DB9 Pin Assignments

RS232 interface settings can be configured from the "**CONFIG MENU"** by selecting "**Remote Control"**, then "**RS232**". See section 6.8.1.1, "Remote Control" on page 86 for details.

Scroll through Baud rate, parity and Stop bits fields and use the shuttle to set the desired values.


Note: This interface does not support XON/XOFF protocol or any hardware handshaking. The controller should be configured to ignore the Handshaking Lines DTR (PIN 4), DSR (PIN 6) and RTS (PIN 9). If the port cannot be configured through software to ignore the lines, the handshaking lines should then be jumped together in two different pairs. Both pins 4 & 6 and pins 7 & 8 must be jumpered together at the controller end of the cable.

5.10.2 RS485 Serial Interface

Figure 5-13 shows the RS485 connector (Male) on the rear panel. This connects the power source to an RS485 port of a computer.

PIN	Abbreviation	Description
Pin 1	GND	Receive Data
Pin2 & 3	+Data	Transmit Data
Pin 4 & 5	-Data	Ground
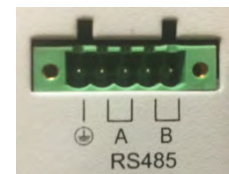
RS485 interface settings can be configured from the "**CONFIG MENU"** by selecting "**Remote Control"**, then "**RS485**".

Scroll through Baud rate, parity, Stop bits and Address fields and use the shuttle to set the desired values. See section 6.8.1.1, "Remote Control" on page 86 for details.

5.10.3 USB Interface

The USB interface provides a virtual COM port for the PC. Via this port, the unit can be controlled as a normal RS232 interface, e.g. with a terminal program or user application program.

Refer to the section 9, "USB Driver Installation" for further setup and configuration information.

5.10.4 LAN Interface (Option on all CPS Models)

The power source can be ordered with a LAN (Ethernet) interface. The LAN interface option is located on the rear panel.

The Ethernet port is for use with a standard CAT-5 Ethernet cable and may be connected to any Ethernet network or directly to a PC's Ethernet port. The Ethernet interface provides all of the control functions of the standard RS-232 and USB interfaces. Refer to section 10, "LAN Interface Configuration" on page 198 for network and port configuration setup information.

The default settings for the Ethernet interface are as follows:

Parameter	Default Values
ETH Setting	Manual
IP Address	192.168.001.100
Network Mask	255.255.255.000
Gateway Mask	192.168.001.001
Socket	2001

LAN interface settings can be configured from the "CONFIG MENU" by selecting "Remote Control", then "Ethernet Setting". See section 6.8.1.1, "Remote Control" on page 86 for details.

5.10.5   GPIB Interface (Option on all CPS Models)

GPIB connection is via a 24pin IEEE-488 Centronics connector on the rear panel of the unit. This interface option allows the unit to be connected to a GPIB controller and other GPIB devices. A GPIB system can be connected in any configuration (star, linear, or both) as long as the following conditions are met:

- The maximum number of devices including the controller is equal or less than 15.
- The maximum length of the GPIB cable is no more than 2 meters.
- The total lead length of all devices connected together totals less than 20 meters.
- Please make sure the lock screws are firmly hand-tightened, use a screwdriver only for the removal of screws.

Each device on the GPIB (IEEE-488) interface must have a unique address. You can set the address of the CPS series to any value between 1 and 30. The address can only be set from the front panel. The address is stored in non- volatile memory and does not change when the power has been off or after a remote reset.

Note: The available address range is 1 ~ 30.

GPIB interface settings can be configured from the "**CONFIG MENU"** by selecting "**Remote Control"**, then "**GPIB**". See section 6.8.1.1, "Remote Control" on page 86 for details.

Scroll to the GPIB Addr field and use the shuttle to set the desired address.
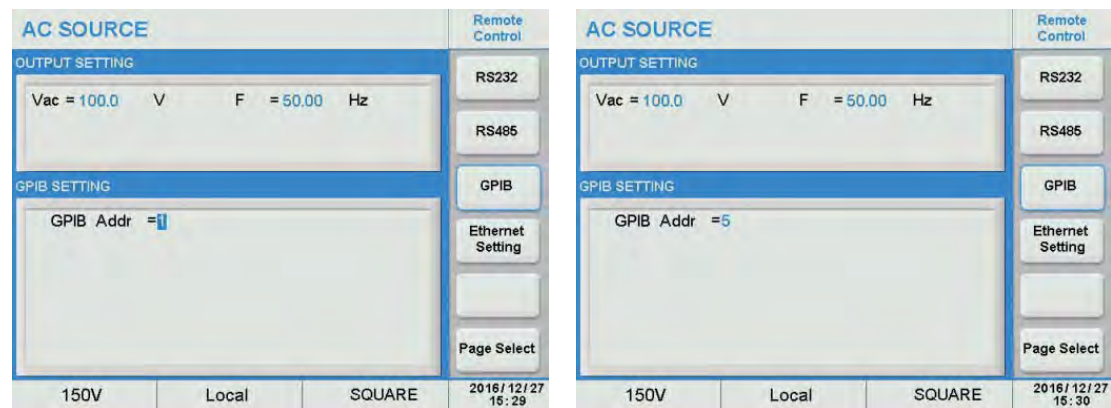
The GPIB connector pin-out is defined by the IEEE-488 standard and shown for reference only in Table 5-7 below.

No	Name	Function
1	DIO1	Data line 1
2	DIO2	Data line 2
3	DIO3	Data line 3
4	DIO4	Data line 4
5	EOI	End or Identify
6	DAV	Data Valid
7	NRFD	Not Ready For Data
8	NDAC	No Data Accepted
9	IFC	Interface Clear
10	SRQ	Service Request
11	ATN	Attention
12	SHIELD	Shield
13	DIO5	Data line 5
14	DIO6	Data line 6
15	DIO7	Data line 7
16	REN	Remote Enable
18 - 23	GND	Ground
24	SGND	Signal Ground

Table 5-7: IEEE-488 Connector Pin Assignments

5.10.6   Remote Control Commands

The USB, RS232, LAN and GPIB interfaces use the same command set for setting of test parameters. However, there are some functions of the GPIB 488.2 interface that are not available through USB/RS-232/LAN. The IEEE-488 interface option for the CPS series conforms to the requirements of the IEEE-488.2 standard.

These interfaces provide all of the control commands and parameter setting commands of the GPIB interface with the exception of the 488.2 Common Command the Status Reporting commands and SRQ capability.

For information on supported programming commands, refer to section 7, "Remote Control Programming". The identification command *IDN is also available through USB, RS-232 and LAN interfaces.

The RS485 Serial interface uses ModBUS command packets instead of the SPCI message based control commands. ModBUS programming is register based instead of message based and requires values to be put in specific register locations to control the output settings or register read backs for measurement data. This communication protocol is covered in a separate manual, "APS_CPS100_Series_AC_Source_MODBUS_Protocol_Guide-PN160954-10_v1.1.pdf" part number 160954-10 available for download at https://adaptivepower.com.

5.1 Installation of Optional Remote Control Interfaces

The CPS100 Series power sources provide a number of available interface options that can be installed in the field. The interface option slot is located at the rear panel making it easy for the user to plug in a new interface or replace an existing one.

Refer to the illustration on the right for correct assembly details.

Optional interface cards for 2U Units are:

- Remote I/O Card
- GPIB & LAN Interface Card

Optional interface cards for 3U and 4U Units are:
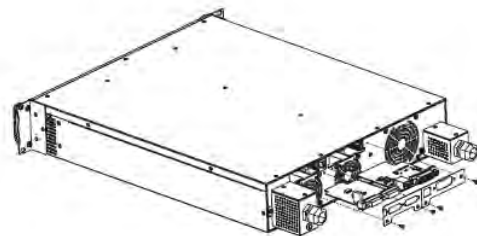
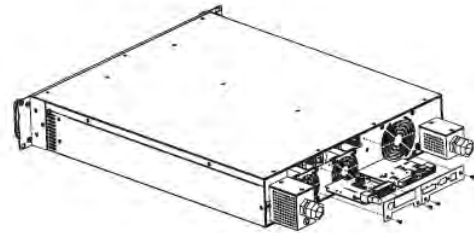- System Interface Card
- GPIB Interface Card
- LAN Interface

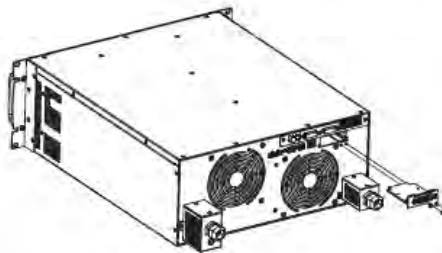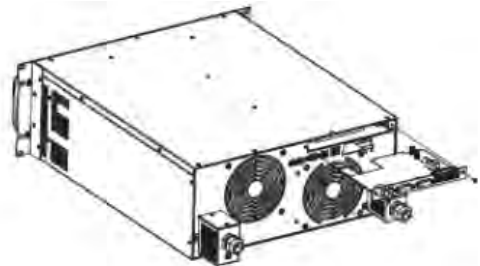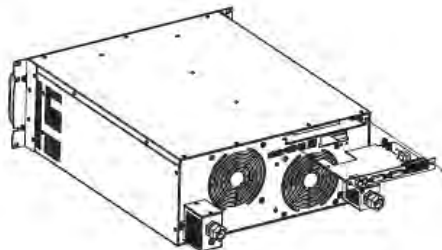*Figure 5-14: Interface Installation on 2U Models*

*Figure 5-15: GPIB Interface Installation on 3U and 4U Models*

5.2   Instrument Rack Installation

The CPS100 Series power sources can be installed in a standard 19" rack mount cabinet. The cabinet used must be rated for the weight of the number of CPS100 Series units installed plus any additional equipment. Refer to the Dimensions and Weight section of the Technical Specifications, (Section 4.7).

5.2.1   Installing Rack Mount Handles

Install the rack mount handles provided in the CSP100 Series ship kit on the power source before mounting the unit in an instrument rack.

Refer to the illustration on the right for correct assembly. The required screws are included in the ship kit.
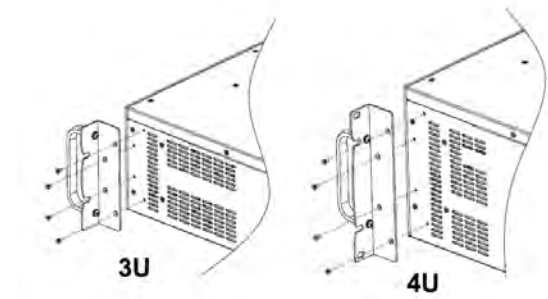
5.2.2 Rack Installation

The power source **must** be supported by either a 19" shelf or L-brackets of sufficient width rated for more than the weight of the unit.

To allow sufficient cooling for each unit, leave at least 20 mm or 0.75" of space between 2 or more units or between units and other equipment as shown to the right. This allows sufficient air to move between units to provide additional convection cooling.

20mm / 0.75"

Secure each unit to the front mounting strip of the cabinet using at least two screws on each side.

Note: These screws are not included in the ship kit of the CPS100 Series.
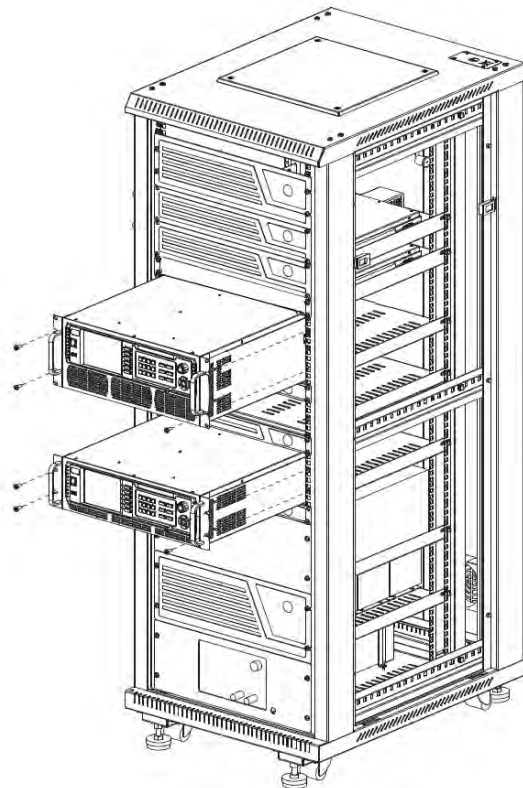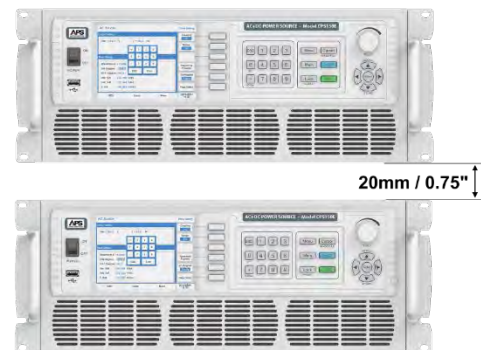
Figure 5-16: Cabinet Installation Drawing

6   Front Panel Operation

This Chapter provides an overview of front panel operation for the CPS100 Series power sources. For remote control operation, refer to Section 7 "Remote Control Programming" of this manual for an overview of available programming commands.

6.1   Powering On

The power source is turned ON using the power toggle switch located on the left hand side of the front panel. A splash screen will appear as shown below.

After several seconds, the LCD will display the Diagnostics screen. The diagnostics will take several seconds to complete. If all results are OK, the unit will revert to the default screen.
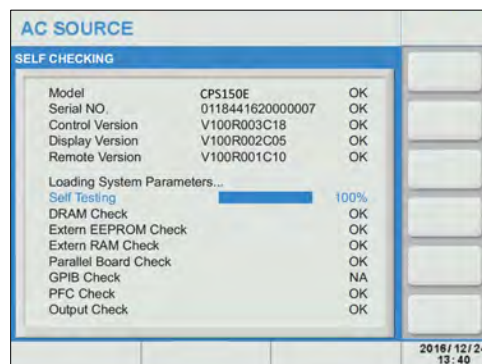

Figure 6-1: Power-On Diagnostics Screen

Note: If the PFC Check or Output Check shows a FAIL result, the power source will not operate. If there is a FAIL result in any of the other tests, the power source is still operational. In this case, press the [Enter] key to proceed to the MAIN screen.

6.2 Operating Modes

There are three operating modes available:

Front Panel   All settings are controlled from the front panel

Remote Control   All settings are controlled over one of the digital control interfaces. In this mode, the front panel keys are all disabled except for the decimal point key on the decimal pad, which may be used to revert to front panel (LOCAL) mode unless this function is disabled over the digital interface.

External Control In this mode, the output of the power sources follows a user provided analog input signal so neither front panel or remote interface operations are available.

The first two modes can be selected under computer control and doing so will not affect the output setting or interrupt the output. External mode can only be selected from the front panel and will disrupt the output when switching between modes.

6.3 Front Panel Layout

The front panel layout is shown in Figure 6-2 below. Operation is accomplished by using a combination of on-screen touch controls, function keys, a decimal keypad, a small grouping of menu keys and a shuttle knob and cursor pad combination.

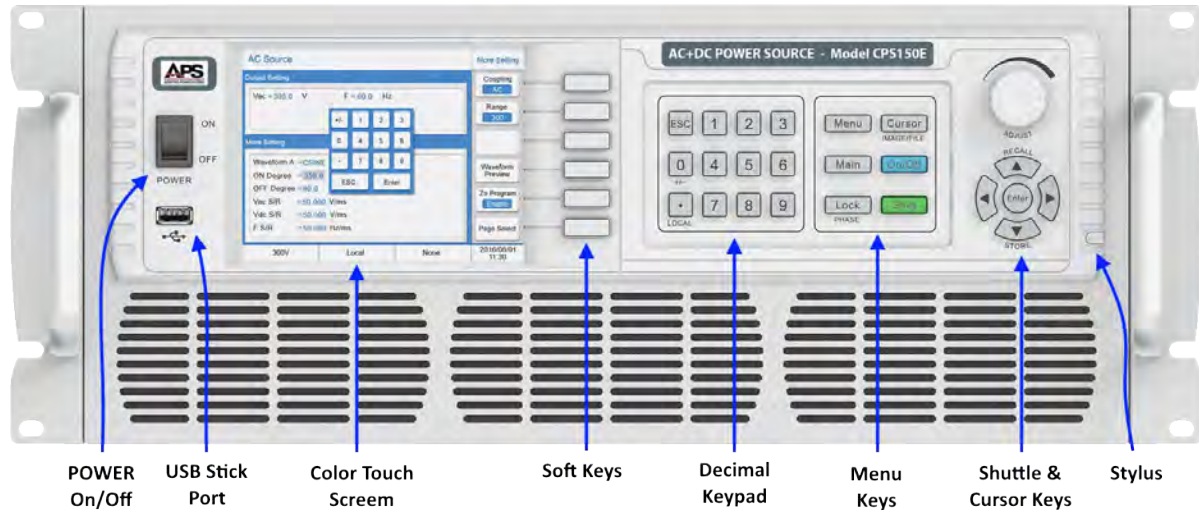The front panel control sections are shown in the image below.

Figure 6-2: CPS100 Series Front Panel Displays and Controls

The following controls and indicators are available for use.

Item	Description	Purpose
1	Power ON / OFF Switch	Turns AC input power to the unit on or off. The ON position is marked "|". The OFF position is marker "O"
2	USB Memory Stick Port	Used to store, retrieve setups or screen captures to a USB thumb drive.
3	Color LCD Touch Sensitive Display	Displays all settings, measurements and messages. Also used to select soft keys, drop down list entries of number or name entries.
4	Soft Keys	Soft Keys change function depending on the menu and parameter selected.
5	Decimal Keypad	Keys 0 through 9 allow direct entry of parameter values. The decimal point key allows entry of fractional values. The +/- Key allows entering of negative DC voltage values. ← ESC key backs up to previous screen or entry.
6	Menu Keys	This section has six fixed function keys: **Menu** Selects Function Setting Menu **Main** Selects Main Menu **Lock** Locks out front panel controls **Cursor** Selects value field or menu. Also saves LCD screen image to USB drive if

Item	Description	Purpose
		installed when combined with the SHIFT key.
		ON/OFF Toggles Output on or off
		Shift Selects alternate function of other keys as indicated by silkscreen directly below key.
6	Adjust Shuttle Knob	Allows slewing of Voltage or Frequency while output is ON or off. Also referred to as 'rotary knob'.
	Cursors, Store, Save and Enter keys	The curser key cluster has an ENTER key at its center. The Up and Down cursors double as RECALL and STORE keys for settings when used with the SHIFT key.
7	Stylus	A stylus is provided in the front panel to use with the touch screen. You can use your fingers as well but the stylus is smaller making it more precise to use. To remove the stylus, Pull it FOREWARD towards you when in front of the unit.

## 6.4   Front Panel Controls

The following sections explain the various key functions available.

- LCD Touch Screen
- Soft Keys
- Decimal Keypad
- Multi-Function Keys
- ADJUST Shuttle
- Cursor Keys

6.4.1   LCD Touch Screen

The Color LCD touch screen displays all setting, measurements, menus and error or warning messages. It may also be used to enter parameter values and setting by using its capacitive touch function. The use can use his fingers or the built-in touch pen located inside the front panel directly to the right of the ▼ key on the cursor keypad.

To enter parameter values using the LCD screen, touch any display parameter or setting value. An on-screen decimal keypad will pop up. Touch the relevant number keys
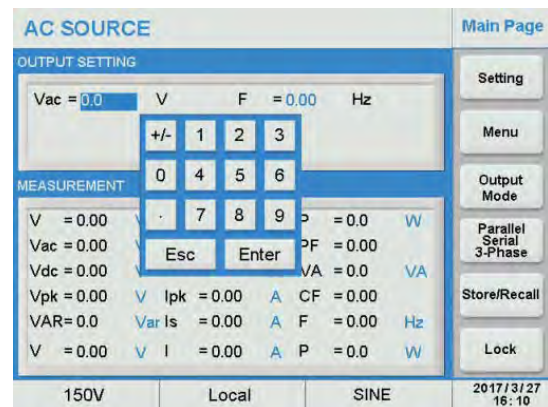
on screen to enter a value and press the [Enter] key when done. To abort, press the [Esc] key instead and the previous value will re-appear.

6.4.2   Soft Keys

There are six soft key located along the right hand side of the LCD screen. The labels of these key will change when selecting different screens. To select any of these soft keys, either press the area on the touch LCD or press the actual button on the right hand side of the screen.

6.4.3   Decimal Keypad

The Decimal keypad is used to enter numeric values. It contains numbers [0] through [9], a decimal point key to enter fractional values and an [ESC] Escape key. The decimal key doubles as the goto LOCAL key when the front panel is locked out. The [0] key can be used to toggle between + or – by pressing [Shift] + [0].

6.4.4   Multi-Function Keys

The multi-function area contains six special purpose keys that are used to display top-level menu screens.

This section has six fixed function keys:

- Menu   Selects Function Setting Menu

- Main   Selects Main Menu

- Lock   Locks out front panel controls or Phase select [Shift] + [Lock] in three phase configurations

- Cursor   Selects value field or menu or saves screen bitmap image to USB drive [Shift] + [Cursor].

- ON/OFF   Toggles Output on or off

- Shift   Selects alternate function of other keys as indicated by silkscreen directly below key.

6.4.5 ADJUST Shuttle Knob

The ADJUST shuttle knob or rotary digital encoder in the upper right hand corner of the front panel can be used to adjust any programmable parameter or select and confirm an entry from a drop down menu.

Turning the shuttle to right (clockwise) increments a selected field value. Turing it to the left (counter clockwise) decrements a selected field value.

Note: If the front panel is locked (LOCK is set to ON), the shuttle knob is disabled.
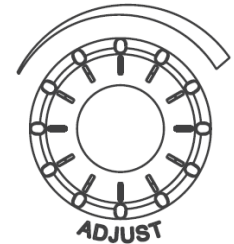
6.4.6 Cursor Keys

The cursor keypad located directly below the Shuttle consist of four cursor direction keys and an **ENTER** confirmation key. These keys have the following function(s).

The ▲ and ▼ cursor keys may be used to quickly access stored settings by holding down the SHIFT key.

Key	Function	Manual Reference
RECALL (Shift+ △)	Recall setup from internal non-volatile memory	[Shift] + [▼]
STORE (Shift + ▽)	Store setup to internal non-volatile memory	[Shift] + [▲]
◁	Up / Left Key	[◀]
▽	Down / Right Key	[▶]
Enter	Confirm Key	[Enter]

Table 6-1: Cursor Keypad Functions

6.5 Menu Structure

The CPS100 Series power sources use a hierarchy of menu screens divided into function areas that allow full control over output settings, modes of operation, system parameters and several special test functions.

There are three levels of nested menus under the Main Screen. The Main screen is always the first screen displayed after the power source is turned on. All sub screens can be accessed using the MENU and MAIN keys in combination with one or more on-screen soft keys.

The figure below shows the entire menu system at once. Each section will be covered in subsequent sections in more detail.
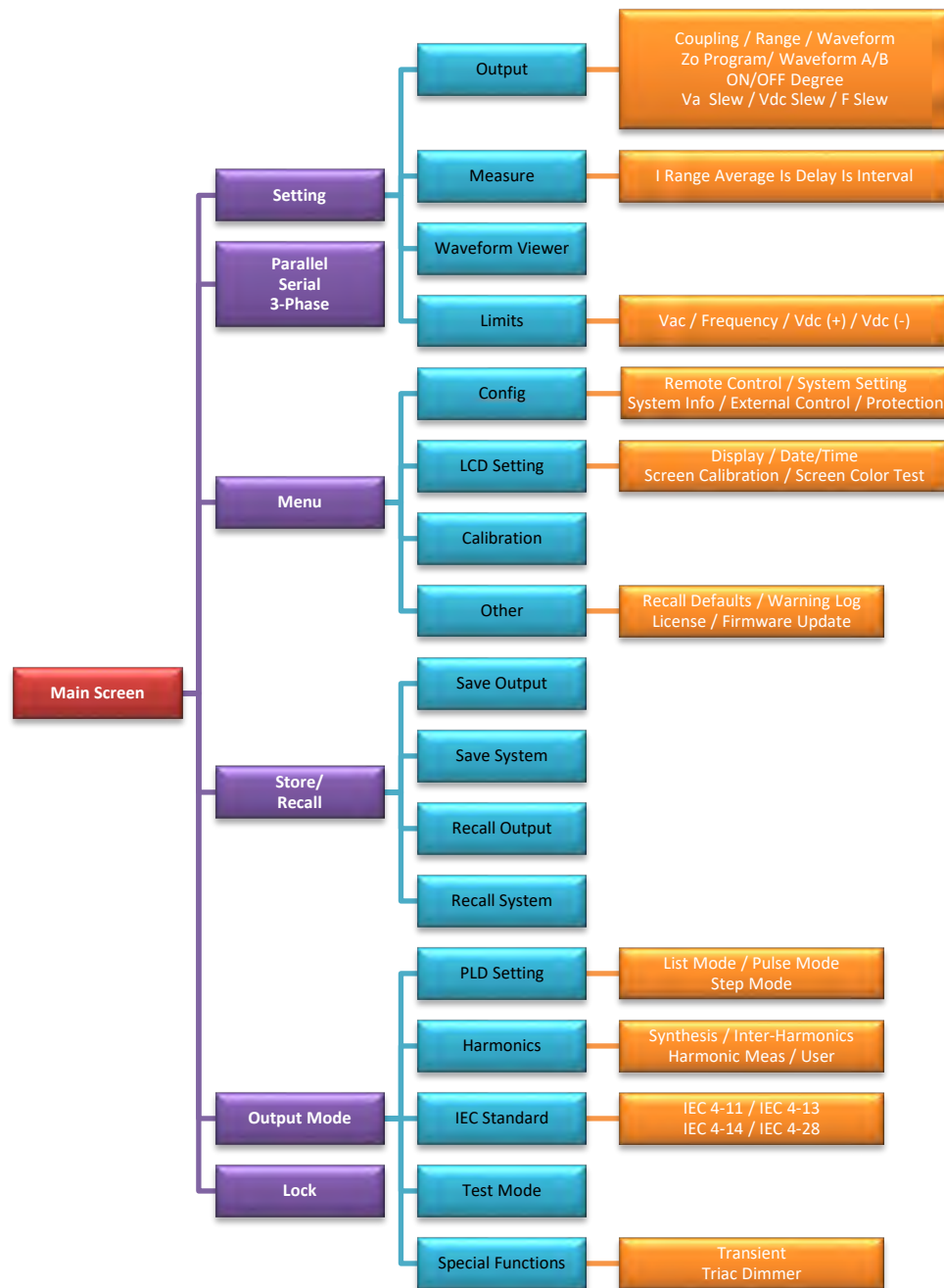
Main Screen	**Setting**	Output — Coupling / Range / Waveform, Zo Program/ Waveform A/B, ON/OFF Degree, Va Slew / Vdc Slew / F Slew
	Parallel Serial 3-Phase	Measure — I Range Average Is Delay Is Interval
		Waveform Viewer
		Limits — Vac / Frequency / Vdc (+) / Vdc (-)
	Menu	Config — Remote Control / System Setting, System Info / External Control / Protection
		LCD Setting — Display / Date/Time, Screen Calibration / Screen Color Test
		Calibration
		Other — Recall Defaults / Warning Log, License / Firmware Update
	Store/ Recall	Save Output
		Save System
		Recall Output
		Recall System
	Output Mode	PLD Setting — List Mode / Pulse Mode, Step Mode
		Harmonics — Synthesis / Inter-Harmonics, Harmonic Meas / User
		IEC Standard — IEC 4-11 / IEC 4-13, IEC 4-14 / IEC 4-28
		Test Mode
		Special Functions — Transient, Triac Dimmer
	Lock	

Figure 6-3: Complete Menu Structure Overview

6.6 MAIN Screen

The MAIN screen shows after power up or whenever the [Main] key is pressed. It displays the Output settings in the top portion of the screen and all available measurements in the lower portion of the screen. Thus, all settings and measurements are visible on this screen.

At the bottom of the screen, a status bar is visible. This status bar displays selected voltage range, Local or Remote State, Waveform selected in AC mode or DC and the date and time.
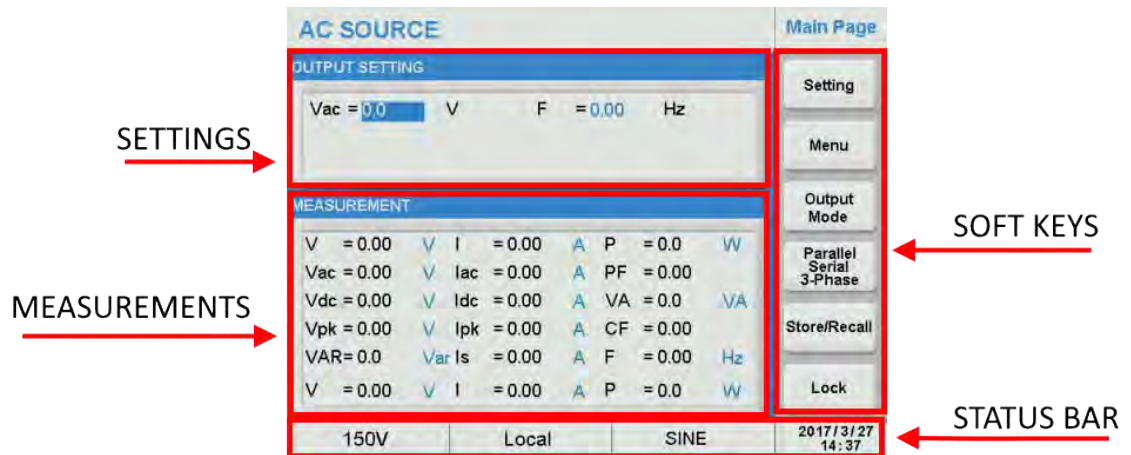
The following **soft keys** are available on the right hand side of the Main screen:

- Setting   Displays **Settings** screen
- Menu   Displays **Menu** screen
- Output Mode   Displays **Output Mode** screen
- Parallel, Serial, 3-Phase   Display **P/S/3Phs** screen
- Store/Recall   Displays **Store/Recall** screen
- Lock   Displays **Lock** screen

6.7   SETTING Screens

The SETTING screen is used to program steady state output parameters like voltage, frequency, waveform and user programming limits. It also allows configuring the mode for either AC, DC or both. The SETTING menu structure is shown in the diagram below.
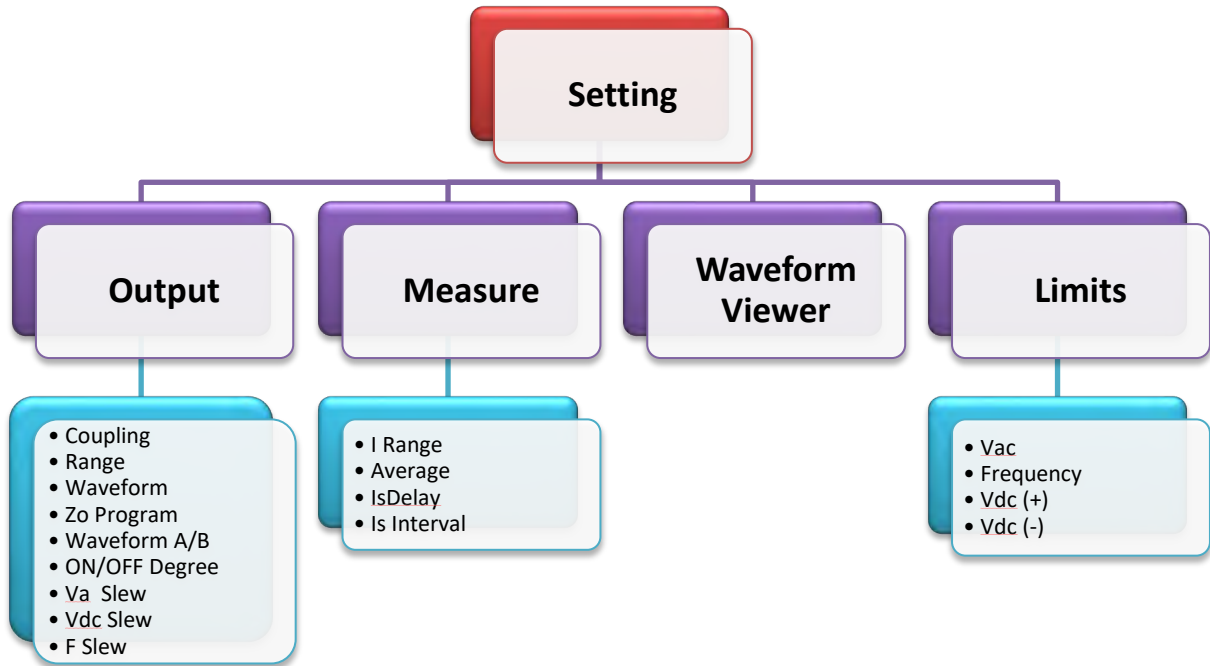
Figure 6-4: SETTING Menu Structure

The following Soft Keys are available in the Setting screen to access these setup screens.

- Output & More Settings
- Measurement Settings
- Waveform Viewer
- Limitations (User Limits)

6.7.1 Output & More Settings

This screen allows control over the following output settings using these soft keys:

- Coupling

- Range

- Waveform Preview

- Zo Program

6.7.1.1 Coupling Mode

Available modes are AC only, DC only or AC+DC combination. Press the Coupling soft key to display the drop down list. Available entries to select are AC, DC and AC+DC. Use the shuttle and Enter key to select of press the Coupling soft key repeatedly to toggle through the available selections.

When selecting AC+DC mode, both the Vac = and Vdc = values are displayed in the OUTPUT SETTING portion of the screen.
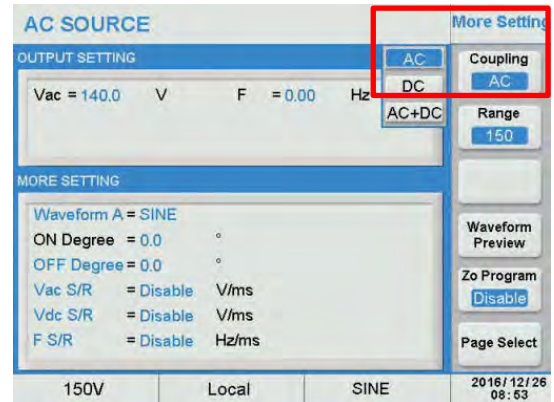
AC+DC
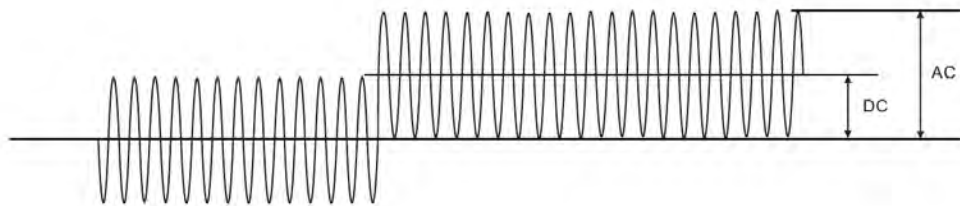
Note: In AC+DC Coupling mode, any combination of AC and DC voltage may be selected as long as the positive or negative peak voltage of the combined output does not exceed the allowable maximum peak voltage. Refer to figure above.

6.7.1.2 Voltage Range

The Range soft keys offers 3 selections, 150, 300 or AUTO. There are 2 voltage ranges, 300 and 150. The 300 range supports AC voltage output to 300Vac RMS or DC voltage to 424Vdc. The 150 range supports AC voltage output to 150Vac RMS or DC voltage to 212Vdc. Regardless of coupling mode, the range indication remains 150 or 300.

Selecting AUTO range means the power source will switch between high or low range automatically depending on the programmed voltage value for Vac and/or Vdc.

Note: Using AUTO ranging means the power source will have to drop the output for a short period of time as it performs the range change. Thus, in AUTO range mode, the output will be interrupted for about 300 msecs during a range change. If a load is connected, it will turn off until the relay is closed again and output voltage is restored. To prevent this from happening, use either 150 or 300 range setting instead.

The selected voltage range is always shown on the left hand side of the status bar at the bottom of each screen. Displayed values are either 150V, 300V or AUTO.

6.7.1.3 Waveform Preview

There are 2 available waveform groups called A and B respectively. Both groups contain the following standard waveforms:

Sinusoidal (SINE), Square Wave (SQUARE), Clipped Sine (CSINE), 30 fixed predefined waveforms (FIXED) and six user defined waveforms (USER).

Touch the Waveform A or Waveform B field to change the selected waveform. A list of available selections including USER will be shown. (See screen above). Use the shuttle or touch screen to pick one of the available waveforms.

The Waveform Preview soft key shows the selected output waveform in graphical form on the LCD display.

Press the Waveform Preview soft key to display the currently selected waveform.

Example to the right displays the SQUARE wave.
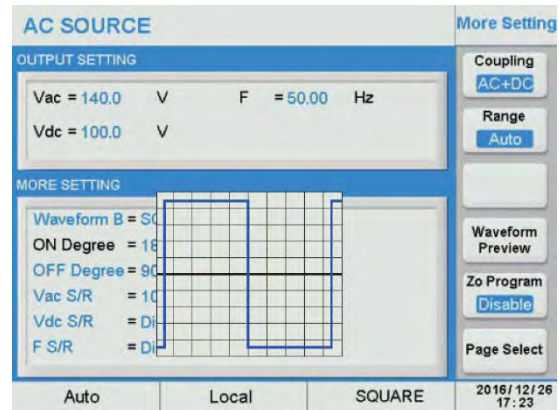
The same screen also allows programming of the start and stop phase angles in degrees and voltage and frequency slew rates.

6.7.1.4   Phase Angle Programming

Start and stop phase angle settings for enabling and disabling the output can be controlled by setting the ON Degree and OFF degree fields in the **More Setting** screen. The example here shows settings of 180° for ON and 90° for OFF.

Either setting has a range from 0.0° to 359.9°. These fields can be set to **Disable** if no phase control is desired or needed. When **Disabled**, the output on and off will occur immediately, regardless of phase angle.

To change these setting to **Disable**, select each field and press the ESC key. To set a degree value, select each field and use the key pad or touch screen to enter a value and press ENTER.

6.7.1.5   Slew Rate Programming

Slew rates for Vac, Vdc and Frequency can be set in the More Setting screen using these three fields:

- Vac S/R
- Vdc S/R
- F S/R

Slew Rate settings are in Volts per msec for voltage and Hz per msec for frequency. When set to **Disable** output changes occur as fast as the power source is able to change its output.
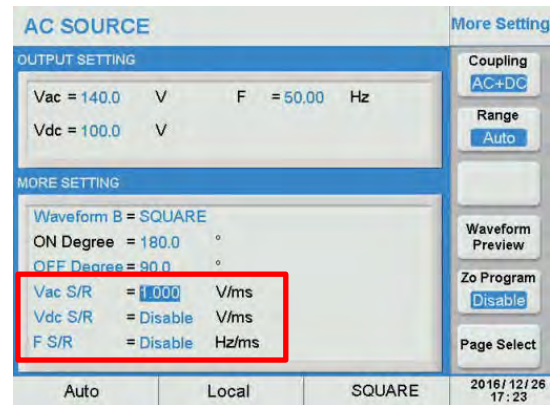
Programmable slew rates set values supported are as follows:

Vac slew rate: 0.001 V/ms ~ 1200.000 V/ms (or **Disable**)
Vdc slew rate: 0.001 V/ms ~ 1000.000 V/ms (or **Disable**)
Frequency slew rate   0.001 Hz/ms ~ 1600.00 Hz/ms (or **Disable**)

Note: If the user programs a slew rate setting, the ON Degree (Start phase angle of an AC output waveform may not be directly visible. It can be inferred however from the waveform cycle and frequency setting.

6.7.1.6 Zo Program

The Zo Program soft key is used to Enable or Disable the programming output impedance function of the power source. When Enabled, the R and L component of the output impedance are displayed in the MORE SETTING area of the screen.

Default settings are Zo R = 0.00 Ω and Zo L = 0.00 mH. By touching either field, the user can set a value for R and L to obtain a specific output impedance.

Available set value ranges for Zo Program are:

Zo R = 0.01 ~ 1.00 Ω
Zo L = 0.01 ~ 1.00 mH

The example to the right shows a setting of 0.5 resistive only. The output voltage will now drop as a function of load current by the amount of current x 0.5.
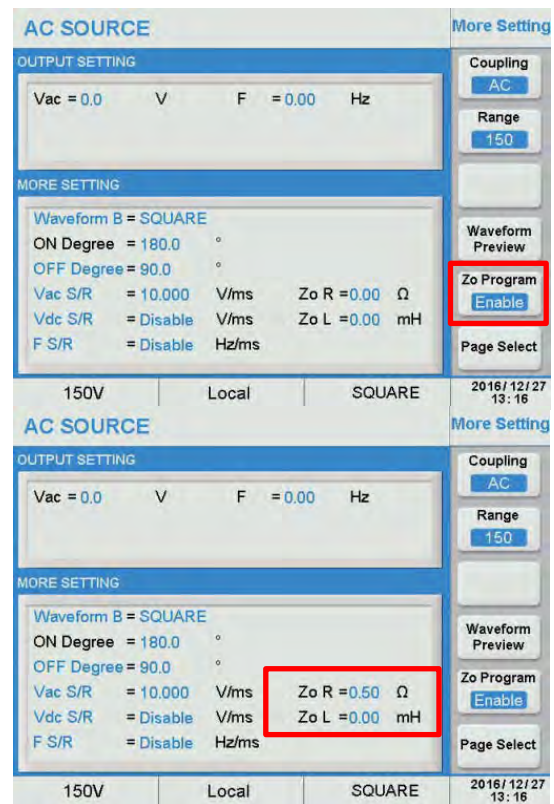
⚠ **WARNING**

The upper limit for Programmable output impedance is 1.0 Ohm / 1.0 mH. If L is more than 0.5 mH and the output voltage is low (e.g. less than 100Vac), any large load current may cause an unstable output voltage. It is important that the user adjusts the L value slowly while monitoring the output voltage and listening for any unusual sounds coming from the power source. If any unusual high frequency output voltage is observed or any abnormal sound is heard, **DO NOT** use this feature. Instead, use an external actual impedance circuit in series with the load.

6.7.2   Measurement Settings

The CPS100 Series power sources support 15 different output measurements. All 15 can be displayed at the same time in the Measurement display area of the MAIN screen as shown below.
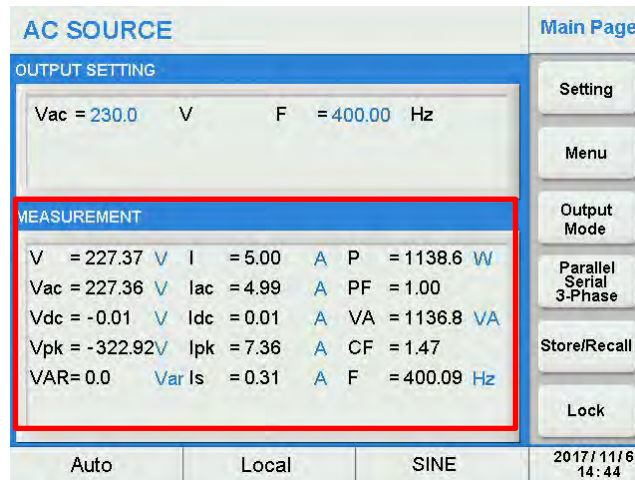
The Measure screen arranges these measurements in any way the user prefers. You can either display all measurement parameters or just a few by customizing this display using the Measure screen shown below.
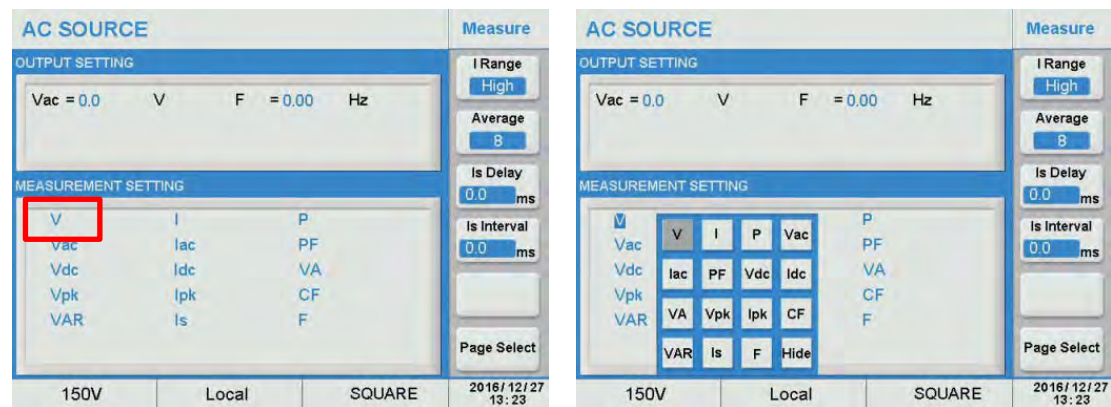
To change a selection, press the location on the screen or move the cursor to the position you would like to edit. A on-screen touch pad will be displayed at that location containing all 15 measurements and a **Hide** button. Select the desired read-out at this position by pressing it or press Hide if you want no readout at this position.

The following measurement parameters are available to choose from:

LABEL	MEASUREMENT	UNIT
LEFT COLUMN		
V	Voltage (Vac+Vdc)	V
Vac	Voltage AC RMS	V
Vdc	Voltage DC	V
Vpk	Peak-to-Peak Voltage	V
VAR	Reactive Power	VAR
CENTER COLUMN		
I	Total Current (Iac + Idc)	A
Iac	AC Current RMS	A
Idc	DC Current	A
Ipk	Peak Current	A
Is	Surge Current	A
RIGHT COLUMN		
P	True Power	W
PF	Power Factor (P / VA)	
VA	Apparent Power (VA = P + VAR)	VA
CF	Crest Factor (Ipk / I)	
F	Frequency	Hz

Table 6-2: Available Measurements and Units

The following four Soft keys are available in the Measurement Settings screen:

- I Range
- Average
- Is Delay
- Is Interval

6.7.2.1   I Range Setting

The I Range soft key allows selection of the current measurement range. Available settings are:

- High
- Middle
- Low
- Auto
- mA

Actual measurement ranges of each of these settings may vary by model. Consult the Technical data section for data by model.

To select a current range, press the I Range soft key and select a range from the available list.

Note: The **Auto** Range selection will only switch between High and Middle ranges. To change settings between High/Middle and Low/mA ranges, the power source must be turned off first.

