Testing Frequently Asked Questions

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1. Where do you measure the input voltage?

The input voltage measurement is taken as closely as possible to the unit's input connector. A C19 and C14 extractable cable is tailored for common input connectors to achieve this. This specialized input power cable is equipped with voltage measurement leads affixed to the input voltage wires within one-and-a-half-inch proximity to the unit's input power mating connector, as shown in Figure 1 and Figure 2.

Figure 1: C19 Open Connector

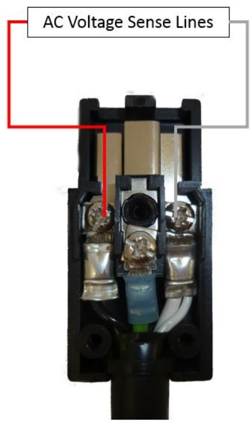
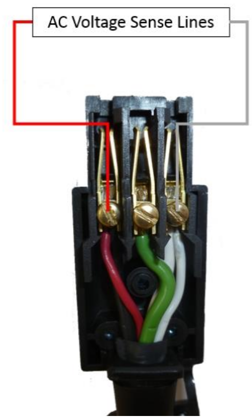


Figure 2: C14 Open Connector



2. 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, and 230V & 277/480V Internal Redundant (for North American servers) are conducted at 60 Hz, and 380V DC Internal Redundant- is conducted at 0 Hz.

3. What power source do you use?

An Ametek, 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, 277V, 380V DC Internal Redundant.

4. Where do you measure the output voltage?

For desktop units operated at 115V and 230V EU, we measure the output voltage at the back of the connector that mates with the load end of the output cable. We use the 63640-150-60 and 63610-80-20 Chroma load bank sense leads to measure the voltage. The measurements are recorded at 1-second intervals during the 15-minute interval per load set point. Figure 1 below provides an example of the piercing probes used to measure the voltage on the back of the unit's output connector.

Figure 3: Insulated Piercing Probe to Measure the Output Voltage of Desktop Power Supply

The same procedure is followed for 230V & 277V Internal Redundant, 115V Industrial, and 380V DC test power supplies unless a custom interface board is supplied with the unit. If a custom interface board is provided, test points must be incorporated to measure the output voltage and return ground directly when 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 4.

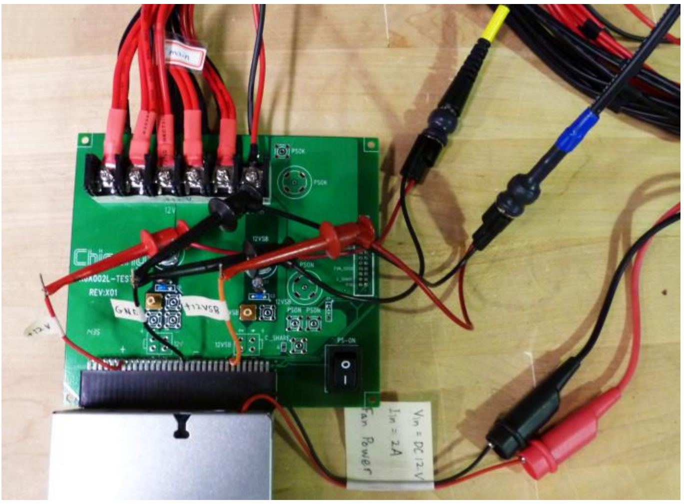


Figure 4: Sense Line, when provided, is used to measure the output voltages

5. What instruments and settings do you use to measure the input and output parameters?

For the 115V and 230V EU Internal Non-Redundant test bench, the Yokogawa WT3000E is employed to monitor and measure various input parameters, including input voltage (V), input current (A), input frequency (Hz), input power (Watts), power factor (λ), and input current total harmonic distortion (THD %).

The Yokogawa WT3000 monitors these input parameters with no filters applied to the power analyzer. An exponential average rate of 32 samples is enabled with a refresh rate of 500 milliseconds. A 1-Phase 2-Wire wiring configuration is used, 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 maximum order set to 50 using the IEC formula, 1/Total.

