Inverting Regulator – Buck, Boost, Switching

DESCRIPTION

TS34063 is a monolithic switching regulator and subsystem intended for use as DC-to-DC converter. It consist of an internal temperature compensated reference, comparator, controlled duty cycle oscillator with an active peak current limit circuit, driver and high current output switch. The TS34063 is specifically designed to be incorporated in Step-Up, Step-Down and Voltage-Inverting applications with minimum number of external components.

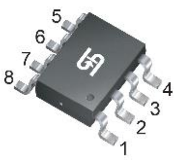
FEATURES

- Power forward control circuit
- Operating voltage from 3V to 40V
- Low standby current
- Current limit adjustable
- Output switch current up to 1.5A
- Variable oscillator frequency up to 100kHz (max.)
- Output voltage adjustable
- RoHS Compliant
- Halogen-free according to IEC 61249-2-21

APPLICATION

- Charger
- xD-ROM, xDSL products
- DC to DC converter

SOP-8

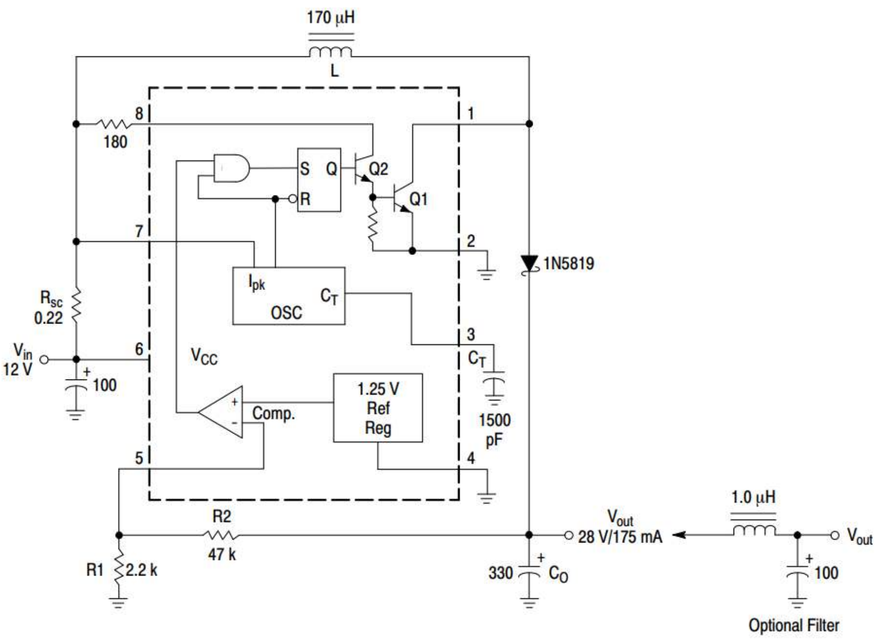


Pin Definition:

1. Switch Collector
2. Switch Emitter
3. Timing Capacitor
4. GND
5. Comparator Inverting Input
6. V_{CC}
7. Ipk
8. Driver Collector

Note: MSL 3 (Moisture Sensitivity Level) per J-STD-020

TYPICAL APPLICATION CIRCUIT



Step-Up Converter

ABSOLUTE MAXIMUM RATINGS (Note 1)			
PARAMETER	**SYMBOL**	**LIMIT**	**UNIT**
Supply Voltage	V_{CC}	40	V
Comparator Input Voltage Range	V_{FB}	-0.3 ~ 40	V
Switch Collector Output Voltage	$V_{C(SW)}$	40	V
Switch Emitter Voltage	$V_{E(SW)}$	40	mA
Switch Collector to Emitter Voltage	$V_{CE(SW)}$	40	mW
Driver Collector Voltage	$V_{C(DRIVER)}$	40	°C
Driver Collector Current (note 1)	$I_{C(DRIVER)}$	100	V
Output Switching Current	I_{SW}	1.5	A
Power Dissipation	P_D	0.5	W
Operating Ambient Temperature Range	T_{OPR}	-40 ~ +85	°C
Junction Temperature Range	T_J	0 ~ +125	°C
Storage Temperature Range	T_{STG}	-65 ~ +150	°C

