TLE4946-2L

High Precision Hall Effect Latch

About this document

Overview

The TLE4946-2L is a high precision Hall effect latch with highly accurate switching thresholds for operating temperatures up to 150°C.

Features

- 2.7 V to 18 V supply voltage operation.
- Operation from unregulated power supply.
- High sensitivity and high stability of the magnetic switching points.
- High resistance to mechanical stress by active error compensation
- Reverse battery protection (V_S = -18 V)
- Superior temperature stability
- Low jitter (typically 1 µs)
- High ESD performance (± 4 kV HBM)
- Digital output signal

Target applications

The TLE4946-2L is an integrated circuit Hall-effect sensor with low switching thresholds and low hysteresis. It is specially designed for high sensitivity applications and is ideally suited to detect the rotor position in a BLDC motor. Also for index counting with small pole wheels and large air gaps the sensor provides a reliable switching information.

Product name	Product type	Ordering code	Package
Hall Effect Latch	TLE4946-2L	SP000398352	PG-SSO-3-2

Table of contents

1 Functional description

1.1 General

Precise magnetic switching thresholds and high temperature stability are achieved by active compensation circuits and chopper techniques on chip. Offset voltages, generated by temperature induced stress or overmolding are canceled and high accuracy is achieved. The IC has an open collector output stage with 20 mA current sink capability. A wide operating voltage range form 2.7 V to 18 V with reverse polarity protection up to -18V makes the device suitable for a wide range of applications. A magnetic south pole with field strength above B_{op} turns the output on and a magnetic north pole exceeding B_{rp} turns it off.

1.2 Pin configuration

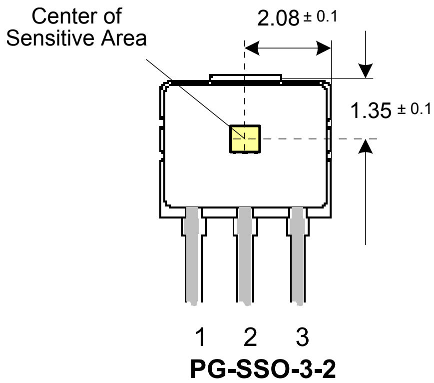

Figure 1 Pin configuration and sensitive area (Top View, Figure not to Scale)

1.3 Pin description

Table 1 Pin description

Pin or Ball No.	Name	Pin Type	Function	Comments
1	Vs	*I*	Supply voltage	
2	GND	*O*	Ground	
3	Q	*O*	Output	

