DC to DC Converter Controller

Description

The MC34063 is a monolithic switching regulator control circuit containing the primary functions required for DC-DC converters. This devices consists of internal temperature compensated reference, voltage comparator, controlled duty cycle oscillator with active current limit circuit, driver and high current output switch. The device is specifically designed to be incorporated in step-down,step-up and voltage-inverting applications with a minimum number of external components.

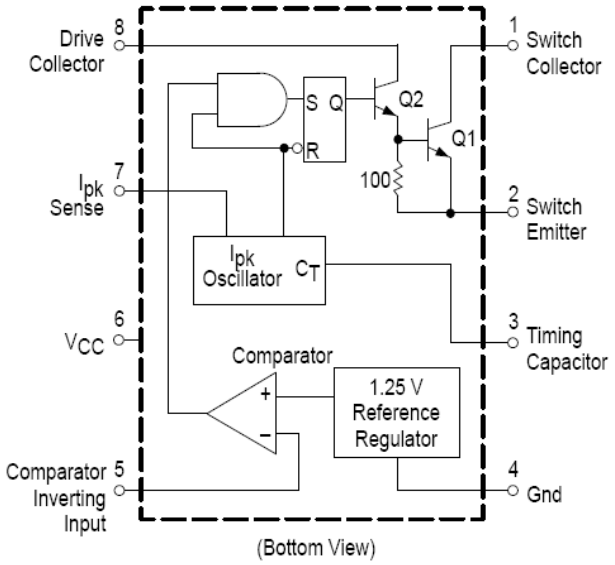
Features

- Operation from 3.0V to 40V
- Low Standby Current.
- Current Limiting
- Output Switch Current to 1.2A
- Output Voltage Adjustable
- Operation Frequency up to 180KHz (C_T=100pF)
- Precision 2% Reference

Applications

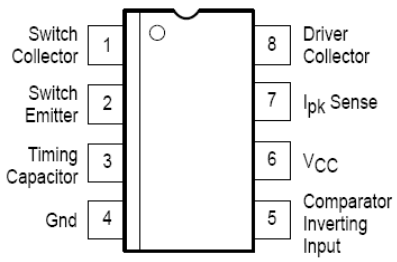
- Battery Chargers
- ADSL Modems
- NICs/Switches/Hubs
- Negative Voltage Power Supplies

Block Diagram



(Bottom View)

Pin Description



(Top View)

◆ Ordering Information

Part Number	Operating Temperature Range	Package	Packing
MC34063KI	-40 °C ~ +85 °C	SOP-8	Tape & Reel
MC34063JI		DIP-8	Tube

◆ Absolute Maximum Ratings(NOTE1)

Symbol	Parameter	Value	Unit
V_{CC}	Power Supply Voltage	40	V
V_{IR}	Comparator Input Voltage Range	-0.3 ~ +40	V
$V_{C(switch)}$	Switch Collector Voltage	40	V
$V_{E(switch)}$	Switch Emitter Voltage (V_{PIN1}=40V)	40	V
$V_{CE(switch)}$	Switch Collector to Emitter Voltage	40	V
$V_{C(driver)}$	Driver Collector Voltage	40	V
$I_{C(driver)}$	Driver Collector Current (NOTE2)	100	mA
I_{SW}	Switch Current	1.2	A
T_J	Operating Junction Temperature Range	+150	°C
T_A	Operating Ambient Temperature Range	-40 ~ +85	°C
T_{stg}	Storage Temperature Range	-65 ~ +150	°C
ESD		2000	V

Notes:

1 Stresses greater than those listed under .Absolute Maximum Ratings. may cause permanent damage to the device. These are stress ratings only, and functional operation of the device at these or any other conditions beyond those indicated under .Recommended Operating Conditions. is not implied. Exposure to .Absolute Maximum Ratings. for extended periods may affect device reliability.

2 Maximum package power dissipation limits must be observed.

◆ Thermal Characteristics

Symbol	Parameter	Package	Typical Value	Unit
θ_{JA}	Thermal Resistance From Junction to Ambient in Free Air. (Measured with the component mounted on a high effective thermal conductivity test board in free air.)	SOP-8	160	°C/W
		DIP-8	100	

◆ Electrical Characteristics (T_a=25 °C, V_{CC}=5.0V, unless otherwise noted .)

