Low Noise, 24V, 200mA Low Dropout Linear Regulator

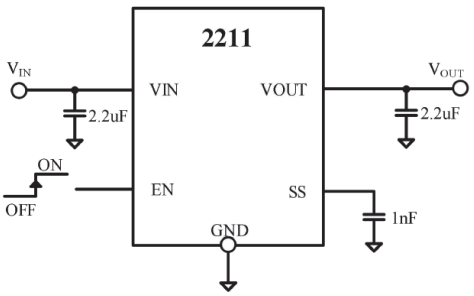
Features

- Low noise: 8uV$_{RMS}$
- High PSRR:
  - 90dB at 1kHz
  - 70dB at 100kHz
  - 63dB at 1MHz
- Input voltage range: 2.7V to 24V
- Maximum output current: 200mA
- High output voltage accuracy: ±1%
- Low dropout voltage: 80mV at I_{OUT} = 100mA (Typ.)
- User-programmable soft start
- Low quiescent current, I_{GND}: 66uA (Typ.)
- Low shutdown current: 4uA at V_{IN} = 5V
- Stable with a 2.2uF ceramic output capacitor
- Fixed output voltages: 1.2V, 1.5V, 1.8V, 2.5V, 2.8V, 3.0V, 3.3V and 5.0V
- For automotive applications requiring specific change control

Applications

- Regulation to noise sensitive applications
- Communications and infrastructure
- Medical and healthcare
- Industrial and instrumentation

Typical Application



24V, Low Dropout Linear Regulator

Description

The OSU22211 is a low dropout linear regulator that operates from 2.7V to 24V and deliver 200mA output current. The OSU22211 features high power supply rejection, low noise, and achieves excellent line and load transient response with a small 2.2uF ceramic output capacitor. The output noise is 8uV$_{RMS}$, independent of the output voltage for the fixed options of 5V or less.

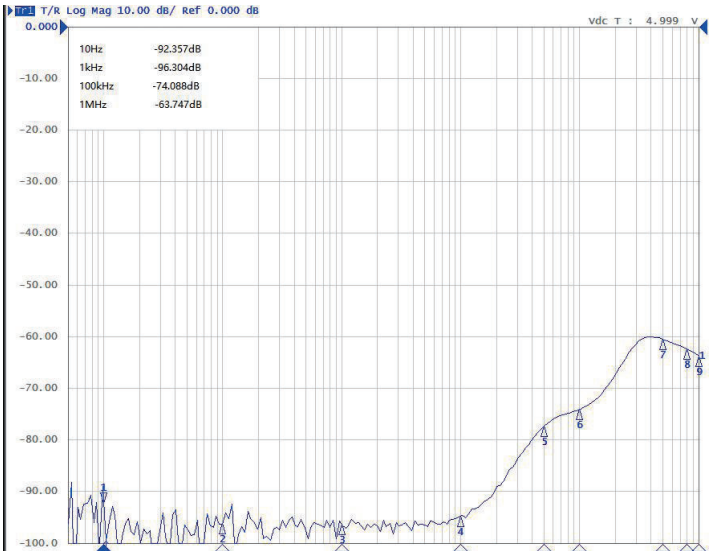
The OSU22211 series contains eight fixed output voltages of 1.2V, 1.5V, 1.8V, 2.5V, 2.8V, 3.0V, 3.3V and 5.0V

A programmable soft start with an external capacitor is available in the OSU22211. The OSU22211 is available in SOT23-6 and SOT23-5 package.

Device Information

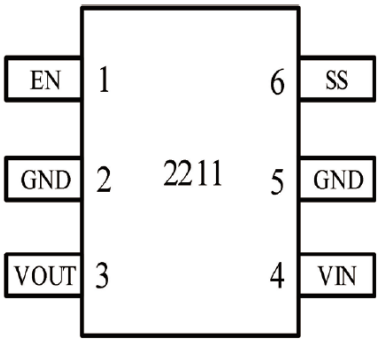
PART NUMBER	PACKAGE	BODY SIZE(NOM)
OSU22211ASF-XX	SOT23-6	2.9mm*2.8mm
OSU22211ATG-XX	SOT23-5	2.9mm*2.8mm

PSRR

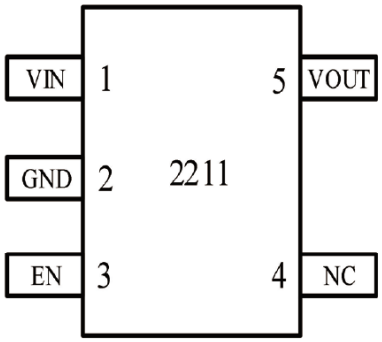


V_{IN}=5.3V,V_{OUT}=3.3V,I_{OUT}=10mA

Pin Configuration and Functions



SOT23-6



SOT23-5

Pin		Pin Name	Function
SOT23-6	SOT23-5		
1	3	EN	The enable pin controls the operation of the LDO. Drive EN high to turn on the regulator. Drive EN low to turn off the regulator. For automatic startup, connect EN to VIN.
2, 5	2	GND	Ground
3	5	VOUT	Output Pin
4	1	VIN	Input Pin
6	-	SS	Soft Start. An external capacitor connected to this pin determines the soft start time. Leave this pin open for a typical 340us start-up time. Do not ground this pin.
-	4	NC	No connection

