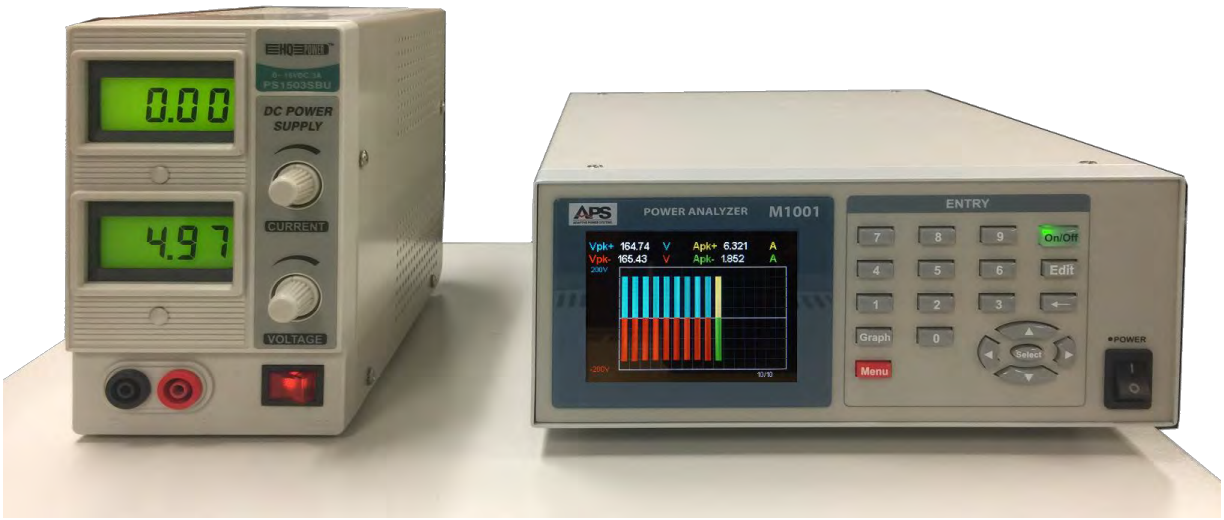
ADAPTIVE POWER SYSTEMS
11771 Mitchell North
Irvine CA 92614
Tel: (949) 752-8400
Email: info@adaptivepower.com
www.adaptivepower.com

APPLICATION NOTE

M1001 Power On-Off Cycling

October 24, 2019



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1 Introduction

This application note illustrates the use of the M1001 Power Analyzer's power On/Off cycling function for AC powered products. The product used to illustrate this function is a general-purpose programmable bench DC power supply. Power cycling is accomplished using the internal solid-state power relay of the analyzer, which allows phase angle controlled power cycling of the unit under test. Peak voltage and current are recording for each power cycle. This mode is useful for endurance and reliability testing on new designs.

2 EUT Power ON/OFF Cycling

2.1 Equipment Setup

Before any measurements can be made, it is imported to set up the equipment used. For this application, we will use a standard US 120Vac, 60Hz power outlet to provide power to the EUT.

The EUT for this example is a bench DC power supply. The general equipment setup is simple and illustrated in the figure below.

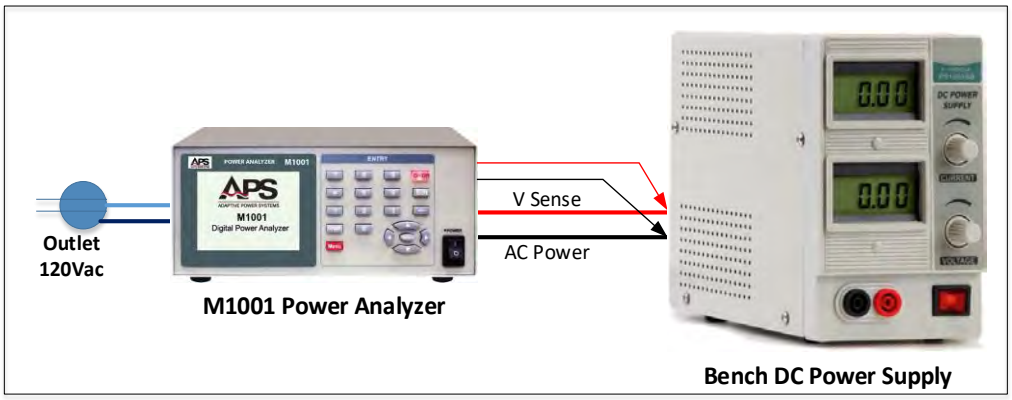


Figure 1: Equipment Setup

2.2 Measurement cable wiring

The connections between the power source (wall outlet), power analyzer and load are shown in Figure 2 below. Follow the illustration to connect the DC Power Supply (EUT) to the power analyzer.