1.4 Block diagram

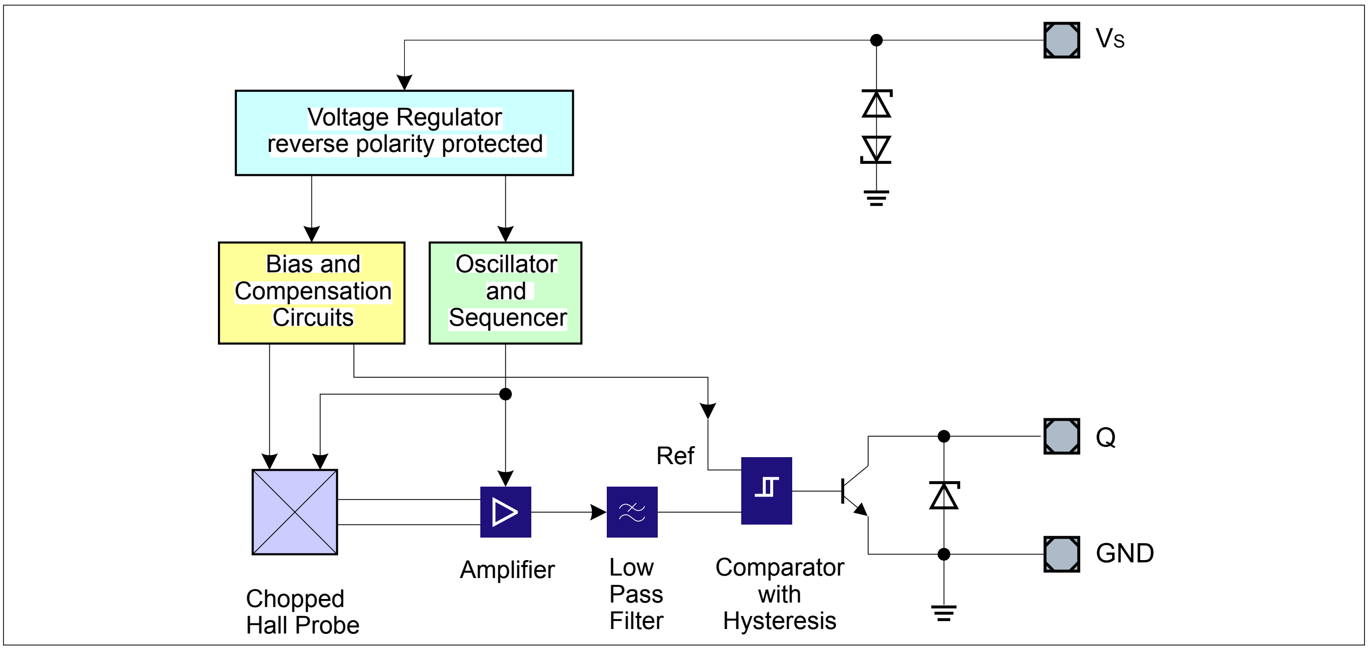

Figure 2 **TLE4946-2L Block diagram**

1.5 Operating modes and states

Field Direction Definition: Positive magnetic fields are related with the south pole of the magnet to the branded side of package.

