

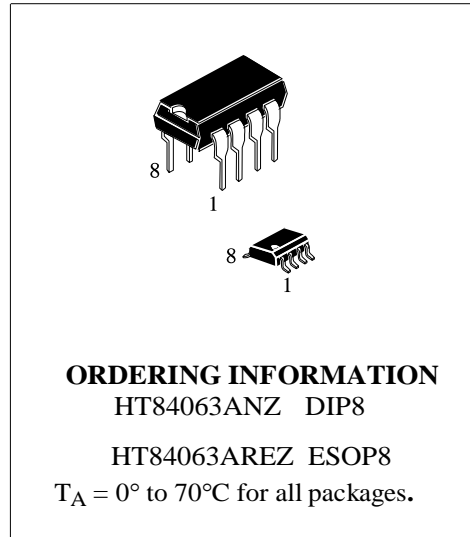
## DC-to-DC Converter Control Circuits (compatible to MC34063)

### 1. DESCRIPTION

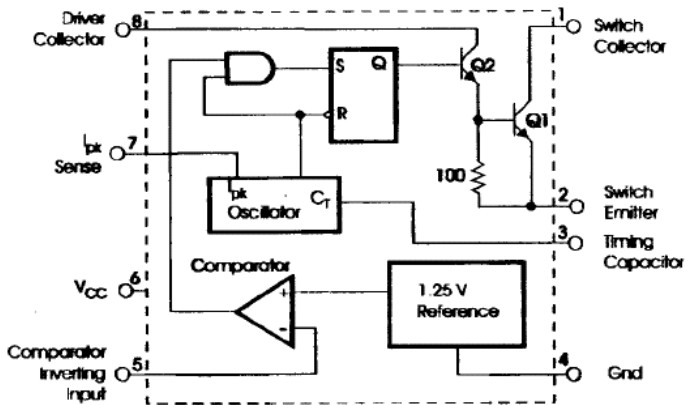
The HT84063A is a monolithic control circuit containing the primary functions required for DC-to-DC converters. These devices consist of an internal temperature compensated reference, comparator, controlled duty cycle oscillator with an active current limit circuit, driver and high current output switch. 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

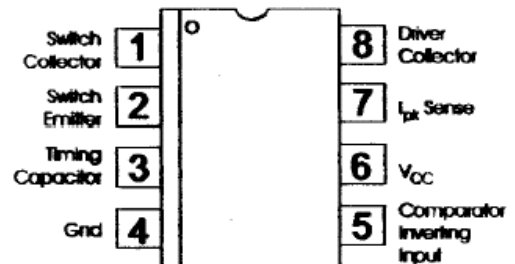
- Operation from 3.0V to 40V Input
- Low Standby Current
- Current Limiting
- Output Switch Current to 1.5A
- Output Voltage Adjustable
- Frequency Operation to 100kHz
- Precision 2% Reference



