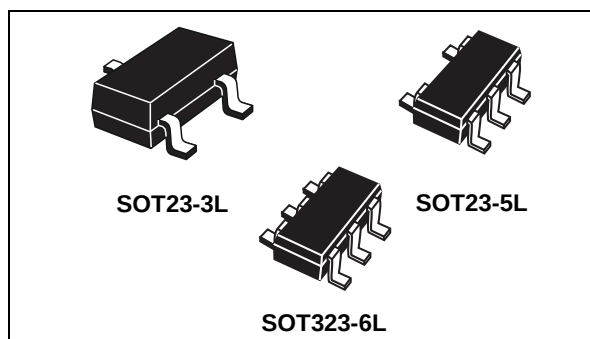


Programmable shunt voltage reference

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%, 0.5%, 1% and 1.5% 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°C
TLVH431BIL3T	0.25%		
TLVH431MIL3T	1%		
TLVH431LIL3T	1.5%		
TLVH431AIL5T	0.5%	SOT23-5L	
TLVH431BIL5T	0.25%		
TLVH431LIL5T	1.5%		
TLVH431AICT	0.5%	SOT323-6L	
TLVH431BICT	0.25%		
TLVH431LICT	1.5%		

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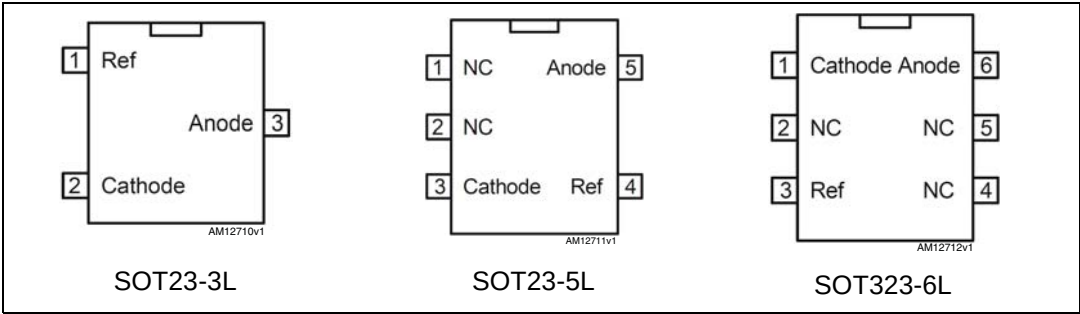
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1 Pin configuration

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

$I_K = 10 \text{ mA}$, $T_{\text{amb}} = 25 \text{ }^{\circ}\text{C}$ (unless otherwise specified).

