



Switching Regulator Power Controller

Features

- 2.2V~6V Supply Voltage Operating Range
- Low Current Consumption: 5mA in Operation, 1μA or Less in Stand-by
- 20kHz to 1MHz Operation Frequency Range
- Built-In Soft Start Circuit
- Built-In Timer-Latch Type Short Circuit Detection and Protection (SCP) Circuit
- Use External Resistor to Set a Fixed Output Current

Applications

- LCD Displays
- PDAs
- Digital Still Cameras

General Description

The G5180 is a single-channel PWM control IC for low voltage DC/DC conversion incorporating a soft start function and short circuit detection function. The device has a low minimum operating voltage of 2.2V and is ideal for the power supply of battery-operated electronic equipment.

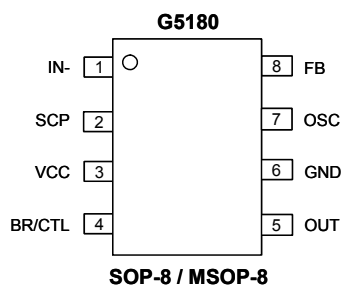
Ordering Information

ORDER NUMBER	MARKING	TEMP. RANGE	PACKAGE (Pb free)
G5180P1U	G5180	0°C to 85°C	SOP-8
G5180P8U	G5180	0°C to 85°C	MSOP-8

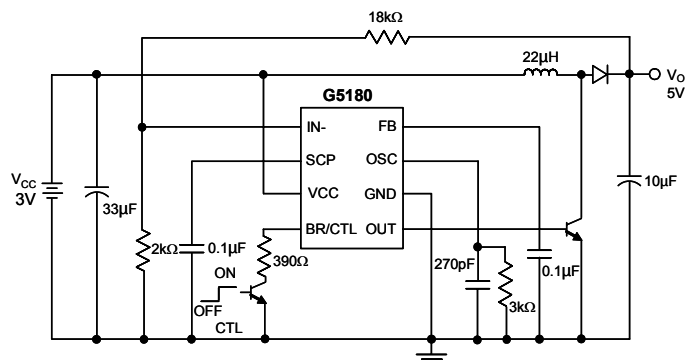
Note: P1: SOP-8; P8: MSOP-8

U: Tape & Reel

Pin Configuration



Typical Application Circuit



Absolute Maximum Ratings

Power Supply Voltage, V_{CC} 7V
 V_{CC} , IN- to GND. -0.3V to +7V
 SCP, BR/CTL, OUT, OSC, FB to GND
 -0.3V to ($V_{CC}+0.3V$)

Operating Temperature, T_{OP} 0°C to +85°C
 Storage Temperature Range, T_{STG} -65°C to +165°C
 Reflow Temperature (soldering, 10sec) 260°C

Electrical Characteristics

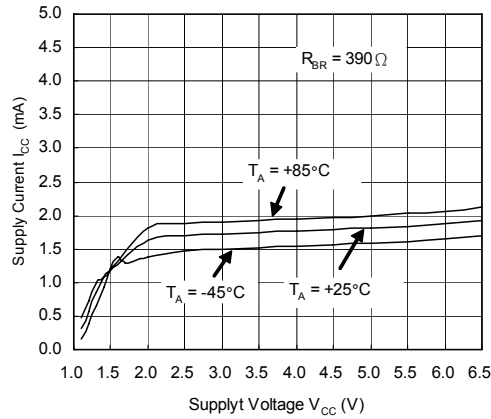
$V_{CC}=2.2V$, $T_A=25^{\circ}C$, unless otherwise noted.

