

Programmable shunt voltage reference

Datasheet –production data

Features

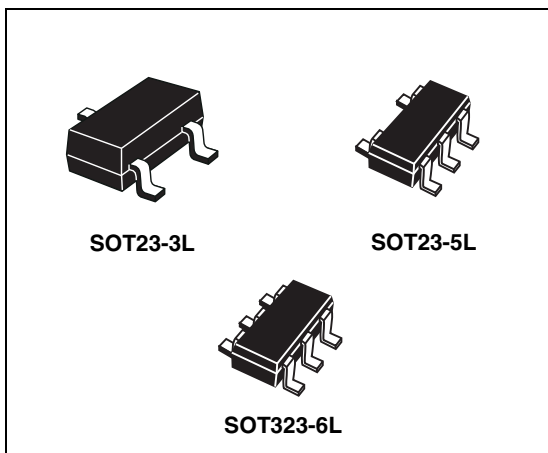
- Adjustable output voltage: 1.24 V to 18 V
- Low operating current: 100 μ A at 25 $^{\circ}$ C
- 0.25% and 0.5% voltage precision
- Sink current capability up to 60 mA
- -40 to +125 $^{\circ}$ C temperature range
- 100 ppm/ $^{\circ}$ C maximum temperature coefficient
- Available in SOT23-3L, SOT23-5L and SOT323-6L packages

Applications

- Computers
- Battery chargers
- Switch mode power supplies
- Battery operated equipment
- Data acquisition systems
- Energy management

Description

The TLVH431 is a low power programmable shunt voltage reference, with guaranteed temperature stability over the entire operating temperature range.



The output voltage may be set to any value between 1.24 V and 18 V by means of an external resistor divider.

The TLVH431 operates with a wide current range from 100 μ A to 60 mA with a typical dynamic impedance of 0.22 Ω

Available in SOT23-3L, SOT23-5L and SOT323-6L surface mounted packages, it can be designed in applications where space saving is a critical issue.

The low operating current is a key advantage for power restricted designs.

Table 1. Device summary

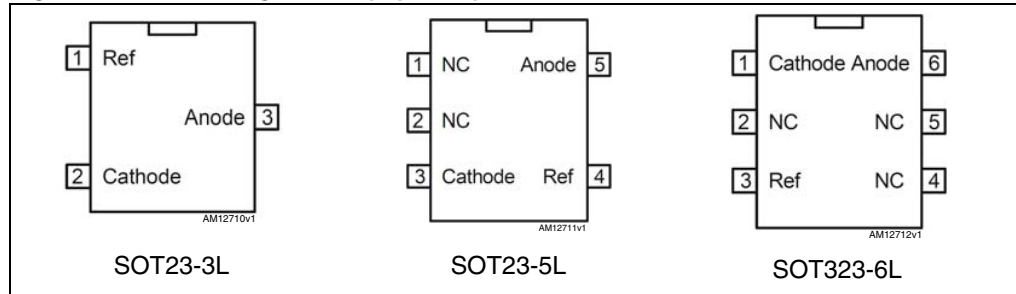
Part number	Precision	Package	Temperature range
TLVH431AIL3T	0.5%	SOT23-3L	-40 to +125 $^{\circ}$ C
TLVH431BIL3T	0.25%		
TLVH431AIL5T	0.5%	SOT23-5L	
TLVH431BIL5T	0.25%		
TLVH431AICT	0.5%	SOT323-6L	
TLVH431BICT	0.25%		

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1 Pin configuration

Figure 1. Pin configuration (top view)



2 Maximum ratings

Table 2. Absolute maximum ratings

Symbol	Parameter	Value	Unit
V_{KA}	Cathode to anode voltage	22	V
I_K	Continuous cathode current range	- 100 to +100	mA
I_{REF}	Reference input current range	- 0.05 to +3	mA
T_{STG}	Storage temperature	- 65 to +150	°C
ESD	Human body model (HBM)	2	kV
	Machine model (MM)	200	V
	Charged device model	1500	V
T_{LEAD}	Lead temperature (soldering) 10 sec	260	°C
T_J	Max. junction temperature	+150	°C

Note: Absolute maximum ratings are those values beyond which damage to the device may occur. Functional operation under these conditions is not implied.

