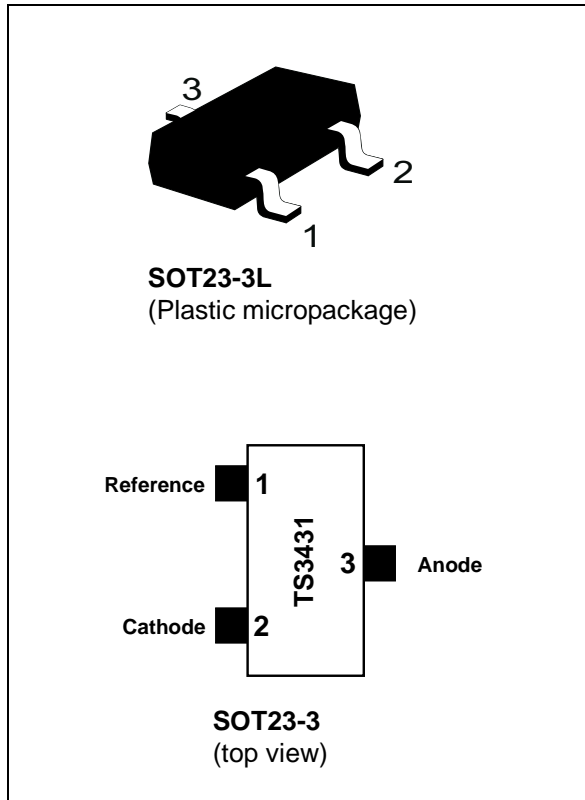


## 1.24 V adjustable shunt voltage reference

Datasheet - production data



- Battery chargers
- Switch mode power supply
- Battery operated equipment

### Description

The TS3431 is an adjustable shunt voltage reference with guaranteed temperature stability over the entire operating temperature range (-40 °C to +125 °C). The output voltage can be set to any value between 1.24 V and 24 V with an external resistor bridge.

Available in SOT23-3 surface mount package, it can be used in application designs where space saving is critical.

### Features

- Adjustable output voltage: 1.24 to 24 V
- Several precision levels @ 25 °C ± 2%, ± 1%, ± 0.5% and ± 0.25%
- Sink current capability: 0.4 to 100 mA
- Industrial temperature range: -40 °C to +125 °C
- Performance compatible with the industry standard TL431

### Applications

- Computers
- Instrumentation

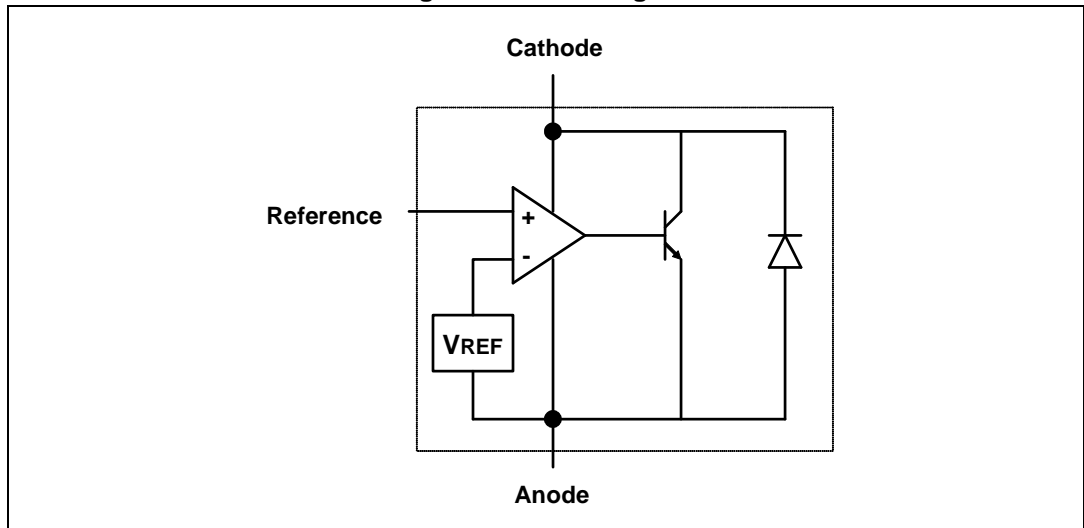
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# 1 Block diagram

