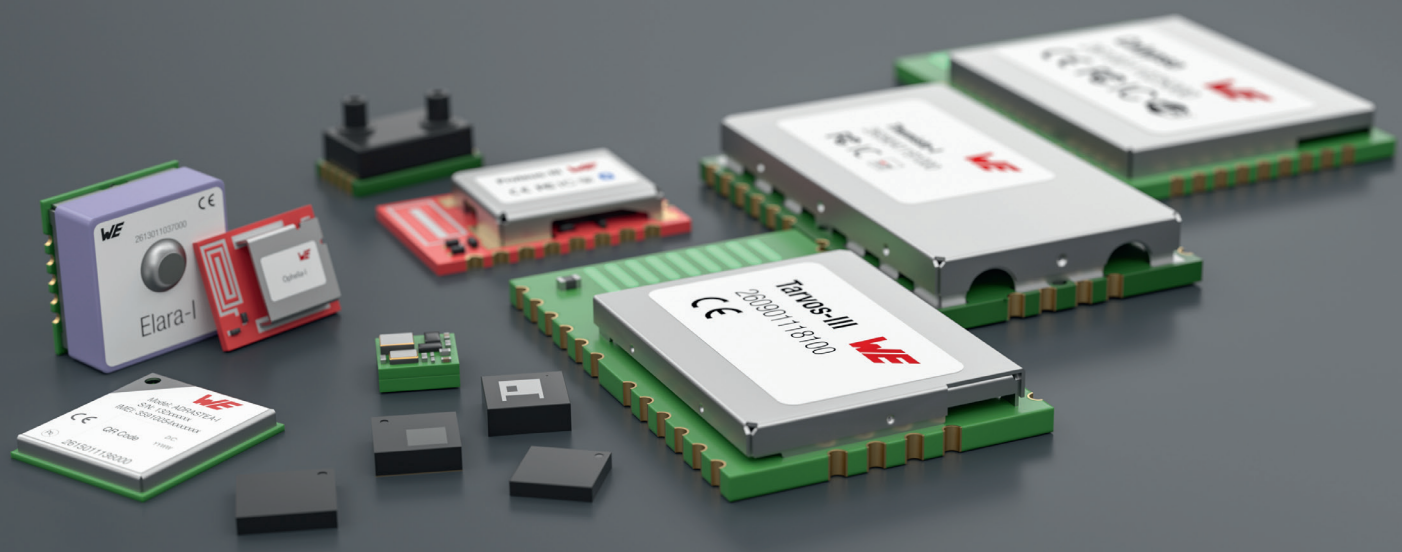

User manual

Evaluation board/kit for radio modules Proteus-e, Ophelia-I, Thyone-e

2612011024000,
2612011022000, 2612011021000

Version 1.2

February 5, 2025

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 including the possibility of a firmware update in the customer system design.

Revision history

Manual version	HW version	Notes	Date
1.0	1.0	• Initial version	October 2021
1.1	2.1	• Added radiation characteristics in chapter `Internal antenna radiation characteristics` • New corporate design	May 2023
1.2	2.1	• Added product Thyone-e (2612011021000) • Added chapters `Marking` and `UART via USB`	February 2025

Abbreviations

Abbreviation	Name	Description
BDM	Business Development Engineer	Support and sales contact person responsible for limited sales area
COM port	Communication port	
EV (Board)	Evaluation (Board)	
ESD	Electro Static Discharge	
FCC	Federal Communications Commission	
FTDI	Future Technology Devices International	USB to serial converter chip
GND	Ground	
GPIO	General Purpose Input/Output	
HIGH	High signal level	
JTAG	Joint Test Action Group	Flash und debug interface
Bluetooth LE	Bluetooth Low Energy	
LDO	Low Dropout	Low dropout voltage regulator
LED	Light Emitting Diode	
LFCLK	Low frequency clock	
LFXO	Low frequency crystal oscillator	
LOW	Low signal level	
PC	Personal Computer	
PCB	Printed Circuit Board	
RF	Radio frequency	Describes everything relating to the wireless transmission.
SMA	Sub Miniature version A	
SWD	Serial Wire Debug	Flash und debug interface
UART	Universal Asynchronous Receiver Transmitter	Serial communication with the radio module.
USB	Universal Serial Bus	
VDD	Voltage Drain Drain	Supply voltage

Contents

1 Supported radio modules

The EV-Board described in this manual can be used to evaluate the following products:

Order code	Product Name	Description
2612011024000	Proteus-e	Bluetooth® LE 5.1 radio module with smart antenna configuration
2612011022000	Ophelia-I	Ophelia-I radio module with smart antenna configuration
2612011021000	Thyone-e	Thyone-e radio module with smart antenna configuration

Order code	Product Name
261201902x001	Proteus-e/Ophelia-I/Thyone-e EV-Board

Table 1: Compatibility

For both order codes 2612019024001 (Proteus-e EV-Board) and 2612019022001 (Ophelia-I EV-Board), the board is equipped with the Proteus-e Bluetooth 5.1 radio module. These modules have the same hardware platform, based on Nordic nRF52805 chipset.

No micro-USB connection cable is delivered with the EV-Board.

2 Functional description

The EV-Board offers the user the possibility to develop hard- and software for the mounted radio module. It can be connected to an USB port of a PC.

For the connection to a micro controller system the development board is equipped with a multi-pin connector that makes all pins of the radio module accessible. Jumpers allow the module to be disconnected from components such as the USB interface which are not required.

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 Taking into operation

First of all, the corresponding FTDI driver package (*www.ftdichip.com/Drivers/VCP.htm*) has to be installed on your PC to communicate with the USB interface of the EV-Board.

Then place the jumpers of the EV-Board on their default location as shown in Figure 2.

The next step is to connect the EV-Board to the PC using a USB-cable. In that way a COM port can be detected and installed on your PC. Check the device manager to acquire the COM port name of the EV-Board. A typical name is "COM12" in Windows systems or "/dev/ttyUSB0" in Linux systems.

The WE UART Terminal PC tool [1] or any other serial terminal program (like *Hterm* for Windows) has to be run and the corresponding COM port has to be opened using the default settings of the mounted radio module.
After the module is powered through the USB jack or an alternative power supply, the reset button should be pressed to ensure a clean start-up of the module.

To turn the mounted radio module into an Ophelia-I module, the firmware needs to be erased from the module using the programming interface (see Chapter 3.5.6). To do that, please refer to Nordic instructions and resources [2].

Please refer to the module user manual to get the detailed module specific quick start instructions [3] [4].

3 Development board

3.1 Block diagram

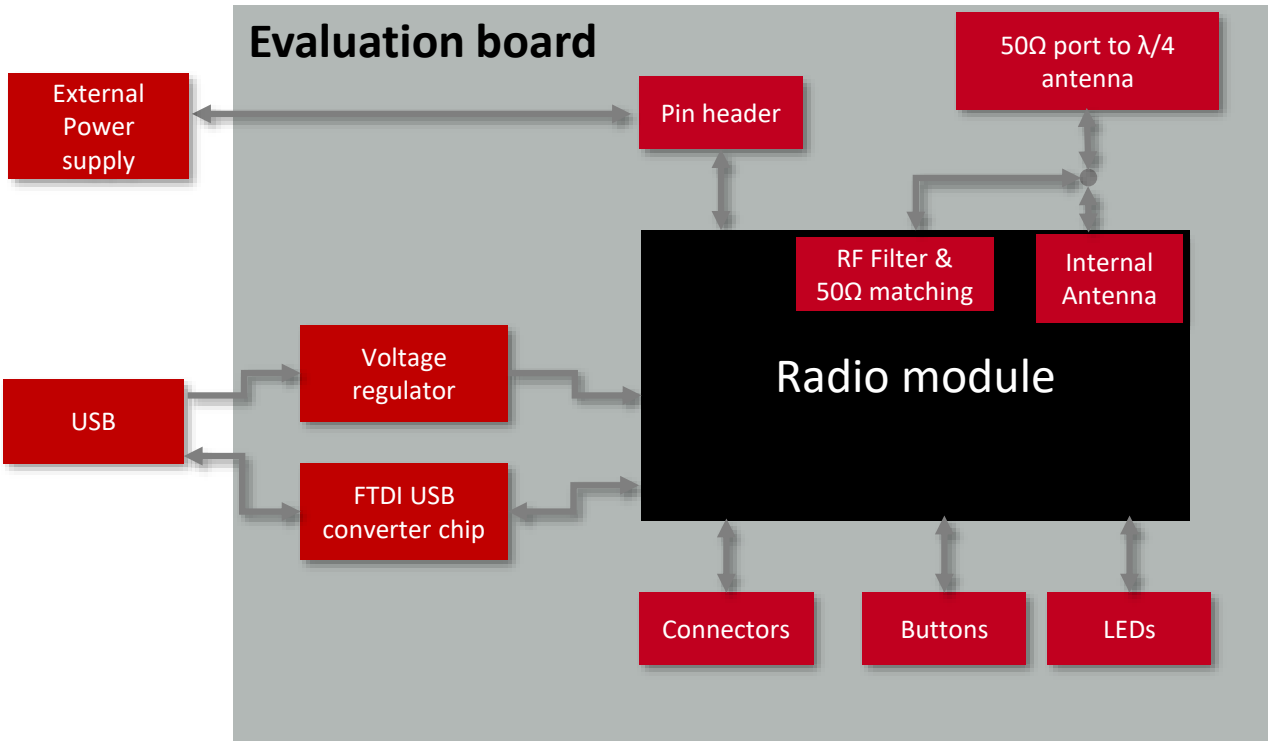

Figure 1: Block diagram

By default, the internal PCB antenna is used on the EV-Board. For details on connection of an external antenna, please refer to chapter 3.3.2.

