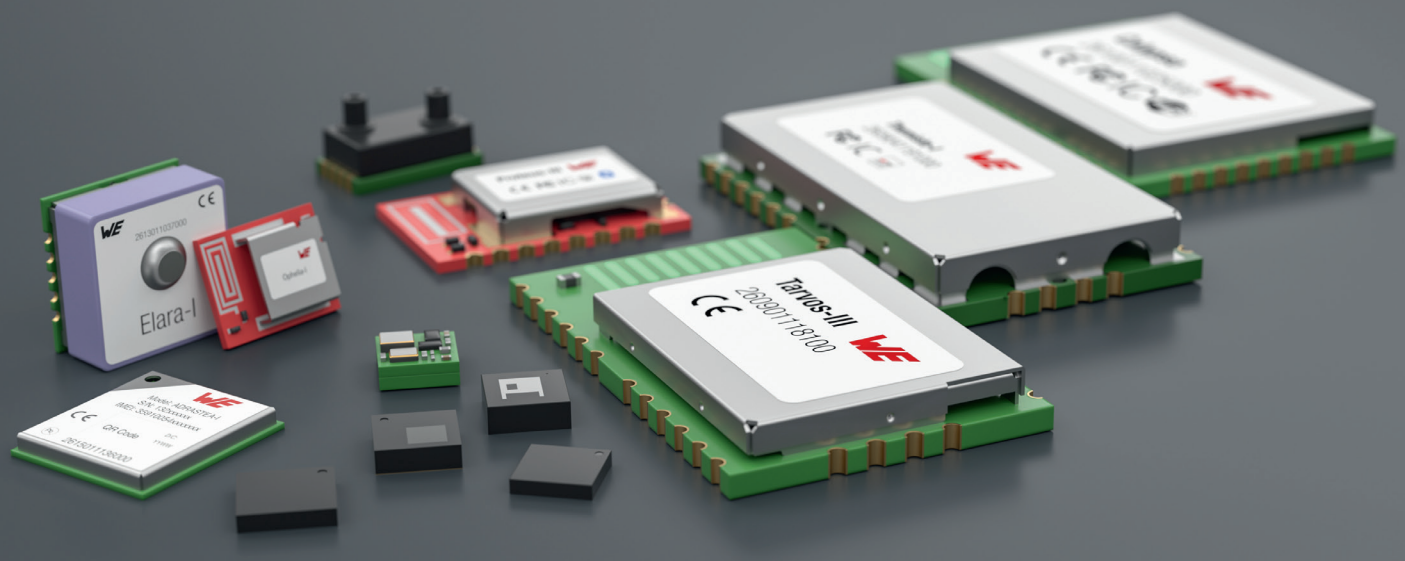


User manual

Sensor FeatherWing

2501000201291

Version 1.3

June 19, 2023

Würth Elektronik more than you expect

****

MUST READ

Check for firmware updates

Before using the product make sure you use the most recent firmware version, data sheet and user manual. This is especially important for Wireless Connectivity products that were not purchased directly from Würth Elektronik eiSos. A firmware update on these respective products may be required.

We strongly recommend to include in the customer system design, the possibility for a firmware update of the product.

Revision history

Manual version	HW version	Notes	Date
1.0	2.0	Initial version	November 2020
1.1	2.2	Correction of typo in article number in schematic	February 2021
1.2	2.2	Updated github repository links	February 2021
1.3	2.2	New corporate design	June 2023

Abbreviations

Abbreviation	Name	Description
CISPR	Comité International Spécial des Perturbations Radioélectriques	International Special Committee on Radio Interference
EV	Evaluation	
ESD	Electro Static Discharge	
EMC	Electro Magnetic Compatibility	
GND	Ground	
HIGH	High signal level	
IDE	Integrated development environment	
IEC	International Electrotechnical Commission	
JST	Japan Solderless Terminal	
JTAG	Joint Test Action Group	
LED	Light Emitting Diode	
LGA	Land Grid Array	
Li-Po	Lithium-Polymer	
LOW	Low signal level	
MEMS	Micro-Electro Mechanical Systems	
PC	Personal Computer	
PCB	Printed Circuit Board	
SCL	Serial clock	
SDA	Serial data	
SDK	Software Development Kit	
SPI	Serial Peripheral Interface	
VCC		Supply voltage
VDD	Voltage Drain Drain	Supply voltage

Contents

1 General description

1.1 Introduction

The Würth Elektronik eiSos Sensor FeatherWing is a sensor development board fully compatible to the popular Adafruit Feather line of development boards. It consists of the following four sensors,

- WSEN-PADS - Absolute pressure sensor (2511020213301)
- WSEN-ITDS - 3-axis acceleration sensor (2533020201601)
- WSEN-TIDS - Temperature sensor (2521020222501)
- WSEN-HIDS - Humidity sensor (2523020210001)

All four sensors are connected over the shared I^{2}C bus and hence can be connected to any of the Feather microcontroller boards. The Arduino (C/C++) drivers and examples (see chapter 4) made available makes it easy to build a prototype to kick-start the application development.

The Sensor FeatherWing also has the 4-pin JST QWIIC® connector on-board. This enables easy connection to the QWIIC® ecosystem of development boards. Additionally, a 6 pin connector enables extension of the FeatherWing with a host of evaluation boards from Würth Elektronik eiSos.

