SETEBOS-I USER MANUAL

2611011024020

VERSION 1.0

JUNE 29, 2021

****

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	FW version	HW version	Notes	Date
1.0	1.0	1.2	Initial release	June 2021

Abbreviations and abstract

Abbreviation	Name	Description
ARM	Advanced RISC Machine	
BER	Bit Error Rate	
CPU	Central Processing Unit	
CS	Checksum	Byte wise XOR combination of the preceding fields.
CSMA-CA	Carrier sense multiple access - collision avoidance	
DC	Direct Current	
ESD	Electrostatic discharge	
FCC	Federal Communications Commission	
FOTA	Firmware Over-The-Air	
FW	Firmware	
GFSK	Gaussian frequency shift keying	Modulation scheme.
GND	Ground	Ground signal level that corresponds to 0 V.
GPIO	General Purpose Input/Output	
HIGH		High signal level that corresponds to VCC.
HW	Hardware	
IC	Integrated Circuit	
I/O	Input/output	Pinout description.
Bluetooth LE	Bluetooth Low Energy	
LED	Light Emitting Diode	
LDO	Low Dropout	
LOW		Low signal level that corresponds to 0 V
MCU	Micro Controller Unit	
OEM	Original Equipment Manufacturer	
OTAP	Over-the-Air Programming	
PC	Personal Computer	
PCB	Printed Circuit Board	
PCN	Product Change Notification	
PER	Packet Error Rate	
RAM	Random Access Memory	

Abbreviation	Name	Description
RED	Radio Equipment Directive	
RF	Radio frequency	Describes wireless transmission.
RPS	Radio Protocol Selection	Pin of the module for selection of radio protocol (Proprietary or Bluetooth Low Energy).
RSSI	Receive Signal Strength Indicator	The RSSI indicates the strength of the RF signal. Its value is always printed in two's complement notation.
SMA	SubMiniature version A	
SWD	Serial Wire Debug	
TTL	Transistor-Transistor Logic	
UART	Universal Asynchronous Receiver Transmitter	Allows the serial communication with the module.
USB	Universal Serial Bus	
VDD	Supply voltage	
VSWR	Voltage Standing Wave Ratio	

Contents

1 Introduction

The Setebos-I is a radio 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, it combines two radio standards in a single hardware platform. The Setebos-I can be configured to work with either Bluetooth® LE, or with WE-ProWare radio stack.

- When selecting the Bluetooth® LE standard, the Setebos-I acts as a Proteus-III radio module.
- When selecting the WE-ProWare radio stack, the Setebos-I acts as a Thyone-I radio module.

Depending on the selected standard, the corresponding module's specifications apply. These are available in the dedicated Proteus-III [1] and Thyone-I [2] user manuals.

Small dimensions (8 x 12 mm) comparable to a nano-sim card including an on-board PCB antenna make Setebos-I ideal for small form factor design. The Setebos-I interfaces the host system via serial UART.

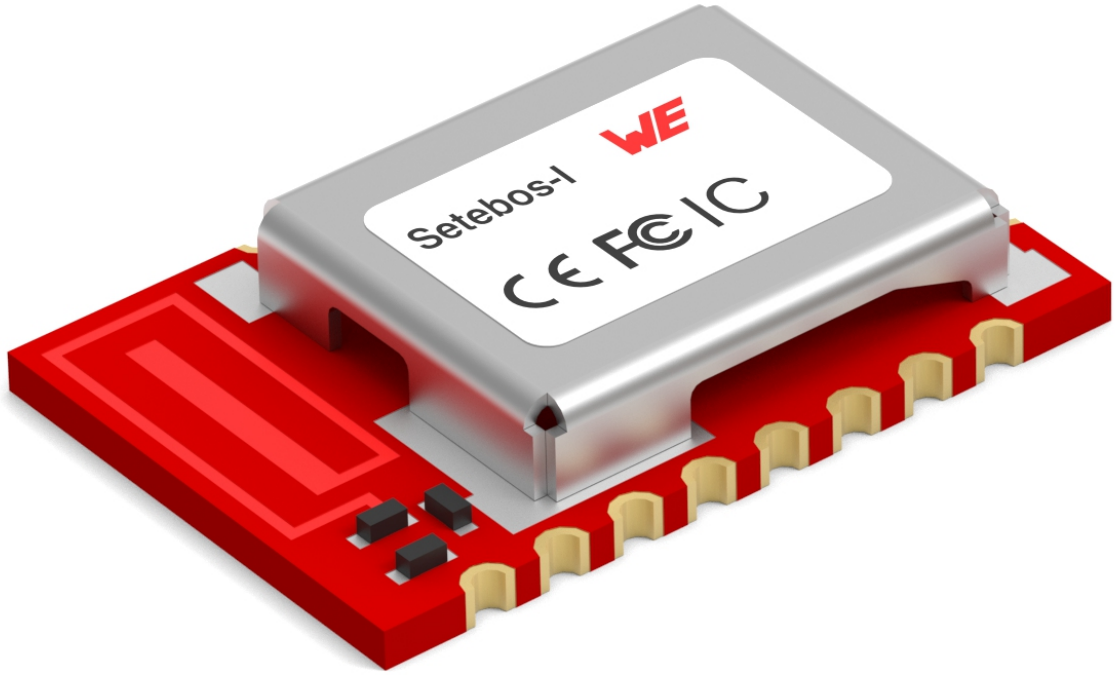

Figure 1: Setebos-I

1.1 Block diagram

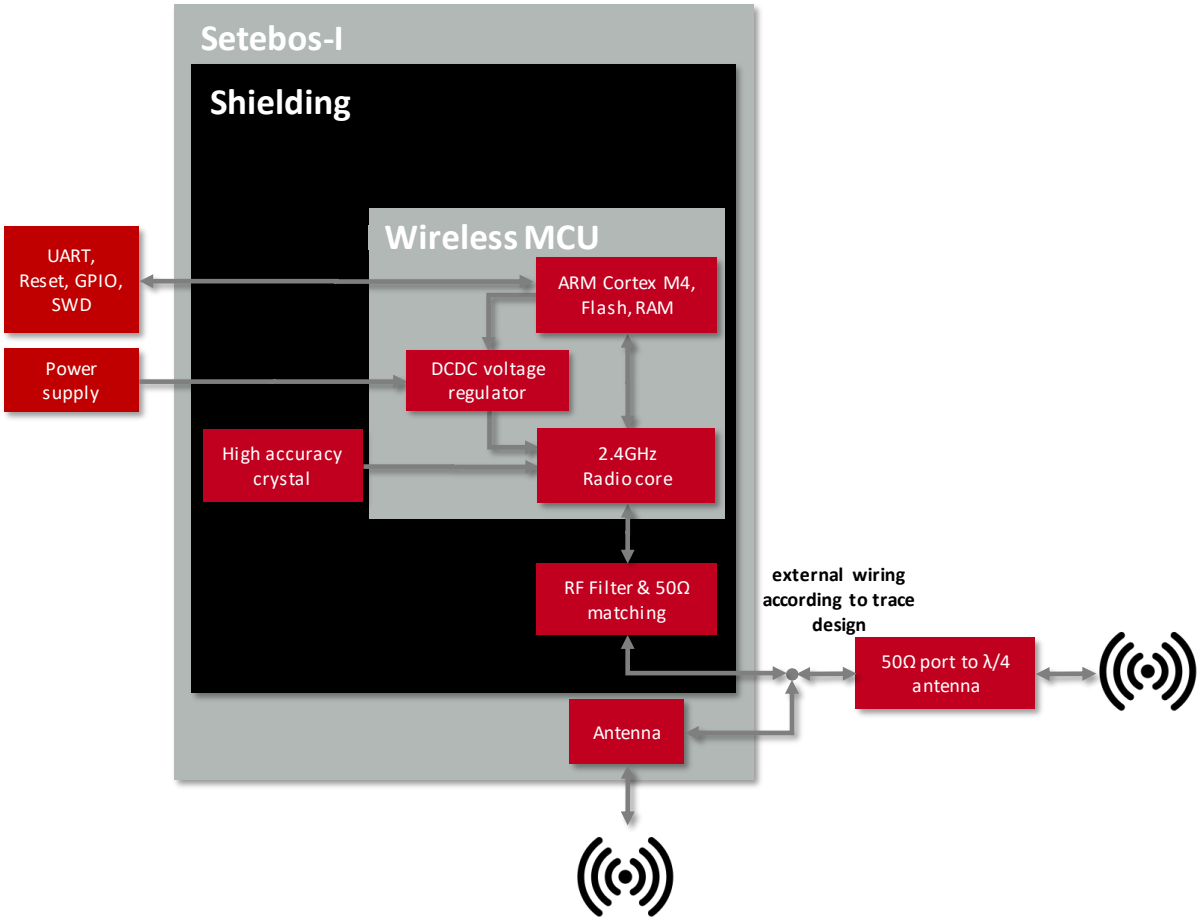

Figure 2: Block diagram of the module

1.2 Ordering information

WE order code	Description
2611011024020	Setebos-I Module, Tape & Reel
2611129024021	Mini evaluation board for Setebos-I

Table 1: Ordering information

2 Electrical specifications

As not otherwise stated measured on the evaluation board Setebos-I-EV with T=25℃, VDDS=3V, f=2.44GHz, internal DC-DC converter in use.

2.1 Recommended operating conditions

Description	Min.	Typ.	Max.	Unit
Ambient temperature	-40	25	85	℃
Supply voltage (VDDS)	1.8[1]	3	3.6	V
Supply rise time (0V to ≥ 1.8V)			60	ms

Table 2: Recommended operating conditions

The on-chip power-on reset circuitry may not function properly for rise times longer than the specified maximum.

An instable supply voltage may significantly decrease the radio performance and stability.

2.2 Absolute maximum ratings

Description	Min.	Typ.	Max.	Unit
Supply voltage (VDD)	-0.3		+3.9	V
Voltage on any digital pin, VDD≤3.6V	-0.3		VDD+0.3	V
Voltage on any digital pin, VDD≥3.6V	-0.3		3.9	V
Input RF level			10	dBm
Flash endurance	10 000			Write/erase cycles

Table 3: Absolute maximum ratings

[1] Power fail comparator is set to 1.8V to avoid flash fail due to voltage drop.

2.3 Power consumption

2.3.1 Static

Continuous test mode	Min.	Typ.	Max.	Unit
TX current consumption at +8 dBm		16.4[1]		mA
TX current consumption at 0 dBm		6.4[1]		mA
RX current consumption		6.25[1]		mA
TX current consumption at +8 dBm		18.9[2]		mA
TX current consumption at 0 dBm		8[2]		mA
RX current consumption		7.7[2]		mA
Sleep (system off mode)		0.4		µA

Table 4: Power consumption for 100% transmission/reception

2.4 Radio characteristics

Specifications of timing and RSSI value

Description	Min.	Typ.	Max.	Unit
RSSI accuracy valid range (±2dB)	-90		-20	dBm
Enable TX or RX delay		140		µs
Enable TX or RX delay (fast mode)		40		µs
Disable TX delay		6		µs
Disable RX delay		0		µs

Table 5: Timing and RSSI

Description	Typ.	Unit
Output power conducted	+6	dBm
Output power integrated antenna	+4	dBm
Input sensitivity conducted (BER=1E-3, 1Mbps)	-92	dBm
Input sensitivity integrated antenna (BER=1E-3, 1Mbps)	-90	dBm

Table 6: Transmit and receive power

All transmit and receive power levels are measured on the evaluation board. The values already include losses of transitions from module to motherboard to SMA or modules PCB antenna. They are realistic values for the end application. Sensitivity in the table above is stated for the common used bit error rate of 0.1%. In the table below, the sensitivity is stated for a packet error rate of 1% with a payload length of 38 byte at different data rates. The PER 1% is a harder criteria resulting in 2 dBm less sensitivity.

