Testing Frequently Asked Questions

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Where do you measure the output voltage?

For 115V input units, the output voltage is measured at the back pin of the mating connector on the load end of the output cable. Voltage is measured with the DVM test probe and recorded manually into the unit under the test data sheet. Figure 1-1 below is an example of manual probes used to measure the voltage on the back of the unit output connector pin. The output connector is plugged into the loading fixture interface board, as shown in Figure 1.

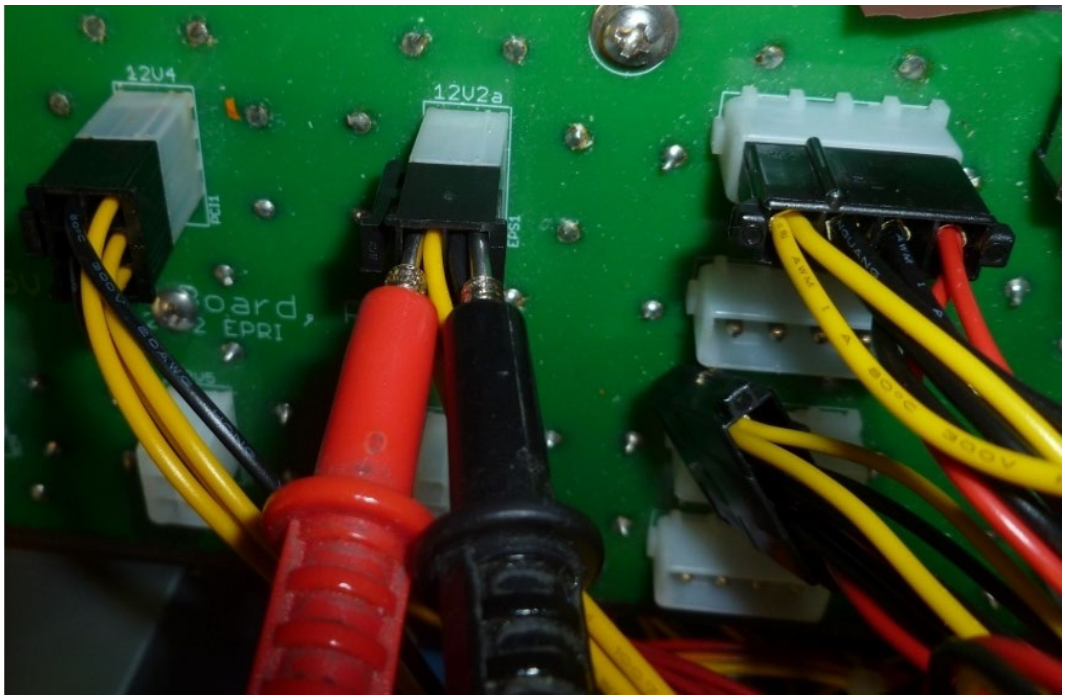


Figure 1: Back pinning 12V2 to measure the output voltage of 12V2 rail

For 230V input units, the same procedure is followed unless a custom interface board is supplied with the unit. If a custom interface board is supplied, test points must be incorporated to measure the output voltage and return ground directly at the point they exit the mating connector on the load side of the unit. Test points should be marked on the test board or in photos accompanying the submitted units, as shown in Figure 2.

