TLE4954C/51C

Differential Hall Effect Transmission Speed Sensors

TLE4954C
TLE4954C-E1
TLE4954C-E2
TLE4954C-E4
TLE4954CB
TLE4954CB-E1
TLE4954CB-E2
TLE4951C
TLE4951CB

Product Information

2013-10-15

Sense & Control

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1 General





1.1 Target Application

TLE4954C/51C is an integrated differential Hall effect sensor for transmission applications with two wire PWM current interface. Its basic function is to provide information about rotational speed and direction of rotation to the transmission control unit. TLE4954C/51C includes a sophisticated algorithm which actively suppresses vibration while keeping excellent airgap performance. Infineon also offers customers the possibility to purchase sensors with already attached back bias magnets (CB versions).

1.2 Features

Product Name	CCW[1)]	CW[2)]	Pre Low time	Direction signal	Speed
TLE4954C	60 µs	120 µs	30 µs		30 µs above 1kHz
TLE4954C-E1	45 µs	180 µs	30 µs	Direction signal up to 8kHz typ. (ccw) and 12kHz typ. (cw)	none
TLE4954C-E2	45 µs	90 µs	30 µs		180 µs
TLE4954C-E4	45 µs	90 µs	15 µs	Direction signal up to 8kHz min. (ccw) and 12kHz min. (cw)	30 µs
TLE4951C	Speed signal only				
All sensors with a B in the product name have an integrated back bias magnet.					
TLE4954CB	60 µs	120 µs	30 µs		30 µs above 1kHz
TLE4954CB-E1	45 µs	180 µs	30 µs	Direction signal up to 8kHz typ. (ccw) and 12kHz typ. (cw)	none
TLE4954CB-E2	45 µs	90 µs	30 µs		180 µs
TLE4951CB	Speed signal only				

1) Rotation direction left 2) Rotation direction right

Note: More specific information about the timer-characteristics can be found in the FAQ for TLE4954C/51C.

Product Name	Order Code	Marking	Package
TLE4954C	SP000848260	54C00A	PG-SSO-2-53
TLE4954C-E1	SP000848264	54CE1A	PG-SSO-2-53
TLE4954C-E2	SP000848268	54CE2A	PG-SSO-2-53
TLE4954C-E4	SP001050144	54CE4A	PG-SSO-2-53
TLE4954CB	SP000913564	54CB0A	PG-SSOM-2-11
TLE4954CB-E1	SP000913568	54CB1A	PG-SSOM-2-11
TLE4954CB-E2	SP000913572	54CB2A	PG-SSOM-2-11
TLE4951C	SP000848256	51C00A	PG-SSO-2-53
TLE4951CB	SP000913560	51CB0A	PG-SSOM-2-11

2 Functional Description

2.1 General

The differential Hall sensor IC detects the motion of tooth and magnet encoder applications. To detect the motion of ferromagnetic objects, the magnetic field must be provided by a back biasing permanent magnet. Either south or north pole of the magnet can be attached to the rear unmarked side of the IC package. The magnetic measurement is based on three equally spaced Hall elements, integrated on the IC. Both magnetic and mechanical offsets are cancelled by a self calibration algorithm. The sensor includes a current output PWM protocol.

2.2 Sensor assembly

Sensor and back bias magnet can be applied in the following ways:

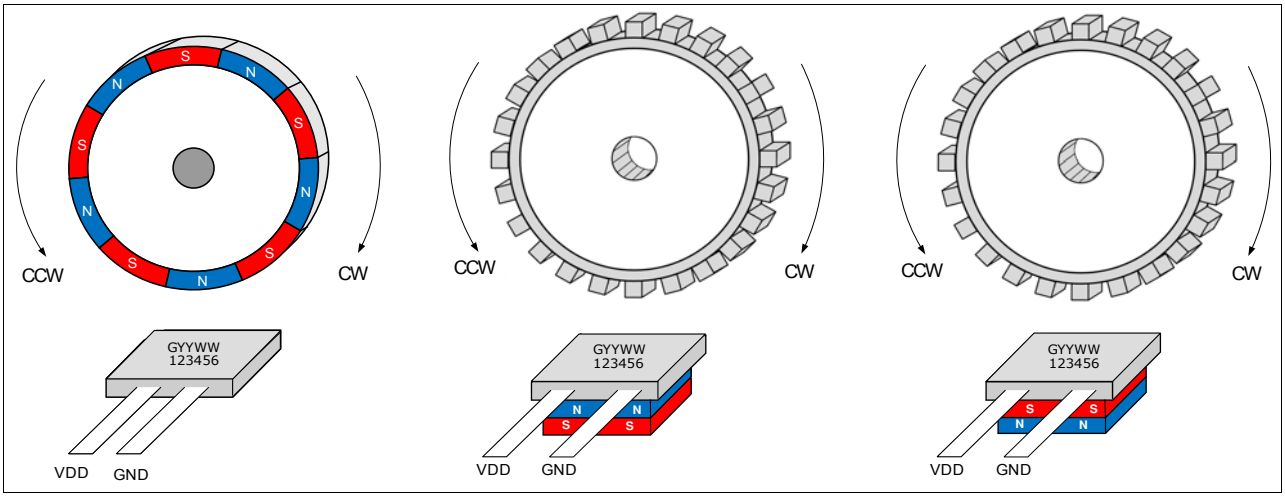


Figure 2-1 Sensor assembly and definition of rotating directions

The output signals for a south biased sensor with a magnetic encoder and ferromagnetic tooth wheel will be issued in the following way.

