

600kHz, 1A Switch PWM DC/DC Converter

August 1999

FEATURES

- 1.1A, 0.5Ω, 30V Internal Switch
- Operates with V_{IN} as Low as 1.5V
- 600kHz Fixed Frequency Operation
- Low-Battery Detector Active in Shutdown
- Low V_{CESAT} Switch: 410mV at 800mA
- Pin-for-Pin Compatible with the LT1317B
- Small 8-Lead MSOP Package

APPLICATIONS

- LCD Bias Supplies
- GPS Receivers
- Battery Backup
- Portable Electronic Equipment
- Diagnostic Medical Instrumentation

DESCRIPTION

The LT[®]1949 is a fixed frequency step-up DC/DC converter with a 1.1A, 0.5Ω internal switch. Capable of generating 10V at 175mA from a 3.3V input, the LT1949 is ideal for generating bias voltages for large screen LCD panels. Constant frequency 600kHz operation results in a low noise output that is easy to filter and the 30V switch rating allows output voltage up to 28V using a single inductor. An external compensation pin gives the user flexibility in determining loop compensation, allowing small low ESR ceramic capacitors to be used at the output. The 8-lead MSOP package ensures a low profile overall solution.

The LT1949 has a low-battery detector that stays alive when the device goes into shutdown. Quiescent current in shutdown is 25μA, while operating current is 4.5mA.

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TYPICAL APPLICATION

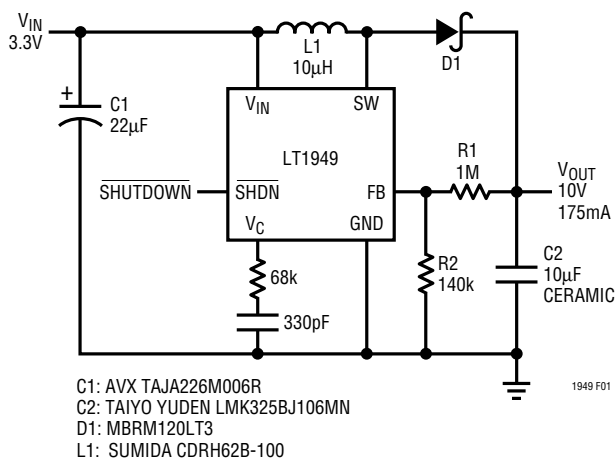


Figure 1. 3.3V to 10V/175mA DC/DC Converter

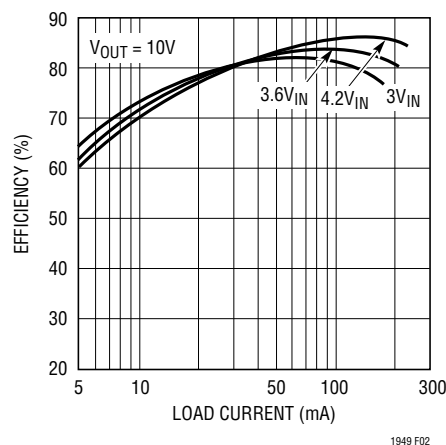
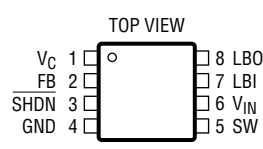
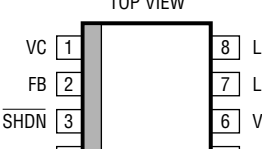


Figure 2. 3.3V to 10V Converter Efficiency

ABSOLUTE MAXIMUM RATINGS (Note 1)

V_{IN} , LBO Voltage	12V	Junction Temperature	125°C
SW Voltage	-0.4V to 30V	Operating Temperature Range (Note 2)	
FB Voltage	$V_{IN} + 0.3V$	LT1949EMS8	-40°C to 85°C
V_C Voltage	2V	LT1949ES8/LT1949IS8	-40°C to 85°C
LBI Voltage	$0V \leq V_{LBI} \leq 1V$	Storage Temperature	-65°C to 150°C
SHDN Voltage	6V	Lead Temperature (Soldering, 10sec)	300°C

