

## GENERAL DESCRIPTION

The SP34063A is a monolithic switching regulator control circuit containing the primary functions required for DC-DC converters.

This device consists of an internal temperature compensated reference, voltage comparator, controlled duty cycle oscillator with active current limit circuit, driver and high current output switch. This device was specifically designed to be used in buck, boost, and Voltage-Inverting applications with a minimum number of external components.

The SP34063A is available in the 8 pin NSOIC package.

## APPLICATIONS

- Battery Charger Circuit
- NICs/Switches/Hubs
- ADSL Modems
- Negative Voltage Power Supply

## FEATURES

- Supply Voltage: 3V - 36V
- Current Limiting
- Output Switch Current to 1.5A
- Adjustable Output Voltage
- Operation frequency up to 180KHz
- Low Quiescent Current
- Precision 2% Reference
- Available in 8 pin NSOIC Package

## TYPICAL APPLICATION DIAGRAM

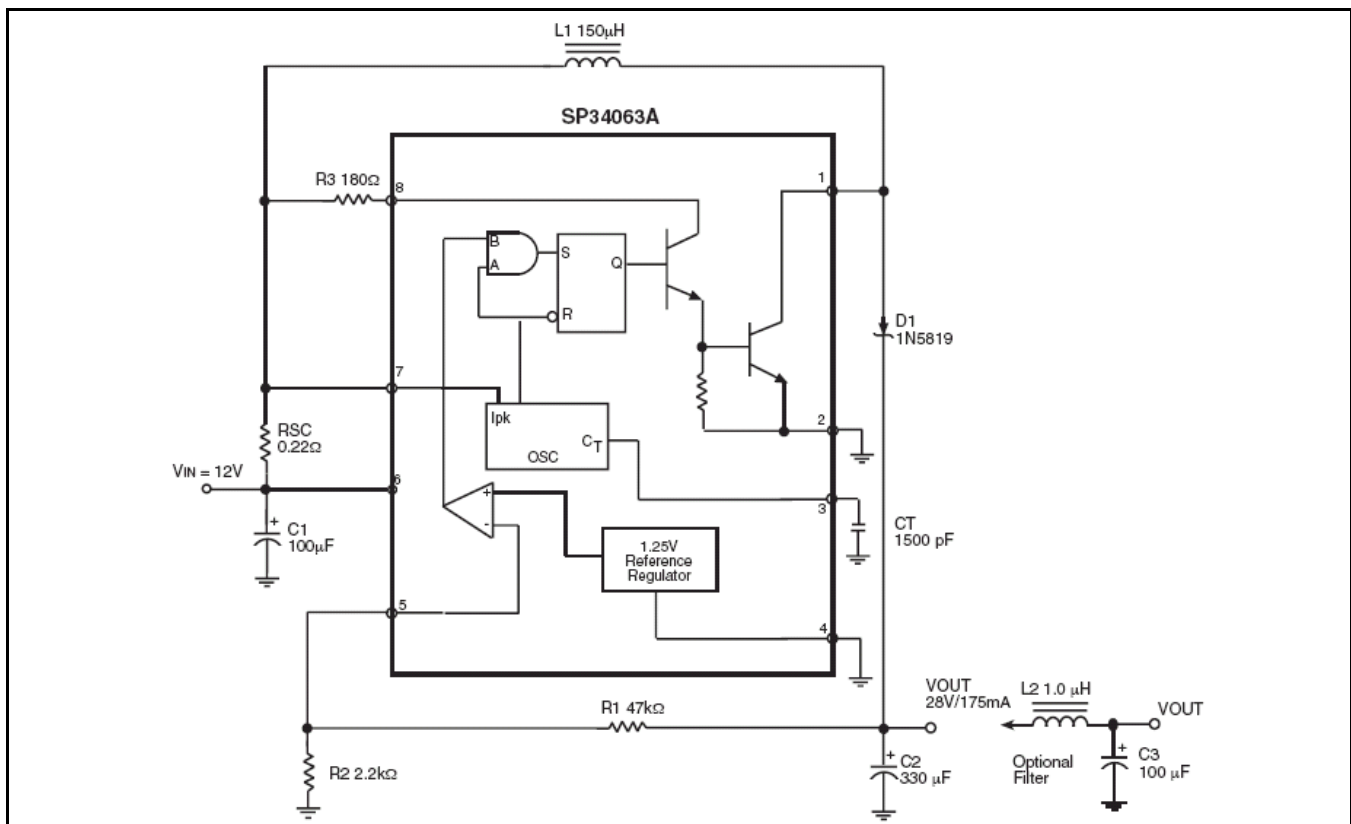


Fig. 1: SP34063A Application Diagram



**1.5A Buck/Boost/Inverting DC-DC Regulator**

**ABSOLUTE MAXIMUM RATINGS**

These are stress ratings only and functional operation of the device at these ratings or any other above those indicated in the operation sections of the specifications below is not implied. Exposure to absolute maximum rating conditions for extended periods of time may affect reliability.

- Power Supply Voltage  $V_{CC}$  ..... 40V
- Comparator Input Voltage ..... -0.3V to 40V
- Switch Collector Voltage ..... 40V
- Switch Emitter Voltage ( $V_{PIN1}=40V$ ) ..... 40V
- Switch Collector to Emitter Voltage ..... 40V
- Driver Collector Voltage ..... 40V
- Driver Collector Current (Note 2) ..... 100mA
- Switch Current ..... 1.5A
- Storage Temperature ..... -65°C to 150°C
- ESD Rating (HBM - Human Body Model) ..... 2kV

**OPERATING RATINGS**

- Input Voltage Range  $V_{IN}$  ..... 3.0V to 36V
