1A Adjustable & Fixed Voltage LDO Linear Regulator

Features

- **Operating Voltage Range：+2.3V to +7.0V**
- **Output Voltages：+1.0V to +5.0V (0.1V Step) (Fixed), +1.25V to +5.0V (ADJ Type)**
- **Maximum Output Current：1A**
- **Dropout Voltage：700mV @ 1000mA (Fixed)**
- **Fast Response in Power-on (Fixed Voltage Only)**
- **Low Current Consumption：60μA (Typ.)**
- **±2% Output Voltage Accuracy (special ±1% highly accurate), V_{OUT}≧1.8V**
- **Low ESR Capacitor Compatible**
- **High Ripple Rejection：55 dB (Typ.)**
- **Output Current Limit Protection：1.3A (Typ.)**
- **Short Circuit Protection：600mA (Typ.)**
- **Thermal Overload Shutdown Protection**
- **SOT-223, TO-252, TO-263 Packages**
- **RoHS Compliant and 100% Lead (Pb)-Free and Green (Halogen Free with Commercial Standard)**

General Description

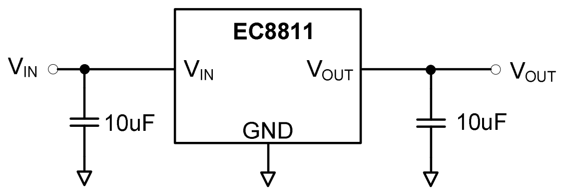
The EC8811 series is a low-dropout linear regulator that operates in the input voltage range from +2.3V to +7.0V and delivers 1.0A output current.

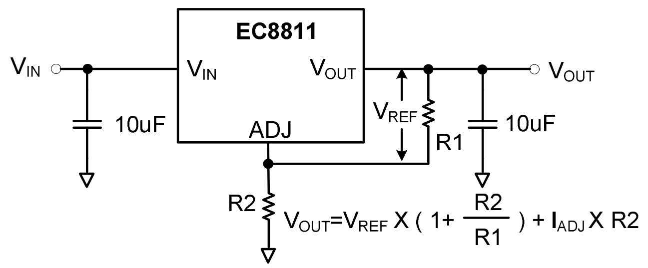
The EC8811 is available in two types, fixed output voltage type and adjustable output voltage type. The fixed output voltage type is preset at an internally trimmed voltage 1.0V,1.2V,1.8V, 2.5V, or 3.3V. Other options 1.2V, 1.5V, 2.85V, 3.0V and 3.6V are available by special order only. The output voltage range of the adjustable type is from 1.25V to 5V.
The EC8811 (ADJ type) consists of a 1.25V band-gap reference, an error amplifier, and a P-channel pass transistor. Other features include short-circuit protection and thermal shutdown protection.
The EC8811 (Fixed type) consists of a 0.95V band-gap reference, an error amplifier, and a P-channel pass transistor. Other features include short-circuit protection and thermal shutdown protection. The EC8811 series devices are available in SOT-223, TO-252, TO-263 packages.

Applications

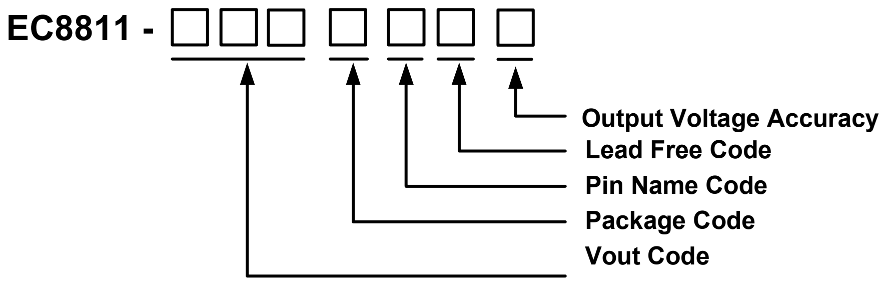
- Active SCSI Terminators
- High Efficiency Linear Regulators
- Monitor Microprocessors
- Low Voltage Micro-Controllers
- Post Regulator for Switching Power

Simplified Application Circuit





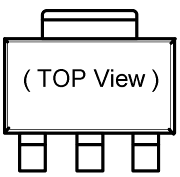
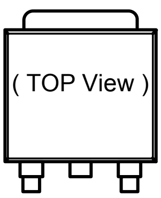
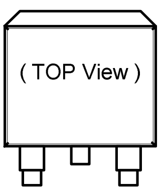
Ordering Information



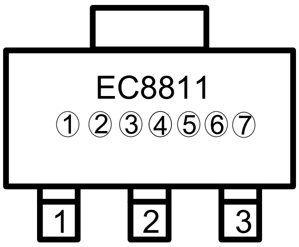
Vout Code：			
10=1.0V,**12**=1.2V,**18=**1.8V, **25=**2.5V, **33=**3.3V,**ADJ**=ADJ			
Package Code：	SOT-223 = **B7**	TO-252 = **A4**	TO-263 = **A8**
Pin Name Code :	SOT-223 = **J ' G ' X**	TO-252 = **P ' R**	TO-263 = **U**
Lead Free Code：G：Green (Halogen Free with Commercial Standard)			
Output Voltage Accuracy：			
1：±1%	**2**：±2%		

Note： * The difference between “J”, “G” & “X” type and “P” & “R” type, please refer to ”Pin Description”.

