# High Precision Hall-Effect Switch   TLE4976-1H

Data Sheet Version 1.0
2003-11-20

Features

- 2-wire current interface 6/14 mA
- 3.0V 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)
- High ESD performance (±8kV HBM)
- Digital output signal
- Unipolar version
- SMD package P-SC59-3-2 (SOT-23 compatible)
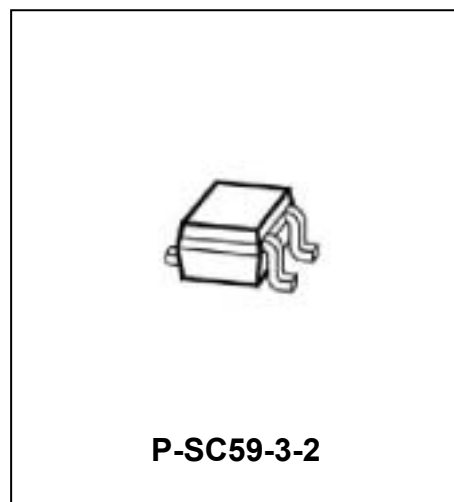
P-SC59-3-2

Type	Ordering Code	Package
TLE4976-1H	Q62705K0710	P-SC59-3-2

Functional Description

The TLE4976-1H is an integrated circuit Hall-effect sensor designed specifically for highly accurate applications with a current interface. Precise magnetic switching points and high temperature stability are achieved by active compensation circuits and chopper techniques on chip.

