

### Description

The TL431 is three-terminal adjustable regulator with a guaranteed thermal stability over applicable temperature ranges. The output Voltage may be set to any value between  $V_{ref}$  (approximately 2.495V) and 36 V with two external resistors. These devices have provides a very sharp turn-on characteristic, making these devices excellent replacement for zener diodes in many applications..

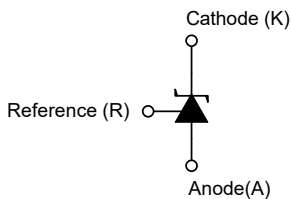
### Feature

- Wide programmable rise output voltage from 2.495V to 36V
- Sink current capability from 1mA to 100mA.
- Low output noise
- Wide Operating Range of -40 to 125°C

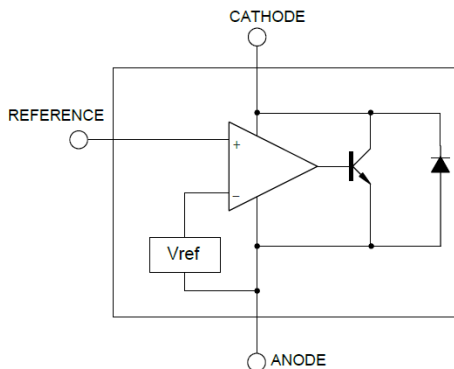
### Application

- Adjustable voltage and current references
- Voltage monitoring
- Replacement of zener diode
- Comparator with integrated reference

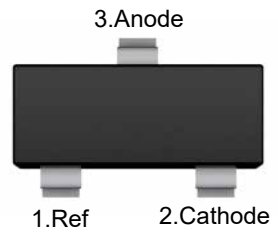
### Schematic diagram



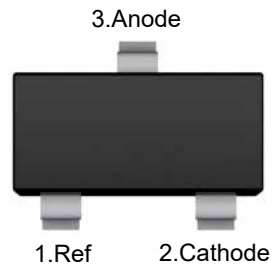
### Functional block diagram



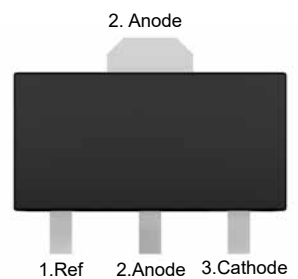
#### SOT-23



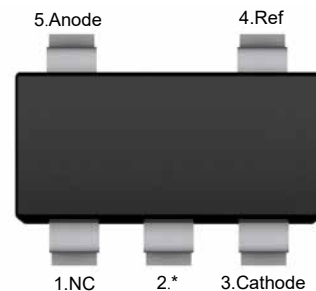
#### SOT-23-3



#### SOT-89

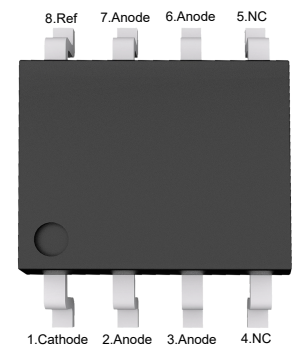


#### SOT-23-5



NC:No internal connection  
\*: Attached to substrate and must be connected to Anode or left open

