SL POWER ELECTRONICS

External Power Supplies: Energy Efficiency Requirements

VI

LEVEL VI+
EFFICIENCY
EMI & EMC

External Power Supplies: Energy Efficiency Requirements

In the early 1990's, the U.S. Environmental Protection Agency (EPA) started a voluntary program to promote energy efficiency and reduce pollution, which eventually became the Energy Star program. However, it was not until 2004 that the first mandatory regulations dictating average efficiency minimums and no-load power consumption for External Power Supplies (EPS) were put into place.

As different countries enacted stricter requirements and moved from voluntary to mandatory programs, the Energy Star program defined the International Efficiency Marking Protocol to minimize confusion between regions and their similar standards. The defined markings set minimum average efficiency and maximum no-load power consumption levels for EPS.The evolution of the various marking levels is detailed below:

- **Level I**: Power supply does not meet any of the standards defined
- **Level II**: Power supply meets minimum efficiencies that were set required by China in November 2005
- **Level III**: Power supply meets Energy Star Tier 1, CEC Tier 1, and Australian MEPS standards
- **Level IV**: Power supply meets EISA 2007, CEC Tier 2 and the Australian MEPS High Efficiency category
- **Level V**: Power supply meets CEC Tier 3 and EU phase 2 standards
- **Level VI**: Power supply meets DOE new standards, to go into effect in the US on February 10, 2016

Below are the countries or regions mandating that external power supplies (EPS) (with some exemptions) shipped across their borders meet specific efficiency levels:

LEVEL	COUNTRY
IV	United States (current)
IV	Canada (current)
V	European Union (current)
VI	United States (2/10/16)

TABLE I. Current Efficiency Levels

New Level VI Requirement:

The new U.S. DoE Level VI efficiency standard mandates that No-Load power consumption shall not exceed 0.100 W for an EPS ranging from <1 W to ≤ 49 W and shall not exceed 0.210W for an EPS ranging from >49W to ≤250W output power rating. It boosts the mandatory average efficiency by about 1%, and sets standards for adapters with power ratings above 250 W for the first time. The new regulations apply to all direct and indirect operation EPS, and also extend their scope to encompass lower voltage DC-output and multiple-output voltage EPS.

Compliance Date:

The new rule mandates that EPS efficiency and no-load power levels comply with “Level VI” standards. The rule also advises that as of February 10th, 2016, these new regulations will take effect. According to the new rule, all EPS products manufactured after this date and shipped into the U.S. must meet the new Level VI standards.

EPS’s that are compliant will be marked with the letters “VI” similar to items shown in Figure I.

Figure I: Efficiency Level VI marking

It should be noted that there is in place a Code of Conduct that was generated in October 2013 by a working group from the EC Joint Research Centre. This Code of Conduct includes a 2-tier implementation of efficiency and no-load power levels. The levels in Tier 1 (Jan 2014 are slightly less stringent than the U.S. DoE Level VI requirements, and Tier 2 levels (Jan 2016) are slightly more stringent. The European Commission has not formally enacted these levels as a firm regulation such as ErPII, and it has not yet been decided whether to enact regulations with the Code of Conduct levels or to be consistent with the U.S. DoE Level VI requirements.

SL Power Level VI Product Offerings:

To address these imminent efficiency requirements, SL Power has developed a new line of external power supplies called the TE+ Series. The TE+ Series are available in power levels from 10W to 220W and in many output voltages, and include other enhanced performance parameters and product features:

TE+ Series External Power Supplies

- Compliant to DoE Level VI requirements
  - No load
  - Avg. Efficiency
- 12W, 20W, 30W, 40W, 60W, 90W, 120W, 220W model families
- Meet Cond Emissions Class B with 6db margin

LEVEL ME EFFICIENCY EMI & EMC

- Meets Radiated Emissions Class B with 3db margin
- IEC61000-4-2, level 4: 8kV/15kV ESD
- IEC61000-4-5, level 4: 2kV/4kV Surge
- Other “Heavy” levels of EMC compliance
- IP22 Rated Enclosures
- >7 year e-cap life
- >500K hrs MTBF (Telcordia 332)
- 0°C to 50° Operating Temp (derate above 40°C)
- Wall-plug (10W thru 30W) and Desktop (10W thru 220W) versions
- Class I and Class II input versions
- 2.5mm barrel connector standard (6 pin Molex on high power)
- Many other output connector options
- Medical Versions (ME Series) will also be available.
  - Compliant to IEC60601-1-2, 4th Edition (EMC)
  - Required for Home Healthcare in 2017

The nameplate of single voltage EPS are marked with a Roman numeral (figure I) from the sequence I (least efficient) to VI (most efficient) that corresponds to specific minimum Active average efficiency and No-Load power levels. The performance requirements for each Roman numeral are shown in Table II.