Table 5. Electrical characteristics for TLVH431

Symbol	Parameter	Test conditions	Min.	Typ.	Max.	Unit
V_{ref}	Reference voltage	$V_{KA} = V_{\text{ref}}$ 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 $^{\circ}\text{C} < T_{\text{amb}} < +125 \text{ }^{\circ}\text{C}$ 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	$V_{KA} = V_{\text{ref}}$, - 40 $^{\circ}\text{C} < T_{\text{amb}} < +125 \text{ }^{\circ}\text{C}$		± 30	± 100	ppm/ $^{\circ}\text{C}$
$I_{K\text{min}}$	Minimum cathode current for regulation	$V_{KA} = V_{\text{ref}}$		60	100	μA
		$V_{KA} = V_{KA\text{max}}$		160	200	
$\Delta I_{K\text{min}}$	Minimum cathode current variation over temperature range	$V_{KA} = V_{\text{ref}}$, - 40 $^{\circ}\text{C} < T_{\text{amb}} < +125 \text{ }^{\circ}\text{C}$		70	100	μA
		$V_{KA} = V_{KA\text{max}}$, - 40 $^{\circ}\text{C} < T_{\text{amb}} < +125 \text{ }^{\circ}\text{C}$		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 over temperature range	$R_1 = 10 \text{ k}\Omega$, $R_2 = \infty$ - 40 $^{\circ}\text{C} < T_{\text{amb}} < +125 \text{ }^{\circ}\text{C}$		2.5	3.5	μA
$\frac{\Delta V_{\text{ref}}}{\Delta V_{KA}}$	Ratio of change in reference input voltage to change in cathode to anode voltage	$\Delta V_{KA} = 18 \text{ V to } V_{\text{ref}}$			-2	mV/V
		$\Delta V_{KA} = 18 \text{ V to } V_{\text{ref}}$, - 40 $^{\circ}\text{C} < T_{\text{amb}} < +125 \text{ }^{\circ}\text{C}$			-2.5	
I_{off}	Off-state cathode current	$V_{KA} = V_{KA\text{max}}$, $V_{\text{ref}} = \text{GND}$		10	80	nA
ΔI_{off}	Off-state cathode current over temperature range	$V_{KA} = V_{KA\text{max}}$, $V_{\text{ref}} = \text{GND}$ - 40 $^{\circ}\text{C} < T_{\text{amb}} < +125 \text{ }^{\circ}\text{C}$		1000	2000	nA
$ R_{KA} $	Static impedance	$V_{KA} = V_{\text{ref}}$, $\Delta I_K = 100 \text{ } \mu\text{A to } 60 \text{ mA}$		0.14	0.62	W
$ Z_{KA} $	Dynamic impedance ⁽²⁾	$V_{KA} = V_{\text{ref}}$, $\Delta I_K = 10 \text{ mA to } 60 \text{ mA}$, $f \leq 1 \text{ kHz}$		0.22	0.85	W
e_n	Wide band noise	$I_K = 10 \text{ mA}$; $10 \text{ Hz} < f < 100 \text{ kHz}$		30		mV _{RMS}
T_{ON}	Turn-on setting time	$V_{KA} = V_{\text{ref}}$, $\Delta I_K = 10 \text{ mA}$		40	70	μsec

1. The tolerance values, across the temperature range, are calculated as: $\pm V_{K25^{\circ}\text{C}} \times \{\text{tolerance}_{25^{\circ}\text{C}} + [(\text{ppm}_{\text{max}}/^{\circ}\text{C}) \times (\Delta T)]\}$.
Example: TLVH431A $\Delta V_K = \pm 1.24 \times (0.5\% + 100 \text{ ppm}/^{\circ}\text{C} \times 165^{\circ}\text{C}) = \pm 1.24 \times (0.5\% + 1.65\%) = \pm 1.24 \times 2.15\% = \pm 26.7 \text{ mV}$.

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

Note: Limits are 100% production tested at 25 $^{\circ}\text{C}$. 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 $T_A = 25\text{ }^{\circ}\text{C}$.

