TLE4961-3K

High Precision Automotive Hall Effect Latch

Technical Product Description

Rev. 1.0, 2012-01-17

Sense & Control

Edition 2012-01-17

Published by
Infineon Technologies AG
81726 Munich, Germany

Legal Disclaimer

The information given in this document shall in no event be regarded as a guarantee of conditions or characteristics. With respect to any examples or hints given herein, any typical values stated herein and/or any information regarding the application of the device, Infineon Technologies hereby disclaims any and all warranties and liabilities of any kind, including without limitation, warranties of non-infringement of intellectual property rights of any third party.

Information

For further information on technology, delivery terms and conditions and prices, please contact the nearest Infineon Technologies Office (**www.infineon.com**).

Warnings

Due to technical requirements, components may contain dangerous substances. For information on the types in question, please contact the nearest Infineon Technologies Office.

Infineon Technologies components may be used in life-support devices or systems only with the express written approval of Infineon Technologies, if a failure of such components can reasonably be expected to cause the failure of that life-support device or system or to affect the safety or effectiveness of that device or system. Life support devices or systems are intended to be implanted in the human body or to support and/or maintain and sustain and/or protect human life. If they fail, it is reasonable to assume that the health of the user or other persons may be endangered.

Revision History	
Page or Item	**Subjects (major changes since previous revision)**
Rev. 1.0, 2012-01-17	

Trademarks of Infineon Technologies AG

AURIX™, C166™, CanPAK™, CIPOS™, CIPURSE™, EconoPACK™, CoolMOS™, CoolSET™, CORECONTROL™, CROSSAVE™, DAVE™, EasyPIM™, EconoBRIDGE™, EconoDUAL™, EconoPIM™, EiceDRIVER™, eupec™, FCOS™, HITFET™, HybridPACK™, I²RF™, ISOFACE™, IsoPACK™, MIPAQ™, ModSTACK™, my-d™, NovalithIC™, OptiMOS™, ORIGA™, PRIMARION™, PrimePACK™, PrimeSTACK™, PRO-SIL™, PROFET™, RASIC™, ReverSave™, SatRIC™, SIEGET™, SINDRION™, SIPMOS™, SmartLEWIS™, SOLID FLASH™, TEMPFET™, thinQ!™, TRENCHSTOP™, TriCore™.

Other Trademarks

Advance Design System™ (ADS) of Agilent Technologies, AMBA™, ARM™, MULTI-ICE™, KEIL™, PRIMECELL™, REALVIEW™, THUMB™, µVision™ of ARM Limited, UK. AUTOSAR™ is licensed by AUTOSAR development partnership. Bluetooth™ of Bluetooth SIG Inc. CAT-iq™ of DECT Forum. COLOSSUS™, FirstGPS™ of Trimble Navigation Ltd. EMV™ of EMVCo, LLC (Visa Holdings Inc.). EPCOS™ of Epcos AG. FLEXGO™ of Microsoft Corporation. FlexRay™ is licensed by FlexRay Consortium. HYPERTERMINAL™ of Hilgraeve Incorporated. IEC™ of Commission Electrotechnique Internationale. IrDA™ of Infrared Data Association Corporation. ISO™ of INTERNATIONAL ORGANIZATION FOR STANDARDIZATION. MATLAB™ of MathWorks, Inc. MAXIM™ of Maxim Integrated Products, Inc. MICROTEC™, NUCLEUS™ of Mentor Graphics Corporation. Mifare™ of NXP. MIPI™ of MIPI Alliance, Inc. MIPS™ of MIPS Technologies, Inc., USA. muRata™ of MURATA MANUFACTURING CO., MICROWAVE OFFICE™ (MWO) of Applied Wave Research Inc., OmniVision™ of OmniVision Technologies, Inc. Openwave™ Openwave Systems Inc. RED HAT™ Red Hat, Inc. RFMD™ RF Micro Devices, Inc. SIRIUS™ of Sirius Satellite Radio Inc. SOLARIS™ of Sun Microsystems, Inc. SPANSION™ of Spansion LLC Ltd. Symbian™ of Symbian Software Limited. TAIYO YUDEN™ of Taiyo Yuden Co. TEAKLITE™ of CEVA, Inc. TEKTRONIX™ of Tektronix Inc. TOKO™ of TOKO KABUSHIKI KAISHA TA. UNIX™ of X/Open Company Limited. VERILOG™, PALLADIUM™ of Cadence Design Systems, Inc. VLYNQ™ of Texas Instruments Incorporated. VXWORKS™, WIND RIVER™ of WIND RIVER SYSTEMS, INC. ZETEX™ of Diodes Zetex Limited.

Last Trademarks Update 2011-02-24

Table of Contents

1 Product Description

1.1 Overview

The TLE4961-3 is a high precision Hall effect switch with a latching characteristic, highly accurate switching thresholds for operating temperatures up to 170°C.

