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.

Ordering Information

RT34063A□□

- Package type
  - N : DIP-8
  - S : SOP-8
- Operating temperature range
  - C: Commercial standard

Marking Information

Part Number	Marking
RT34063ACN	RT34063ACN
RT34063ACS	RT34063ACS

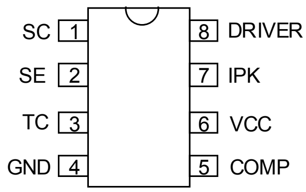
Features

- **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

Pin Configurations

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

Absolute Maximum Ratings

- Power Supply Voltage ---------- 30V
- Feedback Input Voltage Range ---------- -0.3 ~ +30V
- Switch Collector Voltage ---------- 30V
- Switch Emitter Voltage ---------- 30V
- Switch Collector to Emitter Voltage ---------- 30V
- Driver Collector Voltage ---------- 30V
- Driver Collector Current (see Note 1) ---------- 100mA
- Switch Current ---------- 1.5A
- Power Dissipation, P_D @ T_A = 25°C
  DIP-8 ---------- 1.25W
  SOP-8 ---------- 0.625W
- Package Thermal Resistance
  DIP-8, θ_{JA} ---------- 100°C/W
  SOP-8, θ_{JA} ---------- 160°C/W
- Operating Junction Temperature Range ---------- -40 ~ +125°C
- Storage Temperature Range ---------- -65 ~ +150°C

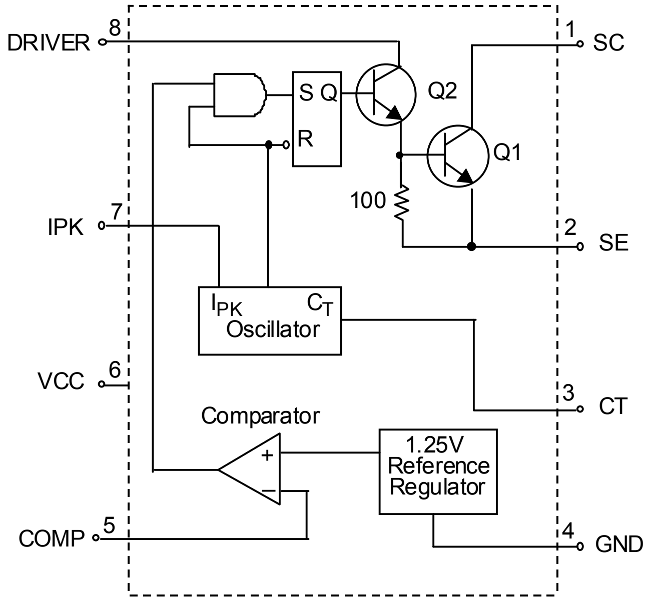
Note: 1. Maximum package power dissipation limits must be observed.

Electrical Characteristics

(VCC = 5V, T_A = 25°C, unless otherwise specified)

Parameter	Symbol	Test Conditions	Min	Typ	Max	Units
Oscillator						
Frequency		V_{PIN5} = 0V, C_T = 1.0nF	26	38	48	kHz
Charge Current	I_{CHG}	5.0V ≤ VCC ≤ 30V	25	36	43	µA
Discharge Current	I_{DISCHG}	5.0V ≤ VCC ≤ 30V	160	250	290	µA
Discharge to Charge Current Ratio		Pin 7 to VCC	5.5	6.9	7.9	--
Current Limit Sense Voltage	V_{LIMIT}	I_{CHG} = I_{DISCHG}	280	330	380	mV
Output Switch						
Saturation Voltage, Darlington Connection		I_{SW} = 1.0A, Pins1, 8 connected	--	1.0	1.3	V
Saturation Voltage, Darlington Connection		I_{SW} = 1.0A, R_{PIN8} = 82Ω to VCC, Forced β ≅ 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 ≤ VCC ≤ 30V	--	1.4	5.0	mV
Input Bias Current	I_{BIAS}	V_{IN} = 0V	--	-20	-400	nA
Total Device						
Supply Current	I_{CC}	VCC = 5.0V to 30V, C_T = 1.0nF, Pin7 = VCC, V_{PIN5} > V_{TH}, Pin2 = GND, Remaining pins open	--	3.0	4.5	mA