6.7.2.2   Average Setting

The Average soft key changes the number of times a reading is averaged before the corresponding measurement parameter display is updated. Available average values are 1, 2, 4, 8, 16 and 32.

The higher the number readings averaged, the slower the measurement update rate will be so we recommend you choose the lowest acceptable number.

Make a selection by pressing the Average soft key and selecting an averaging value from the list, then press ENTER to confirm.
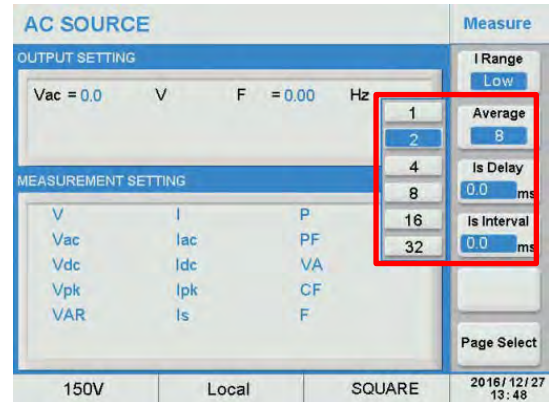
6.7.2.3   Is Delay & Is Interval Setting

The Is Delay and Is Interval settings are used to determine the inrush current of a unit under test.

Is delay defines the delay time between the beginning of the output voltage transition to the start of the measurement of I surge.

Is Interval defines the measurement time.

For example, for a 50Hz application, setting the Is delay to 10 msec will cause the I surge current measurement to start half a cycle after the voltage is applied.

Available setting values are:

Is Delay:	0.0 ~ 999.9 msec
Is Interval:	0.0 ~ 999.9 msec
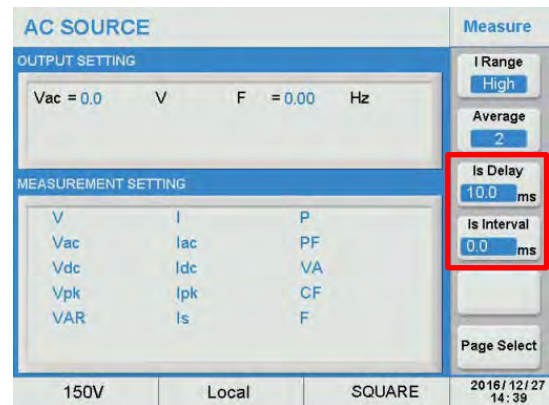
6.7.3 Waveform Viewer

The Waveform Viewer soft key displays a visual time domain representation of the selected AC waveform. It is similar to the Preview Waveform function in the Settings & More screen covered in section 6.7.1.3.
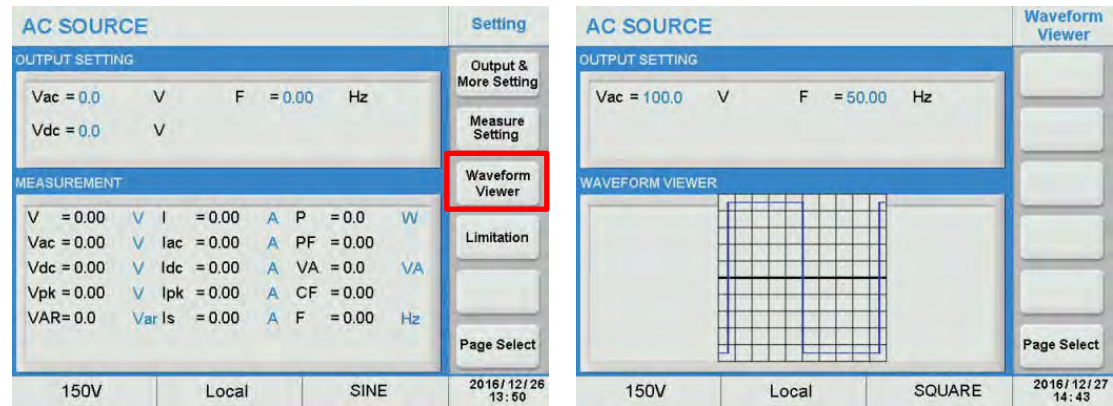
6.7.4 Limitation (User Limits)

The Limitation soft key displays the user limit setting screen. User limits are useful to protect a unit under test from operator error by setting upper and or lower parameter value limits for key output parameters like voltage and frequency.

The user limits must fall within the hardware limits of the power source, which are:

- Vac range: 0 ~ 300 V
- Vdc range: -424.2 Vdc to + 424.2 Vdc
- Frequency: 15 ~ 1000 Hz for Standard models, 15 ~ 1200 Hz for Enhanced models.

Thus, user limits cannot be set higher than these upper hardware limits.

To set any of the available user limits, use the cursor or touch screen to select one of the available limit set values. You can also use the **Set to Maximum** or **Set to Minimum** soft keys to enter max or min limit values.

Note: User limits are independent of the selected voltage range so an upper Vac limit setting higher than 150V will have no effect while on the 150V AC voltage range as the voltage range limit supersedes the user limit.

6.8 MENU Screens

The MENU screen is used to configure system level settings such as interfaces, LCD screen contrast, External input modes, Calibration etc. These are settings that are not related to the power source output. The **Menu** structure is shown in the diagram below.
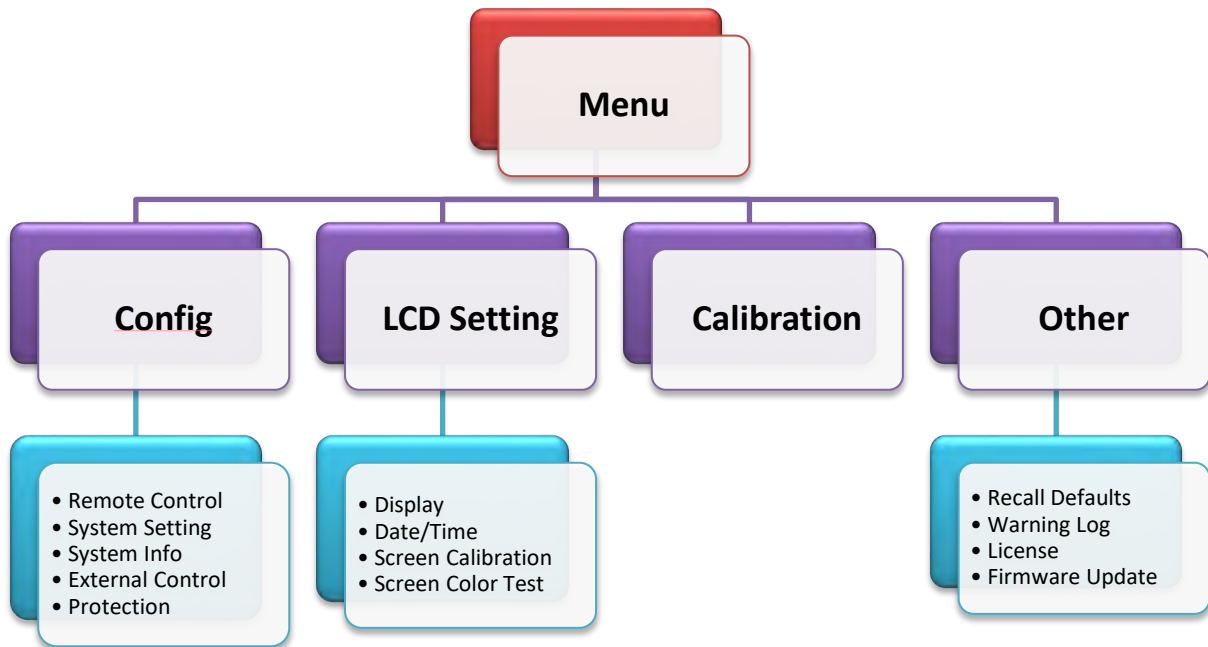
Figure 6-5: Menu Structure

The following Soft Keys are available in the Menu screen to access these settings.

- Config
- LCD Setting
- Calibration
- Master/Slave
- Other
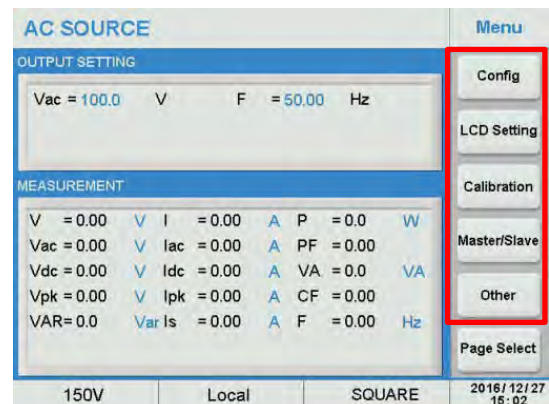
6.8.1   Config

The configuration screen controls the
following aspects of the power source.

- Remote Control

- System Settings

- System Information

- External Control

- Protection
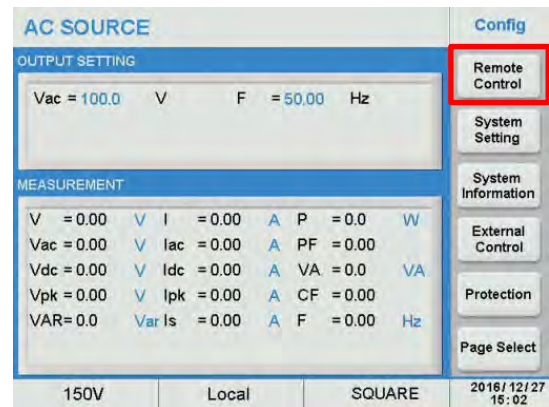
6.8.1.1   Remote Control

The remote control screen provides access to
all four available control interfaces:

- RS232
- RS485
- GPIB
- Ethernet

Note that some models may not support all
four interfaces at the same time and thus
fewer than four may be displayed.

To configure each interface, press the
corresponding soft key and use the cursor or touch screen to adjust parameters as needed.

For available interface settings, refer to section 5.10, "Remote Control Programming
Interfaces" on page 59.

Setting information for all available interface types is provided in this section.
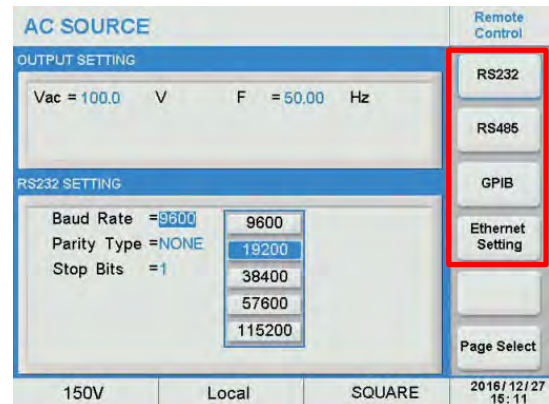
RS232 Settings

From the Remote Control screen, press the **RS232** soft key to change RS232 interface settings. Scroll through Baud rate, parity and Stop bits fields and use the shuttle to set the desired values. Press the [Esc] key when done to back up to the Remote Control screen.
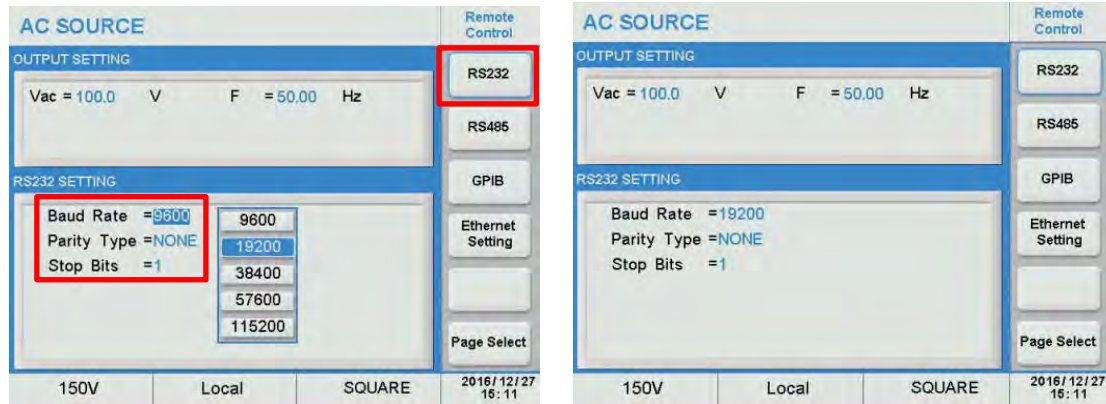
Parameter ranges are:

- Baud Rate: 9600, 19200, 38400, 57600, 115200
- Parity Type: None, Even, Odd
- Stop Bits: 1, 2

Note: This interface does not support XON/XOFF protocol or any hardware handshaking. The controller should be configured to ignore the Handshaking Lines DTR (PIN 4,), DSR (PIN 6) and RTS (PIN 9). If the port cannot be configured through software to ignore the lines, the handshaking lines should then be jumped together in two different pairs. Both pins 4 & 6 and pins 7 & 8 must be jumpered together at the controller end of the cable.

RS485 Settings

From the Remote Control screen, press the **RS485** soft key to change RS485 interface settings. Scroll through Baud rate, parity, Stop bits and Address fields and use the shuttle to set the desired values. Press the [Esc] key when done to back up to the Remote Control screen.
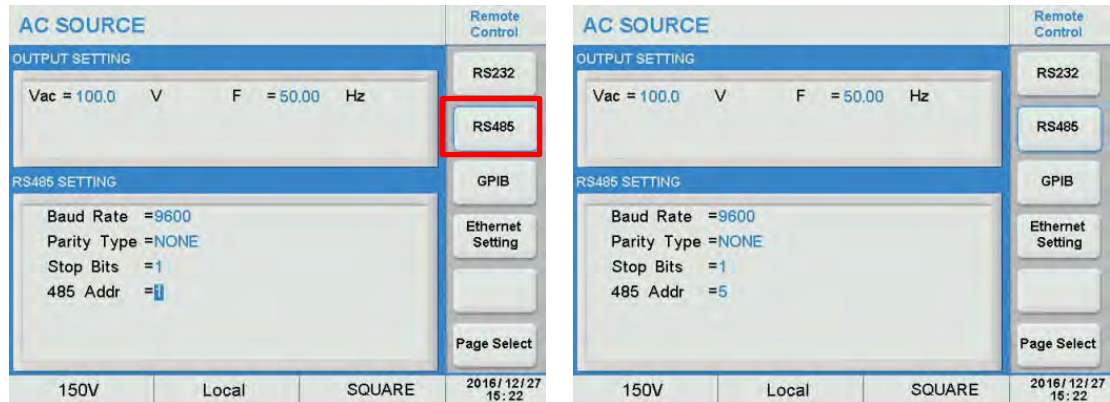
Parameter ranges are:

- Baud Rate: 9600, 19200, 38400, 57600, 115200
- Parity Type: None, Even, Odd
- Stop Bits: 1, 2
- 485 Addr: 1 ~ 254

GPIB Settings (Option)

From the Remote Control screen, press the **GPIB** soft key to change GPIB interface settings. Scroll to the "GPIB Addr" field and use the shuttle to set the desired address. Press the [Esc] key when done to back up to the Remote Control screen.
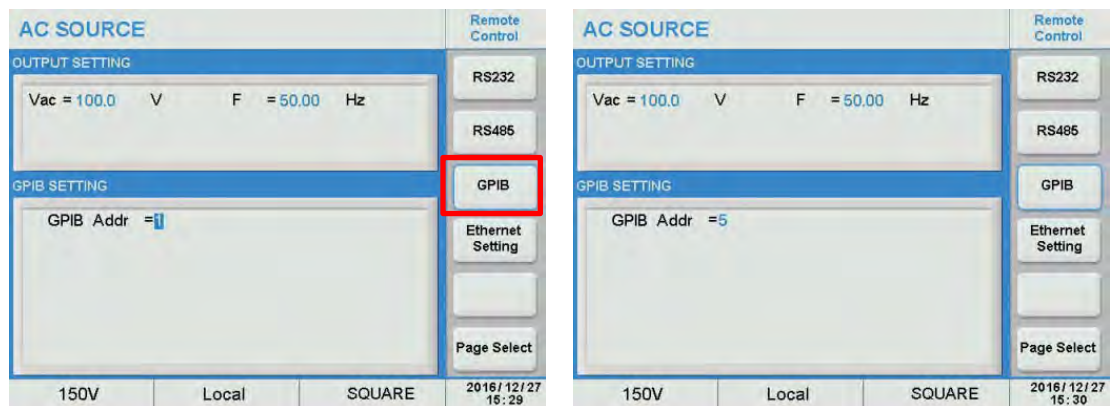
Parameter ranges are:

- GPIB Addr: 1 ~ 30

Ethernet Settings

From the Remote Control screen, press the **Ethernet Setting** soft key to change LAN interface settings. Scroll to the "ETH Setting" field and use the shuttle to set DCHP mode (Auto) or use Manual to assign a fixed IP address. For additional information on LAN communications, refer to section 10, "LAN Interface Configuration" on page 198.

Press the [Esc] key when done to back up to the Remote Control screen.
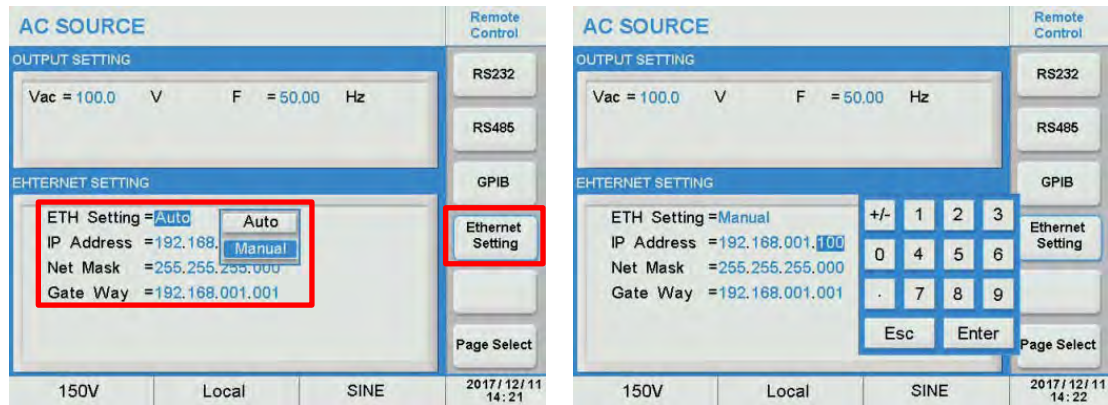
Parameter ranges are:

- ETH Setting: Auto, Manual   **Note:** Presently, Auto mode is **NOT SUPPORTED**
- IP Address: 0 ~ 255
- Net Mask: 0 ~ 255
- Gate Way: 1 ~ 254

The factory default Ethernet setting values are:

ETH Setting =   Manual
IP Address =   192.168.001.100
Net Mark =   255. 255. 255.000
Gate Way =   192.168.001.001
Socket =   2001

6.8.1.2   System Settings

The System setting screen is used to configure the following resources of the power source:

- Buzzer

- P/O State

- O/P Relay
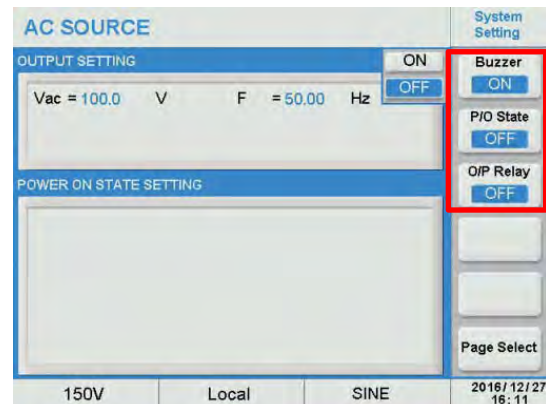
Buzzer Setting:

The buzzer can be turned on or off by pressing the "Buzzer" soft key and toggling the setting between ON and OFF.

When ON, a sound will sound each time the user presses a key on the front panel or presses the shuttle.

If an audible indication is not desired, turn the buzzer sound OFF.

Power On State Setting:

The Power On state (P/O State) soft key allows the user to select the programmed state of the power source after turning on the input power. Available selections are:

- OFF   The power source will NOT store any setting when powered off and initialize with factory default at power on.

- LAST   The power source will store the last setting in effect when powered off and recall this same setting at power on. That means the unit will power up in the same conditions as when it was turned off.

- USER   In this mode, a user-defined setup can be assigned for recall when the power source is turned on. This means the power source will always turn on with this specific setup.

Example: To set a power on setting of AC+DC coupled output, Vac = 100V, F = 50Hz and Vdc = 20V, use the following steps:

1. Press the P/O State soft key and scroll to the USER entry, then press [Enter] to confirm. Available setting parameters are now visible in the lower portion of the LCD.

2. Move the cursor to the "Couple = ", press [Enter] to confirm.

3. Rotate the shuttle to highlight the "AC+DC" option, press [Enter] to confirm.

4. Use the [0] ~ [9] keys and [Enter] to set the Vac, F and Vdc fields to 100, 50 and 20 respectively.

These steps are illustrated by the four screens below.
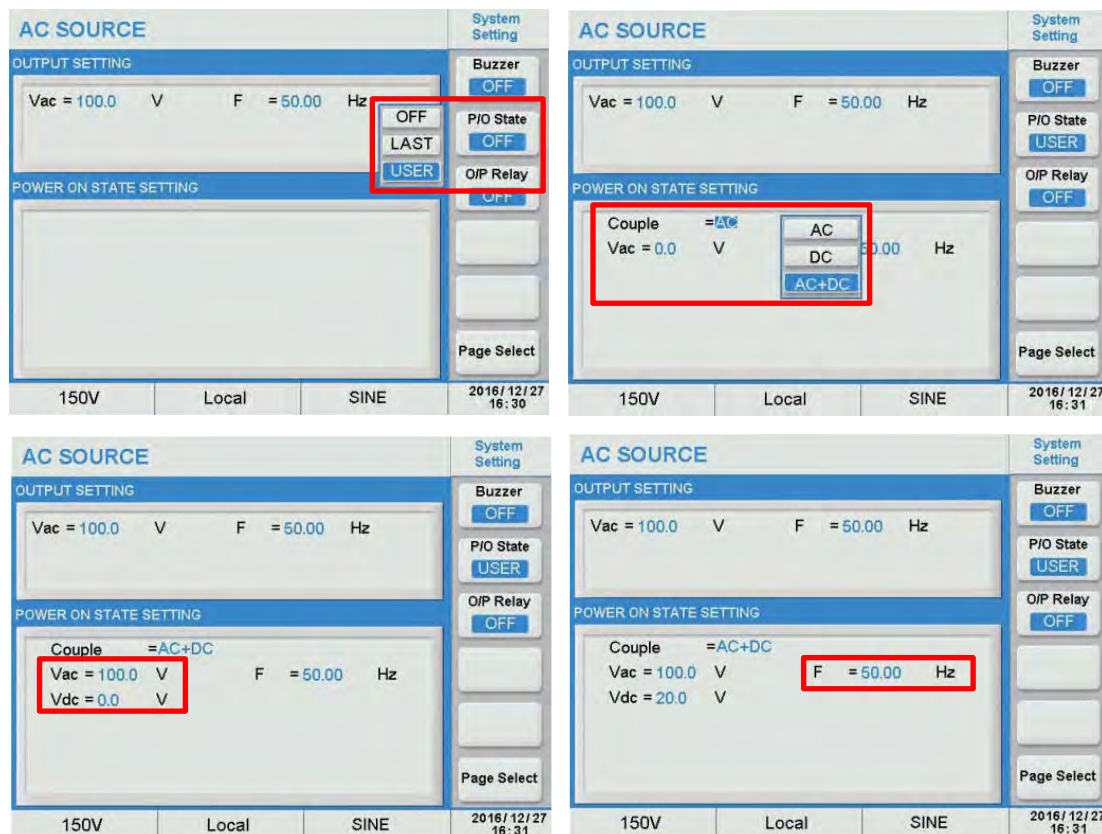
At power on, the power source will have these values already set.

Output Relay Setting:

The power source uses an isolation relay to connect or disconnect the load from the output of the power source. This setting determines how the output relay functions when the user presses the blue _On/Off_ button.

When the output relay (O/P Relay) is OFF, the output relay will close when the output state is ON and open when the output state is OFF. This is 'normal' operation for most power sources and should be the **default** setting.

When this output relay (O/P Relay) state is ON, the relay always remains closed, regardless of the programmed output state, i.e. even if the output state is OFF. The voltage will be set to 0V however. Use this setting only for special applications.
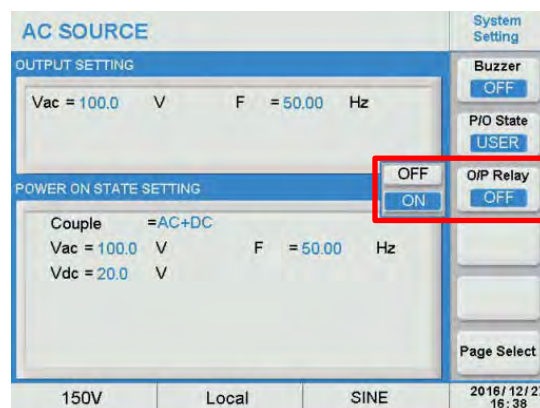
6.8.1.3   System Information

This screen is for information only. For remote service and diagnostics, the user may be asked to provide some of the information shown here to assist customer service.

Note: None of this data can be edited by the user.

6.8.1.4   External Control (Option)

The AC source allows the user to use an external control signal to determine its output. When 'Extern Control' mode is 'ON', the AUX I/O TTL or ANALOG options control input signals will be enabled. Refer to Section 5.9.6 on page 58 for details.

When "Analog Volt I/P" mode is 'ON', it will enable the BNC Sync signal input.

In "Analog Volt I/P" mode, the output voltage is synthesized by the 'Range' setting on the main interface and amplification of the external control voltage. The external input reference voltage range is -10V to +10V. The output Voltage can be calculated using the following formulas (when Vac = 0 and Vdc= 0 on the front panel display).

There are three available modes of external amplitude control:

1. Amplifier Mode
2. Level Mode
3. Volt Set Mode

To enable Amplifier mode, set the Extern Control field and the Analog Volt I/P field both to ON.

The control mode is determined by the Control Method selection. Available selections are Amplifier, Level and Volt Set.

Amplifier Mode

In Amplifier mode, the power source acts as a power amplifier, taking a low-level analog

signal and amplifying it by a fixed amount of gain. This level is summed with the programmed AC and DC voltage level.

The external signal input range is form -10V to +10V. The resulting output voltage can be calculated for the case where set values are Vac = 0 and Vdc = 0 as follows:

For AC output:

300V Range: Vout (ac) = Vref (ac) /10 x 1.414 x 300 Vac

150V Range: Vout (ac) = Vref (ac) /10 x 1.414 x 150 Vac

For DC output:

300V Range: Vout (dc) = Vref (dc) /10 Vdc x 424.2 Vdc

150V Range: Vout (dc) = Vref (dc) /10 Vdc x 212.1 Vdc

Level Mode

In Level mode, the output voltage RMS value responds proportionally to a DC input voltage reference. The permissible DC input level ranges from -10Vdc to +10Vdc. The resulting output voltage can be calculated as follows:

300V Range: Vout (ac) = Abs(Vref (dc) /10) x 300 Vac

150V Range: Vout (ac) = Abs(Vref (dc) /10) x 150 Vac

Volt Set Mode

In Volt Set mode, the output voltage responds proportionally to the input reference voltage. The input gain can be set to 3V, 5V or 10V using the **Voltage Set** field.

For the case of a 3V gain setting, the output voltage can be calculated as follows:

For AC output:

300V Range: Vout (ac) = Vref (ac) /3 x 1.414 x 300 Vac

150V Range: Vout (ac) = Vref (ac) /3 x 1.414 x 150 Vac

For DC output:

300V Range: Vout (dc) = (Vref (dc) / 3) x 424.2 Vdc

150V Range: Vout (dc) = (Vref (dc) / 3) x 212.1 Vdc

Note: The BNC Sync input has priority if "Extern Control" and "Analog Volt I/O" are both set to ON at the same time. However, there will be no output if "Extern Control" is set to OFF.
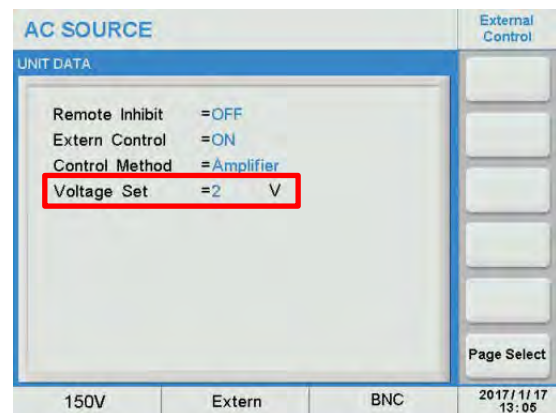
⚠️ **WARNING**

If the peak level of the external signal exceeds 10Vpk or the frequency exceeds 1200Hz, damage to the power source may result.

6.8.1.5   Protection

The protection functions that can be configured from this screen only apply to user programmable protections. All hardware protection functions are like over voltage (OVP) and over temperature (OTP) always enabled and cannot be edited.

Note: When a protection fault occurs, a pop-up fault window is displayed. The user has to clear the fault by pressing the "Enter" key in order to continue operation.
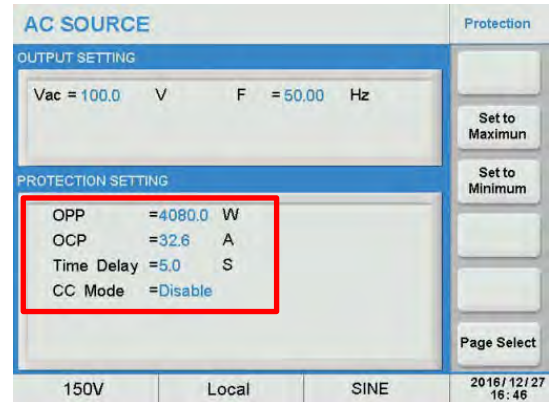
The following user editable protection limits can be controlled from this screen.

Protection Mode	Acronym	Range	Resolution
Over Power Protection	OPP	From 0W to 1.02 x Max. Power Rating	0.1 W
Over Current Protection	OCP	From 0A to 1.02 x Max. Current Rating	0.1 A
OCP Delay Time	OCP Delay	From 0.0 to 5.0 seconds	0.1 sec
Constant Current CC Mode	CC	When enabled, the output voltage will decrease to maintain the programmed current limit level. When disabled, the output will turn off after the set Time Delay and an OCP Fault message will be shown.	n/a

Table 6-3: Configurable Protection Modes

To edit any protection setting, select the relevant field and enter a new value using the shuttle or [0] ~ [9] keys and press Enter to confirm. You can also use the Set to Maximum or Set to Minimum soft keys to enter the maximum or minimum available setting for the selected parameter.

Notes: OCP delay time is approximately one second.

CC Mode response time is approximately 1.4 secs.
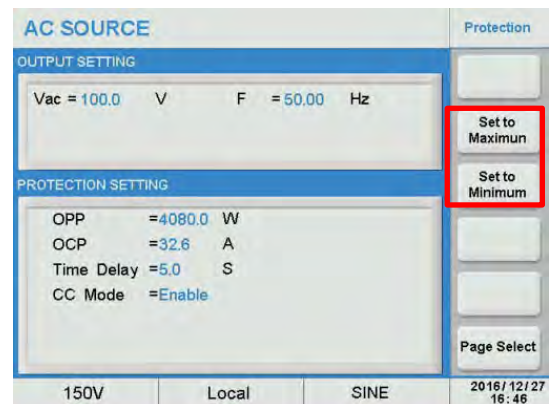
6.8.2   LCD Setting

The LCD setting screen controls the following aspects of the LCD display.

- Display Brightness

- Date & Time

- Touch screen calibration

- Screen Color Test
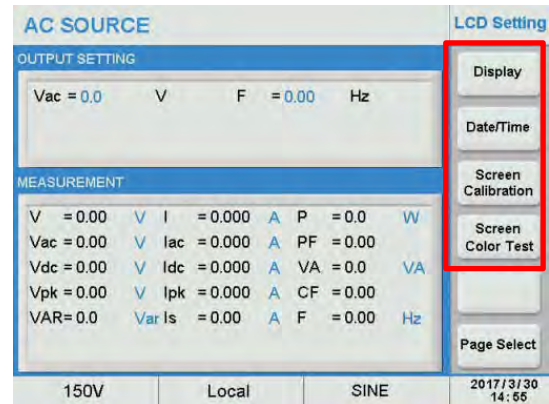
6.8.2.1   Display Brightness

The two soft keys in this screen control LCD brightness adjustment. The brightness can be adjusted up **[Brightness+]** or down **[Brightness-]**.

Adjust the display brightness as needed. for best viewing experience.
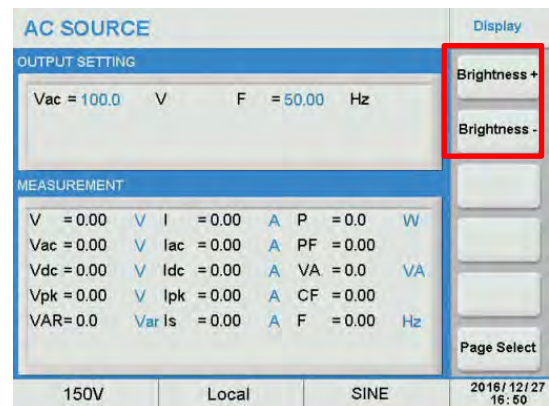
6.8.2.2   Date & Time Setting

The power source has a real-time date and time clock which is battery backed. It is set at the factory at the time of shipment but will have to be adjusted for local date and time zone.

Select the [Date/Time] soft key to display the present date and time setting. Select the year, month, day, hours and/or seconds field to make and adjustment.

Once selected, use the [0] ~ [9] keys to enter the local date and time. Press Enter to confirm each change.
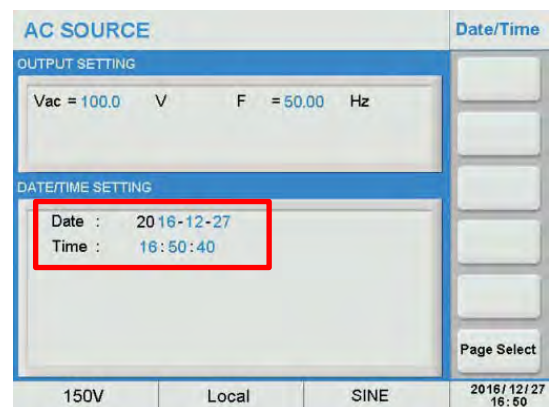
6.8.2.3 LCD Touch Screen Calibration

The touch screen may require period calibration to ensure the on screen fields line up properly with the touch overlay grid.

To do so, select the [Screen Calibration] soft key to display the calibration screen.

A calibration cross hair symbol as shown on the right will appear. Press the center of the cross hair as best as possible with the stylus or your finger. This will complete the touch screen calibration process.

Touch crosshair to calibrate
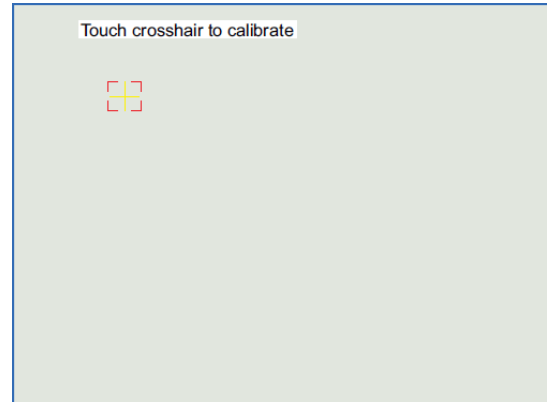
6.8.2.4 Screen Color Test

The screen color test displays a color pattern to check the color correctness of the LCD screen. This is a test only and there are no user adjustments.

6.8.3 Calibration

For calibration information, refer to Section 11, "Calibration" on page 208.

6.8.4 Master/Slave

Master / Slave configuration and operation is described in Section 8, "Master Slave Operation" starting on page 175.

6.8.5   Other

The **Other** setting screen contains miscellaneous system settings.

The following items can be configured from this screen:

- Recall Default
- Warning Log
- User License
- Firmware Update
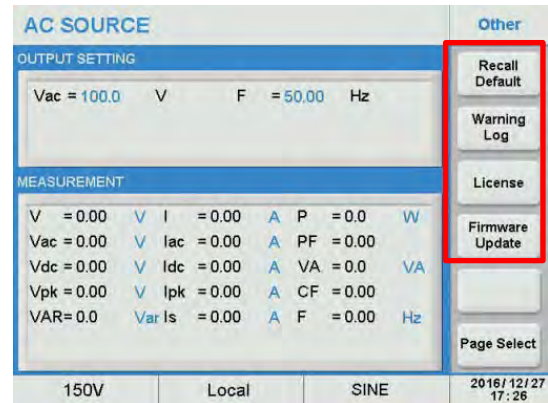
6.8.5.1   Recall Default

The Recall Default screen can be used to recall original factory (default) settings. Doing so will erase the current setup and replace it with default values.

Select this screen by pressing the **[Recall Default]** in the Other screen.

Press the **[Yes]** soft key to restore the factory default setting.
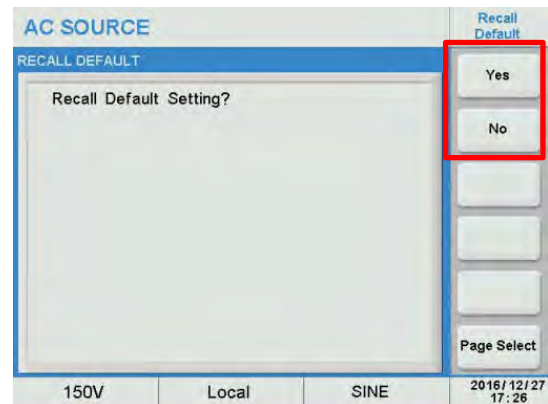
6.8.5.2   Warning Log

The warning log keeps track of any error or warning messages that have been generated by the power since it was last turned on. For each event, the log contains a date stamp, error code and a short description of the event.

6.8.5.3   User License

Displays license information.

6.8.5.4   Firmware Update

This screen is used to perform a firmware update.

6.9   OUTPUT MODE Screens

The OUTPUT MODE screen provides access to select special functions and built-in test modes. Some of these functions are only available on the Enhanced versions of the CPS100 product family (CPS100E models). The **Output Mode** Menu structure is shown in the diagram below.
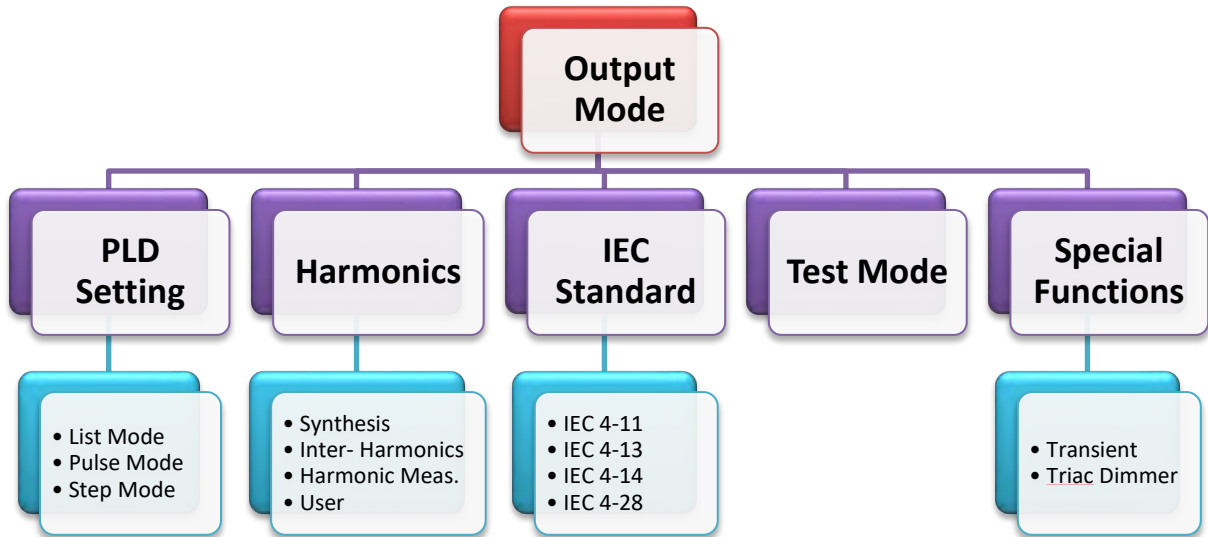
Figure 6-6: Output Mode Menu Structure

The following Soft Keys are available in the Output Mode screen to access these functions:

- Power Line Distortion Testing (PLD)
  Enhanced version only:
- Harmonics
- IEC Standard
- Special Func.
- Test Mode
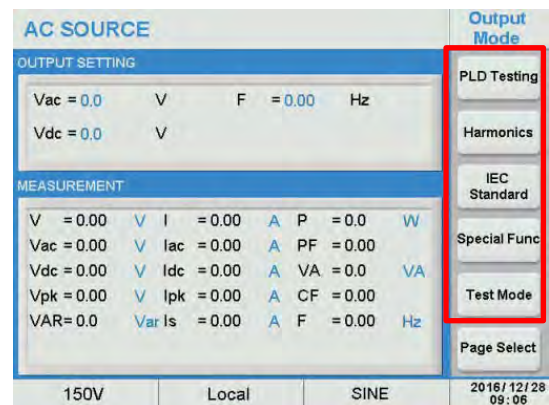
6.9.1   Power Line Distortion Testing (PLD)

Power Line Distortion testing allows testing of a unit under test for immunity against commonly occurring voltage and or frequency anomalies. Such anomalies can be programmed on the power source using one of its transient modes. The CPS100 supports three transient modes:

- LIST
- PULSE
- STEP

The next paragraph describe the use of each list mode in more detail.
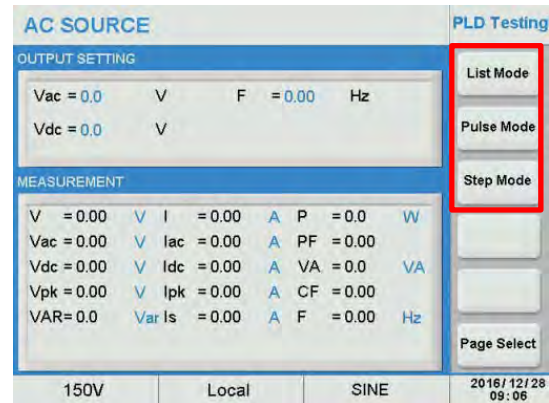
6.9.1.1   List Transient Mode

The list mode is the most versatile of the three transient modes and can do anything the step and list mode can do and more. It allows a sequence of events to be programmed as a list.

Each list entry has set values for voltage, frequency, ramp time, phase angles and dwell times. The list executes sequentially so a sequence of events can be programmed using list mode.
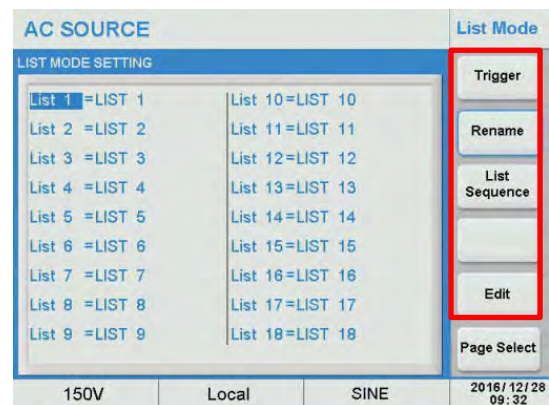
The output change occurs when the transient trigger is generated, either from the front panel or through some other means. The principle behind a list transient is illustrated below. A series of voltage and or frequency changes can be defined using ramp and dwell times for each of several steps. This list of steps is called a transient sequence or transient list.
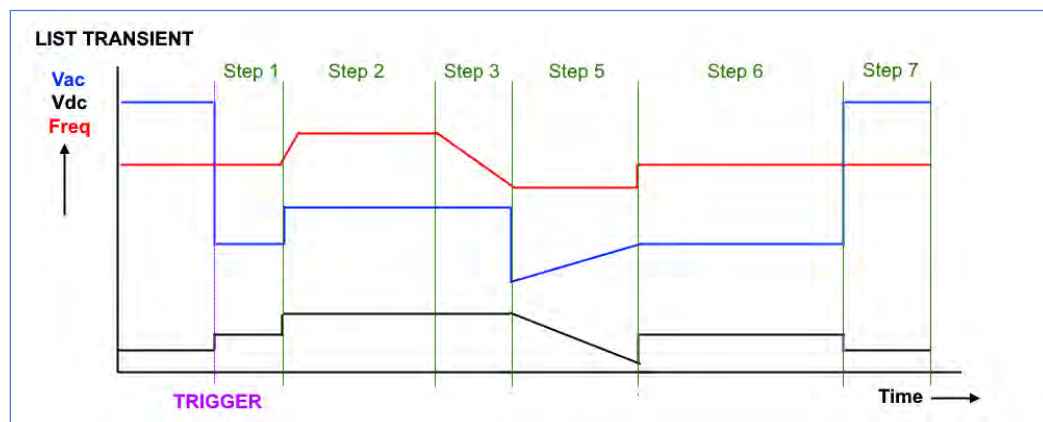
Figure 6-7: Illustration of a LIST Transient

The LIST transient mode supports 50 list files. Each list can be assigned a name. The default name for each list is **LIST n** where n can be from 1 ~ 50.

To edit a list, select it using the cursors or touch screen and press the [Edit] soft key.

This will bring up the list edit screen where the steps in the list can be added, deleted and edited.

Each **Step** allows setting of the following parameters:

- Vac start   Start value for Vac
- Vac end   End value for Vac
- F start   Start value for Frequency
- F end   End value for Frequency
- Vdc start   Start value for Vdc
- Vdc end   End value for Vdc
- Degree   Phase Angle from 0.0° ~ 359.9°
- Waveform   Waveform Group A or B
- Base   Base for Cycle or Dwell Time
- Cycle / Time   Duration in either no. of cycles or time in msecs.
- Count   Repeat Count 0 ~ 9999. . A zero repeat count indicates infinite looping. A1 r
- Trigger   Trigger mode: Cont (continuous) or Step each time Trigger soft key is pressed (one step per trigger event).

The selected Step number is shown at the top of the screen as **Step 1 / Step 3**. This example means step 1 of 3 is being edited. There are five soft keys for the following edit functions:

- Repeat   Repeat Count.
- Last Step   Jumps to the last step
- Next Step   Jumps to the first step
- Step   Determined the number of steps for this list
- Save   Save edits to list to memory when done.

