TLE4916-1K

Low Power Automotive Hall Switch

Datasheet

Rev.1.0, 2010-02-23

Sense & Control

Edition 2010-02-23

Published by
Infineon Technologies AG
81726 Munich, Germany

TLE4916-1K Low-Power Automotive Hall Switch

Revision History: 2010-02-23, Rev.1.0

Previous Version:

Page	Subjects (major changes since last revision)

We Listen to Your Comments

Any information within this document that you feel is wrong, unclear or missing at all?
Your feedback will help us to continuously improve the quality of this document.
Please send your proposal (including a reference to this document) to:

sensors@infineon.com

Table of Contents

1 Product Description

1.1 Overview

The TLE4916-1K is an integrated Hall-Effect Sensor in a SMD package designed specifically to meet the requirements of low-power automotive and industrial applications with operating voltages of 2.4V - 5.0V. A chopped measurement principle provides high stability switching thresholds for operating temperatures between -40°C and 125°C.

1.2 Features

- Micro power design
- 2.4V to 5.0V operation
- High sensitivity and high stability of the magnetic switching points
- High resistance to mechanical stress by Active Error Compensation
- High ESD performance (± 4kV HBM)
- Digital output signal
- SMD package SC59 (SOT23 compatible)
- RoHS compliant (Pb free package)

1.3 Target Applications

Target applications for TLE4916-1K are all automotive and industrial applications which require a low-power Hall switch to save power consumption. Due to its low average supply current of typical 4µA the sensor is ideally suited for battery powered systems or applications with a stand-by mode.
For example, the Hall switch can be used to provide a wake-up signal for other systems which are in a sleep mode by detecting a change in the magnetic field, thus reducing overall current consumption.

Product Name	Product Type	Ordering Code	Package
TLE4916-1K	Low Power Hall Switch	SP000649954	PG-SC59-3-4

2 Functional Description

2.1 General

The Low Power Hall IC Switch is comprised of a Hall probe, bias generator, compensation circuits, oscillator, output latch and a n-channel open drain 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 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 highly accurate magnetic switching points.

Very low power consumption is achieved with a timing scheme controlled by an oscillator and a sequencer. This circuitry activates the sensor for 50µs (typical operating time) sets the output state after sequential questioning of the switch points and latches it with the beginning of the following standby phase (max. 120ms). In the standby phase the average current is typically reduced to 3.5µA. Because of the long standby time compared to the operating time the overall averaged current is only slightly higher than the standby current. The output transistor can sink up to 1 mA with a maximal saturation voltage V_{QSAT}

