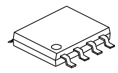
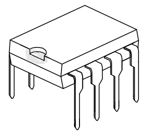
HIGH-EFFICIENCY DC/DC CONVERTER



SOP-8



DIP-8

DESCRIPTION

The UTC 3563 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 UTC 3563 can deliver 1.5A continuous current without requiring a heat sink.

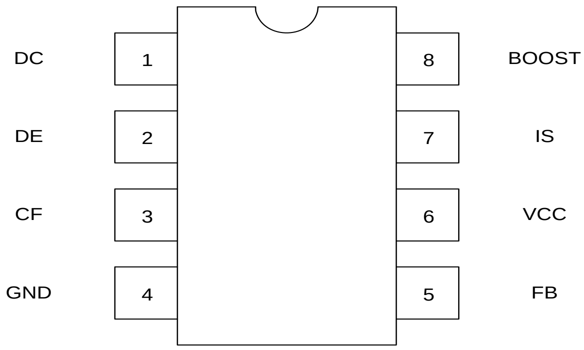
FEATURES

*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.

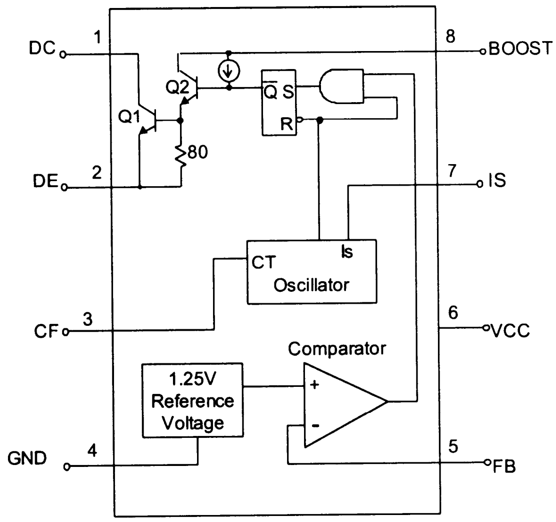
APPLICATIONS

*Constant current source for battery chargers.
*Saver for cellular phones.
*Step-Down DC-DC converter module.

PIN CONFIGURATION



BLOCK DIAGRAM



PIN	SYMBOL	DESCRIPTION	PIN	SYMBOL	DESCRIPTION
1	DC	2A switch collector	5	FB	Feedback comparator inverting input
2	DE	Darlington switch emitter	6	VCC	Power supply input
3	CF	Oscillator timing capacitor	7	IS	Highside current sense input (V_{CC}-V_{IS}=300mV)
4	GND	Power ground	8	BOOST	Bootstrapped driver collector

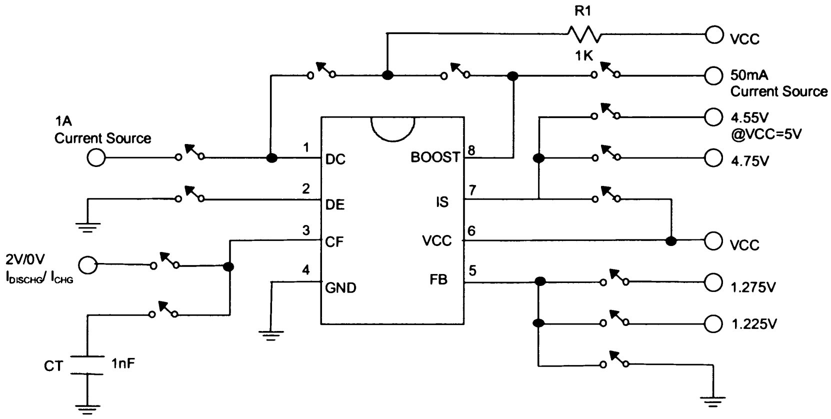
ABSOLUTE MAXIMUM RATINGS (Ta=25°C)

PARAMETER	SYMBOL	VALUE	UNIT
Supply Voltage	VCC	30	V
Comparator input voltage range	Vi	-0.3~+30	V
Switch collector voltage	V_C(switch)	30	V
Switch emitter Voltage	V_E(switch)	30	V
Switch collector to emitter voltage	V_{CE}(switch)	30	V
Driver collector Voltage	V_C(driver)	30	V
Switch current	I_{SW}	2	A
Power dissipation (Ta=25°C) DIP-8 SOP-8		 1000 625	 mW mW
Thermal Resistance DIP-8 SOP-8		 100 160	 °C/W °C/W
Operating junction temperature	Tj	125	°C
Operating ambient temperature range	Ta	-20~+85	°C
Storage temperature range	Tstg	-65~+150	°C

