AIC

AIC1563

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.

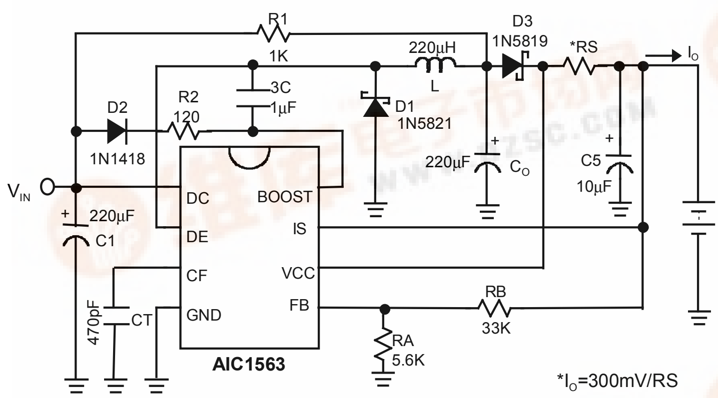
APPLICATIONS

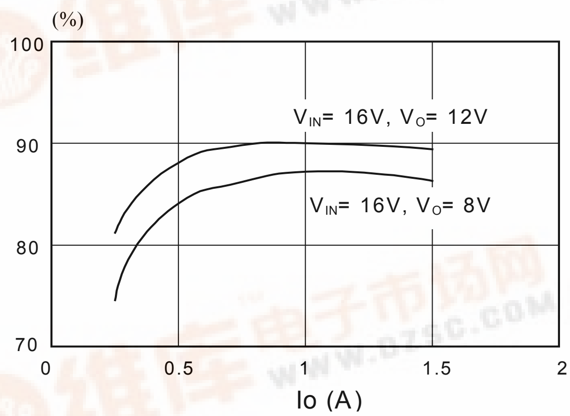
- Constant Current Source for Battery Chargers.
- Saver for Cellular phones.
- Step-Down DC-DC Converter Module.

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





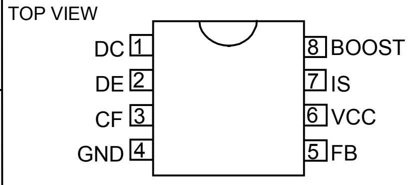
Efficiency vs Output Current

■ 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)	
AIC1563CS (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

DIP Package

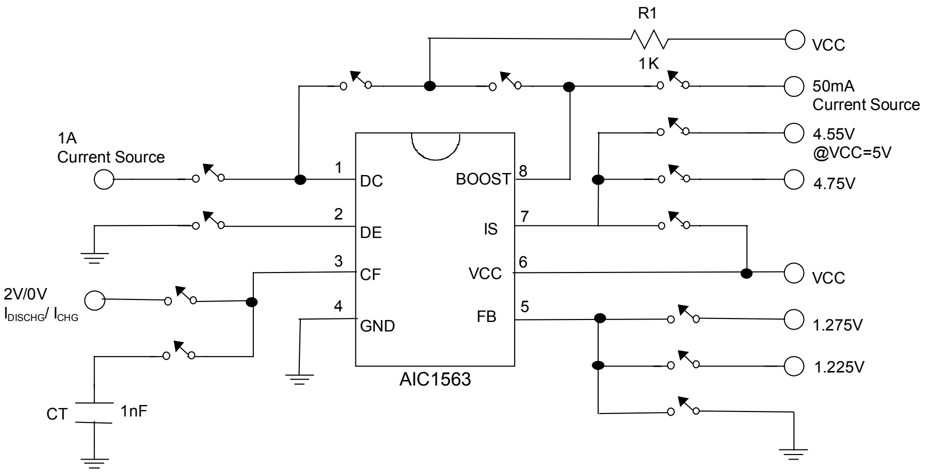
Ta= 25°C 1.0W
Thermal Resistance .... 100°C/W

