

# TLVH431 family

## Low voltage adjustable precision shunt regulators

Rev. 1 — 27 April 2012

Product data sheet

### 1. General description

Low voltage three-terminal shunt regulator family with an output voltage range between  $V_{ref}$  (1.24 V) and 18 V, to be set by two external resistors.

Table 1. Product overview

| Reference voltage tolerance ( $V_{ref}$ ) | Package | Temperature range ( $T_{amb}$ ) |                 |                  | Pinning configuration (see <a href="#">Table 5</a> ) |
|-------------------------------------------|---------|---------------------------------|-----------------|------------------|------------------------------------------------------|
|                                           |         | 0 °C to 70 °C                   | –40 °C to 85 °C | –40 °C to 125 °C |                                                      |
| 1.5 %                                     | SOT23   | TLVH431CDBZR                    | TLVH431IDBZR    | TLVH431QDBZR     | normal pinning                                       |
|                                           |         | -                               | -               | TLVH431MQDBZR    | mirrored pinning                                     |
|                                           | SOT753  | -                               | -               | TLVH431QDBVR     | -                                                    |
| 1 %                                       | SOT23   | TLVH431ACDBZR                   | TLVH431AIDBZR   | TLVH431AQDBZR    | normal pinning                                       |
|                                           |         | -                               | -               | TLVH431AMQDBZR   | mirrored pinning                                     |
|                                           | SOT753  | -                               | -               | TLVH431AQDBVR    | -                                                    |
| 0.75 %                                    | SOT23   | -                               | -               | TLVH431DQDBZR    | normal pinning                                       |
|                                           |         | -                               | -               | TLVH431DMQDBZR   | mirrored pinning                                     |
|                                           | SOT753  | -                               | -               | TLVH431DQDBVR    | -                                                    |

### 2. Features and benefits

- Programmable output voltage up to 18 V
- Three different reference voltage tolerances:
  - ◆ Standard grade: 1.5 %
  - ◆ A-Grade: 1 %
  - ◆ D-Grade: 0.75 %
- Typical temperature drift: 4 mV (in a range of –40 °C up to 125 °C)
- Low output noise
- Typical output impedance: 0.1  $\Omega$
- Sink current capability: 0.08 mA to 70 mA
- AEC-Q100 qualified (grade 1)

### 3. Applications

- Shunt regulator
- Precision current limiter
- Precision constant current sink
- Isolated feedback loop for Switch Mode Power Supply (SMPS)



## 4. Quick reference data

Table 2. Quick reference data

| Symbol    | Parameter              | Conditions                                                              | Min       | Typ  | Max  | Unit |
|-----------|------------------------|-------------------------------------------------------------------------|-----------|------|------|------|
| $V_{KA}$  | cathode-anode voltage  |                                                                         | $V_{ref}$ | -    | 18   | V    |
| $I_K$     | cathode current        |                                                                         | 0.08      | -    | 70   | mA   |
| $V_{ref}$ | reference voltage      | $V_{KA} = V_{ref}$ ; $I_K = 10\text{ mA}$ ;<br>$T_{amb} = 25\text{ °C}$ |           |      |      |      |
|           | Standard-Grade (1.5 %) |                                                                         | 1222      | 1240 | 1258 | mV   |
|           | A-Grade (1 %)          |                                                                         | 1228      | 1240 | 1252 | mV   |
|           | D-Grade (0.75 %)       |                                                                         | 1231      | 1240 | 1249 | mV   |

## 5. Ordering information

Table 3. Ordering information

| Type number    | Package  |                                          |         |
|----------------|----------|------------------------------------------|---------|
|                | Name     | Description                              | Version |
| TLVH431CDBZR   | TO-236AB | plastic surface-mounted package; 3 leads | SOT23   |
| TLVH431IDBZR   |          |                                          |         |
| TLVH431QDBZR   |          |                                          |         |
| TLVH431MQDBZR  |          |                                          |         |
| TLVH431ACDBZR  |          |                                          |         |
| TLVH431AIDBZR  |          |                                          |         |
| TLVH431AQDBZR  |          |                                          |         |
| TLVH431AMQDBZR |          |                                          |         |
| TLVH431DQDBZR  |          |                                          |         |
| TLVH431DMQDBZR |          |                                          |         |
| TLVH431QDBVR   | SC-74A   | plastic surface-mounted package; 5 leads | SOT753  |
| TLVH431AQDBVR  |          |                                          |         |
| TLVH431DQDBVR  |          |                                          |         |

## 6. Marking

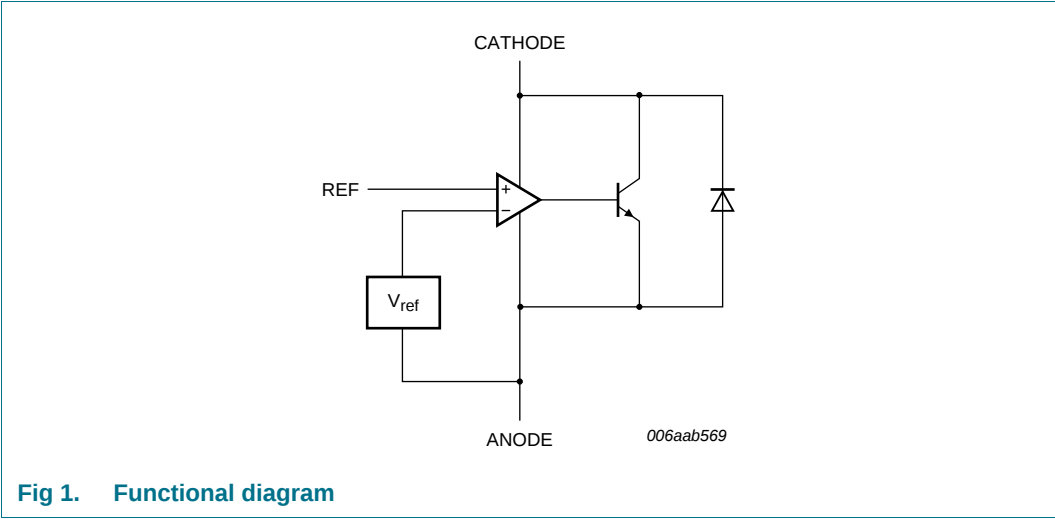
Table 4. Marking codes

| Type number   | Marking code <sup>[1]</sup> | Type number    | Marking code <sup>[1]</sup> |
|---------------|-----------------------------|----------------|-----------------------------|
| TLVH431CDBZR  | NM*                         | TLVH431AMQDBZR | NX*                         |
| TLVH431IDBZR  | NN*                         | TLVH431DQDBZR  | *SE                         |
| TLVH431QDBZR  | NP*                         | TLVH431DMQDBZR | *SF                         |
| TLVH431MQDBZR | NW*                         | TLVH431QDBVR   | AB3                         |
| TLVH431ACDBZR | NQ*                         | TLVH431AQDBVR  | AB6                         |
| TLVH431AIDBZR | NR*                         | TLVH431DQDBVR  | AC1                         |
| TLVH431AQDBZR | NS*                         | -              | -                           |

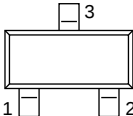
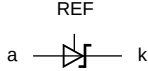
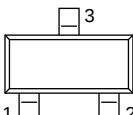
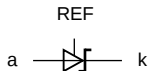
[1] \* = placeholder for manufacturing site code.

7. Functional diagram

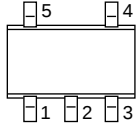
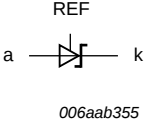
The TLVH431 family comprises a range of 3-terminal adjustable shunt regulators, with specified thermal stability over applicable automotive and commercial temperature ranges. The output voltage can be set to any value between  $V_{ref}$  (approximately 1.24 V) and 18 V with two external resistors (see [Figure 10](#)). These devices have a typical output impedance of 0.1  $\Omega$ . Active output circuitry provides a very sharp turn-on characteristic, making these devices excellent replacements for Zener diodes in many applications like on-board regulation, adjustable power supplies and switching power supplies.



8. Pinning information

| Table 5. Pinning                                       |        |             |                                                                                       |                                                                                                           |
|--------------------------------------------------------|--------|-------------|---------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------|
| Pin                                                    | Symbol | Description | Simplified outline                                                                    | Graphic symbol                                                                                            |
| SOT23; normal pinning: All types without MQDBZR ending |        |             |                                                                                       |                                                                                                           |
| 1                                                      | REF    | reference   |  | <br><i>006aab355</i> |
| 2                                                      | k      | cathode     |                                                                                       |                                                                                                           |
| 3                                                      | a      | anode       |                                                                                       |                                                                                                           |
| SOT23; mirrored pinning: All types with MQDBZR ending  |        |             |                                                                                       |                                                                                                           |
| 1                                                      | k      | cathode     |  | <br><i>006aab355</i> |
| 2                                                      | REF    | reference   |                                                                                       |                                                                                                           |
| 3                                                      | a      | anode       |                                                                                       |                                                                                                           |

**Table 5. Pinning ...continued**

| Pin           | Symbol | Description   | Simplified outline                                                                  | Graphic symbol                                                                      |
|---------------|--------|---------------|-------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------|
| <b>SOT753</b> |        |               |                                                                                     |                                                                                     |
| 1             | n.c.   | not connected |  |  |
| 2             | n.c.   | not connected |                                                                                     |                                                                                     |
| 3             | k      | cathode       |                                                                                     |                                                                                     |
| 4             | REF    | reference     |                                                                                     |                                                                                     |
| 5             | a      | anode         |                                                                                     |                                                                                     |

[1] Pin 1 and 2 can be connected to anode for better thermal performance.