Figure 1-1 Image of TLE4961-3 in the PG-SC59-3-5 package

1.2 Features

- 3.0V to 32 V operating supply voltage
- Operation from unregulated power supply
- Reverse polarity protection (-18V)
- Overvoltage capability up to 42 V without external resistor
- Output overcurrent & overtemperature protection
- Active error compensation
- High stability of magnetic thresholds
- Low jitter (typ. 0.35µs)
- High ESD performance
- SOT23 like SMD package PG-SC59-3-5

1.3 Target Applications

Target applications for the TLE496x Hall switch family are all applications which require a high precision Hall switch with a operating temperature range from -40°C to 170°C. Its superior supply voltage range from 3.0 V to 32V with overvoltage capability (e.g. load-dump) up to 42 V without external resistor makes it ideally suited for automotive and industrial applications.

The magnetic behavior as a latch and switching thresholds of typical make the device especially suited for the use with a pole wheel for index counting applications as e.g. power closing and window lifter.

Table 1-1 Ordering Information

Product Name	Product Type	Ordering Code	Package
TLE4961-3K	Hall Latch	SP000848004	PG-SC59-3-5

2 Functional Description

2.1 General

The TLE4961-3 is an integrated Hall effect latch designed specifically for highly accurate applications with superior supply voltage capability, operating temperature range and temperature stability of the magnetic thresholds.

