

# High Precision Hall Effect Switch for Consumer Applications

Hall Effect Switch

## TLV4964-4T

TLV4964-4TA

TLV4964-4TB

TLV4964-4T

## Data Sheet

Revision 1.0, 2015-05-18

Sense & Control

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## Product Description

### 1 Product Description



#### 1.1 Overview

Characteristic	Supply Voltage	Supply Current	Sensitivity	Interface	Temperature $T_A$
Hall Effect Switch	3.0~26 V	1.6 mA	$B_{OP}$ : 10 mT $B_{RP}$ : 8.5 mT	Open Drain Output	-40 °C to 125 °C



Figure 1 Image of TLV4964-4T TO92S-3-1 TO92S-3-2

#### 1.2 Features

- 3.0 V to 26 V operating supply voltage
- Operation from unregulated power supply
- Output overcurrent & overtemperature protection
- Active error compensation
- High stability of magnetic thresholds
- High ESD performance
- Leaded, halogen-free package TO92S-3-1 for TLV4964-4TA, TO92S-3-2 for TLV4964-4TB

#### 1.3 Target Applications

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

The TLV4964-4T is a unipolar switch with a typical operating point  $B_{OP} = 10$  mT and a hysteresis of  $B_{HYS} = 1.5$  mT. It is ideally suited for various position detection applications.

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

Table 1 Ordering Information

Product Name	Product Type	Ordering Code	Package
TLV4964-4TA	Hall Switch	SP001274780	TO92S-3-1 (Bulk)
TLV4964-4TB	Hall Switch	SP001283600	TO92S-3-2 (Ammo pack)

1) Only the package is halogen-free.

Functional Description

## 2 Functional Description

### 2.1 General

The TLV4964-4T is an integrated Hall effect designed specifically for highly accurate applications with superior supply voltage capability, and temperature stability of the magnetic thresholds.

