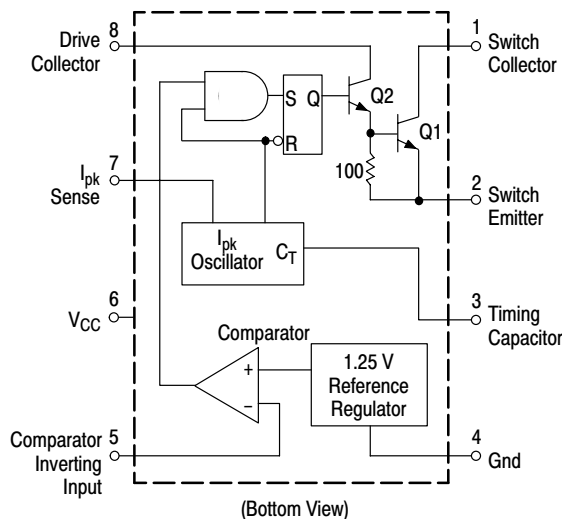


## 1.5A, Step-Up/Down/Inverting Switching Regulators

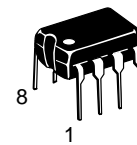
The CP34063 Series is a monolithic control circuit containing the primary functions required for DC-to-DC converters. These devices consist of an internal temperature compensated reference, comparator, controlled duty cycle oscillator with an active current limit circuit, driver and high current output 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.

- 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



This device contains 51 active transistors.

**Figure 1. Representative Schematic Diagram**

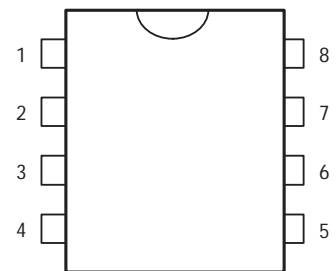


**PDIP-8**



**SOP-8**

### PIN CONNECTIONS



- 1 - Switch Collector
- 2 - Switch Emitter
- 3 - Timing Capacitor
- 4 - Gnd
- 5 - Comparator Inverting Input
- 6 - Vcc
- 7 - Ipk Sense
- 8 - Driver Collector

\* All specs and applications shown above subject to change without prior notice.

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

**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 ( $V_{P_{in\ 1}} = 40\text{ V}$ )	$V_{E(switch)}$	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, PDIP-8			
$T_A = 25^\circ\text{C}$	$P_D$	1.25	W
Thermal Resistance	$R_{\theta JA}$	100	$^\circ\text{C/W}$
SOIC Package, SOP-8			
$T_A = 25^\circ\text{C}$	$P_D$	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	$^\circ\text{C}$

1. Maximum package power dissipation limits must be observed.
2. ESD data available upon request.
3. NCV prefix is for automotive and other applications requiring site and change control.

**ORDERING INFORMATION**
**CP 34063 X**

A : Taping (SOP-8)

N : Tube (DIP-8)

\* All specs and applications shown above subject to change without prior notice.

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

**ELECTRICAL CHARACTERISTICS** ( $V_{CC} = 5.0\text{ V}$ ,  $T_A = T_{low}$  to  $T_{high}$  [Note 4], unless otherwise specified.)

Characteristics	Symbol	Min	Typ	Max	Unit
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**OSCILLATOR**

Frequency ( $V_{Pin\ 5} = 0\text{ V}$ , $C_T = 1.0\text{ nF}$ , $T_A = 25^\circ\text{C}$ )	$f_{osc}$	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	33	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

**OUTPUT SWITCH** (Note 5)

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 6) ( $I_{SW} = 1.0\text{ A}$ , $R_{Pin\ 8} = 82\ \Omega$ 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	120	–	–
Collector Off-State Current ( $V_{CE} = 40\text{ V}$ )	$I_{C(off)}$	–	0.01	100	$\mu\text{A}$

**COMPARATOR**

Threshold Voltage $T_A = 25^\circ\text{C}$ $T_A = T_{low}$ to $T_{high}$	$V_{th}$	1.225 1.21	1.25 –	1.27 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 ( $V_{in} = 0\text{ V}$ )	$I_{IB}$	–	–40	–400	nA

