

# Bipolar Hall Latch

High Precision Hall Effect Latch for Consumer Applications

TLV4961-3TA

TLV4961-3TB

SP001274776

SP001283606

## TLV4961-3T

## Data Sheet

Revision 1.2, 2019-12-20

Sense & Control

## Table of contents

	<b>Table of contents</b> .....	<b>2</b>
	<b>List of tables</b> .....	<b>3</b>
	<b>List of figures</b> .....	<b>4</b>
<b>1</b>	<b>Product description</b> .....	<b>5</b>
1.1	Overview .....	5
1.2	Features .....	5
1.3	Target applications .....	6
<b>2</b>	<b>Functional description</b> .....	<b>7</b>
2.1	General .....	7
2.2	Pin configuration (top view) .....	7
2.3	Pin description .....	7
2.4	Block diagram .....	8
2.5	Functional block description .....	9
2.6	Default start-up behavior .....	10
<b>3</b>	<b>Specification</b> .....	<b>11</b>
3.1	Application circuit .....	11
3.2	Absolute maximum ratings .....	12
3.3	Operating range .....	13
3.4	Electrical and magnetic characteristics .....	14
<b>4</b>	<b>Package information</b> .....	<b>16</b>
4.1	Package outline .....	16
4.2	Packing information .....	18
4.3	Distance between chip and package .....	18
4.4	Package marking .....	19
<b>5</b>	<b>Revision history</b> .....	<b>20</b>

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## List of tables

Table 1	Ordering information .....	5
Table 2	Pin description .....	7
Table 3	Absolute maximum rating parameters .....	12
Table 4	ESD protection ( $T_A = 25^\circ\text{C}$ ) .....	13
Table 5	Operating conditions parameters .....	13
Table 6	General electrical characteristics .....	14
Table 7	Magnetic characteristics .....	15

## List of figures

Figure 1	TLV4961-3T in the TO92S-3-1 and TO92S-3-2 package. ....	5
Figure 2	Pin configuration and center of sensitive area. ....	7
Figure 3	Functional block diagram TLV4961-3T. ....	8
Figure 4	Timing diagram TLV4961-3T. ....	9
Figure 5	Output signal TLV4961-3T. ....	9
Figure 6	Start-up behavior of the TLV4961-3T. ....	10
Figure 7	Basic application circuit #1: only pull-up resistor is necessary. ....	11
Figure 8	Enhanced application circuit #2: for extended ESD robustness. ....	11
Figure 9	Definition of magnetic field direction TO92S-3-1, TO92S-3-2. ....	15
Figure 10	Package outline TLV4961-3TA: TO92S-3-1 (all dimensions in mm) ....	16
Figure 11	Package outline TLV4961-3TB: TO92S-3-2 (all dimensions in mm) ....	17
Figure 12	Packing information. ....	18
Figure 13	Distance between chip and package. ....	18
Figure 14	Marking of TLV4961-3T. ....	19

Product description

1 Product description



1.1 Overview

Characteristic	Supply Voltage	Supply Current	Sensitivity	Interface	Temperature
Bipolar Hall Effect Latch	3.0 V ~ 26 V	1.6 mA	$B_{OP}$ : 7.5 mT $B_{RP}$ : -7.5 mT	Open Drain Output	-40°C to 125°C

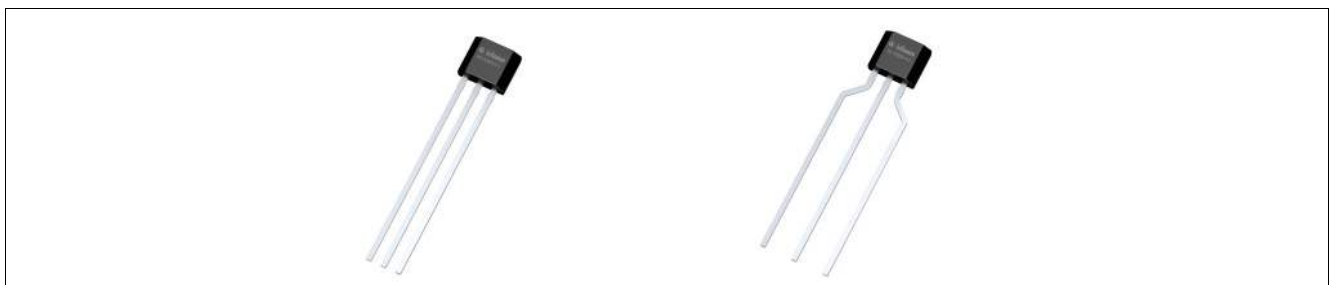


Figure 1 TLV4961-3T in the TO92S-3-1 and TO92S-3-2 package

1.2 Features

- 3.0 V to 26 V operating supply voltage
- Operation from unregulated power supply
- Output overcurrent and overtemperature protection
- Active error compensation
- High stability of magnetic thresholds
- High ESD performance
- Leaded, halogen-free package TO92S-3-1 for TLV4961-3TA, TO92S-3-2 for TLV4961-3TB

For automotive applications please refer to the Infineon TLE Hall Switches/Latches series.

Table 1 Ordering information

Product name	Product type	Ordering code	Package
TLV4961-3TA	Bipolar Hall Latch	SP001274776	TO92S-3-1 (Bulk)
TLV4961-3TB	Bipolar Hall Latch	SP001283606	TO92S-3-2 (Ammo pack)

1) Only the package is halogen-free.

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**Product description****1.3 Target applications**

Target applications for the TLV496x Hall Latch family are all applications which require a high precision Hall Latch with an operating temperature range from -40°C to 125°C.

The magnetic behavior as a latch and switching thresholds of typical  $\pm 7.5$  mT make the device especially suited for the use with a pole wheel for index counting applications, for rotor position detection as in brushless DC motor commutation and for white goods or open/closing detection.

Functional description

## 2 Functional description

### 2.1 General

The TLV4961-3T is an integrated Hall effect latch designed specifically for highly accurate applications with superior supply voltage capability and temperature stability of the magnetic thresholds.