PACKAGE/ORDER INFORMATION

 <p>MS8 PACKAGE 8-LEAD PLASTIC MSOP</p> <p>$T_{JMAX} = 125^{\circ}C$, $\theta_{JA} = 120^{\circ}C/W$</p>	ORDER PART NUMBER	 <p>S8 PACKAGE 8-LEAD PLASTIC SO</p> <p>$T_{JMAX} = 125^{\circ}C$, $\theta_{JA} = 120^{\circ}C/W$</p>	ORDER PART NUMBER
	LT1949EMS8		LT1949ES8 LT1949IS8
	MS8 PART MARKING		S8 PART MARKING
	LTJC		1949E 1949I

Consult factory for Military grade parts.

ELECTRICAL CHARACTERISTICS The ● denotes specifications which apply over the full operating temperature range, otherwise specifications are $T_A = 25^{\circ}C$. Commercial Grade: $V_{IN} = 2V$, $V_{SHDN} = 2V$ unless otherwise noted.

SYMBOL	PARAMETER	CONDITIONS	MIN	TYP	MAX	UNITS
I_Q	Quiescent Current	$V_{SHDN} = 0V$	●	4.5	7.5	mA
			●	25	40	μA
V_{FB}	Feedback Voltage		●	1.22	1.24	V
			●	1.20	1.24	V
I_B	FB Pin Bias Current (Note 3)		●	12	80	nA
	Input Voltage Range		●	1.7	12	V
g_m	Error Amp Transconductance	$\Delta I = 5\mu A$	●	70	140	$\mu mhos$
A_V	Error Amp Voltage Gain			700		V/V
	Maximum Duty Cycle		●	80	85	%
	Switch Current Limit (Note 4)	$V_{IN} = 2.5V$, Duty Cycle = 30%	●	1	1.13	A
		$V_{IN} = 2.5V$, Duty Cycle = 30%	●	0.95	1.5	A
f_{OSC}	Switching Frequency	$V_{SHDN} = V_{IN}$ $V_{SHDN} = 0V$	●	500	620	kHz
			●		0.015	μA
	LBI Threshold Voltage		●	190	200	mV
			●	180	200	mV
	LBO Output Low	$I_{SINK} = 10\mu A$	●	0.15	0.25	V
	LBO Leakage Current	$V_{LBI} = 250mV$, $V_{LBO} = 5V$	●	0.02	0.1	μA
	LBI Input Bias Current (Note 5)	$V_{LBI} = 150mV$	●	5	60	nA
	Low-Battery Detector Gain	1M Ω Load		2000		V/V
	Switch Leakage Current	$V_{SW} = 5V$	●	0.01	3	μA

ELECTRICAL CHARACTERISTICS

The ● denotes specifications which apply over the full operating temperature range, otherwise specifications are $T_A = 25^\circ\text{C}$. Commercial Grade: $V_{IN} = 2\text{V}$, $V_{\overline{\text{SHDN}}} = 2\text{V}$ unless otherwise noted.

SYMBOL	PARAMETER	CONDITIONS	MIN	TYP	MAX	UNITS
	Switch V_{CESAT}	$I_{\text{SW}} = 800\text{mA}$ $I_{\text{SW}} = 500\text{mA}$		410		mV
	Reference Line Regulation	$1.8\text{V} \leq V_{IN} \leq 12\text{V}$	●	0.08	0.15	%/V
	$\overline{\text{SHDN}}$ Input Voltage High		●	1.4	6	V
	$\overline{\text{SHDN}}$ Input Voltage Low		●		0.4	V

Note 1: Absolute Maximum Ratings are those values beyond which the life of a device may be impaired.

