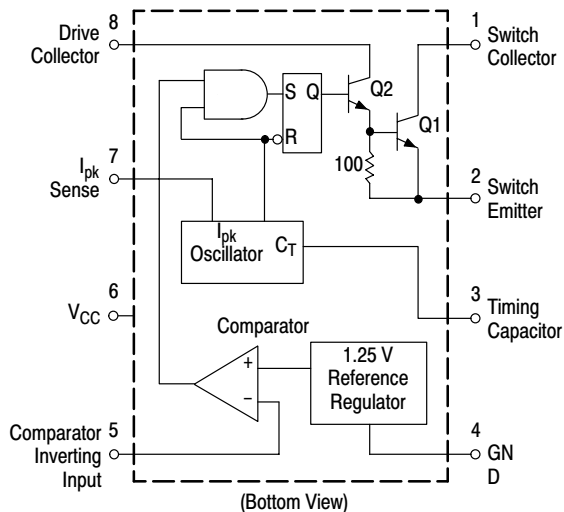
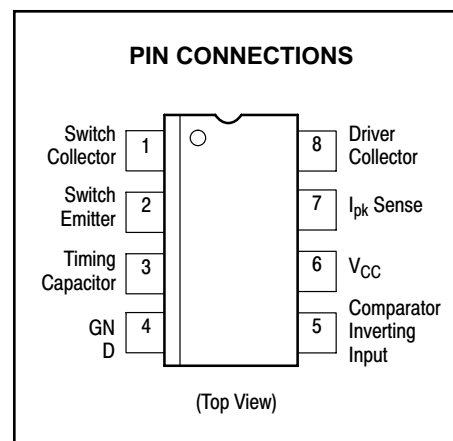
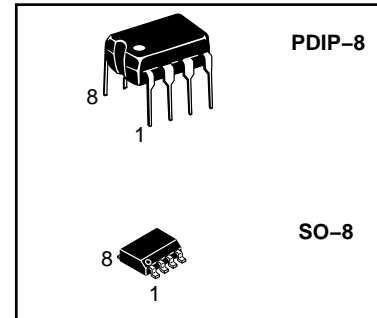


# S34063

## DC-to-DC Converter Control Circuits

The STC 34063 Series is a monolithic control circuit containing the primary functions required for DC-to-DC converters. These devices consist of an internal temperature compensated reference, comparator, controlled duty cycle oscillator with an active current limit circuit, driver and high current output switch. This series was specifically designed to be incorporated in Step-Down and Step-Up and Voltage-Inverting applications with a minimum number of external components.

- Operation from 2.5 V to 30 V Input
- Low Standby Current
- Current Limiting
- Output Switch Current to 1.5 A
- Output Voltage Adjustable from 1.25 to 30V
- Frequency Operation from 100Hz to 100 kHz
- Precision 1% Reference



This device contains 51 active transistors.

**Figure 1. Representative Schematic Diagram**

## MAXIMUM RATINGS

Rating	Symbol	Value	Unit
Power Supply Voltage	$V_{CC}$	40	Vdc
Comparator Input Voltage Range	$V_{IR}$	-0.3 to +40	Vdc
Switch Collector Voltage	$V_{C(switch)}$	40	Vdc
Switch Emitter Voltage ( $V_{Pin\ 1} = 40\text{ V}$ )	$V_{E(switch)}$	40	Vdc
Switch Collector to Emitter Voltage	$V_{CE(switch)}$	40	Vdc
Driver Collector Voltage	$V_{C(driver)}$	40	Vdc
Driver Collector Current (Note 1)	$I_{C(driver)}$	100	mA
Switch Current	$I_{SW}$	1.5	A
Power Dissipation and Thermal Characteristics			
Plastic Package, P, P1 Suffix			
$T_A = 25^\circ\text{C}$	$P_D$	1.25	W
Thermal Resistance	$R_{\theta JA}$	100	$^\circ\text{C/W}$
SOIC Package, D Suffix			
$T_A = 25^\circ\text{C}$	$P_D$	625	mW
Thermal Resistance	$R_{\theta JA}$	160	$^\circ\text{C/W}$
Operating Junction Temperature	$T_J$	+150	$^\circ\text{C}$
Operating Ambient Temperature Range			
S3406		0 to +70	
Storage Temperature Range	$T_{stg}$	-65 to +150	$^\circ\text{C}$

ELECTRICAL CHARACTERISTICS ( $V_{CC} = 5.0\text{ V}$ ,  $T_A = T_{low}$  to  $T_{high}$  [Note 4], unless otherwise specified.)