- Power Dissipation ( $T_A=25^\circ C$  - NSOIC) ..... 780mW
- Junction Temperature Range ..... -40°C to 150°C
- Thermal Resistance  $\theta_{JA}$  ..... 160°C/W

**ELECTRICAL SPECIFICATIONS**

Specifications with standard type are for an Operating Temperature of  $T_A = 25^\circ C$  only. Minimum and Maximum limits are guaranteed through test, design, or statistical correlation. Typical values represent the most likely parametric norm at  $T_A = 25^\circ C$ , and are provided for reference purposes only. Unless otherwise indicated,  $V_{CC} = 5.0V$ ,  $T_A = -40^\circ C$  to  $85^\circ C$ .

Parameter	Min.	Typ.	Max.	Units	Conditions
<b>Oscillator</b>					
Frequency $F_{OSC}$	30	38	45	KHz	$V_{PIN5} = 0V$ , $CT = 1.0nF$ , $T_A = 25^\circ C$
Charge Current $I_{CHG}$	30	38	45	$\mu A$	$V_{CC} = 5.0V$ to $36V$ , $T_A = 25^\circ C$
Discharge Current $I_{DISCHG}$	180	240	290	$\mu A$	$V_{CC} = 5.0V$ to $36V$ , $T_A = 25^\circ C$
Discharge to Charge Current Ration $I_{DISCHG}/I_{CHG}$	5.2	6.5	7.5		Pin 7 to $V_{CC}$ , $T_A = 25^\circ C$
Current Limit Sense Voltage $V_{IPK(sense)}$	250	300	350	mV	$I_{DISCHG} = I_{CHG}$ , $T_A = 25^\circ C$
<b>Output Switch (Note 1)</b>					
Saturation Voltage, Darlington Connection $V_{CE(sat)}$		1.0	1.3	V	$I_{SW}=1A$ , pin1,8 connected
Saturation Voltage (note 2)		0.45	0.7	V	$I_{SW}=1A$ , R pin8 = 82ohms to $V_{CC}$ , forced $\beta=20$
DC Current Gain	50	75			$I_{SW}=1A$ , $V_{CE} = 5V$ , $T_A = 25^\circ C$
Collector Off-State Current		0.01	100	$\mu A$	$V_{CE}=36V$
<b>Comparator</b>					
Threshold Voltage $V_{TH}$	1.225	1.250	1.275	V	$T_A = 25^\circ C$
	1.210	1.250	1.290	V	$T_A = -40^\circ C$ to $85^\circ C$
Threshold Voltage Line Regulation $R_{EGLINE}$		1.4	5	mV	$V_{CC} = 3.0V$ to $36V$
Input Bias Current $I_{IB}$		-20	-400	nA	$V_{IN} = 0V$
<b>Total Device</b>					
Supply Current $I_{CC}$			4	mA	$V_{CC}=5.0V$ to $36V$ , $CT=1nF$ , pin 7 = $V_{CC}$ $V_{pin5} > V_{TH}$