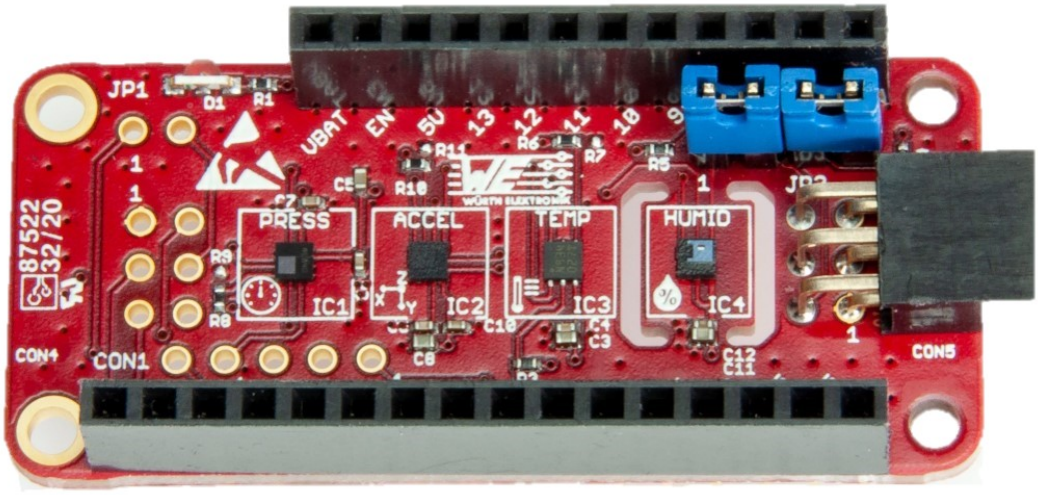


Figure 1: The WE Sensor FeatherWing (2501000201291)

1.2 Block diagram

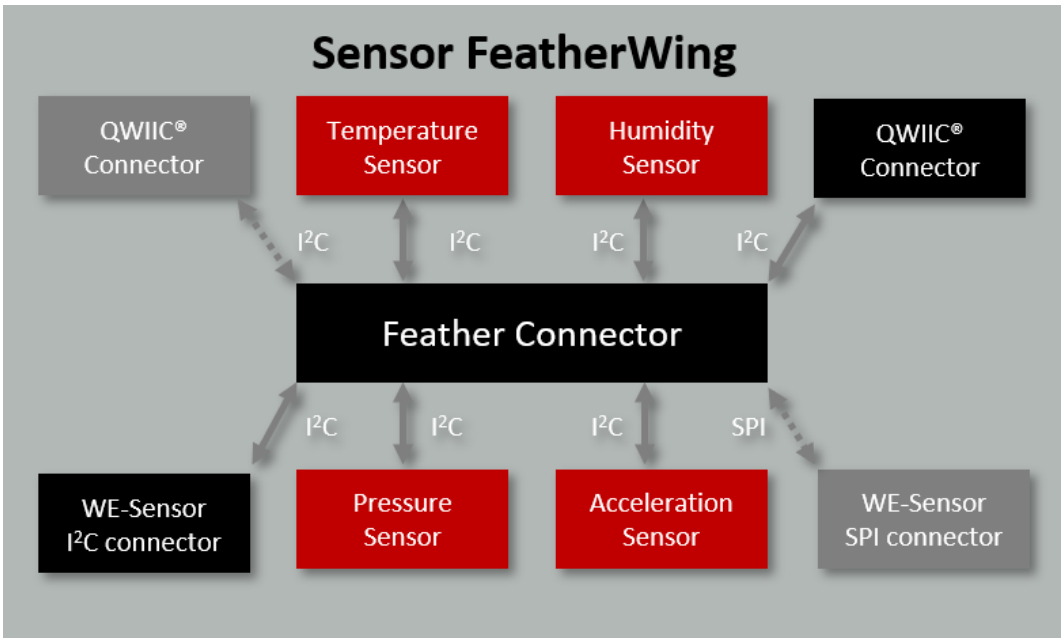


Figure 2: Block diagram - Sensor FeatherWing

1.3 Contents

Description	Quantity
WE Sensor FeatherWing	1
QWIIC® connector	1
2×3 WE-sensor connector (right angled)	1
Packaging: ESD safe bag	2

Table 1: Contents 2501000201291

2 Functional description

The Sensor FeatherWing was designed with rapid prototyping in mind. Being fully compatible with the Adafruit ecosystem, this FeatherWing allows the user the flexibility to choose the preferred host microcontroller. The inherent modularity of the ecosystem allows the FeatherWing to be easily integrated into any project.
The next sections provide a brief introduction to Adafruit's Feather ecosystem and details on the sensors present on the FeatherWing.
Feel free to check our youtube channel:
www.youtube.com/user/WuerthElektronik/videos for video tutorials, hands-ons and webinars relating to our products.

2.1 Adafruit Feather

The Adafruit Feather ecosystem consists of two types of boards apart from a host of accessories:

- **Feather:** Adafruit Feathers are a complete line of development boards from Adafruit that are standalone and stackable. They can be powered either over the on-board micro-USB plugs or using a Li-Po battery. Feathers are portable, flexible and light as their namesake.
- **FeatherWings:** FeatherWings are stackable boards that when used along with a Feather add a certain functionality to the system.

The Feather system with more than 50+ Wings, several different types of accessories and arduino/circuit python based code support provides a perfect ecosystem for rapid prototyping. Please refer to *adafruit.com/feather* for more details on the Adafruit Feather ecosystem.

2.2 Sensor FeatherWing

The Sensor FeatherWing consists of four sensors. This section provides details regarding the key features of these sensors.

2.2.1 WSEN-PADS (2511020213301)

The WSEN-PADS is a MEMS based piezo-resistive absolute pressure sensor with an integrated ASIC and an embedded temperature sensor. The fully molded holed LGA package and low current consumption makes this sensor suitable for a range of applications including weather stations, barometers, altimeters and indoor navigation.

