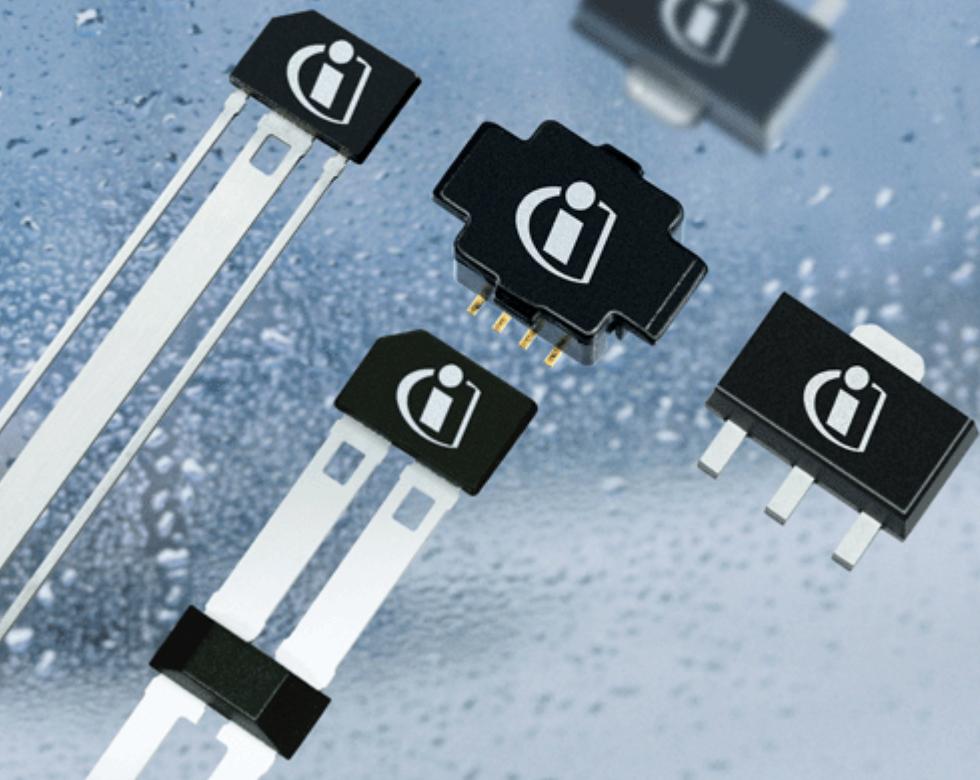


# TLE4946K

High Precision Bipolar Hall-Effect Latch



Sensors

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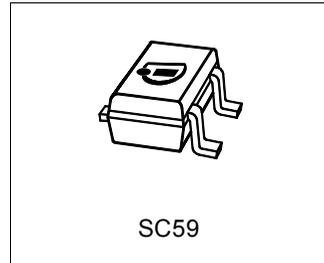
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## 1 Overview

### 1.1 Features

- 2.7 V to 24 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 (– 18 V)
- Superior temperature stability
- Peak temperatures up to 195°C without damage
- Low jitter (typ. 1  $\mu$ s)
- High ESD performance ( $\pm$  6 kV HBM)
- Digital output signal
- SMD package SC59 (SOT23 compatible)



### 1.2 Functional Description

The TLE4946K is a integrated circuit Hall-effect sensor 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.