ELECTRICAL SPECIFICATIONS (V_{CC} = 5V, T_A = 25°C unless otherwise noted)						
PARAMETER	**SYMBOL**	**CONDITIONS**	**MIN**	**TYP**	**MAX**	**UNIT**
Oscillator						
Frequency	F_{OSC}	C_T = 1nF, Vpin5= 0V	24	33	42	kHz
Charge Current	I_{CHARGE}	V_{CC} = 5V ~ 40V	24	30	42	µA
Discharge Current	$I_{DISCHARGE}$	V_{CC} = 5V ~ 40V	140	200	260	µA
Discharge to Charge current ratio	$I_{DISCHARGE}$ / I_{CHARGE}	Pin7 to V_{CC}	5.2	6.5	7.5	--
Current Limit Sense Voltage	$V_{IPK(SENSE)}$	$I_{DISCHARGE}$ = I_{CHARGE}	250	--	350	mV
Output switch (note1)						
Saturation Voltage	$V_{CE(SAT)}$	I_{SW}= 1A, Pin1, 8 connected	--	1.0	1.3	V
Saturation Voltage	$V_{CE(SAT)}$	I_{SW}= 1A, I_D=50mA	--	0.45	0.7	V
DC current gain	H_{FE}	I_{SW} = 1A, V_{CE}= 0.5V	50	75	--	--
Collector off-state current	$I_{C(OFF)}$	V_{CE} = 40V	--	0.01	100	µA
Comparator						
Threshold Voltage	V_{REF}		1.225	1.25	1.275	V
Line regulation	REG_{LINE}	V_{CC} = 3V ~ 40V	--	--	6	mV
Total device						
Supply Current	I_{CC}	V_{CC} = 5V ~ 40V, C_T = 1nF, pin7= V_{CC}, pin5> V_{TH}, pin2=Gnd, remaining pins open	--	3	5	mA

Note:

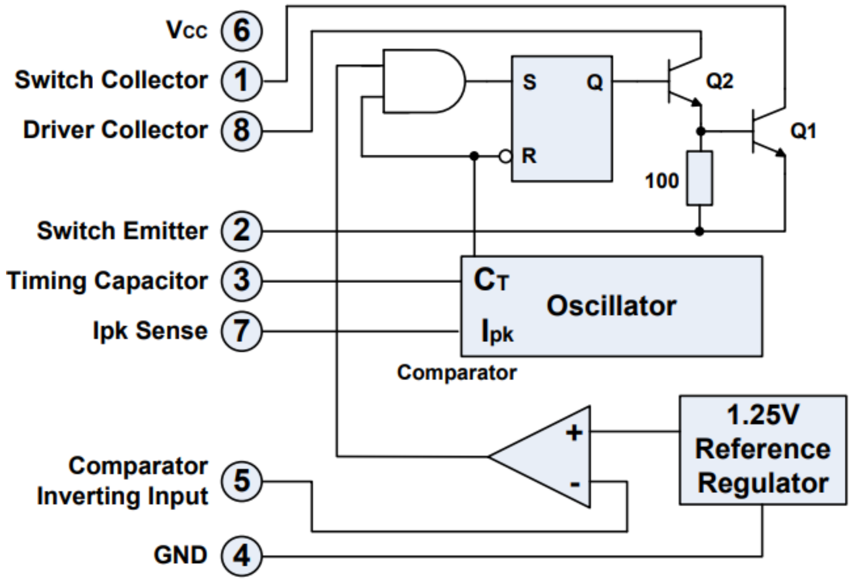
1. Low duty cycle pulse techniques are used during test to maintain junction temperature as close to ambient temperature as possible.
2. If the output switch is driven into hard saturation (non-Darlington configuration) at low switch currents (≤300mA) and high driver currents (≥30mA), it may take up to 2µs for it 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: Forced Bata of output switch: I_C output / (I_C driver – 7mA*) ≥ 10

* The 100ohm resistor in the emitter of the driver divide requires about 7mA before the output switch conducts.

