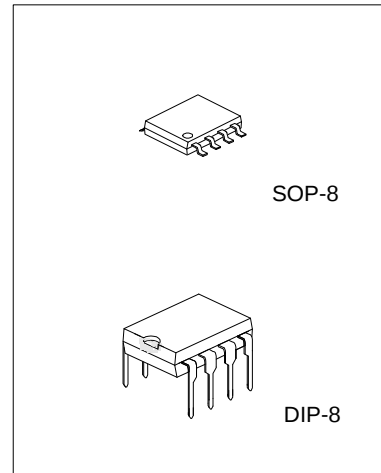


HIGH-EFFICIENCY DC/DC CONVERTER

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.



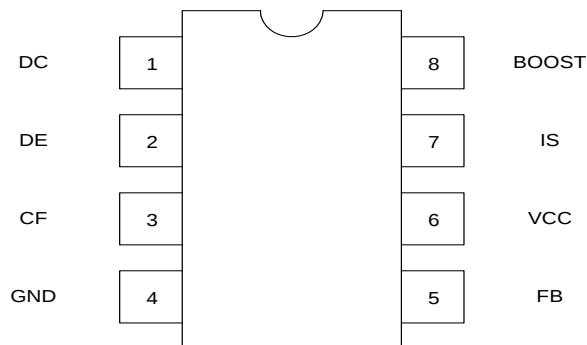
FEATURES

- *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 $\pm 2\%$ reference.
- *Low quiescent current at 1.6mA.
- *Frequency operation from 100Hz to 100KHz.

APPLICATIONS

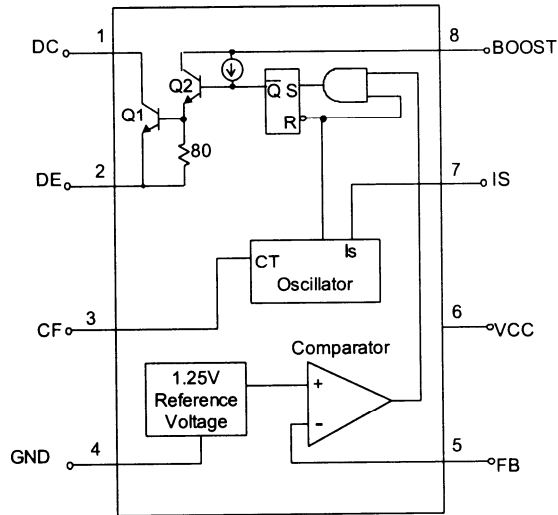
- *Constant current source for battery chargers.
- *Saver for cellular phones.
- *Step-Down DC-DC converter module.

PIN CONFIGURATION



LINEAR INTEGRATED CIRCUIT

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

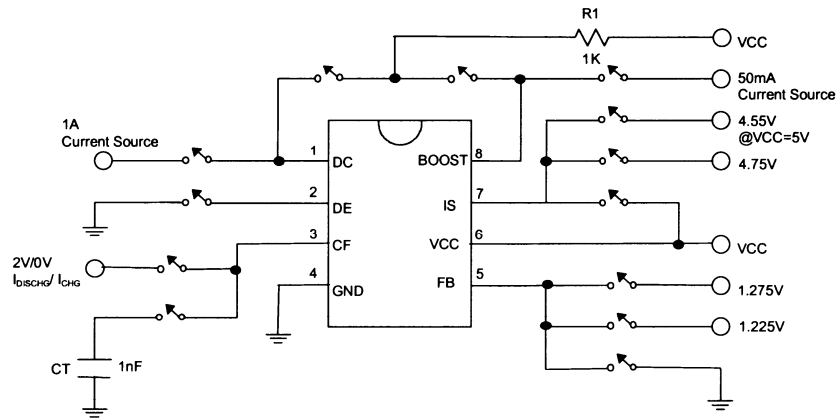
ABSOLUTE MAXIMUM RATINGS (Ta=25°C)

