

## Versatile DC/DC Converter

### FEATURES

- 3V to 30V Input Voltage Operation.
- Internal 2A Peak Current Switch.
- 1.5A Continuous Output Current.
- Bootstrapped Driver.
- High Side Current Sense Capability.
- High Efficiency (up to 90%).
- Internal  $\pm 2\%$  Reference.
- Low Quiescent Current at 1.6mA.
- Frequency Operation from 100Hz to 100KHz.

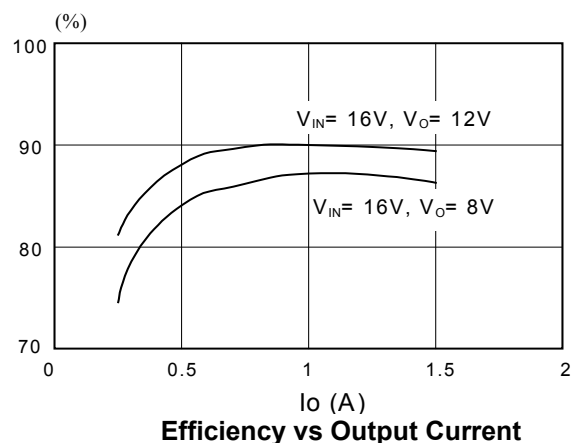
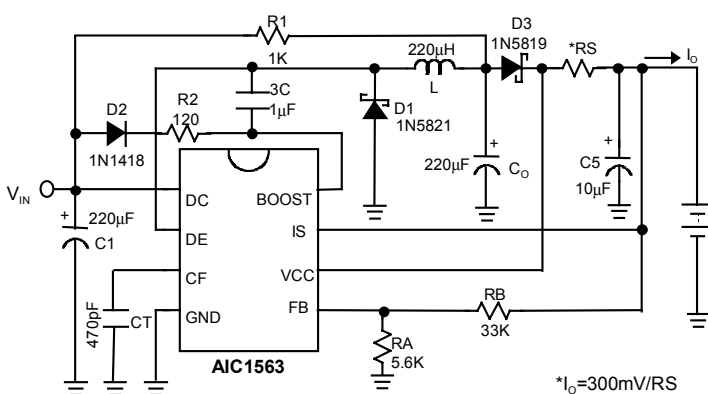
### APPLICATIONS

- Constant Current Source for Battery Chargers.
- Saver for Cellular phones.
- Step-Down DC-DC Converter Module.

### DESCRIPTION

The AIC1563 is a monolithic control circuit containing the primary functions required for DC to DC converters and highside-sensed constant current source. The device consists of an internal temperature compensated reference, comparator, controlled duty cycle oscillator with an active current sense circuit, bootstrapped driver, and high current output switch. This device is specifically designed to construct a constant current source for battery chargers with a minimum number of external components. Bootstrapped driver can drive the NPN output switch to saturation for higher efficiency and less heat dissipation. The AIC1563 can deliver 1.5A continuous current without requiring a heat sink.

