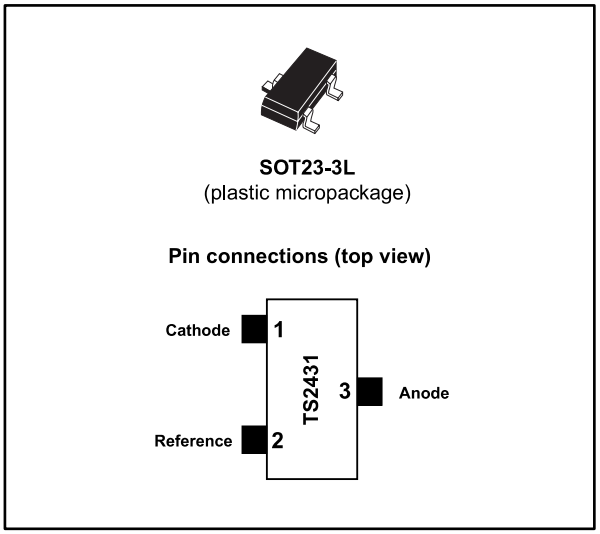
TS2431

Adjustable shunt voltage reference

Datasheet - production data



Features

- Adjustable output voltage: 2.5 to 24 V
- Precision selection at 25 °C: ± 2%, ± 1% and ± 0.5%
- Sink current capability: 1 to 100 mA
- Industrial temperature range: - 40 to + 105 °C
- Performance compatible with industry-standard TL431

Applications

- Computers
- Instrumentation
- Battery chargers
- Switch mode power supplies
- Battery-operated equipment

Description

The TS2431 is an adjustable shunt voltage reference with guaranteed temperature stability over the entire temperature range of operations from - 40 to + 105 °C. The output voltage may be set to any value between 2.5 and 24 V with an external resistor bridge. Available in an SOT23-3L surface mount package, the device can be implemented for those applications where space-saving is of the utmost importance.

Table 1: Device summary

Order code	Temperature range	Package	Packing	Precision	Marking
TS2431ILT	-40 to + 105 °C	SOT23-3L	Tape and reel	2%	L285
TS2431AILT				1%	L286
TS2431BILT				0.5%	L287

Contents

1 Absolute maximum ratings and operating conditions

Table 2: Absolute maximum ratings

Symbol	Parameter	Value	Unit
V_{ka}	Cathode to anode voltage	25	V
I_K	Reverse breakdown current	-100 to +150	mA
I_{REF}	Reference input current range	0.05 to +10	mA
P_d	Power dissipation(1) SOT23-3L	360	mW
T_{std}	Storage temperature	-65 to +150	°C
ESD	Human body model (HBM)(2)	2	kV
	Machine model (MM)(3)	200	V
T_{LEAD}	Lead temperature (soldering, 10 s)	260	°C

Notes:

(1)Pd has been calculated with T_{amb} = 25 °C, $T_{junction}$ = 150 °C, R_{thjc} = 110 °C/W and R_{thja} = 340 °C/W for the SOT23-3 package.

(2)Human body model: a 100 pF capacitor is charged to the specified voltage, then discharged through a 1.5 kΩ resistor between two pins of the device. This is done for all couples of connected pin combinations while the other pins float.

(3)Machine model: a 200 pF capacitor is charged to the specified voltage, then discharged directly between two pins of the device with no external series resistor (internal resistor < 5 Ω). This is applied for all couples of connected pin combinations while the other pins float.

Table 3: Operating conditions

Symbol	Parameter	Value	Unit
V_{KA}	Cathode to anode voltage	V_{REF} to 24	V
I_K	Cathode operating current(1)	1 to 100	mA
T_{oper}	Operating free air temperature range	- 40 to + 105	°C

Notes:

(1)Maximum power dissipation must be strictly observed to avoid damaging the component.

