Micro-Power Inverting DC/DC Controller

■ 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 (87%).
- 70KHz to 160KHz switching frequency.
- Power-saving shutdown mode (0.7μA typical).
- High efficiency with low cost external P-channel MOSFET or PNP bipolar transistor.
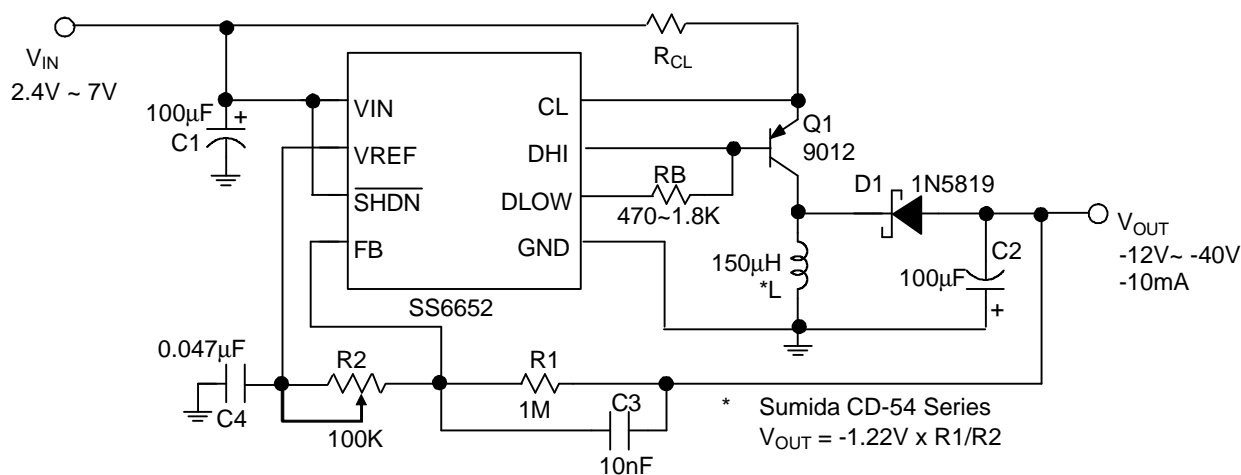
■ APPLICATIONS

- Negative LCD Contrast Bias for
  1. Notebook & Palmtop Computers.
  2. Pen-Based Data System.
  3. Portable Data Collection Terminals.
  4. Personal Digital Assistants.
- Negative Voltage Supply.

■ DESCRIPTION

The SS6652 is a high-performance inverting DC/DC controller, designed to drive an external power switch to generate programmable negative voltages, and is particularly suited to LCD bias contrast applications. Efficiency of 87% can be achieved with low cost PNP bipolar transistor drivers. Output voltage can be scaled to -40V or greater by two external resistors. A pulse frequency modulation scheme is employed to maintain high-efficiency conversion over a wide input voltage range. Quiescent current is about 80μA and can be reduced to 0.7μA in shutdown mode. With switching frequencies in the 70KHz to 160KHz range, the small size switching components are ideal for battery powered portable equipment, like notebook and palmtop computers.

■ TYPICAL APPLICATION CIRCUIT

Negative LCD Contrast Bias Power Supply

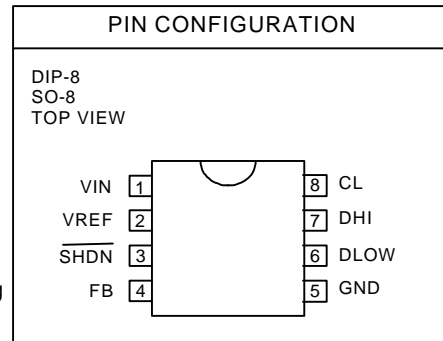$V_{OUT} = -1.22V \times R1/R2$

■ ORDERING INFORMATION

SS6652CXXX

└─ PACKING TYPE
TR: TAPE & REEL
TB: TUBE

└─ PACKAGE TYPE
N: PLASTIC DIP
S: SMALL OUTLINE

EX: SS6652CSTR

→ in SO-8 Package in Tape & Reel Packing
(CN is not available in TR packing type.)