3.2 Jumpers

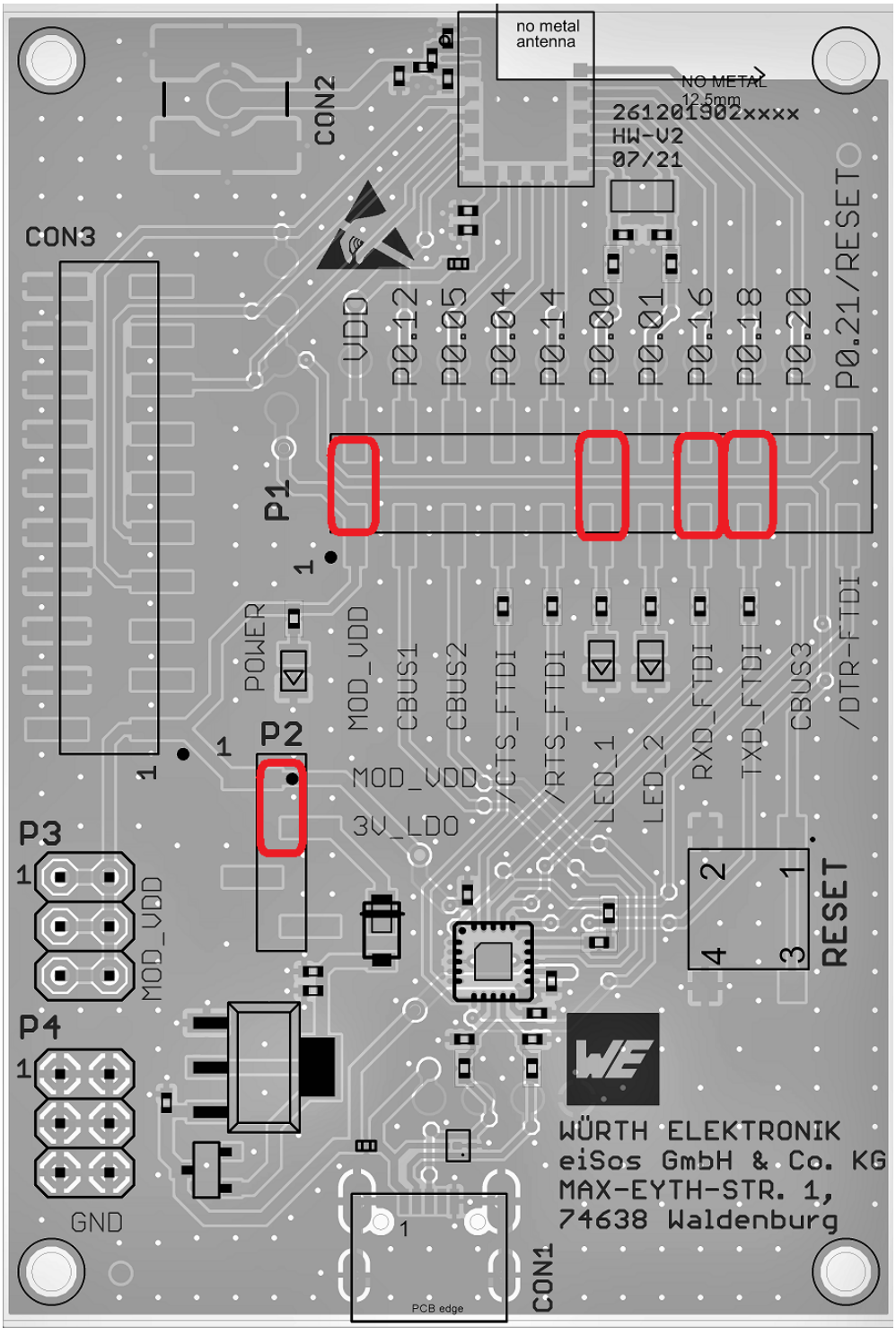

Figure 2: Jumpers, default placement

P1	Pin (Module Function)	Jumper set (default)
1,2	Current consumption measurement bridge	Yes
3,4	P0.12 (MODE_1) to CBUS1-FTDI	No
5,6	P0.05 (GPIO_2) to CBUS2-FTDI	No
7,8	P0.04 (/RTS) to /CTS-FTDI	No
9,10	P0.14 (/CTS) to /RTS-FTDI	No
11,12	P0.00 (LED_1) to LED_1	Yes
13,14	P0.01 (BUSY/UART-ENABLE) to LED_2	No
15,16	P0.16 (UTXD) to RXD-FTDI	Yes
17,18	P0.18 (URXD) to TXD-FTDI	Yes
19,20	P0.20 (GPIO_1) to CBUS3-FTDI	No
21,22	P0.21 (/RESET) to /DTR-FTDI	No

Table 2: Jumper P1

P2	Function	Jumper set (default)
1,2	LDO power supply	Yes
1,2	External power supply	No
3	Not connected	
4	Not connected	

Table 3: Jumper P2

By default, Jumper P2 Pin 1-2 is connected for internal LDO power supply. To use external power supply Jumper P2 Pin 1-2 shall be removed. Pin headers P3 and P4 shall be used to source the EV-Board.