#### SOP-8



NC:No internal connection



## Ordering Information

TL431-□ □

└ Package Type

□□(Blank): SOT-23

SC: SOT-23-3

SQ: SOT-89

SE: SOT-23-5

PA: SOP-8

└ V<sub>REF</sub> tolerance

□(Blank): 1%

A: 0.5%

B: 0.4%

Orderable Device	Voltage Tolerance	Package	Reel (inch)	Package Qty (PCS)	Eco Plan <sup>Note</sup>	MSL Level	Marking Code
TL431	1%	SOT-23	7	3000	RoHS & Green	MSL1	431
TL431A	0.5%	SOT-23	7	3000	RoHS & Green	MSL1	431A
TL431B	0.4%	SOT-23	7	3000	RoHS & Green	MSL1	431B
TL431SC	1%	SOT-23-3	7	3000	RoHS & Green	MSL3	431
TL431ASC	0.5%	SOT-23-3	7	3000	RoHS & Green	MSL3	431A
TL431BSC	0.4%	SOT-23-3	7	3000	RoHS & Green	MSL3	431B
TL431SQ	1%	SOT-89	7 / 13	1000 / 3000	RoHS & Green	MSL1	TL431
TL431ASQ	0.5%	SOT-89	7 / 13	1000 / 3000	RoHS & Green	MSL1	TL431A
TL431BSQ	0.4%	SOT-89	7 / 13	1000 / 3000	RoHS & Green	MSL1	TL431B
TL431SE	1%	SOT-23-5	7	3000	RoHS & Green	MSL3	431E
TL431ASE	0.5%	SOT-23-5	7	3000	RoHS & Green	MSL3	431AE
TL431BSE	0.4%	SOT-23-5	7	3000	RoHS & Green	MSL3	431BE
TL431PA	1%	SOP-8	13	4000	RoHS & Green	MSL3	431P
TL431APA	0.5%	SOP-8	13	4000	RoHS & Green	MSL3	431AP
TL431BPA	0.4%	SOP-8	13	4000	RoHS & Green	MSL3	431BP

**Note:**

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.

**Absolute Maximum Ratings** ( $T_a=25^{\circ}\text{C}$  unless otherwise specified)

Parameter	Symbol	Value	Units
Cathode Voltage	$V_{KA}$	37	V
Cathode Current Range(Continuous)	$I_{KA}$	-100 ~ +150	mA
Reference Input Current Range	$I_{REF}$	-0.05 ~ +10	mA
Operating Junction Temperature	$T_J$	150	$^{\circ}\text{C}$
Storage Temperature Range	$T_{STG}$	-65 ~ +150	$^{\circ}\text{C}$

Note: Absolute maximum ratings are those values beyond which the device could be permanently damaged.  
Absolute maximum ratings are stress ratings only and functional device operation is not implied.

**Recommended Operating Conditions**

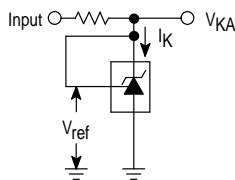
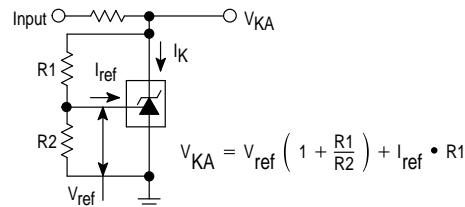
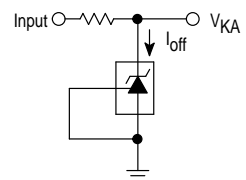
Parameter	Symbol	Min.	Max.	Units
Cathode Voltage	$V_{KA}$	$V_{REF}$	36	V
Cathode Current	$I_{KA}$	1	100	mA
Operating Ambient Temperature Range	$T_{OPR}$	-40	125	$^{\circ}\text{C}$