2.2 Pin Configuration (top view)

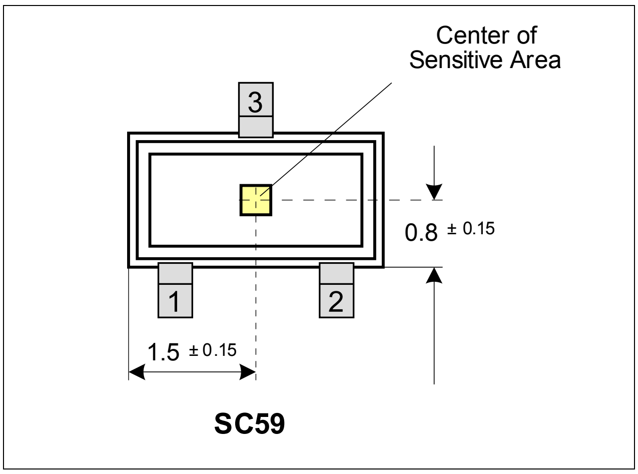

Figure 1 Pin Configuration and Center of Sensitive Area

2.3 Pin Description

Table 1 Pin Description

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

2.4 Block Diagram

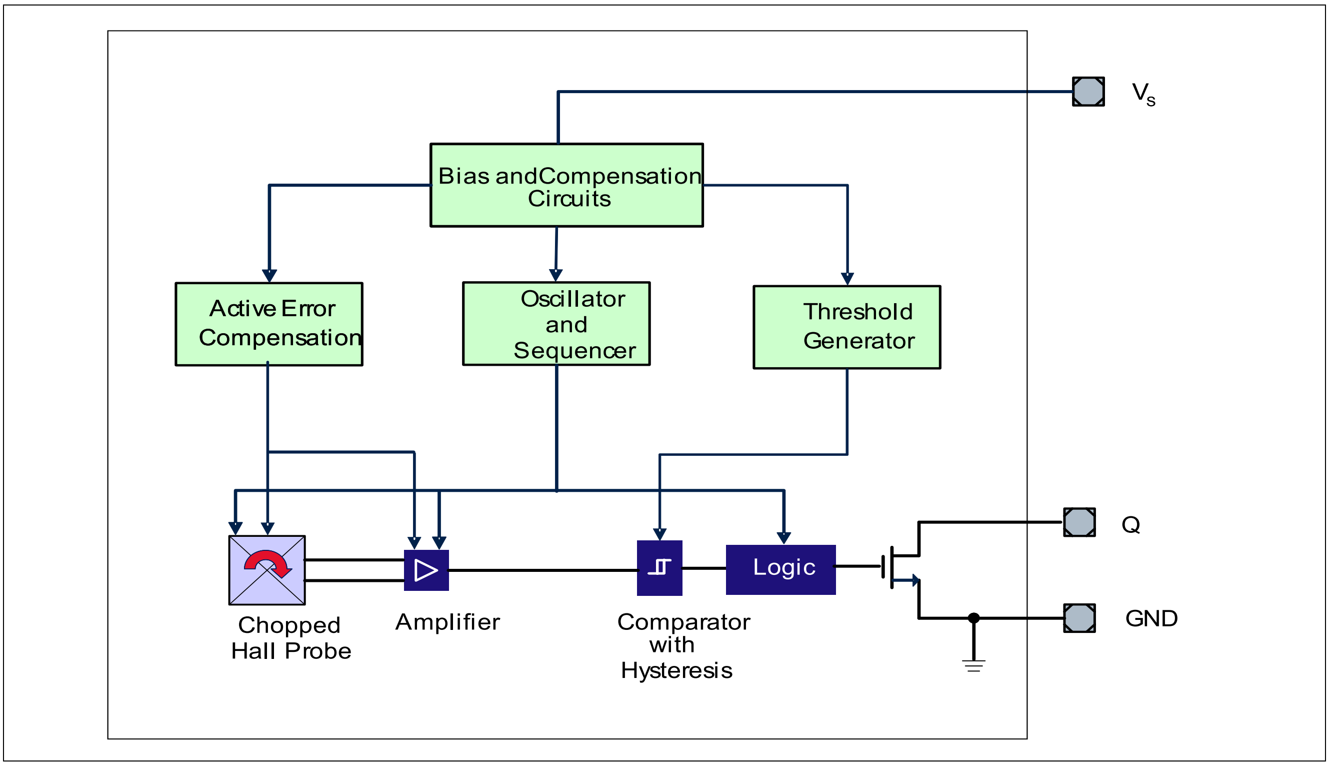

Figure 2 Functional Block Diagram

2.5 Functional Block Description

The TLE4916-1K is an integrated Hall-Effect Sensor designed specifically to meet the requirements of low-power applications with operating voltages of 2.4V - 5.0V.

Precise magnetic switching points and high temperature stability are achieved through the unique design of the internal circuit.

An onboard clock scheme is used to reduce the average operating current of the IC.

During the operating phase the IC compares the actual magnetic field detected to the internally compensated switching points. The output Q is switched at the end of each operating phase.

During the stand-by phase the output stage is latched and the current consumption of the device reduced to 4µA µA (typ. value).

The IC switching behaviour is designed as a latch, i.e. it can be switched on (Q = LO) with the south pole of a magnet and switched off (Q = HI) with the north pole.

.