**Block Diagram**



**Pin Connection**



### 3. ABSOLUTE MAXIMUM RATINGS

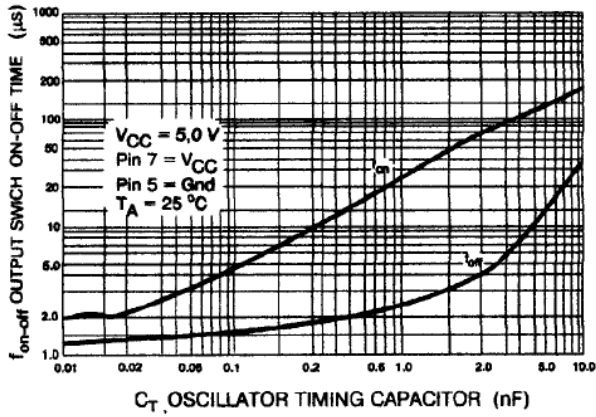
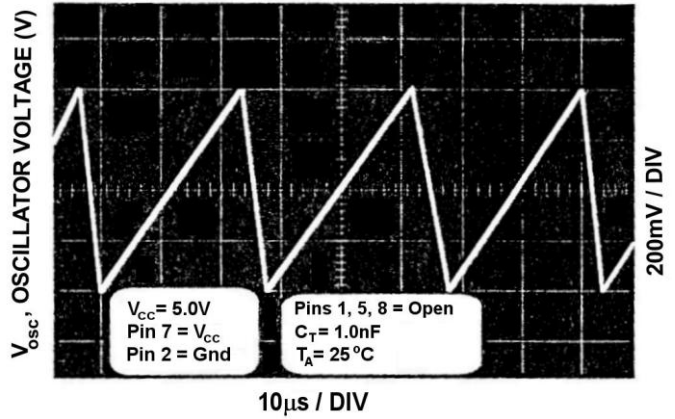
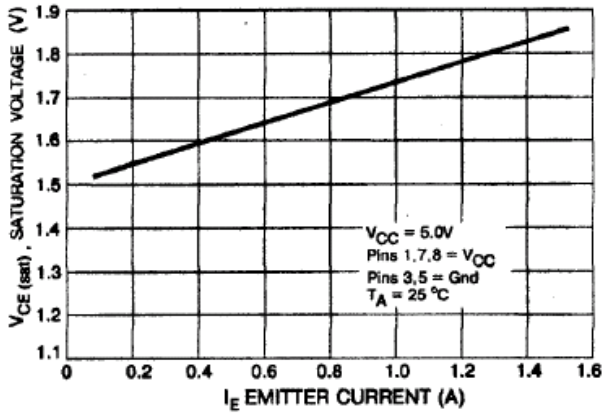
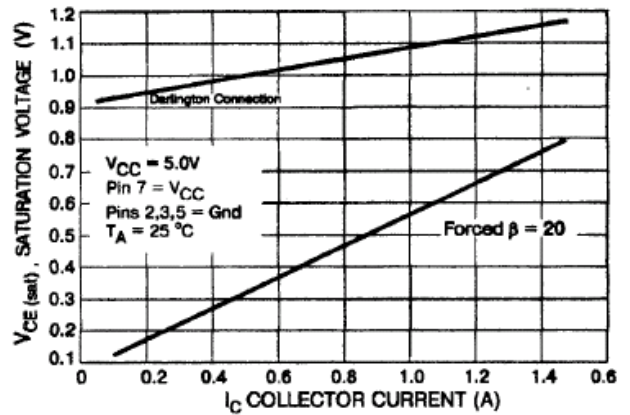
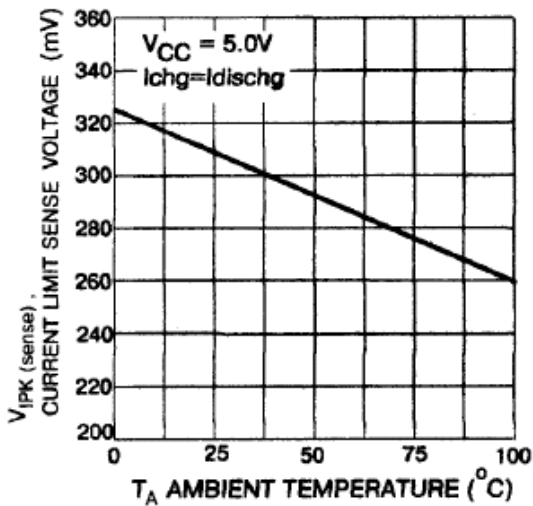
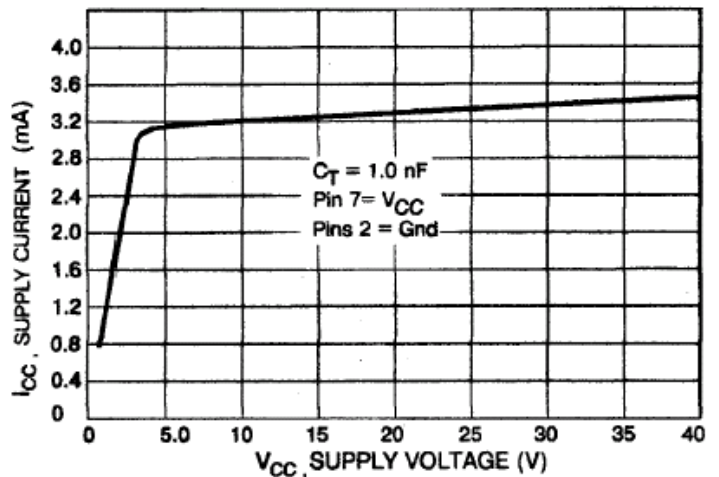
Rating	Symbol	Value	Unit
Power Supply Voltage	$V_{CC}$	40	Vdc
Comparator Input Voltage Range	$V_{IR}$	-30 to +40	Vdc
Switch Collector Voltage	$V_{C(\text{switch})}$	40	Vdc
Switch Emitter Voltage ( $V_{PIN1} = 40\text{V}$ )	$V_{E(\text{switch})}$	40	Vdc
Switch Collector to Emitter Voltage	$V_{CE(\text{switch})}$	40	Vdc
Driver Collector Voltage	$V_{C(\text{driver})}$	40	Vdc
Driver Collector Current (Note 1)	$I_{C(\text{driver})}$	100	MA
Switch Current	$I_{SW}$	1.5	A
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	$^\circ\text{C}$