Key features

- Absolute pressure range : 26 to 126 kPa
- Output data rate : 1 to 200 Hz
- Pressure data resolution : 24-bits
- Current consumption : 4 μA

- Programmable pressure threshold and data-ready interrupt

Further details about this sensor can be found under *we-online.de/katalog/en/WSEN-PADS*

2.2.2 WSEN-ITDS (2533020201601)

The WSEN-ITDS sensor is a 14-bit digital ultra-low-power and high-performance three-axis accelerometer with a digital output interface. Capability of detecting events like free fall, tap recognition, wake up, stationary/motion, activity/inactivity and 6D orientation make the sensor suitable for applications like vibration monitoring, tilt measurement, impact detection and many more.

Key features

- Selectable full scale : $\pm$2g, $\pm$4g, $\pm$8g, $\pm$16g,
- Bandwidth : 400 Hz
- Output data rate : Up to 1600 Hz
- Noise density : 90 μg / $\sqrt{Hz}$
- Operating modes : High-performance, Low-power, Normal
- Current consumption : 16 μA (Low-power mode)

Further details about this sensor can be found under *we-online.de/katalog/en/WSEN-ITDS*

2.2.3 WSEN-TIDS (2521020222501)

The WSEN-TIDS is a high precision silicon-based digital temperature sensor IC with an integrated ASIC and a digital I^2C interface. A compact UDFN package and fast thermal response make this sensor ideal for a range of applications like environmental monitoring, HVAC, PCB thermal monitoring, industrial control and many more.

Key features

- Temperature range : -40 to 125 °C
- Output data rate : 25 to 200 Hz
- Temperature data resolution : 16-bits
- Current consumption : 1.75 μA
- Programmable temperature threshold interrupt

Further details about this sensor can be found under *we-online.de/katalog/en/WSEN-TIDS*

2.2.4 WSEN-HIDS (2523020210001)

The WSEN-HIDS is a 16-bit ultra-low power and high-performance humidity sensor with a digital interface. The pre-calibrated sensor in a compact LGA package is suitable for a variety of applications including HVAC systems, white goods, building automation and air conditioning.

Key features

- Humidity range : 0 to 100 % rH
- Humidity noise : 0.35 % rH RMS
- Output data rate : 1 Hz, 7 Hz and 12.5 Hz
- Current consumption : 8.9 μA
- Integrated temperature sensor

Further details about this sensor can be found under *we-online.de/katalog/en/WSEN-HIDS*

3 Hardware description

This sections contains a detailed description of the hardware features of the Sensor FeatherWing. The design files for this hardware can be downloaded from *github.com/WurthElektronik/FeatherWings*.

3.1 Jumpers

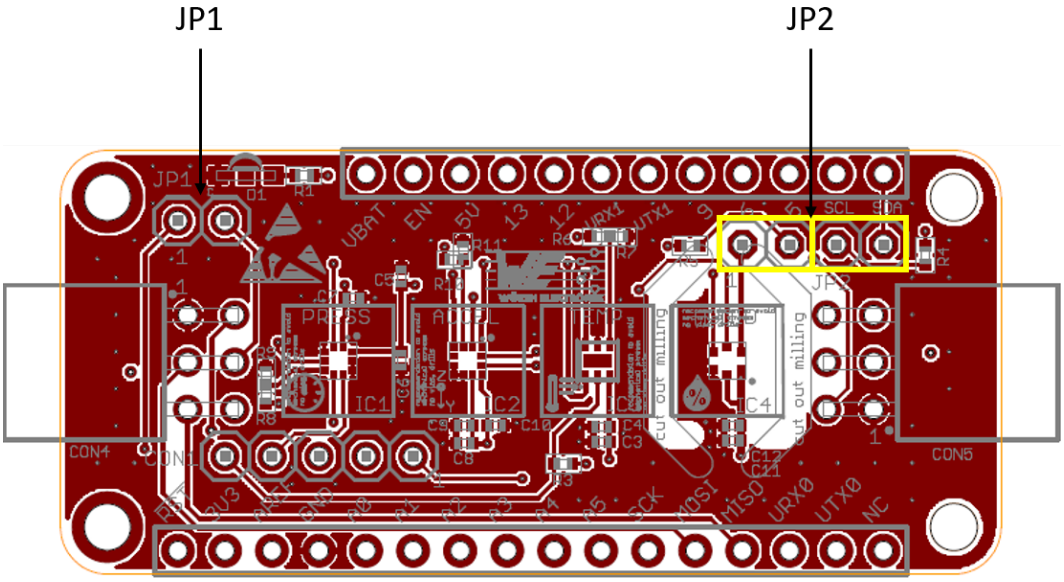


Figure 3: Jumpers and their default state

3.1.1 JP1

This jumper has to be mounted and set when the CON4 is used to connect to a sensor using the SPI interface.

JP1	Function	Jumper set (default)
1,2	SPI_CE(CON4) to GPIOA5	No (Not mounted)

Table 2: Jumper JP1

3.1.2 JP2

The standard I^{2}C interface requires the SCL and SDA lines to be pulled up with resistors. These jumpers can be removed in cases where the pull-ups already exist on the I^{2}C bus.