Type	Package
TLE4946K	SC59

### 1.3 Pin Configuration (top view)

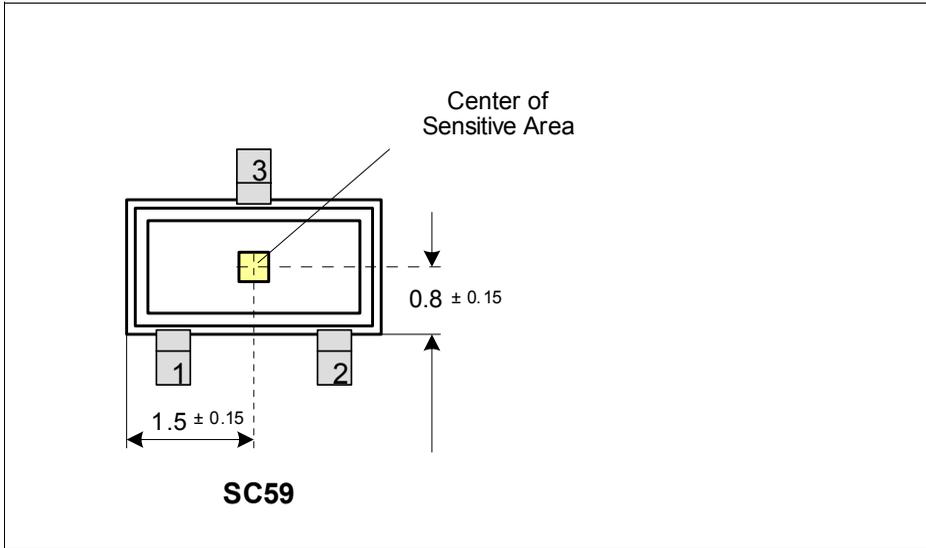


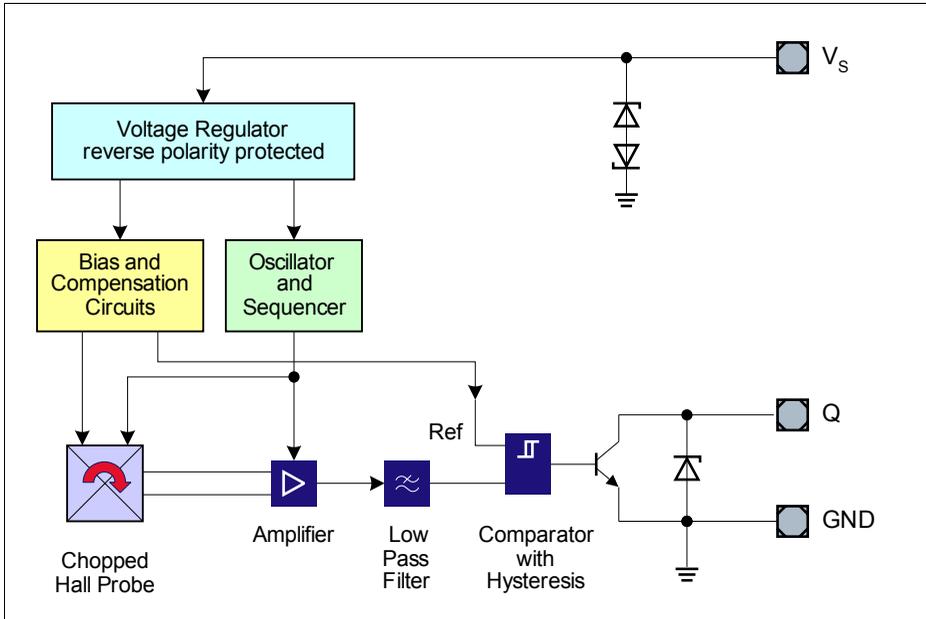
Figure 1 Pin Definition and Center of Sensitive Area

Table 1 Pin Definitions and Functions SC59

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

## 2 General

### 2.1 Block Diagram



**Figure 2** Block Diagram

### 2.2 Circuit 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.

**Maximum Ratings**

### 3 Maximum Ratings

**Table 2 Absolute Maximum Ratings**
 $T_j = -40^{\circ}\text{C to } 150^{\circ}\text{C}$ 

Parameter	Symbol	Limit Values		Unit	Conditions
		min.	max.		
Supply voltage	$V_S$	- 18 - 18 - 18	18 24 26	V	for 1 h, $R_s \geq 200 \Omega$ for 5 min, $R_s \geq 200 \Omega$
Supply current through protection device	$I_S$	- 50	+ 50	mA	
Output voltage	$V_Q$	- 0.7 - 0.7	18 26	V	for 5 min @ 1.2 k $\Omega$ pull up
Continuous output current	$I_Q$	- 50	+ 50	mA	
Junction temperature	$T_j$	- - - -	155 165 175 195	$^{\circ}\text{C}$	for 2000 h (not additive) for 1000 h (not additive) for 168 h (not additive) for 3 x 1 h (additive)
Storage temperature	$T_S$	- 40	150	$^{\circ}\text{C}$	
Magnetic flux density	B	-	unlimited	mT	

