

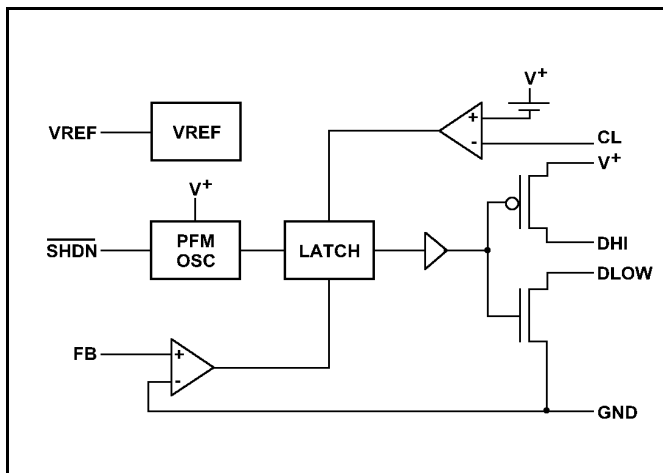
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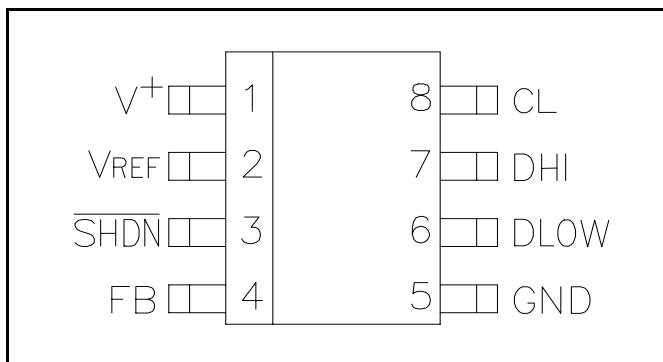
DESCRIPTION

The SC1650 is a high performance inverting DC-DC converter, designed to drive an external power switch to generate programmable negative voltages. In the particularly suitable LCD bias contrast application, maximum efficiency of 90% can be achieved with low cost PNP bipolar transistor drivers. The 4V to 24V input operation range allows the SC1650 to be powered directly by the battery pack in most battery-operated applications for greater efficiency. The output voltage can be scaled to -40V by two external resistors. A pulse frequency modulation scheme is employed to maintain high efficiency conversion under wide input voltage ranges. Quiescent current is about 100 μ A and can be reduced to 8 μ A in shutdown mode. With a switching frequency range of 100kHz to 320kHz, small size switching components may be used, which is ideal for battery powered portable equipment such as notebook and palmtop computers.

BLOCK DIAGRAM



PIN CONFIGURATION



FEATURES

- 4V to 24V input voltage operation
- Adjustable output voltage up to -40V
- Low quiescent current at 100 μ A
- Pulse frequency modulation maintains high efficiency (max 90%)
- 100kHz to 320kHz switching frequency
- Power-Saving shutdown mode (8 μ A typical)
- High efficiency with low cost external PNP bipolar transistor

APPLICATIONS

- Negative LCD contrast bias for
 1. Notebook & palmtop computers
 2. Pen-based data systems
 3. Portable data collection terminals
 4. Personal digital assistants
- Negative voltage supplies

ORDERING INFORMATION

DEVICE ⁽¹⁾	V _{OUT}	PACKAGE
SC1650CS	Adj	SO-8

Note:

(1) Add suffix 'TR' for tape and reel.