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PIN CONFIGURATION

DIP-8
SO-8
TOP VIEW

VIN   [1]          [8]  CL
VREF  [2]          [7]  DHI
SHDN  [3]          [6]  DLOW
FB    [4]          [5]  GND
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■ ABSOLUTE MAXIMUM RATINGS

Supply Voltage ....……….............. 7V

$\overline{\text{SHDN}}$ Voltage ....…….................. 7V

Operation Temperature Range ....……….......................... 0°C~70°C

Storage Temperature Range ....………............... -65°C~ 150°C

■ TEST CIRCUIT

Refer to Typical Application Circuit.

■ ELECTRICAL CHARACTERISTICS (V$_{IN}$=5V, Ta=25°C, unless otherwise specified.)

PARAMETER	TEST CONDITIONS	MIN.	TYP.	MAX.	UNIT
Input Voltage		2.4		7	V
Switch Off Current	V$_{FB}$=-50mV		80	150	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 Resistance"			7		Ω
CL Threshold			70		mV
Shutdown Threshold		0.8	1.5	2.4	V
Shutdown Mode Current	V$\overline{\text{SHDN}}$ = 0V		0.7	2	μA

■ TYPICAL PERFORMANCE CHARACTERISTICS
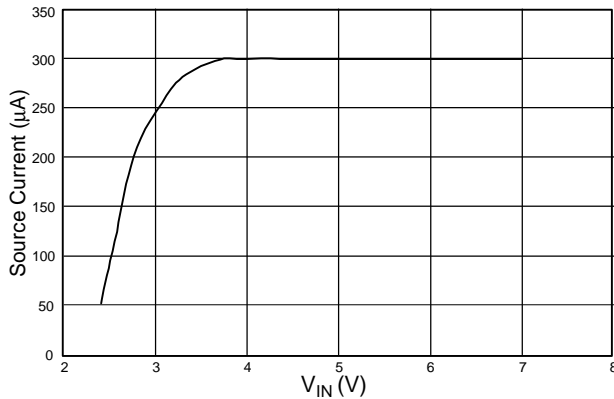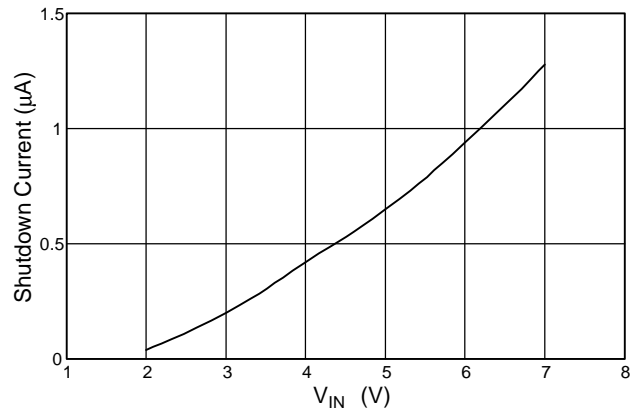
Fig. 1 V_{REF} Source Current vs. V_{IN}
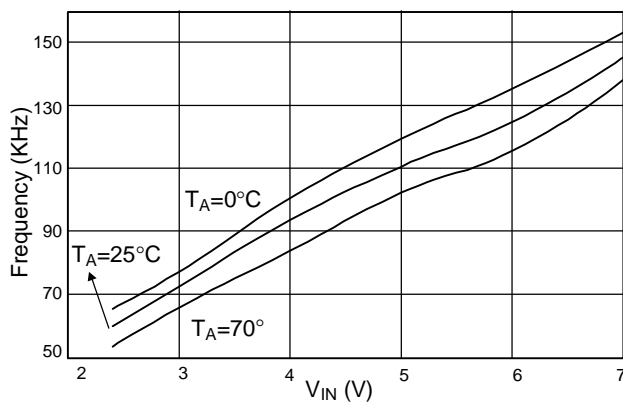
Fig. 2   Shutdown Current vs. V_{IN}