Table 3. Thermal data

Symbol	Parameter	SOT323-6L	SOT23-3L	SOT23-5L	Unit
R_{thJA}	Thermal resistance junction-ambient	221	248	157	°C/W
R_{thJC}	Thermal resistance junction-case	110	136	67	°C/W

Table 4. Operating conditions

Symbol	Parameter	Value	Unit
V_{KA}	Cathode to anode voltage	V_{ref} to 18	V
I_{kmin}	Minimum operating current	100	μA
I_{kmax}	Maximum operating current	60	mA
T_{oper}	Operating free air temperature range	-40 to +125	°C

3 Electrical characteristics

$I_k = 10 \text{ mA}$, $T_{\text{amb}} = 25 \text{ °C}$ (unless otherwise specified).

Table 5. Electrical characteristics for TLVH431

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
V_{ref}	Reference voltage	$V_{\text{KA}} = V_{\text{ref}}$ TLVH431A 0.5% TLVH431B 0.25%	1.234 1.237	1.24	1.246 1.243	V
ΔV_{ref}	Reference voltage variation overtemperature range ⁽¹⁾	$-40 \text{ °C} < T_{\text{amb}} < +125 \text{ °C}$ TLVH431A 0.5% TLVH431B 0.25%	-26.7 -23.5		+26.7 +23.5	mV
$\Delta V_{\text{KA}}/\Delta T$	Average temperature coefficient	$V_{\text{KA}} = V_{\text{ref}}$, $-40 \text{ °C} < T_{\text{amb}} < +125 \text{ °C}$		± 30	± 100	ppm/°C
I_{kmin}	Minimum cathode current for regulation	$V_{\text{KA}} = V_{\text{ref}}$		60	100	μA
		$V_{\text{KA}} = V_{\text{KAmax}}$		160	200	
ΔI_{kmin}	Minimum cathode current variation overtemperature range	$V_{\text{KA}} = V_{\text{ref}}$, $-40 \text{ °C} < T_{\text{amb}} < +125 \text{ °C}$		70	100	μA
		$V_{\text{KA}} = V_{\text{KAmax}}$, $-40 \text{ °C} < T_{\text{amb}} < +125 \text{ °C}$		100	200	
I_{ref}	Reference input current	$R_1 = 10 \text{ k}\Omega$, $R_2 = \infty$		1.5	2.5	μA
ΔI_{ref}	Reference current variation overtemperature range	$R_1 = 10 \text{ k}\Omega$, $R_2 = \infty$ $-40 \text{ °C} < T_{\text{amb}} < +125 \text{ °C}$		2.5	3.5	μA
$\frac{\Delta V_{\text{ref}}}{\Delta V_{\text{ka}}}$	Ratio of change in reference input voltage to change in cathode to anode voltage	$\Delta V_{\text{KA}} = 18 \text{ V to } V_{\text{ref}}$			-2	mV/V
		$\Delta V_{\text{KA}} = 18 \text{ V to } V_{\text{ref}}$ $-40 \text{ °C} < T_{\text{amb}} < +125 \text{ °C}$			-2.5	
I_{off}	Off-state cathode current	$V_{\text{KA}} = V_{\text{KAmax}}$, $V_{\text{ref}} = \text{GND}$		10	80	nA
ΔI_{off}	Off-state cathode current overtemperature range	$V_{\text{KA}} = V_{\text{KAmax}}$, $V_{\text{ref}} = \text{GND}$ $-40 \text{ °C} < T_{\text{amb}} < +125 \text{ °C}$		1000	2000	nA
$ R_{\text{KA}} $	Static impedance	$V_{\text{KA}} = V_{\text{ref}}$, $\Delta I_{\text{K}} = 100 \text{ }\mu\text{A to } 60 \text{ mA}$		0.14	0.62	Ω
$ Z_{\text{KA}} $	Dynamic impedance ⁽²⁾	$V_{\text{KA}} = V_{\text{ref}}$, $\Delta I_{\text{K}} = 10 \text{ mA to } 60 \text{ mA}$, $f \leq 1 \text{ kHz}$		0.22	0.85	Ω
e_{n}	Wide band noise	$I_{\text{K}} = 10 \text{ mA}$; $10 \text{ Hz} < f < 100 \text{ kHz}$		30		mV _{RMS}
T_{ON}	Turn-on setting time	$V_{\text{KA}} = V_{\text{ref}}$, $\Delta I_{\text{K}} = 10 \text{ mA}$		40	70	μsec

1. The overtemperature tolerance values are calculated as: $\pm V_{\text{K}25\text{°C}} \times \{\text{tolerance}_{25\text{°C}} + [(\text{ppm}_{\text{max}}/\text{°C}) \times (\Delta T)]\}$.
Example: TLVH431A $\Delta V_{\text{K}} = \pm 1.24 \times (0.5\% + 100 \text{ ppm/°C} \times 165 \text{ °C}) = \pm 1.24 \times (0.5\% + 1.65\%) = \pm 1.24 \times 2.15\% = \pm 26.7 \text{ mV}$.

