

## SMALL PACKAGE PFM CONTROL STEP-UP DC/DC CONVERTER

## LR8301 Series

### Introduction

The **LR8301 Series** is a CMOS PFM-control step-up switching DC/DC converter that mainly consists of a reference voltage source, an oscillator, and a comparator. The PFM controller allows the duty ratio to be automatically switched according to the load (light load: 50%, high output current: 75%), enabling products with a low ripple over a wide range, high efficiency, and high output current. With the LR8301 Series, a step-up switching DC/DC converter can be configured by using an external coil, capacitor, and diode. The built-in MOS FET is turned off by a protection circuit when the voltage at the LX pin exceeds the limit to prevent it from being damaged. This feature, along with the mini package and low current consumption, makes the LR8301 Series ideal for applications such as the power supply unit of portable equipment.

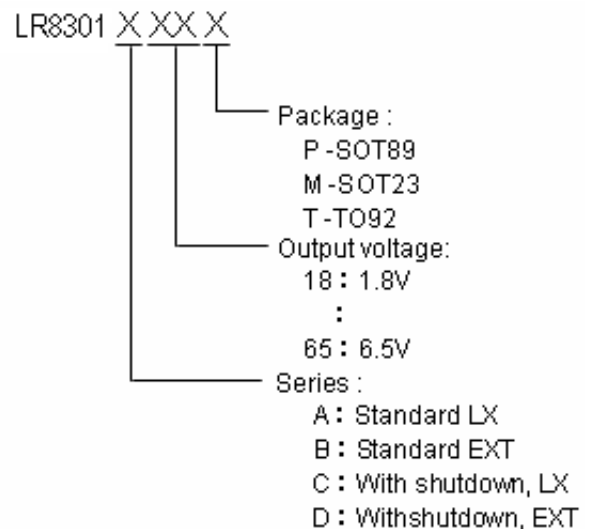
### Applications

- Power supply for portable equipment such as digital cameras, electronic notebooks, and PDAs
- Power supply for audio equipment such as portable CD/MD players
- Constant voltage power supply for cameras, video equipment, and communications equipment
- Power supply for microcomputers

### Features

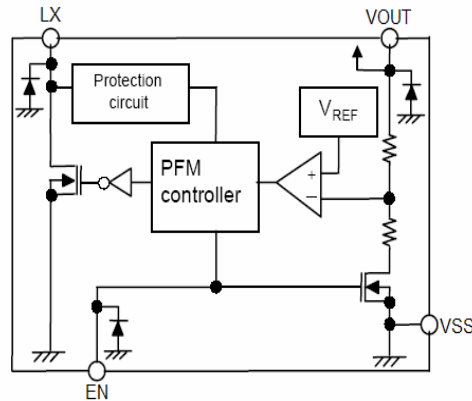
- Low voltage operation: Startup at 0.9 V min. ( $I_{OUT} = 1 \text{ mA}$ ) guaranteed
- Duty ratio: 66/78%, builtin auto switching type PFM controller
- External parts: Coil, capacitor, diode
- Output voltage: Settable to between 1.8 to 6.5 V in 0.1 V steps
- Accuracy of  $\pm 2\%$
- High efficiency:  $\pm 85\%$  (typ.)
- Standard function (product type A)
- Shutdown function (product type C、D)
- External transistor type available (product type B、D)

### Ordering Information



# LR8301 Series

## Block Diagrams



## Pin Assignment

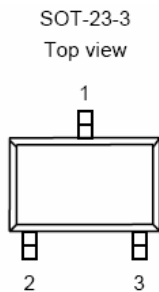


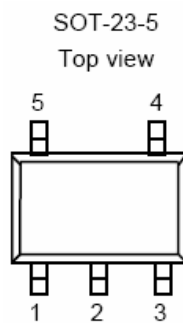
Table 1 LR8301A Series (SOT-23-3 PKG)

Pin No.	Pin Name	Functions
1	V <sub>OUT</sub>	Output voltage pin
2	V <sub>SS</sub>	GND pin
3	LX	External inductor connection pin

Table 2 LR8301B Series (SOT-23-3 PKG)

