THYONE WIRELESS FEATHERWING

USER MANUAL

2611059021001

VERSION 1.2

MARCH 16, 2022

Revision history

Manual version	HW version	Notes	Date
1.0	2.0	Initial version	November 2020
1.1	2.0	Updated github repository links	February 2022
1.2	2.0	Updated hardware design files	March 2022

Abbreviations

Abbreviation	Name	Description
CISPR	Comité International Spécial des Perturbations Radioélectriques	International Special Committee on Radio Interference
ECC	Elliptical Curve Cryptography	
ECDH	Elliptic Curve Diffie Hellman	
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

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1 General description

1.1 Introduction

The Würth Elektronik eiSos Thyone Wireless FeatherWing is a development board that offers a secure 2.4 GHz proprietary wireless connectivity solution. It is fully compatible to the popular Adafruit Feather line of development boards. The Thyone Wireless FeatherWing consists of two important components,

- Thyone-I (2611011021000)) - A 2.4 GHz proprietary radio module
- ATECC608A-TNGTLS - Secure element from Microchip Technologies

The Thyone-I module has an UART interface and the secure element an I^2C interface 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.

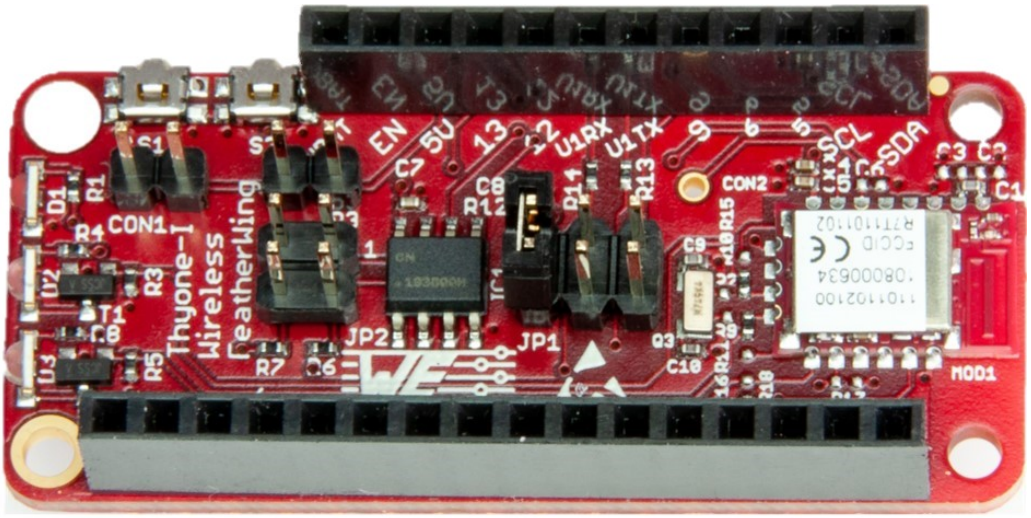

Figure 1: The WE Thyone Wireless FeatherWing (2611059021001)