2. The dynamic impedance is defined as $|Z_{\text{KA}}| = \Delta V_{\text{KA}}/\Delta I_{\text{K}}$.

Note: Limits are 100% production tested at 25 °C. Limits over the temperature range are guaranteed through correlation and by design.

4 Typical performance characteristics

The following plots are referred to the typical application circuit and, unless otherwise noted, at $T_A = 25\text{ }^\circ\text{C}$.

Figure 2. Test circuit for $V_{KA} = V_{ref}$

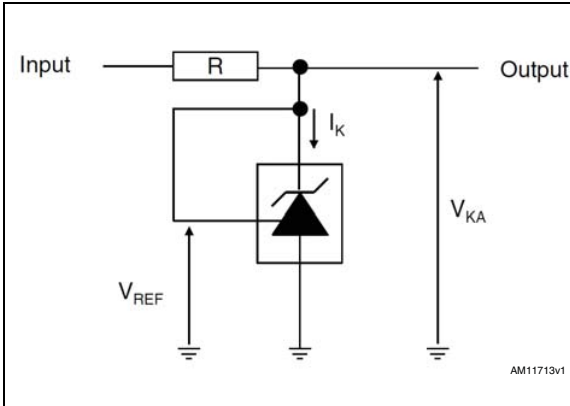


Figure 3. Test circuit for $V_{KA} > V_{ref}$

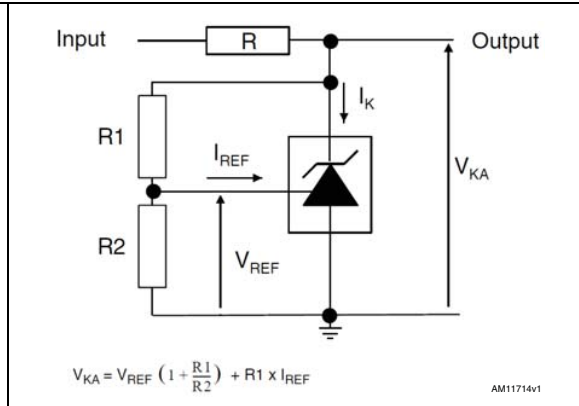