**4. ELECTRICAL CHARACTERISTIC** ( $V_{CC}=5.0V$ ,  $T_A = T_{low}$  to  $T_{high}$ , unless otherwise specified)

Characteristics	Symbol	Min	Typ	Max	Unit
<b>OSCILLATOR</b>					
Frequency ( $V_{pin5} = 0V$ , $C_T = 1.0nF$ , $T_A=25^\circ C$ )	$f_{osc}$	24	33	42	kHz
Charge Current ( $V_{CC}=5.0$ to $40 V$ , $T_A=25^\circ C$ )	$I_{CHG}$	24	35	42	$\mu A$
Discharge Current ( $V_{CC}=5.0$ to $40 V$ , $T_A=25^\circ C$ )	$I_{DISCHG}$	140	220	260	$\mu A$
Discharge To Charge Current Ratio	$I_{DISCHG}/I_{CHG}$	5.2	6.5	7.5	
Current Limit Sense Voltage ( $I_{CHG}=I_{DISCHG}$ , $T_A=25^\circ C$ )	$V_{ipk(sense)}$	250	300	350	mV
<b>OUTPUT SWITCH</b>					
Saturation Voltage, Darlington Connection ( $I_{SW}=1A$ $V_{CC}=5.0V$ , pin 1, 8 connected)	$V_{CE(SAT)}$		1.0	1.3	V
Saturation Voltage, Darlington Connection ( $I_{SW}=1A$ $V_{CC}=5.0V$ , pin8 = 82)	$V_{CE(SAT)}$		0.45	0.7	V
DC Current Gain ( $I_{SW}=1A$ $V_{CC}=5.0V$ , $T_A=25^\circ C$ )	$h_{FE}$	50	75		
Collector Off-State Current ( $V_{CE}=40V$ )	$I_{C(off)}$		40	100	$\mu A$
<b>COMPARATOR</b>					
Threshold Voltage ( $T_A=25^\circ C$ ) ( $T_A = T_{low}$ to $T_{high}$ )	$V_{th}$	1.225 1.21		1.275 1.29	V
Threshold Voltage Line Regulation ( $V_{CC}=3.0V$ to $40V$ , $T_A=25^\circ C$ )	$Reg_{line}$		1.4	5.0	mV
Input Bias Current ( $V_{IN}=0V$ )	$I_{IB}$		-20	-400	nA
<b>TOTAL DEVICE</b>					
Supply Current ( $V_{CC} = 5.0 V$ to $40 V$ , $C_T = 1.0 nF$ , Pin 7 = $V_{CC}$ , Vpin 5 > $V_{th}$ , Pin 2 = Gnd, remaining pins open)	$I_{cc}$			4.0	mA