1.2 Block diagram

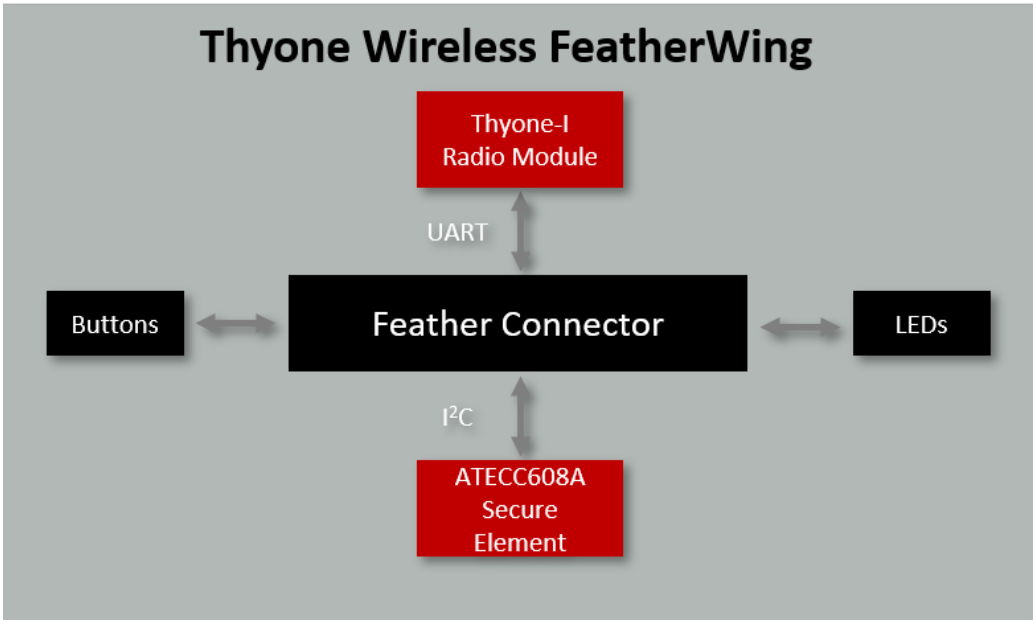

Figure 2: Block diagram - Thyone Wireless FeatherWing

1.3 Contents

Description	Quantity
WE Thyone Wireless FeatherWing	1
Packaging: ESD safe bag	1

Table 1: Contents 2611059021001

2 Functional description

The Thyone Wireless 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 Thyone-I radio module and the Secure element 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.
- **FeatherWing:** 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 Thyone Wireless FeatherWing

The Thyone Wireless FeatherWing consists of the Thyone-I radio module and the ATECC608A secure element. This section provides details regarding these components.

2.2.1 Thyone-I (2611011021000)

The Thyone-I module is a radio sub-module for wireless communication between devices such as control systems, remote controls, sensor nodes etc. Operating in the globally available 2.4 GHz license free band, Thyone-I offers a robust and secure data transmission in point-to-point as well as mesh configurations.
It is pre-loaded with the WE-ProWare radio stack which ensures high flexibility without compromising the reliability. Interfacing with the host system via serial UART, the module allows easy configuration and control of the radio using a simple command interface. To ensure ease-of-use for cable replacement applications, the module also offers a transparent mode to function as a serial-to-radio adapter. Small dimensions comparable a nano-SIM card (8 x 12 mm) including an on-board PCB antenna makes Thyone-I ideal for small form factor design.

Key features

The Thyone-I offers a wide range of configurable features to suit even the most sophisticated application design. From low power long range to line-powered high throughput, the Thyone-I can be configured to cover a wide range of applications.

Extremely small dimensions: Owing to its small size (8 x 12 mm) the module can be easily designed-in to compact end devices.

Energy efficient: The Thyone-I has extremely low current consumption especially in sleep mode (< 0.4 μ A) making it suitable for battery driven applications.

Globally available 2.4 GHz band: The Thyone-I operates in the 2.4 GHz license free band that allows global deployment of the end-device.

Smart antenna selection: The Thyone-I offers a choice of using the on-board PCB antenna for compact designs or connecting an external antenna for application that require long range.

Long range mode: A radio profile with channel coding allows a radio link of up to 750 m with a data rate of 125 kbit/s[1].

High throughput mode: The Thyone-I offers a radio profile with 2 Mbit/s data transmission over the air leading to an effective end-to-end throughput of around 400 kbit/s.

Fast serial interface: The Thyone-I offers a UART-interface to communicate with a host using a user-defined baud rate of up to 1 Mbit/s.

Embedded security on-module: The secure bootloader on the module verifies the image signature on boot-up offering tamper protection. The module also supports hardware accelerated end-to-end encryption.

Additional local/remote GPIOs: The Thyone-I firmware allows configuration and control of free digital I/O pins on the module via serial or radio interface.

Transparent mode: A transparent mode is available out-of-the-box enabling easy serial cable replacement.

Network addressing: The Thyone-I implements network addressing to enable unicast, multicast as well as broadcast data transmission. Additionally, packet ACK is available with automatic retry mechanism to ensure reliable data transmission.

Mesh network: The Thyone-I offers repeater functionality to enable the creation of a simple flooding mesh network. The repeater mode can also be used for range extension.