### TYPICAL APPLICATION CIRCUIT

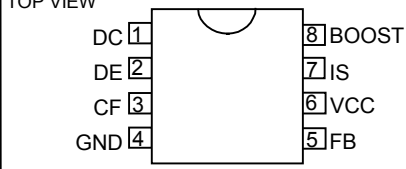


## ORDERING INFORMATION

AIC1563 XX

PACKAGE TYPE  
 N: PLASTIC DIP  
 S: SMALL OUTLINE

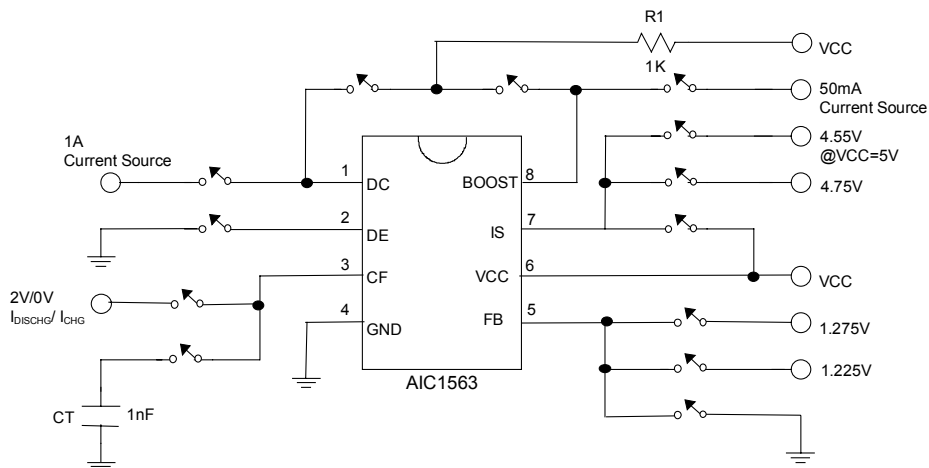
TEMPERATURE  
 C: 0°C~+70°C

| ORDER NUMBER               | PIN CONFIGURATION   |
|----------------------------|---|
| AIC1563CN<br>(PLASTIC DIP) | TOP VIEW<br> |
| AIC1563CS<br>(PLASTIC SO)  |   |

## ABSOLUTE MAXIMUM RATINGS

|   |                |
|---|----------------|
| Supply Voltage                                | 30V            |
| Comparator Input Voltage Range                | -0.3V~30V      |
| Switch Collector Voltage                      | 30V            |
| Switch Emitter Voltage                        | 30V            |
| Switch Collector to Emitter Voltage           | 30V            |
| Driver Collector Voltage                      | 30V            |
| Switch Current                                | 2A             |
| Power Dissipation and Thermal Characteristics |                |
| <b>DIP Package</b>                            |                |
| Ta= 25°C                                      | 1.0W           |
| Thermal Resistance                            | 100°C/W        |
| <b>SO Package</b>                             |                |
| Ta= 25°C                                      | 625mW          |
| Thermal Resistance                            | 160°C/W        |
| Operating Junction Temperature                | 125°C          |
| Operating Ambient Temperature Range           | 0~70°C         |
| Storage Temperature Range                     | - 65°C ~ 150°C |