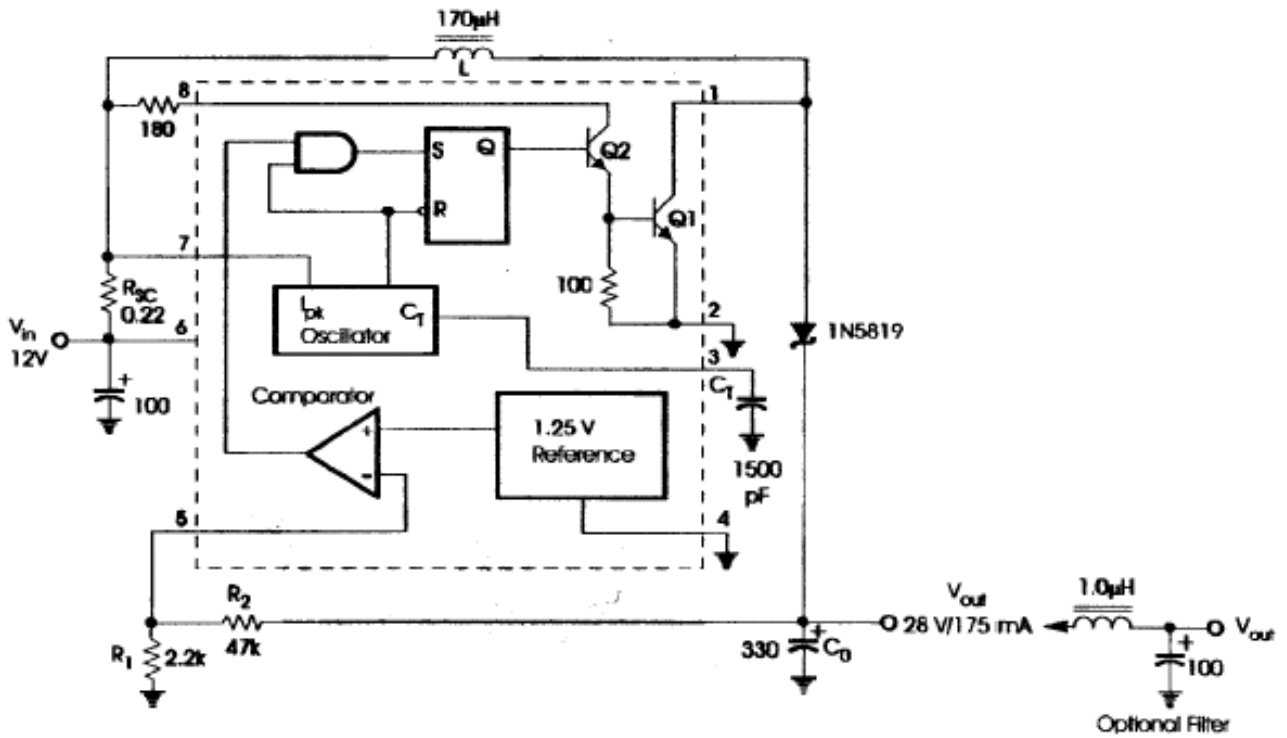
Note:

1. Maximum package power dissipation limits must be observed
2. Low duty cycle pulse techniques are used during test to maintain junction temperature as close to ambient temperature as possible.

**5. TYPICAL PERFORMANCE 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 Voltage versus Collector Current**

**Figure 5. Current Limit Sense Voltage versus Temperature**

**Figure 6. Standby Supply Current versus Supply Voltage**


6. APPLICATION CIRCUIT

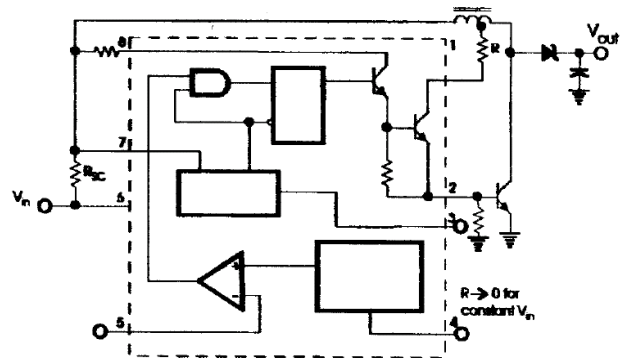
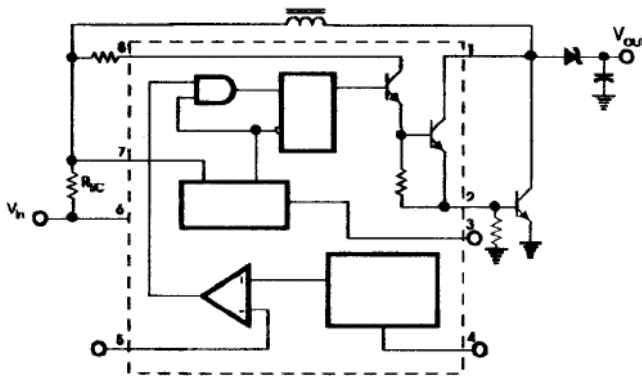
6.1 Step-up Converter



