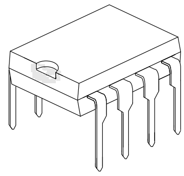
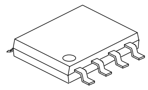
DC TO DC CONVERTER CONTROLLER



DIP-8



SOP-8

■ DESCRIPTION

The UTC **UC33063A** is a monolithic regulator subsystem, intended for use as DC to DC converter. This device contains a temperature compensated band gap reference, a duty-cycle control oscillator, driver and high current output switch. It can be used for step down, step-up or inverting switching regulators as well as for series pass regulators.

■ FEATURES

* Operation from 3.0V to 40V.
* Short Circuit Current Limiting.
* Low Standby Current.
* Output Switch Current of 1.5A without External Transistors.
* Frequency of Operation from 100Hz to 100kHz.
* Step-up, Step-down or Inverting Switch Regulators.

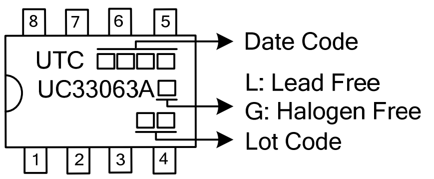
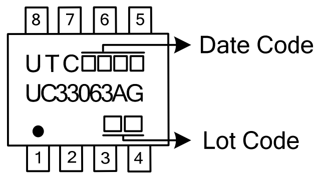
■ ORDERING INFORMATION

Ordering Number		Package	Packing
Lead Free	Halogen Free		
UC33063AL-D08-T	UC33063AG-D08-T	DIP-8	Tube
-	UC33063AG-S08-R	SOP-8	Tape Reel

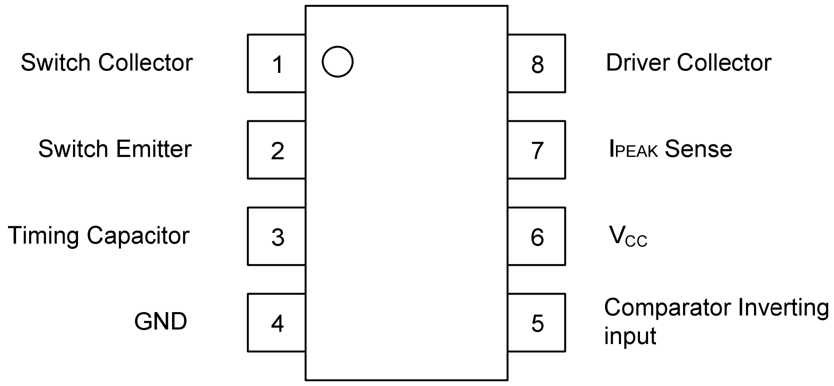
UC33063AL-D08-T
(1)Packing Type
(2)Package Type
(3)Green Package

(1) T: Tube, R: Tape Reel
(2) D08: DIP-8, S08: SOP-8
(3) L: Lead Free, G: Halogen Free and Lead Free