[1] Transmitter only with DC/DC converter from nRF52 data sheet, CPU current not included.
[2] Full module power consumption.

Data rate [kbit/s]	Typ.	Unit
1000 (PER 1%)	-90	dBm
2000 (PER 1%)	-87	dBm
500 (PER 1%)	-94	dBm
125 (PER 1%)	-98	dBm

Table 7: Sensitivity at different data rates

2.5 Pin characteristics

Specifications from nRF52 data sheet

Description	Min.	Typ.	Max.	Unit
Input high voltage	0.7 ×VCC		VCC	V
Input low voltage	VSS		0.3 ×VCC	V
Current at VSS+0.4 V, output set low, standard drive, VDD ≥1.7V	1	2	4	mA
Current at VSS+0.4 V, output set low, high drive, VDD ≥ 2.7 V	6	10	15	mA
Current at VSS+0.4 V, output set low, high drive, VDD ≥ 1.7 V	3			mA
Current at VDD-0.4 V, output set high, standard drive, VCC ≥1.7V	1	2	4	mA
Current at VDD-0.4 V, output set high, high drive, VDD ≥ 2.7 V	6	9	14	mA
Current at VDD-0.4 V, output set high, high drive, VDD ≥ 1.7 V	3			mA
Internal pull-up resistance	11	13	16	kΩ
Internal pull-down resistance	11	13	16	kΩ

Table 8: Pin characteristics

3 Pinout

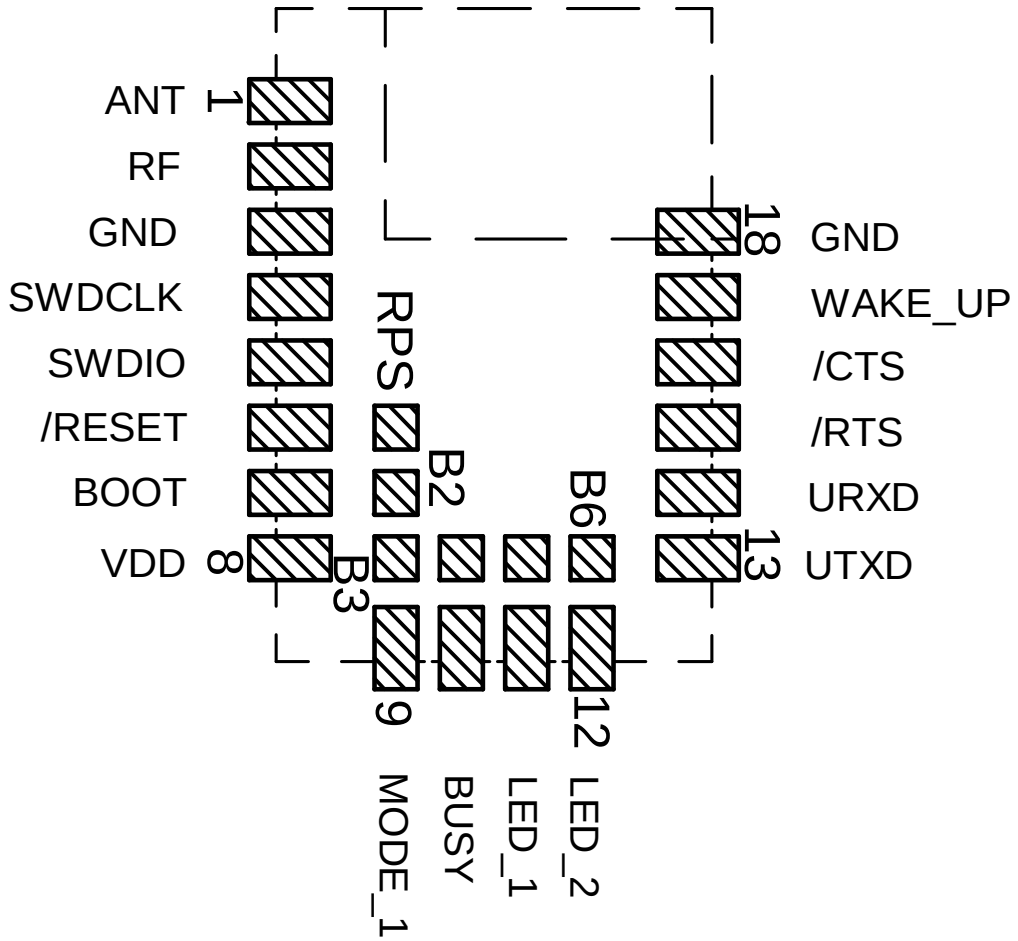

Figure 3: Pinout (top view)

No	µC Pin	Designation	I/O	Description
1		*ANT*	I/O	RF connection to PCB antenna. (see section 4.2)
2		*RF*	I/O	50Ω RF connection through radio front end to transceiver part of chipset. (see section 4.2)
3		*GND*	Supply	Ground
4		*SWDCLK*	Input	Serial wire clock (SWD Interface). Uses internal pull down resistor. Do not connect if not needed.
5		*SWDIO*	Input	Serial wire input/output (SWD Interface). Uses internal pull up resistor. Do not connect if not needed.
6	P0.18	*/RESET*	Input	Reset pin. A low signal resets the module. Uses internal pull up resistor.
7	P0.02	*BOOT*	Input	Boot pin. A low signal during and short after reset starts the module in OTA bootloader mode. Uses internal pull up resistor[1]. Do not connect if not needed.
8		*VDD*	Supply	Supply voltage
9	P0.19	*MODE_1*	Input	Operation mode pin with internal pull down resistor[1] during start-up. Low level or open: Normal Mode. High level: Peripheral only Mode. Do not connect if not needed.
10	P0.22	*BUSY*	Output	Indicates if module is busy with data transmission when using Peripheral only Mode/Transparent Mode. Do not connect, if not needed.
11	P0.00/XL1[2]	*LED_1*	Output	Indicates the module state (active high). Do not connect if not needed.
12	P0.01/XL2[2]	*LED_2*	Output	Indicates the module state (active high). Do not connect if not needed.
13	P1.08	*UTXD*	Output	UART (Transmission)
14	P1.09	*URXD*	Input	UART (Reception). Uses internal pull up resistor[1].
15	P0.11	*/RTS*	Output	/RTS signal, if flow control is enabled. Static low, otherwise. Do not connect if not needed.

Table 9: Pinout, first part

[1] Internal pull-ups or pull-downs are configured at startup by the firmware installed in the SoC. The pull up on the */RESET* pin cannot be disabled by firmware.

[2] Pins available to connect an external crystal in custom firmware. The standard firmware of Setebos-I does not implement this function.

No	µC Pin	Designation	I/O	Description
16	P0.12	*/CTS*	Input	/CTS signal, if flow control is enabled. Using internal pull down[1], otherwise. Do not connect if not needed.
17	P0.03	*WAKE_UP*	Input	Wake-up will allow leaving the system-off mode or re-enabling the UART. Uses internal pull up resistor[1]. Do not connect if not needed.
18		*GND*	Supply	Ground
B1	P0.09/NFC1	*RPS*	Input	Radio protocol selection pin. A low level during and shortly after reset starts the Proteus-III function. A high level during and shortly after reset starts the Thyone-I function. Uses internal pull down resistor[1].
B2	P0.10/NFC2	*B2*	GPIO	Pin for remote GPIO access. Do not connect, if not needed.
B3	P0.23	*B3*	GPIO	Pin for remote GPIO access. Do not connect, if not needed.
B4	P1.00	*B4*	GPIO	Pin for remote GPIO access. Do not connect, if not needed.
B5	P0.21	*B5*	GPIO	Pin for remote GPIO access. Do not connect, if not needed.
B6	P0.07	*B6*	GPIO	Pin for remote GPIO access. Do not connect, if not needed.

Table 10: Pinout, second part

4 Quick start

The Setebos-I module comes pre-flashed, tested and ready to use out-of-the-box. This chapter describes the steps to quickly build a prototype system and test the capabilities of the module. Depending on the radio protocol in use (Bluetooth Low Energy 5.1 or Proprietary), specific quick start information and examples can be found on the Proteus-III [1] and Thyone-I [2] user manuals.

4.1 Minimal pin connections

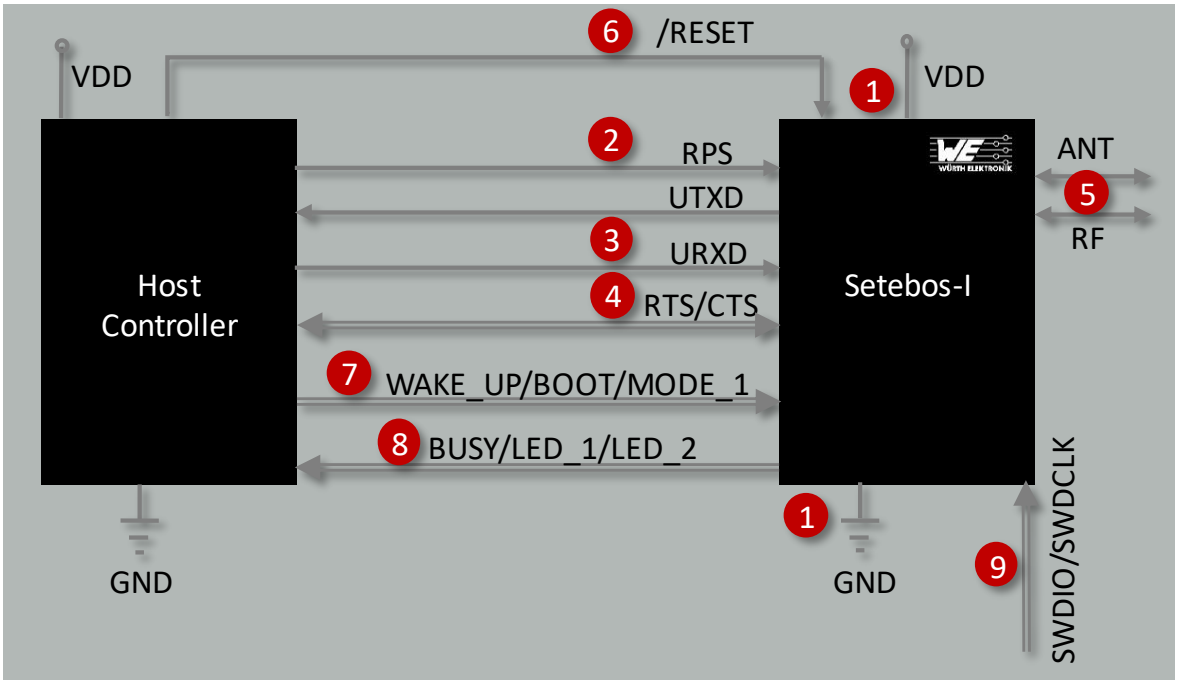

Figure 4: Minimal pin connections

The above image shows the steps to be performed to integrate the Setebos-I into a custom end device.

1. Supply voltage and ground
   Connect the *VDD* and *GND* pins to supply the radio module with power.

2. Radio standard selection
   Connect the *RPS* to the host controller to choose between the radio standards.

3. UART serial interface to the host
   Connect the UART pins *UTXD* and *URXD* to the host to control the module via host.

4. UART flow control
   In case of fast UART baud rates higher than 115.2 kbaud the UART flow control is activated automatically. For lower data rates the flow control is inactive per default. If activated the */RTS* and */CTS* pins must be connected to the host controller.

5. Antenna connection
   The antenna configuration must be performed. See chapter 4.2.

6. Reset
   Connect the */RESET* pin to the host to allow a hard reset of the module.

7. (Optional) Wakeup from sleep, FOTA and mode selection

   - Connect the *WAKE_UP* pin to the host controller to leave power saving modes, like the sleep mode.

   - Connect the *BOOT* pin to the host controller to set the module into boot mode to enable firmware updates via radio.

