GAMMA MICROELECTRONICS

GM34063/ GM34063E
1.5A DC-to-DC CONVERTER CONTROL CIRCUIT

Power Management

Description

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 GM34063 designed for step-down, step-up and voltage-inverting applications using a minimum number of external components.

Features

◆ **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**

Application

CD-ROM
Motherboards
SMPS Power Supply

Battery Chargers
DSL Modem

SCHEMATIC DIAGRAM
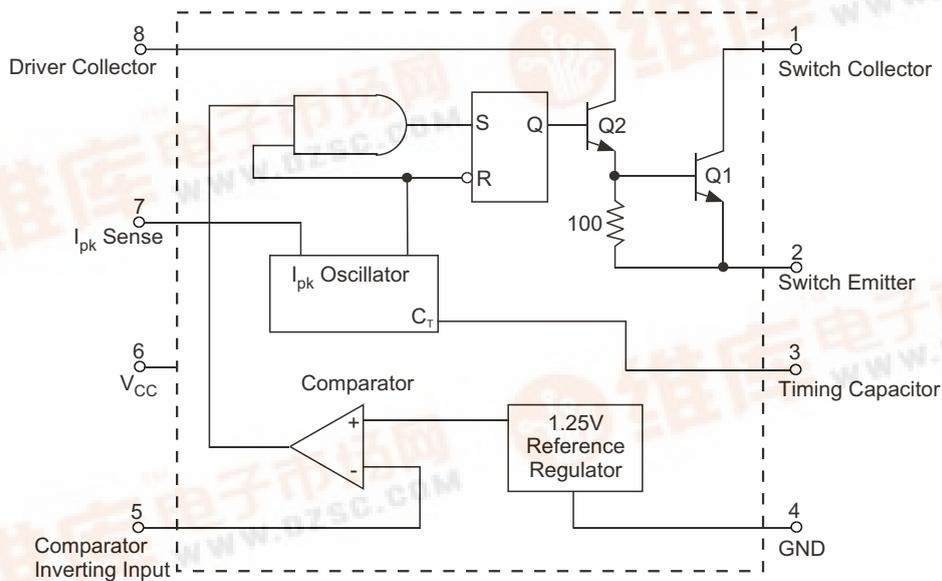
(Bottom View)

* The GM34063 has 51 active transistors on-chip.

GM34063/ GM34063E Revision 1, May. 2004

◆ **MARKING INFORMATION & PIN CONFIGURATIONS** (TOP VIEW)

SOP-8(SO - 8)

I$_{pk}$ Sense → ← → V$_{CC}$
Driver Collector → ← → Comparator
                         Inventing Input

| 8 | 7 | 6 | 5 |

GM34063G
AYWW

| 1 | 2 | 3 | 4 |

Switch Collector ← GND
Switch Emitter ← Timing Capacitor

DIP - 8

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| 8 | 7 | 6 | 5 |

GM34063G
AYWW

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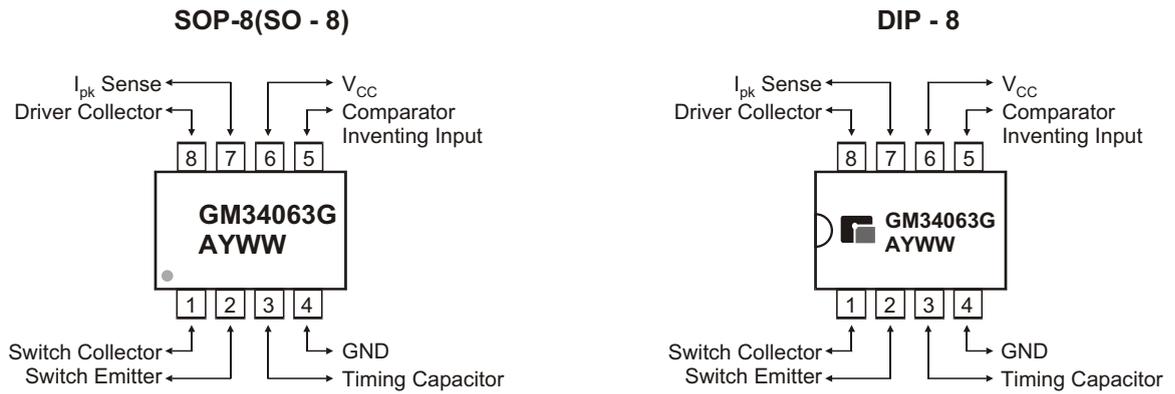
G : Grade (Blank : Operating Ambient Temp. Range [0 to 70°C])
          (E   : Operating Ambient Temp. Range [-40 to 125°C])
A : Assemble Location
Y : Year
W W : Work weeks

◆ **ORDERING INFORMATION**

Ordering Number	Operation Ambient Temperature Range	Package	Shipping
GM34063D8T	0 to 70°C	DIP-8	60 Units/ Tube
GM34063S8T	0 to 70°C	SO-8	100 Units/ Tube
GM34063S8R	0 to 70°C	SO-8	2,500 Units/Tape &Reel
GM34063ED8T	-40 to 125°C	DIP-8	60 Units/ Tube
GM34063ES8T	-40 to 125°C	SO-8	100 Units/ Tube
GM34063ES8R	-40 to 125°C	SO-8	2,500 Units/Tape &Reel

* For detail Ordering Number identification, please see last page.