## 9. Limiting values

**Table 6. Limiting values**

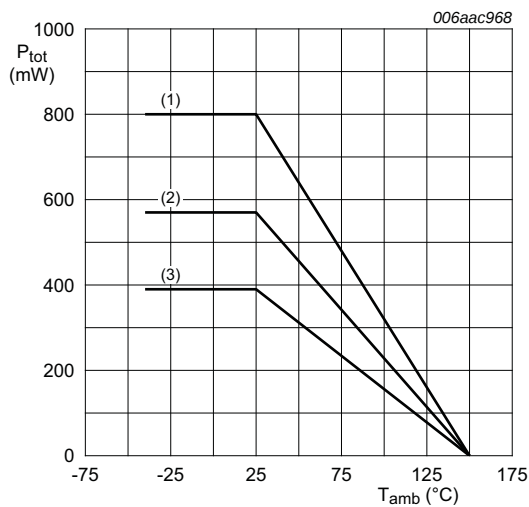
In accordance with the Absolute Maximum Rating System (IEC 60134).

| Symbol           | Parameter               | Conditions               | Min   | Max  | Unit |
|------------------|-------------------------|--------------------------|-------|------|------|
| V <sub>KA</sub>  | cathode-anode voltage   |                          | -     | 20   | V    |
| I <sub>K</sub>   | cathode current         |                          | −25   | 80   | mA   |
| I <sub>ref</sub> | reference current       |                          | −0.05 | 3    | mA   |
| P <sub>tot</sub> | total power dissipation | T <sub>amb</sub> ≤ 25 °C |       |      |      |
|                  | SOT23                   |                          | [1] - | 390  | mW   |
|                  |                         |                          | [2] - | 570  | mW   |
|                  |                         |                          | [3] - | 800  | mW   |
|                  | SOT753                  |                          | [1] - | 310  | mW   |
|                  |                         |                          | [2] - | 460  | mW   |
|                  |                         |                          | [3] - | 700  | mW   |
| T <sub>j</sub>   | junction temperature    |                          | -     | 150  | °C   |
| T <sub>amb</sub> | ambient temperature     |                          |       |      |      |
|                  | TLVH431XCDBZR           |                          | 0     | +70  | °C   |
|                  | TLVH431XIDBZR           |                          | −40   | +85  | °C   |
|                  | TLVH431XQDBZR           |                          | −40   | +125 | °C   |
|                  | TLVH431XQDBVR           |                          |       |      |      |
| T <sub>stg</sub> | storage temperature     |                          | −65   | +150 | °C   |

[1] Device mounted on an FR4 Printed-Circuit Board (PCB), single-sided copper, tin-plated and standard footprint.

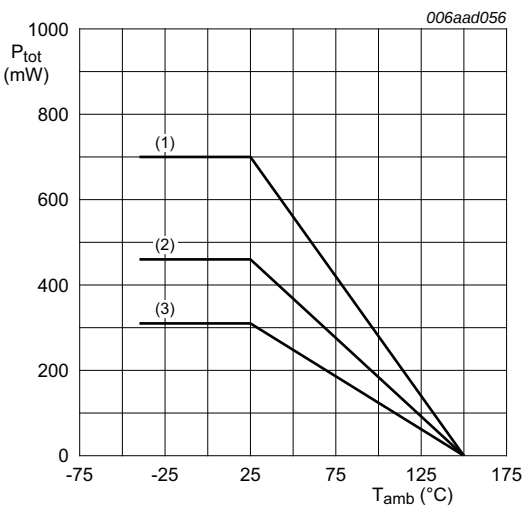
[2] Device mounted on an FR4 PCB, single-sided copper, tin-plated, mounting pad for anode 1 cm<sup>2</sup>.

[3] Device mounted on a ceramic PCB, Al<sub>2</sub>O<sub>3</sub>, standard footprint.



- (1) Ceramic PCB, Al<sub>2</sub>O<sub>3</sub>, standard footprint
- (2) FR4 PCB, mounting pad for anode 1 cm<sup>2</sup>
- (3) FR4 PCB, standard footprint

Fig 2. SOT23: Power derating curves



- (1) Ceramic PCB, Al<sub>2</sub>O<sub>3</sub>, standard footprint
- (2) FR4 PCB, mounting pad for anode 1 cm<sup>2</sup>
- (3) FR4 PCB, standard footprint

Fig 3. SOT753: Power derating curves

Table 7. ESD maximum ratings  
*T<sub>amb</sub> = 25 °C unless otherwise specified.*

| Symbol           | Parameter                       | Conditions                     | Min | Max | Unit |
|------------------|---------------------------------|--------------------------------|-----|-----|------|
| V <sub>ESD</sub> | electrostatic discharge voltage | MIL-STD-883 (human body model) | -   | 4   | kV   |
|                  |                                 | machine model                  | -   | 400 | V    |

10. Recommended operating conditions

Table 8. Operating conditions

| Symbol          | Parameter             | Conditions | Min              | Max | Unit |
|-----------------|-----------------------|------------|------------------|-----|------|
| V <sub>KA</sub> | cathode-anode voltage |            | V <sub>ref</sub> | 18  | V    |
| I <sub>K</sub>  | cathode current       |            | 0.08             | 70  | mA   |

## 11. Thermal characteristics

**Table 9. Thermal characteristics**

| Symbol         | Parameter                                        | Conditions  | Min | Typ | Max | Unit |
|----------------|--------------------------------------------------|-------------|-----|-----|-----|------|
| $R_{th(j-a)}$  | thermal resistance from junction to ambient      | in free air |     |     |     |      |
|                |                                                  |             |     |     |     |      |
|                |                                                  |             |     |     |     |      |
|                |                                                  |             |     |     |     |      |
|                |                                                  |             |     |     |     |      |
|                |                                                  |             |     |     |     |      |
|                |                                                  |             |     |     |     |      |
|                |                                                  |             |     |     |     |      |
|                |                                                  |             |     |     |     |      |
| $R_{th(j-sp)}$ | thermal resistance from junction to solder point |             |     |     |     |      |
|                |                                                  |             |     |     |     |      |
|                |                                                  |             |     |     |     |      |
|                |                                                  |             |     |     |     |      |
|                |                                                  |             |     |     |     |      |
|                |                                                  |             |     |     |     |      |

[1] Device mounted on an FR4 PCB, single-sided copper, tin-plated and standard footprint.

[2] Device mounted on an FR4 PCB, single-sided copper, tin-plated, mounting pad for anode 1 cm<sup>2</sup>.

[3] Device mounted on a ceramic PCB, Al<sub>2</sub>O<sub>3</sub>, standard footprint.

[4] Soldering point of anode.

## 12. Characteristics

**Table 10. Characteristics**

$T_{amb} = 25\text{ }^{\circ}\text{C}$  unless otherwise specified.