Figure 1. Block diagram



## 2 Absolute maximum ratings

**Table 1. Absolute maximum ratings (AMR)**

Symbol	Parameter	Value	Unit
$V_{KA}$	Cathode to anode voltage	25	V
$I_K$	Reverse breakdown current	-100 to +150	mA
$I_{REF}$	Reference current	-0.05 to 10	mA
$P_d$	Power dissipation <sup>(1)</sup> SOT23-3L	360	mW
$T_{stg}$	Storage temperature	-65 to +150	°C
ESD	Human body model (HBM)	2	kV
	Machine model (MM)	200	V
$T_{lead}$	Lead temperature (soldering, 10 seconds)	250	°C

1.  $P_d$  is calculated with  $T_{amb} = 25\text{ °C}$ ,  $T_j = 150\text{ °C}$ ,  $R_{thjc} = 110\text{ °C/W}$ ,  $R_{thja} = 340\text{ °C/W}$ .

**Table 2. Operating conditions**

Symbol	Parameter	Value	Unit
$I_K$	Cathode operating current	0.5 to 100	mA
$V_K$	Cathode operating voltage	1.24 to 24	V
$T_{oper}$	Operating free air temperature range	-40 to +125	°C

### 3 Electrical characteristics

Limits are 100% production tested at 25 °C. Behavior at the temperature range limits is guaranteed through correlation and by design.  $T_{amb} = 25\text{ °C}$  (unless otherwise specified).

**Table 3. Electrical characteristics**

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
$V_K$	Reference input voltage $I_K = 10\text{ mA}$ , $V_{ka} = V_{ref}$	TS3431 (2%)	1.215	1.24	1.265	V
		TS3431A (1%)	1.228		1.252	
		TS3431B (0.5%)	1.234		1.246	
		TS3431C (0.25%)	1.237		1.243	
$\Delta V_K$	Variation of reference input voltage over temperature, $V_{ka} = V_{ref}$	$0\text{ °C} < T < +70\text{ °C}$			10	mV
		$-40\text{ °C} < T < +105\text{ °C}$			18	
		$-40\text{ °C} < T < +125\text{ °C}$			21	
$T_C$	Temperature coefficient	$-40\text{ °C} < T < +125\text{ °C}$			100	ppm/°C
$I_{Kmin}$	Minimum operating current	$T = 25\text{ °C}$		0.35	0.4	mA
		$-40\text{ °C} < T < +125\text{ °C}$			0.5	
$\frac{ \Delta V_{ref} }{ \Delta V_{ka} }$	Ratio of change in reference input voltage to change in cathode to anode voltage	$I_K=10\text{ mA}$ $V_K= 24\text{ to }1.24\text{ V}$		1.2	1.5	mV/V
		$-40\text{ °C} < T < +125\text{ °C}$			2	
$I_{REF}$	Reference input current $I_K=10\text{ mA}$ , $R1=10\text{ k}\Omega$ , $R2=+\infty$	$T= 25\text{ °C}$		0.9	1.5	$\mu\text{A}$
		$-40\text{ °C} < T < +125\text{ °C}$			2	
$\Delta I_{REF}$	Reference input current deviation $I_K=10\text{ mA}$ , $R1=10\text{ k}\Omega$ , $R2=+$	$0\text{ °C} < T < +70\text{ °C}$		0.5	1	$\mu\text{A}$
		$-40\text{ °C} < T < +125\text{ °C}$		0.9	1.5	
$I_{OFF}$	Off-state cathode current $V_K=24\text{ V}$	$T= 25\text{ °C}$		35	500	nA
		$-40\text{ °C} < T < +105\text{ °C}$			1000	
		$-40\text{ °C} < T < +125\text{ °C}$			2000	
$R_{KA}$	Reverse static impedance	$I_K = 1\text{ to }100\text{ mA}$		0.2	0.4	W
$E_N$	Wide band noise	$I_K = 10\text{ mA}$ $1\text{ kHz} < f < 100\text{ kHz}$		100		nV/ $\sqrt{\text{Hz}}$

