1. DESCRIPTION

The 34063/33063 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.

2. FEATURES

- Operation from 3.0 V to 40 V Input
- Low Standby Current
- Current Limiting
- Output Switch Current Up to 1.5A (Peak)
- Output Voltage Adjustable
- Frequency Operation to 100 kHz
- Precision 2% Reference

3. PIN CONFIGURATIONS AND FUNCTIONS

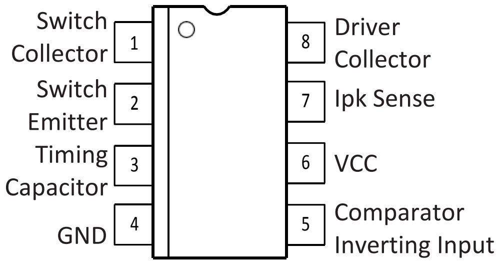


Figure 1. Pin Connections

Pin Functions

PIN		TYPE	DESCRIPTION
NAME	NO.		
Switch Collector	1	I/O	High-current internal switch collector input.
Switch Emitter	2	I/O	High-current internal switch emitter output.
Timing Capacitor	3	—	Attach a timing capacitor to change the switching frequency.
GND	4	—	Ground
Comparator Inverting Input	5	I	Attach to a resistor divider network to create a feedback loop.
V_{CC}	6	I	Logic supply voltage. Tie to V_{IN}.
I_{PK} Sense	7	I	Current-limit sense input.
Driver Collector	8	I/O	Darlington pair driving transistor collector input.

4. FUNCTIONAL BLOCK DIAGRAM

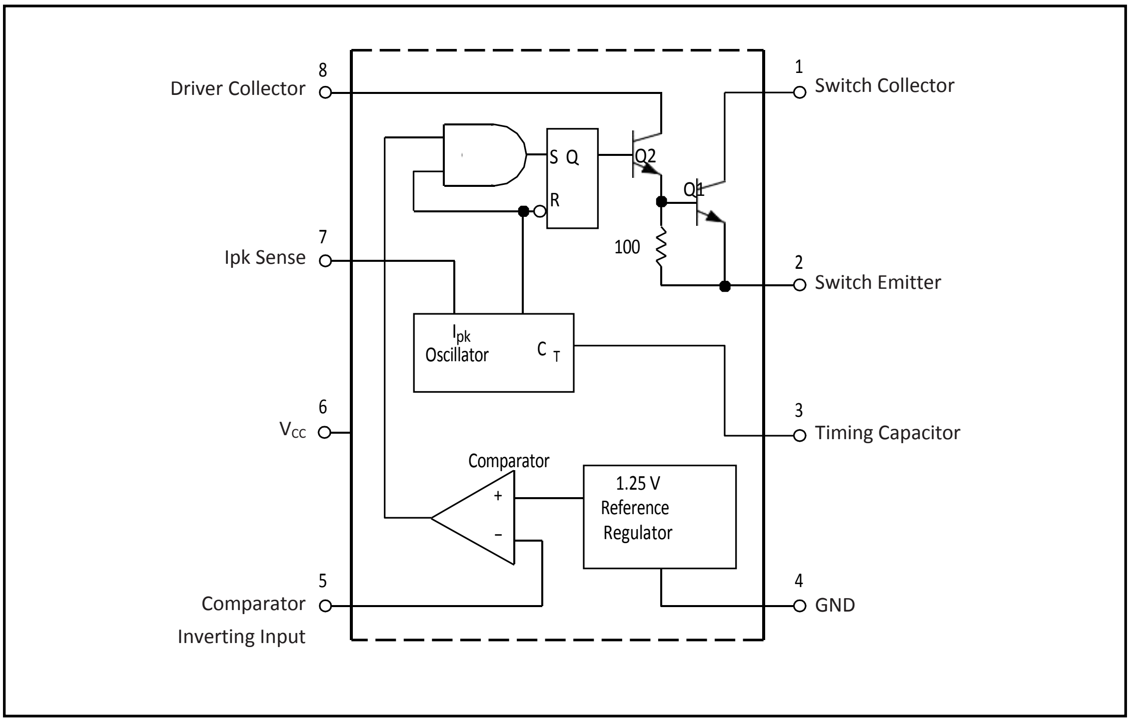


Figure 2. Representative Schematic Diagram

5. SPECIFICATIONS

5.1. 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 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°C	P_D	1.25	W
Thermal Resistance	$R_{\theta JA}$	115	°C/W
SOIC Package, D Suffix			
T_A = 25°C	P_D	625	mW
Thermal Resistance	$R_{\theta JA}$	160	°C/W
Operating Junction Temperature	T_J	+125	°C
Operating Ambient Temperature Range	T_A		°C
34063		0 to +70	°C
33063		−40 to +85	°C
Storage Temperature Range	T_{stg}	−45 to +125	°C