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

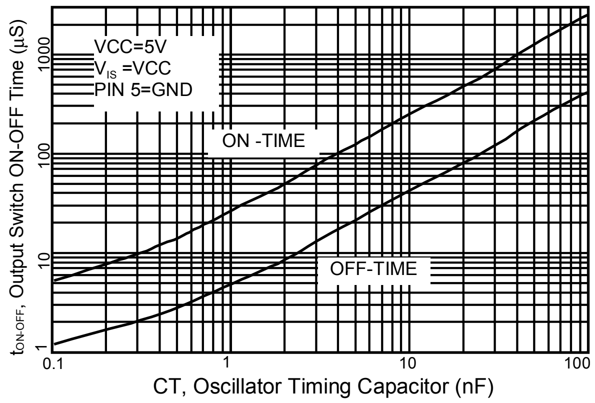


■ ELECTRICAL CHARACTERISTICS (VCC= 5V, Ta=25°C, unless otherwise specified.)

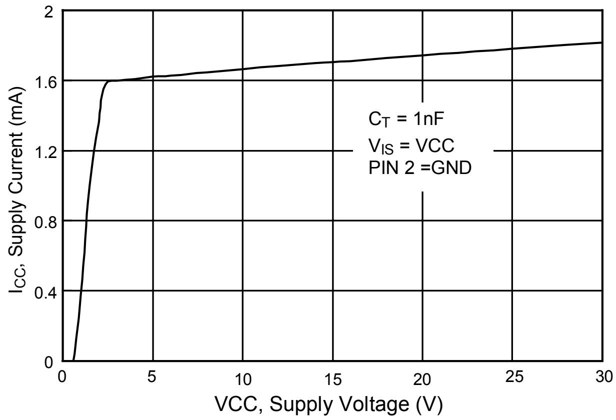
PARAMETER	TEST CONDITIONS	SYMBOL	MIN.	TYP.	MAX.	UNIT
Oscillator						
Charging Current	$5.0V \le VCC \le 30V$	I_{CHG}	10	25	40	µA
Discharge Current	$5.0V \le VCC \le 30V$	I_{DISCHG}	100	150	200	µA
Voltage Swing	PIN 3	V_{OSC}		0.6		V
Discharge to Charge Current Ratio	V_{IS} =VCC	I_{DISCHG} / I_{CHG}		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 0°C ≤ Ta ≤ 70°C	V_{FB}	1.225 1.21	1.25	1.275 1.29	V V
Threshold Voltage Line Regulation	$3.0V \le VCC \le 30V$	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≤ VCC ≤30V C_T=1nF PIN 2=GND Remaining pins open	I_{CC}		1.6	3	mA

TYPICAL PERFORMANCE CHARACTERISTICS

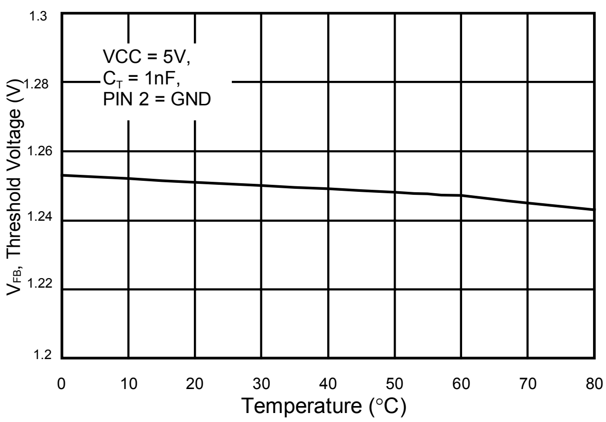
Output Switch ON-OFF Time vs Oscillator Timing Capacitor



