TLE4906K / TLE4906L

High Precision Hall Effect Switch

About this document

Overview

The TLE4906 is a high precision Hall effect switch with highly accurate switching thresholds for operating temperatures up to 150°C.



Features



- 2.7V to 24V supply voltage
- 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 (-18V)
- Superior temperature stability • Peak temperatures up to 195°C without damage
- Low jitter (typ. 1µs)
- High ESD performance (± 6kV HBM)
- Digital output signal
- SMD package SC59 (SOT23 compatible) - (TLE4906K))
- Leaded package PG-SSO-3-2 - (TLE4906L)

Target applications

Target applications for TLE4906 are all automotive applications which require a high precision Hall switch for position sensing with a operating temperature range from -40°C to +150°C.

Product name	Product type	Ordering code	Package
Hall Effect Switch	TLE4906K	SP000475028	SC59
Hall Effect Switch	TLE4906L	SP000012949	PG-SSO-3-2

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1 Functional description

1.1 General

The TLE4906K and the TLE4906L are integrated circuit Hall-effect sensors designed specifically for highly accurate applications. Precise magnetic switching points and high temperature stability are achieved by active compensation circuits and chopper techniques on chip.

1.2 Pin configuration (top view)

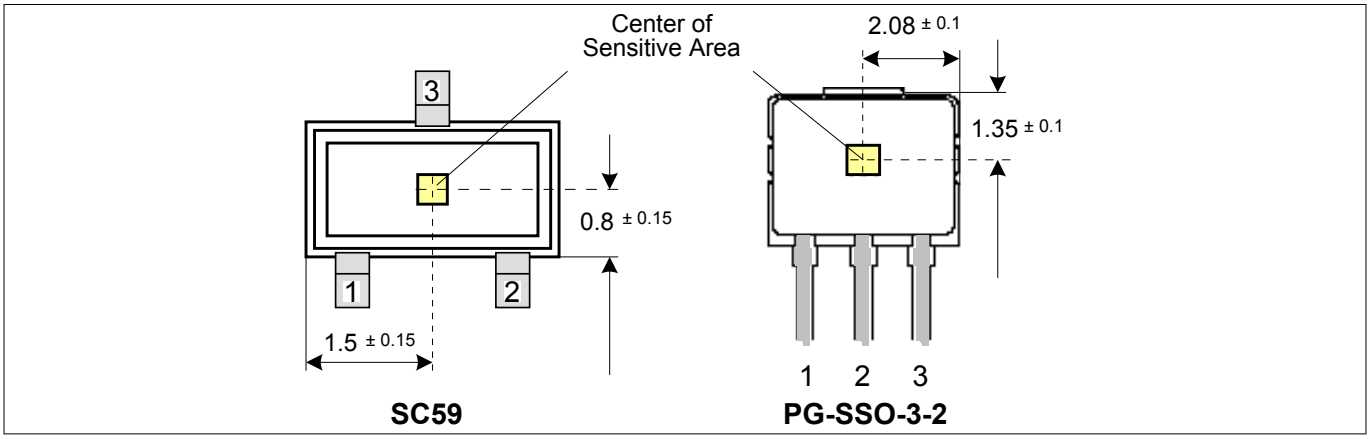


Figure 1 Pin configuration and center of sensitive area

1.3 Pin description

Table 1 Pin description SC59

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

Table 2 Pin description PG-SSO-3-2

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

1.4 Block diagram

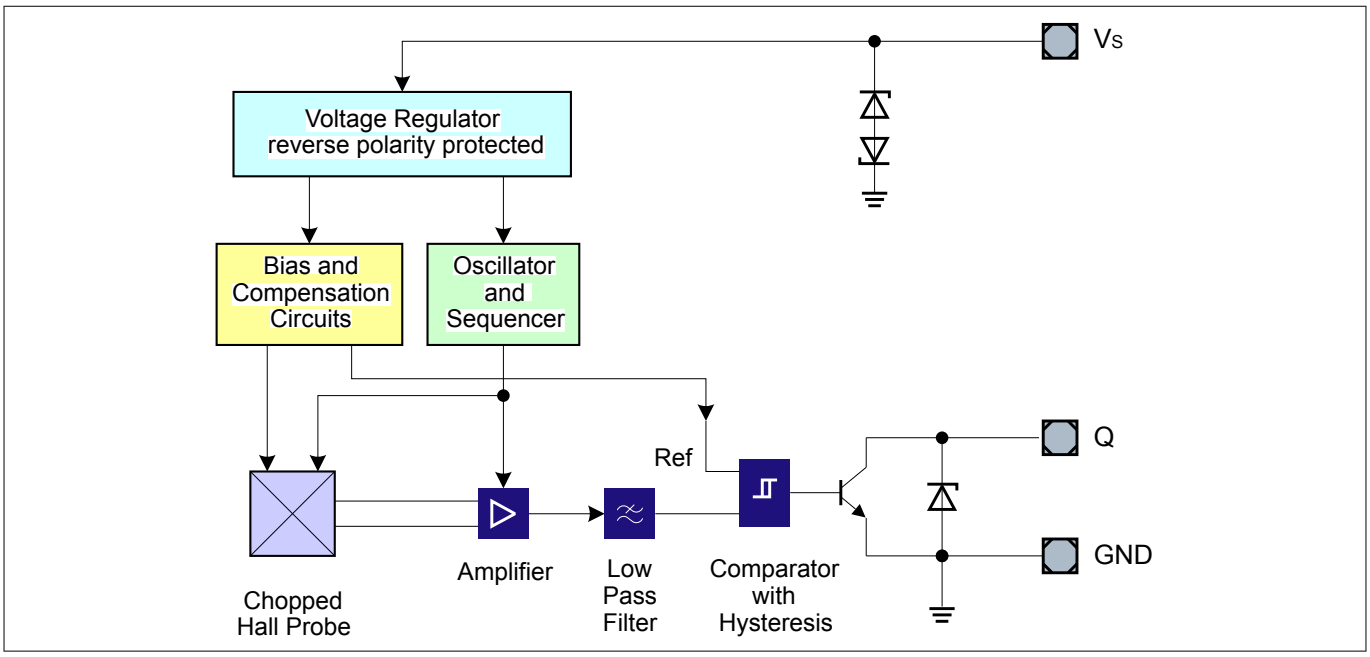


Figure 2 Functional block diagram

1.5 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 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.

