

## 28V, 3A Buck Constant Current Switching Regulator for White LED



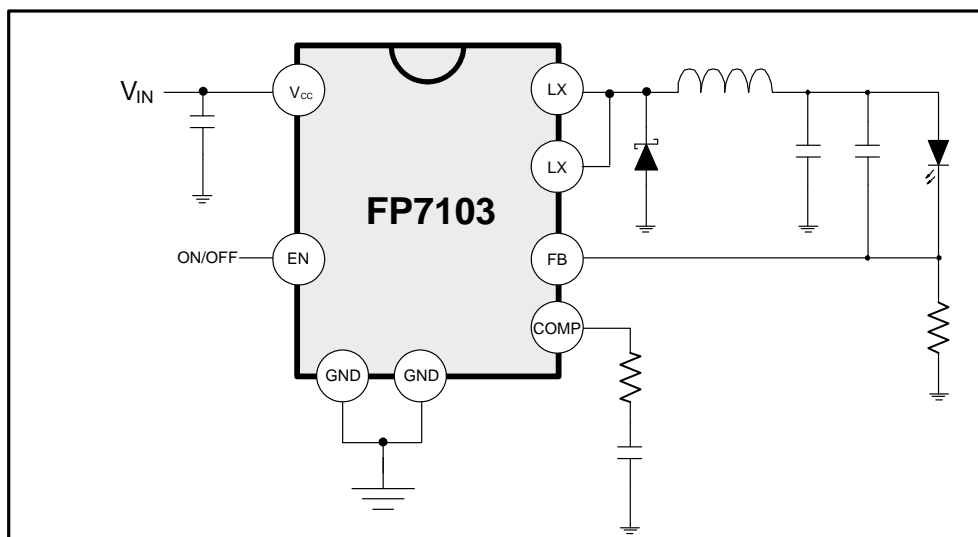
### General Description

The FP7103 is a PWM control buck converter designed to provide a simple, high efficiency solution for driving high power LEDs. With a 0.25V reference voltage feedback control to minimize power dissipation, an external resistor sets the current as needed for driving various types of LEDs. The FP7103 includes a high current P-MOSFET to realize high efficiency and excellent transient characteristics. The PWM control circuit is able to change the duty ratio linearly from 0 up to 100%. Other features include user accessible EN pin for enabling, thermal shutdown, cycle-by-cycle current limit and over current protection.

### Features

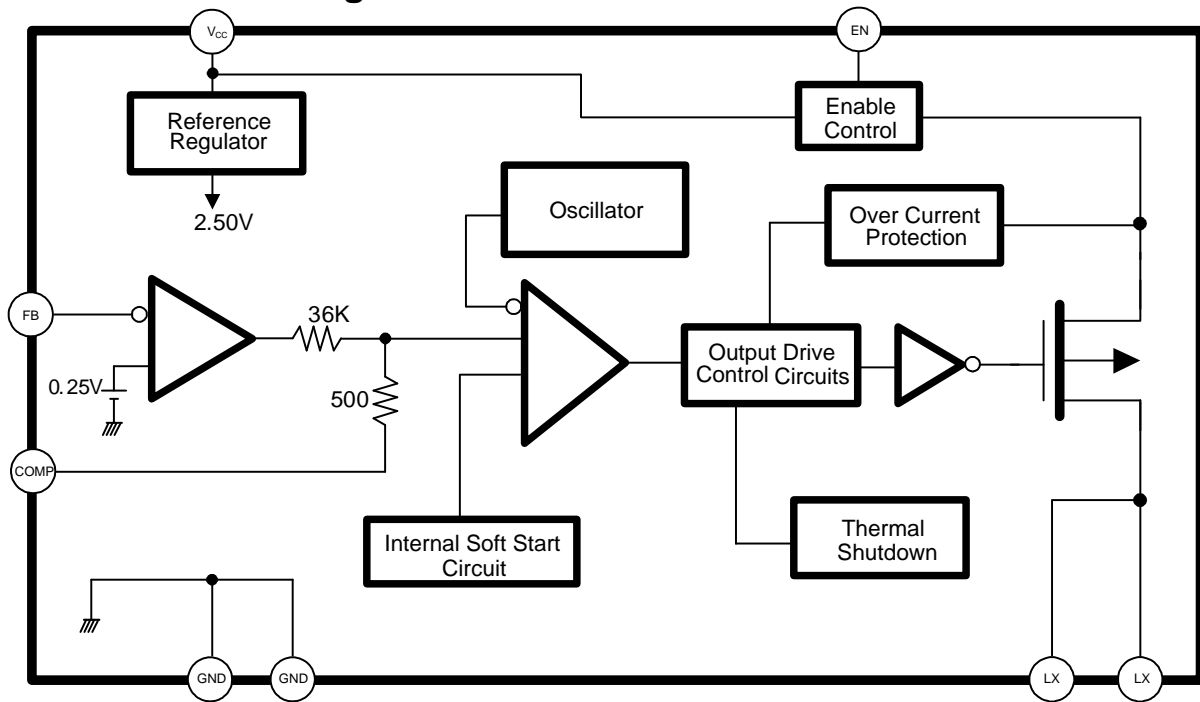
- Wide Supply Voltage Operating Range: 3.6 to 28V
- Built-in P-MOSFET for 3A Loading Capability
- Precision Feedback Reference Voltage: 0.25V (2%)
- Low Current Consumption: 4mA
- Internal Fixed Oscillator Frequency: 320KHz (Typ.)
- Internal Soft-Start Function (SS)
- Over Current Protection
- Package: SOP-8L& SOP-8L(EP)

