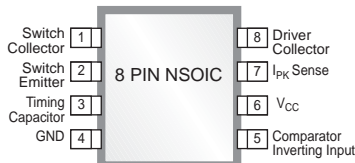


## 1.5A Buck/Boost/Inverting DC-DC Switching Regulator

### FEATURES

- Supply Voltage: 3V - 36V
- Current Limiting
- Output Switch Current to 1.5A
- Adjustable Output Voltage
- Operation frequency up to 110KHz
- Low Quiescent Current
- Precision 2% Reference
- Available in 8 pin NSOIC Package



*Now Available in Lead Free Packaging*

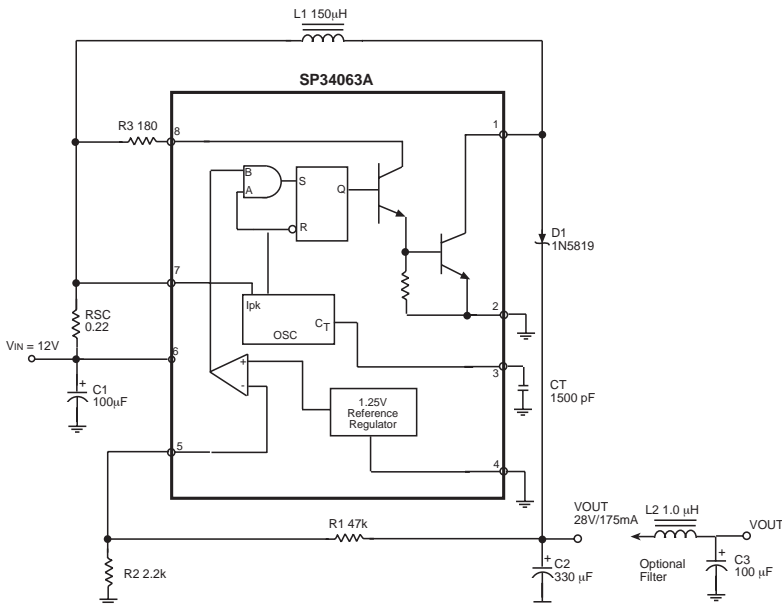
### APPLICATIONS

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

### 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 8 pin NSOIC package.

### TYPICAL APPLICATION CIRCUIT



## 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.

Parameter	Symbol	Value	Unit
Power Supply Voltage	$V_{CC}$	40	V
Comparator Input Voltage Range	$V_{IR}$	-0.3 to 40	V
Switch Collector Voltage	$V_C(\text{switch})$	40	V
Switch Emitter Voltage ( $V_{pin1}=40V$ )	$V_E(\text{switch})$	40	V
Switch Collector to Emitter Voltage	$V_{CE}(\text{switch})$	40	V
Driver Collector Voltage	$V_C(\text{driver})$	40	V
Driver Collector Current (Note 2)	$I_C(\text{driver})$	100	mA
Switch Current	$I_{SW}$	1.5	A
Power Dissipation and Thermal Characteristics for NSOIC Package			
Power Dissipation ( $T_A=25^\circ\text{C}$ )	$P_D$	625	mW
Thermal Resistance	$R_{\theta JA}$	160	$^\circ\text{C}/\text{W}$
Operating Junction Temperature	$T_J$	150	$^\circ\text{C}$
Storage Temperature Range	$T_{STG}$	-65 to 150	$^\circ\text{C}$
ESD (Human Body Model)	-	2000	V

## ELECTRICAL CHARACTERISTICS

Unless otherwise noted, the following specifications apply for  $V_{CC} = +5.0V$ ,  $T_A = -40$  to  $85^\circ C$ .

PARAMETER	SYMBOL	MIN.	TYP.	MAX.	UNITS	CONDITIONS
<b>Oscillator</b>						
Frequency	$F_{OSC}$	30	38	45	KHz	VPin 5 = 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 Ratio	$I_{DISCHG}/I_{CHG}$	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	$I_{CHG} = I_{DISCHG}$ , $T_A = 25^\circ C$
<b>Output Switch (note 1)</b>						
Saturation Voltage, Darlingon Connection VCE(sat)	$V_{CE(SAT)}$	-	1.0	1.3	V	$I_{SW} = 1.0A$ , Pins 1, 8 connected
Saturation Voltage (note 2)	$V_{CE(SAT)}$	-	0.45	0.7	V	$I_{SW} = 1.0A$ , RPin 8 = 82 to $V_{CC}$ , Forced $\beta = 20$
DC Current Gain	$h_{FE}$	50	75	-		$I_{SW} = 1.0A$ , $V_{CE} = 5.0V$ , $T_A = 25^\circ C$
Collector Off-State Current	$I_C(off)$	-	0.01	100	$\mu A$	$V_{CE} = 36V$
<b>Comparator</b>						
Threshold Voltage	$V_{TH}$	1.225	1.250	1.275	V	$T_A = 25^\circ C$
		1.21	1.250	1.29		$T_A = -40^\circ C$ 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 = 1.0nF, Pin 7 = $V_{CC}$ , VPin 5 > $V_{TH}$

Note 1: Low duty cycle pulse technique are used during test 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 off time at frequencies 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.