**TOTAL DEVICE**

Supply Current ( $V_{CC} = 5.0\text{ V to } 40\text{ V}$ , $C_T = 1.0\text{ nF}$ , Pin 7 = $V_{CC}$ , $V_{Pin\ 5} > V_{th}$ , Pin 2 = Gnd, remaining pins open)	$I_{CC}$	–	2.5	4.0	mA
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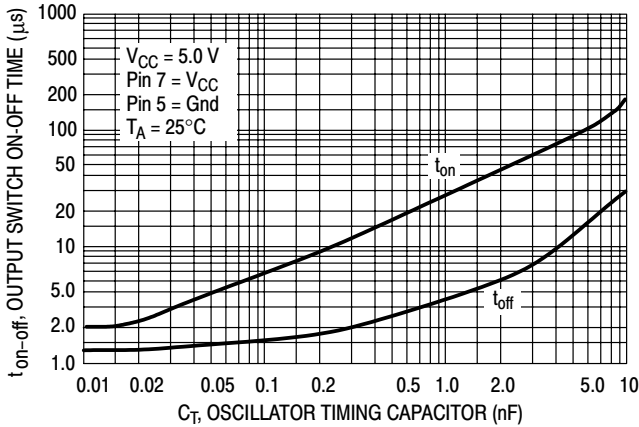
4.  $T_{low} = 0^\circ\text{C}$  for CP34063
5. Low duty cycle pulse techniques are used during test to maintain junction temperature as close to ambient temperature as possible.
6. If the output switch is driven into hard saturation (non-Darlington configuration) at low switch currents ( $\leq 300\text{ mA}$ ) 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:

$$\text{Forced } \beta \text{ of output switch : } \frac{I_{C\ \text{output}}}{I_{C\ \text{driver}} - 7.0\text{ mA}} \geq 10$$

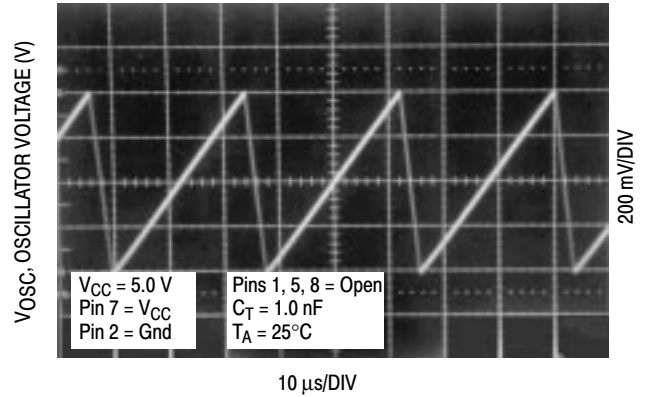
\* The  $100\ \Omega$  resistor in the emitter of the driver device requires about  $7.0\text{ mA}$  before the output switch conducts.

\* All specs and applications shown above subject to change without prior notice.

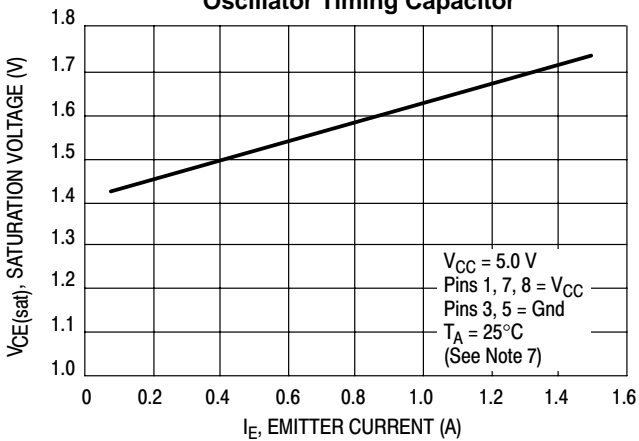
# 1.5A, Step-Up/Down/Inverting Switching Regulators