ORDERING INFORMATION

ORDERING CODE	PACKAGE	PACKING
TS34063CS RLG	SOP-8	2,500pcs / 13” Reel

BLOCK DIAGRAM



ELECTRICAL CHARACTERISTICS CURVE

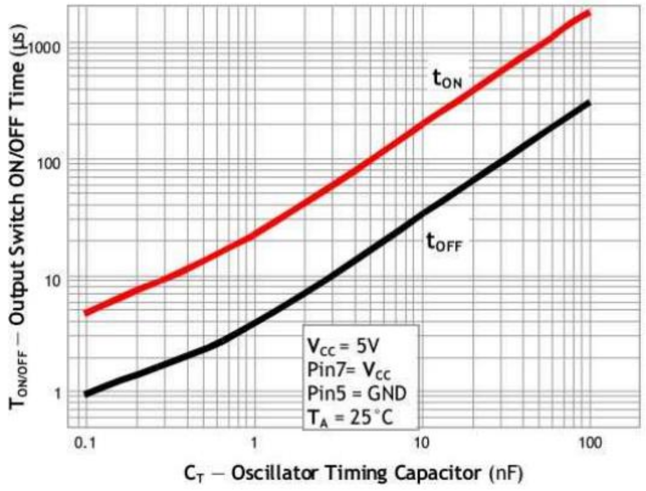


Fig 1. Output Switch On-Off Time vs. Oscillator Timing Capacitor

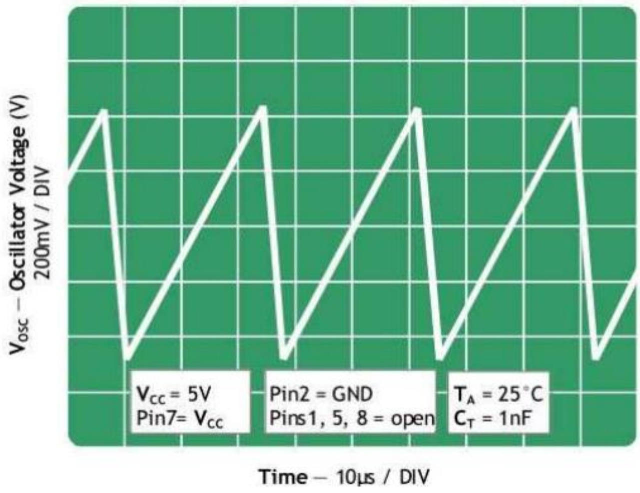


Fig 2. Timing Capacitor Wave Form

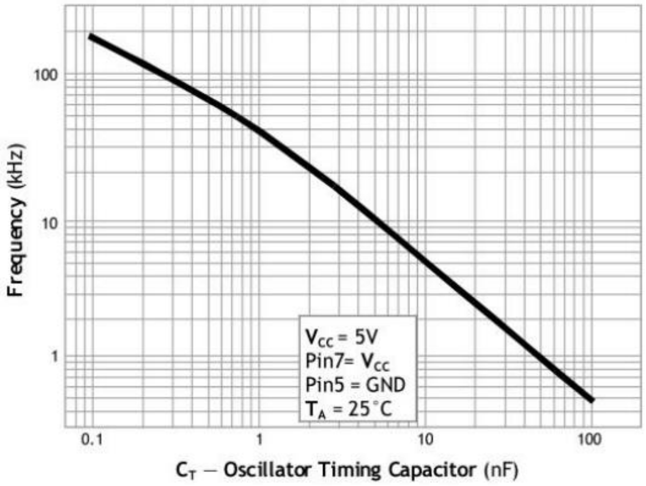


Fig 3. Oscillator Frequency vs. Timing Capacitor

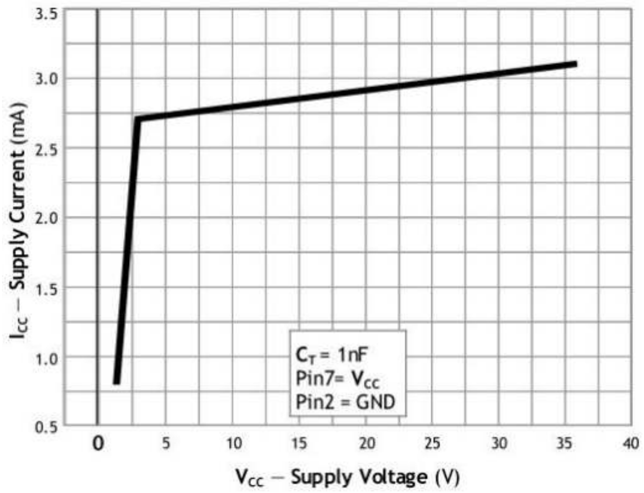


