

## General Description

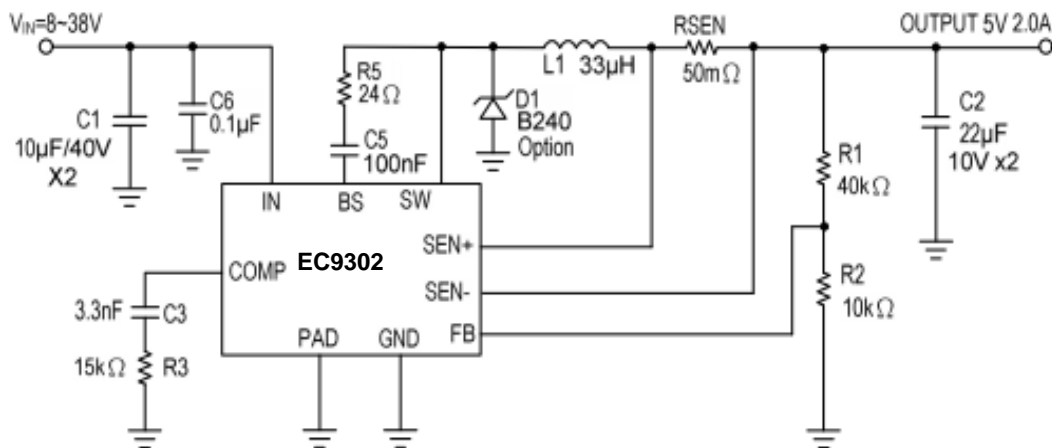
EC9302 is a wide input voltage, high efficiency Active CC step-down DC/DC converter that operates in either CV (Constant Output Voltage) mode or CC (Constant Output Current) mode. EC9302 provides up to 2.5A output current at 160kHz switching frequency. Current mode control provides fast transient response and cycle-by-cycle current limit.

An internal soft-start prevents inrush current at turn-on, This device, available in an SOP8L-EP(Exposed pad) package, provides a very compact solution with minimal external components.

## Features

- Wide 8V to 38V Operating Input Range
- Integrated 140mΩ Power MOSFET Switches
- Output Adjustable from VFB(1.0V) to 5.5V
- Up to 92% Efficiency
- Internal Soft-Start.
- Stable with Low ESR Ceramic Output Capacitors
- Fixed 160KHz Frequency
- Cycle-by-Cycle Over Current Protection
- Input Under/Over Voltage Lockout

## Application Circuit

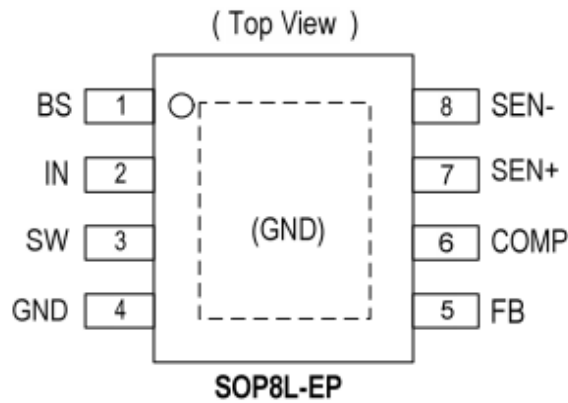


$$V_{OUT} = V_{FB} \times (1 + R1/R2), \quad V_{FB} = 1.00V, \quad R2 \text{ suggest } 10k \sim 30k\Omega$$

$$I_{SEN} \doteq 2.0A (R_{SEN} = 50m\Omega)$$

## Pin Assignment

The package of EC9302 is SOP8L-EP(Exposed pad); the pin assignment is given by:



Name	Description
<b>BS</b>	Boot-Strap Pin. Supply high side gate driver. Decouple this pin to LX pin with 24ohm +
<b>IN</b>	Power Input pin. Bypass IN to GND with a suitably large capacitor to eliminate noise on the input to the IC.
<b>SW</b>	Power Switching Output. SW is the switching node that supplies power to the output. Connect the output LC filter from SW to the output load.
<b>GND</b>	Ground.
<b>PAD</b>	Ground (Connect to GND).
<b>FB</b>	Feedback Input. FB senses the output voltage to regulate that voltage. Drive FB with a resistive voltage divider from the output voltage.
<b>COMP</b>	Compensation Node. COMP is used to compensate the regulation control loop. Connect a series RC network from COMP to GND to compensate the regulation control loop.
<b>SEN+</b>	The Current Sense Input (+) pin.
<b>SEN-</b>	The Current Sense Input (-) pin.

