

RichTek

RT34063A

March, 2000

RT34063A Data Sheet



DC-to-DC Converter Control Circuits

General Description

The RT34063A 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 specially designed to be incorporated in Step-down and Step-up and Voltage-inverting applications with a minimum number of external components.

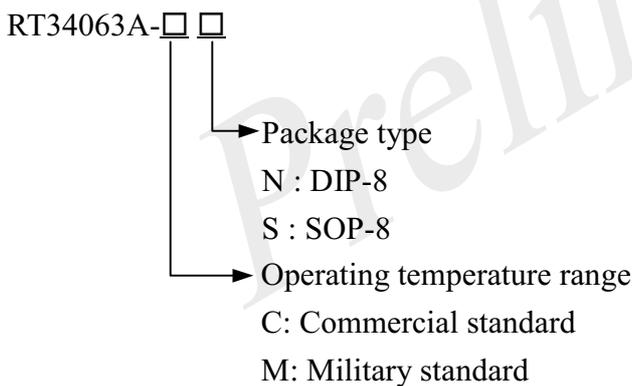
Features

- Operation from 3.0V to 30V Input
- Low Standby Current
- Current Limiting
- Internal Switch Current to 1.5A
- Output Voltage Adjustable
- Frequency Operation to 100kHz
- Precision 2% Reference

Applications

- Saver for Cellular Phones
- DC-DC Converter Module

Ordering Information



Marking Information

| Part Number | Marking |
|-------------|------------|
| RT34063ACN | RT34063ACN |
| RT34063ACS | RT34063ACS |

Pin Configurations

| Part Number | Pin Configurations |
|-------------------------------|--------------------|
| RT34063ACN (Plastic DIP-8) | |
| RT34063ACS (Plastic SOP-8) | |

Absolute Maximum Ratings

- Power Supply Voltage, V_{CC} ----- 30V
- Feedback Input Voltage Range ----- -0.3 to +30V
- Switch Collector Voltage, $V_C(\text{switch})$ ----- 30V
- Switch Emitter Voltage ($V_{PIN1}=30V$), $V_E(\text{switch})$ ----- 30V
- Switch Collector to Emitter Voltage, $V_{CE}(\text{switch})$ ----- 30V
- Driver Collector Voltage, $V_C(\text{driver})$ ----- 30V
- Driver Collector Current (see Note 1), $I_C(\text{driver})$ ----- 100mA
- Switch Current, I_{SW} ----- 1.5A
- Power Dissipation and Thermal Characteristics:
 DIP Plastic Package, $P_D @ T_A=25^\circ C$ ----- 1.25W
 Thermal Resistance, $R_{\theta JA}$ ----- $100^\circ C/W$
 SOP Plastic Package, $P_D @ T_A=25^\circ C$ ----- 0.625W
 Thermal Resistance, $R_{\theta JA}$ ----- $160^\circ C/W$
- Operating Junction Temperature, T_J ----- $+150^\circ C$
- Storage Temperature Range, T_{STG} ----- -60 to $+150^\circ C$

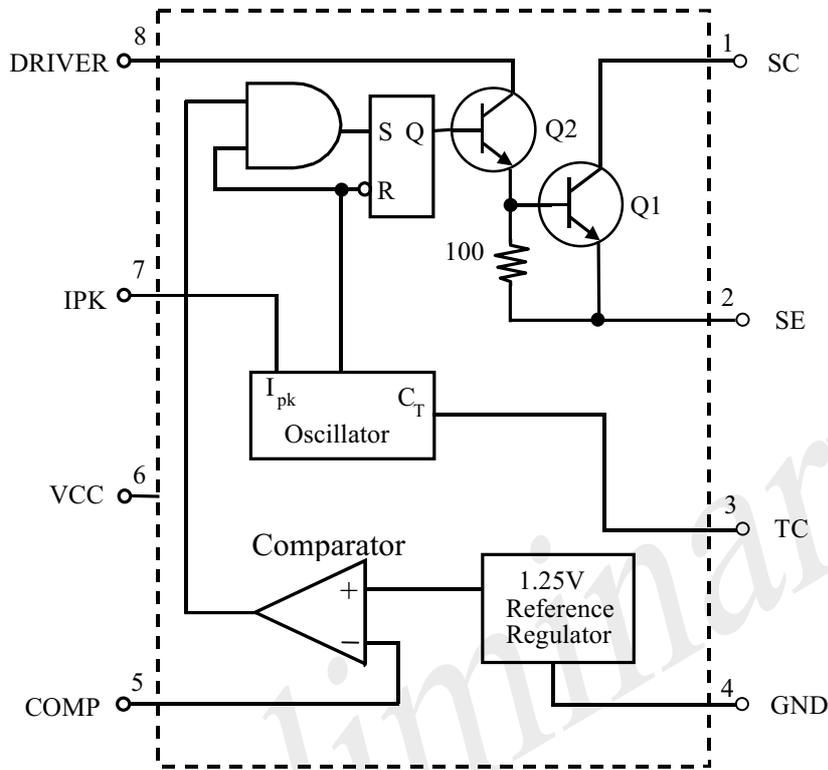
Note: 1. Maximum package power dissipation limits must be observed.