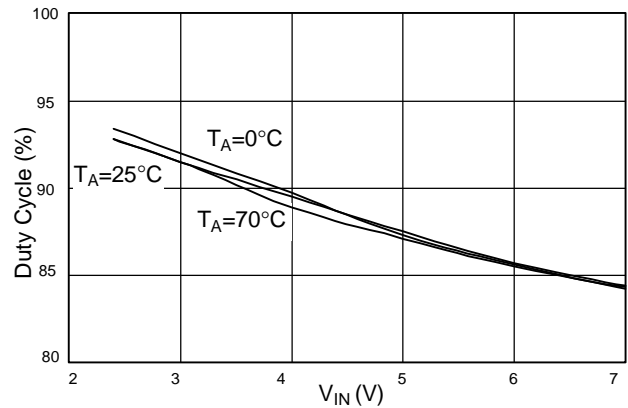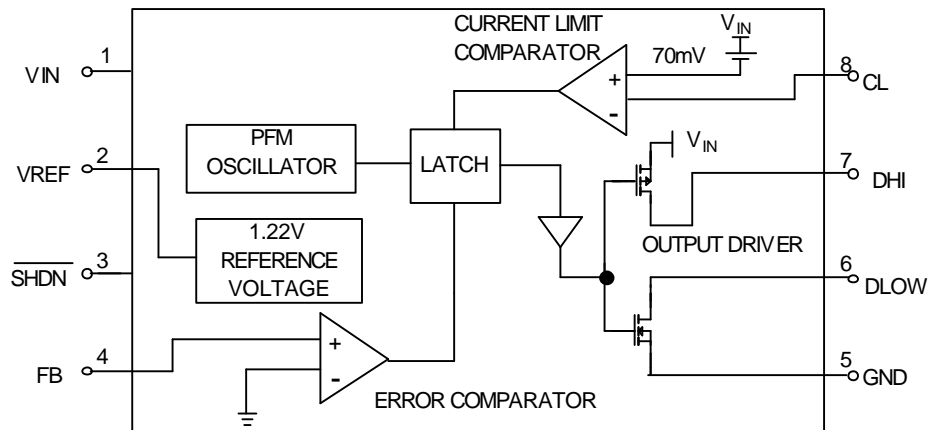Fig. 3   Frequency vs. V_{IN} Voltage

Fig. 4   Duty Cycle vs. V_{IN} Voltage

■ BLOCK DIAGRAM

■ PIN DESCRIPTIONS

PIN 1: VIN - Input supply voltage (2.4V~7V)

PIN 2: VREF - Reference output (1.22V). Bypass with a 0.047µF capacitor to GND. Sourcing capability is guaranteed to be greater than 250µA.

PIN 3: $\overline{SHDN}$ - Logic input to shutdown the chip.
>1.5V = normal operation,
GND = shutdown
In shutdown mode DLOW and DHI pins are at high level.

PIN 4: FB - Feedback signal input to sense ground. Connecting a resistor R1 to V_{OUT} and a resistor R2 to V_{REF} pin yields the output voltage:

$$V_{OUT} = - (R1/R2) \times V_{REF}$$

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 RB from this pin to DHI. RB value depends on V_{IN}, inductor and PNP bipolar transistor. By adjusting the RB value, efficiency can be optimized.

PIN 7: DHI - Driver sourcing output. Connect to 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 to prevent over-current damage to the external switch.

