Description

The TN9193B Series are low-dropout (LDO), low-power linear regulators offers very high power supply rejection ratio (PSRR) while maintaining very low 40μA ground current,suitable for RF applications. The family uses an advanced CMOS process and a PMOSFET pass device to achieve fast start-up, very low noise, excellent transient response, and excellent PSRR performance. The TN9193B Series are stable with a 1.0μF ceramic output capacitor, and uses a precision voltage reference and feedback loop to achieve a worst-case accuracy of 2% over all load, line, process, and temperature variations. It is fully specified from T_J=-40°C to +150°C and is offered in a small package, which is ideal for small form factor portable equipment such as wireless handsets and PDAs.

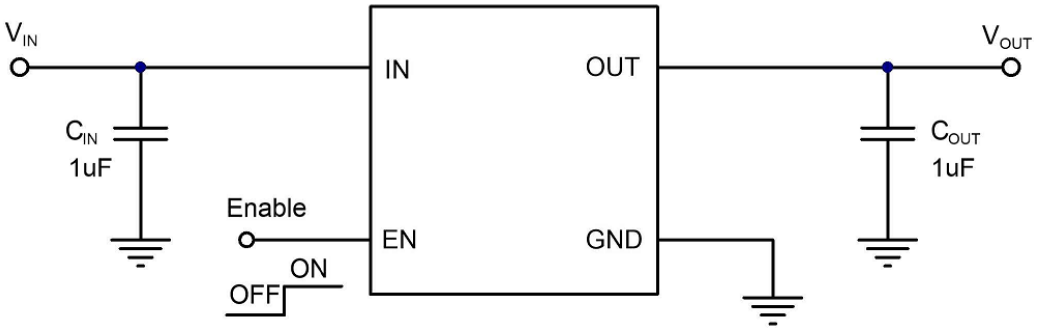
Features

- Wide Input Voltage Range: 2V to 6V
- Maximum Output Current: 500mA
- Standard Fixed Output Voltage Options: 1.2V,1.5V, 1.6V, 1.8V, 2.5V, 2.8V, 3.0V, and 3.3V,etc
- Low Quiescent Current: 40uA(Typ.)
- PSRR=75dB@1KHz
- Low Dropout Voltage: 250mV @ 300mA at V_{OUT}=2.8V
- Low Output Voltage Accuracy: ±2%
- Ultra Fast Response in Line/Load Transient
- Ultra Low Noise for RF Application
- Available Packages: SOT-23, SOT-23-3, SOT-89, SOT-23-5 and DFN1x1-4L

Applications

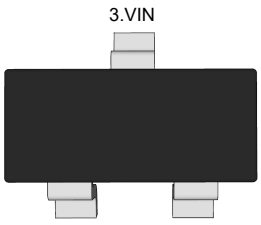
- Digital Still Cameras
- Portable instruments
- MP3/MP4 Player
- Smart Phones and Cellular Phones

Typical Application Circuit



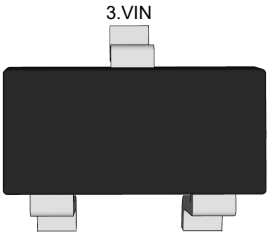
Pin Distribution

SOT-23



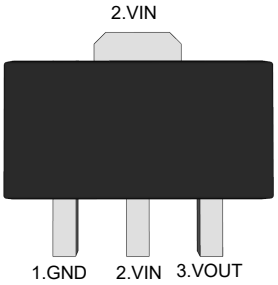
(Top View)

SOT-23-3



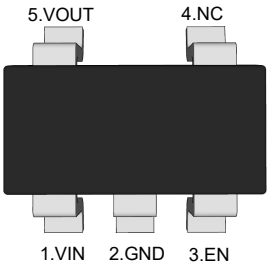
(Top View)

SOT-89



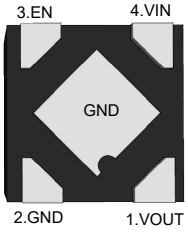
(Top View)

SOT-23-5



(Top View)

DFN1x1-4L



(Bottom View)

Functional Pin Description

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

Ordering Information

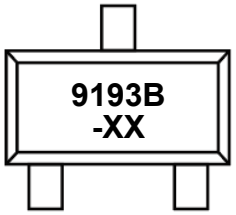
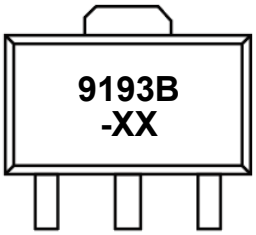
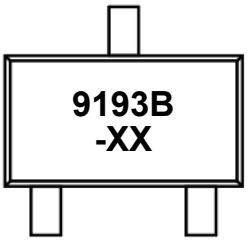
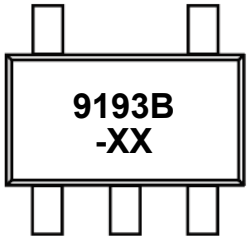
TN9193B□□□□

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

Output Voltage
12 : 1.2V 15 : 1.5V 16 : 1.6V
18: 1.8V 25 : 2.5V 28 : 2.8V
30 : 3.0V 33 : 3.3V

