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 ±2% Reference.
- Low Quiescent Current at 1.6mA.
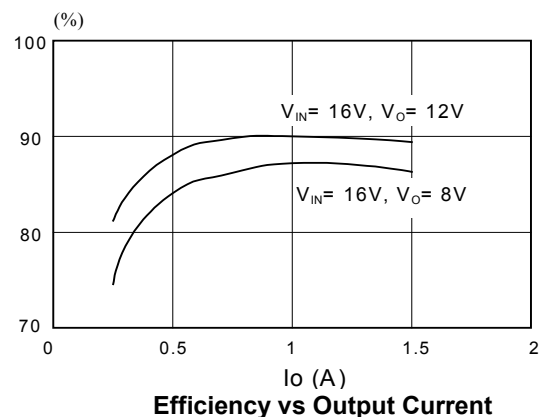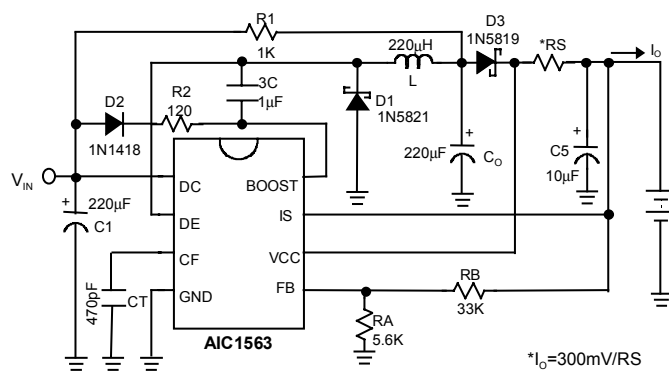- Frequency Operation from 100Hz to 100KHz.

■ 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.
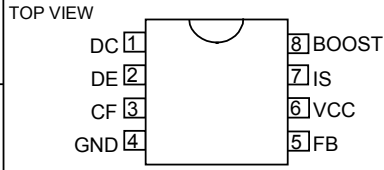
■ TYPICAL APPLICATION CIRCUIT

Analog Integrations Corporation   4F, 9, Industry E. 9th Rd, Science Based Industrial Park, Hsinchu Taiwan, ROC   www.analog.com.tw

DS-1563-01   Jan 30, 01   TEL: 886-3-5772500   FAX: 886-3-5772510

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■ ORDERING INFORMATION

AIC1563 XX

PACKAGE TYPE
N: PLASTIC DIP
S: SMALL OUTLINE

TEMPERATURE
C: 0°C~+70°C

ORDER NUMBER	PIN CONFIGURATION
AIC1563CN (PLASTIC DIP)	TOP VIEW
AIC1563CS (PLASTIC SO)	DC [1] [8] BOOST DE [2] [7] IS CF [3] [6] VCC GND [4] [5] FB

■ 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

       DIP Package

           Ta= 25°C ....……….............................. 1.0W

           Thermal Resistance ....………....................... 100°C/W

       SO Package

           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
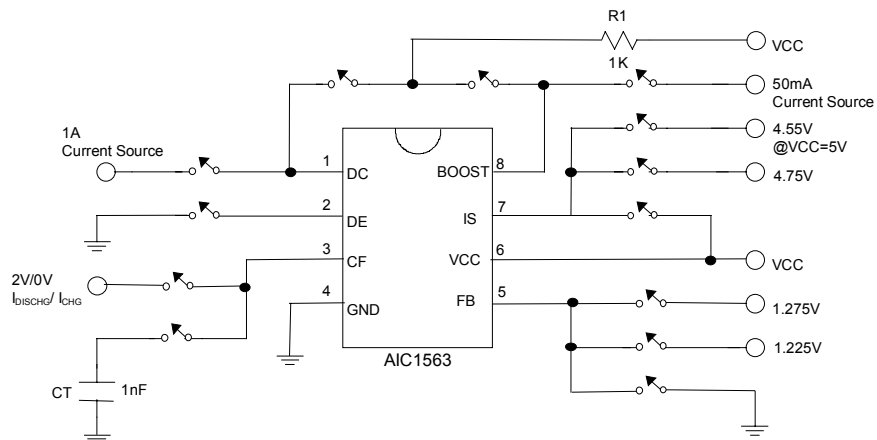
ELECTRICAL CHARACTERISTICS (VCC= 5V, Ta=25°C, unless otherwise specified.)