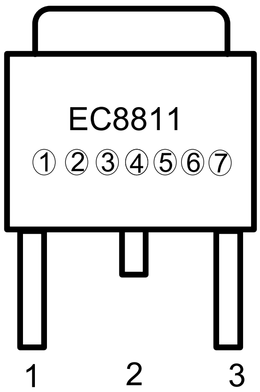
Pin Description

Part NO.	**Pin**			**Symbol**	**Pin Description**
	J	**G**	**X**		
 **SOT-223**	3	1	3	V_{IN}	Regulator Input Pin.
	1	2	2	GND/ADJ	Ground Pin or ADJ Terminal Pin.
	2	3	1	V_{OUT}	Regulator Output Pin.
Part NO.	**Pin**			**Symbol**	**Pin Description**
	P	**R**			
 **TO-252**	1	3		V_{IN}	Regulator Input Pin.
	2	1		GND/ADJ	Ground Pin.
	3	2		V_{OUT}	Regulator Output Pin.
Part NO.	**Pin**			**Symbol**	**Pin Description**
	U				
 **TO-263**	3			V_{IN}	Regulator Input Pin.
	1			GND/ADJ	Ground Pin.
	2			V_{OUT}	Regulator Output Pin.

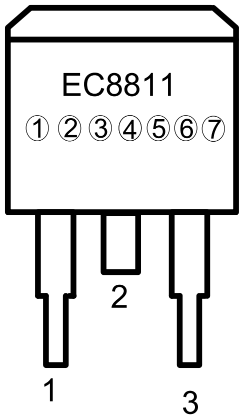
Package Marking Information



SOT-223
(Top View)



TO-252
(Top View)



TO-263
(Top View)

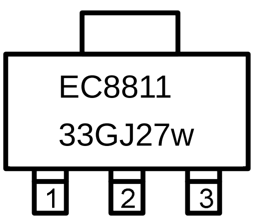
Top Point Represents Products Series

Mark	**Products Series**
Top Point	Part No. : EC8811

①、②、③、④、⑤ **Represents Products Series**

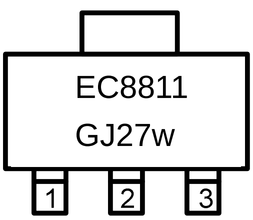
Mark		**Description**
①、②	Voltage	Voltage Code or Blank for Adjustable
③	F, G	Lead Free or Green Code
④	J, G, X, P, R,U	Pin name Code
⑤	Accuracy	1 (±1%) or 2 (±2%)
⑥、⑦	**Represents Production Date Code**	
⑥	Year	16 bit code ' 08 = 8' 09 = 9' 10 = A'
		11 = B' 12 = C….16 = G
⑦	weekly	1 ~ 26 = A ~ Z ' 27 ~ 52 = a ~ z

Example：



SOT-223
(Top View)

Part No.:EC8811-33B7JG2
1% Output Voltage Accuracy
Date Code: 7w
2007/49th week
Green Package



SOT-223
(Top View)

Part No.: EC8811-ADJB7JG2
Date Code: 7w
2007/49th week
Green Package

Absolute Maximum Ratings

Parameter		Symbol	Ratings	Units
Input Voltage V_{IN} to GND		V_{IN}	9.0	V
Output Current Limit, $I_{(LIMIT)}$		I_{OUT}	1.3	A
Junction Temperature		T_J	+155	℃
Thermal Resistance	SOT-223	θ_{JA}	155	℃/W
	TO-252		90	℃/W
	SOT-263		30	℃/W
	SOT-223	θ_{JC}	16	℃/W
	TO-252		11	℃/W
	SOT-263		6.5	℃/W
Power Dissipation	SOT-223	P_D	900	mW
	TO-252		1200	
	SOT-263		3300	
Operating Ambient Temperature		T_{OPR}	-40 ~ +85	℃
Storage Temperature		T_{STG}	-55 ~ +150	℃
Lead Temperature (soldering, 10sec)			+260	℃

Note：

* The power dissipation values are based on the condition that junction temperature T_J and ambient temperature T_A difference is 100℃.

* Stresses beyond those listed under “absolute maximum ratings” may cause permanent damage to the device. These are stress ratings only, and function operation of the device at these or any other conditions beyond those indicated under “recommended operating conditions” is not implied. Exposure to absolute-maximum -rated conditions for extended periods may affect device reliability.

Electrical Characteristics

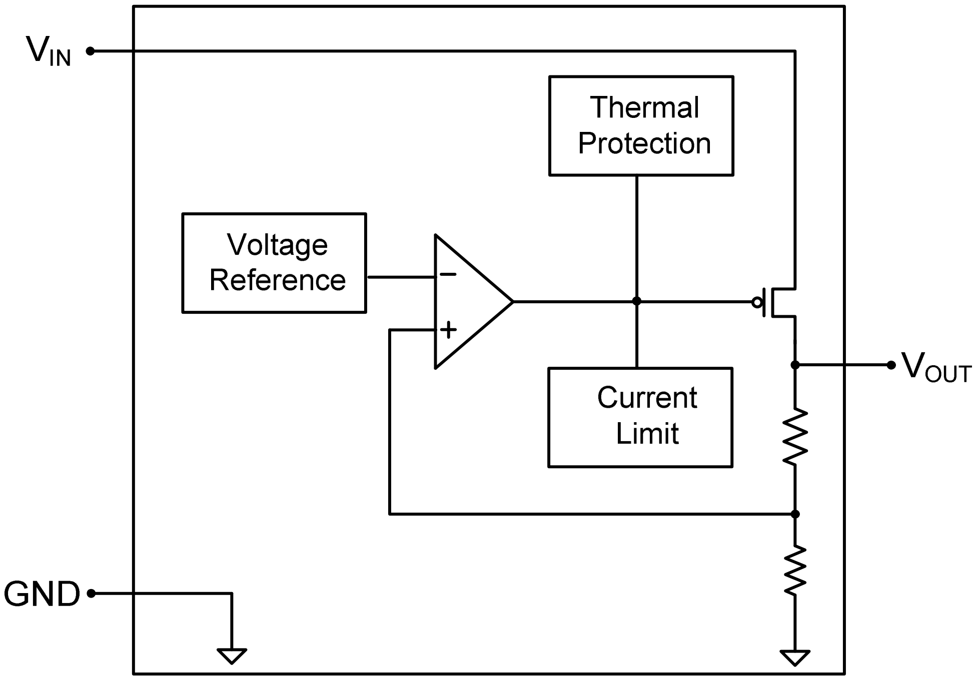
(V_{IN}=5V, T_A=25℃, unless otherwise noted.)