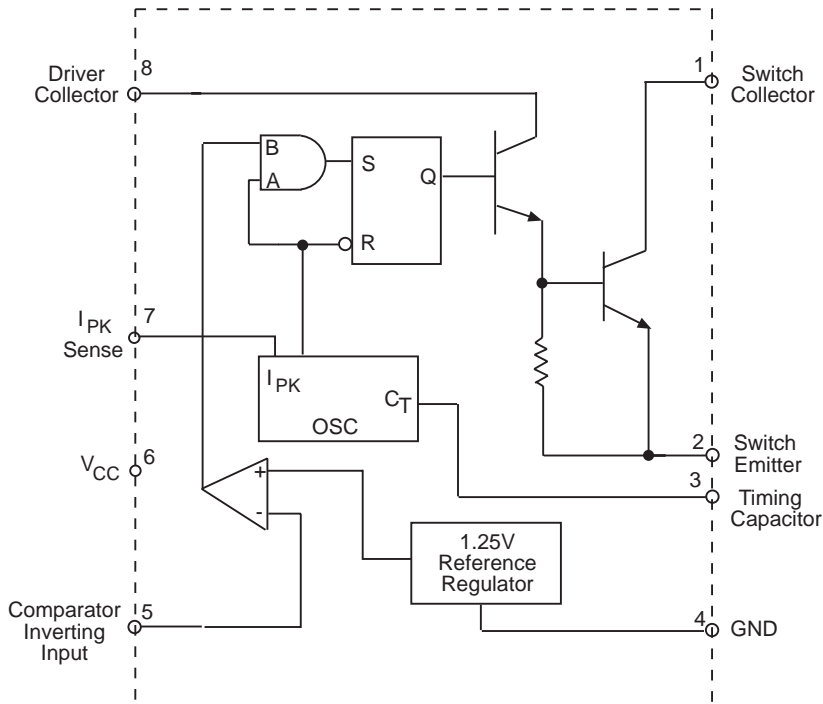
$$\text{Forced } \beta \text{ of output switch: } \frac{I_C \text{ Output}}{I_C \text{ driver} - 7.0mA^*} \geq 10$$

