Powering the future: minimizing the flow of wasted energy with GreenChip™ technology

Around the world, battery chargers for mobile phones, MP3 players and other useful devices are consuming electricity – even after the device itself has been unplugged. As long as the power supply or charger remains in the outlet, milliamps of current are flowing through them so that the electronics inside the power supply will have the right voltage ready when it's needed.

Since that voltage is available instantaneously as soon as the power supply is plugged in, this is wasted energy.

A trickle of milliamps into a mobile phone charger doesn't seem like much. But when it is multiplied by all the world's chargers – the average person in many countries has four of them – billions of trickles combine into a torrent of wasted energy. The total amount of energy lost worldwide has been estimated as the equivalent of a 500 megawatt generating station based on 4 billion devices in service worldwide of which 25% (1 billion) are in service at any one time. If one-half of a watt could be saved per device times 1 billion devices, it would amount of a savings of 500 MW. In the U.S., the ENERGY STAR® program, a joint effort of the U.S. Environmental Protection Agency and the U.S. Department of Energy, has targeted the wasteful ways of power supplies (sometimes known as wall warts). Over the past five years, it has established aggressive goals for increasing power supply efficiency. Figure 1 shows the efficiency requirements (vertical axis) of end-use power supplies according to their capacity. The horizontal axis shows the allowable power consumption under no-load conditions. A power supply must meet both criteria (i.e. fall into one of the EPS blocks) to earn an EnergyStar rating.

A Decade of GreenChip™

NXP's first GreenChip™ based solutions were released in 1998. They reduced standby power of CRTs from a typical value of 8W to less than 3W – without the need for a separate standby power supply.

Although the EnergyStar program is recognized as setting aggressive goals for energy efficiency in many instances, GreenChip™ based products outperform energy specifications such as EnergyStar ®.

GreenChip™ standby housekeeping ICs can bring the standby consumption of a 90W notebook adapter down to below 30mW, a ten-fold improvement over currently available Green products.

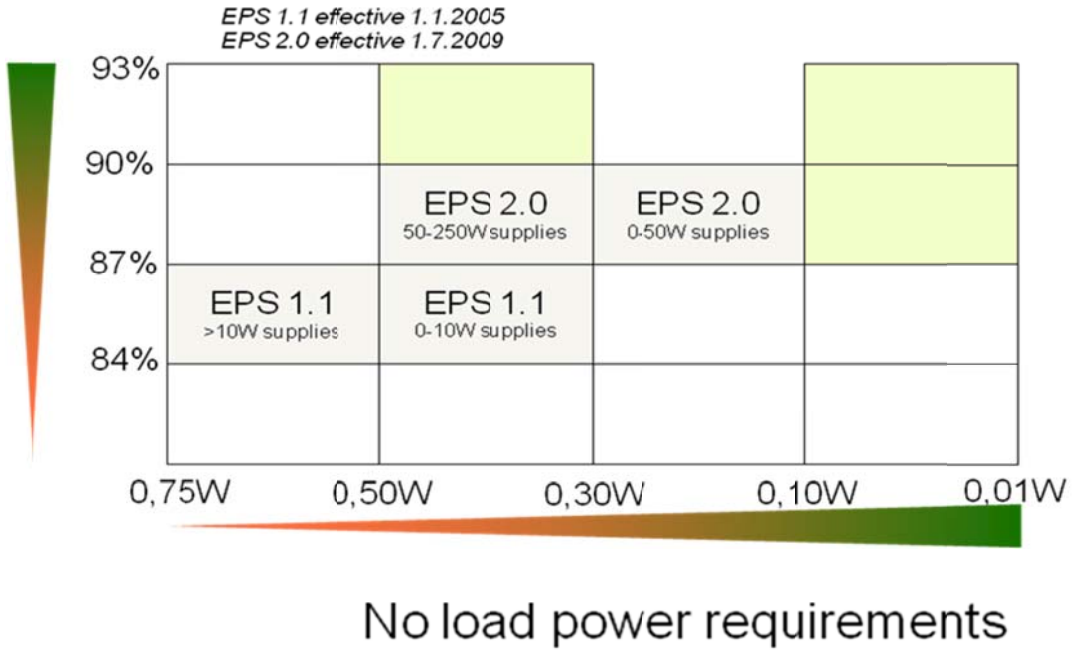

Figure 1. ENERGY STAR® *requirements for external power supplies (EPS) became effective in 2005 and 2009.*

Beginning January 2005, 84% efficiency while charging and less than 0,50W no-load power consumption (horizontal axis) was required for a greater than 10W supply to earn an EnergyStar rating. In July 2009, more stringent specifications were implemented that encompassed the supplies targeted by EPS 1.1 and added larger supplies (0-50W and 50-250W).

The most aggressive specifications are on the horizontal axis, which measures the energy wasted while the end-use devices are not plugged in. A seven-fold decrease – from 0,75W to 0,10W – marks the upper end of the EPS 2.0 specification for >50W supplies.

The GreenChip™™ story

Fifteen years ago, power supplies for TVs, notebook PCs and desktop PCs had operating efficiencies in the range of 70-80%. Recognizing that potential energy savings – and savings on energy bills – was significant in aggregate, NXP Semiconductors formed an engineering team to set things right. The first GreenChip™ based product was released in 1998, and was aimed at CRT monitors. Standby power – the power used while the CRT screen wasn't on – was reduced from typically 8W to less than 3W without the need for a separate standby power supply. Since then, GreenChip™ solutions have followed one after another, year after year.

