Description

TN9500 Series is high accuracy,very low quiescent current,low-dropout linear regulator able to provide 500mA load current.

TN9500 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.

TN9500 Series integrated short circuit protection, current limiting protection and thermal protection function. By putting the EN pin down to turn on shuntdown mode.

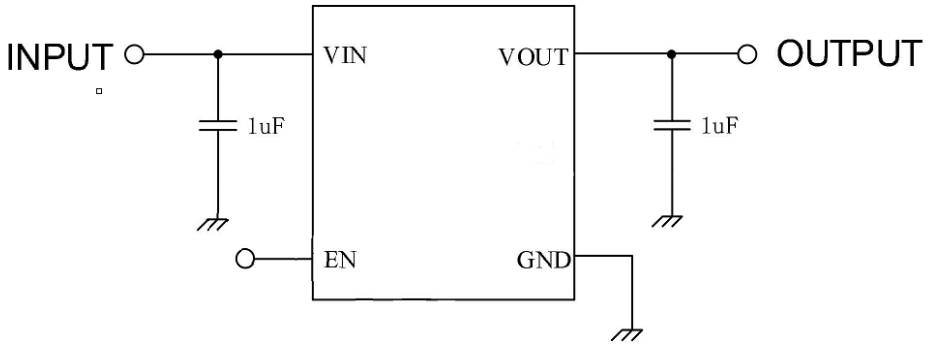
Features

- Wide Input Voltage Range: 1.8V~6V
- Maximum Output Current: 500mA
- Standard Fixed Output Voltage Options: 1.2V,1.5V,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

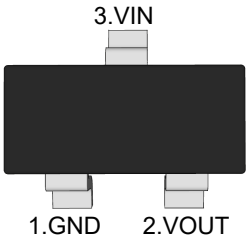
- Battery-Powered Equipment
- Smoke Detector and Sensor
- Micro Controller Applications

Typical Application Circuit

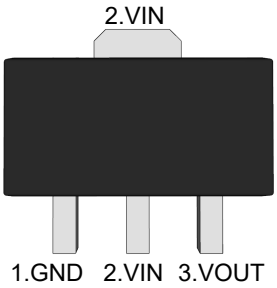


Pin Distribution

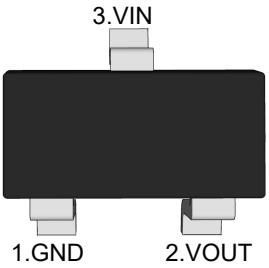
SOT-23



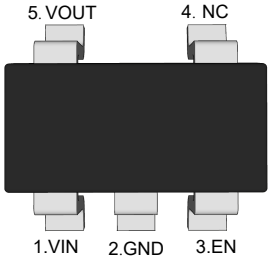
SOT-89



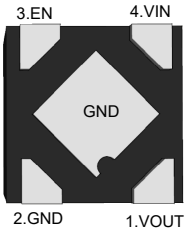
SOT-23-3



SOT-23-5

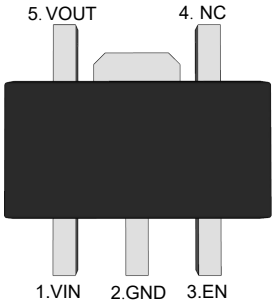


DFN1x1-4L



(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

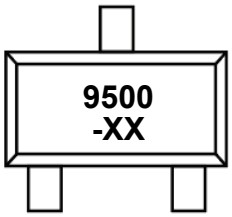
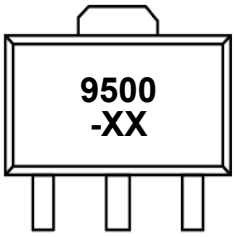
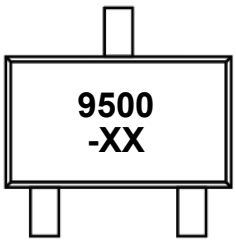
TN9500□□□□

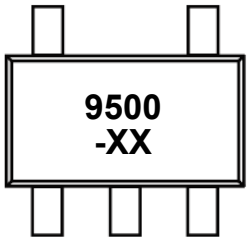
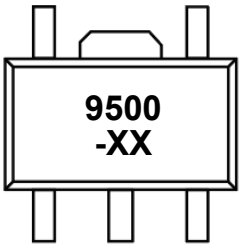
Package Type
SA:SOT-23 SQ:SOT-89
SC:SOT-23-3 SE:SOT-23-5
DE:DFN1x1-4L SR: SOT-89-5

Output Voltage
12 : 1.2V 15 : 1.5V 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