Figure 5: Yokogawa WT3000E

In the context of the 115V and 230V EU Internal Non-Redundant test bench, the monitoring and measurement of output parameters are carried out using the Chroma 63640-150-60 and 63610-80-20 DC load banks shown in Figure 6. These measurements are taken at 1-second intervals during the 15-minute interval per load set point. The recorded parameters encompass output voltage (V), output current (A), and output power (Watts).

Figure 6: Chroma 63640-150-60 & 63610-80-20 DC Load Banks

230V, 277/480V, and 380V DC Internal Redundant power supply; the Hioki PW6001-16 monitors and measures a range of input parameters. These parameters encompass input voltage (V), input current (A), input frequency (Hz), input power (Watts), power factor (λ), and input current total harmonic distortion (THD %). Additionally, it is used to monitor output and external fan parameters, including voltage (V), current (A), and output power (Watts).

Specifically, for the 230V Internal Redundant, 115V Industrial, and 380V DC test benches, the Hioki PW6001 is employed. Filters are not applied to the power analyzer, and an exponential average rate of 32 samples is set with a refresh rate of 250 milliseconds. The wiring configuration is 1-Phase 2-Wire, with voltage and current ranges set to Autoscale. The measuring mode is RMS for the AC Input channel and DC mode for the DC output channels. For harmonics, the maximum order is configured to 50 using the IEC formula 1/Total.

Regarding output current measurement for the test bench, Hioki current transformers are actively used, as depicted in Figure 7. The selection of current transformers depends on the maximum rated current of the power supply rail, which can be 20A, 50A, 200A, 500A, or 1000A. Before each test, each current transformer undergoes demagnetization and zero adjustment.

									
Hioki Channel	Channel 1		Channel 2			Channel 3	Channel 4	Channel 5	Channel 6
Description	Input Power		Main Rail 1			Extra Rail 2	Stby Rail 3	Extra Rail 4	External Fan
Rating	20A, DC to 2 MHz	50A, DC to 10 MHz	200A, DC to 700 kHz	500A, DC to 500 kHz	1000A, DC to 20 kHz	200A, DC to 700 kHz	20A, DC to 2 MHz	200A, DC to 700 kHz	20A, DC to 2 MHz
CT Model	CT6841A	CT6872	CT6843A	CT6844-05	CT6846-05	CT6843A	CT6872	CT6843A	CT6872
Configuration	Standard	Optional	Standard	Optional	Optional	Standard	Standard	Standard	Standard

Figure 7: Hioki PW6001-16 and CTs

6. Why must we use an LISN and 1uF capacitor in the input circuit for testing efficiency?

A LISN (Line Impedance Stabilization Network) and 1uF capacitor was added to the Generalized Test Protocol for Calculating the Energy Efficiency of Internal AC-DC and DC-DC Power Supplies (Version 6.7.2). The addition of the 50µH LISN provides a known and stable input impedance when measuring the input power factor of very lightly loaded power supplies (below 20% loading) while the 1uF capacitor is used as a low pass filter. Testing at several labs, including OEM labs, showed that the power factor readings were much more repeatable when using the LISN and 1uF capacitor.

7. 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*.

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

We begin the testing protocol for each Unit Under Test (UUT) by starting with a 0% load, recording and operating each load interval for 15 minutes. The loading of the unit is then incremented to the next loading level (5% load), and the 15-minute run time is initiated before data is recorded. The process repeats for each loading set points of 10%, 20%, 50%, and 100%.

9. How and when is the load adjusted for each level?

The AC source and DC 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.

10. 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. The test is terminated if the second unit fails, and a report is issued with recorded failure data.

11. 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 Hioki PW6001 power analyzer used by 80 PLUS has an Active power base accuracy of ± 0.02% of the reading plus 0.03% of the range + current sensor accuracy, and the Yokogawa WT3000E has a base accuracy of ± 0.01% of the reading + 0.03% of the range.

12. 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, 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.

13. 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.

