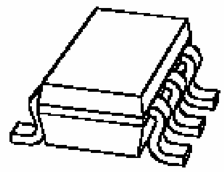
High Precision Hall-Effect Switch TLE4966H

Data Sheet Version 1.0
2003-11-20

Features

- 2.7V to 24V 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 (-18V)
- Superior temperature stability
- Peak temperatures up to 195°C without damage
- Low jitter (typ. 1µs)
- Digital output signal
- Bipolar version
- Excellent matching between the 2 Hall probes
- Hall plate distance 1.45mm
- Direction & speed information
- Direction signal switches 1 µs before the speed signal
- SMD package P-TSOP-6-6-3



P-TSOP-6-6-3

Type	Ordering Code	Package
TLE4966H	Q62705-K693	P-TSOP-6-6-3

Functional Description

The TLE4966H is an integrated circuit double 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. The TLE4966H provides a speed signal at Q2 for every magnetic pole pair and a direction information at Q1. The direction output switches 1µs (min.) before the speed output.

Circuit Description

The chopped Double Hall Switch comprises two Hall probes, bias generator, compensation circuits, oscillator, and output transistors.
The bias generator provides currents for the Hall probes 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 probes caused by molding and soldering processes and other thermal stresses in the package. This chopper technique together with the threshold generator and the comparator ensures high accurate magnetic switching points.