Symbol	Parameter	Test Condition	Min.	Typ.	Max.	Unit
Oscillator						
F_{osc}	Frequency	V_{pin5}=0V, C_T=1.0nF	30	38	45	KHz
I_{chg}	Charge Current	V_{CC}=5.0V to 40V	30	38	45	uA
I_{dischg}	Discharge Current	V_{CC}=5.0V to 40V	180	240	290	uA
I_{dischg}/I_{chg}	Discharge to Charge Current Ratio	Pin 7 to V_{CC}	5.2	6.5	7.5	-
$V_{ipk(sence)}$	Current Limit Sense Voltage	I_{cha}=I_{discha}	250	300	350	mV
Output Switch (NOTE3)						
$V_{CE(sat)}$	Saturation Voltage, Darlington Connection	I_{SW}=1.0A, Pins 1,8 connected	-	1.0	1.3	V
$V_{CE(sat)}$	Saturation Voltage, (NOTE4)	I_{SW}=1.0A, R_{pin8}=82Ω to V_{CC}, Forcedβ=20	-	0.45	0.8	V
h_{FE}	DC Current Gain	I_{SW}=1.0A, V_{CE}=5.0V	50	75	-	-
$I_{C(off)}$	Collector Off-State Current	V_{CE}=40V	-	0.01	100	uA
Comparator						
V_{th}	Threshold Voltage	T_A=25 °C	1.225	1.25	1.275	V
		T_A=-40 °C to +85 °C	1.21		1.29	
Reg_{line}	Threshold Voltage Line Regulator	V_{CC}=3.0V to 40V	-	1.4	5.0	mV
I_{IB}	Input Bias Current	V_{in}=0V	-	-20	-400	nA
Total Device						
I_{CC}	Supply Current	V_{CC}=5.0V to 40V, C_T=1.0nF, Pin 7=V_{CC} $V_{pin\ 5}$>V_{th}, pin2=GND Remaining pins open	-	-	4.0	mA

Notes:

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

4.If the output switch is driven into hard saturation (non-Darlington configuration) at low switch currents (≤ 300mA) and high driver currents (≥ 30mA), it may take up to 2.0μs 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 β of output switch: $\frac{I_{C(OUTPUT)}}{I_{C(DRIVER)}\text{-}7.0mA^*} \geq 10$

* The 100Ω resistor in the emitter of the driver device requires about 7 mA before the output switch conducts.

◆ Typical Characteristics

Figure 1. Output Switch On–Off Time versus Oscillator Timing Capacitor

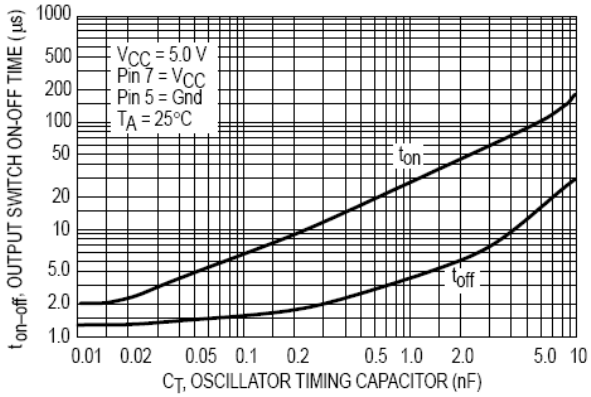


Figure 2. Timing Capacitor Waveform

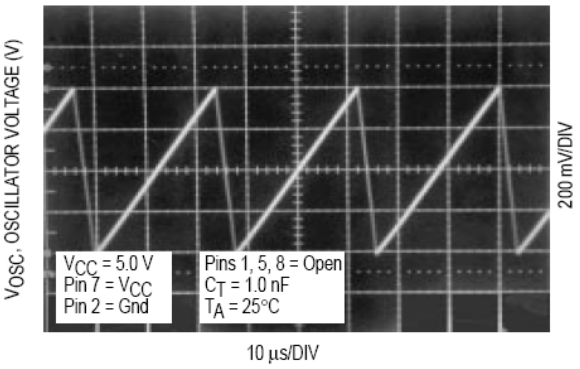


Figure 3. Emitter Follower Configuration Output Saturation Voltage versus Emitter Current