Electrical Characteristics

$V_{CC}=5.0V$, $T_A=25^\circ C$, unless otherwise specified.

| Parameter | Test Conditions | Min | Typ | Max | Units |
|---|---|-------|------|-------|---------|
| Oscillator | | | | | |
| Frequency | $V_{Pin5}=0V$, $C_T=1.0\ nF$ | 26 | 38 | 48 | kHz |
| Charge Current | $5.0V \leq V_{CC} \leq 30V$ | 25 | 36 | 43 | μA |
| Discharge Current | $5.0V \leq V_{CC} \leq 30V$ | 160 | 250 | 290 | μA |
| Discharge to Charge Current Ratio | Pin7 to V_{CC} | 5.5 | 6.9 | 7.9 | -- |
| Current Limit Sense Voltage | $I_{chg}=I_{dischg}$ | 280 | 330 | 380 | mV |
| Output Switch | | | | | |
| Saturation Voltage, Darlington Connection | $I_{SW}=1.0A$, Pins 1, 8 connected | -- | 1.0 | 1.3 | V |
| Saturation Voltage, Darlington Connection | $I_{SW}=1.0A$, $R_{PIN8}=82\ \Omega$ to V_{CC} , Forced $\beta \doteq 20$ | -- | 0.45 | 0.7 | V |
| DC Current Gain | $I_{SW}=1.0A$, $V_{CE}=5.0V$ | 50 | 75 | -- | -- |
| Collector Off-state Current | $V_{CE}=30V$ | -- | 0.01 | 100 | μA |
| Comparator | | | | | |
| Threshold Voltage | - | 1.225 | 1.25 | 1.275 | V |
| Threshold Voltage Line Regulation | $3.0V \leq V_{CC} \leq 30V$ | -- | 1.4 | 5.0 | mV |
| Input Bias Current | $V_{in}=0V$ | -- | -20 | -400 | nA |
| Total Device | | | | | |
| Supply Current | $V_{CC}=5.0V$ to $30V$, $C_T=1.0nF$, Pin7= V_{CC} , $V_{PINS}>V_{th}$, Pin2=GND, Remaining pins open | -- | 3.0 | 4.5 | mA |

