

## 1.6A, 13V, 600KHz Synchronous Rectified Step-Down Converter

### ❖ GENERAL DESCRIPTION

The AX3821 is a monolithic synchronous buck regulator. The device integrates two 100mΩ MOSFETs, and provides 1.6A of continuous load current over a wide input voltage of 4.5V to 13V. Current mode control provides fast transient response and cycle-by-cycle current limit.

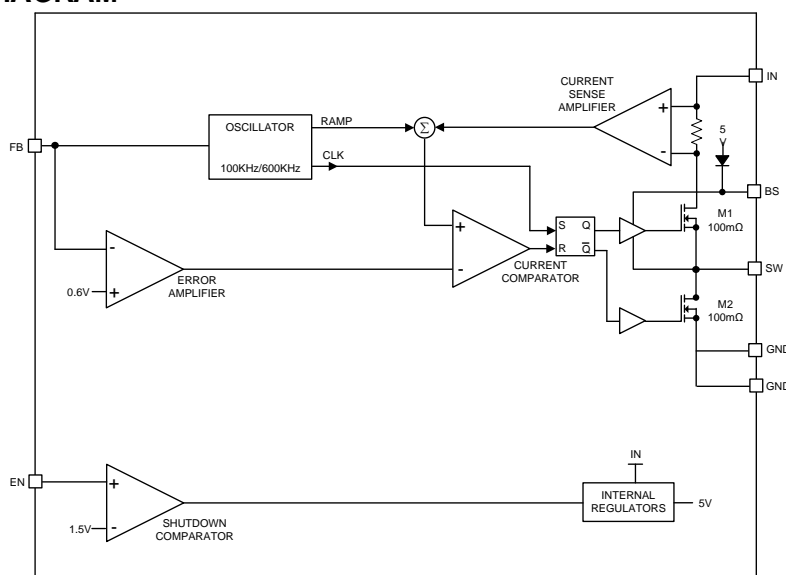
Internal soft-start prevents inrush current at turn-on, and in shutdown mode the supply current drops to 1μA.

This device, available in SOT-23-6L package, provides a very compact solution with minimal external components.

### ❖ FEATURES

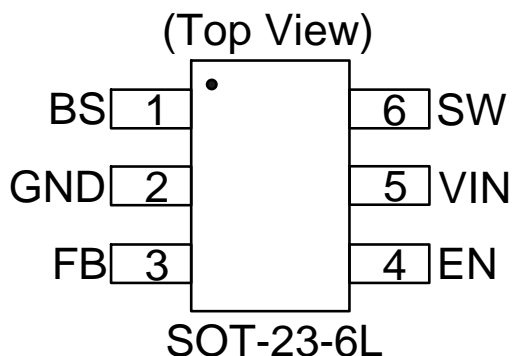
- 1.6A Output Current
- Wide 4.5V to 13V Operating Input Range
- Integrated 100mΩ Power MOSFET Switches
- Output adjust from  $V_{FB}$  to 11V
- Internal compensation
- Up to 94% Efficiency
- Stable with Low ESR Ceramic Output Capacitors
- Fixed 600KHz Frequency
- Cycle-by-Cycle Over Current Protection
- Thermal shutdown and short circuit protections

### ❖ BLOCK DIAGRAM



**❖ PIN ASSIGNMENT**

The package of AX3821 is SOT-23-6L; the pin assignment is given by:



Name	Description
<b>BS</b>	Bootstrap. A 10nF capacitor is connected between SW and BS pins to drive the power switch's gate above the supply voltage.
<b>GND</b>	Ground Pin. Connect this pin to exposed pad.
<b>FB</b>	Feedback. An external resistor divider from the output to GND, tapped to the FB pin sets the output voltage.
<b>VIN</b>	Power Supply Input. Drive 4.5V to 13V voltage to this pin to power on this chip. Connect a 10μF ceramic bypass capacitor between VIN and GND to eliminate noise.
<b>SW</b>	Switch Output. Connect this pin to the switch end of the inductor.
<b>EN</b>	Enable Input. EN is a digital input that turns the regulator on or off. Drive EN high to turn on the regulator, drive it low to turn it off. Pull up with 100kΩ resistor for automatic startup.