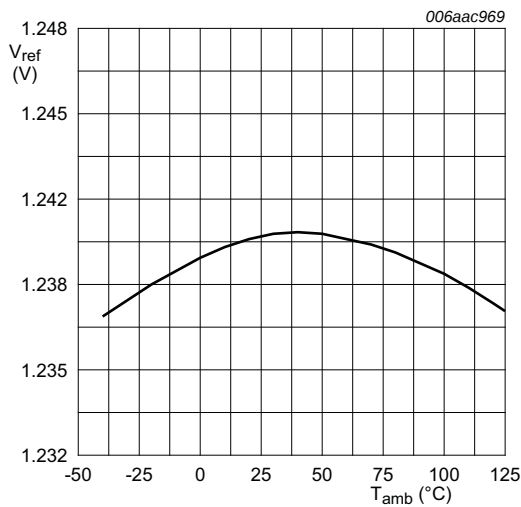
| Symbol                                                                                               | Parameter                                                            | Conditions                                                                      | Min  | Typ  | Max  | Unit          |
|------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------|---------------------------------------------------------------------------------|------|------|------|---------------|
| <b>Standard-Grade (1.5 %): TLVH431CDBZR; TLVH431IDBZR; TLVH431QDBZR; TLVH431MQDBRZ; TLVH431QDBVR</b> |                                                                      |                                                                                 |      |      |      |               |
| $V_{ref}$                                                                                            | reference voltage                                                    | $V_{KA} = V_{ref}; I_K = 10\text{ mA}$                                          |      |      |      |               |
|                                                                                                      |                                                                      | $T_{amb} = 25\text{ }^{\circ}\text{C}$                                          | 1222 | 1240 | 1258 | mV            |
|                                                                                                      | TLVH431CDBZR                                                         | $T_{amb} = 0\text{ }^{\circ}\text{C to } 70\text{ }^{\circ}\text{C}$            | 1210 | -    | 1270 | mV            |
|                                                                                                      | TLVH431IDBZR                                                         | $T_{amb} = -40\text{ }^{\circ}\text{C to } 85\text{ }^{\circ}\text{C}$          | 1202 | -    | 1278 | mV            |
|                                                                                                      | TLVH431QDBZR<br>TLVH431MQDBRZ<br>TLVH431QDBVR                        | $T_{amb} = -40\text{ }^{\circ}\text{C to } 125\text{ }^{\circ}\text{C}$         | 1194 | -    | 1286 | mV            |
| $\Delta V_{ref}$                                                                                     | reference voltage variation                                          | $V_{KA} = V_{ref}; I_K = 10\text{ mA}$                                          |      |      |      |               |
|                                                                                                      | TLVH431CDBZR                                                         | $T_{amb} = 0\text{ }^{\circ}\text{C to } 70\text{ }^{\circ}\text{C}$            | -    | 2    | 10   | mV            |
|                                                                                                      | TLVH431IDBZR                                                         | $T_{amb} = -40\text{ }^{\circ}\text{C to } 85\text{ }^{\circ}\text{C}$          | -    | 3    | 10   | mV            |
|                                                                                                      | TLVH431QDBZR<br>TLVH431MQDBRZ<br>TLVH431QDBVR                        | $T_{amb} = -40\text{ }^{\circ}\text{C to } 125\text{ }^{\circ}\text{C}$         | -    | 4    | 10   | mV            |
| $\Delta V_{ref}/\Delta V_{KA}$                                                                       | reference voltage variation to cathode-anode voltage variation ratio | $I_K = 10\text{ mA};$<br>$\Delta V_{KA} = V_{ref}\text{ to } 18\text{ V}$       | -    | -0.5 | -1.5 | mV/V          |
| $I_{ref}$                                                                                            | reference current                                                    | $I_K = 10\text{ mA};$<br>$R1 = 10\text{ k}\Omega; R2 = \text{open}$             | -    | 0.19 | 0.30 | $\mu\text{A}$ |
| $\Delta I_{ref}$                                                                                     | reference current variation                                          | $I_K = 10\text{ mA};$<br>$R1 = 10\text{ k}\Omega; R2 = \text{open}$             |      |      |      |               |
|                                                                                                      | TLVH431CDBZR                                                         | $T_{amb} = 0\text{ }^{\circ}\text{C to } 70\text{ }^{\circ}\text{C}$            | -    | 0.03 | 0.10 | $\mu\text{A}$ |
|                                                                                                      | TLVH431IDBZR                                                         | $T_{amb} = -40\text{ }^{\circ}\text{C to } 85\text{ }^{\circ}\text{C}$          | -    | 0.06 | 0.16 | $\mu\text{A}$ |
|                                                                                                      | TLVH431QDBZR<br>TLVH431MQDBRZ<br>TLVH431QDBVR                        | $T_{amb} = -40\text{ }^{\circ}\text{C to } 125\text{ }^{\circ}\text{C}$         | -    | 0.07 | 0.24 | $\mu\text{A}$ |
| $I_{K(min)}$                                                                                         | minimum cathode current                                              | $V_{KA} = V_{ref}$                                                              | -    | 55   | 80   | $\mu\text{A}$ |
| $I_{off}$                                                                                            | off-state current                                                    | $V_{KA} = 18\text{ V}; V_{ref} = 0$                                             | -    | 0.01 | 0.05 | $\mu\text{A}$ |
| $Z_{KA}$                                                                                             | dynamic cathode-anode impedance                                      | $I_K = 0.1\text{ mA to } 70\text{ mA};$<br>$V_{KA} = V_{ref}; f < 1\text{ kHz}$ |      |      |      |               |
|                                                                                                      | SOT23                                                                |                                                                                 | -    | 0.10 | 0.15 | $\Omega$      |
|                                                                                                      | SOT753                                                               |                                                                                 | -    | 0.15 | 0.20 | $\Omega$      |

**Table 10. Characteristics ...continued** $T_{amb} = 25\text{ }^{\circ}\text{C}$  unless otherwise specified.

| Symbol                                                                                           | Parameter                                                            | Conditions                                                                       | Min  | Typ  | Max  | Unit          |
|--------------------------------------------------------------------------------------------------|----------------------------------------------------------------------|----------------------------------------------------------------------------------|------|------|------|---------------|
| <b>A-Grade (1 %): TLVH431ACDBZR; TLVH431AIDBZR; TLVH431AQDBZR; TLVH431AMQDBZR; TLVH431AQDBVR</b> |                                                                      |                                                                                  |      |      |      |               |
| $V_{ref}$                                                                                        | reference voltage                                                    | $V_{KA} = V_{ref}; I_K = 10\text{ mA}$                                           |      |      |      |               |
|                                                                                                  |                                                                      | $T_{amb} = 25\text{ }^{\circ}\text{C}$                                           | 1228 | 1240 | 1252 | mV            |
|                                                                                                  | TLVH431ACDBZR                                                        | $T_{amb} = 0\text{ }^{\circ}\text{C}$ to $70\text{ }^{\circ}\text{C}$            | 1221 | -    | 1259 | mV            |
|                                                                                                  | TLVH431AIDBZR                                                        | $T_{amb} = -40\text{ }^{\circ}\text{C}$ to $85\text{ }^{\circ}\text{C}$          | 1215 | -    | 1265 | mV            |
|                                                                                                  | TLVH431AQDBZR<br>TLVH431AMQDBZR<br>TLVH431AQDBVR                     | $T_{amb} = -40\text{ }^{\circ}\text{C}$ to $125\text{ }^{\circ}\text{C}$         | 1209 | -    | 1271 | mV            |
| $\Delta V_{ref}$                                                                                 | reference voltage variation                                          | $V_{KA} = V_{ref}; I_K = 10\text{ mA}$                                           |      |      |      |               |
|                                                                                                  | TLVH431ACDBZR                                                        | $T_{amb} = 0\text{ }^{\circ}\text{C}$ to $70\text{ }^{\circ}\text{C}$            | -    | 2    | 10   | mV            |
|                                                                                                  | TLVH431AIDBZR                                                        | $T_{amb} = -40\text{ }^{\circ}\text{C}$ to $85\text{ }^{\circ}\text{C}$          | -    | 3    | 10   | mV            |
|                                                                                                  | TLVH431AQDBZR<br>TLVH431AMQDBZR<br>TLVH431AQDBVR                     | $T_{amb} = -40\text{ }^{\circ}\text{C}$ to $125\text{ }^{\circ}\text{C}$         | -    | 4    | 10   | mV            |
|                                                                                                  |                                                                      |                                                                                  |      |      |      |               |
| $\Delta V_{ref}/\Delta V_{KA}$                                                                   | reference voltage variation to cathode-anode voltage variation ratio | $I_K = 10\text{ mA};$<br>$\Delta V_{KA} = V_{ref}$ to $18\text{ V}$              | -    | -0.5 | -1.5 | mV/V          |
| $I_{ref}$                                                                                        | reference current                                                    | $I_K = 10\text{ mA};$<br>$R1 = 10\text{ k}\Omega; R2 = \text{open}$              | -    | 0.19 | 0.30 | $\mu\text{A}$ |
| $\Delta I_{ref}$                                                                                 | reference current variation                                          | $I_K = 10\text{ mA};$<br>$R1 = 10\text{ k}\Omega; R2 = \text{open}$              |      |      |      |               |
|                                                                                                  | TLVH431ACDBZR                                                        | $T_{amb} = 0\text{ }^{\circ}\text{C}$ to $70\text{ }^{\circ}\text{C}$            | -    | 0.03 | 0.10 | $\mu\text{A}$ |
|                                                                                                  | TLVH431AIDBZR                                                        | $T_{amb} = -40\text{ }^{\circ}\text{C}$ to $85\text{ }^{\circ}\text{C}$          | -    | 0.06 | 0.16 | $\mu\text{A}$ |
|                                                                                                  | TLVH431AQDBZR<br>TLVH431AMQDBZR<br>TLVH431AQDBVR                     | $T_{amb} = -40\text{ }^{\circ}\text{C}$ to $125\text{ }^{\circ}\text{C}$         | -    | 0.07 | 0.24 | $\mu\text{A}$ |
|                                                                                                  |                                                                      |                                                                                  |      |      |      |               |
| $I_{K(min)}$                                                                                     | minimum cathode current                                              | $V_{KA} = V_{ref}$                                                               | -    | 55   | 80   | $\mu\text{A}$ |
| $I_{off}$                                                                                        | off-state current                                                    | $V_{KA} = 18\text{ V}; V_{ref} = 0$                                              | -    | 0.01 | 0.05 | $\mu\text{A}$ |
| $Z_{KA}$                                                                                         | dynamic cathode-anode impedance                                      | $I_K = 0.1\text{ mA}$ to $70\text{ mA};$<br>$V_{KA} = V_{ref}; f < 1\text{ kHz}$ |      |      |      |               |
|                                                                                                  | SOT23                                                                |                                                                                  | -    | 0.10 | 0.15 | $\Omega$      |
|                                                                                                  | SOT753                                                               |                                                                                  | -    | 0.15 | 0.20 | $\Omega$      |

