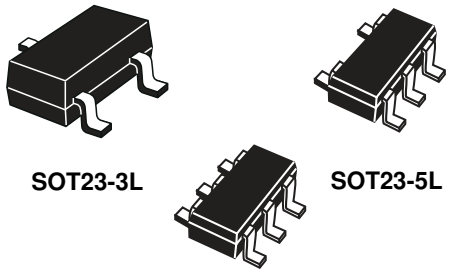
TLVH431

Adjustable shunt voltage reference

Datasheet - production data



Features

- Adjustable output voltage: 1.24 V to 18 V
- Low operating current: 100 µA at 25 °C
- 0.25%, 0.5%, 1% and 1.5% voltage precision
- Sink current capability up to 60 mA
- -40 to +125 °C temperature range
- 100 ppm/°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 adjustable 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 µA 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	Marking	Package	Temperature range
TLVH431AIL3T	0.5%	H43A	SOT23-3L	-40 to +125°C
TLVH431BIL3T	0.25%	H43B		
TLVH431MIL3T	1%	43L		
TLVH431LIL3T	1.5%	43L		
TLVH431AIL5T	0.5%	H43A	SOT23-5L	
TLVH431BIL5T	0.25%	H43B		
TLVH431LIL5T	1.5%	43L		
TLVH431AICT	0.5%	H43	SOT323-6L	
TLVH431BICT	0.25%	H43		
TLVH431LICT	1.5%	43L		

This is information on a product in full production. www.st.com

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3 Electrical characteristics 5

4 Typical performance characteristics 6

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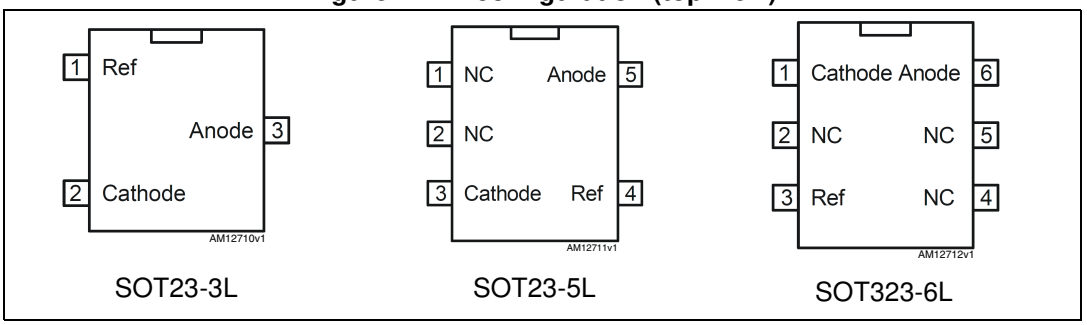
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1 Pin configuration

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 mA, T_{amb} = 25 °C (unless otherwise specified).

