LT1948

DC/DC Converter for TFT-LCD Panels

August 2000

OBSOLETE:
FOR INFORMATION PURPOSES ONLY
Contact Linear Technology for Potential Replacement

FEATURES

- **Complete Solution Under 1.2mm**
- Develops Three Outputs from a 3.3V or 5V Supply
- Externally Programmable V_{ON} Delay
- Fixed Frequency Low Noise Outputs
- All Ceramic Capacitors
- Operates at 3MHz Switching Frequency
- Fast Transient Response
- Few External Components Required
- 2.6V to 6V Input Range
- Tiny 8-Lead MSOP Package

APPLICATIONS

- TFT-LCD Notebook Display Panels
- TFT-LCD Desktop Monitor Display Panels
- Digital Cameras
- Handheld Computers

DESCRIPTION

The LT®1948 is a highly integrated multiple output DC/DC converter designed for use in TFT-LCD panels. The device contains two independent switching regulators: the main regulator has an adjustable output voltage with an internal 1.1A switch that can generate a boosted voltage as high as 30V while the second regulator generates 23V at up to 10mA for positive bias. A simple level-shift charge pump off the main switch node generates the negative bias voltage. An external capacitor sets the delay time from AV_{DD} reaching final value to 23V appearing at the V_{ON} pin. The 3MHz switching frequency allows the use of tiny low profile chip inductors and capacitors throughout, providing a low noise, low cost total solution with all components under 1.25mm in height. The device operates from an input range of 2.6V to 6V and is available in an 8-lead MSOP package.

TYPICAL APPLICATION

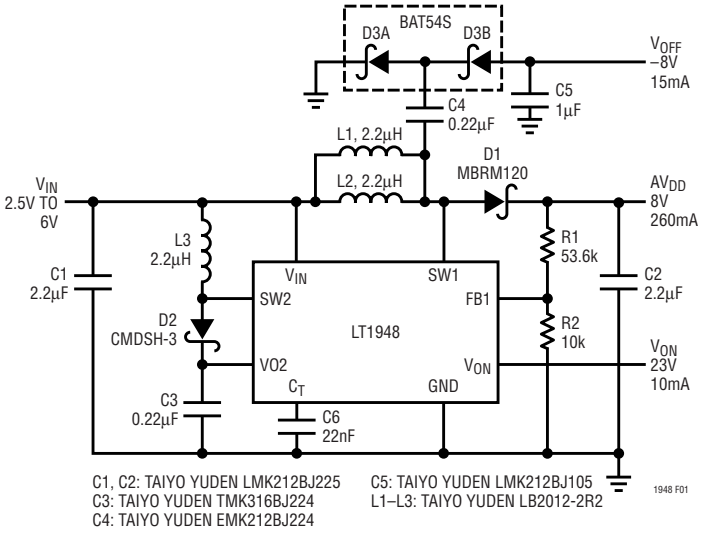
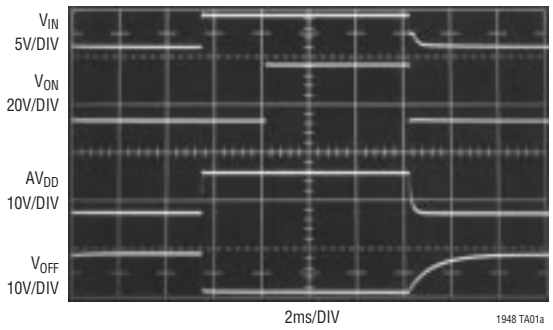


Figure 1. 3.3V Powered TFT-LCD Bias Generator

Start-Up Waveforms

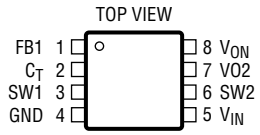


ABSOLUTE MAXIMUM RATINGS

(Note 1)

V_{IN} Voltage 8V
C_T Voltage 6V
SW1, SW2 Voltage 36V
FB Voltage 3V
V_{ON}, VO2 Voltage 30V
Operating Temperature Range (Note 2) .. –40°C to 85°C
Lead Temperature (Soldering, 10 sec) ..... 300°C

PACKAGE/ORDER INFORMATION



MS8 PACKAGE
8-LEAD PLASTIC MSOP

T_{JMAX} = 125°C, θ_{JA} = 200°C/W

ORDER PART NUMBER
LT1948EMS8
MS8 PART MARKING
LTNR

Consult factory for Industrial and Military grade parts.