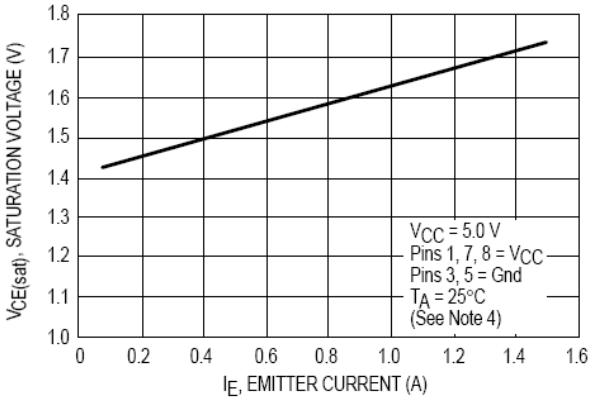


Figure 4. Common Emitter Configuration Output Switch Saturation Voltage versus Collector Current

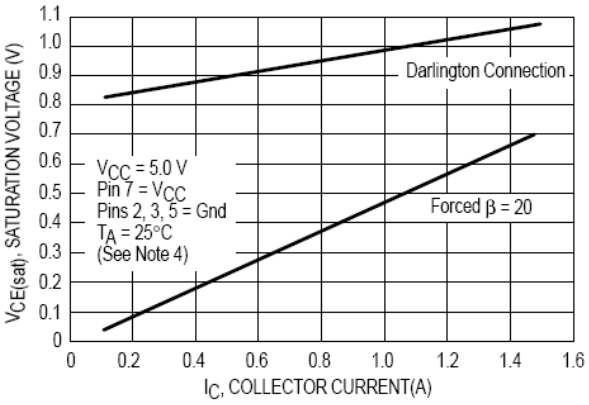


Figure 5. Current Limit Sense Voltage versus Temperature

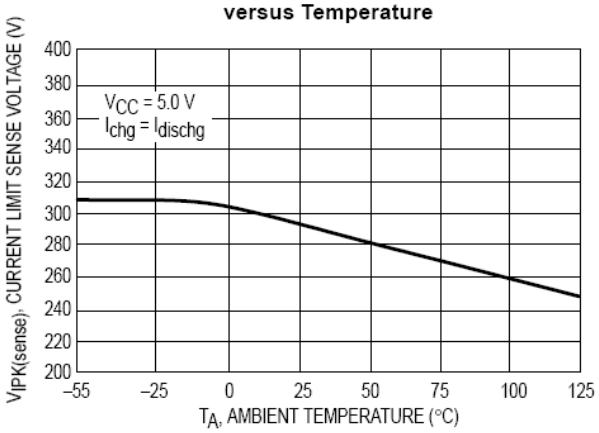
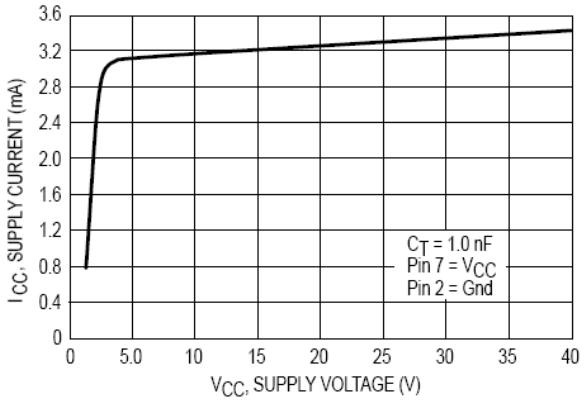