Figure 4. Reference voltage vs. temperature

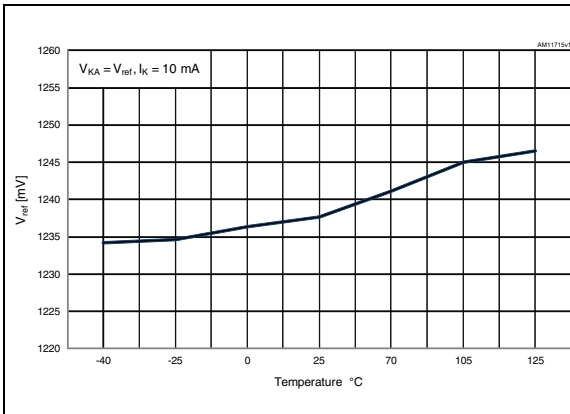


Figure 5. Minimum cathode current for regulation vs. temperature

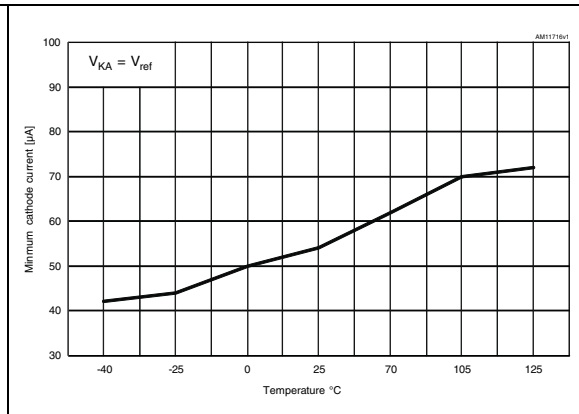


Figure 6. Off-state cathode current vs. temperature

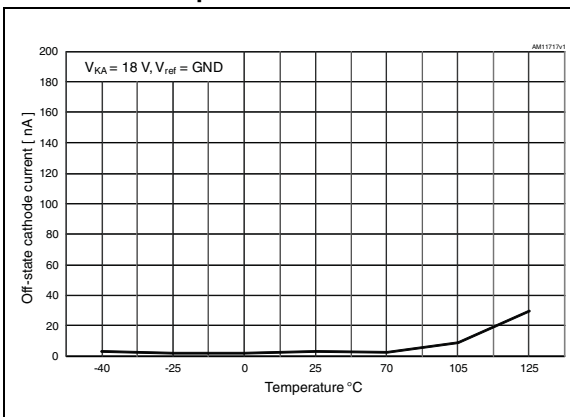


Figure 7. Reference input current vs. temperature

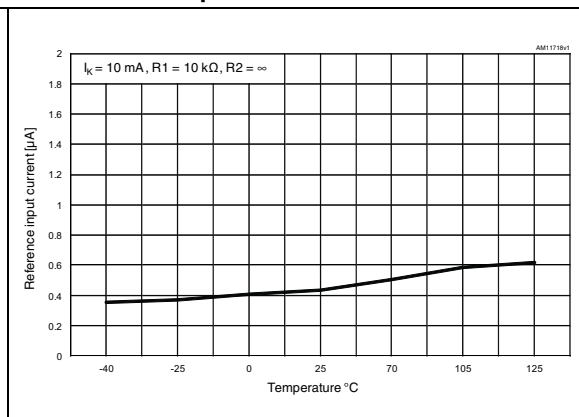


Figure 8. Cathode current vs. cathode voltage

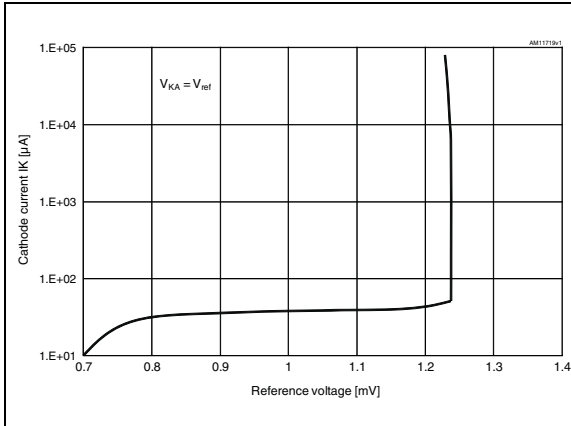


Figure 9. ΔV_{ref} vs. ΔV_{KA}

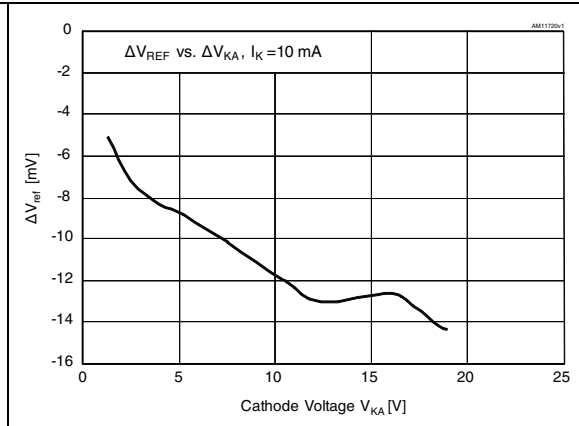


Figure 10. Wideband noise