Function Block Diagram

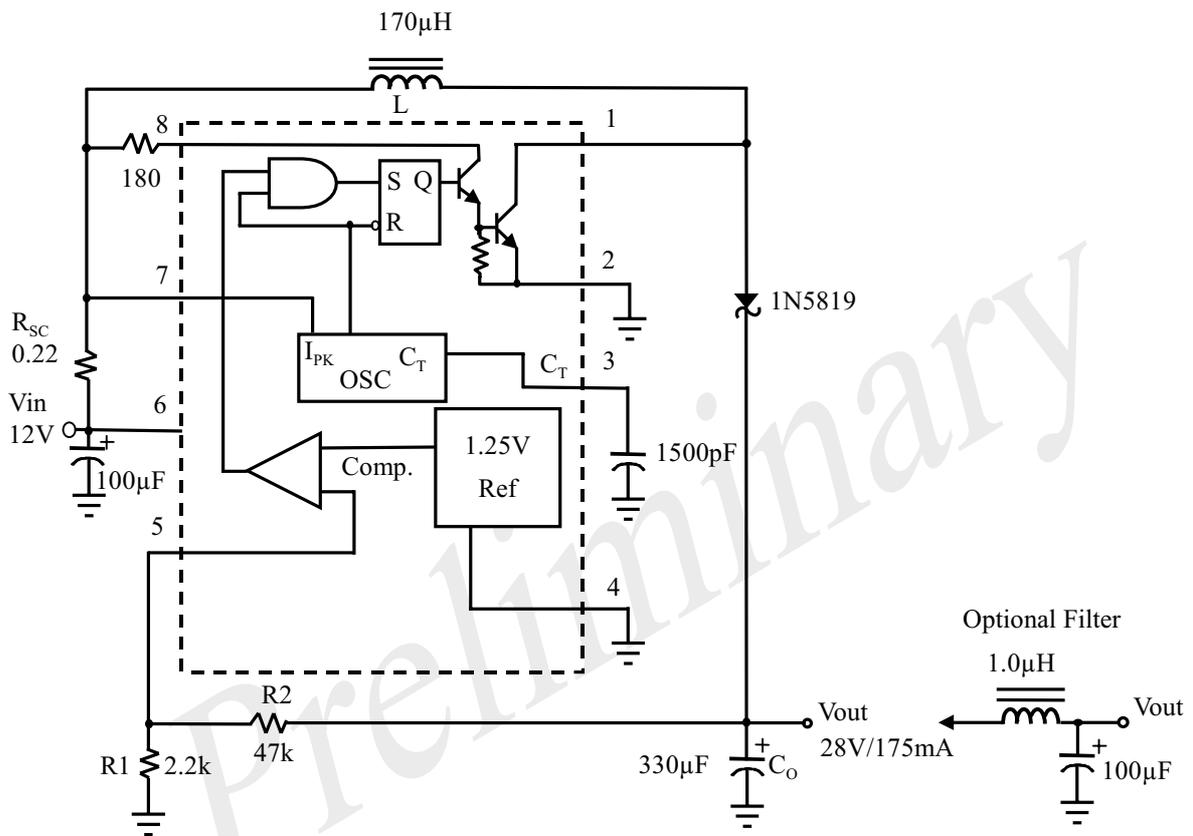


Pin Description

| Pin No. | Pin Name | Pin Function |
|---------|----------|--|
| 1 | SC | 1.5A switch collector |
| 2 | SE | Darlington switch emitter |
| 3 | TC | Oscillator timing capacitor |
| 4 | GND | Power GND |
| 5 | COMP | Feedback comparator inverting input |
| 6 | VCC | Power supply input |
| 7 | IPK | Highside current sense input $VCC - V_{IPK} = 330mV$ |
| 8 | DRIVER | Driver collector |