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

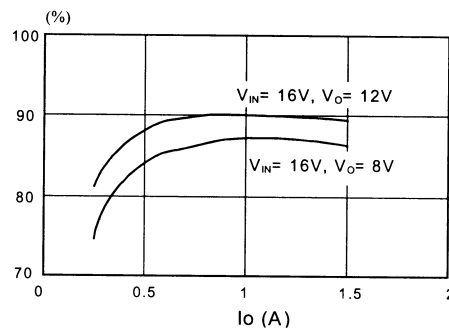
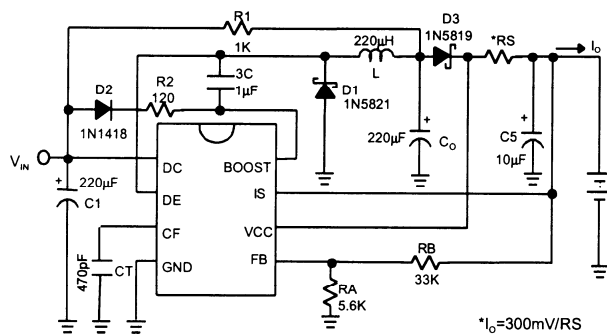
ELECTRICAL CHARACTERISTICS (VCC=5.0V, Ta=25°C, unless otherwise specified)

PARAMETER	SYMBOL	TEST CONDITIONS	MIN	TYP.	MAX	UNIT
Oscillator						
Charging Current	ICHG	5V≤VCC≤30V	10	25	40	μA
Discharging Current	IDISCHG	5V≤VCC≤30V	100	150	200	μA
Voltage Swing	Vosc	PIN 3		0.6		V
Discharge to Charge Current Ratio	IDISCHG / ICHG	Vis=VCC		6.0		
Current limit Sense Voltage	VCC -Vis	ICHG=IDISCHG	250	300	350	mV
Output Switch						
Saturation Voltage, Emitter Follower Connection	VCE(SAT)	IDE=1.0A, VBOOST=VDC=VCC		1.5	1.8	V
Saturation Voltage	VCE(SAT)	IDC=1.0A, IBOOST=50mA, (Forced β≈20)		0.4	0.7	V
DC Current Gain	hFE	ISC=1.0A, VCE=5.0V	35	120		
Collector Off State Current	IC(OFF)	VCE=30V		10		nA
Comparator						
Threshold Voltage	VFB	Ta=25°C 0°C≤Ta≤70°C	1.225 1.210	1.250	1.275 1.290	V V
Threshold voltage Line Regulation	REGLINE	3V≤VCC≤30V		0.1	0.3	mV/V
Input Bias Current	IIB	VIN=0V		0.4	1.0	μA
Supply Current	ICC	Vis=VCC, PIN 5>VFB, 5.0V≤VCC≤30V, CT=1nF, PIN 2=GND, Remaining pins open		1.6	3.0	mA

