

## Non-Synchronous PWM Boost Converter



### General Description

The FP6288 is a boost topology switching regulator for wide operating voltage applications. Its built-in 20 mΩ power MOSFET makes this regulator highly power efficient. The non-inverting input of error amplifier connects to a 0.6V precision reference voltage. The FP6288 has internal soft start and programmable over current protection set by external resistor.

The FP6288 is available in the small footprint SOP-8L(EP) package to fit in space-saving PCB layout for miscellaneous application fields.

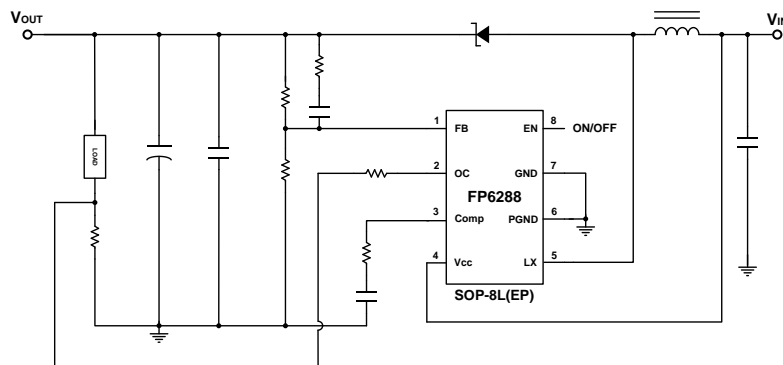
### Features

- Wide Supply Voltage Operating Range: 2.4 to 5.5V
- Precision Feedback Reference Voltage: 0.6V (±2%)
- Shutdown Current: <1μA
- Internal Fixed PWM frequency: 350KHz
- Internal Soft Start Function :7ms (SS)
- Over Current Protection Function (OCP)
- Over Voltage Protection
- Package: SOP-8L(EP)
- Duty Cycle: PWM Switching Control Circuit (15%~90%)

### Applications

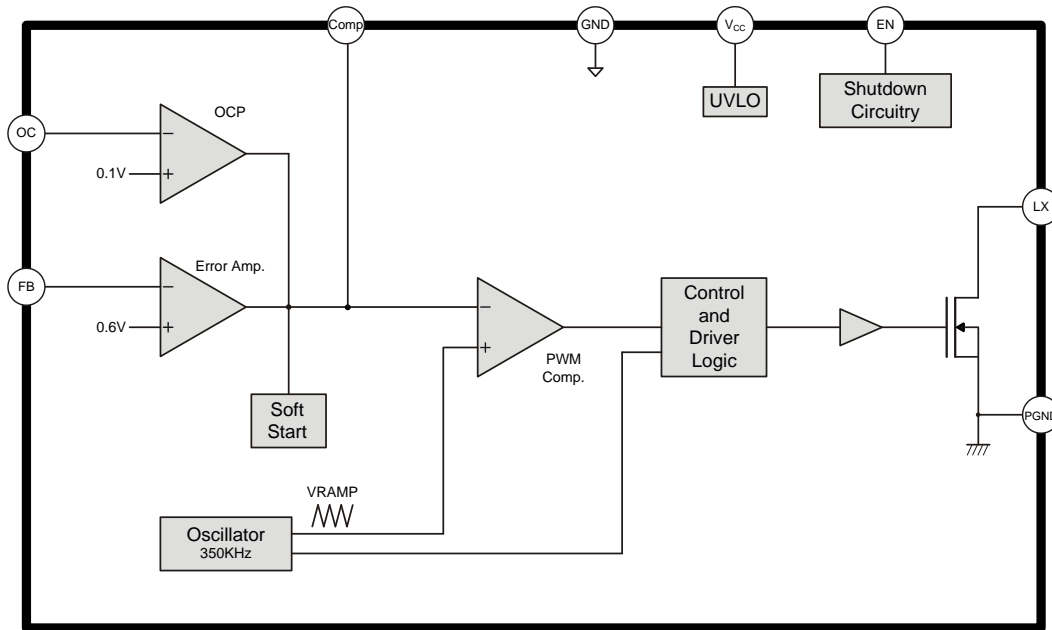
- Chargers
- LCD Displays
- Digital Cameras
- Handheld Devices
- Portable Products