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

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■ TYPICAL PERFORMANCE CHARACTERISTICS

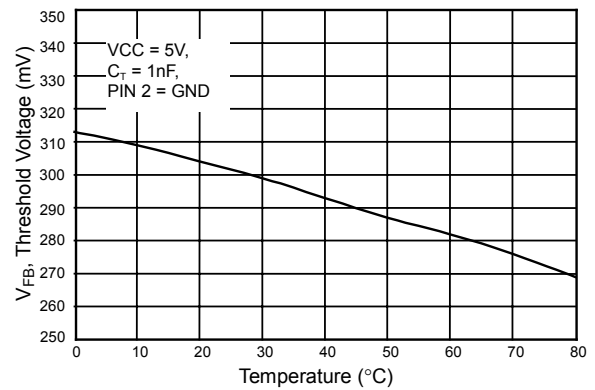Output Switch ON-OFF Time vs Oscillator Timing Capacitor
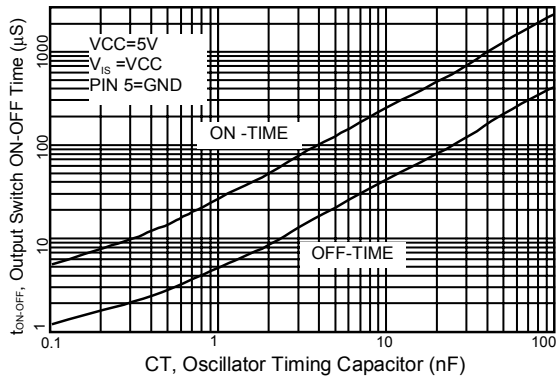
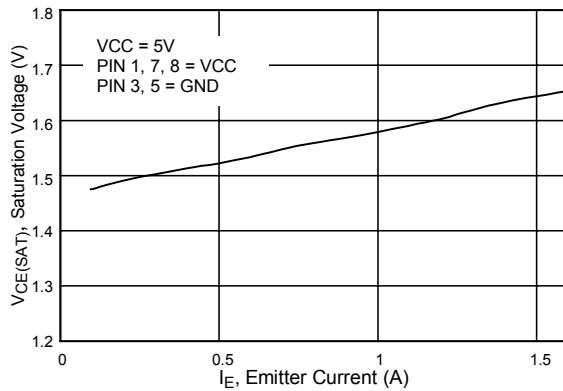Standby Supply Current vs Supply Voltage
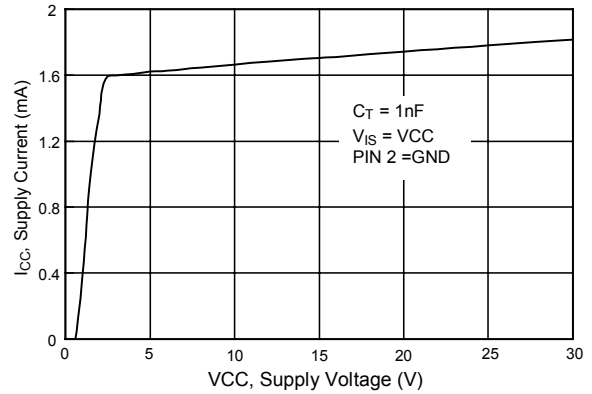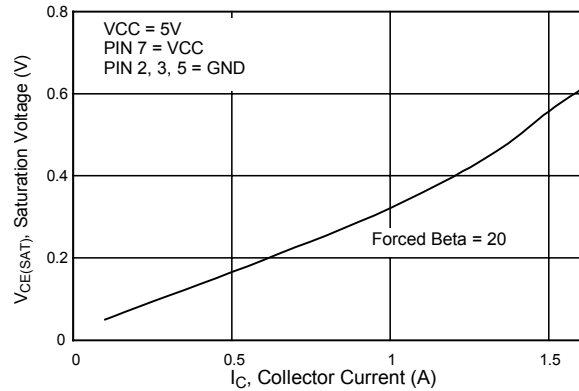