Pin No.	Pin Name	Functions
1	V <sub>OUT</sub>	Output voltage pin
2	V <sub>SS</sub>	GND pin
3	EXT	External transistor connection pin

Table 3 LR8301C Series (SOT-23-5 PKG)



Pin No.	Pin Name	Functions
1	EN	Shutdown pin "H": Normal operation "L": Step-up stopped
2	V <sub>OUT</sub>	Output voltage pin
3	NC	(N.C.)
4	V <sub>SS</sub>	GND pin
5	LX	External inductor connection pin

Table 4 LR8301D Series (SOT-23-5 PKG)

Pin No.	Pin Name	Functions
1	EN	Shutdown pin "H": Normal operation "L": Step-up stopped
2	V <sub>OUT</sub>	Output voltage pin
3	NC	(N.C.)
4	V <sub>SS</sub>	GND pin
5	EXT	External transistor connection pin

## LR8301 Series

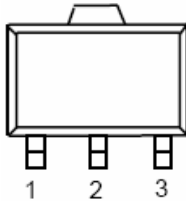
 SOT-89-3  
Top view


Table 5 LR8301A Series (SOT-89-3 PKG)

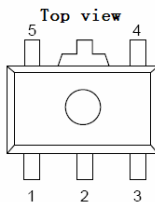
Pin No.	Pin Name	Functions
1	V <sub>SS</sub>	GND pin
2	V <sub>OUT</sub>	Output voltage pin
3	LX	External inductor connection pin

Table 6 LR8301B Series (SOT-89-3 PKG)

Pin No.	Pin Name	Functions
1	V <sub>SS</sub>	GND pin
2	V <sub>OUT</sub>	Output voltage pin
3	EXT	External transistor connection pin

Table 7 LR8301C Series (SOT-89-5 PKG)

SOT-89-5



Pin No.	Pin Name	Functions
1	NC	(N.C.)
2	V <sub>OUT</sub>	Output voltage pin
3	EN	Shutdown pin "H": Normal operation "L": Step-up stopped
4	LX	External inductor connection pin
5	V <sub>SS</sub>	GND pin

Table 8 LR8301D Series (SOT-89-5 PKG)

Pin No.	Pin Name	Functions
1	NC	(N.C.)
2	V <sub>OUT</sub>	Output voltage pin
3	EN	Shutdown pin "H": Normal operation "L": Step-up stopped
4	EXT	External transistor connection pin
5	V <sub>SS</sub>	GND pin

### Absolute Maximum Ratings

(Unless otherwise specified, Ta=25 °C)

Parameter	Symbol	Ratings	Unit
V <sub>OUT</sub> pin voltage	V <sub>OUT</sub>	V <sub>SS</sub> -0.3 ~ V <sub>SS</sub> +10	V
EN pin voltage	EN	V <sub>SS</sub> -0.3 ~ V <sub>SS</sub> +10	V
LX pin voltage	V <sub>LX</sub>	V <sub>SS</sub> -0.3 ~ V <sub>SS</sub> +10	V
LX pin current	I <sub>LX</sub>	1000	mA
Power dissipation	SOT-23-3	PD	250
	SOT-23-5		250
	SOT-89-3		500
Operating temperature	Topr	-40 ~ +85	°C
Storage temperature	Tstg	-40 ~ +125	°C

## LR8301 Series

### Electrical Characteristics

(Unless otherwise specified, Ta = 25 °C)