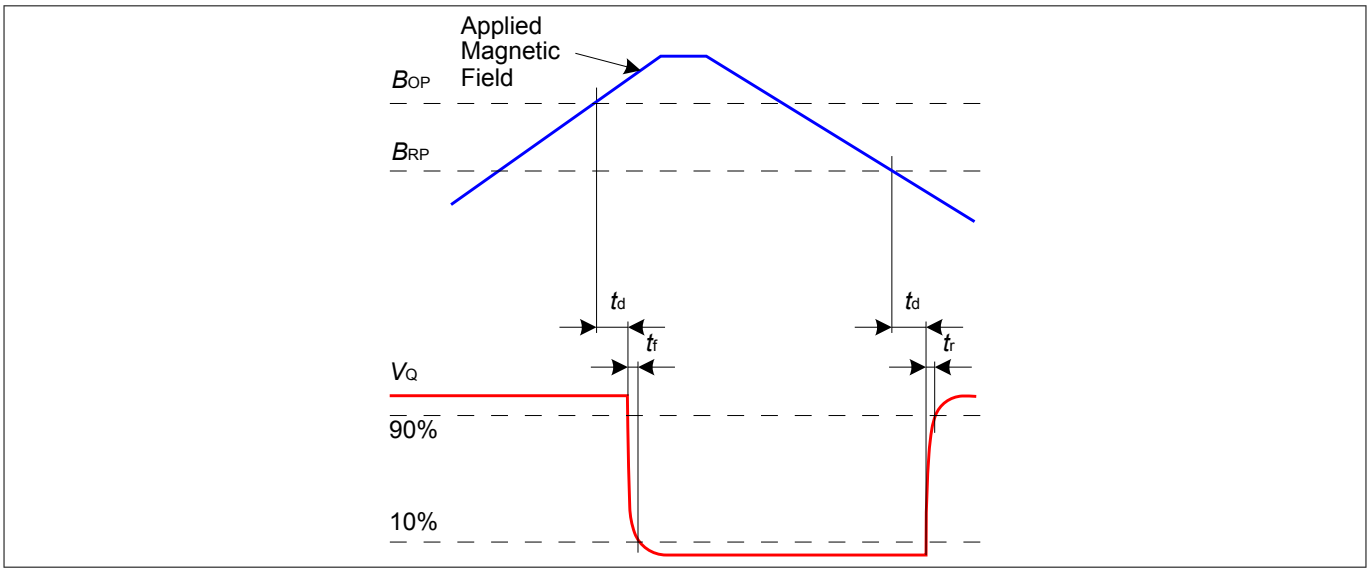


Figure 3 Timing diagram

1 Functional description

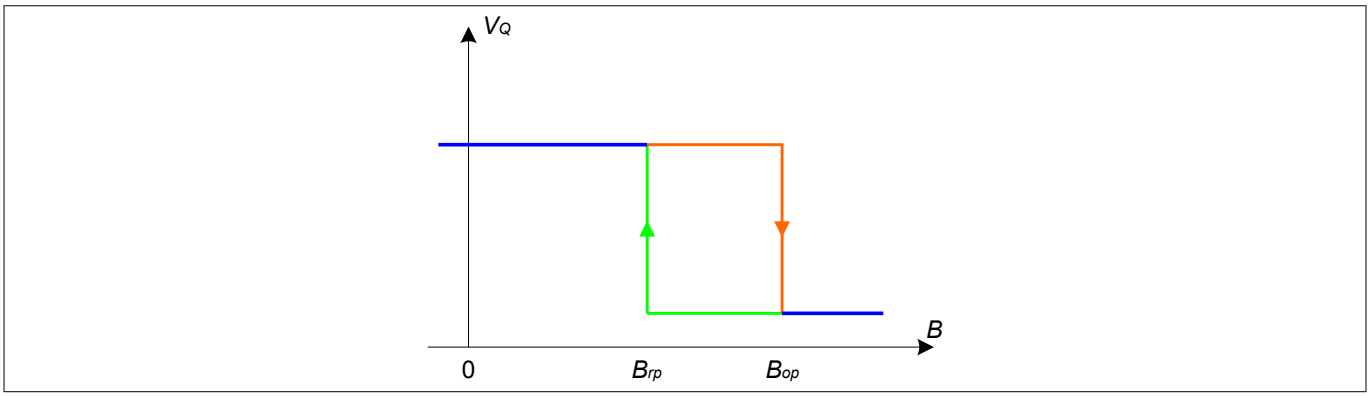


Figure 4 Output signal

2 Specification

2.1 Absolute maximum ratings

Table 3 Absolute maximum rating parameters

T_j = -40°C to 150°C

Parameter	Symbol	Limit Values		Unit	Note/Test Condition
		Min.	Max.		
Supply voltage	V_S	-18	18	V	
		-18	24		for 1 h, $R_S \geq 200\ \Omega$
		-18	26		for 5 min, $R_S \geq 200\ \Omega$
Supply current through protecion device	I_S	-50	50	mA	
Output voltage	V_Q	-0.7	18	V	for 5 min @ 1.2 kΩ pull up
		-0.7	26		
Continuous output current	I_Q	-50	50	mA	
Junction temperature	T_j	–	155	°C	for 2000 h (not additive)
		–	165		for 1000 h (not additive)
		–	175		for 168 h (not additive)
		–	195		for 3 x 1 h (additive)
Storage temperature	T_S	-40	150	°C	
Magnetic flux density	B	–	unlimited	mT	

Note: 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.