   - Connect the *MODE_1* pin to the host controller to switch between command and peripheral only mode.

8. (Optional) Status indication
   Connect the *BUSY*, *LED_1* and *LED_2* pins to the host controller to allow easy indication of the status.

9. (Optional) Flash and debug interface
   In case of custom firmware development, it is recommended to additionally have the pins *SWDIO* and *SWDCLK* accessible in order to support a fail-safe update of firmware. A standard socket on the customer's PCB for connecting a flash adapter can be useful for debugging purposes (e.g. a JTAG 2*10 pin header with 2.54 mm pin-to-pin distance).

If the module has to be connected to a PC, a converter (TTL to RS-232 or TTL to USB) has to be used. See chapter 3 for details on all pins. Please refer to the Setebos-I-EV schemes for a reference design.

The logic level of the module is based on 3V. A 5V logic level must not be connected directly to the module.

4.2 Antenna connection

Setebos-I's smart antenna configuration enables the user to choose between two antenna options:

4.2.1 On-board PCB antenna

The Setebos-I has an on-board PCB antenna optimized for strong miniaturization operating in the 2.4 GHz frequency band. A simple short between the pins *RF* and *ANT* feeds the RF output of the module to the on-board antenna of the Setebos-I. In this configuration, the module does not require any additional RF circuitry. For US and Canada, please refer to the trace design in chapter 10.2.

4.2.2 External antenna

For applications that use an external antenna, the Setebos-I provides a 50 Ω RF signal on pin *RF* of the module. In this configuration, pin *ANT* of the module has to be connected to ground and pin *RF* to the external antenna via 50 Ω feed line. Refer to chapter 10 for further information.

The use cases for the integrated antenna are miniaturization and re-use of module certifications for the end-application. The use cases for the external antenna are optimization of radio range spending more space for the antenna and differentiated antenna for example when metal housings are used.

5 Functional description

The Setebos-I module integrates the Bluetooth Low Energy 5.1 and the Würth Elektronik eiSos proprietary radio protocol in a single device. The RPS Pin allows to switch between Bluetooth and Proprietary radio (please refer to Chapter 3).

- A low level during and shortly after reset starts the Bluetooth 5.1 firmware. In this case, the functional description of the Proteus-III radio module applies. This can be found in chapter 5 of the Proteus-III user manual [1].
- A high level during and shortly after reset starts the WE-ProWare firmware. In this case, the functional description of the Thyone-I radio module applies. This can be found in chapter 5 of the Thyone-I user manual [2].

6 Host connection

The Setebos-I is intended to be used as a radio module in a system, interfaced with a host micro-controller. The use of industry standard UART as the primary interface ensures a very minimal requirement set on the host MCU. As a result of this, the module can be designed in with most host controllers from a 8051 to the more advanced ARM core architecture.

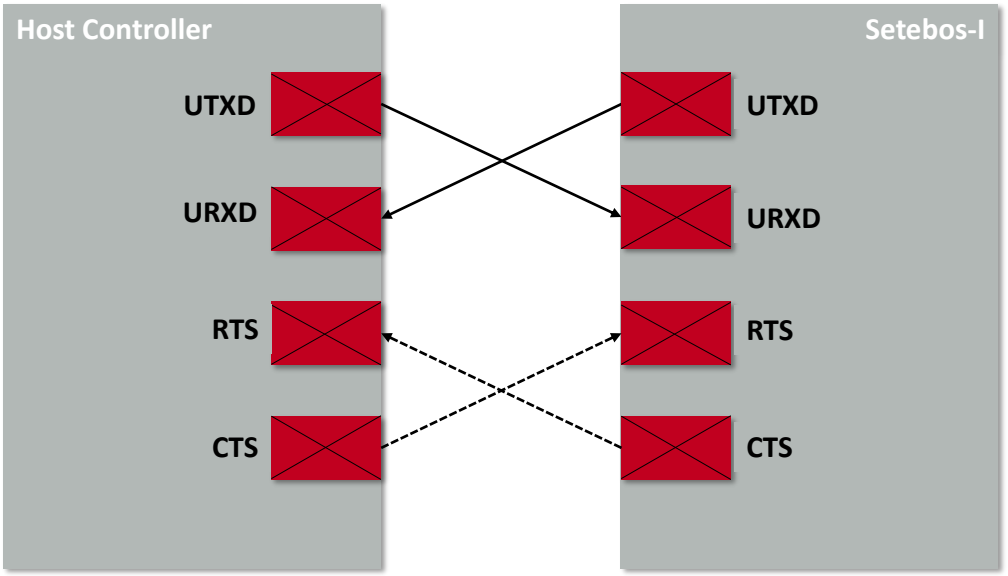

Figure 5: Host Interface

Depending on the selected standard (Bluetooth Low Energy 5.1 or Proprietary), the corresponding characteristics apply. These are available in the dedicated Proteus-III [1] and Thyone-I [2] user manuals.

7 Firmware updates

All products will experience maintenance, security and/or feature updates from time to time. For the standard products these are maintained via the PCN process.
Customers can request the creation of a customized product including a "firmware freeze" to ensure that they will receive their verified product even if the standard product is updated.

The Setebos-I uses the OTAP (over the air) update procedure of the Proteus-III radio module. The OTAP mode can be enabled using the *BOOT* pin or the respective Proteus-III UART command. For more details, please refer to the Proteus-III user manual [1].

8 Firmware history

Version 1.0.0 "Release"

- First production release
- Includes Proteus-III firmware version 1.3.0
- Includes Thyone-I firmware version 1.5.0

9 Design in guide

9.1 Advice for schematic and layout

For users with less RF experience it is advisable to closely copy the relating evaluation board with respect to schematic and layout, as it is a proven design. The layout should be conducted with particular care, because even small deficiencies could affect the radio performance and its range or even the conformity.
The following general advice should be taken into consideration:

- A clean, stable power supply is strongly recommended. Interference, especially oscillation can severely restrain range and conformity.
- Variations in voltage level should be avoided.
- LDOs, properly designed in, usually deliver a proper regulated voltage.
- Blocking capacitors and a ferrite bead in the power supply line can be included to filter and smoothen the supply voltage when necessary.

No fixed values can be recommended, as these depend on the circumstances of the application (main power source, interferences etc.).

The use of an external reset IC should be considered if one of the following points is relevant:

- The slew rate of the power supply exceeds the electrical specifications.
- The effect of different current consumptions on the voltage level of batteries or voltage regulators should be considered. The module draws higher currents in certain scenarios like start-up or radio transmit which may lead to a voltage drop on the supply. A restart under such circumstances should be prevented by ensuring that the supply voltage does not drop below the minimum specifications.
- Voltage levels below the minimum recommended voltage level may lead to malfunction. The /Reset pin of the module shall be held on LOW logic level whenever the VCC is not stable or below the minimum operating Voltage.
- Special care must be taken in case of battery powered systems.

- Elements for ESD protection should be placed on all pins that are accessible from the outside and should be placed close to the accessible area. For example, the RF-pin is accessible when using an external antenna and should be protected.

- ESD protection for the antenna connection must be chosen such as to have a minimum effect on the RF signal. For example, a protection diode with low capacitance such as the 8231606A or a 68 nH air-core coil connecting the RF-line to ground give good results.
- Placeholders for optional antenna matching or additional filtering are recommended.
- The antenna path should be kept as short as possible.

Again, no fixed values can be recommended, as they depend on the influencing circumstances of the application (antenna, interferences etc.).

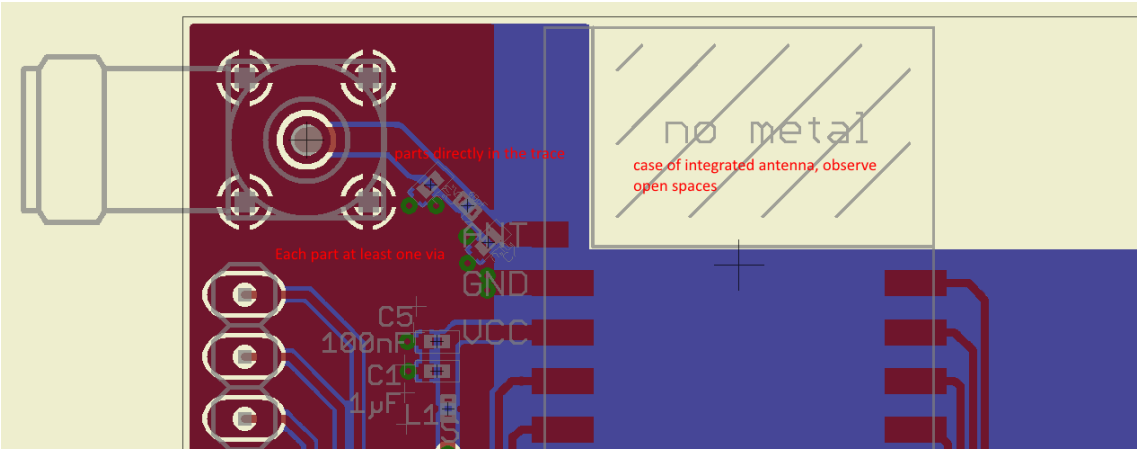

Figure 6: Layout

- To avoid the risk of short circuits and interference there should be no routing underneath the module on the top layer of the baseboard.
- On the second layer, a ground plane is recommended, to provide good grounding and shielding to any following layers and application environment.
- In case of integrated antennas it is required to have areas free from ground. This area should be copied from the evaluation board.
- The area with the integrated antenna must overlap with the carrier board and should not protrude, as it is matched to sitting directly on top of a PCB.
- Modules with integrated antennas should be placed with the antenna at the edge of the main board. It should not be placed in the middle of the main board or far away from the edge. This is to avoid tracks beside the antenna.
- Filter and blocking capacitors should be placed directly in the tracks without stubs, to achieve the best effect.
- Antenna matching elements should be placed close to the antenna / connector, blocking capacitors close to the module.

- Ground connections for the module and the capacitors should be kept as short as possible and with at least one separate through hole connection to the ground layer.
- ESD protection elements should be placed as close as possible to the exposed areas.

