LM2608,LM2612,LM2614,LM2618

Sub-Miniature Buck Converters Tailored For Portable Power Applications

Literature Number: SNVA525

Sub-Miniature Buck Converters Tailored For Portable Power Applications

Application Brief 119

Anne Lu and Mathew Jacob

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 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 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 1V to 3.6V, controlled by a DAC signal from the baseband processor. Other features include fast output slew rate (<30 µs) 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.

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

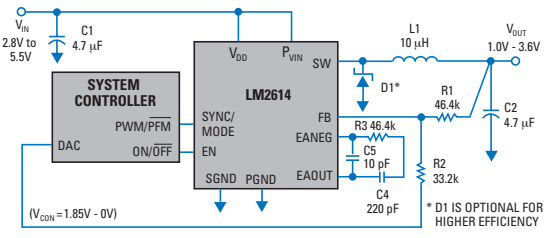

Figure 1: LM2614 Typical Application Circuit

National Semiconductor
The Sight & Sound of Information

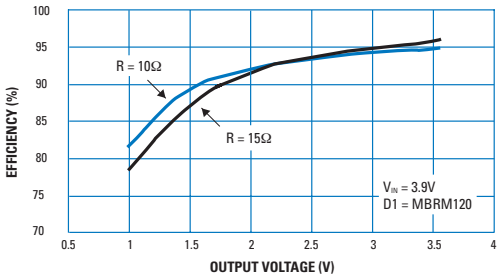

Figure 2: LM2614 High-Efficiency Curve

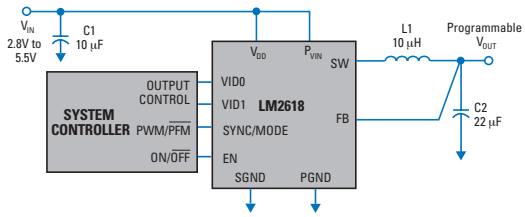

Figure 3: LM2618 Typical Application Circuit

Figure 4 and *5* 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 µA 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_{DSON} MOSFETs and PWM operation are essential for good efficiency at higher load currents. With quiescent current of only 180 µA, low power PFM mode keeps efficiency high at light loads. LDO

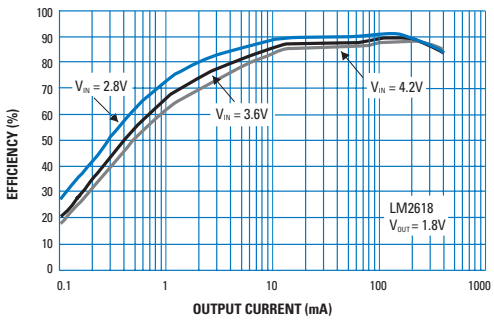

Figure 4: LM2618 Typical Efficiency Curve

mode keeps the system alive during standby while only using 20 µA 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

Visit The National Edge, our online technical journal for an archive of Application Briefs and other interesting information.
edge.national.com

National Semiconductor
2900 Semiconductor Dr.
PO Box 58090
Santa Clara, CA 95052
1-800-272-9959

Visit our Web site at:
www.national.com

For more information, send email to:
new.feedback@nsc.com

National Semiconductor
The Sight & Sound of Information

IMPORTANT NOTICE

Texas Instruments Incorporated and its subsidiaries (TI) reserve the right to make corrections, modifications, enhancements, improvements, and other changes to its products and services at any time and to discontinue any product or service without notice. Customers should obtain the latest relevant information before placing orders and should verify that such information is current and complete. All products are sold subject to TI's terms and conditions of sale supplied at the time of order acknowledgment.

TI warrants performance of its hardware products to the specifications applicable at the time of sale in accordance with TI's standard warranty. Testing and other quality control techniques are used to the extent TI deems necessary to support this warranty. Except where mandated by government requirements, testing of all parameters of each product is not necessarily performed.

TI assumes no liability for applications assistance or customer product design. Customers are responsible for their products and applications using TI components. To minimize the risks associated with customer products and applications, customers should provide adequate design and operating safeguards.

TI does not warrant or represent that any license, either express or implied, is granted under any TI patent right, copyright, mask work right, or other TI intellectual property right relating to any combination, machine, or process in which TI products or services are used. Information published by TI regarding third-party products or services does not constitute a license from TI to use such products or services or a warranty or endorsement thereof. Use of such information may require a license from a third party under the patents or other intellectual property of the third party, or a license from TI under the patents or other intellectual property of TI.

Reproduction of TI information in TI data books or data sheets is permissible only if reproduction is without alteration and is accompanied by all associated warranties, conditions, limitations, and notices. Reproduction of this information with alteration is an unfair and deceptive business practice. TI is not responsible or liable for such altered documentation. Information of third parties may be subject to additional restrictions.

Resale of TI products or services with statements different from or beyond the parameters stated by TI for that product or service voids all express and any implied warranties for the associated TI product or service and is an unfair and deceptive business practice. TI is not responsible or liable for any such statements.

TI products are not authorized for use in safety-critical applications (such as life support) where a failure of the TI product would reasonably be expected to cause severe personal injury or death, unless officers of the parties have executed an agreement specifically governing such use. Buyers represent that they have all necessary expertise in the safety and regulatory ramifications of their applications, and acknowledge and agree that they are solely responsible for all legal, regulatory and safety-related requirements concerning their products and any use of TI products in such safety-critical applications, notwithstanding any applications-related information or support that may be provided by TI. Further, Buyers must fully indemnify TI and its representatives against any damages arising out of the use of TI products in such safety-critical applications.

TI products are neither designed nor intended for use in military/aerospace applications or environments unless the TI products are specifically designated by TI as military-grade or "enhanced plastic." Only products designated by TI as military-grade meet military specifications. Buyers acknowledge and agree that any such use of TI products which TI has not designated as military-grade is solely at the Buyer's risk, and that they are solely responsible for compliance with all legal and regulatory requirements in connection with such use.

TI products are neither designed nor intended for use in automotive applications or environments unless the specific TI products are designated by TI as compliant with ISO/TS 16949 requirements. Buyers acknowledge and agree that, if they use any non-designated products in automotive applications, TI will not be responsible for any failure to meet such requirements.

Following are URLs where you can obtain information on other Texas Instruments products and application solutions:

Products		**Applications**	
Audio	www.ti.com/audio	Communications and Telecom	www.ti.com/communications
Amplifiers	amplifier.ti.com	Computers and Peripherals	www.ti.com/computers
Data Converters	dataconverter.ti.com	Consumer Electronics	www.ti.com/consumer-apps
DLP® Products	www.dlp.com	Energy and Lighting	www.ti.com/energy
DSP	dsp.ti.com	Industrial	www.ti.com/industrial
Clocks and Timers	www.ti.com/clocks	Medical	www.ti.com/medical
Interface	interface.ti.com	Security	www.ti.com/security
Logic	logic.ti.com	Space, Avionics and Defense	www.ti.com/space-avionics-defense
Power Mgmt	power.ti.com	Transportation and Automotive	www.ti.com/automotive
Microcontrollers	microcontroller.ti.com	Video and Imaging	www.ti.com/video
RFID	www.ti-rfid.com		
OMAP Mobile Processors	www.ti.com/omap		
Wireless Connectivity	www.ti.com/wirelessconnectivity		
	TI E2E Community Home Page		e2e.ti.com

Mailing Address: Texas Instruments, Post Office Box 655303, Dallas, Texas 75265