TK9500 Series
Low Dropout Regulators

Description

TK9500 Series is high accuracy,very low quiescent current,low-dropout linear regulator able to provide 500mA load current.

TK9500 Series features very fast response against line voltage transient and load current transient, and ensures no overshoot voltage during the LDO start up and short circuit recovery.

TK9500 Series integrated short circuit protection, current limiting protection and thermal protection function. By putting the EN pin down to turn on shuntdown mode.

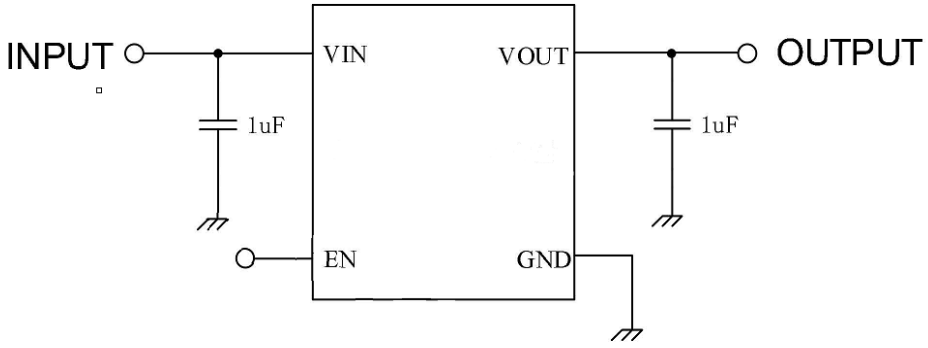
Features

- Wide Input Voltage Range: 1.8V~6V
- Maximum Output Current: 500mA
- Standard Fixed Output Voltage Options: 1.2V,1.8V,2.5V,2.8V,3V,3.3V,3.6V,etc
- Low Quiescent Current: 800nA
- PSRR=60dB@1KHz
- Low Dropout: 130mV @ 100mA
- Low Output Voltage Accuracy: ±2%
- Short Circuit Protection
- Current Limiting Protection
- Thermal Shutdown Protection
- Available Packages: SOT-23, SOT-23-3, SOT-89, SOT-23-5,DFN1x1-4L and SOT-89-5

Applications

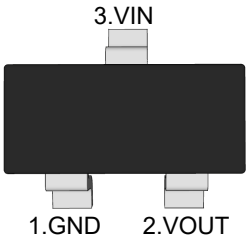
- Battery-Powered Equipment
- Smoke Detector and Sensor
- Micro Controller Applications

Typical Application Circuit

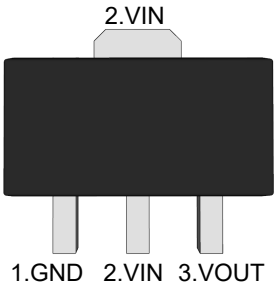


Pin Distribution

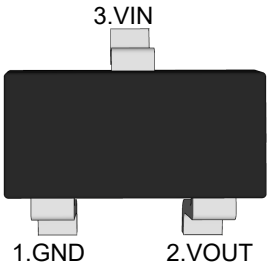
SOT-23



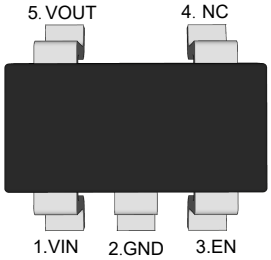
SOT-89



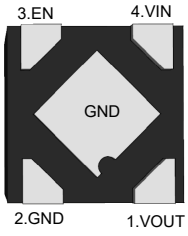
SOT-23-3



SOT-23-5

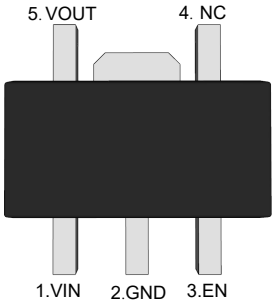


DFN1x1-4L



(Bottom View)

SOT-89-5



Functional Pin Description

Pin Name	Pin Function
VIN	Power Input Voltage
GND	Ground
EN	Chip Enable (Active High). Note that this pin is high impedance
NC	NO Connected
VOUT	Output Voltage

Ordering Information

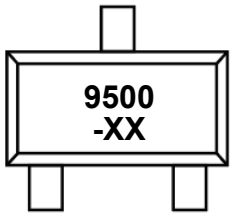
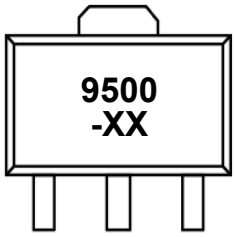
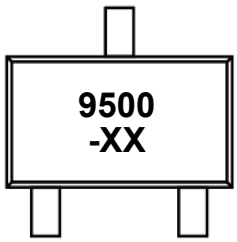
TK9500□□□□

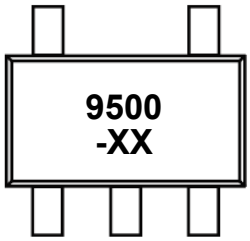
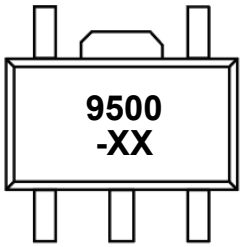
Package Type
SA:SOT-23 SQ:SOT-89
SC:SOT-23-3 SE:SOT-23-5
DE:DFN1x1-4L SR: SOT-89-5