## TEST CIRCUIT

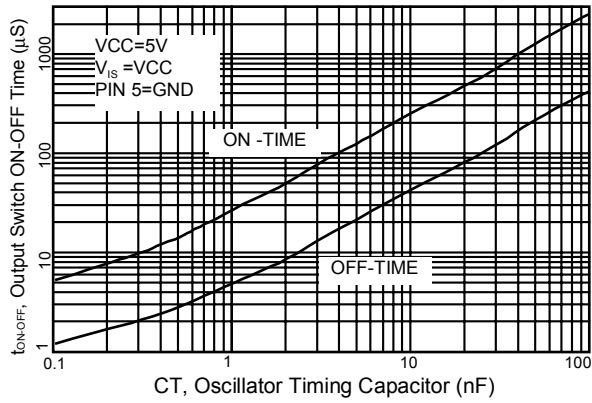


**ELECTRICAL CHARACTERISTICS** ( $V_{CC}=5V$ ,  $T_a=25^{\circ}C$ , unless otherwise specified.)

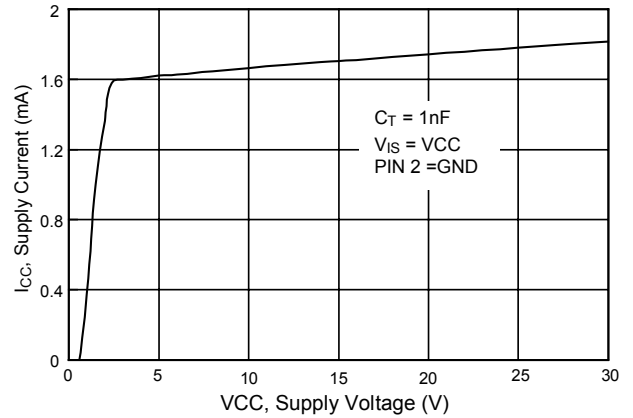
| PARAMETER                                       | TEST CONDITIONS  | SYMBOL                 | MIN.  | TYP. | MAX.  | UNIT    |
|---|--|------------------------|-------|------|-------|---------|
| <b>Oscillator</b>                               |  |                        |       |      |       |         |
| Charging Current                                | $5.0V \leq V_{CC} \leq 30V$  | $I_{CHG}$              | 10    | 25   | 40    | $\mu A$ |
| Discharge Current                               | $5.0V \leq V_{CC} \leq 30V$  | $I_{DISCHG}$           | 100   | 150  | 200   | $\mu A$ |
| Voltage Swing                                   | PIN 3  | $V_{OSC}$              |       | 0.6  |       | V       |
| Discharge to Charge Current Ratio               | $V_{IS} = V_{CC}$  | $I_{DISCHG} / I_{CHG}$ |       | 6.0  |       |         |
| Current Limit Sense Voltage                     | $I_{CHG} = I_{DISCHG}$   | $V_{CC} - V_{IS}$      | 250   | 300  | 350   | mV      |
| <b>Output Switch</b>                            |  |                        |       |      |       |         |
| Saturation Voltage, Emitter Follower Connection | $I_{DE} = 1.0A$ ;<br>$V_{BOOST} = V_{DC} = V_{CC}$   | $V_{CE(SAT)}$          |       | 1.5  | 1.8   | V       |
| Saturation Voltage                              | $I_{DC} = 1.0A$ ; $I_{BOOST} = 50mA$ , (Forced $\beta \approx 20$ )  | $V_{CE(SAT)}$          |       | 0.4  | 0.7   | V       |
| DC Current Gain                                 | $I_{SC} = 1.0A$ ; $V_{CE} = 5.0V$  | $h_{FE}$               | 35    | 120  |       |         |
| Collector Off-State Current                     | $V_{CE} = 30V$   | $I_{C(OFF)}$           |       | 10   |       | nA      |
| <b>Comparactor</b>                              |  |                        |       |      |       |         |
| Threshold Voltage                               | $T_a = 25^{\circ}C$<br>$0^{\circ}C \leq T_a \leq 70^{\circ}C$  | $V_{FB}$               | 1.225 | 1.25 | 1.275 | V       |
|   |  |                        | 1.21  |      | 1.29  | V       |
| Threshold Voltage Line Regulation               | $3.0V \leq V_{CC} \leq 30V$  | $REG_{LINE}$           |       | 0.1  | 0.3   | mV/V    |
| Input Bias Current                              | $V_{IN} = 0V$  | $I_{IB}$               |       | 0.4  | 1     | $\mu A$ |
| Supply Current                                  | $V_{IS} = V_{CC}$ , pin 5 $> V_{FB}$<br>$5.0V \leq V_{CC} \leq 30V$<br>$C_T = 1nF$<br>PIN 2=GND<br>Remaining pins open | $I_{CC}$               |       | 1.6  | 3     | mA      |

**TYPICAL PERFORMANCE CHARACTERISTICS**

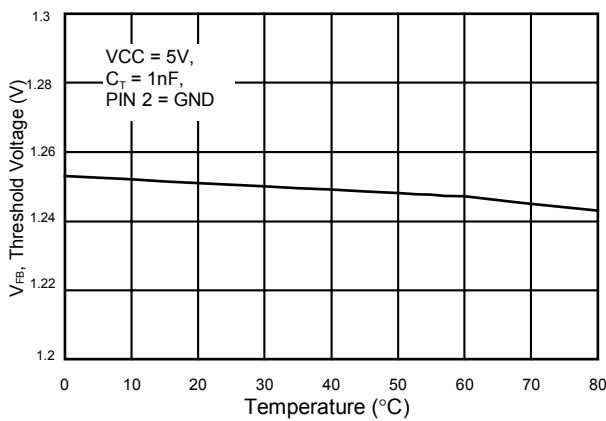
Output Switch ON-OFF Time vs Oscillator Timing Capacitor



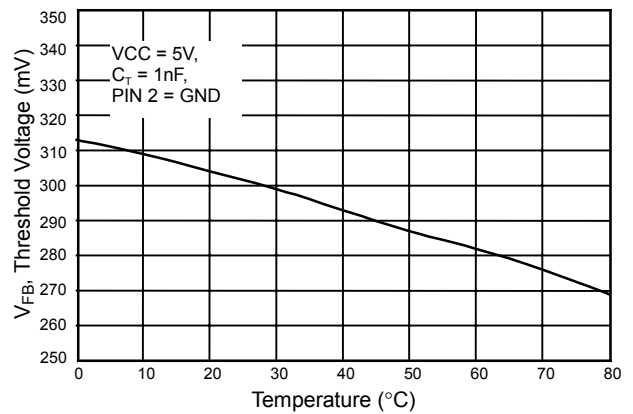
Standby Supply Current vs Supply Voltage