Table 4 ESD protection(1)

Parameter	Symbol	Limit Values		Unit	Note/Test Condition
		Min.	Max.		
ESD Voltage	V_{ESD}		±6	kV	HBM, R = 1.5 kΩ, C = 100 pF T_A = 25°C

(1) Human Body Model (HBM) tests according to: EOS/ESD Association Standard S5.1-1993 and Mil. Std. 883D method 3015.7

2.2 Operating range

The following operating conditions must not be exceeded in order to ensure correct operation of the TLE4906K / TLE4906L. 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/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	

2.3 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.

Table 6 General electrical characteristics(1)

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 see ***Figure 3***
Output rise time	t_r	–	0.4	1	µs	
Chopper frequency	f_{OSC}	–	320	–	kHz	
Switching frequency	f_{SW}	0	–	15(2)	kHz	
Delay time (3)	t_d	–	13	–	µs	
Output jitter (4)	t_{QJ}	–	1	–	$µs_{RMS}$	typical value for square wave signal with 1 kHz
Power-on time(5)	t_{PON}	–	13	–	µs	$V_S \geq$ 2.7 V
Thermal resistance(6)	R_{thJA}	–	100	–	K/W	SC59
		–	–	190		PG-SSO-3-2

(1) over operating range, unless otherwise specified. Typical values correspond to V_S = 12 V and T_A = 25°C
(2) 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.
(3) Systematic delay between magnetic threshold reached and output switching.

(4) Jitter is the unpredictable deviation of the output switching delay.
(5) Time from applying $V_S \geq 2.7$ V to the sensor until the output state is valid
(6) Thermal resistance from junction to ambient.

Calculation of the ambient temperature (SC59 example)

e.g. for $V_S = 12.0$ V, $I_{Styp} = 4$ mA, $V_{QSATtyp} = 0.3$ V and $I_Q = 20$ mA
Power dissipation $P_{DIS} = 54.0$ mW
In $T_A = T_j - (R_{thJA} \times P_{DIS}) = 175°C - (100\ K/W \times 0.054\ W)$
Resulting max. ambient temperature: TA = 169.6°C

Table 7 Magnetic characteristics(1)

Parameter	Symbol	Tj[°C]	Values			Unit	Note or Test Condition
			Min.	Typ.	Max.		
Operating point	B_{OP}	-40	6.7	10.3	13.9	mT	
		25	6.5	10.0	13.5		
		150	6.2	9.5	12.9		
Release point	B_{RP}	-40	5.2	8.7	12.3	mT	
		25	5.0	8.5	12.0		
		150	4.7	8.1	11.4		
Hysteresis	B_{HYS}	-40	–	–	–	mT	
		25	0.7	1.5	3.0		
		150	–	–	–		
Temperature compensation of magnetic thresholds	T_C		–	-350	–	pmm/°C	
Repeatability of magnetic thresholds(2)	B_{REP}		–	20	–	μT_{RMS}	typ. value for $\Delta B/\Delta t > 12$ mT/ms

(1) over operating range, unless otherwise specified. Typical values correspond to $V_S = 12$ V and $T_A = 25°C$.
(2) B_{REP} is equivalent to the noise constant

