1.5A Buck/Boost/Inverting DC-DC Regulator

February 2014 Rev. 2.1.1

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

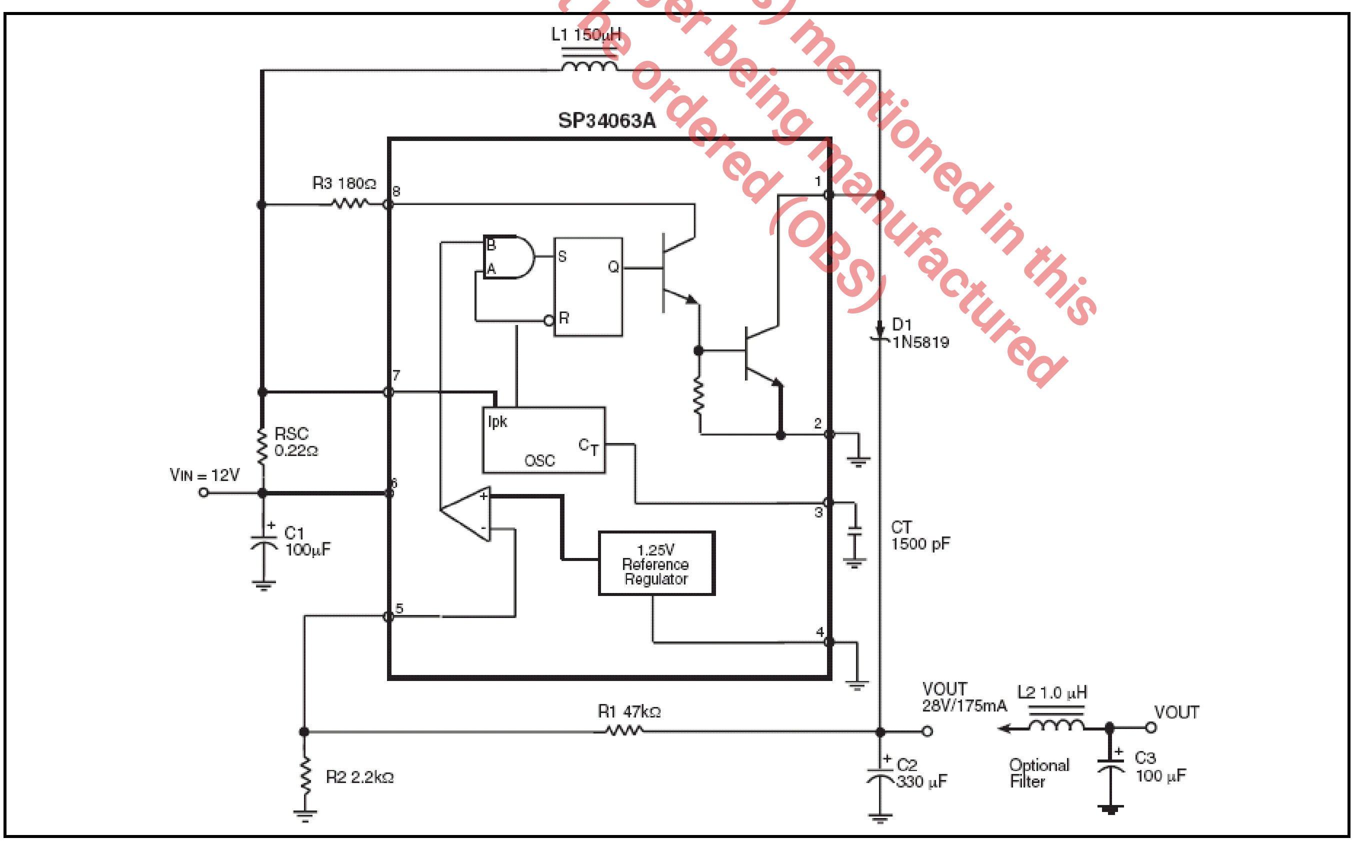

Fig. 1: SP34063A Application Diagram

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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°C - NSOIC) 780mW
Junction Temperature Range ....-40°C to 150°C
Thermal Resistance θ_{JA} ....160°C/W

ELECTRICAL SPECIFICATIONS

Specifications with standard type are for an Operating Temperature of T_A = 25°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°C, and are provided for reference purposes only. Unless otherwise indicated, V_{CC} = 5.0V, T_A= −40°C to 85°C.