Absolute Maximum Ratings

Parameter	Description	Min	Max	Unit
Input voltage	VIN to GND	-0.3	26	V
	VOUT to GND	-0.3	26	V
	VIN to VOUT	-0.3	26	V
Current	Peak output current	Internally limited		
Temperature	Operating temperature range	-40	125	℃
	Storage temperature	-40	150	℃
Thermal resistance (Junction to ambient)	SOT23-6	200		℃/W
	SOT23-5	200		
Power dissipation	SOT23-6	600		mW
	SOT23-5	600		

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)	8	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, C_{IN} = 2.2uF, V_{IN} = V_{OUTNOM} + 1.0V, V_{OUT} = 3.3V,C_{OUT} = 2.2uF, unless otherwise noted)

Symbol	Parameter	Test Conditions	Min	Typ	Max	Unit
V_{IN}	Operating input voltage	V_{OUT} = 1.8V	2.7	—	24	V
I_{GND}	Quiescent current	V_{IN} = 12V, No load	—	66	110	uA
$I_{ShutDown}$	Shutdown current	V_{IN} = 12V, V_{EN} = 0V	—	4	—	uA
V_{OUT}	Output voltage	V_{IN} = 12V, I_{OUT} = 10mA	V_{OUTNOM} * 0.99	V_{OUTNOM}	V_{OUTNOM} *1.01	V
I_{OUT_MAX}	Output current	V_{IN} = V_{OUTNOM} + 1V	200	—	—	mA
V_{DROP}	Dropout voltage(1)	I_{OUT} = 100mA , V_{IN} = V_{OUTNOM} - 0.1V	—	80	100	mV
$T_{START\ UP}$	Start up time	V_{IN} = 5V	—	340	—	us
$SS_{I\text{-}SOURCE}$	Soft start source current	V_{SS} = 0V	—	1	—	uA
$\Delta V_{OUT}/\Delta I_{OUT}$	Load regulation	V_{IN} = V_{OUTNOM} + 1V, 1mA ≤ I_{OUT} ≤ 200mA	—	0.1	—	mV/mA
$\Delta V_{OUT}/\Delta V_{IN}$	Line regulation	I_{OUT} = 1mA, V_{OUTNOM} + 1V ≤ V_{IN} ≤ 24V	—	0.2	—	mV/V
V_{EN_H}	Enable high threshold	V_{IN} = 5V	1.5	—	—	V
V_{EN_L}	Enable low threshold	V_{IN} = 5V	—	—	0.4	
I_{LIMIT}	Current limit	V_{IN} = V_{OUT}*0.9	—	400	—	mA
T_{SHDN}	Thermal shutdown temperature	Shutdown, temperature increasing	—	165	—	°C
		Reset, temperature decreasing	—	130	—	
Noise	Output voltage noise	V_{IN} = 5.3V , I_{OUT} = 10mA	—	8	—	uV_{RMS}
PSRR		V_{IN} = 5.3V , I_{OUT} = 10mA F = 1kHz	—	90	—	dB