ABSOLUTE MAXIMUM RATINGS

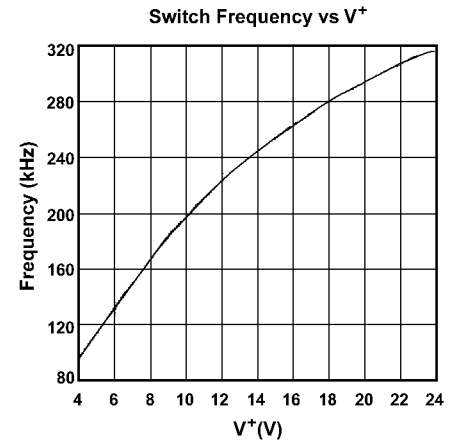
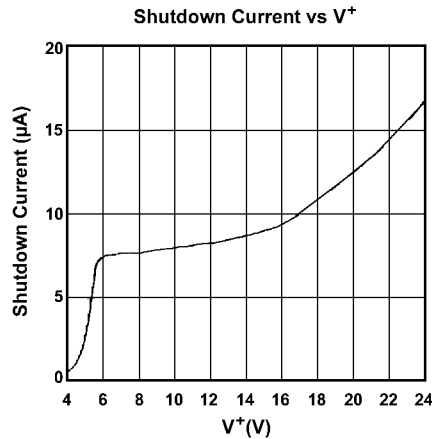
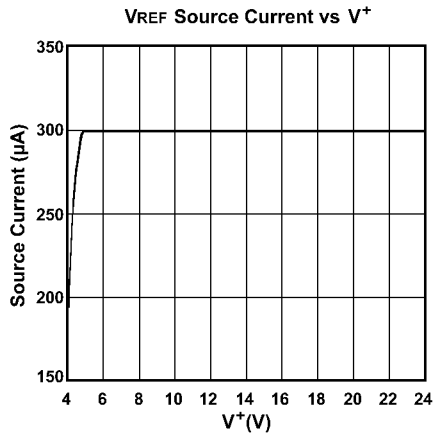
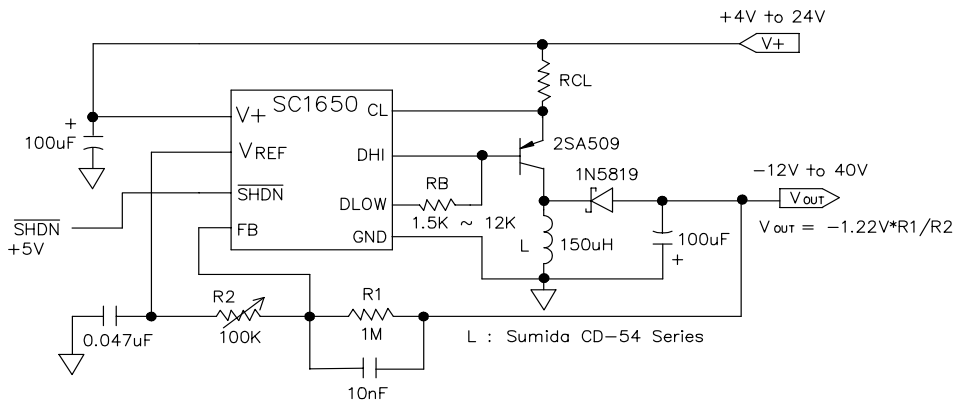
Parameter	Symbol	Maximum	Units
Supply Voltage	V ⁺	24	V
SHDN Voltage	V _{SHDN}	15	V
Operating Temperature Range	T _A	0 to 70	°C
Storage Temperature Range	T _{STG}	-65 to 125	°C