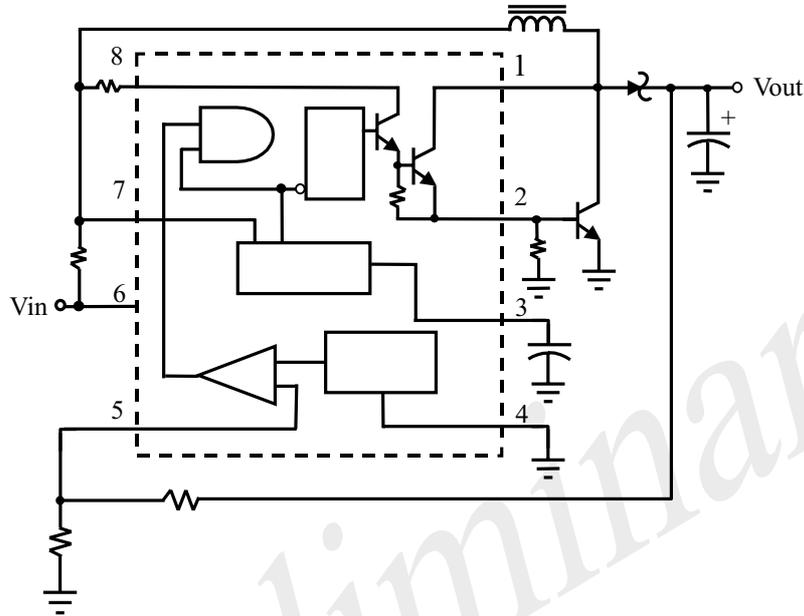
Typical Application Circuit

Step-up Converter

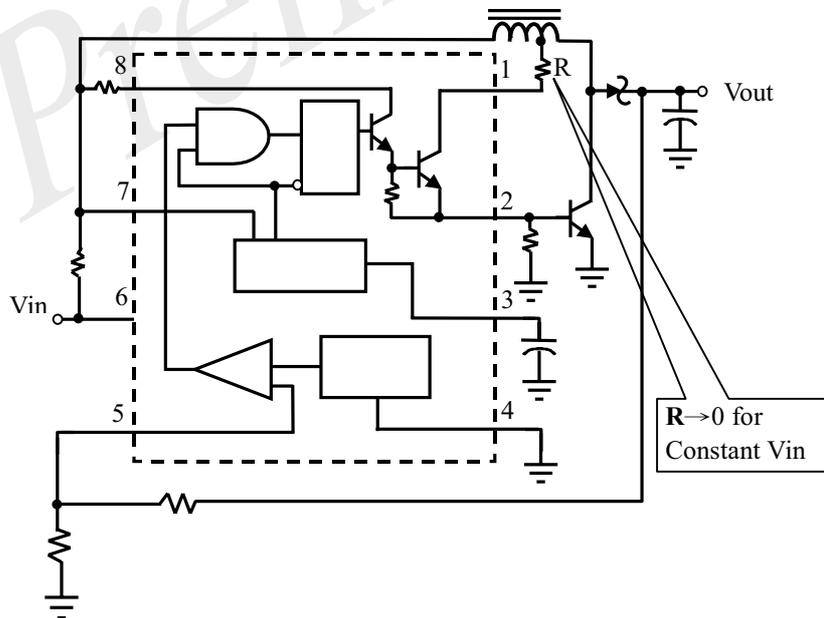


External Current Boost Connections for I_C Peak Greater than 1.5A

a. External NPN Switch

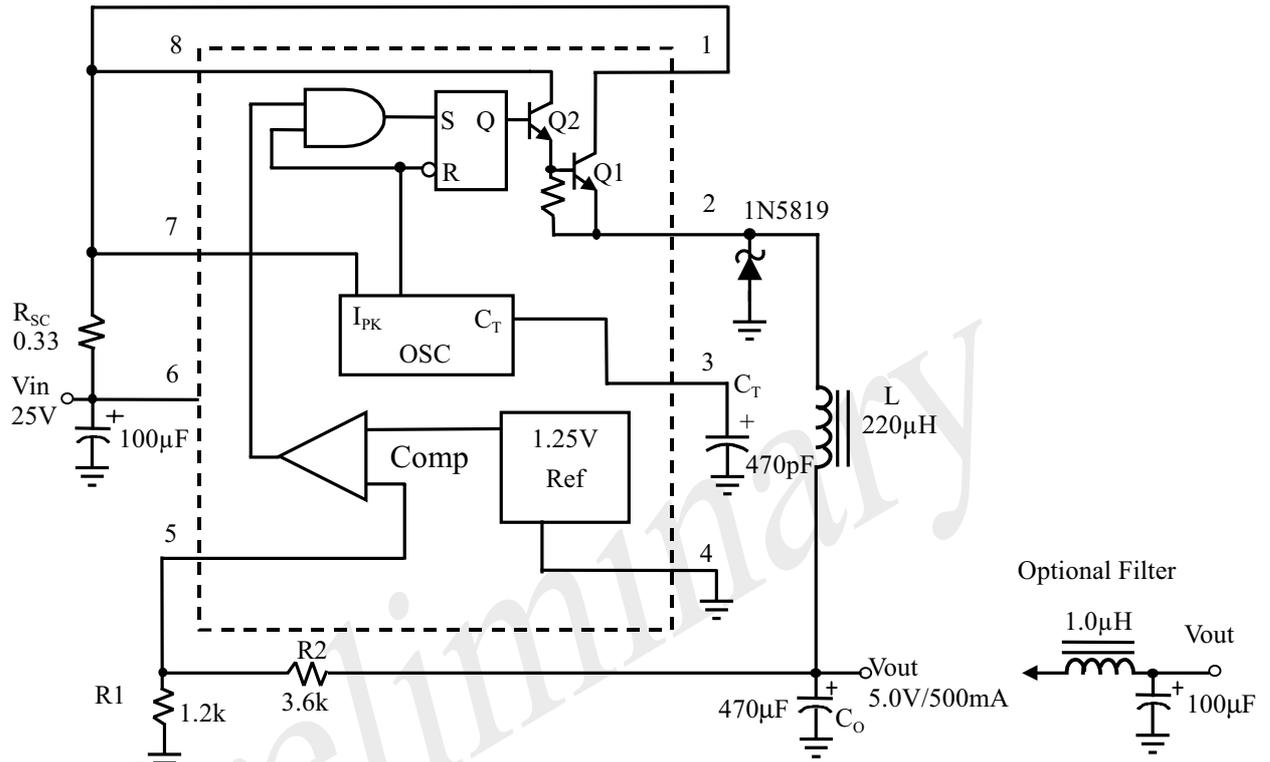


b. External NPN Saturated Switch (See Note)



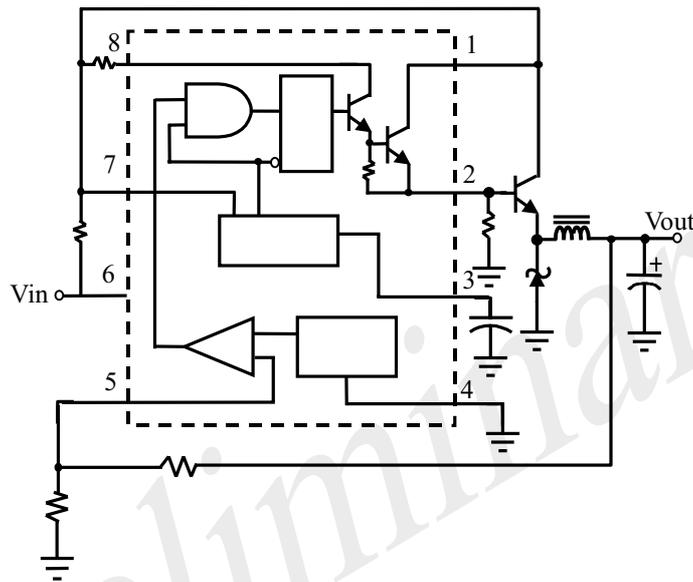
Note: If the output switch is driven into hard saturation (non-Darlington configuration) at low switch currents ($\leq 300\text{mA}$) and high driver currents ($\geq 30\text{mA}$), it may take up to $2.0\mu\text{s}$ to come out of saturation. This condition will shorten the off time at frequencies $\geq 30\text{kHz}$, and is magnified at high temperature. 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.