The tooth wheel is rotating in clockwise above the sensor. The output pulse will be issued by reaching the hysteresis levels after the pre low time. For a tooth wheel with ideal pitch (tooth to tooth) 5mm the direction signal achieves a phase shift of 90° compared to the speed signal.

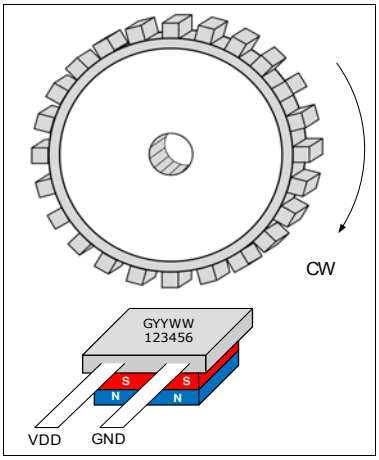


Figure 2-2 Clockwise rotation; south biased sensor

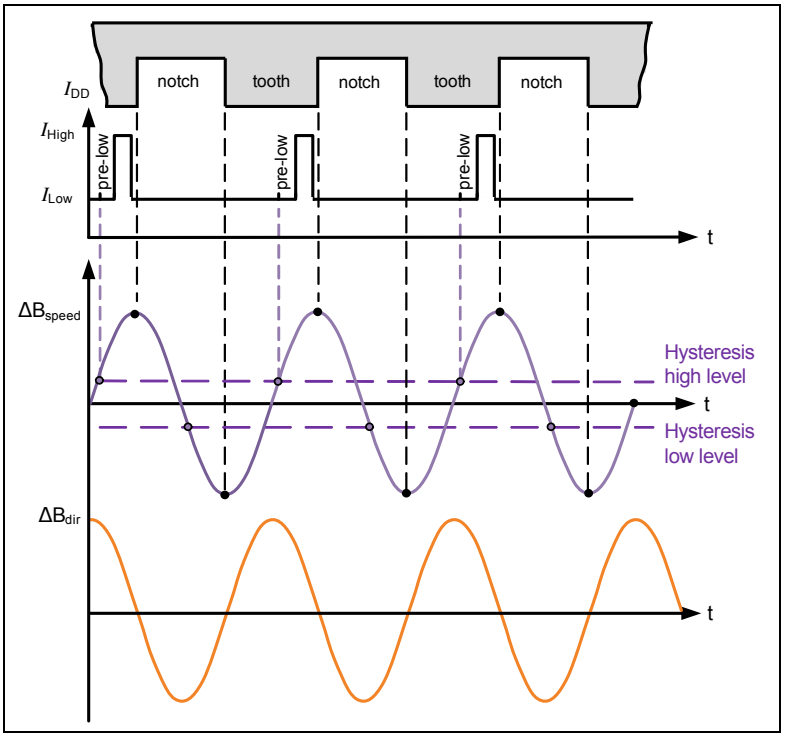


Figure 2-3 Tooth wheel vs. sensor output signal in clockwise rotation; south biased sensor - TLE4954C, TLE4954C-E1, TLE4954C-E2, TLE4954C-E4

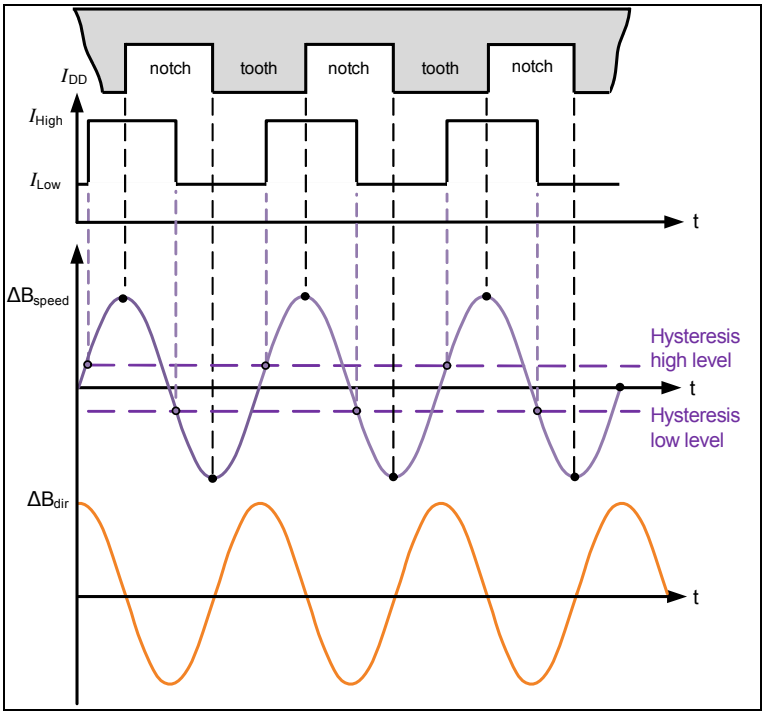


Figure 2-4 Tooth wheel vs. sensor output signal in clockwise rotation; south biased sensor - TLE4951C