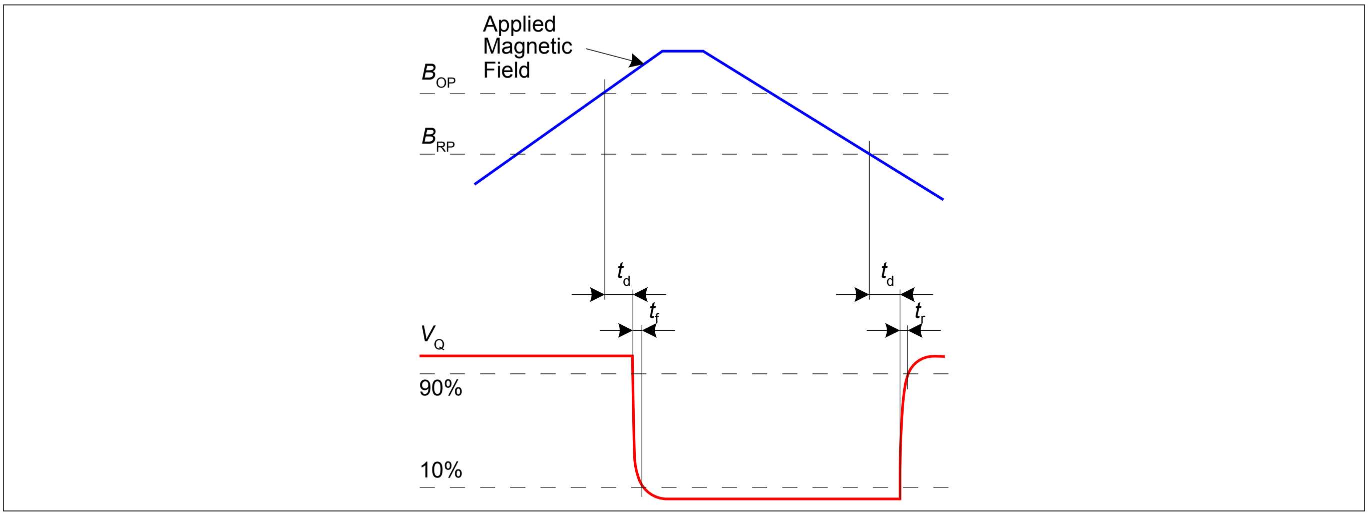

Figure 3 **Timing diagram**

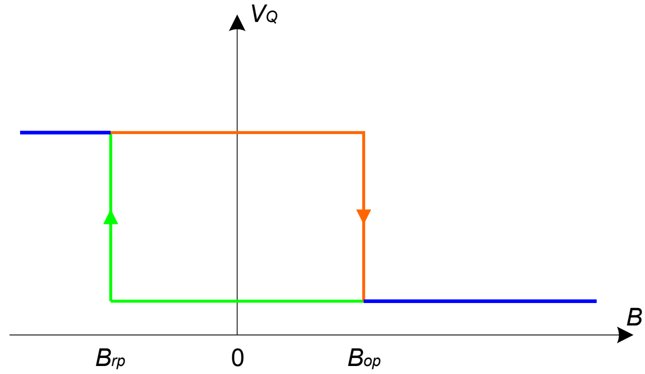

Figure 4 **Output signal**

1.6 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 technology variations. The Active Error Compensation rejects offsets in signal stages and the influence of mechanical stress to the Hall probe caused by molding and soldering processes and other thermal stresses in the package. This chopper technique together with the threshold generator and the comparator ensure high accurate magnetic switching points.

2 Specification

2.1 Application circuit

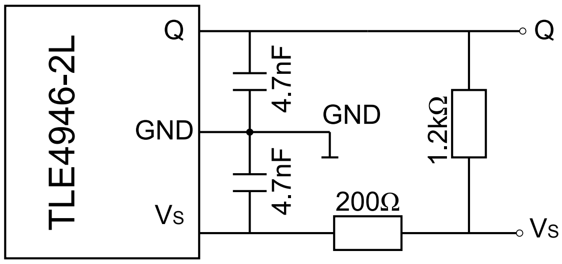

Figure 5 Application circuit

It is recommended to use a serial resistor of 200 Ω in the supply line for current limitation in the case of a overvoltage pulse. Two capacitors of 4.7 nF enhance the EMC performance. The pull-up resistor of 1.2 kΩ limits the current through the output transistor.

2.2 Absolute maximum ratings

Table 2 Absolute maximum ratings

Parameter	Symbol	Values			Unit	Note/Test Condition
		Min.	Typ.	Max.		
Max. junction temperature	T_J	-40	–	150	°C	
		–	–	155		for 2000 h (not additive)
		–	–	165		for 1000 h (not additive)
		–	–	175		for 168 h (not additive)
		–	–	195		for 3 x 1 h (additive)
Supply voltage	V_{DD}	-18	–	18	V	
		-18	–	24		for 1h, $R_S \geq 200\ \Omega$
		-18	–	26		for 5min, $R_S \geq 200\ \Omega$
Supply current through protection device	I_S	-50	–	50	mA	
Output voltage	V_Q	-0.7	–	18	V	
		-0.7	–	26		for 5min @ 1.2 kΩ pull up
Storage temperature	T_S	-40	–	150	°C	
Magnetic flux density	B		–	unlimited	mT	
ESD robustness HBM: 1.5 kΩ, 100 pF	$V_{ESD,HBM}$	4			kV	According to EIA/JESD22-A114-B

***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.*

2.3 Operating range

The following operating conditions must not be exceeded in order to ensure correct operation of the TLE4946-2L. All parameters specified in the following sections refer to these operating conditions unless otherwise mentioned.

Table 3 Operating range

Parameter	Symbol	Values			Unit	Note/Test Condition
		Min.	Typ.	Max.		
Supply voltage	V_S	2.7	–	18	V	
Output voltage	V_Q	-0.7	–	18	V	
Junction temperature	T_j	-40	–	150	°C	
Output current	I_Q	0	–	20	mA	

2.4 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 (at V_S = 12 V and T_A = 25°C).