When the List edit are complete, press the [Save] soft key to save all changes made to the list.

Warning: Failure to Save a transient list will cause it to be lost when the power source is turned off.
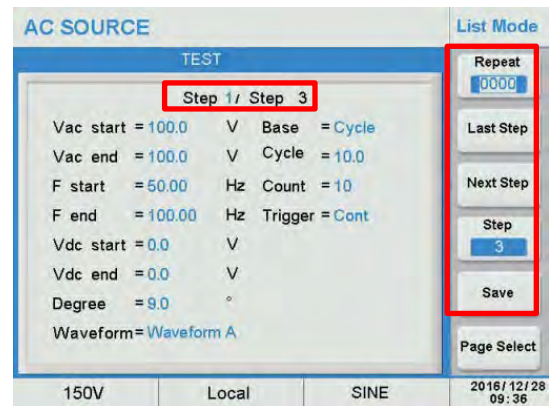
To execute a selected Transient List, press the [Trigger] soft key.

The selected step in the list is shown in the top part of the display, as are the Count and Cycle settings for this step. During transient execution, the Step = 0/3 will update as each step in the list executes.
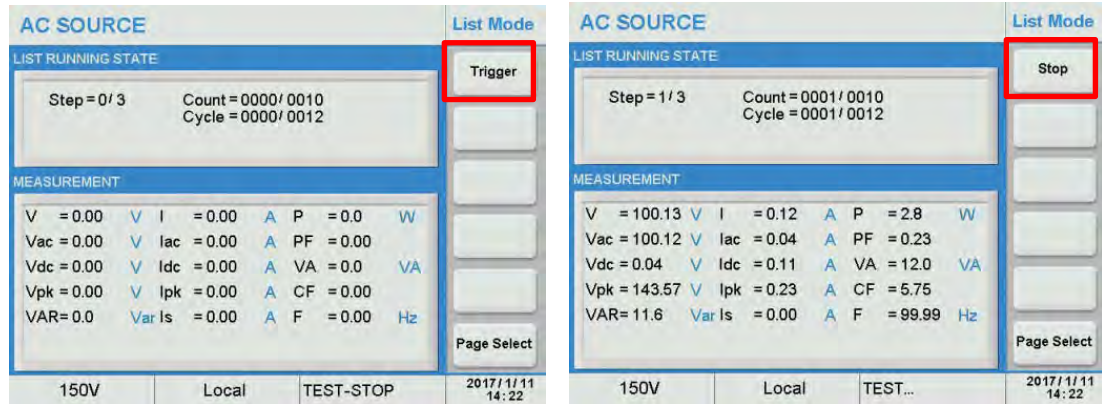
As the [Trigger] soft key is pressed, its label changes to [Stop]. Use the [Stop] soft key to abort a transient list in progress.

The following operation of transient mode execution should be noted:

- If the transient list execution is started while the power source output is ON, the output settings will return to the settings present at the time the transient execution was started (triggered). Thus, the output state will return to its pre-transient state.

- If the power source output was OFF, the output will turn off when the transient execution ends.

- It the transient execution mode is set to **Step**, the output state of the power source will remain at the last step value in the transient list until the next press of the [Trigger] soft key.

- If a transient execution is interrupted by pressing the [Stop] soft key, it will start at the beginning of the list when in Cont. mode or resume form the current step when in **Step** mode.

- The voltage range will automatically change to the 300V (High) range during LIST transient execution. If the power source was in 150V at the start of the transient, a range change will occur causing the output to be interrupted for about 300 msecs.

6.9.1.2   Pulse Transient Mode

The Pulse mode of operation allows repetitive output level changes between two different set values to be implemented easily. These alternative values can be repeat and the duty cycle can be set anywhere from 1% to 99%.

The output change occurs when the transient trigger is generated, either from the front panel or through some other means. The principle behind a step transient is illustrated below.
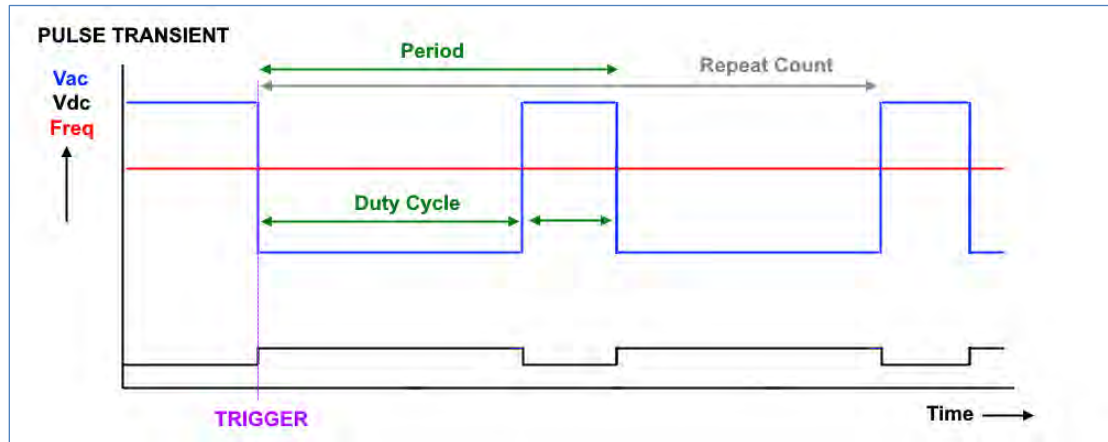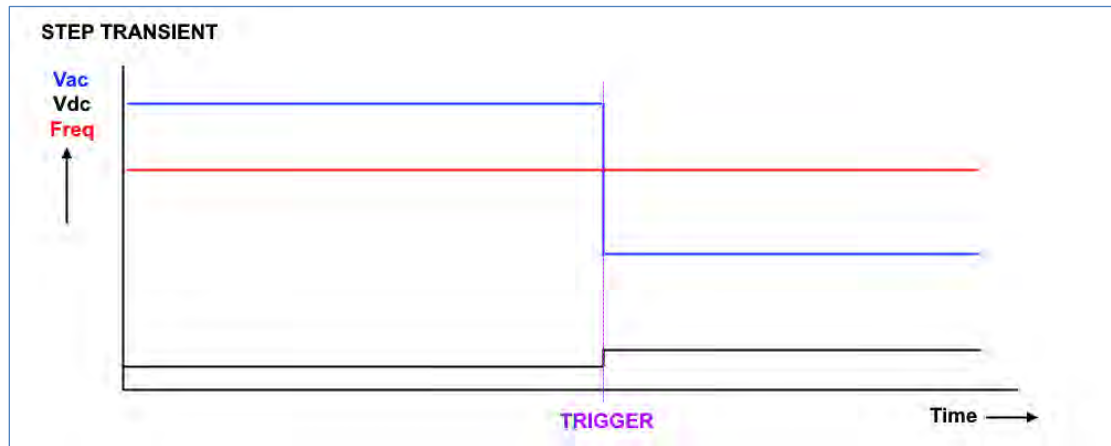

Figure 6-8: Illustration of a PULE Transient

The PULSE transient is accessed by pressing the [Pulse] soft key in the PLD screen. To create an new or edit an existing PULSE transient, press the [Edit] soft key to enter Edit mode.

A Pulse transient definition includes the following parameters:

- Vac   Step value for Vac
- Vdc start   Step value for Vdc
- F   Step value for Frequency
- Duty Cycle   Duty cycle in % of period at Step Value
- Degree   Phase Angle from 0.0° ~ 359.9°
- Waveform   Waveform Group A or B
- Period   Duration time
- Count   Repeat Count 0 ~ 9999. . A zero repeat count indicates infinite looping.
- Start   The time period to hold the present output set values before starting the pulse period(s).
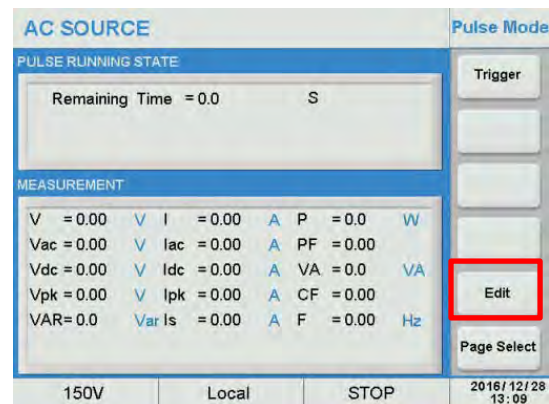
When the Pulse edits are complete, press the [Save] soft key to save all changes made to the list.

Warning: Failure to Save a Pulse transient setup will cause it to be lost when the power source is turned off.

To execute a Pulse Transient, press the [Trigger] soft key. As the [Trigger] soft key is pressed, its label changes to [Stop]. Use the [Stop] soft key to abort a transient in progress.
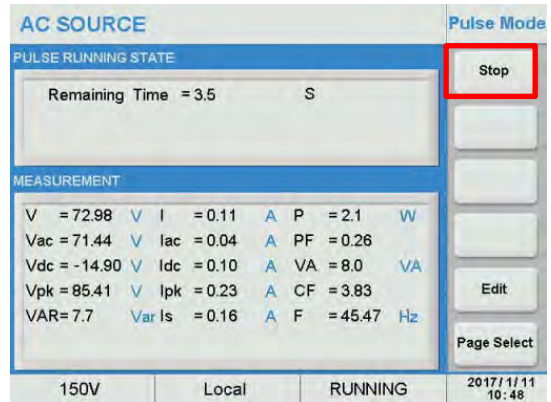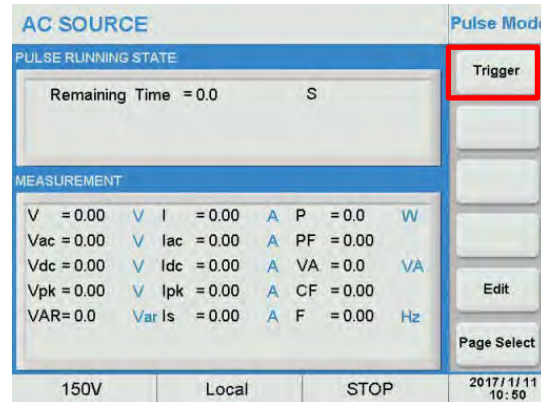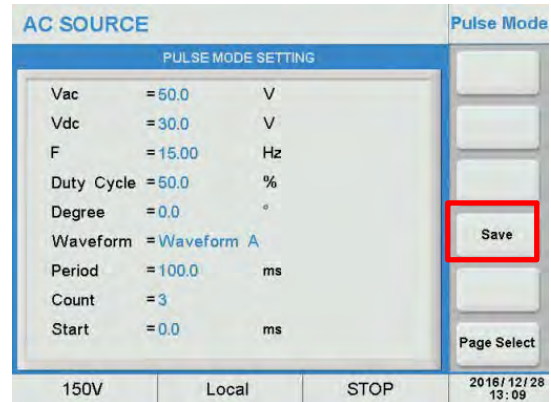
During execution, the remaining period time is shown in the top part of the display. This value updates regularly while the pulse transient is running.

The Pulse transient can be interrupted by pressing the [Stop] soft key at any time.

6.9.1.3   Step Transient Mode

The step mode allows the output state to transition from its present setting to a new output state using one or more discrete voltage and or frequency steps. This represents a STEP function as long as at least one of the parameters in the STEP differs from the present value.

The output change occurs when the transient trigger is generated, either from the front panel or through some other means.

The principle behind a step transient is illustrated below.

Figure 6-9: Illustration of a STEP Transient

A STEP transient requires the least number of parameters to define. The required parameters are:

- Vac   Start value for Vac
- δVac   Vac step value
- Vdc   Start value for Vdc
- δVdc   Vdc step value
- F   Start value for Frequency
- δF   F step value
- Deg.   Phase Angle from 0.0° ~ 359.9°
- Count   Repeat count from 0 ~ 9999. A zero repeat count indicates infinite looping.
- Waveform   Waveform Group A or B
- Dwell   Dwell time between steps
- Power Sweep   Power sweep function enable or disable
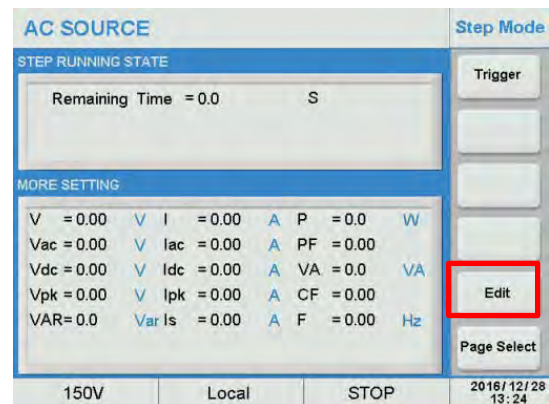
These values can be entered using the Step Mode screen. Press the [Edit] soft key to enter edit mode.

Enter values for all step parameters as needed in edit mode using the cursor keys, shuttle and/or touch screen.

When the Step edits are complete, press the [Save] soft key to save all changes made to the list.

Warning: Failure to Save a Step transient setup will cause it to be lost when the power source is turned off.
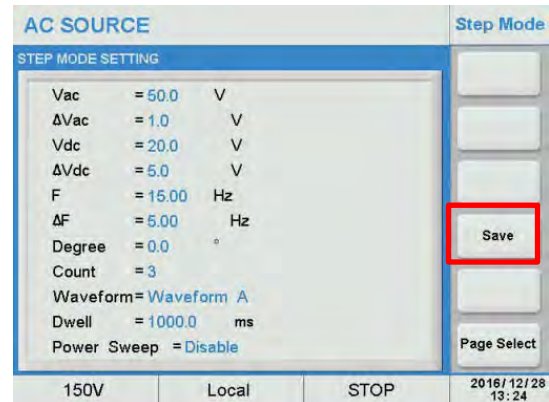
To execute a Step Transient, press the [Trigger] soft key. As the [Trigger] soft key is pressed, its label changes to [Stop]. Use the [Stop] soft key to abort a transient in progress.
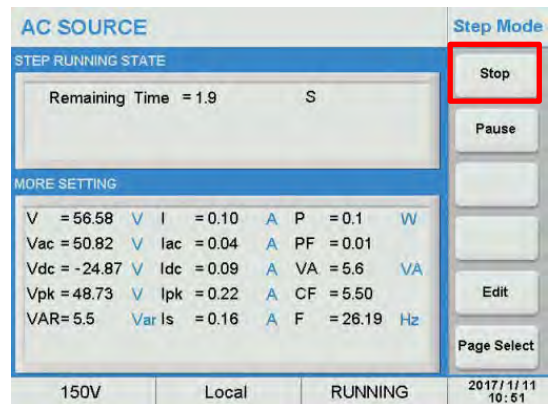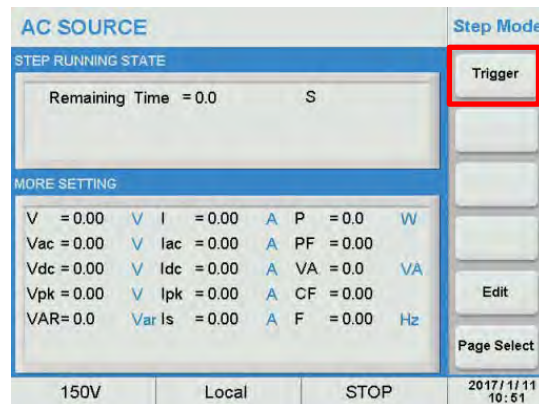
During execution, the remaining time is shown in the top part of the display. This value updates regularly while the step transient is running.

The Step transient can be interrupted by pressing the [Stop] soft key at any time.

Power Sweep Mode

The step transient is useful for checking the efficiency of a power supply can capturing the voltage, current, power and frequency at the maximum power operating point. By changing either using a series of steps of similar size (step ladder). In this mode, the steps are applied till the end value is reached after the specified number of counts. If Power Sweep mode is **Enabled**, the measurements will be displayed at the end of the sweep.

6.9.2   Harmonics

ENHANCED VERSION ONLY

The Harmonics screen controls the following aspects of harmonic waveform synthesis and measurements:

- Synthesis
- Inter-Harmonics
- Harmonic Measure
- User

6.9.2.1   Waveform Synthesis

ENHANCED VERSION ONLY

The waveform synthesis screens is used to create waveforms made up of a series of harmonic frequencies, amplitudes and phase shifts. Up to 40 order harmonics of **50Hz** or **60Hz** can be specified.

Note: Higher fundamental frequencies are not allowed as the CPS100 bandwidth does not support high frequency components to be generated.

To create a harmonic waveform, press the Synthesis soft key.

Next press the Edit soft key. This displays a table of harmonics frequencies from 1 through 40.

Use the **Next Page** soft key to display the 22nd through 40th values on the second screen.

First, set the fundamental parameters:

- Vac_fund: Fundamental AC voltage
- Vdc: DC Offset. The DC component can be set when in AC+DC coupling mode.
- F_fund: V_fund. Select either 50 or 60.
- Degree: Start phase angle (0~359.9)

Then press the **Compose** soft key to select [Value] or [Percent].

To create a new waveform, use the touch screen to press any of the harmonics numbers you want to edit. Set amplitude and phase angle of any of the harmonics you want to include.

Press the **Waveform Preview** soft key for a visual representation of the resulting wave shape.

The preview of the wave shape will appear in the center of the LCD screen.

If you are satisfied with the result, use the Save soft key to save the new waveform to non-volatile memory.

Note: If the waveform is not saved, it will be lost when the power source is turned off.

Once created and saved, the synthesized waveform can be applied at the output of the power source. To do so, press the [Esc] key to back up to the previous Synthesis screen.

Press the **Trigger** soft key to load the waveform to the output register. Once pressed, this softkey changes to **Stop**.

The waveform will start at the start phase angle set for the synthesized waveform.

See next page.

To revert back to the regular waveform selection – not the synthesized waveform – press the **Stop** soft key.
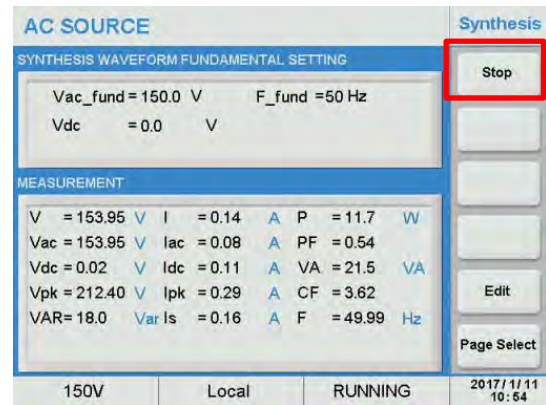
Notes:

- The following amplitude limitations apply to the synthesized waveform settings:
  - For N = 2 ~ 10: Amplitude value ≤ 150V or percent ≤ 100%
  - For N = 11 ~ 20: Amplitude value ≤ 120V or percent ≤ 50%
  - For N = 21 ~ 30: Amplitude value ≤ 80V or percent ≤ 30%
  - For N = 31 ~ 40: Amplitude value ≤ 45V or percent ≤ 15%

- An OVP error is generated if the output of the synthesized waveform + DC offset exceeds 424Vpk on the 300V range or 212Vpk on the 150V range.
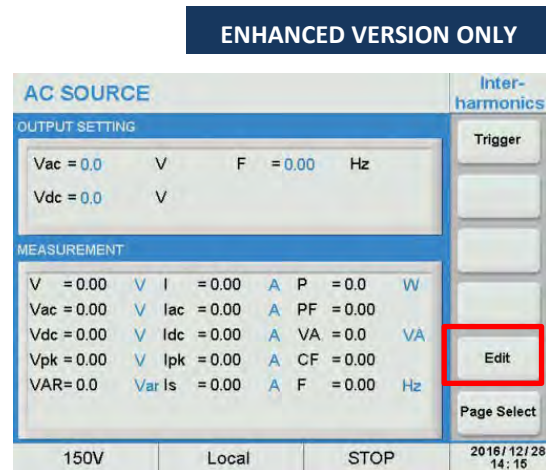
6.9.2.2 Inter-Harmonics

ENHANCED VERSION ONLY

Inter-harmonics allow the user to insert a frequency component sweep at the output at a frequency that is not harmonically related to the fundamental frequency. This function is useful for performing immunity tests.

Press the Inter-Harmonics soft key to display the Inter-Harmonics screens shown here.

There are two available soft keys on this screen:

- Trigger
- Edit

Press the **Edit** soft key to set the inter-harmonic parameters.

The following parameters are available to define the inter-harmonic component:

- F start   Start frequency
- F end   End frequency
- Level   Amplitude in % of nVac
- Time   Time duration from F start to Fend
- nVac   Fundamental voltage
- nF   Fundamental frequency

Use the cursor keys or touch screen to set the inter-harmonics and fundamental parameters to create the desired inter-harmonic frequency sweep. When done, press the **Save** soft key to save this setting to non-volatile memory.

Note: If the inter-harmonic setting is not saved, it will be lost when the power source is turned off.

The output the inter-harmonic sweep, press the [Esc] key to return to the previous screen.

Next, press the **Trigger** soft key to start the sweep. Once pressed, it changes to Stop.

After the Time duration expires – in this example 10 seconds - the output will revert to the prior steady state setting and the **Stop** soft key reverts to **Trigger**.

The sweep can be aborted if needed by pressing the **Stop** soft key.

6.9.2.3 Harmonic Measurements

ENHANCED VERSION ONLY

The harmonics measurement function measures total harmonic distortion (THD), DC voltage and current and fundamental voltage and current for output settings of 50Hz or 60Hz. Thus, this function is useful for commercial and industrial development and test applications.

Note: Avionics applications requiring higher frequencies are not supported by the Harmonics Measurement function due to sampling rate and bandwidth limitations.
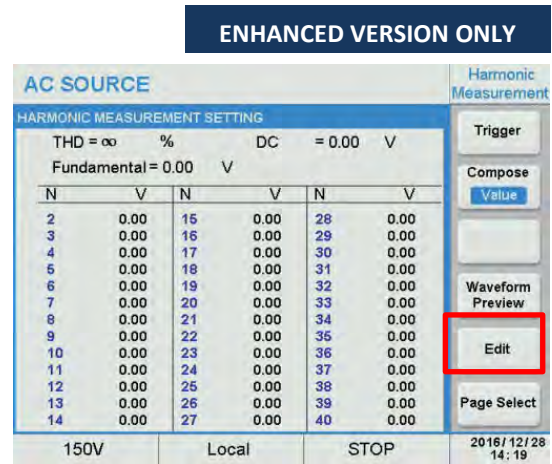
The Harmonic Measurement screen displays the harmonic measurement results and contains the following soft key selections:

- Trigger
- Compose Value
- Waveform Preview
- Edit

To set up a harmonic measurement, press the **Edit** soft key. There are three parameters that can be set:

- Source   Voltage or Current
- F_fund   50Hz or 60Hz
- TIMES   Single or Continue

TIMES = Single means one measurement is taken when the **Trigger** soft key is pressed. Continue means the harmonic measurement runs till the **Stop** soft key is pressed. Once pressed, it changes to Stop.

When done, press the [Esc] key to return to the previous screen. The measurement is started using the **Trigger** soft key.

The measurement results can be displayed in absolute values (**Value**) or in percent of the fundamental (**Percent**) by toggling the **Compose** soft key.
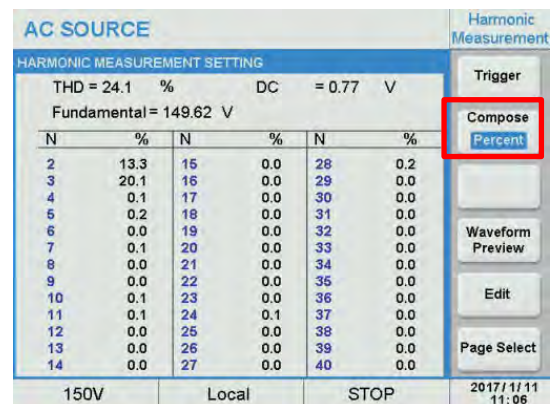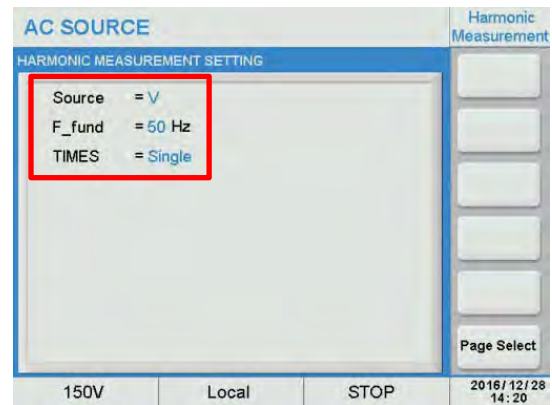
The **Waveform Preview** soft key displays a graphical representation of the harmonic measurements.
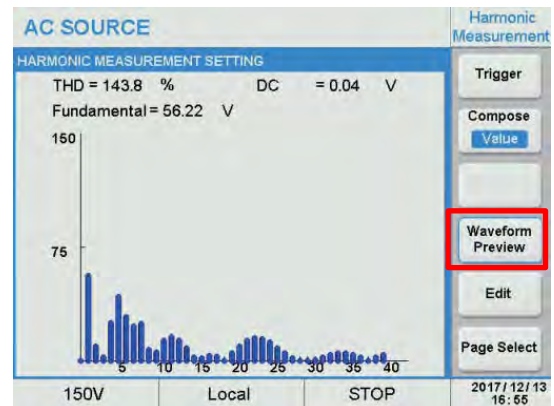
6.9.2.4   User Waveforms

ENHANCED VERSION ONLY

The User function contains 6 sets of user defined harmonic waveforms, USER NO. 0 through USER NO. 5. These waveforms are in addition to the 30 harmonic waveforms described in Section 12, "Fixed Waveform Library" on page 217.

Press the User soft key in the Harmonics screen to select the User waveform settings.

Available soft keys in this screen are:

- Next Page
- Waveform Preview
- Save

The **Next Page** soft keys toggles between the Harmonics 2~21 and 22~40.

To define a waveform, move the cursor to the User NO. = field and press [Enter] to confirm. Then select the number of the USER waveform to create or edit.

In this example, we will create USER NO. = 1.

Use the cursor to move between harmonic numbers and set amplitude and phase angle as needed. Use the **Next Pag**e soft key to edit any harmonics over 21st.
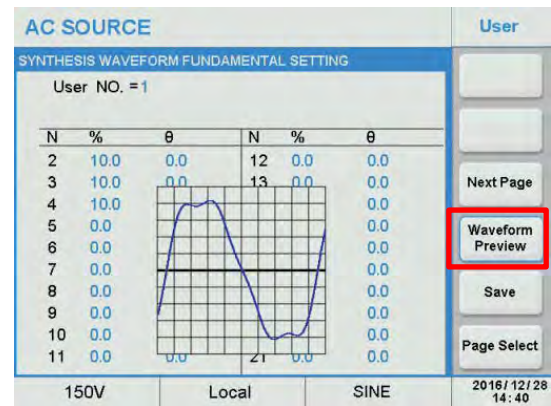
Use the Preview Waveform soft key as needed to see a graphical representation of the waveform.

Once completed, press the **Save** soft key to save the waveform in the selected User NO. non-volatile memory location.

Note: If the User Waveform setting is not saved, it will be lost when the power source is turned off.

User waveform can be selected for output from the Output & More Settings menu by selecting the USER entry in the Waveform A or B group field.

A NO. field will appear to the right of the Waveform A/B field that enable selection of User NO. 0 through 5.
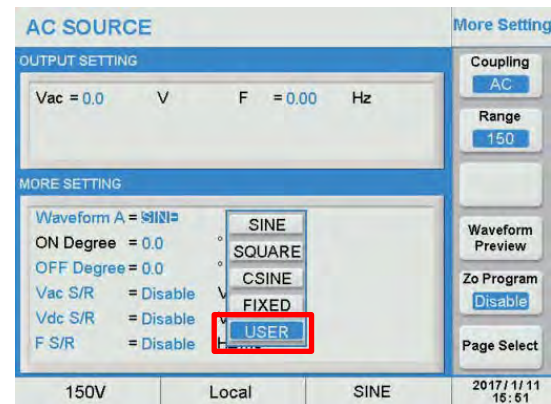
6.9.3   IEC Standards

ENHANCED VERSION ONLY

The IEC 61000-4 test function support immunity testing to the following four IEC 61000-4 standards:

IEC Standard No.	Description	CPS100E Test
IEC 61000-4-11	Testing and measurement techniques-Voltage dips, short interruptions and voltage variations immunity tests (AC,<16A)	IEC 4-11
IEC 61000-4-13	Testing and measurement techniques-Harmonics and inter harmonics including mains signaling at AC power port, low frequency immunity tests	IEC 4-13
IEC 61000-4-14	Testing and measurement techniques-Voltage fluctuation immunity test	IEC 4-14
IEC 61000-4-28	Testing and measurement techniques-Variation of power frequency, immunity test for equipment with input current not exceeding 16 A per phase	IEC 4-28

Table 6-4: IEC 61000-4 Test standards supported on Enhanced Models

Products exported to Europe have to meet compliance to these power line immunity test standards. The CPS100 Enhanced version offers a cost effective solution for compliance or pre-compliance testing of single-phase utility powered products.

6.9.3.1   IEC 4-11 Tests

Compliance of Pre-compliance Notice

Testing for IEC 61000-4-11 may require voltage dips at 90° or 270° phase angles. The IEC standard calls out a 1 ~ 5 µsec voltage rise and fall time. This is not feasible with most AC power sources. If the product category you are testing requires this, the CPS100E 411 test will be pre-compliance only. For product standards that specify dips at 0° or 180° degrees, the rise/fall time requirement of the AC Source is irrelevant and testing is fully compliant.

The 411 Tests include both the required voltage dips and voltage variations. Default test parameters are conform the current revision of the IEC 61000-4-11 test standard but all can be edited by the user if needed to support future standard changes.

Press the **IEC 4-11** soft key to from the IEC Standard menu access all IEC 4-11 tests. The following two soft keys are available from this menu:

- Voltage Dips
- Voltage Variations

IEC 4-11 Voltage Dips

To select Voltage Dips testing, press the **Voltage Dips** soft key.

To create a new voltage dip setting, press the **Edit** soft key.

Move the cursor to the Voltage Dips = Entry to select the product to be tested's IEC Class. Available classes are 2, 3 or User. Class 2 and 3 test limits and durations are specified in the IEC 61000-4-11 standard. User classes are open and determined by specific IEC product specific category standards. These values can be entered when selecting the User class.

Select the appropriate class for the product to be tested. This will set up all voltage dip parameters per the class standard. This includes nominal test voltage of 230Vac, repeat count of 3 and inter Dip delay of 10 seconds for classes 2 and 3.

These default settings can be changed if desired. The following value ranges apply:

- Count: 0 ~ 65535
- Unom: 0 ~ 300 Vac
- Frequency: 50Hz or 60Hz.

The normal Count setting for IEC 4-11 testing is 3. Setting 0 will cause the dips to run in an infinite loop.

The CPS100 must be in 300V range to perform IEC 4-11 for products exported to Europe (230Vac grid).

To toggle the frequency between 50 or 60 Hz, select the "Frequency =" field and press the [Enter] key.

The steps at different dip levels and durations (expressed in cycles) are shown in the table in the lower portion of the screen.

The start phase angles for each step can be changed by moving the cursor to the Start Degree field for any row and using the [0] ~ [9] keys to change the value. Press the [Enter] key to confirm. Range is 0~359.9 degrees.

When done, press the **Save** soft key to save the IEC 4-11 settings to non-volatile memory.
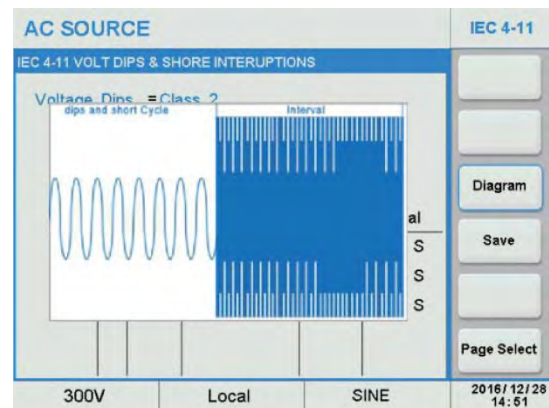
Note: If the IEC 4-11 test setting is not saved, it will be lost when the power source is turned off.

A visual display of the IEC 4-11 test sequence is available for pre-viewing the test by pressing the **Diagram** soft key.

The preview will pop up in the center of the IEC 4-11 Test screen. Press [Esc] to clear the preview.

Running an IEC 4-11 Dips test

To execute the IEC 4-11 test, press the [Esc] key to exit the Edit mode and return to the main IEC 4-11 test screen.

Start the test by pressing the **Trigger** soft key. Once pressed, it changes to **Stop**.

The test will now run until all steps have been completed. Total test time is a function of the repeat count, number of steps, no of cycles for each dip and the inter-dip delay time.

At the completion of the entire sequence, the **Stop** soft key will revert to **Trigger**. To abort a test in progress, press the **Stop** soft key during a test run.
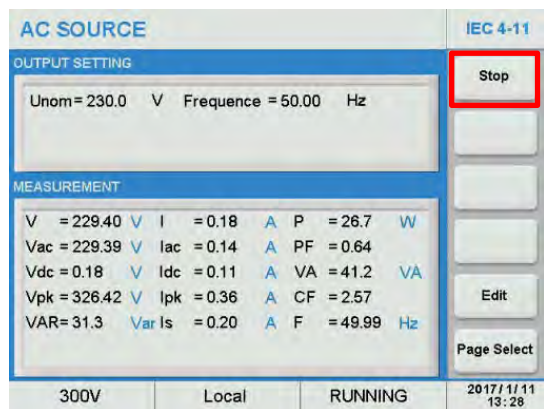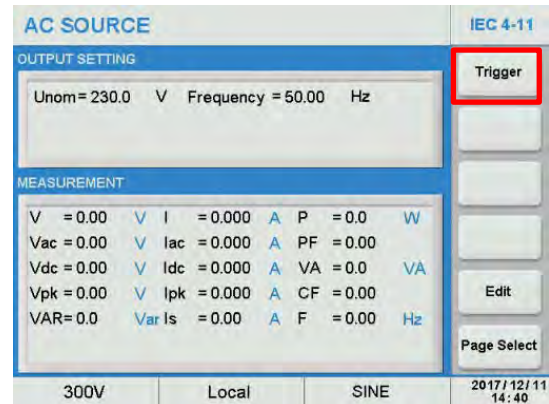
IEC 4-11 Voltage Variations

To select the IEC 4-11 Voltage Variations test, return to the IEC 4-11 menu and press the **Voltage Variations** soft key.

This menu has the same two soft keys as the Voltage Dip menu:

- Load
- Edit

The **Load** soft key sets up the power source to start the test.

The Edit soft key allows changes to the test setup.

To change an existing or create a new setup, press the **Edit** soft key.

Once the Edit screen appears, select the "Operation =" field and press the [Enter] key to switch between Standard Setup and User Def. Setup.

The following parameters can be edited by the user as needed:

- Count: Number of repeat cycles. Range is 0~9999. A zero (0) setting means the test runs in an infinite loop.
- Unom: Nominal Voltage. Range = 0 ~ 300Vac. Fixed to 230Vac in Standard mode.
- Frequency: 50Hz or 60Hz in Standard mode.
- td: Fall time for voltage in secs. Fixed to 0 in Standard mode.
- ts: Duration at variation voltage in secs. Fixed to 1 in Standard mode.
- ti: Rise time for voltage in secs. Fixed to 0 in Standard mode.
- Interval: Duration at Unom after variation is complete.
- Rate: Variation voltage level in percent of Unom.

Note: The duration for count includes the voltage variation duration plus the test interval delay time.
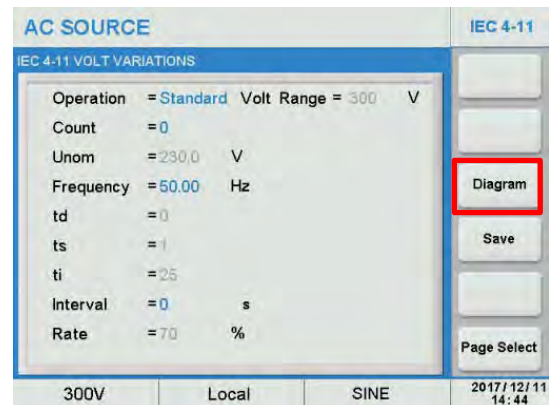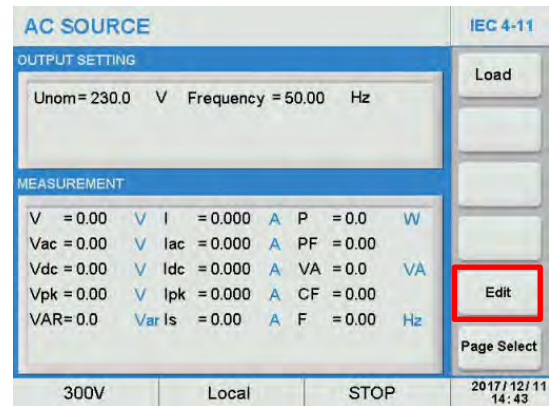
These setting correspond with the test diagram from the IEC 61000-4-11 test standard shown below.
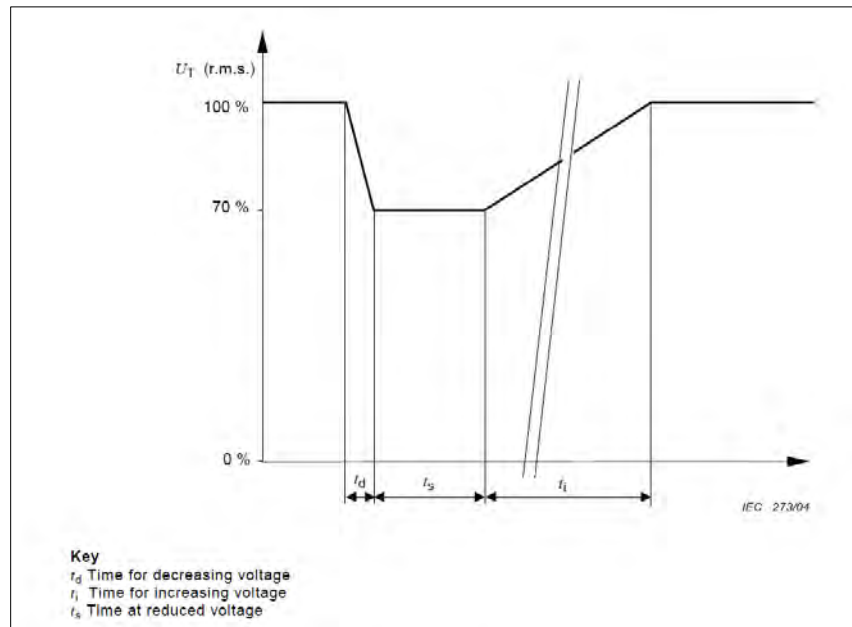

Figure 6-10: IEC 6100-4-11 Standard Voltage Variation

Once completed, press the Save soft key to save the modified User Def. settings to non-volatile memory.

Note: If the IEC 4-11 test setting is not saved, it will be lost when the power source is turned off.

A visual display of the IEC 4-11 test sequence is available for pre-viewing the test by pressing the **Diagram** soft key.

The preview will pop up in the center of the IEC 4-11 Test screen. Press [Esc] to clear the preview.
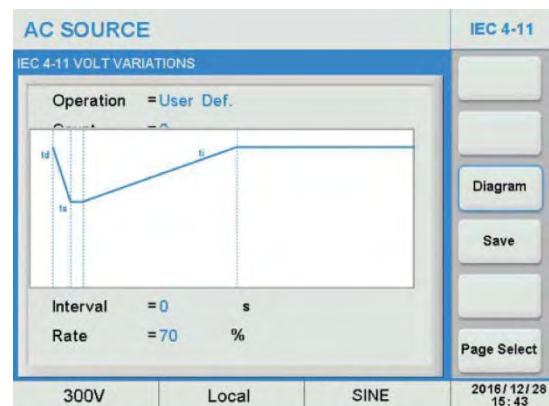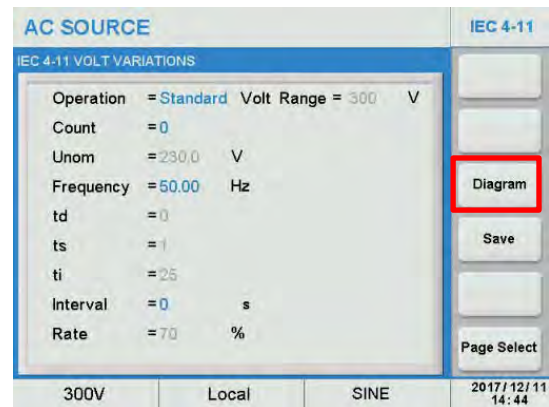
Running an IEC 4-11 Variations test

To execute the IEC 4-11 test, press the [Esc] key to exit the Edit mode and return to the main IEC 4-11 test screen.

Start the test by pressing the **Trigger** soft key. Once pressed, it changes to **Stop**.

The test will now run until completed. Total test time is a function of the count, interval, td, ti and ds.

At the completion of the entire sequence, the **Stop** soft key will revert to **Trigger**. To abort a test in progress, press the **Stop** soft key during a test run.
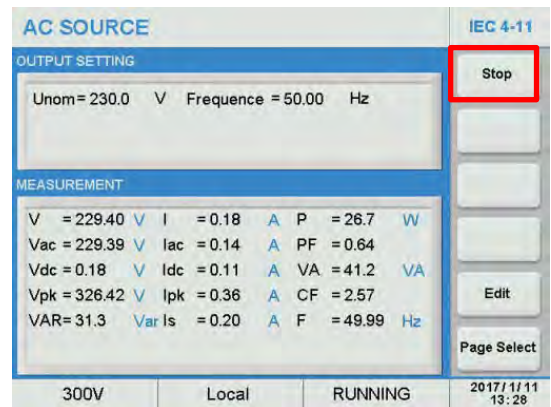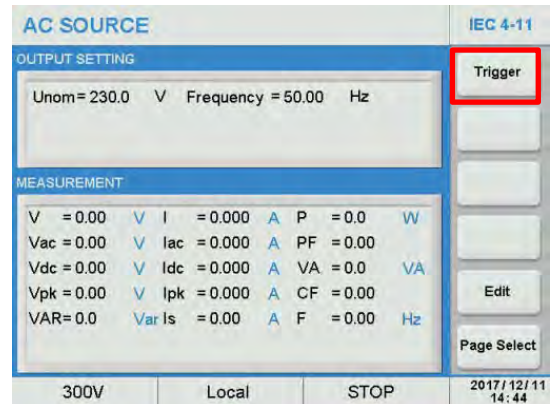
6.9.3.2 IEC 4-13 Tests

ENHANCED VERSION ONLY

The IEC 61000-4-13 Immunity test is required for all products that are exported to Europe and require the CE mark. This test applies a range of inter-harmonic frequencies summed with the 50Hz or 60Hz fundamental power frequency to a unit under test. The inter-harmonic frequencies must be stepped or swept at specific rates and at specific amplitudes of the nominal AC voltage. There are also combinations of harmonics and inter-harmonics as well as special waveforms that need to be applied to the unit under tests. These special waveforms are called Over swing and Flat curve.

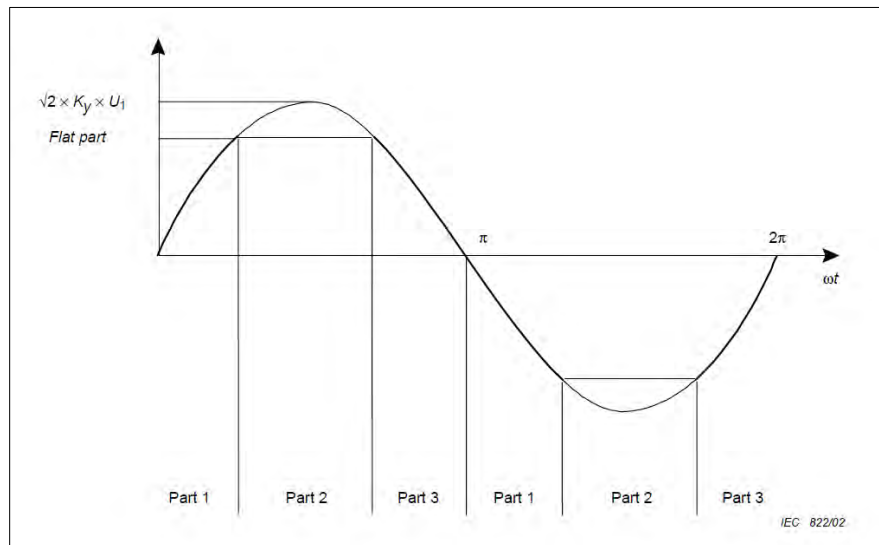Illustrations of both special waveforms are shown below.
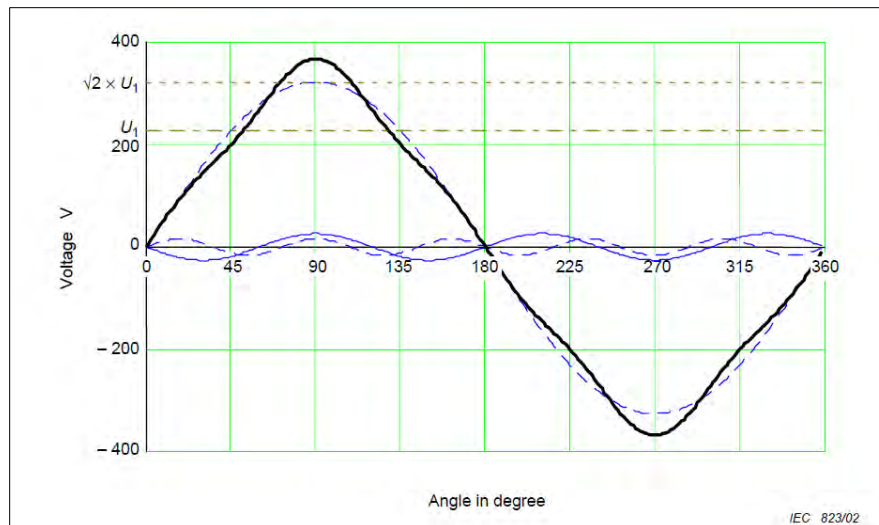

Figure 6-11: IEC 61000-4-13 Flat Curve

Figure 6-12: IEC 61000-4-13 Over Swing

The IEC 4-13 test option is suitable for pre-compliance testing of products that require CE marking.

