PUCK-I REFERENCE MANUAL

AMB2301 / 2604021024000

VERSION 2.4

JUNE 4, 2020

Revision history

Manual version	FW version	HW version	Notes	Date
1.0 - 1.2	12.2	1.1	• Initial version	June 2018
2.1	12.2	1.1	• New corporate design and structure	November 2018
2.2	12.2	1.1	• Added chapter `Information for Ex protection`	March 2019
2.3	12.2	1.1	• Updated label in chapter `General labeling information` • Updated address of Division Wireless Connectivity & Sensors location	October 2019
2.4	12.2	1.1	• Updated label in chapter `General labeling information` • Added Declaration of conformity for Japan. • Actualized EU declaration of conformity	June 2020

Contents

1 Introduction

1.1 Operational description

Würth Elektronik eiSos provides with the Puck-I a certified, qualified and listed Bluetooth® class 2 module. It is based on LMX9830 from Texas Instruments. This module is qualified for a serial data or audio transmission.

The module has an integrated PCB-antenna and can be placed into a circuit with surface mount techniques.

Puck-I comes with an integrated firmware with the complete Bluetooth® Stack (Bluetooth® 2.0). The stack supports SPP, GAP, SDAP, DUN, OBEX, HSP and other profiles.

A Point-to-Point connection and a Point-to-Multipoint (Piconet) connection are supported by the firmware. Up to seven active links (Piconet) and one SCO-link (Audio) are possible.

The module can be integrated easily in a system. According to the application and the settings the Puck-I can work as a stand-alone-slave-module e.g. as a virtual cable replacement in combination with any other commercial Bluetooth® system.

1.2 Block diagram

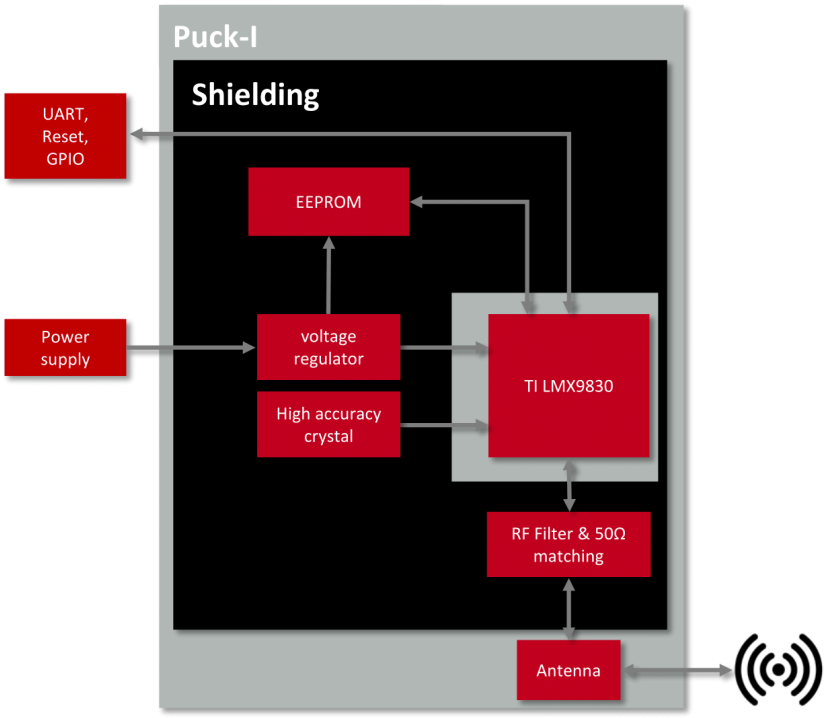


Figure 1: Block diagram

1.3 Ordering information

WE order code	Former order code	Description
2604021024001	AMB2301	Bluetooth® 2.0 module 2.4 GHz with integrated PCB antenna
2604021024000	AMB2301-TR	Bluetooth® 2.0 module 2.4 GHz with integrated PCB antenna, Tape & Reel
2604021024009	AMB2301-DEV	Bluetooth® 2.0 module development kit
2004029024001	AMB2301-EV	Bluetooth® 2.0 evaluation kit

Table 1: Ordering information

2 Physical parameters

Type	Value
Voltage supply	2.9 to 3.6V
Current consumption	typ. 65mA
RF output	typ. 0dBm (Class 2)
Rx sensitivity	typ. -80dBm
Data rate UART	2.4 to 921.6 kbits/s
Operating temperature	-40 °C to 85 °C
Antenna	Integrated PCB antenna
Maximum input level	-10dBm
Dimension	27.5 x 16.0 x 3.5mm
Bluetooth® default PIN	0000
Miscellaneous	All further technical data are according to the LMX9830 IC documentation of Texas Instruments