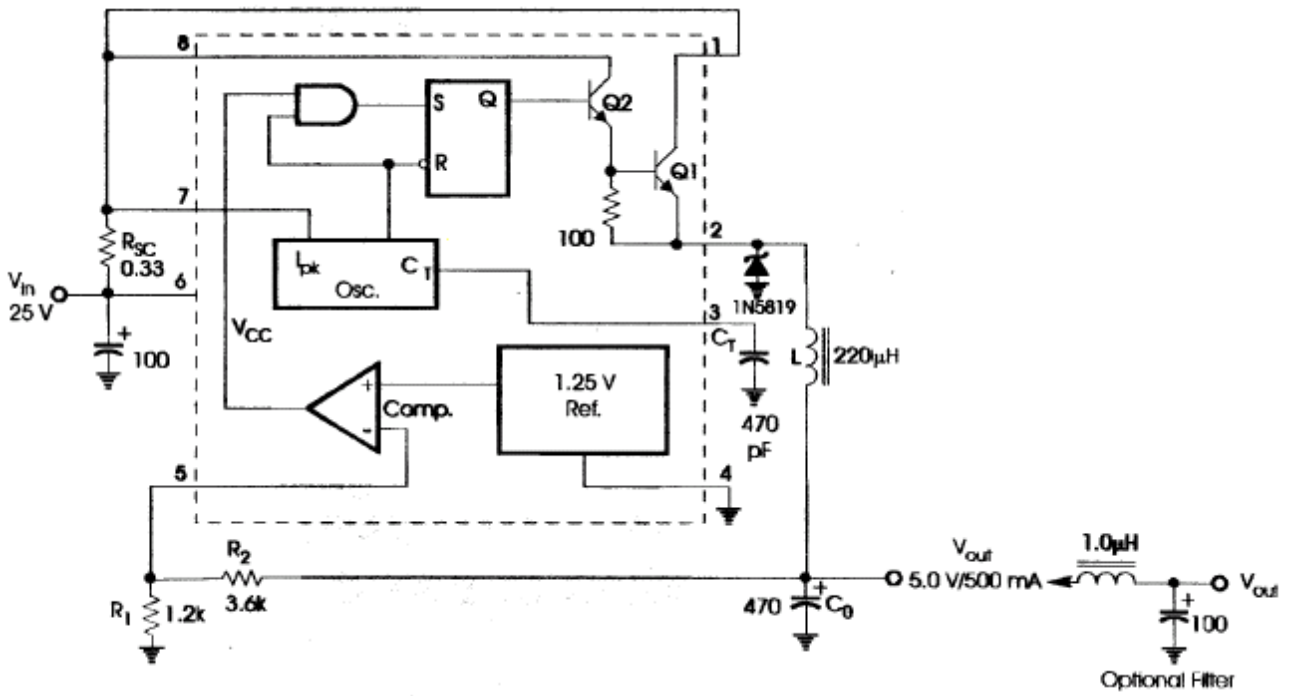
6.2 External Current Boost Connections for  $I_C$  Peak Greater than 1.5A

