

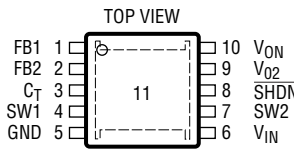
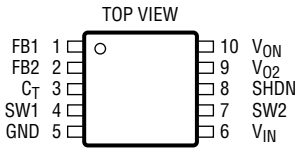
ABSOLUTE MAXIMUM RATINGS

(Note 1)

V_{IN} Voltage	8V
C_T Voltage	6V
SW1, SW2 Voltage	36V
V_{ON} , V_{O2} Voltage	30V

FB1, FB2	3V
SHDN	8V
Operating Temperature Range (Note 2) ..	–40°C to 85°C
Lead Temperature (Soldering, 10 sec)	300°C

PACKAGE/ORDER INFORMATION

TOP VIEW  FB1 1 10 V_{ON} FB2 2 9 V_{O2} C_T 3 8 SHDN SW1 4 7 SW2 GND 5 6 V_{IN} MSE PACKAGE 10-LEAD PLASTIC MSOP EXPOSED PAD (PIN 11) IS GND MUST BE SOLDERED TO PCB T_{JMAX} = 125°C, θ_{JA} = 40°C/W	ORDER PART NUMBER LT1947EMSE MSE PART MARKING LTBQW	TOP VIEW  FB1 1 10 V_{ON} FB2 2 9 V_{O2} C_T 3 8 SHDN SW1 4 7 SW2 GND 5 6 V_{IN} MS PACKAGE 10-LEAD PLASTIC MSOP T_{JMAX} = 125°C, θ_{JA} = 120°C/W	ORDER PART NUMBER LT1947EMS MS PART MARKING LTUE
Order Options Tape and Reel: Add #TR, Lead Free: Add #PBF, Lead Free Tape and Reel: Add #TRPBF Lead Free Part Marking: http://www.linear.com/leadfree/			

Consult LTC Marketing for parts specified with wider operating temperature ranges.

ELECTRICAL CHARACTERISTICS

The ● denotes the specifications which apply over the full operating temperature range, otherwise specifications are at $T_A = 25^{\circ}\text{C}$. $V_{IN} = 3.3\text{V}$, $V_{SHDN} = 3.3\text{V}$ unless otherwise specified.

SYMBOL	CONDITIONS	MIN	TYP	MAX	UNITS
Input Voltage Range		2.7		8	V
Supply Current	SHDN = 2.4V SHDN = 0V		9.5	12.5 1	mA μA
FB1 Voltage		● 1.240 1.225	1.26	1.280 1.295	V V
FB2 Voltage		● 1.225 1.210	1.26	1.295 1.310	V V
Reference Line Regulation	$V_{IN} = 2.7\text{V}$ to 8V		0.01	0.05	%/V

ELECTRICAL CHARACTERISTICS

The ● denotes the specifications which apply over the full operating temperature range, otherwise specifications are at $T_A = 25^\circ\text{C}$. $V_{IN} = 3.3\text{V}$, $V_{\overline{\text{SHDN}}} = 3.3\text{V}$ unless otherwise specified.

SYMBOL	CONDITIONS	MIN	TYP	MAX	UNITS
Error Amplifier Voltage Gain	EA1 and EA2		100		V/V
C_T Current Source	$V_{\overline{\text{FB1}}} = 1.3\text{V}$	4	5.5	6.5	μA
C_T Threshold to Turn On Q3		1.25	1.28	1.30	V
FB1 Voltage to Begin C_T Charge		1.17	1.2	1.23	V
SW1 Current Limit	(Note 3)	1.1	1.4	2	A
SW2 Current Limit	(Note 3)	0.35	0.6	1	A
SW1 Saturation Voltage	$I_{\text{SW1}} = 800\text{mA}$		0.230	0.280	V
SW2 Saturation Voltage	$I_{\text{SW2}} = 300\text{mA}$		0.3	0.36	V
SW1 Maximum Duty Cycle		82			%
SW2 Maximum Duty Cycle			85		%
Oscillator Frequency		● 2.3	3	3.5	MHz
V_{ON} Switch Drop	$I_{\text{Q3}} = 7\text{mA}$		160	200	mV
SW1 Leakage Current	Switch Off, $\text{SW1} = 3.3\text{V}$		0.01	5	μA
SW2 Leakage Current	Switch Off, $\text{SW2} = 3.3\text{V}$		0.01	5	μA
$\overline{\text{SHDN}}$ Pin Bias Current	$V_{\overline{\text{SHDN}}} = 2.4\text{V}$		10	25	μA
$\overline{\text{SHDN}}$ Pin High	Active Mode	2.4			V
$\overline{\text{SHDN}}$ Pin Low	Shutdown Mode			0.4	V