2.2.1 Vibration Suppression

TLE4954C offers two different kinds of vibration suppression:

The magnetic signal amplitude and the direction information are used for detection of parasitic magnetic signals. Unwanted magnetic signal can be caused by angular or airgap vibrations. If an input signal is identified as a vibration the output pulse will be suppressed.

- Vibration suppression via hysteresis. This is available after power on
- Vibration suppression via direction detection. This is available after start up calibration is performed.

3 Specifications

3.1 Operating Range

Table 3-1 Operating Range

Parameter	Symbol	Values			Unit	Note / Test Condition
		Min.	Typ.	Max.		
Supply voltage	V_{DDIC}	4		20	V	Directly on the IC leads
Operation junction temperature	T_j	-40		170	°C	
Speed signal range	$\Delta B_{speed,range}$	-120		120	mT	

3.2 Electrical Characteristics

Table 3-2 Electrical Characteristics

Parameter	Symbol	Values			Unit	Note / Test Condition
		Min.	Typ.	Max.		
Supply current low	I_{Low}		7		mA	
Supply current high	I_{High}		14		mA	
Output rise/fall slew rate	SR_r, SR_f		17		mA/µs	Valid for t_r and t_f, between 10% and 90% value R_M=75 Ω, T_j<175 °C
Reset voltage	$V_{DD\ Reset}$		3.7	4	V	
Power on time	t_{ON}			1	ms	V_{DD} >4V
Period Jitter, f ≤ 2500 Hz	$S_{Jit\text{-}far}$, T_j≤150 °C		3.2		%	±3σ value, V_{DD}=12 V, ΔB_{speed}≥4 mT peak to peak
Period Jitter, 2500Hz< f < 12kHz	$S_{Jit\text{-}far}$, T_j≤150 °C		4.2		%	±3σ value, V_{DD}=12 V, ΔB_{speed}≥4 mT peak to peak

3.3 ESD Robustness

Table 3-3 ESD Protection

Parameter	Symbol	Test	Unit	Note
ESD-Protection	V_{ESD}	± 12	kV	R = 1.5 kΩ, C = 100 pF

3.4 Timing Characteristics

Between each magnetic transition and the rising edge of the corresponding output pulse, the output current is low for $t_{pre\text{-}low}$ in order to allow reliable internal conveyance. After pre low time the output current level is set to high.

After power on the speed pulse is being issued. As soon as the sensor has enough information to recognize the direction of the target wheel, the output pulse will include the direction information.

Rotation direction is evaluated only for low rotation speed. The speed signal will be delivered again if the magnetic frequency is above $f_{DR,max}$.