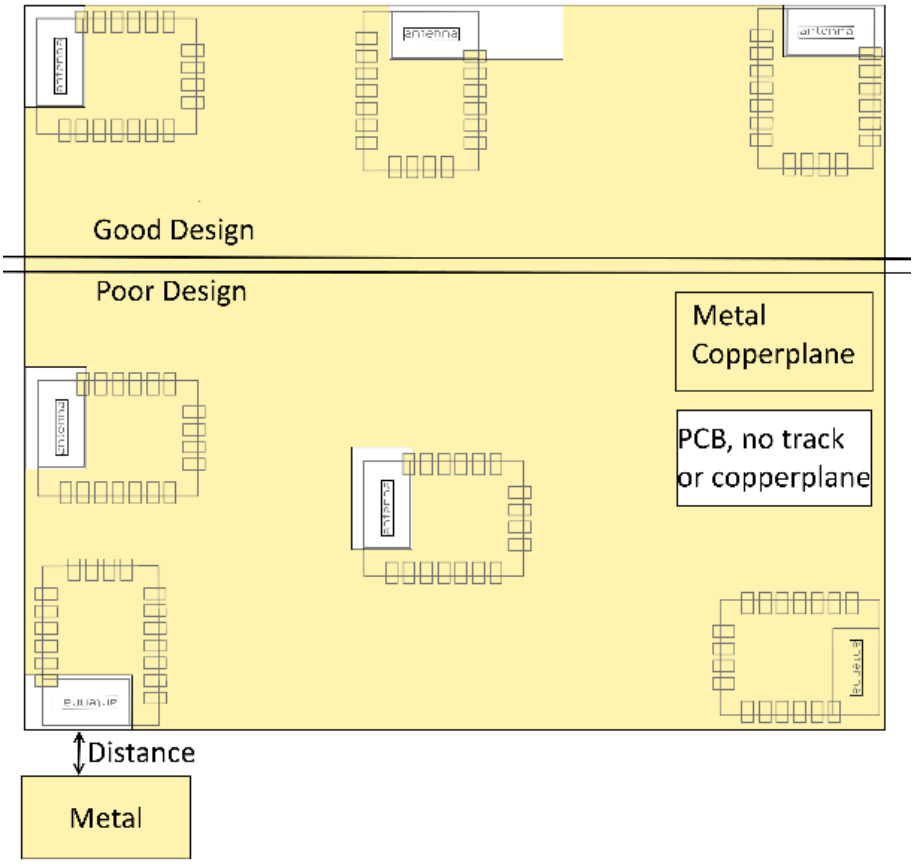

Figure 7: Placement of the module with integrated antenna

9.2 Dimensioning of the micro strip antenna line

The antenna track has to be designed as a 50Ω feed line. The width W for a micro strip can

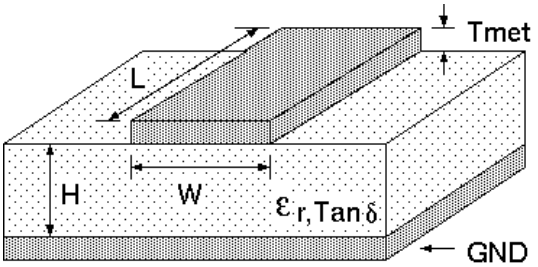

Figure 8: Dimensioning the antenna feed line as micro strip

be calculated using the following equation:

$$W = 1.25 \times \left(\frac{5.98 \times H}{e^{\frac{50 \times \sqrt{\epsilon_r} + 1.41}{87}}} - T_{met} \right) \quad (1)$$

Example:
A FR4 material with ε_r = 4.3, a height H = 1000 µm and a copper thickness of T_{met} = 18 µm will lead to a trace width of W ~ 1.9 mm. To ease the calculation of the micro strip line (or e.g. a coplanar) many calculators can be found in the internet.

- As rule of thumb a distance of about 3×W should be observed between the micro strip and other traces / ground.
- The micro strip refers to ground, therefore there has to be the ground plane underneath the trace.
- Keep the feeding line as short as possible.

9.3 Antenna solutions

There exist several kinds of antennas, which are optimized for different needs. Chip antennas are optimized for minimal size requirements but at the expense of range, PCB antennas are optimized for minimal costs, and are generally a compromise between size and range. Both usually fit inside a housing.
Range optimization in general is at the expense of space. Antennas that are bigger in size, so that they would probably not fit in a small housing, are usually equipped with a RF connector. A benefit of this connector may be to use it to lead the RF signal through a metal plate (e.g. metal housing, cabinet).
As a rule of thumb a minimum distance of λ/10 (which is 3.5 cm @ 868 MHz and 1.2 cm @ 2.44 GHz) from the antenna to any other metal should be kept. Metal placed further away will not directly influence the behaviour of the antenna, but will anyway produce shadowing.

Keep the antenna away from large metal objects as far as possible to avoid electromagnetic field blocking.

The choice of antenna might have influence on the safety requirements.

In the following chapters, some special types of antenna are described.

9.3.1 Wire antenna

An effective antenna is a λ/4 radiator with a suiting ground plane. The simplest realization is a piece of wire. It's length is depending on the used radio frequency, so for example 8.6 cm 868.0 MHz and 3.1 cm for 2.440 GHz as frequency. This radiator needs a ground plane at its feeding point. Ideally, it is placed vertically in the middle of the ground plane. As this is often not possible because of space requirements, a suitable compromise is to bend the wire away from the PCB respective to the ground plane. The λ/4 radiator has approximately 40 Ω input impedance. Therefore, matching is not required.

9.3.2 Chip antenna

There are many chip antennas from various manufacturers. The benefit of a chip antenna is obviously the minimal space required and reasonable costs. However, this is often at the expense of range. For the chip antennas, reference designs should be followed as closely as possible, because only in this constellation can the stated performance be achieved.

9.3.3 PCB antenna

PCB antenna designs can be very different. The special attention can be on the miniaturization or on the performance. The benefits of the PCB antenna are their small / not existing (if PCB space is available) costs, however the evaluation of a PCB antenna holds more risk of failure than the use of a finished antenna. Most PCB antenna designs are a compromise of range and space between chip antennas and connector antennas.

9.3.4 Antennas provided by Würth Elektronik eiSos

9.3.4.1 2600130021 - Himalia - 2.4 GHz dipole antenna

Figure 9: 2.4 GHz dipole-antenna

Due to the fact, that the antenna has dipole topology there is no need for an additional ground plane. Nevertheless the specification was measured edge mounted and 90° bent on a 100 x 100 mm ground plane.

Specification	Value
Frequency range [GHz]	2.4 – 2.5
Impedance [Ω]	50
VSWR	$\leq$ 2:1
Polarization	Linear
Radiation	Omni-Directional
Peak Gain [dBi]	2.8
Average Gain [dBi]	-0.6
Efficiency	85 %
Dimensions (L x d) [mm]	83.1 x 10
Weight [g]	7.4
Connector	SMA plug
Operating temp. [°C]	-40 – +80

Special care must be taken for FCC certification when using this external antenna to fulfil the requirement of permanently attached antenna or unique coupling for example by using the certified dipole antenna in a closed housing, so that only through professional installation it is possible to remove it.

10 Reference design

The module was tested and certified on the corresponding evaluation board. For the European Conformity the evaluation board serves as reference design. For the FCC the evaluation board serves as trace design (chapter 10.2) that has to be followed when referencing the module FCC ID. The certification runs on Proteus-III and is valid for the Setebos-I by a class 1 permissive change.