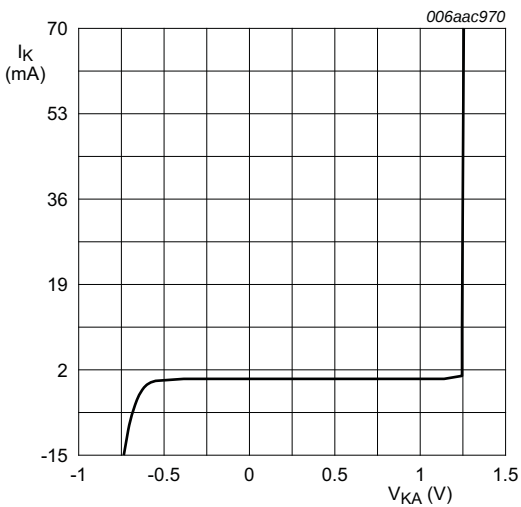
**Table 10. Characteristics ...continued** $T_{amb} = 25\text{ }^{\circ}\text{C}$  unless otherwise specified.

| Symbol                                                                | Parameter                                                            | Conditions                                                                                                                                      | Min  | Typ  | Max  | Unit          |
|-----------------------------------------------------------------------|----------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------|------|------|------|---------------|
| <b>D-Grade (0.75 %): TLVH431DQDBZR; TLVH431DMQDBZR; TLVH431DQDBVR</b> |                                                                      |                                                                                                                                                 |      |      |      |               |
| $V_{ref}$                                                             | reference voltage                                                    | $V_{KA} = V_{ref}; I_K = 10\text{ mA}$                                                                                                          |      |      |      |               |
|                                                                       |                                                                      | $T_{amb} = 25\text{ }^{\circ}\text{C}$                                                                                                          | 1231 | 1240 | 1249 | mV            |
|                                                                       |                                                                      | $T_{amb} = -40\text{ }^{\circ}\text{C to } 125\text{ }^{\circ}\text{C}$                                                                         | 1215 | -    | 1265 | mV            |
| $\Delta V_{ref}$                                                      | reference voltage variation                                          | $V_{KA} = V_{ref}; I_K = 10\text{ mA}$                                                                                                          |      |      |      |               |
|                                                                       |                                                                      | $T_{amb} = 0\text{ }^{\circ}\text{C to } 70\text{ }^{\circ}\text{C}$                                                                            | -    | 2    | 10   | mV            |
|                                                                       |                                                                      | $T_{amb} = -40\text{ }^{\circ}\text{C to } 85\text{ }^{\circ}\text{C}$                                                                          | -    | 3    | 10   | mV            |
|                                                                       |                                                                      | $T_{amb} = -40\text{ }^{\circ}\text{C to } 125\text{ }^{\circ}\text{C}$                                                                         | -    | 4    | 10   | mV            |
| $\Delta V_{ref}/\Delta V_{KA}$                                        | reference voltage variation to cathode-anode voltage variation ratio | $I_K = 10\text{ mA};$<br>$\Delta V_{KA} = V_{ref}\text{ to } 18\text{ V}$                                                                       | -    | -0.5 | -1.5 | mV/V          |
| $I_{ref}$                                                             | reference current                                                    | $I_K = 10\text{ mA};$<br>$R1 = 10\text{ k}\Omega; R2 = \text{open}$                                                                             | -    | 0.19 | 0.30 | $\mu\text{A}$ |
| $\Delta I_{ref}$                                                      | reference current variation                                          | $I_K = 10\text{ mA};$<br>$R1 = 10\text{ k}\Omega; R2 = \text{open};$<br>$T_{amb} = -40\text{ }^{\circ}\text{C to } 125\text{ }^{\circ}\text{C}$ | -    | 0.07 | 0.24 | $\mu\text{A}$ |
| $I_{K(min)}$                                                          | minimum cathode current                                              | $V_{KA} = V_{ref}$                                                                                                                              | -    | 55   | 80   | $\mu\text{A}$ |
| $I_{off}$                                                             | off-state current                                                    | $V_{KA} = 18\text{ V}; V_{ref} = 0$                                                                                                             | -    | 0.01 | 0.05 | $\mu\text{A}$ |
| $Z_{KA}$                                                              | dynamic cathode-anode impedance                                      | $I_K = 0.1\text{ mA to } 70\text{ mA};$<br>$V_{KA} = V_{ref}; f < 1\text{ kHz}$                                                                 |      |      |      |               |
|                                                                       |                                                                      | SOT23                                                                                                                                           | -    | 0.10 | 0.15 | $\Omega$      |
|                                                                       |                                                                      | SOT753                                                                                                                                          | -    | 0.15 | 0.20 | $\Omega$      |



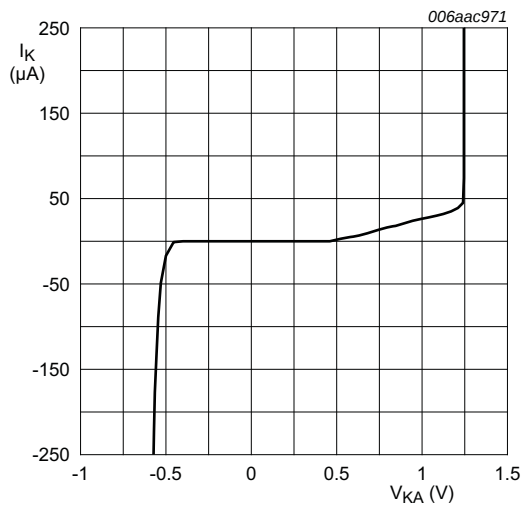
$I_K = 10\text{ mA}$ ;  $V_{KA} = V_{ref}$

Fig 4. Reference voltage as a function of ambient temperature; typical values



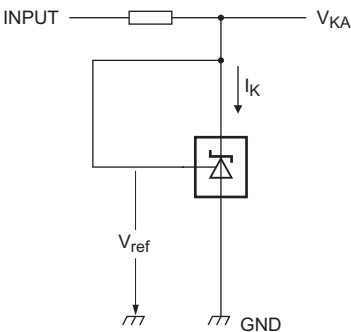
$V_{KA} = V_{ref}$ ;  $T_{amb} = 25\text{ °C}$

Fig 5. Cathode current as a function of cathode-anode voltage; typical values



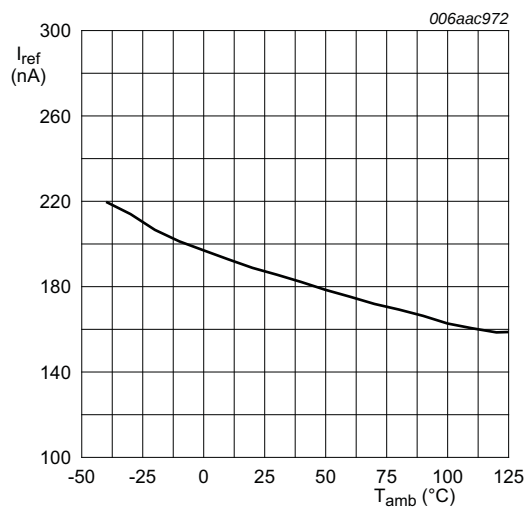
$V_{KA} = V_{ref}$ ;  $T_{amb} = 25\text{ °C}$

Fig 6. Cathode current as a function of cathode-anode voltage; typical values



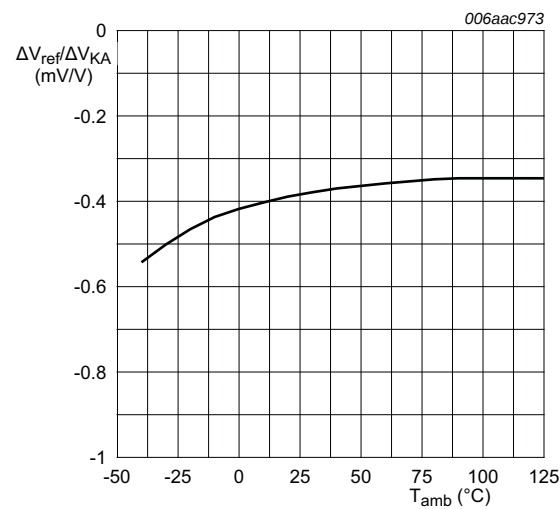
$I_K = 10\text{ mA}$ ;  $V_{KA} = V_{ref}$

Fig 7. Test circuit to [Figure 4](#), [5](#) and [6](#)



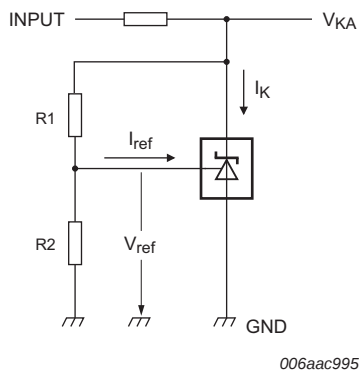
V<sub>KA</sub> = 1.24 V; I<sub>K</sub> = 10 mA; R1 = 10 kΩ; R2 = open