Table 5. Electrical characteristics for TLVH431

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
V_{ref}	Reference voltage	$V_{KA} = V_{ref}$ TLVH431A 0.5% TLVH431B 0.25% TLVH431M 1% TLVH431L 1.5%	 1.234 1.237 1.227 1.222	 1.24 	 1.246 1.243 1.253 1.258	V
ΔV_{ref}	Reference voltage variation over temperature range (1)	- 40 °C < T_{amb} < +125 °C TLVH431A 0.5% TLVH431B 0.25% TLVH431M 1% TLVH431L 1.5%	 -26.7 -23.5 -32.8 -39	 	 +26.7 +23.5 +32.8 +39	mV
$\Delta V_{KA}/\Delta T$	Average temperature coefficient	$V_{KA} = V_{ref}$, - 40 °C < T_{amb} < +125 °C		±30	±100	ppm/°C
I_{kmin}	Minimum cathode current for regulation	$V_{KA} = V_{ref}$		60	100	µA
		$V_{KA} = V_{KAmax}$		160	200	
ΔI_{kmin}	Minimum cathode current variation over temperature range	$V_{KA} = V_{ref}$, - 40 °C < T_{amb} < +125 °C		70	100	µA
		$V_{KA} = V_{KAmax}$, - 40 °C < T_{amb} < +125°C		100	200	
I_{ref}	Reference input current	R_1 = 10 kΩ, R_2 = ∞		1.5	2.5	µA
ΔI_{ref}	Reference current variation over temperature range	R_1 = 10 kΩ, R_2 = ∞ - 40 °C < T_{amb} < + 125 °C		2.5	3.5	µA
$\frac{\Delta Vref}{\Delta Vka}$	Ratio of change in reference input voltage to change in cathode to anode voltage	ΔV_{KA} = 18 V to V_{ref}			-2	mV/V
		ΔV_{KA} = 18 V to V_{ref}, - 40 °C < T_{amb} < +125 °C			-2.5	
I_{off}	Off-state cathode current	$V_{KA} = V_{KAmax}$, V_{ref} = GND		10	80	nA
ΔI_{off}	Off-state cathode current over temperature range	$V_{KA} = V_{KAmax}$, V_{ref} = GND - 40 °C < T_{amb} < +125 °C		1000	2000	nA
$\lvert R_{KA} \rvert$	Static impedance	$V_{KA} = V_{ref}$, ΔI_K = 100 µA to 60 mA		0.14	0.62	W
$\lvert Z_{KA} \rvert$	Dynamic impedance (2)	$V_{KA} = V_{ref}$, ΔI_K = 10 mA to 60 mA, f ≤ 1 kHz		0.22	0.85	W
e_n	Wide band noise	I_K = 10 mA; 10 Hz < f < 100 kHz		30		mV_{RMS}
T_{ON}	Turn-on setting time	$V_{KA} = V_{ref}$, ΔI_K = 10 mA		40	70	µsec

1. The tolerance values, across the temperature range, are calculated as: $\pm Vk_{25°C}$ x {$tolerance_{25°C}$+[(ppm_{max} /°C) x (ΔT)]}.
   Example: TLVH431A ΔV_k = ±1.24 x (0.5% + 100 ppm/°C x 165 °C) = ±1.24 x (0.5%+1.65%)= ±1.24 x 2.15% = ± 26.7 mV.
2. The dynamic impedance is defined as $\lvert Z_{KA} \rvert = \Delta V_{KA}/\Delta I_k$.

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 °C.