Table 2: Physical parameters

3 Pinout

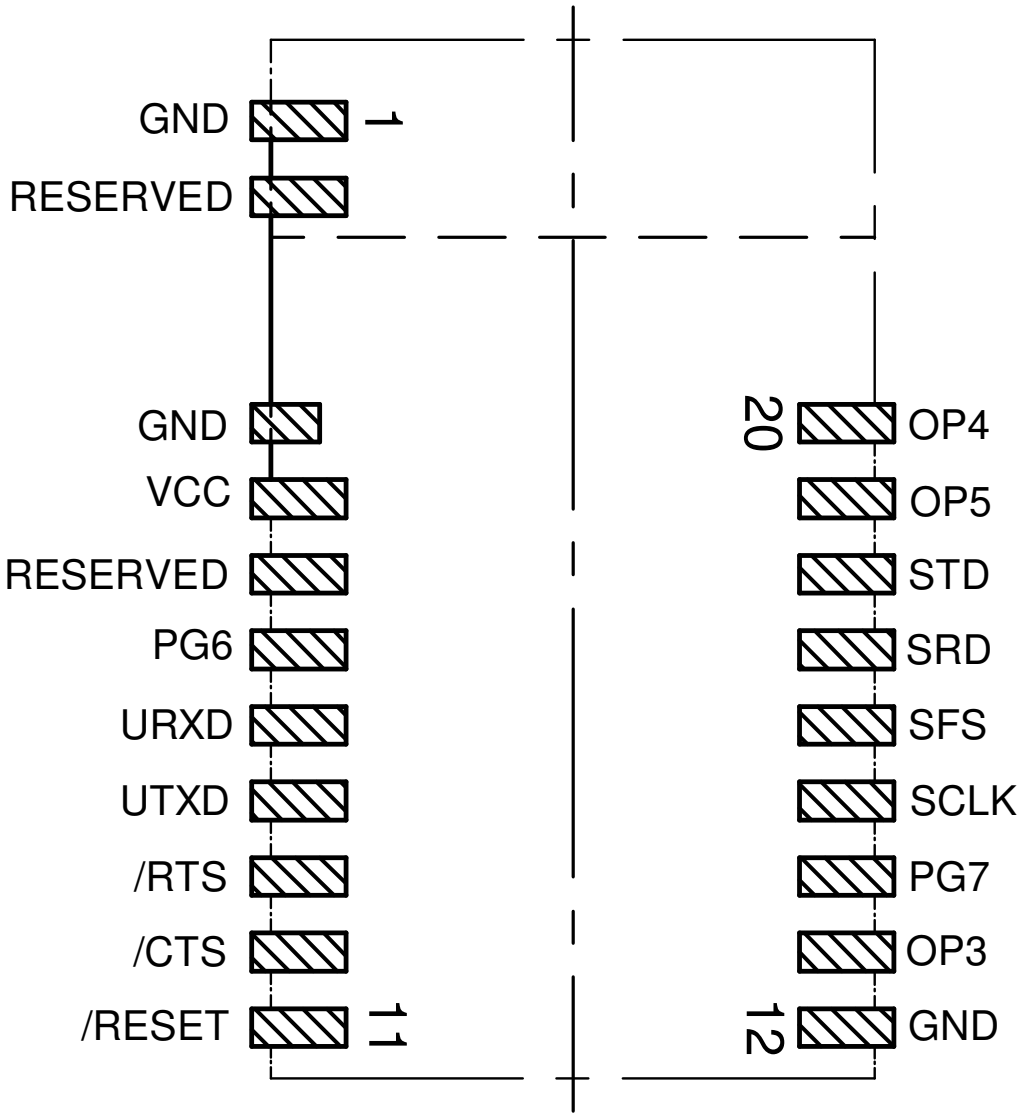


Figure 2: Pinout (top view)

Pin name	Typ [1]	Notice
GND		Ground
OP3	I	Must be connected to VCC
PG7	I/O	GPIO (default setting: UART activity)
SCLK	I/O	Audio PCM Interface Clock
SFS	I/O	Audio PCM Interface Frame Synchronization
SRD	I	Audio PCM Interface Receive Data Input
STD	O	Audio PCM Interface Transmit Data Output
OP5	I	Configuration UART-data rate at Start up
OP4	I/O	Configuration UART-data rate at Start up, otherwise GPIO
/RESET	I	Reset, internal Pull up, active low
/CTS	I	Host Serial Port Clear To Send, active low [2]
/RTS	O	Host Serial Port Request To Send, active low [3]
UTXD	O	Host Serial Port Transmit Data
URXD	I	Host Serial Port Receive Data
PG6	I/O	GPIO (default setting: Bluetooth® link status)
RESERVED		Reserved. Do not connect.
VCC		Power supply, 2.9V to 3.6V