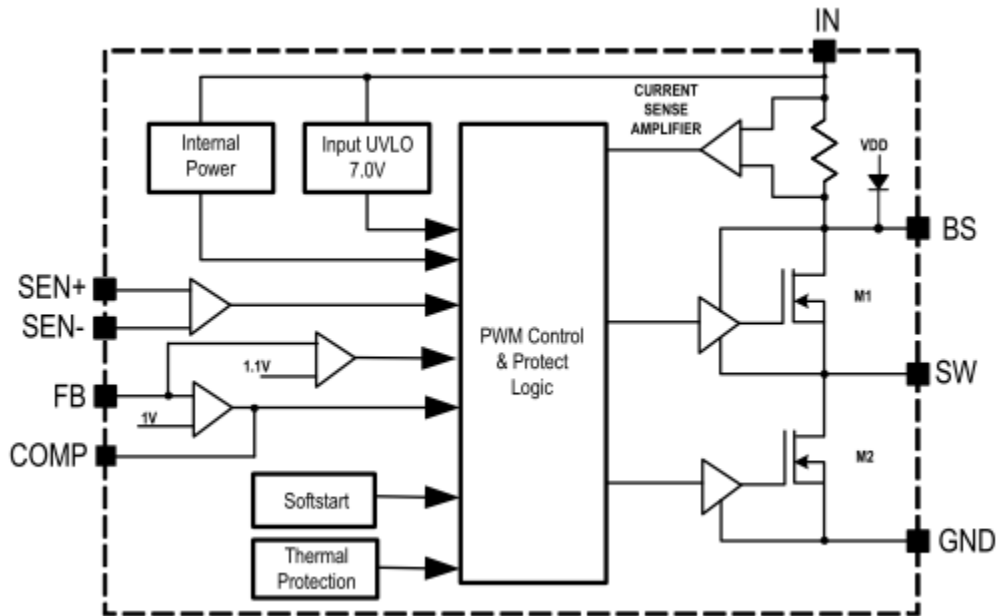
**Ordering/ Marking Information**

**EC9302NN XX X**

R : Tape & Reel  
 MH : SOP 8(Exposed Pad)

Package type	Part Number	Marking	Marking Information
SOP 8L (Exposed Pad)	EC9302NNMHR	EC9302 LLLLL YYWW	1. LLLLL : Last five number of lot no. 2. YYWW : Date Code

**Block Diagram**



**Absolute Maximum Ratings** (at  $T_A=25^{\circ}\text{C}$ )

Characteristics	Symbol	Rating	Unit
Supply Voltage	$V_{IN}$	-0.3 to +42	V
Switch Node Voltage	$V_{SW}$	- 0.3 to $V_{IN} + 0.3$	V
Boost Voltage	$V_{BS}$	$V_{SW} - 0.3$ to $V_{SW} + 6$	V
All Other Pins		-0.3 to +6	V
Lead Temperature		260	$^{\circ}\text{C}$
Storage Temperature		-65 to +150	$^{\circ}\text{C}$
Junction Temperature	$T_J$	150	$^{\circ}\text{C}$
Output Voltage	$V_{OUT}$	$V_{FB}$ to 6	V
Ambient Operating Temperature		-40 to +85	$^{\circ}\text{C}$
Thermal Resistance from Junction to case	$\theta_{JC}$	15	$^{\circ}\text{C}/\text{W}$
Thermal Resistance from Junction to Ambient	$\theta_{JA}$	40	$^{\circ}\text{C}/\text{W}$

Note:  $\theta_{JA}$  is measured with the PCB copper area of approximately 1 in<sup>2</sup>(Multi-layer). That need connect to exposed pad.