Fig 8. Reference current as a function of ambient temperature; typical values



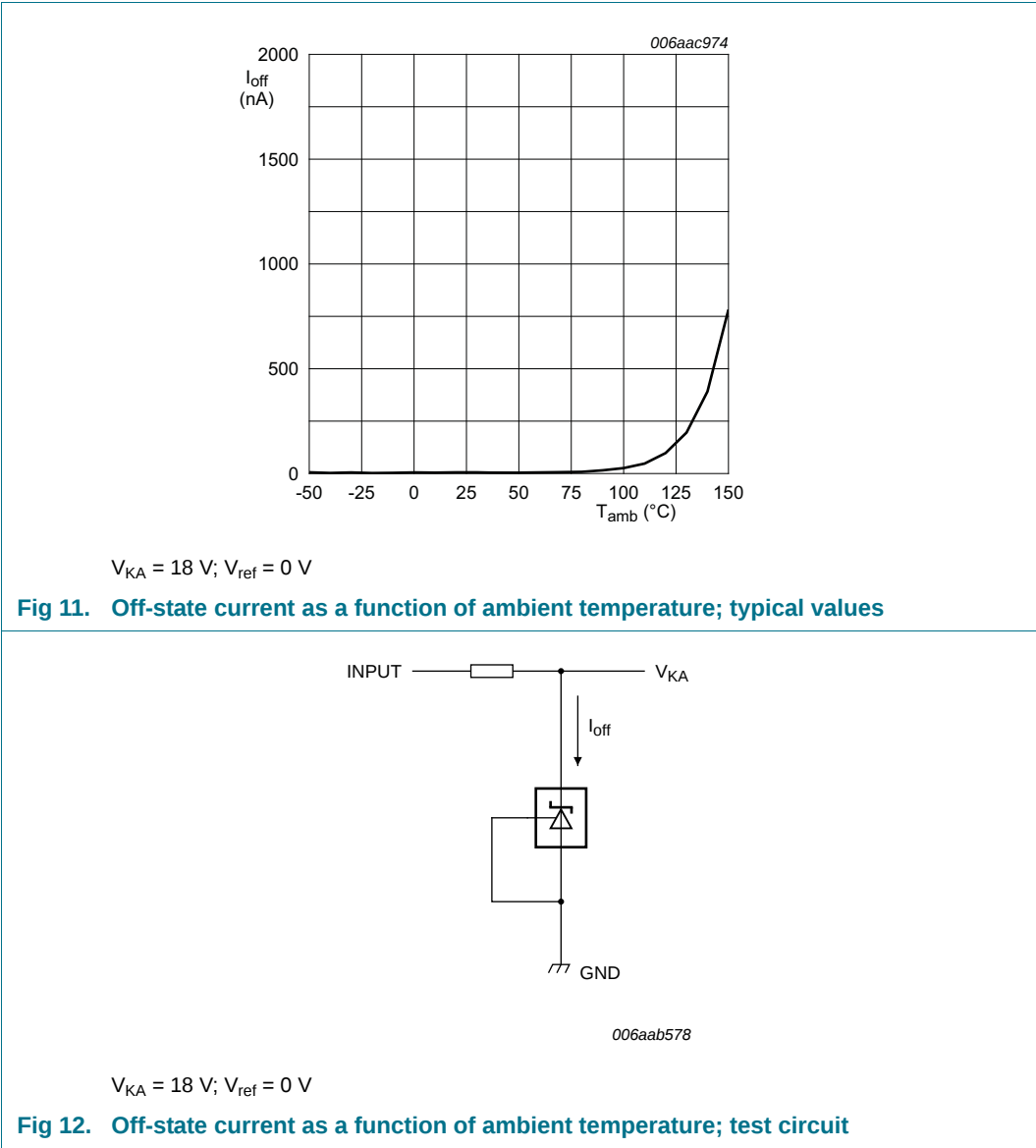
I<sub>K</sub> = 10 mA; T<sub>amb</sub> = 25 °C

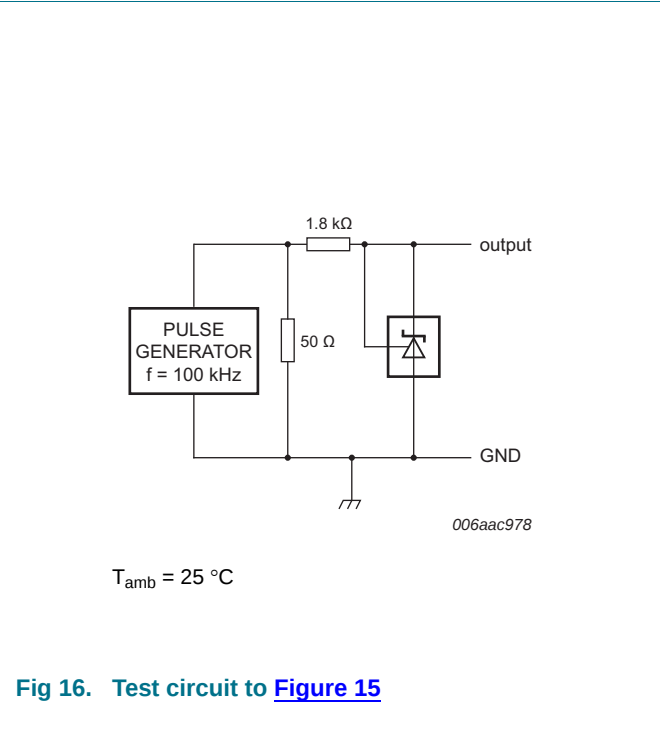
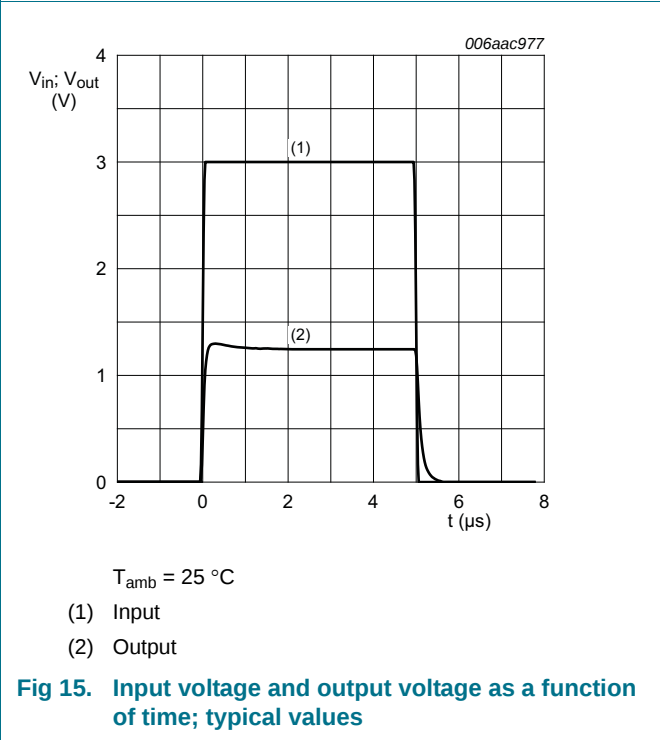
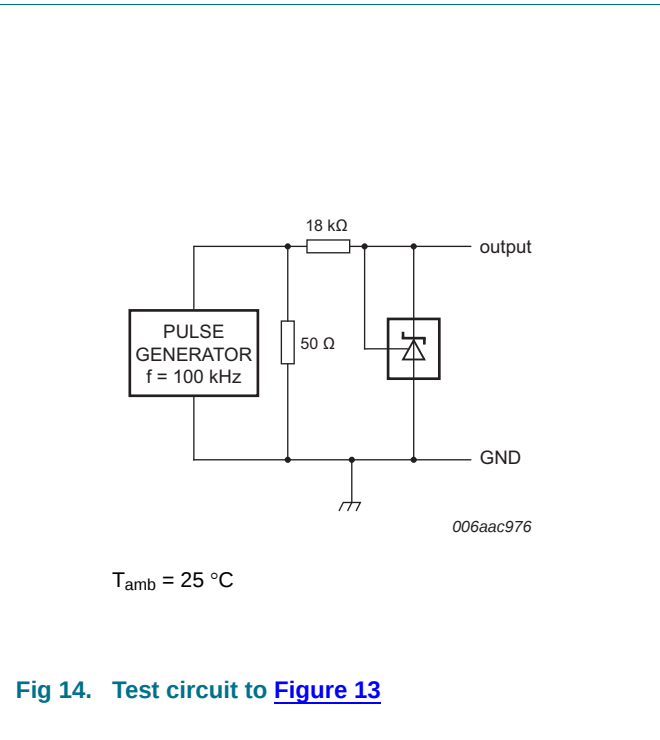
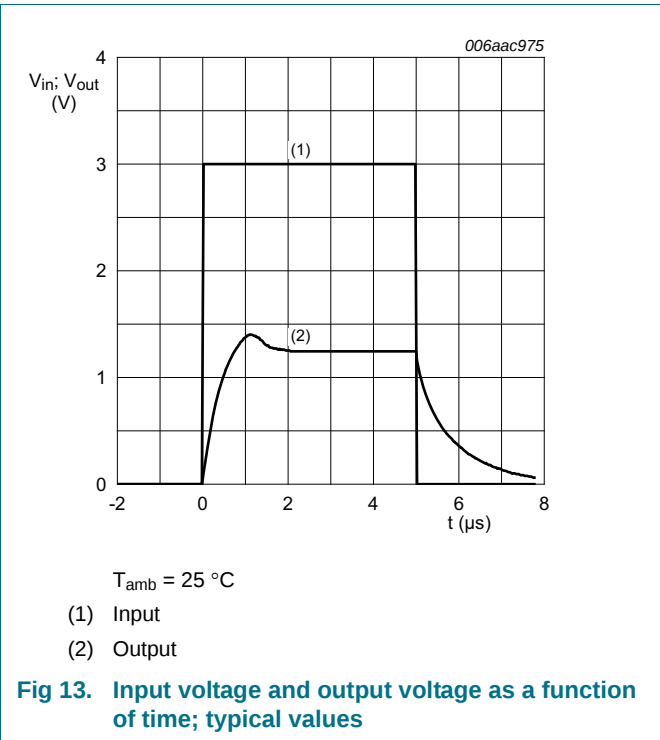
Fig 9. Reference voltage variation to cathode-anode voltage variation ratio as a function of ambient temperature; typical values