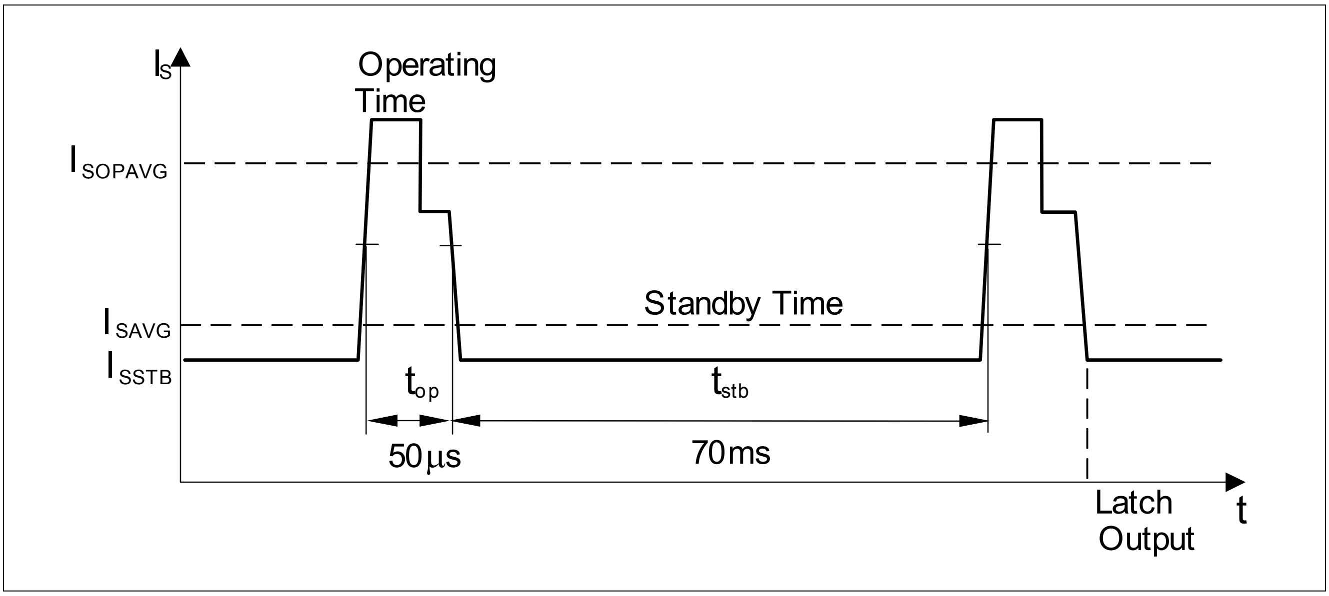

Figure 3 Timing Diagram

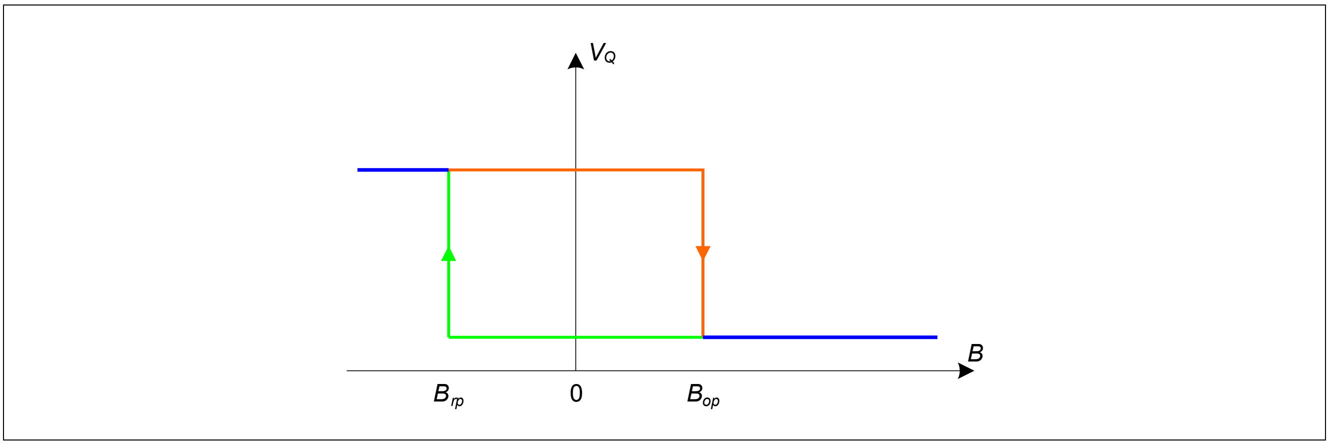

Figure 4 Output Signal

3 Specification

3.1 Application Circuit

For operating the sensor a pull-up resistor is required. A ceramic bypass capacitor at Vs to GND is recommended.