Characteristics	Symbol	Min	Typ	Max	Unit
-----------------	--------	-----	-----	-----	------

## OSCILLATOR

Frequency ( $V_{Pin\ 5} = 0\text{ V}$ , $C_T = 1.0\text{ nF}$ , $T_A = 25^\circ\text{C}$ )	$f_{osc}$	24	33	42	kHz
Charge Current ( $V_{CC} = 5.0\text{ V to }40\text{ V}$ , $T_A = 25^\circ\text{C}$ )	$I_{chg}$	24	35	42	$\mu\text{A}$
Discharge Current ( $V_{CC} = 5.0\text{ V to }40\text{ V}$ , $T_A = 25^\circ\text{C}$ )	$I_{dischg}$	140	220	260	$\mu\text{A}$
Discharge to Charge Current Ratio (Pin 7 to $V_{CC}$ , $T_A = 25^\circ\text{C}$ )	$I_{dischg}/I_{chg}$	5.2	6.5	7.5	-
Current Limit Sense Voltage ( $I_{chg} = I_{dischg}$ , $T_A = 25^\circ\text{C}$ )	$V_{ipk(sense)}$	250	300	350	mV

## OUTPUT SWITCH (Note 5)

Saturation Voltage, Darlington Connection ( $I_{SW} = 1.0\text{ A}$ , Pins 1, 8 connected)	$V_{CE(sat)}$	-	1.0	1.3	V
Saturation Voltage (Note 6) ( $I_{SW} = 1.0\text{ A}$ , $R_{Pin\ 8} = 82\ \Omega$ to $V_{CC}$ , Forced $\beta \approx 20$ )	$V_{CE(sat)}$	-	0.45	0.7	V
DC Current Gain ( $I_{SW} = 1.0\text{ A}$ , $V_{CE} = 5.0\text{ V}$ , $T_A = 25^\circ\text{C}$ )	$h_{FE}$	50	75	-	-
Collector Off-State Current ( $V_{CE} = 40\text{ V}$ )	$I_{C(off)}$	-	0.01	100	$\mu\text{A}$

## COMPARATOR

Threshold Voltage $T_A = 25^\circ\text{C}$ $T_A = T_{low}$ to $T_{high}$	$V_{th}$	1.225 1.21	1.25 -	1.275 1.29	V
Threshold Voltage Line Regulation ( $V_{CC} = 5.0\text{ V to }40\text{ V}$ ) S34063 S33063	$Reg_{line}$	- -	1.4 1.4	5.0 6.0	mV
Input Bias Current ( $V_{in} = 0\text{ V}$ )	$I_{IB}$	-	-20	-400	nA

## TOTAL DEVICE

Supply Current ( $V_{CC} = 5.0\text{ V to }40\text{ V}$ , $C_T = 1.0\text{ nF}$ , Pin 7 = $V_{CC}$ , $V_{Pin\ 5} > V_{th}$ , Pin 2 = GND, remaining pins open)	$I_{CC}$	-	-	4.0	mA
-------------------------------------------------------------------------------------------------------------------------------------------------------------------	----------	---	---	-----	----