◆ **ABSOLUTE MAXIMUM RATINGS**

PARAMETER	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_{PIN1} = 40 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, D Suffix
      T_A = 25°C
        Thermal Resistance
   SOIC Package, S Suffix
      T_A = 25°C
        Thermal Resistance
	P_D
	R_{JA}
	
	P_D
	R_{JA}
		1.25
		100
		
		625
		160
			W
			°C/W
			
			mW
			°C/W

Operating Junction Temperature	T_J	+150	°C
Operating Ambient Temperature Range GM34063 GM34063E	T_A	0 to + 70 -40 to +125	°C
Storage Temperature Range	T_{STG}	-65 to +150	°C

Note 1. Maximum package power dissipation limits must be observed

◆ **ELECTRICAL CHARACTERISTICS** (V_{CC} = 5.0 V, T_A = T_{IOW} TO Thigh unless otherwise specified)

CHARACTERISTICS	Symbol	Min	Typ	Max	Unit
OSCILLATOR					
Frequency (V_{pin5} = 0 V, C_T = 1.0nF, 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 Ration (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)	$V_{ipk(sense)}$	250	300	350	mV
OUTPUT SWITCH (Note 2)					
Saturation Voltage, Darlington Connection (I_{SW} = 1.0A, Pins 1, 8 connected)	$V_{CE(sat)}$	-	1.0	1.3	V
Saturation Voltage (Note 3) (I_{SW} = 1.0 A, $R_{Pins\ 8}$ = 82 to V_{CC}, Forced ≈20)	$V_{CE(sat)}$	-	0.45	0.7	V
DC Current Gain (I_{SW} = 1.0 A, V_{EC} = 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_{IOW} to T_{high}	V_{th}	1.225 1.210	1.25 -	1.275 1.29	V
Threshold Voltage Line Regulation (V_{CC} = 3.0V to 40V)	Reg_{line}	-	1.4	5.0	mV
Input Bias Current (V_{IN} = 0V)	I_{IB}	-	-20	-400	nA
TOTAL DEVICE					
Supply Current (V_{CC} = 5.0V to 40 V, C_T = 1.0 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-arlington configuration) at low switch currents (≤300 mA) and high driver currents (≥30 mA), it may take up to 2.0 ms for it to come out of saturation. This condition will shorten the off time at frequencies ≤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:
Forced   of output switch :

$$\frac{I_C\ output}{I_C\ driver - 7.0\ mA^*} \geq 10$$

* The 100   resistor in the emitter of the driver device requires about 7.0 mA before the output switch conducts.

◆ Typical Performance Characteristics
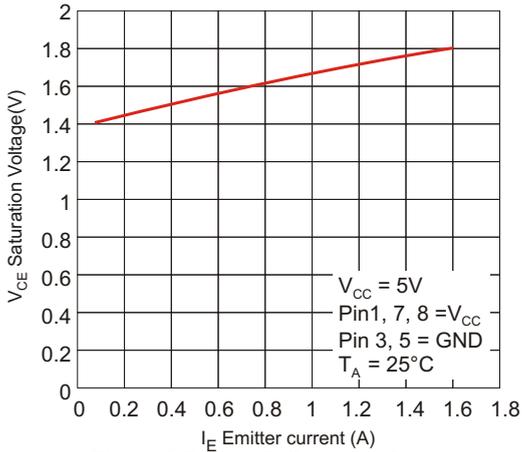
**Figure 1: Emitter Follows Configuration Output**

Plot: V_{CE} Saturation Voltage(V) vs I_E Emitter current (A).
$V_{CC} = 5V$
Pin1, 7, 8 =V_{CC}
Pin 3, 5 = GND
$T_A = 25°C$
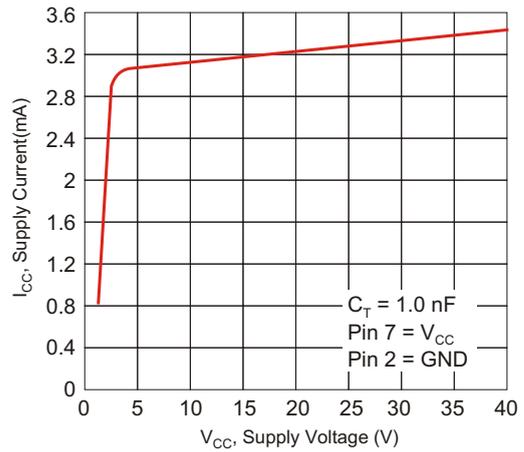
Figure 2: Standley Supply Current Versus Supply Voltage

Plot: I_{CC}, Supply Current(mA) vs V_{CC}, Supply Voltage (V).
$C_T = 1.0$ nF
Pin 7 = V_{CC}
Pin 2 = GND
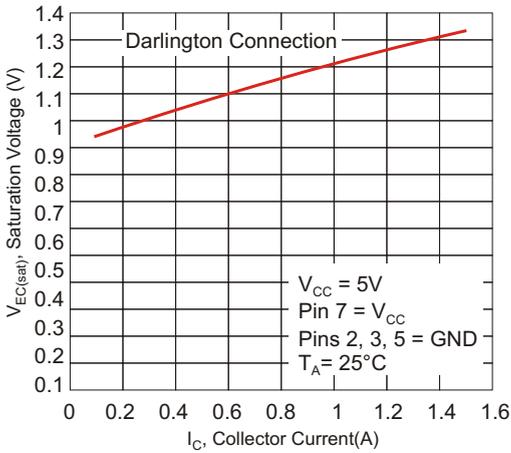
Figure 3: Common Emitter Configuration Output Switch Saturation Voltage versus Collector Current