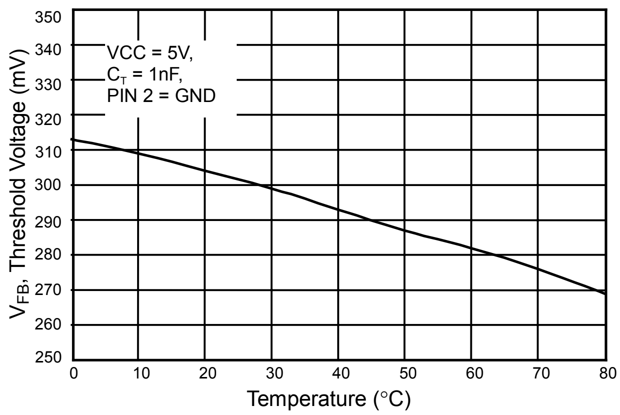
Standby Supply Current vs Supply Voltage



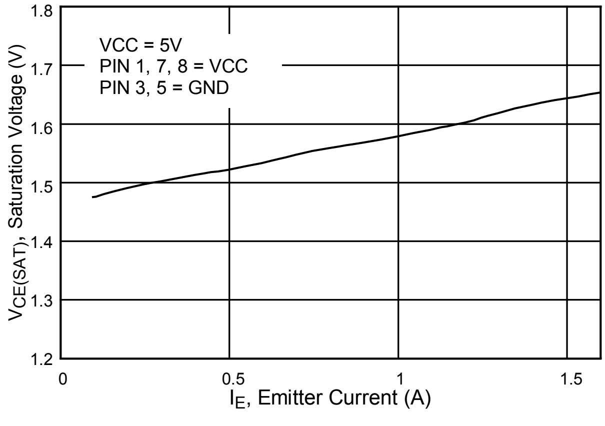
V_{FB}, Threshold Voltage vs Temperature



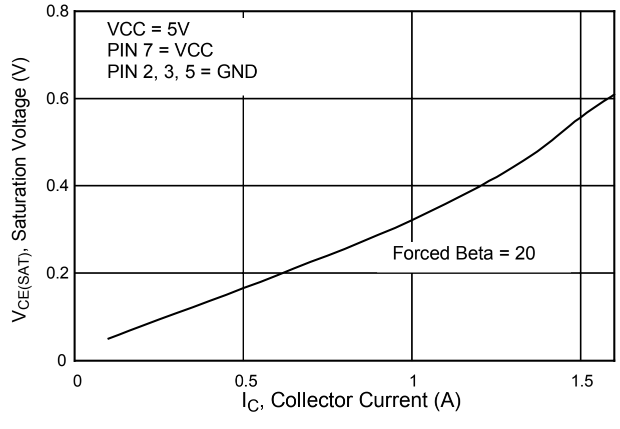
I_S Threshold Voltage vs Temperature



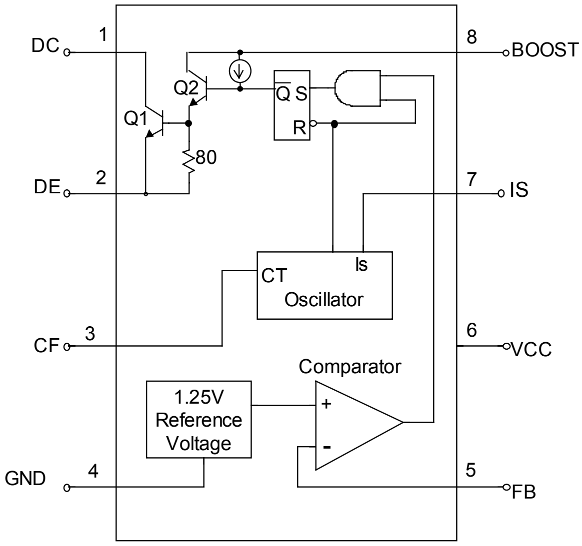
Emmiter Follower Configuration Output Switch Saturation Voltage vs Emmiter Current



Common Emitter Configuration Output Switch Saturation Voltage vs Collector Current