PARAMETER		SYMBOL	CONDITION	MIN	TYP	MAX	UNIT
Under voltage lockout (UVLO)	Threshold voltage	V_{TH}		1.3	1.5	1.7	V
Soft start	Charging current	I_{CS}	$V_{SCP}=0V$	-1.5	-1	-0.7	μA
	Voltage at soft start completion	V_{ts}		0.7	0.8	0.9	V
Short circuit detection and protection (SCP)	Charging current	I_{CSCP}	$V_{SCP}=0V$	-1.5	-1	-0.7	μA
	Threshold voltage	V_{tSCP}		0.7	0.8	0.9	V
Sawtooth waveform oscillator (OSC)	Oscillation frequency	f_{OSC}	$R_T=3.0k\Omega$, $C_T=270pF$	---	500	---	kHz
	Frequency input Stability	$f_{\Delta V}$	$V_{CC}=2.2V$ to 6V	---	2	---	%
	Frequency variation with temperature	$f_{\Delta T}$	$T_A=0^{\circ}C$ to 85°C	---	5	---	%
Error amplifier	Input threshold voltage	V_T	$V_{FB}=450mV$	480	500	520	mV
	V_T input stability	$V_{T\Delta V}$	$V_{CC}=2.2$ to 6V	-10	5	10	mV
	V_T variation with temperature	$V_{T\Delta T}$	$T_A=0^{\circ}C$ to 85°C	---	1	---	%
	Input bias current	I_B	$V_{IN}=0V$	-1	0	1	μA
	Voltage gain	A_V		100	140	180	V/V
	Frequency bandwidth	BW	$A_v=0dB$	---	6	---	MHz
	Maximum output voltage range	V_{OMax}^{+}		0.78	2	---	V
		V_{OMax}^{-}		---	0.05	0.2	V
	Output source current	I_{OMax}^{+}	$V_{FB}=450mV$	---	-60	-24	μA
	Output sink current	I_{OMax}^{-}		24	700	---	μA
Idle period adjustment section	Maximum duty cycle	T_{DUTY}	$R_T=3.0k\Omega$, $C_T=270pF$, $V_{FB}=0.8V$	75	85	95	%
Output section	Output voltage	V_{OH1}	$R_B=390\Omega$, $I_O=-15mA$	1	1.2	---	V
		V_{OH2}	$R_B=750\Omega$, $V_{CC}=2.2V$, $I_O=-10mA$	0.8	1	---	V
		V_{OL1}	$R_B=390\Omega$, $I_O=15mA$	---	0.1	0.2	V
		V_{OL2}	$R_B=750\Omega$, $V_{CC}=2.2V$, $I_O=10mA$	---	0.1	0.2	V
	Output source current	I_O^{+}	$R_B=390\Omega$, $V_O=0.9V$	---	-30	-20	mA
	Output sink current	I_O^{-}	$R_B=390\Omega$, $V_O=0.3V$	30	60	---	mA
	Pull down resistance	R_O		20	30	50	$k\Omega$
Output current Setting /Control Section	Pin voltage	V_{BR}	$R_B=390\Omega$	0.2	0.3	0.4	V
	Input off condition	I_{OFF}		-3	---	0	μA
	Input on condition	I_{ON}		---	---	-40	μA
	Pin current range	I_{BR}		-1.8	---	-0.1	mA
Entire device	Stand-by current	I_{CCS}	BR/CTL pin open or V_{CC}	-1	---	1	μA
	Average supply current	I_{CC}	$R_B=390\Omega$	---	2	5	mA

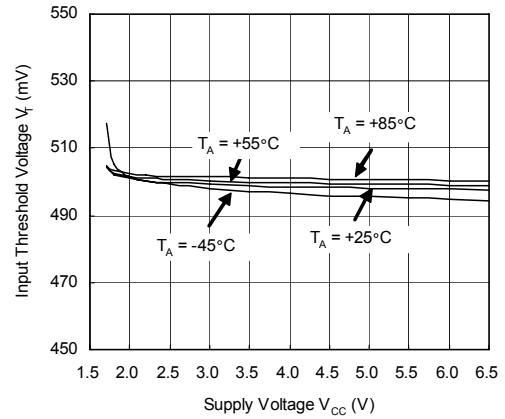
Typical Performance Characteristics

$V_{CC} = 2V$, $R_{BR} = 390\Omega$, $R_T = 3k\Omega$, $C_T = 270pF$, $T_A = 25^\circ C$, unless otherwise noted.