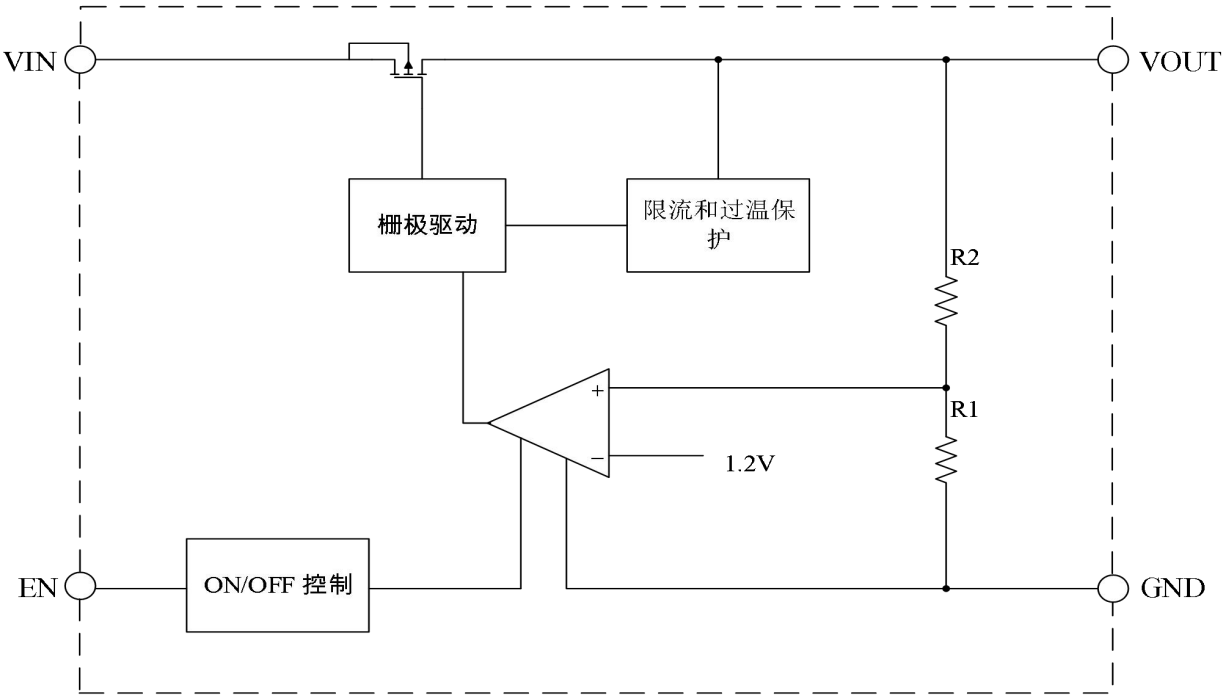
Orderable Device	Package	Reel (inch)	Package Qty (PCS)	Eco Plan Note	MSL Level	Marking Code
TN9500M12SA	SOT-23	7	3000	RoHS & Green	MSL1	 XX:Output Voltage e.g. 3.0:3.0V
TN9500M15SA						
TN9500M18SA						
TN9500M25SA						
TN9500M28SA						
TN9500M30SA						
TN9500M33SA						
TN9500M36SA						
TN9500M12SQ	SOT-89	7/13	1000/3000	RoHS & Green	MSL1	 XX:Output Voltage e.g. 3.0:3.0V
TN9500M15SQ						
TN9500M18SQ						
TN9500M25SQ						
TN9500M28SQ						
TN9500M30SQ						
TN9500M33SQ						
TN9500M36SQ						
TN9500M12SC	SOT-23-3	7	3000	RoHS & Green	MSL3	 XX:Output Voltage e.g. 3.0:3.0V
TN9500M15SC						
TN9500M18SC						
TN9500M25SC						
TN9500M28SC						
TN9500M30SC						
TN9500M33SC						
TN9500M36SC						

TN9500M12SE	SOT-23-5	7	3000	RoHS & Green	MSL3	 XX:Output Voltage e.g. 3.0:3.0V
TN9500M15SE						
TN9500M18SE						
TN9500M25SE						
TN9500M28SE						
TN9500M30SE						
TN9500M33SE						
TN9500M36SE						
TN9500M12DE	DFN1x1-4L	7	1000	RoHS & Green	MSL1	 D:Product Code e.g. D: PJ9500 Series XX:Output Voltage e.g. 30:30V
TN9500M15DE						
TN9500M18DE						
TN9500M25DE						
TN9500M28DE						
TN9500M30DE						
TN9500M33DE						
TN9500M36DE						
TN9500M12SR	SOT-89-5	7/13	1000/3000	RoHS & Green	MSL1	 XX:Output Voltage e.g. 3.0:3.0V
TN9500M15SR						
TN9500M18SR						
TN9500M25SR						
TN9500M28SR						
TN9500M30SR						
TN9500M33SR						
TN9500M36SR						

Note:

1. RoHS：TN 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：TN 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.)

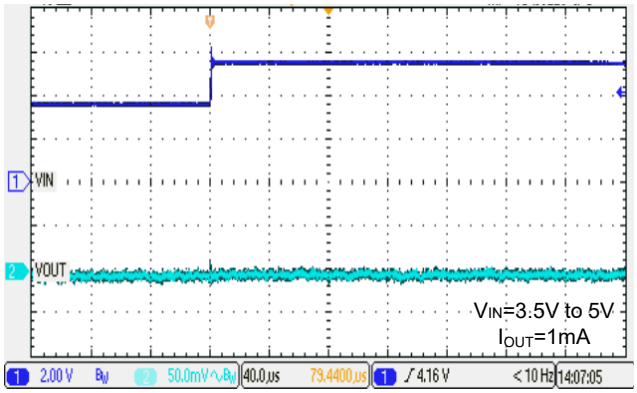
Parameter		Symbol	Test Conditions	Min.	Typ.	Max.	Unit
Input Voltage		V_{IN}		1.8	--	6	V
Output Voltage Accuracy		ΔV_{OUT}	V_{IN}=5V, I_{OUT}=10mA	-2	--	+2	%
Quiescent Current		I_Q	V_{IN}=5.0V, I_{OUT}=0A	--	800	--	nA
Maximum Output Current		I_{OUT_Max}		--	500	--	mA
Dropout Voltage Note		V_{DROP}	V_{IN}=0.98*V_{OUT}, 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.