Function Block Diagram



Pin Description

Pin Name	Pin Function
SC	1.5A Switch Collector
SE	Darlington Switch Emitter
CT	Oscillator Timing Capacitor
GND	Power GND
COMP	Feedback Comparator Inverting Input
VCC	Power Supply Input
IPK	Highside Current Sense Input VCC-V_{IPK} = 330mV
DRIVER	Driver Collector

Typical Application Circuit

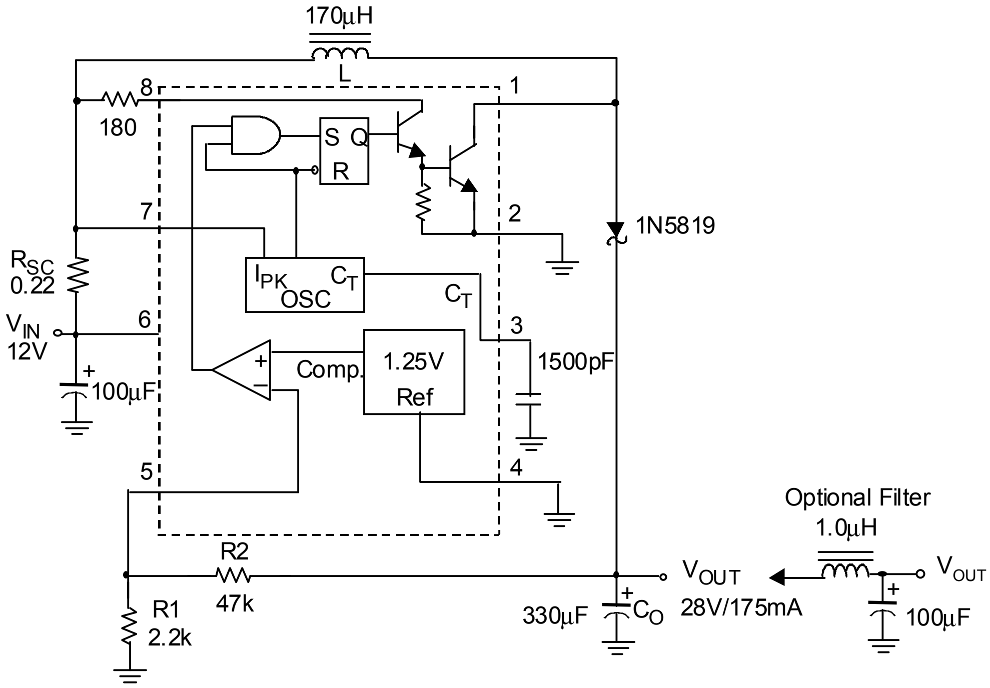


Fig.1 Step-up Converter

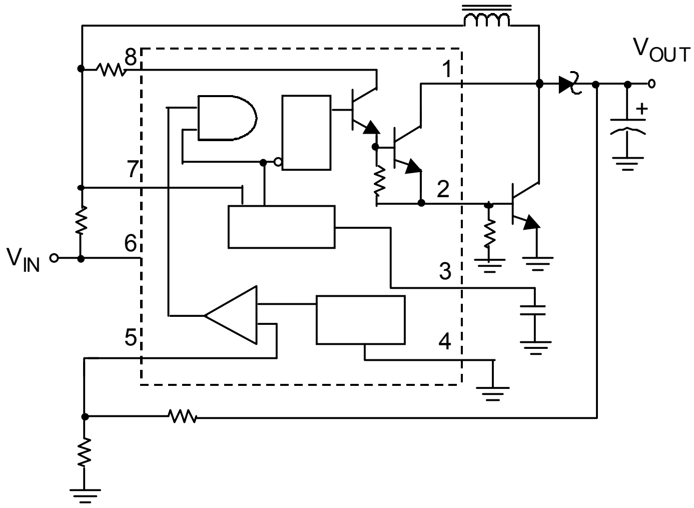


Fig.2a External NPN Switch

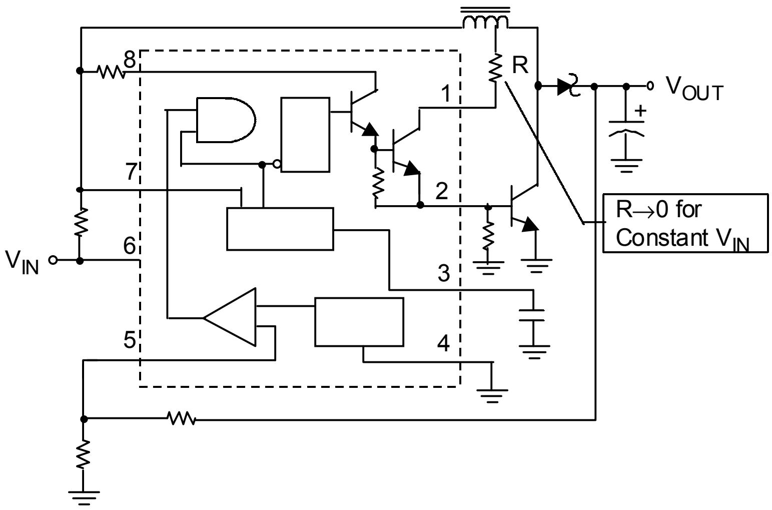


Fig.2b External NPN Saturated Switch (See Note)

Fig.2 External Current Boost Connections for I_C Peak Greater than 1.5A

Note: 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 to come out of saturation. This condition will shorten the off time at frequencies ≥ 30KHz, 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.