To set up and run an IEC 4-13 test, select the **IEC 4-13** soft key from the IEC Standard menu.
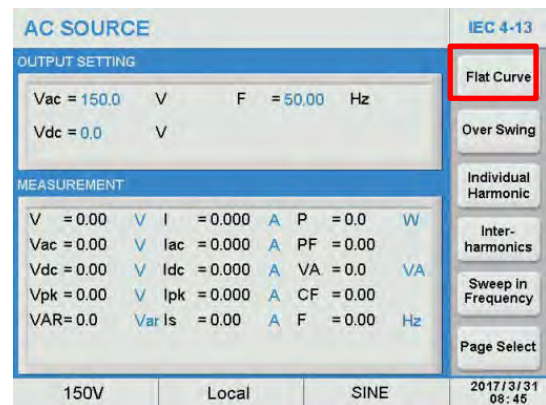
The IEC 4-13 Menu contains the following available soft keys:

- Flat Curve
- Over Swing
- Individual Harmonic
- Inter-harmonics
- Sweep in Frequency

These are all part of the IEC 61000-4-13 test requirements.

IEC 4-13 Flat Curve Test

Press the **Flat Curve** soft key to display the Flat Curve test screen. Available soft keys in this screen are **Trigger** and **Edit**. Press the **Edit** soft key to set the required test selections for this test.

There are three standard product classes for the IEC 61000-4-13. They are Class 1, Class 2 and Class 3. (Standard modes) Test levels and durations for these product classes are defined by the IEC 61000-4-13 standard. There is also a User class, which allows parameters to be changed. (User mode).

To select the appropriate product class for the unit under test, move the cursor to the "Test Level =" field and press [Enter]. A drop down list with product class selections is displayed.

The following other test parameters are available:

- AMP: Voltage amplitude in percent of nominal voltage. Fixed at 100% in standard modes.
- Unom: Nominal test voltage. Fixed at 230V in standard modes.
- Frequency: 50Hz or 60Hz in standard modes.

- Test Time: Duration of the test. Range is from 0 ~ 9999. Zero means infinite loop.

For User class, set these parameters as desired. For classes 1 through 3, select the required frequency – typically 50Hz – and the Test Time.

Press the **Preview** soft key to see a visual representation of the test waveform. Press again to clear the preview.

Once set, press the **Save** soft key to store the test setting in non-volatile memory

Note: If the IEC 4-13 test setting is not saved, it will be lost when the power source is turned off.
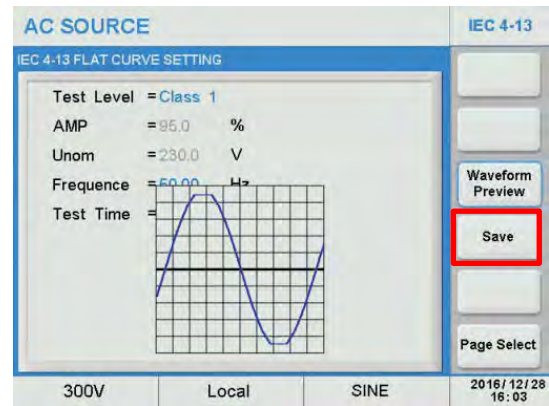
Running the IEC 4-13 Flat Curve test

Return to the previous IEC 4-13 menu by pressing the [Esc] key.

Press the **Trigger** soft key to apply the test to the unit under test. Once pressed, it changes to **Stop**.

The test will now run until completed. Total test time is determined by the Test Time setting.

The test time count down in seconds is visible in the upper part of the IEC 4-13 screen.

At the completion of the test, the **Stop** soft key will revert to **Trigger**. To abort a test in progress, press the **Stop** soft key during a test run
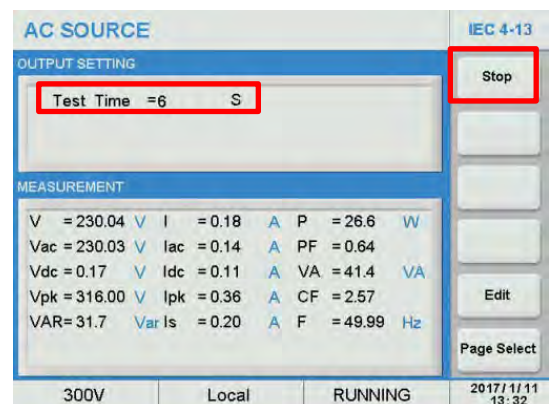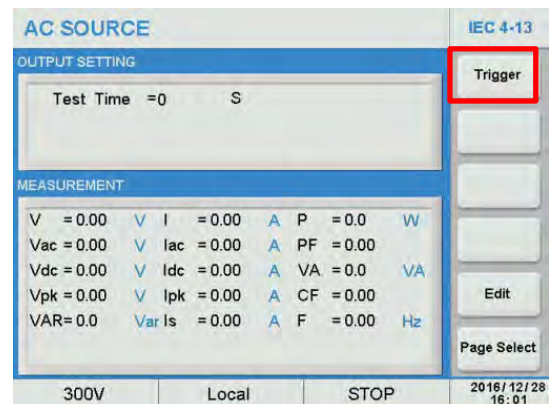
IEC 4-13 Over Swing Test

From the top level IEC 4-13 menu, press the **Over Swing** soft key to display the Over Swing test screen.

Available soft keys in this screen are **Trigger** and **Edit**. Press the **Edit** soft key to set the required test selections for this test.

There are three standard product classes for the IEC 61000-4-13. They are Class 1, Class 2 and Class 3. (Standard modes) Test levels and durations for these product classes are defined by the IEC 61000-4-13 standard. There is also a User class, which allows parameters to be changed. (User mode).

To select the appropriate product class for the unit under test, move the cursor to the "Test Level =" field and press [Enter]. A drop down list with product class selections is displayed.

The following other test parameters are available:

- Unom: Nominal test voltage. Fixed at 230V in standard modes.
- Frequency: 50Hz or 60Hz in standard modes.
- Test Time: Duration of the test. Range is from 0 ~ 9999. Zero means infinite loop.
- Harmonic 3:   Amplitude in percent

- Harmonic 5:   Amplitude in percent
- Phase Shift: Range is 0 ~ 359.9 Degrees. Fixed in standard modes.

For User class, set these parameters as desired. For classes 1 through 3, select the required frequency – typically 50Hz – and the Test Time.

Press the **Preview** soft key to see a visual representation of the test waveform. Press again to clear the preview.

Once set, press the **Save** soft key to store the test setting in non-volatile memory

Note: If the IEC 4-13 test setting is not saved, it will be lost when the power source is turned off.

Running the IEC 4-13 Over Swing test

Return to the previous IEC 4-13 menu by pressing the [Esc] key.

Press the **Trigger** soft key to apply the test to the unit under test. Once pressed, it changes to **Stop**.

The test will now run until completed. Total test time is determined by the Test Time setting.

The test time count down in seconds is visible in the upper part of the IEC 4-13 screen.

At the completion of the test, the **Stop** soft key will revert to **Trigger**. To abort a test in progress, press the **Stop** soft key during a test run
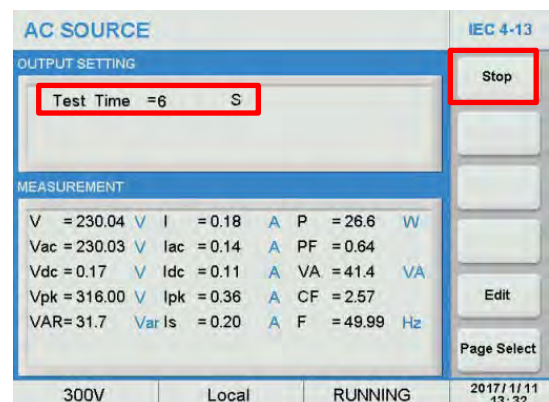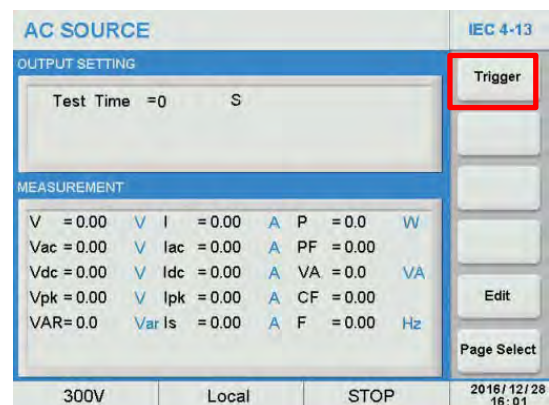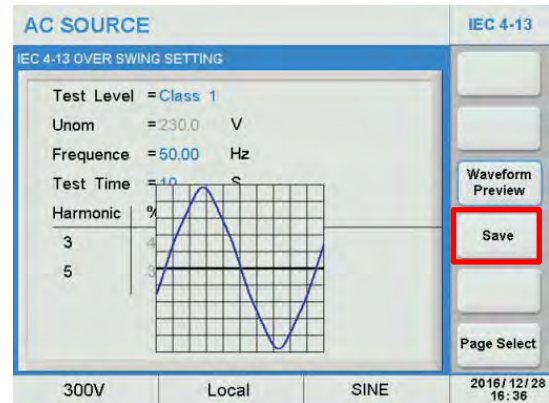
IEC 4-13 Individual Harmonics Test

From the top level IEC 4-13 menu, press the **Individual Harmonics** soft key to display the Individual Harmonics test screen.

Available soft keys in this screen are **Trigger** and **Edit**. Press the **Edit** soft key to set the required test selections for this test.

There are three different applications for the individual harmonics, selectable in the Class field. They are:

- non-multiple of 3
- multiple of 3
- even harmonics

To select the relevant test class, move the cursor to the "Class" field end use the shuttle or touch screen to select. Press [Enter] to confirm.

For the test levels, there are three standard product classes for the IEC 61000-4-13. They are Class 1, Class 2 and Class 3. (Standard modes) Test levels and durations for these product classes are defined by the IEC 61000-4-13 standard. There is also a User class, which allows parameters to be changed. (User mode).

To select the appropriate product class for the unit under test, move the cursor to the "Level =" field and press [Enter]. A drop down list with product class selections is displayed.

The following other test parameters are available:

- Unom: Nominal test voltage. Fixed at 230V in standard modes.
- Frequency: 50Hz or 60Hz in standard modes.

For User class, set the Unom parameter as desired. For classes 1 through 3, select the required frequency – typically 50Hz.

Once set, press the **Save** soft key to store the test setting in non-volatile memory

Note: If the IEC 4-13 test setting is not saved, it will be lost when the power source is turned off.

Running the IEC 4-13 Individual Harmonics test

Return to the previous IEC 4-13 menu by pressing the [Esc] key.

Press the **Load** soft key to apply the test to the unit under test. Once pressed, it changes to **Stop**.

The test will now run until completed. Total test time is determined by the Class and Level settings.

The test time count down in seconds is visible in the upper part of the IEC 4-13 screen.

At the completion of the test, the **Stop** soft key will revert to **Load**. To abort a test in progress, press the **Stop** soft key during a test run

IEC 4-13 Inter-harmonics Test

From the top level IEC 4-13 menu, press the **Inter-harmonics** soft key to display the Inter-harmonics test screen.

Available soft keys in this screen are **Trigger** and **Edit**. Press the **Edit** soft key to set the required test selections for this test.

There are two standard product classes for the IEC 61000-4-13. They are Class 2 and Class 3. (Standard modes) Test levels and durations for these product classes are defined by the IEC 61000-4-13 standard. There is also a User class, which allows parameters to be changed. (User mode).

To select the appropriate product class for the unit under test, move the cursor to the "Level =" field and press [Enter]. A drop down list with product class selections is displayed.

The following other test parameters are available:

- Unom: Nominal test voltage. Fixed at 230V in standard modes.
- Frequency: 50Hz or 60Hz in standard modes.
- Test Levels in % of Unon for Inter-Harmonics ranges:
  o 0.33*f1 to 2*f1   16 ~ 100 Hz
  o 2*f1 to 10*f1   100 ~ 500 Hz
  o 10*f to 15*f1   500 ~ 750 Hz
  o 15*f to 20*f1   750 ~ 1000 Hz
  o 20*f to 40*f1   1000 ~ 2000 Hz

For User class, set the Unom parameter as desired. For classes 2 and 3, select the required frequency – typically 50Hz. The inter-harmonic amplitude percentages can be changed in User mode only.

Once set, press the **Save** soft key to store the test setting in non-volatile memory

Note: If the IEC 4-13 test setting is not saved, it will be lost when the power source is turned off.

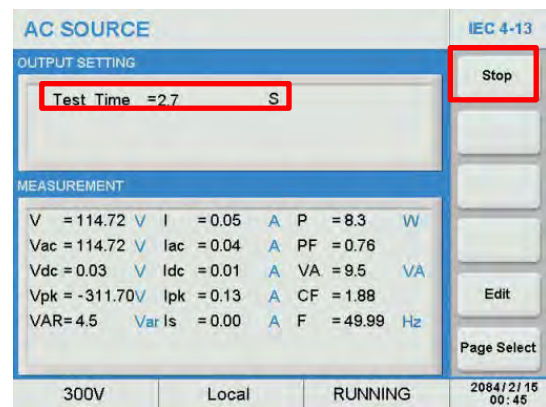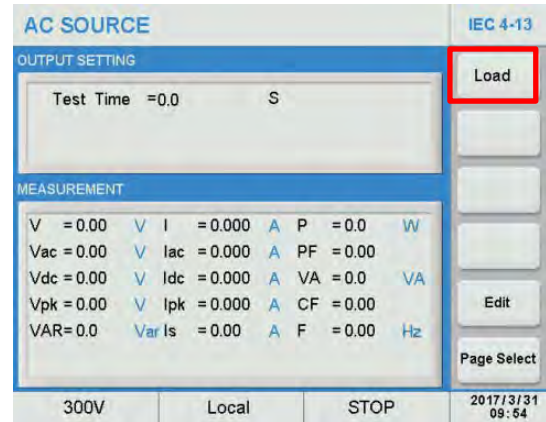**Running the IEC 4-13 Inter-harmonics test**

Return to the previous IEC 4-13 menu by pressing the [Esc] key.

Press the **Trigger** soft key to apply the test to the unit under test. Once pressed, it changes to **Stop**.

The test will now run until completed. Total test time is determined by the Class settings.

The test time count down in seconds is visible in the upper part of the IEC 4-13 screen.

At the completion of the test, the **Stop** soft key will revert to **Trigger**. To abort a test in progress, press the **Stop** soft key during a test run.

IEC 4-13 Sweep in Frequency Test

From the top level IEC 4-13 menu, press the **Sweep in Frequency** soft key to display the Sweep in Frequency test screen.

Available soft keys in this screen are **Trigger** and **Edit**. Press the **Edit** soft key to set the required test selections for this test.

There are three standard product classes for the IEC 61000-4-13. They are Class 1, Class 2 and Class 3. (Standard modes) Test levels and durations for these product classes are defined by the IEC 61000-4-13 standard. There is also a User class, which allows parameters to be changed. (User mode).

To select the appropriate product class for the unit under test, move the cursor to the "Level =" field and press [Enter]. A drop down list with product class selections is displayed.

The following other test parameters are available:

- Unom: Nominal test voltage. Fixed at 230V in standard modes.
- Frequency: 50Hz or 60Hz in standard modes.
- Test Levels in % of Unon for Inter-Harmonics ranges:
  - 0.33*f1 to 2*f1   16 ~ 100 Hz
  - 2*f1 to 10*f1   100 ~ 500 Hz
  - 10*f to 15*f1   500 ~ 750 Hz
  - 15*f to 20*f1   750 ~ 1000 Hz
  - 20*f to 40*f1   1000 ~ 2000 Hz

For User class, set the Unom parameter as desired. For classes 1 through 3, select the required frequency – typically 50Hz. The inter-harmonic amplitude percentages can be changed in User mode only.

Once set, press the **Save** soft key to store the test setting in non-volatile memory

Note: If the IEC 4-13 test setting is not saved, it will be lost when the power source is turned off.

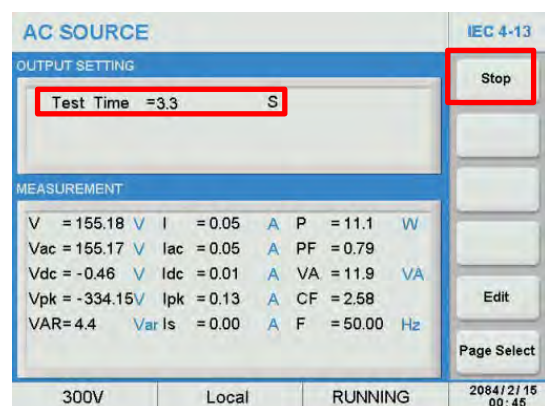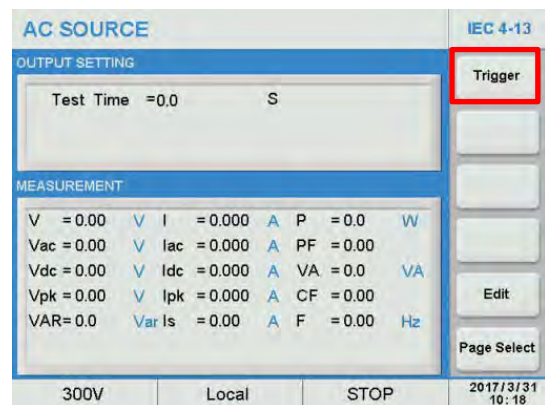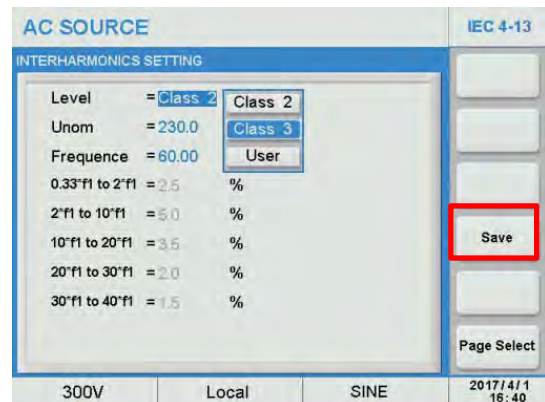### Running the Sweep in Frequency test

Return to the previous IEC 4-13 menu by pressing the [Esc] key.

Press the **Trigger** soft key to apply the test to the unit under test. Once pressed, it changes to **Stop**.

The test will now run until completed. Total test time is determined by the Class settings.

The test time count down in seconds is visible in the upper part of the IEC 4-13 screen.

At the completion of the test, the **Stop** soft key will revert to **Trigger**. To abort a test in progress, press the **Stop** soft key during a test run. If there is any resonance frequency, it, will is displayed at the end of the test.

IEC 4-13 Meister Curve Test

From the top level IEC 4-13 menu, press the Page Select soft key to access the second screen of the IEC 4-13 tests. Next, press the **Meister Curve** soft key to display the Meister Curve test screen.

Available soft keys in this screen are **Trigger** and **Edit**. Press the **Edit** soft key to set the required test selections for this test.

There are two standard product classes for the IEC 61000-4-13 Meister Curve test. They are Class 2 and Class 3. (Standard modes) Test levels and durations for these product classes are defined by the IEC 61000-4-13 standard. There is also a User class, which allows parameters to be changed. (User mode).

To select the appropriate product class for the unit under test, move the cursor to the "Level =" field and press [Enter]. A drop down list with product class selections is displayed.

The following other test parameters are available:

- Unom: Nominal test voltage. Fixed at 230V in standard modes.
- Frequency: 50Hz or 60Hz in standard modes.
- Test Levels in % of Unon for Inter-Harmonics ranges:
  - 0.33*f1 to 2*f1   16 ~ 100 Hz
  - 2*f1 to 10*f1   100 ~ 500 Hz
  - 10*f to 15*f1   500 ~ 750 Hz
  - 15*f to 20*f1   750 ~ 1000 Hz
  - 20*f to 40*f1   1000 ~ 2000 Hz

For User class, set the Unom parameter as desired. For classes 1 through 3, select the required frequency – typically 50Hz. The inter-harmonic amplitude percentages can be changed in User mode only.

Once set, press the **Save** soft key to store the test setting in non-volatile memory

Note: If the IEC 4-13 test setting is not saved, it will be lost when the power source is turned off.

Running the Meister Curve test

Return to the previous IEC 4-13 menu by pressing the [Esc] key.

Press the **Trigger** soft key to apply the test to the unit under test. Once pressed, it changes to **Stop**.

The test will now run until completed. Total test time is determined by the Class settings.

The test time count down in seconds is visible in the upper part of the IEC 4-13 screen.

At the completion of the test, the **Stop** soft key will revert to **Trigger**. To abort a test in progress, press the **Stop** soft key during a test run. If there is any resonance frequency, it, will is displayed at the end of the test.

6.9.3.3 IEC 4-14 Tests

The IEC 61000-4-14 allows pre-compliance testing of products that require CE Marking per the IEC 61000-4-14 test standard for immunity against fluctuating voltage levels.

From the main IEC Standard menu, Press the IEC 4-14 soft key to select the IEC 4-14 test menu.
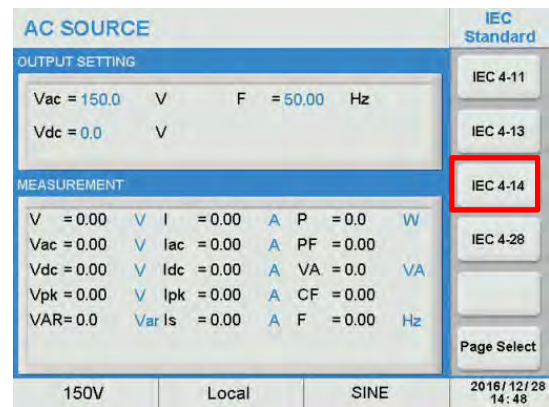
Available soft keys in this screen are **Load** and **Edit**. Press the **Edit** soft key to set the required test selections for this test.
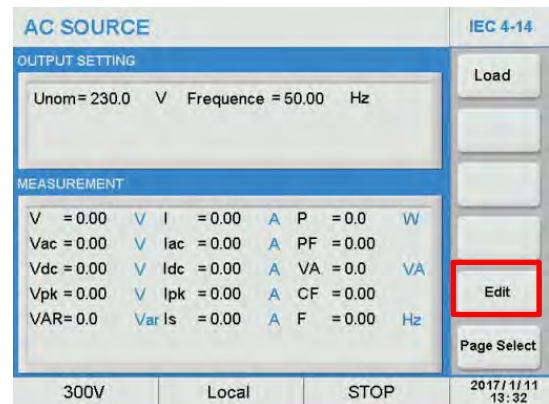
Once the Edit screen appears, select the "Operation =" field and press the [Enter] key to switch between Standard Setup and User Def. Setup. In User mode, parameters can be edited.
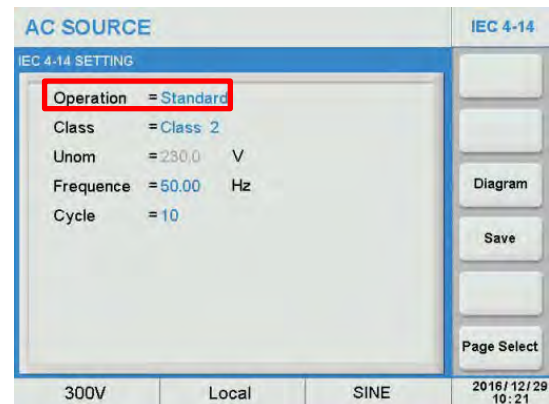
There are two product classes for the IEC 61000-4-14 test. They are Class 2 and Class 3. (Standard modes) Test levels and durations for these product classes are defined by the IEC 61000-4-14 standard.

To select the appropriate product class for the unit under test, move the cursor to the "Class =" field and press [Enter]. A drop down list with product class selections is displayed.

The following parameters can be edited by the user as needed:

- Unom: Nominal test voltage. Fixed at 230V in standard modes.
- Frequency: 50Hz or 60Hz in standard modes.
- Cycle: Number of loops or cycles. Range is 0 ~ 9999. A 0 value means infinite loop.

When done, press the Save soft key to save the IEC 4-14 settings to non-volatile memory.

Note: If the IEC 4-14 test setting is not saved, it will be lost when the power source is turned off.

A visual display of the IEC 4-14 test sequence is available for pre-viewing the test by pressing the Diagram soft key.

The preview will pop up in the center of the IEC 4-14 Test screen. Press [Esc] to clear the preview.
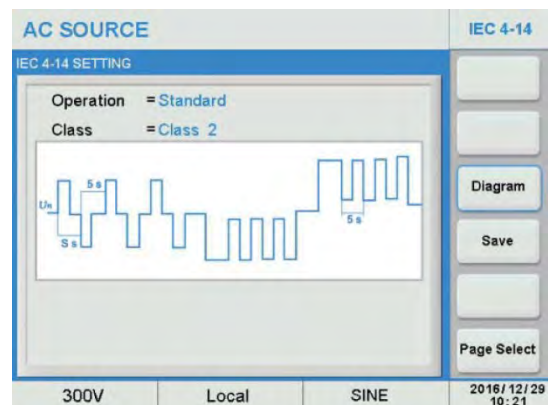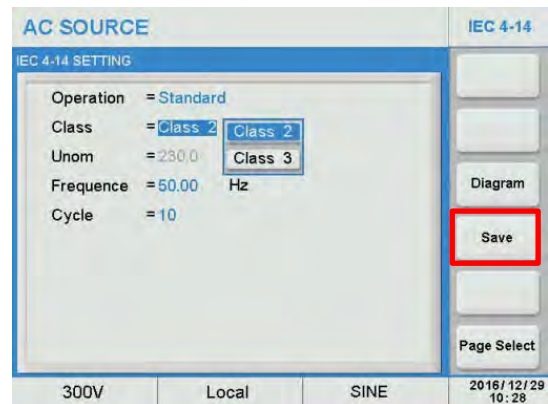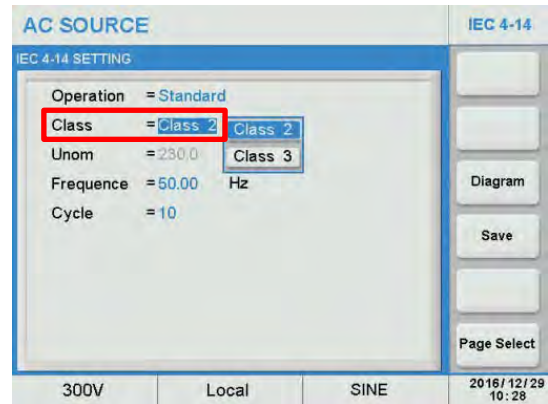
Running the IEC 4-14 test

Return to the previous IEC 4-14 menu by pressing the [Esc] key.

Press the **Trigger** soft key to apply the test to the unit under test. Once pressed, it changes to **Stop**.

The test will now run until completed. Total test time is determined by the Class settings.

The test time count down in seconds is visible in the upper part of the IEC 4-14 screen.

At the completion of the test, the **Stop** soft key will revert to **Trigger**. To abort a test in progress, press the **Stop** soft key during a test run.

ENHANCED VERSION ONLY

6.9.3.4   IEC 4-28 Tests

ENHANCED VERSION ONLY
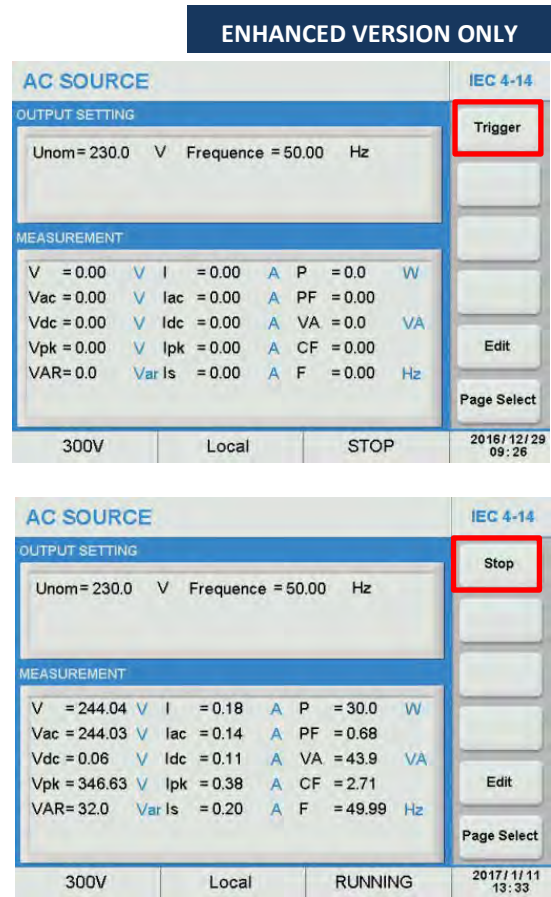
The IEC 61000-4-28 allows pre-compliance testing of products that require CE Marking per the IEC 61000-4-28 test standard for immunity against power frequency variations.

From the main IEC Standard menu, Press the IEC 4-28 soft key to select the IEC 4-28 test menu.
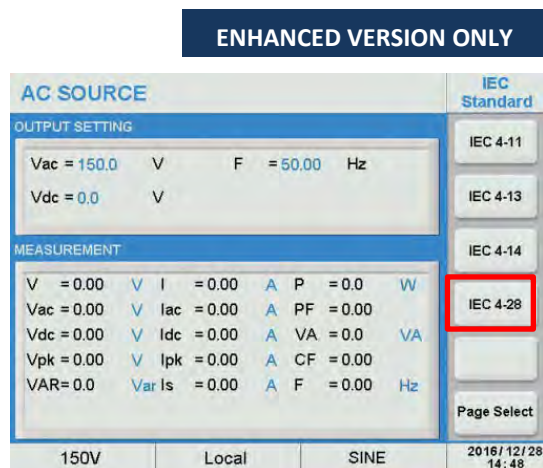
Available soft keys in this screen are **Load** and **Edit**. Press the **Edit** soft key to set the required test selections for this test.
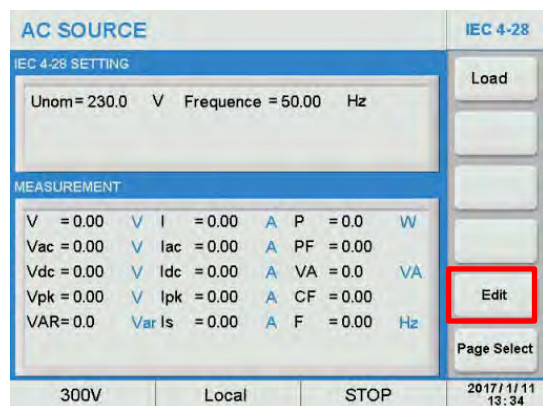
Once the Edit screen appears, select the "Operation =" field and press the [Enter] key to switch between Standard Setup and User Def. Setup. In User mode, parameters can be edited.
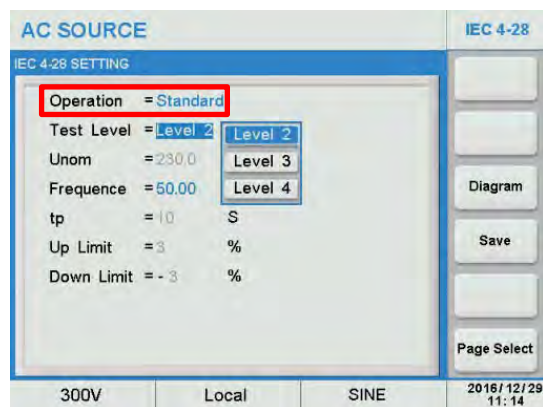
There are three test levels for the IEC 61000-4-28 test. They are Level 2through 4. Test levels and durations are defined by the IEC 61000-4-28 standard.

To select the appropriate product test level for the unit under test, move the cursor to the "Level =" field and press [Enter]. A drop down list with test level selections is displayed.

The following parameters can be edited by the user as needed:

- Unom: Nominal test voltage. Fixed at 230V in standard modes.
- Frequency: 50Hz or 60Hz in standard modes.
- tp: Rise/ Fall time.
- Up Limit: Percent of Nominal Frequency.
- Down Limit: Percent of Nominal Frequency.

These parameters are referenced in the figures below.
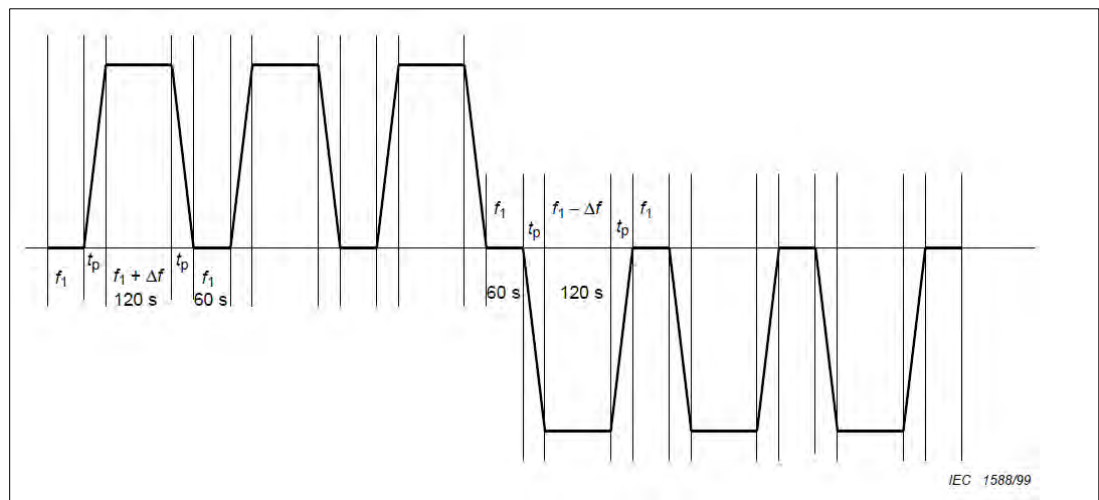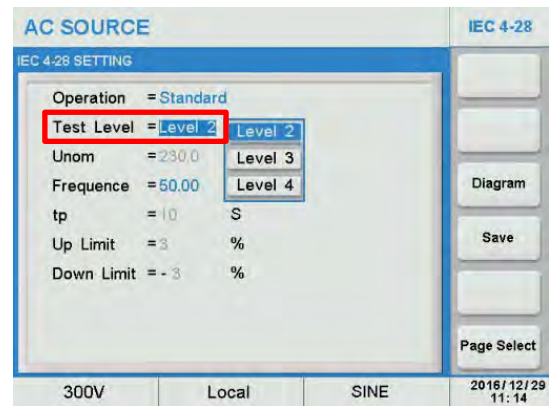
Figure 6-13: IEC 4-28 Frequency Variation Sequence
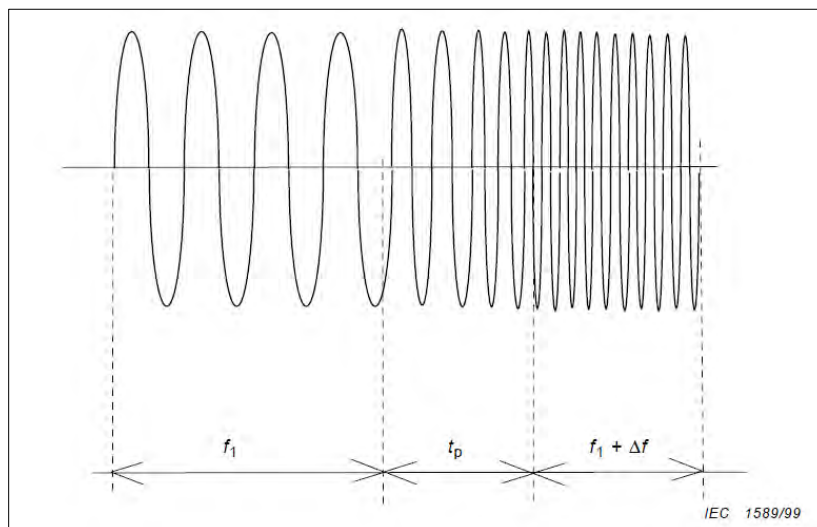
Figure 6-14: IEC 4-28 Frequency Transition Time tp

When done, press the Save soft key to save the IEC 4-28 settings to non-volatile memory.

Note: If the IEC 4-28 test setting is not saved, it will be lost when the power source is turned off.

A visual display of the IEC 4-28 test sequence is available for pre-viewing the test by pressing the Diagram soft key.

The preview will pop up in the center of the IEC 4-28 Test screen. Press [Esc] to clear the preview.
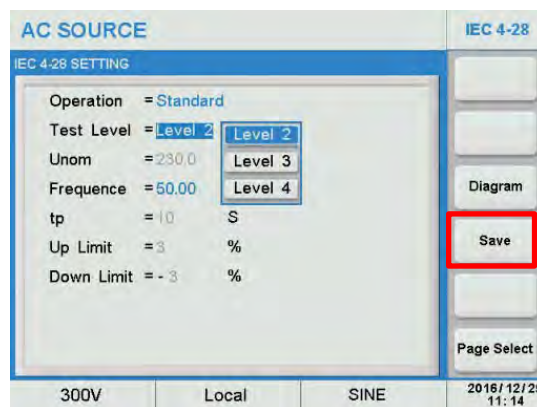
Running the IEC 4-28 test

Return to the previous IEC 4-28 menu by pressing the [Esc] key.

Press the **Trigger** soft key to apply the test to the unit under test. Once pressed, it changes to **Stop**.

The test will now run until completed. Total test time is determined by the Class settings.

The test time count down in seconds is visible in the upper part of the IEC 4-28 screen.

At the completion of the test, the **Stop** soft key will revert to **Trigger**. To abort a test in progress, press the **Stop** soft key during a test run.
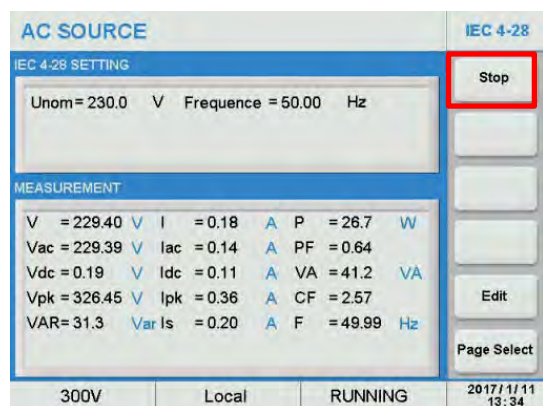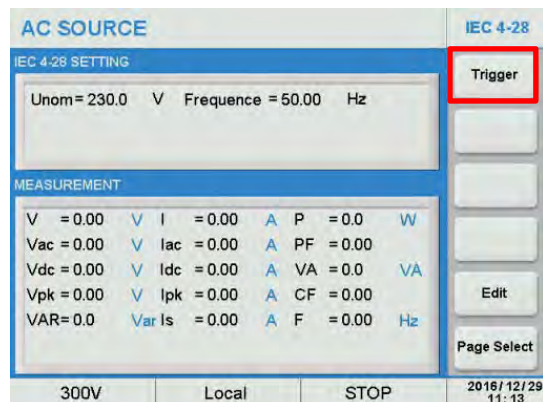
6.9.4   Special Functions.

ENHANCED VERSION ONLY

The Enhanced version CPS100 Series power source support the following special test functions:

- Transient Test
- Triac Dimmer

To access these special functions, press the **Special Func** soft key from the Output Mode menu.

This will bring up the Special Func menu screen.

6.9.4.1   Transient Test

Transient tests simulate the effects of high-speed voltage spikes and sags on a unit under test. This testing can point to vulnerabilities in AC or DC powered products during development or production test.

To select the Transient test mode, press the **Transient** soft key in the Special Func menu.

The transient test can be set up from the Edit screen. Press the **Edit** soft key to enter Edit mode.
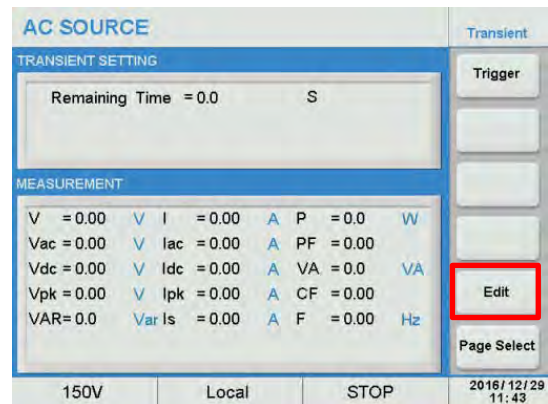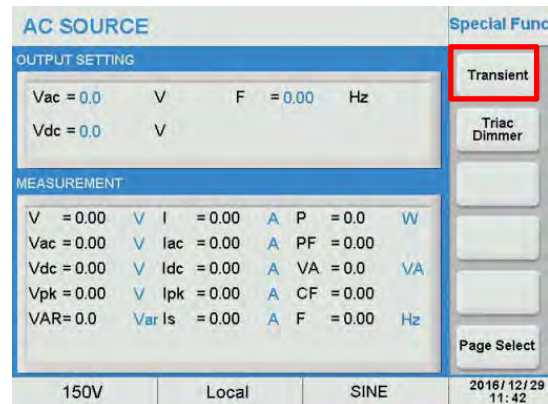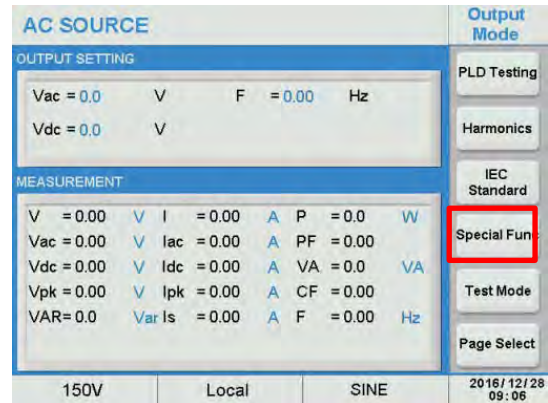
The Transient Edit mode allows the following parameters to be set:

- Trans-Start   Set the starting position in msec.
- Trans-Volt   Set the voltage level.
- Trans-Time   Set the duration of the transient event in msec.
- Trans-Count   Set the repeat count.

The following specifications apply to the Transient test mode:

Setting	Range	Resolution
Trans-Start	0.0 ~ 66.5 ms @ 15Hz	0.1 ms
Trans-Volt	-212V ~ +212V on 150V range -424V ~ +424V on 300V range	0.1 V
Trans-Time	0.0 ~ 66.5 ms @ 15 Hz	0.1 ms
Trans-Count	0 ~ 9999, Constant = 0	
Frequency	15 Hz ~ 70 Hz	

Table 6-5: Transient Function Specifications

When done, press the **Save** soft key to save the transient settings to non-volatile memory.

Note: If the setting is not saved, it will be lost when the power source is turned off.

Running the Transient test

Return to the Transient menu by pressing the [Esc] key.

Press the **Trigger** soft key to apply the test to the unit under test. Once pressed, it changes to **Stop**.

The test will run for the duration x count set with the Transient parameters.

At the completion of the test, the **Stop** soft key will revert to **Trigger**. To abort a test in progress, press the **Stop** soft key during a test run.
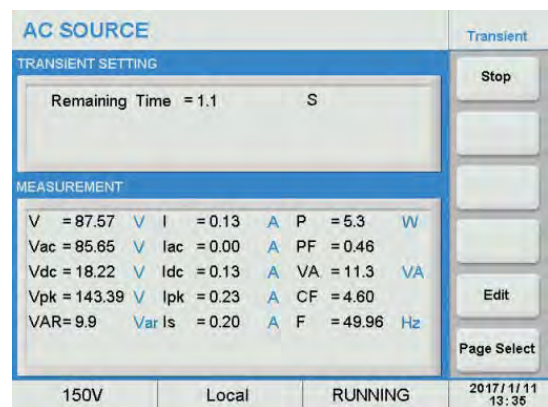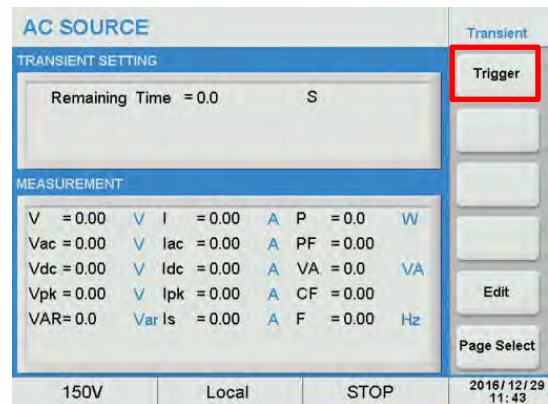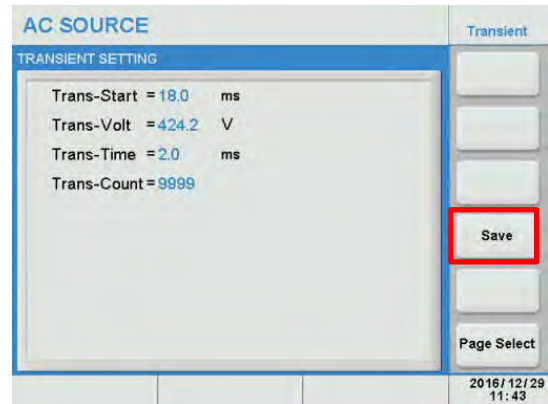
6.9.4.2   Triac Dimmer Test

ENHANCED VERSION ONLY

The Triac test simulates the voltage waveform associated with SCR controlled light dimmers. This test mode is useful for testing lighting products.

To select the Triac Dimmer test mode, press the **Triac Dimmer** soft key in the Special Func menu.
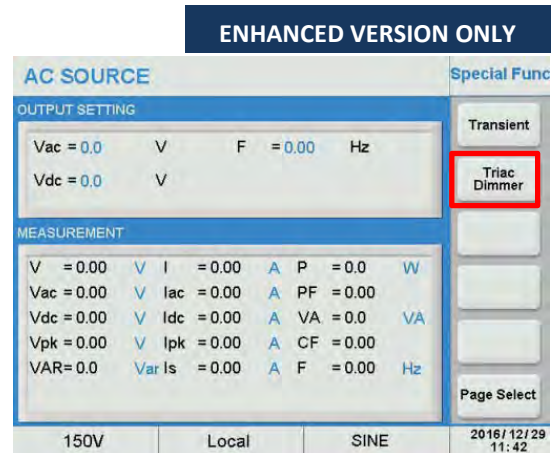
The Triac Dimmer test can be set up from the Edit screen. Press the **Edit** soft key to enter Edit mode.
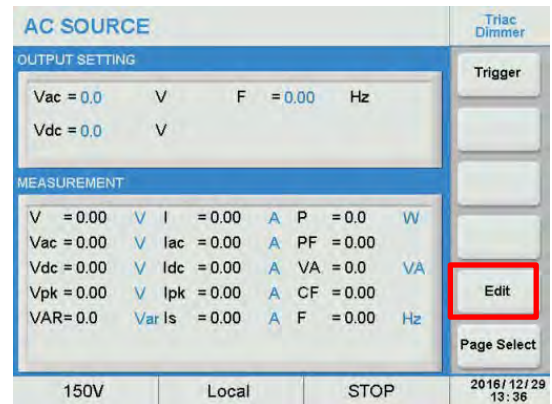
Available Triac parameters are:

- Edge   Leading or Lagging
- Degree: 0 ~ 359.9 degrees

When done, press the **Save** soft key to save the transient settings to non-volatile memory.