10.1 EV-Board

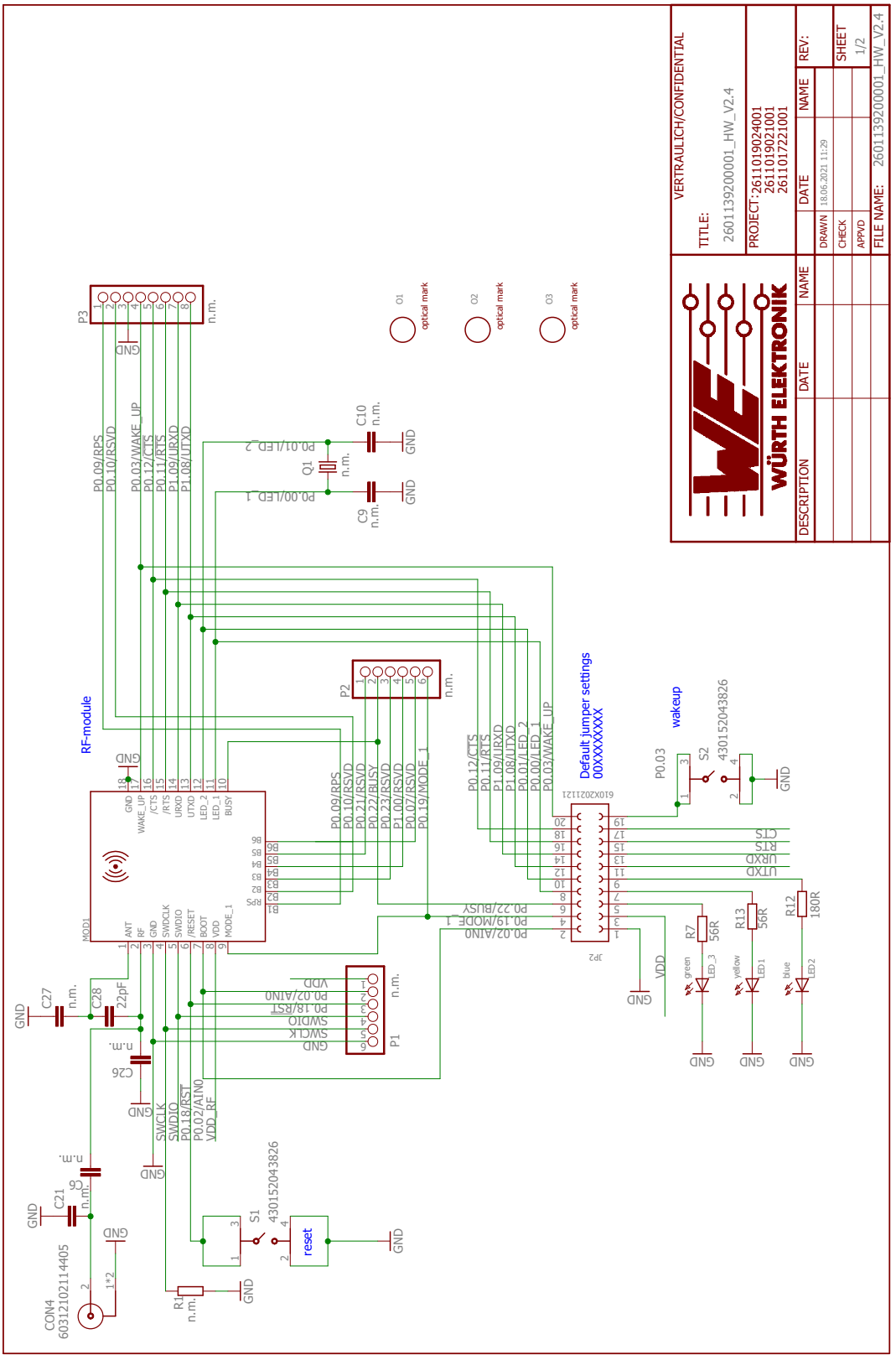

Figure 10: Reference design: Schematic page 1

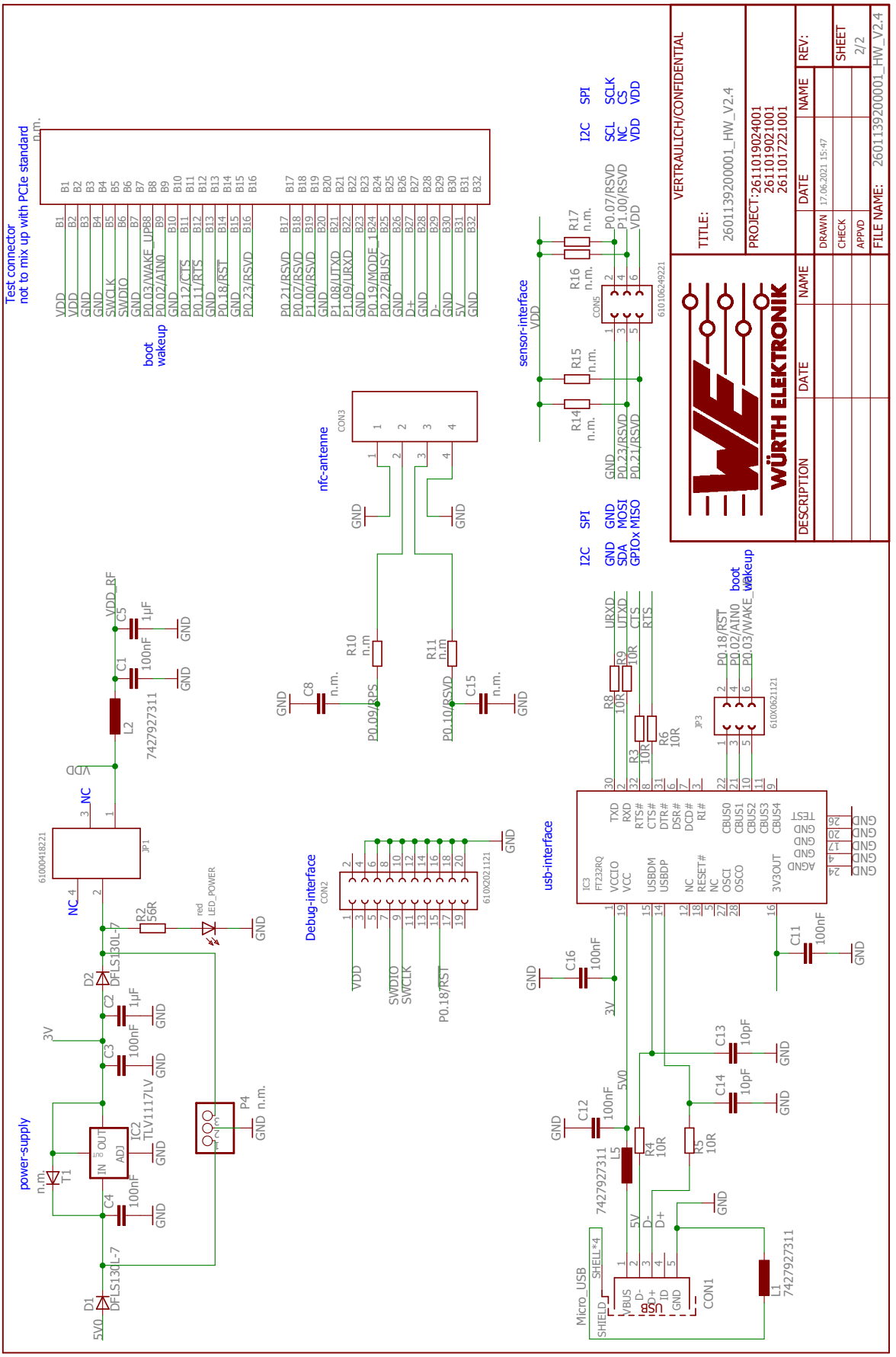

Figure 11: Reference design: Schematic page 2

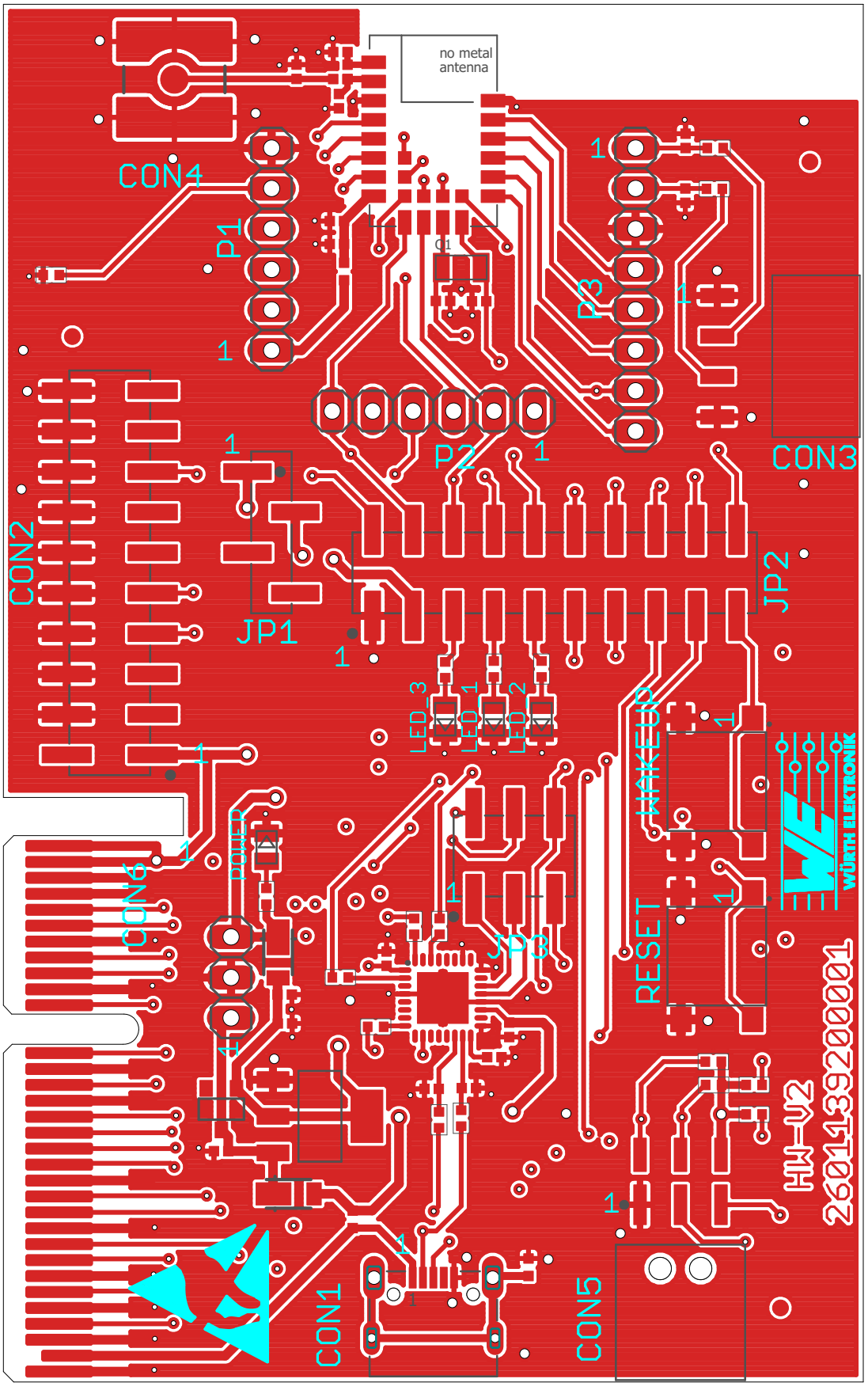

Figure 12: Reference design: Layout

10.2 Trace design

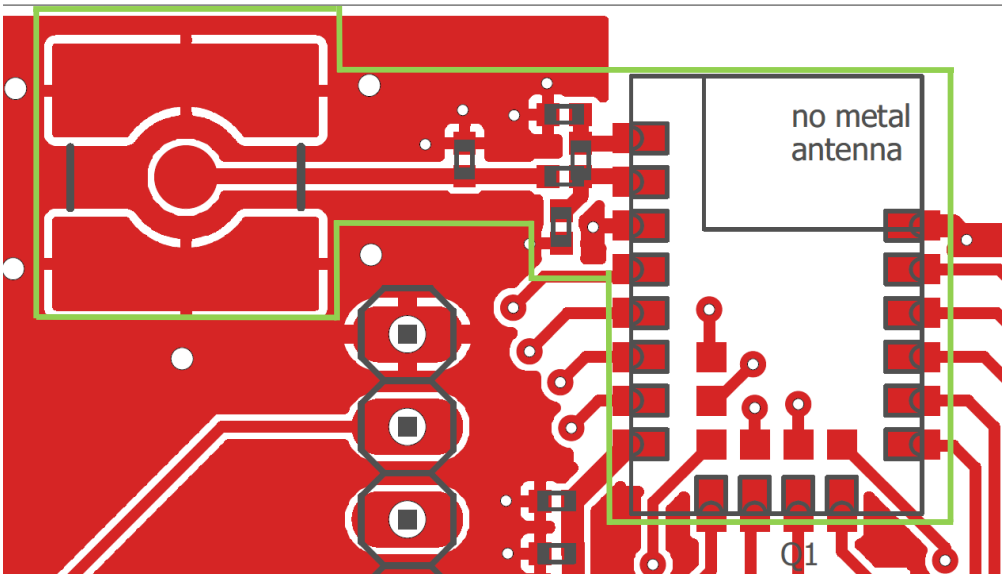

Figure 13: Trace design: Layout

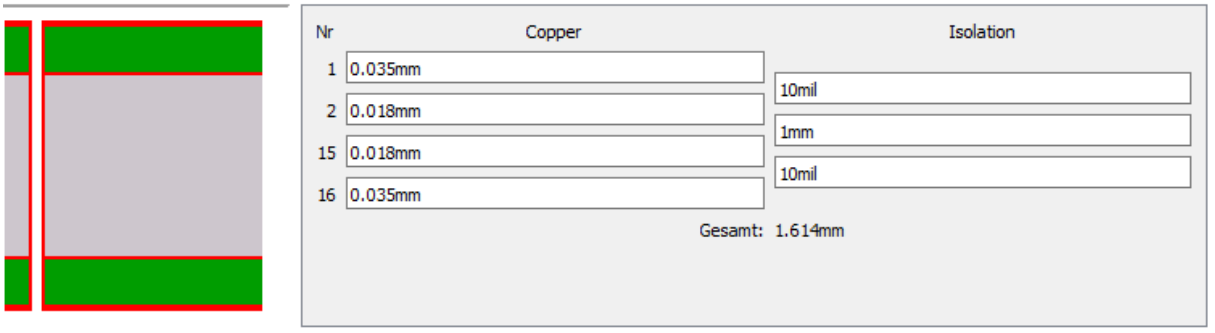

Figure 14: Reference design: Stack-up

- Top layer is used for routing, filled with ground plane except area under the module and antenna free area.
- Second layer is filled with ground plane, except the antenna free area.
- Third layer is the supply layer, except antenna free area. Some routing is allowed, not dividing the supply layer in to many or too small parts.
- Bottom layer is used for routing and filled with ground except antenna free area.

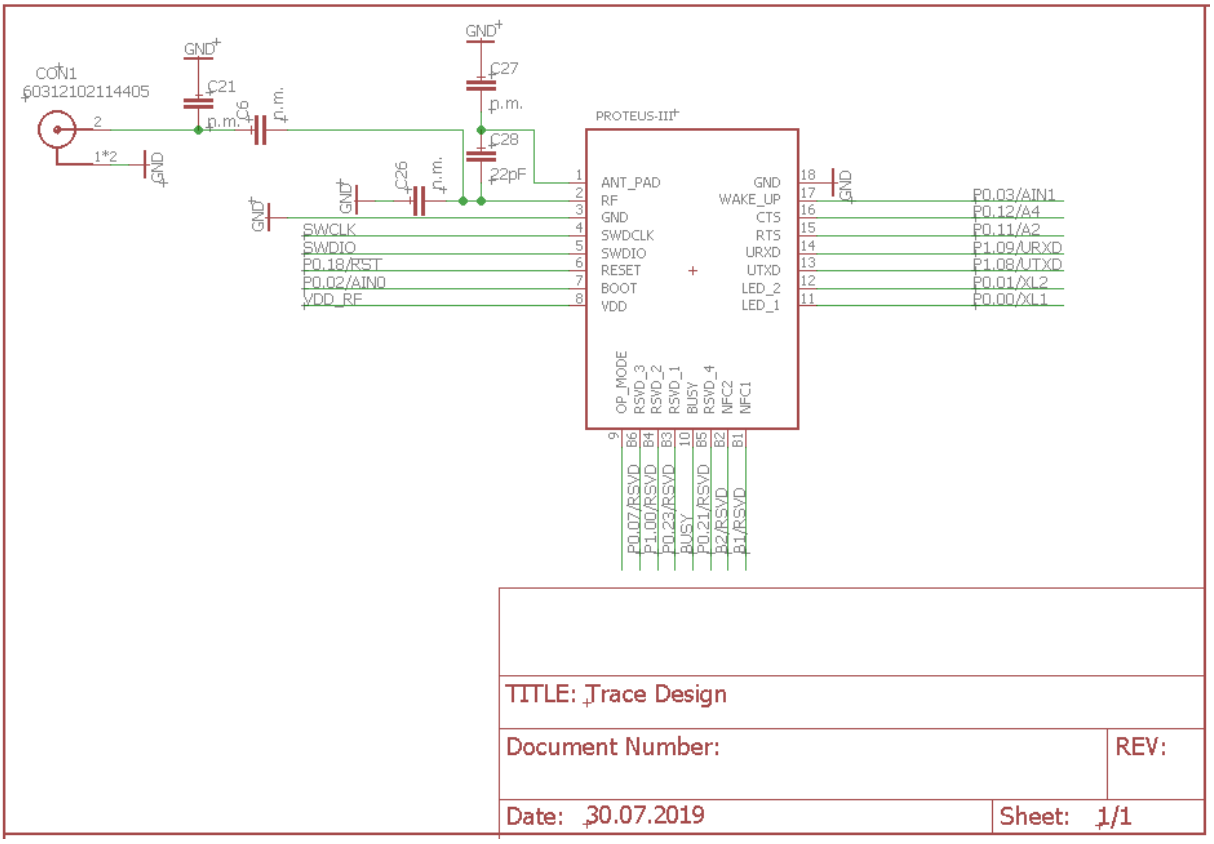

Figure 15: Trace design: Schematic

The RF pin of module can be coupled to on-board PCB antenna or an external antenna. Two variants of the Setebos-I are certified:

- For the on-board PCB antenna: 22 pF shall be assembled on C28.
  - If additional tuning is needed in the end application, C27 and C26 can be assembled.
  - The exact values of C27 and C26 shall be specified in the end application corresponding to the individual need.