2.2 Pin Configuration (top view)

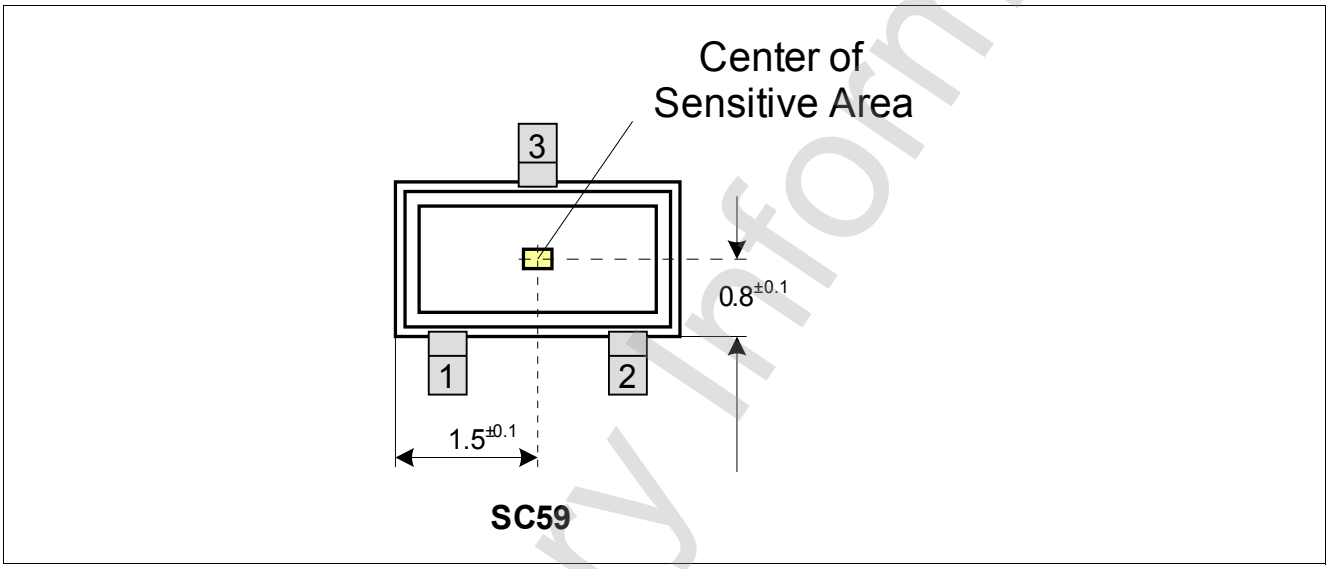


Figure 2-1 Pin Configuration and Center of Sensitive Area

2.3 Pin Description

Table 2-1 Pin Description PG-SC59-3-5

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

2.4 Block Diagram

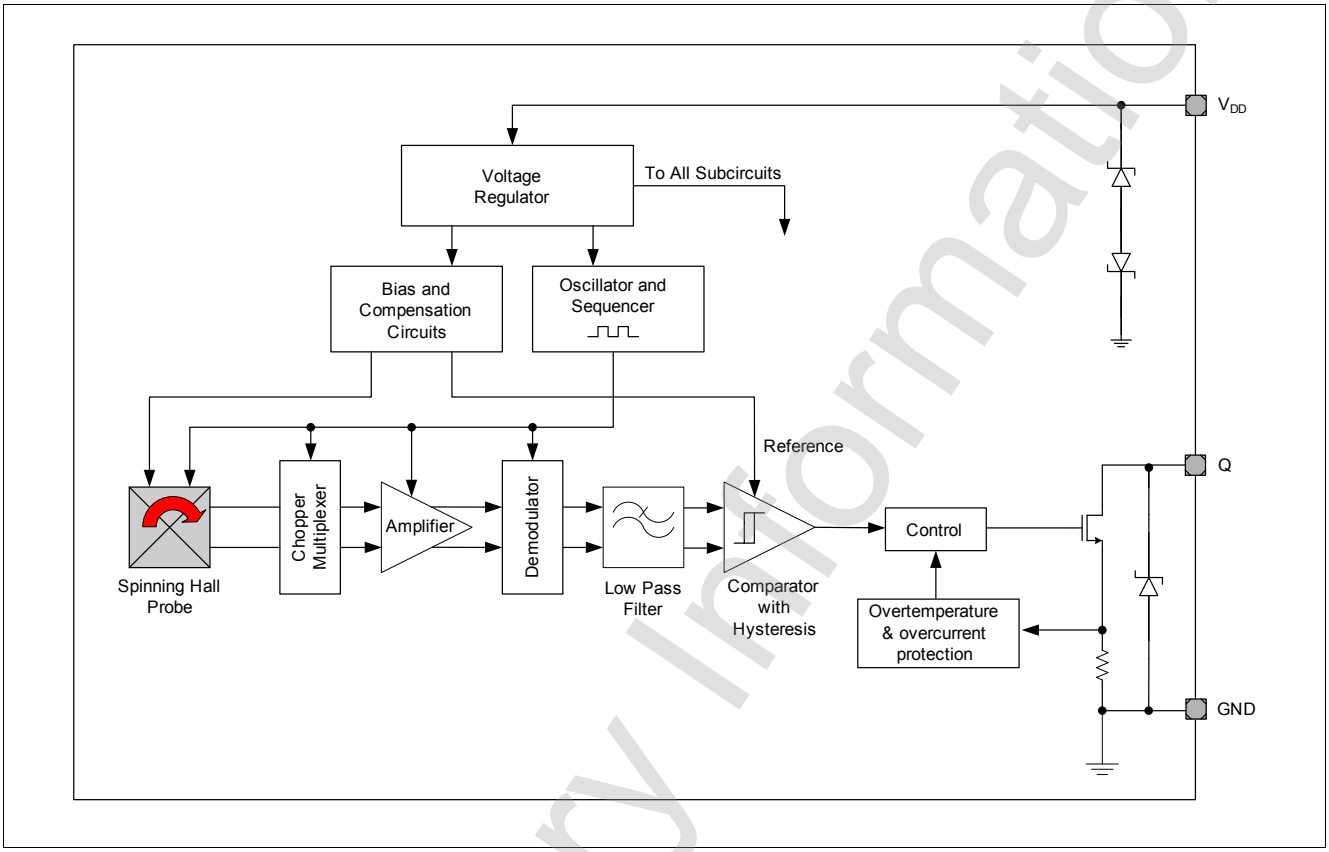


Figure 2-2 Functional Block Diagram TLE4961-3

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.