Symbol	Parameter	Test Conditions		Min	Typ	Max	Unit
V_{IN}	Input Voltage			2.3		7.0	V
V_{OUT}	Output Voltage	Fixed Voltage Type	V_{IN} = V_{OUT}+1.0V, I_{OUT}=1mA, V_{OUT}≧1.8V	-1% -2%	V_{OUT}	+1% +2%	V
			V_{IN} = V_{OUT}+1.0V, I_{OUT}=1mA, V_{OUT}＜1.8V, V_{IN}＞2.4V	-35		+35	mV
		Adjustable Voltage Type	V_{IN} = V_{OUT}+1.2V, I_{OUT}=1mA, V_{OUT}≧1.8V	-1% -2%	V_{OUT}	-1% -2%	V
			V_{IN} = V_{OUT}+1.2V, I_{OUT}=1mA, V_{OUT}＜1.8V, V_{IN}＞2.4V	-50		+50	mV
I_{MAX}	Output Current (see note *1)			1.0			A
I_{LIMIT}	Current Limit				1.3		A
V_{DROP}	Dropout Voltage (For Fixed Voltage)	I_{OUT}=100mA, V_{OUT}＞3.0V			50		mV
		I_{OUT}=500mA, V_{OUT}＞3.0V			300		mV
		I_{OUT}=1000mA, V_{OUT}＞3.0V			700		mV
	Dropout Voltage (For ADJ Voltage)	I_{OUT}=1000mA, V_{OUT}＞3.0V			1100		mV
ΔV_{LINE}	Line Regulation	V_{OUT}+1.0V≦V_{IN}≦7.0V, I_{OUT}=1mA For Fixed Voltage Type			0.2	0.3	%/V
		V_{OUT}+1.2V≦V_{IN}≦7.0V, I_{OUT}=1mA, V_{IN}≧2.8V For Adjustable Voltage Type				0.2	%/V
ΔV_{LOAD}	Load Regulation	V_{IN}=V_{OUT}+1V, 1mA≦I_{OUT}≦100mA			0.01	0.02	%/mA
I_Q	Ground Pin Current	I_{LOAD}=0mA to 1A, V_{IN} = V_{OUT}+1.0V			60		μA
I_{ADJ}	ADJ Pin Current	I_{LOAD}=0mA to 1A, V_{IN} = V_{OUT}+1.0V			60		μA
I_{SC}	Short Circuit Current				600		mA
PSRR	Ripple Rejection	I_{OUT}=30mA, F=1KHz, C_{OUT}=10uF			55		dB
e_N	Output Noise	I_{OUT}=100mA , F=1KHz, C_{OUT}=10uF			40		$\mu V_{(rms)}$
T_{SD}	Thermal Shutdown Temperature				155		℃
T_{HYS}	Thermal Shutdown Hysteresis				20		℃

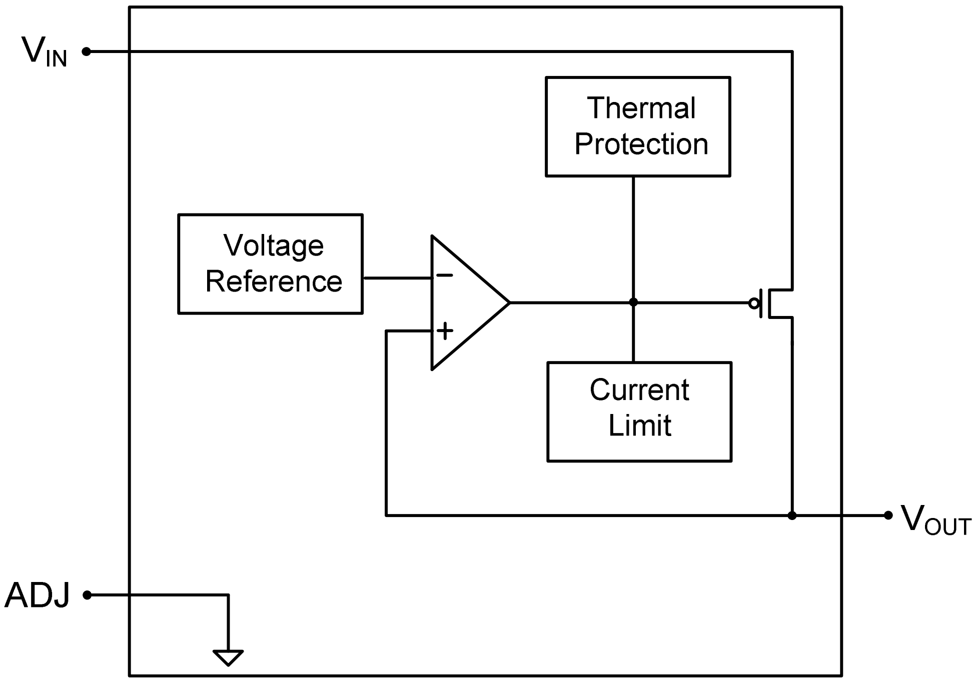
Note：

*1) Measured using a double sided board with 1” x 2” square inches of copper area connected to the GND pins for “heat spreading”.

EC8811 Function Block Diagram



Fixed Voltage Type



Adjustable Voltage Type

Detail Description

The EC8811 is a low-dropout linear regulator. The device provides preset 1.8V, 2.5V and 3.3V output voltages for output current up to 1.0A. Adjustable output voltage and other mask options for special output voltages are also available. As illustrated in function block diagram, it consists of a 1.25V bandgap (Fixed voltage type is 0.95V) reference, an error amplifier, a P-channel pass transistor and an internal feedback voltage divider.