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

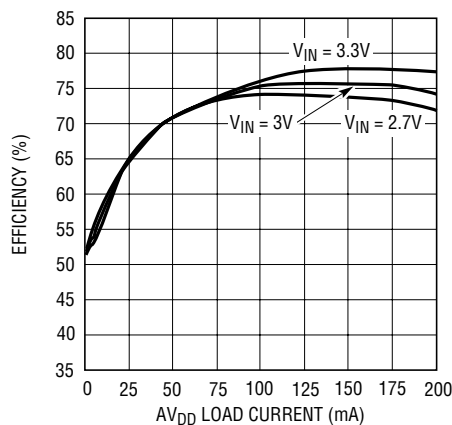
Note 2: The LT1947 is guaranteed to meet performance specifications from 0°C to 70°C . Specifications over the -40°C to 85°C operating

temperature range are assured by design, characterization and correlation with statistical process controls.

Note 3: Switch current limit guaranteed by design and/or correlation to static tests.

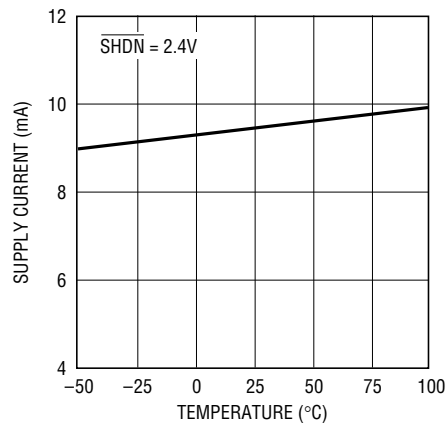
TYPICAL PERFORMANCE CHARACTERISTICS

3.3V TFT-LCD Converter Efficiency



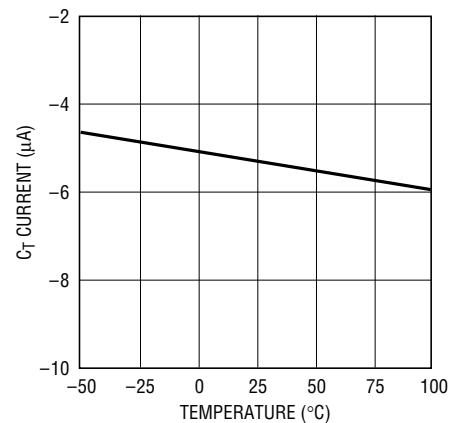
