MICROPOWER INVERTING DC-DC CONVERTER

SC1652

January 29, 1998

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DESCRIPTION

The SC1652 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, efficiency of 87% can be achieved with low cost PNP bipolar transistor drivers. 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 80µA and can be reduced to 0.7µA in shutdown mode. With a switching frequency range of 70kHz to 160kHz, small size switching components may be used, which is ideal for battery powered portable equipment such as notebook and palmtop computers.

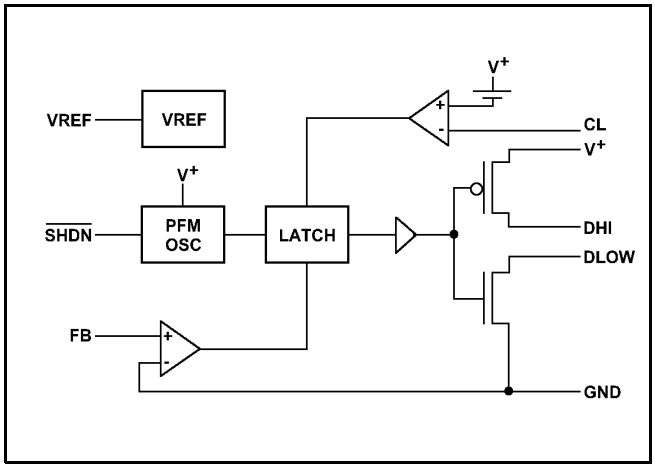
FEATURES

- 2.4V to 7V input voltage operation
- Adjustable output voltage up to -40V
- Low quiescent current at 80µA
- Pulse frequency modulation maintains high efficiency (max 87%)
- 70kHz to 160kHz switching frequency
- Power-saving shutdown mode (0.7µA 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

BLOCK DIAGRAM

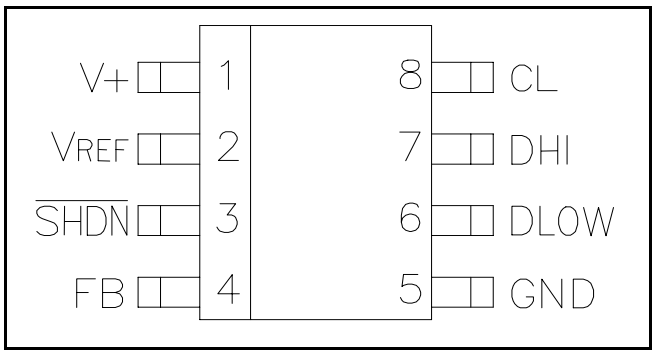


ORDERING INFORMATION

DEVICE(1)	V_{OUT}	PACKAGE
SC1652CS	Adj	SO-8

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

PIN CONFIGURATION



ABSOLUTE MAXIMUM RATINGS

Parameter	Symbol	Maximum	Units
Supply Voltage	V^+	7.0	V
Operating Temperature Range	T_A	0 to 70	°C
Storage Temperature Range	T_{STG}	-65 to 125	°C

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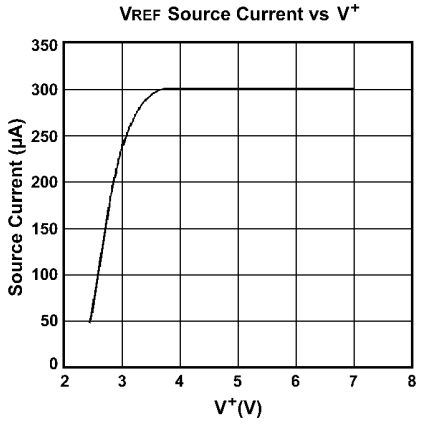
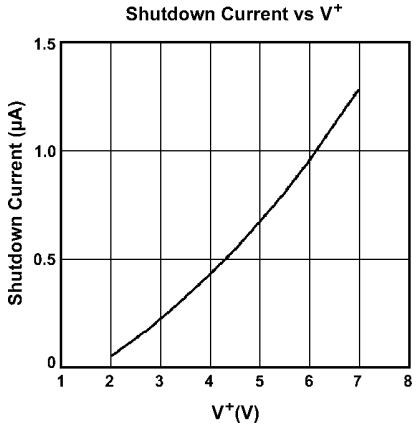
ELECTRICAL CHARACTERISTICS

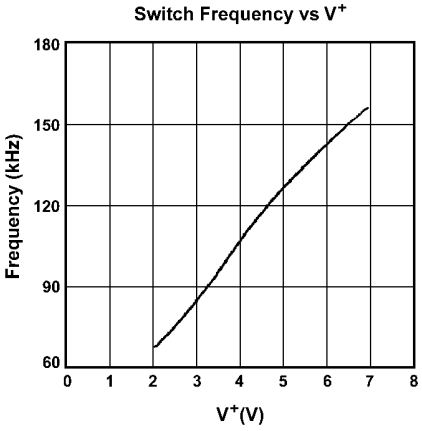
Unless otherwise specified, T_A = 25°C, V^+ = 5V