Note 1: Low duty cycle pulse techniques are used during the test program to maintain junction temperature as close to ambient temperature as possible.

Note 2: If the output switch is driven into hard saturation (non-Darlington configuration) at low switch currents ( $\leq 300mA$ ) and high driver currents ( $\geq 30mA$ ), it may take up to 2.0 $\mu s$  for it to come out of saturation. This condition will shorten the

**1.5A Buck/Boost/Inverting DC-DC Regulator**

off time at frequencies above 30KHz, 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.

$$\text{Forced } \beta \text{ of output switch} = \frac{I_C \text{ Output}}{I_C \text{ Driver} - 7\text{mA}^*} \geq 10$$

\* The 100Ω resistor in the emitter of the driver device requires about 7.0mA before the output switch conducts.

**BLOCK DIAGRAM**

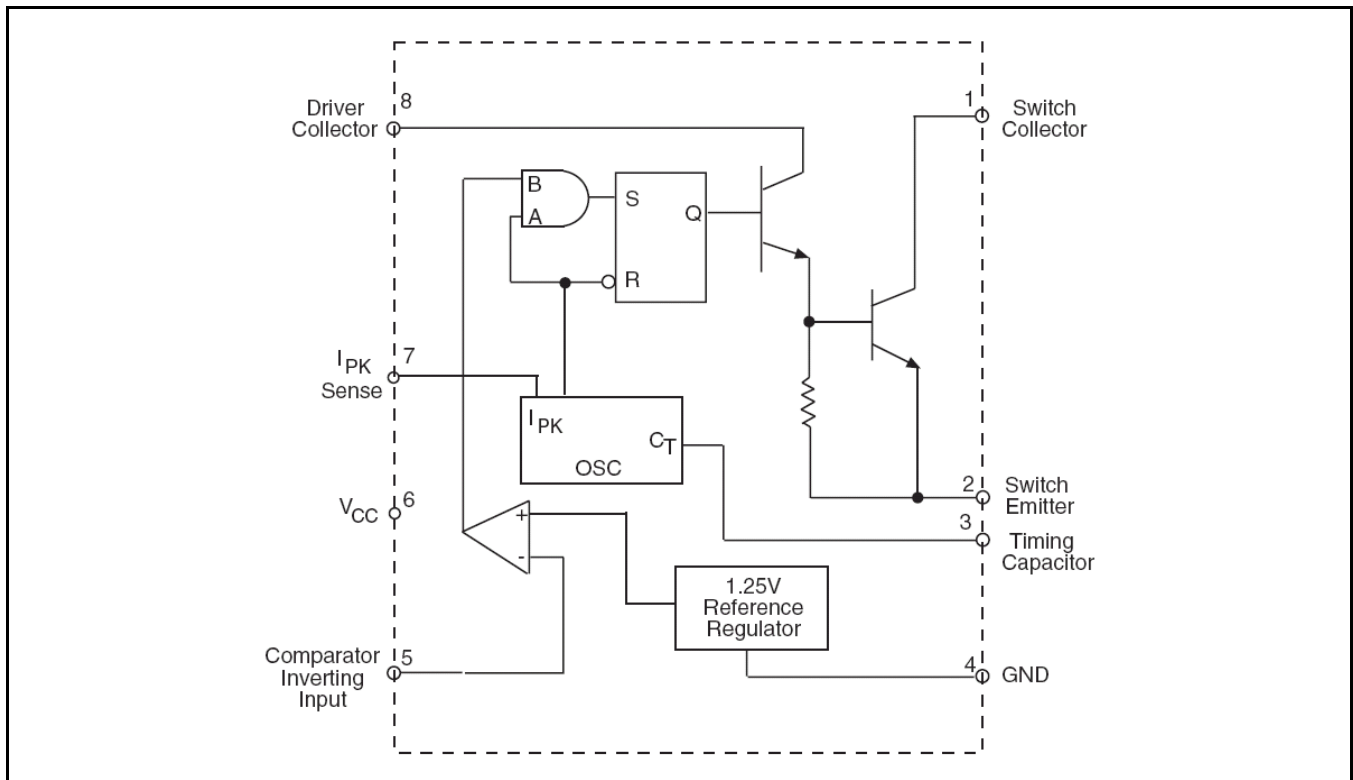


Fig. 2: SP34063A Block Diagram