*Note: Stresses above those listed here may cause permanent damage to the device. Exposure to absolute maximum rating conditions for extended periods may affect device reliability.*

**Table 3 ESD Protection <sup>1)</sup>**

Parameter	Symbol	Limit Values		Unit	Notes
		min.	max.		
ESD voltage	$V_{\text{ESD}}$	-	$\pm 6$	kV	HBM, $R = 1.5 \text{ k}\Omega$ , $C = 100 \text{ pF}$ $T_A = 25^{\circ}\text{C}$

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

## 4 Operating Range

**Table 4 Operating Range**

Parameter	Symbol	Limit Values			Unit	Conditions
		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	

**Electrical and Magnetic Parameters**
**5 Electrical and Magnetic Parameters**
**Table 5 Electrical Characteristics <sup>1)</sup>.**

Parameter	Symbol	Limit Values			Unit	Conditions
		min.	typ.	max.		
Supply current	$I_S$	2	4	6	mA	$V_S = 2.7 \text{ V} \dots 18 \text{ V}$
Reverse current	$I_{SR}$	0	0.2	1	mA	$V_S = -18 \text{ V}$
Output saturation voltage	$V_{QSAT}$	–	0.3	0.6	V	$I_Q = 20 \text{ mA}$
Output leakage current	$I_{QLEAK}$	–	0.05	10	$\mu\text{A}$	for $V_Q = 18 \text{ V}$
Output fall time	$t_f$	–	0.02	1	$\mu\text{s}$	$R_L = 1.2 \text{ k}\Omega$ ; $C_L = 50 \text{ pF}$ see: <b>Figure 3 “Timing Definition” on Page 9</b>
Output rise time	$t_r$	–	0.4	1	$\mu\text{s}$	
Chopper frequency	$f_{OSC}$	–	320	–	kHz	
Switching frequency	$f_{SW}$	0	–	15 <sup>2)</sup>	kHz	
Delay time <sup>3)</sup>	$t_d$	–	13	–	$\mu\text{s}$	
Output jitter <sup>4)</sup>	$t_{QJ}$	–	1	–	$\mu\text{s}_{RMS}$	Typical value for square wave signal 1 kHz
Power-on time <sup>5)</sup>	$t_{PON}$	–	13	–	$\mu\text{s}$	$V_S \geq 2.7 \text{ V}$
Thermal resistance <sup>6)</sup>	$R_{thJA}$	–	100	–	K/W	SC59

1) over operating range, unless otherwise specified. Typical values correspond to  $V_S = 12 \text{ V}$  and  $T_A = 25^\circ\text{C}$

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  $V_S \geq 2.7 \text{ V}$  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  $V_S = 12.0 \text{ V}$ ,  $I_{Styp} = 4 \text{ mA}$ ,  $V_{QSATtyp} = 0.3 \text{ V}$  and  $I_Q = 20 \text{ mA}$  :

Power Dissipation:  $P_{DIS} = 54.0 \text{ mW}$ .

In  $T_A = T_j - (R_{thJA} \times P_{DIS}) = 175^\circ\text{C} - (100 \text{ K/W} \times 0.054 \text{ W})$

Resulting max. ambient temperature:  $T_A = 169.6^\circ\text{C}$

*Note: Typical characteristics specify mean values expected over the production spread.*

**Electrical and Magnetic Parameters**
**Table 6 Magnetic Characteristics TLE4946K <sup>1)</sup>**

Parameter	Symbol	$T_j$ [°C]	Limit Values			Unit	Notes
			min.	typ.	max.		
Operate point	$B_{OP}$	- 40	11.8	15.8	19.2	mT	
		25	11.0	14.0	17.0		
		150	6.1	9.6	13.7		
Release point	$B_{RP}$	- 40	- 19.2	- 15.8	- 11.8	mT	
		25	- 17.0	- 14.0	- 11.0		
		150	- 13.7	- 9.6	- 6.1		
Hysteresis	$B_{HYS}$	- 40	-	-	-	mT	
		25	22.0	28.0	34.0		
		150	-	-	-		
Magnetic Offset	$B_{OFF}$	- 40	-	-	-	mT	<sup>2)</sup>
		25	- 3.0	-	3.0		
		150	-	-	-		
Temperature compensation of magn. thresholds	TC	-	-	- 2000	-	ppm/°C	
Repeatability of magnetic thresholds <sup>3)</sup>	$B_{REP}$		-	20	-	$\mu T_{RMS}$	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.