2 Electrical characteristics

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
V_{REF}	Reference input voltage	$V_K = V_{REF}$, I_K = 10 mA		2.5		V
		TS2431 (2%)	2.45		2.55	
		TS2431A (1%)	2.475		2.525	
		TS2431B (0.5%)	2.488		2.512	
		TS2431B (1%), I_K = 1 mA	2.475		2.525	
$\lvert\Delta V_{REF}\rvert$	Reference input voltage deviation over temperature $V_K = V_{REF}$, I_K = 10 mA(1)(2)	0 °C < T < + 70 °C		10	20	mV
		-40 °C < T < + 85 °C		17	30	
		-40 °C < T < + 105 °C		20	35	
T_C	Temperature coefficient(2)	-40 °C < T < + 105 °C		50	100	ppm/°C
I_{KMIN}	Minimum operating current	T = 25 °C		0.3	0.8	mA
		-40 °C < T < +105 °C			1	
$\left\lvert\frac{\Delta V_{ref}}{\Delta V_K}\right\rvert$	Ratio of change in reference input voltage to change in cathode-to-anode voltage	I_K = 10 mA Vka = 24 to 2.5 V		0.3	2	mV/V
I_{REF}	Reference input current I_K= 10 mA, R1 = 10 kΩ, R2 = + ∞(3)	T = 25 °C		0.5	2.5	µA
		-40 °C < T < +105 °C			3	
$\lvert\Delta I_{REF}\rvert$	Reference input current deviation I_K = 10 mA, R1 = 10 kΩ, R2 = + ∞(3)	-40 °C < T < +105 °C		0.4	1.2	µA
I_{OFF}	Off-state cathode current	V_K = 24 V, V_{REF} = GND		10	500	nA
$\lvert Z_{KA}\rvert$	Reverse dynamic impedance	$V_K = V_{REF}$, ΔI_K = 1 to 50 mA, f < 10 kHz		0.5	0.75	Ω
E_N	Wide band noise	I_K = 10 mA 10 Hz < f < 10 kHz		300		nV/√Hz

Notes:

(1)Limits are 100 % production tested at 25 °C. Overtemperature limits are guaranteed through correlation and by design.

(2)$\lvert\Delta V_{REF}\rvert$ is defined as the difference between the maximum and minimum values of V_{REF} obtained over the full temperature range.

(3)Refer to *Figure 4: "Test circuit for Vka = Vref"*.

Figure 1: Reference voltage vs temperature

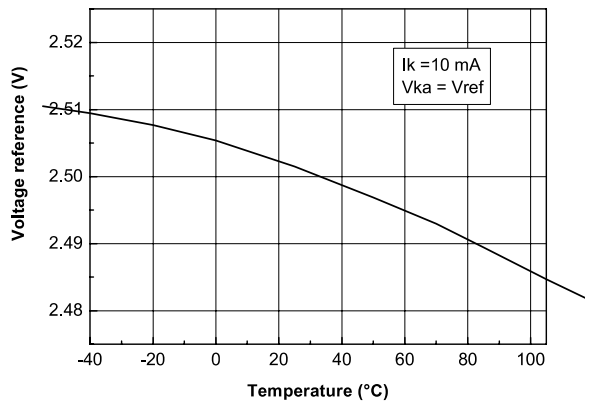


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Figure 2: Cathode voltage vs cathode current

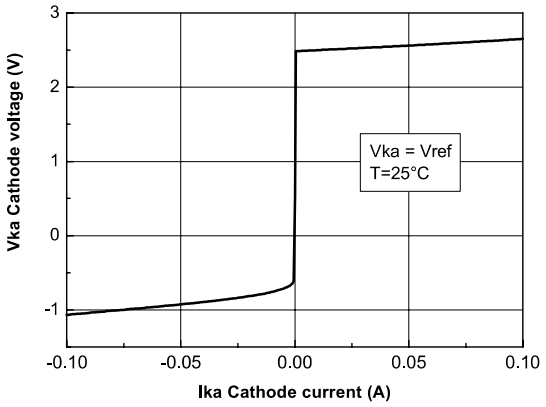

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Figure 3: Reference input current vs temperature

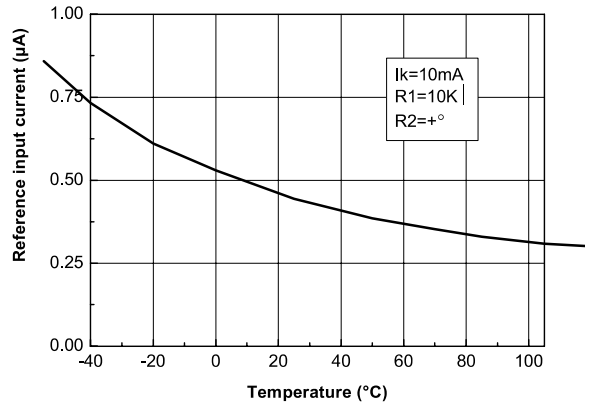

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Figure 4: Test circuit for Vka = Vref

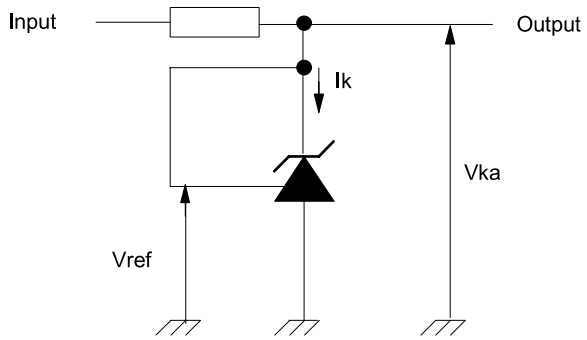

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Figure 5: Cathode voltage vs cathode current