### 2.2 Pin configuration (top view)

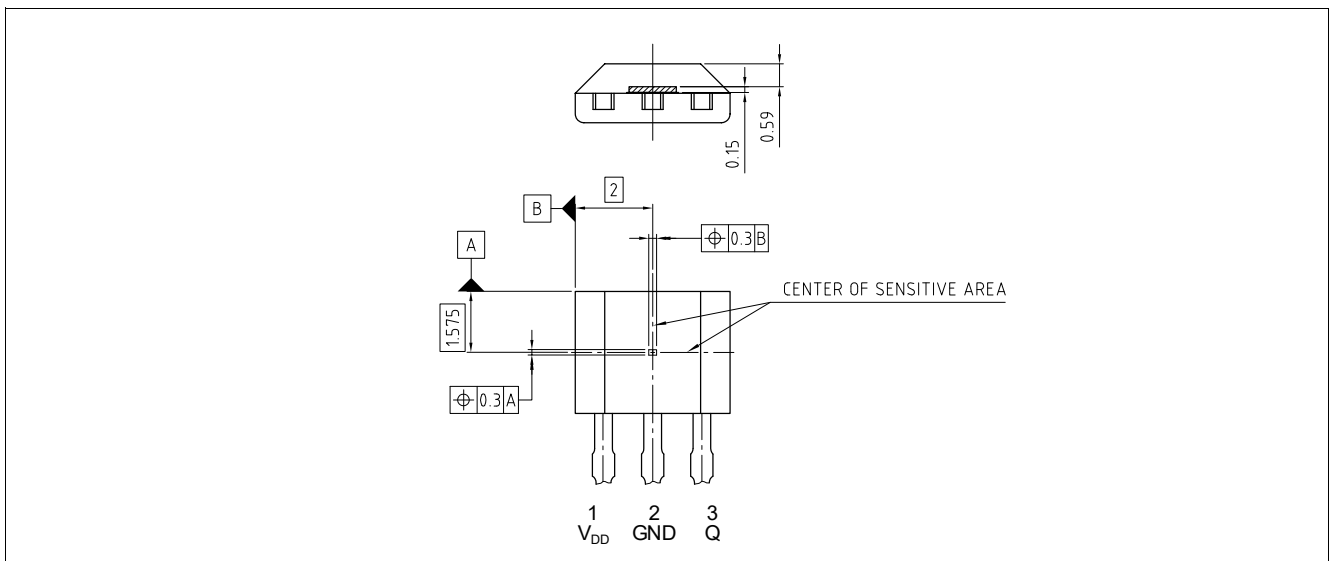


Figure 2 Pin configuration and center of sensitive area

### 2.3 Pin description

Table 2 Pin description

Pin no.	Symbol	Function
1	VDD	Supply voltage
2	GND	Ground
3	Q	Output

Functional description

2.4 Block diagram

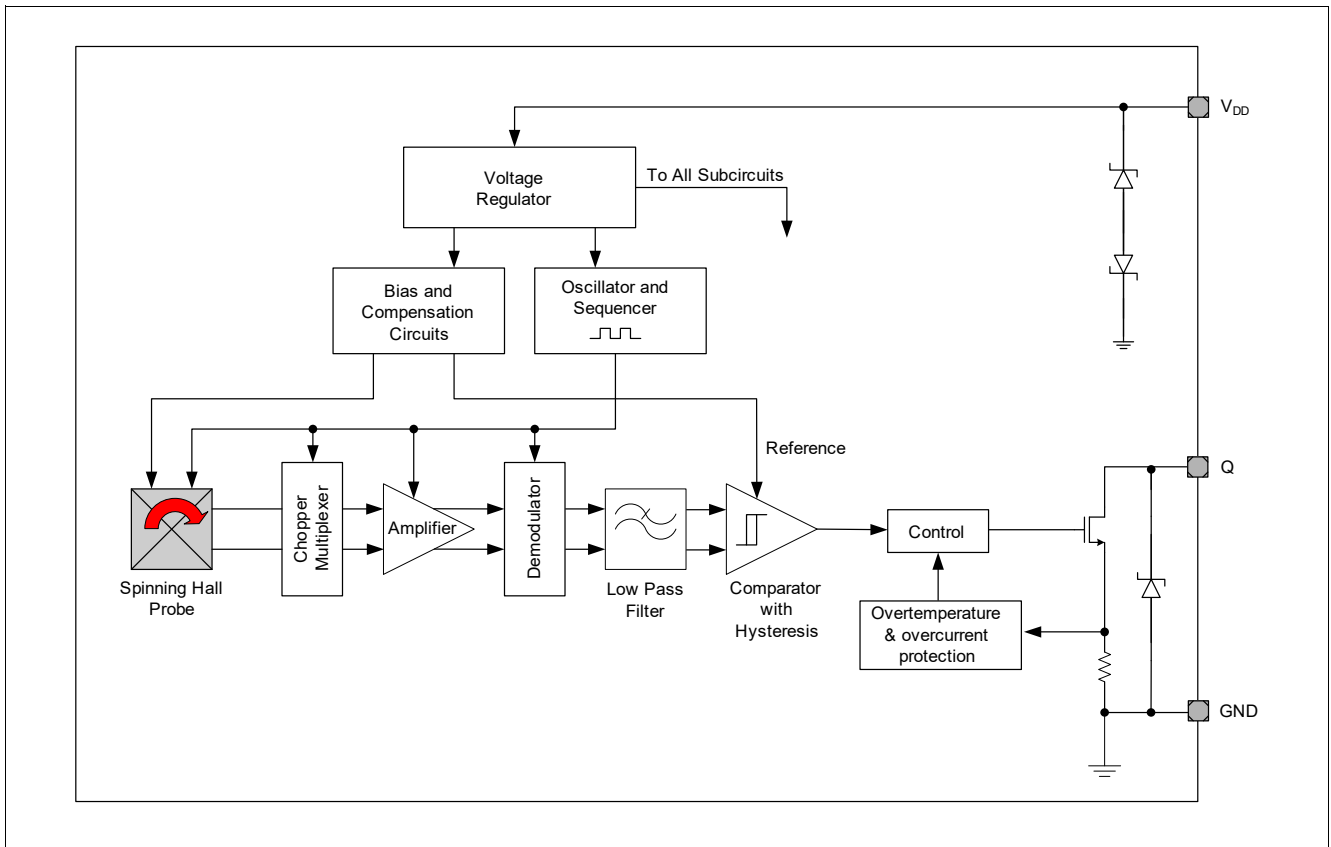


Figure 3 Functional block diagram TLV4961-3T



**Functional description**

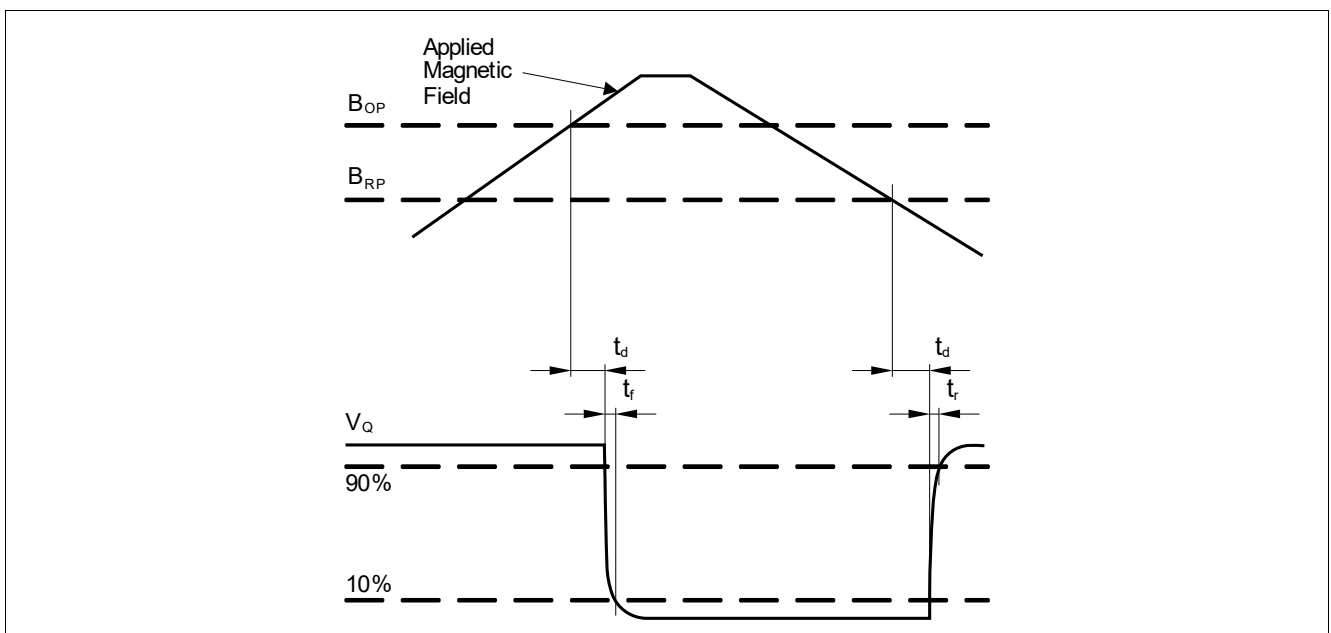
**2.5 Functional block description**

The chopped Hall IC switch comprises a Hall probe, bias generator, compensation circuits, oscillator and output transistor.

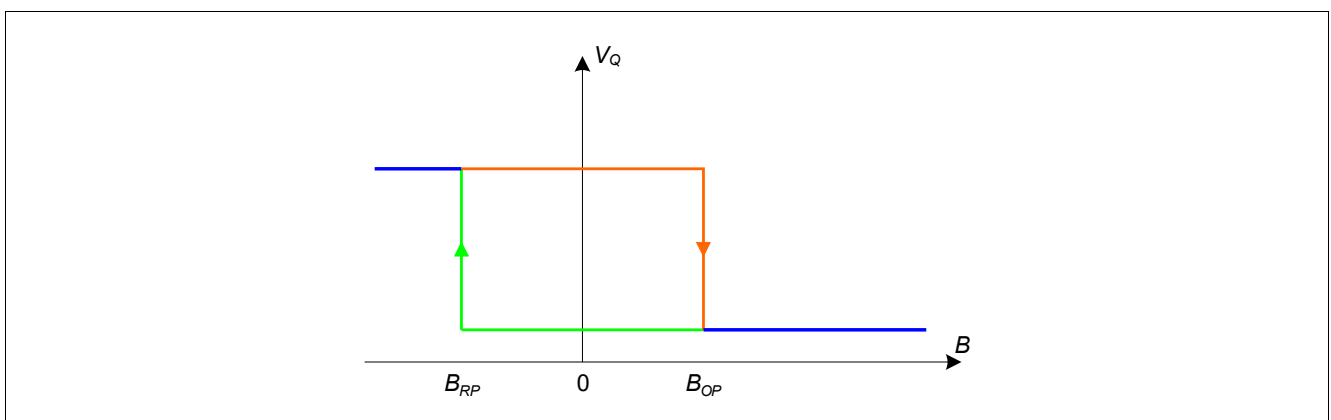
The bias generator provides currents for the Hall probe and the active circuits. Compensation circuits stabilize the temperature behavior and reduce influence of technology variations.

The active error compensation (chopping technique) rejects offsets in the signal path and the influence of mechanical stress to the Hall probe caused by molding and soldering processes and other thermal stress in the package. The chopped measurement principle together with the threshold generator and the comparator ensures highly accurate and temperature stable magnetic thresholds.

The output transistor has an integrated overcurrent and overtemperature protection.