Parameter	Min.	Typ.	Max.	Units		Conditions
Oscillator						
Frequency F_{OSC}	30	38	45	KHz		V_{PIN5} = 0V, CT = 1.0nF, T_A = 25°C
Charge Current I_{CHG}	30	38	45	µA		V_{CC} = 5.0V to 36V, T_A = 25°C
Discharge Current I_{DISCHG}	180	240	290	µA		V_{CC} = 5.0V to 36V, T_A = 25°C
Discharge to Charge Current Ration I_{DISCHG}/I_{CHG}	5.2	6.5	7.5			Pin 7 to V_{CC}, T_A = 25°C
Current Limit Sense Voltage $V_{IPK(sense)}$	250	300	350	mV		I_{DISCHG} = I_{CHG}, T_A = 25°C
Output Switch (Note 1)						
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 ß=20
DC Current Gain	50	75				I_{SW}=1A, V_{CE} = 5V, T_A = 25°C
Collector Off-State Current		0.01	100	µA		V_{CE}=36V
Comparator						
Threshold Voltage V_{TH}	1.225	1.250	1.275	V		T_A = 25°C
	1.210	1.250	1.290	V		T_A = -40°C to 85°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
Total Device						
Supply Current I_{CC}			4	mA		V_{CC}=5.0V to 36V, CT=1nF, pin 7 = V_{CC} Vpin5 >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 (≤ 300mA) and high driver currents (≥ 30mA), it may take up to 2.0µs for it to come out of saturation. This condition will shorten the

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.

