Testing Frequently Asked Questions

July 24th, 2024
Version 2.3

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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

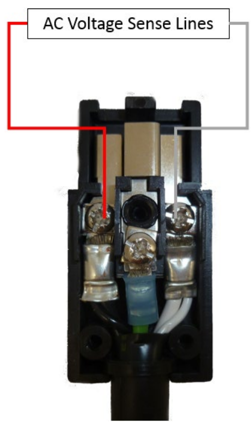
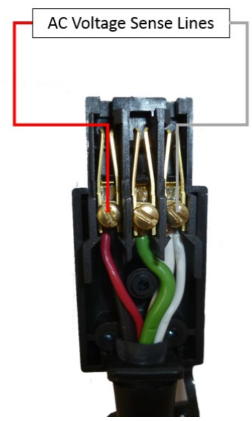


Figure 2: C14 Open Connector



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 desktops. An Chroma 61845, 3-phase 45 kVA voltage source is used to test 230V, 277V, 480V & 380VDC Internal Redundant servers.

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.

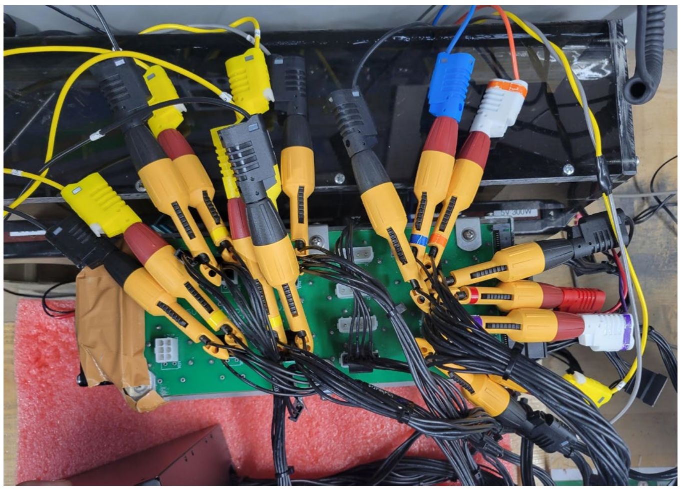


Figure 3: Insulated Piercing Probe to Measure the Multi-Output Voltages of Desktop Power Supply

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.

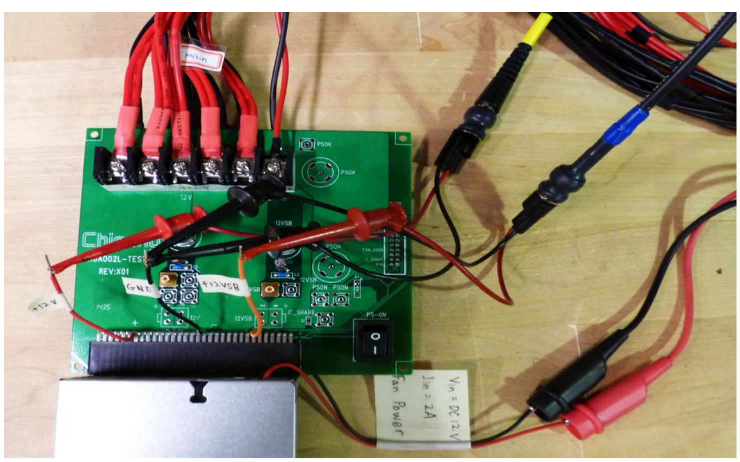


Figure 4: Sense Line, when provided, is used to measure the output voltages

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 Power Analyzer

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 data recorded rate is set to 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 Power Analyzer and Current Transformer Sensors

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	ATX connector 20+4 pin Main PSU
2	4+4 pin EPS12V AUX
4	6+2 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 fan 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. Please refer to the attached photo for proper labeling of external fan/cooling power.