6.2a External NPN Switch

6.2b External NPN Saturated Switch

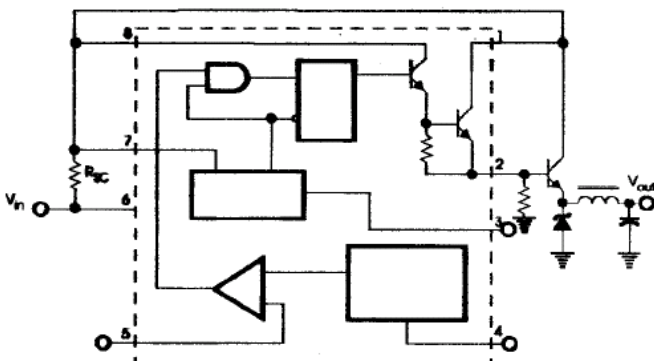


6.3 Step-down Converter

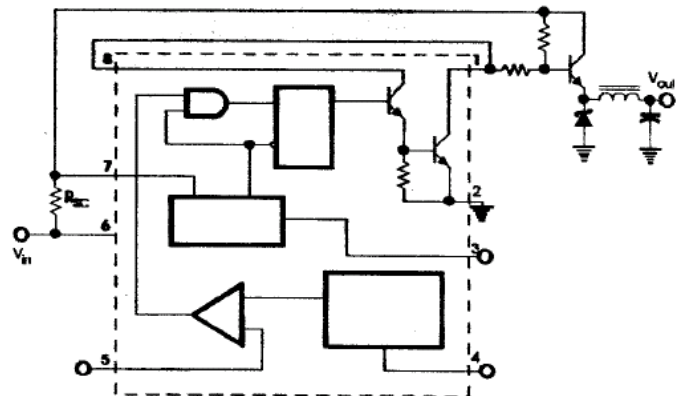


6.4 External Current Boost Connections for IC Peak Greater than 1.5A

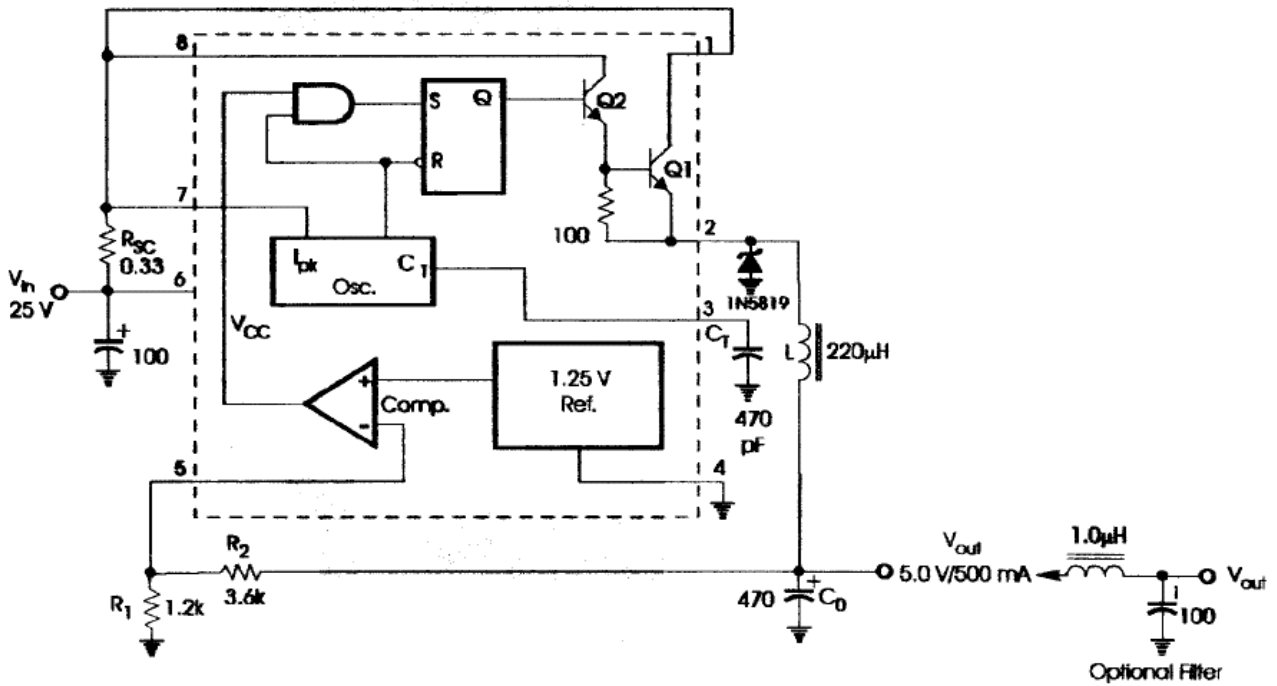
6.4a External NPN Switch



6.4b External NPN Saturated Switch

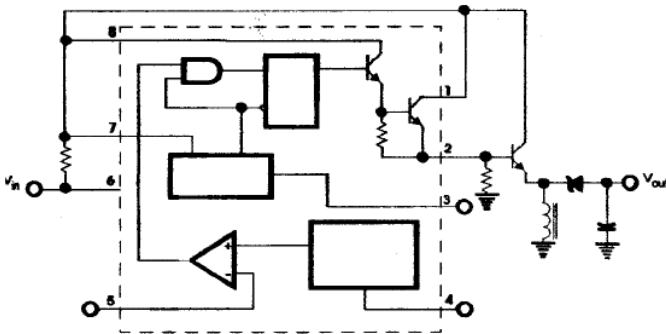


6.5 Voltage Inverting Converter

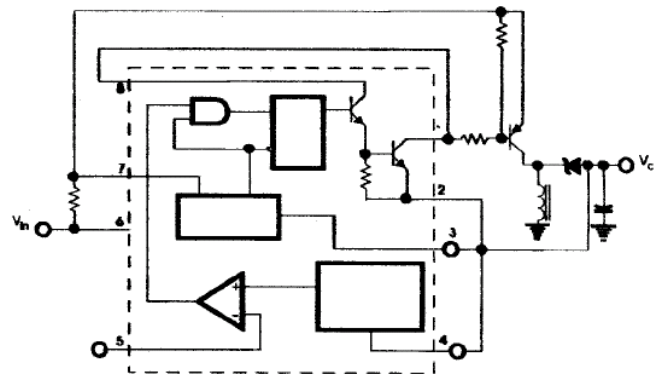


6.6 External Current Boost Connections for IC Peak Greater than 1.5A

6.6a External NPN Switch



6.6b External NPN Saturated Switch



**7. Design Formula Table**

Calculation	Step-Up	Step-Down	Voltage-Inverting
$t_{on} / t_{off}$	$\frac{V_{out} + V_F - V_{in(min)}}{V_{in(min)} - V_{sat}}$	$\frac{V_{out} + V_F}{V_{in(min)} - V_{sat} - V_{out}}$	$\frac{ V_{out}  + V_F}{V_{in} + V_{sat}}$
