80 PLUS®

Testing Frequently Asked Questions

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Version 2.1

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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

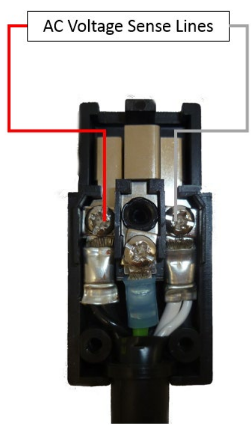
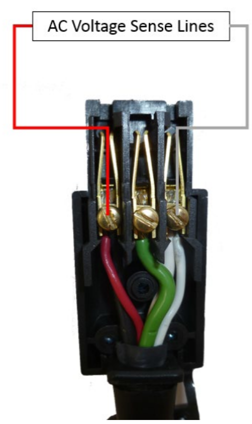


Figure 2: C14 Open Connector



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.

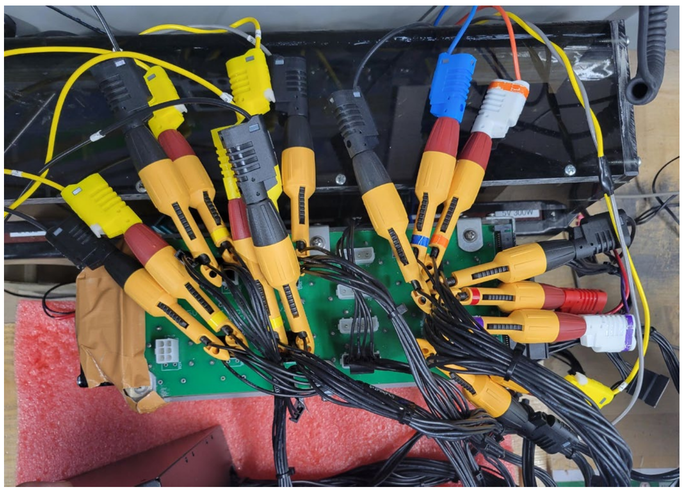


Figure 3: Insulated Piercing Probe to Measure the Output Voltage of Desktop Power Supply

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.

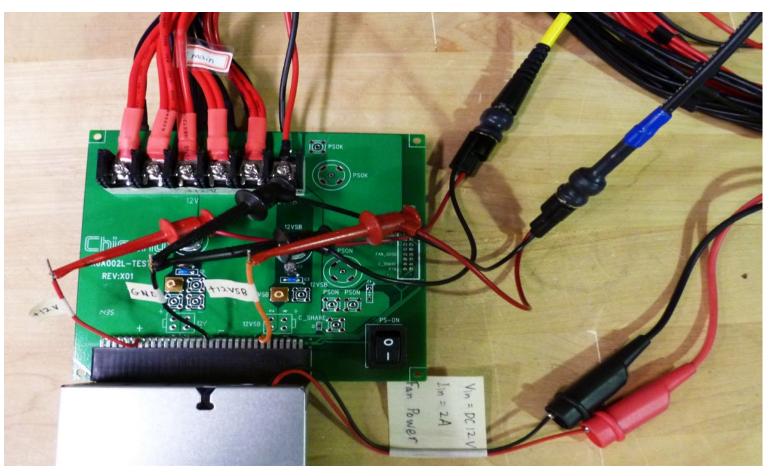


Figure 4: Sense Line, when provided, is used to measure the output voltages

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.

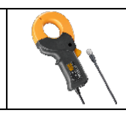
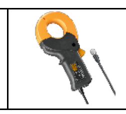
									
Hioki Channel	Channel 1		Channel 2			Channel 3	Channel 4	Channel 5	Channel 6
Description	Input Power		Main Rail 1			Extra Rail 2	Stby Rail 3	Extra Rail 4	External Fan
Rating	20A, DC to 2 MHz	50A, DC to 10 MHz	200A, DC to 700 kHz	500A, DC to 500 kHz	1000A, DC to 20 kHz	200A, DC to 700 kHz	20A, DC to 2 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 0% 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 14-1: 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.