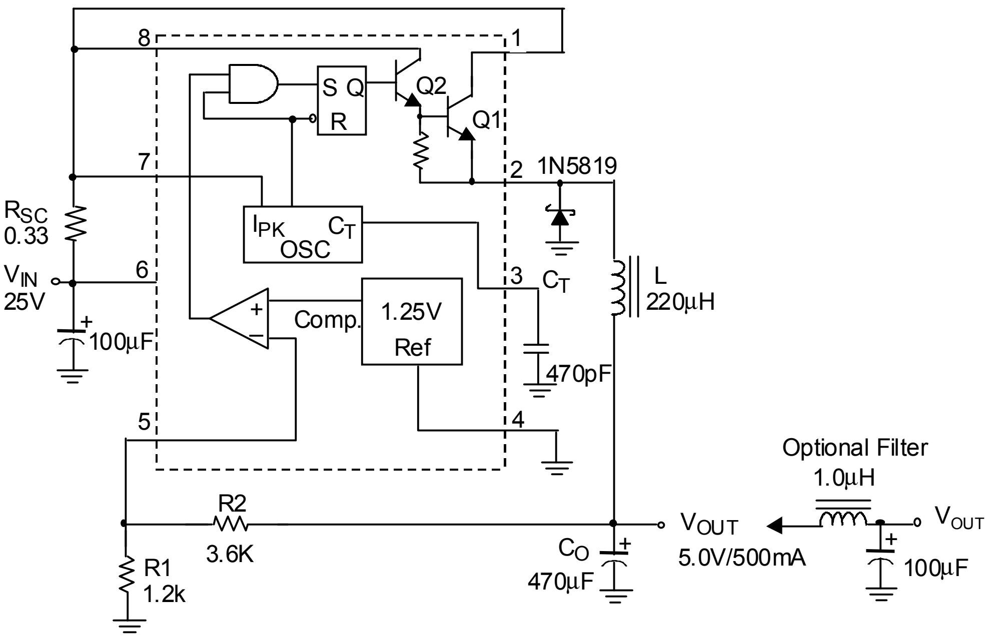


Fig.3 Step-down Converter

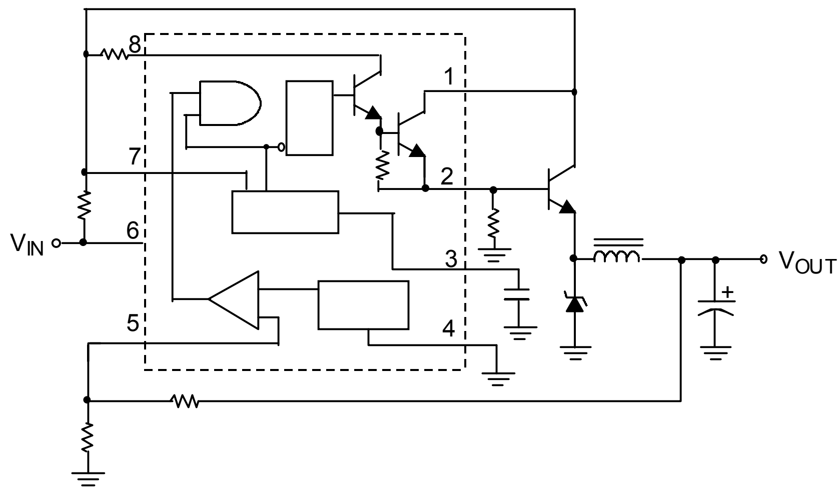


Fig.4a External NPN Switch

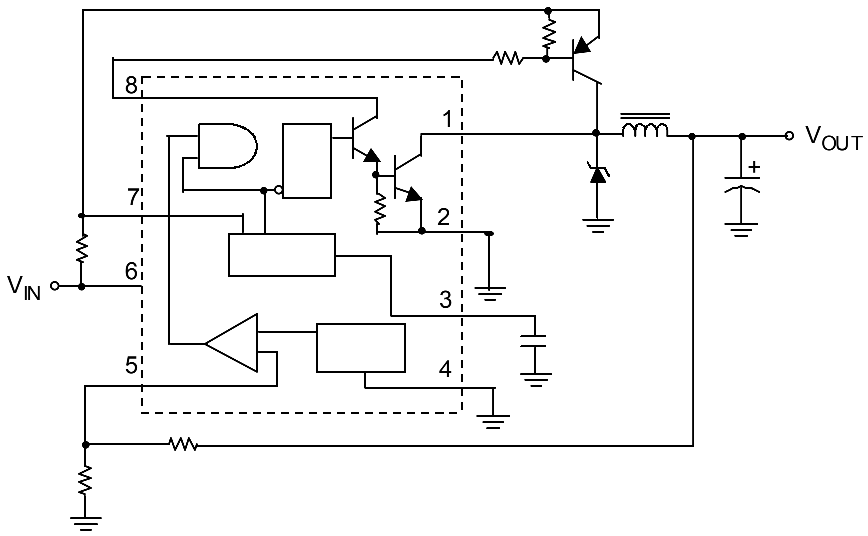


Fig.4b External PNP Saturated Switch

Fig.4 External Current Boost Connections for IC Peak Greater than 1.5A

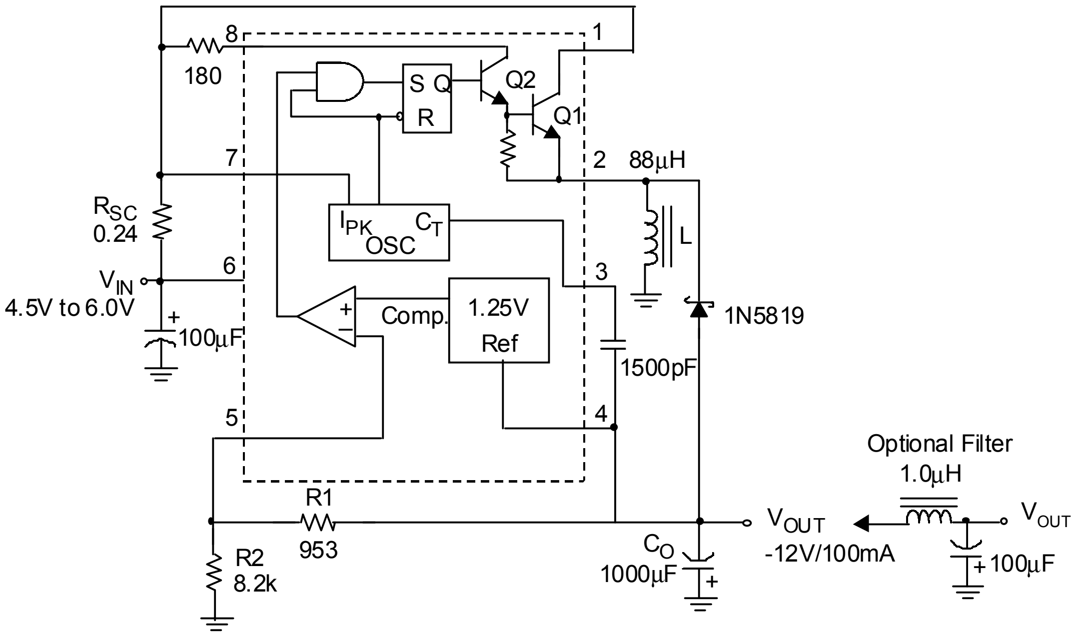


Fig.5 Voltage Inverting Converter

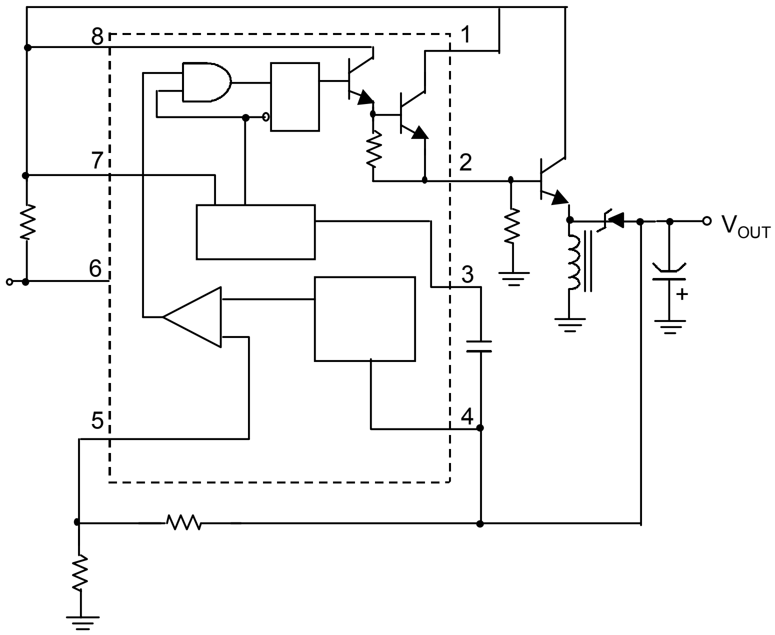


