Operation Manual

M1001 Series – P/N 160987-10, Version 1.3

M1001 Series
Power Analyzers

ADAPTIVE POWER SYSTEMS™

ADAPTIVE Power Systems

Worldwide Supplier of Power Equipment

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1 Contact Information

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2 Warranty 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) year from the date of shipment to the purchaser, APS will either repair or replace, at its sole discretion, any unit returned to one of APS' 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


Direct current (DC)


Alternating current (AC)

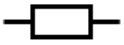

Both direct and alternating current


Three-phase alternating current


Protective Earth (ground) terminal

On (Supply)


Off (Supply)


Fuse


Caution: Refer to this manual before using this product.


Caution, risk of electric shock

CAT IV	For measurements performed at the source of the low voltage installation
CAT III	For measurements performed in the building installation
CAT II	For measurements performed on circuits directly connected to the low voltage installation
CAT I	For measurements performed on circuits not directly connected to Mains

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

General safety conforms to the requirements of EN61010-1. This product is a Safety Class 1 instrument (IEC 13 modular line cord 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 ONLY** in an installation category II, pollution degree 2 environments. It is designed to operate at a maximum relative humidity of 85% non-condensing and at altitudes of up to 2000 meters / 6560 ft. Refer to the specifications tables for the ac mains voltage requirements and ambient operating temperature range.

IF THE POWER ANALYZER IS TRANSPORTED BETWEEN DIFFERING ENVIRONMENTS AND CONDENSATION IS SUSPECTED, THE UNIT SHOULD REMAIN UNPOWERED FOR SUFFICIENT TIME FOR CONDENSATION TO HAVE DISSIPATED. IF THERE IS ANY DOUBT THEN CONTACT ADAPTIVE POWER SYSTEMS FOR ADVICE.

IF FLUIDS OR OTHER CONDUCTIVE MATERIALS ARE ALLOWED TO ENTER THE UNIT ENCLOSURE, EVEN IF NOT POWERED, THEN THE UNIT SHOULD IMMEDIATELY BE TAKEN OUT OF OPERATION AND SERVICED AS SAFETY MAY HAVE BEEN COMPROMISED.

DO NOT OPERATE IN AN EXPLOSIVE ATMOSPHERE.

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

MEASUREMENT SAFETYY CATEGORY II

EN61010-1 CAT I 1000V; CAT II 1000V; CAT III 600V; CAT IV 300V (electrical channel inputs).

THE UNIT MEASURES VOLTAGES AND CURRENTS WHICH MAY BE LETHAL; UNSAFE OPERATION MAY RESULT IN SEVERE INJURY OR DEATH.

BEFORE APPLYING POWER

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

GROUND THE INSTRUMENT

THE POWER ANALYZER IS INTENDED TO BE POWERED FROM A POWER CORD HAVING A PROTECTIVE GROUND WIRE WHICH MUST BE INSERTED INTO A POWER OUTLET HAVING A PROTECTIVE GROUND TERMINAL. IF THE unit IS NOT POWERED FROM A SUITABLE POWER SOURCE, OR IT IS LIKELY THAT THE POWER CORD MAY BE REMOVED FROM THE UNIT WHEN MAINS SIGNALS ARE APPLIED TO THE MEASUREMENT TERMINALS, THEN THE CHASSIS GROUND TERMINAL LOCATED NEAR THE POWER ENTRY CONNECTOR ON THE REAR PANEL MUST BE PROTECTIVE GROUNDED.

DO NOT REMOVE THE POWER CORD FROM THE UNIT OR FROM THE SOURCE OF POWER WHILE IT IS MEASURING HIGH VOLTAGES. THIS WILL REMOVE THE PROTECTIVE GROUND FROM THE CHASSIS OF THE UNIT, WHICH MAY RESULT IN HAZARDOUS VOLTAGES BEING ACCESSIBLE TO THE USER.

FUSES

The unit is internally fused with a non-user serviceable fuse.

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 unit connected to mains. 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.

Do not exceed the rated input as listed in specification section.

DO NOT SUBSTITUTE PARTS OR MODIFY INSTRUMENT.

There are no user serviceable parts inside the instrument – do not attempt to open the instrument, refer service to the manufacturer or his appointed agent.

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 describes the general features of the APS M1001 Series Power Analyzers. It introduces the reader to general operating characteristics of these Power Analyzers. Throughout this document, images of actual screens are shown. The actual screen displayed on your instrument may be slightly different from that shown in this document because of changes to firmware or configuration settings on the Power Analyzer.

Figure 3-1: Front and Rear Views

3.1 General Description

- Less than 0.001W standby power measurements meet IEC62301 Energy Star 0.03W standby power.
- Harmonic analysis to the 50th order
- Six voltage ranges and eighteen current ranges
- Up to 800Vpeak/200Apeak input
- Color Graphics Display
- The built-in power control switch can turn the unit under test ON and OFF at a specified phase angle (0~359˚) of the voltage source.
- RS-232, GPIB, USB and Ethernet Interfaces options (1 can be installed at a time)
- Measuring fixture box option
- Supports the Inrush Current of the power supply at startup and the Surge Current test when the load is suddenly plugged in (Hot Plug-in)

The M1001 use a compact bench chassis. This compact packaging also allows for efficient ATE system design using the available 3U rack mount kit.

The measurement performance of the M1001 Series Power Analyzer models is detailed in section 4, “Technical Specifications”.

3.2 Accessories Included

The following accessories are included with each M1001 Series Power Analyzer. If one or more of these is missing upon incoming inspection of the product, please contact Adaptive Power Systems customer service.

Item	Description	Quantity
A	AC Line Cord - USA	1

Table 3-1: Included Accessories

The Operation Manual can be downloaded from the Adaptive Power Systems website Technical Resources page (https://tr.adaptivepower.com/)

3.3 Remote Control Interfaces

Following remote control interface options are available on the M1001 Series:

- USB
- RS232
- LAN (Ethernet)
- GPIB

Note: Only one interface type can be installed at any one time.

Refer to section 8, “Remote Control Programming” on page 63 for details on using remote control.

4 Technical Specifications

4.1 Measurements

MEASUREMENTS								
AC & DC VOLTAGE Vac, Vdc, Vrms, Vpk+, Vpk-, Vmax, Vmin, V Harmonics		Range	20Vpk	40Vpk	80Vpk	200Vpk	400Vpk	800Vpk
		Resolution	0.001V	0.001V	0.01V	0.01V	0.01V	0.1V
		Max. Input	80Vpk / 50Vrms			800Vpk / 500Vrms		
		Input Imp.	> 100 kΩ			> 1 MΩ		
		Accuracy	± 0.1% (Reading + Range)					
			± 0.5% (Reading + Range) for Vpk+, Vpk-, Vmax, Vmin					
AC & DC CURRENT Aac, Adc, Arms, Apk+, Apk-, Amax, Amin, I Harmonics	Shunt 0.05A (10Ω)	Range	0.002Apk	0.004Apk	0.008Apk	0.02Apk	0.04Apk	0.08Apk
		Resolution	0.1uA	0.1uA	0.001mA	0.001mA	0.001mA	0.01mA
		Max. Input	0.08Apk / 0.05Arms					
	Shunt 0.5A (1Ω)	Range	0.2Apk		0.4Apk		0.8Apk	
		Resolution	0.01mA		0.01mA		0.1mA	
		Max. Input	0.8Apk / 0.5Arms					
	Shunt 5A (0.04Ω)	Range	2.0Apk		4.0Apk		8.0Apk	
		Resolution	0.1mA		0.1mA		0.001A	
		Max. Input	8.0Apk / 5.0Arms					
	Shunt 20A (0.005Ω)	Range	10Apk	20Apk	40Apk	50Apk	100Apk	200Apk
		Resolution	0.001A	0.001A	0.001A	0.001A	0.01A	0.01A
		Max. Input	200Apk / 20Arms					
	Ext. Input	Input Imp.	10 kΩ					
		Range	0 ~ ± 2.5 Vpeak					
		Scaling	1.00 ~ 10,000.00					
	Accuracy		± 0.1% (Reading + Range)					
			± 0.5% (Reading + Range) for Peak Current					
AC & DC POWER Watts	Range / Accuracy		V range * I range / ± 0.2% (Reading + Range)					
POWER FACTOR PF	Range / Accuracy		± 0.001 ~ 1.000 / ± 1.0% (Reading + Range) corresponds to V and I					
	Resolution		0.001					
FREQUENCY Hz	Range / Accuracy		DC, 20 Hz ~ 1000 Hz / ± 0.1 Hz					

MEASUREMENTS			
V/I HARMONICS	Range / Accuracy		1 ~ 50th / ± 0.5% (Reading + Range)
V/I THD	Range / Accuracy		0% ~ 255% / ± 0.5% (Reading + Range)
	Resolution		0.001%
LOW PASS FILTER (V & I)			50 kHz
SPECIAL MODE MEASUREMENTS			
Inrush V/I	Voltage	Range	Same as Aac and Adc
	Current	Range	Same as Aac and Adc. (20A, 5 mΩ Shunt)
	Accuracy		± 2.0% (Reading + Range)
	Measurement window		100 msec
AC ON/OFF Programmable Output Switch	Range		0 ~ 359°
	Accuracy		±1.0° Max. @ 50/60 Hz
	Resolution		1.0°
Standby Power	Accumulated Time		0D : 0H : 0M : 0S ~ 9999D : 23H : 59M : 59S
	WHr Range		0.000000 ~ 999.999999 WHr / 1.000 9999.999 kWHr
	Counter Range		0H : 0M : 0S ~ 99H : 59M : 59S
	Accuracy		± 0.2% (Reading + Range)
DC Ahr / Whr Accumulator	Accumulated Time		0D : 0H : 0M : 0S ~ 9999D : 23H : 59M : 59S
	WHr & AHr Range		0.000000 ~ 999.999999 WHr / 1.000 9999.999 kWHr
	Counter Range		0H : 0M : 0S ~ 99H : 59M : 59S
	Accuracy		± 0.2% (Reading + Range)
ON/OFF Cycling	Range	ON & OFF	0M : 0.200S ~ 10M : 0S
		Repeat Cycle	0 ~ 9999

4.3 AC Input

AC INPUT	
AC Input Voltage	100 ~ 230Vac ±10%, 1 Phase
Input Frequency	50Hz or 60Hz ±3Hz
Power Consumption	40 VA
Line Fuse	250V / 0.5A (6 x 30 mm)

4.4 System Parameters

GENERAL SYSTEM	
Display	3.5" TFT LCD, 320 x 240 RGB Color
Keyboard	Numeric 0~9, MENU, Graph, ON/OFF
Sampling Rates	4096 sample/period @ 50Hz/60Hz
V/I ADC Converters	Dual 16-bit, 500 ksps ADCs w/DSP

4.5 Environmental Conditions

ENVIRONMENTAL CONDITIONS	
Operating Temperature	0° C ~ +40°C / +32°F ~ +104°F
Storage Temperature	-20° C ~ +60°C / -4°F ~ +140°F
Max. Operating Altitude	2000 meters / 6562 feet
Max. Relative Humidity	80% for temperatures up to 31°C (88°F) decreasing linearly to 50% relative humidity at 40°C (104°F)

4.6 Shunt Protection Fuses

SHUNT PROTECTION FUSES	
0.05A, 10Ω Shunt	3.6 x 11 mm, 250Vac, 0.2A Fast
0.5A, 1Ω Shunt	3.6 x 11 mm, 250Vac, 1.0A Slow

4.7 Dimensions & Weight

DIMENSIONS & WEIGHT	
Size (H x W x D)	99.4 x 213 x 304 mm (incl. feet) 3.9" x 8.4" x 12.0"
Shipping Size	200 x 290 x 390 mm
	7.9" x 11.4" x 15.4"
Net Weight	3.5 Kg / 8.4 lbs
Shipping Weight	9.0 Kg / 19.8 lbs

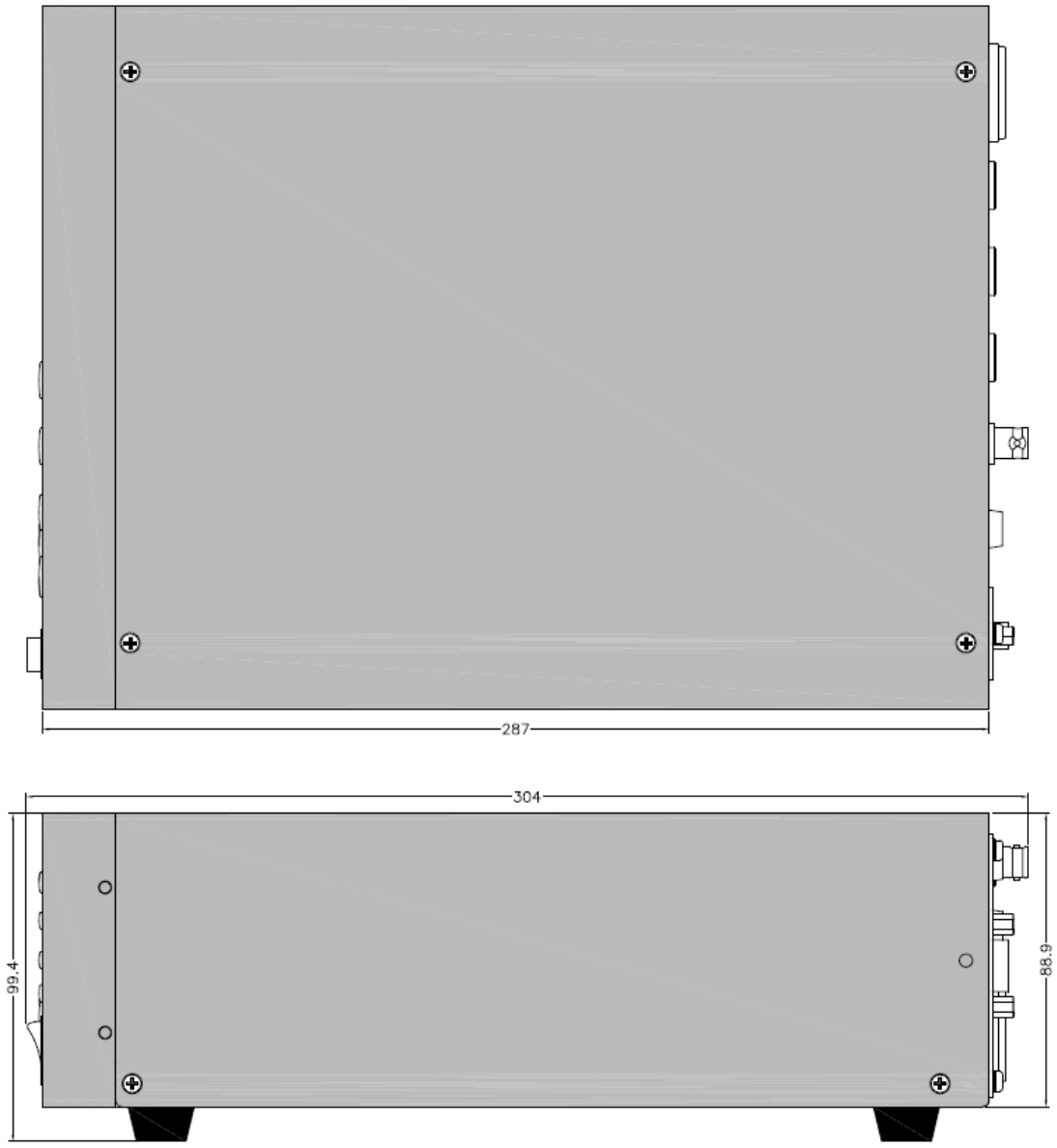


Figure 4-1: Dimension Drawing Sides

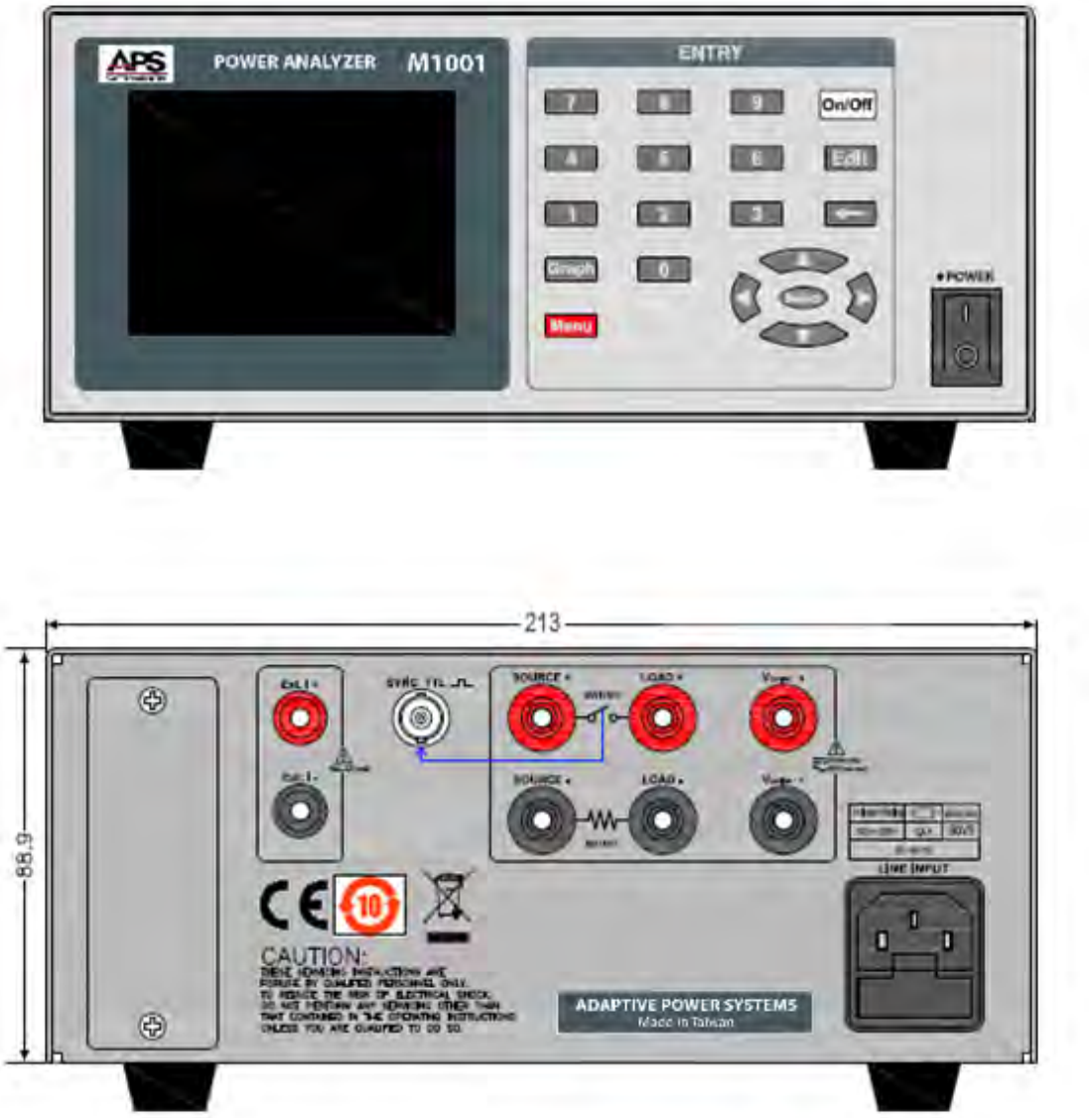


Figure 4-2: Dimension Drawing Front & Back

4.8 Remote Control Interface Options

REMOTE CONTROL INTERFACE OPTIONS	
-USB	USB Serial Interface
Connector	USB Type-B, Rear Panel
Baud Rate	115200 bps
-LAN	Ethernet Interface
Connector	RJ45 , Rear Panel
-GPIB	GPIB / IEEE-488.1 Interface
Connector	24-pin Amphenol , Rear Panel
-RS232	RS232 Serial Interface
Connector	DB9 , Rear Panel
Baud Rate	115200 bps
Parity	None
Data Bits	8
Stop Bits	1

5 Unpacking and Installation

5.1 Inspection

The M1001 Series of Power Analyzers are carefully inspected before shipment. If instrument damage has occurred during transport, please inform Adaptive Power Systems' nearest sales and service office or representative.

The unit is grounded via the AC Input. A line cord with proper Earth Ground must be used at all times. Correct grounding of your electrical system infrastructure according to applicable national standards must also be observed.

5.2 Unpacking

Always inspect the carton for any sign of damage that may have occurred during shipment. If damage to the carton is visible, file a report with the carrier.

After removing the power analyzer from its shipping carton, carefully inspect the unit for any sign of damage before attempting to operate. If any abnormality is noted, is recommended that the unit be serviced prior to being placed into use, as safety may have been compromised. In that case, contact Adaptive Power Systems support department to obtain a Material Return Authorization (RMA) or Case number.

Inside the carton, there should be the following items:

1. M1001 unit
2. US mains power cord

If any of these items is missing, contact Adaptive Power Systems customer support department.

5.3 Applying Power

Before connecting the AC line cord to the mains, make sure the Power On/Off rocker switch on the front panel is in the **OFF** (O) position.

Also remove any of the test leads from the measurement inputs on the rear panel.

Then, connect the mains cord from a properly grounded supply outlet to the inlet on the rear panel of the M1001. This unit has a universal mains input and accepts any supply voltage from 100-230 Vrms at 50 or 60Hz as indicated on the rear panel label.

SAFETY WARNING:

The M1001 must be connected using a power cable with a continuous ground connection and must be plugged into a source of power which provides a safety ground.

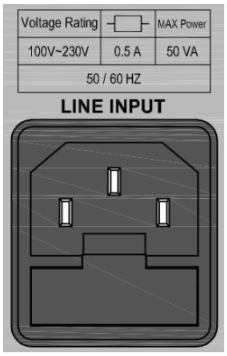


Figure 5-2: AC Mains Power Input Connection

5.4 AC Mains Fuse Replacement

This unit is protected with an AC mains fuse and can be exchanged if ever needed using the following steps:

Note: Always remove input power from the unit before attempting to replace the fuse.

Note: To avoid the fire or electronic shock, the Fuse that will be used in the product must meet all safety standard that apply in your locale or the region. Use of any improper Fuse or shorting the Fuse holder is extremely dangerous and strictly prohibited.

Note: Before exchanging the Fuse, if there are abnormal odor or abnormal noise, stop using immediately and ask for the repair

1. Check the rating of the line fuse and replace it with the correct fuse if necessary. Required type is rated for 100V~230V use T0.5A/250V (5*20mm)
2. The AC line fuse is located below the AC line receptacle see Fig 2-2. Use a small screwdriver to extract the fuse holder, to change a new one. Change an appropriate specifications fuse as indicated below.

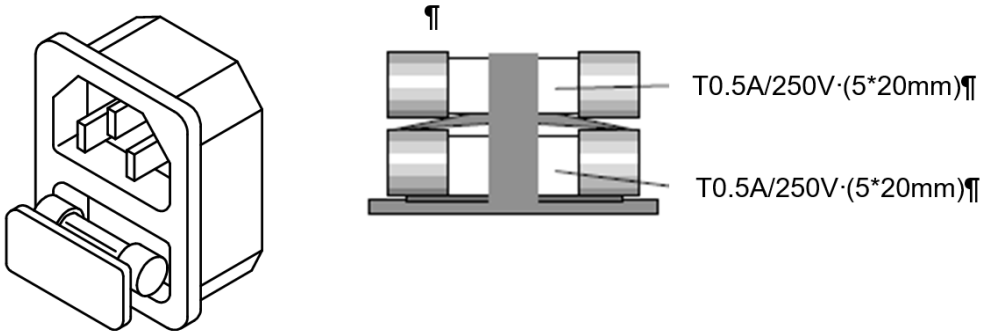


Figure 5-3: AC Mains Input Fuse Holder and Rating

5.5 Turing Power On & Off

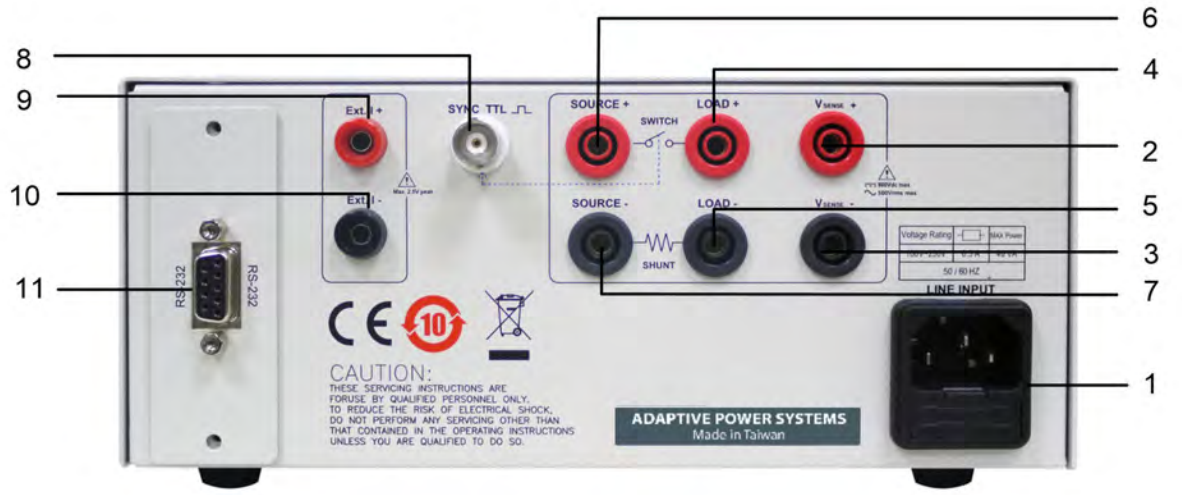
The instrument can be turned on and off using the rocker switch located in the lower right corner of the front panel.

5.6 Measurement Connections

All measurement connections for the M1001 are made at the unit's rear panel using shrouded safety banana jacks.

5.6.1 Rear Panel Overview

The following connections are located on the rear panel of the power analyzer.



1. Power Input 100~230V 50/60Hz
2. Voltage measurement input positive terminal (Safety Banana Jack - Red)
3. Voltage measurement input negative terminal (Safety Banana Jack - Black)
4. Positive Load side input of the EUT (Safety Banana Jack - Red)
5. Negative Load side input of the EUT (Safety Banana Jack - Black)
6. Positive measurement input of the power supply (Safety Banana Jack - Red)
7. Negative measurement input of the power supply (Safety Banana Jack - Black)
8. Internal Load Switch Synchronization Signal
9. External current Shunt input positive terminal (Banana Jack - Red)
10. External current Shunt signal input negative terminal (Banana Jack - Black)
11. Interface card (optional, RS232 shown)

All EUT connections are made using these input connections.

5.6.2 Single Phase EUT Connections Using the Internal Shunt

The internal shunt may be used to measure currents up to 20Arms AC or 20A DC. For larger loads, refer to the next section on using external shunts or current transformers (CT's).