Output current tap
M : 500mA

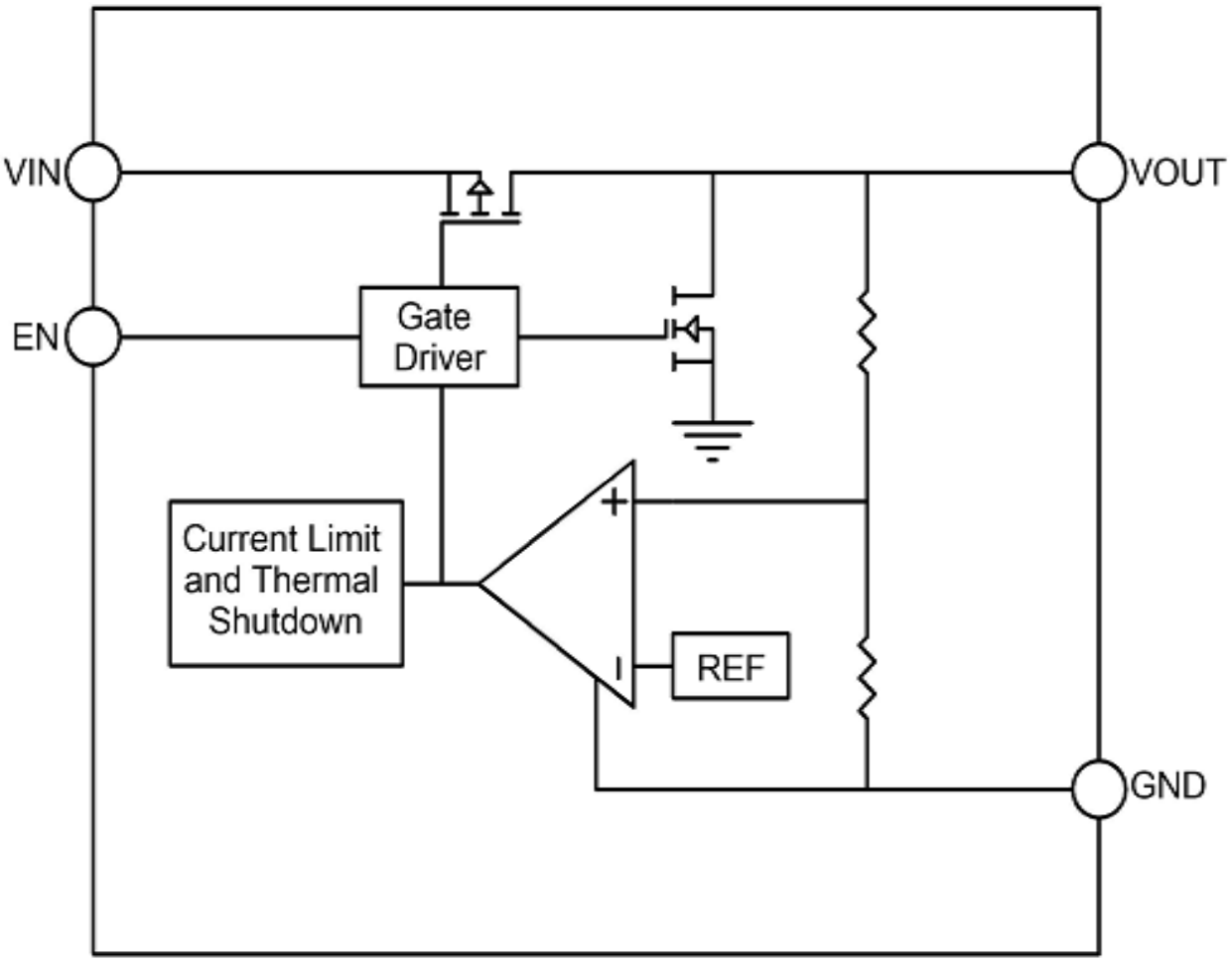
Ordering Information Continue

Orderable Device	Package	Reel (inch)	Package Qty (PCS)	Eco Plan Note	MSL Level	Marking Code
TN9193BM12SA	SOT-23	7	3000	RoHS & Green	MSL1	 XX:Output Voltage e.g. 3.0:3.0V
TN9193BM15SA						
TN9193BM16SA						
TN9193BM18SA						
TN9193BM25SA						
TN9193BM28SA						
TN9193BM30SA						
TN9193BM33SA						
TN9193BM12SQ	SOT-89	7/13	1000/3000	RoHS & Green	MSL1	 XX:Output Voltage e.g. 3.0:3.0V
TN9193BM15SQ						
TN9193BM16SQ						
TN9193BM18SQ						
TN9193BM25SQ						
TN9193BM28SQ						
TN9193BM30SQ						
TN9193BM33SQ						
TN9193BM12SC	SOT-23-3	7	3000	RoHS & Green	MSL3	 XX:Output Voltage e.g. 3.0:3.0V
TN9193BM15SC						
TN9193BM16SC						
TN9193BM18SC						
TN9193BM25SC						
TN9193BM28SC						
TN9193BM30SC						
TN9193BM33SC						
TN9193BM12SE	SOT-23-5	7	3000	RoHS & Green	MSL3	 XX:Output Voltage e.g. 3.0:3.0V
TN9193BM15SE						
TN9193BM16SE						
TN9193BM18SE						
TN9193BM25SE						
TN9193BM28SE						
TN9193BM30SE						
TN9193BM33SE						

Orderable Device	Package	Reel (inch)	Package Qty (PCS)	Eco Plan [Note]	MSL Level	Marking Code
TN9193BM12DE	DFN1x1-4L	7	1000	RoHS & Green	MSL1	 L:Product Code e.g. L: PJ9193B Series XX:Output Voltage e.g. 30:30V
TN9193BM15DE						
TN9193BM16DE						
TN9193BM18DE						
TN9193BM25DE						
TN9193BM28DE						
TN9193BM30DE						
TN9193BM33DE						

Note:
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 ~ +6.5	V
	$V_{ON/OFF}$	-0.3 ~ V_{IN}+0.3	V
VOUT to VIN Voltage		-0.3 ~ V_{IN}+0.3	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
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
Operating Ambient Temperature		-40 ~ +85	°C
Storage temperature range		-65 ~ +150	°C
Lead Temperature & Time		300°C,10S	--
ESD Voltage	HBM	4	KV
	CDM	1.5	KV