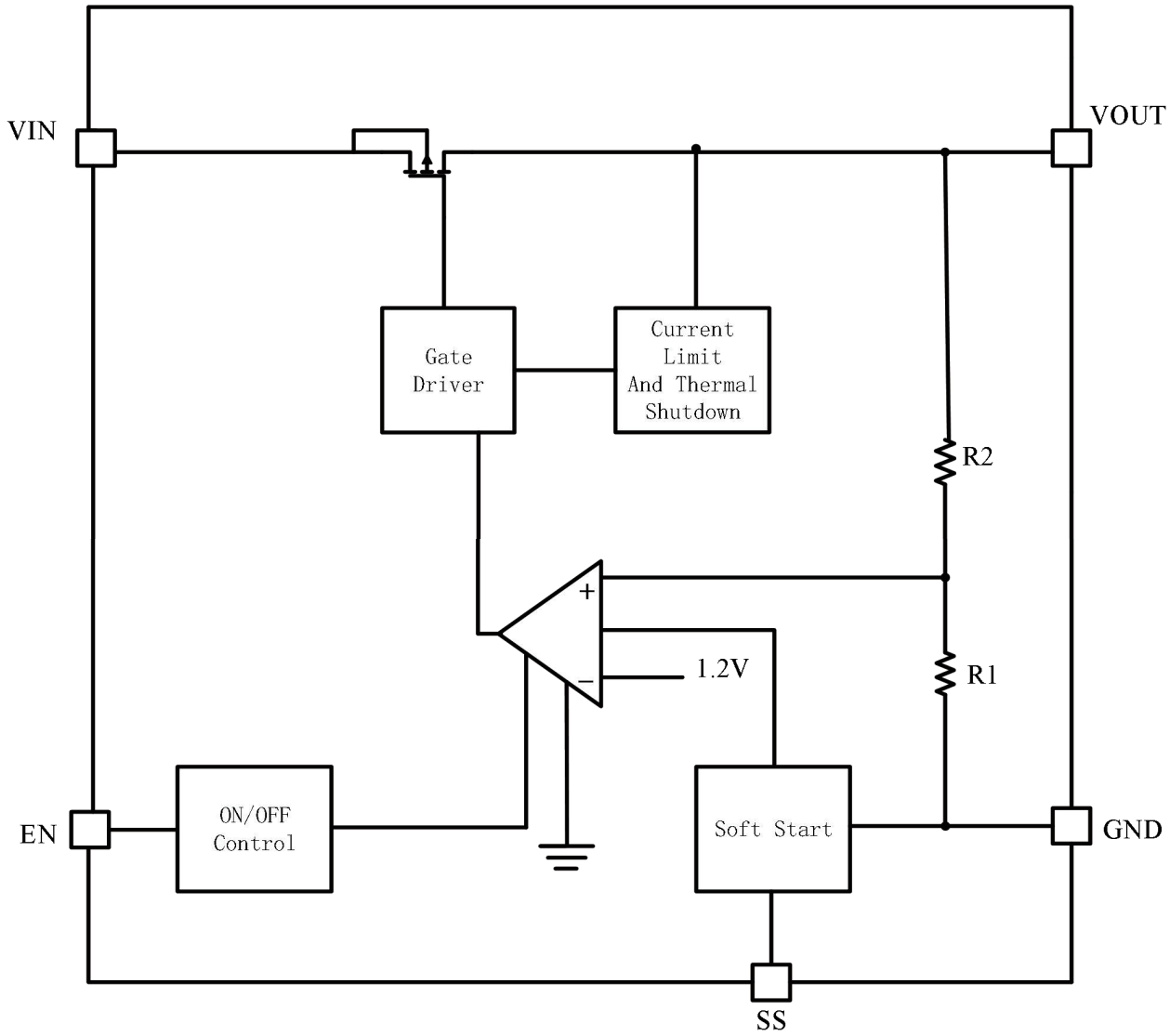
Note：(1) Dropout Voltage is the voltage difference between the input and the output at which the output voltage drops 0.8% below its nominal value.

Detailed Description

Overview

The OSU22211 series is an ultra-small, low dropout linear regulator that can source 200mA of output current. The OSU22211 series is designed to provide high PSRR, high input voltage, and excellent load and line transient performance. The OSU22211 series has thermal shutdown, current limit, and short circuit protections for added safety. Shutdown mode is enabled by pulling the EN pin low.

Functional Block Diagram



Functional Block Diagram

Input Capacitor

A 2.2uF 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 2.2uF. A 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 the output capacitor as close as possible to VOUT and GND pins.

Current-Limit and Short-Circuit Protection

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

Soft Start

Soft start the OSU22211 uses an internal soft start (SS pin open) to limit the inrush current when the output is enabled. The start-up time for the 5V option is approximately 340us from the time the EN active threshold is crossed to when the output reaches 90% of the final value.

SS_{TIME} (sec) = $t_{START-UP}$ at 0pF + (0.6 × C_{SS})/Iss

where: $t_{START-UP}$ at 0pF is the start-up time at C_{SS} = 0pF (typically 380us). C_{SS} is the soft start capacitor (F). Iss is the soft start current (typically 1uA).

Thermal Protection

The OSU22211 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 trigger, shutting down the power MOSFET to prevent the LDO from damage. As soon as the excessive thermal condition is removed and the temperature of the device drops down, the thermal protection circuit will release the control of the power MOSFET, and the LDO device returns to normal operation.

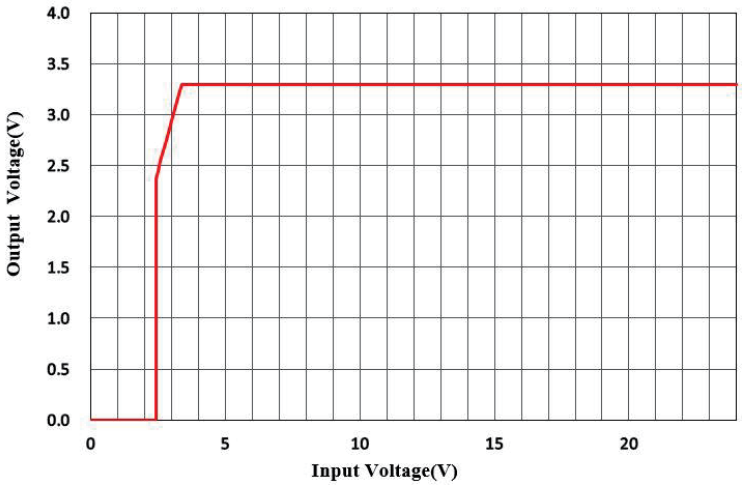
Layout Considerations

For good ground loop and stability, the input and output capacitors should be located close to the input, output, and ground pins of the device. The regulator ground pin should be connected to the external circuit ground to reduce voltage drop caused by trace impedance. Ground plane is generally used to reduce trace impedance. Wide trace should be used for large current paths from VIN to VOUT, and load circuit.