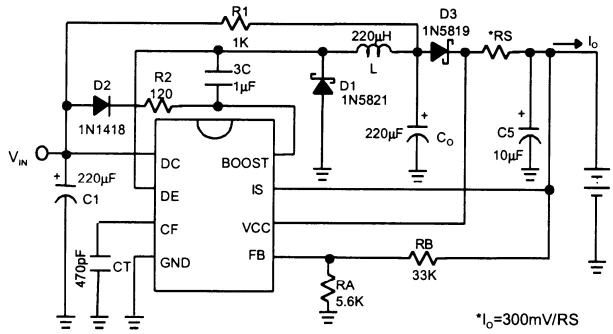
ELECTRICAL CHARACTERISTICS (VCC=5.0V, Ta=25°C, unless otherwise specified)

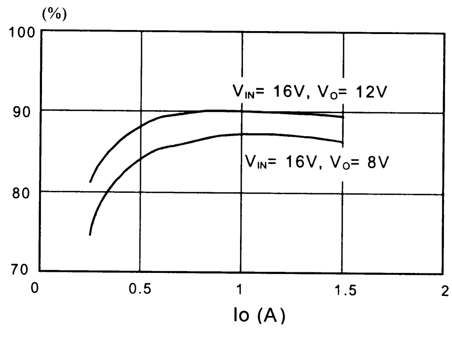
PARAMETER	SYMBOL	TEST CONDITIONS	MIN	TYP.	MAX	UNIT
Oscillator						
Charging Current	I_{CHG}	5V≤VCC≤30V	10	25	40	µA
Discharging Current	I_{DISCHG}	5V≤VCC≤30V	100	150	200	µA
Voltage Swing	Vosc	PIN 3		0.6		V
Discharge to Charge Current Ratio	I_{DISCHG} / I_{CHG}	V_{IS}=VCC		6.0		
Current limit Sense Voltage	VCC - V_{IS}	I_{CHG}=I_{DISCHG}	250	300	350	mV
Output Switch						
Saturation Voltage, Emitter Follower Connection	$V_{CE(SAT)}$	I_{DE}=1.0A, V_{BOOST}=V_{DC}=VCC		1.5	1.8	V
Saturation Voltage	$V_{CE(SAT)}$	I_{DC}=1.0A, I_{BOOST}=50mA, (Forced β≈20)		0.4	0.7	V
DC Current Gain	h_{FE}	I_{SC}=1.0A V_{CE}=5.0V	35	120		
Collector Off State Current	$I_{C(OFF)}$	V_{CE}=30V		10		nA
Comparator						
Threshold Voltage	V_{FB}	Ta=25°C 0°C≤Ta≤70°C	1.225 1.210	1.250	1.275 1.290	V V
Threshold voltage Line Regulation	REG_{LINE}	3V≤VCC≤30V		0.1	0.3	mV/V
Input Bias Current	I_{IB}	V_{IN}=0V		0.4	1.0	µA
Supply Current	ICC	V_{IS}=VCC, PIN 5>V_{FB}, 5.0V≤VCC≤30V, C_T=1nF, PIN 2=GND, Remaining pins open		1.6	3.0	mA

TEST CIRCUIT



TYPICAL APPLICATION CIRCUIT

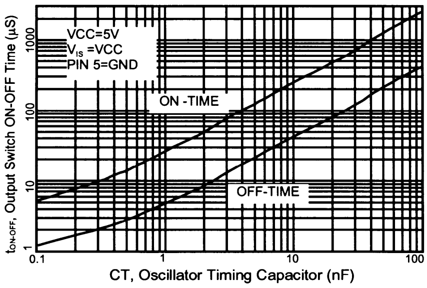




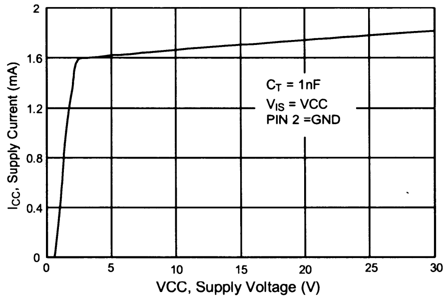
EFFICIENCY vs OUTPUT CURRENT

TYPICAL PERFORMANCE CHARACTERISTICS

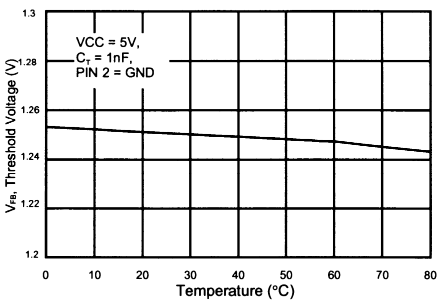
Output Switch ON-OFF Time vs Oscillator Timing Capacitor