Further details about Thyone-I radio module can be found under
we-online.de/katalog/en/THYONE-I

[1] As per two way ground reflection model with transmit power of 8 dBm, antenna height 2 m and a reserve of 6 dB

2.2.2 ATECC608A-TNGTLS

The ATECC608A-TNGTLS is a pre-provisioned variant of the ATECC608A secure element from Microchip Technologies. The device is configured to make the secure element suitable to some of the most common use cases for IoT applications. It offers a rich set of cryptographic features like key agreement using ECDH, sign-verify mechanism, and encryption/decryption over easily accessible I^2C interface. Its tiny form factor and low power consumption make it suitable for a wide variety of battery-driven applications.

Key features

- I^2C interface with one-time changeable I^2C address
- One permanent P-256 ECC private key fixed at manufacturing time
- Three secondary P-256 ECC private keys that can be regenerated by the user
- Signer public Key from signer certificate
- X.509 compressed certificate storage

Further details about this secure element can be found under
www.microchip.com/wwwproducts/en/ATECC608A

3 Hardware description

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

3.1 Connectors

3.1.1 CON1

Connector CON1 provides a possibility to connect an external power supply to the Feather system over the V_USB pin.

Pin	Function
1	VDD external
2	GND

3.1.2 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	3.3V power supply
3	AREF	Not connected
4	GND	Ground
5	A0	Not connected
6	A1	Not connected
7	A2	Not connected
8	A3	(Optional) Thyone-I MODE pin via Jumper JP1
9	A4	Not connected
10	A5	Not connected
11	SCK	Not connected
12	MOSI	Not connected
13	MISO	Not connected
14	U0RX	(Optional) Thyone-I UTXD pin via R18
15	U0TX	(Optional) Thyone-I URXD pin via R17
16	NC	Not connected

Pin Number	Pin name	Function
17	SDA	I²C SDA to secure element
18	SCL	I²C SCL to secure element
19	5	Not connected
20	6	Not connected
21	9	(Optional) Thyone-I WAKE_UP pin via Jumper JP1
22	U1TX	Thyone-I URXD pin via R13
23	U1RX	Thyone-I UTXD pin via R14
24	12	Not connected
25	13	(Optinal) Push button S2 via JP1
26	5V	Not connected
27	EN	Not connected
28	VBAT	Not connected