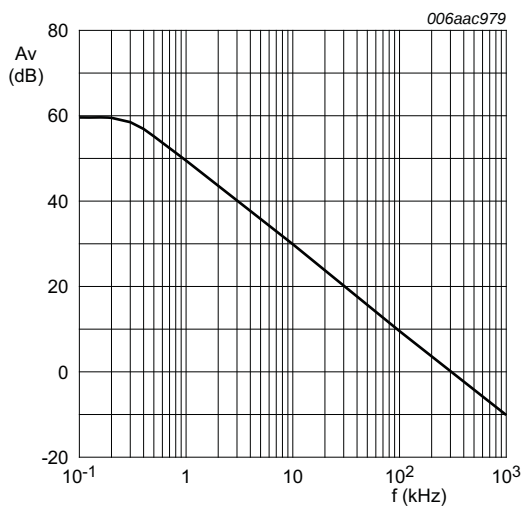


$$V_{KA} = V_{ref} \times \left(1 + \frac{R1}{R2}\right) + I_{ref} \times R1$$

Fig 10. Test circuit to [Figure 8](#) and [9](#)

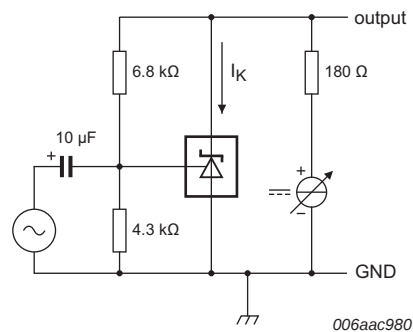






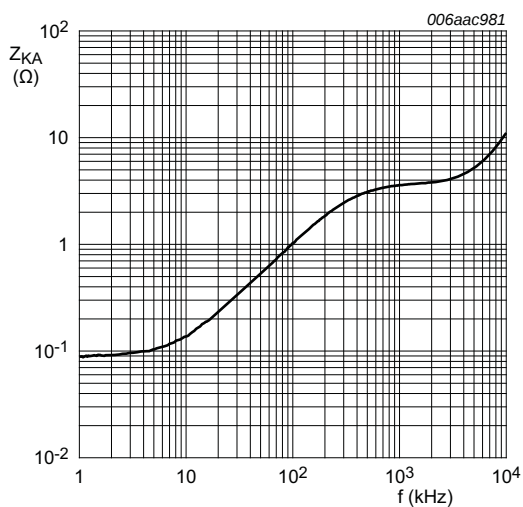
$I_K = 10\text{ mA}$ ;  $T_{\text{amb}} = 25\text{ }^{\circ}\text{C}$

Fig 17. Voltage amplification as a function of frequency; typical values



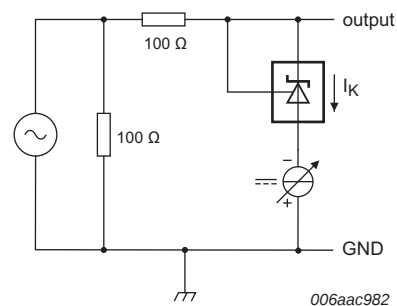
$I_K = 10\text{ mA}$ ;  $T_{\text{amb}} = 25\text{ }^{\circ}\text{C}$

Fig 18. Test circuit to [Figure 17](#)



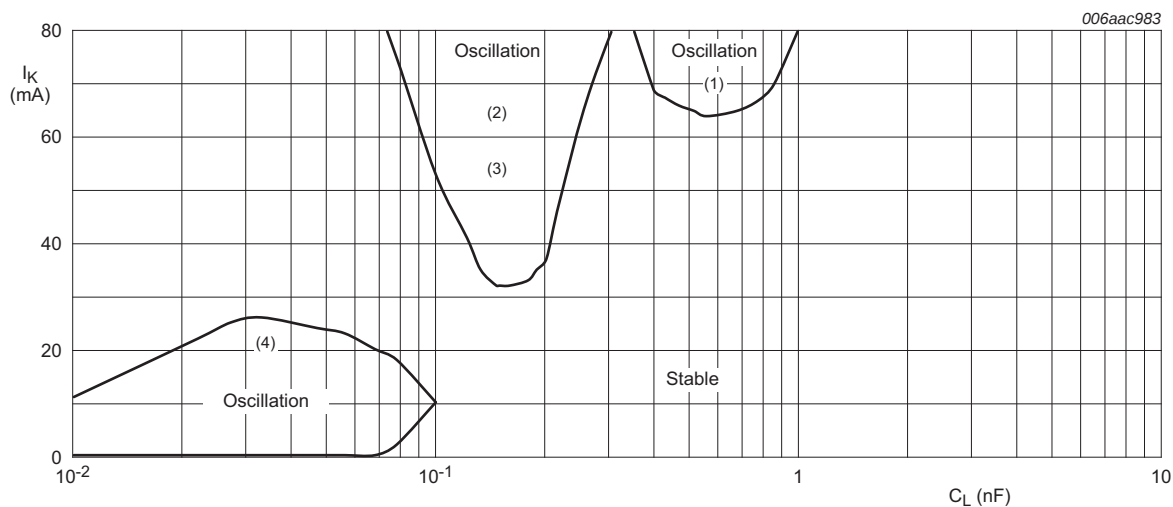
$I_K = 10\text{ mA}$ ;  $T_{\text{amb}} = 25\text{ }^{\circ}\text{C}$

Fig 19. Dynamic cathode-anode impedance as a function of frequency; typical values



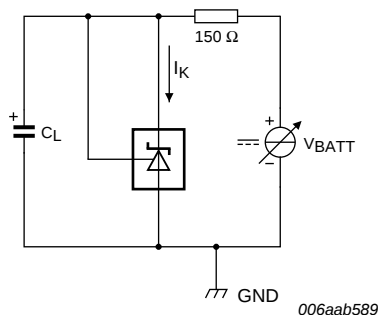
$I_K = 10\text{ mA}$ ;  $T_{\text{amb}} = 25\text{ }^{\circ}\text{C}$

Fig 20. Test circuit to [Figure 19](#)



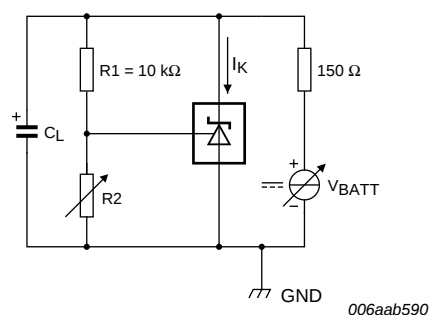
- $T_{amb} = 25\text{ }^{\circ}\text{C}$
- (1)  $V_{KA} = V_{ref}$
  - (2)  $V_{KA} = 2\text{ V}$
  - (3)  $V_{KA} = 3\text{ V}$
  - (4)  $V_{KA} = 18\text{ V}$

**Fig 21. Cathode current as a function of load capacitance; typical values**



$V_{KA} = V_{ref}$   
 $T_{amb} = 25\text{ }^{\circ}\text{C}$

**Fig 22. Test circuit to Figure 21**

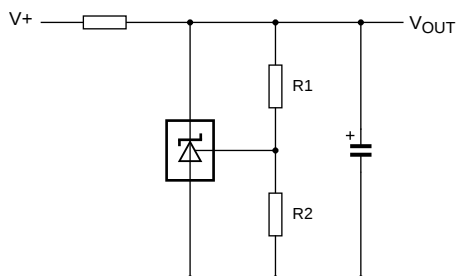


$V_{KA} > V_{ref}$   
 $T_{amb} = 25\text{ }^{\circ}\text{C}$

**Fig 23. Test circuit to Figure 21**

Figure 21, 22 and 23 show the stability boundaries and test circuits for the worst case conditions with a load capacitance mounted as close as possible to the device. The required load capacitance for stable operation varies depending on the operating temperature and capacitor Equivalent Series Resistance (ESR). Verify that the application circuit is stable over the anticipated operating current and temperature ranges.

