Power for change

Meeting no load power consumption requirements. By **Graham Pitcher**.

Out of sight, out of mind. That's been the approach to mobile device chargers for the last few years. We leave them plugged in and turned on, in the belief that no power is being consumed.

But it's not the case; mobile phone chargers and similar devices consumes significant amounts of power when effectively idling. That means power station capacity needs to be available, wasting resources and generating greenhouse gas. It's not an ideal situation.

Recently, a number of initiatives have targeted this area, encouraging – in one way or another – manufacturers to develop more efficient chargers. Bodies such as Energy Star, along with the EU's Code of Conduct, have developed requirements for external power supplies.

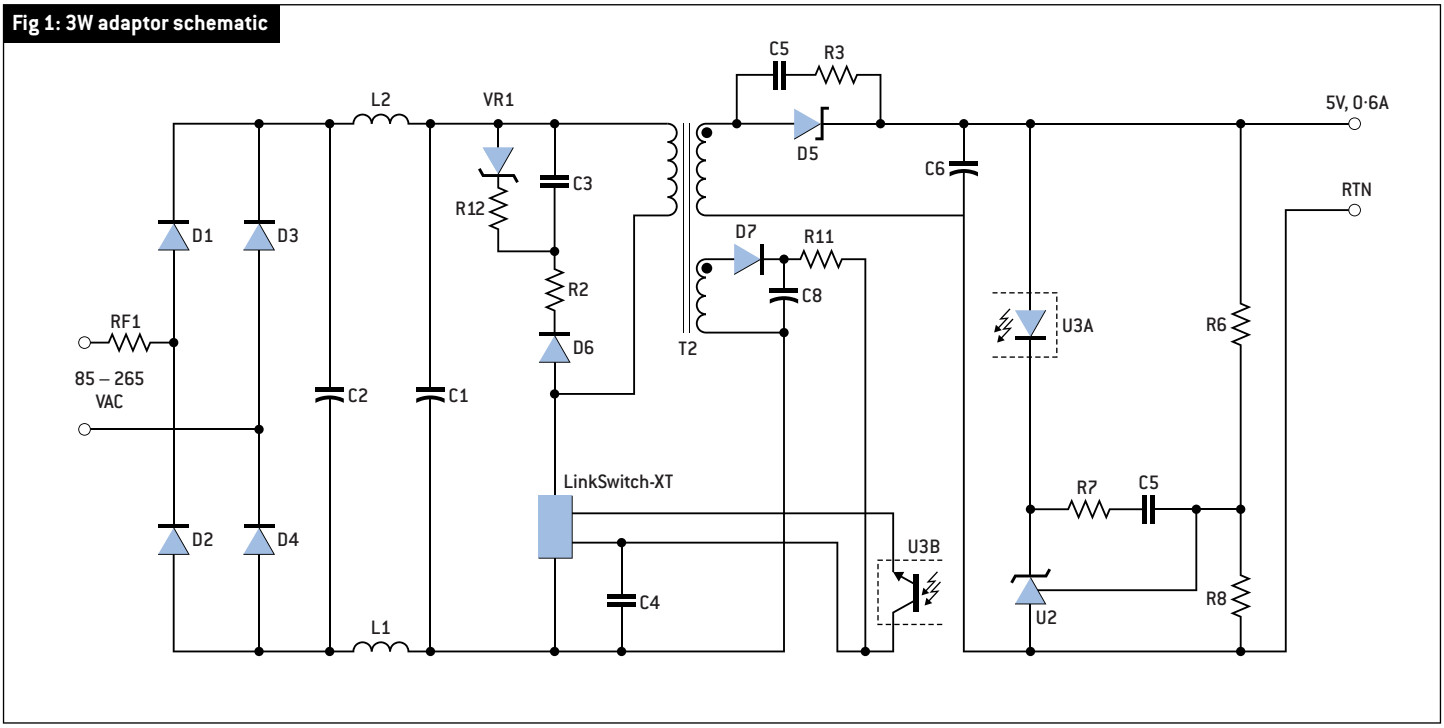
The target in the early days was to cap consumption at 500mW, a figure that was reduced to 300mW. The European Commission's Integrated Product Policy programme and the world's top five mobile phone makers have introduced a voluntary energy rating system for mobile device chargers, making it easier for consumers to determine which ones use the least energy. This rating system covers all chargers currently sold by Nokia, Samsung, Sony Ericsson, Motorola and LG Electronics, and ranges from five stars for the most efficient chargers down to zero stars for the units consuming the most energy. Under this scheme, a product with five stars would have a no load consumption of less than 30mW.

The EC believes that if only 10% of the world's mobile phone users unplugged their chargers, rather than leaving them in a no load state, it would save enough energy to power 60,000 European homes for a year.