### 2.2 Pin Configuration (top view)

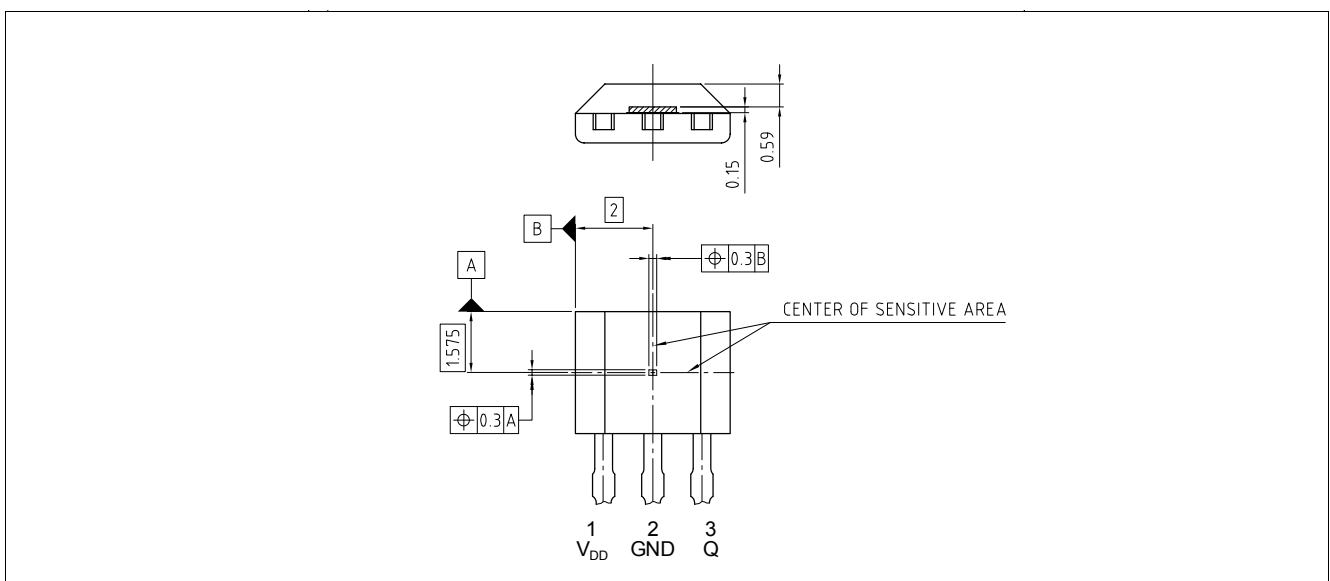


Figure 2 Pin Configuration and Center of Sensitive Area

### 2.3 Pin Description

Table 2 Pin Description

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

## Functional Description

### 2.4 Block Diagram

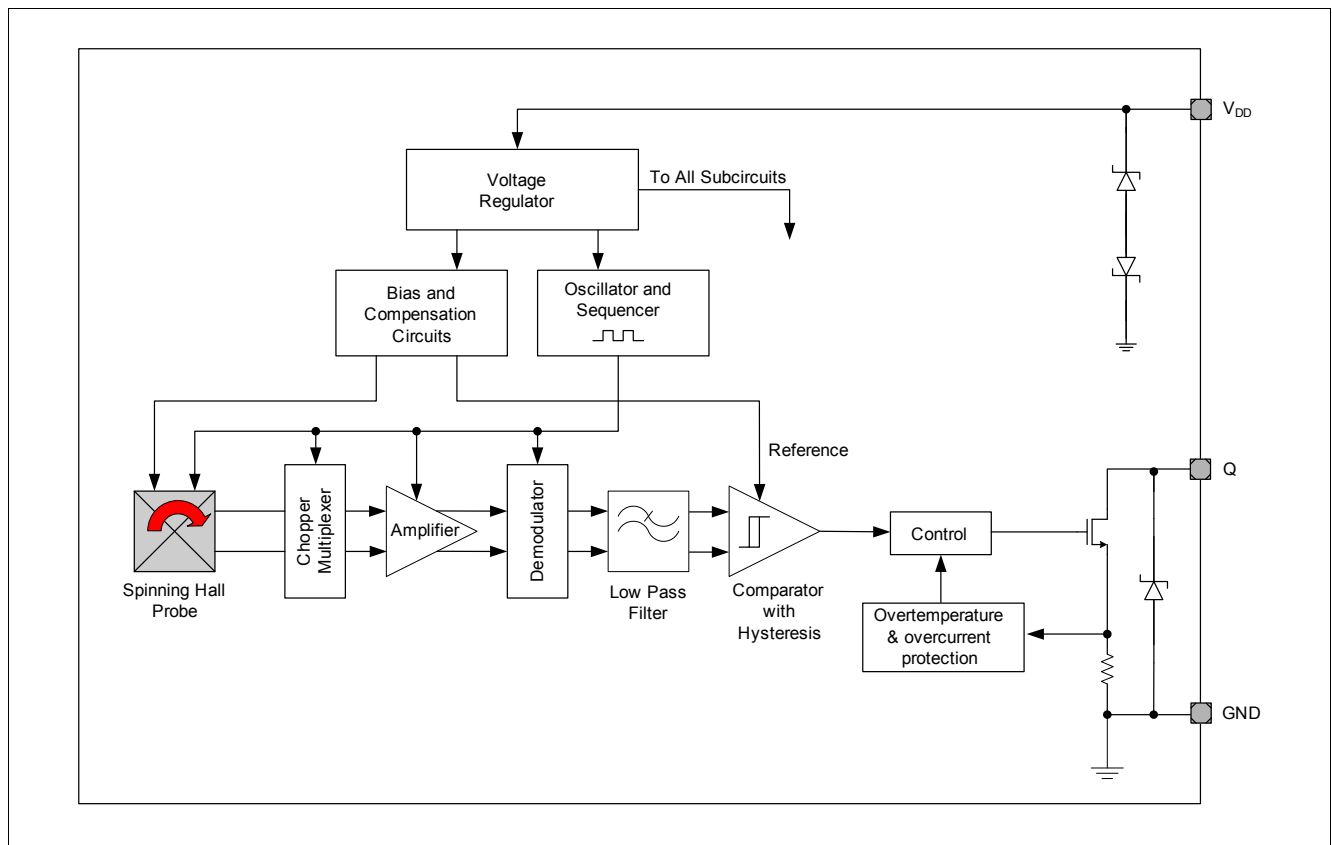