Fig 4. Standby Supply Current vs. Supply Voltage

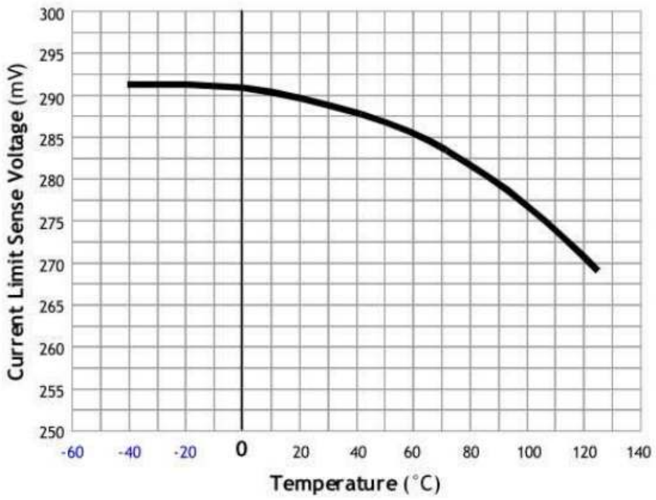
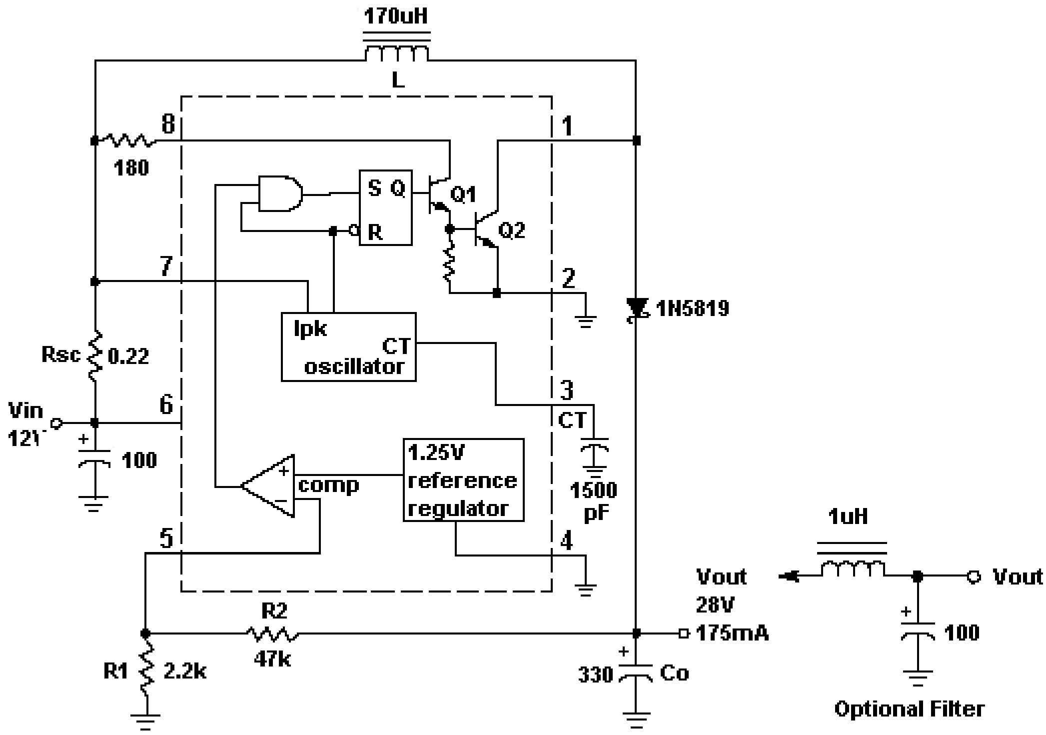


Fig 5. Current Limit Sense Voltage vs. Temperature

TYPICAL APPLICATION CIRCUIT



Test	Conditions	Results
Line Regulation	V_{IN}= 8V~16V, Io= 175mA	30mV = ± 0.05%
Load Regulation	V_{IN} = 12V, Io= 75mA to 175mA	10mV = ± 0.017%
Output Ripple	V_{IN} =12V, Io= 175mA	400mVpp
Efficiency	V_{IN} =12V, Io= 175mA	87.7%
Output Ripple with Optional Filter	V_{IN} =12V, Io= 175mA	40mVpp