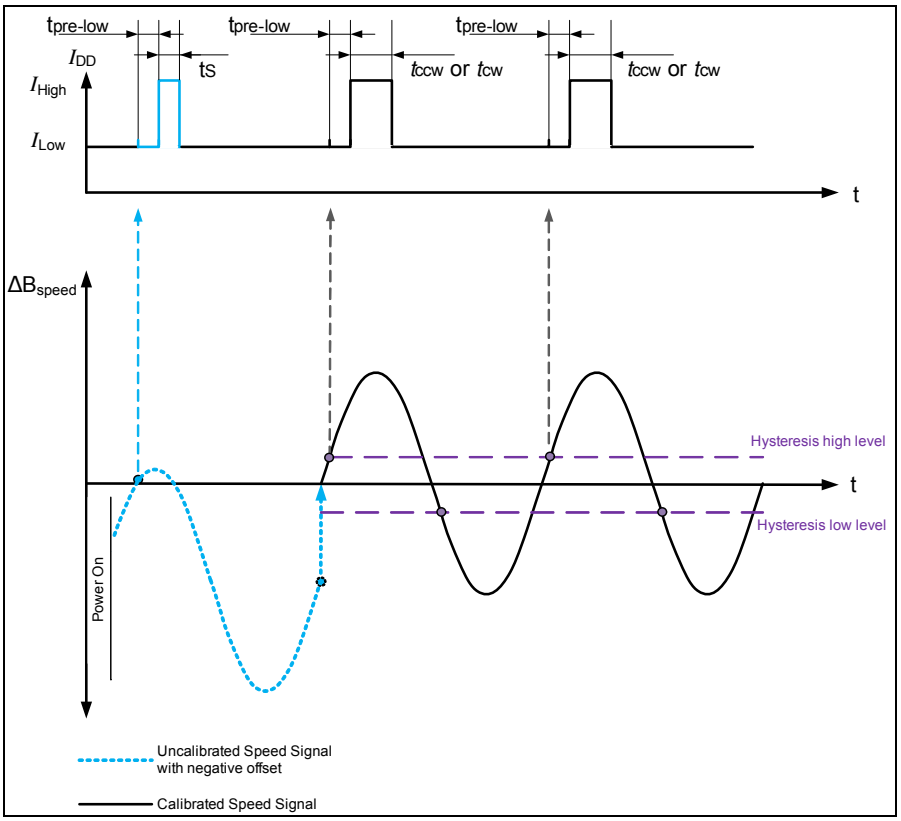


Figure 3-1 Definition of PWM Current Interface - TLE4954C, TLE4954C-E2, TLE4954C-E4