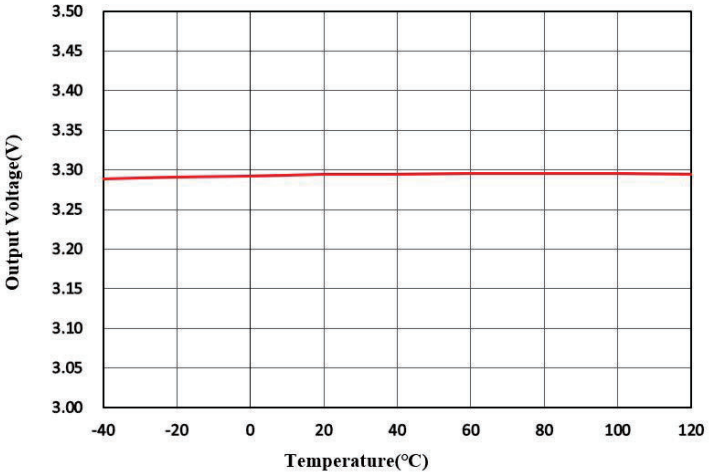
Typical Characteristics

(Test Condition: T_A = 25°C,C_{IN} = 2.2uF,V_{IN} = V_{OUTNOM} + 1V,C_{OUT} = 2.2uF, V_{OUT} = 3.3V unless otherwise note)