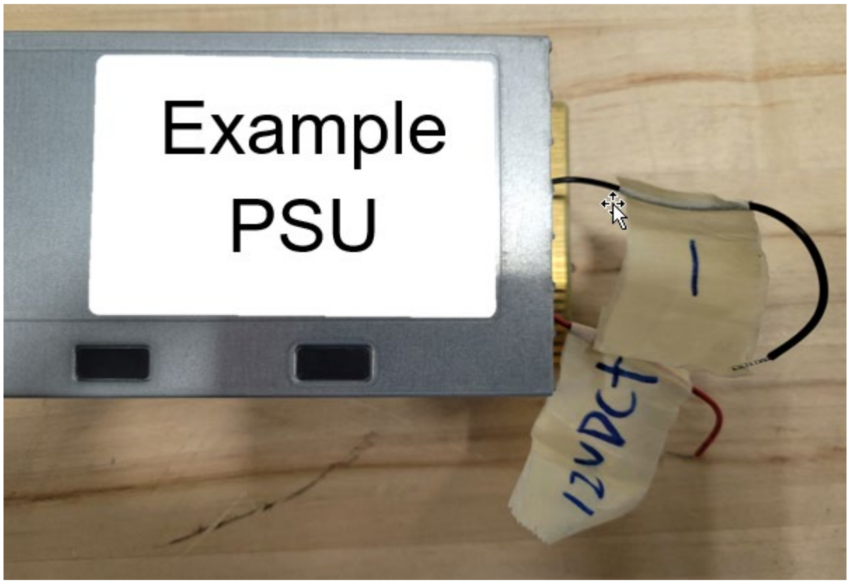


Figure 8: External Fan Power Labeled

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 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 (V)						
PSU Rated Output Voltages	**Voltage Max**	**Current Max**	**Power Max**	**3.3**	**5**	**12**	**24**	**54**	**Voltage**	
12V1	**150**	**30**	**400**	N/A	N/A	360	400	400	**Watts**	**Power Capability**
12V2	**150**	**30**	**400**	N/A	N/A	360	400	400	**Watts**	
12V3	**150**	**30**	**400**	N/A	N/A	360	400	400	**Watts**	
12V4	**150**	**30**	**400**	N/A	N/A	360	400	400	**Watts**	
12V5	**150**	**30**	**400**	N/A	N/A	360	400	400	**Watts**	
12V6	**150**	**30**	**400**	N/A	N/A	360	400	400	**Watts**	
12V7	**150**	**30**	**400**	N/A	N/A	360	400	400	**Watts**	
12V8	**150**	**30**	**400**	N/A	N/A	360	400	400	**Watts**	
12V9	**150**	**30**	**400**	N/A	N/A	360	400	400	**Watts**	
3.3V	**150**	**30**	**400**	99	150	N/A	N/A	N/A	**Watts**	
5V	**150**	**30**	**400**	99	150	N/A	N/A	N/A	**Watts**	
-12V	**80**	**20**	**100**	N/A	N/A	100	N/A	N/A	**Watts**	
Vstb	**80**	**20**	**100**	N/A	100	100	N/A	N/A	**Watts**	
Vstb	**80**	**20**	**100**	N/A	100	100	N/A	N/A	**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:
Our LISN's current rating is 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.

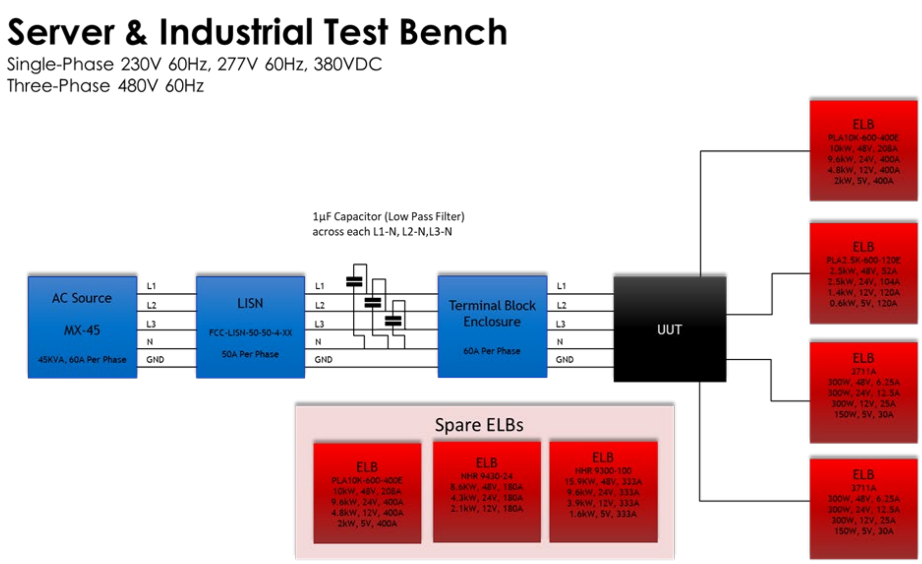


Figure 9: 230V Line Diagram with Load Bank Capabilities

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.