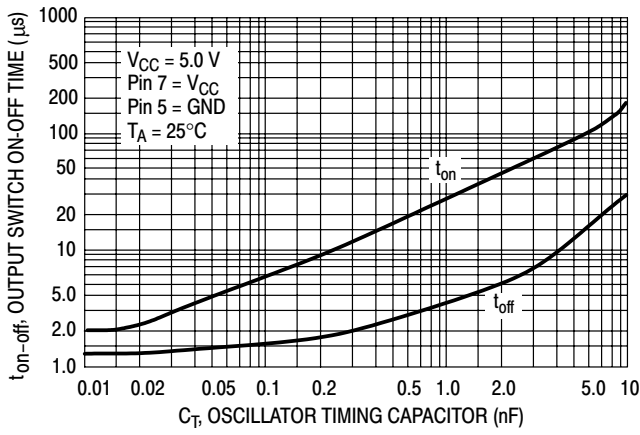


Figure 2. Output Switch On-Off Time versus Oscillator Timing Capacitor

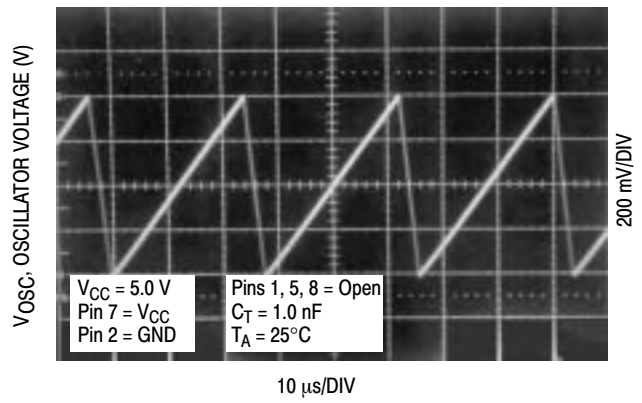


Figure 3. Timing Capacitor Waveform

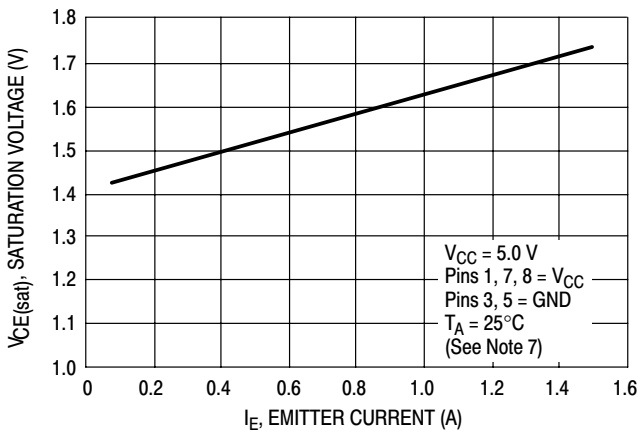


Figure 4. Emitter Follower Configuration Output Saturation Voltage versus Emitter Current

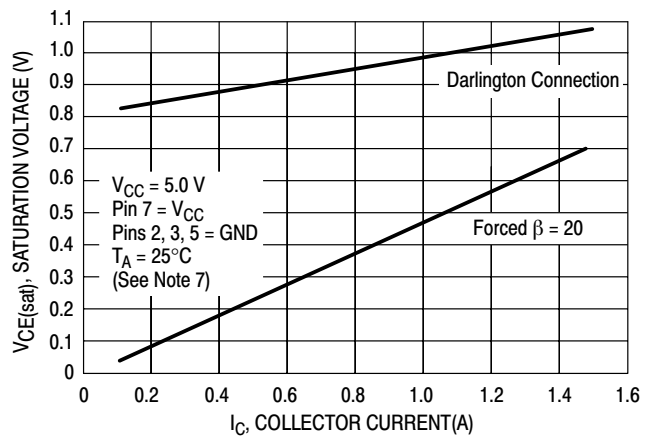


Figure 5. Common Emitter Configuration Output Switch Saturation Voltage versus Collector Current