**Figure 4 Timing diagram TLV4961-3T**



**Figure 5 Output signal TLV4961-3T**

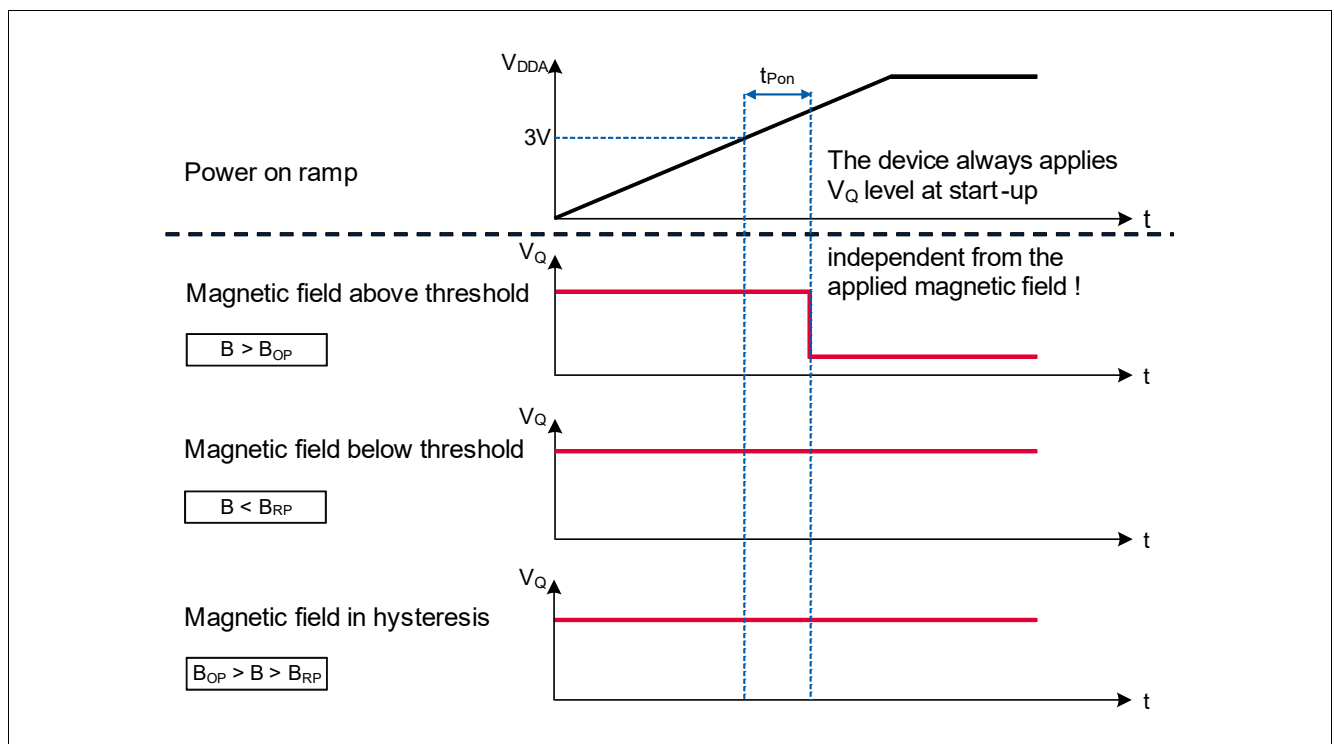
**Functional description**

**2.6 Default start-up behavior**

The magnetic thresholds exhibit a hysteresis  $B_{HYS} = B_{OP} - B_{RP}$ . In case of a power-on with a magnetic field  $B$  within hysteresis ( $B_{OP} > B > B_{RP}$ ) the output of the sensor is set to the pull up voltage level ( $V_Q$ ) per default. After the first crossing of  $B_{OP}$  or  $B_{RP}$  of the magnetic field the internal decision logic is set to the corresponding magnetic input value.

$V_{DDA}$  is the internal supply voltage which is following the external supply voltage  $V_{DD}$ .

This means for  $B > B_{OP}$  the output is switching, for  $B < B_{RP}$  and  $B_{OP} > B > B_{RP}$  the output stays at  $V_Q$ .