Circuit Description

The chopped Hall IC Switch comprises a Hall probe, bias generator, compensation circuits, oscillator, and a current output.
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 ensures high accurate magnetic switching points.
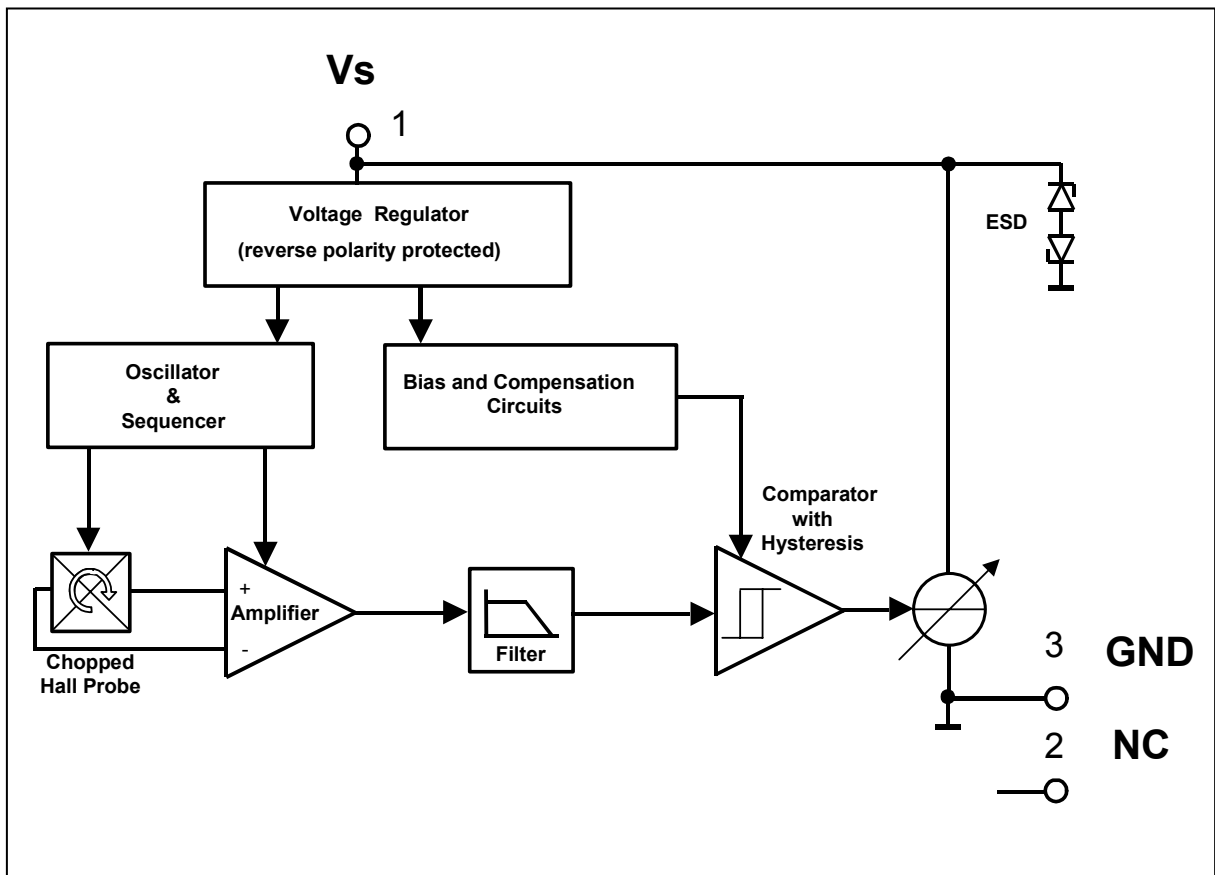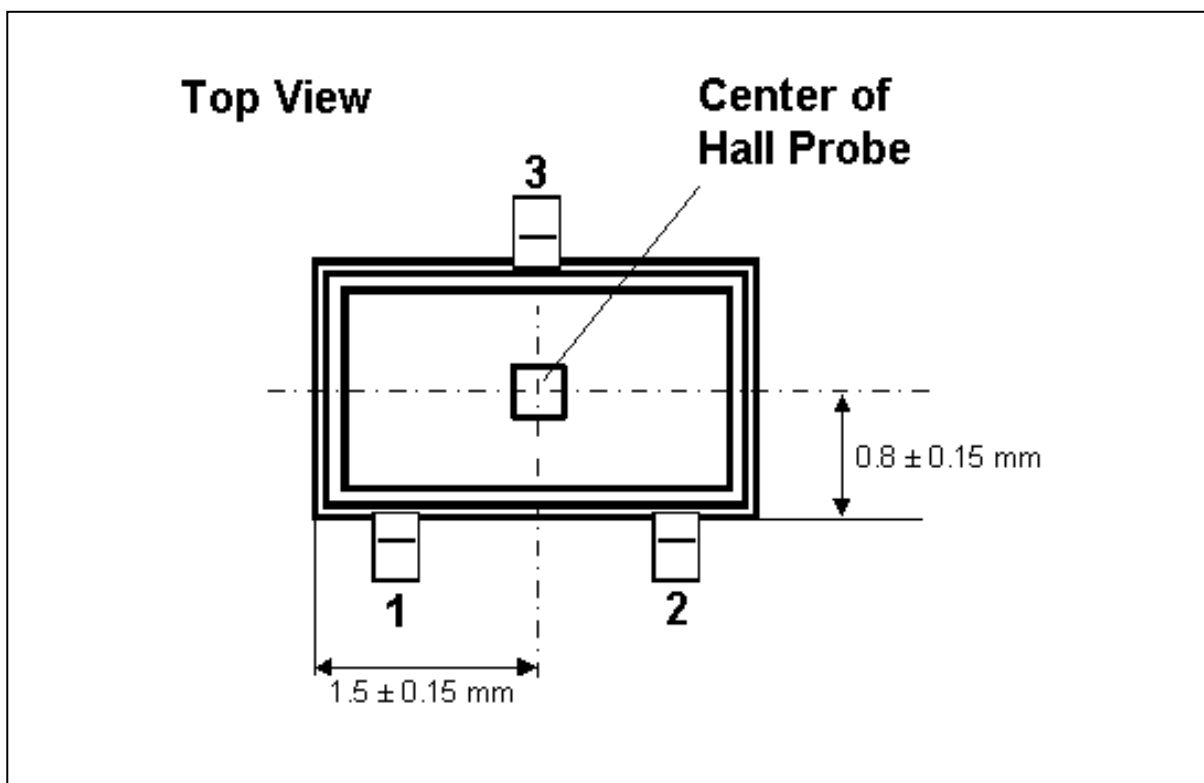