### Typical Application Circuit



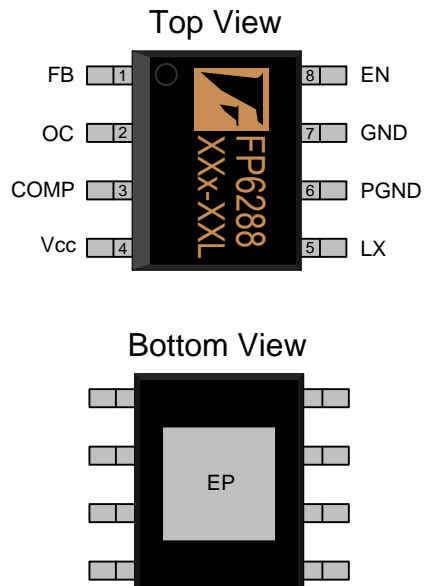
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## Function Block Diagram



## Pin Descriptions

### SOP-8L(EP)

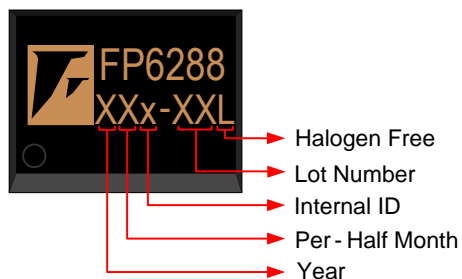


Name	No.	I / O	Description
FB	1	I	Error Amplifier Inverting Input
OC	2	I	Adjustable Output Current Protection
COMP	3	O	Compensation
Vcc	4	P	IC Power Supply
LX	5	O	Power Switch Output
PGND	6	P	IC Ground
GND	7	P	IC Power Ground
EN	8	I	Enable Control (Active High)
EP	9	O	Exposed PAD. Must connect to LX

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## Marking Information

### 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	Operating Temperature	Package	MOQ	Description
FP6288XR-G1	-40°C ~ 85°C	SOP-8L(EP)	2500EA	Tape & Reel