Figure 3 Functional Block Diagram TLV4964-4T

### 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.

Functional Description

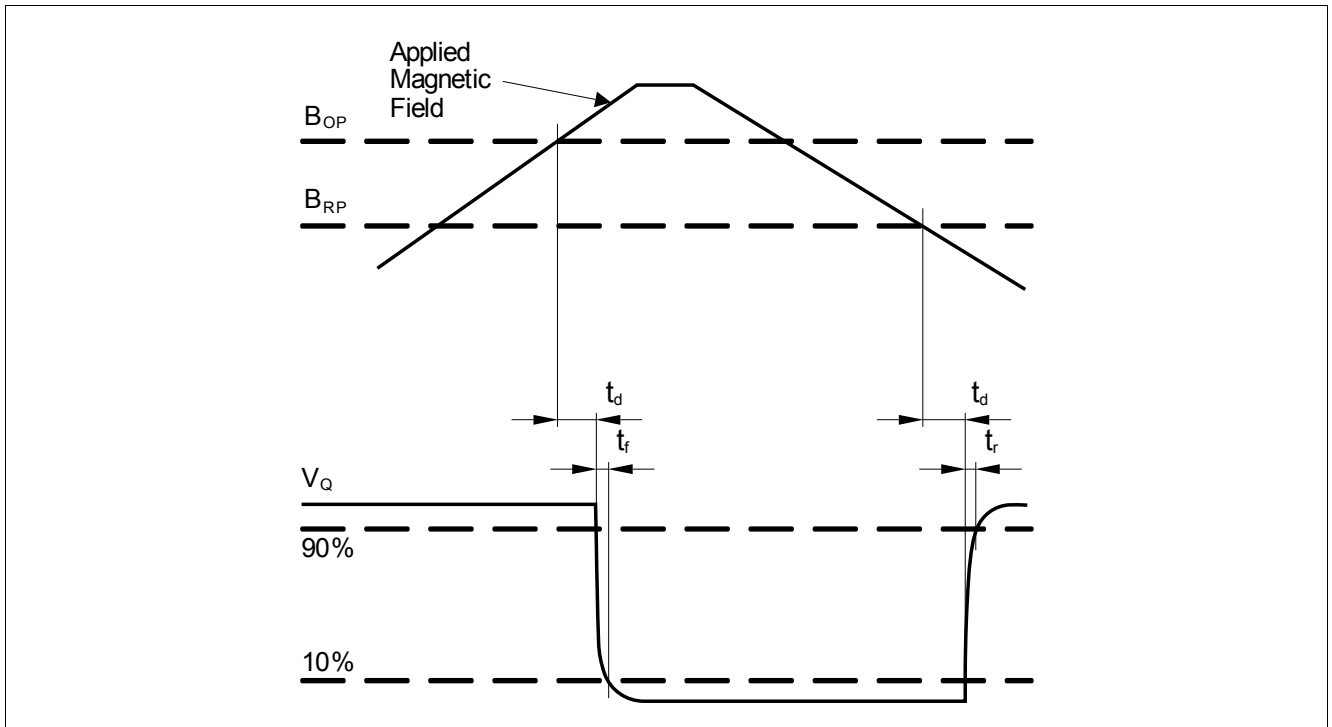


Figure 4 TLV4964-4T

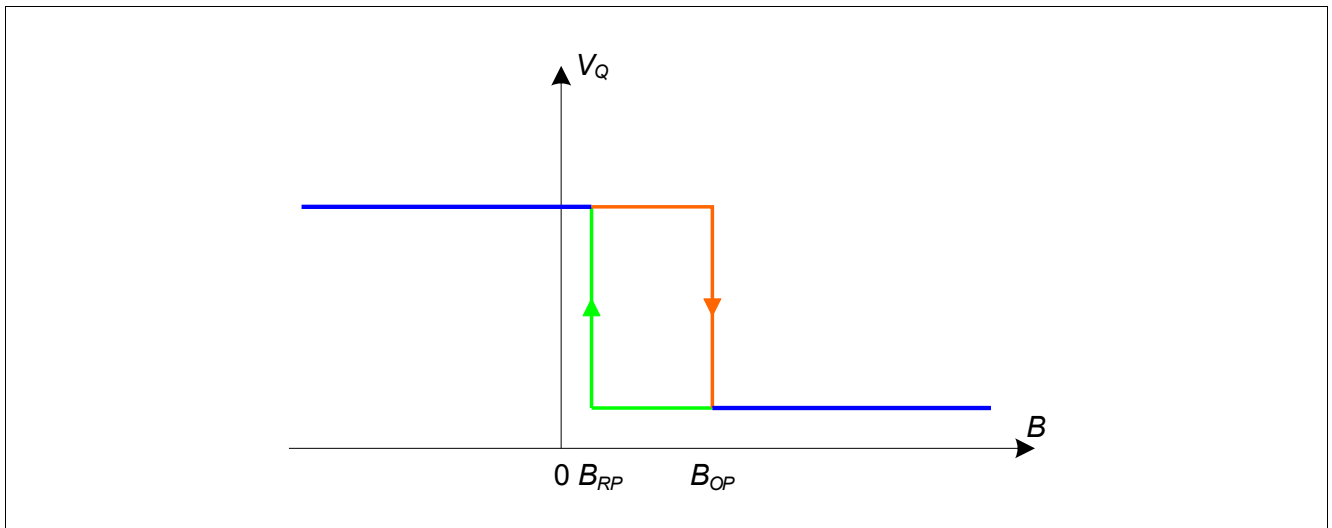


Figure 5 Output Signal TLV4964-4T



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  $V_Q$ .