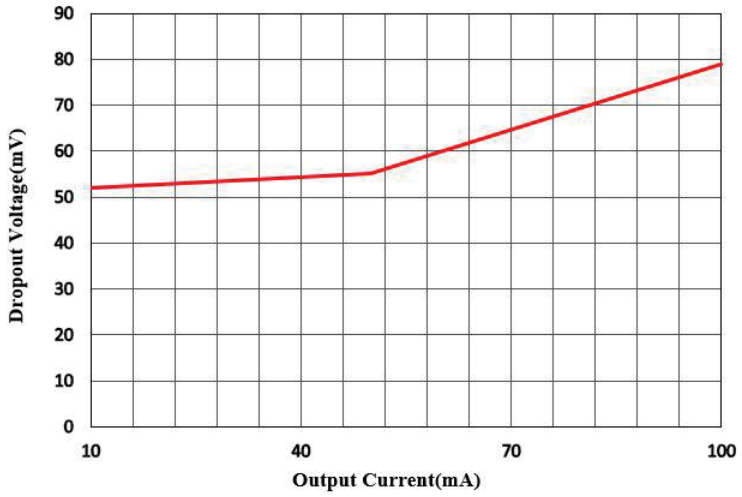
Output Voltage vs. Intput Voltage



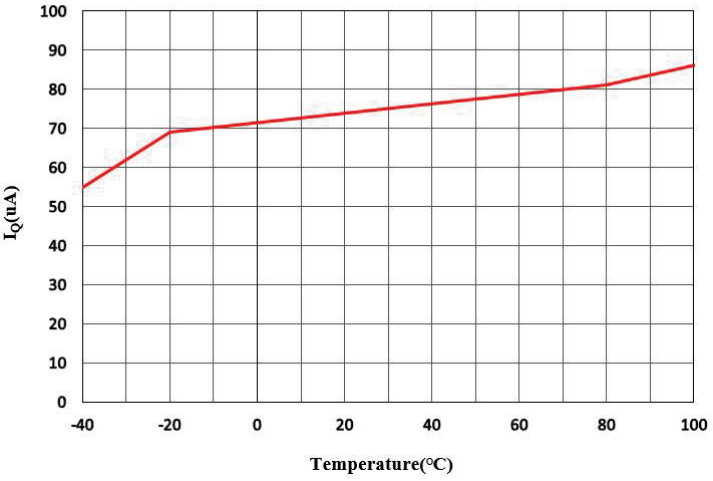
Output Voltage vs. Temperature



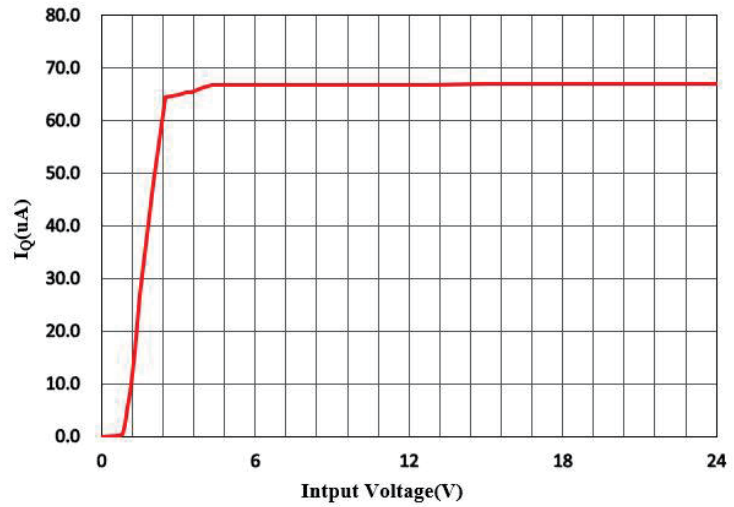
Dropout Voltage vs. Output Current



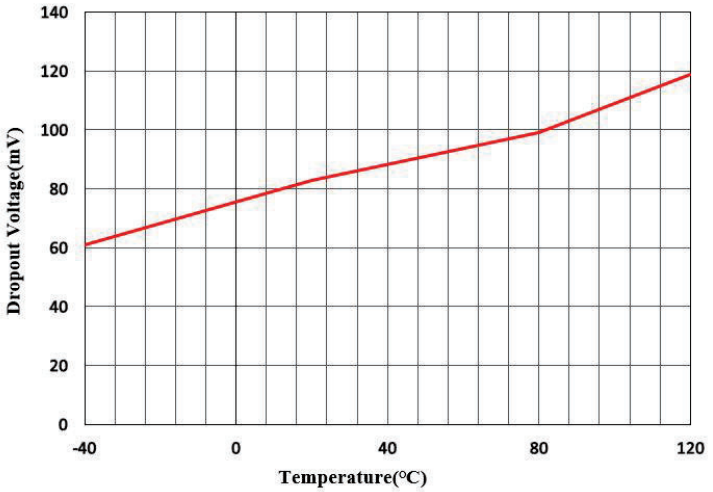
I_Q vs. Temperature



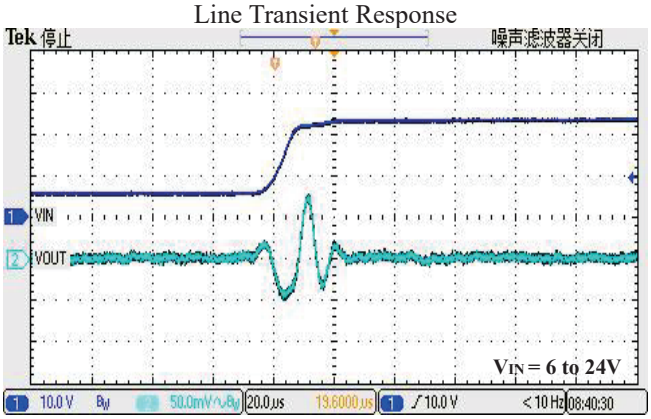
I_Q vs. Intput Voltage



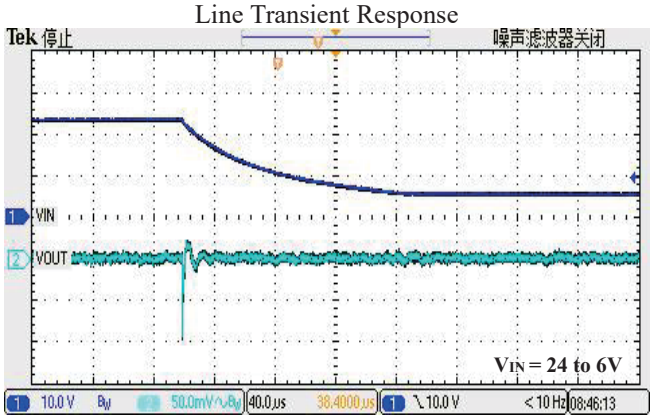
Dropout Voltage vs. Temperature(I_{OUT} = 100mA)



