

# 300mA Alkaline Boost DC/DC Converters in SOT23-5

## Features

- Configurable Output Voltage Up to 5.5V
- 40 $\mu$ A Quiescent Current
- <1 $\mu$ A Shutdown Current
- <1 $\mu$ A Shutdown Pin Current
- Supply Range from 1.7V to 5.5V
- Low  $V_{DS(on)}$ : 120mV ( $I_{SW}=400mA$ )
- Tiny SOT23-5 Package

## Applications

- Personal Digital Assistants (PDAs)
- Handheld Computers
- Digital Still Cameras
- Cellular Phones
- WebPad
- Local 3V to 5V Conversion

## General Description

The G5104 boost converter is designed for 3.3V/5V powered system.

Due to a typical 40 $\mu$ A quiescent current and 1.7V~5.5V supply voltage range, it is suitable for battery powered portable applications. Such as PDAs and Handheld Computers. When the IC sets to shutdown mode, it only consumes less than 1 $\mu$ A.

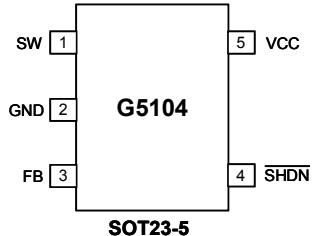
Furthermore, the 500mA current limit, 450ns fixed minimum off-time and tiny SOT23-5 package facilitates the use of smaller inductor and other surface-mount components to minimize the PCB size in those space-conscious applications.

To control the IC, no other external current is needed for the shutdown pin. It typically consumes less than 1 $\mu$ A of full supply range.

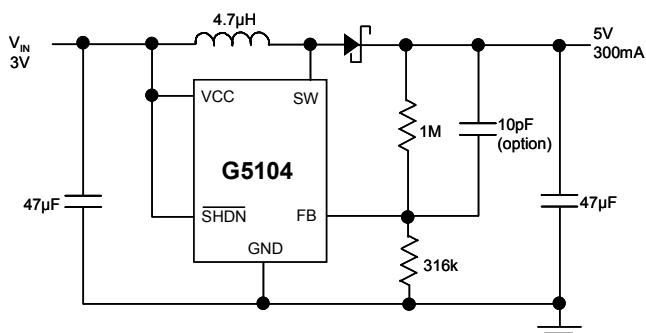
## Ordering Information

ORDER NUMBER	MARKING	TEMP. RANGE	PACKAGE
G5104T11U	5104X	-40°C ~ +85°C	SOT23-5

## Pin Configuration



## Typical Application Circuit



**Absolute Maximum Ratings**

SW to GND.....	-0.3V to +7V	Junction Temperature .....	+125°C
FB to GND.....	-0.3V to $V_{CC}$	Storage Temperature.....	-65°C to +150°C
$V_{CC}$ , $\overline{SHDN}$ to GND.....	-0.3V to +7V	Lead Temperature (Soldering, 10 sec).....	+260°C
Operating Temperature Range (Note 1)	-40°C to +85°C		

Stress beyond those listed under "Absolute Maximum Rating" may cause permanent damage to the device.