Step-down Converter

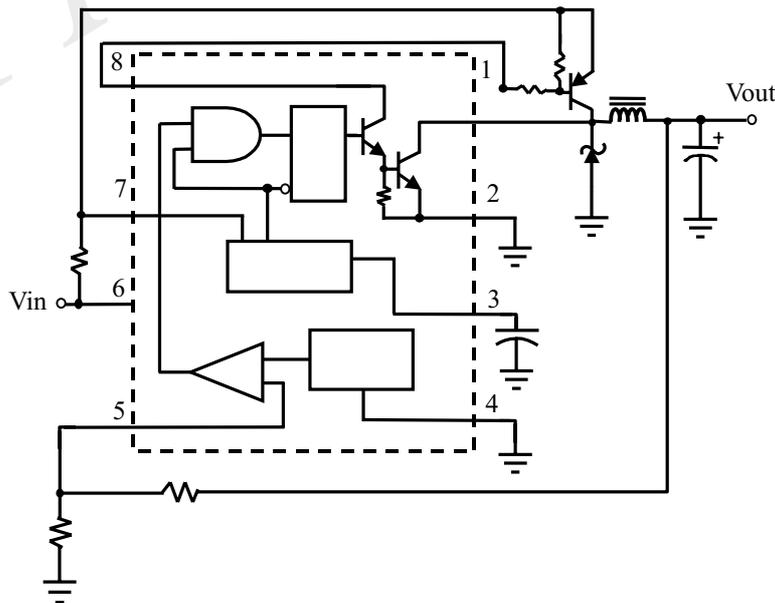


External Current Boost Connections for IC Peak Greater than 1.5A

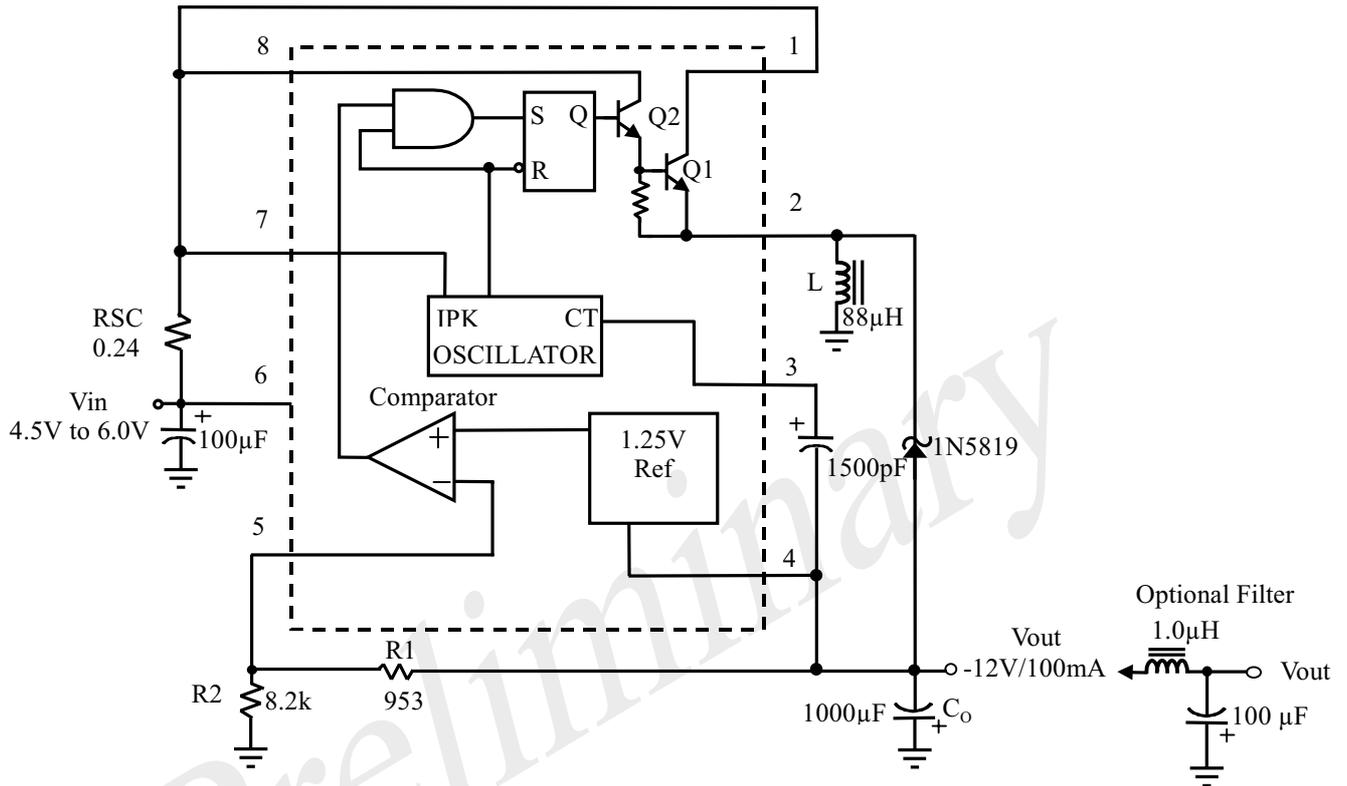
a. External NPN Switch



b. External PNP Saturated Switch

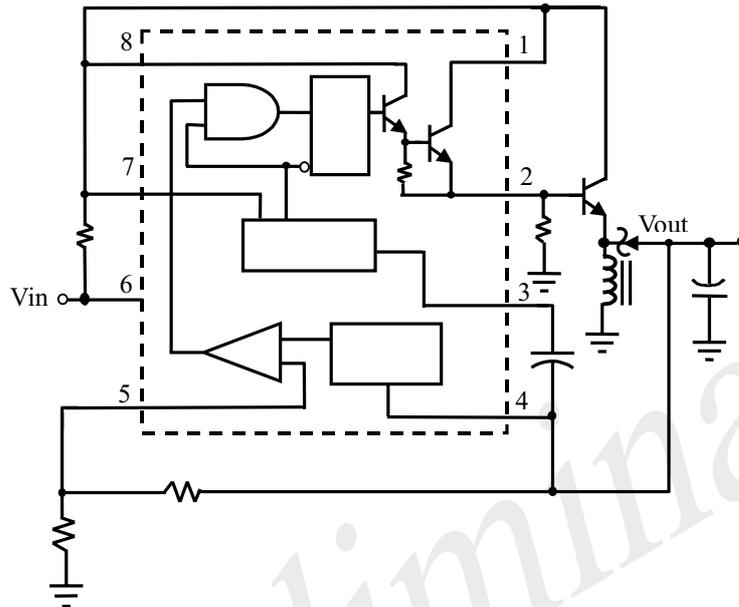


Voltage Inverting Converter

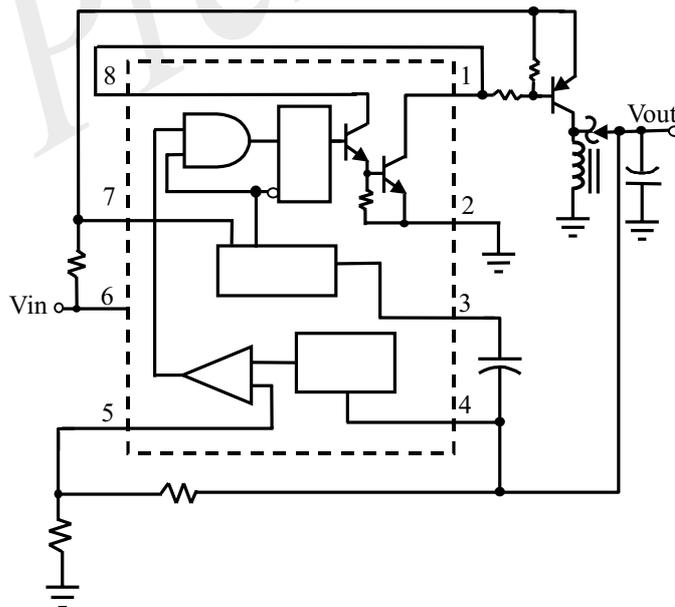


External Current Boost Connections for Peak Greater than 1.5A

a. External NPN Switch



b. External PNP Saturated Switch



Design Formula Table

| Calculation | Step-up | Step-down | Voltage-Inverting |
|-------------------------|--|--|--|