Parameter	Symbol	Conditions	Min.	Typ.	Max.	Unit
Output voltage	$V_{OUT}$	—	$V_{OUT(S)} \times 0.98$	$V_{OUT}$	$V_{OUT(S)} \times 1.02$	V
Input voltage	$V_{IN}$	—	—	—	10	V
Operation start voltage	$V_{ST1}$	$I_{OUT} = 1 \text{ mA}$	—	—	0.9	V
Oscillation start voltage	$V_{ST2}$	No external parts, voltage applied to $V_{OUT}$ LX pulled up to $V_{OUT}$ via 300 resistor	—	—	0.8	V
Current consumption 1	$I_{SS1}$	$V_{OUT} = 0.95 \times V_{OUT}$	—	30	40	$\mu\text{A}$
		$V_{OUT}: 3.0\text{V}$ $V_{OUT}: 5.0\text{V}$	—	50	60	$\mu\text{A}$
Current consumption 2	$I_{SS2}$	$V_{OUT} = V_{OUT} + 0.5 \text{ V}$	—	6	10	$\mu\text{A}$
Current consumption during shutdown	$I_{SSS}$	$V_{EN} = 0 \text{ V}$	—	—	0.5	$\mu\text{A}$
Switching current	$I_{SW}$	$V_{LX} = 0.4 \text{ V}$	100	200	—	mA
Switching transistor leakage current	$I_{SWQ}$	No external parts, $V_{LX} = V_{OUT} = 10 \text{ V}$ , $V_{EN} = 0 \text{ V}$	—	—	0.5	$\mu\text{A}$
Line regulation	$\Delta V_{OUT1}$	$V_{IN} = 0.4 \times V_{OUT} \sim 0.6 \times V_{OUT}$	—	20	50	mV
Load regulation	$\Delta V_{OUT2}$	$I_{OUT} = 10 \mu\text{A} \sim 50\text{mA}$	—	20	50	mV
Maximum Oscillation frequency	$f_{OSC}$	$V_{OUT} = 0.95 \times V_{OUT}$ , measure waveform at LX pin	—	100	—	kHz
Duty ratio 1	Duty1	$V_{OUT} = 0.95 \times V_{OUT}$ , measure waveform at LX pin	70	78	85	%
Duty ratio 2	Duty2	Measure waveform at LX pin with light load	—	66	—	%
Efficiency	EFF1	—	—	85	—	%
Shutdown pin input voltage	$V_{SH}$	$V_{OUT} = 0.95 \times V_{OUT}$ , judge oscillation at LX pin	0.75	—	—	V
	$V_{SL1}$	$V_{OUT} = 0.95 \times V_{OUT}$ , judge stop at LX pin	—	—	0.3	V
Shutdown pin input current	$I_{SH}$	$V_{EN} = 10\text{V}$	-0.1	—	0.1	$\mu\text{A}$
	$I_{SL}$	$V_{EN} = 0\text{V}$	-0.1	—	0.1	$\mu\text{A}$

 Remark:  $V_{IN} = V_{OUT(S)} \times 0.6$  applied,  $I_{OUT} = V_{OUT(S)} / 250 \Omega$ 

 Shutdown function built-in type: EN pin is connected to  $V_{OUT}$ 
 $V_{OUT(S)}$  specified above is the set output voltage value, and  $V_{OUT}$  is the typical value of the actual output voltage.

## LR8301 Series

### Standard Circuits

**Component:** Inductor: 47uH(Sumida)

Capacitor: 47uF/16V(Tantalume type)

NMOS: XP151、XP161

Base Capacitor(Cb): 2200pF

$R_{FB}$ : Set up so that  $R_{FB1}/R_{FB2}=V_{out}-1$ ( $V_{out}$ =set-up output voltage),

Please use with  $R_{FB1} + R_{FB2} \leq 2M \Omega$

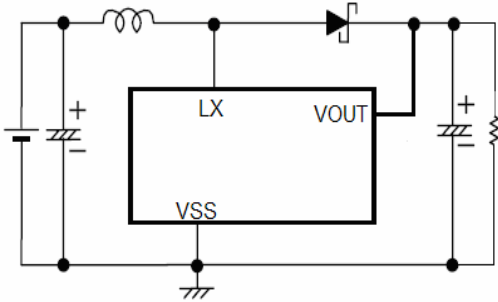
$C_{FB}$ : Set up that  $F_{zfb}=1/(2 \times \pi \times C_{FB} \times R_{FB1})$  is within the Adjustments necessary in respect of  $L, C_L$ .