JP2	Function	Jumper set (default)
1,2	Connect I²C SCL line to a 4.7 kΩ Pull up resistor	Yes
3,4	Connect I²C SDA line to a 4.7 kΩ Pull up resistor	Yes

Table 3: Jumper JP2

3.2 Connectors and pin headers

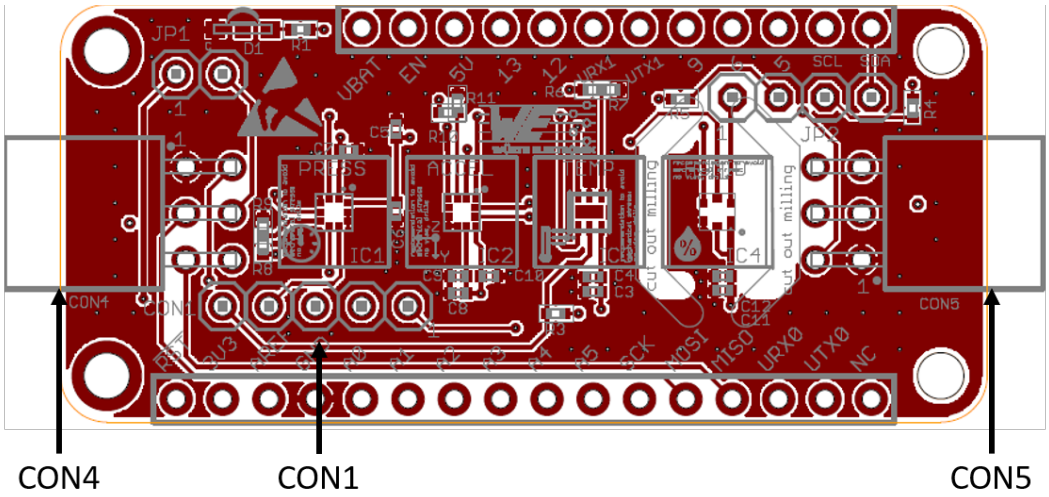


Figure 4: Connectors on the top

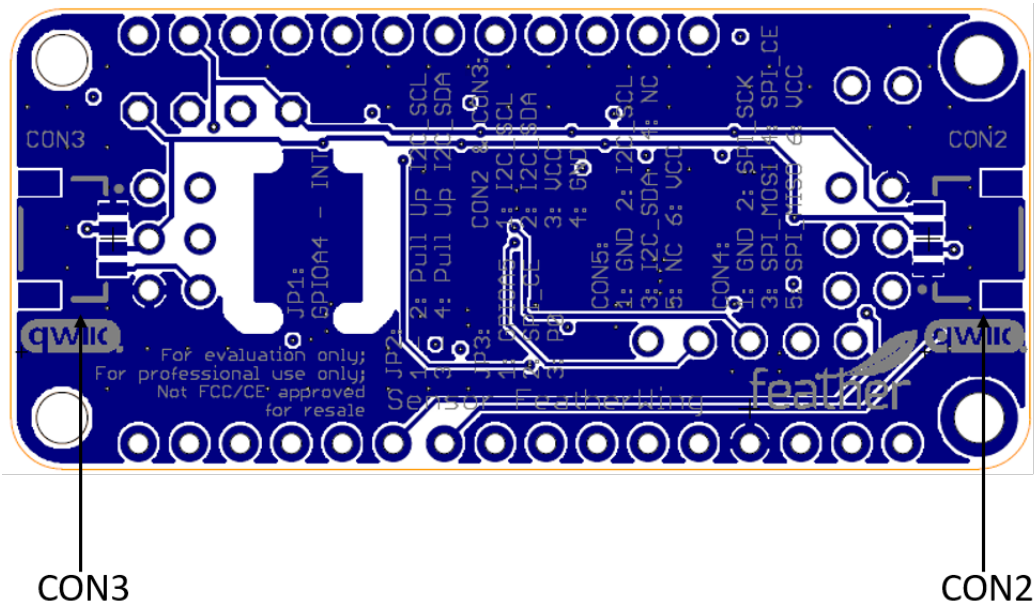


Figure 5: Connectors at the bottom

Connector	Function
CON1	Pin header for interrupt lines of the sensors
CON2	QWIIC® connector
CON3	QWIIC® connector
CON4	2×3 connector for WE sensor EV-boards for SPI
CON5	2×3 connector for WE sensor EV-boards for I^2C
Feather connector	Standard 16 and 12-pin headers for the Feather ecosystem

Table 4: Connector overview

3.2.1 CON1

Connector CON1 is a 1×5 2.54 mm pin header and provides all the interrupt lines that can be optionally connected to the host. This connector is not mounted.

Pin	Function
1	Interrupt of the WSEN-HIDS sensor
2	Interrupt 1 of the WSEN-ITDS sensor
3	Interrupt 0 of the WSEN-ITDS sensor
4	Interrupt of the WSEN-PADS sensor
5	Interrupt of the WSEN-TIDS sensor

3.2.2 CON2 and CON3

CON2 (mounted) and CON3 (not mounted) are 4-pin JST connectors that allow interfacing with SparkFun's QWIIC® development board ecosystem. CON3 is not mounted and needs to be soldered on in order to be daisy chain-able. The QWIIC® ecosystem offers a wide range of development boards and accessories for quick prototyping. Please check *sparkfun.com/qwiic* for details on the QWIIC® ecosystem.

Pin	Function
1	I^2C SCL
2	I^2C SDA
3	VCC
4	GND

3.2.3 CON4

The connector 4 (not mounted) is a 2×2 2.54 mm pitch plug that is compatible with the EV-boards of sensors from Würth Elektronik eiSos using the SPI interface.

Pin	Function
1	GND
2	SPI_SCK (Clock)
3	SPI_MOSI (Master Out Slave In)
4	SPI_CE (Chip Enable)
5	SPI_MISO (Master In Slave Out)
6	VCC

3.2.4 CON5

The connector 5 is a 2×3 2.54 mm pitch plug that is compatible with the EV-boards of sensors from Würth Elektronik eiSos using the I^2C interface.

Pin	Function
1	GND
2	I^2C SCL
3	I^2C SDA
4	Not connected
5	Not connected
6	VCC

3.2.5 Feather connector

This is the standard set of connectors that is used across the Feather ecosystem. The table below describes the functions of each of the 28 pins as applicable to this FeatherWing.