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

Recommended Operating Conditions

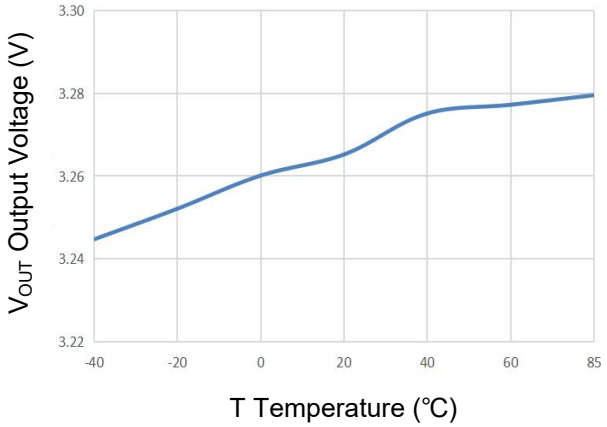
Parameter	Symbol	Value	Unit
Supply Voltage	V_{IN}	2.0 ~ 6.0	V
Output Current	I_{OUT}	0 ~ 300	mA
Operating Ambient Temperature	T_A	-40 ~ +85	°C
Effective Input Ceramic Capacitor	C_{IN}	0.47~ 4.7	μF
Effective Output Ceramic Capacitor	C_{OUT}	0.47~ 4.7	μF
Input and Output Capacitor Equivalent Series Resistance	ESR	5 ~ 100	mΩ

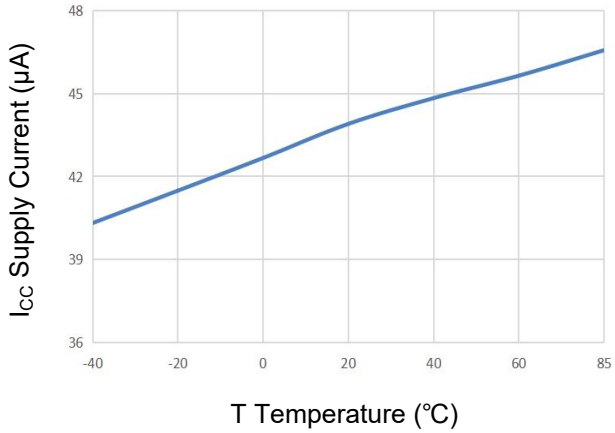
Electrical Characteristics

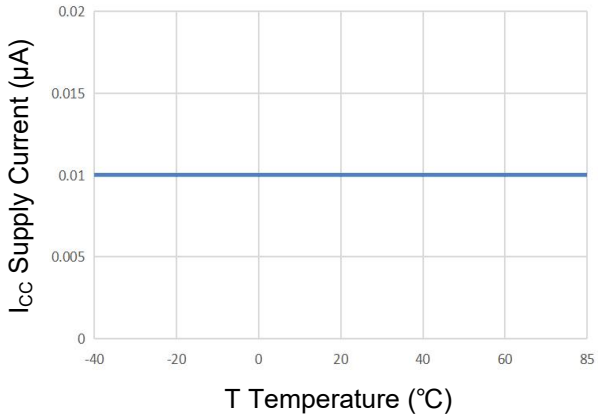
(V_{IN}=V_{OUT}+1, I_{OUT} = 1mA, C_{IN}=1μF, C_{OUT}=1μF, T_A=25℃ , unless otherwise noted.)

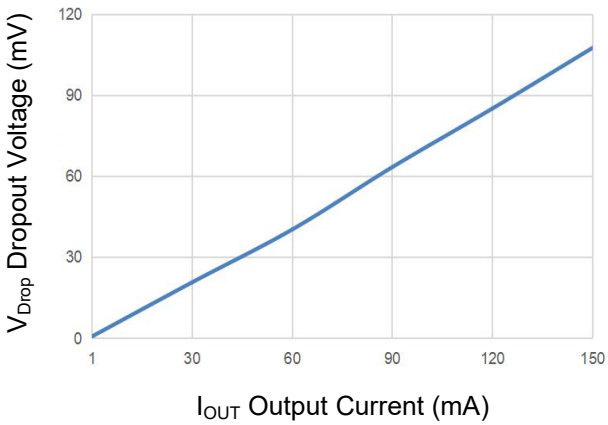
Parameter		Symbol	Test Conditions	Min.	Typ.	Max.	Unit
Input Voltage		V_{IN}		2	--	6	V
Output Voltage Accuracy		ΔV_{OUT}	I_{OUT}=40mA	-2	--	+2	%
Quiescent Current		I_Q	V_{IN}>V_{OUT},EN=V_{IN} I_{OUT}=0mA	--	36	60	μA
DC Supply Shutdown Current		$I_{Q\ OFF}$	VEN=0V	--	0.01	1	μA
Dropout Voltage		V_{DROP}	V_{OUT}=1.2V, I_{OUT}=300mA	--	700	800	mV
			V_{OUT}=1.5V, I_{OUT}=300mA	--	600	730	
			V_{OUT}=1.6V, I_{OUT}=300mA	--	500	650	
			V_{OUT}=1.8V, I_{OUT}=300mA	--	380	520	
			V_{OUT}=2.5V, I_{OUT}=300mA	--	280	400	
			V_{OUT}=2.8V, I_{OUT}=300mA	--	250	400	
			V_{OUT}=3.0V, I_{OUT}=300mA	--	240	390	
			V_{OUT}=3.3V, I_{OUT}=300mA	--	210	360	
Line Regulation		ΔV_{LINE}	V_{IN}=V_{OUT}+1 to 5.5V,I_{OUT}=10mA	--	0.03	0.2	%
Load Regulation		ΔV_{LOAD}	1mA<I_{OUT}<300mA	--	0.2	0.7	%
Current Limit		I_{LIM}		300	--	--	mA
Soft-Start Time		T_{ON}	From Enable to Power On	--	25	--	μs
EN Input Threshold	Logic Low	V_{IL}	Shut down	--	--	0.3	V
	Logic High	V_{IH}	Start up	1.5	--	--	
Power Supply Rejection Rate		PSRR	V_{IN}=V_{OUT}+1, C_{OUT}=1μF f=1KHz,I_{OUT}=20mA	--	75	--	dB
			V_{IN}=V_{OUT}+1, C_{OUT}=1μF f=10KHz,I_{OUT}=30mA	--	65	--	
Output Noise Voltage		eN	10Hz to 100KHz, I_{OUT}=200mA V_{OUT}=2.8V, C_{OUT}=1μF	--	70	--	μV_{RMS}
			10Hz to 100KHz, I_{OUT}=200mA V_{OUT}=1.2V, C_{OUT}=1μF	--	45	--	
EN Pull-Down Resistance		R_{PD}		0.8	1	1.3	MΩ
Over-Temperature Shutdown Threshold		T_{TSD}		--	155	--	°C
Over-Temperature Shutdown Hysteresis		T_{TSR}		--	20	--	°C