■ APPLICATION INFORMATION

Max. Output Power vs V_{IN}

Typical Application Circuit

100µH
120µH
150µH
180µH
220µH
Inductor Value

Max. Output Power (W)

V_{IN} (V)

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

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

PNP : $|V_{CEO}| > V_{IN} + |V_{OUT}|$

$$|I_{C,MAX}| \geq 200 \times \frac{|I_{OUT}|}{V_{IN}}$$

$$|V_{CE}| < 0.4V \text{ at } I_C = 200 \times \frac{I_{OUT}}{V_{IN}}$$

and $b = 10$

$$RB \cong 3 \times L \times (V_{IN} - 0.8)$$

where, $V_{IN}(V)$, $V_{OUT}(V)$, $I_{OUT}(A)$, $L(\mu H)$, $RB(\Omega)$
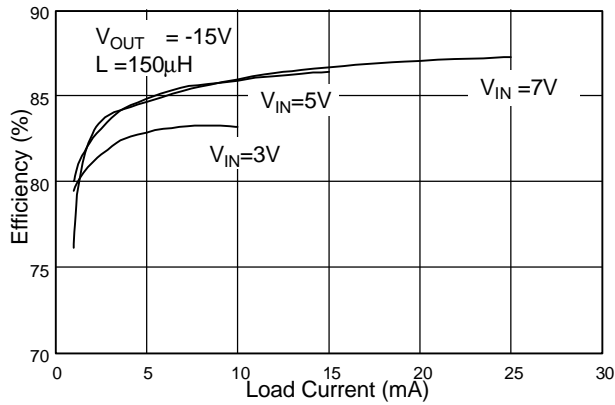
■ APPLICATION CIRCUIT (Refer to TYPICAL APPLICATION CIRCUIT)
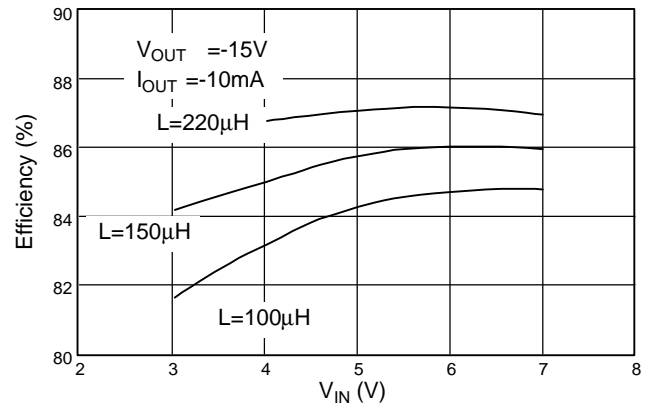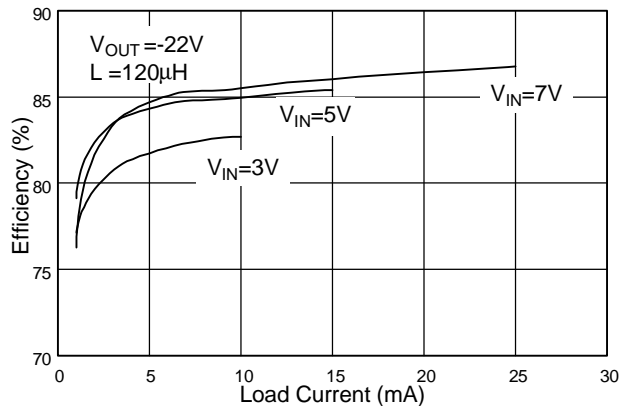