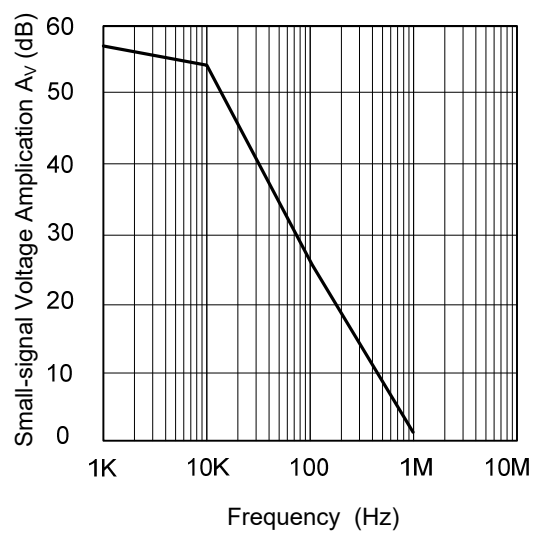
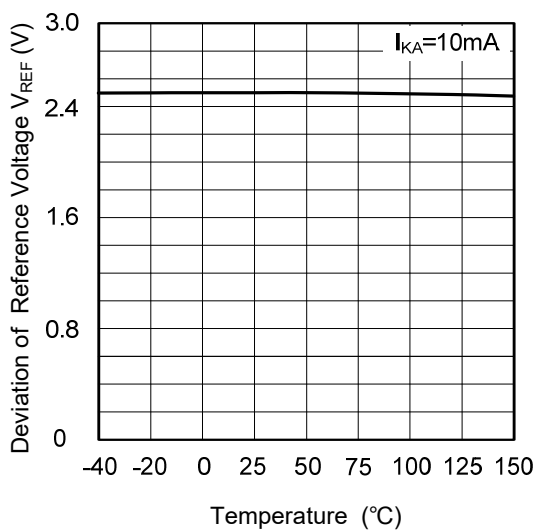
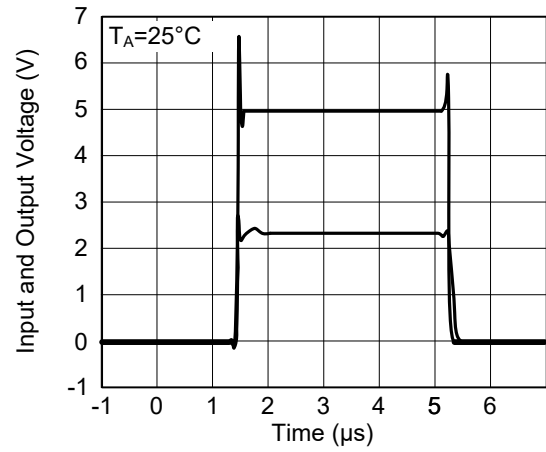
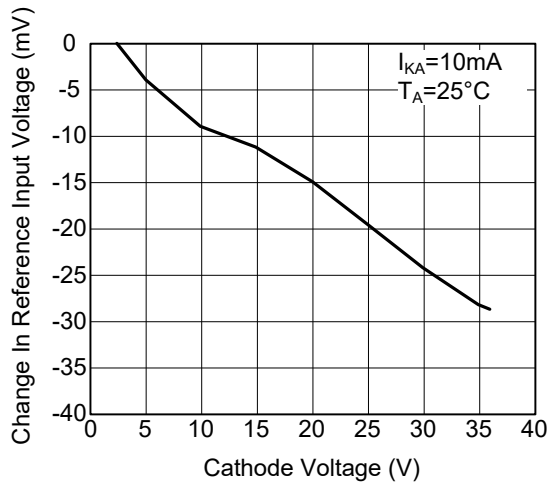
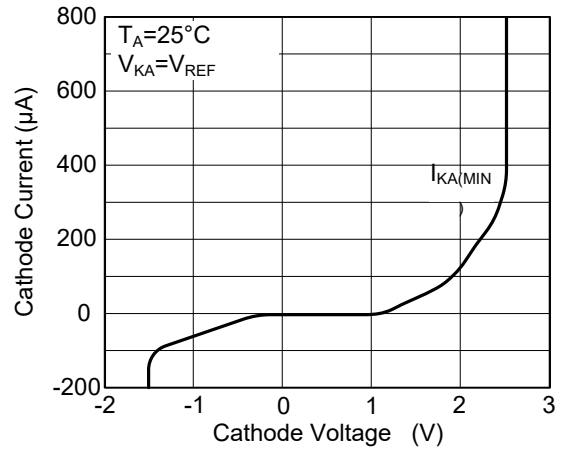
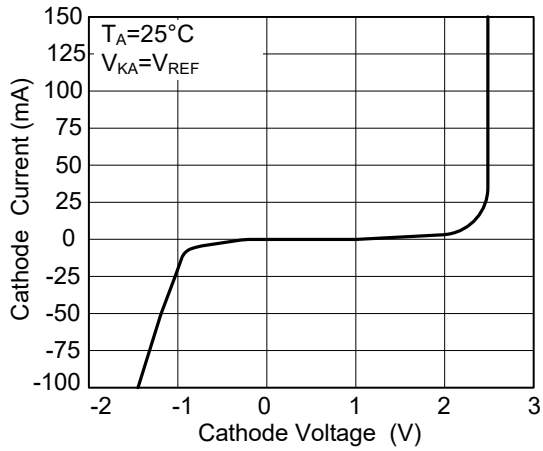
**Thermal Information**