Stresses exceeding Maximum Ratings may damage the device. Maximum Ratings are stress ratings only. Functional operation above the Recommended Operating Conditions is not implied. Extended exposure to stresses above the Recommended Operating Conditions may affect device reliability.

[1] Maximum package power dissipation limits must be observed.

[2] This device series contains ESD protection and exceeds the following tests: Human Body Model 2000 V per MIL−STD−883, Method 3015. Machine Model Method 250 V.

5.2. Electrical Characteristics

(VCC = 5.0 V, TA = Tlow to Thigh [Note 4], unless otherwise specified.)

Characteristics	Symbol	Min	Typ	Max	Unit
OSCILLATOR					
Frequency ($V_{Pin\ 5}$ = 0 V, C_T = 1.0 nF, T_A = 25°C)	f_{osc}	24	33	42	kHz
Charge Current (V_{CC} = 5.0 V to 40 V, T_A = 25°C)	I_{chg}	24	35	42	μA
Discharge Current (V_{CC} = 5.0 V to 40 V, 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)	$V_{ipk(sense)}$	250	300	350	mV
OUTPUT SWITCH (Note 5)					
Saturation Voltage, Darlington Connection (I_{SW} = 1.0 A, Pins 1, 8 connected)	$V_{CE(sat)}$	−	1.0	1.3	V
Saturation Voltage (Note 6) (I_{SW} = 1.0 A, $R_{Pin\ 8}$ = 82 Ω to V_{CC}, Forced ß 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)	$I_{C(off)}$	−	0.01	100	μA
COMPARATOR					
Threshold Voltage T_A = 25°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} = 3.0 V to 40 V) XL33063, XL34063	Reg_{line}	−	1.4	5.0	mV
Input Bias Current (V_{in} = 0 V)	I_{IB}	−	−20	−400	nA
TOTAL DEVICE					
Supply Current (V_{CC} = 5.0 V to 40 V, C_T = 1.0 nF, Pin 7 = V_{CC}, $V_{Pin\ 5}$ > V_{th}, Pin 2 = GND, remaining pins open)	I_{CC}	−	−	4.0	mA

[3] Tlow = 0°C for XL34063; − 40°Cfor XL33063.

Thigh = +70°C for XL34063; + 85°C for XL33063.

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

[5] 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 μs 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 ß of output switch : $\frac{\text{IC output}}{\text{IC driver - 7.0mA *}} \geq 10$