	Test Conditions	Test Limits			
Parameter		**Min**	**Typ**	**Max**	**Units**
Input Voltage		2.4		7	V
Switch Off Current			80	150	µA
Shutdown Mode Current			0.7	2	µA
V_{REF} Voltage	I_{SOURCE}=250µA	1.16	1.22	1.28	V
V_{REF} Source Current		250			µA
DLOW "ON Resistance"			5		Ω
DHI "ON Resisance"			7		Ω
CL Threshold		45	60	75	mV
Shutdown Threshold		0.8	1.5	2.4	V

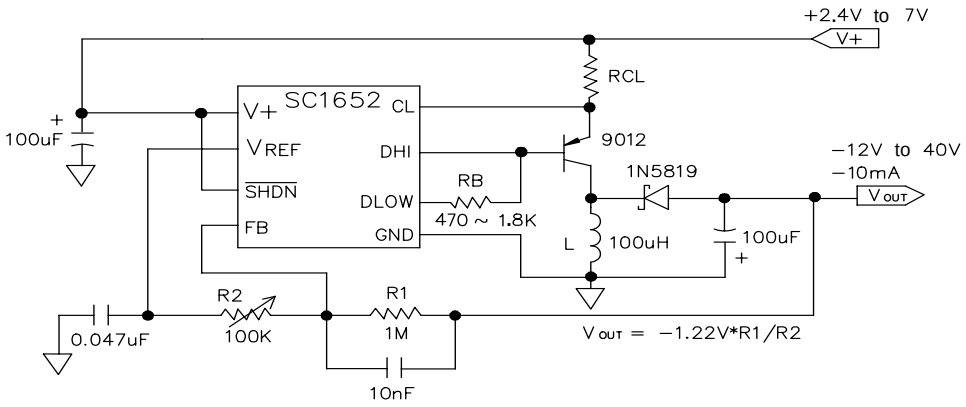
TYPICAL PERFORMANCE CHARACTERISTICS







TYPICAL APPLICATION CIRCUIT



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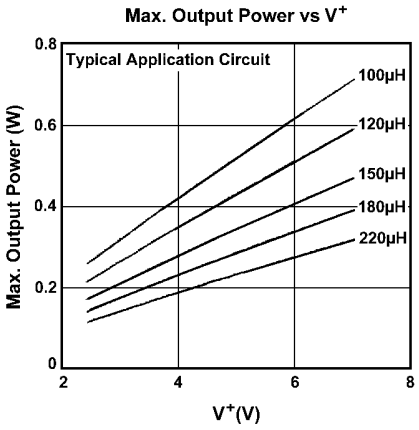
TYPICAL APPLICATION INFORMATION



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 values:

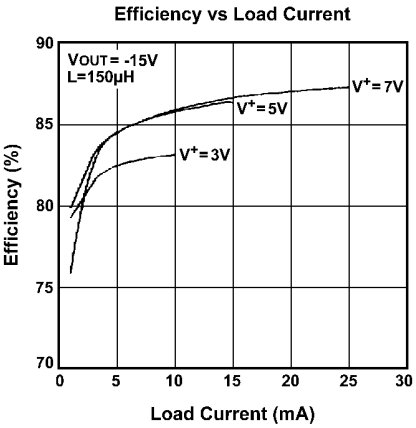
$$L = (11.1 - 0.15 \times V^+) \times \frac{V^+}{|I_{OUT}| \times |V_{OUT}|}$$

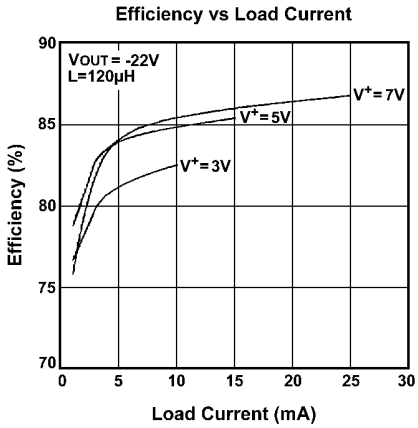
PNP : $|V_{CEO}| > V^+ + |V_{OUT}|$

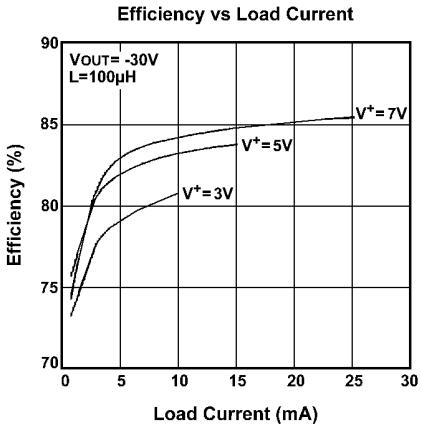
$$|I_{C(MAX)}| \geq 200 \times \frac{|I_{OUT}|}{V^+}$$