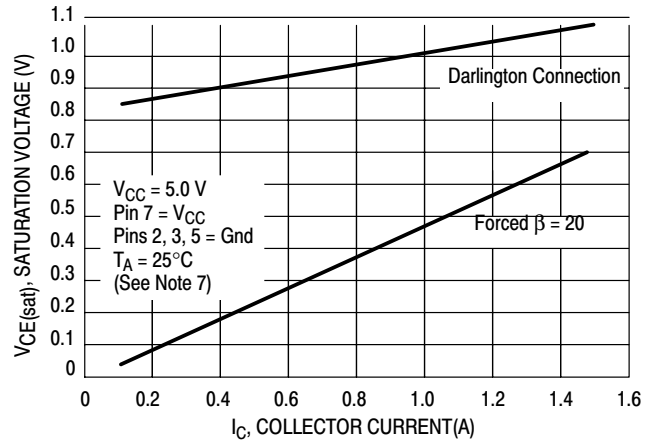
**Figure 2. Output Switch On-Off Time versus Oscillator Timing Capacitor**



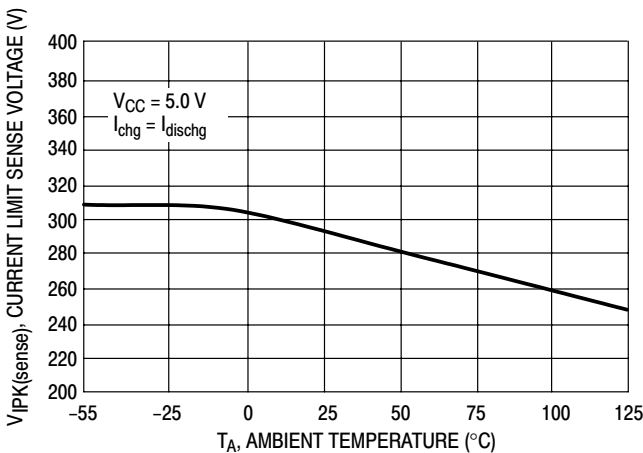
**Figure 3. Timing Capacitor Waveform**



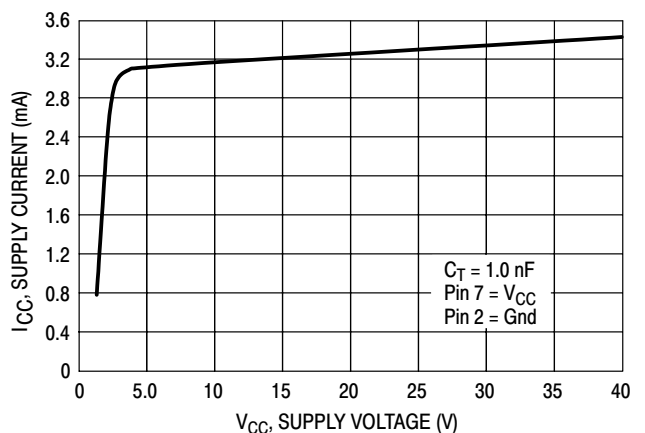
**Figure 4. Emitter Follower Configuration Output Saturation Voltage versus Emitter Current**