Table 4 Electrical Characteristics

Parameter	Symbol	Values			Unit	Note/Test Condition
		Min.	Typ.	Max.		
Supply current	I_S	2	4	6	mA	V_S = 2.7 V ... 18 V
Reverse current	I_{SR}	0	0.2	1	mA	V_S = –18 V
Output saturation voltage	V_{QSAT}	–	0.3	0.6	V	I_Q = 20 mA
Output leakage current	I_{QLEAK}	–	0.05	10	µA	for V_Q = 18 V
Output fall time	t_f	–	0.02	1	µs	R_L = 1.2 kΩ; C_L = 50 pF
Output rise time	t_r	–	0.4	1	µs	
Chopper frequency	f_{OSC}	–	320	–	kHz	
Switching frequency	f_{SW}	0	–	15(1)	kHz	
Delay time(2)	t_d	–	13	–	µs	
Output jitter (3)	t_{QJ}	–	1	–	$µs_{RMS}$	Typ. value for square wave signal 1 kHz
Power-on time (4)	t_{PON}	–	13	–	µs	V_S ≥ 2.7 V
Thermal resistance(5)	R_{thJA}	–		190	K/W	PG-SSO-3-2

(1) To operate the sensor at the max. switching frequency, the value of the magnetic signal amplitude must be 1.4 times higher than for static fields. This is due to the -3 dB corner frequency of the low pass filter in the signal path.
(2) Systematic delay between magnetic threshold reached and output switching
(3) Jitter is the unpredictable deviation of the output switching delay
(4) Time from applying V_S ≥ 2.7 V to the sensor until the output state is valid
(5) Thermal resistance from junction to ambient

Table 5 Magnetic characteristics

Parameter	Symbol	Values			Unit	Note/Test Condition
		Min.	Typ.	Max.		
Operate point	B_{OP}	0.5	2.0	3.5	mT	
Release point	B_{RP}	-3.5	-2.0	-0.5	mT	
Hysteresis	B_{HYS}	1.0	4	6.0	mT	
Magnetic Offset(1)	B_{OFF}	-1.5	0	1.5	mT	
Temperature compensation of magn. thresholds	TC		-350		ppm/°C	
Repeatability of magnetic thresholds(2)	B_{REP}		20		μT_{RMS}	

(1) $B_{off} = (B_{op} + B_{rp}) / 2$
(2) B_{REP} is equivalent to the noise constant