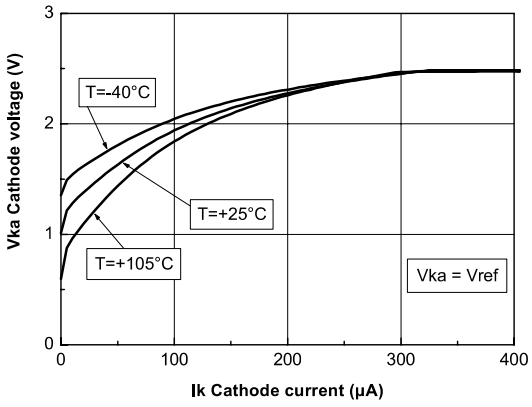

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Figure 6: Dynamic impedance vs frequency

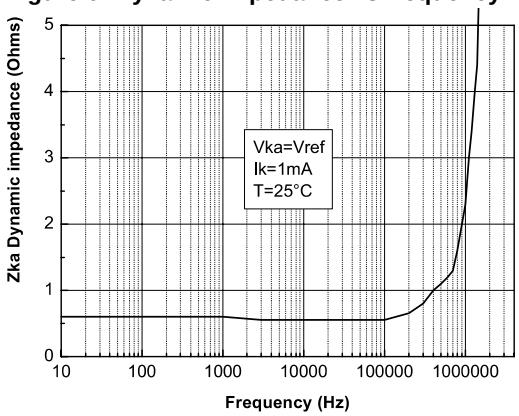

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Figure 7: Off-state current vs temper

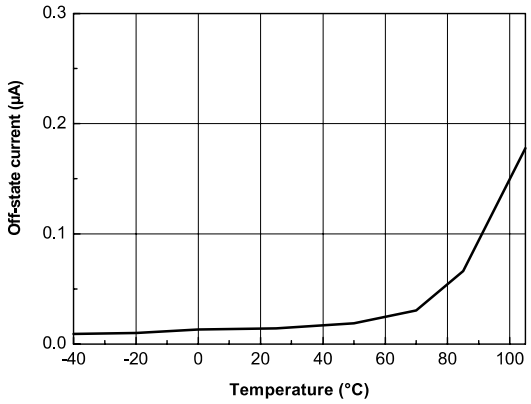

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Figure 8: Ratio of change in reference input voltage to change in Vka voltage vs temperature

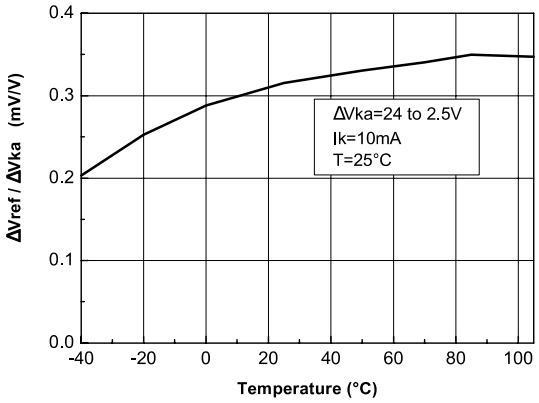

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Figure 9: Phase and gain vs frequency

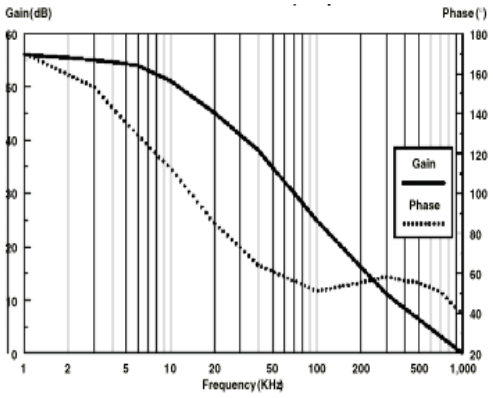

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Figure 10: Test circuit for off-state current measurement