Note: The size of the pull-up resistor increases the overall current consumption as additional current is flowing through this resistor.

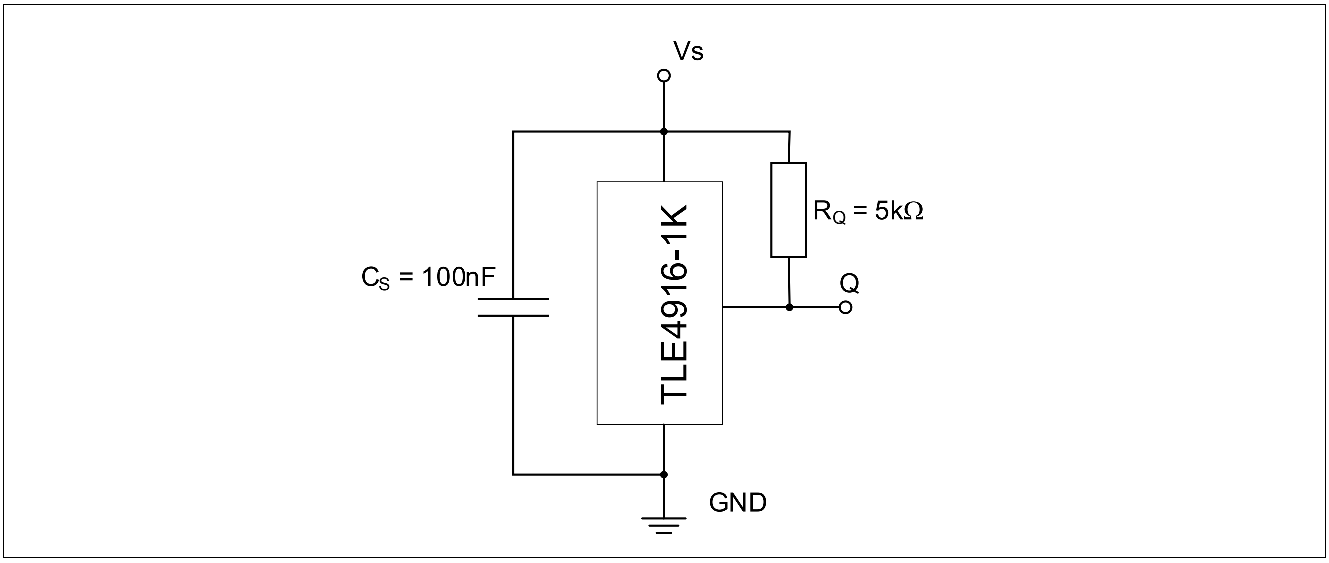

Figure 5 Application Circuit

3.2 Absolute Maximum Ratings

Table 2 Absolute Maximum Rating Parameters

Parameter	Symbol	Limit Values		Unit	Note / Test Condition
		Min.	Max.		
Supply voltage	V_S	-0.3	5.5	V	
Supply current	I_S	-1	2.5	mA	
Output voltage	V_Q	-0.3	5.5	V	
Output current	I_Q	-1	2	mA	
Junction temperature	T_j	– –	125 150 195	°C	for 5000h (not additive) for 2000h (not additive) for 3 x 1h (additive)
Magnetic flux density	B	–	unlimited	mT	
Thermal resistance SC59			100	K/W	

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.

Table 3 ESD Protection[1)]

Parameter	Symbol	Limit Values		Unit	Note / Test Condition
		Min.	Max.		
ESD Voltage	V_{ESD}	±4		kV	HBM, R = 1.5kΩ, C = 100pF 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

3.3 Operating Range

The following operating conditions must not be exceeded in order to ensure correct operation of the TLE4916-1K. All parameters specified in the following sections refer to these operating conditions unless otherwise mentioned.