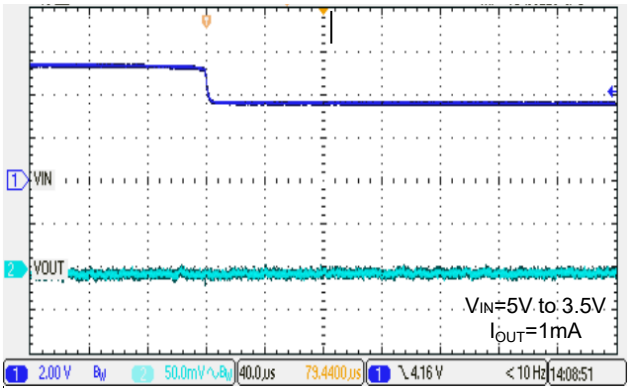
Typical Electrical Curves

T_A=25°C, (unless otherwise noted)

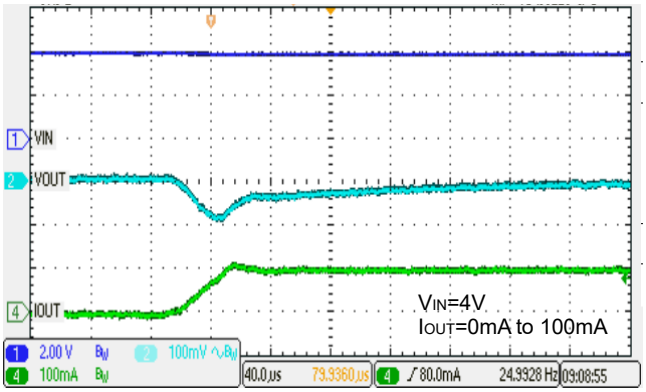
Line transient



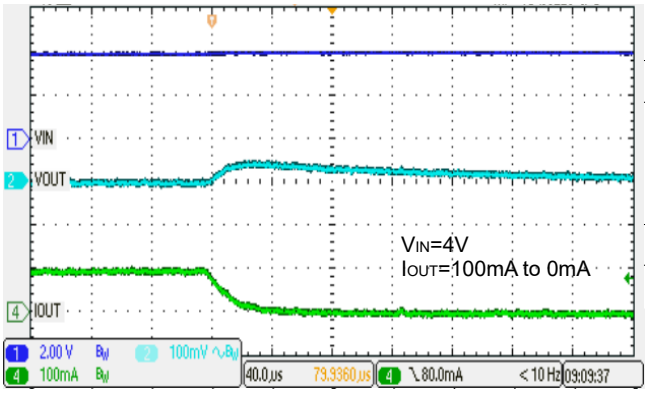
Line transient



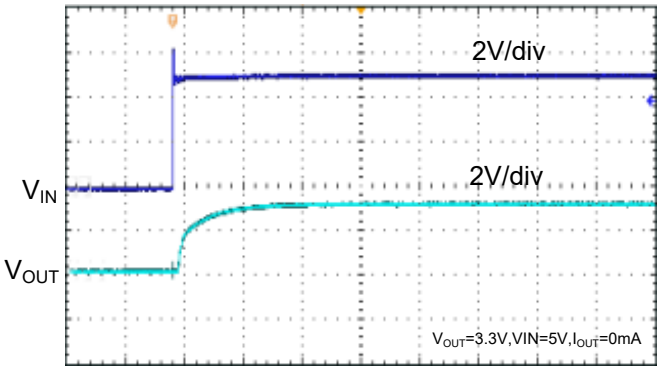
Load transient



Load transient

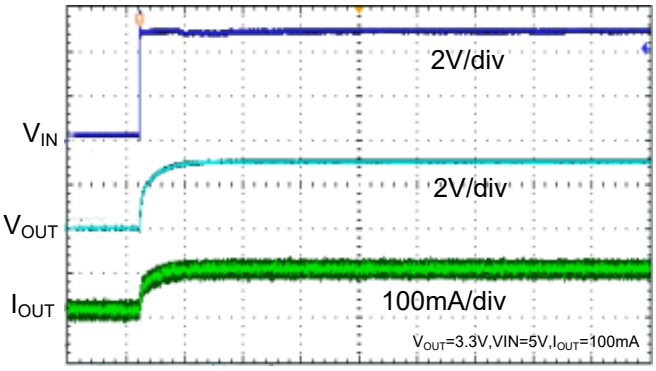


Power-on waveform

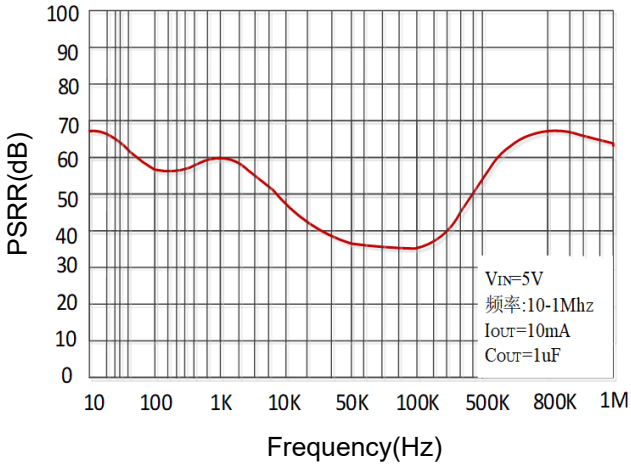


Time(200μs/div)

Power-off waveform



Time(400μs/div)



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 TN9500 EN pin is internally held low by a 1-MΩ resistor to GND. The TN9500 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 TN9500, 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.

