DOWNLOAD PDF SWITCHING POWER SUPPLY DESIGN ABRAHAM PRESSMAN

Chapter 1 : Switching Power Supply Design, 3rd Ed.

Abraham Pressman was a nationally known power supply consultant whose background ranged from army radar officer to four decades as an analog-digital design engineer.. Keith Billings is a practicing engineer with more than 40 years' experience in the design of switching power equipment.

Induction coils use switches to generate high voltages. Variations of this ignition system were used in all non-diesel internal combustion engines until the s when it began to be replaced first by solid-state electronically-switched versions, then capacitive discharge ignition systems. See Voltage regulator Electromechanical regulators. Patent 3,, is filed by Joseph E. Murphy and Francis J. One of its applications is as a switched mode regulator. One thing Holt has to his credit is that he created the switching power supply that allowed us to do a very lightweight computer". In contrast, a switched-mode power supply changes output voltage and current by switching ideally lossless storage elements, such as inductors and capacitors , between different electrical configurations. The basic schematic of a boost converter. For example, if a DC source, an inductor, a switch, and the corresponding electrical ground are placed in series and the switch is driven by a square wave , the peak-to-peak voltage of the waveform measured across the switch can exceed the input voltage from the DC source. This is because the inductor responds to changes in current by inducing its own voltage to counter the change in current, and this voltage adds to the source voltage while the switch is open. If a diode-and-capacitor combination is placed in parallel to the switch, the peak voltage can be stored in the capacitor, and the capacitor can be used as a DC source with an output voltage greater than the DC voltage driving the circuit. This boost converter acts like a step-up transformer for DC signals. A buckâ€”boost converter works in a similar manner, but yields an output voltage which is opposite in polarity to the input voltage. Other buck circuits exist to boost the average output current with a reduction of voltage. In an SMPS, the output current flow depends on the input power signal, the storage elements and circuit topologies used, and also on the pattern used e. The spectral density of these switching waveforms has energy concentrated at relatively high frequencies. As such, switching transients and ripple introduced onto the output waveforms can be filtered with a small LC filter. Advantages and disadvantages[edit] The main advantage of the switching power supply is greater efficiency than linear regulators because the switching transistor dissipates little power when acting as a switch. Other advantages include smaller size and lighter weight from the elimination of heavy line-frequency transformers, and comparable heat generation. Standby power loss is often much less than transformers. Disadvantages include greater complexity, the generation of high-amplitude, high-frequency energy that the low-pass filter must block to avoid electromagnetic interference EMI , a ripple voltage at the switching frequency and the harmonic frequencies thereof. Non- power-factor-corrected SMPSs also cause harmonic distortion. SMPS and linear power supply comparison[edit] There are two main types of regulated power supplies available: The following table compares linear regulated and unregulated AC-to-DC supplies with switching regulators in general: Comparison of a linear power supply and a switched-mode power supply Linear power supply Notes Size and weight Heatsinks for high power linear regulators add size and weight. Smaller transformer if used; else inductor due to higher operating frequency typically 50 kHz â€” 1 MHz. Size and weight of adequate RF shielding may be significant. Therefore, higher operating frequency means either a higher capacity or smaller transformer. Output voltage With transformer used, any voltages available; if transformerless, limited to what can be achieved with a voltage doubler. If unregulated, voltage varies significantly with load. Any voltages available, limited only by transistor breakdown voltages in many circuits. Voltage varies little with load. An SMPS can usually cope with wider variation of input before the output voltage changes. Efficiency , heat, and power dissipation If regulated: Output is regulated using duty cycle control; the transistors are switched fully on or fully off, so very little resistive losses between input and the load. The only heat generated is in the non-ideal aspects of the components and quiescent current in the control circuitry. Complexity Unregulated may be simply a diode and capacitor; regulated has a

