



# 1.7MHz, Single Cell Micropower DC/DC Converter

July 1998

## FEATURES

- Uses Tiny Capacitors and Inductor
- Internally Compensated
- Low Quiescent Current: 30 $\mu$ A
- Operates with  $V_{IN}$  as Low as 1V
- 3V at 30mA from a Single Cell
- 5V at 200mA from 3.3V
- Output Voltage: Up to 28V
- Low Shutdown Current: < 1 $\mu$ A
- Automatic Burst Mode™ Switching at Light Load
- Low  $V_{CESAT}$  Switch: 300mV at 300mA
- 8-Lead MSOP and SO Packages

## APPLICATIONS

- Pagers
- Cordless Phones
- Battery Backup
- LCD Bias
- Portable Electronic Equipment

## DESCRIPTION

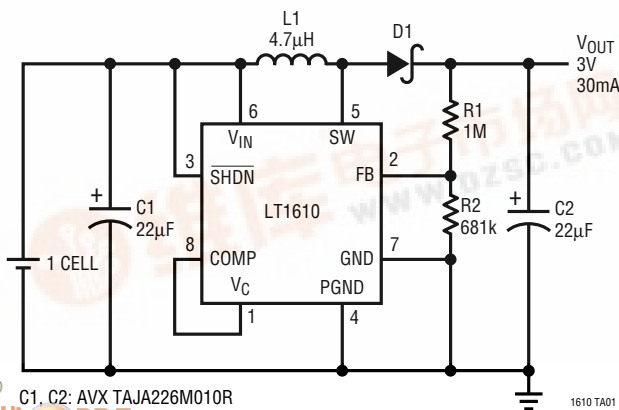
The LT<sup>®</sup>1610 is a micropower fixed frequency DC/DC converter that operates from an input voltage as low as 1V. Intended for small, low power applications, it switches at 1.7MHz, allowing the use of tiny capacitors and inductors. The device can generate 3V at 30mA from a single cell (1V) supply. An internal compensation network can be connected to the LT1610  $V_C$  pin, eliminating two components. No-load quiescent current of the LT1610 is 30 $\mu$ A and the internal NPN power switch handles a 300mA current with a voltage drop of 300mV.

The LT1610 is available in 8-lead MSOP and SO packages.

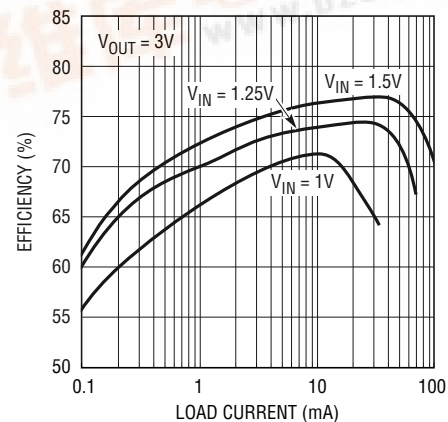
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Burst Mode is a trademark of Linear Technology Corporation.

## TYPICAL APPLICATION

1-Cell to 3V Step-Up Converter



Efficiency



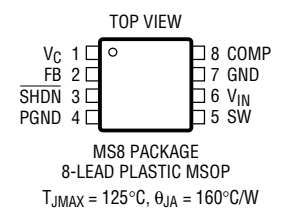
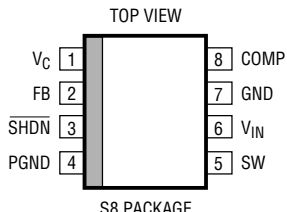
# LT1610

## ABSOLUTE MAXIMUM RATINGS

$V_{IN}$ Voltage .....	8V
SW Voltage .....	–0.4V to 30V
FB Voltage .....	$V_{IN} + 0.3V$
$V_C$ Voltage .....	2V
COMP Voltage .....	2V
Current into FB Pin .....	$\pm 1mA$
SHDN Voltage .....	8V
Maximum Junction Temperature .....	125°C
Operating Temperature Range	
Commercial .....	0°C to 70°C
Extended Commercial (Note 1) .....	–40°C to 85°C
Storage Temperature Range .....	–65°C to 150°C
Lead Temperature (Soldering, 10 sec) .....	300°C

Consult factory for Industrial and Military grade parts.

