

○ TECHNICAL ARTICLE

ENERGY EFFICIENCY FOR EXTERNAL POWER SUPPLIES (EPS)

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Controlling the power consumed by external power supplies, whether when they are supplying power or when disconnected from the load, is important for continuity of the energy supply and reduction of environmental impacts. Legislation and targets are set for external power supplies because of proliferation, lack of on/off control and because they are commonly left plugged in to the mains supply when not in use. Many areas around the world have introduced legislation for no load power consumption and active mode efficiency for external power supplies. In the USA there is the California Energy Commission (CEC) and the Energy Independence and Security Act (EISA). In Europe there is the Energy related Products (ErP) Directive, in Canada there is Natural Resources Canada (NRCan) and in Australia the Minimum Energy Performance Standard (MEPS) to name just a few. These are a just a few examples of mandatory requirements written into legislation.

Other organisations setting targets for energy efficiency and no load power consumption are Energy Star in the USA and the EU Code of Conduct (CoC) in Europe. The limits set in these standards are voluntary and are more stringent than those required by legislation. It is anticipated that the mandatory requirements will also become more stringent in the future as newer standards are adopted. In recent times both Energy star and the EU CoC have set new more demanding standards for both energy efficiency and no load power consumption, the EU CoC has also introduced a new 10% load efficiency requirement reflecting applications which spend a large proportion of time using minimal power from the external power supply such as those with an internal battery and has two tiers to drive future development.

The Energy star level VI and the EU CoC were both introduced in early 2014 with the Energy Star and EU CoC tier 2 requirements coming into force in 2016. While these are voluntary targets, market demand for higher efficiency and reduction of environmental impacts of products drives power supply manufacturers to comply with these latest standards. These new requirements mean both increased active mode efficiency and reduced no load power consumption. The tables below outline the differences between the existing level V limits previously invoked by Energy star and the ErP, the new Energy Star level VI limits and the EU CoC tier 1 & tier 2 limits with implementation dates. Notably the energy star limits now incorporate external power supplies with an output >250W.

DOE (10th Feb 2016)

Energy Star (10th Feb 2016)

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

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	$\geq 0.51 \times P_{out} + 0.085$	$\geq 0.517 \times P_{out} + 0.087$
>1 W to ≤49 W	$\geq [0.0755 \times \ln(P_{out})] + 0.585$	$\geq 0.0834 \times \ln(P_{out}) - 0.0014 \times P_{out} + 0.609$
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	$\geq 0.5 \times P_{out} + 0.145$	$\geq 0.5 \times P_{out} + 0.16$
>1 W to ≤49 W	$\geq [0.0626 \times \ln(P_{out})] + 0.645$	$\geq [0.07 \times \ln(P_{out}) - 0.0014 \times P_{out}] + 0.67$
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	$\geq 0.5 \times P_{out}$	$\geq 0.517 \times P_{out}$
>1 W to ≤49 W	$\geq [0.0755 \times \ln(P_{out})] + 0.485$	$\geq 0.0834 \times \ln(P_{out}) - 0.0014 \times P_{out} + 0.509$
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	$\geq 0.5 \times P_{out} + 0.045$	$\geq 0.5 \times P_{out} + 0.06$
>1 W to ≤49 W	$\geq [0.0626 \times \ln(P_{out})] + 0.0545$	$\geq [0.071 \times \ln(P_{out}) - 0.0014 \times P_{out}] + 0.57$
49 W to ≤250 W	≥ 0.79	≥ 0.79

Energy Star (Nov 1st, 2008) & ErP (April 2011)

No load power limits	
Rated power	No load consumption
0 W to <50 W (≤ 51 W)	0.3 W
≥ 50 W to 250 W (> 51 W)	0.5 W

Active mode efficiency, O/P < 6 V	
Rated power	Average efficiency
0 W to 1 W	$\geq 0.497 \times \text{rated power} + 0.067$
> 1 W to ≤ 49 W (≤ 51 W)	$\geq [0.0750 \times \text{Ln}(\text{Rated power})] + 0.561$
> 49 W (> 51 W)	≥ 0.86

Active mode efficiency, O/P ≥ 6 V	
Rated power	Average efficiency
0 W to 1 W	$\geq 0.48 \times \text{rated power} + 0.14$
> 1 W to ≤ 49 W (≤ 51 W)	$\geq [0.0626 \times \text{Ln}(\text{Rated power})] + 0.622$
> 49 W (> 51 W)	≥ 0.87

Figures in () are for ErP limits

In addition, Energy Star power supplies with an input power of 100 W and above must have minimum power factor of 0.9 at 115 VAC 60 Hz.

The power market is fast moving and customers are keen to design in products that perform to the latest standards and are future proofed. Energy efficiency level VI parts are readily available in both plugtop and desktop..

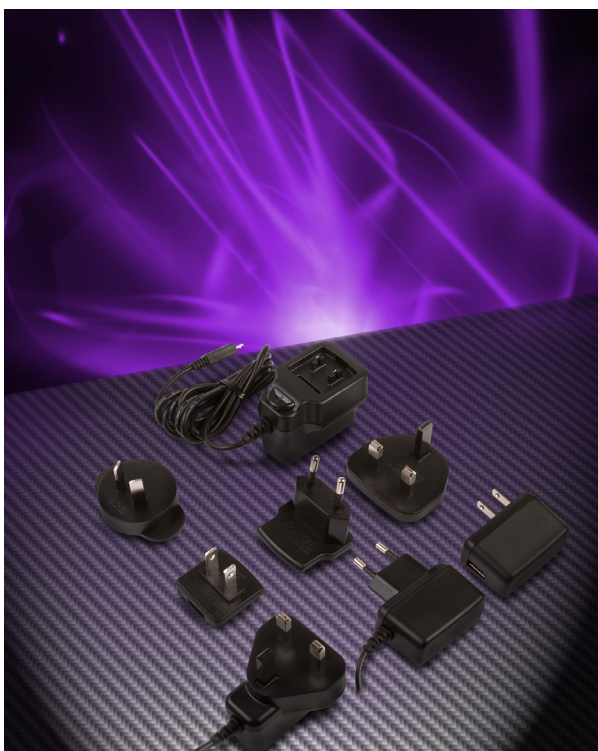


Figure 1: VER05 and VEL05 series from XP Power

An example of products with energy efficiency level VI already available on the market is XP Power’s VER & VEL series of 5 - 36 W wall plug adaptors. Believed to be one of the first plug top power supplies to comply with the new Energy Star level VI energy efficiency standard, they are available with either a fixed input plug as required for use in the US, UK, Europe or Australia (VEL series), or is supplied with four interchangeable mains (VEL series).