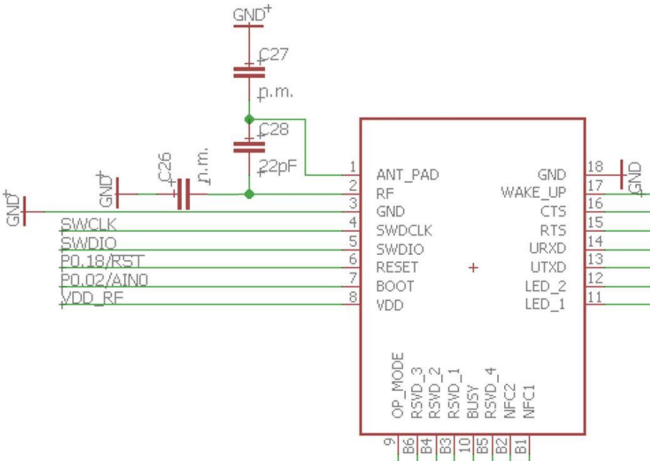

Figure 16: On-board PCB antenna

- For the external antenna: 22 pF shall be assembled on C6.
  - If additional tuning is needed in the end application, C21 and C26 can be assembled.
  - The exact values of C21 and C26 shall be specified in the end application corresponding to the individual need.

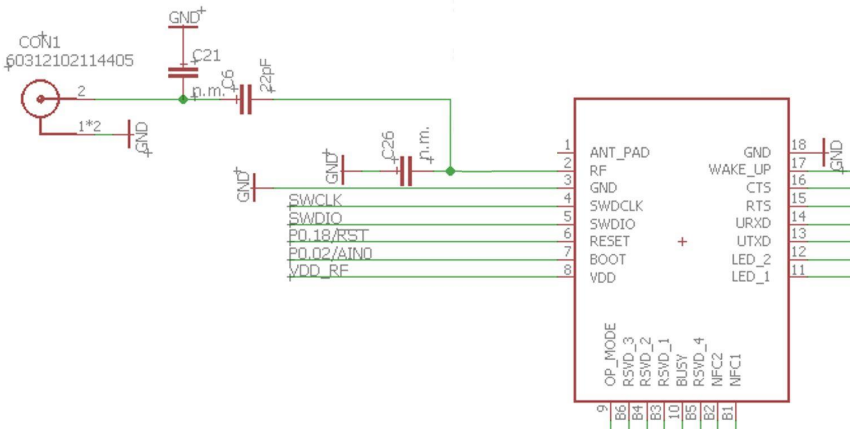

Figure 17: External antenna connection

To reference to the Würth Elektronik eiSos' FCC ID it is mandatory to use the trace design.

11 Manufacturing information

11.1 Moisture sensitivity level

This wireless connectivity product is categorized as JEDEC Moisture Sensitivity Level 3 (MSL3), which requires special handling.

More information regarding the MSL requirements can be found in the IPC/JEDEC J-STD-020 standard on www.jedec.org.

More information about the handling, picking, shipping and the usage of moisture/reflow and/or process sensitive products can be found in the IPC/JEDEC J-STD-033 standard on *www.jedec.org*.

11.2 Soldering

11.2.1 Reflow soldering

Attention must be paid on the thickness of the solder resist between the host PCB top side and the modules bottom side. Only lead-free assembly is recommended according to JEDEC J-STD020.

Profile feature		Value
Preheat temperature Min	$T_{S\ Min}$	150 °C
Preheat temperature Max	$T_{S\ Max}$	200 °C
Preheat time from $T_{S\ Min}$ to $T_{S\ Max}$	t_S	60 - 120 seconds
Ramp-up rate (T_L to T_P)		3 °C / second max.
Liquidous temperature	T_L	217 °C
Time t_L maintained above T_L	t_L	60 - 150 seconds
Peak package body temperature	T_P	see table below
Time within 5 °C of actual peak temperature	t_P	20 - 30 seconds
Ramp-down Rate (T_P to T_L)		6 °C / second max.
Time 20 °C to T_P		8 minutes max.

Table 11: Classification reflow soldering profile, Note: refer to IPC/JEDEC J-STD-020E

Package thickness	Volume mm³ <350	Volume mm³ 350-2000	Volume mm³ >2000
< 1.6 mm	260 °C	260 °C	260 °C
1.6 mm - 2.5 mm	260 °C	250 °C	245 °C
> 2.5 mm	250 °C	245 °C	245 °C

Table 12: Package classification reflow temperature, PB-free assembly, Note: refer to IPC/-JEDEC J-STD-020E

It is recommended to solder this module on the last reflow cycle of the PCB. For solder paste use a LFM-48W or Indium based SAC 305 alloy (Sn 96.5 / Ag 3.0 / Cu 0.5 / Indium 8.9HF / Type 3 / 89%) type 3 or higher.

The reflow profile must be adjusted based on the thermal mass of the entire populated PCB, heat transfer efficiency of the reflow oven and the specific type of solder paste used. Based on the specific process and PCB layout the optimal soldering profile must be adjusted and verified. Other soldering methods (e.g. vapor phase) have not been verified and have to be validated by the customer at their own risk. Rework is not recommended.

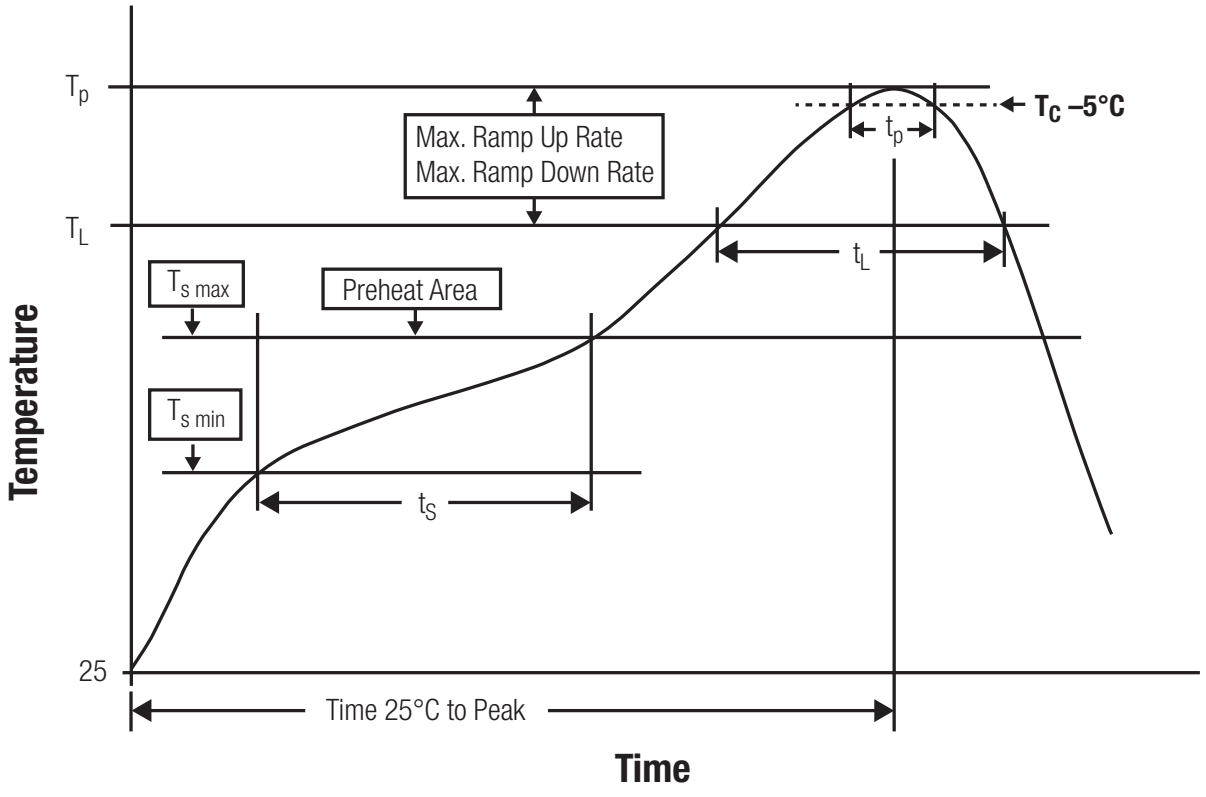

Figure 18: Reflow soldering profile

After reflow soldering, visually inspect the board to confirm proper alignment

11.2.2 Cleaning

Do not clean the product. Any residue cannot be easily removed by washing. Use a "no clean" soldering paste and do not clean the board after soldering.

- Do not clean the product with water. Capillary effects can draw water into the gap between the host PCB and the module, absorbing water underneath it. If water is trapped inside, it may short-circuit adjoining pads. The water may also destroy the label and ink-jet printed text on it.
- Cleaning processes using alcohol or other organic solvents may draw solder flux residues into the housing, which won't be detected in a post-wash inspection. The solvent may also destroy the label and ink-jet printed text on it.
- Do not use ultrasonic cleaning as it will permanently damage the part, particularly the crystal oscillators.

11.2.3 Potting and coating

- If the product is potted in the customer application, the potting material might shrink or expand during and after hardening. Shrinking could lead to an incomplete seal, allowing contaminants into the component. Expansion could damage components. We recommend a manual inspection after potting to avoid these effects.
- Conformal coating or potting results in loss of warranty.
- The RF shield will not protect the part from low-viscosity coatings and potting. An undefined amount of coating and potting will enter inside the shielding.
- Conformal coating and potting will influence the parts of the radio front end and consequently influence the radio performance.
- Potting will influence the temperature behaviour of the device. This might be critical for components with high power.

11.2.4 Other notations

- Do not attempt to improve the grounding by forming metal strips directly to the EMI covers or soldering on ground cables, as it may damage the part and will void the warranty.
- Always solder every pad to the host PCB even if some are unused, to improve the mechanical strength of the module.
- The part is sensitive to ultrasonic waves, as such do not use ultrasonic cleaning, welding or other processing. Any ultrasonic processing will void the warranty.

11.3 ESD handling

This product is highly sensitive to electrostatic discharge (ESD). As such, always use proper ESD precautions when handling. Make sure to handle the part properly throughout all stages of production, including on the host PCB where the module is installed. For ESD ratings, refer to the module series' maximum ESD section. For more information, refer to the relevant chapter 2. Failing to follow the aforementioned recommendations can result in

severe damage to the part.

- the first contact point when handling the PCB is always between the local GND and the host PCB GND, unless there is a galvanic coupling between the local GND (for example work table) and the host PCB GND.
- Before assembling an antenna patch, connect the grounds.
- While handling the RF pin, avoid contact with any charged capacitors and be careful when contacting any materials that can develop charges (for example coaxial cable with around 50-80 pF/m, patch antenna with around 10 pF, soldering iron etc.)
- Do not touch any exposed area of the antenna to avoid electrostatic discharge. Do not let the antenna area be touched in a non ESD-safe manner.
- When soldering, use an ESD-safe soldering iron.