The connection diagram below allows the internal On/Off electronic switch to be used to turn power to the EUT (LOAD) on or off. This electronic switch can be phase angle controlled to facility inrush current measurements. See section 6.7, "Inrush Voltage and Current Measurements" on page 40 for details.

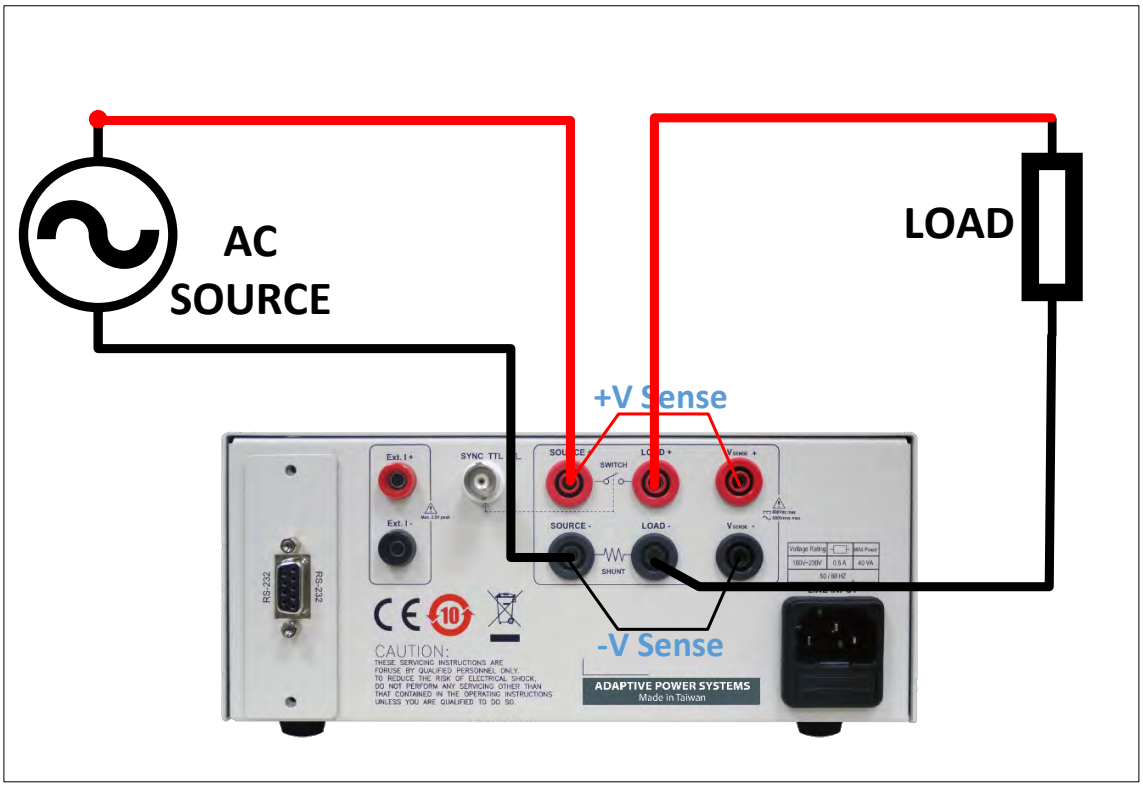


Figure 5-4: Internal Current Shunt EUT Connections

5.6.3 Single Phase EUT Connections Using an External Shunt

An external shunt must be used if RMS, DC or Peak Current readings are expected to exceed the capability and rating of the M1001's internal current shunt. The connections diagram for external shunt use is shown below.

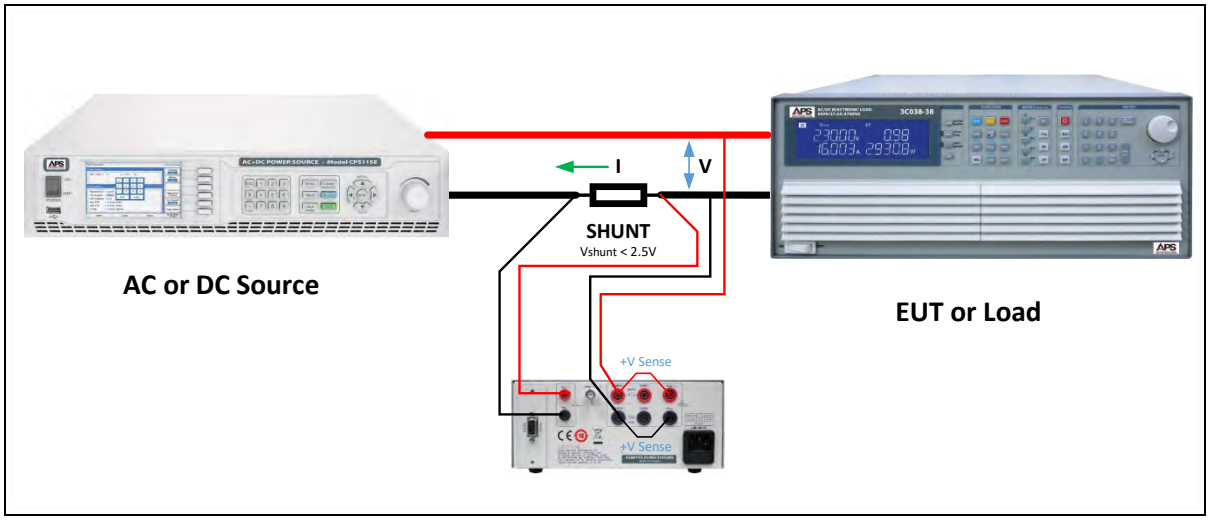


Figure 5-5: External Current Shunt Connection Diagram

The shunt used should be rated to produce no more than ±2.5Vpk voltage. For example, to measure an EUT current of ±250Apk, the shunt impedance must be at least 2.5 / 250 = 0.010 or 10 mOhm.

For optimal voltage measurements, make sure to connect the Vsense inputs as shown in the detail below.

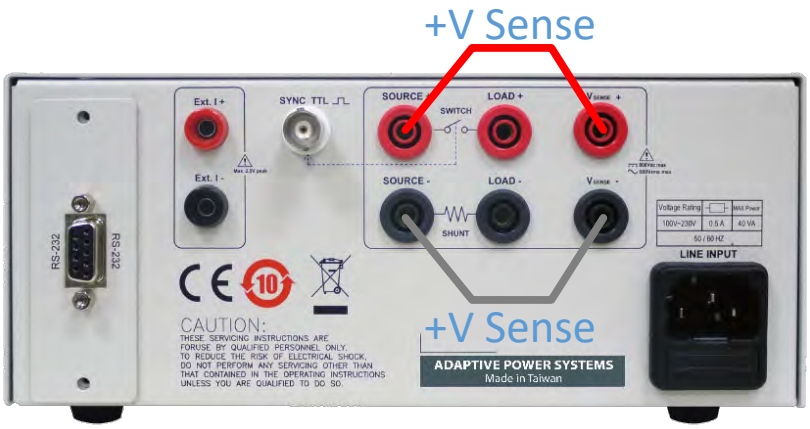


Figure 5-6: External Voltage Sense Connection Detail

Note: The internal electronic On/Off switch function of the M1001 is not available when using an external shunt or CT.

1.1.1 Single Phase EUT Connections Using an External Current Transformer

An external Current Transformer may be used in place of a shunt resistor if isolation is required. The CT may need a scaling resistor to attenuate the output voltage to within acceptable range for the M1001 Power Analyzer. Make sure to use a 0.01% precision resistor as this affects current measurement accuracy.

The connections diagram for external CT use is shown below.

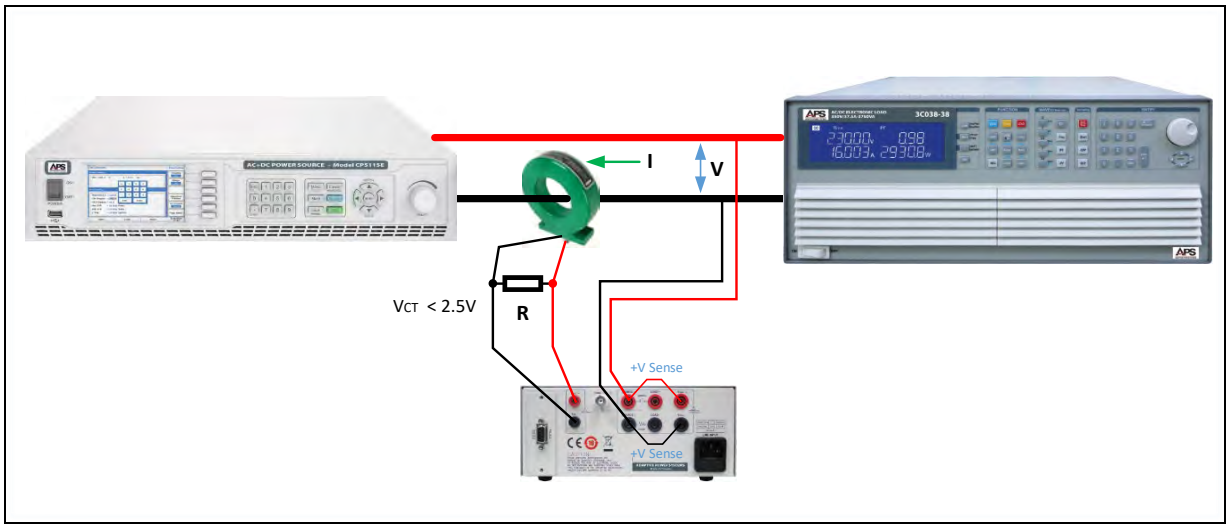


Figure 5-7: External Current Shunt Connection Diagram

Note: The internal electronic On/Off switch function of the M1001 is not available when using an external shunt or CT.

5.6.4 Three Phase - Three Wire EUT Connections

For three wire three phase measurement applications, two M1001 Power Analyzers are required. Both units must be connected as shown below.

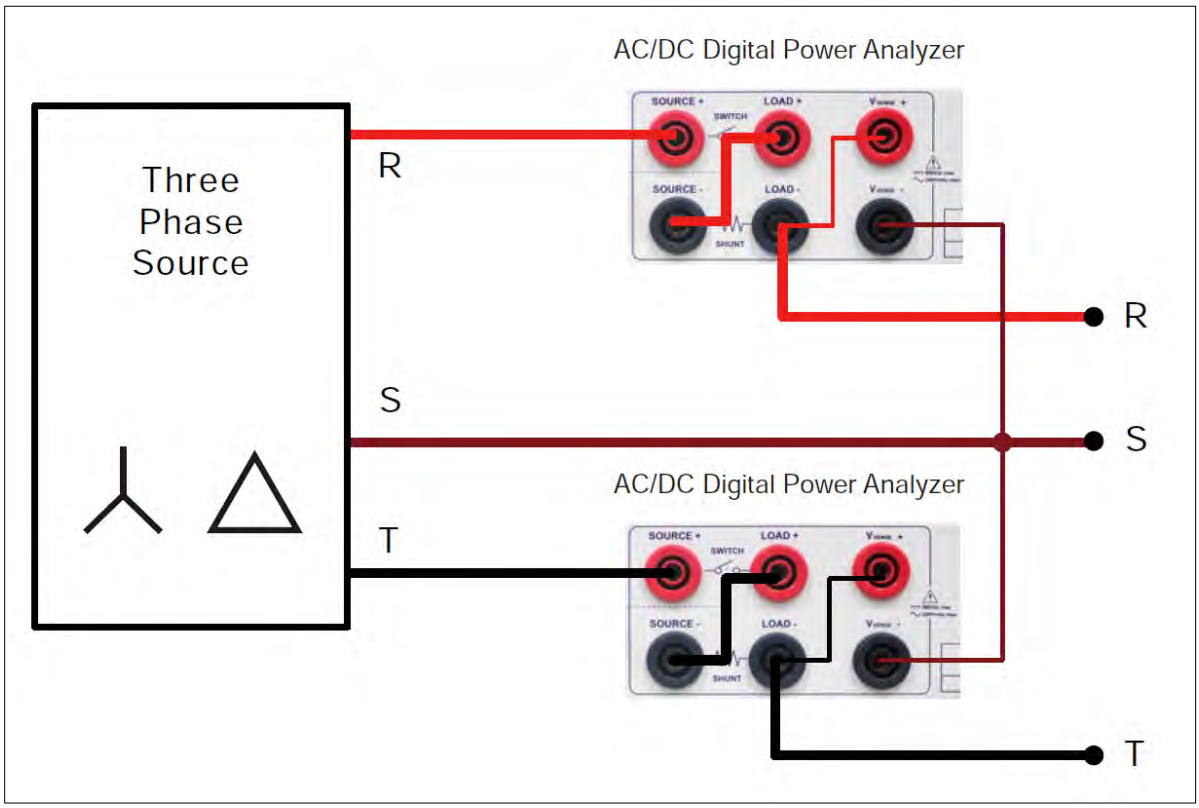


Figure 5-8: Three Phase, Three Wire Measurement Connection Diagram

5.6.5 Three Phase - Four Wire EUT Connections

For four wire, three phase measurement applications, three M1001 Power Analyzers are required. These three units must be connected as shown below.

For Wye connections, make sure the neutral is connected to all three analyzers as shown (Dashed blue lines).

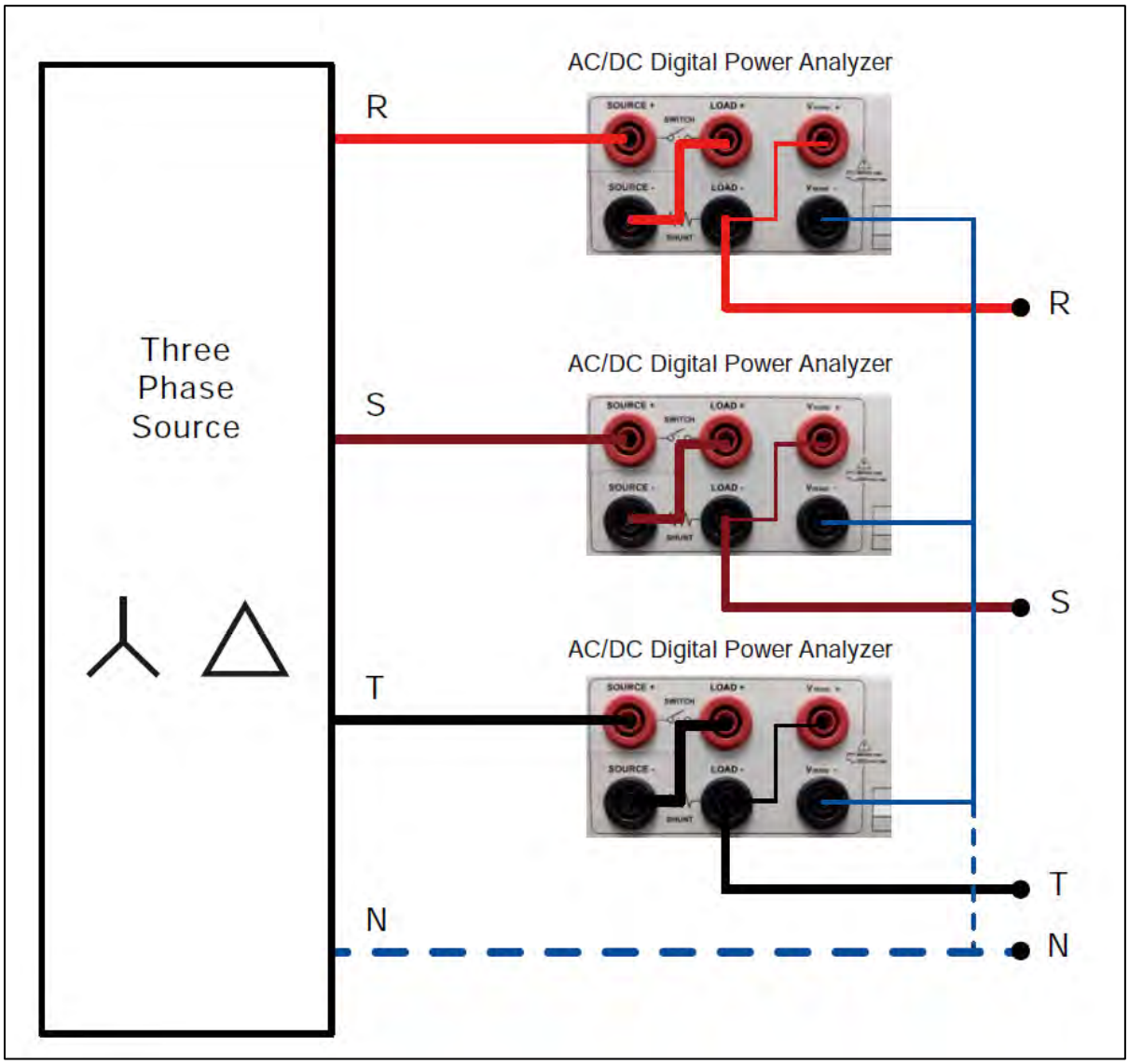


Figure 5-9: Three Phase, Four Wire Measurement Connection Diagram

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 Rack Mount Installation

The M1001 unit can be installed in a 19" instrument rack using the optional M1001-RMK rack mount kit depicted below. The rack height required in 2U or 3.5" / 88.9 mm.

Figure 5-10: M1001-RMS Rack Mount Kit accessory

5.9 Cleaning

The exterior of the instrument may be cleaned using a soft or slightly damp cloth.

Caution: Before cleaning the instrument, turn off the power and remove the line cord.
Note: DO NOT use any organic solvent capable of affecting the nature of plastics such as benzene or acetone.
Note: Always make sure not liquid is allowed to penetrate the instrument.

6 Front Panel Operation

This section describes operation of the Power Analyzer using the front panel. For remote control operation, refer to section 8, “Remote Control Programming” on page 63.

6.1 Front Panel Layout

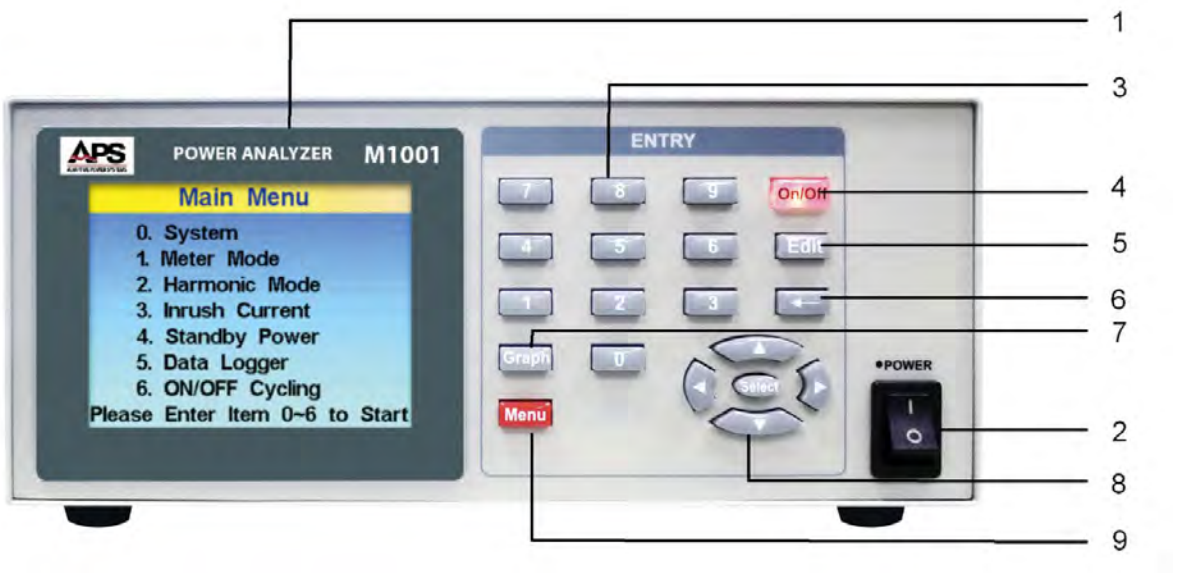


Figure 6-1: Front Panel Keypad controls

The front panel of the M1001 contains the following keys used for front panel operation:

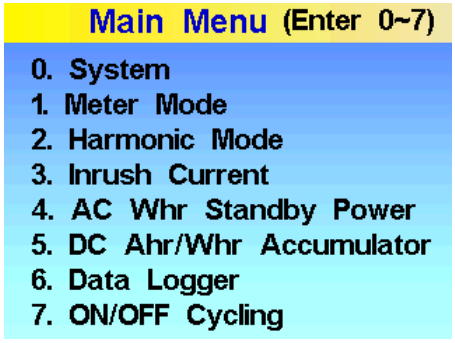
Key	Function

1. Power Analyzer Model number
2. Power Analyzer On / Off switch
3. Number keys **0** through **9**
4. Load **On/Off**. Turns output to EUT on or off. The output switch has an angle control function. In the AC mode, VSource and VSense need to be connected on the input power supply side of the internal load switch to operate normally.
5. **Edit** Key (5), Enter or leave the edit page
6. ← Key. Clears data
7. **Graph** key. Switches between numeric data and graphics display mode pages.
8. The arrow keys and the **Select** key. The **Select** key moves between a selected setting (left column) and its parameter **Setting** field (right column). The arrow keys move through the available parameters or digits of any numeric setting for the selected function.
9. **Menu**. Returns to the main Menu screen

6.2 MAIN Menu

The MAIN menu provides access to all settings and modes and can be selected at any time by pressing the **Menu** .key.

From this menu screen, all other screens can be selected by pressing the corresponding numeric keypad number key (0 through 7).



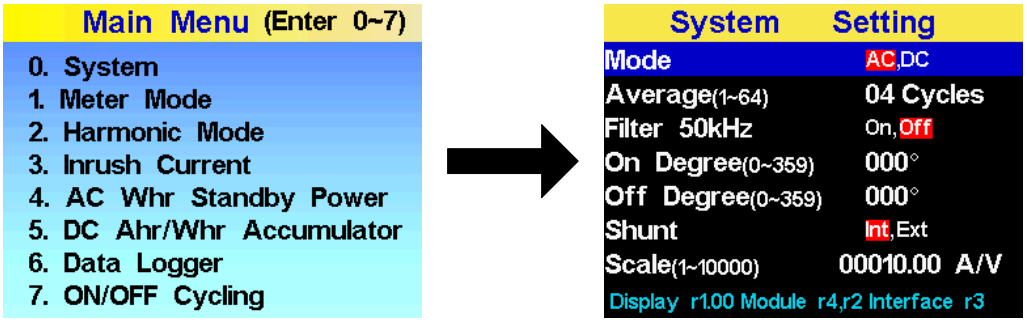
The following sections explain the use of all eight (0 – 7) menus selections.

6.3 Data Entry Operation

Use the Up/Down arrow keys to move up and down through any setting screen. To change selected settings, press the **Select** key. This moves the active cursor to the **Setting** field. use the Left/Right arrow keys to cycle through available settings. To confirm your selection press the cursor pad **Select** key.

6.4 System Settings

Press the '0' key to select the System menu screen.



The System screens contains general settings that apply to all measurement modes as well as other functions of the Power Analyzer.

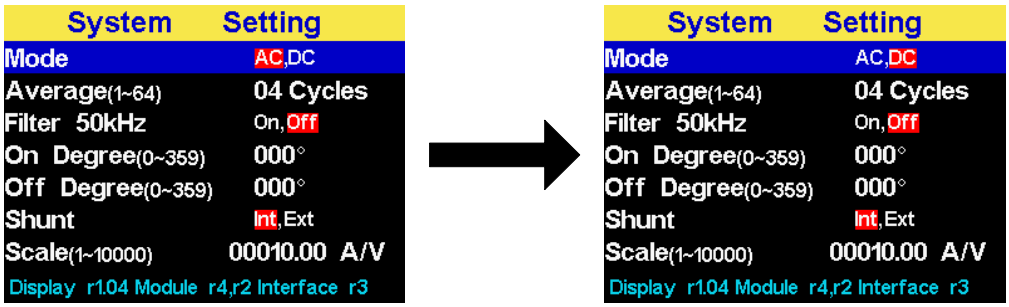
The following fields and available settings are contained in the System menu,

Setting	Description	Parameter Range
Mode	Measurement Mode	AC, DC
Average	Number of measurement cycles averaged	0 through 64 Cycles
Filter 50kHz	Enable or Disable 50kHz low pass filtering	On, Off

Setting	Description	Parameter Range
On Degree (0 ~ 359)	Set EUT Power On Electronic Switch phase angle	0 through 359
Off Degree (0 ~ 359)	Set EUT Power Off Electronic Switch phase angle	0 through 359
Shunt	Select Internal or External Current shunt	Int, Ext
Scale (1 ~ 10000)	Set Amps per Volt scale of External Shunt used	1.00 through 10000.00

To edit any of these settings, use the following steps:

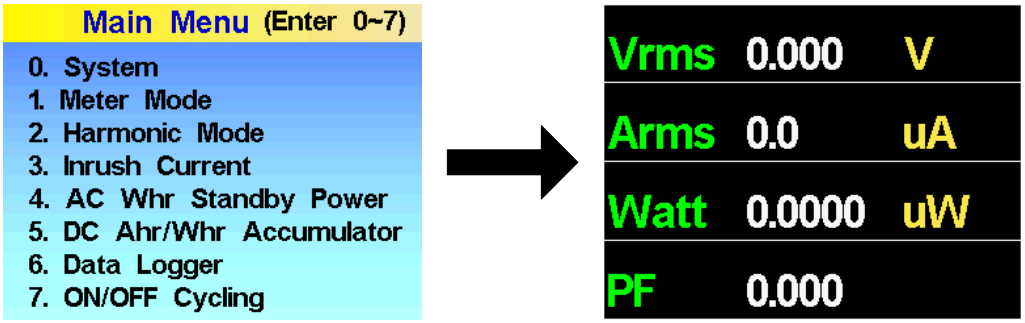
1. Use the ↑ and ↓cursor keys to scroll up or down until the desired setting is highlighted. In this example, the Mode is highlighted.



2. To change the selected setting, press the **Select** key. The available Mode Setting field on the right hand side will now have the active setting highlighted.
3. To change to the desired setting, use the ← or → cursor keys to select between available options.
4. For numeric values, use the ← or → cursor keys to edit each position in the number and use the ↑ and ↓cursor keys to increment of decrement each number. You can also use the numeric keypad number keys (0 through 7) to edit each number.
5. Once the new setting or value is established, press the **Select** key to confirm the new set value and return to the left hand column in the System screen.
6. Repeat this for any other setting that needs changing.
7. When done, press the **Menu** .key to return to the Main Menu.