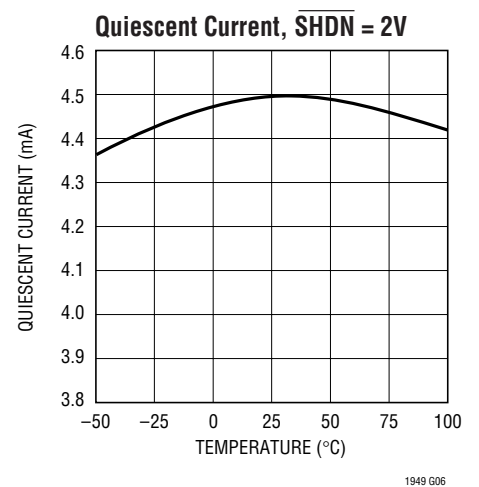
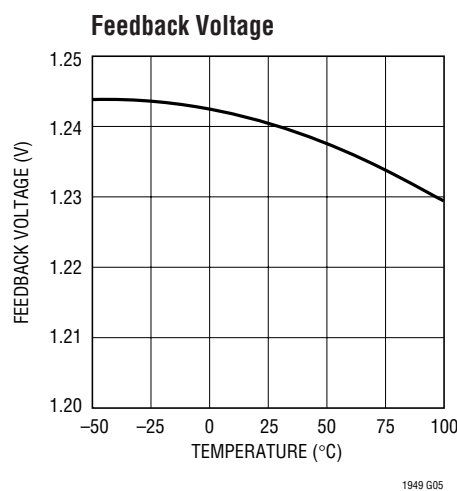
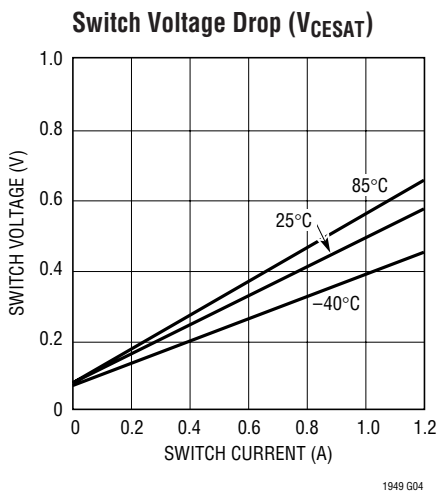
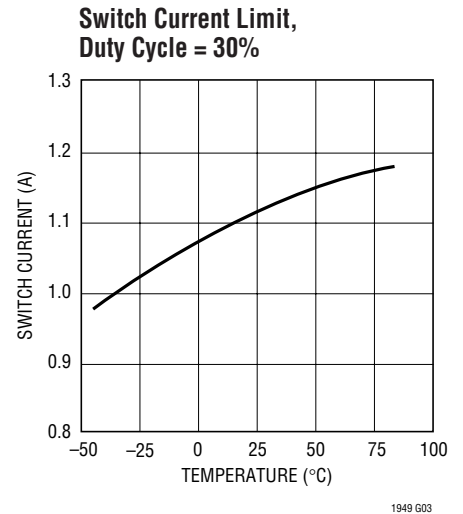
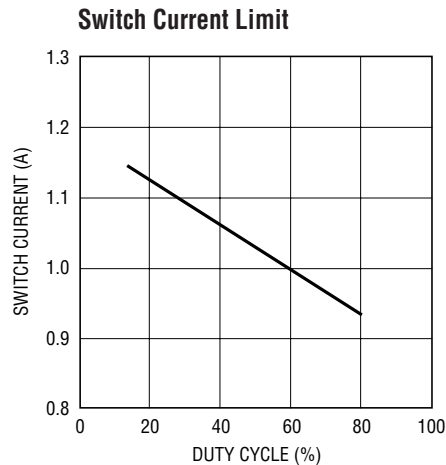
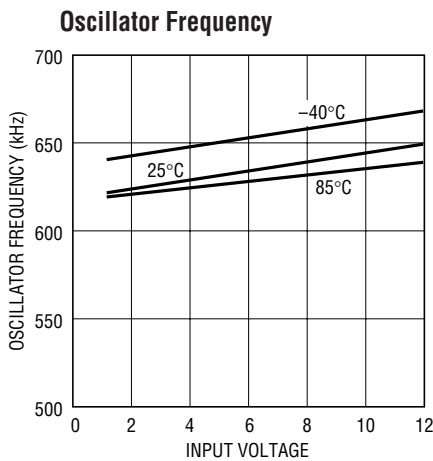
Note 2: The LT1949E is guaranteed to meet performance specifications from 0°C to 70°C . Specifications over the -40°C to 85°C operating temperature range are assured by design, characterization and correlation with statistical process controls.

Note 3: Bias current flows into FB pin.

