GAMMA MICROELECTRONICS

GM34063

1.5A DC-TO-DC CONVERTER CONTROL CIRCUIT

Description

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.

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

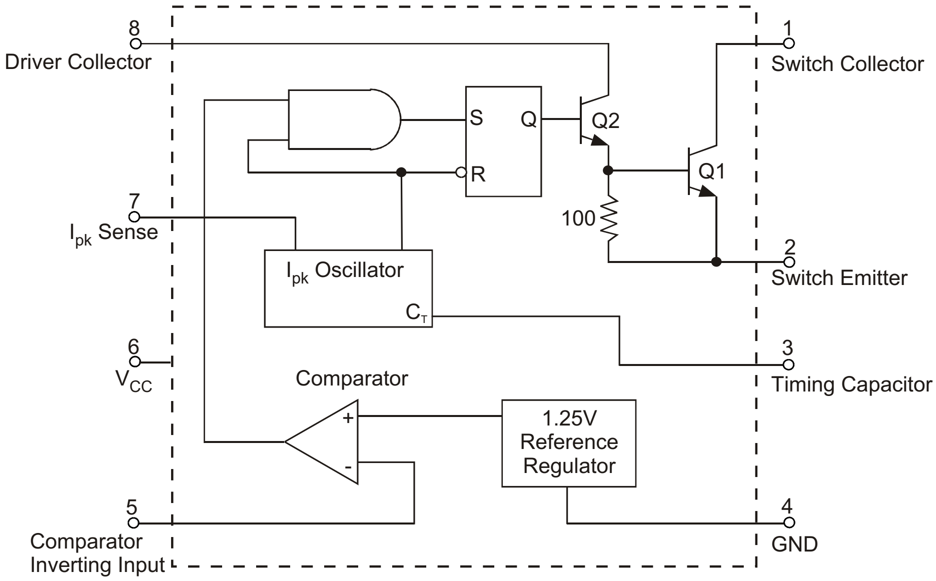
Features

- 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

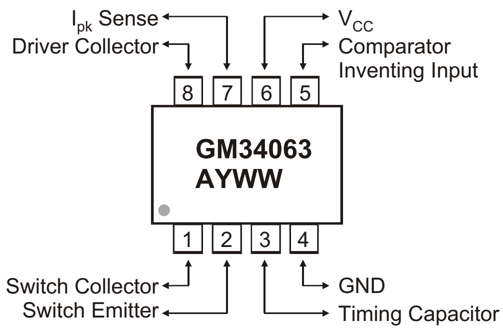
SCHEMATIC DIAGRAM



(Bottom View)

◆ MARKING INFORMATION & PIN CONFIGURATIONS (TOP VIEW)

SOP-8



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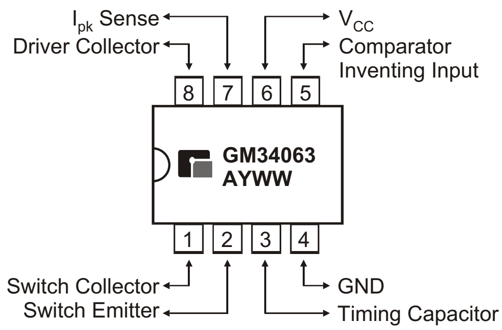


A : Assembly Location
Y : Year
W W : Weekly

◆ 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	SOP-8	100 Units/ Tube
GM34063S8R	0 to 70°C	SOP-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_{low} 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 :