Diode: 1N5817, 1N5819

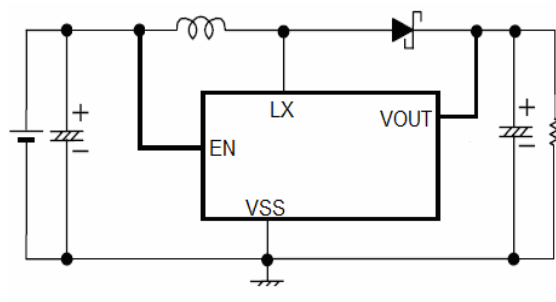
Transistor: 2SD1628G、2SD3279

Base Resistor( $R_b$ ): 1K  $\Omega$

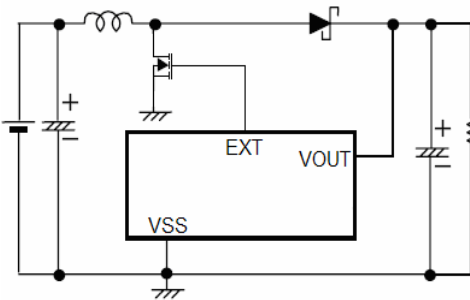
#### 1、 LR8301A Circuits:



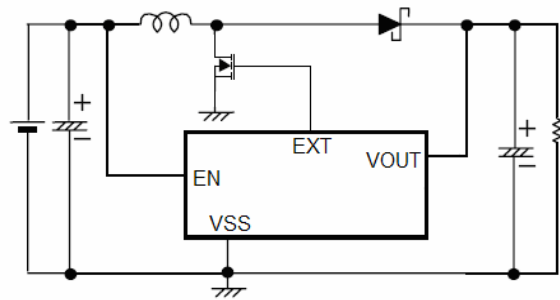
#### 2、 LR8301C Circuits:



#### 3、 LR8301B Circuits:



#### 4、 LR8301D Circuits:

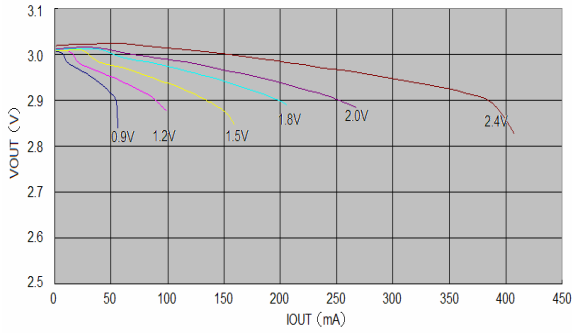


# LR8301 Series

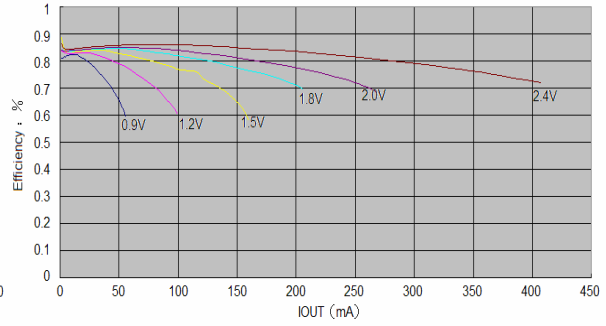
## Characteristics

### 1. LR8301A30P:

a、 $V_{OUT}$  vs.  $I_{OUT}$  :

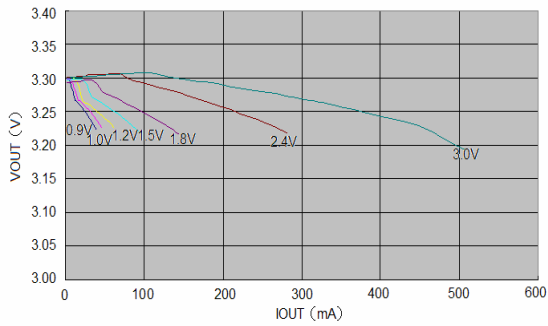


b、Efficiency vs.  $I_{OUT}$  :