Output Voltage
12 : 1.2V 18 : 1.8V 25 : 2.5V
28 : 2.8V 30 : 3.0V 33 : 3.3V
36 : 3.6V

Output current tap
M : 500mA

Ordering Information Continue

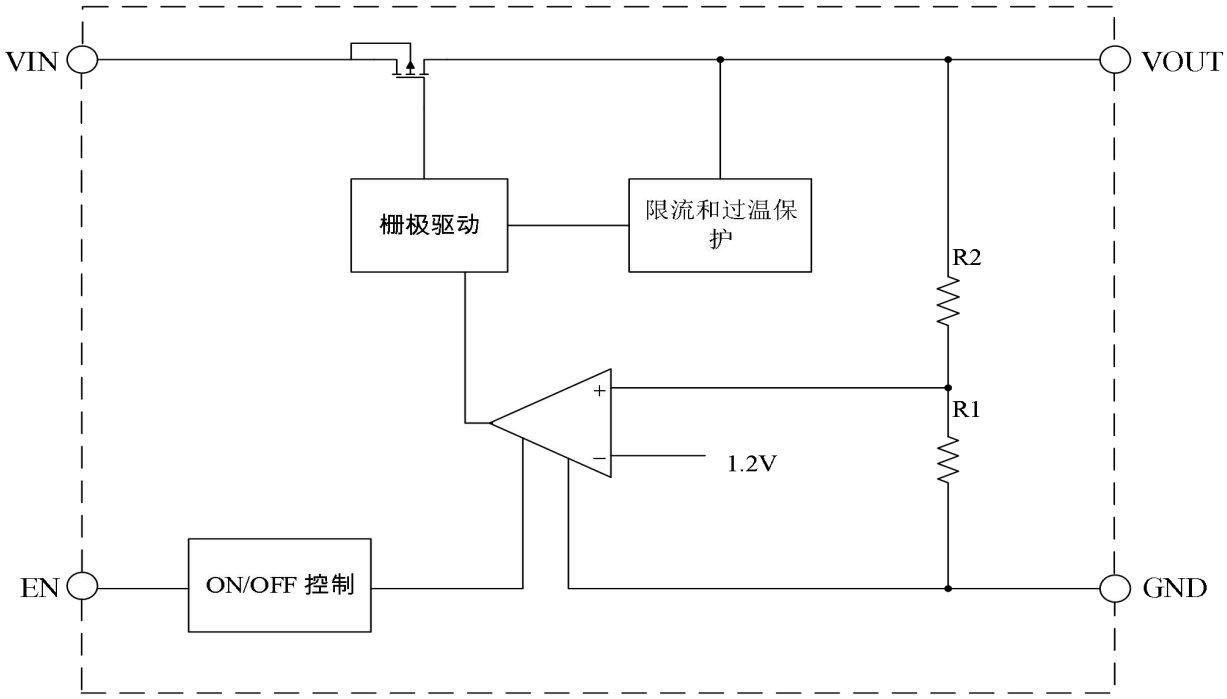
Orderable Device	Package	Reel (inch)	Package Qty (PCS)	Eco Plan Note	MSL Level	Marking Code
TK9500M12SA	SOT-23	7	3000	RoHS & Green	MSL1	 XX:Output Voltage e.g. 3.0:3.0V
TK9500M18SA						
TK9500M25SA						
TK9500M28SA						
TK9500M30SA						
TK9500M33SA						
TK9500M36SA						
TK9500M12SQ	SOT-89	7/13	1000/3000	RoHS & Green	MSL1	 XX:Output Voltage e.g. 3.0:3.0V
TK9500M18SQ						
TK9500M25SQ						
TK9500M28SQ						
TK9500M30SQ						
TK9500M33SQ						
TK9500M36SQ						
TK9500M12SC	SOT-23-3	7	3000	RoHS & Green	MSL3	 XX:Output Voltage e.g. 3.0:3.0V
TK9500M18SC						
TK9500M25SC						
TK9500M28SC						
TK9500M30SC						
TK9500M33SC						
TK9500M36SC						

TK9500M12SE TK9500M18SE TK9500M25SE TK9500M28SE TK9500M30SE TK9500M33SE TK9500M36SE	SOT-23-5	7	3000	RoHS & Green	MSL3	 XX:Output Voltage e.g. 3.0:3.0V
TK9500M12DE TK9500M18DE TK9500M25DE TK9500M28DE TK9500M30DE TK9500M33DE TK9500M36DE	DFN1x1-4L	7	1000	RoHS & Green	MSL1	 D:Product Code e.g. D: PJ9500 Series XX:Output Voltage e.g. 30:30V
TK9500M12SR TK9500M18SR TK9500M25SR TK9500M28SR TK9500M30SR TK9500M33SR TK9500M36SR	SOT-89-5	7/13	1000/3000	RoHS & Green	MSL1	 XX:Output Voltage e.g. 3.0:3.0V

Note:

1. RoHS: PJ defines "RoHS" to mean semiconductor products that are compliant with the current EU RoHS requirements for all 10 RoHS substances, including the requirement that RoHS substance do not exceed 0.1% by weight in homogeneous materials.
   Green: PJ defines "Green" to mean Halogen-Free and Antimony-Free.