Note: If the setting is not saved, it will be lost when the power source is turned off.
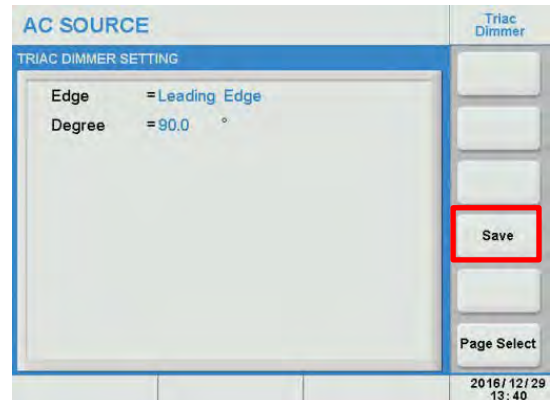
Running the Triac Dimmer test

Return to the Triac Dimmer menu by pressing the [Esc] key.

Press the **Trigger** soft key to apply the test to the unit under test. Once pressed, it changes to **Stop**.
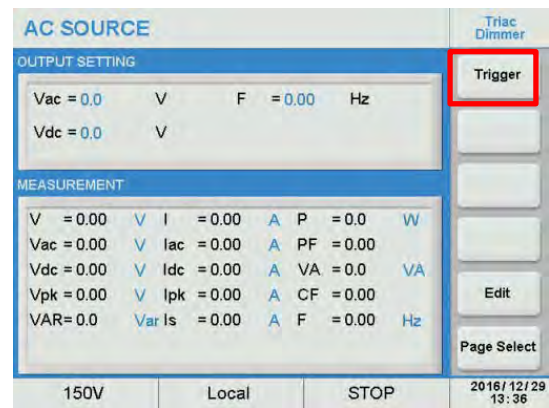
The test will run continuously till aborted by the user. To abort a test in progress, press the **Stop** soft key during a test run.

6.9.5   Test Mode

ENHANCED VERSION ONLY

The Test Mode compares measurement values against a user defined set of measurement limits and shows a PASS or FAIL result in one or more measurements are out of range. This type of limit testing is useful for production test applications.

Measurements include I, Iac, Idc, Ipk, Is, P, PF, VA, CF and VAR. (current and power related measurements.)

6.9.5.1   Limit Test Settings

To set up the Limit Test mode, press the **Test Mode** soft key from the Output Mode menu screen.

This will display the Test Mode setup screen where the following high and low measurement values can be entered:

I, Iac, Idc, Ipk, Is, P, PF, VA, CF and VAR

For each measurement, move the cursor to the Low Limit entry and use the [0] ~ [9] keys to enter the lower limit pass value. Then set the upper limit pass value.

For measurements that should be excluded from pass/fail testing, set the Switch parameter to **Disable**.

At the bottom of the Test Mode setup screen, enter the following times:

- Delay Time: Time delay between enabling the output of the power source and the start of measurement pass/fail testing in seconds.
- Test Time: Duration of measurement and limit compare period.
- Remaining Time: Time to wait after end of Test time to turn output OFF.

When done, press the Save soft key to save the transient settings to non-volatile memory.

Note: If the setting is not saved, it will be lost when the power source is turned off.

6.9.5.2 Running Limit Tests

Return to the Test Mode menu by pressing the [Esc] key.

To run a limit test, return the MAIN screen and set the output voltage and frequency as needed. Once the output is turned on, the measurements will start and compare against the limits set for the period of time programmed. A PASS or FAIL Result will be displayed when the total time period is over.

Note: If the optional Remote I/O & Parallel Multiphase Link (option AUX I/O) is installed, the result of the limit test and the output relay state (ON/OFF) can be detected from relay 1 ~ 3.

6.10 PARALLEL / SERIES / 3-PHASE Screen

This screen allows configuration of multi-unit systems in one for three available configurations:

- Parallel Mode   Two or more units can be paralleled to provide higher power and current output. The maximum number of units supported in parallel mode is 4.

- Series Mode   Two units can be used in series to obtain a higher output voltage. The maximum number of units supported in series mode is 2.

- 3-Phase Mode   Three units can be used in a three phase Wye or Delta configuration to obtain a three phase power source. The maximum number of units supported in 3-Phase mode is 3.

For details on multi-unit configuration operation and use, refer to section 8, "Master Slave Operation" on page 175 of this manual.

6.11 STORE / RECALL Screens

The STORE/RECALL screen is used to manage power source setups. The **Store/Recall** Menu structure is shown in the diagram below.
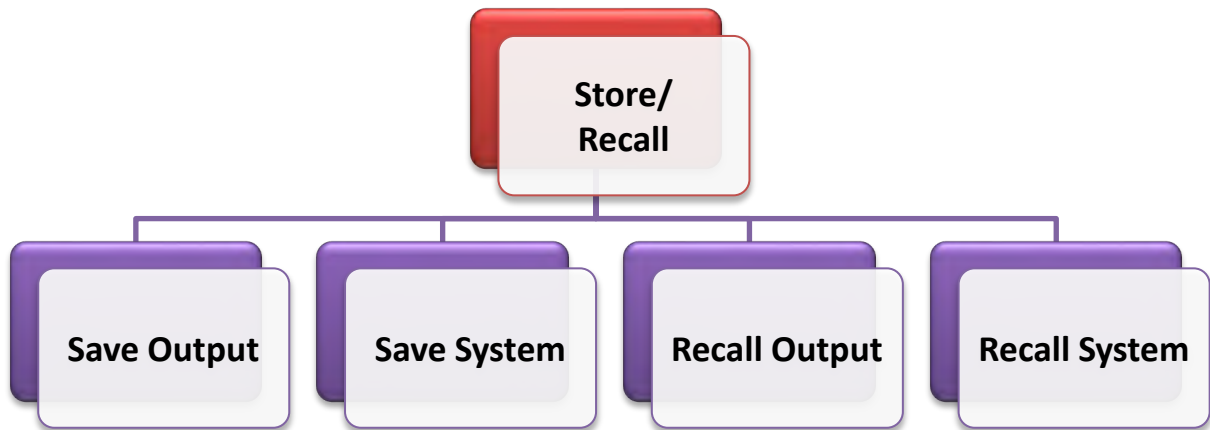
Figure 6-15: STORE / RECALL Menu Structure

The power source has 51 non-volatile Channel registers that store instrument settings including Vac, Vdc and frequency. It also has five [5] non-volatile register Groups that store system settings including user measurement screen configurations.

The memory resources are access using the following four soft keys:

- Save Output
- Save System
- Recall Output
- Recall System
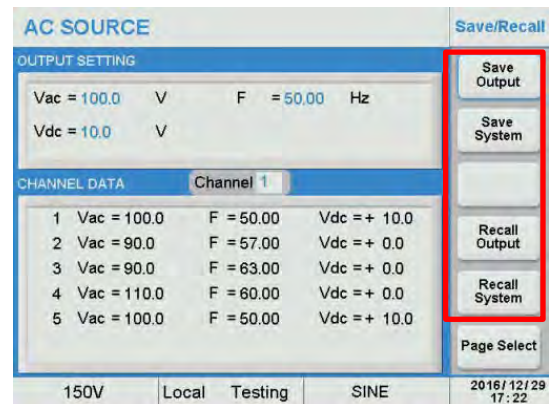
6.11.1.1 Save Output

To save an output setup, program the steady state parameters and any transient first. To save this setting, press the [Save Output] soft key.

Move the cursor to the Channel field located in the middle of the screen.

Use the [0] ~ [9] keys to select a channel number from 1 through 51 and press [Enter] to save the output settings to this Channel register.
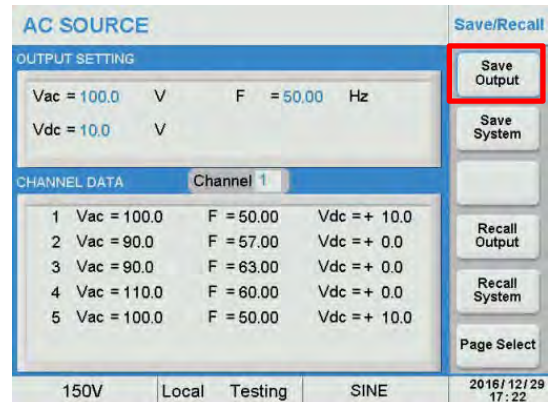
A list of available settings and their channel number is shown in the bottom part of the display. This helps will recall later.

6.11.1.2 Save System

To save an output setup, program the steady state parameters, any transient and measurement settings first. To save this setting, press the [Save System] soft key.

Move the cursor to the Group field located in the middle of the screen.

Use the [1] ~ [5] keys to select a group number from 1 through 5 and press [Enter] to save the output settings to this Group register.
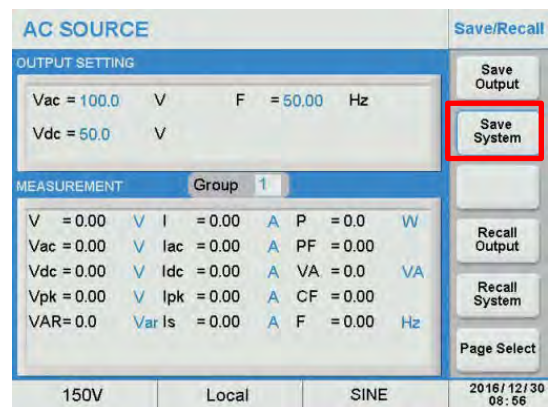
6.11.1.3 Recall Output

To recall an existing Output setting, press the [Recall Output] soft key. . Select the **Channel** field and use the [0] ~ [9] keys to enter the channel number.(1 ~ 51). Press [Enter] to recall the output settings.
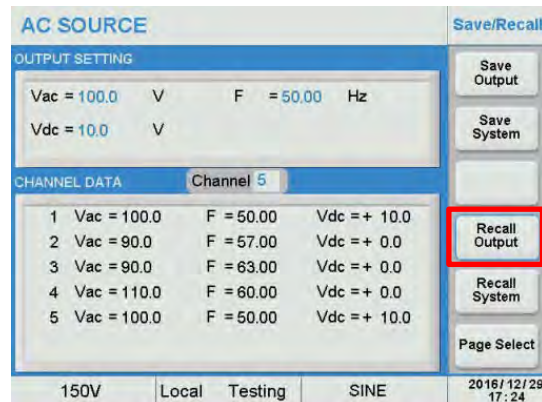
6.11.1.4 Recall System

To recall an existing System setting, press the [Recall System] soft key. . Select the **Group** field and use the [1] ~ [5] keys to enter the group number.(1 ~ 5). Press [Enter] to recall the system settings.
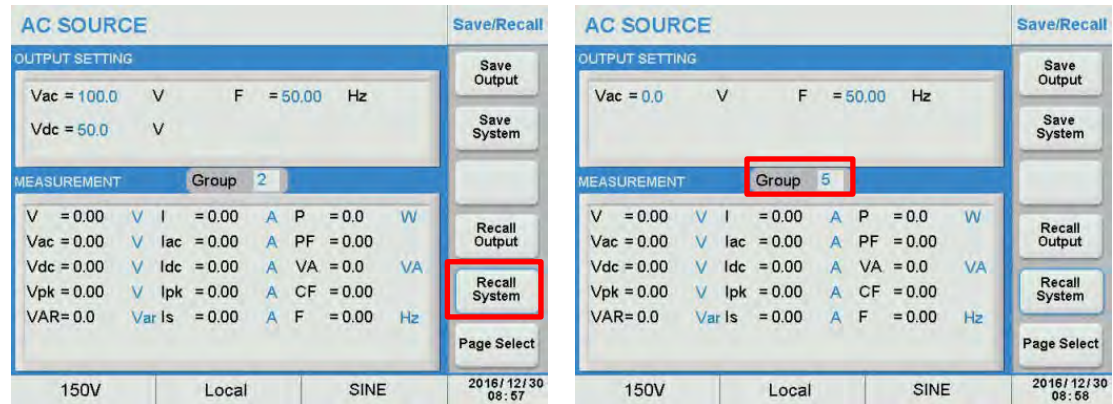
6.12 LOCK Screen

The front panel keys and touch screen function can be locked to prevent unwanted changes to output settings and power source configuration. A LOCK symbol will be displayed in the status bar on the right hand side to indicate this key board lock state.

To unlock the keyboard and touch screen, press the decimal key [.] on the numeric key pad.
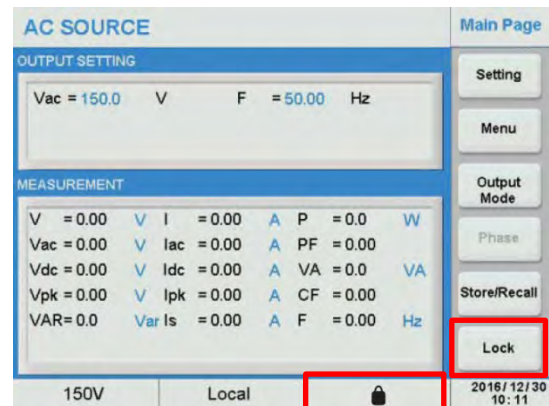
7   Remote Control Programming

7.1   Overview

All CPS100 models up to 1500VA rated are shipped with standard USB, RS232 and RS485 control interfaces. An optional LAN or GPIB is available for these models. Higher power models – 3000VA and higher - all include USB, LAN, RS232 and RS485 interfaces. A GPIB interface option is available for these higher power models as well.

The digital control interface allows the powers source settings to be configured remotely and measurement data to be retrieved for analysis and test report generation.

Note: For the RS485 multi-drop serial interface, ModBUS protocol is used instead of SCPI message strings. This communication protocol is covered in a separate manual, "APS_CPS100_Series_AC_Source_MODBUS_Protocol_Guide-PN160954-10_v1.1.pdf" part number 160954-10 available for download at https://adaptivepower.com.

7.2   Command Syntax

All CPS100 Series power sources use non-standard SCPI (Standard Commands for Programmable Instruments) command syntax. The command look SCPI like but don't meet the actual SCPI standard and as such should be considered proprietary. Commands are not case sensitive so any combination of upper and lower case characters is permissible. There are not long or short versions of these commands, only the commands documented here.

7.2.1   Command Terminators

Allowable terminator characters are:

Character	ASCII	Dec value	Hex value
Carriage Return	<CR>	13	0x0d
Line Feed	<LF>	10	0x0a

All commands should be terminated or they will not be accepted by the power source.

7.2.2   Numeric Parameters

If a command requires a parameter, it must be entered as a real number using a period as the decimal separator.

7.2.3   Parameter Unit Options

When sending a parameter value, it is **NOT** permissible to include a unit character such as V for voltage or A for amps. All command parameters and query responses are without any unit designator characters.

7.3   Syntax Notation Convention

The following parentheses are used in the command descriptions to indicate whether a command is necessary or optional and whether a choice has to be made. The symbols { }, [ ], | are not actually used in the programming commands. The symbols { }, [ ] and | are merely used to illustrate the command syntax as needed.

[ ] - Optional:	The contents of the [ ] symbol indicates that the command is optional. The use of the contents depends on the test application.
{ } - Selection:	The contents between the { } symbols is a list of available parameter values.
	- Required Choice:	This symbol acts as a separator between multiple parameter options. It means a choice must be made between the stated parameter key words. For example, "LOW|HIGH" Means a LOW or HIGH choice needs to be made as part of the command.
<> - Parameter Value:	Indicates a numeric value.
_ Underscore	Indicates a space 0x20 character. Added for readability of the manual only. **DO NOT** include these underscore characters when sending commands. Use a space character 0x20 instead.

7.4   IEEE488.2 Common Commands

The following IEEE488.2 common commands (a.k.a. star commands) are supported by the power source. These commands are provided for compatibility with the IEEE488.2 standard.

Command	Name	Description
*IDN?	Identification Query	Returns: Company, Model Number, Model Type, Serial Number, Firmware Control FW, Display FW, Remote FW as follows: *IDN?/n APS,CPS140E,ENHANCED,0143731810000001,V100R003C40,V100R003C31,V100R002C21 APS Manufacturer CPS140E Model Number ENHANCED Standard or Enhanced Model 0143731810000001 Serial Number V100R003C40 Control Firmware Version V100R003C31 Display Firmware Version V100R002C21 Remote Control Firmware Version

Table 7-1: IEEE488.2 Common Commands Supported

7.5   Measurement Commands

Measurements commands are all query which return a measurement result.

Note: These measurement commands apply to an individual CPS100 series power source. For Master/Slave configuration measurement commands, refer also to Section 7.2.2, "Master / Slave Measurement Commands" on page 172.

Command	Description		
MEAS:VOLT?	Returns the Voltage RMS value of the output in volts.		
MEAS:VDC?	Returns the DC Voltage value of the output in volts.		
MEAS:VAC?	Returns the AC Voltage value of the output in volts.		
MEAS:I?	Returns the Current RMS value of the output current in amps.		
MEAS:IDC?	Returns the DC Current value of the output current in amps.		
MEAS:IAC?	Returns the AC Current value of the output current in amps.		
MEAS:FREQ?	Returns the output frequency measurement in Hz.		
MEAS:VPK?	Returns the peak voltage of the output measurement in volts.		
MEAS:IPK?	Returns the peak current measurement at the output in amps.		
MEAS:CF?	Returns the crest factor measurement of the output voltage		
MEAS:IS?	Returns the inrush current of the output current in amps.		
MEAS:POWER?	Returns the true power output measurement in watts.		
MEAS:VAR?	Returns the reactive power output measurement in VAR.		
MEAS:VA?	Returns the apparent power output measurement in volt-amps.		
MEAS:PF?	Returns the Power Factor of the output power.		
MEAS:ALL?	Returns all 14 measurements, Output State and Alarm code as a comma separated data string. The order in which measurement values are returned is as follows.		
	Index - Measurement	Index – Measurement	Index – Meas. / State
	0 – Vrms	6 – Freq	12 – VAR
	1 – Vac	7 – Vpk	13 – VA
	2 – Vdc	8 – Ipk	14 – PF
	3 – Irms	9 – CF	15 – OUTPUT STATE
	4 – Iac	10 – Is	16 – ALARM CODE
	5 – Idc	11 – PWR	

Table 7-2: Measurement Commands

7.6 Harmonics Measurement Commands

Harmonics Measurement commands are all query which return a measurement result.

Note: These commands apply to Enhanced model versions of the CPS Series only.

Note: These measurement commands apply to an individual CPS100 series power source. For Master/Slave configuration measurement commands, refer also to Section 7.2.2, "Master / Slave Measurement Commands" on page 172.

Command	Description
HARMONICS:MEASURE:RUN	Starts the harmonics measurement. Returns OK or FALSE.
HARMONICS:MEASURE:STOP	Stops the harmonics measurement. Returns OK or FALSE.
HARMONICS:MEASURE:FREQ:_<NR2>	Sets the fundamental frequency for the harmonics measurement. Allowable values are: 0 50 Hz 1 60 Hz Returns OK or FALSE.
HARMONICS:MEASURE:TIMES:_<NR2>	Sets the measurement time for the harmonics measurement. Allowable values are: 0 Single 1 Continuous Returns OK or FALSE.
HARMONICS:MEASURE:SOURCE:_<NR2>	Sets the measurement source for the harmonics measurement. Allowable values are: 0 Voltage 1 Current Returns OK or FALSE.
HARMONICS:MEASURE:ALL?	Returns all 41 harmonic measurement values as a comma separated data string.

Table 7-3: Measurement Commands

7.7 Status Commands

Status commands are used to determine the state of the power source report on any error conditions or faults.

Command	Description
ASWRS?	Returns last error code
ASWRC_0	This command clears all error codes. Also removes Fault pop-ups displayed on LCD screen.

Table 7-4: Status Commands

Refer to tables below for a listing of all error codes for either Stand-alone mode or multi-unit Master / Slave mode of operation.

Error Code	Information	Instruction
0x0100	INNER LVP	Inner Under Voltage Protection
0x0080	INNER OVP	Inner Over Voltage Protection
0x0040	RCP	Reverse Current Protection
0x0020	SHT	Short Circuit Protection
0x0010	FAN	Fan Fault
0x0008	OTP	Over Temperature Protection
0x0004	OPP	Over Power Protection
0x0002	OCP	Over Current Protection
0x0001	OVP	Over Voltage Protection
0x0280	Frequency over 1.2kHz	Input frequency BNC input > 1.2kHz
0x0210	Over range (mA)	Over Range mA current range
0x0208	Over range (low)	Over Range low current range
0x0204	Primary OCP	Primary Over Current Protection
0x0202	Primary OTP	Primary Over Temperature Protection
0x0201	Primary UVP	Primary Under Voltage Protection

Table 7-5: Error Codes - Stand-alone Mode

Error Code	Information	Instruction
0x0401	Mode No Match	Modes for Master/Slave don't match
0x0402	Model No Match	Model numbers are not the same
0x0404	No Phase B	Missing Phase Slave unit B
0x0408	No Phase C	Missing Phase Slave unit C
0x0410	Master Conflict	More than one Master unit in system
0x0420	CAN No Slave	No Slave unit found
0x0440	CAN No Master	No Master unit found
0x0480	Slave Conflict	More than one Slave with same number
0x0500	Slave offline	Slave Unit off line

Table 7-6: Error Codes –Master / Slave Mode

7.8   Programming Commands

The following command and queries are available to program the output of the power source.

Note: These measurement commands apply to an individual CPS100 series power source. For Master/Slave configuration measurement commands, refer also to Section 7.2.1, "Master / Slave Programming Commands" on page 172.

7.8.1   OUTPUT Sub-system

The OUTPUT sub-system commands control output related parameters and configurations.

Command	Description
OUTPUT:VAC:_<nr2>	Sets the AC output voltage in volts. Setting range is 0.0 ~ 300.0. Returns OK or FALSE.
OUTPUT:VAC?	Queries AC output voltage setting.
OUTPUT:VDC:_<nr2>	Sets the DC output voltage in volts. Setting range is 424.4 ~ 424.2. Returns OK or FALSE.
OUTPUT:VDC?	Queries DC output voltage setting.
OUTPUT:FREQ:_<nr2>	Sets the output frequency in Hz. Range is 15.00 ~ 1000.00 on Standard version models or 15.00 ~ 1200.00 on Enhanced version models. Returns OK or FALSE.
OUTPUT:FREQ?	Queries the output frequency setting
OUTPUT:RELAY:_<nr2>	Turns the output on (ON) or off (OFF) by closing or opening the output relay. Returns OK or FALSE.
OUTPUT:RELAY?	Queries the output relay state. 0 = Open or OFF , 1 = Closed or on
OUTPUT:OUT:<STATE>	Enables the output to be (STATE = ON) or disables the output (STATE = OFF). Returns OK or FALSE.
OUTPUT:OUT?	Queries the output state. Returns ON or OFF
OUTPUT:WAVEFORM:SELECT:_<nr2>	Sets the output waveform to group A (0) or B (1). Returns OK or FALSE.

OUTPUT:WAVEFORMA:_<nr2>,<nr3>	Sets the parameters of waveform A. Returns OK or FALSE.
	
	<nr2> 0 SINE
	            1 SIQUA
	            2 CSINE <nr3> 0 ~ 100
	            3 FIXED 0 ~ 29
	            4 USER 0 ~ 5

Command	Description
OUTPUT:WAVEFORMA?	Queries the parameters of waveform A. Possible return values are: 0 SINE 1 SQUA 2,60 CSINE, AMP = 60% 3,4 FIXED, NO. 4 4,3 USER, NO. 3

OUTPUT:WAVEFORMB:_<nr2>,<nr3>	Sets the parameters of waveform B. Return signal is OK or FALSE.
	
	<nr2> 0 SINE
	       1 SIQUA
	       2 CSINE <nr3> 0 ~ 100
	       3 FIXED 0 ~ 29
	       4 USER 0 ~ 5

OUTPUT:WAVEFORMB?	Queries the parameters of waveform B. Possible return values are: 0 SINE 1 SQUA 2,60 CSINE, AMP = 60% 3,4 FIXED, NO. 4 4,3 USER, NO. 3
OUTPUT:ONDEGREE:_<nr2>	Sets the start phase angle in degrees. Range is 0.0 ~ 359.9. Returns OK or FALSE.
OUTPUT:ONDEGREE?	Queries the start phase angle
OUTPUT:OFFDEGREE:_<nr2>	Sets the end phase angle in degrees. Range is 0.0 ~ 359.9. A 360 setting means DISABLE. Return signal is OK or FALSE.
OUTPUT:OFFDEGREE?	Queries the end phase angle
OUTPUT:SLEW:VOLT:AC:_<nr2>	Sets the slew rate of the AC output voltage in V/ms. Range is 0.001 ~ 1200.000. Returns OK or FALSE.
OUTPUT:SLEW:VOLT:AC?	Queries the AC output voltage slew rate setting in V/ms.
OUTPUT:SLEW:VOLT:DC:_<nr2>	Sets the slew rate of the DC output voltage in V/ms. Range is 0.001 ~ 1000.000or 0 (disabled). Returns OK or FALSE.
OUTPUT:SLEW:VOLT:DC?	Queries the DC output voltage slew rate setting in V/ms.
OUTPUT:SLEW:FREQ:_<nr2>	Sets the slew rate of the output frequency in Hz/ms. Range is 0.001 ~ 1600.000. Returns OK or FALSE.
OUTPUT:SLEW:FREQ?	Queries the output frequency slew rate setting in Hz/ms.
OUTPUT:IMPED:FLAG:ON OUTPUT:IMPED:FLAG:OFF	Enables (ON) or disables (OFF) the output impedance function. Returns OK or FALSE.
OUTPUT:IMPED:FLAG?	Queries the output impedance function status. Returns ON of OFF.

Command	Description
OUTPUT:IMPED:RES:_<nr2>	Sets the Zo_R resistance of the output impedance. (Zo_R) in ohms. Range is 0.01 ~ 1.00. Returns OK or FALSE.
OUTPUT:IMPED:RES?	Queries the R setting of the output impedance (Zo_R) in Ohms.
OUTPUT:IMPED:INDU:_<nr2>	Sets the Zo_L inductance of the output impedance. (Zo_L) in mH. Range is 0.01 ~ 1.00. Returns OK or FALSE.
OUTPUT:IMPED:INDU?	Queries the L setting of the output impedance (Zo_L) in mH.

OUTPUT:RANGE:_<nr2>	Sets the output voltage range as follows:
	<nr2> 0 150V
	          1 300V
	          2 AUTO
	Return signal is OK or FALSE.

OUTPUT:RANGE?	Queries the voltage range setting. 0 = 150V / 1 =300V / 2 = AUTO

OUTPUT:COUPLE:_<nr2>	Sets the output coupling.
	<nr2> 0 AC
	          1 DC
	          2 AC+DC
	Return signal is OK or FALSE.

OUTPUT:COUPLE?	Queries the output coupling setting. 0 = AC / 1 = DC / 2 = AC+DC

OUTPUT:IRANGE:_<nr2>	Sets the current measurement range.
	<nr2> 0 High Range
	          1 Middle Range
	          2 Low Range
	          3 mA Range
	          4 Auto Range

OUTPUT:IRANGE?	Queries the current measurement range. 0 = High / 1 = Middle / 2 = Low / 3 = mA / 4 = Auto
OUTPUT:ISSTART:_<nr2>	Sets the delay time for testing surge current Is in msec. Range is 0 ~ 999. Returns OK or FALSE.
OUTPUT:ISSTART?	Queries the delay time setting for the inrush current test.
OUTPUT:ISINTERVAL:_<nr2>	Sets the interval time for testing surge current Is in msec. Range is 0 ~ 999. Returns OK or FALSE.
OUTPUT:ISINTERVAL?	Queries the interval time setting for the inrush current test.

Table 7-7: OUTPUT Sub-system Commands

7.8.2   LIMIT Sub-system

The LIMIT sub-system controls user limits and protections.

Command	Description
LIMIT:VAC:_<nr2>	Sets the upper AC voltage limit. Range is 0.0 ~ 300.0 V. Returns OK or FALSE.
LIMIT:VAC?	Queries the upper AC voltage limit.
LIMIT:VDC+:_<nr2>	Sets the upper DC voltage limit. Range is 0.0 ~ 424.2 V. Returns OK or FALSE.
LIMIT:VDC+?	Queries the upper DC voltage limit.
LIMIT:VDC-:_<nr2>	Sets the lower DC voltage limit. Range is -424.2 ~ 0.0 V. Returns OK or FALSE.
LIMIT:VDC-?	Queries the lower DC voltage limit.
LIMIT:FREQ:_<nr>	Sets the upper Frequency limit for output in Hz. Setting range is 15.00 ~ 1000.00 for Standard models or 15.00 ~ 1200.00 Hz for Enhanced models. Returns OK or FALSE
LIMIT:FREQ?	Queries the upper frequency limit setting.
LIMIT:OPP:_<nr2>	Sets the Over Power Protection limit. Range varies by model but is 30 ~ 102% of Max Power Rating by model number. Refer to Section 4.1 on page 28. Returns OK or FALSE
LIMIT:OPP?	Queries the Over Power Protection limit setting
LIMIT:OCPLIMIT:_<nr2>	Sets the Over Current Protection limit. Range varies by model but is 0.2 ~ Max Current Rating on 150V range. Refer to Section 4.1 on page 28. Returns OK or FALSE. **Note:** For CV or CC mode selection, see CCMODE command on next page.
LIMIT:OCPLIMIT?	Queries the Over Current Protection limit setting
LIMIT:OCPDELAY:_<nr2>	Sets the Over Current Protection trip delay in secs. Range is 0 ~ 5.0 secs. Returns OK or FALSE.
LIMIT:OCPDELAY?	Queries the Over Current Protection limit trip delay setting in seconds.

Table 7-8: LIMIT Sub-system Commands

7.8.1 CCMODE Sub-system

The CCMODE sub-system controls constant current mode operation.

Command	Description
CCMODE:_<nr2>	Enables (1) or Disables (0) the Constant Current mode. Returns OK of FALSE.
CCMODE?	Queries the Constant Current mode state. Returns 0 (Disabled) or 1 (Enabled).

Table 7-9: CCMODE Sub-system Commands

7.8.2 LIST Sub-system

The LIST sub-system controls output transient sequence programming.

Command	Description
LIST:BASE:_<nr2>	Sets the base for the selected step as either Cycle (0) or Time (1). Returns OK or FALSE.
LIST:COUNT:_<nr2>	Set the repeat time for the selected step. Range is 0 ~ 9999. A 0 value means an infinite loop. Returns OK or FALSE.
LIST:CYCLE?	Queries the repeat time of the current step.
LIST:DEGREE:_<nr2>	Sets the start angle for the selected step in degrees. Range is 0.0 ~ 359.9 degrees. Returns OK or FALSE.
LIST:FREQEND:_<nr2>	Sets the end frequency for the selected step in Hz. Range is 15.00 ~ 1000.00 for Standard models or 15.00 ~ 1200.00 for Enhanced models. Returns OK or FALSE.
LIST:FREQSTART:_<nr2>	Sets the start frequency for the selected step in Hz. Range is 15.00 ~ 1000.00 for Standard models or 15.00 ~ 1200.00 for Enhanced models. Returns OK or FALSE.
LIST:LOAD	Loads programmed list sequence to power source's list memory. Returns OK of FALSE.
LIST:SAVE	Save the list sequence to no-volatile memory. Returns OK or FALSE. Note: There is no way at present to recall the List file directly after cycling power on the unit. Because the file is saved in the Display LCD controller instead of DSP. To run a the list file after power on, the data must be transferred from screen to DSP first.
LIST:MODE:_<nr2>	Sets the running mode of the list to either Continuous (0) or Step mode (1). Returns OK or FALSE.
LIST:NUMM:_<nr2>	Save the settings to a list. Range is 0 ~ 49.
LIST:RUN	Starts execution of a list sequence. Returns OK or FALSE.
SYST:MODE?	Queries the running status of the list file. Returns 1 is running or 0 if completed.

Command	Description
LIST:STATUS?	Queries the status of the list sequence. 0 = Running, 1 = Completed. The command LIST:STATUS? and SEQ:STATUS? Commands can be used when the Trigger mode is set to STEP, that means when LIST:MODE or LIST:STEPMODE are set to 1 (step). Note: LIST:STATUS? and SEQ:STATUS? Commands query the status of the current step only, not the status of the whole list file. Please using "SYS:MODE?" query the running status of the list file, return 1 (running) or 0 (finished

LIST:STEP:ALL:_<nr2>,..,<nr2>	Sets all parameters for a list step at once. There are 18 parameters for each list step. The 18 parameters must all be specified in the exact order shown below.
	
	    Parameter1=SEQ:LISTID
	    Parameter2=LIST:MODE
	    Parameter3=SEQ:STEPCOUNT
	    Parameter4=LIST:STEPNUM
	    Parameter5=LIST:STEPID
	    Parameter6=LIST:NUM ------- （0~49）
	    Parameter7=LIST:STEPMODE
	    Parameter8=LIST:COUNT
	    Parameter9=LIST:WAVEFORM
	    Parameter10=LIST:BASE
	    Parameter11=LIST:DEGREE
	    Parameter12=LIST:FREQSTART
	    Parameter13=LIST:FREQEND
	    Parameter14=LIST:VACSTART
	    Parameter15=LIST:VACEND
	    Parameter16=LIST:VDCSTART
	    Parameter17=LIST:VDCEND
	    Parameter18=LIST: TIME
	
	## Programmed list Example:
	
	SEQ:STEPNUM: 1
	SEQ:CYCLE: 1
	LIST:STEP:ALL: 1,0,3,4,1,2,0,1,A,1,0.0,,50.00,50.00,220.0,220.0,0.0,0.0,1000.0
	LIST:STEP:ALL: 1,0,3,4,2,2,0,1,A,1,0.0,50.00,50.00,0.0,0.0,0.0,0.0,1000.0
	LIST:STEP:ALL: 1,0,3,4,3,2,0,1,A,1,0.0,50.00,50.00,220.0,220.0,0.0,0.0,2000.0
	LIST:STEP:ALL: 1,0,3,4,4,2,0,1,A,1,0.0,50.00,50.00,0.0,0.0,0.0,0.0,1000.0
	LIST:LOAD
	<DELAY TIME>1000 /* allow time to load list data to controller
	LIST:SAVE
	LIST:RUN

LIST:STEP?	Queries the number of steps in the list. Range is 0 ~ 49.
LIST:STEPID:_<nr2>	Sets the number for the current list step. Range is 1 ~ 9. Returns OK or FALSE.
LIST:STEPMODE:_<nr2>	Sets the run mode for the current list step as Continuous (0) or Step mode (1). Returns OK or FALSE.

Command	Description
LIST:STEPNUM:_<nr2>	Sets the total number of steps for the list. Range is 1 ~ 9. Returns OK or FALSE.
LIST:STOP	Stops the execution of a list sequence. Returns OK.
LIST:TIME:_<nr2>	Sets the dwell time for the selected step. Range is 0 ~ 9999999.9 in msecs. Returns OK or FALSE.
LIST:VACEND:_<nr2>	Sets the end value of the AC voltage for the selected step in volts. Range is 0.0 ~ 300.0 V. Returns OK or FALSE.
LIST:VACSTART:_<nr2>	Sets the start value of the AC voltage for the selected step in volts. Range is 0.0 ~ 300.0 V. Returns OK or FALSE.
LIST:VDCEND:_<nr2>	Sets the end value of the DC voltage for the selected step in volts. Range is -424.2 ~ 424.2 V. Returns OK or FALSE.
LIST:VDCSTART:_<nr2>	Sets the start value of the DC voltage for the selected step in volts. Range is -424.2 ~ 424.2 V. Returns OK or FALSE.
LIST:WAVEFORM:_<nr2>	Sets the waveform generator to A (0) or B (1). Returns OK or FALSE.
SEQ:CYCLE:_<nr2>	Sets the repeat time of the list sequence in secs. Range is `1 ~ 9999. Returns OK or FALSE.
SEQ:CYCLE?	Queries the repeat time of the selected list in the sequence at this moment in time. Returns 1 ~ 9999.
SEQ:LISTCYCLE?	Queries the repeat time of the selected step in the list sequence at this moment in time. Returns 0 ~ 9999.
SEQ:LISTID:_<nr2>	Sets the number of the list file. Range is 1 ~ 50. Returns OK or FALSE.

SEQ:LOAD	Loads the sequence settings to the power source internal memory. Returns OK.
	
	If the SEQ:STEPNUM: is 1, that means there is only one list file. After editing the file, send the LIST:LOAD and LIST:RUN commands.
	
	If the SEQ:STEPNUM: is 2 or more, that means there is more than one list file. After editing the file, send the SEQ:LOAD and SEQ:RUN commands.
	
	Example: SEQ:STEPNUM: xx
	                 SEQ:CYCLE: xx
	                 SEQ:LISTID: xx
	                 LIST:MODE: xx
	                 SEQ:STEPCOUNT: xx
	                 LIST:STEPNUM: xx

SEQ:RUN	Runs the sequence file. Returns OK. (See to SEQ:LOAD)
SEQ:STATUS?	Queries the state of the sequence file. 0 = Running, 1 = Finished.
SEQ:STEP?	Queries the number of the current step in the sequence.

Command	Description
SEQ:STEPCOUNT:_<nr2>	Sets the number of loop cycles for the current step. Range is 1 ~ 9999. Returns OK or FALSE.
SEQ:STEPNUM:_<nr2>	Sets the total number of steps in the sequence. Range is 1 ~ 50. Returns OK or FALSE.

Table 7-10: LIST Sub-system Commands

7.8.2.1   LIST Mode programming examples

The correlation between programming a transient list from the front panel and using remote commands is shown the figure below. The following two examples show two alternate ways of programming the same list sequence.
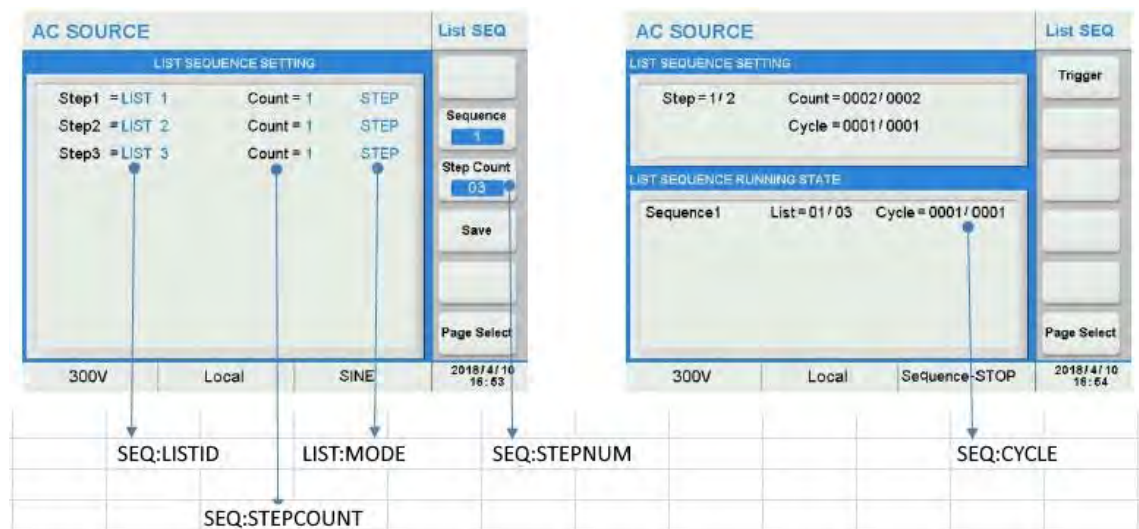
Figure 7-1: Transient Front Panel vs Commands relationship

Example 1: For steps in list #3 programming using individual step commands.

```
SEQ:STEPNUM: 1
SEQ:CYCLE: 1
SEQ:LISTID:1

SEQ:STEPCOUNT: 3
LIST:STEPNUM: 4

LIST:STEPID: 1
LIST:BASE: 1
LIST:WAVEFORM: A
LIST:COUNT: 1
LIST:TIME: 1000
LIST:STEPMODE: 0
LIST:DEGREE: 0
LIST:VACSTART: 220
LIST:VACEND: 220
LIST:VDCSTART: 0
LIST:VDCEND: 0
LIST:FREQSTART: 50
LIST:FREQEND: 50
```

```
LIST:STEPID: 2
LIST:BASE: 1
LIST:WAVEFORM: A
LIST:COUNT: 1
LIST:TIME: 1000
LIST:STEPMODE: 0
LIST:DEGREE: 0
LIST:VACSTART: 0
LIST:VACEND: 0
LIST:VDCSTART: 0
LIST:VDCEND: 0
LIST:FREQSTART: 50
LIST:FREQEND: 50

LIST:STEPID: 3
LIST:BASE: 1
LIST:WAVEFORM: A
LIST:COUNT: 1
LIST:TIME: 2000
LIST:STEPMODE: 0
LIST:DEGREE: 0
LIST:VACSTART: 220
LIST:VACEND: 220
LIST:VDCSTART: 0
LIST:VDCEND: 0
LIST:FREQSTART: 50
LIST:FREQEND: 50

LIST:STEPID: 4
LIST:BASE: 1
LIST:WAVEFORM: A
LIST:COUNT: 1
LIST:TIME: 1000
LIST:STEPMODE: 0
LIST:DEGREE: 0
LIST:VACSTART: 0
LIST:VACEND: 0
LIST:VDCSTART: 0
LIST:VDCEND: 0
LIST:FREQSTART: 50
LIST:FREQEND: 50

LIST:LOAD

<DELAY TIME>10000

LIST:NUM: 2        Note: To save the settings to LIST #3. Range is 0~49.
LIST:SAVE          Note: Optional if list is to be available after power off.

LIST:RUN
```

Example 2: For steps in list #3 programming using LIST:STEP:ALL commands.

```
SEQ:STEPNUM: 1
SEQ:CYCLE: 1
LIST:STEP:ALL: 1,0,3,4,1,2,0,1,A,1,0.0,,50.00,50.00,220.0,220.0,0.0,0.0,1000.0
LIST:STEP:ALL: 1,0,3,4,2,2,0,1,A,1,0.0,50.00,50.00,0.0,0.0,0.0,0.0,1000.0
LIST:STEP:ALL: 1,0,3,4,3,2,0,1,A,1,0.0,50.00,50.00,220.0,220.0,0.0,0.0,2000.0
LIST:STEP:ALL: 1,0,3,4,4,2,0,1,A,1,0.0,50.00,50.00,0.0,0.0,0.0,0.0,1000.0

LIST:LOAD

<DELAY TIME>1000

LIST:SAVE

LIST:RUN
```

7.8.3 PULSE Sub-system

The PULSE sub-system controls output transient pulse mode programming.

Command	Description
PULSE:CYCLE:_<nr2>	Sets the repeat time of the pulse. Range is 0 ~ 65535. A 0 setting means infinite loop. Returns OK or FALSE.
PULSE:DEGREE:_<nr2>	Sets the start angle of the pulse in degrees. Range is 0.0 ~ 359.9. Returns OK or FALSE.
PULSE:DUTYCYCLE:_<nr2>	Sets the duty cycle of the pulse in percent. Range is 0.0 ~ 100.0. Returns OK or FALSE.
PULSE:FREQ:_<nr2>	Sets the frequency of the pulse in Hz. Range is 15.00 ~ 1000.00 for Standard models or 15.00 ~ 1200.00 for Enhanced models. Returns OK or FALSE.
PULSE:PERIOD:_<nr2>	Sets the cycle time of the pulse in msec. Range is 0 ~ 9999999.9. Returns OK or FALSE.
PULSE:REMAINTIME?	Queries the remaining time of the pulse execution in seconds. Range is 0.0 ~ 6553434465.
PULSE:START:_<nr2>	Sets when to run the pulse waveform in msecs. Range is 0.0 ~ 25.0. Returns OK or FALSE.
PULSE:TRIGER **>>> PULSE:TRIGGER <<<**	Starts execution of the pulse transient. Returns OK. **Note:** Remote firmware revision V100R002C21 of lower will not accept correct spelling of TRIGGER key word. Use TRIGER as shown instead.
PULSE:STOP	Abort execution of the pulse transient. Returns OK.
PULSE:VAC:_<nr2>	Sets the pulse AC voltage in volts. Range is 0.0 ~ 300.0. Returns OK or FALSE.
PULSE:VDC:_<nr2>	Sets the pulse DC voltage in volts. Range is -424.2 ~ 424.2. Returns OK or FALSE.
PULSE:WAVEFORM:_<nr2>	Selects waveform group A (0) or B (1) for the pulse. Returns OK or FALSE.

Table 7-11: PULSE Sub-system Commands

7.8.4   STEP Sub-system

The STEP sub-system controls output transient step mode programming.