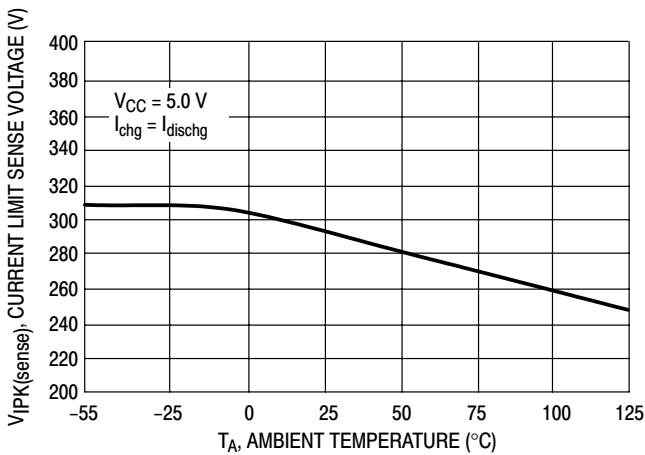


Figure 6. Current Limit Sense Voltage versus Temperature

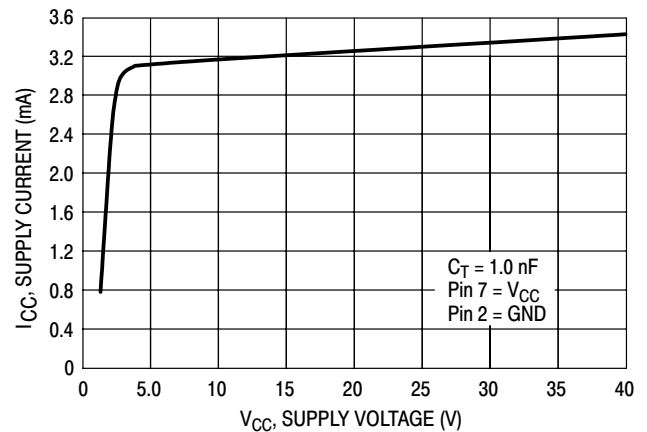
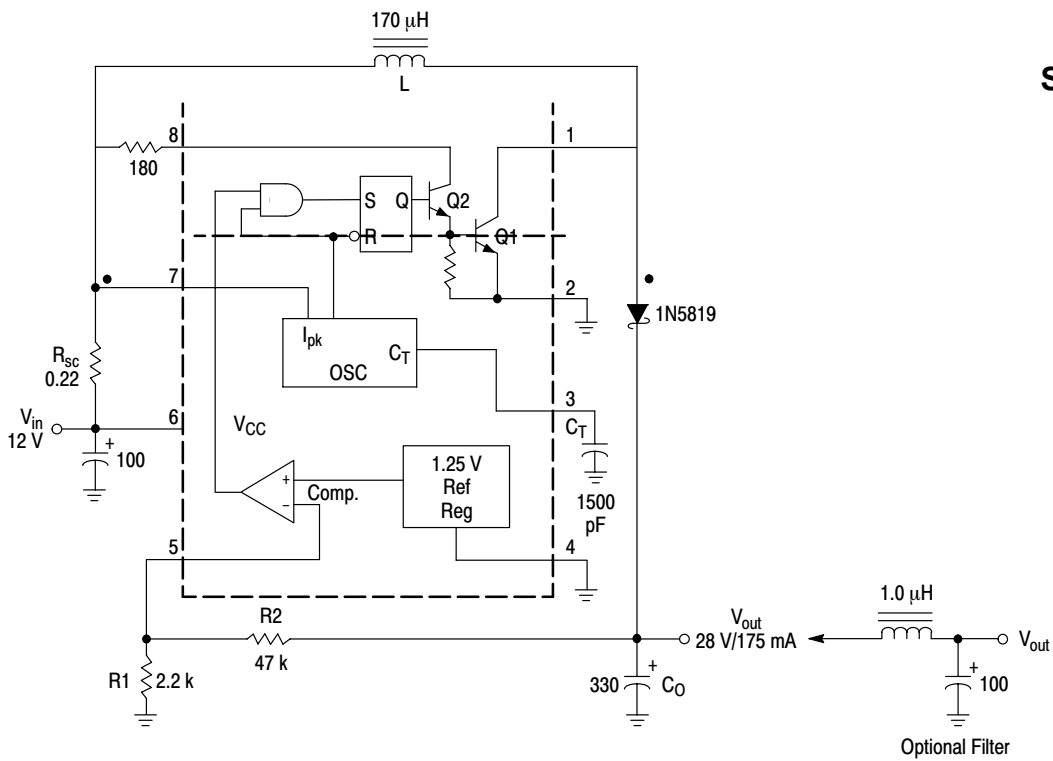