Fig.6a External NPN Switch

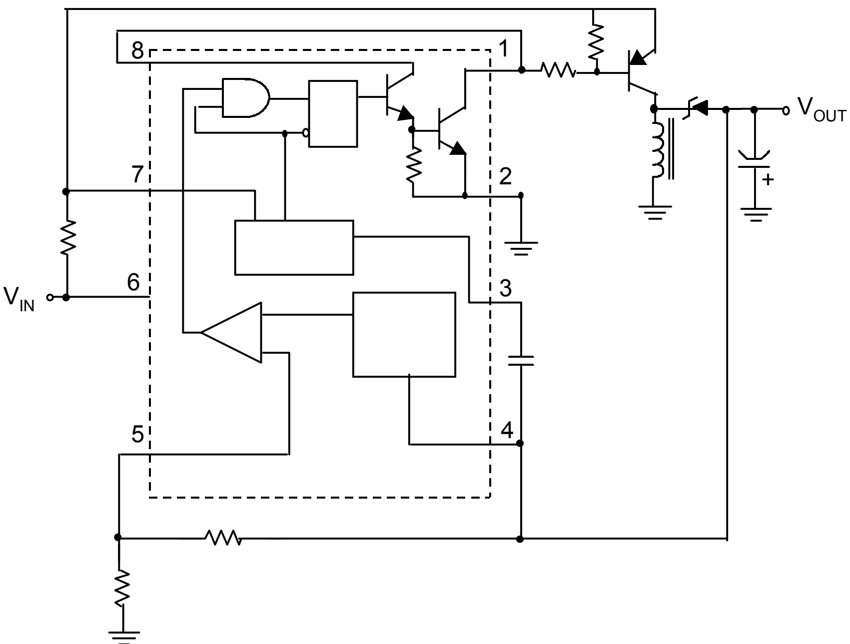


Fig.6b External PNP Saturated Switch

Fig.6 External Current Boost Connections for Peak Greater than 1.5A

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}	$\frac{ton+toff}{\frac{ton}{toff}+1}$	$\frac{ton+toff}{\frac{ton}{toff}+1}$	$\frac{ton+toff}{\frac{ton}{toff}+1}$
t_{on}	$(ton+toff)-toff$	$(ton+toff)-toff$	$(ton+toff)-toff$