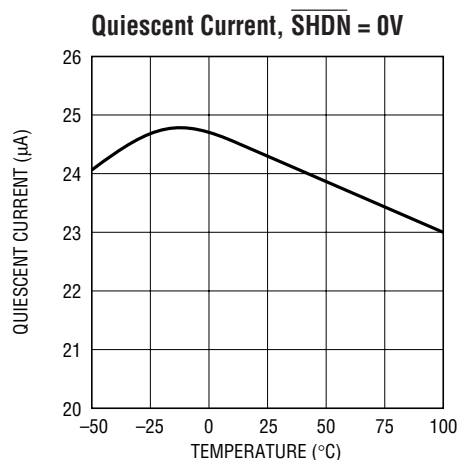
Note 4: Switch current limit guaranteed by design and/or correlation to static tests. Duty cycle affects current limit due to ramp generator.

Note 5: Bias current flows out of LBI pin.

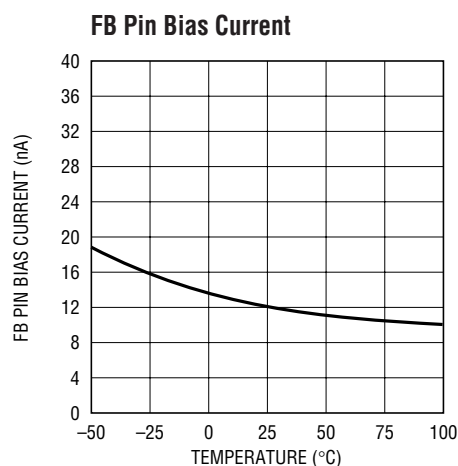
TYPICAL PERFORMANCE CHARACTERISTICS



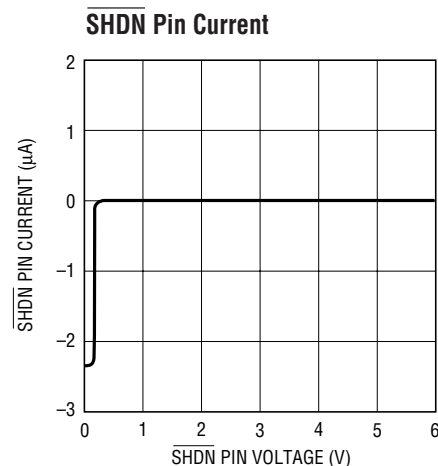
TYPICAL PERFORMANCE CHARACTERISTICS



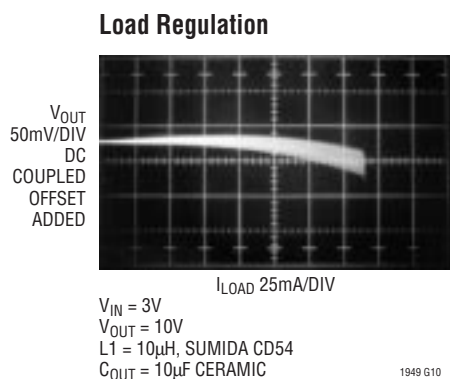
1317 TPC10



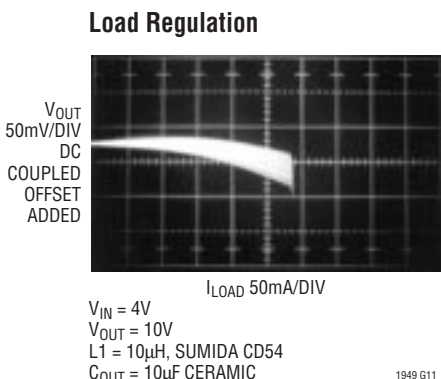
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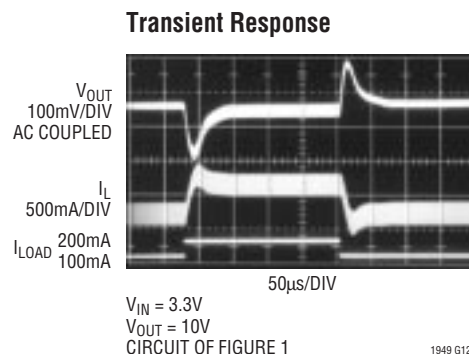
1317 TPC12



1949 G10



1949 G11



1949 G12

PIN FUNCTIONS

V_C (Pin 1): Compensation Pin for Error Amplifier. Connect a series RC network from this pin to ground. Typical values for compensation are a 68k/330pF combination when using ceramic output capacitors. Minimize trace area at V_C .