Figure 6. Standby Supply Current versus Supply Voltage



◆ Typical Application Circuits

Figure 7. Step–Up Converter

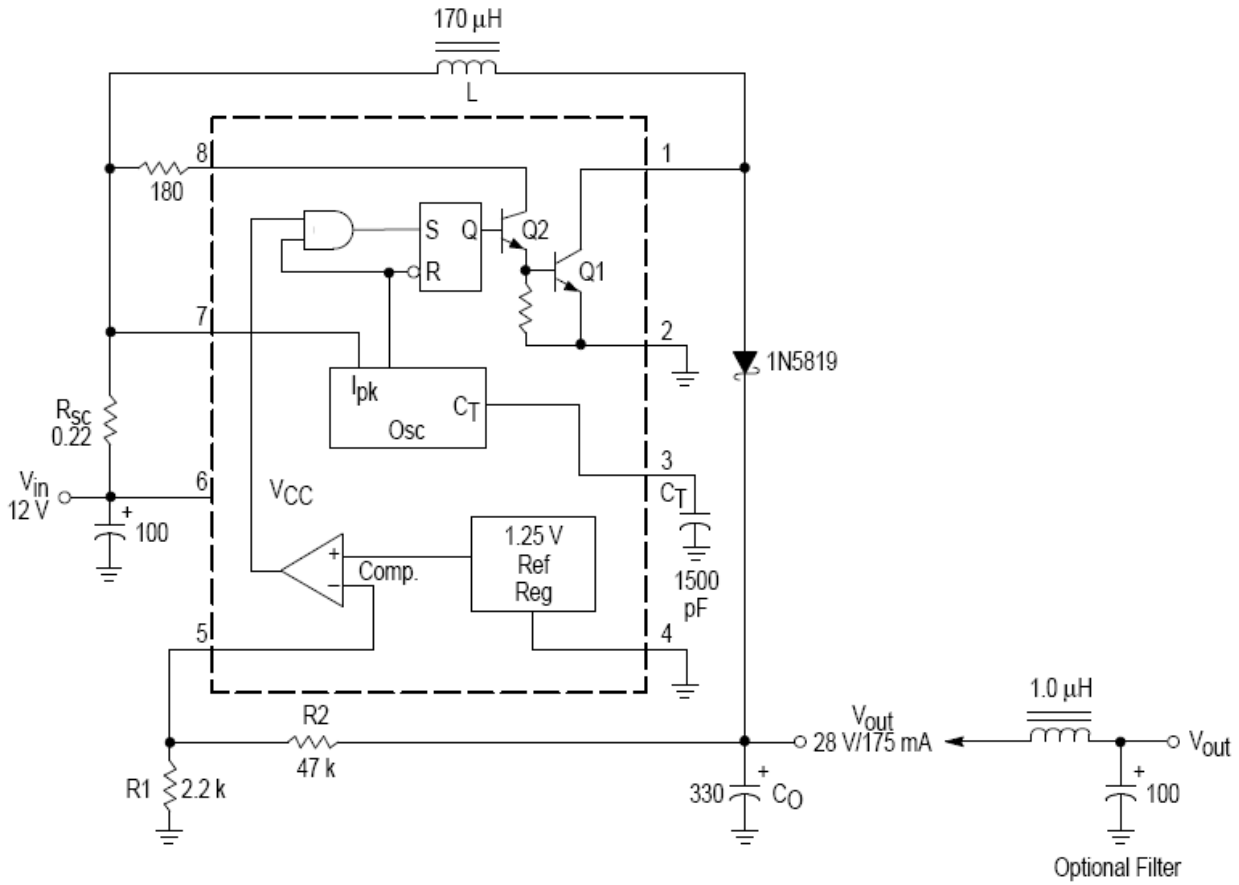
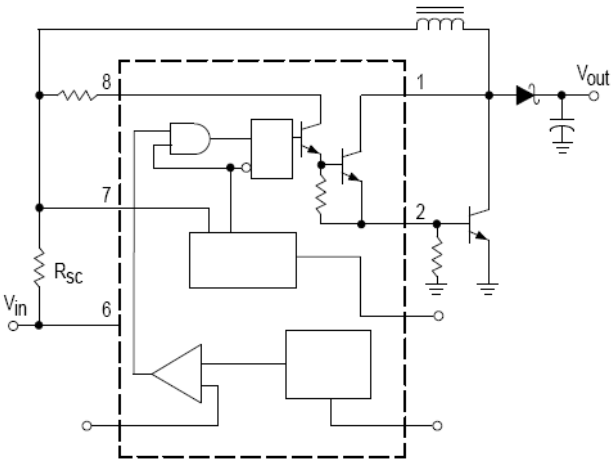
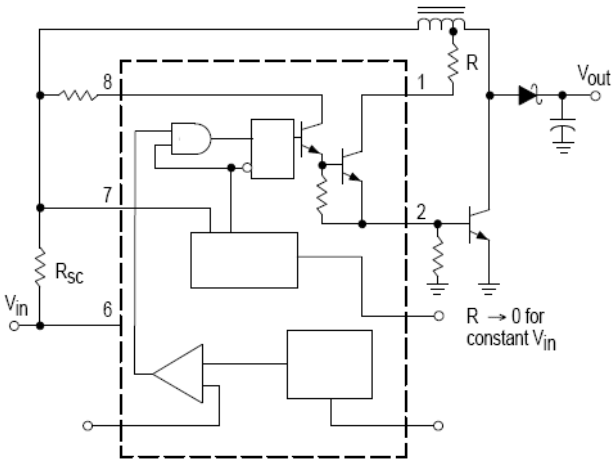


Figure 8. External Current Boost Connections for I_C Peak Greater than 1.5 A



8a. External NPN Switch



8b. External NPN Saturated Switch

◆ Typical Application Circuits (Continued)