ELECTRICAL CHARACTERISTICS

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

SYMBOL	CONDITIONS		MIN	TYP	MAX	UNITS
Supply Current	Not Switching			7	13	mA
Reference Voltage				1.26		V
Reference Line Reg	2.7V < V_{IN} < 8V			0.01		%/V
C_T Source Current	V_{FB1} = 1.3V		4.5	5.5	6.5	µA
C_T Voltage to Turn On Q3			1.25	1.28	1.30	V
FB1 Voltage to Begin C_T Charge			1.17	1.20	1.23	V
SW1 Current Limit	(Note 3)		1.2	1.5		A
SW2 Current Limit	(Note 3)		0.5	0.8		A
SW1 Saturation Voltage	I_{SW1} = 800mA			350	410	mV
SW2 Saturation Voltage	I_{SW2} = 300mA			250	300	mV
Oscillator Frequency		●	2.4	3.2	3.6	MHz
Maximum Duty Cycle			70	75	90	%
	0°C ≤ T_A ≤ 85°C	●	69			%
	–40°C ≤ T_A ≤ 0°C	●	67			%
VO2 Pin Resistance	Measured to Ground			400		kΩ
SW1, SW2 Error Amp Gain				100		V/V
SW1, SW2 Error Amp Gm				50		µA/V
FB1 Regulation Voltage			1.240	1.260	1.280	V
		●	1.230		1.285	V
FB1 Line Regulation	2.7V < V_{IN} < 8V			0.01	0.05	
VO2 Regulation Voltage			22	23	24	V
V_{ON} Switch Drop	VO2 = 25V, 7mA Load from V_{ON}, C_T Voltage >1.30V			200	260	mV
SW1 Leakage Current	Switch Off, SW1 Voltage = 3.3V			0.01	5	µA
SW2 Leakage Current	Switch Off, SW2 Voltage = 3.3V			0.01	2	µA

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

Note 2: The LT1948 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: Current limit guaranteed by design and/or correlation to static test.

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).

C_T (Pin 2): Timing Capacitor Pin. Connect a 22nF capacitor from C_T to ground to program a 3ms delay from FB1 reaching 1.26V to V_{ON} turning on.

SW1 (Pin 3): AV_{DD} Switch Node. Connect inductor and D1 here (see Figure 1). Minimize trace area at this pin to keep EMI down.

GND (Pin 4): Ground. Connect directly to local ground plane.

V_{IN} (Pin 5): Input Supply Pin. Must be bypassed with a ceramic capacitor close to the pin.

SW2 (Pin 6): VO2 Switch Node. Connect inductor and D2 here. Minimize trace area at this pin to keep EMI down.

VO2 (Pin 7): Sense Pin for 23V Output. Connect to VO2 output capacitor. This node is also internally connected to the emitter of Q3 (see Block Diagram), the high side switch between VO2 and V_{ON}.

V_{ON} (Pin 8): This is the Delayed 23V Output. V_{ON} becomes 23V after the internal timer times out.

OPERATION

To best understand operation of the LT1948, please refer to the LT1948 Block Diagram. The device contains two switching regulators, a timer and a high side switch. Three outputs can be generated: an adjustable AV_{DD} output, a charge-pumped inversion of the AV_{DD} output, called V_{OFF}, and a 23V/15mA output, called V_{ON}. Q3 keeps V_{ON} off for an externally set time interval, set by a capacitor connected to the C_T pin.

The switching frequency of both switchers is 3MHz, set internally. The switchers are current mode and are internally compensated. The main AV_{DD} switcher is current limited at 1.5A, while the second V_{ON} switcher is limited to 800mA. They share the same 1.26V reference voltage. When the input voltage is below approximately 2.4V, an undervoltage lockout circuit disables switching.

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 5.5µA current source to charge the external capacitor, C_T. When the voltage on the C_T pin reaches 1.25V, Q3 turns on, connecting VO2 to V_{ON}. Capacitor value can be calculated using the following formula:

$$C = (5.5\mu A \bullet t_{DELAY})/1.25V$$

A 22nF capacitor results in approximately 3ms of delay.