2)  $B_{OFF} = (B_{OP} + B_{RP}) / 2$

3)  $B_{REP}$  is equivalent to the noise constant

**Field Direction Definition**

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

## 6 Timing Diagram

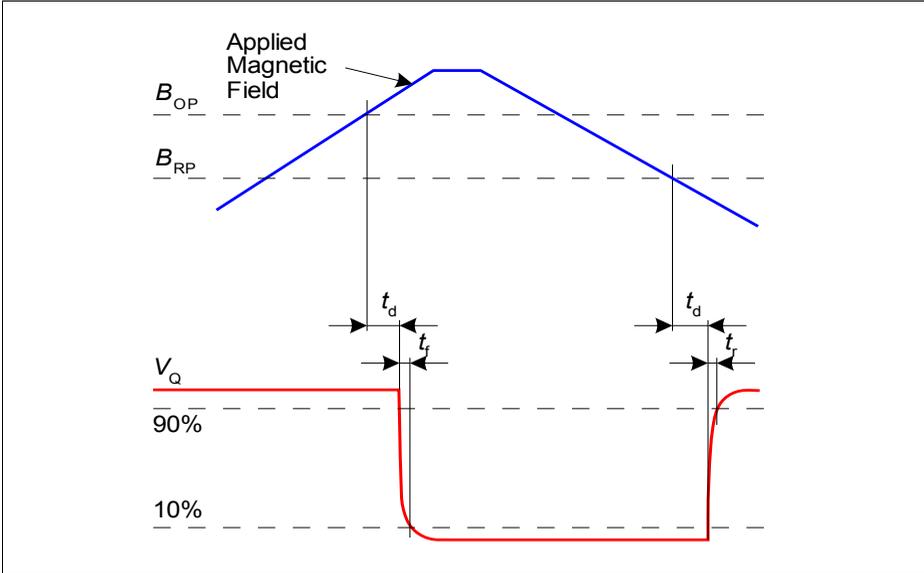


Figure 3 Timing Definition

## 7 Package Information

### 7.1 Package Marking

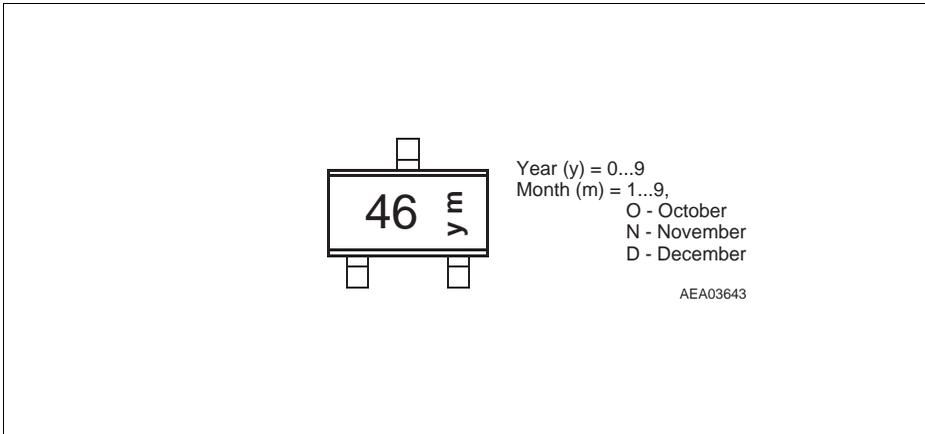


Figure 4 Marking TLE4946K

## 7.2 Distance between Chip and Package Surface

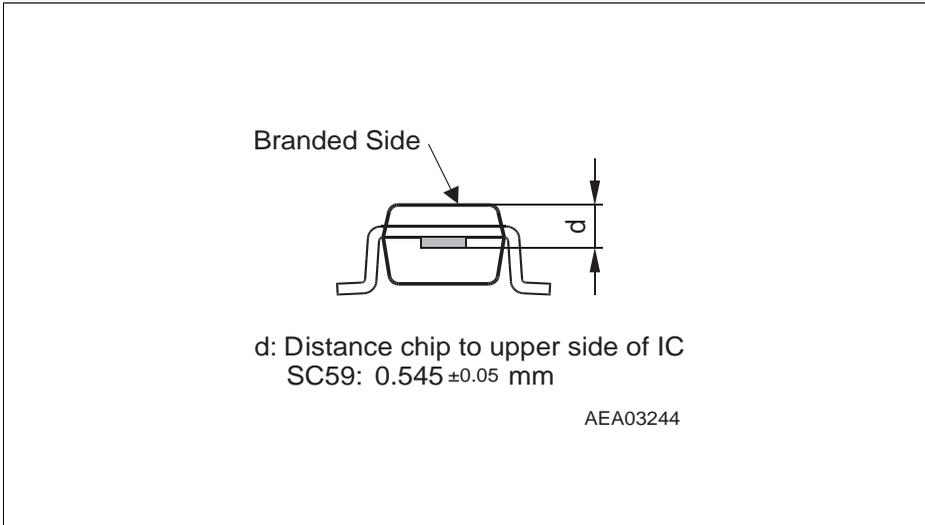


Figure 5 Distance Chip SC59 to Upper Side of IC