FB (Pin 2): Feedback Pin. Reference voltage is 1.24V. Connect resistor divider tap here. Minimize trace area at FB. Set V_{OUT} according to: $V_{\text{OUT}} = 1.24\text{V}(1 + R1/R2)$.

$\overline{\text{SHDN}}$ (Pin 3): Shutdown. Pull this pin low for shutdown mode (only the low-battery detector remains active). Leave this pin floating or tie to a voltage between 1.4V and 6V to enable the device. $\overline{\text{SHDN}}$ pin is logic level and need only meet the logic specification (1.4V for high, 0.4V for low).

GND (Pin 4): Ground. Connect 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_{IN} (Pin 6): Supply Pin. Must be bypassed close to the pin.

LBI (Pin 7): Low-Battery Detector Input. 200mV reference. Voltage on LBI must stay between ground and 700mV. Low-battery detector remains active in shutdown mode.

LBO (Pin 8): Low-Battery Detector Output. Open collector, can sink 10µA. A 1MΩ pull-up is recommended.



OPERATION

The ground terminal of output capacitor C2 should tie close to Pin 4 of the LT1949. Doing this reduces dI/dt in the ground copper which keeps high frequency spikes to a minimum. The DC/DC converter ground should tie to the PC board ground plane at one place only, to avoid introducing dI/dt in the ground plane.

OPERATION

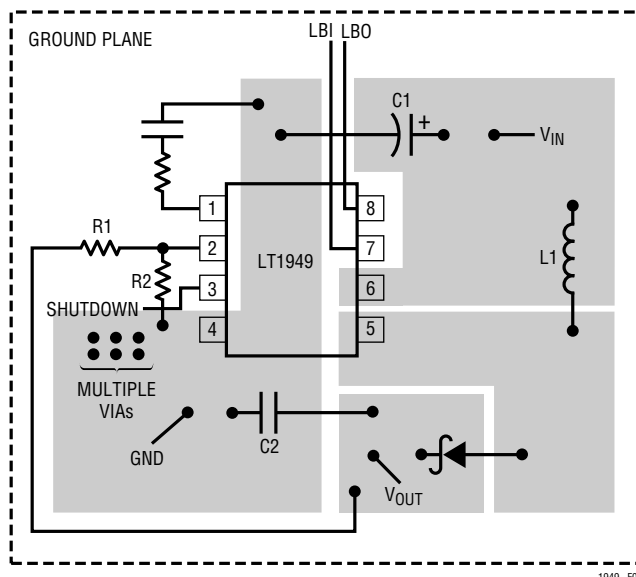


Figure 4. Recommended Component Placement for Boost Converter. Note Direct High Current Paths Using Wide PC Traces. Minimize Trace Area at Pin 1 (V_C) and Pin 2 (FB). Use Multiple Vias to Tie Pin 4 Copper to Ground Plane. Use Vias at One Location Only to Avoid Introducing Switching Currents into the Ground Plane

APPLICATIONS INFORMATION

Low-Battery Detector

The LT1949's low-battery detector is a simple PNP input gain stage with an open collector NPN output. The negative input of the gain stage is tied internally to a 200mV $\pm 5\%$ reference. The positive input is the LBI pin. Arrangement as a low-battery detector is straightforward.

