24V,1A,5uA,Low-Dropout Voltage Regulator With Enable

Features

- Fixed and adjustable output voltages to 0.6V
- Wide input voltage range :Up to 24V
- High output current : 800mA
- High PSRR : 65dB at 1kHz
- Low dropout voltage : 150mV at 100mA
- Fixed output voltages : 1.8V,3.0V,3.3V,5.0V and ADJ
- Output voltage accuracy : ±2%
- Fast transient response
- Current limit protection
- Short circuit protection
- Enable pin is available
- Thermal shutdown protection
- Available packages : SOT89-3,SOT23-5,ESOP8 and TO252-3

Applications

- Servers and laptops
- Smart phone and PDA
- MP3/MP4
- Home appliance

Description

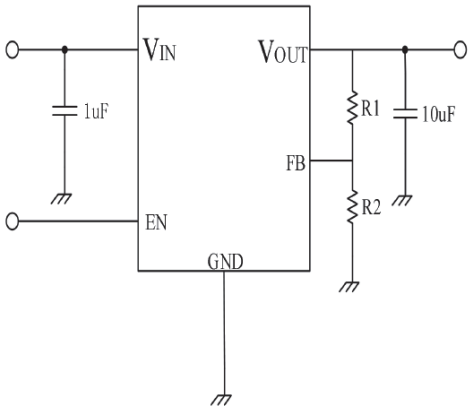
The OSU224XXB series is an ultra-small, low dropout (LDO) linear regulator that can source 800mA of output current. The OSU224XXB series is designed to provide high input voltage, and excellent load and line transient performance. The OSU224XXB series has thermal shutdown, current limit, and short circuit protections for added safety. Shutdown mode is enabled by pulling the EN pin low.

The OSU224XXB series contains fixed output voltages of 1.8V, 3.0V, 3.3V and 5.0V and ADJ.

Device Information

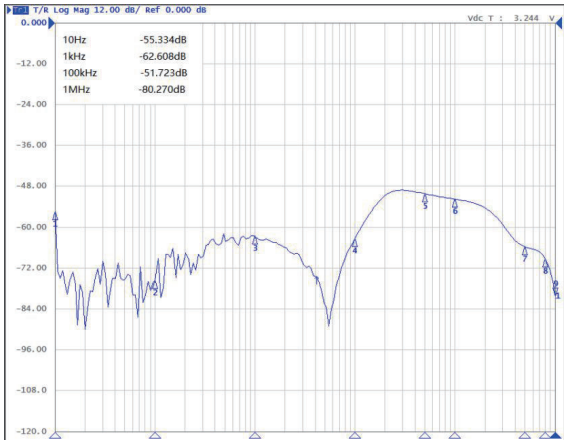
PART NUMBER	PACKAGE	BODY SIZE(NOM)
OSU224XX-BTS-C	SOT89-3	4.5mm*4.2mm
OSU224XX-BTQ	TO252-3	6.5mm*10mm
OSU224XXBKP	ESOP8	4.9mm*6.0mm
OSU22411BTG-ADJ	SOT23-5	2.9mm*2.8mm

Typical Application



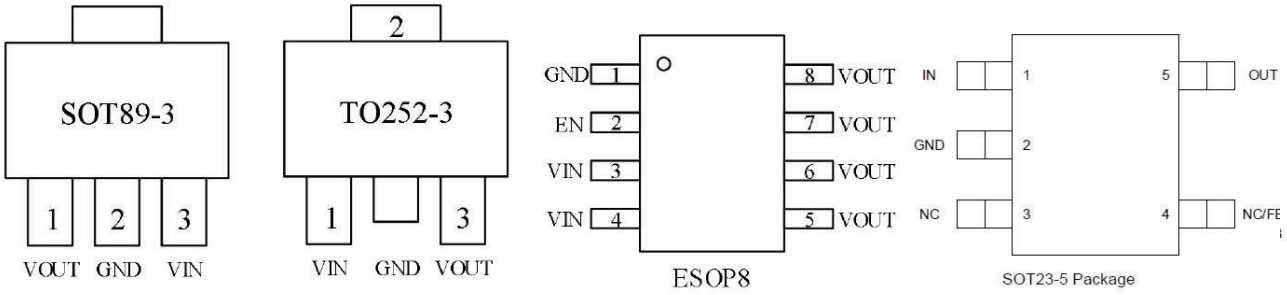
40V, Low-Dropout Voltage Regulator

PSRR



V_{IN}=5.3V, I_{OUT}=10mA, V_{OUT}=3.3V

Pin Configuration and Functions



Package	SOT89-3	TO252-3	Description
Name	OSU224XX-BTS-C	OSU224XX-BTQ	
VOUT	1	3	Output pin
GND	2	2	Ground pin
VIN	3	1	Input pin
Package	ESOP8	SOT23-5	Description
Name	OSU224XXBKP	OSU22411BTG-ADJ	
GND	1	2	Ground pin
EN	2	3	EN pin
VIN	3,4	1	Input pin
VOUT	5,6,7,8	5	Output pin
FB	-	4	FB pin
NC	-	4	NC

