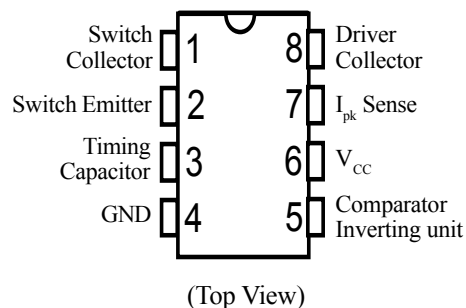


## 1.5A DC-to-DC CONVERTER CONTROL CIRCUIT

- 3.0V to 40V input
- Adjustable Output Voltage
- Current Limiting
- Output Switch Current to 1.5A
- Low Standby Current
- Operating Frequency to 100kHz
- Precision 2% Reference

The GM34063 has all the functions required for DC-to-DC converters: an internal temperature-compensated reference, comparator, controlled duty cycle oscillator with an active current limit circuit, driver, and high-current output switch. The 34063 designed for step-down, step-up and voltage-inverting applications using a minimum number of external components.

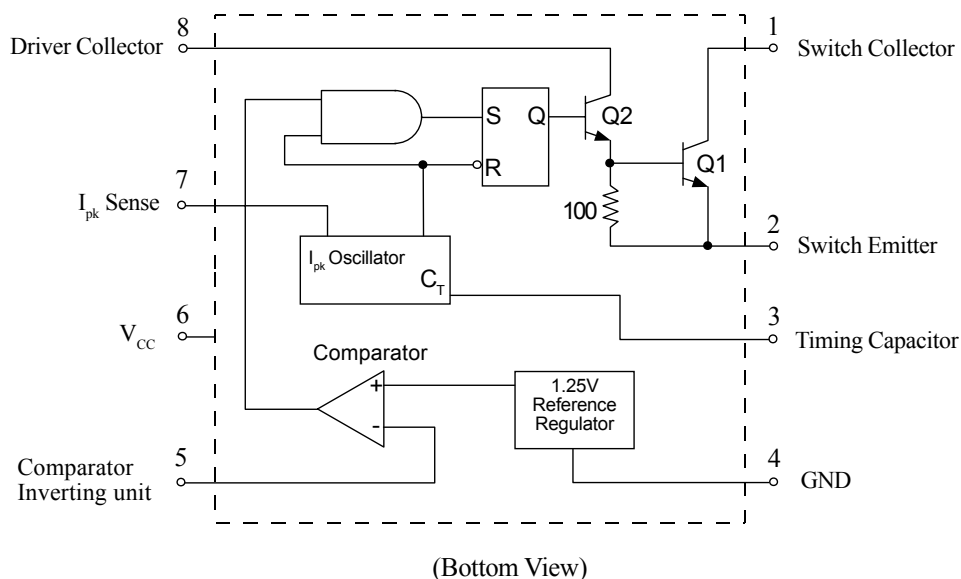
### PIN CONNECTIONS



### Applications:

- CD-ROM
- Motherboards
- SMPS Power Supply
- Battery Chargers

### SCHEMATIC DIAGRAM



\* The GM34063 has 51 active transistors on-chip.

**1.5A DC-to-DC CONVERTER CONTROL CIRCUIT**
**Absolute 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	Vc
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	$T_A$	0 to +70	$^\circ\text{C}$
Storage Temperature Range	$T_{stg}$	−65 to +150	$^\circ\text{C}$

Note 1. Maximum package power dissipation limits must be observed.

## 1.5A DC-to-DC CONVERTER CONTROL CIRCUIT

### ELECTRICAL CHARACTERISTICS

( $V_{CC} = 5.0\text{ V}$ ,  $T_A = T_{low}$  to  $T_{high}$  unless otherwise specified)

Characteristics	Symbol	Min	Typ	Max	Unit
<b>OSCILLATOR</b>					
Frequency ( $V_{Pin5} = 0\text{ V}$ , $C_T = 1.0\text{ nF}$ , $T_A = 25^\circ\text{C}$ )	$f_{osc}$	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
<b>OUTPUT SWITCH (Note 2)</b>					
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 3) ( $I_{SW} = 1.0\text{ A}$ , $R_{Pin8} = 82\ \Omega$ 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	$\mu\text{A}$
<b>COMPARATOR</b>					
Threshold Voltage $T_A = 25^\circ\text{C}$ $T_A = T_{low}$ to $T_{high}$	$V_{th}$	1.225 1.210	1.25 –	1.275 1.29	V
Threshold Voltage Line Regulation ( $V_{CC} = 3.0\text{ V}$ to $40\text{ V}$ )	$Reg_{line}$	–	1.4	5.0	mV
Input Bias Current ( $V_{in} = 0\text{ V}$ )	$I_B$	–	–20	–400	nA
<b>TOTAL DEVICE</b>					
Supply Current ( $V_{CC} = 5.0\text{ V}$ to $40\text{ V}$ , $C_T = 1.0\text{ nF}$ , Pin 7 = $V_{CC}$ , $V_{Pin5} > V_{th}$ , Pin 2 = Gnd, remaining pins open)	$I_{CC}$	–	–	4.0	mA

