XP Power

TECHNICAL ARTICLE

UPDATES TO LEGISLATION DRIVE EXTERNAL POWER SUPPLIES' EFFICIENCY

As concern for carbon emissions grows, most countries have introduced legislation to regulate the efficiency of external power supplies (EPS), so that as little as possible of our natural resource is wasted. This legislation encourages power supply manufacturers to introduce EPS models with higher efficiency and lower no-load power consumption and, by gradually tightening the limits on these figures, governments and regulatory bodies around the world are effectively driving the power supply industry to produce more energy efficient products.

In the USA there are a number of bodies legislating on energy efficiency; the California Energy Commission (CEC), US Congress with its Energy Independence and Security Act (EISA) and recently the United States Department of Energy (DoE). There is also Energy Star that sets limits for electrical and electronic equipment. In Europe there is the Energy related Products (ErP) Directive, formerly known as the Energy Using Products (EuP) directive, which is mandatory. There is also the EU Code of Conduct (EU CoC) for external power supplies, which is voluntary. In Canada there is Natural Resources Canada (NRCan), and in Australia, the Minimum Energy Performance Standard (MEPS). The standards are broadly similar describing levels of energy efficiency in Roman numerals (level I to VI and, where level I means an EPS doesn't conform to any standard, and VI means the EPS conforms to the most stringent standard).

Of the legislation produced by these bodies, the US DoE and EU CoC rules are of primary interest to power supply manufacturers because they represent the most stringent of all the requirements. Products designed for global markets are designed to comply with the most stringent requirements in mind, since it's more straightforward to produce one product for all markets than to continue producing older designs that can only be sold in one particular territory. It's worth noting that at present both these pieces of legislation apply only to EPS for consumer products; medical devices are specifically exempt, along with battery chargers (a power supply that can't operate the equipment without a battery present, called an 'indirect power supply').

Changing Efficiency Limits

Legislation focuses on two things; the average active mode efficiency, and the no-load power consumption. The average active mode efficiency is calculated by taking the efficiency of the EPS at 25%, 50%, 75% and 100% of full load and averaging the four figures. The no-load power consumption is quite simply defined as any power the EPS consumes when it is plugged in to the mains, but disconnected from the equipment it is powering.

The EU CoC, Tier 2 of which came into force on 1st January 2016 and featured several changes. The average active mode efficiency has been increased and the no-load power consumption decreased (see figure 1). EU CoC also introduces a minimum efficiency for operation at 10% of full load to bridge the gap between active mode and no-load requirements; there are some applications where the load consumes a relatively small amount of power from the EPS during normal operation, perhaps spending a large proportion of its time in an idle mode. This 10% limit has also been lowered for Tier 2.

From 10th February 2016, the US DoE's Level VI specification came into force, which applies to all products manufactured in the US after that date, and all EPSs imported into the US after that date (regardless of when or where they were manufactured). Average active mode efficiency and no-load power consumption requirements have both been tightened (see figure 2).
Along with tightening the limits, the DoE has also increased the scope of the legislation to include single-voltage EPSs with an output power above 250W, which were previously exempt. Multiple-voltage EPSs up to 250W are also included for the first time.

Effects on the Industry

The effects of all this new legislation have been to encourage power supply manufacturers to develop new EPS products with better efficiency; gone are the days of the very cheap, very inefficient wall-wart. This new generation of higher quality EPS products obviously comes at a cost, but not enough to outweigh the savings consumers will make by using less energy. As energy tariffs continue to increase significantly year on year, this saving becomes more pronounced. Combined with government energy awareness initiatives, it means consumers and business buyers alike now have energy efficiency as a key selection criterion.

While the US is the first territory to adopt Level VI energy efficiency standards, Europe, Canada and Australia are not far behind. It's also often cheaper and more straightforward to specify one type of EPS for global use with a product than to work with several different part numbers and the resulting inventory. For these reasons, most OEMs should be supplying Level VI EPSs with their products in all territories.