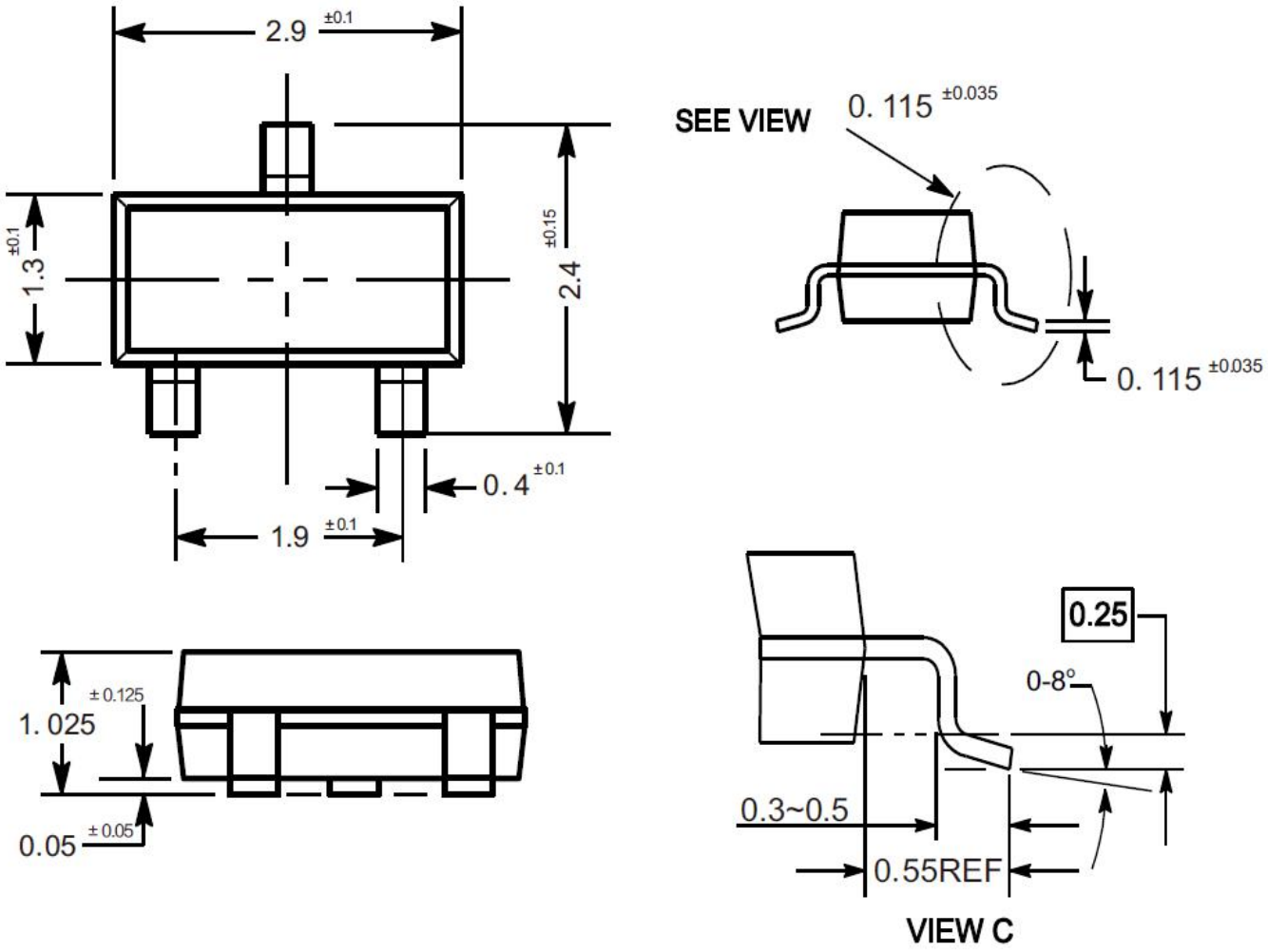
Thermal Overload Protection

The TN9500 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

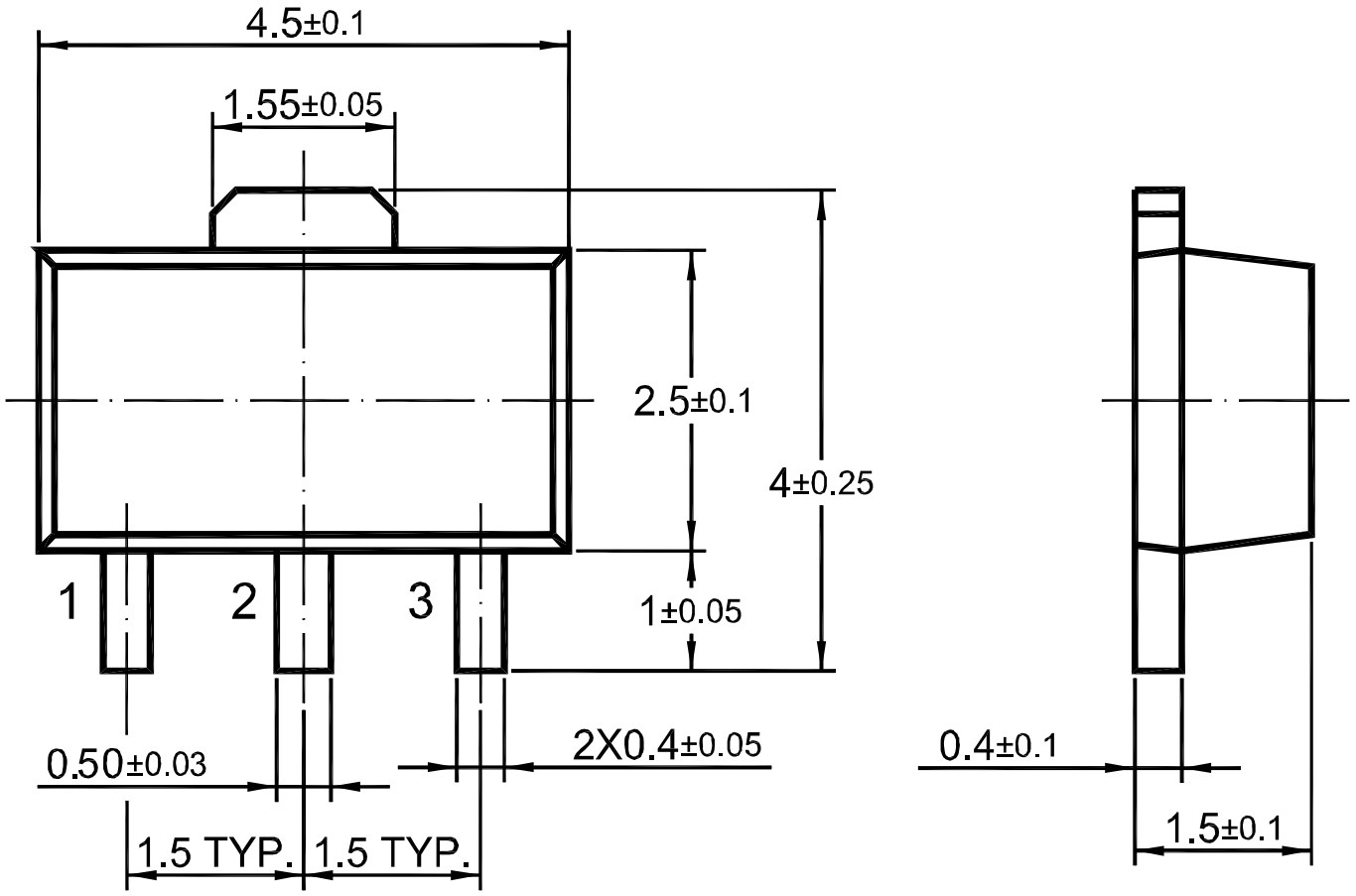
Dimensions in mm



Package Outline

SOT-89

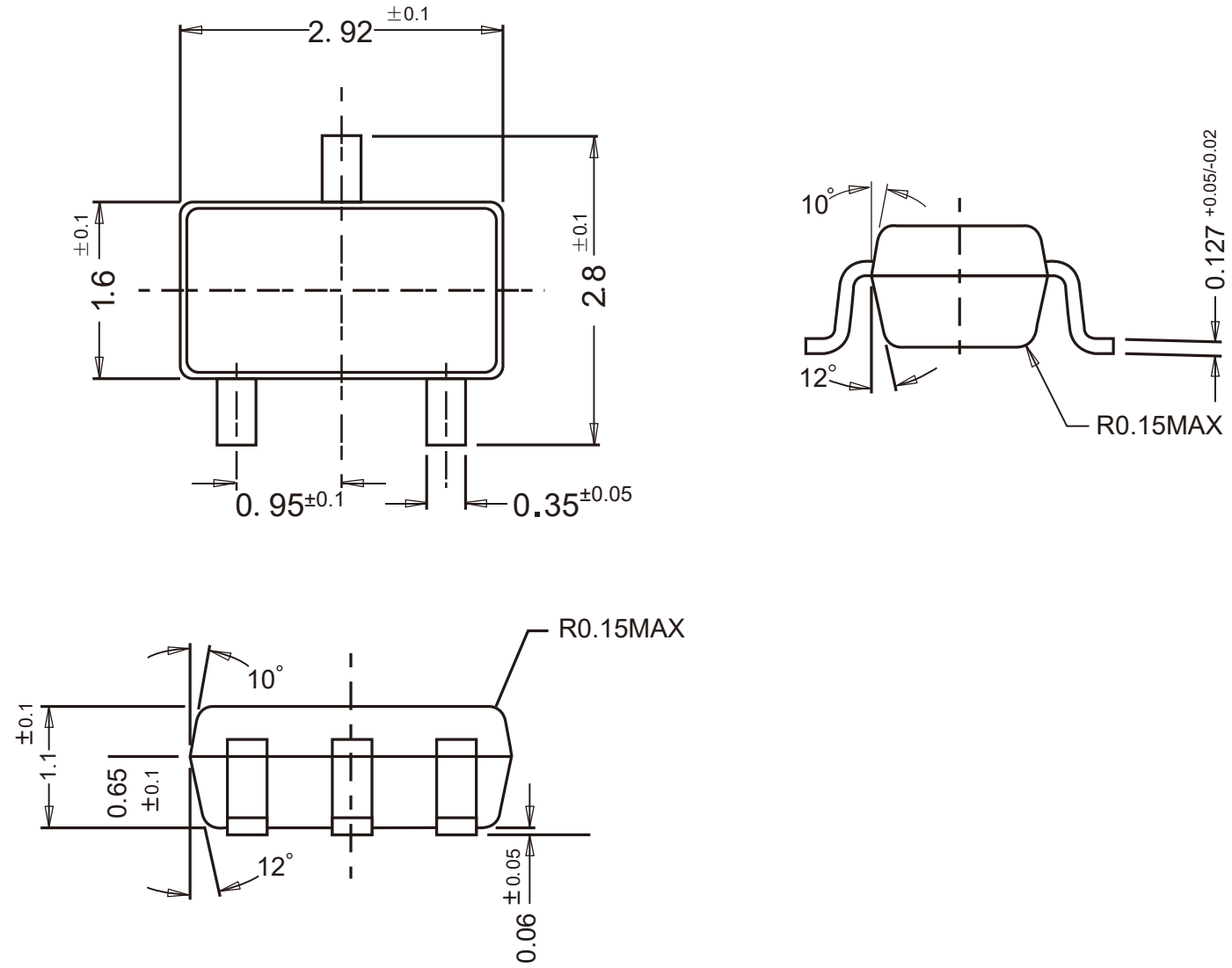
Dimensions in mm



Package Outline

SOT-23-3

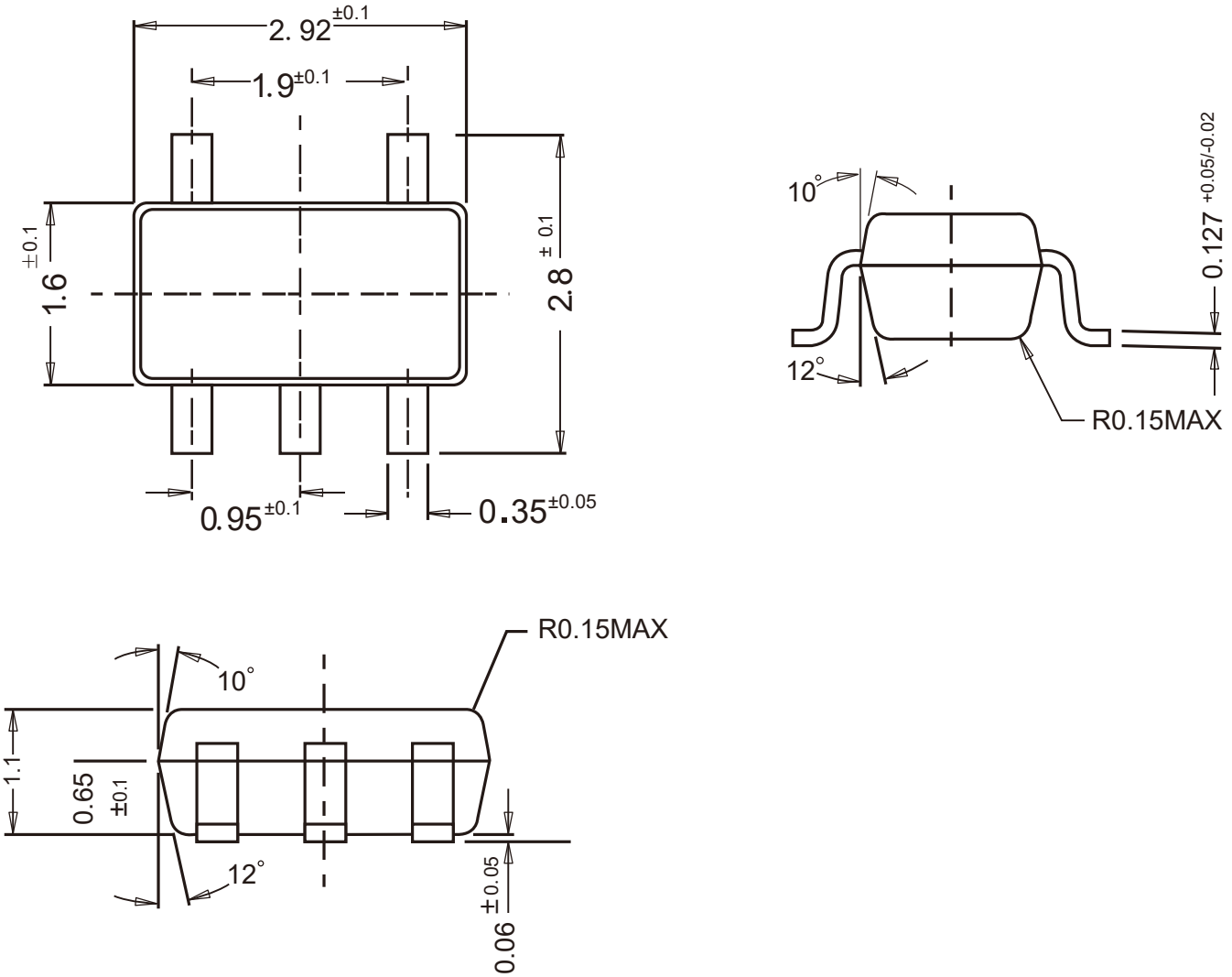
Dimensions in mm



Package Outline

SOT-23-5

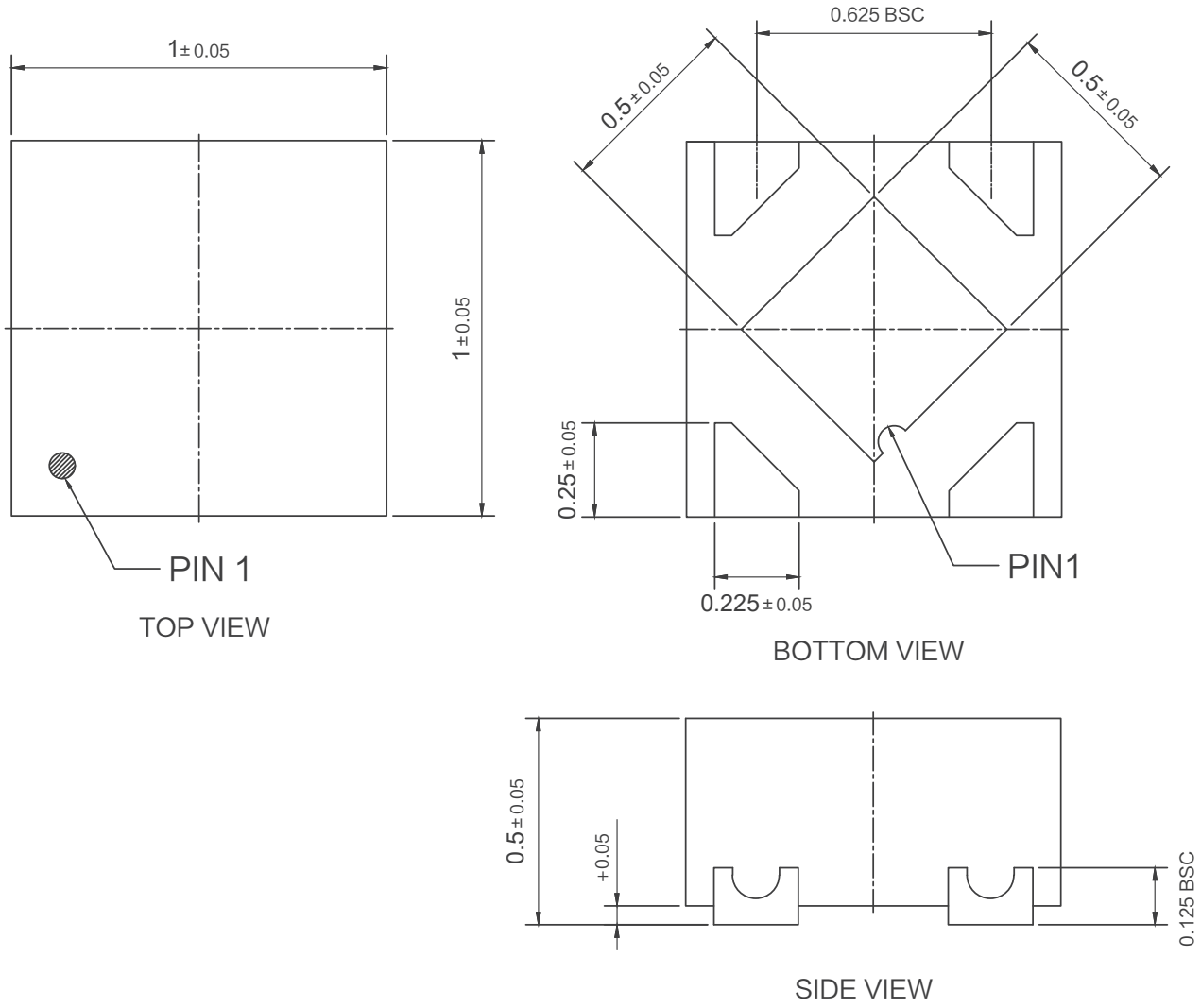
Dimensions in mm



Package Outline

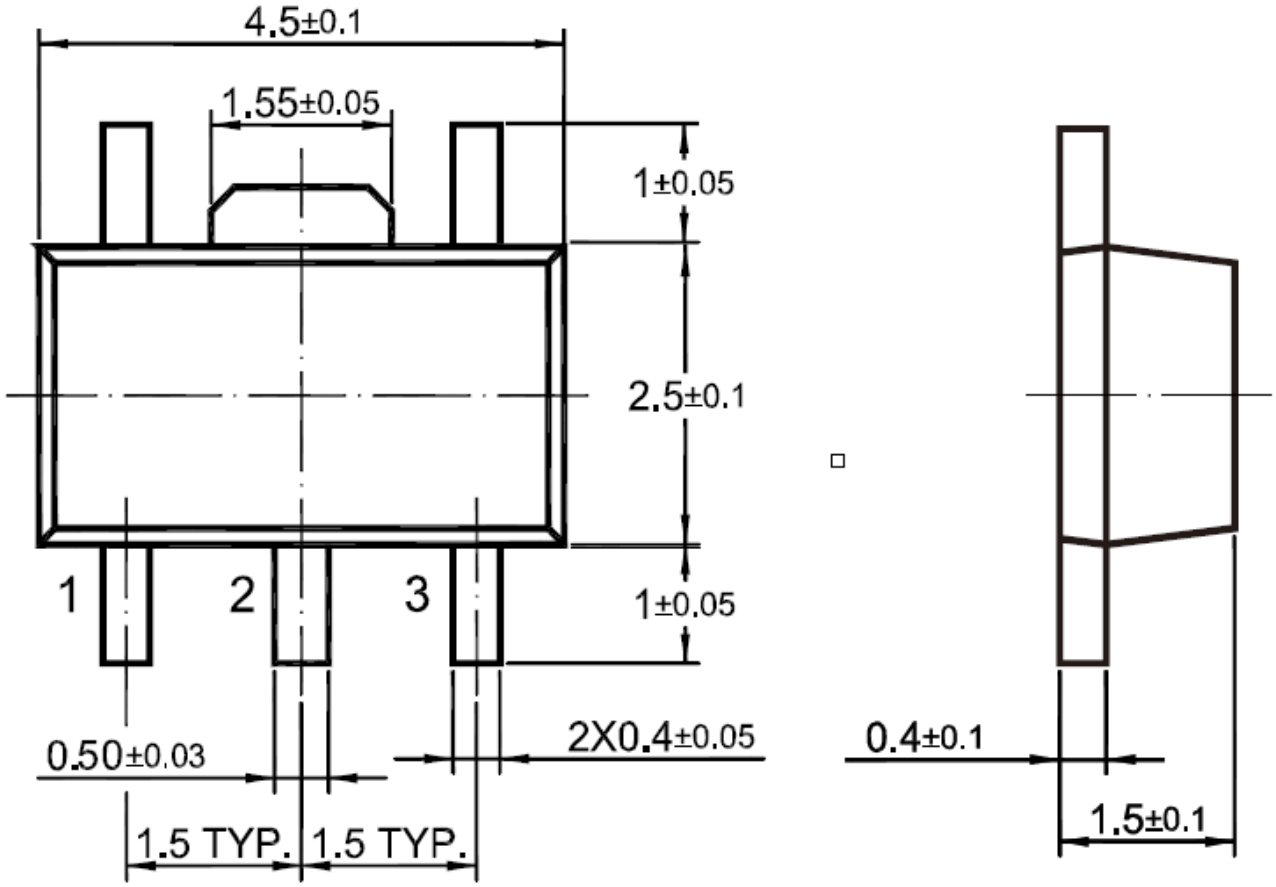
DFN1x1-4L

Dimensions in mm



Package Outline

SOT-89-5 Dimensions in mm



Contact Information

TANI website: **http://www.tanisemi.com** Email:tani@tanisemi.com

For additional information, please contact your local Sales Representative.

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Product Specification Statement