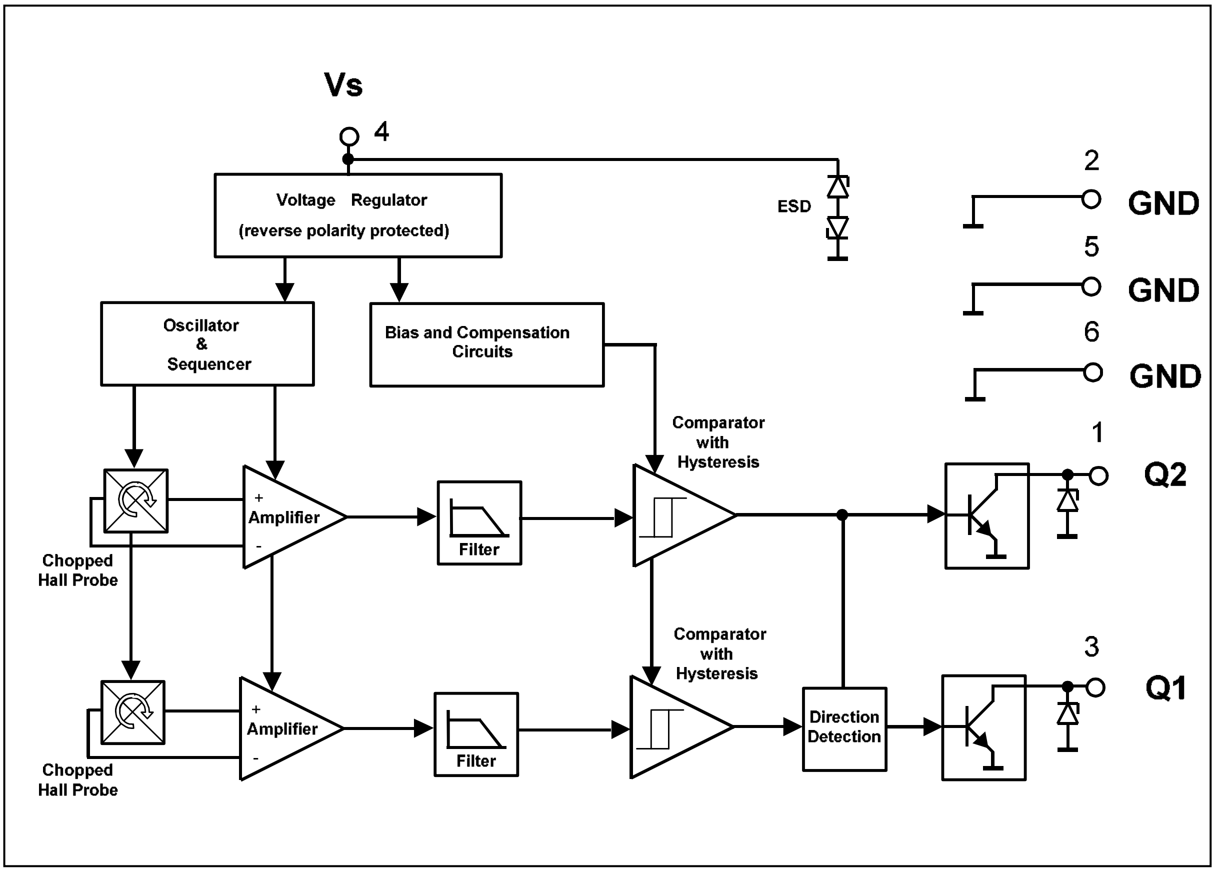


Figure 1: Block Diagram

Pin Configuration

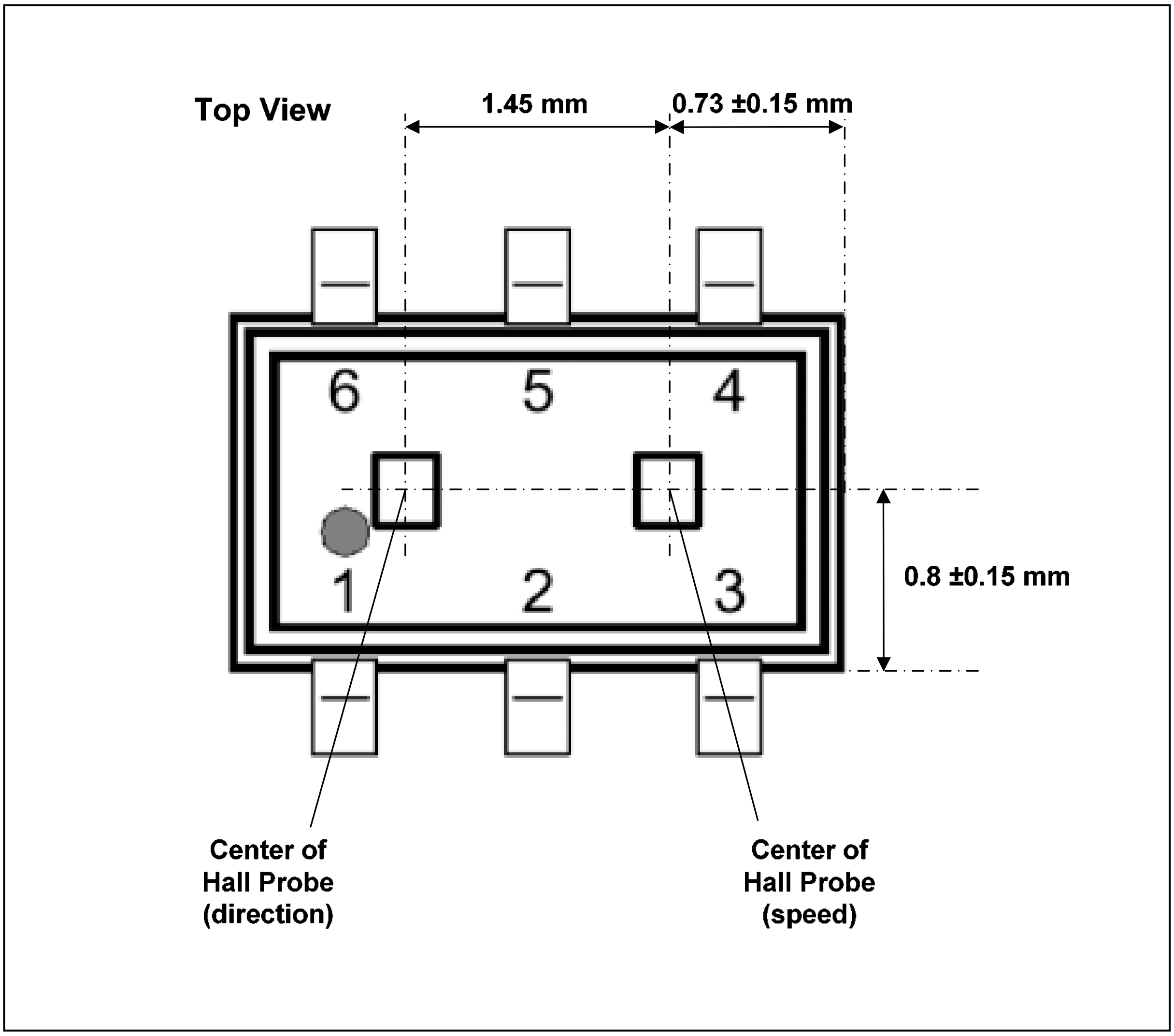


Figure 2: Pin Configuration

Pin Definition and Functions P-TSOP-6-6-3 package

Pin	Symbol	Function
1	Q2	Speed
2	GND	Recommended connection to GND
3	Q1	Direction
4	Vs	Supply voltage
5	GND	Recommended connection to GND
6	GND	Ground

Absolute Maximum Ratings

Tj = -40 to 150°C

Parameter	Symbol	min.	max.	Unit	Conditions
Supply Voltage	V_S	-18 -18 -18	18 24 26	V	 for 1h ,Rs>=200 Ohm for 5min, Rs>=200 Ohm
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 kOhm pull up
Continuous Output Current	I_Q	-50	+50	mA	
Junction Temperature	T_j	-	155 165 175 195	°C	for 2000 h (not additive) for 1000 h (not additive) for 168 h (not additive) for 3x1 h (additive)
Storage Temperature	T_S	-40	150	°C	
Magnetic Flux Density	B	-	unlimit.	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.

ESD Protection

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

Parameter	Symbol	max.	Unit	Conditions
ESD Voltage	V_{ESD}	± 4	kV	HBM, R= 1.500 Ohm, C= 100pF; T_A = 25°C

Operating Range

Parameter	Symbol	min.	typ.	max.	Unit	Conditions
Supply Voltage	V_S	2.7	-	18 24 26	V	 1h with R_S >= 200 Ohm for 5min R_S >=2 00 Ohm
Output Voltage	V_Q	-0.7	-	18	V	
Junction Temperature	T_j	-40	-	150 175	°C	 for 168 h
Output Current	I_Q	0	-	10	mA	

AC/DC Characteristics

over operating range, unless otherwise specified. Typical values correspond to V_S=12V and T_A=25°C.