Figure 9. Step–Down Converter

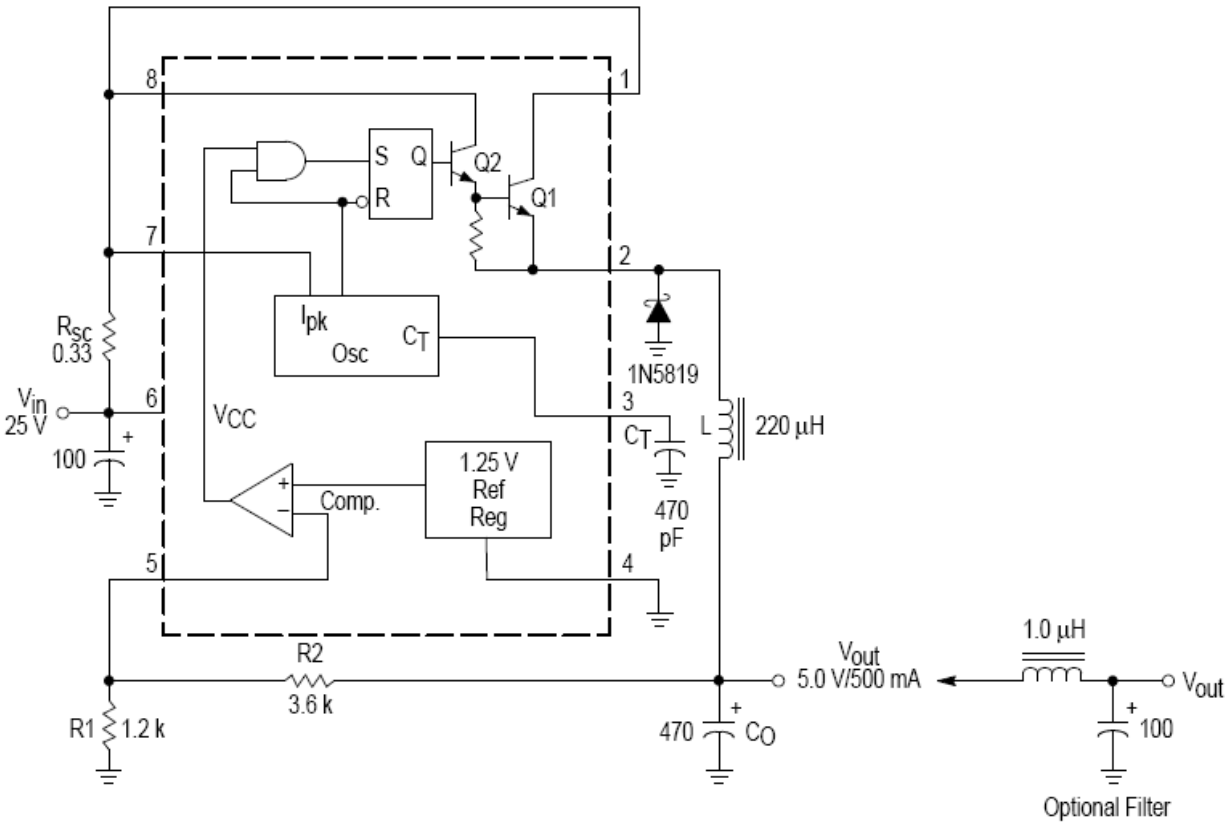
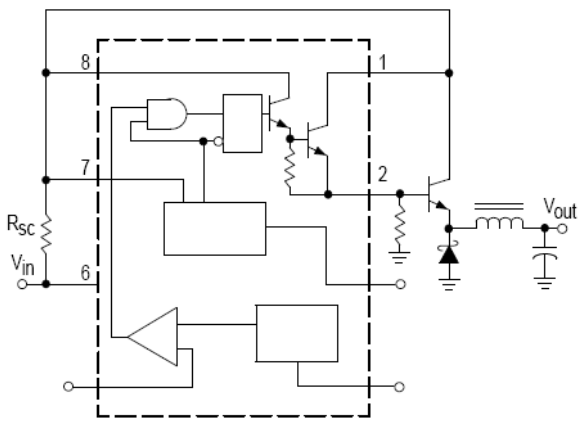
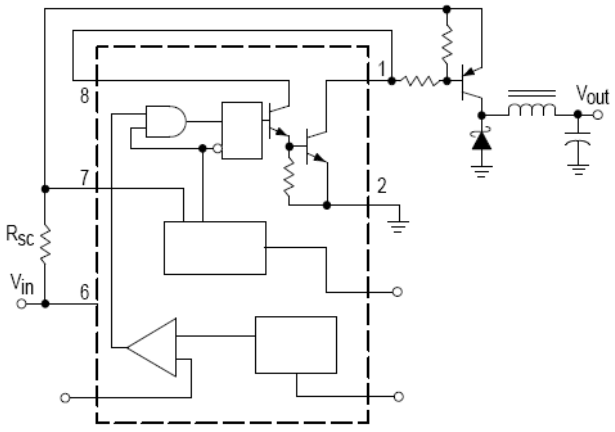