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

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

◆ Typical Performance Characteristics

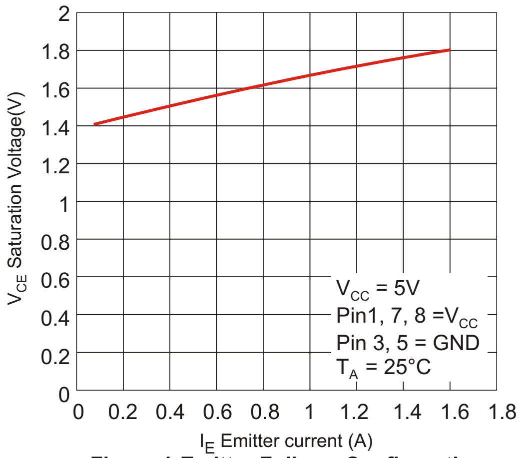


Figure 1:Emitter Follows Configuration Output

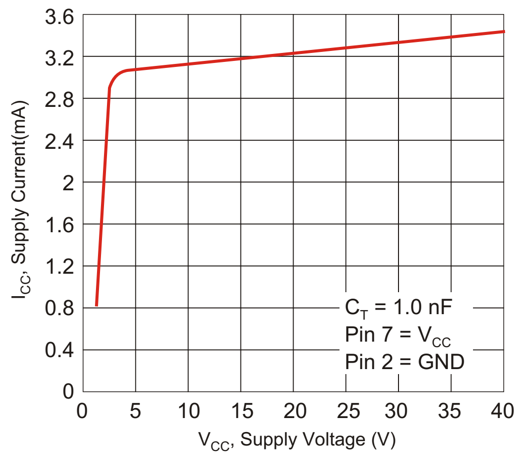


Figure 2: Standley Supply Current Versus Supply Voltage

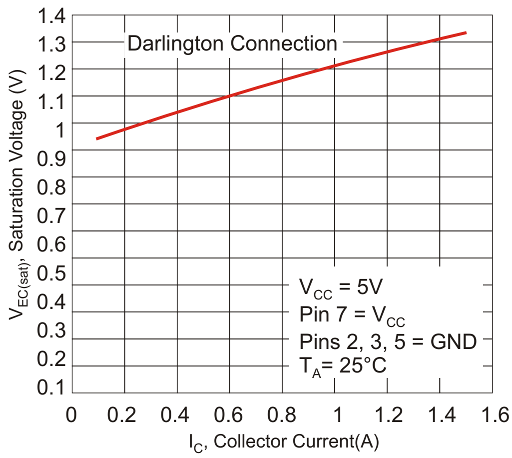


Figure 3: Common Emitter Configuration Output Switch Saturation Voltage versus Collector Current

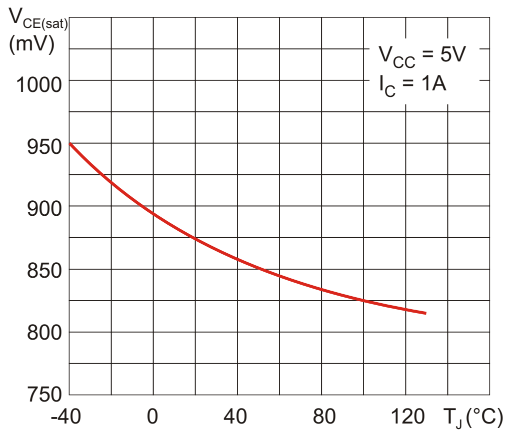


Figure 4: Darlington Configuration Collector Emitter Saturation Voltage ($V_{CE(sat)}$) vs Temperature