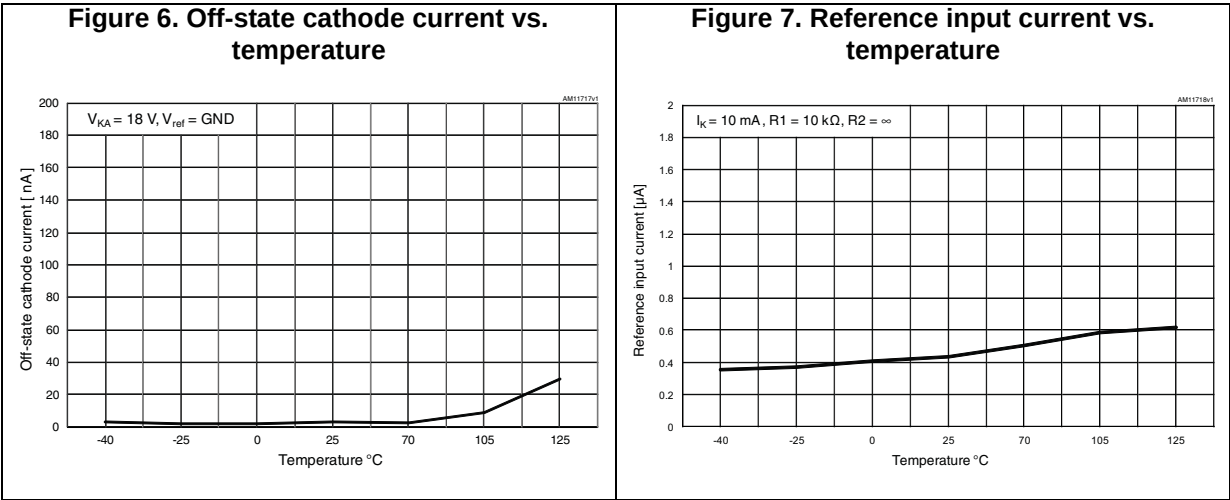
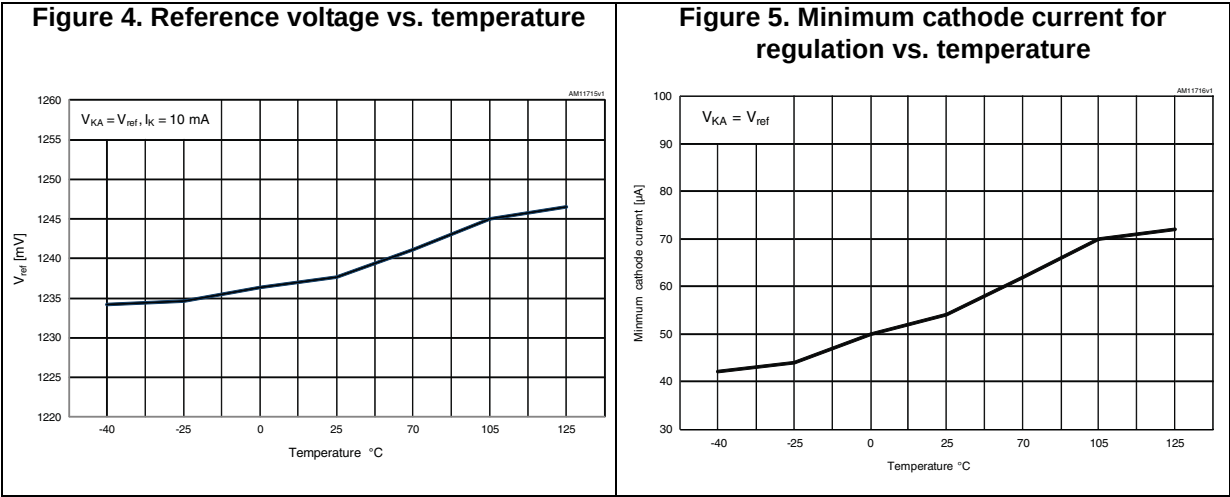
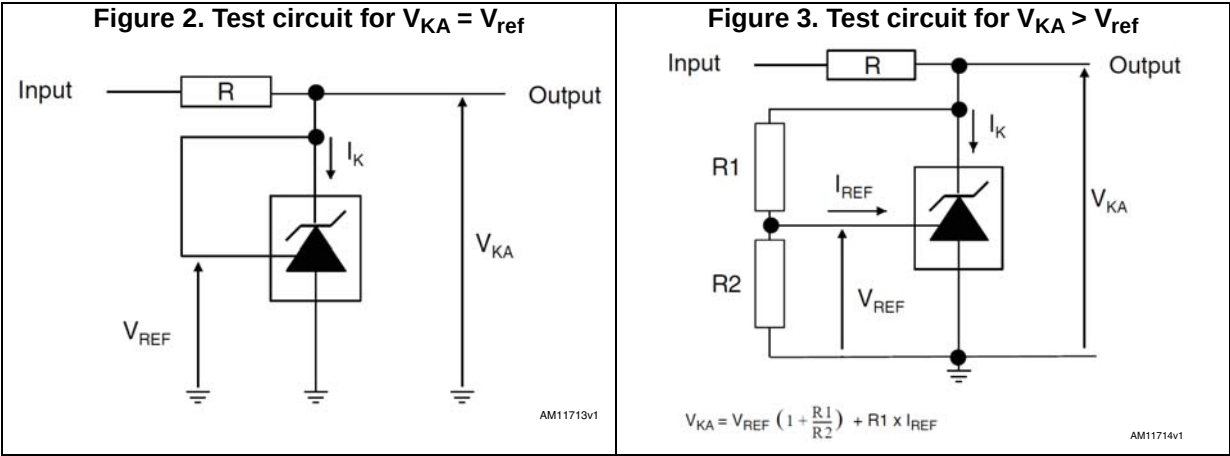