Figure 7. Standby Supply Current versus Supply Voltage

7. Low duty cycle pulse techniques are used during test to maintain junction temperature as close to ambient temperature as possible.



Test	Conditions	Results
Line Regulation	$V_{in} = 8.0 \text{ V to } 16 \text{ V}, I_O = 175 \text{ mA}$	$30 \text{ mV} = \pm 0.05\%$
Load Regulation	$V_{in} = 12 \text{ V}, I_O = 75 \text{ mA to } 175 \text{ mA}$	$10 \text{ mV} = \pm 0.017\%$
Output Ripple	$V_{in} = 12 \text{ V}, I_O = 175 \text{ mA}$	$400 \text{ mVpp}$
Efficiency	$V_{in} = 12 \text{ V}, I_O = 175 \text{ mA}$	$87.7\%$
Output Ripple With Optional Filter	$V_{in} = 12 \text{ V}, I_O = 175 \text{ mA}$	$40 \text{ mVpp}$

Figure 8. Step-Up Converter

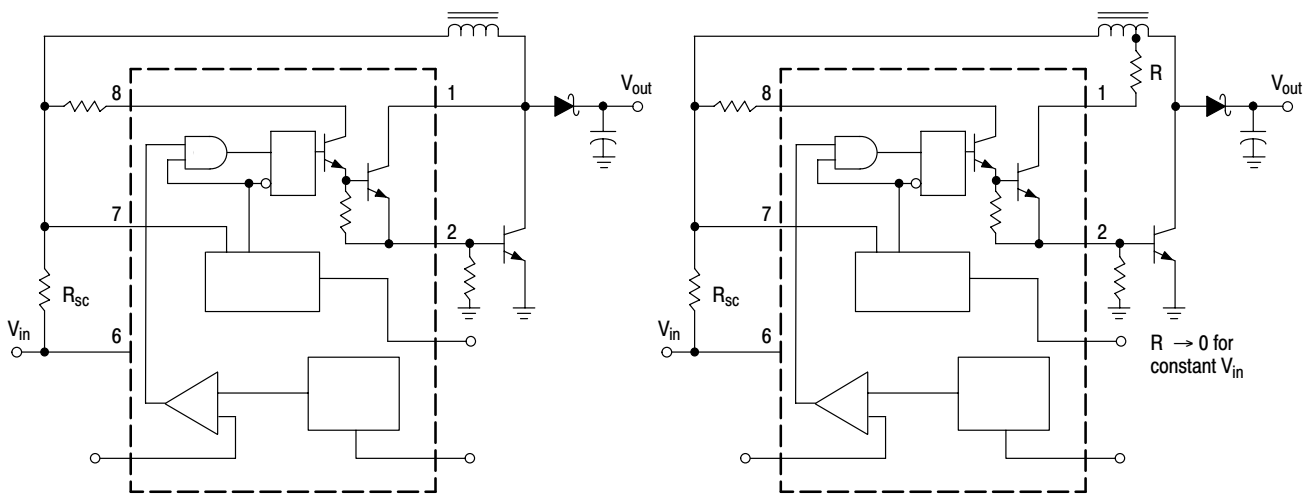


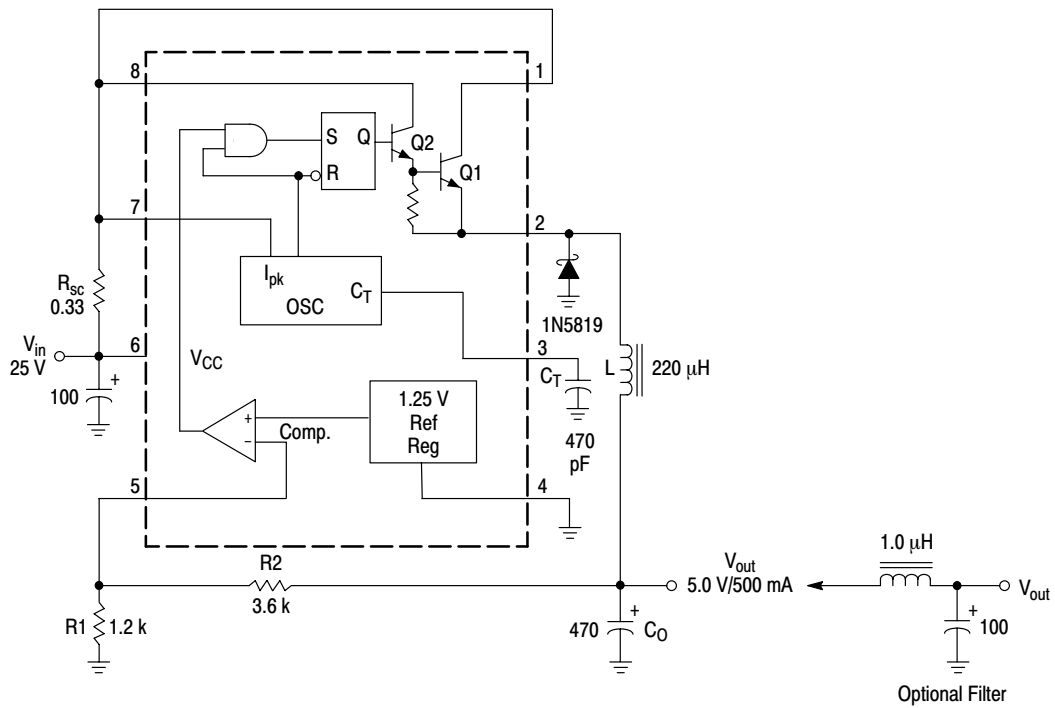
Figure 9. External Current Boost Connections for  $I_C$  Peak Greater than 1.5 A

9a. External NPN Switch

9b. External NPN Saturated Switch

(See Note 8)