The product specification aims to provide users with a reference regarding various product parameters, performance, and usage. It presents certain aspects of the product's performance in graphical form and is intended solely for users to select product and make product comparisons, enabling users to better understand and evaluate the characteristics and advantages of the product. It does not constitute any commitment, warranty, or guarantee.

The product parameters described in the product specification are numerical values, characteristics, and functions obtained through actual testing or theoretical calculations of the product in an independent or ideal state. Due to the complexity of product applications and variations in test conditions and equipment, there may be slight fluctuations in parameter test values. TANI shall not guarantee that the actual performance of the product when installed in the customer's system or equipment will be entirely consistent with the product specification, especially concerning dynamic parameters. It is recommended that users consult with professionals for product selection and system design. Users should also thoroughly validate and assess whether the actual parameters and performance when installed in their respective systems or equipment meet their requirements or expectations. Additionally, users should exercise caution in verifying product compatibility issues, and TANI assumes no responsibility for the application of the product. TANI strives to provide accurate and up -to- date information to the best of our ability. However, due to technical, human, or other reasons, TANI cannot guarantee that the information provided in the product specification is entirely accurate and error-free. TANI shall not be held responsible for any losses or damages resulting from the use or reliance on any information in these product specifications.

TANI reserves the right to revise or update the product specification and the products at any time without prior notice, and the user's continued use of the product specification is considered an acceptance