Fig 6. Step-Up Converter

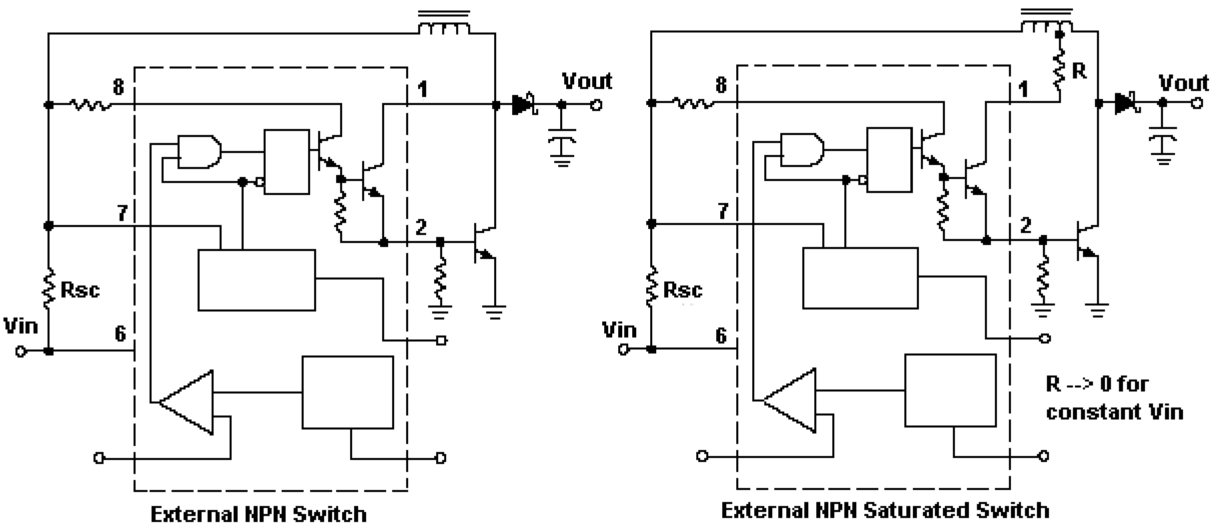
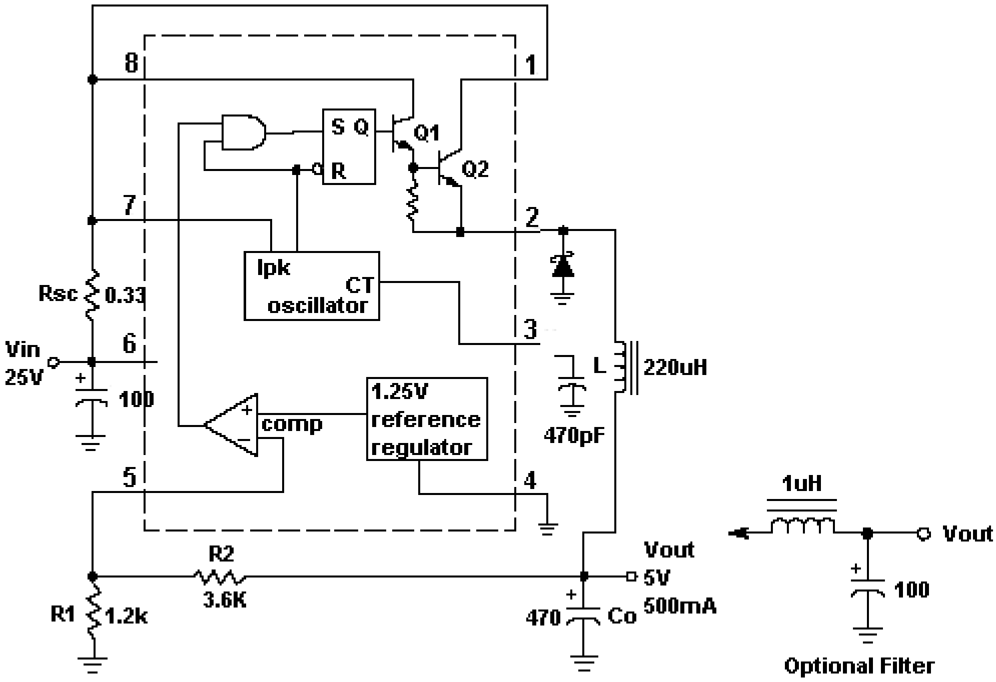