Parameter	Symbol	Value		Units
Junction-to-Ambient thermal resistance	$R_{\theta JA}$	SOT-23	416	$^{\circ}\text{C}/\text{W}$
		SOT-23-3	416	$^{\circ}\text{C}/\text{W}$
		SOT-23-5	416	$^{\circ}\text{C}/\text{W}$
		SOT-89	156	$^{\circ}\text{C}/\text{W}$
		SOP-8	208	$^{\circ}\text{C}/\text{W}$

**Electrical Characteristics (Ta=25°C unless otherwise specified)**

Parameter	Symbol	Test Conditions	Min.	Typ.	Max.	Unit	
Reference Input Voltage Fig1	V <sub>REF</sub>	V <sub>KA</sub> =V <sub>REF</sub> , I <sub>KA</sub> =10mA	TL431(1%)	2.47	2.495	2.52	V
			TL431A(0.5%)	2.483	2.495	2.507	V
			TL431B(0.4%)	2.485	2.495	2.505	V
Deviation of Reference Input Voltage Over Temperature Fig1	ΔV <sub>REF</sub>	V <sub>KA</sub> =V <sub>REF</sub> , I <sub>KA</sub> =10mA -40°C ≤ T <sub>A</sub> ≤ +85°C	--	4.5	17	mV	
Ratio of Change in Reference Input Voltage to The Change in Cathode Voltage Fig2	$\frac{\Delta V_{REF}}{\Delta V_{KA}}$	I <sub>KA</sub> =10mA	ΔV <sub>KA</sub> =10V~V <sub>REF</sub>	--	-1.0	-2.7	mV/V
			ΔV <sub>KA</sub> =36V~10V	--	-0.5	-2.0	
Reference Input Current Fig2	I <sub>REF</sub>	I <sub>KA</sub> =10mA, R1=10KΩ, R2=∞	--	1.5	4	μA	
Deviation of Reference Input Current Over Full Temperature Range Fig2	ΔI <sub>REF</sub>	I <sub>KA</sub> =10mA, R1=10KΩ, R2=∞, -20°C ≤ T <sub>A</sub> ≤ +85°C	--	0.4	1.2	μA	
Minimum Cathode Current for Regulation Fig1	I <sub>KA(MIN)</sub>	V <sub>KA</sub> =V <sub>REF</sub>	--	0.45	1	mA	
Off-State Cathode Current Fig3	I <sub>KA(OFF)</sub>	V <sub>KA</sub> =36V, V <sub>REF</sub> =0	--	0.05	1.0	μA	
Dynamic Impedance	Z <sub>KA</sub>	V <sub>KA</sub> =V <sub>REF</sub> , I <sub>KA</sub> =1~100mA, f ≤ 1.0KHz	--	0.15	0.5	Ω	