Command	Description
STEP:COUNT:_<nr2>	Sets the number of steps. Range is 0 ~ 9999. A 0 value means infinite loop. Returns OK or FALSE.
STEP:DEGREE:_<nr2>	Sets the start angle of the steps in degrees. Range is 0.0 ~ 359.9. Returns OK or FALSE.
STEP:DFREQ:_<nr2>	Sets the step value of the Frequency in Hz. Range is 15.00 ~ 1000.00 for Standard models or 15.00 ~ 1200.00 for Enhanced models. Returns OK or FALSE.
STEP:DVAC:_<nr2>	Sets the step increment value for the AC voltage in volts. Range is -300.0 ~ 300.0. Returns OK or FALSE.
STEP:DVDC:_<nr2>	Sets the step increment value for the AC voltage in volts. Range is -424.2 ~ 424.2. Returns OK or FALSE.
STEP:DWELL:_<nr2>	Sets the duration of each step in msec. Range is 0 ~ 9999999.9. Returns OK or FALSE.
STEP:FREQ:_<nr2>	Sets the starting frequency in Hz. Range is 15.00 ~ 1000.00 for Standard models or 15.00 ~ 1200.00 for Enhanced models. Returns OK or FALSE.
STEP:MAXPOWER:FREQ?	Queries the frequency reached at the maximum power point in Hz.
STEP:MAXPOWER:I?	Queries the current reached at the maximum power point in amps.
STEP:MAXPOWER:P?	Queries the power reached at the maximum power point in Watts.
STEP:MAXPOWER:PF?	Queries the power factor reached at the maximum power point.
STEP:MAXPOWER:V?	Queries the voltage reached at the maximum power point in volts.
STEP:PAUSE	Pauses or resumes the step transient. Returns OK.
STEP:POWERSWEEP:_<nr2>	Enables (1) or Disables the power sweep function.
STEP:REMAINTIME?	Queries the remaining time left for the step transient in secs.
STEP:TRIGER >>> STEP:TRIGGER <<<	Starts execution of the step transient. Returns OK. **Note:** Remote firmware revision V100R002C21 of lower will not accept correct spelling of TRIGGER key word. Use TRIGER as shown instead.
STEP:STOP	Abort execution of the step transient. Returns OK.
STEP:VAC_<nr2>	Sets the start AC voltage in volts. Range is 0.0 ~ 300.0. Returns OK or FALSE.
STEP:VDC_<nr2>	Sets the start DC voltage in volts. Range is -424.2 ~ 424.2. Returns OK or FALSE.
STEP:WAVEFROM:_<nr2>	Selects waveform group A (0) or B (1) for the step. Returns OK or FALSE.

Table 7-12: STEP Sub-system Commands

7.9 Synthesis Commands

The Synthesis-commands allow creation of harmonic waveforms.

Command	Description
SYNTHESIS:COMPOSE:_<nr2>	Sets the data entry mode for harmonic amplitude programming to either absolute value (0) or percent of fundamental (1). Returns OK or FALSE.
SYNTHESIS:DEGREE:_<nr2>	Sets the start phase angle of the waveform in degrees. Range is 0.0 ~ 359.0. Returns OK or FALSE.
SYNTHESIS:F:_<nr2>	Sets frequency to either 50 Hz (0) or 60 Hz (1). Returns OK or FALSE. <nr2> = < 0 | 1 > Returns OK or FALSE
SYNTHESIS:PHASE:_<nr2>,<nr3>	Sets the phase angle for each order harmonic. <nr2> 2 ~ 40 <nr3> 0.0 ~ 359.9 Returns OK or FALSE
SYNTHESIS:TRIGGER	Start output of the synthesized waveform. Returns OK.
SYNTHESIS:STOP	Stops running of the synthesized waveform. Returns OK.
SYNTHESIS:V:_<nr2>,<nr3>	Sets the amplitude for each order harmonic. <nr2> 2 ~ 40 <nr3> See table for value ranges: (see table below)
SYNTHESIS:VAC:_<nr2>	Sets the fundamental (H1) AC voltage in volts. Range is 0.0 ~ 150.0 on 150V range, 0.0 ~ 300.0 on 300V range. Returns OK or FALSE.
SYNTHESIS::VDC:_<nr2>	Sets the fundamental (H1) DC voltage in volts. Range is -212.1 ~ 212.1 on 150V range, -424.2 ~ 424.2 on 300V range. Returns OK or FALSE.
SYNTHESIS:PHASE:ALL:_<nr2>	Sets the phase angle for all harmonics. <nr2> 0.0 ~ 359.9 Returns OK or FALSE
SYNTHESIS:V:ALL_<nr2>,<nr3>	Sets the amplitude for all harmonics. <nr2> See table for value ranges: (see table below)

For SYNTHESIS:V:_<nr2>,<nr3>:

Order	2 ~ 10	11 ~ 20	21 ~ 30	31 ~ 40
Value (V)	0.0 ~ 150.0	0.0 ~ 120.0	0.0 ~ 80.0	0.0 ~ 45.0
Percent (%)	(0.0 ~ 100.0 %)* Vac	(0.0 ~ 50.0 %)* Vac	(0.0 ~ 30.0 %)* Vac	(0.0 ~ 15.0 %)* Vac

Where Vac = Fundamental Voltage. Amplitude of fundamental will be fundamental voltage * setting %.
Returns OK or FALSE

For SYNTHESIS:V:ALL_<nr2>,<nr3>:

Order	2 ~ 10	11 ~ 20	21 ~ 30	31 ~ 40
Value (V)	0.0 ~ 150.0	0.0 ~ 120.0	0.0 ~ 80.0	0.0 ~ 45.0
Percent (%)	(0.0 ~ 100.0 %)* Vac	(0.0 ~ 50.0 %)* Vac	(0.0 ~ 30.0 %)* Vac	(0.0 ~ 15.0 %)* Vac

Where Vac = Fundamental Voltage. Amplitude of fundamental will be fundamental voltage * setting %.
Returns OK or FALSE

Table 7-13: Waveform Synthesis System Commands

7.10 System Commands

The system commands provide system level functions.

Command	Description
SYS:DIM:EDGE:_<nr2>	Sets the edge of the dimmer test function to either Leading (0) or Trailing (1). Range is 0 ~ 1. Returns OK or False.
SYS:DIM:DEGREE:_<nr2>	Sets the phase angle of the blanking period. Range is 0.0 ~ 180.0. Returns OK or False.
SYS:LOC	Enables local operation (front panel active). Puts the unit in LOCAL mode when controlled from a computer program. Returns OK or False.
SYS:RECALLDEFAULT	Recalls factory default setting. This will erase all use settings. Returns OK or False.
SYS:RECALLIP	Resets the LAN interface IP address. Returns OK or False.

Table 7-14: System Commands

7.1 External Input Control Mode Commands

The External Input commands control the operation of external I/O functions.

Command	Description
EXTERN:CONTROLMETHOD:_<nr2>	Sets the external control mode for the analog input. Available modes <nr2> are: 0 Amplifier Mode 1 Level Mode 2 Voltage Set Mode Returns OK or FALSE
EXTERN:CONTROLMETHOD?	This command queries the external control mode setting. Return values are: 0 Amplifier Mode 1 Level Mode 2 Voltage Set Mode Returns OK or FALSE
EXTERN:VOLTAGE:_<nr2>	This command sets the input scaling for the analog input. Available settings are: 3 3 Volt full scale 5 5 Volt full scale 10 10 Volt full scale Returns OK or FALSE
EXTERN:VOLTAGE?	This command queries the input scale setting. Return values are: 3, 5 or 10

Table 7-15: External Input Commands

7.2 Master / Slave Configuration Commands

Master / Slave programming commands apply to configurations using more than one CPS100 power source in either Series, Parallel or 3-Phase mode. For details on these configurations, refer to section 8, "Master Slave Operation" on page 175.

7.2.1 Master / Slave Programming Commands

Command	Description
PARA:NUM?	This command queries the number of slaves. The return signal is 0~3.
PARA:MODE?	This command queries the connection mode. Return values are: 0 Single Mode 1 Parallel Mode 2 Series Mode 3 Link Output for 3-Phase
PARA:FREQ?	This command queries the frequency in Hertz (Hz). Returns OK or FALSE.
PARA:PHASEB:VAC:_<NR2>	This command sets the AC output voltage of phase B in volts. The setting range is 0.0~300.0V. Returns OK or FALSE.
PARA:PHASEB:VDC:_<NR2>	This command sets the DC output voltage of phase B in volts. The setting range is -424.2~424.2V. Returns OK or FALSE.
PARA:PHASEC:VAC:_<NR2>	This command sets the AC output voltage of phase C in volts. The setting range is 0.0~300.0V. Returns OK or FALSE.
PARA:PHASEC:VDC:_<NR2>	This command sets the DC output voltage of phase C in volts. The setting range is -424.2~424.2V. Returns OK or FALSE.
PARA:THREEPHASE:CONNECT: _<NR2>	This command sets the connection mode for the three-phase system. The setting range is 0 ~ 1: 0 Three-phase, 4 Wire (Wye configuration) 1 Three phase, 3 Wire (Delta configuration) Returns OK or FALSE.
PARA:THREEPHASE:MODE: _<NR2>	This command sets the three-phase voltage output mode. The setting range is 0 ~ 1: 0 Three-phase voltage follows the master 1 Each phase voltage can be set individually Returns OK or FALSE.

Table 7-16: Master / Slave Programming Commands

7.2.2 Master / Slave Measurement Commands

Command	Description
PARA:MASTER:ALL?	This command queries all measurement parameters from the Master unit. Returns a comma-delimited string.
PARA:SLAVEA:VOLT?	This command queries the measurement of the slave 1 output voltage in volts RMS.
PARA:SLAVEA:CURR?	This command queries the measurement of the slave 1 output current in amperes RMS.
PARA:SLAVEA:POWER?	This command queries the measurement of the slave 1 output power in Watts (W).
PARA:SLAVEA:VDC?	This command queries the measurement of DC component of the slave 1 output in volts.

Command	Description
PARA:SLAVEA:ALL?	This command queries all measurement parameters from Slave A. Returns a comma-delimited string.
PARA:SLAVEB:VOLT?	This command queries the measurement of the slave 2 output voltage in volts RMS.
PARA:SLAVEB:CURR?	This command queries the measurement of the slave 2 output current in amperes RMS.
PARA:SLAVEB:POWER?	This command queries the measurement of the slave 2 output power in Watts (W).
PARA:SLAVEB:VDC?	This command queries the measurement of DC component of the slave 2 output in volts.
PARA:SLAVEB:ALL?	This command queries all measurement parameters from Slave B. Returns a comma-delimited string.
PARA:SLAVEC:VOLT?	This command queries the measurement of the slave 3 output voltage in volts RMS.
PARA:SLAVEC:CURR?	This command queries the measurement of the slave 3 output current in amperes RMS.
PARA:SLAVEC:POWER?	This command queries the measurement of the slave 3 output power in Watts (W).
PARA:SLAVEC:VDC?	This command queries the measurement of DC component of the slave 3 output in volts.
PARA:SLAVEC:ALL?	This command queries all measurement parameters from Slave C. Returns a comma-delimited string.

Table 7-17: Master / Slave Configuration Commands

8 Master Slave Operation

8.1 Overview

Two or more CPS100 power sources can be configured in one of three possible configurations:

- Parallel Mode   Max. no of units = 4   Increases output power & current
- Series   Max. no of units = 2   Increases output voltage
- Three Phase   Max. no of units = 3   Delta or Wye load applications

8.2 Restrictions

The following restrictions apply and should be considered at all times:

- **DO NOT** connect units in both series and parallel mode at the same time.

- **DO NOT** connect different models in series or parallel mode. All units must be the same model number.

- **DO NOT** exceed the number of maximum units listed above for each mode.

- Set up all Slave units first, then set up the Master in Master/Slave configurations.

- There can only be **ONE** Master unit in any Master/Slave configuration.

- Each Slave unit's number **MUST** be unique or the Master/Slave mode cannot be set.

8.3 Setting up a Unit as a Slave

Multi-unit configurations require the use of one or more Slaves. The first step to configuring a multi-unit system is to set up one more slave units. This done from the MAIN menu

Press the **Parallel / Series / 3-Phase** soft key to display the multi-unit menu.
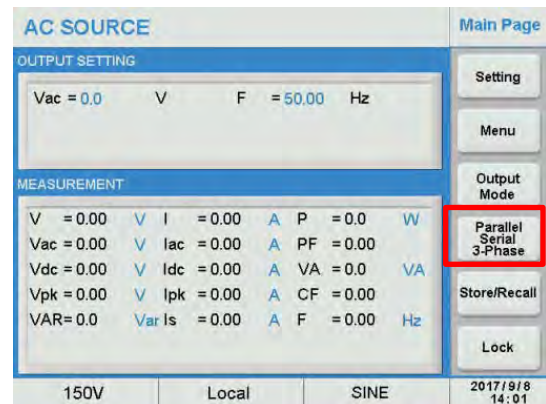
Move the cursor position to the Mode field in the top part of the screen.

Available unit modes are:

- Single   Stand-alone operation
- Master   Master unit
- Slave   Slave unit

From the drop down list, select the **Slave** entry and press the [Enter] key to confirm.

The **Slave Type =** field will now be visible.

The maximum number of slaves is three for parallel mode. For three phase mode, two slaves (Slave1 & Slave2) are required.

For Series mode, there can only be one Slave so Slave1 must be selected.

Note: For series operation of two units, the Slave Type setting **MUST** be set to Slave1.

Next, press the Set soft key to save the Mode and Slave type selection. This will lock this power source into Slave mode.

Note: The Slave unit can also be unlocked using the [.] key on the front panel.

Now press the Load soft key to load and display the saved settings for this slave unit.

Finally, press the Save soft key to store the Master-Slave mode setting to non-volatile memory. This unit is now ready to be used in a Master/Slave configuration. Slave units will keep their output **OFF** as they are controlled by the Master unit.

Note: NEVER change the connections and modes of Master and Slave units while in multi-unit mode operation as it could damage one of more units.
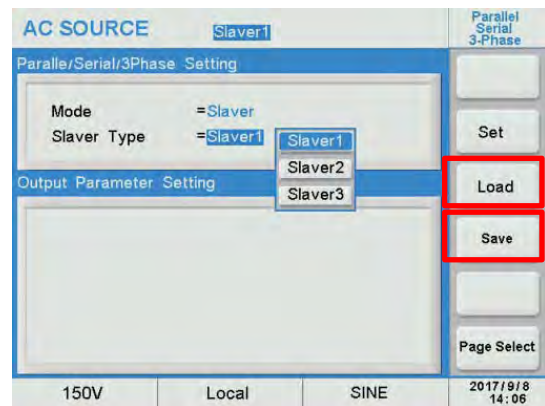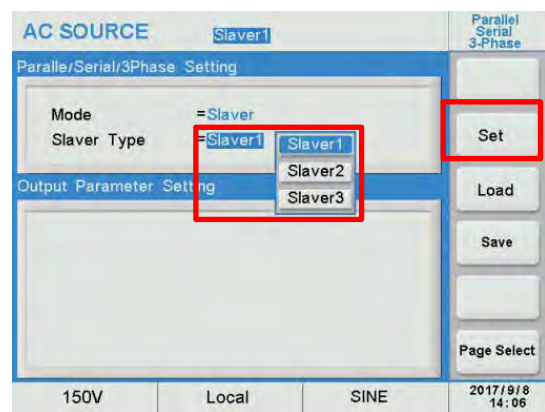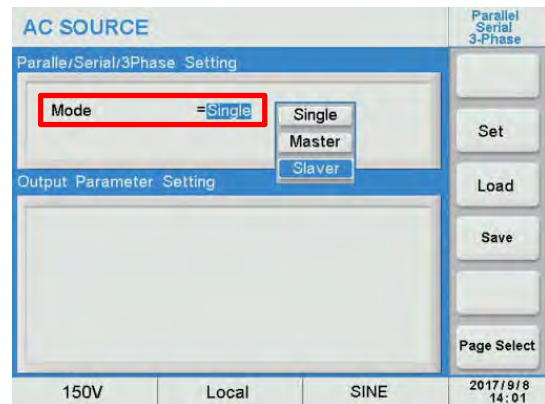
8.4 Setting up a Unit as a Master

Multi-unit configurations require the use of only one Master. After configuring the Slave(2), proceed with set up of the Master unit. This done from the MAIN menu

Press the **Parallel / Series / 3-Phase** soft key to display the multi-unit menu.

Move the cursor position to the Mode field in the top part of the screen.

Available unit modes are:

- Single   Stand-alone operation
- Master   Master unit
- Slave   Slave unit

From the drop down list, select the **Master** entry and press the [Enter] key to confirm.

The **Master Type =** field will now be visible.

The Master Type has three options:

- Parallel   Parallel mode for up to 4 units
- Series   Series mode for 2 units
- 3 Phase   Three phase mode for 3 units

Select the required mode of operation from this drop down list. In this example, Parallel mode.

Next, press the Set soft key to save the Mode and Slave type selection. This will lock this power source into Master mode.
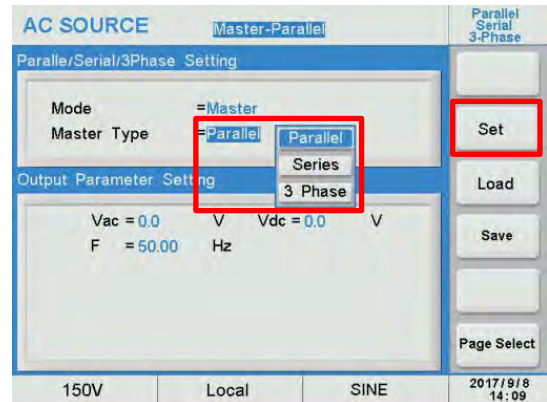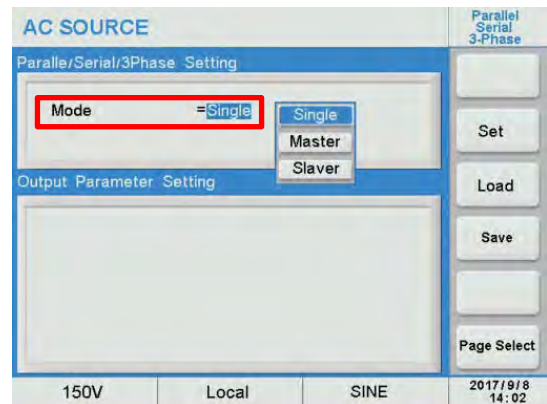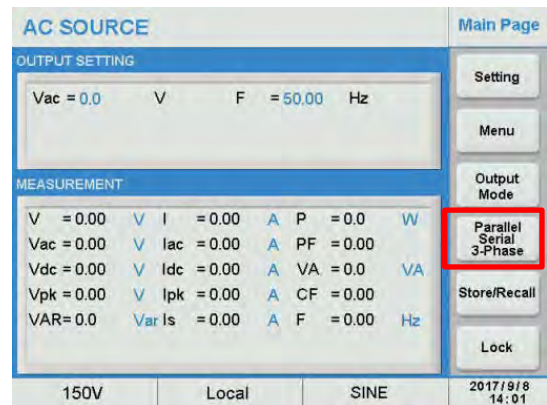
Now press the Load soft key to load and display the saved settings for this Master unit.

Finally, press the Save soft key to store the Master-Slave mode setting to non-volatile memory. This unit is now ready to for use in a Master/Slave configuration.

Note: NEVER change the connections and modes of Master and Slave units while in multi-unit mode operation as it could damage one of more units.

8.5   Multi-Unit Modes of Operation

This section shows how two connect two or more CPS100 power sources into a specific multi-unit configuration.

Note: Make sure each unit used is configured for Master or Slave operation before interconnecting them.

Note: For configurations consisting of 3 or more units, it is strongly recommended to use 3 phase mains input provided 230V~ Line-to-Neutral (Europe/Asia) or 208V~ Line-to-Line (US) which different phases feeding one unit. See diagrams on pages 183 through 187 for reference.

8.5.1   Parallel Mode System Use

For this configuration, there is one Master and up to three Slaves. In this example, only one Slave is used so there are 2 units. The Master unit must be set to Mode = Master, Master Type = Parallel as shown in the screens below.
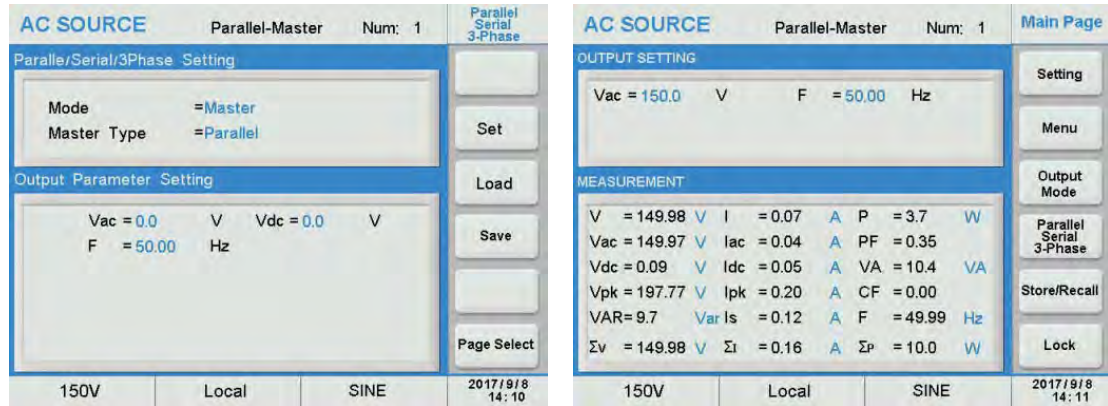
8.5.1.1   Parallel Mode Connection Diagram
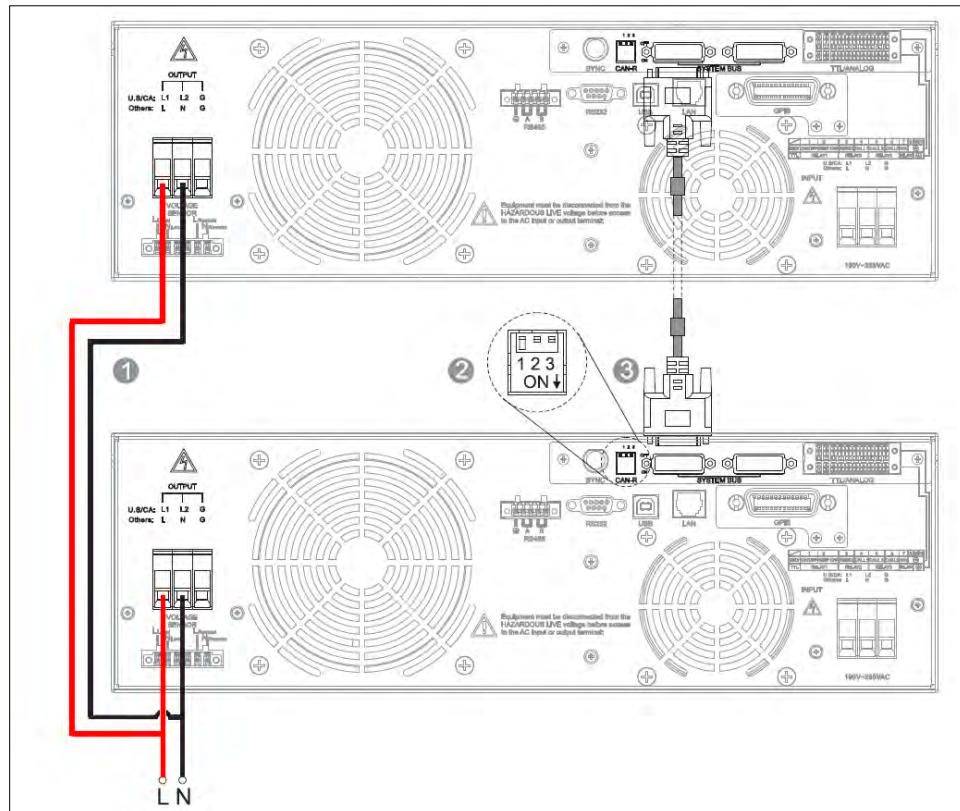
Call outs:

1. Output Connections
2. Termination resistor CAN-R, Flip Dip Switch 1 to ON Position (down)
3. System Bus Communication Cable

8.5.2   Series Mode System Use

For this configuration, there is one Master and only one Slave so there are 2 units. The Master unit must be set to Mode = Master, Master Type = Series as shown in the screens below.
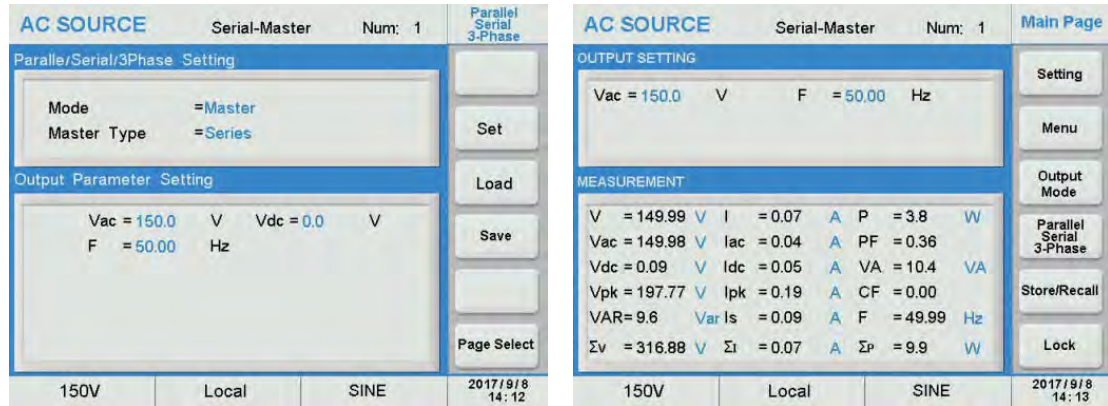
8.5.2.1   Series Mode Connection Diagram
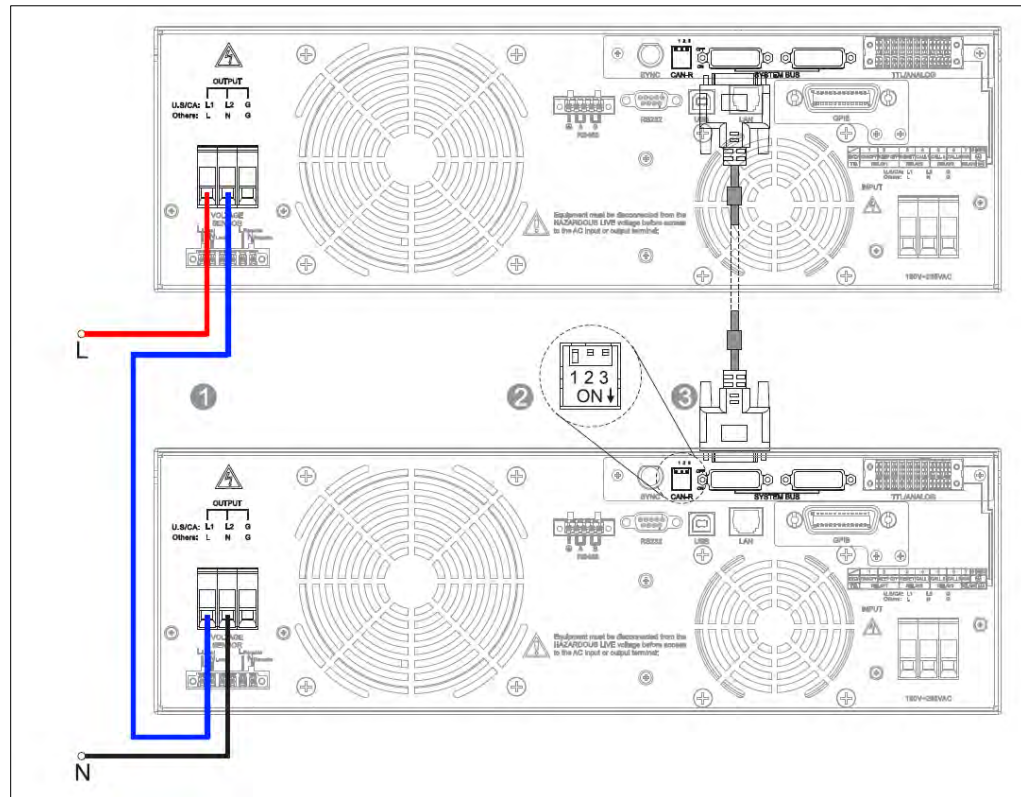
Call outs:
1. Output Connections
2. Termination resistor CAN-R, Flip Dip Switch 1 to ON Position (down)
3. System Bus Communication Cable

8.5.3   Three-Phase System Use

8.5.3.1   Output Wiring Configurations

The output of a 3-Phase system can be connected for three-phase, four wire (Wye configuration) loads or for three-phase, five wire (Delta configuration).

⚠ **3-PHASE CONFIGURATION NOTES:**

- **Phasing:** The Master unit is always phase A, Slave1 is always phase B and Slave2 is always phase C.
- Connect Mode: Connect Mode covers both Wye and Delta types.
- The output voltage of phase B and C will be set to the same settings as that for phase A (Master). Automatically if the Voltage Mode is set to **COM** (Coupled). If the Voltage Mode is set to **Multi**, phase B and C output voltage can be set individually (Uncoupled).
- The output frequency of phase B and C is always set to the same frequency as phase A. The phase difference between phase A and B is always 120° and between phase A and C is always 240°.
- Waveforms groups A and B can only be switched **AFTER** the system output is OFF.

For a 3-Phase configuration, there is one Master and two Slave so there are always 3 units. The Master unit must be set to Mode = Master, Master Type = 3-Phase as shown in the screen below.

8.5.3.1   Wye or Delta Measurements

The MAIN page measurement readings will differ between Wye and Delta output connections as the Wye measurements show Line-to-Neutral measurement readings whereas the Delta output connections show Line-to-Line measurement readings. The difference is shown in the screens below.
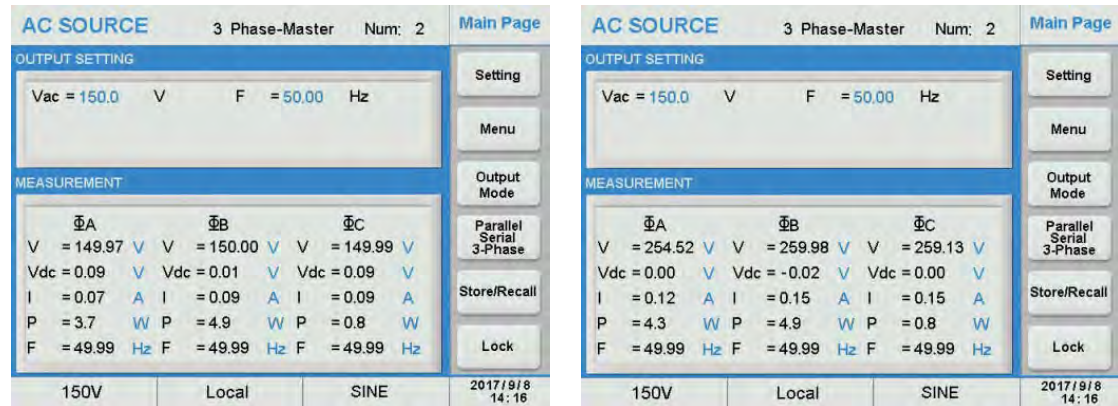
Figure 8-1: Measurement Readings Wye Configurations versus Delta Configuration

8.5.4   AC Input Wiring Configurations by Region

When using three CPS100 unit up to 1000W, it is possible to run all units from a single 230Vac phase grid connection in Europe or Asia. For US customers, it is not recommended to run all three units from a 115Vac grid connection due to grid current limitations of single phase outlets. For US customers, a 208Vac three phase delta input connection is recommended.

NOTE: DO NOT operate three CPS100 units on a US 480Vac three phase grid connection in either delta or Wye input configuration as the AC input voltage per unit CANNOT support 277Vac L-N or 480Vac L-L.

When using three CPS100 units at 2000W or higher, it is not recommended to use a single-phase AC input connection due to the high AC input current required for 3 units.

For **US** customers, a 3-Phase 208V Delta or Wye mains connection is required. Each CPS100 unit requires 208V Line-to-Line input using 2 of 3 phases. Make sure the three power sources are spread across all three phases.

E.g: Master – A-B / Slave A-C / Slave2 B-C.

For **Europe** and **Asia**, a 3-Phase 400V Wye mains connection is required. Each CPS100 unit requires 230 V Line-to-Neutral input, using a different phase for each unit.

E.g: Master – A-B / Slave A-C / Slave2 B-C.

8.5.4.1   1-Phase Mode Connection Diagram – 230 V~ 1ø AC Input

This configuration can only be used for 2U chassis size CPS100 models rated at 1500W or less and only in locales where the single phase grid voltage is 200Vac ~ 240Vac, e.g. Europe or Asia.
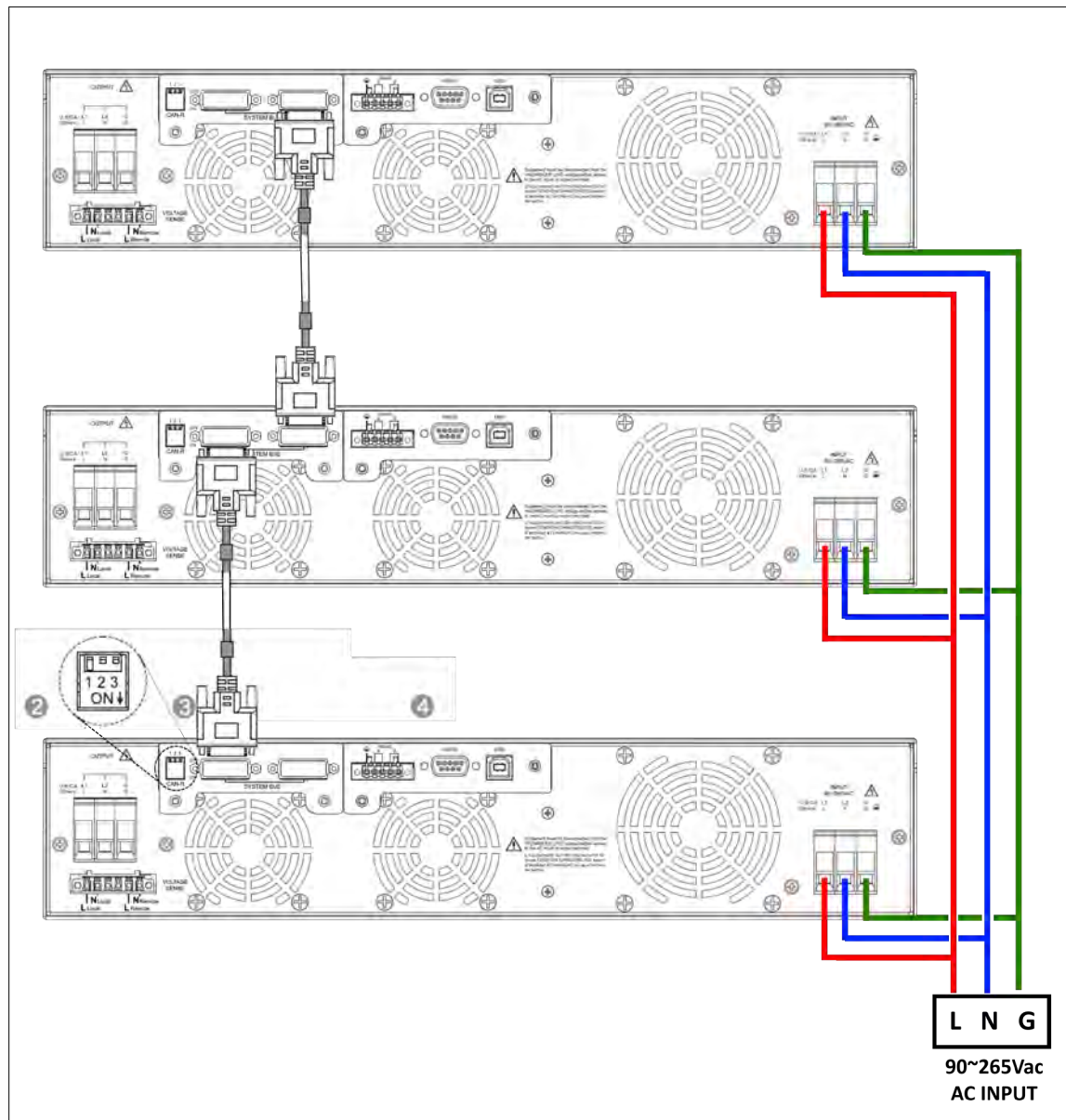
8.5.4.2 3-Phase Mode Wye (5-Wire) Connection Diagram – 208 V~ 3ø AC Input
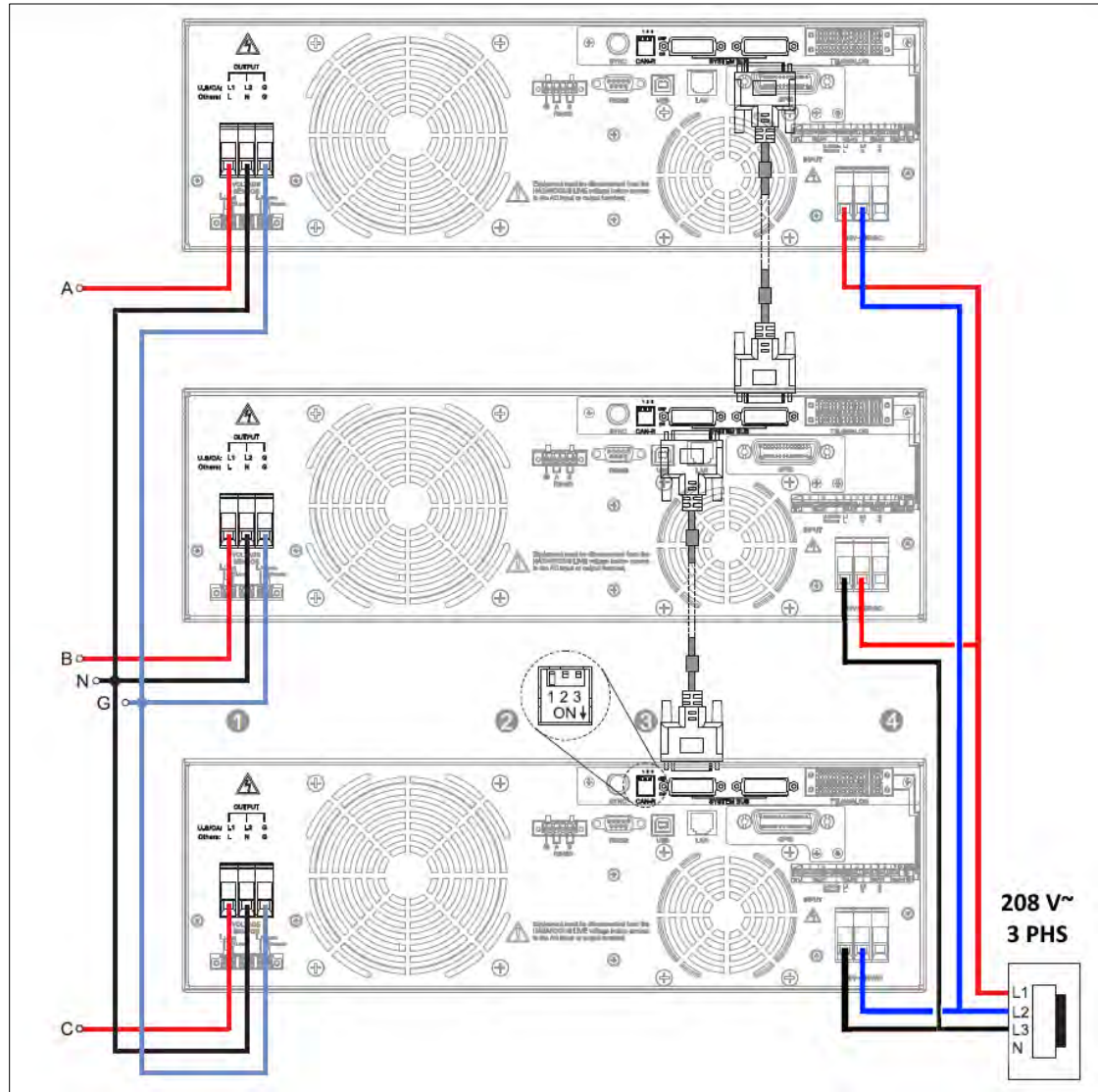
Call outs:

1. Output Connections- Wye 5 Wire
2. Termination resistor CAN-R, Flip Dip Switch 1 to ON Position (down)
3. System Bus Communication Cable
4. Only supports three-phase five wire connection

8.5.4.3   3-Phase Mode Wye (5-Wire) Connection Diagram – 400 V~ 3ø AC Input
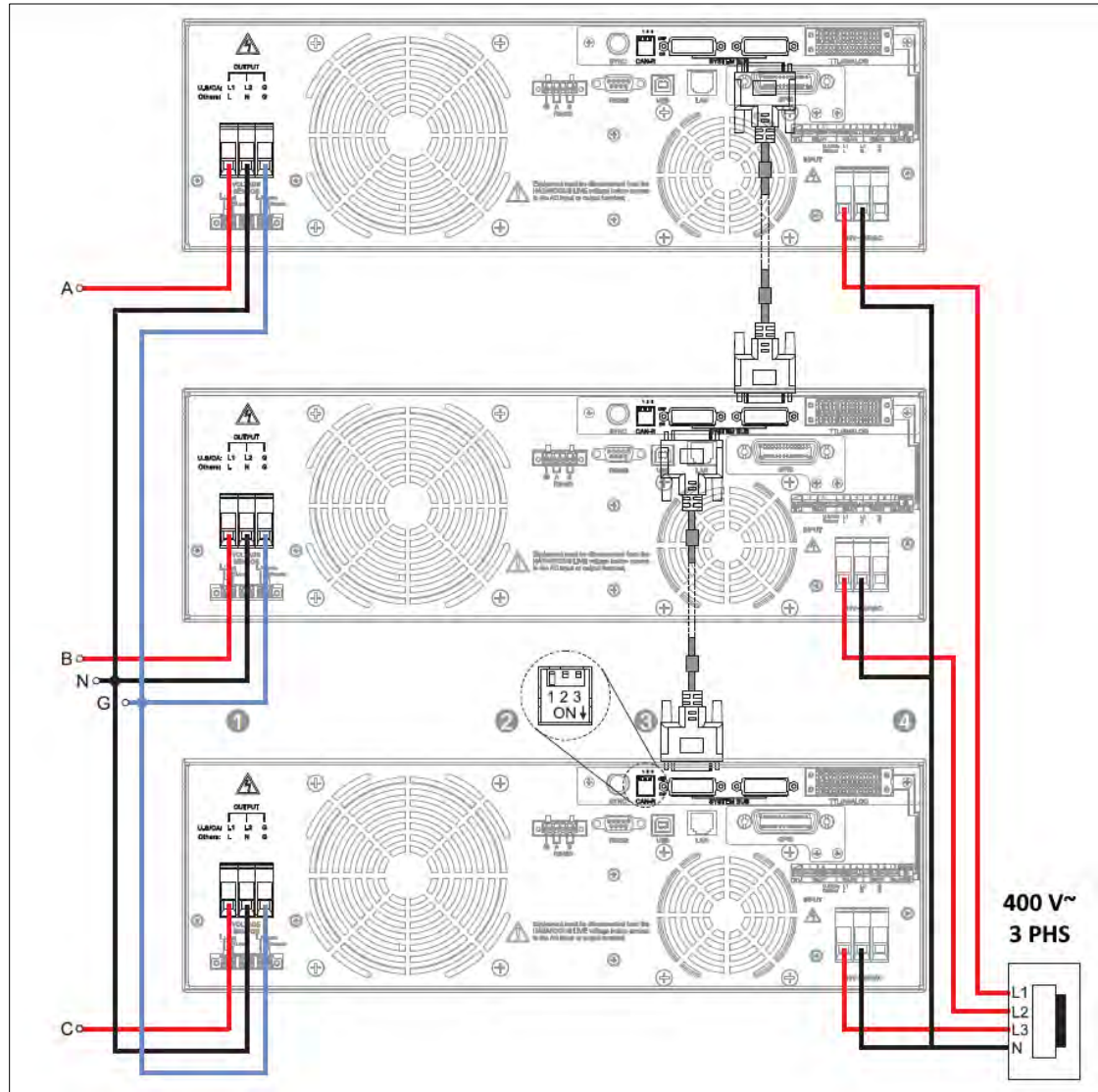
Call outs:

1. Output Connections- Wye 5 Wire
2. Termination resistor CAN-R, Flip Dip Switch 1 to ON Position (down)
3. System Bus Communication Cable
4. Only supports three-phase five wire connection

8.5.4.4   3-Phase Mode Delta (4-Wire) Connection Diagram – 208 V~ 3ø AC Input
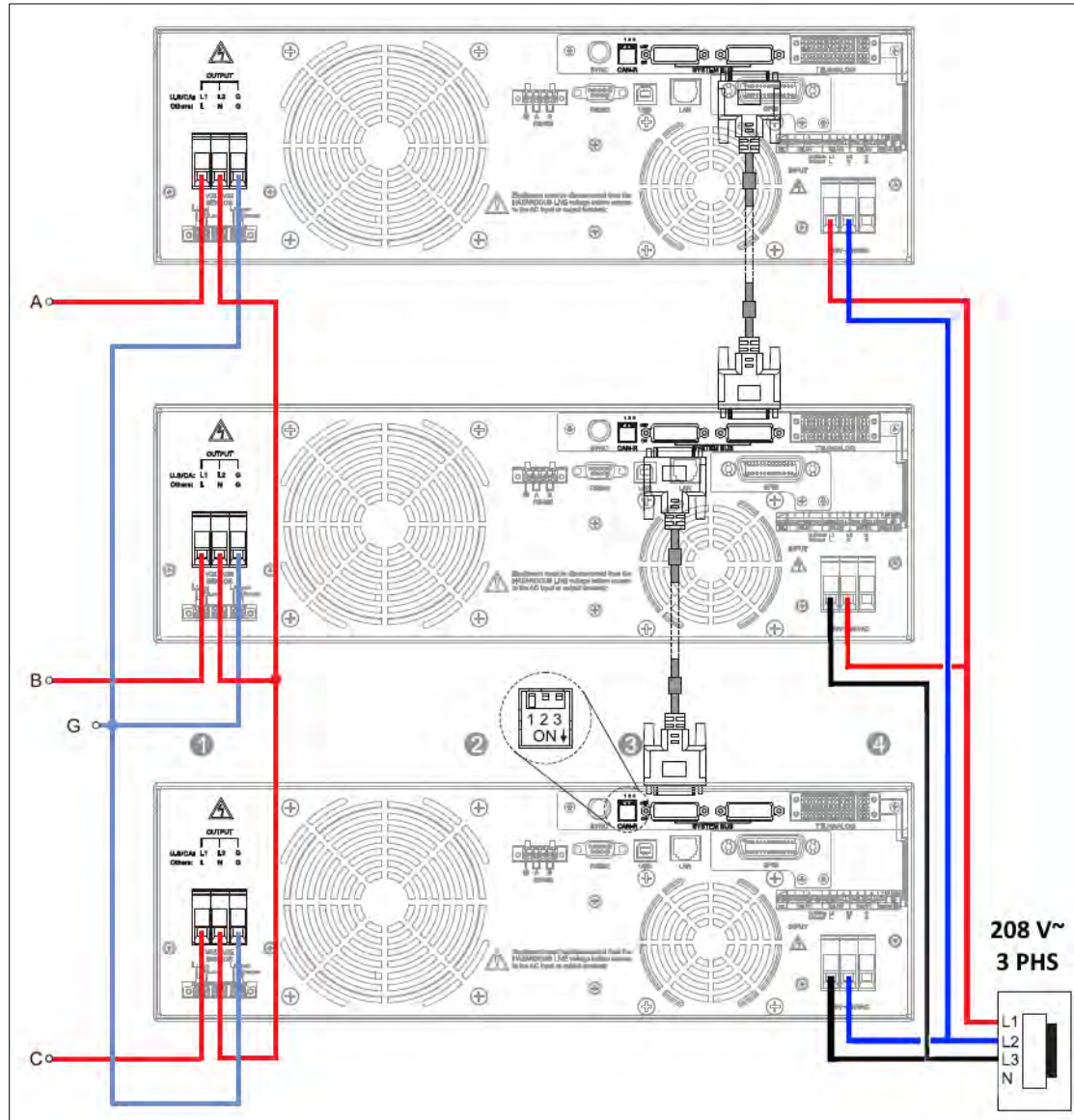
Call outs:

1. Output Connections- Delta 4 Wire
2. Termination resistor CAN-R, Flip Dip Switch 1 to ON Position (down)
3. System Bus Communication Cable
4. Only supports three-phase four wire connection

8.5.4.5   3-Phase Mode Delta (4-Wire) Connection Diagram – 400 V~ 3ø AC Input
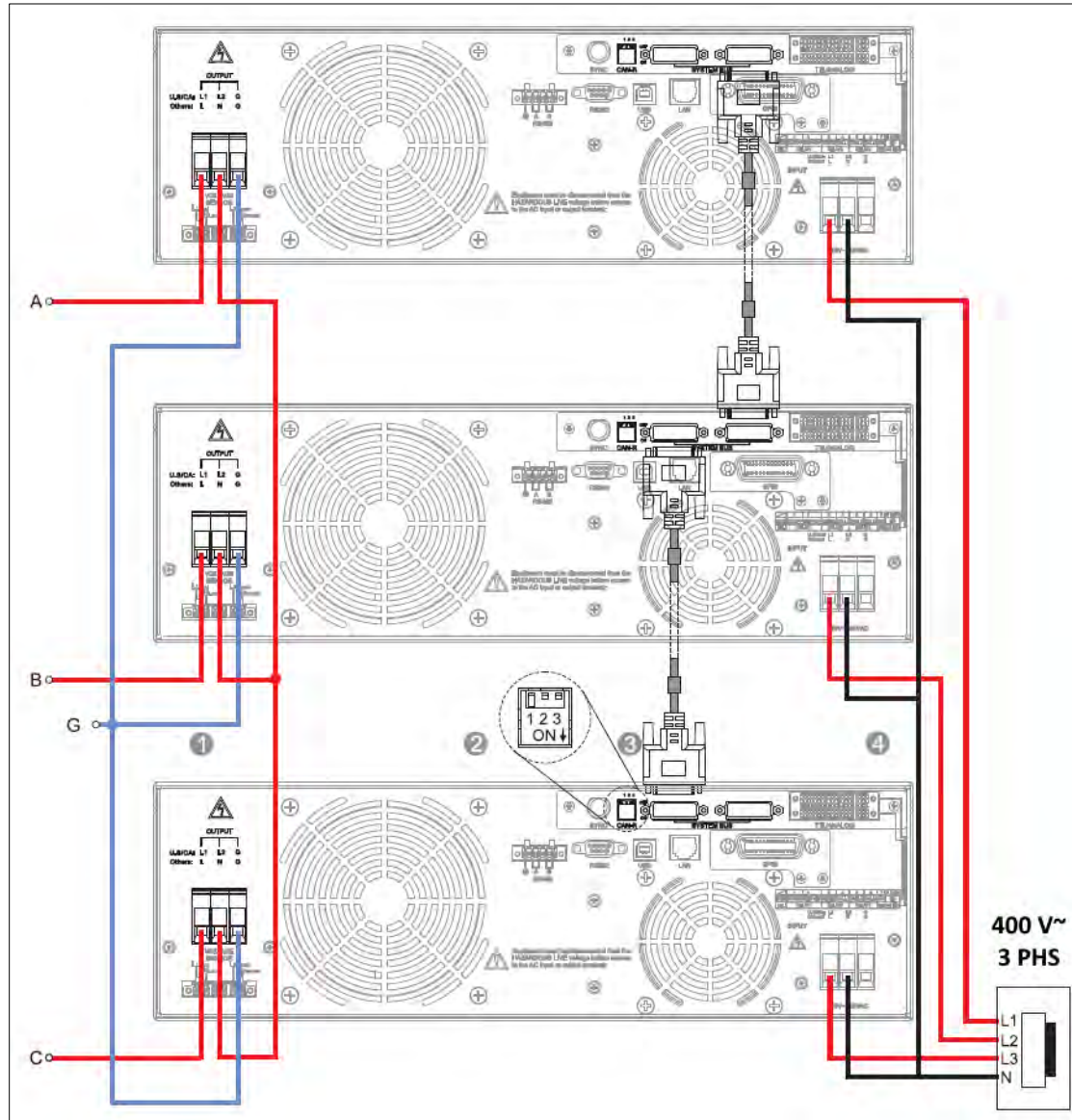
Call outs:

1. Output Connections- Delta 4 Wire
2. Termination resistor CAN-R, Flip Dip Switch 1 to ON Position (down)
3. System Bus Communication Cable
4. Only supports three-phase four wire connection

8.6 Multi-Unit Programming Instructions

Some front panel operations and menu operate differently when using multi-unit configurations. The table below provides and overview of the key differences between stand-alone mode (1 unit only) and any of the available multi-unit configurations.