V_{FB}, Threshold Voltage vs Temperature
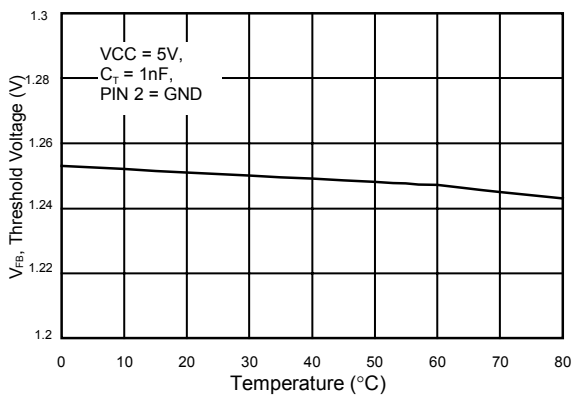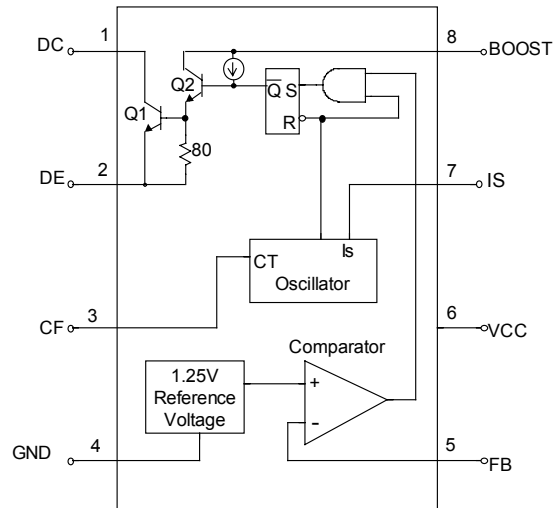

I_S Threshold Voltage vs Temperature

Emmiter Follower Configuration Output Switch Saturation Voltage vs Emmiter Current

Common Emitter Configuration Output Switch Saturation Voltage vs Collector Current

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■ BLOCK DIAGRAM

■ PIN DESCRIPTIONS

PIN 1: DC   - 2A switch collector.

PIN 2: DE   - Darlington switch emitter.

PIN 3: CF   - Oscillator timing capacitor.

PIN 4: GND - Power ground.

PIN 5: FB   - Feedback comparator inverting input.

PIN 6: VCC - Power supply input.

PIN 7: IS   - Highside current sense input.
               VCC - V_{IS}=300mV.

PIN 8: BOOST-Bootstrapped driver collector.