The bandgap reference voltage is connected to the error amplifier, which compares this reference with the feedback voltage and amplifies the voltage difference. If the feedback voltage is lower than the reference voltage, the pass-transistor gate is pulled lower, which allows more current to pass to the output pin and increases the output voltage. If the feedback voltage is too high, the pass transistor gate is pulled up to decrease the output voltage.

The output voltage is feed back through an internal resistive divider (or external resistive divider for adjustable output voltage type) connected to OUT pin. Additional blocks include an output current limiter, thermal sensor, and shutdown logic.

Internal P-channel Pass Transistor

The EC8811 features a P-channel MOSFET pass transistor. Unlike similar designs using PNP pass transistors, P-channel MOSFETs require no base drive, which reduces quiescent current. PNP-based regulators also waste considerable current in dropout when the pass transistor saturates, and use high base-drive currents under large loads. The EC8811 does not suffer from these problems and consumes only 60µA (Typ.) of current consumption under heavy loads as well as in dropout conditions.

Output Voltage Selection

For fixed voltage type of EC8811, the output voltage is preset at an internally trimmed voltage. The first two digits of part number suffix identify the output voltage (see Ordering Information). For example, the EC8811-33 has a preset 3.3V output voltage.

For adjustable voltage type of EC8811, the output voltage is set by comparing the feedback voltage at adjust terminal to the internal bandgap reference voltage. The reference voltage V_{REF} is 1.25V. The output voltage is given by the equation:

$$V_{OUT} = V_{REF} \times \left(1 + \frac{R2}{R1}\right) + I_{ADJ} \times R2$$

(See Typical Application Schematic.)

Current Limit

The EC8811 also includes a fold back current limiter. It monitors and controls the pass transistor's gate voltage, estimates the output current, and limits the output current within 1.3A (Typ.).

Thermal Overload Protection

Thermal overload protection limits total power dissipation in the EC8811. When the junction temperature exceeds T_J = +150℃, a thermal sensor turns off the pass transistor, allowing the IC to cool down. The thermal sensor turns the pass transistor on again after the junction temperature cools down by 20℃, resulting in a pulsed output during continuous thermal overload conditions.

Thermal overload protection is designed to protect the EC8811 in the event of fault conditions. For continuous operation, the absolute maximum operating junction temperature rating of T_J = +125℃ should not be exceeded.

Operating Region and Power Dissipation

Maximum power dissipation of the EC8811 depends on the thermal resistance of the case and circuit board, the temperature difference between the die junction and ambient air, and the rate of airflow. The power dissipation across the devices is $P = I_{OUT} \times (V_{IN}-V_{OUT})$. The resulting maximum power dissipation is:

$$P_{MAX} = \frac{(T_J - T_A)}{\theta_{JC} + \theta_{CA}} = \frac{(T_J - T_A)}{\theta_A}$$

Where (T_J-T_A) is the temperature difference between the EC8811 die junction and the surrounding air, θ_{JC} is the thermal resistance of the package chosen, and θ_{CA} is the thermal resistance through the printed circuit board, copper traces and other materials to the surrounding air. For better heat-sinking, the copper area should be equally shared between the IN, OUT, and GND pins.

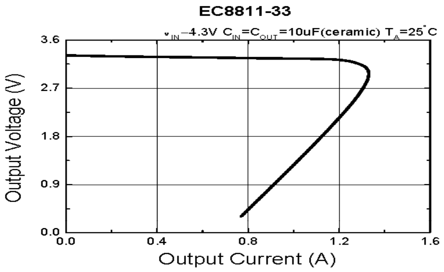
Dropout Voltage

A regulator's minimum input-output voltage differential, or dropout voltage, determines the lowest usable supply voltage. In battery-powered systems, this will determine the useful end-of-life battery voltage. The EC8811 use a P-channel MOSFET pass transistor, its dropout voltage is a function of drain-to-source on-resistance $R_{DS(ON)}$ multiplied by the load current.

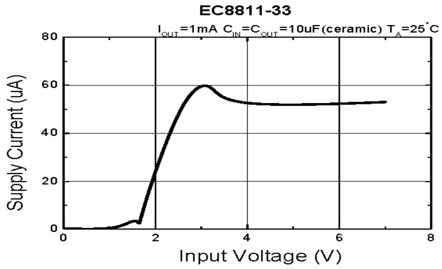
$$V_{DROPOUT} = V_{IN} - V_{OUT} = R_{DS(ON)} \times I_{OUT}$$

Typical Operating Characteristics

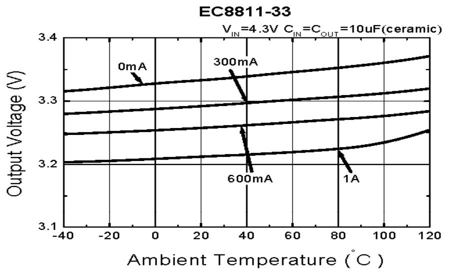
(1) Output Voltage vs. Output Current



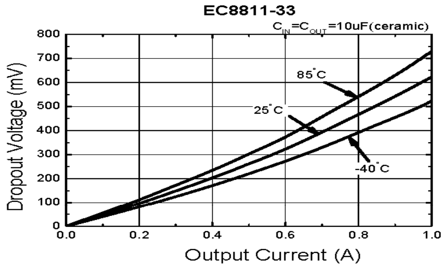
(2) Supply Current vs. Input Voltage



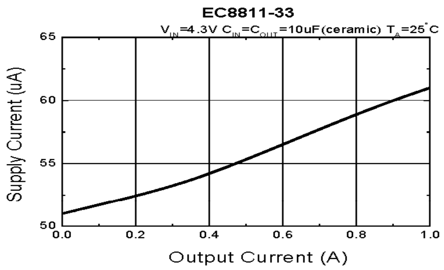
(3) Output Voltage vs. Ambient Temperature