Figure 1 Block Diagram

Pin Configuration

Figure 2: Pin Configuration (SOT-23 pin compatible)

Pin Definition and Functions

Pin	Symbol	Function
1	V_S	Supply voltage
2	NC	No internal connection
3	GND	Ground

Absolute Maximum Ratings

T_j = -40 to 150°C

Parameter	Symbol	min.	max.	Unit	Conditions
Supply Voltage	V_S	-18	18	V	
		-18	24		for 1h (R_S+R_L > 75 Ohm)
		-18	26		for 5min (R_S+R_L > 75 Ohm)
Supply Current through protection device	Is	-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 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}	$\pm$ 8	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	3.0	-	18	V	
		3.0		24		for 5min (R_S+R_L > 100 Ohm)
Junction Temperature	T_j	-40	-	150	°C	
				175		for 168 h

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 low	I_{Slow}	5	6	7	mA	B<Brp; V_S = 3.0V .. 18V
Supply Current high	I_{Shigh}	12	14	17	mA	B>Bop; V_S = 3.0V .. 18V
Reverse Current	I_{SR}	0	-	0.2	mA	V_S= -18V
Output Fall Time	t_f		0.4	1.6	µs	R_S= 100 Ohm; Figure 3
Output Rise Time	t_r		0.4	1.6	µs	R_S= 100 Ohm; Figure 3
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 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 >= 3.0V
Thermal Resistance[6] P-SC59-3-2	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 >= 3.0 V to the sensor until the output state is valid.

[6] Thermal resistance from junction to ambient.
   e.g.: V_S=12.0 V, R_S=100 Ohms, I_{Shigh_typ}=14 mA => Power Dissipation P_{dis}=148.4 mW.
   In $T_A = T_j - (R_{thJA} * P_{dis}) = 175\ °C - (100\ K/W * 0.1484\ W) => \underline{T_A = 160.1\ °C}$