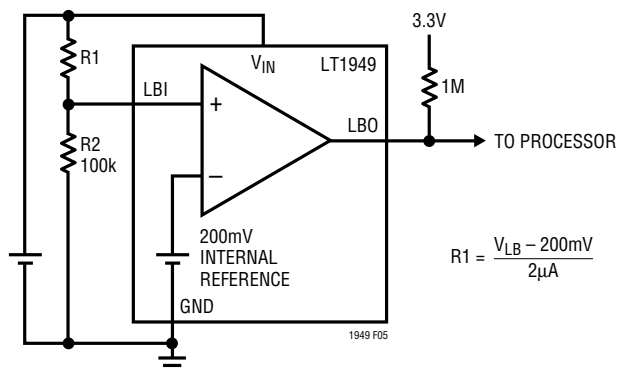


Figure 5. Setting Low-Battery Detector Trip Point

Figure 5 details hookup. R1 and R2 need only be low enough in value so that the bias current of the LBI pin doesn't cause large errors. For R2, 100k is adequate. The 200mV reference can also be accessed as shown in Figure 6. The low-battery detector remains active in shutdown.

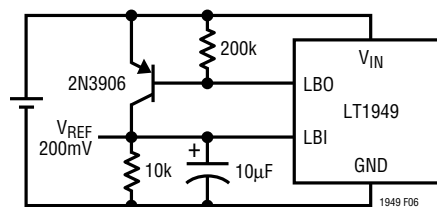
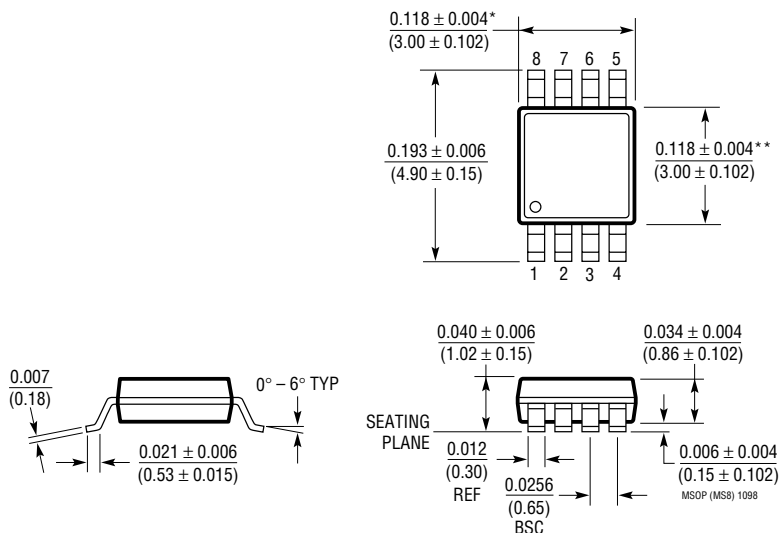


Figure 6. Accessing 200mV Reference

PACKAGE DESCRIPTION Dimensions in inches (millimeters) unless otherwise noted.

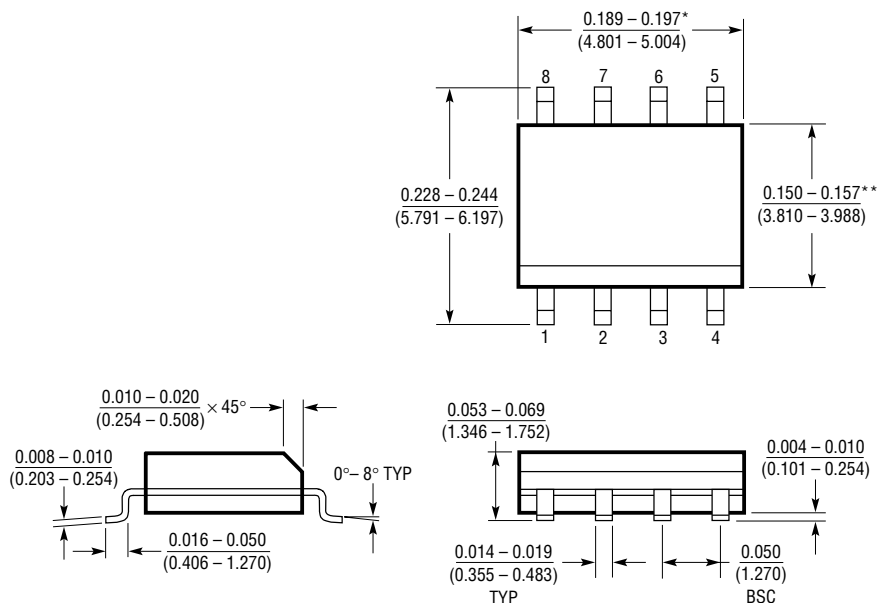
MS8 Package 8-Lead Plastic MSOP (LTC DWG # 05-08-1660)