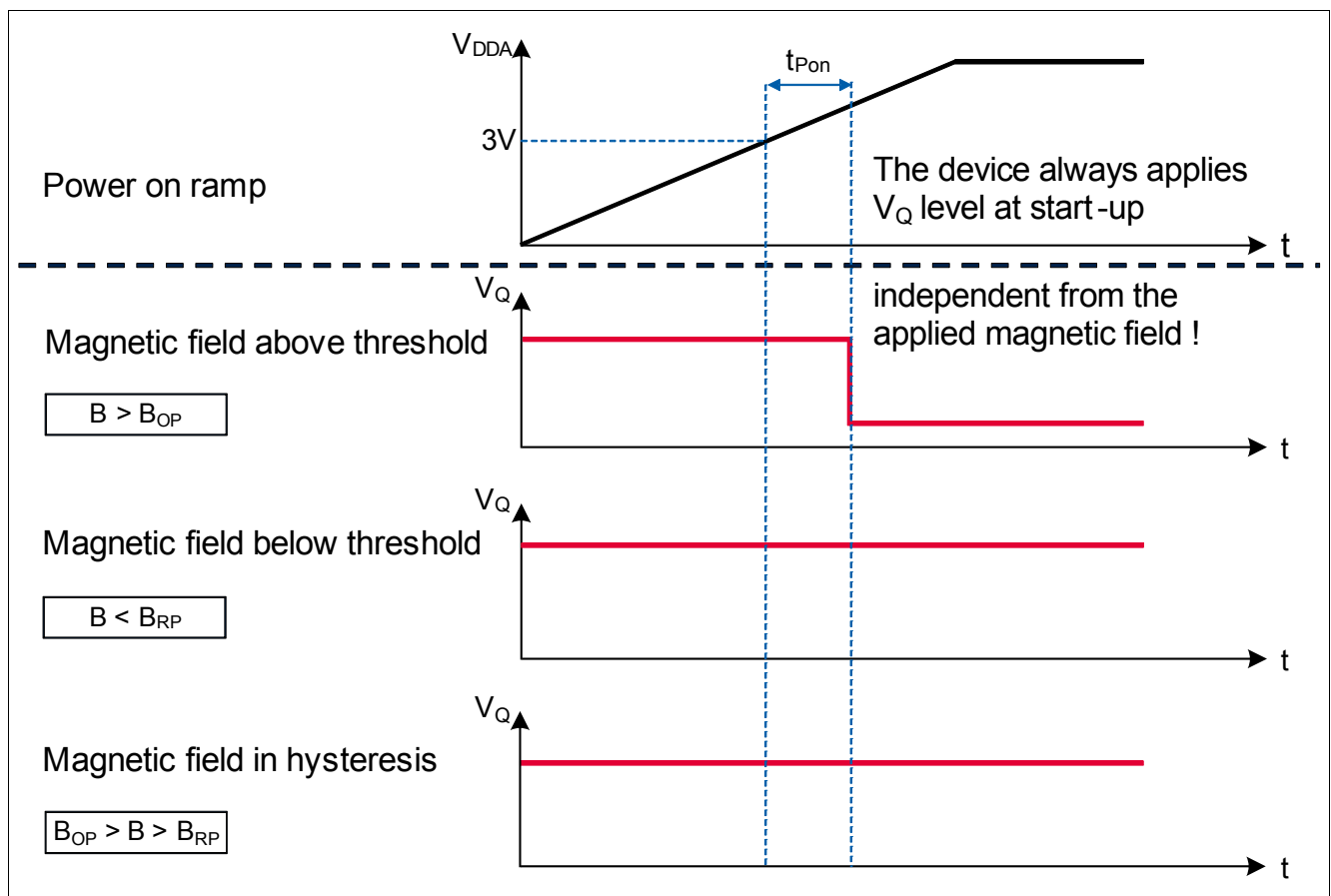


Figure 6 Illustration of the Start-up Behavior of the TLV4964-4T

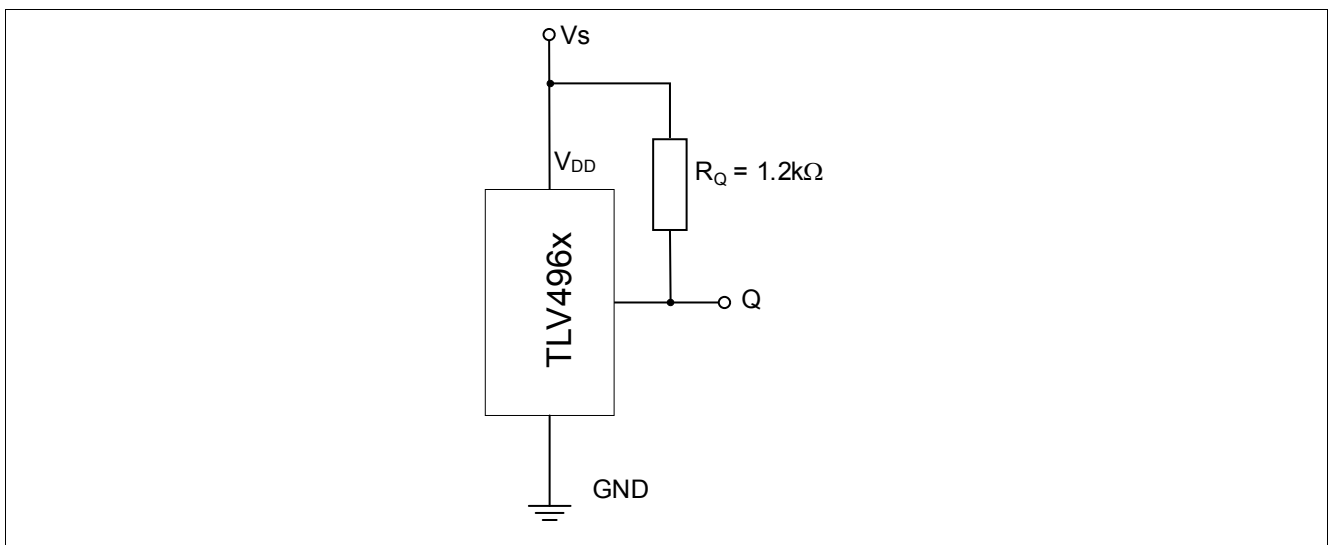
## Specification

### 3 Specification

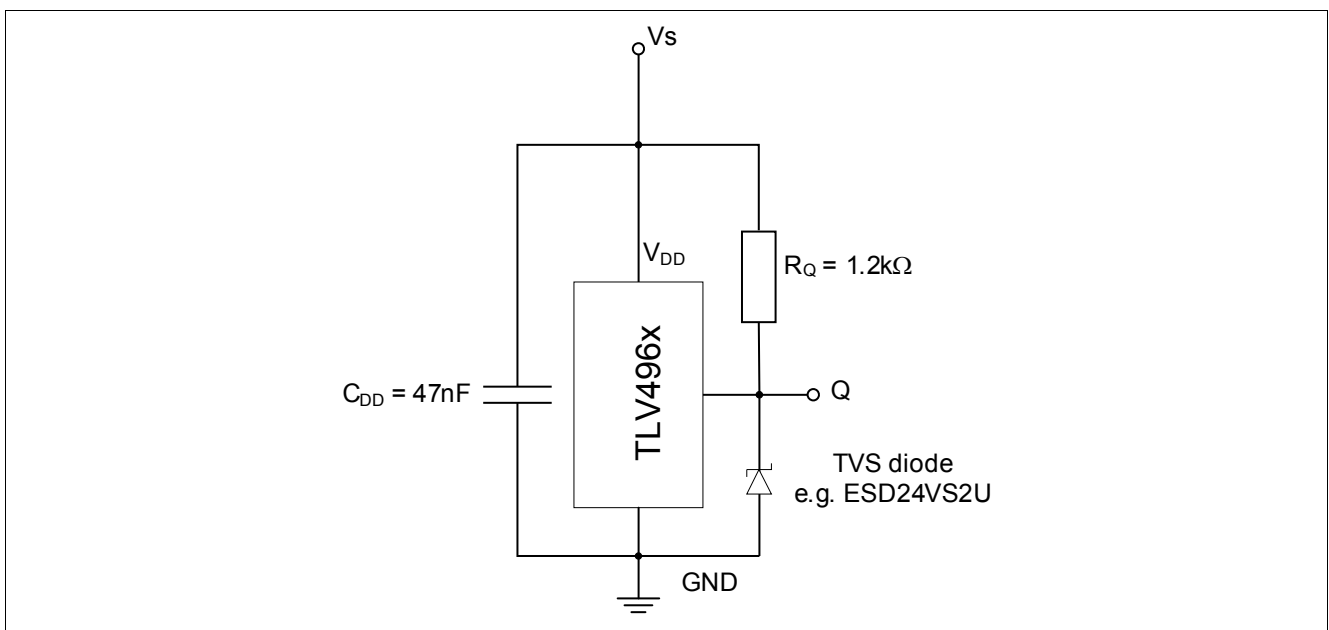
#### 3.1 Application Circuit

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-3-2 (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:

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

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

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

## Specification

### 3.3 Operating Range

The following operating conditions must not be exceeded in order to ensure correct operation of the TLV4964-4T.

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

**Table 5 Operating Conditions Parameters**

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