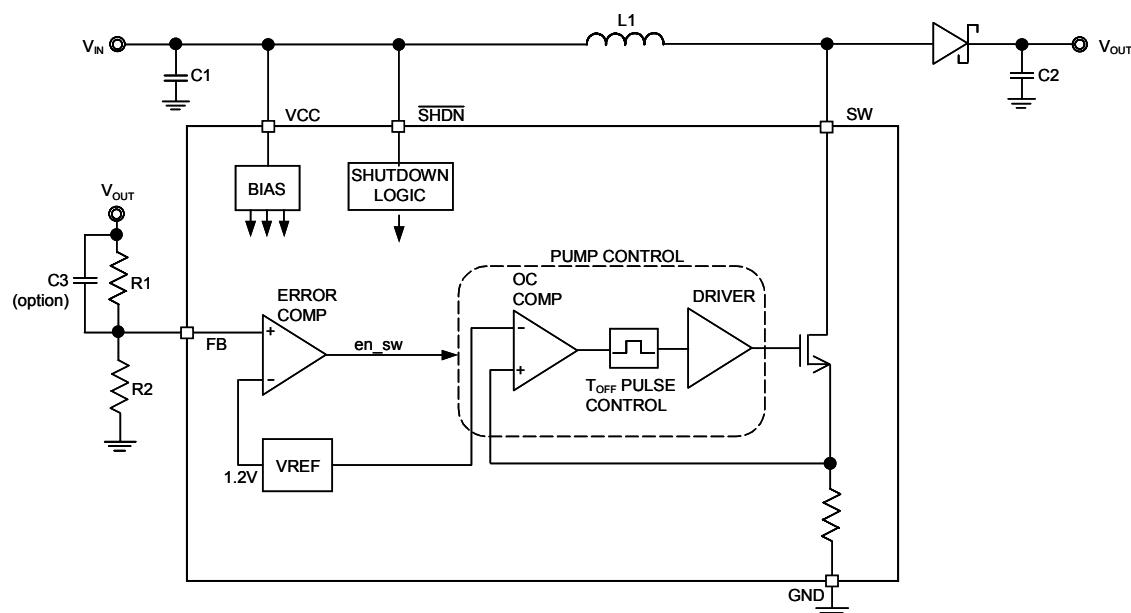
**Electrical Characteristics**

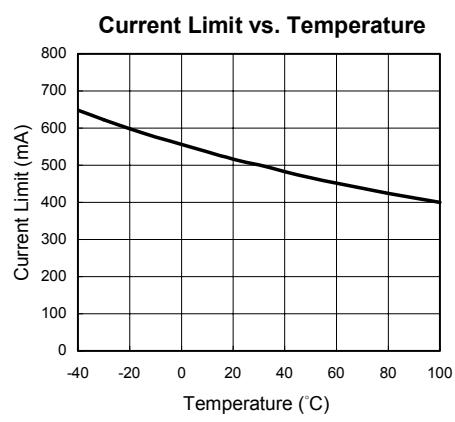
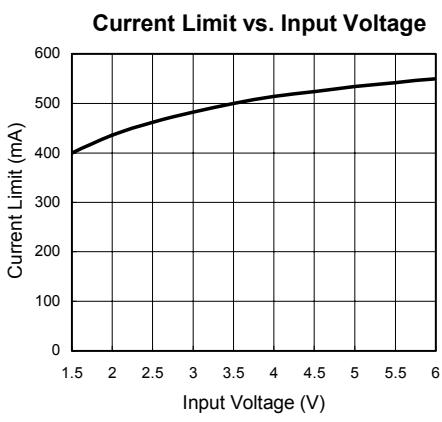
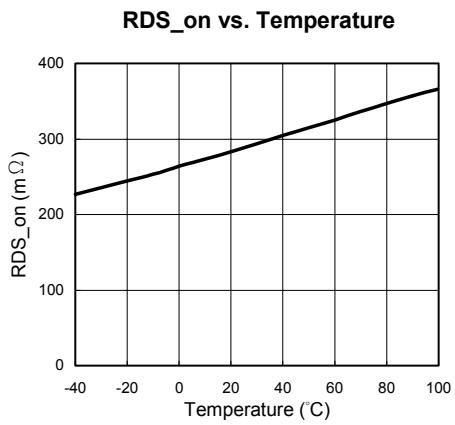
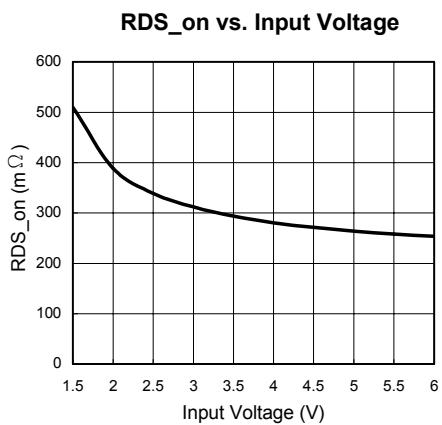
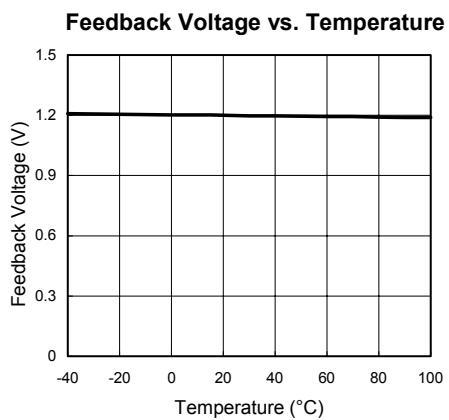
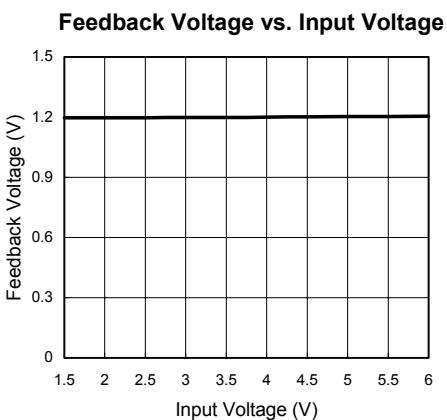
( $V_{CC} = 3.6V$ ,  $V_{\overline{SHDN}} = 3.6V$ ,  $T_A = 25^\circ C$ )