Menu	Sub-Menu	Parallel	Series	3-Phase
Output & More	Waveform	Yes, Slaves in sync with the master unit		
	On Degree	Yes, Slaves in sync with the master unit	Applies to phase A only. Phase B &C will be shifted 120° & 240°	
	Off Degree	Yes, Slaves in sync with the master unit		
	Soft Start[1]	Yes, Slaves in sync with the master unit		
	Coupling	Yes, Slaves in sync with the master unit		
	Range	Yes, Slaves in sync with the master unit		
	Waveform Preview	Yes but only Master unit can display		
	Zo Program	Not supported		
Measure Setting	Irange	Yes, Slaves in sync with the master unit		
	Average	Yes	Yes	Yes
	Is Delay	Yes	Yes	Yes
	Is Interval	Yes	Yes	Yes
Waveform Viewer		Yes	Yes	Yes
Limitation		Yes, Slaves in sync with the master unit		
Config	Remote Control	Yes	Yes	Yes
	System Setting[2]	Yes	Yes	Yes
	External Control	Yes	Yes	Yes
	Protection	Yes, Slaves in sync with the master unit		
LCD Setting		Yes	Yes	Yes
Calibration[3]		Not supported	Not supported	Not supported
Other		Yes	Yes	Yes
Output Mode	PLD Testing	Yes	Yes	Yes
	Harmonics[4]	Yes	Yes	Not supported
	IEC Standard[5]	Yes	Yes	Yes
	Special Function	Yes	Yes	Not supported
	Test Mode	Not supported	Not supported	Not supported
Store / Recall		Yes	Yes	Yes

Table 8-1: Multi-Unit Programming Summary

Footnotes:
1. Soft Start includes Vac S/R, Vdc S/R and F S/R settings
2. O/P Relay function set as ON only available in single mode.
3. Calibration function only only available in single mode.
4. Harmonics function only available for the master unit.
5. Only IEC 61000-4-11 available for the 3-phase system.

9　USB Driver Installation

9.1　Overview

USB driver support for USB is available under Windows 10. The USB NI-VISA device driver can be downloaded from the Adaptive Power Systems website (www.adaptivepower.com) under Technical Resources.

The following are the driver installation steps.

9.2　USB Driver Installation

Before installing the USB driver, make sure the AC power source is on and found by the PC or laptop connected to it using a USB device cable. This will confirm that the connection is correct.

To open the Device manager, open Windows, Settings and use the search box to locate "Device Manager".
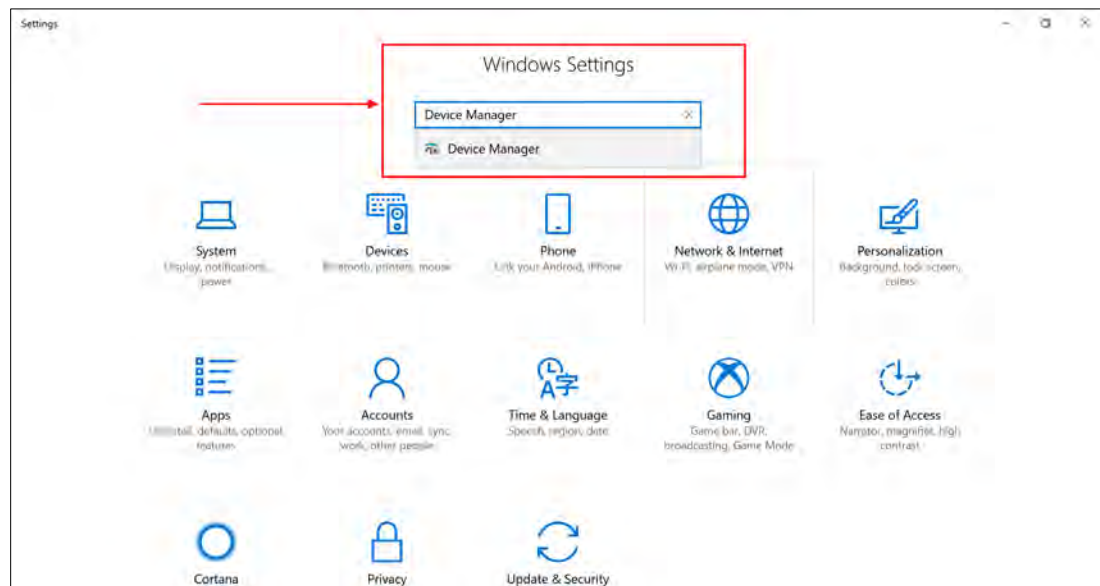
Open the device manager as shown below. Locate the "APM (R) SP USB2.0 Device" under the "Other Devices" category. See Figure 9-1 below.
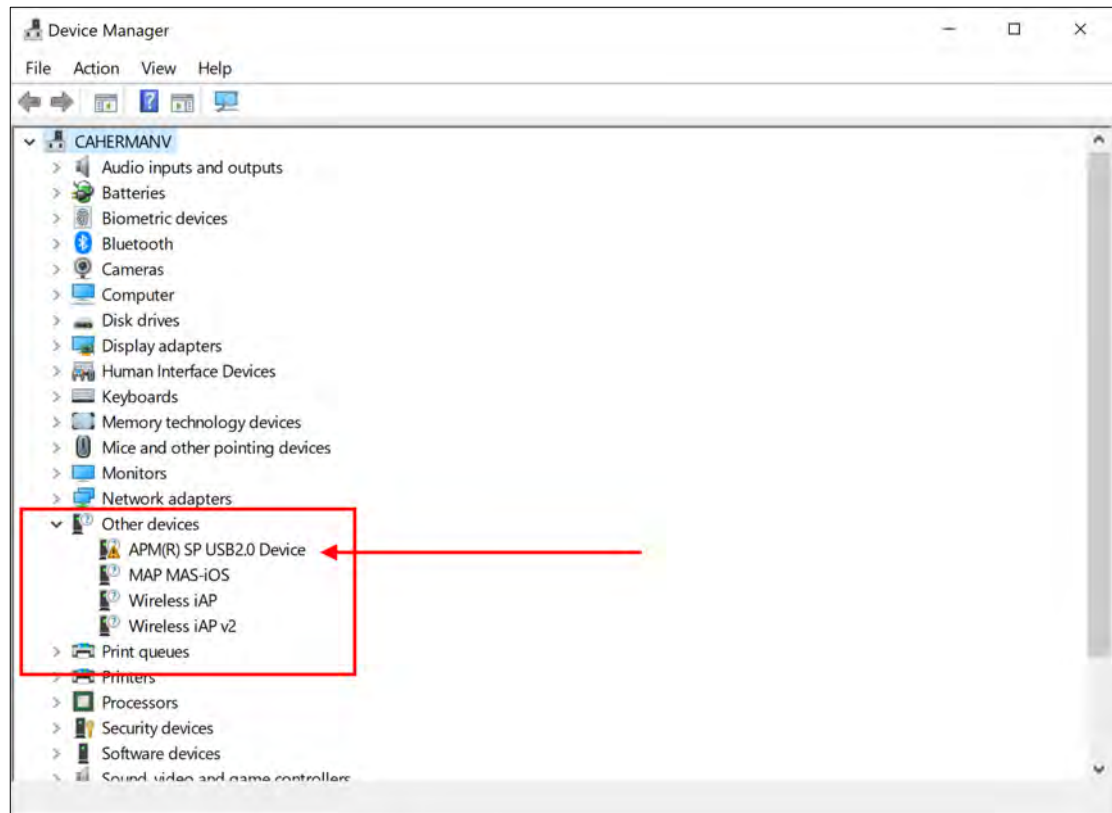
Figure 9-1: Device Driver, Other Devices, USB Entry

Right mouse click and choose "Update Driver Software" as shown below.

When prompted, select the Browse for driver entry as shown in Figure 9-2 below.
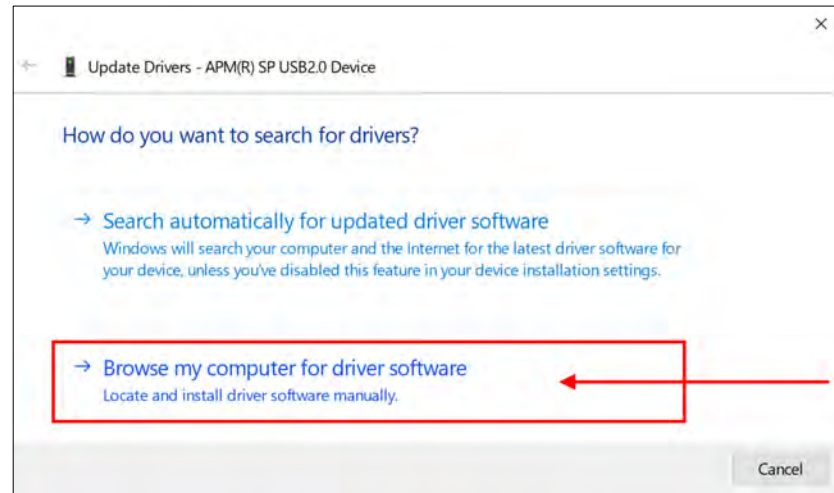
Figure 9-2: Driver installation prompt

A warning will appear regarding the driver software publisher verification. Select the second entry "Install this driver software anyway". See Figure 9-3.
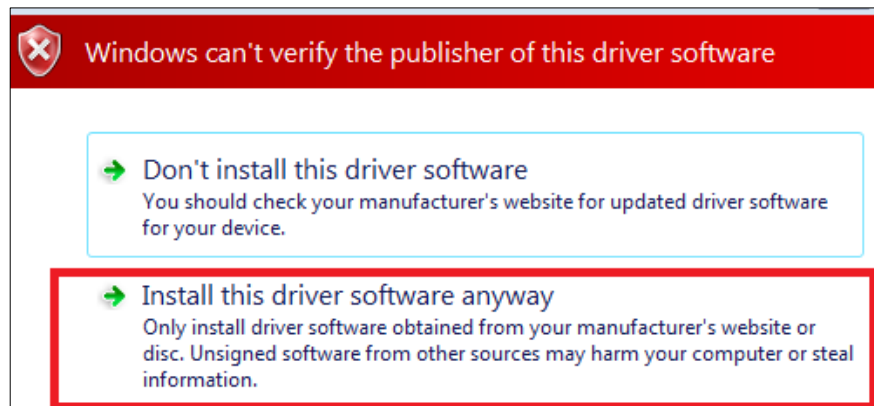
Figure 9-3: Driver Publisher verification Prompt

If instead of the dialog box shown above, you encounter an "Install Error" like the one shown here, you will need to disable your digital authentication mode in Windows 10 first. See section 9.3, "Disabling Driver Signature Enforcement in Windows 10" on page 194.
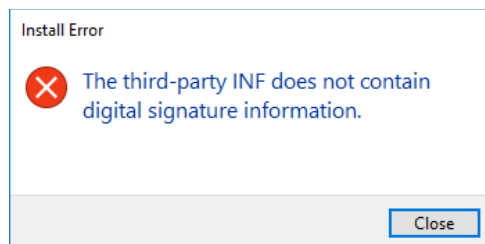
Wait for the driver installation to finish. The dialog shown below should appear when done.
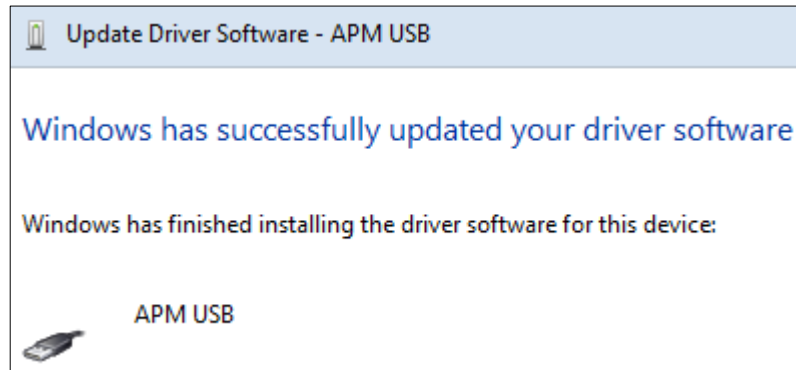
Figure 9-4: Driver Install Completed

The USB driver should now be visible in the Device Manager.
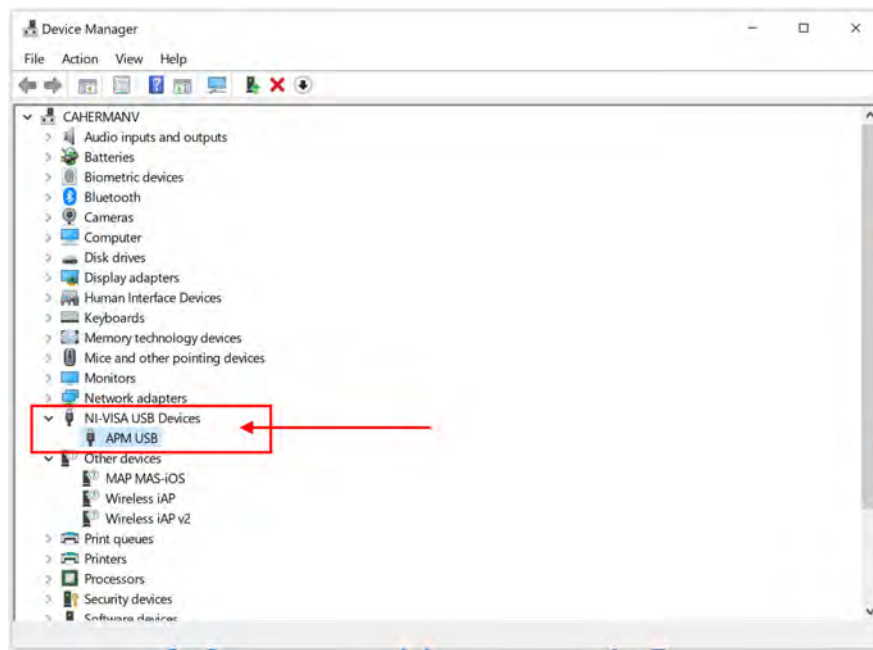
Figure 9-5: NI-VISA USB Devices entry for CPS100

9.3 Disabling Driver Signature Enforcement in Windows 10

If your Windows PC is configured for Driver signature enforcement, it will be necessary to temporarily disable this OS features to allow the CPS100 USB driver installation. One way to do so it use the Advanced Boot Menu. Follow these steps do so. Another option is to click on the lower left corner Windows symbol and select "Settings".
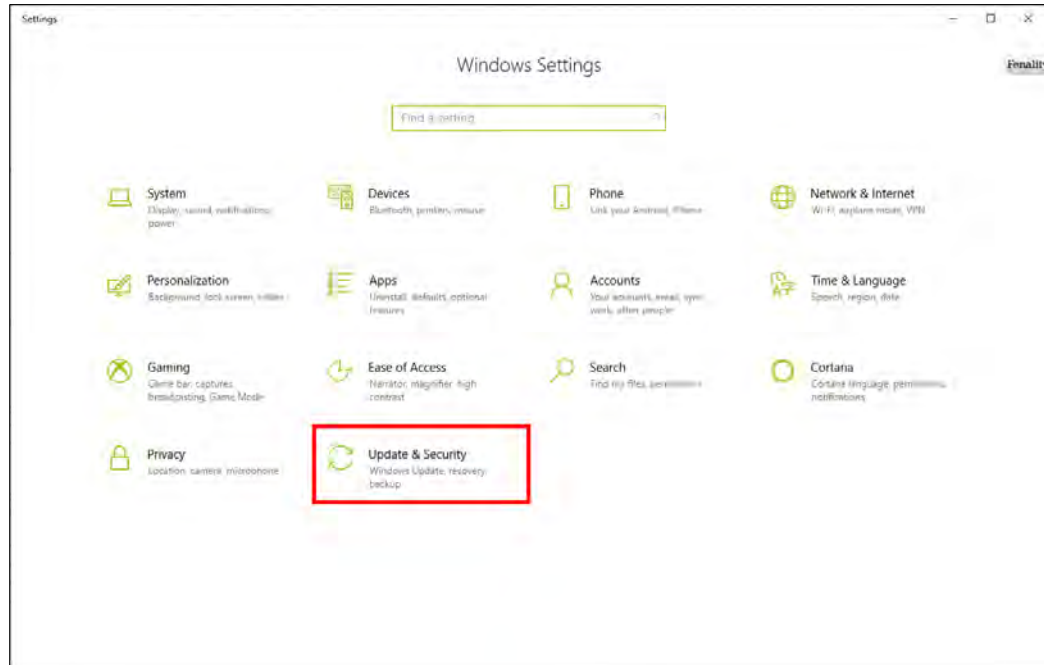
From the Setting menu, click on "Update & Security". This will bring up the following screen. Click on the "Restart now" button at the bottom under "Advanced startup" as shown below.
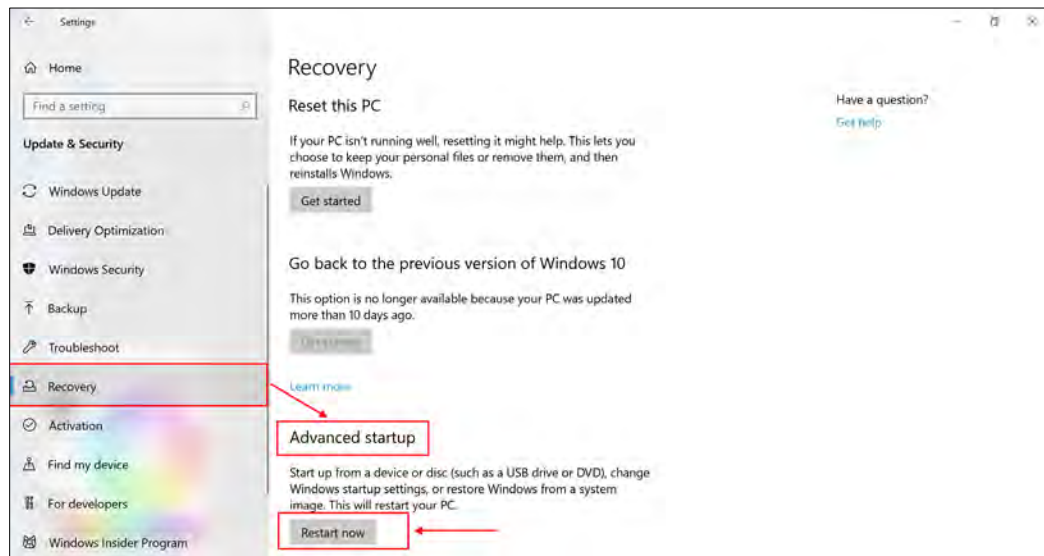
Either method will get you to the screen shown below. Now follow the steps outlined on next few pages.

1. Hold down the Shift key while choosing the "Restart" option in Windows. Your computer will restart with Advanced Options. From the list of options displayed, select the "Troubleshoot" tile.
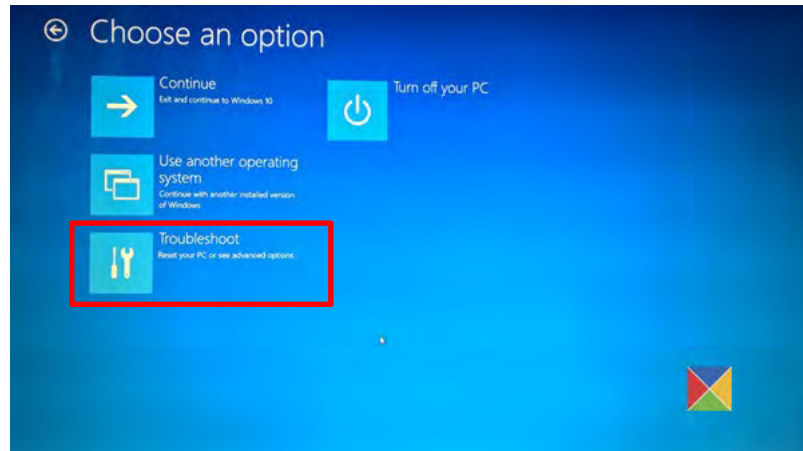
2. Next, select "Advanced options" and hit the "Startup Settings" tile.
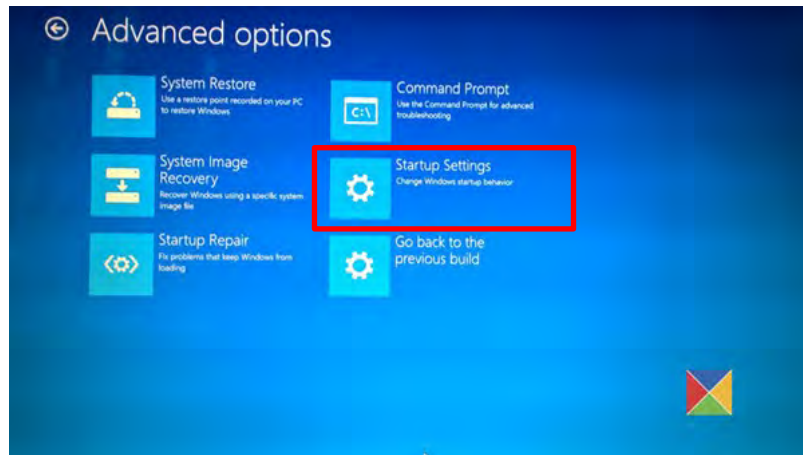
3. Next, select the "Restart" button to restart your PC on the Startup Settings screen.

4. You will see the following screen on restart. Press the number "7" keyboard key to activate the "Disable driver signature enforcement" option.
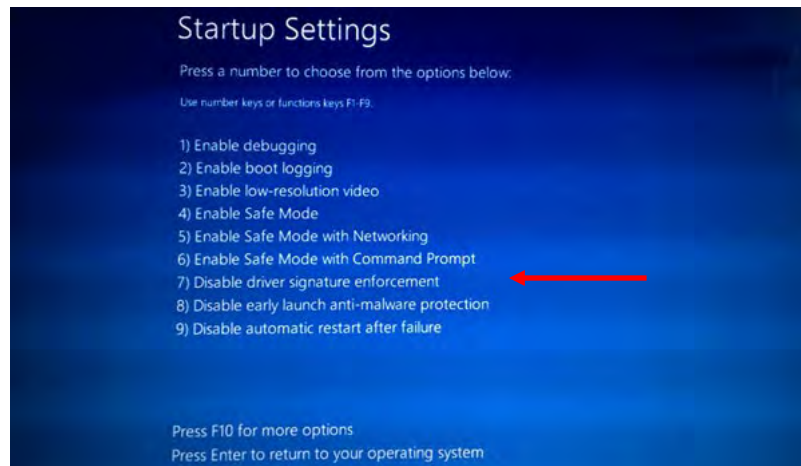
5. Once done, your PC will reboot with driver signature enforcement disabled, and you will be able to install unsigned drivers.

Return to Section 9.2, "USB Driver Installation" on page 190 to install the USB driver.

9.4   VISA Access using NI Explorer.

Once the USB driver is installed, the power source USB VISA interface should be accessible. You can check communication using the NI Explorer utility.

Make sure the CPS100 power source is powered on and connected via a USB cable to the PC. Launch NI MAX Explorer and select the "**Devices and Interfaces**" in the top left corner. The USB NI VISA device should be visible.

Locate the power source, right click with your mouse and select the "**Open VISA Test Panel**" entry to open the VISA Test Panel.
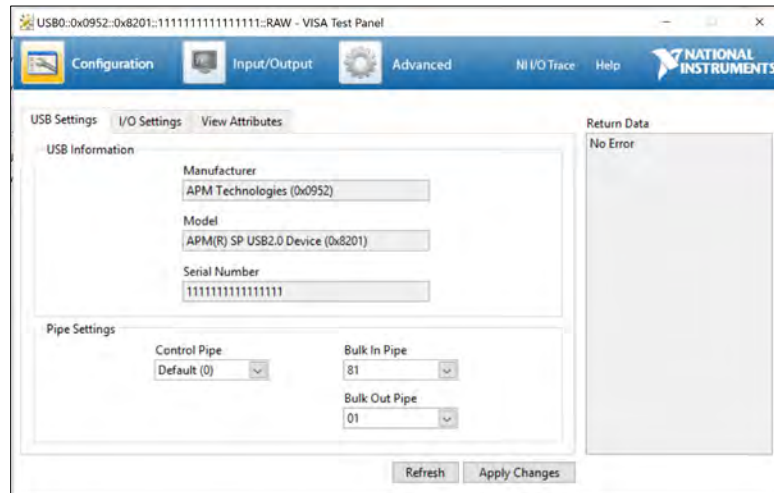
Use the Input/Output Tab to interact with the power source.
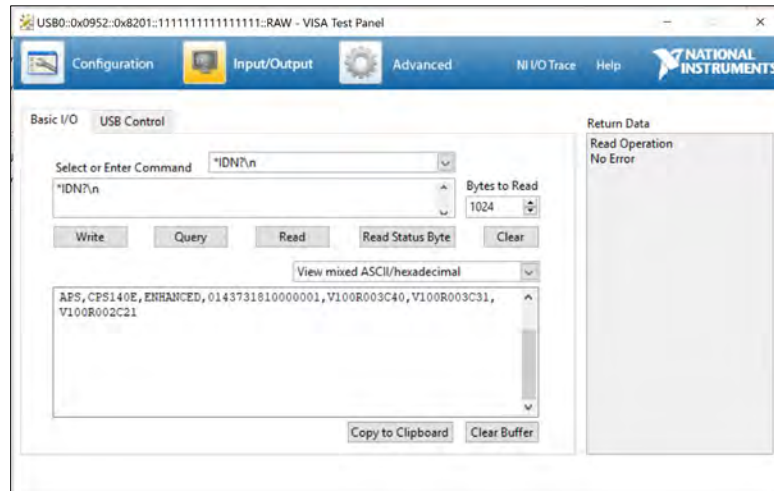
10 LAN Interface Configuration

10.1 Overview

This sections provides information on setting up a direct Ethernet connection to the power source.

Note following provisions that apply to the LAN interface:

- The CPS100 Series used UDP protocol over its LAN interface.

- The TCP/IP protocol is **not** supported.

- UPD protocol is not supported by National Instruments™ VISA.

10.2 Local LAN use

There are several situations where a user may want to avoid using a corporate LAN network when connecting a power source like the CPS100 Series. A direct LAN connection between the power source and a PC or Laptop using a RJ45 network cable eliminates the need for an actual network and avoids network security issues.

To do so, it is necessary to set up a static IP address on the PC. If the PC has a DCHP server, other network resources such as a WIFI device may lay claim to a previously used IP address lease.

10.2.1 Setting a Static IP address – Windows 10

To access network setting, right-clock on the Windows symbol in the lower left corner of the screen and select "Network Connections".
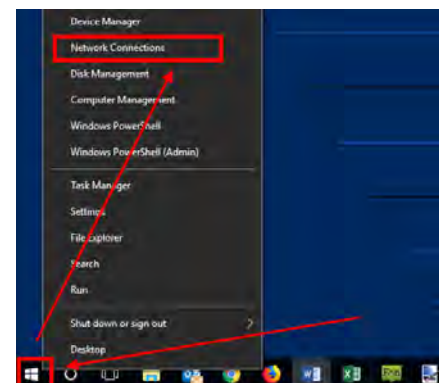
This will display the network-setting screen shown to the right.
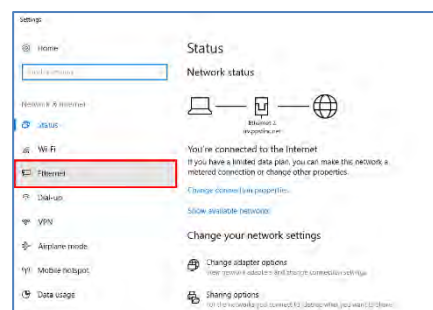
Under Related Settings, select "Change Adaptor" options. This selection may also appear on the right hand side of the screen on larger displays.
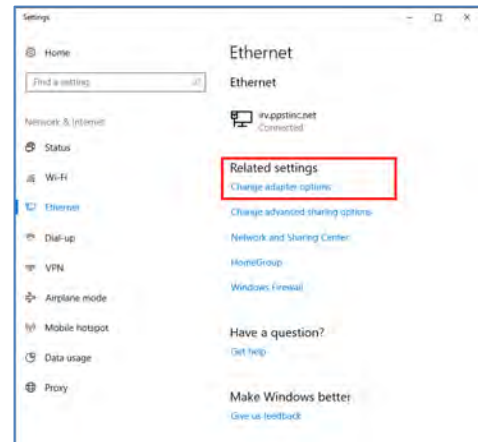
The Change Adaptor options screen will display all available network adaptors on you PC. Choose the regular LAN connector adaptor by right-clicking on it and selecting the RJ45 LAN port adaptor. In this example, it is "Ethernet 2".
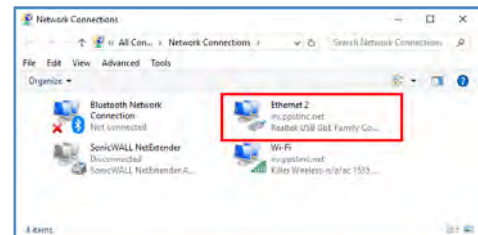
Right click on the connection and select "Properties".
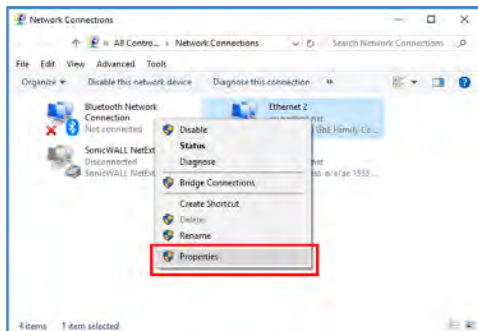
Select the "Internet Protocol Version 4 (TCP/IP) entry in the list as shown to the right.
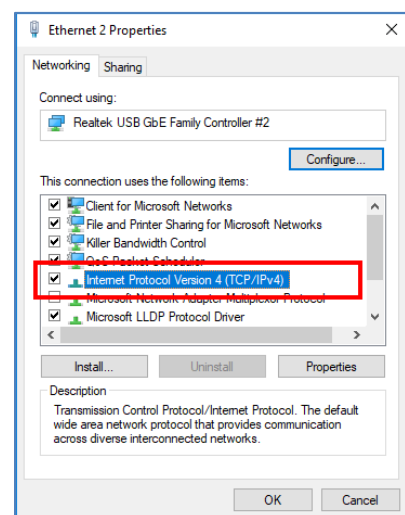
This will bring up the TCP/IP Setting screen shown here.

Select the "Use the following IP address:" radio button and enter the static IP address. Use a subnet mask as shown below and a default gateway that matches the IP address except for the last octet. Then click the OK button.

IP Address =   192.168.1.10
Net Mark =   255. 255.254.0
Gate Way =   192.168.1.1

Close the Network setting screens as the PC setup is now done.

Next we need to set the power source LAN configuration.

10.2.2 Setting a Manual Power Source IP address

For this purpose, we will use the default Manual Ethernet interface settings of the CPS100 Series.

IP Address =   192.168.001.100
Net Mark =   255. 255. 255.000
Gate Way =   192.168.001.001

10.2.3 Testing the LAN Connection

To test the LAN settings, proceed as follows:

1. Connect a CAT 5 RJ45 network cable between the PC or laptop and the power source LAN connector.

2. Open a web browser on the PC and type in 192.168.1.100, then press ENTER.

3. The power source should display its built-in web page as shown below. This confirms the LAN connection works.

10.3 LAN Web Server Use

When operating the power source over the Ethernet (LAN) interface, the built in web server can be accessed over the network using any mainstream web browser on PC, tablet or mobile phone.

The home page (or Welis the first page that will appear when entering the IP address of the connected power source in the browser address bar. A sample is shown below.

AC Source Control Panel

| Welcome Page | Brower Web Control | View & Modify Configuration | Help with this page |

Welcome to your

AC Source

Instrument	AC Source Control Panel
Model:	CPS120E
Serial Number:	0143571810000002
Control Version:	V100R003C48
Display Version:	V100R003C35
Remote Version:	V100R002C28
Description:	yyyyyyyyyyyyyyyyyyyyyyyyyyyyyyyyyyyyyyyy
Hostname:	yyyyyyyyyyyyyyy
IP Assress:	192.168.14.180
Mac:	00.04.A3.F1.00.61
VISA TCPIP Connect String:	-----#j--------
Type:	Enhanced

Figure 10-1: CPS100 Series Web server Home Page

The home page is for information display purposes only and has no user accessible fields or controls. It shows information on model, serial number, firmware versions, IP address set and MAC address.

At the top of the Home page are four controls including the "Welcome Page" control. They are:

Welcome page		See Page
Welcome page	Displays Home Page	202
Browser Web Control	Used to configure LAN settings	204
View & Modify Configuration	Used to control power source settings and display measurement read back data	205
Help with this page	Basic information about the power source	207
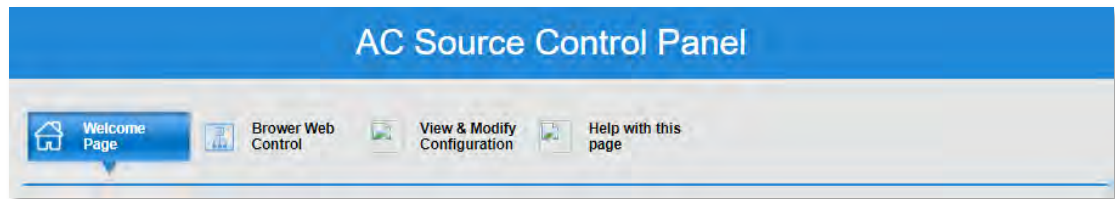
The three control screens are covered in the following sub-sections.

10.3.1 Browser Web Control

The Browser Web Control page is shown here.

Figure 10-2: Browser Web Control Page

It contains the following current and possible new setting values for the LAN interface. Current setting value for LAN control are shown in the center column under the "Current Setting" header. Any changes can be made under the "New Setting" header in the third column.

10.3.2 Recommendations for LAN settings:

- If you are connecting the power source through your company Ethernet, contact your network administrator or IT support department to assist in setting appropriate LAN setting for your network.

- In the interest of safety, we recommend using a Static IP address (Select **Manual** setting for "Obtain IP Address"). This prevents accidental access to a unit at a different IP address if the dynamic assigned address lease expires. It also ensures the power source and always be found the same IP address. Refer also to section 10.2, "Local LAN use" on page 198.

- Using a Manual IP address (Static) a requires setting of the desired IP address, Gateway and Network mask as seen in Figure 10-2 on page 204.

10.3.3 View & Modify Configuration

The View and Modify configuration page offers a means to change most settings on the power source and view the measurement values – if the output is ON. This page has a short form where only Vac, Frequency and Vdc settings plus all measurements are displayed so no scrolling in your browser windows is typically needed. The short form version of this page is shown below.

Figure 10-3: View & Modify Page - Short Form

Note: Any changes to Vac(V), F(Hz) and Vdc(V) you make will not be sent to the power source till the green ON button is pressed. (see figure above).

Note: On some firmware versions, the front panel LCD may not display updated setting for all parameters.

The longer version can be displayed by pressing the **MORE** button directly below the output setting area. See Figure 10-4 below.

Figure 10-4: View & Modify Page - Long Form

The long form screen allows all other settings the be viewed and changed as needed. This includes voltage ranges, output modes, waveforms, slew rates, user limits, protection limits, start and stop phase angles etc.

On Enhanced models, programmable impedance can selected and set as well.

To return to the Short form page, press the LESS button located towards the bottom of the screen just above the Measurement section.

10.3.4   Web server Help Page

The Help page contains basic information about the power source. Its present contents is shown in Figure 10-5 below.

Figure 10-5: Web Server Help Screen Contents

11 Calibration

11.1 Overview

All Adaptive Power Systems' instruments are factory calibrated prior to shipment. The recommended calibration interval for CPS100 Series instruments is one year (every 12 months).

11.2 Calibration equipment required.

The following equipment is required to perform calibration on any of the CPS100 Series power sources.

Item	Type	Range	Suggested Make & Model
1	DMM	300 Vac RMS min.	Keysight, Model 34465A Digital Multimeter, 6½ Digit https://www.keysight.com
2	Precision Current Shunt	50 Arms[1], 0.01 Ohm	Precision Shunts, Model CS-50, 0.01W, 0.01% (or equivalent http://www.ohm-labs.com/precision-shunts/cs-20-50.html
3	Adjustable Resistive or Programmable Load	240V min.	Adaptive Power Systems, Model 3C, AC & DC programmable load or equivalent.. https://adaptivepower.com/products/ac-dc-loads/3c-series/

Table 11-1: Required Calibration Equipment List

Note 1: For lower power models, a suitable smaller precision shunt may be used.

11.3 Calibration Equipment Setup

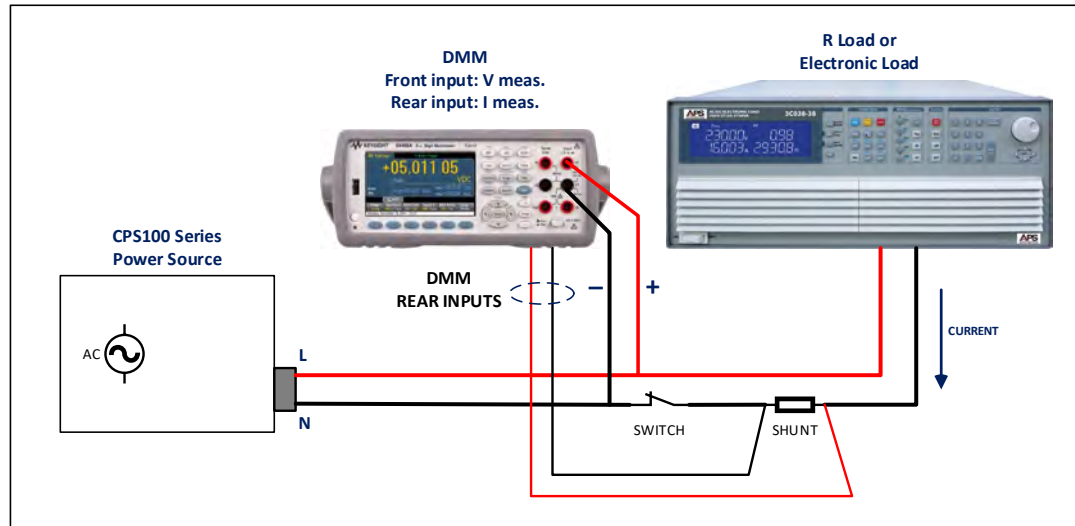The calibration equipment must be connected as shown in the diagram below.

Figure 11-1: Calibration Equipment Setup

Notes:

1. The DMM is used for both voltage and current measurements, requiring the operator to switch between front and read inputs. Alternatively, a second DMM may be used for current measurements instead if this is preferred.

2. The switch shown is used to disconnect any load when performing voltage calibrations.

11.4 Calibration Procedure

The power source can be calibrated from the front panel. There are no manual calibration adjustment inside the unit so there is no need to remove the top cover.

The following items require routine calibration:

- Output Voltage Setting
- Voltage Measurement
- Current Limit Setting
- Current Measurement

The user can perform his own calibration if needed. For traceability, it is recommended a calibration lab perform these calibrations.
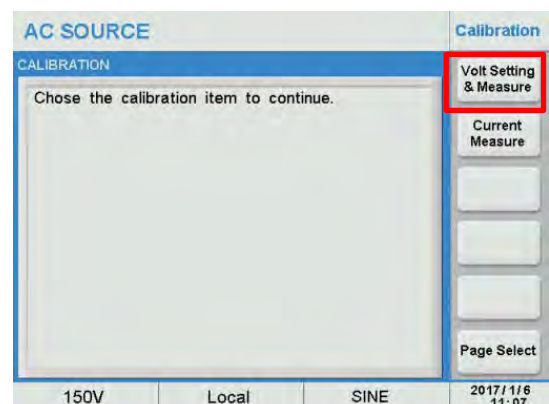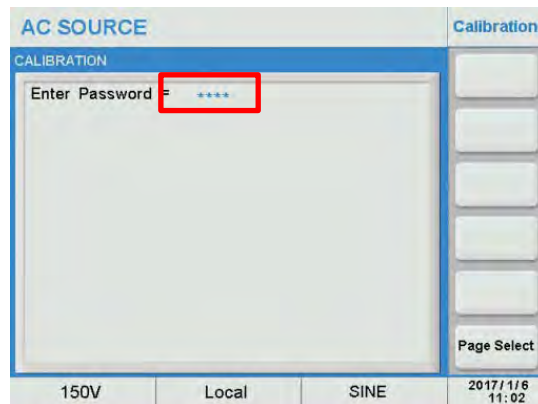
11.4.1 Accessing Calibration Mode

The Calibration screens are located under the MAIN menu. Press the MAIN key to display the MAIN menu.