Figure 8. Cathode current vs. cathode voltage

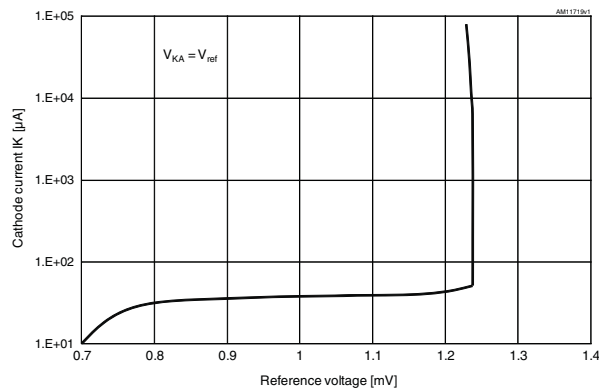
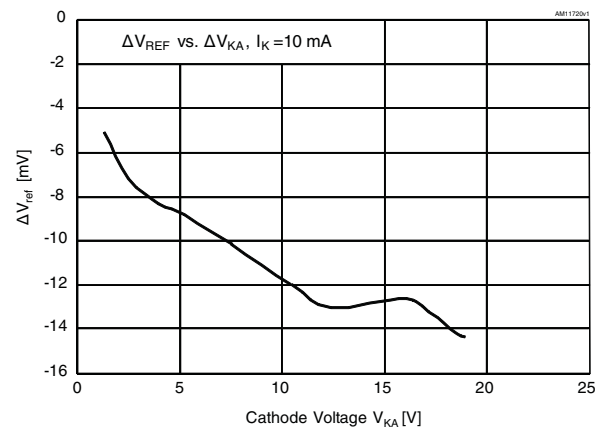
Figure 9. ΔV_{ref} vs. ΔV_{KA} 

