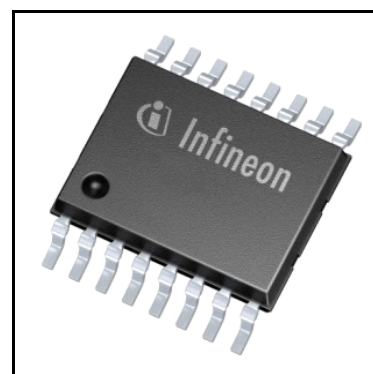


TLE5014D



Preface

This document is an addendum to the TLE5014 datasheet and describes the TLE5014D dual die angle sensor. For all parameters which are not specified here, the TLE5014 datasheet is valid.



Features

- Giant Magneto Resistance (GMR)-based principle
- Two identical dies in one package (providing channel 1 and channel 2 output)
- Fully redundant 2-channel solution for highest functional safety requirements
- High voltage and reverse polarity capability
- EEPROM for storage of configuration (e.g. zero angle) and customer specific ID
- 12 bit representation of absolute angle value on the output
- Max. 1° angle error over lifetime and temperature range
- Developed according to ISO26262 with process complying to ASIL-D
- Internal safety mechanisms with diagnostic coverage >97% for each channel
- Interfaces: PWM, SPC, SENT (based on SAE J2716-2010)
- 32 point look-up table to correct for systematic angle errors (e.g. magnetic circuit)
- 112 bit customer ID (programmable)
- Automotive qualified Q100, Grade 1: -40°C to 125°C (ambient temperature)

Functional Safety

- Safety Manual and Safety Analysis Summary Report available on request

Applications

The TLE5014 GMR-based angle sensor is designed for angular position sensing in automotive applications. Fully redundancy of two chips in one package supporting highest functional safety requirements.

Description

Table 0-1 Derivative Ordering codes (see [Chapter 4](#) for description of derivatives)

| Product Type | Marking | Ordering Code | Package | Comment |
|--------------|---------|---------------|------------|----------------|
| TLE5014S16D | 014SD | SP001410046 | PG-TDSO-16 | SENT Interface |
| TLE5014C16D | 014CD | SP001410042 | PG-TDSO-16 | SPC Interface |
| TLE5014P16D | 014PD | SP001673472 | PG-TDSO-16 | PWM Interface |

