



High Precision Hall-Effect Switch

TLE4946H

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)
- High ESD performance ($\pm 6\text{kV}$ HBM)
- Digital output signal
- Bipolar version
- SMD package P-SC59-3-2 (SOT-23 compatible)



P-SC59-3-2

Type	Ordering Code	Package
TLE4946H	Q62705K-697	P-SC59-3-2

Functional Description

The TLE4906H is an 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.

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.

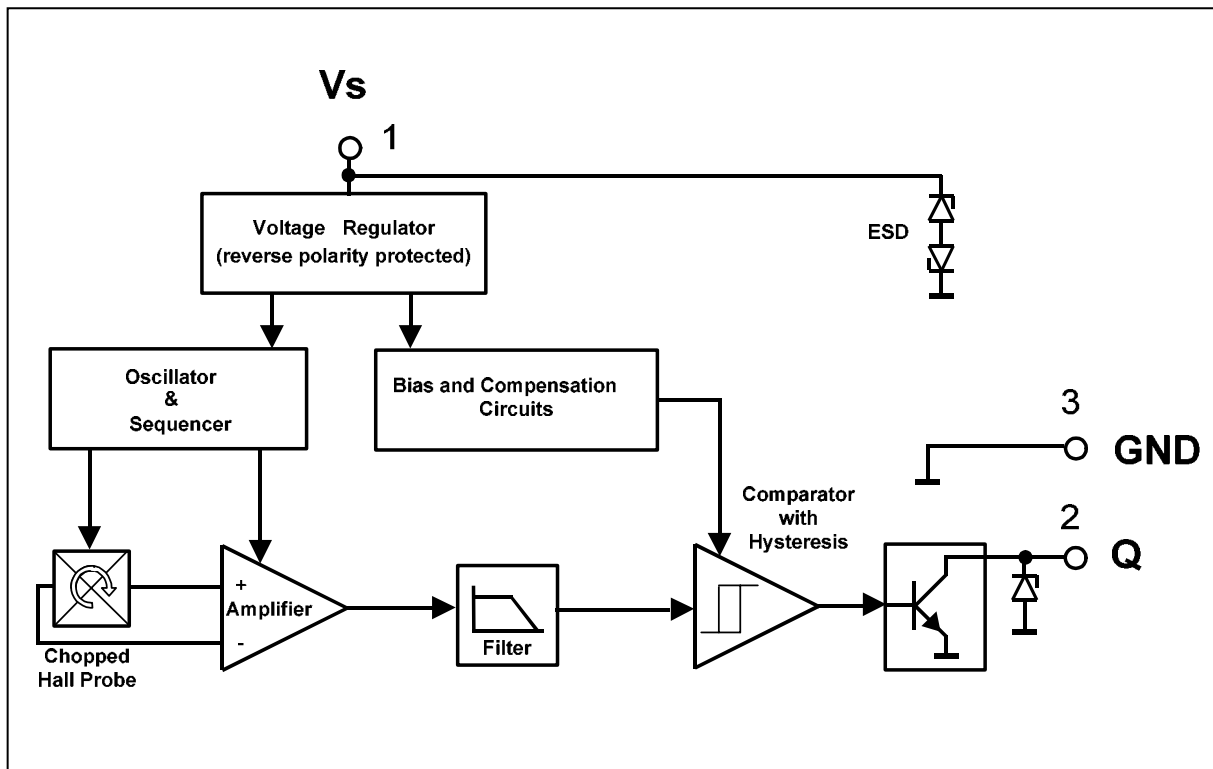


Figure 1: Block Diagram

Pin Configuration

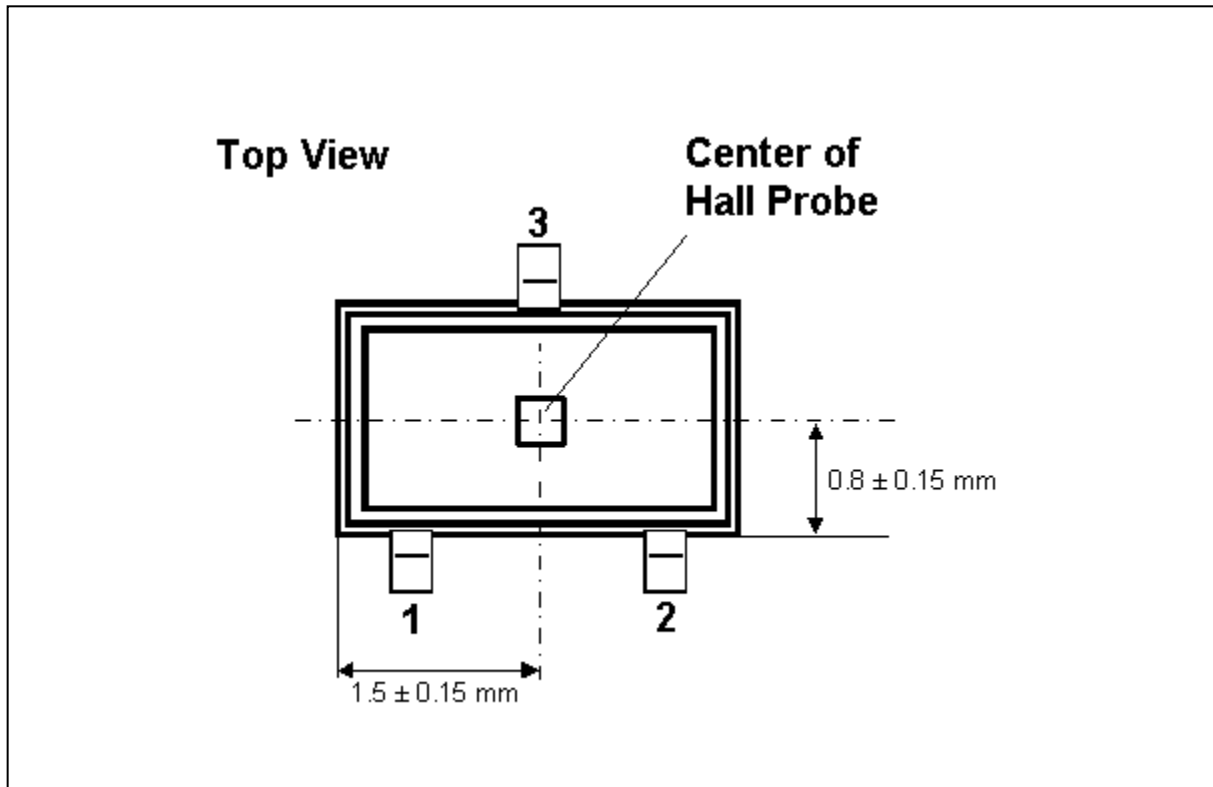


Figure 2: Pin Configuration (SOT-23 pin compatible)

Pin Definition and Functions

Pin	Symbol	Function
1	V_S	Supply voltage
2	Q	Output
3	GND	Ground

Absolute Maximum Ratings

$T_j = -40$ to 150°C

Parameter	Symbol	min.	max.	Unit	Conditions
Supply Voltage	V_S	-18 -18 -18	18 24 26	V	for 1h, $R_S \geq 200\ \Omega$ for 5min, $R_S \geq 200\ \Omega$
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 Ω 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 3x1 h (additive)
Storage Temperature	T_S	-40	150	$^{\circ}\text{C}$	
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}	± 6	kV	HBM, $R = 1.500\ \Omega$, $C = 100\text{pF}$; $T_A = 25^{\circ}\text{C}$

Operating Range

Parameter	Symbol	min.	typ.	max.	Unit	Conditions
Supply Voltage	V_S	2.7	-	18 24 26	V	1h with $R_S \geq 200\ \Omega$ for 5min $R_S \geq 200\ \Omega$
Output Voltage	V_Q	-0.7	-	18	V	
Junction Temperature	T_j	-40	-	150 175	$^{\circ}\text{C}$	for 168 h
Output Current	I_Q	0	-	20	mA	