| t_{on}/t_{off} | $\frac{V_{OUT} + V_F - V_{IN(min)}}{V_{IN(min)} - V_{sat}}$ | $\frac{V_{OUT} + V_F}{V_{IN(min)} - V_{sat} - V_{OUT}}$ | $\frac{ V_{OUT} + V_F}{V_{IN} - V_{sat}}$ |
| $(t_{on} + t_{off})$ | $\frac{1}{f}$ | $\frac{1}{f}$ | $\frac{1}{f}$ |
| 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 | $4.0 \times 10^{-5} t_{on}$ | $4.0 \times 10^{-5} t_{on}$ | $4.0 \times 10^{-5} t_{on}$ |
| $I_{pk}(\text{switch})$ | $2 I_{out(max)} \left(\frac{t_{on}}{t_{off}} + 1 \right)$ | $2 I_{out(max)}$ | $2 I_{out(max)} \left(\frac{t_{on}}{t_{off}} + 1 \right)$ |
| R_{SC} | $0.3/I_{pk}(\text{switch})$ | $0.3/I_{pk}(\text{switch})$ | $0.3/I_{pk}(\text{switch})$ |
| $L(\text{min})$ | $\left(\frac{V_{IN(min)} - V_{sat}}{I_{pk}(\text{switch})} \right) t_{on(max)}$ | $\left(\frac{V_{IN(min)} - V_{sat} - V_{OUT}}{I_{pk}(\text{switch})} \right) t_{on(max)}$ | $\left(\frac{V_{IN(min)} - V_{sat}}{I_{pk}(\text{switch})} \right) t_{on(max)}$ |
| C_O | $9 \frac{I_{OUT} t_{ON}}{V_{ripple(pp)}}$ | $\frac{I_{pk}(\text{switch})(t_{on} + t_{off})}{8V_{ripple(pp)}}$ | $9 \frac{I_{OUT} t_{ON}}{V_{ripple(pp)}}$ |

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.

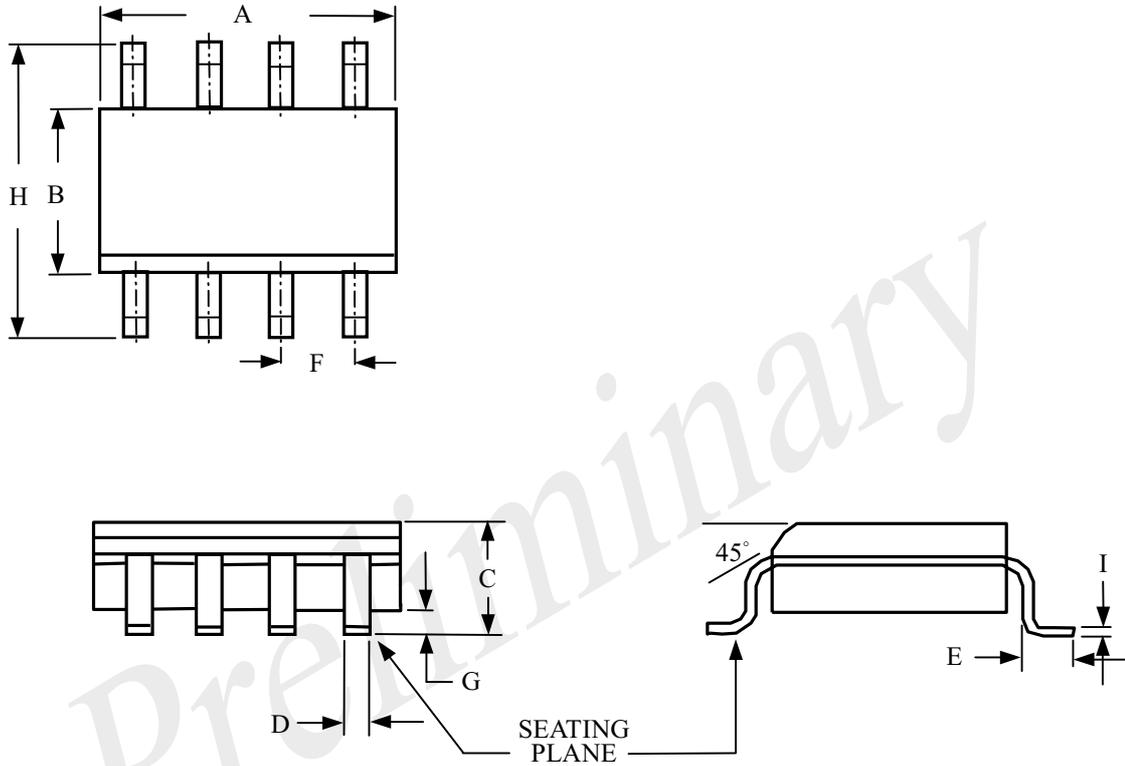
V_{OUT} : Desired output voltage, $|V_{OUT}| = 1.25 \left(1 + \frac{R_2}{R_1} \right)$

I_{OUT} : Desired output current.

f : Minimum desired output switching frequency at the selected values of V_{in} and I_O .