**Figure 6 Start-up behavior of the TLV4961-3T**

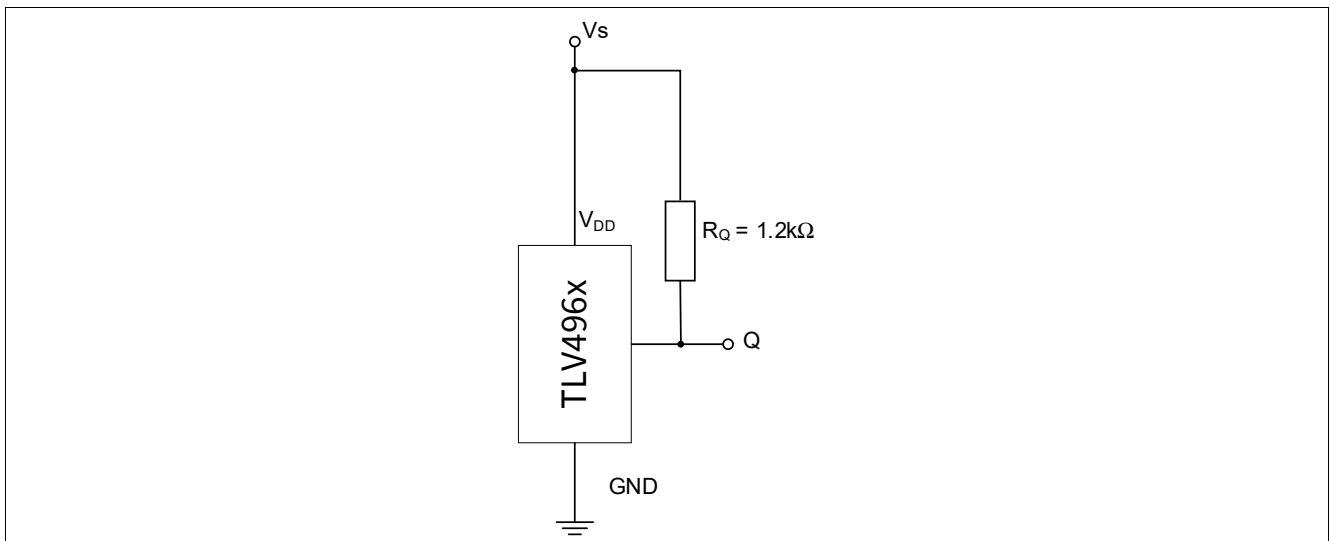
Specification

### 3 Specification

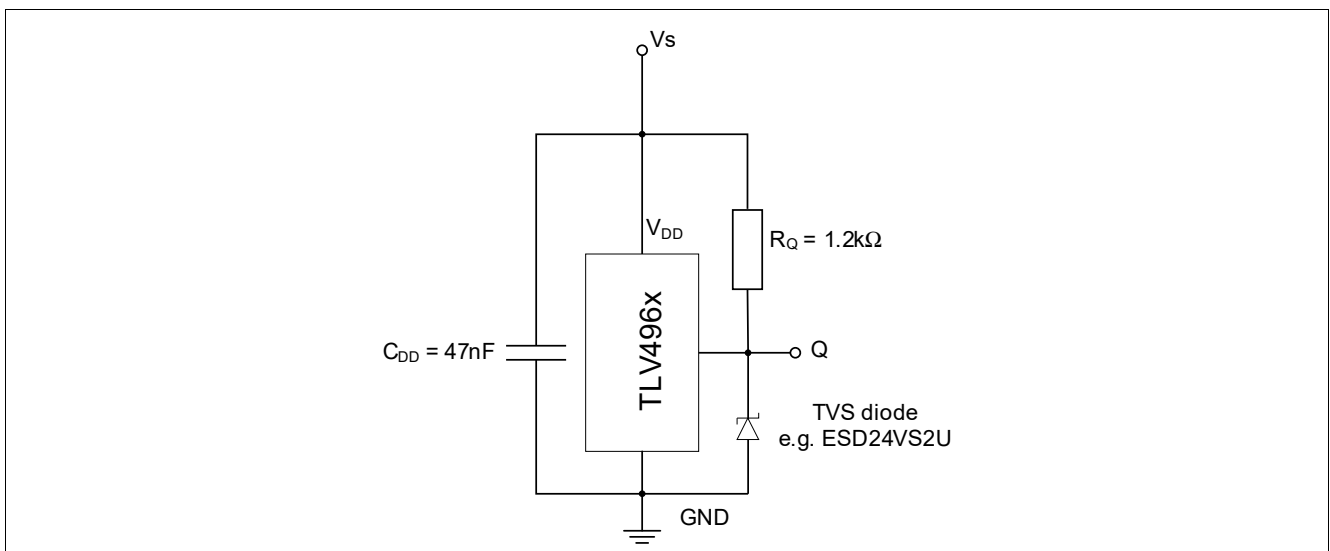
#### 3.1 Application circuit

The following **Figure 7** shows the basic option of an application circuit. Only a pull-up resistor  $R_Q$  is necessary. The resistor  $R_Q$  has to be in a dimension to match the applied  $V_S$  to keep  $I_Q$  limited to the operating range of maximum 25 mA.

e.g.:  $V_S = 12\text{ V}$ ;  $I_Q = 12\text{ V}/1200\ \Omega = 10\text{ mA}$



**Figure 7 Basic application circuit #1: only pull-up resistor is necessary**



**Figure 8 Enhanced application circuit #2: for extended ESD robustness**

With an additional capacitor  $C_{DD}$  and a transient voltage suppression (TVS) diode an extended ESD robustness on system level is achieved (**Figure 8**).

## Specification

### 3.2 Absolute maximum ratings

**Table 3 Absolute maximum rating parameters**

Parameter	Symbol	Values			Unit	Note or Test Condition
		Min.	Typ.	Max.		
Supply voltage <sup>1)</sup>	$V_{DD}$	3	–	26	V	–
Output voltage	$V_Q$	-0.5	–	26	V	–
Reverse output current	$I_Q$	-70	–	–	mA	–
Junction temperature <sup>1)</sup>	$T_J$	-40	–	150	°C	–
Storage temperature	$T_S$	-40	–	150	°C	–
Thermal resistance Junction ambient	$R_{thJA}$	–	–	250	K/W	for TO92S-3-1, TO92S-3-2 (2s2p)

1) This lifetime statement is an anticipation based on an extrapolation of Infineon's qualification test results. The actual lifetime of a component depends on its form of application and type of use etc. and may deviate from such statement. The lifetime statement shall in no event extend the agreed warranty period.

**Attention:** *Stresses above the max. values listed here may cause permanent damage to the device. Exposure to absolute maximum rating conditions for extended periods may affect device reliability. Maximum ratings are absolute ratings; exceeding only one of these values may cause irreversible damage to the integrated circuit.*

Calculation of the dissipated power  $P_{DIS}$  and junction temperature  $T_J$  of the chip (TO92S example):

e.g. for:  $V_{DD} = 12\text{ V}$ ,  $I_S = 2.5\text{ mA}$ ,  $V_{QSAT} = 0.5\text{ V}$ ,  $I_Q = 20\text{ mA}$

Power dissipation:  $P_{DIS} = 12\text{ V} \times 2.5\text{ mA} + 0.5\text{ V} \times 20\text{ mA} = 30\text{ mW} + 10\text{ mW} = 40\text{ mW}$

Temperature  $\Delta T = R_{thJA} \times P_{DIS} = 250\text{ K/W} \times 40\text{ mW} = 10\text{ K}$

For  $T_A = 50^\circ\text{C}$ :  $T_J = T_A + \Delta T = 50^\circ\text{C} + 10\text{ K} = 60^\circ\text{C}$

## Specification

**Table 4 ESD protection<sup>1)</sup> ( $T_A = 25^\circ\text{C}$ )**

Parameter	Symbol	Values			Unit	Note or Test Condition
		Min.	Typ.	Max.		
ESD voltage (HBM) <sup>2)</sup>	$V_{\text{ESD}}$	-4	-	4	kV	$R = 1.5 \text{ k}\Omega$ , $C = 100 \text{ pF}$
ESD voltage (CDM) <sup>3)</sup>	$V_{\text{ESD}}$	-1	-	1	kV	-

1) Characterization of ESD is carried out on a sample basis, not subject to production test.

2) Human Body Model (HBM) tests according to ANSI/ESDA/JEDEC JS-001.

3) Charge device model (CDM) tests according to JESD22-C101.

### 3.3 Operating range

The following operating conditions must not be exceeded in order to ensure correct operation of the TLV4961-3T.

All parameters specified in the following sections refer to these operating conditions unless otherwise mentioned.

The maximum tested magnetic field is 600 mT.

**Table 5 Operating conditions parameters**

Parameter	Symbol	Values			Unit	Note or Test Condition
		Min.	Typ.	Max.		
Supply voltage	$V_{\text{DD}}$	3.0	-	26 <sup>1)</sup>	V	-
Output voltage	$V_{\text{Q}}$	3.0	-	26	V	-
Operation temperature	$T_A$	-40	-	125	$^\circ\text{C}$	$R_{\text{thJA}} \leq 250 \text{ K/W}$
Output current	$I_{\text{Q}}$	0	-	25	mA	-

1) Latch-up test with factor 1.5 is not covered. Please see max ratings also.

## Specification

### 3.4 Electrical and magnetic characteristics

Product characteristics involve the spread of values guaranteed within the specified voltage and ambient temperature range. Typical characteristics are the median of the production and correspond to  $V_{DD} = 12\text{ V}$  and  $T_A = 25^\circ\text{C}$ . The below listed specification is valid in combination with the application circuit shown in [Figure 7](#) and [Figure 8](#).

