

## Micro-power Step-Up DC/DC Converters in SOT-23-5

### Features

- Configurable Output Voltage Up to 16V
- 20 $\mu$ A Quiescent Current
- <1 $\mu$ A Shutdown Current
- <1 $\mu$ A Shutdown Pin Current
- Supply Range from 2.5V to 6.5V
- Low  $V_{DS(on)}$ : 250mV ( $I_{SW}=300mA$ )
- Tiny SOT-23-5 Package

### Applications

- STN/TFT LCD Bias
- Personal Digital Assistants (PDAs)
- Handheld Computers
- Digital Still Cameras
- Cellular Phones
- WebPad
- White LED Driver
- Local 3V to 5V Conversion

### General Description

The G5103 boost converter is designed for small/ medium size LCD panel of high bias voltage.

Due to a typical 20 $\mu$ A quiescent current and 2.5V~6.5V 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.

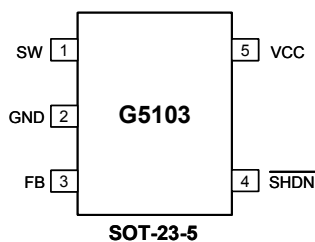
Furthermore, the 350mA current limit, 500ns fixed minimum off-time and tiny SOT23-5 package facilitates the use of smaller inductor and other surface-mount components to minimize the PCB size in those space-conscious applications.

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.

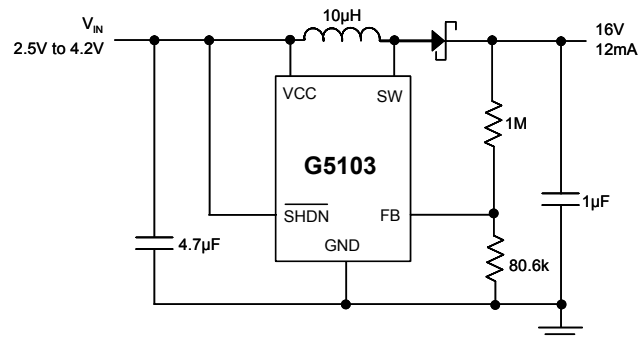
### Ordering Information

ORDER NUMBER	ORDER NUMBER (Pb Free)	MARKING	TEMP. RANGE	PACKAGE
G5103T11U	G5103T11Uf	5103x	-40°C ~ +85°C	SOT-23-5

### Pin Configuration



### Typical Application Circuit



## Absolute Maximum Ratings

SW to GND.....	-0.3V to +18V	Junction Temperature .....	+125°C
FB to GND.....	-0.3V to V <sub>CC</sub>	Storage Temperature.....	-65°C to +150°C
V <sub>CC</sub> , $\overline{\text{SHDN}}$ to GND.....	-0.3V to +7V	Reflow Temperature (soldering, 10sec).....	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

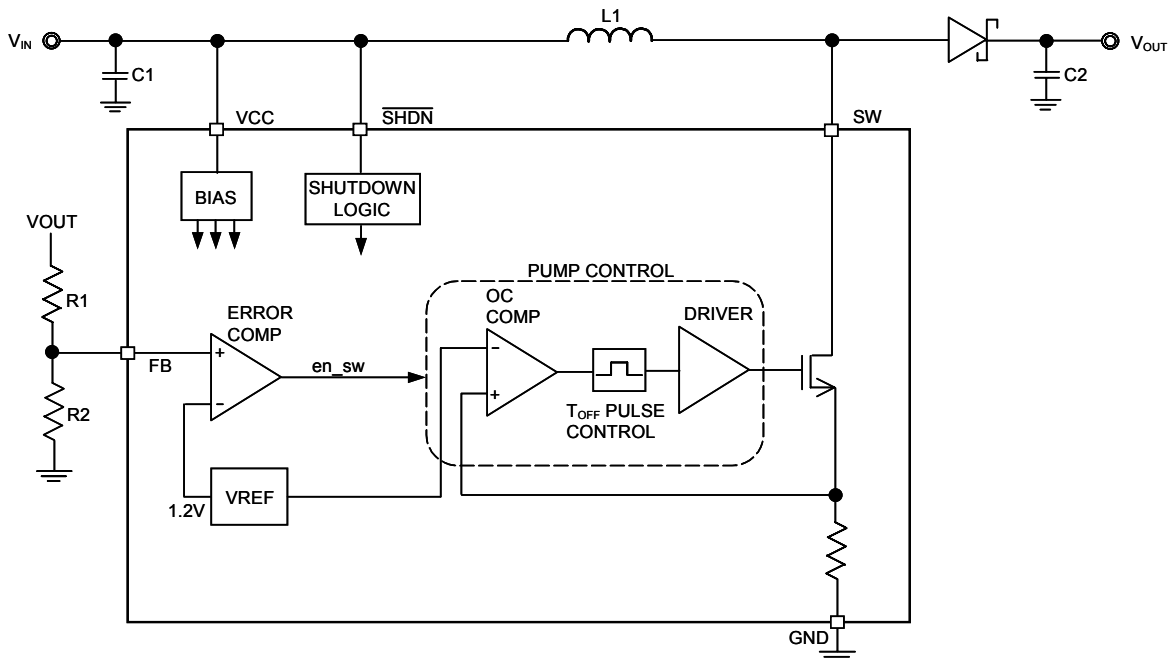
(V<sub>CC</sub> = 3.6V, V<sub>SHDN</sub> = 3.6V, T<sub>A</sub> = 25°C)