**Electrical Characteristics** ( $V_{IN} = 12\text{V}$ ,  $T_A = +25^{\circ}\text{C}$ , unless otherwise noted.)

Characteristics	Symbol	Conditions	Min	Typ	Max	Units
Input Voltage Range			8	-	38	V
Quiescent Current	$I_{CCQ}$	$V_{FB} = 1.05\text{V}$	-	1	1.5	mA
Feedback Voltage	$V_{FB}$	$8\text{V} \leq V_{IN} \leq 38\text{V}$	0.98	1.00	1.02	V
Feedback Overvoltage Threshold	$OVP_{(FB)}$		-	1.1X	-	$V_{FB}$
High-Side Switch On Resistance (Note)	$R_{DS(ON)1}$		-	150	-	m $\Omega$
Low-Side Switch On Resistance (Note)	$R_{DS(ON)2}$		-	140	-	m $\Omega$
High-Side Switch Leakage Current		$V_{FB} = 1.05\text{V}$ , $V_{SW} = 0\text{V}$	-	-	10	$\mu\text{A}$
Upper Switch Current Limit		Minimum Duty Cycle	2.9	3.5	-	A
Lower Switch Current Limit		From Drain to Source	-	0.9	-	A
Oscillation Frequency	$F_{OSC1}$		-	160	-	KHz
Short Circuit Oscillation Frequency	$F_{OSC2}$	$V_{FB} = <0.5\text{V}$	-	60	-	KHz
Maximum Duty Cycle	$D_{MAX}$		-	90	-	%

Minimum On Time (Note)	T <sub>ON(min)</sub>		-	220	-	ns
Sense Voltage	ΔV <sub>SEN</sub>	(V <sub>SEN+</sub> ) - (V <sub>SEN-</sub> )	114	120	126	mV
V <sub>IN</sub> OVP Turn-Off Voltage		Input Voltage Rising	-	40	-	V
V <sub>IN</sub> OVP Hysteresis		Input Voltage Falling	-	5	-	V
Input Under Voltage Lockout Threshold	UVLO	V <sub>IN</sub> Rising	6.5	7.0	7.5	V
Input Under Voltage Lockout Threshold Hysteresis	UVLO-Hys		-	800	-	mV
Soft-Start Period			-	3	-	ms
Thermal Shutdown	T <sub>SD</sub>		-	150	-	°C
Thermal Shutdown Hysteresis	T <sub>SH</sub>		-	30	-	°C

Note: Guaranteed by design.

## Function Description

The EC9302 is a synchronous rectified, current-mode, step-down regulator. It regulates input voltages from 8V to 38V down to an output voltage as low as V<sub>FB</sub>, and supplies up to 2.5A of load current.

The EC9302 uses current-mode control to regulate the output voltage. The output voltage is measured at FB through a resistive voltage divider and amplified through the internal Transconductance error amplifier.

The converter uses internal N-Channel MOSFET switches to step-down the input voltage to the regulated output voltage. Since the high side MOSFET requires a gate voltage greater than the input voltage, a boost capacitor connected between SW and BS is needed to drive the high side gate. The boost capacitor is charged from the internal 5V rail when SW is low.

When the EC9302 FB pin exceeds 10% of the nominal regulation voltage of V<sub>FB</sub>, the over voltage comparator is tripped and the COMP pin is discharged to GND, forcing the high-side switch off.

## Application Information

### Setting the Output Voltage

The output voltage is set using a resistive voltage divider from the output voltage to FB pin. The voltage divider divides the output voltage down to the feedback voltage by the ratio. Thus the output voltage is:

$$V_{OUT} = V_{FB} \times \frac{R1 + R2}{R2}$$

For example, V<sub>FB</sub> = 1.00V for a 5.0V output voltage, R<sub>2</sub> is 10kΩ, and R<sub>1</sub> is 40kΩ.

### Inductor Selection

The inductor is required to supply constant current to the output load while being driven by the switched input voltage. A larger value inductor will result in less ripple current that will result in lower output ripple voltage. However, the larger value inductor will have a larger physical size, higher series resistance, and/or lower saturation current. A good rule for determining the inductance to use is to allow the peak-to-peak

ripple current in the inductor to be approximately 30% of the maximum switch current limit.