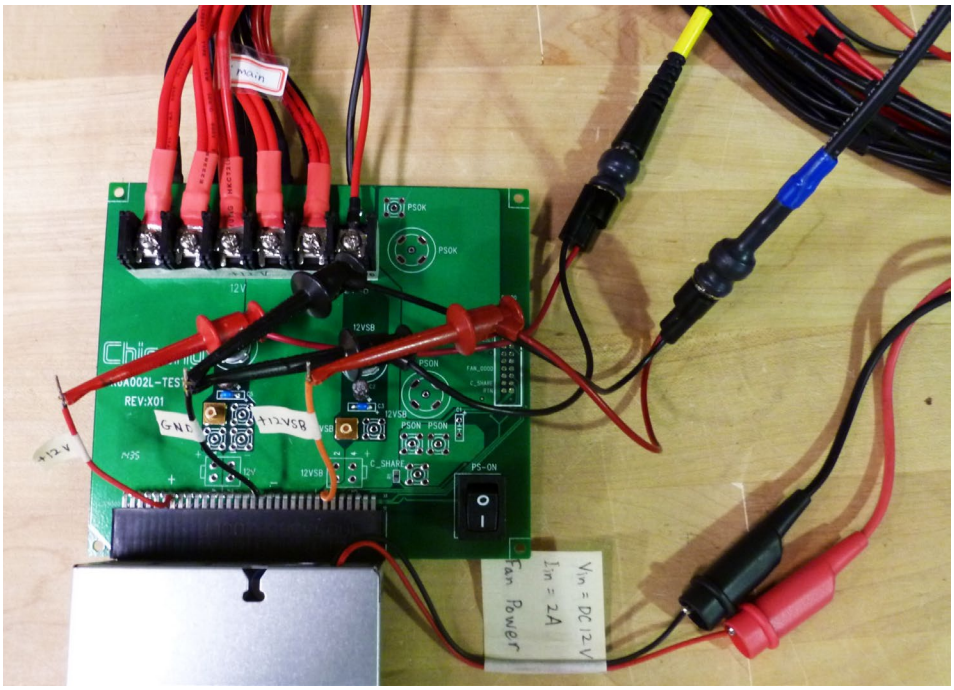


Figure 2: Sense Line, when provided, is used to measure the output voltages

Where do you measure the input voltage?

For both 115V input and 230V input test benches, the input voltage is measured as close to the input connector of the unit as possible. A standard cable has been prepared for common input connectors. The input power cable provides voltage measurement leads attached to the cable's input voltage wires within one and a half inches of the unit input power mating connector shown in Figure 3 and Figure 4.

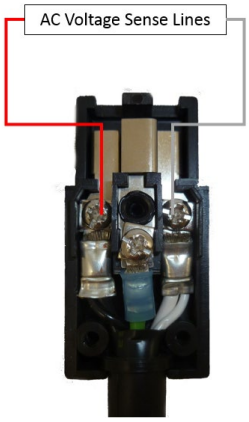


Figure 4: C19 Open Connector

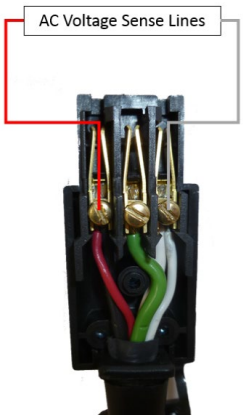


Figure 3: C14 Open Connector

What instrument do you use to measure the input parameters?

For the 115V Internal Non-Redundant test bench, the Yokogawa WT2030 is used to monitor and measure the input parameters, including the input voltage (V), input current (A), input frequency (Hz), input power (Watts), power factor (λ), and input current total harmonic distortion (THD %).

Figure 5: Yokogawa WT2030

For the 230V Internal Redundant, 115V Industrial, and 380V DC, the Yokogawa WT3000 is used to monitor and measured the input parameters, including the input voltage (V), input current (A), input frequency (Hz), input power (Watts), power factor (λ), and input current total harmonic distortion (THD %).

Figure 6: Yokogawa WT3000

What instrument do you use to measure the output voltages?

All output voltages are measured using test probes and a Fluke 8846A 6 ½ Digit Multimeter (Figure 4-1). Data is captured manually, one reading at a time, and entered into the unit under the test data sheet.

Take a sample of 10 data points per output voltage using the statistical analysis function of the Fluke 8846A. This displays the minimum and maximum measurements and the average and standard deviation values at the resolution of the 6-digit 10 power line cycle (PLC) setting.

For example, selecting "6 DIGIT 10 PLC" will display 6½ digit resolution and take a measurement using the ten power line cycle integration period. For 60 Hz power, a measurement is almost once every 60th of a second or 166.666 milliseconds.