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
$\frac{t_{ON}}{t_{OFF}}$	$\frac{V_{OUT} + V_F}{V_{IN(MIN)} - V_{SAT} - V_{OUT}}$	$\frac{V_{OUT} + V_F - V_{IN(MIN)}}{V_{IN(MIN)} - V_{SAT}}$
$(t_{ON} + t_{OFF})_{MAX}$	$\frac{1}{F_{MIN}}$	$\frac{1}{F_{MIN}}$
C_T	$4x10^{-5}t_{ON}$	$4 \times 10^{-5}t_{ON}$
$I_{C (SWITCH)}$	$2I_{OUT(MAX)}$	$2I_{OUT(MAX)} \left(\frac{t_{ON} + t_{OFF}}{t_{OFF}}\right)$
RS	$0.3/I_{C(SWITCH)}$	$0.3/ I_{C (SWITCH)}$
L(MIN)	$\left(\frac{V_{IN(MIN)} - V_{SAT} - V_{OUT}}{I_{C(SWITCH)}}\right)t_{ON(MAX)}$	$\left(\frac{V_{IN(MIN)} - V_{SAT}}{I_{C(SWITCH)}}\right)t_{ON(MAX)}$
Co	$\frac{I_{C(SWITCH)}(t_{ON} + t_{OFF})}{8V_{RIPPLE(P-P)}}$	$\frac{I_{OUT}\ t_{ON}}{V_{RIPPLE(P-P)}}$

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}.

$V_{RIPPLE\ (P\text{-}P)}$ - 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