Parameter	Symbol	min.	typ.	max.	Unit	Conditions
Supply Current	I_S	3	5.5	8	mA	V_S = 2.7V .. 18V
Reverse Current	I_{SR}	0	0.2	1	mA	V_S= -18V
Output Saturation Voltage	V_{QSAT}	-	0.3	0.6	V	I_Q= 10mA
Output Leakage Current	IQ_{LEAK}	-	0.05	10	µA	for V_Q=18 V
Output Fall Time	t_f	-	0.2	1	µs	R_L= 1.2 kOhm ;C_L<50pF; Figure 3
Output Rise Time	t_r	-	0.2	1	µs	R_L= 1.2 kOhm ;C_L<50pF; Figure 3
Chopper Frequency	f_{OSC}	-	320	-	kHz	
Switching Frequency	f_{SW}	0	-	15[1)]	kHz	
Delay Time[2)]	t_d	-	13	-	µs	
Delay of Count Signal	$t_{d,count}$	-	1	-	µs	
Output Jitter[3)]	t_{QJ}	-	1	-	$µs_{RMS}$	Typ. Value for Square-Wave Signal 1kHz
Repeatability of magnetic thresholds[4)]	B_{REP}	-	40	-	$µT_{RMS}$	Typ. Value for $\Delta B/\Delta t$>12mT/ms
Power-On Time[5)]	t_{PON}	-	13	-	µs	V_S >= 2.7V
Distance of Hall plates	d_{HALL}	-	1.45	-	mm	
Thermal Resistance[6)] P-TSOP-6-6-3	R_{thJA}	-	100	-	K/W	

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 -3dB 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) B_{REP} is equivalent to the noise constant.
5) Time from applying V_S >= 2.7 V to the sensor until the output state is valid.
6) Thermal resistance from junction to ambient.
e.g.: V_S=12.0 V, I_{S_typ}=5.5 mA, V_{QSAT_typ}=0.3 V, 2*I_Q=10mA => Power Dissipation P_{dis}= 72.0 mW.
In $T_A = T_j – (R_{thJA} * P_{dis})$ = 175 °C – (100 K/W * 0.072 W) => $\underline{T_A = 167.8\ °C}$

Magnetic Characteristics

over operating range, unless otherwise specified. Typical values correspond to V_S=12V.