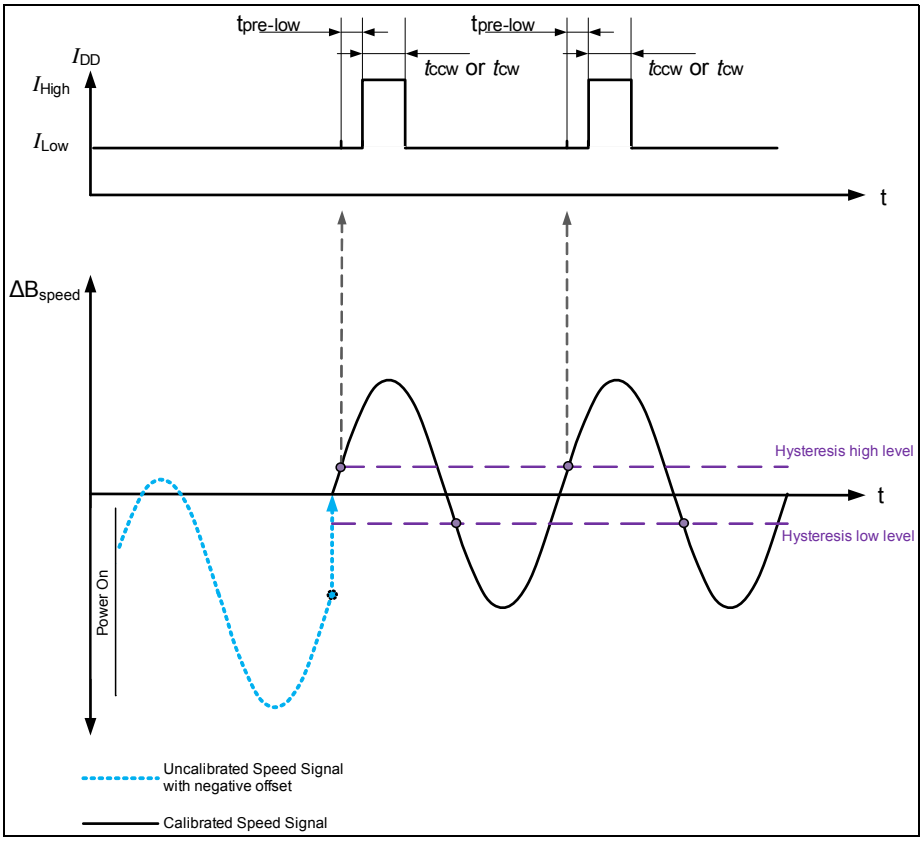


Figure 3-2 Definition of PWM Current Interface - TLE4954C-E1

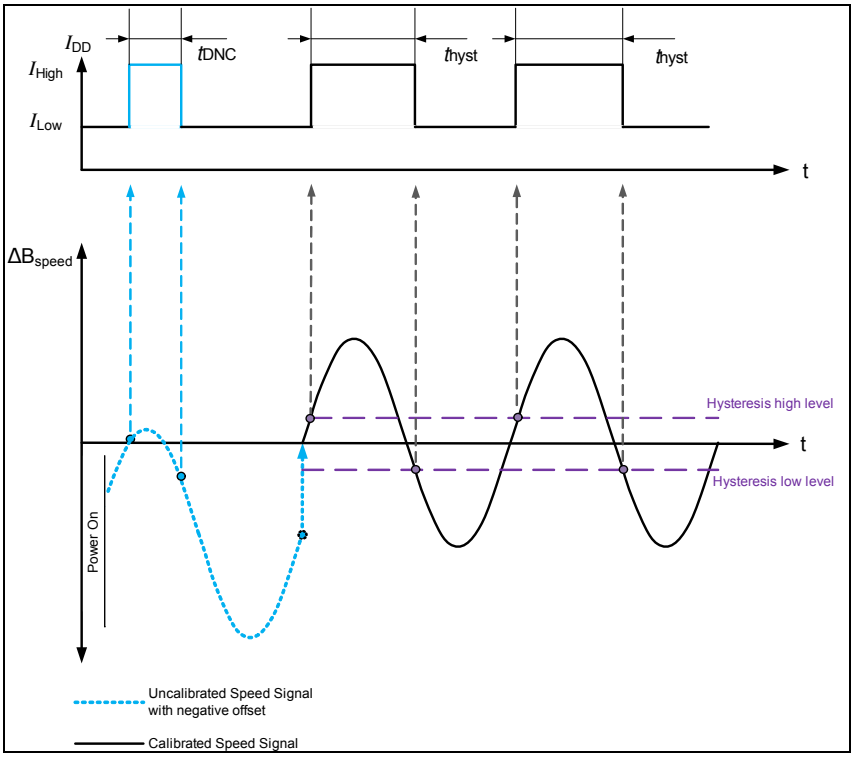


Figure 3-3 Definition of Current interface - TLE4951C

3.5 Operation characteristics - TLE4951CB, TLE4954CB, TLE4954CB-E1, TLE4954CB-E2

Table 3-4 TLE4954CB, TLE4951CB

Parameter	Symbol	Values			Unit	Remarks
		min	typ	max		
Operational airgap	AG		3.3		mm	Valid in running mode, measured from sensor housing (branded side) to target tooth. Valid at 25°C & 0h. No missing output pulses.
Minimum speed signal	$\Delta B_{\text{speed-limit}}$		2.2		mT	Peak to peak value 99% criteria
Minimum direction signal	$\Delta B_{\text{Bdir-limit}}$		0.36		mT	Peak to peak value 99% criteria

Table 3-5 TLE4954CB-E1, TLE4954CB-E2

Parameter	Symbol	Values			Unit	Remarks
		min	typ	max		
Operational airgap	AG		-		mm	Valid in running mode, measured from sensor housing (branded side) to target tooth. Valid at 25°C & 0h. No missing output pulses.
Minimum speed signal	$\Delta B_{\text{speed-limit}}$		2.2		mT	Peak to peak value 99% criteria
Minimum direction signal	$\Delta B_{\text{Bdir-limit}}$		0.9		mT	Peak to peak value 99% criteria

3.6 Reference Target Wheel for TLE4951CB, TLE4954CB, TLE4954CB-E1, TLE4954CB-E2

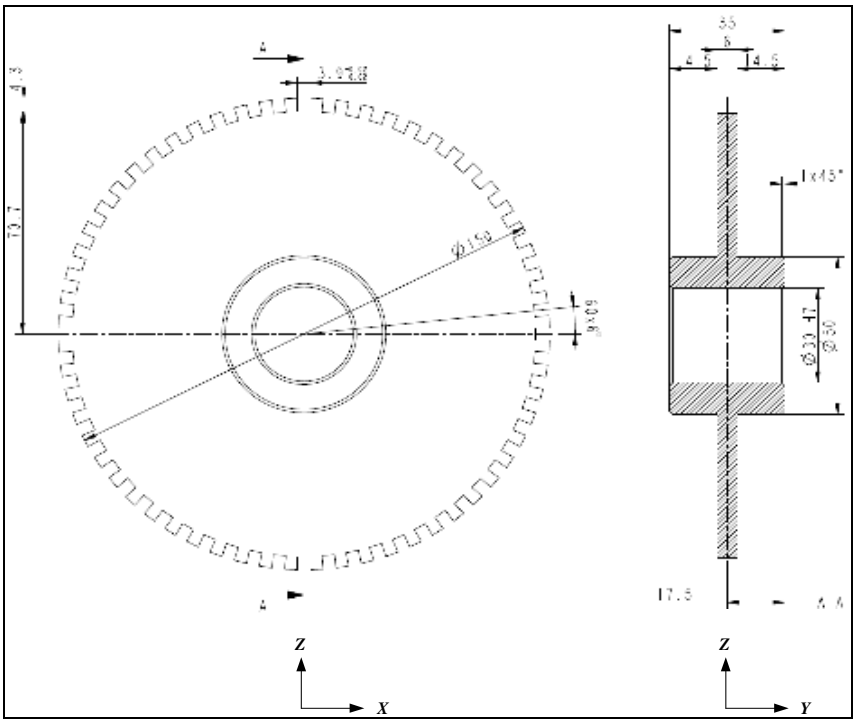


Figure 3-4 Reference target wheel

Table 3-6 Reference target wheel geometry

Parameter	Symbol	Typ value	Unit	Remarks
Outside diameter	d	150	mm	
Number of teeth	Z	60	-	
Pitch Ratio		50:50	%	
Material		ST37		