Table 3: Pinout

3.1 Minimum connection to run the Puck-I

In order to realize a radio transmission, the following connections of the Puck-I have to be wired:

1. *VCC*, *GND*: Power supply
2. *URXD*, *UTXD*: UART data
3. */RTS*, */CTS*: UART handshake; if does not need: short RTS and CTS or contact CTS at GND (without flow control it can come to overrun and lost data)
4. *OP3*: High (connect to VCC)
5. *OP4*, *OP5*: Configuration UART (open or 1K Ω pull-up)

All other pins don't need to be connected.

[1] I = Input, O = Output
[2] Connect with ground if not used
[3] Not connected if not used

3.2 Default settings

All parameters are stored inside the internal EEPROM. In the Bluetooth® environment, the device announces itself as a XXXXXX (Device Name), whereas XXXXXX has to be replaced by the device's Bluetooth® address.

3.3 Detailed Description

3.3.1 UART configuration

The serial interface of the Puck-I must be configured as follows:

OP4	*OP5*	Function
Open	Open	UART speed read from NVS (EEPROM)
Open	High	UART speed 9.6 kbps
High	Open	UART speed 115.2 kbps
High	High	UART speed 921.6 kbps

Use external 1kΩ pull ups to achieve compatible OP4 and OP5 HIGH level.

While module boot up *OP4* and *OP5* are pulled down internally. Using other pull up resistor values as stated above can lead to malfunctions.

3.3.2 UART interface

The interface serves for communication with the Puck-I. Hardware handshake is used (*RTS*/*CTS*). If this should not be supported by the host system, */RTS* and */CTS* must be short circuit or */CTS* pulled down to LOW level. This can lead to data loss due to overrun of either the module or the host.
Therefore it is highly recommended to use UART handshake.

3.3.3 Details to the remaining connections of the Puck-I

1. */RESET*: Internal Pull up, low active, no external pull up recommended
2. *SCLK*, *SFS*, *SRD*, *STD*: Audio interface, if not used, pins does not attached
3. *PG6*, *PG7*: I/O ports, if not used, pins does not attached
4. *VCC*, *GND*: Power supply

4 Command interface

The Puck-I based on LMX9830 provides a simple Commando Interface. Detailed Information can be found in the IC documentation from the Texas Instruments homepage. To simplify the use of this commands further a PC tool, the "Simply Blue Commander" is available from the Texas Instruments homepage.