**❖ ORDER/MARKING INFORMATION**

Order Information	Top Marking
<b>AX3821XX</b> Package Type      Packing C: SOT-23-6L      Blank: Tube A : Taping	<b>RYYWX</b> → ID code:internal WW:01~26 (A~Z) 27~52 (a~z) Year: A=2010 1=2011 2=2012 ⋮ 9=2019 AX3821

**❖ ABSOLUTE MAXIMUM RATINGS (at  $T_A=25^{\circ}\text{C}$ )**

Characteristics	Symbol	Rating	Unit
Input Voltage	$V_{IN}$	-0.3 to +13	V
Switch Node Voltage	$V_{SW}$	-1V to $V_{IN}+0.3\text{V}$	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	$V_{OUT}$	0.6 to 11	V
Ambient Operating Temperature		-40 to +85	$^{\circ}\text{C}$
Thermal Resistance from Junction to case	$\theta_{JC}$	180	$^{\circ}\text{C}/\text{W}$
Thermal Resistance from Junction to ambient	$\theta_{JA}$	250	$^{\circ}\text{C}/\text{W}$

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

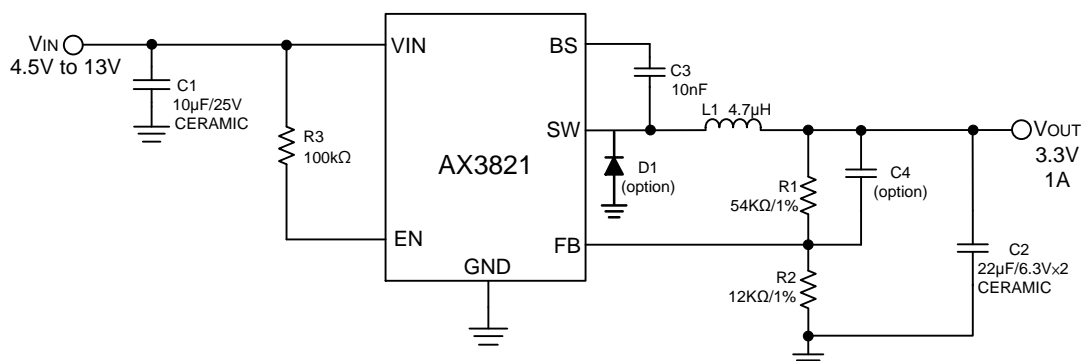
**❖ ELECTRICAL CHARACTERISTICS**

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

Characteristics	Symbol	Conditions	Min	Typ	Max	Units
Operating Voltage	$V_{IN}$		4.5	-	13	V
Shutdown Supply Current	$I_{SD}$		-	1	-	$\mu\text{A}$
Shutdown Current Operation		$V_{FB}=0.6\text{V}$	-	0.5	0.7	mA
Feedback Voltage	$V_{FB}$	$4.5\text{V} \leq V_{IN} \leq 13\text{V}$	0.58	0.6	0.62	V
Line Regulation	$\Delta V_{OUT}/V_{OUT}$	$V_{CC}=5\text{V}\sim 11\text{V}$	-	0.06	-	V
Load Regulation		$I_{OUT}=0 \sim 1.6\text{A}$	-2	-	+2	%
High-Side Switch On Resistance (Note)	$R_{DS(ON)1}$		-	100	-	m $\Omega$
Low-Side Switch On Resistance (Note)	$R_{DS(ON)2}$		-	100	-	m $\Omega$
High-Side Switch Leakage Current		$V_{SW} = 0\text{V}$	-	-	10	$\mu\text{A}$
Switch Current Limit			2	-	-	A
Oscillation Frequency	$F_{OSC1}$		-	600	-	KHz
Short Circuit Oscillation Frequency	$F_{OSC2}$	$V_{FB} = 0\text{V}$	-	100	-	KHz
Maximum Duty Cycle	$D_{MAX}$	$V_{FB} = 0.4\text{V}$	-	90	-	%
EN High-Level Input Voltage	$V_{EN\_H}$		2.5	-	-	V
EN Low-Level Input Voltage	$V_{EN\_L}$		-	-	0.6	V
EN Shutdown Threshold Voltage Hysteresis			-	110	-	mV
Thermal Shutdown	$T_{SD}$		-	150	-	$^{\circ}\text{C}$
Thermal Shutdown Hysteresis	$T_{SH}$		-	20	-	$^{\circ}\text{C}$

Note: Guaranteed by design.