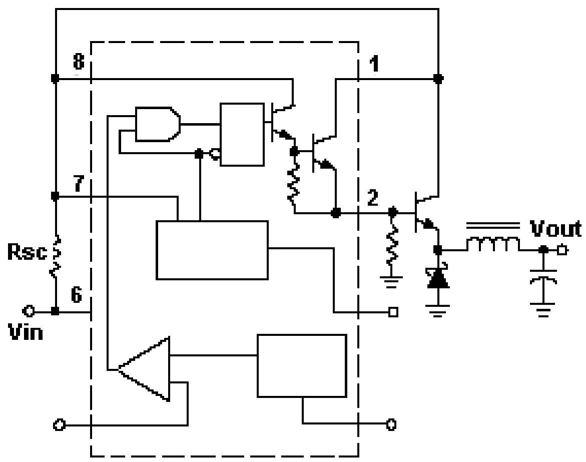
Fig. 7. External current Boost connections for IC peak greater than 1.5A

TYPICAL APPLICATION CIRCUIT (CONTINUE)

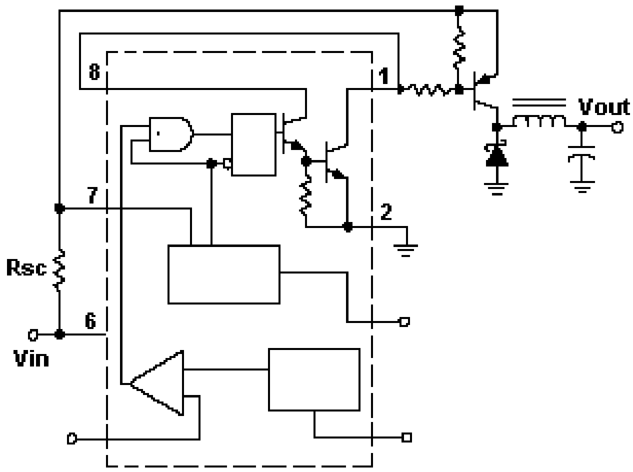


Test	Conditions	Results
Line Regulation	V_{IN}= 15V~25V, Io= 500mA	12mV = ±12%
Load Regulation	V_{IN} = 25V, Io= 50mA to 500mA	3mV = ±0.03%
Output Ripple	V_{IN} =25V, Io= 500mA	120mVpp
Short Circuit Current	V_{IN} =25V, R_L= 0.1mΩ	1.1A
Efficiency	V_{IN} =25V, Io= 500mA	83.7%
Output Ripple with Optional Filter	V_{IN} =25V, Io= 500mA	40mVpp