Press the **Calibration** soft key to display the calibration password screen.
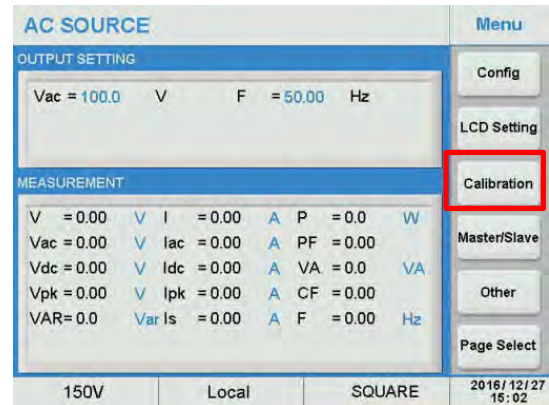
Move the cursor to the "Enter Password" field and enter the number "9527" as the password. Press the [Enter] key to confirm.

You will now be able to select either the Voltage Setting & Measurement or the Current Measurement calibration screens.
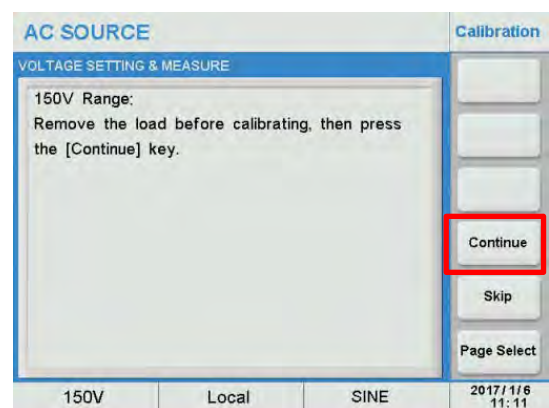
11.4.2 Voltage Setting & Measurement Calibration

Press the **Volt Setting & Measure** soft key.

The first calibration point is DC offset on the **150V** range.

Make sure there is NO Load at the output. Then press the **Continue** soft key.
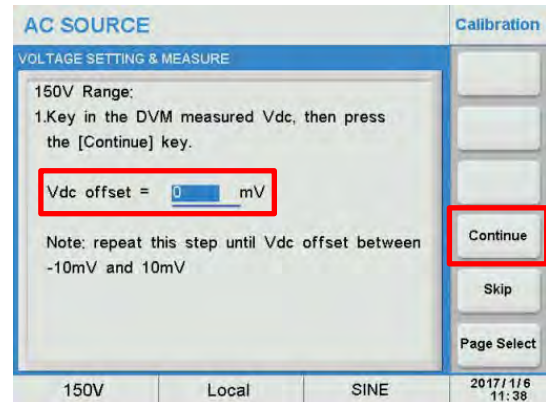
Set the DMM to VDC mode.

Move the cursor to the **Vdc offset** field.

Enter the DMM Vdc reading using the touch keypad or [0] ~ [9] keys, then press the [Enter] key to confirm.
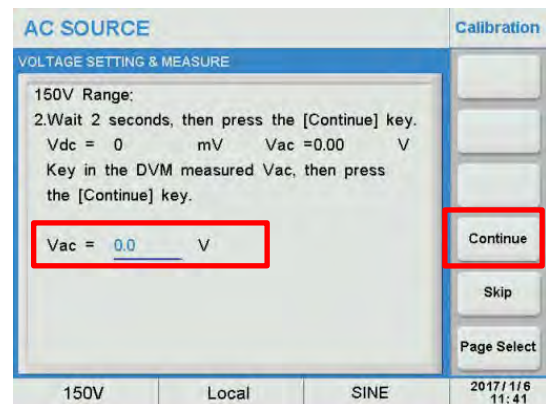
Repeat this step until the DMM reading is between -10 mV and +10 mV.

Wait 2 seconds, then press the Continue soft key to proceed to the next calibration point.

Put the DMM in mode.

Move the cursor to the **Vac =** field and enter the Vac reading using the touch keypad or [0] ~ [9] keys, then press the [Enter] key to confirm.

Follow the on-screen prompts to complete calibration the **150V AC range**. Both AC & DC output and AC & DC measurements are calibrated. This will require changing the DMM measurement functions as prompted.

Once completed, repeat the same process for the **300V AC range**.

11.4.1 Current Measurement Calibration

This menu is for calibration of the power source's current measurement functions. The power source uses up to four measurement ranges depending on model. Each range has two calibration coefficients. Follow the on-screen prompts to complete the complete calibration sequence for all ranges and coefficients.

Move the cursor to the "Enter Password" field and enter the number "9527" as the password. Press the [Enter] key to confirm.
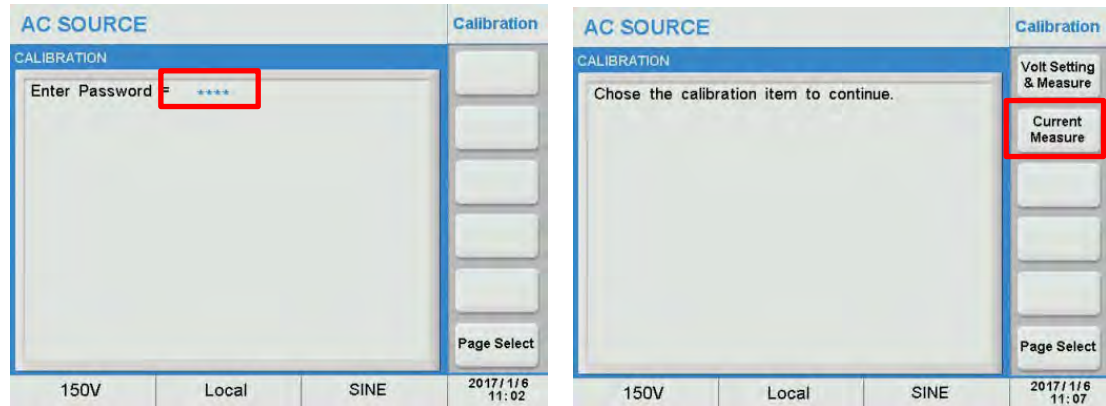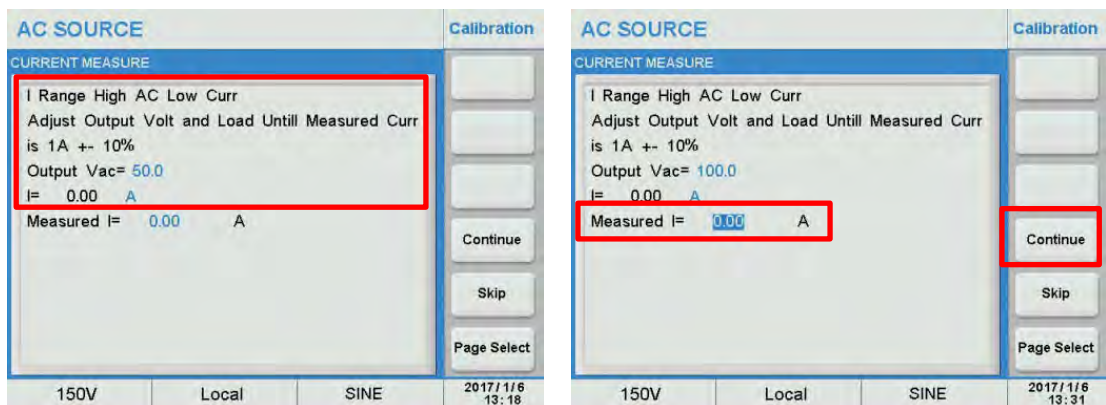

Press the **Current Measurement** soft key to display the calibration screen.

11.4.1.1 I Range High AC, Low Current coefficient

Make sure the load in connected (switch is closed) and adjust the AC voltage and load setting for a current of 1.0 Aac ± 10%. When using a programmable load, set the load to CC mode and program 0.01A. When using a resistive load, set the load for 50V/ 1A = 50 Ohms.

Highlight the **Measured I** field value, then enter the current reading from the DMM (select rear input terminals for current shunt AC voltage measurement). Based on the shunt value, calculate the current from the voltage and enter this value. E.g. for a CS-50 model 0.01 Ohm shunt, a 10 mVac measurement equals 1.0Aac. For a CS-20 model 0.05 Ohm shunt, a 50 mVac measurement equals 1.0Aac.
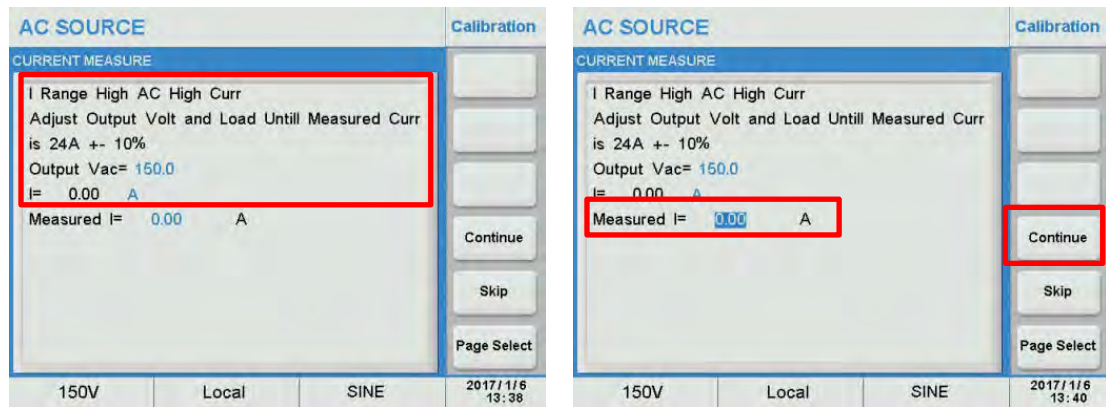

When done, press the **Continue** soft key to proceed to the next calibration coefficient.

11.4.1.2 I Range High AC, High Current coefficient

The next calibration point is for high AC current measurements. Adjust the programmable load to 24.0 Aac. Adjust the AC voltage on the source to 150Vac to support this current draw. When using a R Load, adjust the resistor value to 150V/24A = 6.25 Ohm or as close to it as possible and then adjust the voltage as needed to obtain 24Aac ± 10 %.

Note: Depending on the CPS100 model and max. current rating, the actual high current value may be different that shown in this example. Always follow the on-screen prompted current setting values.

Highlight the **Measured I** field value, then enter the current reading from the DMM (select rear input terminals for current shunt AC voltage measurement). Based on the shunt value, calculate the current from the voltage and enter this value. E.g. for a CS-50 model 0.01 Ohm shunt, a 240 mVac measurement equals 24.0Aac.
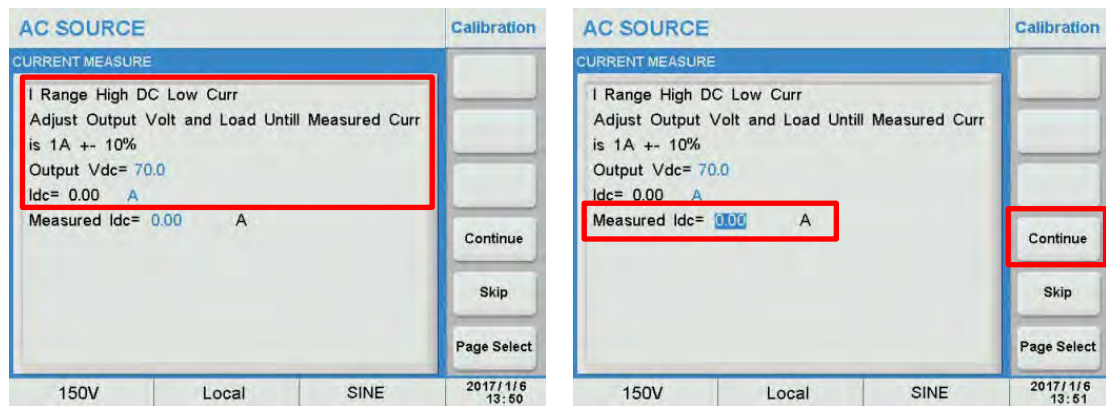

When done, press the **Continue** soft key to proceed to the next calibration coefficient.

11.4.1.3 I Range High DC, Low Current coefficient

The power source will now be in DC mode. Change the programmable load to DC mode..
Make sure the load in connected (switch is closed) and adjust the DC voltage and load
setting for a current of 1.0 Adc ± 10%. When using a programmable load, set the load to CC
mode and program 0.01A. When using a resistive load, set the load for 50V/ 1A = 50 Ohms.

Highlight the **Measured I** field value, then enter the current reading from the DMM (select
rear input terminals for current shunt DC voltage measurement). Based on the shunt value,
calculate the current from the voltage and enter this value. E.g. for a CS-50 model 0.01 Ohm
shunt, a 10 mVdc measurement equals 1.0Adc. For a CS-20 model 0.05 Ohm shunt, a 50
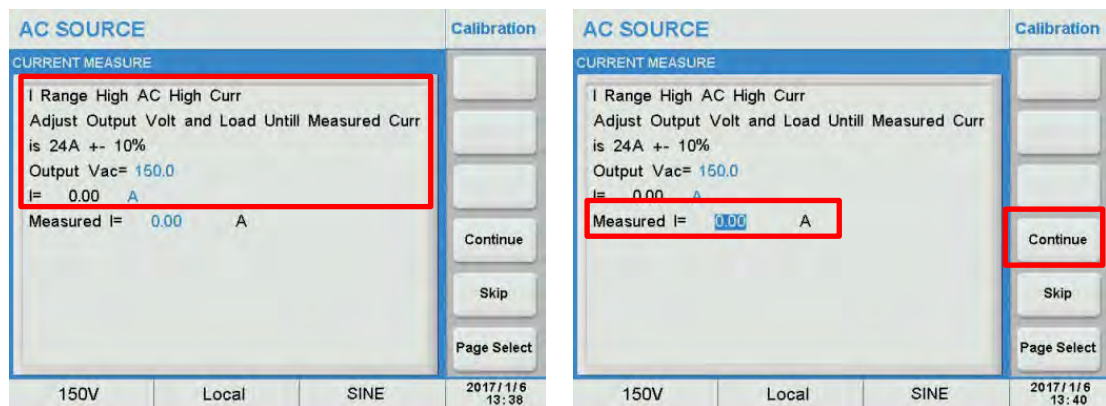mVdc measurement equals 1.0Adc.

When done, press the **Continue** soft key to proceed to the next calibration coefficient.

11.4.1.4 I Range High DC, High Current coefficient

The next calibration point is for high DC current measurements. Adjust the programmable load to 16.0 Adc. Adjust the DC voltage on the source to 212Vdc to support this current draw. When using a R Load, adjust the resistor value to 212V/16A = 13.25 Ohm or as close to it as possible and then adjust the voltage as needed to obtain 16Adc ± 10 %.

Note: Depending on the CPS100 model and max. current rating, the actual high current value may be different that shown in this example. Always follow the on-screen prompted current setting values.

Highlight the **Measured I** field value, then enter the current reading from the DMM (select rear input terminals for current shunt DC voltage measurement). Based on the shunt value, calculate the current from the voltage and enter this value. E.g. for a CS-50 model 0.01 Ohm shunt, a 160 mVac measurement equals 16.0Aac. For a CS-20 model 0.05 Ohm shunt, an 800 mVdc measurement equals 16.0Aac.

When done, press the **Continue** soft key to proceed to the next calibration coefficient.

11.4.1.5 Remaining Current Measurement Coefficients

Continue to follow the on screen prompts till the calibration process for Middle and Low current measurement calibration is complete.

Note: It is possible to **SKIP** any coefficient by press the **Skip** soft key if calibration is deemed not required for specific ranges.

11.5 Saving Calibration Coefficients

Once all calibration steps are completed, the user is asked to "Save Calib Data?

Press the **Yes** soft key to save the new coefficient values.

Note: Pressing No means the old calibration coefficient will be retained.
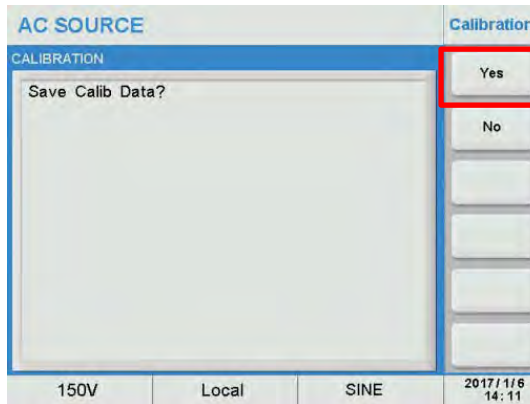
12 Fixed Waveform Library

12.1 Overview

The CPS100 Series power sources provide a built-in library of 30 waveforms that can be used in AC or AC+DC mode instead of a normal sine wave. These waveforms contain various higher order harmonics of the programmed fundamental frequency and allow product testing for immunity to voltage distortion conditions.

The FIXED waveforms are numbered from 0 through 29 and can be selected by Selecting the USER entry, pressing [Enter] to confirm and entering a number between 0 and 29 using the [0] ~ [9] keys.

12.2 Waveform Details

This summary shows the harmonic content of each FIXED waveform expressed in % of fundamental amplitude (relative) and phase shift with respect to the fundamental frequency F_0. A visual representation of the waveshape is shown as well for reference.
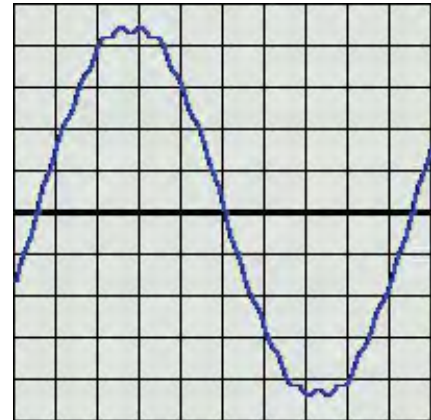
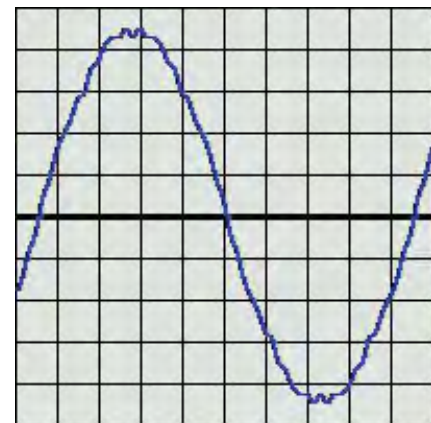### 12.2.1 FIXED Waveform No 0

Harmonic	% Ampl	Phase
5	9.8	0
7	15.8	0
8	2.16	0
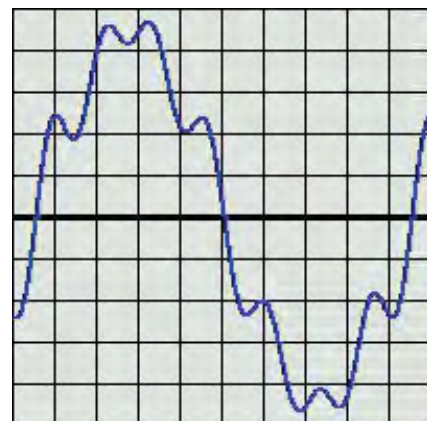
12.2.2   FIXED Waveform No 1

Harmonic	% Ampl	Phase
3	1.44	0
7	1.47	0
19	1.95	0

12.2.3   FIXED Waveform No 2

Harmonic	% Ampl	Phase
3	1.96	0
5	1.37	0
7	1.98	0
23	1.42	0
31	1.00	0

12.2.4   FIXED Waveform No 3

Harmonic	% Ampl	Phase
3	2.45	0
5	1.88	0
7	2.46	0
23	1.95	0
25	1.09	0
31	1.52	0
33	1.09	0
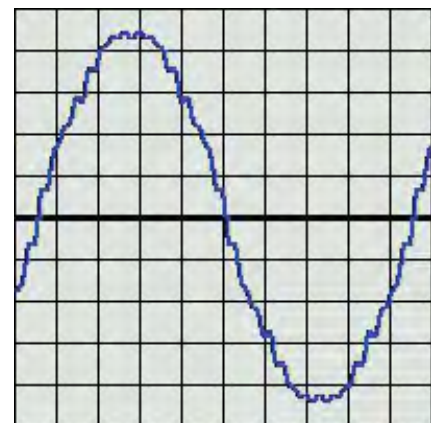
12.2.5   FIXED Waveform No 4

Harmonic	% Ampl	Phase
3	1.00	0
5	2.75	0
7	1.35	0
9	2.25	0
11	1.45	0
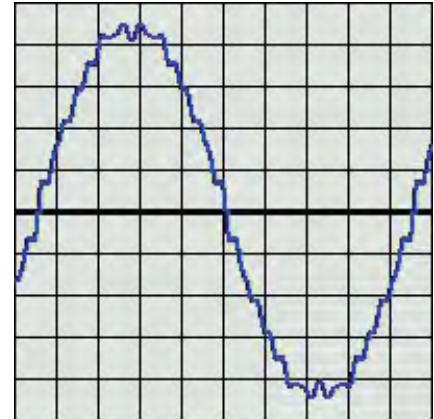
12.2.6   FIXED Waveform No 5

Harmonic	% Ampl	Phase
3	1.60	0
5	4.17	0
7	3.40	0
15	1.02	0
19	2.92	0
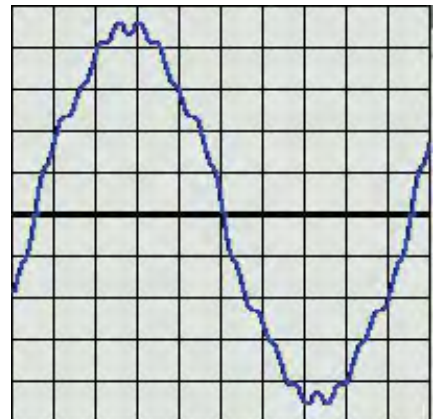
12.2.7   FIXED Waveform No 6

Harmonic	% Ampl	Phase
3	2.17	0
5	5.59	0
7	2.79	0
9	4.58	0
11	2.92	0
15	1.35	0
21	0.99	0
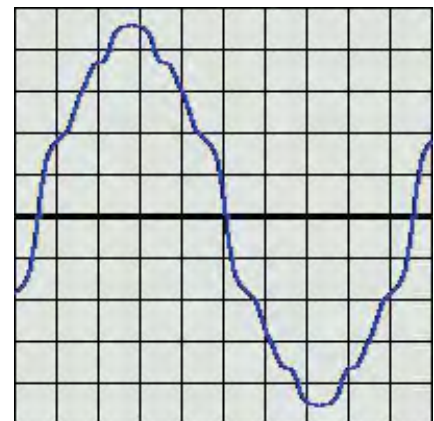
12.2.8   FIXED Waveform No 7

Harmonic	% Ampl	Phase
3	4.86	0
5	1.58	0
7	2.64	0
11	1.37	0
15	1.95	0
17	1.06	0
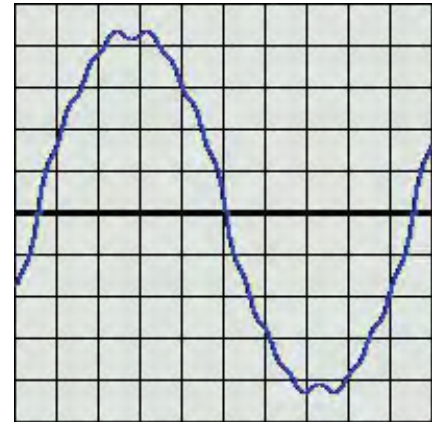
12.2.9   FIXED Waveform No 8

Harmonic	% Ampl	Phase
3	7.27	0
5	2.39	0
7	4.01	0
11	2.07	0
13	1.03	0
15	2.94	0
17	1.59	0
19	1.00	0
21	1.04	0
23	1.19	0
25	1.03	0
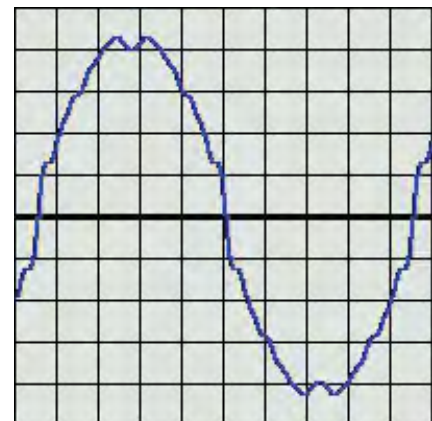
12.2.10 FIXED Waveform No 9

Harmonic	% Ampl	Phase
3	9.78	0
5	3.19	0
7	5.37	0
9	1.17	0
11	2.76	0
13	1.37	0
15	3.92	0
17	2.13	0
19	1.34	0
21	1.39	0
23	1.59	0
25	1.36	0
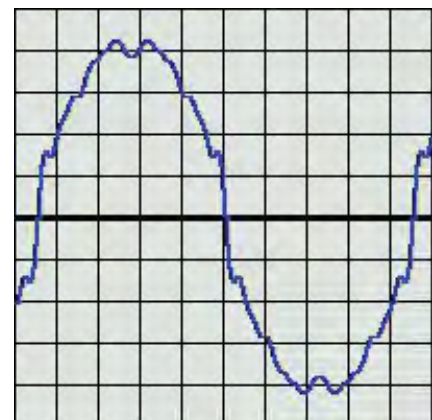
12.2.11 FIXED Waveform No 10

Harmonic	% Ampl	Phase
3	17.72	0
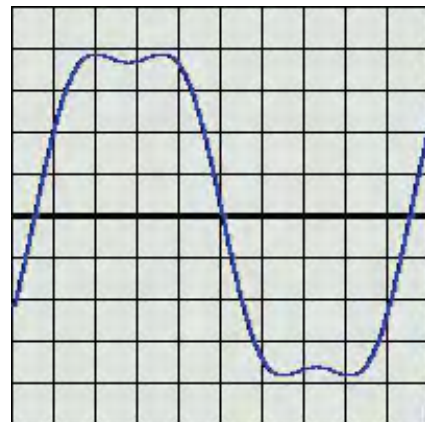
12.2.12 FIXED Waveform No 11

Harmonic	% Ampl	Phase
3	21.21	0
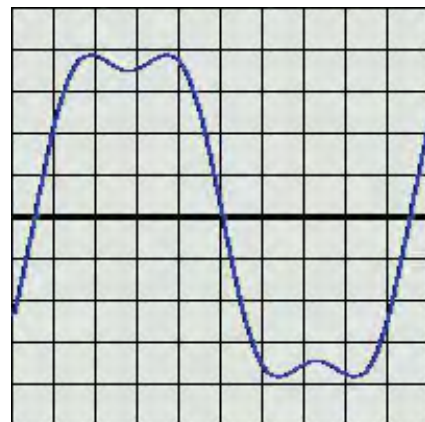
12.2.13 FIXED Waveform No 12

Harmonic	% Ampl	Phase
3	24.48	0
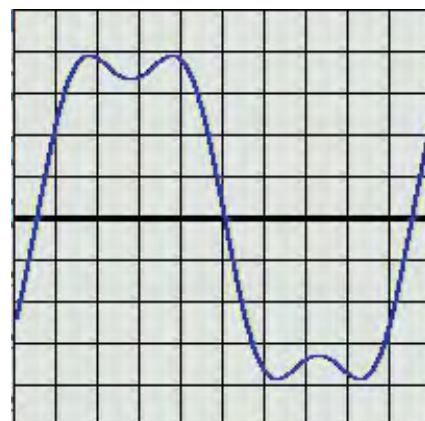
12.2.14 FIXED Waveform No 13

Harmonic	% Ampl	Phase
2	2.19	0
5	9.83	0
7	15.76	0
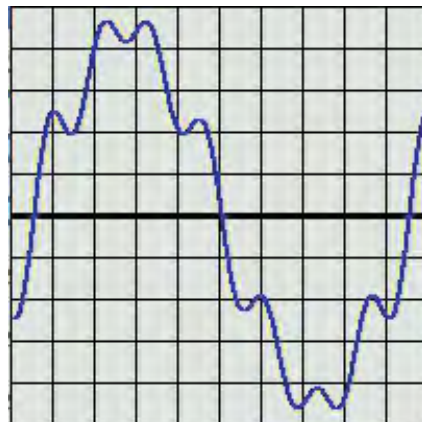
12.2.15 FIXED Waveform No 14

Harmonic	% Ampl	Phase
2	1.04	0
5	4.90	0
7	7.86	0
8	1.14	0
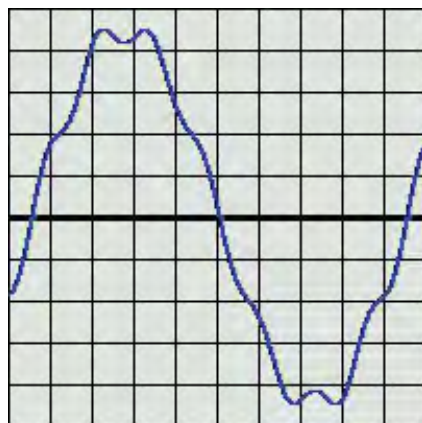
12.2.16 FIXED Waveform No 15

Harmonic	% Ampl	Phase
5	2.42	0
7	3.91	0
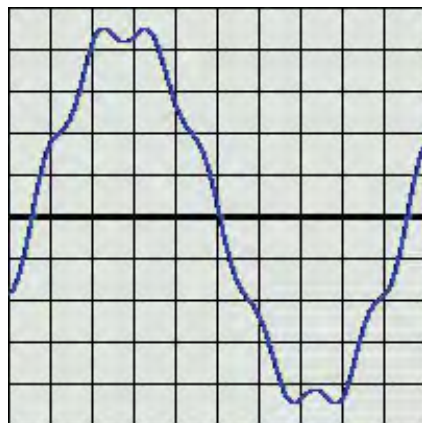
12.2.17 FIXED Waveform No 16

Harmonic	% Ampl	Phase
3	11.08	180
5	4.05	0
7	2.03	180
9	1.27	0
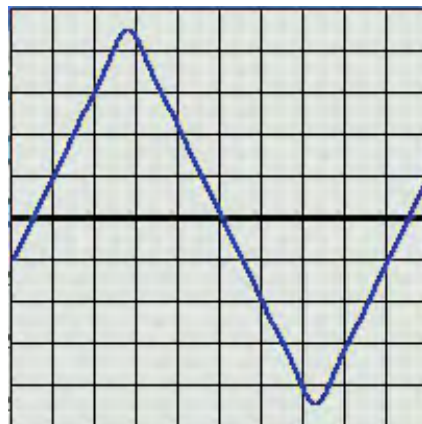
12.2.18 FIXED Waveform No 17

Harmonic	% Ampl	Phase
3	7.16	0
5	3.46	180
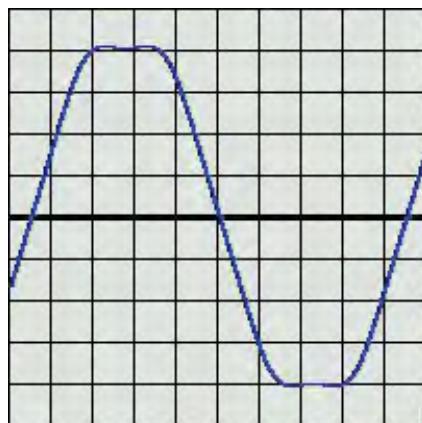
12.2.19 FIXED Waveform No 18

Harmonic	% Ampl	Phase
3	8.07	0
5	3.55	180
9	0.96	0
13	0.92	180
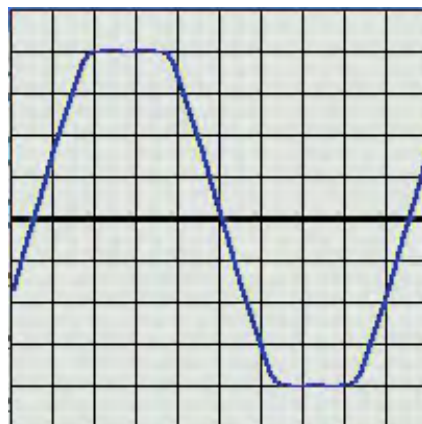
12.2.20 FIXED Waveform No 19

Harmonic	% Ampl	Phase
3	9.38	0
5	3.44	180
9	1.12	0
13	0.50	180
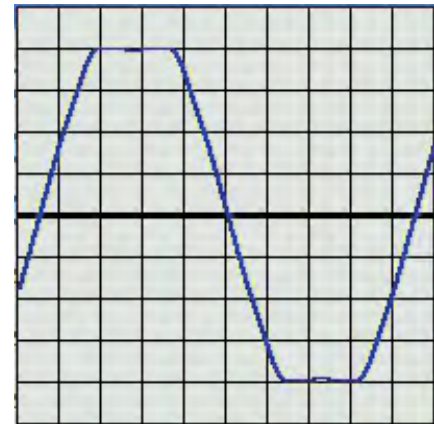
12.2.21 FIXED Waveform No 20

Harmonic	% Ampl	Phase
3	2.06	180
5	1.77	0
7	1.62	180
9	1.23	0
11	0.91	180
13	0.54	0
23	0.51	0
25	0.53	180
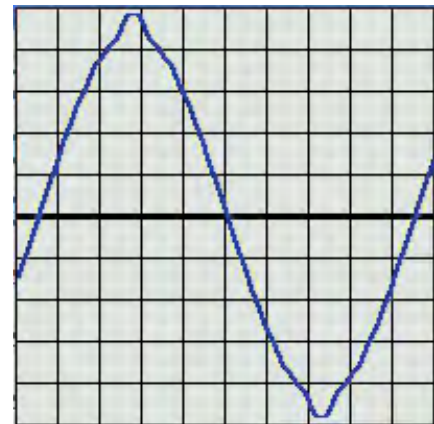
12.2.22 FIXED Waveform No 21

Harmonic	% Ampl	Phase
3	3.08	180
5	2.72	0
7	2.43	180
9	1.97	0
11	1.41	180
13	0.86	0
21	0.62	180
23	0.73	0
25	0.77	180
27	0.69	0
29	0.56	180
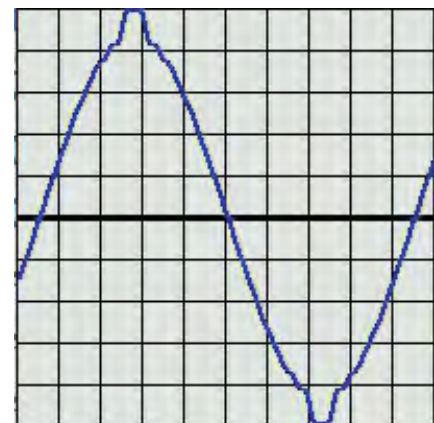
12.2.23 FIXED Waveform No 22

Harmonic	% Ampl	Phase
2	0.13	180
3	4.28	180
5	3.77	0
7	3.27	180
9	2.57	0
11	1.93	180
13	1.22	0
15	0.55	180
19	0.46	180
21	0.83	0
23	0.97	180
25	1.04	0
29	0.75	180
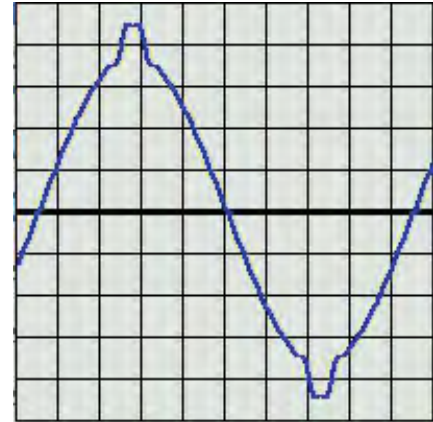
12.2.24 FIXED Waveform No 23

Harmonic	% Ampl	Phase
3	5.74	180
5	5.11	0
7	4.44	180
9	3.52	0
11	2.63	180
13	1.65	0
15	0.80	180
19	0.61	0
21	1.07	180
23	1.28	0
25	1.35	180
27	1.22	0
29	0.98	180
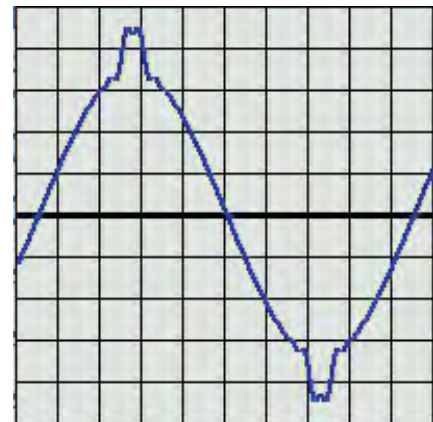
12.2.25 FIXED Waveform No 24

Harmonic	% Ampl	Phase
3	7.35	180
5	6.60	0
7	5.74	180
9	4.57	0
11	3.41	180
13	2.16	0
15	1.04	180
19	0.74	0
21	1.35	180
23	1.64	0
25	1.73	180
27	1.56	0
29	1.24	180
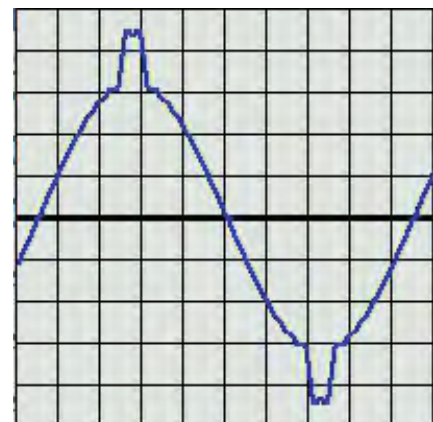
12.2.26 FIXED Waveform No 25

Harmonic	% Ampl	Phase
5	3.41	0
7	2.55	0
11	9.22	0
13	7.68	0
17	0.90	0
19	0.90	0
23	3.88	0
25	3.56	0
31	0.50	0
35	2.34	0
37	2.21	0
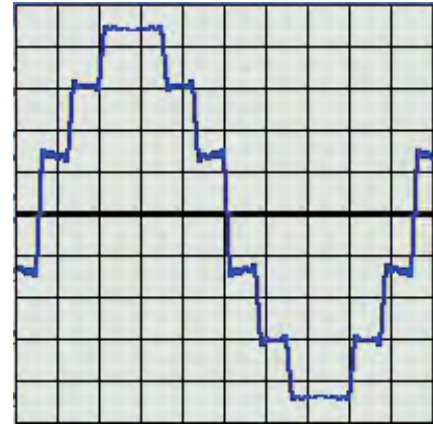
12.2.27 FIXED Waveform No 26

Harmonic	% Ampl	Phase
21	1.24	0
23	4.91	0
25	2.21	0
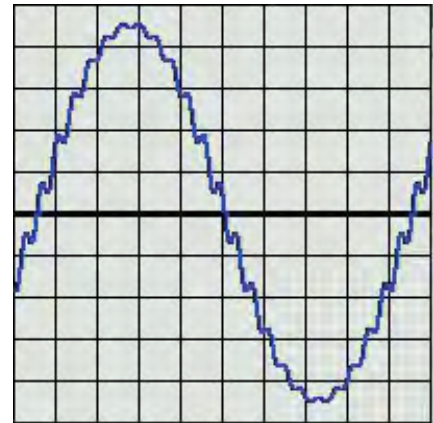
12.2.28 FIXED Waveform No 27

Harm	% Ampl	Phase	Harm	% Ampl	Phase
3	33.39	0	23	4.00	0
5	20.01	0	25	3.49	0
7	13.76	0	27	2.91	0
9	10.70	0	29	2.45	0
11	8.39	0	31	1.94	0
13	7.06	0	33	1.95	0
15	5.85	0	35	1.91	0
17	4.86	0	37	1.89	0
19	4.86	0	39	1.83	0
21	4.52	0			
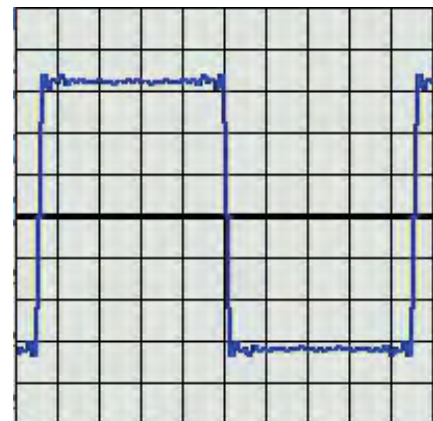
12.2.29 FIXED Waveform No 28

Harm	% Ampl	Phase	Harm	% Ampl	Phase
3	33.39	0	23	3.93	0
5	20.01	0	25	0.89	0
7	13.75	0	27	0.92	0
9	10.71	0	29	0.94	0
11	8.37	0	31	0.94	0
13	7.05	0	33	0.94	0
15	5.84	0	35	0.93	0
17	4.84	0	37	0.92	0
19	4.83	0	39	0.91	0
21	4.48	0			
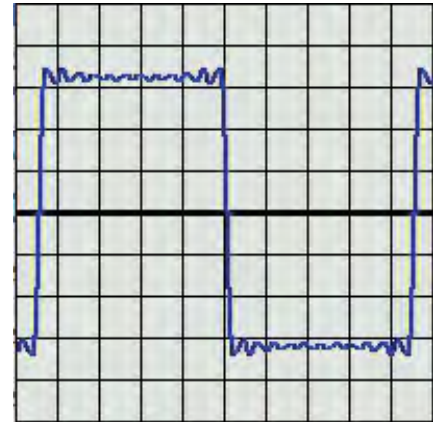
12.2.30 FIXED Waveform No 29

Harmonic	% Ampl	Phase
3	33.39	0
5	20.01	0
7	13.74	0
9	10.67	0
11	8.33	0
13	6.99	0
15	5.26	0
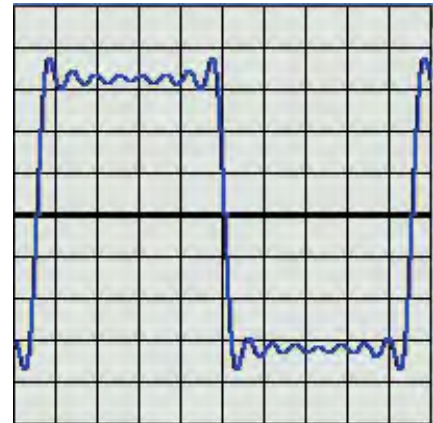
13 Error Messages & Troubleshooting

13.1 Overview

This section contains recommendations on some possible causes and remedies for potential problems that may occur during the use of the CPS 100 Series power sources.

If these recommendations do not resolve the problem, contact APS customer service for further instructions.

13.2 Problem Matrix

Problem	Possible Causes	Possible Solutions
Screen shows message C001 PRI_OPT	Primary power stage temperature is too high	Make sure there is no airflow obstruction around the unit, in particular front and back. If problem is not resolved, contact customer service.
Screen shows message C002 PRI_OCP	Input Over Current	Contact customer service
LCD Screen if blank (OFF)	Input over voltage	Turn off the unit using the On/Off switch and check the AC input voltage to make sure it is in spec.
Screen shows message C004 PRI_UVP	Input under voltage	Turn off the unit using the On/Off switch and check the AC input voltage to make sure it is in spec
Screen shows message C005 BUS_UVP	Internal DC Bus over current	Contact customer service
Screen shows message C006-USB_OCP	USB over current	Check the USB memory port on the front panel or the USB interface
Screen shows message C007-DISPLAY EPROM FAIL	Display memory error	Contact customer service
Screen shows message C008-DSP COMM. FAIL	Internal memory error	Contact customer service
Screen shows message C009-OUTPUT OVP	Output over voltage	Check the output voltage
Screen shows message C010-OUTPUT OCP	Output over current	Adjust the setting range for the current or the OCP setting
Screen shows message C011-OUTPUT OPP	Output over power	Adjust OCP setting
Screen shows message C012-SEC OTP	Output power stage temperature is too high.	Make sure there is no airflow obstruction around the unit, in particular front and back. If problem is not resolved, contact customer service.
Screen shows message C013-FAN ALARM	Fan failure	Contact customer service

Problem	Possible Causes	Possible Solutions
Screen shows message C014 SHORT ALARM	Output wiring short circuit or connected load shorted	Turn off the output and check the output cables to make sure they are connected correctly before turning power back on.
Screen shows message C015 RCP ALARM	RCP circuit failed	Contact customer service
Screen shows message C016 OUTPUT 1 OVP	Remote voltage sense compensation exceeds 5V	Make sure remote voltage sense compensation is no more than 5 volts.
Screen shows message SELF TEST FAIL	Power on self-test failed	Contact customer service
Screen shows message UNACTIVATED	Activation Failure	Contact customer service

Table 13-1: Troubleshooting Matrix

14 CE MARK Declaration of Conformity

EU Directives:	**2006/95/EC and 93/68/EEC**
Manufacturer	**Adaptive Power Systems, Inc.**
Product Name	CPS100 Series AC & DC Power Sources
Serial Number	_____

The manufacturer hereby declares that the products are in conformity with the following standards or other normative documents:

RoHS (DIRECTIVE 2011/65/EU)
  Standard applied EN 50581:2012 (Exempt as WEEE Category 9 until 22 July 2017)
SAFETY (DIRECTIVE 2006/95/EC):
  Standard applied EN 61010–1: 2010 (3rd Edition)
EMC (DIRECTIVE 2014/30/EU):
  Standard applied EN 61326-1: 2013
EMC (DIRECTIVE 2014/30/EU):
  Standard applied EN 61326-1: 2013
ELECTROMAGNETIC EMISSIONS:
  Radiated Emissions CISPR 11/22, CLASS A LIMITS
  Conducted Emissions CISPR 11/22, CLASS A LIMITS
ELECTROMAGNETIC IMMUNITY:

RF Electromagnetic Field	IEC 61000-4-3:2006+A1:2007+A2:2010	
	1 kHz sinewave (80% AM)	80 – 1000 MHz, 10 V/m
		1.4 – 2 GHz, 3 V/m
		2.0 – 2.7 GHz, 1 V/m
Conducted RF Immunity	IEC 61000-4-6:2013	
	Conducted RF Immunity 0.15-80 MHz @ 3 Vrms	
Electrostatic Discharge	IEC 61000-4-2:2008	
	±4 kV contact discharge	
	±8 kV air discharge	
Electrical Fast Transient/Burst	IEC 61000-4-4:2004+A1:2010	
	AC or DC power ports, ±2 kV	
	Signal and I/O ports, ±1.0 kV	
Surge	IEC 61000-4-5:2005	
	AC or DC power ports, ±2 kV Line to ground and ±1.0 kV line to line	
Power Frequency Magnetic Field	IEC 61000-4-8:2009	
	30 A/M	

Supplemental Information:

When and Where Issued:	June 4, 2016
	Irvine, California, USA
Authorized Signatory	Quality Assurance Inspector
	Adaptive Power Systems
Responsible Person	Production Manager
	Adaptive Power Systems
	2802 Kelvin Avenue, Suite 100
	Irvine, California, 92614, USA

CE

Mark of Compliance, LVD

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ADAPTIVE Power Systems

Worldwide Supplier of Power Equipment