## PACKAGE/ORDER INFORMATION

 <p>MS8 PACKAGE 8-LEAD PLASTIC MSOP <math>T_{JMAX} = 125^{\circ}C</math>, <math>\theta_{JA} = 160^{\circ}C/W</math></p>	ORDER PART NUMBER			
	LT1610CMS8			
	MS8 PART MARKING			
 <p>S8 PACKAGE 8-LEAD PLASTIC SO <math>T_{JMAX} = 125^{\circ}C</math>, <math>\theta_{JA} = 120^{\circ}C/W</math></p>	ORDER PART NUMBER			
	LT1610CS8			
	S8 PART MARKING			
	1610			

## ELECTRICAL CHARACTERISTICS

Commercial grade 0°C to 70°C,  $V_{IN} = 1.5V$ ,  $V_{SHDN} = V_{IN}$ ,  $T_A = 25^{\circ}C$  unless otherwise noted. (Note 1)

PARAMETER	CONDITIONS	MIN	TYP	MAX	UNITS
Minimum Operating Voltage			0.9	1	V
Maximum Operating Voltage				8	V
Feedback Voltage	●	1.20	1.23	1.26	V
Quiescent Current	$V_{SHDN} = 1.5V$ , Not Switching		30	60	$\mu A$
Quiescent Current in Shutdown	$V_{SHDN} = 0V$ , $V_{IN} = 2V$		0	0.5	$\mu A$
	$V_{SHDN} = 0V$ , $V_{IN} = 5V$		0	1.0	$\mu A$
FB Pin Bias Current	●		27	60	nA
Reference Line Regulation	$1V \leq V_{IN} \leq 2V$ (25°C, 0°C)		0.6	1	%/V
	$1V \leq V_{IN} \leq 2V$ (70°C)			2	%/V
	$2V \leq V_{IN} \leq 8V$ (25°C, 0°C)		0.1	0.3	%/V
	$2V \leq V_{IN} \leq 8V$ (70°C)			0.4	%/V
Error Amp Transconductance	$\Delta I = 2\mu A$		40		$\mu mhos$
Error Amp Voltage Gain			100		V/V
Switching Frequency	●	1.4	1.7	2	MHz
Maximum Duty Cycle	●	77	80	95	%
	●	75		95	%
Switch Current Limit	(Note 2)	450	600	900	mA
Switch $V_{CESAT}$	$I_{SW} = 300mA$		300	350	mV
	●			400	mV
Switch Leakage Current	$V_{SW} = 5V$		0.01	1	$\mu A$
SHDN Input Voltage High		1			V
SHDN Input Voltage Low				0.3	V
SHDN Pin Bias Current	$V_{SHDN} = 3V$		10		$\mu A$
	$V_{SHDN} = 0V$		0	0.1	$\mu A$

The ● denotes specifications which apply over the specified temperature range.

**Note 1:** C grade device specifications are guaranteed over the 0°C to 70°C temperature range. In addition, C grade device specifications are assured

over the –40°C to 85°C temperature range by design or correlation, but are not production tested.

**Note 2:** Current limit guaranteed by design and/or correlation to static test. Current limit is affected by duty cycle due to ramp generator. See Block Diagram.

## PIN FUNCTIONS

**V<sub>C</sub> (Pin 1):** Error Amplifier Output. Frequency compensation network must be connected to this pin, either internal (COMP pin) or external series RC to ground. 100k $\Omega$ /200pF typical value.

**FB (Pin 2):** Feedback Pin. Reference voltage is 1.23V. Connect resistive divider tap here. Minimize trace area at FB. Set V<sub>OUT</sub> according to  $V_{OUT} = 1.23V (1 + R1/R2)$ .

