

# RF Front End Power Solutions

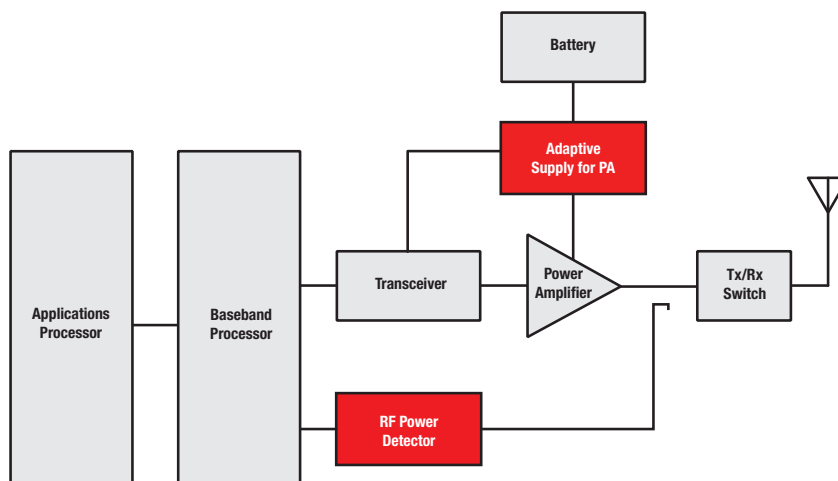
## For 2G, 3G, and 4G Portable Devices



### Extend Battery Life, Reduce Heat

Operation of the radio circuitry in a portable device accounts for a significant amount of the total power consumption — leading to reduced battery life and more heat. Both challenges can be addressed by using RF power management products from Texas Instruments.

Typical System Application



*RF power solutions from TI enable more efficient RF front end designs.*

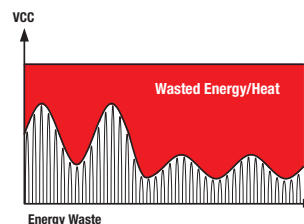
Traditionally, the RF power amplifier (PA), which is used to drive the antenna, is connected directly to the battery. However, this approach wastes a significant amount of energy as the PA is supplied with maximum power when often only a fraction is required to reliably ensure wireless voice and data connection.

TI's broad portfolio of RF power solutions deliver energy and heat savings that enable higher performing RFFE systems. TI's switching supply for power amplifier DC/DC converters are dynamically adjustable power supplies for RF power

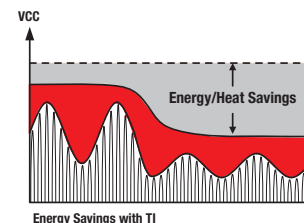
amplifiers that optimize power usage — especially when maximum PA power is not needed. By minimizing energy waste, TI's solutions extend battery life and simplify thermal design for devices such as smartphones, tablets, and machine-to-machine terminals.

The RF DC/DC converters have been qualified, designed in, and software supported by multiple Tier 1 RFIC reference design/platform suppliers and PA partners. Product compatibility and performance is proven and trusted. TI has an extensive RF DC/DC portfolio that supports 2G/3G/4G air standards.

Traditional Approach: Fixed Battery Supply for RF PA



TI Solution: Adaptive Supply for RF PA



# RF DC/DC Switching Converters for RF Power Amplifiers

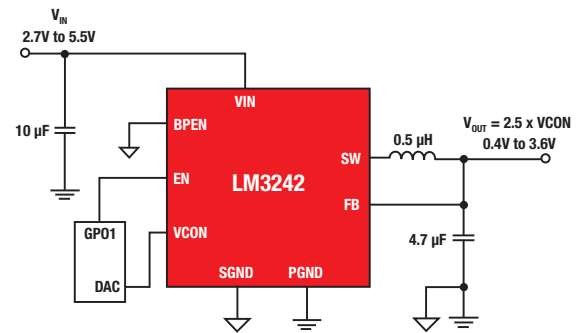
TI's Supply for Power Amplifier products are DC/DC converters with dynamically adjustable power outputs. Buck and Buck-Boost solutions are designed especially for supplying RF power amplifiers – including in new LTE and lower voltage battery applications, by extending battery life for more talk and data usage time and reducing heat dissipation by up to 30°C for a more reliable, easier-to-design system.

