

Switch-Mode Power Supplies

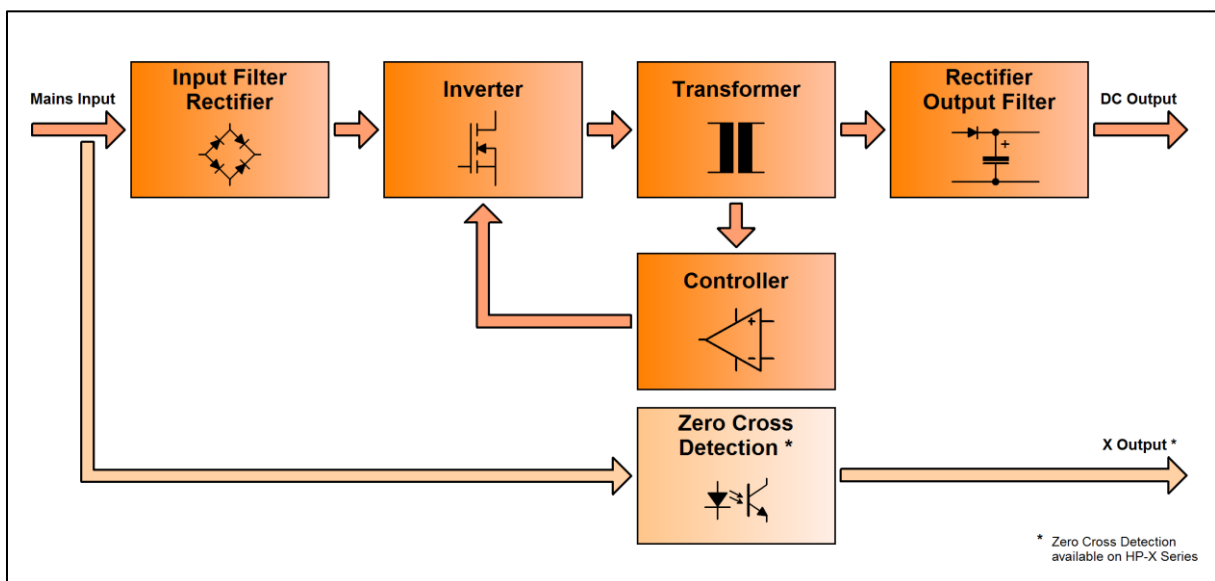
Overview

In conventional power supplies, a linear regulator provides the desired output voltage by dissipating excess electric power in form of heat and, hence, its maximum power efficiency is given by the ratio of input to output voltage.

A Switch Mode Power Supply (SMPS) regulates its output voltage by switching energy storage elements such as inductors, by means of a transistor changing “on” and “off” states at high frequencies. In this mode of operation, the transistor has a very low resistance in its “on” state, thus enabling the converters to operate with high efficiency. The PWM duty cycle of the transistor is controlled by an integrated circuit ensuring proper output voltage regulation.

For mains input Switch Mode Power Supplies the necessary isolation is achieved by the built-in transformer which also acts as a mutual inductor for energy storage. Due to the high switching frequency this transformer can be of a much smaller size compared to 50/60Hz iron core types. This results in compact and light weight supplies, enabling applications with high power density.

Switch Mode Power Supplies come in various topologies, all with their specific advantages for certain applications and output power ranges. In the low to medium output power range, Flyback Switch Mode Power Supplies provide a solid and cost effective solution for a wide array of demands.



The first stage of a mains AC input SMPS is the input filter and rectifier stage which converts the mains voltage into an unregulated DC voltage, fed to a large filter capacitor. The current drawn from the AC side flows in short pulses at the peak input voltage which causes harmonic distortions. These have to be compensated by suitable line filter circuits and PFC (Power Factor Correction) circuits, usually also contained in the input stage.

The inverter stage converts the unregulated DC voltage to AC by chopping it with a power transistor at high frequency. The duty cycle of the resulting AC voltage determines the amount of energy fed to the primary winding of the transformer, which then converts the voltage down to the required output levels on its secondary side.

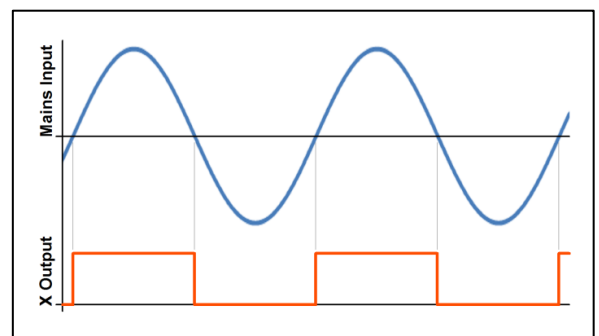
SMPS transformers run at high frequency. Most of the cost and space savings in mains input Switch Mode Power Supplies result from the smaller size of the high frequency transformer. The transformer's capability to transfer energy is proportional to the operating frequency. By using a much higher frequency, the core can be greatly reduced compared to 50/60Hz types. However, core losses increase at higher frequencies, thus ferrite material which has a low loss at the high frequencies is used.