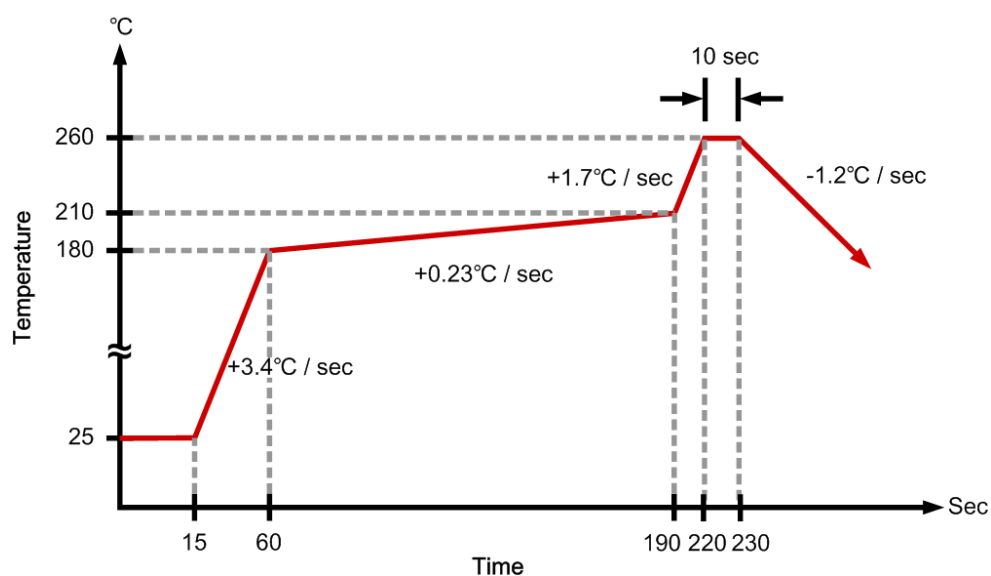
## Absolute Maximum Ratings

Parameter	Symbol	Conditions	Min.	Typ.	Max.	Unit
Supply Voltage	$V_{CC}$		0		6	V
LX Voltage	$V_{LX}$		0		20	V
EN,FB Voltage			0		6	V
Build-in MOSFET Current					5	A
Thermal Resistance (Note1)	$\theta_{JA}$	SOP-8L(EP)			+60	°C / W
Junction Temperature	$T_J$				+150	°C
Operating Temperature	$T_{OP}$		-40		+85	°C
Storage Temperature	$T_{ST}$		-65		+150	°C
Lead Temperature		(soldering, 10 sec)			+260	°C

### Note1:

$\theta_{JA}$  is measured in the natural convection at  $T_A=25^\circ\text{C}$  on a low effective thermal conductivity test board of JEDEC 51-3 thermal measurement standard.

## IR Re-flow Soldering Curve



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## Recommended Operating Conditions

Parameter	Symbol	Conditions	Min.	Typ.	Max.	Unit
Supply Voltage	$V_{CC}$		2.4		5.5	V
Operating Temperature Range	$T_A$	Ambient Temperature	-40		+85	°C

## DC Electrical Characteristics ( $V_{CC}=3.3V$ , $T_A=25^{\circ}C$ , unless otherwise specified)

Parameter	Symbol	Conditions	Min.	Typ.	Max.	Unit
<b>System Supply Input</b>						
Input Supply Range	$V_{CC}$		2.4		5.5	V
Under Voltage Lockout	$V_{UVLO}$			2.1		V
UVLO Hysteresis				0.1		V
Quiescent Current	$I_{CC}$	FB=1.0V, No switch		70		$\mu A$
Shutdown Current	$I_{CC}$	$V_{EN}=GND$		0.1		$\mu A$
<b>Oscillator</b>						
Operation Frequency	$f_{OSC}$	$V_{FB}=0.6V$		350		kHz
Minimum Duty Ratio	%			15		%
Maximum Duty Ratio	%			90		%
Soft-Start Time	$t_{SS}$	$V_{CC}=5V$		7		ms
<b>Reference Voltage</b>						
Feedback Voltage	$V_{REF}$	$V_{CC}=5V$	0.588	0.6	0.612	V
<b>Enable Control</b>						
Enable Voltage	$V_{EN}$		0.96			V
Shutdown Voltage	$V_{EN}$				0.6	V
<b>MOSFET</b>						
On Resistance of Driver	$R_{DS(ON)}$	$I_{LX}=2A$		20		m $\Omega$

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## Function Description

### Operation

The FP6288 is a voltage mode boost controller. The switching frequency is 350kHz and operates with pulse width modulation (PWM). Build-in 20V/5A MOSFET provides a high output voltage. An internal resistive divider provides 0.6V reference for the error amplifier. The FP6288 changes to SKIP mode when output is light load. It can increase efficiency, but SKIP mode also increases output voltage ripple.

### Soft Start Function

Soft start circuitry is integrated into FP6288 to avoid inrush current during power on. After the IC is enabled, the output of error amplifier is clamped by the internal soft-start function, which causes PWM pulse width increasing slowly and thus reducing input surge current.

### Over Current Protection

The FP6288 provides an output current limit protection function. The circuit is shown in Figure 1. The output current limiting will be activated when the OC pin voltage is higher than 0.1V. The OCP will make PWM duty reduced and output voltage drops at the same time.

OC pin is a sensitive node. It is necessary 10K $\Omega$  is connected between OC pin and R<sub>OC</sub> to reduce noise. 10K $\Omega$  also must be connected to ground when OC function is disabled. OC pin cannot float.