Note 2. Low duty cycle pulse techniques are used during test to maintain junction temperature as close to ambient as possible.

Note 3. 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  $2.0\ \mu\text{s}$  for it 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:

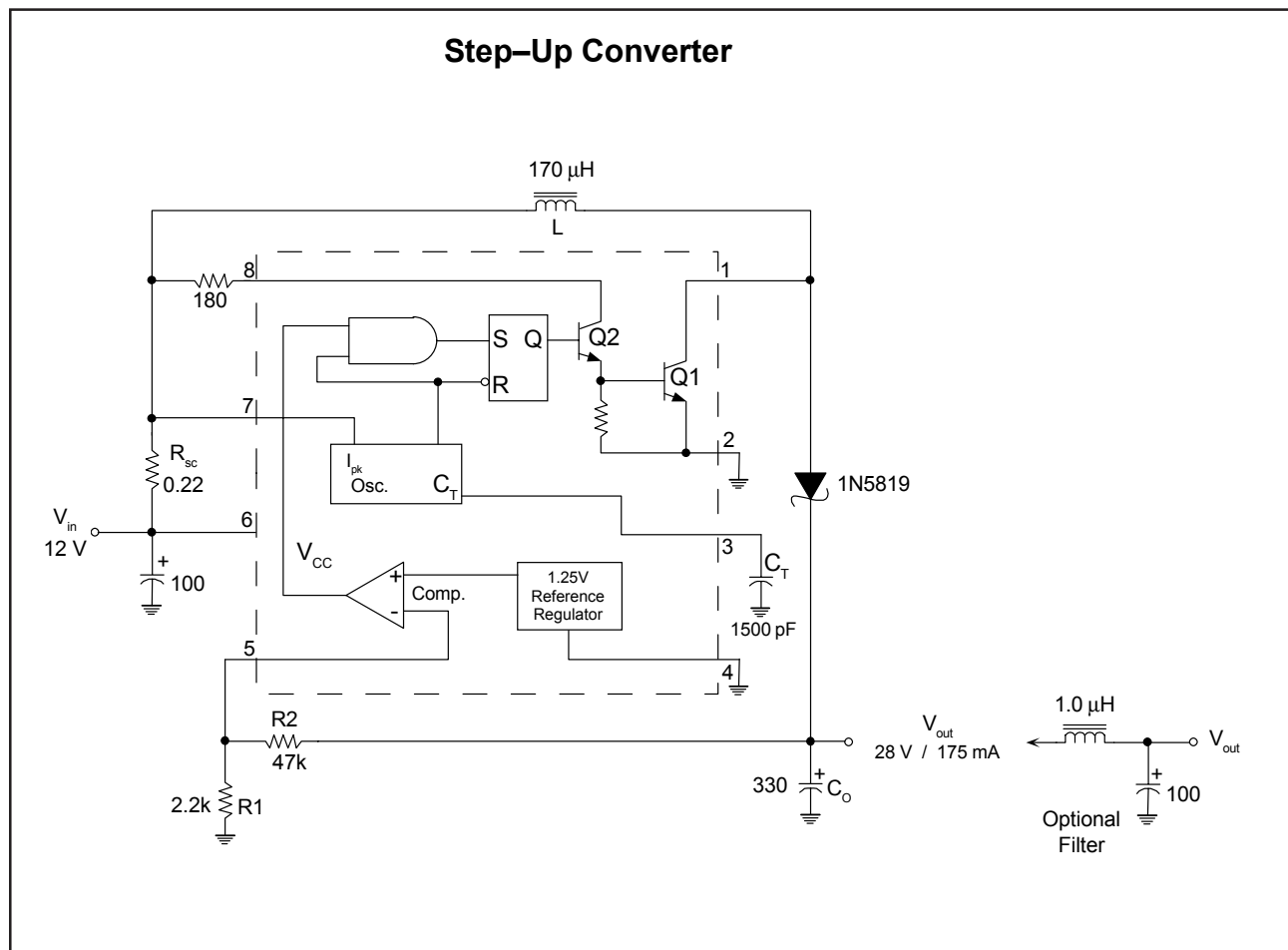
Forced  $\beta$  of output switch :