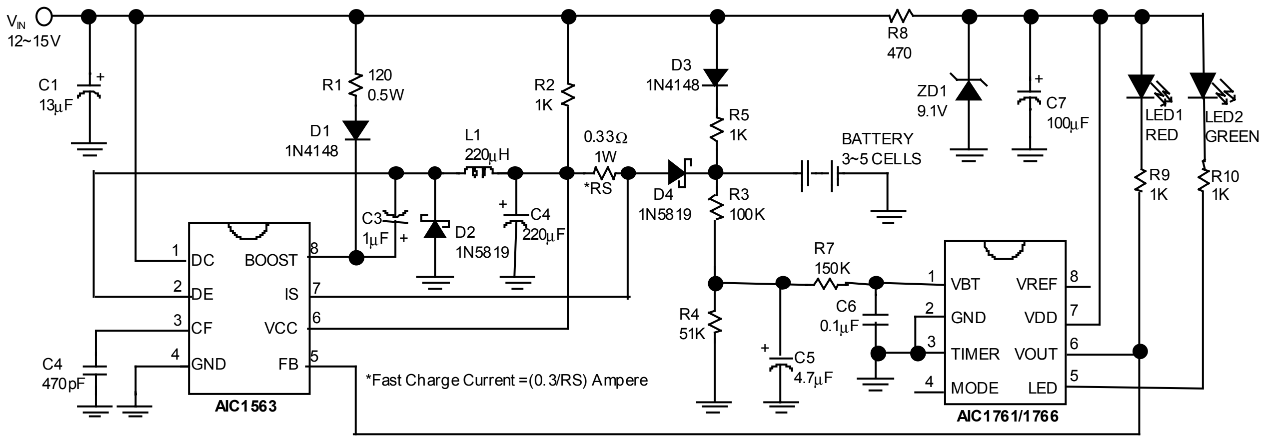


Fig. 1 Simplified Battery Charge Circuit for Ni-Cd/ Ni-MH Battery

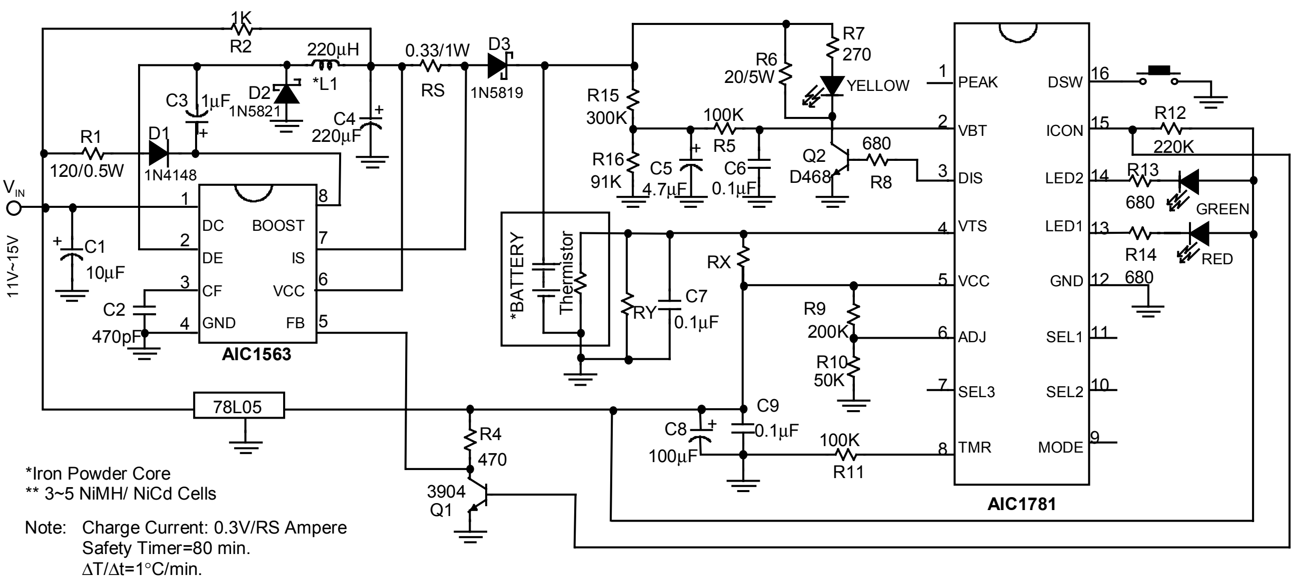
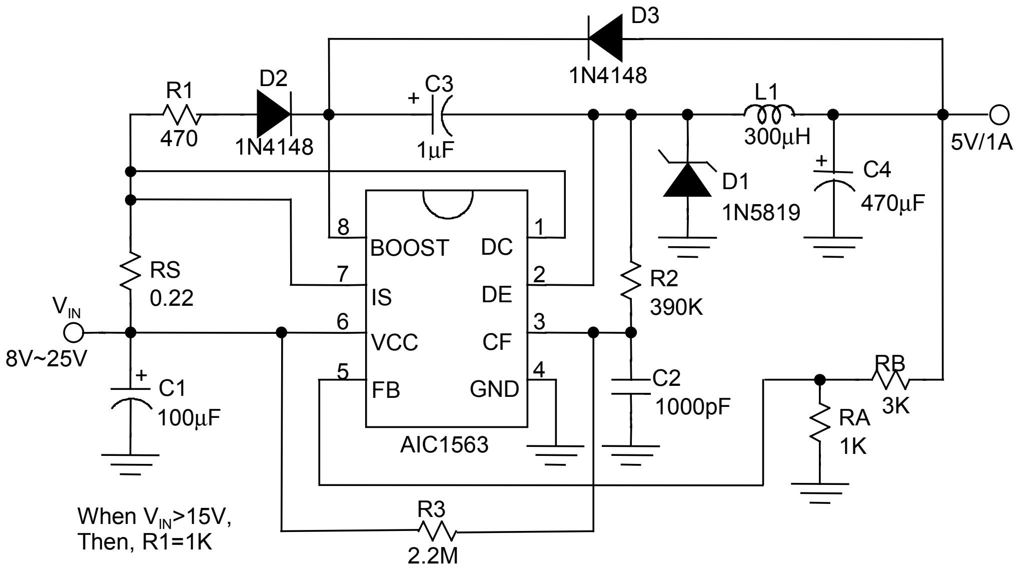