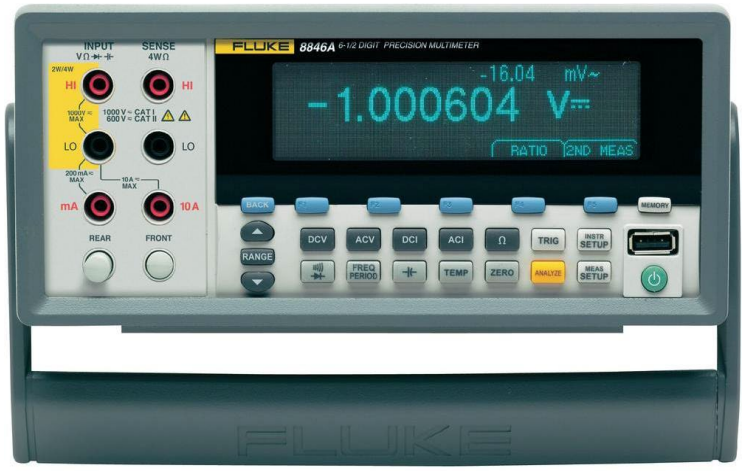


Figure 7: Fluke 8846A

Why must we use a LISN in the input circuit for testing efficiency?

A LISN (Line Impedance Stabilization Network) was added to the Generalized Test Protocol Version 6.2. The addition of the LISN provides a stable input impedance when measuring the input power factor of very lightly loaded power supplies (below 20% loading). Testing at several labs, including OEM labs, showed that the power factor readings were much more repeatable when using the LISN.

What power source do you use?

An Amtek, MX45-3PI-480-HV, 3-phase 45 kVA solid state voltage source is used to test all 115V and 230V EU Internal Non-Redundant, 230V and 380V DC Internal Redundant, 115V Industrial power supplies.

Do you start at 100% load and then reduce the load or do you start at 10% load and increase to 100%?

For each UUT, the protocol is to start at 10% load, run the unit for 15 minutes and then take data. The loading of the unit is then incremented to the next loading level (20% load), and the 15-minute run time is initiated before data is recorded. The process repeats until data at 100% load is taken.

How and when is the load adjusted for each level?

The AC source and load banks are manually set and adjusted at the initial start of the 15-minute interval. Adjustments of the AC source or loads are no longer adjusted during the 15-minute interval while the unit is in operation.

What happens if my unit fails?

If a unit fails to meet any 80 PLUS criteria for certification, the test for that unit is terminated. The second unit is then tested at the specific condition of failure. If the second unit passes, the second unit is tested thoroughly, and data is used for the report. If the second unit fails, the test is terminated, and a report is issued with recorded failure data.

Our results are significantly different from yours. Why?

The test equipment used can have a significant impact on measurements. In most cases, the difference will be due to input power measurement. The accuracy of the input power measurement is dependent on the power factor of the unit under test, as well as the base accuracy of the measuring equipment. If all equipment and setups were identical, it is still possible to have a difference in readings of twice the stated accuracy. For example, if a power analyzer has an accuracy of ± 0.1%, the worst-case difference could be as much as 0.2%. The power analyzer WT2030 used by 80 PLUS has a base accuracy of ± 0.04% of the reading plus 0.04% of the range, and the WT3000 has a base accuracy of ± 0.01% of the reading + 0.03% of the range.

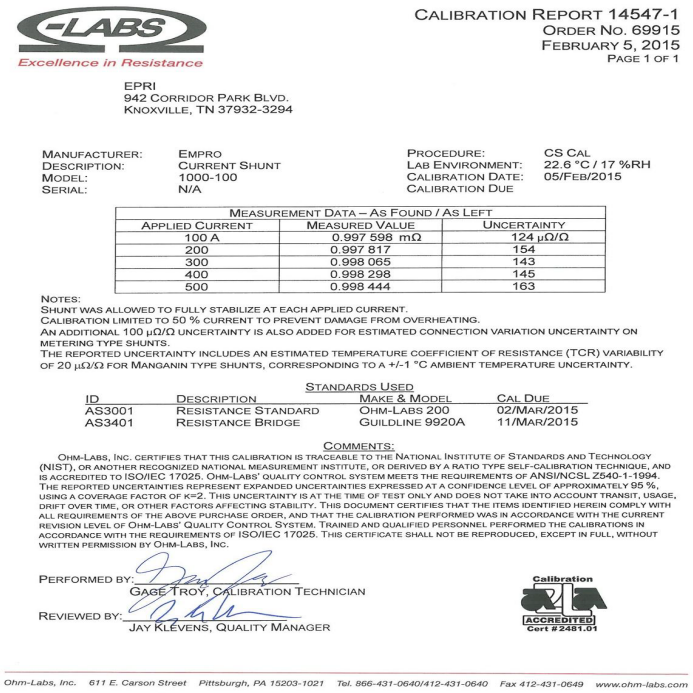
What happens if my unit performance misses a badge performance level?