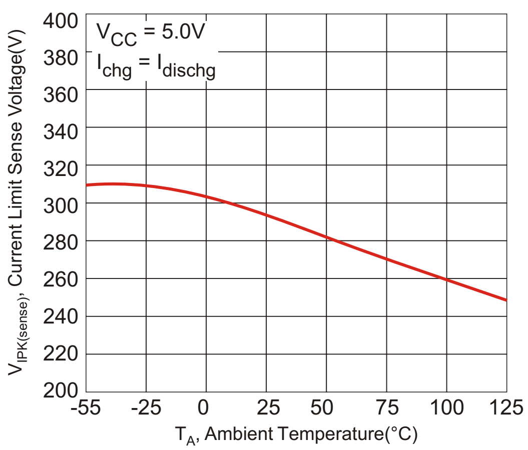


Figure 5: Current Limit Sense Voltage versus Temperature

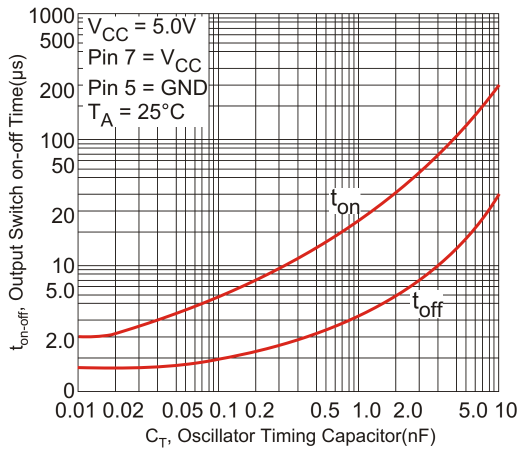
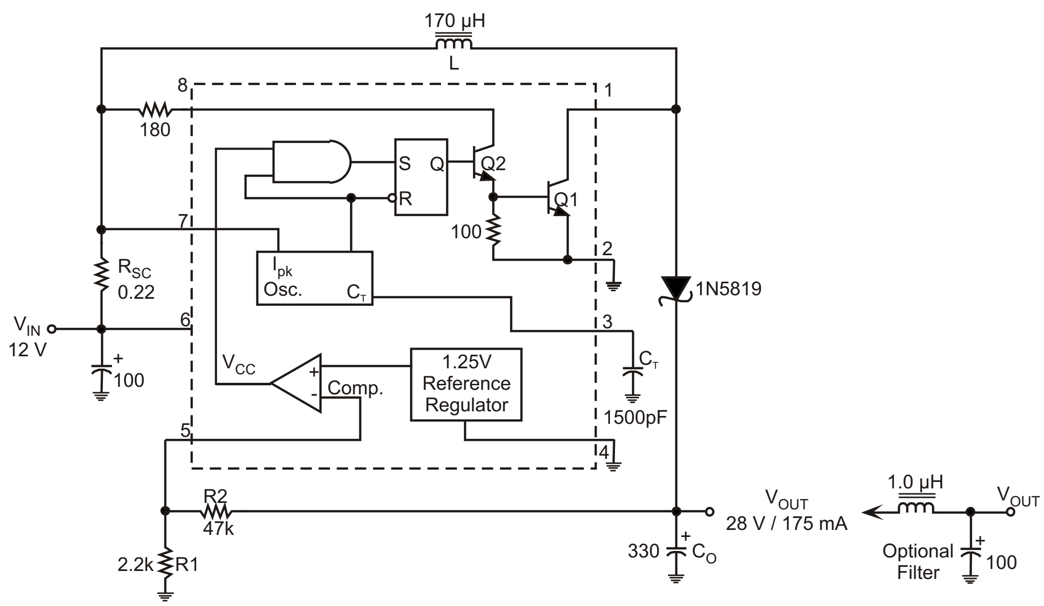


Figure 6: Output Switch On- Off Time versus Oscillator Timing Capacitor

◆ 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 Filter	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

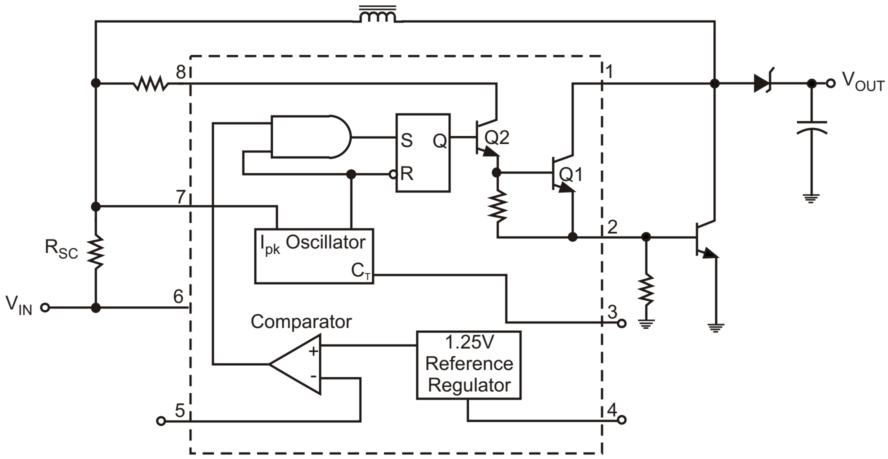


Figure 6a. External NPN Switch

If the output switch is driven into hard saturation (non-Darlington configuration) at low switch currents (≤300 mA) and high driver currents (≥30 mA), it may take up to 2.0 ms 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 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.