AC/DC Characteristics

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

Parameter	Symbol	min.	typ.	max.	Unit	Conditions
Supply Current	I_S	2	4	6	mA	$V_S = 2.7V \dots 18V$
Reverse Current	I_{SR}	0	0.2	1	mA	$V_S = -18V$
Output Saturation Voltage	V_{QSAT}	-	0.3	0.6	V	$I_Q = 20mA$
Output Leakage Current	I_{QLEAK}	-	0.05	10	μA	for $V_Q=18V$
Output Fall Time	t_f	-	0.02	1	μs	$R_L = 1.2 k\Omega$; $C_L=50pF$; Figure 3
Output Rise Time	t_r	-	0.4	1	μs	$R_L = 1.2 k\Omega$; $C_L=50pF$; Figure 3
Chopper Frequency	f_{OSC}	-	320	-	kHz	
Switching Frequency	f_{SW}	0	-	15 ¹⁾	kHz	
Delay Time ²⁾	t_d	-	13	-	μs	
Output Jitter ³⁾	t_{QJ}	-	1	-	μs_{RMS}	Typ. Value for Square-Wave Signal 1kHz
Repeatability of magnetic thresholds ⁴⁾	B_{REP}	-	20	-	μT_{RMS}	Typ. Value for $\Delta B/\Delta t > 12mT/ms$
Power-On Time ⁵⁾	t_{PON}	-	13	-	μs	$V_S \geq 2.7V$
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 $V_S \geq 2.7V$ to the sensor until the output state is valid.

⁶⁾ Thermal resistance from junction to ambient.

e.g.: $V_S=12.0V$, $I_{S_typ}=4mA$, $V_{QSAT_typ}=0.3V$ and $I_Q=20mA \Rightarrow$ Power Dissipation $P_{dis}=54.0mW$.

In $T_A = T_j - (R_{thJA} * P_{dis}) = 175^\circ C - (100 K/W * 0.054 W) \Rightarrow T_A = 169.6^\circ C$

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 TLE4946H	B_{OP}	-40 25 150	11.8 11.0 6.1	15.8 14.0 9.6	19.2 17.0 13.7	mT	
Release Point TLE4946H	B_{RP}	-40 25 150	-19.2 -17.0 -13.7	-15.8 -14.0 -9.6	-11.8 -11.0 -6.1	mT	
Hysteresis TLE4946H	B_{HYS}	-40 25 150	- 22.0 -	- 28.0 -	- 34.0 -	mT	
Magnetic Offset TLE4946H	B_{OFF}	-40 25 150	- -3.0 -	- - -	- 3.0 -	mT	$(B_{OP}+B_{RP})/2$
Temperature Compensation of Magnetic Thresholds	TC	-	-	-2000	-	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