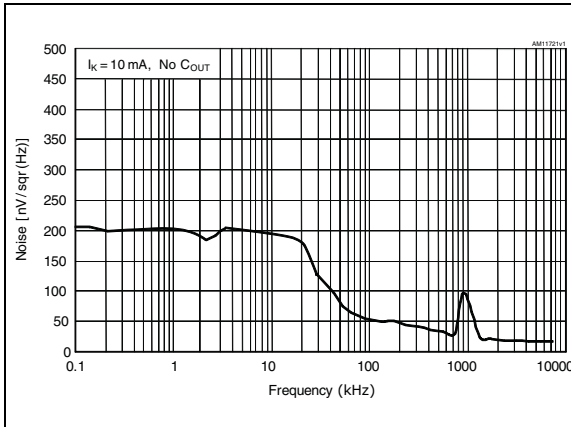


Figure 11. Gain and phase vs. frequency

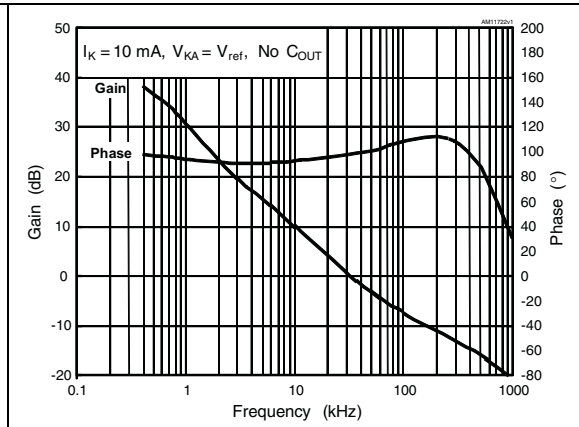


Figure 12. Turn-on (no C_{LOAD})

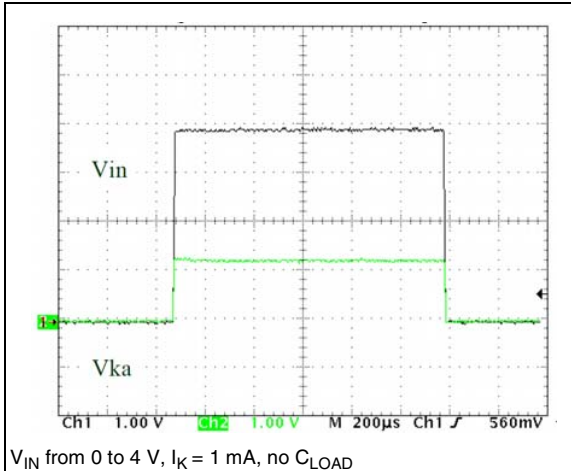
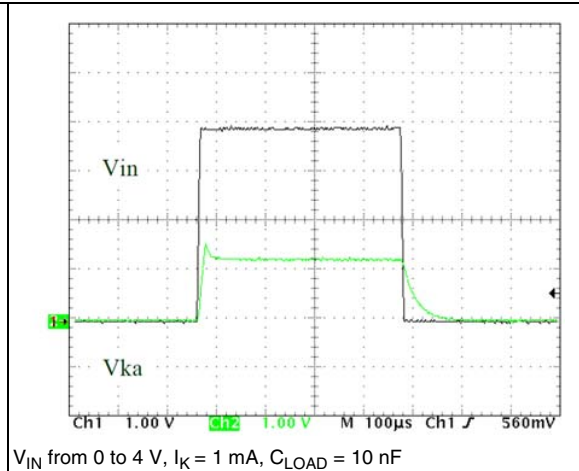


Figure 13. Turn-on ($C_{LOAD} = 10$ nF)



5 Package mechanical data

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.

Table 6. SOT23-3L mechanical data

Dim.	mm		
	Min.	Typ.	Max.
A	0.89		1.12
A1	0.01		0.10
A2	0.88	0.95	1.02
b	0.30		0.50
c	0.08		0.20
D	2.80	2.90	3.04
E	2.10		2.64
E1	1.20	1.30	1.40
e		0.95	
e1		1.90	
L	0.40	0.50	0.60
L1		0.54	
k	0°		8°