1947 G01

Supply Current



1947 G02

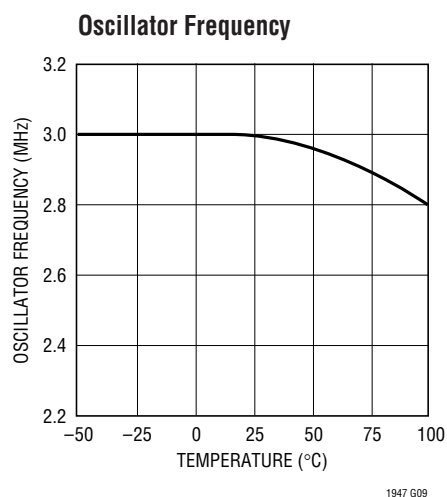
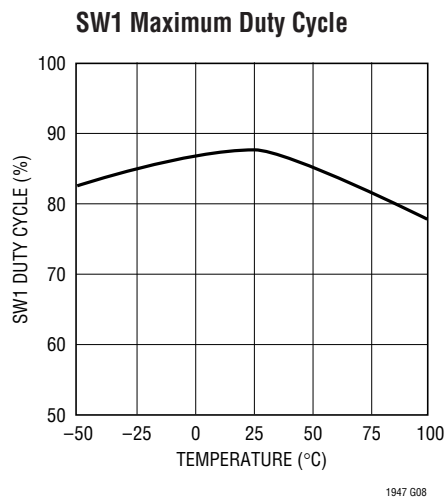
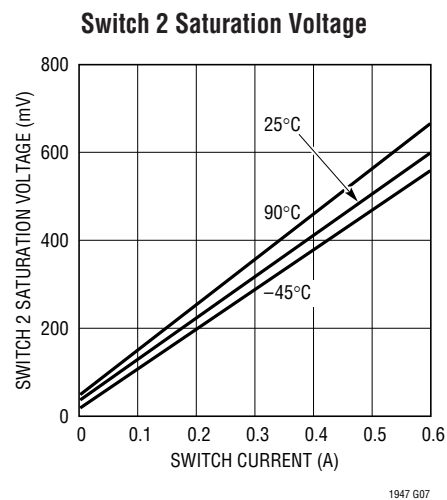
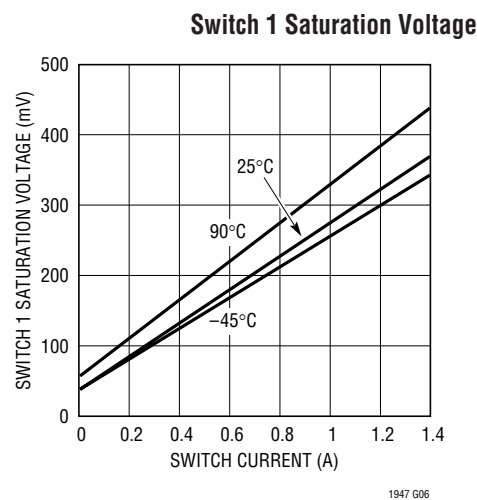
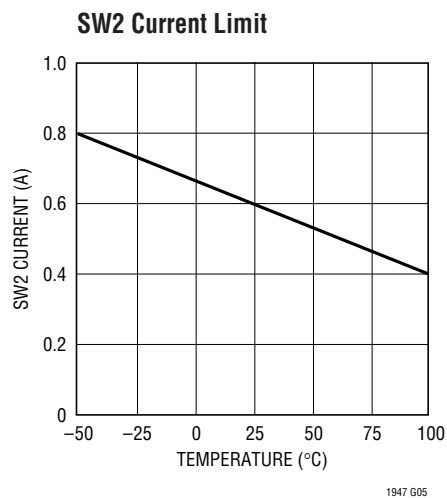
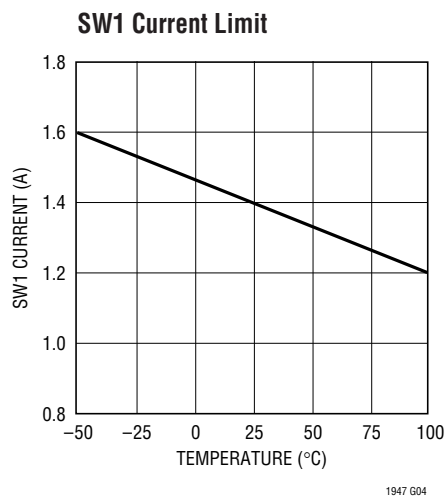
C_T Current Source



1947 G03

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TYPICAL PERFORMANCE CHARACTERISTICS



PIN FUNCTIONS

FB1 (Pin 1): Feedback Pin for First Switcher. Connect resistor divider tap here. Set AV_{DD} according to: $AV_{DD} = 1.26V(1 + R1/R2)$.