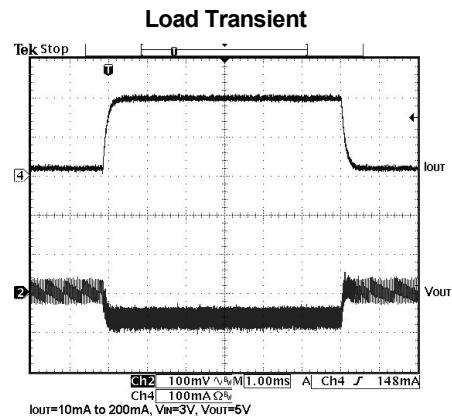
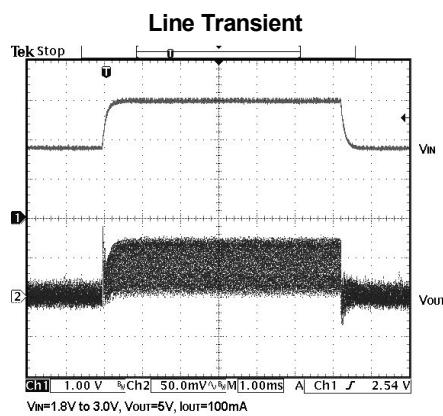
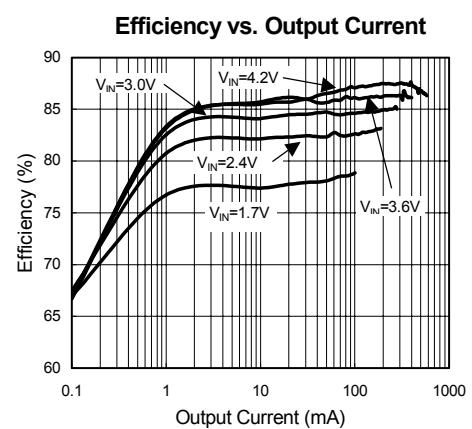
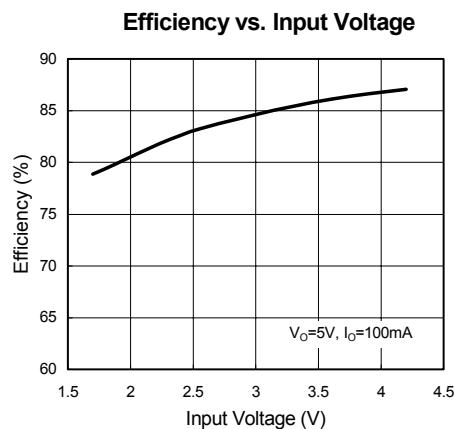
PARAMETER	CONDITIONS	MIN	TYP	MAX	UNITS
Input Voltage Range		1.7	---	5.5	V
Quiescent Current	Not Switching	---	40	80	$\mu A$
	$V_{\overline{SHDN}} = 0V$	---	0.1	1	$\mu A$
FB Comparator Trip Point		1.18	1.2	1.22	V
Output Voltage Line Regulation	$2.5V < V_{IN} < 5.5V$	---	-0.05	---	%/V
FB Pin Bias Current (Note 2)	$V_{FB} = 1.2V$	---	---	1	$\mu A$
Switch Off Time		---	450	---	ns
Switch $V_{DS(ON)}$	$I_{SW} = 0.4A$	---	120	160	mV
Switch Current Limit		400	500	600	mA
$\overline{SHDN}$ Pin Current		---	0.1	1	$\mu A$
$\overline{SHDN}$ Input Voltage High		0.9	---	---	V
$\overline{SHDN}$ Input Voltage Low		---	---	0.25	V
Switch Leakage Current	Switch Off, $V_{SW} = 7V$	---	0.01	5	$\mu A$