## Buck/Step-Down Solutions

### LM3242 – 6 MHz, 750 mA Miniature, Adjustable, Step-Down Converter

- Automatically operates in one of five modes (PWM, ECO, Bypass, Standby, Shutdown) for optimal performance during all load requirements and battery conditions
- 6 MHz PWM switching frequency and tiny chip-scale package enable small solution size

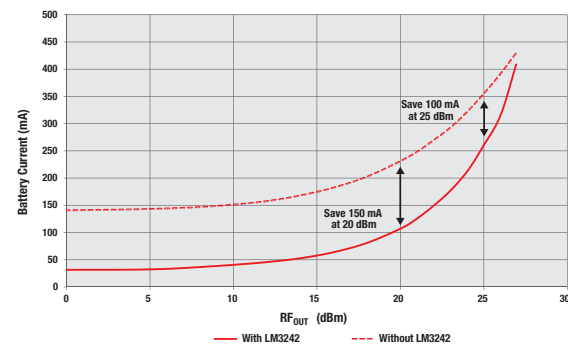
Typical Application Circuit



### LM3242 Reduces PA Heat by 30° at max RF power (28 dBm)



Battery Current vs  $RF_{OUT}$  with and without LM3242

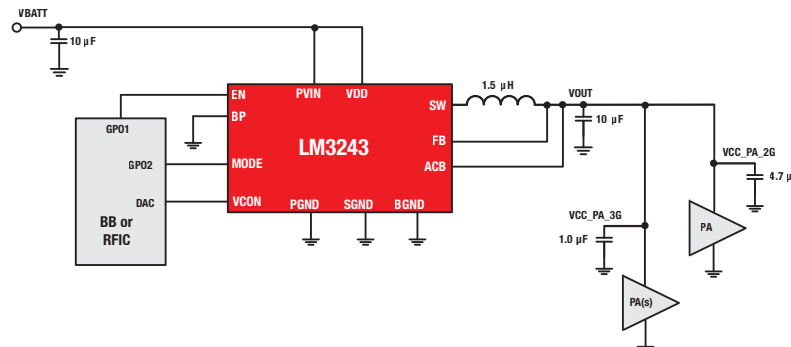


► Supports 3G and 4G/LTE applications

### LM3243 – 2.7 MHz, High-Current, Step-Down Converter with Active Current Assist and Analog Bypass (ACB)

- Automatically operates in one of five modes (PWM, PFM, ACB, Bypass, Shutdown) for optimal performance during all load requirements and battery condition
- Unique Active Current Assist and Analog Bypass (ACB) mode minimizes inductor sizing while enabling high current and very low-dropout voltage support

Typical Application Circuit



► Supports 2G, 3G and 4G/LTE applications

## Buck-Boost Solutions

### LM3209-G3 and LM3269 – Seamless Buck-Boost DC/DC Converters

The LM3209-G3/69 buck-boost DC/DC converters are designed to generate output voltages above or below a given input voltage and are particularly suited for single cell Li-ion batteries for portable applications.

Both LM3209-G3 and LM3269 operate at a 2.4 MHz typical switching frequency in full synchronous operation providing seamless transitions between buck and boost operating regimes. The LM3269 operates in energy-saving PFM mode for increased efficiencies and current savings during low-power RF transmission modes.

► Supports 3G and 4G/LTE applications

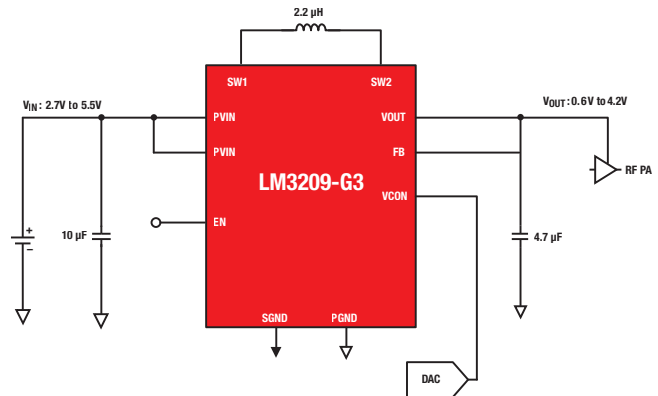
#### Features

- Up to 4.2V adjustable output voltage
  - LM3269 up to 3.8V  $V_{OUT}$
- 1A maximum load capability for  $V_{IN} \geq 3.2V$ ,  $V_{OUT} = 3.6V$
- Fast output voltage transition 0.8 to 4.0V in  $<20 \mu s$
- High-efficiency, 95% typ at 3.7  $V_{IN}$ , 3.5  $V_{OUT}$ , at 300 mA
- Only one external inductor and two external caps