■ MARKING

DIP-8	SOP-8
	

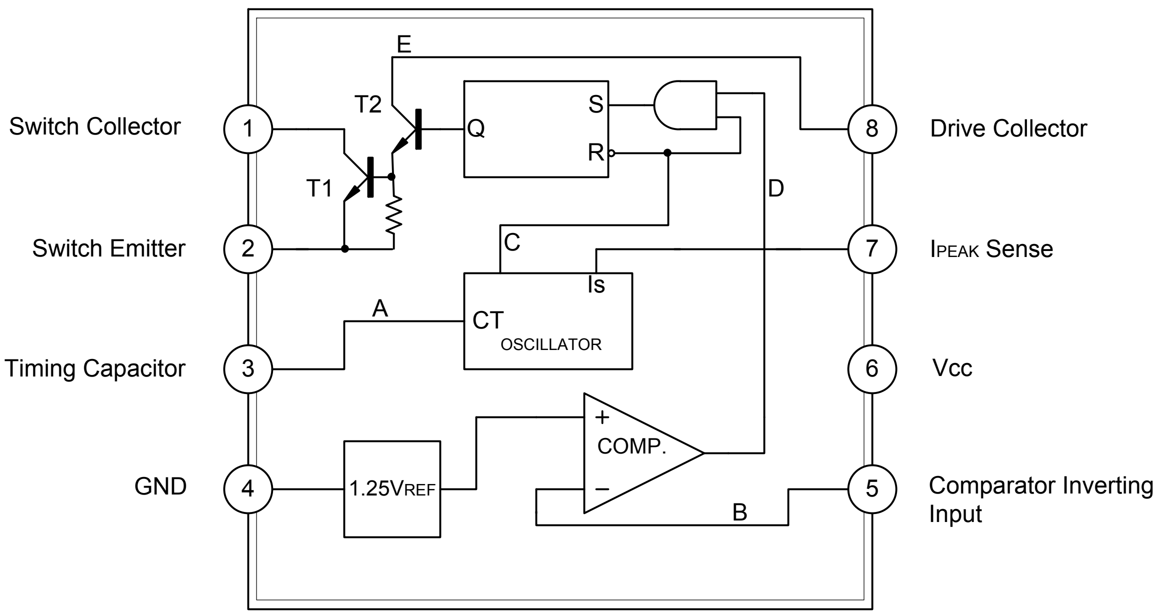
■ PIN CONFIGURATION



■ PIN DESCRIPTION

PIN NO	PIN NAME	I/O	DESCRIPTION
1	Switch Collector	I	Internal Darlington pairs TI collector
2	Switch Emitter	O	Internal Darlington pairs TI emitter
3	Timing Capacitor		The value of selected capacitor controls the internal oscillator run rate
4	GND		
5	Comparator Inverting Input	I	Inverting input of comparator which can set & initiate the Darlington pairs output switch
6	V_{CC}		
7	I_{PEAK} Sense	I	Current sense input to monitor the voltage drop across an external resistor placed in series with V_{CC}
8	Driver Collector	I	Internal Darlington pairs TI collector

■ BLOCK DIAGRAM



■ ABSOLUTE MAXIMUM RATINGS (T_A=25°C, unless otherwise specified)

PARAMETER		SYMBOL	RATINGS	UNIT
Supply Voltage		V_{CC}	40	V
Comparator Input Voltage Range		$V_{IN(COMP)}$	-0.3 ~ +40	V
Switch Collector Voltage		$V_{C(SW)}$	40	V
Switch Emitter Voltage		$V_{E(SW)}$	40	V
Switch Collector to Emitter Voltage		$V_{CE(SW)}$	40	V
Driver Collector Voltage		$V_{C(DR)}$	40	V
Switch Current		I_{SW}	1.5	A
Power Dissipation (Ta=25°C)	DIP-8	P_D	1250	mW
	SOP-8		800	
Junction Temperature		T_J	+150	°C
Operating Temperature		T_{OPR}	-40~ +90	°C
Storage Temperature		T_{STG}	-65 ~ +150	°C

Note: Absolute maximum ratings are those values beyond which the device could be permanently damaged. Absolute maximum ratings are stress ratings only and functional device operation is not implied.