22. What Information Do We Use from the Power Supply Label and the Manufacturer's Order Application?

The Order Application:
From the order application submitted by the manufacturer, we use the following in the report:

- **Product Information:** Used to determine what voltage the PSU is to be tested at.
- **Brand Name:** The name used in the report as the “Manufacturer” name.
- **Model Name:** The name used in the report for the “Model Number” name.
- **Form Factor:** The description used to identify the “Type” topology of the PSU in the report.
- **Wattage:** The value is used in the report as the rated output power. However, it is not used as the rated wattage of the power supply when determining the loading guidelines. The power supply label will determine this value.

The Power Supply Label:
From the power supply label itself, we extract the following information for testing:

- **Input-rated Specifications Ratings:** These include the voltage, current, and frequency ratings that the power supply can safely handle and operate.
- **Serial Number:** A unique identifier for the power supply, used for tracking and record-keeping purposes.
- **Output Voltage, Current, and Power Rating:** These ratings specify the power supply's performance on the output side. This information is crucial for determining the actual output voltage, max current, and rated wattage of the power supply and is used to calculate the loading guidelines of the power supply.

Note: Max DC Wattage or Peak Wattage is not used as the rated wattage of the power supply. The power supply should clearly display what the rated wattage of the power supply is on the label.

23. How are derating factors determined for multi-rail power supplies with subgroup limits?

Reference: [Generalized Test Protocol for Calculating the Energy Efficiency of Internal Ac-Dc and Dc-Dc Power Supplies](), section 6.1.1 Proportional allocation method for loading multiple and single-output ac- dc and dc-dc power supplies.

For this specific power supply, we have a sub-group current limited factor in the railing system

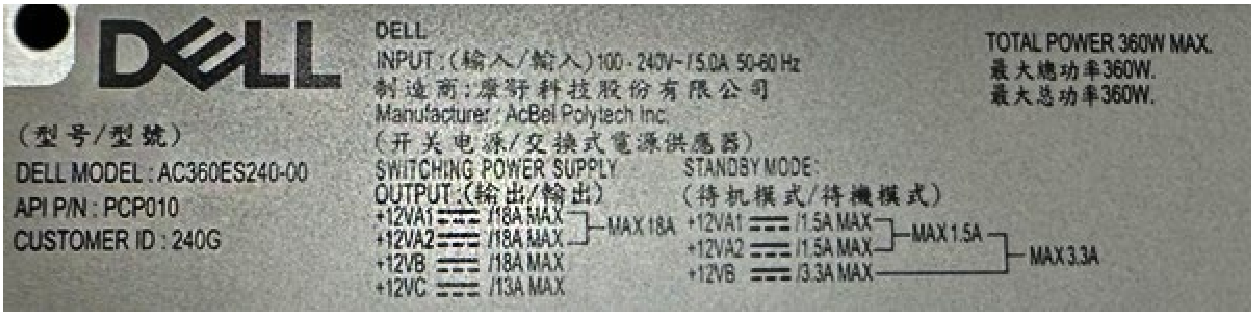


Figure 10:Multi Rail with Sub-Group Current Limits Power Supply Label

Current Ratings:
- +12V1A: 18 A & +12V2A: 18A with a Max Total Current rating 18 A
- +12VB: 18 A
- +12VC: 13 A

Table 23-1: Output Variable Label with Sub-Group Current Limits and Multi-Rail Output Voltage Bus

Rail	Voltage (V)	Max Current (A)	Maximum Rated Output Wattage for Subgroups (W)	Maximum Power Supply Total Rating (W)
+12V1A	12	18	216	360W
+12V2A	12	18		
+12VB	12	18	216	
+12VC	12	13	156	

Step 1: Calculate derating factors for voltage rail or sub-groups rails as shown in below.