When a unit comes within 0.5% of the next higher badge level on any loading parameter, the test of that unit is completed, and a second unit is tested at the failed point. Should the second unit pass the next level, then the second unit is thoroughly tested, and that data is used for the 80 PLUS report. If the second unit fails to meet the higher level, then the first unit's data is used to create the 80 PLUS report.

How do you measure output current?

Output current on the 115V test bench is measured using the Yokogawa WT3000. The electronic load box (ELB) is set to a current that varies from 1% to 100% of the ELB power rating. The current value in amps is read from 0% to 10% loading in 1% increments. Each value is recorded. The current is then varied in 5% increments up to 100% of the ELB rating, with data recorded at each increment. The values are then used to create a piecewise linear calibration curve for that load bank. The curve is recorded and used to calculate the calibrated current from the recorded current in the efficiency tab of the datasheet for each unit under test. This calibration process is repeated annually.

Output current for the 230V test bench uses calibrated current shunts. The main output is a custom-designed shunt capable of operation to 1000 amperes. The shunt is calibrated to within ±165ppm. Figure12-1 shows an example of the shunt calibration certificate.



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FEBRUARY 5, 2015
PAGE 1 OF 1

EPRI
942 CORRIDOR PARK BLVD.
KNOXVILLE, TN 37932-3294

MANUFACTURER: EMPRO
DESCRIPTION: CURRENT SHUNT
MODEL: 1000-100
SERIAL: N/A

PROCEDURE: CS CAL
LAB ENVIRONMENT: 22.6 °C / 17 %RH
CALIBRATION DATE: 05/FEB/2015
CALIBRATION DUE

MEASUREMENT DATA – AS FOUND / AS LEFT

APPLIED CURRENT	MEASURED VALUE	UNCERTAINTY
100 A	0.997 598 mΩ	124 µΩ/Ω
200	0.997 817	154
300	0.998 065	143
400	0.998 298	145
500	0.998 444	163

NOTES:
SHUNT WAS ALLOWED TO FULLY STABILIZE AT EACH APPLIED CURRENT.
CALIBRATION LIMITED TO 50 % CURRENT TO PREVENT DAMAGE FROM OVERHEATING.
AN ADDITIONAL 100 µΩ/Ω UNCERTAINTY IS ALSO ADDED FOR ESTIMATED CONNECTION VARIATION UNCERTAINTY ON METERING TYPE SHUNTS.
THE REPORTED UNCERTAINTY INCLUDES AN ESTIMATED TEMPERATURE COEFFICIENT OF RESISTANCE (TCR) VARIABILITY OF 20 µΩ/Ω FOR MANGANIN TYPE SHUNTS, CORRESPONDING TO A +/-1 °C AMBIENT TEMPERATURE UNCERTAINTY.

STANDARDS USED

ID	DESCRIPTION	MAKE & MODEL	CAL DUE
AS3001	RESISTANCE STANDARD	OHM-LABS 200	02/MAR/2015
AS3401	RESISTANCE BRIDGE	GUILDLINE 9920A	11/MAR/2015