To set the over current trip point, follow below equation:

$$I_{OCP} = \frac{0.1V}{R_{oc}}$$

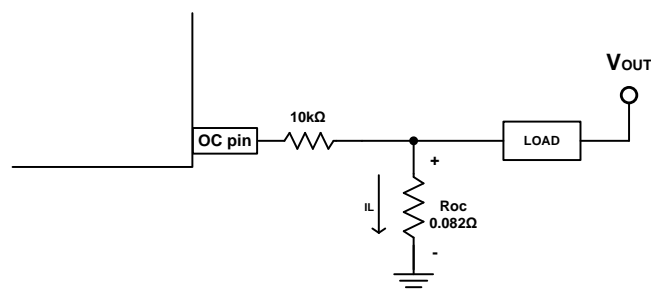


Figure1. OC pin circuit

### Shutdown Function

Drive Enable pin to ground to shut down the FP6288. Shutdown mode forces to turn off all internal circuitry, and reduces the VIN supply current to 0.1 $\mu$ A (typ). The Enable pin rising threshold is 0.96V (typ). Before any operation begins, the voltage at Enable pin must exceed 0.96V (typ).

## Application Information

### Inductor Selection

Inductance value is decided based on different condition. 3.3uH to 10μH inductance value is recommended for general application circuit. There are three important inductor specifications, DC resistance, saturation current and core loss. Low DC resistance has better power efficiency.

### Capacitor Selection

The output capacitor is required to maintain the DC voltage during switching. Low ESR capacitors are preferred to reduce the output voltage ripple. Ceramic capacitor of X5R and X7R are recommended, which have low equivalent series resistance (ESR) and wider operation temperature range.

### Diode Selection

Schottky diodes with fast recovery times and low forward voltages are recommended. Ensure the diode average and peak current rating exceed the average output current and peak inductor current. In addition, the diode's reverse breakdown voltage must exceed the output voltage.

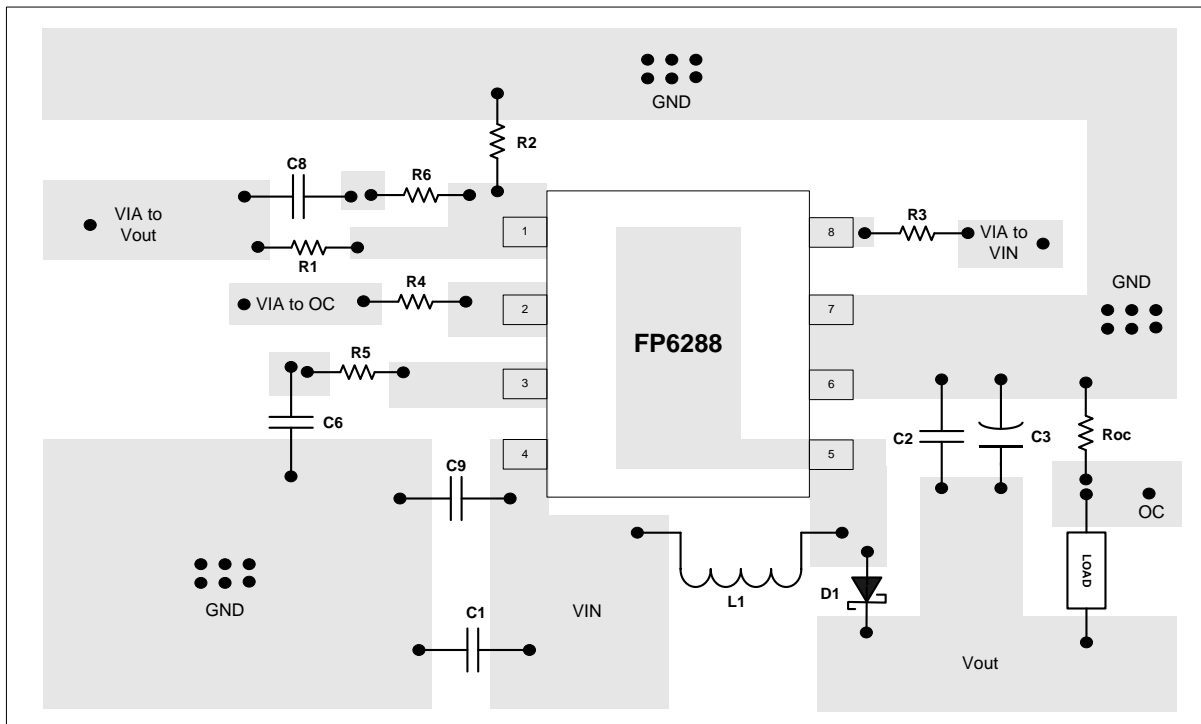
### Output Voltage Programming

The output voltage is set by a resistive voltage divider from the output voltage to FB. The output voltage is:

$$V_{OUT} = 0.6V \left( 1 + \frac{R1}{R2} \right)$$

## Layout Considerations

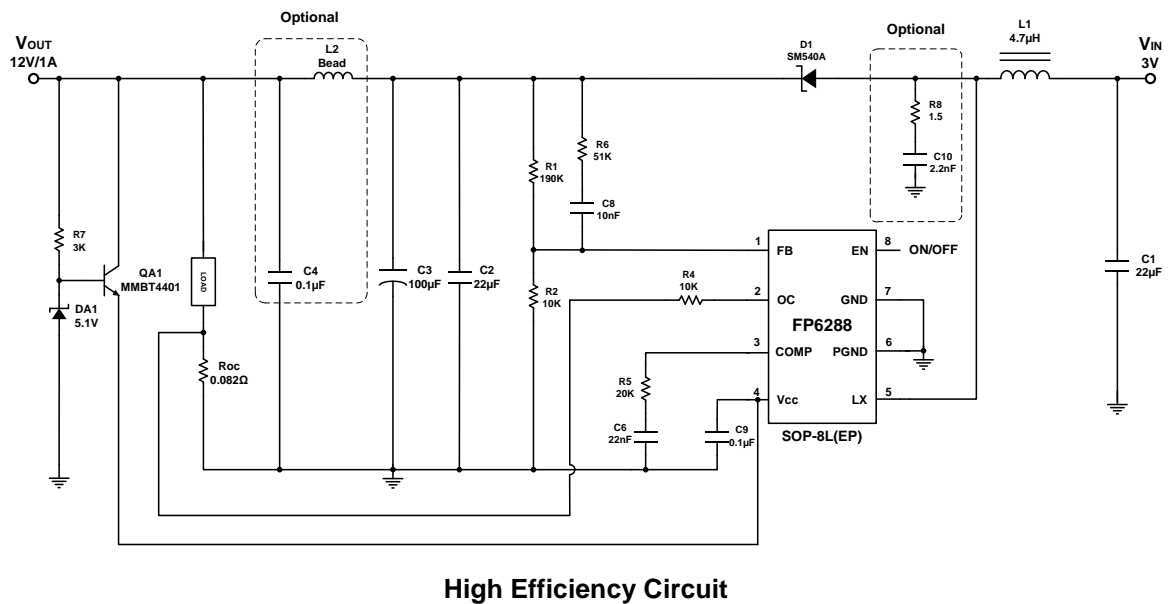
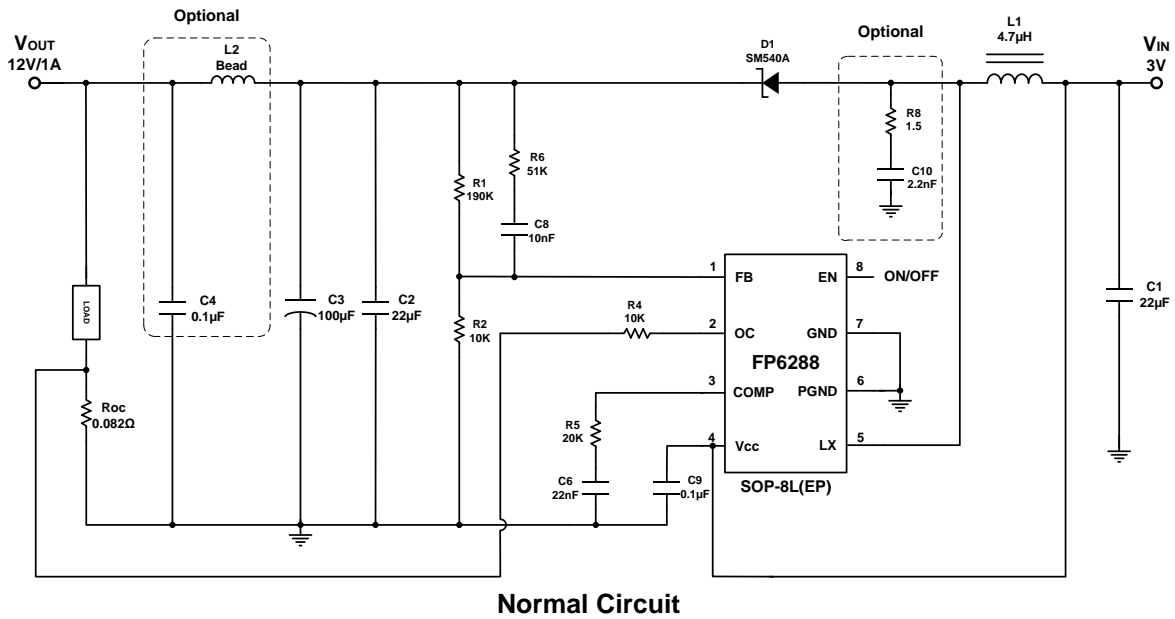
1. The power traces, consisting of the GND trace, the LX trace and the  $V_{CC}$  trace should be kept short, direct and wide.
2. Layout switching node LX, inductor and diode connection traces wide and short to reduce EMI.
3. Place  $C_{IN}$  nearby  $V_{CC}$  pin as closely as possible to maintain input voltage steady and filter out the pulsing input current.
4. The resistive divider R1 and R2 must be connected to FB pin directly and as closely as possible.
5. FB is a sensitive node. Please keep it away from switching node, LX.
6. The GND of the IC,  $C_{IN}$  and  $C_{OUT}$  should be connected close together and directly to a ground plane.
7. OC pin is a sensitive node. Roc must be connected to IC GND pin directly as closely as possible.
8. The output capacitor C2 and C3 should be connected close and together directly to the PGND.