PARAMETER	CONDITIONS	MIN	TYP	MAX	UNITS
Input Voltage Range		2.5		6.5	V
Quiescent Current	Not Switching		20	35	μA
	V <sub>SHDN</sub> = 0V		0.1	1	μA
FB Comparator Trip Point		1.18	1.2	1.22	V
Output Voltage Line Regulation	2.5V < V <sub>IN</sub> < 6.5V		-0.05		%/V
FB Pin Bias Current (Note 2)	V <sub>FB</sub> = 1.2V		30	80	nA
Switch Off Time	V <sub>FB</sub> > 1V		500		ns
	V <sub>FB</sub> < 0.6V		1.6		μs
Switch V <sub>DS(ON)</sub>	I <sub>SW</sub> = 300mA		250	350	mV
Switch Current Limit		300	350	400	mA
SHDN Pin Current			0.1	1	μA
SHDN Input Voltage High		0.9			V
SHDN Input Voltage Low				0.25	V
Switch Leakage Current	Switch Off, V <sub>SW</sub> = 16V		0.01	5	μA

Note 1: The G5103 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.

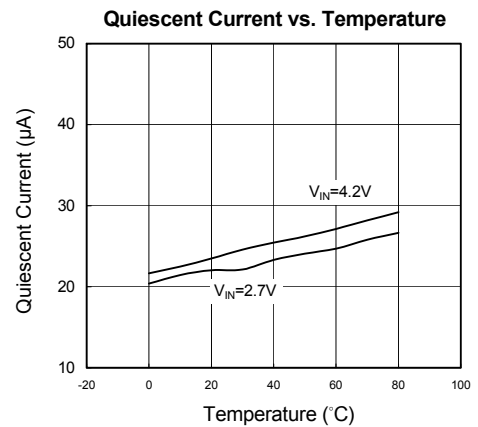
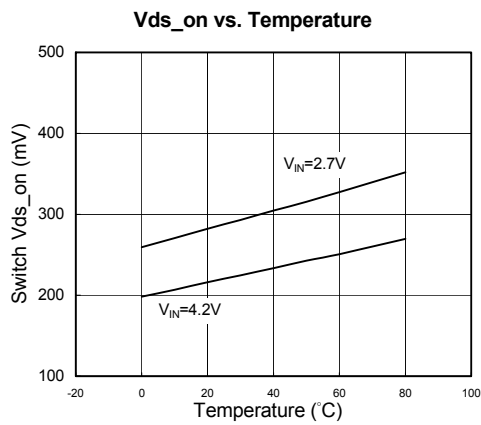
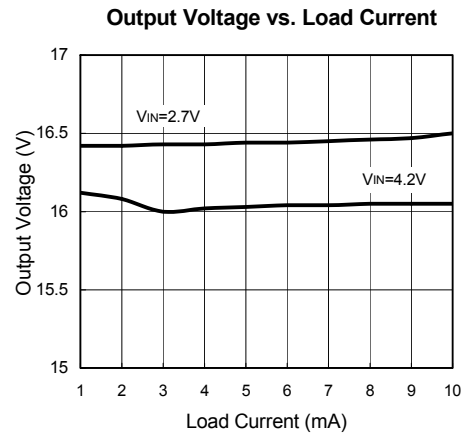
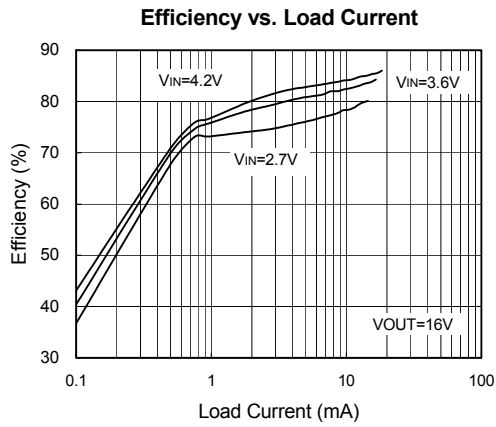
Note 2: Bias current flows into the FB pin.