Pin Number	Pin name	Function
1	$\overline{RST}$	Not connected
2	3V3	3.3 V power supply
3	AREF	Not connected
4	GND	Ground
5	A0	Not connected
6	A1	Not connected
7	A2	Not connected
8	A3	Not connected
9	A4	Not connected
10	A5	(Optional) SPI_CE via JP1
11	SCK	SPI clock
12	MOSI	SPI MOSI
13	MISO	SPI MISO
14	U0RX	Not connected
15	U0TX	Not connected
16	NC	Not connected

Pin Number	Pin name	Function
17	SDA	I^2C SDA
18	SCL	I^2C SCL
19	5	Not connected
20	6	Not connected
21	9	Not connected
22	U1TX	Not connected
23	U1RX	Not connected
24	12	Not connected
25	13	Not connected
26	5 V	Not connected
27	EN	Not connected
28	VBAT	Not connected

3.3 Schematics

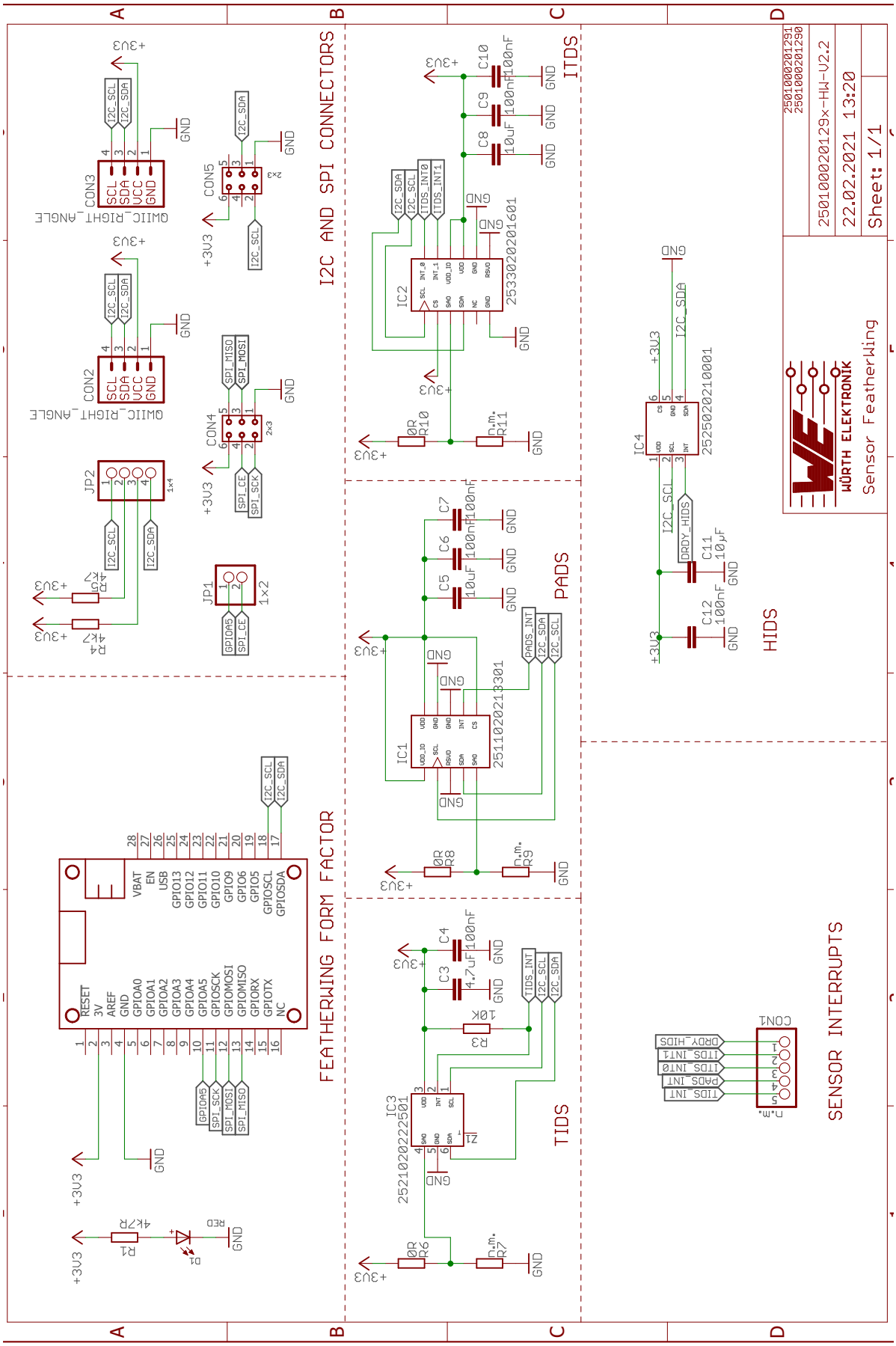
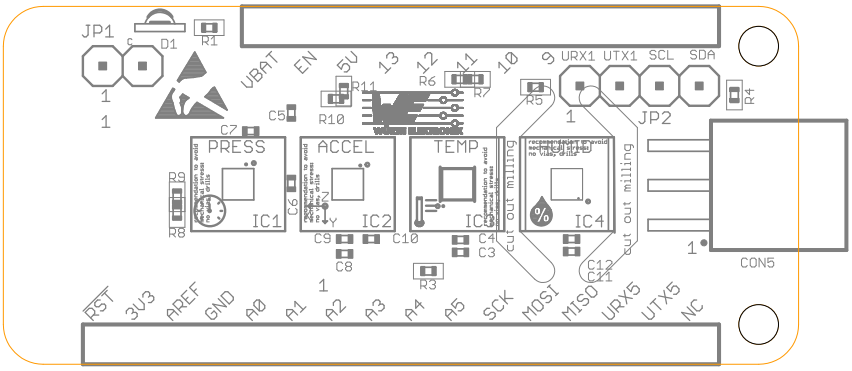