Figure 2. Reference voltage vs. temperature

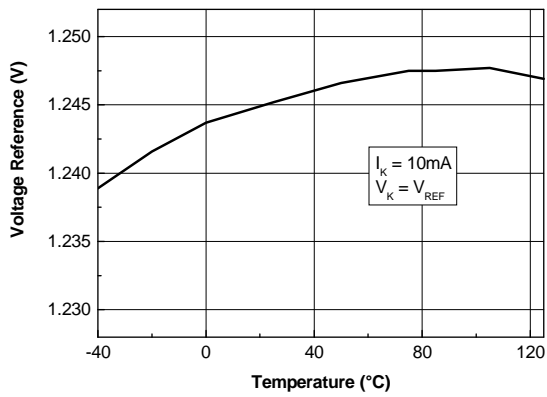


Figure 3. Test circuit for  $V_K = V_{ref}$

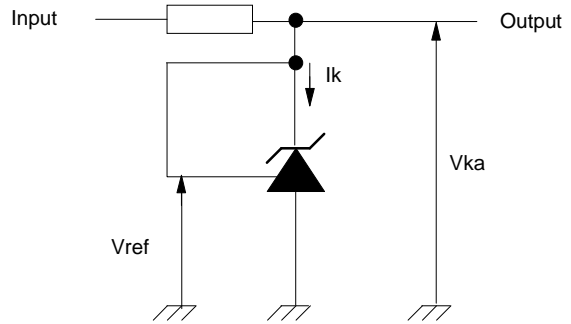


Figure 4. Cathode voltage vs. cathode current

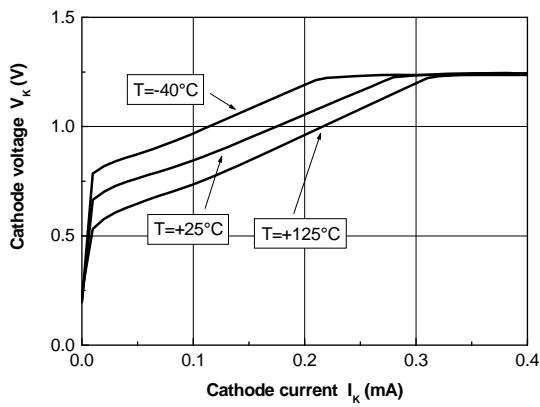


Figure 5. Minimum operating current vs. temperature

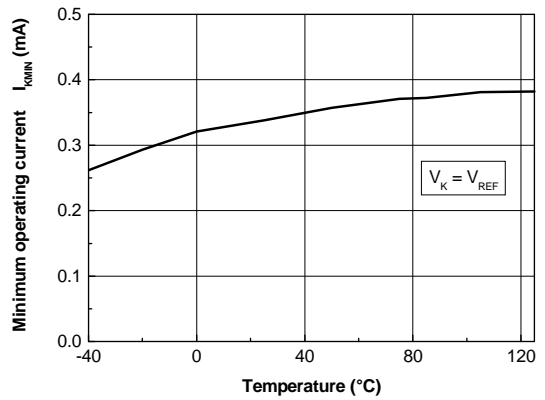


Figure 6. Reference input current vs. temperature