Table of Contents

1 Pin Configuration 3

1.1 Pin Description 3

2 Dual Sensor Angle Output 4

3 Absolute Maximum Ratings 5

4 Pre-Configured Derivatives 6

4.1 TLE5014C16D 6

4.2 TLE5014S16D 6

4.3 TLE5014P16D 7

5 Package Information 8

5.1 Package Parameters 8

5.2 Package Outline 9

5.3 Footprint 10

5.4 Packing 10

5.5 Marking 11

6 Revision History 12

1 Pin Configuration

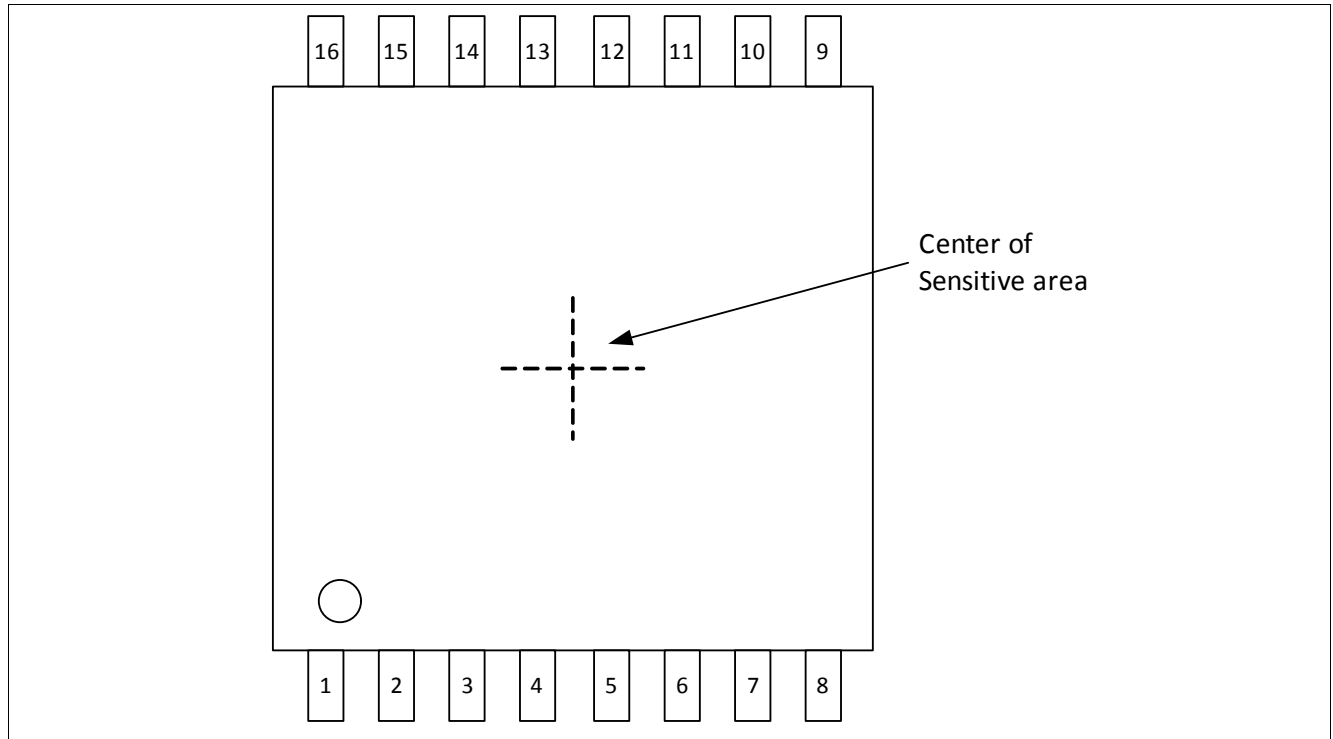


Figure 1-1 Pin configuration (top view)

1.1 Pin Description

The following table describes the pin-out of the chip. Pins 1-8 correspond to channel 1 of the sensor (top IC in the package). Pins 9-16 correspond to channel 2 (bottom IC in the package). The two sensors are galvanically decoupled.

Table 1-1 Pin Description

| Pin No. | Symbol | In/Out | Function |
|---------|--------|--------|--|
| 1 | IF1-1 | I | address coding for programming in bus mode, channel 1 (see TLE5014 datasheet) connect to GND for SENT / PWM interface |
| 2 | IF2-1 | I | address coding for programming in bus mode, channel 1 (see TLE5014 datasheet) connect to GND for SENT / PWM interface |
| 3 | IF3-1 | I | connect to IFC |
| 4 | VDD-1 | - | supply voltage, positive for channel 1 |
| 5 | GND-1 | - | supply voltage, ground for channel 1 |
| 6 | IFA-1 | - | connect to GND |
| 7 | IFB-1 | I/O | SENT / SPC / PWM / SICI interface for channel 1 |
| 8 | IFC-1 | O | address coding for programming in bus mode, channel 1 (see TLE5014 datasheet) connect to IF3 |

Dual Sensor Angle Output

Table 1-1 Pin Description (cont'd)

| Pin No. | Symbol | In/Out | Function |
|---------|--------|--------|--|
| 9 | IFC-2 | O | address coding for programming in bus mode, channel 2 (see TLE5014 datasheet) connect to IF3 |
| 10 | IFB-2 | I/O | SENT / SPC / PWM / SICI interface for channel 2 |
| 11 | IFA-2 | - | connect to GND |
| 12 | GND-2 | - | supply voltage, ground for channel 2 |
| 13 | VDD-2 | - | supply voltage, positive for channel 2 |
| 14 | IF3-2 | I | connect to IFC |
| 15 | IF2-2 | I | address coding for programming in bus mode, channel 2 (see TLE5014 datasheet) connect to GND for SENT / PWM interface |
| 16 | IF1-2 | I | address coding for programming in bus mode, channel 2 (see TLE5014 datasheet) connect to GND for SENT / PWM interface |

2 Dual Sensor Angle Output

The bottom sensor element of the Product_Short is flipped relative to the orientation of the top sensor element. Therefore the rotation direction sensed by the bottom element is opposite to the top element. This is advantageous for safety critical applications, as the two sensor elements do generally not output the same angle. **Figure 2-1** shows the output of the two sensor ICs for a given external magnetic field orientation.