3.2 Jumpers

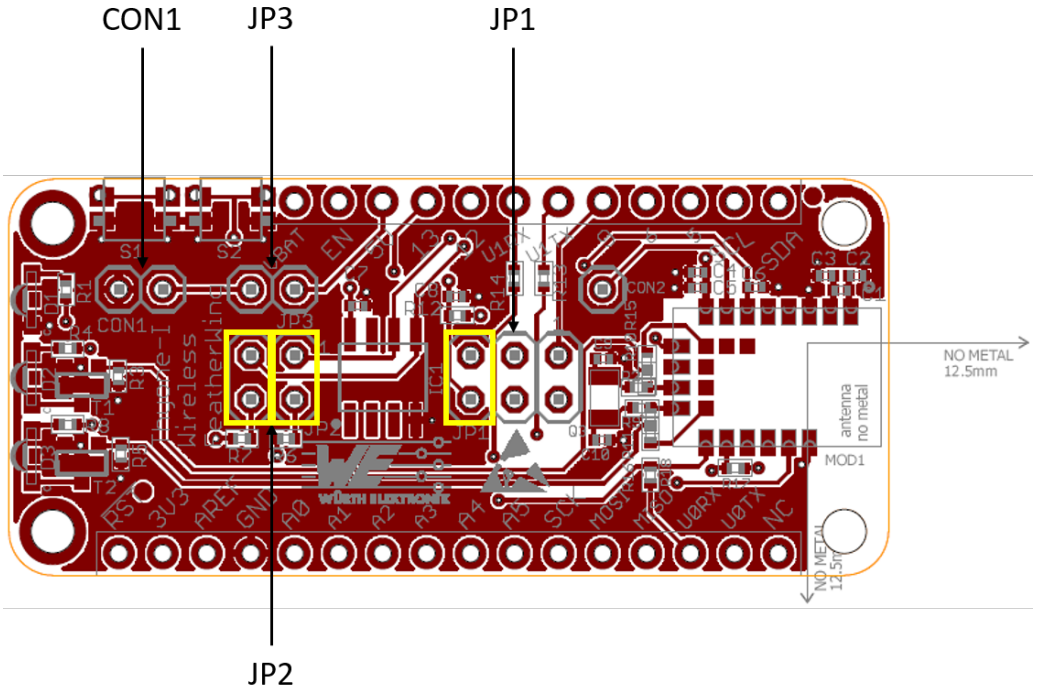

Figure 3: Jumpers and their default state

3.2.1 JP1

This jumper enables the use of WAKE_UP and MODE pins of the Thyone-I module as well as the Switch S2 from the host microcontroller.

JP1	Function	Jumper set (default)
1,2	WAKE_UP to GPIO9	No
3,4	MODE to GPIOA3	No
5,6	Switch S2 to GPIO13	Yes

Table 2: Jumper JP1

3.2.2 JP2

The standard I²C 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 I²C 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

3.2.3 JP3

This jumper, when set, connects the external power supply coming from CON1 to V_USB.

JP2	Function	Jumper set (default)
1,2	Connect external supply connected to CON1 to V_USB	No

Table 4: Jumper JP2

3.3 Push buttons

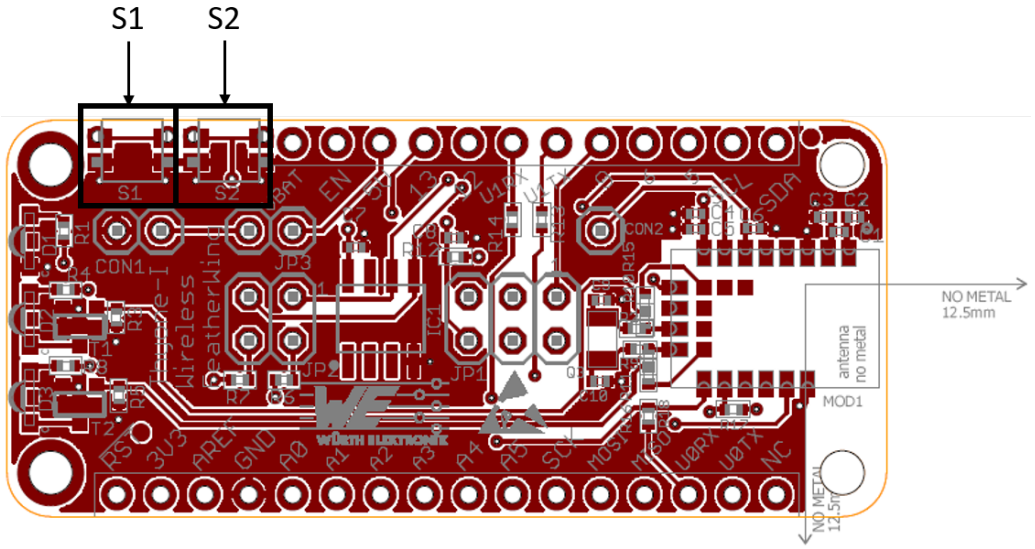

Figure 4: Push buttons

3.3.1 S1

This push button is connected to the /RESET pin of the Thyone-I module. Pressing this button resets the module.

3.3.2 S2

S2 is a general purpose push button which is connected to GPIO 13 when a jumper is set between pins 5 and 6 of JP1.