$$\frac{I_{C \text{ output}}}{I_{C \text{ driver}} - 7.0\text{ mA}} \geq 10$$

\* The  $100\ \Omega$  resistor in the emitter of the driver device requires about  $7.0\text{ mA}$  before the output switch conducts.

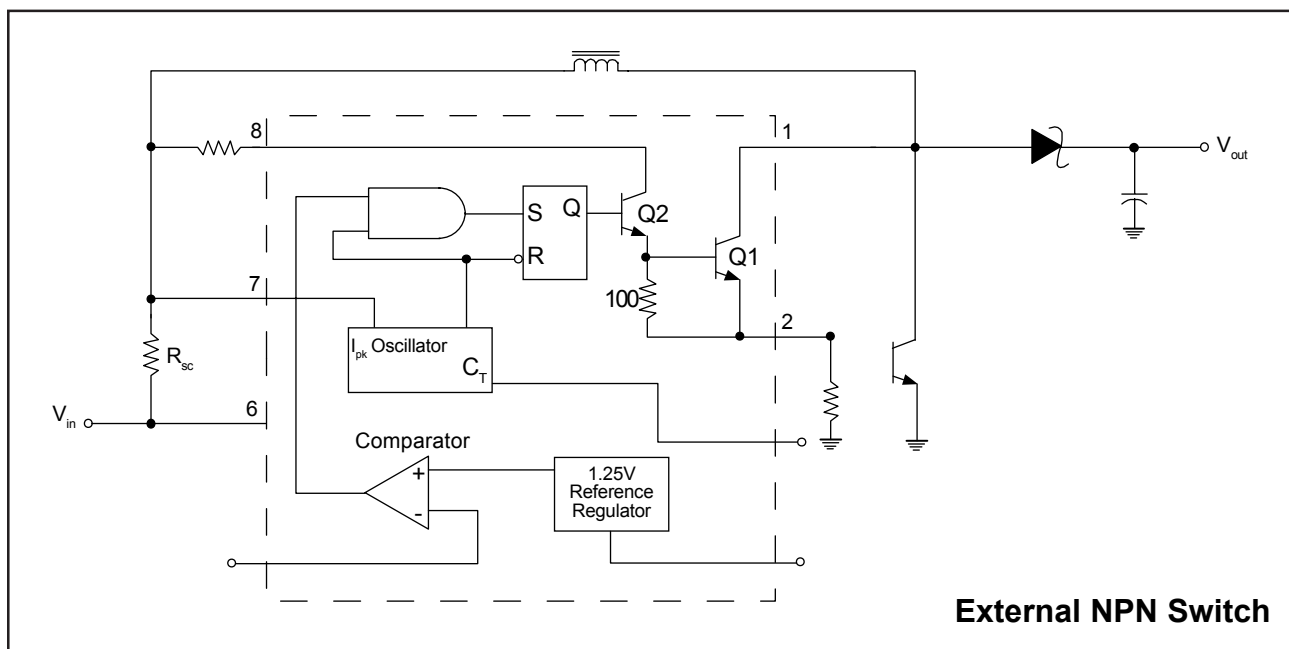
## 1.5A DC-to-DC CONVERTER CONTROL CIRCUIT

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	$V_{in} = 12 \text{ V}$ , $I_o = 175 \text{ mA}$	$40 \text{ mVpp}$