3.3 Connectors and pin headers

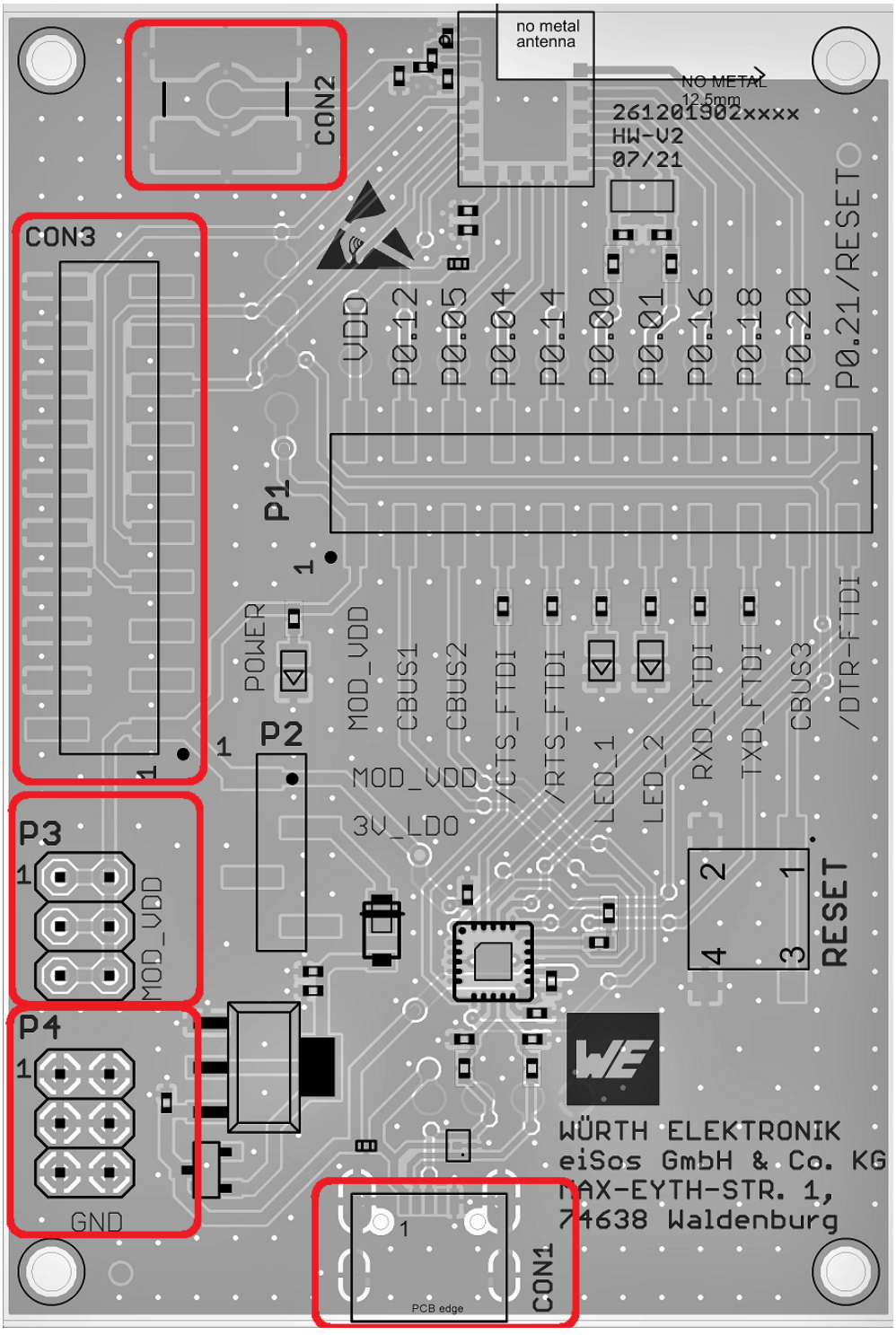

Figure 3: Connectors

Connector	Function
CON1	Micro-USB connector for host connection and VDD bus supply
CON2	SMA connector for external antenna
CON3	2×10 JTAG/SWD connector
P3	External power supply VDD (not mounted)
P4	External power supply GND (not mounted)

Table 4: Connector overview

To use external power supply Jumper P2 Pin 1-2 shall be removed. Pin headers P3 and P4 shall be used to source the EV-Board.

By default, P3 and P4 are not mounted.

3.3.1 CON1

Connector CON1 is a micro-USB connector that enables connection to PC via standard micro-USB cable.

CON1	Function
	Micro-USB connector for host connection and VDD bus supply

3.3.2 CON2

Connector CON2 (SMA receptacle) is used to connect an external antenna. For example, the 2.4 GHz antenna Himalia- *2600130021* can be used.

CON2	Function
Inner	RF signal
Outer	GND

The board supports 50 Ω connection by just soldering/unsoldering one component to use either module's internal PCB antenna or to connect an external antenna.

In default state, the internal PCB antenna is used on the EV-Board.

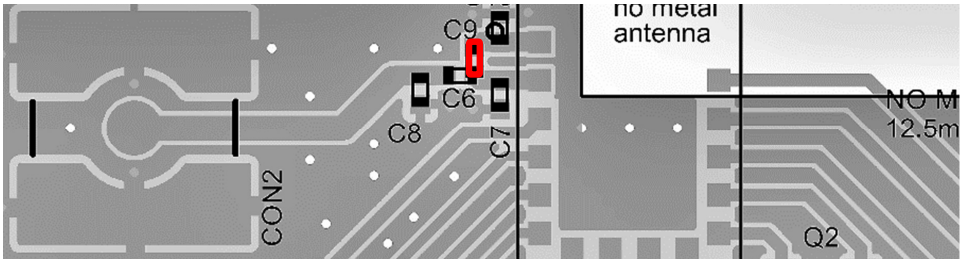

Figure 4: Capacitor connection to internal antenna

In the EV-Board default state, for usage of internal PCB antenna, C9 is populated with a 22 pF capacitor *885012005027*, and C6 is left unpopulated.

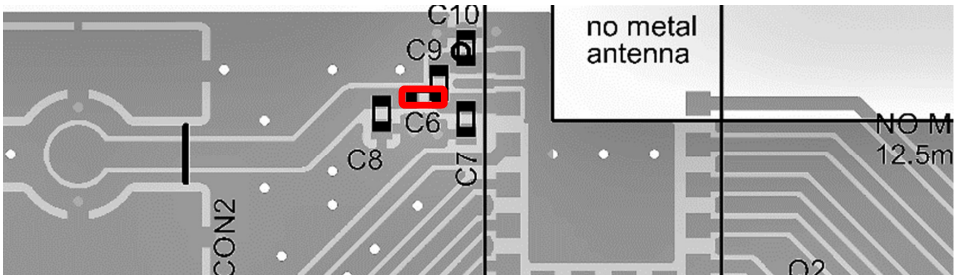

Figure 5: Capacitor connection to external antenna

In order to use the external antenna for long range tests, capacitor C6 has to be populated with a 22 pF capacitor *885012005027* and C9 shall be removed.

3.3.3 CON3

Connector CON3 is the JTAG debugging interface.

CON3	nRF52805	Function
1		*VDD*
7	*SWDIO*	*SWDIO*
9	*SWCLK*	*SWCLK*
15	P0.18	*RESET*
4,6,8,10,12,14,16,18,20		*GND*
2,3,5,11,13,17,19		Not connected

Table 5: Connector CON3

3.3.4 P3

Pin header P3 is a 3x2 pin header with *MOD_VDD* connection. P3 shall be used for external power supply.

3.3.5 P4

Pin header P4 is a 3x2 pin header with *GND* connection. P3 shall be used for external power supply.

3.4 Buttons

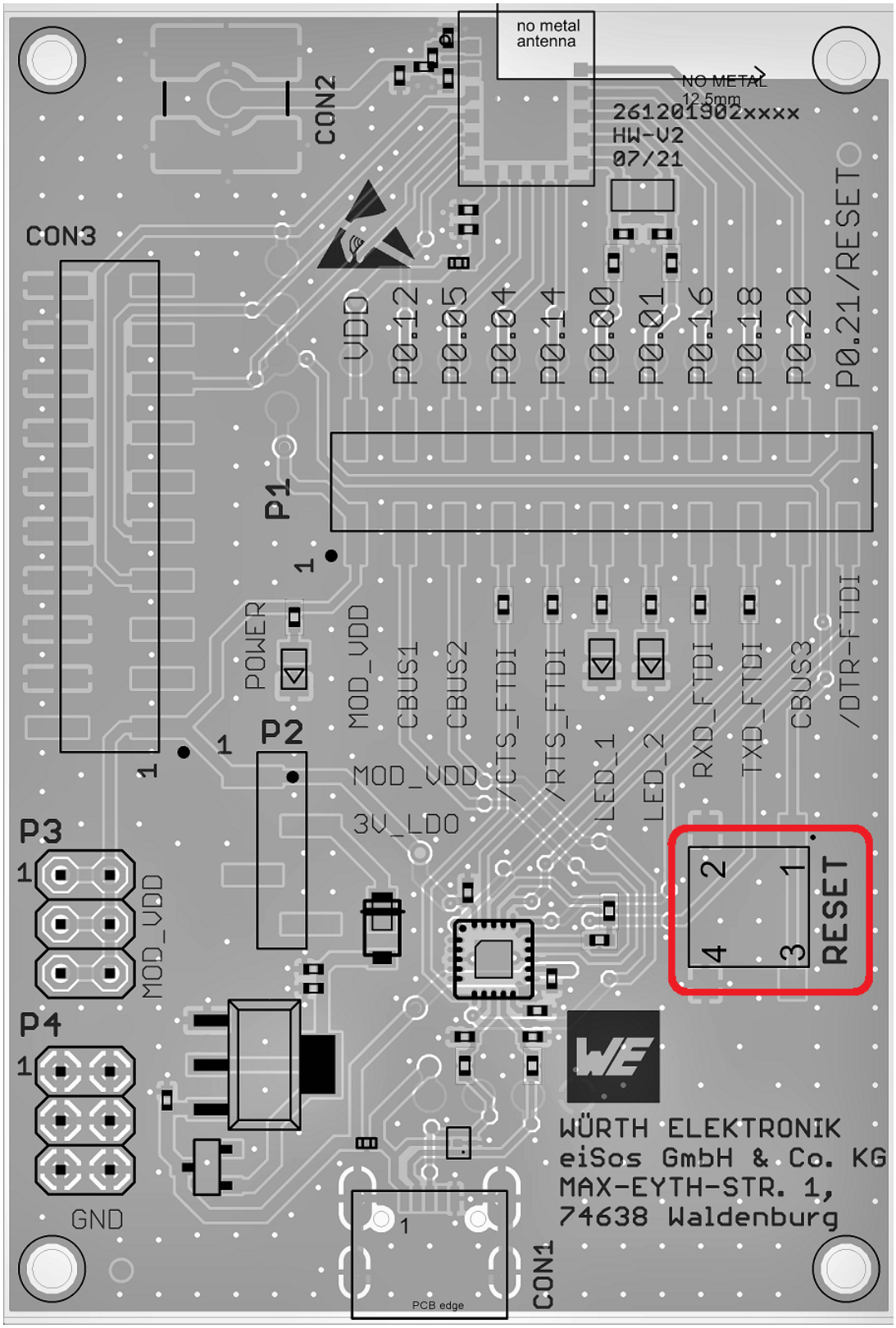

Figure 6: Buttons

3.4.1 RESET button

Internally the active low reset input of the micro processor is connected via a RC combination with the power supply to ensure a proper startup of the module. The module provides a */RESET* pin that is connected to this button so that the module can be restarted properly. The module provides an internal pull-up resistor. Please refer to the module specific manual for detailed information [4, 3, 5].