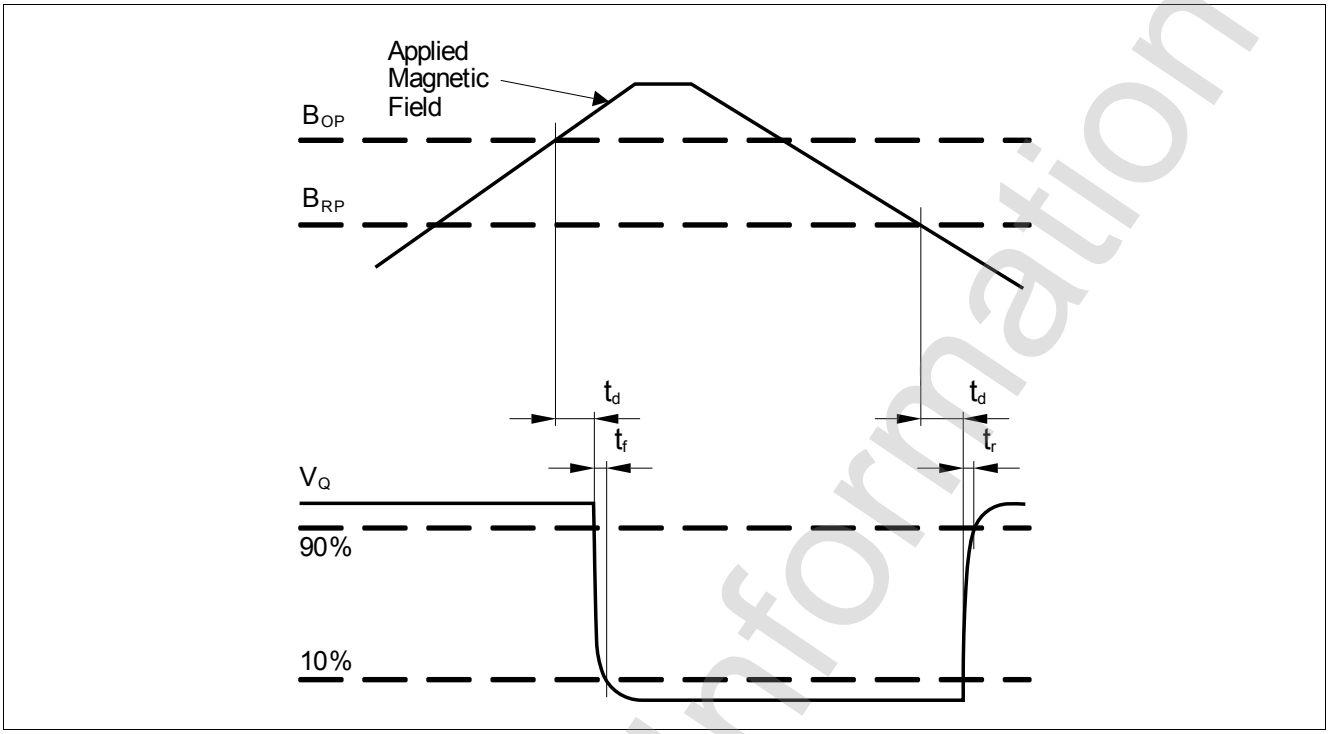


Figure 2-3 Timing Diagram TLE4961-3

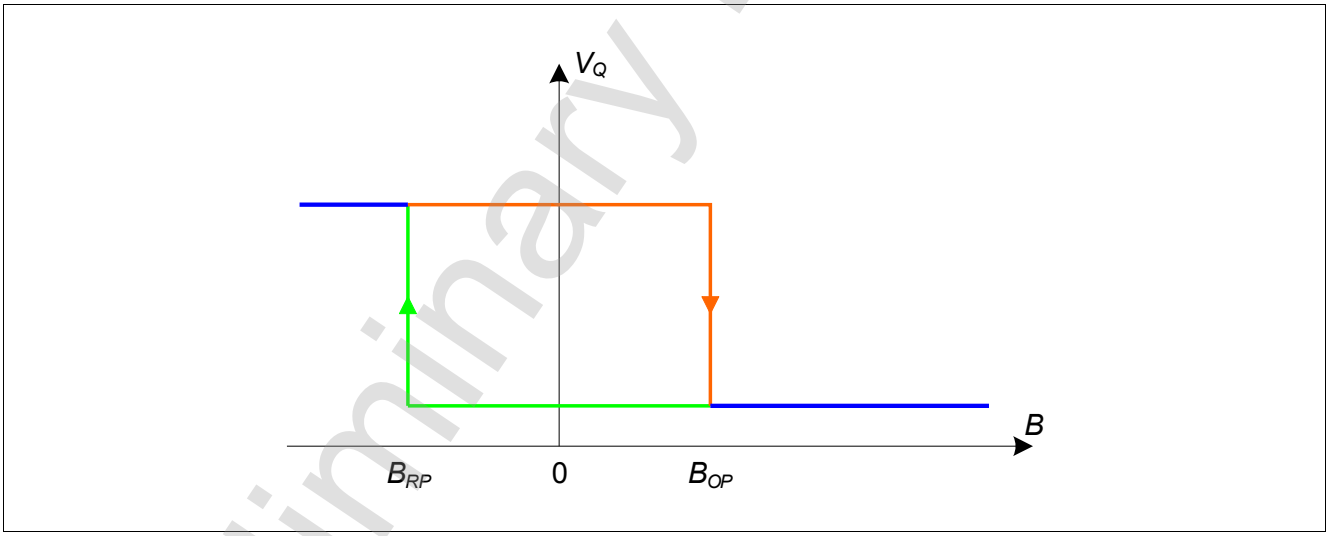


Figure 2-4 Output Signal TLE4961-3

3 Specification

3.1 Application Circuit

The following **Figure 3-1** shows one option of an application circuit. As explained above the resistor R_S can be left out (see **Figure 3-2**). The resistor R_Q has to be in a dimension to match the applied V_S to keep I_Q limited to the operating rage of maximal 25mA.

e.g.:

V_S = 12 V

I_Q = 12 V/1200Ω = 10mA

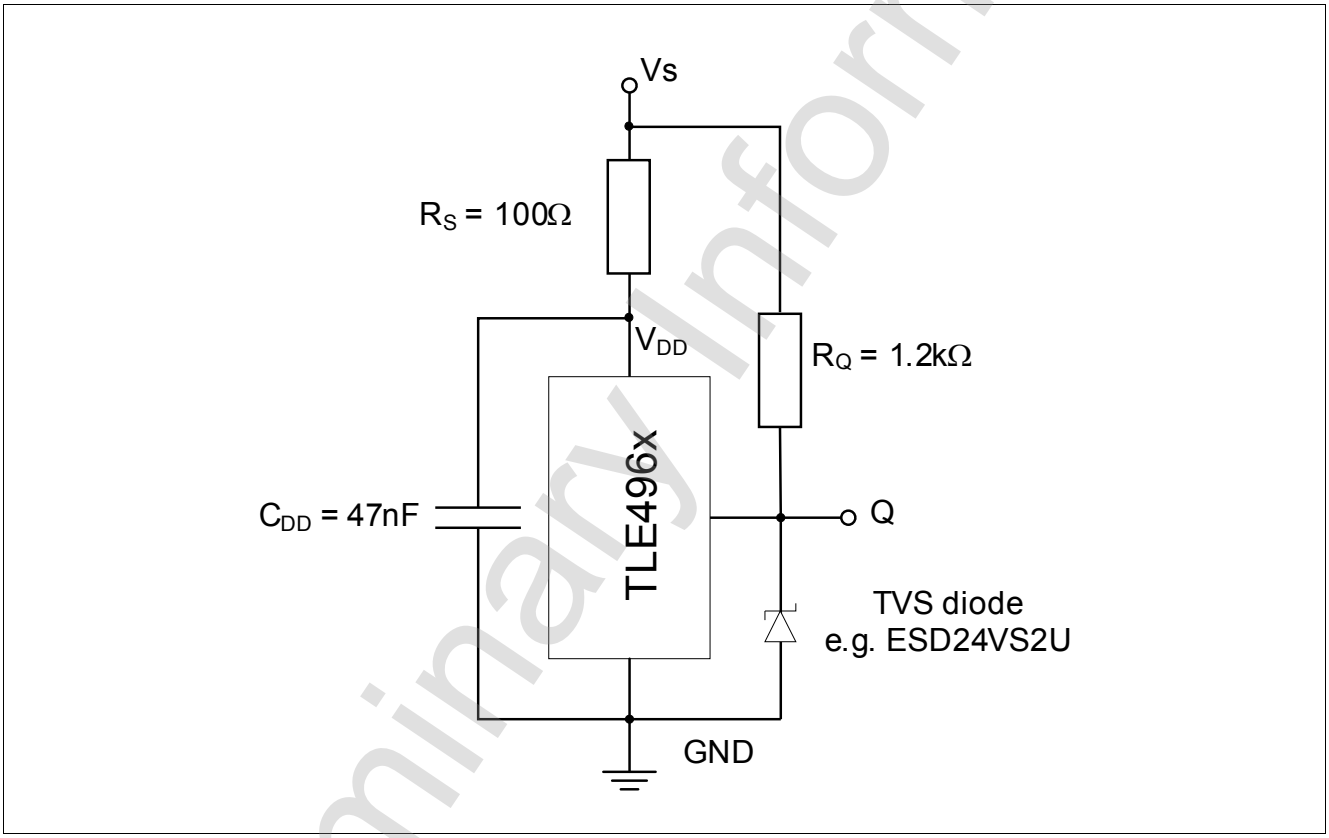


Figure 3-1 Application Circuit 1: with external resistor

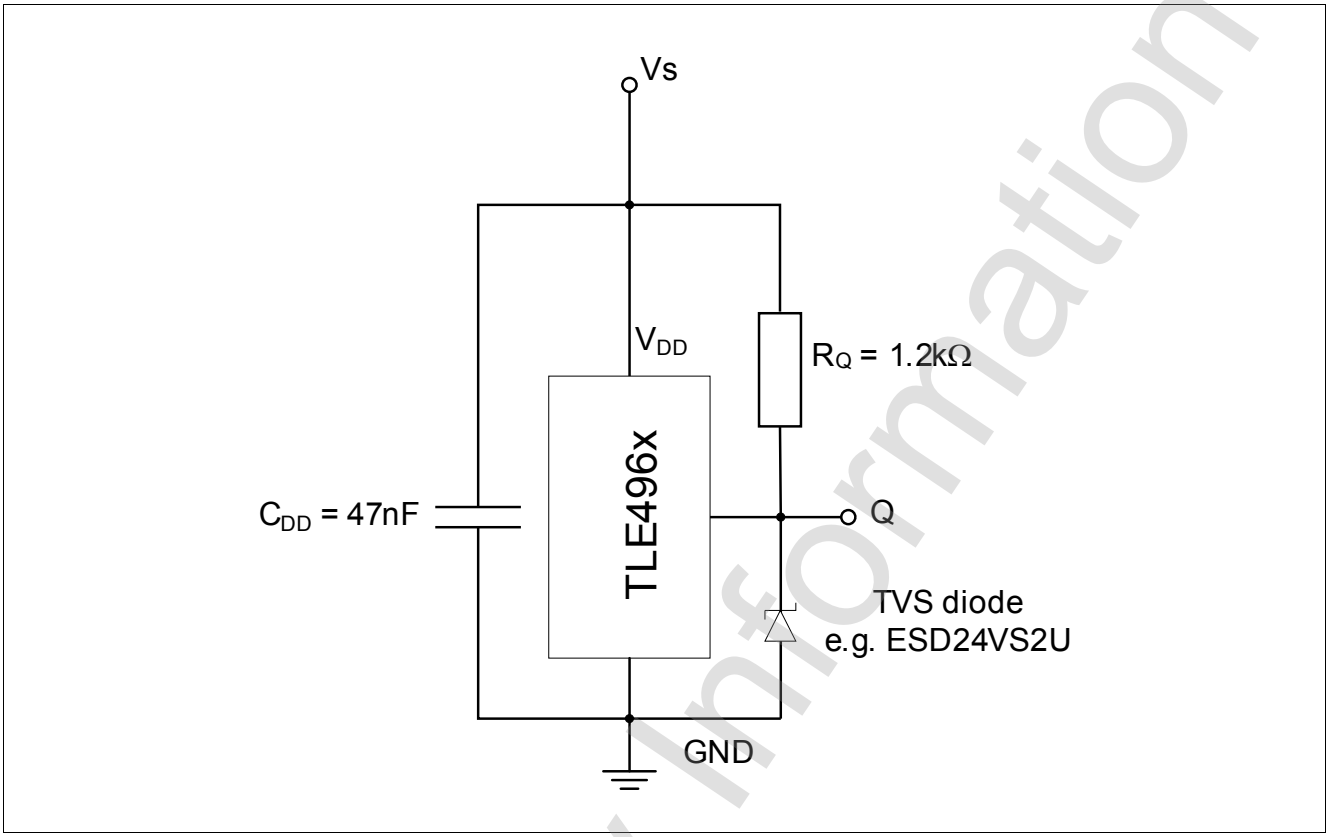


Figure 3-2 Application Circuit 2: without external resistor

3.2 Absolute Maximum Ratings

Table 3-1 Absolute Maximum Rating Parameters

Parameter	Symbol	Values			Unit	Note / Test Condition
		Min.	Typ.	Max.		
Supply voltage	V_{DD}	-18		32 42	V	 10h, no external resistor required
Output voltage	V_Q	0		32	V	
Reverse output current	I_Q	-70			mA	
Junction temperature	T_J	-40		155 165 175 195	°C	for 2000h (not additive) for 1000h (not additive) for 168h (not additive) for 3 x 1h (additive)
Thermal resistance Junction ambient	R_{thJA}			300	K/W	for PG-SC59-3-5
Thermal resistance Junction lead	R_{thJL}			100	K/W	for PG-SC59-3-5

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 (SC59 example):
e.g for: V_{DD} = 12 V, I_S = 2.5mA, V_{QSAT} = 0.5 V, I_Q = 20mA
Power dissipation: P_{DIS} = 12 V x 2.5mA + 0.5 V x 20mA = 30mW + 10mW = 40mW
Temperature $\Delta T = R_{thJA} \times P_{DIS}$ = 300K/W x 40mW = 12K
For T_A = 150°C: $T_J = T_A + \Delta T$ = 150°C + 12K = 162°C

Table 3-2 ESD Protection[1] (TA = 25°C)

Parameter	Symbol	Values			Unit	Note / Test Condition
		Min.	Typ.	Max.		
ESD voltage (HBM)[2]	V_{ESD}	-7		7	kV	R = 1.5kΩ, C = 100pF
ESD voltage (SDM)[3]		-1		1		
ESD voltage (system level)[4]		-15		15		with circuit shown in Figure 3-1 & Figure 3-2

1) Characterization of ESD is carried out on a sample basis.
2) Human Body Model (HBM) tests according to EIA/JESD22-A114
3) Socket device model (SDM) tests according to EOS/ESD-DS5.3-1993
4) Gun test (2kΩ / 330pF or 330Ω / 150pF) according to ISO 10605-2008

3.3 Operating Range