3 Package information

3.1 Package outline

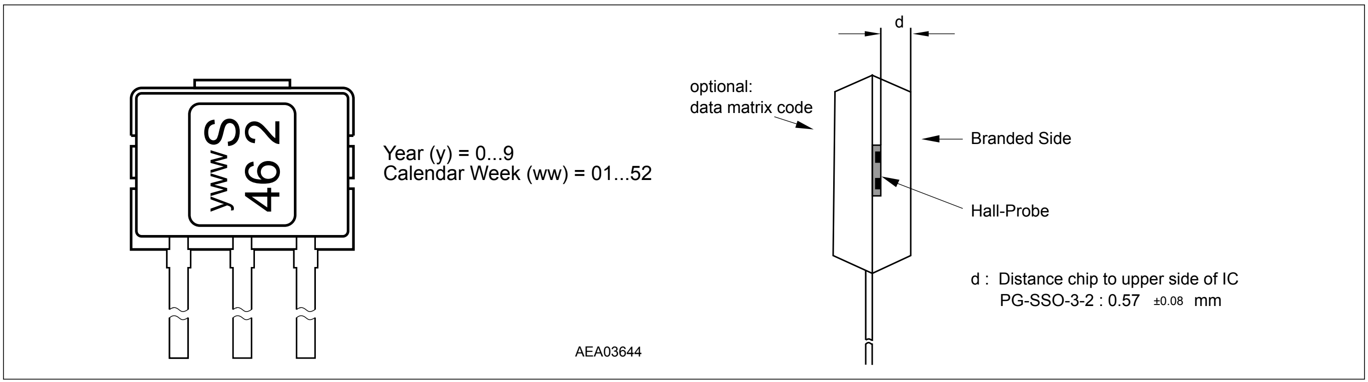

Figure 6 **Marking of TLE4946-2L and Distance of chip to upper side of IC**

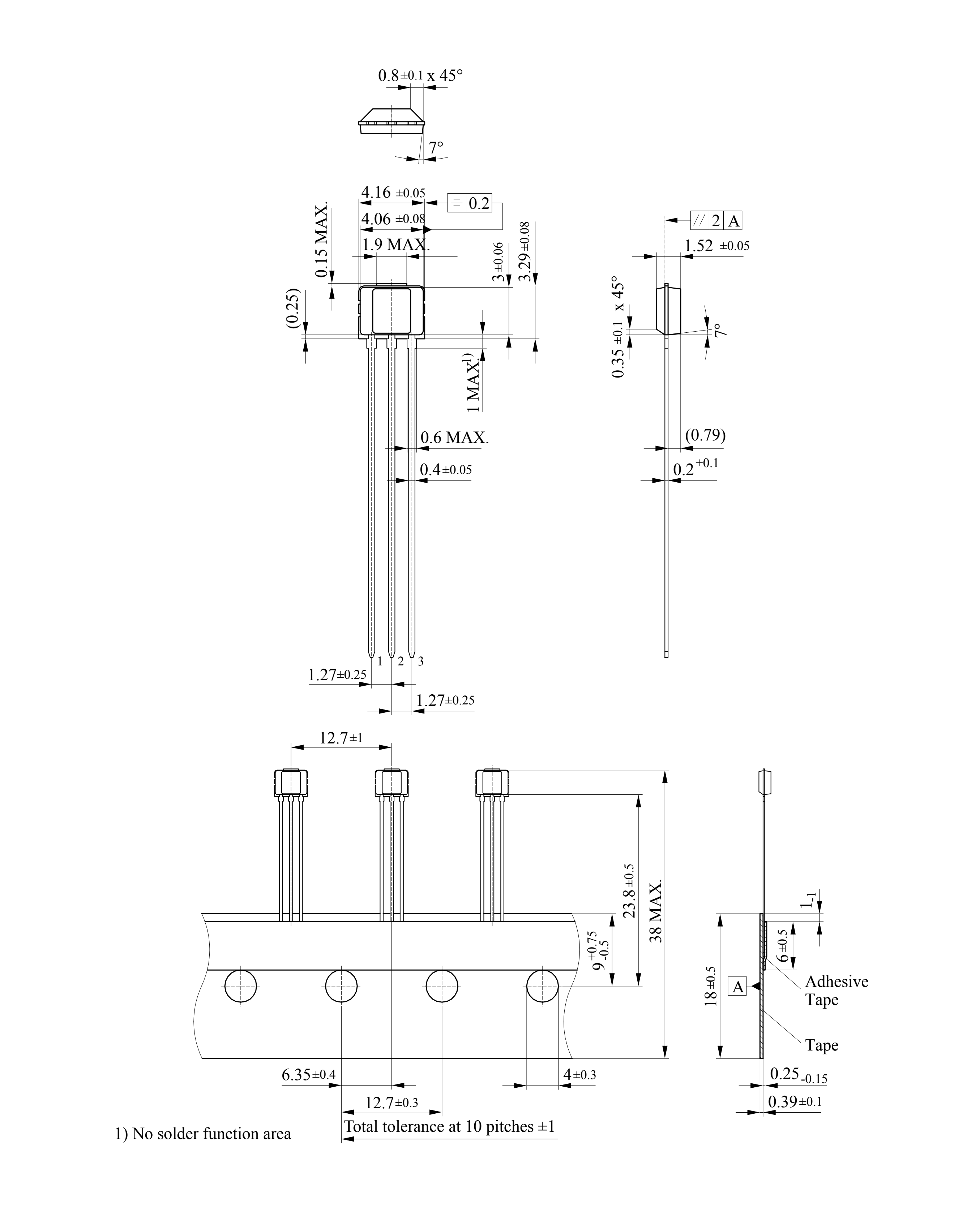

Figure 7 **Package outline**

4 Revision history

Revision History	
Page	**Subjects (major changes since last revision)**
Revision History: 2020-08, Rev 1.1	
Previous Revisions: 1.0	
10	Edited figure 6 (optional: data matrix code)

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Edition 2020-08

Published by

Infineon Technologies AG

81726 Munich, Germany

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Document reference
IFX-enm1597660844002