Performance Requirements* – Single Output EPS				
Level	Nameplate Output Power (Pno)	Minimum Average Efficiency in Active Mode (expressed as a decimal)	Maximum Power in No-Load Mode (W)	Power Factor
I	Used if none of the other criteria are met			
II	<1 watt	≥0.39xPno	≤0.75	Not Applicable
	1 to ≤10 watts	≥0.107 x Ln(Pno) + 0.39		
	>10 to 49 watts	≥0.107 x Ln(Pno) + 0.39	≤1.0	
	>49 watts	≥0.82		
III	≤1 watt	≥0.49xPno	≤0.5	Not Applicable
	>1 to <10 watts	≥0.09 x Ln(Pno) + 0.49		
	10 to 49 watts	≥0.09 x Ln(Pno) + 0.49	≤0.75	
	>49 to 250 watts	≥0.84		
IV	<1 watt	≥0.5xPno	≤0.5	Not Applicable
	1 to 51 watts	≥0.09 x Ln(Pno) + 0.50		
	>51 to 250 watts	≥0.85		
V	≤1 watt	Basic Voltage[1]: ≥0.480 x Pno + 0.140	≤0.3	≥0.9 at 115Vac/60Hz for power supply with input power ≥100 watts
		Low Voltage[2]: ≥0.497 x Pno + 0.067		
	>1 to ≤49 watts	Basic Voltage[1]: ≥0.0626 x Ln(Pno) + 0.622		
		Low Voltage[2]: ≥0.0750 x Ln(Pno) + 0.561		
	≥50 to ≤250 watts	Basic Voltage[1]: ≥0.870	≤0.5	
		Low Voltage[2]: ≥0.860		
VI	≤1 watt	Basic Voltage[1]: ≥0.5 x Pno + 0.160	≤0.100	≥0.9 at 115Vac/60Hz for power supply with input power ≥100 watts
		Low Voltage[2]: ≥0.517 x Pno + 0.087		
	>1 to ≤49 watts	Basic Voltage[1]: ≥0.071 x Ln(Pno) - 0.0014 x Pno + 0.67		
		Low Voltage[2]: ≥0.0834 x Ln(Pno) - 0.0014 x Pno + 0.609		
	>49 to ≤250 watts	Basic Voltage[1]: ≥0.880	≤0.210	
		Low Voltage[2]: ≥0.870		
	>250 watts	Basic Voltage[1]: ≥0.875	≤0.500	
		Low Voltage[2]: ≥0.875		

TABLE II. Efficiency Level Requirements

* Excluded any device that requires Federal Food and Drug Administration (FDA) listing and approval as a medical device. Consult DoE 10 CFR Part 430 for more details.

1) Basic Voltage: nameplate voltage ≥ 6V. 2) Low Voltage: nameplate output voltage < 6V and nameplate output current ≥550mA.

The new level VI requirements now include multiple output EPS, where previous regulations did not. The requirements for these in detailed in Table III.

Multiple-Voltage External AC-DC Power Supply Performance Requirements			
Level	Nameplate Output Power (Pno)	Minimum Average Efficiency in Active Mode (expressed as a decimal)	Maximum Power in No-Load Mode (W)
VI	<1 watt	≥ 0.497 x Pno + 0.067	≤0.300
	>1 to ≤49 watts	≥ 0.075 x Ln(Pno) + 0.561	
	>49 watts	≥ 0.860	

TABLE III. Efficiency Level Requirements for Multi-Voltage EPS

Test Methodology:

It is important to make sure the measurements made on an EPS in order to validate their performance to the standard is performed carefully to ensure proper results. Please see SL Power Application Notes AN-G-001/15 “Energy Efficiency Requirements by Levels” and AN-G-002/15 “No Load Power Measurement Considerations” for guidelines on the testing of EPS to these standards.

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