Figure 10. Wideband noise

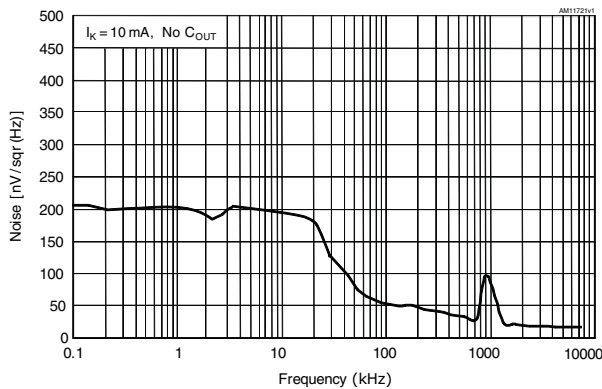
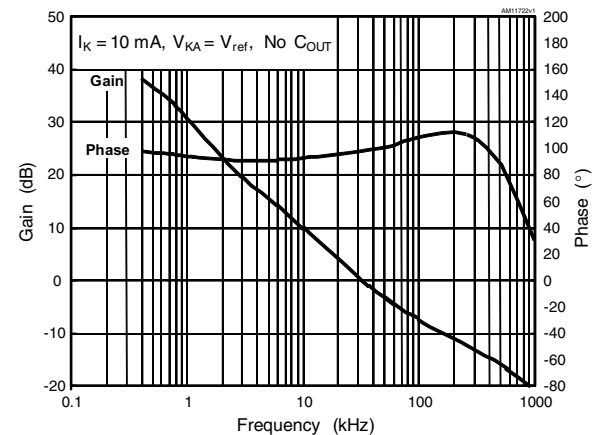
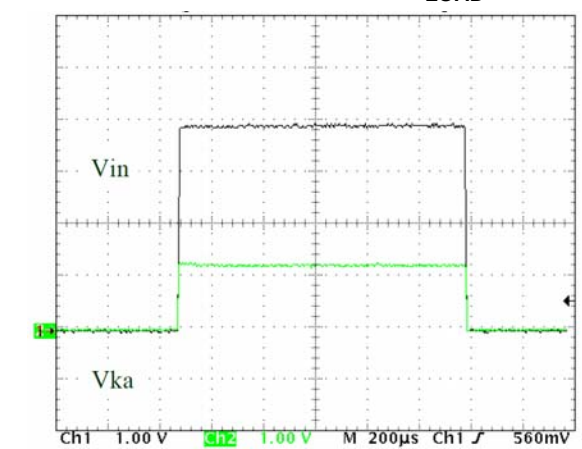
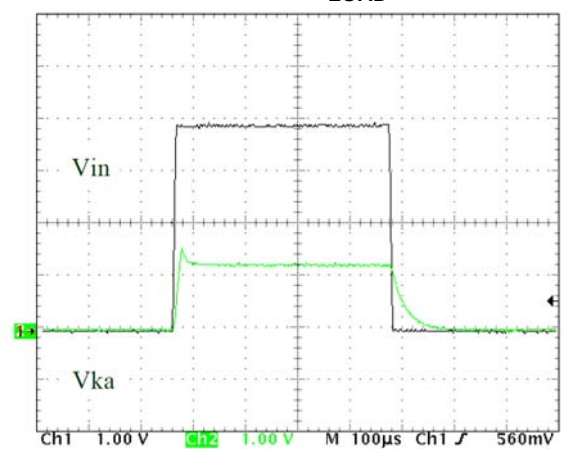