■ APPLICATION INFORMATIONS

●   **DESIGN FORMULA TABLE**

CALCULATION	STEP-DOWN	STEP-UP
$\dfrac{t_{ON}}{t_{OFF}}$	$\dfrac{V_{OUT} + V_F}{V_{IN(MIN)} - V_{SAT} - V_{OUT}}$	$\dfrac{V_{OUT} + V_F - V_{IN(MIN)}}{V_{IN(MIN)} - V_{SAT}}$
$(t_{ON} + t_{OFF})_{MAX}$	$\dfrac{1}{F_{MIN}}$	$\dfrac{1}{F_{MIN}}$
C_T	$4\times10^{-5}t_{ON}$	$4 \times 10^{-5}t_{ON}$
$I_{C\,(SWITCH)}$	$2I_{OUT(MAX)}$	$2I_{OUT(MAX)}\left(\dfrac{t_{ON}+t_{OFF}}{t_{OFF}}\right)$
RS	$0.3/I_{C(SWITCH)}$	$0.3/\,I_{C\,(SWITCH)}$
L(MIN)	$\left(\dfrac{V_{IN(MIN)} - V_{SAT} - V_{OUT}}{I_{C(SWITCH)}}\right)t_{ON(MAX)}$	$\left(\dfrac{V_{IN(MIN)} - V_{SAT}}{I_{C(SWITCH)}}\right)t_{ON(MAX)}$
Co	$\dfrac{I_{C(SWITCH)}\,(t_{ON} + t_{OFF})}{8V_{RIPPLE(P-P)}}$	$\dfrac{I_{OUT}\ t_{ON}}{V_{RIPPLE(P-P)}}$

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V_{SAT} = Saturation voltage of the output switch.

V_F = Forward voltage of the ringback rectifier

The following power supply characteristics must be chosen:

V_{IN} - Nominal input voltage.

V_{OUT} - Desired output voltage,
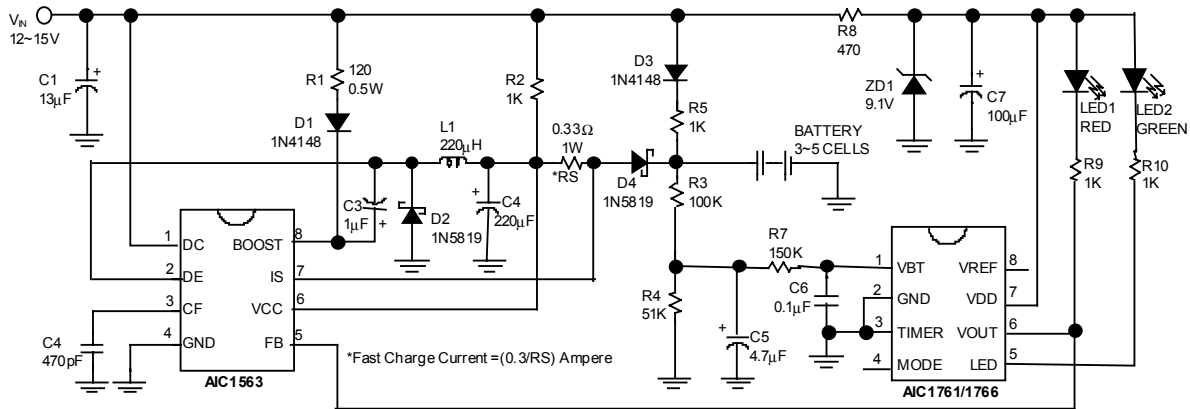V_{OUT} = 1.25 (1 + RB/RA)

I_{OUT} - Desired output current.

F_{MIN} - Minimum desired switching frequency at selected values for V_{IN} and I_{OUT}.

$V_{RIPPLE (P-P)}$ - Desired peak-to-peak output ripple voltage. In practice, the calculated value will need to be increased due to the capacitor equivalent series resistance and board layout. The ripple voltage should be kept to a low value since it will directly affect the line and load regulation.