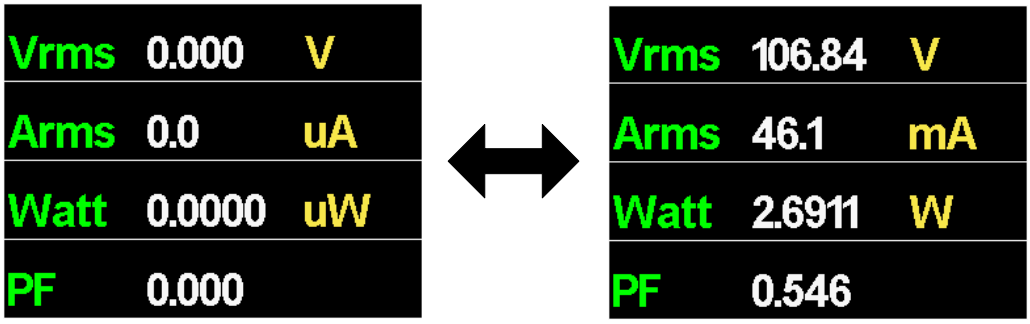
6.5 Meter Mode (Press 1)

The Meter screen is selected by pressing the -1- key from the Main menu screen. The Meter screen displays numerical measurement results in easy to read, large color coded numbers.

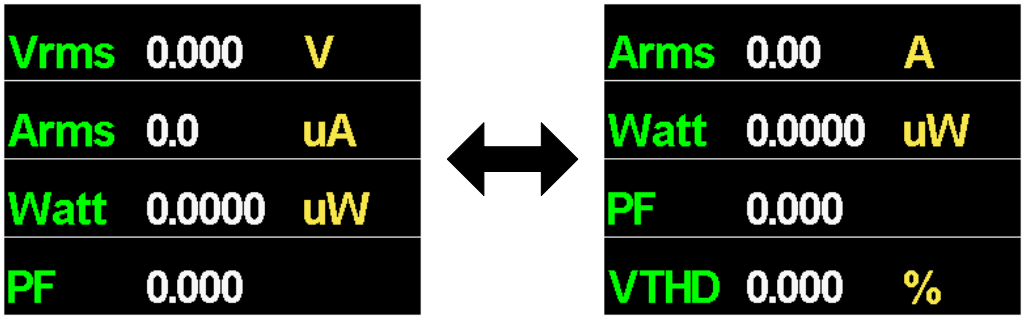


The measurement parameter is shown in green, the measured value is shown in white and the unit (if any) is shown in yellow. See image above.

If the EUT output of the power analyzer is OFF, press the Load On/Off key to enable power output to the EUT. This should result in measurement readings as shown below.



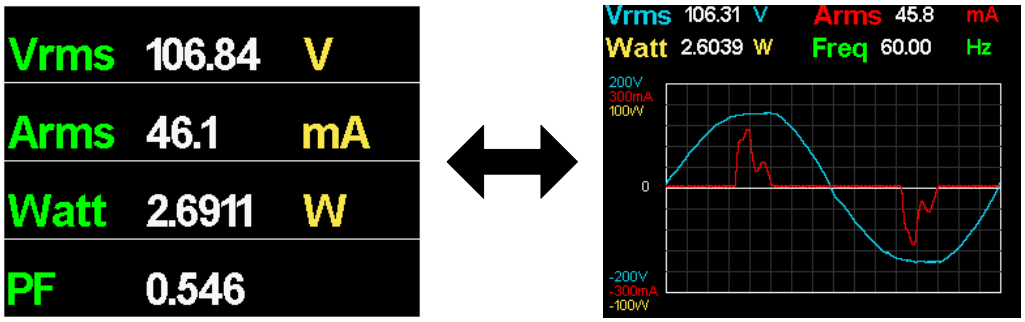
To scroll down to other measurement parameters, use the ↓ down arrow cursor key.



The order in which measurement data is displayed is as follows:

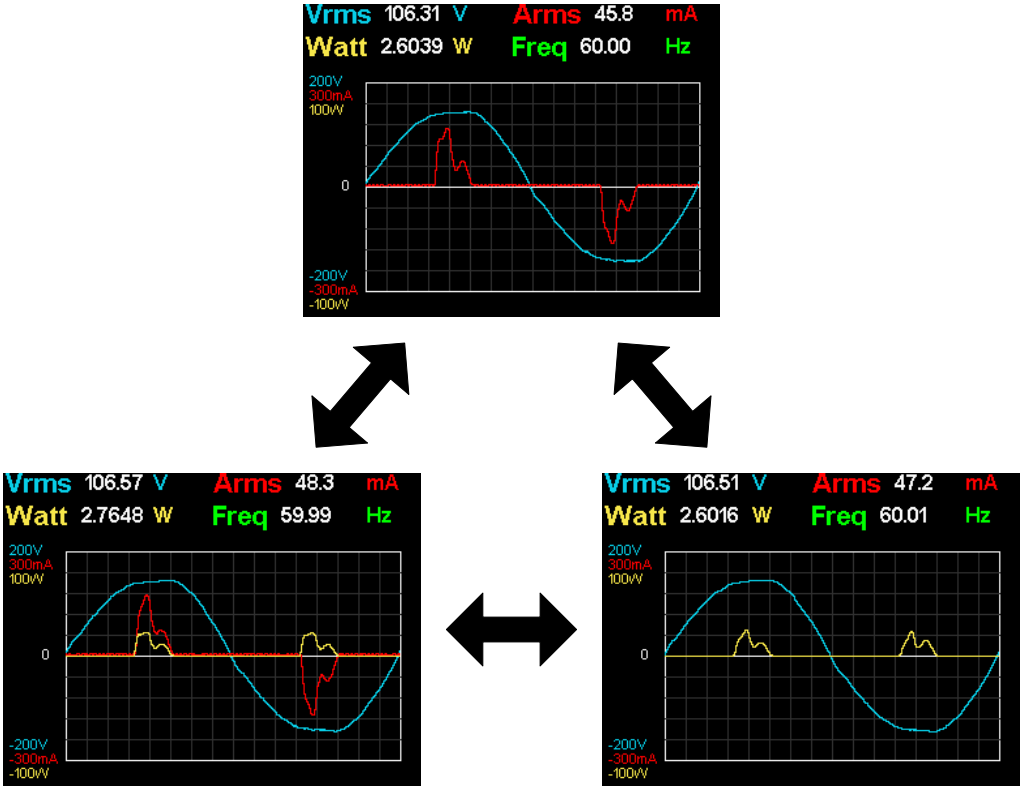
Vrms ⇨ Arms ⇨ Watt ⇨ PF (Power Factor) ⇨ VTHD (Voltage distortion) ⇨ ITHD (Current Distortion) ⇨ VA (Apparent Power) ⇨ Freq ⇨ Vpk+ ⇨ Vpk- ⇨ Vmax ⇨ Vmin ⇨ Apk+ ⇨ Apk- ⇨ Amax ⇨ Amin ⇨ Wmax ⇨ Wmin ⇨ VAR (Reactive Power) ⇨ VCF (Voltage Crest Factor) ⇨ ICF (Current Crest Factor).

The Meter mode also displays data in a graphical or Scope like mode. To toggle to the Graph display mode, press the **Graph** key on the front panel.



While in graphics mode, press the ← or →cursor key to switch between the three available Graph displays:

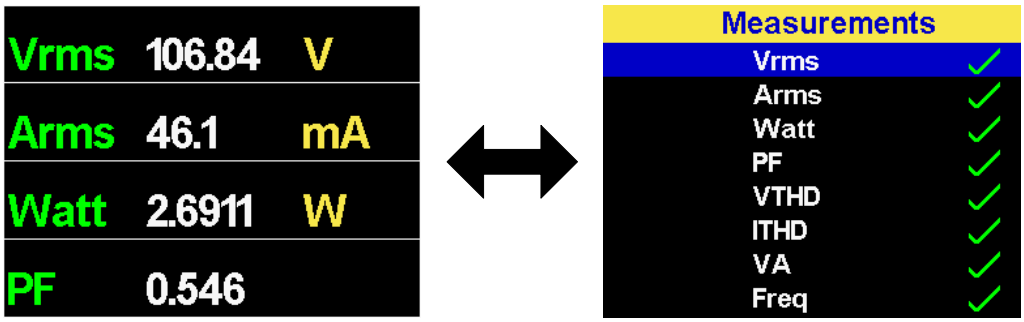
- Volt & Amp
- Volt & Watt
- Volt & Amp & Watt.



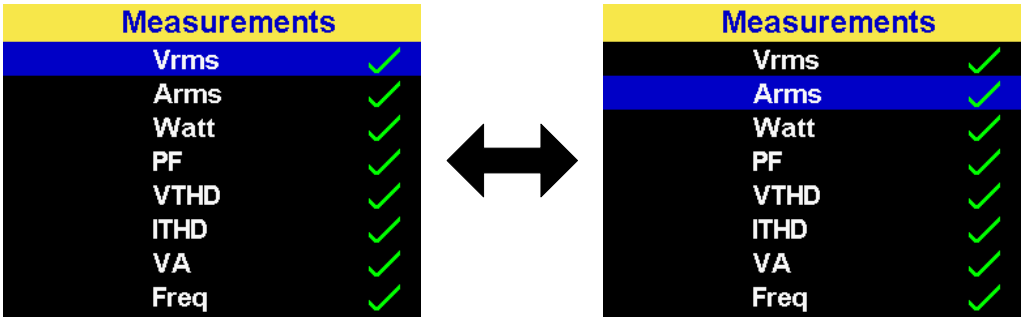
6.5.1 Customizing Meter Display screens

Meter displays can be customized by the user to show only relevant measurement values or display the most important measurements at the top. This can be accomplished by editing the Meter display configuration.

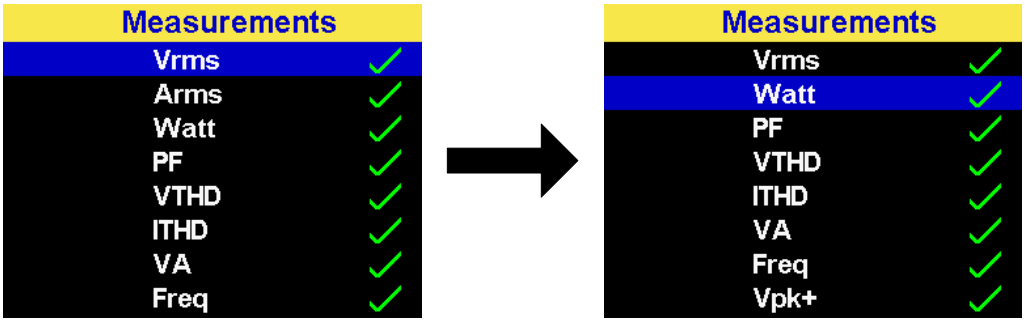
To Edit the Meter display, press the **Edit** Key while in Meter display mode. This will enter Edit mode as shown below.



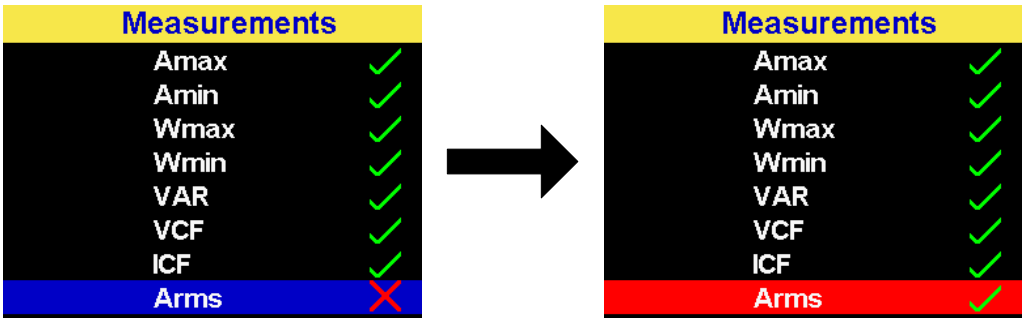
Press the ↑ or ↓ down key to move the display item you want to modify.



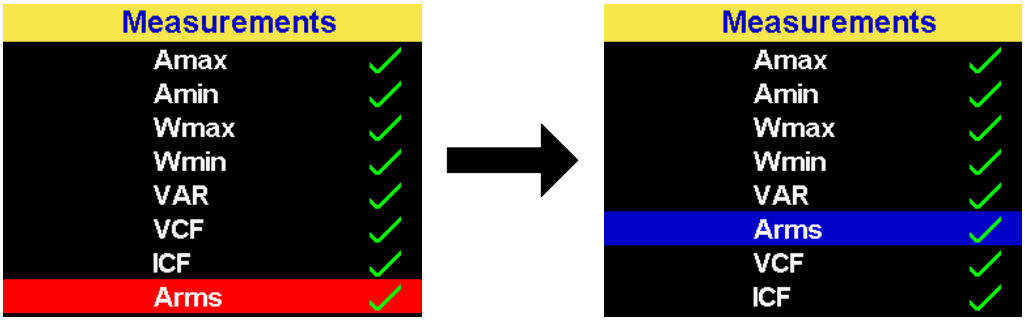
Select the open display item; press the **Select** key to close the display item (the closed item will automatically move to the end of the display pages).



To move a closed item- for example Arms - to a new custom location in the display list, select the closed display item by pressing the **..Select** key to open the display item and lock the indicator (the selected item is shown in **red** when locked as shown below).



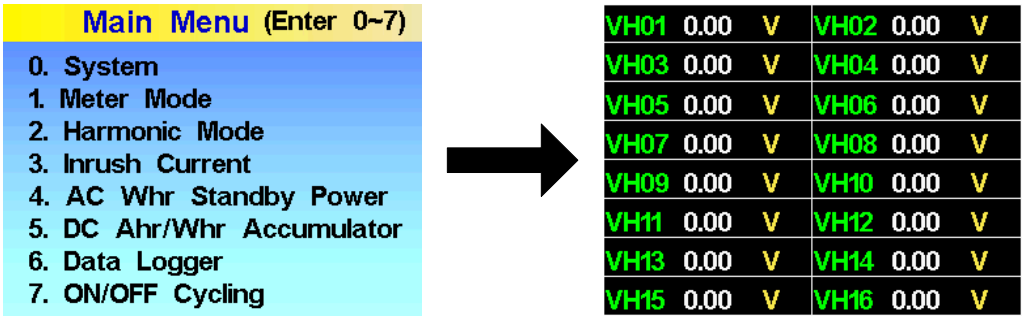
Once locked, you can move the indicator by pressing the ↑ or ↓ down key to move it to the position you want to place it. Press the **Select** key to confirm the placement position.



When done customizing the measurement display order, press the **Edit** Key again to exit the Edit mode.

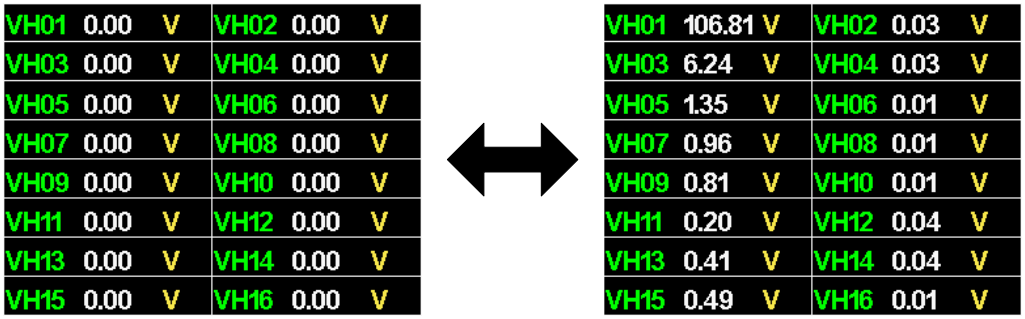
6.6 Harmonic Measurement Mode

The Harmonic Measurement mode is selected from the Main menu by pressing the number 2 key on the keypad.

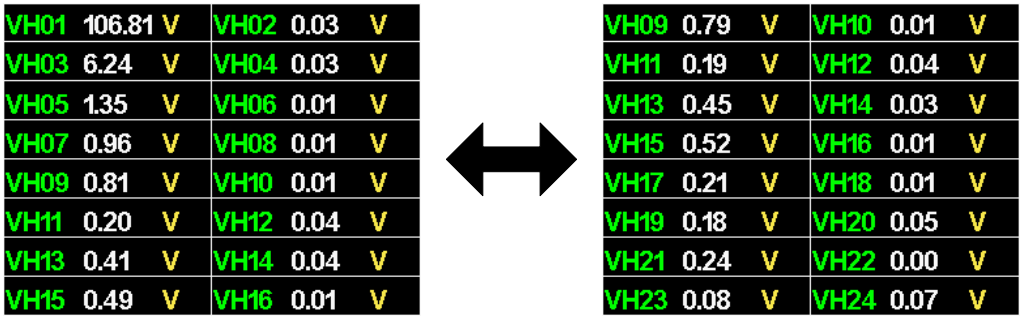


The voltage or current harmonic number is shown in green, the measured value is shown in white and the unit (V or A) is shown in yellow. See image above.

If the EUT output of the power analyzer is OFF, press the Load On/Off key to enable power output to the EUT. This should result in measurement readings as shown below.



To select harmonics past no 16, use the ↓ cursor key. To scroll back up, use the ↑ cursor key.



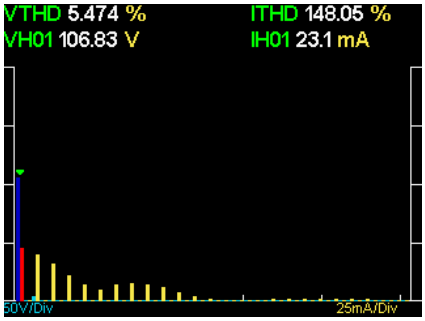
To toggle between Voltage harmonics and Current harmonics, use the ← or → cursor keys.

VH01	106.81	V	VH02	0.03	V
VH03	6.24	V	VH04	0.03	V
VH05	1.35	V	VH06	0.01	V
VH07	0.96	V	VH08	0.01	V
VH09	0.81	V	VH10	0.01	V
VH11	0.20	V	VH12	0.04	V
VH13	0.41	V	VH14	0.04	V
VH15	0.49	V	VH16	0.01	V

IH01	24.2	mA	IH02	0.1	mA
IH03	21.7	mA	IH04	0.0	mA
IH05	17.5	mA	IH06	0.0	mA
IH07	12.6	mA	IH08	0.0	mA
IH09	8.7	mA	IH10	0.0	mA
IH11	7.9	mA	IH12	0.0	mA
IH13	8.8	mA	IH14	0.0	mA
IH15	9.3	mA	IH16	0.0	mA

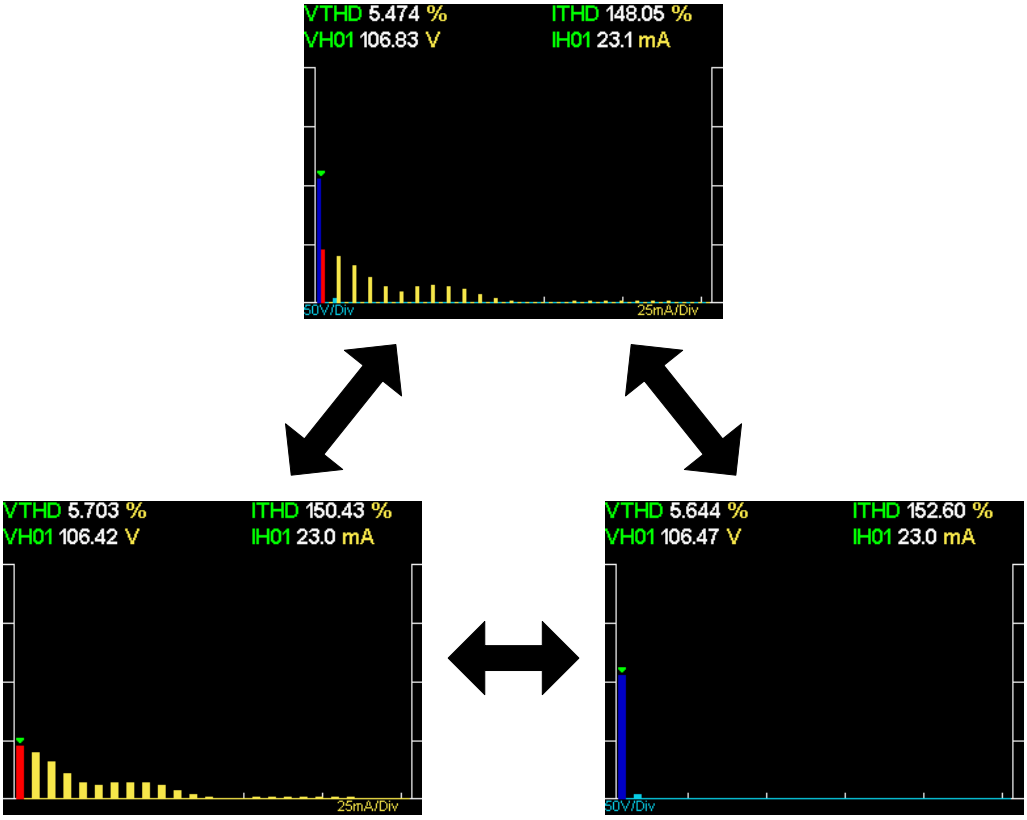
The Harmonics mode also displays data in a graphical bar chart mode. To toggle to the Graph display mode, press the **Graph** key on the front panel.

VH01	106.81	V	VH02	0.03	V
VH03	6.24	V	VH04	0.03	V
VH05	1.35	V	VH06	0.01	V
VH07	0.96	V	VH08	0.01	V
VH09	0.81	V	VH10	0.01	V
VH11	0.20	V	VH12	0.04	V
VH13	0.41	V	VH14	0.04	V
VH15	0.49	V	VH16	0.01	V

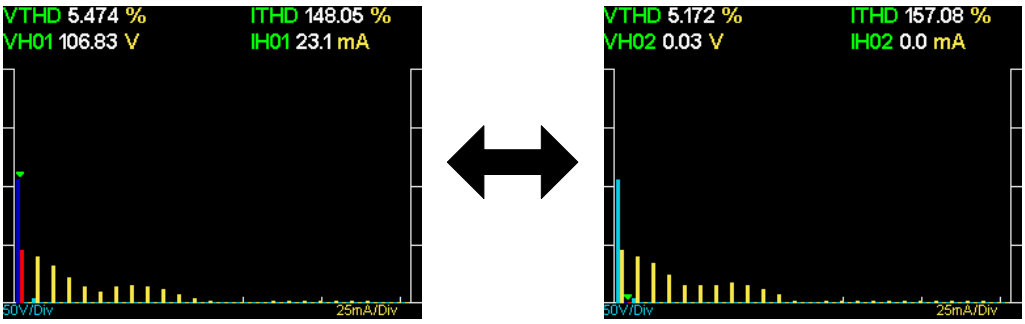


While in graphics mode, press the ← or →cursor key to switch between the three available Harmonic Graph display modes:

- Voltage
- Current
- Voltage and Current

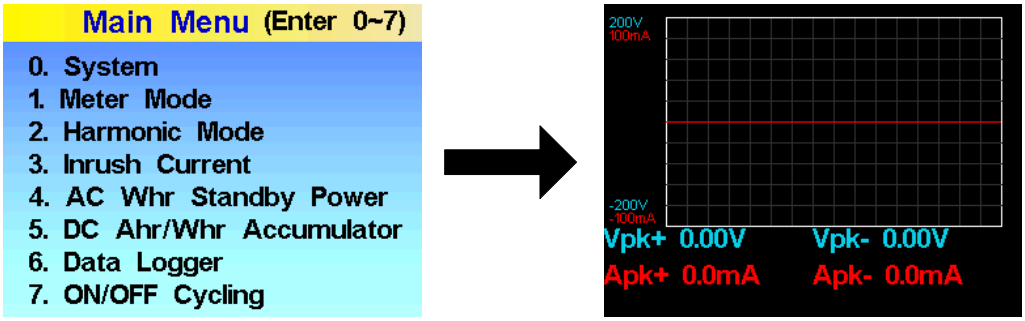


While in Harmonics Graph display mode, the highlighted individual voltage or current harmonics can be selected using the ← and → cursor keys. This will scroll left or right displaying the values for the selected bar at the top of the display.



6.7 Inrush Voltage and Current Measurements

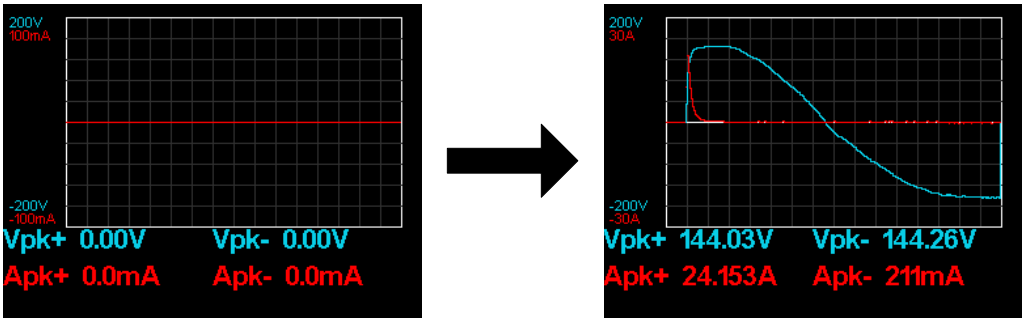
The Inrush Current mode is selected from the Main menu by pressing the number 3 key on the keypad. This mode allows both inrush current and voltage to be captured and measured.



The internal electronic On/Off switch is used to turn on power to the EUT at the programmed start phase angle set in the System Menu. See section 6.4, “System Settings” on page 31 for details on setting the start phase angle. It can also be set from the Inrush Mode itself using the Edit Key. See section 6.7.1, “Inrush Settings” on page 41.

If the EUT output of the power analyzer is already ON, press the Load **On/Off** key to turn **OFF** power to the EUT first and allow it to completely bleed of any input capacitor charge that may still be present.

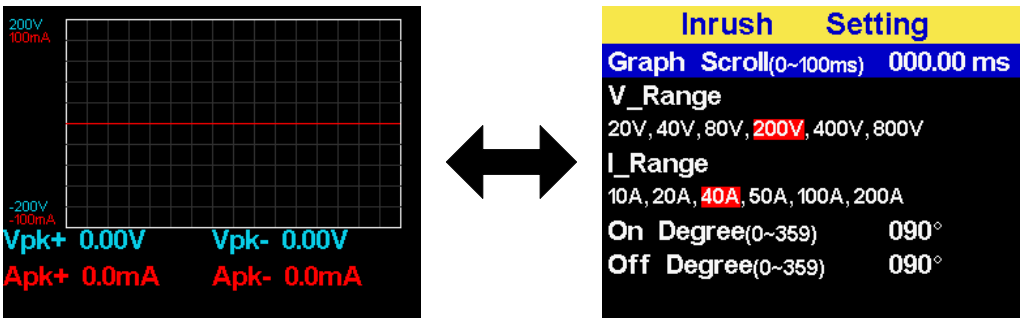
To start the inrush measurement, press the Load **On/Off** key to enable power output to the EUT. This should result in measurement readings as shown below.



The peak current is displayed as either Apk+ or Apk- depending on the start phase angle of the voltage. In this example, a 90-degree start phase angle was set so the positive peak current is the highest.

6.7.1 Inrush Settings

To display the inrush measurement setting page, press **Edit** Key. This will display the Inrush Setting page as shown below.