### Typical Application Circuit



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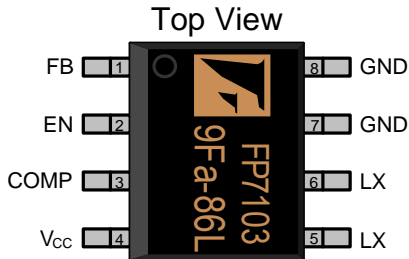
**Function Block Diagram**



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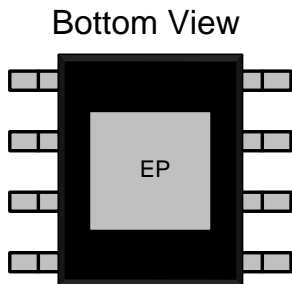
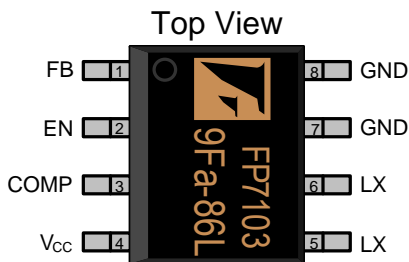
## Pin Descriptions

### SOP- 8L



Name	No.	I / O	Description
FB	1	I	Error Amplifier Inverting Input
EN	2	I	Enable Control
COMP	3	O	Error Amplifier Compensation Output
V <sub>CC</sub>	4	P	IC Power Supply (PMOS Source)
LX	5	P	PMOS High Current Output
LX	6	P	PMOS High Current Output
GND	7	O	IC Ground
GND	8	O	IC Ground

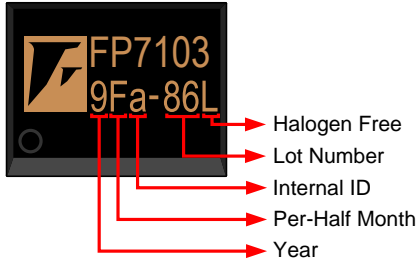
### SOP-8L (EP)



Name	No.	I / O	Description
FB	1	I	Error Amplifier Inverting Input
EN	2	I	Enable Control
COMP	3	O	Error Amplifier Compensation Output
V <sub>CC</sub>	4	P	IC Power Supply (PMOS Source)
LX	5	P	PMOS High Current Output
LX	6	P	PMOS High Current Output
GND	7	O	IC Ground
GND	8	O	IC Ground
EP	9	P	Exposed PAD. Must connect to LX