**Table 6 General electrical characteristics**

Parameter	Symbol	Values			Unit	Note or Test Condition
		Min.	Typ.	Max.		
Supply current	$I_S$	1.1	1.6	2.5	mA	–
Output current limitation	$I_{QLIMIT}$	30	56	70	mA	internally limited and thermal shutdown
Output fall time <sup>1)</sup>	$t_f$	0.17	0.4	1	$\mu\text{s}$	1.2 k $\Omega$ / 50 pF, see <a href="#">Figure 4</a>
Output rise time <sup>1)</sup>	$t_r$	0.4	0.5	1	$\mu\text{s}$	1.2 k $\Omega$ / 50 pF, see <a href="#">Figure 4</a>
Delay time <sup>1)2)</sup>	$t_d$	12	15	30	$\mu\text{s}$	see <a href="#">Figure 4</a>
Power-on time <sup>1)3)</sup>	$t_{PON}$	–	80	150	$\mu\text{s}$	$V_{DD} = 3\text{ V}$ , $B \leq B_{RP} - 0.5\text{ mT}$ or $B \geq B_{OP} + 0.5\text{ mT}$

- 1) Not subject to production test, verified by design/characterization.
- 2) Systematic delay between magnetic threshold reached and output switching.
- 3) Time from applying  $V_{DD} = 3.0\text{ V}$  to the sensor until the output is valid.

Specification

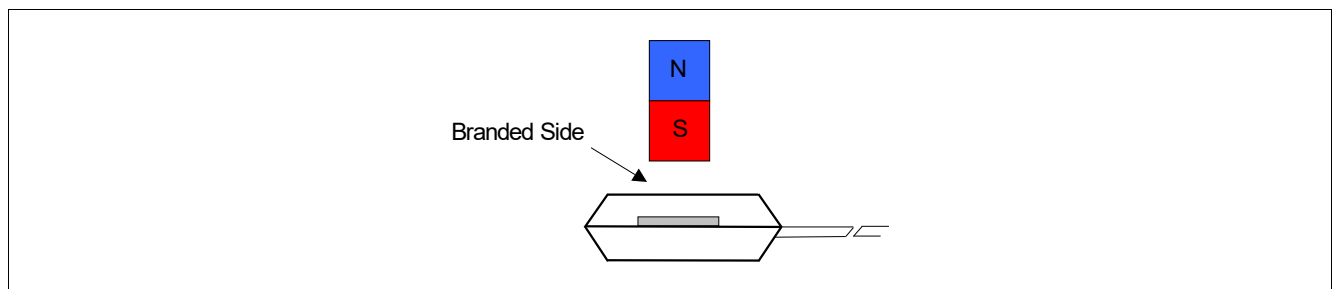
**Table 7 Magnetic characteristics**

Parameter	Symbol	T (°C)	Values			Unit	Note / Test Condition
			Min.	Typ.	Max.		
Operating point	$B_{OP}$	-40	5.2	8.4	11.5	mT	-
		25	4.6	7.5	10.4		
		125	3.6	6.2	8.7		
Release point	$B_{RP}$	-40	-11.5	-8.4	-5.2	mT	-
		25	-10.4	-7.5	-4.6		
		125	-8.7	-6.2	-3.6		
Hysteresis	$B_{HYS}$	-40	12.4	16.8	22.9	mT	-
		25	11.2	15.0	20.8		
		125	9.2	12.3	17.4		
Temperature compensation of magnetic thresholds <sup>1)</sup>	$T_C$	-	-	-1800	-	ppm/K	-

1) Not subject to production test, verified by design/characterization.

**Field direction definition**

Positive magnetic fields are defined with the south pole of the magnet to the branded side of package.



**Figure 9 Definition of magnetic field direction T092S-3-1, T092S-3-2**

Package information

### 4 Package information

The TLV4961-3TA is available in Bulk packing with TO92S-3-1-package.  
 The TLV4961-3TB is available in AMMO packing with TO92S-3-2-package.