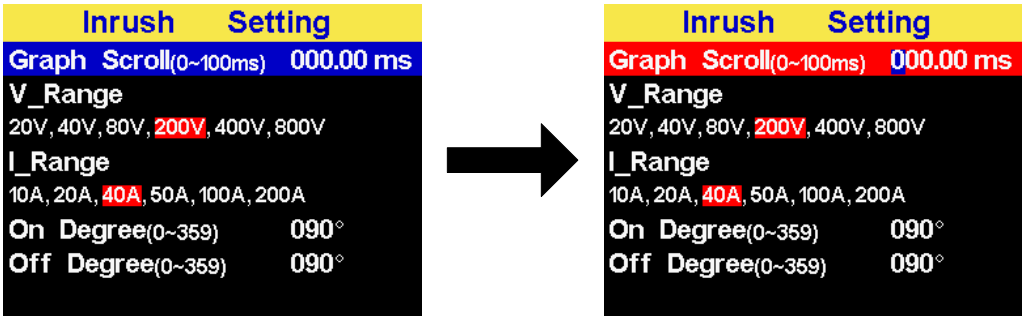


The following fields and available settings are contained in the Inrush Setting menu:

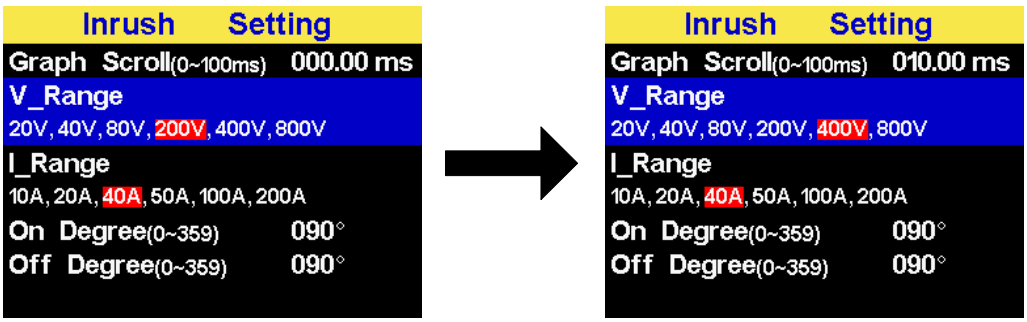
Setting	Description	Parameter Range
Graph Scroll	Sets the graph display offset display in miliseconds (ms)	0.00 ~ 100.ms
V_Range	Sets the voltage peak measurement range to be used for Inrush voltage measurements (Vpk)	20V, 40V, 80V, 200V, 400V, 800V
I_Range	Sets the current peak measurement range to be used for Inrush current measurements (Ipk)	10A, 20A, 40A, 50A, 100A, 200A
On Degree (0 ~ 359)	Set EUT Power On Electronic Switch phase angle	0 through 359
Off Degree (0 ~ 359)	Set EUT Power Off Electronic Switch phase angle	0 through 359

Sample setting screens for Inrush measurement settings are shown below. Changing settings is accomplished as explained earlier in section 6.3, “Data Entry Operation” on page 31.

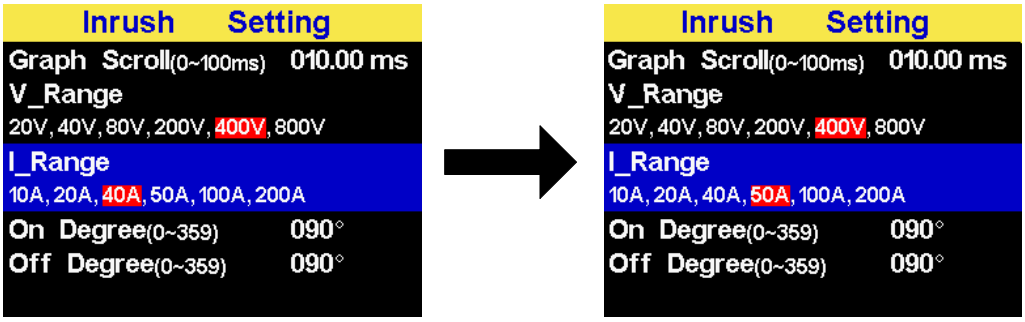
Graph Scroll Setting



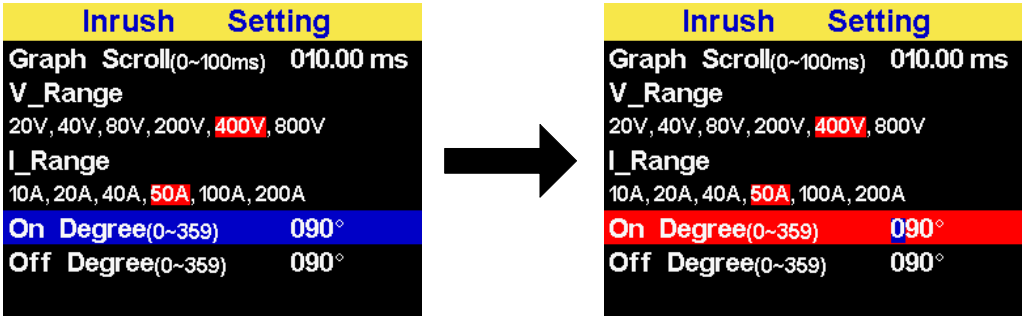
Voltage Range Selection



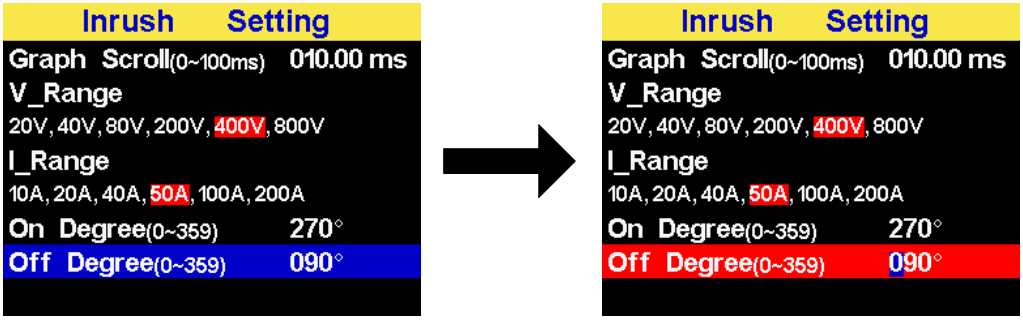
Current Range Selection



Power On Phase Angle Setting



Power Off Phase Angle Setting



6.8 AC Whr Standby Power

AC power standby measurements involve very low AC current levels multiplied by the AC voltage across the EUT load terminals. As such, it is important to minimize the effect of the voltage drop across the current shunt on the voltage measurement so the calculated power is as accurate as possible.

6.8.1 Standby Power Test Fixture Box Accessory

To facilitate this, APS offers a special standby power test fixture box adaptor to make the appropriate connections to a US line cord connected unit under test (EUT).

Figure 6-2: M1001-TFB Test Fixture Box Accessory

This test fixture allows the EUT to plugged in the LOAD socket. Power is applied to the SOURCE input male socket on the left.

The rear of the adaptor includes the required banana jack terminated wires to connect to the M1001 Power Analyzer rear panel as illustrated in the figure below.

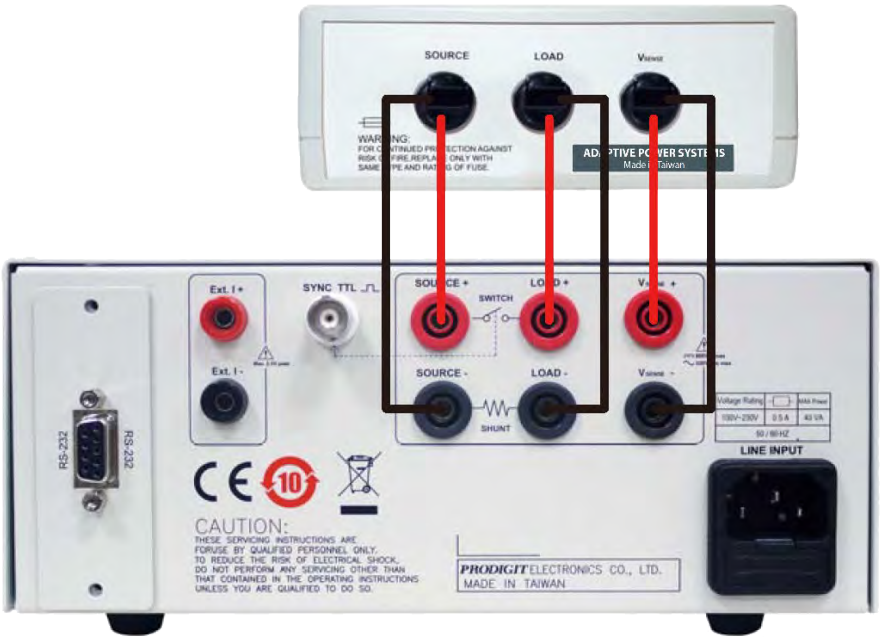
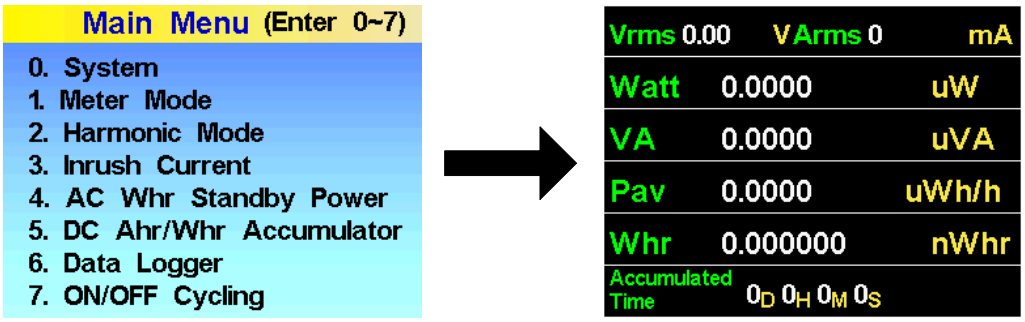


Figure 6-3: Test Fixture Box connections for Standby Power Measurements

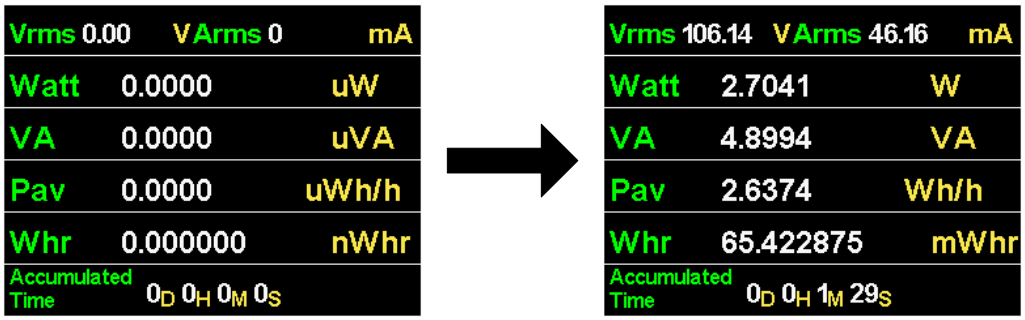
Note: Since Standby Power measurements involve low current levels, the use of the internal current shunt is recommended.

6.8.2 Making AC Standby Power Measurements

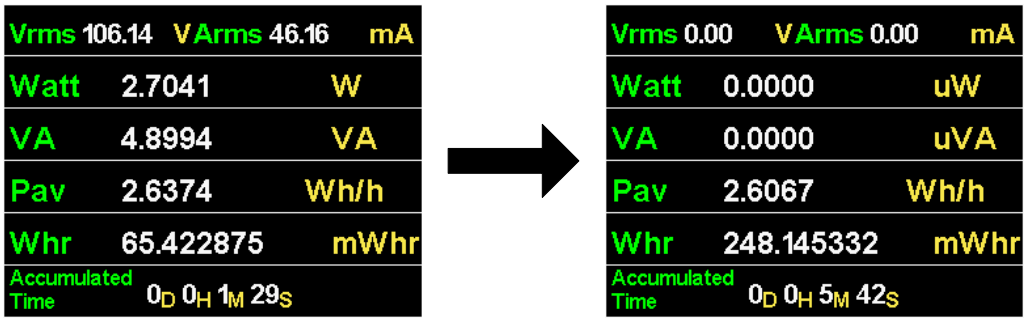
The AC Standby Power screen is selected by pressing the -4- key from the Main menu screen. The Standby Power screen displays power measurement results in easy to read, large color coded numbers.



If the EUT output of the power analyzer is OFF, press the Load **On/Off** key to enable power output to the EUT. This will start power consumption accumulation.

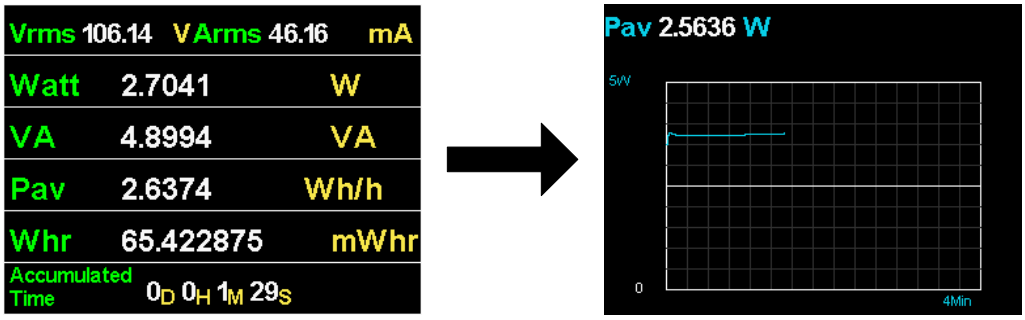


When sufficient time has passed and the Whr reading has stabilized, terminate the measurement by turning off the EUT using the Load **On/Off** key.



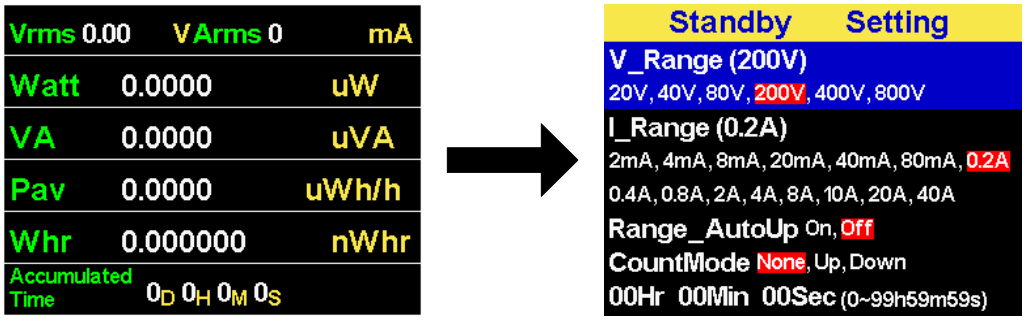
6.8.3 AC Standby Power Graph Display

The Standby Power mode also displays data in a graphical strip chart mode. To toggle to the Graph display mode, press the **Graph** key on the front panel.



6.8.4 AC Standby Power Settings

To display the measurement setting page, press **Edit** Key. This will display the AC Standby Power Setting page as shown below.

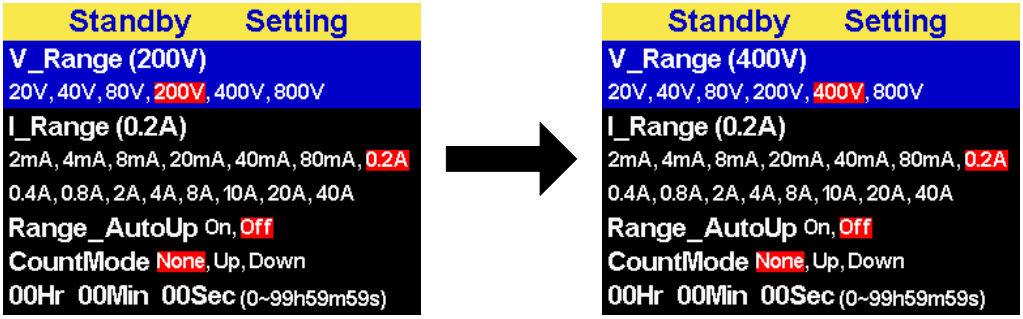


The following fields and available settings are contained in the AC Standby Power Setting menu:

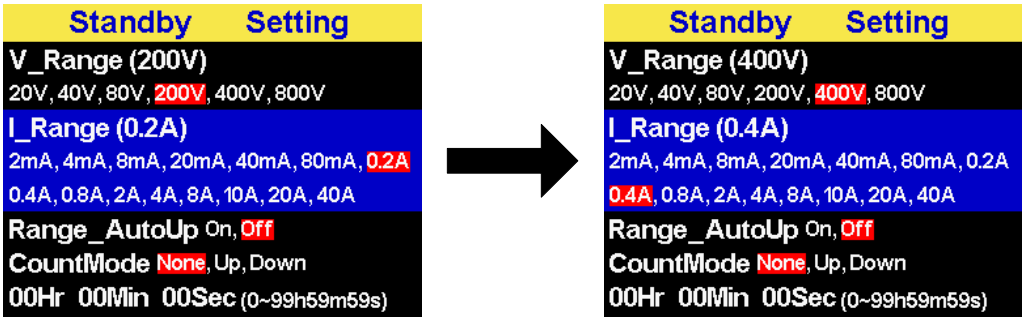
Setting	Description	Parameter Range
V_Range	Sets the voltage peak measurement range to be used for the voltage measurement	20V, 40V, 80V, 200V, 400V, 800V
I_Range	Sets the current peak measurement range to be used for standy current measurements (Arms)	2mA, 4mA, 8mA, 20mA, 40mA, 0.2A, 0.4A, 0.8A, 10A, 20A, 40A
Range_AutoUp	When on, voltage and/or current ranges are automatically increased as needed based on measured values.	On, Off
CountMode	Accumulated time count up or down display of OFF.	None, Up, Down
Measurement Time	Measurement Time Setting. Max is 100 hours.	0 ~ 99h59m59s

Sample setting screens for Standby Power measurement settings are shown below. Changing settings is accomplished as explained earlier in section 6.3, “Data Entry Operation” on page 31.

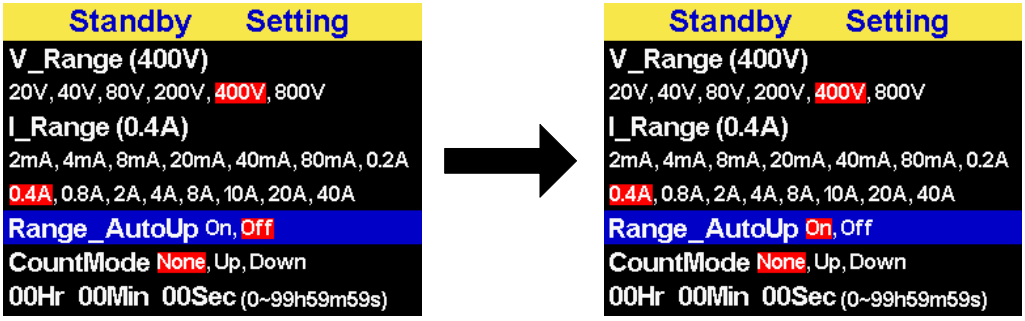
Voltage Range Selection



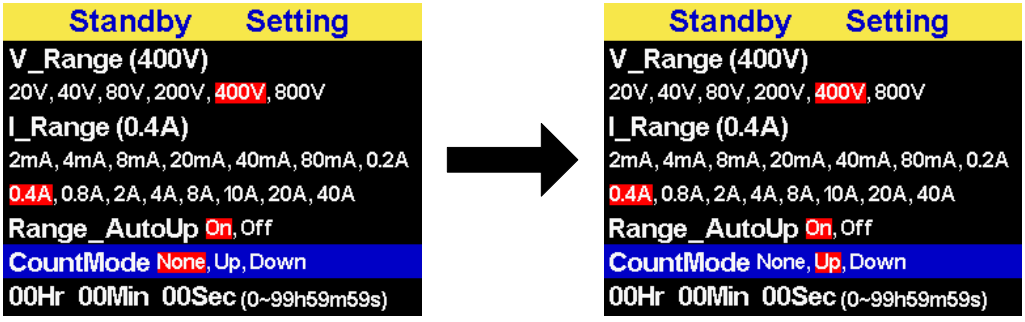
Current Range Selection



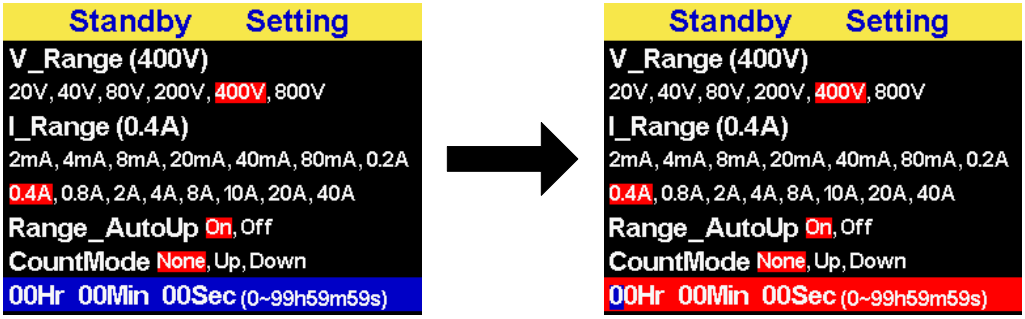
Range_AutoUp



Count Mode



Measurement Time



6.9 DC Ahr/Whr Accumulator

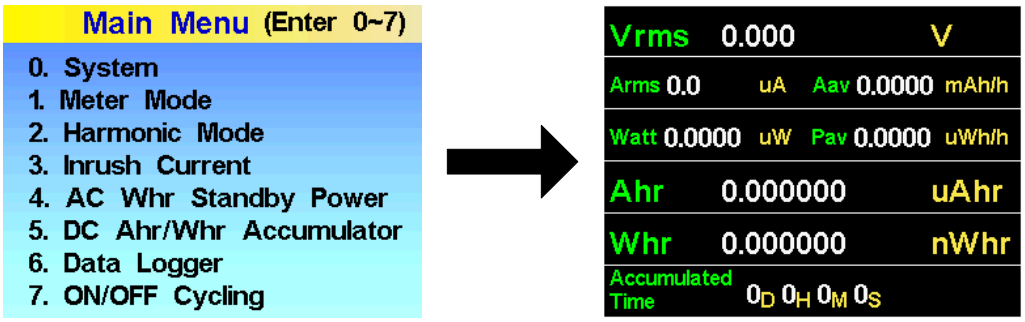
DC power standby measurements involve very low DC current levels multiplied by the DC voltage across the EUT load terminals. As such, it is important to minimize the effect of the voltage drop across the current shunt on the voltage measurement so the calculated power is as accurate as possible.

6.9.1 Standby Power Test Fixture Box Accessory

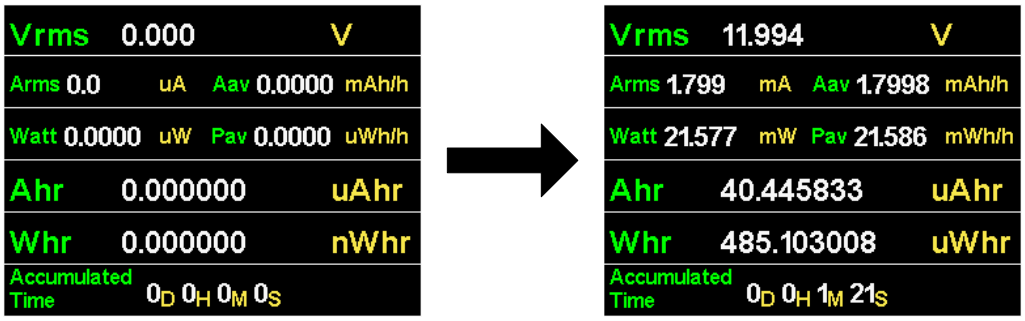
To facilitate this, APS offers a special standby power test fixture box adaptor to make the appropriate connections to a US line cord connected unit under test (EUT). Refer to section 6.8.1, “Standby Power Test Fixture Box Accessory’ on page 43 for details.

6.9.2 Making DC Standby Power Measurements

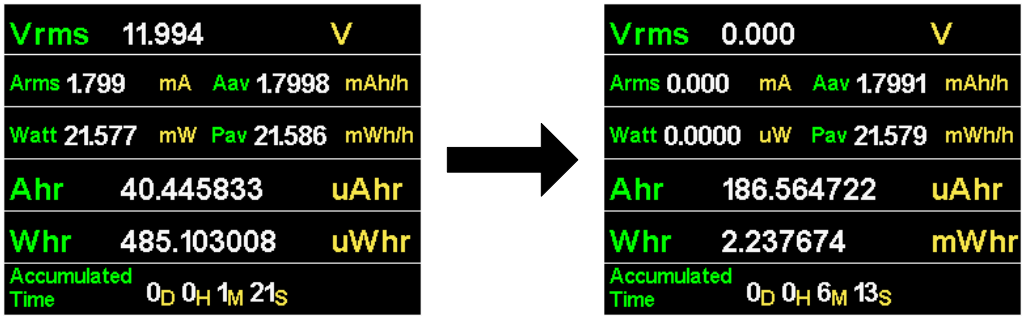
The DC Standby Power screen is selected by pressing the -5- key from the Main menu screen. The Standby Power screen displays power measurement results in easy to read, large color coded numbers. Note that voltage and current are displayed in RMS as in DC mode, RMS and DC are identical.



If the EUT output of the power analyzer is OFF, press the Load **On/Off** key to enable power output to the EUT. This will start power consumption accumulation.

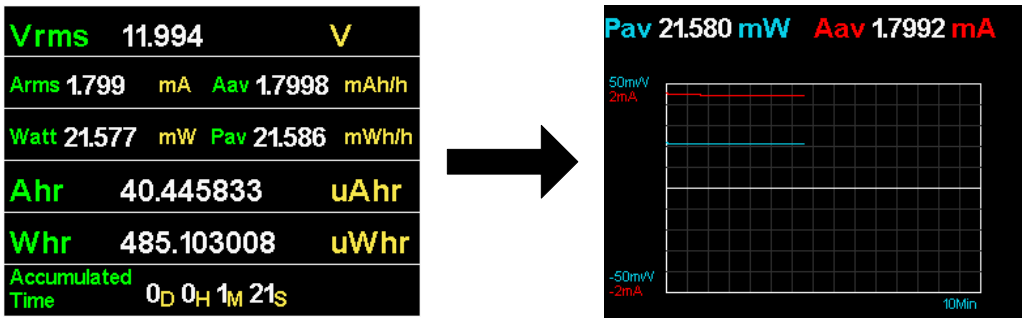


When sufficient time has passed and the Whr reading has stabilized, terminate the measurement by turning off the EUT using the Load **On/Off** key.