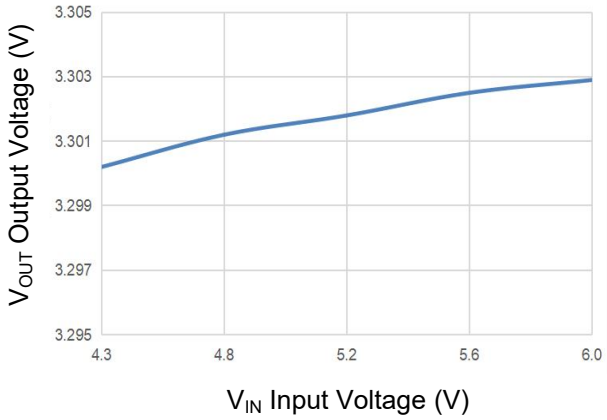
Typical Characteristic Curves

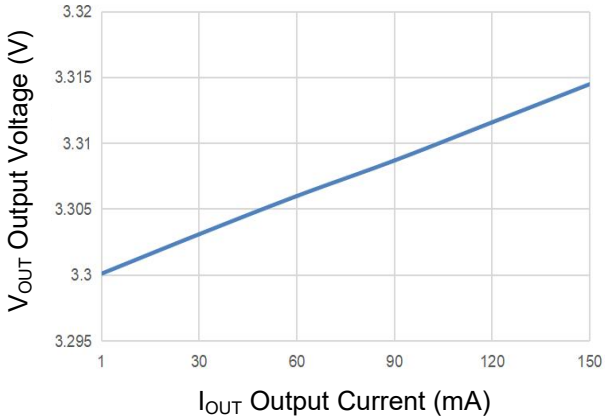


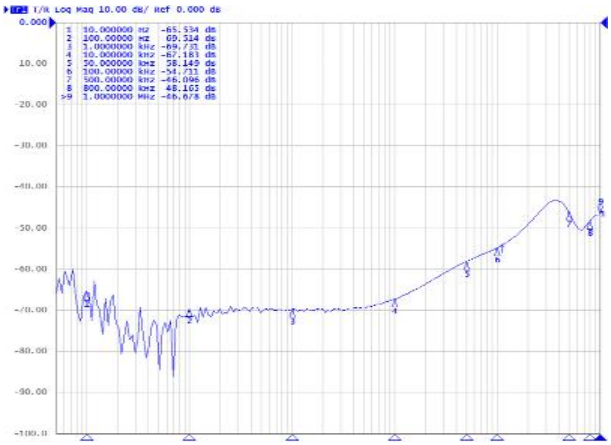




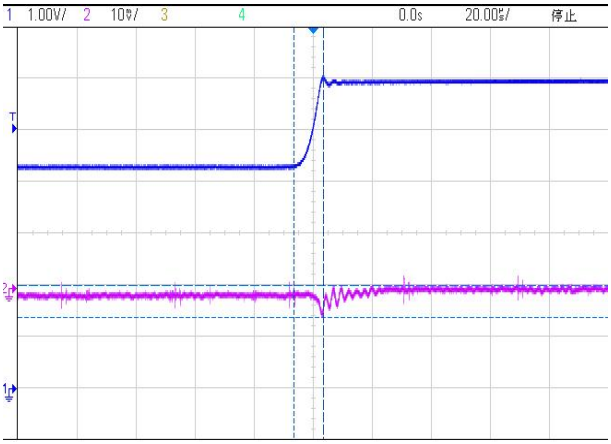




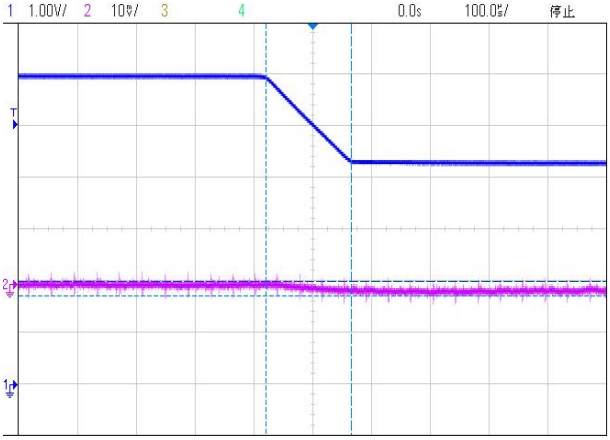




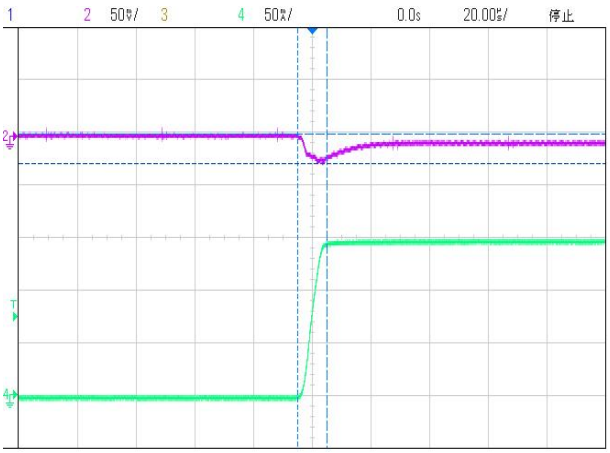
PSRR



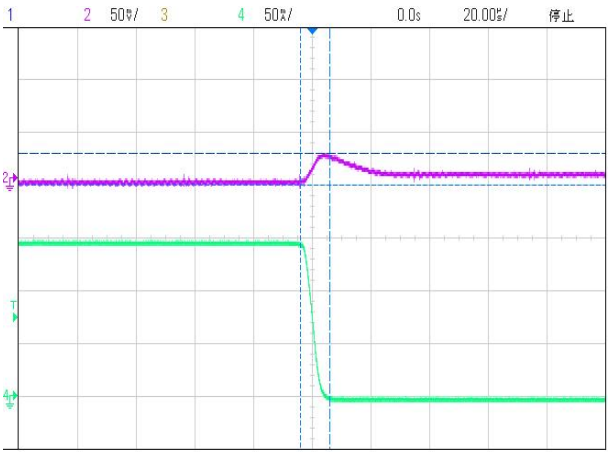
Input Transient(4.3~6V t=10us 10mA)



Input Transient(6~4.3V t=10us 10mA)



Load Transient(1mA~150mA t=10us)



Load Transient(150mA~1mA t=10us)

Applications Information

Overview

The TN9193B series products are 500mA wide input voltage range linear regulators.These voltage regulators operate from 2V to 6V DC input voltage with supporting 6V transient input voltage and consume 40μA quiescent current at no load.

The TN9193B series products also provide enable control and Power-Good feature, which is very suitable for the applications needing sequence configuration. Other protection features include the VIN input under-voltage lockout, over current protection, output hard short protection and thermal shutdown protection.

The TN9193B series products are available in fixed voltage versions of 1.2V,1.5V,1.6V,1.8V, 2.5V,2.8V,3.0V and 3.3V with 1% output voltage accuracy at room temp and 2% output voltage accuracy over operating conditions.

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.

Output Capacitor

An output capacitor is required for the stability of the LDO. The recommended output capacitance is from 1μF to 2.2μF, Equivalent Series Resistance (ESR) is from 5mΩ to 100mΩ, 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 TN9193B is turned on by setting the EN pin high, and is turned off by pulling it low. If this feature is not used, the EN pin should be tied to IN pin to keep the regulator output on at all time.

High PSRR and Low Noise

RF circuits such as LNA (low-noise amplifier), up/down-converter, mixer, PLL, VCO, and IF stage, require low noise and high PSRR LDOs. The temperature-compensated crystal oscillator circuit requires very high PSRR at RF power amplifier burst frequency. For instance, minimum 65dB PSRR at 217Hz is recommended for the GSM handsets. The TN9193B, with PSRR of 75dB at 1KHz, is suitable for most of these applications that require high PSRR and low noise.

Ultra Fast Start-up

After enabled, the TN9193B is able to provide full power in as little as tens of microseconds, typically 25μs.This feature will help load circuitry move in and out of standby mode in real time, eventually extend battery life for mobile phones and other portable devices.

Fast Transient Response

Fast transient response LDOs can also extend battery life. To meet this load requirement, the LDO must react very quickly without a large voltage drop or overshoot — a requirement that cannot be met with conventional, general-purpose LDOs.

The TN9193B's fast transient response from 0 to 150mA provides stable voltage supply for fast DSP and GSM chipset with fast changing load.

Low Quiescent Current

The TN9193B, consuming only around 40μA for all input range and output loading, 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-circuit to GND, the current limit protection will be triggered and clamp the output current to approximately 500mA to prevent over-current and to protect the regulator from damage due to overheating.