TEST CIRCUIT



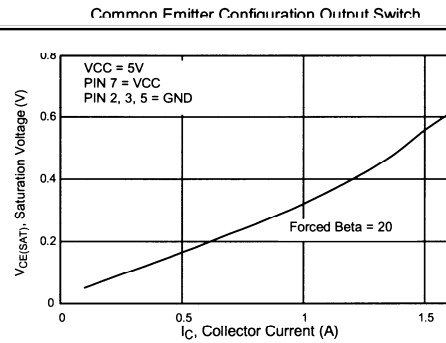
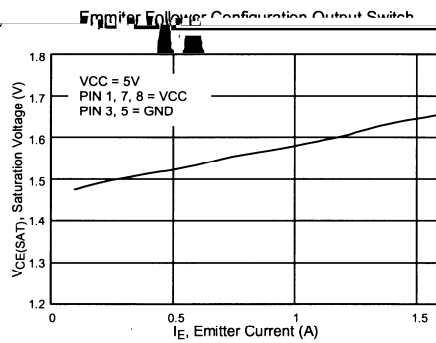
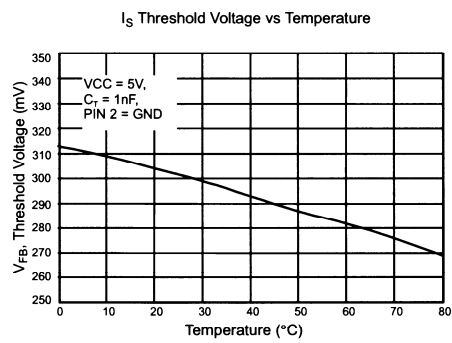
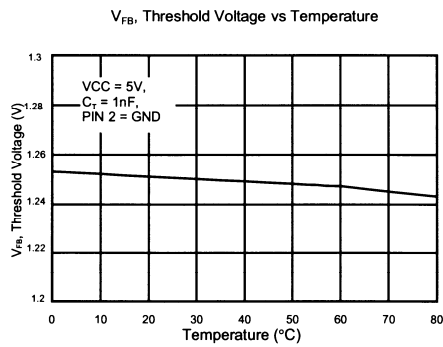
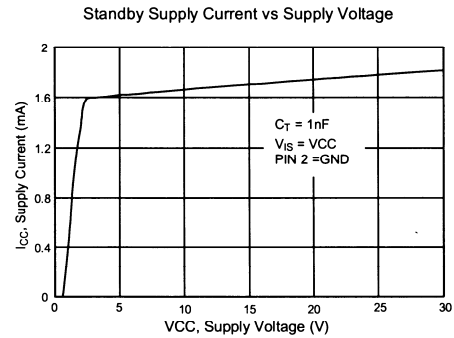
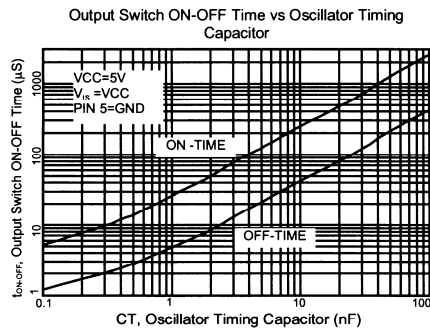
TYPICAL APPLICATION CIRCUIT



EFFICIENCY vs OUTPUT CURRENT

UTC 3563 LINEAR INTEGRATED CIRCUIT

TYPICAL PERFORMANCE CHARACTERISTICS



APPLICATION INFORMATION

DESIGN FORMULA TABLE

CALCULATION	STEP-DOWN	STEP-UP
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	$4 \times 10^{-5} t_{ON}$	$4 \times 10^{-5} t_{ON}$
$I_{C(SWITCH)}$	$2I_{OUT(MAX)}$	$2I_{OUT(MAX)} \left(\frac{t_{ON} + t_{OFF}}{t_{OFF}} \right)$
R_S	$0.3/I_{C(SWITCH)}$	$0.3/I_{C(SWITCH)}$
$L(MIN)$	$\left(\frac{V_{IN(MIN)}-V_{SAT}-V_{OUT}}{I_{C(SWITCH)}} \right) t_{ON(MAX)}$	$\left(\frac{V_{IN(MIN)} - V_{SAT}}{I_{C(SWITCH)}} \right) t_{ON(MAX)}$
C_O	$\frac{I_{C(SWITCH)} (t_{ON}+t_{OFF})}{8V_{RIPPLE(P-P)}}$	$\frac{I_{OUT} t_{ON}}{V_{RIPPLE(P-P)}}$

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, $V_{OUT}=1.25(1+R_B/R_A)$

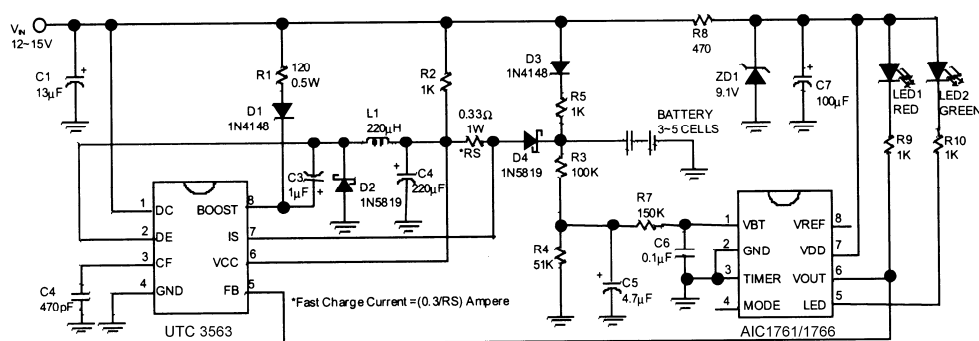
I_{OUT} : Desired output current

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



LINEAR INTEGRATED CIRCUIT

*Iron Powder Core
 ** 3-5 NiMH NiCd Cells

Note: Charge Current: 0.3V/RS Ampere
 Safety Timer=80 min.
 $\Delta T/\Delta t=1^{\circ}\text{C}/\text{min.}$

