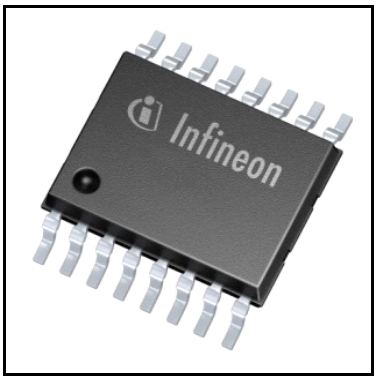
TLE5014D



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

- **G**iant **M**agneto **R**esistance (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

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1 Pin Configuration

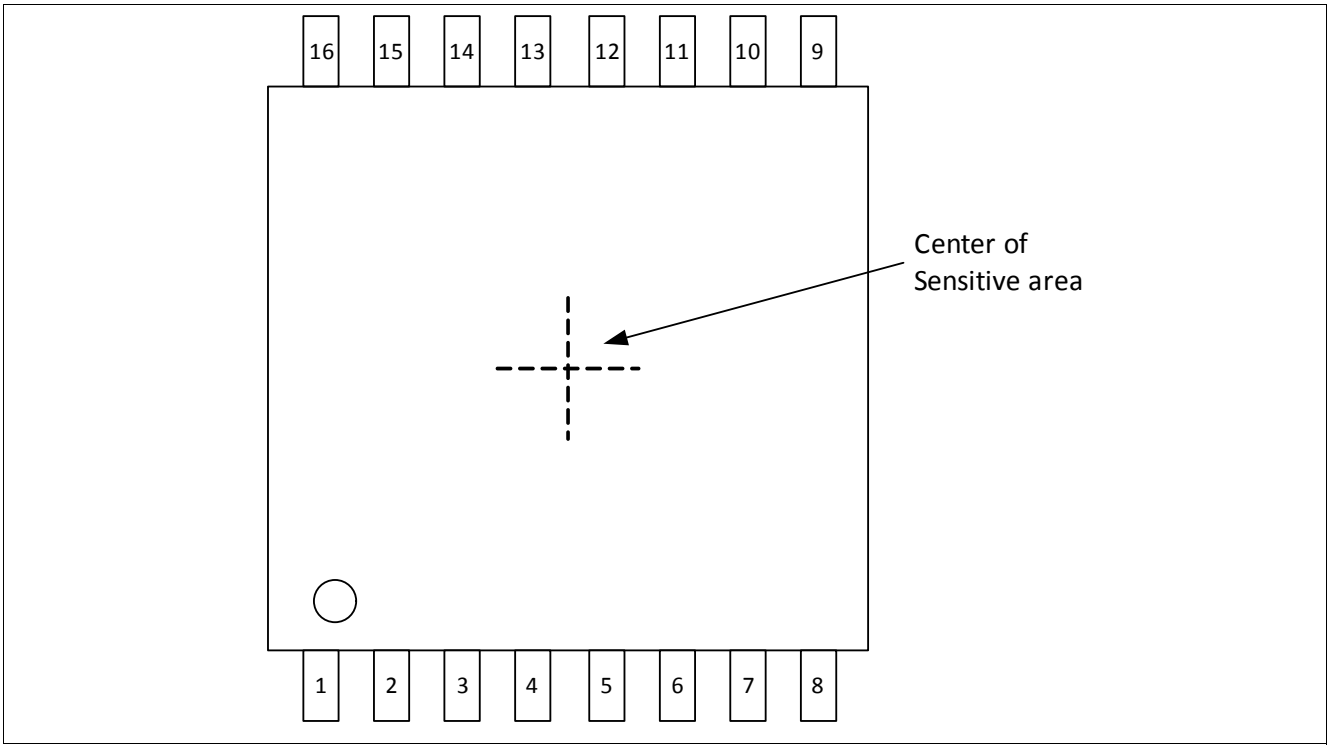

Figure 1-1 Pin configuration (top view)

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

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.