Figure 11. Gain and phase vs. frequency

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

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

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

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

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

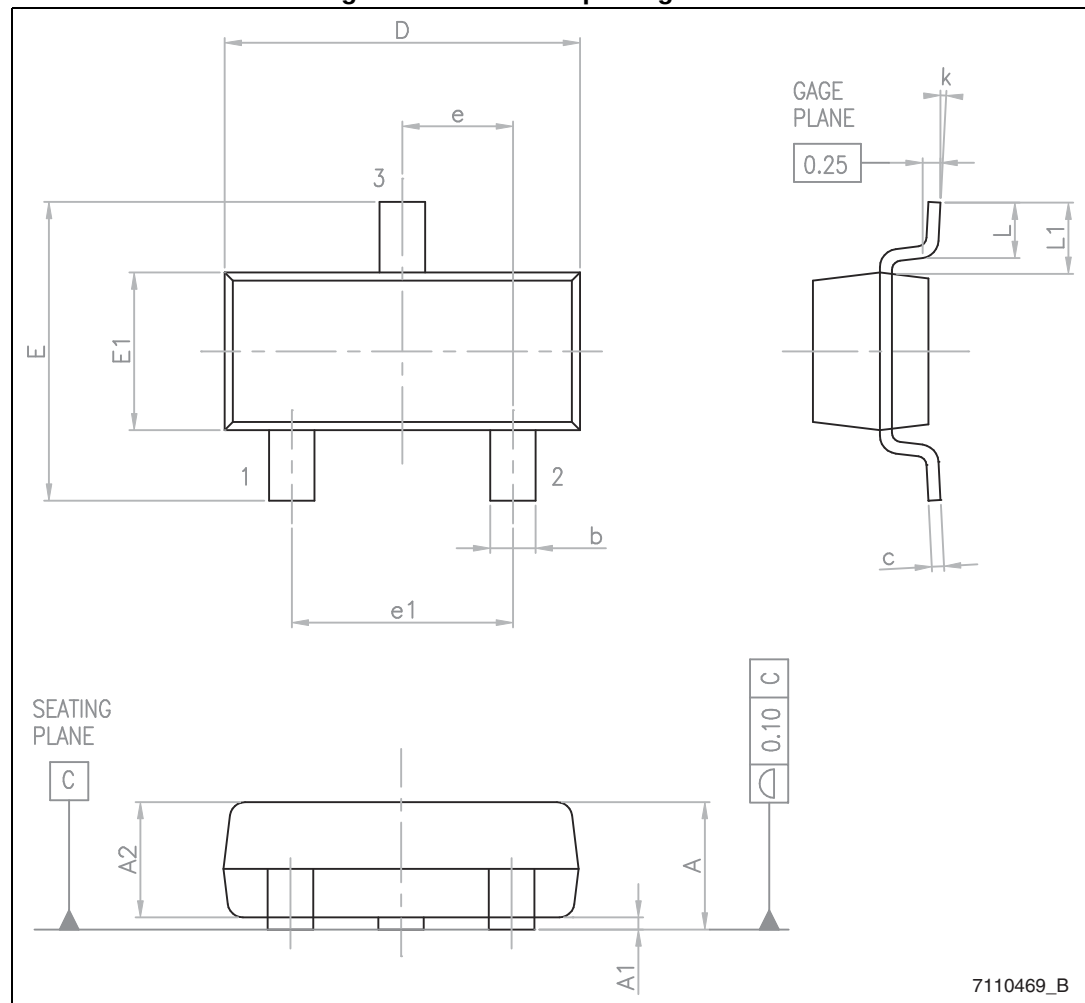


Table 6. SOT23-3L mechanical data

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

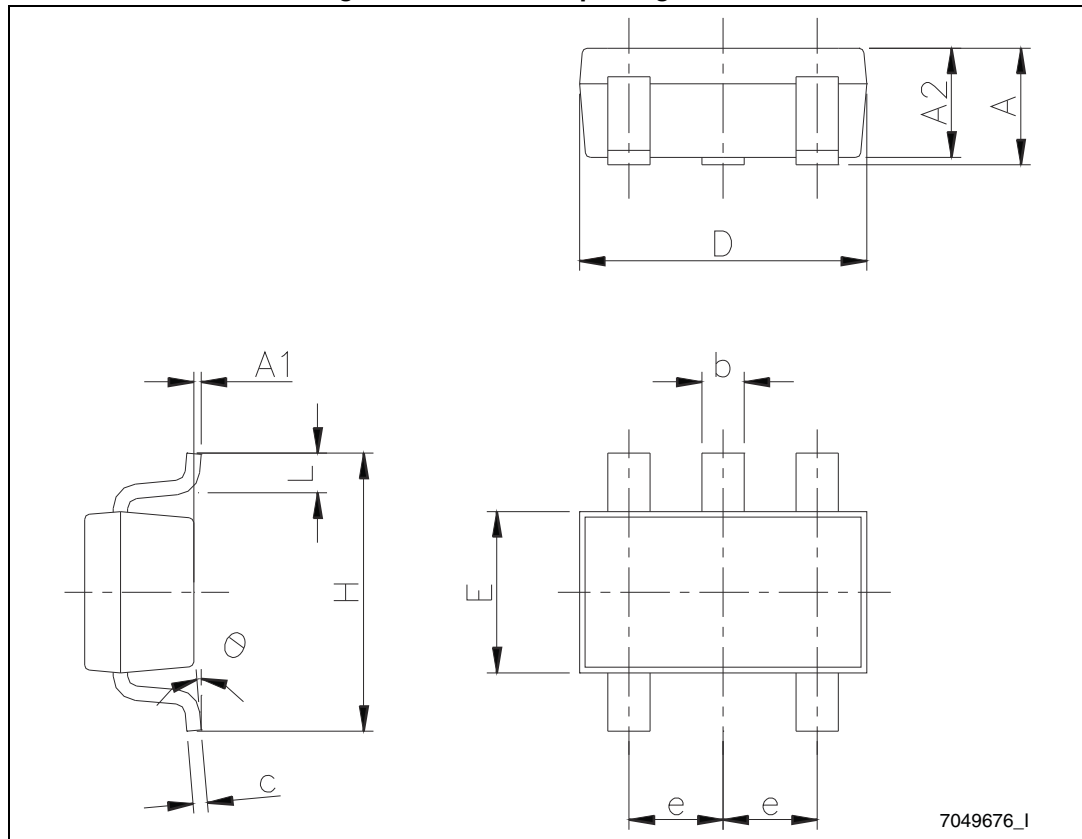
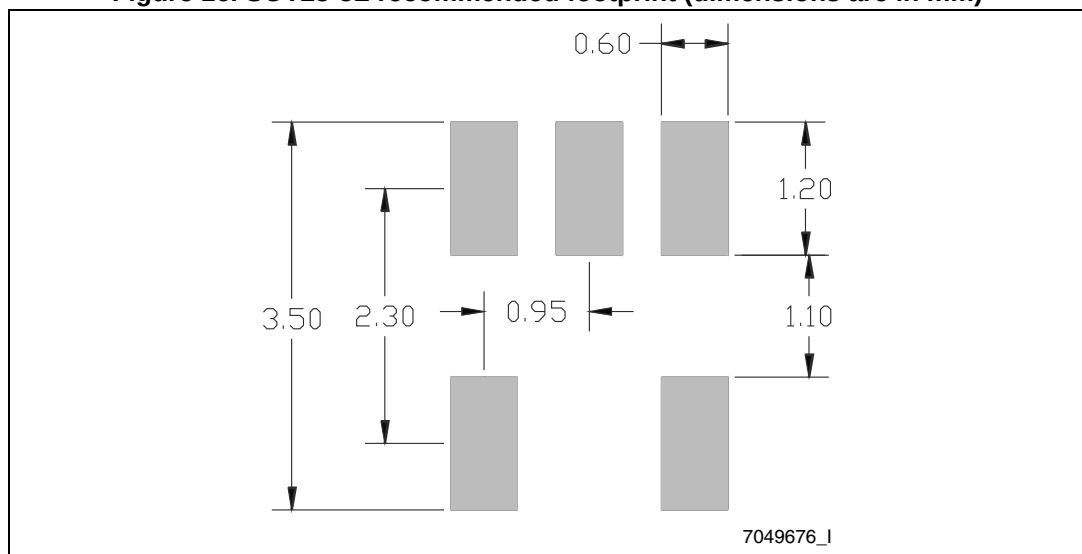