■ THERMAL DATA

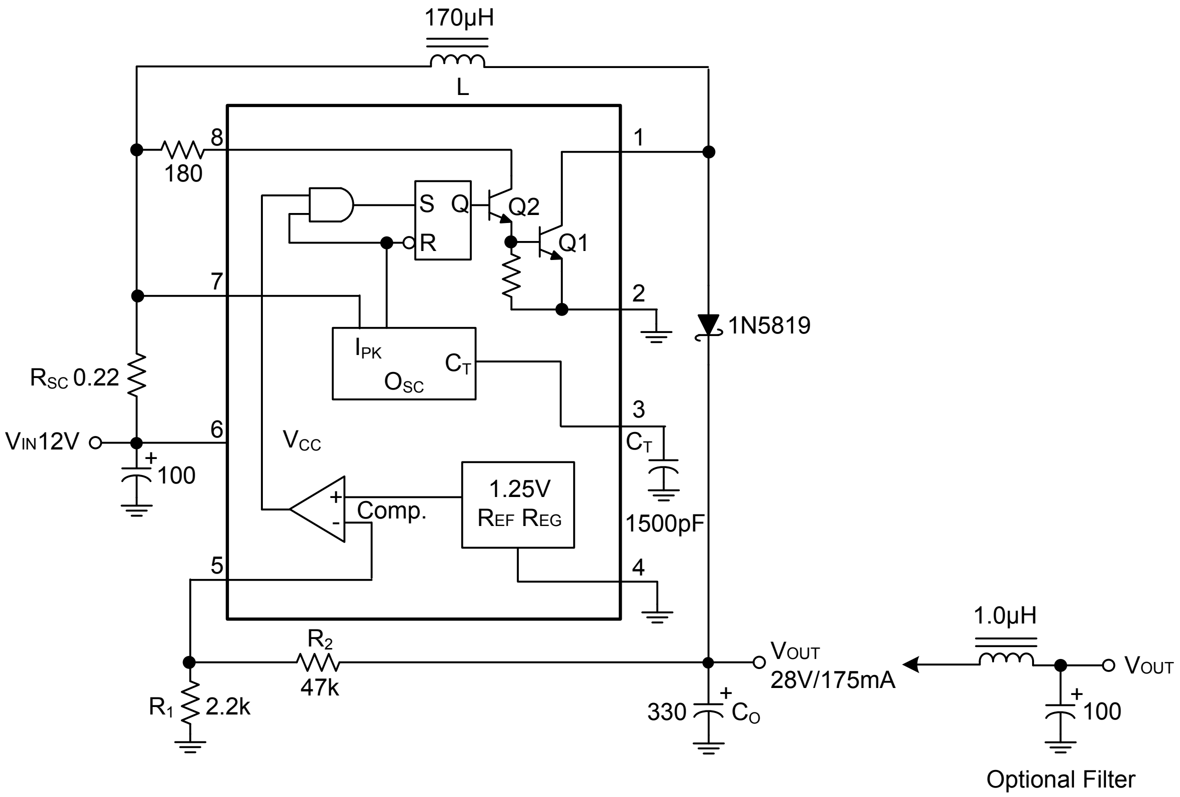
PARAMETER		SYMBOL	RATINGS	UNIT
Junction to Ambient	DIP-8	θ_{JA}	100	°C/W
	SOP-8		150	

■ ELECTRICAL CHARACTERISTICS (V_{CC}=5.0V, T_A=-40~+90°C, unless otherwise specified)

PARAMETER	SYMBOL	TEST CONDITIONS	MIN	TYP	MAX	UNIT
Oscillator						
Charging Current	I_{CHG}	V_{CC}=5 to 40V, Ta=25°C	22	31	42	μA
Discharging Current	I_{DISCHG}	V_{CC}=5 to 40V, Ta=25°C	140	190	260	μA
Oscillator Amplitude	V_{OSC}	Ta=25°C		0.5		V
Discharge to Charge Current Ratio	K	V_7=V_{CC}, Ta=25°C	5.2	6.1	7.5	
Current limit Sense Voltage	V_{SENSE}	I_{CHG}=I_{DISCHG}, Ta=25°C	250	300	350	mV
Output Switch						
Saturation Voltage 1(Note)	$V_{CE(SAT)1}$	I_{SW}=1.0A, $V_{C(DRIVER)}$=$V_{C(SW)}$		0.95	1.3	V
Saturation Voltage 2(Note)	$V_{CE(SAT)2}$	I_{SW}=1.0A, $V_{C(DRIVER)}$=50mA		0.45	0.7	V
DC Current Gain(Note)	$G_{I\ (DC)}$	I_{SW}=1.0A, V_{CE}=5.0V, Ta=25°C	50	180		
Collector Off State Current(Note)	$I_{C(OFF)}$	V_{CE}=40.0V, Ta=25°C		0.01	100	μA
Comparator						
Threshold Voltage	V_{THD}		1.21	1.24	1.29	V
Threshold Voltage Line Regulation	V_{THD}	V_{CC}=3 ~ 40V		2.0	5.0	mV
Input Bias Current	$I_{I(BIAS)}$	V_{IN}=0V		50	400	nA
Total Device						
Supply Current	I_{CC}	V_{CC}=5~40V, C_T=0.001 V_7=V_{CC}, V_C>V_{THD}, Pin2=GND		2.7	4.0	mA