Fig. 2 Battery Charge Circuit for Fluctuating Charging Current Applications

■ 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

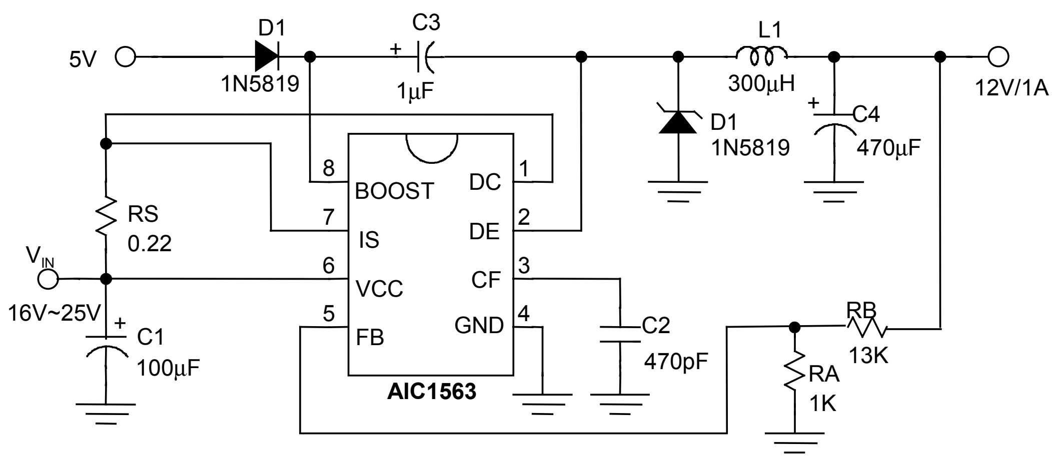
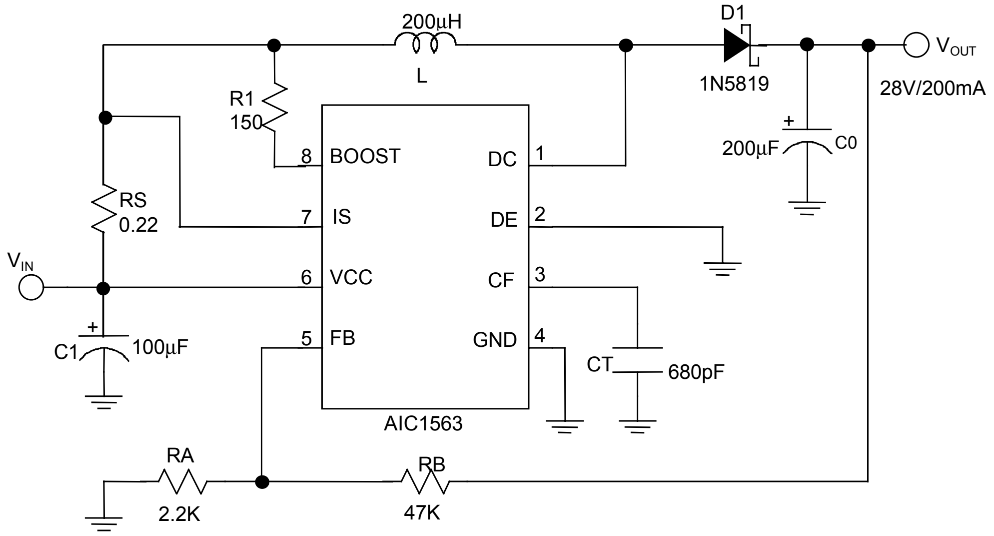