Absolute Maximum Ratings

Parameter	Description	Min	Max	Unit
Input voltage	VIN to GND	-0.3	40	V
	VOUT to GND	-0.3	14	V
	VOUT to VIN	-55	0.3	V
	EN to GND	-0.3	40	V
Current	Peak output current	Internally limited		
Temperature	Operating ambient temperature	-40	85	℃
	Storage temperature	-40	150	℃
	Operating virtual junction temperature	150		℃
Thermal resistance (Junction to ambient)	SOT89-3	130		℃/W
	TO252-3	80		℃/W
	ESOP8	130		℃/W
	SOT23-5	200		℃/W
Power dissipation	SOT89-3	900		mW
	TO252-3	1700		mW
	ESOP8	700		mW
	SOT23-5	600		mW

Note:

exceeding the range specified by the rated parameters will cause damage to the chip, and the working state of the chip beyond the range of rated parameters cannot be guaranteed. Exposure outside the rated parameter range will affect the reliability of the chip.

ESD Ratings

Parameter	Description	Range	Unit
V_{ESD}	Human body model(HBM)	4	KV

Note:

JEDEC document JEP155 states that 500-V HBM allows safe manufacturing with a standard ESD control process.

Electrical Characteristics

(At T_A=25℃, C_{IN}=1uF, V_{IN}=V_{OUTNOM}+1.0V, C_{OUT}=10uF,V_{OUT}=3.3V, unless otherwise noted)

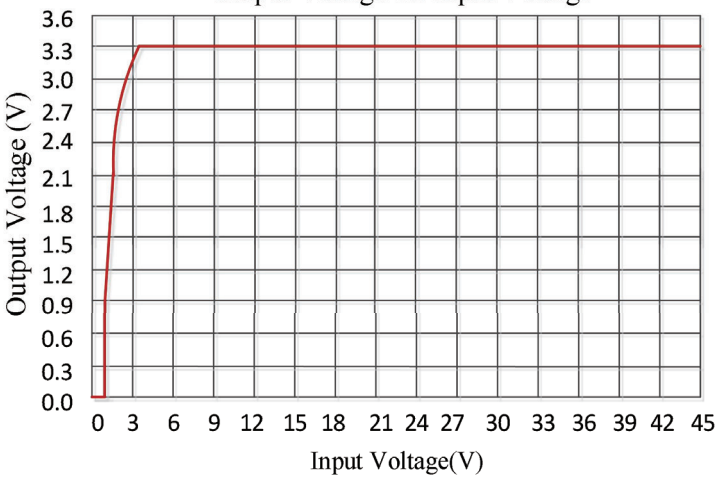
Symbol	Parameter	Test Conditions	Min	Typ	Max	Unit
V_{IN}	Input voltage		3	—	40	V
I_Q	Quiescent current	V_{IN} = 40V, No load	—	5	—	uA
$I_{ShutDown}$	Shutdown current	V_{IN} = 5.3V, V_{EN} = 0V	—	—	0.3	uA
V_{OUT}	Output voltage	V_{IN}=12V, I_{OUT}=10mA	V_{OUTNOM} * 0.98	V_{OUTNOM}	V_{OUTNOM} * 1.02	V
I_{OUT_MAX}	Output current		800	—	—	mA
V_{DROP}	Dropout voltage(1)	I_{OUT}= 10mA , V_{IN}=V_{OUTNOM}-0.1V	—	15	—	mV
		I_{OUT}= 100mA , V_{IN}=V_{OUTNOM}-0.1V	—	150	—	mV
		I_{OUT}=800mA , V_{IN}=V_{OUTNOM}-0.1V	—	1160	—	mV
$\Delta V_{OUT}/\Delta I_{OUT}$	Load regulation	V_{IN} = V_{OUTNOM} + 1V, 1mA ≤ I_{OUT} ≤ 800mA	—	0.005	—	mV/mA
$\Delta V_{OUT}/\Delta V_{IN}$	Line regulation	I_{OUT} = 1mA, V_{OUTNOM} + 1V ≤ V_{IN} ≤ 45V	—	0.05	—	mV/V
I_{LIMIT}	Current limit	V_{IN} < 17V	—	1.1	—	A
		V_{IN} ≧ 17V	—	700	—	mA
I_{SHORT}	Short current	V_{IN} = 5.3V	—	140	—	mA
T_{SHDN}	Thermal shutdown temperature	Shutdown, temperature increasing	—	160	—	℃
		Reset, temperature decreasing	—	130	—	
PSRR		V_{IN}=5.3V , I_{OUT}=10mA f=1kHz	—	65	—	dB
V_{EN_H}	EN high level	V_{IN} = 5.3V,V_{OUT} = 3.3V	1	—	—	V
V_{EN_L}	EN low level	V_{IN} = 5.3V,V_{OUT} = 3.3V	—	—	0.4	V

Note：(1) Dropout Voltage is the voltage difference between the input and the output at which the output voltage drops 2% below its nominal value.