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

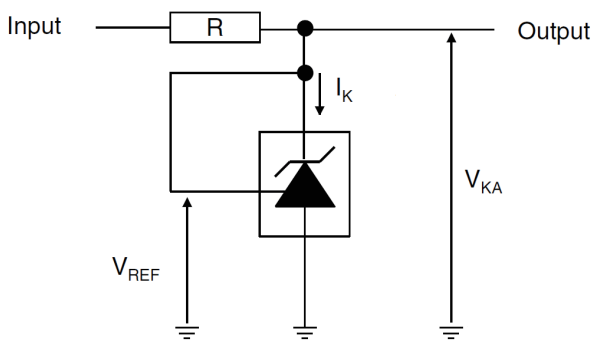


Figure 3. Test circuit for $V_{KA} > V_{ref}$

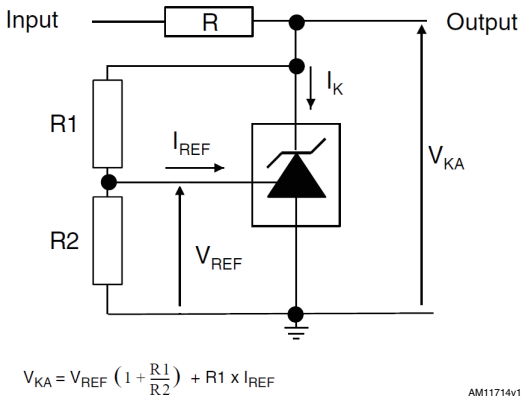


Figure 4. Reference voltage vs. temperature

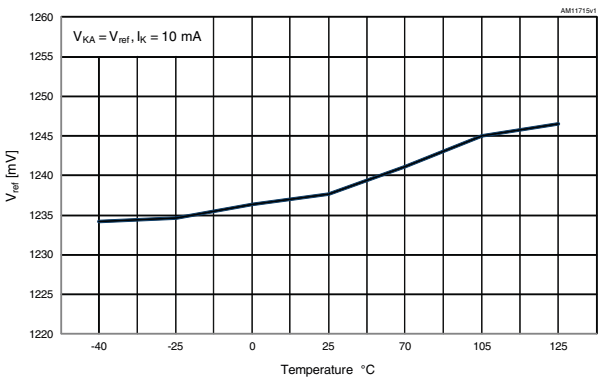


Figure 5. Minimum cathode current for regulation vs. temperature

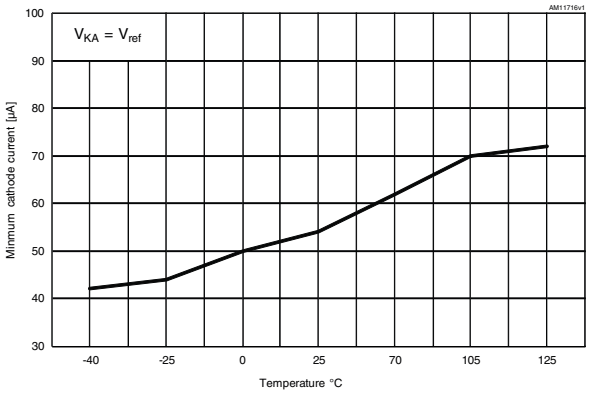


Figure 6. Off-state cathode current vs. temperature

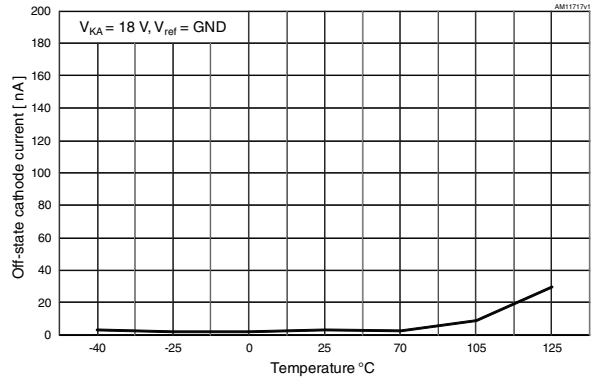