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

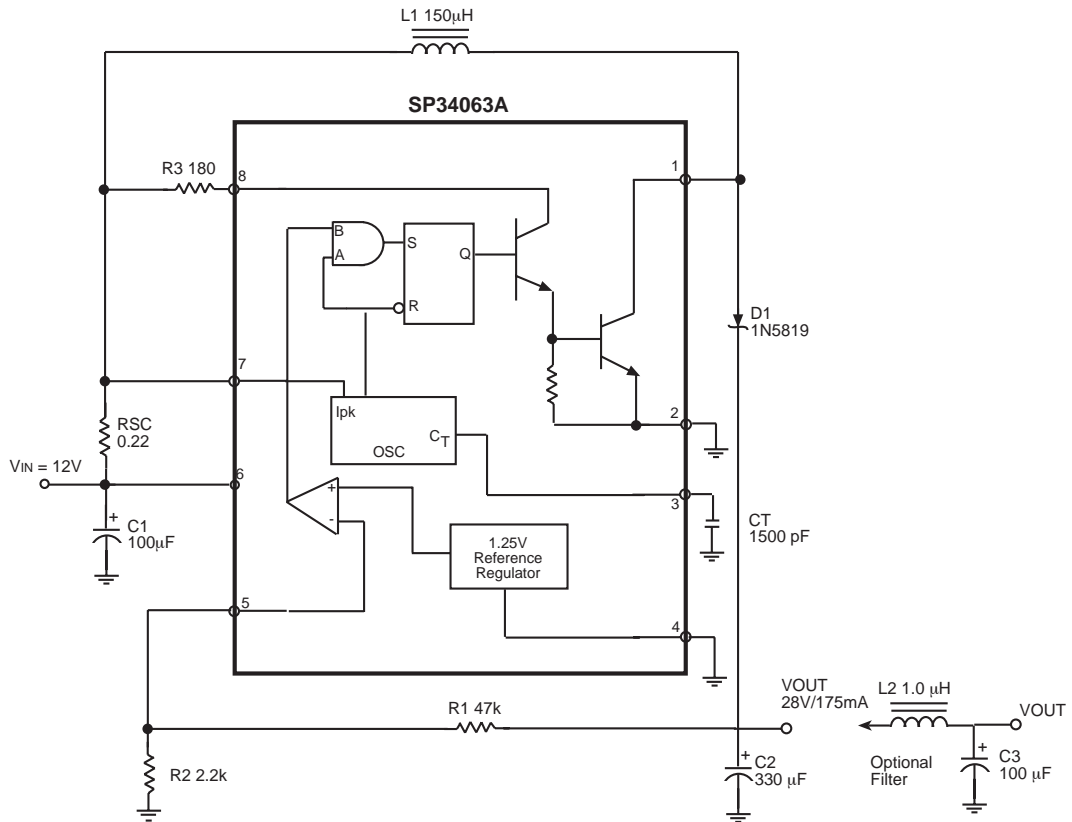
## PIN DESCRIPTION

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

## BLOCK DIAGRAM

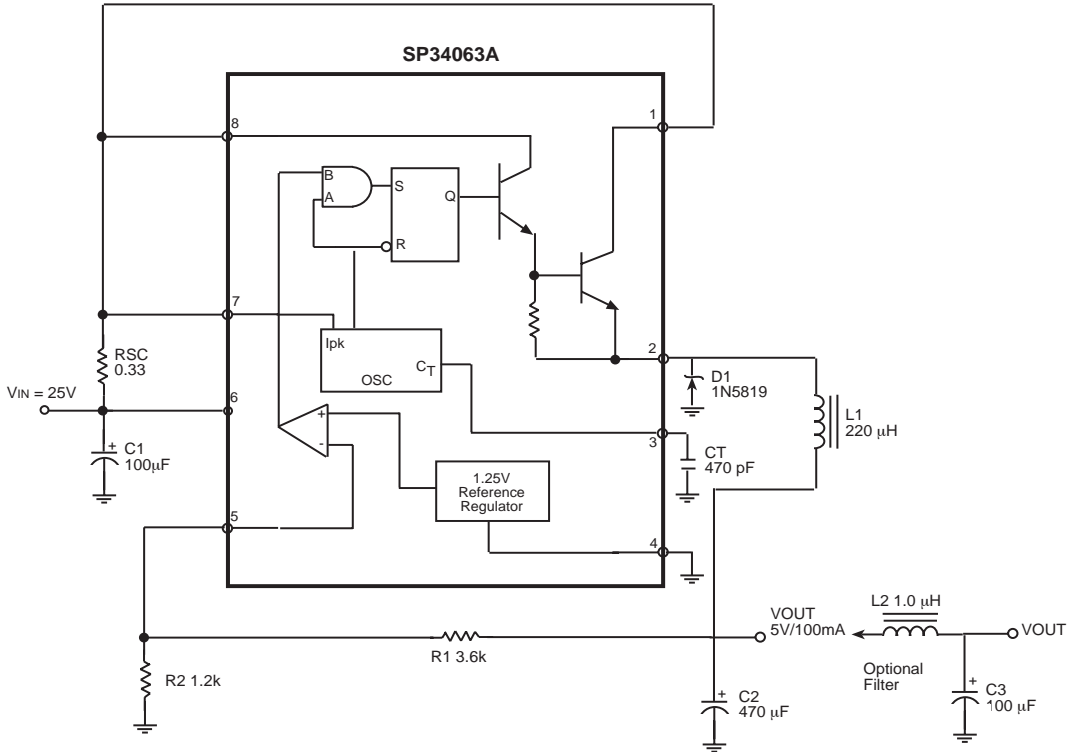


## TYPICAL BOOST CONVERTER CIRCUIT



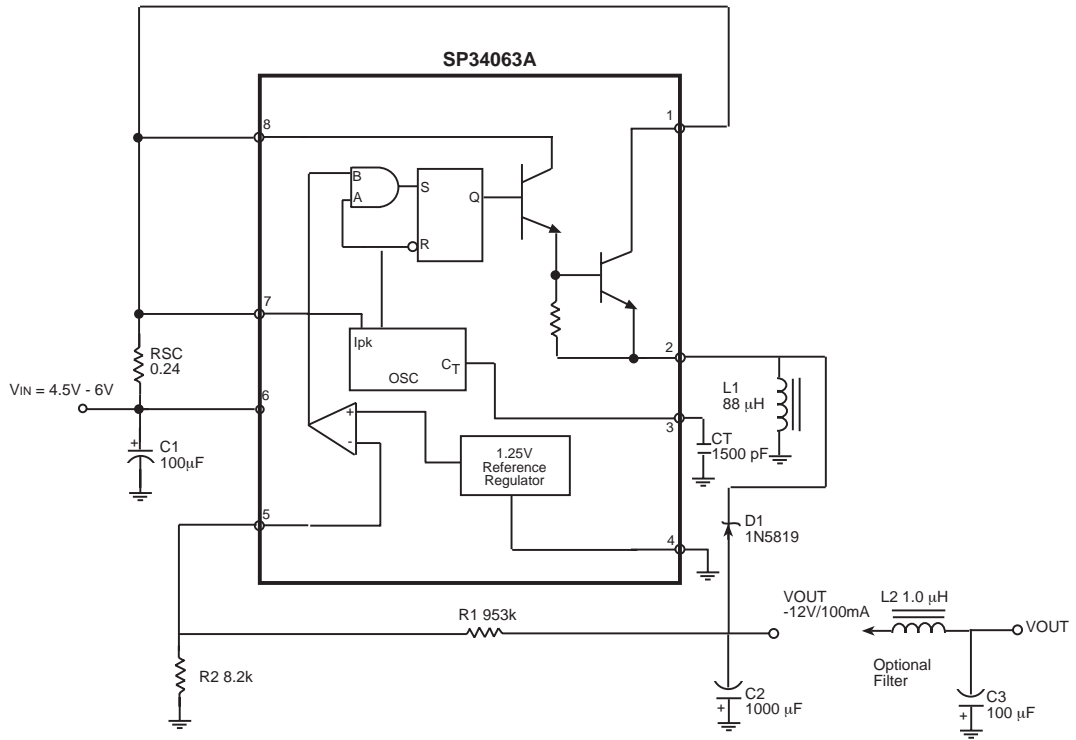
This is a typical boost converter configuration. In the steady state, if the resistor divider voltage at pin 5 is greater than the voltage in the non-inverting input, which is 1.25V determined by the internal reference, the output of the comparator will go low. At the next switching period, the output 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).