■ APPLICATION EXAMPLES

Fig. 1 Simplified Battery Charge Circuit for Ni-Cd/ Ni-MH Battery
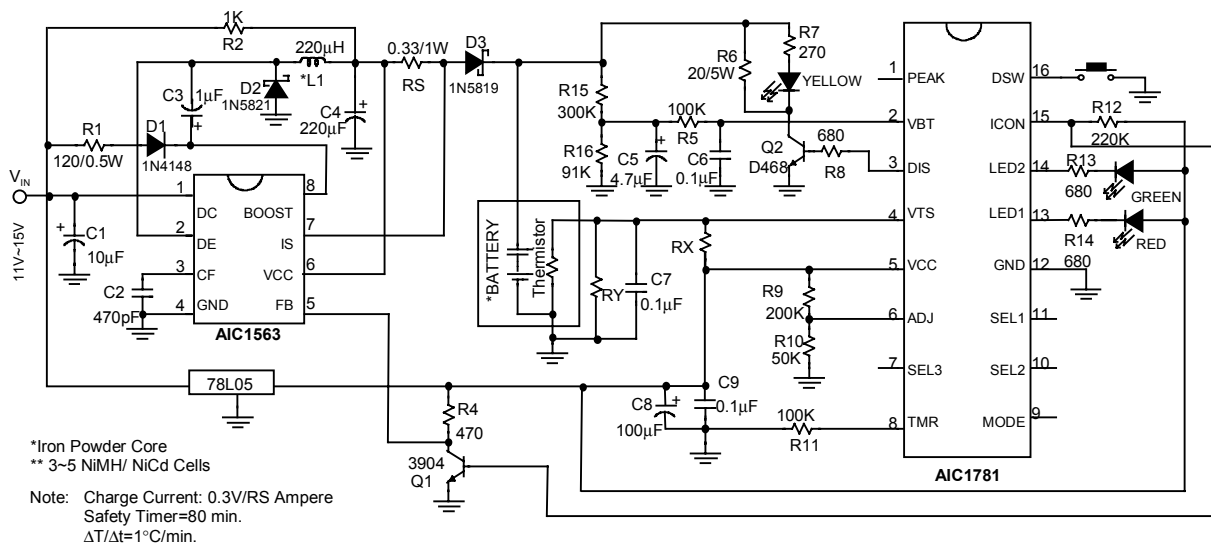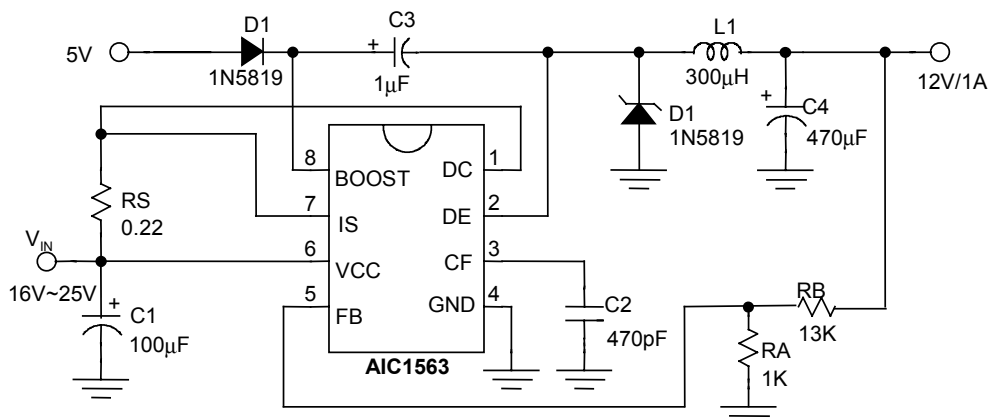