#### 4.1 Package outline

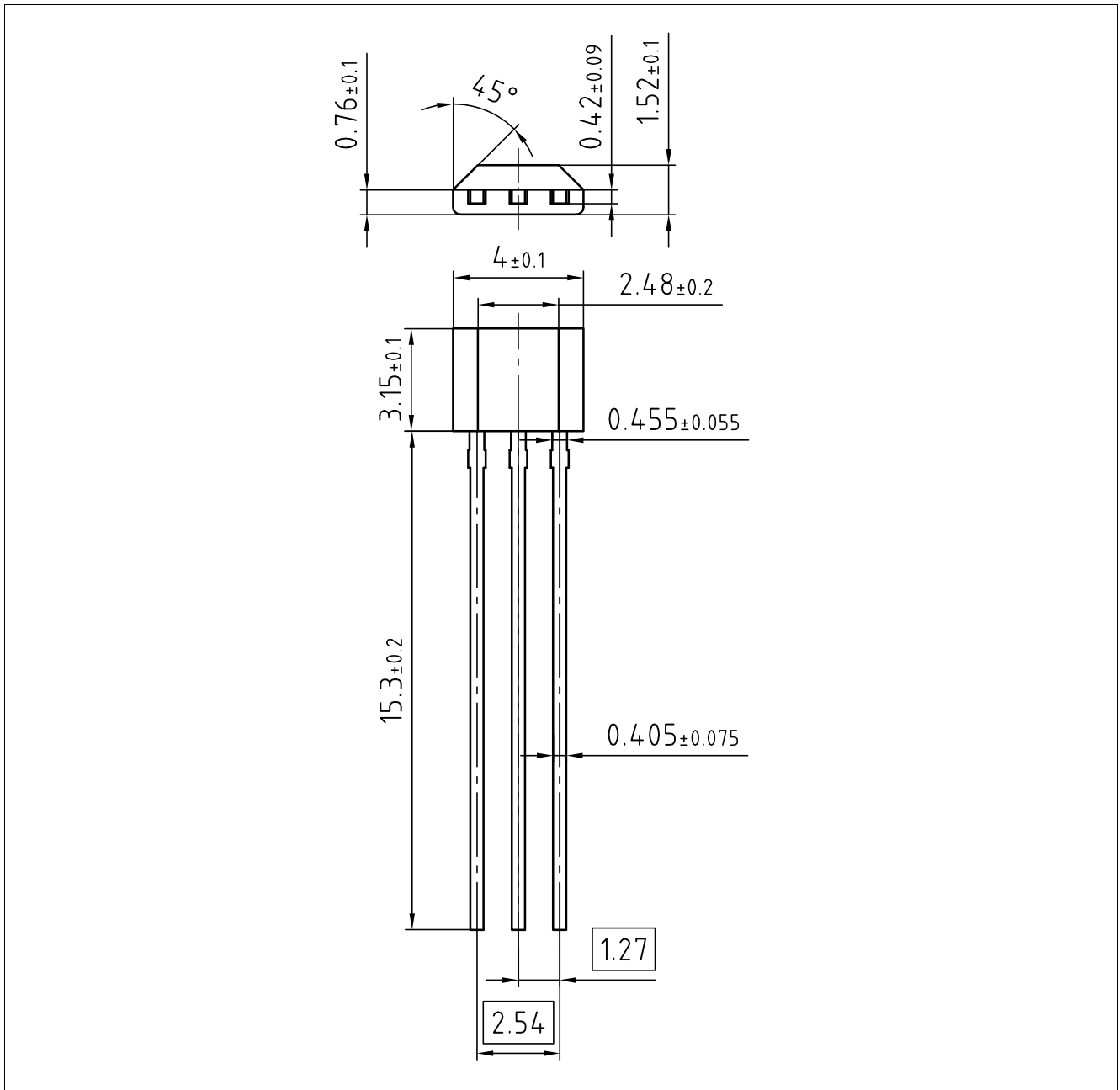


Figure 10 Package outline TLV4961-3TA: TO92S-3-1 (all dimensions in mm)



Package information

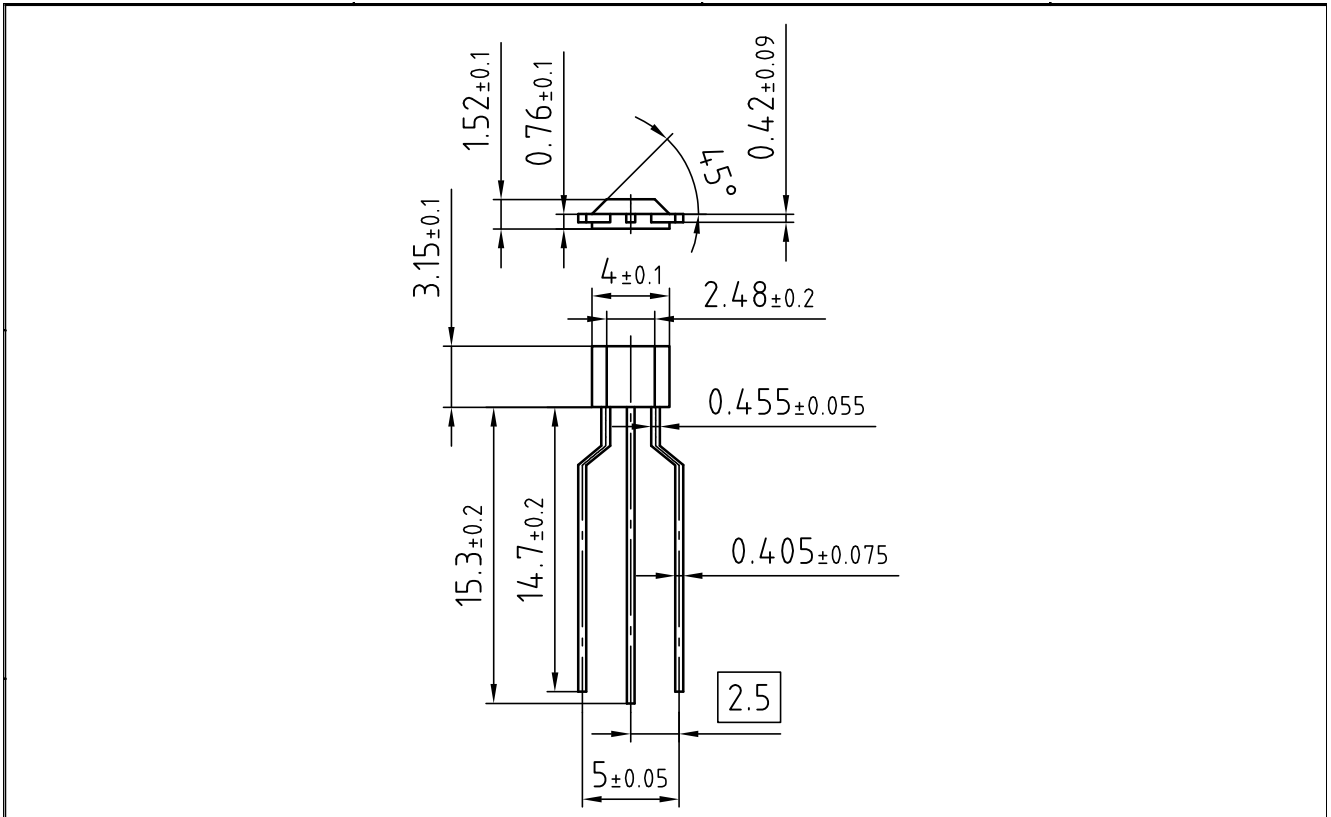


Figure 11 Package outline TLV4961-3TB: TO92S-3-2 (all dimensions in mm)