**PIN ASSIGNMENT**

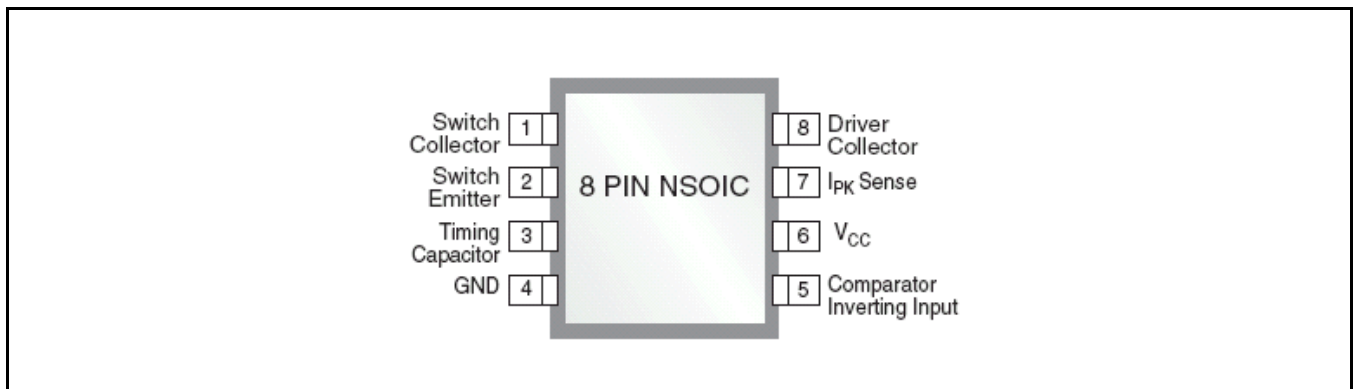


Fig. 3: SP34063A Pin Assignment

**PIN DESCRIPTION**

Name	Pin Number	Description
Switch Collector	1	Internal switch transistor collector
Switch Emitter	2	Internal switch transistor emitter
Timing Capacitor	3	Timing capacitor to control the switching frequency
GND	4	Ground pin for all internal circuit
Comparator Inverting Input	5	Inverting input pin for internal comparator
V <sub>CC</sub>	6	Voltage supply
I <sub>PK</sub> Sense	7	Peak Current Sense Input by monitoring the voltage drop across an external I sense resistor to limit the peak current through the switch
Driver Collector	8	Voltage driver collector

**ORDERING INFORMATION**

Part Number	Temperature Range	Package	Packing Quantity	Note 1	Note 2
SP34063AEN-L	-40°C ≤ T <sub>A</sub> ≤ +85°C	NSOIC-8	Bulk	Lead Free	
SP34063AEN-L/TR	-40°C ≤ T <sub>A</sub> ≤ +85°C	NSOIC-8	2.5K/Tape & Reel	Lead Free	