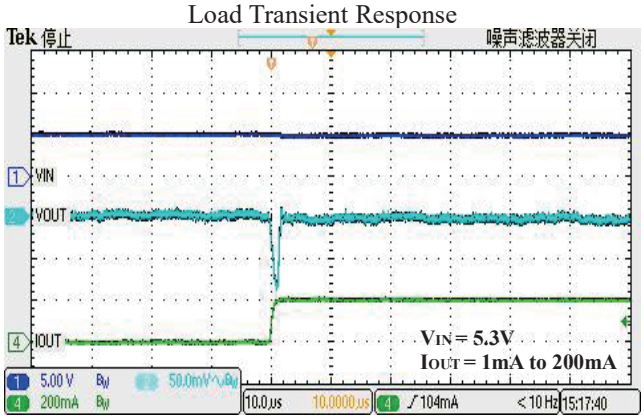
Line Transient Response



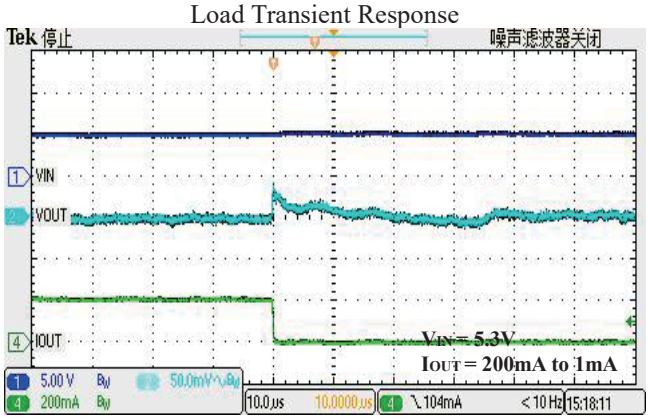
Line Transient Response



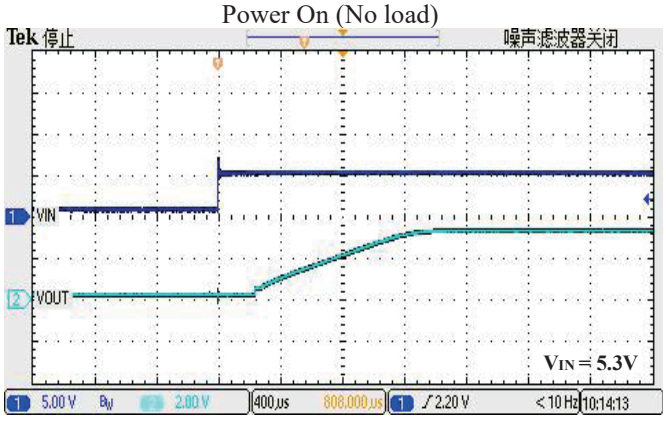
Load Transient Response



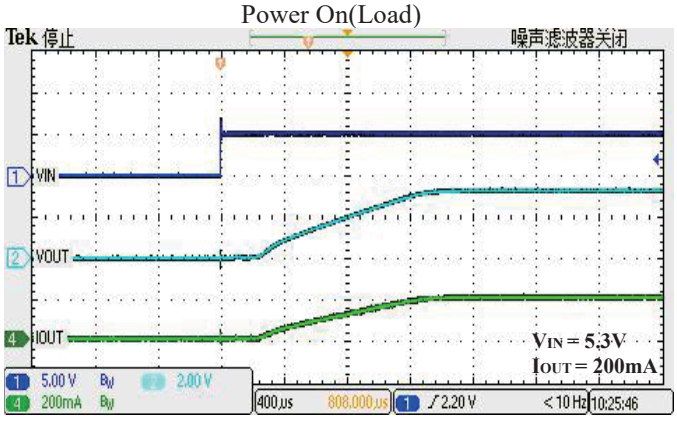
Load Transient Response



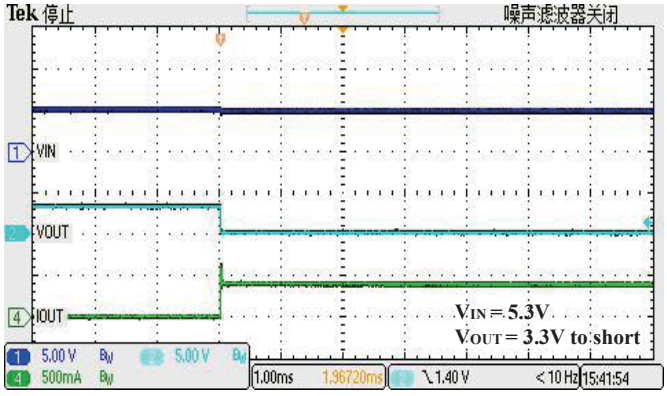
Power On (No load)



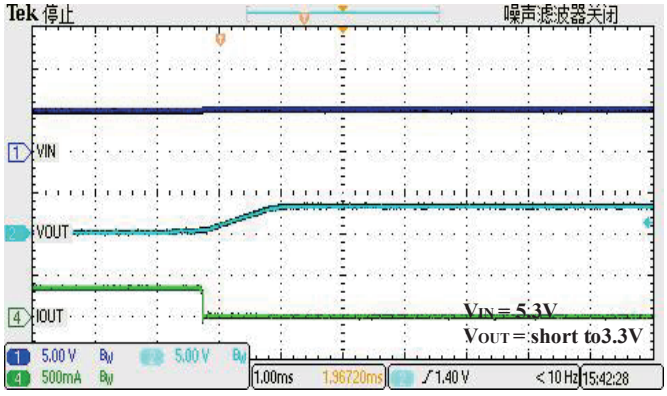
Power On(Load)