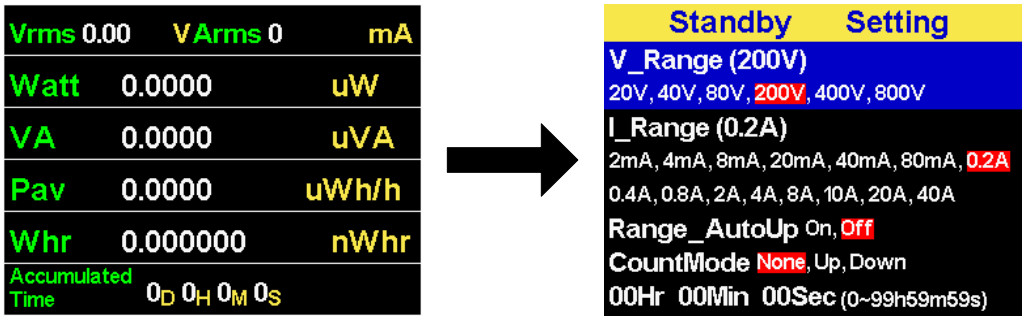
6.9.3 DC Standby Power Graph Display

The Standby Power mode also displays data in a graphical strip chart mode. To toggle to the Graph display mode, press the **Graph** key on the front panel.



6.9.4 DC Standby Power Settings

To display the measurement setting page, press **Edit** Key. This will display the DC Standby Power Setting page as shown below.

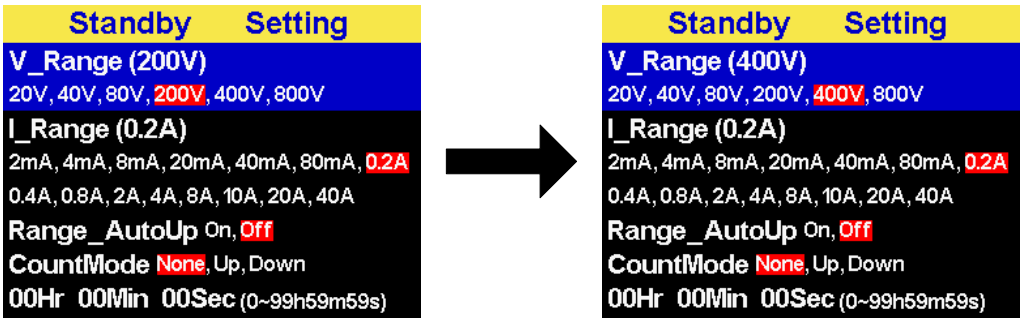


The following fields and available settings are contained in the DC Standby Power Setting menu:

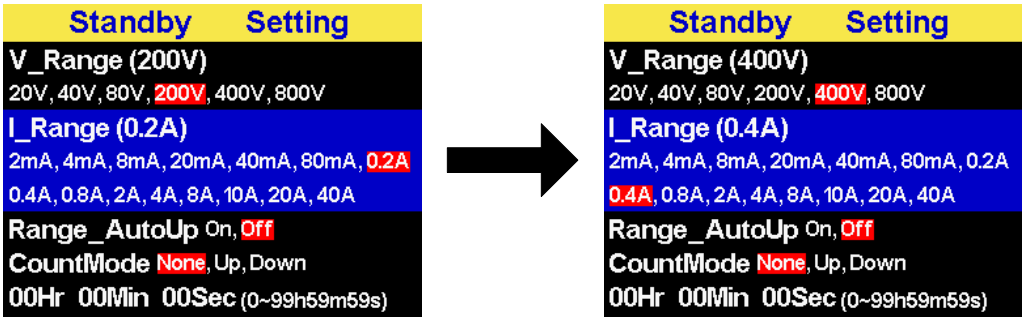
Setting	Description	Parameter Range
V_Range	Sets the voltage peak measurement range to be used for the voltage measurement	20V, 40V, 80V, 200V, 400V, 800V
I_Range	Sets the current peak measurement range to be used for standy current measurements (Arms)	2mA, 4mA, 8mA, 20mA, 40mA, 0.2A, 0.4A, 0.8A, 10A, 20A, 40A
Range_AutoUp	When on, voltage and/or current ranges are automatically increased as needed based on measured values.	On, Off
CountMode	Accumulated time count up or down display of OFF.	None, Up, Down
Measurement Time	Measurement Time Setting. Max is 100 hours.	0 ~ 99h59m59s

Sample setting screens for Standby Power measurement settings are shown below. Changing settings is accomplished as explained earlier in section 6.3, “Data Entry Operation” on page 31.

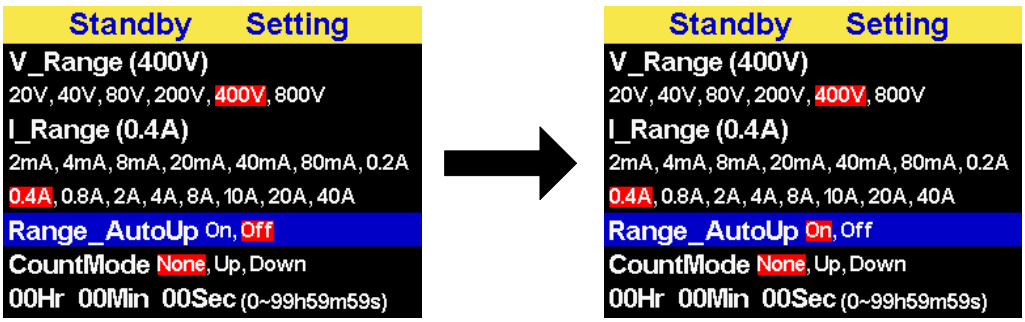
Voltage Range Selection



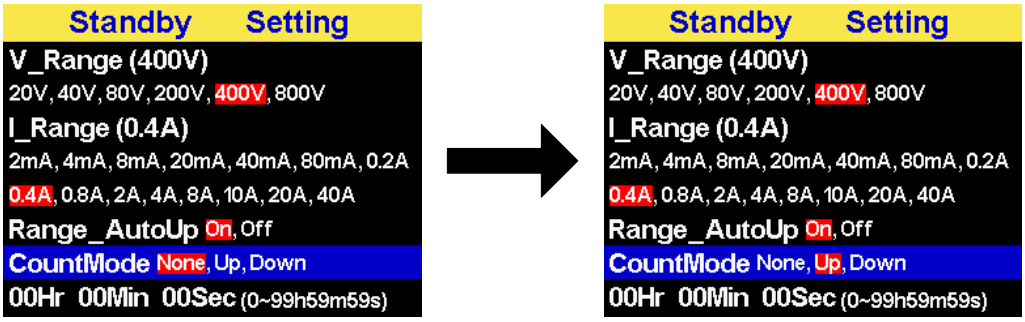
Current Range Selection



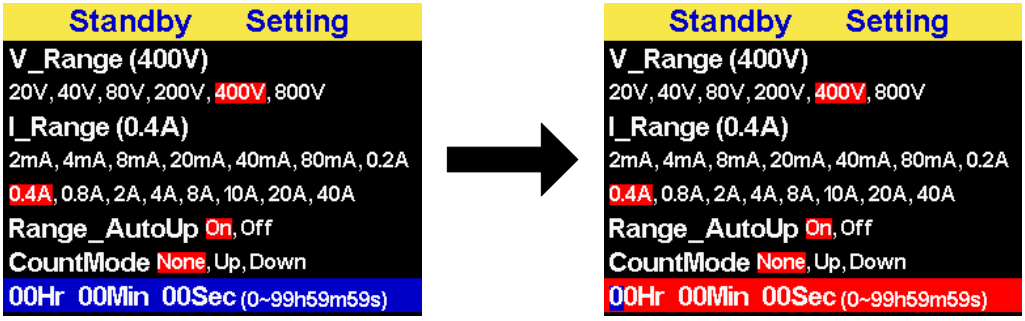
Range_AutoUp



Count Mode

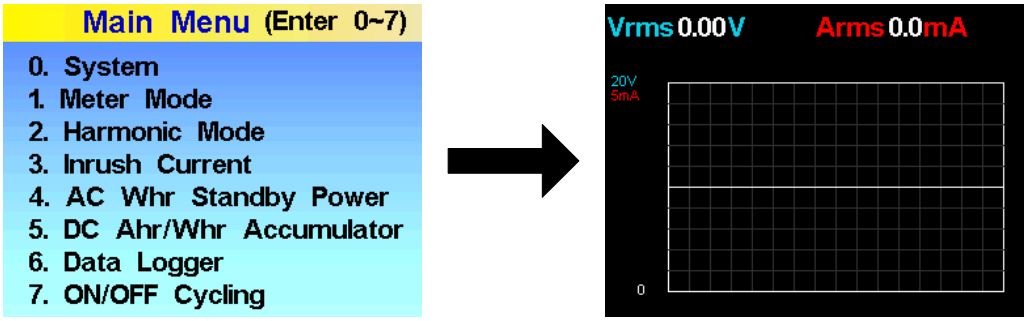


Measurement Time

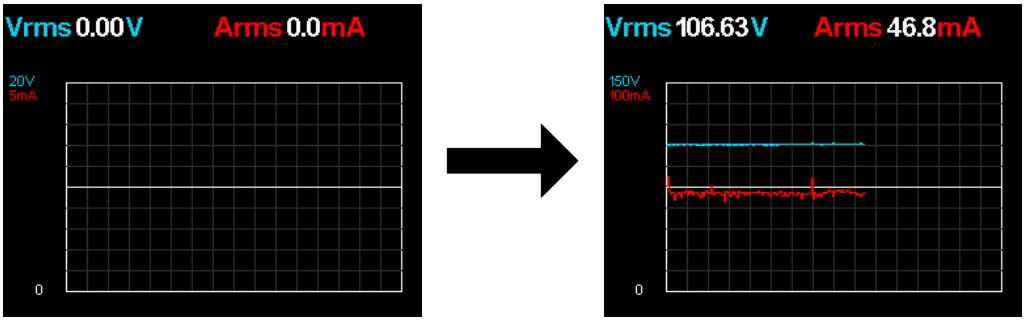


6.11 Data Logger

The Data Logger screen is selected by pressing the -6- key from the Main menu screen. The data logger screen consists of a strip chart like graph.

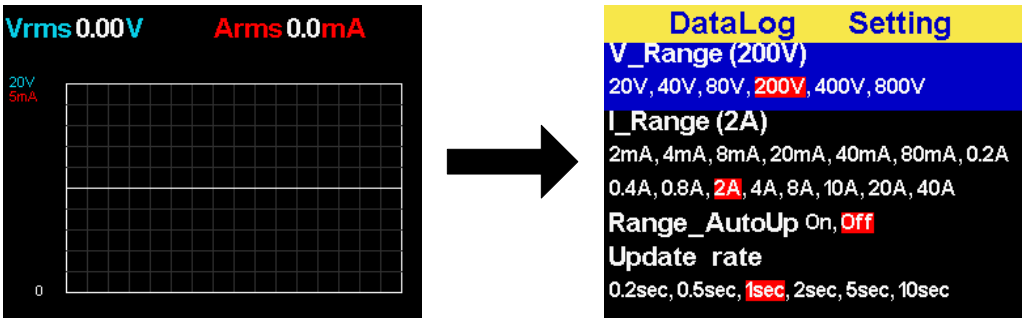


Press the Load **On/Off** key to start and stop measurement data logging.



6.11.1 Inrush Settings

To display the Data Logger setting page, press **Edit** Key. This will display the Setting page as shown below.

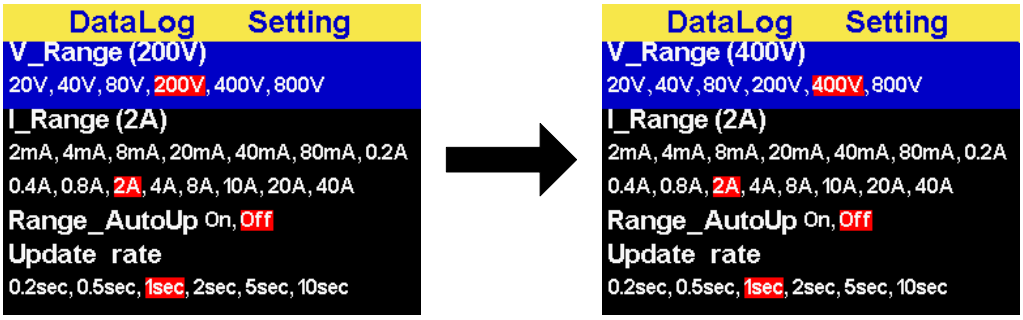


The following fields and available settings are contained in the Data Logger Setting menu:

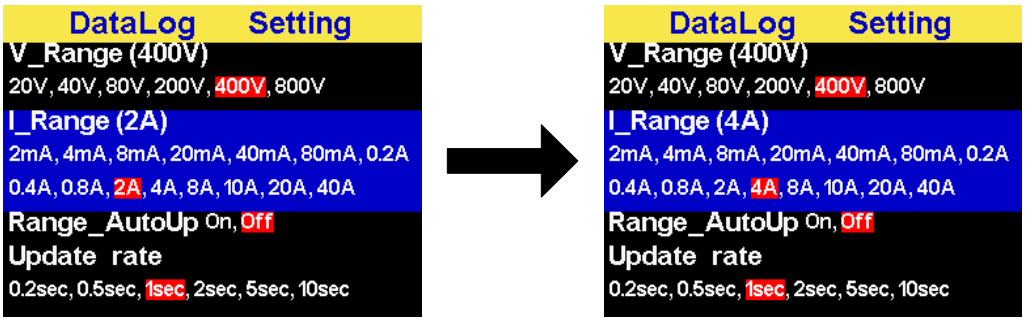
Setting	Description	Parameter Range
V_Range	Sets the voltage peak measurement range to be used for the voltage measurement	20V, 40V, 80V, 200V, 400V, 800V
I_Range	Sets the current peak measurement range to be used for standy current measurements (Arms)	2mA, 4mA, 8mA, 20mA, 40mA, 0.2A, 0.4A, 0.8A, 10A, 20A, 40A
Range_AutoUp	When on, voltage and/or current ranges are automatically increased as needed based on measured values.	On, Off
Update rate	The update rate determines the time interval between successive measurement log recordings in seconds.	0.2sec, 0.5sec, 1sec, 2sec, 5sec, 10sec

Sample setting screens for Data Logger measurement settings are shown below. Changing settings is accomplished as explained earlier in section 6.3, “Data Entry Operation” on page 31.

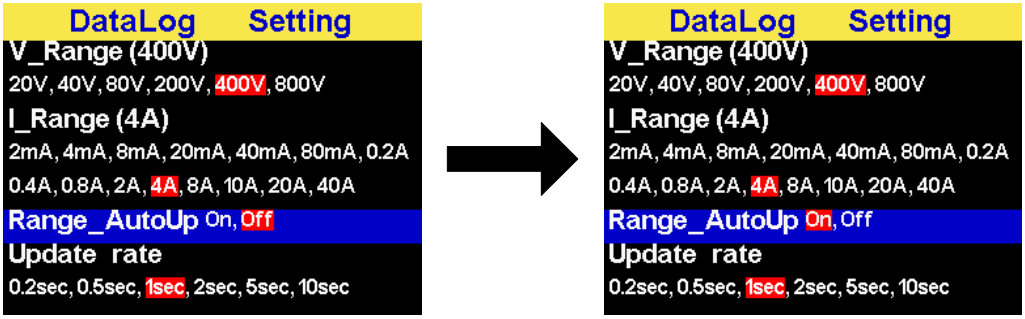
Voltage Range Selection



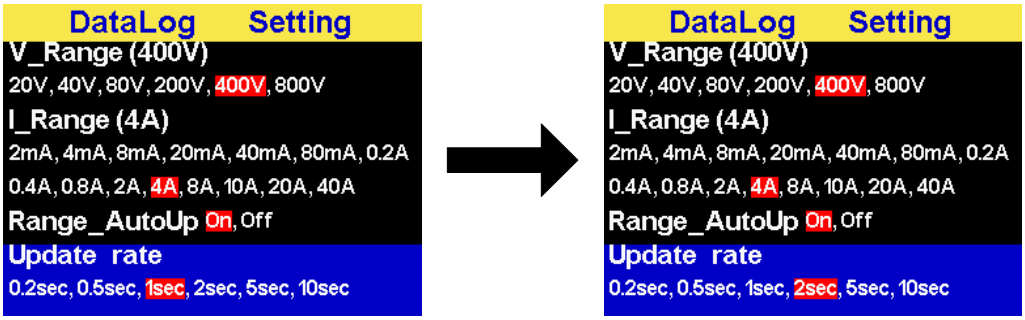
Current Range Selection



Range_AutoUp

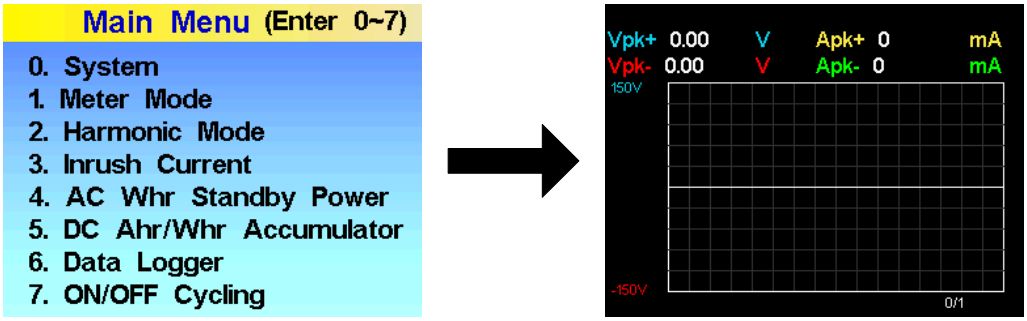


Update rate

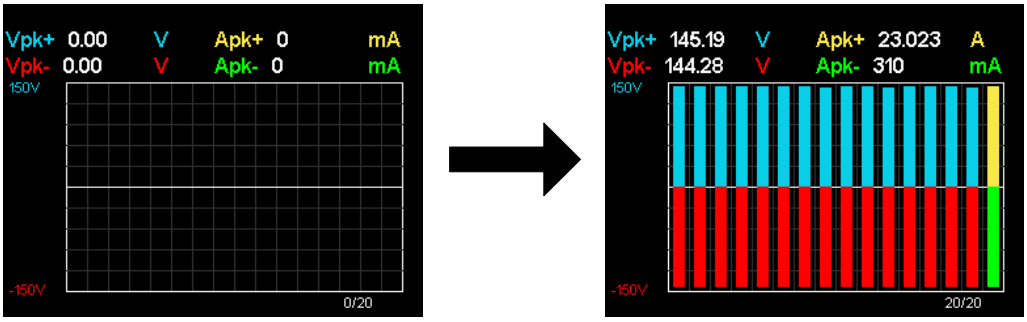


6.12 ON/OFF Cycling

The Meter screen is selected by pressing the -7- key from the Main menu screen. The ON/OFF Cycling screen consists of a bar chart like graph.

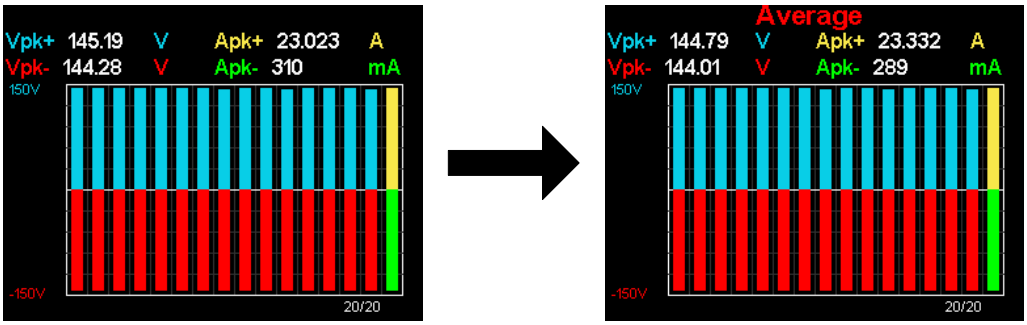


Press the Load **On/Off** key to start and stop power cycling of the EUT.

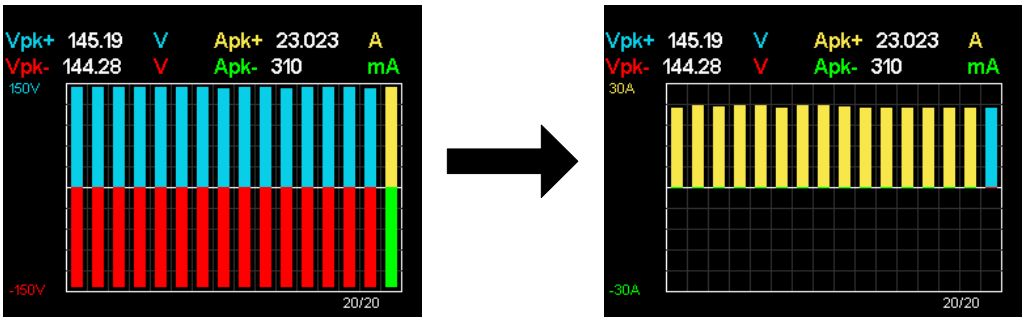


6.12.1 Power Cycling Display Mode Selections

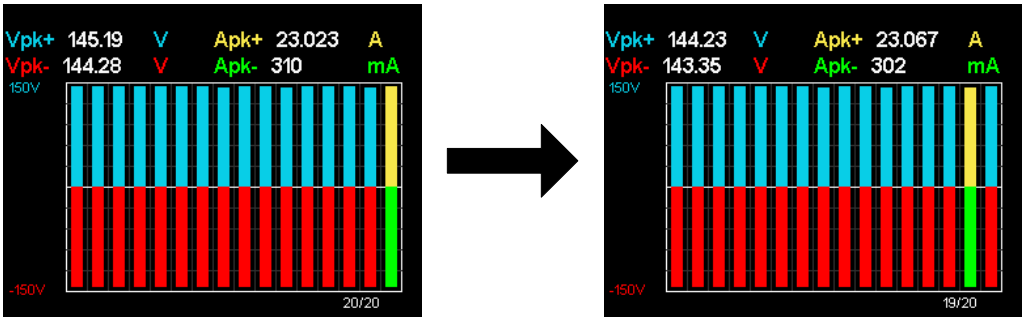
To toggle between instantaneous (immediate) and average measurement values display, press the ↑or ↓ cursor keys.



To toggle between voltage or current measurement display formats, press the **Select** key.

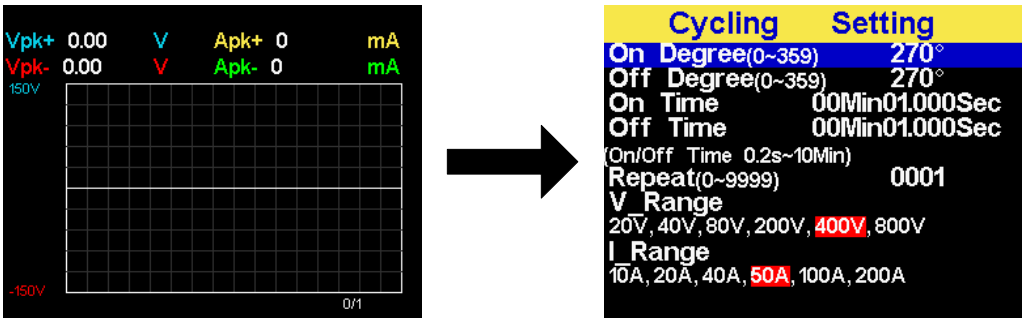


To select a specific cycle in the sequence, use the ← and → cursor keys to scroll through the display. The Power Cycle test retains the last 256 power cycles. Data for the highlighted bar is shown at the top of the display.



6.12.2 Power Cycling Settings

To display the Power Cycling setting page, press **Edit** Key. This will display the Setting page as shown below.

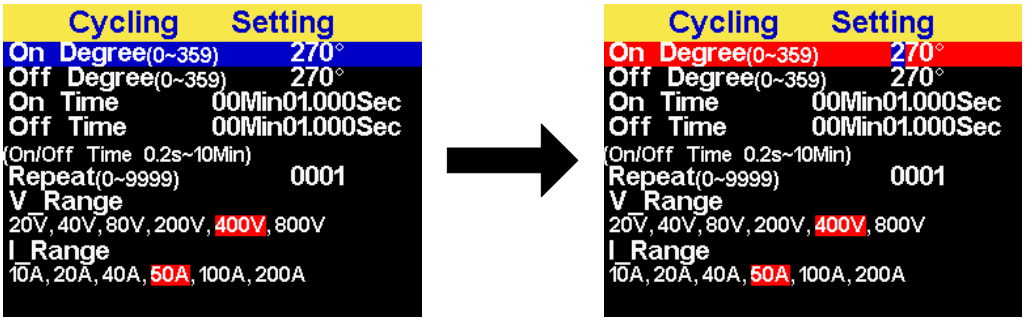


The following fields and available settings are contained in the Data Logger Setting menu:

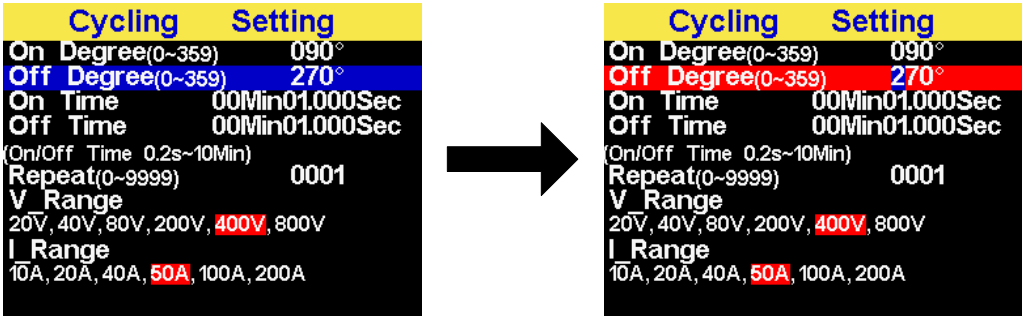
Setting	Description	Parameter Range
On Degree (0 ~ 359)	Set EUT Power On Electronic Switch phase angle	0 through 359
Off Degree (0 ~ 359)	Set EUT Power Off Electronic Switch phase angle	0 through 359
On Time	Time for EUT to be on in 00 Min 01.000 Sec.	0.2 sec ~ 10.00 min
Off Time	Time for EUT to be off in 00 Min 01.000 Sec.	0.2 sec ~ 10.00 min
Repeat	Number of time to repeat On and Off cycle	0 ~ 9999
V_Range	Sets the voltage peak measurement range to be used for Inrush voltage measurements (Vpk)	20V, 40V, 80V, 200V, 400V, 800V
I_Range	Sets the current peak measurement range to be used for Inrush current measurements (Ipk)	10A, 20A, 40A, 50A, 100A, 200A

Sample setting screens for Power Cycling are shown below. Changing settings is accomplished as explained earlier in section 6.3, “Data Entry Operation” on page 31.