TYPICAL PERFORMANCE CHARACTERISTICS

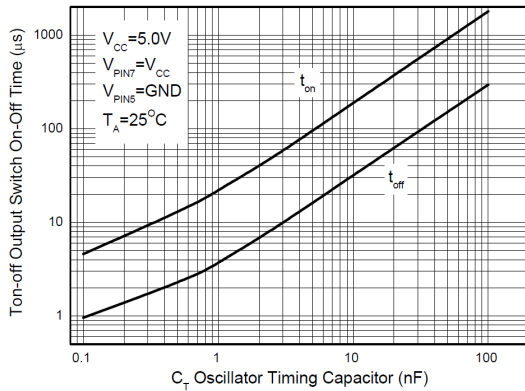


Fig. 4: Output Switch On-Off Time vs. Oscillator Timing Capacitor

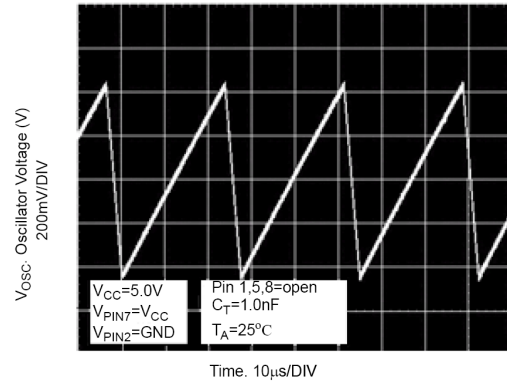


Fig. 5: Timing Capacitor Waveform

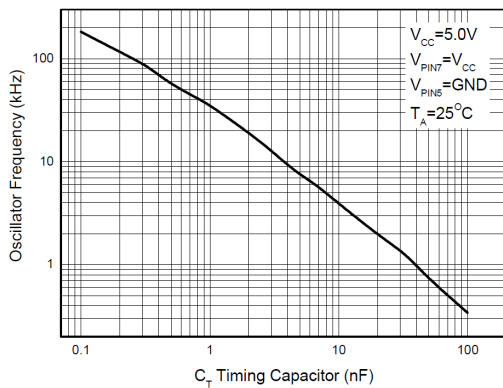


Fig. 6: Oscillator Frequency vs. Timing Capacitor

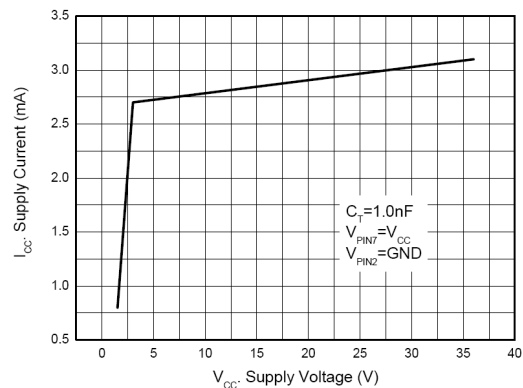


Fig. 7: Standard Supply Current vs. Supply Voltage

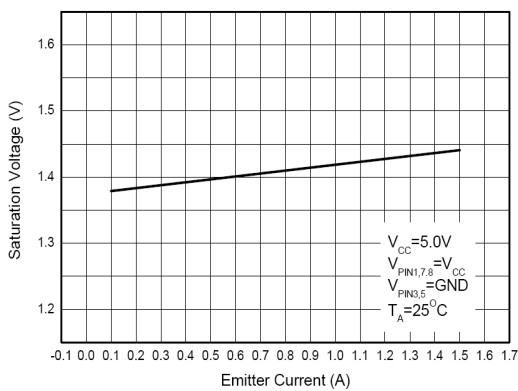


Fig. 8: Emitter Follower Configuration Output Switch Saturation vs. Emitter Current

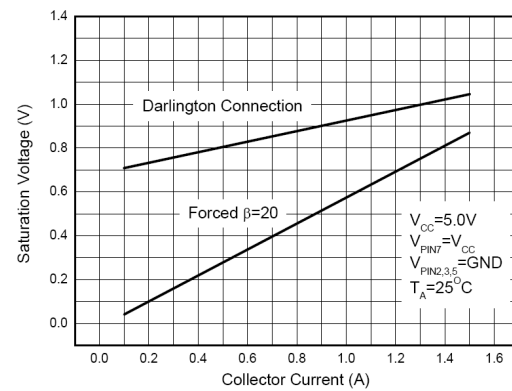


Fig. 9: Common Emitter Configuration Output Switch Saturation vs. Collector Current