Function Block Diagram



Absolute Maximum Ratings Note1

Ratings at 25℃ ambient temperature unless otherwise specified.

Parameter		Value	Unit
VIN,VEN to GND Voltage	V_{IN}	-0.3 ~ 6	V
	V_{EN}	-0.3 ~ 6	V
VOUT to VIN Voltage		-0.3 ~ 5	V
Maximum Load Current		500	mA
Power Dissipation	SOT-23	300	mW
	SOT-89	400	mW
	SOT-23-3	250	mW
	SOT-23-5	250	mW
	DFN1x1-4L	250	mW
	SOT-89-5	400	mW
Thermal Resistance,Junction-to-Ambient	SOT-23	330	°C/W
	SOT-89	250	°C/W
	SOT-23-3	400	°C/W
	SOT-23-5	400	°C/W
	DFN1x1-4L	400	°C/W
	SOT-89-5	250	°C/W
Operating Ambient Temperature		-40 ~ +125	°C
Storage temperature range		-40 ~ +150	°C
Lead Temperature		300°C,10S	--
ESD Voltage	HBM	4	KV
	CDM	200	V

Note1: Exceed these limits to damage to the device. Exposure to absolute maximum rating conditions may affect.

Recommended Operating Conditions

Parameter	Value	Unit
Supply Voltage	1.8~6	V
Maximum Output Current	500	mA
Operating Ambient Temperature	-40 ~ +125	°C

Electrical Characteristics

(V_{IN}=V_{OUT}+1V, C_{IN}=1μF, C_{OUT}=1μF, T_A=25℃ , unless otherwise noted.)

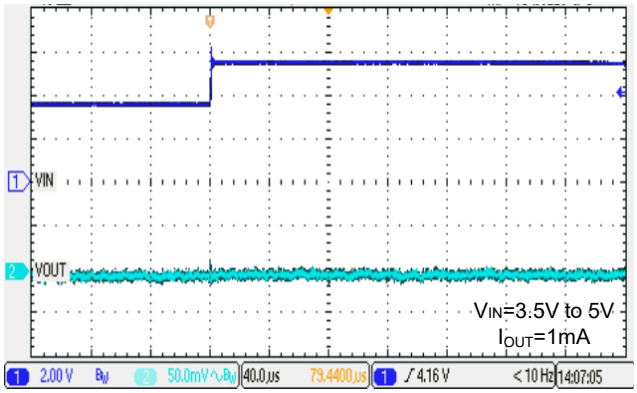
Parameter		Symbol	Test Conditions	Min.	Typ.	Max.	Unit
Input Voltage		V_{IN}		1.8	--	6	V
Output Voltage Accuracy		ΔV_{OUT}	V_{IN}=5V, I_{OUT}=10mA	-2	--	+2	%
Quiescent Current		I_Q	V_{IN}=5.0V, I_{OUT}=0A	--	800	--	nA
Maximum Output Current		I_{OUT_Max}		--	500	--	mA
Dropout Voltage Note		V_{DROP}	V_{IN}=0.98*V_{OUT}, I_{OUT}=100mA V_{OUT}≥2.8V	--	120	--	mV
			V_{IN}=0.98*V_{OUT}, I_{OUT}=100mA 1.8≤V_{OUT}＜2.8V	--	160	--	mV
			V_{IN}=0.98*V_{OUT}, I_{OUT}=100mA V_{OUT}=1.5V	--	190	--	mV
			V_{IN}=0.98*V_{OUT}, I_{OUT}=100mA V_{OUT}=1.2V	--	280	--	mV
Line Regulation		ΔV_{LINE}	V_{IN}=(V_{OUT}+2V)~7V, I_{OUT}=1mA	--	1	3	mV
Load Regulation		ΔV_{LOAD}	V_{OUT}=4V, I_{OUT}=1~200mA	--	0.1	0.2	mV/mA
Short Circuit Current		I_{SHORT}	V_{EN}=V_{IN} VOUT Short to GND	--	120	150	mA
Current Limit		I_{LIMIT}	V_{IN}=V_{OUT}+1V	--	700	--	mA
EN Input Threshold	Logic Low	V_{IL}		--	--	0.9	V
	Logic High	V_{IH}		1.2	--	--	V
Power Supply Rejection Rate		PSRR	V_{IN}=5V, I_{OUT}=10mA,f=1 KHz	--	60	--	dB
Output Noise Voltage		eN	V_{IN}= 5V, I_{OUT}= 300mA, f=10Hz to100KHz, (V_{OUT}=3.3V), C_{OUT}=1μF	--	66	--	μV_{RMS}
Thermal Shutdown Temperature		T_{SHDN}	Shutdown, Temp increasing	--	129	--	°C
Thermal Reset Temperature			Reset, Temp decreasing	--	105	--	°C

Note:The dropout voltage difference is the voltage difference between the input and output, where the output voltage is 2% lower than its nominal value.