Field direction definition

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

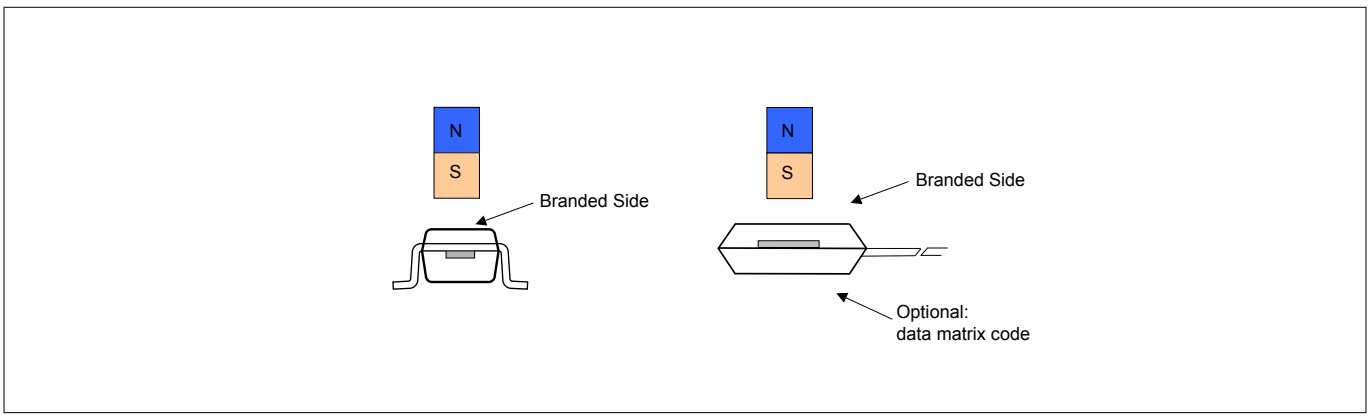


Figure 5 Definition of magnetic field direction (left: SC59, right: PG-SSO-3-2)

3 Package information

3.1 Package outline

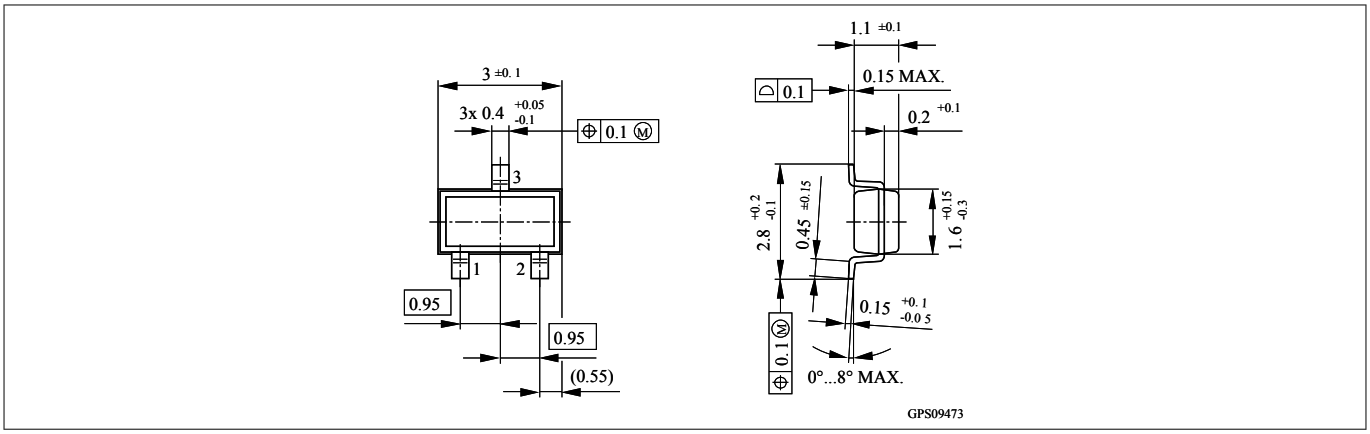


Figure 6 SC59 Package outline (all dimensions in mm)

The following picture shows a recommendation for the PCB layout.