At the beginning of the 21st century, GreenChip™ based products made it easier for manufacturers to comply with energy efficiency government mandates and specifications. Since then, generation after generation of GreenChip™ based solutions, each with a new technology innovation, has helped downsize power use in numerous applications.

Fast forward to 2010. NXP augments the GreenChip™ IC family by adding a chip with a resonant converter that can be used in a wide range of applications between 90 and 600W at efficiencies up to 95%. While establishing a new efficiency benchmark, NXP also opened power savings to a broader application range including LCD TV, and high efficiency computing power like high density travel adapters.

NXP is taking big steps with GreenChip™ standby housekeeping ICs that can bring the standby consumption of a 90W notebook adapter down to below 30mW, a ten-fold improvement over currently available Green products.

Originated from work with the lighting industry, GreenChip™ engineers drew on more than 15 years experience in high performance mixed signal technology and fluorescent lighting driver knowledge for high voltage resonant converters, to achieve the highest level of integration and protection features in the industry.

GreenChip™ technology has been a consistent leader in the industry and NXP continues to invest in research, development and design. Figure 2 shows how GreenChip™ technology aimed at adapters compares, for example, with the EnergyStar goals in Figure 1. In many instances, GreenChip™ outperforms energy specifications such as EnergyStar.

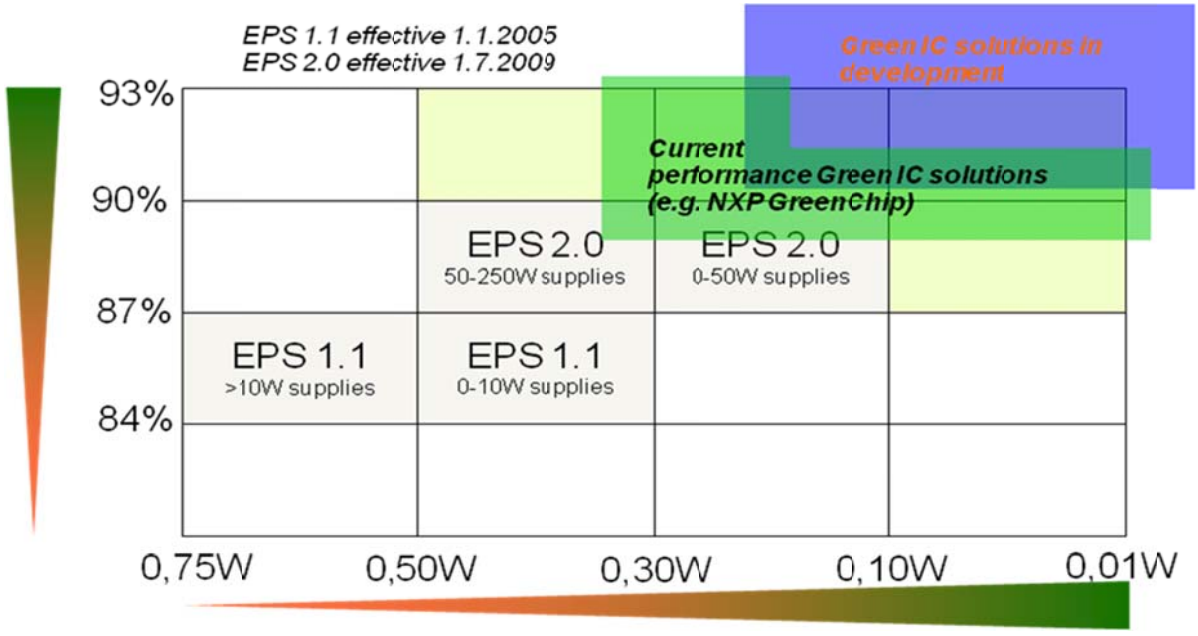

Figure 2. NXP's GreenChip™ technology performs well above EnergyStar requirements.

Into the future

With efficiencies reaching into the range of 95%, what energy-savings frontiers remain?

The implementation of smart-grid technologies that endow entire buildings or campuses with the intelligence to recognize when energy is being wasted and take remedial action is one possible direction. The only thing better than realizing ultra-high efficiencies is turning the power supply off virtually when it is not being used.

Measuring, reporting, and reducing energy consumption across an entire corporate infrastructure, can significantly reduce a company's energy budget. In order to measure, report and reduce globally, however, each device – including power supplies for laptops and mobile phones but also lighting, HVAC and anything else that consumes electrical energy – must be able to measure, report and reduce locally.

Not plain vanilla

Unlike the majority of semiconductor companies, who have become specialists in either the analog or digital domains, NXP has always kept its focus balance on mixed-signal disciplines. This includes design expertise, of course, but mixed-signal fabrication processes are equally important.

In power supplies, in particular, implementing the “intelligence” necessary for them to have specific states and operating modes requires digital technology even though the foundation process for switching power supplies is analog. Breakdown voltages of up to 700V are realized in NXP’s EZ-HV process. Power process technologies are part of the story but so is the design expertise that ultimately realizes GreenChip™ capabilities.

The combination of these technical factors along with NXP’s long-standing interest in improving the environment though eco-engineering has put it in the forefront of the green chip movement.