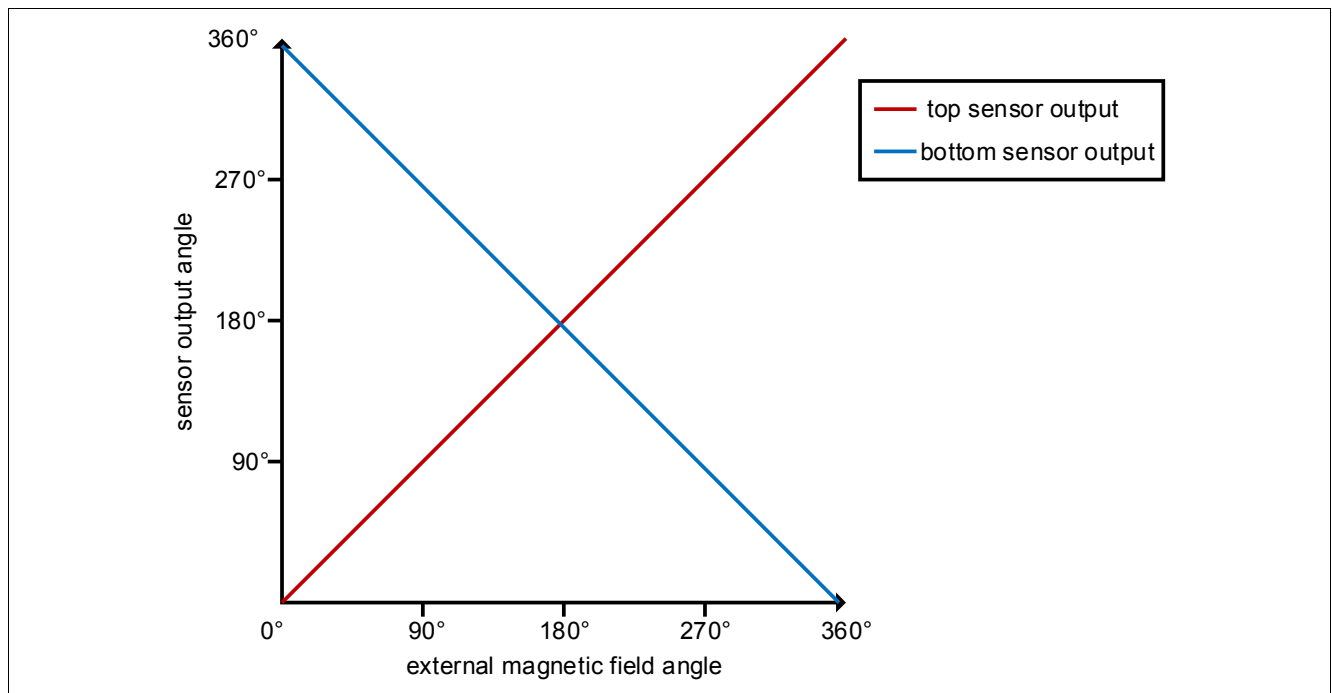


Figure 2-1 Dual die angle output

For applications where an identical angle output of both ICs is desired, the rotation direction and angle offset of one sensor IC can be reconfigured by changing the settings in the ANG_BASE register of the EEPROM.

Absolute Maximum Ratings

3 Absolute Maximum Ratings

Attention: Stresses above the max. values listed here may cause permanent damage to the device. Exposure to absolute maximum rating conditions for extended periods may affect device reliability. Maximum ratings are absolute ratings; exceeding only one of these values may cause irreversible damage to the device.

Table 3-1 ESD protection

| Parameter | Symbol | Values | | Unit | Notes |
|---|------------------|--------|-------|------|---|
| | | Min. | Max. | | |
| Electro-Static-Discharge voltage (HBM), according to ANSI/ESDA/JEDEC JS-001 | V_{HBM} | | ±4.0 | kV | HBM contact discharge for pins VDD, GND, IFB; ground pins connected |
| | V_{HBM} | | ±2.0 | kV | HBM contact discharge for all pins, ground pins not connected |
| Electro-Static-Discharge voltage (CDM), according to JESD22-C101 | V_{CDM} | | ±0.5 | kV | for all pins except corner pins |
| | | | ±0.75 | kV | for corner pins only |

Pre-Configured Derivatives

4 Pre-Configured Derivatives

Derivatives of the TLE5014D are available with different pre-configured register settings for specific application ("settings"). For each derivative with such settings, the interface type is locked and cannot be changed. Only the derivatives with such settings have been released for production by Infineon.