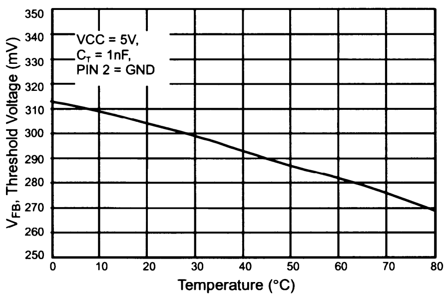
Standby Supply Current vs Supply Voltage



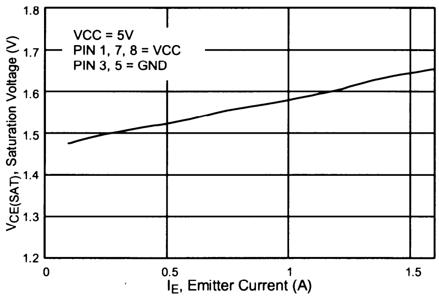
V_{FB}, Threshold Voltage vs Temperature



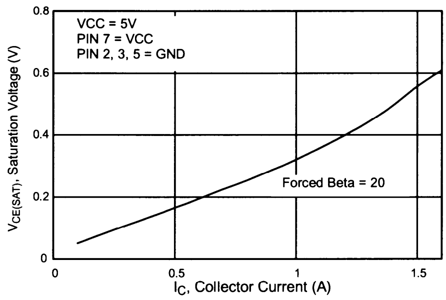
I_S Threshold Voltage vs Temperature



Emmiter Follower Configuration Output Switch Saturation Voltage vs Emmiter Current



Common Emitter Configuration Output Switch Saturation Voltage vs Collector Current



APPLICATION INFORMATION

DESIGN FORMULA TABLE

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

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} : Norminal 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