C_T	$4.0\times10^{-5}ton$	$4.0\times10^{-5}ton$	$4.0\times10^{-5}ton$
Ipk (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/Ipk (SWITCH)	0.3/Ipk (SWITCH)	0.3/Ipk (SWITCH)
L (min)	$\left(\frac{(V_{IN(MIN)}-V_{SAT})}{Ipk_{(SWITCH)}}\right)t_{on(MAX)}$	$\left(\frac{(V_{IN(MIN)}-V_{SAT})}{Ipk_{(SWITCH)}}\right)t_{on(MAX)}$	$\left(\frac{(V_{IN(MIN)}-V_{SAT})}{Ipk_{(SWITCH)}}\right)t_{on(MAX)}$
C_O	$9\frac{I_{OUT}\ ton}{Vripple\ (pp)}$	$\frac{I_{pk(SWITCH)}(t_{on}+t_{off})}{8V_{ripple(pp)}}$	$9\frac{I_{OUT}\ ton}{Vripple\ (pp)}$

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.

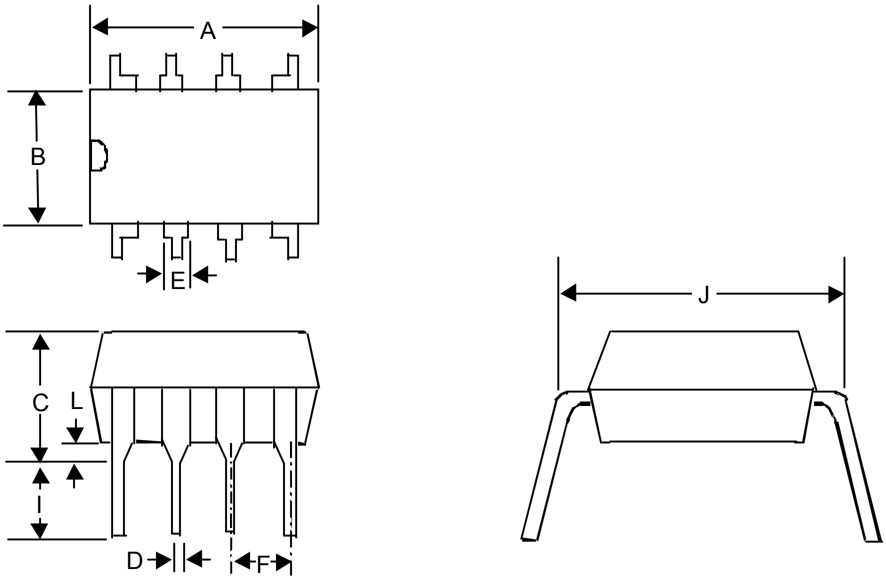
V_{OUT} : Desired output voltage $\lvert V_{OUT}\rvert = 1.25\left(1+\frac{R_2}{R_1}\right)$

I_{OUT} : Desired output current.

f : Minimum desired output switching frequency at the selected values of Vin and I_O.