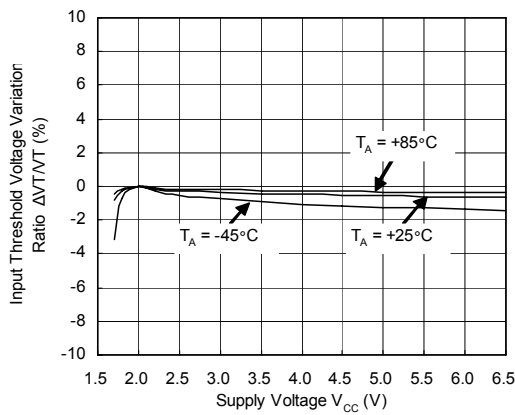
Supply Current I_{CC} vs.
Supply Voltage V_{CC}



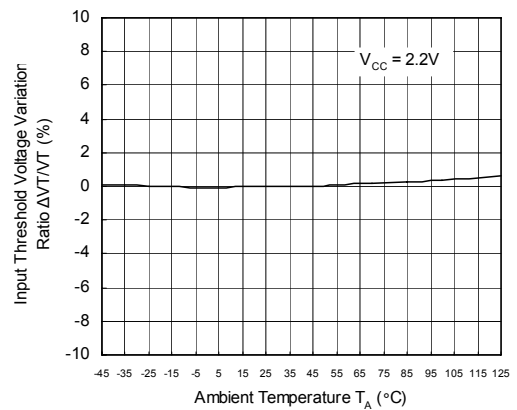
Input Threshold Voltage V_T vs.
Supply Voltage V_{CC}



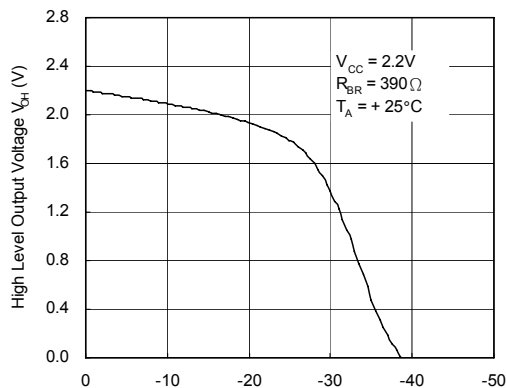
Input Threshold Voltage Variation Ratio
 $\Delta V_T/V_T$ vs. Supply Voltage V_{CC}



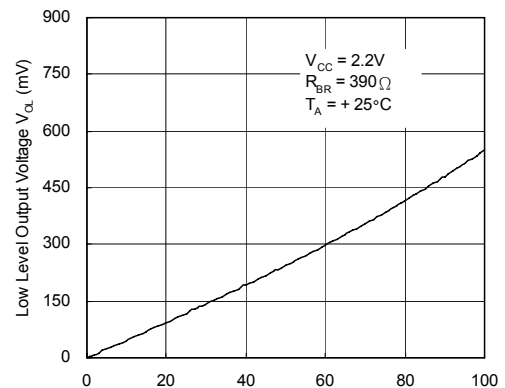
Input Threshold Voltage Variation Ratio
 $\Delta V_T/V_T$ vs. Ambient Temperature T_A