**Figure 5. Common Emitter Configuration Output Switch Saturation Voltage versus Collector Current**

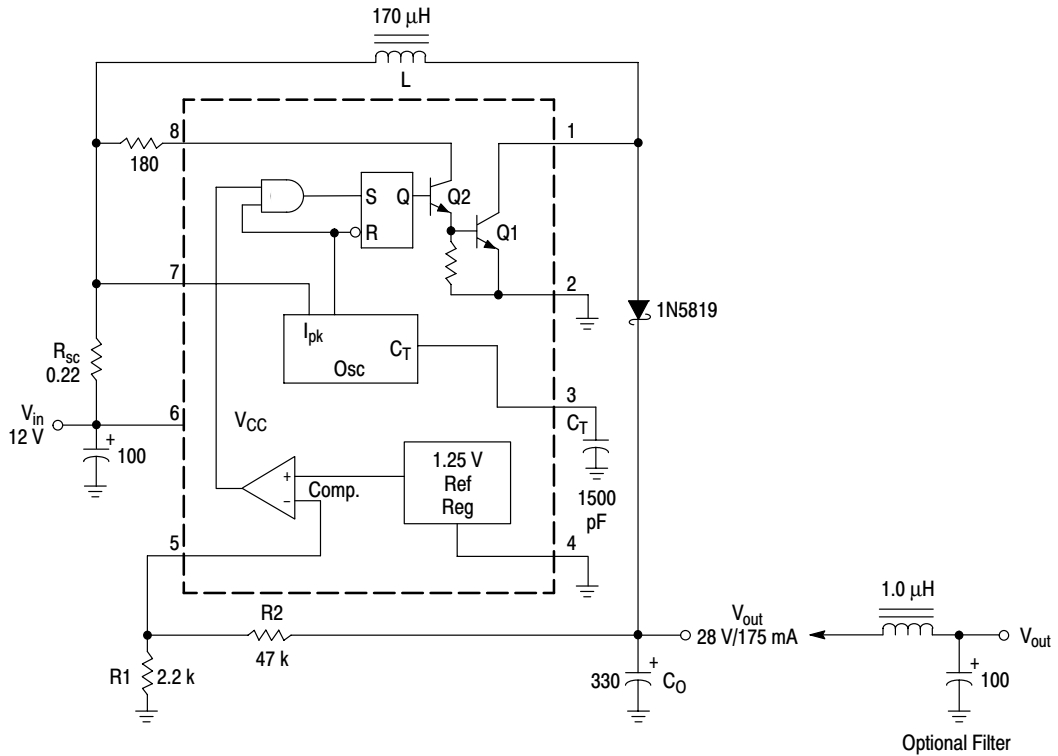


**Figure 6. Current Limit Sense Voltage versus Temperature**



**Figure 7. Standby Supply Current versus Supply Voltage**

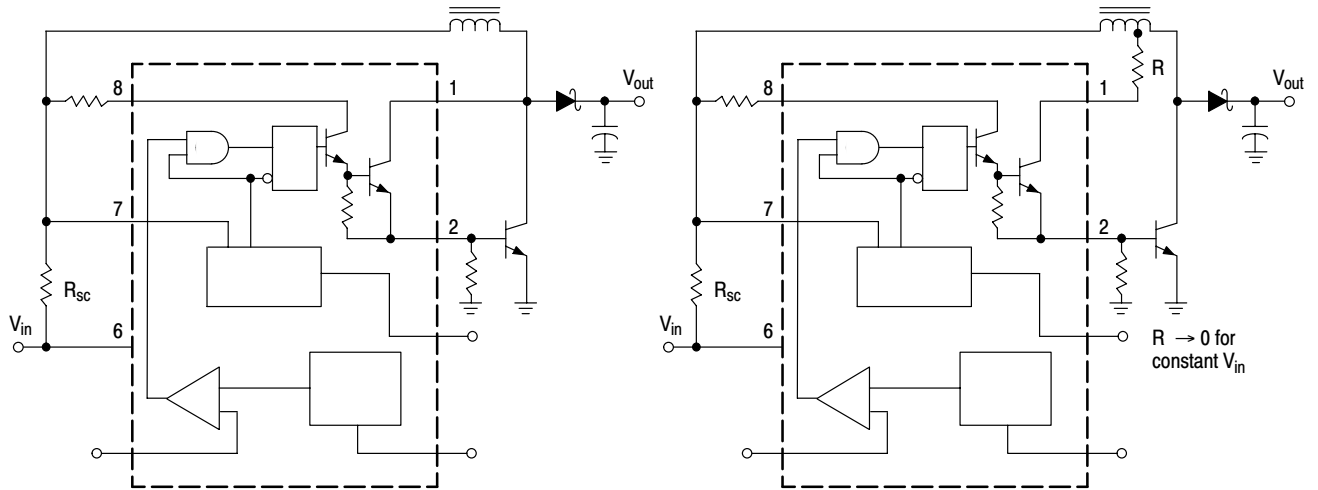
\* All specs and applications shown above subject to change without prior notice.

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


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

**Figure 8. Step-Up Converter**

\* All specs and applications shown above subject to change without prior notice.