## Marking Information

### SOP-8L & SOP-8L (EP)



**Halogen Free:** Halogen free product indicator

**Lot Number:** Wafer lot number's last two digits

For Example Lot : 123456 → XXx-56L

**Internal ID:** Internal Identification Code

**Per-Half Month:** Production period indicator in half month time unit

For Example : A → First Half Month of January  
B → Second Half Month of January  
C → First Half Month of February  
D → Second Half Month of February

**Year:** Production year's last digit

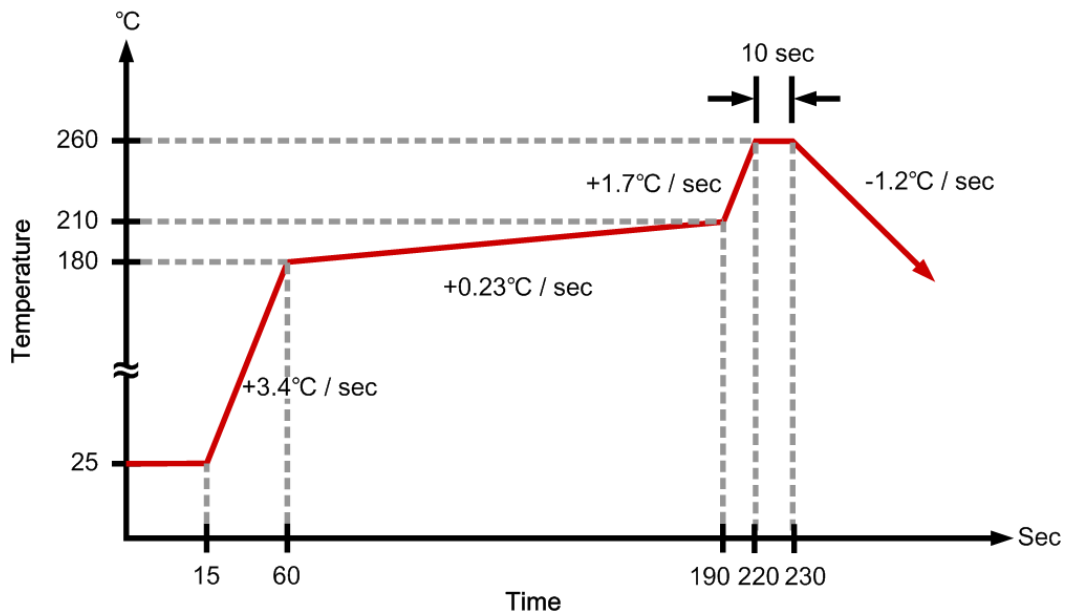
## Ordering Information

Part Number	Ambient Operating Temperature	Junction Operating Temperature	Package	MOQ	Description
FP7103DR-LF	-25°C ~ +85°C	-25°C ~ +125°C	SOP-8L	2500EA	Tape & Reel
FP7103XR-LF	-25°C ~ +85°C	-25°C ~ +125°C	SOP-8L (EP)	2500EA	Tape & Reel

## Absolute Maximum Ratings

Parameter	Symbol	Conditions	Min.	Typ.	Max.	Unit
Power Supply Voltage	$V_{IN}$				28	V
Output Source Current					3	A
Error Amplifier Inverting Input			-0.3		+1.2	V
Allowable Power Dissipation	$P_D$	SOP-8L, $T_A \leq +25^\circ\text{C}$			650	mW
		SOP-8L (EP), $T_A \leq +25^\circ\text{C}$			1500	mW
Thermal Resistance Junction to Ambient	$\theta_{JA}$	SOP-8L			+110	$^\circ\text{C} / \text{W}$
		SOP-8L (EP)			+60	$^\circ\text{C} / \text{W}$
Thermal Resistance Junction to Case	$\theta_{JC}$	SOP-8L			+55	$^\circ\text{C} / \text{W}$
		SOP-8L (EP)			+10	$^\circ\text{C} / \text{W}$
ESD Susceptibility		HBM (Human Body Mode)		2		KV
		MM (Machine Mode)		200		V
Storage Temperature			-55		+150	$^\circ\text{C}$
Lead Temperature (soldering, 10 sec)					+260	$^\circ\text{C}$