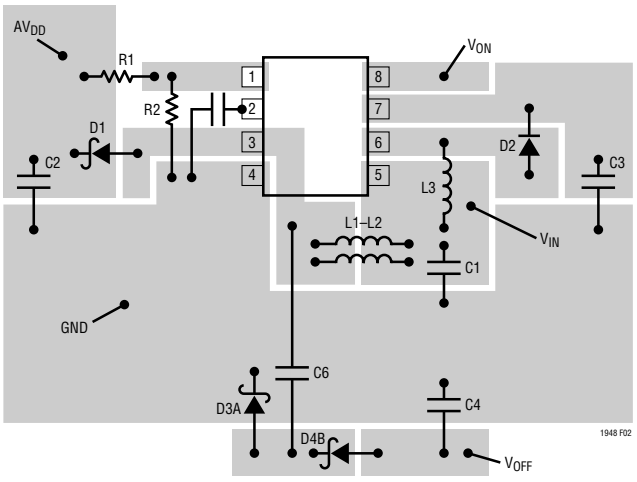
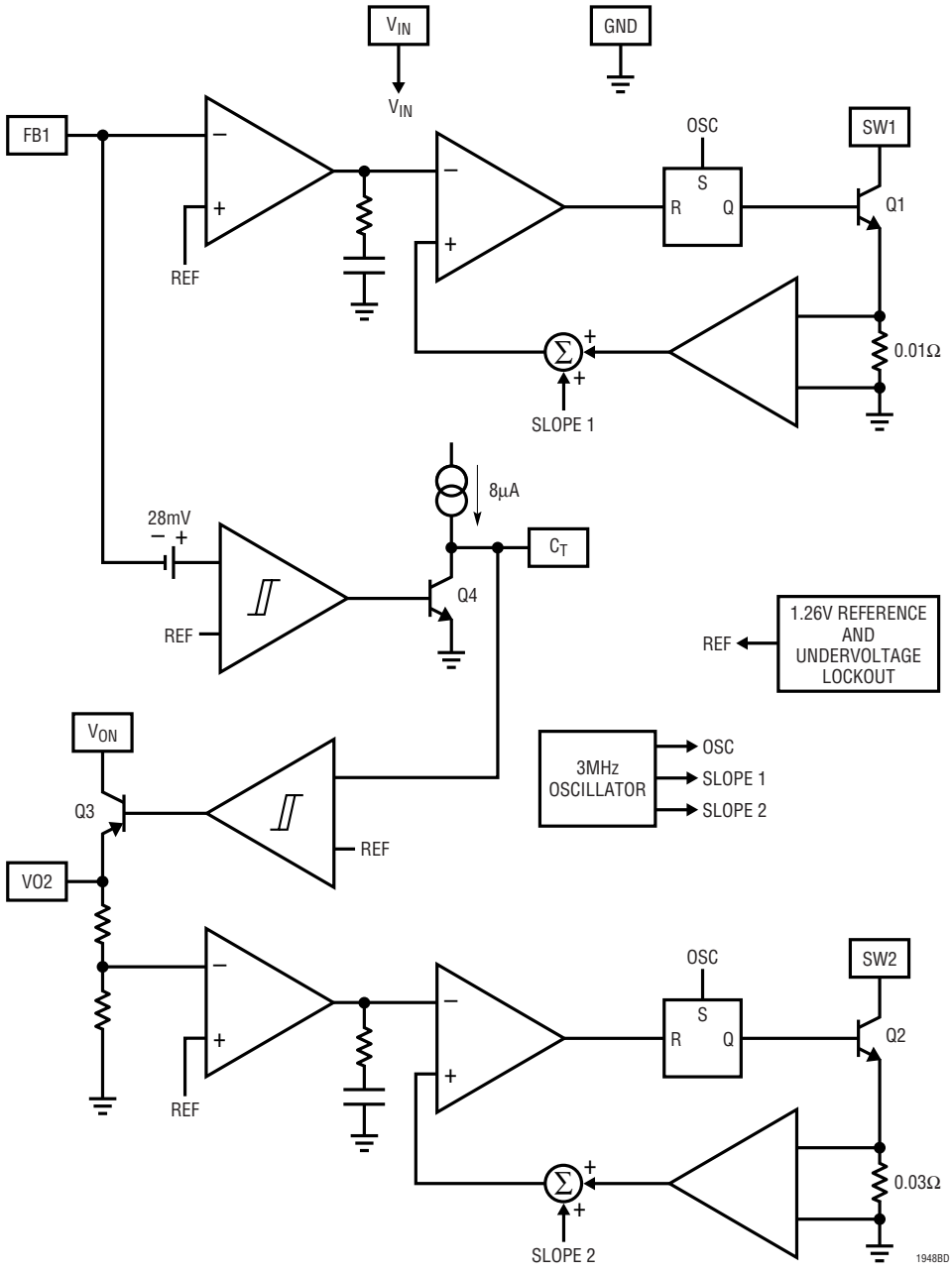


Figure 2. Recommended Component Placement

BLOCK DIAGRAM



RELATED PARTS

PART NUMBER	DESCRIPTION	COMMENTS
LT1949	600kHz, 1A Switch PWM DC/DC Converter	10V at 175mA from 3.3V Input
LT1317	2-Cell Micropower DC/DC with Low-Battery Detect	3.3V at 200mA from 2-Cell Input
LT1308B	600kHz Single Cell Step-Up Regulator	5V at 1A from a 1-Cell Li-Ion Battery
LT1615	Micropower Step-Up Regulator in SOT-23	20V at 12mA from 2.5V Input, 5-Lead SOT-23 Package
LT1930	1.2MHz, Step-Up Regulator in SOT-23	5V at 480mA from 3.3V, 5-Lead SOT-23 Package

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