3.4 Schematics

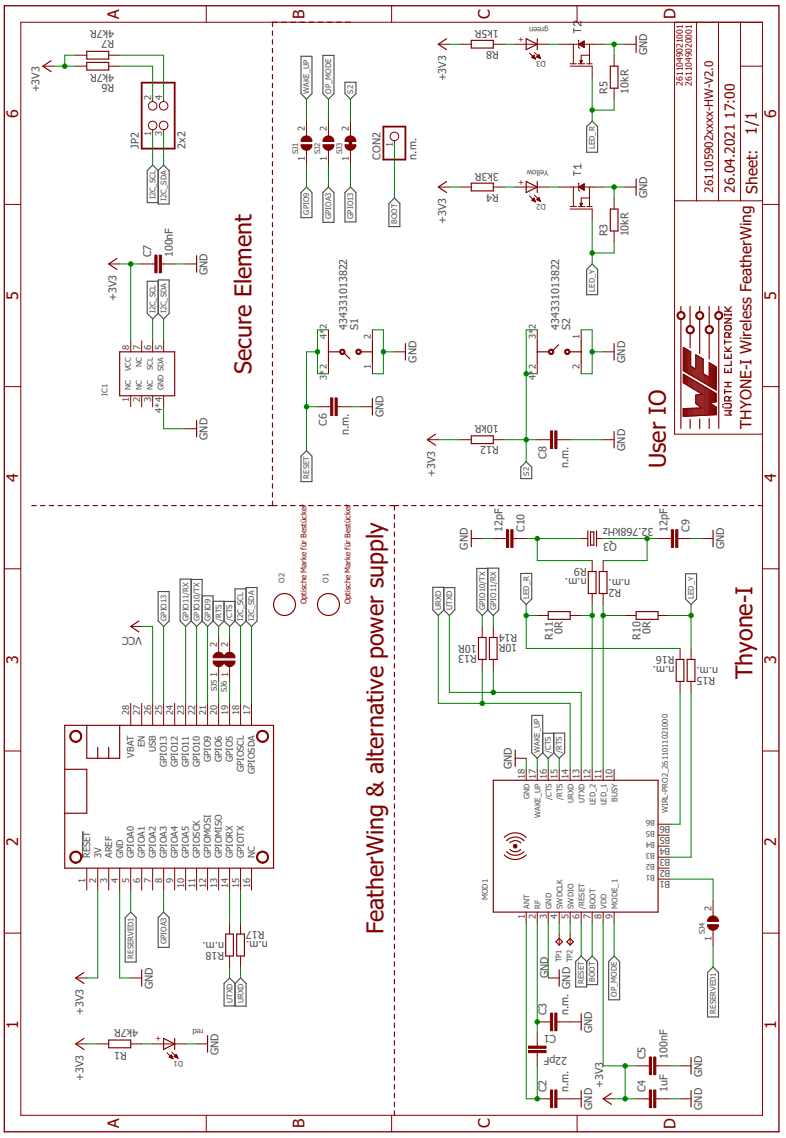

Figure 5: Schematics

3.5 Layout

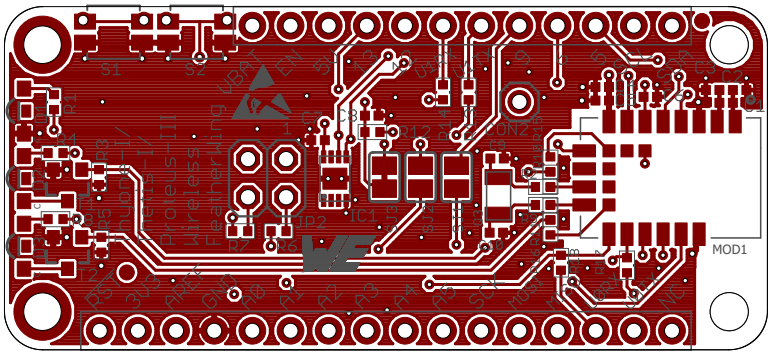

Figure 6: Assembly diagrams