4 Package Information

4.1 Package Information TLE4954C, TLE4954C-E1, TLE4954C-E2, TLE4951C

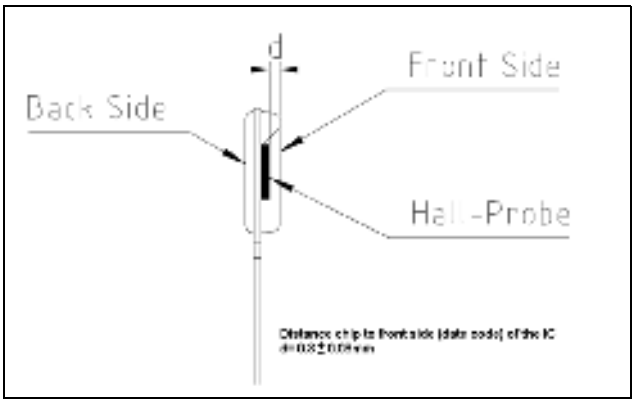


Figure 4-1 Distance of the chip to the upper package edge

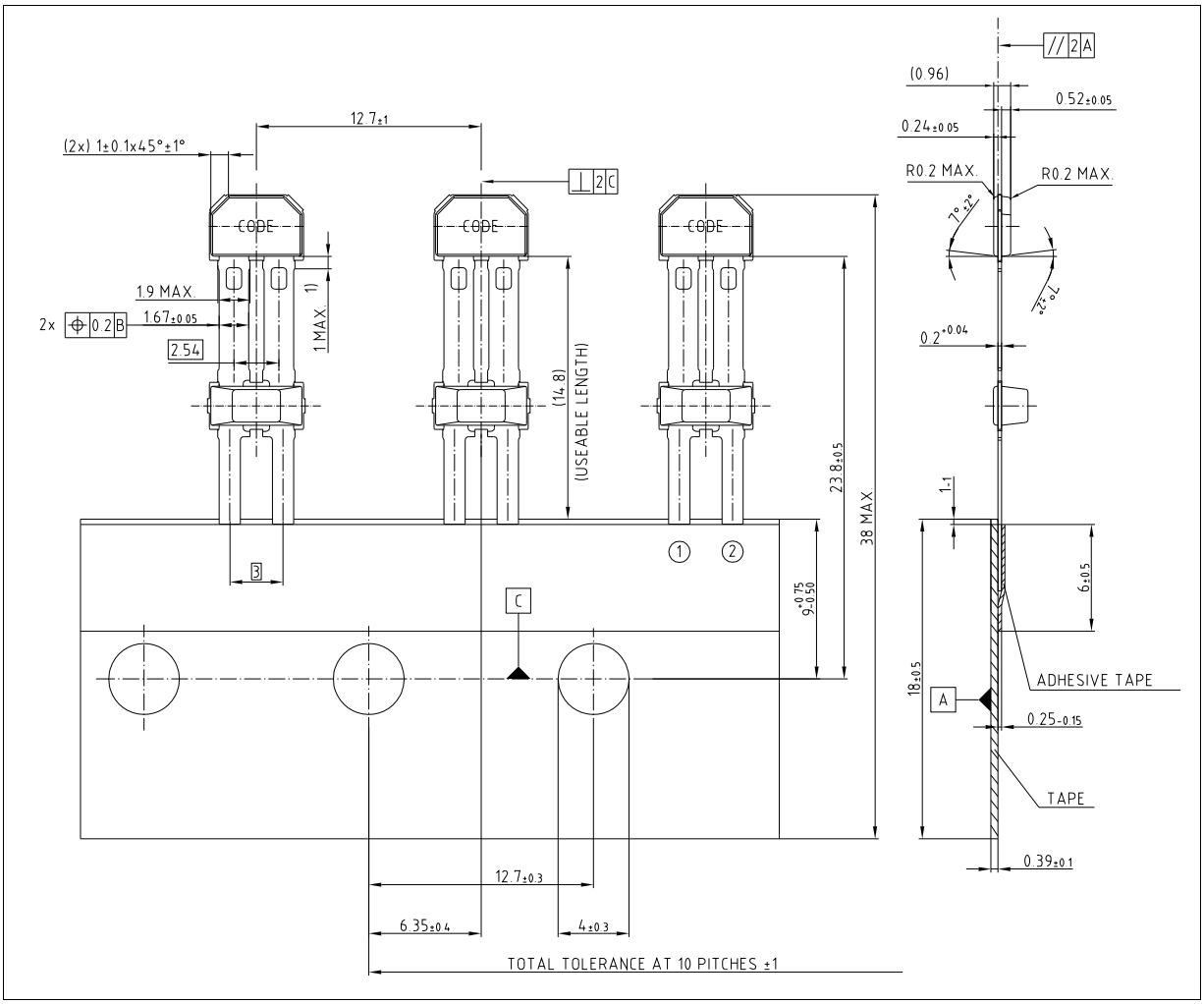


Figure 4-2 PG-SSO-2-53 (Plastic Single Small Outline Package) packing, all dimensions in mm