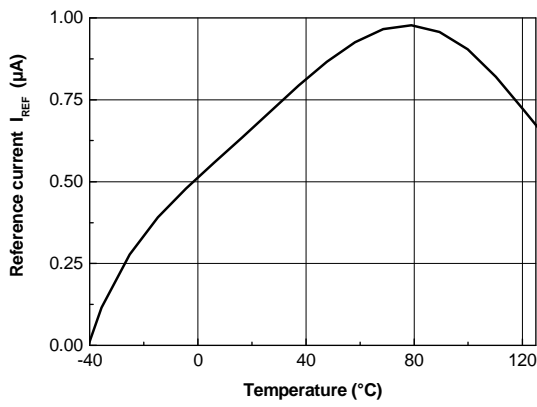


Figure 7. Dynamic impedance vs. frequency

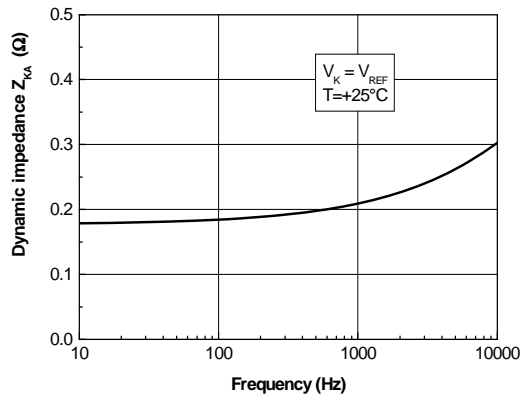


Figure 8. Off-state current vs. temperature

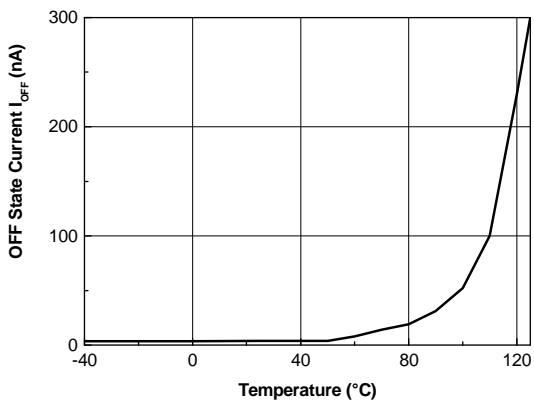
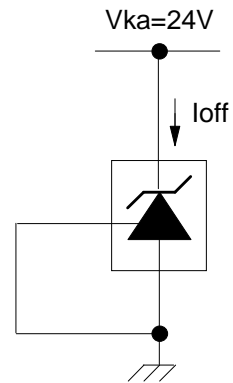


Figure 9. Test circuit for off-state current measurement



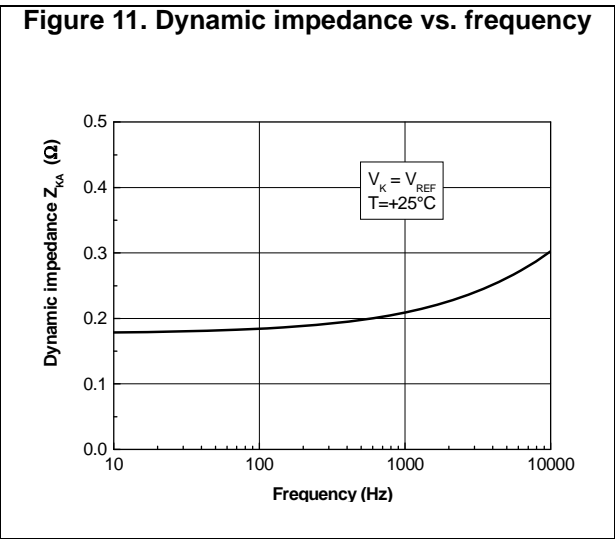
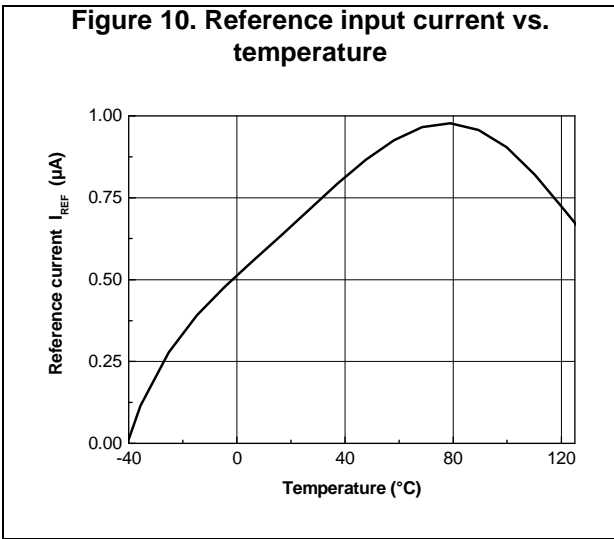