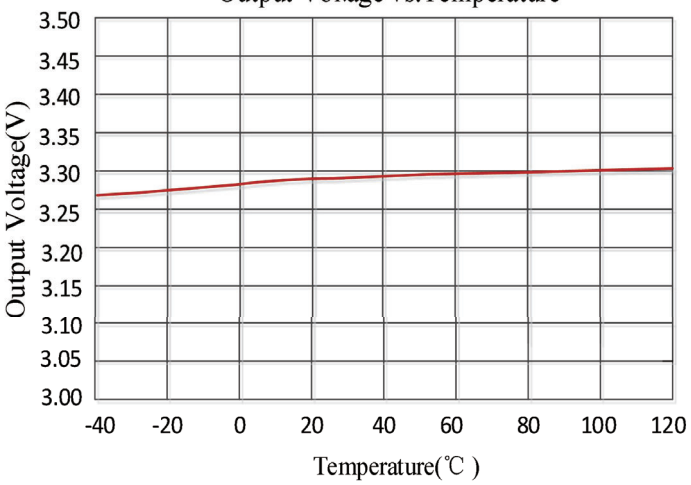
Typical Characteristics

(Test condition: T_A=25°C,V_{IN}=12V, I_{OUT}=1mA,C_{OUT}=10uF,V_{OUT}=3.3V unless otherwise note)

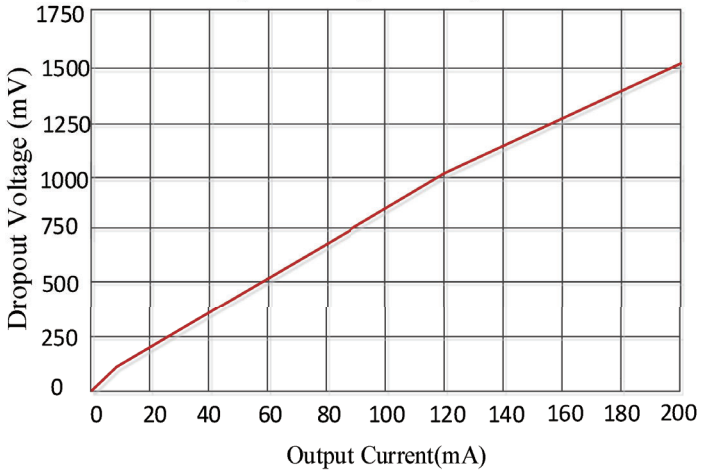
Output Voltage vs. Input Voltage



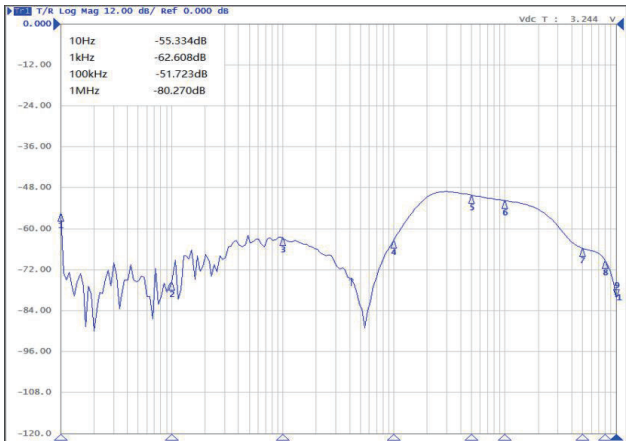
Output Voltage vs.Temperature



Dropout Voltage vs. Output Current



PSRR

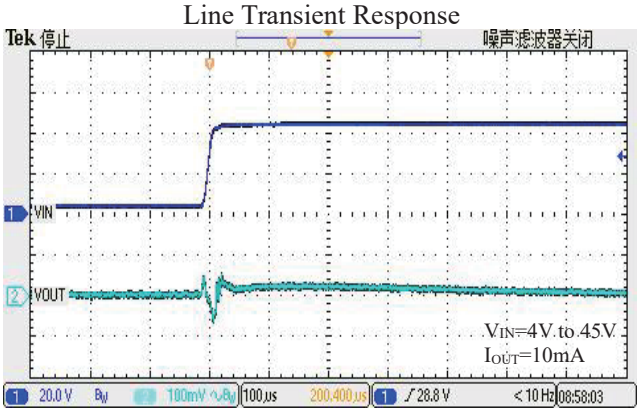


V_{IN}=5.3V, I_{OUT}=10mA, V_{OUT}=3.3V

Typical Characteristics

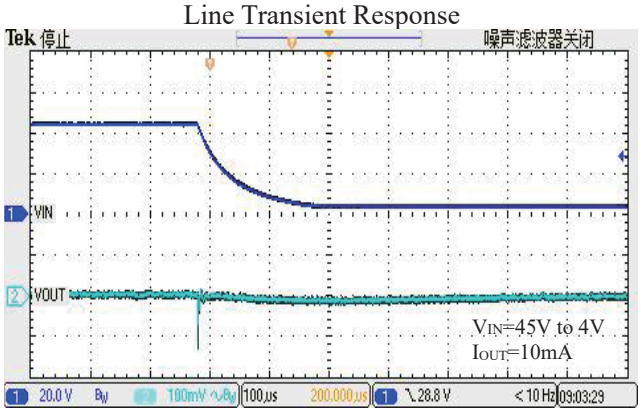
(Test condition: T_A=25°C,V_{IN}=5.3V, I_{OUT}=1mA,C_{OUT}=10uF,V_{OUT}=3.3V unless otherwise note)