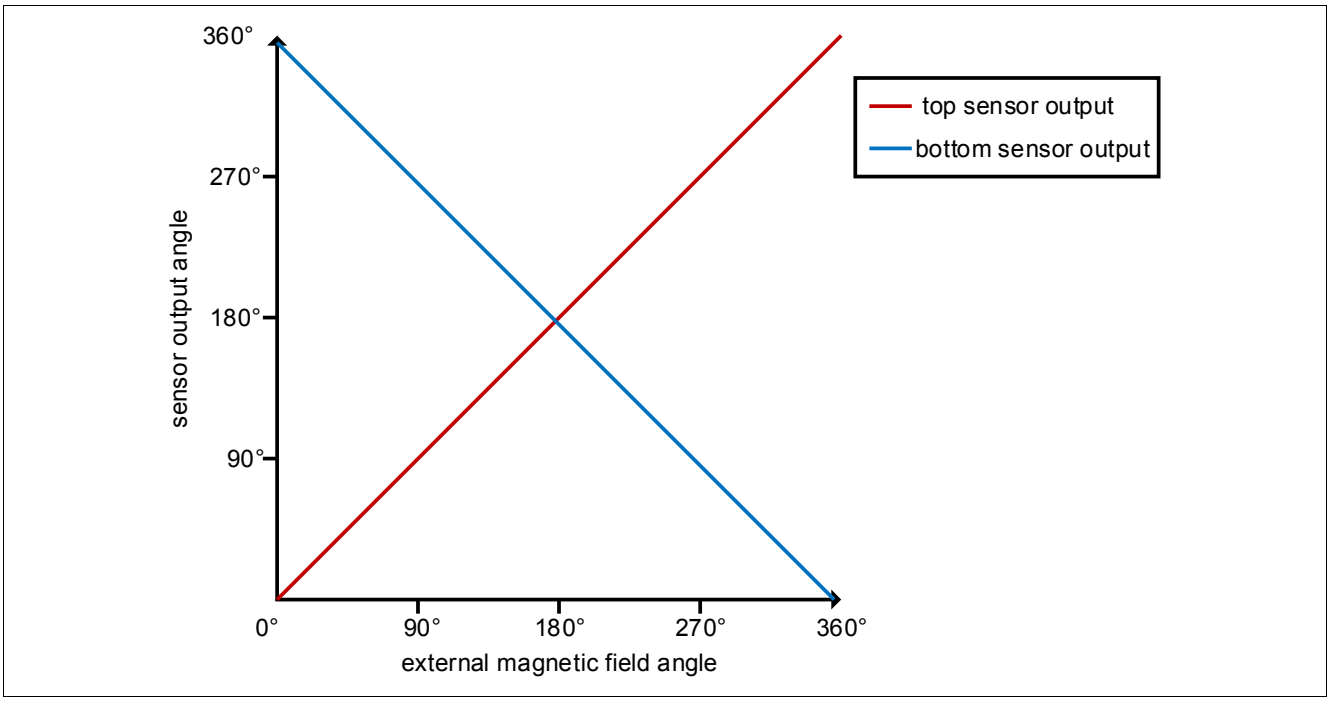

Figure 2-1 Dual die angle output

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.

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

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

- 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

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 Sensitively 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