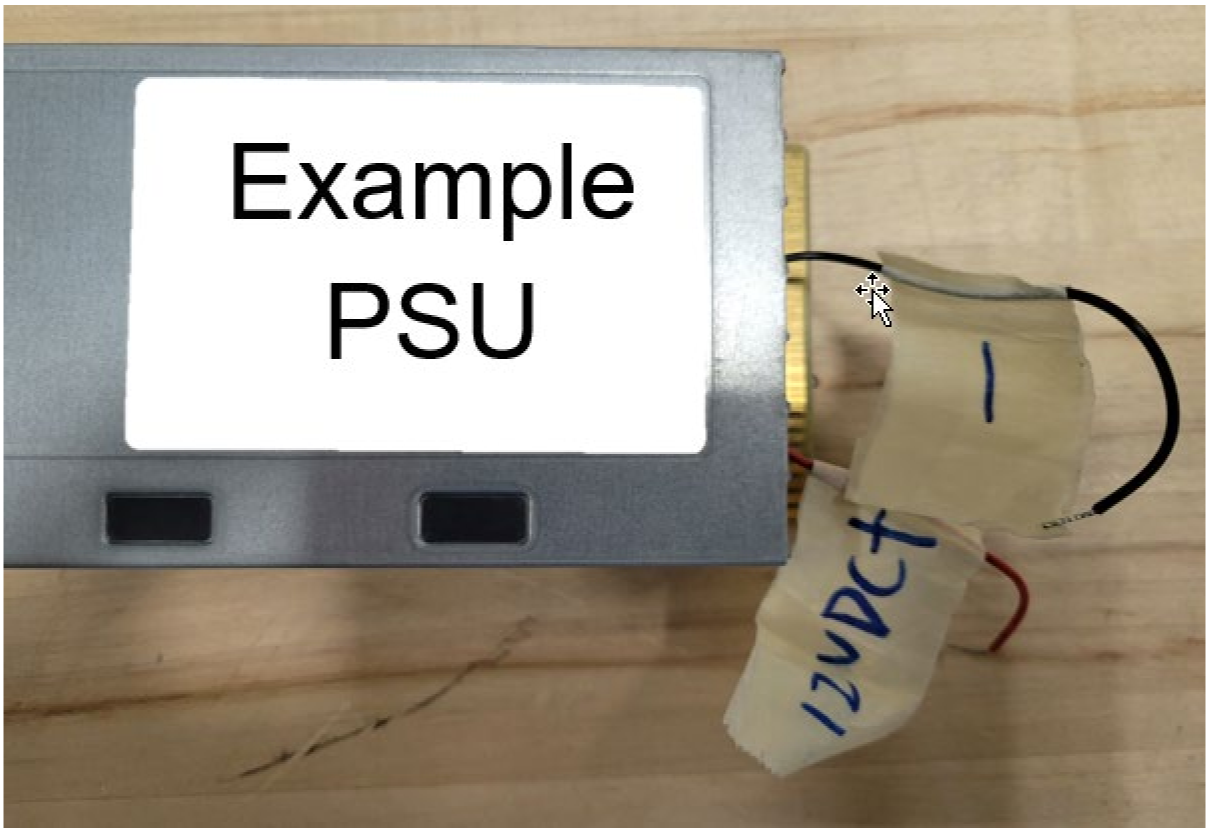


Figure 8 External Fan Power Labeled

17. What is the maximum power capacity that our desktop test bench can handle?

Our desktop test bench is equipped to test units with a power capacity upwards to a maximum of about 2.8 to 3kW. This robust capability allows us to support a broad spectrum of desktop units, offering comprehensive testing for a variety of models and specifications to meet diverse testing needs.

Input Line Impedance Stabilization Network (LISN) Rating Limitation:
The LISN is single-phase and is rated for 20A.

- At 115V, the LISN can support up to approximately 2.3kW.
- At 230V, the capacity increases to about 4.6kW.

Load Bank Power Limitations:
The diagram below Q19 includes a table of the power limitations of each load bank we have available. These limitations are essential to consider when configuring your tests to ensure that the load banks can adequately support the power requirements of the server units being tested.

18. Do all power supplies fit the same loading criteria?

No, not all power supplies adhere to the same loading criteria. The capability of our load bank setup to test these supplies varies depending on several factors, including the output voltage and current ratings of the unit being tested. It's important to understand that different output voltages can affect both the power and current capabilities of our testing process.

To help you understand how the output voltage impacts our testing capabilities, we've provided a table below. This table outlines the power capabilities of our load bank setup at various output voltage levels.