Figure 6: Schematics

3.4 Layout



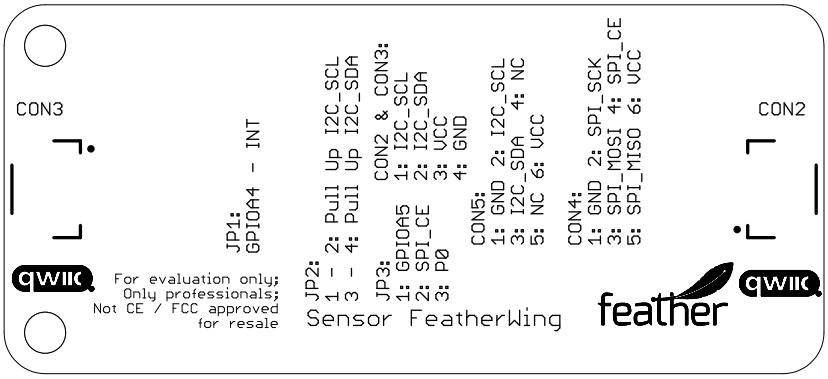


Figure 7: Assembly diagrams

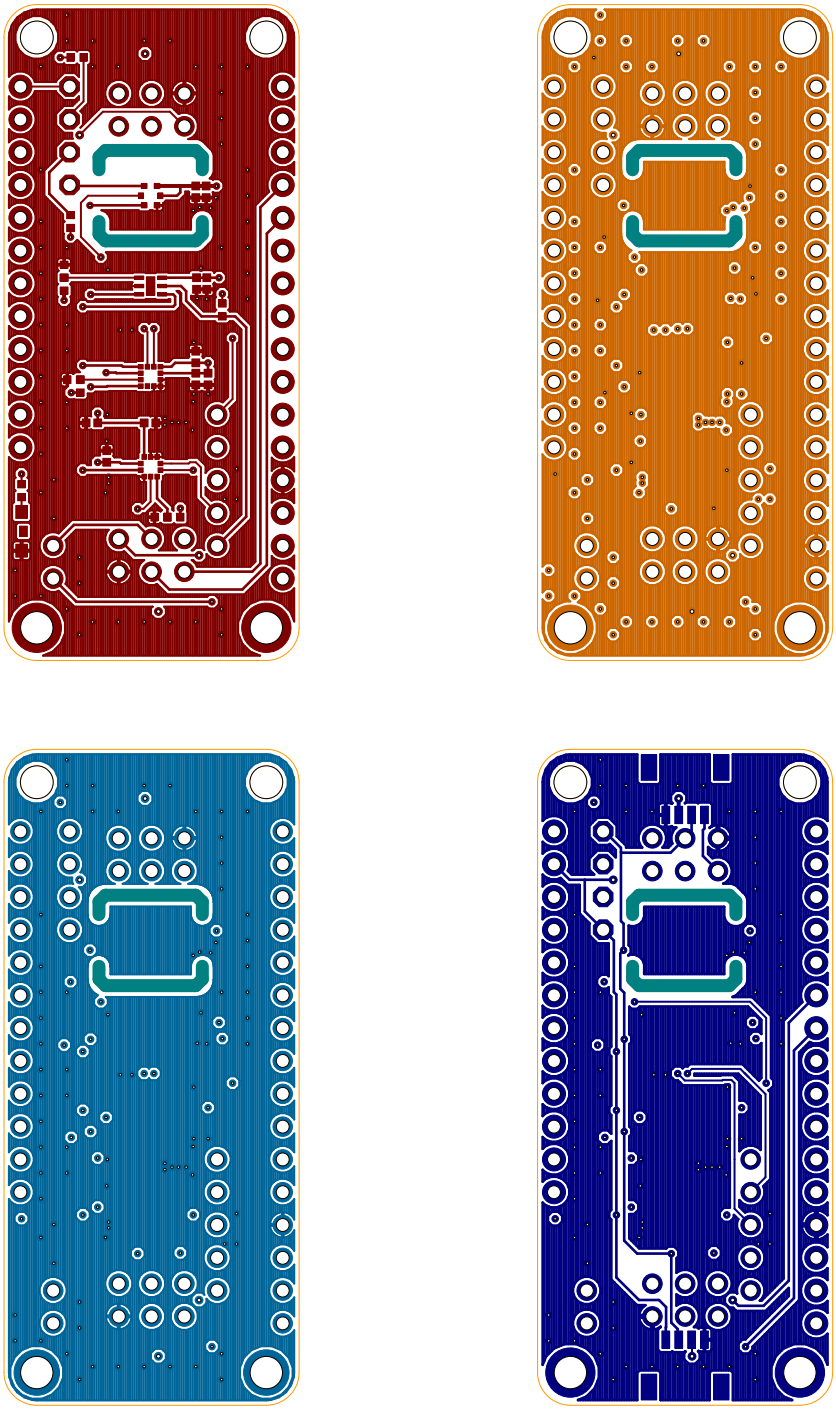


Figure 8: Top, bottom and internal layers

4 Software description

Würth Elektronik eiSos provides a software development kit (SDK) with examples to support all the WE FeatherWings. Here are the salient features of the WE FeatherWing SDK.

- The SDK is open-source and well documented.
- It uses popular open-source tool chain including an IDE.
- The examples are written in Arduino-styled C/C++ for quick prototyping.
- The core components of the SDK are written in pure C to enable easy porting to any microcontroller platform.
- Development platform independent (Windows, Linux or MAC).
- Modular structure of the software stack makes it easy to integrate into any project.

The SDK can be accessed on Github at *github.com/WurthElektronik/FeatherWings*.

4.1 Software architecture

The WE FeatherWing SDK is built up in a modular way using a set of open-source tools to enable complete flexibility for the user.
The figure 9 shows the architecture of the WE FeatherWing SDK.