Figure 7. Reference input current vs. temperature

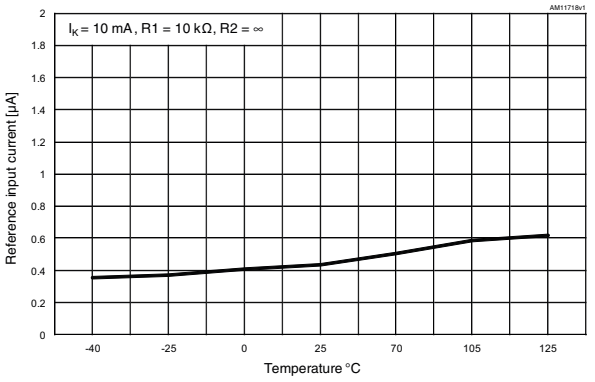


Figure 8. Cathode current vs. cathode voltage

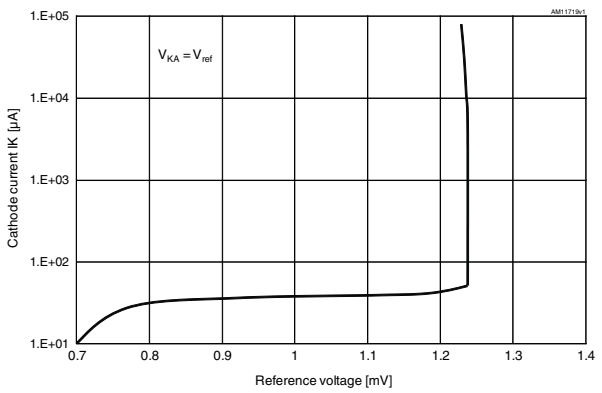


Figure 9. ΔV_{ref} vs. ΔV_{KA}

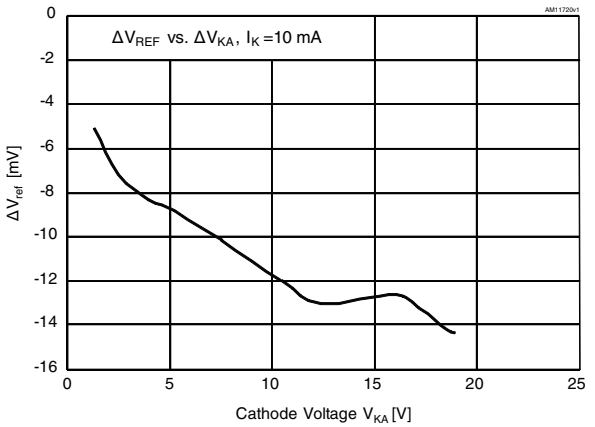


Figure 10. Wideband noise

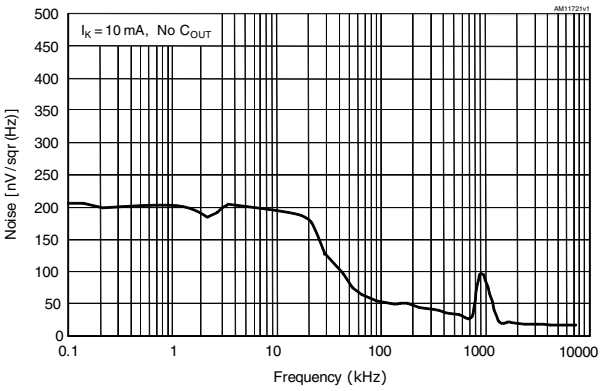


Figure 11. Gain and phase vs. frequency

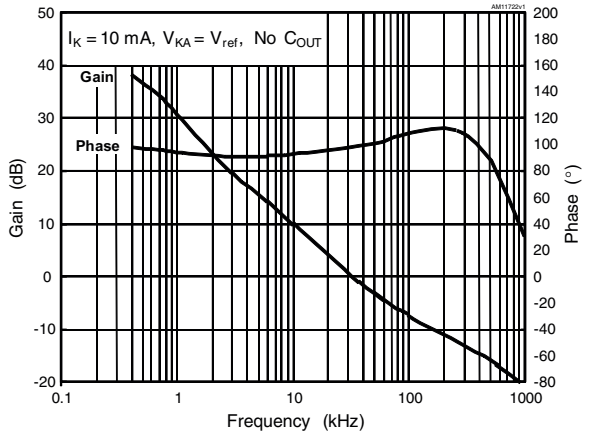
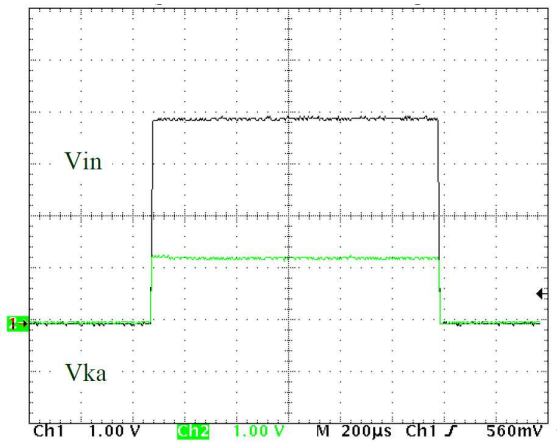
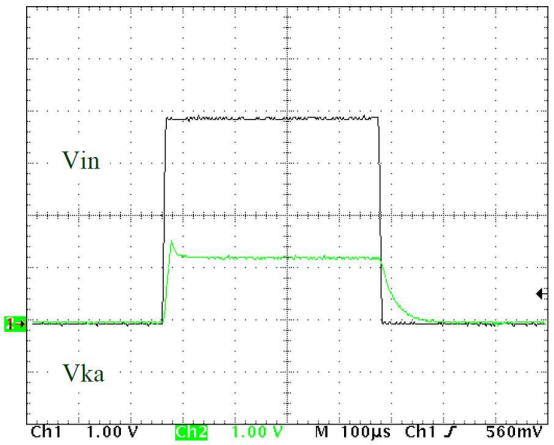