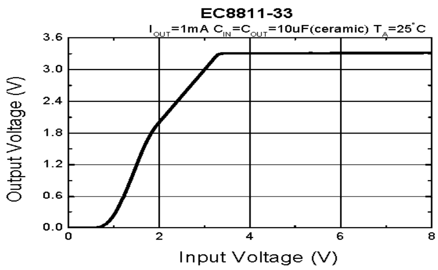
(4) Dropout Voltage vs. Output Current



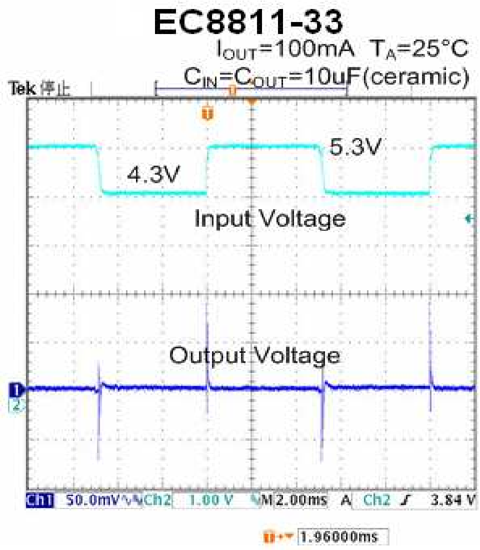
(5) Supply Current vs. Output Current

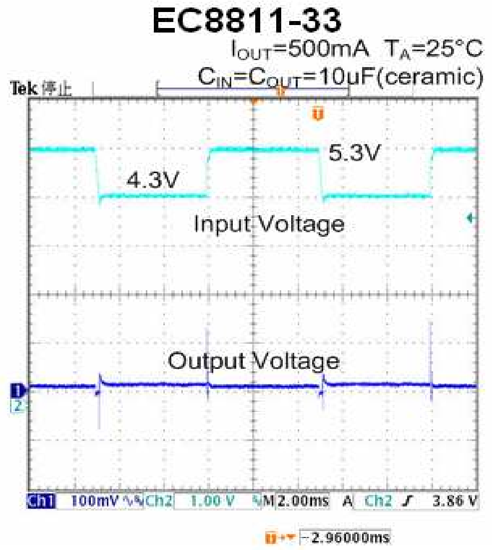


(6) Output Voltage vs. Input Voltage

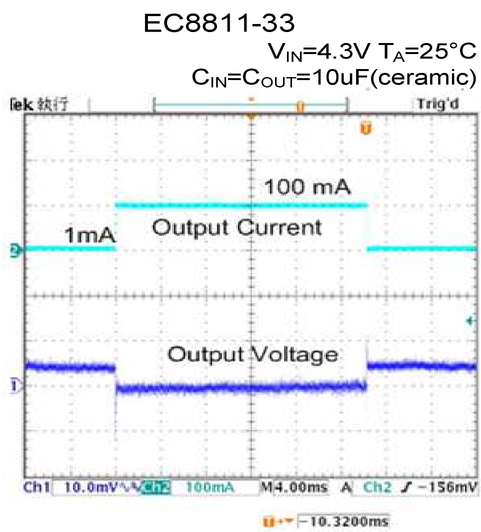


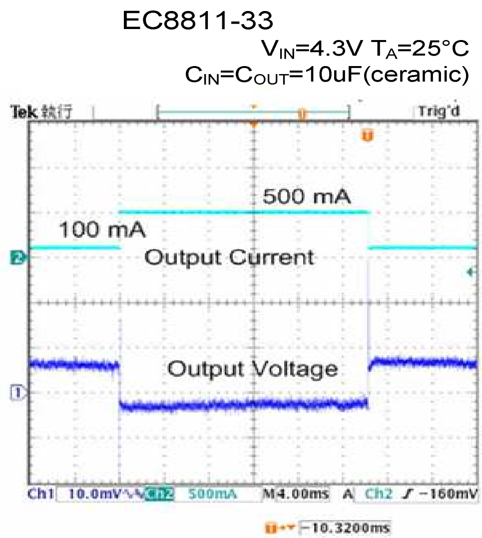
(7) Input Transient Response

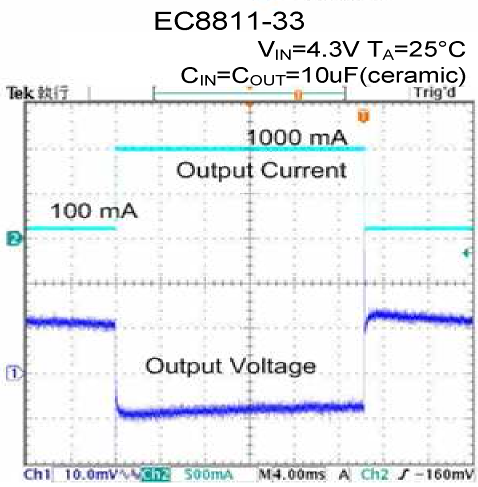




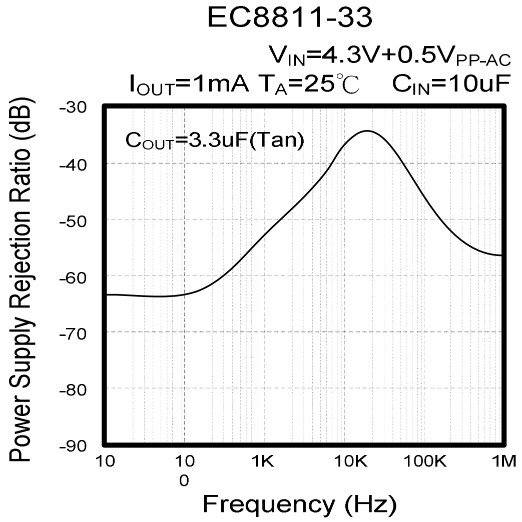
(8) Load Transient Response







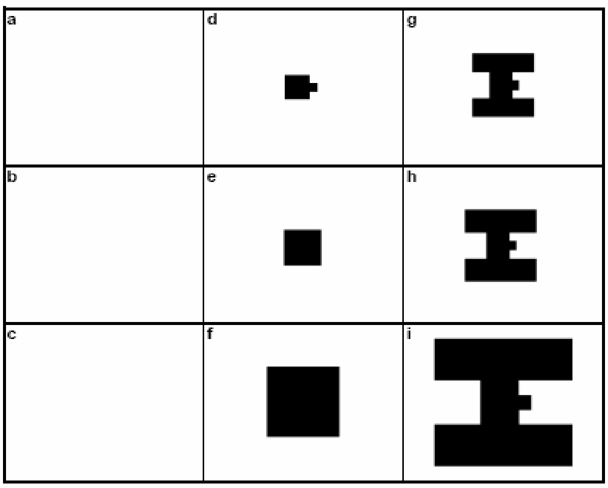