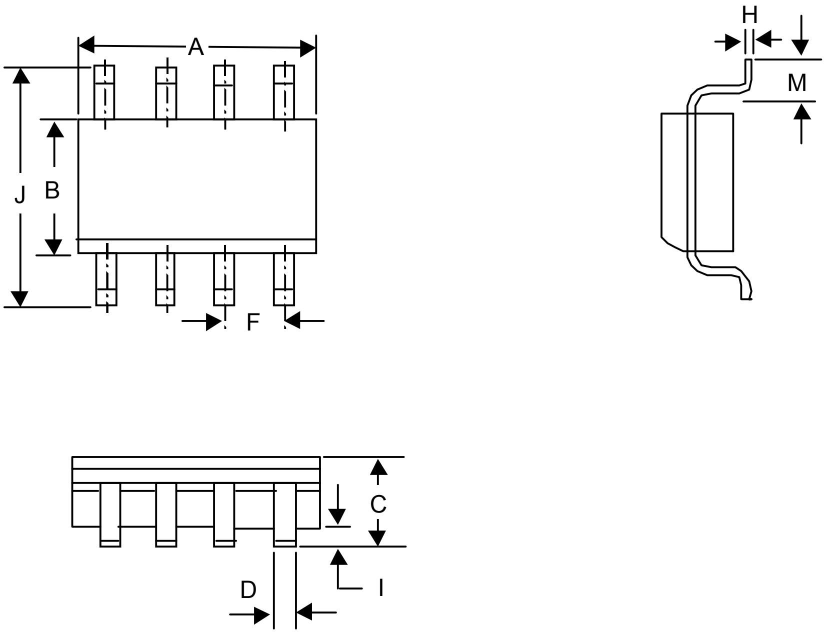
$V_{ripple(pp)}$: Desired peak-to-peak output ripple voltage. In practice, the calculated capacitor value needs to be increased due to its equivalent series resistance and board layout. The ripple voltage should be kept to a low value since it directly affects the line and load regulation.

Package Information



Symbol	Dimensions In Millimeters		Dimensions In Inches	
	Min	Max	Min	Max
A	9.068	9.627	0.357	0.379
B	6.198	6.604	0.244	0.260
C	--	4.318	--	0.170
D	0.356	0.559	0.014	0.022
E	1.397	1.651	0.055	0.065
F	2.337	2.743	0.092	0.108
I	3.048	3.556	0.120	0.140
J	7.366	8.255	0.290	0.325
L	0.381	--	0.015	--

8-Lead DIP Plastic Package



Symbol	Dimensions In Millimeters		Dimensions In Inches	
	Min	Max	Min	Max
A	4.801	5.004	0.189	0.197
B	3.810	3.988	0.150	0.157
C	1.346	1.753	0.053	0.069
D	0.330	0.508	0.013	0.020
F	1.194	1.346	0.047	0.053
H	0.178	0.254	0.007	0.010
I	0.102	0.254	0.004	0.010
J	5.791	6.198	0.228	0.244
M	0.406	1.270	0.016	0.050

8–Lead SOP Plastic Package

RICHTEK TECHNOLOGY CORP.
Headquarter
6F, No. 35, Hsintai Road, Chupei City
Hsinchu, Taiwan, R.O.C.
Tel: (8863)5510047 Fax: (8863)5537749

RICHTEK TECHNOLOGY CORP.
Taipei Office (Marketing)
8F-1, No. 137, Lane 235, Paochiao Road, Hsintien City
Taipei County, Taiwan, R.O.C.
Tel: (8862)89191466 Fax: (8862)89191465
Email: marketing@richtek-ic.com.tw