MC34063A
1.5 A, Step-Up/Down/Inverting Switching Regulators

DESCRIPTION

The MC34063A 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.

FEATURES

- Operation from 3.0 V to 40 V Input
- Low Standby Current
- Current Limiting
- Output Switch Current to 1.5 A
- Output Voltage Adjustable
- Frequency Operation to 100 kHz
- Precision 2% Reference
- Plug-in replacement of On Semi. MC34063A

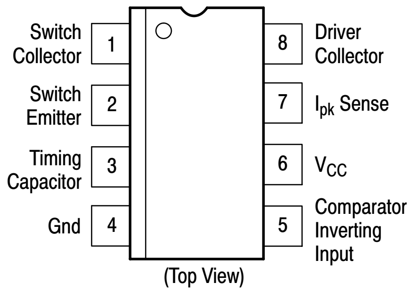
APPLICATIONS

- Chargers
- Adaptors
- Mother Board
- Scanner
- Server for Cellular Phones
- DC-DC Converter Module

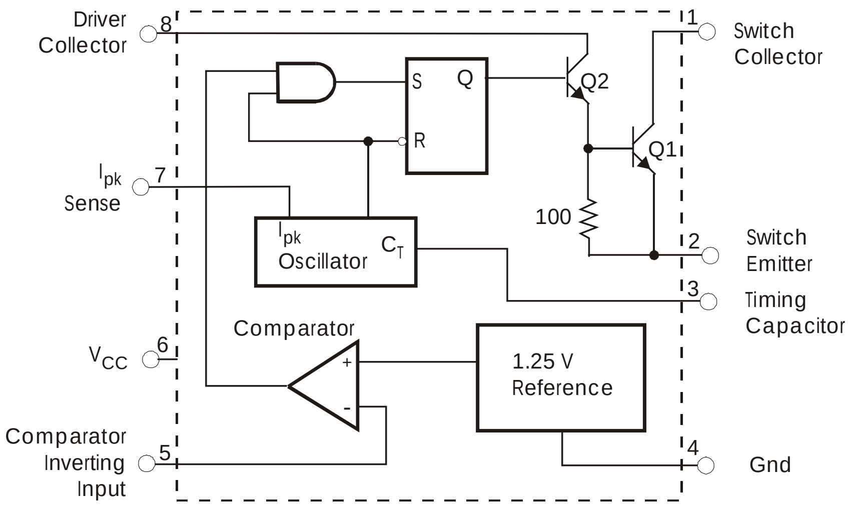
ORDERING INFORMATION

PART NO.	Temp. Range (°C)	Package
MC34063AP	0 to 70	8 Pin DIP
MC34063AM	0 to 70	8 Pin SOP

PINOUT



SCHEMATIC DIAGRAM



ABSOLUTE MAXIMUM RATINGS

Symbol	Parameter	Maximum	Units
V_{CC}	Power Supply Voltage	40	Vdc
V_{IR}	Comparator Input Voltage Range	-0.3 to +40	Vdc
$V_{C(switch)}$	Switch Collector Voltage	40	Vdc
$V_{E(switch)}$	Switch Emitter Voltage (V_{PIN1} = 40 V)	40	Vdc
$V_{CE(switch)}$	Switch Collector to Emitter Voltage	40	Vdc
$V_{C(driver)}$	Driver Collector Voltage	40	Vdc
$I_{C(driver)}$	Driver Collector Current (Note 1)	100	mA
I_{SW}	Switch Current	1.5	A
T_J	Operating Junction Temperature	+150	℃
T_A	Operating Ambient Temperature Range	0 to +70	℃
Tstg	Storage Temperature Range	-65 to +150	℃

ELECTRICAL CHARACTERISTICS

(Vcc = 5.0 V, $T_A = T_{low}$ to T_{high} , unless otherwise specified.)