Plot: $V_{EC(sat)}$, Saturation Voltage (V) vs I_C, Collector Current(A).
Darlington Connection
$V_{CC} = 5V$
Pin 7 = V_{CC}
Pins 2, 3, 5 = GND
$T_A = 25°C$
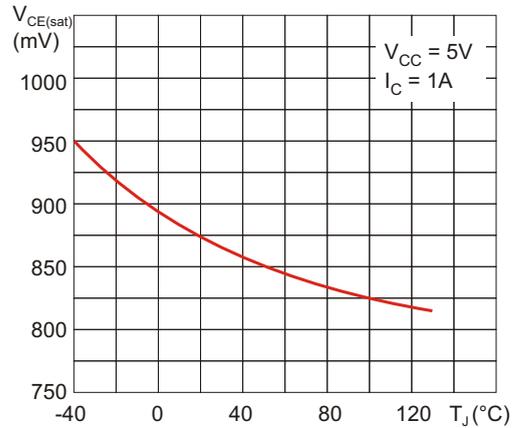
Figure 4: Darlington Configuration Collector Emitter Saturation Voltage ($V_{CE(sat)}$) vs Temperature

Plot: $V_{CE(sat)}$ (mV) vs T_J (°C).
$V_{CC} = 5V$
$I_C = 1A$
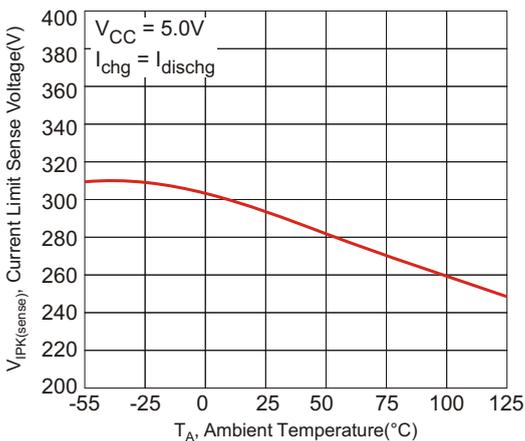
Figure 5: Current Limit Sense Voltage versus Temperature

Plot: $V_{IPK(sense)}$, Current Limit Sense Voltage(V) vs T_A, Ambient Temperature(°C).
$V_{CC} = 5.0V$
$I_{chg} = I_{dischg}$
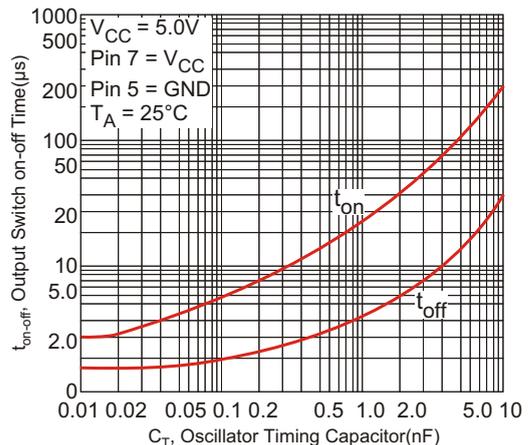
Figure 6: Output Switch On- Off Time versus Oscillator Timing Capacitor

Plot: t_{on-off}, Output Switch on-off Time(µs) vs C_T, Oscillator Timing Capacitor(nF).
$V_{CC} = 5.0V$
Pin 7 = V_{CC}
Pin 5 = GND
$T_A = 25°C$
t_{on}
t_{off}

◆ **Figure 7. External Current Boost Connections for I_c Peak Greater than 1.5A**

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 = 75mA to 175 mA	10mV = ± 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 Fitter	V_{IN} = 12 V, I_O = 175 mA	40 mVpp