3.5 Function blocks

3.5.1 Power supply

3.5.1.1 Bus powered, power supply through USB

The development board can be run via USB. The integrated voltage regulator reduces the connected USB voltage 5 V down to 3 V and supplies the remaining parts of the circuit. If the EV-Board is power sourced the power *Power LED* lights up.

3.5.2 P1 - Current measurement

By default, the jumper P1 pin 1-2 is set for normal operation. If a current meter is connected in place of the jumper, the power consumption of the radio module can be measured.
If the meter is not attached and the bridge is not set, the module will not receive a supply voltage. However, the power *Power LED* may be active, as it is connected prior to the current measurement bridge in order not to distort the module's power consumption.

3.5.3 UART via USB

The UART of the module can be connected to the USB converter by setting the bridge P1. In this case it is available on the USB jack. With help of the installed FTDI-driver the PC will provide a virtual COM port which can be used to communicate with the module.

The USB cable length must not exceed 3 meters.

In order to establish a stable UART communication between the FTDI USB to UART converter chipset and the radio module's chipset, the difference between the baud rates of each entity must not exceed the respective immunity level. Both devices use an internal clock to generate the configured UART baud rate. Due to the fixed clock frequency, only specific baud rates can be run without frequency error.
To figure out which baud rates of the radio module can be evaluated using the mounted FTDI chipset (FT232R or FT231X), it is important to know the real baud rate B with its introduced error. To get them, the FTDI's clock of 3000 kHz must be divided by the respective prescaler P:

$$B = \frac{3000}{P} \text{ [kBaud]}$$

The supported prescalers P can be chosen as:

$$P \in \{1, 1.5\} \text{ or } P = 2 + (N \cdot 0.125) \text{ with } N \in \{0, 1, 2, 3, 4, \ldots\}$$

When a baud rate is configured in the FTDI chip, the prescaler is chosen that meets the closest baud rate. In that case, the real baud rate differs from the configured one, introducing a UART clock error, which may lead to UART communication issues.

Example: In case the desired baud rate $B_{desired} = 1250$ kBaud, the desired prescaler is $P_{desired} = \frac{3000}{1250} = 2.4$. The closest prescaler P is determined by $P = 2 + (N \cdot 0.125) = 2.375$ with $N = 3$. This results in a real baud rate $B = \frac{3000}{2.375} = 1263$ kBaud, which introduces an error of $\frac{B - B_{desired}}{B_{desired}} = 1.04$ % with respect to the desired baud rate.

Desired baud rate [kBaud]	Closest prescaler P	Real baud rate B [kBaud]	Error [%]
3000	1	3000	0
2500	1.5	2000	-20
2000	1.5	2000	0
1500	2	1500	0
1250	2.375	1263	1.04
1411.764706	2.125	1411.764706	0
⋮	⋮	⋮	⋮
1000	3	1000	0
921.6	3.25	923.0769231	0.16
⋮	⋮	⋮	⋮
230.4	13	230.7692308	0.16
⋮	⋮	⋮	⋮
115.2	26	115.3846154	0.15
⋮	⋮	⋮	⋮
38.4	78.125	38.4	0
⋮	⋮	⋮	⋮
19.2	156.25	19.2	0
⋮	⋮	⋮	⋮
9.6	312.5	9.6	0
⋮	⋮	⋮	⋮

Table 6: Example baud rates

3.5.4 UART direct

If a micro-controller is to be connected to the module, remove the jumpers 11-12, 15-16, 17-18 on P1. The UART of the host micro controller can be attached directly on the pin header P1 (all even numbered pins). The module *RXD* line must be handled accordingly by your host (i.e. pulled up while inactive and during module boot-up). The host must obey the I/O level

incompatibility values stated in the module's manual.

3.5.5 LFXO crystal

For higher LFCLK accuracy (better than ±500 ppm) a low frequency crystal oscillator of 32.768 kHz (LFXO) shall be used. A crystal, 3.2 ×1.6 mm package, for example *830009706*, can be placed on the EV-Board to position Q2. The needed load capacitance can be reached with capacitors $C31$ and $C41$, 0402 package.

In default state, a crystal oscillator is not mounted on the EV-Board.

If the jumpers P1 pin 11-12, 13-14 are set, the radio chip nRF52805 pin P0.00 and P0.01 are connected to *LED_1* and *LED_2* on EV-Board through 0 Ω resistors R6 and R11 respectively.

If a LFXO is mounted to the EV-Board the resistors $R6$ and $R11$ shall be demounted, capacitors $C31$ and $C41$ shall be mounted.

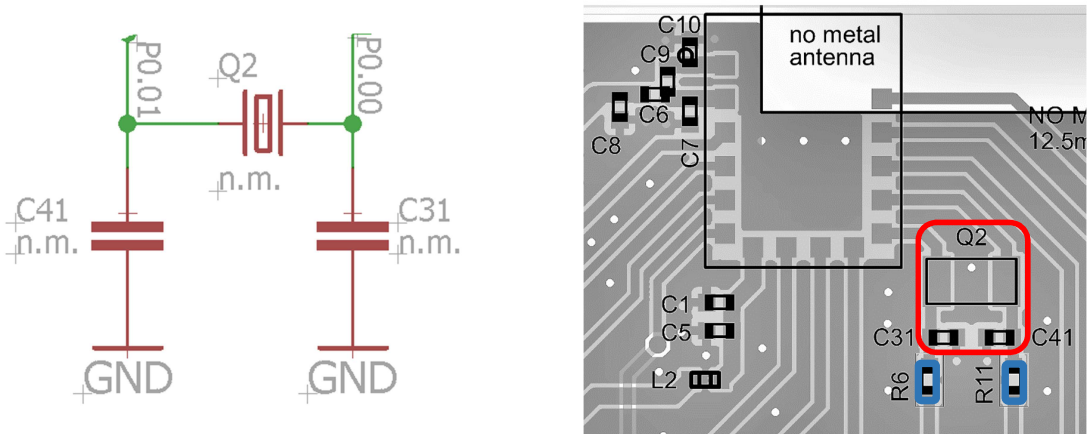

Figure 7: LFXO mounting

The input capacitance of the pin P0.00 and P0.01 are 4 pF. The values of $C31$ and $C41$ can be calculated as follows.

The load capacitance C_l of LFXO calculates as

$$C_l = \frac{C31_l * C41_l}{C31_l + C41_l}$$

if we assume that $C31_l = C41_l$.

$$C_l = \frac{C31_l}{2} = \frac{C41_l}{2}$$

Whereas,

$$C31_l = C31 + C_{XL2} + C_{PCB}$$

$$C41_l = C41 + C_{XL2} + C_{PCB}$$

With this, $C31$ and $C41$ calculate as

$$\begin{aligned} C31 &= 2 \cdot C_l - C_{XL1} - C_{PCB} \\ C41 &= 2 \cdot C_l - C_{XL2} - C_{PCB} \end{aligned}$$

whereas

C_l = Load capacitance of LFXO crystal
C_{XL1} = Input capacitance of pad *LED_1* (4 pF)
C_{XL2} = Input capacitance of pad *LED_2* (4 pF)
C_{PCB} = Parasitic capacitance of PCB

Parasitic capacitance C_{PCB} can vary depending on design and track length. It can vary from 0.5 pF to 2 pF.

For the crystal *830009706* with a load capacitance C_l of 9 pF and a parasitic capacitance C_{PCB} of 2 pF, the value of $C31$ and $C41$ results in 12 pF, which was also tested on the EV-Board.

Depending on parasitic capacitance of host PCB, a capacitance of 12 pF may be a good starting value for $C31$ and $C41$.

Using standard firmware with Proteus-e, the external crystal is not needed. To enable use of the LFXO a custom firmware is required.

3.5.6 Programming interface

The EV-Board provides a 2×10 pin connector to connect directly to a SWD flash adapter used for development. Please take care of the correct mounting of the flash adapter. The recommended flash adapter is one of the "Segger J-Link" family.