**SHDN (Pin 3):** Shutdown. Ground this pin to turn off device. Tie to 1V or more to enable.

**PGND (Pin 4):** Power Ground. Tie directly to local ground plane.

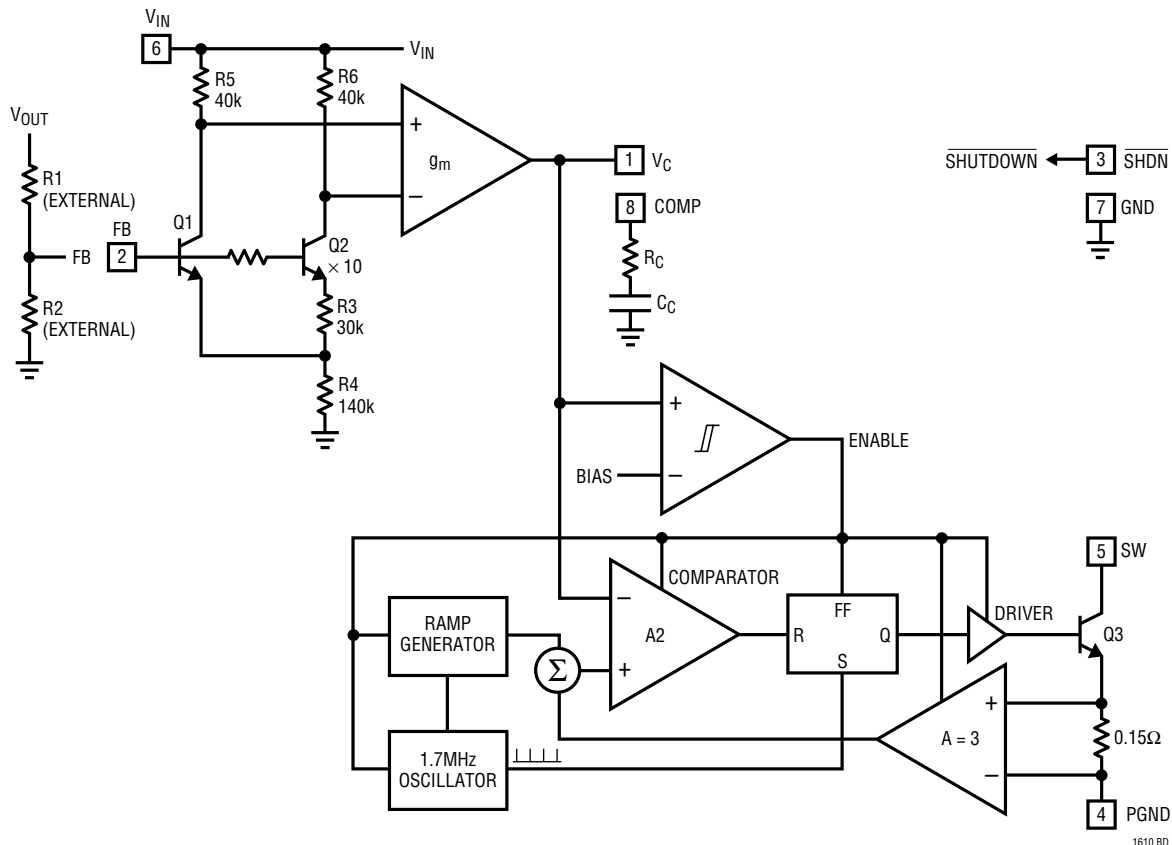
**SW (Pin 5):** Switch Pin. Connect inductor/diode here. Minimize trace area at this pin to keep EMI down.

**V<sub>IN</sub> (Pin 6):** Input Supply Pin. Must be locally bypassed.

**GND (Pin 7):** Signal Ground. Carries all device ground current except switch current. Tie to local ground plane.

**COMP (Pin 8):** Internal Compensation Network. Tie to V<sub>C</sub> pin, or let float if external compensation is used. Output capacitor must be tantalum if COMP pin is used for compensation.