Fig. 4 Step-Down Converter with External 5V Bootstrap

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

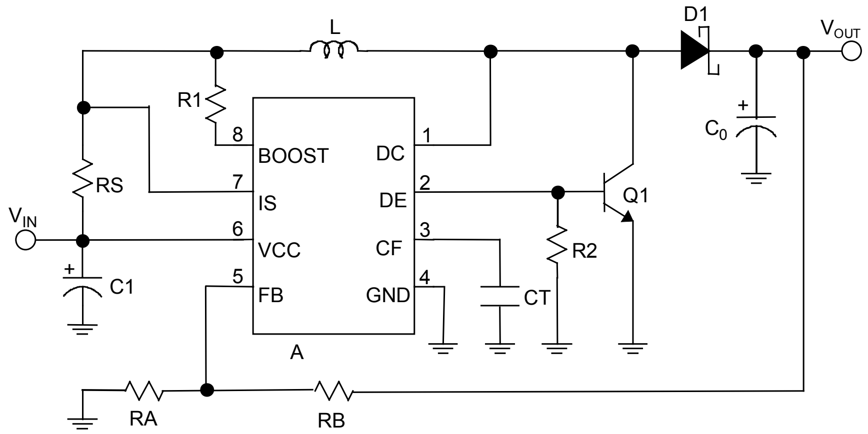
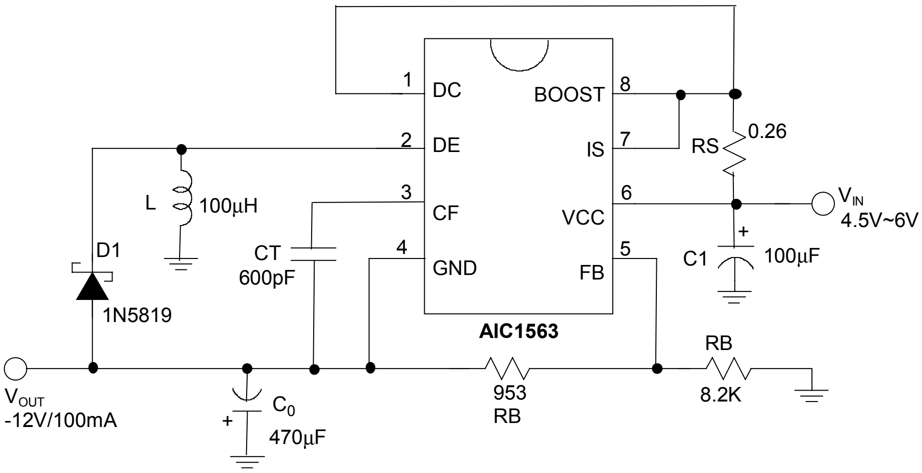


Fig. 6 Step-Up Converter with External NPN Switch

APPLICATION EXAMPLES (CONTINUED)

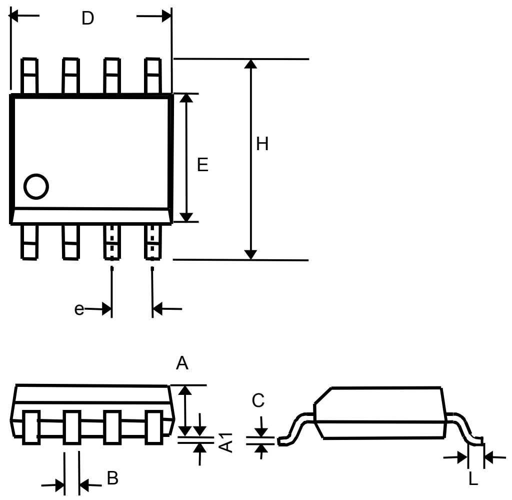


Line Regulation	V_{IN} = 4.5V~6V @ I_O=100mA	20mV
Load Regulation	V_{IN} = 5V, @ I_O=10mA~100mA	100mV

Fig.7 Inverting Converter

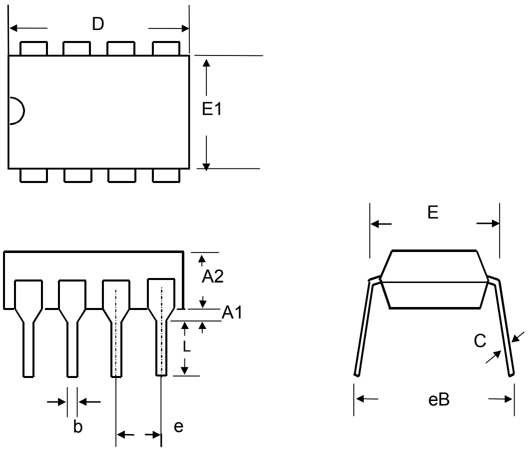
PHYSICAL DIMENSIONS

- **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

- **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