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

### 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 & 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

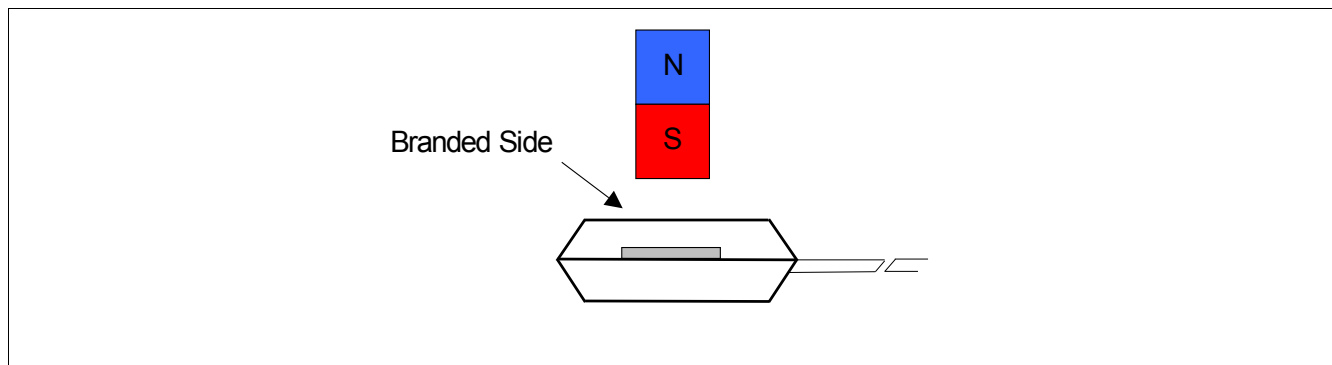
**Table 7 Magnetic Characteristics**

Parameter	Symbol	T (°C)	Values			Unit	Note / Test Condition
			Min.	Typ.	Max.		
Operating point	$B_{OP}$	-40	7.8	11.7	15.6	mT	-
		25	6.5	10.0	13.5		-
		125	4.6	7.4	10.3		-
Release point	$B_{RP}$	-40	6.5	9.9	13.4	mT	-
		25	5.4	8.5	11.6		-
		125	3.7	6.3	8.9		-
Hysteresis	$B_{HYS}$	-40	1.0	1.8	2.5	mT	-
		25	0.8	1.5	2.2		-
		125	0.5	1.1	1.7		-
Temperature compensation of magnetic thresholds <sup>1)</sup>	$T_C$	-	-	-2600	-	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-3-2, T092S-3-1**

Package Information

### 4 Package Information

The TLV4964-4TA is available in Bulk packing with TO92S-3-1-package.