Characteristics	Symbol	Min	Typ	Max	Units
OSCILLATOR					
Frequency (V_{pin5} = 0V, C_T = 1.0 nF, T_A = 25°C)	f_{OSC}	24	33	42	kHz
Charge Current(V_{CC} = 5.0V to 40V, T_A = 25°C)	I_{chg}	24	35	42	µA
Discharge Current (V_{CC} = 5.0V to 40V, T_A = 25°C)	I_{dischg}	140	220	260	µA
Discharge to Charge Current Ratio (Pin 7 to V_{CC}, T_A = 25°C)	I_{dischg} / I_{chg}	5.2	6.5	7.5	–
Current Limit Sense Voltage ($I_{chg} = I_{dischg}$, T_A = 25°C)	$V_{ipk(sence)}$	250	300	350	mV
OUTPUT SWITCH (NOTE 2)					
Saturation Voltage, Darlington Connection (I_{SW} = 1.0 A, Pins 1, 8 connected)	$V_{CE(sat)}$	–	1.0	1.3	V
Saturation Voltage, Darlington Connection (I_{SW} = 1.0 A, $R_{pin\,8}$ = 82Ω to V_{CC} , Forced $\beta \cong 20$)	$V_{CE(sat)}$	–	0.45	0.7	V
DC Current Gain (I_{SW} = 1.0 A, V_{CE} = 5.0 V, T_A = 25°C)	h_{FE}	50	75	–	–
Collector Off-State Current (V_{CE} = 40 V)	$I_{C(off)}$	–	40	100	µA
COMPARATOR					
Threshold Voltage (T_A=25°C) ($T_A=T_{low}$ to T_{high})	Vth	 1.225 1.21	 1.25 –	 1.275 1.29	V
Threshold Voltage Line Regulation (Vcc=3.0 V to 40 V)	Reg_{line}	–	1.4	5.0	mV
Input Bias Current (Vin=0 V)	I_{IB}	–	-20	-400	nA
TOTAL DEVICE					
Supply Current (Vcc = 5.0 V to 40 V, C_T = 1.0 nF, Pin 7 = V_{CC}, Vpin 5 > Vth, Pin 2 = Gnd, remaining pins open)	I_{CC}	–	–	4.0	mA

Note1: Maximum package power dissipation limits must be observed.

Note2: Low duty cycle pulse techniques are used during test to maintain junction temperature as close to ambient temperature as possible.