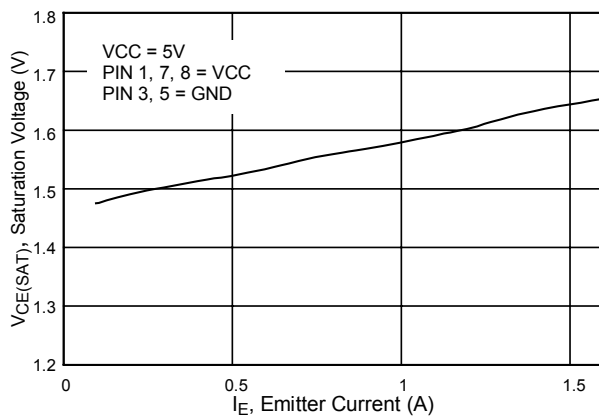
V<sub>FB</sub>, Threshold Voltage vs Temperature



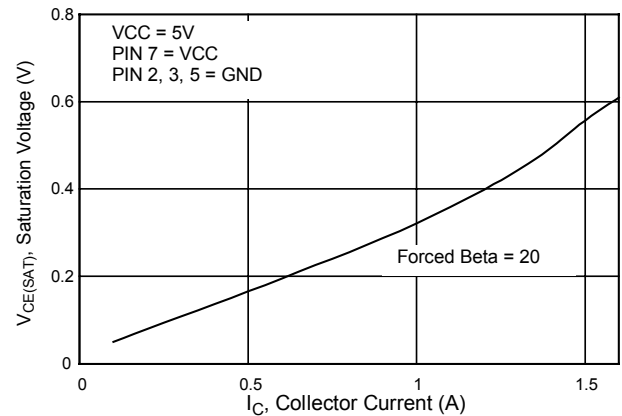
I<sub>S</sub> Threshold Voltage vs Temperature



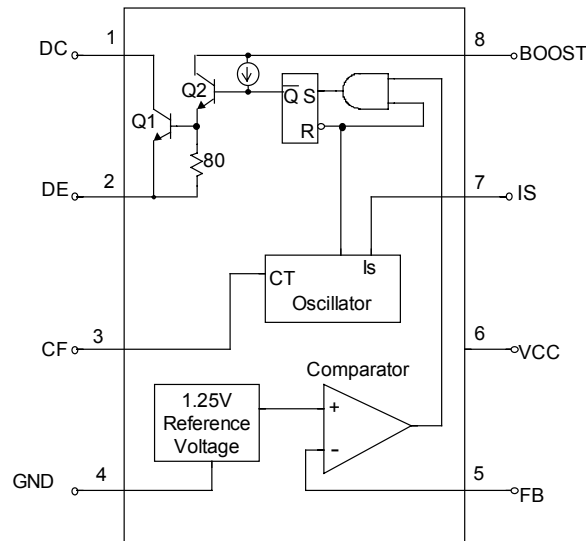
Emmitter Follower Configuration Output Switch Saturation Voltage vs Emmitter Current



Common Emmitter Configuration Output Switch Saturation Voltage vs Collector Current



## ■ BLOCK DIAGRAM



## ■ PIN DESCRIPTIONS

- |  |   |
|--|---|
| PIN 1: DC - 2A switch collector.         | PIN 5: FB - Feedback comparator inverting input.                    |
| PIN 2: DE - Darlington switch emitter.   | PIN 6: VCC - Power supply input.                                    |
| PIN 3: CF - Oscillator timing capacitor. | PIN 7: IS - Highside current sense input.<br>VCC - $V_{IS}=300mV$ . |
| PIN 4: GND - Power ground.               | PIN 8: BOOST-Bootstrapped driver collector.                         |