FB2 (Pin 2): Feedback Pin for Second Switcher. Connect resistor divider 2 here and set V_{ON} using: $V_{ON} = 1.26V(1 + R3/R4) - 160mV$.

C_T (Pin 3): Timing Capacitor Pin. Connect a 10nF capacitor from C_T to ground to program a 2.3ms delay from FB1 reaching 1.26V to V_{ON} turning on.

SW1 (Pin 4): AV_{DD} Switch Node. Connect L1 and D1 here (see Figure 1). Minimize trace area at this pin to keep EMI down.

GND (Pin 5): Ground. Connect directly to local ground plane.

V_{IN} (Pin 6): Input Supply Pin. Must be bypassed with a ceramic capacitor close to the pin.

SW2 (Pin 7): V_{O2} Switch Node. Connect L2 and D2 here. Minimize trace area at this pin to keep EMI down.

$\overline{SHDN}$ (Pin 8): Pull this pin low for shutdown mode. For normal operation, tie to a voltage between 2.4V and 8V.

V_{O2} (Pin 9): SW2 Output. This node is also internally connected to the emitter of Q3 (see Block Diagram), the high side switch between V_{O2} and V_{ON} .

V_{ON} (Pin 10): This is the delayed output for second Switcher. V_{ON} reaches its programmed voltage after the internal timer times out.

Exposed Pad (Pin 11): Ground (MSE package only). The exposed pad must be soldered to the PCB and electrically connected to ground.



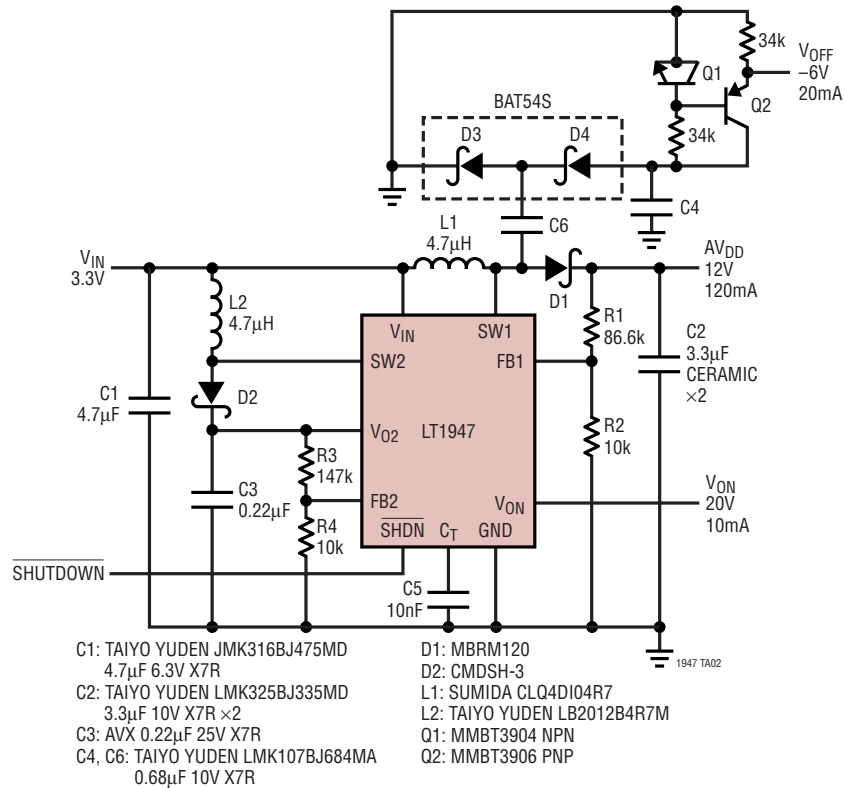
When AV_{DD} is less than its final voltage, Q4 is turned on, holding the C_T pin at ground. When AV_{DD} reaches final value, Q4 lets go of the C_T pin, allowing the $5.5\mu A$ current source to charge the external capacitor, C_T . When the voltage on the C_T pin reaches $1.28V$, Q3 turns on, connecting V_{O2} to V_{ON} . Capacitor value can be calculated using the following formula:

For applications requiring soft-start, a circuit consisting of R_{SS} and C_{SS} tied to the SHDN pin can be used, as shown in Figure 3. For a combination of 33.2k/33nF, AV_{DD} rises to its final value in approximately 3ms.

