LT1610 Micropower Step-Up DC/DC Converter Runs at 1.7MHz
by Steve Pietkiewicz

Introduction
When designing portable electronics, be it a pager, handheld computer or cell phone, “footprint” is one of the most important specifications of any component. Most such products use at least one DC/DC converter to generate regulated voltages from a battery. The LT1610, a micropower DC/DC converter IC, addresses the issue of footprint in several ways. First, the switching frequency is 1.7MHz, allowing the use of small, inexpensive, minimal-height inductors and capacitors. Second, the frequency-compensation components have been integrated, eliminating the requirement for an external RC network in most applications. Finally, the device comes in LTC's 8-lead MSOP package, one-half the size of the 8-lead SO package.

The LT1610's input voltage ranges from 1V to 8V, and the 30V, 300mA switch allows several different configurations, such as boost, SEPIC and flyback, to be successfully implemented. Output voltage can be up to 28V in boost mode. Operating quiescent current is 50µA unloaded; grounding the shutdown pin reduces the current to 0.5µA. The device can generate 3V at 30mA from a single (1V) cell, or 5V at 100mA from two cells (2V). Configured as a Li-Ion cell to 3.3V SEPIC converter, the LT1610 can deliver 100mA. In boost mode, efficiency ranges from 60% at a 100µA load to 83% at full load.

Single-Cell to 3V DC/DC Converter
A 1V to 3V boost converter is shown in Figure 1. The specified components take up very little board space. The 4.7µH Murata inductor specified measures 2.5mm by 3.2mm and is only 2mm high. The 22µF AVX “A” case tantalum capacitors measure 1.6mm by 3.2mm and are 1.6mm tall. Circuit efficiency, which reaches 77%, is detailed in Figure 2. Transient response to a 1mA to 31mA load step is pictured in Figure 3. The device features Burst Mode operation at light loads. This can be seen at a load of 1mA. When the load is increased to 31mA, the device shifts to constant-frequency switching and peak switch current is controlled to achieve output regulation.

---

continued on page 35
Although single-tone distortion measurements are a good indicator of circuit performance in single-carrier applications, they do not provide any insight into amplifier linearity when processing more than one tone at a time. An effective tool in gauging dynamic performance in these applications is 2-tone intermodulation. Figure 4 illustrates the performance of Figure 1’s circuit with two sine waves at 600kHz and 700kHz. The frequency spectrum displayed is representative of both DMT and CAP downstream operation, and the two tones were chosen to show both 2nd and 3rd order IMD products (2IMD and 3IMD) that fall in-band. With a 1:1 turns-ratio transformer, the output level of the circuit was adjusted to produce an 18.9V_p-p envelope across the 100Ω load. This output voltage level implies a peak differential voltage across the line driver outputs of approximately 38V_p-p. With each amplifier operating at a supply current of 13mA, the circuit achieves a spur-free dynamic performance of 63dBc, sufficient for peak power operation in CAP-based systems. Improved performance at lower supply currents can be achieved with a transformer turns ratio greater than 1:1, whereby amplifier output current drive is substituted for amplifier output voltage drive.

Conclusion
Under DC voltage or digital control, the quiescent supply current of the line-driver CFAs can be adjusted (statically or dynamically) to reduce their static power dissipation without sacrificing either downstream or upstream dynamic performance. In addition, this supply-current control can be coupled with a reduction of the line-driver supply voltage to reduce an amplifier’s dynamic power dissipation. The supply voltage should not be reduced below a level that causes the amplifier output stage to clip the peak transmitted signal, however. The best method for gauging dynamic performance is to monitor the bit-error-rate (BER) performance of the modem. Under normal DMT or CAP operation (downstream or upstream), the supply voltage and quiescent currents of the line-driver amplifiers can be reduced until the system BER degrades beyond an acceptable minimum.

For additional information on a complete line of driver solutions, featuring the LT1210 (1.1A), the LT1206 (250mA) and the LT1497 (125mA), please consult the LTC factory.

Note:

**LT1610, continued from page 32**

### 2-Cell to 5V DC/DC Converter

By simply changing the feedback resistor values, the LT1610 can generate 5V. Figure 4’s circuit generates 5V at a load of up to 100mA from a 2-cell input. Figure 5’s graph shows efficiency the of the circuit, which reaches 83%. This circuit is also suitable for 3.3V to 5V conversion, supplying over 200mA.

![Figure 5. 2-cell converter efficiency reaches 83%](image)

### Li-Ion to 3.3V SEPIC Converter

Figure 6 employs the SEPIC (single ended primary inductance converter) topology to provide a regulated 3.3V output from an input that can range above or below the output voltage. Although the circuit requires two inductors and a ceramic coupling capacitor, the total footprint of this solution is still attractive compared with alternative methods of generating 3.3V, such as a boost converter followed by a linear regulator. The circuit can supply up to 100mA. Efficiency, while lower than that of a standard boost converter, reaches approximately 73%. Unlike a boost converter, this topology provides input-to-output isolation. The output is completely disconnected from the battery in shutdown mode, preventing inadvertent battery discharge through the load. The LT1610’s sub-µA shutdown current reduces standby losses, increasing battery life.

![Figure 6. Li-Ion to 3.3V SEPIC converter delivers 100mA.](image)