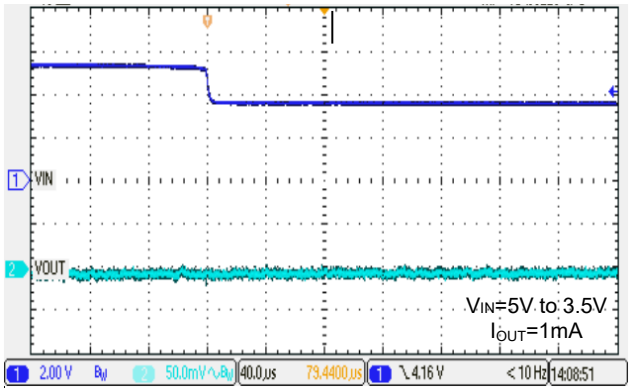
Typical Electrical Curves

T_A=25°C, (unless otherwise noted)

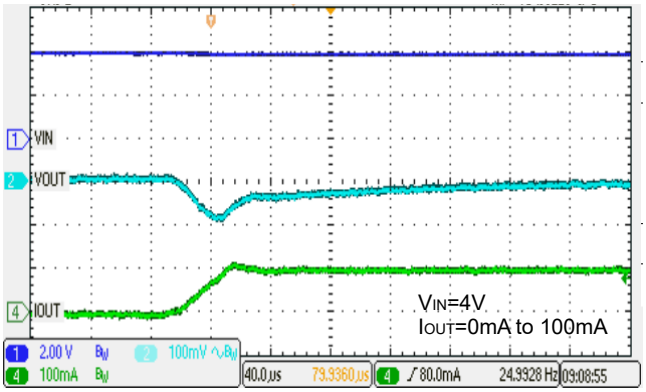
Line transient



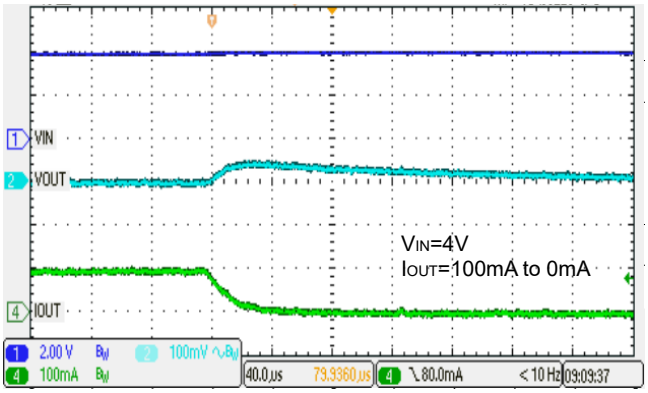
Line transient



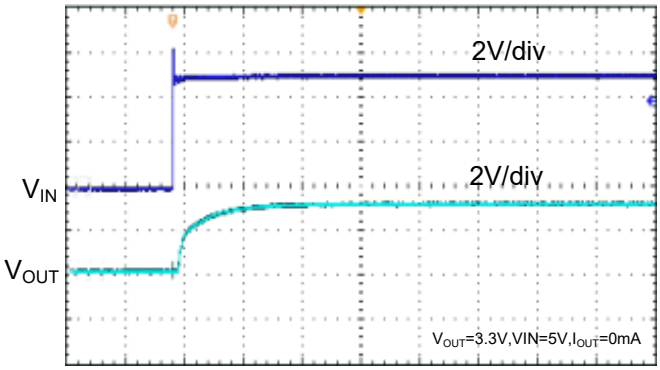
Load transient



Load transient

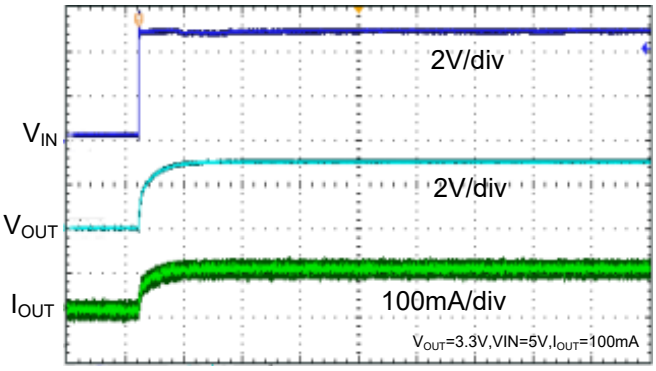


Power-on waveform

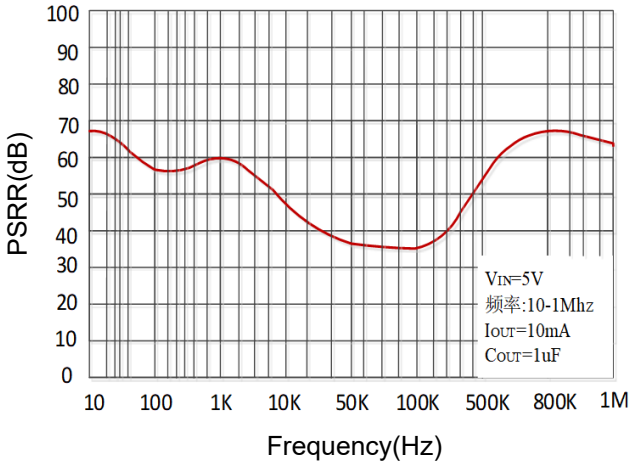


Time(200μs/div)