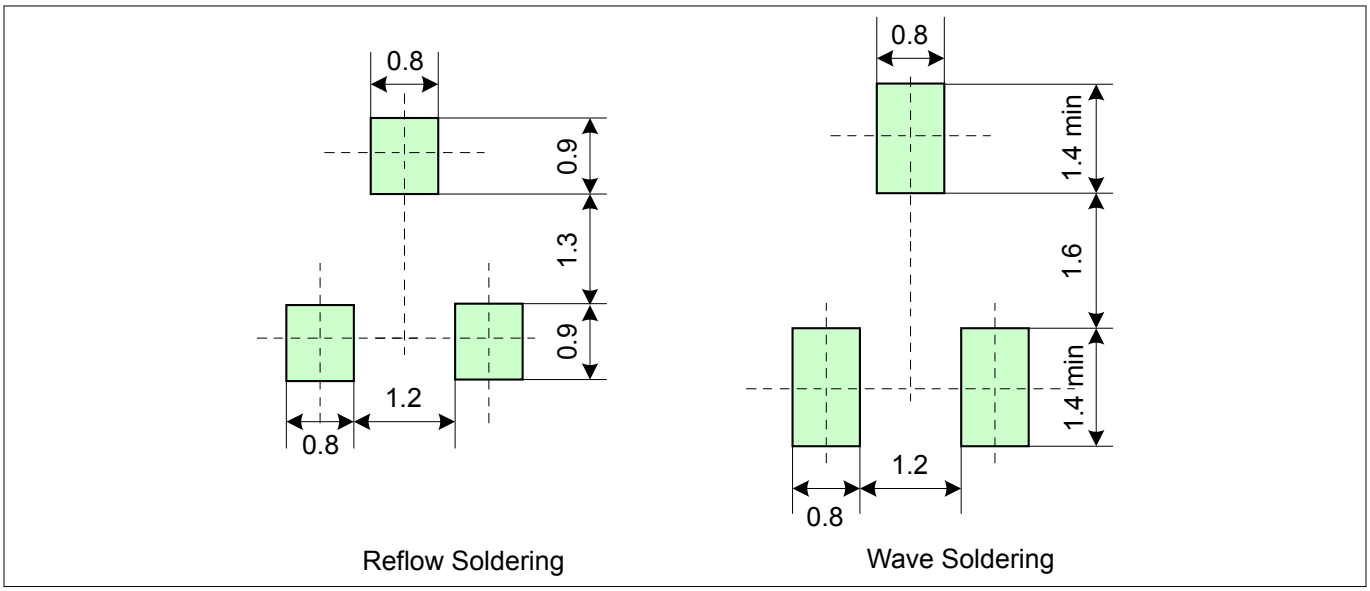


Figure 7 SC59 Footprint (SOT23 compatible, all dimensions in mm)