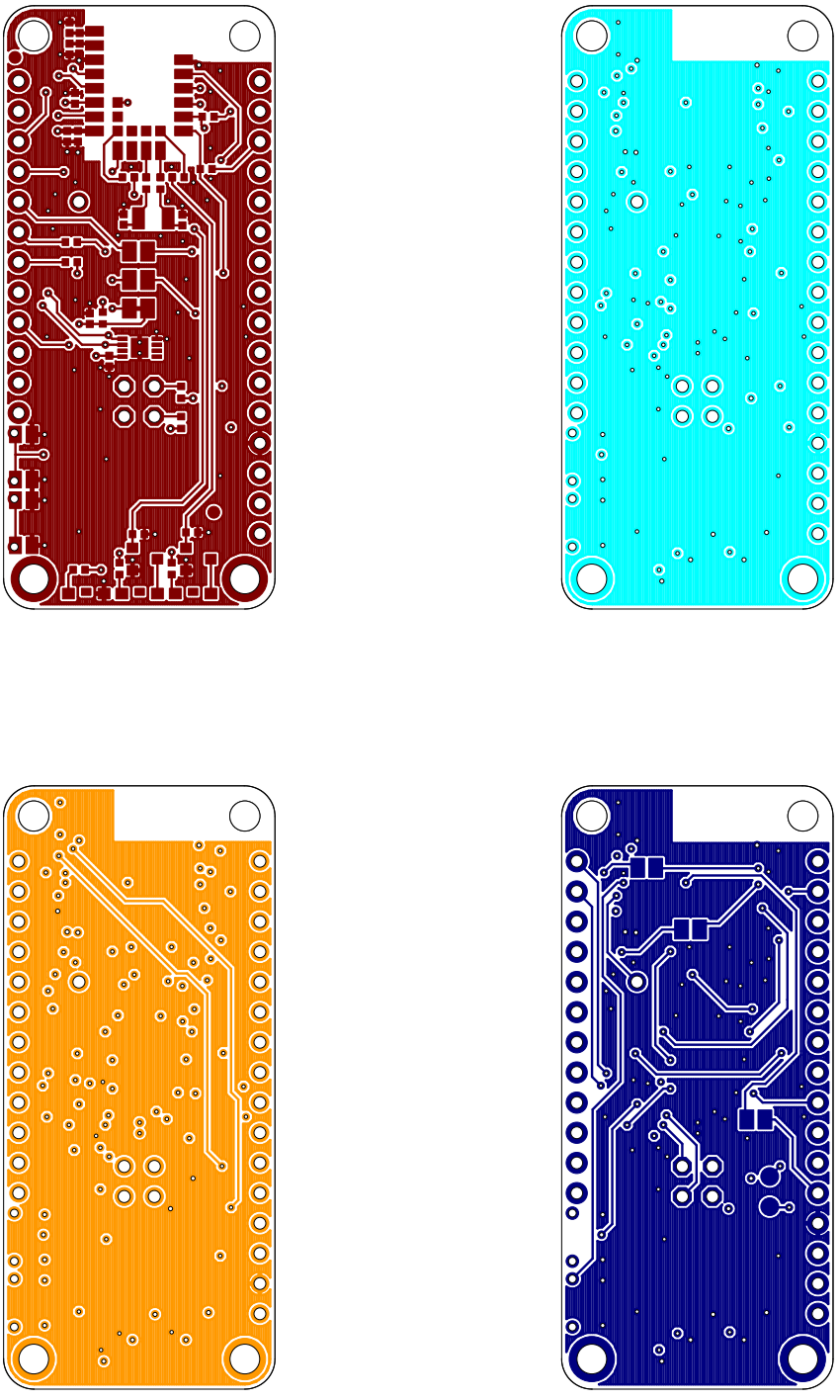

Figure 7: Top, bottom and internal layers

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 8 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.