$(t_{on} + t_{off})_{max}$	$\frac{1}{f_{min}}$	$\frac{1}{f_{min}}$	$\frac{1}{f_{min}}$
$C_T$	$4.0 \times 10^{-5} t_{on}$	$4.0 \times 10^{-5} t_{on}$	$4.0 \times 10^{-5} t_{on}$
$I_{pk(switch)}$	$2I_{out(max)} \left( \frac{t_{on}}{t_{off}} + 1 \right)$	$2I_{out(max)}$	$2I_{out(max)} \left( \frac{t_{on}}{t_{off}} + 1 \right)$
$R_{SC}$	$0.3 / I_{pk(switch)}$	$0.3 / I_{pk(switch)}$	$0.3 / I_{pk(switch)}$
$L_{(min)}$	$\left( \frac{V_{in(min)} - V_{sat}}{I_{pk(switch)}} \right) \times t_{on(max)}$	$\left( \frac{V_{in(min)} - V_{sat} - V_{out}}{I_{pk(switch)}} \right) \times t_{on(max)}$	$\left( \frac{V_{in(min)} - V_{sat}}{I_{pk(switch)}} \right) \times t_{on(max)}$
$C_O$	$9 \frac{I_{out} t_{on}}{V_{ripple(pp)}}$	$\frac{I_{pk(switch)}(t_{on} + t_{off})}{8V_{ripple(pp)}}$	$9 \frac{I_{out} t_{on}}{V_{ripple(pp)}}$

**Terms and Definitions**

$V_{sat}$  – Saturation voltage of the output switch.