Line Transient Response



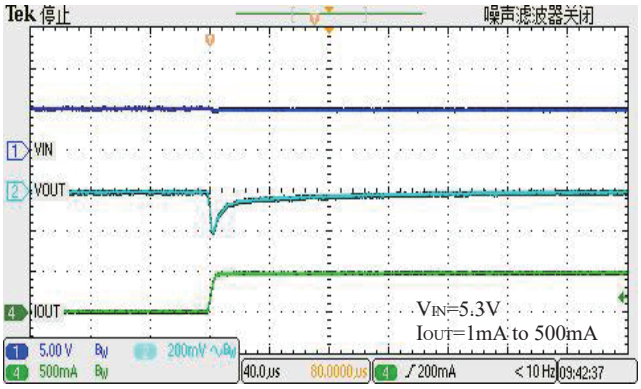
Time(100us/div)

Line Transient Response



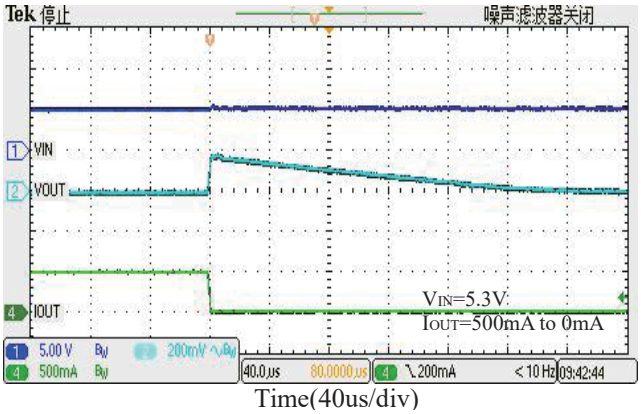
Time(100us/div)

Load Transient Response



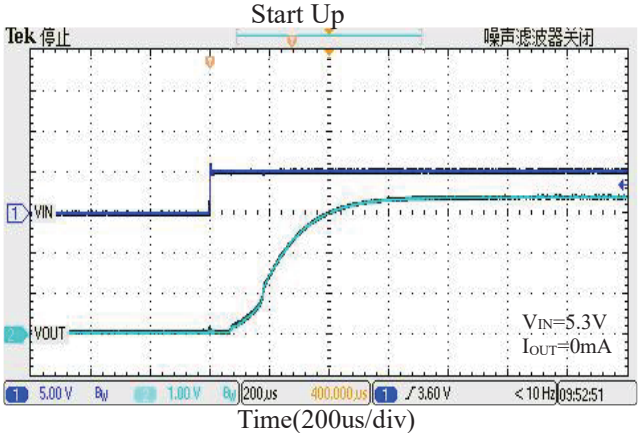
Time(40us /div)

Load Transient Response



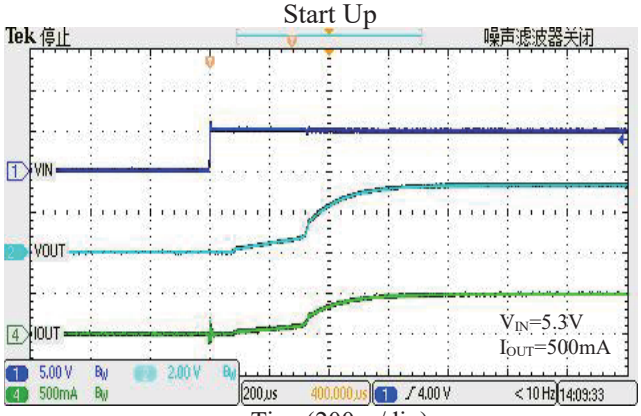
Time(40us/div)

Start Up



Time(200us/div)

Start Up



Time(200us/div)