(9) Power Supply Rejection Ratio



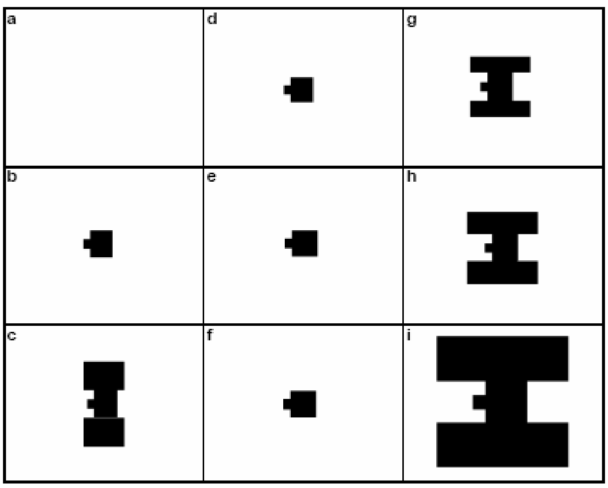
Application Note

Table 1. θ_{JA} Different Heatsink Area

Layout	Copper Area		Thermal Resistance	
	Top Side (in²)	Bottom Side (in²)	SOT-223 (θ_{JA}, ℃/W)	TO-252 (θ_{JA}, ℃/W)
a	0	0	140	106
b	0	0.070	127	91
c	0	0.310	84	64
d	0.067	0.067	125	89
e	0.200	0.080	118	87
f	0.600	0.080	89	63
g	0.285	0.285	92	64
h	0.393	0.393	78	58
i	0.500	0.500	73	55



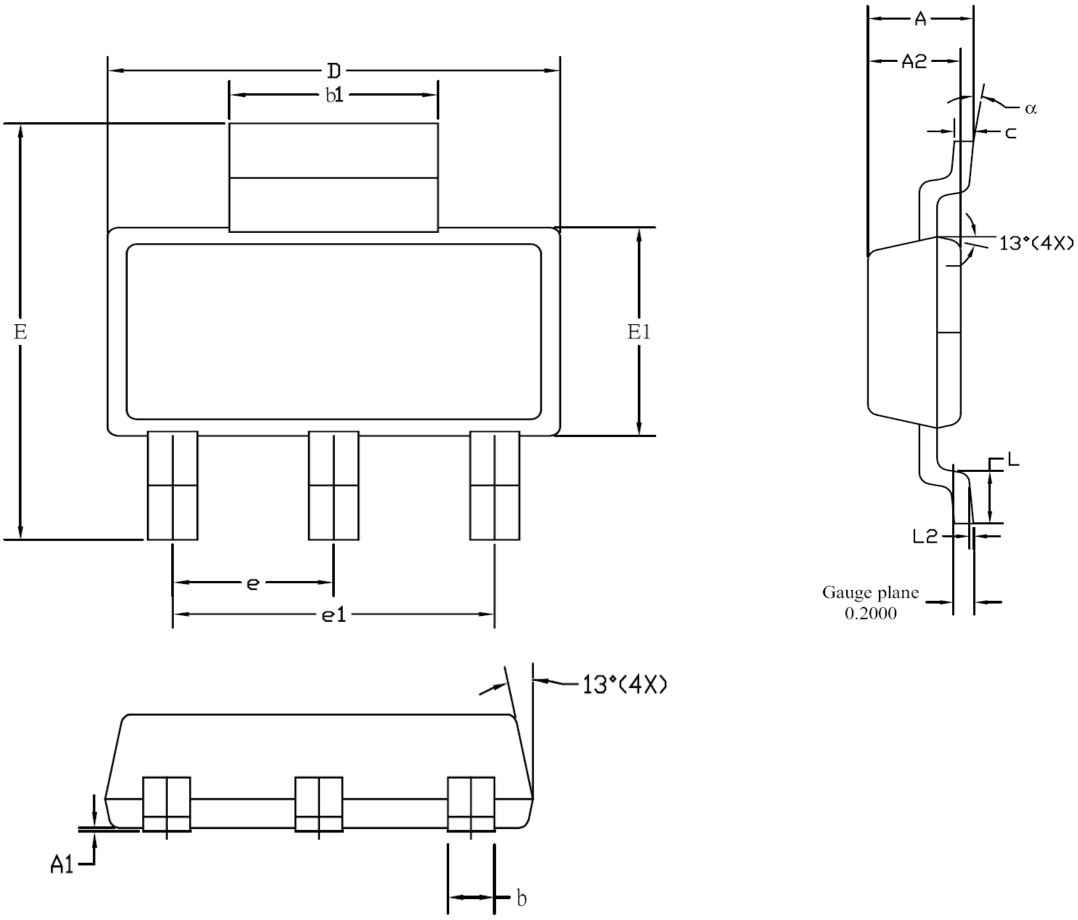
Top View of the PCB layout in real size.



Bottom View of the PCB layout in real size.