The circuit diagram shows a boost converter. The input voltage V_{IN} (8V~25V) is connected to the non-inverting input (pin 6) of the op-amp. A resistor R_S (0.22) is connected between the input and the non-inverting input. A capacitor C_1 (100 μ F) is connected between the input and ground. The op-amp's output (pin 1) is connected to the anode of diode D_2 (1N4148). The cathode of D_2 is connected to the anode of diode D_3 (1N4148). The cathode of D_3 is connected to the output terminal (5V/1A). A capacitor C_3 (1 μ F) is connected between the output and the non-inverting input. A resistor R_1 (470) is connected between the output and the non-inverting input. A resistor R_2 (390K) is connected between the output and the inverting input (pin 5). A capacitor C_2 (1000pF) is connected between the inverting input and ground. A resistor R_3 (2.2M) is connected between the inverting input and the output. A diode D_1 (1N5819) is connected between the output and ground. A capacitor C_4 (470 μ F) is connected between the output and ground. A resistor R_B (3K) is connected between the output and ground. A resistor R_A (1K) is connected between the output and ground.

When $V_{IN} > 15V$,
Then, $R_1 = 1K$

UTC UNISONIC TECHNOLOGIES CO., LTD.

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

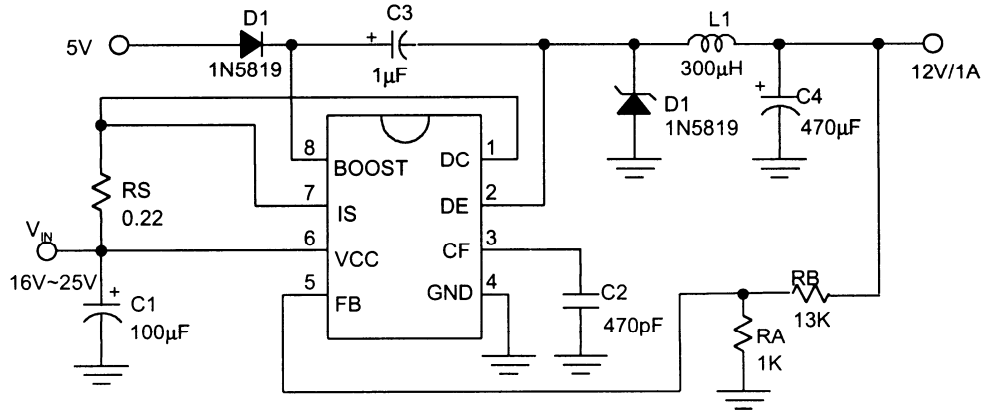
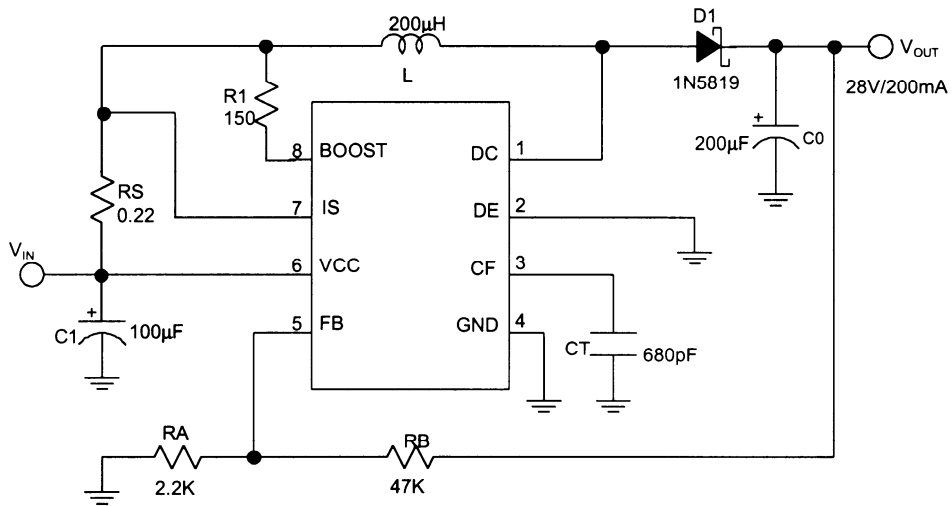