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 TLE4976-1H	B_{OP}					mT	
		-40	5.5	9.25	11.0		
		25	5.5	9.25	11.0		
		150	5.5	9.25	11.0		
Release Point TLE4976-1H	B_{RP}					mT	
		-40	5.0	7.25	10.5		
		25	5.0	7.25	10.5		
		150	5.0	7.25	10.5		
Hysteresis TLE4976-1H	B_{HYS}					mT	
		-40	0.5	2.0	3.0		
		25	0.5	2.0	3.0		
		150	0.5	2.0	3.0		
Temperature Compensation of Magnetic Thresholds	TC	-	-	0	-	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.
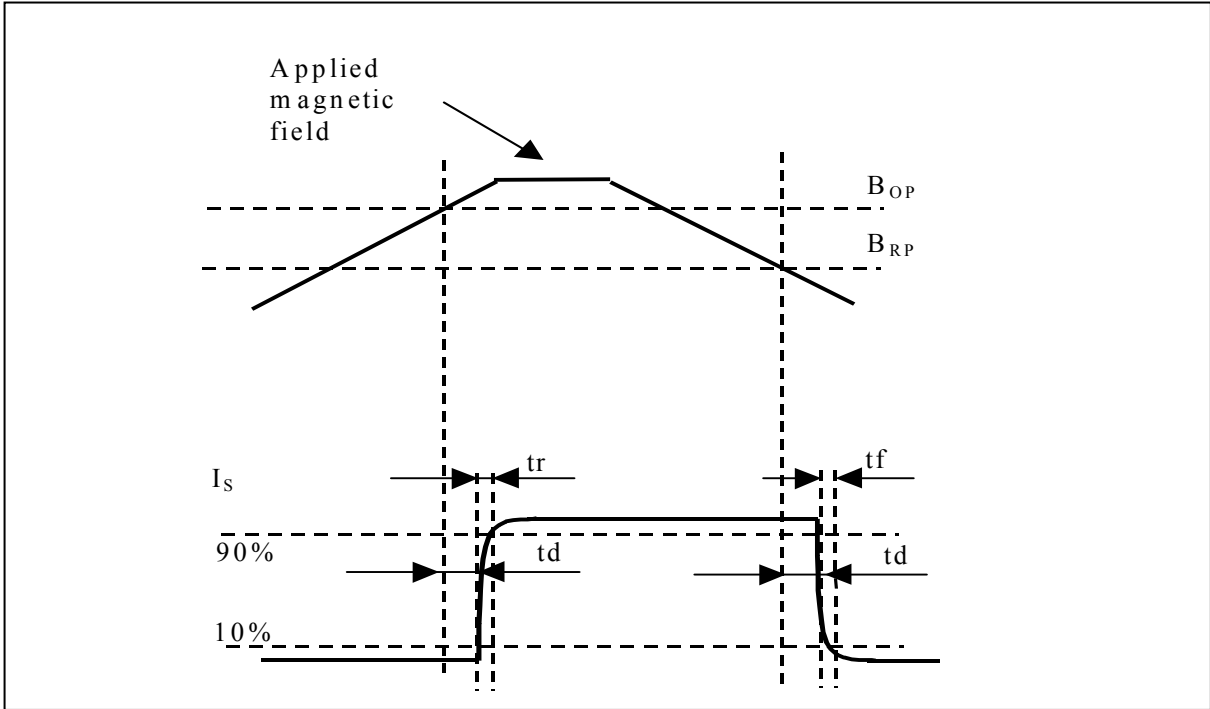
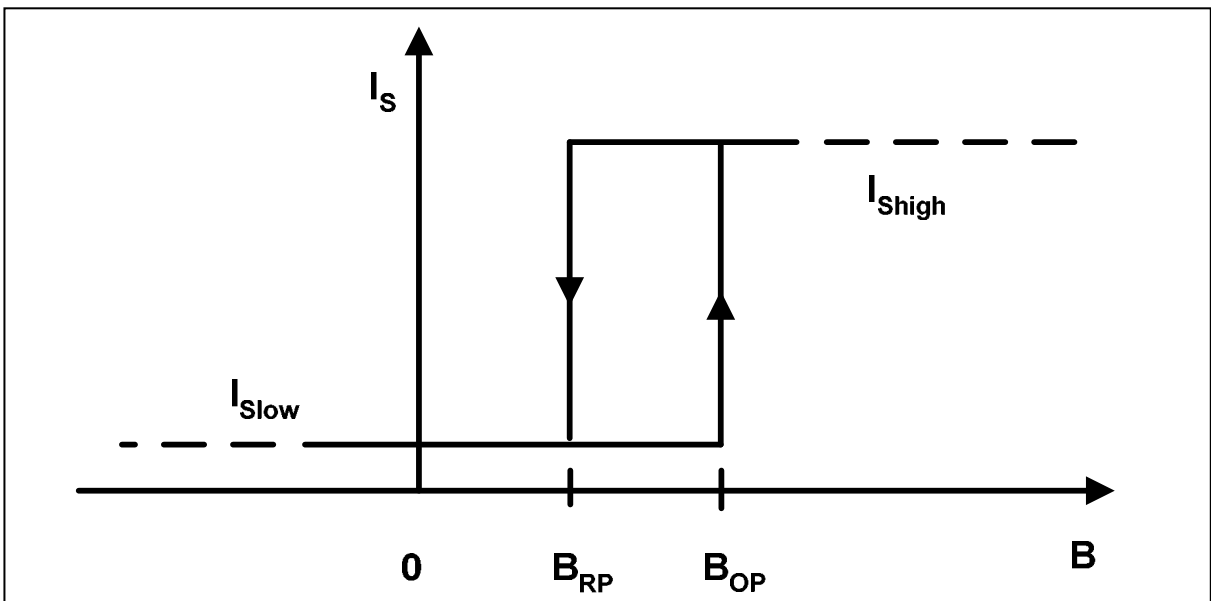## Timing Diagram