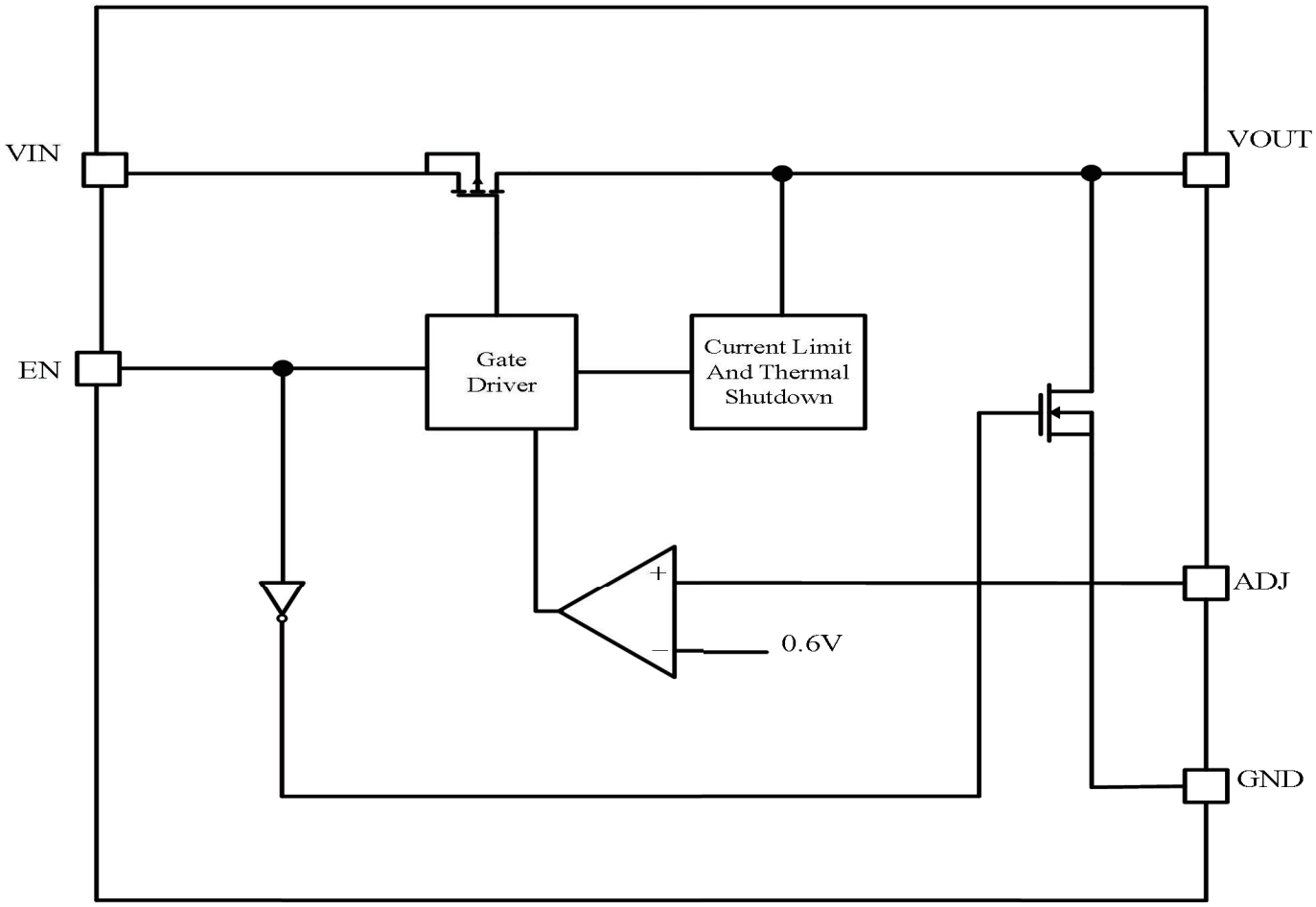
Detailed Description

Overview

The OSU224XXB series products are 800mA wide input voltage range linear regulators with very low quiescent current. These voltage regulators operate from 3V to 40V DC input voltage with supporting 40V transient input voltage and consume 5uA quiescent current at no load.

The OSU224XXB series products are available in fixed voltage versions of 1.8V, 3.0V, 3.3V, 5.0V and ADJ with 2% output voltage accuracy over operating conditions. The series products are available in SOT89-3, TO252-3, SOT23-5 and ESOP8 packages.

Functional Block Diagram



Functional Block Diagram

Input Capacitor

A 1uF ceramic capacitor is recommended to connect between VIN and GND pins to decouple input power supply glitch and noise. The amount of the capacitance may be increased without limit. This input capacitor must be located as close as possible to the device to assure input stability and less noise. For PCB layout, a wide copper trace is required for both VIN and GND.

Output Capacitor

An output capacitor is required for the stability of the LDO. The recommended minimum output capacitance is 10uF, ceramic capacitor is recommended, and temperature characteristics are X7R or X5R. Higher capacitance values help to improve load/line transient response. The output capacitance may be increased to keep low undershoot/overshoot. Place output capacitor as close as possible to VOUT and GND pins.

Output Voltage

The output voltage is set by an external resistor divider R1and R2 in typical application schematic. Recommended R1 resistance is 100K. Use equation (1) to calculate R2,V_{FB}=0.6V.

$$R_1=\left(\frac{V_{OUT}}{0.6}-1\right)\times R_2 \quad (1)$$

EN Pin Operation

The OSU224XXB is turned on by setting the EN pin to “H” . Since the EN pin is neither pulled down nor pulled up internally, do not set it in floating status. When the EN pin is not used, connect the EN pin with VIN to keep the LDO in operating mode.