5 Hardware integration

5.1 Dimension

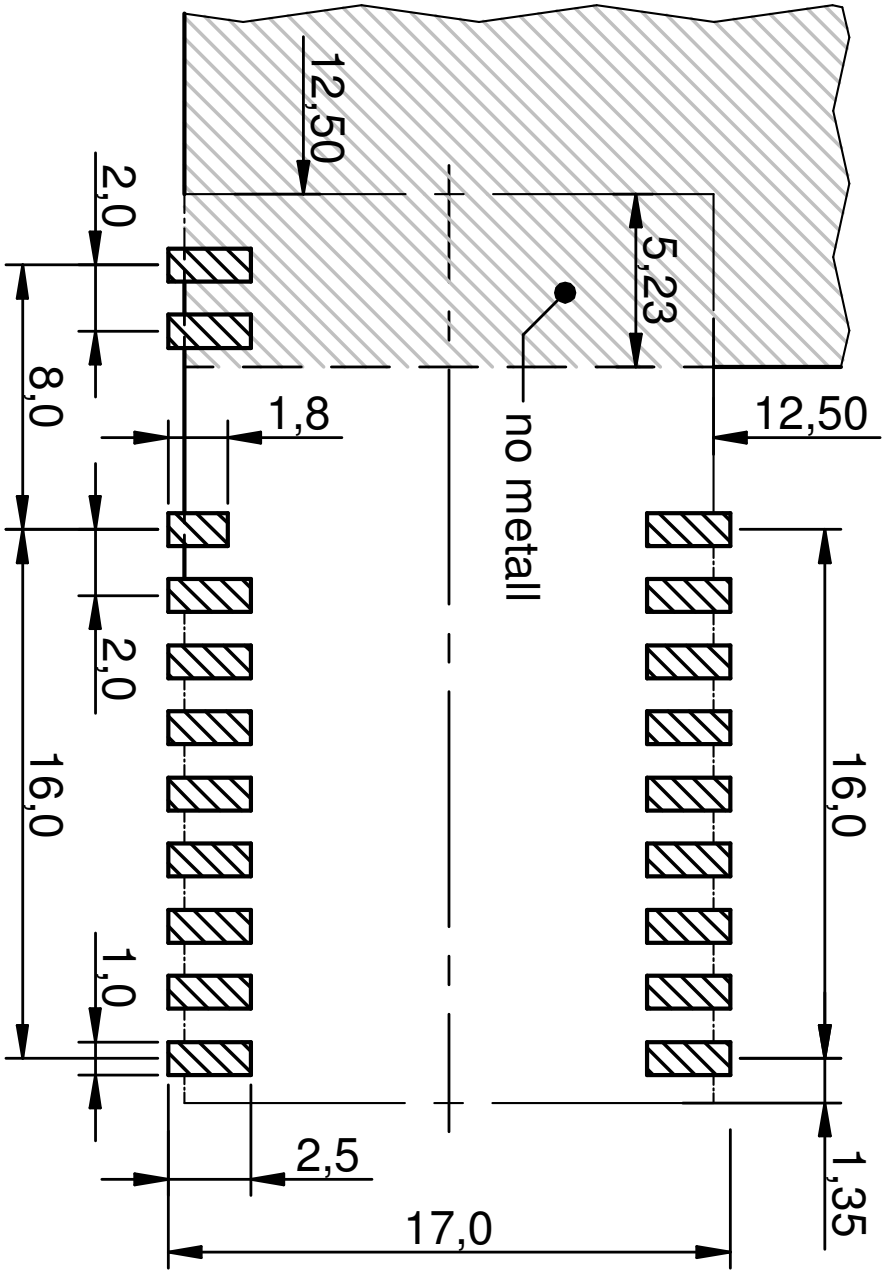


Figure 3: Measures, recommended distance to antenna

5.2 Design recommendation

5.2.1 Layout

To achieve the maximum of range no metal (ground, strip line, components, etc..) has to be near the antenna, as shown hatched in the following figure. The antenna should have a distance of minimum 12.5mm to any ground, strip line or component. Most suitable is to place the antenna at the edge of the motherboard.

Caution: The Puck-I is not isolated on the bottom side, so even if there are normally no short circuit problems because of the solder resist, an isolation should be placed between Puck-I and motherboard in case of any copper on the top side of the motherboard underneath the Puck-I.

5.2.2 Power supply

For a reliable operation of the module, the power supply has to be provided with a slew rate over 3V per 500 microseconds. Take care of having no voltage on any pin until the power supply is turned on properly. Further advice on the power supply can be obtained from the Ti LMX9830 documentation.

Pay attention to remaining charges of smoothing capacitors.

5.2.3 System start up sequence

Apply VCC to the module. For a reliable operation of the module, the power supply has to be provided with a slew rate over 3V per 500 microseconds.
The RESET_BB should be driven high for another 1ms after VCC is stable.
A typical module start up time is 30ms.

6 Migration from AMB2300 to Puck-I

There is no modification required regarding hardware connection or connection to the host (soft and hardware).

Due to the new integrated antenna any Radio Matters inside the end application shall be retested.

No modification concerning the Bluetooth® listing is required, as the Puck-I comes under the same Declaration ID as the AMB2300. Customer Listings are supposed to link to the Declaration ID "D013784" of Puck-I.

Bluetooth® Listing of end applications and devices is mandatory.

7 References

[1] LMX9830 Data Sheet

[2] LMX9830 Software User's Guide

[3] Simply Blue Commander

8 Design in guide

8.1 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 misfunction. 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.).