$V_F$  – Forward voltage drop of the output rectifier.

The following power supply characteristics must be chosen:

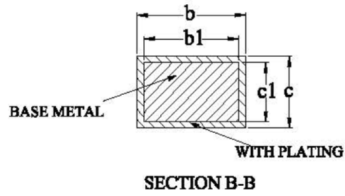
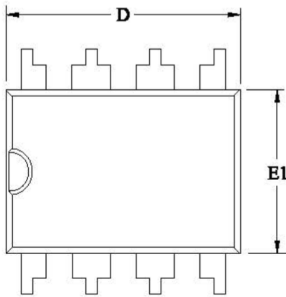
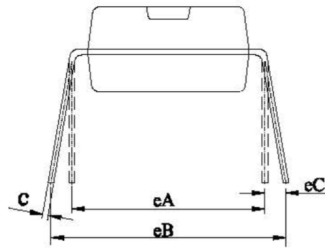
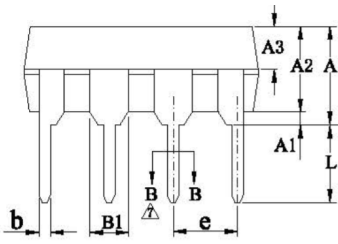
$V_{in}$  – Nominal input voltage

$V_{out}$  – Desired output voltage.

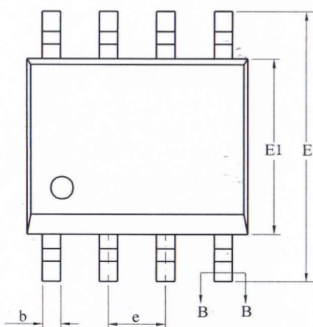
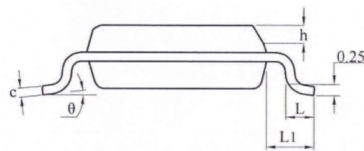
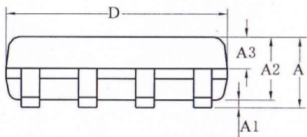
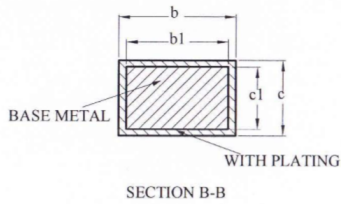
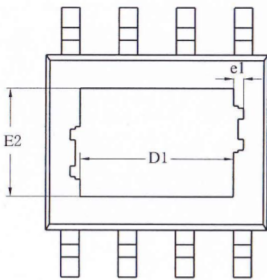
$I_{out}$  – Desired output current.

$f_{min}$  – Minimum desired output 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.

**DIP8**


SYMBOL	MILLIMETER		
	MIN	NOM	MAX
A	3.60	3.80	4.00
A1	0.51	—	—
A2	3.20	3.30	3.40
A3	1.55	1.60	1.65
b	0.44	—	0.52
b1	0.43	0.46	0.49
B1	1.52REF		
c	0.25	—	0.29
c1	0.24	0.25	0.26
D	9.15	9.25	9.35
E1	6.25	6.35	6.45
e	2.54BSC		
eA	7.62REF		
eB	7.62	—	9.30
eC	0	—	0.84
L	3.00	—	—

**ESOP8**


SYMBOL	MILLIMETER		
	MIN	NOM	MAX
A	—	—	1.65
A1	0.05	—	0.15
A2	1.30	1.40	1.50
A3	0.60	0.65	0.70
b	0.39	—	0.47
b1	0.38	0.41	0.44
c	0.20	—	0.24
c1	0.19	0.20	0.21
D	4.80	4.90	5.00
E	5.80	6.00	6.20
E1	3.80	3.90	4.00
e	1.27BSC		
h	0.25	—	0.50
L	0.50	0.60	0.80
L1	1.05REF		
θ	0	—	8°

Size (mm) L <sup>1</sup> Size (mil)	D1	E2	e1
90*90	2.09REF	2.09REF	0.16REF
95*130	3.10REF	2.21REF	0.10REF