High Level Output Voltage V_{OH} vs.
Output Source Current I_O^+

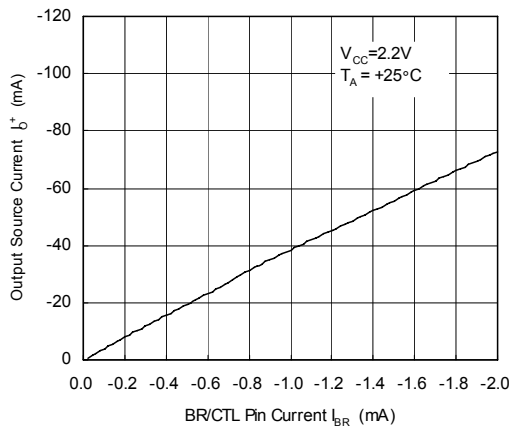


Low Level Output Voltage V_{OL} vs.
Output Sink Current I_O^-

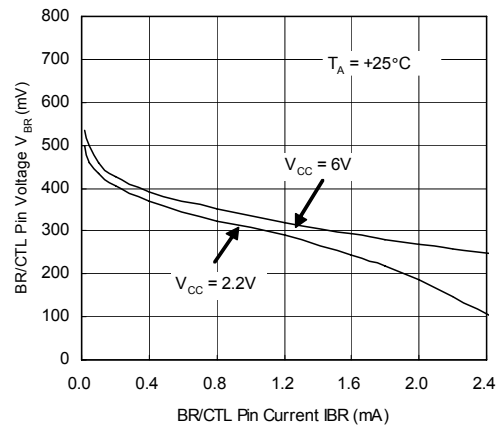


Typical Performance Characteristics (continued)

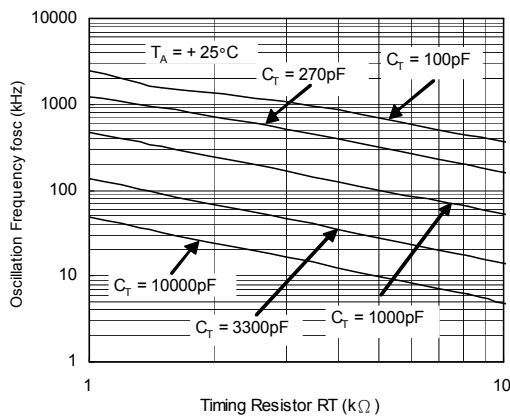
Output Source Current I_{O^+} vs.
BR/CTL Pin Current I_{BR}



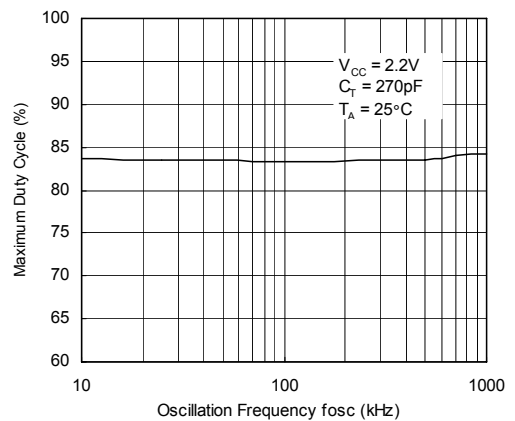
BR/CTL Pin Voltage V_{BR} vs.
BR/CTL Pin Current I_{BR}



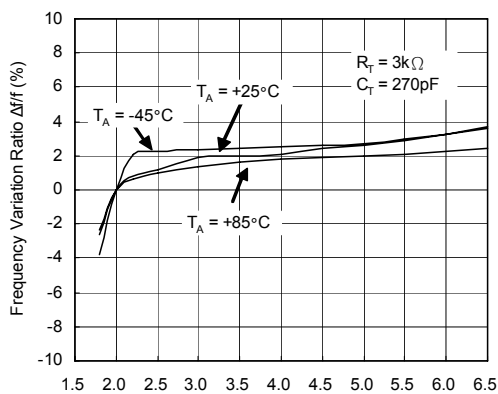
Oscillation Frequency f_{osc} vs.
Timing Resistor R_T