The transformer's AC output then is rectified and smoothed by a filter consisting of inductors and capacitors. The higher the switching frequency, the smaller the size of these components is needed.

To compensate for output load variations and input voltage changes, a feedback control loop is needed. This feedback loop typically consists of an isolated auxiliary winding of the transformer fed to the controller IC. In addition the controller IC serves the purpose of supervisory and security protection features. Common protection features are over temperature protection, output short protection and over voltage protection.

Zero Cross Detection Output

In many applications it is advantageous to synchronize various events to the mains frequency and phase. For example, the efficiency of power Thyristor circuits is increased and component service life is extended, e.g. for relays, if switching occurs at zero-crossing. In addition, sensing applications like those frequently found in the 'Smart Home' market, need to eliminate 50/60 Hz noise, which can be easily accomplished by synchronizing built-in A/D converters with the mains frequency.



Zettler Magnetics' patent-pending HP-X Series SMPS come with a **built-in zero-cross detection 'X-Output'**. The output is electrically isolated from the mains input and monitors frequency and phase of the AC input. With this pre-certified solution, customers have an easy and cost effective way to optimize their design (see more below).

SMPS Solutions from Zettler Magnetics

Zettler Magnetics offers a series of cost effective and reliable encapsulated AC-DC power modules with a wide universal input range in a compact, plug & play package. These are ideal for a variety of smart energy solutions such as low power lighting controls, audio or thermostat controls and other smart home electronics applications, as well as industrial controls.



Key Features

- Universal Input Range 85VAC-305VAC*
- Compact encapsulated design
- Wide ambient temperature capability -25°C to +85°C*, full power output w/o derating
- Low standby power consumption <0.1W
- Protection Capability: OVP, OSP, OCP, OPP.
- Compliance with UL/IEC standards
- EMC compatible.

Key Benefits

- Easy Plug & Play solution for control board applications
- Long life: MTBF >1 million hours*
- High Efficiency
- Customizable.

Zettler Magnetics SMPS Modules come in high performance “HP” and performance “ZP” series. (* available in HP Series)

High Performance HP Series

HP01/HP02/HP03 Series

- Output Power: 1W, 2W & 3W available
- Various output voltages available
- Extended wide input voltage range: 85VAC-305VAC
- DC input voltage available as well
- High operating temperature w/o derating: 85C
- Compact size: 1W: 33.7mm/22.2mm/15mm, 2W/3W: 37mm/24mm/15mm
- Long lifetime: MTBF > 1 million hours.

HP01/HP02/HP03 -X Series (zero-cross detection)

- Subset of HP series, Patent Pending
- Isolated output synchronous to main zero crossing
- Mains phase, frequency and zero-cross detection and monitoring
- Suitable to minimize losses in power Thyristor/TRIAC circuits
- Operating components at zero crossing to extend life and reduce switching power losses
- Timing applications, A/D converter to mains synchronization
- Mains dropout detection.

Performance ZP Series

ZP01/ ZP02/ ZP03/ZP05/ZP10 Series

- Output power 1W, 2W, 3W, 5W & 10W available
- Various output configurations and voltages
- Wide input voltage range: 85VAC – 264VAC
- Input voltage frequency up to 400Hz
- High module efficiency of typically > 80%
- Compact Dimensions and light weight, due to high switching frequency of up to 100kHz
- Complete set of protection features:
 - output short protection
 - over voltage protection
 - over current protection
 - over power protection.

Applications

Zettler SMPS Modules are designed and suited for a broad spectrum of possible applications:

- **Building Automation Control Boards**
 - Smart Home applications
 - Wireless switching
 - Lighting Controls (including LED Driver boards)
 - HVAC control boards (including Thermostats)
 - Motorized Blinds & Shades
 - Smart Energy applications.
- **White Goods/Appliances**
 - Washing Machines
 - Refrigerators
 - Microwaves
 - Coffee machines and other small appliances.
- **Test & Measurement Devices**
 - Smart Meters

- Scientific Instruments
- Smart power outlets/Smart power strips.

SMPS modules from Zettler Magnetics are manufactured in our fully automated manufacturing facility in Xiamen, China, and subject to stringent quality controls. They are sold and distributed globally via Zettler Group's Magnetics companies, operating in China, Europe, North America and Hong Kong.

For more information and datasheets please visit:

<http://www.zettlermagnetics.com/encapsulated-switch-mode-modules>

Or

<http://zettlermagnetics.eu/en/encapsulated-switch-mode-modules>

Or

<http://www.zettlermagneticshk.com/encapsulated-switch-mode-modules>