Table 7. SOT23-5L mechanical data

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

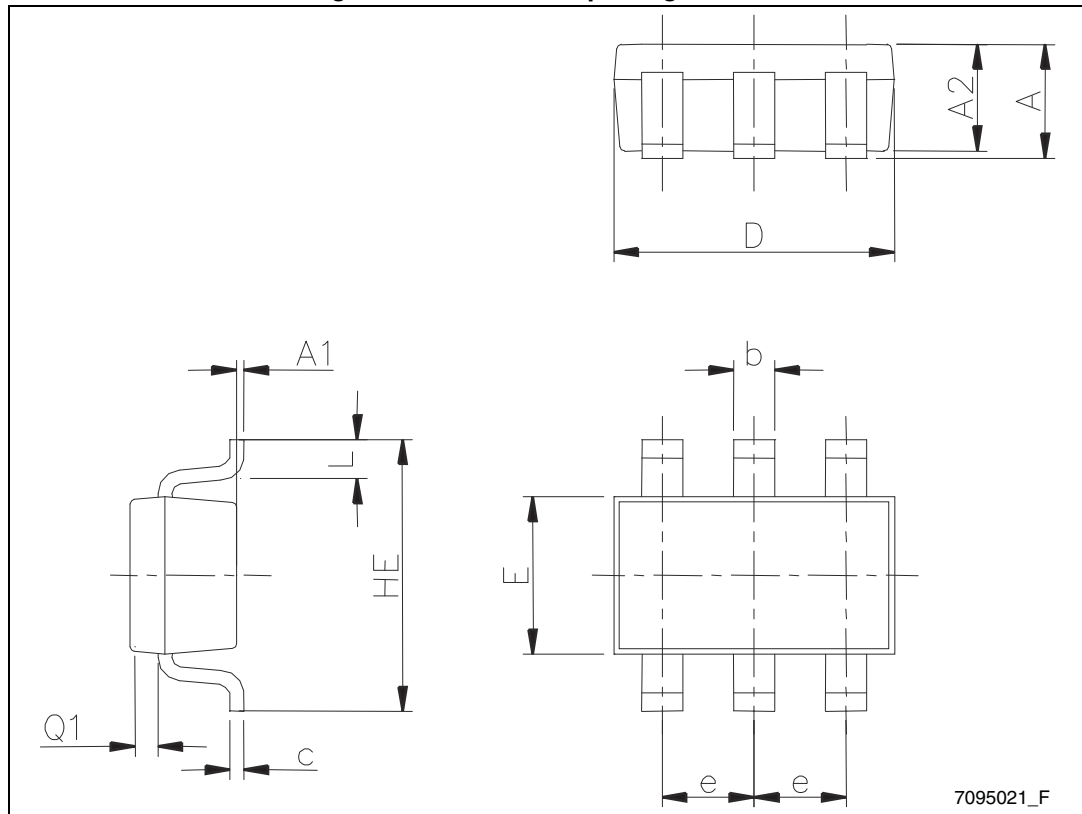
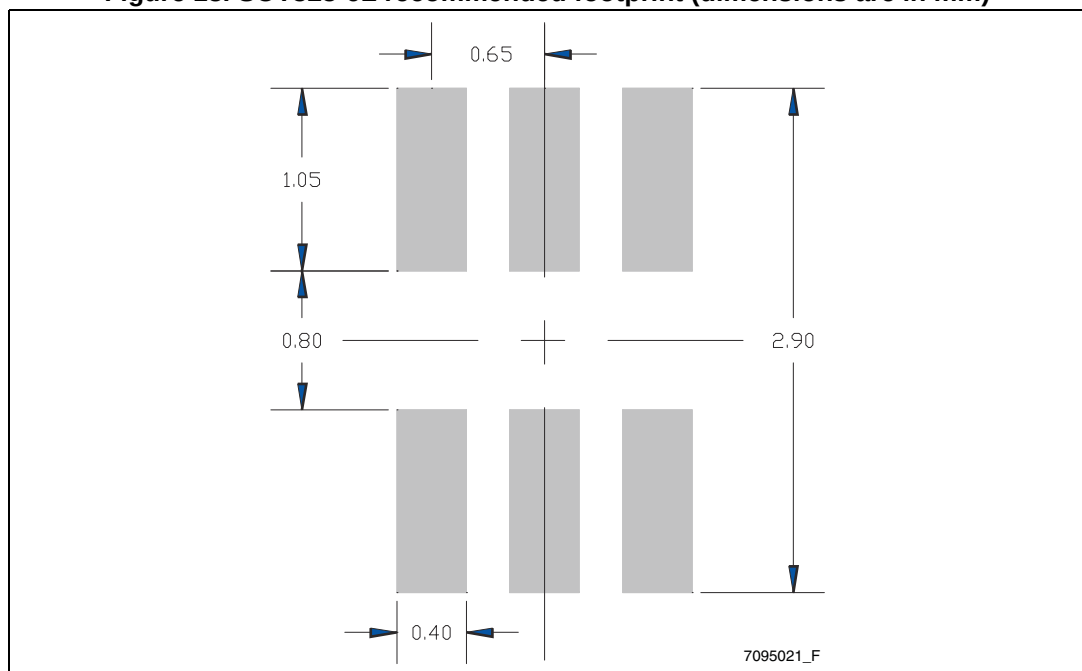


Table 8. SOT323-6L mechanical data

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.

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