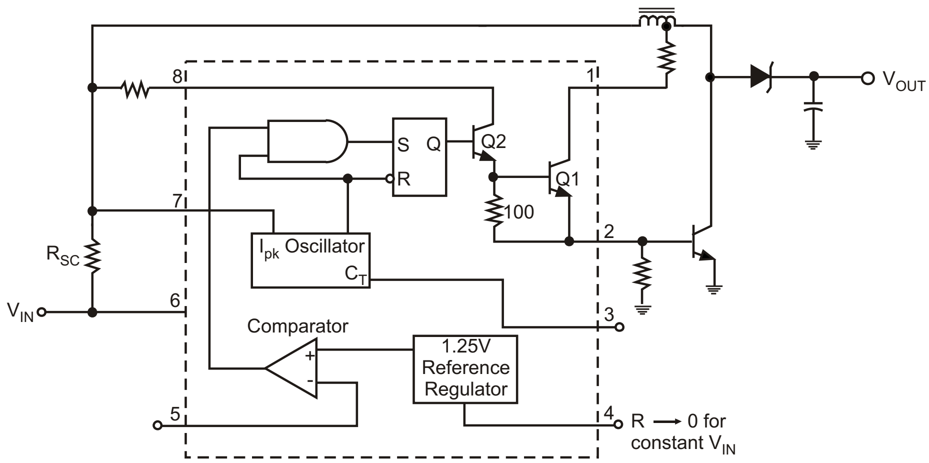
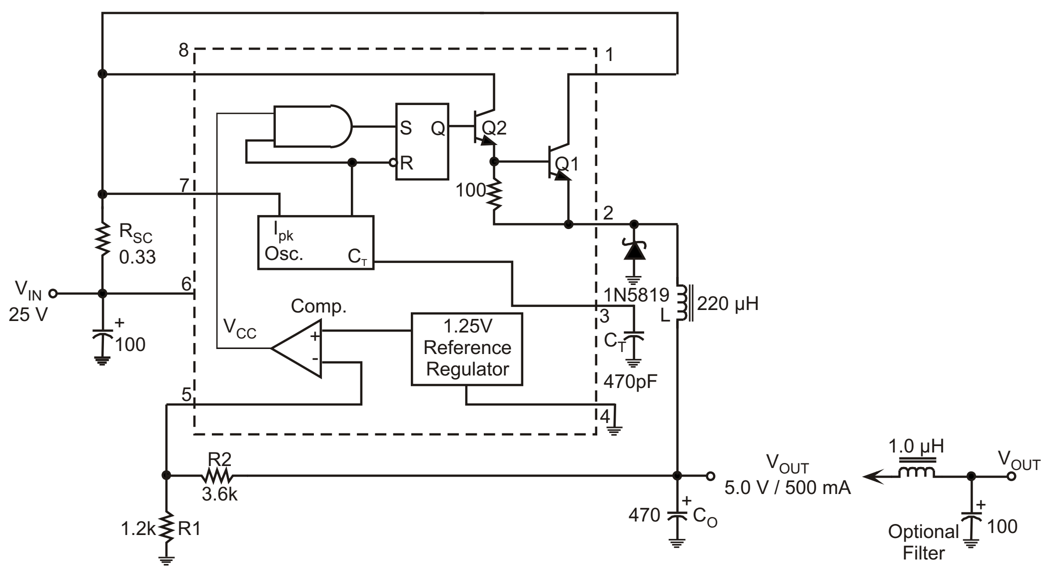


Figure 6b. External NPN Switch

◆ Figure 8. External Current Buck 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 Filter	V_{IN} = 25 V, I_O = 500 mA	40 mVpp