Note 1: The G5104 are guaranteed to meet performance specifications from 0°C to 85°C. Specifications over the -40°C to 85°C operating temperature range are assured by design, characterization and correlation with statistical process controls.

Note 2: Bias current flows into the FB pin.

**Block Diagram**


**Typical Performance Characteristics**(V<sub>CC</sub>=+3V, V<sub>SHDN</sub>=+3V, L=4.7μH, T<sub>A</sub>=25°C, unless otherwise noted.)

**Typical Performance Characteristics (continued)**




## Pin Description

PIN	NAME	FUNCTION
1	SW	Switch Pin. The drain of the internal NMOS power switch. Connect this pin to inductor.
2	GND	Ground.
3	FB	Feedback Pin. Set the output voltage by selecting values for R1 and R2 (see Block Diagram): $R1 = R2 \left( \frac{V_{OUT}}{1.2} - 1 \right)$
4	SHDN	Active-Low Shutdown Pin. Tie this pin to logic-high to enable the device or tied it to logic-low to turn this device off.
5	VCC	Input Supply Pin. Bypass this pin with a capacitor as close to the device as possible.

## Function Description

The G5104 is a boost converter with a NMOS switch embedded (refer to Block Diagram). The boost cycle is getting started when FB pin voltage drop below 1.2V as the NMOS switch turns on. During the switch on period, the inductor current ramps up until 500mA current limit is reached. Then turns the switch off, while the inductor current flows through external schottky diode, and ramps down to zero. During the switch off period, the inductor current charges output capacitor and the output voltage is boosted up. This pumping mechanism continues cycle by cycle until the FB pin voltage exceed 1.2V and entering the none switching mode.

## Applications Information

### Choosing an Inductor

There are several recommended inductors that work well with the G5104 in Table 1. Use the equations and recommendations in the next few sections to find the proper inductance value for your design.

