User manual

Evaluation Kit for radio module Metis-e

2609051183000

Version 1.0

September 27, 2024

WÜRTH ELEKTRONIK MORE THAN YOU EXPECT

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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 [1]	• Initial version	September 2024

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[1]The table shows hardware version of the EV board. For the actual version of the module refer to [1].

Abbreviations

Abbreviation	Name	Description
COM Port	Communication Port	
EV (Board)	Evaluation (Board)	
ESD	Electro Static Discharge	
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.
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 evaluation board described in this manual can be used to evaluate the following product:

WE order code	Description
2609051183000	Metis-e radio module

Table 1: Compatibility

The EV-Kit can be ordered using the following order code:

WE order code	Description
2609059283001	EV-Kit Metis-e

Table 2: Order Code

Kit Content 2609059283001	Quantity
Evaluation board with Metis-e	1
868 Mhz antenna	1
USB data cable USB-C	1
Packaging: cardboard box, ESD safe cover	1

Table 3: Content Metis-e EV- Kit

Figure 1: EV kit containing evaluation board, 868 MHz antenna and a USB data cable

2 Functional description

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

For the connection to a microcontroller system, the development board is equipped with a multi-pin connector, which is connected to all pins of the radio module. Jumpers allow the module to be disconnected from components, such as the USB interface, when they are not required.

Refer to our YouTube channel:
www.youtube.com/user/WuerthElektronik/videos for video tutorials, hands-on activities, and webinars related to our products.

2.1 Taking into operation

To run the evaluation board, the jumpers must be placed on the default location as shown in figure 3. This helps to connect the module's UART to the FTDI USB-to-UART converter.

The corresponding FTDI driver package *FTDI driver package* has to be installed on your PC.

The next step is to connect the evaluation board to the PC via a USB cable. This will allow a COM port to be detected and installed on the PC. Check the Device Manager to find the COM port name of the evaluation board. A typical designation could be "COM12" on Windows systems or "/dev/ttyUSB0" on Linux systems.

The WE UART Terminal PC tool [2] or any other serial terminal program (like *Hterm* for Windows) must be executed and the corresponding COM port to be opened using the default settings of the mounted radio module. After the module has been 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.

Refer to the module's user manual for detailed, module specific quick start instructions [1].

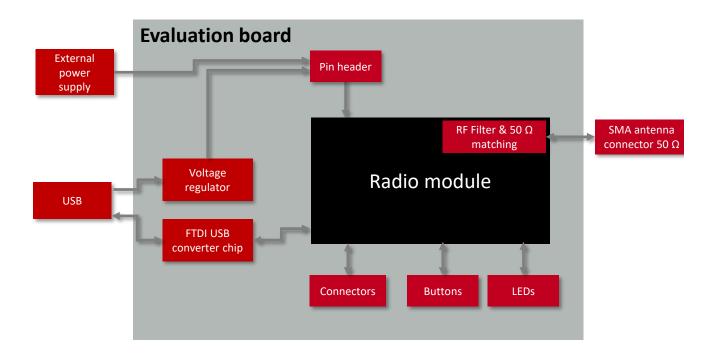# 3 Development board

3.1 Block diagram

Figure 2: Block diagram

> No antenna is integrated in the module. The EV kit contains an antenna which fits the SMA connector on the EV board.
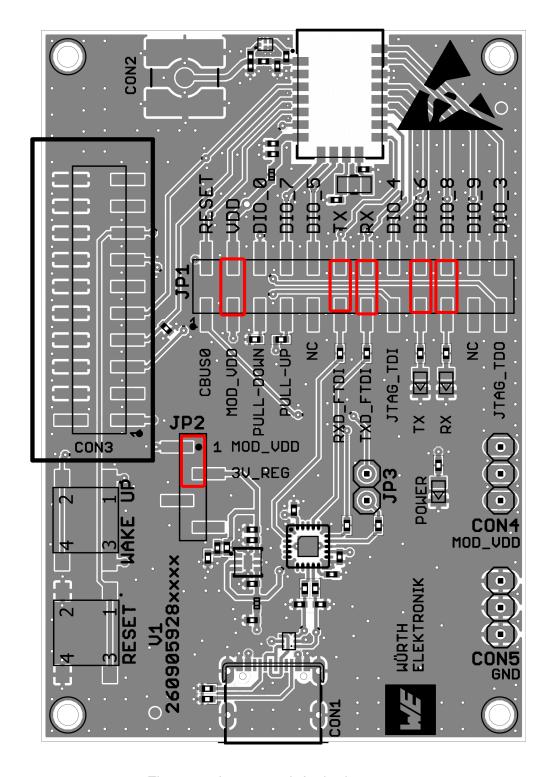
3.2 Jumpers