The following operating conditions must not be exceeded in order to ensure correct operation of the TLE4961-3K. All parameters specified in the following sections refer to these operating conditions unless otherwise mentioned.

Table 3-3 Operating Conditions Parameters

Parameter	Symbol	Values			Unit	Note / Test Condition
		Min.	Typ.	Max.		
Supply voltage	V_{DD}	3.0		32[1)]	V	
Output voltage	V_Q	0		32	V	
Junction temperature	T_j	-40		170	°C	
Output current	I_Q	0		25	mA	
Magnetic signal input frequency[2)]	f_{SW}	0		10	kHz	

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

2) For operation at the maximum switching frequency the magnetic input signal must be 1.4 times higher than for static fields. This is due to the -3dB corner frequency of the internal low-pass filter in the signal path.

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 V and TA = 25°C. The below listed specification is valid in combination with the application circuit shown in **Figure 3-1** and **Figure 3-2**

Table 3-4 General Electrical Characteristics

Parameter	Symbol	Values			Unit	Note / Test Condition
		Min.	Typ.	Max.		
Supply current	I_S	1.1	1.6	2.5	mA	
Reverse current	I_{SR}		0.05	1	mA	for V_{DD} = -18V
Output saturation voltage	V_{QSAT}		0.2	0.5	V	I_Q = 20mA
			0.24	0.6	V	I_Q = 25mA
Output leakage current	I_{QLEAK}			10	µA	
Output current limitation	I_{QLIMIT}	30	56	70	mA	internally limited & thermal shutdown
Output fall time[1)]	t_f	0.17	0.4	1	µs	1.2kΩ / 50pF, see **Figure 2-3**
Output rise time[1)]	t_r	0.4	0.5	1	µs	1.2kΩ / 50pF, see **Figure 2-3**
Output jitter[1)2)]	t_{QJ}		0.35	1	µs	For square wave signal with 1kHz
Delay time[1)3)]	t_d	12	15	30	µs	see **Figure 2-3**
Power-on time[1)4)]	t_{PON}		80	150	µs	V_{DD} = 3 V, B ≤ B_{RP} - 0.5 mT or B ≥ B_{OP} + 0.5 mT
Chopper frequency[1)]	f_{OSC}		350		kHz	