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

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

BLOCK DIAGRAM

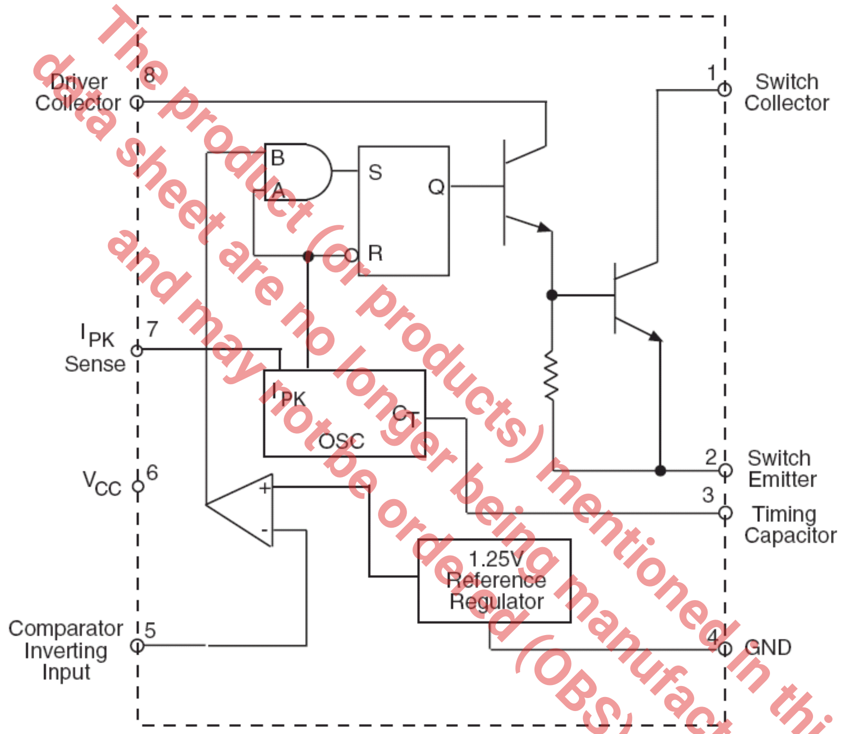


Fig. 2: SP34063A Block Diagram

PIN ASSIGNEMENT

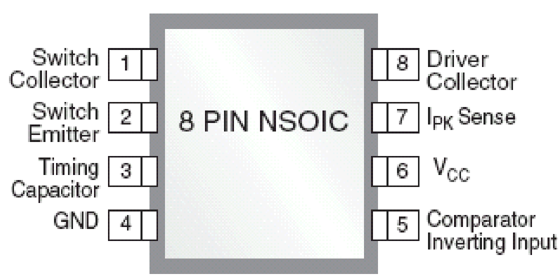


Fig. 3: SP34063A Pin Assignment

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_{CC}	6	Voltage supply
I_{PK} 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_A≤+85°C	NSOIC-8	Bulk	Lead Free	
SP34063AEN-L/TR	-40°C≤T_A≤+85°C	NSOIC-8	2.5K/Tape & Reel	Lead Free	