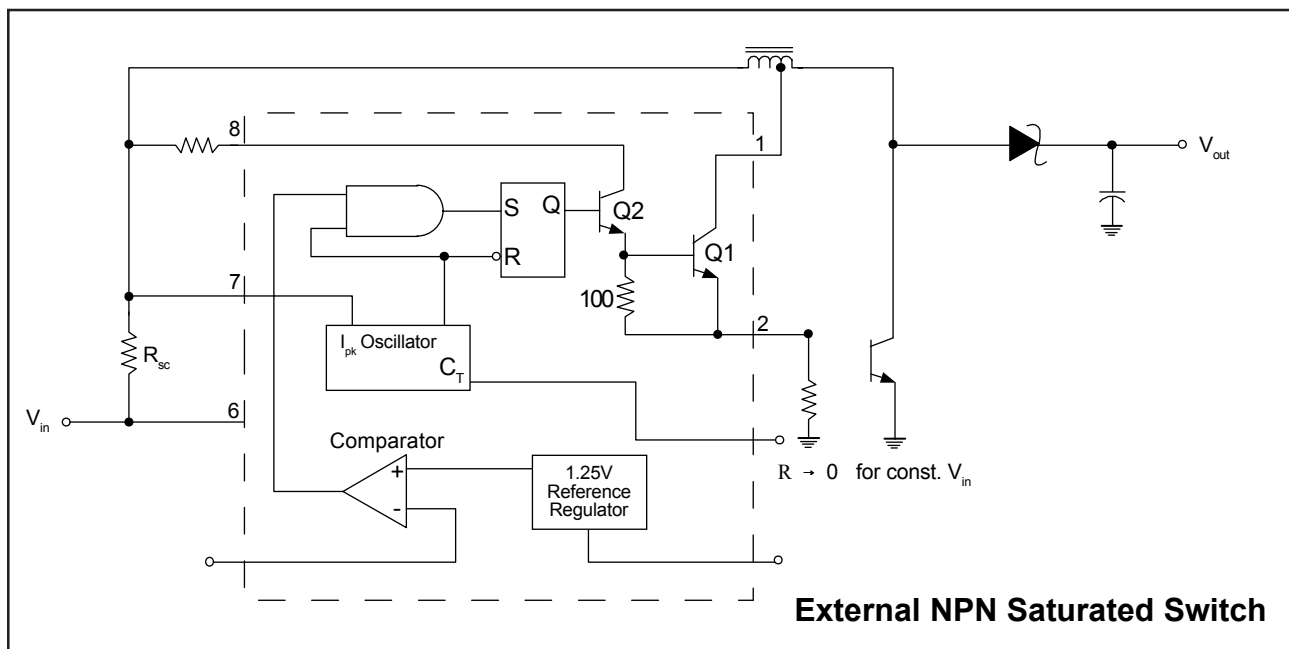


# 1.5A DC-to-DC CONVERTER CONTROL CIRCUIT

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

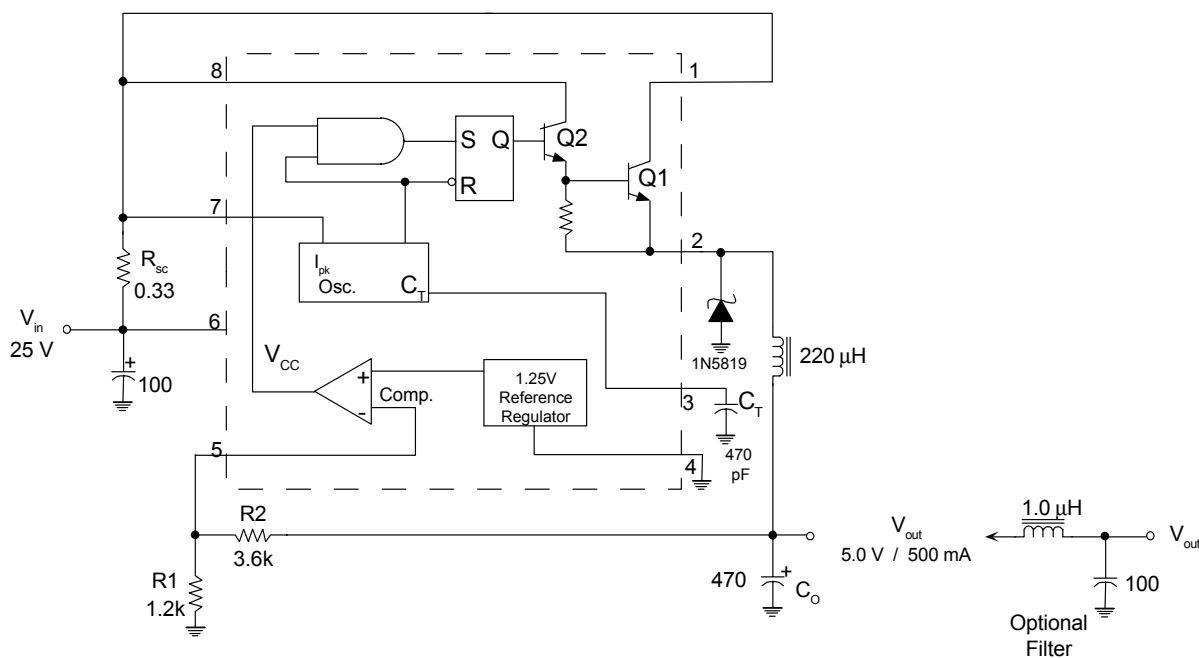


If the output switch is driven into hard saturation (non – Darlington configuration) at low switch currents ( $\leq 300$  mA) and high driver currents ( $\geq 30$  mA), it may take up to  $2.0 \mu s$  to come out of saturation. This condition will shorten the off time at frequencies  $\geq 30$  kHz, 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.