11.4 Safety recommendations

It is your duty to ensure that the product is allowed to be used in the destination country and within the required environment. Usage of the product can be dangerous and must be tested and verified by the end user. Be especially careful of:

- Use in areas with risk of explosion (for example oil refineries, gas stations).
- Use in areas such as airports, aircraft, hospitals, etc., where the product may interfere with other electronic components.

It is the customer's responsibility to ensure compliance with all applicable legal, regulatory and safety-related requirements as well as applicable environmental regulations. Disassembling the product is not allowed. Evidence of tampering will void the warranty.

- Compliance with the instructions in the product manual is recommended for correct product set-up.
- The product must be provided with a consolidated voltage source. The wiring must meet all applicable fire and security prevention standards.
- Handle with care. Avoid touching the pins as there could be ESD damage.

Be careful when working with any external components. When in doubt consult the technical documentation and relevant standards. Always use an antenna with the proper characteristics.

Würth Elektronik eiSos radio modules with high output power of up to 500 mW, as for example the radio module Thebe-II, generate a high amount of warmth while transmitting. The manufacturer of the end device must take care of potentially necessary actions for his application.

12 Physical dimensions

12.1 Dimensions

Dimensions
12 x 8 x 2 mm

Table 13: Dimensions

12.2 Weight

Weight
<1g

Table 14: Weight

12.3 Module drawing

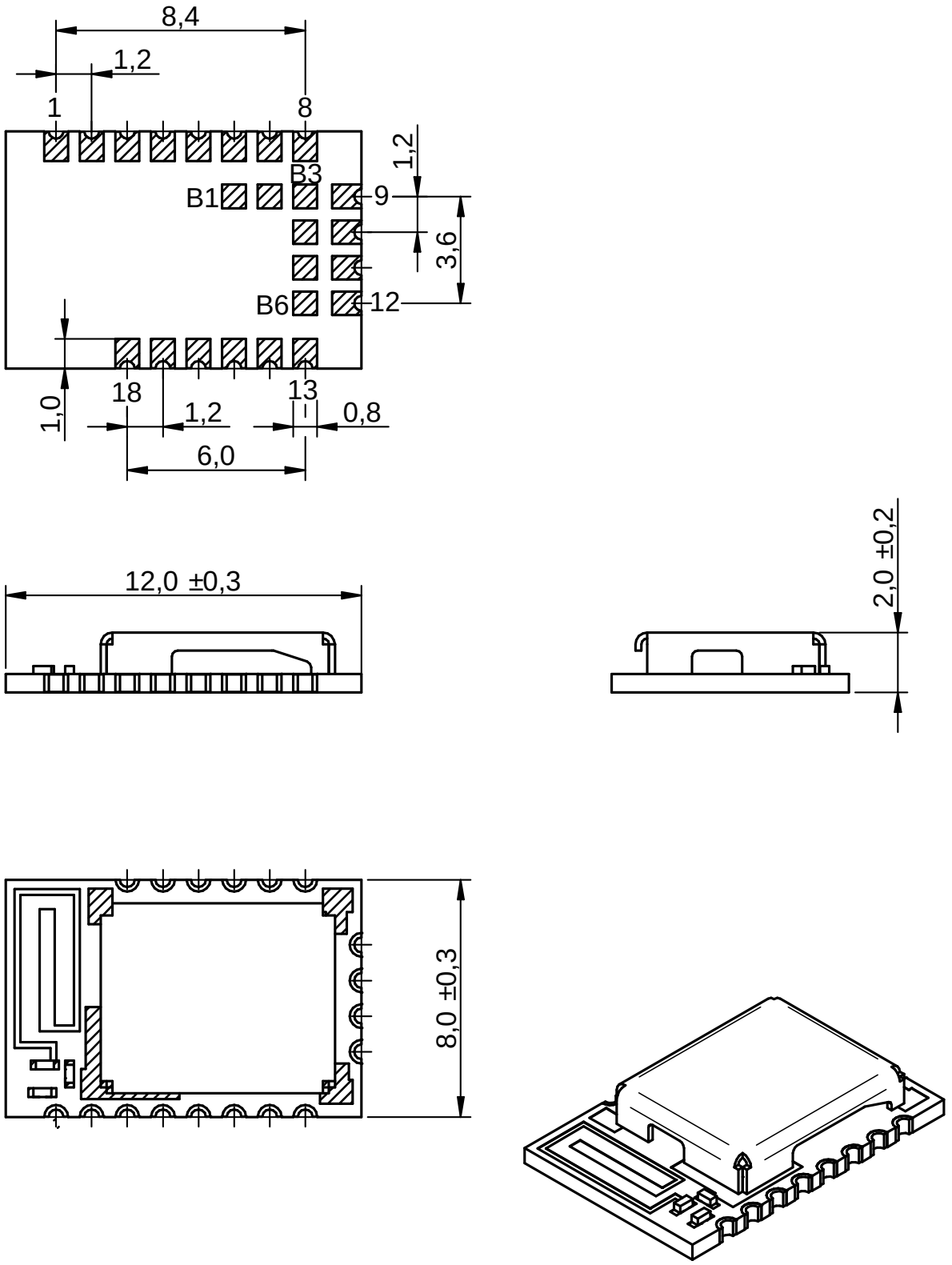

Figure 19: Module dimensions [mm]

12.4 Footprint WE-FP-4+

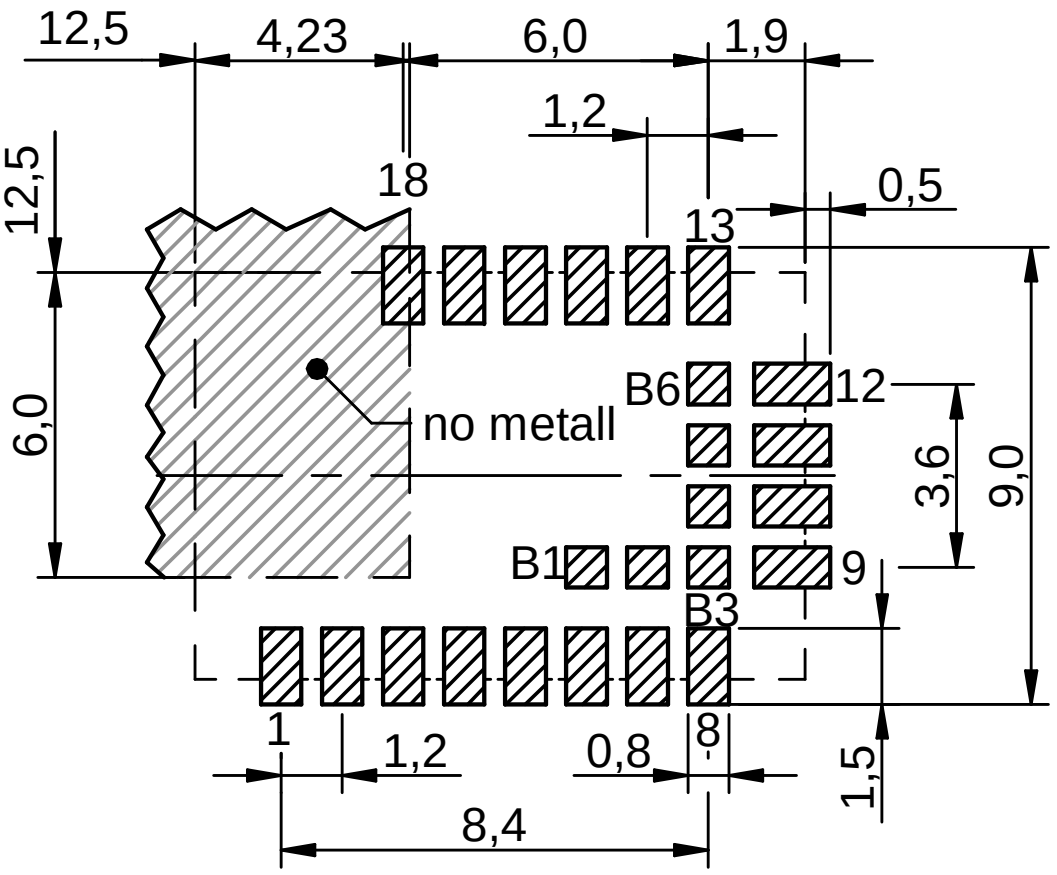

Figure 20: Footprint WE-FP-4+ [mm]

12.5 Antenna free area

To avoid influence and mismatching of the antenna the recommended free area around the antenna should be maintained. As rule of thumb a minimum distance of metal parts to the antenna of λ/10 should be kept (see figure 20). Even though metal parts would influence the characteristic of the antenna, but the direct influence and matching keep an acceptable level.

13 Marking

13.1 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.

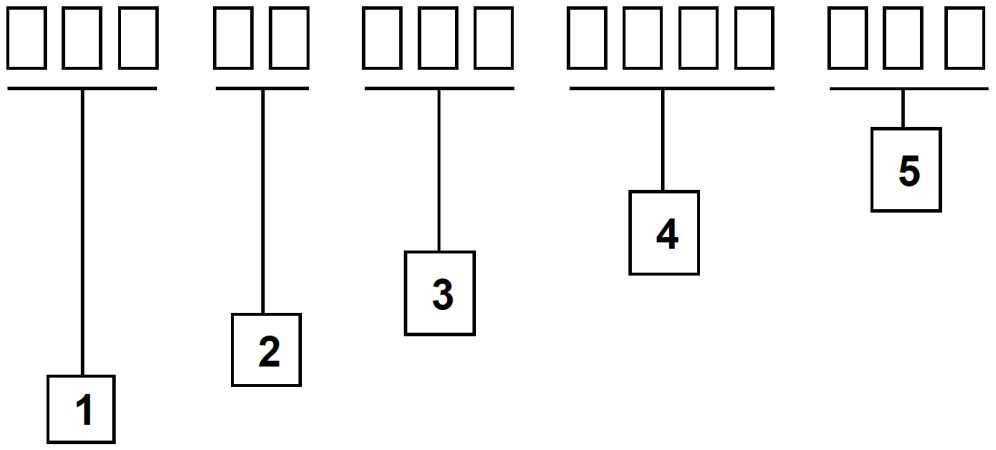

Figure 21: Lot number structure

Block	Information	Example(s)
1	eiSos internal, 3 digits	439
2	eiSos internal, 2 digits	01
3	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	Firmware version, 3 digits	V3.2 = 302, V5.13 = 513

Table 15: 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.

13.2 General labeling information

The module labels may include the following fields:

- Manufacturer identification WE, Würth Elektronik or Würth Elektronik eiSos
- WE Order Code and/or article alias
- Serial number or MAC address
- Certification identifiers (CE, FCC ID, IC, ARIB,...)
- Bar code or 2D code containing the serial number or MAC address

If the module is using a Serial Number, this serial number includes the product ID (PID) and an 6 digit number. The 6 rightmost digits represent the 6 digit number, followed by the product ID (2 or 3 digits). Some labels indicate the product ID with a "." as marker in-between the 2 fields. The PID and the 6 digit number form together a unique serial number for any wireless connectivity product.
In case of small labels, the 3 byte manufacturer identifier (0x0018DA) of the MAC address is not printed on the labels. The 3 byte counter printed on the label can be used with this 0018DA to produce the full MAC address by appending the counter after the manufacturer identifier.

Figure 22: Label of the Setebos-I

14 Information for explosion protection

In case the end product should be used in explosion protection areas the following information can be used:

- The module itself is unfused.
- The maximum output power of the module is 6 dBm for external antenna and 4 dBm for internal antenna.
- The total amount of capacitance of all capacitors is 7.2 µF.
- The total amount of inductance of all inductors is 10.025 µH.
- A DC/DC regulator is included in the chip set and used to obtain low power functionality.