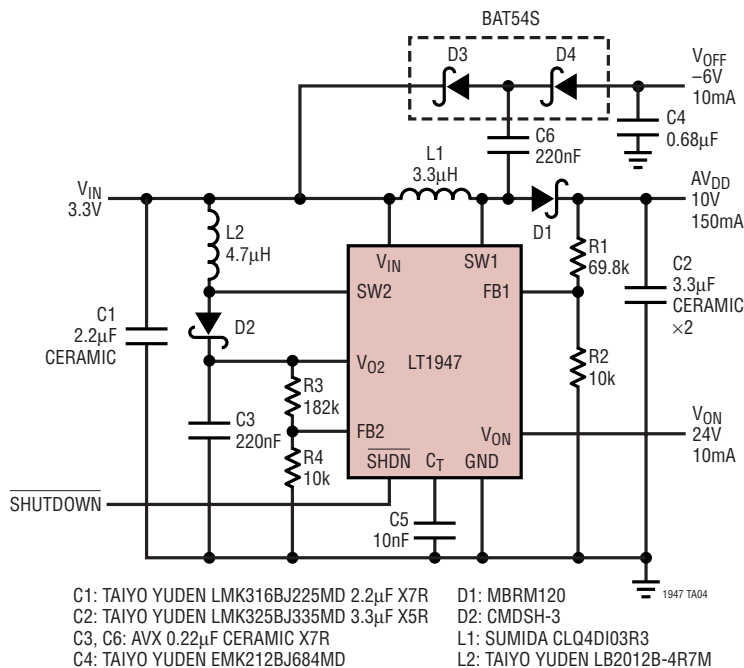


TYPICAL APPLICATIONS

TFT-LCD Bias Generator: 12V, 20V, -6V Output

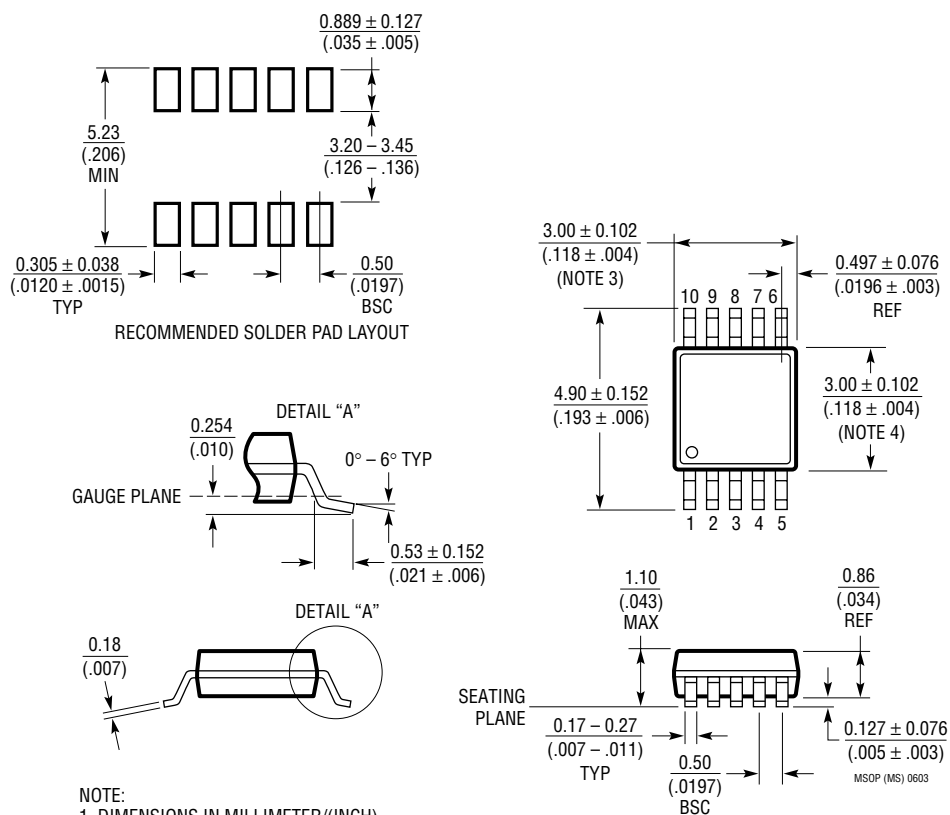