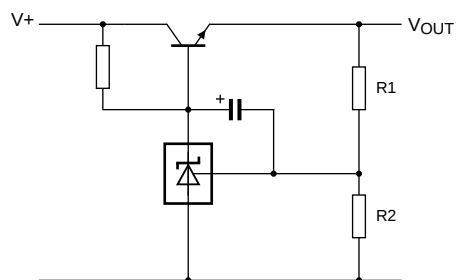
## 13. Application information



006aab592

$$V_{OUT} = \left(1 + \frac{R1}{R2}\right) \times V_{ref}$$

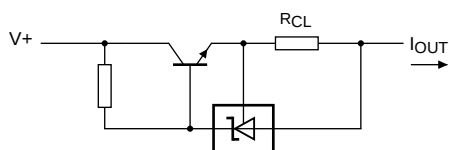
**Fig 24. Shunt regulator**



006aab593

$$V_{OUT} = \left(1 + \frac{R1}{R2}\right) \times V_{ref}; V_{OUT(min)} = V_{ref} + V_{be}$$

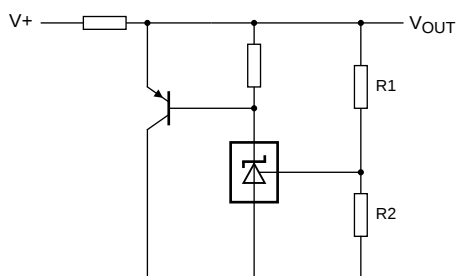
**Fig 25. Series pass regulator**



006aab595

$$I_{OUT} = \frac{V_{ref}}{R_{CL}}$$

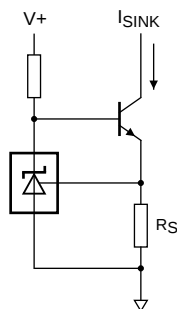
**Fig 26. Constant current source**



006aab596

$$V_{OUT} = \left(1 + \frac{R1}{R2}\right) \times V_{ref}$$

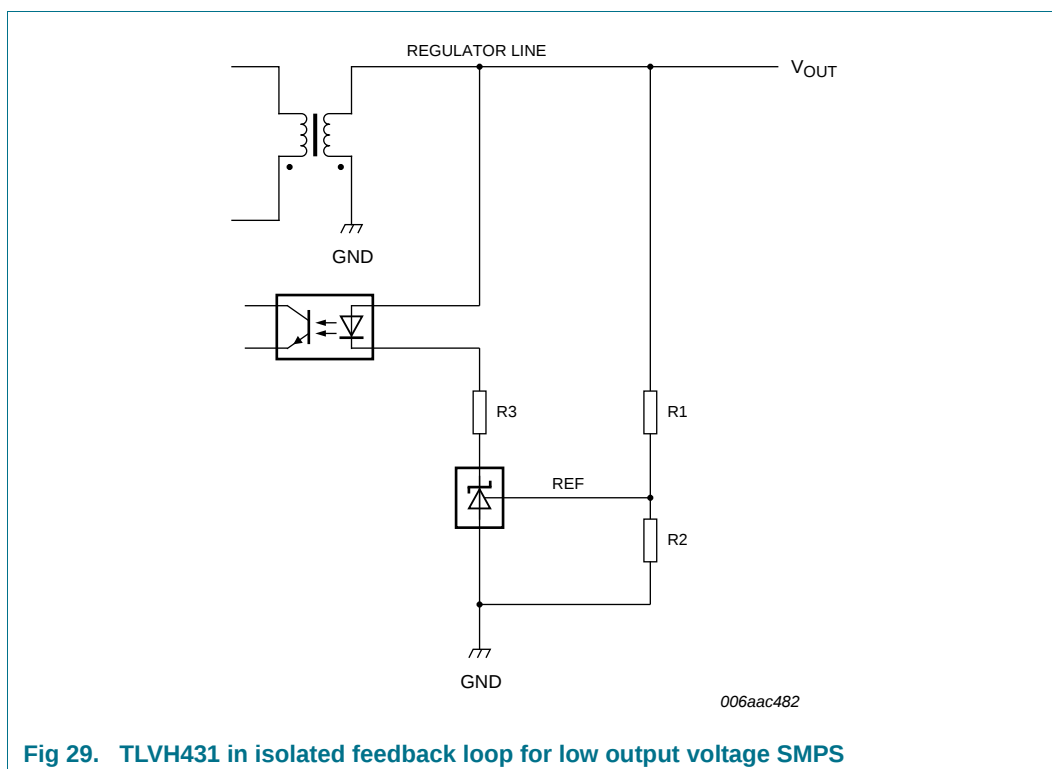
**Fig 27. High-current shunt regulator**



006aab597

$$I_{SINK} = \frac{V_{ref}}{R_S}$$

**Fig 28. Constant current sink**

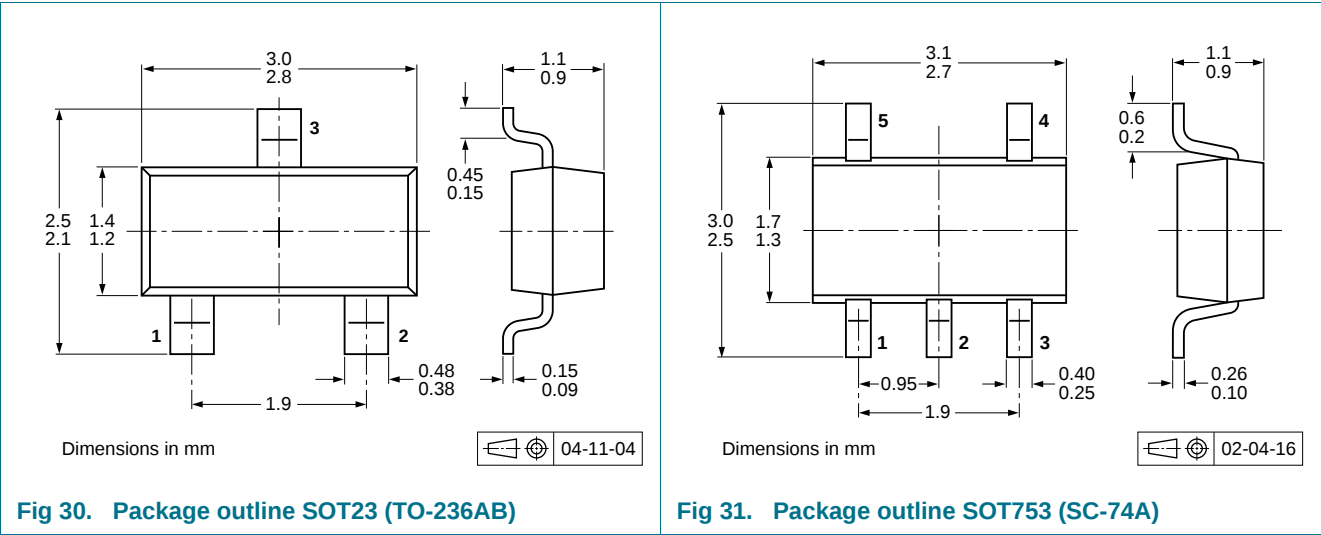


## 14. Test information

### 14.1 Quality information

This product has been qualified in accordance with the Automotive Electronics Council (AEC) standard *Q100 - Failure mechanism based stress test qualification for integrated circuits*, and is suitable for use in automotive applications.

15. Package outline



16. Packing information

**Table 11. Packing methods**  
*The indicated -xxx are the last three digits of the 12NC ordering code.*<sup>[1]</sup>

| Type number | Package | Description                    | Packing quantity |       |
|-------------|---------|--------------------------------|------------------|-------|
|             |         |                                | 3000             | 10000 |
| TLVH431XBZR | SOT23   | 4 mm pitch, 8 mm tape and reel | -215             | -235  |
| TLVH431XBVR | SOT753  | 4 mm pitch, 8 mm tape and reel | -115             | -     |

[1] For further information and the availability of packing methods, see [Section 20](#).