◆ Step - Down Converter



◆ External Current Buck Connections for I_C Peak Greater than 1.5A

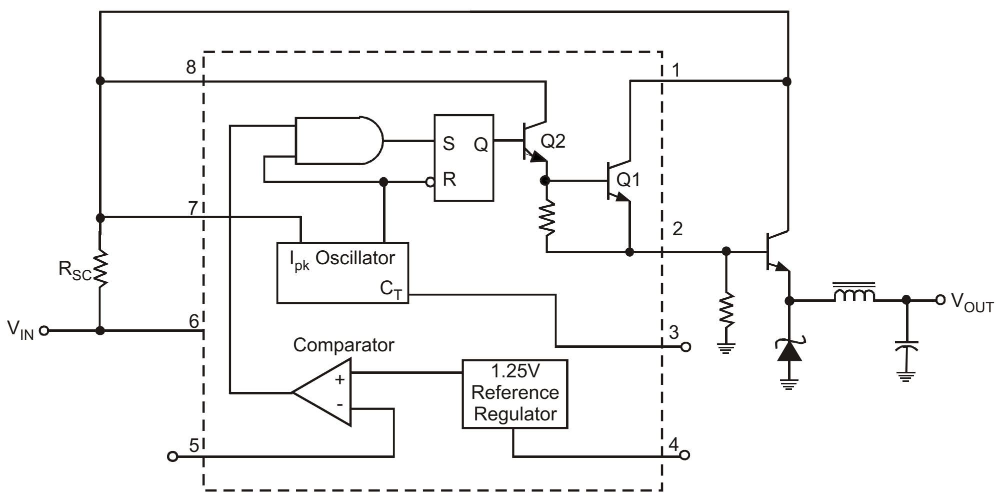


Figure 7a. External NPN Switch

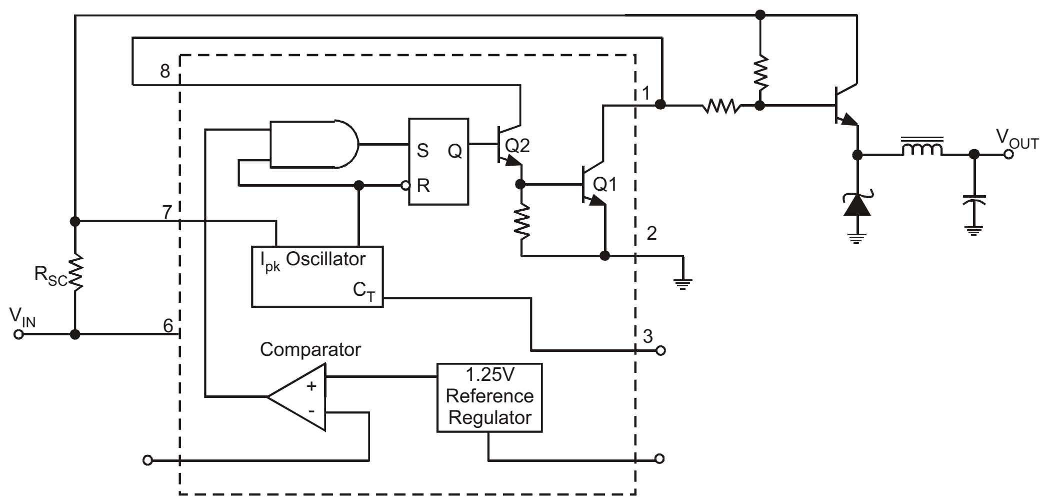
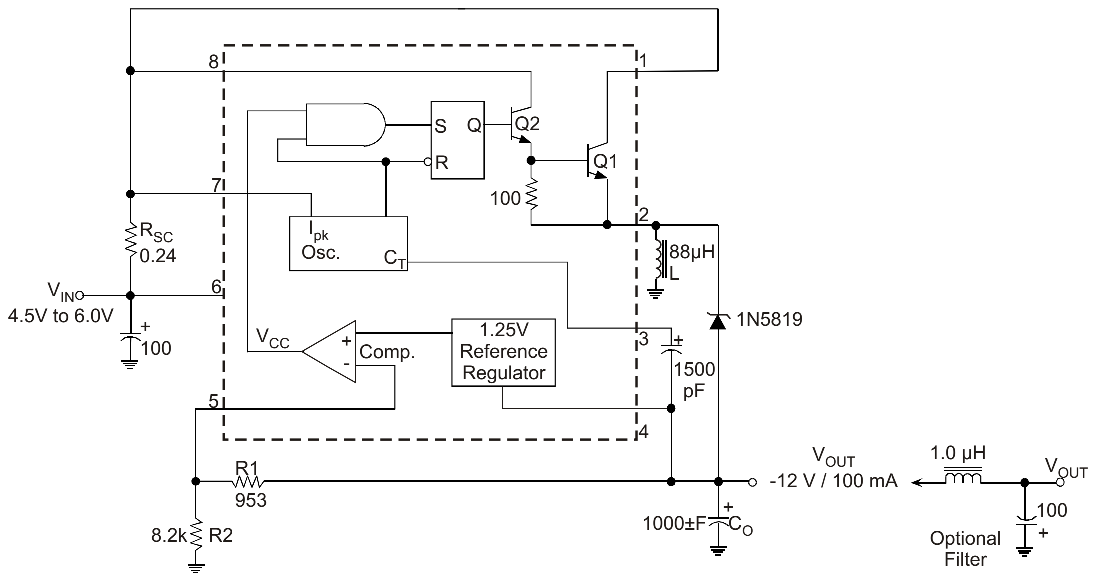