3.6 Schematic

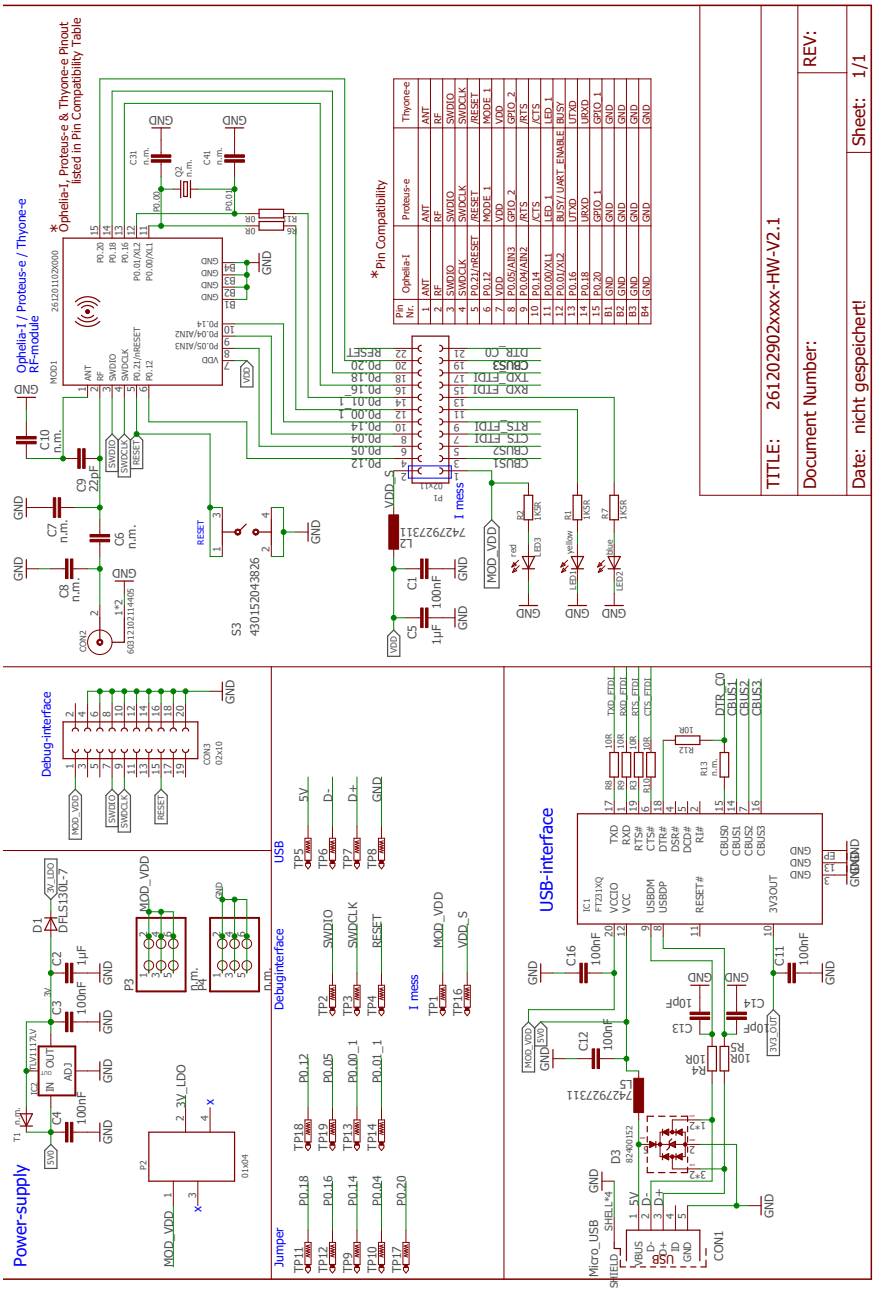

Figure 8: Reference design: Schematic

The reference design is the same for the Proteus-e, Ophelia-I and Thyone-e radio modules. The module's pins on the schematic are named according to Ophelia-I module. The pin compatibility table between Ophelia-I, Proteus-e and Thyone-e is shown in the schematic.

3.7 Layout

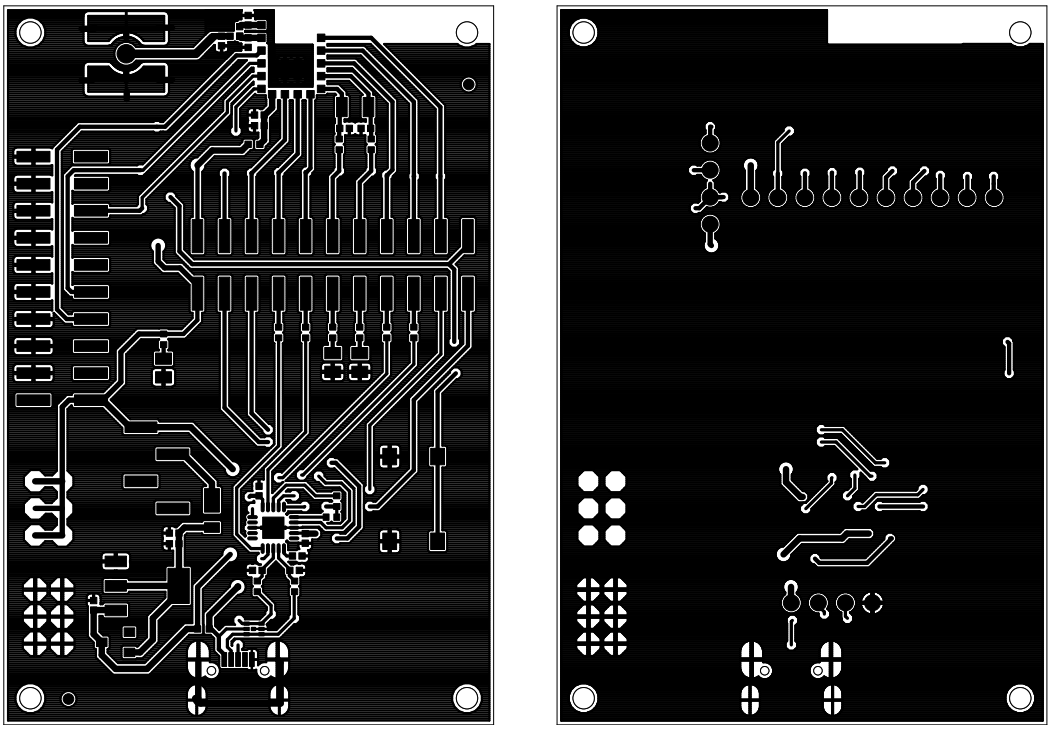

Figure 9: Top layer (top), bottom layer (bottom)