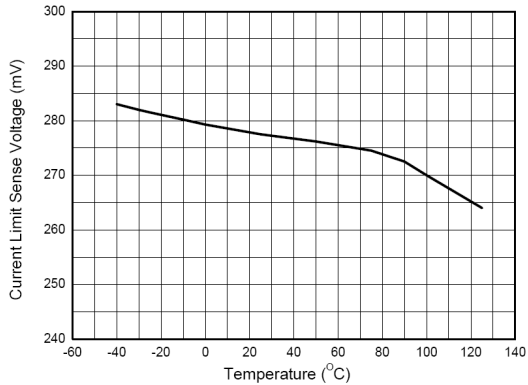
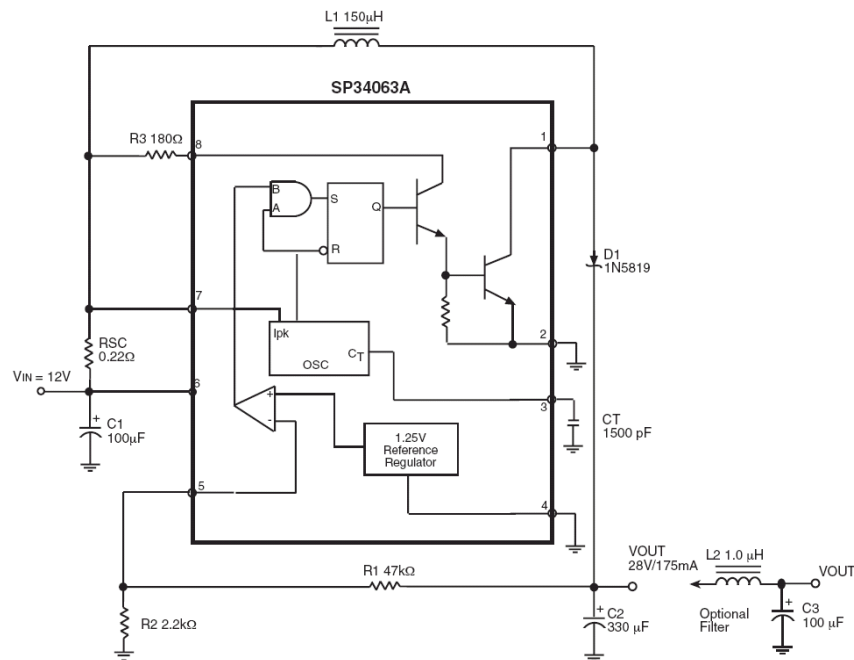