Figure 3: Timing Definition

Figure 4: Output Signal
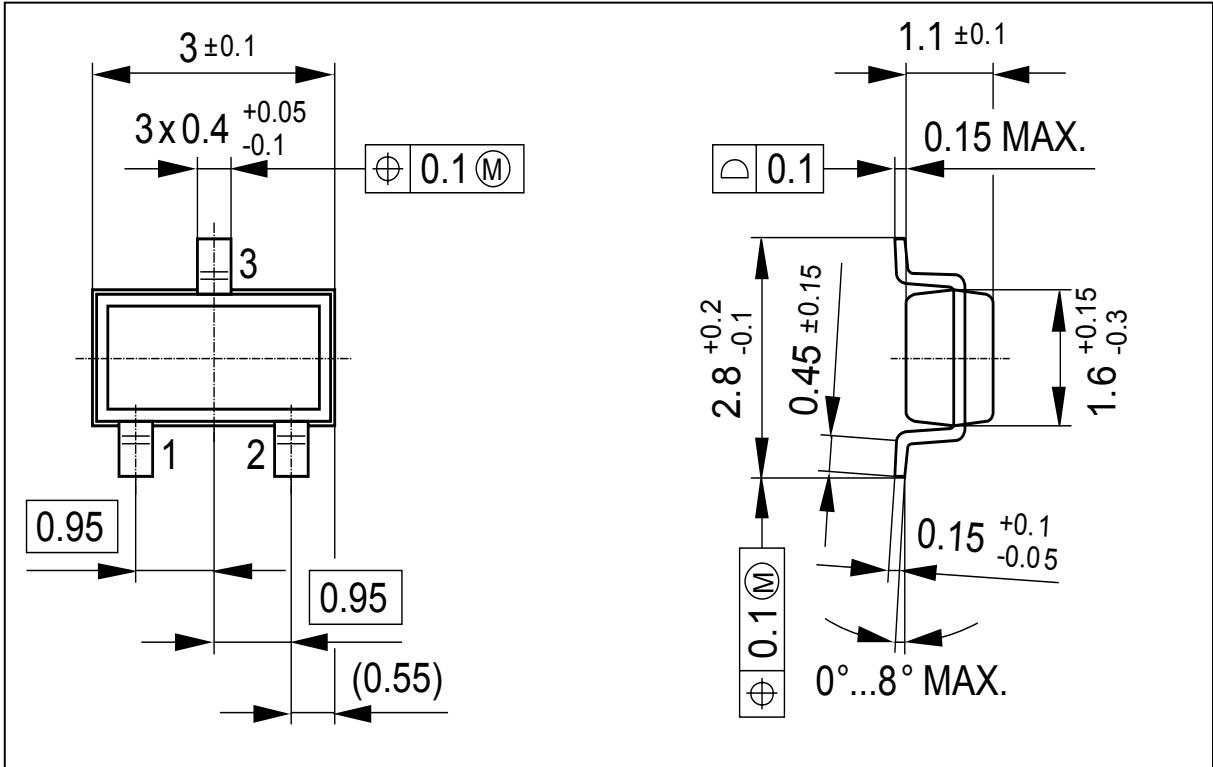
Package Dimensions