Short Circuit Protection



Short Circuit Protection

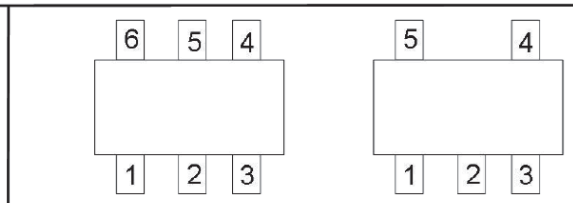


Ordering Information

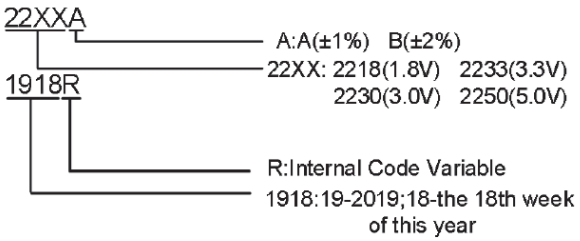
Model	Package Description	Specified Temperature Range	Packing Option
OSU22211ASF-12	SOT23-6	-40℃ to + 125℃	Tape and Reel, 3000
OSU22211ASF-15	SOT23-6	-40℃ to + 125℃	Tape and Reel, 3000
OSU22211ASF-18	SOT23-6	-40℃ to + 125℃	Tape and Reel, 3000
OSU22211ASF-25	SOT23-6	-40℃ to + 125℃	Tape and Reel, 3000
OSU22211ASF-28	SOT23-6	-40℃ to + 125℃	Tape and Reel, 3000
OSU22211ASF-30	SOT23-6	-40℃ to + 125℃	Tape and Reel, 3000
OSU22211ASF-33	SOT23-6	-40℃ to + 125℃	Tape and Reel, 3000
OSU22211ASF-50	SOT23-6	-40℃ to + 125℃	Tape and Reel, 3000
OSU22211ATG-12	SOT23-5	-40℃ to + 125℃	Tape and Reel, 3000
OSU22211ATG-15	SOT23-5	-40℃ to + 125℃	Tape and Reel, 3000
OSU22211ATG-18	SOT23-5	-40℃ to + 125℃	Tape and Reel, 3000
OSU22211ATG-25	SOT23-5	-40℃ to + 125℃	Tape and Reel, 3000
OSU22211ATG-28	SOT23-5	-40℃ to + 125℃	Tape and Reel, 3000
OSU22211ATG-30	SOT23-5	-40℃ to + 125℃	Tape and Reel, 3000
OSU22211ATG-33	SOT23-5	-40℃ to + 125℃	Tape and Reel, 3000
OSU22211ATG-50	SOT23-5	-40℃ to + 125℃	Tape and Reel, 3000

Marking Information

Part Number	
OSU22211AXX-XX Output Voltage Package Definition Accuracy Product Name Company Name	**Package Outline**
	Minimum Package
	Marking