**Table 1. Recommended Inductors**

PART	VALUE(μH)	MAX DCR (Ω)	VENDOR
LQH3C4R7	4.7	0.26	Murata <a href="http://www.murata.com">www.murata.com</a>
LQH3C100	10	0.30	
LQH3C220	22	0.92	
972AS-4R7M	4.7	0.22	TOKO <a href="http://www.toko.co.jp">www.toko.co.jp</a>
972AS-100M	10	0.48	
A914BYW-4R7M	4.7	0.072	
A914BYW-100M	10	0.125	

### Current Limit Overshoot

The G5104 use a constant off-time control scheme, the power switch is turned off after the 500mA current limit is reached. When the current limit is reached and when the switch actually turns off, there is a 100ns

delay time. During this time, the inductor current exceeds the current limit by a small amount. The formula below can calculate the peak inductor current.

$$I_{PEAK} = I_{LIM} + \left( \frac{V_{IN(MAX)} - V_{SAT}}{L} \right) \times 100\text{ns}$$

Where  $V_{SAT} = 0.2\text{V}$  (switch saturation voltage). When the systems with high input voltages and uses smaller inductance value, the current overshoot will be most apparent. This overshoot can be useful as it helps increase the amount of available output current. To use small inductance value for systems design, the current limit overshoot can be quite high. Even if it is internally current limited to 500mA, the power switch of the G5104 can operate larger currents without any problem, but the total efficiency will suffer. The  $I_{PEAK}$  is keep below 700mA for the G5104 will be obtained best performance.

### Capacitor Selection

Low ESR (Equivalent Series Resistance) capacitors should be used at the output to minimize the output ripple voltage and the peak-to-peak transient voltage. Multilayer ceramic capacitors (MLCC) are the best choice, as they have a very low ESR and are available in very small packages. Their small size makes them a good match with the G5104's SOT-23 package. If solid tantalum capacitors (like the AVX TPS, Sprague 593D families) or OS-CON capacitors are used, they will occupy more volume than a ceramic ones and the higher ESR increases the output ripple voltage. Notice that use a capacitor with a sufficient voltage rating.

A low ESR surface-mount ceramic capacitors also make a good selection for the input bypass capacitor, which should be placed as close as possible to the G5104. A 47μF input capacitor is sufficient for most applications.

### Diode Selection

For most G5104 applications, the high switching frequency requires a high-speed rectifier Schottky diodes, such as the VISHAY SS12 (1A, 20V) with their low forward voltage drop and fast switching speed, are recommended. Many different manufacturers make equivalent parts, but make sure that the component is rated to operate at least 0.5A. To achieve high efficiency, the average current rating of the Schottky diodes should be greater than the peak switching current. Choose a reverse breakdown voltage greater than the output voltage.