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


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

**9a. External NPN Switch**

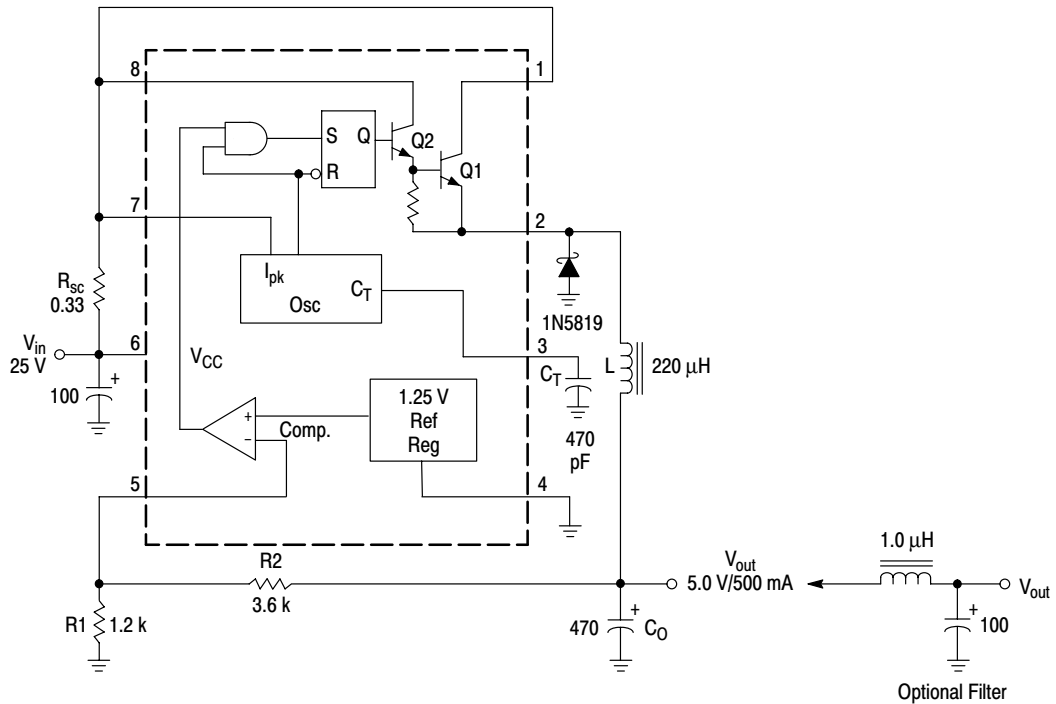
**9b. External NPN Saturated Switch**

(See Note 8)

8. 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  $2.0 \mu\text{s}$  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.

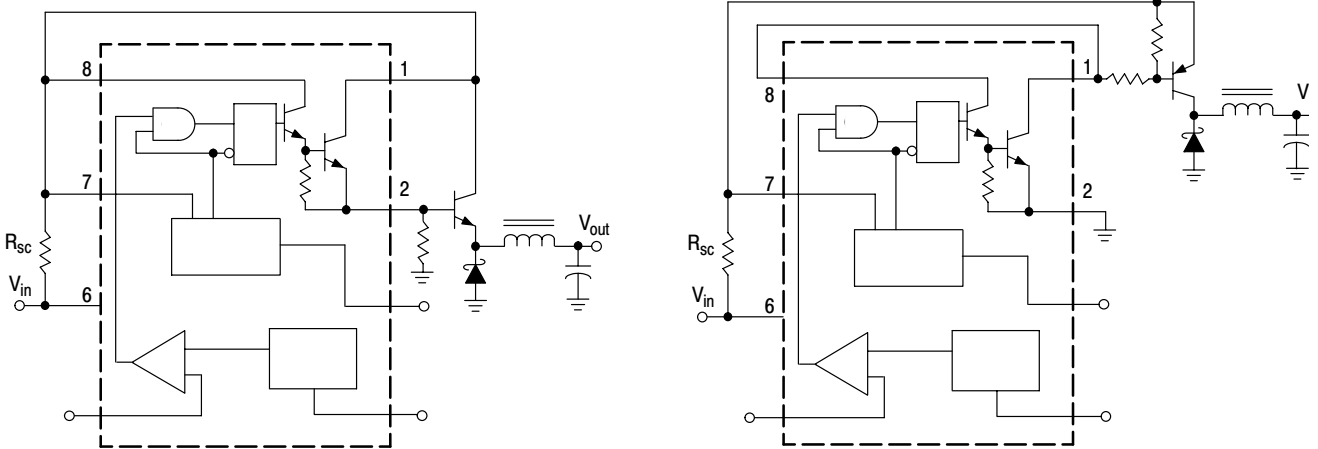
\* All specs and applications shown above subject to change without prior notice.