17. Soldering

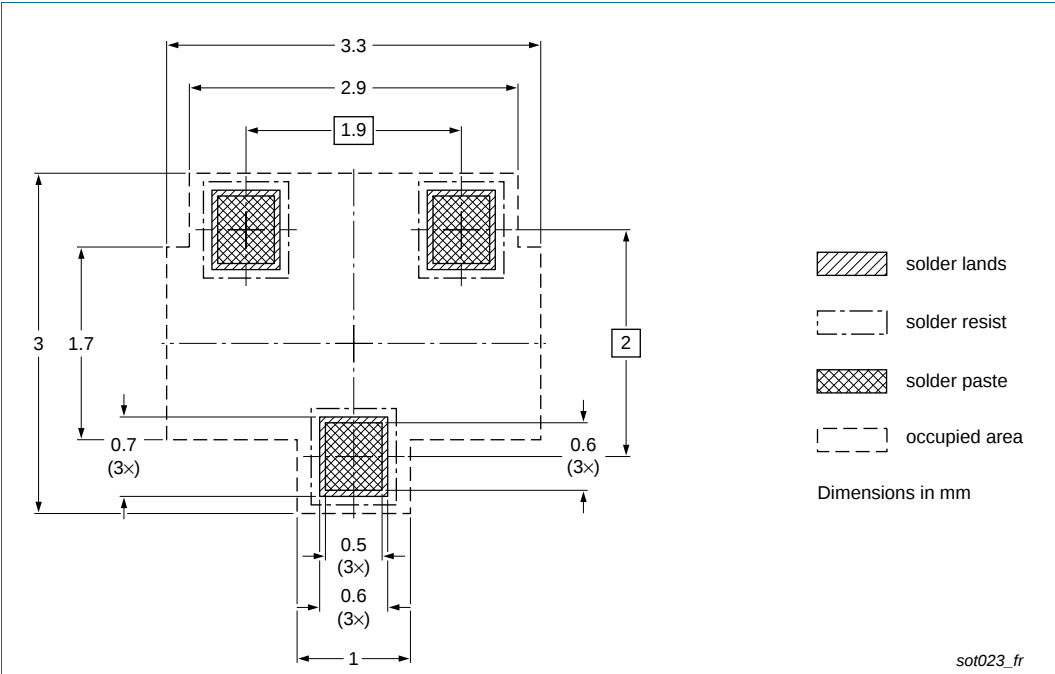


Fig 32. Reflow soldering footprint SOT23 (TO-236AB)

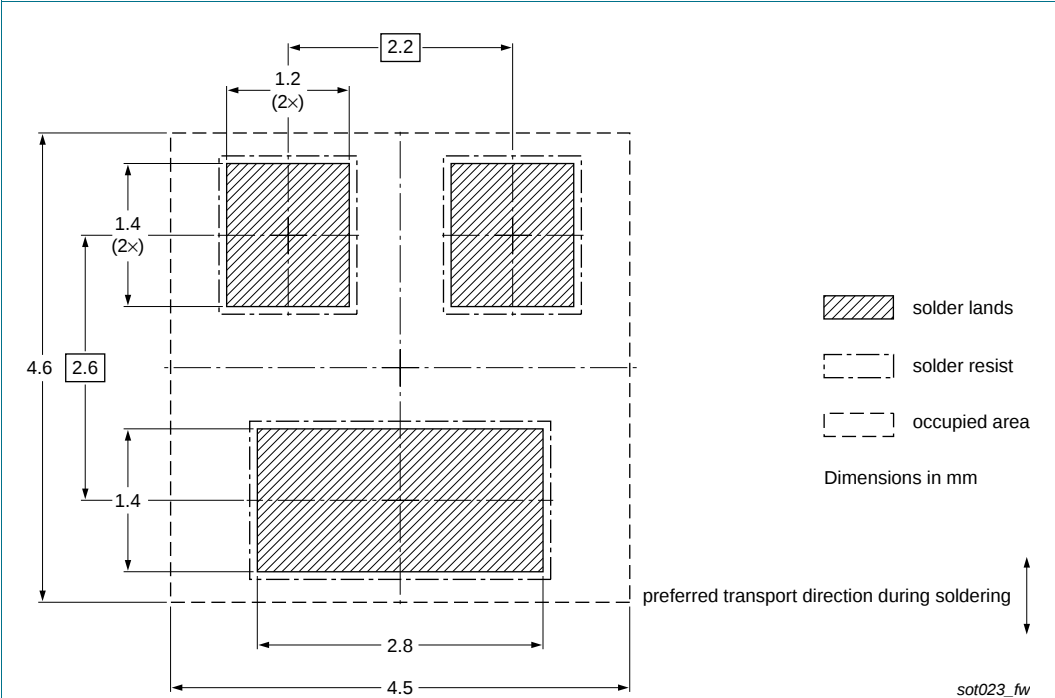


Fig 33. Wave soldering footprint SOT23 (TO-236AB)

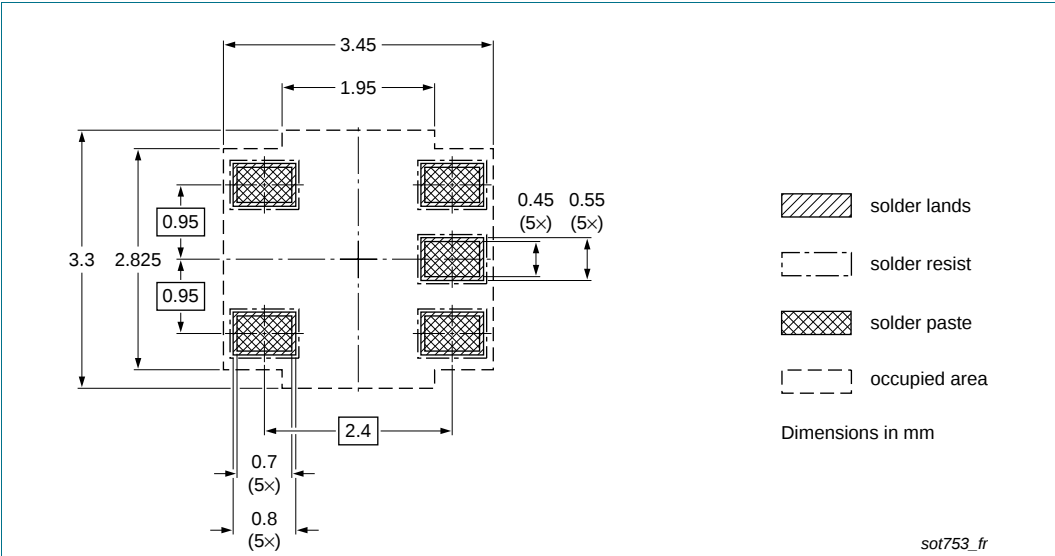


Fig 34. Reflow soldering footprint SOT753 (SC-74A)

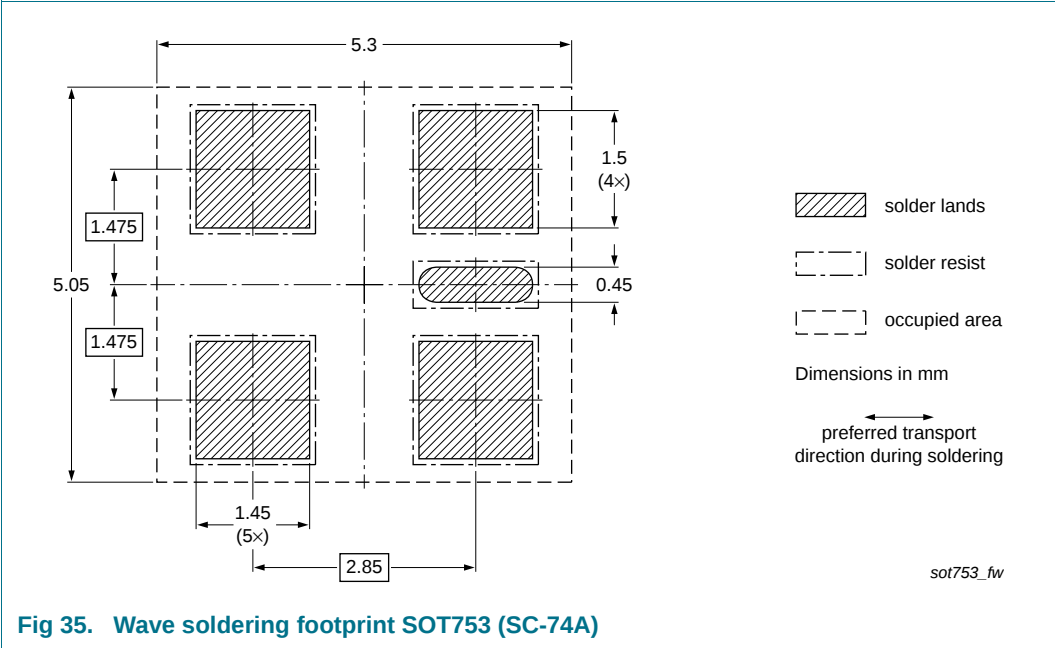


Fig 35. Wave soldering footprint SOT753 (SC-74A)

## 18. Revision history

Table 12. Revision history

| Document ID     | Release date | Data sheet status  | Change notice | Supersedes |
|-----------------|--------------|--------------------|---------------|------------|
| TLVH431_FAM v.1 | 20120427     | Product data sheet | -             | -          |

## 19. Legal information

### 19.1 Data sheet status

| Document status <sup>[1][2]</sup> | Product status <sup>[3]</sup> | Definition                                                                            |
|-----------------------------------|-------------------------------|---------------------------------------------------------------------------------------|
| Objective [short] data sheet      | Development                   | This document contains data from the objective specification for product development. |
| Preliminary [short] data sheet    | Qualification                 | This document contains data from the preliminary specification.                       |
| Product [short] data sheet        | Production                    | This document contains the product specification.                                     |

[1] Please consult the most recently issued document before initiating or completing a design.

[2] The term 'short data sheet' is explained in section "Definitions".

[3] The product status of device(s) described in this document may have changed since this document was published and may differ in case of multiple devices. The latest product status information is available on the Internet at URL <http://www.nxp.com>.

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