EU Code of Conduct (Jan 1st 2014 and Jan 1st 2016)

No load power limits		
Rated power	No load consumption	
	Tier 1 (1st Jan 2014)	Tier 2 (1st Jan 2016)
0 W to ≤1 W	≤0.15 W	≤0.075 W
>1 W to ≤49 W	≤0.15 W	≤0.075 W
>49 W to ≤250 W	≤0.25 W	≤0.15 W

Active mode efficiency, O/P < 6 V		
Rated power	Average efficiency	
	Tier 1 (1st Jan 2014)	Tier 2 (1st Jan 2016)
0 W to ≤1 W	≥0.51 x Pout + 0.085	≥0.517 x Pout + 0.087
>1 W to ≤49 W	≥[0.0755 x Ln (Pout)] + 0.585	≥0.0834 x Ln (Pout) - 0.0014 x Pout + 0.609
49 W to ≤250 W	≥0.88	≥0.88

Active mode efficiency, O/P ≥ 6 V		
Rated power	Average efficiency	
	Tier 1 (1st Jan 2014)	Tier 2 (1st Jan 2016)
0 W to ≤1 W	≥0.5 x Pout + 0.145	≥0.5 x Pout + 0.16
>1 W to ≤49 W	≥[0.0626 x Ln (Pout)] + 0.645	≥[0.07 x Ln (Pout) 0.0014 x Pout] + 0.67
49 W to ≤250 W	≥0.89	≥0.89

EU Code of Conduct (Jan 1st 2014 and Jan 1st 2016)

10% Efficiency Requirement, O/P < 6 V		
Rated power	10% Efficiency Requirement	
	Tier 1 (1st Jan 2014)	Tier 2 (1st Jan 2016)
0 W to ≤1 W	≥0.5 x Pout	≥0.517 X Pout
>1 W to ≤49 W	≥[0.0755 x Ln (Pout)] + 0.485	≥0.0834 X Ln (Pout) - 0.0014 x Pout + 0.509
49 W to ≤250 W	≥0.78	≥0.78

10% Efficiency Requirement, O/P ≥ 6 V		
Rated power	10% Efficiency Requirement	
	Tier 1 (1st Jan 2014)	Tier 2 (1st Jan 2016)
0 W to ≤1 W	≥0.5 x Pout + 0.045	≥0.5 x Pout + 0.06
>1 W to ≤49 W	≥[0.0626 x Ln (Pout)] + 0.0545	≥[0.071 x Ln (Pout)] - 0.0014 x Pout] + 0.57
49 W to ≤250 W	≥0.79	≥0.79

Figure 1. The EU Code of Conduct Level V Tier 2 regulations came into force on 1st January 2016. Tier 2 includes tightened regulations for average active mode efficiency, no-load power consumption and 10% efficiency.

No load power limits	
Rated power	No load consumption
0 W to ≤1 W	≤0.1 W
>1 W to ≤49 W	≤0.1 W
>49 W to ≤250 W	≤0.21 W
>250 W	≤0.5 W

Active mode efficiency, O/P < 6 V	
Rated power	Average efficiency
0 W to ≤1 W	≥0.517 x Pout + 0.087
>1 W to ≤49 W	≥0.0834 x Ln (Pout) - 0.0014 x Pout + 0.609
>49 W to ≤250 W	≥0.87
>250 W	≥0.875

Active mode efficiency, O/P ≥ 6 V	
Rated power	Average efficiency
0 W to ≤1 W	≥0.5 x Pout + 0.16
>1 W to ≤49 W	≥[0.071 x Ln (Pout) - 0.0014 x Pout] + 0.67
>49 W to ≤250 W	≥0.88
>250 W	≥0.875

Figure 2. The US DoE's Level VI regulations came into force on 10th February 2016. The new standard includes more stringent regulations for average active mode efficiency and no-load power consumption, as well as introducing limits for external power supplies above 250W for the first time.