Current Limit and Short Circuit Protection

When output current at VOUT pin is higher than current limit threshold or the VOUT pin is direct short to GND, the current limit protection will be triggered and clamp the output current at a pre-designed level to prevent over-current and thermal damage.

Power Dissipation and Thermal Protection

The OSU224XXB has internal thermal sense and protection circuits. When excessive power dissipation happens on the device, such as short circuit at the output pin or very heavy load current with a large voltage drop across the device, the internal thermal protection circuit will be triggered, and it will shut down the power MOSFET to prevent the LDO from damage. As soon as excessive thermal condition is removed and the temperature of the device drops down, the thermal protection circuit will lease the control of the power MOSFET, and the LDO device goes to normal operation.
Power dissipation caused by voltage drop across the LDO and by the output current flowing through the device needs to be dissipated out from the chip. The maximum junction temperature is dependent on power dissipation,package, the PCB layout, number of used Cu layers, Cu layers thickness and the ambient temperature.

During normal operation, LDO junction temperature should not exceed 150°C, or else it may result in deterioration of the properties of the chip. Using below equations to calculate the power dissipation and estimate the junction temperature.

The power dissipation can be calculated using Equation (1).

$$P_D = (V_{IN} - V_{OUT}) \times I_{OUT} \quad (1)$$

The junction temperature can be estimated using Equation . $R_{\theta JA\_EVM}$ is the junction-to-ambient thermal resistance based on customer's PCB. Verify the application and allow sufficient margins in the thermal design by the Equation (2).

$$T_J = T_A + P_D \times R_{\theta JA\_EVM} \quad (2)$$

$R_{\theta JA\_EVM}$ is a critical parameter and depends on many factors such as the following:

· Power dissipation

· Air temperature/flow

· PCB area

· Copper heat-sink area

· Number of thermal vias under the package

· Adjacent component placement

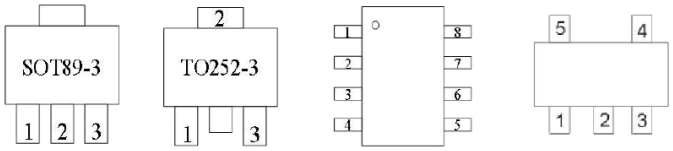
Ordering And Marking Information

Part Number

OSU 224 33 B TS-C

- Pin definition
- Package definition
- Voltage accuracy
- Otput voltage
- Product Name
- Company Name

Package Outline



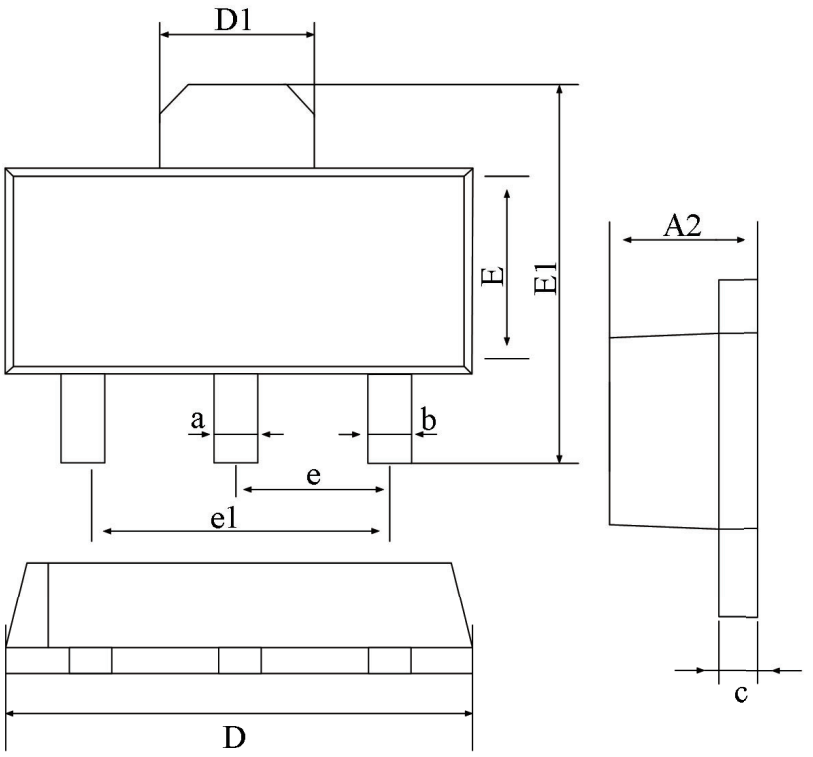
Marking

224XX X XX
246 X

- TS-C:SOT89-3 TQ:TO252-3 KP:ESOP8 blank(ADJ)
- B:B(±2%) A(±1%) C(±3%) blank(ADJ)
- XX:33(3.3V) 18(1.8V) blank(ADJ)
  30(3.0V) 50(5.0V)
- X:Internal code variable
- 246:2-2022;46-the 46th week of this year