Figure 10. External Current Boost Connections for I_C Peak Greater than 1.5 A



10a. External NPN Switch



10b. External PNP Saturated Switch

◆ Typical Application Circuits (Continued)

Figure 11. Voltage Inverting Converter

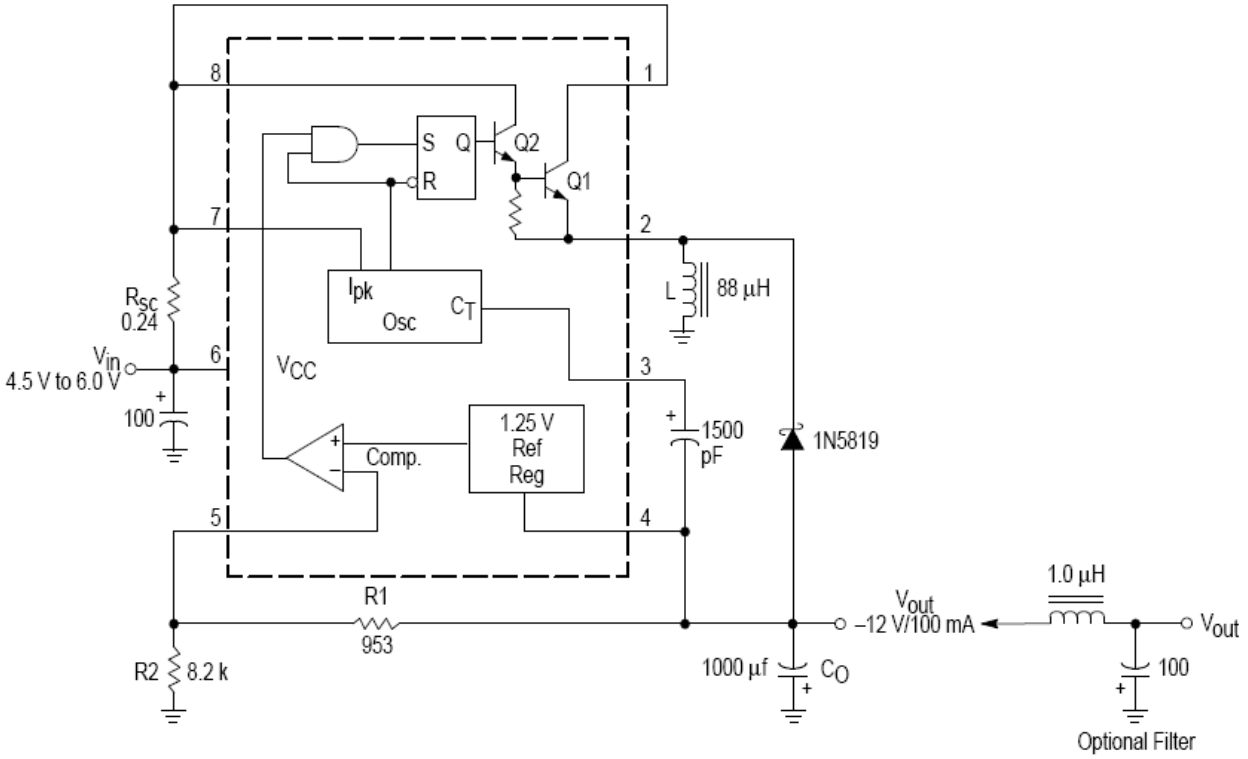
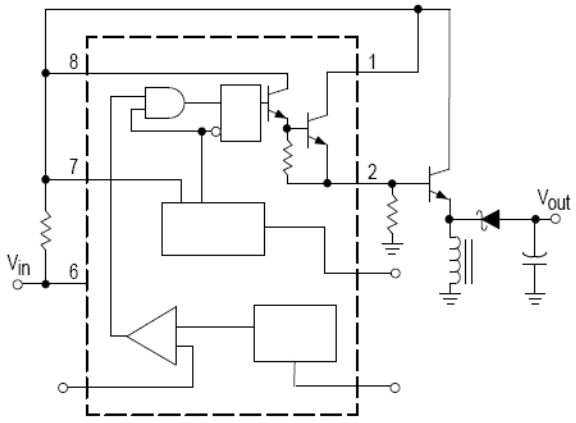
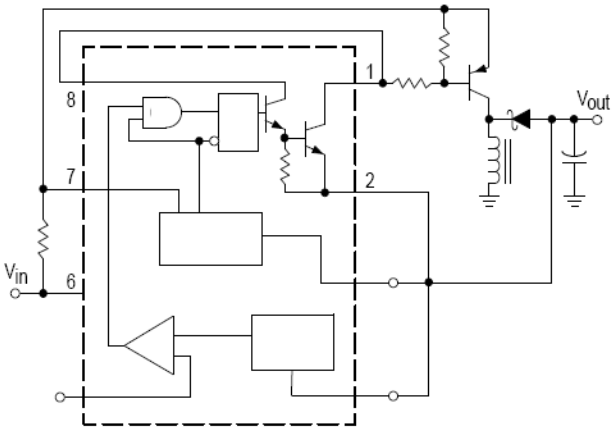