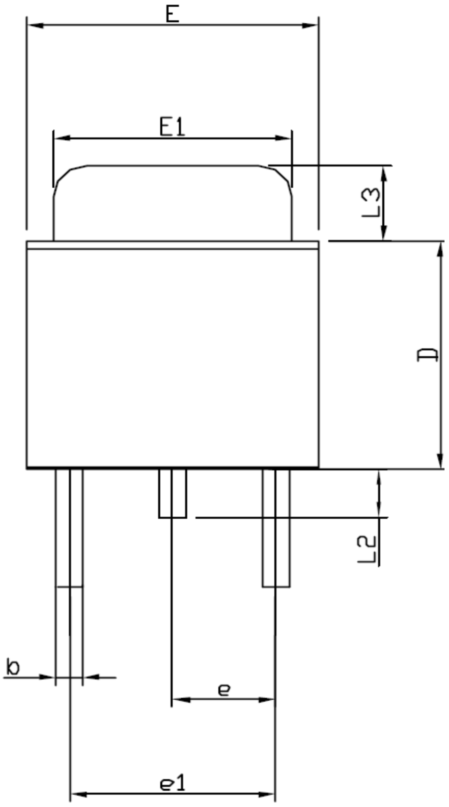
Package Outline

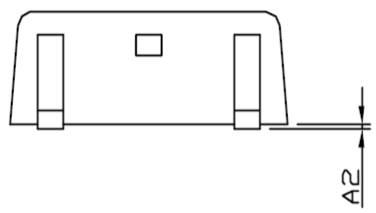
A) SOT-223

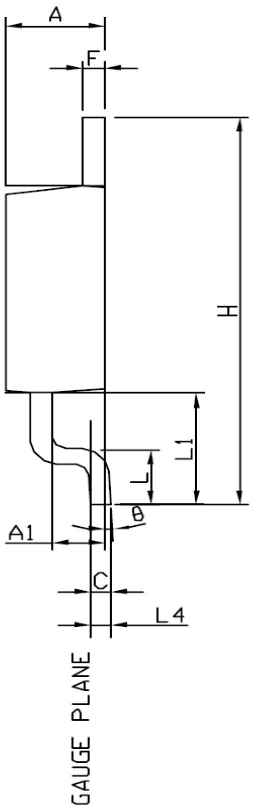


Symbols	Millimeters		Inches	
	Min	Max	Min	Max
A	1.52	1.80	0.061	0.071
A1	0.02	0.10	0.0008	0.0040
A2	1.50	1.70	0.059	0.067
b	0.60	0.80	0.024	0.031
b1	2.90	3.10	0.114	0.122
C	0.24	0.32	0.009	0.013
D	6.30	6.80	0.248	0.268
E1	3.30	3.70	0.130	0.146
e	2.30 BSC		0.090 BSC	
e1	4.60 BSC		0.181 BSC	
E	6.70	7.30	0.264	0.287
L	0.90 MIN		0.036 MIN	
L2	0.06 BSC		0.0024 BSC	
α	0°	10°	0°	10°

B) TO-252

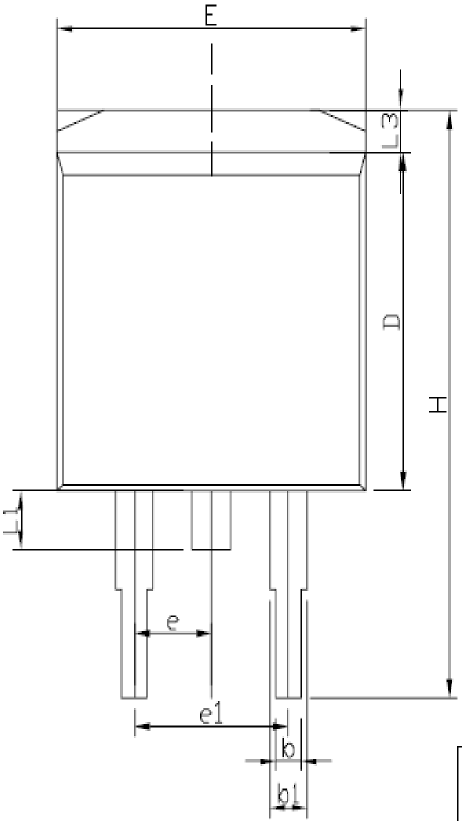


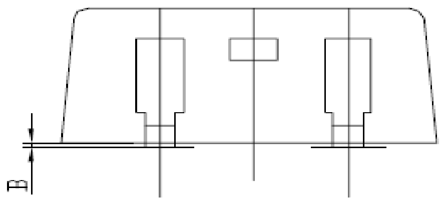


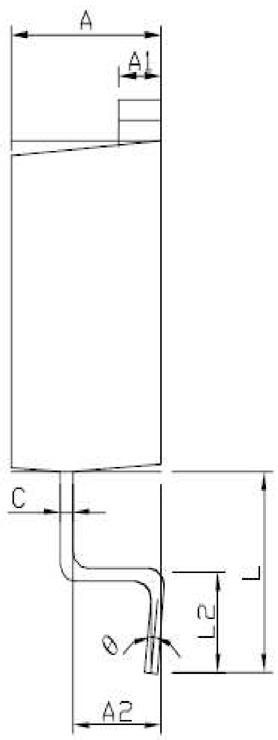


Symbols	Millimeters		Inches	
	Min	Max	Min	Max
A	2.19	2.38	0.086	0.094
A1	0.89	1.27	0.035	0.050
A2	0.00	0.13	0.000	0.005
b	0.51	0.89	0.020	0.035
C	0.46	0.58	0.018	0.023
D	5.97	6.22	0.235	0.245
E	6.35	6.73	0.250	0.265
E1	5.21	5.46	0.205	0.215
e	2.28 BSC		0.090 BSC	
e1	3.96	5.18	0.156	0.204
F	0.46	0.58	0.018	0.023
L	1.40	1.78	0.055	0.070
L1	2.67 (REF.)		0.105 (REF.)	
L2	0.64	1.02	0.025	0.040
L3	1.52	2.03	0.060	0.080
L4	0.51 BSC		0.020 BSC	
H	9.40	10.40	0.370	0.410
θ	0°	8°	0°	8°