Package information

4.2 Packing information

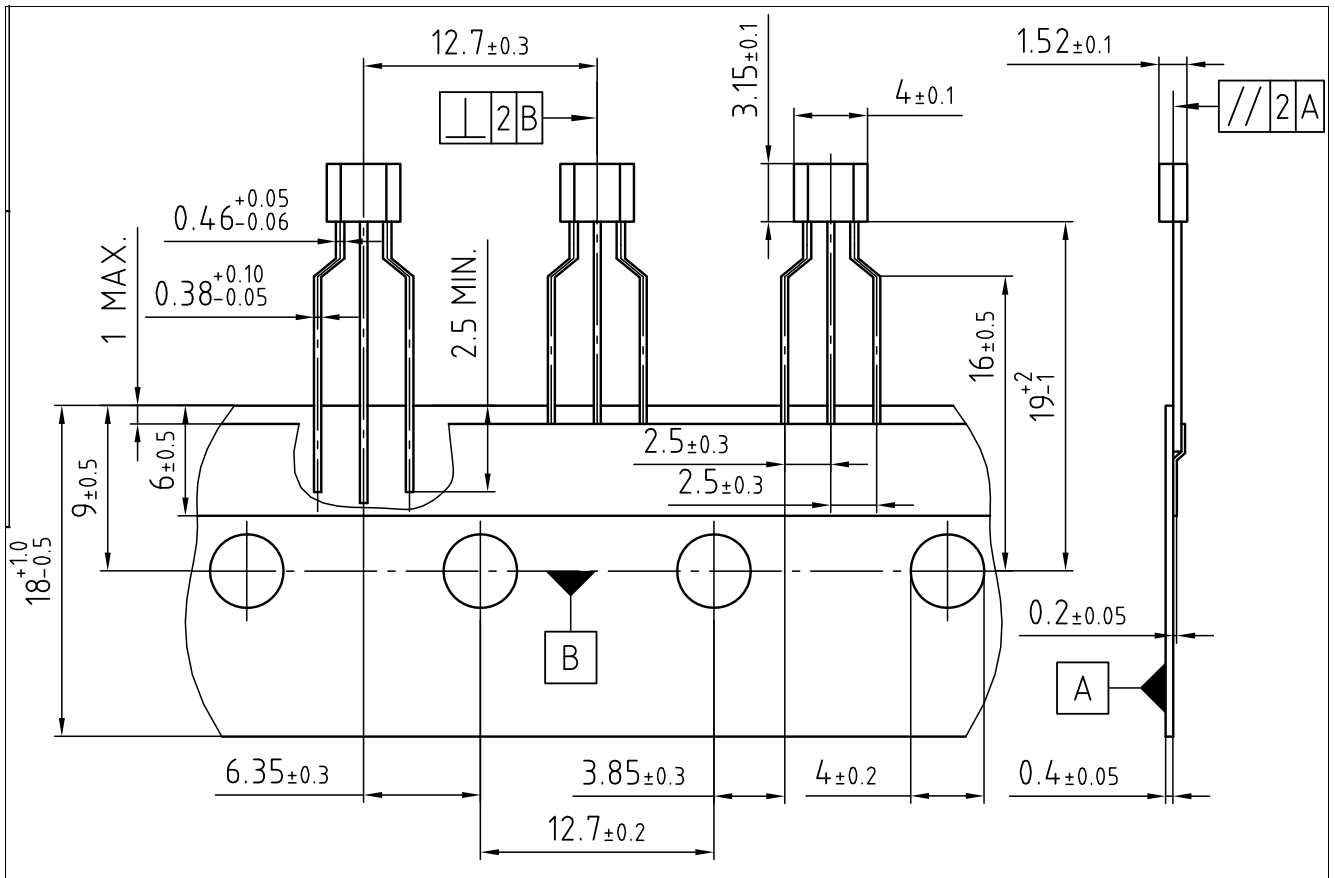


Figure 12 Packing information

4.3 Distance between chip and package

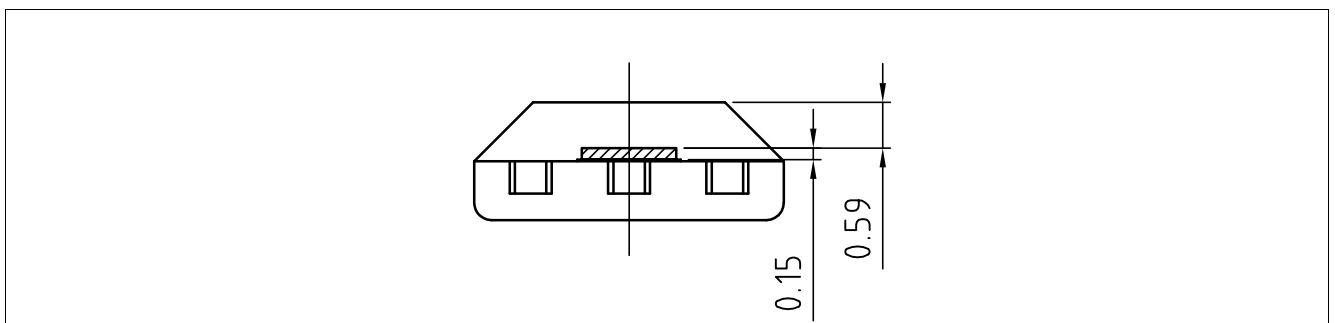


Figure 13 Distance between chip and package

Package information

4.4 Package marking

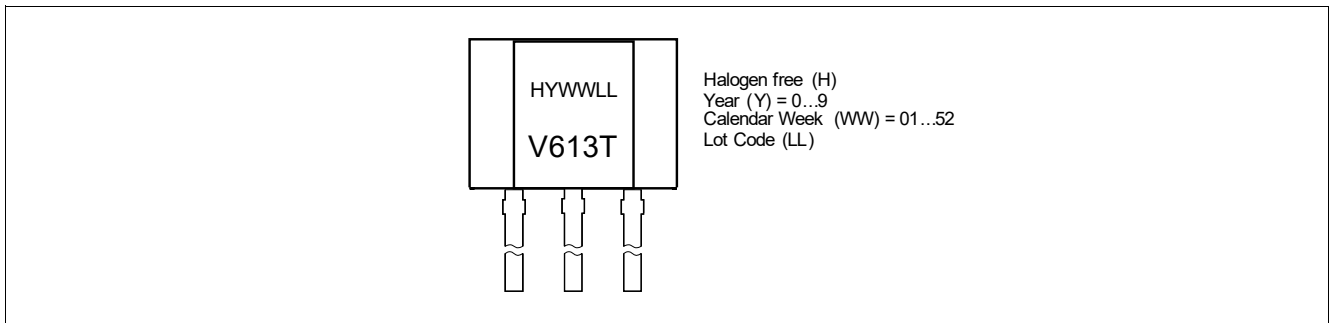


Figure 14 Marking of TLV4961-3T

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**Revision history****5 Revision history**

<b>Revision</b>	<b>Date</b>	<b>Changes</b>
Revision 1.2	2019-12-20	Updated text and figure in <b>Chapter 2.6</b> Updated standards in <b>Table 4</b> Added maximum tested magnetic field in <b>Chapter 3.3</b> Editorial changes
Revision 1.0	2015-05-18	Initial release

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