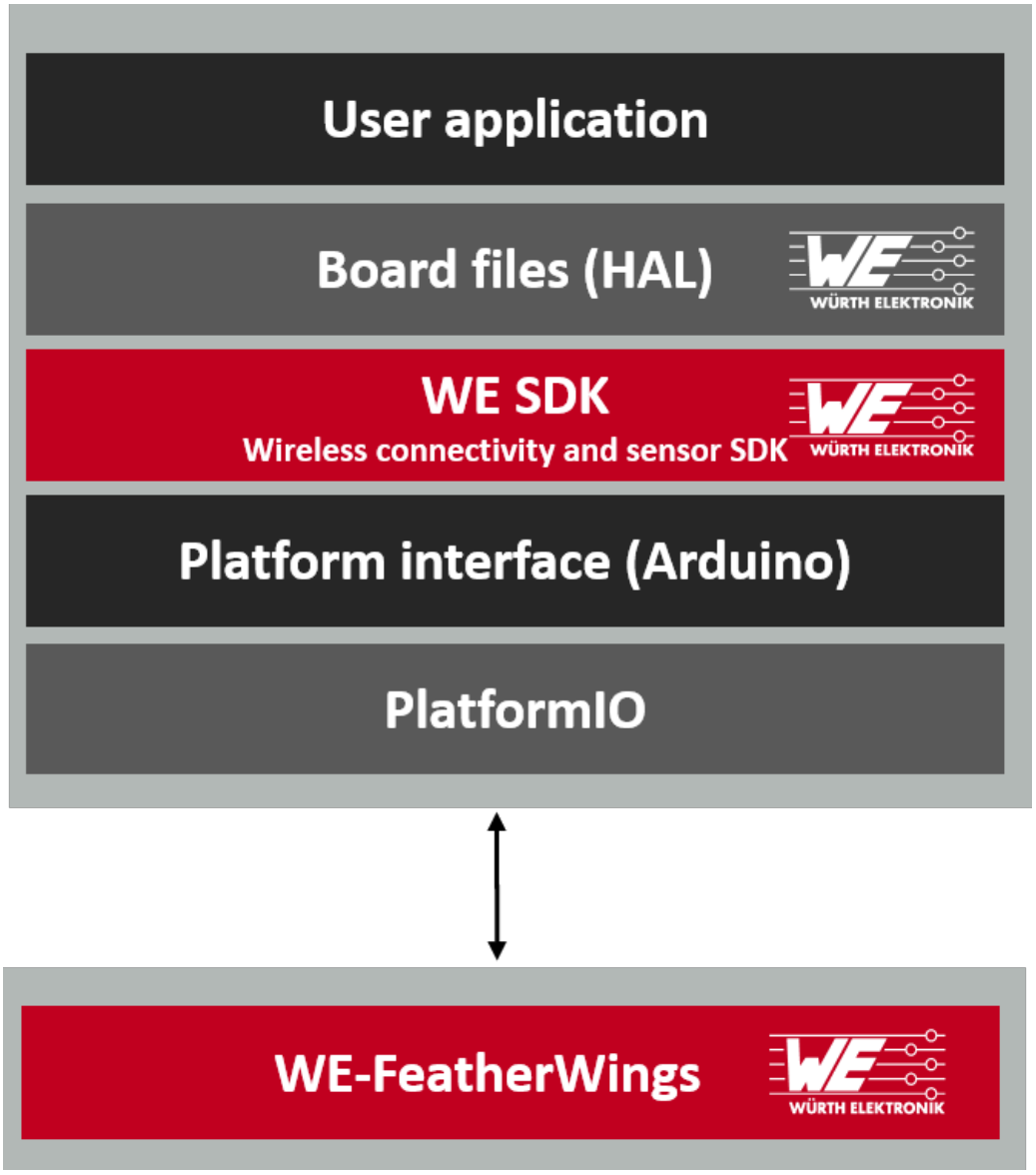

Figure 8: Software architecture

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 9
- After successful upload, click on Monitor to view the debug logs in the serial terminal (See Figure 9).