Other settings/parameters for other applications could be adjusted but such adjusted settings would not have been released for production by Infineon.

Furthermore, the available safety analysis and safety manual does only include these preconfigured derivatives.

4.1 TLE5014C16D

The sensor has SPC as predefined interface which is locked and cannot be changed.

The predefined SPC configuration of TLE5014C16D is shown below:

Table 4-1 SPC Derivative Configuration TLE5014C16D

| Interface | SPC unit time | SPC low time | SPC Trigger | Short Serial Message |
|-----------|---------------|--------------|---------------|----------------------|
| SPC | 2.5µs | 5UT | constant 90UT | enabled |

Table 4-2 SPC Derivative Configuration TLE5014C16D

| Rolling Counter | Rolling Counter in CRC | Look-up Table | SPC ID | Output driver |
|-----------------|------------------------|------------------------|-----------------|-----------------------------------|
| enabled | disabled | enabled, preconfigured | 00 _B | open drain w/ controlled slope |

Following parameters and values are allowed to modify:

- SPC unit time: 1.5µs / 2.5µs
- Short serial message: enable / disable
- Rolling counter in CRC: enable /disable
- SPC ID: 0 / 1 / 2 / 3

4.2 TLE5014S16D

The sensor has SENT as predefined interface which is locked and cannot be changed.

The predefined SENT configuration of TLE5014S16D is shown below:

Table 4-3 SENT Derivative Configuration TLE5014S16D

| Interface | SENT unit time | SENT low time | SENT Protocol Type | Short Serial Message |
|-----------|----------------|---------------|----------------------|----------------------|
| SENT | 3.0µs | 5UT | single secure sensor | enabled |

Table 4-4 SENT Derivative Configuration TLE5014S16D

| SENT Error Indication | SENT Data Range | Pause Pulse | Look-up Table | Output driver |
|-------------------------|-----------------|-------------|------------------------|---------------|
| error code 4091 enabled | 1 ... 4088 | enabled | enabled, preconfigured | push/pull |

Following parameters and values are allowed to modify:

- Short serial message: enable / disable
- Pause pulse: enable /disable
- SENT Protocol Type: Standard / Single Secure Sensor

Pre-Configured Derivatives

- SENT Error Indication: enable (data range: 1 ... 4088 , error code: 4091) / disable (data range: 0 ... 4095, no error code)

4.3 TLE5014P16D

The sensor has PWM as predefined interface which is locked and cannot be changed.

Table 4-5 PWM Derivative Configuration TLE5014P16D

| Interface | PWM Frequency | PWM Data Range | PWM Fault indication | PWM BIST Error or Reset Indication |
|-----------|---------------|-----------------|----------------------|------------------------------------|
| PWM | 200Hz | 12.5% ... 87.5% | 5% | 95% |

Table 4-6 PWM Derivative Configuration TLE5014P16D

| PWM Starting Level | Look-up Table | Output driver |
|--------------------|------------------------|---------------|
| high (rising edge) | enabled, preconfigured | push/pull |

- To be compliant with the existing safety analysis no change of above parameters is allowed unless authorized by Infineon

Package Information

5 Package Information

The device is qualified with a MSL level of 3. It is halogen free, lead free and RoHS compliant.

5.1 Package Parameters

Table 5-1 Package Parameters

| Parameter | Symbol | Limit Values | | | Unit | Notes |
|----------------------------|------------|--------------|------|------|------|---|
| | | Min. | Typ. | Max. | | |
| Thermal resistance | R_{thJA} | | | 120 | K/W | Junction to air ¹⁾ , only one chip is active |
| | | | | 100 | K/W | Junction to air ¹⁾ , both chips are active |
| | R_{thJC} | | | 45 | K/W | Junction to case |
| | R_{thJL} | | | 70 | K/W | Junction to lead |
| Moisture Sensitivity Level | MSL 3 | | | | | 260°C ²⁾ |
| Lead Frame | Cu | | | | | |
| Plating | Sn 100% | | | | | > 7 µm |

1) according to Jedec JESD51-7

2) suitable for reflow soldering with soldering profiles according to JEDEC J-STD-020E (December 2014)