Table 18-1 Desktop Load Bank Power Capabilities

Power Capability of 115V Bench				PSU Rated Output Voltages						
PSU Rated Output Voltages	Voltage Max	Current Max	Power Max	3.3	5	12	48	54	Voltage	
12V1	150	80	400	264	400	400	400	400	Watts	Power Capability
12V2	150	80	400	264	400	400	400	400	Watts	
12V3	150	80	400	264	400	400	400	400	Watts	
12V4	150	80	400	264	400	400	400	400	Watts	
12V5	150	80	400	264	400	400	400	400	Watts	
12V6	150	80	400	264	400	400	400	400	Watts	
12V7	150	80	400	264	400	400	400	400	Watts	
3.3V	150	80	400	264	400	400	400	400	Watts	
5V	150	80	400	264	400	400	400	400	Watts	
-12V	80	20	100	66	100	100	100	100	Watts	
5Vstb	80	20	100	66	100	100	100	100	Watts	

19. Server Test Bench and Load Capabilities

Our Server Test Bench is designed to accommodate a wide range of testing scenarios with an input source capacity of up to 45kVA/45kW. However, it's important to note that there are specific limitations related to the Line Impedance Stabilization Network (LISN) and the total power that can be distributed across the phases during testing.

Input Source Limitation:
The Server Test Bench can handle an input source of up to 45kVA/45kW, providing robust testing capabilities for a variety of server units.

LISN Rating Limitation:
The LISN is rated for only 50A per phase. This translates to approximately 11.5kW per phase, culminating in a total of around 32kW across all phases. This limitation is crucial for planning your test setup, especially when testing high-power server units.

Load Bank Power Limitations:
The diagram below (not displayed here) includes a red box highlighting the power limitations of each load bank we have available. These limitations are essential to consider when configuring your tests to ensure that the load banks can adequately support the power requirements of the server units being tested.

20. How do these limitations affect my testing for servers?

Understanding these limitations is vital for effectively planning and conducting your server tests. The LISN rating, in particular, restricts the maximum power that can be tested per phase, which may require adjustments to your testing setup or the distribution of power across different phases to stay within the safe operating limits of the test bench and load banks.

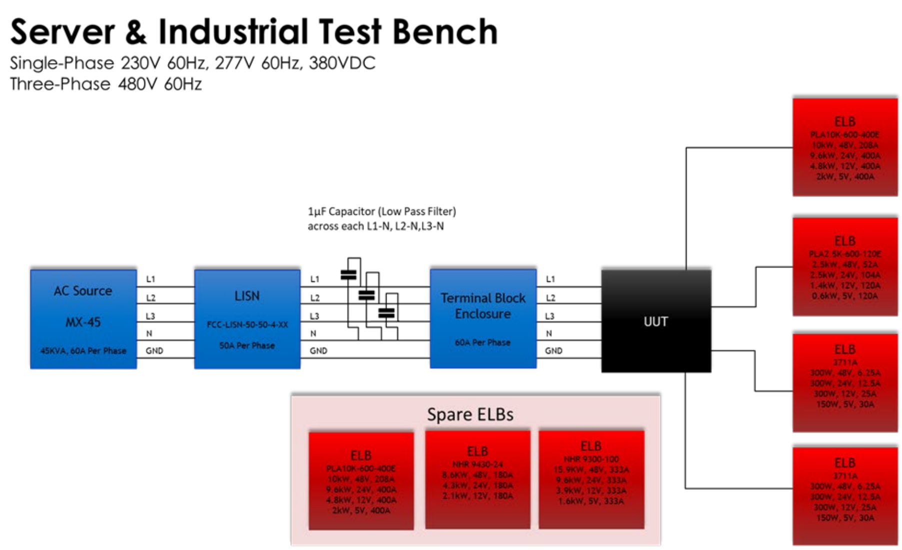


Figure 9 230V Line Diagram with Load Bank Capabilities

21. What should I do if my desktop or server's power requirements exceed these limitations?

If your desktop or server's power requirements exceed the limitations of our test bench, we recommend contacting our support team to discuss alternative testing strategies. In some cases, it may be possible to adjust the test setup or use multiple phases strategically to accommodate higher power requirements. Our team is here to help you find the best solution for your testing needs.