Power-off waveform



Time(400μs/div)


100
90
80
70
60
50
40
30
20
10
0
PSRR(dB)
10
100
1K
10K
50K
100K
500K
800K
1M
Frequency(Hz)
VIN=5V
频率:10-1Mhz
IOUT=10mA
COUT=1uF

Functional Description

Input Capacitor

A 1μF 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. The input capacitor should be at least equal to, or greater than, the output capacitor for good load transient performance。

Output Capacitor

An output capacitor is required for the stability of the LDO. The recommended output capacitance is from 1μF to 10μF, Equivalent Series Resistance (ESR) is from 5mΩ to 500mΩ, 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 OUT and GND pins.

ON/OFF Input Operation

The PJ9500 EN pin is internally held low by a 1-MΩ resistor to GND. The PJ9500 is turned on by setting the EN pin higher than VIH threshold, and is turned off by pulling it lower than VIL threshold. If this feature is not used, the EN pin should be tied to IN pin to keep the regulator output on at all time.

Low Quiescent Current

Cellular phone baseband internal digital circuits typically operate all the time. That requires LDO stays on at all times. However, in the standby mode, the microprocessor consumes only around 100~300μA. Since the phone stays in standby for the longest percentage of time, using a 0.8μA quiescent current LDO, instead of 100μA, saves 99.2μA and can substantially extends the battery standby time.

The PJ9500, consuming only 0.8μA quiescent current, provides great power saving in portable and low power applications.

Current Limit Protection

When output current at the OUT pin is higher than current limit threshold or the OUT pin is short-circuiting to GND, the current limit protection will be triggered and clamp the output current to a pre-set level to prevent over-current and to protect the regulator from damage due to overheating.