Fig. 2 Battery Charge Circuit for Fluctuating Charging Current Applications

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APPLICATION EXAMPLES (CONTINUED)
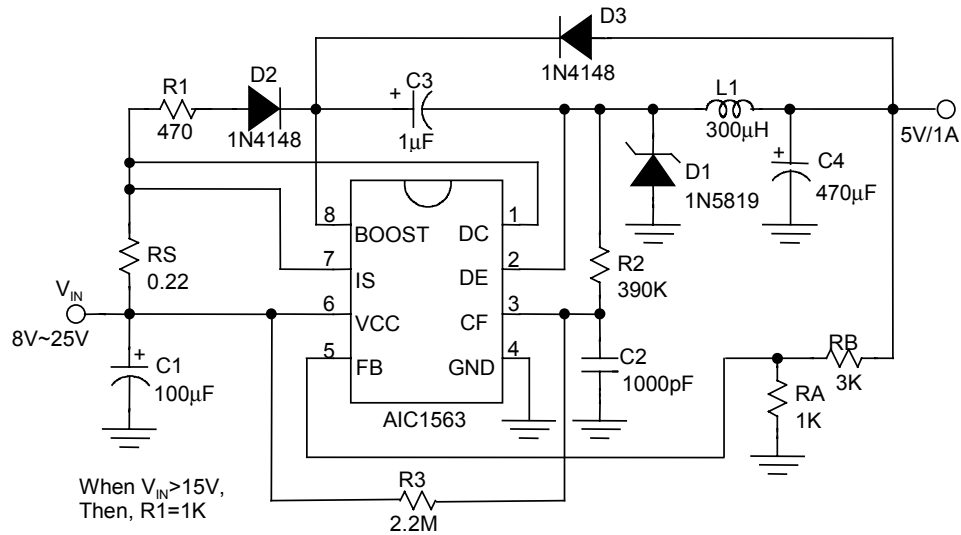
Line Regulation	V_{IN} = 10V~20V @ I_O=1A	40mV
Load Regulation	V_{IN} = 15V, @ I_O=100mA~1A	20mV
Short Circuit Current	V_{IN} =15V, @ R_L = 0.1Ω	1.3A

Fig. 3   Step-Down Converter

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

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■ APPLICATION EXAMPLES (CONTINUED)
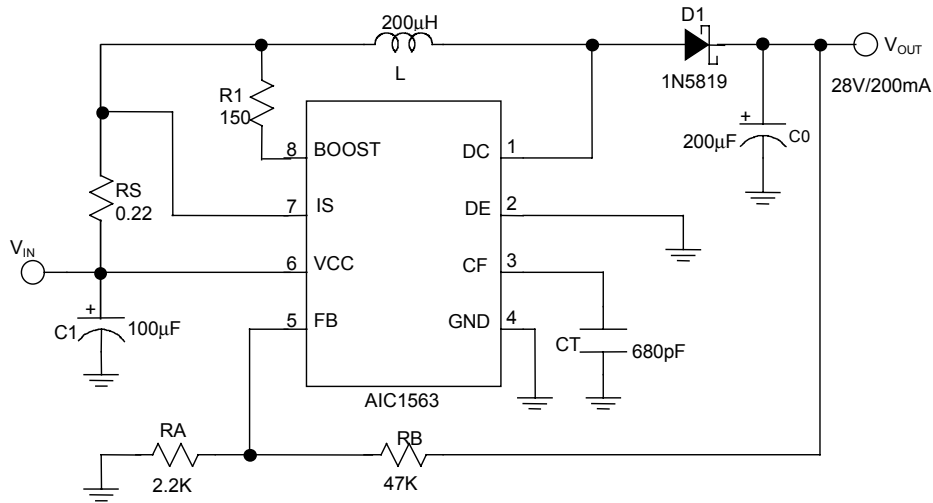
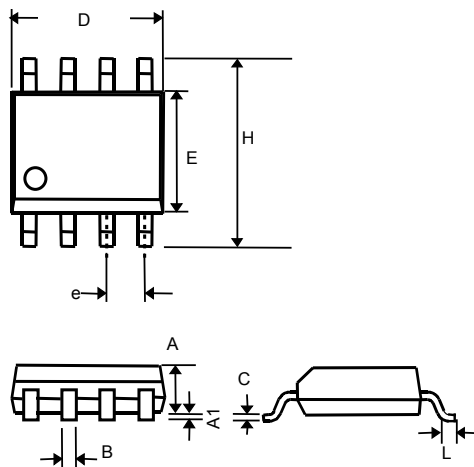| Line Regulation	V_{IN} = 8V~16V @ I_O=200mA	100mV
Load Regulation	V_{IN} = 12V, @ I_O=80mA~200mA	40mV