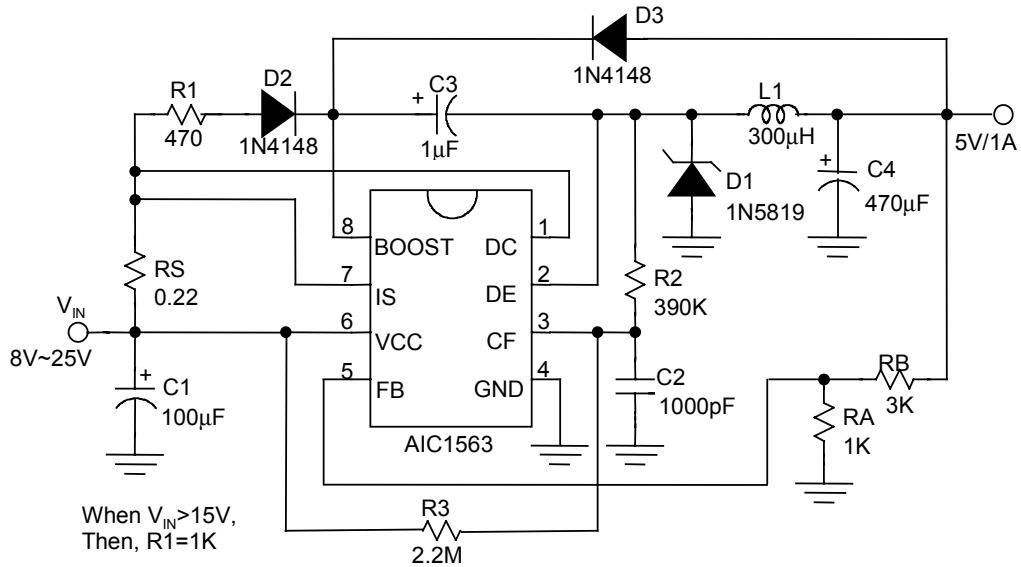
## ■ APPLICATION INFORMATIONS

### ● DESIGN FORMULA TABLE

| CALCULATION                | STEP-DOWN  | STEP-UP  |
|----------------------------|--|--|
| $\frac{t_{ON}}{t_{OFF}}$   | $\frac{V_{OUT} + V_F}{V_{IN(MIN)} - V_{SAT} - V_{OUT}}$                          | $\frac{V_{OUT} + V_F - V_{IN(MIN)}}{V_{IN(MIN)} - V_{SAT}}$            |
| $(t_{ON} + t_{OFF})_{MAX}$ | $\frac{1}{F_{MIN}}$  | $\frac{1}{F_{MIN}}$  |
| $C_T$                      | $4 \times 10^{-5} t_{ON}$  | $4 \times 10^{-5} t_{ON}$  |
| $I_C(SWITCH)$              | $2I_{OUT(MAX)}$  | $2I_{OUT(MAX)} \left( \frac{t_{ON} + t_{OFF}}{t_{OFF}} \right)$        |
| RS                         | $0.3/I_C(SWITCH)$  | $0.3/ I_C(SWITCH)$   |
| L(MIN)                     | $\left( \frac{V_{IN(MIN)} - V_{SAT} - V_{OUT}}{I_C(SWITCH)} \right) t_{ON(MAX)}$ | $\left( \frac{V_{IN(MIN)} - V_{SAT}}{I_C(SWITCH)} \right) t_{ON(MAX)}$ |
| $C_o$                      | $\frac{I_C(SWITCH) (t_{ON} + t_{OFF})}{8V_{RIPPLE(P - P)}}$                      | $\frac{I_{OUT} t_{ON}}{V_{RIPPLE(P - P)}}$                             |