The TLV4964-4TB is available in AMMO packing with TO92S-3-2-package.

#### 4.1 Package Outline

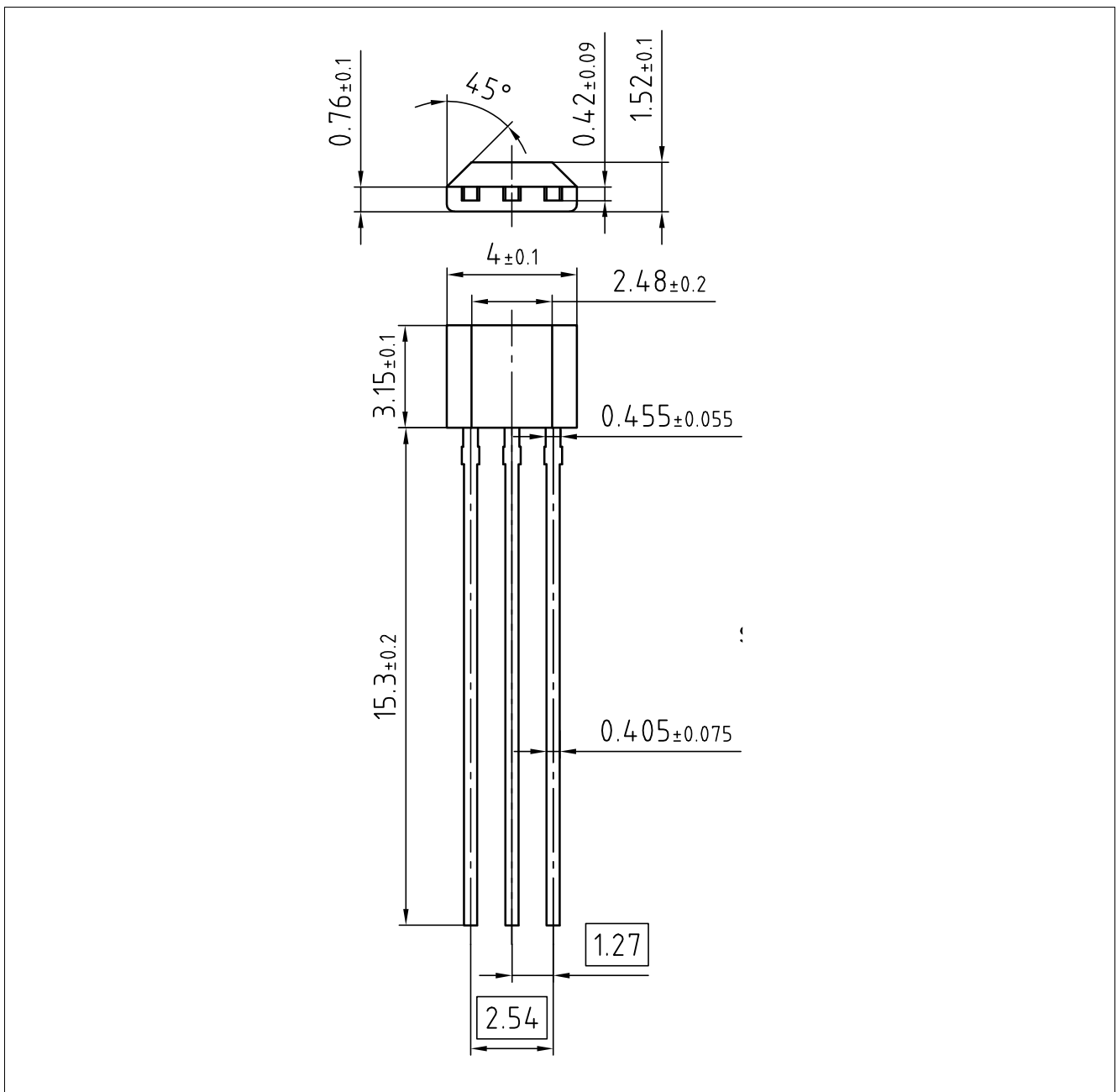


Figure 10 Package Outline TLV4964-4TA: TO92S-3-1 (All Dimensions in mm)