Figure 3: Jumpers, default placement

JP1	Pin (Module Function)	Jumper set (default)
1, 2	/RESET to CBUS0-FTDI	No
3, 4	Current consumption measurement bridge	Yes
5, 6	DIO_0 to pull down to change boot mode	No
7, 8	DIO_7 to pull up for change operating mode	No
9, 10	DIO_5 to open	No
11, 12	DIO_2 (UTXD) to RXD-FTDI	Yes
13, 14	DIO_1 (URXD) to TXD-FTDI	Yes
15, 16	DIO_4 to CON3	No
17, 18	DIO_6 to LED	Yes
19, 20	DIO_8 to LED	Yes
21, 22	DIO_9 WAKEUP to open	No
22, 23	DIO_3 to CON3	No

Table 4: Jumper JP1

In table 4 the initial pin names of the chipset are used. As this evaluation board is used for several firmware variants of the module, the functions are not fixed.

JP2	Function	Jumper set (default)
1,2	LDO output to power supply of the module via JP1	Yes
3,4	Not connected, no function	No

Table 5: Jumper JP2

> When using external power supply, Jumper JP2 Pin 1-2 shall be removed to avoid applying voltage to the output of the LDO. Pin headers CON4 and CON5 shall be used to source the evaluation board.
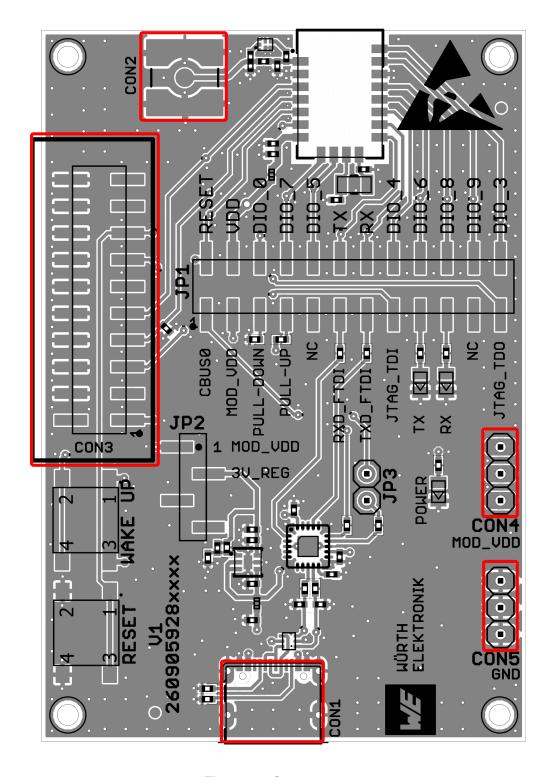
3.3 Connectors and pin headers

Figure 4: 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
CON4	External power supply VDD (not mounted)
CON5	External power supply GND (not mounted)

Table 6: Connector overview

> When using external power supply Jumper JP2 Pin 1-2 shall be removed to avoid applying voltage to the output of the LDO. Pin headers CON4 and CON5 shall be used to source the evaluation board.

> By default, CON4 and CON5 are not mounted.

3.3.1 CON1

Connector CON1 is a USB C connector which enables a connection to PC via standard USB C cable.