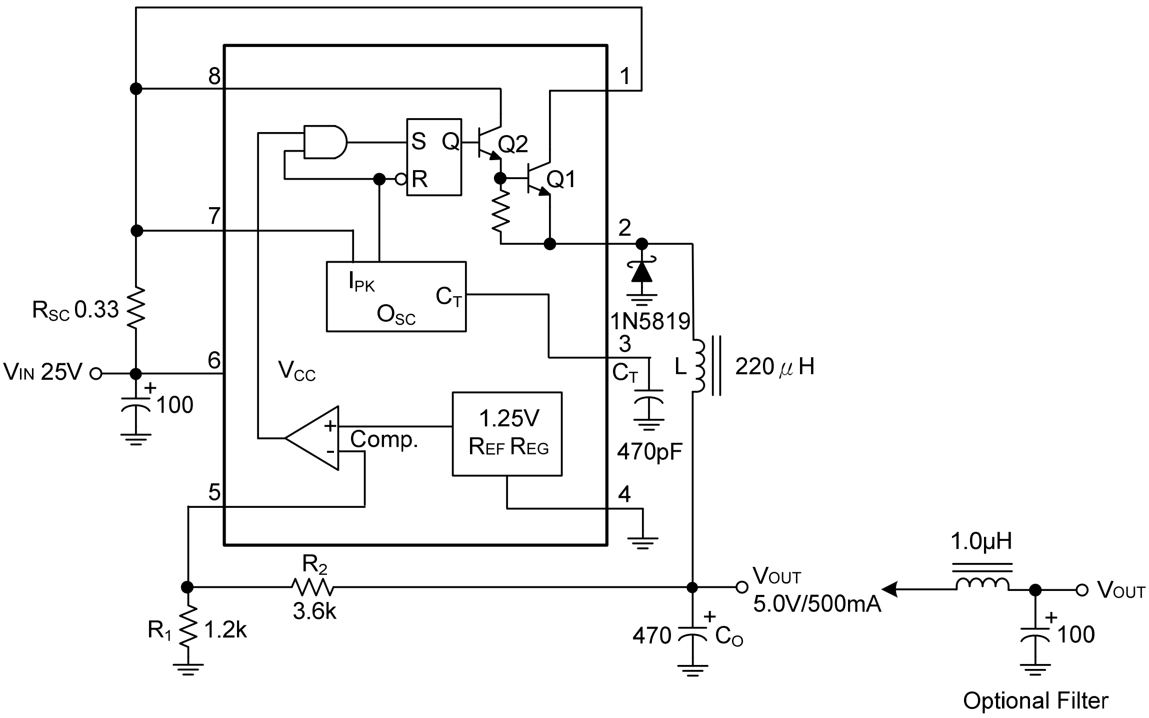
Note: Output switch tests are performed under pulsed conditions to minimize power dissipation.

■ STEP-UP CONVERTER



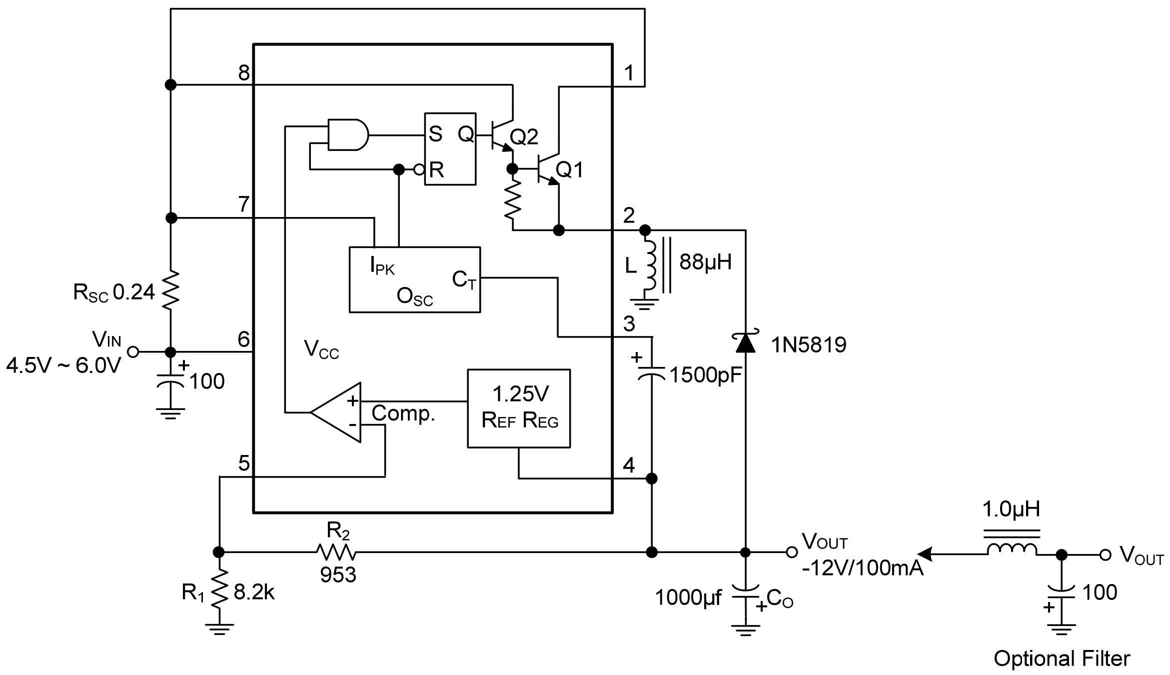
Test	Conditions	Results
Line Regulation	V_{IN} = 8.0V ~ 16V, I_{OUT} = 175mA	30mV = ±0.05%
Load Regulation	V_{IN} = 12V, I_{OUT} = 75mA ~ 175mA	10mV = ±0.017%
Output Ripple	V_{IN} = 12V, I_{OUT} = 175mA	400mVp-p
Efficiency	V_{IN} = 12V, I_{OUT} = 175mA	87.7%
Output Ripple With Optional Filter	V_{IN} = 12V, I_{OUT} = 175mA	40mVp-p