C) TO-263

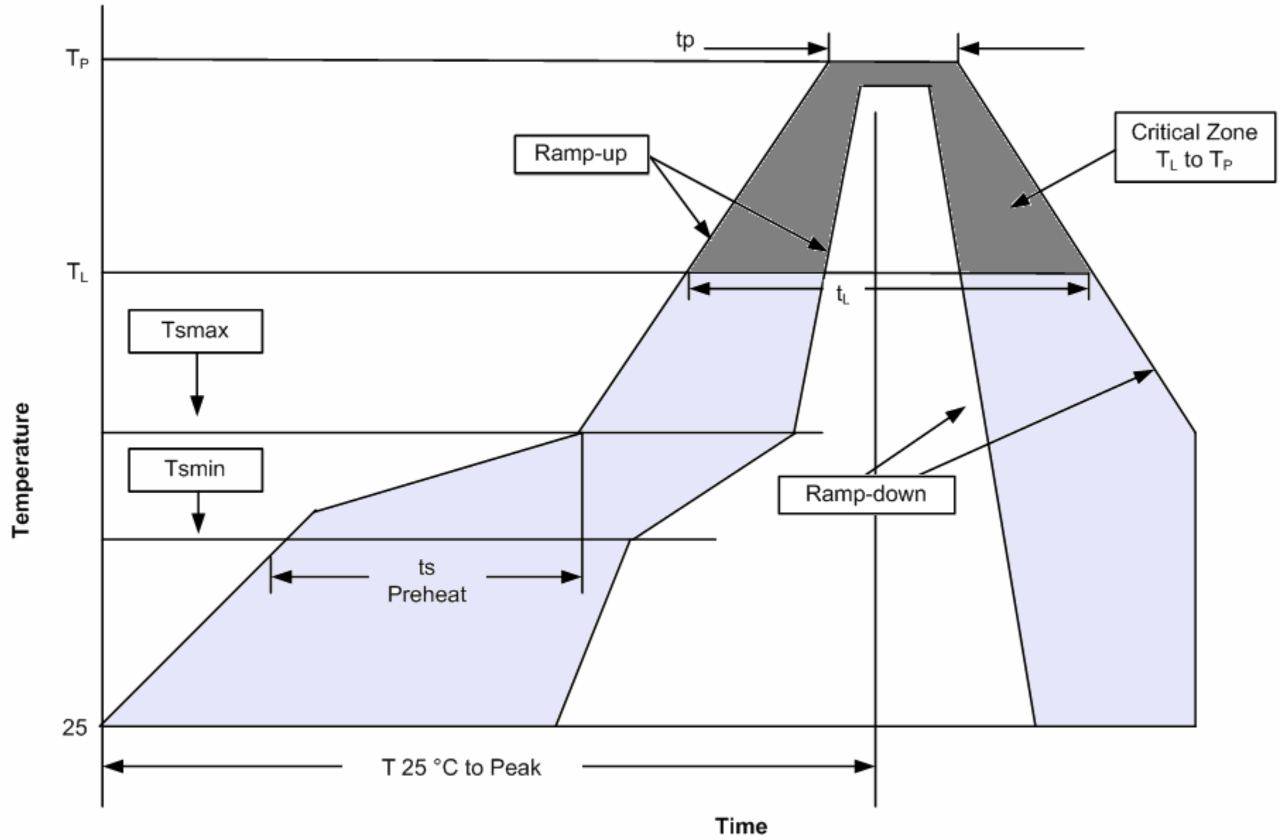






Symbols	Millimeters		Inches	
	Min	Max	Min	Max
A	4.30	4.70	0.169	0.185
A1	1.22	1.40	0.048	0.055
A2	2.64	2.69	0.104	0.106
b	0.69	0.94	0.027	0.037
b1	1.22	1.40	0.048	0.055
C	0.36	0.56	0.014	0.022
D	8.64	9.652	0.340	0.380
E	9.70	10.54	0.382	0.415
e	2.29	2.79	0.090	0.110
e1	4.83	5.33	0.190	0.210
H	14.60	15.87	0.575	0.625
L	4.70	5.84	0.185	0.230
L1	1.19	1.778	0.047	0.070
L2	2.24	2.82	0.088	0.111
L3	1.40 MAX		0.055 MAX	
θ	0°	8°	0°	8°
B	0.00	0.15	0.000	0.006

Reflow Condition (IR/Convection or VPR Reflow)



Classification Reflow Profiles

Profile Feature	Pb-Free / Green Assembly
Average ramp-up rate (T_L to T_P)	3℃/second max
Preheat - Temperature Min (Tsmin) - Temperature Max (Tsmax) - Time (min to max) (ts)	150℃ 200℃ 60-180 seconds
Time maintained above: - Temperature (T_L) - Time (t_L)	217℃ 60-150 seconds
Peak/Classification Temperature (Tp)	See table 1
Time within 5℃ of actual Peak Temperature (tp)	20-40 seconds
Ramp-down Rate	6℃/second max
Time 25℃ to Peak Temperature	8 minutes max

Notes：
1) All temperatures refer to topside of the package.
2) Measured on the body surface.

Classification Reflow Profiles (Continued)

2.0Table 1. Pb-free / Green Process – Package Classification Reflow Temperatures

Package Thickness	Volume mm³ <350	Volume mm³ 350~2000	Volume mm³ ≧2000
<2.5 mm	260 +0℃*	260 +0℃*	260 +0℃*
1.6-2.5 mm	260 +0℃*	250 +0℃*	245 +0℃*
≧2.5 mm	250 +0℃*	245 +0℃*	245 +0℃*

Notes：

* Tolerance: The device manufacturer/supplier shall assure process compatibility up to and including the stated classification temperature (this means Peak reflow temperature +0℃. For example 260℃+0℃) at the rat ed MSL level.