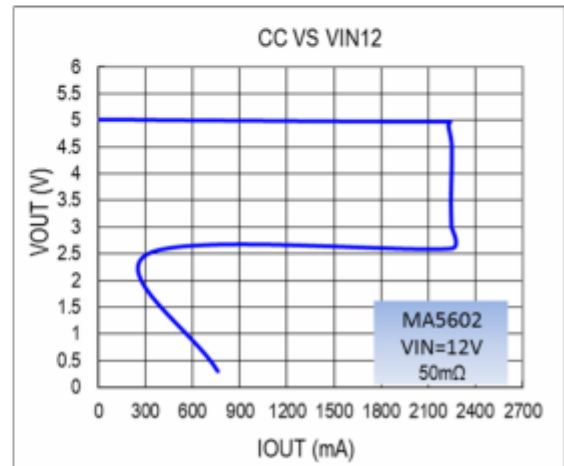
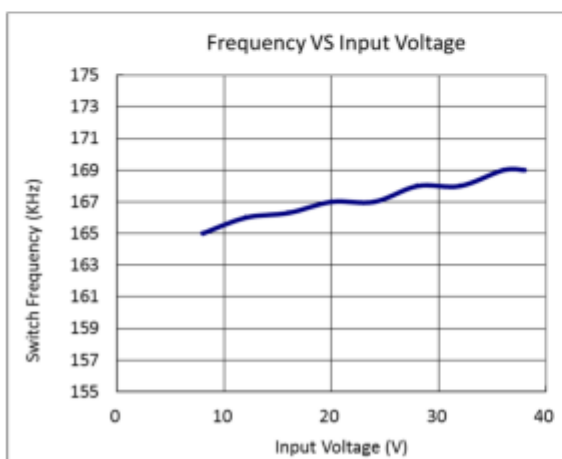
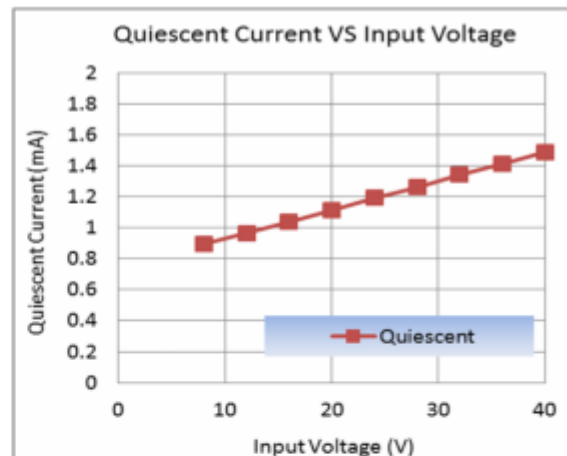
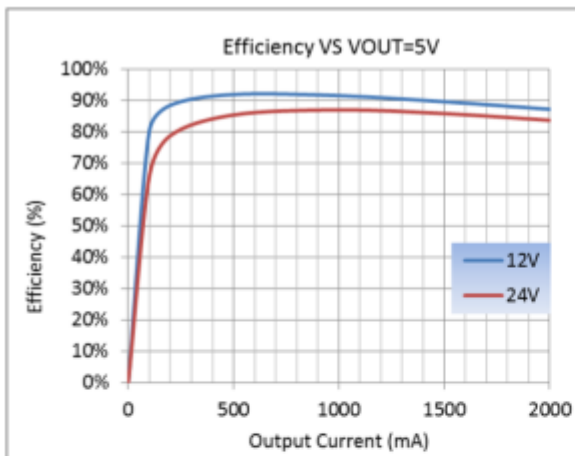
<b>VIN</b>	<28V	<35V
<b>Inductor</b>	47uH	33uH

The choice of which style inductor to use mainly depends on the price vs. size requirements and any EMI requirements.

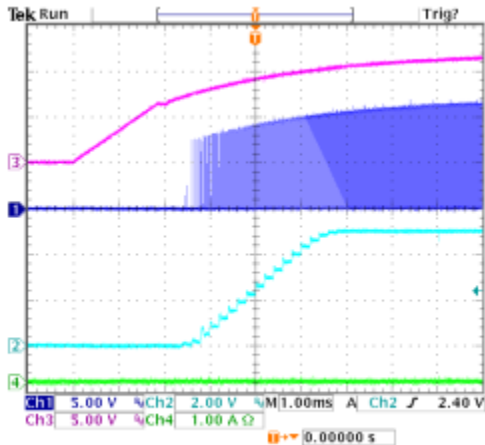
<b>RSEN</b>	100mΩ	50mΩ	45mΩ	40mΩ
<b>IOUT</b>	900mA	2000mA	2200mA	2500mA