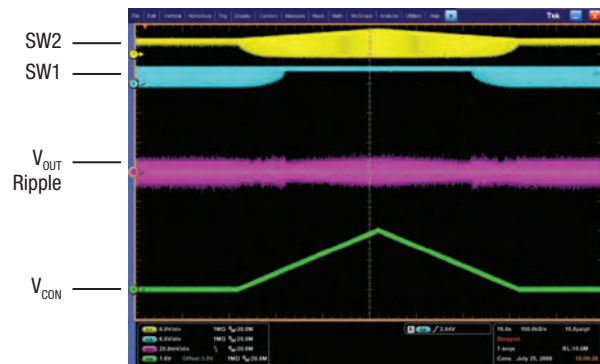
#### Benefits

- Reduces battery current draw
- Allows higher PA output power across battery voltage range with boost capability
- Enables higher data rate uplink
- Extends battery operation range
- Maximizes LTE usage
- Maximum power transmission possible with VBAT low at 3V and also 2.7V
- Eliminates minimum cut-off constraint for  $RF_{OUT}$  max power
- Meets stringent LTE specifications (ACLR and slot timing)

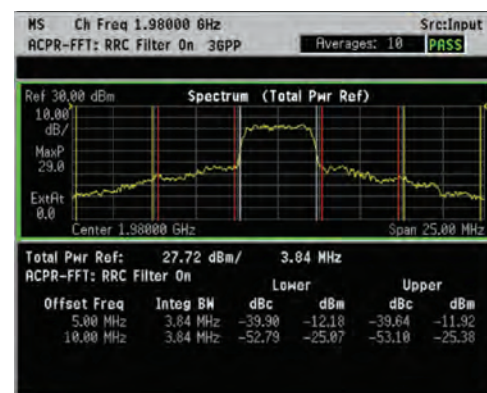
Typical Application Circuit



Seamless Buck – Boost Mode Transition



Noise Measurement – Buck Mode



#### RF DC/DC Switching Converters

Device	Topology	$V_{OUT}$ (V)	$V_{IN}$ (V)	$I_{OUT}$ (mA)	Efficiency (typ.) 3.6V <sub>IN</sub> / 3.4V <sub>OUT</sub> *	Air Standards	micro SMD Package
LM3241	Buck with ECO/PWM	0.6 to 3.6	2.7 to 5.5	750	Up to 95%	3G/4G	6-bump
LM3242	Buck with Bypass/ECO/PWM	0.4 to 3.6	2.7 to 5.5	750/1000	Up to 95%	3G/4G	9-bump
LM3212	Buck with ACB	0.5 to 3.6	2.7 to 5.5	2500	Up to 95%	2G/3G/4G	16-bump
LM3243	Buck with ACB	0.4 to 3.6	2.7 to 5.5	750	Up to 95%	2G/3G/4G	16-bump
LM3253	Buck with ACB	0.4 to 3.6	2.7 to 5.5	750	Up to 95%	2G/3G/4G	16-bump
LM3209-G3	Buck-Boost	0.6 to 4.2	2.7 to 5.5	1000	Up to 95%	3G/4G	12-bump
LM3269	Buck-Boost with PFM/PWM	0.6 to 3.8	2.7 to 5.5	1000	Up to 95%	3G/4G	12-bump

\* Refer to datasheet for more efficiency conditions. New products are listed in bold red. Preview devices are listed in bold blue.

# RF Power Detectors

TI's family of RF detectors provides transmit power control so that only the necessary amount of power is used, saving energy and increasing transmission range. These RF detectors feature high linearity and accuracy over temperature to reduce PA power guard-band requirements for greater coverage range, battery power savings, and increased channel quality.