## Block Diagram

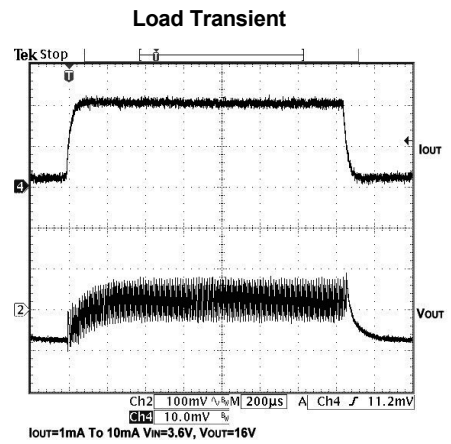
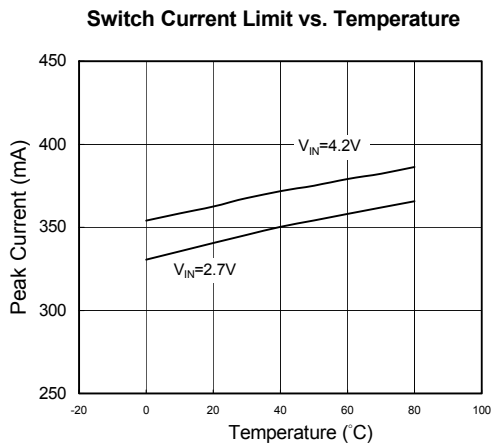
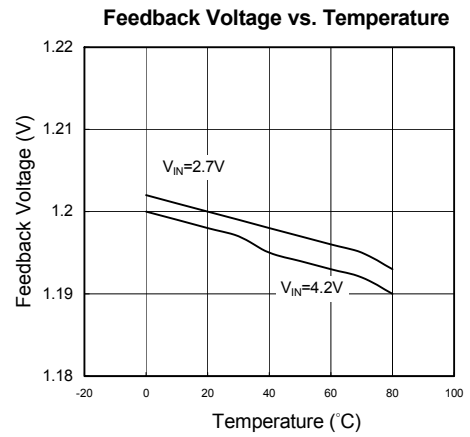
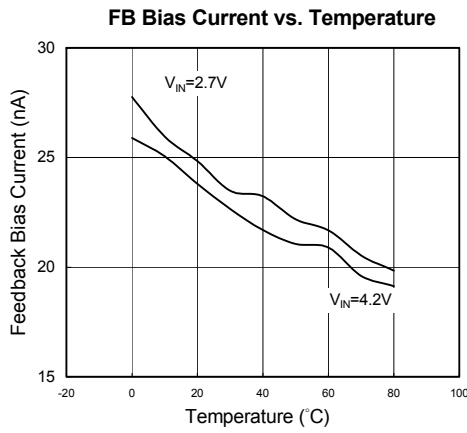


**Typical Performance Characteristics**

( $V_{CC}=+3.6V$ ,  $V_{SHDN}=+3.6V$ ,  $L=10\mu H$ ,  $T_A=25^\circ C$ , 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 G5103 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 350mA 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. In this mode, the G5103 consumes as low as 20uA typically to save battery power.

## Applications Information

### Choosing an Inductor

There are several recommended inductors that work well with the G5103 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 www.murata.com
LQH3C100	10	0.30	
LQH3C220	22	0.92	
CD43-4R7	4.7	0.11	Sumida www.sumida.com
CD43-100	10	0.18	
CDRH4D18-4R	4.7	0.16	
7	10	0.20	
CDRH4D18-100			
DO1608-472	4.7	0.09	Coilcraft www.coilcraft.com
DO1608-103	10	0.16	
DO1608-223	22	0.37	

### Inductor Selection—Boost Regulator

The appropriate inductance value for the boost regulator application may be calculated from the following equation. Select a standard inductor close to this value.

$$L = \frac{V_{OUT} - V_{IN(MIN)} + V_D}{I_{LIM}} \times t_{OFF}$$

Where  $V_D = 0.4V$  (Schottky diode voltage),  $I_{LIM} = 350mA$  and  $t_{OFF} = 500ns$ . A larger value can be used to lightly increase the available output current, but limit it to about twice the calculating value. When too large of an inductor will increase the output voltage ripple without providing much additional output current. In varying  $V_{IN}$  condition such as battery power applications, use the minimum  $V_{IN}$  value in the above equation. A smaller value can be used to give smaller physical size, but the inductor current overshoot will be occurs (see Current Limit Overshoot section).