■ STEP-DOWN CONVERTER(Cont.)



Test	Conditions	Results
Line Regulation	V_{IN} = 15V ~ 25V, I_{OUT} = 500mA	12mV = ±0.12%
Load Regulation	V_{IN} = 25V, I_{OUT} = 50mA ~ 500mA	3.0mV = ±0.03%
Output Ripple	V_{IN} = 25V, I_{OUT} = 500mA	120mVp-p
Short Circuit Current	V_{IN} = 25V, R_L = 0.1Ω	1.1A
Efficiency	V_{IN} = 25V, I_{OUT} = 500mA	83.7%
Output Ripple With Optional Filter	V_{IN} = 25V, I_{OUT} = 500mA	40mVp-p

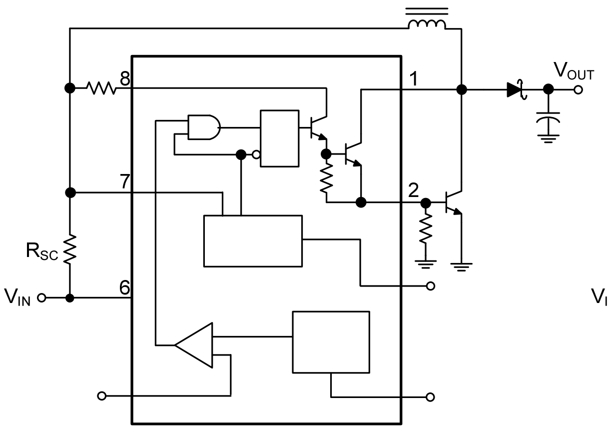
■ VOLTAGE INVERTING CONVERTER



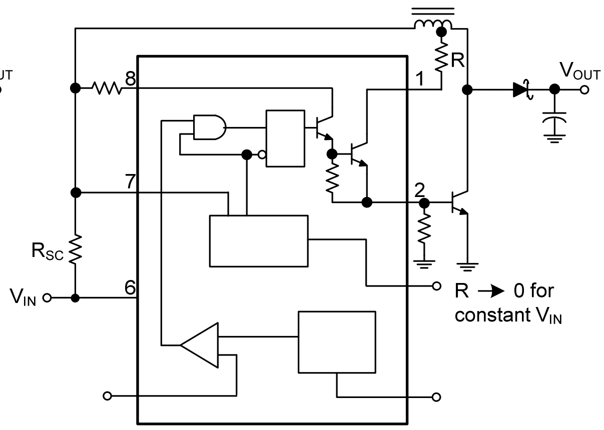
Test	Conditions	Results
Line Regulation	V_{IN} = 4.5V ~ 6.0V, I_{OUT} = 100mA	3.0mV = ±0.012%
Load Regulation	V_{IN} = 5.0V, I_{OUT} = 10mA ~ 100mA	0.022V = ±0.09%
Output Ripple	V_{IN} = 5.0V, I_{OUT} = 100mA	500mVp-p
Short Circuit Current	V_{IN} = 5.0V, R_L = 0.1Ω	910mA
Efficiency	V_{IN} = 5.0V, I_{OUT} = 100mA	62.2%
Output Ripple With Optional Filter	V_{IN} = 5.0V, I_{OUT} = 100mA	70mVp-p