Figure 7b. External NPN Switch

◆ 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

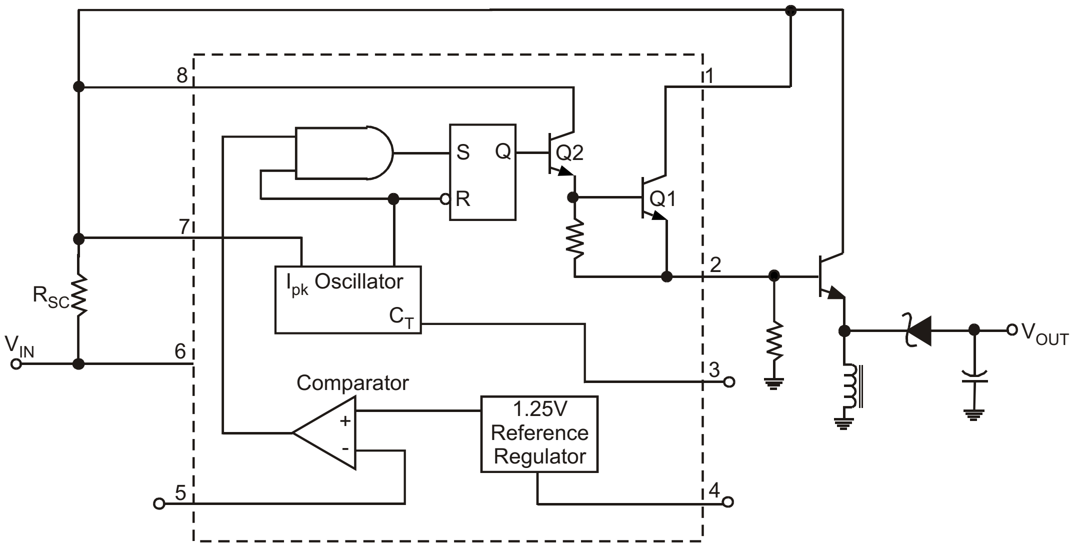


Figure 8a. External NPN Switch

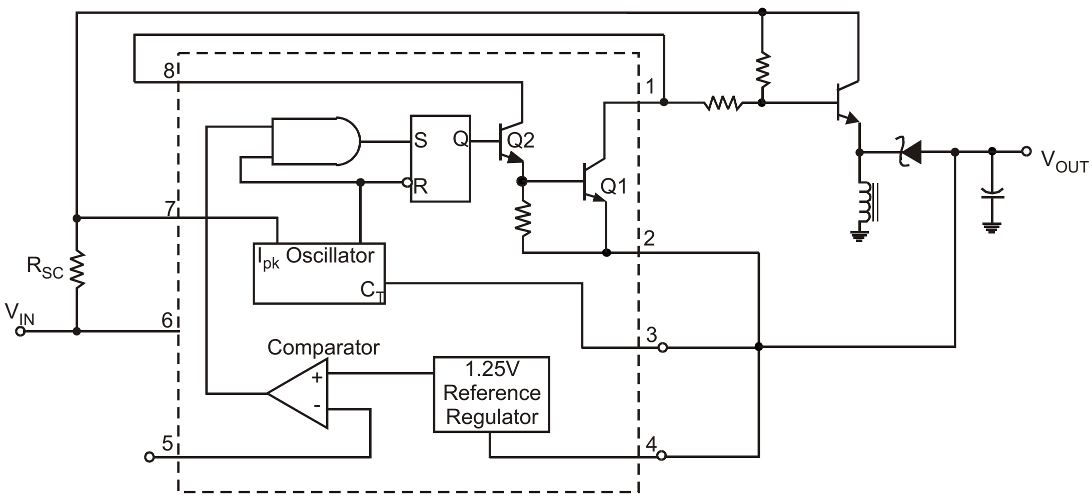


Figure 8b. External NPN Switch

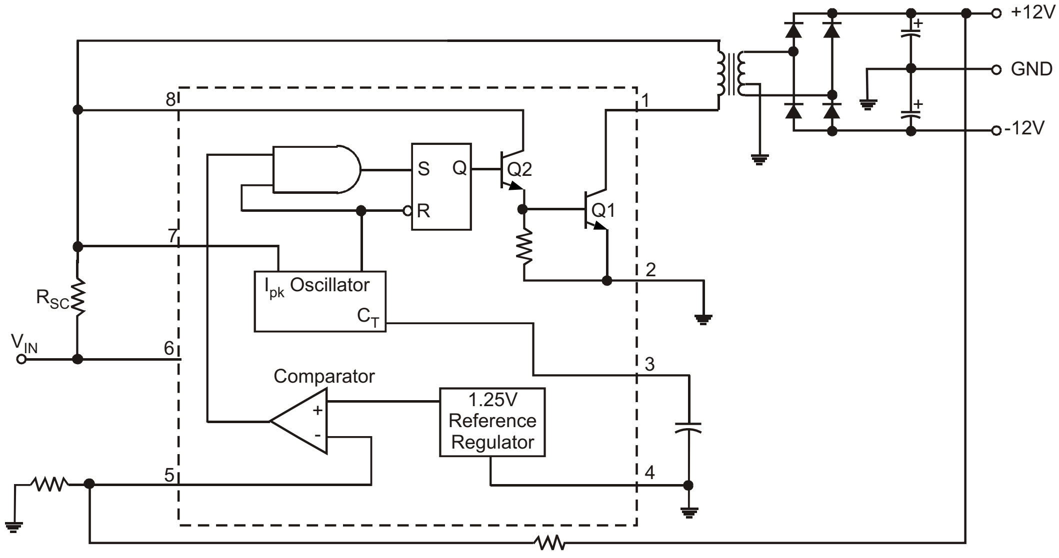


Figure 9. Dual Output Voltage

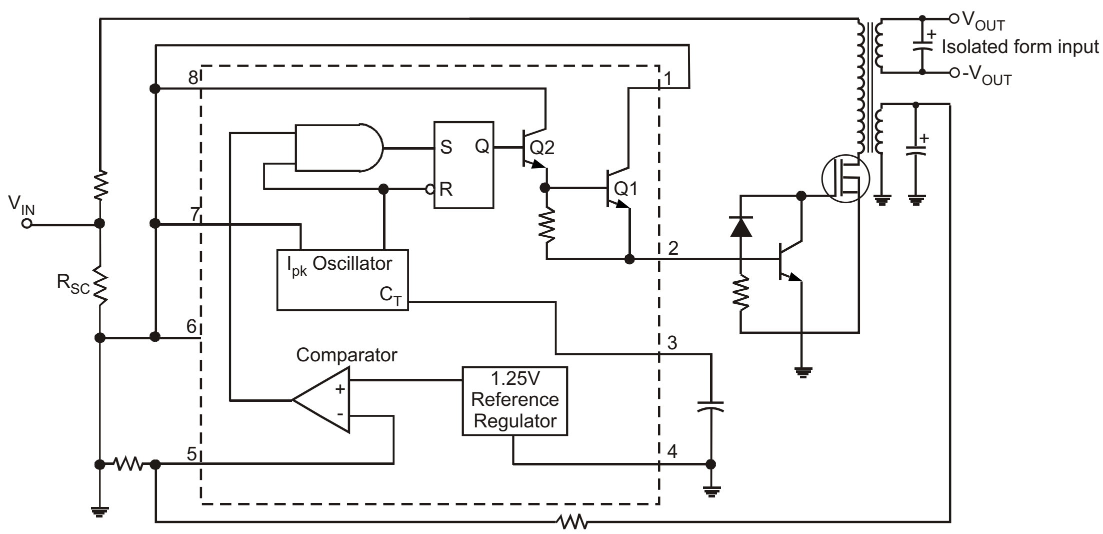