TYPICAL PERFORMANCE CHARACTERISTICS

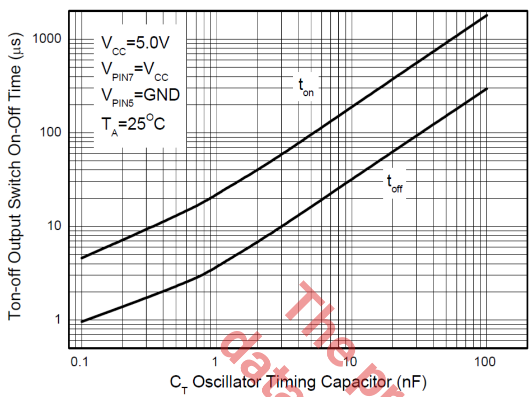


Fig. 4: Output Switch On-Off Time vs. Oscillator Timing Capacitor

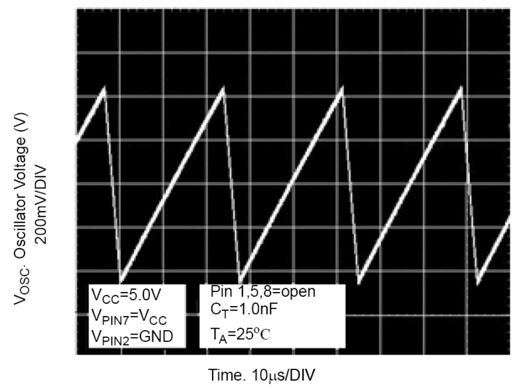


Fig. 5: Timing Capacitor Waveform

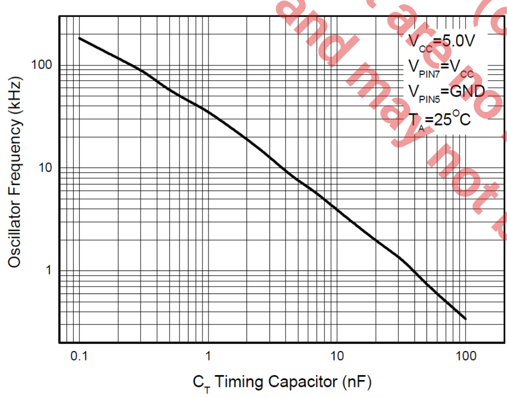


Fig. 6: Oscillator Frequency vs. Timing Capacitor

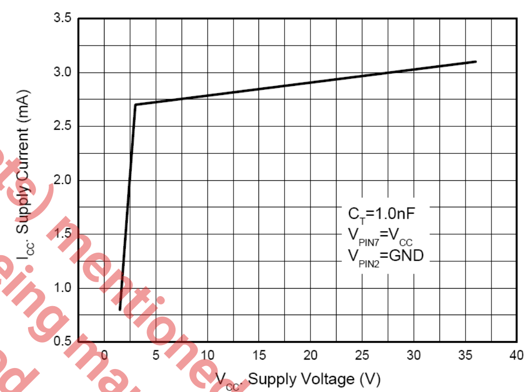


Fig. 7: Standard Supply Current vs. Supply Voltage

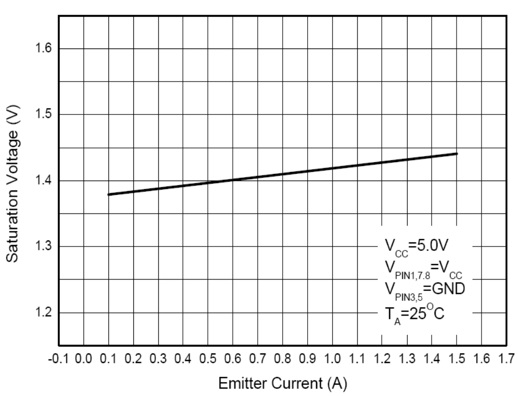


Fig. 8: Emitter Follower Configuration Output Switch Saturation vs. Emitter Current

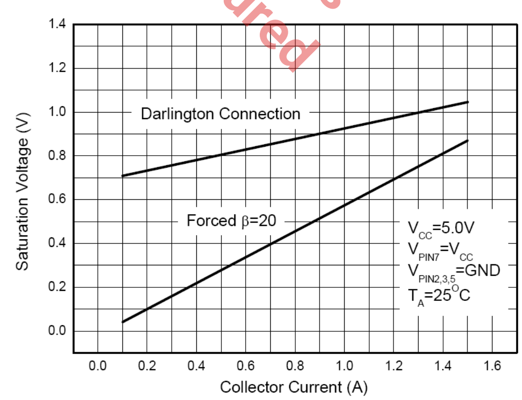


Fig. 9: Common Emitter Configuration Output Switch Saturation vs. Collector Current

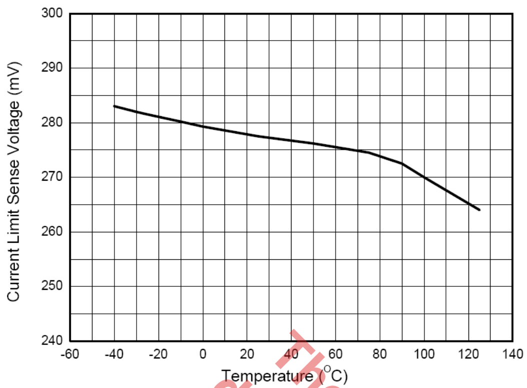
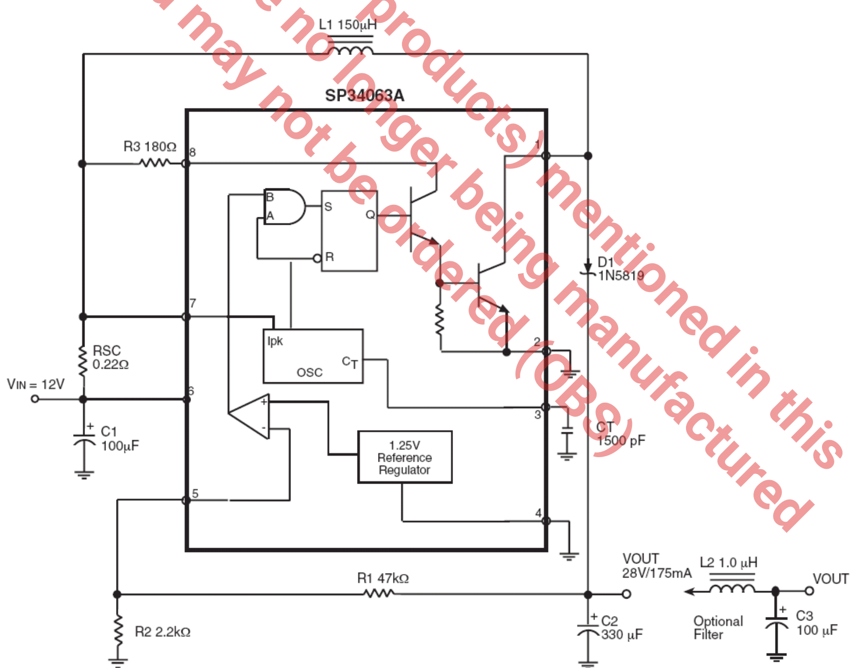