CON1	Function
	USB C connector for host connection and VDD bus supply

3.3.2 CON2

Connector CON2 (SMA connector) is used to connect an external antenna. For example, the 868 MHz antenna Hermippe-III *2600130086* can be used.

CON2	Function
Inner	RF signal
Outer	GND

The EV board allows the possibility to either connect directly to an antenna, or to go through a SAW filter. In delivery state, the filter is bypassed by C6, directly connecting CON2, as shown in figure 5.
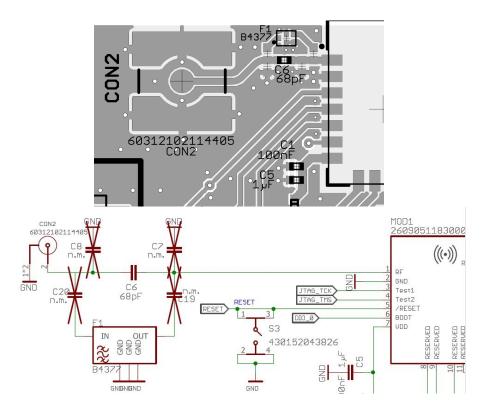

Figure 5: Example without filtering

To facilitate testing with additional filtering, a SAW filter is already assembled. Some soldering is needed to remove C6 and place C19 and C20 as shown in figure 6.
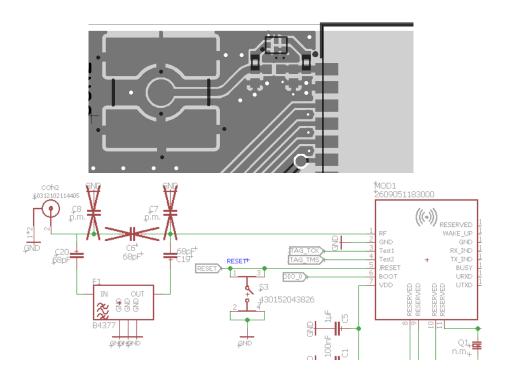

Figure 6: Example with filtering

3.3.3 CON3

Connector CON3 is the JTAG debugging interface.

CON3	CC1310	Function
1		*VDD*
7	*JTAG_TMS*	*Test2*
9	*JTAG_TCK*	*Test1*
15	RESET_N	*/RESET*
4,6,8,10,12,14,16,18,20		*GND*
2,3,5,11,13,17,19		Not connected

Table 7: Connector CON3

3.3.4 CON4

Pin header CON4 is a 3x1 pin header with 2.54 mm grid connected to *MOD_VDD* in the PCB. CON4 shall be used for external power supply.

3.3.5 CON5

Pin header CON5 is a 3x1 pin header with 2.54 mm grid connected to *GND* in the PCB. CON5 shall be used for external power supply.
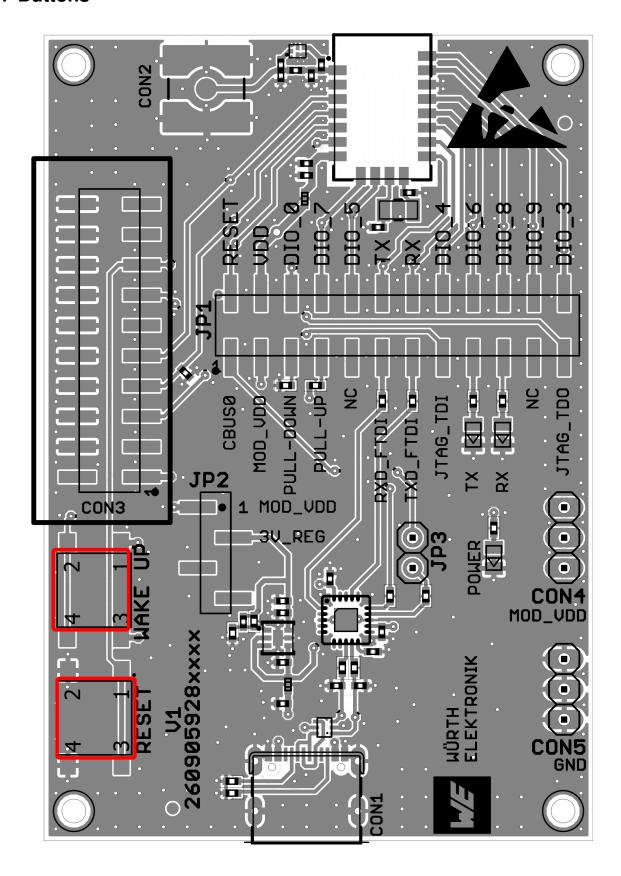
3.4 Buttons