### CC Measurement (L=33uH)

## Typical Characteristics

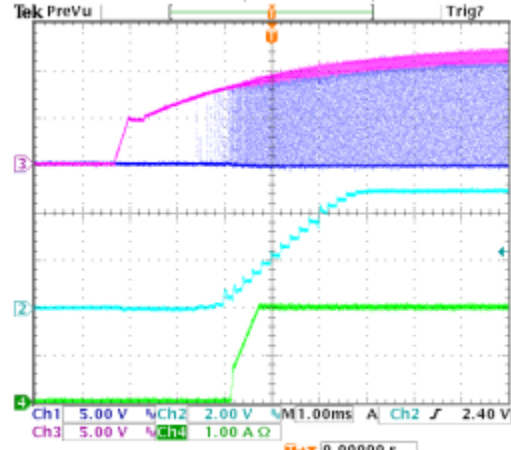


Power On :  $V_{IN} = 12V$ ,  $V_{OUT} = 5V$ ,  $I_{LOAD} = 0A$



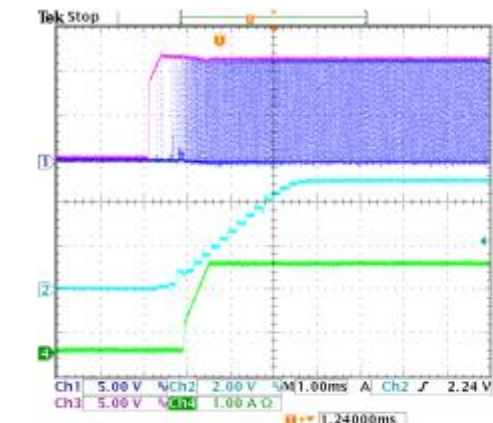
Ch1=SW , Ch2=V<sub>OUT</sub> , Ch3=V<sub>IN</sub> , Ch4=I<sub>OUT</sub>

Power On :  $V_{IN} = 12V$ ,  $V_{OUT} = 5V$ ,  $I_{LOAD} = 2A$



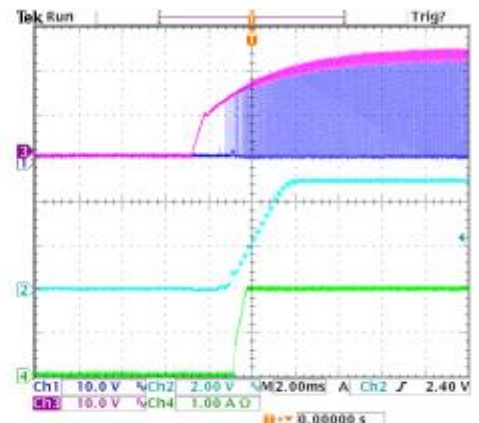
Ch1=SW , Ch2=V<sub>OUT</sub> , Ch3=V<sub>IN</sub> , Ch4=I<sub>OUT</sub>

Cable On :  $V_{IN} = 12V$ ,  $V_{OUT} = 5V$ ,  $I_{LOAD} = 2A$



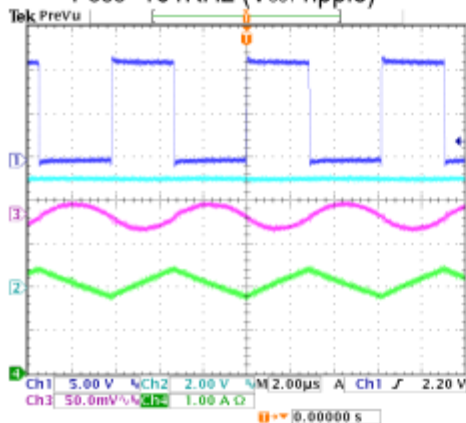
Ch1=SW , Ch2=V<sub>OUT</sub> , Ch3=V<sub>IN</sub> , Ch4=I<sub>OUT</sub>

Power On :  $V_{IN} = 24V$ ,  $V_{OUT} = 5V$ ,  $I_{LOAD} = 2A$



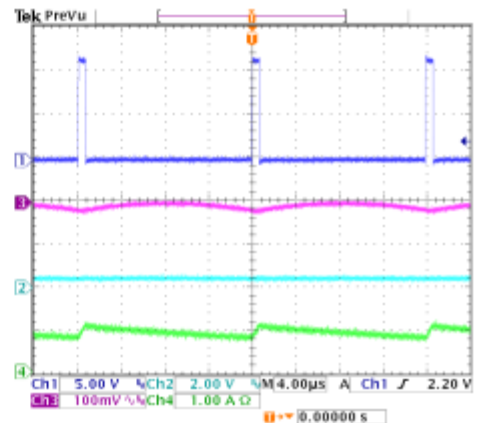
Ch1=SW , Ch2=V<sub>OUT</sub> , Ch3=V<sub>IN</sub> , Ch4=I<sub>SW</sub>

$V_{IN} = 12V$ ,  $V_{OUT} = 5V$ ,  $I_{LOAD} = 2A$ ,  
 $F_{OSC} = 161KHz$  ( $V_{OUT}$  ripple)