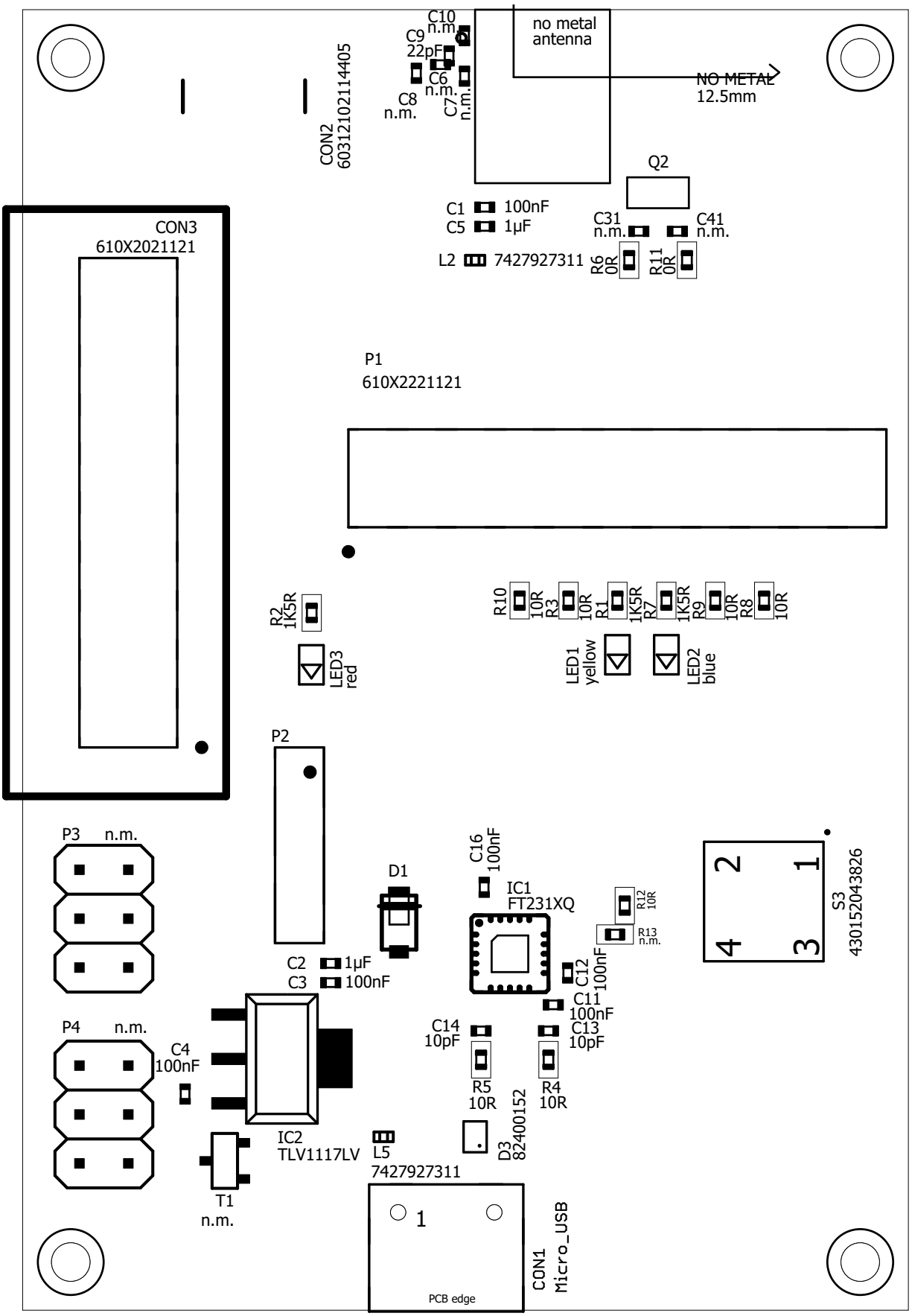

Figure 10: Assembly diagram

3.8 Bill of materials

MOD1	Ophelia-I/ Proteus-e/ Thyone-e	SMD	Würth Elektronik	2612011022000/ 2612011024000/ 2612011021000
C1	100nF	C0402_IPC	Würth Elektronik	885012205037
C2	1µF	C0402_IPC	Würth Elektronik	885012105012
C3	100nF	C0402_IPC	Würth Elektronik	885012205037
C4	100nF	C0402_IPC	Würth Elektronik	885012205037
C5	1µF	C0402_IPC	Würth Elektronik	885012105012
C6	n.m.	C0402_IPC	Würth Elektronik	
C7	n.m.	C0402_IPC		
C8	n.m.	C0402_IPC		
C9	22pF	C0402_IPC	Würth Elektronik	885012005027
C10	n.m.	C0402_IPC		
C11	100nF	C0402_IPC	Würth Elektronik	885012205037
C12	100nF	C0402_IPC	Würth Elektronik	885012205037
C13	10pF	C0402_IPC	Würth Elektronik	885012005055
C14	10pF	C0402_IPC	Würth Elektronik	885012005055
C16	100nF	C0402_IPC	Würth Elektronik	885012205037
C31	n.m.	C0402_IPC		
C41	n.m.	C0402_IPC		
CON1	Micro_USB	629105150521	Würth Elektronik	629105150521
CON2	60312102114405	60312102114405	Würth Elektronik	60312102114405
CON3	02x10	610X2021121	Würth Elektronik	61002021121
D1	DFLS130L-7	SOD123_POWERDI	Diodes incorporated	DFLS130L-7
D3	82400152	WE-TVS_SOT563	Würth Elektronik	82400152
IC1	FT231XQ	QLP20	FTDI	FT231XQ-R
IC2	TLV1117LV	SOT223-4	Texas Instruments	TLV1117LV30DCYx
L2	7427927311	L0402_WE-MK	Würth Elektronik	7427927311
L5	7427927311	L0402_WE-MK	Würth Elektronik	7427927311
LED1	yellow	805	Würth Elektronik	150080YS75000
LED2	blue	805	Würth Elektronik	150080BS75000
LED3	red	805	Würth Elektronik	150080RS75000
P1	02x11	61002221121	Würth Elektronik	61002221121
P2	01x04	61000418221	Würth Elektronik	61000418221
P3	n.m.	2X03		
P4	n.m.	2X03		
Q2	n.m.	3216	Würth Elektronik	830009678
R1	1K5R	R0402_IPC	Yageo	RC0402FR-071K5L
R2	1K5R	R0402_IPC	Yageo	RC0402FR-071K5L
R3	10R	R0402_IPC	Yageo	RC0402FR-0710RL
R4	10R	R0402_IPC	Yageo	RC0402FR-0710RL
R5	10R	R0402_IPC	Yageo	RC0402FR-0710RL
R6	0R	R0402_IPC	Yageo	RC0402FR-070RL
R7	1K5R	R0402_IPC	Yageo	RC0402FR-071K5L
R8	10R	R0402_IPC	Yageo	RC0402FR-0710RL
R9	10R	R0402_IPC	Yageo	RC0402FR-0710RL
R10	10R	R0402_IPC	Yageo	RC0402FR-0710RL
R11	0R	R0402_IPC	Yageo	RC0402FR-070RL
R12	10R	R0402_IPC	Yageo	RC0402FR-0710RL
R13	n.m.	R0402_IPC	Yageo	RC0402FR-0710RL
S3	430152043826	430152043826	Würth Elektronik	430152043826

3.9 Internal antenna radiation characteristics

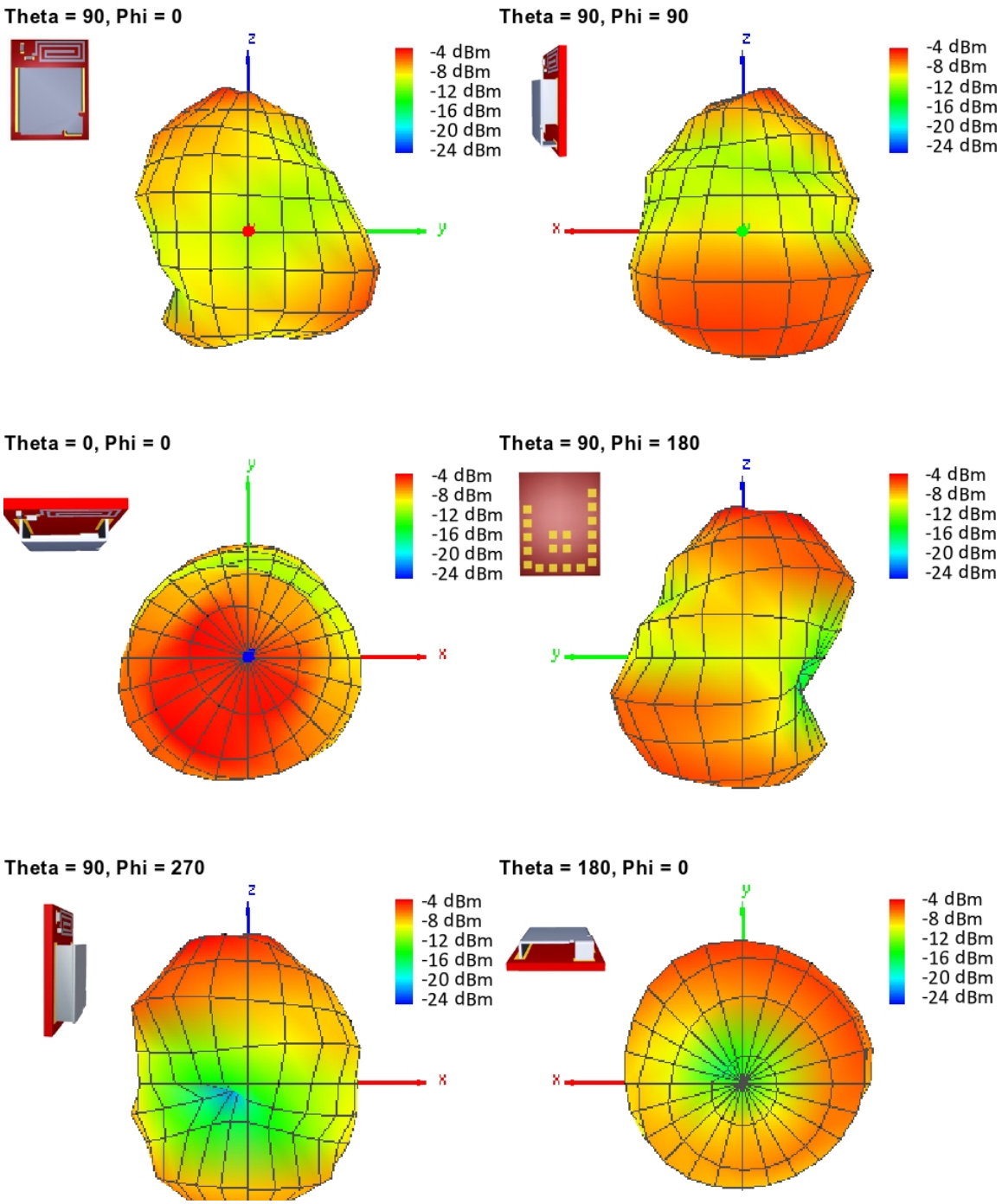

Figure 11: Antenna characteristic from integrated antenna measured on official EV-Board[1]

[1] Radiation characteristic shown is valid for the module on the EV-Board. It is important to be aware that size of ground plane and placement of module has influence on the radiation pattern.