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

2) Output jitter is the 1σ value of the output switching distribution

3) Systematic delay between magnetic threshold reached and output switching

4) Time from applying V_{DD} = 3.0 V to the sensor until the output is valid

Table 3-5 Magnetic Characteristics

Parameter	Symbol	T (°C)	Values			Unit	Note / Test Condition
			Min.	Typ.	Max.		
Operating point	B_{OP}	-40	5.0	8.1	11.1	mT	
		25	4.6	7.5	10.4		
		170	3.6	6.2	8.8		
Release point	B_{RP}	-40	-11.1	-8.1	-5.0	mT	
		25	-10.4	-7.5	-4.6		
		170	-8.8	-6.2	-3.6		
Hysteresis	B_{HYS}	-40	12.0	16.2	22.2	mT	
		25	11.2	15.0	20.8		
		170	9.3	12.4	17.6		
Effective noise value of the magnetic switching points[1)]	B_{Neff}	25		64		µT	
Temperature compensation of magnetic thresholds[2)]	T_C			-1200		ppm/K	

1) The magnetic noise is normal distributed and can be assumed as nearly independent to frequency without sampling noise or digital noise effects. The typical value represents a the rms-value and corresponds therefore to a 1 σ probability of normal distribution. Consequently a 3 σ value corresponds to 99.7% probability of appearance.

2) 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.

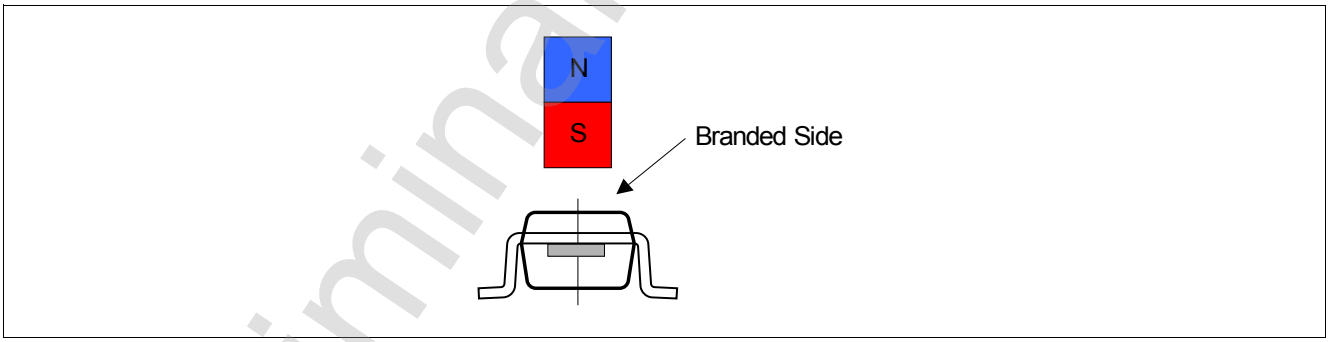


Figure 3-3 Definition of magnetic field direction PG-SC59-3-5

4 Package Information

The TLE4961-3 is available in the SMD package PG-SC59-3-5 with a SOT23 like pinout and footprint.