8. If the output switch is driven into hard saturation (non-Darlington configuration) at low switch currents ( $\leq 300 \text{ mA}$ ) and high driver currents ( $\geq 30 \text{ mA}$ ), it may take up to  $2.0 \mu\text{s}$  to come out of saturation. This condition will shorten the off time at frequencies  $\geq 30 \text{ kHz}$ , and is magnified at high temperatures. This condition does not occur with a Darlington configuration, since the output switch cannot saturate. If a non-Darlington configuration is used, the following output drive condition is recommended.



Test	Conditions	Results
Line Regulation	$V_{in} = 15 \text{ V to } 25 \text{ V}, I_O = 500 \text{ mA}$	12 mV = $\pm 0.12\%$
Load Regulation	$V_{in} = 25 \text{ V}, I_O = 50 \text{ mA to } 500 \text{ mA}$	3.0 mV = $\pm 0.03\%$
Output Ripple	$V_{in} = 25 \text{ V}, I_O = 500 \text{ mA}$	120 mVpp
Short Circuit Current	$V_{in} = 25 \text{ V}, R_L = 0.1 \Omega$	1.1 A
Efficiency	$V_{in} = 25 \text{ V}, I_O = 500 \text{ mA}$	83.7%
Output Ripple With Optional Filter	$V_{in} = 25 \text{ V}, I_O = 500 \text{ mA}$	40 mVpp