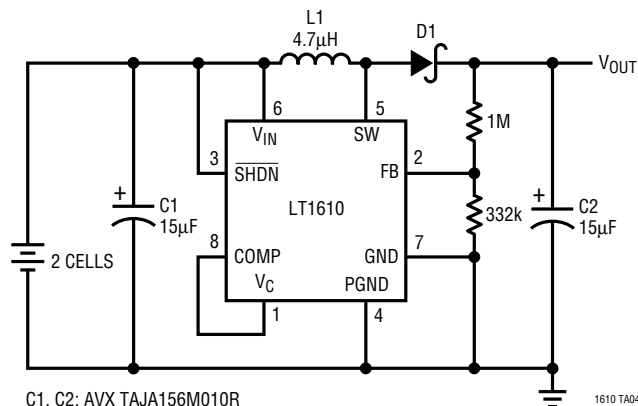
## BLOCK DIAGRAM



# LT1610

## TYPICAL APPLICATIONS

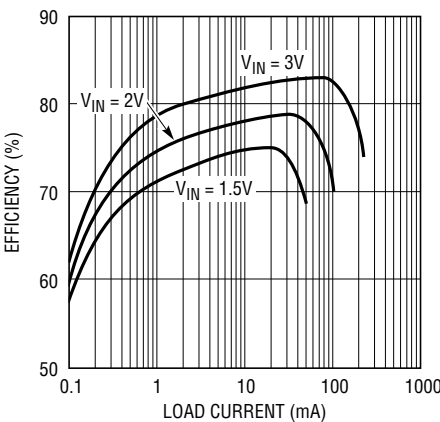
2-Cell to 5V Converter



C1, C2: AVX TAJA156M010R  
D1: MOTOROLA MBR0520  
L1: SUMIDA CD43-4R7  
MURATA LQH1C4R7

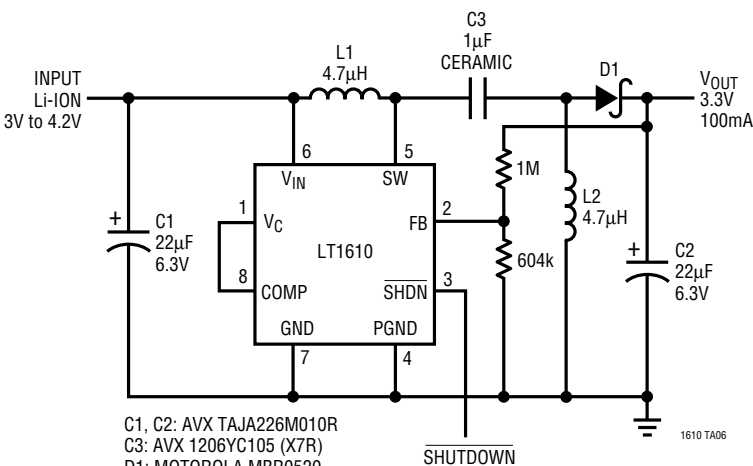
1610 TA04

Efficiency



1610 TA05

Li-Ion to 3.3V SEPIC DC/DC Converter



C1, C2: AVX TAJA226M010R  
C3: AVX 1206YC105 (X7R)  
D1: MOTOROLA MBR0520  
L1, L2: MURATA LQH3C4R7M24

1610 TA06

## RELATED PARTS

PART NUMBER	DESCRIPTION	COMMENTS
LTC®1163	Triple High Side Driver for 2-Cell Inputs	1.8V Minimum Input, Drives N-Channel MOSFETs
LTC1474	Micropower Step-Down DC/DC Converter	94% Efficiency, 10µA I <sub>Q</sub> , 9V to 5V at 250mA
LT1302	High Output Current Micropower DC/DC Converter	5V/600mA from 2V, 2A Internal Switch, 200µA I <sub>Q</sub>
LT1304	2-Cell Micropower DC/DC Converter	Low-Battery Detector Active in Shutdown
LT1307	Single Cell Micropower 600kHz PWM DC/DC Converter	3.3V at 75mA from 1 Cell, MSOP Package
LTC1440/1/2	Ultralow Power Single/Dual Comparators with Reference	2.8µA I <sub>Q</sub> , Adjustable Hysteresis
LTC1516	2-Cell to 5V Regulated Charge Pump	12µA I <sub>Q</sub> , No Inductors, 5V at 50mA from 3V Input
LT1521	Micropower Low Dropout Linear Regulator	500mV Dropout, 300mA Current, 12µA I <sub>Q</sub>