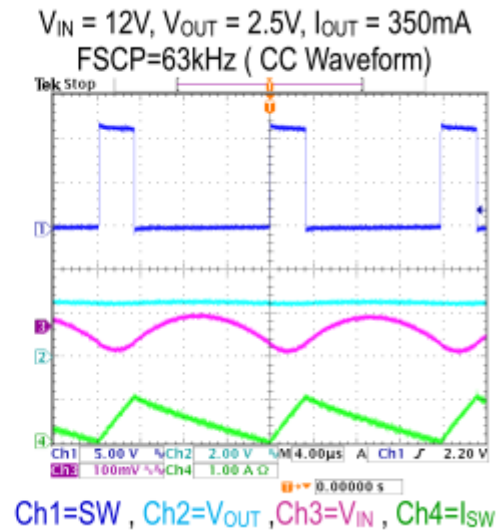
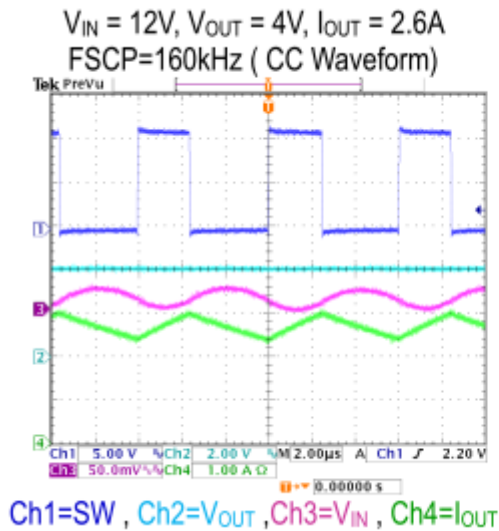


Ch1=SW , Ch2=V<sub>OUT</sub> , Ch3=V<sub>IN</sub> , Ch4=I<sub>SW</sub>

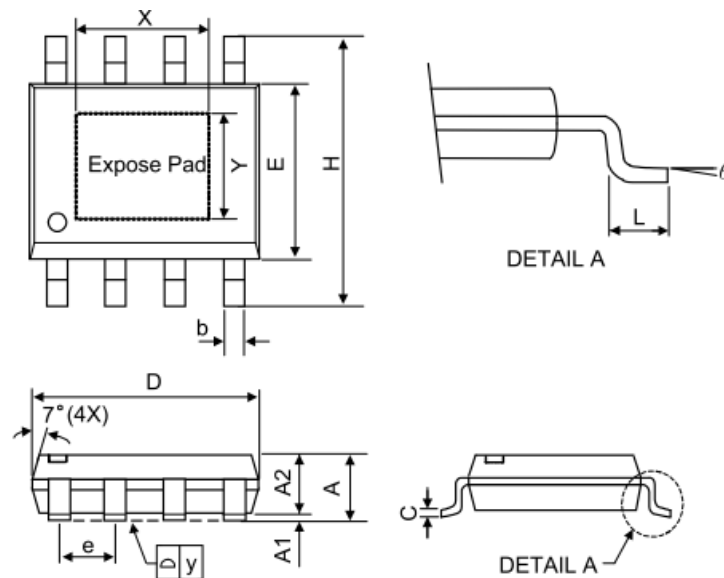
FSCP,  $V_{IN} = 12V$ ,  $V_{OUT} = 0.3V$ ,  $I_{OUT} = 350mA$



Ch1=SW , Ch2=V<sub>OUT</sub> , Ch3=V<sub>IN</sub> , Ch4=I<sub>SW</sub>



## Package Outlines



Symbol	Dimensions in Millimeters			Dimensions in Inches		
	Min.	Nom.	Max.	Min.	Nom.	Max.
A	-	-	1.75	-	-	0.069
A1	0	-	0.15	0	-	0.06
A2	1.25	-	-	0.049	-	-
C	0.1	0.2	0.25	0.0075	0.008	0.01
D	4.7	4.9	5.1	0.185	0.193	0.2
E	3.7	3.9	4.1	0.146	0.154	0.161
H	5.8	6	6.2	0.228	0.236	0.244
L	0.4	-	1.27	0.015	-	0.05
b	0.31	0.41	0.51	0.012	0.016	0.02
e	1.27 BSC			0.050 BSC		
y	-	-	0.1	-	-	0.004
X	-	2.34	3.33	-	0.092	0.131
Y	-	2.34	2.54	-	0.092	0.10
θ	0°	-	8°	0°	-	8°

Mold flash shall not exceed 0.25mm per side  
JEDEC outline: MS-012 BA