Fig. 10: Current Limit Sense Voltage vs. Temperature

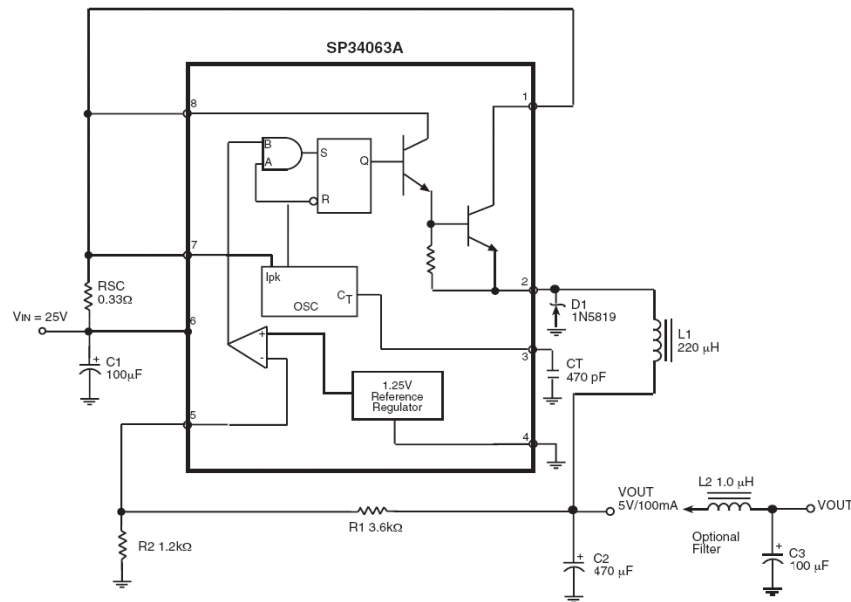
## APPLICATION INFORMATION

### TYPICAL BOOST CONVERTER CIRCUIT



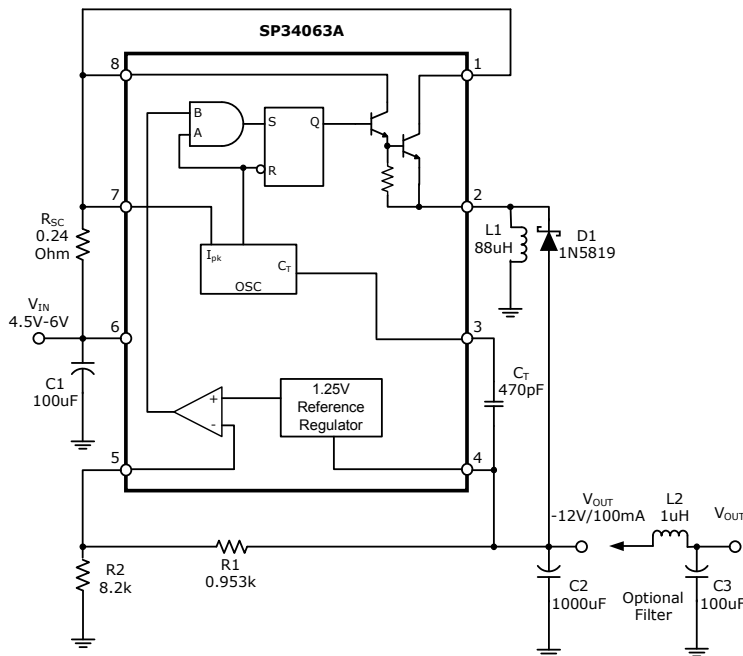
This is a typical boost converter configuration. In the steady state, if the resistor divider voltage at pin 5 is greater than the voltage in the non-inverting input, which is 1.25V determined by the internal reference, the output of the comparator will go low. At the next switching period, the output switch will not conduct and the output voltage will eventually drop below its nominal voltage until the divider voltage at pin 5 is lower than 1.25. Then the output of the comparator will go high, the output switch will be allowed to conduct. Since  $V_{PIN5} = V_{OUT} * R2 / (R1 + R2) = 1.25(V)$ , The output voltage can be decided by  $V_{OUT} = 1.25V * (R1 + R2) / R2(V)$ .

**TYPICAL BUCK CONVERTER CIRCUIT**



This is a typical buck converter configuration. The working process in the steady state is similar to a boost converter,  $V_{PIN5} = V_{OUT} * R2 / (R1 + R2) = 1.25(V)$ . The output voltage can be decided by  $V_{OUT} = 1.25V * (R1 + R2) / R2(V)$ .