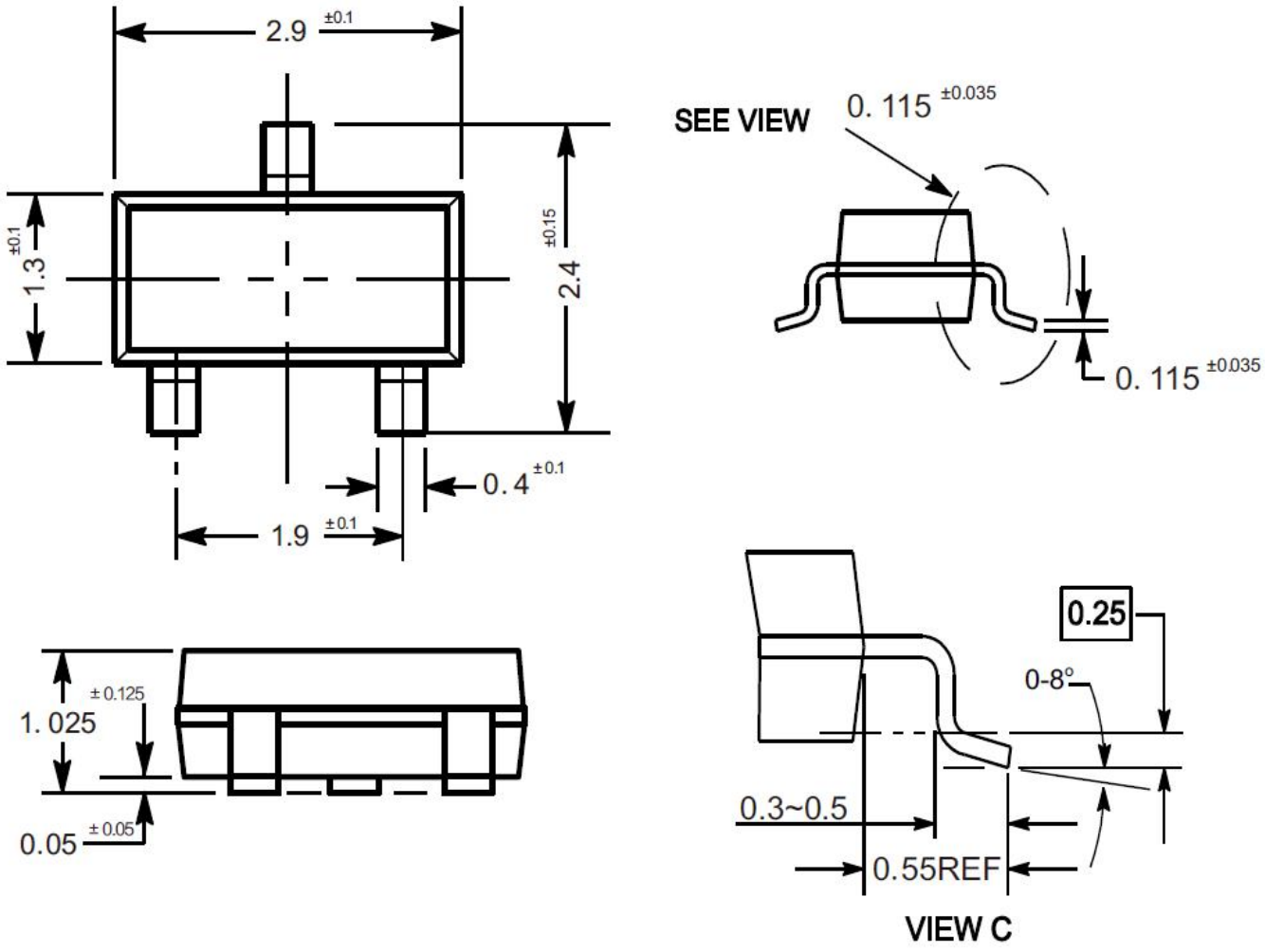
Thermal Shutdown Protection

Thermal protection disables the output when the junction temperature rises to approximately +155°C, allowing the device to cool down. When the junction temperature reduces to approximately +130°C the output circuitry is enabled again. Depending on power dissipation, thermal resistance, and ambient temperature, the thermal protection circuit may cycle on and off. This cycling limits the heat dissipation of the regulator, protecting it from damage due to overheating.