voltage-regulating circuit and a noise-filtering capacitor; usually a simpler circuit and simpler feedback loop stability criteria than switched-mode circuits. Consists of a controller IC, one or several power transistors and diodes as well as a power transformer, inductors, and filter capacitors. For this SMPSs have to use duty cycle control. One of the outputs has to be chosen to feed the voltage regulation feedback loop usually 3. The other outputs usually track the regulated one pretty well. Both need a careful selection of their transformers. Due to the high operating frequencies in SMPSs, the stray inductance and capacitance of the printed circuit board traces become important. Radio frequency interference Mild high-frequency interference may be generated by AC rectifier diodes under heavy current loading, while most other supply types produce no high-frequency interference. Some mains hum induction into unshielded cables, problematical for low-signal audio. Long wires between the components may reduce the high frequency filter efficiency provided by the capacitors at the inlet and outlet. Stable switching frequency may be important. It can cause audible mains hum in audio equipment, brightness ripples or banded distortions in analog security cameras. Noisier due to the switching frequency of the SMPS. An unfiltered output may cause glitches in digital circuits or noise in audio circuits. This can be suppressed with capacitors and other filtering circuitry in the output stage. With a switched mode PSU the switching frequency can be chosen to keep the noise out of the circuits working frequency band e. Non power-factor-corrected SMPSs also cause harmonic distortion. Acoustic noise Faint, usually inaudible mains hum, usually due to vibration of windings in the transformer or magnetostriction. The operating frequency of an unloaded SMPS is sometimes in the audible human range, and may sound subjectively quite loud for people whose hearing is very sensitive to the relevant frequency range. Power factor Low for a regulated supply because current is drawn from the mains at the peaks of the voltage sinusoid , unless a choke-input or resistor-input circuit follows the rectifier now rare. The internal resistance of low-power transformers in linear power supplies usually limits the peak current each cycle and thus gives a better power factor than many switched-mode power supplies that directly rectify the mains with little series resistance. Inrush current Large current when mains-powered linear power supply equipment is switched on until magnetic flux of transformer stabilises and capacitors charge completely, unless a slow-start circuit is used. Extremely large peak "in-rush" surge current limited only by the impedance of the input supply and any series resistance to the filter capacitors. Empty filter capacitors initially draw large amounts of current as they charge up, with larger capacitors drawing larger amounts of peak current. Being many times above the normal operating current, this greatly stresses components subject to the surge, complicates fuse selection to avoid nuisance blowing and may cause problems with equipment employing overcurrent protection such as uninterruptible power supplies. Mitigated by use of a suitable soft-start circuit or series resistor. Risk of electric shock Supplies with transformers isolate the incoming power supply from the powered device and so allow metalwork of the enclosure to be grounded safely. Transformerless mains-operated supply dangerous. In both linear and switch-mode the mains, and possibly the output voltages, are hazardous and must be well-isolated. Two capacitors are connected in series with the Live and Neutral rails with the Earth connection in between the two capacitors. This forms a capacitive divider that energizes the common rail at half mains voltage. However, this current may cause nuisance tripping on the most sensitive residual-current devices. Risk of equipment damage Very low, unless a short occurs between the primary and secondary windings or the regulator fails by shorting internally. Can fail so as to make output voltage very high. Stress on capacitors may cause them to explode. The floating voltage is caused by capacitors bridging the primary and secondary sides of the power supply. Connection to earthed equipment will cause a momentary and potentially destructive spike in current at the connector as the voltage at the secondary side of the capacitor equalizes to earth potential. This is called rectification. In some power supplies mostly computer ATX power supplies , the rectifier circuit can be configured as a voltage doubler by the addition of a switch operated either manually or automatically. The rectifier produces an unregulated DC voltage which is then sent to a large filter capacitor. The current drawn from the mains supply by this rectifier circuit occurs in short pulses around the AC voltage peaks. These pulses have significant high frequency energy which reduces the power factor. To correct for

this, many newer SMPS will use a special PFC circuit to make the input current follow the sinusoidal shape of the AC input voltage, correcting the power factor. This type of use may be harmful to the rectifier stage, however, as it will only use half of diodes in the rectifier for the full load. This could possibly result in overheating of these components, causing them to fail prematurely. The diodes in this type of power supply will handle the DC current just fine because they are rated to handle double the nominal input current when operated in the V mode, due to the operation of the voltage doubler. This is because the doubler, when in operation, uses only half of the bridge rectifier and runs twice as much current through it. The inverter stage converts DC, whether directly from the input or from the rectifier stage described above, to AC by running it through a power oscillator, whose output transformer is very small with few windings at a frequency of tens or hundreds of kilohertz. Voltage converter and output rectifier[edit] If the output is required to be isolated from the input, as is usually the case in mains power supplies, the inverted AC is used to drive the primary winding of a high-frequency transformer. This converts the voltage up or down to the required output level on its secondary winding. The output transformer in the block diagram serves this purpose. If a DC output is required, the AC output from the transformer is rectified. For output voltages above ten volts or so, ordinary silicon diodes are commonly used. For lower voltages, Schottky diodes are commonly used as the rectifier elements; they have the advantages of faster recovery times than silicon diodes allowing low-loss operation at higher frequencies and a lower voltage drop when conducting. For even lower output voltages, MOSFETs may be used as synchronous rectifiers ; compared to Schottky diodes, these have even lower conducting state voltage drops. The rectified output is then smoothed by a filter consisting of inductors and capacitors. For higher switching frequencies, components with lower capacitance and inductance are needed. Simpler, non-isolated power supplies contain an inductor instead of a transformer. This type includes boost converters , buck converters , and the buck-boost converters. These belong to the simplest class of single input, single output converters which use one inductor and one active switch. The buck converter reduces the input voltage in direct proportion to the ratio of conductive time to the total switching period, called the duty cycle. A feedback control loop is employed to regulate the output voltage by varying the duty cycle to compensate for variations in input voltage.