Derating for 12V1A and 12V2A has a max current limitation of 18A, so you would use the following equation and for this example: *Derating1 for both 12V1A & 12V2A = 0.5*

$$\frac{\text{12V1A\&12V2A } (12 * 18)}{\text{12V1A } (12 * 18) + \text{ 12V2A } (12 * 18)}$$

12VB has a max current of 18A, an equation you would use for this. *Derating1 = 1*

$$\frac{\text{12VB } (12 * 18)}{\text{12VB } (12 * 18)}$$

12VC has a max current of 13A, an equation you would use for this. *Derating1 = 1*

$$\frac{\text{12VC } (12 * 13)}{\text{12VC } (12 * 13)}$$

If the derating factor DS ≥ 1, then it is clear that when the subgroup is loaded to the rated dc output currents, the subgroup rated output powers will not be exceeded and there is no need for derating. However, if one or more DS factors are less than 1 then the subgroup power will be exceeded if the outputs are loaded to their full output currents and there is a need for derating

Step 2: There is also a need to check whether the sum of the subgroup maximum rated powers is greater than the total maximum power rating of the power supply (PT). If the sum of the subgroup maximum rated powers is greater than the overall power rating of the power supply then a second derating factor DT must be applied. This factor is calculated as shown below: If DT ≥ 1 then no derating is needed. If DT < 1 then the derating for each of the outputs has to be applied and is shown below.

$$\frac{\text{Rated Power 360W}}{\text{12V1A } \left(12(\text{V}) * 18(\text{A}) * 0.5(\text{Darating})\right) + \text{ 12V2A } \left(12(\text{V}) * 18(\text{A}) * 0.5(\text{Derating})\right) + 12VB\ \left(12(V) * 18(A) * 1(Derating)\right) + 12VC\ (12(V) * 18(A) * 1(Derating))}$$

$$\frac{360\text{W}}{588\text{W}}$$

The total derating factor, Dt = 0.6122

12VA1 rail: 18A x 0.5 (Derating1) x 0.6122 (Dt) x 100% (load)= 5.510 A
12VA2 rail: 18A x 0.5 (Derating1) x 0.6122 (Dt) x 100% (load)= 5.510 A
12VB rail: 18A x 1 (Derating1) x 0.6122 (Dt) x 100% (load)= 11.020 A
12VC rail: 13A x 1 (Derating1) x 0.6122 (Dt) x 100% (load)= 7.959 A

Here is a screenshot of what this specific loading would be at each loading point.

Loading Guidelines as per v 6.7.2 Generalized Test Protocol for Calculating the Energy Efficiency of Internal Ac-Dc and Dc-Dc Power Supplies

	Output	Output Voltage (DC)	Min Current (A)	Min DC Output (W)	Max Current (A)	Max DC Output (W)	Full Load (FL) DC Amps	FL as % of Max Current	FL DC Load
CH1	12VA1	12	0	0	18.00	216.00	5.510	0.306	66.122
CH2	12VA2	12	0	0	18.00	216.00	5.510	0.306	66.122
CH3	12VB	12	0	0	18.00	216.00	11.020	0.612	132.245
CH4	12VC	12	0	0	13.00	156.00	7.959	0.612	95.510
CH5	12V5	12	0	0	0.00	0.00	0.000	0.612	0.000
CH6	12V6	12	0	0	0.00	0.00	0.000	0.612	0.000
CH7	12V7	12	0	0	0.00	0.00	0.000	0.612	0.000
CH8	3.3V	3.3	0	0	0.00	0.00	0.000	0.000	0.000
CH9	5V	5	0	0	0.00	0.00	0.000	0.000	0.000
CH10	-12V	12	0	0	0.00	0.00	0.0000	0.612	0.000
CH11	5Vstb	5	0	0	0.00	0.00	0.000	0.612	0.000
	Total Output (W)			0		804.0			360.000
	Total as % of Rated			0.00%		223.3%			100.0%