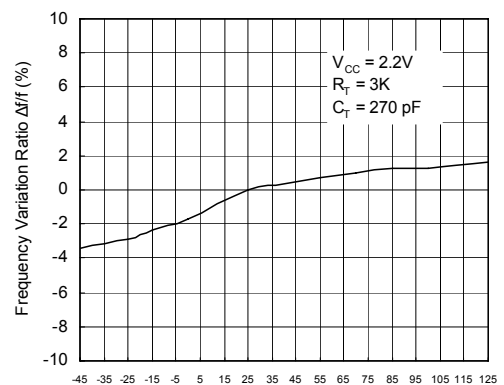
Oscillation Frequency f_{osc} vs.
Maximum Duty Cycle



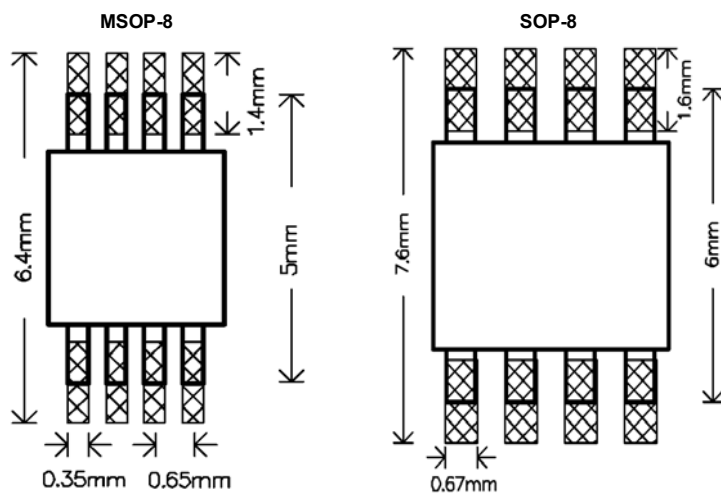
Frequency variation ratio $\Delta f/f$ vs.
Supply Voltage V_{CC}