Fig. 5 Step-Up Converter
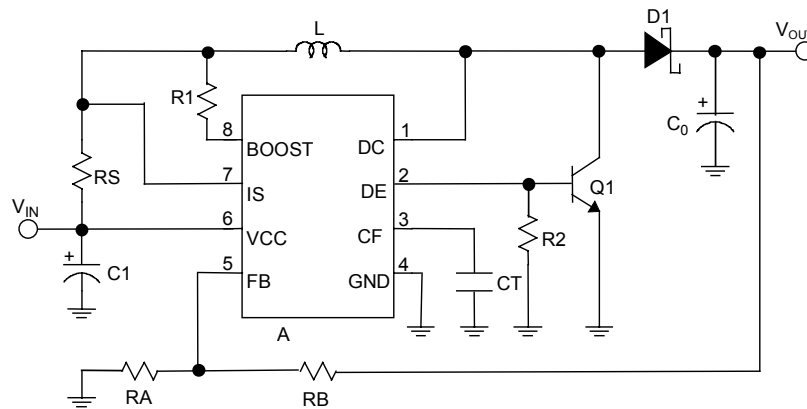
Fig. 6 Step-Up Converter with External NPN Switch

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APPLICATION EXAMPLES (CONTINUED)
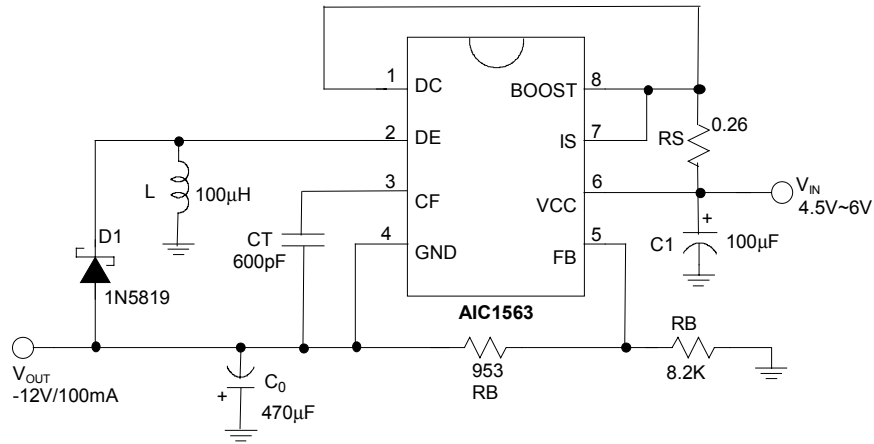
Line Regulation	V_{IN} = 4.5V~6V @ I_O=100mA	20mV
Load Regulation	V_{IN} = 5V, @ I_O=10mA~100mA	100mV

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

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- **8 LEAD PLASTIC DIP (unit: mm)**
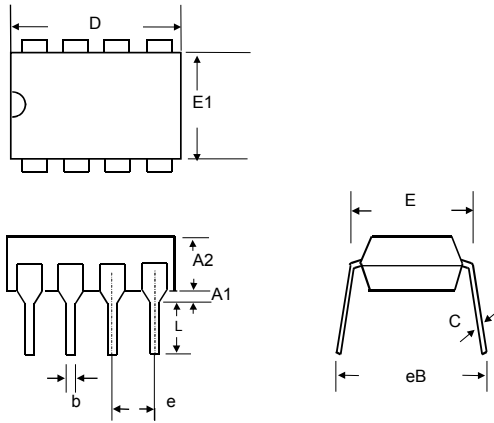
SYMBOL	MIN	MAX
A1	0.381	—
A2	2.92	4.96
b	0.35	0.56
C	0.20	0.36
D	9.01	10.16
E	7.62	8.26
E1	6.09	7.12
e	2.54 (TYP)	
eB	—	10.92
L	2.92	3.81