Figure 10. Step-Down Converter

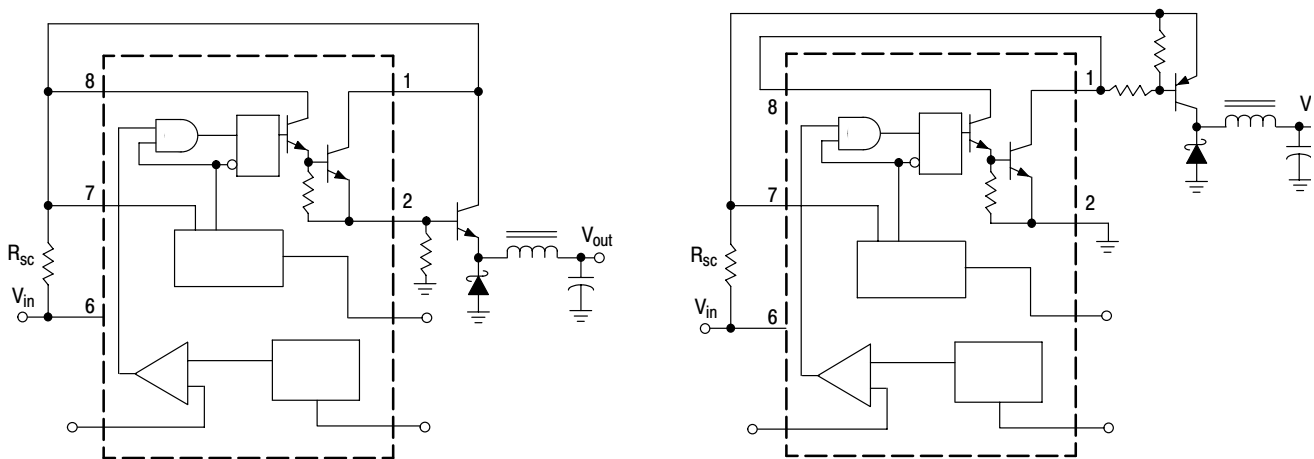
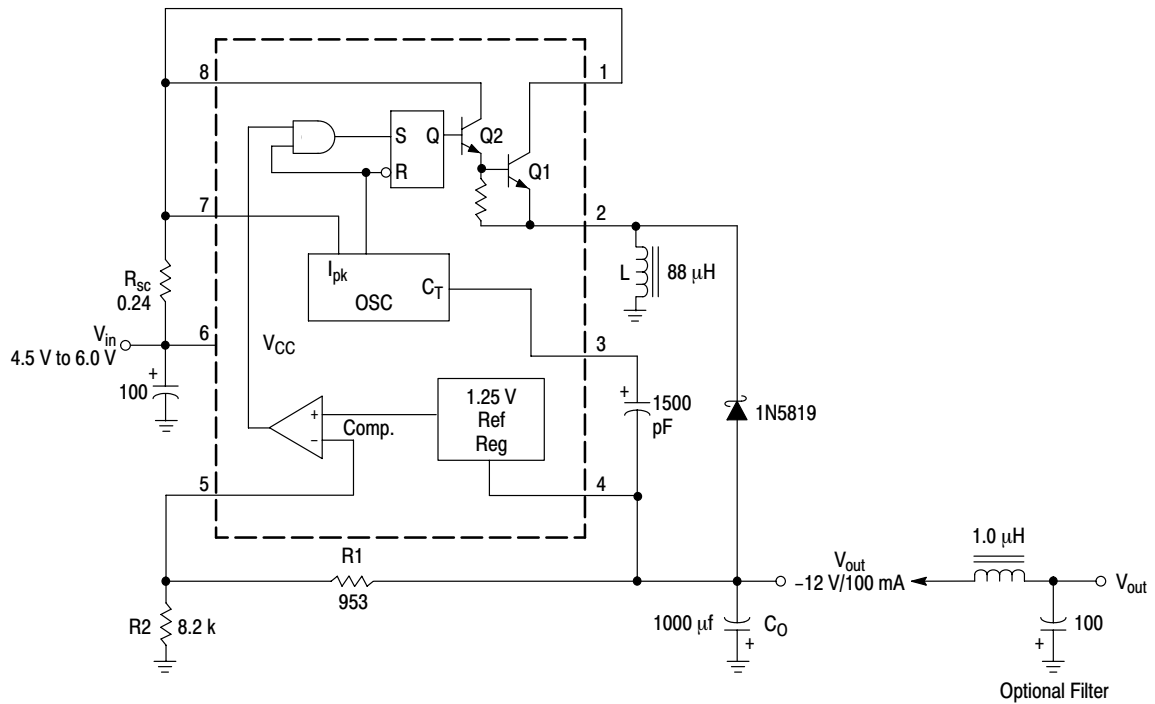