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

6. TEST INFORMATION

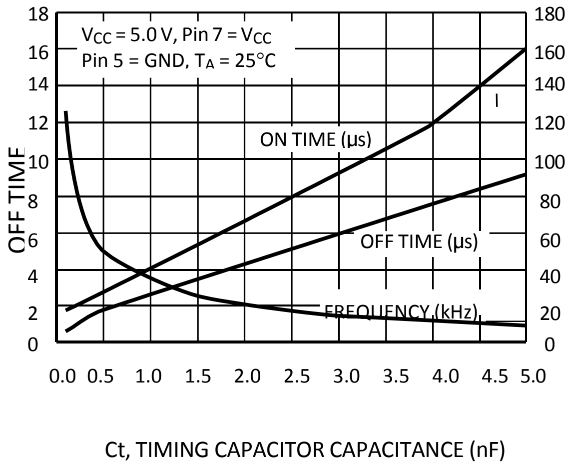


Figure 1. Oscillator Frequency

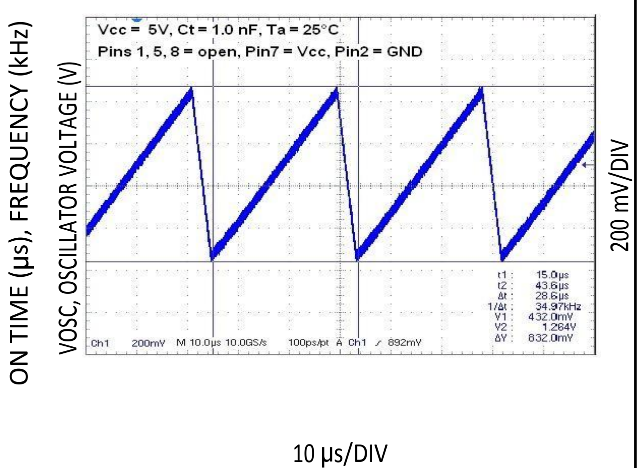


Figure 2. Timing Capacitor Waveform

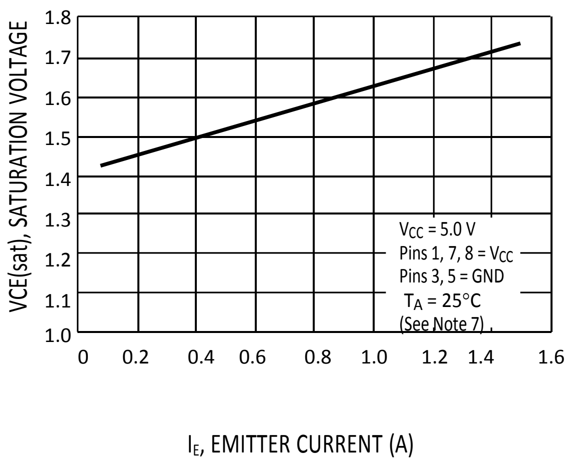


Figure 3. Emitter Follower Configuration Output Saturation Voltage versus Emitter Current

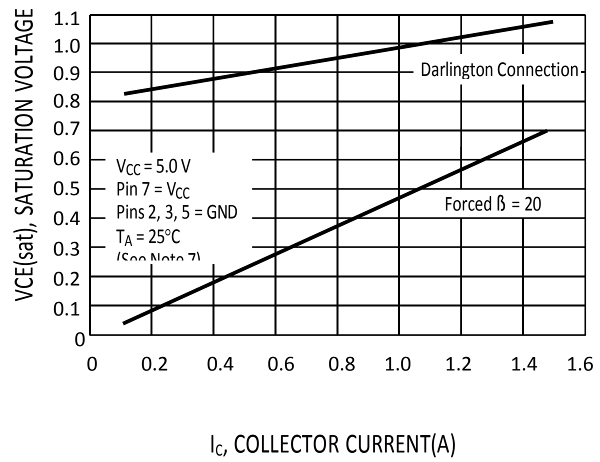


Figure 4. Common Emitter Configuration Output Switch Saturation Voltage versus Collector Current