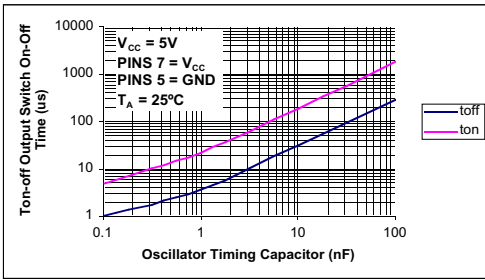


Figure 1. Output Switch On-Off Time vs. Oscillator Timing Capacitor

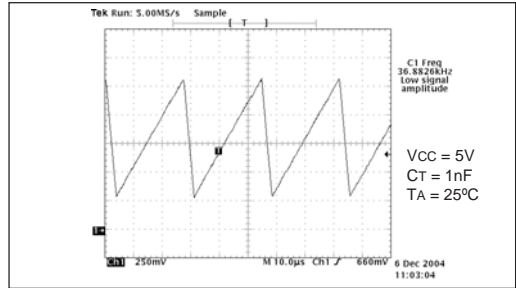


Figure 2. Timing Capacitor Waveform

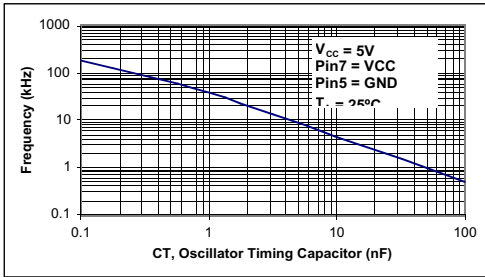


Figure 3. Oscillator Frequency vs. Timing Capacitor

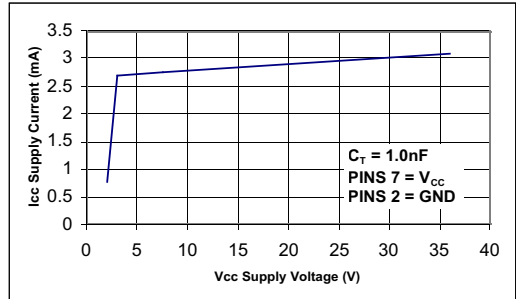


Figure 4. Standard Supply Current vs. Supply Voltage

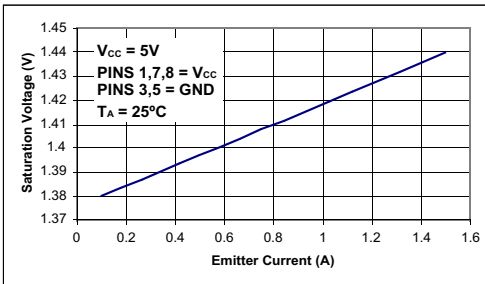


Figure 5. Emitter Follower Configuration Output Switch Saturation vs. Emitter Current