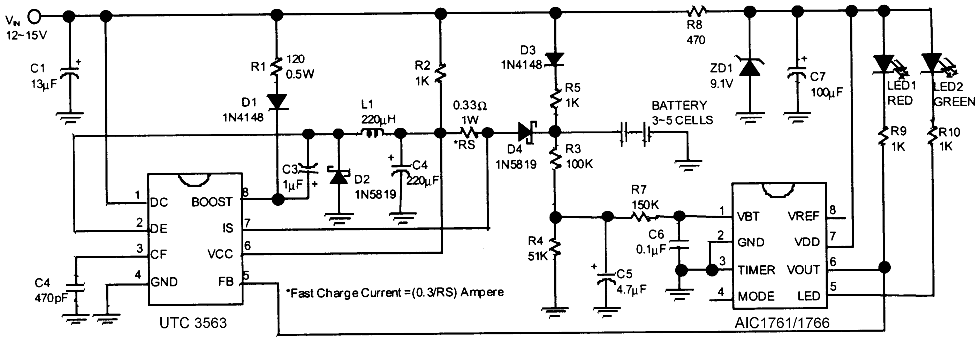


Fig.2 Battery Charge Circuit for Fluctuating Charging Current Applications

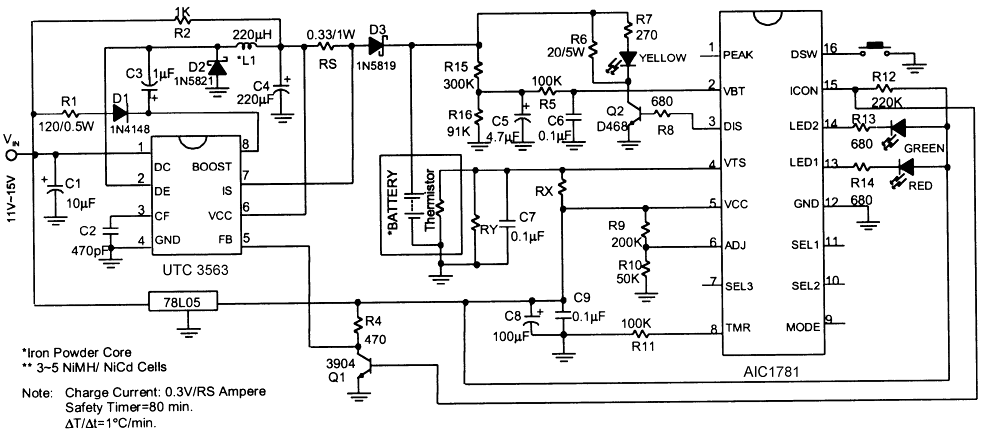
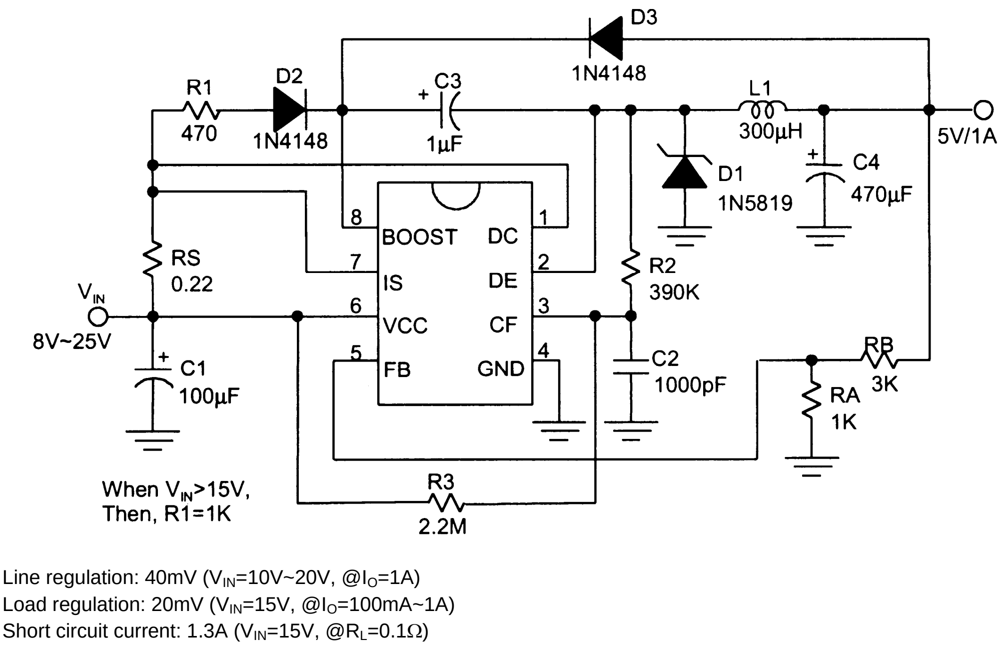


Fig. 3 Step-Down Converter



Line regulation: 40mV (V_{IN}=10V~20V, @I_O=1A)
Load regulation: 20mV (V_{IN}=15V, @I_O=100mA~1A)
Short circuit current: 1.3A (V_{IN}=15V, @R_L=0.1Ω)