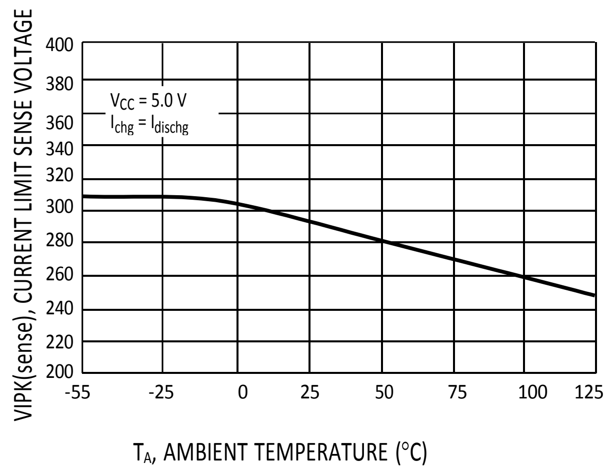


Figure 5. Current Limit Sense Voltage versus Temperature

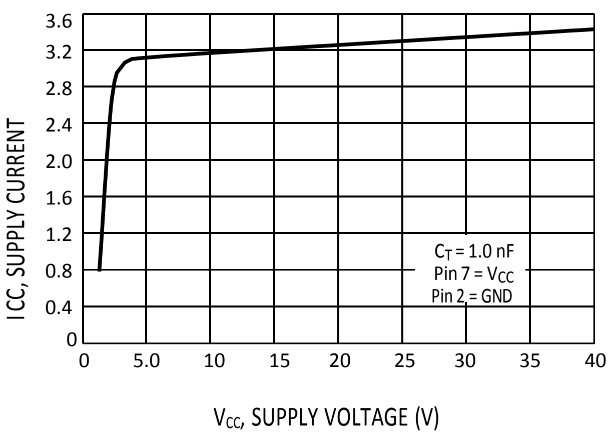
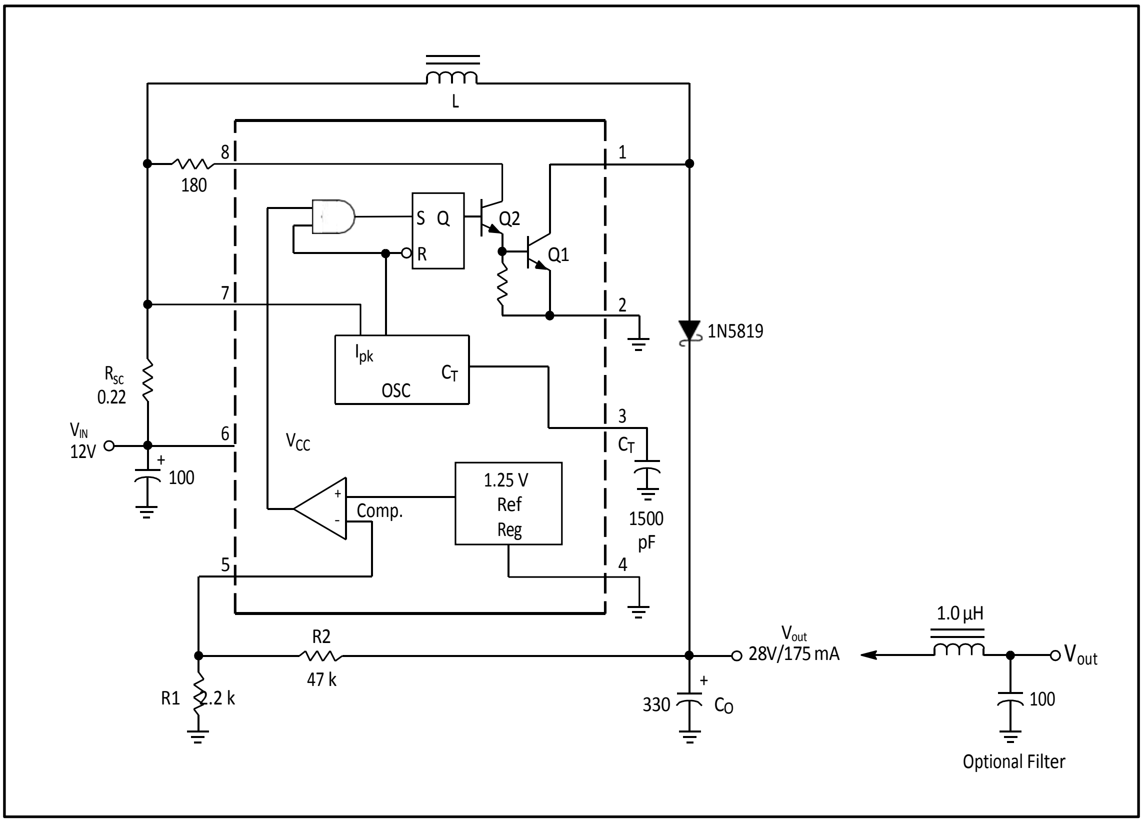


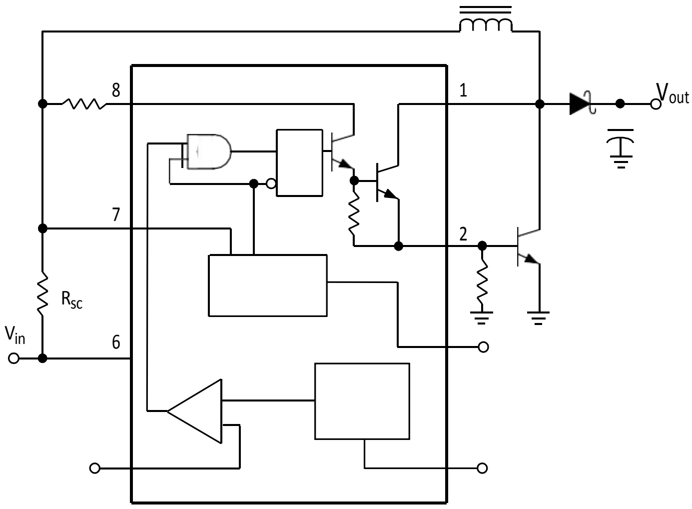
Figure 6. Standby Supply Current versus Supply Voltage