Figure 12. External Current Boost Connections for I_C Peak Greater than 1.5 A



12a. External NPN Switch



12b. External PNP Saturated Switch

◆ Design Formula Table

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	$4.0 \times 10^{-5}\, t_{on}$	$4.0 \times 10^{-5}\, t_{on}$	$4.0 \times 10^{-5}\, t_{on}$
$I_{pk(switch)}$	$2I_{out(max)} \left(\frac{t_{on}}{t_{off}} + 1\right)$	$2I_{out(max)}$	$2I_{out(max)} \left(\frac{t_{on}}{t_{off}} + 1\right)$
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.

The following power supply characteristics must be chosen.

V_{in} : Nominal input voltage.

V_{out} : Desired output voltage.

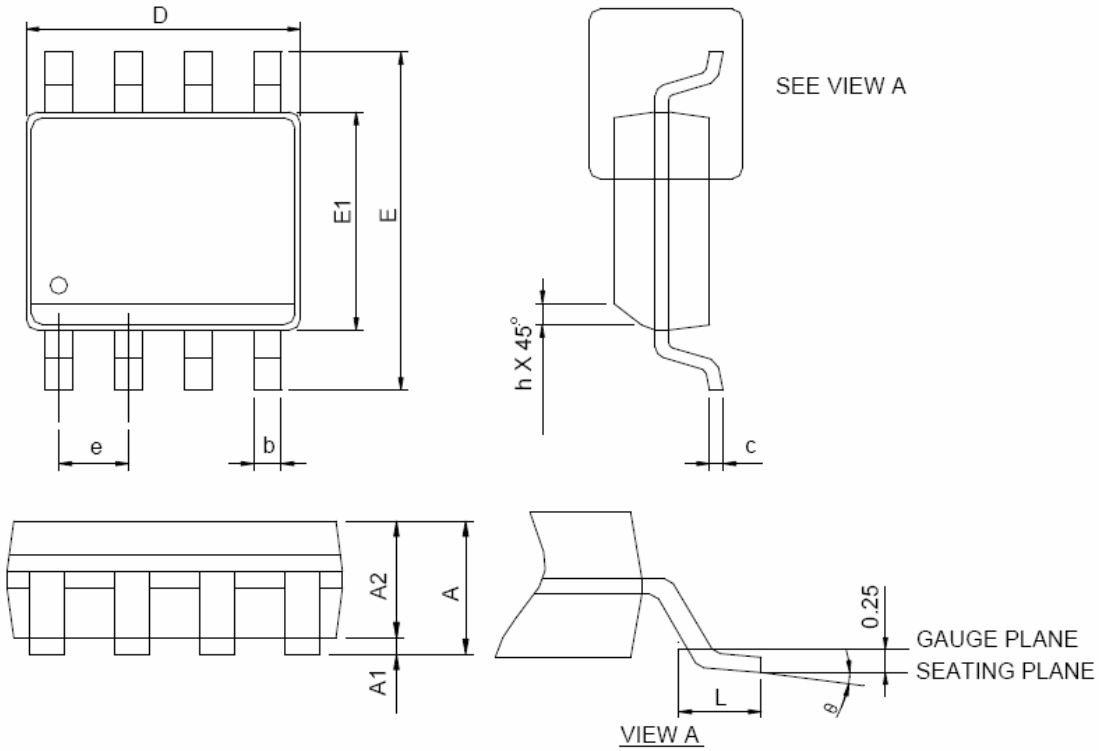
I_{out} : Desired output current.