Typical Performance Characteristics

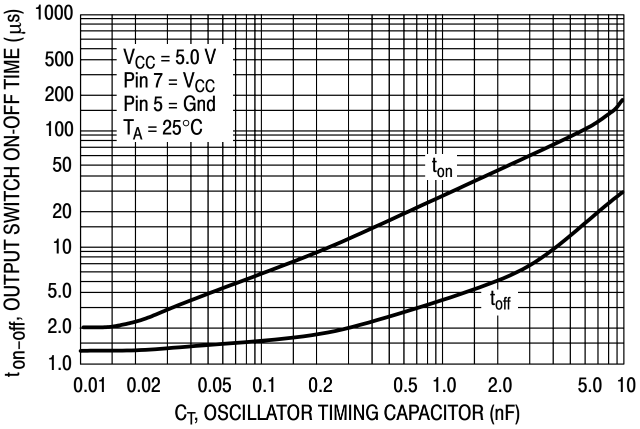


Figure 1. Output Switch On–Off Time versus Oscillator Timing Capacitor

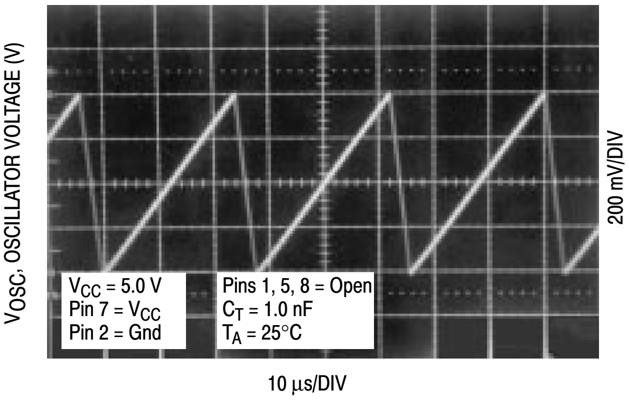


Figure 2. Timing Capacitor Waveform

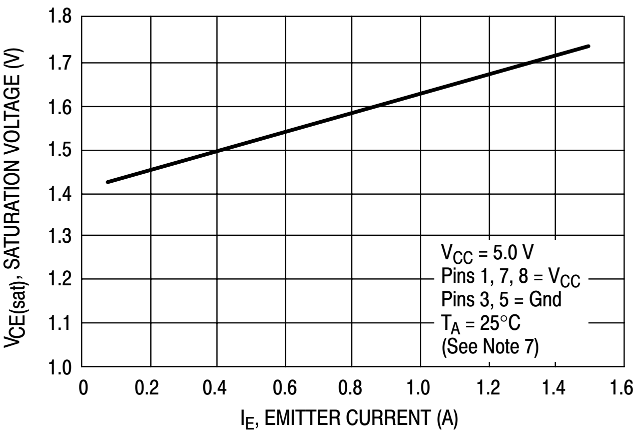


Figure 3. Emitter Follower Configuration Output Saturation Voltage versus Emitter Current

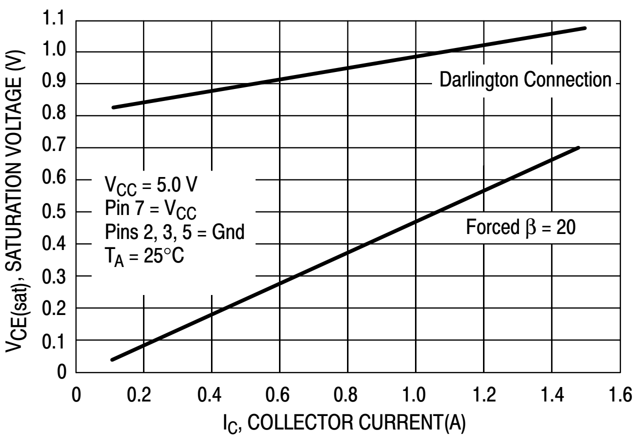


Figure 4. Common Emitter Configuration Output Switch Saturation Voltage versus Collector Current