Figure 5: Package Dimension
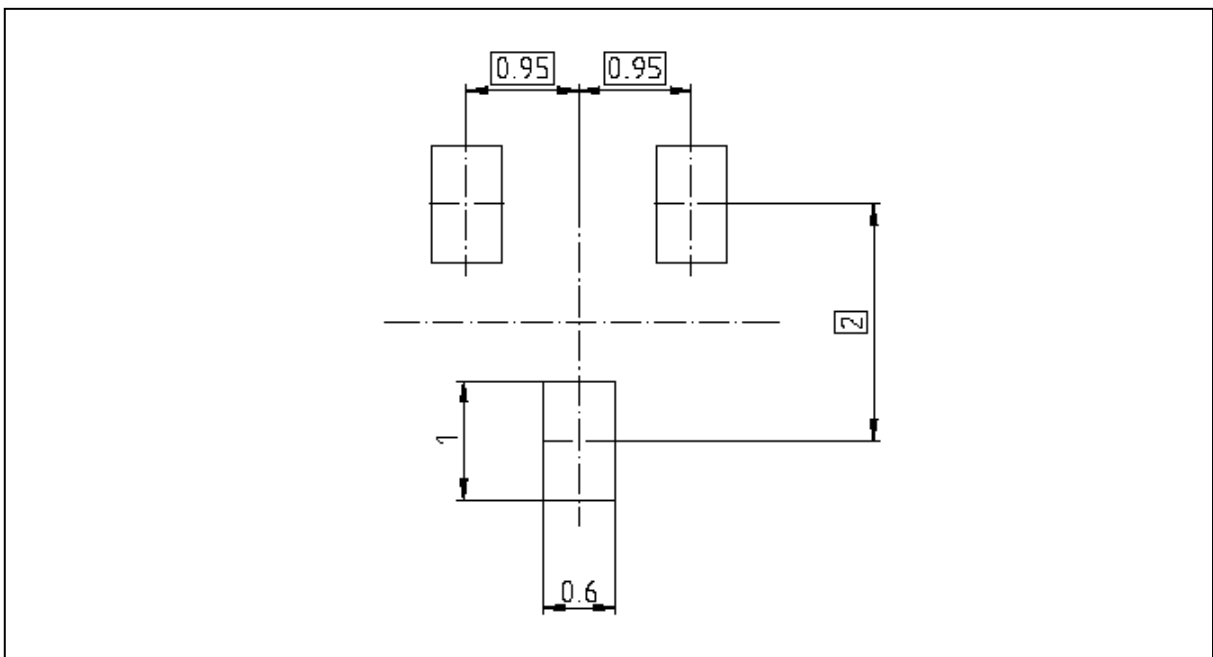
Figure 6: Foot print (SOT-23 compatible)
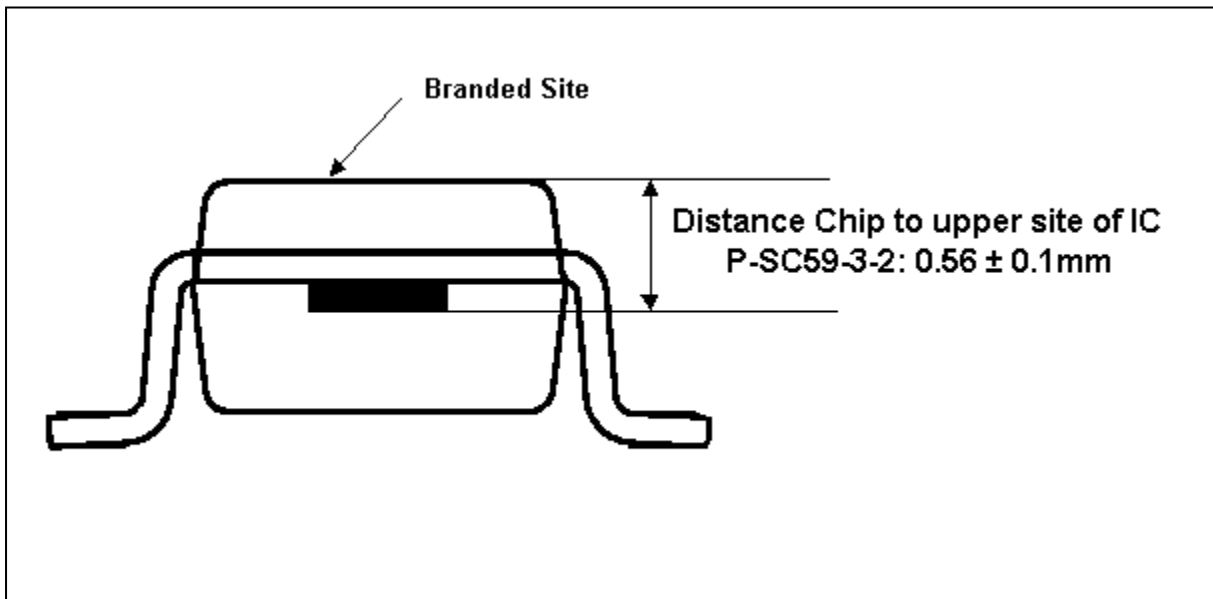
Figure 7: Distance from Package to Die