❖ APPLICATION CIRCUIT



$$V_{OUT} = V_{FB} \times \left(1 + \frac{R1}{R2}\right), V_{FB} = 0.6V, R2 \text{ suggest } 10k \sim 30K\Omega$$

Table Recommended Component Selection

V <sub>OUT</sub>	R <sub>H</sub>	R <sub>L</sub>	L	C <sub>OUT</sub>
5	110KΩ	15KΩ	4.7uH	22uF*2
3.3	54KΩ	12KΩ	4.7uH	22uF*2
2.5	47KΩ	15KΩ	4.7uH	22uF*2
1.8	60KΩ	30KΩ	4.7uH	22uF*2
1.5	45KΩ	30KΩ	2.2uH	22uF*2

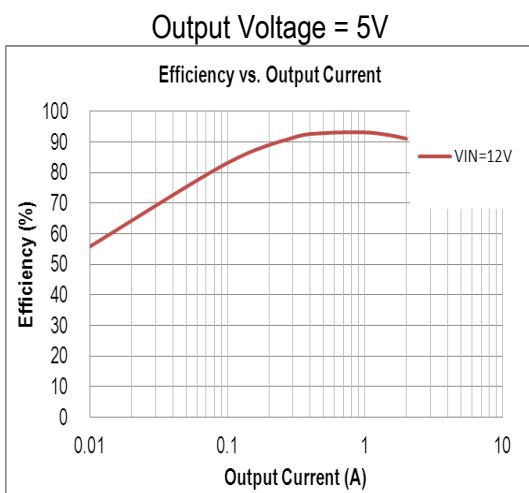
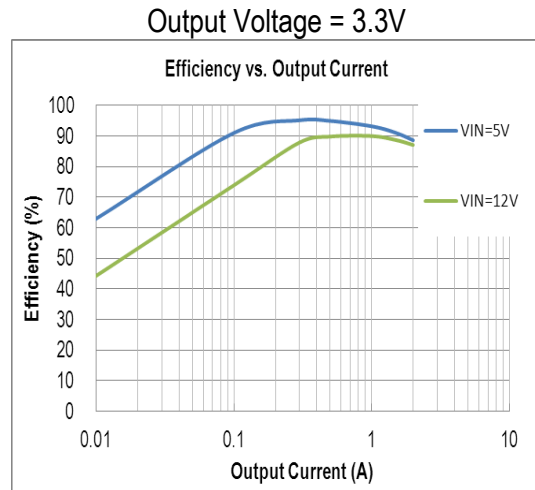
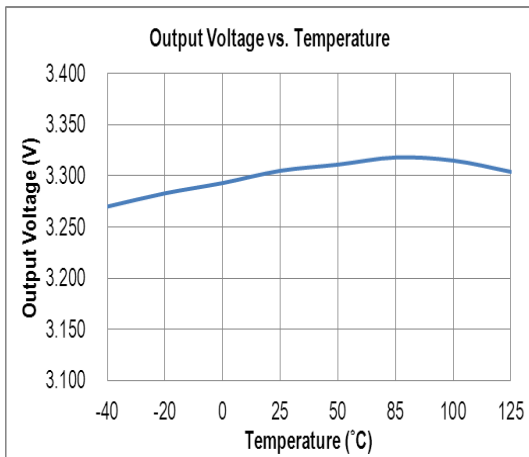
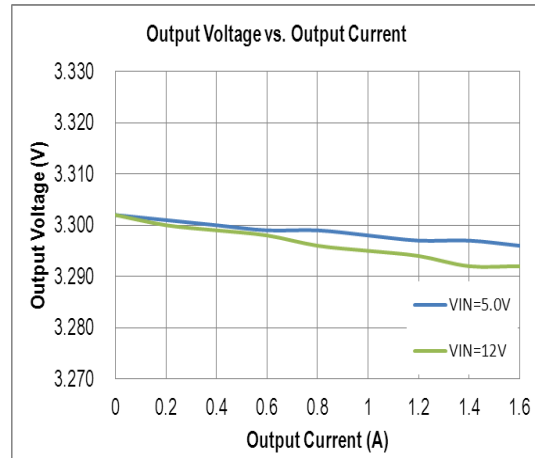
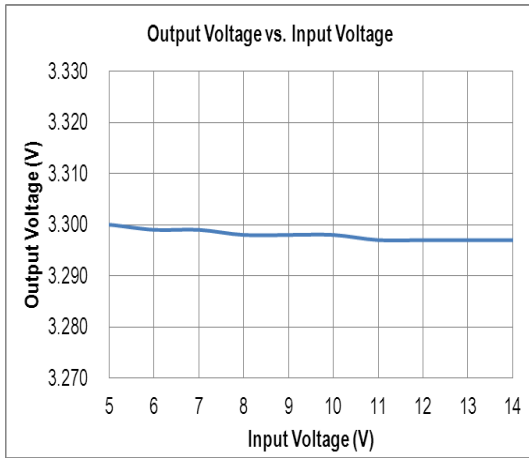
❖ FUNCTION DESCRIPTIONS