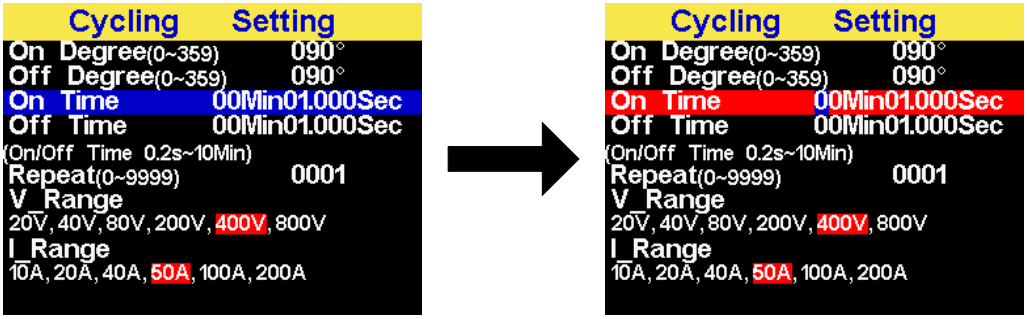
Power On Phase Angle Setting



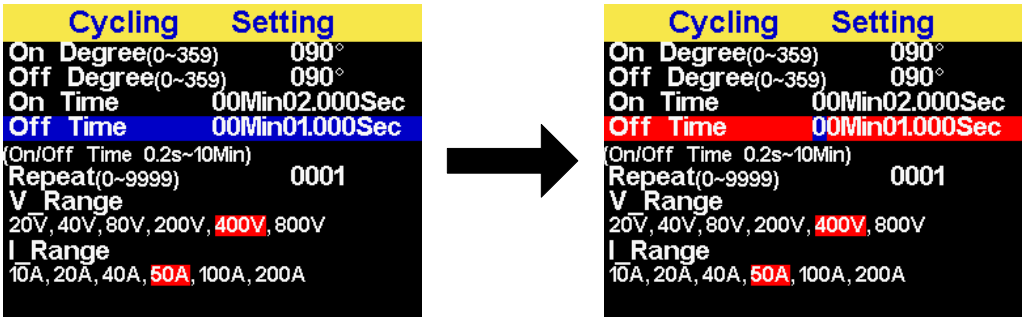
Power Off Phase Angle Setting



On Time Setting

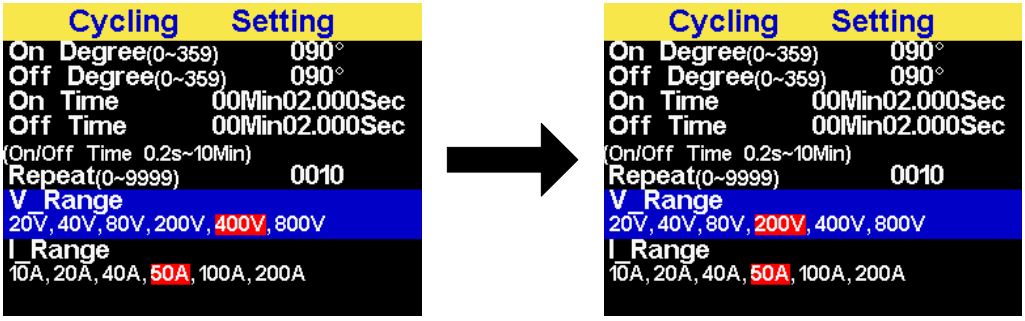


Off Time Setting

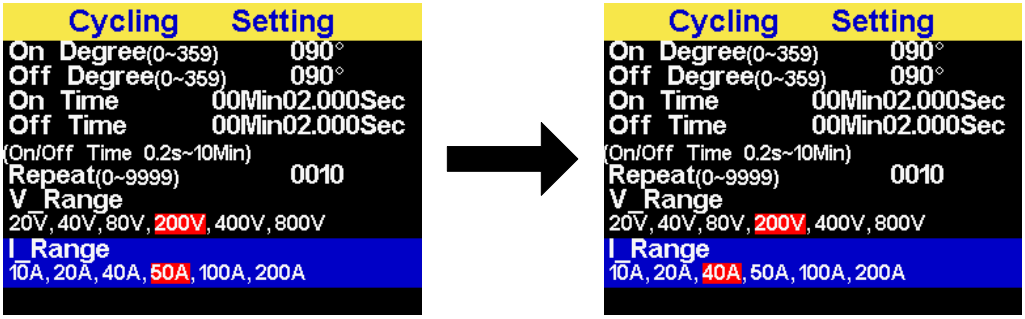


Repeat Cycles Setting

Voltage Range Setting



Current Range Setting



7 Measurement Functions

This section establishes definitions and formulas used for the various measurements that can be performed with the power analyzer. It also explains the digital sampling methods used to acquire measurements.

7.1 Voltage Measurements

The following formulas are used by the power analyzer to calculate Voltage values:

Measurement	Formula
RMS Voltage	$\sqrt{\frac{1}{T}\int_0^T V_i^2\,dt}$
+ / - V pk	Max [Value(t)] or Min [Value(t)]
Vmax, Vmin	Max [Value] or Min [Value]
Crest Factor (VCF)	Peak Value / RMS Value

7.2 Current Measurements

The following formulas are used by the power analyzer to calculate Current values:

Measurement	Formula
RMS Current	$\sqrt{\frac{1}{T}\int_0^T A_i^2\,dt}$
+ / - A pk	Max [Value(t)] or Min [Value(t)]
Amax, Amin	Max [Value] or Min [Value]
Crest Factor (ICF)	Peak Value / RMS Value

7.3 Power Measurements

The following formulas are used by the power analyzer to calculate Power values:

Measurement	Formula
Active Power (Watt)	$\frac{1}{T}\int_0^T V_i \times A_i\,dt$
Apparent Power (VA)	Vrms × Arms
Reactive Power (VAR)	$\sqrt{VA^2 - W^2}$
Wmax / Wmin	Max [Value] or Min [Value]
Power Factor	$\frac{Watt}{Vrms \times Arms}$

7.4 Harmonic Measurements

The following formulas are used by the power analyzer to calculate Voltage and Current Harmonic values:

Measurement	Formula
Harmonic	$\sqrt{Hr^2 + Hq^2}$
Total Harmonic Distortion (%)	$\sqrt{H_2^2 + H_3^2 + \ldots H_{50}^2} \div H_1$

7.5 Sampling Methods

The M1001 display updated rate is 200ms or five times per second. The first measurement value is shown as soon as it is available.

The unit measurement value is obtained at a fixed sampling rate of 4096 points in the sampling cycle and the measurement of each unit is performed continuously or gap-less.

The relationship between the sampling cycle and the fundamental frequency of the input voltage is as shown in the table below.

Voltage Fundamental Frequency	Sampling Cycle
20 ~100 Hz	1 Cycle
100 ~ 200 Hz	2 Cycles
200 ~ 400 Hz	4 Cycles
400 ~ 800 Hz	8 Cycles
800 ~ 1000 Hz	16 Cycles

Table 7-1: Sampling Cycles as a function of input Voltage Fundamental Frequency

The unit measurement time depends on the voltage fundamental frequency and is 1 ~ 16 Cycles:

- 50Hz - 1 cycle <20ms>
- 60Hz - 1 cycle <16.6ms>.

The 50 / 60 Hz 1 Cycle samples 4096 points from the 16-bit A/D and displays the Power value in Watt through real-time DSP operation performing and integral accumulation operation.

No gap analysis is used for Standby Power accumulation and Pav calculations. Typical examples for 50 Hz and 400 Hz are shown in the figure below.

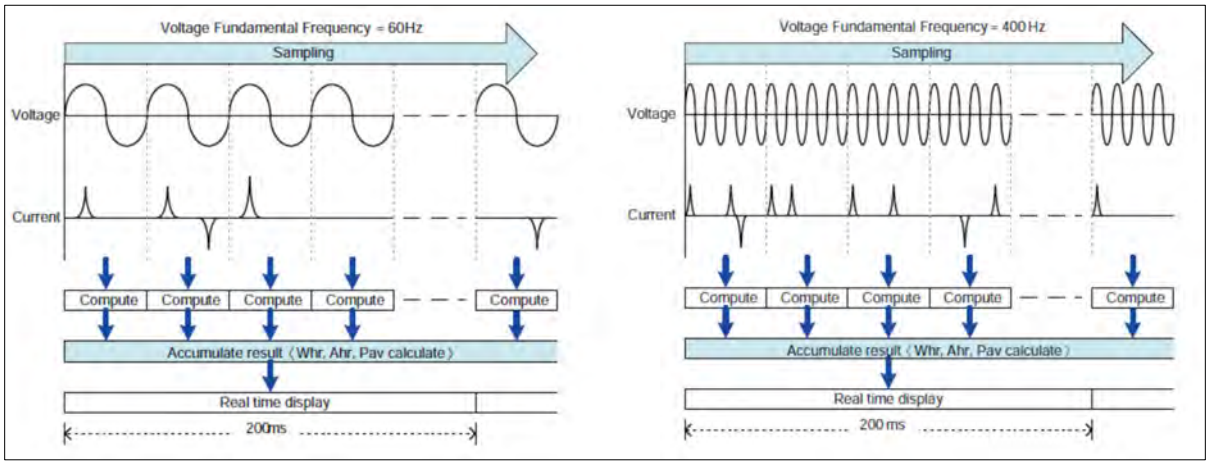


Figure 7-1: Sampling method and interval for different frequencies

7.6 Averaging Function

When the power supply is unstable as can be the case when using the AC mains, you can select averaging over 2 to 64 readings to obtain more stable value of Vrms, Arms, Watt and, VA.

When selecting averaging, the update rates of displayed measurements will slow down proportional to the selected number of readings averaged.

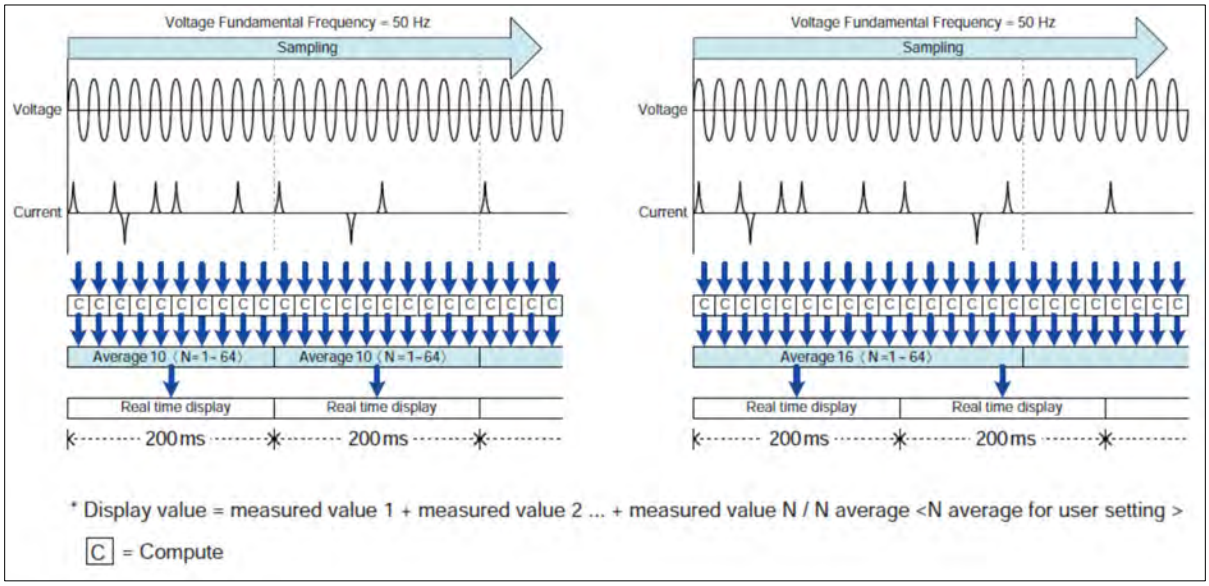


Figure 7-2: Measurement Averaging Computation

8 Remote Control Programming

8.1 Preface

One of four available Remote Control Interface options can be installed at the rear panel of the power analyzer using the interface slot. The cover plate may have to be removed if no interface option was ordered when purchased. Interface options can be ordered and added at a later time in the field.

Remote programming of M1001 Series requires the use of a Windows PC or Laptop. Any development environment may be used as needed, including but not limited to NI LabView™, MS Visual # or Keysight VEE.

The command syntax is message based and the same for all interface types.

8.2 Available Interface Options

The following four interface options are available for the M1001 Power Analyzer. Only **one** can be installed at any time.

8.2.1 LAN / Ethernet Interface

The LAN interface is installed in the interface slot on the rear panel. The LAN interface uses a standard RJ45 Cat-5 Connector. This interface can be connected to an existing Ethernet network or directly to PC or Laptop using a Cat-5 Ethernet cable.

For LAN configuration information, refer to Section 11, “LAN Interface Settings” on page 88.

8.2.2 USB Interface

The USB interface is installed in the interface slot on the rear panel. A standard Type B to Type A USB device cable is required to connect to a PC or Laptop USB port (not included).

The baud rate used for the USB interface is 115200 bps fixed. Make sure the correct terminators are used by your application program. See section 8.3.3, “Termination Characters” on page 65.

Note: When using USB interface to control the power analyzer, the unit appear as an RS232 interface COM interface using a virtual USB-COM driver. (see Section 10, “USB Driver Installation” on page 79).

8.2.3 RS232 Serial Interface

The RS232 interface protocol used is fixed as follows:

Baud-rate:	115200bps
Parity:	None
Data bit:	8 bits
Stop bit:	1 bit

Handshaking: Hardware (RTS/CTS).

The baud rate used for the RS232 interface is 115200 bps fixed. Make sure the correct terminators are used by your application program. See section 8.3.3, “Termination Characters” on page 65.

The RS232 Interface connector is located on the rear panel of the unit and shown in the figure below. A standard straight-through RS232 cable is required to connect to a PC or Laptop (not included).

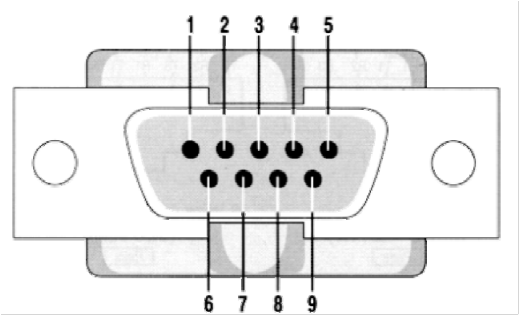


Figure 8-1: Rear Panel RS232 DB9 Connector Pins

The signal assignments are shown in the table below.

PIN	Abbreviation	Description
Pin1	CD	Carrier Detect
Pin2	RXD	Receive
Pin3	TXD	Transmit
Pin4	DTR	Data Terminal Ready
Pin5	GND	Ground
Pin6	DSR	Data Set Ready
Pin7	RTS	Request To Send
Pin8	CTS	Clear To Send
Pin9	RI	Ring Indicator

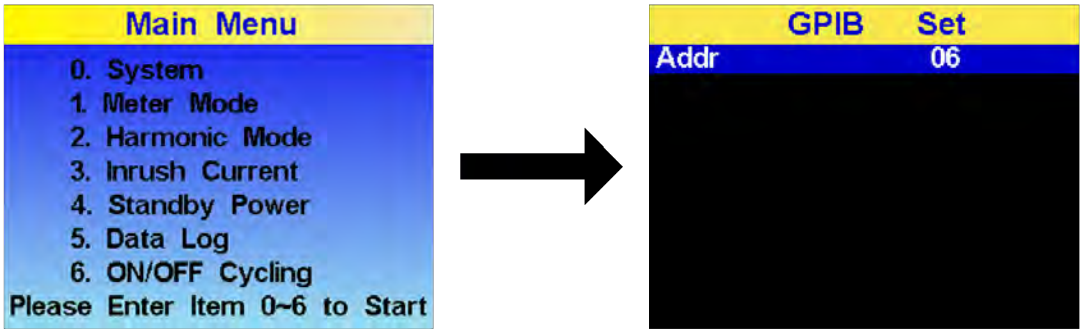
Table 8-1: RS232 Interface Connector Pin-out

8.2.4 GPIB Interface

The GPIB interface is installed in the interface slot on the rear panel. A standard GPIB cable (not included) is required to connect to a PC or Laptop equipped with a GPIB Controller. Alternatively, a USB to GPIB controller adaptor may be used (not included).

Make sure the correct terminators are used by your application program. See section 8.3.3, “Termination Characters” on page 65.

To use the GPIB interface, a GPIB address from 1 through 30 needs to be set on the power analyzer. To set the GPIB address, follow these steps:



1. Press the **EDIT** key under the Menu page to enter the Edit GPIB Settings page.
2. Press the **Select** key to enter the edit.
3. Use the number keys or the up and down cursor keys to set the GPIB address value.
4. Press the Select key to finish editing.
5. Press the Menu key to leave the GPIB screen.
6. After modifying the GPIB address and returning to the MENU page, you need to power off the M1001 and reboot (power on again) to update the GPIB address.

8.3 Command Syntax

The following syntax conventions apply to programming commands:

8.3.1 Data Formats

SP Space, the ASCII code is 20 Hexadecimal.

; Semicolon, Program line terminator, the ASCII code is 0A Hexadecimal.

CRLF Carriage Return and Line Feed terminator, the ASCII code is x0D0A Hexadecimal or \r\n.

NR2 Digits with decimal point. Range and format is ###.#####.
For Example:
30.12345, 5.0

8.3.2 Command Parameters

{ } The contents between the { } brackets must be used as a part or data of the command. It cannot be omitted.

[ ] The contents between the [ ] brackets is optional. Its use depends on the application.

8.3.3 Termination Characters

Each command much be terminated with one of the following termination characters:

Terminator	Hex Value	NI Explorer	Notes
LF WITH EOI	0x0A + EOI	\n	GPIB Only
CR,LF	0x0D, 0x0A	\r\n	USB, LAN and RS232
CR,LF WITH EOI	0x0D, 0x0A	\r\n	GPIB Only

8.4 Measurement Query Commands

8.4.1 Summary Table

The table below summarizes all Measurement query commands and returned data formats for each command. Additional details for each are listed in next section.

COMMAND	RETURN	note
MEAS:VRMS?{; | CRLF}	###.###V	
MEAS:VPEAK?{; | CRLF}	###.###V,###.###V	
MEAS:VMAXMIN?{; | CRLF}	###.###V,###.###V	
MEAS:IRMS?{; | CRLF}	###.####(uA | mA | A)	
MEAS:IPEAK?{; | CRLF}	###.####(uA | mA | A), ###.####(uA | mA | A)	
MEAS:IMAXMIN?{; | CRLF}	###.####(uA | mA | A), ###.####(uA | mA | A)	
MEAS:WATT?{; | CRLF}	###.####(uW | mW | W | kW)	
MEAS:WMAXMIN?{; | CRLF}	###.####(uW | mW | W | kW), ###.####(uW | mW | W | kW)	
MEAS:VA?{; | CRLF}	###.####(uVA | mVA | VA | kVA)	
MEAS:VAR?{; | CRLF}	###.####(uVAr | mVAr | VAr | kVAr)	
MEAS:PF?{; | CRLF}	#.###	
MEAS:VCF?{; | CRLF}	#.####	
MEAS:ICF?{; | CRLF}	#.####	
MEAS:FREQ?{; | CRLF}	####.##Hz	
MEAS:VH?{; | CRLF}	###.###,...., ###.###(V)	
MEAS:IH?{; | CRLF}	###.###, …, ###.###(uA | mA | A)	
MEAS:VTHDR?{; | CRLF}	###.###%	
MEAS:VTHDF?{; | CRLF}	###.###%	
MEAS:ITHDR?{; | CRLF}	###.###%	
MEAS:ITHDF?{; | CRLF}	###.###%	
MEAS:KWH?{; | CRLF}	####.###(Whr | kWhr)	
MEAS:AVGWATT?{; | CRLF}	###.###(uW | mW | W | kW)	
MEAS:ELT?{; | CRLF}	####D##H##S	
MEAS:INRUSHV?{; | CRLF}	###.### V	
MEAS:INRUSHI?{; | CRLF}	###.###(mA | A)	
MEAS:GROUP?{; | CRLF}	###.###(V), ###.###(V), ###.###(V), ###.###(V), ###.###(V), ###.####(uA | mA | A), ###.####(uA | mA | A), ###.####(uA | mA | A), ###.####(uA | mA | A), ###.####(uA | mA | A), ###.####(uW | mW | W | kW), ###.####(uW | mW | W | kW), ###.####(uW | mW | W | kW), ###.####(uVA | mVA | VA | kVA), ###.####(uVAr | mVAr | VAr | kVAr)	Vrms,Vpk+,Vpk-,Vmax,Vmin,
Irms,Ipk+,Ipk,Imax,Imin,Watt,Wmax ,Wmin,VA,VAR,PF,VCF,ICF,Hz		
MEAS:GRAPH?{; | CRLF}	3 bytes x 4096 (Volt Graph Data) + 3 bytes x 4096 (Current Graph Data) + 5 bytes x 4096 (Watt Graph Data) + 0x0D 0x0A	Hex
MEAS:VGRAPH?(; | CRLF)	3 bytes x 4096 (Volt Graph Data)+ 0x0D 0x0A	Hex

COMMAND	RETURN	note
MEAS:IGRAPH?(; | CRLF)	3 bytes x 4096 (Currnet Graph Data) + 0x0D 0x0A	Hex
MEAS:WGRAPH?(; | CRLF)	5 bytes x 4096 (Watt Graph Data) + 0x0D 0x0A	Hex
MEAS:AH?(; | CRLF)	####.######(uAh | mAh | Ah | kAh)	
MEAS:PAV?(; | CRLF)	###.###(uW | mW | W | kW)	
MEAS:AAV?	###.####(uA | mA | A)	

8.4.2 Measurement Query Command Details

VRMS?
Syntax: MEAS: VRMS? {; | CRLF}
Description: Returns Voltage rms.

VPEAK?
Syntax: MEAS: VPEAK? {; | CRLF}
Description: Returns Voltage VPEAK.

VMAX/MIN?
Syntax: MEAS: VMAXMIN? {; | CRLF}
Description: Returns the measured voltage maximum and minimum

IRMS?
Syntax: MEAS: IRMS? {; | CRLF}
Description: Returns the measured current RMS value.

IPEAK?
Syntax: MEAS: IPEAK? {; | CRLF}
Description: Returns the measured current PEAK value.

IMAX/MIN?
Syntax: MEAS: IMAXMIN? {; | CRLF}
Description: Returns the measured current maximum and minimum

WATT?
Syntax: MEAS: WATT? {; | CRLF}
Description: Returns measured effective power

WMAXMIN?
Syntax: MEAS: WMAXMIN? {; | CRLF}
Description: Returns the measured maximum and minimum effective power

VA?
Syntax: MEAS:VA? {; | CRLF}
Description: Returns power.

VAR?
Syntax: MEAS:VAR? {; | CRLF}
Description: Returns measurement invalid power.

PF?
Syntax: MEAS:PF? {; | CRLF}
Description: Returns measurement power factor.

VCF?
Syntax: MEAS:VCF? {; | CRLF}
Description: Returns measurement voltage peak factor.

ICF?
Syntax: MEAS:ICF? {; | CRLF}
Description: Returns measurement current peak factor.

FREQ?
Syntax: MEAS:FREQ? {; | CRLF}
Description: Returns measurement frequency.
:VH? {; | CRLF}
Description: Returns the 50 measured voltage harmonics values.

IH?
Syntax: MEAS:IH? {; | CRLF}
Description: Returns the 50 measured current harmonics values.

VTHDR?
Syntax: MEAS:VTHDR? {; | CRLF}
Description: Returns measurement voltage total harmonic distortion rate.

VTHDF?
Syntax: MEAS:VTHDF? {; | CRLF}
Description: Returns measurement voltage total harmonic distortion rate.

ITHDR?
Syntax: MEAS:ITHDR? {; | CRLF}
Description: Returns measurement current total harmonic distortion rate.

ITHDF?
Syntax: MEAS:ITHDF? {; | CRLF}
Description: Returns measurement current total harmonic distortion rate.

KWH?
Syntax: MEAS:KWH? {; | CRLF}
Description: Returns accumulated watt hour value.

AVGWATT?
Syntax: MEAS:AVGWATT? {; | CRLF}
Description: Returns the average power in watt.

ELT?
Syntax: MEAS:ELT? {; | CRLF}
Description: Returns elapsed time.

INRUSHV?
Syntax: MEAS:INRUSHV? {; | CRLF}
Description: Returns and measure the Inrush voltage value.

INRUSHI?
Syntax: MEAS:INRUSHI? {; | CRLF}
Description: Returns and measure the Inrush current value.

GROUP?
Syntax: MEAS:GROUP? {; | CRLF}
Description: Returns all measured values in this order:
(Vrms, Vpk+, Vpk-, Vmax, Vmin, Irms, Ipk+, Ipk-, Imax, Imin, Watt, Wmax, Wmin, VA, VAR, PF, VCF, ICF, Hz).

GRAPH? ***[Applies to RS232 or USB Interface only]***
Syntax: MEAS:GRAPH? {; | CRLF}
Description: Returns data for Volt, Current and Power Graphs. Format is:
3 bytes x 4096 (Volt Graph Data) + 3 bytes x 4096 (Current Graph Data) + 5 bytes x 4096 (Watt Graph Data) + 0x0D 0x0A

Graphic data format:

The 1st highest bit is positive and negative flag, 0=positive value 1=negative value, the value contains decimal place, the decimal place is determined according to the current range (please refer to Specifications), the watt decimal place is determined by the voltage and current ranges:

Volt Graph (VRange = 400V) : 0x00 0x2A 0xF8 = 110.00V

Current Graph(IRange = 10A) : 0x80 0x1F 0x40 = -8.000A

Watt Graph (400V 10A range) : 0x80 0x05 0x3E 0xC6 0x00 = 880.00000W

Note: Before taking a reading , you need to send the command “LOCK ON” to lock the data update. At this time, the measurement data will not be updated. After reading , you need to send command “LOCK OFF” to unlock the data again.

Note: The starting point of the graphic data is random, i.e. it does not start at 0 degrees

V GRAPH? ***[Applies to RS232 or USB Interface only]***
Syntax: MEAS:VGRAPH?{; | CRLF}
Description: Returns data for Volt Graph. Format is:
3 bytes x 4096 (Volt Graph Data) + 0x0D 0x0A

Graphic data format:

The 1st highest bit is positive and negative flag, 0=positive value 1=negative value, the value contains decimal place, the decimal place is determined according to the current range (please refer to Specifications):

Volt Graph (VRange = 400V) : 0x00 0x2A 0xF8 = 110.00V

Note: Before taking a reading , you need to send the command "LOCK ON" to lock the data update. At this time, the measurement data will not be updated. After reading , you need to send command "LOCK OFF" to unlock the data again.