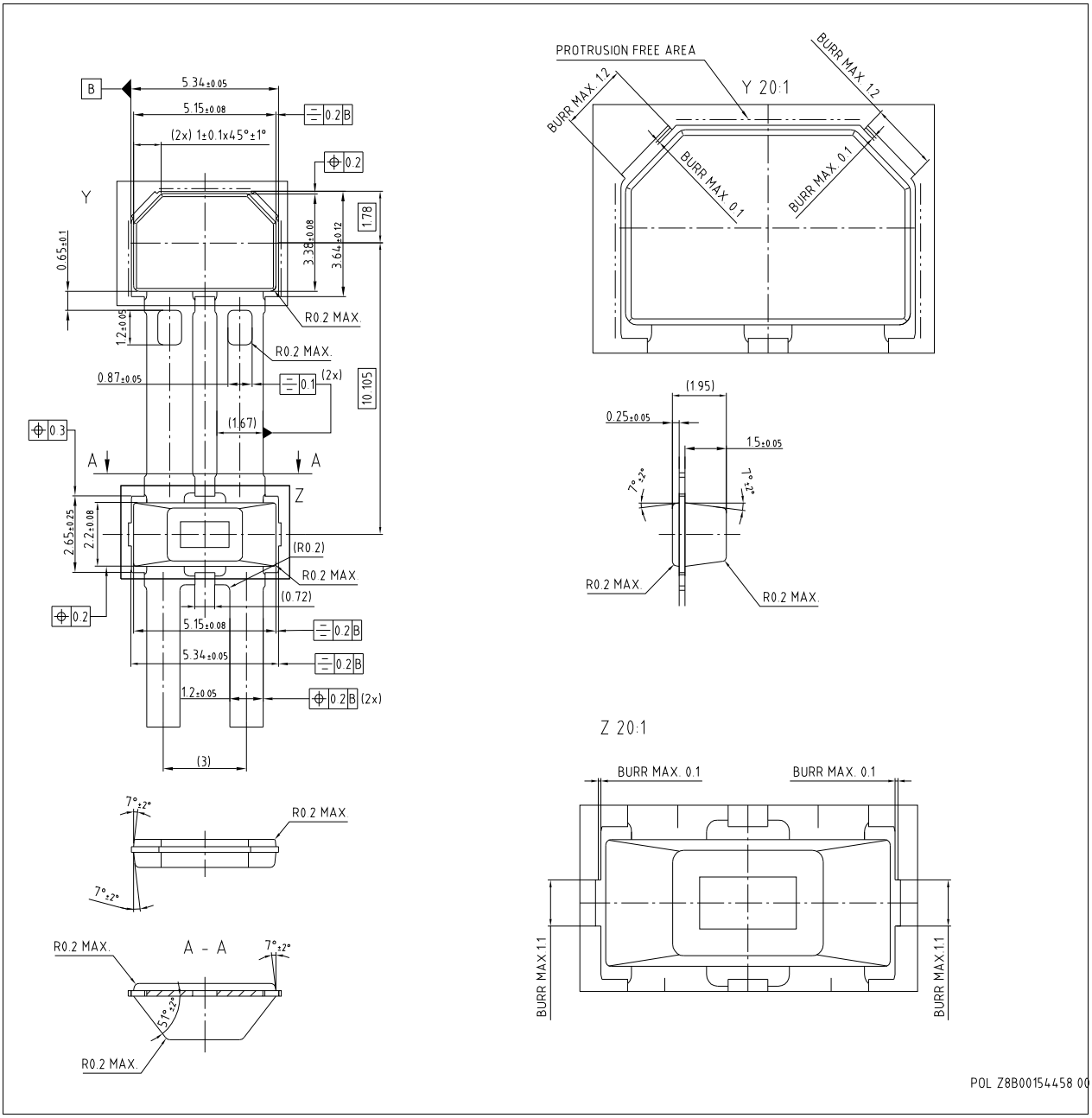


Figure 4-3 PG-SSO-2-53 package outline, dimensions in mm.