Fig. 5 Step-Up Converter



Line regulation: 100mV ($V_{IN}=8V\sim16V$, @ $I_O=200mA$)

Load regulation: 40mV ($V_{IN}=12V$, @ $I_O=80mA\sim200mA$)

Fig. 6 Step-Up Converter with External NPN Switch

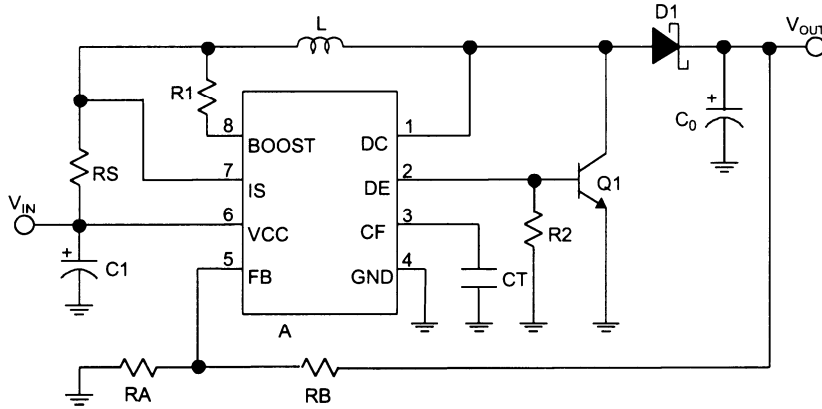
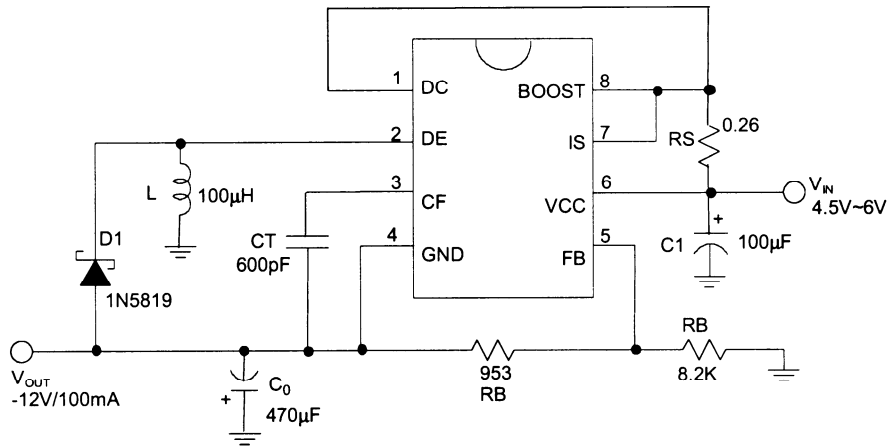


Fig. 7 Inverting Converter



Line regulation: 20mV ($V_{IN}=4.5V\sim6V$, @ $I_O=100mA$)
Load regulation: 100mV ($V_{IN}=5V$, @ $I_O=10mA\sim100mA$)

UTC assumes no responsibility for equipment failures that result from using products at values that exceed, even momentarily, rated values (such as maximum ratings, operating condition ranges, or other parameters) listed in products specifications of any and all UTC products described or contained herein. UTC products are not designed for use in life support appliances, devices or systems where malfunction of these products can be reasonably expected to result in personal injury. Reproduction in whole or in part is prohibited without the prior written consent of the copyright owner. The information presented in this document does not form part of any quotation or contract, is believed to be accurate and reliable and may be changed without notice.