of these revisions and updates. Prior to purchasing and using the product, users should verify the above information with TANI to ensure that the prod uct specification is the most current, effective, and complete. If users are particularly concerned about product parameters, please consult TANI in detail or request relevant product test reports. Any data not explicitly mentioned in the product specification shall be subject to separate agreement.

Users are advised to pay attention to the parameter limit values specified in the product specification and maintain a certain margin in design or application to ensure that the product does not exceed the parameter limit values defined in the product specification. This precaution should be taken to avoid exceeding one or more of the limit values, which may result in permanent irreversible damage to the product, ultimately affecting the quality and reliability of the system or equipment.

The design of the product is intended to meet civilian needs and is not guaranteed for use in harsh environments or precision equipment. It is not recommended for use in systems or equipment such as medical devices, aircraft, nuclear power, and similar systems, where failures in these systems or equipment could reasonably be expected to result in personal injury. TANI shall assume no responsibility for any consequences resulting from such usage.

Users should also comply with relevant laws, regulations, policies, and standards when using the product specification. Users are responsible for the risks and liabilities arising from the use of the product specification and must ensure that it is not used for illegal purposes. Additionally, users should respect the intellectual property rights related to the product specification and refrain from infringing upon any third- party legal rights. TANI shall assume no responsibility for any disputes or controv ersies arising from the above-mentioned issues in any form.