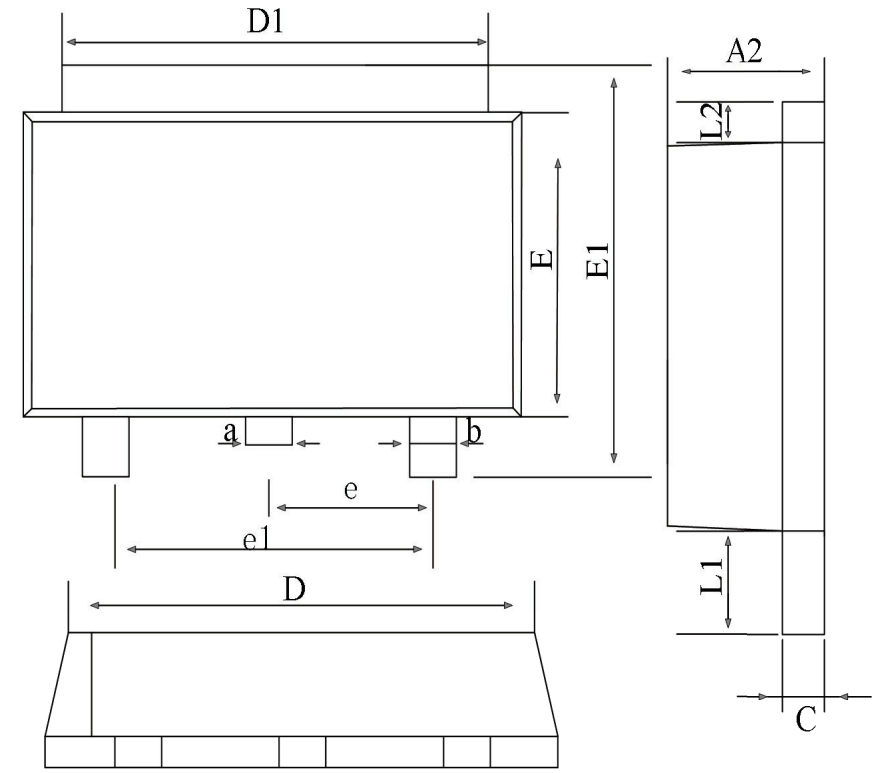
Package Outline

SOT89-3



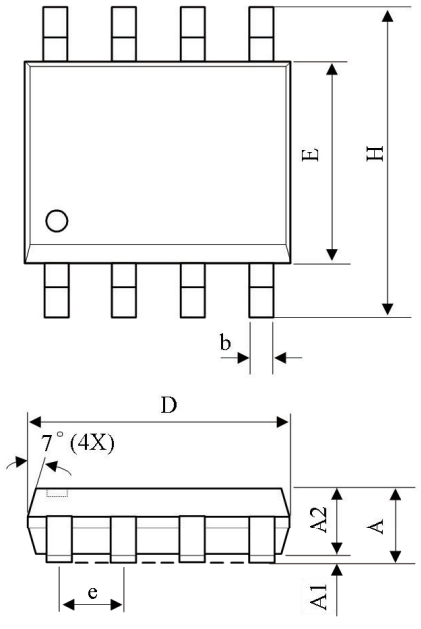
REF.	Millimeter	
	Min.	Max.
A2	1.40	1.60
a	0.40	0.58
b	0.32	0.52
c	0.36	0.46
D	4.40	4.60
D1	1.60	1.80
E	2.30	2.60
E1	4.00	4.30
e	1.00	2.00
e1	2.95	3.05

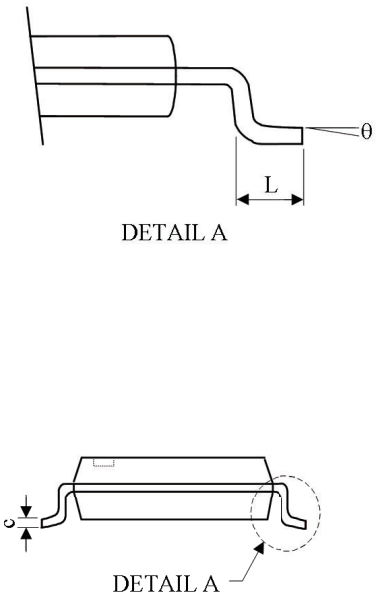
TO252-3



REF	Millimeter	
	Min.	Max.
A2	2.2	2.4
a	0.64	0.88
b	0.64	0.88
c	0.45	0.58
D	6.45	6.70
D1	5.21	5.46
E	6.00	6.20
E1	9.40	10.40
e	2.28	2.30
e1	4.56	4.60
L1	2.70	2.75
L2	0.90	1.27