Note: The starting point of the graphic data is random, i.e. it does not start at 0 degrees

I GRAPH? ***[Applies to RS232 or USB Interface only]***
Syntax: MEAS:IGRAPH?{; | CRLF}
Description: Returns data for Volt Graph. Format is:
3 bytes x 4096 (Current Graph Data) + 0x0D 0x0A

Graphic data format:

The 1st highest bit is positive and negative flag, 0=positive value 1=negative value, the value contains decimal place, the decimal place is determined according to the current range (please refer to Specifications):

Current Graph(IRange = 10A) : 0x80 0x1F 0x40 = -8.000A

Note: Before taking a reading , you need to send the command "LOCK ON" to lock the data update. At this time, the measurement data will not be updated. After reading , you need to send command "LOCK OFF" to unlock the data again.

Note: The starting point of the graphic data is random, i.e. it does not start at 0 degrees

W GRAPH? ***[Applies to RS232 or USB Interface only]***
Syntax:MEAS:WGRAPH?{; | CRLF}
Description: Returns bitmap image for Volt Graph. Format is:
5 bytes x 4096 (Watt Graph Data) + 0x0D 0x0A

Graphic data format:

The watt decimal place is determined by the voltage and current ranges:

Watt Graph (400V 10A range) : 0x80 0x05 0x3E 0xC6 0x00 = 880.00000W

Note: Before taking a reading , you need to send the command "LOCK ON" to lock the data update. At this time, the measurement data will not be updated. After reading , you need to send command "LOCK OFF" to unlock the data again.

Note: The starting point of the graphic data is random, i.e. it does not start at 0 degrees

AH?
Syntax: MEAS: AH? {; | NL}
Description: Read Cumulative Amp Hour

PAV?
Syntax: MEAS: PAV? {; | NL}
Description: Read Average Watt

AAV?
Syntax: MEAS: AAV? {; | NL}
Description: Read Average Amp

8.5 Setting Commands

8.5.1 Summary Table

The table below summarizes all Setting commands and relevant parameters for each command. Additional details for each are listed in next section.

COMMAND	Note
OUT {SP}{0 | 1} {; | CRLF}	Set Output
MODE{SP}{0 | 1 | AC | DC}{; | CRLF}	Set AC/DC Mode
METER{SP}{0~6}{; | CRLF}	Set Meter Mode
VRANG{SP}{1~6}{; | CRLF}	Set Vrange
IRANG{SP}{1~18}{; | CRLF}	Set Irange
SHUNT{SP}{0 | 1 | INT | EXT}{; | CRLF}	Set Shunt INT/EXT
FILTER{SP}{0 | 1}{; | CRLF}	Set FILTER
ONDEG{SP}{0 ~ 359}{; | CRLF}	Set On Degree
OFFDEG{SP}{0 ~ 359}{; | CRLF}	Set Off Degree
GRAPHT{SP}{0~100.00}{; | CRLF}	Set_Inrush Graph T
REMote{; | CRLF}	Set Remote
LOCAL{; | CRLF}	Set Local
CLEAR{; | CRLF}	Clear MaxMin Data
ONTIME{SP}{0.200~600.000}{; | CRLF}	Set Output OnTime
OFFTIME{SP}{0.200~600.000}{; | CRLF}	Set Ourput OffTime
REPEAT{SP}{1~9999}{; | CRLF}	Set Outpit Repeat
AUTOUP{SP}{0 | 1 | ON | OFF}{; | CRLF}	Set Range Auto Up

8.5.2 Setting Command Details

OUT
Syntax: OUT {SP}{0|1} {; | CRLF}
Description: Set switch on or off
Allowable Parameters: 0: OFF, 1: ON

MODE
Syntax: MODE {SP} {0|1|AC|DC} {; | CRLF}
Description: Set AC and DC measurement mode
Allowable Parameters: 0: AC, 1: DC

METER
Syntax: METER {SP} {0~6} {; | CRLF}
Description: Set the analyzer function mode:
Allowable Parameters: 0 = Menu, 1 = Meter, 2 = Harmonic, 3 = Inrush, 4 = Standby , 5 = DataLog, 6=On/Off Cycling

VRANG
Syntax: VRANG {SP} {1~6} {; | CRLF}
Description: Set the Voltage position
Allowable Parameters: 0=Automatic shifting, 1=20V, 2=40V, 3=80V, 4=200V, 5=400V, 6=800V

IRANG
Syntax: IRANG {SP} {1~18} {; | CRLF}
Description: Set the Current position
Allowable Parameters: 0=Auto-Ranging, , 1=2mA, 2=4mA, 3=8mA, 4=20mA, 5=40mA, 6=80mA, 7=0.2A, 8=0.4A, 9=0.8A, 10=2A, 11=4A, 12=8A, 13=10A, 14=20A, 15=40A, 16=50A, 17=100A, 18=200A

SHUNT
Syntax: SHUNT {SP} {0|1|INT|EXT} {; | CRLF}
Description: Set the internal or external CT measurement current
Allowable Parameters: 0 or INT=Internal SHUNT, 1 or EXT=External CT

FILTER
Syntax: FILTER {SP} {0|1|} {; | CRLF}
Description: Set filter switch
Allowable Parameters: 0=off, 1=on

ONDEG
Syntax: ONDEG{SP} {0~359} {; | CRLF}
Description: Set switch opening angle
Allowable Parameters: Setting range 0~359 degree

OFFDEG
Syntax: OFFDEG {SP} {0~359} {; | CRLF}
Description: Set switch off angle
Allowable Parameters: Setting range 0~359 degree

GRAPHT
Syntax: GRAPHT {SP} {0~100} {; | CRLF}
Description: Set the Inrush current measurement mode waveform displacement time
Allowable Parameters: Setting range 0~100.00ms.

REMote
Syntax: REMote {; | CRLF}
Description: Set to remote control lock button

LOCAL
Syntax: LOCAL {; | CRLF}
Description: Set to stand-alone mode

CLEAR
Syntax: CLEAR {; | CRLF}
Description: Clear voltage, current, watt maximum and minimum

ONTIME
Syntax: ONTIME {SP} {0.200~600.000} {; | CRLF}
Description: Set switch on hold time (Cycling Mode)

OFFTIME
Syntax: OFFTIME {SP} {0.200~600.000} {; | CRLF}
Description: Set switch off hold time (Cycling Mode)

REPEAT
Syntax: REPEAT {SP} {1~9999} {; | CRLF}
Description: Set the number of switch cycle tests (Cycling Mode)

AUTOUP
Syntax: AUTOUP {SP}{0 | 1 | ON | OFF}
Description: Set automatic upshift function, 0 or OFF= closed, 1 or ON=open
(Standby Mode & Accumulator & Data Logger Mode)

8.6 Setting Query Commands

8.6.1 Summary Table

The table below summarizes all Setting query commands and returned data formats for each command. Additional details for each command are provided in next section.

COMMAND	RETURN	Note
OUT?{; | CRLF}	ON | OFF	0=OFF,1=ON
MODE?{; | CRLF}	AC | DC	
METER?{; | CRLF}	0~6	0=Menu,1=Meter,2=Harmonic,3=Inrush,4=Standby,5=DataLog,6=On/Off Cycling
VRANG?{; | CRLF}	1~6	1=20V,2=40V,3=80V,4=200V,5=400V,6=800V
IRANG?{; | CRLF}	1~18	1=2mA,2=4mA,3=8mA,4=20mA,5=40mA,6=80mA,7=0.2A,8=0.4A,9=0.8A,10=2A,11=4A,12=8A,13=10A,14=20A,15=40A,16=50A,17=100A,18=200A
SHUNT?{; | CRLF}	INT | EXT	
FILTER?{; | CRLF}	ON | OFF	
ONDEG?{; | CRLF}	0~359	
OFFDEG?{; | CRLF}	0~359	
GraphT?{; | CRLF}	0~100ms	
VERsion?{; | CRLF}	r#.##,r#,r#	Display rev. , Module1 rev. , Module2 rev.
*IDN?{; | CRLF}	APS:M1001	
ONTIME?	###.### (sec)	
OFFTIME?	###.### (sec)	
REPEAT?	####	
AUTOUP?	ON | OFF	

8.6.2 Setting Query Command Details

OUT?
Syntax: OUT? {; | CRLF}
Description: Query output status
Returns: ON, OFF

MODE?
Syntax: MODE? {; | CRLF}
Description: Query setting, AC or DC mode
Returns: AC, DC

METER?
Syntax: METER? {; | CRLF}
Description: Query Measurement Mode
Returns: 0=Menu, 1=Meter, 2=Harmonic, 3=Inrush, 4=Standby, 5=DataLog, 6=On/Off Cycling

VRANG?
Syntax: VRANG? {; | CRLF}
Description: Query Voltage range.
Returns: 1=20V, 2=40V, 3=80V, 4=200V, 5=400V, 6=800V

IRANG?
Syntax: IRANG? {; | CRLF}
Description: Query Current range
Returns: 1=2mA, 2=4mA, 3=8mA, 4=20mA, 5=40mA, 6=80mA, 7=0.2A, 8=0.4A, 9=0.8A, 10=2A, 11=4A, 12=8A, 13=10A, 14=20A, 15=40A, 16=50A, 17=100A, 18=200A

SHUNT?
Syntax: SHUNT? {; | CRLF}
Description: Query internal or external current shunt selection.
Returns: INT=internal, EXT=external

FILTER?
Syntax: FILTER? {; | CRLF}
Description: Query filter setting.
Returns: ON, OFF

ONDEG?
Syntax: ONDEG? {; | CRLF}
Description: Query the EUT switch ON phase angle.
Returns: Sets the internal EUT power switch ON angle control. Range is 0-359 degrees.

OFFDEG?
Syntax: OFFDEG? {; | CRLF}
Description: Query the EUT switch OFF phase angle.
Returns: Sets the internal EUT power switch OFF angle control. Range is 0-359 degree.

Grapht?
Syntax: Grapht? {; | CRLF}
Description: Query the INRUSH current waveform time setting.
Returns: 0 ~ 100ms

VERsion?
Syntax: VERsion? {; | CRLF}
Description: Query the firmware version of the unit.
Returns: r#. ##,r#,r#

*IDN?
Syntax: *IDN? {; | CRLF}
Description: Query the instrument Make and Model.
Returns: APS:M1001

ONTIME?
Syntax: ONTIME?{; | CRLF}
Description: Query the internal EUT power switch ON hold time.
Returns: ###. ### (Sec)

OFFTIME?
Syntax: OFFTIME?{; | CRLF}
Description: Query the internal EUT power switch OFF hold time.
Returns: ###. ### (Sec)

REPEAT?
Syntax: REPEAT?{; | CRLF}
Description: Query the EUT On/Off switch repeat test number setting.
Returns: ####

AUTOUP?
Syntax: AUTOUP?{; | CRLF}
Description: Query the automatic range change setting.
Returns: ####

9 Calibration

9.1 Overview

This section will be added in a future manual revision. Contact customer service for status updates on manual revisions.

10 USB Driver Installation

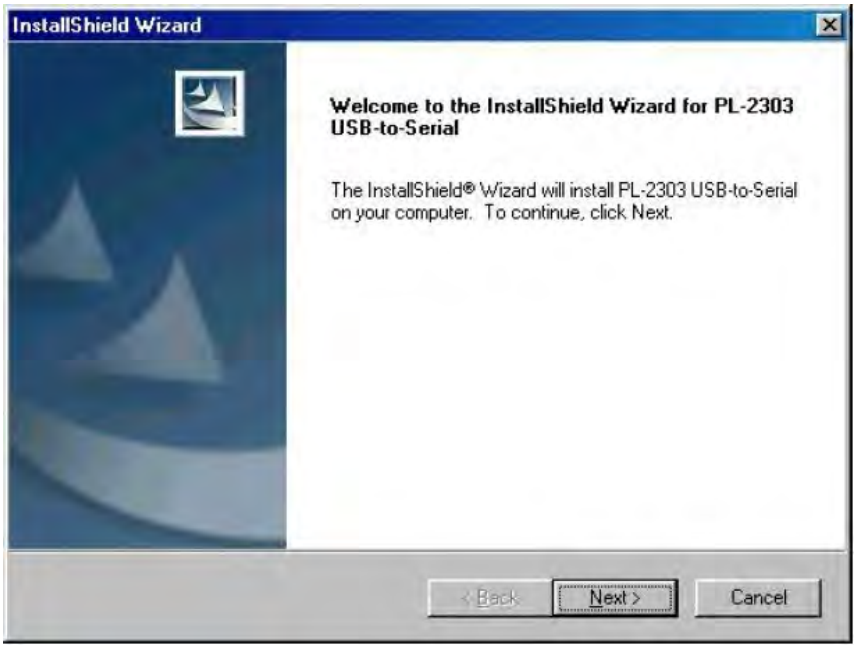
10.1 Overview

The power analyzer may be equipped with a USB interface. To communicate with this interface, a USB device driver is required on a Windows PC. This appendix describes the driver installation process for the PL-2303 USB to Serial Driver. Once installed, the USB port will appear as a COM port to the Windows Operating System.

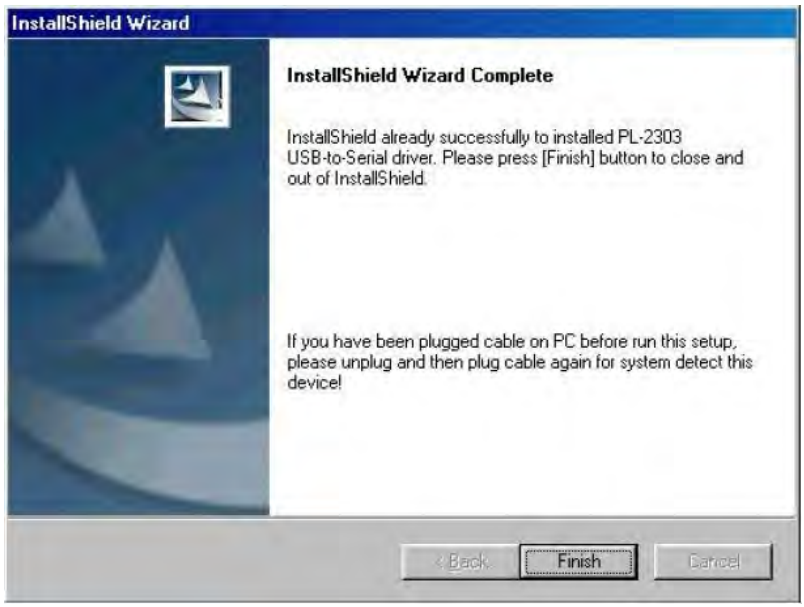
10.2 USB Driver Installation

To install the USB device driver, proceed as follows:

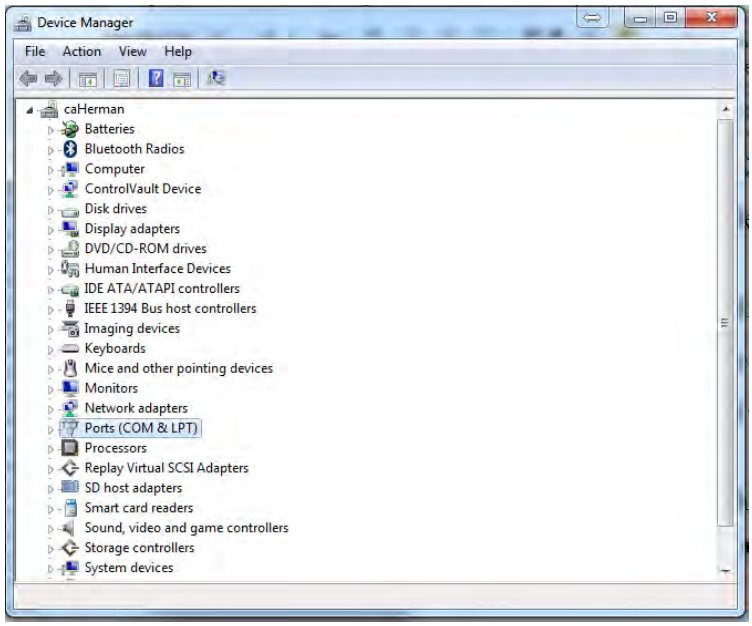
1. Insert the supplied CD ROM into a CD Rom drive.
2. If configured for auto-start, the driver installation program will launch. If not, run "USB\SETUP\PL-2303 Driver Installer.exe" from the CD Rom drive.
3. This will open the first installation wizard screen.



4. Follow the on-screen prompts.

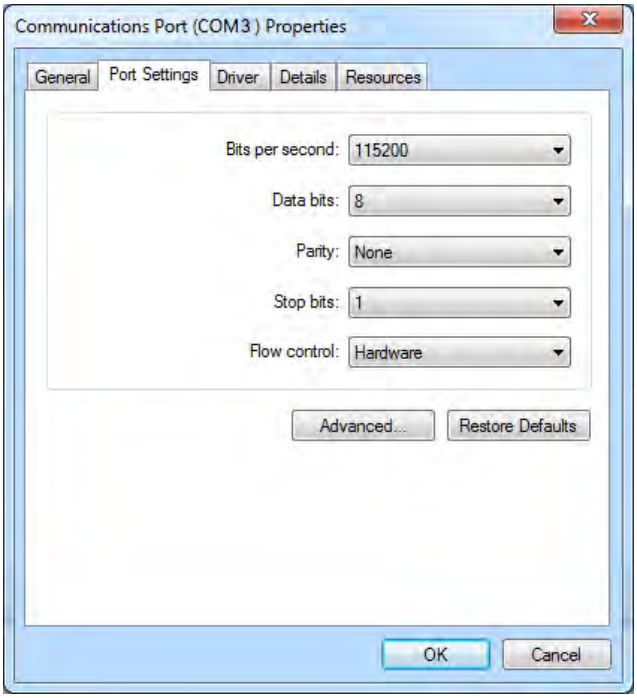


5. After the installation completes, open the Windows Control Panel from the Start menu and select “Device Manager”.
6. In the Device Manger Listing, locate the “Ports (COM & LPT)” entry



7. One of the entries should show “USB to Serial Port (COMx) with x any value higher than two.
8. Note the Com port number at which the USB device is located. Right click on this Com port and select “Properties”.
9. In the Properties dialog box, select “Port Settings”.

10. Select the relevant COM port and set Bit per second (baud rate) to “115200” and Flow control “Hardware”.



11. Connect the instrument to the PC using a suitable USB cable. (Not supplied with the instrument).
12. You should now be able to communicate with the instrument through COMn.

10.3 Configuring USB VISA Resource in NI Max

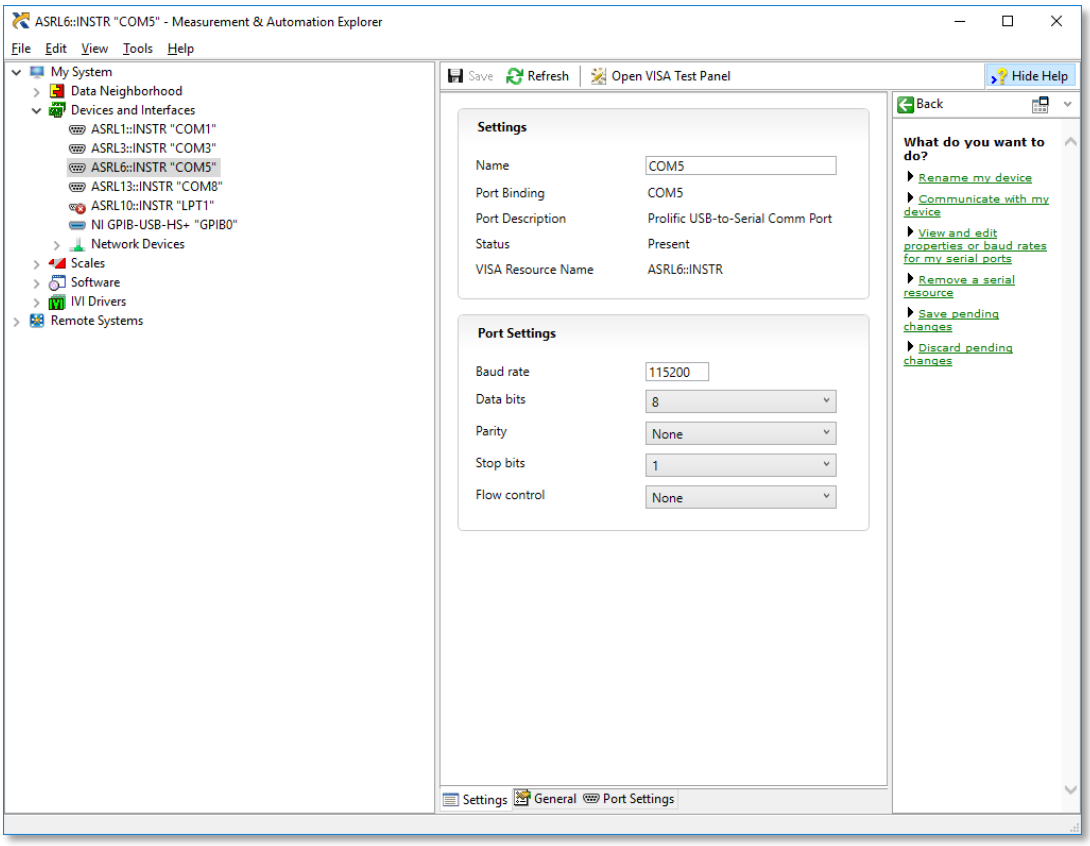
National Instrument NI Explorer is a useful tool to check the remote interface operation of your instrument. This sections shows you how to configure the VISA resource string and use the interactive I/O Panel command line function to send commands to the unit.

The USB interface uses a Virtual COM driver so it will be displayed in Windows Device manager as a COMx port where x is typically 3 or higher. You will need to determine the COM port number to set up an ASRL resource for the instrument.

Proceed as follows:

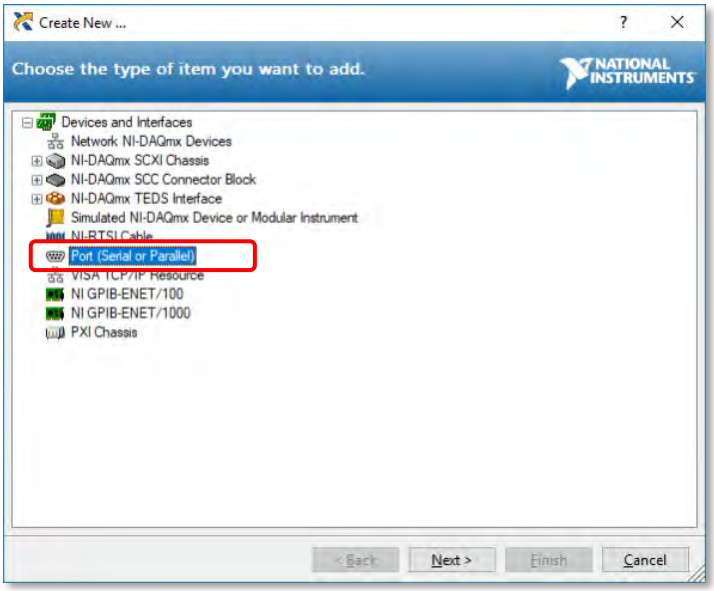
Launch NI Explorer and wait for the program to open. The screen below will be visible.

In the left panel, you will see all available resources on your PC. Expand the **"Devices & Interfaces"** entry by clicking the > arrow. This will show a list of all connected devices.

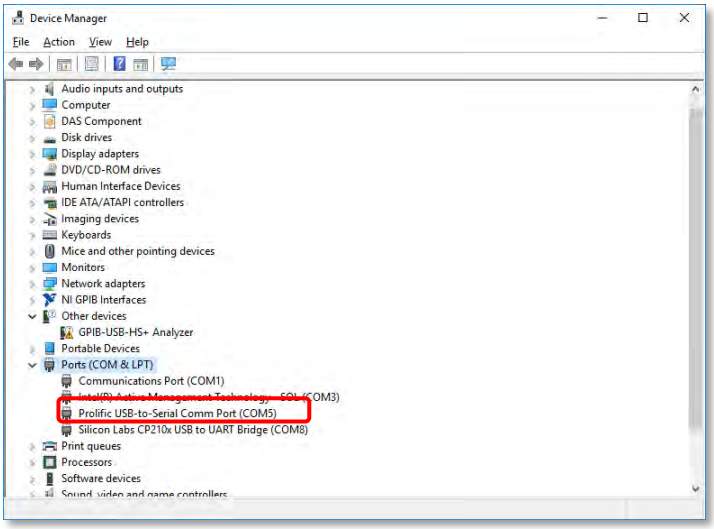


If the serial device is properly recognized, it will show up in the list. If not, try F5 to refresh the devices list. If this is the first time you are connecting the instrument, it may not be shown if it does not support Plug & Play operation. In that case, you have to set up the VISA resource manually. The next few steps show this process. If the ASRL for the instrument is already listed, skip to page 83.

To create a resource, right click on **"Devices & Interfaces"** and select "Create New…". This will open the dialog shown below.

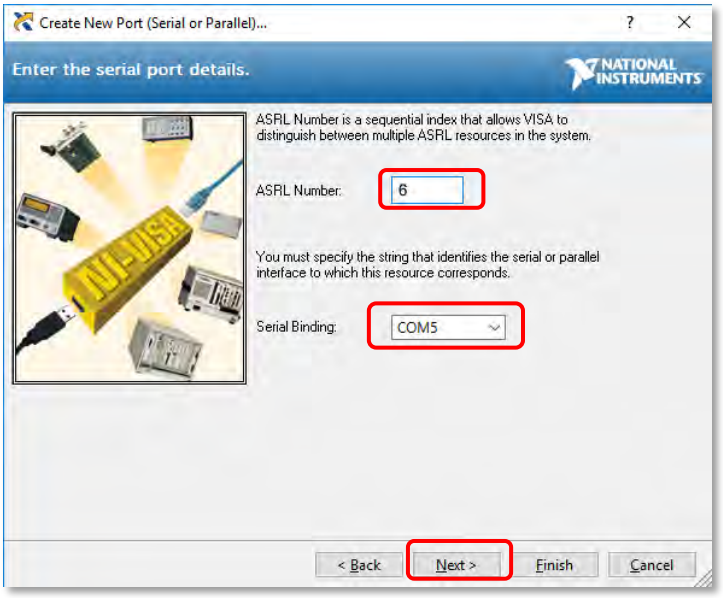


In this example, the unit is at COM5 using the Prolific USB-to-Serial driver. This can be determined from the Windows Device Manager tool as shown below.