Figure 12. Pulse response at  $I_K=1\text{ mA}$

Figure 13. Test circuit for pulse response at  $I_K = 1\text{ mA}$

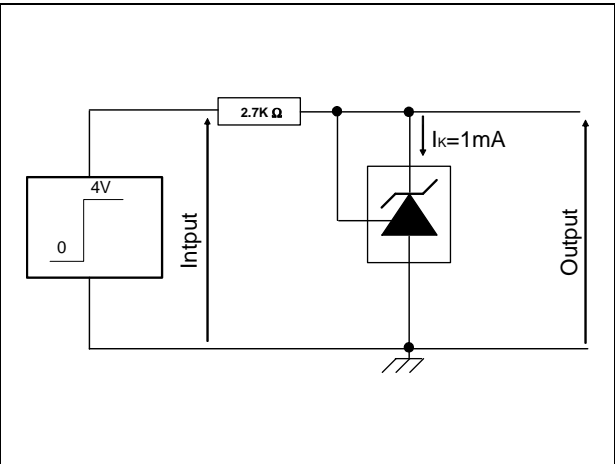
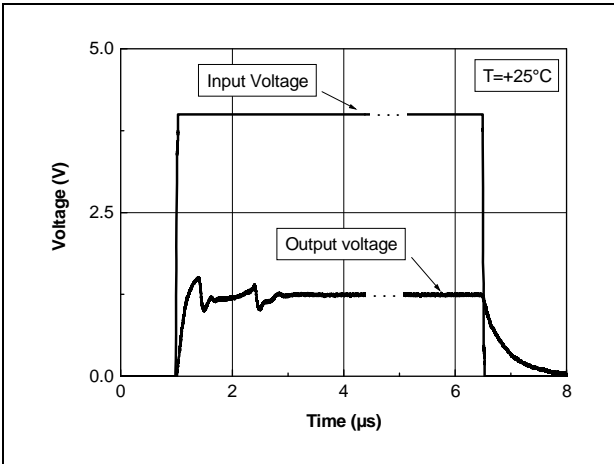


Figure 14. Pulse response at  $I_K=10\text{ mA}$

Figure 15. Test circuit for pulse response at  $I_K = 10\text{ mA}$

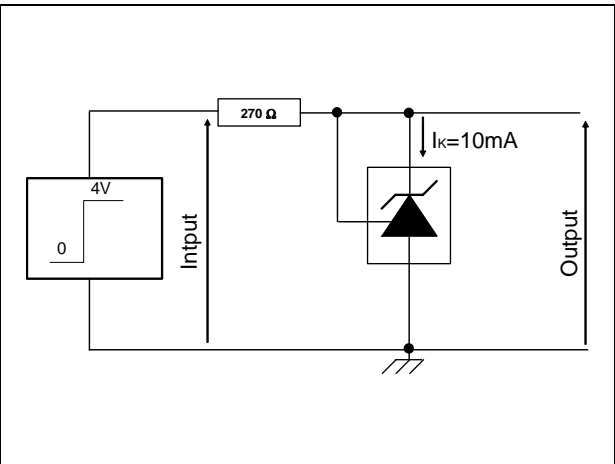
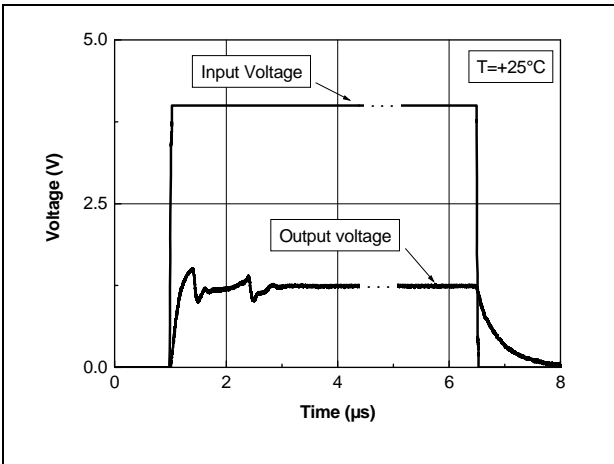