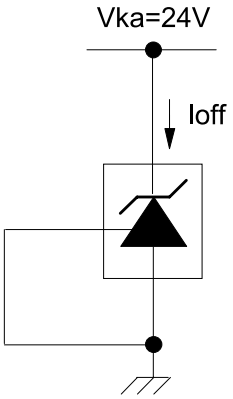

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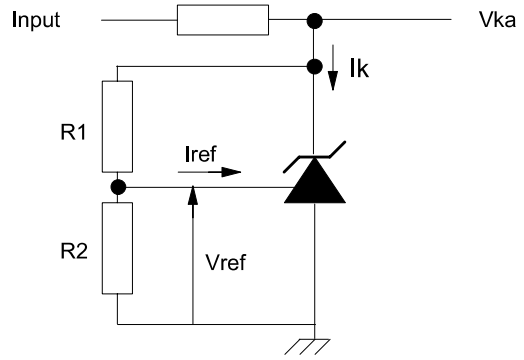
Figure 11: Test circuit for Vka > Vref



Vka = Vref . (1+R1/R2) + Iref . R1

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Figure 12: Test circuit for phase and gain measurement

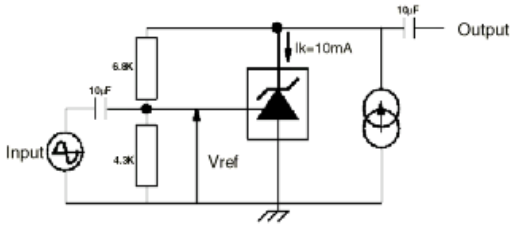

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Figure 13: Pulse response at Ik = 0 to 1 mA

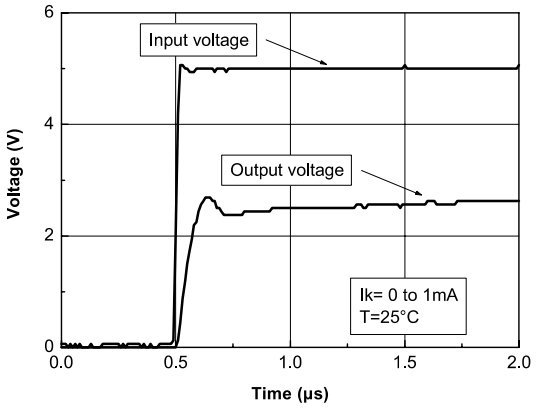

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Figure 14: Pulse response at Ik = 1 to 0 mA

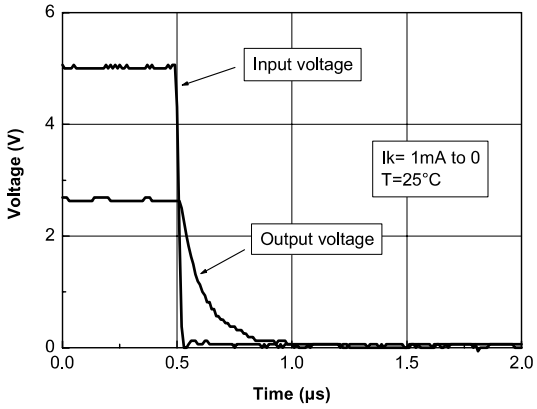

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Figure 15: Stability boundary conditions

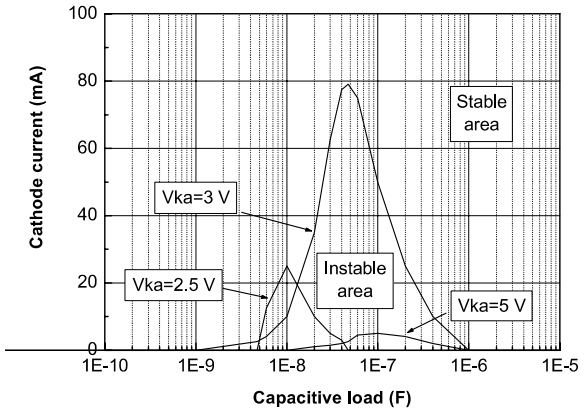

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Figure 16: Test circuit for pulse response at Ik = 1 mA

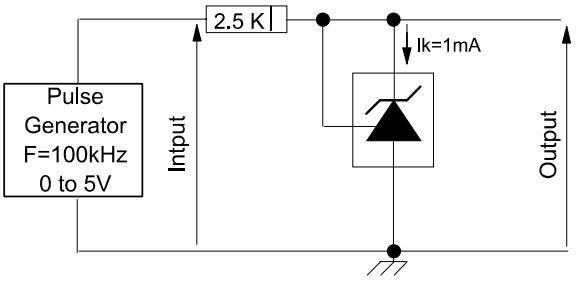

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Figure 17: Equivalent input noise vs frequency