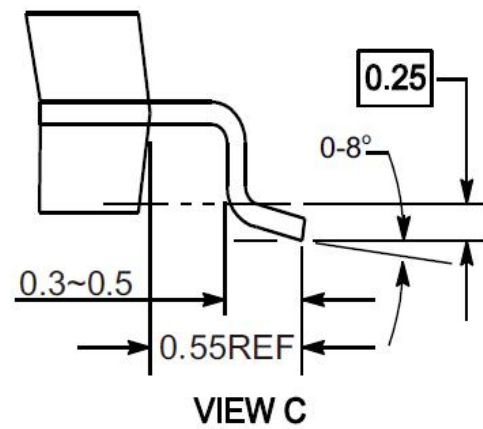
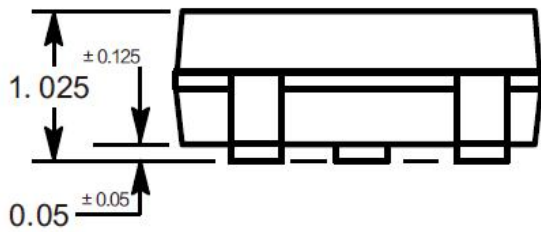
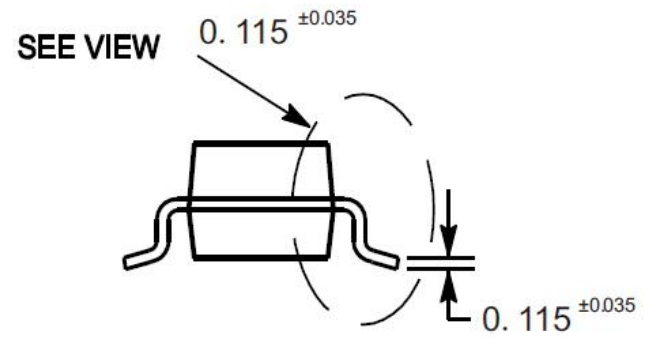
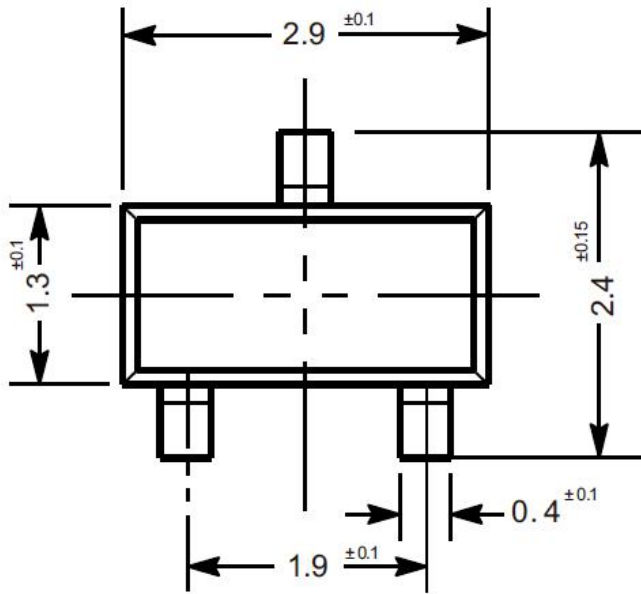
**Figure 1. Test Circuit for V<sub>KA</sub> = V<sub>REF</sub>**

**Figure 2. Test Circuit for V<sub>KA</sub> > V<sub>REF</sub>**

**Figure 3. Test Circuit for I<sub>OFF</sub>**


**Typical Characteristic Curves**


**Package Outline**

SOT-23

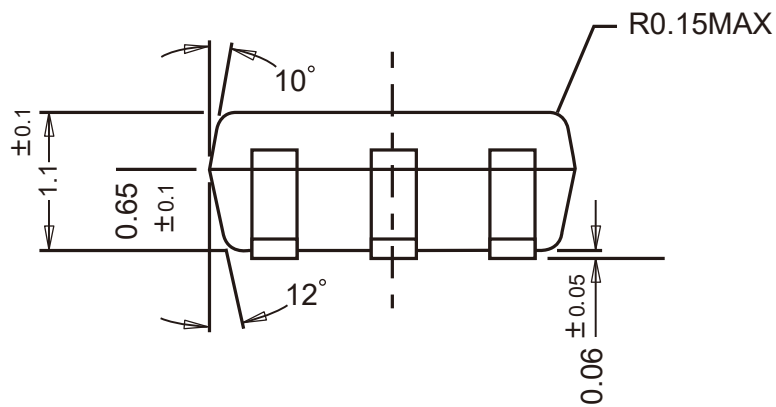
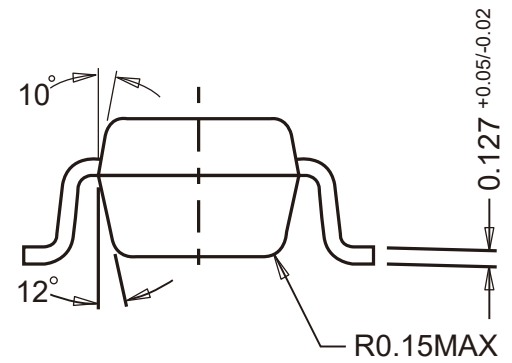
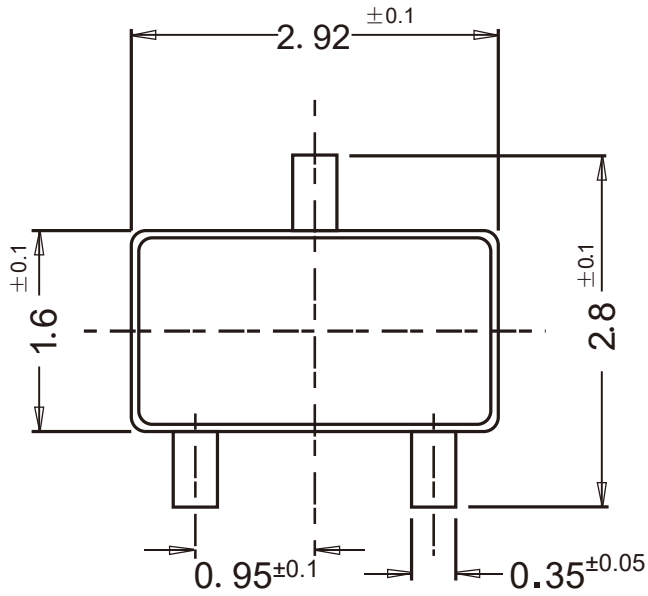
Dimensions in mm