Table 5-2 Position of the die in the package

| Parameter | Symbol | Limit Values | | | Unit | Notes |
|--------------------------------|--------|--------------|------|------|------|---|
| | | Min. | Typ. | Max. | | |
| Tilt | | | | ±3 | ° | in respect to the z-axis and reference plane (see Figure 5-1), |
| Rotational displacement | | | | ±3 | ° | in respect to the reference axis (see Figure 5-1) |
| Placement tolerance in package | | | | ±100 | µm | in x and y direction, for each die in the package |

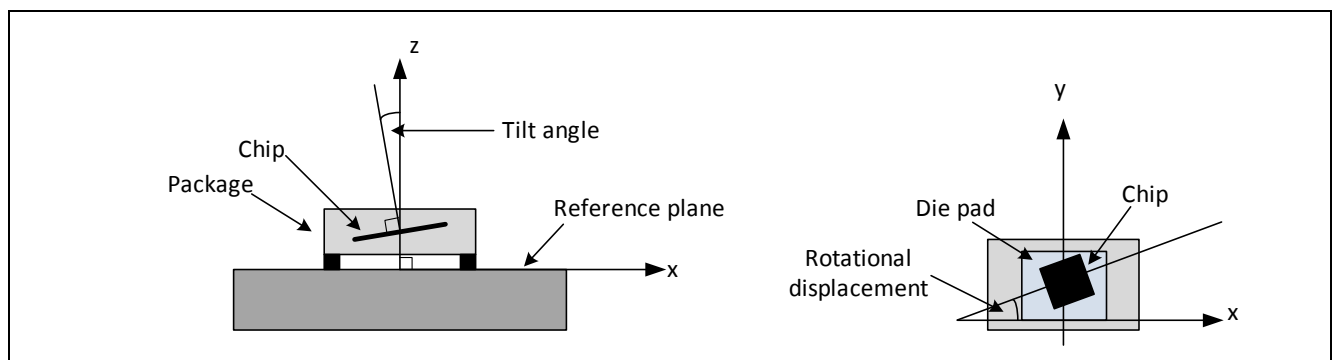


Figure 5-1 Tolerance of the die in the package

Package Information

5.2 Package Outline

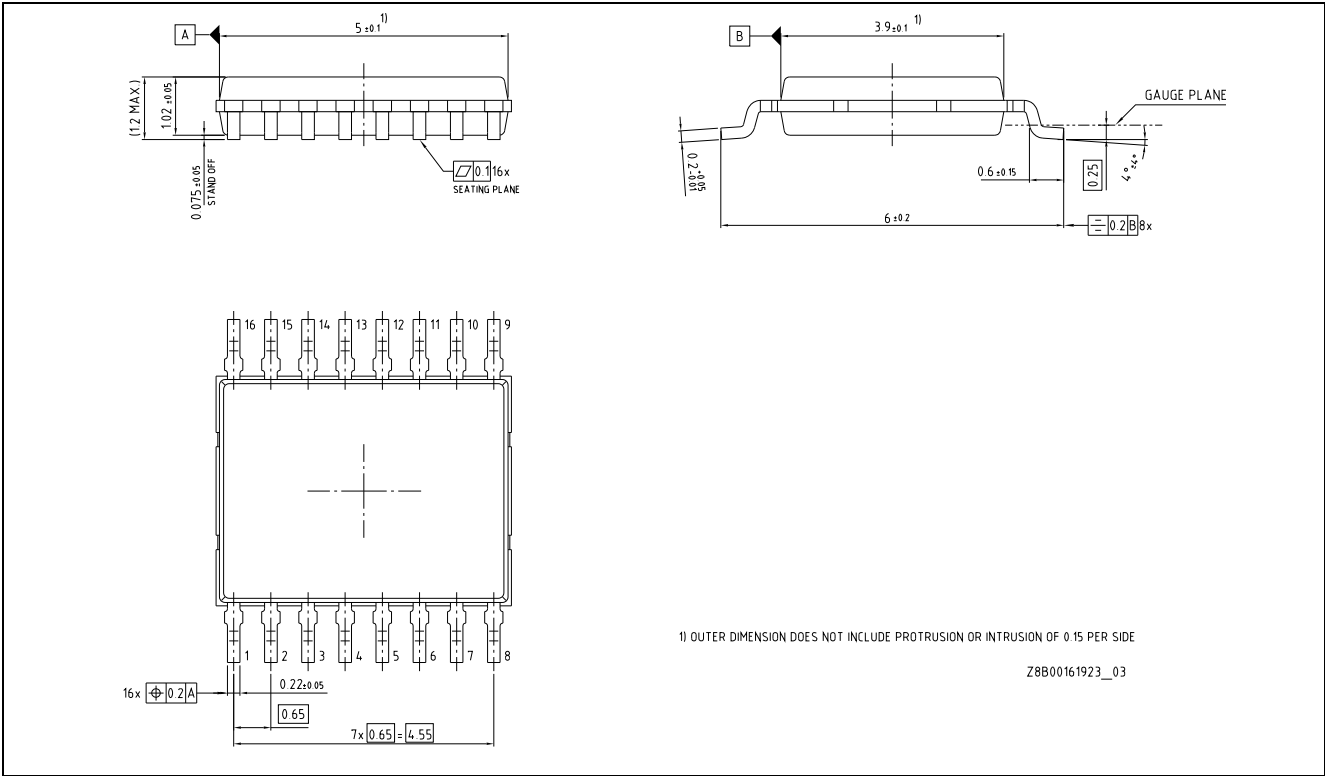


Figure 5-2 PG-TDSO-16 package dimension

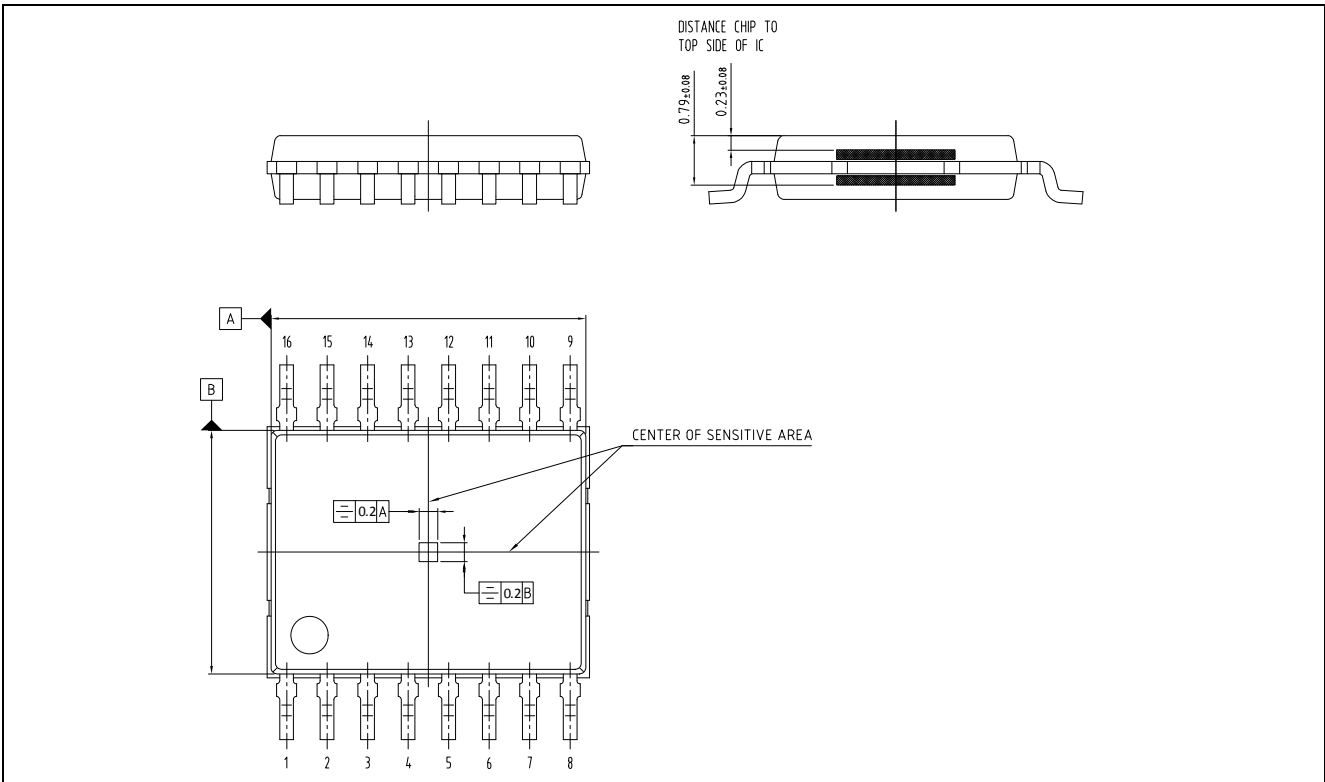


Figure 5-3 Position of sensing element