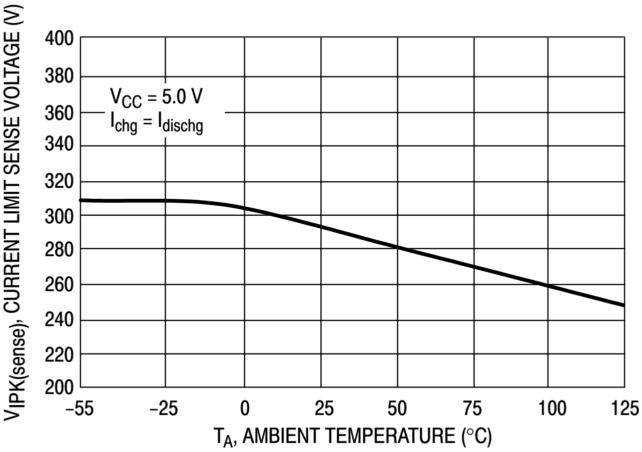


Figure 5. Current Limit Sense Voltage versus Temperature

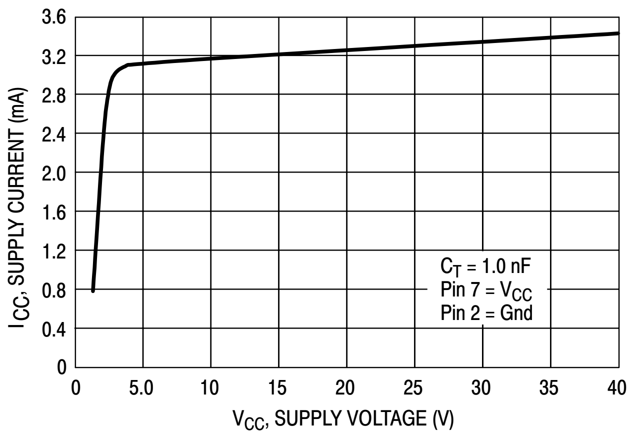
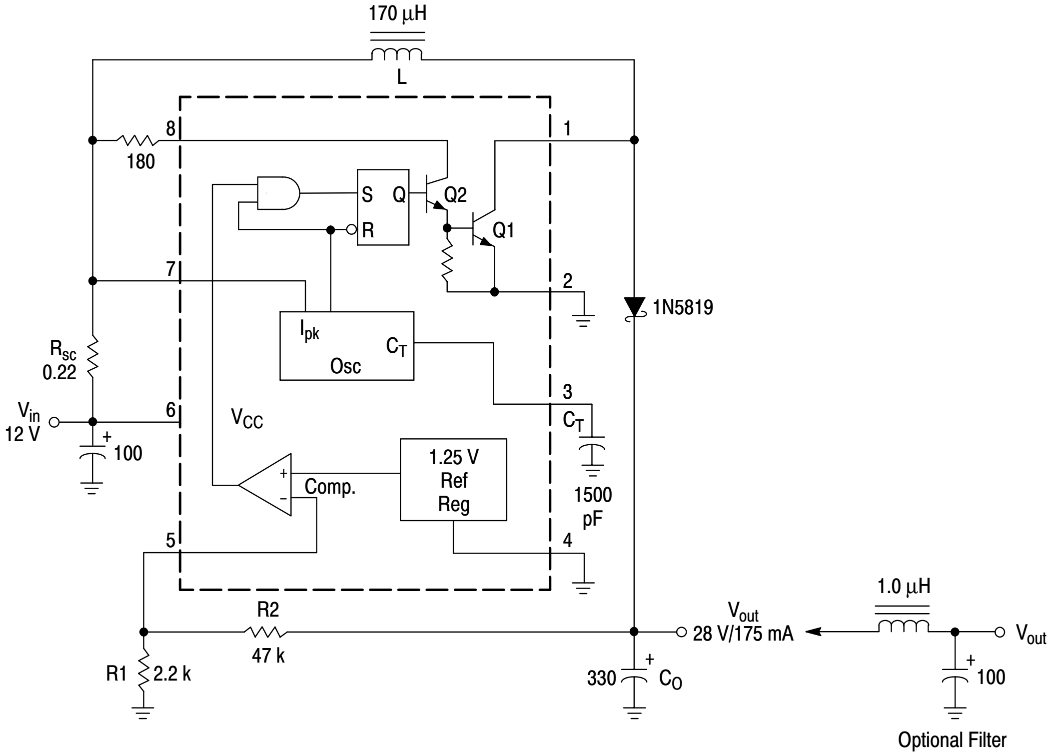