Figure 14. SOT23-3L drawing dimensions

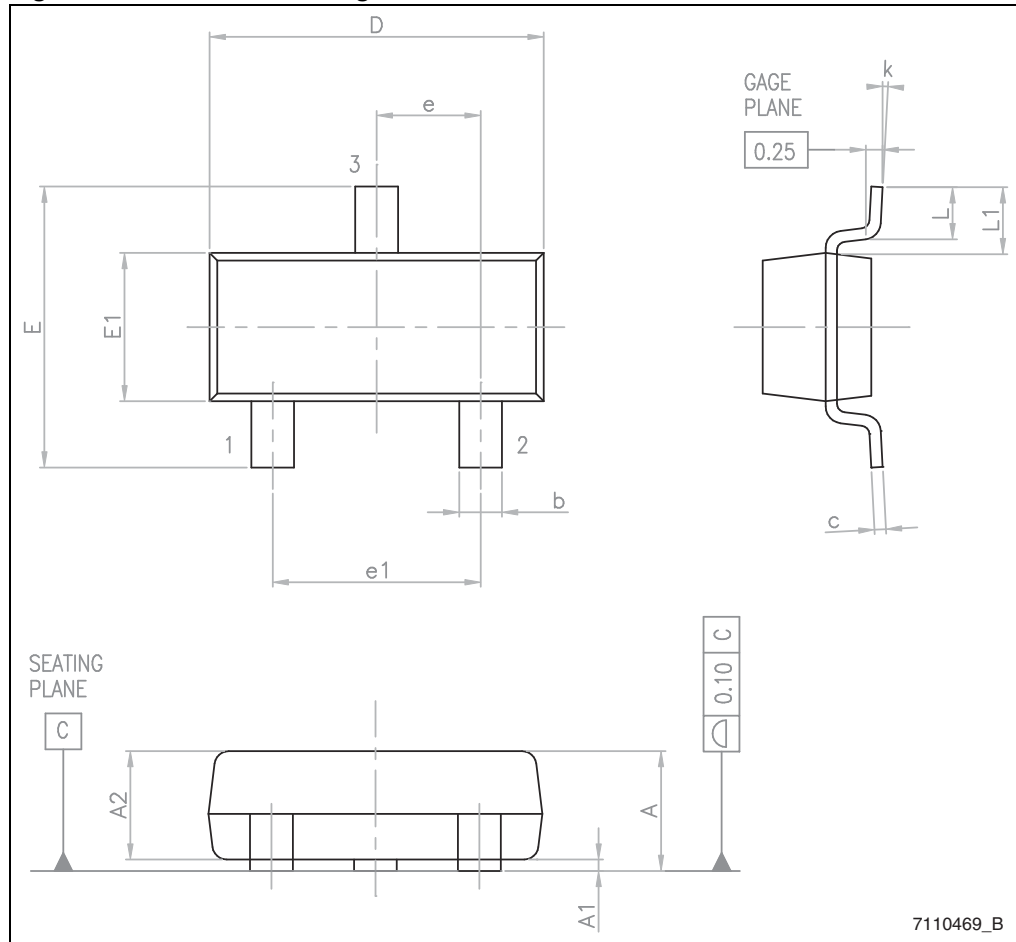


Table 7. SOT23-5L mechanical data

Dim.	mm		
	Min.	Typ.	Max.
A	0.90	1.20	1.45
A1			0.15
A2	0.90	1.05	1.30
B	0.35	0.40	0.50
C	0.09	0.15	0.20
D	2.80	2.90	3.00
D1		1.90	
e		0.95	
E	2.60	2.80	3.00
F	1.50	1.60	1.75
L	0.10	0.35	0.60
K	0°		10°