◆ **Step - Up Converter**
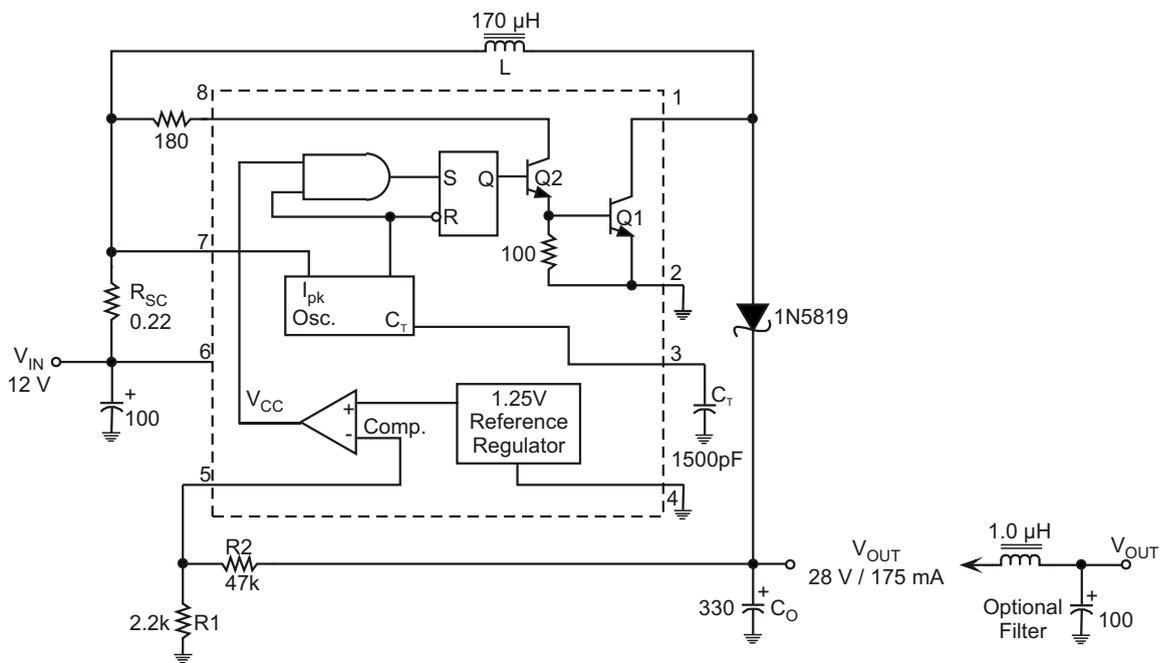
◆ External Current Boost Connections for I_C Peak Greater than 1.5A
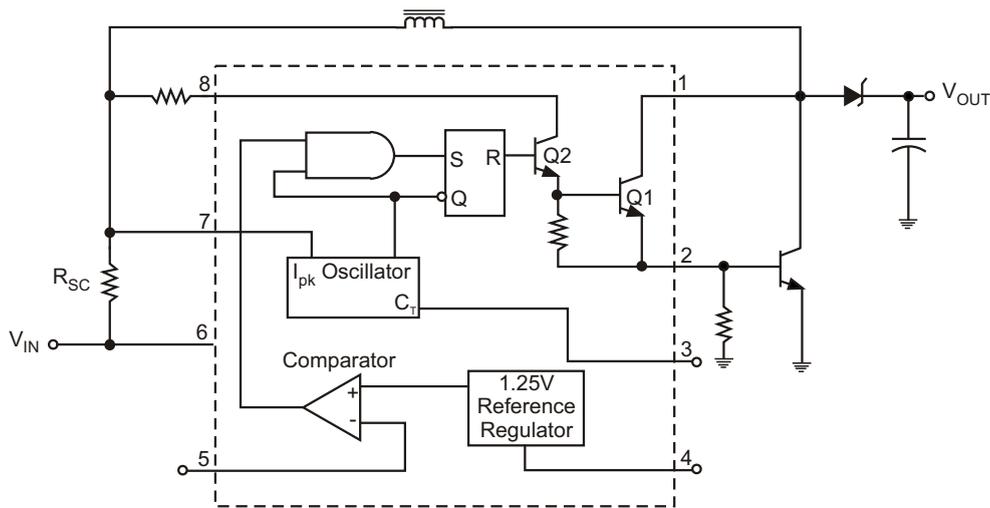
Figure 6a. External NPN Switch

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 ms 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 occure with a Darlington configuration, since the output switch cannot saturate. If a non-Darlington configuration is used, the following output drive condition is recommended.
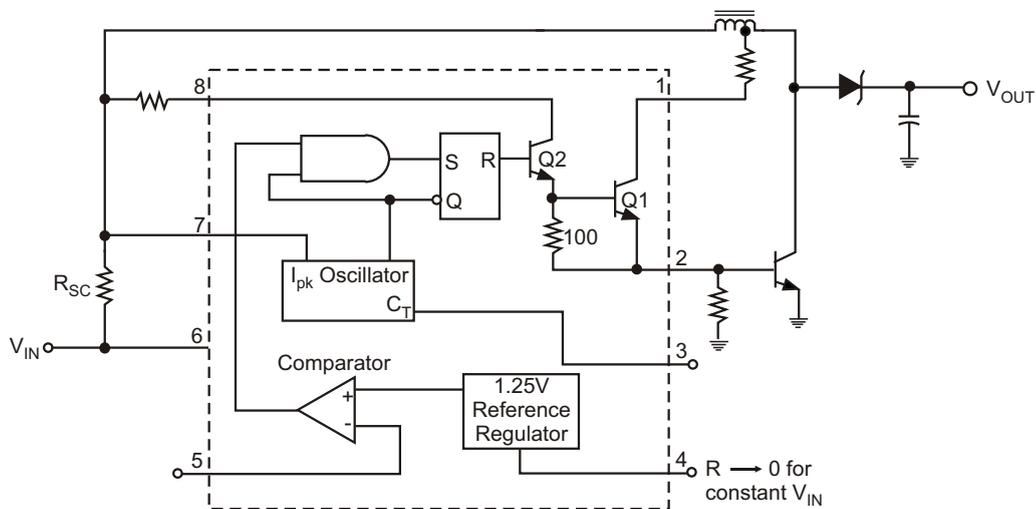
Figure 6b. External NPN Switch

◆ **Figure 8. External Current Boost Connections for I$_C$ Peak Greater than 1.5A**

Test	Conditions	Results
Line Regulation	V$_{IN}$ = 15 V to 25 V, I$_O$ = 500 mA	12 mV = ± 0.15%
Load Regulation	V$_{IN}$ = 25 V, I$_O$ = 75mA to 500 mA	3.5mV = ± 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	1.1 A
Efficiency	V$_{IN}$ = 25 V, I$_O$ = 500 mA	83.7%
Output Ripple With Optional Fitter	V$_{IN}$ = 25 V, I$_O$ = 500 mA	40 mVpp