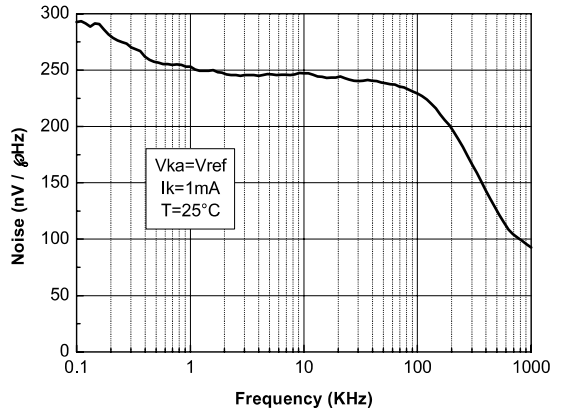

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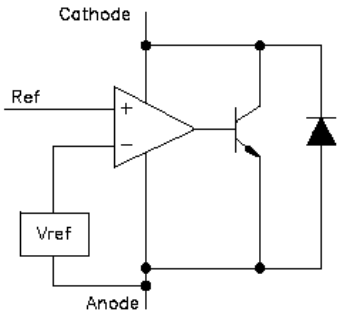
Figure 18: Block diagram



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3 Package information

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

3.1 SOT23-3L package information

Figure 19: SOT23-3L (Nantong Fujitsu) package outline

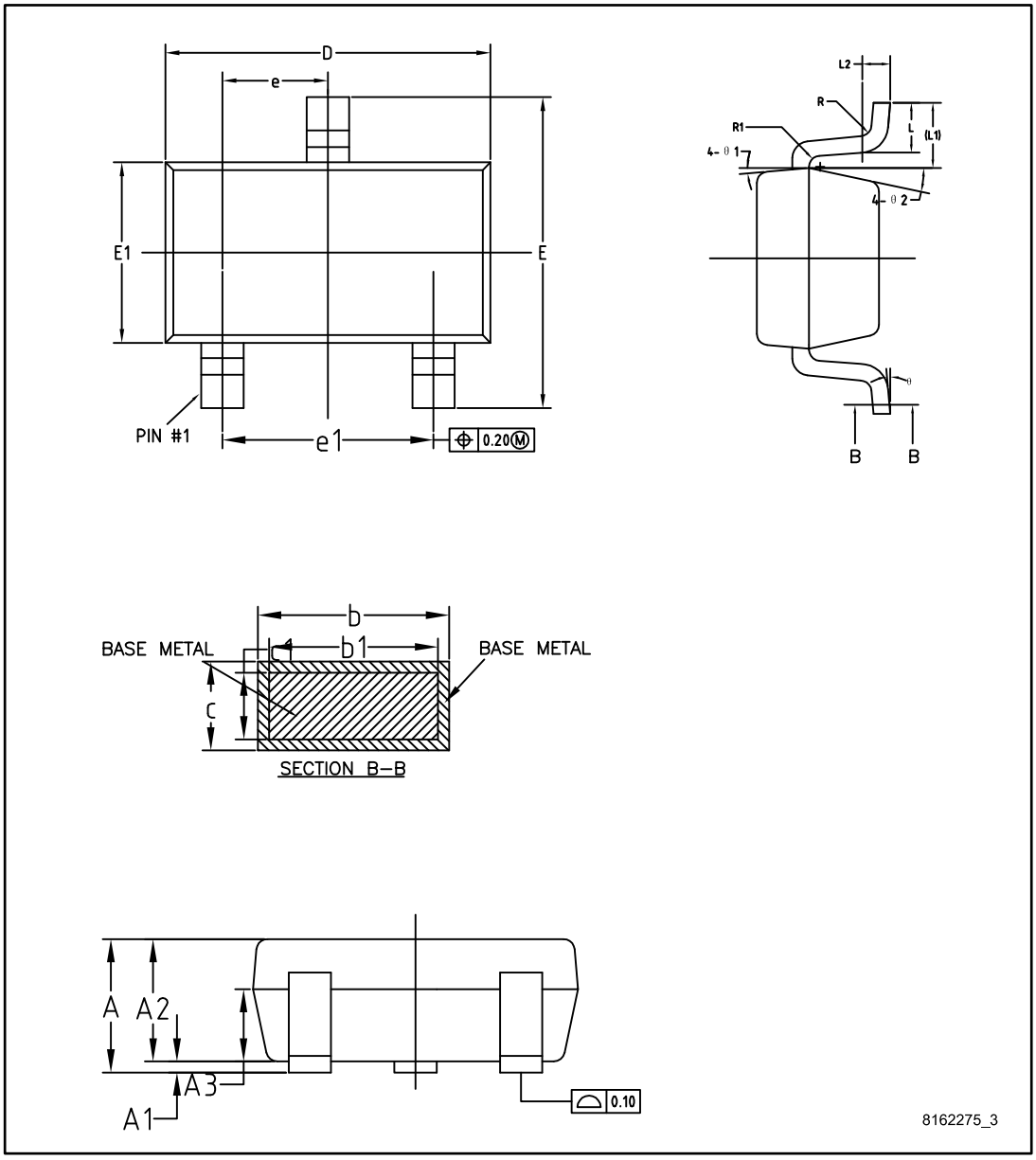


Table 4: SOT23-3L (Nantong Fujitsu) mechanical data

Dim.	mm		
	Min.	Typ.	Max.
A			1.25
A1	0		0.15
A2	1	1.10	1.20
A3	0.60	0.65	0.70
b	0.36		0.50
b1	0.36	0.38	0.45
c	0.14		0.20
c1	0.14	0.15	0.16
D	2.826	2.926	3.026
E	2.60	2.80	3.00
E1	1.526	1.626	1.726
e	0.90	0.95	1.00
e1	1.80	1.90	2.00
L	0.35	0.45	0.60
L1	0.59 REF		
L2	0.25 BSC		
R	0.05		
R1	0.05		
θ	0°		8°
θ1	3°	5°	7°
θ2	6°		14°