- **PlatformIO:** is a cross-platform, cross-architecture, multiple framework professional tool for embedded software development. It provides the tool chain necessary for the software development including building, debugging, code-upload and many more. PlatformIO works well on all the modern operating systems and supports a host of development boards including the Feathers from Adafruit. Further details about PlatformIO can be found under *platformio.org*
- **Platform interface:** This layer provides abstraction to the peripheral drivers for the platform being used. Currently, this SDK implements an abstraction to the Arduino peripheral drivers for the Feather M0 express platform.
- **WE SDK:** This is a layer of platform-independent pure C drivers for sensors and wireless connectivity modules from Würth Elektronik eiSos. These drivers implement all the necessary functions to utilize full feature set of the sensors and wireless connectivity modules. More details on the SDK and dowloads under, *we-online.com/wcs-software*.
- **Board files:** This layer provides abstraction at a board level and provides functions to configure and control individual FeatherWings from WE.
- **User application:** The SDK currently implements a quick start example for each of the FeatherWings.

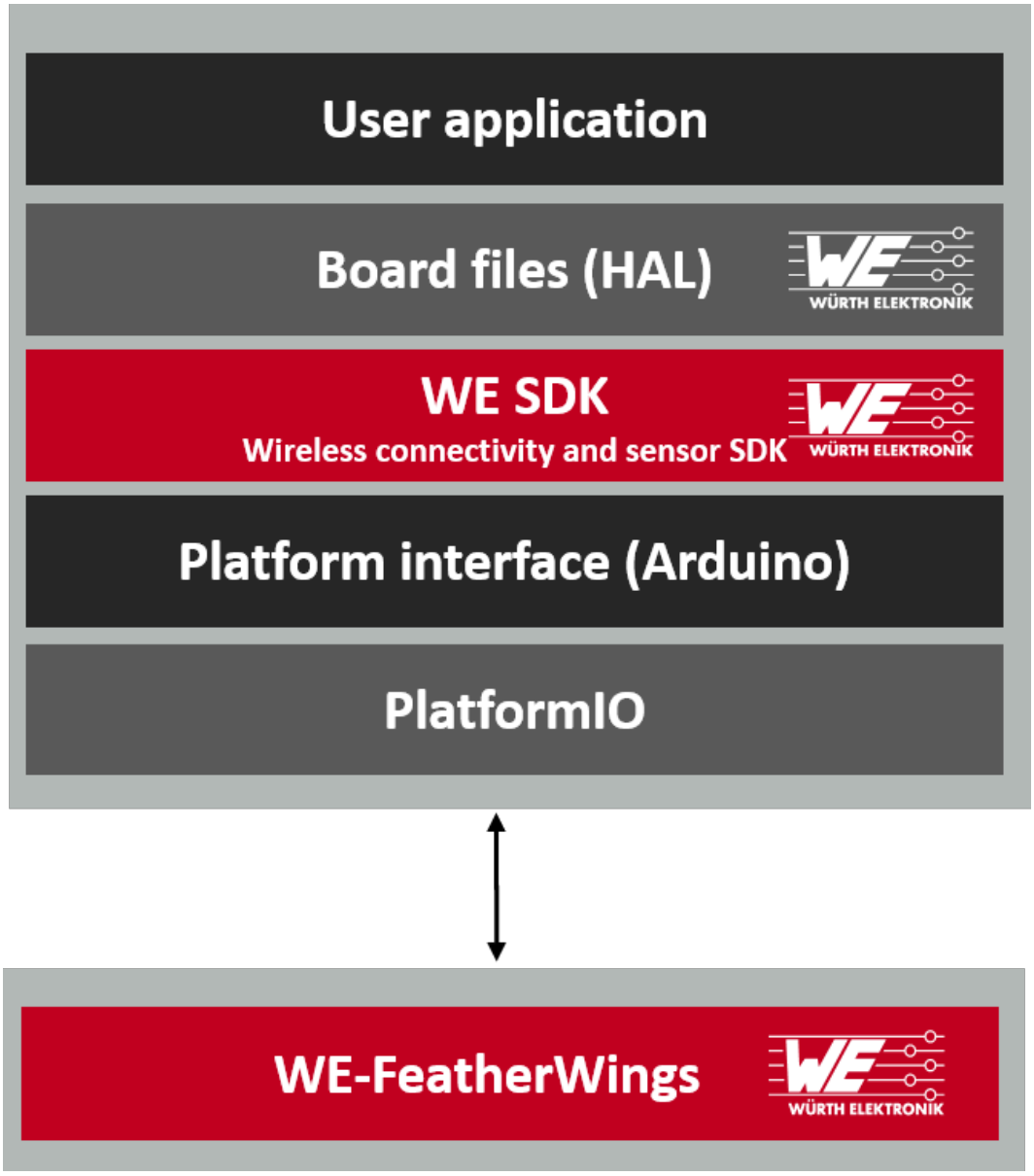


Figure 9: Software architecture

4.2 Installing the tools

4.2.1 IDE

Although, platformIO provides a versatile command line interface for development, the SDK provides quick start projects for the Visual Studio Code. This popular IDE makes for better code organization as well as code editing. Visual Studio Code is available on all modern operating systems. Support for extensions, built-in Git and a versatile code editor make it a well rounded tool for embedded software development. Please refer to *code.visualstudio.com* for more details on Visual Studio Code.

4.2.2 Installation steps

- Install Visual Studio Code on the platform of your choice following the instructions under *code.visualstudio.com/docs*
- Follow the instructions under *platformio.org/install/ide?install=vscode* to install PlatformIO IDE extension.

4.3 Hardware Setup

The quick start examples in the SDK are written to be run on *Adafruit's Feather M0 express*. The hardware setup is as simple as stacking up the FeatherWing on top of the M0 Feather and powering up the board.