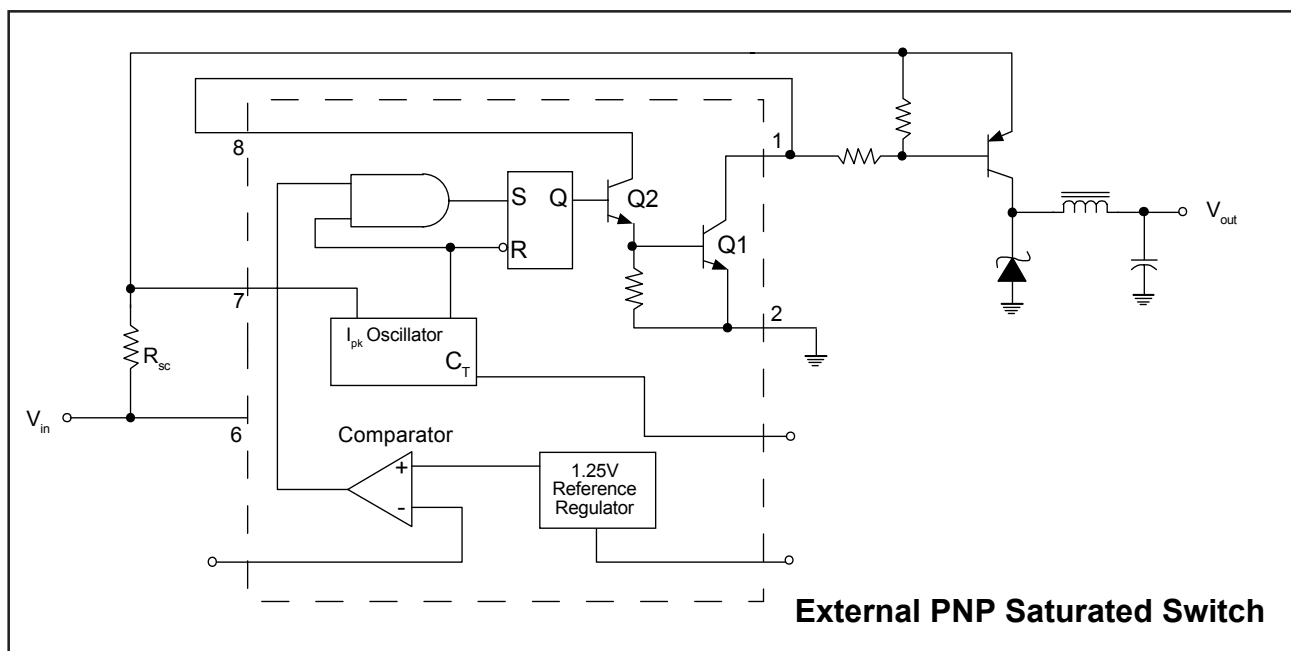
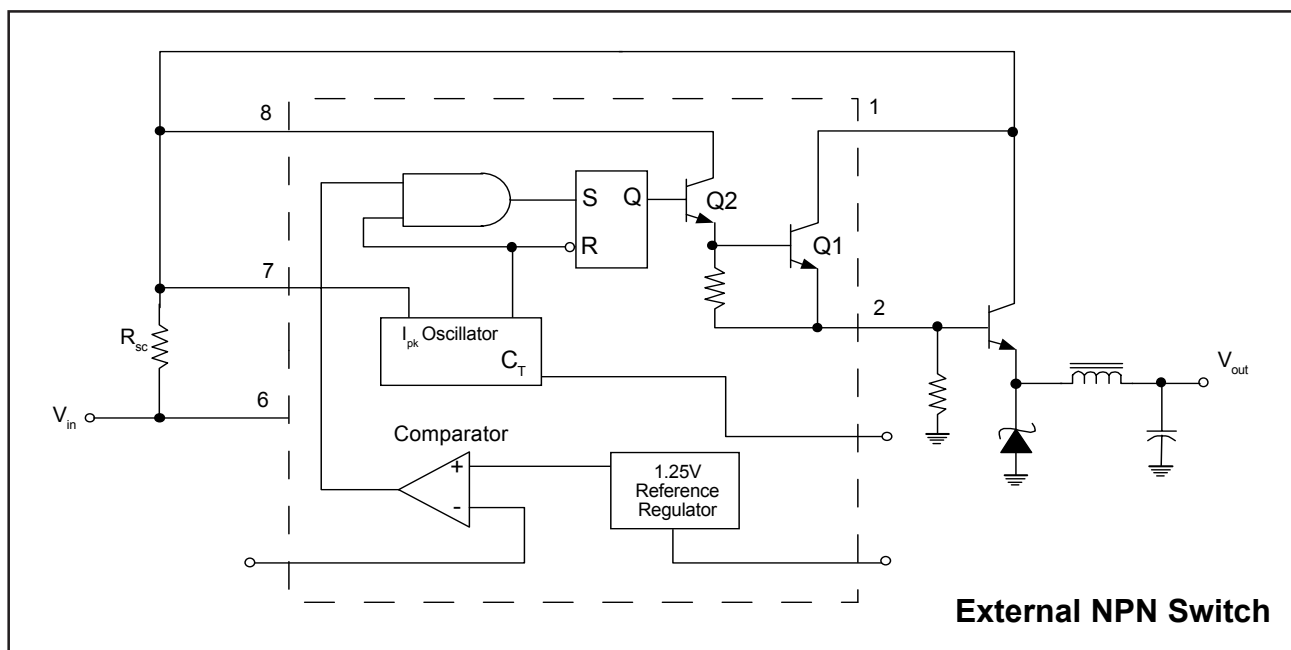
**1.5A DC-to-DC CONVERTER CONTROL CIRCUIT**

