TLE4927x
Dynamic Differential Hall Effect Sensor

TLE4927C E6547
TLE4927CB E6547

Product Information
2013-10-03
# Table of Contents

Table of Contents ............................................................... 2  
1 General .............................................................................. 3  
1.1 Target Application ......................................................... 3  
1.2 Features .......................................................................... 3  
2 Functional Description ....................................................... 4  
2.1 General ........................................................................... 4  
2.2 Sensor assembly ............................................................... 4  
3 Specification ........................................................................ 5  
3.1 Operating Range ............................................................. 5  
3.2 Electrical Characteristics ............................................... 5  
3.3 ESD Protection ............................................................... 5  
3.4 Magnetic Characteristics in Running Mode ......................... 6  
3.5 Operating Characteristics ............................................... 6  
3.6 Reference Target Wheel - TLE4927CB E6547 ..................... 6  
4 Package Information ......................................................... 7  
4.1 Application Example ....................................................... 7  
4.2 Gear Tooth Sensing ......................................................... 7  
4.3 Package Information - TLE4927C E6547 ......................... 8  
4.4 Package Outline - TLE4927CB E6547 .............................. 10  
4.5 Back-bias field orientation .............................................. 10  
4.6 Packing Information ....................................................... 11
1 General

1.1 Target Application
The TLE4927C E6547 is an active Hall sensor suited to detecting the motion and position of ferromagnetic or permanent magnet targets. An additional self-calibration module is implemented to achieve optimum accuracy during normal running operation. The device comes in a 3-pin package providing pins for the supply voltage and an open drain output. Infineon also offers customers the possibility to purchase sensors with already attached back bias magnets (TLE4927CB E6547).

1.2 Features

- High sensitivity
- Single chip solution
- Symmetrical thresholds
- High resistance to Piezo effects
- South and north pole pre-induction possible
- Low cut-off frequency
- Digital output signal
- Advanced performance through dynamic self calibration principle
- Two-wire and three-wire configuration possible
- Wide operating temperature range
- Fast start-up time
- Large operating air gaps
- Reverse voltage protection on \( V_S \) pin
- Short-circuit and overtemperature protection of output
- Digital output signal (voltage interface)
- Integrated back bias magnet as an option
- Module style package with two integrated capacitors:
  - 4.7 nF between Q and GND
  - 47 nF between \( V_S \) and GND: Needed for micro cuts in power supply

<table>
<thead>
<tr>
<th>Type</th>
<th>Order Code</th>
<th>Marking</th>
<th>Package</th>
</tr>
</thead>
<tbody>
<tr>
<td>TLE4927C E6547</td>
<td>SP00718266</td>
<td>27D8</td>
<td>PG-SSO-3-92</td>
</tr>
<tr>
<td>TLE4927CB E6547</td>
<td>SP00913548</td>
<td>927D00</td>
<td>PSG-SSO-3-11</td>
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</tbody>
</table>
2 Functional Description

2.1 General
The differential Hall sensor IC detects the motion and position of ferromagnetic and permanent magnet structures by measuring the differential flux density of the magnetic field. To detect ferromagnetic objects the magnetic field must be provided by a back biasing permanent magnet (south or north pole of the magnet attached to the rear unmarked side of the IC package).

Offset cancellation is achieved by advanced digital signal processing. Immediately after power-on, motion is detected (start-up mode). After a few transitions, the sensor has finished self-calibration and switches to a high accuracy mode (running mode). In running mode, switching occurs at the zero crossing points of the magnetic signal. This zero crossing is found by calculating the arithmetic mean of the maximum and minimum value of the magnetic differential signal (\(\Delta B\)). \(\Delta B\) is defined as the field difference between Hall plate 1 and Hall plate 2. See Figure 2-2.

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

![Figure 2-1 Sensor assembly](image)

![Figure 2-2 System operation with hidden adaptive hysteresis](image)
3 Specification

3.1 Operating Range

Table 3-1 Operating Range

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Symbol</th>
<th>Values</th>
<th>Unit</th>
<th>Note / Test Condition</th>
</tr>
</thead>
<tbody>
<tr>
<td>Supply voltage</td>
<td>( V_S )</td>
<td>3.2</td>
<td>26</td>
<td>V</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>time limited with ( R_{Series} \geq 200 , \Omega )</td>
</tr>
<tr>
<td>Continuous output OFF voltage</td>
<td>( V_Q )</td>
<td>0</td>
<td>18</td>
<td>V</td>
</tr>
<tr>
<td>Continuous output ON current</td>
<td>( I_Q )</td>
<td>0</td>
<td>20</td>
<td>mA ( V_{Qmax} = 0.6 , V )</td>
</tr>
<tr>
<td>Operating junction temperature</td>
<td>( T_J )</td>
<td>-40</td>
<td>175</td>
<td>°C</td>
</tr>
</tbody>
</table>