Needless to say, this challenge is attracting a number of leading developers of power devices, including Power Integrations. It has recently published a Design Engineering Report in which the design of a 3W power supply circuit that consumes just 10 mW during no load operation is detailed. According to the company, this level of power consumption within the power supply leaves more power available for use by electronic systems, including those which have to comply with the EU's Energy Using Products (EuP) Directive.

While the EuP standard limits standby power consumption to 500mW, Power Integrations says many eco minded manufacturers of consumer

Fig 1: 3W adaptor schematic



products and appliances are choosing even lower standby power budgets – as little as 30mW.

It notes that a standby power supply that consumes 10mW at zero load allows a greater margin for other leaky circuit components, such as input filters, capacitors and bias components, while still providing the power required to support system standby activities. In consumer electronics products, these activities include functions such as powering circuits to monitor an infrared remote control, hardware that senses a key press to activate appliances or which sends automated wake up signals.

Andrew Smith, product marketing manager at Power Integrations, said: "Consumers are increasingly interested in green products. In response, equipment manufacturers are developing products that use energy more efficiently and the market is moving rapidly towards exceptionally low power use, particularly in standby mode. Our EcoSmart technology meets this need by drastically reducing power consumption in no-load and light-load conditions."

The power circuit described in the Design Engineering Report (**www.powerint.com/PDFFiles/der227.pdf**) is based on Power Integrations' LNK363DN, part of the company's LinkSwitch-XT offline switcher family. The reference design contains the power supply specification, schematic, bill of materials, transformer documentation, printed circuit layout and performance data.

The 3W single output isolated power supply operates from a universal 85 to 265V ac input and delivers 5V at up to 0.6A. According to Power Integrations, the part meets EN55022B/CISPR22B limits without the need for a Y capacitor, as well as the efficiency requirements of the European EuP Ecodesign Directive and Energy Star EPS v 2.0.

Smith added: "The power supply also features careful transformer design and circuit bias component selection, combined with algorithms that switch only when required to maintain output voltage regulation, facilitating extremely low power consumption. This allows the supply to deliver power to the system immediately when it turns on, while consuming very little power itself."

The flyback power supply shown in Figure 1 is designed around the LNK363DN. The output voltage is sensed and fed back to the device through optocoupler U2. That feedback is used by the LinkSwitch device to maintain constant voltage regulation of the output.

The LinkSwitch-XT range helps to save no load power

Diodes D1 to D4 rectify the ac input voltage, while capacitors C1 and C2 filter the rectified ac input voltage and provide a high voltage dc bus connected to pin 1 of the transformer. Inductor L1 and ferrite bead L2 are used to provide differential mode filtering for conducted emi compliance.

The LNK363DN device integrates the oscillator, controller, startup and other protection circuitry as well as a high voltage mosfet. It operates at a fixed current limit (Ilimit) and, during every enabled switching cycle, the primary current ramps to this current limit level. Output regulation is maintained by skipping switching cycles (ON/OFF control).

The internal controller determines if the next switching cycle should be enabled or disabled, based on the current flowing into the part's feedback pin. If a current of less than 49 A flows into the feedback pin when the internal clock signal occurs, mosfet switching is enabled. If the current is greater than 49 A, the mosfet is disabled for the current switching cycle.

At full load, few switching cycles will be skipped (disabled), resulting in a high effective switching frequency. As the load reduces, more switching cycles are skipped, which reduces the effective switching frequency.

At no load, most switching cycles are skipped, which minimises no load power consumption, since switching is the dominant loss mechanism at light loading. Additionally, since the amount of energy per switching cycle is fixed by Ilimit, the skipping of switching cycles gives the supply a flat efficiency characteristic over the load range.

Reference kit helps designers to meet power efficiency requirements

Power Integrations has introduced a Reference Design Kit for a dual rail power supply with high loop bandwidth and peak power for home theatre systems. Rated at up to 650W audio power, the reference design enables developers to meet emerging standby power usage regulations for consumer audio video equipment.

The design is based on Power Integrations' PKS607YN, which has a response time of 40μs. According to the company, amplifiers powered by power supplies featuring the part can keep up with high crest-factor, high-frequency audio signals common in high quality digital music and DVD movie soundtracks.

By managing power delivery as required by the audio amplifier, PeakSwitch prevents the power rail voltage from falling during sustained high energy segments without requiring a large bank of output capacitors. This ensures low audio distortion, due to clipping, or dynamic range compression, caused by a reduction in the amplifier's power supply voltage. Independent rail regulation eliminates coupling between the positive and negative supplies, further reducing distortion and increasing audio quality.

The RDK circuit consumes less than 0.9W at 240V rms input, meeting the power efficiency regulations established by organisations such as Energy Star and the European Commission's Energy using Products Directive.