**Package Outline**

SOT-23-3

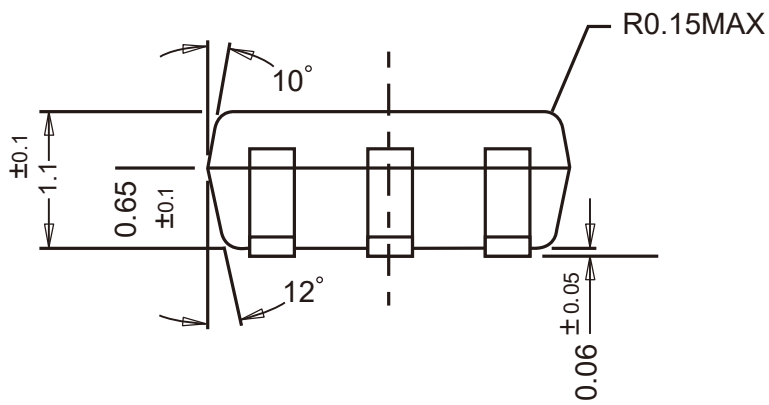
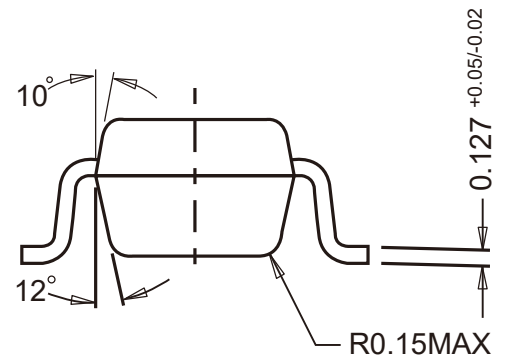
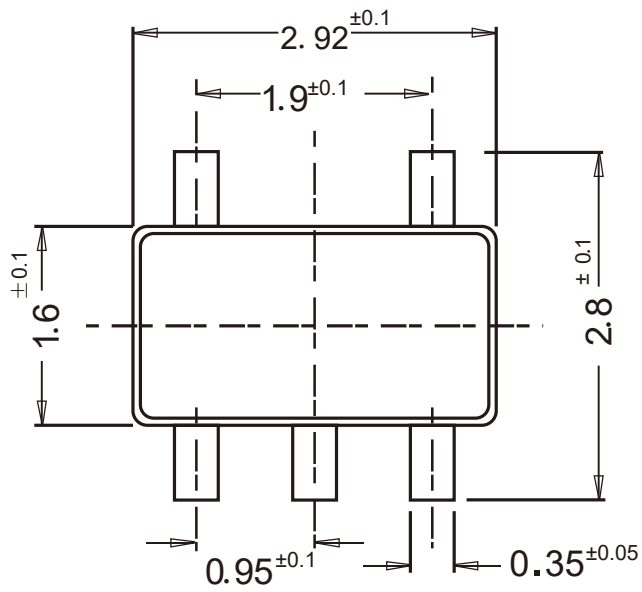
Dimensions in mm