◆ **Step - Down Converter**
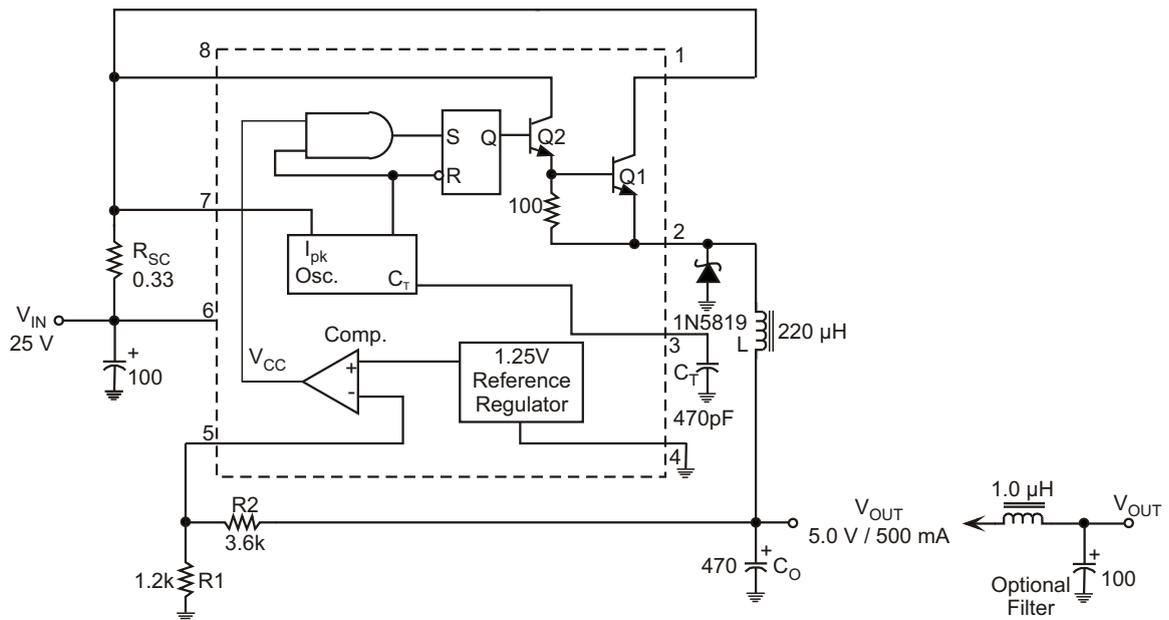
◆ **External Current Boost Connections for I$_c$ Peak Greater than 1.5A**
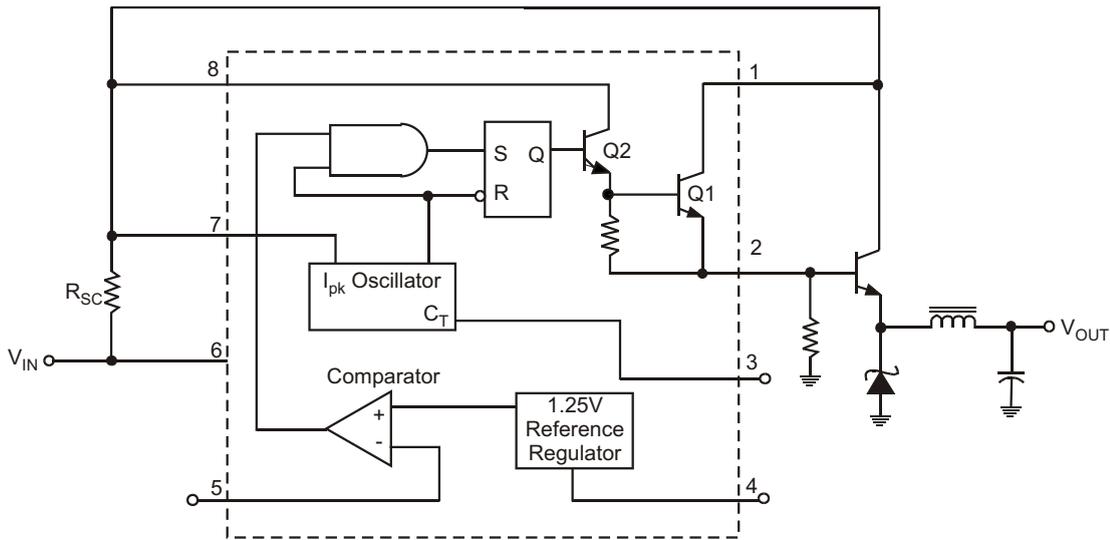

Figure 7a. External NPN Switch
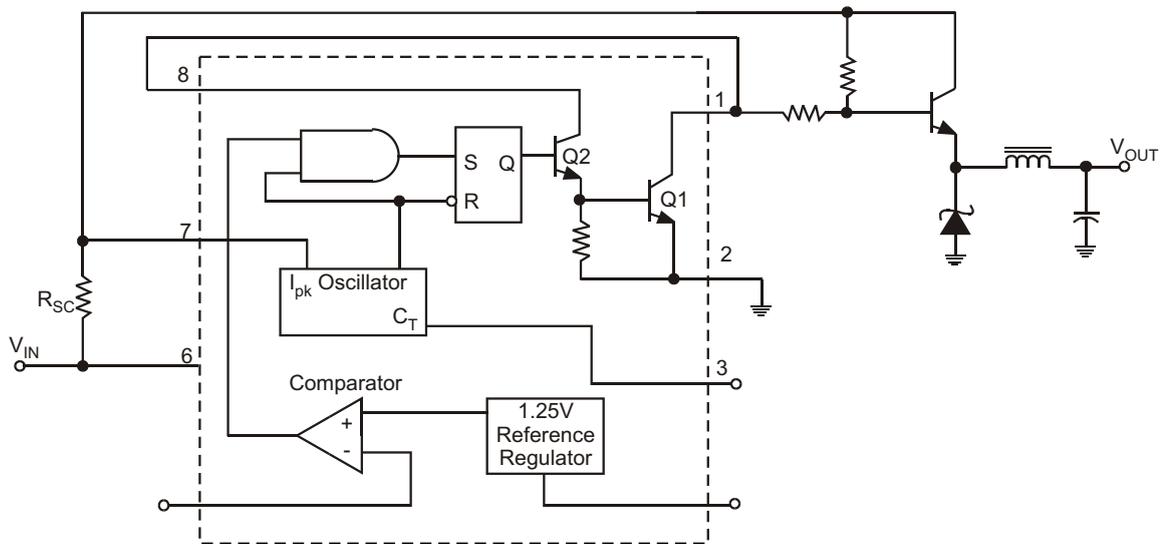
Figure 7b. External NPN Switch