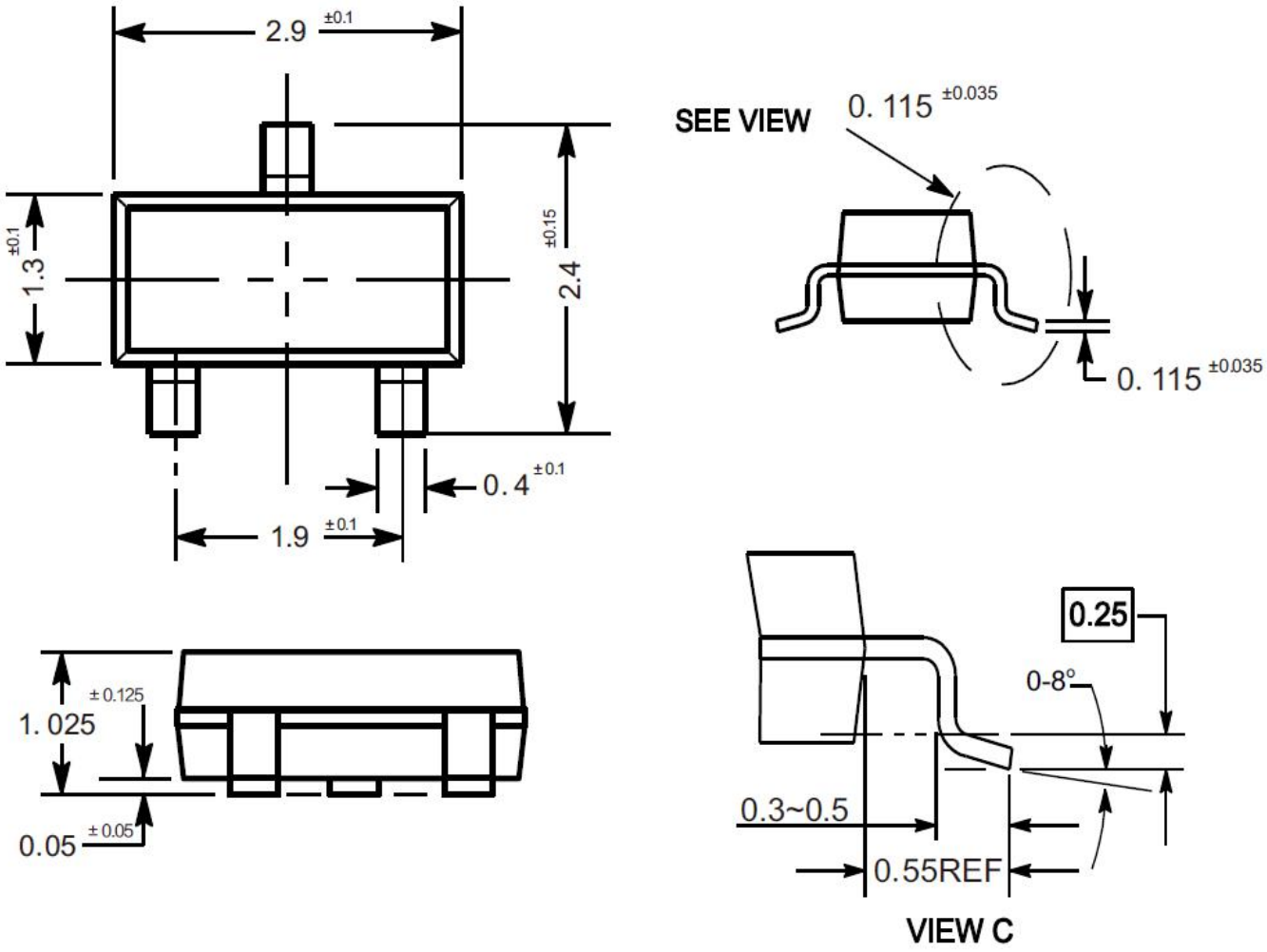
Thermal Overload Protection

The 9500 has internal thermal protection. When the temperature is too high, such as a short circuit in the output pins or a device with a very large load current and a large voltage drop, the internal thermal protection circuit will be triggered, which will shut down the power supply MOSFET and prevent LDO damage. Once the excessive thermal conditions are eliminated and the temperature of the device drops, the thermal protection circuit will restore control of the power MOSFET and allow the LDO device to enter normal operation