Figure 7: Buttons

3.4.1 RESET button

Internally, the active low reset input of the microprocessor is connected via a RC combination with the power supply to ensure a proper startup of the module. The module provides this */RESET* pin. On the EV board it is connected to button S3, marked as *RESET* on the PCB so that the module can be restarted properly by hand.

3.4.2 Wake up button

Internally, the wake up input of the microprocessor is pulled down. On the evaluation board, the push button S1 connects this pin to modules positive power supply, generating a falling edge when releasing the button, which is needed to wake up the module. On the EV board the button is marked as *WAKE UP*.

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 evaluation board is powered, the *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.

3.5.4 UART direct

If a microcontroller is to be connected to the module, remove the jumpers 11-12,15-16, 17-18 on P1. The UART of the host microcontroller 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 adhere to the I/O level compatibility values stated in the module's manual.

3.5.5 LFXO crystal

The standard Metis-e firmware does not use an external low-frequency crystal. Nevertheless, it is possible to mount one on the EV board. A 32.768 kHz (LFXO) crystal, 3.2 ×1.6 mm package, for example *830009706*, can be placed on the evaluation board to position $Q1$. The needed load capacitance can be reached with capacitors $C15$ and $C17$, 0402 package. As these pins support no functionality besides LFXO, these pins are not connected to a pin header.
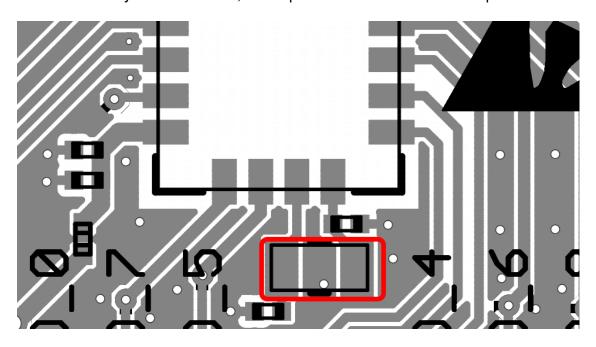

Figure 8: LFXO mounting

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

3.5.6 Programming interface

The evaluation board with CON3 provides a 2×10 pin connector to connect directly to a JTAG flash adapter, supporting JTAG 2 wire or JTAG 4 wire, used for development. Pin1 is marked on the PCB for correct mounting of the flash adapter. The recommended flash adapter is one of the "Segger J-Link" family.
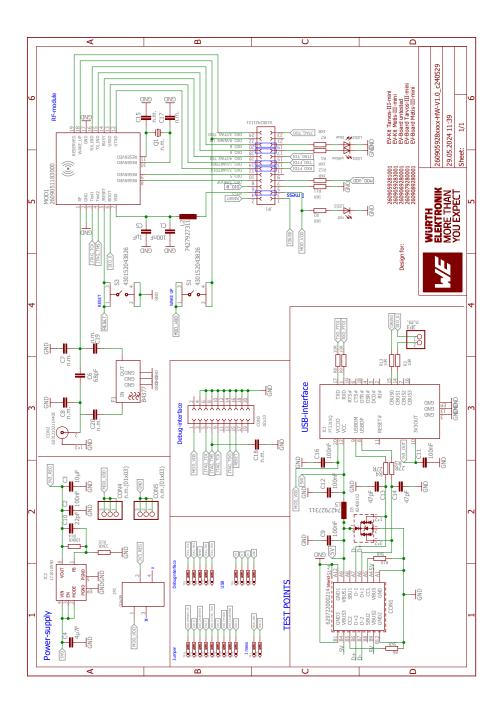
3.6 Schematic