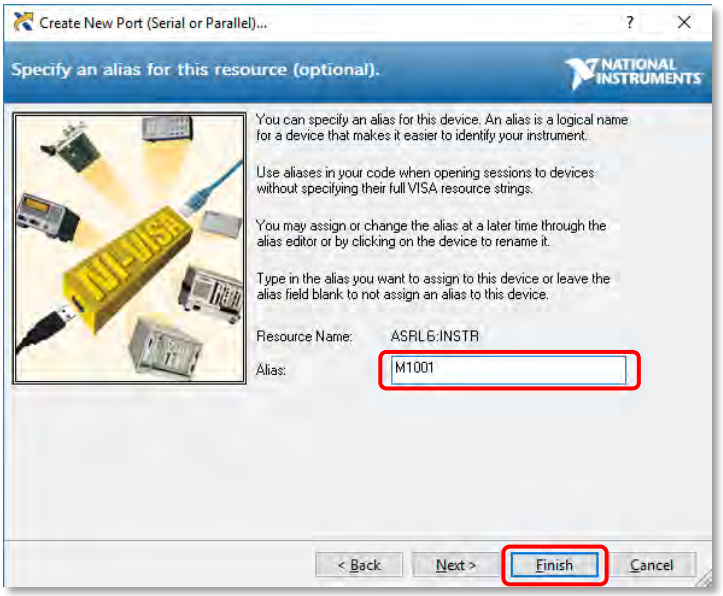


Click on the "**Port (Serial and Parallel)**" entry to show the Create New Port Since we are using USB via virtual COM, the instrument will be shown under the Port (Serial or Parallel) entry. Click on this entry to open the port creation dialog and set the ASRL Number to a number not already used by another VISA resource. In this example, the used the number 6.

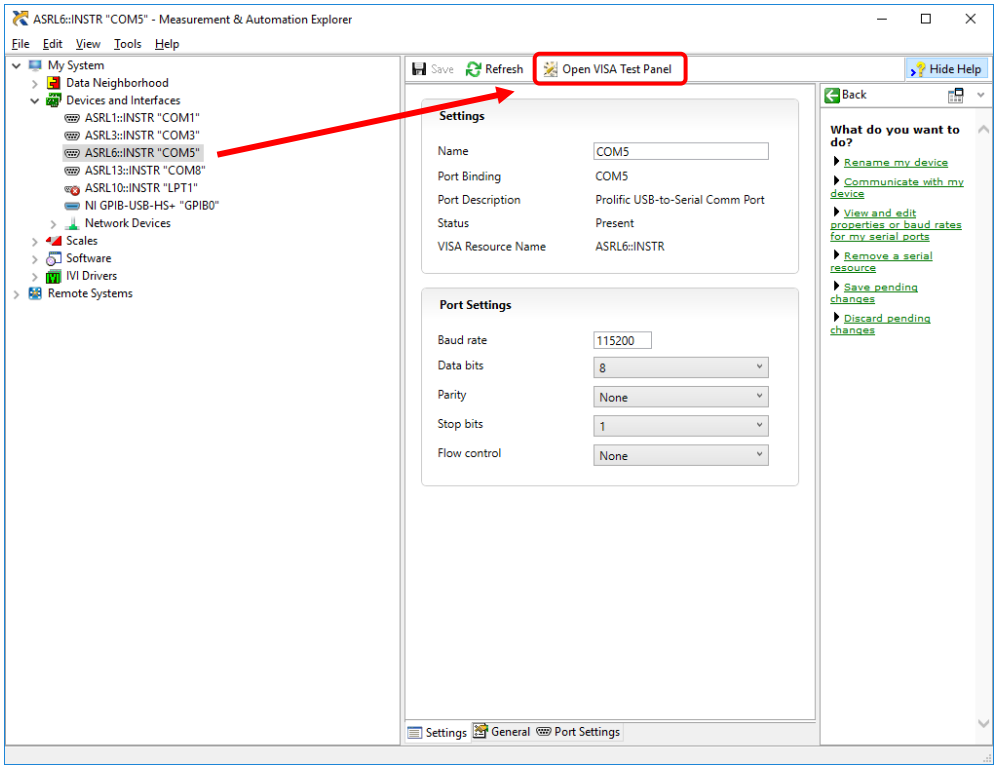
Bind this resource in the drop down control at the bottom to COM5 which is the COM port for the instruments we want to communicate with.



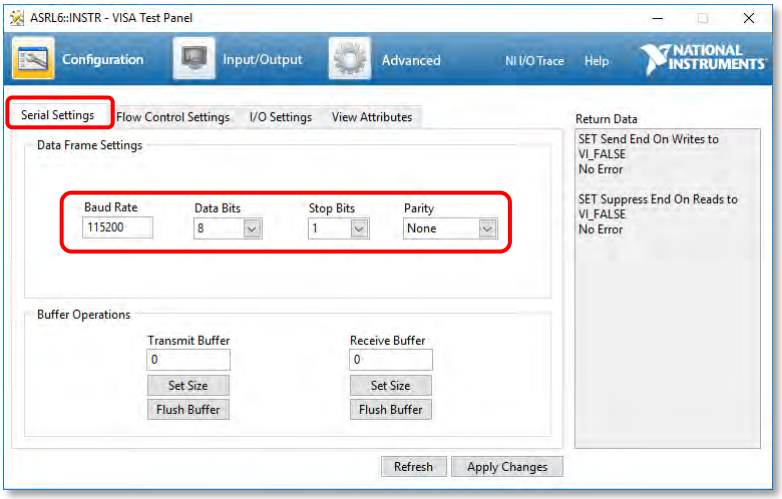
Click on Next to set up the Alias for this instrument. In our example, we will use the model of the instrument "M1001" as the alias so it is easy to recognize later. Click Finish when done.



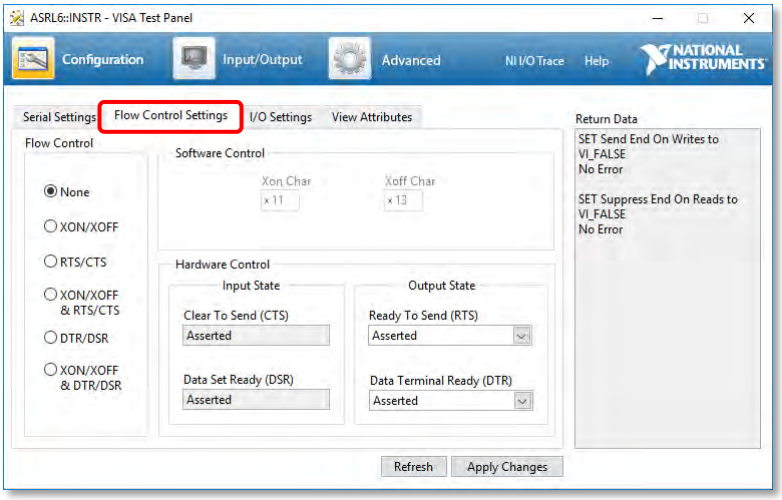
Once the resource is assigned, we can use the VISA Test Panel screen to interface with the instrument. Select the **ASRL6:INSTR "COM5"** resource from the Devices and Interfaces list and click on the "**Open VISA Test Panel**" tab shown below.



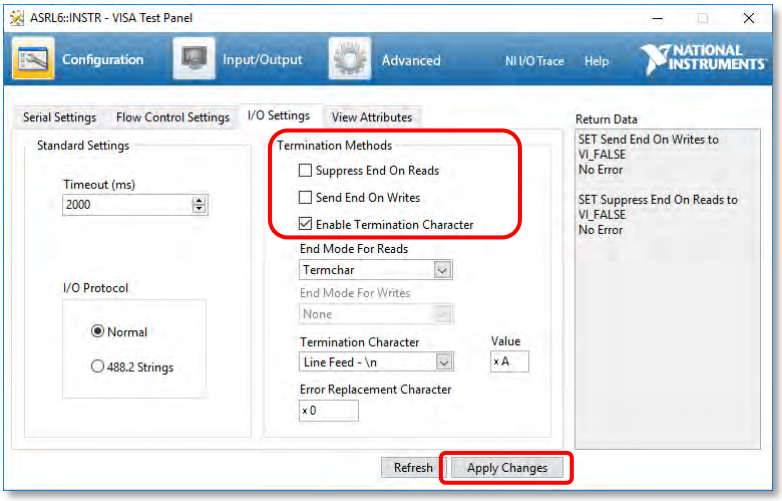
The VISA Test Panel is shown below and needs to be configured to work with the instrument. The first tab is the **Serial Settings**. The baud rate, data bits, stop bits and parity fields must be set as shown below.



Next click on the **Flow Control Settings** tab. Select None for Flow Control. Other settings can be left at defaults. Next click on the **I/O Settings**.

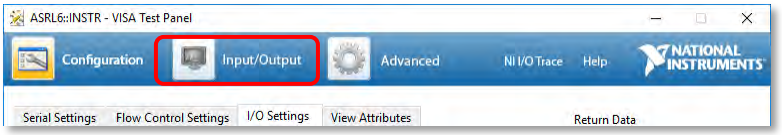


In the I/O Setting tab, turn off the Suppress End On Reads and Send End On Writes check boxes as shown below. Make sure to click on the “Apply Changes” button in the lower left corner of the dialog box when done with all settings.

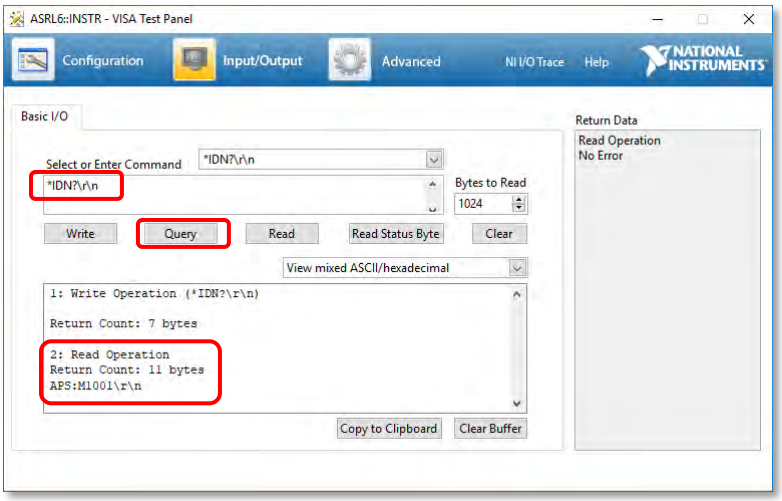


You are now ready to interface with the instrument.

Click on the Input / Output button in the top tool bar.



This brings up the I/O Utility screen. Enter the string "*IDN?\r\n" without the double quotes in the Command text box as shown below. Then, click the **Query** button to send the command and read back the input buffer. If setup was successful, the make and model will be returned as shown below. **Don't use** the default "*IDN?\n" normally shown in the common commands dropdown list just above the Command text box as it only has the LF terminator.



Note: Make sure to append both /r and /n as shown. If only one or the other is used, the query command will time out.

11 LAN Interface Settings

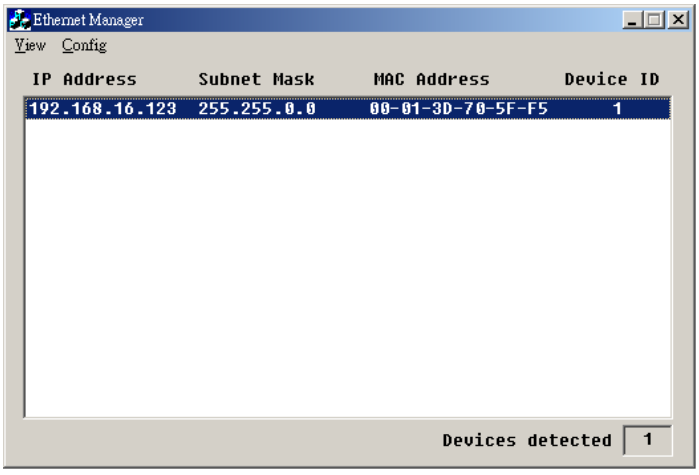
11.1 Overview

The instrument may be equipped with a LAN (Ethernet) interface. To communicate with this interface, an Ethernet Manager Utility program is supplied with the LAN interface. This appendix describes the use of this utility to establish a network connection with the instrument under Windows.

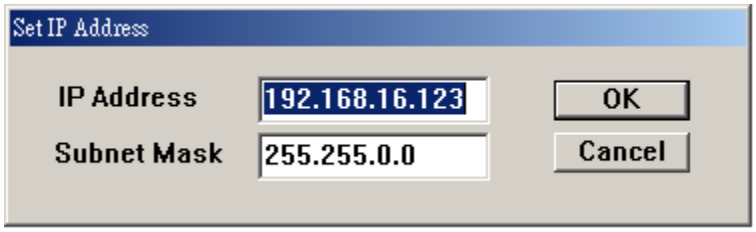
11.2 Introduction

To establish an Ethernet connection between a PC on your network and the instrument, proceed as follows:

1. Connect AC power and the network (LAN) CAT5 cable to the instrument.
2. Connect the other side of the network cable to an existing Ethernet network.
3. After inserting the driver CD-ROM, run LAN\ETM.EXE from the CD.
4. The Ethernet Manager screen will be displayed as shown below. If the Ethernet Manager window does not appear, press F5 to search again (refresh), and check the LAN connections if necessary.



5. The connected unit will appear on the list, click it to set the IP Address and Subnet Mask as shown in the figure below.



6. At this point, the Controller Setup page should be accessible, once everything is set correctly. This allows greater control over the communications interface.

Controller Setup	
IP Address	192.186.16.128
Subnet mask	255.255.255.0
Gateway address	0.0.0.0
Network link speed	Auto
DHCP client	Enable
Socket port of HTTP setup	80
Socket port of serial I/O	4001 TCP Server
Socket port of digital I/O	5001 TCP Server
Destination IP address / socket port (TCP client and UDP) Connection	0.0.0.0 0 Auto
TCP socket inactive timeout (minutes)	0
Serial I/O settings (baud rate, parity, data bits, stop bits)	115200 N 8 1
Interface of serial I/O	RS 232 (RTS/CTS)
Packet mode of serial input	Disable
Device ID	1
Report device ID when connected	Disable
Setup password	
UPDATE	

7. Insert the following into the controller set up screen:

   IP Address: as recommended according to your network
   Subnet Mask: as recommended according to your network
   Gateway Address: as recommended according to your network
   Network link speed: Auto
   DHCP client: Enable
   Socket port of HTTP setup: 80
   Socket port of serial I/O: 4001, TCP Server
   Socket port of digital I/O: 5001, TCP Server
   Destination IP address / socket port (TCP client and UDP) Connection: Auto
   TCP socket inactive timeout(minutes) : Set the network disconnection after N minutes, set 0 minutes will work forever.
   Serial I/O settings (baud rate, parity, data, bits, stop bits): 115200, N, 8, 1
   Interface of serial I/O: RS 232 (RTS/CTS)
   Packet mode of serial input: Disable
   Device ID : 5
   Report device ID when connected : Auto
   Setup password: Not required

If you experience difficulties establishing a connection, contact your network administrator for assistance. Network security setting may prevent you from connecting properly.

11.3 Configuring LAN VISA Resource in NI Max

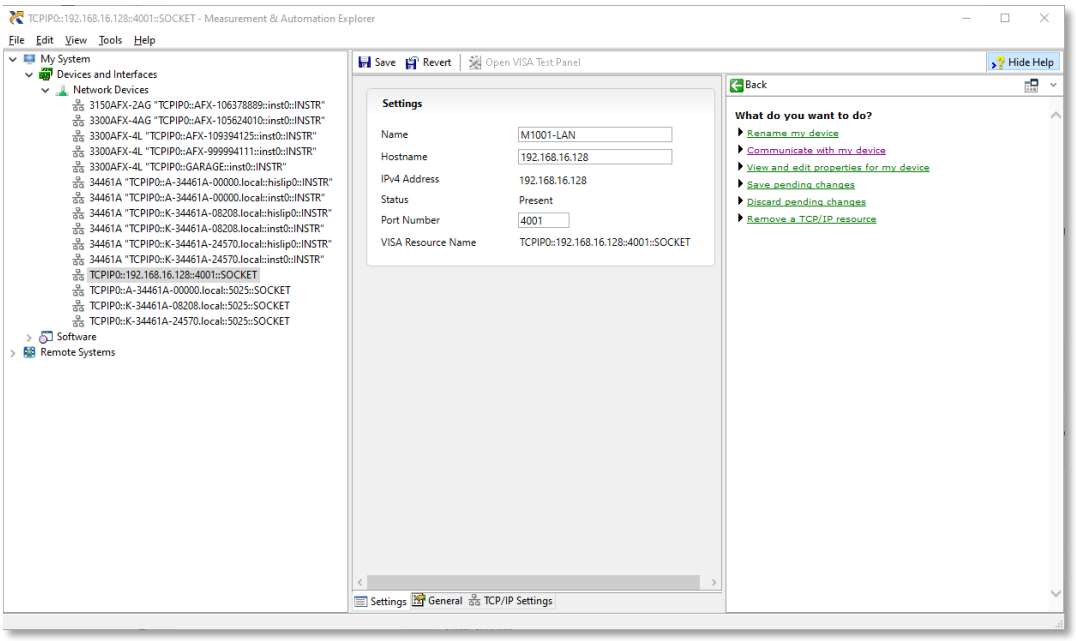
National Instrument NI Explorer is a useful tool to check the remote interface operation of your instrument. This sections shows you how to configure the VISA resource string and use the interactive I/O Panel command line function to send commands to the unit.

The USB interface uses a Virtual COM driver so it will be displayed in Windows Device manager as a COMx port where x is typically 3 or higher. You will need to determine the COM port number to set up an ASRL resource for the instrument.

Proceed as follows:

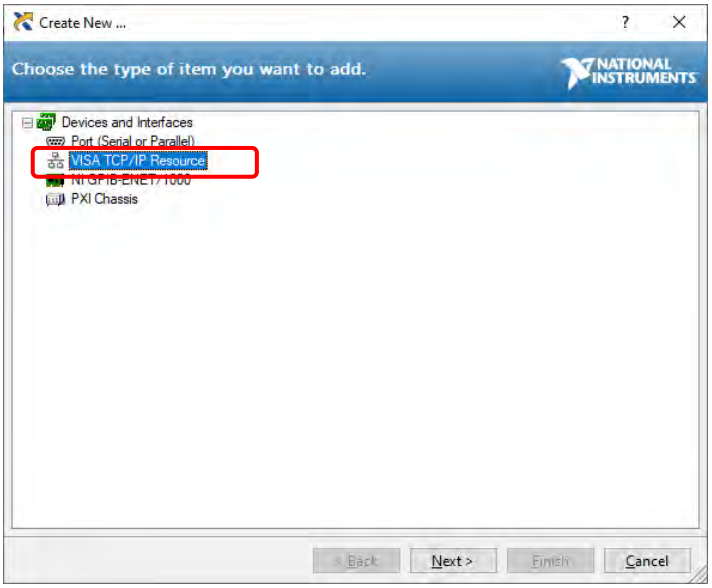
Launch NI Explorer and wait for the program to open. The screen below will be visible.

In the left panel, you will see all available resources on your PC. Expand the **"Devices & Interfaces"** entry by clicking the > arrow. This will show a list of all connected devices.



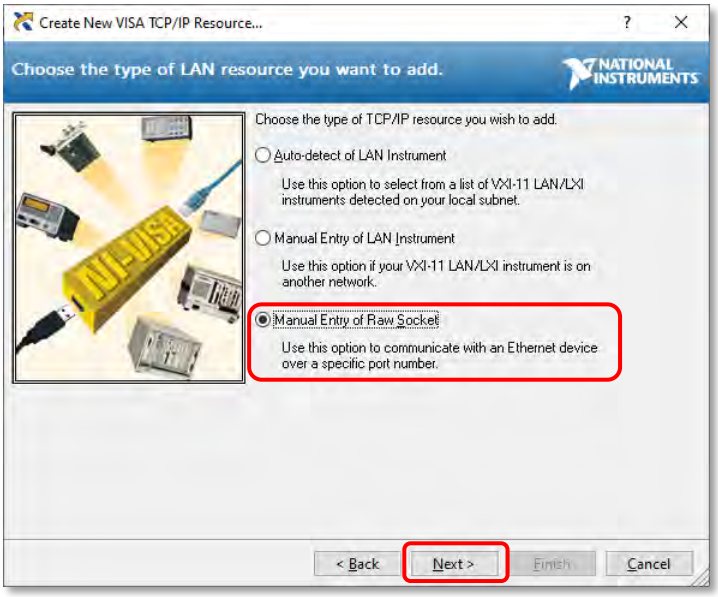
If the LAN device is properly recognized, it will show up in the list. If not, try F5 to refresh the devices list. Since the M1001 is not an LXI device, we need to create a raw socket TCP/IP VISA resource manually. The next few steps show this process.

To create a resource, right click on **"Devices & Interfaces"** and select "Create New…". This will open the dialog shown below.



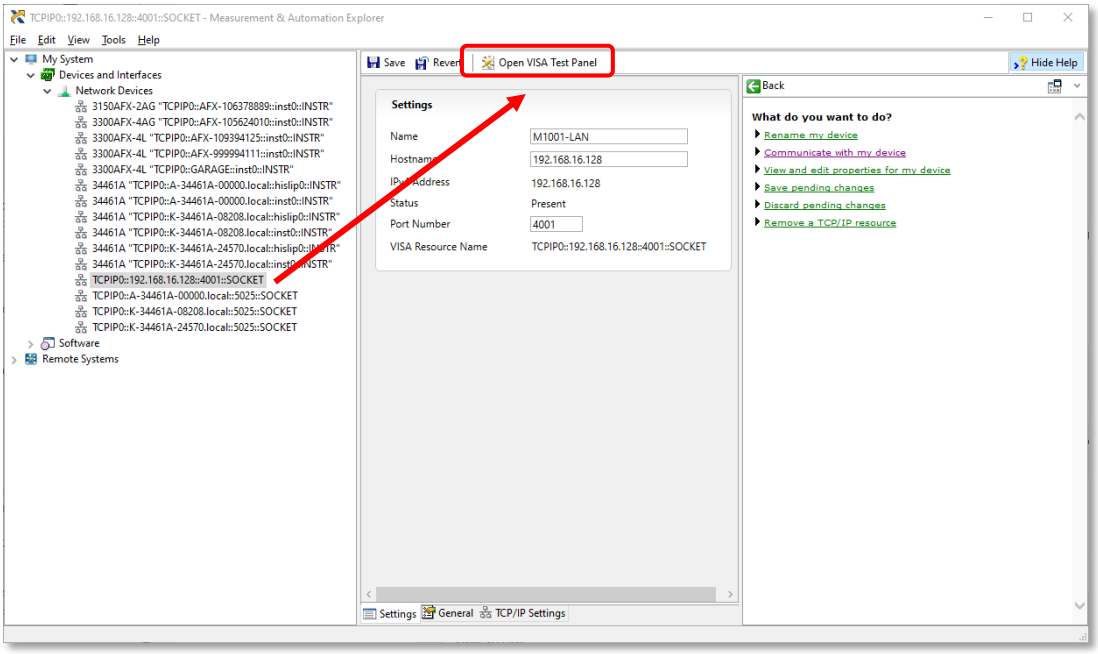
Click on the "**VISA TCP/IP Resource**" entry to show the Create a new LAN device.

Select the third option labelled "**Manual Entry or Raw Socket**".

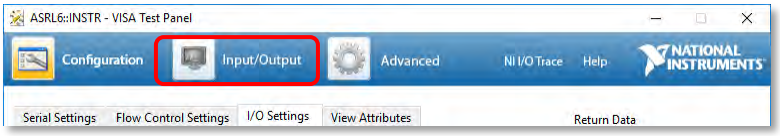


Click on Next to set up the IP address and Socket number for this instrument. For the M1001 product series, the default socket number is **4001**. Click Finish when done.

Once the resource is assigned, we can use the VISA Test Panel screen to interface with the instrument. Select the **TCPIP0:xxx.xxx.xxx.xxx::4001::SOCKET"** resource from the Devices and Interfaces list and click on the "**Open VISA Test Panel**" tab shown below.

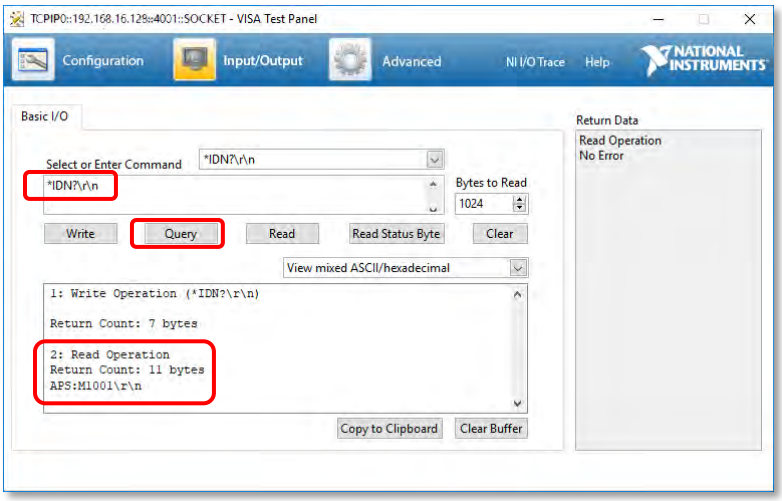


The VISA Test Panel is shown as below and you are now ready to interface with the instrument. Click on the Input / Output button in the top tool bar.



Continued next page…

This brings up the I/O Utility screen. Enter the string "*IDN?\r\n" without the double quotes in the Command text box as shown below. Then, click the **Query** button to send the command and read back the input buffer. If setup was successful, the make and model will be returned as shown below. **Don't use** the default "*IDN?\n" normally shown in the common commands dropdown list just above the Command text box as it only has the LF terminator.



Note: Make sure to append both /r and /n as shown. If only one or the other is used, the query command will time out.

12 CE MARK Declaration of Conformity

Product Name: M1001 Series Power Analyzers, All Models in Series
Manufacturer: Adaptive Power Systems, Inc.
17711 Mitchell North
Irvine, California, 92614, USA

This declaration of conformity is issued under the sole responsibility of the manufacturer. It serves to declare that the M1001 Power Analyzer Series complies with all requirements for CE marking.

The object of the declaration described above is in conformity with here relevant Community harmonization legislation:

EU Directives:	**2014/30/EC**	**EMC Directive**
	2014/35/EC	**Low Voltage Directive**
	2011/65/EC	**RoHS2 directive**

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 2014/35/EC):
Standard applied EN 61010–1: 2010 (3rd Edition)
EMC (DIRECTIVE 2014/30/EU):
Standard applied EN 61326-1: 2013

Reference Standards:
EMISSIONS:
EN 61326-1:2006
EN 61326-2-1:2006
EN 55011:2009+A1:2010
EN 61000-3-2:2006+A1:2009+A2:2009
EN 61000-3-3:2008
EN 61000-6-4: 2007

IMMUNITY:
EN 61000-4-2:2009
EN 61000-4-3:2006+A1:2008+A2:2010
EN 61000-4-4:2004+A1:2010
EN 61000-4-5:2006
EN 61000-4-6:2009
EN 61000-4-8:2010
EN 61000-4-11:2004

Supplemental Information:

When and Where Issued: January 2019
San Diego, CA

Authorized Signatory Quality Assurance Inspector
Adaptive Power Systems

Mark of Compliance

Index

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Worldwide Supplier of Power Equipment