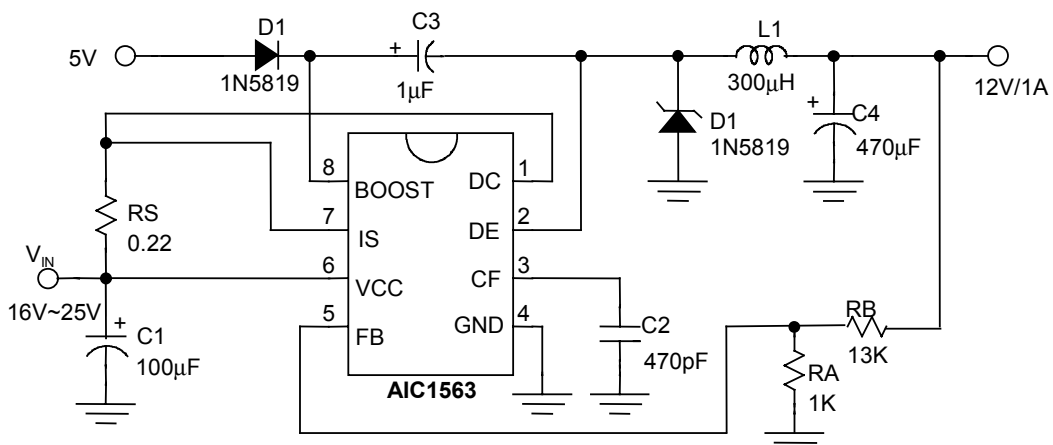


**APPLICATION EXAMPLES (CONTINUED)**



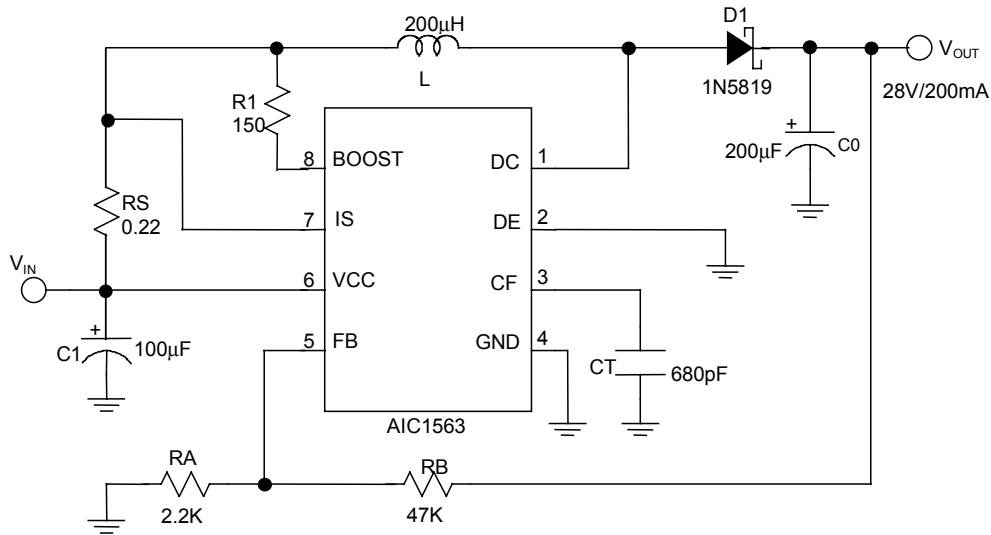
|                       |                                       |      |
|-----------------------|---------------------------------------|------|
| Line Regulation       | $V_{IN} = 10V \sim 20V @ I_o = 1A$    | 40mV |
| Load Regulation       | $V_{IN} = 15V, @ I_o = 100mA \sim 1A$ | 20mV |
| Short Circuit Current | $V_{IN} = 15V, @ R_L = 0.1\Omega$     | 1.3A |

**Fig. 3 Step-Down Converter**



**Fig. 4 Step-Down Converter with External 5V Bootstrap**

■ APPLICATION EXAMPLES (CONTINUED)



|                 |   |       |
|-----------------|---|-------|
| Line Regulation | $V_{IN} = 8V \sim 16V @ I_O = 200mA$    | 100mV |
| Load Regulation | $V_{IN} = 12V, @ I_O = 80mA \sim 200mA$ | 40mV  |