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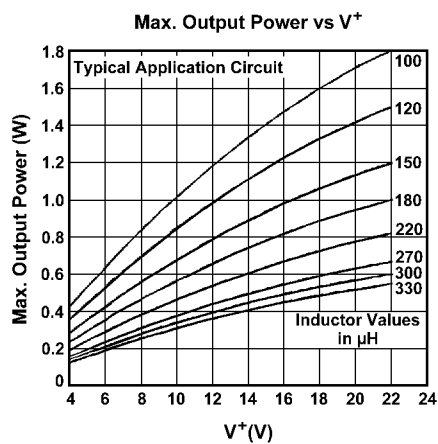
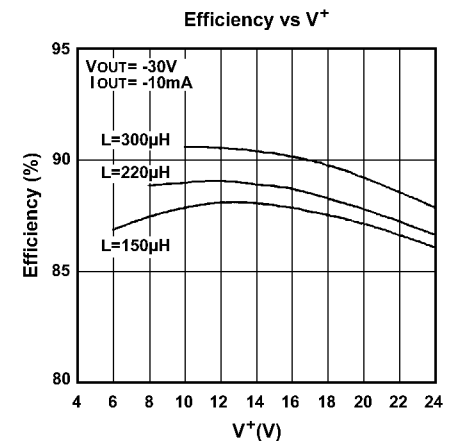
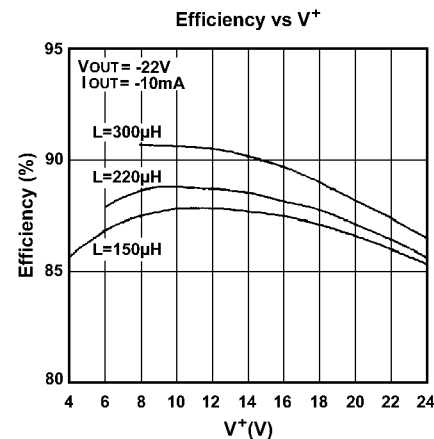
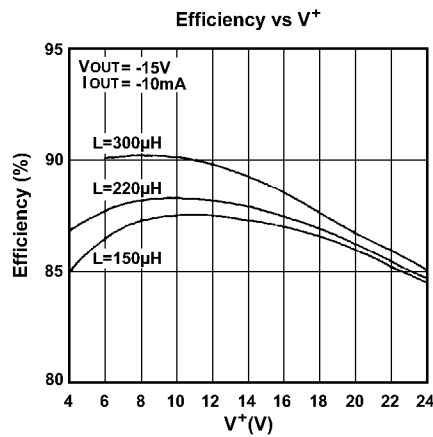
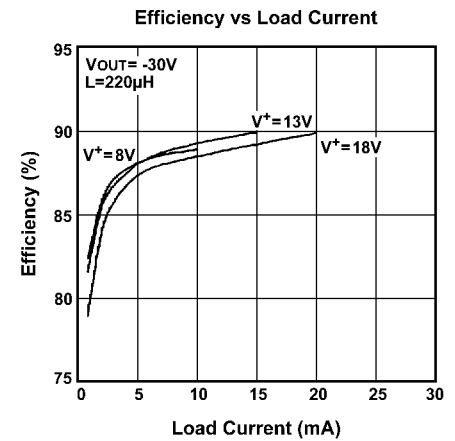
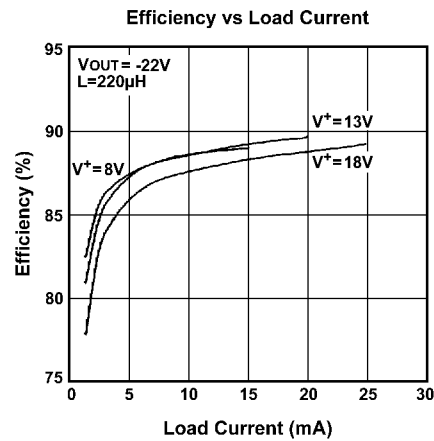
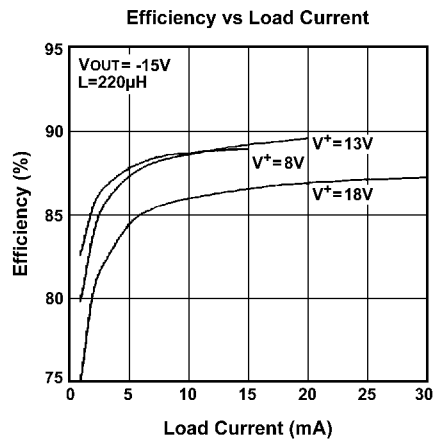
ELECTRICAL CHARACTERISTICS

 Unless otherwise specified, $T_A = 25^\circ\text{C}$, $V^+ = 13\text{V}$

Parameter	Test Conditions	Test Limits			Units
		Min	Typ	Max	
Input Voltage		4		24	V
Switch Off Current	$V_{FB} = -50\text{mV}$		100	200	μA
Shutdown Mode Current			8	20	μA
V_{REF} Voltage	$I_{SOURCE} = 250\mu\text{A}$	1.16	1.22	1.28	V
V_{REF} Source Current		250			μA
DLOW "ON Resistance"			15		Ω
DHI "ON Resistance"			10		Ω
CL Threshold		45	60	75	mV
Shutdown Threshold		0.8	1.5	2.4	V

TYPICAL PERFORMANCE CHARACTERISTICS

TYPICAL APPLICATION CIRCUIT


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TYPICAL APPLICATION INFORMATION


The typical application circuit generates an adjustable negative voltage for contrast bias of LCD displays. Efficiency and output power can be optimized by using the appropriate inductor and switch. The following formulas provide a guideline for determining the optimal component val-