4 Marking

4.1 Lot number

The 15 digit lot number is printed in numerical digits as well as in form of a machine readable bar code. It is divided into 5 blocks as shown in the following picture and can be translated according to the following table.

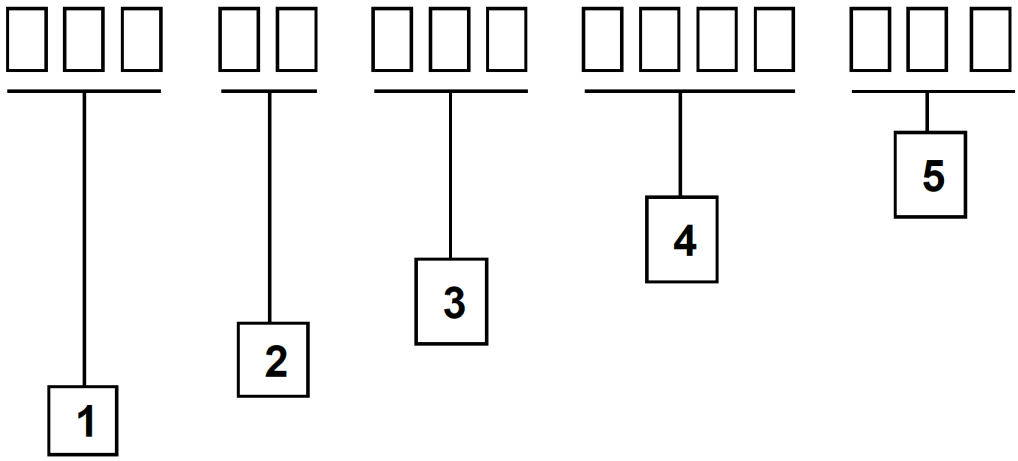

Figure 12: Lot number structure

Block	Information	Example(s)
1	eiSos internal, 3 digits	438
2	eiSos internal, 2 digits	01
3	Radio module hardware version, 3 digits	V2.4 = 024, V12.2 = 122
4	Date code, 4 digits	1703 = week 03 in year 2017, 1816 = week 16 in year 2018
5	Radio module firmware version, 3 digits	V3.2 = 302, V5.13 = 513

Table 7: Lot number details

As the user can perform a firmware update the printed lot number only shows the factory delivery state. The currently installed firmware can be requested from the module using the corresponding product specific command. The firmware version as well as the hardware version are restricted to show only major and minor version not the patch identifier.

5 Regulatory compliance information

5.1 European Conformity

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 EV-Kits designed for professionals to be used solely at research and development facilities for such purposes.

5.2 FCC

Pursuant to §2.803 (c) of Title 47 Chapter I Subchapter A Part 2 Subpart I, the EV-Kit falls under the FCC exception. Therefore it is marked as "For evaluation only; not FCC approved for resale".

5.3 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.

Notwithstanding the above, Würth Elektronik eiSos makes no representations and warranties of any kind related to their accuracy, correctness, completeness and/or usability for customer applications. No responsibility is assumed for inaccuracies or incompleteness.

6 References

[1] Würth Elektronik. WE UART Terminal PC tool (Smart Commander). https://www.we-online.de/wcs-software.

[2] Nordic Semiconductor. Nordic nRF52805 resources. https://www.nordicsemi.com/products/nrf52805.

[3] Würth Elektronik. Proteus-e user manual. https://www.we-online.de/katalog/de/manual/2612011024000.

[4] Würth Elektronik. Ophelia-I user manual. https://www.we-online.de/katalog/de/manual/2612011022000.

[5] Würth Elektronik. Thyone-e user manual. https://www.we-online.de/katalog/de/manual/2612011021000.

7 Important notes

The following conditions apply to all goods within the wireless connectivity and sensors product range of Würth Elektronik eiSos GmbH & Co. KG:

General customer responsibility
Some goods within the product range of Würth Elektronik eiSos GmbH & Co. KG contain statements regarding general suitability for certain application areas. These statements about suitability are based on our knowledge and experience of typical requirements concerning the areas, serve as general guidance and cannot be estimated as binding statements about the suitability for a customer application. The responsibility for the applicability and use in a particular customer design is always solely within the authority of the customer. Due to this fact, it is up to the customer to evaluate, where appropriate to investigate and to decide whether the device with the specific product characteristics described in the product specification is valid and suitable for the respective customer application or not. Accordingly, the customer is cautioned to verify that the documentation is current before placing orders.

Customer responsibility related to specific, in particular safety-relevant applications
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 source code 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.

Best care and attention
Any product-specific data sheets, manuals, application notes, PCNs, warnings and cautions must be strictly observed in the most recent versions and matching to the products revisions. These documents can be downloaded from the product specific sections on the wireless connectivity and sensors homepage.

Customer support for product specifications
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 Business Development Engineer (BDM) or the internal sales person in charge should be contacted who will be happy to support in this matter.

Product improvements
Due to constant product improvement, product specifications may change from time to time. As a standard reporting procedure of the Product Change Notification (PCN) according to the JEDEC-Standard, we inform about major changes. In case of further queries regarding the PCN, the Business Development Engineer (BDM), the internal sales person or the technical support team in charge should be contacted. The basic responsibility of the customer as per section 7 and 7 remains unaffected.
All software like ¨wireless connectivity SDK¨, ¨Sensor SDK¨ or other source codes as well as all PC software tools are not subject to the Product Change Notification information process.

Product life cycle
Due to technical progress and economical evaluation, we also reserve the right to discontinue production and delivery of products. As a standard reporting procedure of the Product Termination Notification (PTN) according to the JEDEC-Standard we will inform at an early stage about inevitable product discontinuance. According to this, we cannot ensure that all products within our product range will always be available. Therefore, it needs to be verified with the Business Development Engineer (BDM) or the internal sales person in charge about the current product availability expectancy before or when the product for application design-in disposal is considered. The approach named above does not apply in the case of individual agreements deviating from the foregoing for customer-specific products. The approach named above does not apply in the case of EV-Boards. EV-Boards may be changed without any notification.

Property rights
All the rights for contractual products produced by Würth Elektronik eiSos GmbH & Co. KG on the basis of ideas, development contracts as well as models or templates that are subject to copyright, patent or commercial protection supplied to the customer will remain with Würth Elektronik eiSos GmbH & Co. KG. Würth Elektronik eiSos GmbH & Co. KG does not warrant or represent that any license, either expressed or implied, is granted under any patent right, copyright, mask work right, or other intellectual property right relating to any combination, application, or process in which Würth Elektronik eiSos GmbH & Co. KG components or services are used.

General terms and conditions
Unless otherwise agreed in individual contracts, all orders are subject to the current version of the "General Terms and Conditions of Würth Elektronik eiSos Group", last version available at *www.we-online.com*.

8 Terms of Use for Würth Elektronik eiSos GmbH & Co. KG EV-Boards, evaluation kits and evaluation modules

Würth Elektronik eiSos GmbH & Co. KG provide you as a user with technical data (including data sheets), design resources (including reference designs), recommendations for use or other design recommendations, web tools, safety information and other information in the form of evaluation-boards, -kits or -modules (hereinafter jointly referred to as "EVB") in accordance with the terms and conditions contained here. The EVB is provided in the "as is" state. WE disclaims all express and implied warranties, in particular those concerning the suitability for a certain purpose, the absence of defects or non-violation of third-party rights. The EVB is intended for experienced developers to develop

their application with WE components. As a user, you are solely responsible for: (1) selection of the appropriate WE components for the application, (2) design, validation and testing the application, and (3) assurance that the application meets the applicable standards and all other safety requirements and other applicable requirements. WE may change the EVB without prior notice. WE grants you permission to use the EVB only for developing an application suitable for using WE components. Any other duplication, representation or transfer of the EVB is expressly prohibited. WE does not grant any licenses for the use of the intellectual property rights from WE or third parties. WE is fully indemnified from all claims, damages, costs, losses and liabilities arising from the misuse of this EVB The WE components are provided in accordance with WE's conditions of sale or other applicable conditions available either at *https://katalog.we-online.com* or in conjunction with such WE components. WE's provision of the EVB does not constitute an extended warranty in relation to the WE components.