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Chapter 2 : - Switching Power Supply Design by Abraham Pressman

Abraham Pressman was a nationally known power supply consultant whose background ranged from army radar officer to four decades as an analog-digital design engineer. Description: Fully updated to reflect the latest technologies and materials.

Preface Not many technical books continue to be in high demand well beyond the natural life of their author. It speaks well to the excellent work done by Abraham Pressman that his book on switching power supply design, first published in , still enjoys brisk sales some eight years after his demise at the age of Abraham had been active in the electronics industry for nearly six decades. For 15 years, up to the age of 83, Abraham had presented a training course on switching design. Abe would tell his students that my book was the second best book on switching power supplies not true, but rare and valuable praise indeed from the old master. When I started designing switching power supplies in the s, very little information on the subject was available. With the insight provided by Abe, I moved forward with great strides. When, in , Abe found he was no longer able to continue with his training course, I was proud that he asked me to take over his course notes with a view to continuing his presentation. I found the volume of information to be daunting, however, and too much for me to present in four days, although he had done so for many years. Furthermore, I felt that the notes and overhead slides had deteriorated too much to be easily readable. I simplified the presentation and converted it to PowerPoint on my laptop, and I first presented the modified, three-day course in Boston in November There were only two students most companies had cut back their training budget , but this poor turnout was more than compensated for by the attendance of Abraham and his wife Anne. Abe was very frail by then, and I was so pleased that he lived to see his legacy living on, albeit in a very different form. I think he was a bit bemused by the dynamic multimedia presentation, as I leisurely controlled it from my laptop. The state-space averaging models, canonical models, the bilateral inversion techniques, or duality principles so valuable to modern experts in this field were not for Abraham. His book provides a solid underpinning of the fundamentals, explaining not only how but also why we do things. There is time enough later to learn the more modern concepts from some of the excellent specialist books now available see the bibliography. For this third edition, McGraw-Hill converted the manuscript to digital files for ease of editing. This made it easier for Taylor Morey and me to make minor and mainly cosmetic changes to the text and many corrections to equations, calculations, and diagrams, some corrupted by the conversion process. We also made adjustments where we felt such changes would help the flow, making it easier for the reader to follow the presentation. Where new technology and recent improvements in components have changed some of the limitations mentioned in the second edition, you will find my adjusting notes under the heading After Pressman. Where I felt additional explanations were justified, I have inserted a Tip or Note. I have also added new sections to Chapter 7 and Chapter 9, where I felt that recent improvements in design methods would be helpful to the reader and also where improvements in IGBT technology made these devices a useful addition to the more limited range of devices previously favored by Abraham. In this way, the original structure of the second edition remains unchanged, and because the index and cross references still apply, the reader will find favorite sections in the same places. Unfortunately, the page numbers did change, as there was no way to avoid this. You will also findmybook, Switchmode Power Supply Handbook, Second Edition McGraw-Hill, , a good companion, providing additional information with a somewhat different approach to the subject.

Chapter 3 : Switching Power Supply Design by Abraham I. Pressman | eBay

The World's #1 Guide to Power Supply Design Now Updated! Recognized worldwide as the definitive guide to power supply design for over 25 years, Switching Power Supply Design has been updated to cover the latest innovations in technology, materials, and components. This Third Edition presents the.

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Chapter 4 : Switching Power Supply Design by Abraham I. Pressman

Abraham Pressman was a nationally known power supply consultant whose background ranged from army radar officer to four decades as an analog-digital design engineer. Keith Billings is a practicing engineer with more than 40 years' experience in the design of switching power equipment.

Chapter 5 : Switched-mode power supply - Wikipedia

Abraham I. Pressman (Waban, Massachusetts) is a nationally known power supply consultant and lecturer. His background ranges from an Army radar officer to over four decades as an analog-digital design engineer in industry.

Chapter 6 : Switching Power Supply Design, Third Edition

Using this book as a guide, Pressman promises, even a novice can immediately design a complete switching power supply circuit. No other book has such complete instruction in one volume. Using a tutorial, how-to approach, Pressman covers every aspect of this new technology, including circuit and.

Chapter 7 : Ø¯Ø§Ù†Ù„Ùˆ Ø± Ø±Ø§ÛŒÚ¯Ø§Ù† Ú©ØªØ§Ø¨ (Switching Power Supply Design (Abraham I.

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