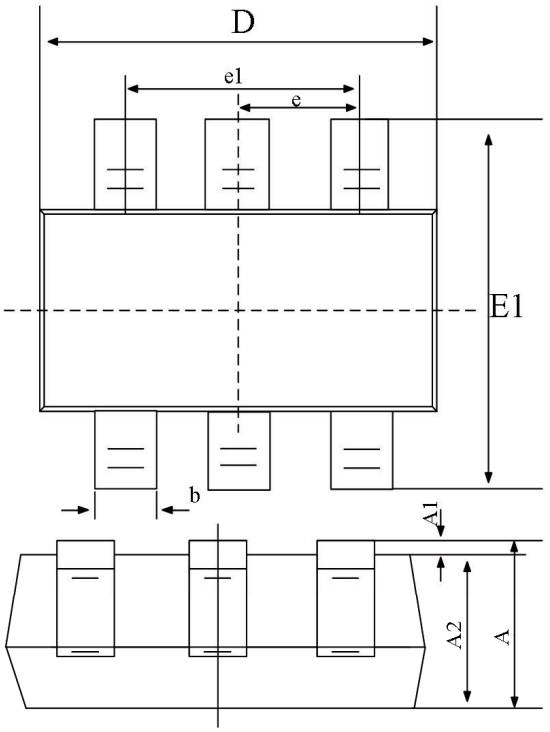
ESOP8

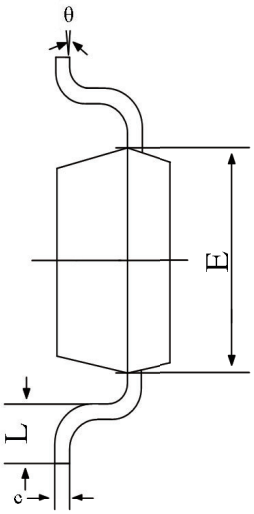




REF.	Millimeter	
	Min.	Max.
A	1.35	1.75
A1	0.05	0.25
A2	1.25	1.55
C	0.1	0.25
D	4.7	5.1
E	3.7	4.1
H	5.8	6.2
L	0.4	1.27
b	0.31	0.51
e	1.27BSC	
θ	0°	8°

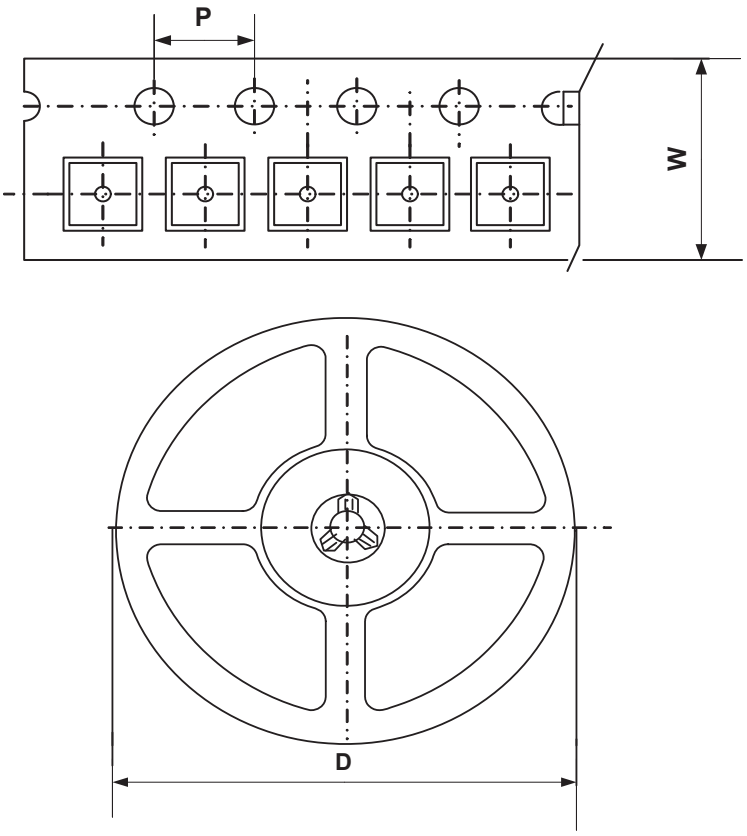
SOT23-5





REF.	Millimeter	
	Min.	Max.
A	1.05	1.25
A1	0.00	0. 10
A2	1.05	1.15
b	0.30	0.50
c	0.10	0.20
D	2.85	3. 05
E	1.50	1.70
E1	2.65	2.95
e	0.95(BSC)	
e1	1. 80	2.00
L	0. 30	0.60
θ	0°	8°

Packing Information



Type	W(mm)	P(mm)	D(mm)	Qty (pcs)
SOT89-3	12.0mm	4.0mm	178.0mm	1000pcs
TO252-3	16.0mm	4.0mm	330.0mm	2500pcs
ESOP8	12.0mm	4.0mm	330.0mm	4000pcs
SOT23-5	8.0mm	4.0mm	178.0mm	3000pcs

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