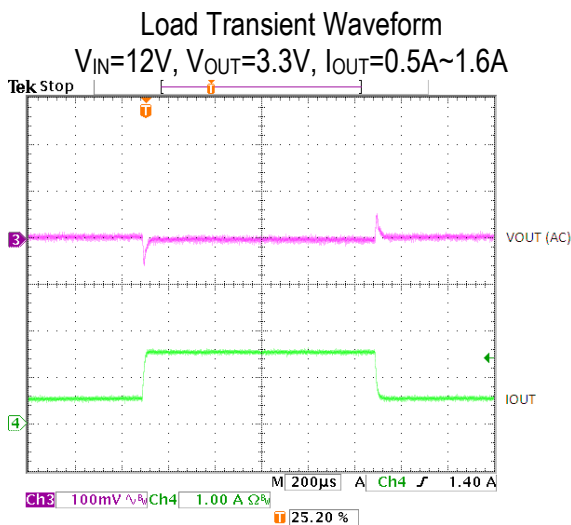
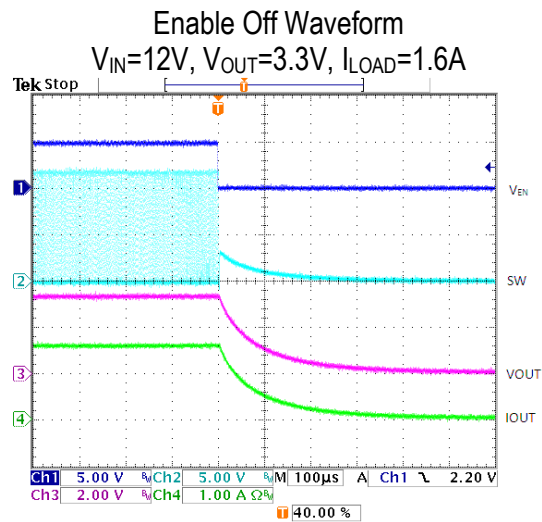
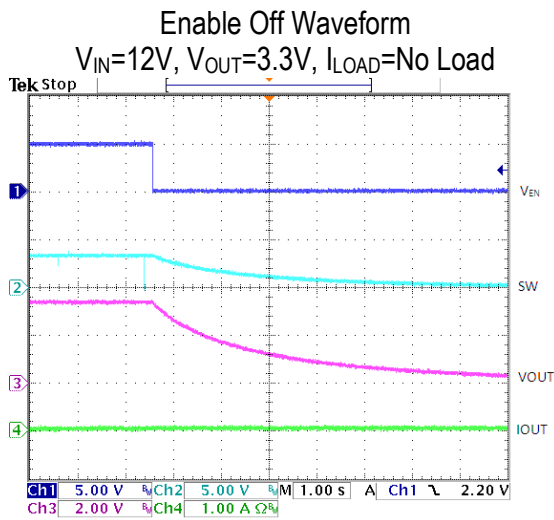
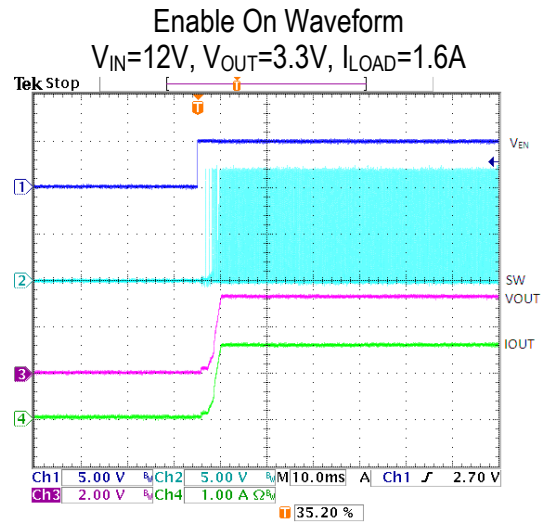
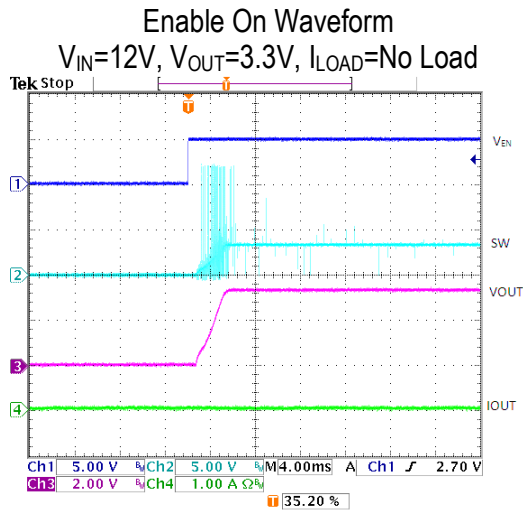
The AX3821 is a synchronous rectified, current-mode, step-down regulator. It regulates input voltages from 4.5V to 13V down to an output voltage as low as 0.6V, and supplies up to 1.6A of load current.