Parameter	Symbol	Tj [°C]	min.	typ.	max.	Unit	Conditions
Operate Point TLE4966H	B_{OP}	 -40 25 150	 5.2 5.0 4.7	 7.7 7.5 7.1	 10.3 10.0 9.5	mT	
Release Point TLE4966H	B_{RP}	 -40 25 150	 -10.3 -10.0 -9.5	 -7.7 -7.5 -7.1	 -5.2 -5.0 -4.7	mT	
Hysteresis TLE4966H	B_{HYS}	 -40 25 150	 - 10.0 -	 - 15.0 -	 - 20.0 -	mT	
Magnetic Matching TLE4966H	B_{match}	 -40 25 150	 - -3.0 -	 - 0 -	 - 3.0 -	mT	Valid for B_{OP1}-B_{OP2} and B_{RP1}-B_{RP2}
Magnetic Offset TLE4966H	B_{OFF}	 -40 25 150	 - -3.0 -	 - 0 -	 - 3.0 -	mT	$(B_{OP}+B_{RP})/2$
Temperature Compensation of Magnetic Thresholds	TC	-	-	-350	-	ppm/°C	

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

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

Timing diagrams for the speed and direction outputs

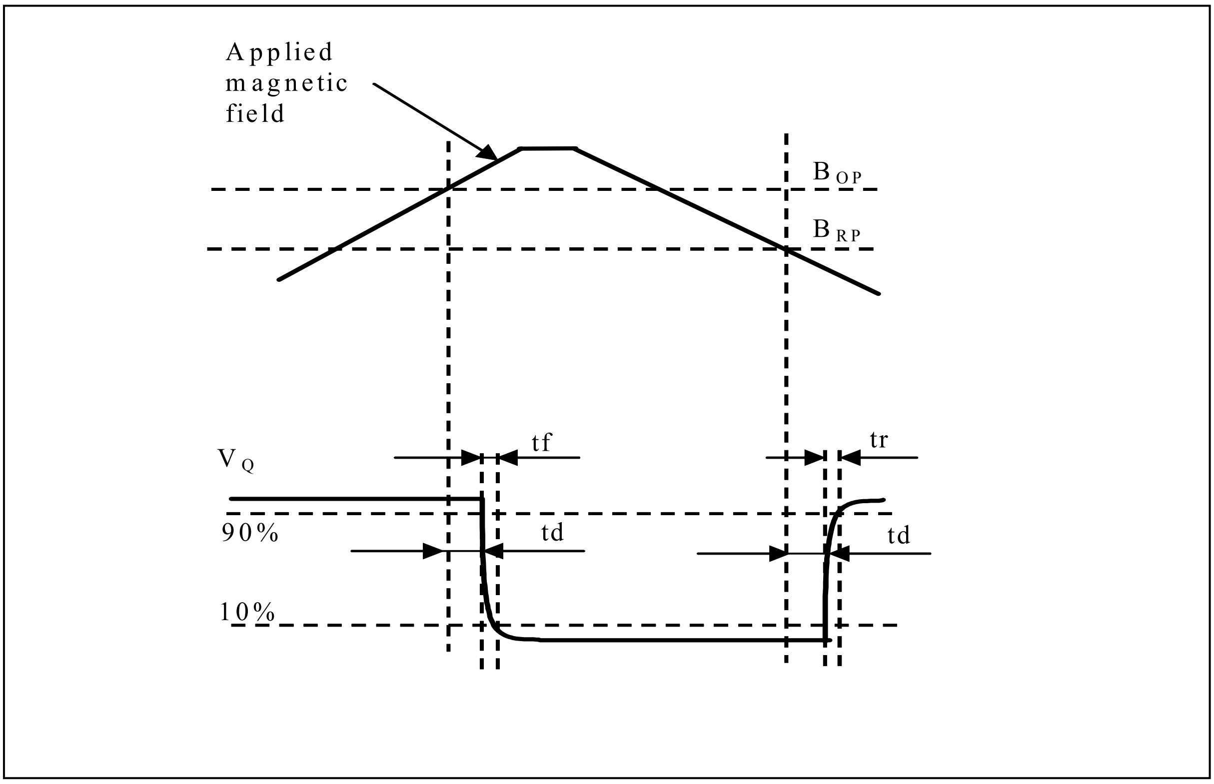


Figure 3: Timing definition of the speed signal

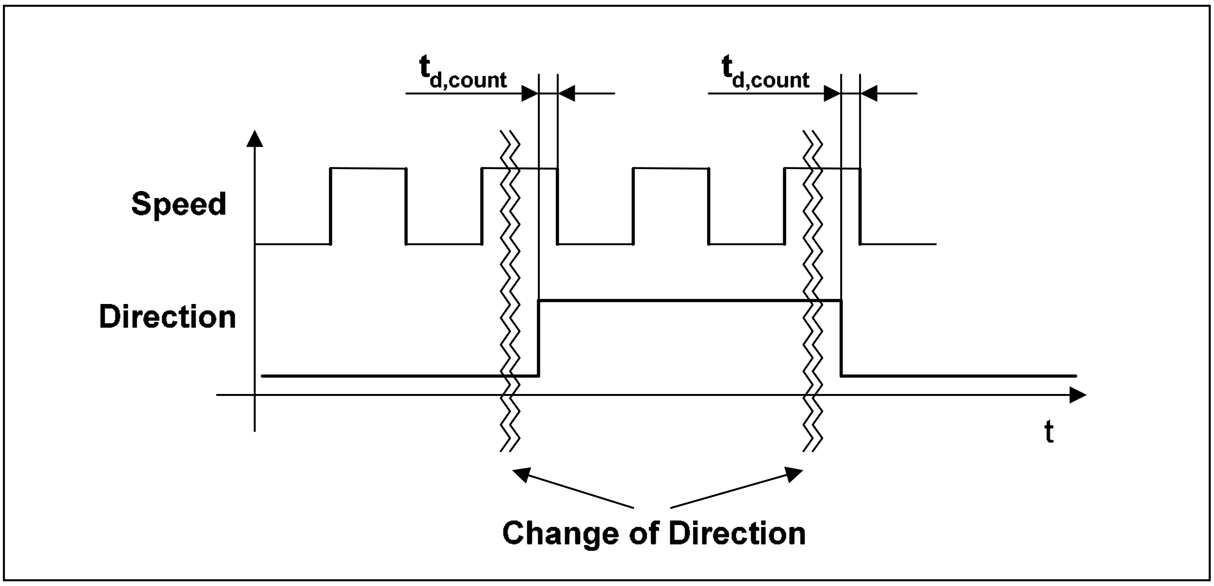


Figure 4: Timing Definition of the Direction Signal

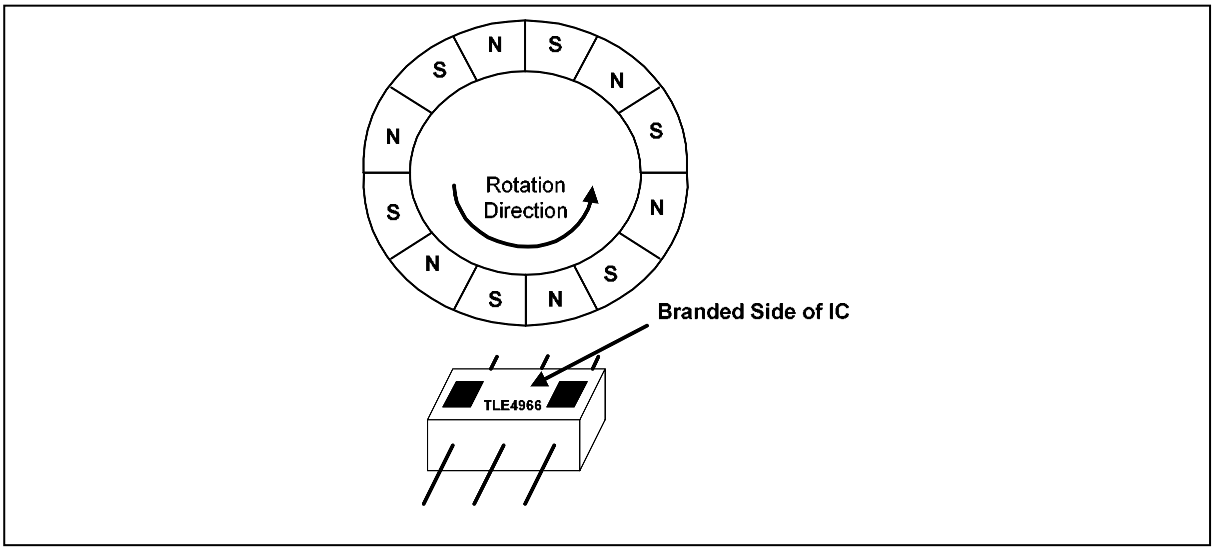


Figure 5: Definition of the Direction Signal

Rotation Direction	State of Direction Output V_{Q1}
left to right	low
right to left	high