Fig. 10: Current Limit Sense Voltage vs. Temperature

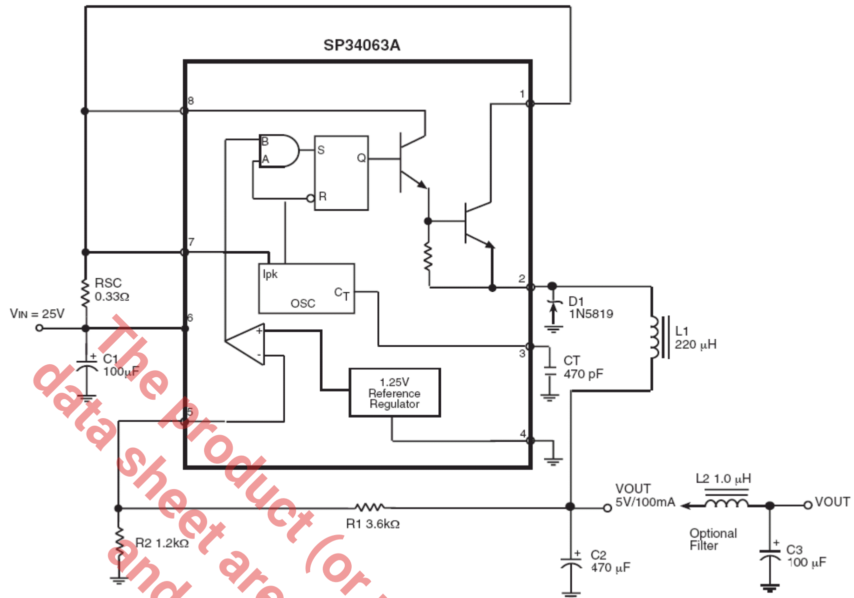
APPLICATION INFORMATION

TYPICAL BOOST CONVERTER CIRCUIT



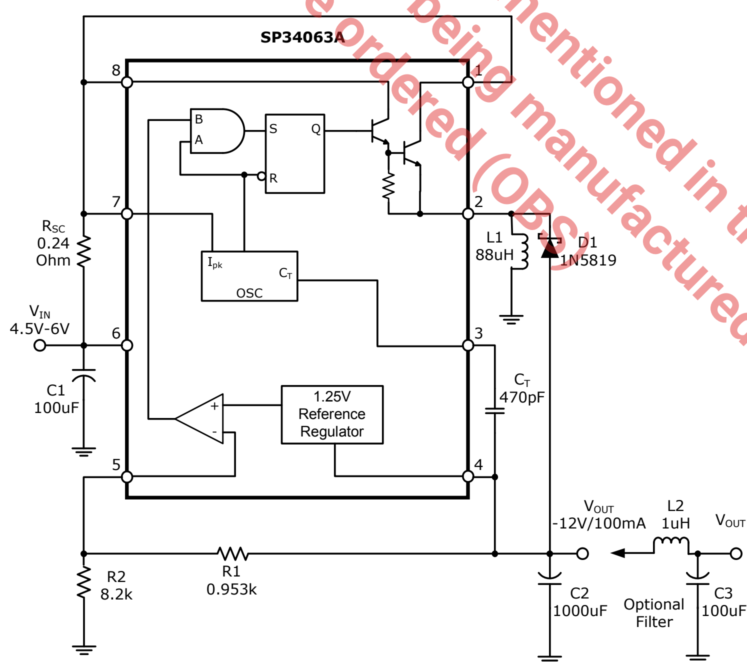
This is a typical boost converter configuration. In the steady state, if the resistor divider voltage at pin 5 is greater than the voltage in the non-inverting input, which is 1.25V determined by the internal reference, the output of the comparator will go low. At the next switching period, the output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