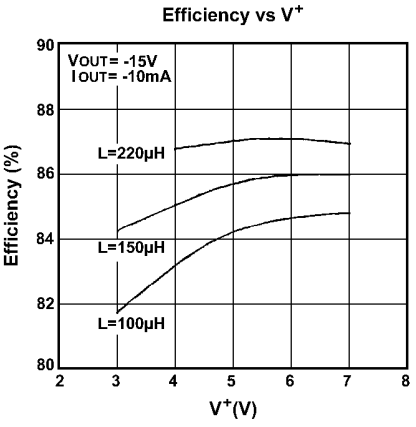
$$|V_{CE(SAT)}| < 0.4V \text{ at } I_C = 200 \times \frac{I_{OUT}}{V^+} \text{ and } \beta = 10$$

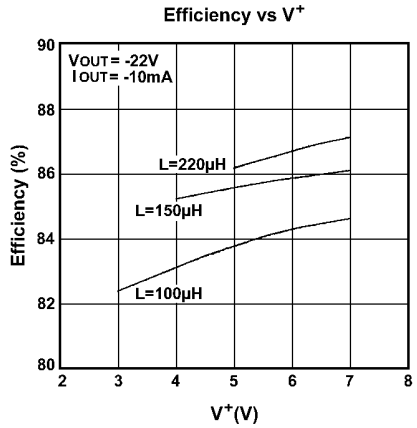
$R_B \cong 3 \times L \times (V^+ - 0.8)$, where units : V^+ in Volt, V_{OUT} in Volt, I_{OUT} in Ampere, L in µH, R_B in Ohm.

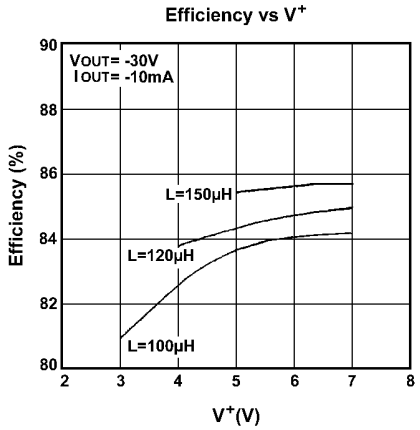












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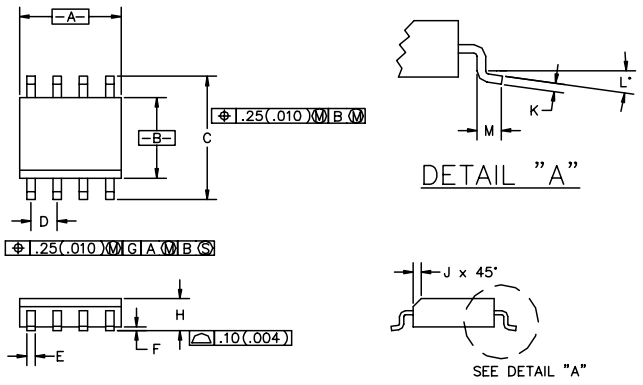
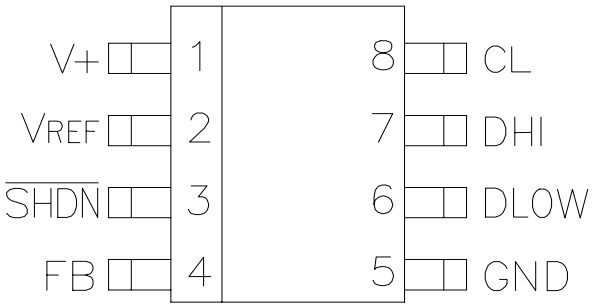
OUTLINE DRAWING SO-8



DIMENSIONS					
DIM	INCHES		MM		NOTE
	MIN	MAX	MIN	MAX	
A	.188	.197	4.80	5.00	
B	.149	.158	3.80	4.00	
C	.228	.244	5.80	6.20	
D	.050	BSC	1.27	BSC	
E	.013	.020	0.33	0.51	
F	.004	.010	0.10	0.25	
H	.053	.069	1.35	1.75	
J	.011	.019	0.28	0.48	
K	.007	.010	.19	.25	
L	0°	8°	0°	8°	
M	.016	.050	0.40	1.27	

PIN CONFIGURATION



PIN DESCRIPTIONS

PIN 1: V^+ 2.4V to 7V 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:

$$V_{OUT} = -\frac{R1}{R2} \times V_{REF}$$

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.