Table 4 Operating Condition Parameters

Parameter	Symbol	Values			Unit	Note / Test Condition
		Min.	Typ.	Max.		
Supply voltage	V_S	2.4	2.7	5.0	V	
Output voltage	V_Q	-0.3	2.7	5.0	V	
Junction temperature	T_j	-40		125	°C	

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. The specification listed in **Table 5** are valid in combination with the application circuit shown in **Figure 5** unless other conditions are stated.

Table 5 General Electrical Characteristics[1)]

Parameter	Symbol	Values			Unit	Note / Test Condition
		Min.	Typ.	Max.		
Average supply current	I_{SAVG}	1	4	10	µA	$V_s \leq 3.3V$ $-40°C \leq T_j \leq 125°C$
		1	4	11		$V_s \leq 5.0V$ $-40°C \leq T_j \leq 85°C$
		1	4	13		$V_s \leq 5.0V$ $85°C \leq T_j \leq 125°C$
Average supply current during operating time	I_{SOPAVG}	0.5	1.1	2.5	mA	
Transient peak supply current during operating time[2)]	I_{SOPT}	–	–	2.5	mA	t < 100ns
Supply current during stand-by time	I_{SSTB}	1	3.5	9.5	µA	$V_s \leq 3.3V$ $-40°C \leq T_j \leq 125°C$
		1	3.5	10.5		$V_s \leq 5.0V$ $-40°C \leq T_j \leq 85°C$
		1	3.5	12.5		$V_s \leq 5.0V$ $85°C \leq T_j \leq 125°C$
Output saturation voltage	V_{QSAT}	–	0.13	0.4	V	I_Q = 1mA
Output leakage current	I_{QLEAK}	–	0.01	1	µA	
Output fall time	t_f	–	0.1	1	µs	R_L = 2.7kΩ, C_L = 10pF
Output rise time	t_r	–	0.5	1	µs	R_L = 2.7kΩ, C_L = 10pF
Operating time	t_{op}	15	50	93	µs	
Stand-by time	t_{stb}	–	70	120	ms	$-40°C \leq T_j \leq 0°C$
		–	70	100		$0°C \leq T_j \leq 125°C$
Duty cycle	t_{op}/t_{stb}	–	0.07	–	%	

1) Over operating range, unless otherwise specified. Typical values correspond to V_S = 2.7V and T_A = 25°C

2) Transient peak I_{SOPT} occurs on top of I_{SOPAVG}

Table 6 Magnetic Characteristics[1)]

Parameter	Symbol	Values			Unit	Note / Test Condition
		Min.	Typ.	Max.		
Operating point	B_{OP}	2	3.5	5	mT	
Release point	B_{RP}	-5	-3.5	-2	mT	
Hysteresis	B_{HYS}	4	7	10	mT	
Temperature compensation of magnetic thresholds	T_C	–	-700	–	ppm/°C	

1) Over operating range, unless otherwise specified. Typical values correspond to V_S = 2.7V and T_A = 25°C.