Fig 8. Step-Down Converter



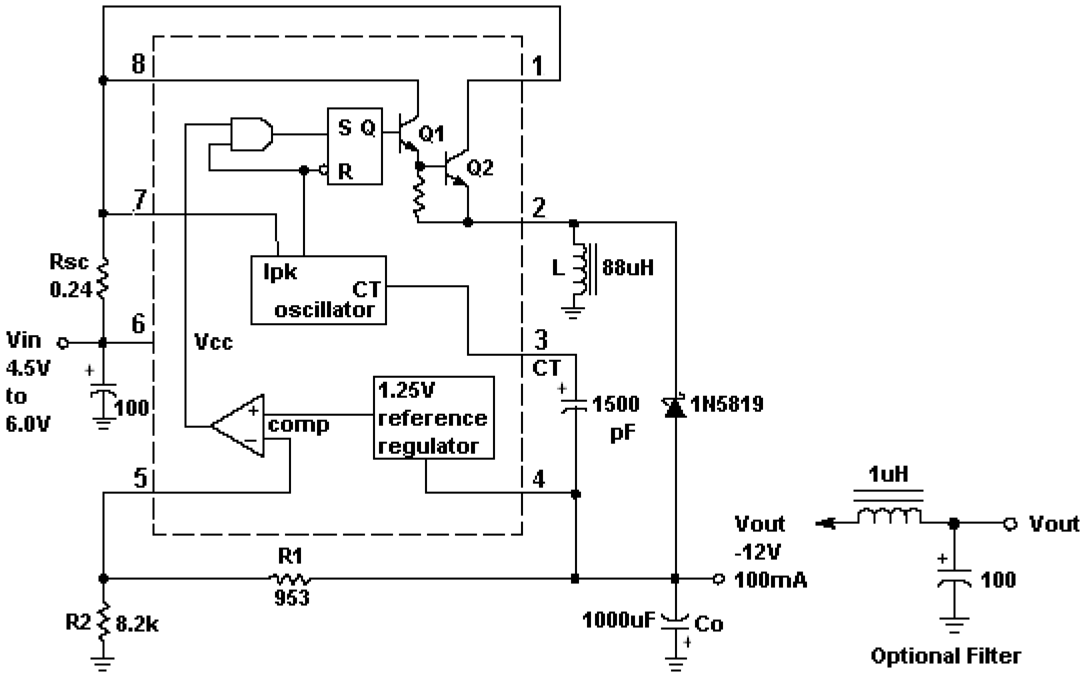
External NPN switch



External PNP Saturated Switch

Fig. 9. External current Boost connections for IC peak greater than 1.5A

TYPICAL APPLICATION CIRCUIT (CONTINUE)



Test	Conditions	Results
Line Regulation	V_{IN}= 4.5V~6V, Io= 100mA	3mV = ±120.012%
Load Regulation	V_{IN} = 5V, Io= 10mA to 100mA	0.022V = ±0.09%
Output Ripple	V_{IN} =5V, Io= 100mA	500mVpp
Short Circuit Current	V_{IN} =5V, R_L= 0.1Ω	910mA
Efficiency	V_{IN} =5V, Io= 100mA	62.2%
Output Ripple with Optional Filter	V_{IN} =5V, Io= 100mA	70mVpp