4.1 Package Outline PG-SC59-3-5

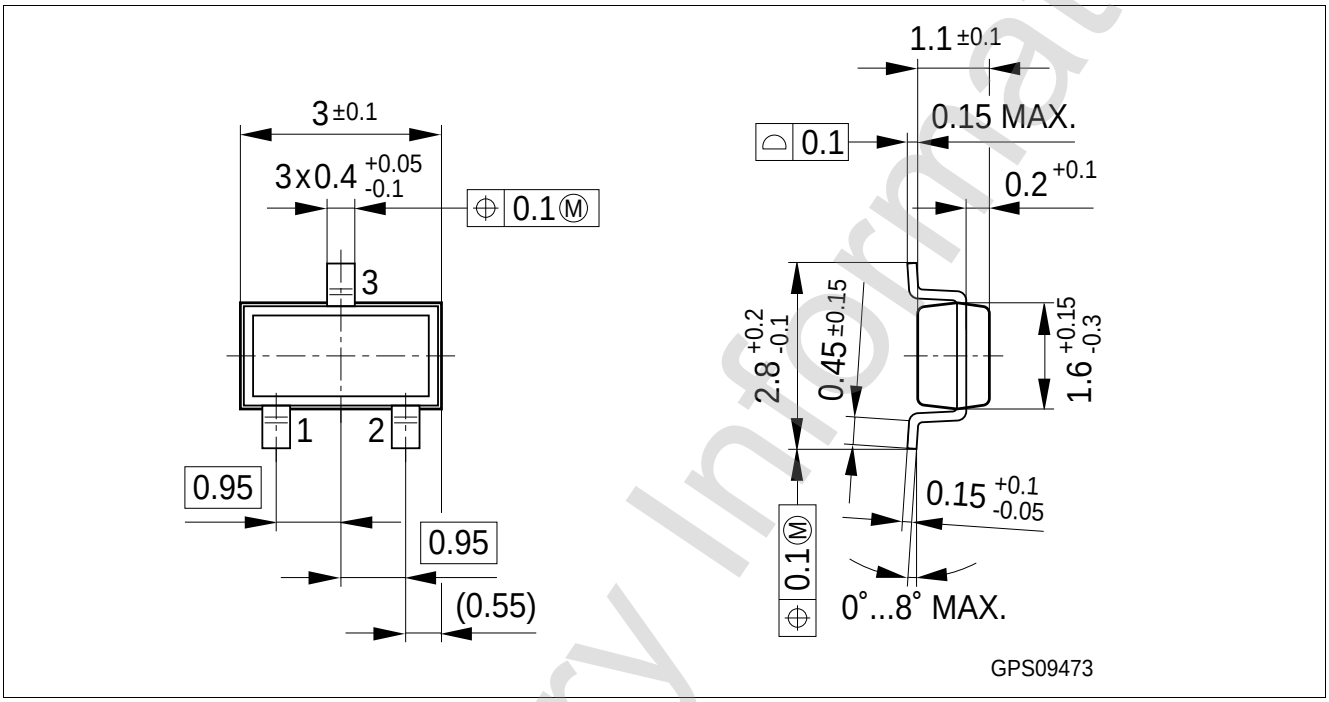


Figure 4-1 PG-SC59-3-5 Package Outline (All dimensions in mm)

4.2 Footprint

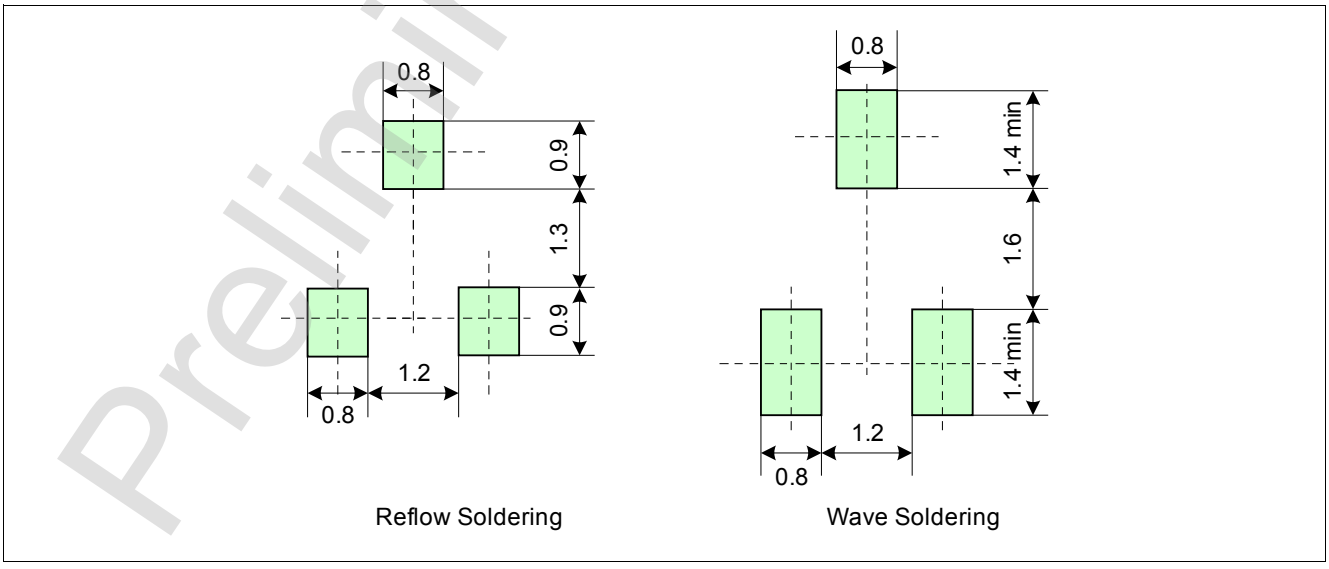
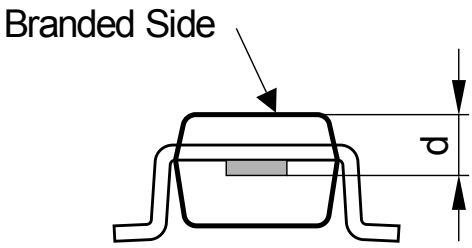


Figure 4-2 Footprint PG-SC59-3-5 and PG-SOT23

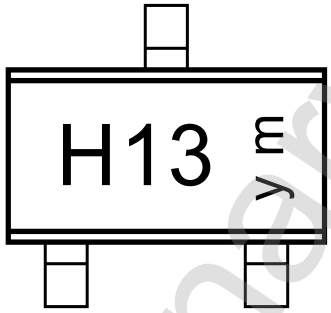
4.3 PG-SC59-3-5 Distance between Chip and Package



d: Distance chip to upper side of IC
SC59: $0.515^{\pm 0.05}$ mm

Figure 4-3 Distance between chip and package

4.4 Package Marking



Year (y) = 0…9
Month (m) = 1…9,
o - October
n - November
d - December

Figure 4-4 Marking of TLE4961-3K

www.infineon.com

Published by Infineon Technologies AG