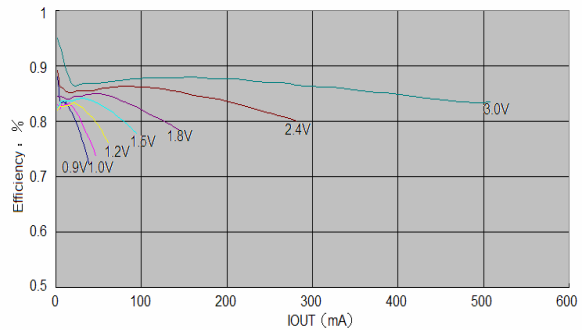


### 2. LR8301A33P:

a、 $V_{OUT}$  vs.  $I_{OUT}$  :

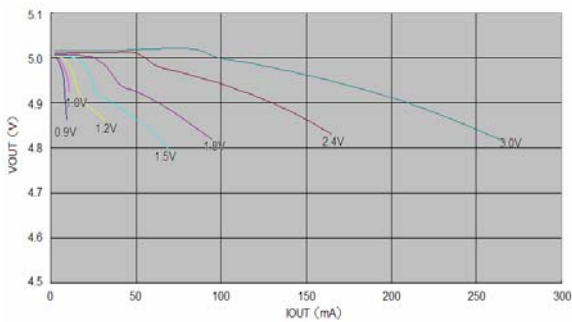


b、Efficiency vs.  $I_{OUT}$  :

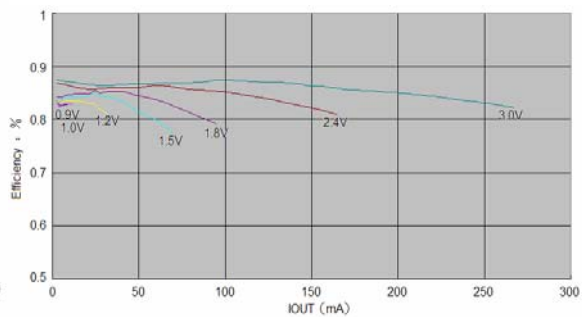


### 3. LR8301A50P:

a、 $V_{OUT}$  vs.  $I_{OUT}$  :



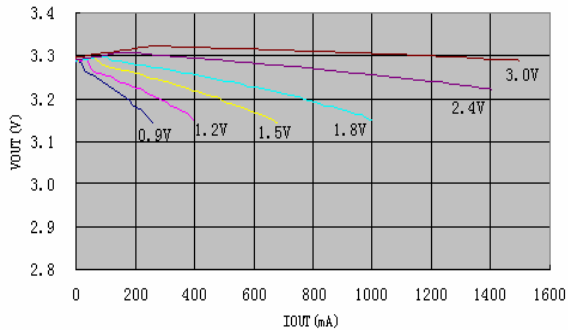
b、Efficiency vs.  $I_{OUT}$  :



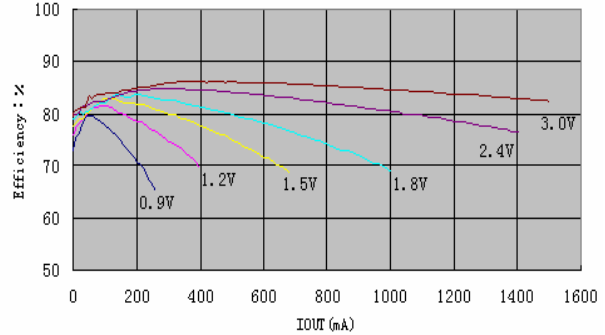
## LR8301 Series

### 4. LR8301B33P:

a、 $V_{OUT}$  vs.  $I_{OUT}$  :

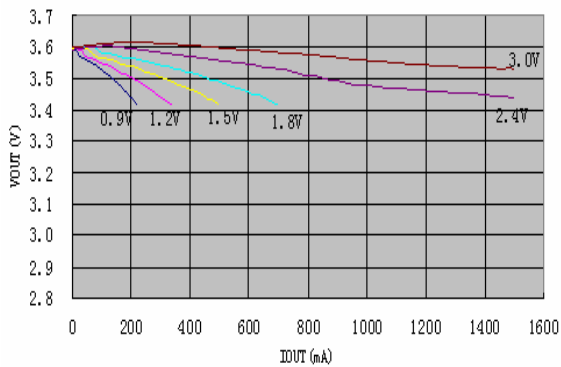


b、Efficiency vs.  $I_{OUT}$  :