Frequency variation ratio $\Delta f/f$ vs.
Ambient Temperature T_A



Recommended Minimum Footprint

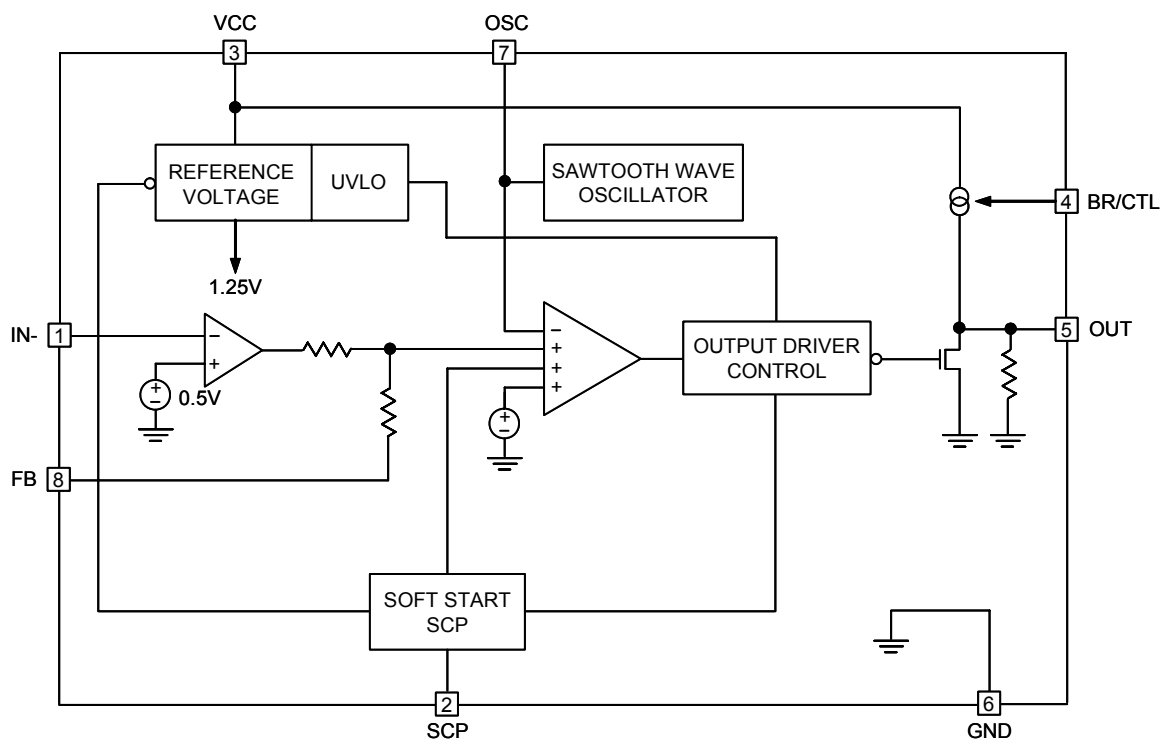




Pin Description

PIN	NAME	I/O	FUNCTION
1	IN-	I	Error amplifier inverting input
2	SCP	-	Soft start and SCP setting capacitor connection
3	VCC	-	Power supply
4	BR/CTL	I	Output current setting and control
5	OUT	O	Output
6	GND	-	Ground
7	OSC	-	Capacitor and resistor connection pin for setting the oscillation frequency
8	FB	O	Error amplifier output

Block Diagram



Description

Soft Start SCP

At power on, the G5180 enters the soft-start mode to prevent current spike and overshoot. The capacitor C_S is charged from 0V with a constant current of $1\mu A$.

The soft-start time for the duty cycle

$$t_S = 0.8 \times C_S (\mu F)$$

When V_{SCP} reaches 0.8V, the G5180 leaves the soft-start mode to enter the normal mode and enable the SCP function. If the output load conditions change rapidly causing the output to drop suddenly, the external capacitor C_S will start to charge because the error amplifier output (FB pin) is fixed at V_{OMax}^+ . When the external capacitor is charged above 0.8V, the output pin is set low. Once the latch circuit has set, the capacitor C_S will be discharged to low state and the latch circuit will not reset until power is turned off or the power supply is restarted.

Short-circuit detection time (or full soft-start time):

$$t_{PE} = 0.8 \times C_S (\mu F)$$

Setting Oscillating Frequency

The oscillator circuit generates a triangular sawtooth wave with a peak of 0.8V and a trough of 0.1V using the timing capacitor (C_T) and the timing resistor (R_T) that are connected to the OSC pin. This oscillator can provide oscillating frequency in the range from 20kHz to 1MHz. The waveform of the OSC pin is shown as Figure 1.

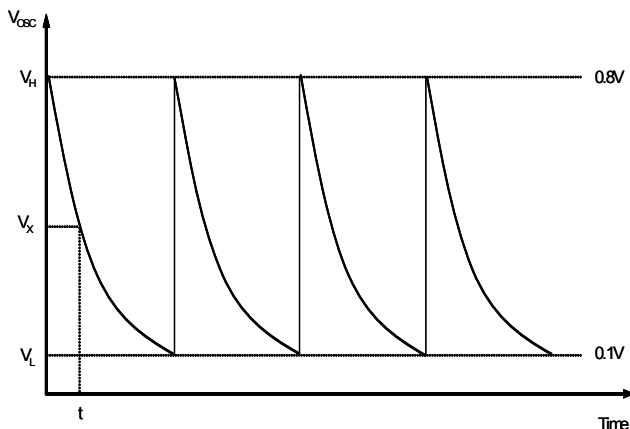


Figure 1

The cycle (T) can be determined as follows:

$$V_X = V_H \times e^{-t / (C_T \times R_T)} \quad t = -C_T \times R_T \times \ln \left(\frac{V_X}{V_H} \right)$$

$$T = -C_T \times R_T \times \ln(0.1/0.8) \approx 2.1 \times C_T \times R_T [s]$$

Switching Regulator Function

Reference Voltage circuit

A temperature-compensated reference voltage (~1.25V) is generated by the reference voltage circuit from the voltage supplied by the power supply pin (pin 3). The circuit also sets the idle period besides providing the reference voltage for the switching regulator.