Package Outline

SOT-23

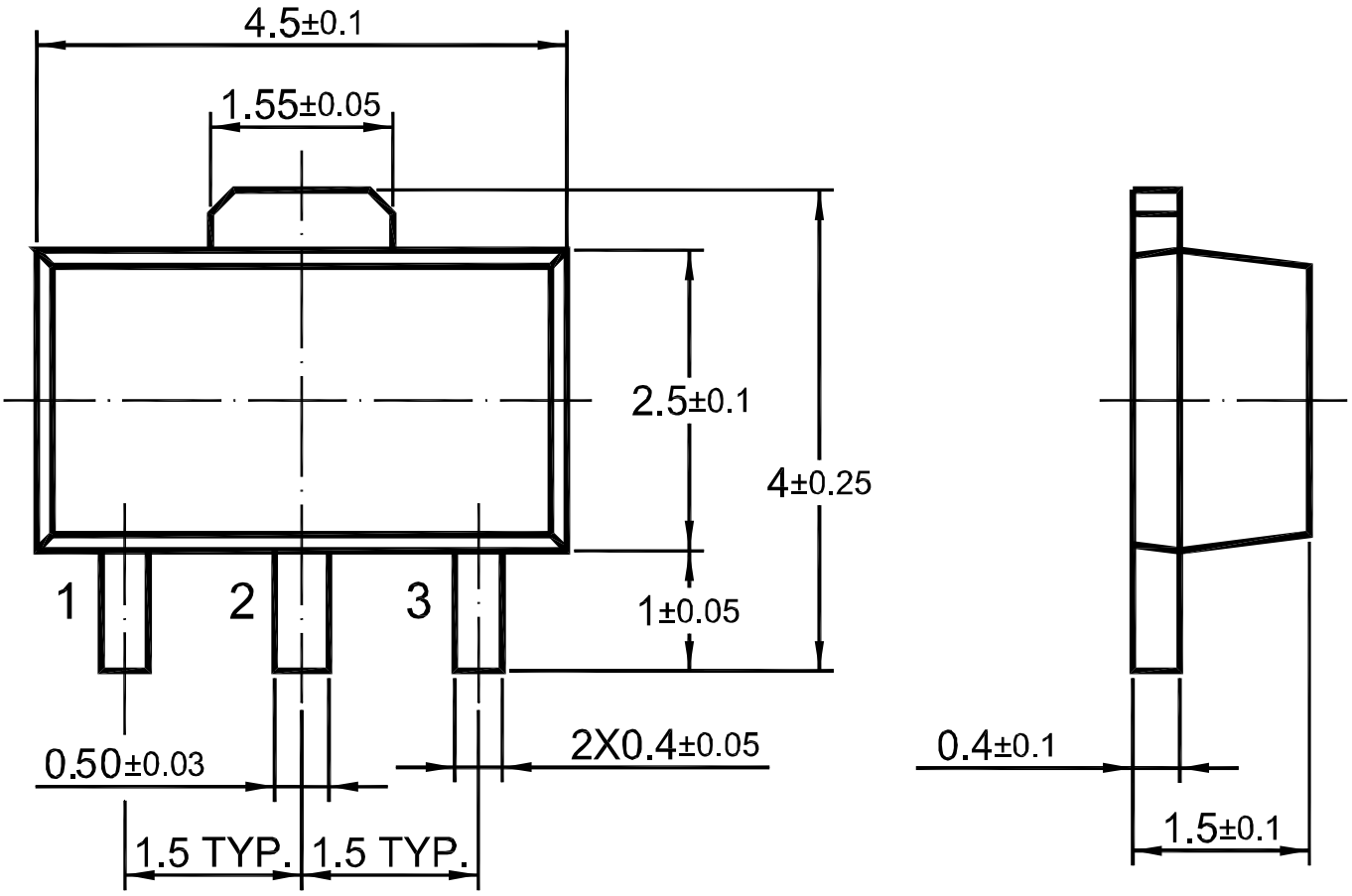
Dimensions in mm



Package Outline

SOT-89

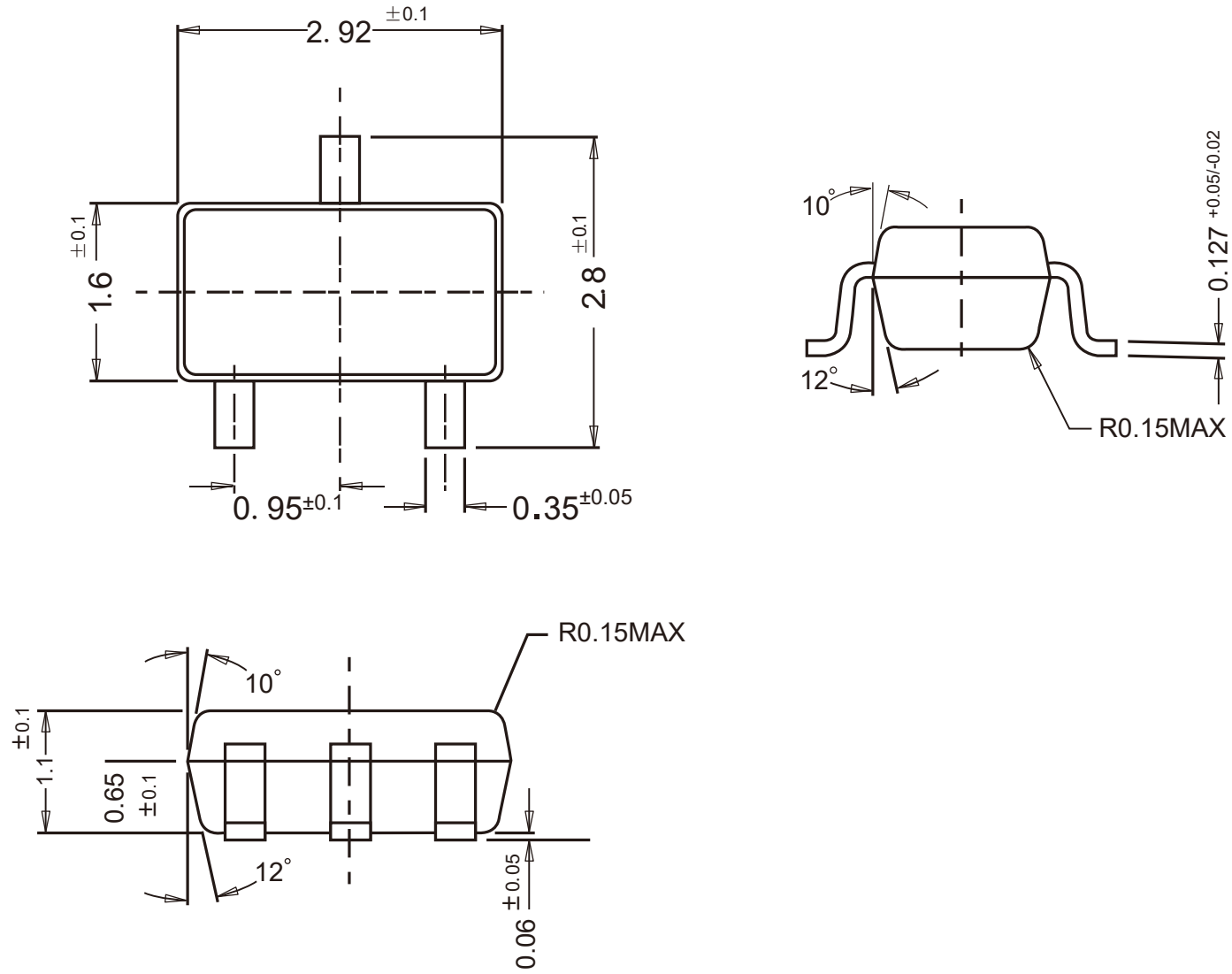
Dimensions in mm



Package Outline

SOT-23-3

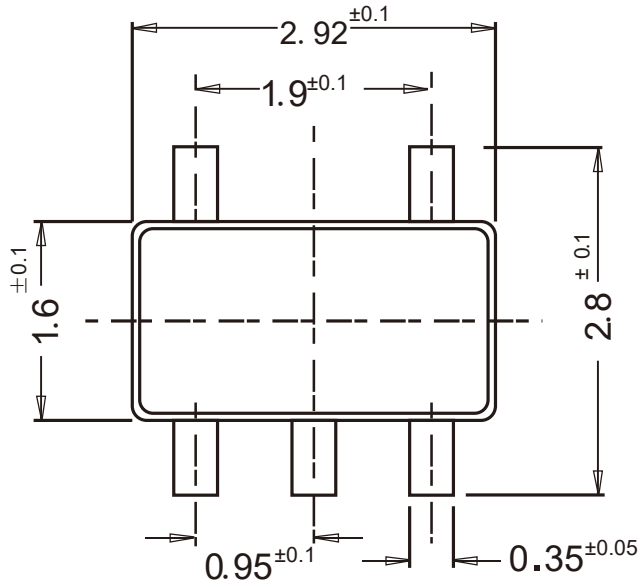
Dimensions in mm

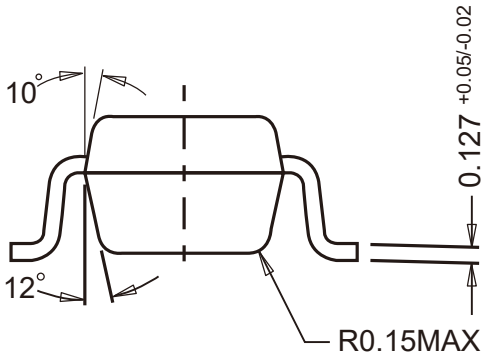


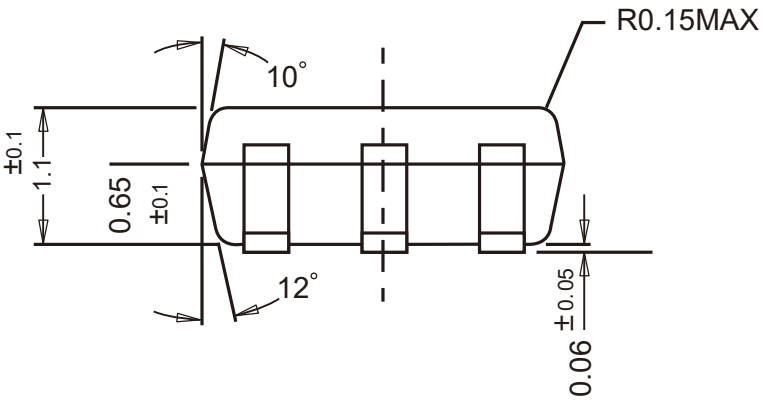