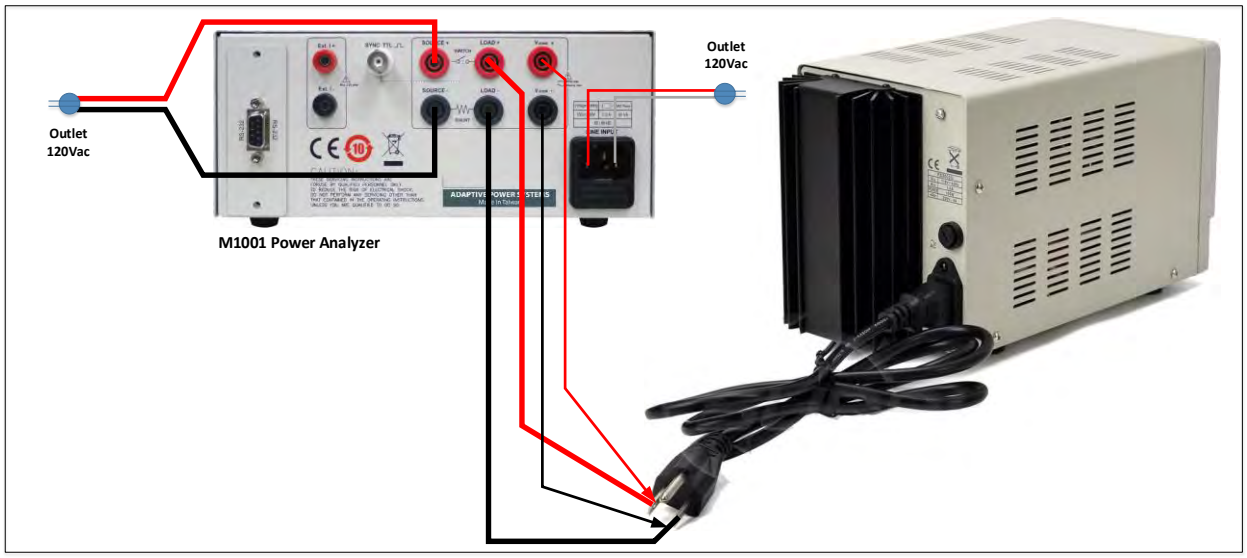


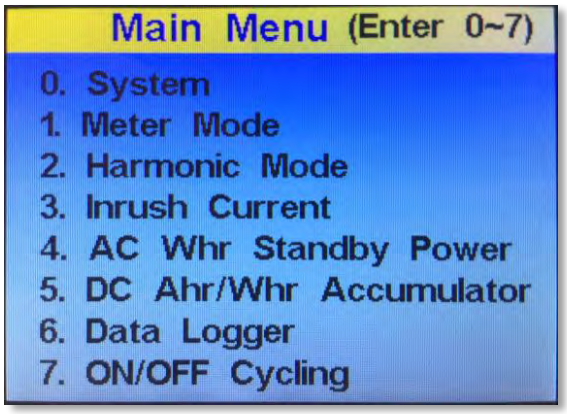
Figure 2: Equipment connections

Note the $\mathbf{V_{SENSE}}$ lines of the power analyzer must be connected to the load input to make sure any wire impedance voltage drops do not affect measurements.

2.3 Initial Power Analyzer Setup

Before we determine the worst-case inrush current of the DC power supply, we need to make sure the power analyzer is configured for AC measurements and will use the correct voltage and current measurement ranges as auto-ranging is not possible when trying to capture the initial current peak value at EUT startup.

Settings are made from the System Setting menu, available by pressing the **Menu** key followed by the number zero key **0**.

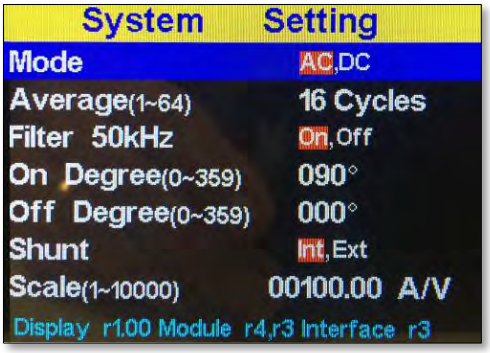


Once in the System Setting menu, press the **Edit** key and use the cursor keys to scroll through the available settings. To change a numeric setting, enter the new value and press the **Select** key inside the cursor keypad. To change alternate fields, use the left and right cursor keys to move between field settings and press **Select** when done.

Use the up down cursor keys to move to the next setting.

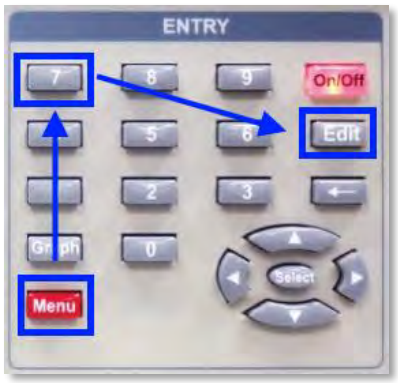
Since we are making AC measurements, we will make the following selections:

- Mode AC
- Average 16
- Filter 50 kHz On
- On Degree 090°
- Off Degree 000°
- Shunt Int (Internal)



This is reflected in the System Setting screen shown here.