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

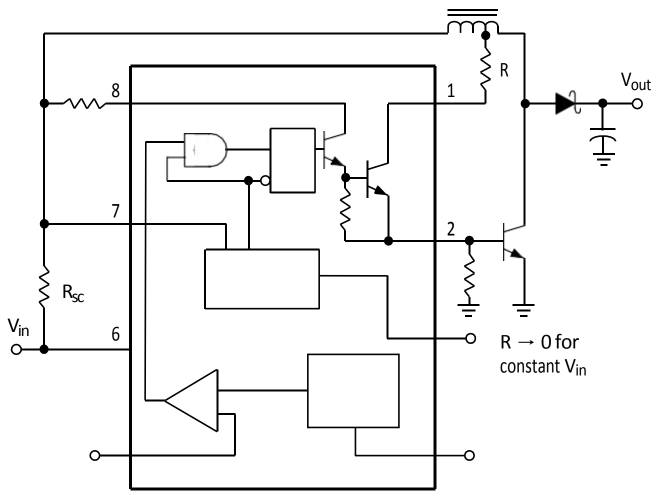


Test	Conditions	Results
Line Regulation	V_{in} = 8.0 V to 16 V, I_O = 175 mA	30 mV = ±0.05%
Load Regulation	V_{in} = 12 V, I_O = 75 mA to 175 mA	10 mV = ±0.017%
Output Ripple	V_{in} = 12 V, I_O = 175 mA	400 mVpp
Efficiency	V_{in} = 12 V, I_O = 175 mA	87.7%
Output Ripple With Optional Filter	V_{in} =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