Figure 9: Reference design: Schematic
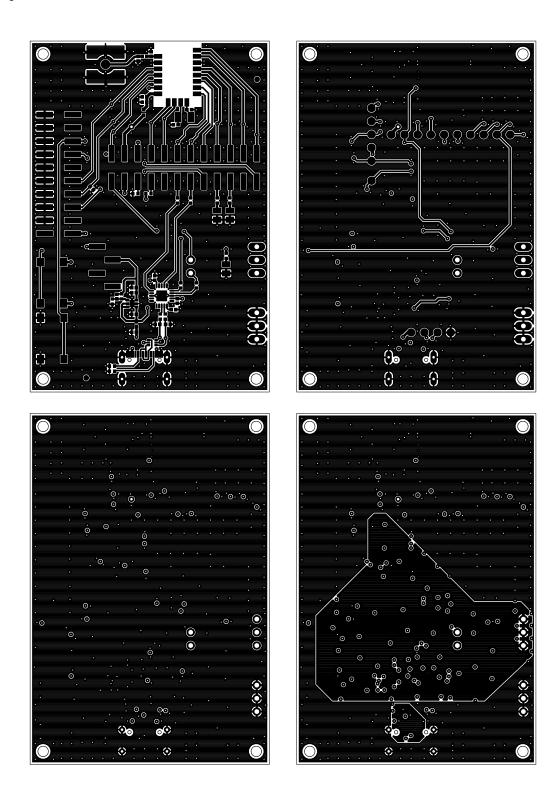
3.7 Layout

Figure 10: From left to right and from up to down : Top layer, bottom layer, 2nd Layer, 3rd Layer
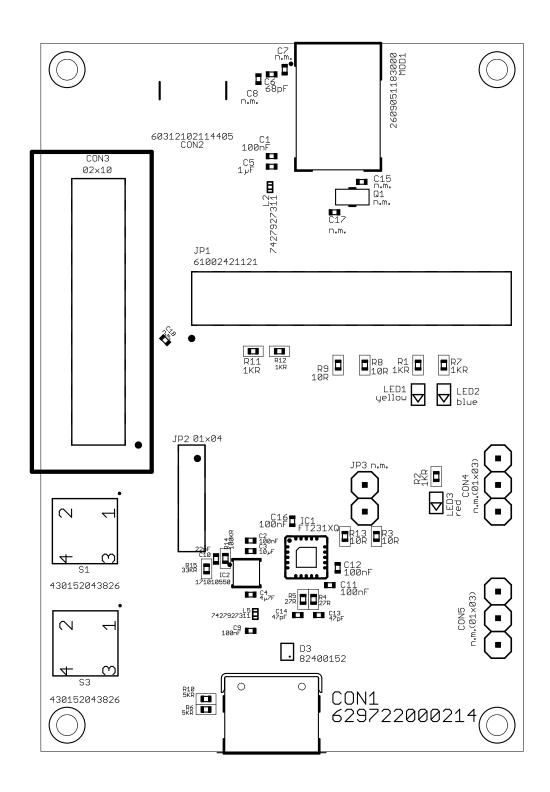
Figure 11: Assembly diagram