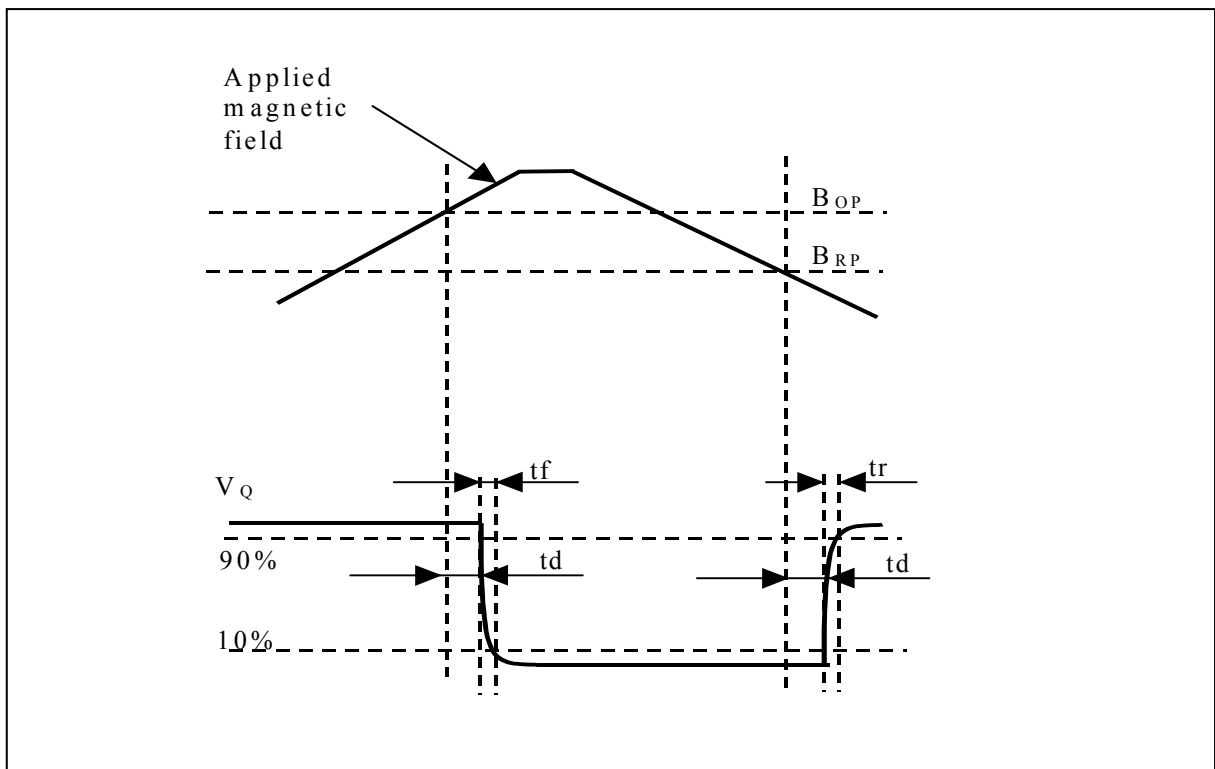


Figure 3: Timing Definition

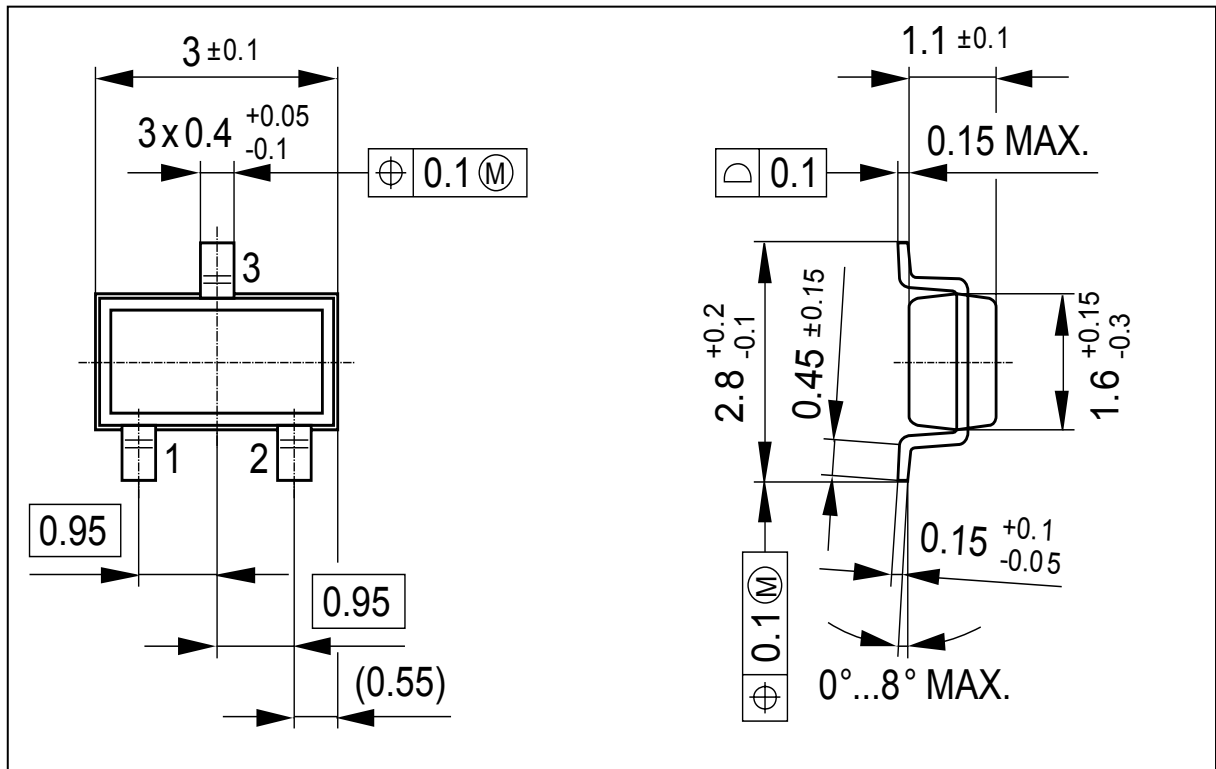
Package Dimension P-SC59-3-2