Package Information

5.3 Footprint

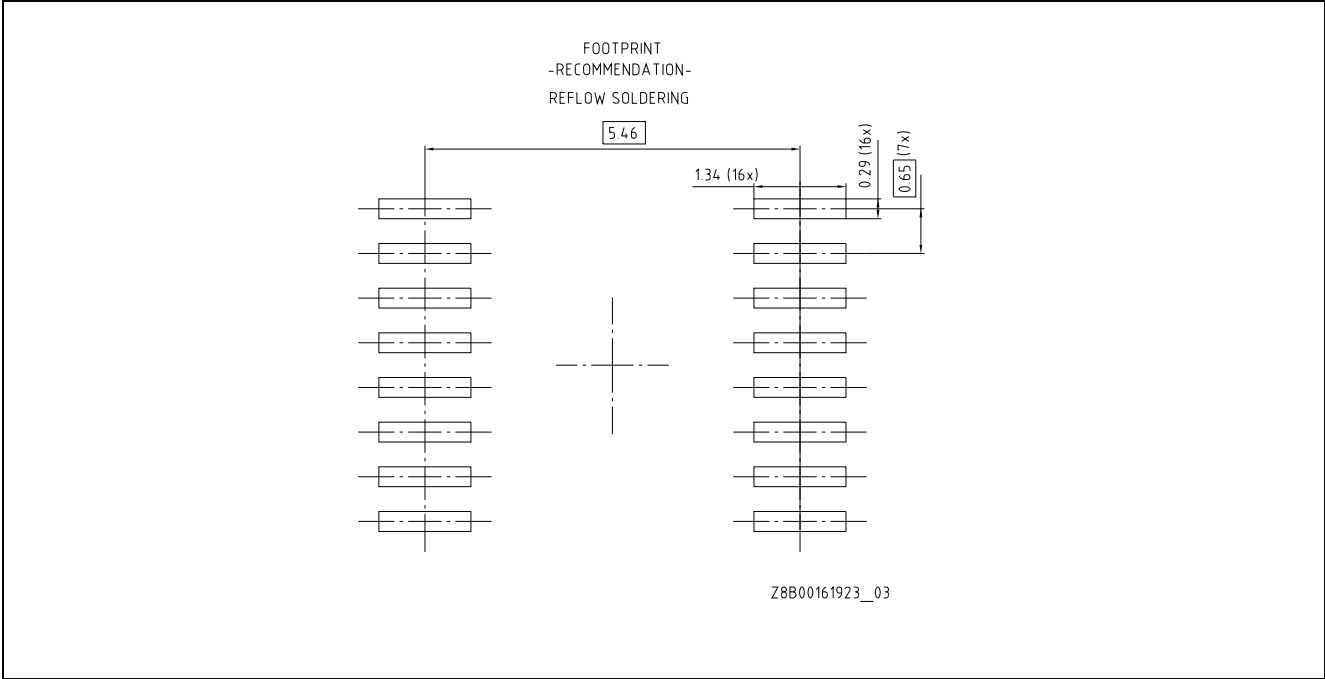


Figure 5-4 Footprint of PG TDSO-16

5.4 Packing

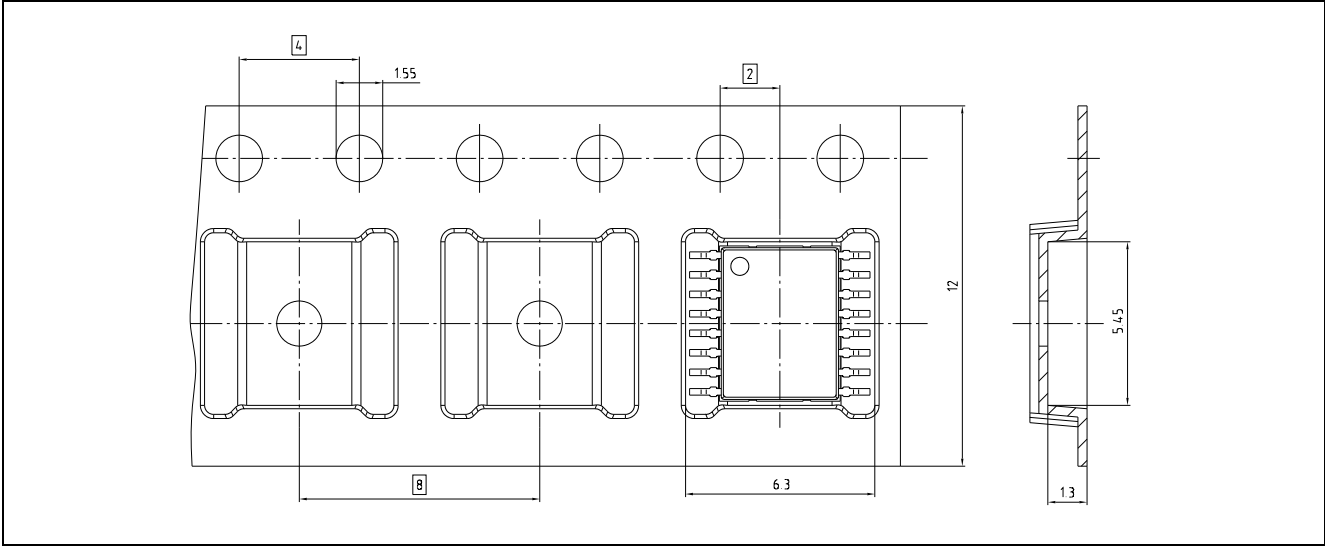


Figure 5-5 Tape and Reel

Package Information

5.5 Marking

| Position | Marking | Description |
|----------|----------|---|
| 1st Line | Gxxxx | G..green, 4-digit..date code |
| 2nd Line | xxxxxxxx | Interface type and version (see Table 0-1 , Marking) |