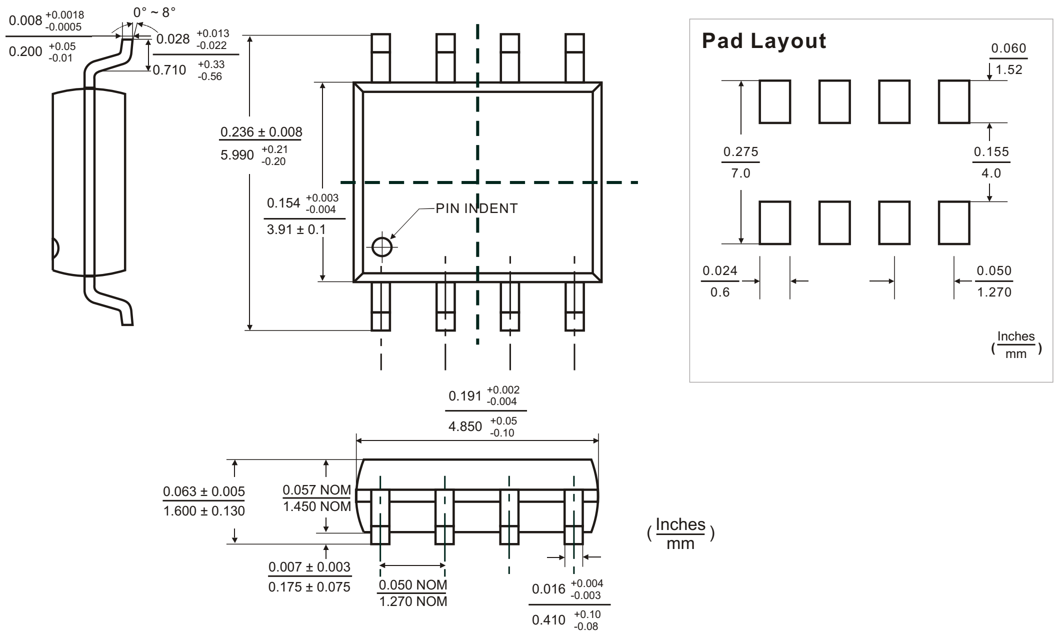
Figure 10. Higher Output Power, Higher Input Voltage

◆ DESIGN FORMULAS

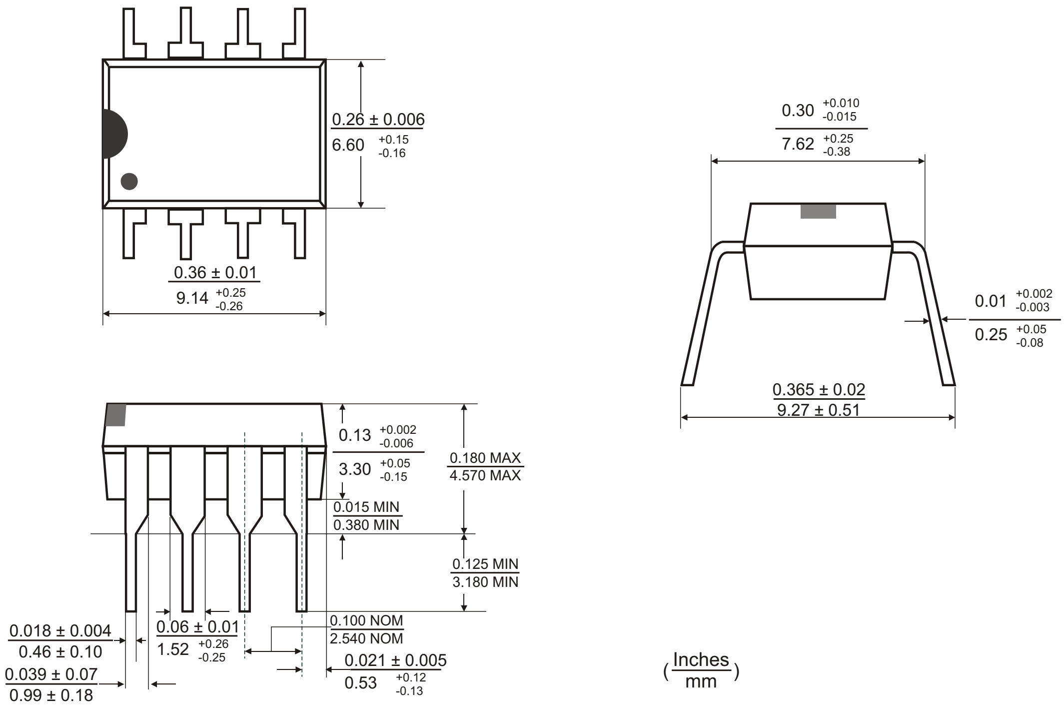
Calculation	Step - Up	Step - Down	Voltage - Inverting
t_{on} / t_{off}	$\frac{V_{out} + V_F - V_{IN(min)}}{V_{IN(min)} - V_{sat}}$	$\frac{V_{out} + V_F}{V_{IN(min)} - V_{sat} - V_{out}}$	$\frac{\lvert V_{out}\rvert + V_F}{V_{IN} - V_{sat}}$
$(t_{on} + t_{off})$	$\frac{1}{f}$	$\frac{1}{f}$	$\frac{1}{f}$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

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.

◆ SOP-8 PACKAGE OUTLINE DIMENSIONS



◆ DIP-8 PACKAGE OUTLINE DIMENSIONS



◆ ORDERING NUMBER