14. Do you ensure all connectors are loaded?

In the testing process, most, if not all, power supply connectors are utilized and connected to the load test fixture. Various power supply configurations may have a multitude of connectors. For instance, the 80 PLUS desktop test board provides several connectors for connecting loads, including:

Table 1: Available Connectors for Desktop Power Supplies

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

15. 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.

16. How should the external power source be prepared and labeled for this purpose?

We request the manufacturer to extract the fan power leads for 230V, 277V/480V, & 380VDC Internal Redundant Data Center power supplies. The external power source should be appropriately labeled with polarity and voltage specifications, and it should be supplied in the required DC format. This separation enhances the accuracy of efficiency measurements, thereby contributing to improved product testing and quality control. Please refer to the attached photo for proper labeling of external fan/cooling power.

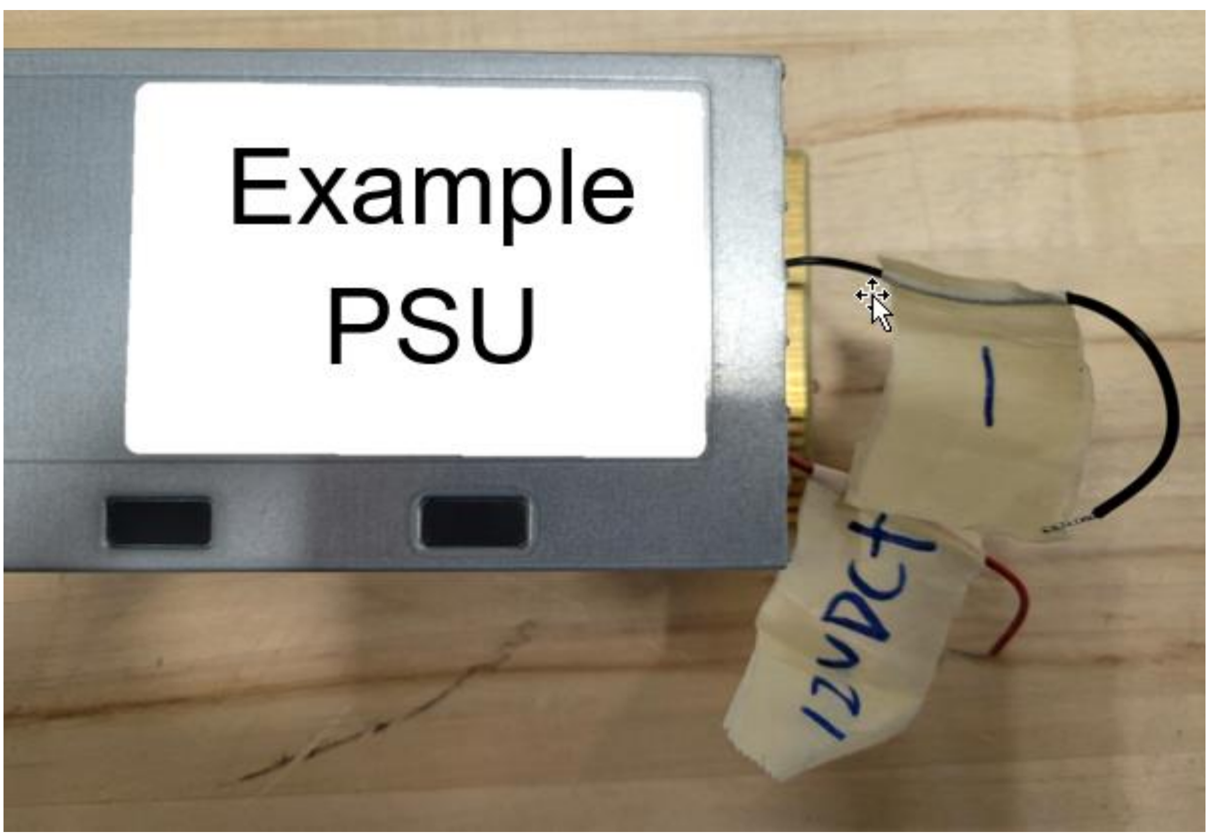


Figure 8 External Fan Power Labeled