**Package Outline**

SOT-23-5

Dimensions in mm

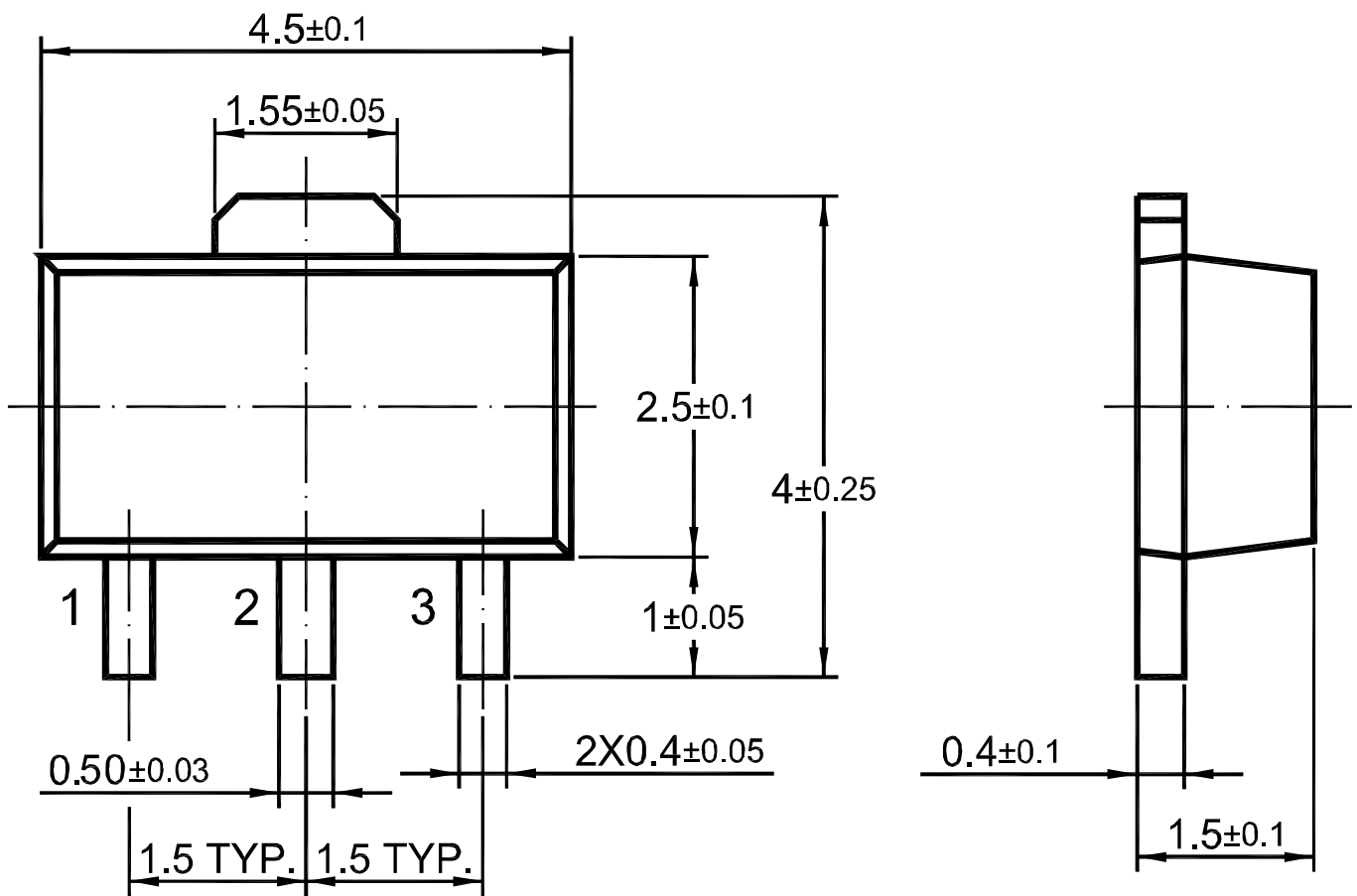




**Package Outline**

SOT-89