The AX3821 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.

❖ TYPICAL CHARACTERISTICS



**❖ TYPICAL CHARACTERISTICS (COUNTINOUS)**


## ❖ APPLICATION INFORMATION COMPONENT SELECTION

### 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:

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

Where V<sub>FB</sub> is the feedback voltage and V<sub>OUT</sub> is the output voltage.

Thus the output voltage is:

$$V_{OUT} = 0.6 \times \frac{R1 + R2}{R2}$$

R2 can be as high as 100kΩ, but a typical value is 10kΩ. Using the typical value for R2, R1 is determined by:

$$R1 = 20 \times (V_{OUT} - 0.6) \text{ (k}\Omega\text{)}$$

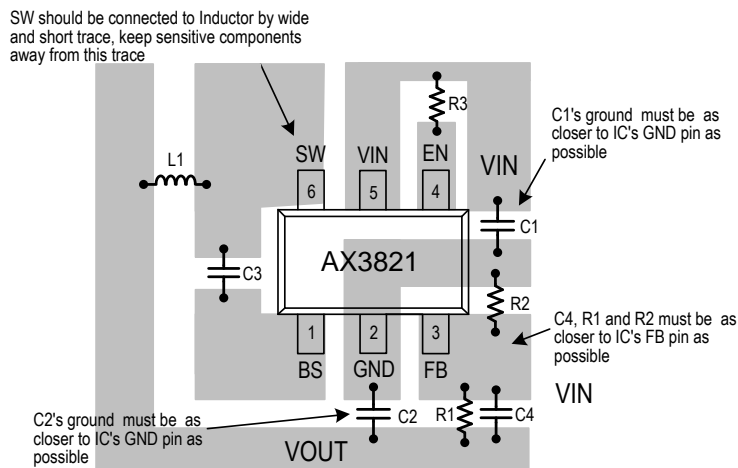
For example, for a 3.3V output voltage, R2 is 12kΩ, and R1 is 54kΩ.