Package Information

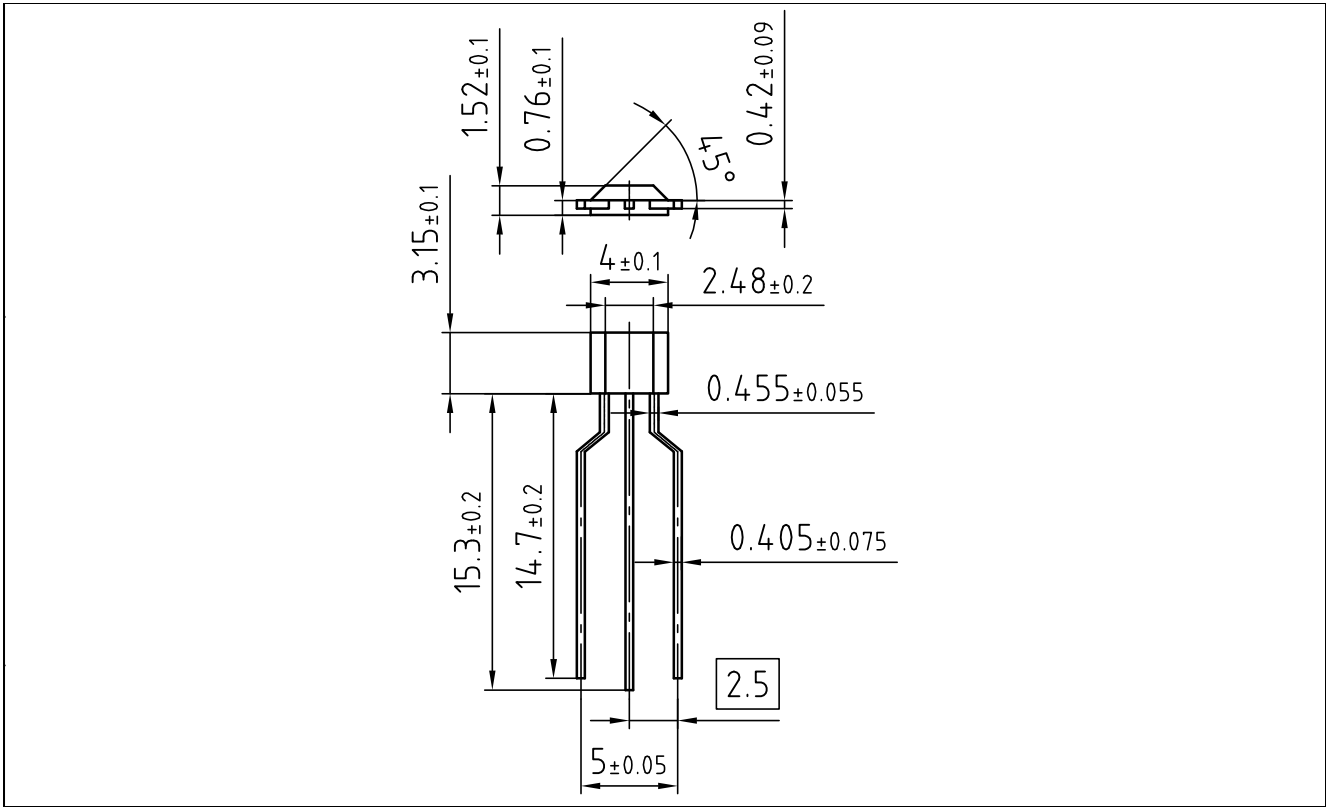


Figure 11 Package Outline TLV4964-4TB: TO92S-3-2 (All Dimensions in mm)