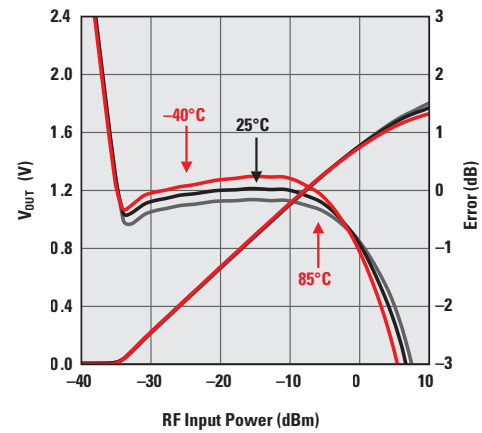
## LMH2110, LMH2120 – 8 GHz LOG/LIN RMS RF Power Detectors

- LMH2110: 40-dB linear-in-dB power detection range
- LMH2120: 40-dB linear-in-V power detection range
- > 30-dB dynamic range, 1900 MHz, n = 50
- Shutdown pin
- Multi-band operation from 50 MHz up to 8 GHz

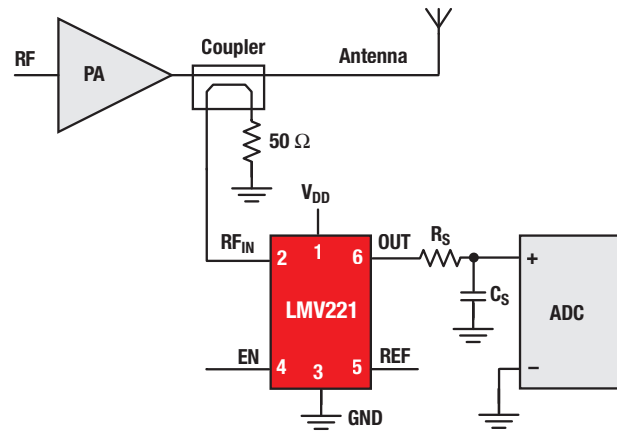
## LMV221, LMH2100 – 50 MHz to 4 GHz 40 dB Logarithmic Power Detectors

- 40-dB linear-in-dB power detection range
- 0.3-V to 2-V output voltage range
- Shutdown pin
- Multi-band operation from 50 MHz to 3.5 GHz
- 0.5-dB accurate temperature compensation
- External configurable output filter bandwidth

$V_{OUT}$  and Log Conformance Error vs. RF Input Power



Typical Application Circuit



## RF Power Detectors

Device	Application	Channels	Supply Voltage Range (V)	Dynamic Range (dB)	Frequency Range (MHz)	Type	Package(s)
LMV221	CDMA, WCDMA, GSM, GPRS	1	2.7 to 3.3	40	50 to 3500	LOG Amp	LLP-6
LMV225	CDMA, WCDMA, GSM, EDGE, GPRS, TDMA	1	2.7 to 5.5	>30	450 to 2000	LOG Amp	micro SMD-4, LLP-6
LMV226	CDMA, WCDMA, GSM, EDGE, GPRS, TDMA	1	2.7 to 5.5	>30	450 to 2000	LOG Amp	micro SMD-4
LMV228	CDMA, WCDMA, GSM, EDGE, GPRS, TDMA	1	2.7 to 5.5	>30	450 to 2000	LOG Amp	micro SMD-4
LMV232	3G, UMTS, WCDMA, CDMA2000, LAN, GPS	2	2.5 to 3.3	20	50 to 2000	LIN MS Amp	micro SMD-8
LMH2100	CDMA, WCDMA, GSM, GPRS	1	2.7 to 3.3	40	50 to 4000	LOG Amp	micro SMD-6
LMH2110	LTE, UMTS, WCDMA, CDMA2000, GSM/EDGE	1	2.7 to 5	45	50 to 8000	LOG RMS	micro SMD-6
LMH2120	LTE, UMTS, WCDMA, CDMA2000, GSM/EDGE	1	2.7 to 5	40	50 to 6000	LIN RMS	micro SMD-6
LMV242	GSM, GPRS, TDMA, LAN	2	2.6 to 5.5	50	450 to 2000	LOG Amp	LLP-10

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