2.4 Selecting ON/OFF Cycling Mode



Before we can make any measurements, we need to select the **ON/OFF CYCLING** mode by pressing the **Menu** key followed by the number three key **7** (ON/OFF Cycling).

Next, we need to configure the Inrush Current mode for the application at hand. This is accomplished by pressing the **Edit** key and use the cursor keys to scroll through the available settings.

The ON/OFF Cycling Mode allows selection of a fixed range for voltage and current. Auto-ranging is not possible for this measurement as there is only one initial current cycle. For our example, we will set up as follows:

- The On Degree determines at what phase angle the power is applied to the EUT. We will use 90° to maximize inrush current.
- The Off Degree determines at what phase angle power is removed from the EUT. We will use 270° to turn power off at the peak of the voltage waveform.
- The ON time is set to 1 min, the OFF time to 2 mins for a cycle time of 3 mins or 20 cycles per hour.
- The repeat count is set to 10 in this example so total cycle time will be 10 x 3 mins = 30 mins.
- Use the 200V range as our power source (US grid voltage) is 120Vac rms.
- For current, we expect the peak current to be well below 20 Apeak to we select the 20A range.

When done, press the **Edit** key to return to the Standby Power screen. We are now ready to start the test pressing the **On/Off** key in the upper right corner of the keypad. Once pressed, this key back light will change to orange (**On/Off**) and the first Power ON cycle is applied to the EUT. During the OFF State, the (**On/Off**) is grey to indicate power to the EUT is OFF.

2.5 Power Cycling Data

For each power on and off cycle of the equipment under test, the power analyzer will record the positive and negative peak value for both the voltage and the current. This information is display graphically on the screen of the power analyzer, shown in First Power ON Cycle.

The active ON cycle count and total cycles are displayed in the lower right hand corner of the display, in this example **1/10**.

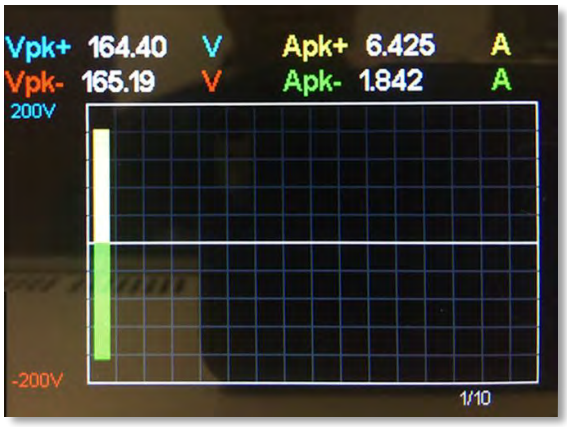


Figure 3: First Power ON Cycle

The active ON state will be shown using green and yellow bars. Prior ON states are shown using blue (positive peak) and red (negative peak). In our example, the full scale display is 200Vpk with vertical 10 divisions or 40Vpk/ div.

When the preset number of cycles are completed, the **On/Off** button will be lit again and the data remains on the screen.

Figure 4: Ten Completed Power Cycles

Note: To repeat the power cycling sequence again, press the green **On/Off** button. This will clear the previous run test data and start a new cycle. The setting for duration and/or number of cycles may be changed between test runs as needed using the **Edit** key.

3 Other M1001 Measurement Functions

Additional measurement functions of the M1001 are covered in other application notes. Contact Adaptive Power Systems or its representative for copies of other power analyzer application notes.

- Standard Meter Mode
- Inrush Current Measurements
- Standby Power Whr measurement
- Measurement Data Logging

4 Summary

Gathering key measurements and harmonics content for an AC load is quick and easy when using a dedicated power analyzer.

5 Contact Information

For product information or technical support by region, contact our exclusive equipment representative shown below.

NORTH AMERICA	EUROPE	ASIA
PPST Solutions	**Caltest Instruments GmbH.**	**PPST Shanghai Co. Ltd.**
Irvine, USA	Kappelrodeck, Germany	Shanghai, China
Phone: +1(888) 239-1619	Phone: + 49(0)7842-99722-00	Phone: +86-21-6763-9223
Fax: +1 (949) 756-0838	Fax: + 49(0)7842-99722-29	Fax: +86-21-5763-8240
Email: info@ppstsolutions.com	Email: support@adaptivepower.com	Email: support@adaptivepower.com

M2000 Series Power Analyzers

ADAPTIVE POWER SYSTEMS
17711 Mitchell North
Irvine, CA 92614
United States
Tel: +1.949.752-8400
Fax: +1.949.756-0838