TFT-LCD Bias Generator: 10V, 24V, -6V Output



PACKAGE DESCRIPTION

MS Package 10-Lead Plastic MSOP (Reference LTC DWG # 05-08-1661)

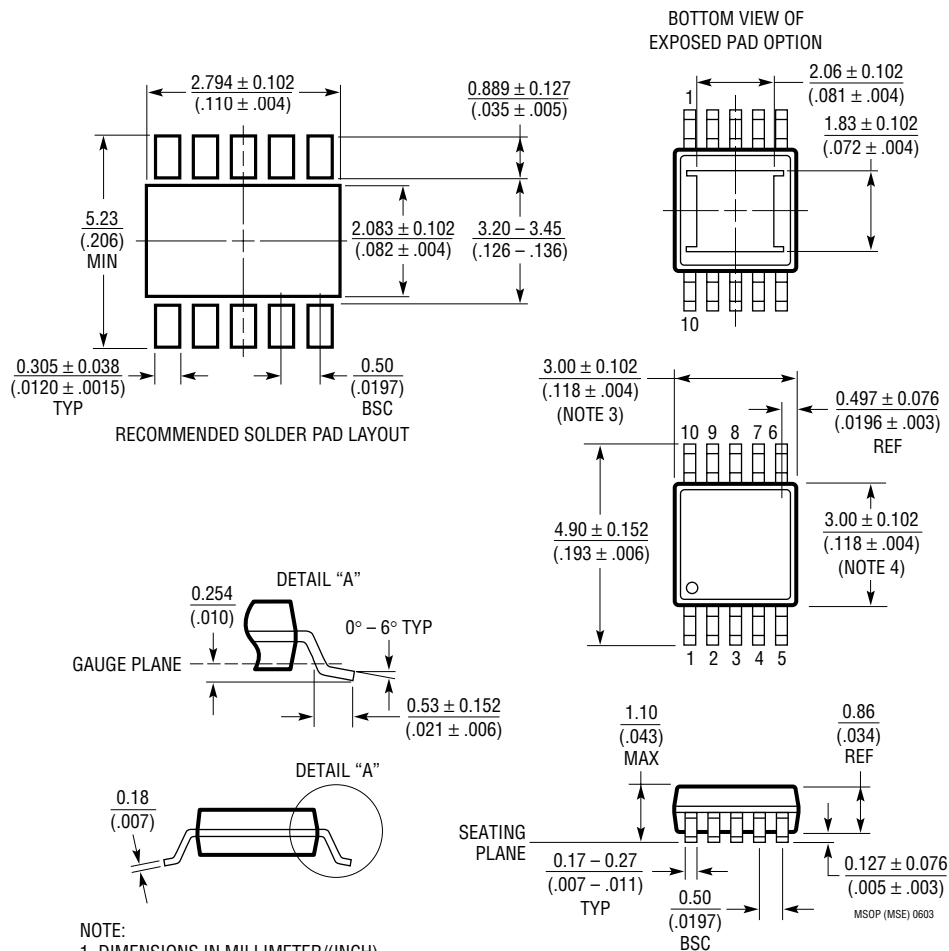


NOTE:

1. DIMENSIONS IN MILLIMETER/(INCH)
2. DRAWING NOT TO SCALE
3. DIMENSION DOES NOT INCLUDE MOLD FLASH, PROTRUSIONS OR GATE BURRS.
MOLD FLASH, PROTRUSIONS OR GATE BURRS SHALL NOT EXCEED 0.152mm (.006") PER SIDE
4. DIMENSION DOES NOT INCLUDE INTERLEAD FLASH OR PROTRUSIONS.
INTERLEAD FLASH OR PROTRUSIONS SHALL NOT EXCEED 0.152mm (.006") PER SIDE
5. LEAD COPLANARITY (BOTTOM OF LEADS AFTER FORMING) SHALL BE 0.102mm (.004") MAX

PACKAGE DESCRIPTION

MSE Package 10-Lead Plastic MSOP (Reference LTC DWG # 05-08-1663)

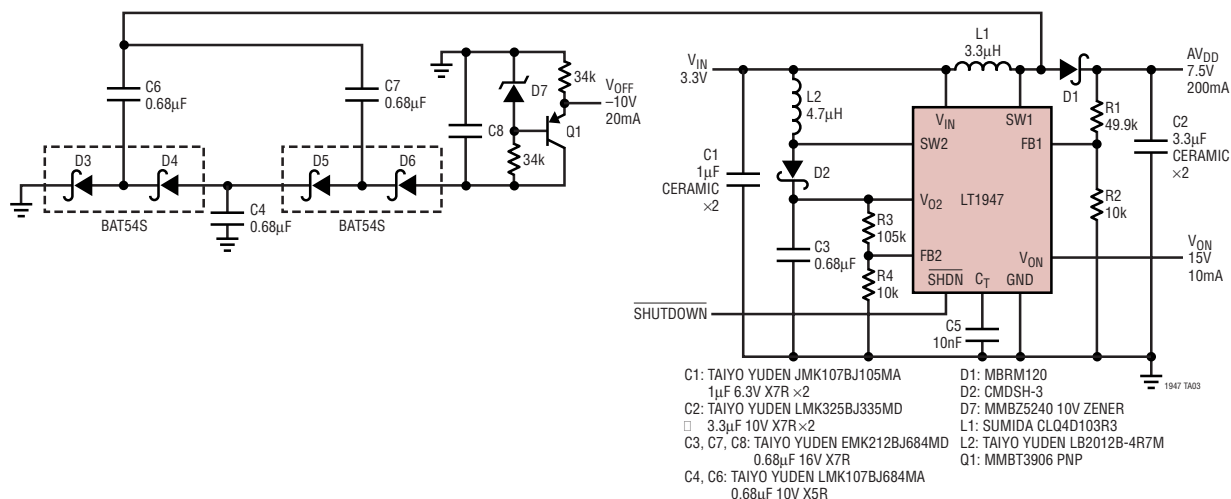


NOTE:

1. DIMENSIONS IN MILLIMETER/(INCH)
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3. DIMENSION DOES NOT INCLUDE MOLD FLASH, PROTRUSIONS OR GATE BURRS.
MOLD FLASH, PROTRUSIONS OR GATE BURRS SHALL NOT EXCEED 0.152mm (.006") PER SIDE
4. DIMENSION DOES NOT INCLUDE INTERLEAD FLASH OR PROTRUSIONS.
INTERLEAD FLASH OR PROTRUSIONS SHALL NOT EXCEED 0.152mm (.006") PER SIDE
5. LEAD COPLANARITY (BOTTOM OF LEADS AFTER FORMING) SHALL BE 0.102mm (.004") MAX