Figure 12. Turn-on (no C_{LOAD})



V_{IN} from 0 to 4 V, I_K = 1 mA, no C_{LOAD}

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



V_{IN} from 0 to 4 V, I_K = 1 mA, C_{LOAD} = 10 nF

5 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.

5.1 SOT23-3L package information

Figure 14. SOT23-3L package outline

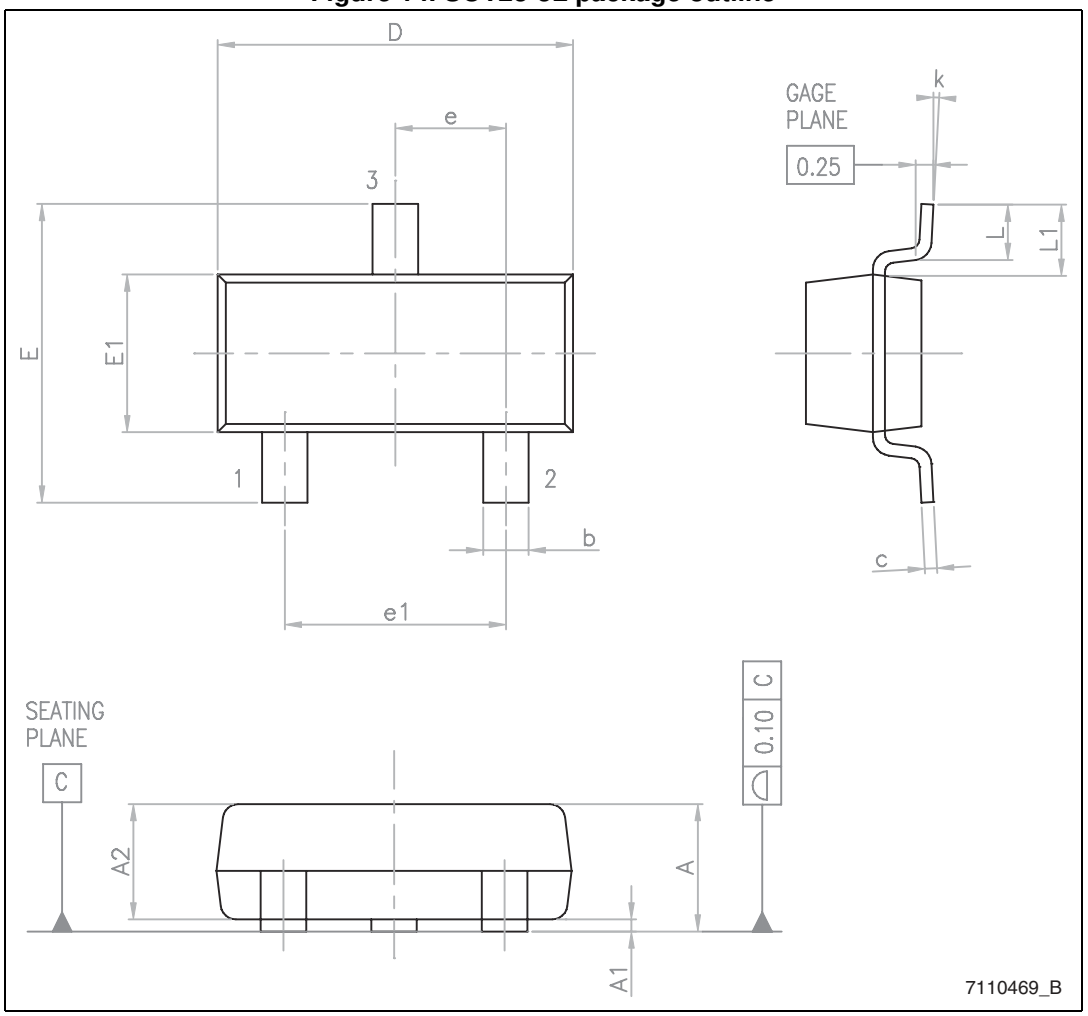


Table 6. SOT23-3L mechanical data

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°

5.2 SOT23-5L package information

Figure 15. SOT23-5L package outline

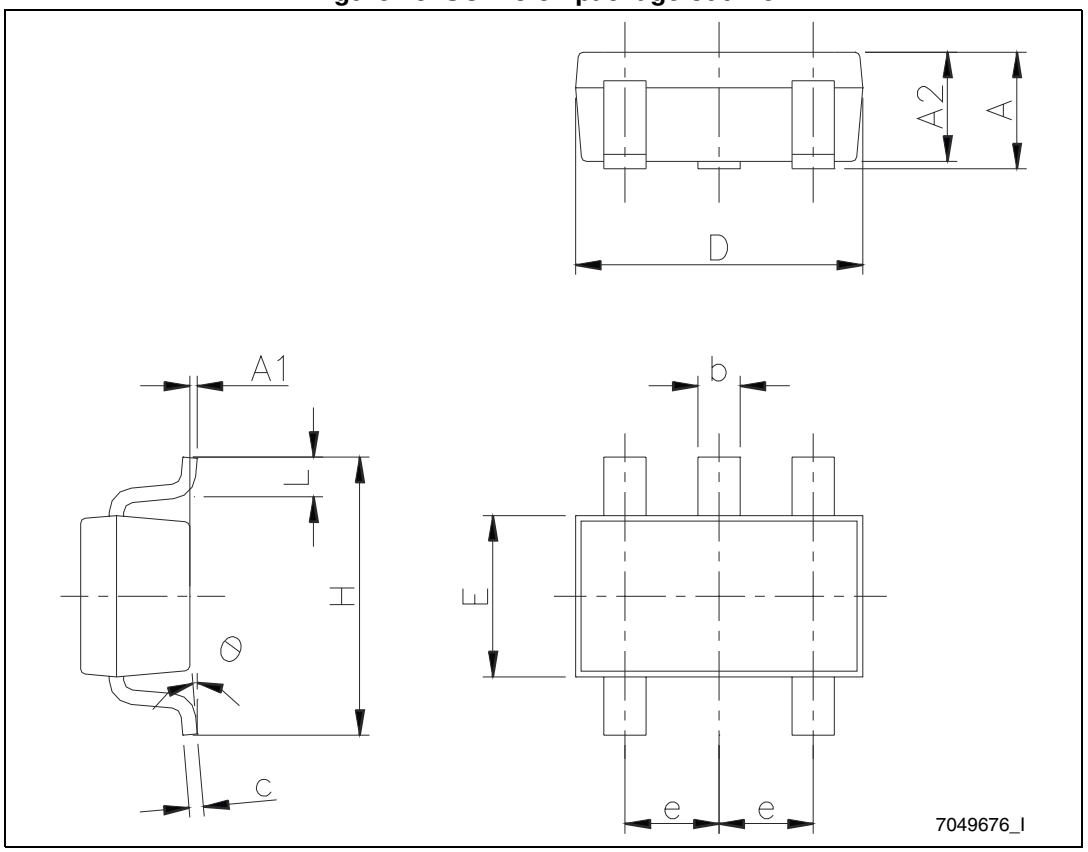
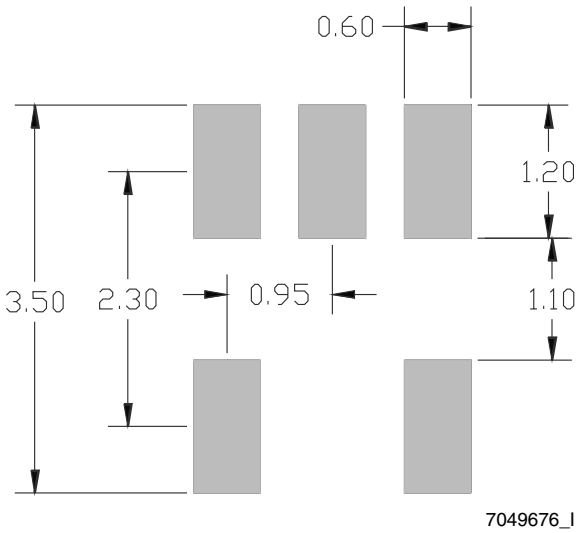