4.4 Running the quick start example

- Clone or download the WE FeatherWing SDK from Github. *github.com/WurthElektronik/FeatherWings*
- Open the workspace of interest with the filename <FeatherWing>.code-workspace in Visual Studio code.
- Build and upload the code from the PlatformIO tab as shown in the Figure 10
- After successful upload, click on Monitor to view the debug logs in the serial terminal (see Figure 10).

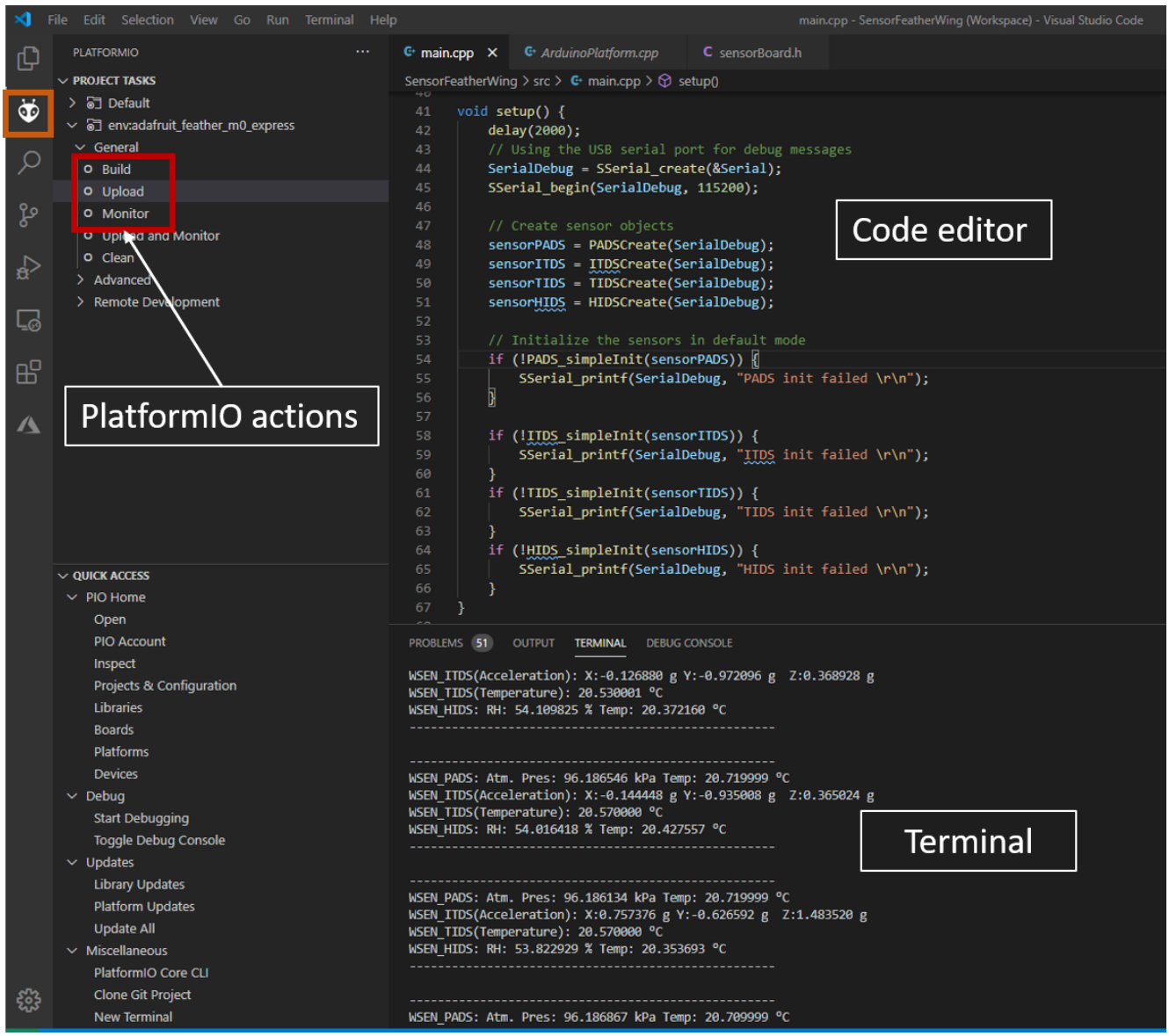


Figure 10: Running the quick start example

5 Regulatory compliance information

Pursuant to Article 1 (2.) of the EU directive 2014/53/EU, Article 1 (2.) the directive does not apply to equipment listed in Annex I (4.): custom-built evaluation kits destined for professionals to be used solely at research and development facilities for such purposes.

Nevertheless this evaluation board has been tested to satisfy general EMC requirements. Following standards have been applied:

- IEC 61000-4-3
- IEC 61000-4-4
- IEC 61000-4-6
- CISPR 16-2-1
- CISPR 16-2-3

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It has to be clearly pointed out that the possibility of a malfunction of electronic components or failure before the end of the usual lifetime cannot be completely eliminated in the current state of the art, even if the products are operated within the range of the specifications. The same statement is valid for all software sourcecode and firmware parts contained in or used with or for products in the wireless connectivity and sensor product range of Würth Elektronik eiSos GmbH & Co. KG. In certain customer applications requiring a high level of safety and especially in customer applications in which the malfunction or failure of an electronic component could endanger human life or health, it must be ensured by most advanced technological aid of suitable design of the customer application that no injury or damage is caused to third parties in the event of malfunction or failure of an electronic component.

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Any product-specific data sheets, manuals, application notes, PCN's, warnings and cautions must be strictly observed in the most recent versions and matching to the products firmware revisions. This documents can be downloaded from the product specific sections on the wireless connectivity homepage.

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