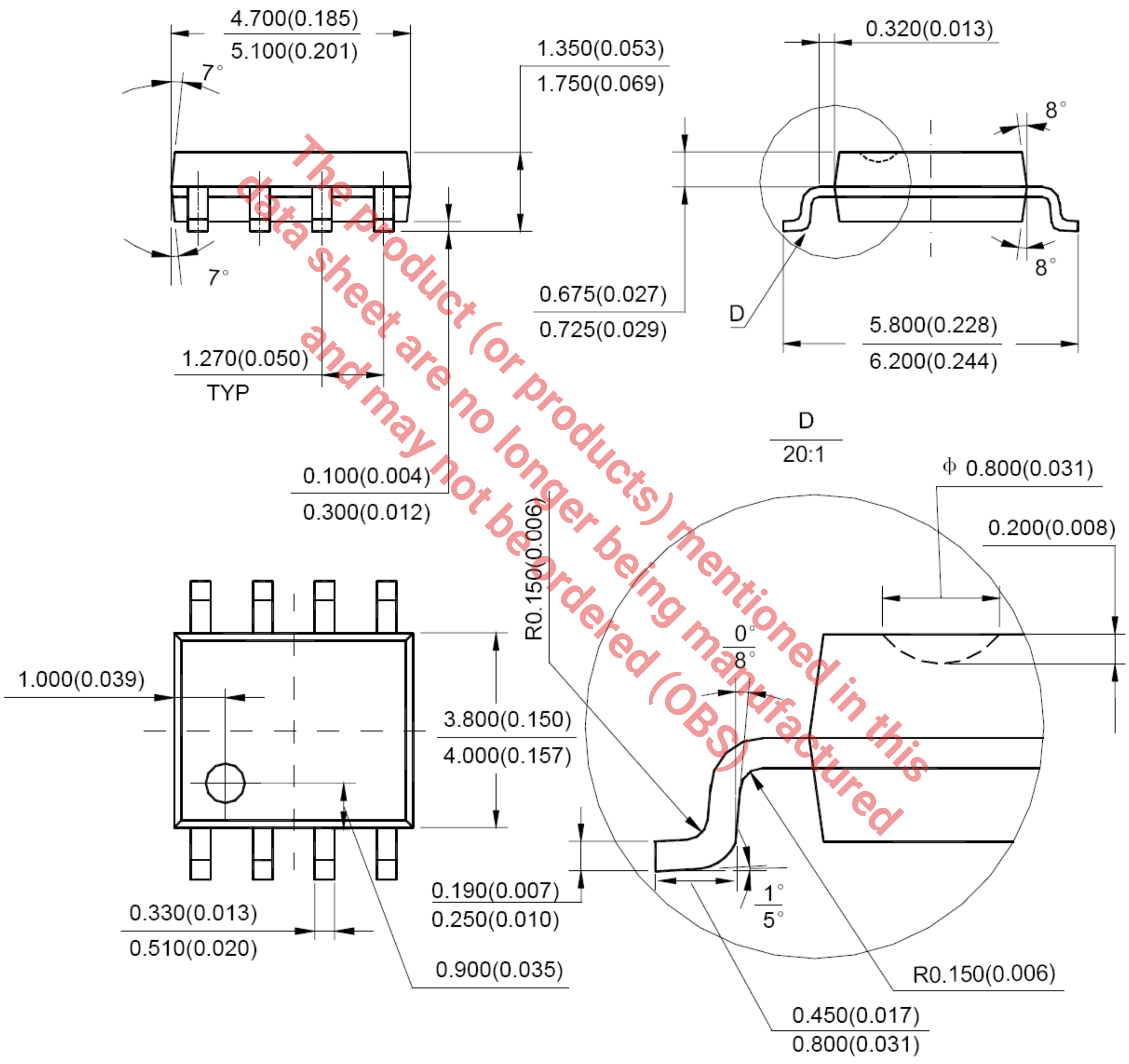


This is a typical boost converter configuration. The working process in the steady state is similar to a boost converter, the difference in this situation is that the voltage at the non-inverting pin of the comparator is equal to $1.25V + V_{OUT}$, then $V_{PIN5} = V_{OUT}*R2/(R1+R2) = 1.25V, + V_{OUT}$.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