Figure 6. Standby Supply Current versus Supply Voltage

Application Information



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

Figure 7. Step–Up Converter

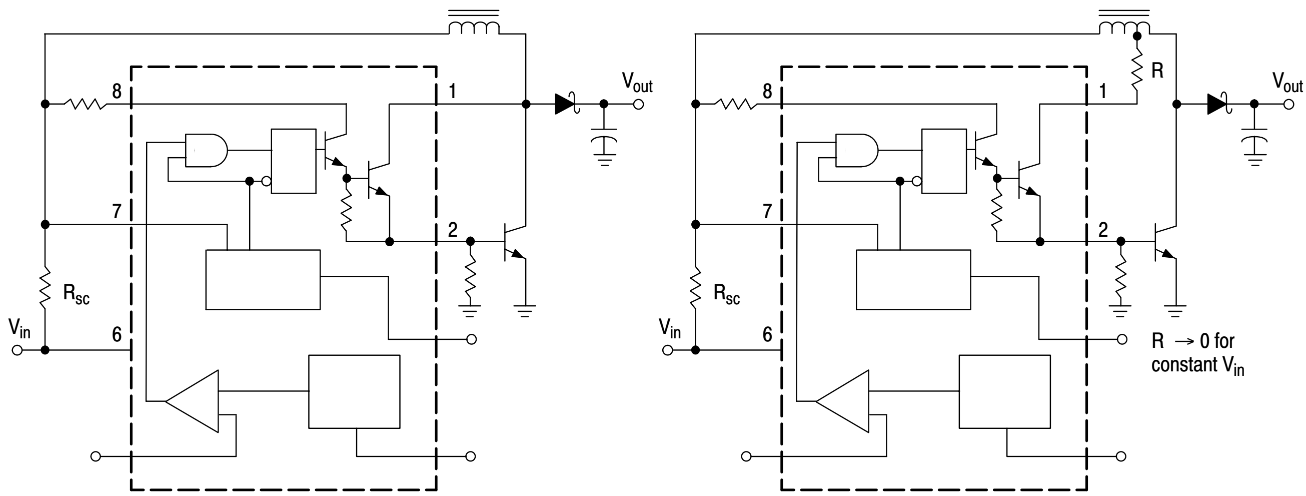
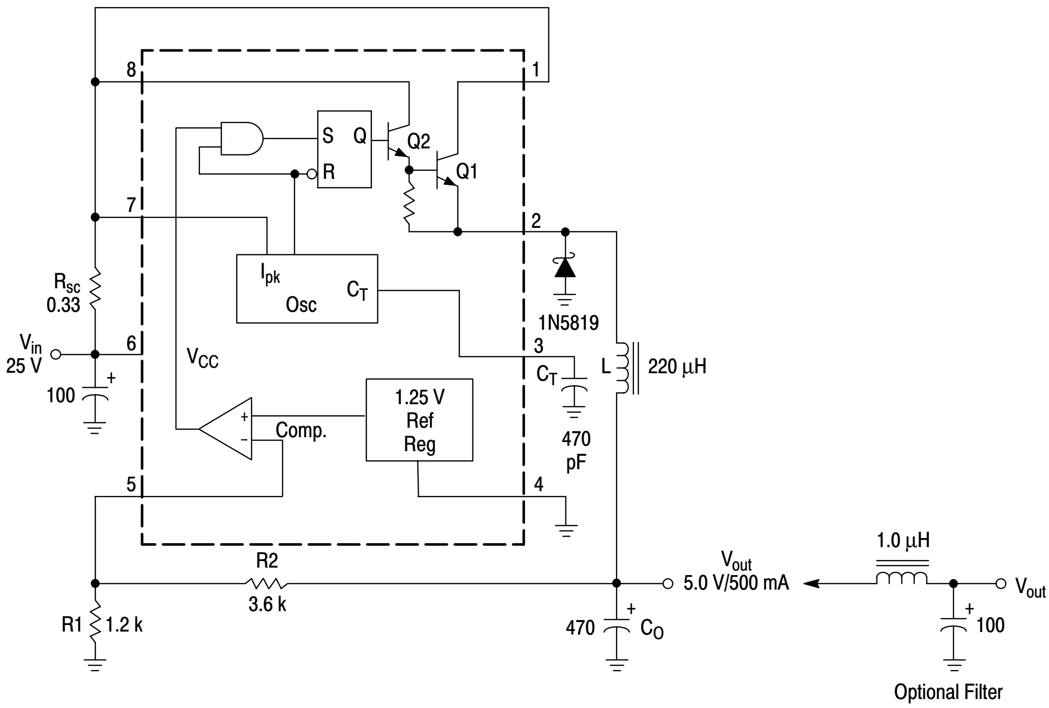