3.2 Electrical Characteristics

Table 3-2 Electrical Characteristics

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Symbol</th>
<th>Values</th>
<th>Unit</th>
<th>Note / Test Condition</th>
</tr>
</thead>
<tbody>
<tr>
<td>Supply current</td>
<td>( I_S )</td>
<td>6.8</td>
<td>mA</td>
<td>–</td>
</tr>
<tr>
<td>Output saturation voltage</td>
<td>( V_{Qsat} )</td>
<td>0.25</td>
<td>V</td>
<td>( I_Q = 20 , mA )</td>
</tr>
<tr>
<td>Output rise time</td>
<td>( t_r )</td>
<td>12</td>
<td>µs</td>
<td>( V_{Load} = 4.5 ) ( \text{to} ) ( 24 , V ) ( R_{Load} = 1.2 , k\Omega ) ( C_{Load} = 4.7 , nF ) included in package.</td>
</tr>
<tr>
<td>Output fall time</td>
<td>( t_f )</td>
<td>0.9</td>
<td>µs</td>
<td>( V_{Load} = 5 , V ) ( R_{Load} = 1.2 , k\Omega ) ( C_{Load} = 4.7 , nF ) included in package.</td>
</tr>
<tr>
<td>Delay time</td>
<td>( t_d )</td>
<td>12.5</td>
<td>µs</td>
<td>–</td>
</tr>
<tr>
<td>Frequency range</td>
<td>( f )</td>
<td>–</td>
<td>8 kHz</td>
<td>–</td>
</tr>
</tbody>
</table>

3.3 ESD Protection

Table 3-3 ESD Protection

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Symbol</th>
<th>Values</th>
<th>Unit</th>
<th>Note / Test Condition</th>
</tr>
</thead>
<tbody>
<tr>
<td>ESD Protection</td>
<td>( V_{ESD} )</td>
<td>–</td>
<td>±6</td>
<td>( \text{According to standard EIA/JESD22-A114-B} ) ( \text{Human Body Model} ) ( (HBM , 1500 , \Omega / 100 , pF) ).</td>
</tr>
</tbody>
</table>
3.4 Magnetic Characteristics in Running Mode

Table 3-4 Magnetic Characteristics in Running Mode

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Symbol</th>
<th>Values</th>
<th>Unit</th>
<th>Note / Test Condition</th>
</tr>
</thead>
<tbody>
<tr>
<td>Minimum signal amplitude</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Minimum signal amplitude</td>
<td>$</td>
<td>\Delta B_{\text{min}}</td>
<td>$</td>
<td>0.75</td>
</tr>
</tbody>
</table>

3.5 Operating Characteristics

Table 3-5 Operating Range - TLE4927CB E6547

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Symbol</th>
<th>Values</th>
<th>Unit</th>
<th>Remarks</th>
</tr>
</thead>
<tbody>
<tr>
<td>Operational airgap</td>
<td>$AG$</td>
<td>0.5</td>
<td>mm</td>
<td>Valid in running mode, measured from sensor housing (branded side) to target tooth. Valid at 25°C &amp; 0h. No missing output pulses.</td>
</tr>
<tr>
<td>Phase jitter</td>
<td>$\varphi$ jitter</td>
<td>0.035</td>
<td>°crank</td>
<td>Output falling edge 360° repeatability, 1000 rotations, 3 sigma value, min. input signal size 10 mT_{pp}</td>
</tr>
</tbody>
</table>

3.6 Reference Target Wheel - TLE4927CB E6547

Figure 3-1 Reference target wheel
4 Package Information

4.1 Application Example

![3-Wire Application Diagram](image)

Table 3-6 Reference target wheel geometry

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Symbol</th>
<th>Typ value</th>
<th>Unit</th>
<th>Remarks</th>
</tr>
</thead>
<tbody>
<tr>
<td>Outside diameter</td>
<td>(d)</td>
<td>150</td>
<td>mm</td>
<td></td>
</tr>
<tr>
<td>Number of teeth</td>
<td>(Z)</td>
<td>60</td>
<td>-</td>
<td></td>
</tr>
<tr>
<td>Pitch Ratio</td>
<td></td>
<td>50:50</td>
<td>%</td>
<td></td>
</tr>
<tr>
<td>Material</td>
<td></td>
<td>ST37</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

![Figure 4-1 TLE4927C E6547 Application Circuits (*capacitors included in package)](image)

4.2 Gear Tooth Sensing

In the case of ferromagnetic toothed wheel applications, the IC must be biased by the south or north pole of a permanent magnet which should cover both Hall probes (e.g. a SmCO5 magnet (Vacuumschmelze VX145) with dimensions 8 mm x 5 mm x 3 mm).

The maximum air gap depends on:

- The magnetic field strength (magnet used; pre-induction).
- The toothed wheel that is used (dimensions, material, etc.; resulting differential field).

![Figure 4-2 Sensor Spacing](image)
4.3 Package Information - TLE4927C E6547

Figure 4-3 Toothed Wheel Dimensions

Figure 4-4 Hall Probe Spacing in PG-SSO-3-92 Package

Figure 4-5 Tape Loading Orientation in PG-SSO-3-92 Package
Figure 4-6  Package Dimensions of PG-SSO-3-92 (Plastic Green Single Small Outline)
4.4 Package Outline - TLE4927CB E6547

Figure 4-7  PG-SSOM-3-11 package outline

4.5 Back-bias field orientation

Figure 4-8  Back-bias field orientation
4.6 Packing Information

![Packing Blister Carrier Tape](image)

Figure 4-9 PG-SSOM-3-11 blister tape packing information

For additional packages information, sort of packing and others, please see Infineon internet web page: http://www.infineon.com/products

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