## IR Re-flow Soldering Curve



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## Recommended Operating Conditions

Parameter	Symbol	Conditions	Min.	Typ.	Max.	Unit
Supply Voltage	$V_{IN}$		3.6		28	V
Ambient Operating Temperature			-25		+85	°C
Junction Operating Temperature			-25		+125	°C

## DC Electrical Characteristics ( $V_{CC}=6V$ , $T_A=25^\circ C$ , unless otherwise noted)

Parameter	Symbol	Conditions	Min.	Typ.	Max.	Unit
<b>Reference</b>						
Output Voltage	$V_{REF}$	FB connected to COMP	0.245	0.25	0.255	V
Input Regulation	$\Delta V_{REF}$	$V_{CC}=3.6V$ to $25V$		2	12.5	mV
Output Voltage Change with Temperature	$\frac{\Delta V_{REF}}{V_{REF}}$	$T_A = -25^\circ C$ to $+25^\circ C$		1	2	%
		$T_A = +25^\circ C$ to $+85^\circ C$		1	2	
<b>Oscillator Section</b>						
Oscillation Frequency	f			320		KHz
Frequency Change with Voltage	$\Delta f / \Delta V$	$V_{CC}=3.6V$ to $25V$		5		%
Frequency Change with Temperature	$\Delta f / \Delta T$	$T_A = -25^\circ C$ to $+85^\circ C$		5		%
<b>Error Amplifier Section</b>						
Input Bias Current	$I_B$		-1.0	-0.2	1.0	$\mu A$
Voltage Gain	$A_V$			100		V / V
Frequency Bandwidth	BW	$A_V=0$ dB		6		MHz
Output Voltage Swing Positive	$V_{POS}$		1.7	2		V
Output Voltage Swing Negative	$V_{NEG}$			0.1	0.2	V
Output Source Current	$I_{SOURCE}$	$V_{comp}=200mV$	-15	-30		$\mu A$
Output Sink Current	$I_{SINK}$	$V_{comp}=200mV$	15	30		$\mu A$
<b>Idle Period Adjustment Section</b>						
Maximum Duty Cycle	$T_{DUTY}$	$V_{FB}=0.2V$		100		%
<b>Output Section</b>						
PMOS D-S Voltage	$V_{DSS}$	$V_{COMP}=0.1V$		-20		V
PMOS Source Current	$I_D$			-3		A
PMOS On Resistance	$R_{DS(ON)}$	$V_{CC}=5.0V$ , $V_{FB}=0V$		64	87	m $\Omega$
		$V_{CC}=10V$ , $V_{FB}=0V$		40	52	
Output Leakage Current	$I_L$	$V_{DS}=-24V$ , $V_{GS}=0V$			-1	$\mu A$
<b>Thermal Shutdown Section</b>						
Thermal shutdown Temperature				150		°C
<b>Over Current Protection Section</b>						
PMOS OCP Current	$I_{OCP}$			4		A

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Parameter	Symbol	Conditions	Min.	Typ.	Max.	Unit
<b>Total Device Section</b>						
EN Input Current	$I_{EN}$	EN pin Open			20	$\mu A$
Upper Threshold Voltage (EN)	$V_{UPPER}$			1.12		V
Lower Threshold Voltage (EN)	$V_{LOW}$			0.87		V
Hysteresis	$V_{HYS}$		210	250		mV
Average Supply Current	$I_{AVE}$			4	6	mA
$V_{CC}$ Shutdown Current	$I_{shutdown}$			15		$\mu A$

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## Detailed Description

### Voltage Reference

A built-in 2.5V reference regulator supplies FP7103 internal circuits. Also, this 2.5V reference voltage is divided down by an internal resistive divider to provide a 0.25V precision reference voltage to the error amplifier non-inverting terminal.