Figure 8. External Current Boost Connections for I_C Peak Greater than 1.5 A

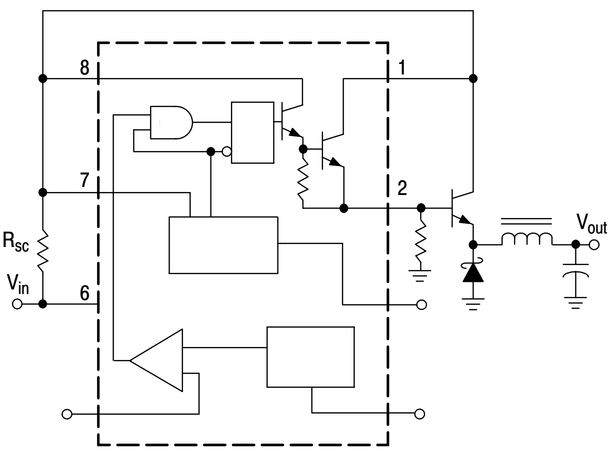
8a. External NPN Switch

8b. External NPN Saturated Switch



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

Figure 9. Step–Down Converter



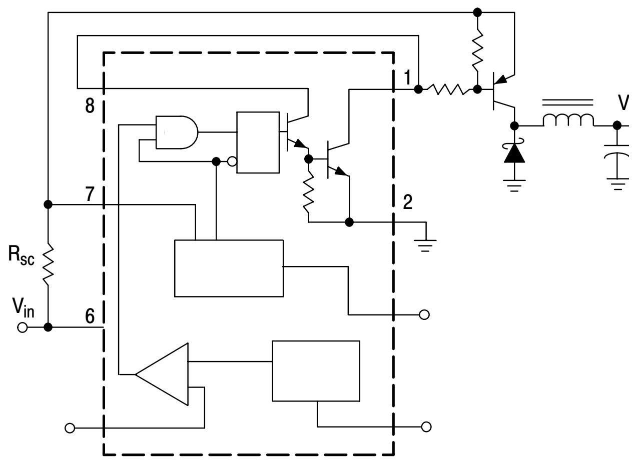
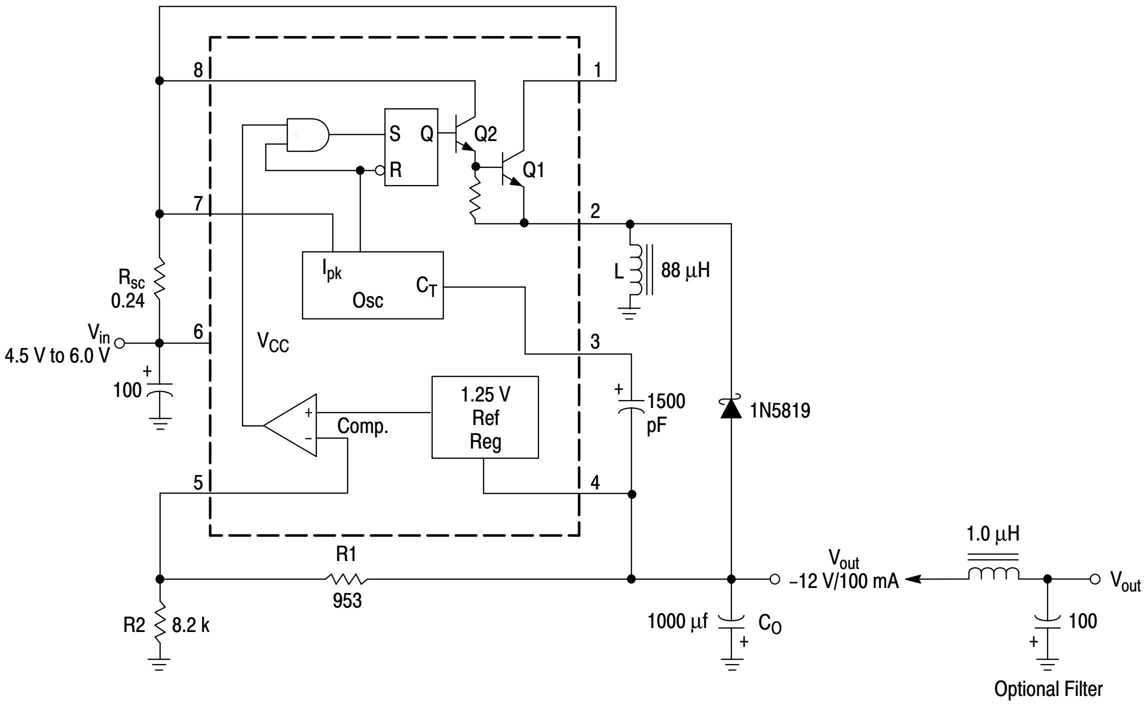