General warnings
Do not touch the EVB when it is live, and allow charged components, such as capacitors, to discharge completely before handling the EVB. Depending on the individual application, high voltages can occur on the EVB and some components can reach temperatures above 50 °C. Even after disconnecting the EVB from the power source, these conditions remain for a significant time. Please ensure that the appropriate safety precautions are taken when installing and operating this EVB, as one of the following may occur if you handle or use this EVB without observing the relevant safety precautions: - Death - Serious injury - Electric shock - Electric burns - Severe heat burns -
When using the EVB, you undertake to read the instructions for use in full together with the relevant information supplied and/or available on the homepage *www.we-online.de/wcs-manuals* before putting this EVB into operation. The following points have to be observed in particular:
- Do not touch the EVB while it is live.
- The EVB must be fully assembled and all devices to be tested must be connected before voltage is applied to the EVB.
- The EVB should never be left unattended during operation.
- Capacitors must be completely discharged. The capacitors must be actively discharged using a suitable resistor.

Protection against static electricity
Use the unpackaged product only in ESD protected areas. Wear the ESD personal protective equipment prescribed for these areas. Ground all conductive components, including personnel, as prescribed in ESD protected areas. Ensure that the product is only used by trained personnel.

Purpose and use
The EVB is not a finished product and is not intended for general use by the consumer. The EVB is intended exclusively for use in the evaluation of WE components in the lab or in development environments by highly qualified technicians or engineers, familiar with the risks involved in handling electrical or mechanical components, systems and subsystems. The use of the EVB is your full and independent responsibility. The EVB is expressly not intended to be installed in a terminal device or to be part of a terminal device in whole or in part. WE reserves the right, at its own discretion, to make corrections, improvements, adjustments or other changes to the EVB or to discontinue the EVB. The EVB is not intended for use in devices and applications for which a higher safety and reliability standard is prescribed. It is also not approved for use in safety-relevant applications or where personal injury or fatal consequences must be expected in the event of failure.

Operation of the EVB
The EVB may only be operated within the specifications and environmental parameters recommended by WE, as described in the instructions for use. Exceeding the specified parameters (including, but not limited to, input and output voltage, current, power, and ambient conditions) may result in damage to property. If you have questions about these electrical parameters, please contact WE at (regulatory-compliance@we-online.com) prior to connecting peripheral electronics (including the input voltage and intended loads). Any load outside a certain power range may lead to negative consequences, including, but not limited to, unintended or inaccurate evaluations or possibly permanent damage to the EVB or the electronics connected to it. Please ensure that the appropriate safety precautions are taken when working with the EVB, as serious injuries, including severe or even fatal injuries from electric shock or electric burns, may occur if you do not follow the appropriate safety precautions. Under no circumstances should the EVB be touched while live. When the EVB is connected to a power source, some of its components are electrically charged and/or have temperatures above 50 °C. This condition also applies for a short time after disconnecting from the supply voltage until the capacitors are completely discharged and hot components have cooled down. These components include connectors, linear regulators, switching transistors, heat sinks, resistors, diodes, inductors and other components, which can be identified from the documentation in the instructions for use. As with all electronic lab work, only qualified persons with knowledge of electronic performance evaluation, measurement and diagnostic tools, should use the EVB.

Hazards and warnings
Before putting the EVB into operation, please read the instructions for use and especially the various hazards and warnings described therein. The instructions for use contain important safety information on voltages and temperatures. You take full responsibility and liability for the proper and safe handling of the EVB. You agree to comply with all safety requirements, rules and regulations related to the use of the EVB. You also take full responsibility for: (1) establishing safeguards to ensure that the use of the EVB does not cause damage to property, personal injury or death, even if the EVB does not function as described, intended or expected, (2) the test setup in which the EVB is integrated, all safety requirements, rules and regulations and also that no damage to property, personal injury or other hazardous situation occurs even if the EVB fails, and (3) ensuring the safety of all activities performed by you or your employees when using the EVB. In particular, this means that the technical rules VDE [German Electrical Engineering, Electronic and Information Technology Association] 0105-100 and BGI [German trade association information] 891 (or corresponding applicable safety regulations outside Germany) for the operation of electrical test setups must be observed, the test area is protected against unauthorized access or accidental touching, current limitations, and emergency stop mechanisms are functional and test setups are never operated unattended. If you have any questions about the safe use of the EVB, please contact WE at *regulatory-compliance@we-online.com* for more information.

Your responsibility with regard to the applicable laws
- You are responsible for being sufficiently informed about and complying with all international, national, state and local applicable laws, rules and regulations that apply to the handling or use of the EVB by you or your employees.
- The EVB generates, uses and radiates radio frequency energy, but has not been tested for conformity with the limits applicable to the product category, which are applicable according to the European Union regulations for protection against radio frequency interference. Operation of the EVB may cause interference with radio communication. In this case, the costs incurred for necessary measures to remedy the interference are to be borne by the user.

As the EVB is not a finished product, it may not comply with applicable regulatory, safety or certification standards that are normally as-

sociated with other products, such as Directive 2011/65/EC of the European Parliament and of the Council of 8 June 2011 on the restriction of the use of hazardous substances and Directive 2002/96/EC on waste electrical and electronic equipment (WEEE). You take full responsibility for compliance with such standards that apply to the EVB. You also take responsibility for the proper disposal of the components and materials of the EVB.

Exclusion of further rights and rights of use for intellectual property of EVB
The sale of an EVB does not constitute the granting by WE of any license or other right of any kind - expressly or implicitly - including, but not limited to, any patent, copyright, trademark or other proprietary rights. All rights from such patent, copyright, trademark or other proprietary rights are expressly reserved by WE. The EVB must not be used in any manner that directly or indirectly infringes any patent, copyright, trademark or other proprietary rights of WE.

Warranty of EVB
WE ensures that the EVB meets the specifications given in the instructions for use (within the deviations stated therein) for a period of 12 months from the date of purchase and functions in accordance with the instructions for use. On the basis of the underlying statutory provisions, WE shall rectify defects or offer free replacement of the EVB to which damage occurs that is evidently attributable to a defect for which WE is responsible and is at fault. A warranty claim is subject to the user having complied with the statutory duties of inspection and notification of defects and that the EVB has been received by WE no later than ten (10) days after expiry of the warranty period. This warranty is not transferable to others. This warranty does not apply to defects or impairments in performance resulting from incorrect use, use contrary to WE's instructions, improper installation, improper operation or misuse. WE accepts no liability whatsoever for the failure of equipment or other items not manufactured by or for WE, including, but not limited to, equipment or items to which the EVB is attached or for which the EVB is used. WE DOES NOT GRANT ANY WARRANTIES OR ASSURANCES WHATSOEVER, EXPRESS OR IMPLIED, WITH RESPECT TO THE EVB, INCLUDING, BUT NOT LIMITED TO, ANY IMPLIED WARRANTIES OF MARKETABILITY OR SUITABILITY FOR A PARTICULAR PURPOSE.

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10 License terms

These License terms will take effect upon the purchase and usage of the Würth Elektronik eiSos GmbH & Co. KG wireless connectivity products. You hereby agree that these license terms are applicable to the product and the incorporated software, firmware and source codes (collectively, "Software") made available by Würth Elektronik eiSos in any form, including but not limited to binary, executable or source code form. The software included in any Würth Elektronik eiSos wireless connectivity product is purchased to you on the condition that you accept the terms and conditions of these license terms. You agree to comply with all provisions under these license terms.

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You are responsible for using the Würth Elektronik eiSos wireless connectivity product with the incorporated firmware in compliance with all applicable product liability and product safety laws. You acknowledge to minimize the risk of loss and harm to individuals and bear the risk for failure leading to personal injury or death due to your usage of the product.
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You have the opportunity to request the current and actual firmware for a bought wireless connectivity product within the time of warranty. However, Würth Elektronik eiSos has no obligation to update a modules firmware in their production facilities, but can offer this as a service on request. The upload of firmware updates falls within your responsibility, e.g. via ACC or another software for firmware updates. Firmware updates will not be communicated automatically. It is within your responsibility to check the current version of a firmware in the latest version of the product manual on our website. The revision table in the product manual provides all necessary information about firmware updates. There is no right to be provided with binary files, so called "firmware images", those could be flashed through JTAG, SWD, Spi-Bi-Wire, SPI or similar interfaces.

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We recommend you to be updated about the status of new firmware and software, which is available on our website or in our data sheet and manual, and to implement new software in your device where appropriate.
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List of Figures

List of Tables

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