Figure 11. External Current Boost Connections for  $I_C$  Peak Greater than 1.5 A

11a. External NPN Switch

11b. External PNP Saturated Switch



Test	Conditions	Results
Line Regulation	$V_{in} = 4.5 \text{ V to } 6.0 \text{ V}, I_O = 100 \text{ mA}$	$3.0 \text{ mV} = \pm 0.012\%$
Load Regulation	$V_{in} = 5.0 \text{ V}, I_O = 10 \text{ mA to } 100 \text{ mA}$	$0.022 \text{ V} = \pm 0.09\%$
Output Ripple	$V_{in} = 5.0 \text{ V}, I_O = 100 \text{ mA}$	$500 \text{ mVpp}$
Short Circuit Current	$V_{in} = 5.0 \text{ V}, R_L = 0.1 \Omega$	$910 \text{ mA}$
Efficiency	$V_{in} = 5.0 \text{ V}, I_O = 100 \text{ mA}$	$62.2\%$
Output Ripple With Optional Filter	$V_{in} = 5.0 \text{ V}, I_O = 100 \text{ mA}$	$70 \text{ mVpp}$

Figure 12. Voltage Inverting Converter

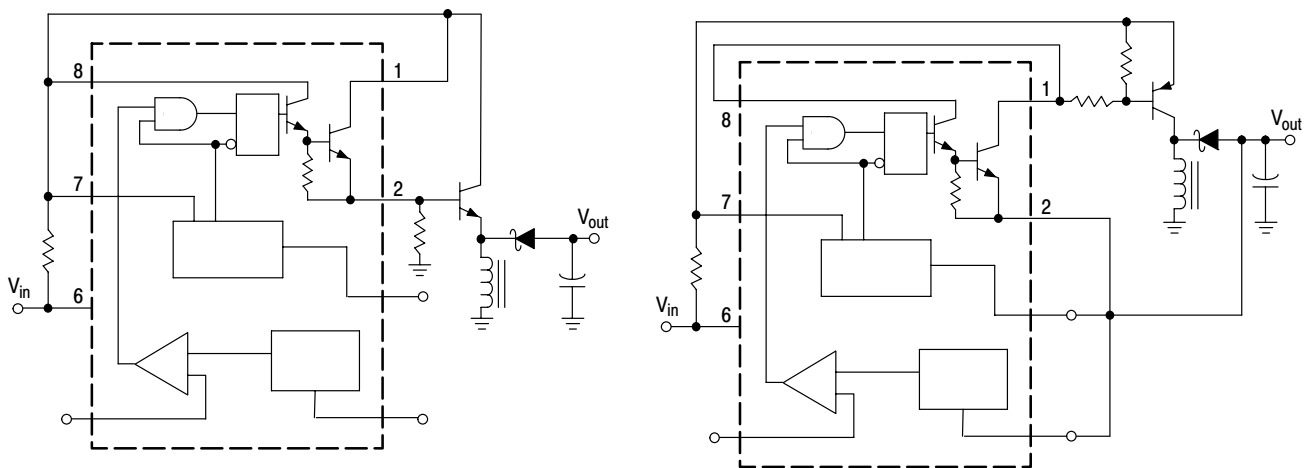


Figure 13. External Current Boost Connections for  $I_C$  Peak Greater than 1.5 A

13a. External NPN Switch

13b. External PNP Saturated Switch