3.8 Bill of materials

Part	Value	PACK	NR	MANUFACTURER
C1	100nF	0402	885012205037	Würth Elektronik
C2	100nF	0402	885012205037	Würth Elektronik
C3	10μF	0402	885012105020	Würth Elektronik
C4	47μF	0402	885012105008	Würth Elektronik
C5	1μF	0402	885012105012	Würth Elektronik
C6	68pF	0402	885012005030	Würth Elektronik
C7	n.m.	0402		
C8	n.m.	0402		
C9	100nF	0402	885012205037	Würth Elektronik
C10	22pF	0402	885012005057	Würth Elektronik
C11	100nF	0402	885012205037	Würth Elektronik
C12	100nF	0402	885012205037	Würth Elektronik
C13	47pF	0402	885012005059	Würth Elektronik
C14	47pF	0402	885012005059	Würth Elektronik
C15	n.m.	0402		
C16	100nF	0402	885012205037	Würth Elektronik
C17	n.m.	0402		
C18	n.m.	0402		
C19	n.m.	0402		
C20	n.m.	0402		
CON1	629722000214		629722000214	Würth Elektronik
CON2	60312102114405		60312102114405	Wüth Elektronik
CON3	02x10	SMD	61002021121	Würth Elektronik
CON4	n.m.(01x03)	THT		Würth Elektronik
CON5	n.m.(01x03)	THT		Würth Elektronik
JP1	61002421121		61002421121	Würth Elektronik
JP2	01x04	SMD	61000418221	Würth Elektronik
JP3	n.m.			
R1	1KR	0402	RC0402FR-071KL	Yageo

Table 8: Bill of materials

Part	Value	PACK	NR	MANUFACTURER
R2	1KR	0402	RC0402FR-071KL	Yageo
R3	10R	0402	RC0402FR-0710RL	Yageo
R4	27R	0402	RC0402FR-0727RL	Yageo
R5	27R	0402	RC0402FR-0727RL	Yageo
R6	5KR	0402	RC0402FR-075KL	Yageo
R7	1KR	0402	RC0402FR-071KL	Yageo
R8	10R	0402	RC0402FR-0710RL	Yageo
R9	10R	0402	RC0402FR-0710RL	Yageo
R10	5KR	0402	RC0402FR-075KL	Yageo
R11	1KR	0402	RC0402FR-071KL	Yageo
R12	1KR	0402	RC0402FR-071KL	Yageo
R13	10R	0402	RC0402FR-0710RL	Yageo
R14	100KR	0402	RC0402FR-07100KL	Yageo
R15	33KR	0402	RC0402FR-0733KL	Yageo
S1	430152043826	SMD	430152043826	Würth Elektronik
S3	430152043826	SMD	430152043826	Würth Elektronik
D3	82400152	WE-TVS_SOT563	82400152	Würth Elektronik
F1	B4377	SMD	B39871B4377P810	Qualcomm
IC1	FT231XQ	QFN	FT231XQ-R	FTDI
IC2	171010550	SMD	171010550	Würth Elektronik
L2	7427927311	0402	7427927311	Würth Elektronik
L5	7427927311	0402	7427927311	Würth Elektronik
LED1	yellow	0805	150080YS75000	Würth Elektronik
LED2	blue	0805	150080BS75000	Würth Elektronik
LED3	red	0805	150080RS75000	Würth Elektronik
MOD1	2609051183000	SMD	2609051181000	Würth Elektronik
Q1	n.m.			Würth Elektronik

Table 9: Bill of materials cont.

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.
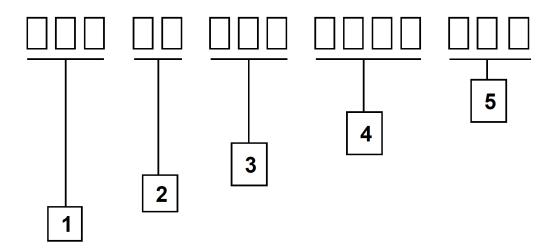

Figure 12: Lot number structure

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 10: 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 evaluation 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 evaluation kit falls under the FCC exception. Therefore it is marked as "For evaluation only; not FCC approved for resale".

5.3 Exemption clause

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6 References

[1] Würth Elektronik. Metis-e user manual. `https://www.we-online.de/katalog/de/manual/2609051183000`.

[2] Würth Elektronik. WE UART Terminal PC tool (Smart Commander). `https://www.we-online.com/SmartCommander`.

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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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Ownership

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Firmware update(s)
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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