4.2 Package Information TLE4951CB, TLE4954CB, TLE4954CB-E1, TLE4954CB-E2

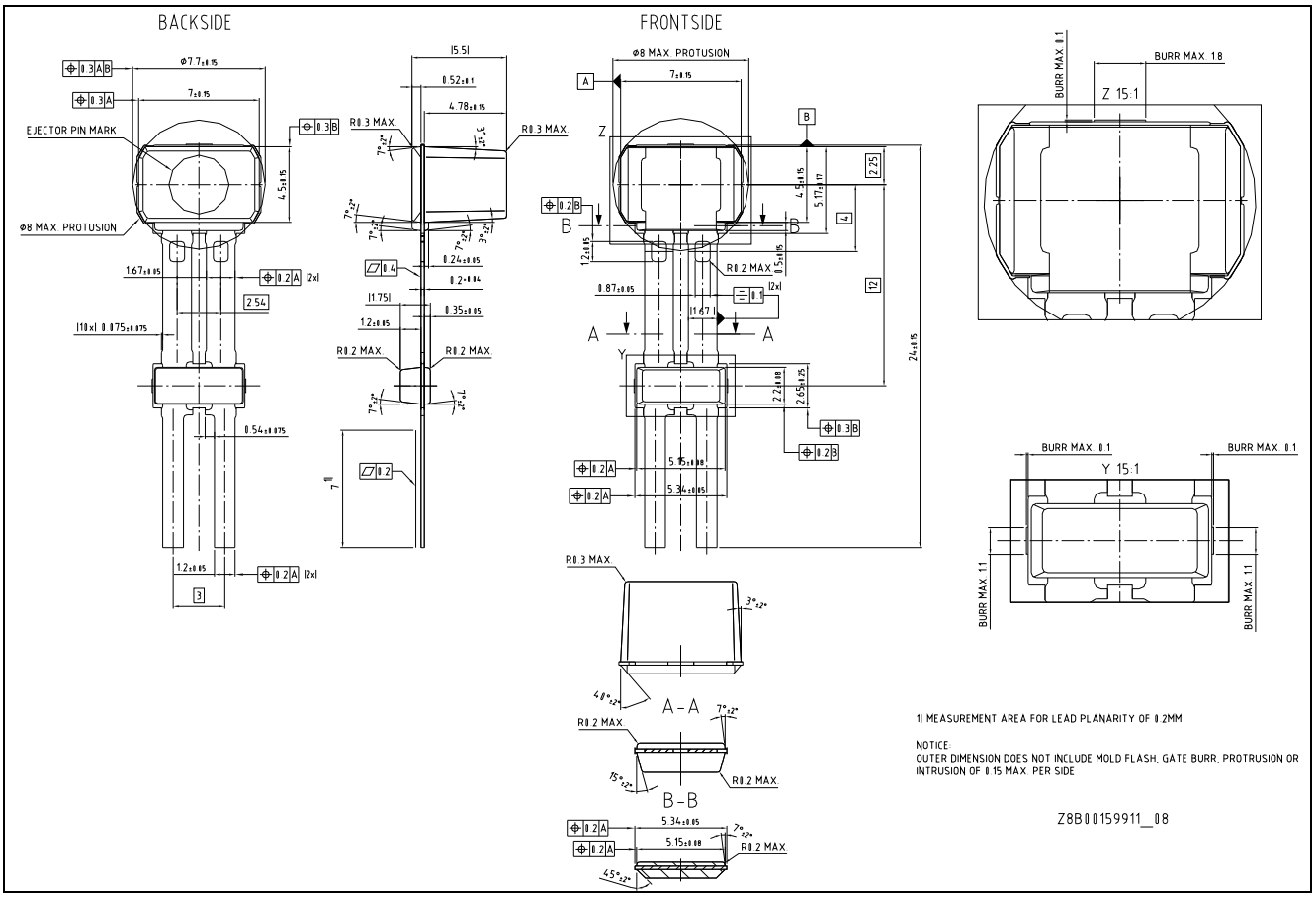


Figure 4-4 PG-SSOM-2-11 package outline

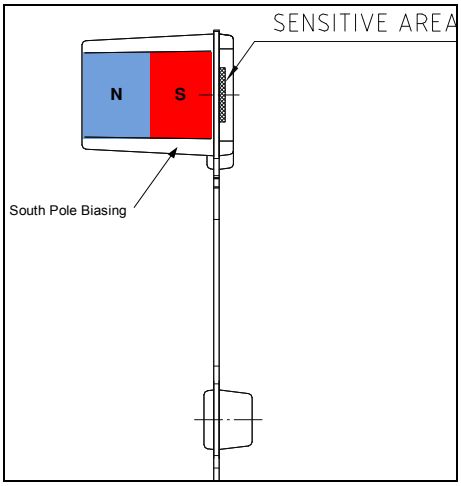


Figure 4-5 Back-bias field orientation

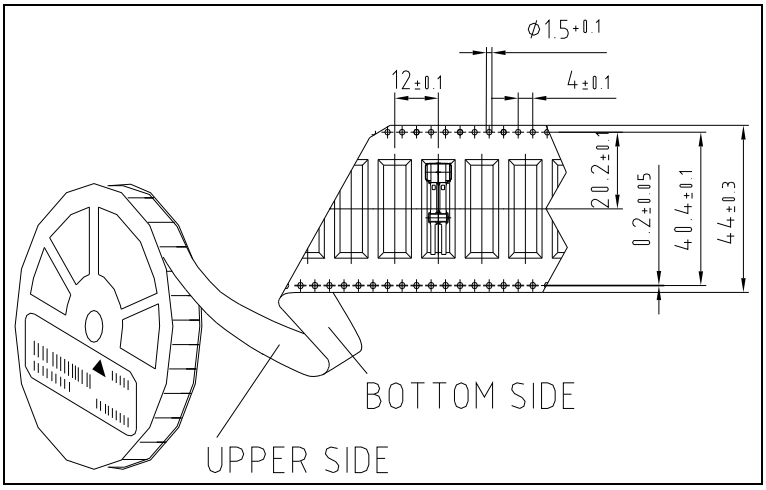


Figure 4-6 PG-SSOM-2-11 blister tape packing information

For additional and more detailed information about the chip and package please visit the Infineon web page http://www.infineon.com.

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