Figure 15. SOT23-5L drawing dimensions

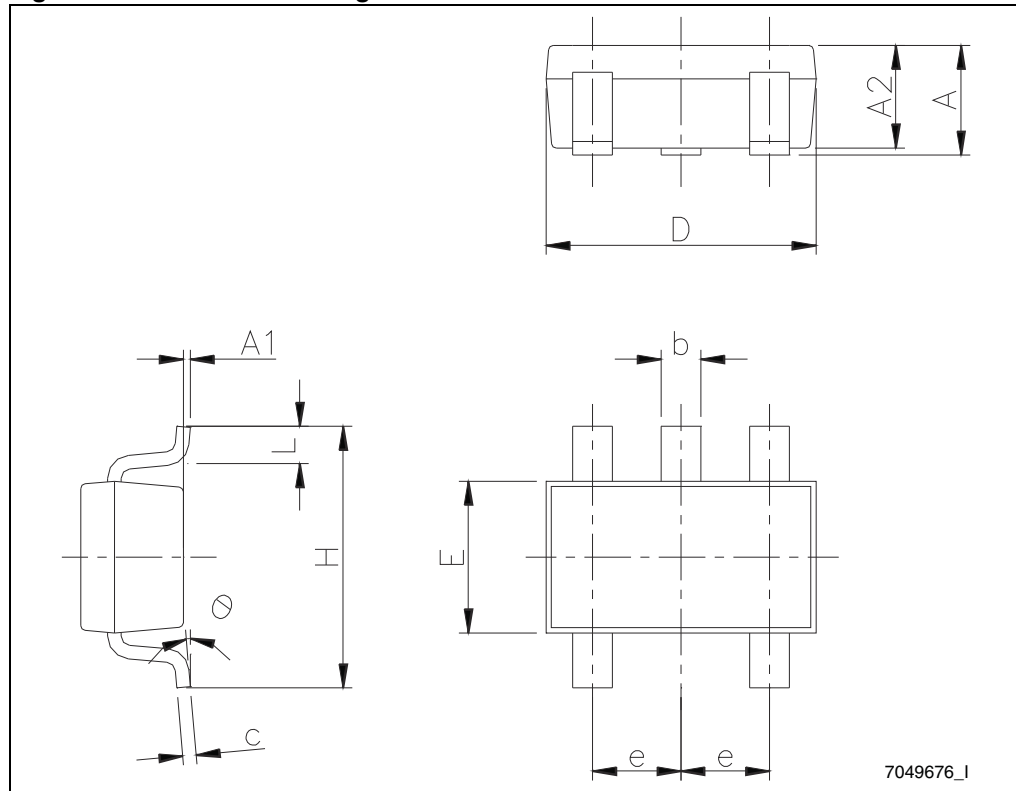


Table 8. SOT323-6L mechanical data

Dim.	mm		
	Min.	Typ.	Max.
A	0.80		1.10
A1	0		0.10
A2	0.80		1.00
b	0.15		0.30
c	0.10		0.18
D	1.80		2.20
E	1.15		1.35
e		0.65	
HE	1.80		2.40
L	0.10		0.40
Q1	0.10		0.40

Figure 16. SOT323-6L drawing dimensions

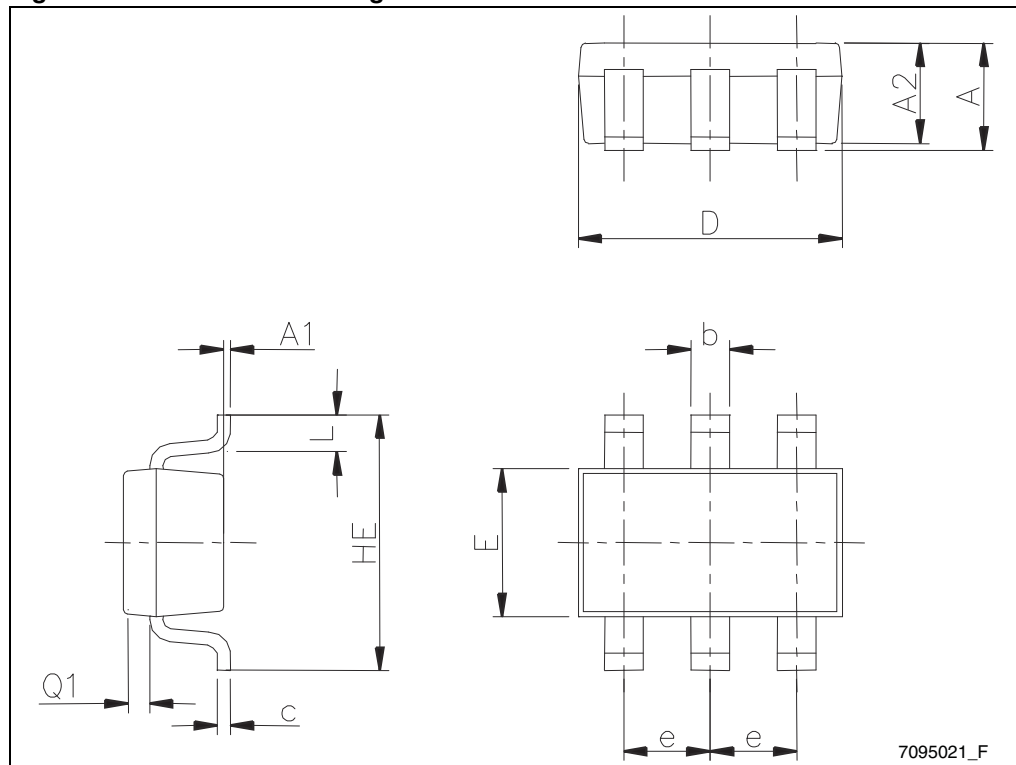


Figure 17. SOT23-5L footprint recommended data (dimensions are in mm)