Figure 7. Step−Up Converter



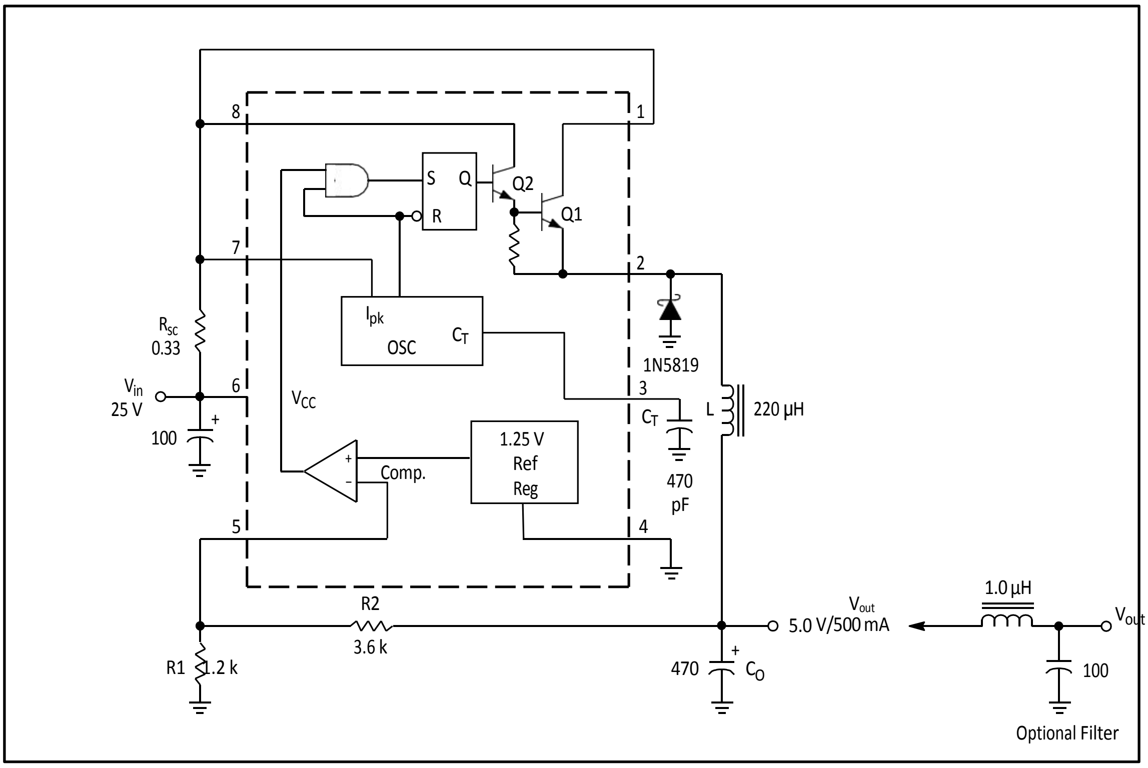
a. External NPN Switch



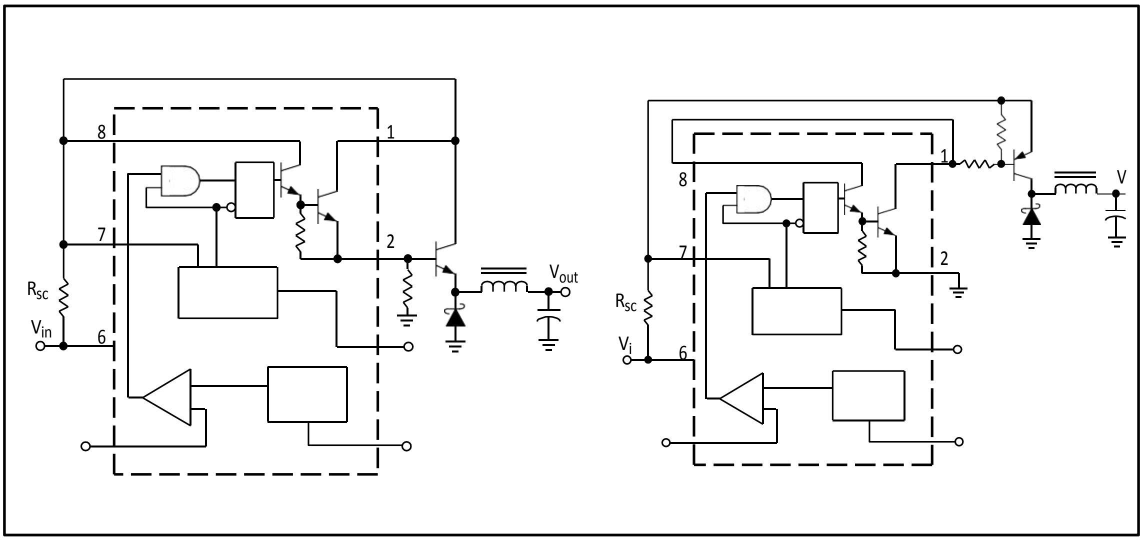
b. External NPN Saturated Switch

Figure 8. External Current Boost Connections for IC Peak Greater than 1.5 A (See Note 8)

[7] 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 µs 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.