15 References

[1] Würth Elektronik. Proteus-III user manual. https://www.we-online.de/katalog/de/manual/2611011024000.

[2] Würth Elektronik. Thyone-I user manual. https://www.we-online.de/katalog/de/manual/2611011021000.

16 Regulatory compliance information

16.1 Important notice EU

The use of RF frequencies is limited by national regulations. The Setebos-I has been designed to comply with the R&TTE directive 1999/5/EC and the RED directive 2014/53/EU of the European Union (EU).
The Setebos-I can be operated without notification and free of charge in the area of the European Union. However, according to the R&TTE / RED directive, restrictions (e.g. in terms of duty cycle or maximum allowed RF power) may apply.

Since the module itself is not fused the voltage supply shall be fed from a power source which is class PS2 according to EN 62368-1.

16.2 Important notice FCC

The use of RF frequencies is limited by national regulations. The Setebos-I has been designed to comply with the FCC Part 15.
The Setebos-I can be operated without notification and free of charge in the area of the United States of America. However, according to the FCC Part 15, restrictions (e.g. in terms of maximum allowed RF power and antenna) may apply.

16.3 Conformity assessment of the final product

The Setebos-I is a subassembly. It is designed to be embedded into other products (products incorporating the Setebos-I are henceforward referred to as "final products").
It is the responsibility of the manufacturer of the final product to ensure that the final product is in compliance with the essential requirements of the underlying national radio regulations. The conformity assessment of the subassembly Setebos-I carried out by Würth Elektronik eiSos does not replace the required conformity assessment of the final product.

16.4 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.

16.5 EU Declaration of conformity

EU DECLARATION OF CONFORMITY

Radio equipment: **2611011024020**

The manufacturer: Würth Elektronik eiSos GmbH & Co. KG
Max-Eyth-Straße 1
74638 Waldenburg

This declaration of conformity is issued under the sole responsibility of the manufacturer.

Object of the declaration: 2611011024020

The object of the declaration described above is in conformity with the relevant Union harmonisation legislation Directive 2014/53/EU and 2011/65/EU with its amending Annex II EU 2015/863 . Following harmonised norms or technical specifications have been applied:

EN 300 328 V2.2.2 (2019-07)
EN 301 489-1 V2.2.3 (2019-11)
EN 301 489-17 V3.2.4 (2020-09)
EN 62479 : 2010
EN 62368-1:2014 + AC:2015 +A11:2019

i.A. G. Erdrich

Trier, 20th of May 2021
Place and date of issue

16.6 FCC Compliance Statement

FCC ID: R7T1101102

This device complies with Part 15 of the FCC Rules.
Operation is subject to the following two conditions:
(1) this device may not cause harmful interference, and
(2) this device must accept any interference received, including interference that may cause undesired operation.
(FCC 15.19)

Modifications (FCC 15.21)

Caution: Changes or modifications for this equipment not expressly approved by Würth Elektronik eiSos may void the FCC authorization to operate this equipment.

16.7 IC Compliance Statement

Certification Number: 5136A-1101102
PMN: 1101102
This device complies with Industry Canada licence-exempt RSS standard(s). Operation is subject to the following two conditions: (1) this device may not cause harmful interference, and (2) this device must accept any interference received, including interference that may cause undesired operation.
Le présent appareil est conforme aux CNR d'Industrie Canada applicables aux appareils radio exempts de licence. L'exploitation est autorisée aux deux conditions suivantes : (1) l'appareil ne doit pas produire de brouillage, et (2) l'utilisateur de l'appareil doit accepter tout brouillage radioélectrique subi, même si le brouillage est susceptible d'en compromettre le fonctionnement.

16.8 FCC and IC requirements to OEM integrators

This module has been granted modular approval. OEM integrators for host products may use the module in their final products without additional FCC/IC (Industry Canada) certification if they meet the following conditions. Otherwise, additional FCC/IC approvals must be obtained.
The host product with the module installed must be evaluated for simultaneous transmission requirements.

- The users manual for the host product must clearly indicate the operating requirements and conditions that must be observed to ensure compliance with current FCC/IC RF exposure guidelines.
- To comply with FCC/IC regulations limiting both maximum RF output power and human exposure to RF radiation, the maximum antenna gain including cable loss in a mobile-only exposure condition must not exceed 6dBi.
- A label must be affixed to the outside of the host product with the following statements:
  This device contains FCCID: R7T1101102
  This equipment contains equipment certified under ICID: 5136A-1101102

- The final host / module combination may also need to be evaluated against the FCC Part 15B criteria for unintentional radiators in order to be properly authorized for operation as a Part 15 digital device.
- If the final host / module combination is intended for use as a portable device (see classifications below) the host manufacturer is responsible for separate approvals for the SAR requirements from FCC Part 2.1093 and RSS-102.

OEM requirements:
The OEM must ensure that the following conditions are met.

- The Setebos-I will be used at a distance of at least 10 mm.
- End users of products, which contain the module, must not have the ability to alter the firmware that governs the operation of the module. The agency grant is valid only when the module is incorporated into a final product by OEM integrators.
- The end-user must not be provided with instructions to remove, adjust or install the module.
- The Original Equipment Manufacturer (OEM) must ensure that FCC labeling requirements are met. This includes a clearly visible label on the outside of the final product. Attaching a label to a removable portion of the final product, such as a battery cover, is not permitted.
- The label must include the following text:
  Contains FCC ID: R7T1101102
  The enclosed device complies with Part 15 of the FCC Rules. Operation is subject to the following two conditions:
  (i.) this device may not cause harmful interference and
  (ii.) this device must accept any interference received, including interference that may cause undesired operation.

  When the device is so small or for such use that it is not practicable to place the statement above on it, the information required by this paragraph shall be placed in a prominent location in the instruction manual or pamphlet supplied to the user or, alternatively, shall be placed on the container in which the device is marketed. However, the FCC identifier or the unique identifier, as appropriate, must be displayed on the device.
- The user manual for the end product must also contain the text given above.
  - Changes or modifications not expressly approved could void the user's authority to operate the equipment.
  - The OEM must ensure that timing requirements according to 47 CFR 15.231(a-c) are met.
  - The OEM must sign the OEM Modular Approval Agreement.
  - The module must be used with only the following approved antenna(s).

16.8.1 Pre-certified antennas

The Setebos-I is pre-certified with the following antennas.

Product	Certified antenna
Setebos-I (2611011024020)	PCB antenna included in the Setebos-I

17 Important notes

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

17.1 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.

17.2 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 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.

17.3 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.

17.4 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 field sales engineer or the internal sales person in charge should be contacted who will be happy to support in this matter.

17.5 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 field sales engineer, the internal sales person or the technical support team in charge should be contacted. The basic responsibility of the customer as per section 17.1 and 17.2 remains unaffected. All wireless connectivity module driver software ¨wireless connectivity SDK¨ and it's source codes as well as all PC software tools are not subject to the Product Change Notification information process.

17.6 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 field sales engineer 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.

17.7 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.

17.8 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*.

18 Legal notice

18.1 Exclusion of liability

Würth Elektronik eiSos GmbH & Co. KG considers the information in this document to be correct at the time of publication. However, Würth Elektronik eiSos GmbH & Co. KG reserves the right to modify the information such as technical specifications or functions of its products or discontinue the production of these products or the support of one of these products without any written announcement or notification to customers. The customer must make sure that the information used corresponds to the latest published information. Würth Elektronik eiSos GmbH & Co. KG does not assume any liability for the use of its products. Würth Elektronik eiSos GmbH & Co. KG does not grant licenses for its patent rights or for any other of its intellectual property rights or third-party rights.

Notwithstanding anything above, Würth Elektronik eiSos GmbH & Co. KG makes no representations and/or warranties of any kind for the provided information related to their accuracy, correctness, completeness, usage of the products and/or usability for customer applications. Information published by Würth Elektronik eiSos GmbH & Co. KG regarding third-party products or services does not constitute a license to use such products or services or a warranty or endorsement thereof.

18.2 Suitability in customer applications

The customer bears the responsibility for compliance of systems or units, in which Würth Elektronik eiSos GmbH & Co. KG products are integrated, with applicable legal regulations. Customer acknowledges and agrees that it is solely responsible for compliance with all legal, regulatory and safety-related requirements concerning its products, and any use of Würth Elektronik eiSos GmbH & Co. KG components in its applications, notwithstanding any applications-related in-formation or support that may be provided by Würth Elektronik eiSos GmbH & Co. KG. Customer represents and agrees that it has all the necessary expertise to create and implement safeguards which anticipate dangerous consequences of failures, monitor failures and their consequences lessen the likelihood of failures that might cause harm and take appropriate remedial actions. The customer will fully indemnify Würth Elektronik eiSos GmbH & Co. KGand its representatives against any damages arising out of the use of any Würth Elektronik eiSos GmbH & Co. KG components in safety-critical applications.

18.3 Trademarks

AMBER wireless is a registered trademark of Würth Elektronik eiSos GmbH & Co. KG. All other trademarks, registered trademarks, and product names are the exclusive property of the respective owners.

18.4 Usage restriction

Würth Elektronik eiSos GmbH & Co. KG products have been designed and developed for usage in general electronic equipment only. This product is not authorized for use in equipment where a higher safety standard and reliability standard is especially required or where a failure of the product is reasonably expected to cause severe personal injury or death,

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The responsibility for the applicability and use of the Würth Elektronik eiSos wireless connectivity product with the incorporated Firmware in a particular customer design is always solely within the authority of the customer. Due to this fact, it is up to you to evaluate and investigate, where appropriate, and to decide whether the device with the specific product characteristics described in the product specification is valid and suitable for your respective application or not.
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.
Würth Elektronik eiSos' products with the incorporated Firmware are not authorized for use in safety-critical applications, or where a failure of the product is reasonably expected to cause severe personal injury or death. Moreover, Würth Elektronik eiSos' products with the incorporated Firmware are neither designed nor intended for use in areas such as military, aerospace, aviation, nuclear control, submarine, transportation (automotive control, train control, ship control), transportation signal, disaster prevention, medical, public information network etc. You shall inform Würth Elektronik eiSos about the intent of such usage before design-in stage. In certain customer applications requiring a very high level of safety and in which the malfunction or failure of an electronic component could endanger human life or

health, you must ensure to have all necessary expertise in the safety and regulatory ramifications of your applications. You acknowledge and agree that you are solely responsible for all legal, regulatory and safety-related requirements concerning your products and any use of Würth Elektronik eiSos' products with the incorporated Firmware in such safety-critical applications, notwithstanding any applications-related information or support that may be provided by Würth Elektronik eiSos. YOU SHALL INDEMNIFY WÜRTH ELEKTRONIK EISOS AGAINST ANY DAMAGES ARISING OUT OF THE USE OF WÜRTH ELEKTRONIK EISOS' PRODUCTS WITH THE INCORPORATED FIRMWARE IN SUCH SAFETY-CRITICAL APPLICATIONS.

19.3 Ownership

The incorporated Firmware created by Würth Elektronik eiSos is and will remain the exclusive property of Würth Elektronik eiSos.

19.4 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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Applicable law to this license terms shall be the laws of the Federal Republic of Germany. Any dispute, claim or controversy arising out of or relating to this license terms shall be resolved and finally settled by the court competent for the location of Würth Elektronik eiSos' registered office.

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If a provision of this license terms is or becomes invalid, unenforceable or null and void, this shall not affect the remaining provisions of the terms. The parties shall replace any such provisions with new valid provisions that most closely approximate the purpose of the terms.

19.9 Miscellaneous

Würth Elektronik eiSos reserves the right at any time to change this terms at its own discretion. It is your responsibility to check at Würth Elektronik eiSos homepage for any updates. Your continued usage of the products will be deemed as the acceptance of the change.
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.
By ordering a wireless connectivity product, you accept this license terms in all terms.

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