■ EXTERNAL CURRENT BOOST CONNECTIONS FOR IC PEAK GREATER THAN 1.5A

1a. External NPN Switch

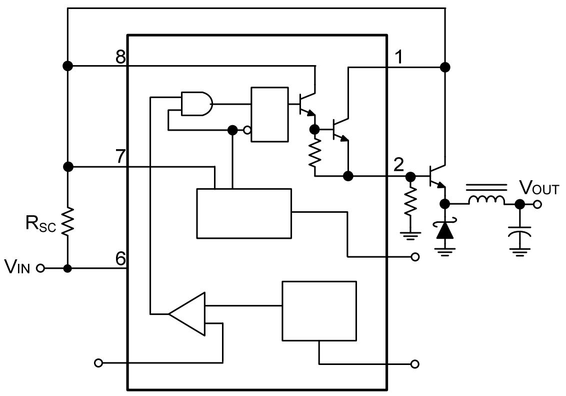


1b. External NPN Saturated Switch
(See Note 4)

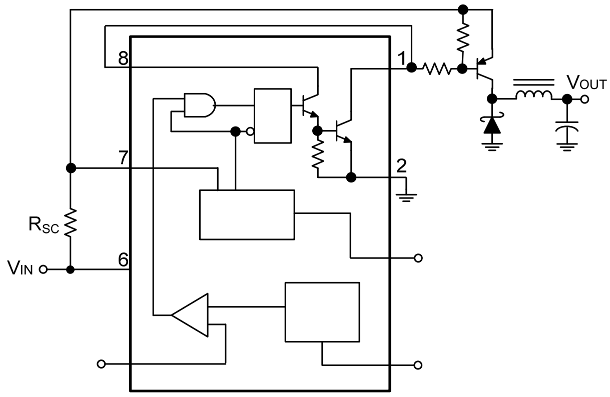


Note: 4. If the output switch is driven into hard saturation (non-Dartington configuration) at low switch currents (≤300mA) and high driver currents (≤30mA), it may take up to 2.0μs to come out of saturation. This condition will shorten the off time at frequencies ≥ 30kHz, and is magnified at high temperatures. 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.