Figure 10. External Current Boost Connections for I_C Peak Greater than 1.5 A

10a. External NPN Switch

10b. External PNP Saturated Switch



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

Figure 11. Voltage Inverting Converter

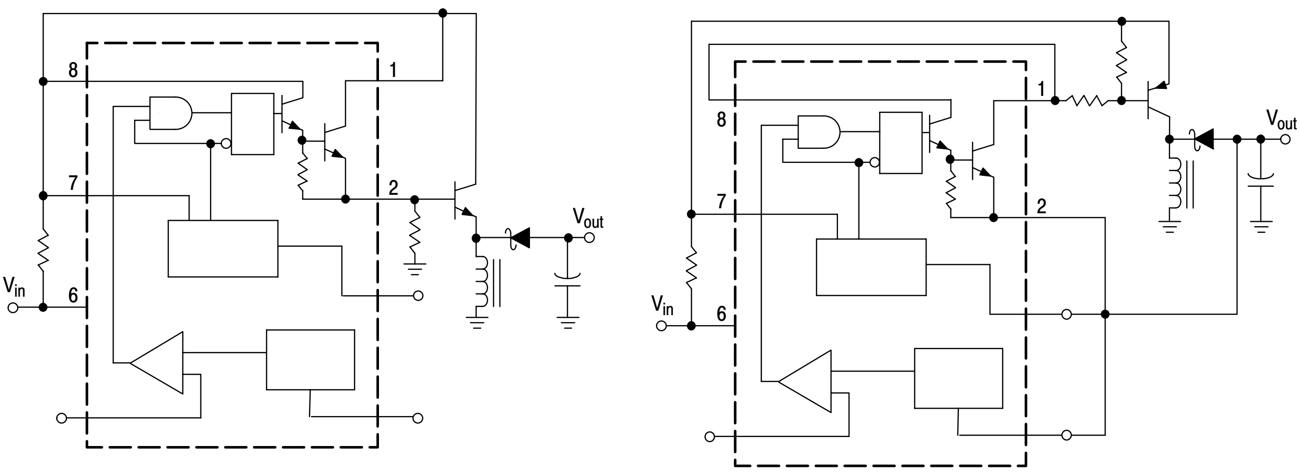


Figure 12. External Current Boost Connections for I_C Peak Greater than 1.5 A

12a. External NPN Switch **12b. External PNP Saturated Switch**

DESIGN FORMULA TABLE

Calculation	Step–Up	Step–Down	Voltage–Inverting
t_{on}/t_{off}	$\frac{V_{out} + V_F - V_{in(min)}}{V_{in(min)} - V_{sat}}$	$\frac{V_{out} + V_F}{V_{in(min)} - V_{sat} - V_{out}}$	$\frac{\lvert V_{out}\rvert + V_F}{V_{in} - V_{sat}}$
$(t_{on} + t_{off})$	$\frac{1}{f}$	$\frac{1}{f}$	$\frac{1}{f}$
t_{off}	$\frac{t_{on} + t_{off}}{\frac{t_{on}}{t_{off}} + 1}$	$\frac{t_{on} + t_{off}}{\frac{t_{on}}{t_{off}} + 1}$	$\frac{t_{on} + t_{off}}{\frac{t_{on}}{t_{off}} + 1}$
t_{on}	$(t_{on} + t_{off}) - t_{off}$	$(t_{on} + t_{off}) - t_{off}$	$(t_{on} + t_{off}) - t_{off}$
C_T	$4.0 \times 10^{-5}\ t_{on}$	$4.0 \times 10^{-5}\ t_{on}$	$4.0 \times 10^{-5}\ t_{on}$
$I_{pk(switch)}$	$2I_{out(max)}\left(\frac{t_{on}}{t_{off}} + 1\right)$	$2I_{out(max)}$	$2I_{out(max)}\left(\frac{t_{on}}{t_{off}} + 1\right)$
R_{sc}	$0.3/I_{pk(switch)}$	$0.3/I_{pk(switch)}$	$0.3/I_{pk(switch)}$
$L_{(min)}$	$\left(\frac{(V_{in(min)} - V_{sat})}{I_{pk(switch)}}\right) t_{on(max)}$	$\left(\frac{(V_{in(min)} - V_{sat} - V_{out})}{I_{pk(switch)}}\right) t_{on(max)}$	$\left(\frac{(V_{in(min)} - V_{sat})}{I_{pk(switch)}}\right) t_{on(max)}$
C_O	$9\ \frac{I_{out} t_{on}}{V_{ripple(pp)}}$	$\frac{I_{pk(switch)}(t_{on} + t_{off})}{8V_{ripple(pp)}}$	$9\ \frac{I_{out} t_{on}}{V_{ripple(pp)}}$

V_{sat} = Saturation voltage of the output switch.
V_F = Forward voltage drop of the output rectifier.

The following power supply characteristics must be chosen:

V_{in} – Nominal input voltage.
V_{out} – Desired output voltage, $\lvert V_{out}\rvert = 1.25\left(1 + \frac{R2}{R1}\right)$
I_{out} – Desired output current.
f_{min} – Minimum desired output switching frequency at the selected values of V_{in} and I_O.
$V_{ripple(pp)}$ – Desired peak–to–peak output ripple voltage. In practice, the calculated capacitor value will need to be increased due to its 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.