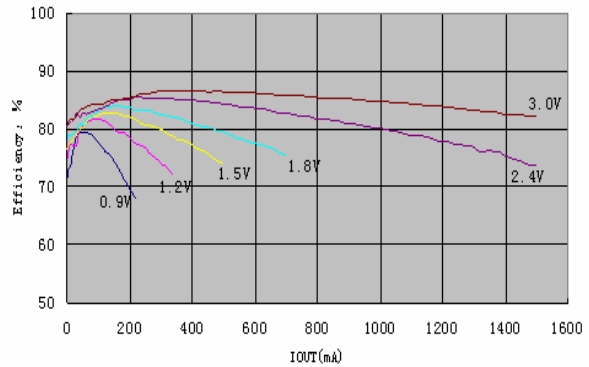


### 5. LR8301B36P:

a、 $V_{OUT}$  vs.  $I_{OUT}$  :

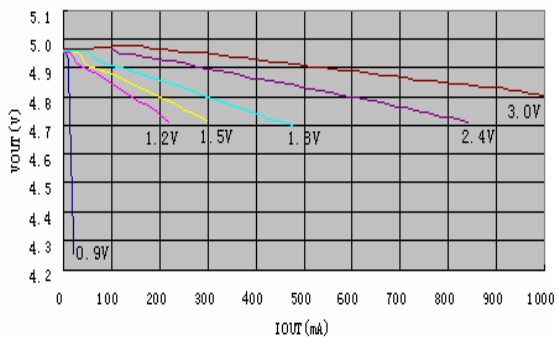


b、Efficiency vs.  $I_{OUT}$  :

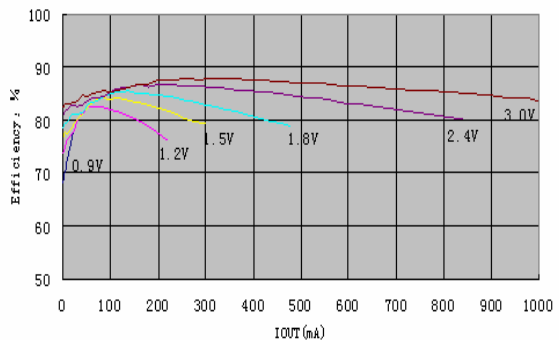


### 6. LR8301B50P:

a、 $V_{OUT}$  vs.  $I_{OUT}$  :

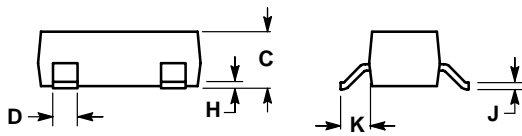
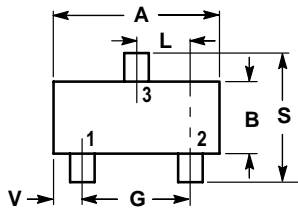


b、Efficiency vs.  $I_{OUT}$  :