3 Package information

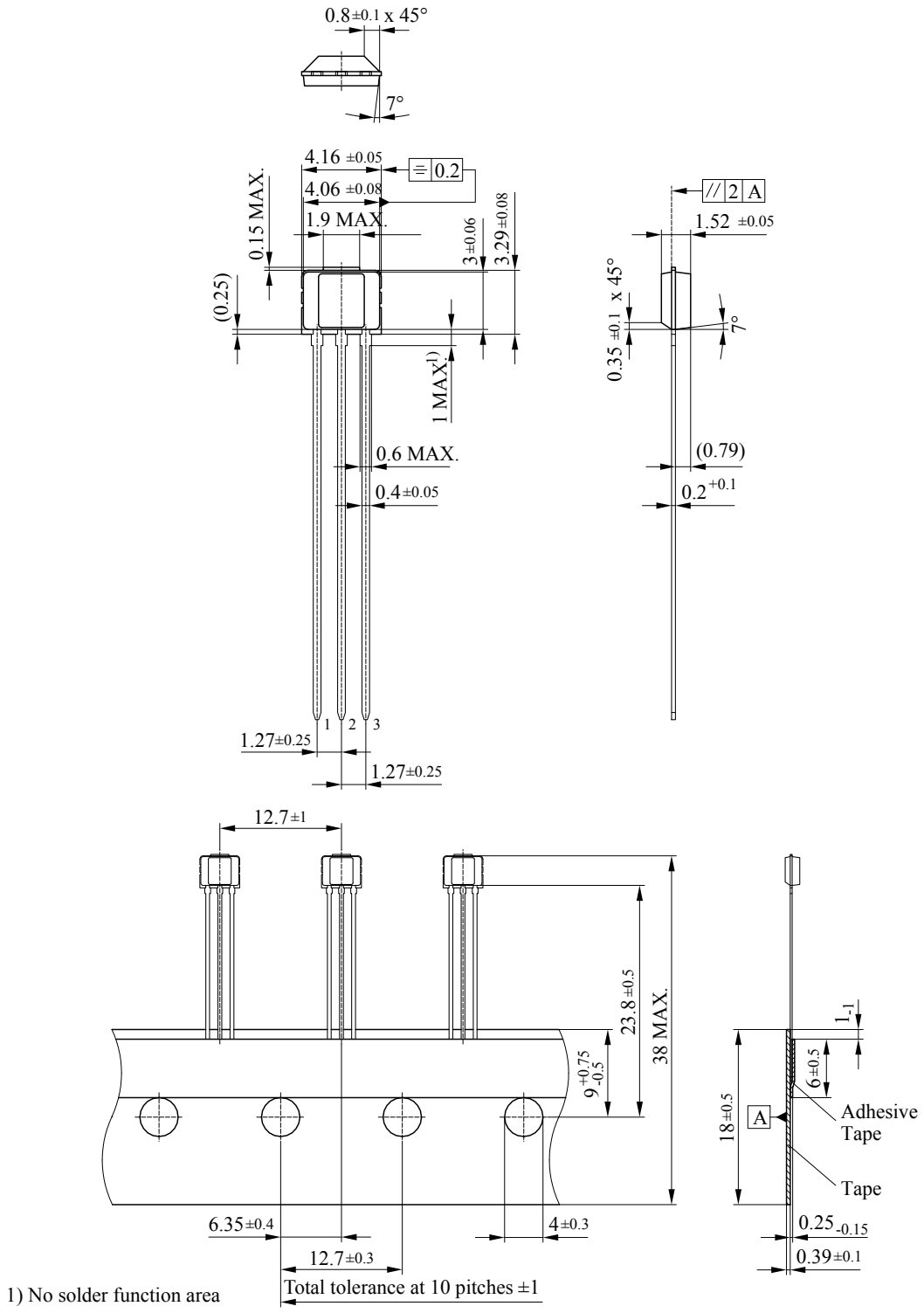


Figure 8 PG-SSO-3-2 Package outline (All dimensions in mm)