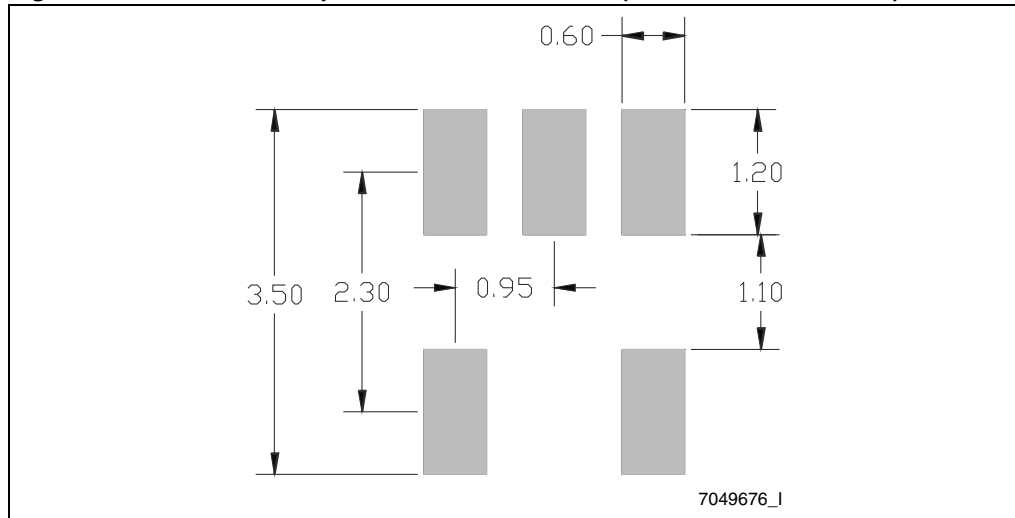
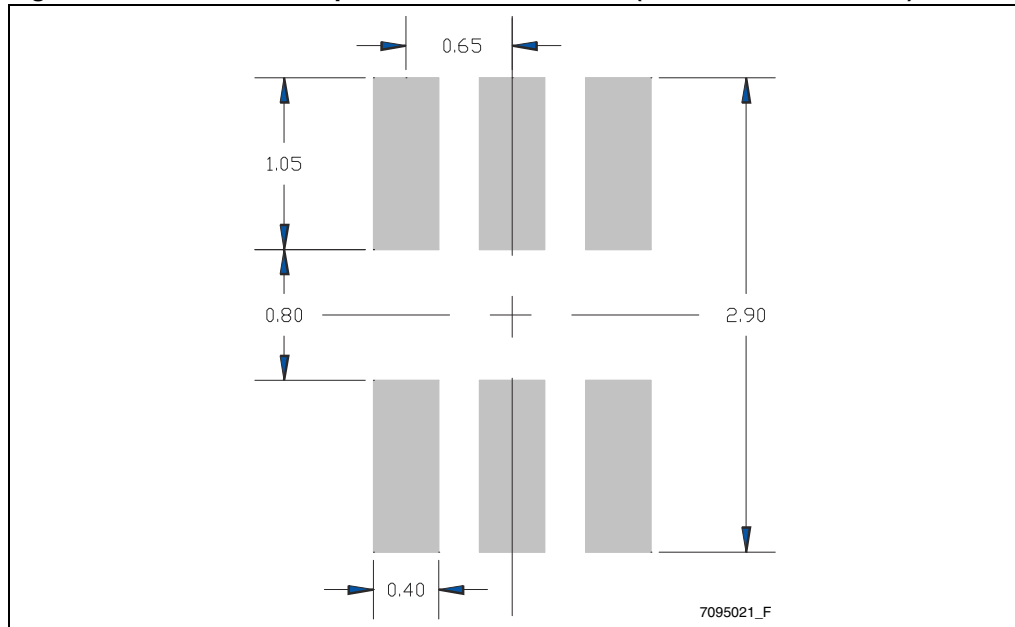


Figure 18. SOT323-6L footprint recommended data (dimensions are in mm)



6 Revision History

Table 9. Document revision history

Date	Revision	Changes
13-Jun-2012	1	Initial release.

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