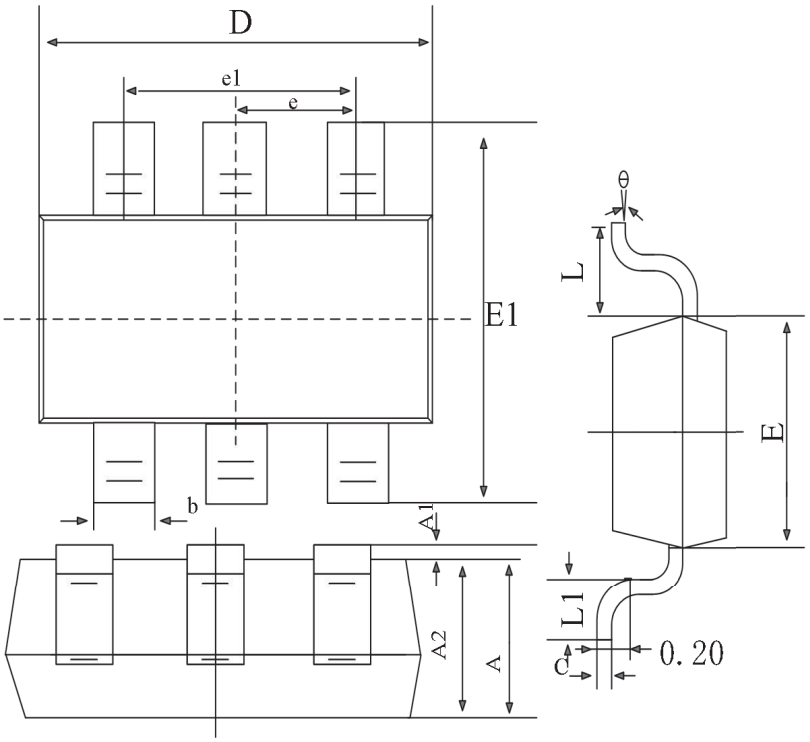


SOT23-6/SOT23-5
3000pcs/Reel



Package Outline

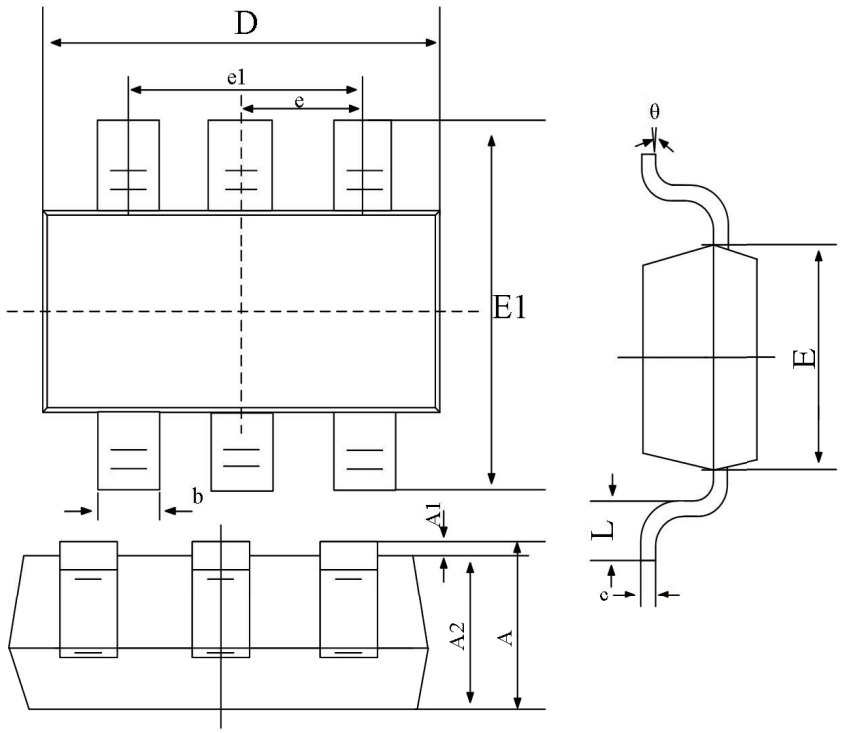
SOT23-6



REF.	Millimeter	
	Min.	Max.
A	1.05	1.25
A1	0	0.1
A2	1.05	1.15
b	0.3	0.5
c	0.1	0.2
D	2.85	3.05
E	1.5	1.7
E1	2.65	2.95
e	0.95(BSC)	
e1	1.8	2.0
L	0.3	0.6
θ	0°	8°

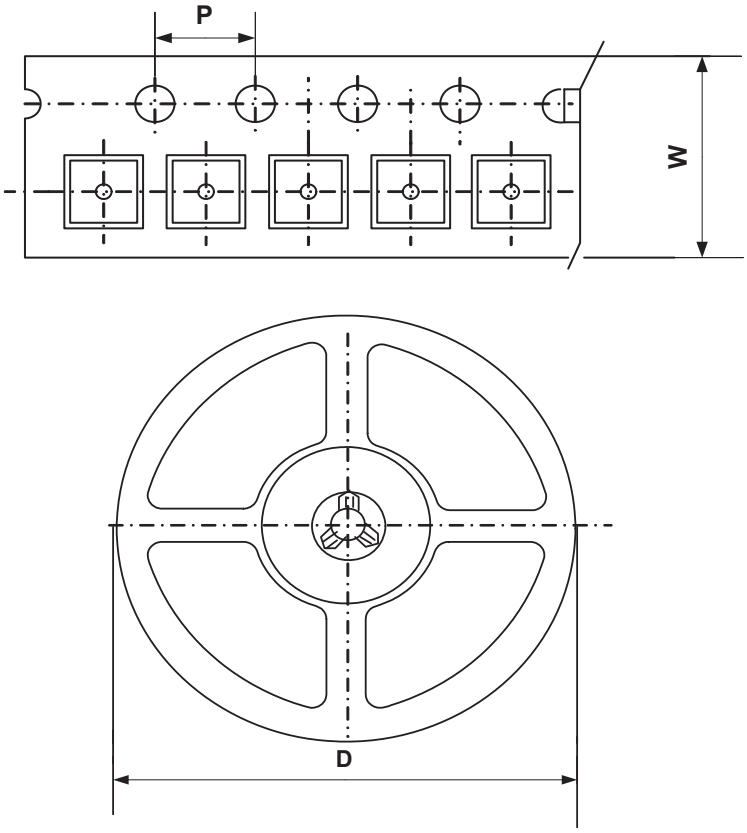
Low Noise, 24V, 200mA Low Dropout Linear Regulator

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)
SOT23-5	8.0mm	4.0mm	178.0mm	3000pcs
SOT23-6	8.0mm	4.0mm	178.0mm	3000pcs

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