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

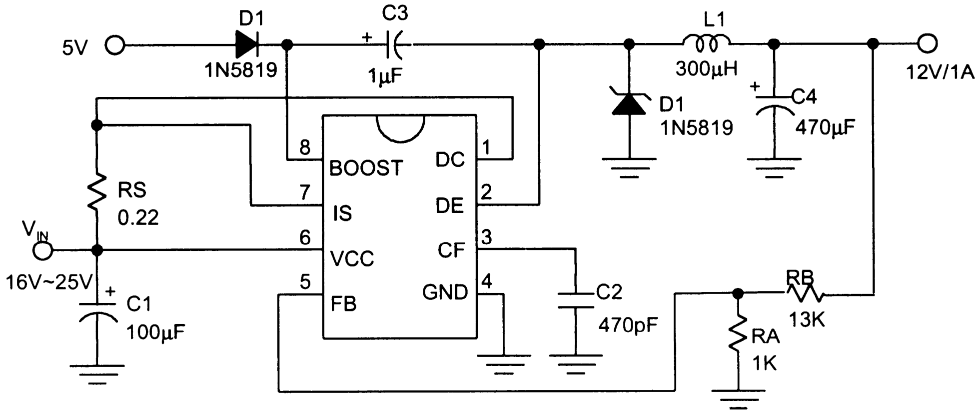
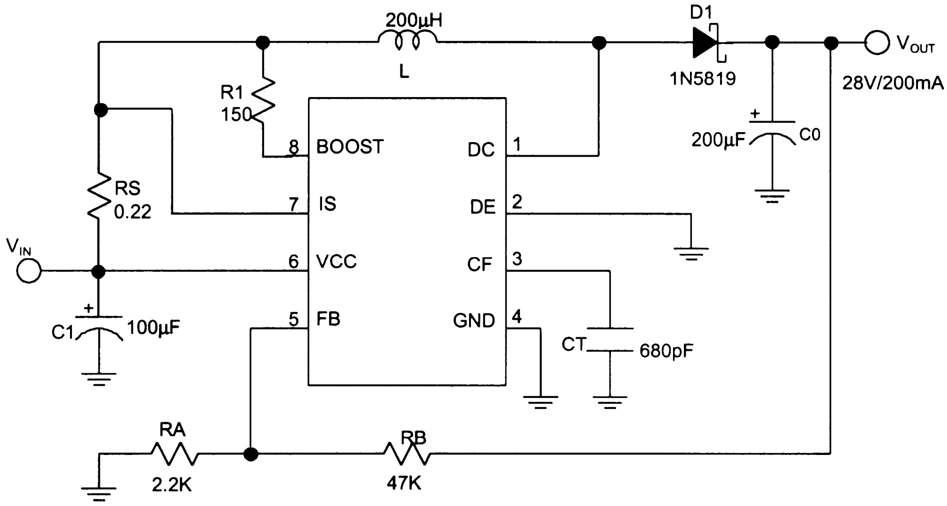


Fig. 5 Step-Up Converter



Line regulation: 100mV (V_{IN}=8V~16V, @Io=200mA)
Load regulation: 40mV (V_{IN}=12V, @I_O=80mA~200mA)

Fig. 6 Step-Up Converter with External NPN Switch

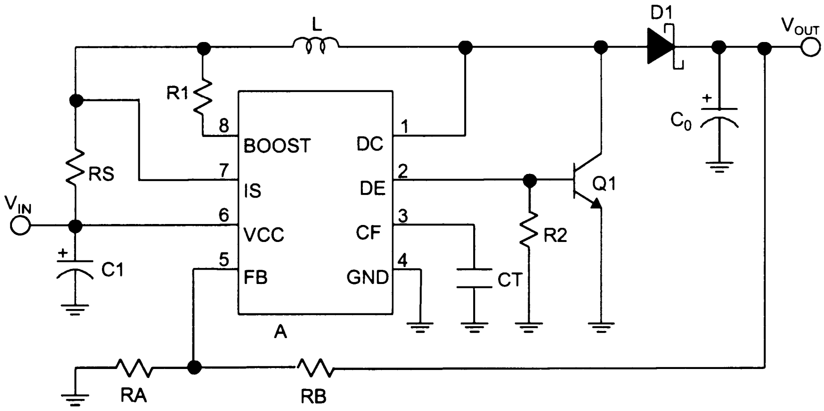
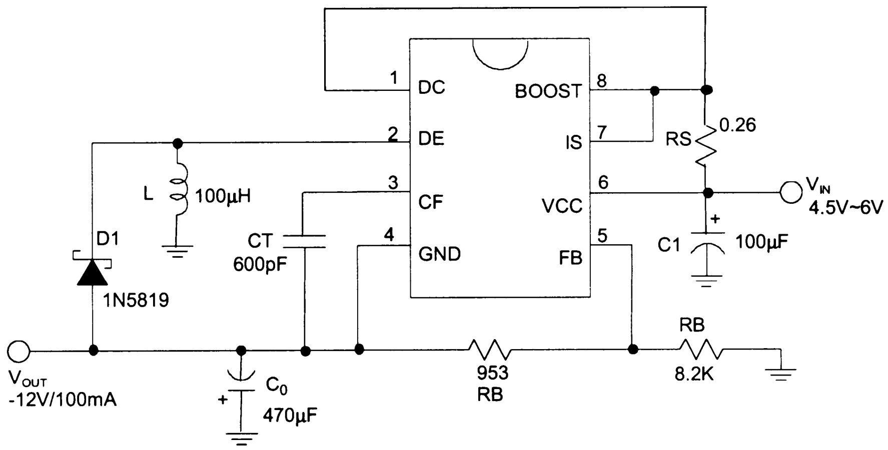


Fig. 7 Inverting Converter



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