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

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 = 10mA to 100 mA	0.022mV = ± 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	910mA
Efficiency	V_{IN} = 5.0 V, I_O = 100 mA	62.2%
Output Ripple With Optional Fitter	V_{IN} = 5.0 V, I_O = 100 mA	70 mVpp

◆ **Voltage Inverting Converter**
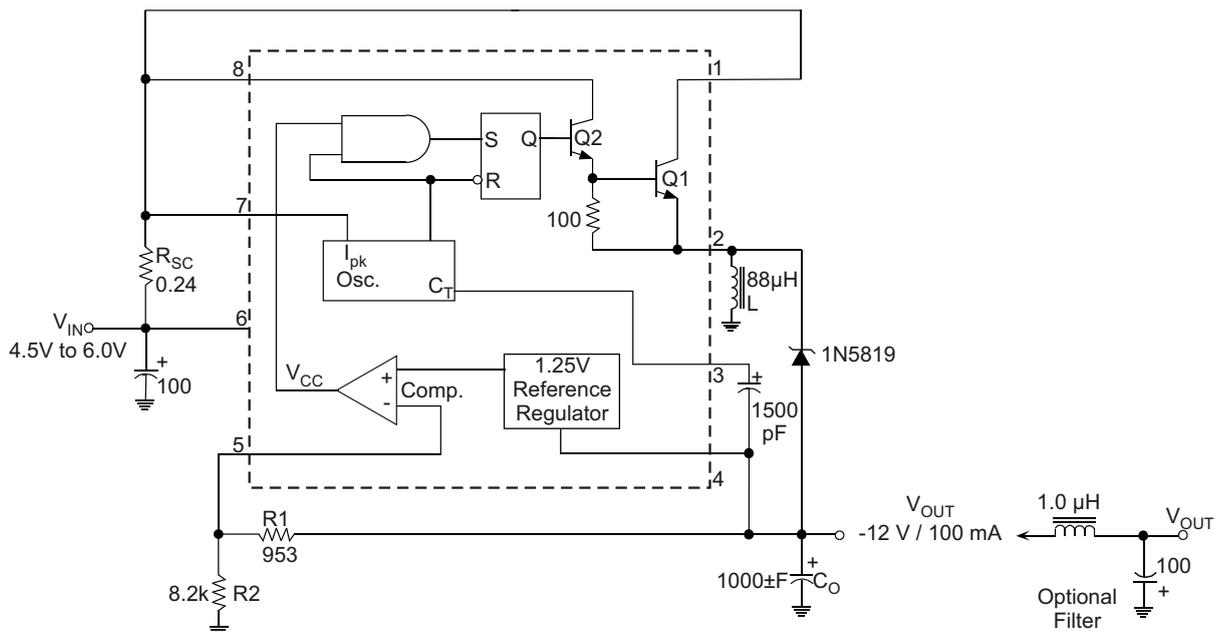