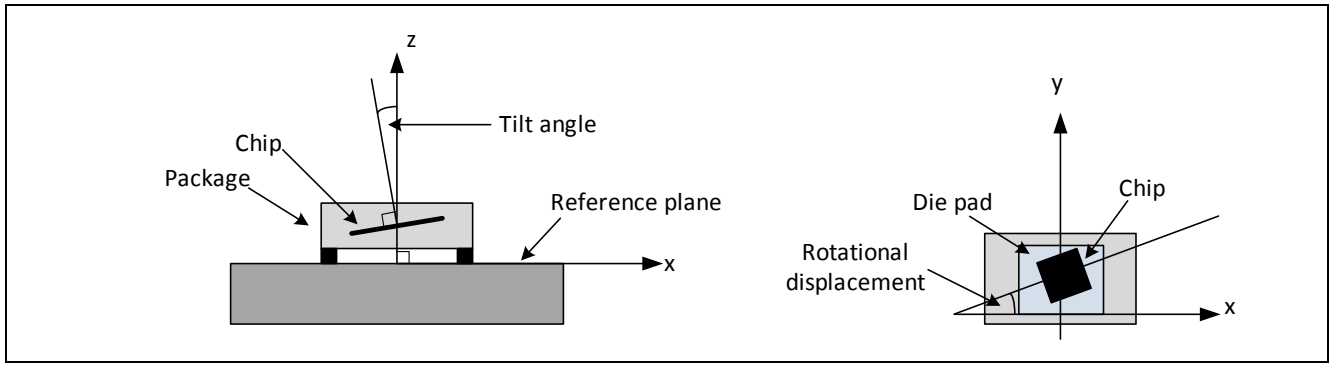

Figure 5-1 Tolerance of the die in the package

5.2 Package Outline

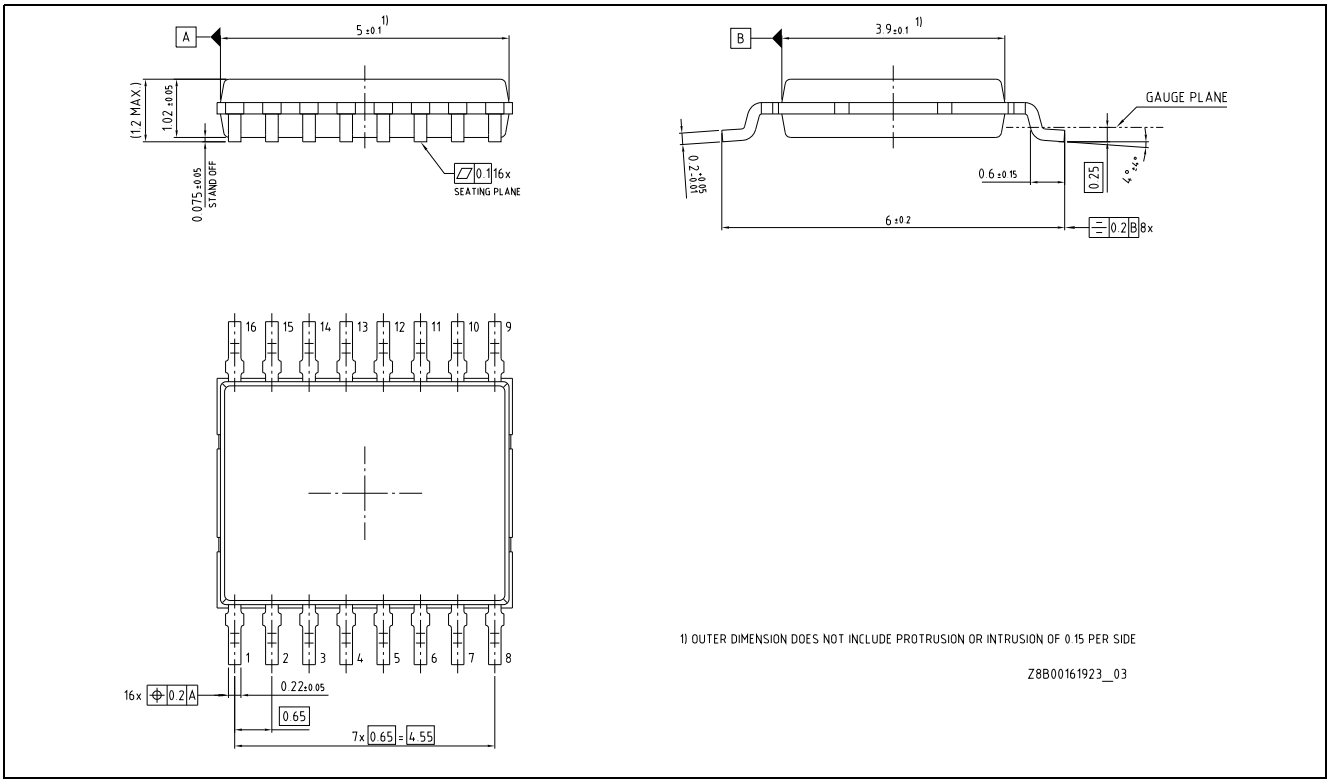

Figure 5-2 PG-TDSO-16 package dimension