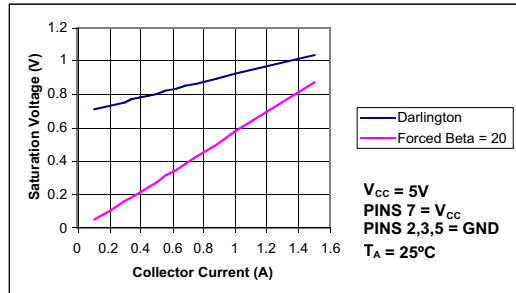


Figure 6. Common Emitter Configuration Output Switch Saturation vs. Collector Current

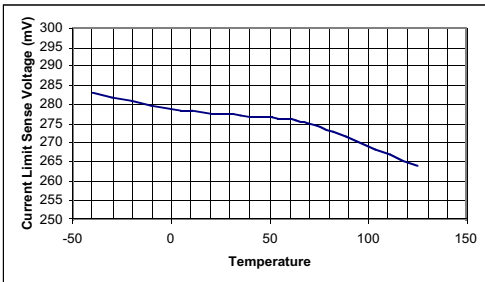
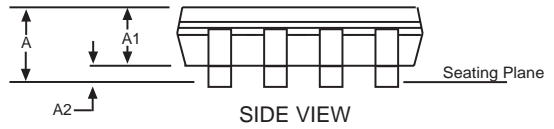
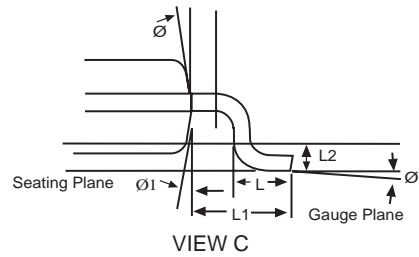
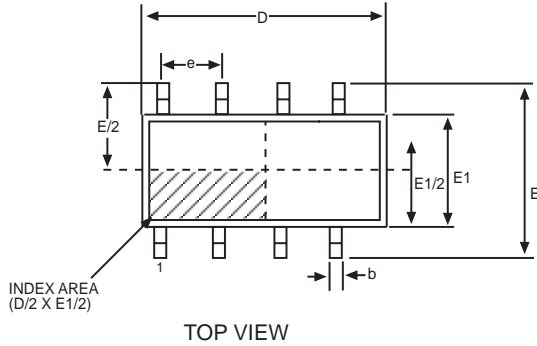


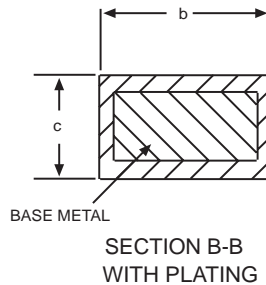
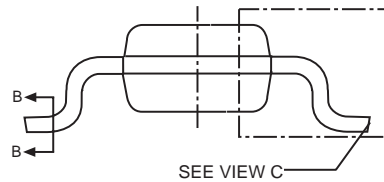
Figure 7. Current Limit Sense Voltage vs. Temperature





8 Pin NSOIC JEDEC MO-012 (AA) Variation			
SYMBOL	MIN	NOM	MAX
A	1.35	-	1.75
A1	0.1	-	0.25
A2	1.25	-	1.65
b	0.31	-	0.51
c	0.17	-	0.24
D	4.90 BSC		
E	6.00 BSC		
E1	3.90 BSC		
e	1.27 BSC		
L	0.4	-	1.27
L1	1.04 REF		
L2	0.25 BSC		
$\phi$	0°	-	8°
$\phi 1$	5°	-	15°

Note: Dimensions in (mm)



## ORDERING INFORMATION

Part Number	Temperature Range	Package Types
SP34063AEN .....	-40°C to +85°C .....	8-pin NSOIC
SP34063AEN/TR .....	-40°C to +85°C .....	8-pin NSOIC

Available in lead free packaging. To order add "-L" suffix to part number.

Example: SP34063AEN/TR = standard; SP34063AEN-L/TR = lead free

/TR = Tape and Reel

Pack quantity is 2,500 for NSOIC.

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