### Setting the LED Current

FP7103 is a constant current buck regulator. The LEDs are connected between  $V_{OUT}$  and FB pin as shown in the **Typical Application Circuit** section. The FB pin is 0.25V in regulation. Therefore, the LEDs current  $I_F$  is set by  $V_{FB}$  and the resistor  $R_2$  connected between FB and ground by the following equation:

$$I_F = \frac{V_{FB}}{R_2}$$

$I_F$  should not exceed the 3A current capability of FP7103 and therefore  $R_2$  minimum must be approximately  $0.083\Omega$

### Output Voltage

The output voltage is primarily determined by the number of LEDs(n) connected between  $V_{OUT}$  and FB pin. Therefore,  $V_{OUT}$  can be written as:

$$V_{OUT} = ((n \times V_F) + V_{FB})$$

Where  $V_F$  is the forward voltage of one LED at the set LED current level (see LED manufacturer datasheet for forward characteristics curve)

### Oscillator

The fixed PWM frequency is generated by an internal oscillator. Its typical values are 320KHz.

### Thermal Protection

The thermal protection is triggered when junction temperature is higher than  $150^\circ\text{C}$  that may occur by an abnormal heavy current loading. When this happens, the FP7103 turns output off. Once the junction temperature is cooled down to lower than  $130^\circ\text{C}$ , FP7103 starts again and turns the power switch on.

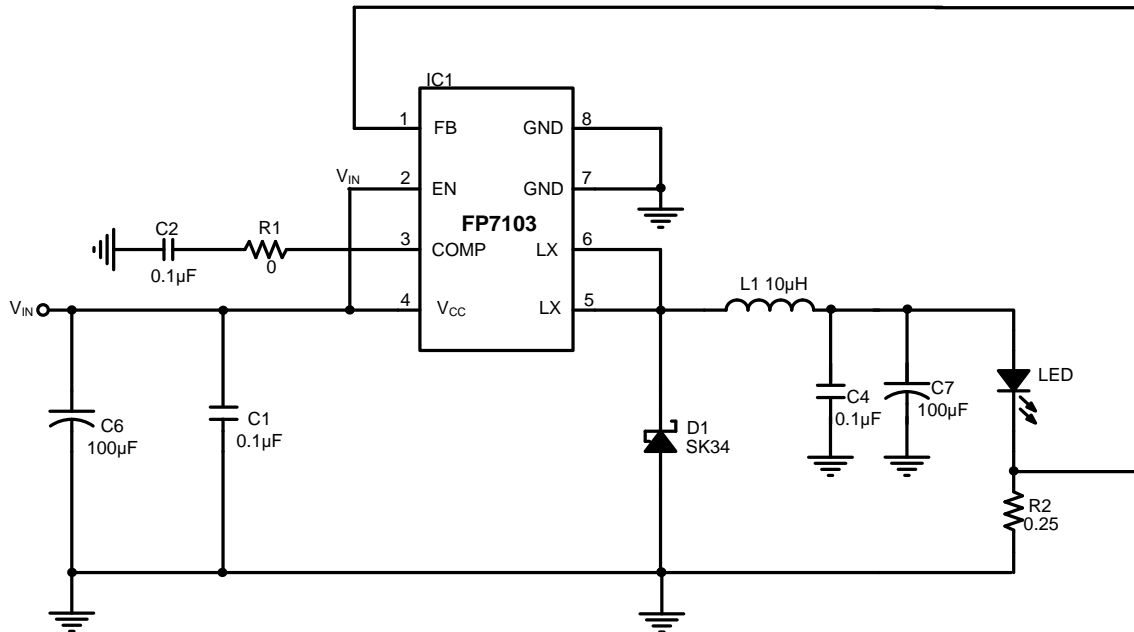


**Over Current Protection**

The FP7103 uses cycle-by-cycle current limit to protect the internal power switch. During each switching cycle, a current limit comparator detects if the power switch current exceeds the internal setting current. If it does, over current protection function decrease the oscillator frequency to prevent thermal issue.