Field Direction Definition

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

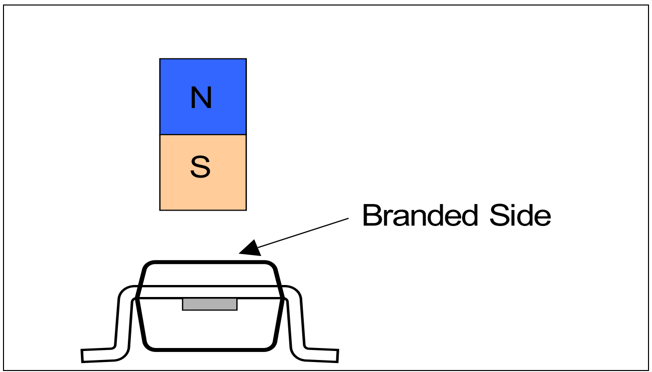

Figure 6 Definition of magnetic field direction

4 Package Information

4.1 Package Outline SC59

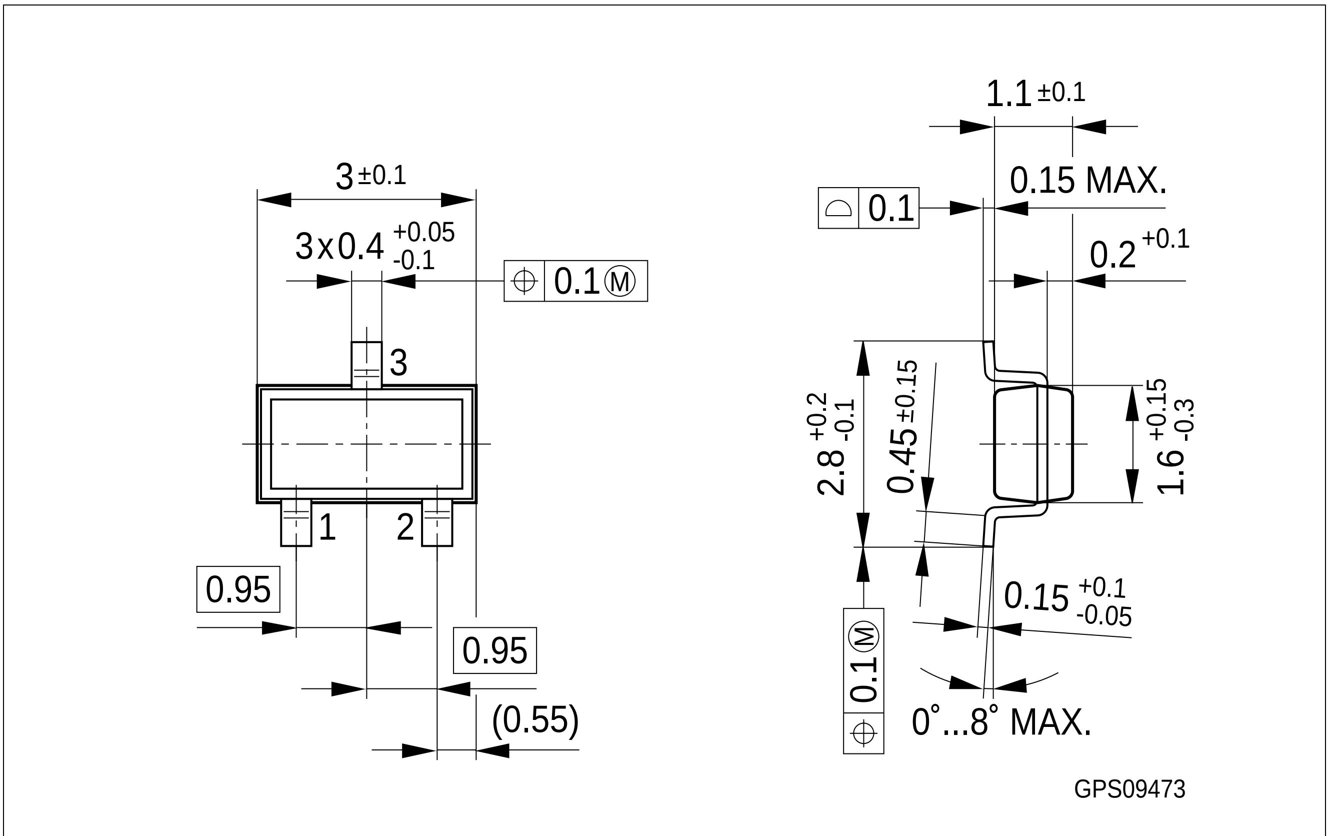

Figure 7 SC59 Package Outline (All dimensions in mm)