Fig. 5 Step-Up Converter

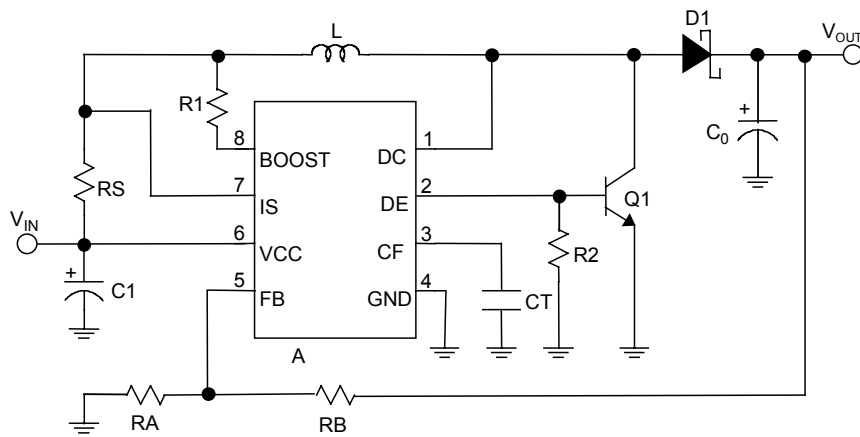
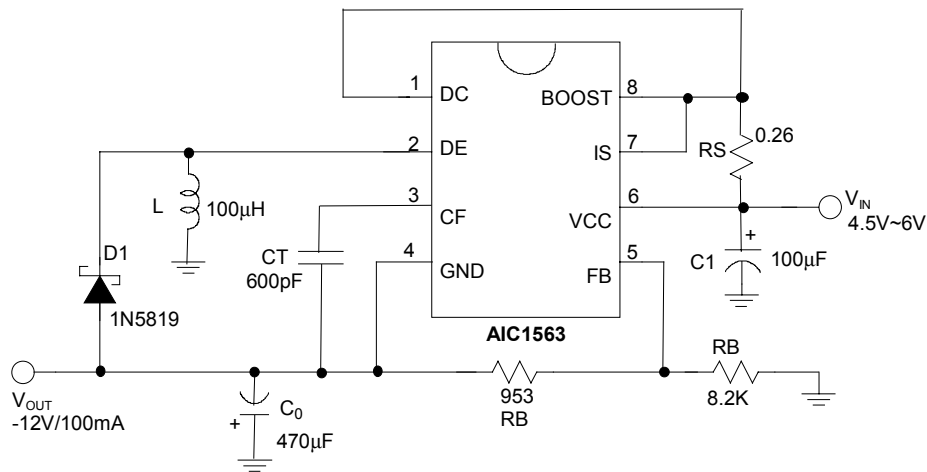


Fig. 6 Step-Up Converter with External NPN Switch

**APPLICATION EXAMPLES (CONTINUED)**

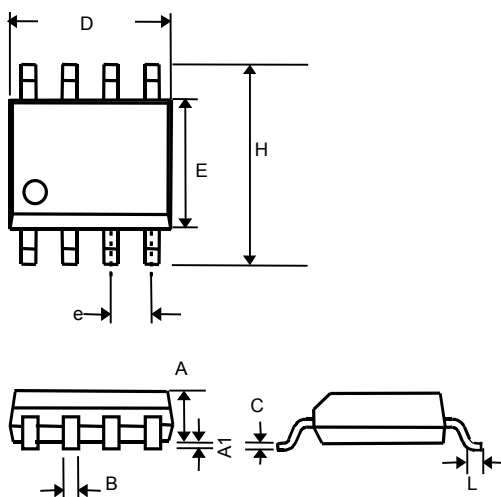


|                 |  |       |
|-----------------|--|-------|
| Line Regulation | $V_{IN} = 4.5V \sim 6V @ I_O = 100mA$  | 20mV  |
| Load Regulation | $V_{IN} = 5V, @ I_O = 10mA \sim 100mA$ | 100mV |

**Fig.7 Inverting Converter**

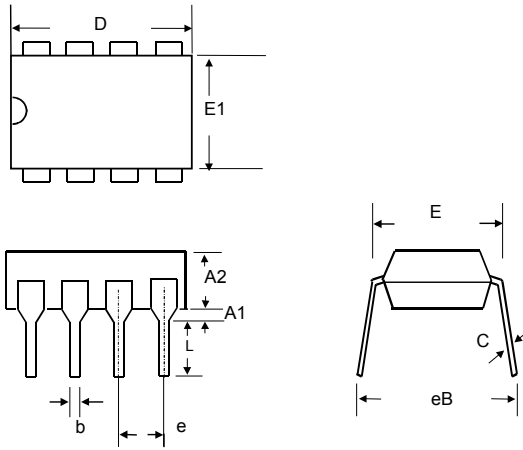
**PHYSICAL DIMENSIONS**

- 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  |



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