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



Test	Conditions	Results
Line Regulation	$V_{in} = 15\text{ V to }25\text{ V}, I_O = 500\text{ mA}$	12 mV = $\pm 0.12\%$
Load Regulation	$V_{in} = 25\text{ V}, I_O = 50\text{ mA to }500\text{ mA}$	3.0 mV = $\pm 0.03\%$
Output Ripple	$V_{in} = 25\text{ V}, I_O = 500\text{ mA}$	120 mVpp
Short Circuit Current	$V_{in} = 25\text{ V}, R_L = 0.1\ \Omega$	1.1 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 mVpp

**Figure 10. Step-Down Converter**



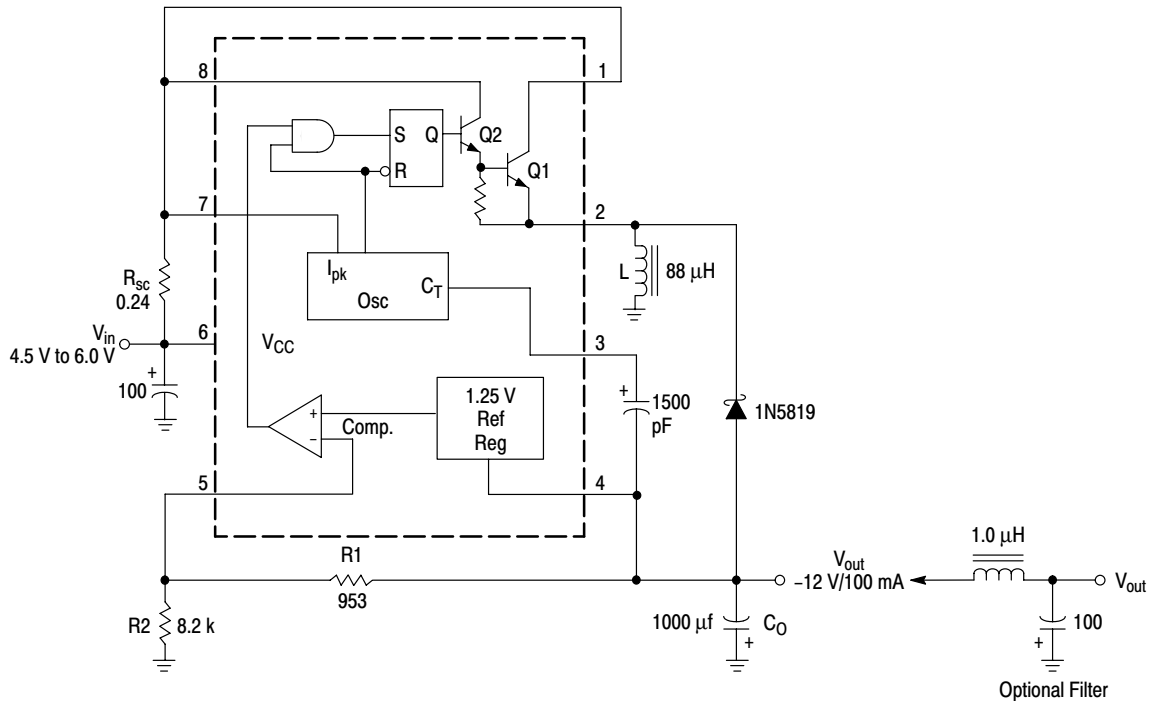
**Figure 11. External Current Boost Connections for  $I_C$  Peak Greater than 1.5 A**

