

Sub-Miniature Buck Converters Tailored For Portable Power Applications

Application Brief 119

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Highlights

- Operates from a Single Li-Ion Cell
- Pin Programmable Output Voltages
- Synchronous Rectification for High Efficiency
- Uses Small Ceramic Capacitors
- Sub-miniature micro SMD-10 Package

Although there are many step-down converters available in the market, they aren't as small and precise enough to meet the demands of portable system manufacturers. National Semiconductor has recently released a family of step-down converters that accommodate the need for smaller packages with enhanced performance and features. These are the

2.8V to 5.5V and can operate from a single Li-Ion cell. They feature pin-selectable operating modes and output voltages with 1% to 2% precision as well as very low ripple (5 mV typ. in PWM mode). *Table 1* shows a selection of buck converters for portable power applications.

Older generation cell phones powered their PA directly from the battery, which was inefficient. The transmit efficiency and battery life can be improved by making adjustments to the RF PA supply voltage depending on the transmit power levels needed. *Figure 1* shows the LM2614 in a typical application circuit used for powering RF PAs. The LM2614 features dynamically adjustable output voltage from

Buck Converter Parts	Output Voltages	MODES	Sync PFM	Output Current
LM2608-1.3	1.3V, 1.5V	PWM/LDO		400 mA/3 mA
LM2608-1.8	1.5V, 1.8V	PWM/LDO		400 mA/3 mA
LM2612 BL/TL	1.05V, 1.3V, 1.5V, 1.8V	PWM/PFM		400 mA/100 mA
LM2614	1.0V - 3.6V (Adjustable)	PWM/PFM		400 mA/100 mA
LM2618	1.8V, 1.83V, 1.87V, 1.92V	PWM/PFM	√	400 mA/100 mA

Table 1

LM2608, LM2612, LM2614, and LM2618. All of these products are offered in a micro SMD-10 package, measuring only 2.25 mm x 2.504 mm and 0.6 mm high. This provides a much smaller solution than other manufacturers' products offered only in the SOT-23 package. National's micro SMD package, the industry's smallest, is a revolution in packaging technology, allowing the die to act as the package. This provides a thermal resistance (θ_{JA}) of 140°C/W compared to 250°C/W for SOT-23. The excellent heat transfer characteristics of the package allow the parts to run cooler, making them more efficient. Smaller footprints combined with low profile makes the micro SMD package an ideal choice.

National's family of buck converters is targeted for digital system applications such as cell phone baseband processors, RF power amplifiers, and PC cards. These devices have an input voltage range of

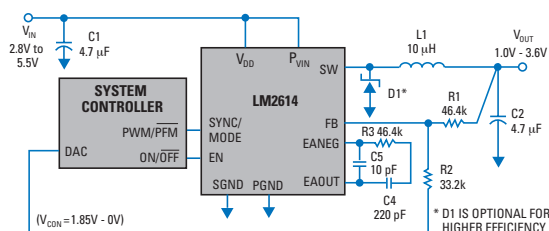


Figure 1: LM2614 Typical Application Circuit

1V to 3.6V, controlled by a DAC signal from the baseband processor. Other features include fast output slew rate ($<30 \mu s$) for a step from $V_{OUT}(\min.)$ to $V_{OUT}(\max.)$, 100% maximum duty cycle operation to maximize the usable battery voltage range and high-efficiency operation as shown in *Figure 2*. The LM2614 can also be used to provide fixed output voltages.

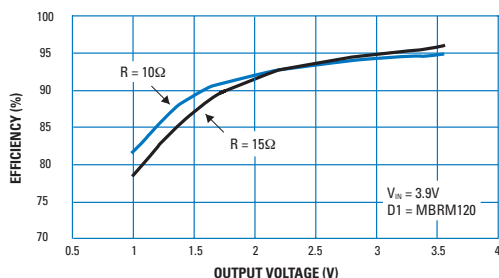


Figure 2: LM2614 High-Efficiency Curve

Figure 3 and 4 show a typical application circuit and typical efficiency curve for the LM2618, featuring synchronous rectification in PFM mode. Lower output voltages will be available soon. The LM2608/12/18 feature an internal DAC to set the output voltages by applying logic signals to the VID pins. This eliminates the need for feedback resistor dividers, ensuring lower output voltage ripple in PFM mode. It also allows dynamic voltage switching, a key feature for intelligent battery management. Internal compensation, low shutdown current (0.02 μ A typ.), frequency synchronization, current limit protection, thermal shutdown, internal soft start, and output over voltage protection are some of the built-in features.

Pin-selectable operating modes like PWM, PFM or LDO, when used by the system controller, can enhance battery life and noise performance. This provision for explicit selection of operating modes allows the system designer to directly manage the mode transition process, an advantage over automatic transitions (based on load current) which may interfere with system operation.

A tight tolerance for oscillator frequency and switch peak current limit (15% for LM2608 and 20% for LM261x family) improves electromagnetic compatibility and allows the use of smaller inductors. Internal synchronous rectification, low $R_{DS(on)}$ MOSFETs and PWM operation are essential for good efficiency at higher load currents. With quiescent current of only 180 μ A, low power PFM mode keeps efficiency high at light loads. LDO

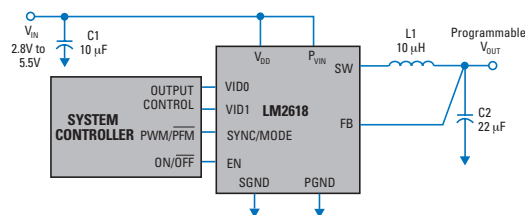


Figure 3: LM2618 Typical Application Circuit

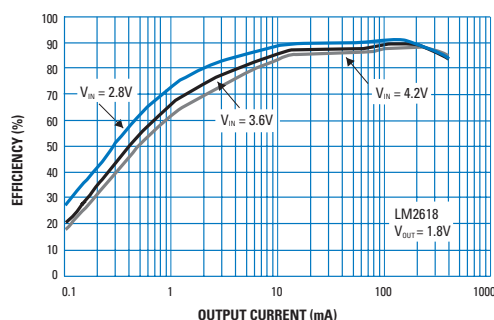


Figure 4: LM2618 Typical Efficiency Curve

mode keeps the system alive during standby while only using 20 μ A of current from the battery. Another major advantage of these converters is that they use small ceramic capacitors. The LM2612/18 needs only three tiny surface mount external components.

Additional Information

www.national.com/pf/LM/LM2608.html
www.national.com/pf/LM/LM2612.html
www.national.com/pf/LM/LM2614.html
www.national.com/pf/LM/LM2618.html
power.national.com

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