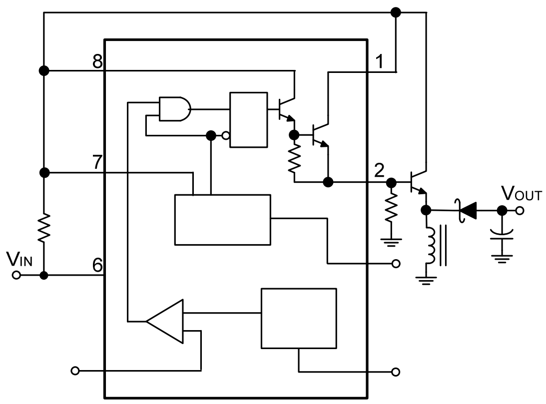
2a. External NPN Switch



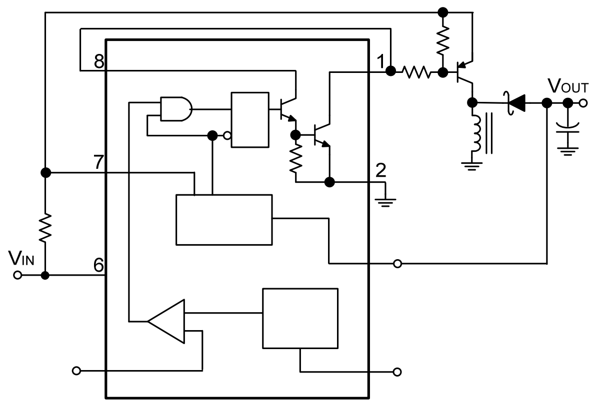
2b. External PNP Saturated Switch



3a. External NPN Switch

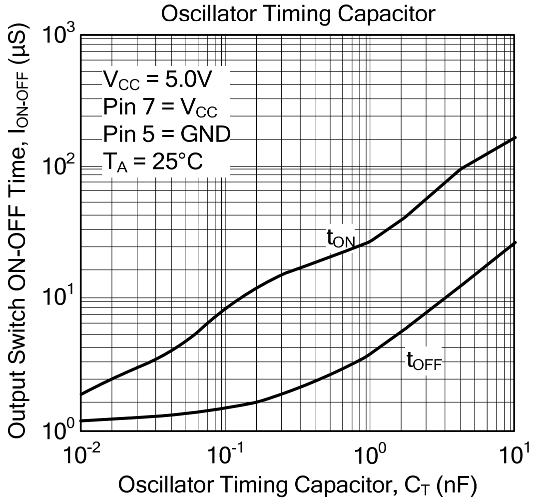


3b. External PNP Saturated Switch

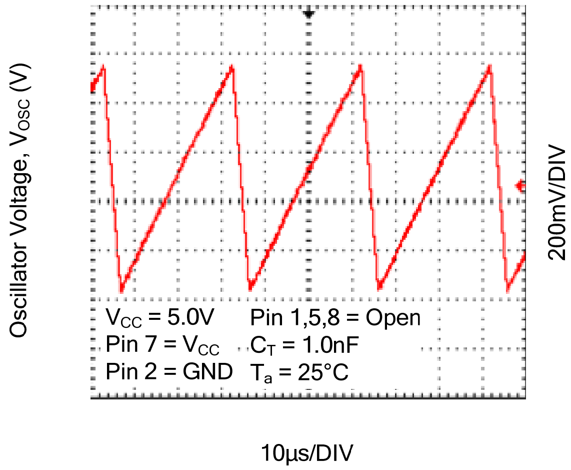


■ TYPICAL CHARACTERISTICS

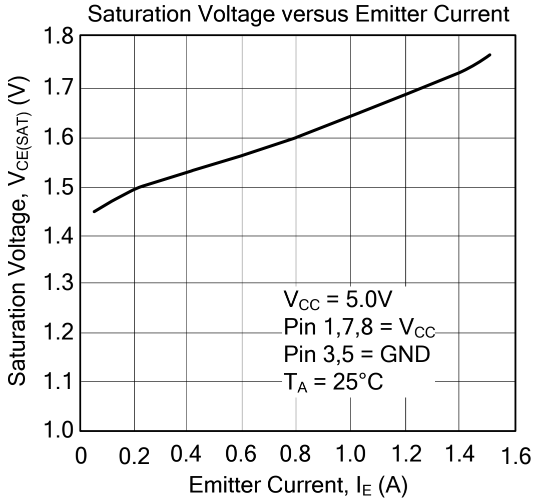
Output Switch ON-OFF Time versus Oscillator Timing Capacitor