Table 7. SOT23-5L mechanical data

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
e		0.95	
E	1.50	1.60	1.75
H	2.60	2.80	3.00
L	0.10	0.35	0.60
θ	0°		10°

Figure 16. SOT23-5L recommended footprint (dimensions are in mm)



5.3 SOT323-6L package information

Figure 17. SOT323-6L package outline

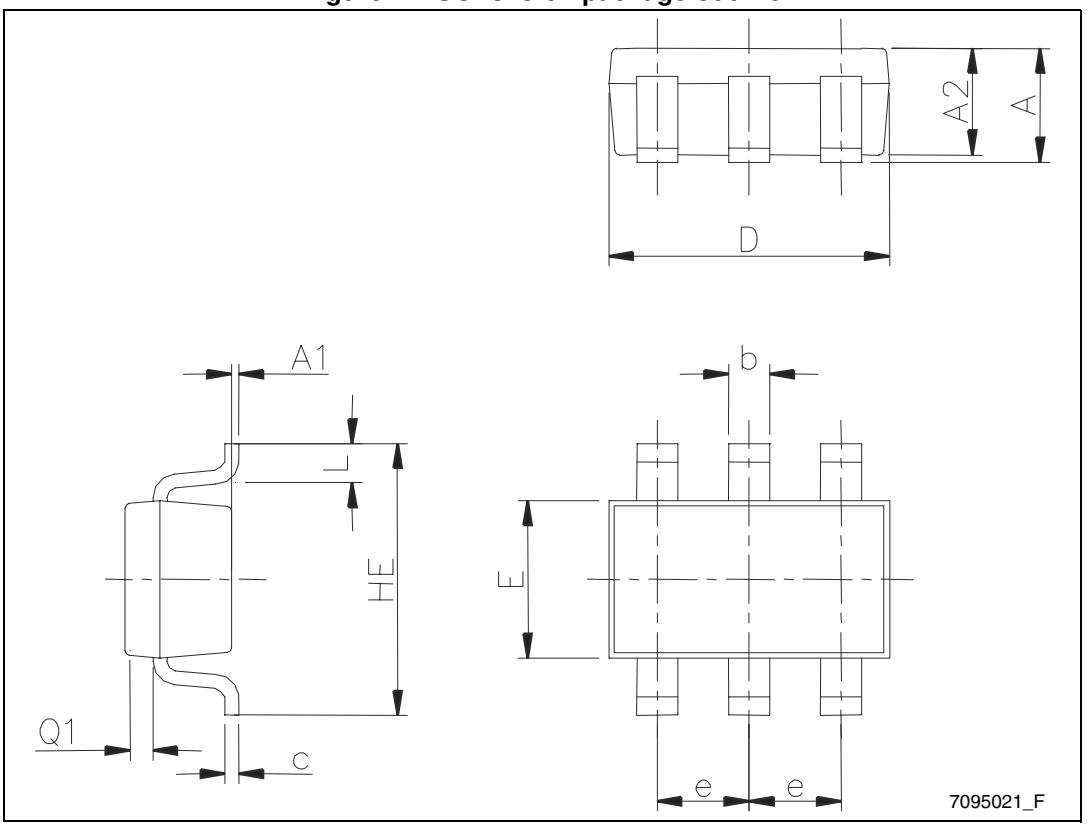
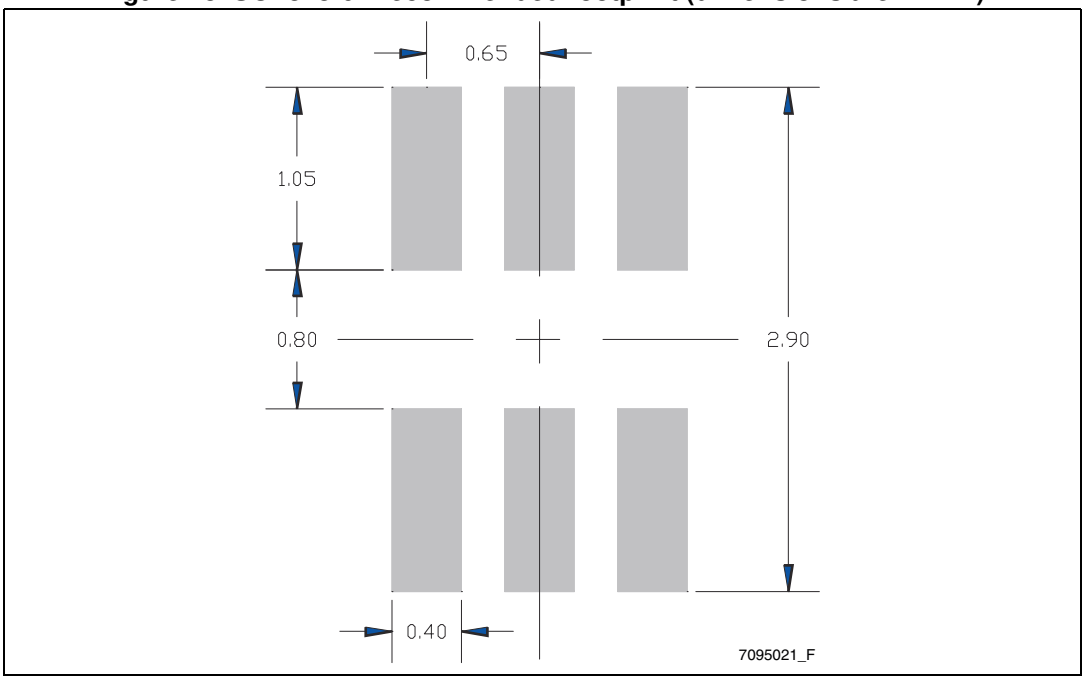


Table 8. SOT323-6L mechanical data

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



6 Revision History

Table 9. Document revision history

Date	Revision	Changes
13-Jun-2012	1	Initial release.
23-Jan-2014	2	Updated the Features in cover page, Table 1: Device summary and Table 5: Electrical characteristics for TLVH431. Minor text changes.
28-Jan-2014	3	Updated the min. value of Vref in Table 5: Electrical characteristics for TLVH431.
24-Mar-2015	4	Updated Table 7: SOT23-5L mechanical data. Minor text changes.
23-Nov-2015	5	Updated features in cover page, Table 1: Device summary and Table 5: Electrical characteristics for TLVH431. Minor text changes.
05-Dec-2017	6	Updated title on the cover page.
07-Jul-2020	7	Updated footnote in *Table 5*.
18-Sep-2020	8	Added Marking in *Table 1: Device summary* on the cover page.

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