Error Amplifier

The error amplifier detects the output voltage of the switching regulator and sets the PWM control signal. The voltage gain is fixed. The system is made stable by connecting a phase compensation capacitor to the FB pin (pin 8).

PWM Comparator

The voltage comparator includes one inverting and three non-inverting inputs. The comparator is a voltage to pulse width converter that controls the ON time of the output pulse depending on the level of input voltage. The output level remains high when the sawtooth wave is lower than the error amplifier output voltage, the soft start setting voltage, and the idle period setting voltage.

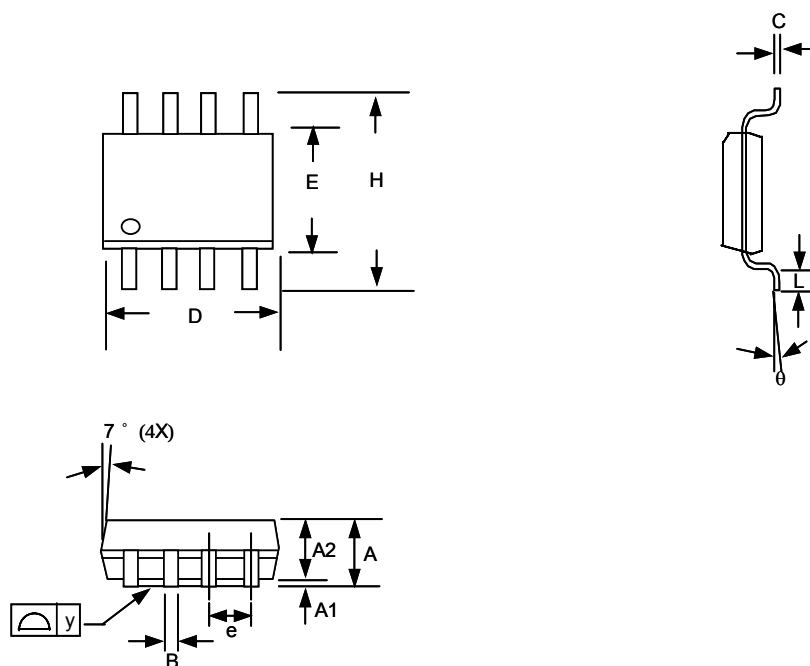
Output Circuit

The output circuit can drive an external NPN transistor or NMOS directly. The value of the ON/OFF current can be set by a resistor connected to the BR/CTL pin (pin 4). Stand-by mode (supply current $1\mu A$ or less) can be set by connecting the BR/CTL pin (pin 4) to V_{CC} or by making the pin open.

Under-Voltage Lockout (UVLO)

Transients during powering on or instantaneous glitches in the supply voltage can cause the control IC to malfunction and damage the system. To prevent malfunction at low input voltage, the circuit compares the supply voltage to the internal reference voltage to detect a low input voltage. Once detected, the circuit sets the output pin low.