Figure 4: Package Dimension

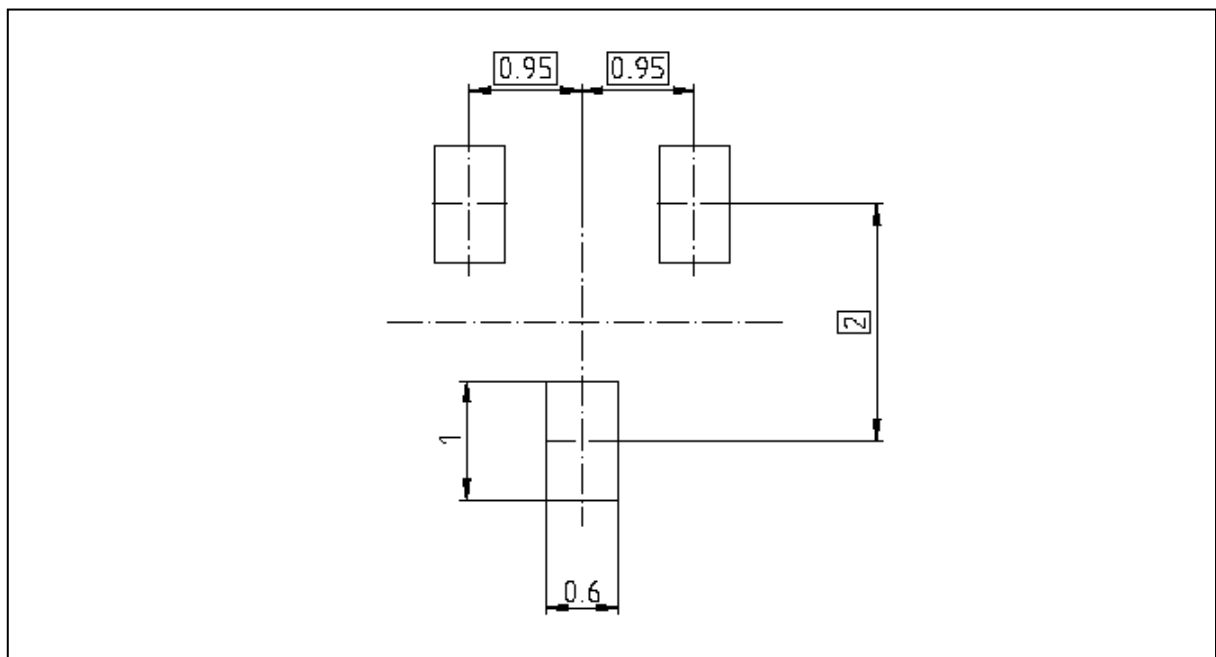


Figure 5: Foot print (SOT-23 compatible)