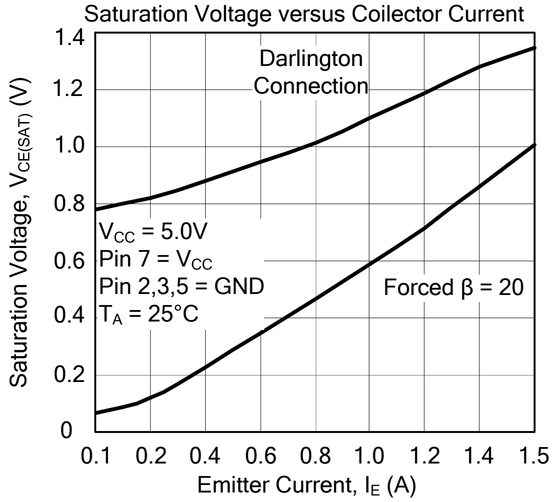
Timing Capacitor Waveform



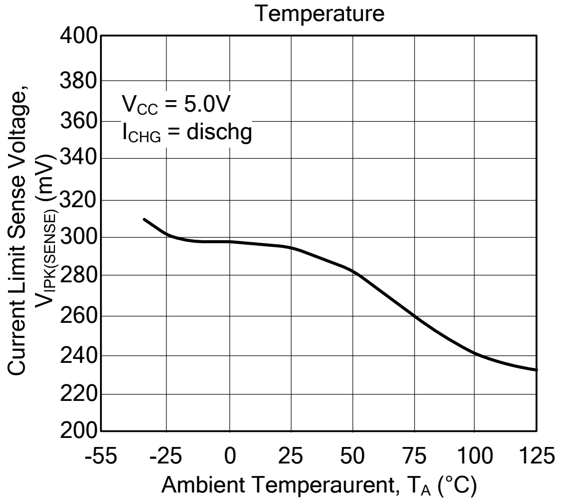
Emitter Follower Configuration Output Saturation Voltage versus Emitter Current



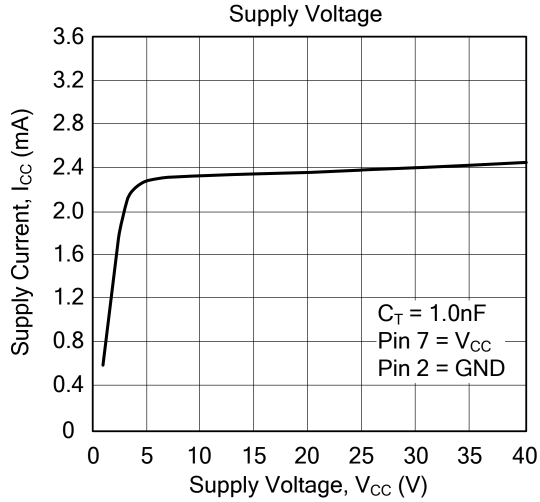
Common Emitter Configuration Output Switch Saturation Voltage versus Coilector Current



Current Limit Sense Voltage versus Temperature



Standby Supply Current versus Supply Voltage



DESIGN FORMULA TABLE

CALCULATION	STEP-DOWN	STEP-UP	VOLTAGE-INVERTING
$\frac{t_{ON}}{t_{OFF}}$	$\frac{V_{OUT}+V_F}{V_{IN(MIN)}-V_{CE(SAT)}-V_{OUT}}$	$\frac{V_{OUT}+V_F-V_{IN(MIN)}}{V_{IN(MIN)}-V_{CE(SAT)}}$	$\frac{\lvert V_{OUT}\rvert+V_F}{V_{IN}-V_{CE(SAT)}}$
$(t_{ON}+t_{OFF})_{MAX}$	$\frac{1}{F_{MIN}}$	$\frac{1}{F_{MIN}}$	$\frac{1}{F_{MIN}}$
C_T	$4x10^{-5}\,t_{ON}$	$4x10^{-5}\,t_{ON}$	$4x10^{-5}\,t_{ON}$
I_{SW}	$2I_{OUT(MAX)}$	$2I_{OUT(MAX)}\frac{t_{ON}+t_{OFF}}{t_{OFF}}$	$2I_{OUT(MAX)}\frac{t_{ON}+t_{OFF}}{t_{OFF}}$
R_S	$0.3/I_{SW}$	$0.3/I_{SW}$	$0.3/I_{SW}$
$L_{(MIN)}$	$\left(\frac{V_{IN(MIN)}-V_{CE(SAT)}-V_{OUT}}{I_{SW}}\right)t_{ON(MAX)}$	$\left(\frac{V_{IN(MIN)}-V_{CE(SAT)}}{I_{SW}}\right)t_{ON(MAX)}$	$\left(\frac{V_{IN(MIN)}-V_{CE(SAT)}}{I_{SW}}\right)t_{ON(MAX)}$
C_O	$\frac{I_{SW}(t_{ON}+t_{OFF})}{8V_{RIPPLE(P-P)}}$	$\frac{I_{OUT}\,t_{ON}}{V_{RIPPLE(P-P)}}$	$\frac{I_{OUT}\,t_{ON}}{V_{RIPPLE(P-P)}}$

$V_{CE(SAT)}$ - Saturation voltage of the output switch.

V_F - Forward voltage drop of the ringback 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(1+R_2/R_1)

I_{OUT} - Desired output current.

F_{MIN} - Minimum desired output switching frequency at the selected values for V_{IN} and I_{OUT}.

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