RDFC topology – Resonant EMI Benefits

Describes why RDFC topology is better than other SMPS topologies

- RDFC smooth resonant waveform enables low EMI
- No Y-capacitors or expensive EMI components up to 20 W
- Can achieve radio AM band-compliance cheaper than equivalent SMPS technologies.

Overview

With the change in requirements mainly driven by commodity material costs and new efficiency regulations, linear power supplies are quickly being replaced by SMPS topologies. However with these hard-switching topologies, come technical and costly challenges in EMI suppression, not faced previously with linears. CamSemi unique resonant SMPS topology has benefits in low EMI.

Electromagnetic Interference (EMI)

Radiated EMI

An electromagnetic (EM) wave is produced when there is a magnitude change in voltage and current. If the change in voltage is coupled to a conductor of suitable length by direct connection, stray capacitance or parasitic inductance, then the EM wave will propagate through space and affect a large area.

This generated wave can affect nearby equipment.

Conducted EMI

Changes in voltage and current can be imposed on any cables connected to a piece of equipment and conducted to another piece of equipment, compromising its operation. Connecting cables include mains supply cabling, audio connection leads, data transfer cables and telephone cabling.

Switch Mode converters & EMI

EMI emissions are the main concern for all switch mode converters as these AC/DC converters cause voltage changes of hundreds of volts (where large current and voltage changes cause larger EMI issues). Also these converters are connected to mains supply cabling, which provides an excellent transmitting antenna for radiated EMI.

A Flyback or Ringing Choke Converter (RCC) topology may be used to realise an AC/DC converter, but their switching waveform is quite rectangular and spreads noise over a wide part of the electromagnetic spectrum.

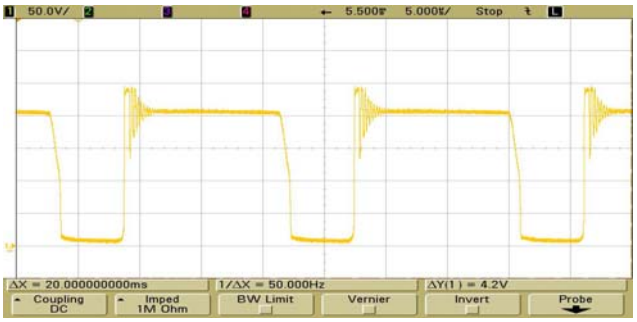

Figure 1: Flyback & RCC switching waveform

With its hard switching, fast falling and rising voltage edges, it can be difficult to prevent a flyback converter from exceeding the radiated and conducted emissions limits at output powers above a few watts. Extra costs are often needed for filter components, such as X & Y capacitors (special safety capacitors for use across mains supply) and a common mode choke (like an extra transformer) to enable compliance with EMC regulations. RCCs are similar in their switching characteristics and associated EMI problems.

RDFC and EMI

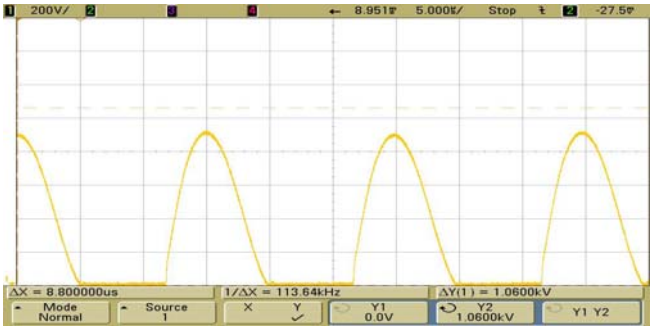

Figure 2: RDFC switching waveform

As shown above, there are no fast edges to the RDFC switching waveform leading to a much more restricted frequency range of significant emissions. These are also more easily suppressed by a simple π filter formed from the input smoothing capacitors and a low cost inductor. Care needs to be taken with PCB layout and transformer design, but no further suppression components are usually needed for PSU powers of up to about 20 W.

Audio Demonstrator PSUs and EMI

Low EMI Audio PSU

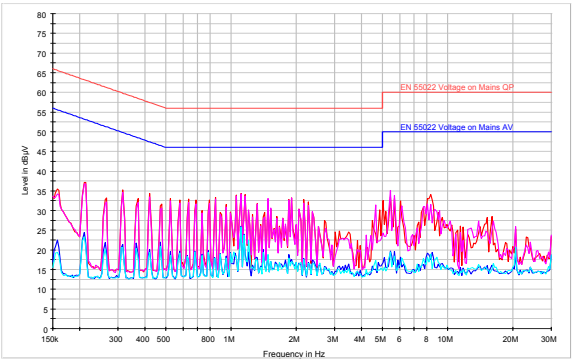

Figure 3: 20 W average 40 W peak audio PSU. Output grounded (worst case)

Low EMI is achieved without needing expensive EMI components. It achieves over 15dB margin to requirements where normally equipment is expected to pass with a 6dB margin to allow for production tolerances in components such as the transformer.

Ultra Low EMI Audio PSU – AM band compliant

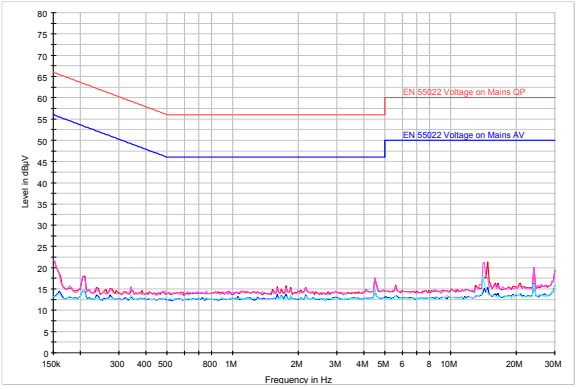

Figure 4:Fully AM band-compliant 20 W average, 40 W peak audio PSU, using extra EMI components such as common mode choke and screening

The above case is more than a 30dB margin, but in fact the noise measurement is from the external room as the PSU is so quiet. This very low EMI is required to stop AM band interference in radios and requires a screened box and additional EMI components but still far fewer components than would be required for conventional SMPS.

Applications

The low EMI emission characteristics of the RDFC topology lends itself to low cost solutions for EMI sensitive applications including:

Telecoms Equipment

Equipment that connects to the public telecommunications network, such as modems and cordless phones. Not only do these need to meet the usual mains supply-side EMI limits, but also limits on EMI that can be imposed on the telephone network.

IT Equipment

Routers and hubs also have limits on their output, as well as on their mains supply connection.

Audio Equipment

Audio equipment with sensitive inputs can have a supply frequency hum injected by the Y capacitor used to suppress Flyback topology EMI. This problem is avoided by the RDFC topology which does not require any.

Audio equipment with built-in AM radios are extremely sensitive to EM radiation between about 0.5 and 1.7 MHz where AM radio broadcasts are positioned. AC/DC converters also generate significant EMI in this frequency region. As the RDFC topology starts from a lower level, it is easier to meet the demanding requirements for PSUs in these applications, even when they may be positioned only a few cm away from the receiver section. An example of this can be seen on the emissions plot to the left.

Controller Series

The following controller options are available:

Part Number	Output Power W	Package
C2471PX2	1-6 W	SOT23-6
C2472PX2	6-40 W	SOT23-6

For more Information

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