Package Dimensions

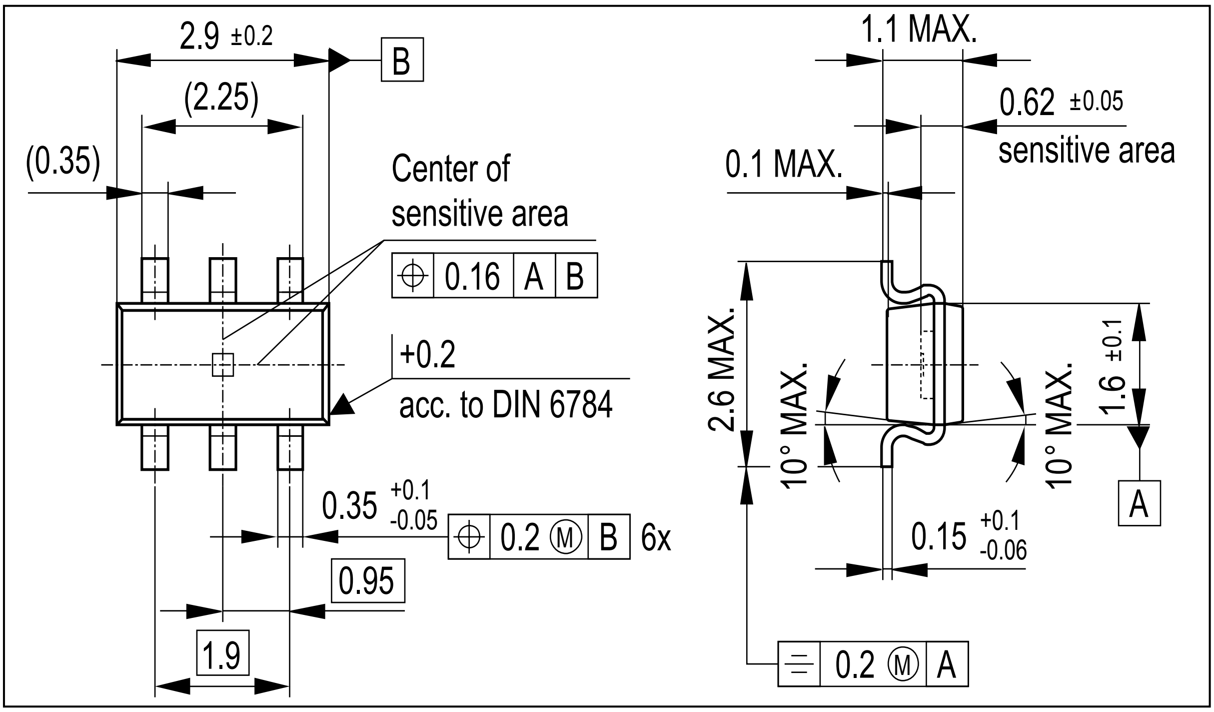


Figure 6: Package Dimension

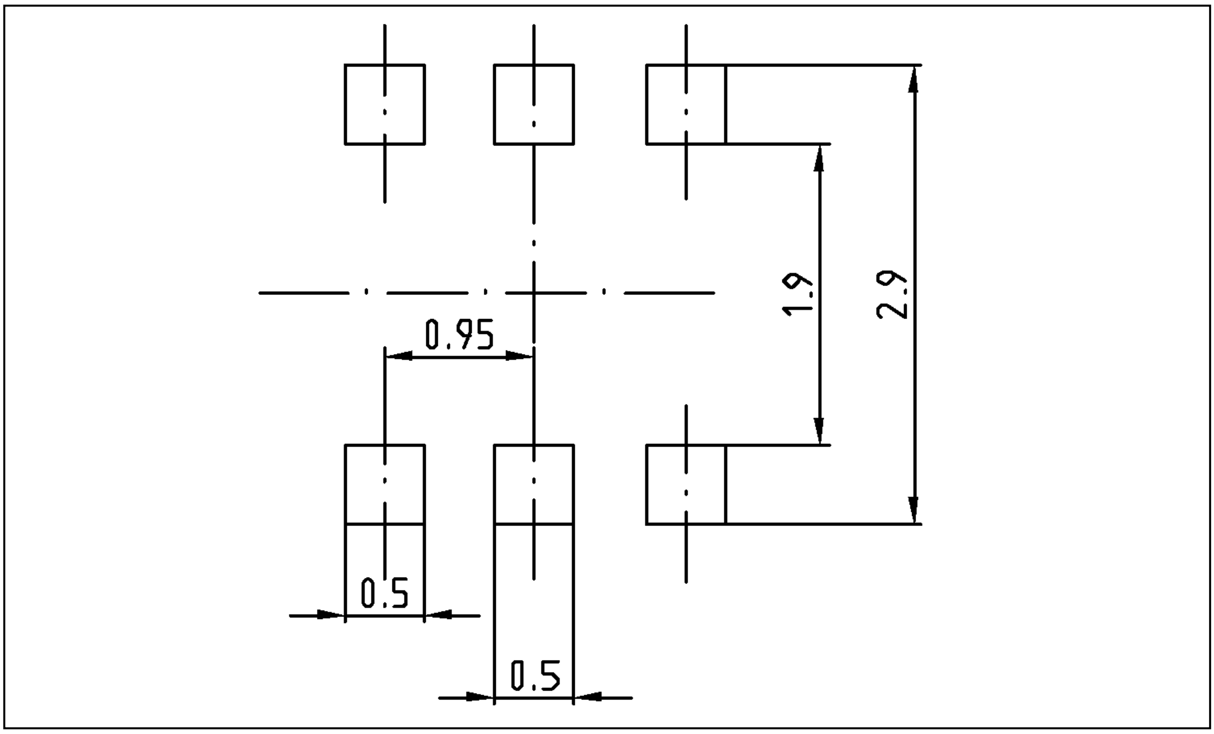


Figure 7: Foot print

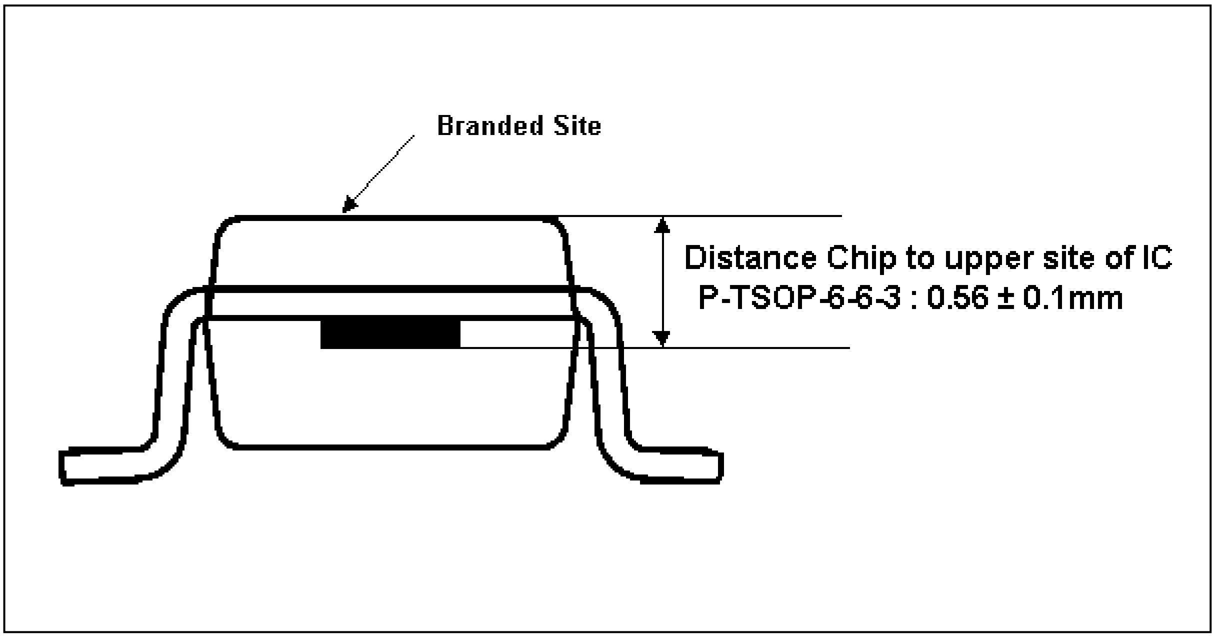