Test	Conditions	Results
Line Regulation	$V_{in} = 15\text{ V to } 25\text{ V}, I_o = 500\text{ mA}$	$12\text{ mV} = \pm 0.12\%$
Load Regulation	$V_{in} = 25\text{ V}, I_o = 75\text{ mA to } 500\text{ mA}$	$3.0\text{ mV} = \pm 0.03\%$
Output Ripple	$V_{in} = 25\text{ V}, I_o = 500\text{ mA}$	$120\text{ mVpp}$
Short Circuit Current	$V_{in} = 25\text{ V}, R_L = 0.1\ \Omega$	$1.1\text{ A}$
Efficiency	$V_{in} = 25\text{ V}, I_o = 500\text{ mA}$	$83.7\%$
Output Ripple With Optional Filter	$V_{in} = 25\text{ V}, I_o = 500\text{ mA}$	$40\text{ mVpp}$

**Step – Down Converter**


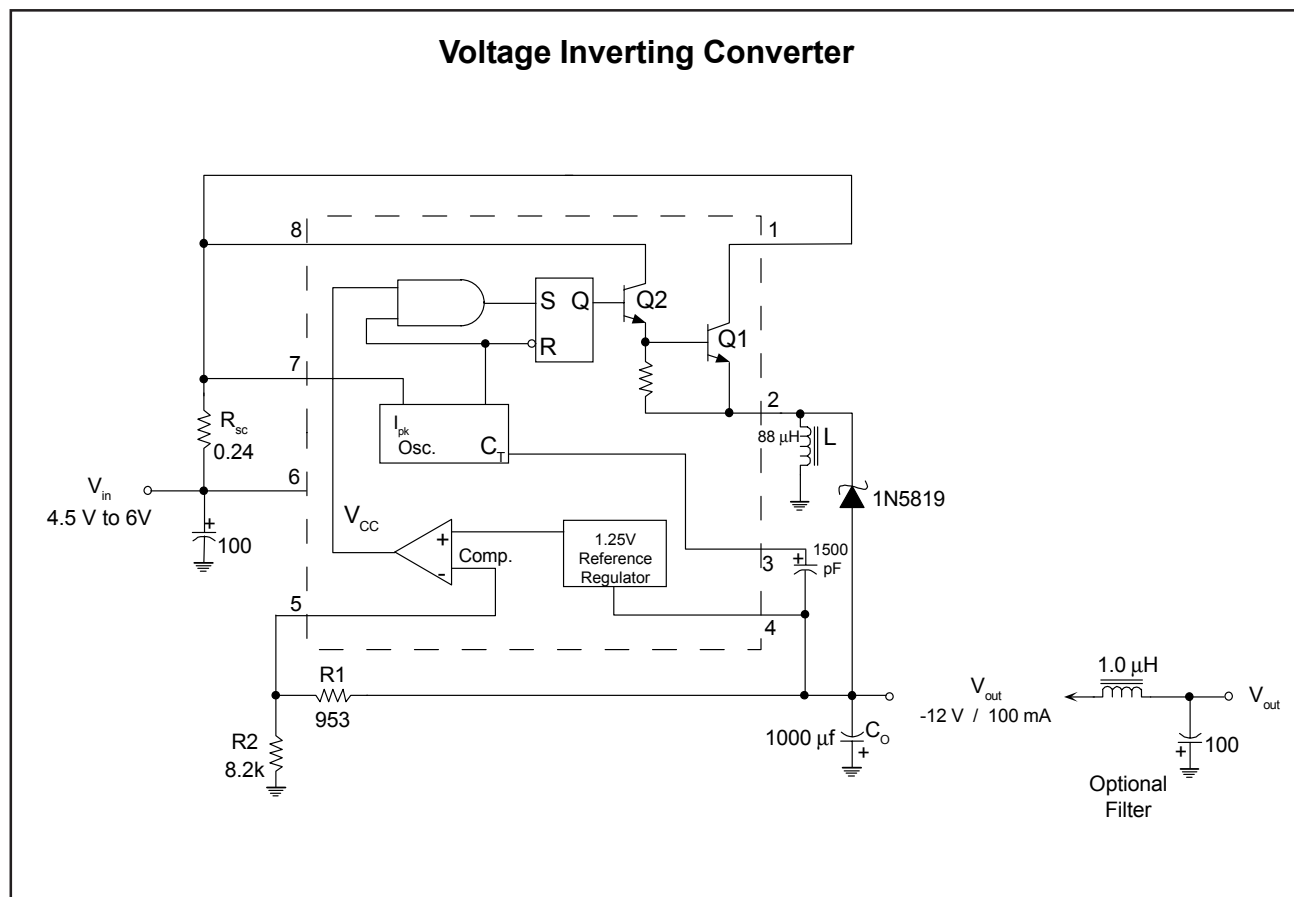
# 1.5A DC-to-DC CONVERTER CONTROL CIRCUIT