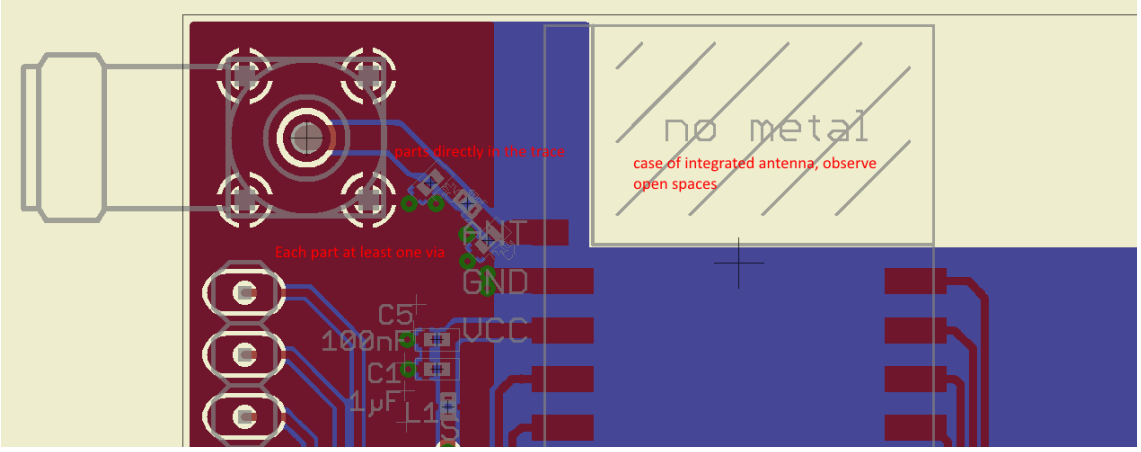


Figure 4: Layout

- 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.

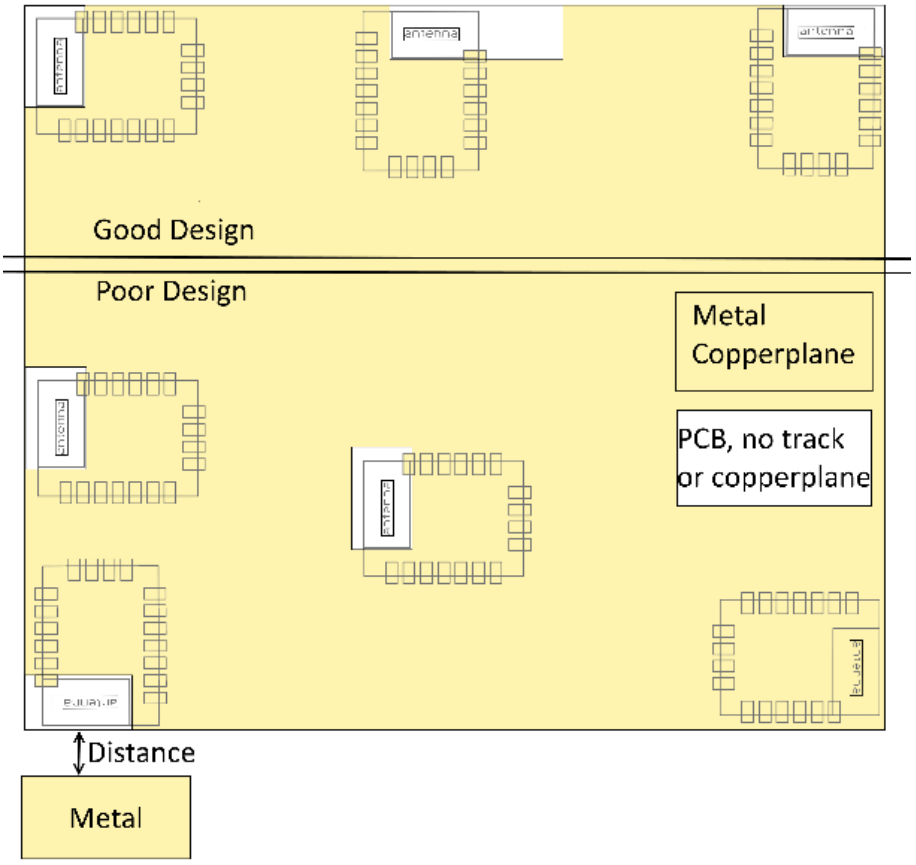


Figure 5: Placement of the module with integrated antenna

8.2 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 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

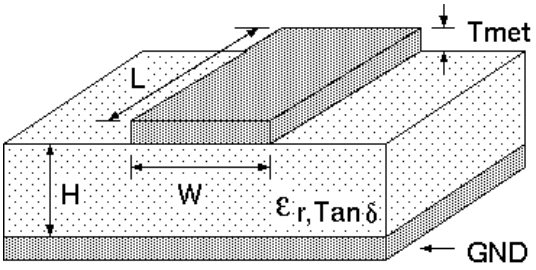


Figure 6: Dimensioning the antenna feed line as micro strip

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.

8.3 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 behavior 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.

8.3.1 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.

8.3.2 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.

8.3.3 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.

8.3.4 Antennas provided by Würth Elektronik eiSos

8.3.4.1 2600130011 - Helike - 169 MHz dipole antenna

Figure 7: 169 MHz dipole-antenna

Specification	Value
Frequency range [MHz]	169
Impedance [Ω]	50
VSWR	$\leq$ 2.1
Gain [dBi]	1
Dimensions (L x d) [mm]	320 x 15
Weight [g]	42
Connector	SMA plug
Operating Temp. [°C]	-40 – +85

This antenna requires a ground plane which will influence the electrical parameters.