**11a. External NPN Switch**

**11b. External PNP Saturated Switch**

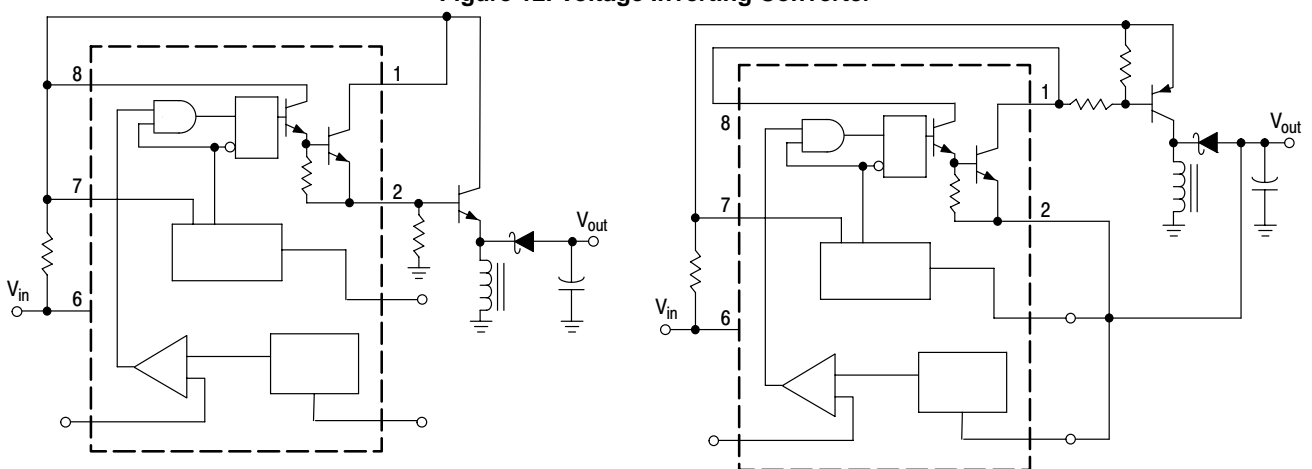
\* All specs and applications shown above subject to change without prior notice.

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



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

**Figure 12. Voltage Inverting Converter**



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

**13a. External NPN Switch**

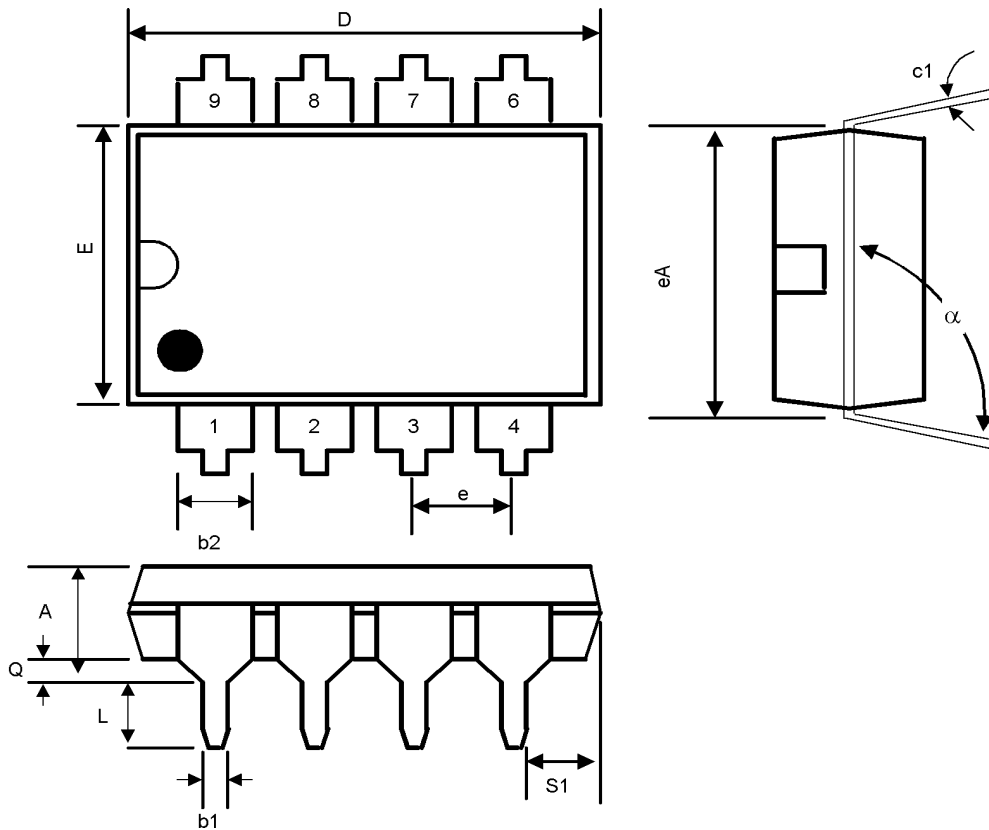
**13b. External PNP Saturated Switch**

\* All specs and applications shown above subject to change without prior notice.