TYPICAL APPLICATION

TFT-LCD Bias Generator: 7.5V, 15V, -10V Output



RELATED PARTS

PART NUMBER	DESCRIPTION	COMMENTS
LT1310	1.5A I_{SW} , 4.5MHz, High Efficiency Step-Up DC/DC Converter	$V_{IN} = 2.75V$ to 18V, V_{OUT} Max = 35V, $I_Q = 12mA$, $I_{SHDN} < 1\mu A$, MS10E
LT1613	550mA I_{SW} , 1.4MHz, High Efficiency Step-Up DC/DC Converter	$V_{IN} = 0.9V$ to 10V, V_{OUT} Max = 34V, $I_Q = 3mA$, $I_{SHDN} < 1\mu A$, ThinSOT
LT1615/LT1615-1	300mA/80mA I_{SW} , Constant Off-Time, High Efficiency Step-Up DC/DC Converter	$V_{IN} = 1.2V$ to 15V, V_{OUT} Max = 34V, $I_Q = 20\mu A$, $I_{SHDN} < 1\mu A$, ThinSOT
LT1940	Dual Output 1.4A I_{OUT} , Constant 1.1MHz, High Efficiency Step-Down DC/DC Converter	$V_{IN} = 3V$ to 25V, V_{OUT} Min = 1.2V, $I_Q = 2.5mA$, $I_{SHDN} < 1\mu A$, TSSOP-16E
LT1944	Dual Output 350mA I_{SW} , Constant Off-Time, High Efficiency Step-Up DC/DC Converter	$V_{IN} = 1.2V$ to 15V, V_{OUT} Max = 34V, $I_Q = 20\mu A$, $I_{SHDN} < 1\mu A$, MS10
LT1944-1	Dual Output 150mA I_{SW} , Constant Off-Time, High Efficiency Step-Up DC/DC Converter	$V_{IN} = 1.2V$ to 15V, V_{OUT} Max = 34V, $I_Q = 20\mu A$, $I_{SHDN} < 1\mu A$, MS10
LT1945	Dual Output, Pos/Neg 350mA I_{SW} , Constant Off-Time, High Efficiency Step-Up DC/DC Converter	$V_{IN} = 1.2V$ to 15V, V_{OUT} Max = $\pm 34V$, $I_Q = 20\mu A$, $I_{SHDN} < 1\mu A$, MS10
LT1946/LT1946A	1.5A I_{SW} , 1.2MHz/2.7MHz, High Efficiency Step-Up DC/DC Converter	$V_{IN} = 2.45V$ to 16V, V_{OUT} Max = 34V, $I_Q = 3.2mA$, $I_{SHDN} < 1\mu A$, MS8
LT1949/LT1949-1	550mA I_{SW} , 600kHz/1.1MHz, High Efficiency Step-Up DC/DC Converter	$V_{IN} = 1.5V$ to 12V, V_{OUT} Max = 28V, $I_Q = 4.5mA$, $I_{SHDN} < 25\mu A$, MS8, S8
LTC3400/LTC3400B	600mA I_{SW} , 1.2MHz, Synchronous Step-Up DC/DC Converter	$V_{IN} = 0.85V$ to 5V, V_{OUT} Max = 5V, $I_Q = 19\mu A/300\mu A$, $I_{SHDN} < 1\mu A$, ThinSOT
LTC3401	1A I_{SW} , 3MHz, Synchronous Step-Up DC/DC Converter	$V_{IN} = 0.5V$ to 5V, V_{OUT} Max = 6V, $I_Q = 38\mu A$, $I_{SHDN} < 1\mu A$, MS10
LTC3402	2A I_{SW} , 3MHz, Synchronous Step-Up DC/DC Converter	$V_{IN} = 0.5V$ to 5V, V_{OUT} Max = 6V, $I_Q = 38\mu A$, $I_{SHDN} < 1\mu A$, MS10
LTC3423	1A I_{SW} , 3MHz, Low V_{OUT} , Synchronous Step-Up DC/DC Converter	$V_{IN} = 0.5V$ to 5V, V_{OUT} Max = 6V, $I_Q = 38\mu A$, $I_{SHDN} < 1\mu A$, MS10
LTC3424	2A I_{SW} , 3MHz, Low V_{OUT} , Synchronous Step-Up DC/DC Converter	$V_{IN} = 0.5V$ to 5V, V_{OUT} Max = 6V, $I_Q = 38\mu A$, $I_{SHDN} < 1\mu A$, MS10

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