### Inductor Selection—SEPIC Regulator

For a SEPIC regulator using the G5103, the approximate inductance value can be calculated by below formula. As for the boost inductor selection, a larger or smaller value can be used.

$$L = 2 \left( \frac{V_{OUT} + V_D}{I_{LIM}} \right) \times t_{OFF}$$

### Current Limit Overshoot

The G5103 use a constant off-time control scheme, the power switch is turned off after the 350mA 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.

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

Where  $V_{SAT} = 0.25V$  (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 350mA, the power switch of the G5103 can operate larger currents without any problem, but the total efficiency will suffer. The  $I_{PEAK}$  is keep below 500mA for the G5103 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 G5103'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 G5103. A 4.7µF input capacitor is sufficient for most applications.

**Diode Selection**

For most G5103 applications, the high switching frequency requires a high-speed rectifier Schottky diodes, such as the MBR0520 (0.5A, 20V) with their low forward voltage drop and fast switching speed, are rec-

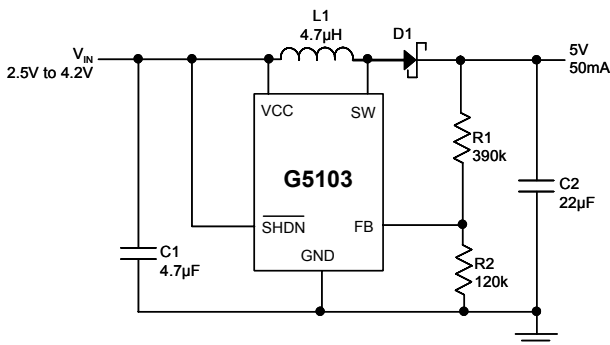
ommended. Many different manufacturers make equivalent parts, but make sure that the component is rated to operate at least 0.35A. To achieve high efficiency, the average current rating of the Schottky diodes should be greater than the peak switching current. Choose a reverse breakdown voltage greater than the output voltage.

**Lowering Output Voltage Ripple**

The G5103 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 G5103 (see the circuits in the Typical Applications section). To add this small, inexpensive 10pF capacitor will greatly reduce the output voltage ripple.