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

Package Outlines : DIP-8

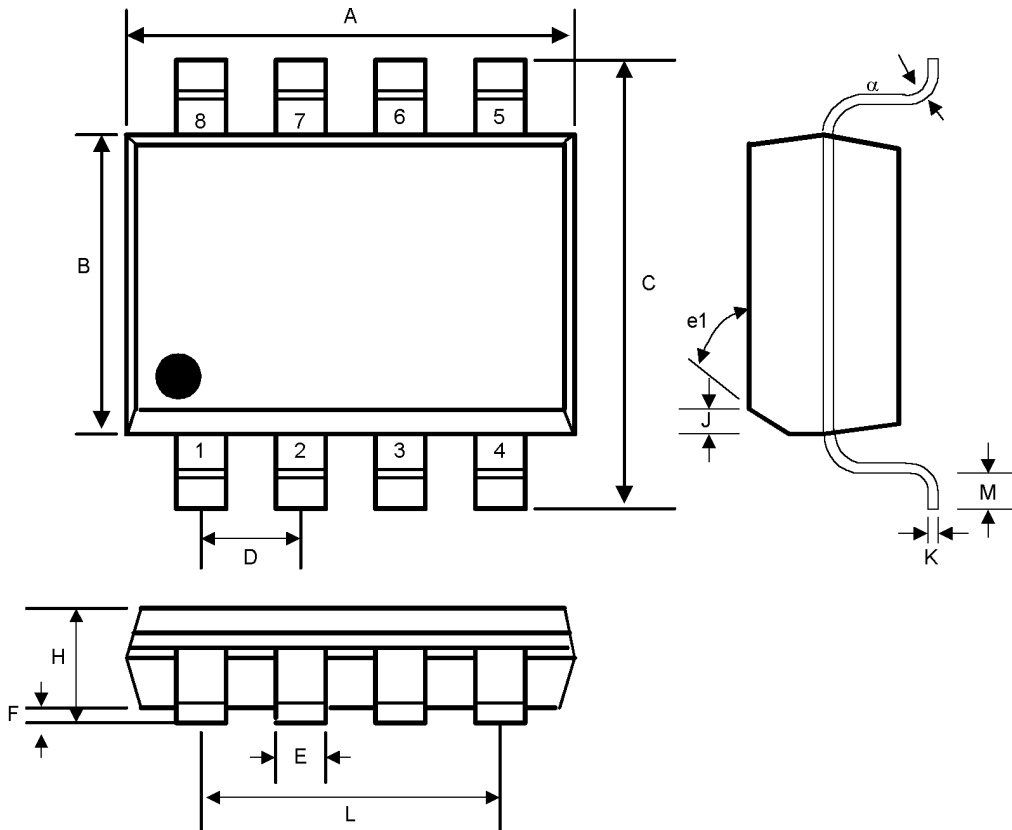


SYMBOL	INCHES		MILLIMETERS		NOTES
	MIN	MAX	MIN	MAX	
A	-	0.200	-	5.08	-
b1	0.014	0.023	0.36	0.58	-
b2	0.045	0.065	1.14	1.65	-
c1	0.008	0.015	0.20	0.38	-
D	0.355	0.400	9.02	10.16	-
E	0.220	0.310	5.59	7.87	-
e	0.100 BSC		2.54 BSC		-
eA	0.300 BSC		7.62 BSC		-
L	0.125	0.200	3.18	5.08	-
Q	0.015	0.060	0.38	1.52	-
s1	0.005	-	0.13	-	-
α	90 <sup>0</sup>	105 <sup>0</sup>	90 <sup>0</sup>	105 <sup>0</sup>	-

\* All specs and applications shown above subject to change without prior notice.

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

Small Outline SOP-8



SYMBOL	INCHES		MILLIMETERS		NOTES
	MIN	MAX	MIN	MAX	
A	0.188	0.197	4.80	5.00	-
B	0.149	0.158	3.80	4.00	-
C	0.228	0.244	5.80	6.20	-
D	0.050 BSC		1.27 BSC		-
E	0.013	0.020	0.33	0.51	-
F	0.004	0.010	0.10	0.25	-
H	0.053	0.069	1.35	1.75	-
J	0.011	0.019	0.28	0.48	-
K	0.007	0.010	0.19	0.25	-
M	0.016	0.050	0.40	1.27	-
L	0.150 REF		3.81 REF		-
e1	45°		45°		-
$\alpha$	0°	8°	0°	8°	-

\* All specs and applications shown above subject to change without prior notice.