Package Information

4.2 Packing Information

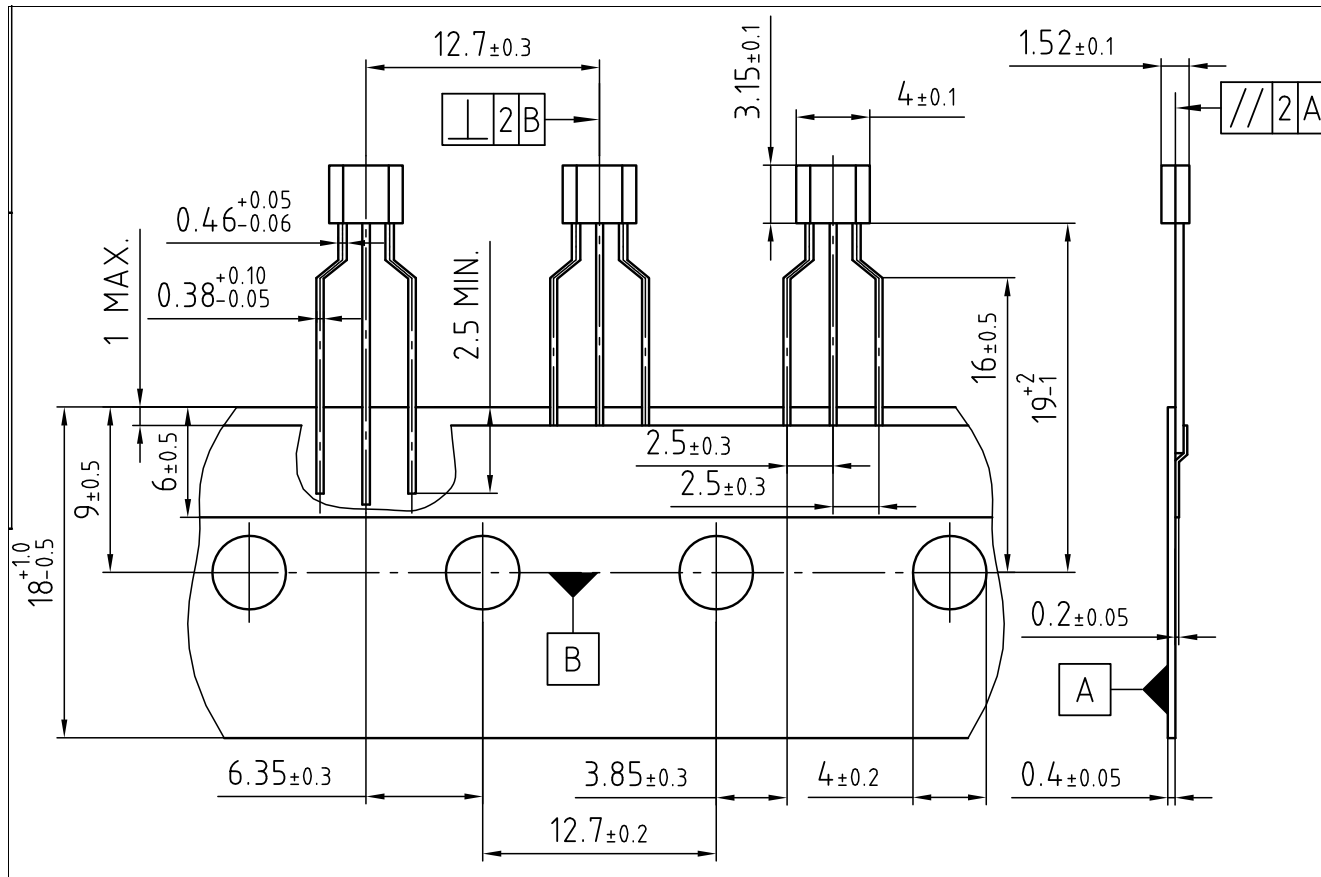


Figure 12 Packing of the TLV4964-4TB TO92S-3-2

4.3 TO92S-3-2 Distance between Chip and Package

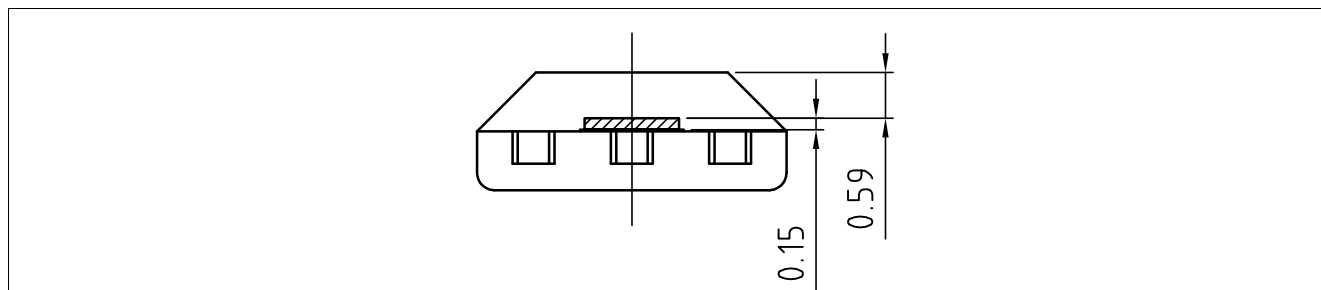


Figure 13 Distance between Chip and Package



Package Information

4.4 Package Marking

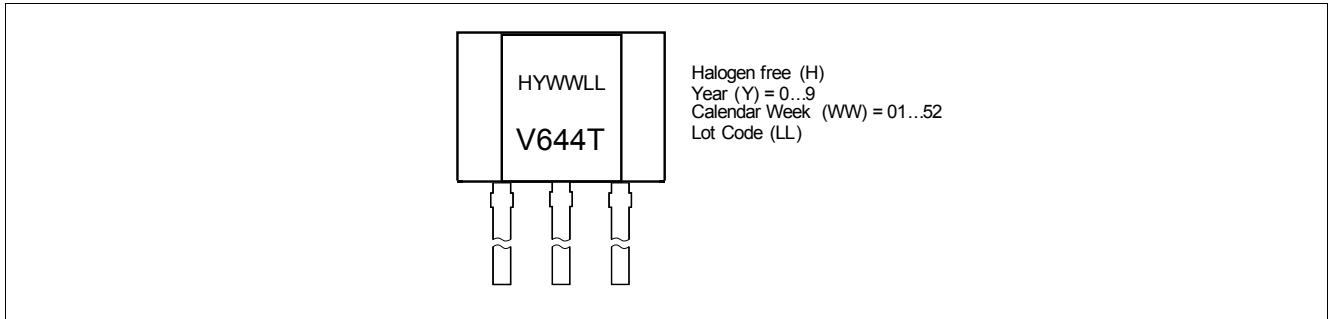


Figure 14 Marking of TLV4964-4T

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**Revision History****5 Revision History**

<b>Revision</b>	<b>Date</b>	<b>Changes</b>
1.0	2015-05-18	Initial release.

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