## Application Information

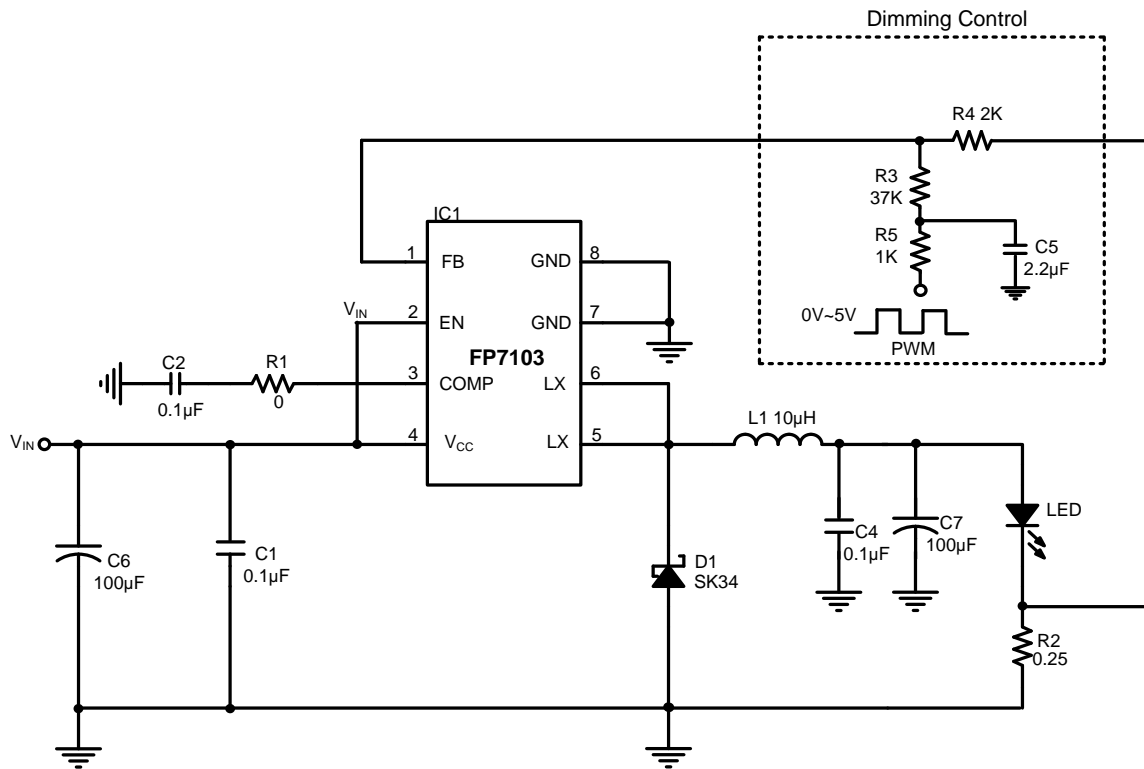
### Typical Application Circuit



**FP7103 3W / 5W LED for DC Input Circuit**

### Dimming Control Circuit

Changing the duty cycle of PWM signal can get different LED current. The PWM signal is recommended above 10kHz. The application circuit is shown in the following.



The LED current can be calculated by the following equation:

$$I_{LED} = \frac{V_{FB} - \frac{R4 \times (V_{PWM} \times Duty - V_{FB})}{R3 + R5}}{R2}$$

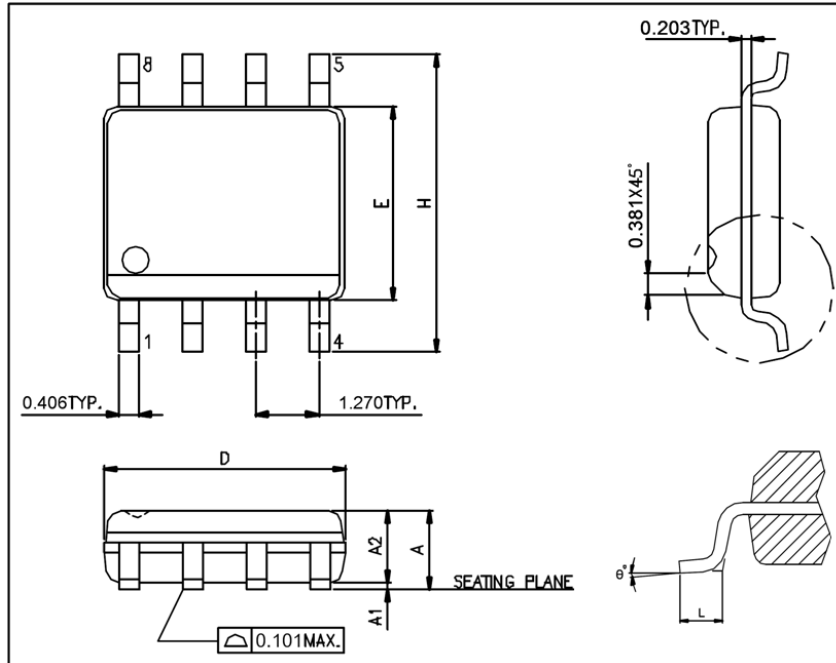
### Notice:

1. Tapping reel aluminum foil bags after unpacking must be stored at ≤10% RH environment.
2. Tapping reel aluminum foil bags after unpacking must sure surface-mount is completed within 168 hours.

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## Package Outline

### SOP-8L

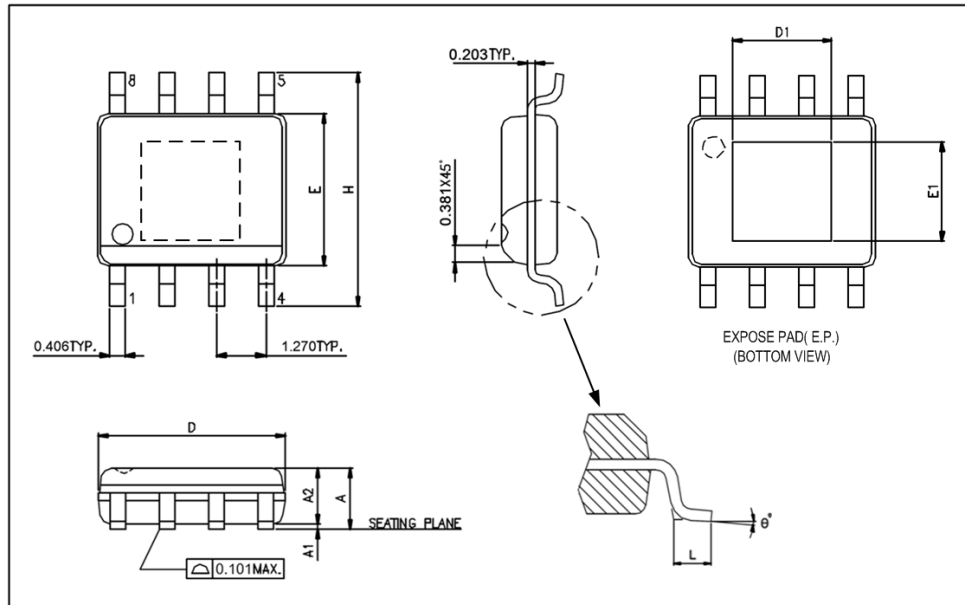


UNIT: mm

Symbols	Min. (mm)	Max. (mm)
A	1.346	1.752
A1	0.101	0.254
A2		1.498
D	4.800	4.978
E	3.810	3.987
H	5.791	6.197
L	0.406	1.270
$\theta^\circ$	0°	8°

**Note:**

1. Package dimensions are in compliance with JEDEC outline: MS-012 AA.
2. Dimension "D" does not include molding flash, protrusions or gate burrs.
3. Dimension "E" does not include inter-lead flash or protrusions.

**SOP-8L (EP)**

**UNIT: mm**

Symbols	Min. (mm)	Max. (mm)
A	1.346	1.752
A1	0.050	0.152
A2		1.498
D	4.800	4.978
E	3.810	3.987
H	5.791	6.197
L	0.406	1.270
$\theta^\circ$	0°	8°

**Exposed PAD Dimensions:**

Symbols	Min. (mm)	Max. (mm)
E1		2.184 REF
D1		2.971 REF

**Note:**

1. Package dimensions are in compliance with JEDEC outline: MO-178 AA.
2. Dimension "D" does not include molding flash, protrusions or gate burrs.
3. Dimension "E" does not include inter-lead flash or protrusions

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