**Suggested Layout**



## Application Information



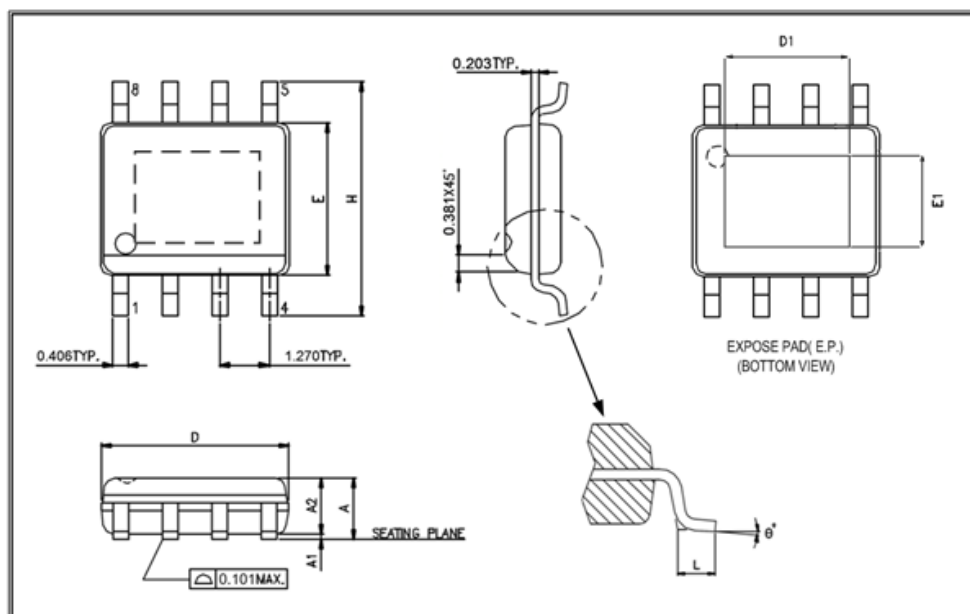
### Note:

1. C1 and C3 choose ceramic capacitor of X5R or X7R.
2. R8, C10 and L2, C4 are added for reducing EMI (Electromagnetic Interference).
3. The EN voltage can't higher than VCC voltage.

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## Package Outline

### 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: 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.

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