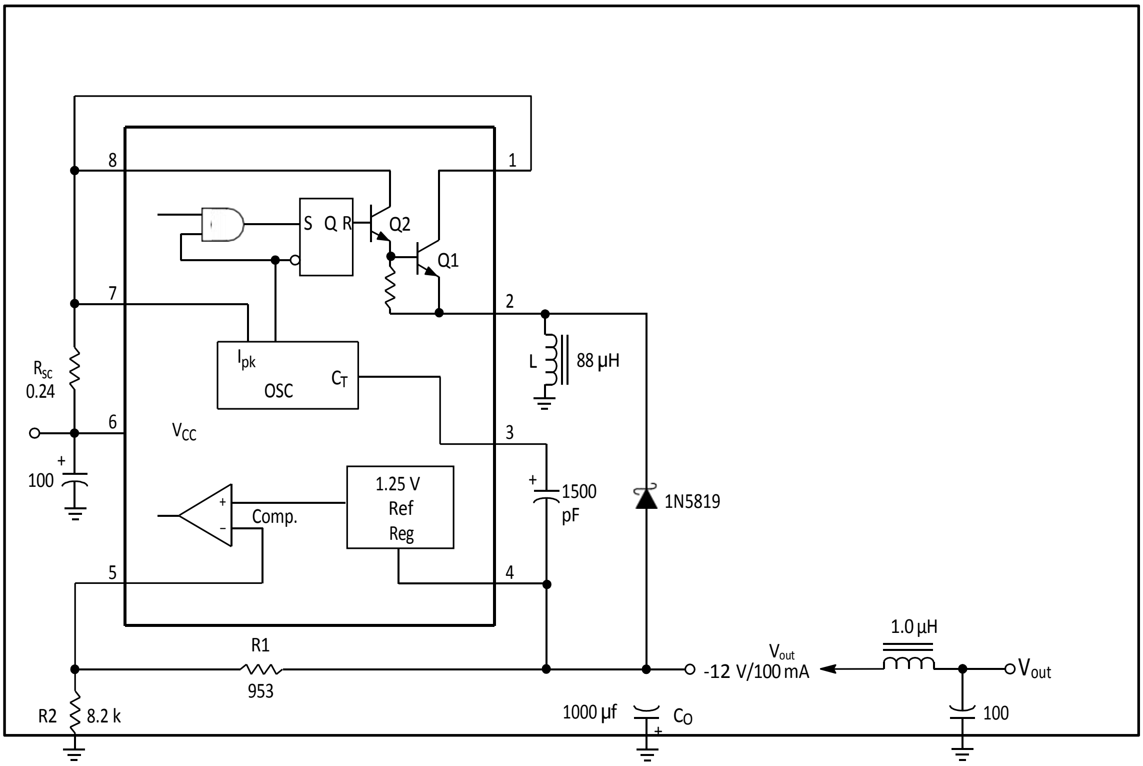


Test	Conditions	Results
Line Regulation	V_{in} = 15 V to 25 V, I_O = 500 mA	12 mV = ±0.12%
Load Regulation	V_{in} = 25 V, I_O = 50 mA to 500 mA	3.0 mV = ±0.03%
Output Ripple	V_{in} = 25 V, I_O = 500 mA	120 mVpp
Short Circuit Current	V_{in} = 25 V, R_L = 0.1 Ω	1.1 A
Efficiency	V_{in} = 25 V, I_O = 500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



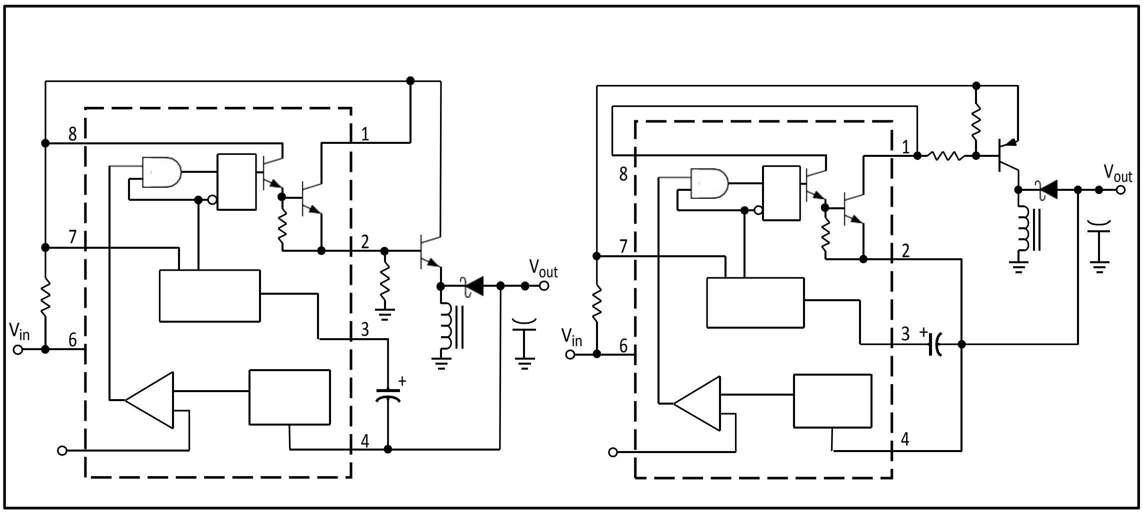
a. External NPN Switch **b. External PNP Saturated Switch**

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



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 10. Voltage Inverting Converter



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

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

INDUCTOR DATA

Converter	Inductance (μH)	Turns/Wire
Step−Up	170	38 Turns of #22 AWG
Step−Down	220	48 Turns of #22 AWG
Voltage−Inverting	88	28 Turns of #22 AWG

All inductors are wound on Magnetics Inc. 55117 toroidal core.