Package Outline

SOT-23

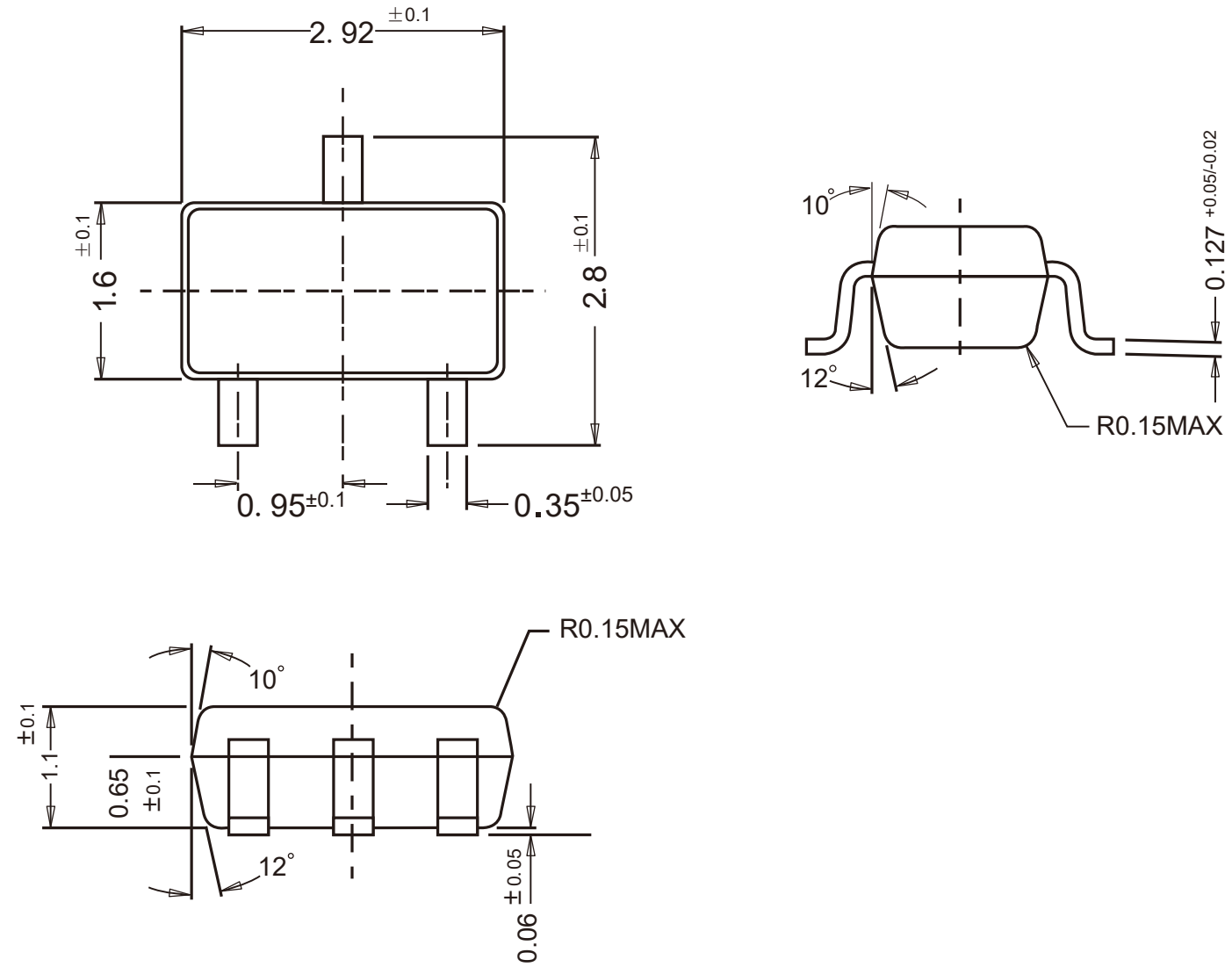
Dimensions in mm



Package Outline

SOT-23-3

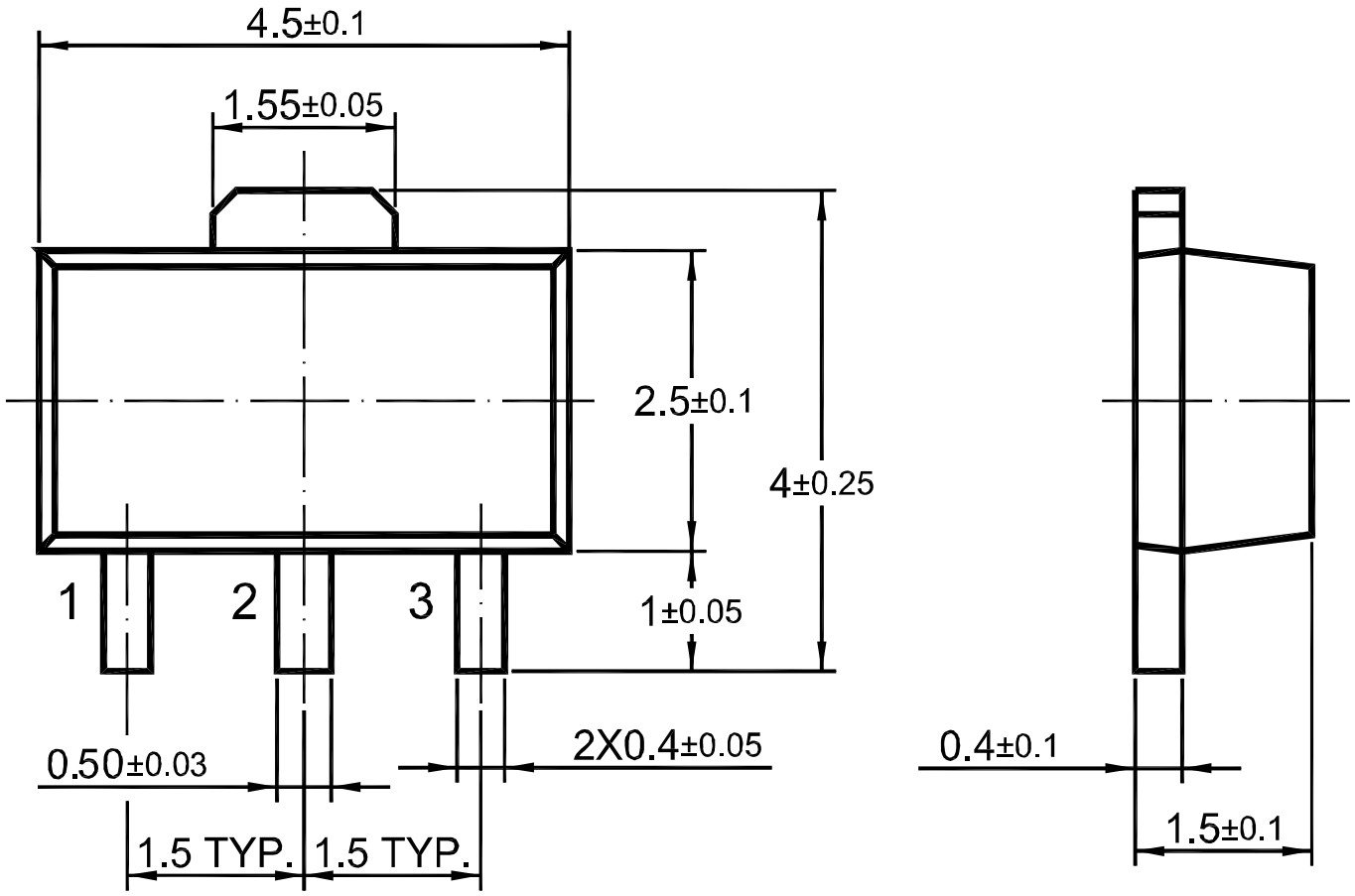
Dimensions in mm



Package Outline

SOT-89