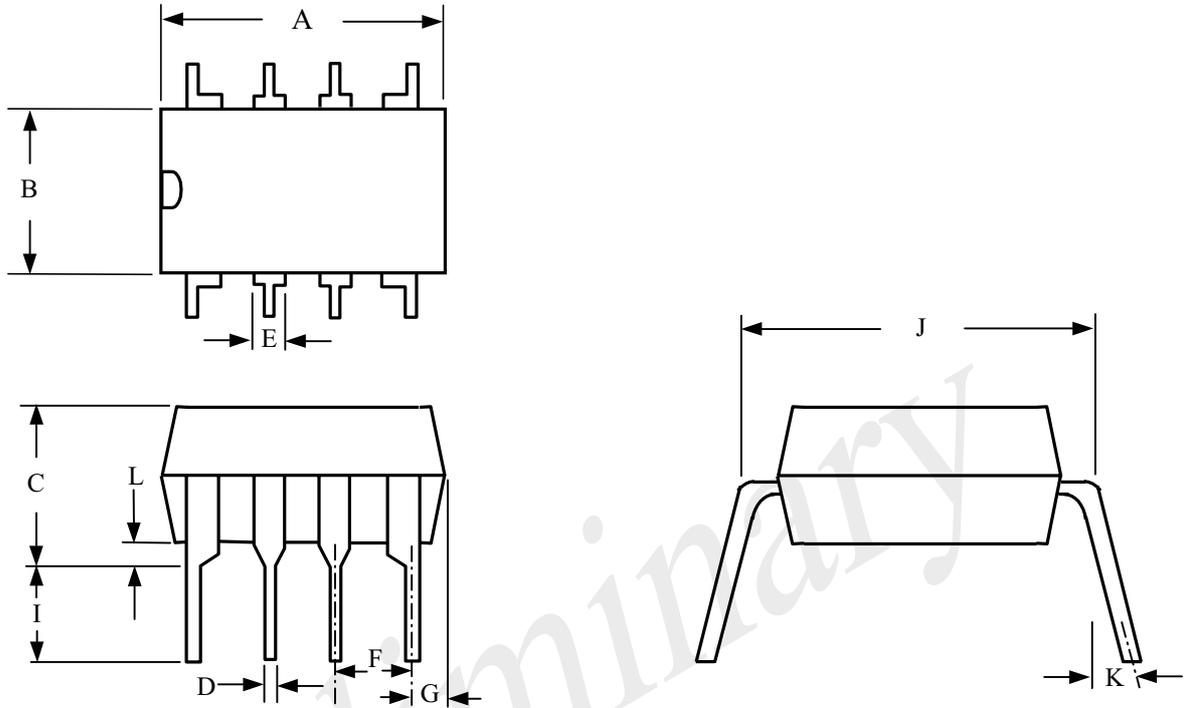
$V_{ripple(pp)}$: Desired peak-to-peak output ripple voltage. In practice, the calculated capacitor value needs to be increased due to its equivalent series resistance and board layout. The ripple voltage should be kept to a low value since it directly affects the line and load regulation.

Package Information



| Symbols | Dimensions In Inches | | | Dimensions In Millimeter | | |
|---------|----------------------|-------|-------|--------------------------|------|------|
| | Min | Norm | Max | Min | Norm | Max |
| A | 0.185 | 0.191 | 0.197 | 4.70 | 4.85 | 5.00 |
| B | 0.150 | 0.153 | 0.157 | 3.80 | 3.90 | 4.00 |
| C | 0.054 | 0.061 | 0.068 | 1.35 | 1.55 | 1.75 |
| D | 0.012 | 0.016 | 0.020 | 0.30 | 0.40 | 0.50 |
| E | 0.016 | -- | 0.050 | 0.40 | -- | 1.27 |
| F | -- | 0.050 | -- | -- | 1.27 | -- |
| G | 0.004 | 0.006 | 0.009 | 0.10 | 0.17 | 0.25 |
| H | 0.229 | 0.237 | 0.244 | 5.80 | 6.00 | 6.20 |
| I | 0.007 | 0.008 | 0.009 | 0.18 | 0.22 | 0.25 |

8-Lead SOP Plastic Package



| Symbols | Dimensions In Inches | | | Dimensions In Millimeter | | |
|---------|----------------------|-------|-------|--------------------------|------|------|
| | Min | Norm | Max | Min | Norm | Max |
| A | 0.357 | 0.362 | 0.367 | 9.00 | 9.30 | 9.60 |
| B | 0.244 | 0.254 | 0.264 | 6.20 | 6.45 | 6.70 |
| C | -- | -- | 0.180 | -- | -- | 4.57 |
| D | 0.016 | 0.018 | 0.020 | 0.35 | 0.45 | 0.55 |
| E | 0.040 | 0.055 | 0.070 | 1.02 | 1.40 | 1.78 |
| F | -- | 0.100 | -- | -- | 2.54 | -- |
| G | -- | 0.035 | 0.050 | -- | 0.89 | 1.27 |
| I | 0.120 | 0.130 | 0.140 | 3.05 | 3.30 | 3.55 |
| J | 0.290 | 0.300 | 0.310 | 7.60 | 8.00 | 8.40 |
| K | -- | -- | 15° | -- | -- | 15° |
| L | 0.015 | 0.025 | 0.035 | 0.39 | 0.64 | 0.89 |

8-Lead DIP Plastic Package