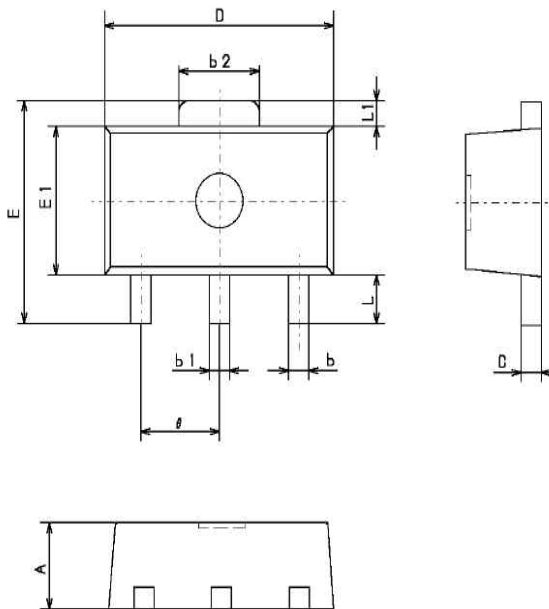
# LR8301 Series

## SOT-23



DIM	INCHES		MILLIMETERS	
	MIN	MAX	MIN	MAX
A	0.1102	0.1197	2.80	3.04
B	0.0472	0.0551	1.20	1.40
C	0.0350	0.0440	0.89	1.11
D	0.0150	0.0200	0.37	0.50
G	0.0701	0.0807	1.78	2.04
H	0.0005	0.0040	0.013	0.100
J	0.0034	0.0070	0.085	0.177
K	0.0140	0.0285	0.35	0.69
L	0.0350	0.0401	0.89	1.02
S	0.0830	0.1039	2.10	2.64
V	0.0177	0.0236	0.45	0.60

## SOT-89

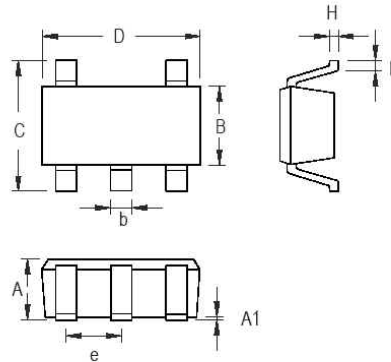


Symbols	Dimensions in millimeters		
	Min	Nom	Max
A	1.40	1.50	1.60
b	0.36	0.42	0.48
b1	0.41	0.47	0.53
b2	1.40	1.60	1.75
C	0.38	0.40	0.43
D	4.40	4.50	4.60
E	—	—	4.25
E1	2.40	2.50	2.60
$\theta$	1.40	1.50	1.60
L	1.80	—	—
L1	—	0.40	—



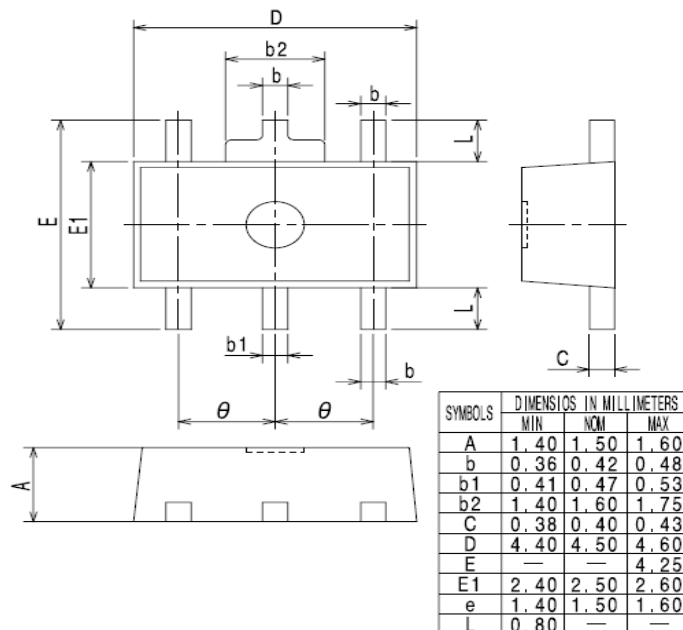
# LR8301 Series

## SOT-23-5



Symbol	Dimensions In Millimeters		Dimensions In Inches	
	Min	Max	Min	Max
A	0.889	1.295	0.035	0.051
A1	0.000	0.152	0.000	0.006
B	1.397	1.803	0.055	0.071
b	0.356	0.559	0.014	0.022
C	2.591	2.997	0.102	0.118
D	2.692	3.099	0.106	0.122
e	0.838	1.041	0.033	0.041
H	0.080	0.254	0.003	0.010
L	0.300	0.610	0.012	0.024

## SOT-89-5



SYMBOLS	DIMENSIONS IN MILLIMETERS		
	MIN	NOM	MAX
A	1.40	1.50	1.60
b	0.36	0.42	0.48
b1	0.41	0.47	0.53
b2	1.40	1.60	1.75
C	0.38	0.40	0.43
D	4.40	4.50	4.60
E	—	—	4.25
E1	2.40	2.50	2.60
e	1.40	1.50	1.60
L	0.80	—	—