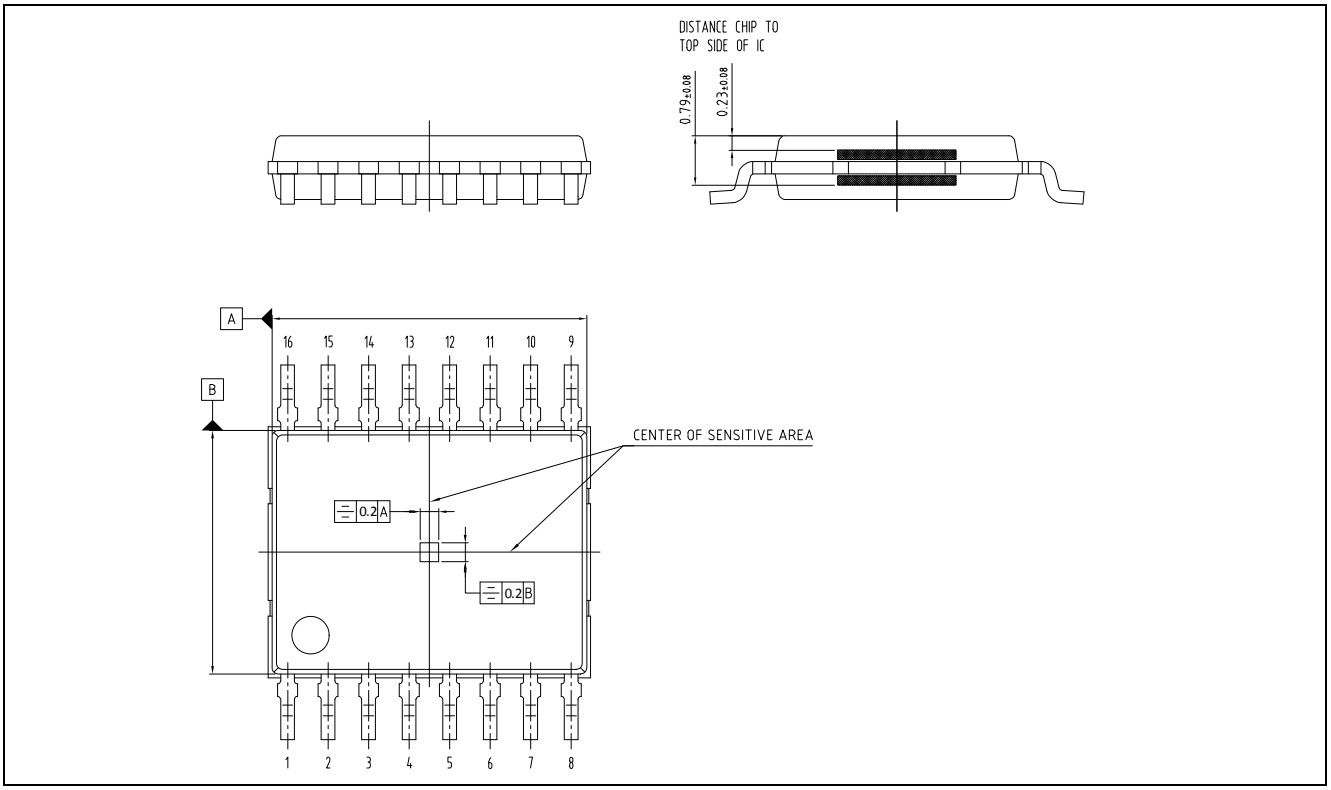

Figure 5-3 Position of sensing element

5.3 Footprint

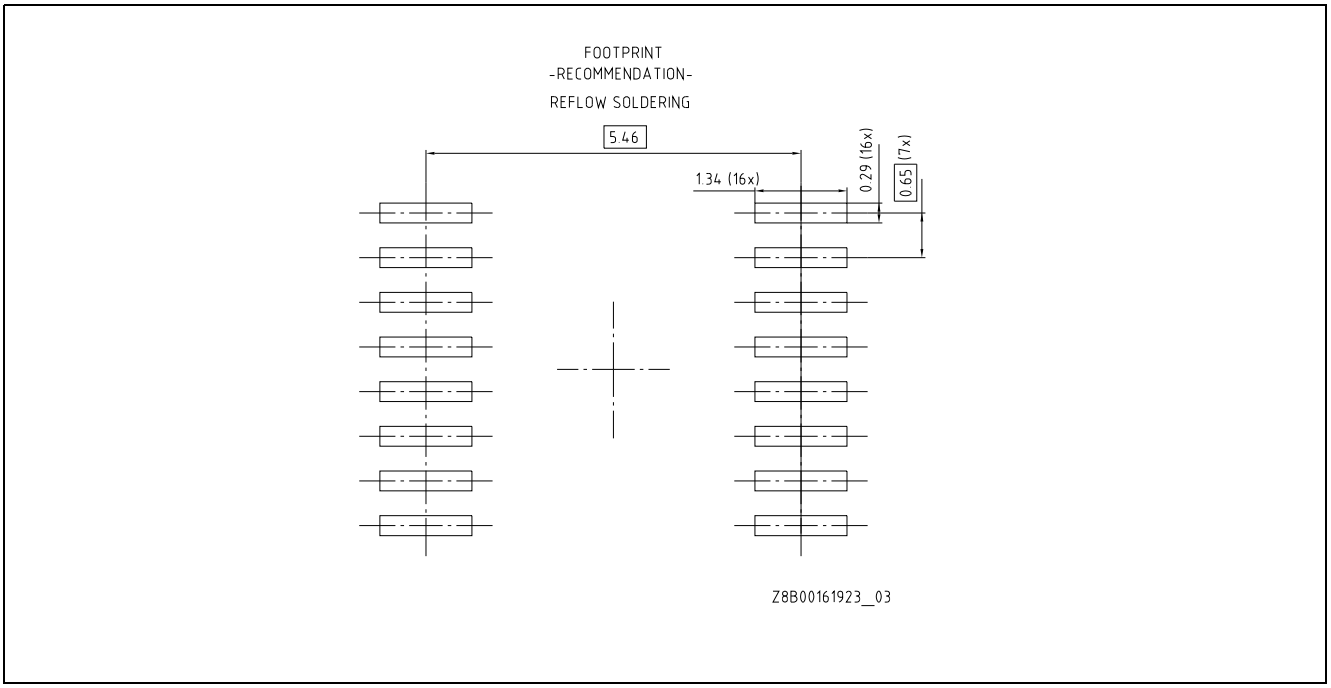

Figure 5-4 Footprint of PG TDSO-16