Figure 20: SOT23-3L (Carsem) package outline

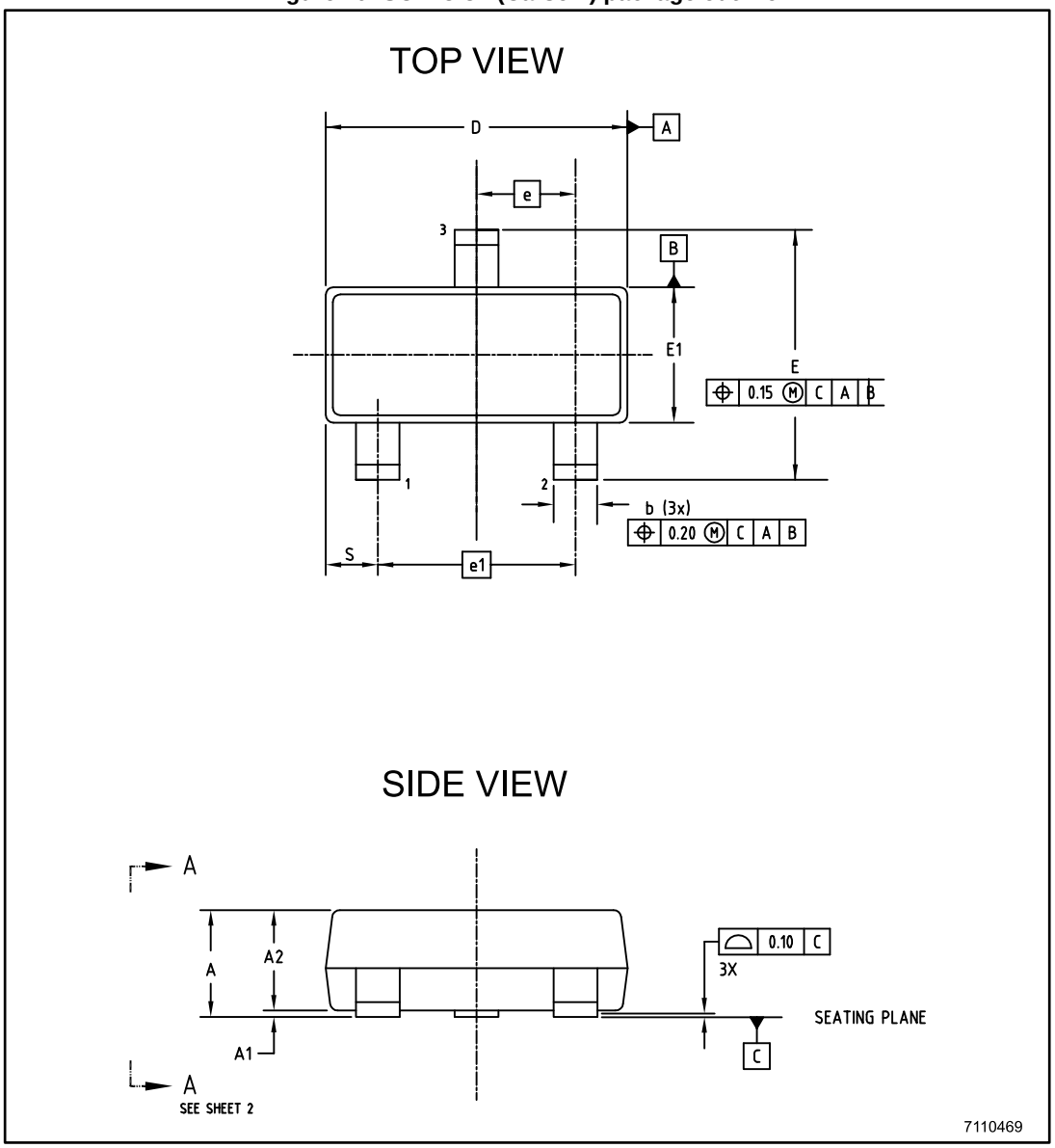


Figure 21: SOT23-3L (Carsem) package section views

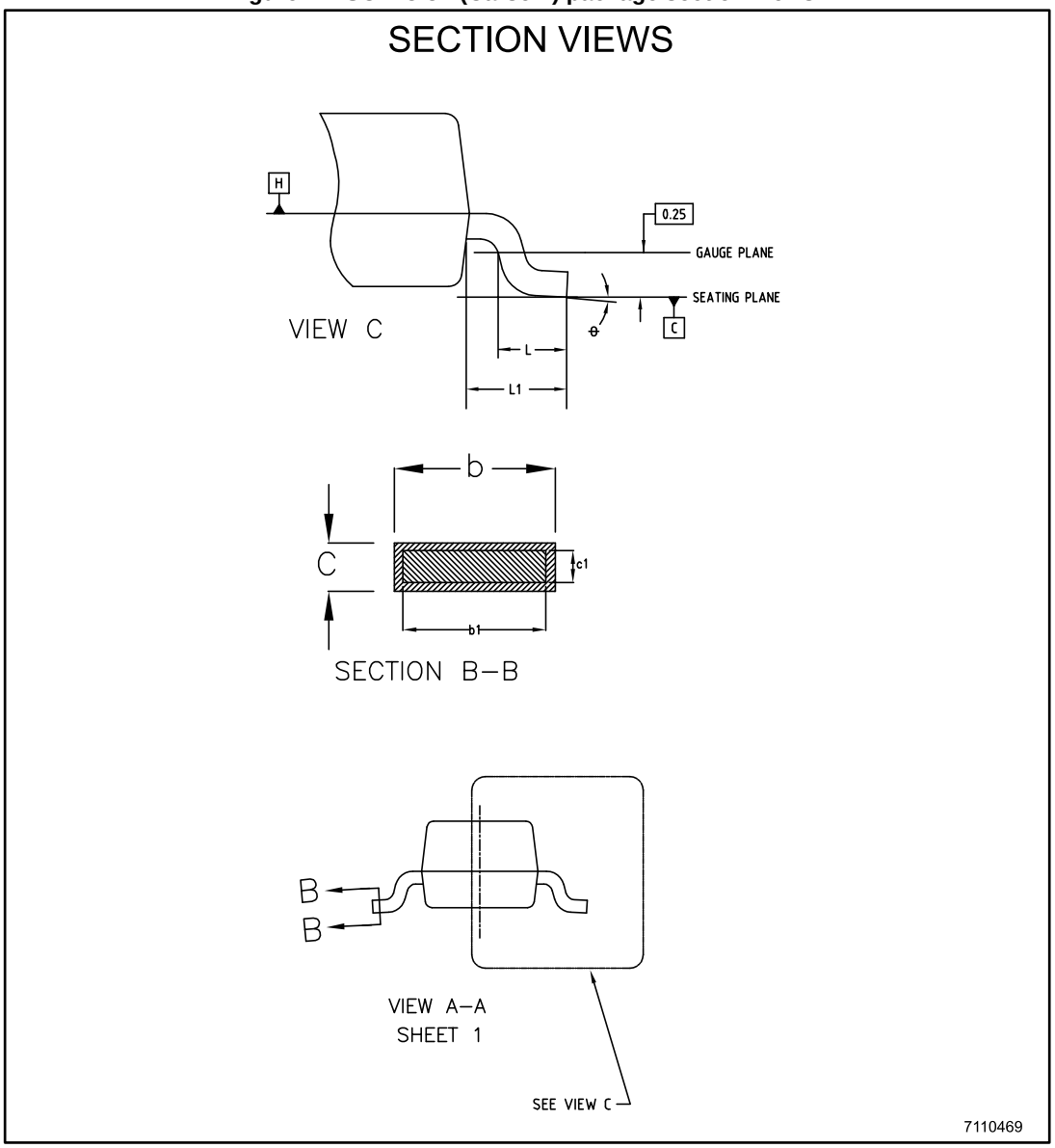
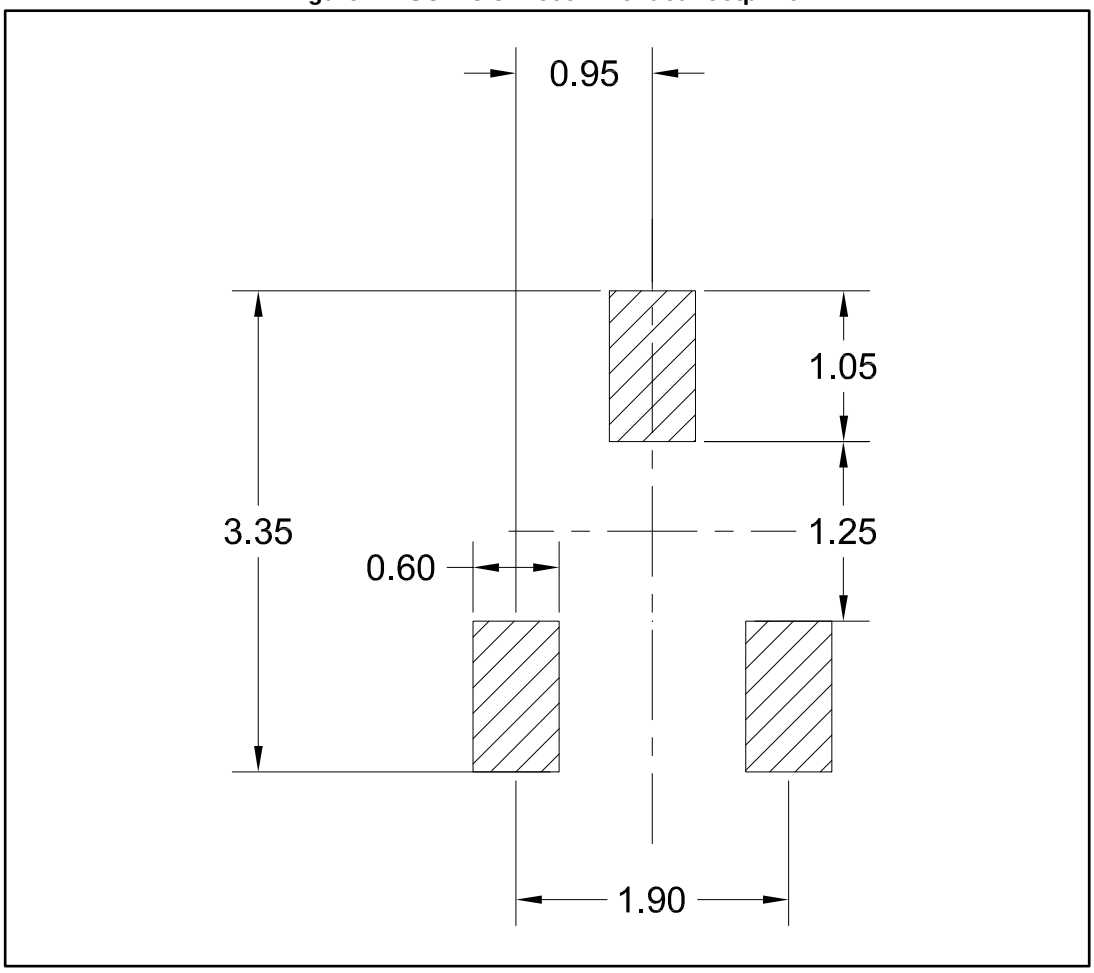


Table 5: SOT23-3L (Carsem) mechanical data

Dimensions			
Ref.	Millimeters		
	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
b1	0.37	0.40	0.45
c	0.085	-	0.18
c1	0.085	-	0.16
D	2.80	2.90	3.04
E	2.10	-	2.64
E1	1.20	1.30	1.40
e		0.95 BSC	
e1		1.90 BSC	
*L	0.28	0.38	0.48
L1		0.55 REF	
L2			
R	0.05		
R1	0.05		
θ	0º		8º
s	0.45	-	0.60

Figure 22: SOT23-3L recommended footprint



4 Revision history

Table 6: Document revision history

Date	Revision	Changes
01-Feb-2002	1	Initial release.
10-Sep-2009	2	Updated document format. Modified footnote 1 under *Table 2: Absolute maximum ratings on page 3*. Added HBM and MM notes under *Table 2*.
11-May-2012	3	Removed: automotive grade order codes *Table 1 on page 1*.
22-Nov-2012	4	Added min. and max. values test condition TS2431B (1%), I_K = 1 mA *Table 4 on page 4*.
28-Nov-2016	5	Updated Section 3: "Package information". Minor text changes.
20-Oct-2017	6	Updated the title and the description in cover page. Minor text changes.

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