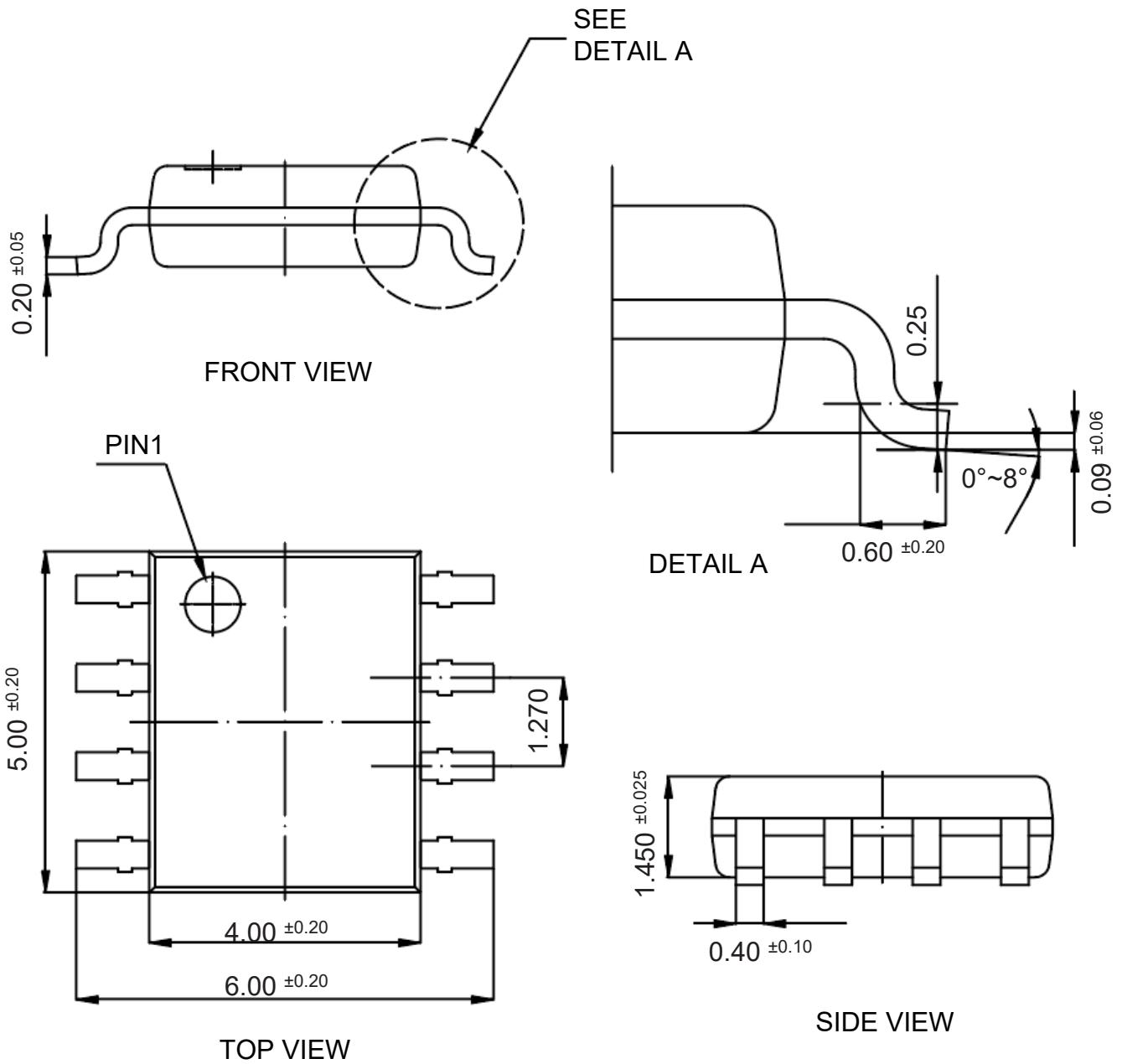
Dimensions in mm



**Package Outline**

SOP-8

Dimensions in mm



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