Figure 16. Phase and gain vs. frequency

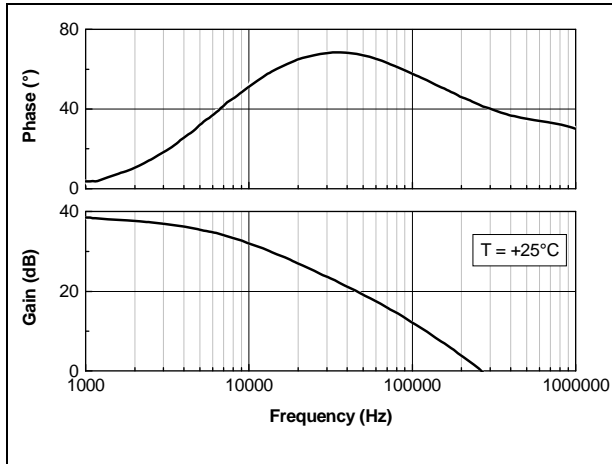


Figure 17. Equivalent input noise vs. frequency

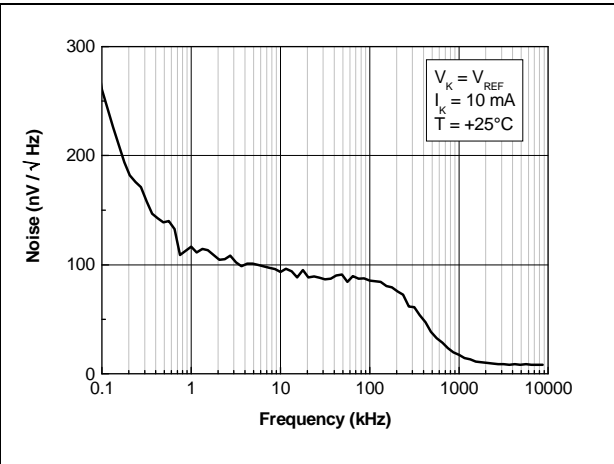
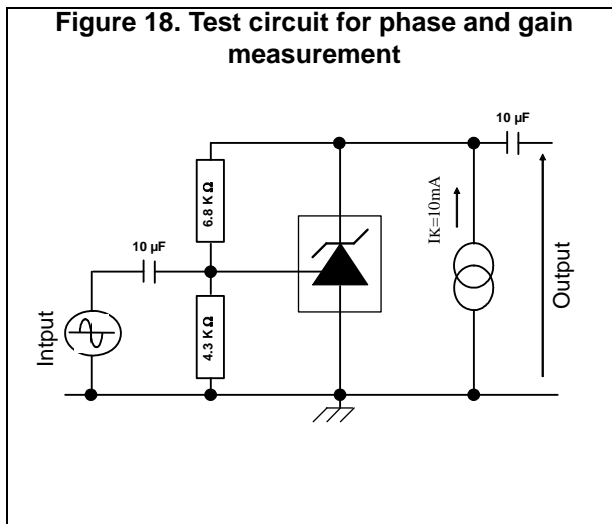


Figure 18. Test circuit for phase and gain measurement



# 4 Package information

In order to meet environmental requirements, ST offers these devices in different grades of ECOPACK<sup>®</sup> packages, depending on their level of environmental compliance. ECOPACK<sup>®</sup> specifications, grade definitions and product status are available at: [www.st.com](http://www.st.com). ECOPACK<sup>®</sup> is an ST trademark.