4.2 Footprint

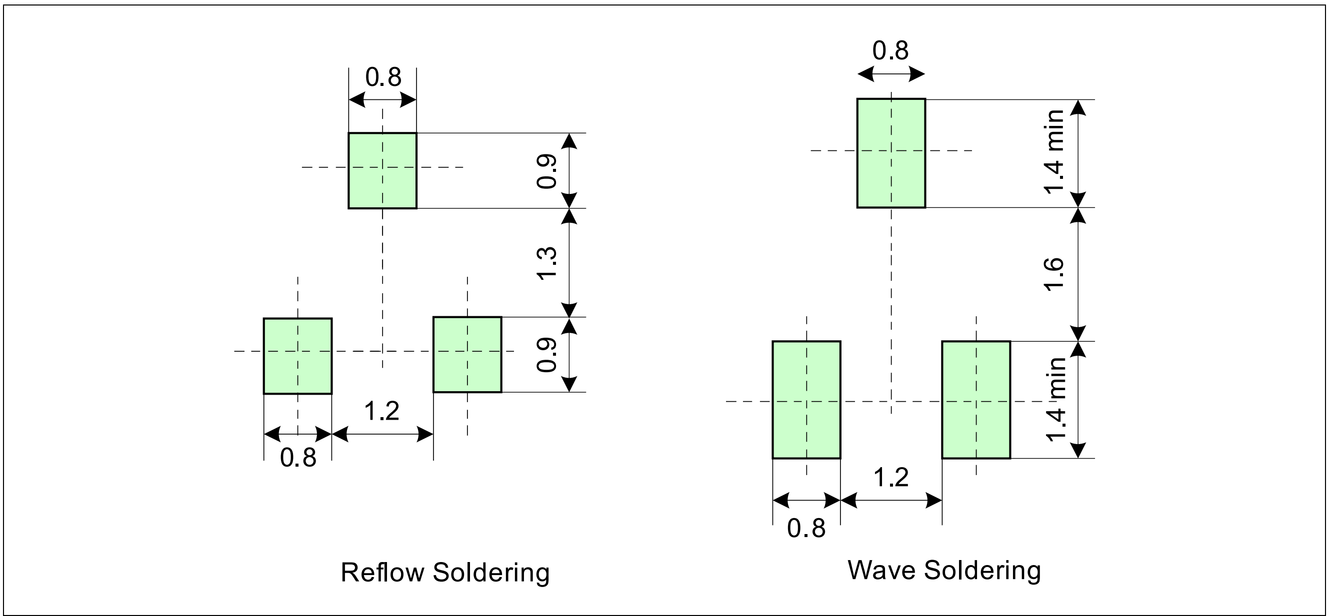

Figure 8 Footprint SC59

4.3 Distance between Chip and Package

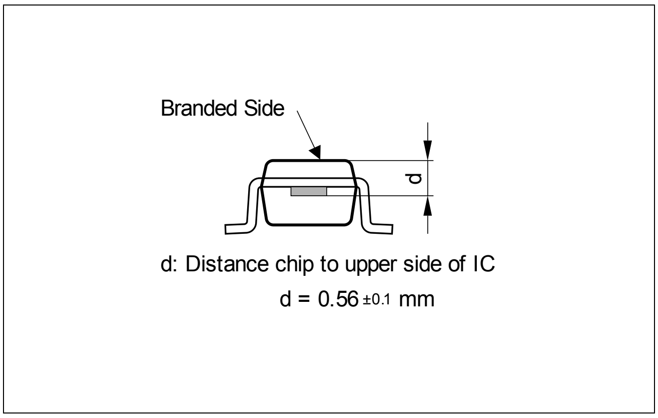

Figure 9 Distance between chip and package

4.4 Package Marking

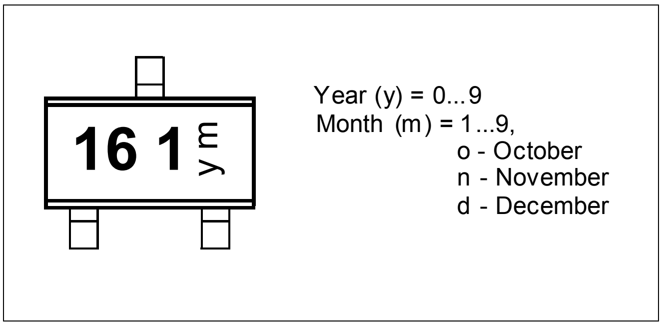

Figure 10 Marking of TLE4916-1K

w w w . i n f i n e o n . c o m

Published by Infineon Technologies AG