Fig 10. Voltage Inverting Converter

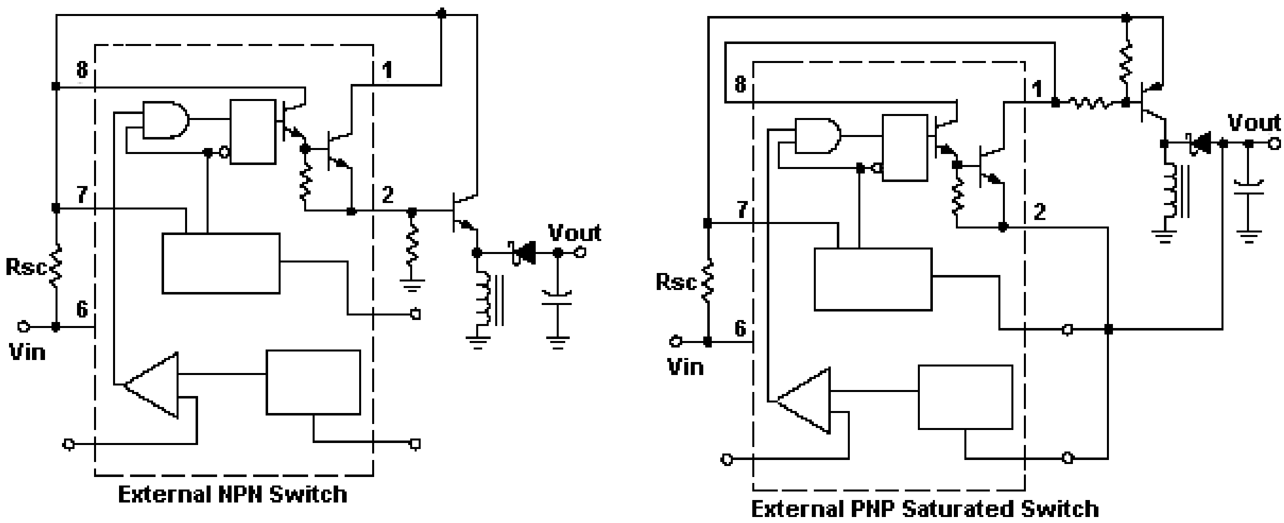


Fig. 11. External current Boost connections for IC peak greater than 1.5A

DESIGN FORMULA TABLE

Test	Step-Up	Step-Down	Voltage Inverting
t_{on}/t_{off}	$\frac{Vout+Vf-Vin(\min)}{Vcc(\min)-Vsat}$	$\frac{Vout+Vf}{Vcc-Vsat-Vout}$	$\frac{\lvert Vout\rvert+Vf}{Vcc-Vsat}$
$(t_{on}+t_{off})$	$\frac{1}{f\min}$	$\frac{1}{f\min}$	$\frac{1}{f\min}$
C_T	$4.0 \times 10^{-5}\ ton$	$4.0 \times 10^{-5}\ ton$	$4.0 \times 10^{-5}\ ton$
$I_{pk(switch)}$	$2Iout(max)\left(\frac{ton}{toff}+1\right)$	$2Iout(max)$	$2Iout(max)\left(\frac{ton}{toff}+1\right)$
R_{sc}	$\left(\frac{0.3}{Ipk(switch)}\right)$	$\left(\frac{0.3}{Ipk(switch)}\right)$	$\left(\frac{0.3}{Ipk(switch)}\right)$
$L_{(min)}$	$\left(\frac{Vin(\min)-Vsat}{Ipk(switch)}\right)*ton(\max)$	$\left(\frac{Vin(\min)-Vsat-Vout}{Ipk(switch)}\right)*ton(\max)$	$\left(\frac{Vin(\min)-Vsat}{Ipk(switch)}\right)*ton(\max)$
C_o	$\left(9\frac{Iout*ton}{Vripple(pp)}\right)$	$\left(\frac{Ipk(switch)(ton+toff)}{8Vripple(pp)}\right)$	$\left(9\frac{Iout*ton}{Vripple(pp)}\right)$

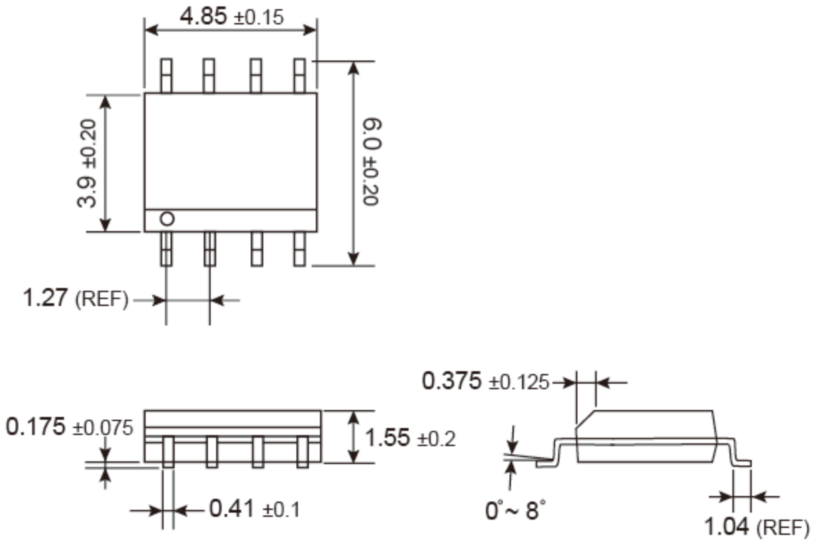
- V_{sat} = Saturation Voltage of the output switch.
- V_F = Forward Voltage drop of the rectifier.

The following power supply characteristics must be chosen:

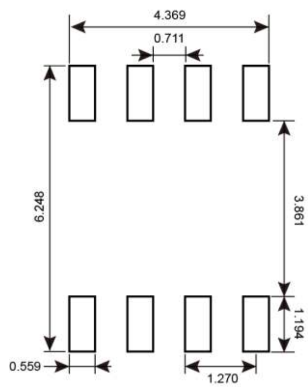
- V_{in}= Normal input voltage
- V_{out}: Desired Output voltage, $|V_{OUT}|$ =1.25 (1+R2 / R1)
- I_{out}: Desired output current.
- f_{min} : Minimum desired output switching frequency at the selected values for Vin and Io.
- $V_{ripple(p-p)}$: Desired peak-to-peak output ripple voltage. in practice, the calculated capacitor value will need to be increased due to its equivalent series resistance and board layout. The ripple voltage should be kept to a low value since it will directly affect the line and load regulation.

PACKAGE OUTLINE DIMENSIONS (Unit: Millimeters)

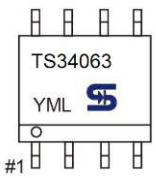
SOP-8



SUGGESTED PAD LAYOUT (Unit: Millimeters)



MARKING DIAGRAM



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M = Month Code for Halogen Free Product

O =Jan	**P** =Feb	**Q** =Mar	**R** =Apr
S =May	**T** =Jun	**U** =Jul	**V** =Aug
W =Sep	**X** =Oct	**Y** =Nov	**Z** =Dec

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