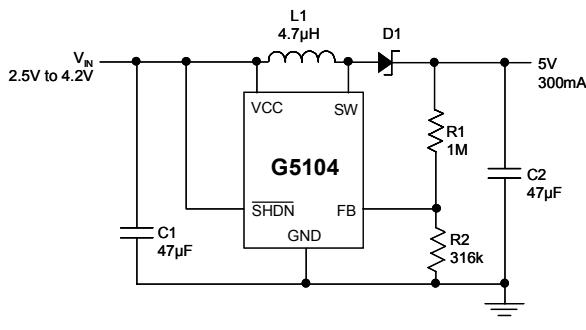
### Lowering Output Voltage Ripple

The G5104 supplies energy to the load in bursts by

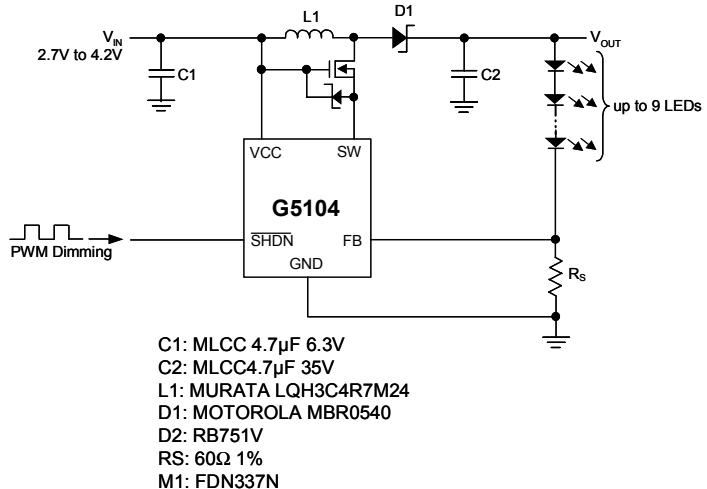
ramping up the inductor current, then delivering that current to the load. To use low ESR capacitors will help minimize the output ripple voltage, but proper selection of the inductor and the output capacitor also plays a big role. If a larger inductance value or a smaller capacitance value is used, the output ripple voltage will increase because the capacitor will be slightly overcharged each burst cycle. To reduce the output ripple, increase the output capacitance value or add a 10pF feed-forward capacitor in the feedback network of the G5104 (see the circuits in the Typical Applications section). To add this small, inexpensive 10pF capacitor will greatly reduce the output voltage ripple.

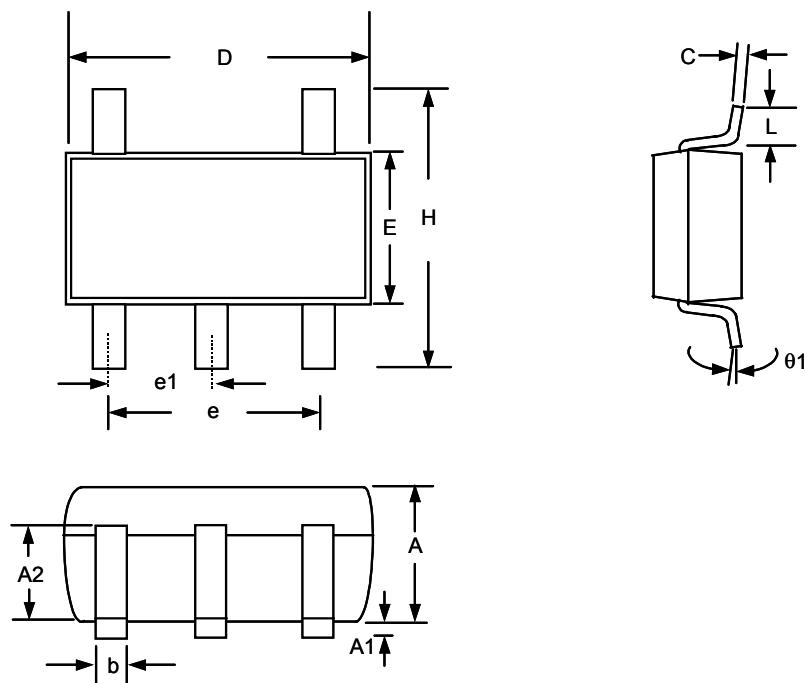
## Typical Applications

### Boost Converter



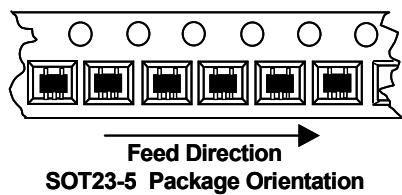
### LED Driver



**Package Information**

**Note:**

1. Package body sizes exclude mold flash protrusions or gate burrs
2. Tolerance  $\pm 0.1000$  mm (4mil) unless otherwise specified
3. Coplanarity: 0.1000mm
4. Dimension L is measured in gage plane

SYMBOLS	DIMENSIONS IN MILLIMETERS		
	MIN	NOM	MAX
A	1.00	1.10	1.30
A1	0.00	-----	0.10
A2	0.70	0.80	0.90
b	0.35	0.40	0.50
C	0.10	0.15	0.25
D	2.70	2.90	3.10
E	1.40	1.60	1.80
e	-----	1.90(TYP)	-----
e1	-----	0.95	-----
H	2.60	2.80	3.00
L	0.37	-----	-----
θ1	1°	5°	9°

**Taping Specification**


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