F_{min} : Minimum desired output switch frequency at the selected values of V_{in} an 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.

◆ Package Information

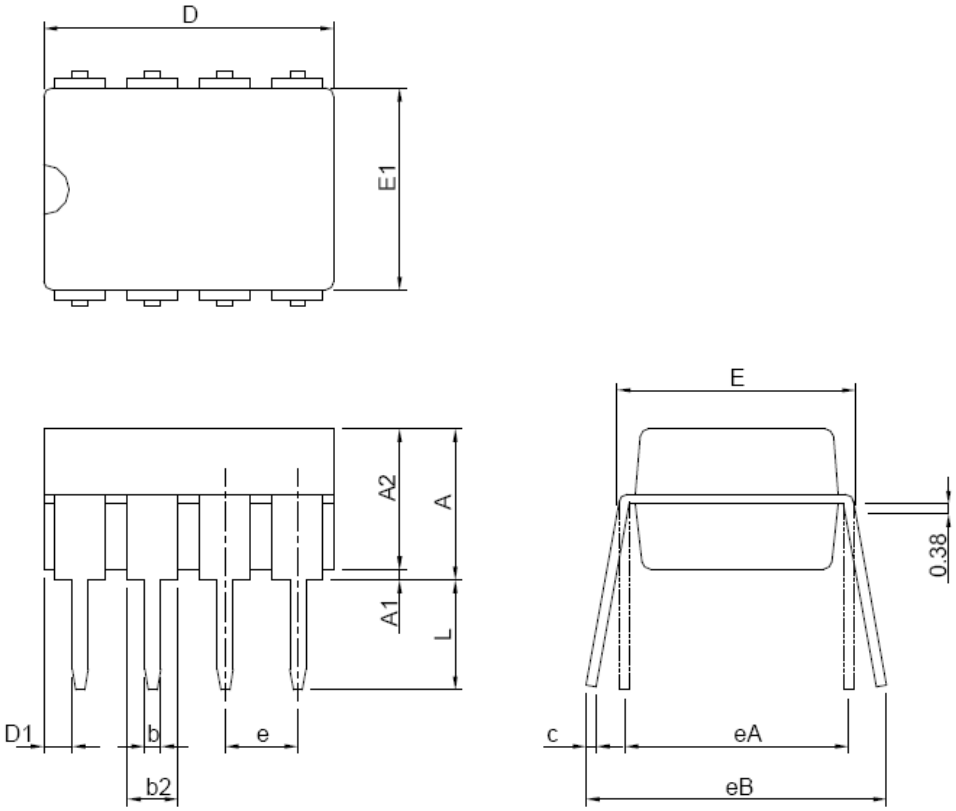
SOP-8



SYMBOL	SOP-8			
	MILLIMETERS		INCHES	
	MIN.	MAX.	MIN.	MAX.
A		1.75		0.069
A1	0.10	0.25	0.004	0.010
A2	1.25		0.049	
b	0.31	0.51	0.012	0.020
c	0.17	0.25	0.007	0.010
D	4.80	5.00	0.189	0.197
E	5.80	6.20	0.228	0.244
E1	3.80	4.00	0.150	0.157
e	1.27 BSC		0.050 BSC	
h	0.25	0.50	0.010	0.020
L	0.40	1.27	0.016	0.050
θ	0°	8°	0°	8°

◆ Package Information

DIP-8



SYMBOL	DIP-8			
	MILLIMETERS		INCHES	
	MIN.	MAX.	MIN.	MAX.
A		5.33		0.210
A1	0.38		0.015	
A2	2.92	4.95	0.115	0.195
b	0.36	0.56	0.014	0.022
b2	1.14	1.78	0.045	0.070
c	0.20	0.35	0.008	0.014
D	9.01	10.16	0.355	0.400
D1	0.13		0.005	
E	7.62	8.26	0.300	0.325
E1	6.10	7.11	0.240	0.280
e	2.54 BSC		0.100 BSC	
eA	7.62 BSC		0.300 BSC	
eB		10.92		0.430
L	2.92	3.81	0.115	0.150