	50% Load DC Amps	50% Loading as % of Max Current	50% DC Load	20% Load DC Amps	20% Loading as % of Max Current	20% DC Load	10% Load DC Amps	10% Loading as % of Max Current	10% DC Load	5% Load DC Amps	5% Loading as % of Max Current	5% DC Load
CH1	2.755	0.153	33.061	1.1020	0.0612	13.2245	0.5510	0.0306	6.6122	0.2755	0.0153	3.3061
CH2	2.755	0.153	33.061	1.1020	0.0612	13.2245	0.5510	0.0306	6.6122	0.2755	0.0153	3.3061
CH3	5.510	0.306	66.122	2.2041	0.1224	26.4490	1.1020	0.0612	13.2245	0.5510	0.0306	6.6122
CH4	3.980	0.306	47.755	1.5918	0.1224	19.1020	0.7959	0.0612	9.5510	0.3980	0.0306	4.7755
CH5	0.000	0.306	0.000	0.0000	0.1224	0.0000	0.0000	0.0612	0.0000	0.0000	0.0306	0.0000
CH6	0.000	0.306	0.000	0.0000	0.1224	0.0000	0.0000	0.0612	0.0000	0.0000	0.0306	0.0000
CH7	0.000	0.306	0.000	0.0000	0.1224	0.0000	0.0000	0.0612	0.0000	0.0000	0.0306	0.0000
CH8	0.000	0.000	0.000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
CH9	0.000	0.000	0.000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
CH10	0.0000	0.306	0.000	0.0000	0.1224	0.0000	0.0000	0.0612	0.0000	0.0000	0.0306	0.0000
CH11	0.000	0.306	0.000	0.0000	0.1224	0.0000	0.0000	0.0612	0.0000	0.0000	0.0306	0.0000
Total Output (W)			180.000			72.0000			36.0000			18.0000
Total as % of Rated			50.0%			20.0%			10.0%			5.0%

PS Rating (W)	360.0	Watts
3.3V & 5V Rating	0.0	Watts
5VSB and -12V max	0.0	Watts
Max Amps on 12V bus	31.0	Amps
3.3V+5V+12V Max	804.0	Watts

CONTINUE

All Green cells are input values

All Orange and Yellow Cells are calculated and or derating values

	Derating Factor I				Derating Factor II			
D1	0.5	>>	108.00	watts	1.00	>>	108.00	watts
D2	0.5	>>	108.00	watts	1.00	>>	108.00	watts
D3	1	>>	216.00	watts	1.00	>>	216.00	watts
D4	1	>>	156.00	watts	1.00	>>	156.00	watts
D5	1	>>	0.00	watts	1.00	>>	0.00	watts
D6	1	>>	0.00	watts	1.00	>>	0.00	watts
D7	1	>>	0.00	watts	1.00	>>	0.00	watts
D8	1	>>	0.00	watts	1.00	>>	0.00	watts
D9	0	>>	0.00	watts	1.00	>>	0.00	watts
D10	0	>>	0.00	watts	1.00	>>	0.00	watts
D11	1	>>	0.00	watts	1.00	>>	0.00	watts
			588.0	watts			588.00	watts
					Dt	0.6122449		

Assuming no degradation in output DC voltage

Figure 11: Loading Guidelines for Multi-Rail System with Sub Group Current Limits

24. How do you calculate derating factors for multi-rail power supplies?

Please reference the Test Protocol for more information.Generalized Test Protocol for Calculating the Energy Efficiency of Internal Ac-Dc and Dc-Dc Power Supplies, section 6.1.1 Proportional allocation method for loading multiple and single-output ac- dc and dc-dc power supplies

Given:

- Overall rated DC output power: 1600W @ 230V, if we were to test this at 115V, rated wattage is 1000W. For this example we will have the rating at 1600W

Current Ratings:

- +55V: 29.1 A
- +12V: 33.3 A

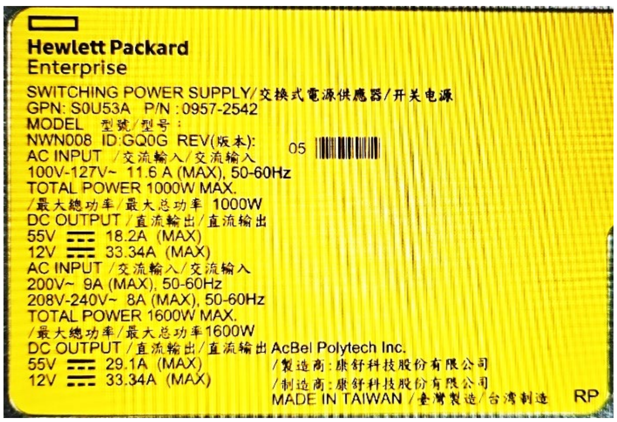


Figure 12: Multi Rail Power Supply Label

Table 24-1: Output Variable Labels with Multi-Rail Output Voltage Bus

Rail	Voltage (V)	Max Current (A)	Maximum Rated Output Wattage for Subgroups (W)	Maximum Power Supply Total Rating (W)
+55V	55	29.1	1600.5	2000.1
+12V	12	33.34	399.6	

Step 1: Calculate derating factors DS1 to DS6 for each of the subgroups as shown in Eq. 6-4.