8.3.4.2 2600130041 - Herse - 434 MHz dipole antenna

Figure 8: 434 MHz dipole-antenna

Specification	Value
Frequency range [MHz]	433
Impedance [Ω]	50
VSWR	$\leq$ 1.5
Polarization	Vertical
Radiation	Omni
Gain [dBi]	0
Antenna Cover	TPEE
Dimensions (L x d) [mm]	90 x 12
Weight [g]	9.6
Connector	SMA plug
Operating Temp. [℃]	-40 – +80

This antenna requires a ground plane which will influence the electrical parameters.

8.3.4.3 2600130081 - Hyperion-I - 868 MHz dipole antenna

Figure 9: 868 MHz dipole-antenna

Ideally suited for applications where no ground plane is available.

The 2600130081 antenna can be also used for 902MHz - 928MHz range.

Specification	Value
Center frequency [MHz]	868
Frequency range [MHz]	853 – 883
Wavelength	0.5 wave
VSWR	$\leq$ 2.0
Impedance [Ω]	50
Connector	SMA (Male)
Dimensions (L x d) [mm]	142 x 10
Peak gain [dBi]	-2.3
Operating temp. [℃]	-30 – +80

8.3.4.4 2600130082 - Hyperion-II - 868 MHz magnetic base antenna

Well suited for applications where the RF is lead through a metal wall that could serve as ground plane to the antenna.

Figure 10: 868 MHz magnet foot antenna with 1.5 m antenna cable

The 2600130082 is a kind of λ/4 radiator and therefore needs a ground plane at the feeding point.

Specification	Value
Frequency range [MHz]	824 – 894
VSWR	$\leq$ 2.0
Polarisation	Vertical
Impedance [Ω]	50±5
Connector	SMA (Male)
Dimensions (L x d) [mm]	89.8 x 27
Weight [g]	50±5
Operating temp. [℃]	-30 – +60

8.3.4.5 2600130021 - Himalia - 2.4 GHz dipole antenna

Figure 11: 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 fulfill 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.

9 Manufacturing information

9.1 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*.

9.2 Soldering

9.2.1 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 4: Classification reflow soldering profile, Note: refer to IPC/JEDEC J-STD-020E

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

Table 5: 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.