♦ **External Current Boost Connections for I_c Peak Greater than 1.5A**
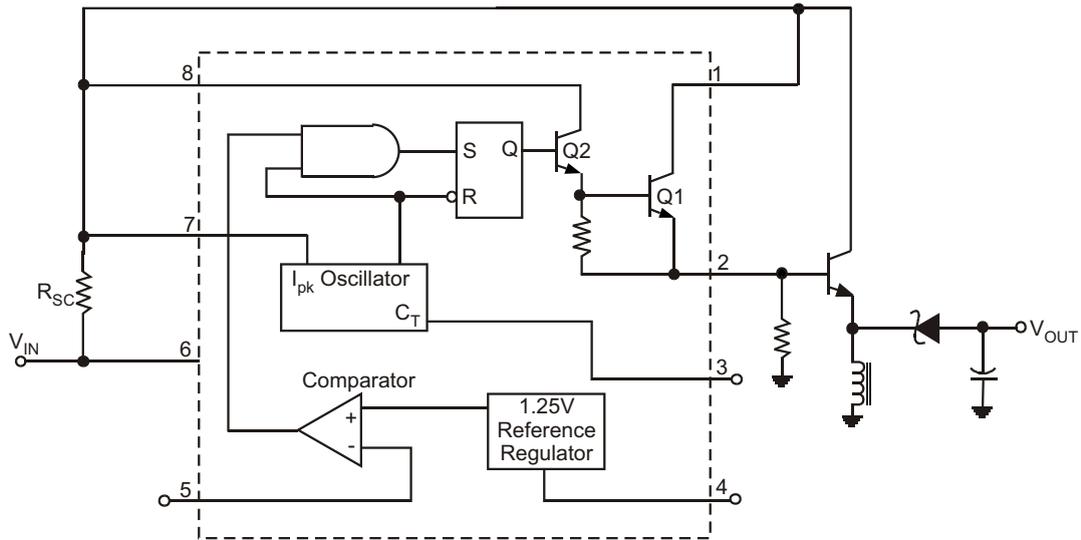
**Figure 8a. External NPN Switch**
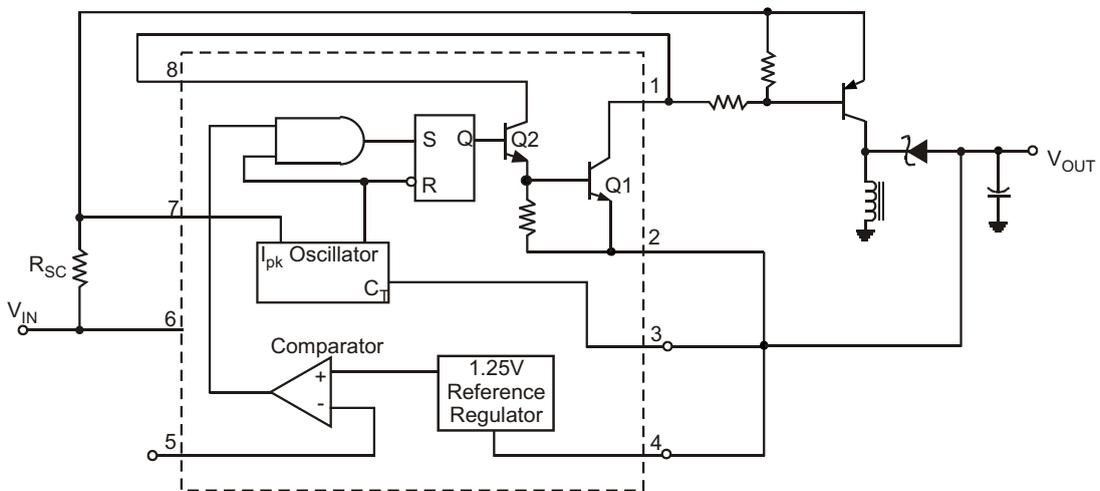
**Figure 8b. External NPN Switch**
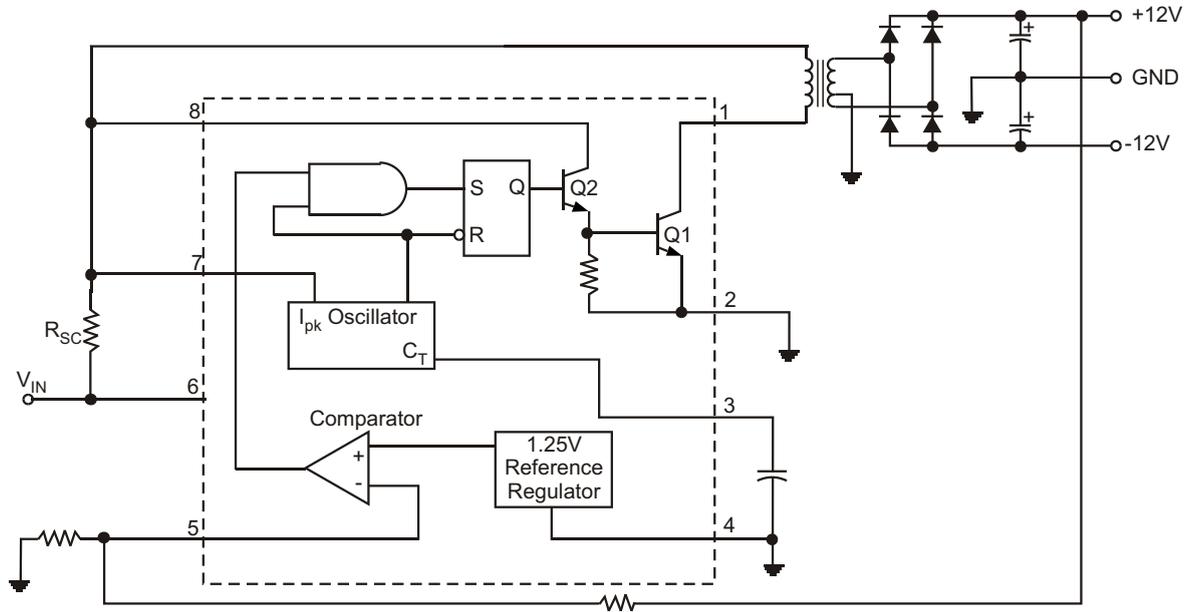
Figure 9. Dual Output Voltage
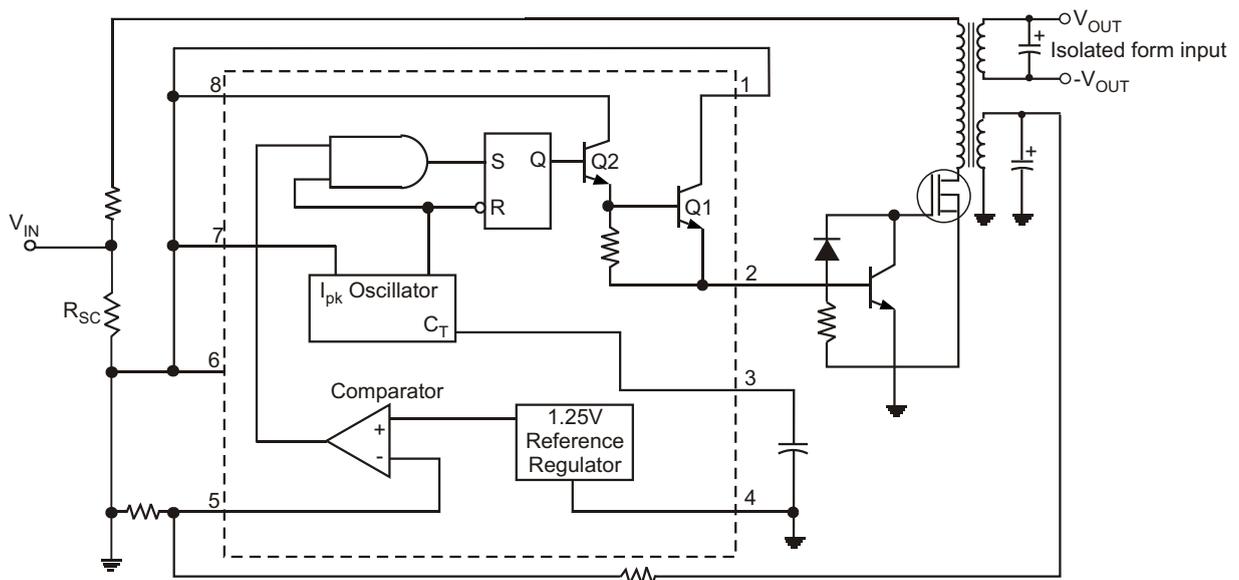
Figure 10. Higher Output Power, Higher Input Voltage