## Layout Guidance

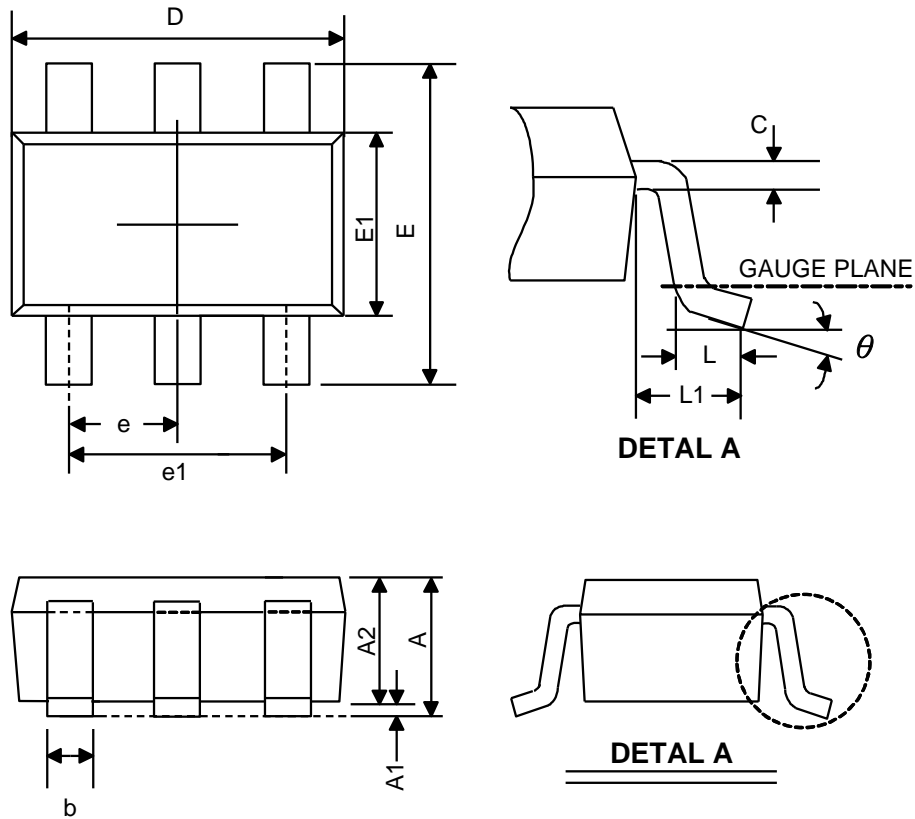
When laying out the PC board, the following suggestions should be taken to ensure proper operation of the AX3821. These items are also illustrated graphically in below.

1. The power traces, including the GND trace, the SW trace and the  $V_{IN}$  trace should be kept short, direct and wide to allow large current flow. Put enough multiply-layer pads when they need to change the trace layer.
2. Connect the input capacitor C1 to the  $V_{IN}$  pin as closely as possible to get good power filter effect.
3. Keep the switching node, SW, away from the sensitive FB node.
4. Do not trace signal line under inductor.

## SOT-23-6L Layout Guide





**❖ PACKAGE OUTLINES**


Symbol	Dimensions in Millimeters			Dimensions in Inches		
	Min.	Nom.	Max.	Min.	Nom.	Max.
A	-	-	1.45	-	-	0.057
A1	0.00	-	0.15	0	0.003	0.006
A2	0.90	1.10	1.30	0.035	0.043	0.051
b	0.30	0.40	0.50	0.012	0.016	0.020
C	0.08	-	0.22	0.003	0.006	0.009
D	2.70	2.90	3.10	0.106	0.114	0.122
E1	1.40	1.60	1.80	0.055	0.063	0.071
E	2.60	2.80	3.00	0.102	0.110	0.118
L	0.30	0.45	0.60	0.012	0.018	0.024
L1	0.50	0.60	0.70	0.020	0.024	0.028
e1	1.9 BSC			0.075 BSC		
e	0.95 BSC			0.037 BSC		
θ	0°	4°	8°	0°	4°	8°

JEDEC outline: MO-178 AB