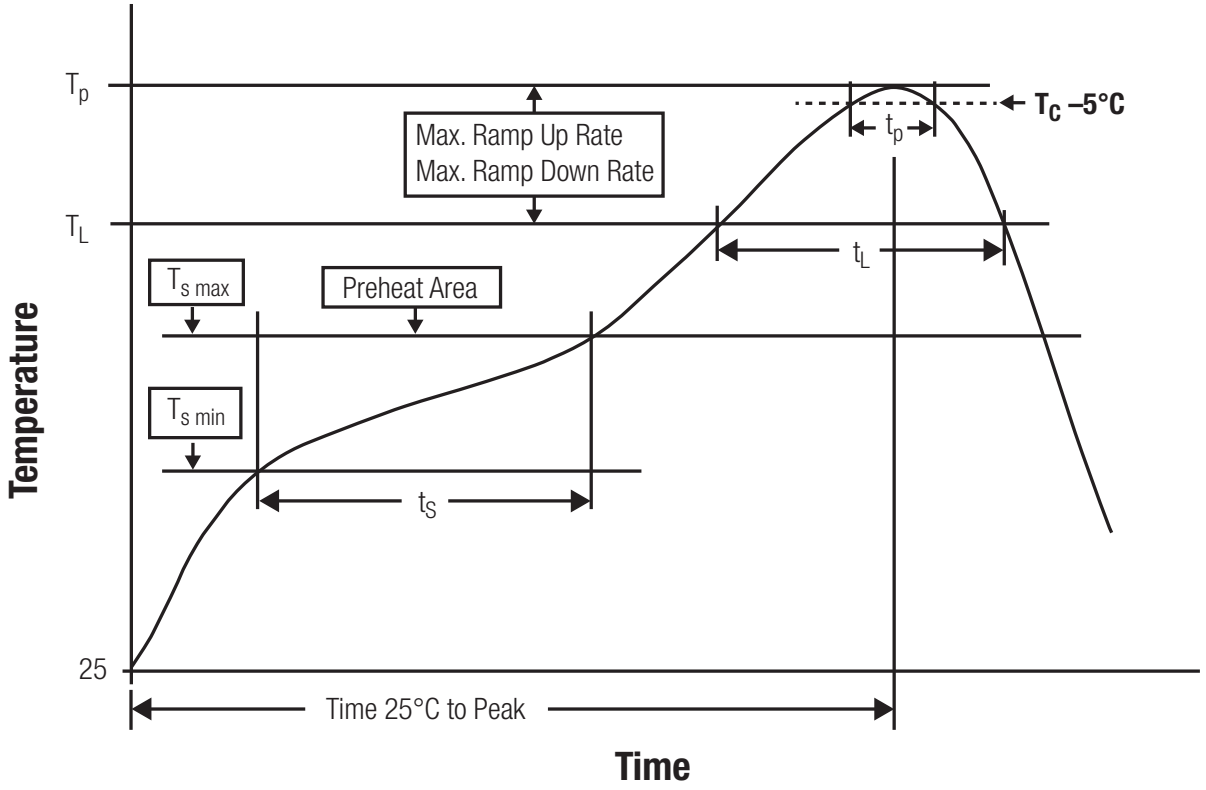


Figure 12: Reflow soldering profile

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

9.2.2 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.

9.2.3 Other notations

- Conformal coating of the product will result in the loss of warranty. The RF shields will not protect the part from low-viscosity coatings.
- 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.

9.3 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.

9.4 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.

10 Marking

10.1 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.

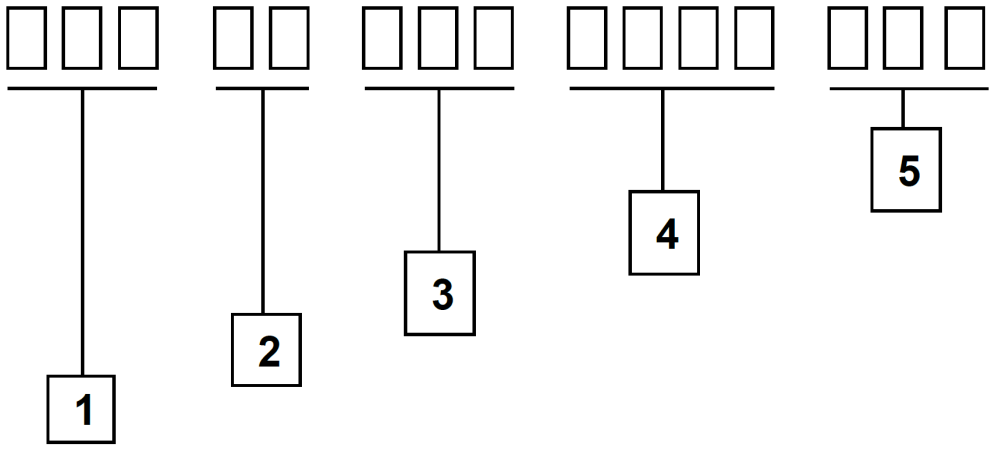


Figure 13: Lot number structure

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 6: 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.

10.2 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.

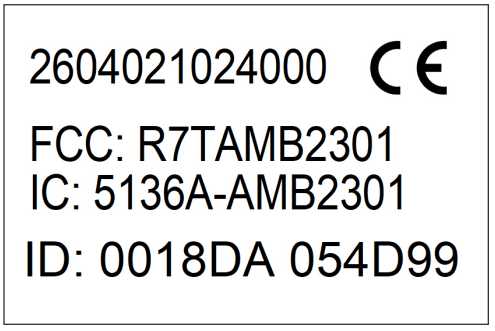


Figure 14: Label of the Puck-I

11 Information for Ex protection

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

- The module itself is unfused.
- The maximum output power of the module is 0dBm.
- The total amount of capacitivity of all capacitors is 4.843µF.

12 Regulatory compliance information

12.1 Important notice EU

The use of RF frequencies is limited by national regulations. The Puck-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 Puck-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.

12.2 Important notice FCC

The use of RF frequencies is limited by national regulations. The Puck-I has been designed to comply with the FCC Part 15.
The Puck-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.

12.3 Conformity assessment of the final product

The Puck-I is a subassembly. It is designed to be embedded into other products (products incorporating the Puck-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 Puck-I carried out by Würth Elektronik eiSos does not replace the required conformity assessment of the final product.

12.4 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.

12.5 EU Declaration of conformity

EU DECLARATION OF CONFORMITY

Radio equipment: **2604021024000**

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: 2604021024000

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

EN 300 328-1 V2.2.2 (2019-07)
EN 301 489-1 V2.2.0 (Draft)
EN 301 489-17 V3.2.0 (Draft)
EN 62479 : 2010
EN 62368-1: 2014/AC: 2015/A11: 2017

i.A. G. Erlandt

Trier, 04th of June 2020
Place and date of issue

12.6 FCC Compliance Statement

FCC ID: R7TAMB2301

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.