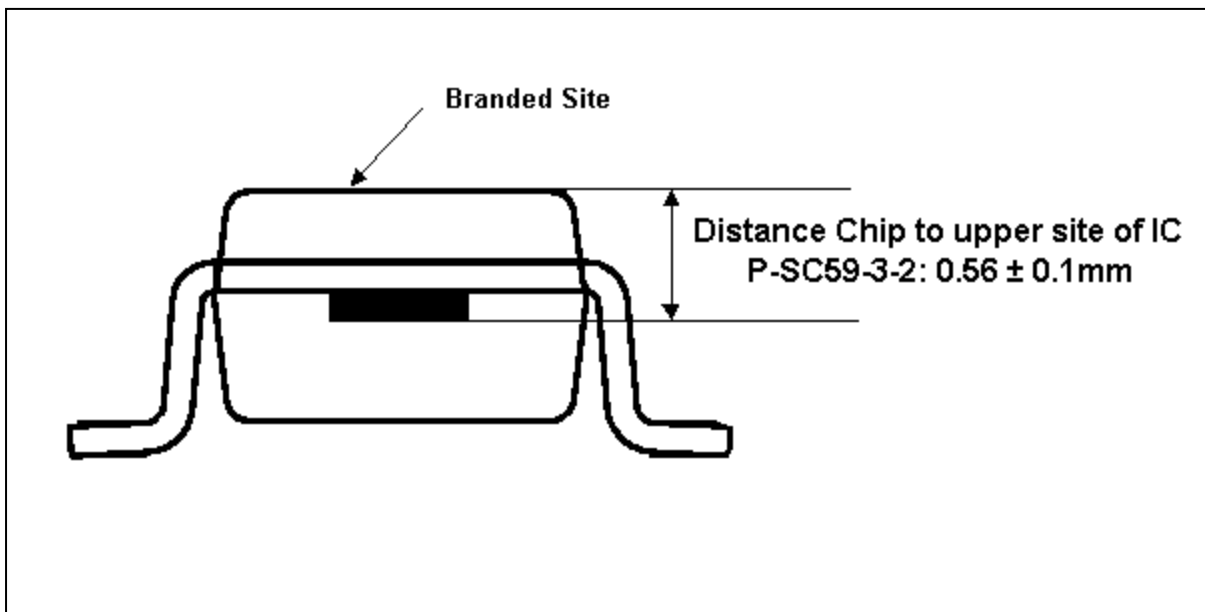


Figure 6: Distance from Package to Die

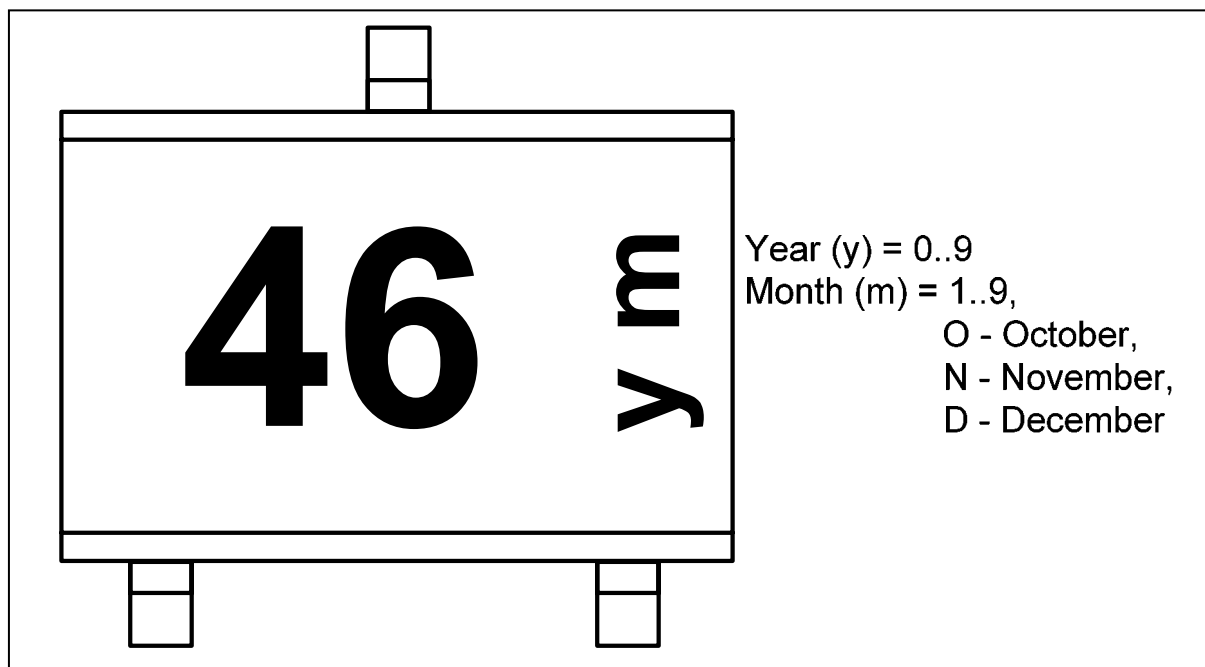


Figure 7: Marking

TLE4946H	
Revision History:	Version 1.0
2003-11-20	
Previous Version:	
Page	Subjects (major changes since last revision)

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