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	$4.0 \times 10^{-5}\ t_{on}$	$4.0 \times 10^{-5}\ t_{on}$	$4.0 \times 10^{-5}\ t_{on}$
$I_{pk(switch)}$	$2I_{out(max)}(\frac{t_{on}}{t_{off}}+1)$	$2I_{out(max)}$	$2I_{out(max)}(+1)$
R_{SC}	$0.3/I_{pk(switch)}$	$0.3/I_{pk(switch)}$	$0.3/I_{pk(switch)}$
$L_{(min)}$	$(\frac{(V_{in(min)}-V_{sat})}{I_{pk(switch)}})t_{on(max)}$	$(\frac{(V_{in(min)}-V_{sat}-V_{out})}{I_{pk(switch)}})t_{on(max)}$	$(\frac{(V_{in(min)}-V_{sat})}{I_{pk(switch)}})t_{on(max)}$
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, $|Vout| = 1.25\ (1+\frac{R2}{R1})$

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.

Figure 12. Design Formula Table

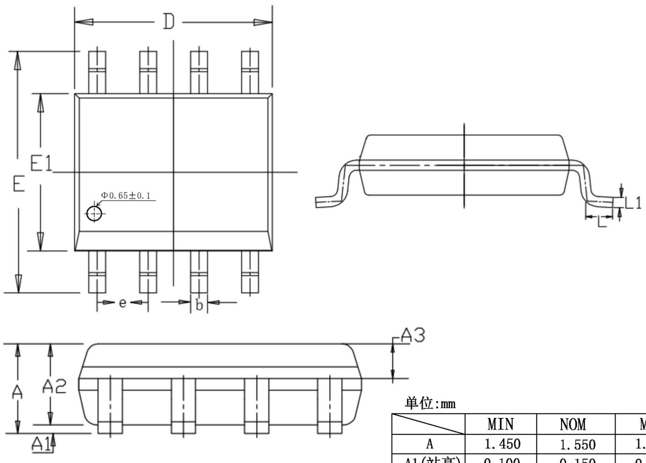
7. ORDERING INFORMATION

Table 1. Ordering Information

Part Number	Device Marking	Package Type	Body size (mm)	Temperature (°C)	MSL	Transport Media	Package Quantity
XL34063	XL34063	SOP8	4.90 * 3.90	-0 to +70	MSL3	T&R	2500
XD34063	XD34063	DIP8	9.25 * 6.38	-0 to +70	MSL3	Tube 50	2000
XL33063	XL33063	SOP8	4.90 * 3.90	-40 to +85	MSL3	T&R	2500
XD33063	XD33063	DIP8	9.25 * 6.38	-40 to +85	MSL3	Tube 50	2000

8. DIMENSIONAL DRAWINGS

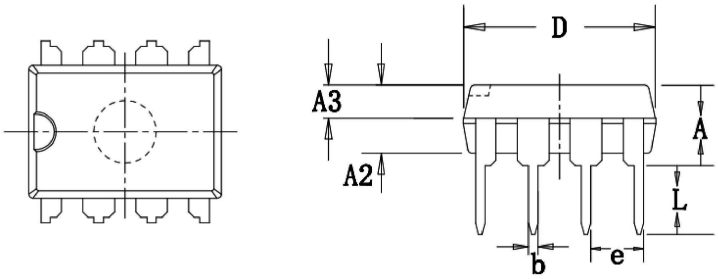
SOP8

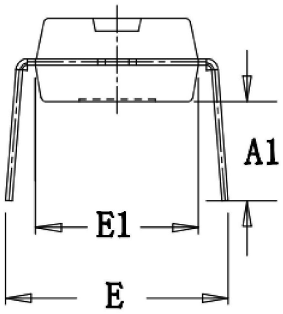


单位:mm

	MIN	NOM	MAX
A	1.450	1.550	1.650
A1(站高)	0.100	0.150	0.200
A2(厚度)	1.300	1.400	1.500
A3	0.600	0.650	0.700
b	0.380	–	0.510
e(脚间距)	1.240	1.270	1.300
D(长度)	4.800	4.900	5.000
E(跨度)	5.800	6.000	6.200
E1(宽度)	3.800	3.900	4.000
L(脚长)	0.450	0.600	0.750
L1	—	0.25BSC	—

DIP8





单位:mm

	MIN	NOM	MAX
A	3.600	3.800	4.000
A1(站高)	3.786	3.886	3.986
A2(厚度)	3.200	3.300	3.400
A3	1.550	1.600	1.650
b	0.440	—	0.490
e(脚间距)	2.510	2.540	2.570
D(长度)	9.150	9.250	9.350
E(跨度)	7.800	8.500	9.200
E1(宽度)	6.280	6.380	6.480
L(脚长)	3.000	—	—