12.7 IC Compliance Statement

Certification Number: 5136A-AMB2301
PMN: AMB2301
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.

12.8 ARIB Declaration of conformity

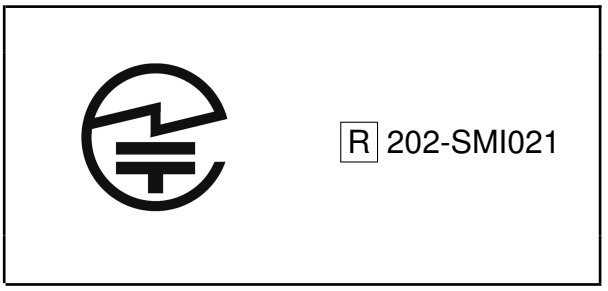
Japanese Radio Law Compliance.
This device is granted pursuant to the Japanese Radio Law.
This device should not be modified (otherwise the granted designation number will become invalid)

ID-Code (Interference provision)

The MAC address of the radio device maintains the format 00:18:DA:xx:xx:xx. The latter part xx:xx:xx of the MAC address coincides with the serial number of the device.

12.8.1 Label

2604021024000:



After integration of the Puck-I in the end device, the corresponding certification label must be recognized from the outside. Otherwise this information must be referenced on the housing as well as in the user manual. E labeling is allowed.

13 Bluetooth product listing certificate

Bluetooth™

BQC: Roland Becker
RB-WWS Limited, Room 2108, 21/F., C C Wu Building, 302-308 Hennessy Road, Hong Kong

PRODUCT LISTING CERTIFICATE

This is to certify that the qualification requirements for the below stated product have been reviewed and BQC acknowledged. As a result thereof an End Product Listing entry has been created which can be found following the above stated hyperlink.

Product ID:	**AMB2301**
Declaration ID:	**D013784**
Related QD ID(s):	**10627**
Member Company:	**Amber wireless GmbH**
Listing Date:	**2018-02-05**
Listing link:	**https://launchstudio.bluetooth.com/ListingDetails/12123**
Coverd Funtionality:	Baseband Conformance, Generic Access Profile, Interoperability Test Specification, Link Manager, Logical Link Control and Adaption Protocol, Radio, RFCOMM, Serial Port Profile, Service Discovery Application Profile, Service Discovery Protocol

HongKong, 2018.02.05
place, date (yyyy.mm.dd)

Roland Becker

Digitally signed by Roland Becker
DN: cn=Roland Becker, o=RB-WWS Limited, ou, email=roland@rb-wws.com, c=HK
Date: 2018.02.05 12:42:27 +08'00'

signature

14 Important notes

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

14.1 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.

14.2 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.

14.3 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.

14.4 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.

14.5 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 14.1 and 14.2 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.

14.6 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.

14.7 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.

14.8 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*.

15 Legal notice

15.1 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.

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15.2 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.

15.3 Trademarks

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15.4 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, unless the parties have executed an agreement specifically governing such use. Moreover, Würth Elektronik eiSos GmbH & Co. KG products 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. Würth Elektronik eiSos GmbH & Co. KG must be informed about the intent of such usage before the design-in stage. In addition, sufficient reliability evaluation checks for safety must be performed on every electronic component, which is used in electrical circuits that require high safety and reliability function or performance. By using Würth Elektronik eiSos GmbH & Co. KG products, the customer agrees to these terms and conditions.

16 License terms

This 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 this license terms is 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 this license terms. You agree to comply with all provisions under this license terms.

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Würth Elektronik eiSos hereby grants you a limited, non-exclusive, non-transferable and royalty-free license to use the software and under the conditions that will be set forth in this license terms. You are free to use the provided Software only in connection with one of the products from Würth Elektronik eiSos to the extent described in this license terms. You are entitled to change or alter the source code for the sole purpose of creating an application embedding the Würth Elektronik eiSos wireless connectivity product. The transfer of the source code to third parties is allowed to the sole extent that the source code is used by such third parties in connection with our product or another hardware provided by Würth Elektronik eiSos under strict adherence of this license terms. Würth Elektronik eiSos will not assume any liability for the usage of the incorporated software and the source code. You are not entitled to transfer the source code in any form to third parties without prior written consent of Würth Elektronik eiSos.
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16.2 Usage and obligations

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.

16.3 Ownership

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

16.4 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.

16.5 Disclaimer of warranty

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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.

16.8 Severability clause

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.

16.9 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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Monitoring & Control

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