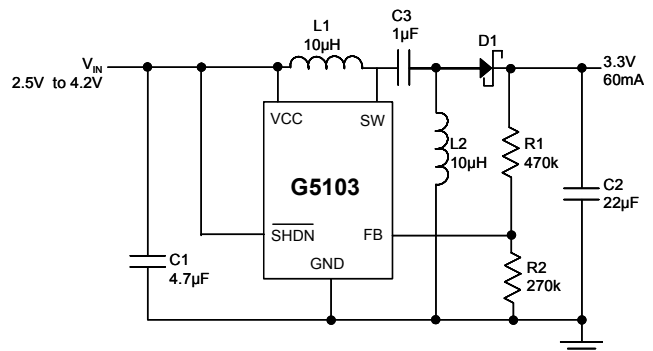
**Typical Applications**

**Boost Converter**



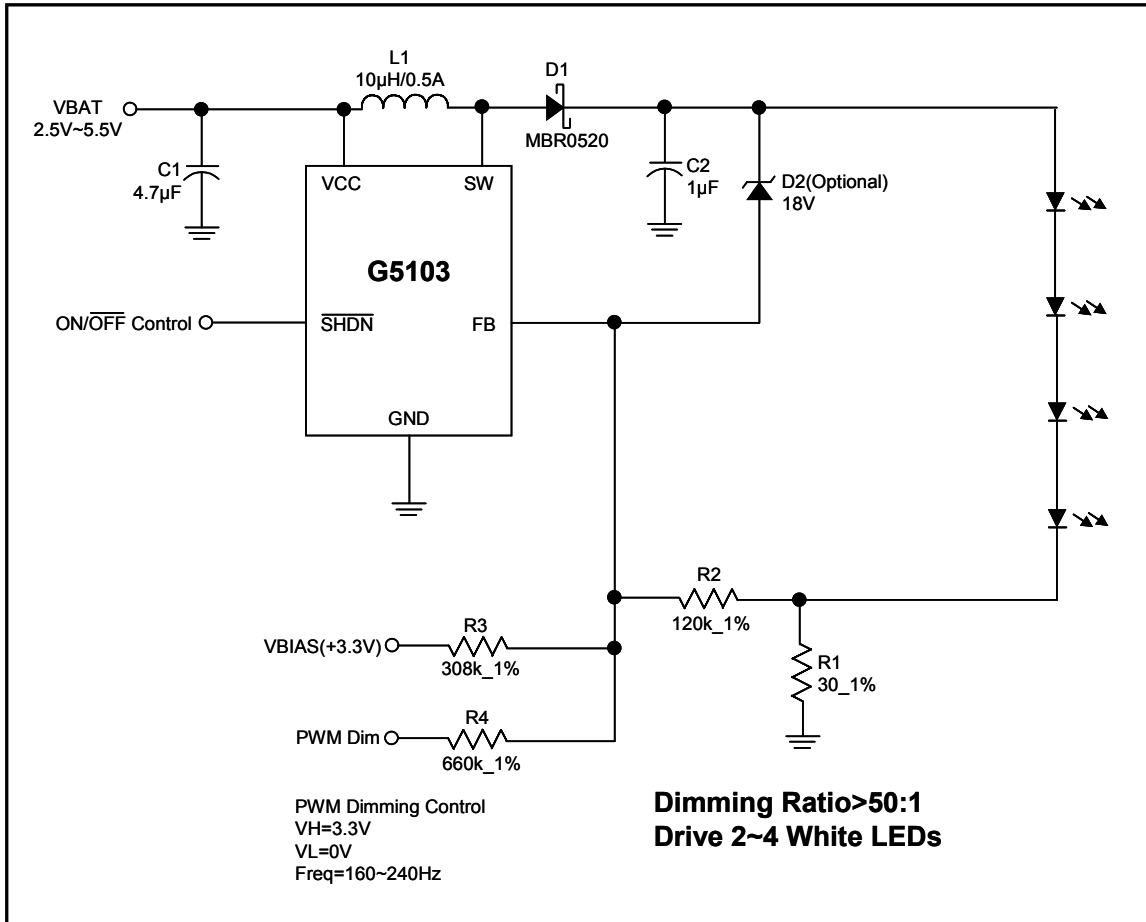
L1:MURATA LQH3C4R7M24  
D1:MOTOROLA MBR0520

**SEPIC Converter**

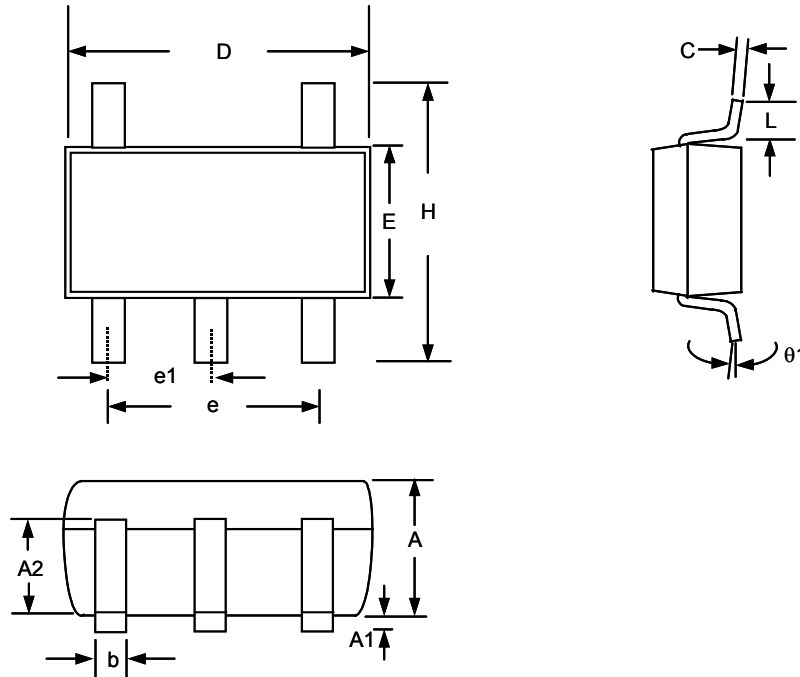


L1,L2:MURATA LQH3C100K24  
D1:MOTOROLA MBR0520

**White LED Driver**



## Package Information

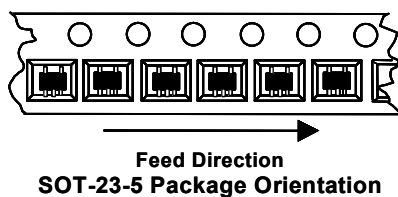


**Note:**

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	-----	-----
$\theta 1$	1°	5°	9°

## Taping Specification



PACKAGE	Q'TY/REEL
SOT-23-5	3,000 ea

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