55V has a max current of 29.1A, an equation you would use for this. Derating = 1

$$\frac{55\text{V}\ (55 * 29.1)}{55\text{V}\ (55 * 29.1)}$$

12V has a max current of 33.34A, an equation you would use for this. Derating = 1

$$\frac{12\text{V}\ (12 * 33.34)}{12\text{V}\ (12 * 33.34)}$$

If the derating factor DS ≥ 1, then it is clear that when the subgroup is loaded to the rated dc output currents, the subgroup rated output powers will not be exceeded and there is no need for derating. However, if one or more DS factors are less than 1 then the subgroup power will be exceeded if the outputs are loaded to their full output currents and there is a need for derating

Step 2: There is also a need to check whether the sum of the subgroup maximum rated powers is greater than the total maximum power rating of the power supply (PT). If the sum of the subgroup maximum rated powers is greater than the overall power rating of the power supply then a second derating factor DT must be applied. This factor is calculated as shown below: If DT ≥ 1 then no derating is needed. If DT < 1 then the derating for each of the outputs has to be applied and is shown below.

For example,

$$\frac{\text{Rated Power 1600W}}{55V\left(55(V)*29.1(A)*1(Derating)\right)+12V\ (12(V)*33.34(A)*1(Derating))}$$

$$\frac{\text{1600W}}{\text{2000.1W}}$$

The total derating factor, Dt = 0.79996

55V rail: 29.1 A x 0.79996 Dt x 100% (load)= 23.279
12V rail: 33.34 A x 0.79996 Dt x 100% (load) = 26.639

Here is a screenshot of what this specific loading would be at each loading point.

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	Output	Output Voltage (DC)	Min Current (A)	Min DC Output (W)	Max Current (A)	Max DC Output (W)	Full Load (FL) DC Amps	FL as % of Max Current	FL DC Load	50% Load DC Amps	50% Loading as % of Max Current	50% DC Load	20% Load DC Amps	20% Loading as % of Max Current	20% DC Load	10% Load DC Amps	10% Loading as % of Max Current	10% DC Load	5% Load DC Amps	5% Loading as % of Max Current	5% DC Load
D1	55V	55.00	0	0	29.1	1600.50	23.279	80%	1280.34	11.639	40%	640.17	4.656	16%	256.07	2.328	8%	128.03	1.164	4%	64.02
D2	12V	12.00	0	0	0.0	0.00	0.000	80%	0.00	0.000	40%	0.00	0.000	16%	0.00	0.000	8%	0.00	0.000	4%	0.00
D3	12V	12.00	0	0	33.3	399.60	26.639	80%	319.66	13.319	40%	159.83	5.328	16%	63.93	2.664	8%	31.97	1.332	4%	15.98
D4	12V	12.00	0	0	0.0	0.00	0.000	80%	0.00	0.000	40%	0.00	0.000	16%	0.00	0.000	8%	0.00	0.000	4%	0.00
	Total Output (W)			**0**		**2000.1**			**1600**			**800**			**320**			**160**			**80**
	Total as % of Rated			0.00%		125.0%			100.0%			50.0%			20.0%			10.0%			5.0%

PS Rating (W)	1600	Watts
Max Amps on Main Rail	29.1	Amps
Max Amps on VBS Rail	33.3	Amps

CONTINUE

NOTE:
The power supplies can have different voltages as their main bus voltage, such as 24V, 48V or 12V. Same holds true for standby also, for example, 3.3VSB, 5VSB or 12VSB etc.

	Derating Factor			
D1	1	>>	1600.50	watts
D2	1	>>	0.00	watts
D3	1	>>	399.60	watts
D4	1	>>	0.00	watts
			2000.1	watts
Dt	0.79996			

Assuming no degradation in output DC voltage

Figure 13: Loading Guidelines for Multi-Rail