Figure 8: Distance from Package to Die

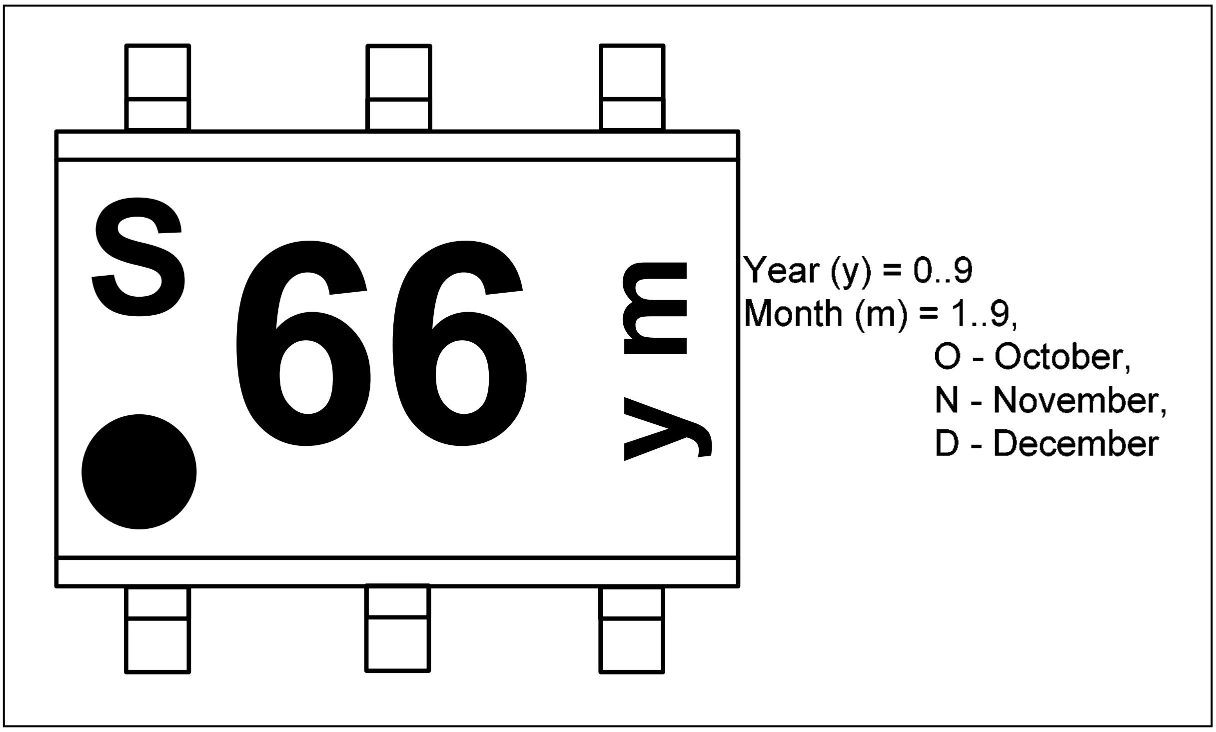


Figure 9: Marking

TLE4966H **Revision History: Version 1.0**	**2003-11-20**
Previous Version:	
Page	Subjects (major changes since last revision)

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Edition 2001-02-22
Published by Infineon Technologies AG
St.-Martin-Strasse 53
D-81541 München

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