3.2 Distance between chip and package

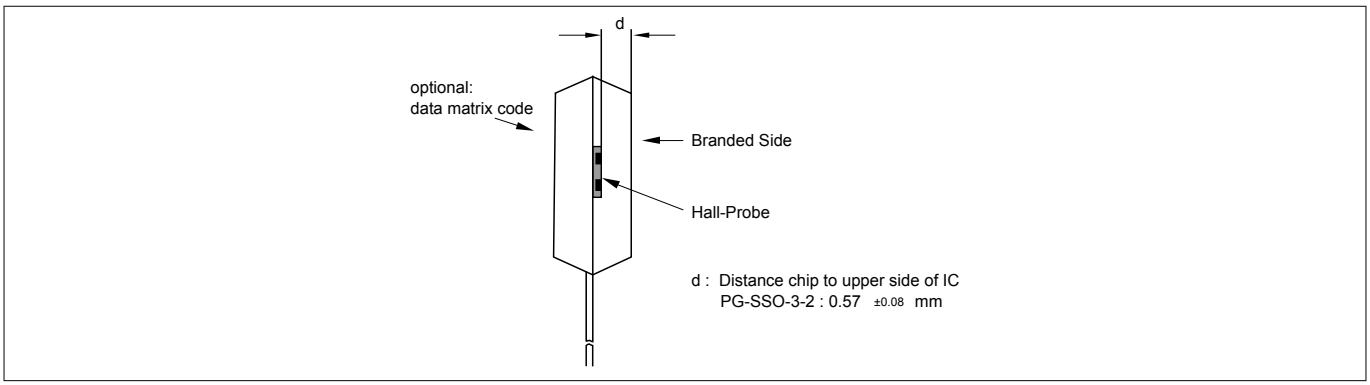


Figure 9 Distance between chip and package PG-SSO-3-2

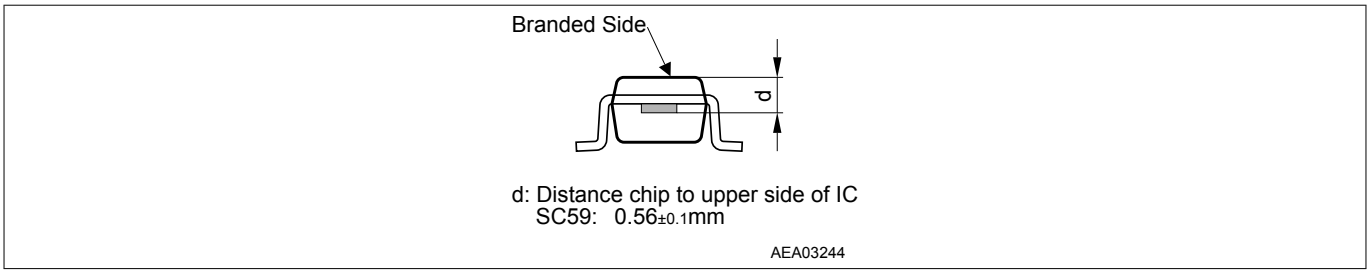


Figure 10 Distance between chip and package SC59

3.3 Package marking

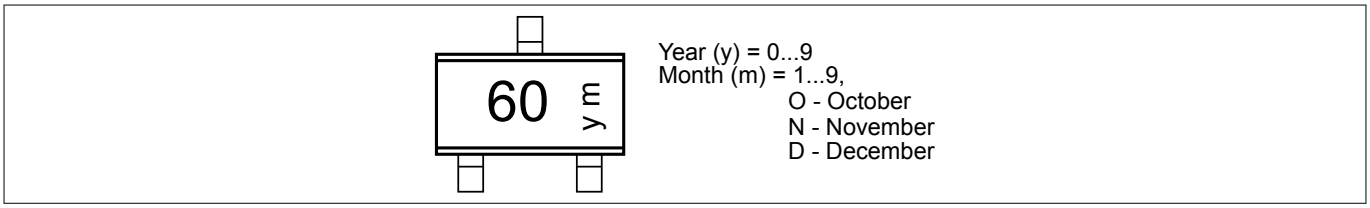


Figure 11 Marking of TLE4906K