* DIMENSION DOES NOT INCLUDE MOLD FLASH, PROTRUSIONS OR GATE BURRS. MOLD FLASH, PROTRUSIONS OR GATE BURRS SHALL NOT EXCEED 0.006" (0.152mm) PER SIDE

** DIMENSION DOES NOT INCLUDE INTERLEAD FLASH OR PROTRUSIONS. INTERLEAD FLASH OR PROTRUSIONS SHALL NOT EXCEED 0.006" (0.152mm) PER SIDE

S8 Package 8-Lead Plastic Small Outline (Narrow 0.150) (LTC DWG # 05-08-1610)



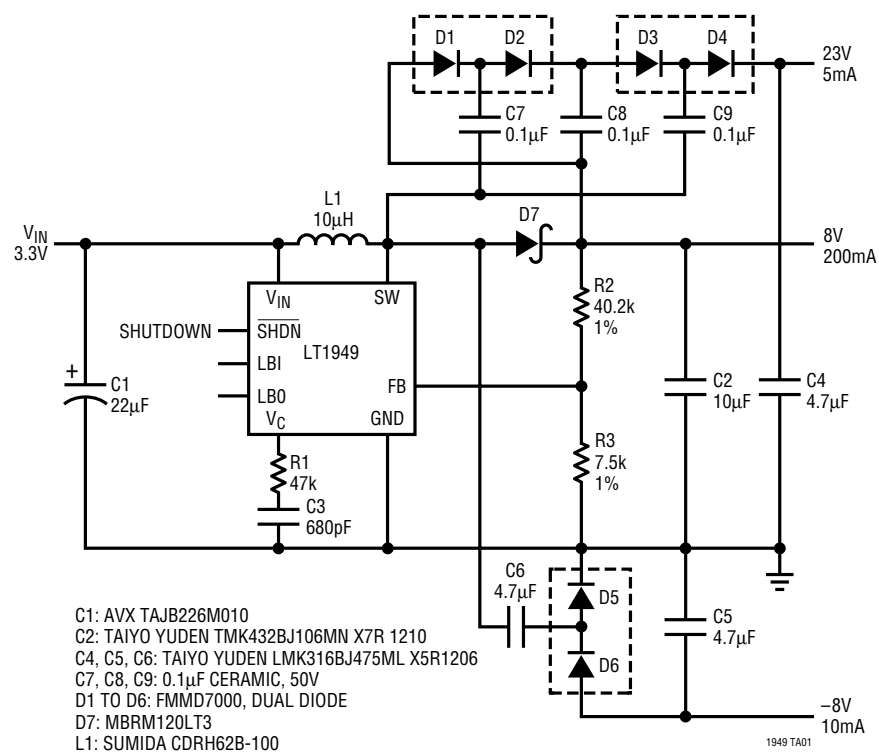
* DIMENSION DOES NOT INCLUDE MOLD FLASH. MOLD FLASH SHALL NOT EXCEED 0.006" (0.152mm) PER SIDE

** DIMENSION DOES NOT INCLUDE INTERLEAD FLASH. INTERLEAD FLASH SHALL NOT EXCEED 0.010" (0.254mm) PER SIDE

S08 1298

TYPICAL APPLICATION

Low Profile Triple Output LCD Bias Generator



RELATED PARTS

PART NUMBER	DESCRIPTION	COMMENTS
LT1054	High Power Regulated Charge Pump	Up to 100mA Output with No Inductors
LT1302	High Output Current Micropower DC/DC Converter	5V/600mA from 2V, 2A Internal Switch, 200µA I _Q
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
LT1317B	Micropower, 600kHz PWM DC/DC Converter	2 Cells to 3.3V at 200mA, MSOP Package
LTC1516	2-Cell to 5V Regulated Charge Pump	12µA I _Q , No Inductors, 5V at 50mA from 3V Input
LT1613	Single Cell 1.4MHz PWM DC/DC Converter	3.3V to 5V at 200mA, SOT-23 Package