## 4.1 SOT23-3L package information

Figure 19. SOT23-3L package outline

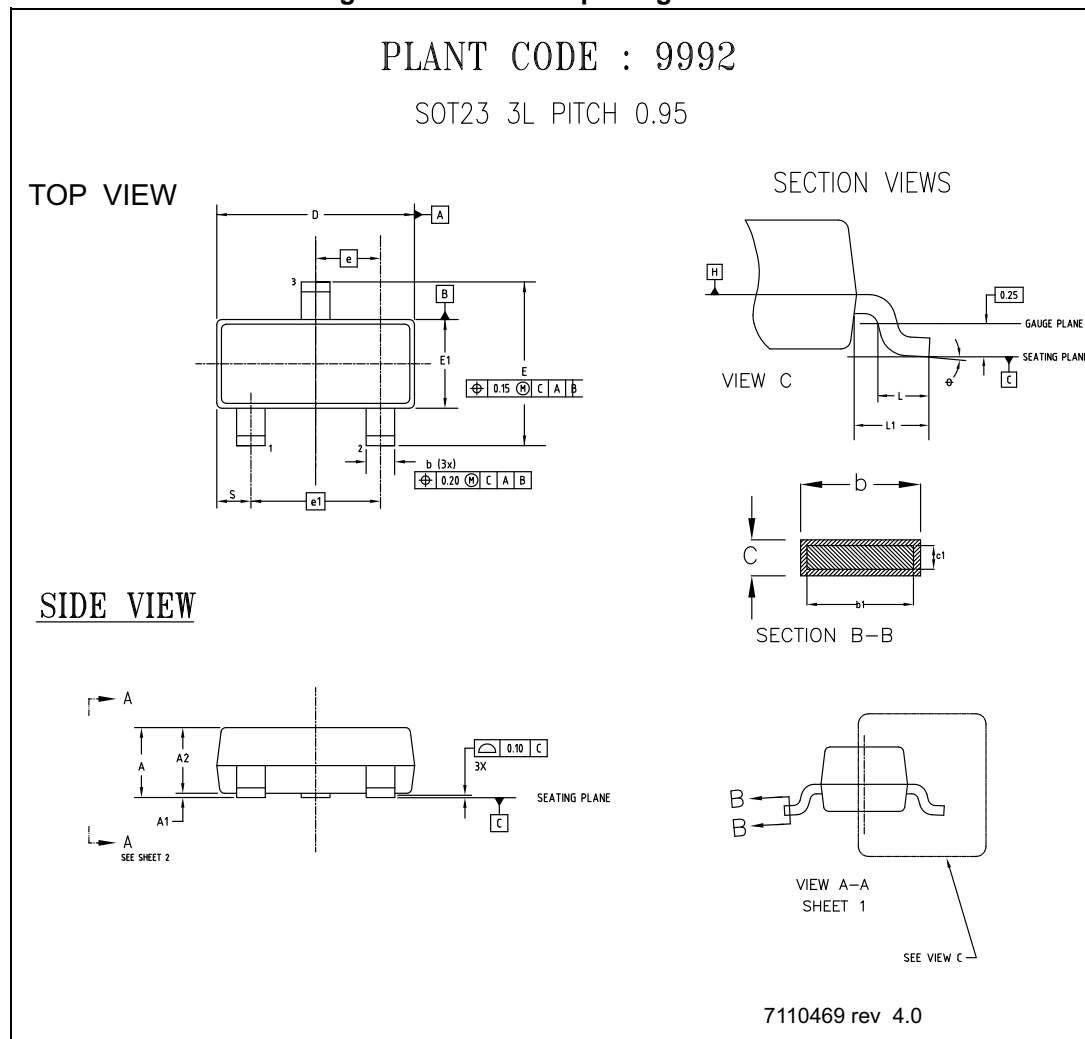


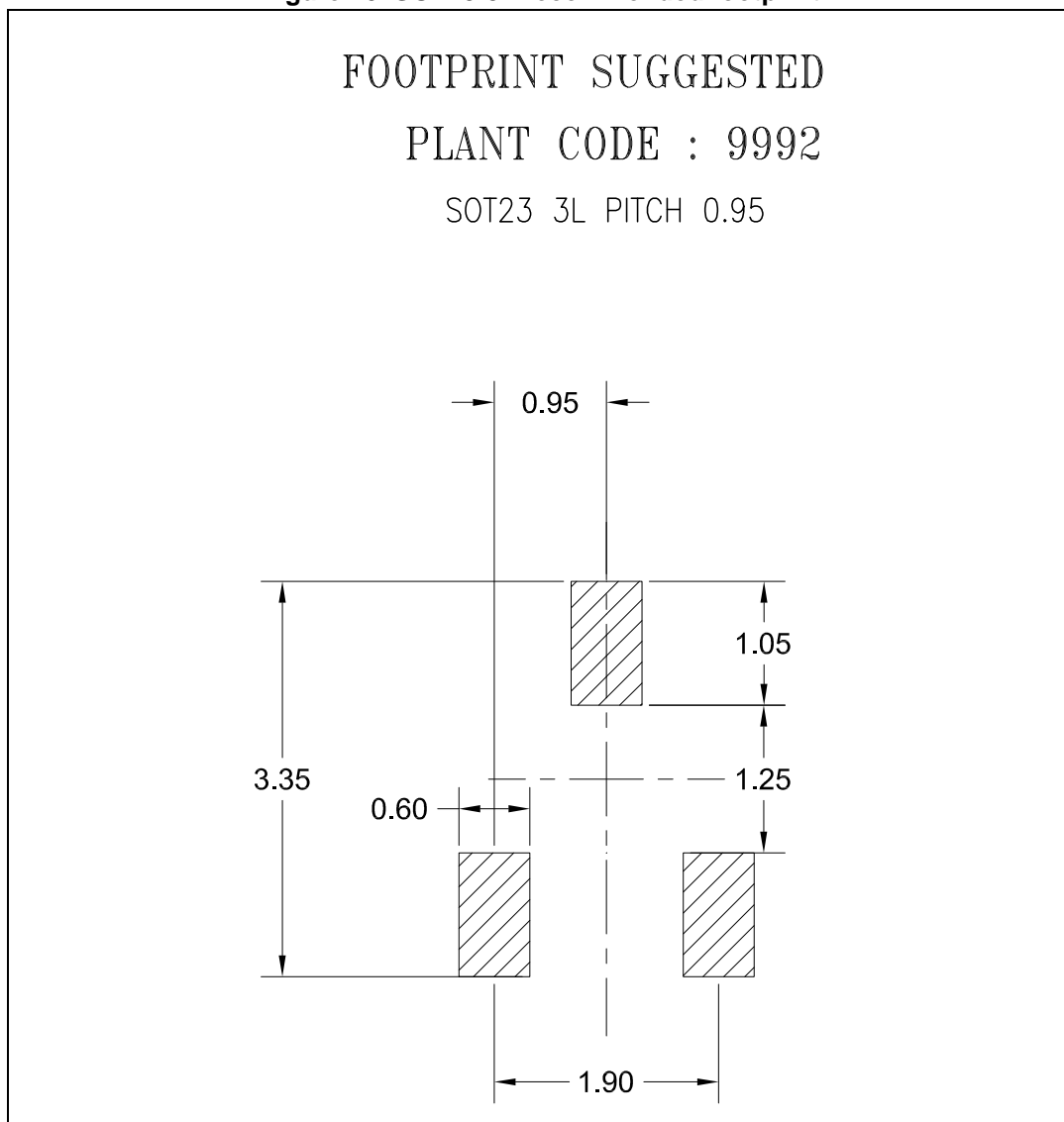
Table 4. SOT23-3L package mechanical data