| 3rd Line | xxx | Lot code |

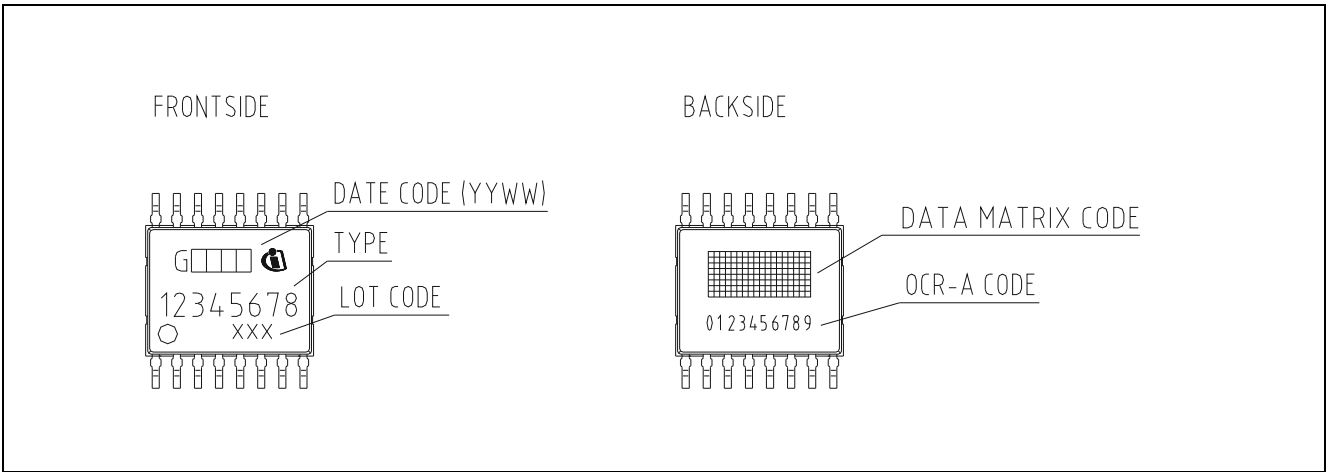


Figure 5-6 Marking of PG-TDSO-16



Revision History

6 Revision History

| Revision | Date | Changes |
|----------|------------|-----------------|
| 1.0 | 2018-03-26 | initial version |
| | | |
| | | |
| | | |
| | | |
| | | |
| | | |

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