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Test Method for AC to DC Power Supplies

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SCOPE AND DEFINITIONS

1. SCOPE

To characterize, document and define test methods for AC to DC power supplies. These tests involve the measurement of AC input parameters and DC output parameters. The application of uniform test methods for power supplies will allow fair performance comparisons to be made between different power supplies.

There are repetitive tests throughout this test document, in which many of the tests can be combined and performed at the same time.

1.1. Definitions

1.1.1. Power Consumption

- 1.1.1.1. Apparent AC Power: the scalar product of the RMS input voltage and RMS input current (Eq. 1).

$$P_{IN}(app) = V_{IN} \times I_{IN} \quad (VA) \quad (1)$$

The apparent power unit is volt-ampere (VA) and is the vector sum of the real and reactive power vectors in the power triangle (Figure 1).

- 1.1.1.2. Real AC Power: the instantaneous product of the time varying voltage and time varying current (Eq. 2).

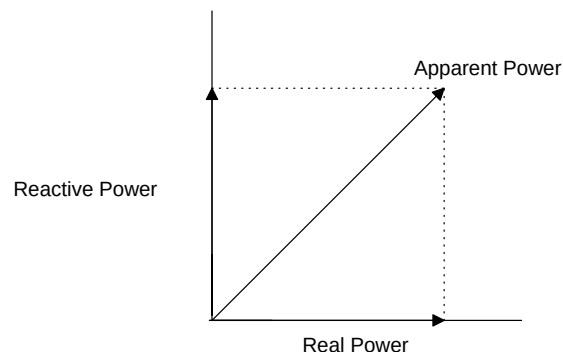


Figure 1: Power Triangle

$$P_{IN}(\text{real}) = \frac{1}{T} \int_0^T v_{IN}(t) \cdot i_{IN}(t) dt \quad (\text{watts}) \quad (2)$$

where T is the period of the waveform

- 1.1.2. **Efficiency:** the ratio of output power to input power. This unit-less parameter will be expressed in percentage form. Efficiency is calculated using Equation 3:

$$\% \text{Eff} = 100 \times \left[\frac{\sum_{m=1}^n P_{OUT\ m}}{P_{IN}(\text{real})} \right] \quad (3)$$

where $P_{OUT} = V_{OUT} \times I_{OUT}$ and 'n' represents the number of outputs

- 1.2.3 **AC Input Loading:** the relationship of a change in the input current usage versus a change in the input voltage for a constant load on the output. This is a directly measured set of data.
- 1.2.4 **Line Regulation:** the relationship of a change in the output DC voltage versus a change in the AC input voltage while holding the load current constant. May be expressed as a difference between two input conditions.

$$\text{Line regulation (mV)} = |(V_{OUT})_{INPUTSTATE\ 1} - (V_{OUT})_{INPUTSTATE\ 2}| \quad (4)$$

- 1.2.5 **Load Regulation:** the relationship of a change in the output DC voltage versus a change in the DC output load current while holding the input voltage constant. May be expressed as a difference between the rated load state and the specified minimum load state.

$$\text{Load regulation (mV)} = |(V_{OUT})_{LOADSTATE\ 1} - (V_{OUT})_{LOADSTATE\ 2}| \quad (5)$$

- 1.2.6 **Power Factor:** the ratio of the real power to the apparent power required to operate a device (refer to Figure 1). Power Factor may be measured directly (from a power analyzer) or it may be calculated using the following relationship (refer to Equations 1 and 2):

$$PF = \frac{P_{IN}(\text{real})}{P_{IN}(\text{app})} \quad (6)$$

- 1.2.7 **Voltage Ripple:** the amplitude of any residual AC voltage which is present on the DC output of the DUT. The "voltage ripple" is a directly measured quantity.

- 1.2.8 DUT: the “device under test” for this test procedure refers to the DC power supply assembly only. It may be tested within the confines of the “intended device” (for heat distribution and filtering purposes), but the input and output connections must be separated from the “intended device” to allow greater control of test conditions. Final performance within the “intended device” should reflect equivalent performance.
- 1.2.9 Hold-up Time: the time duration from when the AC input voltage is removed from the power supply input until the output voltage falls below the minimum specification. The AC input voltage shall be removed at the zero crossing (within ± 1 msec of the zero crossing) of the input waveform.
- 1.2.10 In-rush Current: the instantaneous peak input current that is measured during the initial powering sequence. It shall be performed with the AC input voltage at or near the zero crossing (within ± 1 msec of the zero crossing). It is to be performed with the power supply capacitors completely discharged (>99% discharged).
- 1.2.11. Start-up Time: the time duration from the first in-rush current pulse to the time when all DC output voltages reach their minimum specified operating points. Note that the in-rush current timing reference is the same as in 1.2.10 (above).