Ref.	Dimensions		
	Min.	Typ.	Max.
A	0.89		1.12
A1	0.013		0.10
A2	0.88	0.95	1.02
b	0.37		0.50 <sup>(1)</sup>
b1	0.37	0.40	0.45 <sup>(1)</sup>
c	0.085		0.18 <sup>(2)</sup>
c1	0.085		0.16
D	2.80	2.90	3.04 <sup>(3)</sup>
E	2.10		3.04
E1	1.20	1.30	1.40 <sup>(3)</sup>
e	0.95 BSC		
e1		1.90 BSC	
*L <sup>(4)</sup>	0.28	0.38	0.48
L1		0.55 REF	
R	0.05		
R1	0.05		
Θ	0°		8°
s	0.45		0.60

1. These dimensions apply to the flat section of the lead between 0.08 mm and 0.15mm from the lead tip.
2. The max. value of "c" (terminal thickness) increases to 0.19 mm when Cu base leads are electroplated with Sn or SnPb.
3. Dimension D does not include mold flash, protrusions or gate burrs. Mold flash, protrusions or gate burrs shall not exceed 0.25 mm per side. Dimension E1 does not include interlead flash or protrusion. Interlead flash or protrusion shall not exceed 0.25 mm per side.
4. All dimensions comply with JEDEC T0-236-AB unless otherwise marked with designator " \* ".

**Note:** *Standard for thermally enhanced plastic small outline transistor. Dimension and tolerance conform to ASME Y14.5M-1994. All dimensions are in millimeters. All angles are in degrees.*

Figure 20. SOT23-3L recommended footprint



## 5 Ordering information

Table 5. Order code

Order code	Temperature range	Package	Packing	Marking
TS3431ILT	-40 °C, +125 °C	SOT23-3L	Tape and reel	L280
TS3431AILT				L281
TS3431BILT				L282
TS3431CILT				L283

## 6 Revision history

**Table 6. Document revision history**

Date	Revision	Changes
1-Jan-2004	1	Initial release.
1-Dec-2004	2	Specific content changes as follows: <ul style="list-style-type: none"><li>– CI version added in <i>Table 5: Order code</i>.</li><li>– <math>R_{thjc}</math> information added in <i>Table 1: Absolute maximum ratings (AMR)</i>.</li><li>– Test condition added in electrical characteristics <i>Table 3</i>.</li></ul>
26-Jun-2007	3	Removed TO-92 package information and associated order codes. Re-ordered electrical characteristics figures.
30-Aug-2012	4	Added: $V_{ka} = V_{ref}$ parameter in <i>Table 3 on page 5</i> .
04-Dec-2017	5	Updated the title and <a href="#">Section 4.1: SOT23-3L package information</a> . Minor text changes.

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