5.4 Packing

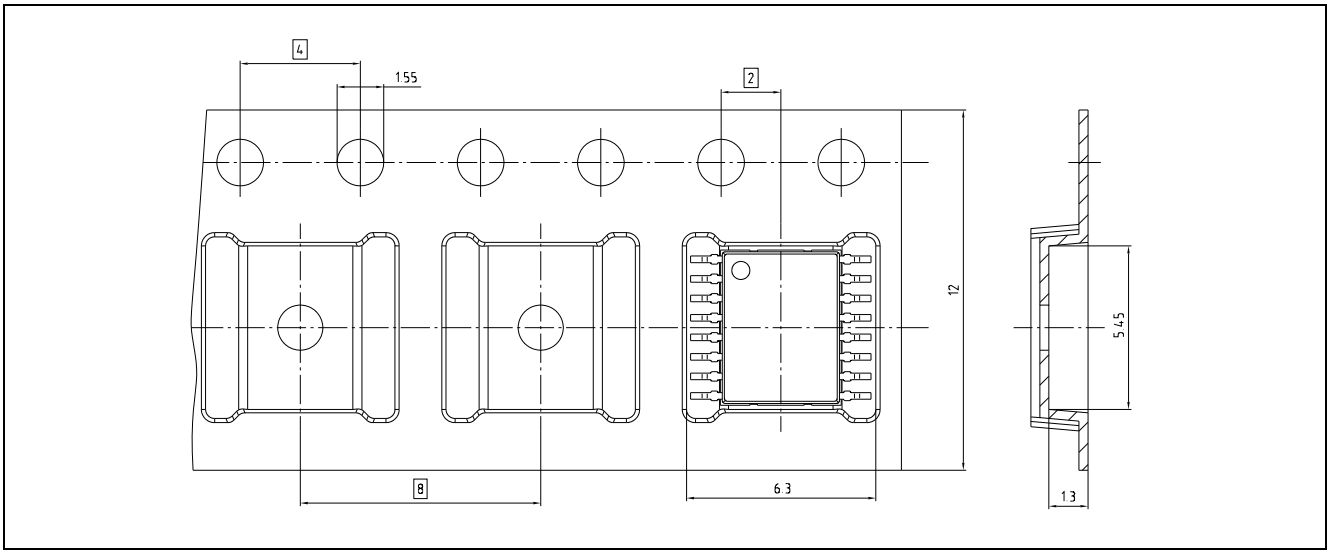

Figure 5-5 Tape and Reel

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

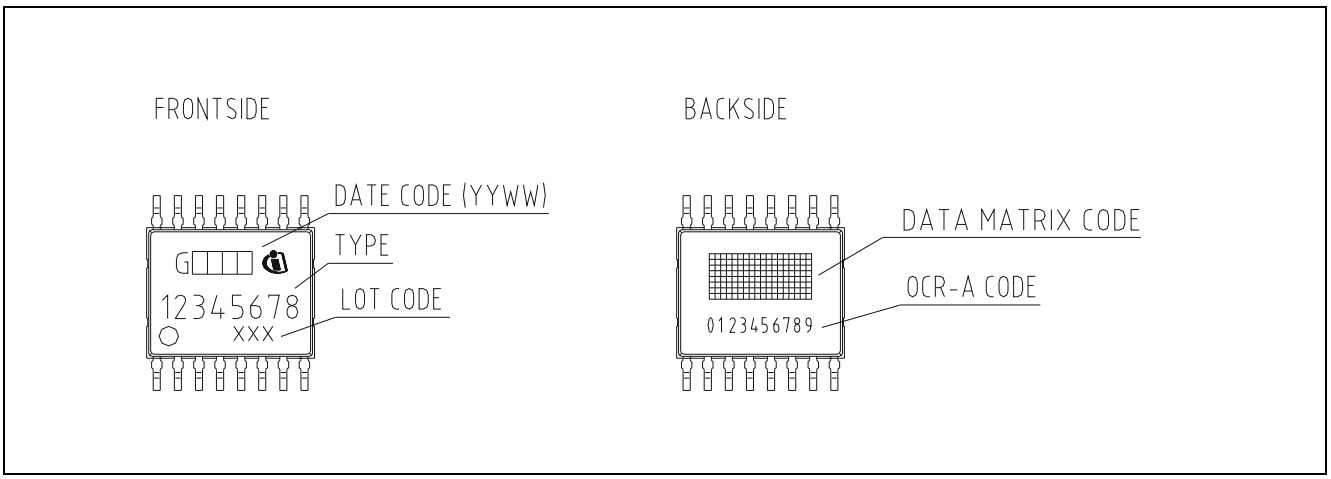

Figure 5-6 Marking of PG-TDSO-16

6 Revision History

Revision	Date	Changes
1.0	2018-03-26	initial version

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