COMMENTS:
OHM-LABS, INC. CERTIFIES THAT THIS CALIBRATION IS TRACEABLE TO THE NATIONAL INSTITUTE OF STANDARDS AND TECHNOLOGY (NIST), OR ANOTHER RECOGNIZED NATIONAL MEASUREMENT INSTITUTE, OR DERIVED BY A RATIO TYPE SELF-CALIBRATION TECHNIQUE, AND IS ACCREDITED TO ISO/IEC 17025. OHM-LABS' QUALITY CONTROL SYSTEM MEETS THE REQUIREMENTS OF ANSI/NCSL Z540-1-1994. THE REPORTED UNCERTAINTIES REPRESENT EXPANDED UNCERTAINTIES EXPRESSED AT A CONFIDENCE LEVEL OF APPROXIMATELY 95 %, USING A COVERAGE FACTOR OF K=2. THIS UNCERTAINTY IS AT THE TIME OF TEST ONLY AND DOES NOT TAKE INTO ACCOUNT TRANSIT, USAGE, DRIFT OVER TIME, OR OTHER FACTORS AFFECTING STABILITY. THIS DOCUMENT CERTIFIES THAT THE ITEMS IDENTIFIED HEREIN COMPLY WITH ALL REQUIREMENTS OF THE ABOVE PURCHASE ORDER, AND THAT THE CALIBRATION PERFORMED WAS IN ACCORDANCE WITH THE CURRENT REVISION LEVEL OF OHM-LABS' QUALITY CONTROL SYSTEM. TRAINED AND QUALIFIED PERSONNEL PERFORMED THE CALIBRATIONS IN ACCORDANCE WITH THE REQUIREMENTS OF ISO/IEC 17025. THIS CERTIFICATE SHALL NOT BE REPRODUCED, EXCEPT IN FULL, WITHOUT WRITTEN PERMISSION BY OHM-LABS, INC.

PERFORMED BY: GAGE TROY, CALIBRATION TECHNICIAN
REVIEWED BY: JAY KLEVENS, QUALITY MANAGER

Calibration
ACCREDITED
Cert # 2481.01

Ohm-Labs, Inc. 611 E. Carson Street Pittsburgh, PA 15203-1021 Tel. 866-431-0640/412-431-0640 Fax 412-431-0649 www.ohm-labs.com

Figure 8: Shunt Calibration Certificate

How do you calculate the loading for a specific unit?

The ratings shown on the label of the test unit are entered into an Excel worksheet that performs a calculation based on the algorithm explained in the Generalized Test Protocol for Calculating the Energy Efficiency of Internal Ac-Dc and Dc-Dc Power Supplies (Version 6.7.2), Paragraph 6.1.1 *Proportional allocation method for loading multiple and single-output AC-DC and DC-DC power supplies*.

Can you test and certify an open-frame unit?

Open frame units can be tested. The unit must be connectorized, and if it requires specific cooling air, instructions to provide that air must be included with the unit. If an air plenum is required, it must be provided with the unit on submittal.

Do you ensure all connectors are loaded?

All power supply output connectors are mated to the load test fixture. Some power supply configurations have many connectors. The 80 PLUS test board has the following connectors available for connecting loads:

Table 1: Available Connectors for Desktop Power Supplies

Number of Connectors	Type of Connector
1	24-pin Main PSU
2	AUX 8-pin 12V
4	6-pin PCI Express
4	Molex 4-pin Peripherals
2	SATA

How do you ensure all connector pins or wires for a given output are equally loaded?

All pins of the loading fixture utilize balancing resistors to ensure that the drop associated with both connector resistance, and wire resistance in series with the load, is insignificant.

At what frequency is a unit tested?

230V EU Internal Non-Redundant tests are conducted at 50 Hz. All other tests-115V Internal Non-Redundant, 115V Industrial, and 230V Internal Redundant (for North American servers) are conducted at 60 Hz, and 380V DC Internal Redundant- is conducted at 0 Hz.

What instrument settings are used to capture input power values?

For the 115V Internal Non-Redundant test bench, the Yokogawa WT2030 is used. No filters are applied to the power analyzer. An exponential average rate of 32 samples at a refresh rate of 250 milliseconds. 1-Phase 2-Wire wiring, with the voltage and current range set to Auto and the measuring mode set to RMS. For harmonics, the max order is set to 50 using the IEC formula 1/Total.

For the 230V Internal Redundant, 115V Industrial, and 380V DC, the Yokogawa WT3000, No filters are applied to the power analyzer. An exponential average rate of 32 samples is enabled with a refresh rate of 250 milliseconds. 1-Phase 2-Wire wiring, with the voltage and current range set to Auto and the measuring mode set to RMS. The instrument is set in normal measurement mode for harmonics measurements, with a max order set to 50 using the IEC formula, 1/Total.