Package Outline

SOT-23-5

Dimensions in mm



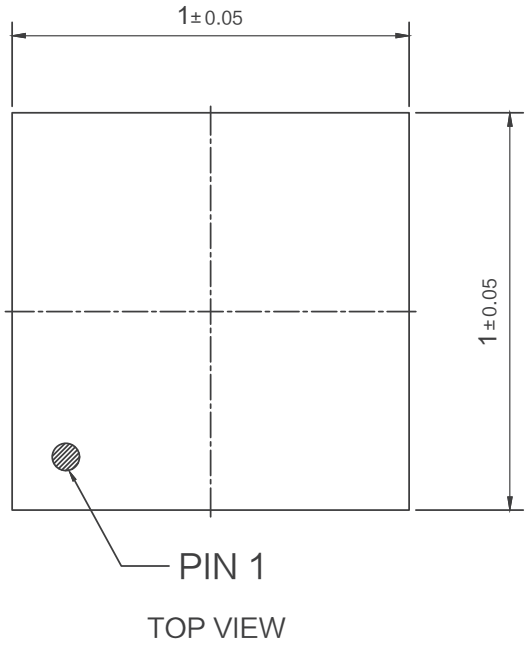




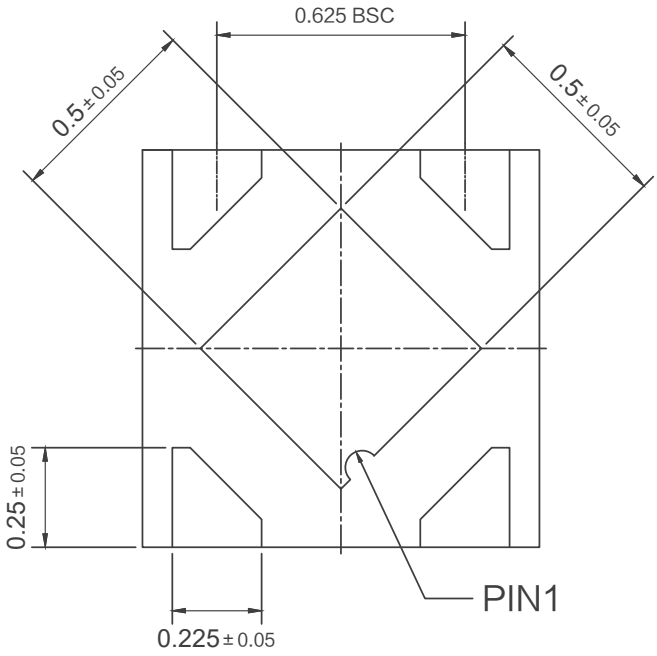
Package Outline

DFN1x1-4L

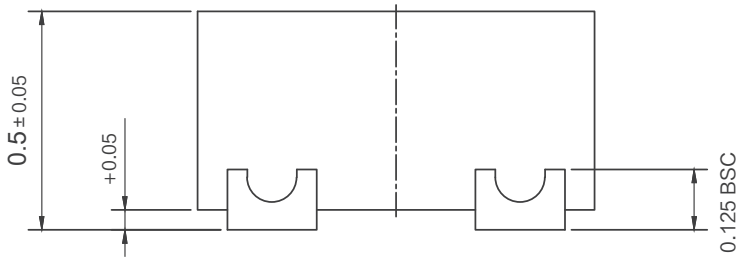
Dimensions in mm



TOP VIEW



BOTTOM VIEW



SIDE VIEW

Package Outline

SOT-89-5

Dimensions in mm