Year (y) = 0..9
Month (m) = 1..9,
　　　　O - October,
　　　　N - November,
　　　　D - December
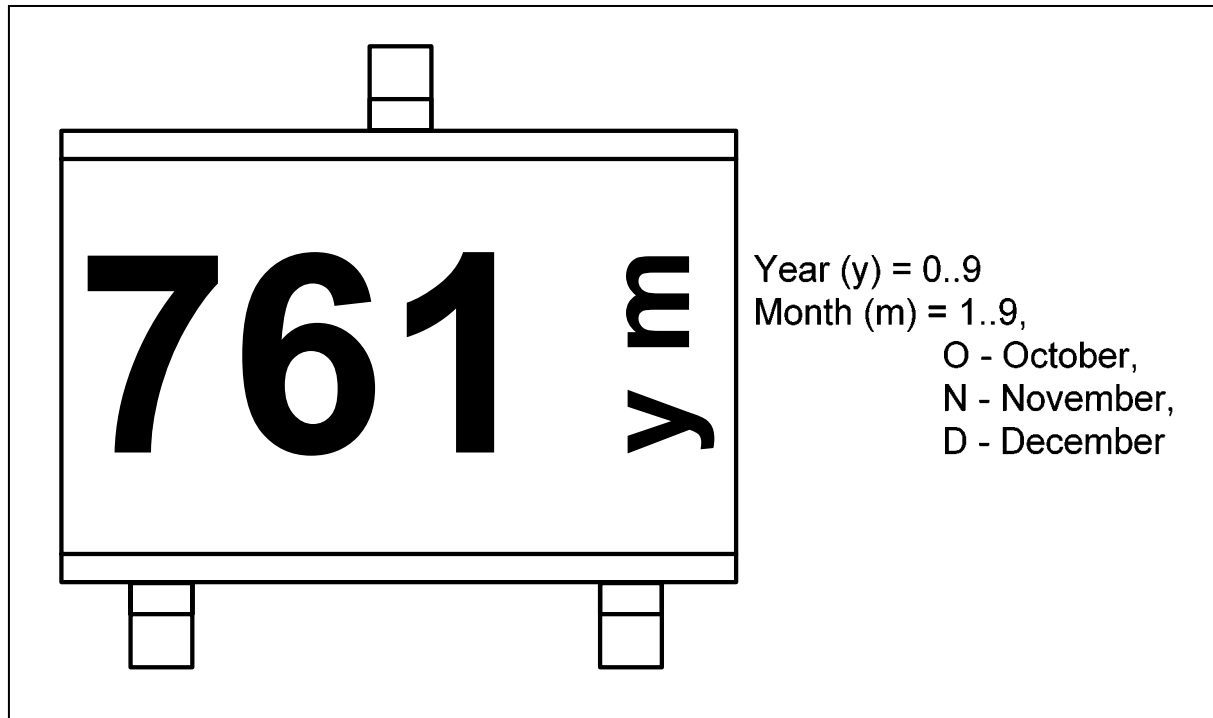
Figure 8: Marking

TLE4976-1H		
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Previous Version: -		
Page	Subjects (major changes since last revision)	

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