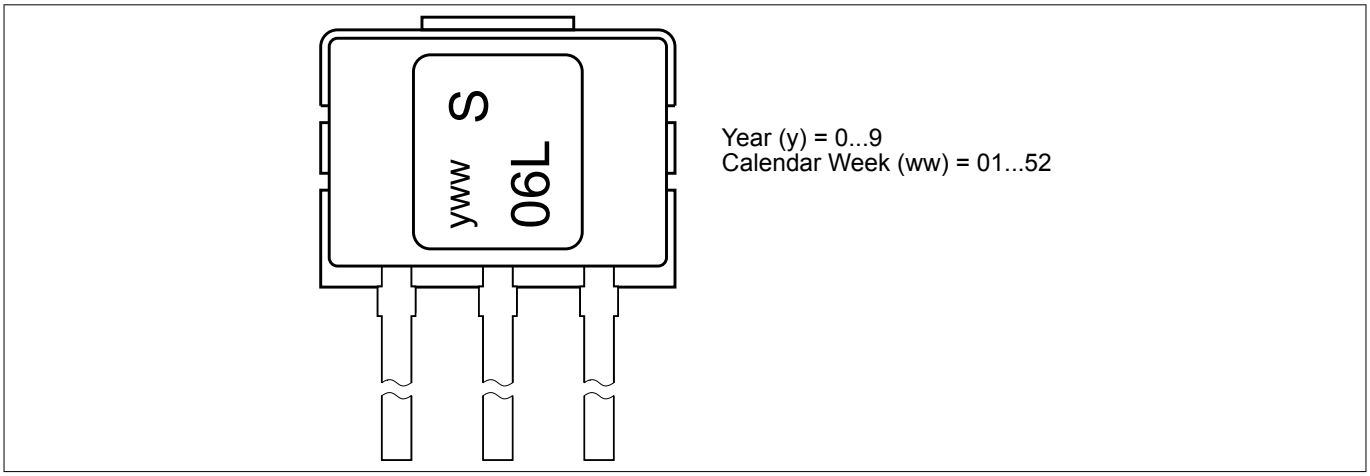


Figure 12 Marking of TLE4906L

Revision history

Revision History	
Page	**Subjects (major changes since last revision)**
Revision History: 2020-08, V 2.1	
Previous Version: 2.0	
13	Edited figure 9 (optional: data matrix code)

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