## 7.3 Package Outlines

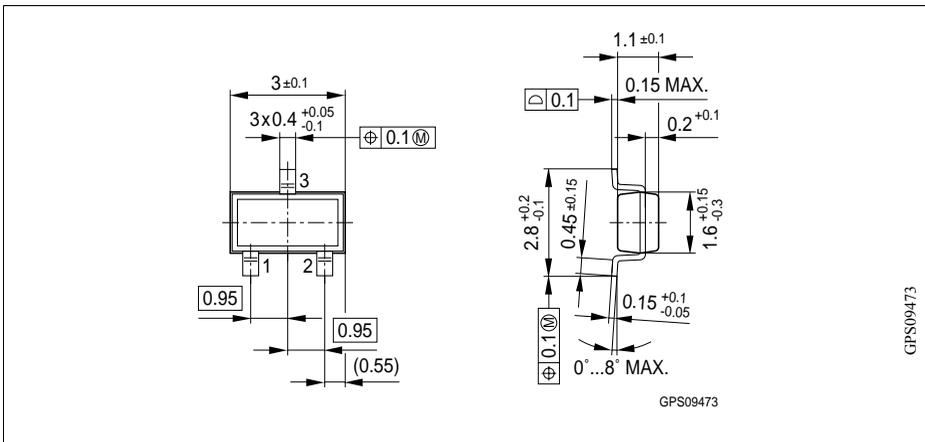
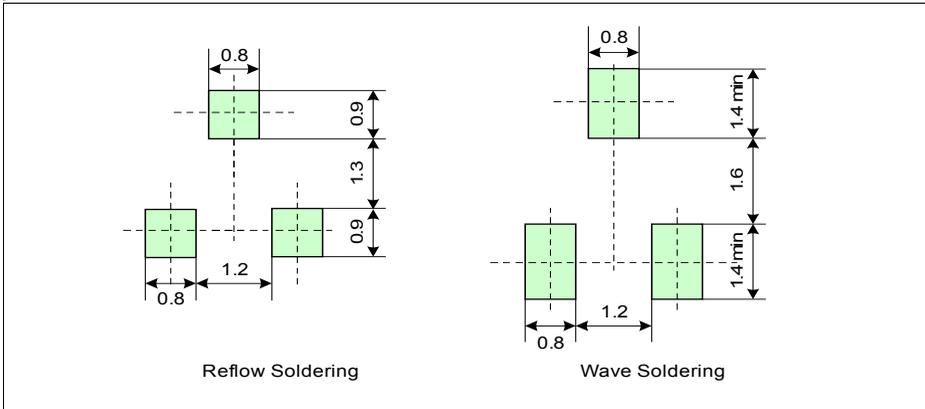


Figure 6 SC59

**PCB Footprint for SC59**

The following picture shows a recommendation for the PCB layout.



**Figure 7 Footprint SC59 (SOT23 compatible)**

*Note: You can find all of our packages, sorts of packing and others in our Infineon Internet Page "Products": <http://www.infineon.com/products>.*

Dimensions in mm







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