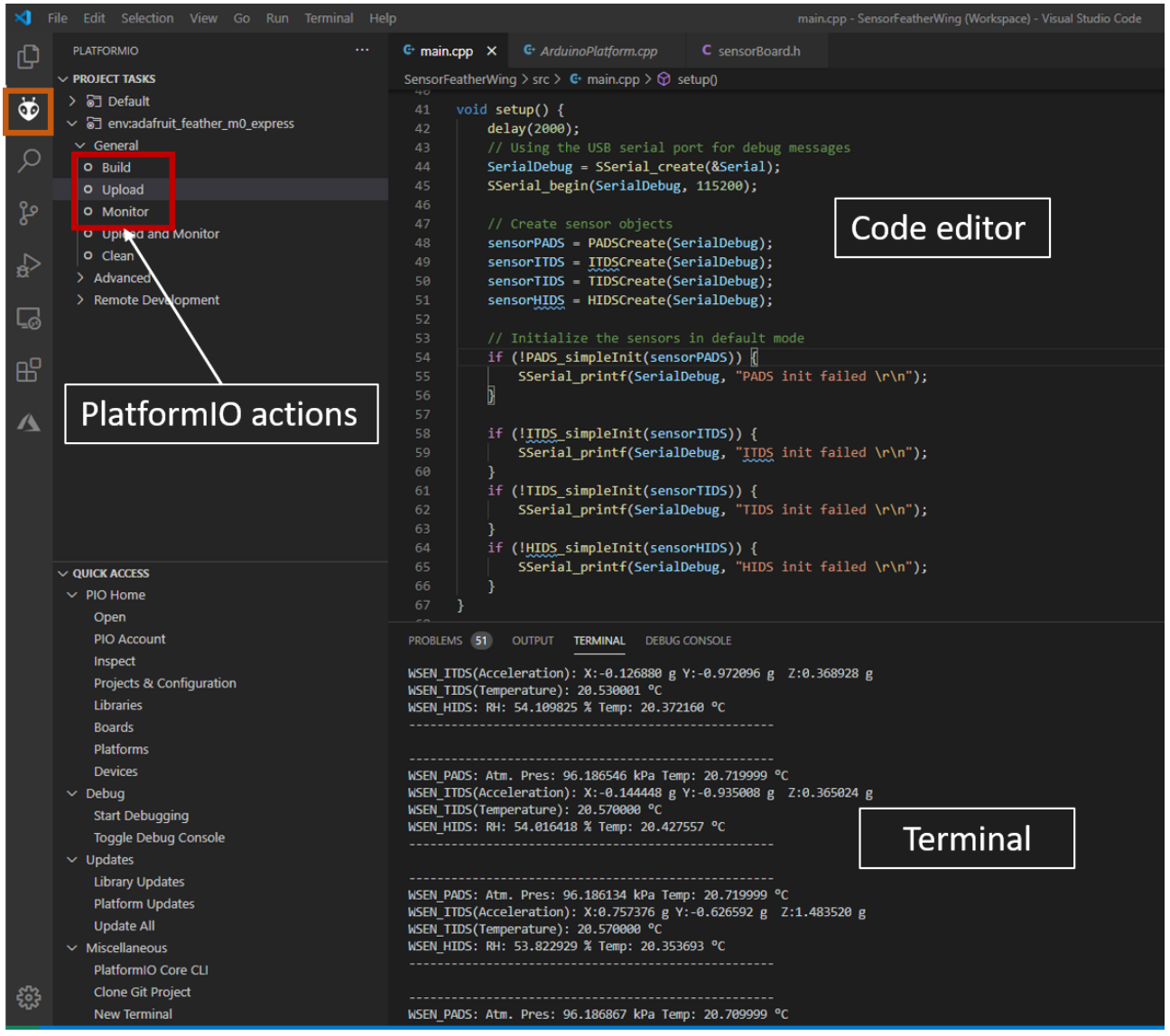

Figure 9: Running the quick start example

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

5.1 Exemption clause

Relevant regulation requirements are subject to change. Würth Elektronik eiSos does not guarantee the accuracy of the before mentioned information. Directives, technical standards, procedural descriptions and the like may be interpreted differently by the national authorities. Equally, the national laws and restrictions may vary with the country. In case of doubt or uncertainty, we recommend that you consult with the authorities or official certification organizations of the relevant countries. Würth Elektronik eiSos is exempt from any responsibilities or liabilities related to regulatory compliance.

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6.3 Best care and attention

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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Some products within the product range may contain substances, which are subject to restrictions in certain jurisdictions in order to serve specific technical requirements. Necessary information is available on request. In this case, the field sales engineer or the internal sales person in charge should be contacted who will be happy to support in this matter.

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Contact:
Würth Elektronik eiSos GmbH & Co. KG
Division Wireless Connectivity & Sensors

Max-Eyth-Straße 1
74638 Waldenburg
Germany

Tel.: +49 651 99355-0
Fax.: +49 651 99355-69
www.we-online.com/wireless-connectivity