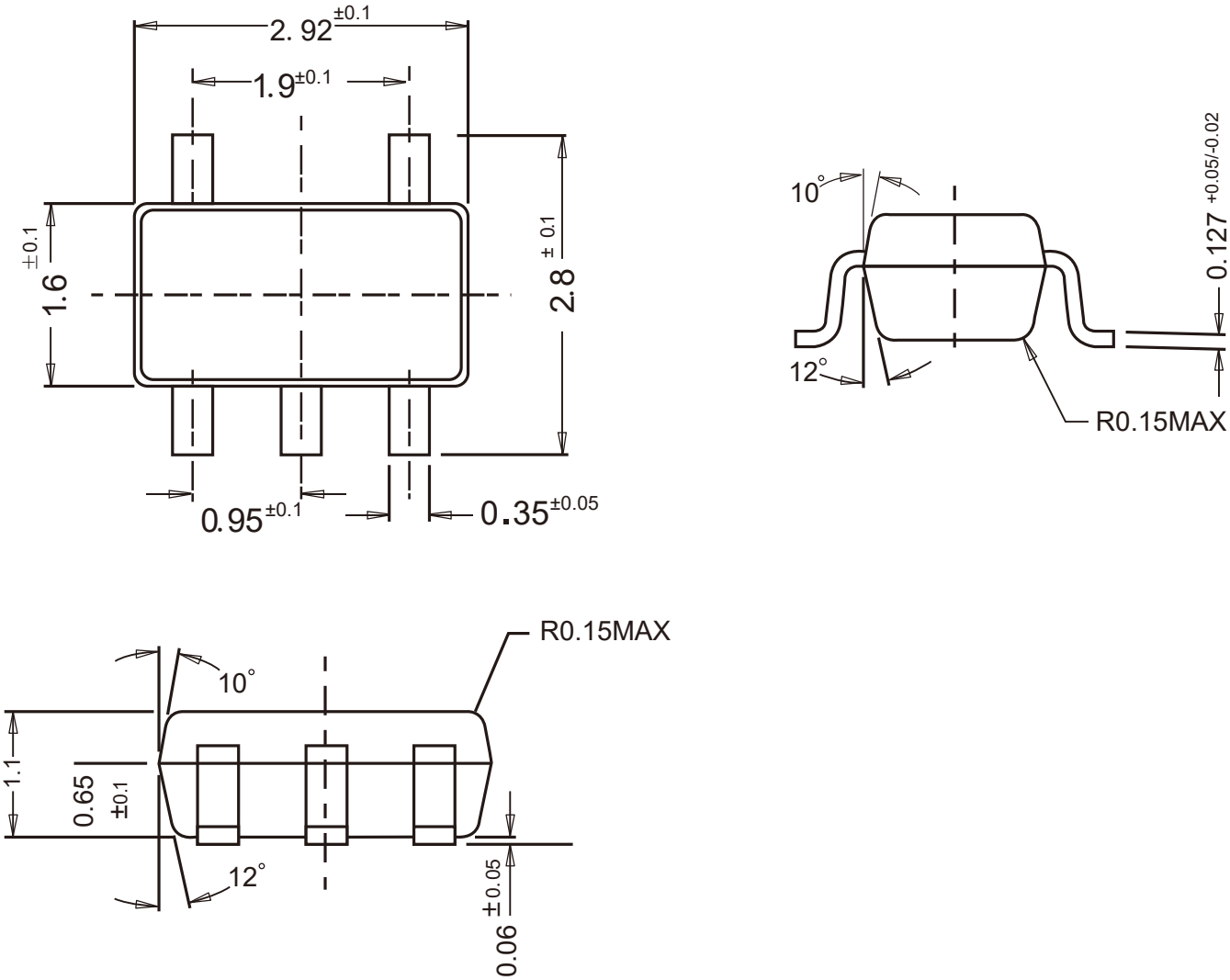
Dimensions in mm



Package Outline

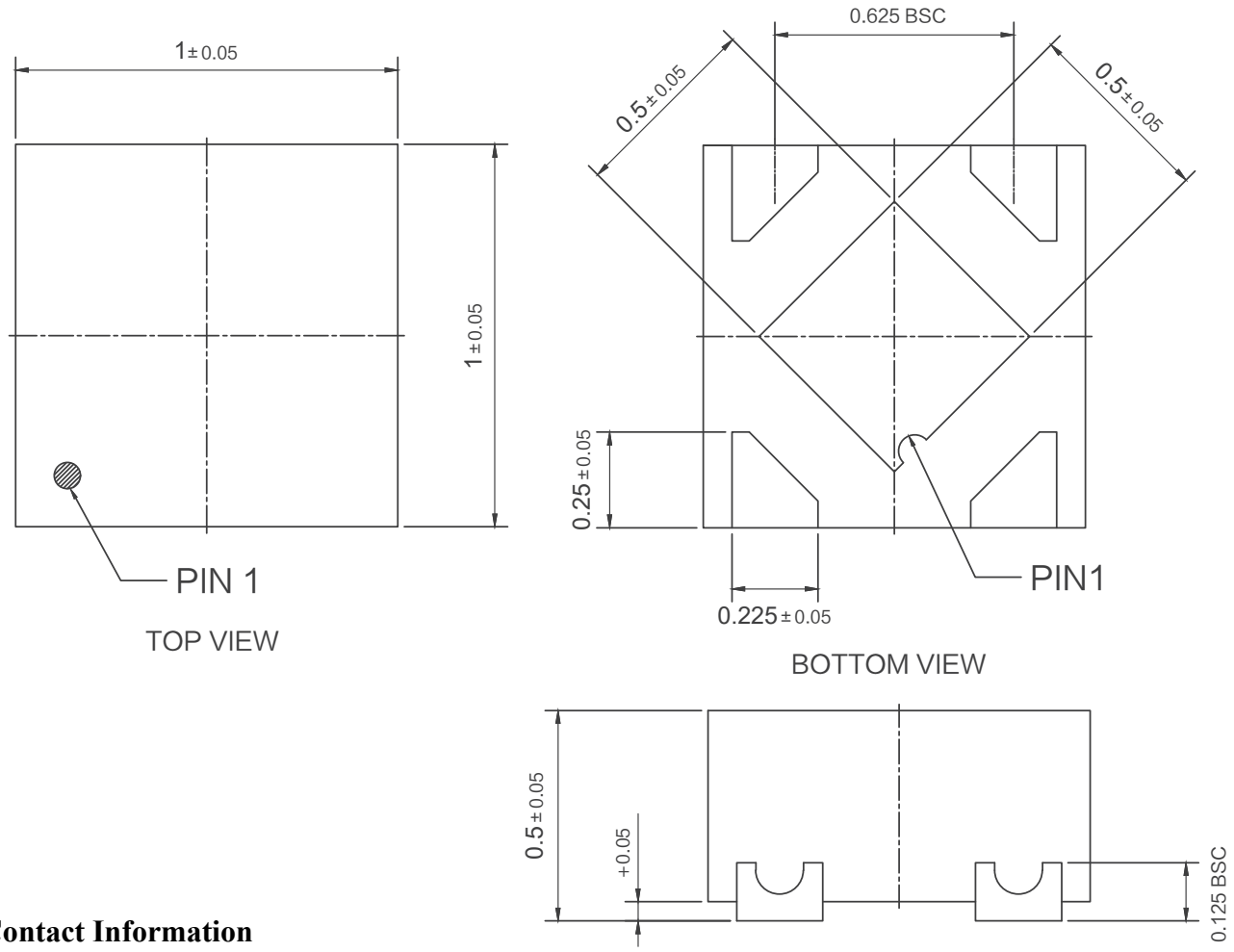
SOT-23-5

Dimensions in mm



Package Outline

DFN1x1-4L Dimensions in mm



Contact Information

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

For additional information, please contact your local Sales Representative.

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.