$$L = (11.1 - 0.15 \times V^+) \times \frac{V^+}{|I_{OUT}| \times |V_{OUT}|}$$

$$\text{PNP} : |V_{CEO}| > V^+ + |V_{OUT}|$$

$$|I_{C(MAX)}| \geq 200 \times \frac{|I_{OUT}|}{V^+}$$

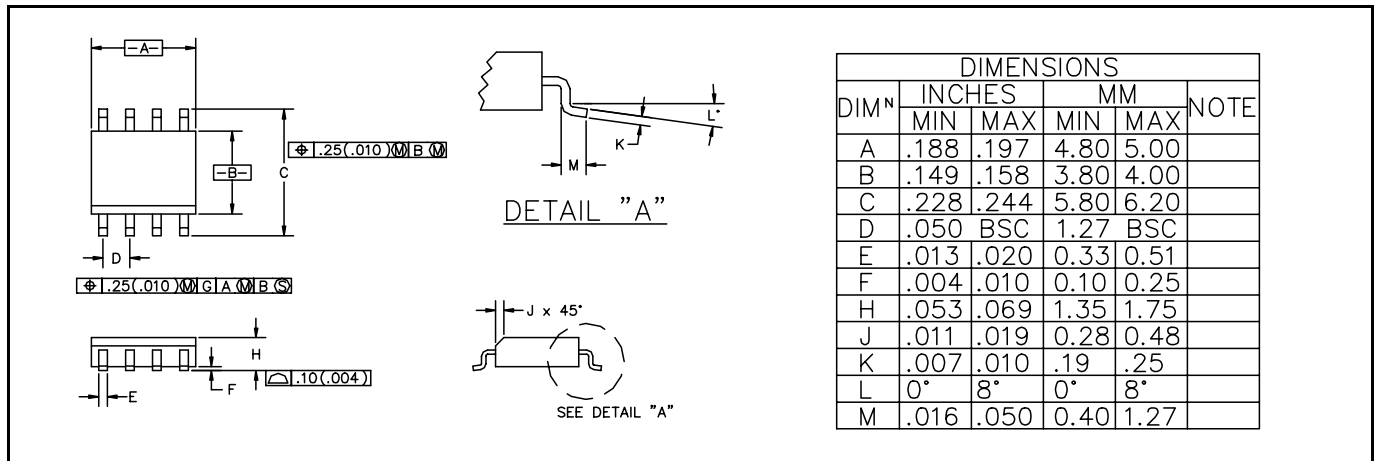
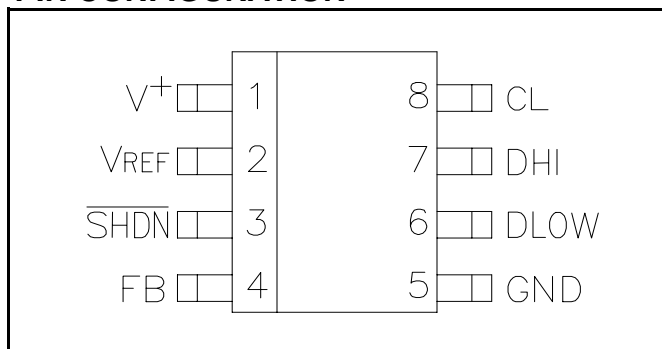
$$|V_{CE(SAT)}| < 0.4V \text{ at } I_C = 200 \times \frac{I_{OUT}}{V^+} \text{ and } \beta = 10$$

$$R_B \cong 3 \times L \times (V^+ - 0.8), \text{ where units : } V^+ \text{ in Volt, } V_{OUT} \text{ in Volt,}$$

$$I_{OUT} \text{ in Ampere, } L \text{ in } \mu\text{H,}$$

$$R_B \text{ in Ohm.}$$

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OUTLINE DRAWING - SO-8

PIN CONFIGURATION

PIN DESCRIPTIONS

- PIN 1: V⁺** 4V to 24V input supply voltage.
- PIN 2: V_{REF}** 1.22V reference output. Bypass with a 0.047μF capacitor to GND. Sourcing capability is guaranteed to be greater than 250μA.
- PIN 3: SHDN** Logic input to shutdown the chip.
 >1.5V = normal operation,
 GND = shutdown
 In shutdown mode DLOW and DHI pins are high.
- PIN 4: FB** Feedback signal input to comparator. Connecting a resistance R1 to V_{OUT} and a resistance R2 to V_{REF} yields the output voltage:
- $$V_{OUT} = - \frac{R1}{R2} * V_{REF}$$
- PIN 5: GND** Power ground.

- PIN 6: DLOW** Driver sinking output. Connected to DHI when using an external P-channel MOSFET. When using an external PNP bipolar transistor, connect a resistor R_B from this pin to DHI. R_B value depends upon V⁺, inductor value and the PNP bipolar transistor. By adjusting the R_B value, efficiency can be optimized.
- PIN 7: DHI** Driver sourcing output. Connect to the gate of the external P-channel MOSFET or base of the PNP bipolar transistor.
- PIN 8: CL** Current-limit input. This pin clamps the switch peak current under abnormal conditions.