**TYPICAL INVERTING CONVERTER CIRCUIT**

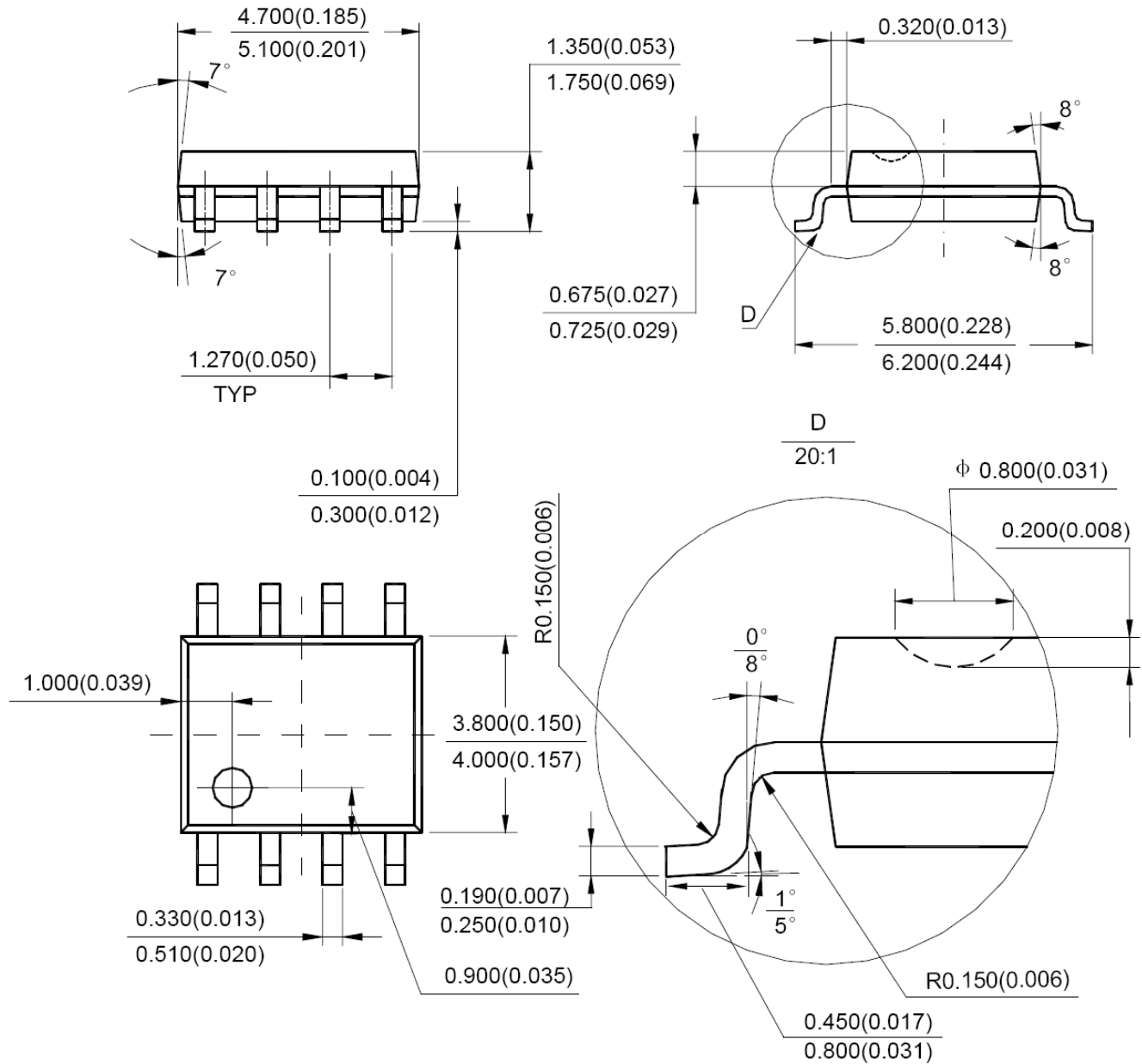


This is a typical boost converter configuration. The working process in the steady state is similar to a boost converter, the difference in this situation is that the voltage at the non-inverting pin of the comparator is equal to  $1.25V + V_{OUT}$ , then  $V_{PIN5} = V_{OUT} * R2 / (R1 + R2) = 1.25V, + V_{OUT}$ . The output voltage can be decided by  $V_{OUT} = -1.25V * (R1 + R2) / R1 (V)$ .

**PACKAGE SPECIFICATION**

**8-PIN NSOIC**

Unit: mm (inch)





**REVISION HISTORY**

Revision	Date	Description
2.0.0	01/16/2009	Reformat of Datasheet
2.0.1	8/24/2010	Pg1, changed operation frequency from 110kHz to 180kHz Fig. 6: Changed title to: Oscillator Frequency vs. Timing Capacitor Pg7, Corrected the inverting converter circuit
2.1.0	02/14/2011	Corrected Power Dissipation value to 780mW under Operating Ratings Added $C_T = fct(T_{ON})$ formula on figure 10 graph Updated package specification
2.1.1	02/06/2014	Updated figure 4 and 6 [ECN 1407-07]

**FOR FURTHER ASSISTANCE**

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