Package Information

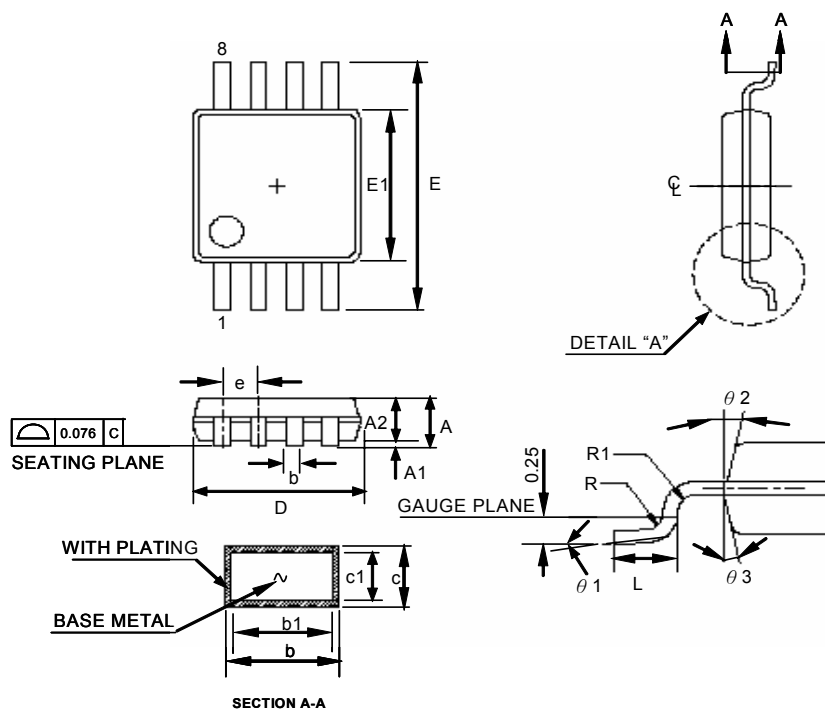


SOP-8 Package

Note:

1. Package body sizes exclude mold flash and gate burrs
2. Dimension L is measured in gage plane
3. Tolerance 0.10mm unless otherwise specified
4. Controlling dimension is millimeter converted inch dimensions are not necessarily exact.

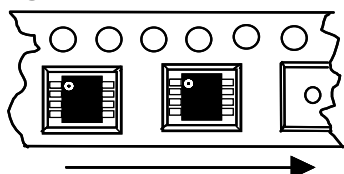
SYMBOL	DIMENSION IN MM			DIMENSION IN INCH		
	MIN.	NOM.	MAX.	MIN.	NOM.	MAX.
A	1.35	1.60	1.75	0.053	0.063	0.069
A1	0.10	----	0.25	0.004	----	0.010
A2	----	1.45	----	----	0.057	----
B	0.33	----	0.51	0.013	----	0.020
C	0.19	----	0.25	0.007	----	0.010
D	4.80	----	5.00	0.189	----	0.197
E	3.80	----	4.00	0.150	----	0.157
e	----	1.27	----	----	0.050	----
H	5.80	----	6.20	0.228	----	0.244
L	0.40	----	1.27	0.016	----	0.050
y	----	----	0.10	----	----	0.004
θ	0°	----	8°	0°	----	8°



MSOP-8 Package

SYMBOL	DIMENSION IN MM			DIMENSION IN INCH		
	MIN.	NOM.	MAX.	MIN.	NOM.	MAX.
A	----	----	1.10	----	----	0.043
A1	0.05	----	0.15	0.002	----	0.006
A2	0.81	0.86	0.91	0.032	0.034	0.036
b	0.25	----	0.40	0.008	----	0.012
b1	0.25	0.30	0.35	0.010	0.012	0.014
c	0.13	----	0.23	0.005	----	0.009
c1	0.13	0.15	0.18	0.005	0.006	0.007
D	2.90	3.00	3.10	0.114	0.118	0.122
E1	2.90	3.00	3.10	0.114	0.118	0.122
e	0.65 BSC			0.026 BSC		
E	4.90 BSC			0.193 BSC		
L	0.445	0.55	0.648	0.0175	0.0217	0.0255
$\theta 1$	0°	----	6°	0°	----	6°
$\theta 2$	12 REF			12 REF		
$\theta 3$	12 REF			12 REF		
R	0.09	----	----	0.004	----	----
R1	0.09	----	----	0.004	----	----
JEDEC	MO-187AA					

Taping Specification



Feed Direction
Typical SOP/MSOP Package Orientation

PACKAGE	Q'TY/REEL
SOP-8	2,500 ea
MSOP-8	2,500 ea

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