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



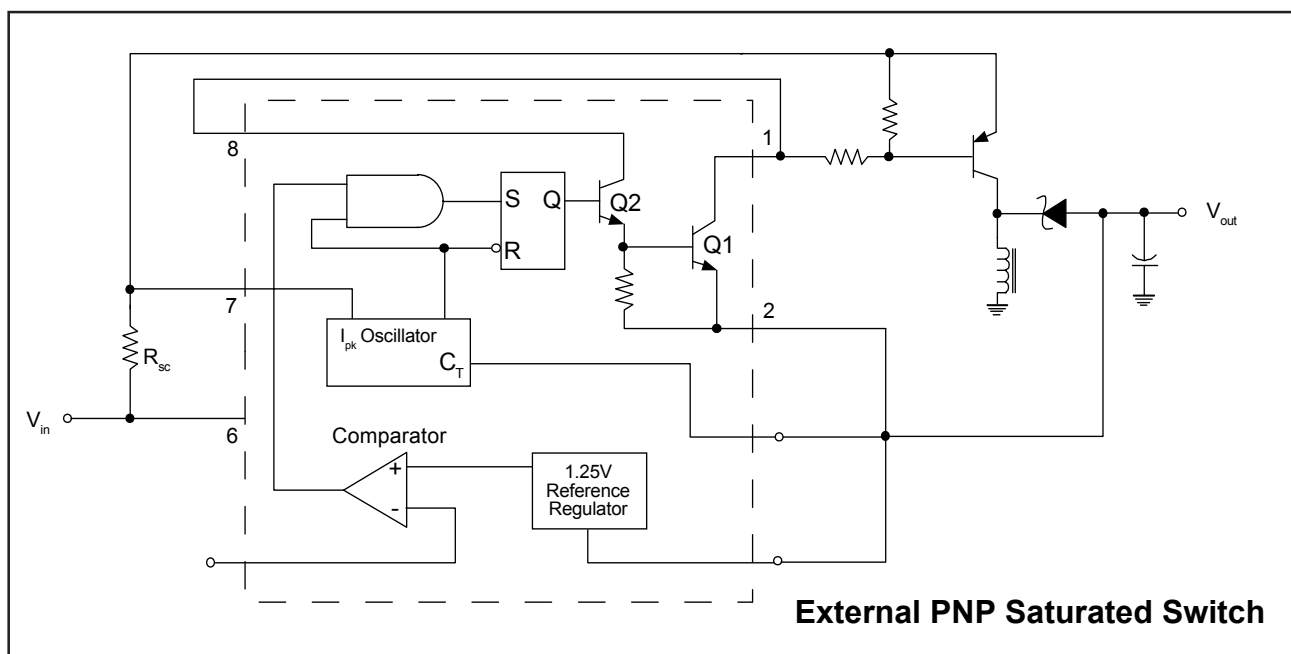
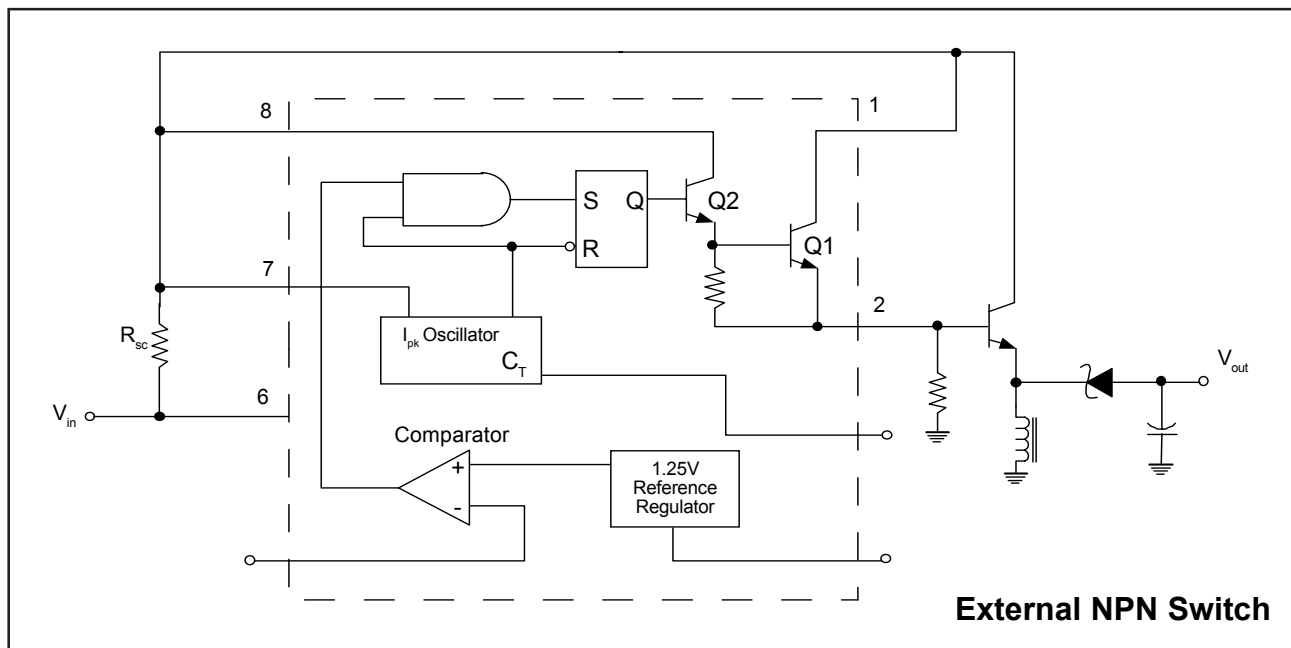
**1.5A DC-to-DC CONVERTER CONTROL CIRCUIT**

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	$V_{in} = 5.0 \text{ V}$ , $I_o = 100 \text{ mA}$	$70 \text{ mVpp}$



# 1.5A DC-to-DC CONVERTER CONTROL CIRCUIT

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



## 1.5A DC-to-DC CONVERTER CONTROL CIRCUIT

### DESIGN FORMULAS

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

$V_{sat}$  = Saturation voltage of the output switch.

$V_F$  = Forward voltage drop of the output rectifier.

$V_{in}$  = Nominal input voltage.

$V_{out}$  = Desired output voltage,

$I_{out}$  = 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.

### ORDERING INFORMATION

GM34063	PACKAGE	PART No.
	SOP-8	GM34063S8
	DIP-8	GM34063D8