◆ DESIGN FORMULAS

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

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.

◆ SOP-8(SO-8) PACKAGE OUTLINE DIMENSIONS

Pad Layout
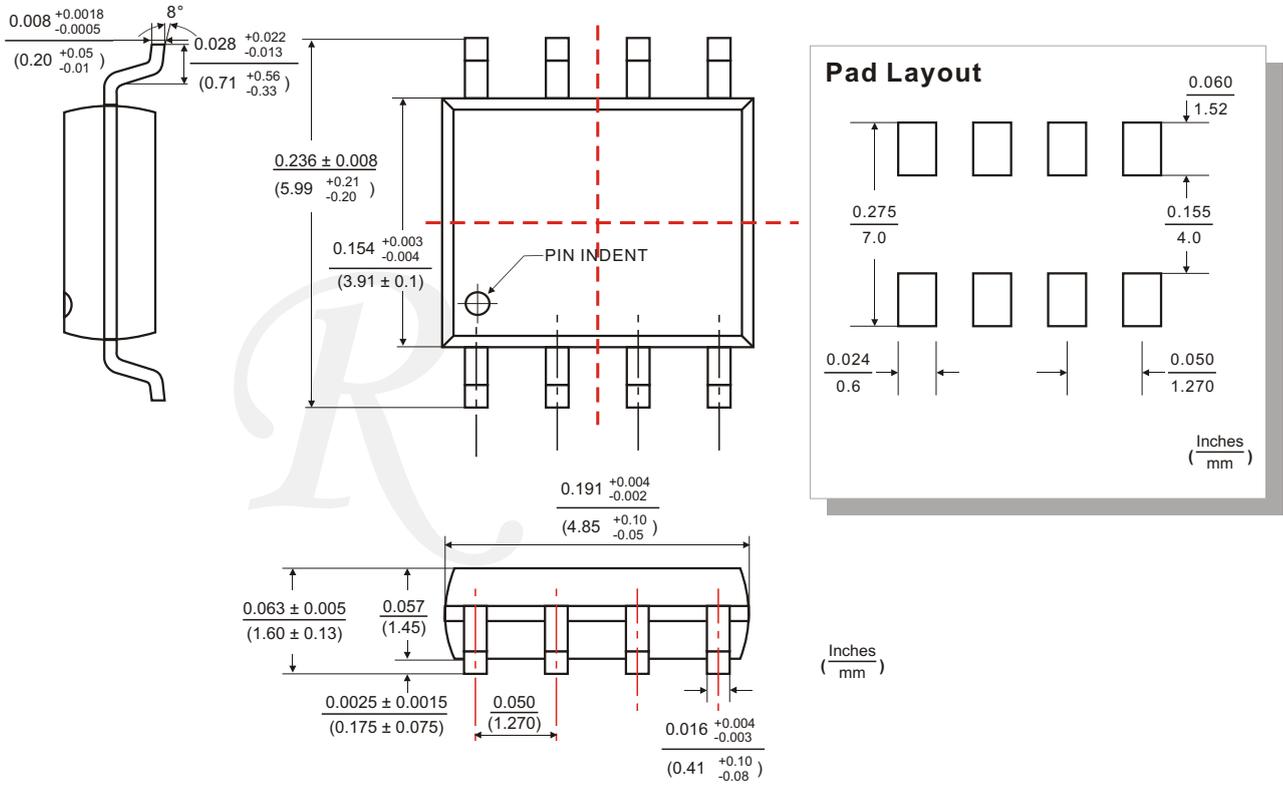
◆ DIP-8 PACKAGE OUTLINE DIMENSIONS

◆ **ORDERING NUMBER**

GM 34063/ 34063E S8 R

Gamma Micro.

Circuit Type

Shipping
T: Tube
R: Tape & Reel

Package
S8: SO-8
D8: DIP-8