Fig. 5   Efficiency vs. Load Current

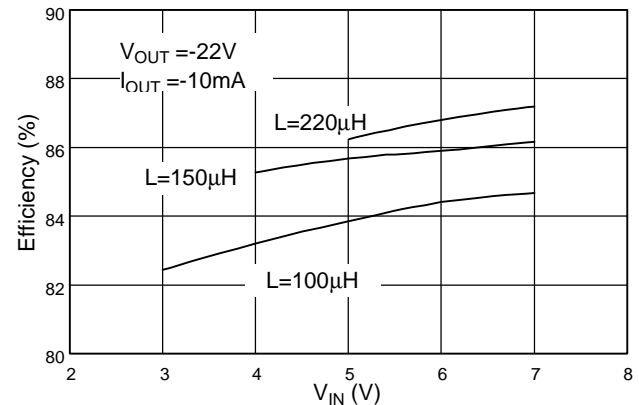Fig. 6   Efficiency vs. V_{IN}
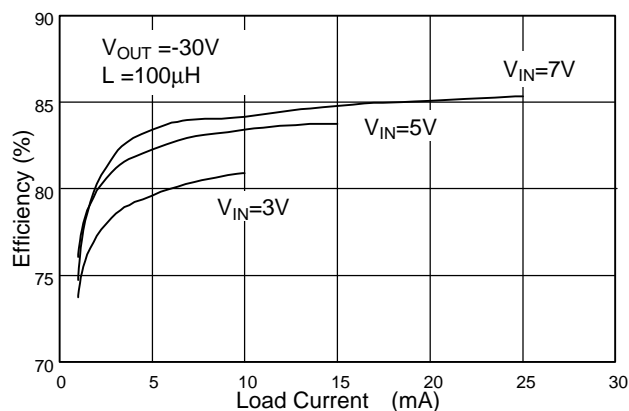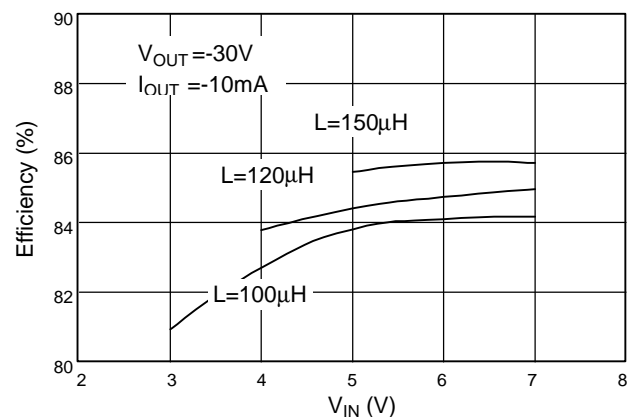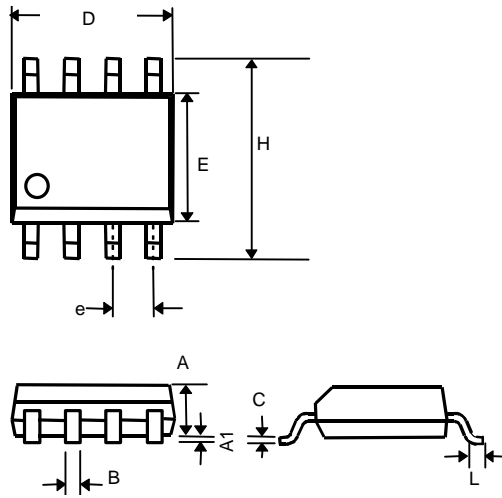

Fig. 7   Efficiency vs. Load Current

Fig. 8   Efficiency vs. V_{IN}

Fig. 9   Efficiency vs. Load Current

Fig. 10   Efficiency vs. V_{IN}

PHYSICAL DIMENSIONS

- **8 LEAD PLASTIC SO (unit: mm)**

SYMBOL	MIN	MAX
A	1.35	1.75
A1	0.10	0.25
B	0.33	0.51
C	0.19	0.25
D	4.80	5.00
E	3.80	4.00
e	1.27(TYP)	
H	5.80	6.20
L	0.40	1.27

- **8 LEAD PLASTIC DIP (unit: mm)**

SYMBOL	MIN	MAX
A1	0.381	—
A2	2.92	4.96
b	0.35	0.56
C	0.20	0.36
D	9.01	10.16
E	7.62	8.26
E1	6.09	7.12
e	2.54 (TYP)	
eB	—	10.92
L	2.92	3.81